PARKS CANADA

CONTRACT FOR THE
FORT HENRY ADVANCED BATTERY PARADE SQUARE
REPAVING, DRAINAGE UPGRADES AND UNDERGROUND
UTILITIES REPLACEMENT

PROJECT NO. 30023382 (FHC11-07)
GENIVAR PROJECT NO. 111-21759-00

TENDER

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Section	Title	Pages
Division 01 - General Requirements		
01 01 00	GENERAL REQUIREMENTS	11
01 29 83	PAYMENT PROCEDURES FOR TESTING LABORATORY SERVICES	2
01 32 16	CONSTRUCTION PROGRESS SCHEDULE - BAR (GANTT) CHART	3
01 33 00	SUBMITTAL PROCEDURES	5
01 35 29	HEALTH AND SAFETY RREQUIREMENTS	4
01 52 00	CONSTRUCTION FACILITIES	3
01 56 00	TEMPORARY BARRIERS AND ENCLOSURES	2
01 74 21	CONSTRUCTION/DEMOLITION WASTE MANAGEMENT AND DISPOSAL	3
01 78 00	CLOSEOUT SUBMITTALS	7
Division 02 - Existing Conditions		
02 41 13.14	ASPHALT PAVING REMOVAL	2
02 41 16.01	STRUCTURE DEMOLITION - SHORT FORM	4
Division 03 - Concrete		
03 10 00	CONCRETE FORMING AND ACCESSORIES	2
03 20 00	CONCRETE REINFORCING	3
03 30 00	CAST-IN-PLACE CONCRETE	5
03 35 00	EXTERIOR CONCRETE FINISHING	3
Division 04 - Masonry		
04 03 07	HISTORIC - STONE MASONRY AND POINTING	8
Division 09 - Finishes		
09 91 23	PAINTING	8
Division 23 - Heating, Ventilating and Air-Conditioning (HVAC)		
23 05 00	COMMON WORK RESULTS - MECHANICAL	7
23 05 05	INSTALLATION OF PIPEWORK	4
23 05 17	PIPE WELDING	4
23 05 53.01	MECHANICAL IDENTIFICATION	5
23 11 23	FACILITY NATURAL GAS PIPING	3
Division 26 - Electrical		
26 05 00	COMMON WORK RESULTS - FOR ELECTRICAL	8
26 05 21	WIRES AND CABLES (0-1000 V)	3
26 05 28	GROUNDING - SECONDARY	5
26 05 31	SPLITTERS, JUNCTION, PULL BOXES AND CABINETS	2
26 05 32	OUTLET BOXES, CONDUIT BOXES AND FITTINGS	2
26 05 34	CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS	5
26 05 43.01	INSTALLATION OF CABLES IN TRENCHES AND IN DUCTS	3
26 12 16.01	DRY TYPE TRANSFORMERS UP TO 600 V PRIMARY	4

26 24 16.01	PANELBOARDS BREAKER TYPE	4
26 28 16.02	MOULDED CASE CIRCUIT BREAKERS	2
Division 26 – Communications		
27 05 26	GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS	1
27 05 28	PATHWAYS FOR COMMUNICATIONS SYSTEMS	2
27 10 05	STRUCTURED CABLING FOR COMMUNICATIONS SYSTEMS	4
27 13 13	FIBER OPTIC CABLE	2
Division 31 – Earthwork		
31 18 10	INTERLOCKING PAVER STONE	2
31 22 13	ROUGH GRADING	2
31 23 33.01	EXCAVATING, TRENCHING AND BACKFILLING	11
31 37 13	PAVEMENT REINFORCEMENT GRID	2
Division 32 – Exterior Improvements		
32 11 16.01	GRANULAR SUB-BASE	3
32 11 17	RESHAPING GRANULAR ROADBED	3
32 11 23	AGGREGATE BASE COURSES	3
32 12 16.01	ASPHALT PAVING - SHORT FORM	3
32 16 15	CONCRETE WALKS, CURBS AND GUTTERS	5
32 92 23	SODDING	4
Division 33 – Utilities		
33 05 14	MAINTENANCE HOLES AND CATCH BASIN STRUCTURES	4
33 41 00	STORM UTILITY DRAINAGE PIPING	7

PART 1 - GENERAL

1.1 Description

.1 General

.1 These detailed specifications cover the requirements for the furnishing of all labour, materials, tools, equipment, power plant, systems, transportation and supervision necessary to completely perform the work, as described by the Drawings and the Specifications for the asphalt resurfacing and sub-surface storm water drainage system repairs within the Advanced Battery Parade Square at Fort Henry National Historic Site of Canada.

.2 Description of Work

.1 The intent of the project is to upgrade the existing service utilities as well as removal and replacement of the existing asphalt surface to promote proper drainage of the parade square. Due to operational constraints at Fort Henry, the work will be divided into two phases:

.1 PHASE 1 - Underground Utilities Replacement

.2 PHASE 2 - Asphalt Resurfacing

.2 More specifically, the work consists of the following and as detailed on the drawings and in these specifications.

.1 Removal of existing asphalt surface.

.2 Removal of existing natural gas, electrical wiring and storm piping.

.3 Replacement of existing storm sewer structures.

.4 Construction of concrete slabs.

.5 Installation of new electrical conduit and panels.

.6 Fine grading and placement of new asphalt surface.

.7 Construction of concrete sidewalk, curbs.

.8 Cistern Lid Reconstruction.

1.2 Location of the Work

.1 Fort Henry is located on the east shore of the Cataraqui River, in the City of Kingston at the confluence with Lake Ontario.

1.3 Relics and Antiquities

.1 Relics and antiquities such as cornerstones and their contents, commemorative plaques, the remains and evidence of ancient persons and peoples, and other objects of historic value and worth will remain the property of the Department. When found, protect such articles and request directions from the Departmental Representative.

.2 Should historic objects be uncovered during the work, stop work immediately and notify the Departmental Representative. Do not resume work until such time as directed by the Departmental Representative.

1.4 Standards

.1 Reference is made to OPSS, CGSB, ASTM, CSA and other national and international standards. These standards, when quoted, form an integral part of and are to be read in conjunction with the specification as if reproduced herein. The latest edition is applicable, unless a dated edition is specified.

1.5 Abbreviations

.1 OPSS - Ontario Provincial Standard Specifications.

.2 CGSB - The Canadian General Standards Board.

.3 CSA - Canadian Standards Association.

.4 CWB - Canadian Welding Bureau.

.5 CAN2 - A National Standard of Canada published by CGSB.

.6 CAN3 - A National Standard of Canada published by CSA.

.7 ASTM - American Society for Testing and Materials.

.8 ACI - American Concrete Institute.

.9 ANSI - American National Standards Institute.

.10 NBC - National Building Code of Canada.

.11 JIC - Joint Industrial Conference, Hydraulic Standards for Industrial Equipment.

.12 NLGA - National Lumber Grades Authority.

.13 AWWA - American Water Works Association.

1.6 Definitions

.1 Unless the context clearly indicates otherwise, the following definitions apply.
.1 Redoubt - the main fortress works at Fort Henry consisting of escarp walls and a gorge wall surrounding a parade square.
.2 Parade Square - large area within a barracks provided for troops to march on parade and perform drills.
.3 Advanced Battery - Large elevated area located immediately to the south of the Redoubt. Main components consists of a Parade, range of Commissariat Stores buildings at East and West and a sea battery including guns and stone perapet at south extent.
.4 Dry Ditch - A wide, deep trench surrounding the fort consisting of an earth base and stone masonry retaining walls. 'Dry'infers that no water is held within the ditch as would be in a 'moat'.
.5 Branch Ditch - Deep ditch located at East and West dies of the Fort. Ditched run from Redoubt dry ditch to Fortification towers at shoreline. Construction is similar main dry ditches.
.6 Entrance Cutting - Entrance ramp leading from Advanced Battery area to Redoubt area.
.7 Equipoise Bridge - Timber draw bridge at entrance to Redoubt.
.8 Plans - the drawings listed in the "List of Drawings".
.9 Specification - the subject matter listed in the "Index to Specification", Addenda to the pecification and all relative written communications sent by the Departmental Representative to the Contractor in connection with the work.
.10 Department - Parks Canada Agency, Eastern Ontario Field Unit.

1.7 Sub-Surface Information

.1 Sub-surface information, when given, is for general information and is not guaranteed.

1.8 Archeological Restraints

.1 The Contractor is to allow for the allotment of a total of **forty (40) hours of down time** over the duration of the project to account for any unexpected archeological delays.

.2 No claims will be entertained for delays up to this upset limit. Contractor to submit records of all delays to Departmental Representative for review.

1.9 Measurement for Payment

.1 No quantities associated with items of work described in this section will be measured for payment purposes.

1.10 Basis of Payment

.1 The lump sum price for the item "Sitework" will cover the costs for the following.
.1 Supply, installation and maintenance of site barricase (i.e. temporary fence).
.2 Provision and maintenance of temporary facilities.
.3 Layout of the work.
.4 Scheduling.
.5 Permits and taxes.
.6 Environmental measures.
.7 Rectification of existing surfaces, materials and access routes including topsoil, finish grading, seeding and mulching.
.8 Site Clean-up and restoration.
.9 Any other miscellaneous work items called for on the drawings and specifications and not specifically covered by other payment items of the Contract.

PART 2 - MATERIALS

2.1 Acceptance of Materials

.1 Where materials and equipment are specified to OPSS, CSA, CGSB, ASTM or similar standards, submit a written request to the Departmental Representative for approval of the relevant items. Include all relevant items. Do not use until written approval has been received from the Departmental Representative.

.2 Use new, unused material only, except as noted or approved by the Departmental Representative in writing.

.3 Materials and equipment specified by a manufacturer's name, catalogue number or trade name are intended to establish a standard of quality. Materials of equipment at least equivalent thereto may be submitted to the Departmental Representative for approval along with proof of equivalence.

2.2 Samples

.1 Be responsible for samples and sampling. The Departmental Representative will be responsible for testing.

2.3 Rectification of Existing Surfaces and Materials

.1 Repair, replace and/or refinish, to the Departmental Representative's approval, existing surfaces and items damaged by the work, including and access route(s).

.2 The repaired, replaced and/or refinished items to be at least equal to those that existed immediately before damage occurred.

.3 Restore topsoil and seed and mulch at the Contractor's expense in areas which have been disturbed by the Contractor's operations under this Contract and which are not covered by the other items of the Contract. All topsoil, seeding and mulch repairs to be carried out in accordance with OPSS 570 and 572 (Standard Roadside Mix for seed mix).

.4 Restoration must occur as soon as possible after construction is completed.

.5 Seeded areas will be accepted when the turf is properly established.

PART 3 - EXECUTION

3.1 Requirements of Regulatory Agencies

.1 Be entirely responsible for the design and adequacy of all supports, bracings, blocking, handrails, scaffolding conveyance systems, etc. used in the construction, and comply with applicable Provincial and Municipal ordinances.

.2 Adhere to National, Provincial and Municipal requirements relating to the safety, health and protection of workers and the environment.

3.2 Scheduling and Site Access

.1 Phase I - Utilities Replacement must be completed by November 15, 2013

.2 Phase II - Asphalt paving and all work of the contract must be completed on or by May 16, 2014

.3 TIMELINES TO COMPLETE WORK. September 16, 2014 or as soon as possible after commencement to May 16, 2014 <Regular hours of work are 7:00 to 17:00 Monday to Friday. All work outside normal working hours is to be approved by Departmental Represenative. PHASE 1 is to be completed by November 15, 2013. PHASE 2 to start after January 5, 2014.

.4 Completion of Phase I as scheduled above is imperative for site operations. Should unforseen subsurface or site conditions compromise ability to acheive project schedule notify departmental representative immediately of schedule concerns to allow for contingency planning and possible rescheduling. The East range utilties shall take priority.

.5 Submit the Construction Progress Schedule within five days of award of Contract. No progress payments will be made until the Construction Progress Schedule is approved. Submit a cost breakdown for each lump sum payment item - the breakdown to be in sufficient detail as to permit the calculation of progress payment amounts. Upon receipt of notice from the Departmental Representative, in writing, that the Progress Schedule is not approved or no longer valid, submit a revised Construction Progress Schedule within five days.

.6 Contractor must commence work within 10 days of contract award to ensure timely completion.

.7 Take all necessary measures to complete the work within the scheduled times approved by the Departmental Representative.

.8 Do not make changes to the approved schedule except with the Departmental Representative's approval.

.9 Contractor is to confirm all access clearances prior to mobilization to site. Refer to drawings for location and approximate dimension. Attendance at the pretender site visit is mandatory to properly examine the site.

.7 The sloped entrance cutting (ramp) leading from the Advanced Battery is the only available entry way to the Redoubt Parade Square. The entrance cutting is typically limited to 1 tonne pick-up trucks due to limited width clearance.

.8 Additional phasing, site access and staging requirements as indicated on the contract drawings. Contractor is responsible to erect and maintain pedestrian access route through coordination with Departmental Representative throughout project.

3.3 Layout of the Work

.1 The contractor is to be responsible for all layout and control work.

3.4 Temporary Services

.1 The contractor will be allowed access to the power service at the Fort as approved by the Departmental Representative and within the capacity of the existing power supply. Any power requirements in excess of that which maybe provided by the Fort's supply will be provided for by the contractor. Temporary sanitary services will be provided by the contractor. The contractor shall make his own arrangments to obtain all water required to carry out the work.

3.5 Temporary Facilities

.1 Provide and maintain:
.1 Suitable storage facilities, of types and at locations approved by the Departmental Representative;

.2 A site trailer/office and temporary sanitary services (portable chemical toilet) at a location approved by the Departmental Representative, open during working hours;
.3 Necessary scaffolding, ladders and platforms to Canadian Construction Safety Code, NRCC 15562;
.4 All necessary enclosures, guards, guardrails, barricades, warning signs, flashing warning lights (for night) and similar items.

3.6 Examination of the Site of the Work

.1 One site visit has been scheduled during the tender period. This visit is tentatively scheduled as indicated in the instructions to tenderer's. **Pre-tender site examination is a mandatory requirement for bid acceptance, all tenderers are to attend the site visit to examine the site's layout and construction. Limitations on site accessibility are highly likely to have an impact on the contractor's selected methods for execution of work.** No other visits will be scheduled by the Owner and, should the tenderer wish to visit the site at other times, it will be his responsibility to make arrangments.

.2 Investigate and be fully informed as to the character and extent of the work to be performed and the difficulties involved, the facilities available for delivering, placing and operating the necessary plant and delivering and handling of materials.

.3 No claims relating to site access will be entertained for the duration of the contract.

3.7 Clean-up

.1 Clean and tidy the work area on a daily basis and permit no undue amounts of debris, trash, and/or garbage to accumulate.

.2 At the completion of the work, remove all surplus materials, tools, plant, rubbish and debris and dispose of them in an approved manner off the site.

3.8 Taxes .1 Pay all taxes properly levied by law (including Federal, Provincial and Municipal).

3.9 Permits .1 Pay all fees, submit, and obtain all permits. Provide authorities with plans and information for acceptance certificates. Notify the Ministry of Labour of the Work. Provide inspection certificates as evidence that work conforms with requirements of authority having jurisdiction.

3.10 Cash Allowance Items .1 The following items shall be paid under cash allowance:

PART 4 - DOCUMENTS .1 MISCELLANEOUS STORM SEWERS AND UTILITIES REPAIRS AND INSTALLATIONS: Shall be paid on an item by item basis as determined during the course of work. Item is to cover minor items (generally $1 to $5,000) not included in the contract drawings and specifications that are identified as requiring repair during site investigations and removals work either as directed by the Departmental Representative or as proposed by the Contractor. Item is limited to payment for sub-surface repairs including those determined during excavations for utilities replacement work as well as any other minor repairs that become evident during the course of work. Work items include the anticipated storm sewer outlet repairs located in the defined until excavations have occured, but may also consist of minor adjustments and additions to other storm lines and utilities works, CCTV camera inspections and flushing required to facilitate contract and other small repair items related to work items of the contract, etc.

.2 Prices for individual cash allowance items are to be negotiated amounts proposed by the Contractor and approved by the Departmental Representative. The formal contemplated change notice (CCN) and change order (CO) processes outlined in the General Conditions of Contract (GC's) shall be adopted as the processes for price determination of cash allowance items. Formal change orders will not be issued for cash allowance items. Cash allowance items will be formally approved during process payment claim certificate process with written (E-mail) consent to proceed from the Departmental Representative serving as an interim insturment of approval.

4.1 Documents Required

.1 Maintain at job site, one copy each of following.
.1 Contract Drawings,
.2 Specifications,
.3 Addenda,
.4 Change Orders,
.5 Other Modifications,
.6 Field Test Reports,
.7 Copy of Approved Work Schedule,
.8 Manufacturers' installation and application instructions,
.9 Notice of Project issued by Ministry of Labour,
.10 All items required to be maintained on site as per 01 35 29.06 - Health and Safety,
.11 Waste Management Plan, and
.12 Site Specific Safety Plan.

PART 5 - ENVIRONMENTAL CONSIDERATIONS

5.1 Fires

.1 Fires and burning of rubbish or any material on site is not permitted.

5.2 Disposal of Waste

.1 Do not bury rubbish and waste materials on site.

.2 Do not dispose of waste (including slurry) or volatile materials, such as mineral spirits, oil or paint thinner on site (i.e. into drains and catch basins).

.3 All waste described as subject to Regulation 309, Environmental Act, must be transported with a valid "Certificate of Approval for a Waste Management System" to a site approved to accept the waste.

5.3 Disruption of Site

.1 Minimize disruption of site and restore all damaged features to satisfaction of Departmental Representative and at least to the condition before damage occurred.

PART 6 - PROGRESS PAYMENTS

6.1 Progress Payments

.1 A number of items in this contract are paid for on a lump sum basis. Prior to submission of the first progress payment claim, the contractor shall submit to the Departmental Representative a detailed breakdown of these lump sum items in order to facilitate approval and processing of progress payment claims. The detailed breakdown is subject to review by the Departmental Representative.

.2 Along with any and all claims for progress payments, contractor must include in their submission the following completed items in addition to any invoices:
.1 Payment Certificate (to be completed by Departmental Representative and signed off by both contractor and Departmental Representative).
.2 WSIB Certificate of Clearance - Workplace Safety and Insurance Board, Province of Ontario.
.3 Statutory Declaration.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 32 11 16.01 - Granular Sub-base
Section 32 11 23 - Aggregate Base Courses
Section 32 12 16.01 - Asphalt Paving - Short Form

1.2 APPOINTMENT AND PAYMENT

.1 Departmental Representative will appoint and pay for services of testing laboratory except follows:
.1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.
.2 Inspection and testing performed exclusively for Contractor's convenience.
.3 Testing, adjustment and balancing of conveying systems, mechanical and electrical equipment and systems.
.4 Mill tests and certificates of compliance.
.5 Tests specified to be carried out by Contractor under supervision of Departmental Representative.

.2 Where tests or inspections by designated testing laboratory reveal Work not in accordance with contract requirements, pay costs for additional tests or inspections as required by Departmental Representative to verify acceptability of corrected work.

1.3 CONTRACTOR'S RESPONSIBILITIES

.1 Provide labour, equipment and facilities to:
.1 Provide access to Work for inspection and testing.
.2 Facilitate inspections and tests.
.3 Make good Work disturbed by inspection and test.
.4 Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.

.2 Notify Departmental Representative 48 hours minimum sufficiently in advance of operations to allow for assignment of laboratory personnel and scheduling of test.

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

.4 Pay costs for uncovering and making good Work that is covered before required inspection or testing is completed and approved by Departmental Representative.

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 (GANTT 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 approved plan (for project, work package, or activity), plus or minus approved scope changes.

.4 Construction Work Week: Monday to Friday, inclusive, will provide a five day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.

.5 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.

.6 Master Plan: summary-level schedule that identifies major activities and key milestones.

.7 Milestone: significant event in project, usually completion of major deliverable.

.8 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.

.9 Project Planning, Monitoring and Control System: overall system operated by 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 Plan to complete Work in accordance with prescribed milestones and time frame.

.3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.

.4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Certificate of Substantial Performance and Certificate of Completion as defined times of completion are of essence of this contract.

.5 Incorporate within schedule and workplan work sequencing (phasing) and client operational requirements as outlined in section 01 01 00 Part 3.2 and further on staging plan.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

1.4 MASTER PLAN

.1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).

.2 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 Shop Drawings, Samples.
.3 Mobilization.
.4 Excavation.
.5 Backfill.
.6 Lighting.
.7 Electrical.
.8 Piping.
.9 Controls.
.10 Testing and Commissioning.
.11 Supplied equipment long delivery items.
.12 Departmental Representative supplied equipment required dates.

1.6 PROJECT SCHEDULE REPORTING

.1 Update Project Schedule on weekly basis reflecting activity changes and completions, as well as activities in progress.

1.7 PROJECT MEETINGS

.1 Discuss Project Schedule at regular site 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 approved dates shown on baseline schedule.

.2 Weather related delays with their remedial measures will be discussed and negotiated.

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 03 20 00 - Concrete Reinforcing
Section 32 11 16.01 - Granular Sub-base
Section 32 11 1.2 - Aggregrate BaseCourses
Section 32 12 16.01 - Asphalt Paving - Short Form

1.2 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.

.3 Present shop drawings, product data, samples and mock-ups in SI Metric units.

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

.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 Verify field measurements and affected adjacent Work are co-ordinated.

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

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.

.10 Keep one reviewed copy of each submission on site.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Canada.

.3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.4 Allow 10 days for Departmental Representative's review of each submission.

.5 Adjustments made on shop drawings by the Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.

.6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.

.7 Accompany submissions with transmittal letter, in duplicate, containing:
.1 Date.
.2 Project title and number.
.3 Contractor's name and address.

.4 Identification and quantity of each shop drawing, product data and sample.
.5 Other pertinent data.

.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 stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
.5 Details of appropriate portions of Work as applicable:
.1 Fabrication.
.2 Layout, showing dimensions, including identified field dimensions, and clearances.
.3 Setting or erection details.
.4 Capacities.
.5 Performance characteristics.
.6 Standards.
.7 Operating weight.
.8 Wiring diagrams.
.9 Single line and schematic diagrams.
.10 Relationship to adjacent work.

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

.10 Submit 6 prints or 1 electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.

.11 Submit 6 prints or 1 electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.

.12 Submit 3 prints or 1 electronic copy of test reports for requirements requested in specification Sections and as requested by Departmental Representative.

.1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
.2 Testing must have been within 3 years of date of contract award for project.

.13 Submit 3 prints or 1 electronic copy of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
.1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
.2 Certificates must be dated after award of project contract complete with project name.

.14 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, transparency copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

1.4 SAMPLES

.1 Submit for review samples as requested in respective specification Sections. Label samples with origin and intended use.

.2 Deliver samples prepaid to Departmental Representative's business address site office.

.3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.

.4 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.

.5 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.5 PHOTOGRAPHIC DOCUMENTATION

.1 Submit electronic copy of colour digital photography in jpg format, fine resolution as directed by Departmental Representative.

.2 Project identification: name and number of project and date of exposure indicated.

.3 Number of viewpoints:
.1 Viewpoints and their location as determined by Departmental Representative.

.4 Frequency of photographic documentation: directed by Departmental Representative.
.1 Upon completion of:
excavation,foundation, framing and services before concealment, of Work, and as directed by Departmental Representative.

1.6 CERTIFICATES AND TRANSCRIPTS

.1 Immediately after award of Contract, submit Workers' Compensation Board status.

.2 Submit transcription of insurance immediately after award of Contract.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Submit site-specific Health and Safety Plan: Within 7 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:

.3 Submit 2 copies of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative and authority having jurisdiction, weekly. Fully complete and submit site specific Health and Safety plan template by Parks Canada. For bid acceptance fully complete and submit Parks Canada 'Form Attestation and Proof of Compliance with Occupational Health and Safety' provided in the tender documents.

.4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.

.5 Submit copies of incident and accident reports.

.6 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 5 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 3 days after receipt of comments from Departmental Representative.

.7 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.

.8 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.3 FILING OF NOTICE

.1 File Notice of Project with Provincial authorities prior to beginning of Work.

1.4 SAFETY ASSESSMENT

.1 Perform site specific safety hazard assessment related to project.

1.5 MEETINGS

.1 Schedule and administer Health and Safety meeting with Departmental Representative and Departmental Representative prior to commencement of Work.

1.6 GENERAL REQUIREMENTS

.1 Complete site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.

.2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.7 RESPONSIBILITY

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

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

1.8 COMPLIANCE REQUIREMENTS

.1 Comply with Ontario Health and Safety Act, R.S.O.

.2 Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

1.9 UNFORSEEN HAZARDS

.1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province Territory having jurisdiction and advise Departmental Representative DCC Representative Departmental Representative verbally and in writing.

1.10 HEALTH AND SAFETY CO-ORDINATOR

.1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:

.1 Have site-related working experience specific to activities associated with.

.2 Have working knowledge of occupational safety and health regulations.

.3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.

.4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.

1.11 POSTING OF DOCUMENTS

.1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with Departmental Representative.

1.12 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative or Departmental Representative.

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

.3 Departmental Representative or Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.13 BLASTING

.1 Blasting or other use of explosives is not permitted.

1.14 WORK STOPPAGE

.1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Construction Documents Committee (CCDC)
.1 CCDC 2-1994, Stipulated Price Contract.

.2 Canadian Standards Association (CSA International)
.1 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
.2 CSA-0121-M1978 (R2003), Douglas Fir Plywood.
.3 CAN/CSA-S269.2-M1987(R2003), Access Scaffolding for Construction Purposes.
.4 CAN/CSA-Z321-96(R2001), Signs and Symbols for the Occupational Environment.

.3 U.S. Environmental Protection Agency (EPA) / Office of Water
.1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention plans and Best Management Practices.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 INSTALLATION AND REMOVAL

.1 Provide construction facilities in order to execute work expeditiously.

.2 Remove from site all such work after use.

1.4 HOISTING

.1 Provide, operate and maintain hoists cranes required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.

.2 Hoists cranes to be operated by qualified operator.

1.5 SITE STORAGE/LOADING

.1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.

.2 Do not load or permit to load any part or Work with weight of force that will endanger work.

1.6 CONSTRUCTION PARKING

.1 Parking will be permitted on site provided it does not disrupt performance of work.

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 No other signs or advertisements, other than warning signs, are permitted on site.

.2 Signs and notices for safety and instruction in both official languages Graphice symbols to CAN/CSA-Z321.

.3 Permanent facilities may be used on approval of Departmental Representative.

1.10 PROTECTION AND MAINTENANCE OF TRAFFIC

.1 Protect travelling public from damage to person and property.

.2 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.

.3 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to raods caused by construction operations.

.4 Provide necessary lighting, signs, barricades,and distinctive markings for safe movement of traffic.

.5 Dust control: adequate to ensure safe opeation at all times.

.6 Provide snow removal during period of work.

.7 Provide hoarding and heating as required for work.

1.11 CLEAN-UP

.1 Remove construction debris, waste materials, packaging meterial 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.

.4 Stack stored new or salvaged material not in construction facilities.

PART 3 - EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

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

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

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

END OF SECTION

PART 1 - GENERAL

1.1 INSTALLATION AND REMOVAL

.1 Provide temporary controls in order to execute Work expeditiously.

.2 Remove from site all such work after use.

1.2 HOARDING

.1 Erect 1.8m high modular steel construction fence around staging and stockpile area. Enclosure shall have a lockable entrance.

.2 Refer to staging plan on drawings for further details

1.3 GUARD RAILS AND BARRICADES

.1 Provide secure, rigid guard rails and barricades around deep excavations, open shafts, open stair wells, open edges of floors and roofs, and open chambers.

.2 Provide as required by governing authorities.

1.4 ACCESS TO SITE

.1 Refer to staging plan on drawings for further details.

1.5 PUBLIC TRAFFIC FLOW

.1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect public.

.2 Maintain public access at all times.

.3 Provide for public access for site events and operations as per contract drawings.

1.6 FIRE ROUTES

.1 Maintain access to property including overhead clearances for use by emergency response vehicles.

1.7 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

.1 Protect surrounding private and public property from damage during performance of Work.

.2 Be responsible for damage incurred.

1.8 PROTECTION OF BUILDING FINISHES

.1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.

.2 Provide necessary screens, covers, and hoardings.

.3 Confirm with Departmental Representative locations and installation schedule 5 days prior to installation.

.4 Be responsible for damage incurred due to lack of or improper protection.

1.9 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 Construction/Demolition Waste Management And Disposal.

END OF SECTION

PART 1 - GENERAL

1.1 WASTE MANAGEMENT GOALS

.1 Accomplish maximum control of solid construction waste.

.2 Preserve environment and prevent pollution and environment damage.

1.2 DEFINITIONS

.1 Class III: non-hazardous waste - construction renovation and demolition waste.

.2 Cost/Revenue Analysis Workplan (CRAW): based on information from WRW, and intended as financial tracking tool for determining economic status of waste managament practices.

.3 Demolition Waste Audit (DWA): relates to actual waste generated from project.

.4 Inert Fill: inert waste - exclusively asphalt and concrete

.5 Materials Source Seperation Program (MSSP): consists of series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.

.6 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.

.7 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.

.8 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of usingin altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

.9 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:

.1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
.2 Returning reusable items including pallets or unused products to vendors.

.10 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.

.11 Separate Condition: refers to waste sorted into individual types.

.12 Source Separation: acts of keeping different types of waste materials separate beginning from first time they became waste.

1.3 MATERIALS SOURCE SEPARATION PROGRAM (MSSP)

.1 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.

.2 Provide containers to deposit reusable and recyclable materials.

.3 Locate containers in locations, to facilitate deposit of materials without hindering daily operations.

.4 Locate separated materials in areas which minimize material damage.

.5 Collect handle, store on-site, and transport off-site, salvaged materials in separate condition.
.1 Transport to approved and authorized recycling facility.

.6 Collect, handle, store on-site, and transport off-site, salvaged materials in combined condition.
.1 Ship materials to site operating under Certificate of Approval.
.2 Materials must be immediately separated into required categories for reuse or recycling.

1.4 STORAGE, HANDLING AND PROTECTION

.1 Store, materials to be reused, recycled and salvaged in locations as directed by Departmental Representative.

.2 Unless specified otherwise, materials for removal do not become contractor's property.

1.5 DISPOSAL OF WASTES

.1 Do not bury rubbish or waste materials.

.2 Do not dispose of waste volatile materials mineral spirits oil paint thinner into waterways, storm, or sanitary sewers.

.3 Remove materials from deconstruction as deconstruction/disassembly Work progresses.

1.6 USE OF SITE AND FACILITIES

.1 Execute work with least possible interference or disturbance to normal use of premises.

.2 Maintain security measures established by existing facility.

1.7 SCHEDULING

.1 Co-ordinate work with other activities at site to ensure timely and orderly progress of work.

PART 3 - EXECUTION

3.1 APPLICATIONS

.1 Handle waste materials not reused, slavaged, or recycled in accordance with appropriate regulations and codes.

3.2 CLEANING

.1 Remove tools and waste materials on completion of work, and leave work area in clean and orderly condition.

.2 Clean-up work area as work progresses.

.3 Sources separate materials to be reused/recycled into specified sort areas.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCES

.1 Canadian Environmental Protection Act (CEPA)
.1 SOR/2008-197, Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Pre-warranty Meeting:
.1 Convene meeting prior to contract completion with contractor's representative, Departmental Representative to:
.1 Verify project requirements.
.2 Review installation and warranty requirements.

.2 Departmental Representative to establish communication procedures for:
.1 Notifying construction warranty defects.
.2 Determine priorities for type of defects.
.3 Determine reasonable response time.

.3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.

.4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, three final copies of operating and maintenance manuals in English.

.3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.

.4 Provide evidence, if requested, for type, source and quality of products supplied.

1.5 FORMAT

.1 Organize data as instructional manual.

.2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.

.3 When multiple binders are used correlate data into related consistent groupings.
.1 Identify contents of each binder on spine.

.4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.5 Arrange content under Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.7 Text: manufacturer's printed data, or typewritten data.

.8 Drawings: provide with reinforced punched binder tab.
.1 Bind in with text; fold larger drawings to size of text pages.

.9 Provide 1:1 scaled CAD files in dwg format on CD.

1.6 CONTENTS - PROJECT RECORD DOCUMENTS

.1 Table of Contents for Each Volume: provide title of project;
.1 Date of submission; names.
.2 Addresses, and telephone numbers of Departmental Representative and Contractor with name of responsible parties.

.3 Schedule of products and systems, indexed to content of volume.

.2 For each product or system:
.1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

.3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

1.7 AS -BUILT DOCUMENTS AND SAMPLES

.1 Maintain, at site for Departmental Representative one record copy of:
.1 Contract Drawings.
.1 Specifications.
.2 Addenda.
.3 Change Orders and other modifications to Contract.
.4 Reviewed shop drawings, product data, and samples.
.5 Field test records.
.6 Inspection certificates.
.7 Manufacturer's certificates.

.3 Store record documents and samples in field office apart from documents used for construction.
.1 Provide files, racks, and secure storage.

.4 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
.1 Label each document "PROJECT RECORD" in neat, large, printed letters.

.5 Maintain record documents in clean, dry and legible condition.
.1 Do not use record documents for construction purposes.

.6 Keep record documents and samples available for inspection by Departmental Representative.

1.8 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

.1 Record information on set of red line opaque drawings.

.2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.

.3 Record information concurrently with construction progress.
.1 Do not conceal Work until required information is recorded.

.4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
.1 Measured depths of elements of foundation in relation to finish first floor datum.
.2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
.3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
.4 Field changes of dimension and detail.
.5 Changes made by change orders.
.6 Details not on original Contract Drawings.
.7 References to related shop drawings and modifications.

.5 Specifications: mark each item to record actual construction, including:
.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
.2 Changes made by Addenda and change orders.

.6 Other Documents: maintain manufacturer's certifications, inspection certifications and field test records, required by individual specifications sections.

.7 Provide digital photos, if requested, for site records.

1.9 MATERIALS AND FINISHES

.1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations.
.1 Provide information for re-ordering custom manufactured products.

.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.4 Additional requirements: as specified in individual specifications sections.

1.10 DELIVERY, STORAGE AND HANDLING

.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.

.2 Store in original and undamaged condition with manufacturer's seal and labels intact.

.3 Store components subject to damage from weather in weatherproof enclosures.

.4 Store paints and freezable materials in a heated and ventilated room.

.5 Remove and replace damaged products at own expense and for review by Departmental Representative.

1.11 WARRANTIES AND BONDS

.1 Develop warranty management plan to contain information relevant to Warranties.

.2 Warranty management plan to include required actions and documents to assure that Departmental Representative receives warranties to which it is entitled.

.3 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.

.4 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.

.5 Conduct joint 12 month warranty inspection, measured from time of acceptance, by Departmental Representative.

.6 Include information contained in warranty management plan as follows:

.1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.

.1 Name of item.

.2 Model and serial numbers.

.3 Location where installed.

.4 Name and phone numbers of manufacturers or suppliers.

.5 Names, addresses and telephone numbers of sources of spare parts.

.6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.

.7 Cross-reference to warranty certificates as applicable.

.8 Starting point and duration of warranty period.

.9 Summary of maintenance procedures required to continue warranty in force.

.10 Cross-Reference to specific pertinent Operation and Maintenance manuals.

.11 Organization, names and phone numbers of persons to call for warranty service.

.12 Typical response time and repair time expected for various warranted equipment.

.2 Contractor's plans for attendance at 12 month post-construction warranty inspections.

.7 Respond in timely manner to oral or written notification of required construction warranty repair work.

.8 Written verification to follow oral instructions.

.1 Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 31 23 33.01 - Excavating, Trenching and Backfilling Section 32 11 17 - Reshaping Granular Roadbed

1.2 MEASUREMENT PROCEDURES

.1 Removal of existing asphalt pavement will be measured in square metres of surface actually removed regardless of depth removed or number of operations required

.2 Payment under this item will include operations involved in removing, hauling and stockpiling designated pavement and cleaning of remaining pavement surface. All work incorporated in the contract documents is to be included in the lump sum price.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

.2 Divert unused asphalt materials from landfill to local facility approved by Deparmental Representative.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Prior to beginning removal operation, inspect and verify with Deparmental Representative areas, depths and lines of asphalt pavement to be removed.

3.2 PROTECTION

.1 Protect existing pavement not designated for removal, light units and structures from damage. In event of damage, immediately replace or make repairs to approval of Deparmental Representative at no additional cost.

3.3 REMOVAL

.1 Remove existing asphalt pavement to lines and grades as indicated.

.2 Use equipment and methods of removal and hauling which do not damage or disturb underlying pavement.

.3 Prevent contamination of removed asphalt pavement by topsoil, underlying gravel or other materials.

.4 Provide for suppression of dust generated by removal process.

3.4 FINISH TOLERANCES

.1 Finished surfaces in areas where asphalt pavement has been removed to be within +/-5 mm of grade specified but not uniformly high or low.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Methods and procedures for demolition of structures, parts of structures, including abandonment. All work incorporated in contract documents is to be included in the lump sum price as approved by the departmental representative.

1.2 REFERENCES

.1 Canadian Council of Ministers of the Environment (CCME)
.1 PN 1326-July 2005, Environmental Code of Practice for aboveground and underground tank systems containing petroleum products and allied petroleum products.

.2 Canadian Standards Association (CSA International)
.1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.

1.3 PAYMENT PROCEDURES

.1 All work for structure demolition incorporatedin the contract documents is to be included in the lump sum price.

1.4 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

.2 Shop Drawings:
.1 Provide shop drawings and product data in accordance with Section 01 33 00.
.2 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.3 Prior to beginning of Work on site submit detailed Waste Reduction Workplan in accordance with Section 01 74 20 and indicate:
.1 Descriptions of and anticipated quantities in percentages of materials to be salvaged reused, recycled and landfilled.
.2 Schedule of selective demolition.
.3 Number and location of dumpsters.
.4 Anticipated frequency of tippage.

.5 Name and address of waste facilities.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:
.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20.

1.6 SITE CONDITIONS

.1 Should material resembling spray or trowel-applied asbestos or other designated substance be encountered, stop work, take preventative measures, and notify Departmental Representative immediately.
.1 Do not proceed until written instructions have been received from Departmental Representative.

.2 Notify Departmental Representative before disrupting building access or services.

PART 2 - PRODUCTS

2.1 EQUIPMENT

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

.2 Demonstrate that tools and machinery are being used in manner which allows for salvage of materials in best condition possible.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Do Work in accordance with Section 01 35 29.

.2 Protection:
.1 Prevent movement, settlement, or damage to adjacent structures, utilities, and parts of building to remain in place. Provide bracing and shoring required.
.2 Keep noise, dust, and inconvenience to occupants to minimum.
.3 Protect building systems, services and equipment.

.4 Provide temporary dust screens, covers, railings, supports and other protection as required.

.3 Disconnect and re-route electrical, telephone and communication service lines. Post warning signs on electrical lines and equipment which must remain energized to serve other products during period of demolition.

.4 Locate and protect utility lines. Do not disrupt active or energized utilities designated to remain undisturbed.

.5 Disconnect and cap designated mechanical services.
.1 Sewer and water lines: as directed by Departmental Representative.
.2 Other underground services: remove and dispose of as indicated.

3.2 DEMOLITION SALVAGE AND DISPOSAL

.1 Remove parts of existing boardwalk to permit new construction. Sort materials into appropriate piles for reuse and recycling as required.

.2 Refer to demolition drawings and specifications for items to be salvaged for reuse.

.3 Remove items to be reused, store as directed by Departmental Representative, and re-install under appropriate section of specification.

.4 Trim edges of partially demolished building elements to tolerances as defined by Departmental Representative to suit future use.

.5 Dispose of removed materials, except where specified otherwise, in accordance with authority having jurisdiction.

3.3 REMOVAL FROM SITE

.1 Dispose of materials not designated for alternate disposal in accordance with applicable regulations. Disposal facilities must be approved of and listed in waste reduction workplan. Do not deviate from disposal facilities listed in waste reduction workplan without prior written authorization from Departmental Representative.

3.6 CLEANING AND RESTORATION

.1 Keep site clean and organized throughout demolition procedure.

.2 Upon completion of project, reinstate areas parking surfaces, walkways, affected by Work to match condition of adjacent, undisturbed areas or better.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Cast-in-Place Concrete: Section 03 30 00

.2 Concrete Reinforcing: Section 03 20 00.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CSA-A23.1-04/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CSA-O86S1-05, Supplement No. 1 to CAN/CSA-O86-01, Engineering Design in Wood.

.3 CSA O151-04, Canadian Softwood Plywood.

.4 CAN/CSA-S269.3-M92(R2003), Concrete Formwork, National Standard of Canada

1.3 PAYMENT PROCEDURES

.1 All work for concrete forming and accessories incorporated in the contract documents is to be included in the lump sum price.

1.3 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Formwork materials:

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

PART 3 - EXECUTION

3.1 FABRICATION AND ERECTION

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

.2 Use of earth forms is not permitted.

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

.4 Align form joints and make watertight.
.1 Keep form joints to minimum.

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

.6 Build in drains, conduit and grate frames required to accommodate Work specified in other sections.

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

3.2 REMOVAL AND RESHORING

.1 Leave formwork in place for following minimum periods of time after placing concrete.
.1 3 days for catchbasins, and manholes.
.2 2 days for slabs.

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

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

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

1.2 REFERENCES

.1 American Concrete Institute (ACI)
- .1 SP-66-04, ACI Detailing Manual 2004.
  - .1 ACI 315-99, Details and Detailing of Concrete Reinforcement.
  - .2 ACI 315R-04, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.
- .2 ASTM International
  - .1 ASTM A 775/A 775M - 07b, Standard Specification for Epoxy Coated Reinforcing Steel Bars.
- .3 CSA International
  - .1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
  - .2 CSA-A23.3-04, Design of Concrete Structures.
  - .3 CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
- .4 Reinforcing Steel Institute of Canada (RSIC)
  - .1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.3 PAYMENT PROCEDURES

.1 All reinforcement work incorporated in the contract documents is to be included in the lump sum price.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario.
    .1 Indicate placing of reinforcement and:
        .1 Bar bending details.
    .2 Lists.
    .3 Quantities of reinforcement.
    .4 Sizes, spacings, locations of reinforcement.

1.5 QUALITY ASSURANCE

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
.1 Mill Test Report: upon request, provide Deparmental Representative with certified copy of mill test report of reinforcing steel, minimum 4 weeks prior to beginning reinforcing work.

PART 2 - PRODUCTS

2.1 MATERIALS

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

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

.3 Cold-drawn annealed steel wire ties: to ASTM A 82/A 82M.

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

.5 Epoxy Coating of non-prestressed reinforcement: to ASTM A 775/A 775M.

.6 Welded steel wire fabric: to ASTM A 185/A 185M.

2.2 FABRICATION

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

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

.3 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.
.1 Ship epoxy coated bars in accordance with ASTM A 775A/A 775M.

PART 3 - EXECUTION

3.1 FIELD BENDING

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

.2 When field bending is authorized, bend without heat, applying slow and steady pressure.

.3 Replace bars, which develop cracks or splits.

3.2 PLACING REINFORCEMENT

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

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

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

.4 Protect epoxy and paint coated portions of bars with covering during transportation and handling.

3.3 FIELD TOUCH -UP

.1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcing steel with compatible finish to provide continuous coating.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

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

.2 Concrete Reinforcing: Section 03 20 00.

1.2 REFERENCES

.1 ASTM International
.1 ASTM D 1751-04, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non extruding and Resilient Bituminous Types).

.2 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-19.24-M90, Multicomponent, Chemical-Curing Sealing Compound.

.3 CSA International
.1 CSA-A23.1/A23.2-2004, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
.2 CAN/CSA-G30.18-M92(R2002), Billet-Steel Bars for Concrete Reinforcement.

1.3 PAYMENT PROCEDURES

.1 All cast-in-place concrete work incorporated in the contract documents is to be included in the lump sum price.

1.4 QUALITY ASSURANCE

.1 Provide to Departmental Representative, 2 weeks minimum prior to starting concrete work, the following:
.1 Hot and cold weather protection.

.2 Curing procedures.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements:
.1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.

.1 Do not modify maximum time limit without receipt of prior written agreement from Departmental Representative and concrete producer as described in CSA A23.1/A23.2.
.2 Deviations to be submitted for review by the Departmental Representative.

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

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Cement: to CAN/CSA - A3000.

.2 Water: to CSA A23.1/A23.2.

.3 Reinforcing bars: to CAN/CSA-G30.18, Grade 400, epoxy coated to ASTM A775/A775M-07b.

.4 Premoulded joint filler:
.1 Bituminous impregnated fibreboard: to ASTM D 1751.

.5 Joint sealer/filler: grey to CAN/CGSB-19.24, Type 1, Class B.

.6 Aggregates: to CAN/CSA-A23.1/A23.2. Coarse aggregates to be normal density.

.7 Air entraining admixture: to ASTM C260.

.8 Chemical admixtures: to CAN3-A266.2. The Departmental Representative is to accept accelerating or set retarding admixtures during cold and hot weather placing.

.9 Concrete curing blankets: Terrafix 240R non-woven geotextile (white) as manufactured by Terratrack or equivalent.

2.2 MIXES

.1 Proportion normal density concrete in accordance with CAN/CSA-A23.1, Alternative 1 to give following properties:
.1 Cement: Type 10 Portland cement.

.2 Minimum compressive strength at 28 days:
.1 35 MPa for slabs, manholes and catchbasins.

.3 Class of exposure: C-2.

.4 Maximum size of coarse aggregate: 20 mm.

.5 Concrete slump at time and point of discharge: 80 mm ± 30 mm.

.6 Air content: 5 to 8%.

.7 Water/cement ratio: 0.55 for F-2 exposure. Use w/c ratio of 0.50 for slabs.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Provide Departmental Representative 24 hours notice before each concrete pour.

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

.3 During concreting operations:
.1 Development of cold joints not allowed.
.2 Ensure concrete delivery and handling facilitates placing with minimum of rehandling, and without damage to existing structure or Work.

.4 Protect previous Work from staining.

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

3.2 INSTALLATION/APPLICATION

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

.2 Sleeves and inserts:
.1 Cast in drains and other inserts required to be built-in.

.3 Hot Weather Concreting:
.1 Contractor to comply with CAN/CSA-A23.1/A23.2. If temperature is expected to, or exceeds, ±25 degrees celcius take the necessary precautions. The Departmental Representative must accept hot weather concreting and protection.

.4 Cold Weather Concreting:

.1 Contractor to comply with CAN/CSA-A23.1/A23.2. Ensure that all surfaces unless noted otherwise that come in contact with fresh concrete are at a minimum of +5 degrees celcius and are kept at +10 degrees celcius for 5 days or +15 degrees celcius for 3 days. Finished slabs and toppings must be placed on surfaces that are at least +13 degrees celcius. Obtain Dteparmental Representative's review and approval of cold-weather concreting and protection procedures before proceeding with any cold-weather concreting.

3.3 FINISHES

.1 Slabs and exposed site concrete:
.1 Screed to plane surfaces and use wood floats.

.2 Trowel smooth to provide lightly brushed non-slip finish.

.3 Stamp all slabs, catch basins, and manholes with the current year ("2013"). Location of stamping to be coordinated with the Departmental Representative.

3.4 CURING

.1 Use curing compounds compatible with applied finish on concrete surfaces free of bonding agents and to CSA A23.1/A23.2.

3.5 SITE TOLERANCES

.1 Concrete slab finishing tolerance to CSA A23.1/A23.2.

3.6 FIELD QUALITY CONTROL

.1 Concrete testing: to CSA A23.1/A23.2 by testing laboratory designated and paid for by Owner.

3.7 CLEANING

.1 Use trigger operated spray nozzles for water hoses.

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

.3 Dispose of excess concrete off-site.

.4 Wash trucks off-site.

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

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-25.20-95, Surface Sealer for Floors.

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

.3 South Coast Air Quality Management District (SCAQMD), California State
.1 SCAQMD Rule 1168-A2005(June 2006), Adhesives and Sealants Applications.

1.2 PAYMENT PROCEDURES

.1 All exterior concrete finishing work incorporated in the contract documents is to be included in the lump sum price.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit submittals in accordance with Section 01 33 00.

.2 Product Data:
.1 Provide manufacturer's printed product literature and data sheets for concrete finishes and include product characteristics, performance criteria, physical size, finish and limitations.
.1 Provide two copies of WHMIS MSDS. WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for concrete floor treatment materials. Indicate VOC content in g/L.
.2 Include application instructions for concrete floor treatments.

1.4 ENVIRONMENTAL REQUIREMENTS

.1 Electrical power:
.1 Provide sufficient electrical power to operate equipment normally used during construction.

.2 Work area:

.1 Make work area water tight protected against rain and detrimental weather conditions.

.3 Temperature:
.1 Maintain ambient temperature of not less than 10 degrees C from 7 days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40% during same period.

.4 Safety:
.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.

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

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 21.

PART 2 - PRODUCTS

2.1 CURING COMPOUNDS

.1 Use curing compounds compatible with applied finish on concrete surfaces free of bonding agents and to CSA A23.1/A23.2.

.2 Select low VOC, water-based, organic-solvent free curing compounds.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verify that substrate and site conditions are ready to receive work and grade elevations are as indicated on contract drawings.

3.2 APPLICATION

.1 Protect all stone masonry walls from concrete during pour and from sealant overspray. Protection to be at minimum 3mm polyethelene tarpaulin against face of wall.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.
.1 Leave Work area clean at end of each day.

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

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 0

3.4 PROTECTION

.1 Protect finished installation in accordance with manufacturer's instructions.

END OF SECTION

PART 1 - GENERAL

1.1 MEASUREMENT PROCEDURES

.1 All work related to stone masonry and pointing incorporated in the contract documents is to be included in lump sum price.

1.2 REFERENCES

.1 Definitions:
.1 Lewis: instrument inserted at top of stone as means of attachment in raising and lowering. Holds stone by means of keys or wedges fitted to dovetailed recess.
.2 Dogs: metal appliance for securing parts or members together by means of one or more projecting teeth or bent portions, lug, cramp.
.3 Fabricator: company having sufficient capacity to quarry, cut, and deliver stonework on schedule.
.4 Installer: company or person specializing in commercial stone work with 10 years experience. Employ skilled stone masons on site to do necessary field cutting as stones are set.
.5 Raking: removal of loose/deteriorated mortar to a depth suitable for repointing until sound mortar, and/or 4x joint thickness and/or a specified mm depth mm is reached.
.6 Repointing: filling and finishing of masonry joints from which mortar is missing has been raked out or has been omitted.
.7 Tooling: finishing of masonry joints using tool to provide final contour.
.8 Low-pressure water cleaning: water soaking of masonry using less than 350 kPa (50 psi) water pressure, measured at nozzle tip of hose.

.2 Reference Standards:
.1 ASTM International
.1 ASTM C 568-08a, Standard Specification for Limestone Dimension Stone.
.2 CSA International
.1 CAN/CSA A179-04(R2009), Mortar and Grout for Unit Masonry.
.2 CAN/CSA A-371-04(R2009), Masonry Construction for Buildings.
.3 CAN/CSA A371-04, Masonry Construction for Buildings.

.4 ASTM C5-79 (1992), Quicklime for Structural Purposes.
.5 ASTM C207-91 (1992), Hydrated Lime for Masonry Purposes.
.6 CAN/CSA A179-04(R2009), Mortar and Grout for Unit Masonry.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Samples:
.1 Submit samples of replacement stones not less than 60 days before masonry work begins.
.1 Submit one of each type of masonry unit specified: limestone.

1.4 QUALITY ASSURANCE

.1 Qualifications:
.1 Execute work by personnel experienced in preservation of historic masonry.
.2 Masons engaged by Masonry Contractor to have minimum of 5-10 years experience with historic masonry.
.3 Masons to have proof of license certification for propriety restoration mortars.
.4 Mock-ups:
.1 Construct mock-up to demonstrate repointing procedures for each type of masonry material specified in locations designated by the Departmental Representative.
.2 Notify Departmental Representative minimum of 24 hours prior to construction of the mock-up.
.3 Work not to proceed prior to approval of mock-up. Allow 24 hours for inspection of mock-up by Departmental Representative before proceeding with masonry repointing work.
.5 Accepted mock-up will demonstrate minimum standard for this work. Mock-up will remain as part of finished work.
.6 Departmental Representative has right to reject masons who do not demonstrate appropriate abilities or experience.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements:
.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
.2 Store cementitious materials and aggregates in accordance with CAN/CSA A23.1.

.3 Store lime putty in plastic lined sealed drums.

.4 Keep material dry. Protect from weather, freezing and contamination.

.5 Ensure that manufacturer's labels and seals are intact upon delivery.

.6 Remove rejected or contaminated material from site.

1.6 AMBIENT CONDITIONS

.1 Maintain masonry temperature between 10 degrees C and 25 degrees C for duration of work.

.2 When ambient temperature is below 10 degrees C:
.1 Store mortar materials for immediate use within heated enclosure. Allow mortar materials to reach minimum temperature of 10 degrees C before use.
.2 Ensure only sand and water are heated
.3 Maintain sand temperature between 10 degrees C and 30 degrees.
.4 Do not mix cement with water or with aggregate or with water-aggregate mixtures having higher temperature than 30 degrees C.
.5 Maintain mortar mix temperature between 10 degrees C and 30 degrees C.

PART 2 - PRODUCTS

2.1 MORTAR

.1 Mortar: in accordance with CAN/CSA A179.

.2 Water: potable, clean and free from contaminants.

.3 Bedding Mortar: pre-blended, pre-packaged, with blend of natural hydraulic lime, hydrated lime and masonry sand with a minimum compressive strength of 3.4 MPa at 28 days and 12-18% air entrainment (King HLM 500 or approved equivalent).

.4 Pointing Mortar: pre-blended, pre-packaged, with blend of natural hydraulic lime and masonry sand with a minimum compressive strength of 1.8 MPa at 28 days and 12-18% air entrainment (King HLM 300 or approved equivalent). Mortar to be coloured to match existing.

2.2 STONE MATERIALS

.1 Obtain new stone from a single quarry source acceptable to the Departmental Representative.
.1 Ensure single quarry source has resources to provide materials of consistent quality and matching existing stone.

.2 Limestone: to ASTM C 568, category III - High Density, colour and texture to match existing and have a minimum thickness of 200 mm.
.1 Limestone shall be from the Black River Geologic formation (Kingston Limestone and selective areas in Ontario and Quebec).

.3 Accepted Suppliers:
.1 Rideauview Contractors: R.R. #2, Inverary, Ontario, KOH 1X0, 613-546-7779.
Note: variations to colour within the Petworth and Mount Chesney Quarries exist. The Contractor shall ensure that new stone is from an area of these quarries that will weather to the same colour as the existing stone of the Redoubt.
.2 St. Marc Quebec Limestone: various suppliers.

2.3 STONE FABRICATION

.1 Cut stone to shape and dimensions to match existing and full to square with joints as indicated.
.1 Dress exposed faces true.

.2 Finish exposed faces and edges of stones to match existing.

2.4 FABRICATION TOLERANCES

.1 Fabricate limestone dimension stone to the following tolerances:
.1 Unit Length: plus or minus 3 mm.
.2 Unit Height: plus or minus 3 mm.
.3 Deviation From Square: plus or minus 3 mm, with measurement taken using the longest edge as the base.
.4 Bed Depth: plus or minus 3 mm.

2.5 ACCESSORIES

.1 Date Demarcation Inserts: 20mm diameter x 50mm long lead plug, grout filled, with year "2014" indicated on the exposed grout face.

PART 3 - EXECUTION

3.1 SITE VERIFICATION OF CONDITIONS

.1 Report to Departmental Representative areas of deteriorated masonry not previously identified.

.2 Obtain Departmental Representative's approval and instructions for replacement of masonry units before proceeding with work.

3.2 PREPARATION

.1 Move and lift stone units using means to prevent damage. Do not make holes or indentations for Lewises or dogs on face or top side of stone.

3.3 RAKING JOINTS

.1 Use manual raking tool to obtain clean masonry surfaces.
.1 Remove deteriorated and adhered mortar from masonry surfaces to sound mortar but in no case less than 2x joint thickness leaving square corners and flat surface at back of cut.
.2 Clean out voids and cavities encountered.

.2 Remove mortar without chipping, altering or damaging masonry units.

.3 Clean surfaces of joints by compressed air without damaging texture of exposed joints or masonry units.

.4 Flush open joints and voids; clean open joints and voids with low pressure water and if not free draining blow clean with compressed air.

.5 Leave no standing water.

3.4 POINTING:

.1 Dampen joints and porous masonry units.

.2 Keep masonry damp while pointing is being performed.

.3 Completely fill joint with mortar.
.1 If surface of masonry units has worn rounded edges keep pointing back from surface to keep same width of joint
.2 Avoid feather edges.
.3 Pack mortar solidly into voids and joints.

.4 Build-up pointing in layers not exceeding 12 mm in depth.
.1 Allow each layer to set before applying subsequent layers.
.2 Maintain joint width.

.5 Finish joints to match existing profile.
.1 Tool, compact and finish using mason's slick to force mortar into joint.

.6 Remove excess mortar from masonry face before it sets.

3.5 CUTTING/SIZING OF STONE

.1 Stones to be cut and sized as per contract drawings.

3.6 MOVING STONES

.1 Use dogs to lift stones to working level.

.2 Move stones horizontally in wheelbarrows.

.3 Slide stones into place on wood ramps.

.4 Protect edges of stone from damage when hoisting and lifting from position. Use separators or wood shims to isolate units from hoisting belts.

3.7 STONE PLACEMENT

.1 Stone pattern, orientation and joint widths as per contract drawings.

.2 Clean dust and stone fragments from slot. Before proceeding with Work, inspect cleaned surface with Departmental Representative.

.3 Dampen slot's surfaces before applying mortar.

.4 Apply mortar and lay stones.
.1 Lay stones on full beds of mortar.
.2 Fill vertical joints buttered and placed full in face, and at vertical joint between wythes.
.3 Lay stones and tool joints in one operation, tooling with a round jointer to provide smooth joints compressed uniformly concave.
.4 Rake bedding mortar back to a minimum depth of 25 mm and make ready for pointing with pointing mortar in separate operation.
.1 Provide minimum 3-day damp cure to bedding mortar prior to pointing.

.5 Apply pointing mortar:
.1 Fill raked joints with pointing mortar.

.6 Finish joints to match those of existing stonework, in area identified by Departmental Representative.

.7 Clean finished stonework as work progresses.
.1 Remove mortar splashings on exposed stonework.
.2 Remove mortar staining before it sets.
.3 Clean masonry with clean water and soft bristle brush only.

.8 Install date demercation insert at stone corner and 50 mm from each stone edge. Face of insert to be flush with stone face. Provide one insert for each randomly replaced stone and one insert for entire stone replacement area.

3.8 PROTECTION OF WORK

.1 Cover completed and partially completed work not enclosed or sheltered at end of each work day.
.1 Extend membranes 0.5 m beyond surface area of work.

.1 Prevent finished work from drying out too rapidly.

.2 Cover with waterproof tarps to prevent weather from eroding recently repointed material.
.1 Maintain tarps in place for minimum of 2 weeks after pointing.
.2 Ensure that bottoms of tarps permit airflow to reach mortar in joints.

.3 Anchor coverings securely in position.

.4 Damp cure:
.1 Provide damp cure for pointing mortars.
.1 Install and maintain wetted burlap protection during the curing process:
.1 Minimum 3 days.
.2 Wet mist burlap only - ensure no direct spray reaches surface of curing mortar.
.3 Shade areas of work from direct sunlight and maintain constant dampness of burlap.

.5 Protect from drying winds. Pay particular attention at corners.

.6 Maintain ambient temperature of minimum 10 degrees C after pointing masonry for:
.1 Minimum 7 days in summer.
.2 Minimum 30 days in cold weather conditions using dry heated enclosures.

3.10 CLEANING

.1 Clean stone work surfaces after repairs have been completed and mortar has set.

.2 Clean stone surfaces of adhesive or mortar residue resulting from work performed without damaging stone or joints.

.3 Clear site of debris, surplus material and equipment, leaving work area in clean and safe condition.

3.11 PROTECTION OF WORK

.1 Protect adjacent work from marking or damage due to work.

.2 Protect adjacent finished work against damage which may be caused by on-going work.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Canadian Painting Contractors' Architectural (CPCA).
.1 Architectural Painting Specification Manual, latest edition (The Master Painters Institute).

.2 Canadian General Standards Board (CGSB). .1 CAN/CGSB-1.59-M89, Alkyd, Exterior, Gloss Enamel. .2 CAN/CGSB-1.121-93, Vinyl Pretreatment Coaring for Metals (Vinyl Wash Primer). .3 CAN/CGSB-1.145-M90, Solvent-Based Pigmented Stain. .4 CAN/CGSB-1.146-92, Cold Curing, Gloss Epoxy Coating
.5 N/CGSB-1.165-M89, Cold Curing, Gloss Epoxy Primer .6 CGSB 1 -GP-180Ma-82, Coating, Polyurethane, Two-Package, General Purpose.
.7 N/CGSB-1.202-92, Interior Low Gloss Alkyd Enamel. .8 CGSB 85-GP-10M-79, Shop Painting Structural Steel.
.9 SB 85-GP-14M-78, Painting Steel Surfaces Exposed to Normally Dry Weather. .10 CAN/CGSB-85.100-93, Painting

.3 Steel Structures Painting Council (SSPC), Systems and Specifications Manual 1989.

1.2 PRODUCT DATA

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

1.3 SAMPLES

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

1.4 MEASUREMENT PROCEDURES

.1 All painting and coating as indicated in contract documents is to be included in the lump sum price as accepted by the departmental representative.

1.5 QUALITY ASSURANCE

.1 Standard of Acceptance:
.1 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

1.7 DELIVERY STORAGE AND HANDLING

.1 Deliver and store materials in original containers, sealed, with labels intact.

.2 Indicate on containers or wrappings:
.1 Manufacturer's name and address.
.2 Type of paint.
.3 Compliance with applicable standard.
.4 Colour number in accordance with established colour schedule.

.3 Remove damaged, opened and regected materials from site.

.4 Provide and maintain dry, temperature controlled, secure storage.

.5 Observe manufacturer's recommendations for storage and handling.

.6 Store materials and supplies away from heat generating devices.

.7 Store materials and equipment in a well ventilated area with temperature range 7 C to 30 C.

.8 Store temperature sensitive products above minimum temperature as recommended by manufacturer.

.9 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of Departmental Representative. After completion of operations, return areas to clean condition to approval of Departmental Representative.

.10 Provide minimum one 9 kg Type ABC fire extinguisher adjacent to storage area.

.11 Remove only in quantities required for same day use.

.12 ire Safety Requirements
.1 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
.2 Handle, store, use and dispose of flammableand combustible materials in accordance with the National Fire Code of Canada.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 General:

.1 Safety: comply with requirements of Workplace Hazardous Materials Information System(WHIMS) regarding use, handling storage, and disposal of hazardous materials.

.2 Exterior:

.1 Apply paint finishes only when conditions forecast for entire period of application fall within manufacturer's recommendations.

.2 Where surface to be painted is not under cover, do not apply paint when:

.1 Substrate and ambient air temperature is below 5 C for alkyd and 7 C for latex paints or when temperature is expected to drop to 0 C before paint has thoroughly cured.

.2 Substrate and ambient air temperature are expected to fall outside limits prescribed in paint standard and by manufacturer.

.3 Temeperature of surface is over 50 C unless pain is specifically formulated for application at high temperatures.

.4 Rain or snow are forecast to occur before paint has thoroughly cured; it is foggy, misty, raining or snowing at site; relative humidity is above 85%

.5 Surface to be painted is wet, damp or frosted.

.6 Previous coat is not dry.

.3 Provide and maintain cover when paint must be applied in damp or cold weather. Heat substrates and surrounding air to comply with temperature and humidity conditions specified by manufacturer. Protect until paint is dry or until weather conditions are suitable

.3 Apply paint finish only when dust is no longer being generated by related construction operations or when wind conditions are such that airborne particles will not affect the quality of the finished surface.

.4 Schedule painting operations such that surfaces exposed to direct, intense sunlight are scheduled for completion during early morning.

.5 Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow ro condensation. Prepare surface again and repaint.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Only top line qaulity paints of well known and reputable paint manufacturers including Benjamin Moore, Pratt and Lambert, Sherwin Williams, Pittsburgh Paints, Para, Sico, or approved alternate will be acceptable.

.2 It is the intent of this specifications that the quality of paint be used is such that complete 'hiding' is obtained in the number of coats specified. If complete hiding is not obtained in the number of coats specified, apply additional coats as required to provide coverage acceptable to the Departmental Representative.

.3 Paint materials for each coating formual to be products of a single manufacturer.

.4 Low odour products: whenever possible, select products exhibiting low odour characteristics. If two products are otherwise equivalent, selectthe product with the lowers odour.

2.2 COLOURS

.1 Colour to be non-glossy gray to match colour aged asphalt.

2.3 EXTERIOR PAINT FINISHES

.1 Ferrous Metal: EXT 5.3
.1 Touch up shop primer with same zinc rich primer as provided by fabricator
.2 One coat acrylic primer.
.3 Two coats hough performance acrylic: Glidden 6900 or Sherwin Williams DRM 66.

PART 3 - EXECUTION

3.1 GENERAL

.1 Perform all painting operations in accordance with CAN/CGSB-85.100 except where specified otherwise.

.2 Perform all painting operations in accordance with MPI Painting Specifications Manual except where specified otherwise.

.3 Apply all paint materials in accordance with paint manufacturers written application instructions.

.4 All areas to recive new paint as denoted on contract drawings.

3.2 PROTECTION

.1 Protect building surfaces not to be painted from paint spatters, markings and other damage. If damaged, clean and restore such surfaces as directed by Departmental Representative.

.2 Cover or mask floors, windows and other ornamental hardware adjacent to areas being painted to prevent damge and to protect from paint drops and splatters. Use non-staining coverings.

.3 Protect items that are permantently attached such as Fire Labels on doors and frames.

.4 Protect factory finished products and equipment.

3.3 CLEANING

.1 Clean all surfaces to be painted as follows:
.1 Remove all dust, dirt, and other surface debris by vacuuming and wiping with dry, clean cloths.
.2 If necessary, wash surfaces with solution of T.S.P. bleach and clean warm water using a stiff brush to remove dirt, oil and other surface containments.
.3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
.4 Allow surfaces to drain completely and allow to dry thoroughly.

.2 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soons as possible after cleaning and before deterioration occurs.

.3 Sand existing surfaces with intact, smooth coatings to provide adequate adhesion for new finishes.

3.4 SURFACE PREPARATION - METAL

.1 Clean new metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with the following:
.1 Solvent cleaning: SSPC-SP-1.
.2 Hand tool cleaning: SSPC-SP-2.
.3 Power tool cleaning: SSPC-SP-3.

.2 Touch up shop primer to CGSB 85-GP-10M with primer as specified in applicable section. Touch up to include cleaning and painting of field connections, welds, rivets, nuts, washers, bolts, and damaged or defective paint and rusted areas.

.3 Prepare galvanized steel and zinc coated steel surfaces to CGSB 85-GP-16M.

.4 Prepare new steel surfaces exposed normally to dry conditions to CGSB 85-GP-14M.

3.5 MIXING PAINT

.1 Mix ingredients in container before and during use and ensure breaking up of lumps, complete dispersion of settled pigment, and uniform composition.

.2 Thin paint for spraying according to manufacturer's instructions. If directions are not on container, obtain instructions in writingfrom manufacturer and provide copy of instructions to Departmental Representative.

3.6 APPLICATION

.1 Method of application to be as approved by Departmental Representative. Apply paint by brush, roller or airless sprayer. Conform to manufacturer's application instructions unless specified otherwise.

.2 Brush application.
.1 Work paint into cracks, crevices and corners. Paint surfaces not accessible to brushes by spray, daubers or sheepskins.
.2 Brush out runs and sags.
.3 Remove runs, sags and brush marks from finished work and repaint.

.3 Spray application:

.1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
.2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
.3 Apply paint in a uniform layer, with overlapping at edges of spray pattern.
.4 Brush out immediately all runs and sags.
.5 Use branches to work paint into cracks, crevices and places which are not adequately painted by spray.

.4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficultaccess and only when specifically authorized by Departmental Representative.

.5 Apply each coat of paint as a continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.7 Sand and dust between each coat to remove visible defects.

.8 Finish closets and alcoves as specified for adjoining rooms.

.9 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

.10 In instances where materials specified are not suitable for a particular job application or are contrary to manufacturer's recommendations for use on a particular surface, such condition shall immediately be brought to the attention of the Departmental Representative for clarification and instructions.

3.7 RESTORATION

.1 Re-install all hardware items that were remove before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of Departmental Representative. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Departmental Representative.

END OF SECTION

PART 1 - GENERAL

1.1 EQUIPMENT LIST

.1 Complete list of equipment and materials to be used on this project and forming part of bid documents by adding manufacturer's name, model number and details of materials, and submit for approval.

.2 Submit for approval at time of bid within 48 h after Award of Contract.

1.2 TRIAL USAGE

.1 Departmental Representative may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Trial usage to apply to following equipment and systems:
.1 Natural gas systems.

1.3 PROTECTION OF OPENINGS

.1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

1.4 PAINTING

.1 Paint all exterior steel piping and protection structures with zinc-rich primer and top coat suitable for metal. Colour and paint specifications to be coordinated with and approved by Departmental Representative.

.2 Prime and touch up marred finished paintwork to match original.

.3 Restore to new condition, finishes which have been damaged too extensively to be merely primed and touched up.

1.5 SPARE PARTS

.1 Furnish spare parts in accordance with Section 01 78 00 as follows:
.1 One glass for each gauge glass.

1.6 SPECIAL TOOLS

.1 Provide one set of special tools required to service equipment as recommended by manufacturers.

1.7 DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTIONS

.1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.2 Where specified elsewhere in Mechanical Divisions, manufacturers to provide demonstrations and instructions.

.3 Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.

.4 Instruction duration time requirements as specified in appropriate sections.

.5 Where deemed necessary, Departmental Representative may record these demonstrations on video tape for future reference.

1.8 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00.

.2 Operation and maintenance manual to be approved by, and final copies deposited with, Departmental Representative before final inspection.

.3 Operation data to include:
.1 Control schematics for each system including environmental controls.
.2 Description of each system and its controls.
.3 Description of operation of each system at various loads together with reset schedules and seasonal variances.
.4 Operation instruction for each system and each component.
.5 Description of actions to be taken in event of equipment failure.
.6 Valves schedule and flow diagram.
.7 Colour coding chart.

.4 Maintenance data shall include:
.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
.2 Data to include schedules of tasks, frequency, tools required and task time.

.5 Performance data to include:
.1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.
.2 Equipment performance verification test results.
.3 Special performance data as specified elsewhere.

.6 Approvals:
.1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless so directed by Departmental Representative.
.2 Make changes as required and re-submit as directed by Departmental Representative.

.7 Additional data:
.1 Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.

1.9 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00.

.2 Shop drawings and product data shall show:
.1 Mounting arrangements.
.2 Operating and maintenance clearances (e.g. access door swing spaces).

.3 Shop drawings and product data shall be accompanied by:
.1 Detailed drawings of bases, supports, and anchor bolts.
.2 Points of operation on performance curves.
.3 Manufacturer to certify as to current model production.
.4 Certification of compliance to applicable codes.

.4 In addition to transmittal letter referred to in Section 01 33 00: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.10 CLEANING

.1 Clean interior and exterior of all systems including strainers.

1.11 AS-BUILT DRAWINGS

.1 Site records:
.1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of the work. Mark there on all changes as work progresses and as changes occur. This shall include changes to existing mechanical systems, control systems and low voltage control wiring.
.2 On a weekly basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.
.3 Use different colour waterproof ink for each service.
.4 Make available for reference purposes and inspection at all times.

.2 As-built drawings:
.1 Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of as-built drawings.
.2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
.3 Submit to Departmental Representative for approval and make corrections as directed.
.4 TAB to be performed using as-built drawings.
.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

.3 Submit copies of as-built drawings for inclusion in final TAB report.

1.12 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21.

.2 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.

.3 Dispose of unused paint material at official hazardous material collections site approved by Departmental Representative.

.4 Do not dispose of unused paint material into sewer system, into streams, lakes, onto ground or in other locations where it will pose health or environmental hazard.

.5 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.6 Dispose of corrugated cardboard, polystyrene, plastic packaging material in appropriate on-site bin for recycling in accordance with site waste management program.

1.13 HALOCARBONS

.1 Comply with Federal Halocarbon Regulations 2003 under the Canadian Environmental Protection Act 1999, EPAM and PWGSC Ontario Region Halocarbon Information Sheet dated March 2010.

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 REFERENCES

.1 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.2 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.3 DIELECTRIC COUPLINGS

.1 General: compatible with system, to suit pressure rating of system.

.2 Locations: where dissimilar metals are joined.

.3 NPS 2 and under: isolating unions or bronze valves.

.4 Over NPS 2: isolating flanges.

3.4 PIPEWORK INSTALLATION

.1 Protect openings against entry of foreign material.

.2 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.3 Assemble piping using fittings manufactured to ANSI standards.

.4 Install exposed piping and equipment parallel or perpendicular to building lines.

.5 Install concealed pipework to minimize furring space, maximize headroom, conserve space.

.6 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.7 Group piping wherever possible and as indicated.

.8 Ream pipes, remove scale and other foreign material before assembly.

.9 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.10 Provide for thermal expansion as indicated.

.11 Valves:
.1 Install in accessible locations.

.2 Install with stems above horizontal position unless otherwise indicated.
.3 Valves accessible for maintenance without removing adjacent piping.

3.5 SLEEVES

.1 General: install where pipes pass through masonry, concrete structures, asphalt, fire rated assemblies, and elsewhere as indicated.

.2 Material:
.1 Masonry, concrete structures, fire ratedassemblies: Schedule 40 black steel pipe.
.2 Asphalt and soil penetrations: Schedule 40 PVC pipe.

.3 Construction: foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.

.4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Installation:
.1 Concrete, masonry walls, concrete floors on grade, asphalt, soil penetrations: terminate flush with finished surface.
.2 Other floors: terminate 25 mm above finished floor.
.3 Before installation, paint exposed exterior surfaces of steel piping with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:
.1 Foundation walls and below grade floors: fire retardant, waterproof non-hardening mastic.
.2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.
.3 Sleeves installed for future use: fill with lime plaster or other easily removable filler.
.4 Ensure no contact between copper pipe or tube and sleeve.

3.6 FLUSHING OUT OF PIPING SYSTEMS

.1 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.7 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.

.2 Pipework: test as specified in relevant sections of natural gas systems work.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant mechanical sections.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Conduct tests in presence of Departmental Representative.

.6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.

.7 Conceal work only after approval and certification of tests by Departmental Representative.

3.8 EXISTING SYSTEMS

.1 Connect into existing piping systems at times approved by Departmental Representative.

.2 Request written approval 10 days minimum, prior to commencement of work.

.3 Be responsible for damage to existing plant by this work.

.4 Ensure daily clean-up of existing areas.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
  .1 ASME B31.1-2010, Power Piping.
  .2 ANSI/ASME B31.3-2006, Process Piping.
  .3 ASME Boiler and Pressure Vessel Code BPVC-2010:
    .1 BPVC 2010 Section I: Power Boilers.
    .2 BPVC 2010 Section V: Nondestructive Examination.
    .3 BPVC 2010 Section IX: Welding and Brazing Qualifications.

.2 American Welding Society (AWS)
  .1 AWS C1.1M/C1.1-2000(R2006), Recommended Practices for Resistance Welding.
  .2 AWS Z49.1-2005, Safety in Welding, Cutting and Allied Process.
  .3 AWS W1-2000, Welding Inspection Handbook.

.3 Canadian Standards Association (CSA International)
  .1 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
  .2 CSA B51-03(R2007), Boiler, Pressure Vessel and Pressure Piping Code.
  .3 CSA-W117.2-2006, Safety in Welding, Cutting and Allied Processes.
  .4 CSA W178.1-2008, Certification of Welding Inspection Organizations.
  .5 CSA W178.2-2008, Certification of Welding Inspectors.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

1.3 QUALITY ASSURANCE

.1 Qualifications:
  .1 Welders:
    .1 Welding qualifications in accordance with CSA B51.
    .2 Use qualified and licensed welders possessing certificate for each procedure performed from authority having jurisdiction.

.3 Submit welder's qualifications to Departmental Representative.
.4 Each welder to possess identification symbol issued by authority having jurisdiction.
.5 Certification of companies for fusion welding of aluminum in accordance with CSA W47.2.

.2 Inspectors:
.1 Inspectors qualified to CSA W178.2.

.3 Certifications:
.1 Registration of welding procedures in accordance with CSA B51.
.2 Copy of welding procedures available for inspection.
.3 Safety in welding, cutting and allied processes in accordance with CSA-W117.2.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

PART 2 - PRODUCTS

2.1 ELECTRODES

.1 Electrodes: in accordance with CSA W48 Series.

PART 3 - EXECUTION

3.1 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 QUALITY OF WORK

.1 Welding: in accordance with ANSI/ASME B31.1, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and applicable requirements of provincial authority having jurisdiction.

3.3 INSTALLATION REQUIREMENTS

.1 Identify each weld with welder's identification symbol.

.2 Backing rings:
.1 Where used, fit to minimize gaps between ring and pipe bore.
.2 Do not install at orifice flanges.

.3 Fittings:
.1 NPS 2 and smaller: install welding type sockets.
.2 Branch connections: install welding tees or forged branch outlet fittings.

3.4 INSPECTION AND TESTS - GENERAL REQUIREMENTS

.1 Review weld quality requirements and defect limits of applicable codes and standards with Departmental Representative before work is started.

.2 Formulate "Inspection and Test Plan" in co-operation with Departmental Representative.

.3 Do not conceal welds until they have been inspected, tested and approved by inspector.

.4 Provide for inspector to visually inspect welds during early stages of welding procedures in accordance with Welding Inspection Handbook. Repair or replace defects as required by codes and as specified.

3.5 SPECIALIST EXAMINATIONS AND TESTS

.1 General:
.1 Perform examinations and tests by specialist qualified to CSA W178.1 and CSA W178.2 and approved by Departmental Representative.
.2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
.3 Inspect and test 10% of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination and spot gamma ray radiographic (hereinafter referred to as "radiography") tests.

.2 Hydrostatically test welds to ANSI/ASME B31.1.

.3 Visual examinations: include entire circumference of weld externally and wherever possible internally.

.4 Failure of visual examinations:
.1 Upon failure of welds by visual examination, perform additional testing as directed by Departmental Representative of total of up to 10% of welds, selected at random by Departmental Representative by radiographic tests.

.5 Radiographic tests for welded piping systems.
.1 Spot radiography:
.1 Conduct spot radiographic tests of up to 10% of welds, selected at random by Departmental Representative from welds which would be most difficult to repair in event of failure after system is operational.
.2 Radiographic film:
.1 Identify each radiographic film with date, location, name of welder, and submit to Departmental Representative. Replace film if rejected because of poor quality.
.3 Interpretation of radiographic films:
.1 By qualified radiographer.
.4 Failure of radiographic tests:
.1 Extend tests to welds by welder responsible when those welds fails tests.

3.6 DEFECTS CAUSING REJECTION

.1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.

3.7 REPAIR OF WELDS WHICH FAILED TESTS

.1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA)
.1 CAN/CSA-B149.1-10, Natural Gas and Propane Installation Code.

.2 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-1.60-97, Interior Alkyd Gloss Enamel.
.2 CAN/CGSB-24.3-92, Identification of Piping Systems.

1.2 SUBMITTALS

.1 Product Data: submit product data for each item specified.

.2 Submittals: in accordance with Section 01 33 00.

.3 Product data to include paint colour chips, other products specified in this section.

.4 Samples:
.1 Submit samples in accordance with Section 01 33 00.
.2 Samples to include nameplates, labels, tags, lists of proposed legends.

1.3 QUALITY ASSURANCE

.1 Quality assurance submittals: submit following in accordance with Section 01 33 00.

.2 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 35 29.06.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:
.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Waste Management and Disposal:
.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

PART 2 - PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers raised or recessed.

.3 Information to include, as appropriate:
.1 Equipment: manufacturer's name, model, size, serial number, capacity.

2.2 SYSTEM NAMEPLATES

.1 Colours:
.1 Hazardous: red letters, white background.
.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:
.1 3 mm thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:
.1 Conform to following table:

Size # mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1	10 x 50	1	3
2	13 x 75	1	5
3	13 x 75	2	3
4	20 x 100	1	8
5	20 x 100	2	5
6	20 x 200	1	8
7	25 x 125	1	12
8	25 x 125	2	8
9	35 x 200	1	20

.2 Use maximum of 25 letters/numbers per line.

2.3 EXISTING IDENTIFICATION SYSTEMS

.1 Apply existing identification system to new work.

.2 Where existing identification system does not cover for new work, use identification system specified this section.

.3 Before starting work, obtain written approval of identification system from Departmental Representative.

2.4 PIPING SYSTEMS GOVERNED BY CODES

.1 Identification:
.1 Natural gas: to CAN/CSA-B149.1 and authority having jurisdiction.

2.5 IDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB-24.3 except where specified otherwise.

.2 Pictograms:
.1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.

.3 Legend:
.1 Block capitals to sizes and colours listed in CAN/CGSB-24.3.

.4 Arrows showing direction of flow:
.1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
.2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
.3 Use double-headed arrows where flow is reversible.

.5 Extent of background colour marking:
.1 To full circumference of pipe or insulation.
.2 Length to accommodate pictogram, full length of legend and arrows.

.6 Materials for background colour marking, legend, arrows:
.1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
.2 Other pipes: pressure sensitive plastic-coated cloth vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.

.7 Colours and Legends:
.1 Where not listed, obtain direction from Departmental Representative.
.2 Colours for legends, arrows: to following table:

Background colour:	Legend, arrows:
Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:
.1 Natural gas
.2 Gas regulator vents

2.6 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

2.7 LANGUAGE

.1 Identification in English.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide CSA registration plates as required by respective agency.

3.2 NAMEPLATES

.1 Locations:
.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Protection:
.1 Do not paint, insulate or cover.

3.3 LOCATION OF IDENTIFICATION ON PIPING SYSTEMS

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification easily and accurately readable from usual operating areas and from access points.

.1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

PART 1 - GENERAL

1.1 REFERENCES

.1 American Society of Mechanical Engineers (ASME)
- .1 ANSI/ASME B16.5-2009, Pipe Flanges and Flanged Fittings.
- .2 ANSI/ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.
- .3 ANSI/ASME B16.22-2001(R2010), Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- .4 ANSI/ASME B18.2.1-2010, Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws.

.2 ASTM International
- .1 ASTM A47/A47M-99(R2009), Specification for Ferritic Malleable Iron Castings.
- .2 ASTM A53/A53M-10, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
- .3 ASTM B32-08, Specification for Solder Metal.
- .4 ASTM B75M-99(R2011), Specification for Seamless Copper Tube Metric.

.3 Canadian Standards Association (CSA)
- .1 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures.
- .2 CAN/CSA-B149.1-10, Natural Gas Installation Code.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Section 01 33 00.

.2 Indicate on manufacturers catalogue literature following: valves, regulators.

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.2 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:
.1 NPS 1/2 to 2, screwed.
.2 NPS2 1/2 and over, plain end.

.2 Buried plastic pipe: tubing shall comply with CSA Standard B137.4, "Polyethylene, Piping Systems for Gas Service". Plastic piping shall be complete with tracing wire.

2.2 JOINTING MATERIAL

.1 Screwed fittings: pulverized lead paste.

.2 Welded fittings: to CSA W47.1.

.3 Flange gaskets: nonmetallic flat.

2.3 FITTINGS

.1 Steel pipe fittings, screwed, flanged or welded:
.1 Malleable iron: screwed, banded, Class 150.
.2 Steel pipe flanges and flanged fittings: to ANSI/ASME B16.5.
.3 Welding: butt-welding fittings.
.4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.
.5 Bolts and nuts: to ANSI/ASME B18.2.1.
.6 Nipples: schedule 40, to ASTM A53/A53M.

.2 Plastic pipe fittings shall comply with CSA Stanadard B137.4, "Polyethylene Piping Systems for Gas Service."

2.4 VALVES

.1 Provincial Code approved, lubricated plug or ball type.

PART 3 - EXECUTION

3.1 PIPING

.1 Install in accordance with Section 23 05 01, supplemented as specified herein.

.2 Install in accordance with applicable Provincial Codes.

.3 Install in accordance with CAN/CSA B149.1.

.4 Install drip points:
.1 At low points in piping system.
.2 At connections to equipment.

3.2 VALVES

.1 Install valves with stems upright or horizontal unless otherwise approved by Departmental Representative.

.2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.3 FIELD QUALITY CONTROL

.1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.

3.4 PURGING

.1 Purge after pressure test in accordance with CAN/CSA B149.1.

3.5 PRE-START-UP INSPECTIONS

.1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.

.2 Check gas trains, entire installation is approved by authority having jurisdiction.

3.6 CLEANING AND START-UP

.1 In accordance with requirements of CAN/CSA B149.1, supplemented as specified herein.

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)
.1 CSA-C22.1-2012, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
.2 CAN3-C235-83(R2006), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
.3 Do underground systems in accordance with CSA C22.3 No.7-10, Underground Systems, except where specified otherwise.

.2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
.1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

.4 The Ontario Electrical Safety Code 2012, and all bulletins (Ontario).

.5 Hydro requirements and local applicable codes and regulations.

1.2 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates and labels for control items in English.

1.3 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00.

.2 Product Data: submit WHMIS MSDS.

.3 Submit for review single line electrical diagrams in glazed weatherproof frames and locate as indicated.
.1 Electrical distribution system in main electrical room.

.4 Shop drawings:
.1 Submit drawings within 3 weeks of Award of Contract.
.2 If changes are required, notify Departmental Representative of these changes before they are made.

.5 Quality Control: in accordance with Section 01 45 00.
.1 Provide CSA certified equipment and material.
.2 Where CSA certified equipment and materia; is not available, submit such equipment and material to authority having jurisdiction for special approval before delivery to site.
.3 Submit test results of installed electrical systems and instrumentation.
.4 Permits and fees: in accordance with General Conditions of contract. Pay associated fees. Departmental Representative will provide drawings and specifications required by Electrical Inspection Department and Supply Authority at no cost.
.5 Submit, upon completion of Work, load balance report as described in PART 3 - Load Balance.
.6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.

1.4 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00.

.2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction.
.1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.

.2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.

.3 Site Meetings:
.1 In accordance with Division 01.

.4 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.

.2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21.

1.6 SYSTEM STARTUP

.1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

.1 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - Submittals.

.2 Factory assemble control panels and component assemblies.

2.2 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of authority having jurisdiction, and Departmental Representative.

.2 Porcelain enamel signs, minimum size 175 x 250 mm.

2.3 WIRING TERMINATIONS

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.4 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates as follows:

.1 Nameplates: lamicoid 3 mm thick plastic engraving sheet, black face, white core, lettering accurately aligned and engraved into core and mechanically attached with self tapping screws.

.2 Sizes as follows:

.1 SIZE 1: 25 x 5 mm with 13 mm high letters

.2 SIZE 2: 75 x 5 mm with 13 mm high letters

.3 SIZE 3: 75 x 5 mm with 13 mm high letters

.4 SIZE 4: 100 x 50 mm with 25 mm high letters

.5 SIZE 5: 125 x 75 mm with 13 mm high letters

.6 SIZE 6: 200 x 100 mm with 25 mm high letters

.2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

.3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.

.4 Allow for minimum of twenty-five (25) letters per nameplate and label.

.5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.7 Terminal cabinets and pull boxes: indicate system and voltage.

.8 Transformers: indicate capacity, primary and secondary voltages.

2.5 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA-C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.6 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

2.7 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
.1 Paint outdoor electrical equipment light grey to EEMAC 24-1.
.2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Do complete installation in accordance with CSA-C22.1 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete.
.1 Sleeves through concrete: plastic sized for free passage of conduit, and protruding 50 mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

3.4 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise.
.1 Panelboards: as required by Code or as indicated.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.7 FIELD QUALITY CONTROL

.1 Load Balance:

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Provide upon completion of work, load balance report as directed in PART 1 - Submittals: phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.2 Conduct following tests:

.1 Distribution system including phasing, voltage, grounding and load balancing.

.2 Circuits originating from branch distribution panels.

.3 Systems: communications.

.4 Insulation resistance testing:

.1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.

.2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.

.3 Check resistance to ground before energizing.

.3 Carry out tests in presence of Departmental Representative.

.4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

3.8 CLEANING

.1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

PART 1 - GENERAL

1.1 PRODUCT DATA

.1 Provide product data in accordance with Section 01 33 00.

PART 2 - PRODUCTS

2.1 BUILDING WIRES

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RWU90 XLPE, Non Jacketted.

2.2 TECK 90 CABLE

.1 Cable: in accordance with Section 26 05 00.

.2 Conductors:
.1 Grounding conductor: copper.
.2 Circuit conductors: copper, size as indicated.

.3 Insulation:
.1 Cross-linked polyethylene XLPE.
.2 Rating: , 600 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride.

.7 Fastenings:
.1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
.2 Channel type supports for two or more cables at 50 mm centers.
.3 Threaded rods: 6 mm diameter to support suspended channels.
.4 All fasteners within mortar joints.

.8 Connectors:
.1 Watertight approved for TECK cable.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00.

.2 Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

.1 Terminate cables in accordance with contract drawings.

.2 Cable Colour Coding: to Section 26 05 00.

.3 Conductor length for parallel feeders to be identical.

.4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.5 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.

.6 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.

.7 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

.8 Install cables in ducts in accordance with section 26 05 43.01

3.3 INSTALLATION OF BUILDING WIRES

.1 Install wiring as follows:
.1 In conduit systems in accordance with Section 26 05 34.

.2 In underground ducts in accordance with Section 26 05 43.01.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

.1 Group cables wherever possible on channels.

.2 Install cable exposed, securely supported by hangers.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 26 05 00.

1.2 REFERENCES

.1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
.1 ANSI/IEEE 837-02, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:
.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect grounding equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as indicated.

.2 Plate electrodes: copper, surface area 0.2 m^2, minimum 1.6 mm thick.

.3 Grounding conductors: bare stranded copper, tinned, soft annealed, size as indicated.

.4 Insulated grounding conductors: green, copper conductors, size as indicated.

.5 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.

.6 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
.1 Grounding and bonding bushings.
.2 Protective type clamps.
.3 Bolted type conductor connectors.
.4 Thermit welded type conductor connectors.
.5 Bonding jumpers, straps.
.6 Pressure wire connectors.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for grounding equipment installation in accordance with manufacturer's written instructions.
.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

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

3.2 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.

.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 Soldered joints not permitted.

.7 Install bonding wire for flexible conduit, connected at one end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.9 Install separate ground conductor to outdoor lighting standards.

.10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.11 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

.12 Ground secondary service pedestals.

3.3 MANHOLES

.1 Install conveniently located grounding stud, electrode, size as indicated stranded copper conductor in each manhole.

.2 Install ground rod in each manhole so that top projects through bottom of manhole. Provide with lug to which grounding connection can be made. Confirm ground resistance meets or exceeds Canadian Electrical Code minimum requirements.

3.4 ELECTRODES

.1 Install rod or plate electrodes and make grounding connections as indicated.

.2 Bond separate, multiple electrodes together.

.3 Use size 3/0 AWG copper conductors for connections to electrodes.

.4 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.5 SYSTEM AND CIRCUIT GROUNDING

.1 Install system and circuit grounding connections to neutral of secondary 120/240 V system.

3.6 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, distribution panels, outdoor lighting, cable trays.

3.7 GROUNDING BUS

.1 Install copper grounding bus mounted on insulated supports on wall of electrical room and communication equipment room.

.2 Ground items of electrical equipment in electrical room and IT equipment to ground bus with individual bare stranded copper connections size 2/0AWG.

3.8 COMMUNICATION SYSTEMS

.1 Install grounding connections for telephone, fire alarm, intercommunication systems as follows:
.1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
.2 Fire alarm, security systems, intercommunication systems as indicated.

3.9 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

3.10 CLEANING

.1 Progress Cleaning:
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)
.1 CSA C22.1-12, Canadian Electrical Code, Part 1, 25th Edition.

1.2 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

.2 Product Data:
.1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Provide shop drawings: in accordance with Section 01 33 00.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:
.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21.

PART 2 - PRODUCTS

2.1 JUNCTION AND PULL BOXES

.1 Construction: welded steel enclosure.

.2 Covers Surface Mounted: screw-on flat turned edge covers.

2.2 CABINETS

.1 Construction: welded sheet steel as indicated hinged door, handle, latch lock 2 keys and catch

.2 Type E Empty: surface return flange mounting as indicated.

PART 3 - EXECUTION

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.

.3 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.3 IDENTIFICATION

.1 Equipment Identification: to Section 26 05 00.

.2 Identification Labels: size 2 indicating system name, voltage and phase or as indicated.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)
.1 CSA C22.1-2012, Canadian Electrical Code, Part 1, 25th Edition.

1.2 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:
.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21.

PART 2 - PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

.6 All boxes to be surface mounted. No penetrations to walls are permitted except within mortar joints for fasteners.

2.2 CONDUIT BOXES

.1 Cast FS or FD boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.3 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 35 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.

.4 Vacuum clean interior of outlet boxes before installation of wiring devices.

.5 Identify systems for outlet boxes as required.

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)
- .1 CAN/CSA-C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
- .2 CAN/CSA-C22.2 NO. 18.1-04, Metallic Outlet Boxes.
- .3 CAN/CSA-C22.2 NO. 18.2-06, Nonmetallic Outlet Boxes.
- .4 CAN/CSA-C22.2 No. 18.3-04(R2009),Conduit, Tubing, and Cable Fittings (Tri-National standard, with ANCE NMX-J-017 and UL 514B).
- .5 CSA C22.2 No. 45.1-07, Electrical Rigid Metal Conduit - Steel (Tri-National standard, with UL 6 and NMX-J-534-ANCE-2007).
- .6 CSA C22.2 No. 83-M1985(R2008), Electrical Metallic Tubing.
- .7 CSA C22.2 No. 211.2-06(R2011), Rigid PVC (Unplasticized) Conduit.
- .8 CAN/CSA-C22.2 No. 227.3-05, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

1.2 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

.2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
- .1 Submit cable manufacturing data.

.3 Quality assurance submittals:
- .1 Test reports: submit certified test reports.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Instructions: submit manufacturer's installation instructions.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

PART 2 - PRODUCTS

2.1 CABLES AND REELS

.1 Provide cables on reels or coils.
.1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.

.2 Each coil or reel of cable to contain only one continuous cable without splices.

.3 Identify cables for exclusively dc applications.

2.2 CONDUITS

.1 Rigid metal conduit: to CSA C22.2 No. 45.galvanized steel threaded.

.2 Epoxy coated conduit: to CSA C22.2 No. 45. with zinc coating and corrosion resistant epoxy finish inside and outside.

.3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with expanded ends.

.4 Rigid pvc conduit: to CSA C22.2 No. 211.2.

.5 Flexible pvc conduit: to CAN/CSA-C22.2 No. 227.3.

2.3 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 50 mm and smaller.
.1 Two hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 1 m on centre.

.4 Threaded rods, 6 mm diameter, to support suspended channels.

2.4 CONDUIT FITTINGS

.1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.

.2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.

.3 Watertight connectors and couplings for EMT.
.1 Set-screws are not acceptable.

2.5 EXPANSION FITTINGS FOR RIGID CONDUIT

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.6 FISH CORD

.1 Polypropylene.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms.

.3 Use rigid galvanized steel threaded conduit except where specified otherwise.

.4 Use electrical metallic tubing (EMT) above 2.4 m not subject to mechanical injury.

.5 Use rigid pvc conduit underground.

.6 Minimum conduit size for lighting and power circuits: 21 mm.

.7 Bend conduit cold:
.1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.8 Mechanically bend steel conduit over 21 mm diameter.

.9 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.10 Install fish cord in empty conduits.

.11 Remove and replace blocked conduit sections.
.1 Do not use liquids to clean out conduits.

.12 Dry conduits out before installing wire.

3.3 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUITS UNDERGROUND

.1 Slope conduits to provide drainage.

.2 Waterproof joints (pvc excepted) with heavy coat of bituminous paint.

3.6 CLEANING

.1 Proceed in accordance with Section 01 74 11.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Insulated Cable Engineers Association, Inc. (ICEA)

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for cables and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

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

.2 Storage and Handling Requirements:
.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect cables from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for cable installation in accordance with manufacturer's written instructions.
.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

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

3.3 CABLE INSTALLATION IN DUCTS

.1 Install cables as indicated in ducts.

.2 Do not pull spliced cables inside ducts.

.3 Install multiple cables in duct simultaneously.

.4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.5 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.

.6 Before pulling cable into ducts and until cables are properly terminated, seal ends of non-leaded cables with moisture seal tape.

.7 After installation of cables, seal duct ends with duct sealing compound.

3.5 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00.

.2 Perform tests using qualified personnel.
.1 Include necessary instruments and equipment.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check each feeder for continuity, short circuits and grounds.
.1 Ensure resistance to ground of circuits is not less than 50 megohms.

.5 Pre-acceptance tests:
.1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
.2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.6 Acceptance Tests:
.1 Ensure that terminations and accessory equipment are disconnected.
.2 Ground shields, ground wires, metallic armour and conductors not under test.
.3 High Potential (Hipot) Testing.
.1 Conduct hipot testing at 100% of original factory test voltage in accordance with manufacturer's ICEA recommendations.

.7 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test.

.8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.6 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

.1 Repair damage to adjacent materials caused by cables installation.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Materials and components for dry type transformers up to 600 V primary, equipment identification and transformer installation.

1.2 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results For Electrical.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)
.1 CAN/CSA-C22.2 No.47-M90(R2007), Air-Cooled Transformers (Dry Type).
.2 CSA C9-M1981(R2001), Dry-Type Transformers.

.2 National Electrical Manufacturers Association (NEMA)

1.4 PRODUCT DATA

.1 Submit product data in accordance with Section 01 33 00.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

.5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 TRANSFORMERS

.1 Use transformers of one manufacturer throughout project and in accordance with CAN/CSA-C22.2 No.47 and CSA-C9.

.2 Design 1.
.1 Type: ANN.
.2 1 phase, 600 V input, 120/240 V output, 60 Hz.
.3 Voltage taps: 2 - 2½% FCAN, 2 - 2½% FCBN.
.4 Insulation: Class H, 150 degrees C temperature rise.
.5 Basic Impulse Level (BIL): standard.
.6 Hipot: standard.
.7 Average sound level: less than 60 decibels measured in any third octave band between 60 Hz and 1000 Hz. (300-500 KVA rating).
.8 Impedance at 17 degrees C: 6% maximum.
.9 Enclosure: NEMA 3R, removable metal front panel. Sprinklerproof.
.10 Mounting: floor.
.11 Finish: in accordance with Section 26 05 00.
.12 Windings: copper.
.13 To CSA C802.2-00.
.14 T-Tap transformers are NOT ACCEPTABLE.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00.

.2 Label size: 7.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Mount floor mounted dry type transformers on 100 mm concrete housekeeping pad.

.2 Ensure adequate clearance around transformer for ventilation.

.3 Install transformers in level upright position.

.4 Remove shipping supports only after transformer is installed and just before putting into service.

.5 Loosen isolation pad bolts until no compression is visible.

.6 Make primary and secondary connections in accordance with wiring diagram. Connect chasis and ground terminals to building ground.

.7 Energize transformers after installation is complete.

.8 Use flexible conduit to make connections to transformer.

3.2 CONNECTIONS

.1 Make primary and secondary connections shown on wiring diagram.

.2 Energize transformers immediately after installation is completed, where practicable.

.3 Adjust primary taps as necessary to produce rated secondary voltage at no-load.

3.3 NOISE/ VIBRATION ISOLATION

.1 Isolate transformer noise and vibration from occupied areas of the building. Provide neoprene isolation for support of the transformer, and utilize flexible wiring connections. Advise other trades not to locate services tin the area adjacent to the transformer, that may hinder the isolation of the transformer noise and vibration.

.2 Utilize Vibro-Acoustics type NSN resilient elements below transformers.

3.4 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00.

.2 Nameplate for each transformer Size 7 engraved in accordance with Section 26 05 00. Indicate transformer designation, capacity, primary and secondary voltages, phase, and name of load the transformer energizes (ie. "T-2, 300 kVA, 500/120/208V, three phase, feeds Sub-Distribution SD-1"). Mount on front face of transformer.

END OF SECTION

PART 1 - GENERAL

1.2 REFERENCES

.1 CSA International
.1 CSA C22.2 No.29-11, Panelboards and Enclosed Panelboards.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
.1 Include on drawings:
.1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00.

.2 Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:
.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect panelboards from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 PANELBOARDS

.1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
.1 Install circuit breakers in panelboards before shipment.
.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 250 V panelboards: bus and breakers rated for 10k A (symmetrical) interrupting capacity or as indicated.

.3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.5 Minimum of 2 flush locks for each panel board.

.6 Two keys for each panelboard and key panelboards alike.

.7 Copper bus with neutral of same ampere rating of mains.

.8 Mains: suitable for bolt-on breakers.

.9 Trim with concealed front bolts and hinges.

.10 Trim and door finish: baked enamel as per colour schedule.

.12 Include grounding busbar with 3 terminals for bonding conductor equal to breaker capacity of the panel board.

2.2 BREAKERS

.1 Breakers: to Section 26 28 16.02.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.5 Lock-on devices for fire alarm, emergency, exit and circuits.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00.

.2 Nameplate for each panelboard size 4 engraved as indicated.

.3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for panelboards installation in accordance with manufacturer's written instructions.
.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panelboards as per drawings.

.3 Mount panelboards to height specified in Section 26 05 00 or as indicated.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

3.3 CLEANING

.1 Progress Cleaning:
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

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

.2 Repair damage to adjacent materials caused by panelboards installation.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Materials for moulded-case circuit breakers, and ground-fault circuit-interrupters.

.2 Text to complete:
.1 Section 26 24 02 - Service Entrance Board.
.2 Section 26 28 18 - Ground Fault Equipment Protection.

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).
.1 CSA-C22.2 No. 5-02(R2007), Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE).

1.3 SUBMITTALS

.1 Submit product data in accordance with Section 01 33 00.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21.

.2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

PART 2 - PRODUCTS

2.1 BREAKERS GENERAL

.1 Moulded-case circuit breakers, and Ground-fault circuit-interrupters: to CSA C22.2 No. 5

.2 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

.3 Common-trip breakers: with single handle for multi-pole applications.

.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
.1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.5 Circuit breakers with interchangeable trips as indicated.

.6 Circuit breakers to have minimum 10 kA symmetrical rms interrupting capacity rating.

2.2 OPTIONAL FEATURES

.1 Include:
.1 On-off locking device, where indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install circuit breakers [as indicated].

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)
.1 ANSI J-STD-607-a-2002.

1.3 SYSTEM DESCRIPTION

.1 Telecommunications raceways system consists of outlet boxes, cover plates, terminal distribution cabinets, conduits, handholes, pull boxes, sleeves and caps, fish wires, concrete encased ducts.

PART 2 - PRODUCTS

2.1 MATERIAL

.1 Underground cable ducts: PVC type, in accordance with Section 33 65 76.

.2 Fish wire: polypropylene type.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install empty raceway system, including underground distribution system, fish wire, patch panels, outlet boxes, handholes, cover plates, conduit, sleeves and caps, miscellaneous and positioning material to constitute complete system.

END OF SECTION

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

.1 Empty telecommunications raceways system consists of outlet boxes, cover plates, patch panels, conduits, handholes, sleeves and caps, fish wires, service fittings and concrete encased ducts.

.2 Underground duct distribution system.

1.2 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal, conduit and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

.5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCTS

2.1 MATERIAL

.1 Conduits: PVC type, in accordance with Section 26 05 34.

.2 Underground cable ducts: PVC type, in accordance with Section 33 65 76.

.3 Fish wire: polypropylene type.

PART 3 - EXECUTION

3.1 INSTALLATION .1 Install empty raceway system, including distribution system, fish wire, patch panels, handholes, outlet boxes, cover plates, conduit, sleeves and caps, miscellaneous and positioning material to constitute complete system.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA International)
- .1 CSA-C22.2 No. 214-02, Communications Cables (Bi-National standard with UL 444).
- .2 CSA-C22.2 No. 232-M1988(R2004), Optical Fiber Cables.

.2 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)
- .1 TIA/EIA-568-B.1-(2001), Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements.
- .2 TIA/EIA-568-B.3-(2000), Optical Fiber Cabling Components Standard.
- .3 TIA/EIA-606-A-(2002), Administration Standard for the Commercial Telecommunications Infrastructure.
- .4 TIA TSB-140-2004, Telecommunications Systems Bulletin - Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems.
- .5 TIA-598-C-(2005), Optical Fiber Cable Color Coding.

1.2 DEFINITIONS

.1 Refer to TIA/EIA-598-C, Annex A for definitions of terms: optical-fiber interconnect, distribution, and breakout cables.

1.3 SYSTEM DESCRIPTION

.1 Structured telecommunications wiring system consist of optical fiber cables, terminations, connectors, cross-connection hardware and related equipment installed inside building for occupant's telecommunications systems, including voice (telephone), data, and image.

.2 Installed in physical star configuration backbone sub-systems.
- .1 Casemates linked to main patch panel by backbone cables.

1.4 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

.2 As-built Records and Drawings:
.1 Provide Microsoft Access database reflecting cable installation and cross-connections.
.2 Provide electronic drawings in AutoCAD 2008 format depicting all construction.
.3 Provide two (2) bound complete hard-copy sets of as-built records to the Departmental Representative.
.1 Provide and place one hard copy of as-built records for each patch panel in plan holder in each patch panel.

1.5 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

PART 2 - PRODUCTS

2.1 OPTICAL-FIBER CABLE

.1 Distribution, with conductive members, 62.5/125 micron single mode, 2 or 12 strands as indicated to: CSA-C22.2 No. 232 and TIA/EIA-568- B.3, flame test classification FT6, each end terminated with duplex SC connectors.

2.2 OPTICAL-FIBER PATCH PANEL

.1 Mounted in rack or cabinet 600 mm wide, 45 rack units, with lockable cover, weatherproof NEMA 3R, capable of terminating 24 pairs of fiber, equipped with duplex SC compatible adapters.

2.3 OPTICAL-FIBER PATCH CORDS

.1 Interconnect cable, 2 strands, 1 metre long, each end equipped with duplex SC connectors. 62.5/125 micron single mode to: TIA/EIA-568-B.3.

PART 3 - EXECUTION

3.3 INSTALLATION OF BACKBONE CABLES

.1 Install backbone cables from each casemate to main patch panel as indicated and according to manufacturers' instructions.
.1 Identify and label as indicated to: TIA/EIA-606-A.

3.2 INSTALLATION OF EQUIPMENT CABLES

.1 Install equipment cables from equipment patch panel as indicated.
.1 Identify and label as indicated to: TIA/EIA-606-A.

3.3 IMPLEMENT CROSS-CONNECTIONS

.1 Implement cross-connections using patch cords as specified.

3.4 FIELD QUALITY CONTROL

.1 Test backbone UTP cables as specified below and correct deficiencies: provide record of results as hard copy and electronic record on CD or USB drive.
.1 Perform tests for Permanent Link on 4-pair cables:
.1 Category 6 using certified level III tester to: TIA/EIA-568-B.2.
.2 Perform Wire Map tests on multi-pair UTP cables to: TIA/EIA-568-B.1.

.2 Test Optical-fiber strands for attenuation to: TIA/EIA-568-B.1 and correct deficiencies: provide record of results as hard copy and electronic record on CD or USB drive.
.1 Test horizontal links need at only one wavelength (850 nm or 1300 nm) and in one direction.
.1 Attenuation to be less than 2.0 dB, unless consolidation point is used.

.2 If consolidation point is used, attenuation test result to be less than 2.75 dB when testing between horizontal cross-connect and telecommunications outlet/connector.

.2 Test backbone links in both directions.

Backbone links:

.1 Test multi-mode fiber at both applicable wavelengths (850 nm and 1300 nm).

.2 Test single-mode fiber at both applicable wavelengths (1550 nm and 1310 m).

.3 Maximum attenuation: Cable attenuation + Connector loss + Splice loss.

.1 Multi-mode-fiber attenuation coefficients:

.1 3.5 db/km @ 850 nm; and

.2 1.5 db km @ 1300 nm

.2 Single-mode fiber attenuation coefficients at both 1310 nm and 1550 nm:

.1 1.0 db/km for inside plant cable; and

.2 0.5 db/km for outside plant cables.

.3 Maximum connector insertion loss: 0.75 db per pair and maximum splice insertion loss: 0.3 db.

PART 1 - GENERAL

1.1 NOT USED

.1 Not used.

PART 2 - PRODUCTS

2.1 FIBER OPTIC CABLES

.1 Optical characteristics:

Type	2 or 12 Fibres, singlemode
Operating Wavelength	1310 and 1550 nm
Maximum Attenuation	.4 db/km
Maximum Attenuation	.3 db/km

.2 Cable characteristics:

Maximum Installing Tension	600 lbs
Maximum Operating Tension	132 lbs
Minimum Installing Bending Radius	16.5 cm
Minimum Operating Radius	8.2 cm
Maximum Vertical Rise	641 m
Operating and Storage Temperature	-40C to +80C

.3 Terminations: ST connectors.

PART 3 - EXECUTION

3.1 FIBER OPTIC CABLE INSTALLATION

.1 Contractor shall test cables before installation.

.2 Contractor shall not exceed manufacturer's minimum bend radius of the maximum tensile rating.

.3 Use pull boxes to allow fiber optic cable access for backfeeding at every third 90 degree bend. When pulling long lengths of fiber optic cables in conduit, maintain less than 80% fill ratio by cross section.

.4 Pull cables through conduit or lay-in tray. In the FEC No. 5, all cables shall be securely fastened in place with cable ties and identified as fiber optic cables.

.5 Take care not to damage the fiber or connector during shipping, handling and installation.

.6 Arrange for test equipment to demonstrate that the cables are performing in accordance with these specifications. Perform a continuity test to detect splice fractures or other defects through analysis of backs scattering signal using an Optical Time Domain Reflectometer (OTDR). Provide Departmental Representative with written certified results of testing.

.7 Splicing to existing F.O. cables and terminations shall be carried out by an approved fiberoptic contractor.

.8 No splice is allowed for new F.O. cables.

.9 Mark fiber optic cables in maintenance holes and pullpits with yellow PVC tape.

END OF SECTION

PART 1 - GENERAL

1.1 Section Includes

.1 Installation of interlocking bricks and edge treatments for walkways at locations specified in the Contract Drawings.

1.2 Related Sections

.1 Section 31 23 33.01 - Excavating, Trenching and Backfilling, Section 32 11 23 - Aggregate Base Courses, Section 32 91 19.13 - Topsoil Placement and Grading.

1.3 Payment Procedure

.1 All work for Interlocking Paver Stones incorporated in the contract documents is to be included in the lump sum price.

1.4 References

.1 Ontario Provincial Specification Standards (O.P.S.S.): 310, 501 & 507.

1.5 Submittals

.1 Submit under provisions of Section 01 33 00 - Submittal Procedures.

PART 2 - PRODUCTS

2.1 Materials

.1 Granular A to OPSS 1010

.2 Stone Dust to OPSS 1010

.3 Silica Sand

.4 New interlocking brick. Material sample to submitted for review by Departmental Representative prior to placement.

PART 3 - EXECUTION

3.1 Preparation

.1 Remove/rework existing granular area as indicated on contract drawings.

.2 Place a minimum 50mm of Granular A compacted to 100% SPD or 50mm of stone dust compacted to 100% SPD.

.3 Replace any existing edge treatments along walkways of stairs prior to placement of interlocking brick.

3.2 Installation

.1 Interlocking Brick Placement
.1 Place pavers in interlocking pattern over bedding and use high frequency plate compactor to vibrate pavers into bedding.
.2 Sweep silica sand into joints.
.3 Contractor shall supply and place missing or deficient interlocking brick as is required upon review by Departmental Representative.
.4 Reinstate surrounding area to the satisfaction of the Departmental Representative.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 29 83 - Payment Procedures: Testing Laboratory Services.

.2 Section 31 23 10 - Excavation, Trenching and Backfilling.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)

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

1.3 EXISTING CONDITIONS

.1 Known underground and surface utility lines and buried objects are as indicated on site plan. The contractor as part of their work shall verify the exact location of all existing utilities before commencing work, and agree to be fully responsible for any, and all damages which may be occasioned by the contractor's failure to exactly locate and preserve any and all underground utilities.

1.4 PROTECTION

.1 Protect and/or transplant existing fencing, landscaping, buildings, pavement, surface or underground utility lines which are to remain as directed by Departmental Representative. If damaged, restore to original or better condition unless directed otherwise.

.2 Maintain access roads to prevent accumulation of construction related debris on roads in accordance with site access and staging plan.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Fill material: Type 1 in accordance with of Section 31 23 10.

.2 Excavated or graded material existing on site may be suitable to use as fill for grading work if approved by Departmental Representative.

PART 3 - EXECUTION

3.1 STRIPPING OF TOPSOIL

.1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected as determined by Departmental Representative.

.2 Commence topsoil stripping of areas as indicated after area has been cleared of grasses and removed from site.

.3 Strip topsoil to depths as directed by Departmental Representative. Retain topsoil on site. Avoid mixing topsoil with subsoil.

.4 Stockpile in locations as directed by Departmental Representative. Stockpile height not to exceed 2 m.

.5 Dispose of unused topsoil off site.

3.2 GRADING

.1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.

.2 Slope rough grade away from building as indicated.

.3 Grade ditches to depth as indicated.

.4 Compact filled and disturbed areas to ASTM D698.

3.4 SURPLUS MATERIAL

.1 Remove surplus material and material unsuitable for fill, grading or landscaping off site.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 33 05 13 - Manholes and Catch Basin Structures

.2 Section 33 11 16 - Site Water Utility Distribution Piping

.3 Section 33 41 00 - Storm Utility Drainage Piping

.4 Section 33 65 76 - Direct Buried Underground Cable Ducts

1.2 MEASUREMENT PROCEDURES

.1 All work to be under this item for excavating, trenching and backfilling (including shoring, bracing, cofferdams, underpinning and de-watering of excavation) except for items as described in 31 23 33.01 - 1.2.2 & 1.2.3 as incorporated in the contract documents is to be included in the lump sum price.

.2 All work associated with backfilling of existing water collection lines (WCL) will be paid per linear meter of WCL exposed and backfilled.

.3 Rock quantities measured will be actual volume removed within following limits:
.1 Width for trench excavation as indicated.
.2 Width for excavation for structures to be bounded by vertical planes up to 500 mm outside of and parallel to neat lines of footings as indicated.
.3 Depth from rock surface elevations immediately prior to excavation, to elevation as indicated.
.4 Where design elevation is less than 300 mm below original rock surface, depth will be considered to be 300 mm below original rock surface.
.5 Volume of individual boulders and rock fragments will be determined by measuring three maximum mutually perpendicular dimensions.

1.3 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
.1 ASTM C 117-04, Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
.2 ASTM C 136-05, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
.3 ASTM D 422-632002, Standard Test Method for Particle-Size Analysis of Soils.
.4 ASTM D 698-00ae1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft ^{3}) (600 kN-m/m ^{3}).
.5 ASTM D 1557-02e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ^{3}) (2,700 kN-m/m ^{3}).
.6 ASTM D 4318-05, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

.2 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
.2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

.3 Canadian Standards Association (CSA International)
.1 CAN/CSA-A3000-03, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
.1 CSA-A3001-03, Cementitious Materials for Use in Concrete.
.2 CSA-A23.1/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.4 U.S. Environmental Protection Agency (EPA)/Office of Water
.1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.4 DEFINITIONS

.1 Unclassified excavation: excavation of deposits of whatever character encountered in Work.

.2 Waste material: excavated material unsuitable for use in Work or surplus to requirements.

.3 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.

.4 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.

.5 Unsuitable materials:
.1 Weak, chemically unstable, and compressible materials.
.2 Frost susceptible materials:
.1 Fine grained soils with plasticity index less than 10 when tested to ASTM D 4318, and gradation within limits specified when tested to ASTM D 422 and ASTM C 136: Sieve sizes to CAN/CGSB-8.1 CAN/CGSB-8.2.
.2 Table:

Sieve Designation	% Passing
2.00 mm	100
0.10 mm	45 - 100
0.02 mm	10 - 80
0.005 mm	0 - 45

.3 Coarse grained soils containing more than 20 % by mass passing 0.075 mm sieve.

.6 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

.7 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.
.1 Rock: solid material in excess of 1.00 m^3 and which cannot be removed by means of heavy duty mechanical excavating equipment with 0.95 to 1.15 m^3 bucket. Frozen material will not be classified as rock.
.2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Preconstruction Submittals:

.1 Submit construction equipment list for major equipment to be used in this section prior to start of Work.
.2 Submit records of underground utility locates, indicating: location plan of existing utilities as found in field.

.3 Samples:
.1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
.2 Inform Departmental Representative at least 2 weeks prior to beginning Work, of proposed source of fill materials and provide access for sampling.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 Construction/Demolition Waste Management and Disposal.

.2 Divert excess aggregate materials from landfill to local quarry for reuse as directed by Departmental Representative.

1.7 EXISTING CONDITIONS

.1 Examine geotechnical report prepared by DBA Engineering, appended.

.2 Examine archaeolgical reports prepared by Parks Canada, appended.

.2 Buried services:
.1 Before commencing work verify location of buried services on and adjacent to site.
.2 Arrange with appropriate authority for relocation of buried services that interfere with execution of work:
.3 Remove obsolete buried services within 2 m of foundations: cap cut-offs.
.4 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
.5 Prior to beginning excavation Work, notify applicable Authorities having jurisdiction establish location and state of use of buried utilities and structures. Authorities having jurisdiction to clearly mark such locations to prevent disturbance during Work.

.6 Confirm locations of buried utilities by careful test excavations.
.7 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.
.8 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing re-routing. Costs for such Work to be paid by Departmental Representative.
.9 Record location of maintained, re-routed and abandoned underground lines.
.10 Confirm locations of recent excavations adjacent to area of excavation.

.3 Existing buildings and surface features:
.1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.
.2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.

.4 Existing WCL lines:
.1 Trace extents as directed by Departmental Representative. Limit excavations to minimum width allowing for backfilling work and any removals (pvc or no corrode).

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Type 1 and Type 2 fill: properties to the following requirements:
.1 Crushed, pit run or screened stone, gravel or sand.
.2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1 CAN/CGSB-8.2.
.3 Table:

Sieve Designation	% Passing	
	Type 1	Type 2
75 mm	–	100
50 mm	–	–
37.5 mm	–	–
25 mm	100	–
19 mm	75-100	–
12.5 mm	–	–
9.5 mm	50-100	–
4.75 mm	30-70	22-85
2.00 mm	20-45	–
0.425 mm	10-25	5-30
0.180 mm	–	–
0.075 mm	3-8	0-10

.2 Type 3 fill: selected material from excavation or other sources, approved by Departmental Representative for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.

.3 Unshrinkable fill: proportioned and mixed to provide:
.1 Maximum compressive strength of 0.4 MPa at 28 days.
.2 Maximum cement content of 25 kg/m ^{3} with 40% by volume fly ash replacement: to CSA-A3001, Type GU.
.3 Minimum strength of 0.07MPa at 24 h.
.4 Concrete aggregates: to CSA-A23.1/A23.2.
.5 Cement: Type GU.
.6 Slump: 160 to 200 mm.

.4 Geotextiles: to Section 31 32 19.01 - Geotextiles.

PART 3 - EXECUTION

3.1 SITE PREPARATION

.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

3.2 PREPARATION/PROTECTION

.1 Protect existing features in accordance with Section 01 56 00 - Temporary Barriers and Enclosures and applicable local regulations.

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

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

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

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

3.3 STOCKPILING

.1 Stockpile fill materials in areas designated by Departmental Representative.
.1 Stockpile granular materials in manner to prevent segregation.

.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 AND HEAVE PREVENTION

.1 Keep excavations free of water while Work is in progress.

.2 Provide for Departmental Representative's approval details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.

.3 Avoid excavation below groundwater table if quick condition or heave is likely to occur.
.1 Prevent piping or bottom heave of excavations by groundwater lowering, sheet pile cut-offs, or other means.

.4 Protect open excavations against flooding and damage due to surface run-off.

.5 Dispose of water to approved runoff areas and in manner not detrimental to public and private property, or portion of Work completed or under construction.
.1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.

.6 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.

3.5 EXCAVATION

.1 Excavate soil and rock as required to install services.

.2 Excavations to be monitored by Parks Canada Archeologist will be identified by Departmental Representative. Stop work immediately upon request of Archeologist to allow for Heritage recording. Do not re-commence work until approved. Refer to Section 01 01 00 part 1.8 for further details.

.3 Excavation must not interfere with bearing capacity of adjacent foundations.

.4 Keep excavated and stockpiled materials safe distance away from edge of trench as directed by Departmental Representative.

.5 Restrict vehicle operations directly adjacent to open trenches.

.6 Dispose of surplus and unsuitable excavated material off site.

.7 Do not obstruct flow of surface drainage or natural watercourses.

.8 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.9 Notify Departmental Representative when bottom of excavation is reached.

.10 Obtain Departmental Representative approval of completed excavation.

.11 Remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.

.12 Correct unauthorized over-excavation as follows:
.1 Fill under bearing surfaces and footings with concrete Type 2 fill compacted to not less than 100% of corrected Standard Proctor maximum dry density.
.2 Fill under other areas with Type 2 fill compacted to not less than 95 % of corrected Standard Proctor maximum dry density.

.13 Hand trim, make firm and remove loose material and debris from excavations.
.1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.

3.6 FILL TYPES AND COMPACTION

.1 Use types of fill as indicated or specified below. Compaction densities are percentages of maximum densities obtained from
ASTM D 698ASTM D 1557
.1 Under concrete slabs: provide compacted base course of Type 1 fill as indicated to underside of slab. Compact base course to 100 %.
.2 Retaining walls: use Type 2 fill to subgrade level on high side for minimum 500 mm from wall and compact to 95 %. For remaining portion, use Type 3 fill compacted to 95 %.

3.7 BEDDING AND SURROUND OF UNDERGROUND SERVICES

.1 Place and compact granular material for bedding and surround of underground services as indicated.

.2 Place bedding and surround material in unfrozen condition.

3.8 BACKFILLING

.1 Do not proceed with backfilling operations until completion of following:
.1 Departmental Representative has inspected and approved installations.

.2 Departmental Representative has inspected and approved of construction below finish grade.
.3 Inspection, testing, approval, and recording location of underground utilities.
.4 Removal of concrete formwork.
.5 Removal of shoring and bracing; backfilling of voids with satisfactory soil material.

.2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

.3 Do not use backfill material which is frozen or contains ice, snow or debris.

.4 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

.5 Backfilling around installations:
.1 Place bedding and surround material as specified elsewhere.
.2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
.3 Place layers simultaneously on both sides of installed Work to equalize loading. Difference not to exceed 0.5m.
.1 Permit concrete to cure for minimum 14 days or until it has sufficient strength to withstand earth and compaction pressure and approval obtained from Departmental Representative. or:
.2 If approved by Departmental Representative, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by Departmental Representative.

.6 Backfilling existing WCL:
.1 Remove and preserve cap stones as required.
.2 Restack/rebuild collapsed areas as per 04 03 42 - Historic - Replacing Stone.
.3 Backfill line as per Section 3.8 - Backfilling.
.4 Replace cap stones.
.5 Backfill excavation to underside of asphalt structure as specified herein.

.7 Place unshrinkable fill in areas as indicated.

.8 Consolidate and level unshrinkable fill with internal vibrators.

3.9 RESTORATION

.1 Upon completion of Work, remove waste materials and debris in accordance to Section 01 74 21 - Construction/Demolition Waste Management and Disposal, trim slopes, and correct defects as directed by Departmental Representative.

.2 Reinstate lawns to elevation which existed before excavation.

.3 Clean and reinstate areas affected by Work as directed by Departmental Representative.

.4 Use temporary plating to support traffic loads over unshrinkable fill for initial 24 hours.

.5 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

END OF SECTION

PART 1 - GENERAL

1.1 Section Includes

.1 Pavement reinforcement grid when used in conjunction with asphalt and road base cover provides additional reinforcement for roadways, highways and heavily trafficked areas.

1.2 Related Sections

.1 Section 31 23 33.01 - Excavating, Tenching and Backfilling, Section 31 11 23 - AggregateBase Courses, Section 32 91 19.13 - Topsoil Placement and Grading.

1.3 Payment Procedure

.1 All Pavement Reinforcement Grid work incorporated in the contract documents is included in the lump sum price.

1.4 References

.1 American Society for Testing and Materials (ASTM):
.1 D6637-11 Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rub Tensile Method.

1.5 Submittals

.1 Submit under provisions of Section 01 33 00 - Submittal Procedures.

PART 2 - PRODUCTS

2.1 Materials

.1 Single layer of pavement reinforcement grid with a minimum ultimate tensile strength of 100kN/m across width and length.

PART 3 - EXECUTION

3.1 Preparation

.1 The installation site shall be prepared by clearing, excavating or filling the area to the design grade.

.2 The surface to receive the pavement reinforcement grid shall be prepared to relatively smooth conditions free of obstructions, depressions, debris and soft or low density pockets of material.

.3 Prior to final placement of the pavement reinforcement grid the prepared surface should be inspected and approved by the Departmental Representative.

3.2 Installation

.1 Reinforcement Grid Placement
.1 Load rolls onto front of tractor or back of pick-up truck and unroll so that the self-adhesive side faces down during placement of mesh. Apply sufficient tension during unrolling process to remove ripples.
.2 Roll over mesh with rubber tired roller or with specially designed fabric tractor in accordance with manufacturers recommendations.

.2 Cut out portions of reinforcement grid as required around structures and ironworks. Adhere to manufacturers recommendations for overlapping reuirements between reinforcementgrid sheets.

.3 Pave directly over top of mesh after final placement.

PART 1 - GENERAL

1.1 Related Requirements

.1 Section 32 11 17 - Reshaping Granular Roadbed
Section 32 11 23 - Agregate Base Courses
Section 32 12 36.14 - Asphalt Seal Coat

1.2 References

.1 American Society for Testing and Materials (ASTM)
.1 ASTM C 117-95, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
.2 ASTM C 131-96, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
.3 ASTM C 136-96a, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
.4 ASTM D 422-63(1998), Standard Test Method for Particle-Size Analysis of Soils.
.5 ASTM D 698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft^3) (600kN-m/m^3).
.6 ASTM D 1557-00, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft^3) (2,700kN-m/m^3).
.7 ASTM D 1883-99, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
.8 ASTM D 4318-00, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

.2 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
.2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

1.3 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

.2 Divert unused granular material from landfill to local quarry as approved by Departmental Representative.

PART 2 - PRODUCTS

2.1 Materials

.1 Granular sub-base material: in accordance with following requirements:
.1 Crushed, pit run or screened stone, gravel or sand.
.2 Granulars to OPSS 1010.

PART 3 - EXECUTION

3.1 Placing

.1 Place granular sub-base after subgrade is inspected and approved by Departmental Representative.

.2 Construct granular sub-base to depth and grade in areas indicated.

.3 Ensure no frozen material is placed.

.4 Place material only on clean unfrozen surface, free from snow or ice.

.5 Place granular sub-base materials using methods which do not lead to segregation or degradation.

.6 Place material to full width in uniform layers not exceeding 150 mm compacted thickness. Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.

.7 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.

.8 Remove and replace portion of layer in which material has become segregated during spreading.

3.2 Compaction

.1 Compaction equipment to be capable of obtaining required material densities.

.2 Compact to density of not less than 98% maximum dry density in accordance with ASTM D 1557.

.3 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.

.4 Apply water as necessary during compaction to obtain specified density.

.5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.

.6 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.3 Site Tolerances

.1 Finished sub-base surface to be within 10 mm of elevation as indicated but not uniformly high or low.

3.4 Protection

.1 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by Departmental Representative.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 32 12 16.01 Granular Sub-base.

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)
.1 ASTM C 117-03, Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.
.2 ASTM C 131-03, Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
.3 ASTM C 136-01, Method for Sieve Analysis of Fine and Coarse Aggregates.
.4 ASTM D 698-00a, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600kN-m/m^3).
.5 ASTM D 4318-00, Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

.2 Canadian General Standards Board (CGSB).
.1 CAN/CGSB-8.1-88, Sieves Testing, Woven Wire, Inch Series.
.2 CAN/CGSB-8.2-M88, Sieves Testing, Woven Wire, Metric.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

.2 Excess materials are to be diverted from landfill to site approved by Departmental Representative.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Granular base material: to following requirements:

.1 Crushed stone or gravel consisting of hard, durable, angular particles, free from clay lumps, cementation, organic material and other deleterious materials.
.2 Granulars as per OPSS 1010.

PART 3 - EXECUTION

3.1 SEQUENCE OF OPERATION

.1 Scarifying and reshaping:
.1 Blade and trim material to elevation and cross section dimensions as indicated unless directed otherwise by Departmental Representative.
.2 Where deficiency of material exists, add and blend in new granular base material as directed by Departmental Representative. Ensure no frozen material is used.

.2 Compaction equipment:
.1 Compaction equipment capable of obtaining required material densities.

.3 Compacting:
.1 Compact to density minimum 100 corrected maximum dry density maximum dry density in accordance with ASTM D 698.
.2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
.3 Apply water as necessary during compaction to obtain specified density.
.4 Use mechanical tampers, approved by Departmental Representative to compact areas not accessible to rolling equipment to specified density.

.4 Repair of soft areas:
.1 Correct soft areas by removing defective material to depth and extent directed by Departmental Representative. Replace with material acceptable to Departmental Representative and compact to specified density.
.2 Maintain reshaped surface in condition conforming to this section until succeeding material is applied or until acceptance by Departmental Representative.

3.2 SITE TOLERANCES .1 Reshaped compacted surface within plus or minus 10 mm of elevation as indicated.

END OF SECTION

PART 1 - GENERAL

1.1 Related Requirements

.1 Section 32 12 16.01 Asphalt Paving - Short Form.

1.2 Payment Procedure

.1 All work for aggregate base courses incorporated in the contract documents is to be included in the lump sum price.

1.3 References

.1 American Society for Testing and Materials (ASTM)

.1 ASTM C 117-95, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.

.2 ASTM C 131-96, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

.3 ASTM C 136-96a, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.4 ASTM D 698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft^3) (600kN-m/m^3).

.5 ASTM D 1557-00, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft^3) (2,700kN-m/m^3).

.6 ASTM D 1883-99, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.

.7 ASTM D 4318-00, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

1.4 Waste Management and Disposal

.1 Separate and recycle waste materials in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.

.2 Divert unused granular material from landfill to local quarry as approved by Departmental Representative.

PART 2 - PRODUCTS

2.1 Materials

.1 Granular base: material in accordance with Section 31 05 16 - Aggregate Materials and following requirements:
.1 Crushed stone or gravel.
.2 Granular as per OPSS 1010.

PART 3 - EXECUTION

3.1 Sequence of Operation

.1 Place granular base after sub-base surface is inspected and approved by Departmental Representative.

.

.2 Placing
.1 Construct granular base to depth and grade in areas indicated.
.2 Ensure no frozen material is placed.
.3 Place material only on clean unfrozen surface, free from snow and ice.

.3 Compaction Equipment
.1 Compaction equipment to be capable of obtaining required material densities.
.2 Equipped with device that records hours of actual work, not motor running hours.

.4 Compacting
.1 Compact to density not less than 100% maximum dry density in accordance with ASTM D 698.
.2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
.3 Apply water as necessary during compacting to obtain specified density.

.4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.

.5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

.6 Where proof rolling reveals defective base or sub-base, remove defective materials to depth and extent as directed by Departmental Representative and replace with new materials in accordance with Section 32 11 16.01 - Granular Sub-base and this section at no extra cost.

3.2 Site Tolerances

.1 Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.

3.3 Protection

.1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by Departmental Representative.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 32 11 23 Aggregate Base Courses.

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)
.1 ASTM D 698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

.2 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-1.5-M91(March 1999), Low Flash Petroleum Spirits Thinner (Reaffirmation of December 1991).
.2 CAN/CGSB-1.74-2001, Alkyd Traffic Paint.

.3 Ontario Provincial Standard Specifications (OPSS)
.1 OPSS 302-April 1999, Construction Specification for Primary Granular Base.
.2 OPSS 310-March 1993, Construction Specification for Hot Mixed, Hot Laid Asphaltic Concrete Paving and Hot Mix Patching.
.3 OPSS 314-December 1993, Construction Specification for Untreated Granular, Subbase, Base, Surface Shoulder and Stockpiling.
.4 OPSS 1010-March 1993, Material Specification for Aggregates, Granular A, B, M and Select Subgrade Material.
.5 OPSS 1103-February 1996, Material Specification for Emulsified Asphalt.
.6 OPSS 1150-May 1994, Material Specification for Hot Mixed, Hot Laid Asphalt Concrete.

1.3 SAMPLES

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

.2 Submit to Consultant, samples of material for sieve analysis at least 1 week before beginning Work.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

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

.4 Divert unused aggregate materials from landfill to quarry for reuse as approved by Consultant.

.5 Fold up metal banding, flatten and place in designated area for recycling.

.6 Divert unused asphalt from landfill to facility capable of recycling materials.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Aggregates to: OPSS 1010.
- .1 Granular A.
- .2 Granular B Type II.
- .3 Select subgrade.

.2 Tack coat: SS-1 to OPSS 1103.

.3 Asphalt concrete: to OPSS 1150.

PART 3 - EXECUTION

3.1 FOUNDATIONS

.1 Compaction: compact each lift of granular material to 100% maximum density to ASTM D 698. Maximum lift thickness: 150 mm.

3.2 PAVEMENT THICKNESS

.1 Pavements for parade square:
- .1 Surface course: 50 mm HL3.

3.3 PAVEMENT CONSTRUCTION

.1 Application of prime coat: OPSS 302.

.2 Construction of asphalt concrete: OPSS 310.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 32 11 23 - Aggregate Base Courses.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
.1 ASTM C 117-04, Standard Test Method for Materials Finer than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
.2 ASTM C 136-05, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
.3 ASTM D 260-86(2001), Standard Specification for Boiled Linseed Oil.
.4 ASTM D 698-00ae1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft^3) (600 kN-m/m^3).

.2 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-3.3-99(March 2004), Kerosene, Amend. No. 1, National Standard of Canada.
.2 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.

.3 Canadian Standards Association (CSA International)
.1 CSA-A23.1-04/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:
.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 11 - Cleaning and Waste Management.

1.4 MEASUREMENT PROCEDURES

.1 All work to be included under walks, curps and gutters involves existing concrete pad removal, new granular and insulation installation, and new cast-in-place concrete work c/w reinforcement and all material as per contract drawings.

.2 Price for concrete walks, curbs and gutters and all associated labour and materials is to be included in the balance of the project.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Concrete mixes and materials: in accordance with Section 03 30 00 - Cast-in-Place Concrete.

.2 Reinforcing steel: in accordance with Section 03 20 00 - Concrete Reinforcing.

.3 Joint filler Curing Compound: in accordance with Section 03 30 00 - Cast-in-Place Concrete.

.4 Granular base for curb and gutter: Granular A material as per Section 32 11 23 - Aggregate Base Courses requirements.

.5 Sand base for sidewalk: sand material as per OPSS 1010.

.6 Boiled linseed oil: to ASTM D 260.

.7 Kerosene: to CAN/CGSB-3.3.

PART 3 - EXECUTION

3.1 GRADE PREPARATION

.1 Do grade preparation work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

.2 Construct embankments using excavated material free from organic matter or other objectionable materials.
.1 Dispose of surplus and unsuitable excavated material off site.

.3 When constructing embankment provide for minimum 0.6 m shoulders, where applicable, outside of neat lines of concrete.

.4 Place fill in maximum 150 mm layers and compact to at least 95 % of maximum dry density to ASTM D 698.

3.2 BASE

.1 For curb and gutter:
.1 Obtain Departmental Representative approval of subgrade before placing granular base.
.2 Place granular base material to lines, widths, and depths as indicated.
.3 Compact granular base in maximum 150 mm layers to at least 95 % of maximum density to ASTM D 698.

.2 For Pads:
.1 Obtain Departmental Representative approval of subgrade before placing base.
.2 Place base material to lines, widths, and depths as indicated.
.3 Compact base in maximum 200 mm layers to at least 95 % of maximum density to ASTM D 698.

3.3 CONCRETE

.1 Obtain Departmental Representative approval of granular base and reinforcing steel prior to placing concrete.

.2 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.

.3 Provide edging as indicated with 10 mm radius edging tool.

.4 Slip-form pavers equipped with string line system for line and grade control may be used if quality of work acceptable to Departmental Representative can be demonstrated. Hand finish surfaces when directed by Departmental Representative.

3.4 TOLERANCES

.1 Finish surfaces to within 3 mm in 3 m as measured with 3 m straight edge placed on surface.

3.5 EXPANSION AND CONTRACTION JOINTS

.1 Install tooled transverse contraction joints after floating, when concrete is stiff, but still plastic, at intervals of 1.5 m.

.2 Install expansion joints at intervals of 6 m.

.3 When sidewalk is adjacent to curb, make joints of curb, gutters and sidewalk coincide.

3.6 ISOLATION JOINTS

.1 Install isolation joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structure.

.2 Install joint filler in isolation joints in accordance with Section 03 30 00 - Cast-in-Place Concrete.

.3 Seal isolation joints with sealant approved by Departmental Representative.

3.7 CURING

.1 Cure concrete by adding moisture continuously in accordance with CSA-A23.1/A23.2 to exposed finished surfaces for at least 1 day after placing, or sealing moisture in by curing compound as directed by Departmental Representative.

.2 Where burlap is used for moist curing, place two prewetted layers on concrete surface and keep continuously wet during curing period.

.3 Apply curing compound evenly to form continuous film, in accordance with manufacturer's requirements.

3.8 BACKFILL

.1 Allow concrete to cure for 7 days prior to backfilling.

.2 Backfill to designated elevations with material as directed by Departmental Representative.
.1 Compact and shape to required contours as indicated.

3.9 LINSEED OIL TREATMENT

.1 Apply two coats of linseed oil mixture uniformly to surfaces of curbs, walks and gutters, after concrete has cured for specified curing time and when surface of concrete is clean and dry.

.2 Linseed oil mixture to consist of 50% boiled linseed oil and 50% mineral spirits by volume.

.3 Apply treatment when air temperature above 10 degrees C.

.4 Apply first coat at 135 mL/m^2.

.5 Apply second coat at 90 mL/m^2 when first coat has dried.

3.10 CLEANING

.1 Proceed in accordance with Section 01 74 11 - Cleaning and Waste Management.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 74 11 - Cleaning and Waste Management.

.3 Section 32 91 19.13 - Topsoil Placement and Grading.

1.2 SCHEDULING

.1 Schedule sod laying to coincide with preparation of soil surface. Sod to be applied immediately after topsoil surface is ready and accepted.

.2 Schedule sod installation when frost is not present in ground.

1.3 MEASUREMENT PROCEDURES

.1 All sodding material and labour incorporated into the work and accepted by the departmental representative to be includeded in lump sum price.

.2 Sodding and grading required to repair areas damaged or disturbed during construction operations shall not be considered for payment. Repair to equal or better quality as existing conditions as directed by Departmental Representative at no additional cost to owner.

1.4 WASTE MANAGEMENT AND DISPOSAL

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

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Number One Turf Grass Nursery Sod: sod that has been especially sown and cultivated in nursery fields as turf grass crop.
.1 Turf Grass Nursery Sod types:

.1 Number One Kentucky Bluegrass Sod - Fescue Sod: Nursery Sod grown solely from seed mixture of cultivars of Kentucky Bluegrass and Chewing Fescue or Creeping Red Fescue, containing not less than 40% Kentucky Bluegrass cultivars and 30% Chewing Fescue or Creeping Red Fescue cultivars.

.2 Turf Grass Nursery Sod quality:

.1 Not more than 2 broadleaf weeds or 10 other weeds per 40 square metres.

.2 Density of sod sufficient so that no soil is visible from height of 1500 mm when mown to height of 50 mm.

.3 Mowing height limit: 35 to 65 mm.

.4 Soil portion of sod: 6 to 15 mm in thickness.

.2 Water:

.1 Supplied by Departmental Representative at designated source.

.3 Fertilizer:

.1 To Canada "Fertilizers Act" and "Fertilizers Regulations".

.2 Complete, synthetic, slow release with 65 % of nitrogen content in water-insoluble form.

2.2 SOURCE QUALITY CONTROL

.1 Obtain approval from Departmental Representative of sod at source.

.2 When proposed source of sod is approved, use no other source without written authorization from Departmental Representative.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Verify that grades are correct and prepared in accordance with Section 32 91 19.13 - Topsoil Placement and Grading. If discrepancies occur, notify Departmental Representative and do not commence work until instructed by Departmental Representative.

.2 Do not perform work under adverse field conditions such as frozen soil, excessively wet soil or soil covered with snow, ice, or standing water.

.3 Fine grade surface free of humps and hollows to smooth, even grade, to tolerance of plus or minus 8 mm, for Turf Grass Nursery Sod, surface to drain naturally.

.4 Remove and dispose of weeds; debris; stones 50 mm in diameter and larger; soil contaminated by oil, gasoline and other deleterious materials; off site.

3.2 SOD PLACEMENT

.1 Lay sod within 24 hours of being lifted if air temperature exceeds 20 degrees C.

.2 Lay sod sections in rows, joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements.

.3 Provide close contact between sod and soil by light rolling. Use of heavy roller to correct irregularities in grade is not permitted.

3.3 SOD PLACEMENT ON SLOPES AND PEGGING

.1 Install and secure geotextile fabric in areas indicated, in accordance with manufacturer's instructions.

.2 Start laying sod at bottom of slopes.

.3 Peg sod on slopes steeper than 3 horizontal to 1 vertical, within 1 m of catch basins and within 1 m of drainage channels and ditches to following pattern:
.1 100 mm below top edge at 200 mm on centre for first sod sections along contours of slopes.
.2 Not less than 3-6 pegs per square metre.
.3 Not less than 6-9 pegs per square metre in drainage structures. Adjust pattern as directed by Departmental Representative.
.4 Drive pegs to 20 mm above soil surface of sod sections.

3.4 MAINTENANCE DURING ESTABLISHMENT PERIOD

.1 Perform following operations from time of installation until acceptance.

.2 Water sodded areas in sufficient quantities and at frequency required to maintain optimum soil moisture condition to depth of 75 to 100 mm.

.3 Cut grass to 50 mm when or prior to it reaching height of 75 mm. Remove clippings which will smother grassed areas as directed by Departmental Representative.

.4 Maintain sodded areas weed free 95%.

.5 Fertilize areas. Spread half of required amount of fertilizer in one direction and remainder at right angles and water in well.

3.5 ACCEPTANCE

.1 Turf Grass Nursery Sod areas will be accepted by Departmental Representative provided that:
.1 Sodded areas are properly established.
.2 Sod is free of bare and dead spots.
.3 No surface soil is visible from height of 1500 mm when grass has been cut to height of 50 mm.

.2 Areas sodded in fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.

3.6 MAINTENANCE DURING WARRANTY PERIOD

.1 Perform following operations from time of acceptance until end of warranty period:

.2 Repair and resod dead or bare spots to satisfaction of Departmental Representative.

.3 Eliminate weeds by mechanical or chemical means to extent acceptable to Departmental Representative.

3.7 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers. Refer to Section 01 74 11 - Cleaning and Waste Management.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 31 23 33.01: Excavating, Trenching and Backfilling.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)
.1 ASTM A 48/A 48M-00, Standard Specification for Gray Iron Castings.
.2 ASTM C 117-04, Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.
.3 ASTM C 136-05, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
.4 ASTM C 139-05, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.
.5 ASTM C 478M-06, Standard Specification for Precast Reinforced Concrete Manhole Sections Metric.
.6 ASTM D 698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).

.2 Canadian General Standards Board (CGSB)
.1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
.2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

.3 Canadian Standards Association (CSA International)
.1 CAN/CSA-A23.1-04/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
.2 CAN/CSA-A3000-03(R2005), Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
.3 CAN/CSA-A165 Series-04, CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
.4 CAN/CSA-G30.18-M92(R2002), Billet Steel Bars for Concrete Reinforcement.
.5 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

.5 Ontario Provincial Standard Specifications (OPSS)
.1 OPSS 407-November 2004, Construction Specification For Maintenance Hole, Catch Basin, Ditch Inlet And Valve Chamber Installation.

1.2 SOURCE QUALITY CONTROL

.1 Departmental Representative will inspect material at construction site.

1.3 MEASUREMENT PROCEDURES

.1 All maintenence holes and catch basin installation material and labour will be included in balance of project.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Cement: to CAN/CSA-A3001-08, Type GU.

.2 Water, aggregates, admixtures: to CSA-A23.1-09/A23.2-09, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.

.3 Frames, gratings, covers: to plan dimensions and to following requirements for designated materials:
.1 Metal gratings and covers to bear evenly on frames. A frame with grating or cover to constitute one unit. Assemble and mark unit components before shipment.
.2 Catch basin frames and covers: to OPSD 400.020 Nov. 2007.
.3 Electrical hand hole and maintenence hole frames and covers to be custom concrete or cast iron to match opening dimensions as per electrical drawings. Covers are to sit flush to final grade elevation and be made accessible. Confirm details with Departmental Representative.

.4 Mortar:
.1 Aggregate: to CSA A179-04(R2009).
.2 Cement: to CAN/CSA-A3002-08.

.5 Brick: to CAN/CSA-A82-06, Grade SW, Type FBS.

.6 Adjustment rings: precast concrete to ASTM C478M-09. 2 grade rings to be installed.

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILL

.1 Excavation and backfill to Section 31 23 33.01 - Excavating, Trenching and Backfilling.

.2 Excavation requires approval prior to installing maintenance holes or catch basins.

3.2 CONCRETE WORK

.1 Do pre-cast concrete work to CSA-A23.1-09/A23.2-09.

.2 Do cast-in-place concrete in accordance with section 03 30 00 - Cast-in-Place Concrete.

.3 Place concrete reinforcement in accordance with Section 03 20 00 - Concrete Reinforcing .

.4 Position metal inserts to dimensions and details shown or required.

3.3 INSTALLATION

.1 Construct units to details indicated, plumb and true to alignment and grade.

.2 Set bottom section of precast unit in place. Make each successive joint watertight with approved rubber ring gaskets, mastic joint filler, cement mortar, or combination thereof.

.3 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.

.4 Plug lifting holes with precast concrete plugs set in cement mortar or compound.

.5 Ensure top risers are parged with hydraulic cement to stop infiltration.

.6 Installing units in existing systems:

.1 Where new unit is within existing run of pipe, carefully remove existing pipe to dimensions required and install new unit as specified.
.2 Make joints watertight between new unit and existing pipe.
.3 Where deemed expedient to maintain service around existing pipes and when systems constructed under this project are ready to be put into operation, complete the installation with appropriate break-outs, removals, redirection of flows, blocking unused pipes or any other necessary work.

.7 Set frame and cover to required elevation, parge and make smooth and watertight.

.8 Place frame and cover on top section to elevation indicated. If adjustment required use concrete ring.

.9 Clean units of debris and foreign materials; remove fins or sharp protuberances.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 31 23 33.01.

1.2 PAYMENT PROCEDURES

.1 After television and photographic pipe inspections:
.1 If no defective work is found, Departmental Representative will pay costs for inspectors, trained operators, equipment rental and materials.
.2 If defective work is found, pay Departmental Representative a part of total inspection cost proportional to number of defective pipe sections of sewer to total number of pipe sections inspected.

.2 All storm utility drainage piping work incorporated in the contract documents is to be included in the lump sum price.

1.3 REFERENCES

.1 American Society for Testing and Materials International, (ASTM)
.1 ASTM C 117-95, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
.2 ASTM C 136-01, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
.3 ASTM C 443M-02, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
.4 ASTM D 698-00a, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).
.5 ASTM D 2680-01, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
.6 ASTM D 3034-00, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
.7 ASTM F 794-01, Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

.2 Canadian Standards Association (CSA International)
.1 CAN/CSA-A3000-98(April 2001), Cementitious Materials Compendium (Consists of A5-98, A8-98, A23.5-98, A362-98, A363-98, A456.1-98, A456.2-98, A456.3-98).
.1 CAN/CSA-A5-98, Portland Cement.
.2 CSA B1800-02, Plastic Non-pressure Pipe Compendium - B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).
.1 CSA B182.2-02, PVC Sewer Pipe and Fittings (PSM Type).
.2 CSA B182.4-02, Profile PVC Sewer Pipe and Fittings.
.3 CSA B182.11-02, Recommended Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.

.3 Department of Justice Canada (Jus)
.1 Canadian Environmental Protection Act, 1999 (CEPA).

.4 Transport Canada (TC)
.1 Transportation of Dangerous Goods Act, 1992 (TDGA)

1.4 DEFINITIONS

.1 A pipe section is defined as length of pipe between successive catchbasins and/or manholes.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling.

.3 Submit to Departmental Representative for testing, at least 2 weeks prior to beginning Work.

.4 Submit manufacturer's test data and certification at least 2 weeks prior to beginning Work.

.5 Certification to be marked on pipe.

.6 Submit to Departmental Representative 1 copy of manufacturer's installation instructions.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 Construction/Demolition Waste Management And Disposal.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper plastic, polystyrene, corrugated cardboard packaging material for recycling in accordance with Waste Management Plan.

.4 Separate for reuse andrecycling and place in designated containers Steel, Metal and Plastic waste in accordance with Waste Management Plan.

.5 Divert unused metal materials from landfill to metal recycling facility for disposal approved by Departmental Representative.

.6 Divert unused concrete materials from landfill to local facility as approved by Departmental Representative.

.7 Divert unused aggregate materials from landfill to quarryfor reuse as approved by Departmental Representative.

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

.9 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

.10 Fold up metal banding, flatten and place in designated area for recycling.

1.7 SCHEDULING

.1 Schedule Work to minimize interruptions to existing services and to maintain existing flow during construction.

.2 Submit schedule of expected interruptions for approval and adhere to approved schedule.

PART 2 - PRODUCTS

2.1 PLASTIC PIPE

.1 Gravity sewer pipe and fittings: Type PSM Poly(Vinyl Chloride): to ASTM D3034-08
.1 Standard Dimensional Ratio (SDR): 35
.2 Locked-in gasket and integral bell system.

2.2 PIPE BEDDING AND SURROUND MATERIAL

.1 Granular material in accordance with OPSS 1010
.1 Crushed or screened stone, gravel or sand.
.2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1 CAN/CGSB-8.2.

.2 Concrete mixes and materials for bedding, cradles, encasement, supports: in accordance with Section 03 30 00 - Cast-in-Place Concrete.

2.3 BACKFILL MATERIAL

.1 As indicated.

.2 Type 2 to Section 31 23 33.01 - Excavating Trenching and Backfilling.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Excavate alone allignment of existing stone storm sewers; remove and protect cap stone for re-instatement upon completion of installation.

.2 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Departmental Representative.

3.2 TRENCHING

.1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

.2 Do not allow contents of sewer or sewer connection to flow into trench.

.3 Trench alignment and depth to approval of Departmental Representative prior to placing bedding material and pipe.

3.3 GRANULAR BEDDING

.1 Place bedding in unfrozen condition.

.2 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.

.3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe. Do not use blocks when bedding pipes.

.4 Shape transverse depressions as required to suit joints.

.5 Compact each layer full width of bed to at least 95 % maximum density to ASTM D 698.

.6 Fill excavation below bottom of specified bedding adjacent to manholes or catch basins with compacted bedding material.

3.4 INSTALLATION .

.1 Handle pipe using methods approved by Departmental Representative.
.1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.

.2 Lay pipes on prepared bed, true to line and grade with pipe inverts smooth and free of sags or high points.
.1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.

.3 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.

.4 Do not exceed maximum joint deflection recommended by pipe manufacturer.

.5 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

.6 Install plastic pipe and fittings in accordance with CSA B182.11.

.7 When any stoppage of Work occurs, restrain pipes as directed by Departmental Representative, to prevent "creep" during down time.

.8 Cut pipes as required for special inserts, fittings or closure pieces, as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.

.9 Make watertight connections to manholes and catch basins.
.1 Use shrinkage compensating grout when suitable gaskets are not available.

.10 Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes.
.1 Joint to be structurally sound and watertight.

.11 Temporarily plug open upstream ends of pipes with removable watertight concrete, steel or plastic bulkheads.

3.5 PIPE SURROUND

.1 Place surround material in unfrozen condition.

.2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.
.1 Leave joints and fittings exposed until field testing is completed.

.3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
.1 Do not dump material within 0.5m of pipe.

.4 Place layers uniformly and simultaneously on each side of pipe.

.5 Compact each layer from pipe invert to mid height of pipe to at least 95 % maximum density to ASTM D 698.

.6 Compact each layer from mid height of pipe to underside of backfill to at least 95 % maximum density to ASTM D 698.

.7 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.6 BACKFILL

.1 Place backfill material in unfrozen condition.

.2 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.

.3 Under paving and walks, compact backfill to at least 95 % maximum density to ASTM D 698. In other areas, compact backfill to at least 90 % maximum density to ASTM D 698.

3.7 FIELD TESTING

.1 Repair or replace pipe, pipe joint or bedding found defective.

.2 Remove foreign material from sewers and related appurtenances by flushing with water.

.3 Television and photographic inspections:
.1 Carry out inspection of installed sewers by television camera, photographic camera or by other related means.
.2 Provide means of access to permit Departmental Representative to do inspections.
.3 Payment for inspection services in accordance with payment procedures in PART 1.

END OF SECTION

APPENDIX A

PAVEMENT REHABILITATION REPORT
FORT HENRY ADVANCED BATTERY
KINGSTON, ONTARIO

Submitted to:

Genivar

Submitted by:

DBA Engineering Ltd

December 20, 2011

DBA Project 11-2019-03

TABLE OF CONTENTS

1.0 INTRODUCTION 1
2.0 DESIGN CRITERIA 2
2.1 Present & Proposed Conditions 2
2.1.1 Advanced Battery 2
3.0 FIELD INVESTIGATION 2
4.0 SUBSOIL CONDITIONS AND PAVEMENT STRUCTURE 3
4.1 Existing Pavement Structure 3
4.1.1 Advanced Battery 3
5.0 RECOMMENDATIONS 3
5.1 Pavement Design 3
5.1.1 Advanced Battery 4
5.1.2 General Pavement Recommendations 5
6.0 CLOSURE 6
REPORT LIMITATIONS 7

Appendix I Record of Boreholes

Appendix II Borehole Locations

1.0 INTRODUCTION

The services of DBA Engineering Ltd. (DBA) were retained by Genivar Kingston to prepare a Pavement Report for the rehabilitation and resurfacing of the Advanced Battery within Fort Henry, in Kingston, ON ("The Site") . The purpose of the report is to provide suitable design and construction recommendations based on a field investigation.

The purpose of the investigation was to obtain information on the subsurface conditions at the Site by means of a limited number of boreholes and visual/tactile analysis of selected soil samples. Based on DBA's interpretation of the data obtained, suitable pavement designs are discussed and necessary recommendations are provided on the geotechnical aspects of the project.

This report contains the findings of DBA's geotechnical investigation, together with recommendations and comments. These recommendations and comments are based on factual information and are intended only for the use of the client and appointed affiliates. Conditions may become apparent during construction which could not be detected or anticipated at the time of the investigation. The anticipated construction conditions are also discussed, but only to the extent that they may influence design decisions. Construction methods discussed, however, express DBA's opinion only and are not intended to direct the contractors on how to carry out the construction.

The report is prepared with the condition that all designs are in accordance with applicable standards and codes, regulations of authorities having jurisdiction, and good engineering practice. Further, the recommendations and opinions in this report are applicable only to the proposed project as described in Section 2.0.

On-going liaison with DBA during the final design and construction phase of the project is recommended to ensure that the recommendations in this report are applicable and/or correctly interpreted and implemented. Also, any queries concerning the geotechnical aspects of the proposed project should be directed to DBA for further elaboration and/or clarification.

2.0 DESIGN CRITERIA

2.1 Present & Proposed Conditions

The following is a general description of the existing site at the time of the site investigation and the proposed redevelopment as understood by DBA.

2.1.1 Advanced Battery

The Advanced Battery area under investigation is within the walls of the national historic site, Fort Henry, in Kingston, ON. The fort is an active tourist attraction and the Advanced Battery is currently in use for historic military demonstrations and re-enactments. The Advanced Battery is located within the southwest section of the Fort. As it is enclosed by the walls of the Fort, access to equipment is limited.

It is currently paved and it is our understanding that the existing pavement was placed approximately 50 years ago. It is in fair to poor shape with areas of cracking, distortion, and pavement breakdown/repair.

3.0 FIELD INVESTIGATION

The fieldwork consisted of advancing a total of five (5) boreholes advanced through existing asphalt within the Advanced Battery. Boreholes were advanced to practical auger refusal on inferred bedrock.

The pavement/granular structure and subsoil stratigraphy encountered at all borehole locations were classified and logged in the field. Observations of any groundwater infiltration were made at all test hole locations. Representative samples of the existing granular materials were secured and returned to our laboratory for further visual and tactile review.

All fieldwork was performed on November 22, 2011 under the constant supervision of DBA Engineering personnel.

Locations of the boreholes within the Advanced Battery are shown on the site plans attached in Appendix II.

4.0 SUBSOIL CONDITIONS AND PAVEMENT STRUCTURE

Details of the typical conditions encountered during the investigations are provided below. Full details of conditions encountered in specific boreholes are provided in the record of boreholes, attached in Appendix I.

4.1 Existing Pavement Structure

4.1.1 Advanced Battery

The average pavement structure encountered within the Advanced Battery consisted of ;

43 mm	asphalt, overlying
78 mm	sand with gravel (resembling Granular 'A'), overlying
	heterogeneous fill subgrade

Hetergeneous fill was encountered underlying the granular base material at depths of 0.1 m to 0.3 m, and consisted of varying amounts of gravel, sand, clay, rock and brick pieces.

Native subsoil consisting of silty sand/clay was encountered within borehole Nos. 2, 3 and 4 at depths of 0.4 m to 0.9 m below existing site grades.

Augering of all boreholes was ended upon practical refusal on inferred bedrock at depths of 0.3 m to 1.9 m below existing site grades.

No infiltration of groundwater was encountered within any test locations.

5.0 RECOMMENDATIONS

5.1 Pavement Design

The following sections outline suitable pavement designs for reconstruction/resurfacing.

5.1.1 Advanced Battery

The rehabilitation of the Advanced Battery will consist of the full depth excavation of the existing asphalt to accommodate the following new pavement structure;

45 mm	HL3 Hot Mix, over
50 mm	new Granular A base for grading purposes, over
	exposed existing granular material

The existing granular structure is to be left in place as granular base, with a minimum of 50 mm of new granular A placed for fine grading and shaping purposes. It is our understanding that a slight raise in grade may be possible. The amount of new granular A material added should be increased to the maximum that the grade raise will allow.

Due to the limited accessibility of the parade square, normal paving methods may not be possible. If hot mix is placed by hand paving methods, care must be taken to ensure proper mix temperatures are maintained and suitable compaction is achieved.

A second option would be to employ an HL3 warm mix. This would allow for easier handling and transportation of the mix, without temperature loss.

HL8 was selected as surface lift because it has a stoney, coarse and segregated appearance, which would more closely resemble older paving methods and be desirable for a historic site.

5.1.2 General Pavement Recommendations

- Prior to the placement of new granular, the existing material should be re-compacted and proof rolled to identify any flexible or soft areas. Any unsuitable areas shall be excavated and repaired with Granular B type II material.

- All subexcavation must be approved by Parks Canada due to the historical significance of the site.

- All granular material shall meet the requirements of OPSS 1010 and shall be compacted to a minimum 100% SPMDD.

- All hot mix courses are to conform to OPSS 1150. It is recommended that PG 58-28 asphalt cement be specified for the roadway hot mix courses. A minimum asphalt cement content of 5.3% is also recommended for the HL3 lift.

- Inspection by qualified geotechnical personnel should be carried out during the construction process to verify the competence of the subgrade material and to verify the compaction densities of both the sub base and base course material.

6.0 CLOSURE

The Limitations of Report attached, form an integral part of this report. We trust this report provides sufficient information for your present requirements in accordance with our Term of Reference. We trust this report is to your satisfaction. Should you have any questions concerning the above, please feel free to contact our office.

Sincerely,
DBA Engineering

Prepared By:

Murray McClelland
Geotechnical Project Manager

Rob Cole. C.E.T.,
Principal/Vice President

Reviewed By:

P. S. Dhillon, P. Eng.
Principal/President

REPORT LIMITATIONS

The conclusions and recommendations given in this report are based on information determined at the testhole locations. The information contained herein in no way reflects on the environmental aspects of the project, unless otherwise stated. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction, which could not be detected or anticipated at the time of the site investigation. It is recommended practice that the Geotechnical Engineer be retained during the construction to confirm that the subsurface conditions across the site do not deviate materially from those encountered in the testholes.

The design recommendations given in this report are applicable only to the project described in the text, and then only if constructed substantially in accordance with the details stated in this report. Since all details of the design may not be known, we recommend that we be retained during the final design stage to verify that the design is consistent with our recommendations, and that assumptions made in our analysis are valid.

The comments made in this report relating to potential construction problems and possible methods of construction are intended only for the guidance of the designer. The number of testholes may not be sufficient to determine all the factors that may affect construction methods and costs. For example, the thickness of surficial topsoil or fill layers may vary markedly and unpredictably. The contractors bidding on this project or undertaking the construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work. This work has been undertaken in accordance with normally accepted geotechnical engineering practices. No other warranty is expressed or implied.

The benchmark and elevations mentioned in this report were obtained strictly for use by this office in the geotechnical design of the project. They should not be used by any other party for any other purpose.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. DBA accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Appendix I
Record of Boreholes

Advanced Battery

BH1

0	-	40	asphalt
40	-	100	fill – sand with gravel, grey
100	-	380	fill – gravel with sand and rock pieces, some clay, brown
380			refusal on inferred bedrock

BH2

0	-	50	asphalt
50	-	300	fill – sand with gravel, grey
300	-	760	fill – sand trace gravel, brown
760	-	900	silty sand trace gravel, light brown
900			refusal on inferred bedrock

BH3

0	-	45	asphalt
45	-	150	fill – sand with gravel, grey
150	-	600	fill – sand with gravel rock and brick pieces sand clay, brown
600	-	900	fill – silty clay some gravel and sand, brown
900	-	1.9	silty clay, brown
1.9			refusal on inferred bedrock

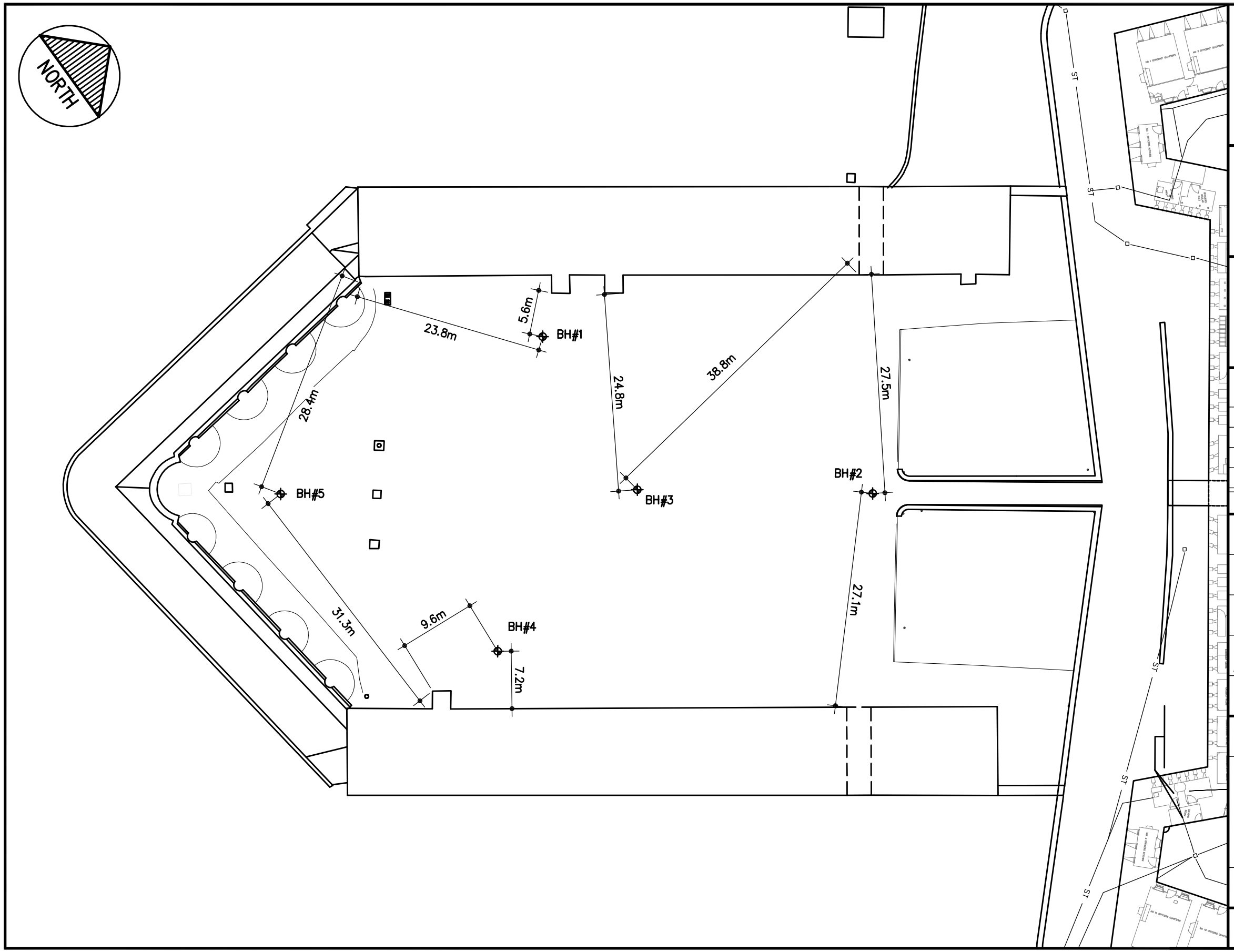
BH4

0	-	40	asphalt
40	-	100	fill – sand with gravel, grey
100	-	400	fill – gravel with clay rock pieces sand, brown
400	-	750	silty sand trace gravel, light brown
750			refusal on inferred bedrock

BH5

0	-	40	asphalt
40	-	125	fill – sand with gravel, grey
125	-	300	fill – gravel with clay rock pieces sand, brown
300			refusal on inferred bedrock

Appendix II
Borehole Locations



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CLIENT:

Parcs Canada Parks Canada

Canada

CLIENT REF. #:

PROJECT:

FORT HENRY ADVANCED BATTERY UPGRADES

ISSUED FOR – REVISION:

IS	RE	DATE	DESCRIPTION

PROJECT NO: 111-21759-00

DATE: SEPTEMBER, 2011

ORIGINAL SCALE: 1:500

IF THIS BAR IS NOT 1" LONG, ADJUST YOUR PLOTTING SCALE.

1"

DESIGNED BY:

DRAWN BY: AB

CHECKED BY: MF

DISCIPLINE: CIVIL

TITLE: BOREHOLE LOCATIONS

SHEET NUMBER: SK1.2

SHEET #: OF

ISSUE:

DATE OF: SEPTEMBER 15, 2011

REV # 0

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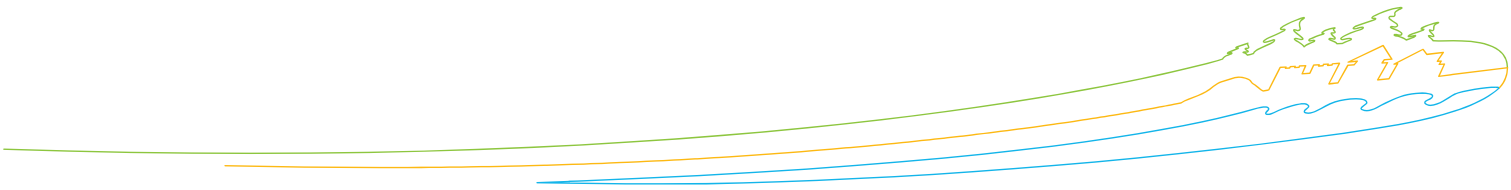
APPENDIX B

Parks Canada Parcs Canada



Fort Henry NHSC:

Archaeological Logging of Borehole Investigation at Advanced Battery, 2011

By Darren Kipping

November 2011

Archaeological Services, Ontario Service Centre, Cornwall, Ontario

Canada

On November 22, 2011 DBA Engineering Ltd conducted a geotechnical investigation on the Advanced Battery within Fort Henry NHSC. Five boreholes were advanced to determine subsurface conditions beneath the current pavement. These findings will be used to establish a pavement design for future repaving and fill requirements.

Archaeological Services, Ontario Service Centre, monitored and recorded the excavations to ensure that no unknown cultural resources were impacted upon during the drilling as well as to assess the area for archaeological potential and gain an understanding of subsurface soils.

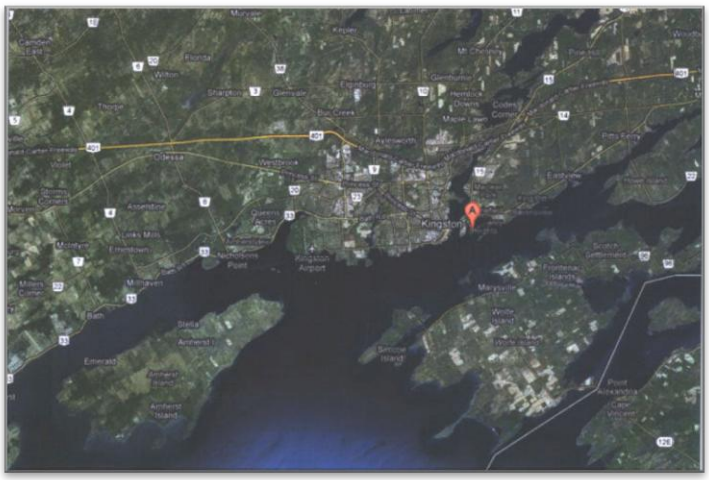


Figure 1: Location of Fort Henry NHSC

Site Background

The Advanced Battery is situated within Fort Henry NHSC, in Kingston, Ontario at the junction of The Great Cataraqui River, Lake Ontario and the St. Lawrence River. The fort proper was constructed starting 1832 and is located on the hill known as Point Henry, positioned between Navy Bay and Deadman's Bay (Figure 1). The site is owned by Parks Canada and operated by the St. Lawrence Parks Commission.

Fort Henry NHSC is historically significant as it is built upon a previous War of 1812 fort and has been instrumental in the defense of Upper Canada throughout the 19th Century.

Physiography

The Kingston area is located within the Napanee Plain as defined in *The Physiography of Southern Ontario* (1984). The Napanee plain consists of a flat-to-undulating plateau of limestone. Soils in this area are usually not very deep due to glacial stripping of overburden (Chapman & Putnam 1984).

On Point Henry, natural limestone bedrock is considerably shallow, and pockets of natural granite bedrock are not uncommon at similar depths. This shallow bedrock has implications for archaeology, as successive occupations had to routinely dig to or through bedrock to establish foundations for buildings, thereby destroying or disturbing the archaeological record from earlier occupation or construction phases.

Brief Historical & Archaeological Background

Present-day Fort Henry NHSC was built starting 1832 on the site of the original 1812 fort. The construction of the Advanced Battery, however, did not begin until 1838 due to the lack of financial support and the threat of Rebellion in Upper Canada in 1837 (Tulloch 2011). In 1838 a separate revelin was constructed in the form of a salient angle which was attached to the newly constructed Redoubt by a wooden palisade. The palisade was eventually replaced by West and East stone Commissariat ranges, constructed 1842 and 1843 respectively (Figure 2) (Cary and Last 2004).

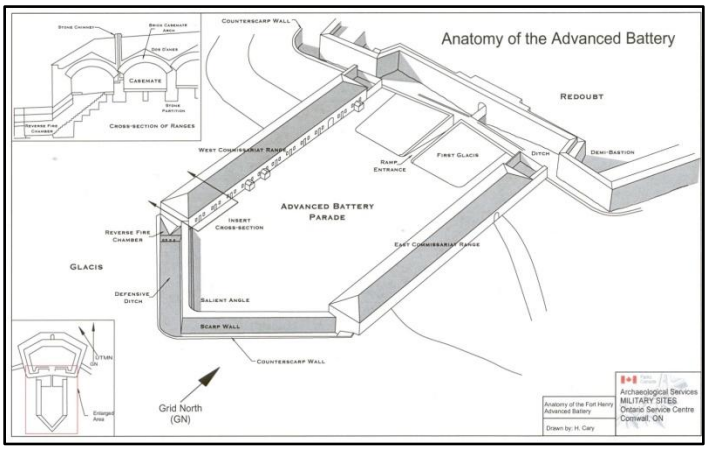


Figure 2: Anatomy of the Advanced Battery (Drawn by H. Cary).

Figure 3: Continuous flight hydraulic auger advancing 131H54L

Since the commemoration of Fort Henry as a national historic site, Parks Canada has executed a number of investigations in the Advanced Battery. The results of these investigations include a vast array of archaeological finds that not only complement the established history but define previously unknown site history and occupation. (Cary 2005; Cary & Last 2004; Garcia 2006; Tulloch 2011)

Methodology

As requested by Genivar, five boreholes were advanced within the confines of the Advanced Battery to determine subsurface conditions (Appendix B). Soil samples were taken using a continuous flight-helical screw hydraulic auger with rotating drill bit (Figure 3). The upward movement of the drill pushes soil up the bit while digging further into the subsurface (ISWD 2011; Aqua Earth 2011). This system, although not ideal for archaeological purposes, is inexpensive and separate stratigraphical layers can be identified through variations of soil on the flights of the screw. The screw itself measured roughly 200cm long and 10cm in diameter.

The five boreholes were advanced until practical auger refusal on bedrock. Drilling never went below 200cm in depth.

Archaeological Recording

All archaeological recording was performed in the field with the assistance of the Geotechnical Supervisor at DBA Engineering Ltd. Lots were recorded using Parks Canada's Recording System (2005), where 131H represents Fort Henry, and the subsequent 54 indicates the Advanced Battery. The letters L, M, N, P and Q designate the individual holes excavated, and the subsequent number identifies the soil layers (lot number) uncovered respectively.

As no hollow sampling system was used for excavation, measurements and interpretation had to be extrapolated from the flights of the auger screw and from the expertise of the geotechnical supervisor on hand. This nature of recording resulted in small errors of thickness measurements. However, thickness measurements can be understood to be accurate within 3cm.

Findings and Recommendations

On November 22, 2011, a Parks Canada archaeologist logged five boreholes advanced within the Advanced Battery of Fort Henry NHSC, Kingston, Ontario.

The drilling revealed almost static-like subsurface conditions across the Advanced Battery. The current pavement was followed by two layers of fill, then a clay and stone layer formed by bedrock spalling, likely the macadamized surface from the second Fort Henry sitting on top of limestone bedrock. One exception occurred in unit 131H54P; at a depth of about 15-60cm where orange brick was encountered. It did not appear to be part of a buried structure as it was in a fill layer. The orange brick was most likely part of the fill layer as seen in the Redoubt (Redoubt Drain Report forthcoming).

No artifacts were encountered.

Based on this investigation, it is recommended that:

1. Archaeological Services Canada, Ontario Service Centre, Parks Canada be consulted regarding all future work that may impact the Advanced Battery of Fort Henry NHSC.

2. Archaeological Services Canada, Ontario Service Centre, Parks Canada be present at all future work that may impact the subsurface of the Advanced Battery. The shallow nature of the bedrock means that any archaeological material will be near the surface and extremely susceptible to disturbance.

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Appendix A

131H54L

Borehole 131H54L was situated directly in front of the entrance ramp to the redoubt, 25m from East and West inner walls of the Advanced Battery (Appendix B). The excavation reached a depth of 90cm when the auger encountered refusal on native bedrock. No artifacts were encountered during this excavation.

Table 1: Soil layers uncovered in 131H54L

Lot	*Soil Description*	*Munsell Colour*	*Thickness*	*Sampler Depth*	*Interpretation*
L1	Compact Asphalt	10YR2/1	5cm	0-5cm	Asphalt
L2	Loose sand with gravel	10YR5/1	25cm	5-30cm	Fill layer
L3	Loose sand trace gravel	10YR6/3	46cm	30-76-cm	Fill layer
L4	Loose silty sand and degenerated bedrock	10YR6/2	14cm	76-90cm	Degenerated Bedrock
L5	Bedrock	10YR7/3	N/A	90cm	Limestone Bedrock

131H54M

Borehole 131H54M was located approximately 5m west from the East wall and 25m north of the scarp wall of the Advanced Battery (Appendix B). The excavation reached a depth of 75cm when the auger encountered refusal on native bedrock. No artifacts were encountered during this excavation.

Table 2: Soil layers uncovered in 131H54M

Lot	*Soil Description*	*Munsell Colour*	*Thickness*	*Sampler Depth*	*Interpretation*
M1	Compact Asphalt	10YR2/1	4cm	0-4cm	Asphalt
M2	Loose sand with gravel	10YR5/1	6cm	4-10cm	Fill layer
M3	Loose gravel with clay rock pieces	10YR6/4	30cm	10-40cm	Fill layer
M4	Loose silty sand and degenerated bedrock	10YR6/2	35cm	40-75cm	Degenerated Bedrock
M5	Bedrock	10YR7/3	N/A	75cm	Bedrock

131H54N

Borehole 131H54N was situated approximately 10m north from the apex of the scarp wall of the Advanced Battery (Appendix B). The excavation reached a depth of 30cm when the auger encountered refusal. This refusal is extremely shallow compared to other excavations in the area indicating that bedrock either undulates or is higher to the south. A similar finding was encountered during archaeological testing in 2011 (Tulloch 2011).

Table 3: Soil layers uncovered in 131H54N

Lot	*Soil Description*	*Munsell Colour*	*Thickness*	*Sampler Depth*	*Interpretation*
N1	Compact Asphalt	10YR2/1	4cm	0-4cm	Asphalt
N2	Loose sand with gravel	10YR5/1	8.5cm	4-12.5cm	Fill layer
N3	Loose gravel with clay rock pieces	10YR6/4	17.5cm	12.5-30cm	Fill layer
N4	Bedrock	10YR7/3	N/A	30cm	Limestone bedrock

131H54P

Borehole 131H54P was located approximately in the center of the Advanced Battery, 25m from east and west walls, 50m north of the scarp wall and 30m south of the entrance ramp to the Redoubt (Appendix B). The excavation reached a depth of 190cm when the auger encountered refusal on native bedrock. At a depth of 15-60cm orange brick was encountered; however, it appeared to be mixed in with fill and not part of an intact feature. No artifacts were encountered during excavation.

Table 4: Soil layers uncovered in 131H54P

Lot	*Soil Description*	*Munsell Colour*	*Thickness*	*Sampler Depth*	*Interpretation*
P1	Compact Asphalt	10YR2/1	4.5cm	0-4.5cm	Asphalt
P2	Loose sand with gravel	10YR5/1	10.5cm	4.5-15cm	Fill layer
P3	Loose sand , gravel and brick pieces	10YR6/4 5YR6/8 (brick)	45cm	15-60cm	Fill layer
P4	Loose silty clay, small amounts of gravel	10YR5/2	30cm	60-90cm	Sterile
P5	Loose silty sand	10YR6/3	85cm	90-175cm	Sterile
P6	Loose silty sand and degenerated Bedrock	10YR6/2	15cm	175-190cm	Degenerated Bedrock
P7	Bedrock	10YR7/3	N/A	190cm	Limestone Bedrock

131H54Q

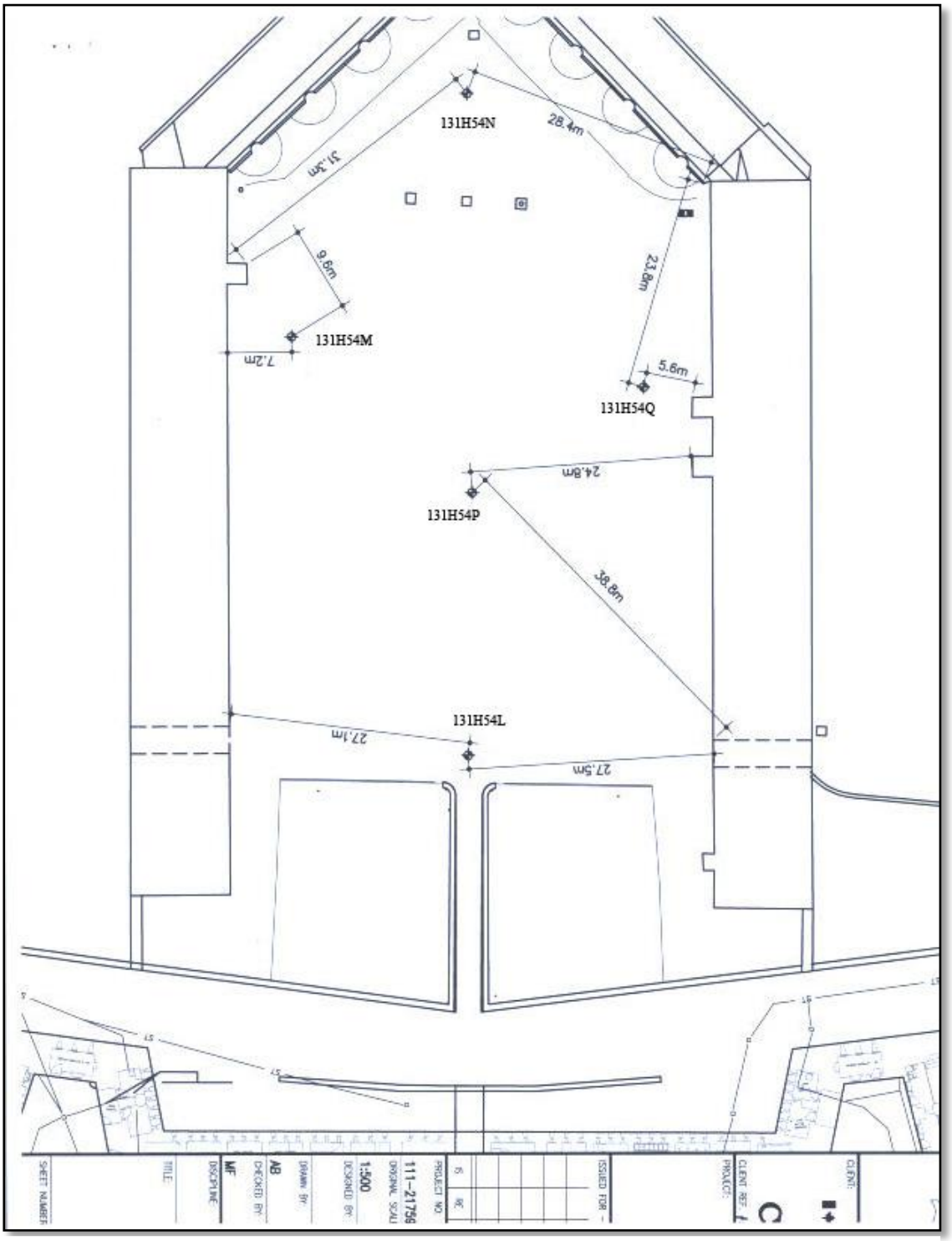
Borehole 131H54Q was located 5m east of the West wall and 25m north of the scarp wall of the Advanced Battery (Appendix B). The excavation reached a depth of 38cm when the auger encountered refusal on native bedrock. No artifacts were encountered during this excavation.

Table 5: Soil layers uncovered in 131H54Q

Lot	*Soil Description*	*Munsell Colour*	*Thickness*	*Sampler Depth*	*Interpretation*
Q1	Compact Asphalt	10YR2/1	4cm	0-4cm	Asphalt
Q2	Loose gravel with sand	10YR5/1	6cm	4-10cm	Fill layer
Q3	Loose sand , some gravel and rock pieces	10YR5/3	28cm	10-38cm	Fill layer
Q4	Bedrock	10YR7/3	N/A	38cm	Limestone Bedrock

Appendix B

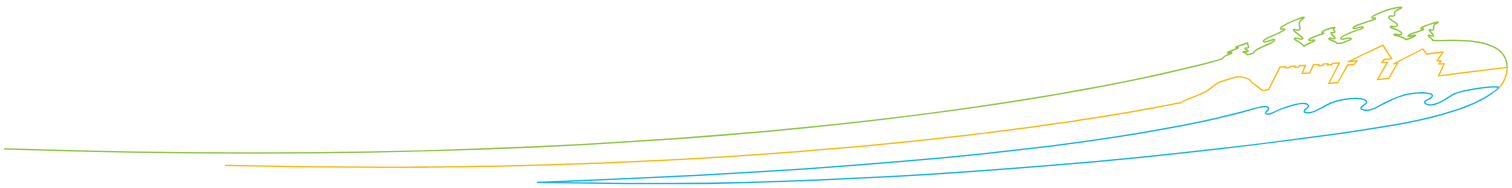
Location of Borehole Excavations



Location of Borehole Excavations in the Advanced Battery (DBA Engineering 2011)

APPENDIX C

Parks Canada Parcs Canada



Fort Henry N.H.S.:

Archaeological Investigations of the Advanced Battery, 2011

By Heather Tulloch and Jennifer Irvine

March 2012

Canada

Table of Contents

Table of Figures ii
Introduction 1
Setting 2
Site Commemoration 2
Historical Background 2
Methodology 9
Phase 1: Natural Strata and Aboriginal Occupation 12
Phase 2: 1812 Construction and Occupation (1812-1832) 13
Material Culture from the Officers' Barracks: 15
Phase 3: 1832 Construction and British Garrison Occupation (1832-1870) 21
Phase 4: Canadian Garrison Occupation and Pre-WWI (1870-1914) 22
Phase 6: Restoration (1936-1938) 23
Phase 7: WWII POW Period and Post WWII Occupancy (1939-1948) 23
Phase 8: The Fort Guard Period (1948-1999) 24
Phase 9: Parks Canada Presence (1999-Present) 24
Conclusions and Recommendations 24
Bibliography 26
Appendix A: Summary of Findings by Excavation Unit 28
131H54A 28
131H54B 30
131H54C 32
131H54D 34
131H54E 35
131H54F 36
131H54G 37
131H54H 38
131H54J 39
131H54K 40

Table of Figures

Figure 1: Anatomy of the Advanced Battery (Drawn by H. Cary). 1
Figure 2: Map of Kingston, Ontario, the "A" indicates the location of Fort Henry (Google maps). 2
Figure 3: Plan of the first Fort Henry, showing structures and design elements. 3
Figure 4: Plan of the 1812 Fort Henry Officers' Barracks. 3
Figure 5: Evolution of the First Fort Henry. 4
Figure 6: Water colour showing elements of the first and second Fort Henry. 4
Figure 8: Plan of the Advanced Battery ca. 1870, showing the shifting room in the center and a fence running diagonally across the north section. 5
Figure 9: photograph of the shifting room ca. 1890. 5
Figure 7: Sir John A. MacDonald ca. 1842-43 (Library and Archives Canada, c004811). 5
Figure 10: Plan of Fort Henry showing the temporary, WWII structures. 6
Figure 11: Post card of Fort Henry from the 1950s, showing the Advanced Battery used as a parking lot. 6
Figure 12: Plan of Advanced Battery archaeological excavations prior to 2011 (drawn by Don Ryan and Henry Cary). 7
Figure 13: Photograph of the southwest foundation of the Officers' Barracks (photograph by H. Cary;131H657E). 7
Figure 14: Reconstruction of the officers' barracks highlighting some of the features and materials found during the 2004 excavation (composite image by H. Cary). 8
Figure 15: Map of the Advanced Battery at Fort Henry, showing the location of the 2011 excavations and showing the outline of the first fort in red (drawn by S. Hossain). 10
Figure 17: West profile of 131H54K, SHOWING granite bedrock (photograph by S. Spigelski ;131H2499E). 12
Figure 16: Plan view of 131H54B, showing limestone bedrock (lot 12) on the north side of the foundation (lot 9) (photograph by S. Spigelski ;131H2525E). 12
Figure 18: Plan view of 131H54E, showing the foundation of the officers' barracks (lot 12) in the centre and an additional foundation (lot 11) to the left (photograph by E. Thurston; 131H2564E). 13
Figure 19: North profile of 131H54C, showing the additional foundation (lot 13 to the left) running perpendicular to the officers' barracks foundation (photograph by S. Hossain; 131H2550E). 14
Figure 20: South profile of the officers' barracks in 131H54A. Lot 8 is part of the foundation and the gap to the left of it is the drain feature (photograph by H. Tulloch; 131H2539. 15
Figure 21: Fragmented Remains of a Cross-belt chain bosse. (Above) (specimen number: 131H54C9-3, photograph by J. Irvine; RAO 4010E). 15
Figure 22: Illustration of a 24th regiment officer wearing a cross-belt with lion bosse, chain and whistle (Left) (Barthrop 1982). 15
Figure 23: Military button with the faintmarkings “IX” or “XI” (specimen number: 131H54E10, photograph by J. Irvine; RAO4009E). 16
Figure 24: Evolution of the British Military Shako. 1)Stovepipe shako (RAO 4025E), 2)Belgic shako (reproduction) (RAO 4027E), 3)Regency shako (reproduction) (RAO 4028E), 4)Bell-top shako (reproduction) (RAO 4023E), 5)Albert shako (reproduction) (RAO 4024E), 6)French shako (original) (RAO 4022E), 7)Quilted shako (original) (RAO 4026E), 8)Last pattern shako (original) (RAO 4029E). (The Stovepipe example is from Fort Henry Collection. All other examples are reproductions and originals from the Parks Canada Resource Collections). 18
Figure 25: A fragment of a shako plate lies over a reproduction of a 24th Regiment, British bell-top style shako plate (specimen number: 131H54C10-1, photograph by J. Irvine; RAO 4011E). 19
Figure 26: Porcelain statuette in 18th century clothing (specimen number: 131H54E10-1, photograph by J. Irvine; RAO4008E). 19
Figure 27: A sample of oyster shell retrieved along the foundation walls of the 1820-41 Officer’s Quarters (specimen number: 131H54C6-2, photograph by J. Irvine; RAO 4007E). 20
Figure 28: West profile of 131H54D, showing the shallow, macadamized surface laying directly above rubble from the demolition of the officers' barracks (photograph by B. Leskovec; 131H2533E). 22
Figure 29: East profile of 131H54B, showing the dark occupation layer (lot 4) and the interior foundation (lot 9) (photograph by S. Spigelski ;131H2527E). 23
Figure 30: West wall profile of 131H54A (drawing by H. Tulloch; 131H-2011-184-1). 29
Figure 31: West wall profile of 131H54A, showing the south foundation of the officers’ barracks covered in rubble (photograph by H. Tulloch;131H2543E). 29
Figure 32: Remains of the north face of the officers’ barracks foundation (photograph by H. Tulloch;131H2539E). 29
Figure 33: Remains of the south face of the officers’ barracks foundation (photograph by H. Tulloch;131H2510E). 29
Figure 34: East and south wall profiles of 131H54B (drawing by S. Spigelski; 131H-2011-222-2). 31
Figure 35: Post excavation plan view of 131H54B, showing a foundation (photograph by S. Spigelski;131H2519E). 31
Figure 36: North and west profiles of 131H54C (drawing by S. Spigelski; 131H-2011-222-3). 33
Figure 37: Post excavation plan view of 131H54C showing the foundation of the officers' barracks foundation (photograph by S. Hossain;131H2548E). 33
Figure 38: West wall profile of 131H54D, showing the Macadamized surface in the south portion of the unit and rubble demolition fill on the north (drawing by B. Leskovec; 131H-2011-155-1). 34
Figure 39: Post excavation plan view of 131H54D, showing the Macadamized surface (photograph by B. Leskovec; 131H2531E). 34

Figure 40: East wall profile of 131H54E (drawing by H. Tulloch; 131H-2011-184-3). 35
Figure 41: Post excavation plan view of 131H54E, showing the south foundations of the officers' barracks in the centre and an unidentified foundation to the south (photograph by E. Thurston;131H2564E). 35
Figure 42: East wall profile of 131H54F (drawing by H. Tulloch; 131H-2011-184-4). 36
Figure 43: Post excavation plan view of 131H54F, showing the Macadamized surface (photograph by H. Tulloch; 131H2566E). 36
Figure 44: North wall profile of 131H54G (drawing by K. Best; 131H-2011-223-3). 37
Figure 45: Post excavation plan view of 131H54G3, showing the Macadamized surface (photograph by K. Best;131H2568E). 37
Figure 46: North wall profile of 131H54H (drawing by E. Thurston; 131H-2011-211-1). 38
Figure 47: Post excavation plan view of 131H54H, showing the Macadamized surface (photograph by H. Tulloch; 131H2487E). 38
Figure 48: North wall profile of 131H54J (drawing by S. Spigelski; 131H-2011-184-5). 39
Figure 49: Post excavation plan view of 131H54J, showing the Macadamized surface (photograph by H. Tulloch; 131H2485E). 39
Figure 50: South wall profile of 131H54K (drawing by H. Tulloch and S. Spigelski;131H-2011-184-7). 41
Figure 51: West wall profile of 131H54K (drawing by H. Tulloch; 131H-2011-184-7). 41
Figure 52: West wall profile of 131H54K, showing a natural granite vein and an iron electrical cable (photograph by S. Spigelski; 131H2499E). 42

Introduction

In June 2011, three weeks of archaeological excavation took place in the Advanced Battery of Fort Henry National Historic Site of Canada (NHSC) to ensure cultural resources would not be impacted by the stripping and subsequent repaving of the current asphalted Advanced Battery. The goals of the 2011 excavation were to determine the extent and depth of the in-situ macadamized surface; to uncover remains of the 1820s Officers' Quarters; and to locate evidence of the 1812 Fort Henry (specifically the demi-lune battery and privies).

Although, the term Advanced Battery technically only refers to the salient angle at Fort Henry's most southern point, in this report the term is used to refer to the entire fortified area south of the Redoubt, which consists of a large parade flanked by Commissariat Ranges that slope down toward the salient angle (Figure 1). This is consistent with terminology in previous Parks Canada Archaeological reports pertaining to Fort Henry.

The Advanced Battery at Fort Henry is unique. The parade is protected by ditches and reverse fire chambers, whereas the Ranges are only protected by musket ports and flanking cannon fire from the Redoubt. It is also curious that the entrances to the fort are not protected by ditches as in other areas of the fort. It is thought that the seeming lack of attention on the Advanced Battery at Fort Henry could be due to the fact that historically, it was believed that any attack on Point Henry would come from the north, and therefore more attention and effort was spent on the northern defensive works (Cary 2004: 2).

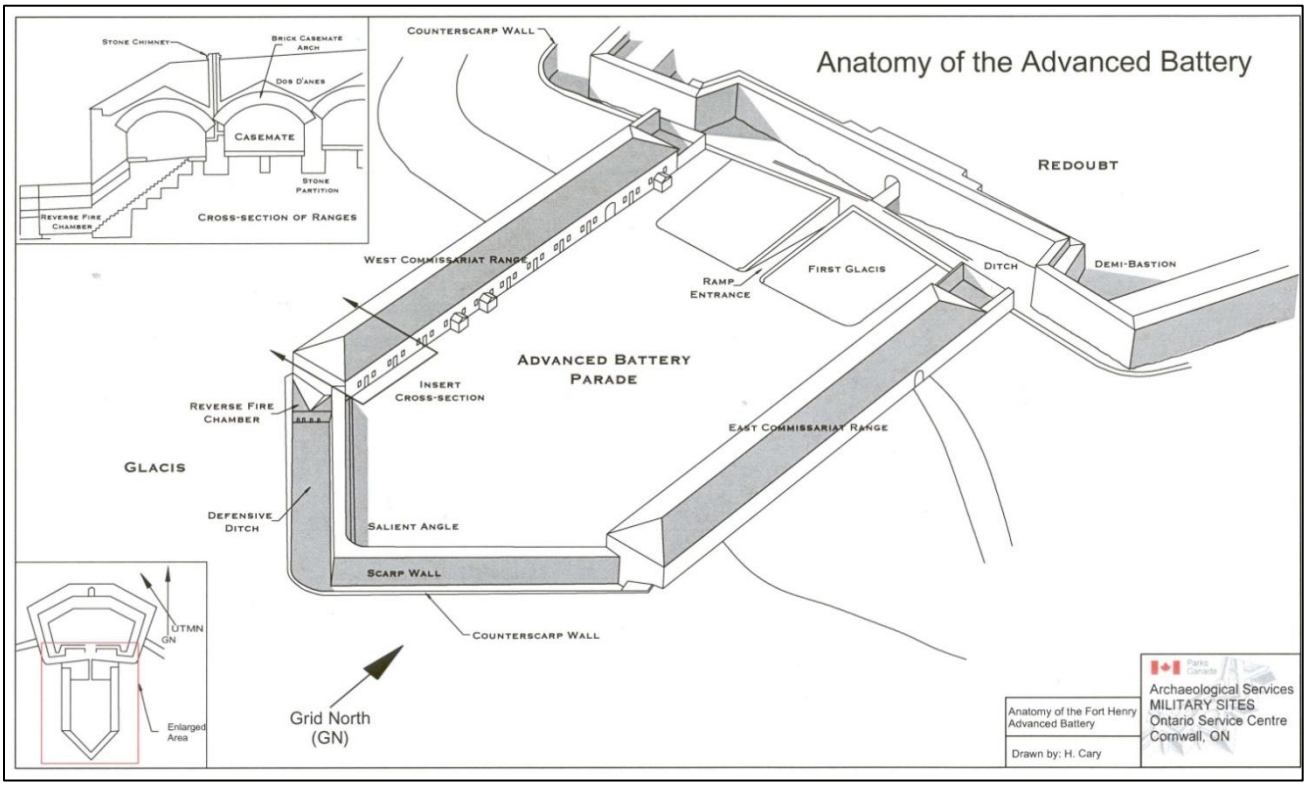


Figure 1: Anatomy of the Advanced Battery (Drawn by H. Cary).

Setting

Fort Henry is strategically located in Kingston Ontario where Lake Ontario, the St. Lawrence River and the Rideau Canal converge. It is located at 1 Fort Henry Drive and is accessible from County Road 2 (Figure 2).The Advanced Battery forms the southern portion of the 1832 fortification. The main entrance to Fort Henry is through the west gate that leads into the Advanced Battery. This area is used to greet visitors and is the starting point for guided tours as well as houses the gift shop and canteen.

Site Commemoration

Fort Henry is a site of national significance because:

- of the fortification built on Point Henry beginning in 1832 for the defence of the Rideau Canal and the Naval Dockyard and;

- this site was the key fortification among a series of military works designed to defend Kingston and its harbor. (Parks Canada 1996:8)

Additionally, those resources directly associated with Fort Henry from 1832-1870 are of national historic significance.

Historical Background

The present-day Advanced Battery, associated with the second Fort Henry, was constructed in the early 1840s following the completion of the Redoubt. At this time though, features from the earlier fort still stood on the subject area. The history of the development of the first and second forts on Point Henry is largely referenced from Henry Cary and Joe Last's Report "The Advanced Battery" written in 2004 and Henry Cary's report "The First Fort and Redoubt" written in 2005.

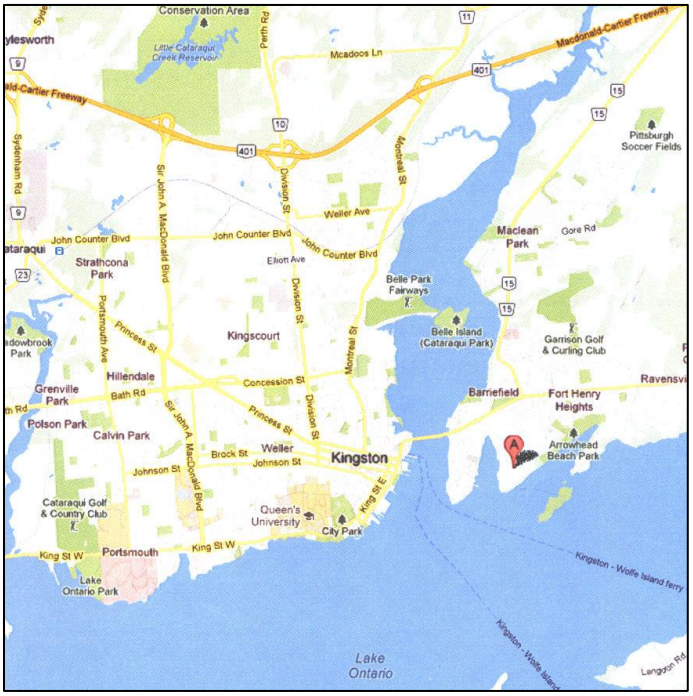


Figure 2: Map of Kingston, Ontario, the "A" indicates the location of Fort Henry (Google maps).

While early military development occurred in Kingston, the strategic location of Point Henry was left undeveloped until war broke out with the Americans in June 1812. As soon as war was declared, brush on Point Henry was ordered cleared and several military structures were erected. In November 1812 the new defensive measures were tested by American warships and while the Americans were unsuccessful in their raid, the event showed that more substantial fortifications were necessary to protect supply routes and Kingston's Royal Naval Dockyard, southwest of Fort Henry at the west end of Navy Bay (Cary 2005:2).

The first Fort Henry had many Vauban style fortification elements (Figure 3). Two demi-bastions connected by a curtain wall were on the north, with a ravelin protecting the entrance. A demi-lune battery protected the south with a 180° firing range and a redan on both the east and west sides offered further protection (Cary 2005:3).

The interior structure of the first fort changed significantly from 1812 to 1832. In the early phase of the fort, with the exception of a stone tower, the majority of the structures within the fort were wood. In 1815, a second stone tower was constructed and several of the wooden structures were demolished. Between 1815 and 1820 several more substantial masonry buildings were constructed; a powder magazine, two soldiers' barracks and the two-storey officers' barracks (Figure 4) (Cary 2005:4,5).

In the late 1820s, stone privies and screens were built east of the soldiers' barracks and south of the officers' barracks. However, by 1832 only a few of the original wood structures remained, including the stable and the guardhouse (Cary 2005:5). Figure 5 illustrates the evolution of the first Fort Henry.

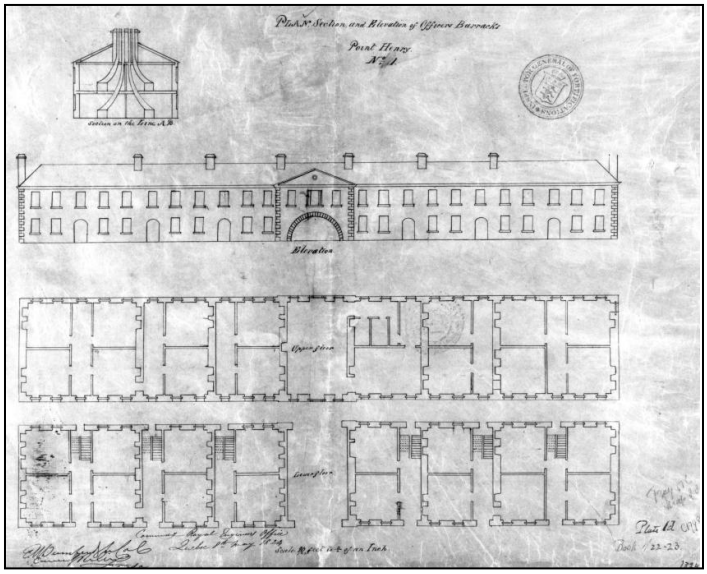


Figure 4: Plan of the 1812 Fort Henry Officers' Barracks.

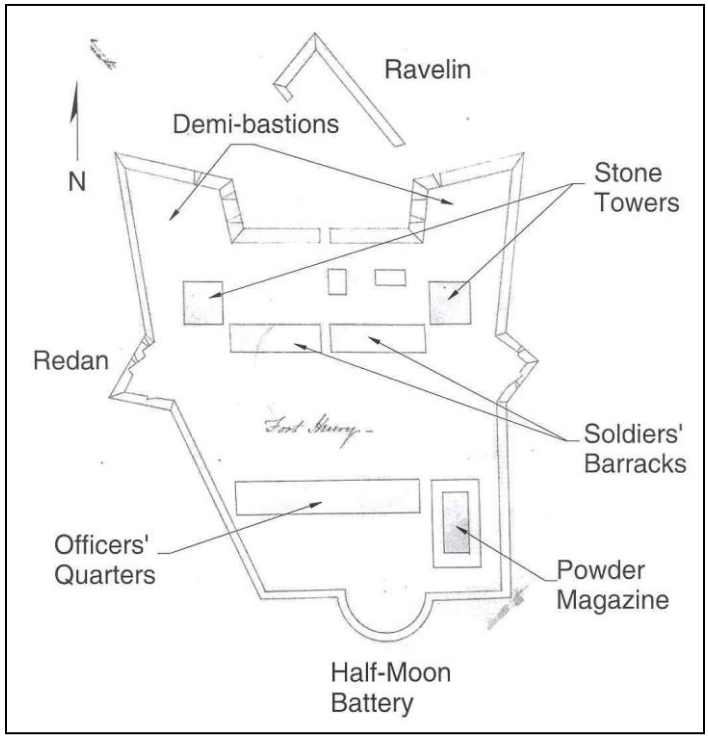


Figure 3: Plan of the first Fort Henry, showing structures and design elements.

Sébastin de Vauban was a French military engineer famous for his fortification designs. His methods of bastioned[1] fortifications were universal and long lasting. They revolutionized fortifications in 17th-century Europe and were used all over the world into the 19th century. During his life, he constructed and adapted over 170 sites in France and nearby regions. His works are commemorated for enhancing and standardizing bastioned fortifications and for his skill at utilizing the surrounding landscape, local material and existing structures (Chardon 2008: 3).

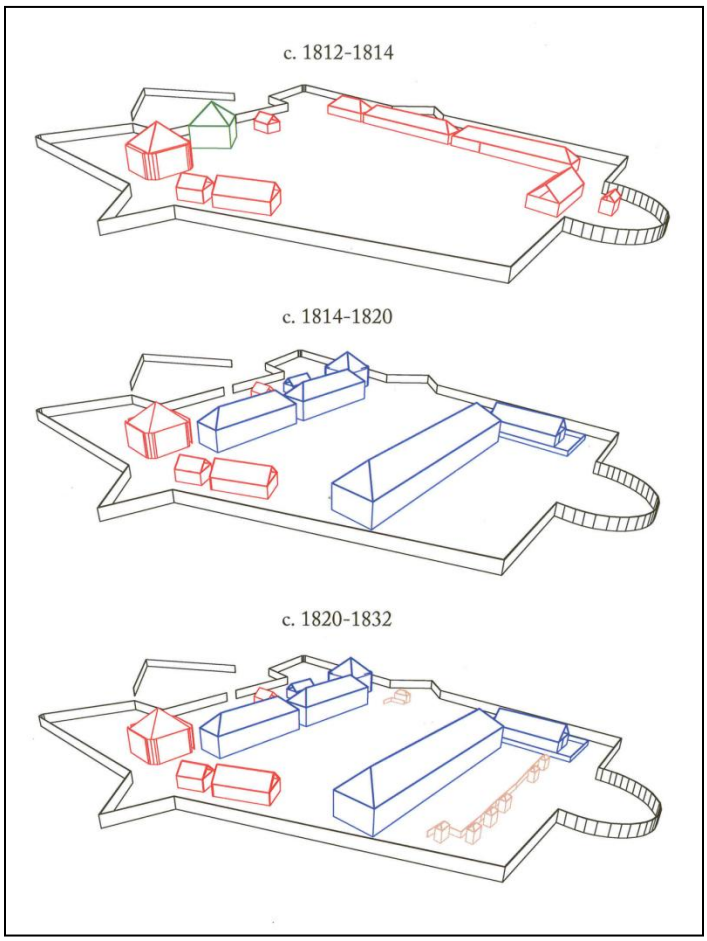


Figure 5: Evolution of the First Fort Henry.

In 1832 construction began on the Redoubt, which required the demolition of the northern section of the first fort, leaving only the officers' barracks, the powder magazine and a few additional structures in the south. Figure 6 depicts this transition period between the 1812 fort and the later fort. The water colour shows the Redoubt and West Branch Ditch constructed, the officers' barracks remains in the foreground and the south end of the power magazine can be seen in the background to the right.

The construction of the Advanced Battery did not happen as quickly as planned due to the threat of the Rebellion in 1837 and lack of funds. In 1838 the salient angle of the battery was constructed as a separate ravelin joined to the main body of the fort by a wood palisade that can be seen in figure 6. In 1841 construction of the Commissariat Ranges began and when the West Range was completed in early 1842, the remaining first fort structures were demolished. One year later the Advanced Battery was enclosed with the completion of the East Range construction (Cary 2004: 5).

Drainage features in the Advanced Battery consisted of two catch basins in the south end of the Advanced Battery that collected water from surface drains that ran parallel to the Commissariat Ranges. A large three vaulted cistern

Figure 6: Water colour showing elements of the first and second Fort Henry.

in the southern end of the Advanced Battery collected and filtered the water that drained through roof downspouts into channels below the floors of the Commissariat Ranges (Cary 2004:6).

The only other known feature in the Advanced Battery from the British Occupation of the site was a shifting room, intended for the temporary storage of powder, and was located in the centre of the northern half of the advanced works. A picket fence linked this room to the east and west Commissariat Ranges. An 1870 plan (Figure 8) shows both features while a photograph (Figure 9) from 1890 shows that although the fence had been removed by this time, the shifting room was still standing (Cary 2004:7).

Fun Fact: In 1838 the officers' barracks was used as a courthouse in the treason trial of Nils Von Schoultz and the "Patriot Hunters" for their involvement in the 1837 Upper Canada Rebellion. One of the defense lawyers in the case was a young John A. MacDonald, Canada's first Prime Minister (Graves 2001:173-4).

Figure 7: Sir John A. MacDonald ca. 1842-43 (Library and Archives Canada: c004811).

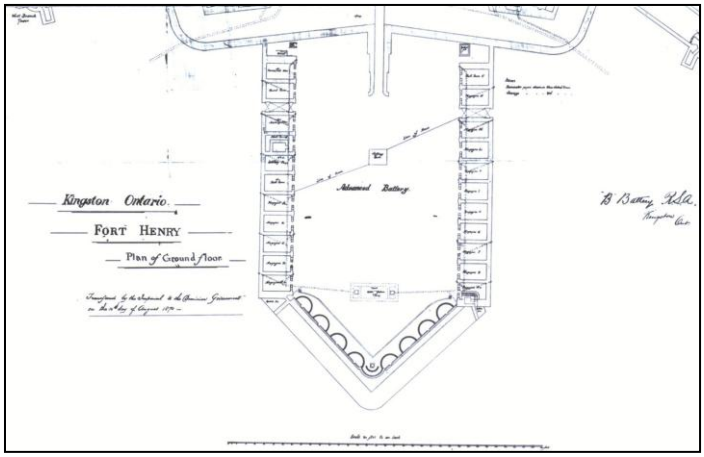


Figure 8: Plan of the Advanced Battery ca. 1870, showing the shifting room in the center and a fence running diagonally across the north section.

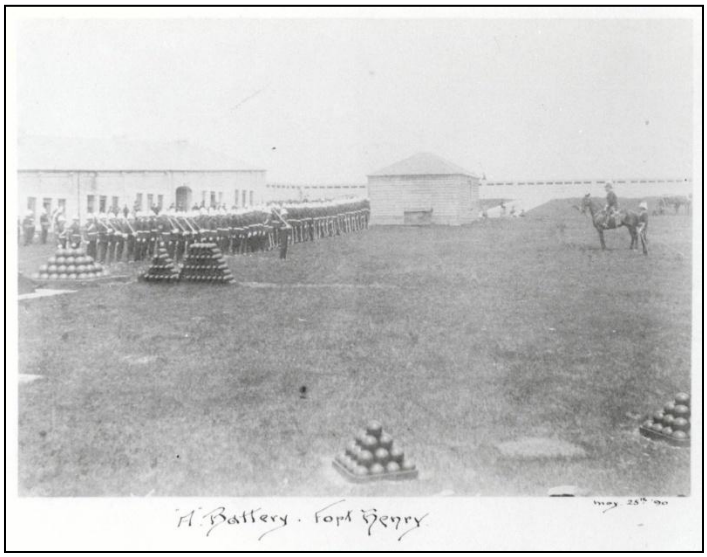


Figure 9: photograph of the shifting room ca. 1890.

During the First World War the Commissariat Ranges were used to hold internees and camp guards. Wooden structures were set up in the parade. Their specific use is unknown but they probably held supplies as opposed to housing people like the Commissariat Ranges These

structures were removed after the war. In 1936 restoration of the Redoubt at Fort Henry began, however, the Advanced Battery was not included since the Department of National Defence (DND) continued to use the Commissariat Ranges to store ammunition. During WWII, Fort Henry was once again used as a Prisoner of War camp. Several structures were erected within the fort including on the Advanced Battery (Figure 10). Little is known about these structures (Cary 2004: 8-9).

In the 1950s the Advanced Battery was paved and served as a parking lot (Figure 11). In the 1970s boardwalks were installed on either side of the Commissariat Ranges. Many modern utilities, that service the offices and stores now housed in the Commissariat Ranges, run below these (Cary 2004:9).

Previous Archaeology

The first excavation in the Advanced Battery at Fort Henry occurred in 2002 when preliminary testing was done to determine if the 1840s macadamized surface remained in the Advanced Battery parade as it did on the first glacis on either side of the ramp. At this time one unit was excavated at the base of the interior east first glacis to investigate the relationship between the glacis, ramp and the Advanced Battery. In this unit the macadamized surface was uncovered approximately 12cm below the current asphalt. Another unit was excavated centrally within the Advanced Battery revealing the macadamized surface approximately 20cm below the current asphalt. In 2002, investigation of the drainage began on the interior and exterior of the Advanced Battery with one unit on the exterior of the West Commissariat Range and one in the interior of the fort, in which the southwest catch basin was located. These preliminary tests led to further investigation of the drainage system in 2003. See Figure 12 for a plan of excavations in the Advanced Battery prior to 2011.

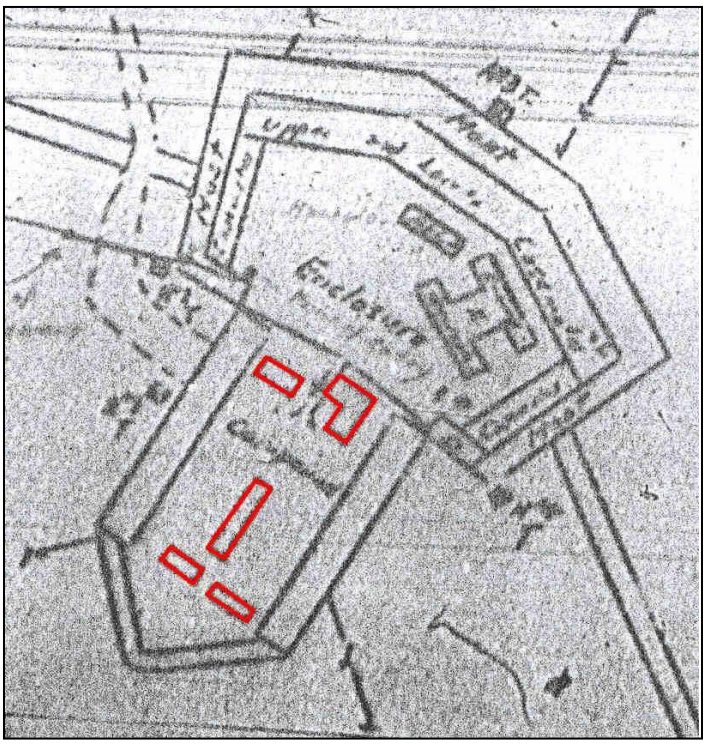


Figure 10: Plan of Fort Henry showing the temporary, WWII structures.

Figure 11: Post card of Fort Henry from the 1950s, showing the Advanced Battery used as a parking lot.

Four weeks were allotted in June 2003 to investigate the drainage on the Advanced Battery prior to the restoration of the roofing on the Commissariat Ranges and the replacement of downspouts. Seven units were excavated;

three on each interior side of the Commissariat Ranges to locate surface drains, catch basins and to investigate the condition of the downspouts. Time also allowed for one unit to be excavated on the interior west first glacis to uncover a good example of the macadamized surface for conservators to make a cast. A cast was also made of the surface drain exposed along the west side of the Advanced Battery. Findings in one of the units on the west side of the Advanced Battery included a large quantity of high end historic material thought to be associated with the 1820 officers' barracks but remains of the structure were not located within the Advanced Battery at this time. The excavations in 2002 and 2003 within the Advanced Battery showed that historic remains of the first and second fort were very shallow, just below the current asphalt.

In the fall of 2003 four units were excavated on the exterior of the West Commissariat Range and two units were excavated on the exterior of the East Commissariat Range prior to upgrading lightning protection. While excavating test pits on the exterior of the West Range a line of large stones was noticed. A trench was excavated over these stones that revealed a portion of what was believed to be the foundation of the officers' barracks. This prompted further archaeological investigation in this area in 2004.

In July 2004 archaeologists returned to Fort Henry to participate in a number of projects. One project was the large undertaking to uncover the southwest corner of the officers' barracks started the previous fall (Figure 13). Also in 2004, remains of the 1812 powder magazine were located on the exterior of the East Commissariat Range. By locating two substantial structures from the first fort, overlays of the historic plans were re-evaluated to determine the location of the officers' barracks within the Advanced Battery. It wasn't until 2011 that an opportunity to utilize this information presented itself.

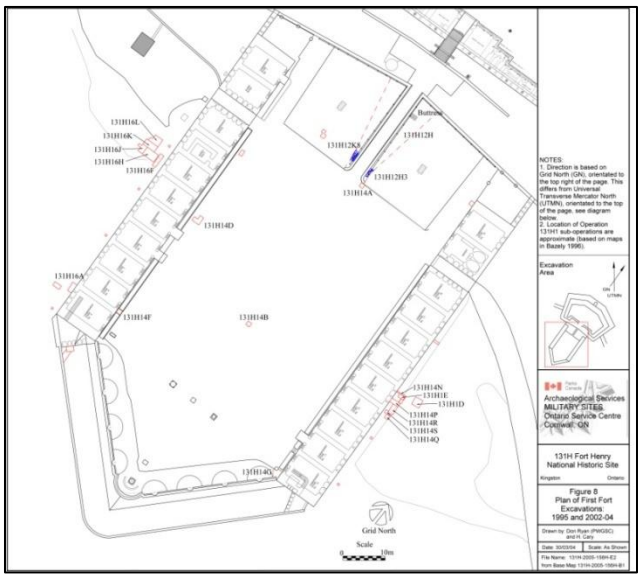


Figure 12: Plan of Advanced Battery archaeological excavations prior to 2011 (drawn by Don Ryan and Henry Cary).

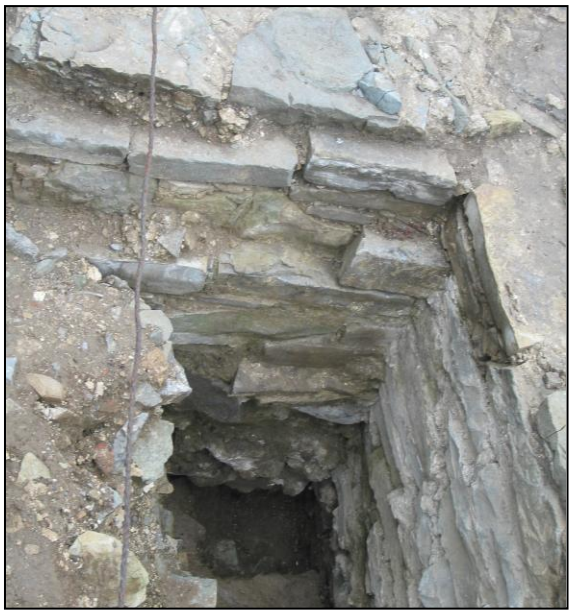


Figure 13: Photograph of the southwest foundation of the Officers' Barracks (photograph by H. Cary;131H657E).

What previous excavations revealed about the officers' barracks:

The foundation was found to be a substantial construction of two parallel lines of large, squared stones, roughly laid and in-filled with rubble and mortar. The foundation is approximately 1 m wide near the top and widens to 1.2 m at the base. A step in the foundation was on the interior, which provided additional support for the upper wall and possibly floor joists.

The foundation for the façade was built on the natural slope of the bedrock and the gable foundation was excavated into the bedrock. It is known from Bonnycastle's report (NA RG8 Vol.31 p.27) that the officers' barracks had a cellar. Since the bedrock, and therefore the foundation of the façade, slope down toward the west in this location and a large quantity of artifacts were found on the interior of the southwest corner of the officers' barracks, Cary suggests that the west end of the barracks would have been the likely location of the cellar (Cary 2005:15).

The construction-related artifacts found during the 2004 excavation provide some information on the structure. A relatively high grade of pane glass was uncovered along with a high quantity of painted plaster. These items indicate the high status of this structure. As well, unpainted tin sheets were found that match the description of the roof in a historical report (Cary 2005: 17, 19).

A large number of complete bricks were also uncovered. These would have been salvaged from the fireplaces and internal chimneys. Cary notes that the bricks were purposefully left out of the auction that was held in Kingston to sell off the stone from the barracks and was likely intended to be re-used in the construction of the Commissariat Range casemates (Cary 2005: 18).

An image showing the reconstruction of the officers' barracks (Figure 14) shows that it was a substantial structure which would have indicated the permanence and strength of the military on Point Henry.

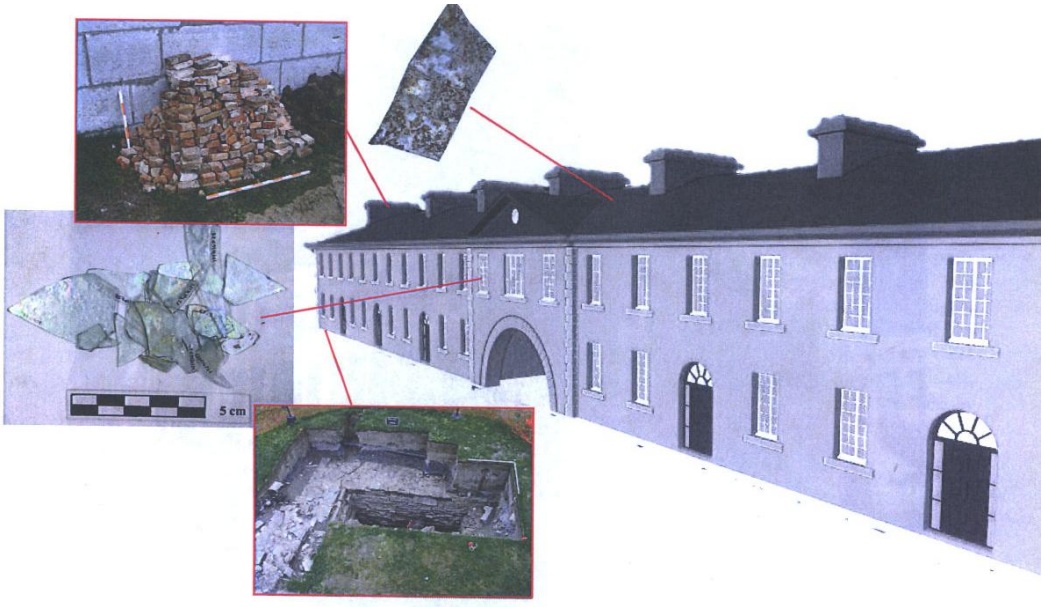


Figure 14: Reconstruction of the officers' barracks highlighting some of the features and materials found during the 2004 excavation (composite image by H. Cary).

Methodology

Excavation was required in the Advanced Battery at Fort Henry NHSC in the summer of 2011 in order to determine the location and depth of cultural resources prior to the re-paving of the Advanced Battery. Archaeologists worked with Engineer, Scott Gauthier, to determine the ideal locations of excavation units to provide information relevant to the engineers and to allow archaeologists to answer additional questions about the earlier forts.

In total, ten units were excavated on the Advanced Battery in the 2011 season (Figure 15). Four units[1] were placed in the north end of the Advanced Battery with the intention of locating the foundation of the officers' barracks from the 1812 fort. The approximate location of the officers' barracks within the Advanced Battery was known based on excavations on the exterior of the fort in 2004 that revealed the southwest corner of the foundation. Using overlays of historic plans, two units measuring 100 cm north to south by 50 cm east to west were marked out with the intention of bisecting the north foundations of the officers' barracks while two units of the same dimension were laid in to locate sections of the south foundation. A fifth unit[2] was placed roughly in the centre of where the officers' barracks would have stood. It measured 100 cm north to south by 50 cm east to west. This unit was placed to identify any possible interior remains of the officers' barracks. In this area there was also the potential to locate the foundation of a shifting room from the second British occupation (Figure 8). These five units were excavated first for two reasons: locating the foundations of the officers' barracks would help locate other remains of the 1812 fort, and secondly, it was requested these units be backfilled prior to the last week of June to accommodate the programming at the site.

After locating foundations from the officers' quarters in three units[3], two more units were laid out that aimed to locate additional remains of the 1812 fort. Unit 131H54G was 100 cm north to south by 50 cm east to west and placed centrally within the Advanced Battery, south of the officers' quarters foundations, with the hopes of locating privies from the first fort. In order to locate remains of the demi-lune bastion from the first fort, a large unit[4] measuring 2 m north to south by 1 m east to west, was located in the southern part of the Advanced Battery. Three additional units[5] were excavated at various locations in the southern half of the Advanced Battery with the sole purpose of determining the depth of the macadamized surface. Unit 131H54H measured 100 cm north to south and 50 cm east to west and the other two units were 50 cm x 50 cm.

During the course of the excavations, three of the units were extended in order to uncover the entire width of the officers' barracks foundations. Unit 131H54A was extended 75 cm to the north after locating the south face of the foundation. A measurement was taken from the south face of the foundation towards the north to see if unit 131H54C was in the right location to expose the wall. It was determined that 131H54C should be extended 1 m to the south. After uncovering only part of the south foundation in 131H54E it was extended 50 cm to the south.

In some cases the excavations that were originally intended to expose 1812 features were terminated when the macadamized surface was reached. The macadamized surface is a level 1 resource and since the exact location of the earlier features is unknown, it was decided the level 1 resource should not be disturbed at this time. Now that more has been learned about the 1812

[1] 131H54A, 131H54C, 131H54D, 131H54E
[2] 131H54B
[3] 131H54A, 131H54C, 131H54E
[4] 131H54K
[5] 131H54F, 131H54H and 131H54J

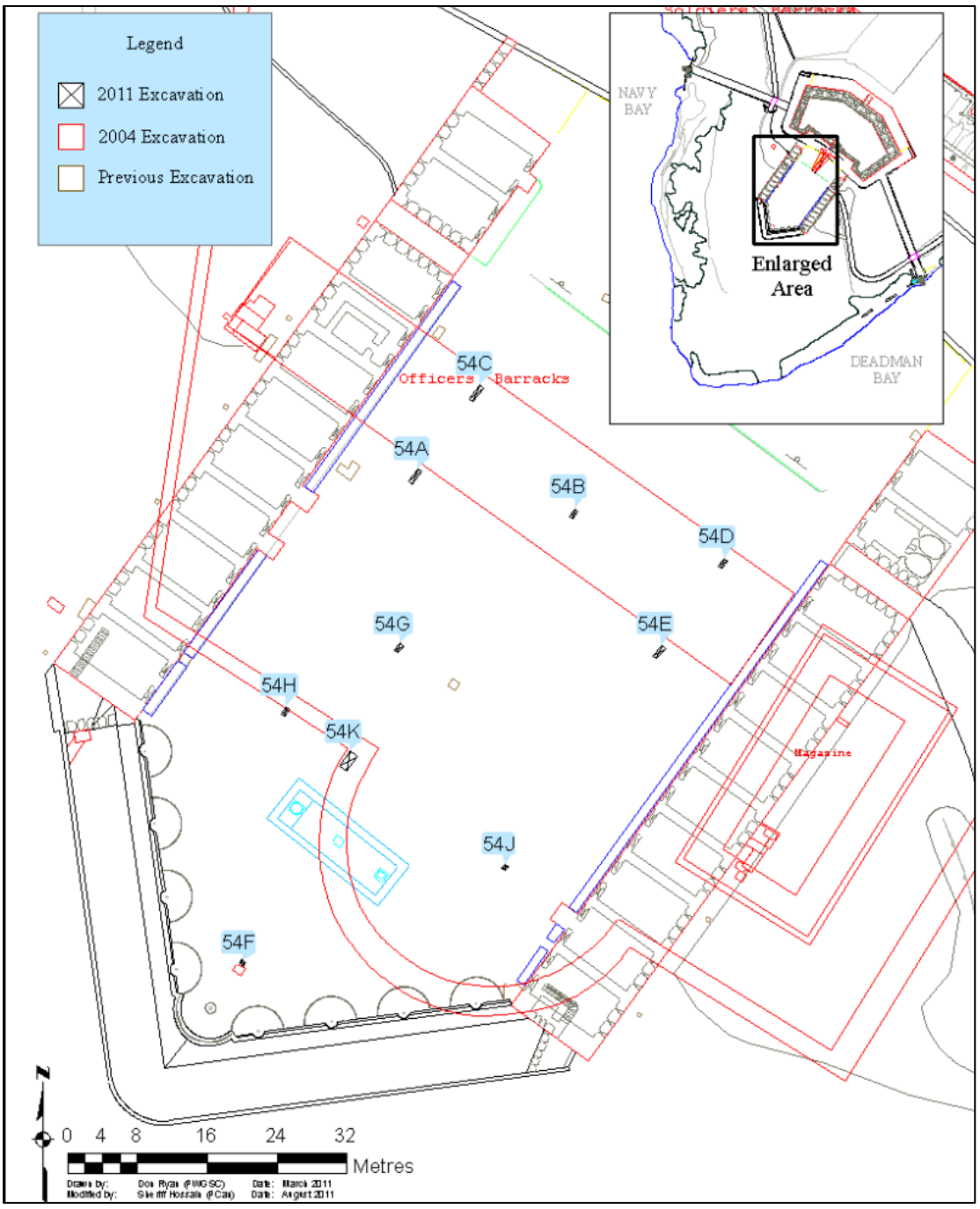


Figure 15: Map of the Advanced Battery at Fort Henry, showing the location of the 2011 excavations and showing the outline of the first fort in red (drawn by S. Hossain).

features, a strategy for uncovering more remains from the first fort will be developed.

In all cases the current asphalt had to be cut by a circular concrete saw. Once the asphalt was removed the subsequent layers and features were excavated stratigraphically by hand. The units were recorded using the Parks Canada Recording System (Parks Canada 2005). where 131H is the alphanumeric code for Fort Henry; 54 denotes the Advanced Battery(previous excavations were 14); the letter that follows represents the individual unit (sub-operation); and the last number indicates a layer or feature within the unit. Therefore, 131H54A1 signifies the first layer in unit A. Significant features, profiles and post-excavation plan views were digitally photographed and drawn for each unit. Soil layers were recording using the standardized Munsell soil colour chart (Munsell 1998). Artifacts recovered from the site were collected for processing at the Archaeological Services Laboratory in Cornwall. Some preliminary processing was carried out at the Cataraqui Archaeological Research Foundation in Kingston when weather did not permit on-site work.

Findings and Interpretation

There are nine phases of occupation on Point Henry. The strata and features identified during the 2011 excavations of the Advanced Battery fall within these phases as follows:

Phase 1: Natural Strata and Aboriginal Occupation

In one unit, 131H54B, the natural limestone bedrock[6] that is common in Kingston was uncovered (Figure 16). It was located at a depth of 56 cm below the current surface. In one unit, 131H54K, the natural strata was uncovered at a higher elevation, 33 cm below the current surface. In this unit the bedrock was granite[7](Figure 17) rather than the typical limestone. Granite veins have been recorded at Fort Henry. The hard stone makes excavation extremely difficult and therefore early features in this area of the Advanced Battery were likely built on the surface of the bedrock rather than excavated into the granite.

Figure 16: Plan view of 131H54B, showing limestone bedrock (lot 12) on the north side of the foundation (lot 9) (photograph by S. Spigelski ;131H2525E).

Figure 17: West profile of 131H54K, SHOWING granite bedrock (photograph by S. Spigelski ;131H2499E).

[6] 131H54B12
[7] 131H54K11

Phase 2: 1812 Construction and Occupation (1812-1832)

The officers' barracks from the first Fort Henry was built in 1820. The foundations of the officers' barracks as well as the other foundations found in association with the barracks date to the second phase of Point Henry's history and the first phase of military construction on the point.

The exterior foundations of the officers' barracks[8] were located in three units between12 cm and 85 cm below the current asphalt. The foundations measure approximately one meter wide and are comprised of two parallel lines of large cut limestone in-filled with mortar and smaller limestone fragments. Figure 18 shows the remains of the foundation in unit 131H54E. At the limit of excavation in the deepest unit (131H54C), 30 cm of the foundation was exposed. More courses of the foundation are likely to exist beneath, but the small size of the excavation units did not allow for the easy removal of the demolition rubble.

In two units, additional foundations related to the officers' barracks were located. In unit 131H54C a foundation[9] perpendicular to the primary foundation was keyed into the officers' barracks (Figure 19). This foundation was approximately 70 cm long on the north exterior side of the barracks. At the north end of this was another foundation running parallel to the officers' barracks. Only one face of each foundation was located so their width and length is unknown. The foundations were uncovered between 65 cm and 85 cm below the asphalt. The U shaped area that was created by these connected foundations was filled with sand[10]. The purpose of these additional foundations is unknown. It is hypothesized that they could have provided support to archways or entrances into the barracks. Further excavation is necessary to determine their extent and help reveal their function.

Figure 18: Plan view of 131H54E, showing the foundation of the officers' barracks (lot 12) in the centre and an additional foundation (lot 11) to the left (photograph by E. Thurston; 131H2564E).

[8] 131H54A8, 131H54C13, 131H54E8/E12

[9] 131H54C13

[10] 131H54C12

Figure 19: North profile of 131H54C, showing the additional foundation (lot 13 to the left) running perpendicular to the officers' barracks foundation (photograph by S. Hossain; 131H2550E).

In unit131H54E another foundation[11] was found running parallel to the officers' barracks on the south exterior side (Figure 18). In this case it is not known if this foundation is related to the officers' barracks. The strata indicated that this secondary foundation was demolished at the same time as the barracks, since both foundations were demolished to a similar level (27cm to 32 cm below the asphalt) and covered by the same demolition debris. It could be that this foundation had the same function as those discovered on the north side of the barracks, however, without further excavation it is difficult to determine how this foundation relates to the primary structure. In this case, a16 cm wide section of the foundation was revealed but again the entire foundation was not uncovered so the width is unknown. No plans currently in the possession of OSC archaeologists and historians show these additional foundations.

Unit 131H54B revealed a 50 cm wide foundation[12] running east to west. There are two possible functions of this foundation. One possibility is that it is from the shifting room which was built during the second phase of British construction. However after consulting plans and photographs of the shifting room and analyzing the strata it seems more likely that this foundation served as an interior support for the 1820 officers' barracks. A plan of the officers' barracks shows a line running east to west through the centre of the barracks, parallel to the exterior façade walls, indicating a dividing wall that may have required a stone foundation to further support such a large building (Figure 4). Strata in this unit was also very similar to that in other units where the officers' barracks remains were found thus suggesting that the foundations are related to the barracks. The interior foundation (Figure 16) is about half the width of the exterior foundations and was located 25 cm below the asphalt. It was excavated to a depth of 34 cm at which point bedrock was encountered on the north side of the foundation.

In unit 131H54A there is a gap running diagonally through the foundation of the officers' barracks. The gap was partially filled with clay/loam soil[13] and no artifacts were uncovered. This hole through the foundation has been).

[11] 131H54E11

[12] 131H54B9

[13] 131H54A9

There is no known drainage plan for the officers' barracks however, it was not uncommon for structures of this period to have drains below the floors channeling water out of the buildings.

Artifacts related to the occupation of the officers' barracks were found in layers associated with the demolition of the structure. Military objects include a fragment of a bell top shako plate, a cross belt chain boss, a 9th Regimental button, Sappers and Miners Button and a shako scale. Domestic and personal objects from the occupation of the officers' barracks include fragments of creamware, pearlware, wine bottle and a porcelain figurine. The dietary artifacts consist mainly of mammal bone and oyster shell.

Figure 20: South profile of the officers' barracks in 131H54A. Lot 8 is part of the foundation and the gap to the left of it is the drain feature (photograph by H. Tulloch; 131H2539).

Material Culture from the Officers' Barracks:

Identifying Rank:
An Officer's Cross Belt Furniture

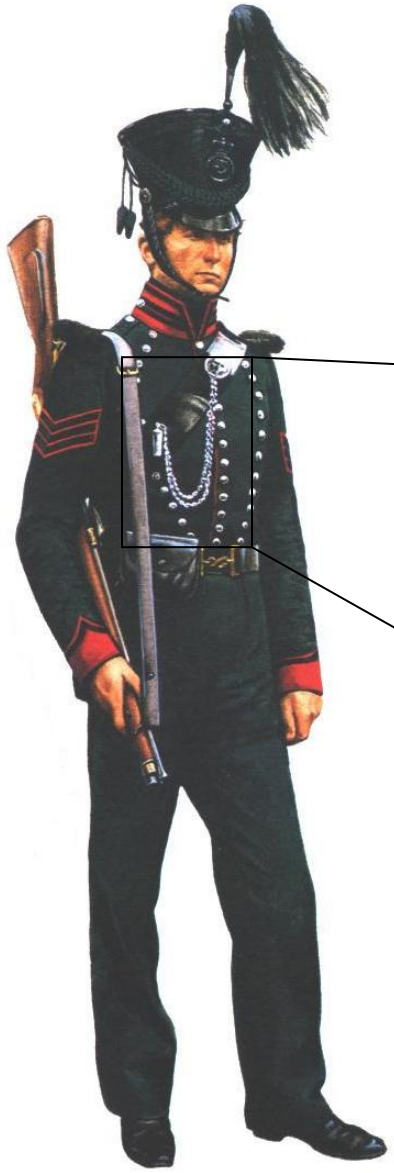


Figure 21: Fragmented Remains of a Cross-belt chain bosse. (Above) (specimen number: 131H54C9-3, photograph by J. Irvine; RAO 4010E).

Figure 22: Illustration of a 24th regiment officer wearing a cross-belt with lion bosse, chain and whistle (Left) (Barthrop 1982).

Amongst the demolition debris of the 1841 Officer's Quarters, lay fragments of an Officer's cross-belt chain bosse. When worn, the copper alloy lion head fit to the cross-belt just under the left epaulette. From the head, a three-strand chain led to a whistle and socket attaching below the cross-belt plate.

The Officers of Rifle Regiments, Light Infantry and Light Infantry Line Regiments all wore cross-belt furniture, thus it is difficult to associate the accoutrement to a particular regiment. The artifact's deposition is associated to the occupation and demolition of the Officer's Quarters, thus estimating a date of 1820-1841.

Eighteen regiments garrisoned Fort Henry from 1820-1841:

1819-1821	70th Regiment of Foot now East Surrey Regiment
1821-1822	76th Regiment of Foot now Duke of Wellington's Regiment
1822-1823	68th Regiment of Foot now Durham Light Infantry
1823-1824	60th Regiment of Foot now King's Royal Rifle Corps
1824-1825	37th Regiment of Foot now Royal Hampshire Regiment
1825-1827	68th Regiment of Foot now Durham Light Infantry
1827-1828	15th Regiment of Foot now East Yorkshire Regiment (The Duke of York's Own)
1828-1829	71st Regiment of Foot now Highland Light Infantry (City of Glasgow Regiment)
1829-1831	79th Regiment of Foot now Queen's Own Cameron Highlanders
1831-1833	66th Regiment of Foot now Royal Berkshire Regiment (Princess Charlotte of Wales')
1833-1834	15th Regiment of Foot now East Yorkshire Regiment
1834-1835	66th Regiment of Foot now Royal Berkshire Regiment
1835-1837	24th Regiment of Foot now South Wales Borderers
1837-1838	1st Regiment of Frontenac Militia
1838	71st Regiment of Foot now Highland Light Infantry (City of Glasgow Regiment)
1838	73rd Regiment of Foot now Highland Light Infantry
1838	83rd Regiment of Foot now Royal Ulster Rifles
1838	35th Regiment of Foot now King's Shropshire Light Infantry
1838	93rd Regiment of Foot now Argyll and Southerland Highlanders
1838-1839	8th Battalion of Incorporated Militia
1839-1840	65th Regiment of foot now York and Lancaster Regiment
1840-1841	34th Regiment of Foot now Border Regiment
1841-1842	43rd Regiment of Foot now Oxfordshire and Buchinghamshire Light Infantry

Dating a British Line Regiment Button

Figure 23: Military button with the faintmarkings "IX" or "XI" (specimen number: 131H54E10, photograph by J. Irvine; RAO4009E).

A flat, heavily polished, pewter button collected from the excavation unit 131H54E bears faint markings of the roman numerals "IX" or "XI". The direction of the mark is uncertain since there are no other markings to orientate it. Dating the button instead relies on the historical record for Fort Henry. According to Charles Stewart's *The Service of British Regiments in Canada and North America*, the 11th Regiment of Foot, Devenshire Regiment, was stationed in Quebec from 1838-1839 and there is no record of their presence close to Kingston. The 9th Regiment of Foot, presently known as the East Norfolk Regiment, was however stationed in Kingston from 1814-1815 and 1856-57.

Assuming the button belongs to the 9th Regiment, the time period of its use can be refined by determining a date range for the layer of soil in which it was deposited.

The stratigraphic lot 131H54E10 is determined to date to the demolition of the officers' quarters, suggesting its material culture is from the occupation of the building and therefore predates 1841. As a result, the pewter regimental button could originate from the 1814-15 occupation of the 9th Regiment at Fort Henry.

The British Military Shako

A shako is a military cap made of a cloth or leather body, with a peak. The shape of the cap varies through British Military history, as does the style of adornment. Most comprise of a central badge, marked with a regimental number or Royal Cypher; and a plume containing hair, feathers or a ball tuft. The orientation of the plume is different with each type of shako cap. The addition of decorative gold or silver cord and lace also varies by regiment or rank.

The first identifiable British shako is the "stovepipe" shako introduced at the turn of the 19th century. The cap stands straight and has a plume in front. The "Belgic", also referred to as the "Waterloo" and occasionally the "Wellington" shako, with false front and plume on its left replaced the "stovepipe" shako in 1812; however, a select few Light infantry, Rifle regiments, and Line regiments continued to wear the original style. The Regency shako 1816-1829 was broad at its top one of the most opulent of the shakos having a composite badge and ornate fittings. This pattern was the first to adorn chin scales in 1816. (Cattley 1936:188-208) An even broader topped pattern of shako arose in 1829, rightfully named the "bell-top". Officers had a swan feather plume, replaced in 1830 by a worsted hackle plume, and in turn substituted by a ball tuft c.1835. Other ranks wore a worsted plume until adopting the ball tuft c 1835. Around 1842 a chin chain with lion's head side ornaments replaced the chin scales and circular side ornaments. (Cattley 1936:196-198) In 1846, the "Albert", named after the Prince Consort who helped design it, replaced the broad-topped shako. This pattern had straight sides and a central plume, as well as two peaks – a front and a smaller back peak. (Carman 1973:34-35) A new infantry headdress replaced the "Albert" in 1855. Although similar in style, the "French" shako had a deeper back and tapered towards the crown, which proved uncomfortable and led to its replacement in 1861 by a small cap with a flap peak. The short cap retained the French tilted style but was plainer. Its blue stitched cloth covering led to its name the "Quilted" shako. (QRSRA 2011) The British Infantry shako took on a gradual change one last time in 1869 with a slightly lower cap with a smooth cloth surface, before its replacement by a Germanic pattern, cloth covered, helmet in 1878. (Carman 1973:36).

Archaeologically the state of the remains of shako caps is dependant on the environment of their deposition. In some cases, portions of the body of the cap remain however; leather and fibers decompose steadily once buried. Metal portions of the headdress such as the shako badge and the scales that form the chinstrap have better success of survival. Though fragile and often fragmented, the shako plate remains are the most useful in determining the type of cap and regimental association.

Figure 24: Evolution of the British Military Shako. 1)**Stovepipe shako (RAO 4025E),** 2)**Belgic shako (reproduction) (RAO 4027E),** 3)**Regency shako (reproduction) (RAO 4028E),** 4)**Bell-top shako (reproduction) (RAO 4023E),** 5)**Albert shako (reproduction) (RAO 4024E),** 6)**French shako (original) (RAO 4022E),** 7)**Quilted shako (original) (RAO 4026E),** 8)**Last pattern shako (original) (RAO 4029E). (The Stovepipe example is from the Fort Henry Museum Collection. All other examples are reproductions and originals from the Parks Canada Resource Collections).**

A fragment of a shako badge found during the excavation of the 1820-1841 officers' quarters exemplifies how even a tiny portion of a badge can identify its style of cap. The small copper alloy fragment is impressed with part of a crown. The double beading along the crown's side is what identifies this plate as a style worn on the British bell-top shako. This shako badge typically had a central starburst containing the number of the regimental, and a crown that sat above. The pattern was used from 1829-1839 when it was replaced with the subsequent badge normally associated with the Albert pattern shako (Cattley,1936:198). Without the remains of the regimental number, the fragment can only be associated to the style of cap and not to the regiment, which proudly wore it.

Figure 25: A fragment of a shako plate lies over a reproduction of a 24th Regiment, British bell-top style shako plate (specimen number: 131H54C10-1, photograph by J. Irvine; RAO 4011E).

Toy Statuette

Important historical events such as the Napoleonic Wars inspired the popularity of toy soldiers and miniature historical figures. Great Britain's industrial revolution brought forth a mass production of luxury items such as toys, thus increasing their availability to the public. An admiration towards historic heroes encouraged a world of imagination for children and adults alike to reenact famous events, or create new encounters.

The figurines came in many forms from paper and ceramic to cast metal and plastic.

A small porcelain statuette lay amongst the demolition debris or the 1820-1841 Officers' Quarters. The male figurine is wearing 18th Century clothing with traces of red paint on the trousers. The head and limbs are missing. The remains of the left arm suggest it was raised upward perhaps pointing into the distance. The right arm, bent at the elbow, is reaching forward or holding onto an object. The placement of the legs suggests the character is standing straight. There is an odd third break behind the two severed legs. An explanation can is in similar figurines that sit or lean against a column for support.

Figure 26: Porcelain statuette in 18th century clothing (specimen number: 131H54E10-1, photograph by J. Irvine; RAO4008E).

Unfortunately, without the individual's face or distinguishable markings identifying the character is impossible. Certainty lies in the figurine being an important male figure from the 18th century. Perhaps the decapitation and loss of limbs could suggest someone unpopular and an action of ill contempt performed in play.

A Taste of Home: the consumption of Oyster shell by the British Military stationed at Fort Henry.

Figure 27: A sample of oyster shell retrieved along the foundation walls of the 1820-41 Officer's Quarters (specimen number: 131H54C6-2, photograph by J. Irvine; RAO 4007E).

When excavating the 1820-41 Officer's Quarters, two foundation units produced oyster shell remains (131H54C6, 131H54C10, 131H54D7). The presence of this shell is of interest because it is not local to the fresh waters of Kingston. According to advertisements in the British Whig and the Kingston Chronicle during the 1830s, oyster was available for purchase by the barrel from local Kingston merchants. The subscriber Baker & Egan of Market Square advertises:

50 Kegs of Oysters- direct from New Haven – only 8 days from the beds.

(Kingston Chronicle, Nov.12, 1831)

All ads specifying the origin of the shellfish refer to locations in the southern United States and preservation would be important for oysters to travel such a distance.

In general, the military avoided seafood at inland postings because of the difficulty of preservation. Mass consumption of spoiled fish and shellfish could lead way to gastric trouble that would quickly overcome an entire regiment. (Henderson 1999) As a result, shellfish such as oyster is not included in the mess orders for British soldiers posted in the Upper Canadas. Regimental men could supplement their diet by fishing and hunting wild game. They were also able to purchase additional food items and supplies from canteen stores within the fort. The 1859 list of canteen items at Fort Henry include the sale of red herring, salt herring and salt cod fish,
but there is no mention of oyster. (Ridley, 2007), If consumed, oyster would need to be brought in from outside sources such as those advertised for sale at the market in Kingston.

Oysters were widely eaten in England during the 19th century. Popular household literature from the time such as *Beeton's Book of Household Management* include recipes for oyster soup, fried oyster, scalloped oyster, stewed oyster, oyster patties, oysters fried in batter, pickled oyster, oyster sauce and oyster ketchup. (Beeton 1861: 196, 286-291, 491-492)

British soldiers and officers stationed the Canadas probably brought with them their taste for shellfish. Oyster may not have been a strictly upper class food at that time however due to availability was mostly likely restricted to those in the military who could afford additional luxuries. Officers were fortunate to have the financial means to acquire specialty items and their own cook to prepare culinary requests.

The oyster shell collected from around the foundation of the 1820-41 officers' quarters is most likely occupation waste from officers who inhabited the building. To date, there are only nine other samples of oyster shell within the material culture collection for Fort Henry. This low number suggests that oyster was not a regular food item consumed by regiments stationed at the fort and remains of the shellfish are from fortunate individuals who had the ability to indulge.

Phase 3: 1832 Construction and British Garrison Occupation (1832-1870)

As mentioned previously, there is a 50 cm wide foundation running east to west across the Advanced Battery. Historic documents and archaeological evidence suggest that this foundation is for interior support of the officers' barracks. The only other stone structure that was historically located in this area was a shifting room. Plans and photos indicate the shifting room was built before 1870 and was still standing in 1890 in the area of this unit (Figure 8 and Figure 9). It appears that unit 131H54B may have been within the interior of the shifting room rather than along one of the exterior walls, therefore, there is a slight possibility that the foundation wall uncovered may belong to the shifting room.

The demolition of the officers' barracks in the early 1840s left behind several layers of demolition debris covered, in some cases, by landscaping layers. There were two different mortar layers, one consisting of partially degraded mortar with approximately 40% angular limestone throughout,[14]and the other[15], more degraded, powdery mortar with only a few small angular limestone fragments. In five units there was a layer of large rock rubble[16] and in 131H54C there was a very distinct layer of crushed red brick[17] (Figure 19). This brick may have been from an interior chimney or fireplace. Unit 131H54C also had a demolition layer[18] that was rich in artifacts from the occupation of the barracks.

The demolition layers associated with the destruction of the officers' barracks contained construction material from the building such as brick, mortar, pane glass, wrought and cut nails. Material from the latter half of the structure's occupation include a variety of military, domestic and dietary objects one would expect from the officers' barracks.

Military items include a Royal Regiment of Artillery button, a heel plate, blacking bottle fragments, friction tubes and friction bars. Examples of the domestic artifacts found are refine white earthenware, creamware, pearlware and course red earthenware sherds, lead glass stemware and smoking pipe fragments. Evidence of the officers' varied diet can be found in the remains of mammal bone, fish bone, egg shell and oyster shell.

After the demolition of the first fort's structures, it appears some effort was made to landscape the area prior to laying the macadamized surface. In three units landscaping layers[19] were identified and in 131H54K an interface[20] between the landscaping layer and the McAdam was recorded. This could indicate a brief occupation period after the landscaping and prior to the construction of the macadamized surface.

A macadamized surface from the early 1840s was located in seven units[21]. The McAdam is extremely shallow, in some cases only 8 cm below the current asphalt. At its greatest depth it is located 18 cm below the asphalt. The macadamized surface is made up of angular limestone ranging from 5 to 7 cm in size. The stones are tightly packed in clay/loam soil. Few artifacts were found in association with the McAdam. The surface served as the parade and, therefore, it is likely that every effort was made to keep it clean and free of debris which explains the lack of artifacts. In most cases there are very few layers between the 1840s McAdam and the current asphalt suggesting that the 1840s McAdam was maintained and used up until the Advanced Battery was

[14] 131H54C10, 131H54E13
[15] 131H54A6, 131H54B7, 131H54E7/E14
[16] 131H54A7, 131H54B11/B8/B10, 131H54C5/C7/C8, 131H54D7, 131H54E10
[17] 131H54C4
[18] 131H54C6/C9
[19] 131H54A5, 131H54E4, 131H54E9, 131H54K10
[20] 131H54K8
[21] 131H54C11, 131H54D5, 131H54F5, 131H54G3, 131H54H3, 131H54J4, 131H54K7

paved in asphalt in the early 1950s. In a few units there was a layer of stone and sand that could have been a later surface or landscaping immediately prior to the 1950s paving.

John Loudon McAdam was a Scottish Engineer who revolutionized paving methods in the early 1800s. Roads were built to his specifications all over Europe and North America during the 19th century. His theory was that thick layers of stone were unnecessary as long as the rock used was a specific and consistent size. The size of the stone was important in creating a durable, self-draining surface for carriage traffic. McAdam specified that the lower road layer should consist of angular stones approximately 3'' (7.5cm) square and the upper layer should consist of 2'' (5cm) square stones. When the stones were driven over or passed over with a roller the angular stones would lock together creating a level and durable surface.

Other engineers added binding agents, such as stone dust or clay, to the macadam stones, in cases where smoother surfaces were required. Surfaces such as these are known as macadamized. In the Advanced Battery at Fort Henry, engineers used McAdam's specifications to create the parade. The stones uncovered in the Advanced Battery parade are angular limestone pieces ranging in size from 5 to 7cm square. In this case, clay was used as a binding agent to make a smooth parade surface. Archaeological investigations have revealed the macadamized surface just below the current asphalt, in most cases with only substrate for the current asphalt separating the two surfaces. This suggests that the macadamized surface, laid in the early 1840s, was used until the mid-21st century, a testament to the durability of the surface.

With the advent of motor vehicles which churned up the stone road surfaces, it became necessary to add binding agents to the stones to make smoother surfaces. Tar was a commonly used binding agent and the surface was subsequently called "tar-bound macadam", later shortened to tarmac, this is a paving method still used widely today (Cary 2003:13).

Figure 28: West profile of 131H54D, showing the shallow, macadamized surface laying directly above rubble from the demolition of the officers' barracks (photograph by B. Leskovec; 131H2533E).

Phase 4: Canadian Garrison Occupation and Pre-WWI (1870-1914)

In two units there is no evidence of a macadamized surface, therefore, the relationship between the post-demolition landscaping and the macadamized surface is unclear in these areas. The landscaping events could have happened during the later occupation of the site, however, based on the stratigraphic sequence in other units, it seems most likely that landscaping occurred shortly after the demolition of the first fort structures.

The general occupation of the Advanced Battery begins earlier, in phase 3 with the completion of the Advanced Battery and the installation of the macadamized surface. The gradual accumulation of material above the McAdam, therefore, spans approximately one hundred years from the mid-1840s to 1948 (later half of phase 3 through to phase 7).

In the northeast corner of 131H54B a dark occupation layer[22], originally identified in the field as a fire pit, was located. While the soil is thicker in the northeast corner of

[22] 131H54B4

the unit, closer examination of photographs of the unit show that the layer, while thinner, covers the entire unit and there is a similar layer in 131H54D[23]. It seems more likely that this layer is related to the later occupation of the site rather than an isolated fire pit. The artifacts found within the deposit date to the long-term occupation of the Advanced Battery and cannot be dated to a specific phase of the fort's history. Also the artifacts are not burnt which confirms this deposit is an occupation layer rather than a fire pit.

Figure 29: East profile of 131H54B, showing the dark occupation layer (lot 4) and the interior foundation (lot 9) (photograph by S. Spigelski ;131H2527E).

Phase 5: Internment Camp and Post WWI Occupancy (1914-1936)

During World War I the Commissariat Ranges were used for internment until the internees were moved into the Redoubt, after which time the camp guards were housed in the Ranges.

There are no deposits or artifacts specifically dated to this phase as it falls within the long-term occupation of the Advanced Battery.

[23] 131H54D3

Phase 6: Restoration (1936-1938)

No evidence of restoration activities were found during the 2011 excavations. At the time when the remainder of Fort Henry was undergoing considerable restoration the Advanced Battery was still controlled by DND and used to store ammunition and was outside of Ronald Way's jurisdiction.

Phase 7: WWII POW Period and Post WWII Occupancy (1939-1948)

An electrical conduit[24] was located in unit 131H54K (Figure 17). It cut into the 1840s McAdam, but was installed prior to the current pavement laid in the 1950s. The exact date for the installation of this conduit is unknown, but it may have been installed during the Second World War to provide electricity to the Commissariat Ranges and the temporary structures that were erected in the Advanced Battery at that time. Mid20th-century artifacts within the trench fill support this possibility.

The trench that was cut for the conduit was filled with mottled clay, sand and re-deposited McAdam[25]and later capped by re-deposited macadamized surface[26] that had been removed in order to lay the conduit. Re-deposited McAdam[27] was located in 131H54A as well. It is possible that there was an earlier utility line in that area, but if so, it was outside the confines of the unit.

Construction material such as brick, mortar, wire nails and a cut nail indicate that construction or repairs were being carried out in the Advanced Battery at this time. This material could be related to either the temporary structures set up on the parade or to the repair of the Commissariat Ranges.

[24] 131H54K12
[25] 131H54K9
[26] 131H54K4
[27] 131H54A4

Phase 8: The Fort Guard Period (1948-1999)
Early in this phase the Advanced Battery was paved, possibly in 1951 when the Redoubt was paved. The 1950s paving[28] still exists today and other than the installation of utilities, and alterations to the drainage, both confined to trenches running along the Commissariat Ranges, the paving has effectively sealed the remains from the earlier phases of Fort Henry's history. The only other disturbance to the paving has been for archaeological investigations carried out since 2002.

The substrate for the 1950s paving is stone dust[29] ranging in thickness from 3 cm to 10 cm. In 131H54E there was a second layer of stone dust[30] and in unit 131H54D there was a thin layer of black sandy silt[31] below the stone dust. A similar silty layer was identified in 131H54K[32].

Below the stone dust, in seven units, there was a compact clay and stone layer[33] that has been identified as landscaping prior to paving the Advanced Battery. In three units there was a second layer of clay landscaping[34], in these cases it was free of stone. Below the landscaping, in two units, there were deposits of gravel[35] which may have served to fill in depressions in the surface of the Advanced Battery prior to paving the area. Profiles of 131H54B and 131H54K show the stone dust substrate below the asphalt (Figure 29 and Figure 17).

Artifacts in these landscaping layers are evidence of the maintenance and repairs that were being carried out in the Advanced Battery during the early Fort Guard period. Brick, mortar, nails and a fragment of a downspout were found in deposits directly below the asphalt that was laid in the 1950s.

Phase 9: Parks Canada Presence (1999-Present)
No previous excavation units were re-opened this summer and since the area has been capped by the 1950s asphalt there are no archaeological resources associated with this phase found during the 2011 season.

Conclusions and Recommendations

The archaeological investigations that were conducted in the Advanced Battery of Fort Henry in 2011 provided evidence that the 1840s macadamized surface remains in most areas of the Advanced Battery. This level 1 resource was confirmed to exist as shallow as 8 cm below the current asphalt.

This season's excavations also revealed foundations of the officers' barracks from the earlier 1812 fort. The fact that foundations of this first fort structure remain intact below the surface of the Advanced Battery indicate that other features from the earlier fortification may still exist in this area. Several artifacts dating to the occupation of the officers' barracks confirm the function of the structure. Having located these remains of the 1812 fort within the current Advanced Battery will aid in locating other first fort structures with greater accuracy.

Additional foundations uncovered in association with the officers' barracks have raised new questions about the construction of the barracks. The purpose of the additional foundations is unknown at this time, but further archaeological testing of the area would provide more information on the function of these foundations.

[28] 131H54A1, 131H54B1, 131H54C1, 131H54D1, 131H54E1, 131H54F1, 131H54G1, 131H54H1, 131H54J1, 131H54K1
[29] 131H54A2, 131H54B2, 131H54C2, 131H54D2, 131H54E2, 131H54F2, 131H54G2, 131H54H2, 131H54J2, 131H54K2
[30] 131H54E3
[31] 131H54D3
[32] 131H54K5
[33] 131H54A3, 131H54B3, 131H54C3, 131H54D4/D6, 131H54F3, 131H54J3, 131H54K3
[34] 131H54B6, 131H54F4, 131H54K6
[35] 131H54B5, 131H54E5/E6

The overall stratigraphic sequence consists of 1950s paving and substrate covering a century of landscaping and occupation layers which overlay the original 1840s macadamized surface. Below the macadamized surface, layers of landscaping cover demolition debris associated with remains of the first fort, which was built on natural bedrock.

These investigations rendered the following recommendations in regards to the re-paving of the Advanced Battery:

1) The removal of the current asphalt should be monitored by archaeologists;

2) Care should be exercised when removing the current paving in areas where cultural resources have been identified by archaeologists to be shallow and in some cases already exposed (ie. the surface drains that run parallel to the boardwalks on either side of the Advanced Battery);

3) An effort should be made to build up the surface of the Advanced Battery to better protect the cultural resources located below.

Additionally, these investigations rendered the following recommendations for the Advanced Battery, Fort Henry N.H.S. C. in general:

1) Archaeological Services, Ontario Service Centre, Parks Canada should be consulted regarding all future work that may impact the Advanced Battery at Fort Henry;

2) Archaeological investigations should proceed all future work that will have a subsurface impact in the Advanced Battery at Fort Henry.

3) Additional archaeological work is required to determine the extent and purpose of the foundation walls uncovered in 2011, and to locate the demi-lune and the privies of the first Fort Henry.

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Appendix A: Summary of Findings by Excavation Unit

131H54A

Unit 131H54A was located in the northwest quadrant of the Advanced Battery. The purpose of this excavation was to determine if any evidence of the 1820s officers' barracks existed in the Advanced Battery. Outside of the current fort walls the southwest corner of the officers' barracks had been located during previous archaeological investigations (Cary 2005:14,15). Using the location of the southwest corner of the structure, historic maps were overlaid to determine the approximate location of the building within the Advanced Battery. Unit 131H54A initially measured 1 m north to south by 50 cm east to west, but because only the south side of the south foundation wall was uncovered the unit was extended 75 cm to the north to expose the entire width of the foundation.

A total of nine lots were identified in this unit. Lot one was the current asphalt and lot two was the stone dust substrate for the asphalt. Lot three was a sandy loam with gravel that may have been a previous advanced battery surface prior to the 1950s asphalt paving. Lot four was a thin layer of clay loam, mortar, brick and angular limestone rocks on the east side of the unit. The rocks are consistent with the size and shape of the rocks used for the macadamized surface on the Advanced Battery. Since the layer was neither flat nor compact and it contained other rubble not consistent with an in-situ macadamized surface, it appears that this layer was re-deposited macadam. A similar section of re-deposited macadamized surface was uncovered in 131H54K (lot 4). Beneath lot 131H54A4 was a thick layer of dark sandy clay that covered the unit. This may be evidence of a landscaping activity after the demolition of the officers' barracks. Lot six was a layer of mortar averaging 10 cm thick likely from the demolition of the officers' barracks. Below the mortar, lot seven was a layer of large limestone rubble from the demolition of the officers' barracks in 1840/41. It was excavated on either side of the foundation to a depth ranging from 10-20 cm in thickness. On either side of the foundation lot seven was not completely excavated and was the limit of excavation.

The foundation of the officers' barracks itself was lot eight. The foundation measures approximately 1m wide north to south. The top of the foundation was covered by compact mortar and rubble that obscures the foundation in plan view but several courses of the foundation were visible below the rubble. On the south side of the unit there were three courses of foundation in situ. The top course of the foundation on the south side was located at 18 cm below the current Advanced Battery surface. On the north side of the unit the foundation was located deeper, at 41 cm below the current Advanced Battery surface. The north side of the foundation was shifted south, as if the wall was pushed in that direction during demolition. There was a gap running through the foundation of the officers' barracks. The gap was filled with loosely compacted, organic, clay loam designated as lot nine. It is possible that this gap in the foundation is a purposefully constructed drain aimed at draining water out of the officers' barracks and the soil was fill that has gathered in the drain over time. Due to the large rubble fill (lot 7) on either side of the foundation and the confined space of the test pit, it was not possible to excavate further to determine the full depth of the remaining foundation or to investigate the possible drain feature. Larger excavations in the future would enable the removal of the rubble fill, which would provide

additional information about the officers' barracks foundation and reveal more occupation-related material thus providing further a glimpse into the early 19th century life at Fort Henry

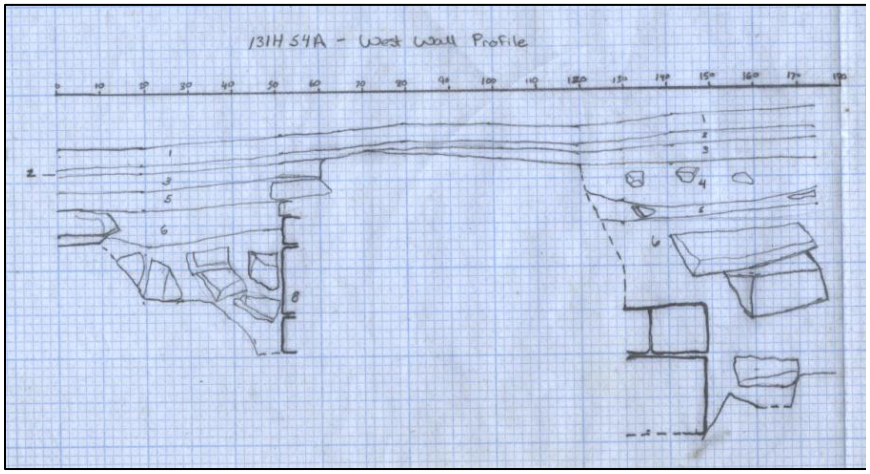

Figure 30: West wall profile of 131H54A (drawing by H. Tulloch; 131H-2011-184-1).

Figure 31: West wall profile of 131H54A, showing the south foundation of the officers' barracks covered in rubble (photograph by H. Tulloch;131H2543E).

Figure 32: Remains of the north face of the officers' barracks foundation (photograph by H. Tulloch;131H2539E).

Figure 33: Remains of the south face of the officers' barracks foundation (photograph by H. Tulloch;131H2510E).

131H54B

Unit 131H54B was located at the north end of the Advanced Battery, just south of the ramp that leads into the Redoubt. The purpose of this excavation was to determine if there were any remains associated with the interior of the 1820 officers' barracks such as a floor or interior walls and to locate the remains of a shifting room that existed in the area. Twelve lots were identified in the unit that measured 1 m north to south by 50 cm east to west. Lot 1 was the current asphalt and lot 2 was the stone dust substrate. Lot 3 was a layer of compact sandy loam with gravel that might have been a previous Advanced Battery surface. Lot 4 was a small charcoal deposit in the northeast corner of the unit. It contained slag and mortar. Lot 6 was a layer of compact clay on the west side of the unit. It was above a layer of stone dust (lot 5). These layers may represent another Advanced Battery surface after the 1840s macadamized surface and prior to the 1950s asphalt. Lot 7 was a layer of sandy clay with mortar and angular limestone debris that covered most of the unit, excluding the area where the charcoal deposit was in the northeast corner (lot 4). These two deposits (lot 4 and lot 7) may have been part of a demolition event or an occupation. The artifacts may help us to identify which demolition activity they are related to. Below lot 4 and lot 7 is a thick layer of large demolition debris that contained several mid19th-century artifacts. This demolition material is likely associated with the demolition of the officers' barracks in the early 1840s (lot numbers 8, 10 and 11 were determined to part of the same demolition layer after excavation).

Lot 9 was a 50 cm thick foundation that runs east to west across this unit. Three courses of this foundation were uncovered on the north side of the unit before natural limestone bedrock (lot 12) was located at approximately 60 cm below the surface of the current asphalt. The top of the foundation is located approximately 25 cm below the surface of the current asphalt. This foundation was likely an interior wall of the officers' barracks, as the stratigraphy superimposing it was similar to that found in other units where the officers' quarters remains were located. However, a shifting room stood in this location in the late 19th century, and the remains may be affiliated with this building. More historical research is required in order to accurately identify the provenance of this foundation.

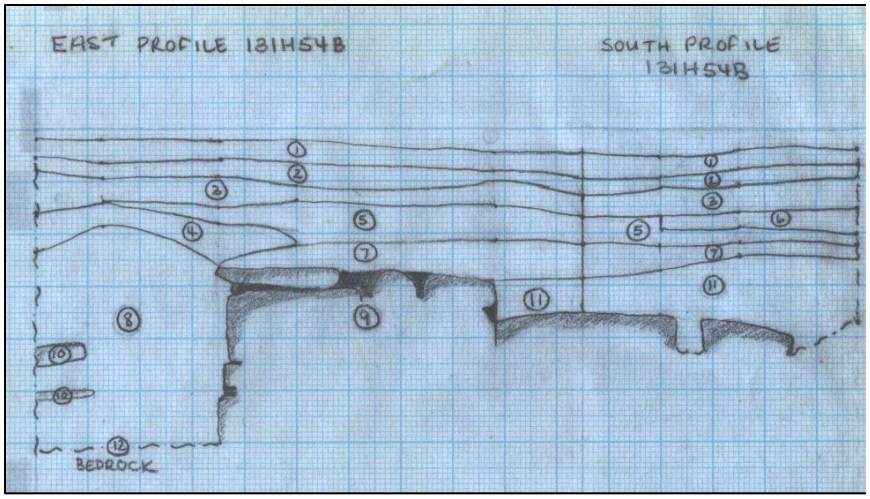

Figure 34: East and south wall profiles of 131H54B (drawing by S. Spigelski; 131H-2011-222-2).

Figure 35: Post excavation plan view of 131H54B, showing a foundation (photograph by S. Spigelski;131H2519E).

131H54C

This unit was situated in the northwest quadrant of the Advanced Battery intended to locate a portion of the north wall of the officers' barracks. The unit initially measured 1 m north to south by 50 cm east to west, but was extended 1 m south after the south wall of the officers' barracks was located in 131H54A. A total of thirteen lots were recorded. Several of the lots were later determined to be part of the same deposit and therefore the number of stratigraphic layers was reduced to ten.

Lot one was the current asphalt, lot two was the stonedust substrate and lot three was possibly a previous surface prior to the paving of the Advanced Battery in the 1950s. One layer that was unique to this unit was a thick layer of red brick fragments, evidence a demolition event. The layer was at least 80% red brick with a small amount of clay loam soil. This may have been the result of a chimney demolition. Lots five, seven and eight were large limestone rocks likely from the demolition of the officers' barracks. Lots six and nine were an artifact rich sandy loam layer. The historic artifacts date to the early 1800s and suggest they are associated with the officer's barracks. Lot ten was another layer associated with the demolition of the officers' barracks, which consisted of mostly mortar with some fragments of limestone rocks. Lot 11 was the 1840s macadamized surface. It was located in the south half of the unit approximately 13 cm below the surface of the current asphalt. Lot 12 was sand fill between several connected foundations and was the limit of excavation in the north section of the unit. Excavation ceased at approximately 110 cm below the surface of the current asphalt. Lot 13 consists of limestone foundations. The southern most foundation is the north wall of the officers' barracks. Perpendicular to the officers' barracks foundation, on the north side was another limestone foundation that seems to be keyed into the officers' barracks foundation. Parallel to the officers' barracks, 50 cm to the north, was the third part of the foundation. These secondary foundations appear to be affiliated with the 1820s officers' barracks and may have provided support for arches. Further research is required to understand the function of these additional foundations.

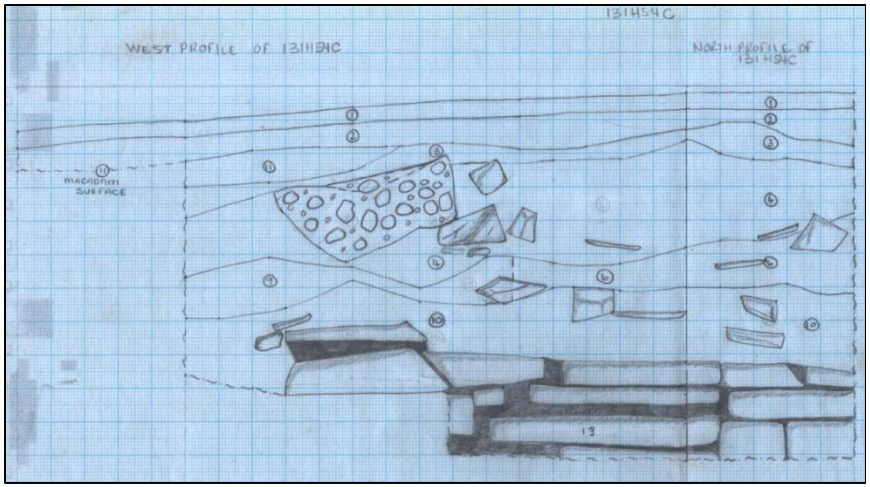

Figure 36: North and west profiles of 131H54C (drawing by S. Spigelski; 131H-2011-222-3).

Figure 37: Post excavation plan view of 131H54C showing the foundation of the officers' barracks foundation (photograph by S. Hossain;131H2548E).

131H54D

Unit 131H54D was located in the northeast quadrant of the Advanced Battery with the purpose of locating the north wall of the officers' barracks. The unit was 1 m north to south and 50 cm east to west and within it seven lots were identified. Lot one was the current asphalt and lot 2 was the stone dust substrate. The third lot was a thin layer of black sandy silt that was a previous Advanced Battery surface. Lot 4, a layer of light brown sandy silt with angular gravel superimposes lot 5, the 1840s macadamized surface. Lot 4 was evidence of a previous surface and may be a landscaping effort made to rehabilitate the macadam beneath. As mentioned, Lot 5, the 1840s macadamized surface, consists of angular limestone averaging 6 x 3 x 2 cm within clay loam soil. It is located approximately 10 cm below the surface of the current asphalt. Lot 6 is an artefact, a nail that was collected from the top of the macadamized surface. In the north quarter of the unit the macadam was excavated to identify what layers lay beneath. Lot 7 was a layer of historic demolition fill below the macadam probably associated with the demolition of the officers' barracks. It was excavated to a depth of 10cm before the large rubble and narrow space made it difficult to excavate further. As the location of the north wall of the officers' barracks had not yet been confirmed in unit 131H54C, the remaining macadamized surface, in very good condition, was left in situ to preserve it.

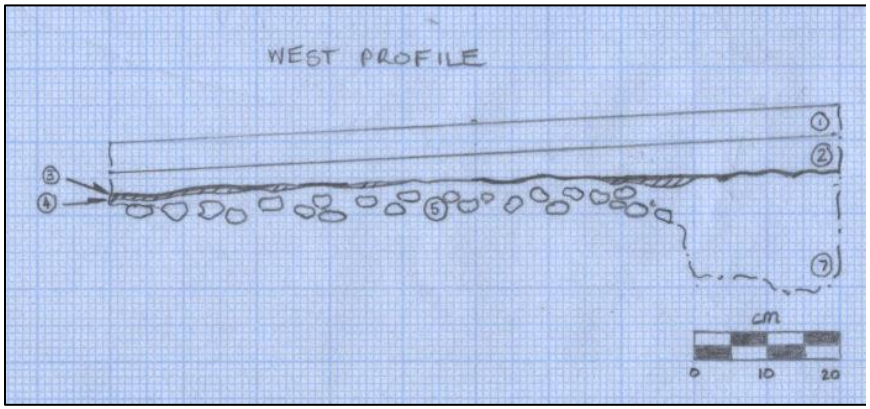

Figure 38: West wall profile of 131H54D, showing the Macadamized surface in the south portion of the unit and rubble demolition fill on the north (drawing by B. Leskovec; 131H-2011-155-1).

Figure 39: Post excavation plan view of 131H54D, showing the Macadamized surface (photograph by B. Leskovec; 131H2531E).

131H54E

Unit 131H54E was also located in the northeast quadrant of the Advanced Battery in order to locate the south wall of the officers' barracks. The unit started as 1 m by 50 cm north to south and was later expanded 55 cm south in order to expose the entire width of the foundation. A total of 14 lots were identified. Lot 1 was the current asphalt and lot 2 was the stone dust substrate. Lot 3 was another layer of substrate. It is stone dust with sandy loam. Lot 4 and lot 9 were very similar layers at the same elevation containing small fragments of brick, mortar and limestone. The difference is the soil; lot 4 to the north was clay and lot 9 to the south was loam. They both seem to be related to a demolition activity. Lot 5 was a long piece of metal, possibly a fragment of eavestrough, within lot 6, which was a pocket of gravel in the northeast corner of the unit. Lot 7 was a mortar demolition layer covering the entire unit and likely associated with the demolition of the officers' barracks. At the bottom of lot 7, on the north side in the east wall of the unit, there was a piece of wood (lot 14). This could be part of a sill plate or part of the rubble from the demolition. Lot 13 was a thin layer of mortar directly above the officers' barracks wall on the north side of the unit. Two foundations were identified in this unit. Lot 12 was part of the south wall of the 1820 officers' barracks, 94 cm wide and ranging from 25cm to 40cm below the current asphalt surface. Lot 11 is the remains of an unidentified foundation. Only the north face of the foundation was uncovered in the south wall of the unit. It was located approximately 30 cm below the current surface of the Advanced Battery and was 40 cm south of the foundation of the officers' barracks. Lot 8 was identified as a feature on the east wall of the unit. It was a roughly square area of sandy loam and mortar directly above the foundation of the officers' barracks. This feature was probably part of the foundation where a rock was removed leaving a square impression behind. Lot 10 was a layer of large rubble demolition fill that overlies and is between the foundations. This indicates that the two foundations were likely contemporaneous. The demolition fill consists of mottled clay, loam and sand with brick, mortar and angular limestone rocks ranging from 5 x 5 x 5 cm to 15 x 10 x 5 cm.

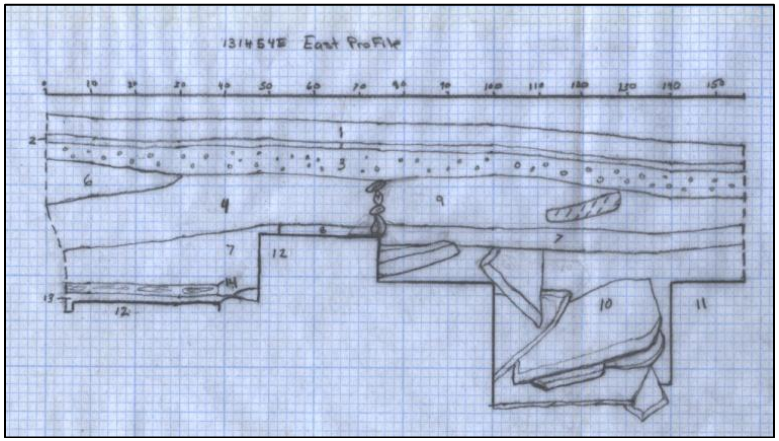

Figure 40: East wall profile of 131H54E (drawing by H. Tulloch; 131H-2011-184-3).

Figure 41: Post excavation plan view of 131H54E, showing the south foundations of the officers' barracks in the centre and an unidentified foundation to the south (photograph by E. Thurston;131H2564E).

131H54F

Unit 131H54F was a 50 x 50 cm unit excavated at the south end of the Advanced Battery near the south sentry box. The purpose of this excavation was to determine the depth of the Macadamized surface below the current asphalt. Five lots were identified in this unit. Lot one was the current asphalt that was laid in the 1950s and lot two was the stone dust substrate for the asphalt. Below the stone dust was a compact layer of gravel and clay measuring 4cm thick on average. This layer was found in a few other units on the Advanced Battery and might be a previous surface dating before the 1950s asphalt but later than the 1840s Macadamized surface. The fourth lot was a thin, mottled clay layer with a few small stones. This could have been clay from re-surfacing the 1840s Macadamized surface or a landscaping activity prior to the 1950s paving. Lot five was the 1840s Macadamized surface, it consisted of angular limestone rocks averaging 5 x 4 x 4 cm in size within a clay soil matrix and was located approximately 12 cm below the current surface of the Advanced Battery. As in the other units excavated on the Advanced Battery this year, the Macadamized surface slopes down to the south, closely mirroring the slope of the current asphalt. The Macadamized surface was the limit of excavation in this unit.

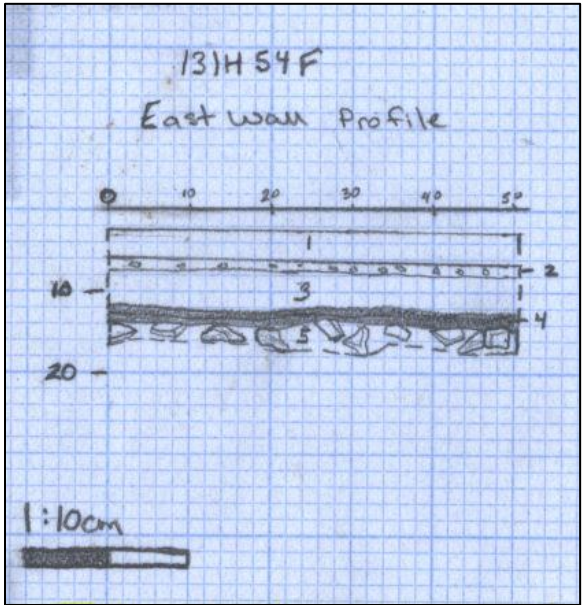

Figure 42: East wall profile of 131H54F (drawing by H. Tulloch; 131H-2011-184-4).

Figure 43: Post excavation plan view of 131H54F, showing the Macadamized surface (photograph by H. Tulloch; 131H2566E).

131H54G

Unit 131H54G was located in the southwest quadrant of the Advanced Battery. It measured 1m north to south and 50cm east to west. The purpose of this excavation was to determine the depth of the 1840s Macadamized surface and it was hoped that evidence of the privies from the 1812 fort would be located. Only three lots were identified in this unit. Lot one being the current asphalt and lot two was the stone dust substrate for the asphalt. Lot three was the 1840s Macadamized surface. In this unit it was located only 8cm below the current Advanced Battery surface and consisted of angular limestone rocks averaging 4 x 4 x 4 cm set in clay loam. It was decided that the Macadamized surface would be the limit of excavation in this unit. Although it is suspected that the 1812 privies are in the area of this unit their exact location is unknown; therefore, archaeologists opted not to excavate through a level one resource without having a better idea of where the privies might be. Privies can yield much information about foodways and lifestyles, but time is needed to record the features properly, therefore, it was determined that more information, time and resources would be necessary to attempt such an excavation.

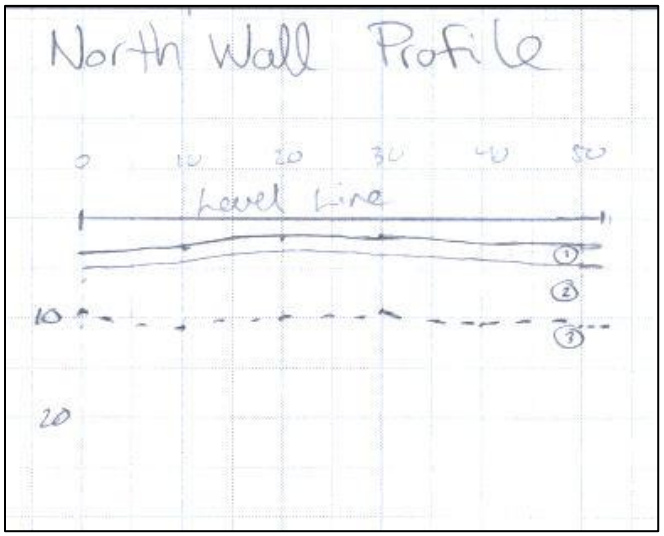

Figure 44: North wall profile of 131H54G (drawing by K. Best; 131H-2011-223-3).

Figure 45: Post excavation plan view of 131H54G3, showing the Macadamized surface (photograph by K. Best;131H2568E).

131H54H

As with 131H54G, unit 131H54H was located in the southwest quadrant of the Advanced Battery. This unit was opened solely for the purpose of determining the depth of the 1840s macadamized surface below the current Advanced Battery surface. This unit was very similar to 131H54G. The same three lots were identified: current asphalt, stone dust substrate for the asphalt and the 1840s macadamized surface consecutively. The macadamized surface was an average of 8 cm below the current Advanced Battery surface and sloped down to the south. The angular limestone rocks comprising the macadam averaged 6 x 6 x 6 cm.

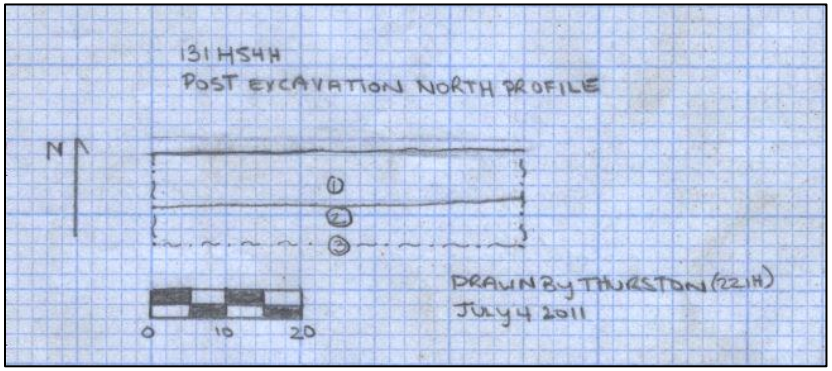

Figure 46: North wall profile of 131H54H (drawing by E. Thurston; 131H-2011-211-1).

Figure 47: Post excavation plan view of 131H54H, showing the Macadamized surface (photograph by H. Tulloch; 131H2487E).

131H54J

Unit 131H54J was similar to 54G and 54H with the addition of one lot. This unit measured 50 cm by 50 cm and was excavated in order to determine the depth of the macadamized surface. Lot 1 was the current asphalt, lot 2 was the stone dust substrate and lot 3 was a layer of sandy loam with gravel that may have been a previous Advanced Battery surface. Lot 4 is the 1840s macadamized surface. The limestone rock spall averages 5 x 5 x 5 cm and is set in clay. The macadamized surface was located approximately 12 cm below the current Advanced Battery surface and was the limit of excavation in this unit.

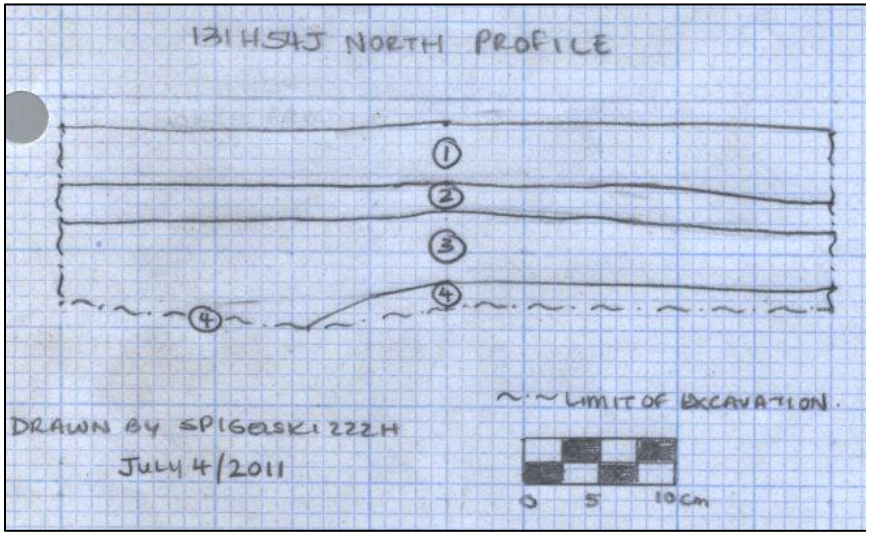

Figure 48: North wall profile of 131H54J (drawing by S. Spigelski; 131H-2011-184-5).

Figure 49: Post excavation plan view of 131H54J, showing the Macadamized surface (photograph by H. Tulloch; 131H2485E).

131H54K

Unit 131H54K was placed in the southwest quadrant of the Advanced Battery to locate the remains of the 1812 demi-lune bastion, a key feature from the 1812 fort. Overlying the 1812 map on a present-day map of the fort it was determined that if anything remained of the stone bastion it should be located in this area. In order to give archaeologists a better chance of locating the bastion a larger unit was opened, measuring 2 m north to south by 1 m east to west. Twelve lots were identified in this unit, but unfortunately, the bastion was not located.

Lot one was the current asphalt, lot 2 was stone dust substrate for the asphalt and lot 3 was a layer of sandy clay with gravel that may have been a previous Advanced Battery surface. Lot 4 was a layer of re-deposited macadam with inclusions of brick. It was later determined that the macadam had been disturbed by the installation of a utility line. On the west side of the unit, lot 5 was a very thin layer of dark silty loam with charcoal and below that was a layer of silty clay with stone dust (lot 6) similar to the layers found in unit 131H54D. These layers may have related to a previous surface of the advanced battery or landscaping. Lot 7 was the 1840s macadamized surface comprised of angular limestone rocks averaging 7 x 5 x 4 cm in size set in clay loam. The macadamized surface in this unit was located slightly deeper than in the other units at an average of 16 cm below the current surface of the asphalt. The macadamized surface in this unit was previously disturbed by the installation of an iron electrical line (lot 12). The trench that was excavated for the utility was backfilled (lot 9) with the original spoil of the trench excavation and, therefore, contained a mixture of limestone spall used in the macadam and the surrounding soil. Because the macadam had been previously disturbed in this area and other good examples of the macadamized surface were uncovered in the parade this summer, it was determined that it was reasonable to excavate through the macadam to locate the remains of the 1812 fort. The macadamized surface was properly recorded before being excavated. Below the macadam, lot 8 was a thin interface of clay above a thick layer of mottled clay landscaping (lot 10). The clay above bedrock was similar in colour to the natural clay that has been uncovered in other areas of the site, but due to its mottled nature and the inclusion of a few rocks, the clay does not appear to be natural in this case. It could be remains of clay used in the earthworks of the first fort or it could be part of a landscaping activity during the construction of the second fort. Below the clay, natural bedrock (lot 11) was uncovered. In this case, the bedrock was a granite vein as opposed to the more common limestone of the area. The bedrock was located at 42 cm below the current asphalt surface on the west side of the unit, sloped down 20 cm to the east and was located 62 cm below the current surface on the east side of the unit.

Remains of the 1812 demi-lune bastion were not located in this unit. One possibility is that due to the high elevation of bedrock in this area the remains of the first fort were completely removed down to bedrock prior to the construction of the second fort. The other possibility is that due to inaccuracies in the map overlays this excavation could have been slightly off to encounter the remains of the first fort. The discovery of the officers' barracks foundation walls will allow for new map overlays, which could provide a more accurate determination of the location of the first fort bastion. Further excavations are necessary to determine if any fortified works exist beneath the asphalt of the Advanced Battery parade.

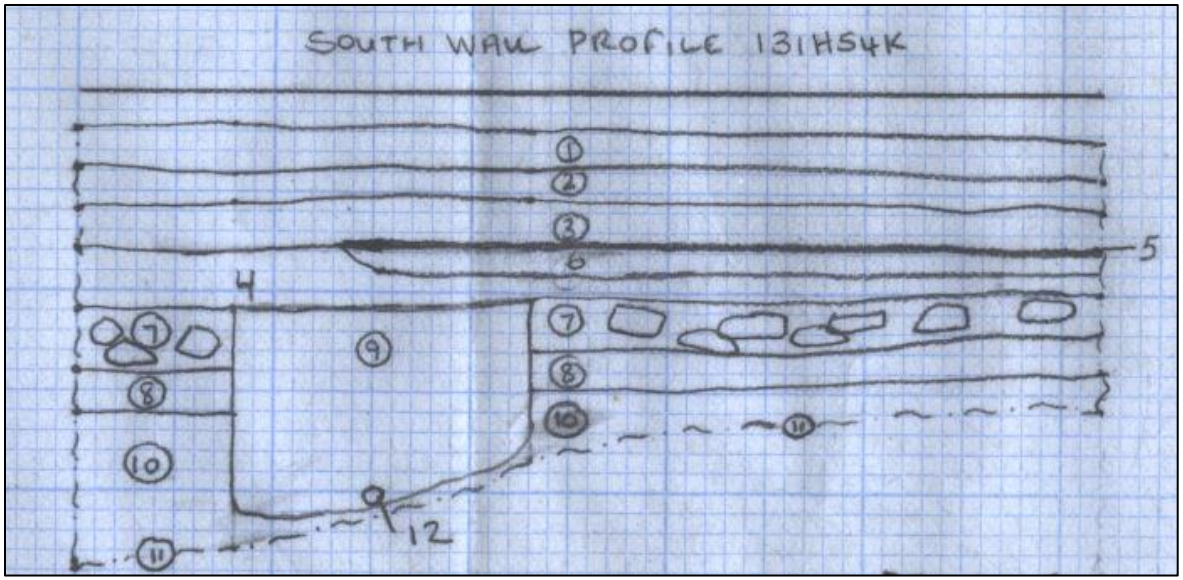

Figure 50: South wall profile of 131H54K (drawing by H. Tulloch and S. Spigelski;131H-2011-184-7).

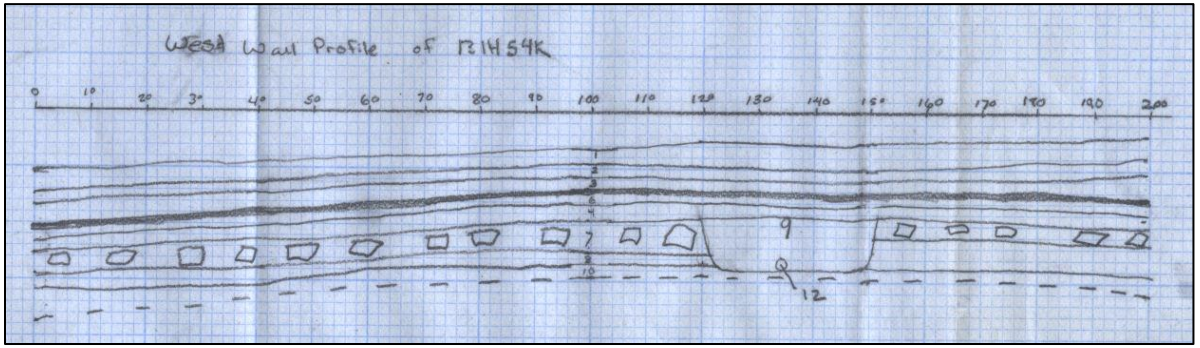

Figure 51: West wall profile of 131H54K (drawing by H. Tulloch; 131H-2011-184-7).

Figure 52: West wall profile of 131H54K, showing a natural granite vein and an iron electrical cable (photograph by S. Spigelski; 131H2499E).