APPENDIX 2

GEOTECHNICAL REPORT

JECTH Consultants Inc.
Geotechnical & Environmental Engineers

GEOTECHNICAL ENGINEERING REVIEW AND ASSESSMENT OPERATION BUILDING KITCHEN UPGRADE

AT

FORT LANGLEY NATIONAL HISTORIC SITE OF CANADA LANGLEY, BC

FOR

PUBLIC WORKS AND GOVERNMENT SERVICES OF CANADA

PREPARED BY

JECTH CONSULTANTS INC.

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JOB NO.: 217P553

DATE: AUGUST 10, 2017

JECTH Consultants Inc.
Geotechnical & Environmental Engineers

Client: PWGSC
Date: August 10, 2017
Our File No.: 217P553

Public Works & Government Services Of Canada
219-800 Burrard Street
Vancouver, BC, V6Z 2V8
Tel.No.: (604) 775-6659
Email: Tom.Dunphy@pwgsc-tpsgc.gc.ca

Attn: Mr. Tom Dunphy

Re: Fort Langley National Historic Site of Canada
Operation Building Kitchen Upgrade
Geotechnical Engineering Report
Fort Langley, BC

1.0 INTRODUCTION

1.1 AUTHORIZATION

As authorized by CWMM Consulting Engineers Ltd. on behalf of Public Works and Government Service Canada on July 7, 2017 with regards to a Kitchen Upgrade for an operation building in Fort Langley Historical Park, JECTH Consultants Inc. (JCI) has carried out a Geotechnical Engineering Review and provides recommendation for foundation design and construction for the proposed renovation project.

1.2 METHODOLOGY

The Geotechnical Engineering Assessment and Review includes:

- Reviewed of available site plan for the operation Building.
- Reviewed Architectural Plan for the Kitchen Upgrade.
- Obtained Surficial Geological Map from The Geological Survey of Canada.
- Conducted site Reconnaissance on July 9, 2017.
- Interviewed with Park Staff for drainage performance of existing operation building.
- Reviewed as-built record of adjacent structure that may affected by proposed Renovation.
- Utilized our previous experience to access subsurface ground conditions from nearby projects.

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- Communicated with Architect and Designers, if required.

1.3 OBJECTIVE

This Geotechnical Engineering Report summarizes our findings and provides Geotechnical Engineering Comments and Recommendations for the foundation design of the Kitchen upgrade renovation at an operation building in Fort Langley Historical Park as required by BC Building Code (2012) - Schedule "B" (Geotechnical).

1.4 DRAWINGS

This report is prepared based on the information provided by CWMM Consulting Engineers Ltd. for the Kitchen Upgrade /Renovation dated May 31, 2017. The drawing is for Architectural, Electrical and Mechanical upgrade for the project.

2.0 SITE CONDITION

A site reconnaissance has been carried out by Technical Staff of JCI at the subject site on July 9, 2017 for the study and evaluation of site condition.

The Site is located within the Fort Langley Historical Park to the east side of Fort Langley Township, Fort Langley as shown in Figure 1 - Site Location Plan. The site is an operation building near to the 'Big House' as shown in Figure 2 - Site Plan.

The existing operation building is a 2-storey high wood frame building with a full reinforced concrete basement. It is used as a seasonal Cafe at main floor and office in upper floor. The kitchen under proposed renovation is situated on the main floor at the south portion within building.

A canopy covered timber deck is situated at the south outside the building. The canopy is supported by existing external building wall and 3 nos. of columns at about 4 m. ± from the wall as shown in Photo No.1. The columns are found on shallow footing as shown in Photo No.2. It is understood that the Kitchen upgrade will involve area within the covered timber deck at south side of the building as shown in Figure 4 - Proposed Building Addition (Main Floor). The covered timber deck is an at-grade deck found on existing grade.

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The site topography around the building is slightly sloping up from north to south along the building. It can be assessed by a gravel path to the main entrance at the east of the building. A suspended timber deck and a Log Palisade wall is observed in adjacent east of building as shown in Photo No.3. The deck is a suspended deck supported by concrete sonnet tube as shown in Photo No.4. Access to the basement can through doors along the deck.

The basement at the south side of the existing building is occupied by washrooms and a Mechanical Room as shown in Figure 5 - Existing Basement Plan. A sump is noticed in the Mechanical Room as shown in Photo No. 5. JCI was informed by Park staff that flooding in the basement occur when the pump went malfunction. JCI was also informed that the sump will be removed and replace by a future drainage system operating by gravity fall to a new drainage system at the area.

Further from the building to the east and beyond the Palisade is a footpath. A slope is located to the east of the footpath. During time of our site reconnaissance on July 9, 2017, a drainage manhole construction is noticed along the footpath at area north to the building outside the Palisade wall as shown in Photo No.6.

3.0 PROPOSED KITCHEN UPGRADE

The proposed Kitchen upgrade in geotechnical aspect involves the followings:

- Removal of the rear Kitchen wall (part of external building wall at south side of building) to expand the Kitchen area outside the building. The to-be removed wall is a load bearing wall as such loading will transfer to new building addition which will be found on new foundation.
- Construction of a new building addition attached to the south side of building which involve construction of new external building walls with new foundations
- The dimension for the building addition is about 1.7 m. ± (north-south) by 5.1 m. ± (east-west), and at about 1/2 length of the existing south side external building wall.
- The Kitchen renovation involve increase of main floor footprint only. The basement and upper floor footprint remain the same in the renovation.
- The existing canopy and columns supporting the canopy will remain. Bulkhead will be introduced below the roof of canopy for mechanical air

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ducting, and grease separator will be constructed below ground within the covered deck area.

The above proposed renovation can be summarized by the following Figures:

- Figure 4 - Proposed Building Addition (Main Floor)
- Figure 5 - Basement Plan.
- Figure 6 - Proposed Building Addition (Section)

4.0 ANTICIPATED SUBSURFACE SOIL CONDITIONS

4.1 GEOLOGICAL MAP

According to the available Surficial Geological Survey map prepared by Geological Survey Canada, the subject site is located at the intersection between Pleistocene formation and Fraser River Sediments. It is likely underlain with Sand and Gravel of the Pleistocene Formation or overbank river deposit composed of SILT and Sandy loam of the Sediments Fraser River formation.

4.2 SITE OBSERVATION

Our site reconnaissance observe an excavation for a manhole construction nearby the site. The excavation is about 2.5 m ± depth with a Yellowish brown, dense, SAND and Gravel with pebbles occur immediate depth below existing grade. No groundwater was observed during the time of site visit.

5.0 FOUNDATION RECOMMENDATION

5.1 GENERAL

It is anticipated that FILL (composed of SAND and Gravel of previous excavated material) will likely encounter at area close to existing basement wall. The FILL is likely perimeter backfill along basement wall in previous building construction.

Since the new external building wall is less than 2 m. off-set from the basement wall, it is recommended the foundation of the new external wall to step down to match the same level of existing building foundation. This

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is to avoid new footing found on FILL which was likely not be compacted adequately during perimeter backfilling process.

5.2 FOUNDATION OPTIONS

The new footing wall can be either (A) a regular structural wall with both side backfilled (i.e. a buried wall) or (B) sonnet tubes found on pad footings with grade beam along top of sonnet tubes to support superstructures. The choice of a buried structural wall or sonnet tube with grade beam will be under the preference of the Structural Engineer.

5.3 BEARING CAPACITY

JECTH recommends an Allowable Bearing Capacity of 2,000 psf. for SLS Design and 3,000 psf. for ULS Design for footing found on the dense native SAND and Gravel. Frost protection is not a concern if footing step down to native soil at basement grade.

5.4 POST CONSTRUCTION SETTLEMENT

Total and differential building settlement for the new addition should be minimal due to the depth of buried footing. Skin friction will be developed between structure and soil whether it is a sonnet tube or buried basement wall. As such settlement of new footing will be minimal. Buried Structural wall or sonnet tube grade beam can be tied into existing basement for even better control of differential settlement between new external wall and existing building.

6.0 FOUNDATION EXCAVATION

6.1 POTENTIAL IMPACT

It is understood that the Canopy at the south side of the building will be remained. Similarly the 3 nos. of columns (which are 4 m. ± from building) supporting the Canopy will not be removed.

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6.2 TEMPORARY EXCAVATION

Open excavation into the native SAND and Gravel should not exceeding a 1H:1.25V temporary cut slope. In the case that the off-set distance of the existing canopy columns is not enough to allow open excavation for a 3 m.± depth excavation for the new footing construction, timber shoring can be used by utilize the existing basement wall as a support.

6.3 TEMPORARY TRENCHING

A 2 m. ± wide, 3 m. ± deep trench excavation can be done by typical timber trench shoring for new foundation construction. The shoring will avoid disturbance of existing canopy footings which are likely found on shallow pad footings.

6.4 OTHER CONSULTANT INVOLVEMENT

It is understood that the presence of an Archaeologist will be required during the excavation due to Historical importance of the site. Excavation with timber shoring must proceed from a gradual, top to bottom incremental process and must allow time for the Archaeologist to carry out his/her duties.

6.5 SUBGRADE PREPARATION

The foundation subgrade can be prepared by installed with 50 mm thick 19 mm. clear crushed gravel for grade levelling due to presence of irregular sizes of cobbles in native soil, as well as protecting the foundation subgrade.

6.6 OTHER STRUCTURE STABILITY

The suspended deck and Palisade to the adjacent east of building are unlikely affected by the excavation since the new addition is involve only half length of south side of building, and is considered relative far away from the deck and Palisade.

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7.0 FOUNDATION DRAINAGE

7.1 PREVIOUS FLOODING

The SAND and Gravel subgrade is considered permeable. Report from Park Staff that the basement flooding during time of sump pump malfunction may due to other drainage problem beside groundwater.

7.2 ROOF DRAINAGE REVIEW

It is not sure whether the roof drainage is connecting to the sump inside the building directly. Rainwater collected from the roof can make the basement flood. JCI is also informed by the Park Staff that a new drainage system will be installed at the basement level and eventually the sump will be removed.

7.3 FOOTING DRAINAGE

For precaution purpose, it is recommended that foundation drainage composed of 4 in. perforated pipe can be installed new foundation subgrade to protect existing basement form moisture migration. The foundation drainage can hook up to the new drainage system by gravity fall. Foundation drainage should be protected by embedded in minimum 100 mm. thick 19 mm. clear crushed gravel covering all around the pipe. **Roof drainage must not connect to foundation drainage directly and must be drained by a separate solid PVC pipe to the anticipated new drainage system.**

8.0 SEISMIC DESIGN

8.1 SITE CLASS

The proposed renovation is located within Seismic Zone 4 of the National and B.C. Building Codes of Canada. It is recommended that the building addition should be designed using **Site Class D for Stiff soil** as recommended by BCBC 2012 (Table 4.1.8.4.A), considering the anticipating presence of dense SAND and Gravel at shallow depth.

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8.2 SPECTRAL ACCELERATION

The design earthquake motions considered in BCBC has a 2% probability of exceedance in 50 years, or a return period of 2475 year. The 2012 BCBC recommends the use of Peak Ground Acceleration (PGA), Site Classification and the 5% damped spectral response acceleration (PGA), Site Classification and the 5% damped spectral response acceleration value Sa (T) for interpretation of acceleration and velocity based site coefficients (Fa and Fv) in Structural Design.

The following tables are obtained from Seismic Hazard Values for a **"Class C"** site by Natural Resource Canada 2010 Earthquake Hazard Map for the subject area. (Latitude 49.1674° North, Longitude 122.5722° West) – Details see Appendix "A" – Seismic Design Criteria.

Sa (0.2)	**Sa (0.5)**	**Sa (1.0)**	**Sa (2.0)**	**PGA**
0.994 g	0.665 g	0.319 g	0.168 g	0.492 g

The above value may be used as a general reference for interpretation by using the Building Code Table 4.1.8.4 of BCBC 2012 to obtain Fa and Fv value for **"Class D"** site for design purpose. Search result print out for the seismic hazard values is shown in Appendix 'A' – Seismic Design Criteria.

A linear interpretation of Table 4.1.8.4 for Fa value and Table 4.1.8.4c under the related PGA are presented as follows:

	Sa (0.2)	Sa (0.2)	Sa (0.2)
	0.75 g.	1.0 g.	0.994 g.
Fa	1.1	1.1	**1.1**

	Sa (1.0)	Sa (1.0)	Sa (1.0)
	0.3 g	0.4 g	0.319 g.
Fv	1.2	1.1	**1.18**

Based on the linear interpretation, of the obtained Fa and Fv respectively are **1.1** and **1.18** for **Class D** site.

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8.3 LIQUEFACTION

Soil liquefaction potential of the site is considered to be low and unlikely to occur due to the shallow presence of dense SAND and Gravel soil.

8.4 SEISMIC BEARING CAPACITY

The Allowable Bearing Capacity can be increase $^1/_3$ for seismic design under a short term seismic event.

9.0 SLAB-ON-GRADE

For the Slab-on-Grade of proposed Kitchen addition floor slab, underslab FILL is required. Prior to placement of underslab FILL, all soft soil or construction debris should be removed from the base of the excavation. Underslab FILL must consist of a minimum of 6 in. (150 mm.) thick of Sand and Gravel which must be compacted to a minimum of 100 % of Standard Proctor Maximum Dry Density. Laboratory and field test must be conducted by Certificated Testing Company.

Polyethylene sheet (Poly sheet) can be provided to minimize moisture migration. In the event of excessive groundwater seepage, crushed gravel is recommended to be used as Underslab FILL for implementation of underslab drainage.

Since the renovated area is considered small and compacting equipment may be restricted under tight space, appropriate compaction effort may be difficult to achieve. It is recommended that the addition kitchen floor to designed as a suspended slab to avoid possible slab settlement due to difficulty of underslab FILL compaction within a tight space.

10.0 STRUCTURAL FILL AND PERIMETER BACKFILL

Structural FILL for foundation system, if require to restore foundation grade due to over excavation (for removal of unsuitable soil) must consist of pit run Sand and Gravel with less than 5% silt (or material approved by Geotechnical Engineer in record) placed and compacted to a minimum of 100% of Standard Proctor Maximum Dry Density.

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Structural FILL must be placed in maximum 12 in. (300 mm.) Loose lifts if compacted by roller or 6 in. ± loose lift if compact by template compactor. Prior to placement of the structural FILL, all topsoil, organic, random FILL, and other unsuitable material etc. should be removed.

A density-testing program must be carried out by certified laboratory and JCI will review the result to ensure that compaction requirements are satisfied.

For perimeter backfill along footing wall, it is recommended that granular soil such as crushed Gravel should be used in order to ensure that the perimeter moisture be removed and collected by the Foundation Drainage system. Native SAND and Gravel excavated on site may be used as Structural fill and Perimeter backfill material under the jurisdiction of Geotechnical Engineer in Record.

11.0 BURIED UTILITIES

For temporary excavations for newly installed utilities, such as storm and sanitary sewer, telephone line, gas line and electrical cable etc., will likely encounter possible FILL near existing basement walls or native SAND and Gravel soil depending location distant from the building. Excavation side slopes must be sloped back no steeper than 1H:1V, or suitable trench shields should be provided for protection of the workmen in the trench.

Under no circumstance that any underground utility trench be located within the 1H:1V stress influence line of any foundation system. If it is occurred, the undermined utility trench will de-stabilize the foundation system and will cause potential collapse and /or unacceptable post-construction settlement.

Backfill for utility trenches must consist of clean, well-graded sand and gravel compacted to at least 100 % of its Standard Proctor Maximum Dry Density. The excavated SOIL encountered below existing grade will not be suitable for trench backfill.

12.0 GEOTECHNICAL ENGINEERING FIELD REVIEW

JCI will provide Field Review (Geotechnical Engineering) according to the 2012 BC Building Code and Letter of Assurance (Schedule "B"). A Standard Geotechnical Field Inspection Requirement is attached in Appendix "B" as a guideline for Field Review.

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The following general field reviews (Require 48 hour notification) are required prior to and during construction stage (see also Appendix "B" – Standard Geotechnical Inspection Requirements). **The general contractor or owner representatives must inform JECTH Consultants Inc for site inspection as required by BC Building Code and Local Municipality.**

- Temporary Excavation and stability for foundation construction
- Work Safe Inspection for excavation as required by the municipal authorities
- Shoring stability (if required)
- Foundation Bearing Capacity (confirmation and Certification)
- Temporary and Permanent Construction Drainage (Foundation Drainage, Sump and temporary Sedimentation control)
- Compaction of Structural FILL (If restoring grade is required)
- Compaction of Underslab FILL
- Perimeter backfill (Material requirements, compaction and Drainage)
- Others site specified as specified in BC Building Code
- Unforeseen subsurface soil and groundwater conditions as encountered prior to, during and after construction stage.
- Other Geotechnical Related Issues.

In the event that the required inspections are not performed, JCI will not be able to prepare the Letter of Compliance (Schedule "C") for Occupancy Permit Application.

Other Geotechnical Engineering technical requirements and in-situ testing will be performed by certified laboratory/testing company and will be reviewed by JCI during construction stage.

Specific Site Geotechnical Engineering and / or other geotechnical related issues must be addressed by JCI prior to and during construction stage.

13.0 FINAL FOUNDATION DESIGN REVIEW

JCI should be given an opportunity to review the followings:

1. The detail and final Architectural, Structural Engineering Drawing must be reviewed by JCI prior to Construction such that the above comments and recommendations can be confirmed and modified.

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2. Any other Electrical and Mechanical as well as Civil Engineering and Landscape Architect Drawings, which will likely affect the foundation design and construction, must be reviewed and approved by JCI

3. A consultant coordination meeting must be arranged prior to Building Permit Application or prior to construction start such that all design team members can confirm all Geotechnical design parameters for this project.

4. JCI will review the exposed subsurface soil and groundwater conditions prior to and during construction stage. It is possible that the Geotechnical recommendations provided in this report be modified due to unforeseen circumstances and change in subsurface soil as well as groundwater condition.

This will allow JCI to confirm the comments and recommendations in this report.

14.0 FIELD INSPECTIONS AND PRE-CONSTRUCTION MEETING

A pre-construction meeting must be organized between the site superintendent/contractor representatives and JCI at a minimum of two weeks before **any site construction activities**. A list of inspection requirement is shown in Appendix "B" – Standard Field Inspection Requirements.

JCI must be notified (24 hours) of all fieldwork **prior to any site work** in particular before site clearing, stripping and preparation. This will allow JCI to provide final comments for the project with respect to Geotechnical Engineering.

15.0 CLOSURE

We trust this report meets your immediate requirements. If you have any questions regarding this report, please do not hesitate to contact the undersigned @ 604-299-6617.

JECTH Consultants Inc.

Ivan CHU, P.Eng.

Encl attachment:

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List Of Photographs

Photo No.1 - External Wall and Canopy at Proposed Building Renovation
Photo No.2 - Shallow Foundation for Column supporting existing Canopy
Photo No.3 - Log Palisade and Timber Deck in adjacent east to building.
Photo No.4 - Sonnet Tube supporting the Timber Deck
Photo No.5 - A sump is located inside Mechanical Room at South eastern corner of building
Photo No.6 - Nearby Drainage Construction identify dense SAND and Gravel in Excavation

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Figure 6 - Proposed Building Addition (Section)
Figure 7 - Deck in Adjacent East to Building

List Of Appendixes

Appendix "A" - Seismic Design Criteria
Appendix "B" - Standard Geotechnical Inspection Requirements

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Client: PWGSC
Date: August 10, 2017
File No.: 217P553

FIGURES

OPERATION BUILDING KITCHEN UPGRADE
FORT LANGLEY NATIONAL HISTORIC SITE OF CANADA
LANGLEY, BC

LIST OF FIGURES

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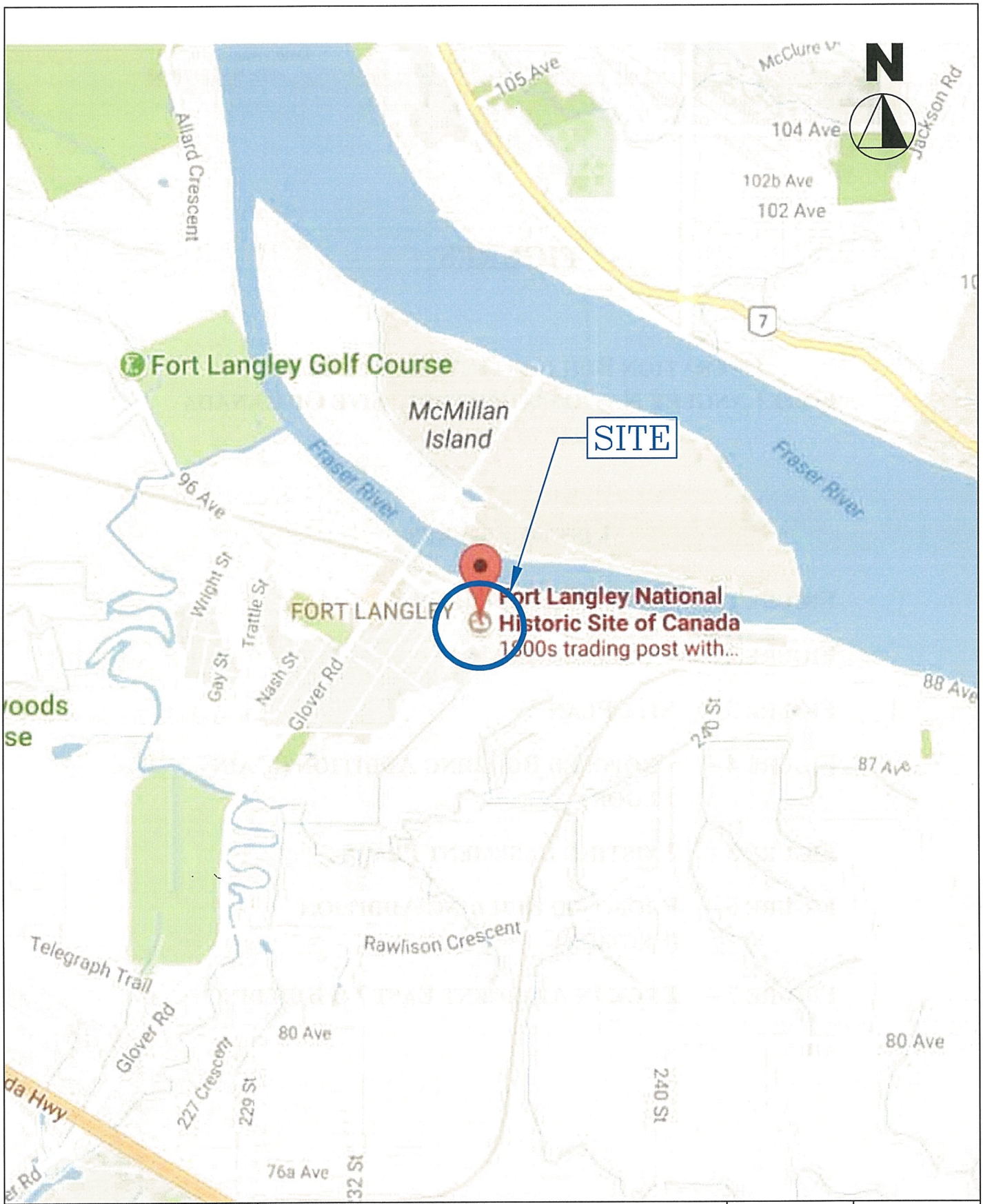
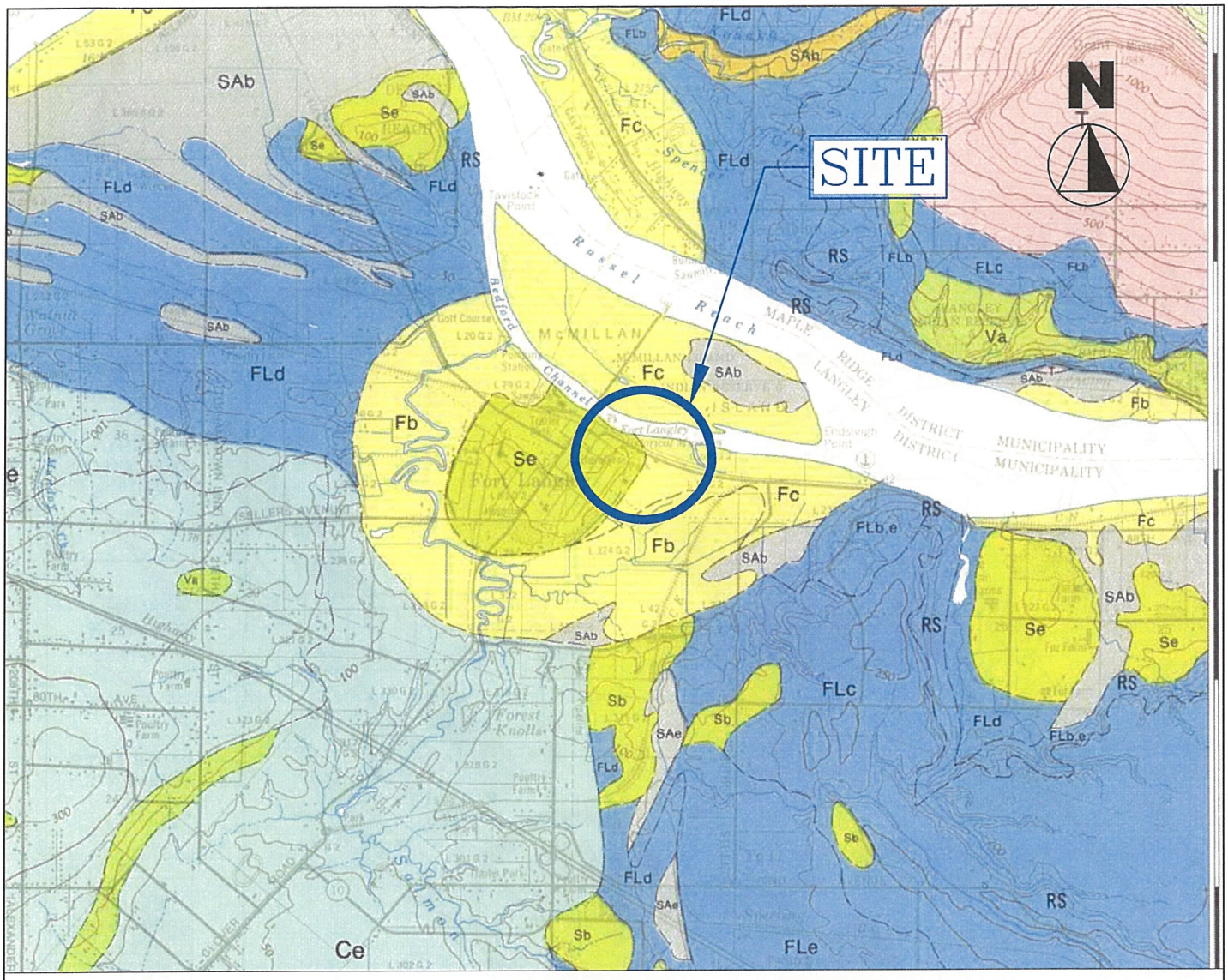


JECTH Consultant Inc. Suite 122, 3823 Henning Drive Burnaby, B.C. V5C 6P7 Phone: (604) 299-6617 Fax: (604) 299-6641	**Site Location Plan** **Operation Building Kitchen Upgrade** **Fort Langley National Historical Site of Canada** **Client: Public Works & Government Services of Canada**	Drawn By: AC	Scale: NTS
		Check by: IC	Date August 2017
		Dwg no: 217P553 - Figure 1	



SUMAS DRIFT

Sa-e

Outwash, ice-contact, and deltaic deposits: Sa, outwash sand and gravel up to 30 m thick; Sb, ice-contact gravel and sand containing till lenses and clasts of glaciomarine stony clayey silt, 2 to 5 m thick overlying FLc, d; Sc, ice-contact gravel and sand containing till lenses and clasts of glaciomarine stony clayey silt, 2 to 5 m thick overlying FLb, e; Sd, ice-contact gravel and sand containing till lenses and clasts of glaciomarine stony clayey silt, more than 5 m thick; Se, raised proglacial deltaic gravel and sand up to 40 m thick

FRASER RIVER SEDIMENTS

Fa-d

Deltaic and distributary channel fill sediments overlying and cutting estuarine sediments and overlain in part of the area by overbank sediments: Fa, channel deposits, fine to medium sand and minor silt occurring along present day river channels; Fb, overbank sandy to silt loam up to 2 m thick overlying 15 m or more of Fd; Fc, overbank silty to silt clay loam normally up to 2 m thick overlying 15 m or more of Fd; Fd, deltaic and distributary channel fill (includes tidal flat deposits) sandy to silt loam, 10 to 40 m thick interbedded fine to medium sand and minor silt beds; may also contain organic and fossiliferous material

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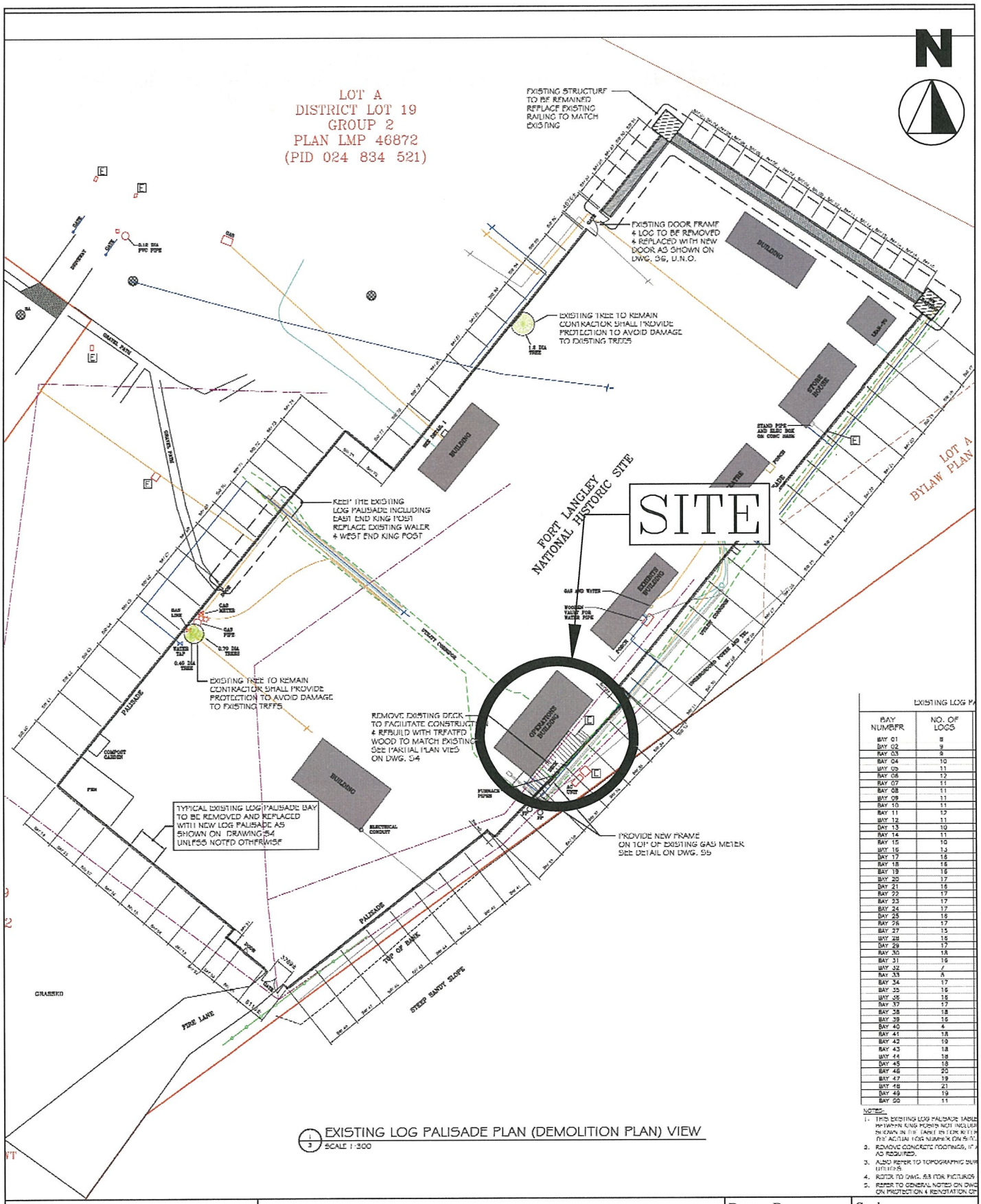
Geological Map

Operation Building Kitchen Upgrade
Fort Langley National Historical Site of Canada
Client: Public Works & Government Services of Canada

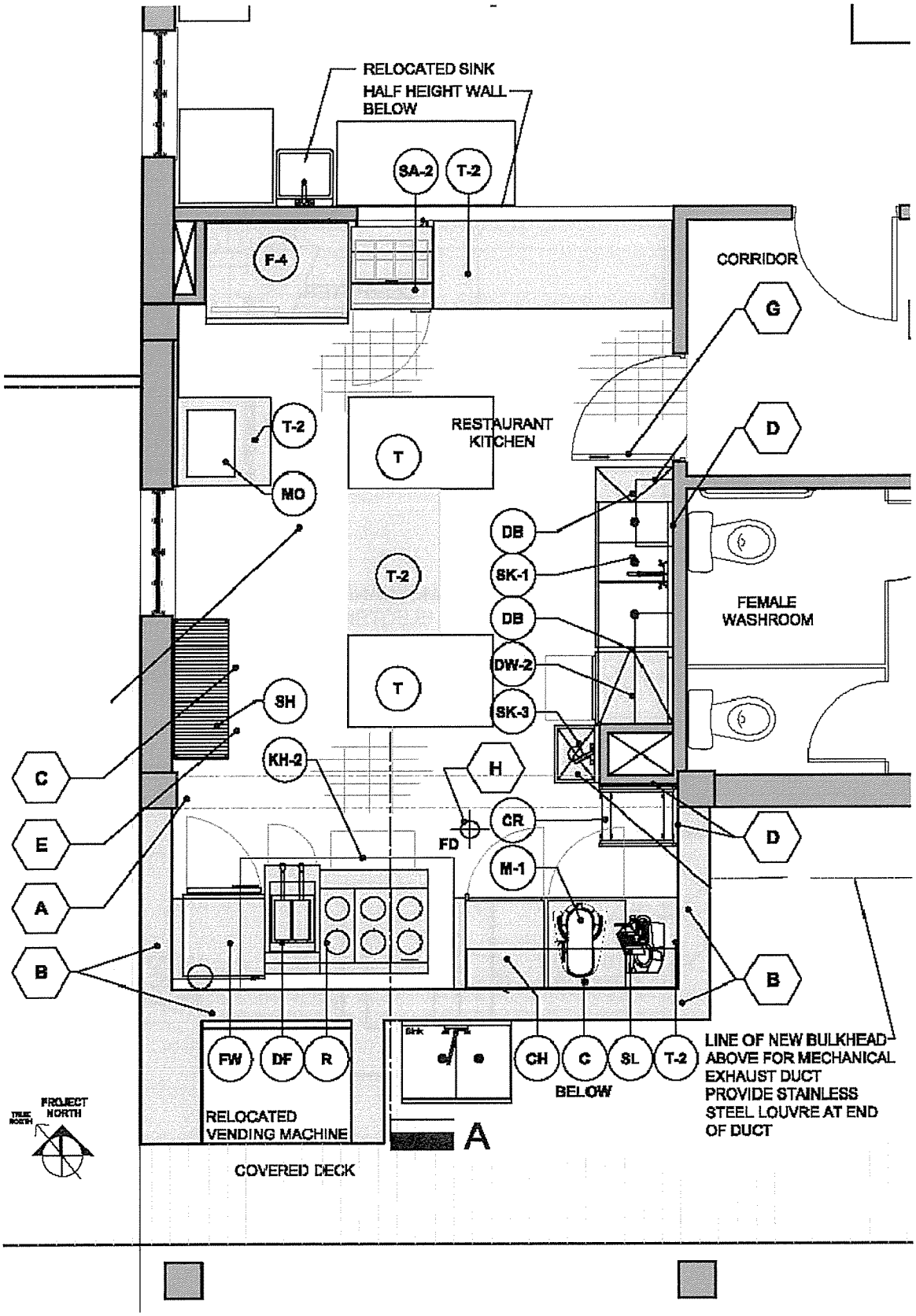
Drawn By:	Scale:
AC	NTS
Check by:	Date
IC	August 2017

Dwg no: 217P553 - Figure 2



3 EXISTING LOG PALISADE PLAN (DEMOLITION PLAN) VIEW
SCALE 1:300

JECTH Consultant Inc. Suite 122, 3823 Henning Drive Burnaby, B.C. V5C 6P7 Phone: (604) 299-6617 Fax: (604) 299-6641	**Site Plan** **Operation Building Kitchen Upgrade** **Fort Langley National Historical Site of Canada** **Client: Public Works & Government Services of Canada**	Drawn By: AC	Scale: NTS
		Check by: IC	Date August 2017
		Dwg no: 217P553 - Figure 3	



Operation Building Ground Floor- Proposed Kitchen Layout

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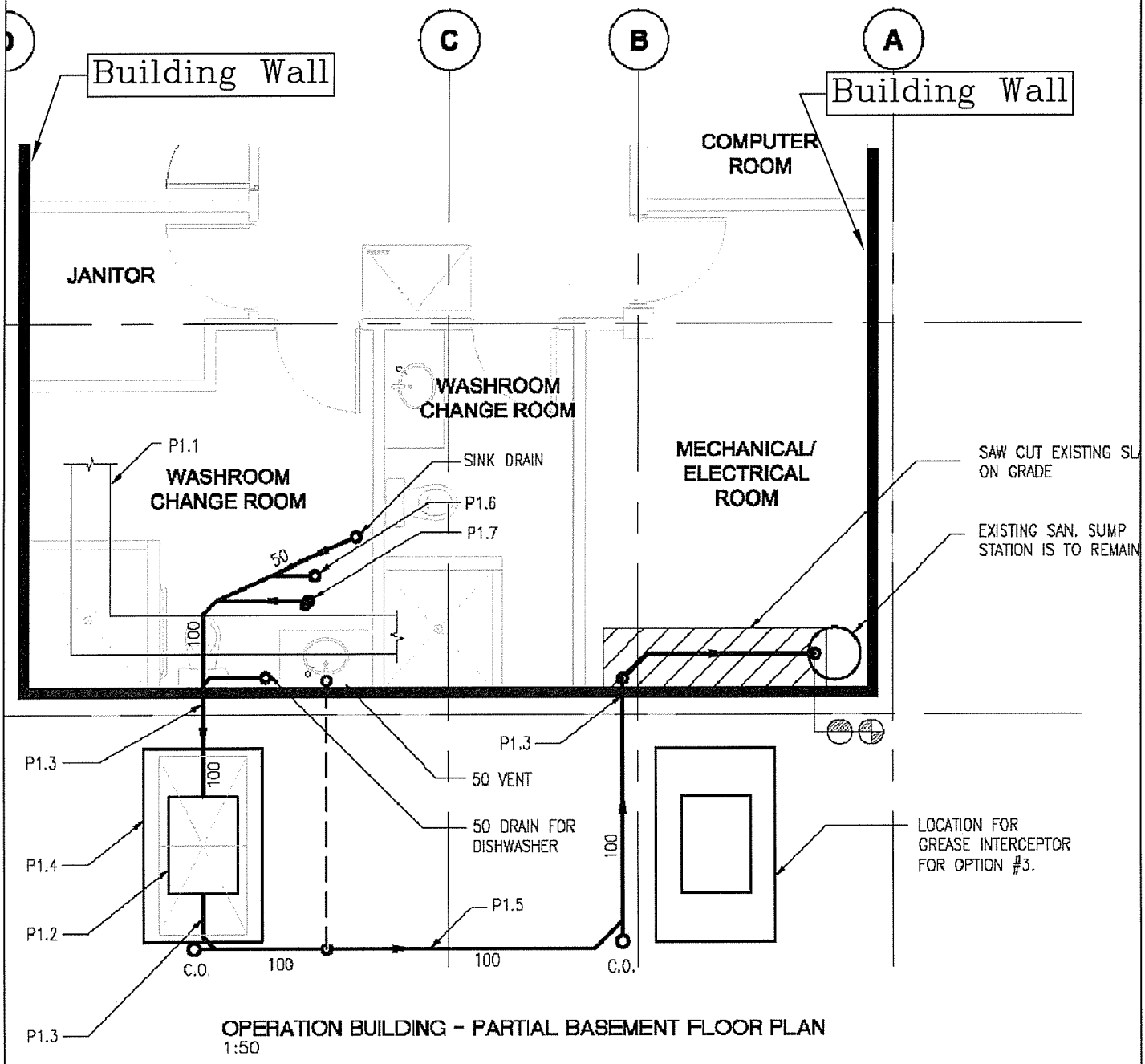
Proposed Building Addition (Main Floor)

Operation Building Kitchen Upgrade
Fort Langley National Historical Site of Canada
Client: Public Works & Government Services of Canada

Drawn By:	Scale:
AC	NTS
Check by:	Date
IC	August 2017

Dwg no: 217P553 - Figure 4



OPERATION BUILDING - PARTIAL BASEMENT FLOOR PLAN
1:50

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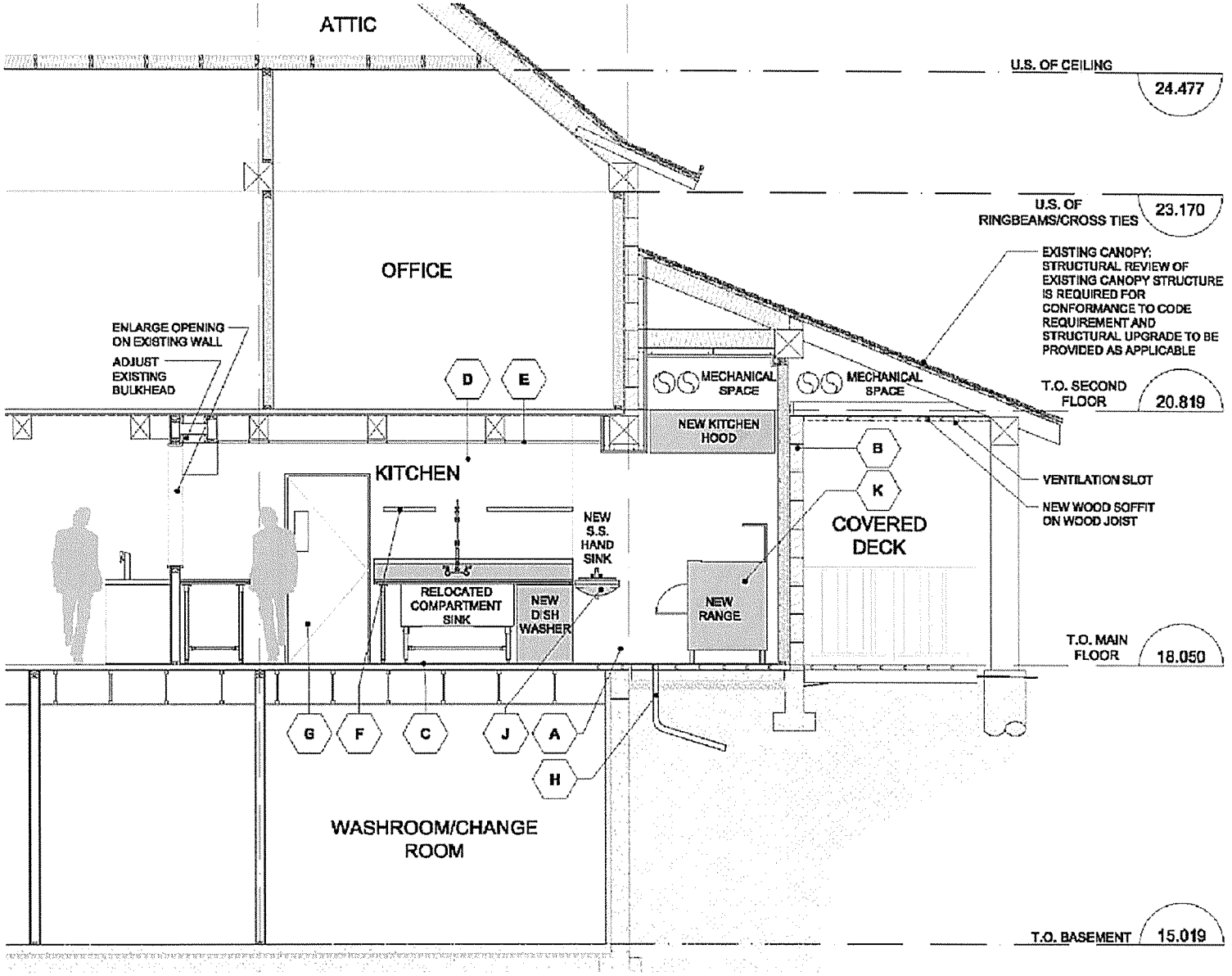
		Check by: IC	Date August 2017
		Dwg no: 217P553 - Figure 5	



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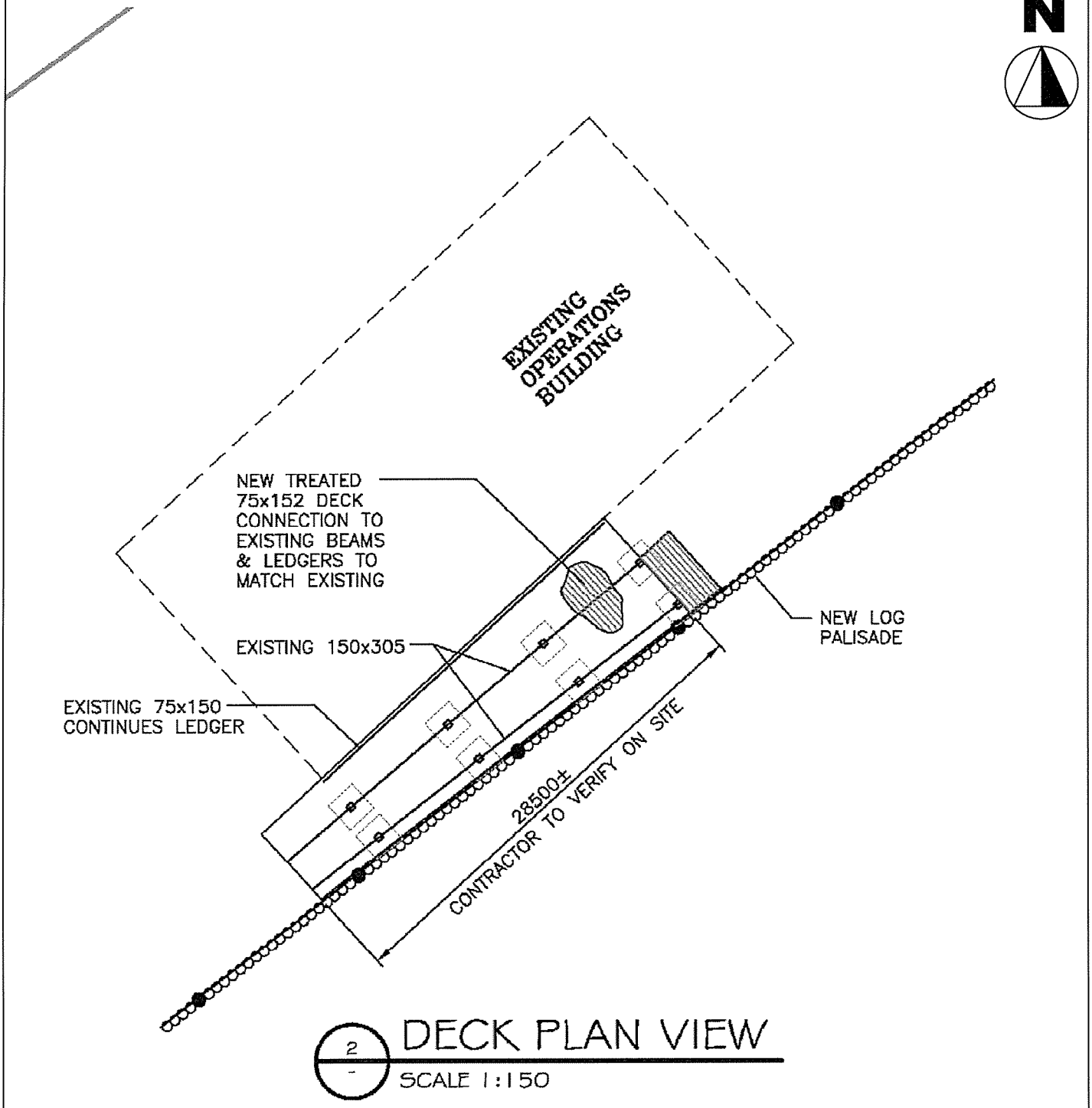
Proposed Building Addition (Section)

Operation Building Kitchen Upgrade
Fort Langley National Historical Site of Canada
Client: Public Works & Government Services of Canada

Drawn by: AC	Scale: NTS
Check by: IC	Date: August 2017
Dwg no: 217P553 - Figure 6	



JECTH Consultant Inc. Suite 122, 3823 Henning Drive Burnaby, B.C. V5C 6P7 Phone: (604) 299-6617 Fax: (604) 299-6641	**Deck in Adjacent East to Building** **Operation Building Kitchen Upgrade** **Fort Langley National Historical Site of Canada** **Client: Public Works & Government Services of Canada**	Drawn By: AC	Scale: NTS
		Check by: IC	Date August 2017
		Dwg no: 217P553 - Figure 7	

JECTH Consultants Inc.
Geotechnical & Environmental Engineers

Client: PWGSC
Date: August 10, 2017
Our File No. 217P553

SITE PHOTOGRAPHS

OPERATION BUILDING KITCHEN UPGRADE
FORT LANGLEY NATIONAL HISTORIC SITE OF CANADA, LANGLEY, BC

LIST OF PHOTOGRAPHS:

PHOTO # 1: EXTERNAL WALL AND CANOPY AT PROPOSED BUILDING RENOVATION

PHOTO # 2: SHALLOW FOUNDATION FOR COLUMN SUPPORTING EXISTING CANOPY

PHOTO # 3: LOG PALISADE AND TIMBER DECK IN ADJACENT EAST TO BUILDING

PHOTO # 4: SONNET TUBE SUPPORTING THE TIMBER DECK

PHOTO # 5: A SUMP IS LOCATED INSIDE MECHANICAL ROOM AT SOUTH EASTERN CORNER OF BUILDING

PHOTO # 6: NEARBY DRAINAGE CONSTRUCTION IDENTIFY DENSE SAND AND GRAVEL IN EXCAVATION

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Photo #1: External Wall and Canopy at Proposed Building Renovation

Photo #2: Shallow Foundation for Column supporting existing Canopy

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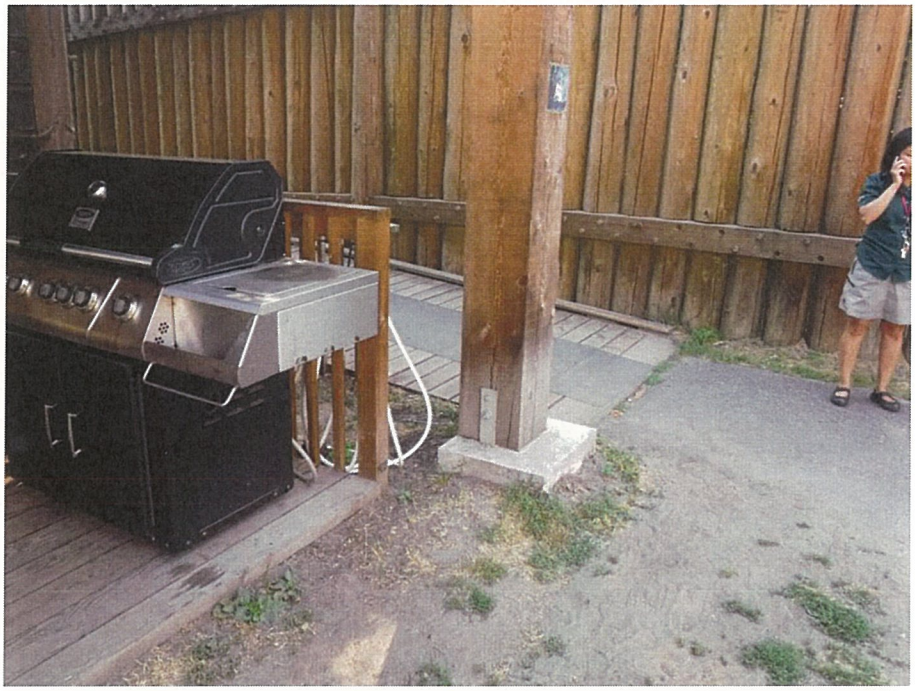

Photo #3: Log Palisade and Timber Deck in adjacent east to Building

Photo #4: Sonnet Tube supporting the timber deck

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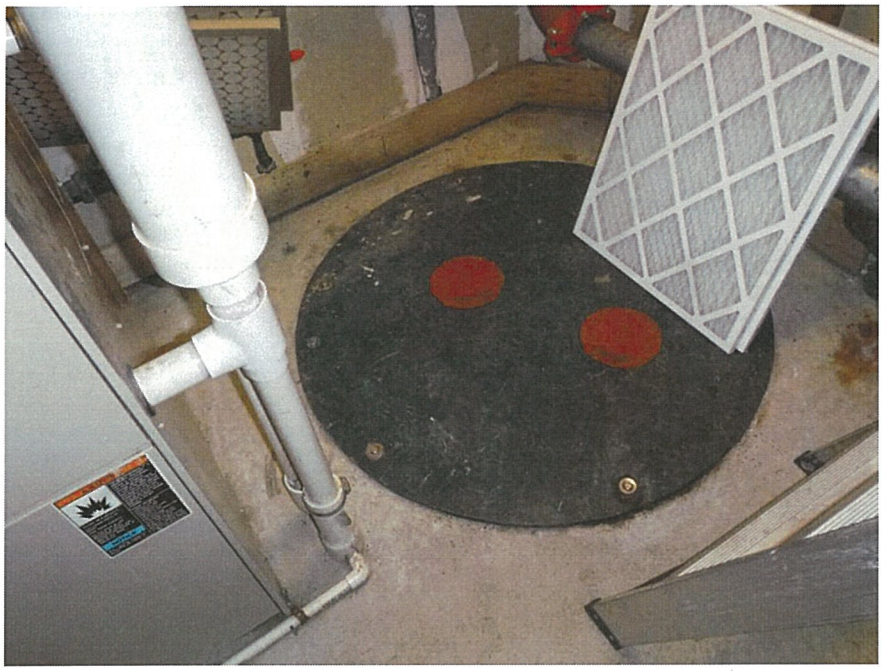

Photo #5: A sump is located inside Mechanical Room at South eastern corner of building

Photo #6: Nearby Drainage Construction identify dense SAND and Gravel in Excavation

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APPENDIX "A"

OPERATION BUILDING KITCHEN UPGRADE
FORT LANGLEY NATIONAL HISTORIC SITE OF CANADA,
LANGLEY, BC

SEISMIC DESIGN CRITERIA

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2010 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Requested by: , JECTH Consultants Inc. August 10, 2017

Site Coordinates: 49.1674 North 122.5722 West

User File Reference: Fort Langley Historical Park

National Building Code ground motions:
2% probability of exceedance in 50 years (0.000404 per annum)

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA (g)
0.994	0.665	0.319	0.168	0.492

Notes. Spectral and peak hazard values are determined for firm ground (NBCC 2010 soil class C - average shear wave velocity 360-750 m/s). Median (50th percentile) values are given in units of g. 5% damped spectral acceleration (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are tabulated. Only 2 significant figures are to be used. ***These values have been interpolated from a 10 km spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the calculated values.*** Warning: You are in a region which considers the hazard from a deterministic Cascadia subduction event for the National Building Code. Values determined for high probabilities (0.01 per annum) in this region do not consider the hazard from this type of earthquake.

Ground motions for other probabilities:

Probability of exceedance per annum	0.010	0.0021	0.001
Probability of exceedance in 50 years	40%	10%	5%
Sa(0.2)	0.235	0.521	0.713
Sa(0.5)	0.150	0.342	0.470
Sa(1.0)	0.077	0.164	0.224
Sa(2.0)	0.039	0.085	0.117
PGA	0.121	0.263	0.354

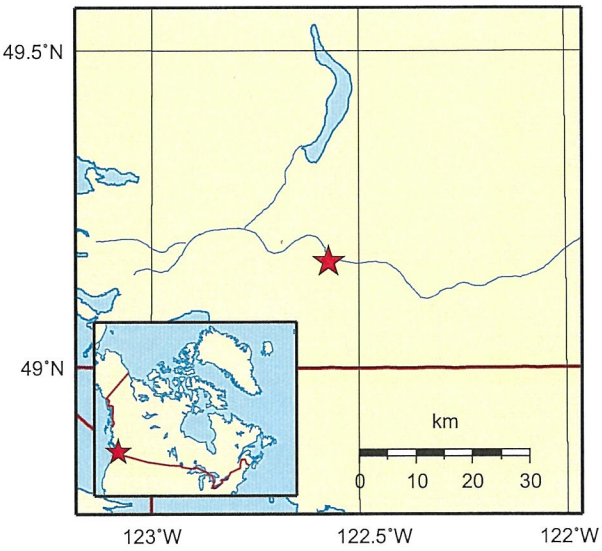
References

National Building Code of Canada 2010 NRCC no. 53301; sections 4.1.8, 9.20.1.2, 9.23.10.2, 9.31.6.2, and 6.2.1.3
Appendix C: Climatic Information for Building Design in Canada - table in Appendix C starting on page C-11 of Division B, volume 2

User's Guide - NBC 2010, Structural Commentaries NRCC no. 53543 (in preparation)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File xxxx
Fourth generation seismic hazard maps of Canada: Maps and grid values to be used with the 2010 National Building Code of Canada (in preparation)

See the websites *www.EarthquakesCanada.ca* and *www.nationalcodes.ca* for more information



Aussi disponible en français

Natural Resources Canada Ressources naturelles Canada

Canada

APPENDIX "B"

OPERATION BUILDING KITCHEN UPGRADE
FORT LANGLEY NATIONAL HISTORIC SITE OF CANADA,
LANGLEY, BC

STANDARD FIELD INSPECTION REQUIREMENTS

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Geotechnical Engineering Field Review and Inspection Requirements
BC Building Code 2012

Based on the BC Building Code 2012, the following Design and field review must be completed by JECTH Consultants Inc. (Geotechnical in Record, **GIR)** such that Letter of Compliance (Schedule "C") required by local municipality for Occupancy Permit can be issued.

7.0 Geotechnical - Temporary

7.1 Excavation

7.1.1 Foundation

Excavation depth more than 4 ft. must be certified by GIR as required by WorkSafe BC ☐

7.1.2 Buildings and Structures

Buildings and Structures within the 1H:1V stress influence line from the bottom of Excavation must be reviewed and approved by GIR ☐

7.1.3 Trench

Excavation for underground utilities for depth more than 4 ft. must be reviewed and approved by GIR ☐

7.1.4 Underground Utilities

All underground utilities (both on-site and off-site) within and along the site perimeter must be identified both on drawing and physical on site prior to any foundation excavation and slope excavation. ☐

7.2 Shoring

7.2.1 Vertical Shoring

Vertical Shoring must be design by GIR to ensure excavation perimeter is stable during foundation excavation before placement of perimeter backfill. ☐

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7.2.2 Temporary Shoring

Temporary Shoring such as sheetpile and shotcrete with tie back anchors or other vertical features must be inspected by GIR ☐

7.2.3 Shoring Method

Shoring method such as sheetpile and shotcrete with tie-back anchors wall must be carried out under the supervision of GIR ☐

7.2.4 Underground Utilities

All underground utilities (both on-site and off-site) within and along the site perimeter must be identified both on drawing and physical on site prior to any foundation excavation and shoring work. ☐

7.3 Underpinning

7.3.1 Pre-Excavation

Pre-excavation inspection and Review must be conducted by both Structural and Geotechnical Engineers (both Geotechnical Engineers from the adjacent structures and GIR) prior to underpinning excavation. ☐

7.3.2 Monitoring Survey

Survey monitoring points must be installed at the underpinning building(s) and/any movement sensitive Structural Component before foundation excavation. The survey monitoring system must be conducted prior to any site activities and submit to GIR. ☐

7.3.3 Structural Inspection

Structural Inspection and photographs must be carried out prior to foundation excavation for future records and reference by Structural Engineer retained by either owner of adjacent property or subject property owner. ☐

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7.4 Temporary Construction Dewatering

7.4.1 Perched groundwater and Surface Drainage

For perched groundwater and surface Drainage by precipitation, conventional pump can be used to maintain the site in relatively dry condition. □

7.4.2 Well point

Well point and other measure of temporary dewatering will be required if high groundwater level (actual ground water table) is encountered □

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8.0 Geotechnical - Permanent

8.1 Bearing Capacity of Foundation Subgrade Soil ☐

8.1.1 Foundation Subgrade Excavation

Review exposed foundation subgrade excavation and ensure that all remove all unsuitable soil/material until suitable bearing subgrade is exposed ☐

8.1.2 Foundation Subgrade Protection

In the event that the exposed foundation subgrade soil is sensitive to moisture, foundation subgrade might be protected by a layer granular soil such as crushed gravel due to wet condition and construction traffic. A lean concrete can be used instead of crushed gravel. ☐

8.1.3 Structural FILL

Review Structural Fill if over-excavated or raise of grade is required. Compaction Density test must be conducted by Certified Laboratory and submit to GIR. ☐

8.2 Geotechnical - Deep Foundation

8.2.1 Piling Inspection

Full time piling inspection such as timber and steel pile etc must be conducted by GIR. All piling record for refusal must be available to review such that the pile capacity can be certified. ☐

8.2.2 Sheetpile Installation

Sheetpile installation as temporary / permanent support must be installed and inspected by Geotechnical Engineer ☐

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8.3 Engineering FILL

8.3.1 Structural FILL

Structural Fill (imported or non-native material) at and below the proposed foundation elevation must be compacted to density as specified by GIR and must be certified by qualified soil laboratory / testing company ☐

8.3.2 Underslab FILL

Underslab fill density must also be tested prior to placement of slab-on-grade concrete to the specified density as required by GIR. ☐

8.4 Slope Stability and Seismic Load

8.4.1 Slope Stability

Evaluate the slope stability along the site and building perimeter for both seismic and static design conditions according to APEBC Guidelines dated November 2010. ☐

8.4.2 Subsurface Stability

Subsurface stability under seismic condition such as densification specified by GIR and tieing of footing structurally must be accommodated by Structural Engineer in Record ☐

8.4.3 Seismic Design Criteria

The acceleration velocity design must be based on Nation Resources of Canada Seismic Hazard Criteria. ☐

8.5 Backfill

8.5.1 Backfill Material

Backfill material for foundation perimeter must be well drained granular soil, such as crushed gravel with waterproof membrance for below grade structure ☐

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8.5.2 Sensitive Structure

If sensitive structure is founded on the Backfill material such as Sand and Gravel compaction density as specified by GIR of the backfill material must be tested by certified testing company ☐

8.6 Permanent Dewatering

8.6.1 Foundation Drainage

For convention foundation drainage, perforated PVC pipe will be used to collect any surface gravity drained to city's storm system migrated and natural groundwater to a sump then ☐

8.6.2 Storm System

If City's storm system is higher than the sump elevation, pumping system must be installed with dual-pump and alarm system and may be with back up generator when power is unavailable during adverse conditions. Mechanical and Civil Engineer must be retained to design the system. ☐

8.6.3 Perforated Drainage

Underslab perforated drainage perforated PVC will be installed to improve the foundation drainage if groundwater table is higher than the slab elevation either seasonally or permanently ☐

8.6.4 Tanking

Tanking is also an option when the pumping system might not be capable to drain all below groundwater or foundation drainage system is not installed. Envelop Consultants must be retained for this option ☐

8.6.5 Retention Tank

Retention Tank with control valve may be required due to City's storm system limitation. Civil Engineer must be retained. ☐

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8.7 Permanent Underpinning

8.7.1 Underpinning Loading

All underpinning loading must be reviewed and approved by Structural Engineer and GIR. ☐

8.7.2 Separation and Drainage

Bond separation and drainage (above and below grade) at the interface of the underpinning area must be reviewed to ensure no water migrate to the underpinning structure. Envelop Consultant must be retained. ☐

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