BC Hydro Seed: Technical, Environmental, and Socio-Economic Study

Emery Barnes Park and Nelson Park/Lord Roberts Annex: Proposed Underground Substations

Executive Summary

Prepared for:

BC Hydro
333 Dunsmuir Street
Vancouver, British Columbia

Stantec

1100 – 111 Dunsmuir Street
Vancouver, British Columbia

Executive Summary

Project Overview

To increase the reliability of existing electrical infrastructure and address growing demand for electricity in the downtown core, ageing existing substations, and seismic issues, BC Hydro is looking to expand their transmission infrastructure in downtown Vancouver. The "seed" concept being proposed by BC Hydro involves deviating from the traditional approach of building substations above ground, and adopting an alternative approach by building two new substations below ground. The land above and adjacent to the substations would be used for a new school, daycare spaces and improved parks for the local communities and the property rights compensation could be used for additional benefits such as new and refreshed park(s), another new school, and additional recreational facilities in the downtown core.

The proposed concept includes building an underground substation on Vancouver Park Board (VPB) property under Emery Barnes Park in Downtown, and for the West End, building a new underground substation on Vancouver School Board (VSB) property next to Nelson Park. Construction of the first underground substation at Nelson Park/Lord Roberts Annex in the West End would start as soon as 2020, and the second underground substation at Emery Barns Park in Yaletown starting in 2036. The proposal also includes improved green spaces at Emery Barnes Park and Cathedral Square Park in the short-term, as well as upgrades to the Cathedral Square substation.

Stantec was commissioned by BC Hydro to study the potential effects of the proposed Projects at Emery Barnes Park and Nelson Park/Lord Roberts Annex based on conceptual designs. This report was prepared at the request of the VPB and VSB. The VPB also provided direction on the detailed scope of work, and VSB provided general direction on their requirements. This report includes a brief overview of baseline conditions, potential Project impacts, key mitigation measures and recommendations for future studies. The study has been broken down into three main parts in order to specifically recognize the impacts and mitigation measures based on ownership of land. The Lord Roberts Annex land is owned by the VSB, whereas the Nelson Park and Emery Barnes Park lands are owned by VPB. The studies are also intended to support consultation with the public and other stakeholders prior to the separate and concurrent decision making process by BC Hydro, the VPB and VSB at the end of March 2017.

Next Steps

If the concept is not approved by all parties, it is Stantec's understanding that BC Hydro will advance its traditional approach of building two above-ground indoor substations, likely within a 3 block radius of the proposed project locations. Stantec recommends additional studies be undertaken to confirm that construction impacts for an above-ground indoor substation would

be comparable, and that operational impacts regarding safety, visual impact and noise would be greater than an underground substation.

If the concept is approved by all parties at the end of March 2017, leasing agreements for the lands will be negotiated and finalized and BC Hydro would move forward with more detailed deigns in consultation with the public and other stakeholders. The British Columbia Utilities Commission, a regulatory agency of the Provincial Government, will also act as a decision maker through its administration of the *Utilities Commission Act*. Additional provincial and municipal permits and authorizations may also be required to advance the construction of the proposed projects.

Construction Schedule and Areas Impacted

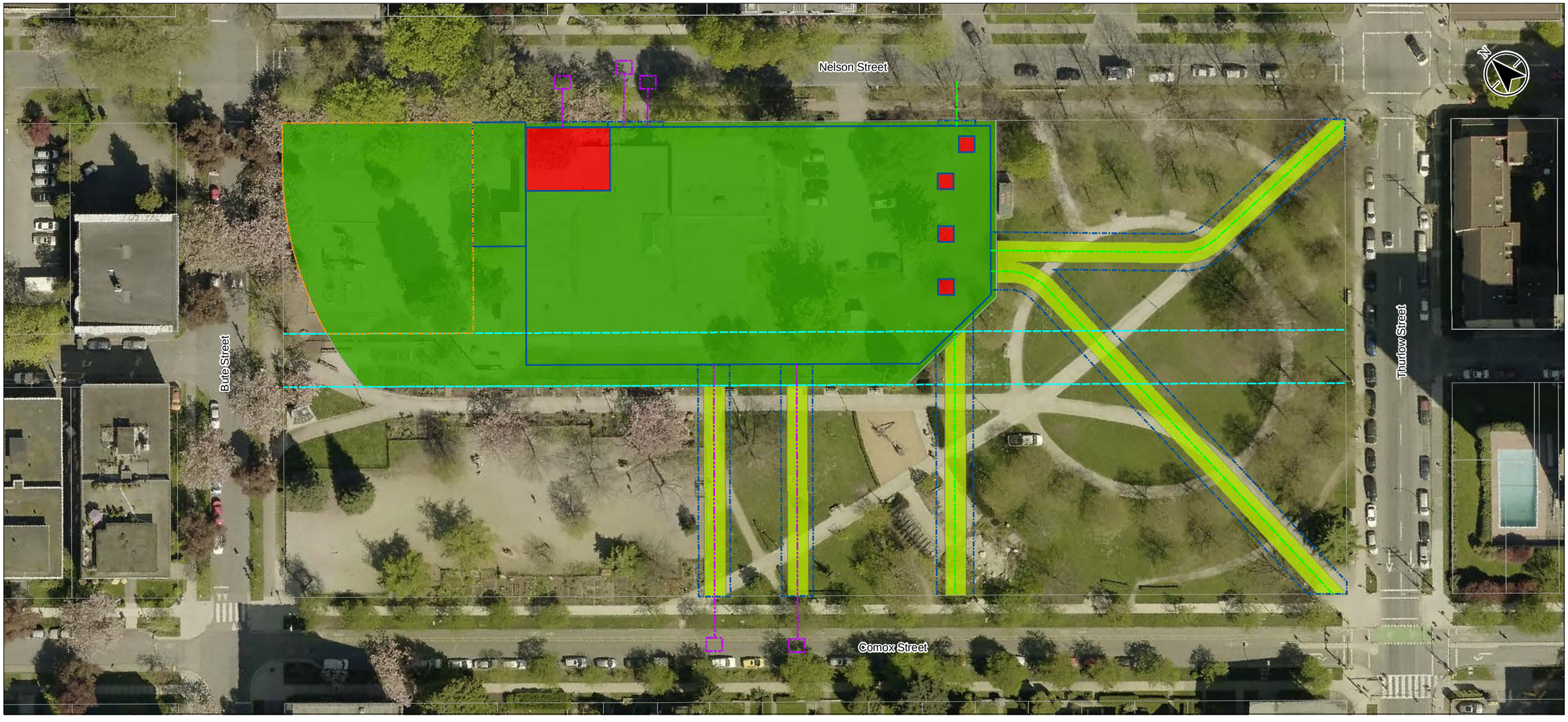
The proposed underground substations at Emery Barnes Park and Lord Roberts Annex would have similar construction sequences and schedules. Total construction time of each project will be approximately five years.

The first three years will include excavation, construction of the substation underground concrete structure and enclosing the structure. For Lord Roberts Annex, the next two years would include fit-out of the substation, installation of the transformer equipment and construction of the green space above the substation. For Emery Barnes Park, the reconstruction of the park would be completed within one year while the fit-out of the substation and installation of the transformer equipment would take the full two additional years.

Laying of the cables from the street, underground through the parks, to the substations would require one to two months within the five-year timeline.

Construction of the school would be sequenced with the construction of the substation at Lord Roberts Annex, with completion about four months ahead of the substation.

A summary of the permanent and temporary areas impacted by the proposed projects is described in Table ES-1 below and presented in Figures ES-1 for Nelson Park/Lord Roberts Annex, and Figure ES-2 for Emery Barnes Park.



- Statutory Right Of Way
- Proposed Statutory Right Of Way
- Temporary Work Area
- Proposed Distribution Duct
- Proposed Transmission Duct
- Proposed Substation
- Property Line

Construction Impact and Duration

- Permanent
- Temporary, min. 3 years
- Temporary, 1-2 months

0 10 20 metres

1:750 (At original document size of 11x17)

Notes

1. Coordinate System: NAD 1983 UTM Zone 10N
2. Base features: DataBC, Government of British Columbia (GovBC); Surrey History National Topographic System, GovBC; CanVec v12,Government of Canada (GC)
3. Orthoimagery: City of Vancouver Open Data catalogue 2015

Stantec

Project Location
Vancouver, BC

123220737
Prepared by L. Trudell 2017-02-15
Reviewed by L. Thompson 2017-02-15

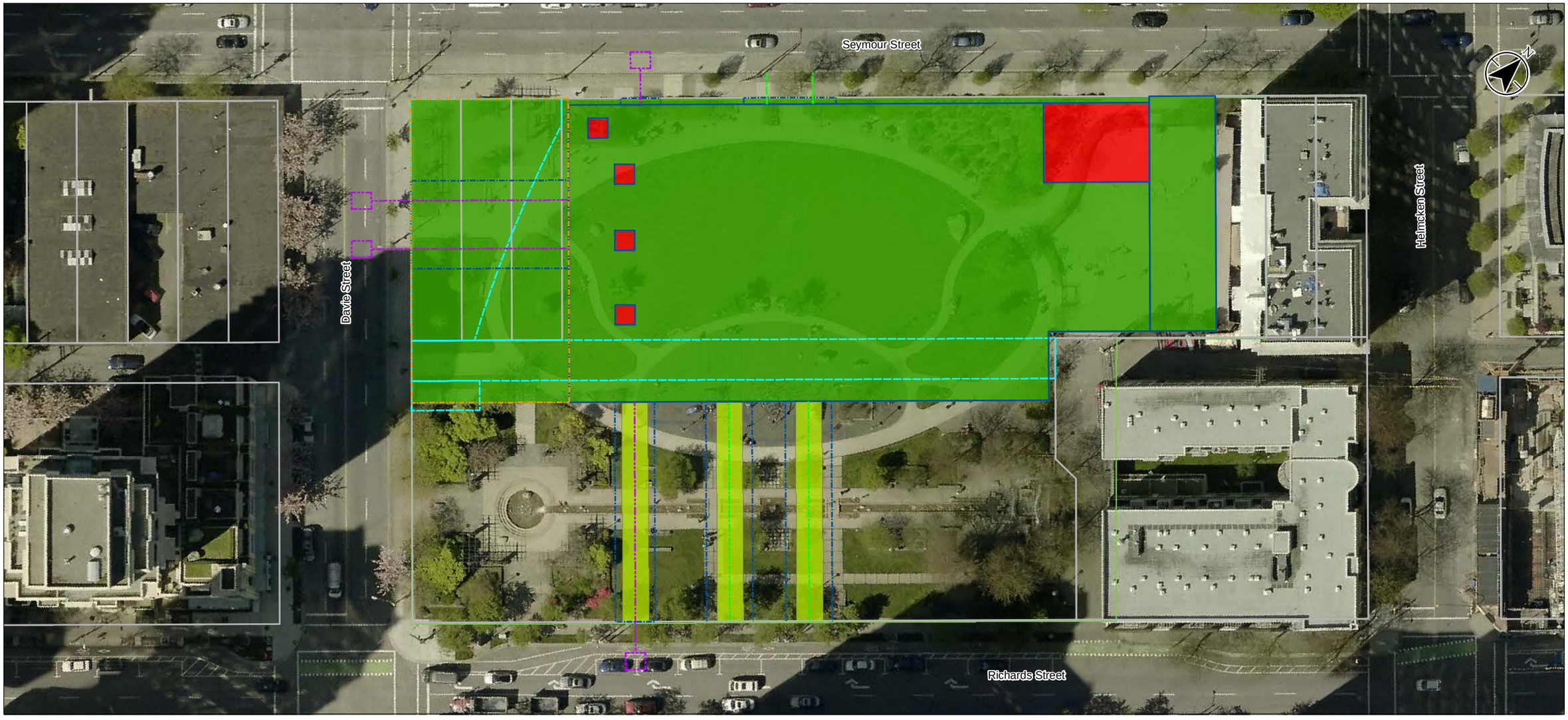
Client/Project
Lord Roberts School Annex / Nelson Park

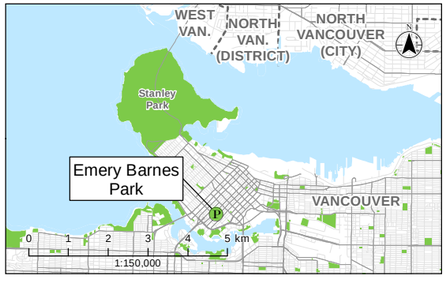
BC Hydro SEED Program Study

Figure No.
ES-1

Title
Lord Roberts School Annex / Nelson Park
Construction Impact and Timelines

\\CD1183-F03\Workgroup\123\Projects\123220785\analyses\Vegetation\20170214_percent_area_lost\fig_123220785_s_001_Lord_Roberts_School_Annex_Nelson_Park_Construction_Impact_and_Timelines.mxd Revised: 2017-02-15 By: ltrudell





Road segment
- Statutory Right Of Way
- Proposed Statutory Right Of Way
- Temporary Work Area
- Proposed Distribution Duct
- Proposed Transmission Duct
- Proposed Substation
- Property Boundary

Construction Impact and Duration
- Permanent
- Temporary, min. 3 years
- Temporary, 1-2 months

0 10 20 metres

1:600 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 UTM Zone 10N
2. Base features: DataBC, Government of British Columbia (GovBC); Surrey History National Topographic System, GovBC; CanVec v12,Government of Canada (GC)
3. Orthoimagery: City of Vancouver Open Data catalogue 2015

Stantec

Project Location
Vancouver, BC

123220737
Prepared by L. Trudell 2017-02-15
Reviewed by L. Thompson 2017-02-15

Client/Project
Emery Barnes Park

BC Hydro SEED Program Study

Figure No.
ES-2

Title
Emery Barnes Park
Construction Impact and Timelines

Table ES-1 Construction Impact and Duration

Site	Construction Impact and Duration	Area (m^2)	Percent
Lord Roberts Annex	Permanently Lost: BC Hydro Infrastructure	228	4%
	Temporary Lost: Substation Construction (min. 3 years)	6,177	96%
	Temporary Lost: Cable Installation (1-2 months)	0	0
	Not impacted	0	0
	Total Area	**6,405**	
Nelson Park	Permanently Lost: BC Hydro Infrastructure	0	0
	Temporary Lost: Substation Construction (min. 3 years)	0	0
	Temporary Lost: Cable Installation (1-2 months)	1,171	10%
	Not impacted	10,487	90%
	Total Area	**11,658**	
Emery Barnes Park	Permanently Lost: BC Hydro Infrastructure	228	3%
	Temporary Lost: Substation Construction (min. 3 years)	4,014	45%
	Temporary Lost: Cable Installation (1-2 months)	400	4%
	Not impacted	4,326	48%
	Total Area	**8,967**	

At the Lord Roberts Annex site, construction of the underground substation will temporarily impact an area of 6,405 m^2 or 100% of the VSB lands for approximately three years. Once construction is complete, 228 m^2 or 4% of the VSB lands will be permanently lost due to the space required for BC Hydro infrastructure, including the vehicle access/intake structure and exhaust shafts. The remaining 6,177 m^2, or 96% of the land will be available for the new school and sports field.

At Nelson Park, installing the underground cables will temporarily impact an area of 1,171 m^2, or 10% of the park for approximately one to two months. Once construction is complete, there will be no permanent loss to the park area, or VPB lands due to BC Hydro infrastructure.

At Emery Barnes Park, construction of the underground substation will temporarily impact 4,014 m^2, or 45% of the park for approximately three years. Installation of the underground cables will also temporarily impact 400 m^2, or 4% of the park for approximately one to two months. Once construction is complete, 228 m^2 or 3% of the VPB lands at Emery Barnes park will be permanently lost due to the space required for BC Hydro infrastructure, including the vehicle access/intake structure and exhaust shafts. The remaining 97% of the VPB land will be available to park users.

Options to incorporate the vent shafts into the design of the new school and park, or allocate them to the perimeter of the properties may further reduce the amount of permanently lost space.

Lord Roberts Annex

Background

Opened in 1972, the Kindergarten to Grade 3 Lord Roberts Annex (the Annex) currently has an enrollment of 140 students. The Annex is connected to Nelson Park, a well-used greenspace for the highly-densified neighbourhood.

The Annex has a Facility Condition Index (FCI) of 0.75. A rating of 0.60 or above does not meet requirements and needs immediate attention to most of its building systems. Most of the building systems are at the end of their life cycle and the risk for system failure is high.

The VSB requires a significantly larger capacity full K to 7 school to replace its current K to 3 Lord Roberts Annex school which is too small to serve current and future school population in the West End. There is also a need for additional childcare in the West End as well as additional all-weather play field space.

Proposed School Project

The seed concept proposes to replace the existing Annex with a -510 capacity modern 21st Century multi-storey school that will cater to kindergarten to grade seven with underground parking facilities. The exterior play areas will be located to south and east of the school with a new artificial turf play field located on top of the roof of the substation to the east.

The new state of the art school is proposed to be net-zero energy use, Passivhaus and/or LEED Gold Certified and would include many more classrooms than currently available at the Annex. It would include a larger gymnasium, library, and multipurpose room that could provide up to 45 spaces for before-and-after school childcare. A City of Vancouver (COV) 0 to 4 childcare is also proposed to be located on the top floor of the new school. The model of combined school and childcare would be a partnership agreement between the VPB and COV to provide much needed non-profit childcare spaces to the West End. This model is currently being implemented at three other replacement schools: Nelson Elementary school which is currently in construction and, Fleming Elementary school and Tennyson Elementary school which are currently in design.

Environmental Studies

Vegetation

As of 2014, the urban forest canopy cover in the West End neighbourhood was approximately 18.6% (City of Vancouver 2014a). Lord Roberts Annex school property has an existing canopy cover of 36%. A total of 39 trees were recorded on the school grounds during a recent field survey, of this total 38 are ≥20 cm diameter at breast height (DBH). No invasive plants, noxious weeds or rare plant species were observed during field surveys.

Based on the conceptual design of the substation, most (approximately 95%) of the existing canopy cover will be lost within the Lord Roberts Annex school property during construction, including 36 trees that are ≥ 20 cm DBH, and one tree that is < 20 cm DBH. This temporary loss of urban canopy includes the loss of ecological functions provided by the urban forest within the park such as habitat for pollinators and urban wildlife, as well as values such as shade. However, the temporary loss of urban canopy can be replaced in the long-term so that there is no net-loss of trees.

Various mitigation measures are recommended for each phase of the Project. Mitigation measures during construction are intended to protect retained trees along the perimeter of the Project footprint and relocate smaller trees within Nelson Park or to nearby parks or streets. Recommended mitigation measures during construction also guide the handling and transportation of soils to reduce erosion and sedimentation, as well as reduce the risk of introduction of invasive plant species. The risk of flooding or drought to trees would be mitigated through surface run-off and groundwater management. Mitigation measures would be implemented to maintain pre-construction drainage patterns to reduce long-term adverse effects on vegetation.

Mitigation measures following construction include working with the VPB to replace the number of trees required by the City of Vancouver. Although large trees cannot be replanted on top of the substation and underground infrastructure, other vegetation such as grass, small shrubs, or possibly small trees (e.g., <5 m height, and <15 cm DBH, at maturity) could be replanted to restore the school grounds following construction and partially offset temporary losses of the urban canopy. A detailed landscape design for the new school grounds would be prepared that incorporates the design constraints presented by the completed Project, while aiming to replace as much of the tree canopy on-site and in-kind as is feasible. The post-construction landscape design for the school grounds would be prepared as a future phase of work following this initial impact and mitigation report.

Final mitigations would be subject to approval by the VSB and VPB.

Electric and Magnetic Fields (EMF)

Stantec Consulting Ltd. contracted Aura Health and Safety Corporation to conduct a study to evaluate the impact of EMF that could result from the Project. Available reports of baseline electric and magnetic field (EMF) measurements around the proposed school site and measurements taken at and above Cathedral Square underground substation (which is similar to the proposed substation) were reviewed. A search of the literature was conducted to find other studies on EMF levels at or near substations, particularly of underground substations. International guidelines and reports on EMF were reviewed to compare predicted exposures with guideline levels and to determine exposure risk to humans. From the exposure and health guideline information, risk categories were assigned. Categories were selected based on two criteria: predicted approximate exposures to human populations, and predicted perceived risk to human populations.

The Lord Roberts Annex is expected to be moved from the current site to the west of the underground substation. As the substation is not expected to produce measurable levels of EMF outside its perimeter and there are no transmission or distribution lines expected to be under the proposed new Annex, the levels above ground at the new Annex are not expected to vary much from the current baseline values at the existing site. A recent review of the literature (2012-2016) indicates there is no new evidence that changes the conclusion of both Health Canada and World Health Organization that there are no confirmed health consequences associated with exposure to low level electromagnetic fields (Exponent, 2017). The risk of impacts from EMF at Lord Roberts Annex is low.

No engineering mitigation strategies would need to be considered as it is expected that the substation and infrastructure would not be impacting the Annex from an EMF perspective. Information sharing and communications in regards to the placement of the substation and transmission and distribution lines may relieve any public perception of risk.

When engineering designs for the proposed substation becomes available, the EMF levels should be modelled for the substation and surrounding areas, and this information should be shared with the public. See Appendix E for additional information on the EMF study completed by Aura Health and Safety Corporation.

Air Quality

Baseline or existing air quality measurements were determined from the two nearest, most representative, continuous air monitoring station in proximity to the Lord Roberts Annex. Generally, the baseline ambient air quality in the vicinity of Lord Roberts Annex is good. Expected sources of criteria air contaminants (CAC) near Lord Roberts Annex include: vehicular traffic, space heating, and other dust sources.

Impacts to air quality were studied based on emission factors from estimated representative off-road excavation and construction equipment. Sources of particulate matter from wind erosion and dust from mobile equipment were not quantified in this study as these sources are difficult to quantify and are highly dependent on the activities/techniques used onsite.

Based on professional judgement and a qualitative assessment of the type, duration and frequency of construction activities, it is predicted that construction of the substation will increase CAC concentrations in the vicinity of Lord Roberts Annex during construction. If best management practices to control CAC emissions are implemented, the degree of change to CAC concentrations is expected to be low. Activities will also be limited to daytime hours, temporary, and irregular in occurrence. As well, impacts would be reversible upon completion of the construction phase. During operations, no air quality impacts are expected as activities will be limited to the venting of air for equipment cooling and maintaining indoor air quality within the substation.

Potential mitigation measures may include, but are not limited to the implementation of best management practices such as watering surfaces prone to wind to suppress fugitive dust, maintaining vehicles in good operating condition, using modern (Tier 3) construction equipment, and reducing idling. Investigating the cause of complaints (if any) may also help yield continuous improvement during construction.

Noise

The acoustic baseline condition was determined by conducting continuous noise measurement within Nelson Park and Lord Roberts Annex on January 20, 2017. During the daytime period, the existing acoustic environment is influenced by local activities within the park (e.g., people, dogs), Lord Roberts Annex (i.e., lunch, recess), natural environment (i.e., wind and birds), and vehicle traffic on the surrounding roads as well as air traffic.

Worst case noise predictions for the construction and operations phase were performed using Cadna/A acoustic modeling software (DataKustik 2015) and in accordance with the internationally accepted sound propagation algorithms (ISO 1993, 1996). During construction, heavy construction equipment such as excavators and jack hammers will generate noise. During operations, noise will be primarily associated with the operation of ventilation equipment for the substation located adjacent to Lord Roberts Annex.

During activities such as jack hammering, the noise level at the nearest point of reception are predicted to be as high as 108.9 dBA., exceeding the noise limit of 85 dBA prescribed in the City of Vancouver Noise By-Law. During operations, noise from the substation ventilation system is predicted to be below the continuous daytime and nighttime quiet zone noise limits of 55 dBA and 45 dBA, respectively for Nelson Park.

Potential mitigation measures to reduce sound levels to allowable limits may include, but are not limited to constructing a 2 m high temporary barrier around the entire construction site to reduce the noise effect by 5 to 10 dBA, and using quieter equipment. Silencers could also be installed on ventilation air inlet and ventilation exhausts. Additional studies could also be implemented to monitor noise levels at night to support a better understanding of ambient conditions, and complete additional modelling once a detailed inventory of construction equipment is known.

Vibration

The vibration study focuses on ground vibration effects from construction equipment, as ground-borne vibration has the potential to affect human health and structural integrity of buildings. The vibration study area extends 200 m out from the project boundary. Vibration effects are not expected during the operation phase of the Project.

There is no available construction vibration guidance for the City of Vancouver or any provincial vibration by-law for construction activities in British Columbia. A such, the City of Toronto Construction Vibration Limit (By-Law No. 514-2008) was referenced for comparison, with a focus on structural damage thresholds. Vibration effects during construction include excavation,

earthworks, construction of the facility and drilling activities. Blasting and pile driving activities are not planned for the construction of the Project.

At the Lord Roberts Annex site, the predicted vibration effects due to excavation and drilling at the closest point of reception is below the recommended structural damage threshold level of 8 mm/s. However, the perceptibility threshold varies from person to person and could result in annoyance.

Vibration can be mitigated by reducing the dynamic forces associated with construction equipment or by isolation. Potential mitigation measures to reduce the vibration effects in order to meet the recommended level of 8 mm/s (City of Toronto Construction Vibration Limit) during construction activities include, but are not limited to confining vibration-generating operations to the least vibration-sensitive part of the day, consulting with the community regarding proposed events, or using smaller equipment or alternative equipment when working close to residential buildings.

Subsurface Hydrology and Ground Conditions

The proposed Nelson Park underground substation will require an excavation depth of approximately 37 m below existing ground level. Data from the Geological Survey of Canada map for Vancouver (Map 1486A), Google Earth imagery, and previous Stantec projects in close proximity to the Project site indicates that the Nelson Park site bedrock, comprised of interbedded sandstone and shale, is within 10 m or less of the surface. Glaciated till soils are comprised of clay, silt, sand, gravel, and cobbles with the occasional boulder, overlay the bedrock. Top soil and fill materials likely comprise the upper 1 to 2 m above the till soils. Perched groundwater is expected at variable depths, depending on the season and weather conditions.

Excavation of soil and rock to construct the underground substation structures is likely to cause noise, vibrations, and dust, all of which are associated with normal construction activities. Excavation of bedrock may involve the use of heavier than normal construction equipment which will require consideration to limit potential impact to nearby structures or nuisance to the local public. Ground subsidence associated with temporary groundwater control is considered to be a low risk to the proposed Lord Roberts Annex project. The risk of ground movement associated with the excavation of soil and rock is also considered to be limited.

Suggested activities to mitigate impacts include, but are not limited to: avoiding potentially noisy construction activities (e.g., excavation) during nighttime hours, using noise barriers and protection blankets during excavation to reduce noise transmittal, limiting generation of dust by wetting surfaces during excavation and covering excavated material prior to and during transport. Geotechnical and groundwater investigations should be undertaken during detailed design to confirm all assumptions made during conceptual design. Condition surveys of nearby structure should be conducted to check for defects or structural weaknesses, to assess the potential risk of damage during construction. Special measures can be provided for temporary and permanent stability if required.

Birds and Other Wildlife

Field surveys conducted by two qualified biologists were completed at Lord Roberts Annex on January 18 and 27, 2017, to record observations and assess value for birds and other wildlife. The Lord Roberts Annex property includes 39 urban trees, which support nesting, foraging, and daytime roosting opportunities for urban birds and other wildlife. One mammal and eight bird species were detected during the field survey and one eastern grey squirrel nest and two northwestern crow nests were detected.

Permanent removal or alteration of trees and understory vegetation at Lord Roberts Annex will reduce nesting, foraging, and daytime roosting opportunities for migratory, resident, and overwintering birds as well as other urban wildlife (e.g., racoons, skunks). Tree removal and reduction in canopy cover will further reduce habitat connectivity for some species. Based on the current proposed conceptual design of the Project, 37 trees will be removed. If construction activities at Lord Roberts Annex are scheduled to coincide with the nesting window for migratory birds, there may be increased potential for incidental take (i.e., mortality or destruction) of breeding individuals and nests located in sections of the park that are subject to vegetation clearing. Sensory disturbance due to noise and vibrations, can also result in avoidance behaviour for birds and other wildlife at Lord Roberts Annex. Noise levels at 70 dB are expected to cause disturbance in the vicinity of the noise source for the duration of construction. Current evidence does not confirm that low levels of EMF exposure result in definitive health or behavioral consequences for birds and other wildlife.

Potential mitigation measures to reduce impacts to birds and other wildlife include, but are not limited to avoiding vegetation clearing during the breeding season for migratory birds (March 28 through August 8) and raptors (February 5 through August 31) to avoid incidental take, and implementing waste management practices to reduce potential wildlife attractants. It is recommended that a pre-construction survey be completed by a qualified biologist to re-assess the presence of wildlife habitat features of concern (e.g., raptor nests, wildlife trees) within the park limits prior to vegetation clearing.

Social Studies

Public Safety—Crime Prevention

A desktop study was undertaken based on the design principles and strategies identified by the National Crime Prevention Council's *Crime Prevention Through Environmental Design (CPTED) Guidebook (2003)*. Additional secondary sources were also consulted to reflect provincial and municipal approaches.

Potential public safety effects that may result from construction of the substation and associated infrastructure at Lord Roberts Annex include: impediment of sight-lines, increased demand for lighting, potential increase in concealed, isolated, and entrapment areas (e.g., public washrooms and entrance to the substation), the timeline of construction and diminishment of maintenance and management of the park, greater demand for signage, and loss of positive aesthetics environment. During operations, potential effects may include, but are not limited to,

public safety concerns in relation to the above-ground ventilation vents, building access and structures which will impede sight-lines.

Potential mitigation measures to support crime prevention during construction and design of the new school may include but are not limited to new designs that allow good visibility, the elimination of concealed or entrapment areas, natural or formal surveillance, or access to help through security features such as emergency telephones. With the implementation of appropriate mitigations and design, the new Lord Roberts Annex may result in some positive outcomes, including reducing the overall number of concealed, isolated, or entrapment areas, increasing the net area of green space (approximately 40% increase), adding new areas to support programming activities, and an overall improvement in the use and design of the school. It is recommended that a full CPTED site risk assessment be undertaken to provide specific CPTED design elements that can be incorporated into the future redesign of the new school.

Public Safety—Accidents and Malfunctions

A desktop study was undertaken to determine potential effects that could result from accidents or malfunctions that may occur during the construction and operation of the proposed Lord Roberts Annex Project. Potential accidents and malfunctions may include: failed equipment, spills of hazardous materials, traffic accidents, electrical hazards from unauthorized access or illegal activity, natural disasters (e.g., earthquakes, fires, and floods), and human caused error.

During construction, most risks to the public and workforce will be related to the movement of materials and people at the construction site. These risks can be reduced through applicable signage, fencing, and adherence to local, municipal, and provincial traffic and safety bylaws, policies and plans, and a project specific Traffic Management Plan.

During construction and post construction, potential risks that may result from the factors described above may be reduced as compared to an above ground substation design because the overall physical impact of effects (e.g., fire, release of hazardous materials, or explosions) will be confined and retained underground. However, the subsurface design may create additional risks to emergency response personnel, because the design creates limited access, confined spaces, and potential for increase in smoke from reduced airflow/ventilation. These effects increase the risks for emergency response providers should a potential operational outage or substation malfunction occur.

BC Hydro could undertake a number of initiatives to manage and reduce these risks, such as using a worst-case scenario approach when designing substations, working with the City of Vancouver in developing a substation specific emergency response plan, training, and applying the Best Available Technology Economically Achievable (BATEA) in the design of the substation (e.g., application of fire retardants, advanced ventilations systems and shut-offs).

Economic Studies

Real Estate Value

Stantec Consulting Ltd. contracted Altus Group to conduct a baseline and literature review of the impact of construction of the two underground substations on property values in the surrounding areas. The two potential impacts on property values as determined by baseline data collected include construction noise and health-related issues associated with electromagnetic fields (EMF) during operations. The two forms of literature reviewed to assess these impacts included questionnaires associated with electrical infrastructure and the analysis of transactional market data of real estate. No literature was found that directly studied the impact of an underground substation on property values; however, similar infrastructure was reviewed. Literature showed that the perception of proximity to a substation could affect property values but there was no technical grounds to confirm this or to determine to what extent.

Based on the BCH conceptual design, having the facility underground removes the risk of a visual intrusion on residents within the area. Having the visual presence of electrical infrastructure did show a decrease in value from similar studies looking at above ground substations however, these conclusions are subjective comparisons when looking at the impact of a below ground substation on local property values. Perceived health impacts of EMF also showed a decrease in value to surrounding property values; however, once again, the literature reviewed only looked at above ground electrical infrastructure and therefore, the conclusion has limitations when comparing to BCH's conceptual design. In conclusion, the BCH conceptual design does have the potential to lower property values for those residents in the surrounding area resulting from the perceived health risk of EMF, however this conclusion currently has no technical merit and is limited in comparison. It was also concluded that independent study of the effect of this uncertainty is likely impossible as it is only one set of factors which can impact property values in the vicinity of electrical works. Construction noise could cause an "annoyance" to residents but no literature showed a decrease in property value.

No mitigation measures were offered within the report, however one could conclude that lowering the perceived risk through public consultation, outreach, and education could be an effective mitigation for those that resided within the immediate surrounding area. One could also conclude that any perceived risk would diminish over time.

The comprehensive Value Impact Report can be found in Appendix F.

Nelson Park

Environmental Studies

Vegetation

As of 2014, the urban forest canopy cover in the West End neighbourhood was approximately 18.6% (City of Vancouver 2014a). Nelson Park has an existing canopy cover of approximately 49% of the park. Nelson Park is less than 1% of the total area of the West End neighbourhood. A

total of 127 trees were recorded within Nelson Park, of this total, 98 trees are ≥20 cm. No invasive plants, noxious weeds, or rare plant species were observed during the survey.

Based on the conceptual design, five trees would need to be removed for construction of the proposed distribution and transmission ducts. Of these five trees, three are ≥ 20 cm DBH and two are < 20 cm DBH. Tree clearing for the proposed Project will result in a loss of approximately 2% of the existing canopy cover from the park, which is less than 0.1% of the West End neighbourhood. This temporary loss of urban canopy includes the loss of ecological functions provided by the urban forest within the park such as habitat for pollinators and urban wildlife, as well as values such as shade. The temporary loss of urban canopy can be replaced in the long-term.

Various mitigation measures are recommended for each phase of the Project. During the design phase, the layout and configuration of the Project has been adjusted to minimize the loss of trees. Mitigation measures during construction are intended to protect retained trees along the perimeter of the Project footprint and relocate smaller trees within Nelson Park or to nearby parks or streets. Recommended mitigation measures during construction also guide the handling and transportation of soils to reduce erosion and sedimentation, as well as reduce the risk of introduction of invasive plant species. The risk of flooding or drought to trees would be mitigated through surface run-off and groundwater management. Mitigation measures would be implemented to maintain pre-construction drainage patterns to reduce long-term adverse effects on vegetation.

Mitigation measures following construction include working with the VPB to replace the number of trees required by the City of Vancouver to achieve no net loss of trees or urban canopy due to the Project. Although large trees cannot be replanted on top of underground infrastructure, other vegetation such as grass, small shrubs, or possibly small trees (e.g., <5 m height, and <15 cm DBH, at maturity) could be replanted to restore the park following construction and partially offset temporary losses of the urban canopy. A detailed landscape design would be prepared that incorporates the design constraints presented by the completed Project, while aiming to replace as much of the tree canopy on-site and in-kind as is feasible. The post-construction landscape design for the park will be prepared as a future phase of work following this initial impact and mitigation report.

Final mitigations would be subject to approval by the VPB.

Electric and Magnetic Fields (EMF)

Stantec Consulting Ltd. contracted Aura Health and Safety Corporation to conduct a study to evaluate the impact of EMF that could result from the project. Available reports of baseline electric and magnetic field (EMF) measurements at the park and measurements taken at and above Cathedral Square underground substation (which is similar to the proposed substation) were reviewed. A search of the literature was conducted to find other studies on EMF levels at or near substations, particularly of underground substations. International guidelines and reports on EMF were reviewed to compare predicted exposures with guideline levels and to determine exposure risk to humans. From the exposure and health guideline information, risk categories

were assigned. Categories were selected based on two criteria: predicted approximate exposures to human populations, and predicted perceived risk to human populations.

The proposed substation will have three 230 kV transmission underground cables near the south-east corner of the station and throughout the park. It is expected that the highest levels of magnetic fields will occur at this corner right above each of the 230 kV cables, but should be less than the levels measured at Cathedral Square where currently three 230 kV transmission cables enter the square. It is anticipated that the magnetic fields levels will be similar to those above the Cathedral Square transmission cables where the majority of the time, the levels immediately above the transmission lines would be expected to be less than 25 mG. A recent review of the literature (2012-2016) indicates there is no new evidence that changes the conclusion of both Health Canada and World Health Organization that there are no confirmed health consequences associated with exposure to low level electromagnetic fields (Exponent, 2017). The risk of impacts from EMF at Nelson Park is low.

Various engineering mitigation strategies to reduce the magnetic fields from underground transmission cables can be considered such as burying the cables deeper and optimizing the conductor spacing and phasing arrangement. These mitigation strategies have been modelled to decrease magnetic field levels substantially (e.g., potentially 75 to 90% reduction). These strategies will further reduce magnetic field levels well below the ICNIRP guideline value of 2000 mG. In addition, information sharing and communications in regard to the actual health risks related to EMF may relieve any public perception of risk.

When engineering designs for the proposed substation becomes available, the EMF levels should be modelled for the substation and surrounding areas, and this information should be shared with the public. See Appendix E for additional information on the EMF study completed by Aura Health and Safety Corporation.

Air Quality, Noise and Vibration

Due to the fact that construction impacts within the borders of Nelson Park will be limited to the installation of underground transmission and distribution lines (which will take place over one to two months), the primary air quality, noise and vibration impacts will result from the construction of the underground substation at Lord Roberts Annex on School Board lands. See the Lord Roberts Annex section for a summary of the air quality, noise and vibration studies that will also affect Nelson Park.

Subsurface Hydrology and Ground Conditions

Proposed activity at the Nelson Park site includes constructing electrical conduits into the substation, with trenches up to 3 m below existing ground level. Data from the Geological Survey of Canada map for Vancouver (Map 1486A), Google Earth imagery, and previous Stantec projects in close proximity to the Project site indicates that the Nelson Park site bedrock, comprised of interbedded sandstone and shale, is within 10 m or less of the surface. Glaciated till soils are likely to overlay the bedrock and are comprised of clay, silt and sand with gravel and cobbles with the occasional boulder. Top soil and fill materials likely comprise the upper 1 to 2 m

above the till soils. Perched groundwater is expected at variable depths, depending on season and weather conditions.

It is expected that the conduit excavations will be within topsoil, fill materials, or till soils. Potential impacts for shallow excavations up to 3 m depth include: perched groundwater and/or surficial water runoff may enter the excavations requiring removal using standard sumps and pumps, groundwater seepage may cause instability to temporary excavation sides; and, temporary shoring may be required should construction workers require entry to excavations over 1.2 m depth.

Minimal mitigation measures are considered necessary for the temporary excavations required for the electrical conduits. Typical temporary construction techniques should include protecting excavation side slopes from exposure to precipitation and associated ground surface run-off, and should be regularly inspected by a professional geotechnical engineer for signs of instability. Geotechnical and groundwater investigations should be undertaken during detailed design to confirm all assumptions made during conceptual design.

Birds and Other Wildlife

Field surveys conducted by two qualified biologists were completed at Nelson Park on January 18 and 27, 2017, respectively to record observations and assess value for birds and other wildlife. The park supports 127 urban trees, which support nesting, foraging, and daytime roosting opportunities for urban birds and other wildlife. One mammal and eight bird species were detected during the field survey and one eastern grey squirrel nest and two northwestern crow nests were detected.

Permanent removal or alteration of trees and understory vegetation in Nelson Park will reduce nesting, foraging, and daytime roosting opportunities for migratory, resident, and overwintering birds as well as other urban wildlife (e.g., racoons, skunks). Tree removal and reduction in canopy cover will further reduce habitat connectivity for some species. Based on the current proposed Nelson Park Project conceptual design, installation of the underground cables will result in the removal of five trees. If construction activities at Nelson Park are scheduled to coincide with the nesting window for migratory birds, there may be increased potential for incidental take (i.e., mortality or destruction) of breeding individuals and nests located in sections of the park that are subject to vegetation clearing. Sensory disturbance due to noise and vibrations, can also result in avoidance behavior for birds and other wildlife at Nelson Park. Noise levels at 70 dB are expected to cause disturbance in the vicinity of the noise source for the duration of construction. Current evidence does not confirm that low levels of EMF exposure result in definitive health or behavioral consequences for birds and other wildlife. A recent review of the literature (2012-2016) indicates there is no new evidence that changes the conclusion of both Health Canada and World Health Organization that there are no confirmed health consequences associated with exposure to low level electromagnetic fields (Exponent, 2017).

Potential mitigation measures to reduce impacts to birds and other wildlife include, but are not limited to avoiding vegetation clearing during the breeding season for migratory birds (March 28

through August 8) and raptors (February 5 through August 31) to avoid incidental take, and implementing waste management practices to reduce potential wildlife attractants. It is recommended that a pre-construction survey be completed by a qualified biologist to re-assess the presence of wildlife habitat features of concern (e.g., raptor nests, wildlife trees) within the park limits prior to vegetation clearing.

Social

Park Use and Programming

A series of desktop and on-site studies were conducted to create an inventory of current park materials, amenities, and conditions, and to understand how Nelson Park is used. Additionally, the site was surveyed to record the current layout and location of major park components.

While the development of the substation is expected to occur on the Vancouver School Board property, it is anticipated that Nelson Park and its users will also be impacted. Construction impacts will include the underground routing of transmission and distribution ducts via trenching through portions of the park. The construction process is anticipated to take one to two months, and certain areas of the park will have restricted public access at that time. The school playground equipment will also be removed during construction, and will not be available to the public.

Should the proposed project move forward and BC Hydro advances their designs, additional engagement will take place with the VPB and the public to reassess the areas of the park that will be affected by the project. Mitigation measures should also include proper construction sequencing to minimize potential impacts on the surrounding community, BC Hydro working with VPB to reassess changes to programming of the park once construction is complete (as the park is older, consideration may be given to update designs, uses, and materials to reflect current uses of public space), and consideration for completing further studies such as a full condition assessment to understand the quality and longevity of each material, site furnishings, and play equipment, including providing recommendations for upgrades and/or replacement.

Public Safety—Crime Prevention

A desktop study was undertaken based on the design principles and strategies identified by the National Crime Prevention Council's *Crime Prevention Through Environmental Design (CPTED) Guidebook (2003)*. Additional secondary sources were also consulted to reflect provincial and municipal approaches.

Potential public safety effects that may result from the installation of underground transmission cables during construction includes: impediment of sight-lines, increased demand for lighting, potential increase in concealed, isolated, and entrapment areas, the timeline of construction and diminishment of maintenance and management of the park, greater demand for signage, and loss of positive aesthetics environment. During post-construction, the potential impacts to park users will be few to none, based on the current plans to bury the cables underground.

Potential mitigation measures to support crime prevention during construction may include but are not limited to allowing good visibility through natural or formal surveillance, the elimination of concealed or entrapment areas, appropriate signage, or access to help through security features such as emergency telephones. It is recommended that a full CPTED site risk assessment be undertaken to provide specific CPTED design elements that can be incorporated into the future redesign of Nelson Park.

Public Safety—Accidents and Malfunctions

A desktop study was undertaken to determine potential effects that could result from accidents or malfunctions that may occur during the construction and operation of the proposed Nelson Park/Annex Project. For Nelson Park, this includes the laying of electric cables under the park and their operation. However, accident or malfunction of the substation adjacent to the park at Lord Roberts Annex will also result in adverse effects to park users and are summarized in the Lord Roberts Annex section.

Economic Studies

Real Estate Value

Stantec Consulting Ltd. contracted Altus Group to conduct a baseline and literature review of the impact of construction of the two underground substations on property values in the surrounding areas. The two potential impacts on property values as determined by baseline data collected includes construction noise and health-related issues associated with electromagnetic fields (EMF) during operations. The two forms of literature reviewed to assess these impacts included questionnaires associated with electrical infrastructure and the analysis of transactional market data of real estate. No literature was found that directly studied the impact of an underground substation on property values; however, similar infrastructure was reviewed. Literature showed that the perception of proximity to a substation could affect property values but there was no technical grounds to confirm this or to determine to what extent.

Based on the BCH conceptual design, having the facility underground removes the risk of a visual intrusion on residents within the area. Having the visual presence of electrical infrastructure did show a decrease in value from similar studies looking at above ground substations however, these conclusions are subjective comparisons when looking at the impact of a below ground substation on local property values. Perceived health impacts of EMF also showed a decrease in value to surrounding property values however, once again, the literature reviewed only looked at above ground electrical infrastructure and therefore, the conclusion has limitations when comparing to BCH's conceptual design. In conclusion, the BCH conceptual design does have the potential to lower property values for those residents in the surrounding area resulting from the perceived health risk of EMF; however, this conclusion currently has no technical merit and is limited in comparison. It was also concluded that independent study of the effect of this uncertainty is likely impossible as it is only one set of factors which can impact property values in the vicinity of electrical works. Construction noise could cause an "annoyance" to residents but no literature showed a decrease in property value.

No mitigation measures were offered within the report, however one could conclude that lowering the perceived risk through public consultation, outreach, and education could be an effective mitigation for those that resided within the immediate surrounding area. One could also conclude that any perceived risk would diminish over time.

The comprehensive Value Impact Report can be found in Appendix F.

Emery Barnes Park

The initial conceptual design for Emery Barnes Park used in BC Hydro's initial consultation materials was modified based on feedback from various stakeholders to improve sightlines and reduce shadow effects. The modified design is a mirror image of the initial concept and was used as the basis for Stantec's impact and mitigation study.

Environmental Studies

Vegetation

As of 2014, the urban forest canopy cover in the Downtown neighbourhood was approximately 8.3% (City of Vancouver 2014a). Emery Barnes Park has an existing canopy cover of 32%, which is approximately 1% of the canopy cover of the Downtown neighbourhood. During the tree inventory survey, 111 trees were measured, of which 33 are ≥ 20 cm DBH. No invasive plants, noxious weeds, or rare plant species were observed during the survey. A large portion of the Project footprint is open grassy field with paths throughout.

Based on the footprint of the conceptual design for the Project within Emery Barnes Park, 59 trees would need to be removed for construction. Of the 59 trees to be removed, 15 of which are ≥ 20 cm DBH. Their removal represents a temporary loss of approximately 33% of the existing canopy cover from the park, and less than 0.1% of the canopy of the Downtown neighbourhood. This temporary loss of urban canopy includes the loss of ecological functions provided by the urban forest within the park such as habitat for pollinators and urban wildlife, as well as values such as shade. However, the temporary loss of urban canopy can be replaced in the long-term.

Various mitigation measures are recommended for each phase of the Project. During the design phase, the layout and configuration of the Project has been adjusted to minimize the loss of trees. Mitigation measures during construction are intended to protect retained trees along the perimeter of the Project footprint and relocate smaller trees within Emery Barnes Park or to nearby parks or streets. Recommended mitigation measures during construction also guide the handling and transportation of soils to reduce erosion and sedimentation, as well as reduce the risk of introduction of invasive plant species. The risk of flooding or drought to trees would be mitigated through surface run-off and groundwater management plans. Mitigation measures would be implemented to maintain pre-construction drainage patterns to reduce long-term adverse effects on vegetation.

Mitigation measures following construction include working with the VPB to replace the number of trees required by the City of Vancouver to achieve no net loss of trees or urban canopy due to the Project. Although large trees cannot be replanted on top of the substation and underground infrastructure, other vegetation such as grass, small shrubs, or possibly small trees (e.g., < 5 m height and <15 cm DBH, at maturity) could be replanted to restore the park following construction and partially offset temporary losses of the urban canopy. The use of raised beds and planter boxes, as currently exhibited in Emery Barnes Park, could potentially support additional tree replacement on-site. A detailed landscape design would be prepared that incorporates the design constraints presented by the completed Project, while aiming to replace as much of the tree canopy on-site and in-kind as is feasible. The post-construction landscape design for the park would be prepared as a future phase of work following this initial impact and mitigation report.

Final mitigations would be subject to approval by the VPB.

Electric and Magnetic Fields (EMF)

Stantec Consulting Ltd. contracted Aura Health and Safety Corporation to conduct a study to evaluate the impact of EMF that could result from the project. Available reports of baseline electric and magnetic field (EMF) measurements at the park and measurements taken at and above Cathedral Square underground substation (which is similar to the proposed substation) were reviewed. A search of the literature was conducted to find other studies on EMF levels at or near substations, particularly of underground substations. International guidelines and reports on EMF were reviewed to compare predicted exposures with guideline levels and to determine exposure risk to humans. From the exposure and health guideline information, risk categories were assigned. Categories were selected based on two criteria: predicted approximate exposures to human populations, and predicted perceived risk to human populations.

The proposed substation will have three 230 kV transmission underground cables near the south-east corner of the station and throughout the park. It is expected that the highest levels of magnetic fields will occur at this corner right above each of the 230 kV cables, but should be less than the levels measured at Cathedral Square where currently three 230 kV transmission cables enter the square. It is anticipated that the magnetic fields levels will be similar to those above the Cathedral Square transmission cables where the majority of the time, the levels immediately above the transmission lines would be expected to be less than 25 mG. A recent review of the literature (2012-2016) indicates there is no new evidence that changes the conclusion of both Health Canada and World Health Organization that there are no confirmed health consequences associated with exposure to low level electromagnetic fields (Exponent, 2017). The risk of impacts from EMF at Nelson Park is low.

Various engineering mitigation strategies to reduce the magnetic fields from underground transmission cables can be considered such as burying the cables deeper and optimizing the conductor spacing and phasing arrangement. These mitigation strategies have been modelled to decrease magnetic field levels substantially (e.g., potentially 75 to 90% reduction). These strategies will further reduce magnetic field levels well below the ICNIRP guideline value of

2000 mG. In addition, information sharing and communications in regard to the actual health risks related to EMF may relieve any public perception of risk.

When engineering designs for the proposed substation become available, the EMF levels should be modelled for the substation and surrounding areas, and this information should be shared with the public. Refer to Appendix E for the full report regarding EMF. See Appendix E for additional information on the EMF study completed by Aura Health and Safety Corporation.

Air Quality

Baseline or existing air quality measurement was determined from the two nearest, most representative, continuous air monitoring station in proximity to the proposed Emery Barnes Project. Generally, the baseline ambient air quality in the vicinity of Emery Barnes Park is good. Expected sources of criteria air contaminants (CAC) near Emery Barnes Park include: vehicular traffic, space heating, and other dust sources.

Impacts to air quality were studied based on emission factors from estimated representative off-road excavation and construction equipment. Sources of particulate matter from wind erosion and dust from mobile equipment were not quantified in this study as these sources are difficult to quantify and are highly dependent on the activities/techniques used onsite.

Based on professional judgement and a qualitative assessment of the type, duration and frequency of construction activities, it is predicted that construction of the substation will increase CAC concentrations in the vicinity of Emery Barnes Park during construction. If best management practices to control CAC emissions are implemented, the degree of change to CAC concentrations is expected to be low. Activities will also be limited to daytime hours, temporary, and irregular in occurrence. As well, impacts would be reversible upon completion of the construction phase. During operations, no air quality impacts are expected as activities will be limited to the venting of air for equipment cooling and to maintaining indoor air quality.

Potential mitigation measures may include, but are not limited to the implementation of best management practices such as watering surfaces prone to wind to suppress fugitive dust, maintaining vehicles in good operating condition, using modern (Tier 3) construction equipment, and reducing idling. Investigating the cause of complaints (if any) may also help to yield continuous improvement during construction.

Noise

The acoustic baseline condition was determined by conducting continuous noise measurement within the Emery Barnes Park on January 20, 2017. During the daytime period, the existing acoustic environment around Emery Barnes Park is influenced by local activities within the park (e.g., people, dogs), commercial activities in nearby streets, natural environment (i.e., wind and birds), vehicle traffic, air traffic and noises associated with the off-leash dog area and children's playground. The noise measurements at Emery Barnes Park were also influenced by ongoing construction activities, occurring at the north end of the park, on Seymour Street.

Worst case noise predictions for the construction and operations phase were performed using Cadna/A acoustic modeling software (DataKustik 2015) and in accordance with the internationally accepted sound propagation algorithms (ISO 1993, 1996). During construction, heavy construction equipment such as excavators, and jack hammers will generate noise. During operations, noise will be primarily associated with the operation of the ventilation equipment for the substation.

During construction activities such as jack hammering, the noise level at the nearest point of reception are predicted to be as high as 109.1 dBA., exceeding the noise limit of 85 dBA prescribed in the City of Vancouver Noise By-Law. During operations, noise from the substation ventilation system is predicted to be below the continuous daytime and nighttime noise limits of 70 dBA and 65 dBA respectively.

Potential mitigation measure to reduce sound levels to allowable limits may include, but are not limited to constructing a 2 m high temporary barrier around the entire construction site to reduce the noise effect by 5 to 10 dBA, and using quieter equipment. Silencers could also be installed on ventilation air inlet and ventilation exhausts. Additional studies could also be implemented to monitor noise levels at night to support a better understanding of ambient conditions, and complete additional modelling once a detailed inventory of construction equipment is known.

Vibration

The vibration study focused on ground vibration effects from construction equipment, as ground-borne vibration has the potential to affect human health and structural integrity of building. The vibration study area extends 200 m out from the project boundary. Vibration effects are not expected during the operation phase of the Project.

There is no available construction vibration guidance for the City of Vancouver or any provincial vibration by-law for construction activities in BC. A such, the City of Toronto Construction Vibration Limit (By-Law No. 514-2008) was referenced for comparison, with a focus on structural damage thresholds. Vibration effect during construction include excavation, earthworks, construction of the facility and drilling activities. Blasting and pile driving activities are not planned for the construction of the Project.

At the Emery Barnes site, the predicted vibration effect due to excavation at the closest point of reception is above the recommended structural damage threshold level of 8 mm/s. The residential building located 7.5 m southeast of the Project is identified within the zone of influence, and the perceptibility of construction vibration could also result in annoyance.

Vibration can be mitigated by reducing the dynamic forces associated with construction equipment or by isolation. Potential mitigation measures to reduce the vibration effects in order to meet the recommended level of 8 mm/s (City of Toronto Construction Vibration Limit) during construction activities include, but are not limited to confining vibration-generating operations to the least vibration-sensitive part of the day, consulting with the community regarding proposed events, or using smaller equipment or alternative equipment when working close to residential buildings.

Subsurface Hydrology and Ground Conditions

The proposed Emery Barnes underground substation will require an excavation depth of approximately 36 m below existing ground level. Data from the Geological Survey of Canada map for Vancouver (Map 1486A), Google Earth imagery, and previous Stantec projects in close proximity to the Project site indicates that at the Emery Barnes Park site bedrock, comprised of interbedded sandstone and shale, is more than 10 m below the surface. Glaciated till soils are likely to overlay the bedrock, and contain clay, silt and sand with gravel and cobbles with the occasional boulder. Top soil and fill materials likely comprise the upper 1 to 2 m above the till soils. Perched groundwater is expected at variable depths, depending on season and weather conditions.

Excavation of soil and rock to construct the underground substation structures is likely to cause noise, vibrations, and dust, all of which are associated with normal construction activities. Excavation of bedrock may involve the use of heavier than normal construction equipment which will require consideration to limit potential impact to nearby structures or nuisance to the local public. Ground subsidence associated with temporary groundwater control is not considered to be a significant risk to the proposed Emery Barnes Project. The risk of ground movement associated with the excavation of soil and rock is also considered to be limited.

Suggested activities to mitigate impacts include, but are not limited to: avoiding potentially noisy construction activities (e.g., excavation) during nighttime hours, using noise barriers and protection blankets during excavation to reduce noise transmittal, limiting generation of dust by wetting surfaces during excavation and covering excavated material prior to and during transport. Geotechnical and groundwater investigations should be undertaken during detailed design to confirm the assumptions made in the conceptual design.

Birds and Other Wildlife

Field surveys conducted by two qualified biologists were completed at Emery Barnes Park on January 18 and 27, 2017, to record observations and assess value for birds and other wildlife. The park includes 111 urban trees, which support nesting, foraging, and daytime roosting opportunities for urban birds and other wildlife. One mammal and three bird species were detected during the field survey.

Permanent removal or alteration of trees and understory vegetation in Emery Barnes Park will reduce nesting, foraging, and daytime roosting opportunities for migratory, resident, and overwintering birds as well as other urban wildlife (e.g., racoons, skunks). Tree removal and reduction in canopy cover will further reduce habitat connectivity for some species. Based on the current proposed Emery Barnes Project conceptual design, construction of the underground substation (and supporting infrastructure) will result in the removal of 59 trees. If construction activities at Emery Barnes Park are scheduled to coincide with the nesting window for migratory birds, there may be increased potential for incidental take (i.e., mortality or destruction) of breeding individuals and nests located in sections of the park that are subject to vegetation clearing. Sensory disturbance due to noise and vibrations, can also result in avoidance behaviour for birds and other wildlife at Emery Barnes Park. Noise levels at 70 dB are expected to cause disturbance in the vicinity of the noise source for the duration of construction. Current evidence does not confirm that low levels of EMF exposure result in definitive health or behavioral consequences for birds and other wildlife. A recent review of the literature (2012-2016) indicates there is no new evidence that changes the conclusion of both Health Canada and World Health Organization that there are no confirmed health consequences associated with exposure to low level electromagnetic fields (Exponent, 2017). A recent review of the literature (2012-2016) indicates there is no new evidence that changes the conclusion of both Health Canada and World Health Organization that there are no confirmed health consequences associated with exposure to low level electromagnetic fields (Exponent, 2017).

Potential mitigation measures to reduce impacts to birds and other wildlife include, but are not limited to avoiding vegetation clearing during the breeding season for migratory birds (March 28 through August 8) and raptors (February 5 through August 31) to avoid incidental take, and implementing waste management practices to reduce potential wildlife attractants. It is recommended that a pre-construction survey be completed by a qualified biologist to re-assess the presence of wildlife habitat features of concern (e.g., raptor nests, wildlife trees) within the park limits prior to vegetation clearing, in order to comply with regulatory requirements.

Social Studies

Park Use and Programming

Much like Nelson Park, a series of desktop and on-site studies were conducted to create an inventory of current park materials, amenities, and conditions, and to understand how the park is used. The Emery Barnes site was also surveyed to record the current layout and location of major park components.

The development of the substation will occur on the VPB's property, therefore impacts to park programming and use will result in changes to the usable space due to substation structure requirements. Construction impacts will include the construction of the underground substation and routing of the underground transmission and distribution ducts via trenching through portions of Emery Barnes Park. The construction process is anticipated to take three years, and it is anticipated that most of the park will be affected though construction activities and a full re-construction of the park space will be necessary after the substation is constructed.

Should the proposed project move forward and BC Hydro advances their designs, additional engagement will take place with the VPB and other interested parties to collaboratively develop solutions for Emery Barnes Park. Mitigation measures should also include proper construction sequencing to minimize potential impacts on the surrounding community, redesign, and changes to programming of the park once construction is complete. Public input on park use may lead to re-programming opportunities to better meet new user needs. Further study should include detailed analysis of the design of the above-ground elements that can be incorporated into the future redesign of the park.

Public Safety—Crime Prevention

A desktop study was undertaken based on the design principles and strategies identified by the National Crime Prevention Council's *Crime Prevention Through Environmental Design (CPTED) Guidebook (2003)*. Additional secondary sources were also consulted to reflect provincial and municipal approaches.

Potential public safety effects that may result from construction of the substation and associated infrastructure at Emery Barnes Park include: impediment of sight-lines, increased demand for lighting, potential increase in concealed, isolated, and entrapment areas (e.g., public washrooms and entrance to the substation), the timeline of construction and diminishment of maintenance and management of the park, greater demand for signage, and loss of positive aesthetics environment. During operations, potential effects may include, but are not limited to, public safety concerns in relation to the above-ground ventilation vents which may impede sight lines, and possible loss of activity generators which encourage natural surveillance.

Potential mitigation measures to support crime prevention during construction and design of the new park may include but are not limited to park designs that allow good visibility, the elimination of concealed or entrapment areas, and natural or formal surveillance. It is recommended that a full CPTED site risk assessment be undertaken to provide specific CPTED design elements that can be incorporated into the future redesign of Emery Barnes Park.

Public Safety—Accidents and Malfunctions

A desktop study was undertaken to determine potential effects that could result from accidents or malfunctions that may occur during the construction and operation of the proposed Emery Barnes Project. Potential accidents and malfunctions may include: failed equipment, spills of hazardous materials, traffic accidents, electrical hazards from unauthorized access or illegal activity, natural disasters (e.g., earthquakes, fire, and floods), and human caused error.

During construction, most risks to the public and workforce will be related to the movement of materials and people at the construction site. These risks can be reduced through applicable signage, fencing, and adherence to local, municipal, and provincial traffic and safety bylaws, policies and plans, and completion of a project-specific Traffic Management Plan.

During construction and post construction, potential risks that may result from the factors described above may be reduced as compared to an above ground substation design because the overall physical impact of effects (e.g., fire, release of hazardous materials, or explosions) will be confined and retained underground. However, the subsurface design may create additional risks to emergency response personnel, because the design creates limited access, confined spaces, and potential for increase in smoke from reduced airflow/ventilation. These effects increase the risks for emergency response providers should a potential operational outage or substation malfunction occur.

BC Hydro could undertake a number of initiatives to manage and reduce these risks, such as using a worst-case scenario approach when designing substations, working with the City of Vancouver in developing a substation specific emergency response plan, training, and applying the Best Available Technology Economically Achievable (BATEA) in the design of the substation (e.g., application of fire retardants, advanced ventilations systems and shut-offs).

Economic

Real Estate Value

Stantec Consulting Ltd. contracted Altus Group to conduct a baseline and literature review of the impact of construction of the two underground substations on property values in the surrounding areas. The two potential impacts on property values as determined by baseline data collected includes construction noise and health-related issues associated with electromagnetic fields (EMF) during operations. The two forms of literature reviewed to assess these impacts included questionnaires associated with electrical infrastructure and the analysis of transactional market data of real estate. No literature was found that directly studied the impact of an underground substation on property values however similar infrastructure was reviewed. Literature showed that the perception of proximity to a substation could affect property values but there was no technical grounds to confirm this or to determine to what extent.

Based on the BCH conceptual design, having the facility underground removes the risk of a visual intrusion on residents within the area. Having the visual presence of electrical infrastructure did show a decrease in value from similar studies looking at above ground substations however, these conclusions are subjective comparisons when looking at the impact of a below ground substation on local property values. Perceived health impacts of EMF also showed a decrease in value to surrounding property values however, once again, the literature reviewed only looked at above ground electrical infrastructure and therefore, the conclusion has limitations when comparing to BCH's conceptual design. In conclusion, the BCH conceptual design does have the potential to lower property values for those residents in the surrounding area resulting from the perceived health risk of EMF; however, this conclusion currently has no technical merit and is

limited in comparison. It was also concluded that independent study of the effect of this uncertainty is likely impossible as it is only one set of factors which can impact property values in the vicinity of electrical works. Construction noise could cause an "annoyance" to residents but no literature showed a decrease in property value.

No mitigation measures were offered within the report, however one could conclude that lowering the perceived risk through public consultation, outreach, and education could be an effective mitigation for those that resided within the immediate surrounding area. One could also conclude that any perceived risk would diminish over time.

The comprehensive Value Impact Report can be found in Appendix F.