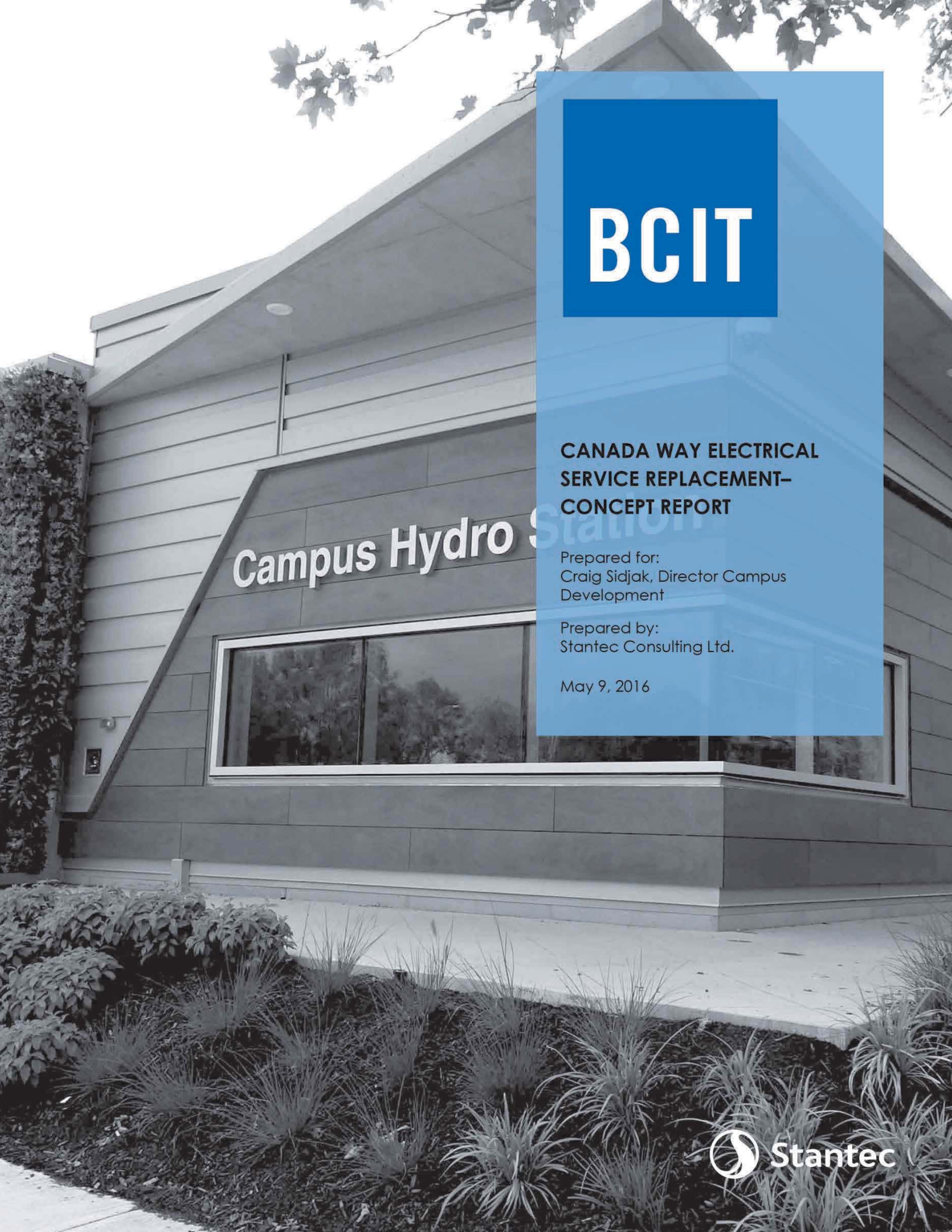

BCIT

CANADA WAY ELECTRICAL SERVICE REPLACEMENT– CONCEPT REPORT

Prepared for:
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Prepared by:
Stantec Consulting Ltd.

May 9, 2016

Stantec

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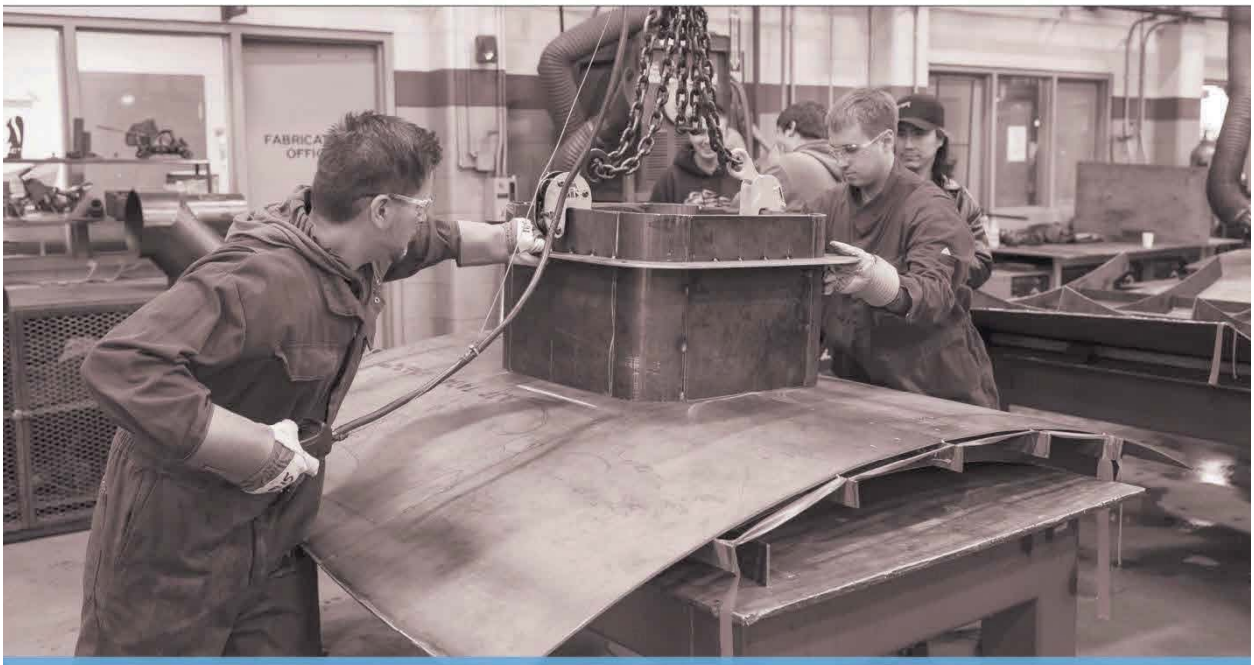


EXECUTIVE SUMMARY

Stantec have been commissioned by BCIT to provide a concept report for the proposed "Canada Way" electrical service replacement project.

In the review performed by Stantec it was revealed that the Canada Way Receiving Power Substation on the north campus and its associated electrical infrastructure is at critical risk of failure. Also, most of the unit substations on the north campus are approaching the end of their expected useful life and need to be replaced immediately or as soon as possible.

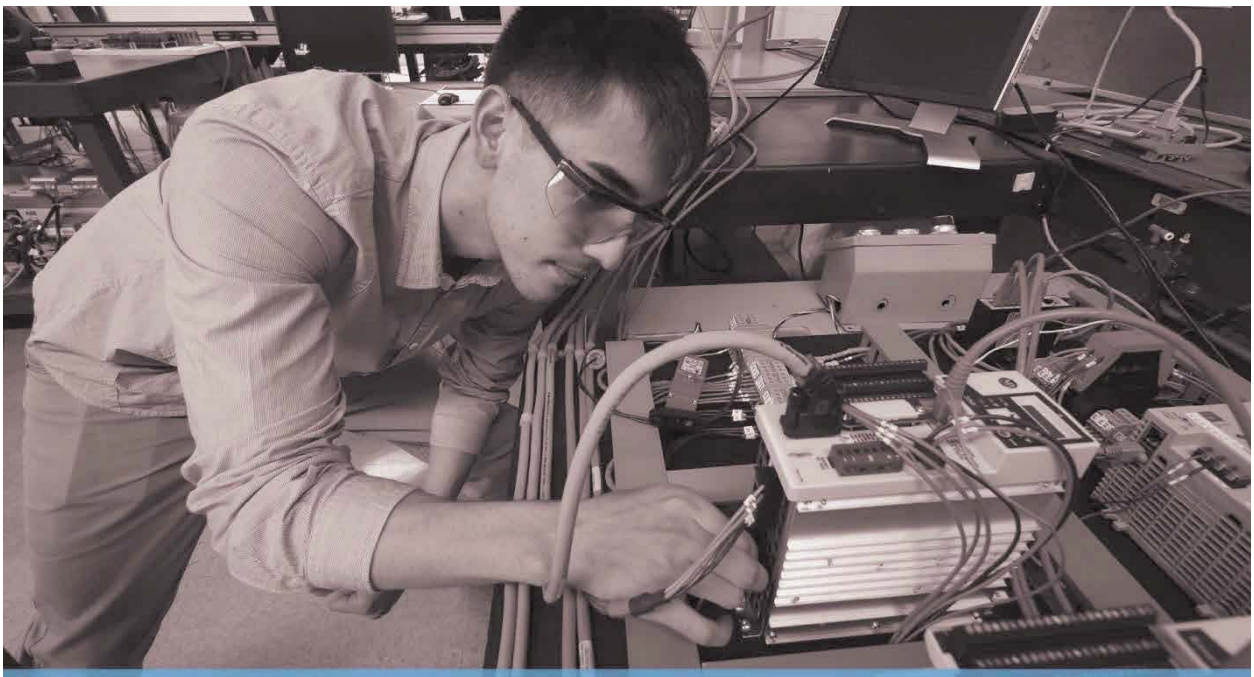
As such, Stantec has recommended that the immediate replacement of the Canada Way Receiving Substation and associated electrical infrastructure should be BCIT's highest infrastructure upgrade priority. The unit substation renewal and planning should be a close second priority and included in the overall electrical infrastructure renewal of the north campus.

Civil upgrades as identified in the previous condition assessment are to be implemented at the same time as the electrical upgrades (refer to previous conditions assessment report).

In order to build on the lessons learned from the Goard Way electrical infrastructure upgrades at the BCIT Burnaby campus (see section 1.5) an integrated design approach is recommended throughout the design and construction process. An integrated design approach involves both a consultant team and a contractor investigating site conditions early during the design phase to base design decisions on known underground conditions.

The Schedule and cost analysis is based on a four year plan that involves the integrated design team producing construction documents in the first year. The following three years focus on the construction of the electrical infrastructure upgrades.

There is potential to reduce the four year plan down to three through the shortening of the construction phases. This will be reviewed during the first year of integrated design. A full cost analysis has been performed and is presented in Appendix D.



1.0 INTRODUCTION

1.1 BACKGROUND

BCIT engaged Stantec in 2014 to assess the condition of all underground utilities for their Burnaby campus. The goal of this assessment was to allow BCIT to better understand the condition of each utility and more effectively plan maintenance activities and infrastructure investments. The result was a Conditions Assessment Report, completed in May 2015. In November of 2015, Stantec authored an Opportunities Assessment Report focusing on the replacement of the Canada Way Receiving Substation and associated electrical infrastructure. These reports formed the basis of the concept design outlined in this Concept Design report.

May 2015	November 2015	May 2016	2016–2020
Conditions Assessment Report	Opportunities Assessment Report	Concept Report	Design and Construction

The Condition Assessment report identified that the Canada Way Receiving Power Substation on the north campus and its associated electrical infrastructure is at critical risk of failure.

Additionally most of the unit substations on the north campus are approaching the end of their expected useful life with 86% of electrical infrastructure and equipment either obsolete or nearing obsolescence. As the existing equipment approaches or exceeds their life cycle, replacement components become more difficult to source. Any disruption to the electrical service at BCIT would have a significant impact on campus operations and potential closure of education programming.

As such, Stantec recommends that the immediate replacement of the Canada Way Receiving Substation and associated electrical infrastructure should be BCIT's highest infrastructure upgrade priority. The unit substation renewal and planning should be considered the next priority and included in the overall electrical infrastructure renewal of the north campus.

1.2 PROJECT OBJECTIVES

The objective of the proposed upgrade works is to improve the electrical infrastructure resiliency at BCIT and to increase the BC Hydro contingency limit which is 2.0 MW. The scope of work defined to achieve project objectives includes:

- Construct a new Canada Way power receiving substation to replace the existing aging Canada Way receiving substation
- Infrastructure improvements associated with the adjacent modernization of electrical upgrades.
- Replace all aging unit substations on the north campus serving buildings north of Goard Way over a period of four (4) years.
- Establish a new BC Hydro connection at the corner of Carey Ave and Canada Way. The new electrical backbone infrastructure is to be built on the north campus. It will encompass three major electrical services:
  - High voltage (HV -12.5/25kV)
  - Low voltage (LV - below 750V) and,
  - Telecommunication / control / safety service.

1.3 PROJECT OUTCOMES

COST EFFECTIVENESS—The proposed design should be cost effective and make use of the newly built existing Goard Way infrastructure. The proposed design utilizes available space in the Goard Way station building to locate the Canada Way Receiving Substation equipment. It also utilizes the Goard Way duct backbone to feed the north campus unit substations West of Guichon Creek.

DISCRETE PHASING—The proposed renewals will be phased over multiple years and align with available funding streams. Canada Way station ducting, equipment and new substations will be replaced as discrete construction initiatives over the next 4 years. 1

BUSINESS CONTINUITY—The proposed phasing and design will have minimal impact on campus operations. Part of the campus must remain on the old Canada Way station while the new receiving station is being built. Corresponding downstream substations will be progressively switched over to the new service/receiving station.

STRATEGIC ALIGNMENT—Strategic Alignment with the Master Plan—BCIT has a vision of future campus development that the new infrastructure design should be able to accommodate in terms of future capacity, flexibility and location. The new power and communication infrastructure will be designed to carry future power demand requirements for the next 20 years.

The Project is aligned with BC government priorities and strategies:

- Aligns directly with *the BC Skills for Jobs Blueprint* with a focus on supporting education for the construction trades. Supports BCIT's role as the primary provider of trades education in the province by ensuring continuity in instruction.
- Supports BCIT Institute Strategic Initiative 4 – Stewardship and Resource Development to ensure that physical facilities and campus infrastructure needs are met through an integrated plan that accounts for teaching space, research facilities, equipment, information and education technologies.
- Supports BCIT Institute strategic initiative 7 – Campus Development by creating a utility spine that is being established in alignment with strategic vision and the above-ground master planning.

RELIABILITY—providing a new electrical network to the North Campus will allow for load shedding redundancy (between Goard Way and Canada Way main feeds) and support future expansion including a planned School of Health Sciences and Trades & Technology buildings.

RESEARCH

In early 2007, BC Hydro and BCIT embarked on a joint research initiative and began the process of designing and constructing Canada's first Smart Power Microgrid at BCIT's Burnaby campus. Through the Smart Microgrid project, GAIT is developing a smart grid test bed on BCIT's Burnaby campus to allow researchers and utilities to experiment and demonstrate their leading-edge technologies and solutions.

The proposed electrical infrastructure upgrade works at BCIT will complement and enhance this research by exposing researchers to the existing electrical infrastructure on site, proposed upgrades, construction methodologies and integration of modern technologies, including microgrid concepts and smart metering.

[1] (contingent on AVED and BCIT Funding approvals)

SUSTAINABILITY

The Intelligent Microgrid Project reflects provincial, national, and international goals to build a smarter, more secure power grid. An intelligent microgrid will help to balance power generation to demand, which will reduce the potential for blackouts. It will also be able to integrate current energy sources such as hydro or natural gas, with alternative energy sources such as biomass, solar, and wind plants. As such, this project will satisfy BCIT sustainability goals;

- Campus **Economic** and **Operational** resiliency through reliable power supply and distribution on campus
- Maintaining education infrastructure for the long term benefit of **Communities**
- **Environmental** protection through the integration of renewable energy sources into the campus Microgrid.

1.4 BASIS FOR DESIGN

The basis of design for the new power distribution network was guided by:

- Existing power distribution network requirements on the North campus
- Preservation and exposure of Guichon Creek for stormwater management
- Newly constructed power distribution with the Goard Way substation on the South campus and,
- BC Hydro's power connection guidelines for customer's primary connections.

The BC Hydro grid voltage switchover from 12.5kV to 25 kV is scheduled for 2019/2020 and the new Canada way receiving station and any future unit substations will be designed for dual voltage.

All these conditions have contributed to the solution presented in this concept plan.

1.5 GOARD WAY LESSONS LEARNED

The Goard Way project has been successfully completed and lessons learned from this most recent project will be incorporated in the future project development and delivery of the Canada Way Receiving Station Project.

Collaborative team up front to reduce risk is a must.

Complex infrastructure projects such as Goard Way and Canada way involves considerable risk mitigation and management of uncertainties. Front end preparation/planning is key to project success.

- Goard way design was based on the limited historical and record information and as a result many unforeseen conditions were encountered.

- Sufficient funding will be spent up front for the Canada Way project to verify site conditions and understand all constraints. (implementation of advanced works program)

Bring a contractor on early during the design process.

- Design of Goard Way was completed without appropriate coordination or an understanding of constructability.
- Future approach for the Canada Way project will allow full integrated team including a contractor at the start of the project. (integrated team approach)

Create less disruption on campus with up front interventions

- Construction schedule should be developed early on with the shut downs planned and scheduled. This will minimize operational impact and maintain staff and student safety.
- Design of the Canada Way project and phasing will be developed keeping BCIT operations in mind. (Construction phasing with planned shutdowns)

Greater flexibility to manage construction budgeting

- Goard way project was delivered through a standard stipulated sum contract.
- There is a need for a form of delivery with flexibility that reduces risk appropriately. It should allow for repositioning of project risk including a good setoff document that does not duplicate risk.

Confirm multi-year funding

- Funding was not certain for each phase of the Goard Way project.
- The Canada Way project will be a four phased project delivered over four fiscal years. Funding will be in place to allow for the construction to start and continue for the each phase without interruption or uncertainty.

Examples of Infrastructure Condition on Burnaby Campus

Blocked Condition of the Storm Water Mains Along the Goard Way


Fragile, High Voltage Electrical Lines in Hazardous Water-filled Manhole

1.6 PROCUREMENT

In order to integrate the lessons learned from the Goard Way project, it is recommended that an integrated design team approach be adopted. This would involve design-assist from a construction manager during the design phase in order to design with an understanding of underground conditions and constructibility. The construction phase would continue with the integrated approach and be led by a construction manager. The options and preferred option outlined in this concept report are based on using this integrated design approach. This solution is best suited to complex projects where in order to mitigate risk, the owner, contractor and designers come together at an early stage in the project to:

- Develop a scope of work, budget and schedule
- Progress the design based on actual field conditions of services / site conditions and allow for investigation during design
- Develop specifications and drawings which will be distributed by the construction manager to sub trades for their constructability review and comments.
- Work directly with users to allow for business continuity
- Maintain high levels of safety for occupants during multi phased construction

This method of project delivery is intended to reduce construction time and costs, improve constructability and add value for the owner.

1.7 SCHEDULE

Project Phase	2016	2017	2018	2019	2020
Year 1 – Electrical and Civil planning, design, advanced Works Program and equipment procurement. Unit Sub R' transferred to Goard way sub.					
Year 2 – Electrical Infrastructure construction along Carey Avenue. New Canada Way substation installed and Energized. Carey Avenue Civil Works.					
Year 3 – Electrical Infrastructure construction between Guichon Creek, 'Green Way', Smith Street and Goard Way. English Street water Main upgrade.					
Year 4 – Electrical Infrastructure construction between Willingdon Ave, Smith St, Goard Way, and 'Green Way.' Existing Canada Way substation is unloaded and will be disconnected from BC Hydro and decommissioned.					

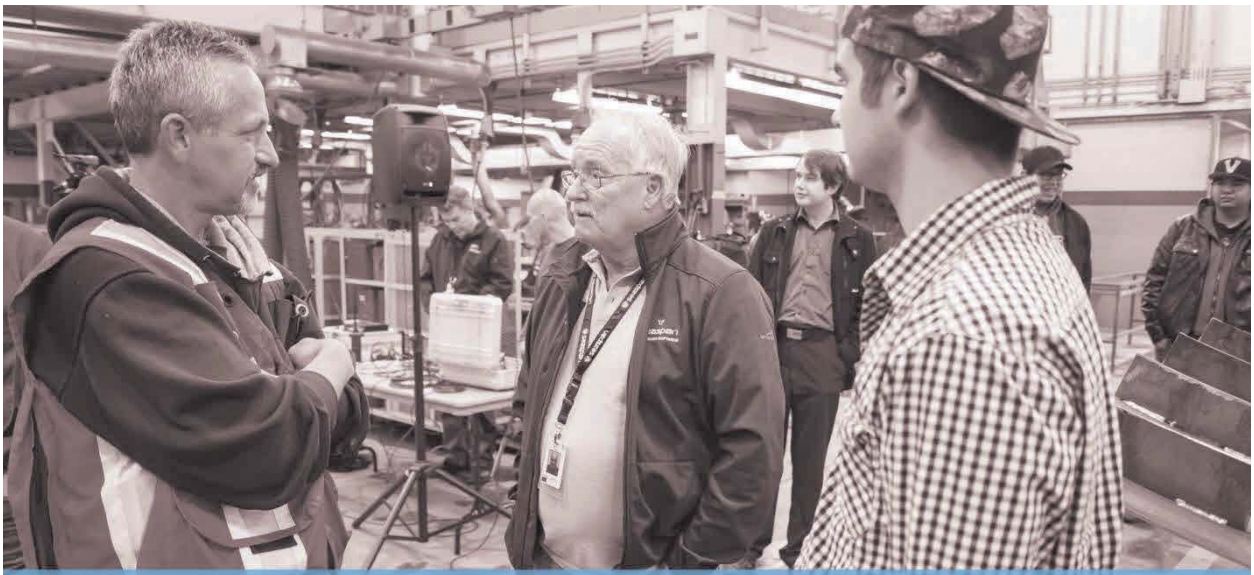
1.8 RISK MATRIX

The following table identifies the risks associated with the preferred project option.

Risk Register–Risk Identification

Risk ID	Life Cycle	Risk Event	Trigger/Cause	Consequence	Notes
1	Strategic Options	Funding to proceed to next phase is not granted.	Funding withheld	Project delayed or cancelled. Infrastructure could fail anytime, impact operations of North campus	
2	Business Case	Capital funding not forthcoming	Funding withheld	Infrastructure could fail anytime, impact operations of North campus	
3	Design	Scope Creep	Design changes	Potential project delays; scope management	BCIT has experienced staff—having just delivered similar project (Goard Way Electrical)
4	Design	Increased budgetary requirements	Unknown site conditions	Budgetary constraints	Undertake site survey and inspections/testing to confirm unknowns prior to detailed design development.
5	Design	Municipal approvals delayed	Lack of understanding of municipal process	Project delay	BCIT has experienced staff—having just delivered similar project
6	Design/ Construction	Excessive change orders	Lack of quality tender/ procurement documents	Budgetary constraints	BCIT has experienced staff—having just delivered similar project
7	Construction	Construction market inflated	External economic factors	Budget and schedule impacts	
8	Construction	Late changes by stakeholders	Insufficient stakeholder engagement	Budget and schedule impacts	BCIT has experienced staff—having just delivered similar project

Risk ID	Life Cycle	Risk Event	Trigger/Cause	Consequence	Notes
9	Construction	Tenders exceed budget	Delays in construction	Budget and schedule impacts Value engineering required	BCIT has experienced staff—having just delivered similar project



2.0 EXISTING ELECTRICAL INFRASTRUCTURE

Power supply to the north campus is provided through the Canada Way receiving substation (12,5kV) located along Canada Way. The south side of the campus is primarily supplied through the new Guard Way receiving substation.

A recent assessment of the current condition of the power infrastructure on the north part of the campus has indicated that the Canada Way receiving station is at critical risk of failure. Moreover, most of the unit substations on the north of campus are approaching their expected useful life and will need to be replaced immediately or over the next four (4) years. The priority for replacement is outlined in section 7.

Figure 1 Existing BC Hydro Electrical Feeds

The BCIT campus is divided into two distinct power distribution zones which coincide with the area north and south of Goard Way, running east to west across campus. The campus is fed from two (2) BC Hydro overhead 12,5kV lines. One line runs along Willingdon Avenue and feeds the recently constructed Goard Way Receiving Substation at the East side of campus; which is the main power source for the South campus. BCIT have confirmed that there are also some individual buildings in the South campus connected independently to the same BC Hydro line.

The second BC Hydro overhead line runs along Canada Way at the northern edge of campus. It feeds the north campus over the existing Canada Way Receiving substation This is then distributed through the network of ten (10) unit substations in the North Campus with one (1) additional on the South side of the campus (Substation R).

Both 12,5kV overhead lines are sourced from the same offsite BC Hydro substation, however from different high voltage (HV) switches.

BCIT's electrical underground infrastructure is aging and is becoming increasing costly to maintain, with failures and unscheduled repairs occurring with increasing frequency. Moreover, the current power demand has risen to the contingency limit (2.0 MW) the Institute had contracted with BC Hydro in 1981.

There are ten (10) unit substations feeding buildings and equipment on the north campus and they are all fed out of the Canada Way receiving substation. These unit subs are: A, B, C, D, G, J,

M, N, T and W. There is also one (1) unit substation (R) on the south campus fed out of the Canada Way substation. This unit sub feeds building SE1.

The Canada Way receiving substation is fed from BC Hydro's overhead line with the pole cable dip running underground to the receiving substation on the north side of campus. From there, the radial network of underground cables is spread over the north campus. Each of the 12,5kV high voltage power feeders is then terminated in one of these eleven (11) unit substations.

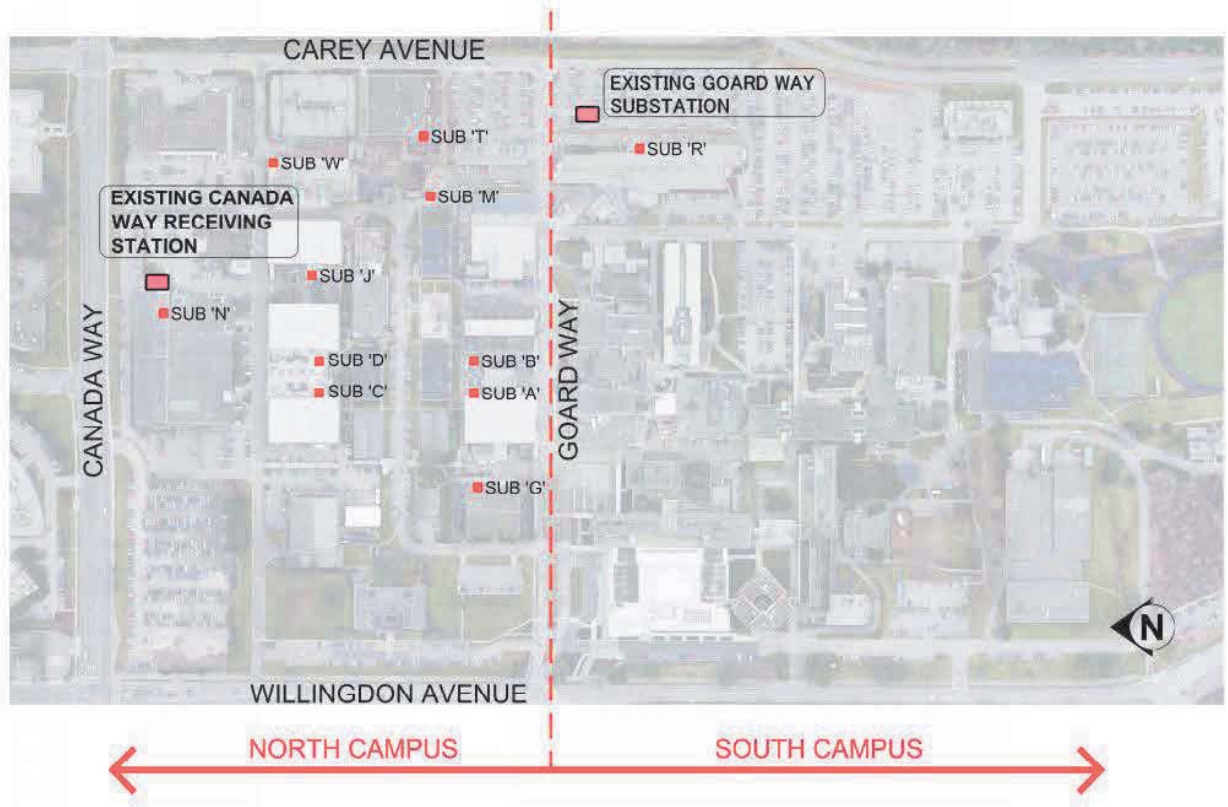


Figure 2 Existing Electrical Substation Locations

Existing Canada Way Receiving Sub Load Schedule

The current power demands on existing Canada Way and Goard Way receiving substations:

Unit Substations	Unit sub ratings (kVA)	Buildings serviced	Peak demand (kW)
Sub A	750	NE20, NE22, NE24	90
Sub B	225	NE18, NE28	90
Sub C	500	NE2, NE 23, NW1,NW3	175
Sub D	500	NE4, NE6, NE21	103
Sub G	600	NW5, NW6	90
Sub J	1000	NE25	123
Sub M	600	NE16	75
Sub N	1500	NE1,NE3, NE7, NE9	657
Sub R	750	SE1	256
Sub T	1000	NE12	150
Sub W	2000	NE8, NE10	384
		Total	**2,193 kW**

Total power demand on existing Canada Way sub: **Pd = 2,193 kW**
The power demand on Goard Way sub (as per BC Hydro's report): **Pd = 3,034 kW**

4.0 DESIGN APPROACH

The diagram below and drawings in Appendix A show the proposed phased four (4) year build-out outlining the construction after each year and its final set up. They are separated into zones for better understanding with proposed existing/new unit substations serving the buildings as development proceeds. It has been envisioned that within the next four (4) years, two new buildings will be constructed. They are indicated on the electrical infrastructure plan as F-NE3 and F-NW2.

1. Electrical demand—the proposed construction development with power demand breakdown over a period of 4 years has been analyzed, and a proposed detailed schedule is shown in Section 7.
2. 25kV switchover strategy—The Goard Way substation building layout can be modified to accommodate the new Canada Way substation. Assuming that all north campus unit substations will be fed out of a 25kV source in 4 years, the south campus stations will need to undergo similar upgrades to be compatible with higher voltage switchover. This could be achieved by either providing a high capacity transformer in the Goard Way building leading also to potential mechanical HVAC upgrades, or upgrade each individual unit substation on the south campus.
3. Creation of Utility ROWs— English Street and Carey Avenue are identified as viable utility corridors which can accommodate required utilities and provide flexibility for future access and development of renovated or new buildings.

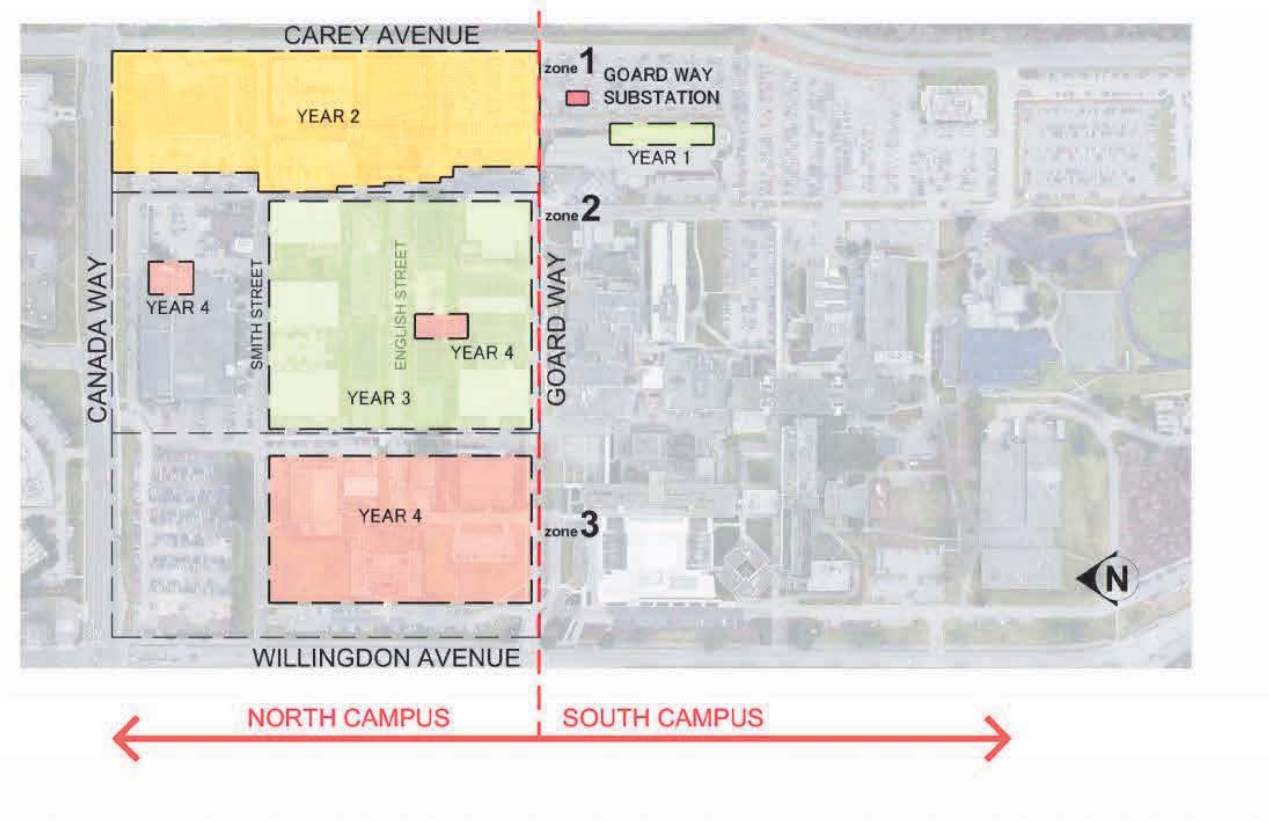


Figure 3 Proposed Year-by-Year Site Areas

Note:

An alternate approach to compressing years 2 and 3 can be reviewed during the design stage. There is an opportunity to purchase equipment earlier in the design process possibly reducing the overall schedule by up to 1 year.

Year 1 includes project design and select preparatory works.

The Summary Schedule of Construction, Power Demand Load progress over the next four (4) years is shown in the following table.

Summary Schedule for Power Demand Load, Construction Schedule

Year	Existing Canada Way Sub			New Canada Way Substation			Area of Work on the North Campus	Notes (Status on the end of the year):
	Demand Load (kW)	Demand Load Reduction (kW)	Remaining Load at the End of Year	Demand Load (kW)	Demand Load Addition (kW)	Remaining Load at the End of Year		
1 (2016–2017)	2,193	256	1,937	Ø	Ø	Ø	• El. infrast. design for North Campus provided • Unit sub "R" load transferred to Goard Way sub.	• Existing Canada Way Substation is operational
2 (2017–2018)	1,937	642	1,295	Ø	642	642	• El. Infrastructure construction between Canada Way road, Carrey Ave, Guichon Creek and Goard Way Street • New Canada Way Sub connection to BC Hydro	• New Canada Way Substation is installed and energized. • Load transfer from existing to new Canada Way substation is ongoing.
3 (2018–2019)	1,295	401	894	642	401	1,043	• El. infrastructure construction between Guichon Creek, 'Green Way', Smith Street and Goard Way.	• Load transfer from existing to new Canada Way substation is ongoing.
4 (2019–2020)	894	894	Ø	1,043	1,164	2,207	• El. infrastructure construction work between Willingdon Ave, Smith St, Goard Way, and 'Green Way.'	• Existing Canada Way substation is unloaded and will be disconnected from BC Hydro and decommissioned. • New buildings F-NE3 (trades education) and F-NW2 are built and operational (new load). • Demand power for North campus reaches its limit as per BC Hydro contract (2,0MW). • Unit Sub 'N' to be independently connected to BC Hydro line.

5.0 OPTIONS ANALYSIS

5.1 POWER DISTRIBUTION SYSTEM UPGRADE ON THE NORTH CAMPUS

Location of Canada Way Receiving Station–Design Options

There are two (2) options considered as a solution to the aging infrastructure on the north campus (north of internal Goard Way in the middle of campus).

Option 1—Install independent Canada Way Substation

The first option is for the new Canada Way substation to be located in the middle of the north campus, e.g. somewhere along English Street. This was considered a technically logical solution with the power source located in the middle of the North Campus, resulting in the short HV cables, minimal voltage drop and quick and easy access for the maintenance crew.

Option 2—Install inside the existing Goard Way Receiving station building

The second option is for the Canada Way substation to be located within the existing Goard Way substation building. This building is located in the middle of the campus, on the corner of Carey Avenue and Goard Way. This recently built structure was constructed with the ability to accommodate an additional floor complete with new power substation equipment.

Figure 4 Canada Way Receiving Station Location Options

A key design consideration was to derive the optimal location for routing the spine of electrical infrastructure in the north campus. Two options were reviewed and it was decided that **Option 2** was the most practical from a cost perspective.

Infrastructure Routing Options

There are two (2) options considered as a solution to the infrastructure routing on the north campus.

Option 1—Smith Street

Smith Street, loacted in the middle of north campus was initially defined as the most logical location for the infrastructure installation. It would serve as a spine for power and other infrastructure instllation and could serve both sides of this Street.

Option 2—Goard Way and English Street

Option 2 however emerged as the more logical solution for the electrical infrastructure at North Campus due to the existence of utilities along Smith Street, and lack of space to install new

utilties there. Also the area north of Smith Street is planned for future market development. The following key considerations also resulted in Option 2 being deemed the most applicable:

- Sufficient space within existing Goard Way building to accommodate the new Canada Way substation
- Minimal cost for upgrade of existing building systems
- Consolidation of power source in one place for the entire BCIT campus
- Easy interlocking between these two substations for redundancy
- Easier maintenance, easier constructability for the Canada Way substation due to minimal obstruction of existing underground services along Carey Avenue
- A more cost effective solution
- Land is preserved for future development and density

BC Hydro had no objections for installation of two substations in the same building fed from different connection points as well as a proposed infrastructure routing along Carey Avenue.

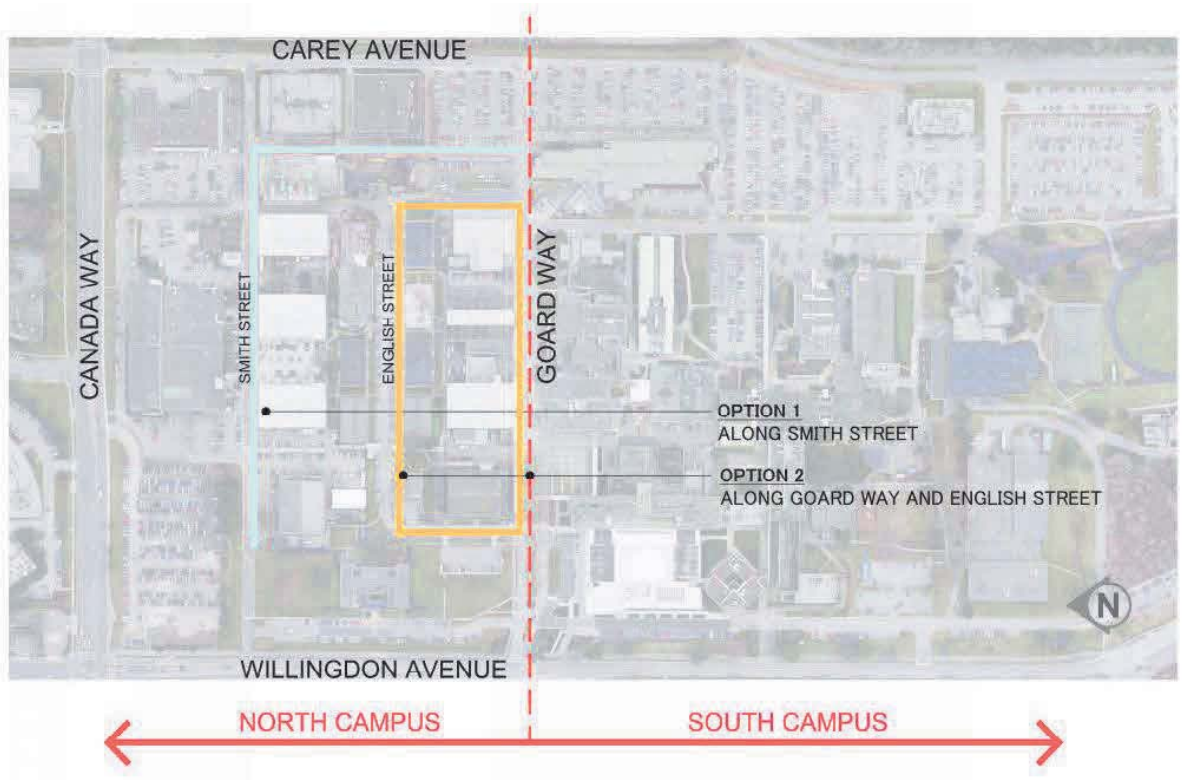


Figure 5 North Campus Electrical Main Distribution Options

6.0 PROPOSED DESIGN FOR THE "CANADA WAY" BC HYDRO SERVICE REPLACEMENT

6.1 PROPOSED ELECTRICAL WORKS

Incoming Service from BC Hydro

1. It is recommended that the existing Canada Way receiving station along Canada Way be decommissioned and replaced with a new dual voltage (12,5kV/25kV, 600A) Canada Way receiving station located inside the existing Goard Way receiving station building. See the attached drawing E-2.13 for the proposed layout of the Canada Way receiving station.
2. BC Hydro incoming service is proposed to be connected to the BC Hydro overhead network at the corner of Canada Way and Carey Avenue.
3. At proposed intersection of Canada Way and Carey Avenue, the cable dip from the closest BC Hydro pole will be run by BC Hydro and connected to the "Vista switch" and the "Metering kiosk" also provided by BC Hydro at that location.
4. BCIT will provide infrastructure (underground ducts and cabling) from the BC Hydro equipmentto the Goard Way substation building. Concrete encased 4x103mm, DB2 duct bank will be run along Carey Avenue together with other ducts and new manholes before turning into the Goard Way receiving station building in the middle of BCIT campus.

Erection of Canada Way Receiving Station and Connection to the North Campus Unit Substations

1. New Canada Way 12.5/25kV receiving station switchboard will be installed within the available space on the ground floor of the Goard Way receiving substation building.
2. The Canada Way receiving station will serve all unit substations at the north campus, the same way the Goard Way receiving station currently serves unit substations on the south campus (using radial distribution). These two receiving stations will be interconnected for service redundancy.
3. All HV feeders to building unit substations on the north campus will be sized for 25kV, although it will feed unit substations at 12.5kV until switchover.
4. The electrical underground infrastructure ducts will be installed and separated into 3 (three) sections that serve HV, LV and communication load. We foresee the following ducts schedule:
   16x103mm HV duct bank / 16x103mm LV duct bank / 8x103mm COMM duct bank
5. The number and size of underground ducts is estimated to meet power capacity requirements of the north campus for the next 20 years.

Consolidation and Renewal of North Campus Unit Substations

1. All building unit substations currently at 12.5kV/347/600V (or 480/277V) on the north campus are planned for consolidation/upgrade/replacement over a four (4) year period.
2. It is planned for most unit substations to be consolidated so as the substation design is aligned with the North Campus building development masterplan. A reduction in substation numbers from ten (10) to six (6) is anticipated in the north campus zone in the first four (4) years.
3. Unit substation R on the south campus will be switched over to Goard Way receiving station.
4. The existing Canada Way receiving station gear will be decommissioned and removed from the site at the end of the fourth year of the project upgrade. Incremental decommissioning of gears and feeders will take place at the end of each year as per summary schedule table.
5. Unit substation N will be disconnected from the existing Canada Way substation and reconnected directly to the BC Hydro overhead line after completion of the power upgrade construction project. It will remain online and operational until buildings NE1 and NE3 are demolished, after which time it will be decommissioned.
6. All new substations will be upgraded to accept 25kV on the primary side estimated to take place as per BC Hydro plans in 2019/2020.

Additional Electrical Works

1. A new grounding grid will be established to interconnect the newly constructed Goard Way substation, the future new Canada Way receiving substation as well as all unit substations on the north campus feeder infrastructure network.
2. There is no planned emergency generator service change on the north campus as per BCIT direction.
3. Existing decentralized generators will continue to serve the load as they are currently set up.
4. The building safety systems, such as fire alarm will use the new infrastructure to communicate between the buildings and the Central Fire Alarm Station (Centre), as well as with remote annunciators and the outside monitoring agency.
5. New efficient LED Street lighting will be installed in the streets, ways and passages upgraded through this project.
6. It is recommended that the existing power feeders and infrastructure work are to be mapped and recorded and feeders removed or cut off and pulled out of existing ducts wherever possible.

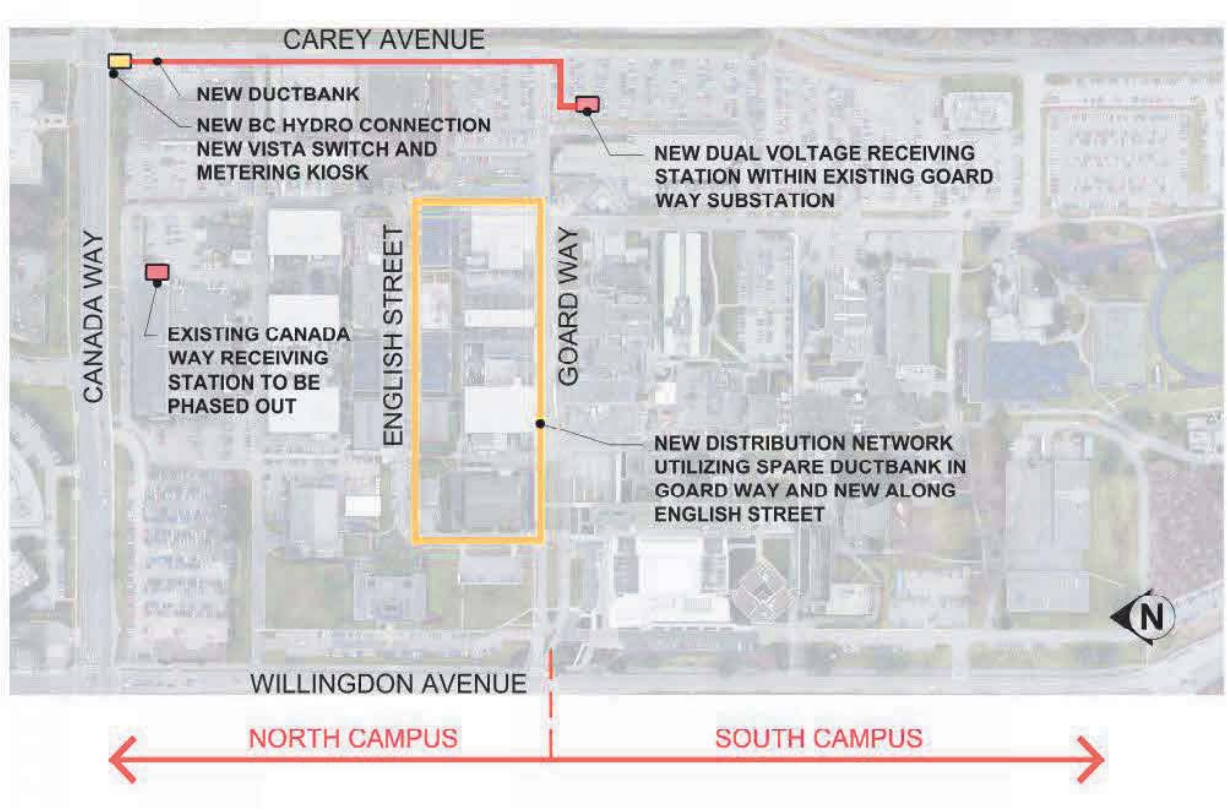


Figure 6 Proposed Electrical Main Distribution Network

6.2 PROPOSED NETWORK COMMUNICATION BACKBONE

1. A fiber optic network ring (loop) will be established throughout the north and south BCIT complex. It will source and terminate in the main communication room on the south campus and will run and interconnect all power receiving and unit substations as well as the other services on campus. It will be interconnected to the BMS system at each of the buildings.
2. This project is the first step towards establishing this loop. The underground infrastructure for the fiber backbone is included in this project scope. It will be routed with power infrastructure services on the north campus expanding communication ducts along Smith Street and crossing Guichon Creek. This optional duct route is shown on drawing E-1.11.

6.3 PROPOSED CIVIL WORKS

All works will be designed and constructed based on the BC Building Code, City of Burnaby Standards, MMCD, and all applicable Electrical Standards.

Design

Cost and scheduling allowances should be included during the preliminary and detailed design phases for the proposed works. Field confirming and locating existing underground utilities and surface features during the design phase will allow for an efficient transition into the construction phase which can minimize risk and scheduling delays.

Coordination

Based on discussion with PCL and Hexcel, (lead contractors on the Goard Way Project), several items proved challenging during the Goard Way reconstruction, and could be addressed prior to start of construction. These include:

- Preparation, submission, and approval of an Erosion and Sediment Control Plan prior to start of construction
- Application and approval for all necessary Environmental approvals associated with possible work on Guichon Creek
- Preparation with input from BCIT of a suitable Traffic Management Plan
- Preparation with input from BCIT of a suitable Construction Phasing Plan

Allowance should be provided to complete these tasks prior to construction.

Sub Station Servicing

The new receiving station will service all existing substations north of Goard Way. Details of the proposed duct and manhole requirements can be found on the electrical drawings (Appendix B). The intent is to reinstate all existing features impacted by the duct bank installations to equivalent conditions or better. This will include removal and replacement of landscaping, sidewalk, curb, roadway, and miscellaneous architectural features.

Guichon Creek Stormwater Management

There is special consideration required for Guichon Creek at the cul-de-sac of English Street. The future plans to daylight Guichon Creek for stormwater management upgrades will be at the current location of the cul-de-sac.

7.0 PROPOSED CONSTRUCTION DEVELOPMENT (2016–2020)

7.1 YEAR 1 (APRIL 2016–MARCH 2017)

1. Construction drawings and specifications “tender ready” for new Canada Way receiving station (all disciplines) for all phases of the project.
2. Switch over the feed for unit sub “R” from existing Canada Way substation to Goard Way receiving substation (use of existing spare cubicle).

Year 1—Existing Canada Way receiving sub load schedule

Unit Substations	Unit sub ratings (kVA)	Buildings serviced	Peak demand (kW)
Sub A	750	NE20, NE22, NE24	90
Sub B	225	NE18, NE28	90
Sub C	500	NE2, NE 23, NW1,NW3	175
Sub D	500	NE4, NE6, NE21	103
Sub G	600	NW5, NW6	90
Sub J	1000	NE25	123
Sub M	600	NE16	75
Sub N	1500	NE1,NE3, NE7, NE9	657
Sub R	**750**	**SE1**	**256**
Sub T	1000	NE12	150
Sub W	2000	NE8, NE10	384
		Total	**1,937 kW**

Total power demand on existing Canada Way sub: **Pd = 1,937 kW**
Total power demand on Goard Way sub: **Pd = 3,290kW**

Figure 7 Proposed Work–Year 1

Note: Year 1 includes project design and select preparatory works

7.2 YEAR 2 (APRIL 2017–MARCH 2018)

1. Construction of underground duct infrastructure on the north-east campus between Guichon Creek and Carey Avenue, and from Canada Way to Goard Way street on the south,
2. Supply and install of new Canada Way Receiving substation in the Goard Way substation building,
3. Pull the incoming cables from BC Hydro connection point at corner of Canada Way and Carey Ave to new Canada Way receiving substation. Pull feeder from new Canada Way substation to unit sub "W" and new unit sub "TF".
4. Upgrade unit substation "W" and construct new unit sub "TF". Decommission and demolish existing unit sub T.
5. Allocate infrastructure stub outs from unit sub "TF" and coordinate stub outs with new building development (F-NE3). New unit sub "TF" will power NE-12 and future F-NE-3 buildings.
6. Carey Avenue Civil Works:
   a. The proposed new duct alignment and manhole locations are outlined on Drawing E-1.11 (See Appendix B). The intent is to install the proposed duct bank and reconstruct Carey Avenue from Canada Way to Goard Way. This will include the removal of existing landscaping, concrete sidewalk, concrete curb, lane markings, and asphalt. Refer to Drawing C01 for works identified along Carey Avenue.
   b. Carey Avenue would be reconstructed with new landscaping, concrete sidewalk, concrete curb, catch basins, lane markings, driveway letdowns, speed humps, and asphalt pavement.
   c. An allowance should be provided to replace the existing street lighting, as well as replacing the existing 200mm water main during the Carey Avenue Road Works construction, as the aging infrastructure has known issues. The watermain shall have all joints wrapped in accordance with AWWA C209 or AWWA C217. Fire hydrants will need to be removed and replaced to include a double check valve backflow assembly for each hydrant.
   d. The existing 450mm to 600mm diameter storm sewer along the east side of Carey will be abandoned and replaced with a 600mm diameter concrete storm sewer within the road corridor.
   e. An allowance for a Mechanically Stabilized Earth wall should be reviewed and considered on the east side of NE10 as there is an elevation grade difference between Carey Avenue and the building. The storm sewer along the east side of Carey Avenue will be removed and replaced within the roadway and will extend from Goard Way to Canada Way.
7. Smith Street Road Works
   a. The proposed new duct alignment and manhole locations are outlined on Drawing E-1.11 (See Appendix B). The intent is to install the proposed duct bank and reconstruct Smith Street from Carey Avenue to NE8. This will include the removal of existing landscaping, concrete sidewalk, concrete curb, lane markings, and asphalt. Smith Street would be reconstructed with new landscaping, concrete sidewalk, concrete curb, catchbasins, lane markings, speed humps, and asphalt pavement. An allowance should

be provided to protect the existing street lighting, as well as replace the existing 200mm watermain during the Carey Avenue Road Works construction.

8. Constructability Notes
   a. There are existing mature trees along Carey Avenue. These should be protected in place during construction, or temporarily removed, safely planted during construction, and reinstated along Carey Avenue upon completion of the works.
   b. BCIT has future plans to remove and replace the existing perimeter drain tiles around NE10 due to its poor condition. Coordination with BCIT shall be considered during the construction works along Smith Street and Carey Avenue to replace the perimeter drain tiles at NE10.
   c. During recent construction works at NE10, concrete pile hap was exposed under the asphalt surface between NE10 and NE8. Further investigation will be required in this area to confirm limits of the concrete layer before construction starts within this area.
   d. Challenges with the elevation grade differences, located east of NE10, will require further investigation. The option to have a Mechanically Stabilized Earth (MSE) retaining wall should be considered to address the grade differences.
   e. Traffic management plan will be developed by contractor to ensure minimal disruption to campus operations.
   f. Impact on the operation of existing buildings— genset backup etc.

Year 2—Existing and new Canada Way receiving station load schedule

Unit Substations	Unit sub ratings (kVA)	Buildings serviced	Peak demand (kW)	Remarks
Sub A	750	NE20, NE22, NE24	90	
Sub B	225	NE18, NE28	90	
Sub C	500	NE2, NE 23, NW1,NW3	175	
Sub D	500	NE4, NE6, NE21	103	
Sub G	600	NW5, NW6	90	
Sub J	1000	NE25	123	
Sub M	600	NE16	75	
Sub N	1500	NE1,NE3	549	
Sub TF	**1000**	**NE12**	**150**	**New unit sub, Connected to new Canada Way Sub**
Sub W	**1000**	**NE8, NE10, NE 7, NE 9**	**492**	**New unit sub, Connected to new Canada Way Sub**
Total for both Canada Way Substations			**1,937 kW**	

Total power demand on existing Canada Way sub: **Pd = 1,295 kW**
Total power demand on new Canada Way sub: **Pd= 642 kW**
Total power demand on Goard Way: **Pd = 3,290 kW**

Note 1: Any additional or reduced power requirement on south campus is not recorded in the above table.

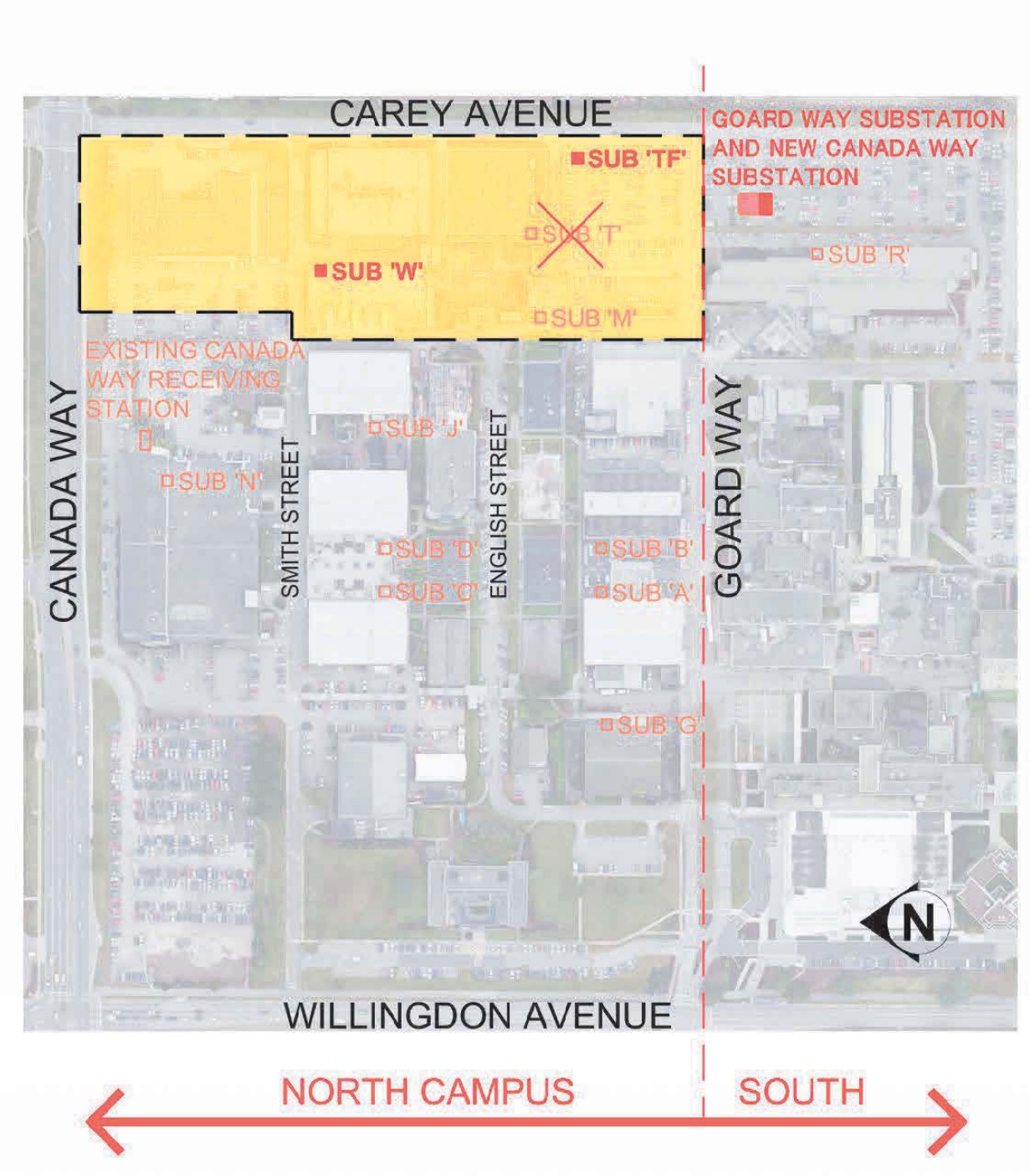


Figure 8 Proposed Work–Year 2

7.3 YEAR 3 (APRIL 2018–MARCH 2019)

1. Construction of underground electrical and mechanical infrastructure c/w HV, LV and communications cabling along English street and interconnecting with Goard Way infrastructure spine,
2. Consolidate unit subs “C”, “D” and “J” into one unit sub “CDJ”, provide new feeders and connect to new Canada Way receiving station.
3. English Street Road Works
    a. Due to the amount of anticipated excavation associated with the underground utility replacement, it will be necessary to reconstruct English Street as part of the project. This would include the complete removal of all existing street lighting, curb, landscaping, and road surface. The reconstructed roadway will remain similar in dimension but improved aesthetically and allow for utility corridors within the roadway.
    b. English Street will be reconstructed along the east-west alignment from the cul-de-sac to the road bend before NW1. New concrete curbs, sidewalks (north and south side), street lighting, landscaping with suitable root barriers, street signage, lane markings, parallel parking stall markings, and delineation features between traffic and pedestrians crossing the proposed greenway path. An allowance should be provided for the stair cases and ramps connecting the English Street, with further landscaping and architecture features (such as canopy covered walkways) along the future greenway path.
    c. Coordination will be required for the existing fibre optic ducts and gas line along English Street. The existing fibre optics will remain however relocated within the new electrical conduits. Crossing of the existing District Heating System at English Street and the future greenway path should be reviewed in further detail and may require special consideration.
    d. For reference, Appendix B provides an illustration for preliminary utility layout on Drawing R09 and typical roadway cross section found on Drawing C06.
4. English Street Watermain
    a. As part of this project, a watermain corridor will be proposed along English Street. A 200mm diameter ductile iron watermain is proposed from NE28 to NW1. As part of the phasing for this work, it is proposed to install one hot tap tee c/w valve near NE 25 and one new hot tap tee c/w valve at NW1. The preliminary sequencing proposed as follows:
        i. Installation of hot tap tee c/w valve at NE25
        ii. Installation of hot tap tee c/w valve at NW1
        iii. Install new watermain along English Street from NE25 to NW1
        iv. Install new hydrants (2) c/w double check valve back flow prevention assembly (see Appendix B for Corix Detail drawing 10908-51 for reference)
        v. Replacement or installation of new building shut off valves
        vi. Chlorinate and test main
        vii. Tie in watermain at NE25 hot tap tee
        viii. Tie in watermain at NW1 hot tap tee
        ix. Tie in water services
        x. Cap and remove old watermain
        xi. Turn on water valves at new hot tap tees

b. The north utility corridor will have the existing watermain removed and replaced with a 150mm diameter ductile iron watermain to allow for the new electrical ducts. The tie in connections will be at NE21 and NE06.
c. The south utility corridor will have the existing watermain removed and replaced with a 150mm diameter ductile iron watermain to allow for the new electrical ducts. The tie in connections will be at NW6 and NE18.

5. English Street Storm Sewer
   a. Upgrading the storm sewer along English Street and the North/South Utility Corridor's will be undertaken during this project. A new 300mm to 375mm diameter SDR 35 PVC storm sewer is proposed to carry runoff from English Street and convey runoff to Guichon Creek and the White Avenue Trunk Sewer.
   b. In the north utility corridor, the twin 250mm storm sewer will be replaced with a single 375mm diameter SDR 35 PVC storm sewer.
   c. The south utility corridor will have the existing 150mm to 250mm storm sewer replaced to connect with the English Street storm sewer.
   d. Proposed locations of storm sewers are illustrated on drawing C02. The existing catchbasins will be upgraded to the industry standards. To accommodate environmental concerns, three (3) hydrodynamic separators will be incorporated into the design to maintain water quality before being discharged to the existing storm sewer systems. At this time the Contech Model 1000 units, or approved equivalent, may be considered as the hydrodynamic separators.
6. English Street Sanitary Sewer
   a. It is proposed to install a Sanitary Sewer corridor within the English Street road works to meet the future development of the BCIT campus. A new 200mm diameter SDR 35 PVC sanitary sewer is proposed to carry future demand loads from adjacent buildings between English Street and Goard Way and connect to the existing sanitary sewer east of NW1. It is anticipated that the existing sanitary sewer located between English Street and Goard way will ultimately be phased out and decommissioned.
   b. The north utility corridor will have the existing sanitary sewer removed and replaced with a 150mm diameter SDR 35 PVC pipe to allow for the new electrical ducts. The connection will be west of NE21.
7. Constructability Notes
   a. Staging/phasing the temporary and permanent utility construction will be required to maintain the operations and service connections to the existing buildings.
   b. The existing utility service connections will require new service connections in the areas of the new substations. Due to the limited space between buildings, it is anticipated that smaller construction equipment will be required which will involve a longer time for construction within those areas.
8. Streetscaping
   a. Replacement of north side of street with new wider sidewalk, street trees and benches. Asphalt to be repaired and replaced

Year 3—Existing and new Canada Way receiving station load schedule

Unit Substations	Unit sub ratings (kVA)	Buildings serviced	Peak demand (kW)	Remarks
Sub A	750	NE20, NE22, NE24	90	
Sub B	225	NE18, NE28	90	
Sub CDJ	**1000**	**NE2, NE 4, NE6, NE21, NE 23, NE 25, NW1,NW3,**	**401**	**New unit sub, Connected to new Canada Way sub**
Sub G	600	NW5, NW6	90	
Sub M	600	NE16	75	
Sub N	1500	NE1,NE3	549	
Sub TF	**1000**	**NE12**	**150**	**New Unit Sub, connected to new Canada Way Sub**
Sub W	**1000**	**NE7, NE8, NE 9, NE 10**	**492**	**New unit sub, Connected to new Canada Way sub**
Total for both Canada Way Substations			**1,937 kW**	

Total power demand on existing Canada Way sub: **Pd = 894 kW**
Total power demand on new Canada Way sub: **Pd = 1,043 kW**
Total power demand on Goard Way sub: **Pd = 3,290 kW**

Note 1: Any additional or reduced power requirement on south campus is not recorded in the above table.

Note 2: Decommissioning and demolition of existing unit subs C, D and J is to be included in the scope of work.

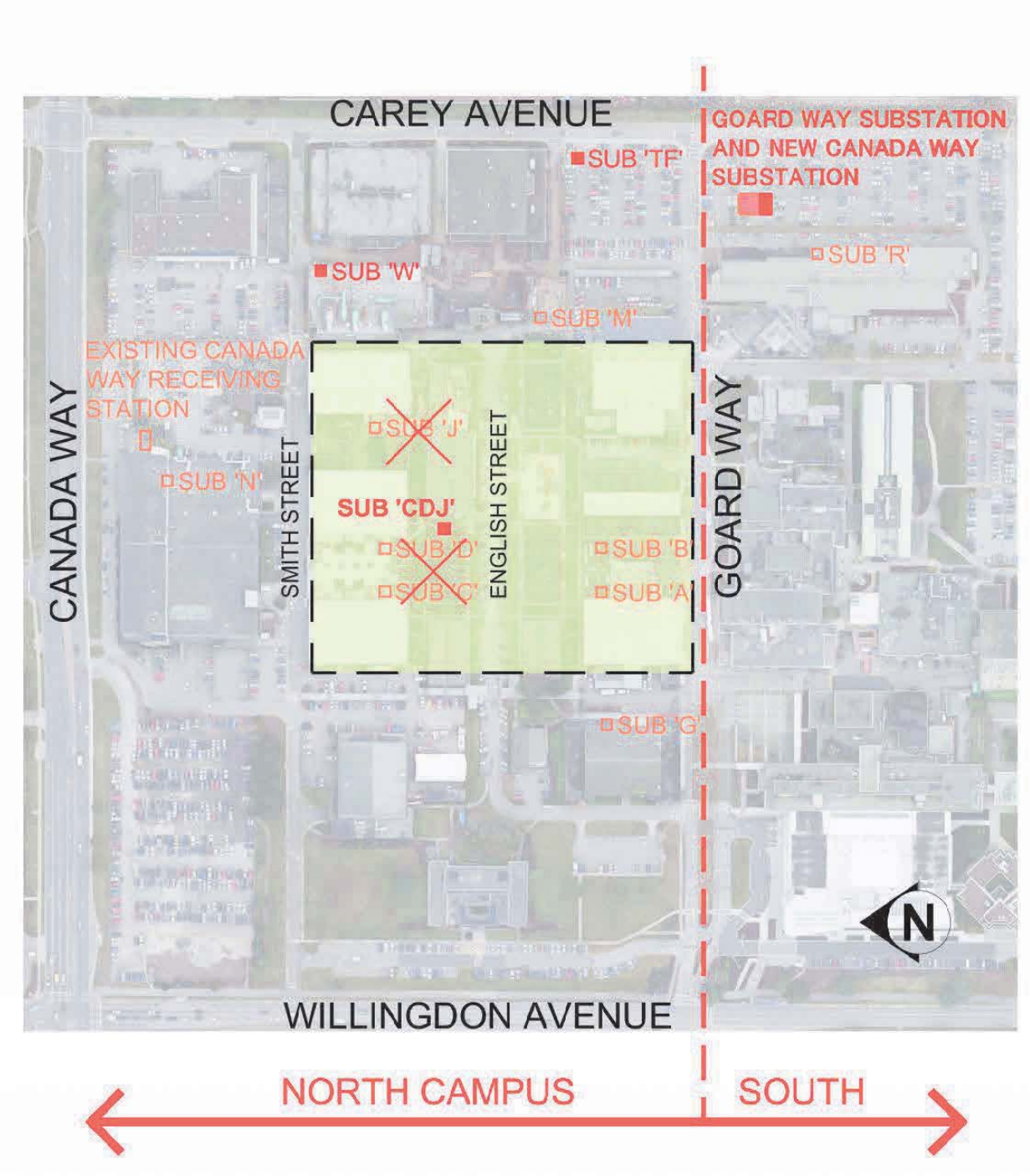


Figure 9 Proposed Work–Year 3

7.4 YEAR 4 (APRIL 2019–MARCH 2020)

1. Consolidate unit subs “A” and “B” into one unit sub “A,B”,
2. Decommission unit sub “M” and connect building NE16 to unit sub “A,B”,
3. Replace existing with new unit sub “G” to allow for current and new building development F-NW2.
4. Disconnect existing Canada Way receiving station from BC Hydro overhead line network and decommission existing receiving substation.
5. Reconnect existing sub “N” to the BC Hydro O/H line at the same point where the Canada Way substation was connected before,
6. New building development F-NE 3 is built up and energized through unit sub “TF”.
7. Existing building NE 22 is demolished and disconnected from unit sub A.
8. New unit sub HF is constructed for future buildings to be built F-NW1, F-NW3. Current load only shown.
9. Constructability Notes
   a. Staging/phasing the temporary and permanent utility construction will be required to maintain the operations and service connections to the existing buildings.
   b. The existing utility service connections will require new service connections in the areas of the new substations. Due to the limited space between buildings, it is anticipated that smaller construction equipment will be required which will involve a longer time for construction within those areas.

Year 4—Existing and new Canada Way receiving station load schedule

Unit Substations	Unit sub ratings (kVA)	Buildings serviced	Peak demand (kW)	Remarks
Sub AB	750	NE16, NE 18, NE20, NE24. NE 28	230	New unit sub, Connect to new Canada Way sub
Sub CDJ	1000	NE2, NE 4, NE6, NE21,NE 23, NE 25	306	New unit sub, Connected to new Canada Way sub
Sub G	1000	NW5, NW6, F-NW2	779	New bldg. F-NW2 load is added. New unit sub connected to new Canada Way sub
Sub HF	1500	NW1, NW3	95	New unit sub, Connected to new Canada Way sub
Sub TF	750	NE12 , F –NE 3	305	New building F – NE3 load is added. New unit connected to new Canada Way sub
Sub W	1000	NE8, NE10, NE 7, NE 9	492	New unit sub connected to new Canada Way sub
Total for both Canada Way Substations			2,207kW	

Total power demand on existing Canada Way sub: **Pd = 0.0 kW**
Total power demand on new Canada Way sub: **Pd = 2,207 kW**
Unit sub N is independently fed from BC Hydro: **Pd = 549 kW**
Total power demand on Goard Way sub: **Pd = 3,290 kW**

Note1: Any additional or reduced power requirement on south campus is not recorded in the above table.

Note 2: Decommissioning and demolishing unit sub A, B and M is to be included in the scope of work.

Note 3: The future buildings (F – NW 1, F- NW 3) are estimated to draw Pd = 1,110 kW. Therefore, new unit sub "HF" is sized for this future load. This load is not added into demand calculation.

Note4: The new contract is to be negotiated with BC Hydro before power demand limit of 2.0MW is achieved.

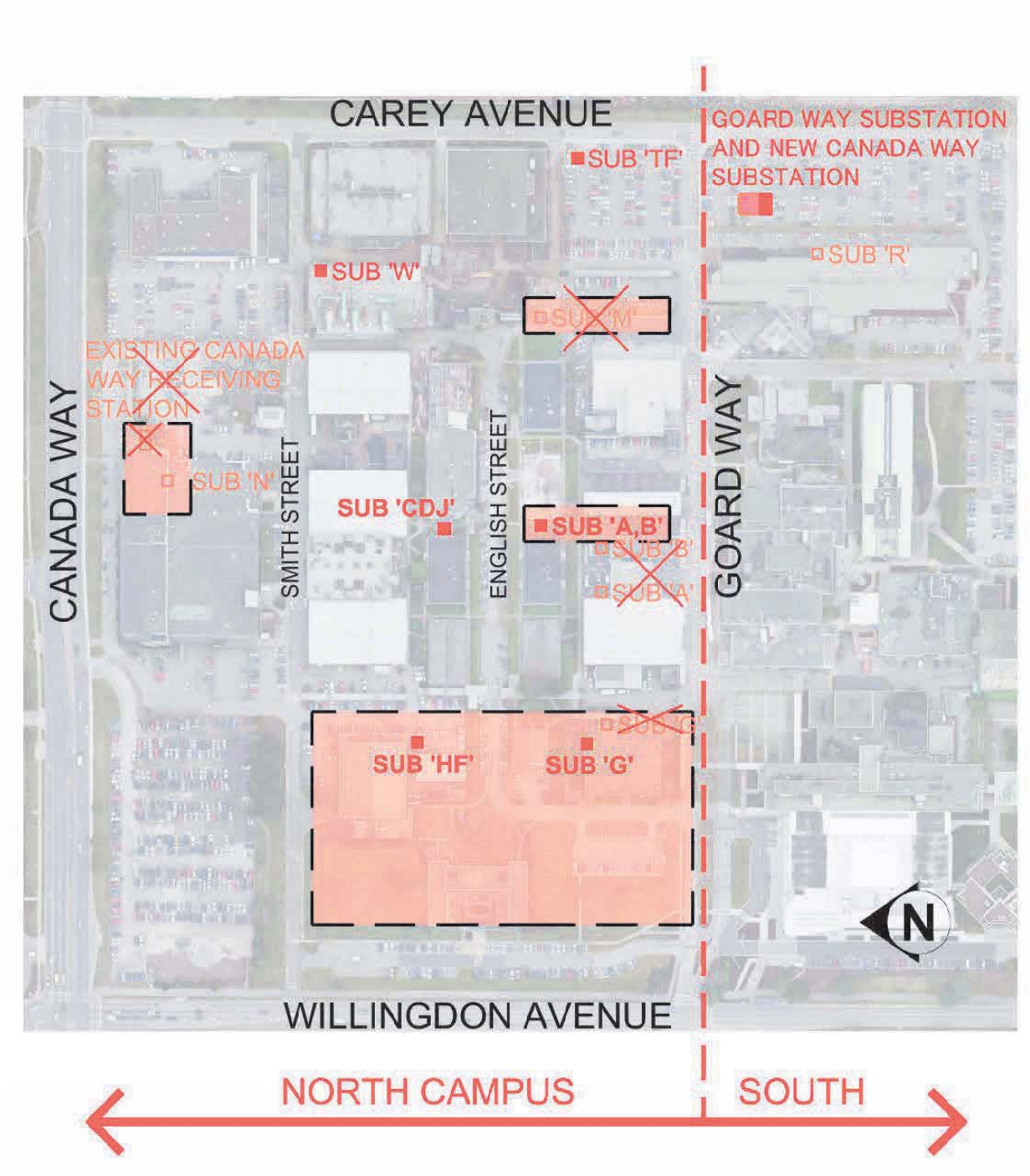


Figure 10 Proposed Work–Year 4