

TM-0592 WIB Property Acquisition Project

Willoughby Substation 414V

Structured Decision Making Support Report

Site Selection Analysis

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Executive Summary

Due to load growth in the Willoughby area of the Township of Langley a new 230/69/25 kV 200 MVA outdoor AIS substation is to be constructed. Currently BC Hydro does not have any suitable properties for the new station. The TM-0592 Property Acquisition project is to search out and find a suitable property to purchase for the substation. This report summarizes the engineering review of the properties evaluated. Due to the dynamic nature of the current property market this report will only be able to consider properties under consideration at the time of writing. It is possible that the site selected will not be covered by this report however the information contained within will help guide the ultimate selection.

At the time of writing, offers to purchase have been made on a set of properties currently owned by Bosa Developments. Project Management is also requesting that additional adjacent properties be purchased to ensure sufficient space is available to fully develop the most efficient station layout while preserving land for future expansion if necessary. It is not known at this time if the sales will be completed and therefore this report does not make any specific recommendation as to the appropriate property for purchase.

1 Introduction

Due to load growth in the Willoughby area of the Township of Langley, a new substation is required. Currently, BC Hydro has no vacant properties on which to construct a new station. On November 1st, 2023, project TM-0592 was initiated to find and purchase a property to develop a new 230/25 kV 200 MVA ultimate Outdoor Air Insulated Switchgear (AIS) substation with provision for a future 60 kV yard. The station is specified as AIS due to the general rural nature of the area, although this could be changed depending on the properties available for purchase.

This report summarizes the engineering evaluations of the properties considered during the conceptual phase of the project. Initially, twenty-two (22) sites were identified as potential locations for a new station. After initial screening, the list was reduced to four (4) sites. As the project advanced some sites were dropped and others added for consideration. The following sections will discuss the properties and the various findings.

The engineering team evaluated a number of factors for each site including transmission ingress, distribution egress, proximity to load center, size of the property, potential electrical layouts, constructability issues and geotechnical conditions among other factors. This evaluation was by nature a high-level investigation with a prime focus of eliminating unsuitable sites. Due to the dynamic nature of the current property market, this report will only consider properties under consideration at the time of writing. It is possible that the site ultimately selected will not be covered by this report, however the information contained within will guide the ultimate selection.

This report does not include any evaluation of Environmental or First Nations concerns nor any financial considerations as these are covered by other groups.

2 Background

Langley is one of the fast-growing areas in Lower Mainland. It is situated within Fraser River to the North, 0 Avenue to the South, 196 Street to the West and 272 Street to the East. Three substations serve the Langley area, Port Kells (PKL), Harvey Road (HRD) and McLellan (MLN) substations. PKL and HRD are 60/25kV substations, and they are at their ultimate capacities of 100MVA in Winter and 79MVA in Summer. MLN is a 230/25kV, 200MVA (Winter)/158MVA (Summer) substation and being upgraded to 400MVA (Winter)/315MVA (Summer) with 30 feeder positions in F2030 to meet the area load growth and customers' requirement. By F2033, most of the augmented capacity and feeder positions at MLN will be used up based on Langley placemat and there will be no capacity and feeder positions available in the existing substations to supply the new area loads.

The Township of Langley (TOL) includes the Willoughby neighbourhood which bounds the City of Surrey at 196th street. Areas of service include, Willoughby, Carvolth, Milner, Willowbrook and parts the City of Langley. Development has been rapid around the 200th St. corridor and the load growth along with electrification upgrades are expected to outstrip supply by 2033. Due to electrification and the rapid growth along the 200th St corridor, the additional load increase in Willoughby area will be about 48MVA by F2033 and 130+MVA beyond F2033. To meet that demand a new substation is needed in the Willoughby area by 2032. It is proposed that a property for a new 230/69/25 kV 200 MVA station be purchased as soon as possible to meet this date.

Currently, BC Hydro has no surplus properties to use for a new station. In order to meet the timeline of the new substation, a piece of property suitable for a 230/69/25kV, 200MVA outdoor AIS substation needs to be purchased as soon as possible in a location near the load center as identified by Distribution Planning (See Figure 1)

properties evaluated may not be available for purchase and other properties considered will not be covered by this report. As of the writing of this report an offer to buy has been made for a set of properties owned by Bosa developments. Additional properties will be needed to provide a site large enough for the new station. While the sales have not been finalized it is assumed that the purchase will be ultimately successful. Should the purchase not be successful the

information contained in this report can be used as a baseline for assessing other options.

3 Properties Reviewed

As noted above the initial choice of sites was reduced to four for further evaluation. Those four are listed below as:

- Alternate 14B is a 12.5 Acre assembly of five residential (5) properties located at the intersection of 80th Avenue and 192nd St in Surrey.



Figure 2 Location of Alt 14B

- Alternate 18 a 8.15 Acre assembly of two properties owned by the Qualico Development group. The parcel is located at the intersection of 78th Avenue and 195B street. An additional separate private parcel of 2.22 acres directly west of Alternate 18 would need to be considered to allow full development of the site.



Figure 3 Location of Alt 18

- Alternate 19 is a 10.9 Acre assembly of three private properties at the intersection of 76th Avenue and the incomplete extension of 196th street.



Figure 4 Location of Alt 19

These parcels are directly south and abutting the Qualico properties of Alternate 18. A fourth parcel directly west of this assembly might be required to allow full development of the site.

- Alternate 20 is a 9.5 Acre assembly of two parcels owned by the Bosa Development group. Additional privately held parcels directly south of the Bosa parcels would need to be added to fully develop the ultimate station layout. Currently, the two parcels to the south-west of the Bosa assembly are being considered to allow the full development of a substation.



Figure 5 Location of Alt 20

The next sections will describe the alternatives in more detail and summarize the findings of the engineering team.

3.1 Alternate 14B

3.1.1 Current Use

Currently, Alternate 14B is a collection of residential parcels with single family homes on large lots. Some of the parcels may be used for hobby farms or left fallow.

3.1.2 Electrical Assessment

The electrical design team has a “typical” layout for a 200 MVA Air Insulated Distribution station. This typical layout is 110.0 m x 198.5 m requires approximately 21,505 m² or about 5.3 Acres of land. This allows for a control building, 2-230/25 kV transformers, two line positions and up to 24 feeders. Station Planning has requested that the new stations in the lower mainland have a provision for future expansion by adding space for additional line positions and provision for a 60 kV section. As part of the analysis of other sites, the electrical design team has developed a number of layouts with this level of equipment which includes a control room, 4 -230 kV line positions, 2-230/25 kV 150 MVA transformers, 2 – 230/60 kV 150 MVA transformers and 4 - 60 kV line positions.

The layout has a minimum dimension of 181 m x 196 m or 35,476 m² or approximately 8.7 Acres. No specific layout was prepared for Alternate 14B as it was considered a lower priority alternate given that the sites were not actively for sale and it would require an assembly of multiple properties when other properties were actively for sale. The overall site is sufficiently large to accommodate the layout required by Planning. For more information refer to the electrical memo in Appendix A.

3.1.3 Civil Assessment

As this site was not considered a primary site to assess, the level of investigation was limited to preliminary site grading and access considerations. The site is located at the corner of 192nd street and 80th Avenue and access is considered to be good. The site has a general slope of approximately 6% from east to west. An analysis by the Civil team indicates that approximately 40,000 m³ of cut and 80,000 m³ of fill would be required to fully level the site for use as a substation. For more information refer to Appendix B

3.1.4 Geotechnical Assessment

This alternative was not directly assessed in the geotechnical review as it was a lower priority as it was not one of the favoured sites. The review however did discuss the geotechnical conditions of the general area and noted that reasonable soil conditions with moderate seismic risk could be expected for alternate 14B. It was noted that if this alternative was to be considered a more thorough review would need to be undertaken with a dedicated field program before it could be recommended as a viable alternative. For more information refer to Appendix C

3.1.5 Transmission Assessment

The alternative was only considered at a high level as the site was not considered to be a leading alternative. O/H routes were plotted along a number of paths using Google Earth however ultimately it was determined that like all other sites under review, the most likely routes were underground from McLellan along 192nd and 196th streets to the local area and from there minor rerouting of the 196th street path along 197th street and 80th avenue would bring the line to the site. For more information refer to Appendix D

3.1.6 Suitability for use as a substation

As other sites were actively for sale this site was considered a lower priority for review it only received a cursory examination from the various disciplines. Based on the level of review, the general site conditions and proximity to the load center this site would possibly be suitable for a substation however more investigation would be required before a final decision could be made.

3.2 Alternate 18

3.2.1 Current Use

Alternate 18 is a two-parcel assembly owned by Qualico Developments. Currently the site holds residences and farm buildings. It is being held until financial conditions for development improve.

3.2.2 Electrical Assessment

As noted in Section 3.1.2 the preferred size for the required development is 181 m x 196 m or 35,476 m² or approximately 8.7 Acres. The site currently is not large enough for the ultimate development but is large enough for a first stage. If the station is expanded in the future, the property to the west would need to be obtained. A second scenario would be if the parcels directly south that comprise Alternate 19 were obtained, the full station could be easily accommodated. However, a decision on this path would need to be made before final design of the initial stage begins so as to make the most efficient use of the properties. Finally, a third scenario would be to develop a GIS station on the two Qualico parcels. This is not preferred due to costs and is noted only to provide all options for consideration in the event additional properties cannot be obtained. For more information refer to the electrical memo in Appendix A.

3.2.3 Civil Assessment

The site is generally flat east to west with an average slope of 4.7% running north to south. Site development to bring the site to an average grade of 3% would require approximately 22,700 m³ of cut and 45,300 m³ of fill. Access is less favourable for this site as 196th Street has not been extended and the only access is from the frontage on 78th Avenue. The city of Surrey or the Township of Langley may require completion of 196th as part of the project construction cost. There is a creek to the west on the property not owned by Qualico that could complicate the full development of the site if it is obtained. High water flows in the creek could introduce flooding or erosion of the substation. Environmental setbacks could reduce the available area such that the station is not viable and runoff from the station could potentially contaminate the creek. These conditions would need to be carefully considered before development of the substation. For more information refer to Appendix B

3.2.4 Geotechnical Assessment

The geotechnical team conducted a desktop review of the area with added attention to some of the sites. Alternative 18 was included in the review. The site is in the Clayton area of Surrey. The surface soils in this area were assessed by reviewing the stratigraphy observed during ground well installation in the area and reviewing the Geologic Survey of Canada Map 148A. The surface soils are comprised of Capilano Sediments with Vashon Drift or Pre-Vashon tills below. These surface deposits consist of marine and glaciomarine stony (including till-like deposits) to stoneless silt loam to clay loam with minor sand and silt usually less than 3 m thick but up to 30 m depth in areas. Below this layer can be found Pre-Vashon till deposits. The static ground water table in the area varies between 18 m and 53 m below surface grade and there is potential for parts of the groundwater to be part of a pressurized Aquifer. The seismic site classification is likely to be site class C or D and liquefaction is not expected. As the expected foundations for the substation would likely be shallow footings there does not appear to be any major issue in developing this site for a substation. A more detailed confirmatory exploration program consisting of two or three augered drill holes and seismic cone penetration testing is recommended before a final decision on purchase of the site is completed. For more information refer to Appendix C

3.2.5 Transmission Assessment

For this site, a review of potential Overhead line routes was conducted. O/H routes were plotted along a number of paths using Google Earth and it was determined the only viable route for O/H would be along 196th street. This would be a challenge as much of 196th street serves newer residential areas, and the corridor is not very wide nor is it continuous. The only solution would be a double circuit monopole however Transmission planning is not comfortable with this due to reliability issues with both circuits supplying the station on the same set of structures. Ultimately it was determined that like all other sites the most likely routes were underground from McLellan generally along 192nd and 196th streets to the local area and from there minor rerouting of the 192nd street path along

78th Avenue to bring the line to the site. For more information refer to Appendix D

3.2.6 Suitability as a substation

Based on the review by each discipline, the general site conditions and proximity to the load center this site would be suitable for a substation provided additional lands can be obtained to develop the ultimate station. However as noted in section 3.2.4 a confirmatory geotechnical investigation is recommended prior to final purchase of the site.

3.3 Alternate 19

3.3.1 Current Use

Alternate 19 is a three parcel assembly of private properties at the corner of 76th Avenue and 196th street in Surrey. This assembly is directly south and abutting Alternate 18. The assembly is currently occupied by private homes. Much of the land has been cleared in the past and some of the land has naturally revegetated with some second growth forest.

3.3.2 Electrical Assessment

As noted in Section 3.1.2 the preferred size for the required development is 181 m x 196 m or 35,476 m² or approximately 8.7 Acres. The Alternate 19 assembly at 44,122 m² (10.9 Acres) is large enough for the ultimate site development based on the layouts prepared by electrical design. If Alternate 19 were reduced to two of the three parcels (assuming the third was not available) it would be necessary to obtain other lands to complete the ultimate station. This could be managed by purchasing Alternate 18 directly to the North. As noted in Section 3.2.3 a decision on purchasing Alternate 18 would need to be confirmed before design of the station to ensure an efficient design. As with Alternate 18, a third scenario would be to develop a GIS station on the two Alternate 19 parcels. This is not preferred due to costs and is noted only to provide all options in the event

additional properties cannot be obtained. For more information refer to the electrical memo in Appendix A.

3.3.3 Civil Assessment

The site is generally flat with a slope of approximately 2.5% from east to west. No significant cut or fill is required to level the site. Access is less favourable as like Alternate 18, 196th is not complete and access is only available from 76th Avenue which is a single lane road at the parcel frontage. The creek noted in section 3.2.3 is not expected to be a concern as it is further west than at Alternate 18 however it would need to be investigated further if this property is selected for purchase. For more information refer to Appendix B

3.3.4 Geotechnical Assessment

Due to the proximity of Alternate 19 to Alternate 18 the general conditions listed in section 3.2.4 would apply to this site as well. For more information refer to Appendix C

3.3.5 Transmission Assessment

Due to the proximity of Alternate 19 to Alternate 18 the general conditions listed in section 3.2.5 would apply to this site as well except that diversion of the transmission route would be along 76th Avenue rather than 78th Avenue. For more information refer to Appendix D

3.3.6 Suitability as a substation

Based on the review by each discipline, the general site conditions and proximity to the load center this site would be suitable for a substation with some caveats. The potential costs to extend 76th Avenue and 196th street to improve access as well as the potential impact of the creek to the west of the site would need to be studied and as noted on section 3.2.4 a confirmatory geotechnical investigation is recommended prior to final purchase of the site.

3.4 Alternate 20

3.4.1 Current Use

Alternate 20 is a five-parcel assembly consisting of two lots owned by Bosa properties, and three parcels owned by individuals. The final assembly is not determined as not all the private owners are willing to sell. The Bosa properties are available and an offer to purchase was made by BC Hydro. Two of the other lots are under negotiation with the third owner holding out. Currently all the lots are occupied with at least one home and potentially farm buildings or left naturally vegetated.

3.4.2 Electrical Assessment

As noted in Section 3.1.2 the preferred size for the required development is 181 m x 196 m or 35,476 m² or approximately 8.7 Acres. For this site, the initial property configuration only consisted of the two Bosa Properties with total dimensions of 390.3 m x 99.05 m. This complicated the design as the site was very long and narrow. The layout developed (WIB-E05-SK004 R0A) was an inefficient layout which included indoor 25 kV and 60 kV Gas Insulated Switchgear (GIS) sections and outdoor 230 kV bus and transformers. The layout required transmission connections on the North boundary. This would have required ROW across private properties. This is not an optimal solution, and the acquisition of adjacent properties was looked at.

The first adjacent property considered was the private parcel to the south and east of the Bosa lands. A number of layouts were considered culminating in WIB-E05-SK006-Op2. This layout located the outdoor 230 kV yard and four transmission terminals on the east side of the assembly and the Air insulated (AIS) 25 kV yard on the western portion of the eastern Bosa property with the future AIS 60 kV yard located on the western Bosa property. This layout requires cables to supply the 60 kV yard and while it makes better use of the property it is still not optimal. What it did prove was that a substation could be constructed if an additional adjacent parcel were purchased along with the Bosa property. Since that layout was completed the focus of additional property has been on adding the parcel on the southwest boundary of the Bosa properties as that owner is willing to sell the land. A revised layout will be prepared for the new assembly however it will not be ready for the completion of this report. The new

layout will effectively be a mirror image of the WIB-E05-SK002-Op2 and will show the site comprising Bosa, Kool and Walia properties can host a substation however as noted previously it will not be optimal.

It is understood that efforts to purchase the parcel to the east of the Kool site will continue and if it becomes available a more efficient station layout will be able to be prepared. For more information refer to the electrical memo in Appendix A.

3.4.3 Civil Assessment

The site has a general slope of 4% from east to west. Some cut and fill work will be required to level the site to an average of 3% grade. Volumes are 13000 m³ of cut and 27000 m³ of fill. Access is better than the Alternate 18 and 19 as 196th while only a single lane fronting the Bosa Property does extend to full width of the site. 194th extends past the full frontage of the site and there is a spur road called 194a St that reaches the southern boundary of the site. There are no water courses near the site. For more information refer to Appendix B

3.4.4 Geotechnical Assessment

Due to the proximity of Alternate 19 to Alternate 18 the general conditions listed in section 3.2.4 would apply to this site as well. However, as the site is under offer to purchase, BC Hydro will be conducting a due diligence geotechnical investigation prior to completion of the purchase. The results of the investigation will not be known before completion of this report. For more information refer to Appendix C

3.4.5 Transmission Assessment

Due to the proximity of Alternate 20 to Alternate 18 and 19 the general conditions listed in section 3.2.5 would apply to this site as well except, that the diversion

from 192nd would occur along 76th avenue and 194th St. For more information refer to Appendix D

3.4.6 Suitability for use as a Substation

Based on the review by each discipline, the general site conditions, and proximity to the load center, this site would be suitable for a substation with some caveats. While an electrical layout will be prepared for the Bosa/Kool/Walia properties it won't be ready for this report. However, it is expected to be a mirror image of that prepared for the Bosa/Kang property as the assemblies are both the same size. As shown for Bosa/Kang layout, a station could be constructed on the assembly but would not be an efficient design. If the Kang property could be purchased a much more efficient layout could be prepared for the site. However, if it is not available the Bosa/Kool/Walia site would be suitable for a station. As noted, offers to purchase the Bosa and Kool properties have been made and a confirmatory geotechnical investigation is being prepared in the event that purchase agreements are completed.

4 Conclusions

The project team investigated several potential sites for the new Willoughby substation. The original selection of 22 sites was reduced to four sites for this stage of the project. The sites were Alternate 14B, Alternate 18, Alternate 19, and Alternate 20. Alternate 14B and Alternate 19 would require assembly by BC Hydro and for this reason they are less preferable. Alternate 18 and 20 were leading as both were assemblies held by developers who were willing to sell. While neither site was large enough on its own for the ultimate substation the project team determined it was likely that adjacent properties could be purchased to make up the required lands.

The team reviewed all the properties and determined that there were no major technical issues that would prevent the development of a substation subject to a confirmatory Geotechnical investigation for each site. Before the project team investigations were complete, senior management made a decision to make an offer on the Bosa properties of Alternate 20 based on the reasonable price and its availability. Purchase negotiations continue at the time writing and further offers have been made for adjacent properties. It is expected that Alternate 20 will be selected provided the Geotechnical investigation scheduled for January 2025 does not find a disqualifying condition.

Appendix A

Electrical Memo - Willoughby Substation (WIB) Property Purchase Project

[https://ppm.bchydro.bc.ca/projects/TM-0592/ProjectDocuments/Design/1_IDN/Electrical%20Memo-Willoughby%20Substation%20\(WIB\)%20Property%20Purchase%20Project%20-%20Signed.pdf](https://ppm.bchydro.bc.ca/projects/TM-0592/ProjectDocuments/Design/1_IDN/Electrical%20Memo-Willoughby%20Substation%20(WIB)%20Property%20Purchase%20Project%20-%20Signed.pdf)

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Appendix B

Willoughby Substation – Civil Memo

https://ppm.bchydro.bc.ca/projects/TM-0592/ProjectDocuments/Design/1_IDN/Willoughby%20Substation%20-%20Civil%20Memo.pdf

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Appendix C

TM0592 Willoughby Sub Geotechnical Desktop

https://ppm.bchydro.bc.ca/projects/TM-0592/ProjectDocuments/Design/1_IDN/TM0592_Willoughby%20Sub_Geotechnical_desktop.pdf

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Appendix D

TM0592 Willoughby Substation Property Purchase Overhead Transmission Assessment

https://ppm.bchydro.bc.ca/projects/TM-0592/ProjectDocuments/Design/1_IDN/TM-0592%20Willoughby%20Substation%20Property%20Purchase%20Overhead%20Transmission%20Assessment.docx

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TM-0592 Willoughby Substation

GIS Discussion

ATTENDEES:	Kally Jiang – Stations Electrical Ken Zeng - Stations Electrical Fariborz Mojebi - Equipment	David Chwackinski – Project Engineering Arthur Carr – Equipment T/L Will Fajber – Stations Principal Eng
ABSENT:		
LOCATION:	EDM_E06_Room 1	
MEETING DATE:	12 March 2024 10:00 to 11:00	

ITEM #	ITEM DESCRIPTION
1	General - This meeting is to discuss options to an Outdoor Air Insulated Substation for Willoughby and or Campbell Heights - The Langley area of Willoughby is being heavily developed and a new 200 MVA substation is required by 2032 - Planning wants to include a 60 kV section as well as the 200 MVA 25 kV feeder section - Initial layouts indicate a land requirement for this type of facility to be approximately 41,000 m² or 441,000 Sf (4.1 Ha or 10.1 acres) - There are very few properties of this size in the load area. Other factors influencing this are: - The preferred area is heavily dedicated to Residential development and very expensive - Township of Langley does not want an AI Station in the residential area or fronting on 200th street - The city boundary between Surrey and Langley at 196th St. restricts movement to the west - The area west of 196th is mostly covered by the Agricultural Land Reserve - South of the area is the City of Langley with limited locations to place a station
4	Options - Stations electrical has developed a layout for an outdoor station CAMP-002-E05 SK003 which is the basis of our property search - I have asked SE to develop a high level layout based on Indoor GIS for the 230, 60 and 25 kV components, They provided CAMP-002_E05_SK003B. This requires a land area of about 18,000 m² or 4.4 acres - One question I had is what if any reductions could be made by using Outdoor GIS? - The rationale is that outdoor GIS would not require a building to house the equipment potentially reducing costs.
5	Discussion

	- David outlines the project and noted, that while the plan is to find a property large enough to construct an outdoor AIS station he was looking for alternatives in case a suitable property was not available - Noted that KZ had provided a rough layout of a station with indoor 230 kV GIS, 69 kV GIS, and 25 kV MVGIS with four outdoor transformers and a control building that was less than half the size required for an outdoor AIS - DC asked in general is there any significant cost difference between outdoor GIS and Indoor GIS - Arthur noted that Horsey 230 kV GIS is indoor and the building is very simple, Steel framing with Steel Cladding and limited ventilation equipment. In his words "the most complex thing about it is the Bridge Crane" - AC noted that the 230 kV GIS can operate normally at 30 deg C - AC noted the 25 kV MVGIS would be the same as any other 25 kV MVGIS - AC noted that 69 kV GIS is the same footprint as outdoor GIS - AC noted that 72.5 KV non GIS breakers are very expensive (\$200 k to \$400 k in todays dollars) - It appears that there would be minimal cost savings for outdoor vs indoor GIS (Buildings only) - We discussed the location and viewed the Google Earth mapping of the areas we are looking at. - KZ noted that cost of transmission would be a factor. - Noted that if we could move west of the load center T cost would reduce but D costs increase and if we move east past Willoughby area both T and D costs would increase. - If we can find a large parcel to the west, it may still be possible to use O/H transmission. - If the station is close to the load center, it most likely will mean cables to supply T - DC asked who could provide information on the GIS equipment cos - AC assigned Fariborz to be the point person for equipment. - He will work with DC, KJ and KZ on developing equipment costs including transformers - DC will talk to estimating to get information on similar stations with 25 kV MVGIS and 230 Connection to try and develop some numbers for comparison for the Willoughby team - DC noted he would be meeting with planning today to determine if 69 kV is required at Willoughby as there is no industrial load to serve - DC noted that Campbell Heights does require 69 kV and the cost information would be used for both stations - AC noted that costs are likely to escalate seriously by the time the stations are in service. - DC noted that this information is to be used for a comparison based on today dollars and would not be relied on past that. - DC asked Fariborz when he might be able to provide the equipment cost information and he noted he would try for March 22nd. - Will F noted that land taxation costs were becoming an issue with BCH and it may be a consideration to go with GIS for the long term benefit of the company (Lower initial land costs, lower taxation vs higher initial equipment and
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	construction costs) - WF also noted that earlier there had been discussions about supplying 69 kV to the Campbell heights area from Nicomekl and Mclellan stations. This would remove he 69 kV requirement entirely - Will discuss in meeting with Planning.
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NEXT MEETING	
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Recorded by: David Chwinklinski

TM-0592 Willoughby Substation Property Purchase Project Conceptual Design

	Feng Liu (Civil) Hussien Berisso (PE _substation)	David Chwaklinski (Project Engineering) Dylan Lee (Geotech) Kally Jiang (electrical)
ABSENT:	Craig Steels (T O/H)	
LOCATION:	Teams Meeting	
MEETING DATE:	11-14-2024; 1:30 – 2.00	

Project Details:	Current Stage: Conceptual	Actuals to date:	Approved Budget:
Est Completion:	Conceptual: April 14 ,2025	Project ISD: May 31, 2031	

ITEM #	ITEM DESCRIPTION	LEAD/ACTION
1	Project Overview	LEAD
	- This project is the property purchase for the future Willoughby Substation . - Project Name: Willoughby Substation property Purchase Project (WSPPP) - Workspace has been set up. Team to upload documents consistently and use naming conventions as specified on Workspace	ACTION
2	Meeting Purpose	LEAD
	- This is an update meeting to discuss changes or progress from the last Activities - General Update - Hazard log development - Conceptual Design report - inputs	ACTION

Document ID: TM-0592 WSPPP Conceptual Design mtg
Document Owner: David Chwaklinski
Release Date: TBD

Version: 01.00
Page: P01.0
1 of 4

	○ Geotechnical design memo ○ Electrical design Memo ○ Civil design memo ○ Transmission design memo ● General Discussion re: team needs ● Wrap up ●	
3	Discussion	LEAD
	Discussion ● Funding for conceptual design stage was released in early may ● Conceptual Completion is early April 14, 2025. ● Effective completion for design is Dec 31, 2024, when all documentation needs to be complete ● Schedule ○ Hazard log September 27th, 2024. ○ Discipline memos September 15, 2024. ○ Draft Conceptual Design Report Sept 27, 2024. ○ Final Conceptual Design Report Dec 31, 2024. ● General ● Station Code is confirmed as WIB ● There have been some changes in the proposed sites due to information provided by property owners. Alternative 14B ● Alternate 14B consists of six (6) privately held properties at the corner of 80th Ave and 192nd St. in the Clayton area of Surrey. The PID's are PID 005-951-704, 003-370-879, 005-951-712, 002-229-561, 005-951-721 and 003-370-887. Civic address is 7954 192nd St., 7914 192nd St., 19234 80th Ave., 19276 80th Ave., 19296 80th Ave. and 19324 80th Ave. The land slopes from east to west at a grade of approximately 8 %. The land is occupied by homes and in some areas is heavily treed with the remainder covered in brush. A 25 kV distribution line runs along 80th avenue. ● Currently it looks as if the largest parcel holder may be willing to sell. If a conditional agreement to purchase can be reached with this parcel it may nudge the other parcel owners into a willing to sell position ● Discussions are ongoing Alternative 18 Alternate 18 is a privately held assembly of two parcels owned by Qualico developments and a private parcel owned by the Mattu	ACTION

	family. The Qualico parcels are PID 011—988-959 and 011-988-967 with Civic address 19570 78th Ave. and 19526 78th Ave. Combined the parcels aggregate to 8.15 acres. This would be large enough for the initial stage but to complete the ultimate more property would be required. An addition of the Mattu parcel to the west would allow the ultimate station to be constructed. The Mattu parcel is PID 005-545-048 at 19510 78th Ave. Distribution lines of unknown voltage run on 78th Ave. Alternate 19 Alternate 19 consists of a three individually owned parcels directly south of the Qualico parcels. The PIDs are 002-401-428, 002-401-436 and 009-360-158 with Civic addresses 19595 76th Ave., 19537 76th Ave and 19489 76th Ave. respectively. The sites are home sites and have houses and barns and are partially cleared with tress and shrubbery. The sites are generally flat with decent access. Distribution lines of unknown voltage run on 76th Ave. Alternate 20 Alternate 20 consists of two properties owned by Bosa Properties and three properties to the south of the Bosa Properties. Initially the Bosa properties were not considered as they were too narrow to meet the requirements. Senior management made a decision to make an offer to purchase the Bosa properties due to the small difference between asking price and market valuation. Subsequent to that offer management has directed the team to attempt to purchase additional properties directly south of Bosa to provide sufficient room for an AIS station • Currently with the offer to purchase Alt 20 is the preferred alternative with alt 18 and 19 as backups. • Moving forward most of our effort will be focused on developing the due diligence required to complete the purchase of Alt 20. Overhead • New – nothing has changed from the previous meeting with the new parcel as all the sites are within the same general area. • It has been confirmed that supply will be from McLellan and Ken Zeng has prepared a layout to account for additional line positions. Hussien Berriso is the assigned PE for the Substation project. He is working with Ken, Transmission planning and Distribution planning to determined the best way to egress T lines out of the station without impacting distribution. • Craig noted that it may be difficult to supply with O/H due to the development along the major streets. Geotechnical • New – nothing has changed from the previous meeting as all the	
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	sites are in the same general area. - Dylan Lee Is meeting with Klohn to discuss potential Geotech investigation scope for Willoughby. He has asked to discuss this with Boas and would like a contact person. David to check with PM . Electrical - New – nothing has changed from the previous meeting as all the sites are in the same general area. - Kally has prepared multiple layouts for the consolidated parcels and we have an acceptable layout. Kally has prepared a draft memo outlining her work on the layouts prepared to date.. - These layouts include Alternatives that include AIS and GIS 60 kV and 25 kV sections. This was done to proved out the concept for each site and not necessarily to be considered as viable alternatives. For Alternate 20 aggregate parcel any configuration could be constructed. Civil - Feng has prepared his memo outlining access and development issues for the alternatives. David has asked that he update the mapping to include the complete Alt 20 Parcels. .	
4	Outstanding items	
	.	

NEXT MEETING	Date;11-28-2024 Time; 2:30-3:00 Location, MS teams Meeting
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Recorded by: David Chwaklinski
(Printed Name)

TM-0592 WIB Property Acquisition Project

Willoughby Substation 414V

Structured Decision Making Support Report

Site Selection Analysis

Prepared for: Robert Hepple, Project Manager STATIONS

Prepared by:

David Chwackinski, P. Eng.
Project Engineer Specialist, Estimating and
Project Engineering

Reviewed by:

Hussien Berisso, P.Eng.
Project Engineer Specialist, Estimating and
Project Engineering

Report Metadata

Header: TM-0592 WIB Property Acquisition Project
Subheader: Willoughby Substation 414V
Title: Structured Decision Making Support Report
Subtitle: Site Selection Analysis
Report Number: 414V-TER-00001
Revision: 0
Confidentiality: BC Hydro Internal
Date: 2025 Apr 01
Volume: 1 of 1

Prepared for: Robert Hepple, Project Manager STATIONS
Prepared by: David Chwackinski, P. Eng.
Title: Project Engineer Specialist, Estimating and Project Engineering
Checked by: Hussien Berisso, P.Eng.
Title: Project Engineer Specialist, Estimating and Project Engineering
Reviewed by: Hussien Berisso, P.Eng.
Title: Project Engineer Specialist, Estimating and Project Engineering

Related Facilities:
Additional Metadata:

Revisions

Revision	Date	Description
0	2025 Jan	Initial release
1	2025 Apr	Revised Overhead Memo included

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Acknowledgements

The authors would like to acknowledge the following for their contribution to the engineering and content of this report.

Individual	Department	Contribution
Dylan Lee, P.Eng.	Transmission Lines Engineering	Geotechnical Analysis
Craig Steels, P.Eng.	Transmission Lines Engineering	Transmission Analysis
Kally Jiang, P.Eng.	Transmission Stations Engineering	Electrical Layout Analysis
Amin Kadivar P.Eng.	Transmission Stations Engineering	Civil Analysis

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Appendices

Appendix A	Electrical Memo - Willoughby Substation (WIB) Property Purchase Project
Appendix B	Willoughby Substation – Civil Memo
Appendix C	TM0592 Willoughby Sub Geotechnical Desktop
Appendix D	TM0592 Willoughby Substation Property Purchase Overhead Transmission Assessment

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Executive Summary

Due to load growth in the Willoughby area of the Township of Langley a new 230/69/25 kV 200 MVA outdoor AIS substation is to be constructed. Currently BC Hydro does not have any suitable properties for the new station. The TM-0592 Property Acquisition project is to search out and find a suitable property to purchase for the substation. This report summarizes the engineering review of the properties evaluated. Due to the dynamic nature of the current property market this report will only be able to consider properties under consideration at the time of writing. It is possible that the site selected will not be covered by this report however the information contained within will help guide the ultimate selection.

At the time of writing, offers to purchase have been made on a set of properties currently owned by Bosa Developments. Project Management is also requesting that additional adjacent properties be purchased to ensure sufficient space is available to fully develop the most efficient station layout while preserving land for future expansion if necessary. It is not known at this time if the sales will be completed and therefore this report does not make any specific recommendation as to the appropriate property for purchase.

1 Introduction

Due to load growth in the Willoughby area of the Township of Langley, a new substation is required. Currently, BC Hydro has no vacant properties on which to construct a new station. On November 1st, 2023, project TM-0592 was initiated to find and purchase a property to develop a new 230/25 kV 200 MVA ultimate Outdoor Air Insulated Switchgear (AIS) substation with provision for a future 60 kV yard. The station is specified as AIS due to the general rural nature of the area, although this could be changed depending on the properties available for purchase.

This report summarizes the engineering evaluations of the properties considered during the conceptual phase of the project. Initially, twenty-two (22) sites were identified as potential locations for a new station. After initial screening, the list was reduced to four (4) sites. As the project advanced some sites were dropped and others added for consideration. The following sections will discuss the properties and the various findings.

The engineering team evaluated a number of factors for each site including transmission ingress, distribution egress, proximity to load center, size of the property, potential electrical layouts, constructability issues and geotechnical conditions among other factors. This evaluation was by nature a high-level investigation with a prime focus of eliminating unsuitable sites. Due to the dynamic nature of the current property market, this report will only consider properties under consideration at the time of writing. It is possible that the site ultimately selected will not be covered by this report, however the information contained within will guide the ultimate selection.

This report does not include any evaluation of Environmental or First Nations concerns nor any financial considerations as these are covered by other groups.

2 Background

Langley is one of the fast-growing areas in Lower Mainland. It is situated within Fraser River to the North, 0 Avenue to the South, 196 Street to the West and 272 Street to the East. Three substations serve the Langley area, Port Kells (PKL), Harvey Road (HRD) and McLellan (MLN) substations. PKL and HRD are 60/25kV substations, and they are at their ultimate capacities of 100MVA in Winter and 79MVA in Summer. MLN is a 230/25kV, 200MVA (Winter)/158MVA (Summer) substation and being upgraded to 400MVA (Winter)/315MVA (Summer) with 30 feeder positions in F2030 to meet the area load growth and customers' requirement. By F2033, most of the augmented capacity and feeder positions at MLN will be used up based on Langley placemat and there will be no capacity and feeder positions available in the existing substations to supply the new area loads.

The Township of Langley (TOL) includes the Willoughby neighbourhood which bounds the City of Surrey at 196th street. Areas of service include, Willoughby, Carvolth, Milner, Willowbrook and parts the City of Langley. Development has been rapid around the 200th St. corridor and the load growth along with electrification upgrades are expected to outstrip supply by 2033. Due to electrification and the rapid growth along the 200th St corridor, the additional load increase in Willoughby area will be about 48MVA by F2033 and 130+MVA beyond F2033. To meet that demand a new substation is needed in the Willoughby area by 2032. It is proposed that a property for a new 230/69/25 kV 200 MVA station be purchased as soon as possible to meet this date.

Currently, BC Hydro has no surplus properties to use for a new station. In order to meet the timeline of the new substation, a piece of property suitable for a 230/69/25kV, 200MVA outdoor AIS substation needs to be purchased as soon as possible in a location near the load center as identified by Distribution Planning (See Figure 1)

and as close as possible to the existing 230kV transmission supply out of McLellan Substation. Two new 230 kV line positions will be installed at McLellan station as part of another project to supply the new Willoughby Substation. Transmission routing is part of the substation project and not part of the property purchase project although potential routing will be considered in the site selection analysis. The report summarizes the high-level review of the various properties evaluated for the purchase for the new substation. Due to the dynamic nature of the current property market this report will only be able to consider properties under consideration at the time of writing. There is a moderate risk that the

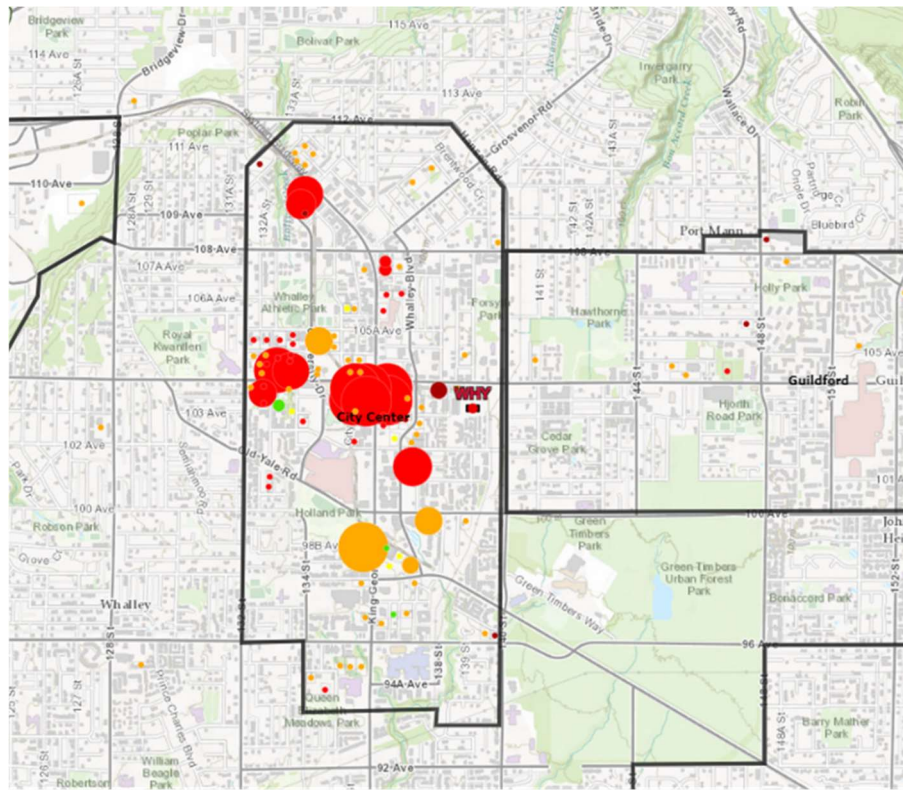


Figure 1 Distribution Load Map

properties evaluated may not be available for purchase and other properties considered will not be covered by this report. As of the writing of this report an offer to buy has been made for a set of properties owned by Bosa developments. Additional properties will be needed to provide a site large enough for the new station. While the sales have not been finalized it is assumed that the purchase will be ultimately successful. Should the purchase not be successful the

information contained in this report can be used as a baseline for assessing other options.

3 Properties Reviewed

As noted above the initial choice of sites was reduced to four for further evaluation. Those four are listed below as:

- Alternate 14B is a 12.5 Acre assembly of five residential (5) properties located at the intersection of 80th Avenue and 192nd St in Surrey.



Figure 2 Location of Alt 14B

- Alternate 18 a 8.15 Acre assembly of two properties owned by the Qualico Development group. The parcel is located at the intersection of 78th Avenue and 195B street. An additional separate private parcel of 2.22 acres directly west of Alternate 18 would need to be considered to allow full development of the site.



Figure 3 Location of Alt 18

- Alternate 19 is a 10.9 Acre assembly of three private properties at the intersection of 76th Avenue and the incomplete extension of 196th street.



Figure 4 Location of Alt 19

These parcels are directly south and abutting the Qualico properties of Alternate 18. A fourth parcel directly west of this assembly might be required to allow full development of the site.

- Alternate 20 is a 9.5 Acre assembly of two parcels owned by the Bosa Development group. Additional privately held parcels directly south of the Bosa parcels would need to be added to fully develop the ultimate station layout. Currently, the two parcels to the south-west of the Bosa assembly are being considered to allow the full development of a substation.



Figure 5 Location of Alt 20

The next sections will describe the alternatives in more detail and summarize the findings of the engineering team.

3.1 Alternate 14B

3.1.1 Current Use

Currently, Alternate 14B is a collection of residential parcels with single family homes on large lots. Some of the parcels may be used for hobby farms or left fallow.

3.1.2 Electrical Assessment

The electrical design team has a “typical” layout for a 200 MVA Air Insulated Distribution station. This typical layout is 110.0 m x 198.5 m requires approximately 21,505 m² or about 5.3 Acres of land. This allows for a control building, 2-230/25 kV transformers, two line positions and up to 24 feeders. Station Planning has requested that the new stations in the lower mainland have a provision for future expansion by adding space for additional line positions and provision for a 60 kV section. As part of the analysis of other sites, the electrical design team has developed a number of layouts with this level of equipment which includes a control room, 4 -230 kV line positions, 2-230/25 kV 150 MVA transformers, 2 – 230/60 kV 150 MVA transformers and 4 - 60 kV line positions.

The layout has a minimum dimension of 181 m x 196 m or 35,476 m² or approximately 8.7 Acres. No specific layout was prepared for Alternate 14B as it was considered a lower priority alternate given that the sites were not actively for sale and it would require an assembly of multiple properties when other properties were actively for sale. The overall site is sufficiently large to accommodate the layout required by Planning. For more information refer to the electrical memo in Appendix A.

3.1.3 Civil Assessment

As this site was not considered a primary site to assess, the level of investigation was limited to preliminary site grading and access considerations. The site is located at the corner of 192nd street and 80th Avenue and access is considered to be good. The site has a general slope of approximately 6% from east to west. An analysis by the Civil team indicates that approximately 40,000 m³ of cut and 80,000 m³ of fill would be required to fully level the site for use as a substation. For more information refer to Appendix B

3.1.4 Geotechnical Assessment

This alternative was not directly assessed in the geotechnical review as it was a lower priority as it was not one of the favoured sites. The review however did discuss the geotechnical conditions of the general area and noted that reasonable soil conditions with moderate seismic risk could be expected for alternate 14B. It was noted that if this alternative was to be considered a more thorough review would need to be undertaken with a dedicated field program before it could be recommended as a viable alternative. For more information refer to Appendix C

3.1.5 Transmission Assessment

The alternative was only considered at a high level as the site was not considered to be a leading alternative. O/H routes were plotted along a number of paths using Google Earth however ultimately it was determined that like all other sites under review, the most likely routes were underground from McLellan along 192nd and 196th streets to the local area and from there minor rerouting of the 196th street path along 197th street and 80th avenue would bring the line to the site. For more information refer to Appendix D

3.1.6 Suitability for use as a substation

As other sites were actively for sale this site was considered a lower priority for review it only received a cursory examination from the various disciplines. Based on the level of review, the general site conditions and proximity to the load center this site would possibly be suitable for a substation however more investigation would be required before a final decision could be made.

3.2 Alternate 18

3.2.1 Current Use

Alternate 18 is a two-parcel assembly owned by Qualico Developments. Currently the site holds residences and farm buildings. It is being held until financial conditions for development improve.

3.2.2 Electrical Assessment

As noted in Section 3.1.2 the preferred size for the required development is 181 m x 196 m or 35,476 m² or approximately 8.7 Acres. The site currently is not large enough for the ultimate development but is large enough for a first stage. If the station is expanded in the future, the property to the west would need to be obtained. A second scenario would be if the parcels directly south that comprise Alternate 19 were obtained, the full station could be easily accommodated. However, a decision on this path would need to be made before final design of the initial stage begins so as to make the most efficient use of the properties. Finally, a third scenario would be to develop a GIS station on the two Qualico parcels. This is not preferred due to costs and is noted only to provide all options for consideration in the event additional properties cannot be obtained. For more information refer to the electrical memo in Appendix A.

3.2.3 Civil Assessment

The site is generally flat east to west with an average slope of 4.7% running north to south. Site development to bring the site to an average grade of 3% would require approximately 22,700 m³ of cut and 45,300 m³ of fill. Access is less favourable for this site as 196th Street has not been extended and the only access is from the frontage on 78th Avenue. The city of Surrey or the Township of Langley may require completion of 196th as part of the project construction cost. There is a creek to the west on the property not owned by Qualico that could complicate the full development of the site if it is obtained. High water flows in the creek could introduce flooding or erosion of the substation. Environmental setbacks could reduce the available area such that the station is not viable and runoff from the station could potentially contaminate the creek. These conditions would need to be carefully considered before development of the substation. For more information refer to Appendix B

3.2.4 Geotechnical Assessment

The geotechnical team conducted a desktop review of the area with added attention to some of the sites. Alternative 18 was included in the review. The site is in the Clayton area of Surrey. The surface soils in this area were assessed by reviewing the stratigraphy observed during ground well installation in the area and reviewing the Geologic Survey of Canada Map 148A. The surface soils are comprised of Capilano Sediments with Vashon Drift or Pre-Vashon tills below. These surface deposits consist of marine and glaciomarine stony (including till-like deposits) to stoneless silt loam to clay loam with minor sand and silt usually less than 3 m thick but up to 30 m depth in areas. Below this layer can be found Pre-Vashon till deposits. The static ground water table in the area varies between 18 m and 53 m below surface grade and there is potential for parts of the groundwater to be part of a pressurized Aquifer. The seismic site classification is likely to be site class C or D and liquefaction is not expected. As the expected foundations for the substation would likely be shallow footings there does not appear to be any major issue in developing this site for a substation. A more detailed confirmatory exploration program consisting of two or three augered drill holes and seismic cone penetration testing is recommended before a final decision on purchase of the site is completed. For more information refer to Appendix C

3.2.5 Transmission Assessment

For this site, a review of potential Overhead line routes was conducted. O/H routes were plotted along a number of paths using Google Earth and it was determined the only viable route for O/H would be along 196th street. This would be a challenge as much of 196th street serves newer residential areas, and the corridor is not very wide nor is it continuous. The only solution would be a double circuit monopole however Transmission planning is not comfortable with this due to reliability issues with both circuits supplying the station on the same set of structures. Ultimately it was determined that like all other sites the most likely routes were underground from McLellan generally along 192nd and 196th streets to the local area and from there minor rerouting of the 192nd street path along

78th Avenue to bring the line to the site. For more information refer to Appendix D

3.2.6 Suitability as a substation

Based on the review by each discipline, the general site conditions and proximity to the load center this site would be suitable for a substation provided additional lands can be obtained to develop the ultimate station. However as noted in section 3.2.4 a confirmatory geotechnical investigation is recommended prior to final purchase of the site.

3.3 Alternate 19

3.3.1 Current Use

Alternate 19 is a three parcel assembly of private properties at the corner of 76th Avenue and 196th street in Surrey. This assembly is directly south and abutting Alternate 18. The assembly is currently occupied by private homes. Much of the land has been cleared in the past and some of the land has naturally revegetated with some second growth forest.

3.3.2 Electrical Assessment

As noted in Section 3.1.2 the preferred size for the required development is 181 m x 196 m or 35,476 m² or approximately 8.7 Acres. The Alternate 19 assembly at 44,122 m² (10.9 Acres) is large enough for the ultimate site development based on the layouts prepared by electrical design. If Alternate 19 were reduced to two of the three parcels (assuming the third was not available) it would be necessary to obtain other lands to complete the ultimate station. This could be managed by purchasing Alternate 18 directly to the North. As noted in Section 3.2.3 a decision on purchasing Alternate 18 would need to be confirmed before design of the station to ensure an efficient design. As with Alternate 18, a third scenario would be to develop a GIS station on the two Alternate 19 parcels. This is not preferred due to costs and is noted only to provide all options in the event

additional properties cannot be obtained. For more information refer to the electrical memo in Appendix A.

3.3.3 Civil Assessment

The site is generally flat with a slope of approximately 2.5% from east to west. No significant cut or fill is required to level the site. Access is less favourable as like Alternate 18, 196th is not complete and access is only available from 76th Avenue which is a single lane road at the parcel frontage. The creek noted in section 3.2.3 is not expected to be a concern as it is further west than at Alternate 18 however it would need to be investigated further if this property is selected for purchase. For more information refer to Appendix B

3.3.4 Geotechnical Assessment

Due to the proximity of Alternate 19 to Alternate 18 the general conditions listed in section 3.2.4 would apply to this site as well. For more information refer to Appendix C

3.3.5 Transmission Assessment

Due to the proximity of Alternate 19 to Alternate 18 the general conditions listed in section 3.2.5 would apply to this site as well except that diversion of the transmission route would be along 76th Avenue rather than 78th Avenue. For more information refer to Appendix D

3.3.6 Suitability as a substation

Based on the review by each discipline, the general site conditions and proximity to the load center this site would be suitable for a substation with some caveats. The potential costs to extend 76th Avenue and 196th street to improve access as well as the potential impact of the creek to the west of the site would need to be studied and as noted on section 3.2.4 a confirmatory geotechnical investigation is recommended prior to final purchase of the site.

3.4 Alternate 20

3.4.1 Current Use

Alternate 20 is a five-parcel assembly consisting of two lots owned by Bosa properties, and three parcels owned by individuals. The final assembly is not determined as not all the private owners are willing to sell. The Bosa properties are available and an offer to purchase was made by BC Hydro. Two of the other lots are under negotiation with the third owner holding out. Currently all the lots are occupied with at least one home and potentially farm buildings or left naturally vegetated.

3.4.2 Electrical Assessment

As noted in Section 3.1.2 the preferred size for the required development is 181 m x 196 m or 35,476 m² or approximately 8.7 Acres. For this site, the initial property configuration only consisted of the two Bosa Properties with total dimensions of 390.3 m x 99.05 m. This complicated the design as the site was very long and narrow. The layout developed (WIB-E05-SK004 R0A) was an inefficient layout which included indoor 25 kV and 60 kV Gas Insulated Switchgear (GIS) sections and outdoor 230 kV bus and transformers. The layout required transmission connections on the North boundary. This would have required ROW across private properties. This is not an optimal solution, and the acquisition of adjacent properties was looked at.

The first adjacent property considered was the private parcel to the south and east of the Bosa lands. A number of layouts were considered culminating in WIB-E05-SK006-Op2. This layout located the outdoor 230 kV yard and four transmission terminals on the east side of the assembly and the Air insulated (AIS) 25 kV yard on the western portion of the eastern Bosa property with the future AIS 60 kV yard located on the western Bosa property. This layout requires cables to supply the 60 kV yard and while it makes better use of the property it is still not optimal. What it did prove was that a substation could be constructed if an additional adjacent parcel were purchased along with the Bosa property. Since that layout was completed the focus of additional property has been on adding the parcel on the southwest boundary of the Bosa properties as that owner is willing to sell the land. A revised layout will be prepared for the new assembly however it will not be ready for the completion of this report. The new

layout will effectively be a mirror image of the WIB-E05-SK002-Op2 and will show the site comprising Bosa, Kool and Walia properties can host a substation however as noted previously it will not be optimal.

It is understood that efforts to purchase the parcel to the east of the Kool site will continue and if it becomes available a more efficient station layout will be able to be prepared. For more information refer to the electrical memo in Appendix A.

3.4.3 Civil Assessment

The site has a general slope of 4% from east to west. Some cut and fill work will be required to level the site to an average of 3% grade. Volumes are 13000 m³ of cut and 27000 m³ of fill. Access is better than the Alternate 18 and 19 as 196th while only a single lane fronting the Bosa Property does extend to full width of the site. 194th extends past the full frontage of the site and there is a spur road called 194a St that reaches the southern boundary of the site. There are no water courses near the site. For more information refer to Appendix B

3.4.4 Geotechnical Assessment

Due to the proximity of Alternate 19 to Alternate 18 the general conditions listed in section 3.2.4 would apply to this site as well. However, as the site is under offer to purchase, BC Hydro will be conducting a due diligence geotechnical investigation prior to completion of the purchase. The results of the investigation will not be known before completion of this report. For more information refer to Appendix C

3.4.5 Transmission Assessment

Due to the proximity of Alternate 20 to Alternate 18 and 19 the general conditions listed in section 3.2.5 would apply to this site as well except, that the diversion

from 192nd would occur along 76th avenue and 194th St. For more information refer to Appendix D

3.4.6 Suitability for use as a Substation

Based on the review by each discipline, the general site conditions, and proximity to the load center, this site would be suitable for a substation with some caveats. While an electrical layout will be prepared for the Bosa/Kool/Walia properties it won't be ready for this report. However, it is expected to be a mirror image of that prepared for the Bosa/Kang property as the assemblies are both the same size. As shown for Bosa/Kang layout, a station could be constructed on the assembly but would not be an efficient design. If the Kang property could be purchased a much more efficient layout could be prepared for the site. However, if it is not available the Bosa/Kool/Walia site would be suitable for a station. As noted, offers to purchase the Bosa and Kool properties have been made and a confirmatory geotechnical investigation is being prepared in the event that purchase agreements are completed.

4 Conclusions

The project team investigated several potential sites for the new Willoughby substation. The original selection of 22 sites was reduced to four sites for this stage of the project. The sites were Alternate 14B, Alternate 18, Alternate 19, and Alternate 20. Alternate 14B and Alternate 19 would require assembly by BC Hydro and for this reason they are less preferable. Alternate 18 and 20 were leading as both were assemblies held by developers who were willing to sell. While neither site was large enough on its own for the ultimate substation the project team determined it was likely that adjacent properties could be purchased to make up the required lands.

The team reviewed all the properties and determined that there were no major technical issues that would prevent the development of a substation subject to a confirmatory Geotechnical investigation for each site. Before the project team investigations were complete, senior management made a decision to make an offer on the Bosa properties of Alternate 20 based on the reasonable price and its availability. Purchase negotiations continue at the time writing and further offers have been made for adjacent properties. It is expected that Alternate 20 will be selected provided the Geotechnical investigation scheduled for January 2025 does not find a disqualifying condition.

Appendix A

Electrical Memo - Willoughby Substation (WIB) Property Purchase Project

Willoughby Substation Property Purchase Project

Electrical Evaluation

Memo Number		Revision	Information Security Classification	
000-TEM-00088		0	BC Hydro Internal	
To:	David Chwackinski, Project Engineer Specialist, Lines and Interconnections		Date	2024 Dec 17
From:	Kally Jiang, Sr. Engineer, Electrical Design			
Copy:	[Comments]			

Related Facilities	Willoughby Substation
--------------------	-----------------------

1 Purpose

The purpose of this memo is to provide information to the project team to support a decision to purchase property to construct a new BC Hydro Willoughby Substation in Township of Langley load center. The memo summarizes and documents the process of site selection and the physical electrical layouts developed based on the selected parcels to support carrying on the purchase.

2 Introduction

Load growth in the Willoughby area of the Township of Langley requires the development of a new 200 MVA substation (WIB) in the area. Currently there are no BC Hydro owned properties available to serve as a station site. The objectives of this project are to purchase a suitable property for the future development of a 200 MVA substation to serve the Willoughby area and future development in the Clayton district of Surrey.

3 Background

During Needs phase eleven (11) properties were initially identified as potentially suitable. Some properties were consolidated with others to make a total of thirteen (13) alternatives for

consideration. An SDM table was prepared with initial screening criteria and the number of properties was narrowed down to three (3) for further investigation. At the late date during negotiations towards purchasing, another parcel has been added as the fourth one for evaluation.

4 General

Transmission Stations Engineering had been involved to provide engineering support for this property purchase project. Stations Electrical Design has developed high-level 2D ultimate layouts when carrying on design. The layout design is based on all potential available properties and the Conceptual design is based on following four (4) parcels (See maps for details on Attachment 1) to support the selecting of the most suitable property for purchase.

1. Alternative 14B

Alternate 14B consists of six (6) privately held properties at the corner of 80th Ave and 192nd St. in the Clayton area of Surrey. The land slopes from east to west at a grade of approximately 8 %. The land is occupied by homes and in some areas is heavily treed with the remainder covered in brush. A 25 kV distribution line runs along 80th avenue.

2. Alternative 18

Alternate 18 is a privately held assembly of two parcels owned by Qualico developments and a private parcel owned by the Mattu family. It is located at the corner of 78th Ave and 196th St. Combined the parcels aggregate to 8.15 acres. This would be large enough for the initial stage but to complete the ultimate more property would be required. An addition of the Mattu parcel to the west would allow the ultimate station to be constructed. Distribution lines of unknown voltage run on 78th Ave.

3. Alternate 19

Alternate 19 consists of a three individually owned parcels directly south of the Qualico parcels at corner of 76th Ave and 196th St. The sites are home sites and have houses and barns and are partially cleared with trees and shrubbery. The sites are generally flat with decent access. Distribution lines of unknown voltage run on 76th Ave.

4. Alternate 20 and 20a

On July 17, 2024, a new set of properties has been taken into consideration as Alternate 20. It consists of two adjacent long narrow lots, 7507 196 ST and 7528 194 ST in Surrey. The two parcels are owned by Bosa Properties. Bosa is interested in selling both lots, less interested in selling only one. BCH has made an offer to purchase both properties on Sep. 17, 2024, although alone the lots do not provide for an efficient station layout. From a stations design perspective, the Bosa lots on their own are not a recommended option. After making an offer to purchase the Bosa properties, a layout design was requested to consider Alternate 20a using Bosa properties and the two other potential properties adjacent and South of the Bosa properties. See maps on Attachment 1 and Emails on Attachment 4 for details.

5 Scope of Work for the New Willoughby Substation

The new 230/25kV outdoor or indoor substation, designated as Willoughby Substation (WIB), will be constructed on the property acquired. The initial stage capacity of the substation is 100MVA, with provisions for future expansion to 200MVA and to add a 60 kV yard at some time in the future. As shown in the Appendix 2 – Station Planning One Line, the scope includes the following:

➤ Initial Stage

- Installation of an outdoor or indoor 230kV ring bus with four (4) circuit breakers, two (2) transformer positions, and two (2) 230kV line positions.
- Installation of two (2) 230/25kV, 150MVA transformers T1 and T2 with dual secondary windings.
- Installation of two (2) 50MVA, 25kV air-insulated (AIS) outdoor feeder sections, each with nine (9) feeder positions with incoming line CBs and sectionalized CB.
- Construction of a control building and other associated infrastructure.
- Installation of station service, protection & control (P&C), civil, mechanical, and other related station facilities.
- Construction of a duct bank extending from the feeder section to the nearest distribution manhole, either inside or near the station boundary.
- Installation of a grounding system, lightning shield wires cable trench and conduit system.

To provide power to the new Willoughby Substation, two (2) new 230kV transmission lines will be constructed from nearby substations. The solution will be based on recommendations from Transmission Planning, Transmission Line Planning and Design.

➤ Ultimate Stage

- Installation of an expanding 230kV ring bus by adding four (4) circuit breakers.
- Installation of two (2) 230/60kV transformers T3 and T4.
- Installation of ten (10) 25kV air-insulated (AIS) outdoor indoor feeder positions similar to the feeders installed at initial stage.
- Installation of an outdoor or indoor 60kV ring bus with six (6) circuit breakers, two (2) transformer positions, and four (4) 60kV line positions.

Two (2) new extra 230kV transmission lines will be constructed from nearby substations to the new Willoughby Substation. The solution will be based on recommendations from Transmission Planning, Transmission Line Planning and Design.

6 Electrical Design Consideration

Many options were explored as requested. Principles for electrical design are as below:

- Latest applicable standards are conformed for design.
- Minimum distance between a driven vehicle and the high voltage bus: 2.5m for 230kV, 1.5m for 25kV.
- Minimum corridor between the perimeter fence and any switchyard equipment: 6m.
- 20m separation between transformers.
- 18m separation from transformer edges to all buildings and property lines.
- 6m separation from station service transformer to Control Building.
- Minimum 6m wide access roads.
- Minimum 6m between substation perimeter fences and property lines for drainage and grounding.
- Minimum 10m turning radius within the substation.
- 27m turning radius for main access roads into substation for transformer transportation.

7 Assumptions And References

The Willoughby (WIB) Substation electrical layout design is based on the following assumptions:

- All electrical conceptual layouts design hereby serve for evaluate property feasibility only.
- All related transmission line entrance supports the current electrical design layouts and will coordinate with Transmission Lines when carry on further design stages.
- The electrical conceptual design for Willoughby substations is based on draft Station Planning One-Line as shown on Attachment 2 that provided on March 06, 2024, by Project Engineer, David Chwaklinski.
- The 230kV ring bus layout spacing is designed according to BC Hydro standard ES44-C0280.
- The future 60kV ring bus layout spacing is based on NKL 60kV Ring Bus layout DWG 414K-E05-00002.
- The 25kV feeder section design is in line with BC Hydro standard ES44-C0186.
- The control building size is based on the size of MLE new control building, as shown on drawing 472R-E05-10041 with some margin in the total length.
- The orientation and positioning of the 230 and 60 kV lines will be determined by Transmission Planning.
- The orientation and positioning of 25kV feeder will be determined with input from Distribution. The location of the first distribution manhole is not yet determined.
- It is assumed that the transmission line egress will be via cable until Transmission's final confirmation.

- 27m turning radius for main access roads into substation for transformer transportation could be met.

8 Electrical Design Layouts and Recommendations

A number of various electrical layouts were explored to try and fit the required equipment onto the parcels identified. In some cases, a combination of AIS and GIS were required to fit the equipment. While the Project called for AIS only it was important to show that for some property assemblies the only way to develop the site was to include GIS. After review by the project team and updates to the Properties, some preferred layouts were selected to consider. The selected a few electrical design layouts are shown on Attachment 3.

Based on all the layouts, Alternative 18 is considered the most feasible and recommended option. It should be noted that there is a creek running through part of the property to the west of Alt 18 that could impact the overall layout of the station.

Alternate 20 will not be suitable without the addition of additional properties to the south or a switch to a GIS station configuration. It is understood that an offer to purchase has been made although the final decisions could take some time to finalize. Alt 20 on its own won't be suitable to develop a substation based on BCH current standards and practices. It is also understood that further negotiations are being conducted with property owners directly south of the Bosa property to obtain an assembly that will be large enough for any conceivable layout. See maps on Attachment 1 and Emails on Attachment 4 for details.

At the time of writing this Memo, the properties listed above under section 4 were actively being reviewed. The purchasing process to obtain parcels #3 and #4 for the Alternate 20a is on going. Due to the dynamic nature of property acquisition, changes to the parcels may occur which will not be captured in this memo.

9 Attachments

See Pages 7 to 17 for details.

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- (b) the intellectual or other property rights of any person or party in, or
- (c) the merchantability, safety or fitness for purpose of,

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Prepared by:

Kally Jiang
2024-12-17

Kally Jiang, P.Eng, Sr. Engineer
Stations Design - Electrical

Checked by:

Ken Zeng
2024-12-17

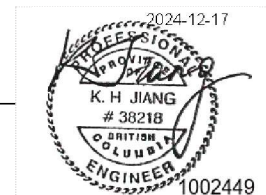
Ken Zeng, P.Eng, Sr. Engineer
Stations Design - Electrical

Accepted by:

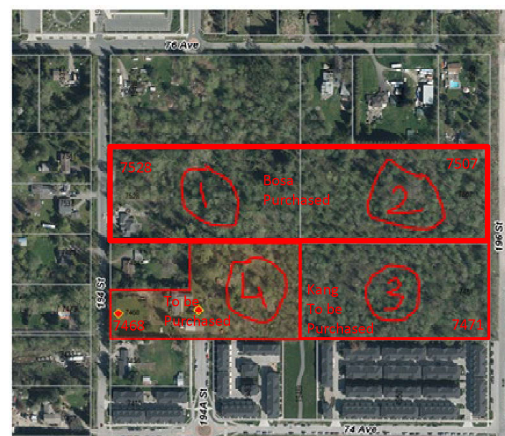
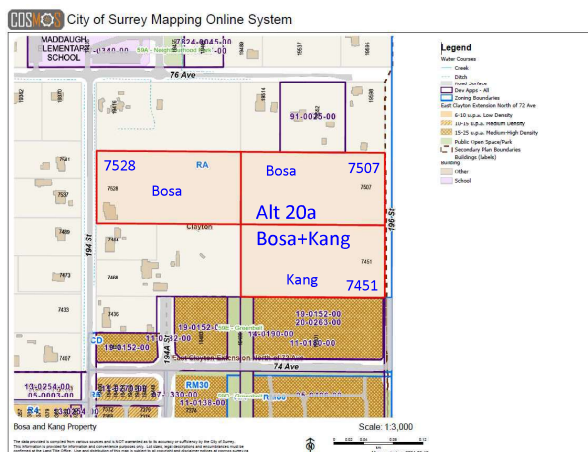
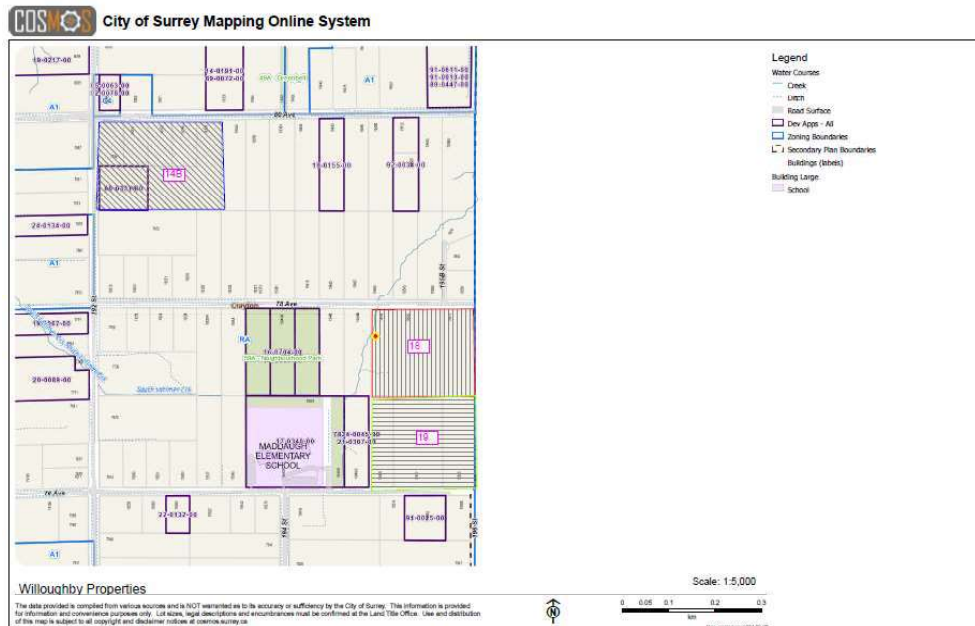
David Chwalski
2024-12-17

David Chwalski, P.Eng,
Project Engineer Specialist
Lines and Interconnections

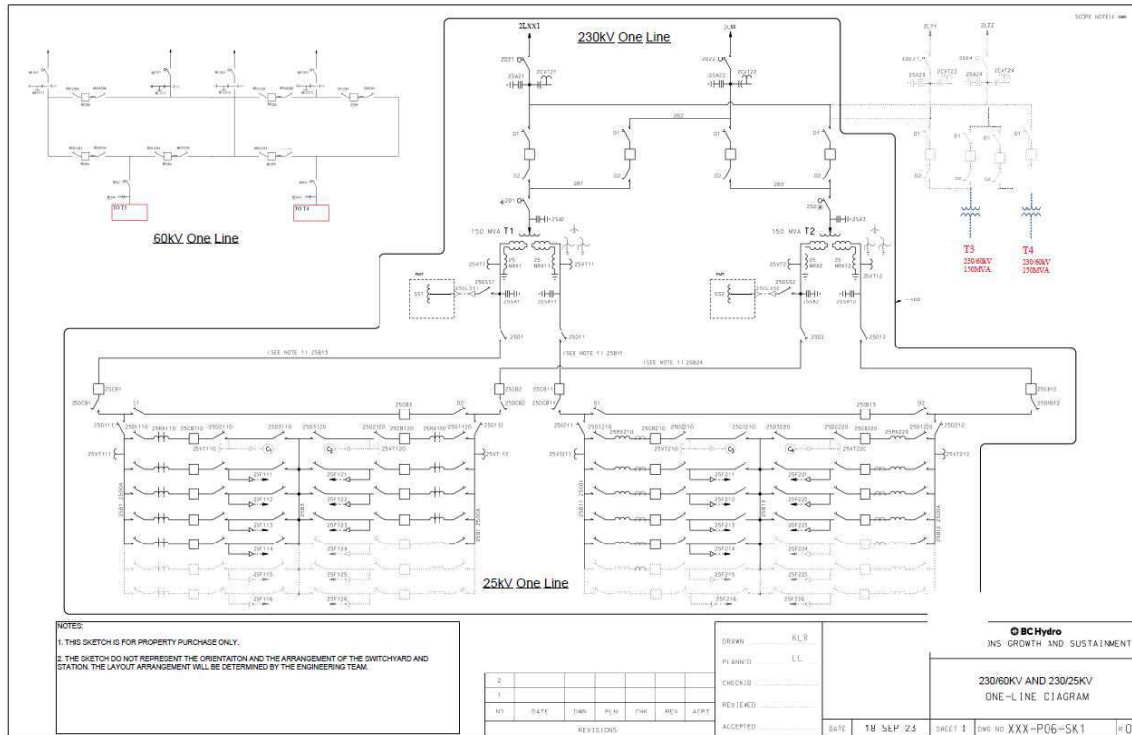
Balea
2025-01-09



Attachment 1 – Map for the Alternate Properties

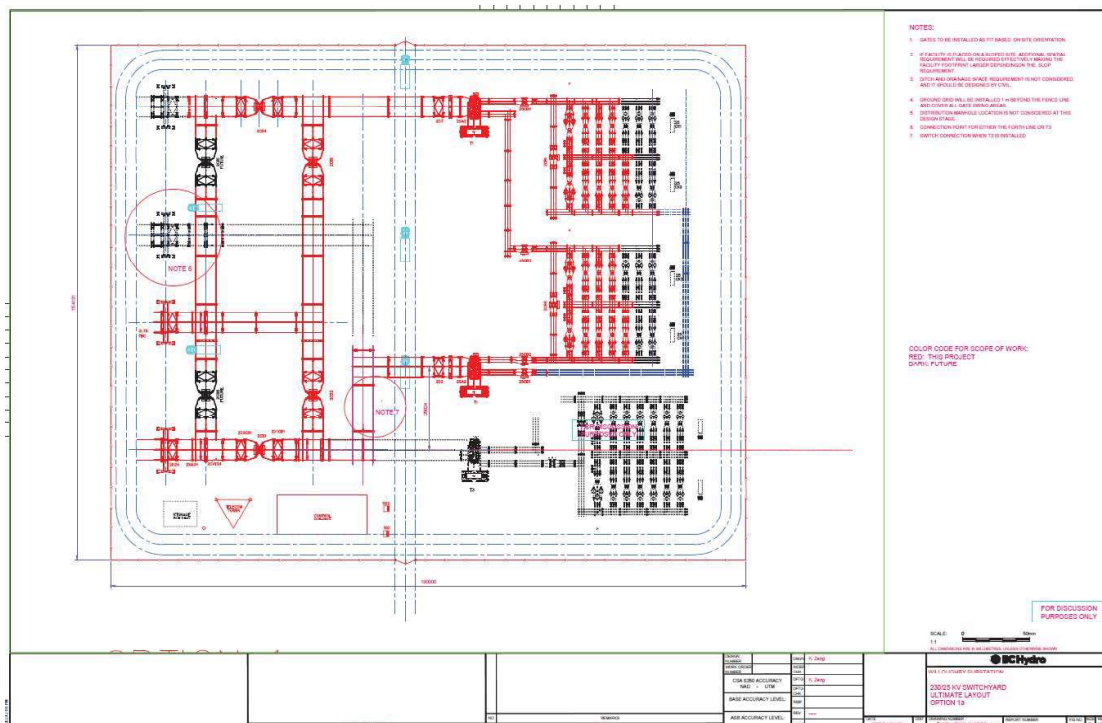
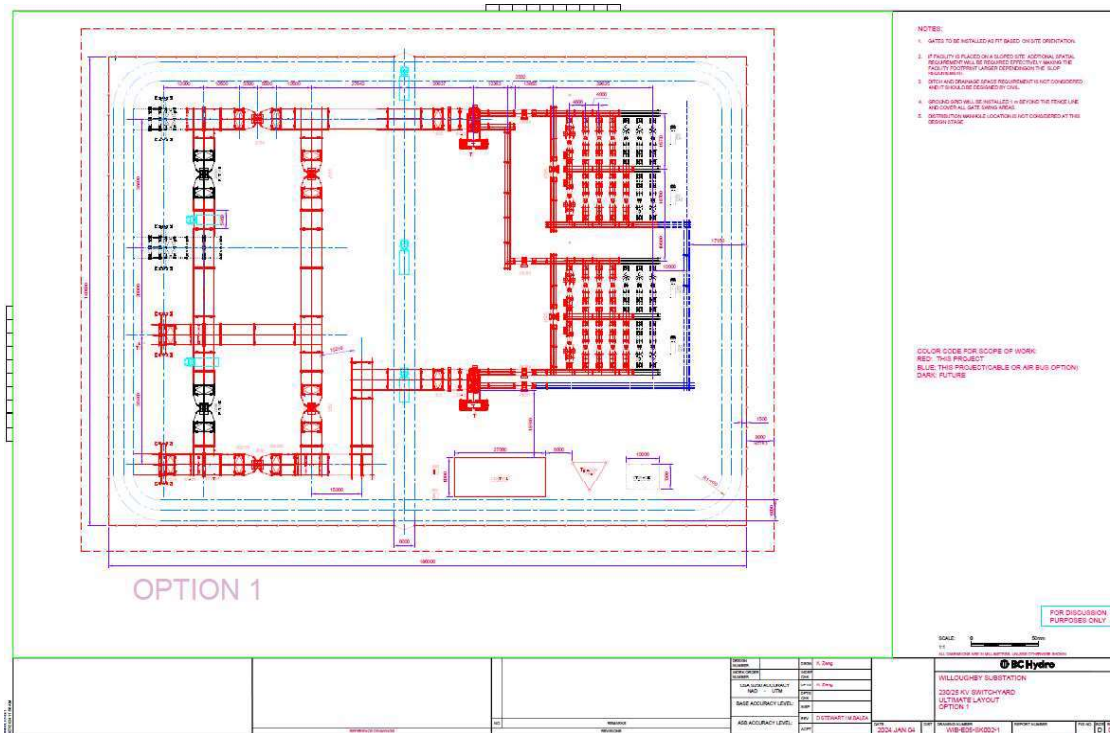


Attachment 2 – Station Planning One-Line



Attachment 3 – Station Electrical Layouts

General Layout for Original AIS (Air Insulated Switchgears) Without 60kV



NOTES:

- GATES TO BE INSTALLED AS FIT BASED ON SITE ORIENTATION
- IF FACILITY IS PLACED ON A SLOPED SITE, ADDITIONAL SPACING REQUIREMENTS WILL BE REQUIRED TO PREVENT SLIDING. THE RESULTS OF THIS ANALYSIS ARE NOT CONSIDERED AS PART OF THIS DESIGN.
- GROUNDING REQUIREMENTS (SPACE REQUIREMENT) IS NOT CONSIDERED AND IT SHOULD BE DESIGNED BY O&M.
- GROUND GRID WILL BE INSTALLED 1 METER FROM THE PERIMETER AND COVER ALL THE SWITCHYARD.
- DESTRUCTION OF EXISTING LOCATIONS IS NOT CONSIDERED IN THIS DESIGN STUDY.

COLOR CODE FOR SCOPE OF WORK:
 RED: THIS PROJECT
 BLUE/BLACK DOTS: FUTURE

FOR DISCUSSION PURPOSES ONLY

SCALE: 0 10m
 1:1
 ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED

BC Hydro

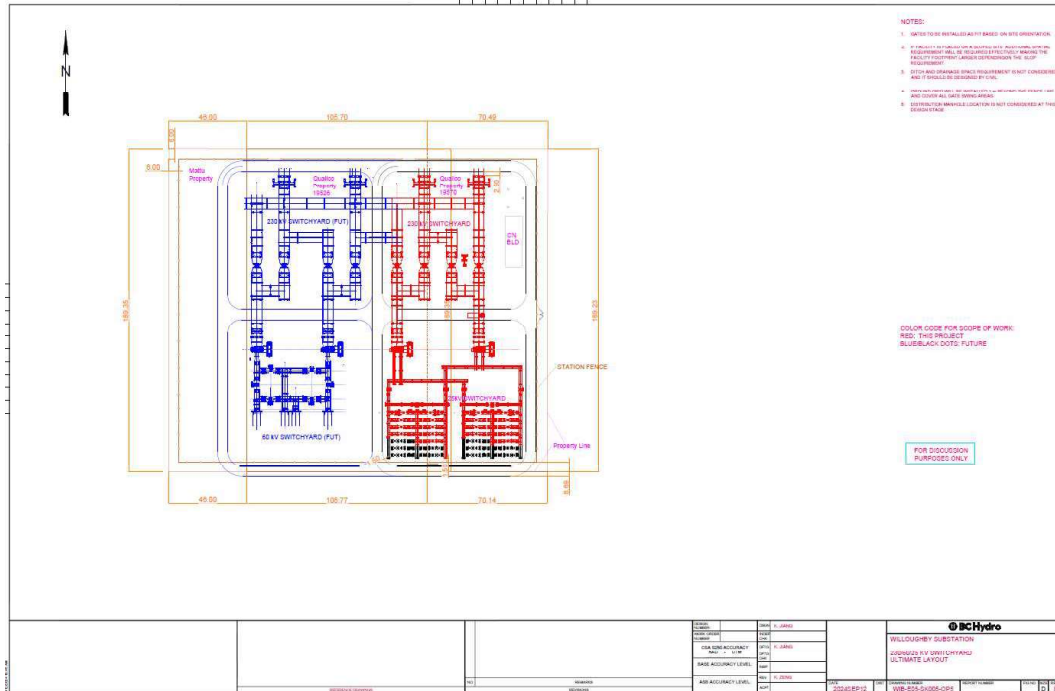
WILLOUGHBY SUBSTATION
 330/60/22 KV SWITCHYARD
 ULTIMATE LAYOUT

REVISIONS:
 230241MAR23 118-655-30231-0301n

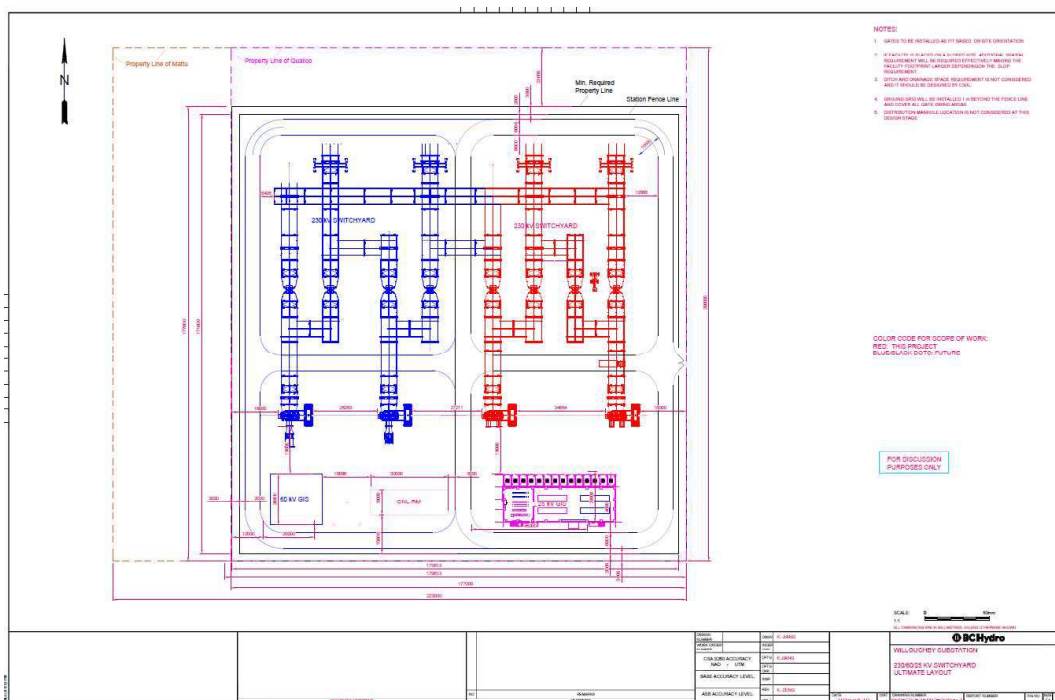
NO.	REVISION	DATE	BY	CHKD.
1	ISSUED FOR CONSTRUCTION	230241MAR23	118-655-30231-0301n	

[illegible]

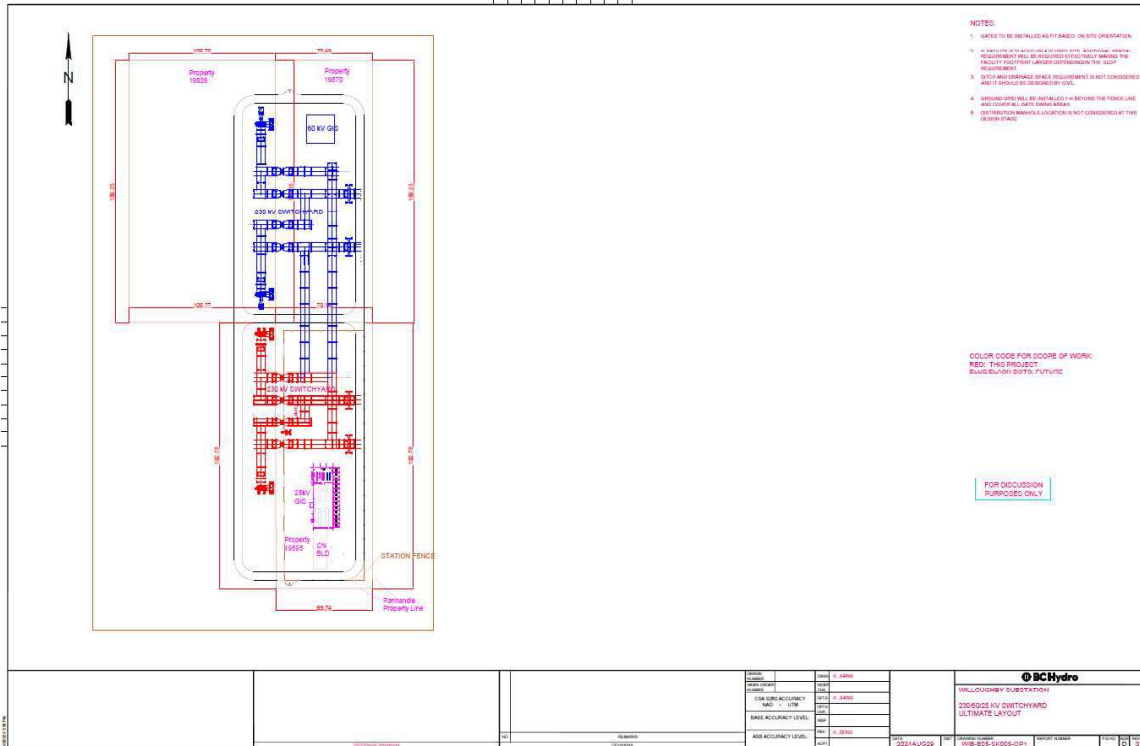
- **Alternate 14B** – Property is not easy to be acquired, no layout had been created.
- **Alternate 18** – extra Mattu Property + 10 meters would be needed for AIS layout.



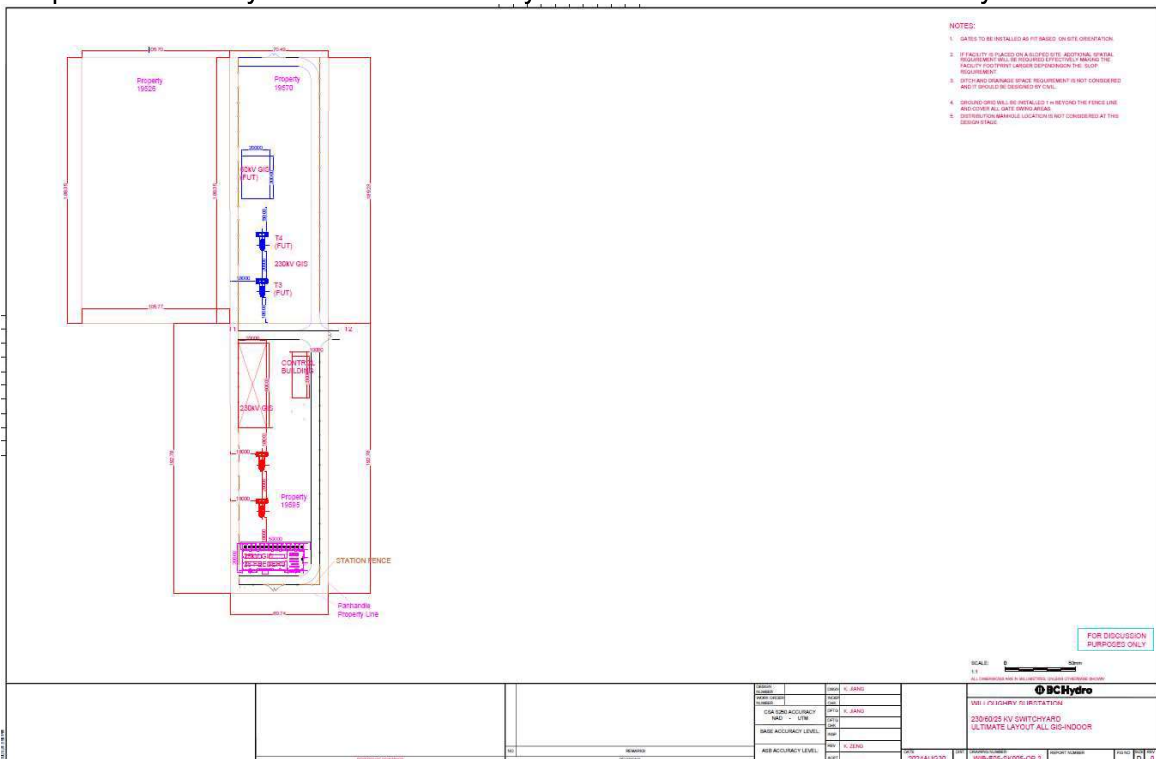
It is just possible to squeeze in Alt 18, Qualico Property for an AIS+GIS combined layout.



- **Alternative 18 + 19 (Partial, one Property names Panhandle or Ngo)**
Properties are not enough for AIS layout.

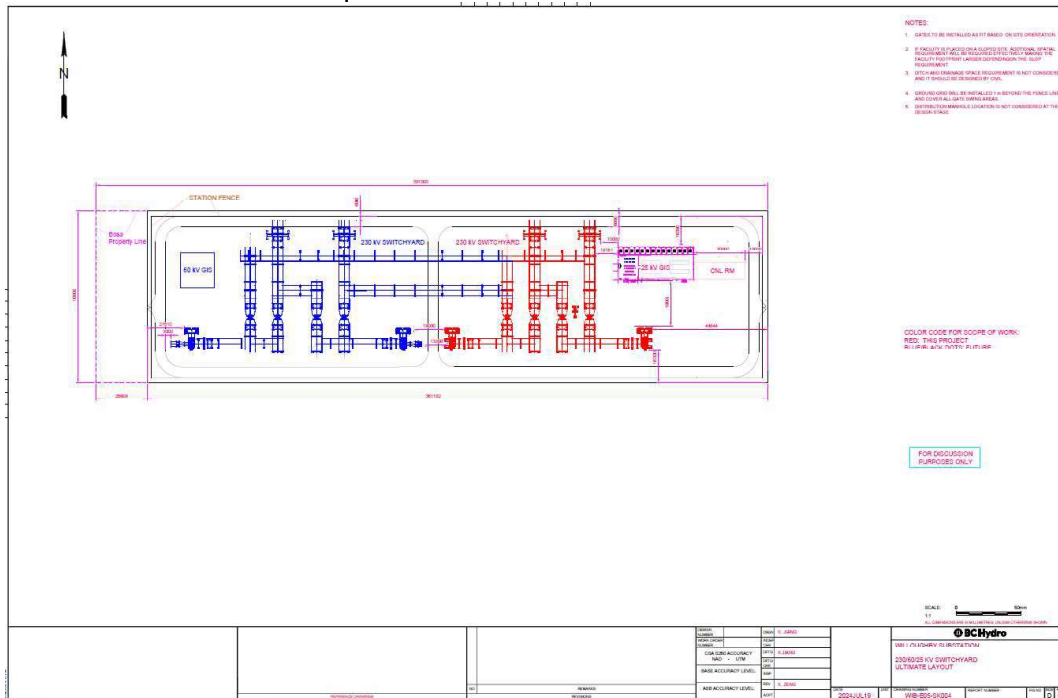


Properties are fairly to fit in an all GIS layout but it is not a recommended layout.

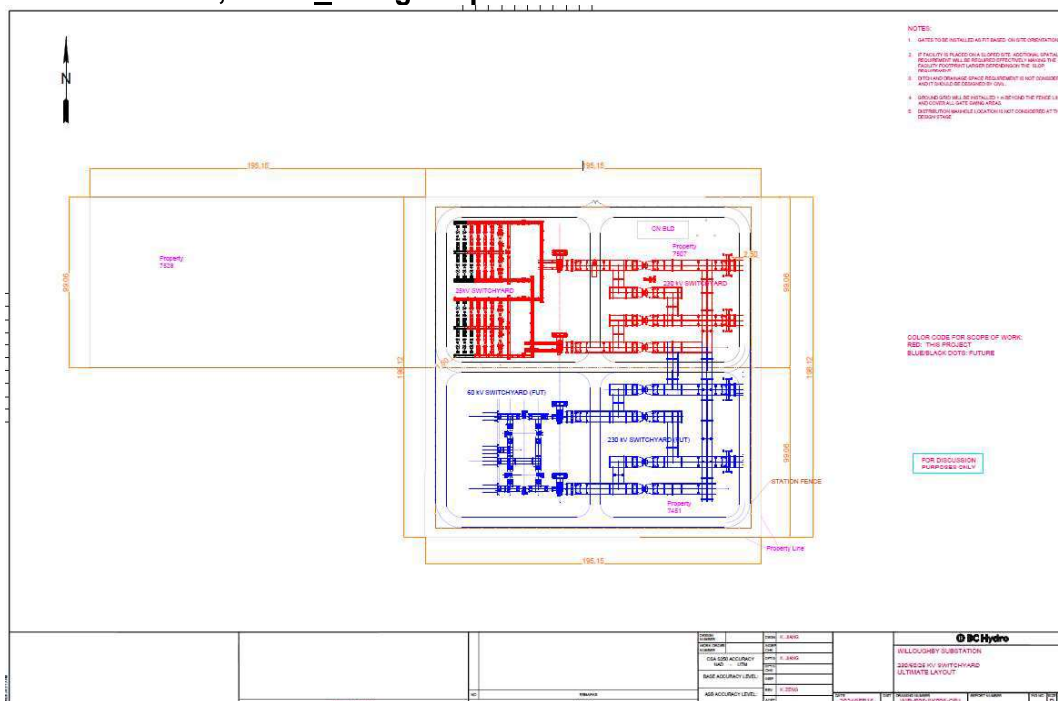


Willoughby Substation Property Purchase Project Electrical Evaluation

- **Alternate 19** - It is not easy to acquire both properties, no layout had been created.
- **Alternate 20, Bosa Property**
 Property is not enough for AIS layout. It may be possible to squeeze in an AIS+GIS layout but not a recommended option.



- **Alternative 20a, Bosa _ Kang Properties**



Attachment 4-1 – Information related to Alternative 20, Bosa Property

RE: TM0592 - Willoughby Heights Sub, Alt 20

From: Jiang, Kally
To: Chwalsinski, David; Hepple, Robert; Sherevuklov, Dmitry
You forwarded this message on 2024-09-17 11:55 AM.

Attachments:
 WIB-E05-SK004-Outdoor 230 +GIS 60n25-To Fit Bosa Property-20240719.pdf
 WIB-E05-SK003-Option 3-Outdoor 230 +GIS 60n25-To Fit Qualico Property-20240719.pdf

Good afternoon, All,

The station layout has been barely fitted onto the Bosa's properties of 100m x 391m lot. This Alternative 20 is not preferable from Station Electrical Design perspective with the reasons below.

1. The 100m width is extremely tight for layout.
2. How the 230kV transmission Lines enter the station would be a concern.
3. The connection between 230kV bus ring would be very long and costly.
4. The high voltage power cables run from TX to both 60/25kV GIS buildings would be complicated and costly.
5. Low voltage cables run from switchyard to the control building would be quite long and costly.
6. There is a beautiful house on Bosa's property of 7528 194 ST SURREY as picture below. It was built in year 2003 and relatively new. What a regret and waste if we have to demolish the house to build our station on the lot.

7528 194 ST SURREY V4N 6E1
Area: Jurisdiction-Rob, 14-326-8222-1002-0

Favorite Compare Print



Total value: \$5,587,000
2024 assessment as of July 1, 2023

Land	\$5,131,000
Buildings	\$456,000
Previous year value	\$3,306,000
Land	\$5,021,000
Buildings	\$483,000

Questions about this property assessment? Visit our [Property assessment FAQ](#) or [Contact us](#) if you have questions.
Visit our [BC Assessment interactive market trends maps](#) for assessed value changes in your area, and our [Property tax](#) page to learn what your assessment value change means for your property taxes.
Find out more about BC Assessment's Data Services.

Property information	Are the property details correct?	Legal description and parcel ID
Year built: 2003		LOT 12, PLAIN HILL 2000, PART SW 1/4, SECTION 22, TOWNSHIP 6, NEW WESTMINSTER LAND DISTRICT
Description: 2 STY House - Semi-Custom		PID: 012-828-696

I also looked into the Qualico property further. The station layout could be squeezed onto that property as attached Option 3. Compare these two options, the layout on Qualico's property is much better than the one on Bosa's properties.

Hope above info helps and have a great weekend!
Kally

Kally Jiang (She/Her/Iters) | P. Eng.
Senior Engineer, Electrical Design
Stations Division, Transmission Engineering

RE: Bosa property Confirmation

From: Hepple, Robert
To: Jiang, Kally; Chwalsinski, David
Tue 2024-09-17 9:16 AM

Kally,

We bought the Bosa property. We may buy the Kang property if needed.

Can you please layout the substation using all the Bosa property and then inform me if we need the Kang property for an Ultimate arrangement?

Robert

Robert Hepple P.Eng.

Project Manager, Stations
Capital Infrastructure Project Delivery
BC Hydro
6911 Southpoint Drive, B02
C 360.410.2244
W 604.528.3433
E Robert.Hepple@BCHydro.com

Web: BCHydro.com

Smart about power in all we do.

Willoughby Substation Property Purchase Project
Electrical Evaluation

Attachment 4-2 – Information related to Alternate 20a, Bosa+Kang Properties

From: Parmar, Surinder <Surinder.Parmar@bchydro.com>
Sent: 2024, September 19 2:26 PM
To: Hepple, Robert <Robert.Hepple@bchydro.com>
Cc: Chwaklinski, David <David.Chwaklinski@bchydro.com>; Jiang, Kally <Kally.Jiang@bchydro.com>
Subject: RE: Willoughby Property - WIB - Bosa Property

Thanks Robert – that is good news.

That said, we got Ajay's approval for extra land for the future plans that IP may have like the battery storage etc).

I will still try to purchase the parcel 4. If we have issues in making the deal, then may be we can rethink.

Surinder Parmar, P.Eng., PMP
BC Hydro
6911 Southpoint Drive

P 604.528.7731
M 604.561.2702
E Surinder.Parmar@bchydro.com

bchydro.com

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FW: Willoughby Property - WIB - Bosa Property

○ Hepple, Robert

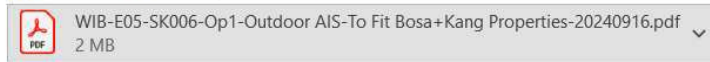
To ○ Parmar, Surinder

Cc ● Chwaklinski, David; 🌟 Jiang, Kally

📧 You forwarded this message on 2024-09-19 4:49 PM.

  Reply  Reply All  Forward  

Thu 2024-09-19 2:18 PM



Hi Surinder,

I know you would like to purchase all 4 parcels for future BCH purposes but the engineering Team would be remis if we did not mention that Kally has a layout with the Kang property and the eastern Bosa property that works.

Please see attached layout.

We would not need the western Bosa property or it could be purchased for future battery installation.

In that case we would not need parcel #4.

Let me know your thoughts.

Robert

Robert Hepple P.Eng.

Project Manager, Stations
Capital Infrastructure Project Delivery
BC Hydro
6911 Southpoint Drive, B02
C 360.410.2244
W 604.528.3433
E Robert.Hepple@BCHydro.com

Web: BCHydro.com

Smart about power in all we do.

Willoughby Substation Property Purchase Project
Electrical Evaluation

RE: Willoughby Property - WIB - Bosa Property

○ Hepple, Robert

To: ○ Parmar, Surinder

Cc: ● Chwinklinski, David; ● Jiang, Kally



Thu 2024-09-19 2:28 PM

From: Parmar, Surinder <Surinder.Parmar@bchydro.com>**Sent:** 2024, September 19 11:46 AM**To:** Lee, Tony S.C. (BCH) <Tony.Lee@bchydro.com>; Chan, David Y.M. <David.Chan@bchydro.com>; Sherevkulov, Dmitry <Dmitry.Sherevkulov@bchydro.com>; Hepple, Robert <Robert.Hepple@bchydro.com>**Cc:** Pradhan, Anil <Anil.Pradhan@bchydro.com>**Subject:** FW: Willoughby Property - WIB - Bosa Property

Gents:

See string of emails below.

In summary – we have IP management consent to buy the Parcel #4 (south-west of Bosa) along with our earlier plan to buy Parcels 1, 2 and 3.

I will leave it with our Properties SMEs to review/decide on when to approach the owners of Parcel 3 and Parcel 4 owner and start these negotiations.

Let me know if any questions/clarifications that you need from me.



Appendix B

Willoughby Substation – Civil Memo

Willoughby Substation Property Purchase Project

Civil Evaluation

Memo Number	Revision	Information Security Classification	
000-TEM-00092	0	BC Hydro Internal	
To:	David Chwakliniski, Project Engineer	Date	2024 Sep 12
From:	Feng Liu, Sr. Engineer		
Copy:	[Comments]		

Related Facilities	Willoughby Substation
--------------------	-----------------------

1 Introduction

Load growth in the Willoughby area of the Township of Langley requires the development of a new 200 MVa distribution substation (WIB) in the area. Currently there are no BC Hydro owned properties available to serve as a station site. The objectives of this project are to purchase a suitable property for the future development of a 200 MVa substation to serve the Willoughby area and future development in the Clayton district of Surrey.

2 Background

The project team selected several potential sites located near 200th avenue. After further review and evaluation, four (4) sites were identified as potentially suitable.

The sites are identified as follows:

Alternative 14B

Alternate 14B consists of six (6) privately held properties at the corner of 80th Ave and 192nd St. in the Clayton area of Surrey. The PID's are PID 005-951-704, 003-370-879, 005-951-712, 002-229-561, 005-951-721 and 003-370-887. Civic address is 7954 192nd St., 7914 192nd St., 19234 80th Ave., 19276 80th Ave., 19296 80th Ave. and 19324 80th Ave.



Site map – Alternative 14B

Alternative 18

Alternate 18 is a privately held assembly of two parcels owned by Qualico developments and a private parcel. The Qualico parcels are PID 011—988-959 and 011-988-967 with Civic address 19570 78th Ave. and 19526 78th Ave. Combined the parcels aggregate to 8.15 acres.



Site map – Alternative 18

Alternative 19

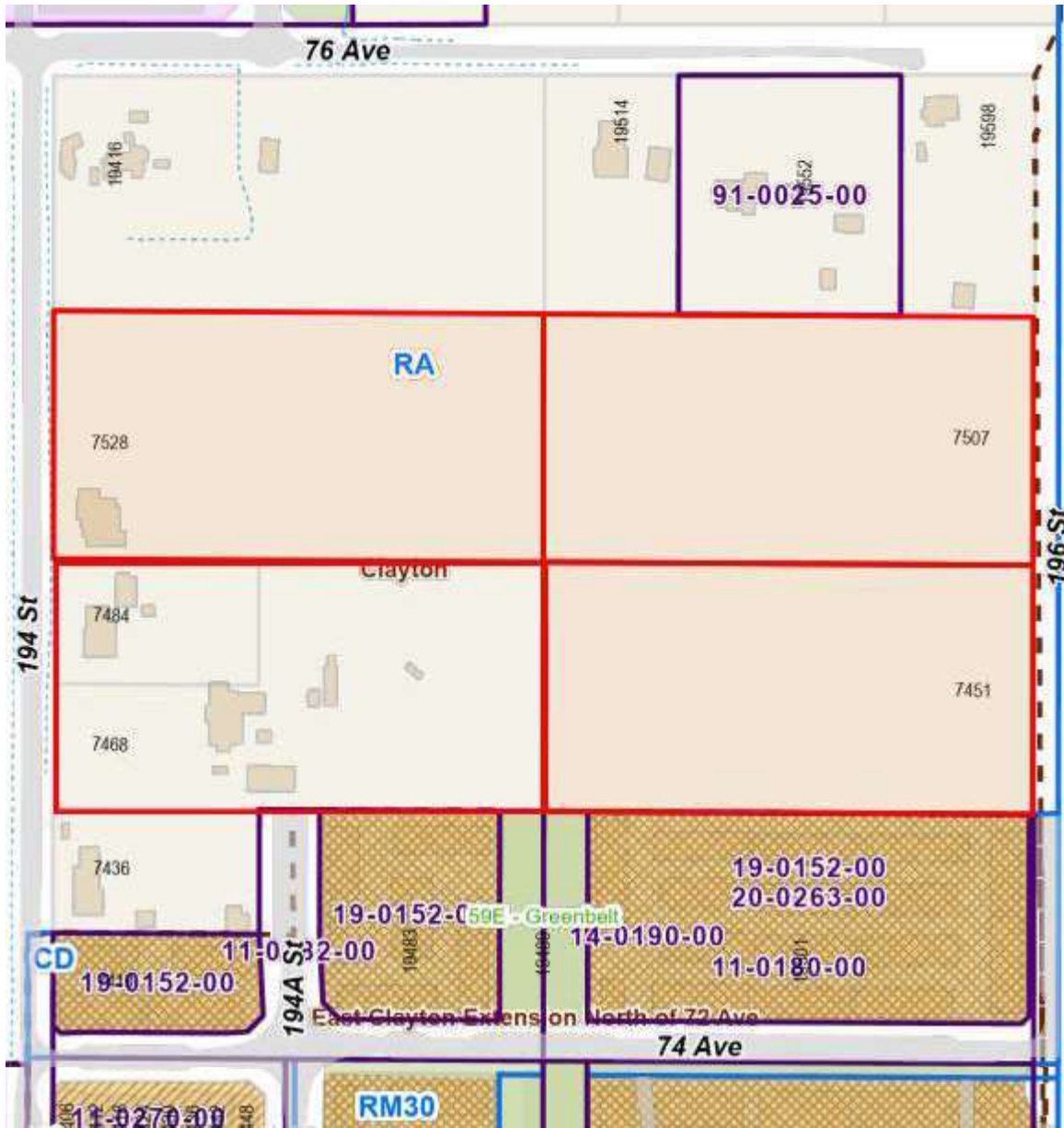
Alternate 19 consists of a three individually owned parcels directly south of the Qualico parcels. The PIDs are 002-401-428, 002-401-436 and 009-360-158 with Civic addresses 19595 76th Ave., 19537 76th Ave and 19489 76th Ave.



Site map – Alternative 19

Alternative 20

Alternate 20 originally consisted of three properties, two parcels owned by Bosa developments and a private parcel located at south of the Bosa properties. Since the initial assessment two additional properties have been added to Alt 20. The Bosa parcels are PID 012-828-696 and 012-828-670 with Civic address 7528 194th St. and 7507 196th Ave. The PIDs and Civic addresses for the private parcels under consideration are PID 012-828-661, 7451 196th St, PID 008-131-554, 7484 194th St and PID 001-787-993, 7468 194th St.



Site map – Alternative 20

At the time of writing, the properties listed above were actively being reviewed. Due to the dynamic nature of property acquisition changes to the parcels may occur which will not be captured in this memo.

3 Geographic Evaluation

Alternative 14B

The natural slope of the land is approximately 6% from east to west, and 6% from south to north. Cut and fill work is required to reduce the slope to 3%. The estimated volume of cut and fill is shown in the table below.

Volume of cut	Volume of fill
40000 m ³	80000 m ³

Geotechnical analysis is required to assess the soil and ground conditions.

Alternative 18

The land is almost flat from east to west, with a natural slope of approximately 4.7% from south to north. Cut and fill work is required to reduce the slope to 3%. The estimated cut and fill volumes are shown in the table below.

Volume of cut	Volume of fill
22700 m ³	45300 m ³

There is a creek located to the west of the site. This has a negative impact on the location of the future substation. The creek may increase the likelihood of flooding, potentially damaging the substation. Runoff from the substation may potentially contaminate the creek, leading to environmental concerns. Geotechnical analysis is required to assess the soil and ground conditions.

Alternative 19

The land is approximately flat from east to west, with a natural slope of approximately 2.5% from south to north. No significant cut and fill work is required for this site.

Like Alternative 18, the same creek is located west of the Alternative 19 site. This has a negative impact on the location of the future substation. The creek may increase the likelihood of flooding, potentially damaging the substation. Runoff from the substation may potentially contaminate the creek, leading to environmental concerns. Geotechnical analysis is required to assess the soil and ground conditions.

Alternative 20

BC Hydro management team has made an offer to purchase the Bosa properties and to negotiated with other landowners in the vicinity. The natural slope of the land is approximately

4% from east to west, and 2.5% from north to south. Cut and fill work is required to reduce the slope to 3%. The estimated volume of cut and fill is shown in the table below.

Volume of cut	Volume of fill
13000 m ³	27000 m ³

Geotechnical analysis is required to assess the soil and ground conditions.

4 Access Evaluation

Alternative 14B

The land is located at the corner of 80th Avenue and 192nd Street. Both 80th Ave and 192nd St are city roads, so there is adequate space for large construction and maintenance vehicles. The access point could be at 192nd St and 80th Ave.

Alternative 18

The land is located south of 78th Avenue. 78th Avenue is a dead-end narrow lane. The substation requires access for large construction and maintenance vehicles. This can be challenging on a narrow lane, which does not have sufficient space for these vehicles. Dead-end street limits construction and maintenance traffic, making it difficult to access the substation.

Alternative 19

Like Alternative 18, Alternative 19 also has limited access. The land is located north of 76th Avenue. 76th Avenue is a dead-end narrow lane, limiting construction and maintenance vehicles, making access to the substation difficult.

Alternative 20

The land is located between 194th St and 196th Street on the south side of 76th Ave. A 200m x 200m substation can be installed on this land. The substation includes a 25kV switchyard, 60kV switchyard, 230kV switchyard and a control building. 194th St, 196th St and 76th Ave are all city roads, so there is adequate space for large construction and maintenance vehicles. The access points can be located at 194th St and 196th St.

5 Conclusion

Alternative 14B

The land has a natural land slope of 6%, with large earthwork (cut and fill) requirements. The site's advantageous positioning at the intersection of two city roads ensures adequate access for large construction and maintenance vehicles, enhancing its operational feasibility.

Alternative 18

The land requires a moderate amount of cut and fill. However, its proximity to a creek poses negative impacts and potential environmental concerns. Additionally, the site is located on a dead-end narrow lane, making access challenging for construction and maintenance activities.

Alternative 19

The land has a favorable natural slope of 2.5%, with no significant earthwork (cut and fill) required, indicating a more straightforward construction process. However, similar to Alternative 18, it is also located near a creek. The dead-end narrow lane access further complicates the logistics of construction and ongoing maintenance.

Alternative 20

The land requires a moderate amount of cut and fill, which is less extensive than that of Alternative 14B and 18. Its location between two city roads provides adequate space for large vehicle access, facilitating easier construction and maintenance.

In summary, Alternative 14B and Alternative 20 emerge as the most favorable options due to their accessible locations and manageable earthwork requirements. Alternative 18 and Alternative 19 are hampered by access challenges and potential environmental impacts (proximity to a creek). Therefore, it is recommended to prioritize Alternative 14B and Alternative 20 for further development considerations.

Attachments

- Attachment A – Willoughby Properties Map



willoughby
properties.pdf



Bosa_Kang_Propert
y.pdf

AI

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Appendix C

TM0592 Willoughby Sub Geotechnical Desktop

Proposed Willoughby Substation

Preliminary Desktop Geotechnical Assessment

TM0592

Memo Number		Revision	Information Security Classification	
000-TEM-00095		0	BC Hydro Internal	
To:	David Chwaklinski		Date	2024 Dec 19
From:	Dylan Lee			
Copy:	Shokooh Meshkinfar			
Related Facilities		Proposed Willoughby Substation		

1 Introduction

As requested by David Chwaklinski, P.Eng., FEC., PMP, Project Engineer Specialist, the Geotechnical Section of the Transmission Civil Department carried out a desktop level preliminary geotechnical assessment of a potential site for the proposed new Willoughby Substation in Surrey. At the time of this report several sites in Surrey and Township of Langley have been or currently undergoing consideration for property purchase. The following properties are discussed in this memo: Alternative 20 (Bosa, Kang, Kool) properties 7528/7468 194 Street and 7507/7451 196 Street. Alternative 18 (Qualico) properties 19526/19570 78th Avenue and Alternative 19 (Qualico) properties 19537/19595/19489 76th Avenue, Surrey. Alternative 14B was also under consideration but not formally assessed in this memorandum. Alternative 14B consists of 7954 192nd Street, 7914 192nd Street, 19234 80th Ave, 19276 80th Avenue, 19296 80th Avenue and 19324 80th Ave.

The key geotechnical considerations for substation development are soil characterization to determine if unfavorable soft/loose soils exist on this site which may warrant special foundation design or significant ground improvement works; if geohazard issues (landslide, flooding, settlement, etc.) exist on the property; identify potential civil works (clearing, road construction, excavation, and regrading) required for the substation development; and identify potential impacts from surrounding third party works. The purpose of this assessment is to screen for these hazards and determine if there are significant geotechnical challenges with developing on these sites.

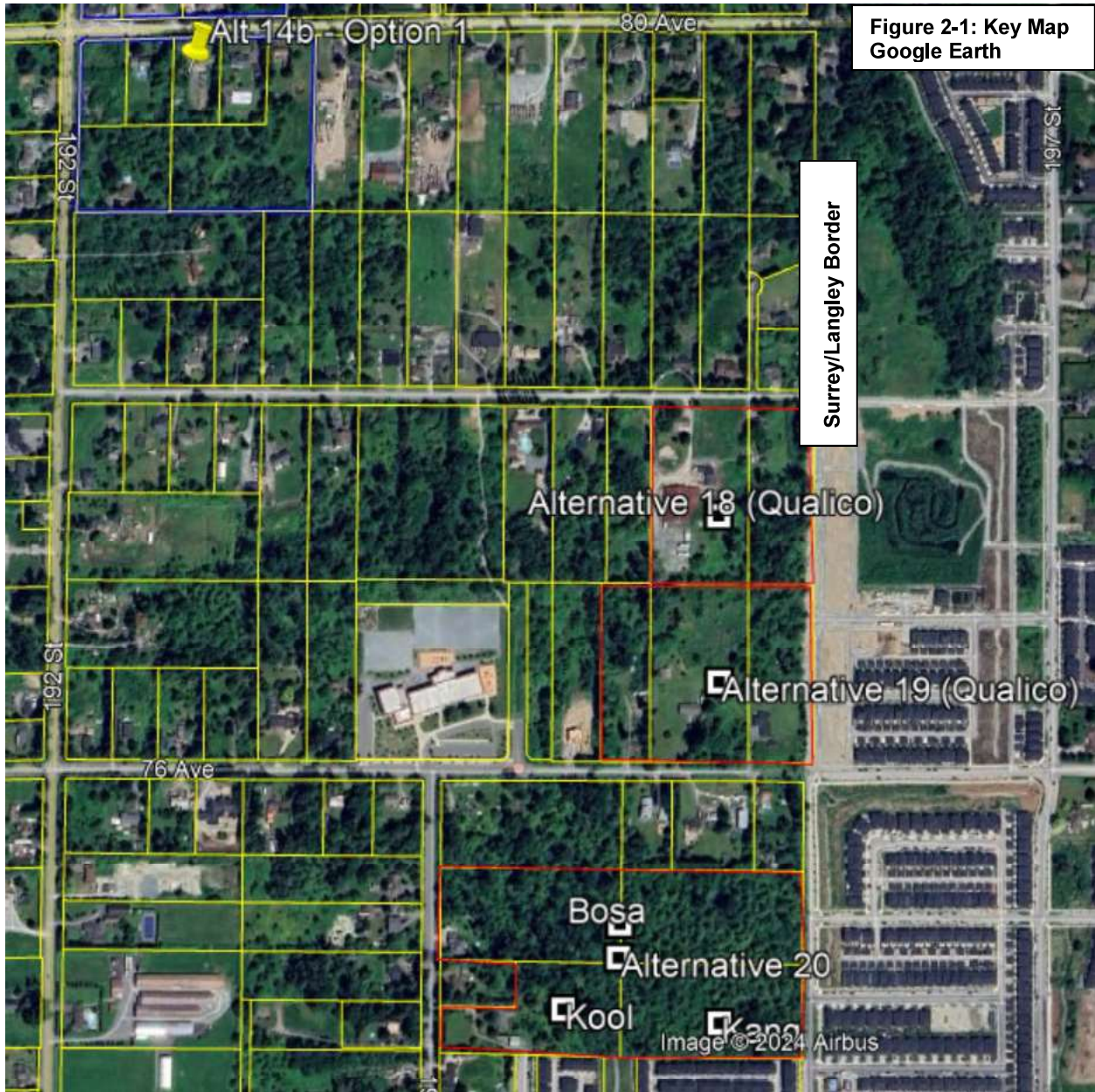
This desktop level assessment is limited to publicly available data sources acquired through the City of Surrey and Township of Langley's Geographic Information System, Province of British Columbia Groundwater wells inventory, Google Earth, review of nearby BC Hydro and third-party

building structures, and surficial geology mapping. A field reconnaissance was not completed at part of this original scope.

2 Geotechnical Assessment

2.1 Site Characterization and Background

An overview map of the properties discussed in the Clayton area is shown in Figure 2-1.



Alternative 20 (Bosa, Kang, Kool)

The properties are rectangular and include four lots: northwest Lot 46002, northeast Lot 46000, southwest Lot 46003, and southeast Lot 45999. The lots are fronting 194 Street or 196 Street Avenue which are classified local sub-urban roads. All four lots are zoned as suburban residential – urban reserve.

According to historical air photos dating back to 1949 to 2023¹ and hill shade LIDAR surfaces between 2009 and 2003, the following land use features were noted for each lot:

Northwest Lot 46002 (7528 194 Street, Surrey, LOT 12 SECTION 22 TOWNSHIP 8 PLAN NWP2600 NWD Part SW 1/4), lot size 19,329 sq meters:

- No additional historical buildings are apparent except for the main residential building located on the southwest corner of the lot fronting 194 street.
- A small section of land around the building has been cleared and grassed. The remaining portion of land on the property has remain undeveloped and heavily vegetated.
- The ground natural slopes northwest at approximately 3 percent but is nearly flat within the northwest quadrant of the property. Site drainage may be poor where the grade is near flat.

Northeast Lot 46000 (7507 196 Street, Surrey, LOT 9 SECTION 22 TOWNSHIP 8 PLAN NWP2600 NWD Part SW 1/4), lot size 19,319 sq meters:

- This property appears undeveloped and heavily treed. No historical buildings or veg clearing work observed in the historical photos.
- The ground naturally slopes down to the northeast at approximately 2 percent.

Northeast Lot 46003 (7468 194 Street, Surrey, LOT 13 SECTION 22 TOWNSHIP 8 PLAN NWP2600 NWD Part E ½ of SW ¼, except PLAN PCL A EXP PL 15559), lot size 15,286 sq meters:

- This property has been subdivided in 1957, and the rectangular plot of land (7484 194 Street) has been developed into a residential dwelling and no longer part of Lot 46003.
- There is a main residential building and a large stand-alone shed located in the southwest corner of the lot. Smaller auxiliary sheds, cars and containers are spread across the property.

¹ Accessed through the City of Surrey Mapping Online System (2024 July 8)
000-TEM-00095
2024 Dec 19

- The southwest corner of the lot front 194 Street has been cleared and grassed. The remaining portion of the property remains vegetated and treed.
- Significant redevelopment was observed to the south (a new lane road 194A street, green belt and townhouse development).
- The ground naturally slopes down to the northwest at approximately 1 percent.

Northeast Lot 45999 (7451 196 Street, Surrey, LOT 8 SECTION 22 TOWNSHIP 8 PLAN NWP2600 NWD), lot size 19,319 sq meters:

- This property appears undeveloped and heavily treed. No historical buildings or veg clearing work observed in the historical photos.
- The ground naturally slopes down to the north and northeast at approximately 2 percent.

Alternative 18 and 19 (Qualico) Properties

The properties are rectangular and include four lots: northwest Lot 45946, northeast Lot 45947, southwest Lot 45949, and southeast Lot 45948. The lots are fronting 78th Avenue or 76 Avenue which are classified local sub-urban roads. All four lots are zoned as suburban residential – urban reserve.

According to historical air photos dating back to 1949 to 2023² and hill shade LIDAR surfaces between 2009 and 2003, the following land use features were noted for each lot:

Northwest Lot 45946 (19526 78th avenue, Surrey, LOT 9 BLOCK 3 SECTION 22 TOWNSHIP 8 PLAN NWP1067 NWD PART NW 1/4), lot size 20,033 sq meters:

- Multiple detached buildings existed on the north half of the property. Throughout the years the buildings have been demolished and replaced.
- Current building footprints include a main residential building on the northwest corner of the lot; possible caretaker building and garage at the centre of the lot; and a large standalone barn at the west centre of the lot. Historical buildings since demolished were located between the caretaker building and the barn.
- Northeast corner of the lot had been used for agriculture.
- Possible horse pen is located south of the main residential building.
- The gravel lot south of the barn may have been an additional pen, historically.

² Accessed through the City of Surrey Mapping Online System (2024 July 8)

- Natural trees and uncleared areas are located along the southern extent of the property line and on the southeast corner of the lot.
- There are soil stockpiles on the east centre and the southwest corner of the lot.
- There is a possible interceptor swale and pond on the north side of the greenbelt at the southeast corner of the lot. This has possibly been infilled.
- No licensed ground water wells³ recorded in the provincial groundwater well inventory.
- The ground naturally slopes downward to the north between 3 to 4 percent gradient.
- Latimer Creek runs south to north between 40 m to 80m from the western property line.

Northeast Lot 45947 (19570 78th avenue, Surrey, LOT 10 BLOCK 3 SECTION 22 TOWNSHIP 8 PLAN NWP1067 NWD), lot size 13,310 sq meters:

- No additional historical buildings on this lot are apparent except for the main residential building on the northwest corner of the lot.
- The north third of the lot has been cleared with selective use for agriculture and garden use.
- The remaining two-third of the lot on the south remain undeveloped and naturally vegetated.
- There exists a minor swale to the east of main building and possibly infilled.
- There exists a possible pond that has been infilled at the treeline.
- There exist possible soil stockpiles at the treeline and on the east side of the cleared lot.
- No licensed ground water wells³ recorded in the provincial groundwater well inventory.
- The ground naturally slopes downward to the northeast at between 5 to 6 percent.
- There is a large townhouse complex being proposed to the east.

Southwest 45950 (19489 76 Avenue, Surrey, LOT 13 BLOCK 3 SECTION 22 TOWNSHIP 8 PLAN NWP1067 NWD Part E 1/2), lot size 10,217 sq meters:

- Historical building that appeared to be a standalone shed was located on the east property line, approximately 53 m north of the south property line. This building appeared demolished at the current time. There is a main residential dwelling located on the southeast quadrant fronting 76th avenue.

³ It is possible a groundwell was installed on this lot but not shown in the groundwater inventory.
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- The south half of the property had been cleared of vegetation in the past for agriculture and garden use.
- The remaining north portion of the lot remains undeveloped and mostly overgrown.
- The ground naturally slopes down to the north at approx. 2 percent.
- Currently surrounded by rural residential development on adjacent lands.
- There used to exist a man-made stormwater detention pond on the west property line, 100m north of the south property line. The pond appeared to be filled in.
- There is an unlicensed ground well located approximately 40 m north of the south property line.

South Lot 45949 (19537 76 Avenue, Surrey, LOT 12 BLOCK 3 SECTION 22 TOWNSHIP 8 PLAN NWP1067 NWD), lot size 20,417 sq meters:

- No additional historical buildings are apparent except for the main residential building and shed near the centre of the lot.
- The entire property had been cleared of vegetation in the past for agriculture and garden use.
- The remaining portion of the lot is undeveloped and mostly overgrown.
- The ground naturally slopes down to the north at approx. 4 percent.
- Currently surrounded by rural residential development on adjacent lands.
- There is an unlicensed ground well located north of the building.

Southeast Lot 45948 (19595 76 Avenue, Surrey, LOT 12 BLOCK 3 SECTION 22 TOWNSHIP 8 PLAN NWP1067 NWD), lot size 13,488 sq meters:

- No additional historical buildings are apparent except for the main residential building and shed near the southern portion of the lot.
- The southern half of property had been cleared of vegetation and mainly grassed.
- The north half of the lot is heavily vegetated and undeveloped.
- The ground naturally slopes down to the northeast at approx. 6 percent.
- Currently surrounded by rural residential development to the north and west; except to the east where this is recent townhouse development.
- There is an unlicensed ground well located north of the building.

3 Surficial Geology and Groundwater

According to Geological Survey of Canada Map 1484A, the surficial soils at all sites under assessment consist of Capilano Sediments (Cd), marine and glaciomarine stony (including till-like deposits) to stoneless silt loam to clay loam with minor sand and silt normally less than 3 m thick but up to 30 m thick containing marine shells. Possible thin veneer of Ca, raised marine beach poorly sorted sand to gravel, in upland areas sediments. At greater depths, Vashon Drift Tills (Va,b) and Pre-vashon till deposits (PVa-h) are likely to exist. The soft clay unit also known as the Fort Langley Formation (FLa-e) which is glacial and deltaic in nature exists south of all the sites towards City of Langley.

Licensed and unlicensed ground water wells have been installed in this region to service residential dwellings and farming needs. An illustration of historic ground wells in proximity to the sites are shown in Figure 3-1 and Figure 3-2. Soil stratigraphy and static groundwater for each well are summarized in Table 3-1 and Table 3-2 for Alternative 20 and Alternative 18/19, respectively. Based on the soil stratigraphy from the ground water wells, the main geological units encountered are Cd, Marine and glacio marine stoney till-like soils, underlain by mainly PVf, pre-vashon Seimahmoo till consisting of glaciofluvial, glaciomarine, and glaciolacustrine deposits. It is likely some thickness of Vashon Drift Till (Va,b) exists between Cd and PVf given some of the soil descriptive indicating hard pan till was observed. The Pre-vashon drift soils are generally interpreted as the sediments that are deposited in front of the glacier as the ice sheet advances and then overridden by the glaciers. PVf soils are typically well draining coarse soils that is likely to contain an established aquifer. The Fort Langley Formation (FLa-e) is likely absent at all these sites since the location is further upland from the glacial basin and at the boundary of where the FLa-e was deposited; however, this can not be totally discounted as the soil logs are not detailed enough.

Due to the fine grained and stiff nature of the upper soil units observed in the Cd, the soils are generally not conducive of drainage (poor permeability). There is potential for limited and isolated sand and gravel units with the Cd as indicated in two of the water wells east and south of the Alternative 18. The Cd can generally be considered as an aquitard in this area. The ground wells were installed with screen depths that penetrate Cd and were set inside the well draining sand and gravel soil units of PVf. The static groundwater table has been observed between 18 m (60 ft) and 53 m (175 ft) for groundwater wells installed between 34 m (111 ft) and 92 m (303 ft) screen depth for all the sites under consideration. This may suggest the aquifer may be pressurized as the static water rises within the aquitard Cd soil unit and above PVf. The fluctuation in groundwater is not completely well understood based on the limited information available and in the absence of a hydrological study that is beyond the scope of this report; however, the following reasons may explain the difference in groundwater:

- There are multiple water bearing aquifers within PVf unit. The higher elevation static groundwater table may correspond to a pressurized aquifer as the screen depths for the shallow wells are targeted within the upper strata of the PVf; while the lower elevation static ground water corresponds to a less or unpressurized aquifer as the screen depths for the deeper wells are targeted much lower in the soil strata compared to the shallow wells; or,
- There is only a single aquifer within PVf and the groundwater has changed over time indicating the aquifer had been depleting. The deeper wells with the deeper groundwater table were observed to be installed approximately one to two decades after the shallow wells were installed.

Given the extensive historic groundwater well use in this region before the 90's, the latter theory is likely more plausible given the chronological installation of the groundwater wells resulting in deeper wells and lower groundwater table through time.

Table 3-1: Alternative 20 Properties - Groundwater wells Lithology and groundwater

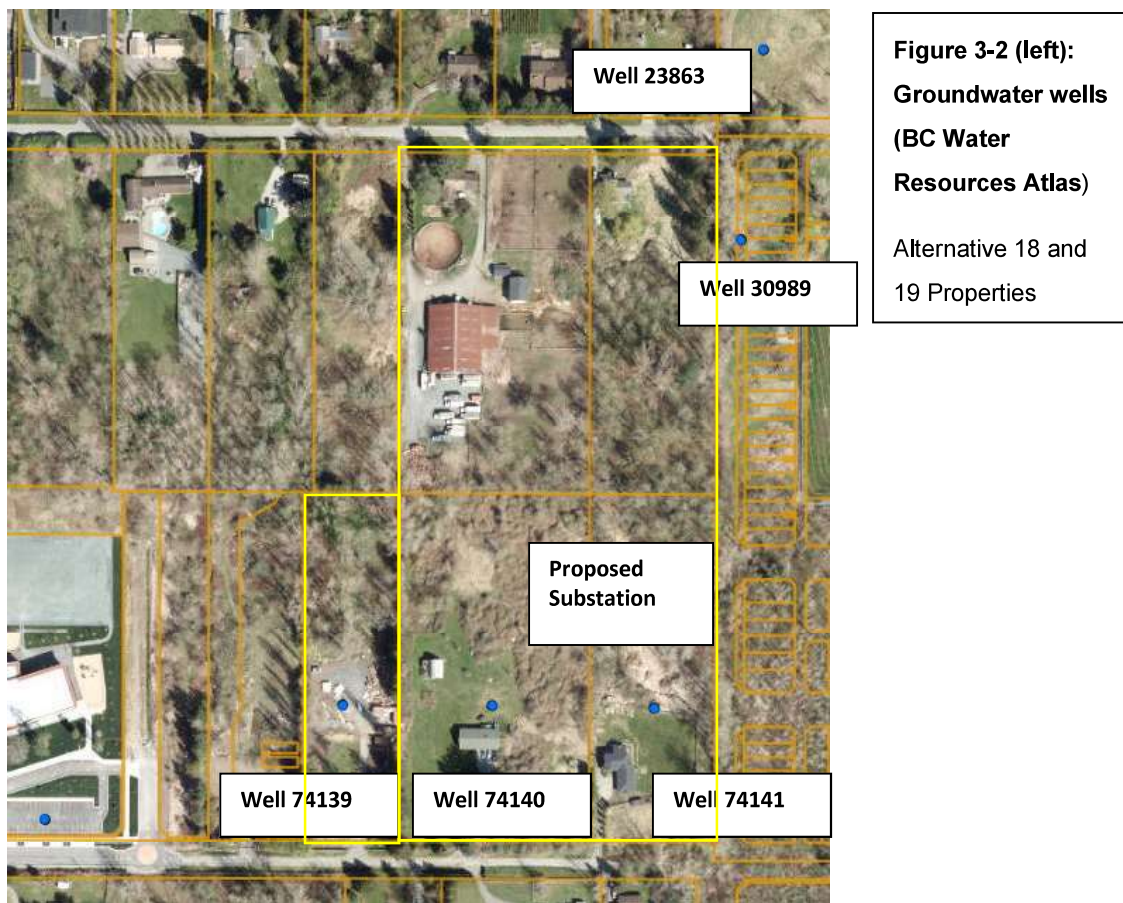
Well 58737 (ft)	Well 15844 (ft)
0-1 Subsoil	0-50 Not recorded
1-15 hard pan stoney	50-81 till
15-45 till	81-101 tight sand and gravel
45-49 sandy soil	101-108 grey clay
49-174 boulder and till	108-142 tight sand and gravel
174-195 damp till	142-147 hard pan
195-235 till wet with sand lenses	147-158 sand, and silt
	158+ clay and till
Static water – 155ft	Static water – 140 ft
Screen Interval – N/A	Screen Interval – N/A
Bottom of casing 235	Bottom Casing @ 297

Figure 3-1 (bottom):
Groundwater wells (BC
Water Resources Atlas)
Alternative 20 Properties



Table 3-2: Alternative 18 and 19 Properties - Groundwater wells Lithology and groundwater

Well 23863 (ft)	Well 30989 (ft)	Well 74141 (ft)	Well 74140 (ft)	Well 7419 (ft)
0-103 Till	0-20 Stoney grey clay boulder	1-17 brown clay to grey clay	2-10 brown clay and gravel	0-2 Top soil
113-111 Clay	20-44 Cemented gravel	17-39 till and boulders	10-48 Till and boulders	2-15 Brown Clay
111-114 Till	44-85 stoney grey till	39-43 dry sand and gravel	48-147 Clay and gravel to sand and gravel	15-47 Till and cobbles
114-123 Sand and Gravel	85-104 Clay	43-120 sandy to hard packed till	147-228 Water bearing till/sand and gravel	47-53 Stoney clay
123 -127 fine sand and gravel	104-115 Sand medium gravel	120-192 sand and gravel		53-150 Gravels and cobbles, layer of clay
	115-121 Coarse sand, grey clay	192-303 Till		150-177 Hard packed silt and sand
		303-306 sand and gravel		177-186 Water bearing sand and gravel
<i>Static water – 60ft</i>	<i>Static water – 80 ft</i>	<i>Static water – 175 ft</i>	<i>Static water – 138 ft</i>	<i>Static water – 136 ft</i>
<i>Screen Interval 122-127, Bottom of casing 127</i>	<i>Screen Interval 110-115, Bottom Casing @ 111</i>	<i>Screen interval 199-306, Bottom Casing @ 303</i>	<i>No screen, Bottom Casing @227</i>	<i>No screen, Bottom Casing @186</i>



4 Discussions

The information provided in this desktop study indicates that Alternative 18, 19, and 20 properties are considered feasible for substation development and there are no significant geotechnical concerns at any of the properties being considered for purchase based on this screening level assessment. We would expect properties nearby of the studied sites that similar conditions exist based on surficial geology mapping, terrain, and groundwater well logs.

Shallow foundation for substation development for *Alternative 18, 19, and 20 properties* is considered feasible if constructed below frost depth (minimum 450 mm depth). No deep ground improvement works are required with exception of general site prep works that include clearing, grubbing, and stripping to expose the shallow native till-like soils. The actual depth of stripping to expose suitable subgrade will depend on site specific conditions ascertain from future site investigative works. The upper till-like soils are likely over consolidated and not prone to long term settlement unless subject to significant long term and excessive surcharge. The native fine grained, cohesive till-like, organic free soils may be rehandled and reused for non-structural loading use such as general landscape fill if moisture controlled and compacted with appropriate

compaction method such as sheepsfoot roller. Stringent erosion and sediment control measures using sediment tanks, sediment ponds, swales, gravel pads, and erosion control mattings will be required during construction to manage runoff and effluents on this site due to large scale civil works and soil disturbance expected for this development. Road improvement works adjacent to the properties will likely be required to facilitate the construction and maintenance equipment for the substation; and transmission/distribution assets. There may be additional civil constraints from nearby re-development (townhouse development and greenways) that may impact the substation development. It is assumed site servicing will be through external infrastructures and a groundwater well for domestic use will not be required.

Natural geotechnical hazards (flooding, liquefaction, and landslides) are unlikely to exist on this site. There are no classified drainage water courses on the properties and the land are not subject to flooding based on the City of Surrey's Hazard Lands Development Permit Area. The gentle gradient on this site suggest that re-levelling works would be minimal; hence the final grades may be supported by short landscape retaining walls or using stable slope configuration.

Foundation settlement risks are possible if the footings are designed with excessive loads or the site is significantly surcharged due to fine grained compressible (clay) soils at this site. A detailed site investigation will be required to ascertain suitable bearing capacity and expected settlement for the footings.

The seismic site class on these properties is likely a Site Class C or D as defined in the 2020 National Building Code and based on Soil Hazard Map of the Lower Mainland of the lower mainland of British Columbia for assessing the earthquake hazard due to lateral ground shaking⁴. The sites are considered to have very low susceptibility to liquefaction based on recent micro-zonation mapping⁵ of the lower mainland; however, there can be local soil conditions that may not be captured in the mapping. This will need to be confirmed in a subsequent detailed geotechnical investigation. Buildings in the generally vicinity (ex. townhouses, residential dwelling), including BC Hydro's Fraser Valley Operation Centre approximately 1 km away, were constructed using conventional shallow footings without structurally tied and/or ground improvement works, suggesting the soils are competent.

⁴ Monahan, Patrick, 2005. Soil hazard map of the lower mainland of British Columbia for assessing earthquake hazard due to lateral ground shaking

⁵ A. Javanbakht, S.r., Adhikari, M.Salsabili, A. Bilson Darko, S., Molnar, 2024. MVSMMP Map 03, Level 1-2 Liquefaction Susceptibility Map

Due to the poor draining soils at Alternative 18 to 20 and the proximity of Latimer Creek at Alternative 18, an appropriately sized storm water management system (water detention system) and oil water separator system is recommended for the substation development. It is very likely any storm runoff from the site will discharge into a municipal storm system which then drains into Latimer Creek or natural watercourses. Significant changes to natural flow regimes into Latimer Creek can have significant impacts downstream (ex. erosion, landslide, loss of natural habitat and vegetation, etc.).

For Alternative 20 and portions of land in Alternative 18 and 19, there are historical land residential/light farming use that may result in the following non-exhaustive risks:

- Oil tanks,
- Buried demolished building foundation,
- Buried septic systems,
- Unlicensed groundwater well,
- Buried irrigation systems,
- Buried contaminated soils or building material,
- Reclamation, and deleterious soils (stockpiled or buried), and last but not least,
- Buried stormwater system that are filled with compressible sediments (ponds and swales)

Alternative 20 properties on Lot 45999 and Lot 46000 appear undeveloped and are unlikely to have pre-existing non-natural imported fill or buried infrastructures; however, this should be confirmed at a later time through detailed discussions with the landowner and subsequent geotechnical investigation.

5 Recommendations

We recommend engaging with the landowners to identify whether these risks exist, completing shallow test pits and drill holes to estimate stripping requirements and soil class, and facilitating an utility locate (electromagnetic and ground penetration radar) where necessary. Soil sampling and testing for contaminated soils is recommended. It may be favorable to rehandle and stockpile deleterious soils on the property should there be sufficient real-estate with the proposed substation development.

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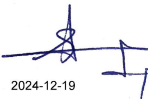
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Reviewed by:

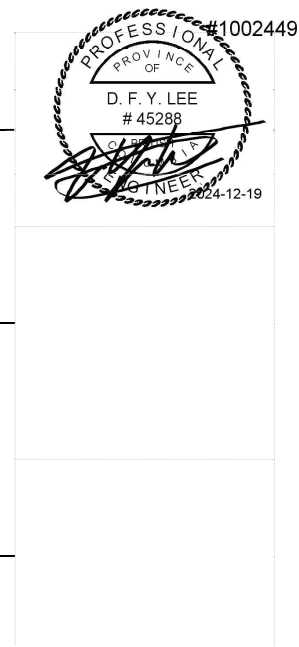

2024-12-19

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Accepted by:


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Project Engineer Specialist



Appendix D

TM0592 Willoughby Substation Property Purchase Overhead Transmission Assessment