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April 24, 2020

British Columbia Utilities Commission
Suite 410, 900 Howe Street
Vancouver, BC
V6Z 2N3

Attention: Mr. Patrick Wruck, Commission Secretary and Manager, Regulatory Support

Dear Mr. Wruck:

**Re: FortisBC Inc. (FBC)**

**Application for a Certificate of Public Convenience and Necessity for the Kelowna Bulk Transformer Addition Project (Application)**

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Pursuant to sections 45 and 46 of the *Utilities Commission Act* (UCA), FBC applies to the British Columbia Utilities Commission (the BCUC) for a CPCN for the Kelowna Bulk Transformer Addition Project.

In particular, FBC seeks approval under sections 45 and 46 of the UCA to:

- Install a new 120/160/200 MVA 230/138 kV bulk transformer at the FA Lee Terminal;
- Modify the FA Lee Terminal station;
- Re-align some existing transmission structures outside the FA Lee Terminal station; and
- Re-align the existing distribution egress within the station.

**Requests for Confidential Treatment of Certain Appendices**

To support the Application, FBC has filed several Appendices, with the following ones being filed confidentially in accordance with the BCUC's Rules of Practice and Procedure regarding confidential documents as set out in Order G-15-19.

- Appendix A Engineering Diagrams for F.A. Lee Terminal Station
- Appendices B and C Cost Estimates and Financial Schedules

FBC respectfully requests that the BCUC hold the above listed documents confidential, and believes that such information should remain confidential even after the regulatory process for this Application is completed. Below, FBC outlines the reasons for keeping the information confidential.

Appendix A

Appendix A consists of engineering documents and should be kept confidential on the basis that it contains sensitive technical information pertaining to the Company's assets. Public disclosure of the technical and engineering information contained in these appendices elevates the risk of potential harm to FBC's assets by persons with malicious intent, which could result in damage to the assets and/or limit, restrict or impair their operation. Disclosure of this information could reasonably be expected to result in harm to the safety of the public, the Company's employees, and the assets themselves.

Appendices B and C

Appendices B and C include cost estimates, containing capital cost estimates for the Project. The capital spending amounts in these Appendices describe the costs of the various and specific Project components. FBC intends to contract the majority of the construction for the KBTA Project; providing potential bidders with this information could reasonably be expected to prejudice FBC's negotiating position when procuring contracts and could result in higher costs for the Project.

**Access to Confidential Information for Interveners**

Should parties that choose to register in the review of this Application require access to some or all of the information filed confidentially, FBC has provided a Confidentiality Declaration and Undertaking Form in Appendix G, to be executed before confidential information may be released to registered parties under the terms of the undertaking. FBC has no objection to providing confidential information to its customary and routine intervener groups representing customer interests. FBC requests that the BCUC provide it with the opportunity to file comments on any objections or concerns that it may have, should any other registered parties seek access to confidential information.

If further information is required, please contact the undersigned.

Sincerely,

**FORTISBC INC.**

***Original signed:***

Doug Slater

Attachments

cc (email only): Registered Parties in the FortisBC Application for a Multi-Year Rate Plan for 2020 through 2024

FortisBC

# FortisBC Inc.

# Application for Approval of a Certificate of Public Convenience and Necessity for the Purchase and Installation of the Kelowna Bulk Electricity Transformer

## Volume 1 - Application

April 24, 2020

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# 1. APPLICATION

## 1.1 EXECUTIVE SUMMARY

In this application (the Application) FortisBC Inc. (FBC or the Company) is seeking approval of the British Columbia Utilities Commission (BCUC) for a Certificate of Public Convenience and Necessity (CPCN) for the Kelowna Bulk Transformer Addition Project (referred to as the KBTA Project or the Project).

In summary, FBC seeks approval from the BCUC to install a third terminal transformer at the F.A. Lee Terminal Station (LEE) on McCurdy Road in Kelowna, BC, including the reconfiguration of the 138 kV bus into an industry standard ring bus configuration. The estimated total cost of the Project in as-spent dollars is $23.288 million, which includes Allowance for Funds Used During Construction (AFUDC) and the cost of equipment removal.

If the Application is approved, FBC plans to initiate the detailed design, procurement and construction for the Project early in the first quarter of 2021. The new transformer is scheduled to be in service by the end of 2022, with Project completion and close-out during the second quarter of 2023.

### 1.1.1 Load Growth Expected to Exceed System Planning Criteria

FBC has experienced high levels of customer load growth in the Kelowna area and it expects that electricity demand will exceed system planning reliability criteria by the summer of 2022[1]. Specifically, FBC will not be able to meet the N-1[2] system reliability planning criteria in order to reliably maintain service to the area load during peak periods in the event of an outage or failure of one of the two existing 230/138 kV transformers at LEE. Therefore, without expanding FBC's current capacity resources, load will need to be shed in 2022 in the event of an outage or failure of one of the two existing transformers at LEE, as explained in Section 3.4 below. The likelihood and duration of the required load shedding under these contingency conditions will increase as load grows in the Kelowna area.

Kelowna's distribution system is supplied by the 138 kV and 230 kV transmission systems. While capacity on the 230 kV system is sufficient, capacity on the 138 kV system, which directly feeds the area's distribution substations, is becoming increasingly constrained. After considering potential solutions (described in Section 4.2), FBC determined that additional transformation capacity from 230 kV to 138 kV is required to continue meeting the transmission planning criteria as area load continues to grow. This can be accomplished by adding a new transformer in the Kelowna area.

The Kelowna area covers a relatively small geographic area, but has the highest load concentration in FBC's service territory. It accounts for almost 50 percent of the total FBC summer

[1] FBC discusses the potential impact of COVID-19 on the load forecast and project need in Section 3.3.2.1.
[2] Please refer to footnotes 15 and 16 for the definitions of normal and contingency operating conditions.

peak load and more than 40 percent of the winter peak load. The City of Kelowna and surrounding area has a population base of more than 140 thousand and is the largest urban centre in the British Columbia interior. Apart from being ranked as the twenty-first largest metropolitan area in Canada, Kelowna has been one of the fastest growing cities in Canada during the last decade, and is also the fastest growing region in FBC's service area. During the 20-year period 1996-2016, Kelowna's population has grown by an average annual rate of 1.6 percent and is forecast to grow at a similar rate in the subsequent 20 year period to 2036.

### 1.1.2 Three Feasible Alternatives Identified

The Company identified three feasible alternatives to increase the 138 kV capacity in the Kelowna Area:

- Alternative A: Purchase and install a third terminal transformer at LEE, and reconfigure the existing 138 kV split bus into an industry standard ring bus configuration;
- Alternative B: Purchase and install a third terminal transformer at LEE, and extend the existing non-standard, 138 kV split bus configuration; and
- Alternative C: Purchase and install a second terminal transformer at DG Bell Terminal Station (DGB) and extend the existing 138 kV industry standard ring bus configuration.

To assess each of these alternatives, they were compared against the following criteria:

Technical Criteria

1. Meets single contingency (N-1) transmission planning criteria;
2. Safety and operability;
3. Potential for future expansion;
4. System reliability; and
5. Project risk.

Financial Criteria

6. Operation and Maintenance (O&M) Costs;
7. Present value of incremental revenue requirement; and
8. Rate impact.

### 1.1.3 The Preferred Alternative

Based on these criteria, the Company submits that the best alternative to address the need for the project is Alternative A – the installation of a third terminal transformer at LEE and the reconfiguration of the 138 kV bus into a standard ring bus configuration. Alternative A best addresses the reliability concerns and growth opportunities for the Kelowna load area. The evaluation of the alternatives and selection of the preferred solution will be discussed in detail in Sections 4.4 and 4.5.

In summary, the KBTA Project consists of:

- The installation of a new 120/160/200 MVA 230/138 kV bulk transformer at the F.A. Lee Terminal Station;
- The required substation modifications, including the reconfiguration of the 238 kV bus to a ring bus configuration, inside LEE;
- Re-alignment of some existing transmission structures outside of LEE; and
- Removal of the existing distribution egress within the station and re-alignment of distribution lines outside the station.

### 1.1.4 Project Costs and Rate Impact

The Project is estimated to have a capital cost of approximately $23.288 million in as-spent dollars, including AFUDC and removal costs.

Table 1-1 below summarizes the total forecast capital costs of the Project.

**Table 1-1: Total Forecast Capital Costs ($ Millions)**

| Item | $ 2019 | $As-Spent | AFUDC | Total |
|---|---|---|---|---|
| Constuction Costs | 20.106 | 21.114 | 1.206 | 22.320 |
| Net Removal Costs | 0.903 | 0.944 | 0.024 | 0.968 |
| **Total** | **$ 21.009** | **$ 22.057** | **$ 1.230** | **$ 23.288** |

Based on the total Project costs and an in-service date in December 2022 the rate impact is estimated to be 0.54 percent when all assets have been transferred to their appropriate plant asset accounts. For a typical FBC residential customer consuming an annual average of 11,000 kWh, this would equate to an approximate annual bill increase of $6.87.

On a forty year basis the Project has a levelized rate increase of 0.39 percent and a levelized average annual residential bill impact of $4.96. This levelized rate increase and bill impact represent the present value of the cost of service over 40 years, as compared to 2020 approved interim rates.

Section 6 provides a summary of the Project cost estimate. Details of the cost estimate are found in Confidential Appendix B and the financial schedules for the cost of service and rate impact analysis are included in Confidential Appendix C.

### 1.1.5 Stakeholder Consultation and Indigenous Engagement

Consultation, engagement and communication with the public, local government, Indigenous communities and other stakeholders is an important component in the development of FBC's KBTA Project.

Prior to filing the Application, FBC sent notification letters to area residents and stakeholders who have the potential to be directly affected by the Project. Various channels were used to reach customers including letters, updates on the Project website[3], and a Project survey. FBC has also notified local government authorities and responded to requests for further information. To date, a few minor concerns were raised that will be considered during Project planning.

Due to the ongoing COVID-19 pandemic and the order from the provincial government to reduce public meetings, FBC hosted a virtual Town Hall / Information Session via teleconference on April 22, 2020 for area residents to attend and provide feedback. FBC will continue to consult with the residents through available channels as the Project progresses, will track concerns raised and will work with customers and stakeholders to address any outstanding items.

FBC has engaged Indigenous communities with interests in the area of the Project to provide information, describe any potential impacts, understand the interests in the area, and provide an opportunity for Indigenous communities to identify additional impacts and to give input on the Project. Engagement was initiated by notification letters, and at the time of filing, FBC has not received any comments or concerns from Indigenous communities. FBC will continue to engage with Indigenous communities throughout the Project, including with respect to potential jobs, training and supply chain opportunities as well as any opportunities for cultural preservation.

FBC considers that the public consultation activities to the time of filing the Application have been sufficient, appropriate and reasonable to meet the requirements of the CPCN Guidelines. FBC will continue to consult with stakeholders regarding construction timelines, mitigation of traffic disruptions (where applicable) and public safety. Further consultation will continue prior to and throughout construction to help inform local government and residents about construction activities in their area in an effort to minimize impacts.

## 1.2 APPROVALS SOUGHT

FBC hereby applies to the BCUC pursuant to Sections 45 and 46 of the *Utilities Commission Act* (UCA), for a CPCN for the KBTA Project.

Specifically, FBC seeks approval from the BCUC to purchase and install a third terminal transformer at the F.A. Lee Terminal Station in the City of Kelowna, including the reconfiguring of the existing 138 kV bus into an industry standard ring bus configuration, and inclusive of all the Project details described in Section 5 of the Application.

[3] www.fortisbc.com/in-your-community/working-in-your-neighbourhood/kelowna-lee-station-upgrade

A CPCN is required for this project because it is a system extension that exceeds the materiality threshold of $20 million set for FBC by Order G-120-15.

A draft Order is attached as Appendix F-1.

### 1.2.1 Confidential Filings Request

FBC requests that certain Appendices to the Application (together, the Confidential Appendices) be filed on a confidential basis, pursuant to section 18 of the BCUC's Rules of Practice and Procedure regarding confidential documents as set out in Order G-15-19. The confidential Appendices contain operationally sensitive information, including detailed information that, if disclosed, could impede FBC's ability to safely and reliably operate its electric system assets and could risk the safety of both its workers and the public. The Confidential Appendices also contain market sensitive information that the Company believes should be kept confidential so as not to influence or hamper negotiations for the construction contractor selection process for the Project. FBC has and will continue to mark all confidential information as such, where applicable. The Appendices for which FBC requests confidential treatment, and the specific reasons for the requested treatment, are as follows:

Appendix A: Engineering Drawings including General Arrangement and Single Line Diagrams for F.A. Lee Terminal Station. Public disclosure of the technical and engineering information contained in these appendices elevates the risk of potential harm to FBC's assets by persons with malicious intent, which could result in damage to the assets and/or limit, restrict or impair their operation. Disclosure of this information could reasonably be expected to result in harm to the safety of the public, the Company's employees, and the assets themselves.

Appendices B and C: Cost Estimates and Financial Schedules. The capital spending amounts in these Appendices describe the costs of the various and specific Project components. FBC intends to contract the majority of the construction for the KBTA Project; providing potential bidders with this information could reasonably be expected to prejudice FBC's negotiating position when procuring contracts and could result in higher costs for the Project.

FBC requests that the BCUC direct that the Confidential Appendices and any future filings which address confidential information be kept confidential. Interveners may access the confidential information upon execution of a Confidentiality Declaration and Undertaking in a form acceptable to the BCUC, a copy of which is provided in Appendix G. FBC will provide electronic access to the confidential appendices to such interveners and will require confirmation at the conclusion of the proceeding that the information has been treated in accordance with the Rules of Practice and Procedure[4].

[4] https://www.bcuc.com/Documents/Participant-Info/G-15-19_BCUC_Rules_of_Practice_and_Procedure.pdf

## 1.3 PROPOSED REGULATORY PROCESS

FBC proposes a written public hearing process for the review of this Application. The information presented in this Application conforms to the BCUC's 2015 CPCN Guidelines, and the alternatives available to FBC are straightforward, with the selected alternative addressing all identified issues and providing the best value for investment over a 40-year analysis period. Construction will be confined to property and facilities wholly owned by FBC or where FBC has an existing Right-of-Way. FBC believes that a written hearing process with two rounds of information requests will provide for an appropriate and efficient review of the Application.

FBC proposes the regulatory timetable set out in Table 1-2 below. A draft procedural order is included as Appendix F-2. Assuming that the CPCN is approved by the end of December 2020, FBC plans to begin engineering, procurement and construction in early 2021, and expects to have Project completion during the second quarter of 2023.

**Table 1-2: Proposed Regulatory Timetable**

| Action | Date (2020) |
|---|---|
| **BCUC Issues Procedural Order by** | Friday, May 22 |
| **FBC Publishes Notice by** | Friday, May 29 |
| **Intervener Registration** | Thursday, June 11 |
| **BCUC Information Request (IR) No. 1** | Thursday, June 18 |
| **Intervener IR No. 1** | Thursday, June 25 |
| **FBC Response to IR No. 1** | Thursday, July 9 |
| **BCUC and Intervener IR No. 2** | Thursday, July 30 |
| **FBC Response to IR No. 2** | Thursday, August 20 |
| **FBC Final Written Submission** | Thursday, September 3 |
| **Intervener Final Written Submissions** | Thursday, September 17 |
| **FBC Written Reply Submission** | Tuesday, September 29 |

## 1.4 ORGANIZATION OF THE APPLICATION

The Application provides detailed information in support of the Project. The remainder of the Application is organized in the following sections:

- Section 2 provides an overview of the Applicant and provides information on its financial and technical capabilities for the Project;
- Section 3 provides an overview of the Project, describes the Kelowna load area, its customers, forecast load for the area, and FBC's transmission planning criteria applicable to the Project;

- Section 4 describes the possible solutions that were not feasible or not cost-effective, the three alternatives considered, and compares and evaluates each alternative against a list of technical and financial criteria;
- Section 5 provides a detailed description of the proposed Project, including construction, design, resource planning and management, and schedule. It includes a risk analysis and discussion of potential Project impacts;
- Section 6 provides the cost estimates, the assumptions upon which the financial analysis is based and the rate impacts;
- Section 7 discusses FBC's public consultation, Indigenous engagement and communication efforts regarding the Project;
- Section 8 provides an overview of the BC Provincial Government energy objectives and policy considerations relevant to the Project; and
- Section 9 provides a conclusion.

# 2. APPLICANT

## 2.1 *NAME, ADDRESS AND NATURE OF BUSINESS*

FortisBC Inc.
Suite 100, 1975 Springfield Road
Kelowna, BC V1Y 7V7

FBC is an investor-owned, integrated utility engaged in the business of generation, transmission, distribution and sale of electricity in the southern interior of British Columbia. It serves approximately 179 thousand customers directly and indirectly. FBC was incorporated in 1897 and is regulated by the BCUC pursuant to the UCA.

## 2.2 *FINANCIAL AND TECHNICAL CAPACITY*

FBC is capable of financing the Project. FBC has credit ratings from DBRS of A (low) for secured and unsecured debentures and from Moody's Investors Service of Baa1 for unsecured debentures.

The Company has a rate base of approximately $1.3 billion. This includes four hydroelectric generating plants, with an aggregate capacity of 225 MW, and approximately 7,300 km of transmission and distribution power lines for the delivery of electricity to major load centres and customers in its service area. FBC has approximately 500 full-time and part-time employees.

FBC has experience in managing the design, construction, operation and maintenance of substations and transmission lines in British Columbia. FBC will provide the necessary resources to manage the design and construction of the KBTA Project, as described in Section 5.3 Project Management and Resources.

## 2.3 *COMPANY CONTACT*

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## 2.4 *LEGAL COUNSEL*

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# 3. PROJECT NEED AND JUSTIFICATION

## 3.1 *OVERVIEW*

FBC has experienced high levels of customer load growth in the Kelowna area[5] and it expects electricity demand will exceed system planning reliability criteria by the summer of 2022. Specifically, FBC will not be able to meet the N-1 system reliability planning criteria in order to reliably maintain service to the area load during peak periods in the event of an outage or failure of one of the two existing 230/138 kV transformers at the F.A. Lee Terminal Station. Therefore, without expanding FBC's current resources, load will need to be shed in 2022 in the event of an outage or failure of one of the two existing transformers at LEE, as explained in Section 3.4 below. During an N-1 contingency event, the consequences of the required load shedding will increase as load grows in the Kelowna area.

Kelowna's distribution system is supplied by the 230 kV and 138 kV transmission systems. While capacity on the 230 kV system is sufficient, capacity on the 138 kV system, which directly feeds the area's distribution substations, is becoming increasingly constrained. After considering potential solutions (described in Section 4), FBC determined that additional transformation capacity from 230 kV to 138 kV is required to continue meeting FBC's transmission planning criteria as area load continues to grow. This can best be accomplished by adding a new transformer in the Kelowna area.

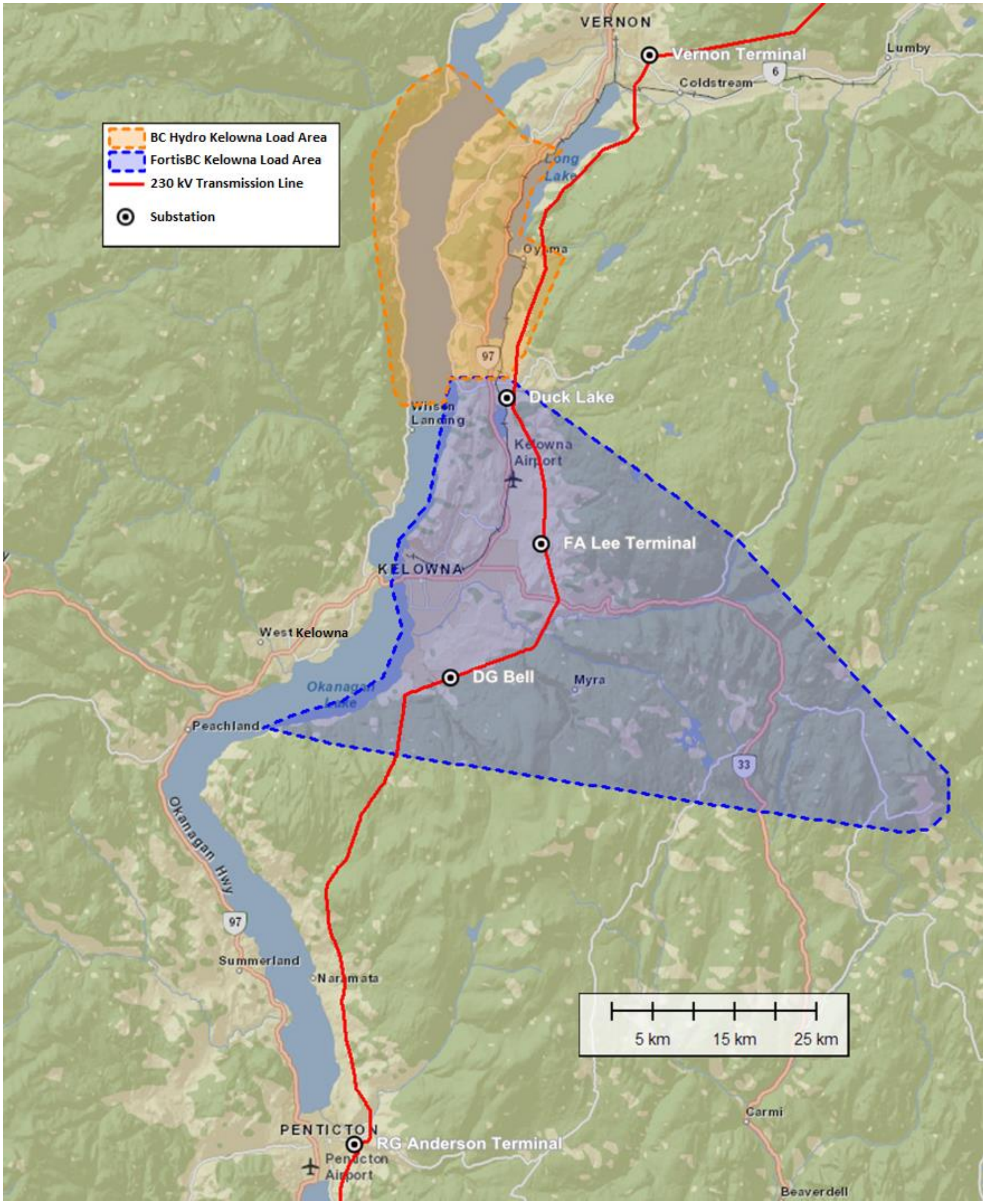
In this section, FBC describes the transmission and distribution systems in the Kelowna area, sets out the forecast load in relation to the existing 138 kV capacity, and explains FBC's transmission system planning criteria, which ensure reliability of service and preserve equipment condition.

## 3.2 *KELOWNA AREA SYSTEM*

The Project will serve FBC's customers in the Kelowna load area, which includes the City of Kelowna and its surrounding areas, such as Joe Rich and the Big White Ski Resort to the east, and Lake Country to the north, as shown in Figure 3-1 below.

[5] The Kelowna load area is shown in Figure 3-1 and includes the City of Kelowna. It is located within the Regional District of Central Okanagan, and FBC also refers to this area as its "North Okanagan" region, since it is the northern extent of the Company's service area.

1 **Figure 3-1: Map of Kelowna Load Area**




2

Compared to other regions in FBC's service territory, the Kelowna load area covers a relatively small geographic area, but has the highest load concentration. It accounts for almost 50 percent of the total FBC summer peak load and more than 40 percent of the winter peak load.

FBC has approximately 76,600 direct customers in the Kelowna area, shown by rate class in Table 3-1:

**Table 3-1: FBC Kelowna Load Area Customers by Class**

| Rate Class | Customer Count |
|---|---:|
| Small Commercial / Commercial | 9,781 |
| Large Commercial | 22 |
| Irrigation | 212 |
| Lighting | 467 |
| Residential | 66,133 |
| Total | 76,615 |

Included in these customers in the Kelowna area are the following major customers:

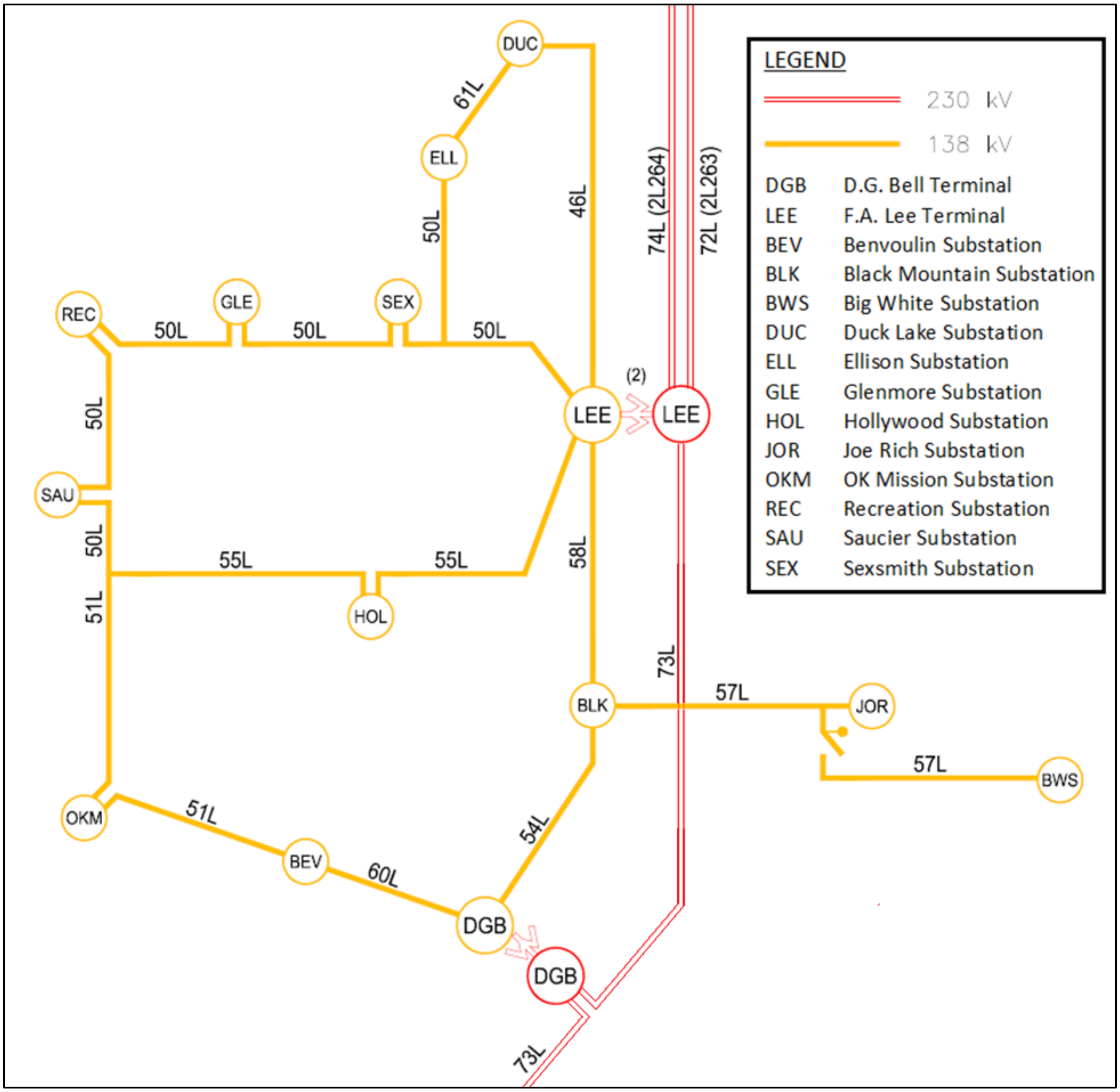
- Kelowna General Hospital;
- University of British Columbia Okanagan;
- Okanagan College;
- Kelowna International Airport; and
- Big White Ski Resort.

In addition, FBC provides electricity to BC Hydro for service to its approximately 8,000 customers in the Duck Lake area[6], which can also be seen in Figure 3-1.

The KBTA Project is required in order to maintain adequate 138 kV supply capacity to serve the expected load during the loss of a single 230 kV/138 kV transformer at LEE (an N-1 outage condition). A simplified single line diagram showing the Kelowna area transmission system is provided below as Figure 3.2.

[6] The Duck Lake Wheeling Agreement between FBC and BC Hydro was approved by Order G-19-10.

**Figure 3-2: Kelowna Area Transmission System**




As depicted in Figure 3-2, bulk power is delivered to the Kelowna area via FBC's 230 kV system (72 and 74 Lines from BC Hydro's Vernon Terminal Station and 73 Line from FBC's R.G. Anderson Terminal Station in Penticton) to two 230/138 kV terminal stations, which in turn supply the area's 138 kV transmission system. The two 230/138 kV terminal stations are the F.A. Lee Terminal Station, which contains two 168 MVA 230/138 kV transformers, and the DG Bell Terminal Station, which contains one 200 MVA 230/138 kV transformer. The transformers were manufactured in 1978 (LEE T4), 1985 (LEE T3), and 2004 (DGB T2). While there are no significant condition issues known for these transformers at present, FBC discusses the impact of operating the transformers above the normal operating limits in Section 3.5.

The 138 kV lines supply 12 distribution substations in the Kelowna area, serving almost 85,000 direct and indirect (BC Hydro) customers, as indicated above.

## 3.3 *KELOWNA AREA LOAD FORECAST*

### 3.3.1 Population and Housing

The Kelowna area is the fastest growing region in FBC's service area. The City of Kelowna and surrounding area has a population base of more than 140 thousand and is the largest urban centre in the British Columbia interior and the twenty-first largest metropolitan area in Canada. Kelowna has been one of the fastest growing cities in Canada during the last decade,[7] and has grown by an average annual rate of 1.6 percent during the 20-year period 1996-2016. As shown in Table 3-2, the population is forecast to continue to grow at a similar rate in the subsequent 20 year period to 2036.

**Table 3-2: Actual and Forecast Kelowna Area Population 1996-2041[8]**

| Year | Population | Annual Avg Growth Rate | 20-Yr Avg Growth Rate |
|---|---|---|---|
| 1996 | 102,021 | | |
| 2001 | 110,995 | 1.7% | |
| 2006 | 120,392 | 1.6% | |
| 2011 | 131,835 | 1.8% | |
| 2016 | 141,022 | 1.4% | 1.6% |
| 2021 | 149,705 | 1.2% | |
| 2026 | 164,711 | 1.9% | |
| 2031 | 177,072 | 1.5% | |
| 2036 | 188,445 | 1.3% | 1.5% |
| 2041 | 199,031 | 1.1% | |

Other sources demonstrate a consensus view of continued, consistent growth in the Kelowna area. For example, in 2011 the City of Kelowna adopted the Kelowna 2030 Official Community Plan,[9] anticipating the addition of 8,565 single / two unit homes and 11,520 multiple unit homes by 2030. In 2018, the City of Kelowna further predicted that the total number of new housing units required by 2040 will be between 23,000 and 25,000 units.[10]

[7] Statistics Canada, Table 17-10-0135-01, Population estimates, July 1, by census metropolitan area and census agglomeration, 2016 boundaries. July 1, 2018 data.

[8] Population projections prepared for FBC by BC Stats.

[9] https://apps.kelowna.ca/CityPage/Docs/PDFs/Bylaws/Official%20Community%20Plan%202030%20Bylaw%20No.%2010500/Chapter%2003%20-%20Growth%20Projections.pdf

[10] https://www.kelowna.ca/sites/files/1/docs/related/ff-population_and_housing.pdf

Also in 2011, the Regional District of Central Okanagan (RDCO) released a "Housing Discussion Paper"[11] which stated that the RDCO anticipates housing demand to increase by up to 40 thousand households by 2036 (or approximately 50 percent over 2011 levels), to accommodate a population increase in the Regional District.

Consistent with the 2011 predictions of Kelowna and the RDCO, the rising value of building permits issued since 2012 as shown in Table 3-3 demonstrates the trend of increasing growth.

**Table 3-3: Building Permits Issued ($ Millions)[12]**

| | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|---|
| Kelowna | 246 | 336 | 312 | 438 | 537 | 690 | 881 |
| Lake Country | 33 | 29 | 50 | 66 | 90 | 88 | 93 |
| Total | 279 | 365 | 362 | 504 | 627 | 778 | 974 |

Kelowna continues to be the municipality with the highest value of building permits issued outside of the Lower Mainland.

### 3.3.2 Kelowna Area Load Forecast

FBC forecasts regional load growth using trends in historical regional load data. The population and housing indicators in Section 3.3.1 above indicate that future growth is likely to be consistent with past trends, and therefore historical load growth can be expected to produce a reasonable "status quo" load forecast. FBC discusses the potential for higher than historical load growth below.

Peak load forecasting for system planning purposes differs from forecasting energy and peak load for resource (energy) supply purposes in one important way. Unlike a resource planning forecast, which is a "weather-normalized" forecast used to determine FBC's resource requirements, the forecast for system planning purposes must account for possible weather extremes that directly impact winter and summer peak loads, in order to ensure sufficient capacity under adverse conditions.

FBC accomplishes this through the use of a "1-in-20" year load forecast. This forecast is higher than the expected load forecast under normal conditions, meaning that there is only a 5 percent probability that loads will be higher than the "1-in-20" year forecast. This forecast is used as the basis for

[11] https://www.regionaldistrict.com/media/49742/Housing.pdf The RDCO represents the electoral areas of Central Okanagan East and Central Okanagan West and the municipalities of Kelowna, Peachland, Lake Country, West Kelowna and Westbank First Nation.

[12] https://www2.gov.bc.ca/gov/content/data/statistics/economy/building-permits-housing-starts-sales. BC Stats no longer publishes data on building permits, but relies on Statistics Canada data. Statistics Canada data is published by census metropolitan area (https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3410006601), which for Kelowna includes areas outside of FBC's service territory. As a result comparable data for 2019 is unavailable.

determining compliance with FBC's transmission planning standards and is also consistent with industry practice.[13]

Historical summer and winter peak loads for the Kelowna area are shown in Table 3-4 below.

**Table 3-4: FBC Kelowna Area Summer and Winter Peak Loads, 2014-2019**

| | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|---|---|---|---|---|---|
| Summer (MW) | 276.4 | 283.7 | 281.4 | 288.1 | 301.0 | 300.5 |
| Winter (MW) | 277.0 | 268.3 | 306.9 | 283.6 | 298.6 | 324.9 |

The Kelowna area load forecast for 2020-2028 is shown below:

**Table 3-5: Kelowna Load Area Summer and Winter Peak Load Forecast, 2020-2028**

| | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|---|---|---|
| Summer (MW) | 309.5 | 314.6 | 319.8 | 325.5 | 331.5 | 336.5 | 343.3 | 349.4 | 355.5 |
| Winter (MW) | 340.4 | 343.9 | 348.3 | 352.9 | 357.0 | 361.3 | 365.8 | 370.3 | 374.5 |

After forecasting peak load from historical data, FBC includes the impact of known or highly probable load developments, such as community developments that have an expected connection date and defined loads. It is reasonable to expect that other incremental loads may materialize in the near to medium term. For example, FBC has received transmission service interconnection inquiries related to cannabis, cryptocurrency and data processing facilities. Additionally, electric vehicle (EV) adoption and electrification of transit fleets and new government policy all have the potential to result in further increases to the Kelowna area load forecast.

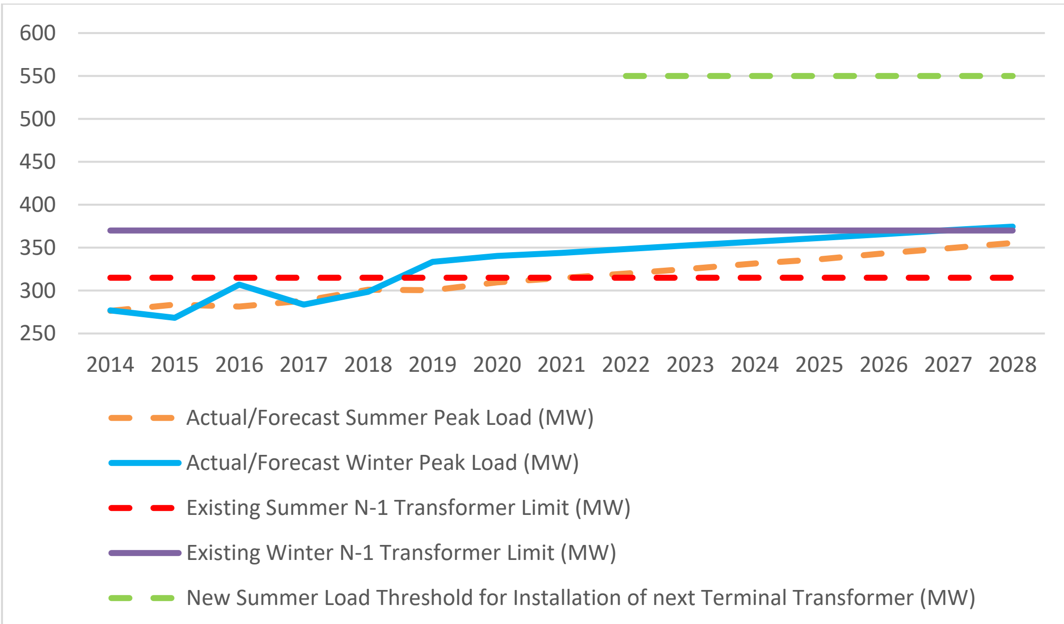
In the last two years, FBC has received five preliminary inquiries from cannabis and data processing facilities for transmission service in the Kelowna area or with the flexibility to locate anywhere in the FBC service territory. The potential load associated with these facilities is approximately 500 MW. While most of these inquiries are considered to be speculative and to have a fairly low probability of proceeding to completion, as an example, one potential connection in the range of 40 MW is considered to be feasible and to have a reasonable probability of proceeding. FBC includes this information to illustrate the potential impact of new large loads on the Kelowna area transmission facilities. None of these potential incremental loads has been included in the forecast above, since none has been confirmed.

Figure 3-3 below indicates the existing summer and winter transformer limits relevant to the KBTA Project and the actual and forecast summer and winter peak loads (the difference between summer and winter seasons and their respective limits is explained in Section 3.4). The summer peak load is

[13] The success rate of the 1-in-20 forecast is expected to be 95 percent (a 5 percent chance that actual load will be higher). Industry practice requires that a quantitative risk factor, such as the 1-in-20 forecast, be incorporated into transmission planning studies such as the power flow models submitted by FBC to the Western Electricity Coordinating Council (WECC) for application in regional and system-wide transmission planning.

forecast to reach the transformer limit of 315 MW in 2021 and to exceed the limit in 2022 as set out in Table 3-5, and the forecast winter peak load will exceed the winter transformer limit of 370 MVA in 2027. Finally, the incremental summer transformer capacity to be gained from the KBTA Project (assuming the preferred alternative) can be seen beginning in 2022. The incremental capacity increase is 235 MW (550 MW less the existing 315 MW).

**Figure 3-3: Kelowna Area Peak Loads and N-1 Transformer Limits (Preferred Alternative)**




### *3.3.2.1 Impact of COVID-19 on Load Forecast*

FBC's peak demand forecast was prepared in 2019, before the onset of the COVID-19 pandemic. FBC acknowledges that the immediate and near-term impacts of the pandemic may be significant for some rate classes and economic sectors. However, the Company is optimistic about the timeline for recovery from these impacts in its service territory and believes that the execution of this critical transmission project should not be deferred as a result of the COVID-19 situation, particularly as the Project is not expected to be in service until the end of 2022. As of the date of filing, there is insufficient data to quantify the COVID-19 impact during 2020, or to forecast future impacts on energy consumption or, more importantly for system planning, on peak loads.

In the near term, COVID-19 may result in commercial loads declining due to business closures (in compliance with public health orders or as a result of general economic conditions). However, there are also some of the factors that may mitigate the economic impacts of COVID-19 as they relate to energy and peak load forecasting, For example, there is expected to be some offsetting increase in residential loads, as a result of individuals working from home or spending more time at home due to job losses. Further, some of these impacts will be temporary and are likely to be resolved during 2020 but the timing and magnitude of full recovery cannot be forecast. Similarly, the reduction in load for some large commercial customers (such as educational institutions) will be temporary and may in fact have a limited impact on 2020 and future summer peak loads. At this time FBC has no information available to quantify the impact on other customer classes or economic sectors.

FBC noted above a number of possible factors that could act to increase load above the baseline forecast presented above, including residential developments, cannabis, cryptocurrency and data processing facilities, EV adoption and government electrification policy. Since the occurrence of COVID-19 FBC continues to receive inquiries and requests for preliminary planning for certain projects. FBC cannot conclude that COVID-19 will result in the deferral or cancellation of these potential additional loads.

In summary, given the lack of firm information on COVID-19 related impacts on the summer peak load in 2022 and future years, the continuing potential for significant new loads in the Kelowna load area, and the lead time required for a project of this nature, FBC concludes that it would not be prudent to delay the addition of transmission capacity in the Kelowna load area and that the KBTA Project should proceed as set out in this Application.

## 3.4 *FBC PLANNING CRITERIA*[14]

Typical industry transmission planning standards require the system to be planned such that all projected customer loads are served during both normal (N-0)[15] operation and single contingency (N-1)[16] operation. FBC transmission planning criteria also specify that customer load should be able to be supplied under N-0 and N-1 conditions.

The normal operation (N-0) contingency planning criteria applies to all transmission facilities. The single contingency (N-1) planning criteria apply to all transmission facilities that are part of the FBC interconnected system, which excludes radial transmission lines. FBC plans and constructs its interconnected transmission system to meet and maintain its N-1 planning contingency criteria. The recently-approved Grand Forks Reliability Project[17] similarly proposed the addition of a new terminal transformer in order to meet the same planning criteria.

The Kelowna load area is part of the interconnected system (that is, it is supplied from more than one 230 kV source, in this case 73 Line and 72/74 Lines as shown in Figure 3-2 above); therefore, the N-1 planning criteria applies. In addition, as discussed in Section 3.2, Kelowna is the largest load centre in FBC's service territory and includes a number of important institutional and other major customers, which emphasizes the importance of N-1 contingency planning.

[14] The Kelowna area 138 kV system is not subject to provincial Mandatory Reliability Standards (MRS). Although greater than 100 kV (the threshold definition for the Bulk Electric System (BES) to which MRS apply, subject to exclusions), this area is a Local Network and meets the BES definition of Exclusion E3 for Local Networks as described in BCUC letter L-56-14 dated October 29, 2014.

[15] Normal operation, also referred to as N-0 reliability, means that with all major elements of the power system in service, the network can be operated to meet projected customer demand in order to avoid a load loss (customer outage).

[16] Single contingency, also referred to as N-1 reliability, means that an outage of a single element with all other elements of the power system in service (a single transmission line, transformer, generating unit, power conditioning unit like a shunt capacitor bank, a shunt reactor bank, a series capacitor, a series reactor, etc.) results in no load loss.

[17] Approved by Order C-2-19.

### 3.4.1 Seasonal Peaks Forecast to Reach Emergency Limits in N-1 Conditions

For the 138 kV transmission system in the Kelowna area, seasonal peaks will reach system emergency limits during the summer season before the seasonal peaks will reach system emergency limits in the winter season. This is because higher ambient temperatures reduce the summer emergency limits below the winter emergency limits. For example, summer emergency limits for LEE T3 and T4 are both much lower in summer at 159 MW, as compared to their respective winter emergency limits of 189 MW and 195 MW.

Power flow simulation studies were used to analyse single contingency scenarios. When either of the two existing LEE terminal transformers[18] is out of service, the loading on the remaining transformer is 191 MVA (91 percent of its emergency limit) when the total Kelowna area load reaches 315 MW, which is just marginally higher than the forecast summer peak load forecast in 2021[19], as provided in Table 3-5. The loading on the remaining LEE transformer can be lowered by adjusting the load supply configuration in the Kelowna 138 kV system to transfer additional load to DGB. After system reconfiguration, the flow on the remaining LEE transformer is 168 MVA, which is 80 percent of the emergency limit and 100 percent of normal rating.

As Kelowna area load increases, an N-1 event in 2022 and beyond would result in loading above 168 MVA on the remaining LEE transformer, even after the reconfiguration described above. FBC's operating procedures allow operation above the normal rating for only six hours[20], and plans to reduce the loading must be implemented within this time frame. If loading above the normal rating of 168 MVA is expected to persist for longer than six hours, the facility loading must be reduced below 168 MVA as soon as practicable by shedding customer load during peak load periods. Initially, the requirement for such load shedding would be confined to only part of the peak load period on summer peak days. However, as Kelowna area load increases, the duration and frequency of required load shedding events would increase. As shown in Figure 3-3, load shedding events could also be required on winter peak days beginning in winter 2027; the forecast winter peak load in load in 2027 is 370.3 MW (Table 3-5) compared to the winter emergency limit of 370 MW. FBC's Kelowna area transmission system will then be in violation of its transmission planning criteria unless additional 138 kV capacity is added.

Finally, in the event of a LEE terminal transformer failure, it would likely take more than a year to procure and install a replacement transformer. Since FBC does not own a mobile transformer of suitable size and voltage, such a failure would require customer outages for the Kelowna area under peak load conditions to prevent excessive operation of the transformers within emergency limits. The number of customers affected and the duration of the outages would depend on load conditions at

[18] The loss of one of the two transformers at LEE is the critical outage for planning purposes. If DGB transformer were to fail, the system could continue to supply all load within normal limits from LEE transformers and 138 kV lines.

[19] It is industry convention to refer to system load in MW, while equipment ratings are expressed in MVA. They are related according to the following formula: Real Power (MW) = Power Factor x Apparent Power (MVA). For the Kelowna area, the average Power Factor = 0.98, which is close to unity. For accuracy, when modelling load flows, FBC applies substation-specific power factors.

[20] The six hour requirement has been verified by FBC operational performance history, engineering analysis, and is based on the recommendations of many IEEE standards.

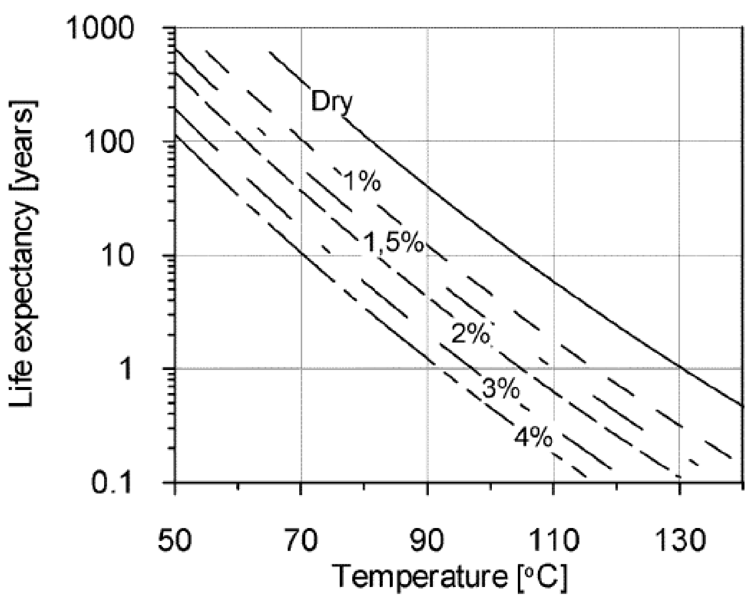
the time; one option to manage loading through peak periods would be to rotate blackouts between substations or feeders in the area to reduce loads to less than 168 MVA.

## 3.5 *OVERLOADING THE TERMINAL TRANSFORMER WILL SHORTEN ITS LIFESPAN*

Loading of substation transformers above the normal nameplate rating has a significant impact on their remaining expected lifespan. As noted in Section 3.4, even after reconfiguration of the Kelowna network in the event of an outage of one of the LEE transformers, the remaining LEE transformer could be overloaded, beginning in summer 2022.

Prolonged loading in the emergency range increases winding hot spot temperature[21] and decreases the expected remaining life of the transformer. For transformers of the type installed at LEE and DGB, this relationship between temperature and life expectancy is exponential, as can be seen below in Figure 3-4. While transformers have an average life of 40 years, if a transformer is lightly loaded throughout its in-service life, the winding insulation can be expected to last longer; conversely, insulation life would be expected to be less than a year if the transformer is overloaded on a consistent basis. Each hour that a transformer is loaded above nameplate rating brings a corresponding increase in winding hotspot temperature that has a substantial negative impact on remaining expected lifespan.

**Figure 3-4: Expected life for solid insulation and its dependence upon moisture and temperature.[22]**




The existing transformers at LEE and DGB are extremely important system assets, as evidenced by the proportion of FBC's peak load in the Kelowna area. Transformers of this size have replacement lead times in excess of a year; consequently the failure of the remaining LEE transformer or the DGB

[21] The winding hot spot temperature is the temperature of the hottest area in the transformer.

[22] Figure 13 from IEEE Transactions on Power Delivery (Volume: 19, Issue: 1, Jan. 2004) "Aging of Oil-Impregnated Paper in Power Transformers" by L.E. Lundgaard; W. Hansen; D. Linhjell; T.J. Painter.

terminal transformer during an existing N-1 event would result in widespread outages in the Kelowna area. The number of customers that could be restored and the duration of any prolonged outages would be dependent on factors such as time of day and weather at the time of such an event. For this reason, planned loading above nameplate rating represents a significant reliability risk. Additionally, the replacement of the failed transformer would result in a substantial unplanned capital cost.

## 3.6 ADDITIONAL 138 KV CAPACITY IS NEEDED

As is described above, there is substantial ongoing population growth in the Kelowna area, and the Kelowna load forecast shows a corresponding projected increase in peak load. Beginning in summer 2022, the outage of a LEE transformer under peak load conditions would result in overloading of the remaining LEE transformer even after Kelowna network reconfiguration. Where overloading is projected to persist for more than six hours over the peak period, it would violate FBC's planning criteria requiring customer load shedding, creating considerable impacts.

In addition, the loading of a LEE terminal transformer above its nameplate rating would also have a significant negative impact on the transformer's lifespan. Given the importance of these transformers and their long replacement timelines, prolonged loading above nameplate rating is not acceptable. Accordingly, additional 138 kV capacity is required to avoid these impacts and to comply with FBC's transmission planning criteria in the Kelowna area.

# 4. DESCRIPTION AND EVALUATION OF ALTERNATIVES

## 4.1 *OVERVIEW*

FBC considered a number of alternatives to increase the 138 kV capacity in the Kelowna load area to continue meeting the transmission planning criteria and to maintain reliable service to Kelowna's growing customer base. Among the alternatives considered were demand reduction measures, local generation, and adding 230 kV to 138 kV transformation capacity. Ultimately FBC determined that the only feasible means of adding the necessary capacity is the addition of an additional transformer at one of the two terminal stations in Kelowna.

FBC then evaluated the three feasible alternatives for the Project, which included identifying the best location for the transformer as well as potential station configurations, and recommends the addition of a third 230/138 kV transformer at LEE, and the use of an industry standard ring bus configuration.

The following sections describe the alternatives that were identified but rejected at the preliminary stage, and then compares and evaluates the feasible alternatives, and describes the preferred solution.

## 4.2 *ALTERNATIVES REJECTED*

The following alternatives were identified but rejected as they either (a) do not meet the required objective of increasing the 138 kV transmission capacity in the Kelowna area, or (b) are clearly inferior to the alternatives that involve adding transformation capacity at one of the existing terminal stations (described in Section 4.3 below) for cost or other reasons.

a) ***Status Quo:*** The status quo is not an option because it does not increase the 138 kV supply capacity which, as explained in Section 3, is necessary for FBC to meet its N-1 transmission planning criteria in the event of a LEE terminal transformer outage. A shortage of transmission capacity could cause potentially lengthy customer outages during peak and near-peak summer conditions, resulting in a level of customer service that is well below established standards.

b) ***Demand Response:*** Demand Response (DR) can be an effective means of reducing or shifting peak load and FBC is investigating the potential use of DR for mitigating system peaks. A DR pilot is currently underway in the Kelowna area, however as explained in FBC's 2019-2022 Demand Side Management Expenditures application, the DR pilot is a proof-of-concept initiative and the magnitude of the proposed target of 1.75 MW capacity is insufficient to defer the KBTA Project. Accordingly, DR is not a reasonable alternative for this Project.

c) ***Local Generation:*** The installation of firm generation resources, such as a gas turbine, near Kelowna and connected to the 138 kV transmission system could increase the Kelowna area transmission capacity and meet the N-1 transmission planning criteria. However, this option was considered and rejected, due to its high capital cost.

Compared to the estimated cost of a transformer capacity addition, the cost of a generation resource is prohibitive. The amount of generation required to be equivalent to a transformer addition is approximately 237 MW, equal to the emergency rating of the proposed transformer. At an estimated cost of $1.5 to $2.0 million per MW of gas-fired generation, the estimated cost of this option equates to $355 million to $474 million.

Due to these high capital costs, this option would be viable only if the generation were also required to meet resource planning needs. However, on the basis of FBC's 2016 Long Term Electric Resource Plan (LTERP) and preliminary results for the 2021 LTERP, there is no requirement for additional capacity resources in the timeframe required for the Kelowna area capacity increase.

d) ***Addition of a Terminal Transformer to Distribution Substation:*** 138 kV transmission capacity could also be increased in the Kelowna area by the addition of a 230/138 kV terminal transformer at an existing distribution substation. There are two distribution substations within reasonable proximity to 230 kV transmission lines, which could be candidates for this alternative, as shown in Figure 3-2. Transmission taps from either 74 Line to the Duck Lake station (DUC) or from 73 Line to the Black Mountain station (BLK) are technically feasible.

However, neither substation has a large enough footprint to accommodate the new transformer and associated 230 kV buswork that would be required, and FBC would need to acquire adjacent land for expansion. This would increase the cost in relation to the option of locating a transformer at an existing terminal station. In addition, the vacant land adjacent to both the DUC and BLK sites is located within the Agricultural Land Reserve and approval of the Agricultural Land Commission (ALC) would be required to rezone any acquired property. Both of these factors would likely delay the Project beyond the required timeframe. For these reasons, FBC dismissed this option.

## 4.3 *ALTERNATIVES FOR FURTHER REVIEW*

Having identified and rejected the above alternatives, FBC concluded that an alternative that includes the addition of another terminal transformer at one of the existing terminal stations (LEE or DGB) is the preferred means of increasing the 138 kV supply to the Kelowna area.

As a result, FBC has identified and conducted a detailed analysis of three alternatives for increasing the 138 kV capacity in the Kelowna Area through the addition of a terminal transformer at an existing terminal station:

**Alternative A:** Purchase and install a third terminal transformer at LEE and reconfigure the existing 138 kV split bus into an industry standard ring bus configuration.

**Alternative B:** Purchase and install a third terminal transformer at LEE and extend the existing non-standard 138 kV split bus configuration.

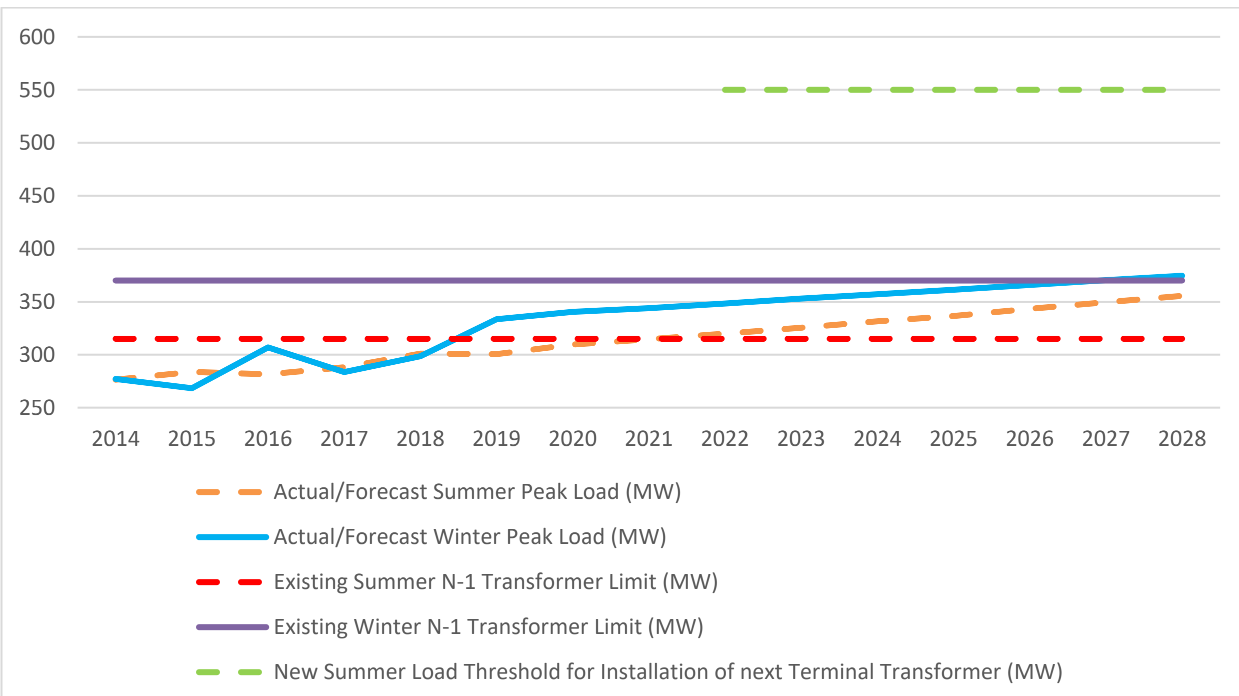
**Alternative C:** Purchase and install a second terminal transformer at DGB and extend the existing 138 kV industry standard ring bus configuration.

Each of these alternatives is discussed in more detail in Sections 4.4.1 through 4.4.3

In each alternative, the transformer to be installed is a 230/138 kV transformer with a rating of 120/160/200 MVA, which is the modern standard size for transformers in applications of this type, and matches the rating of the transformers at DGB and other FBC terminal stations. The new transformer rating needs to match or exceed the 168 MVA rating of the existing LEE transformers so that its rating would not be the limiting factor in future N-1 scenarios.

Figures 4-1[23] and 4-2 below show the incremental 138 kV capacity that would be achieved by installing the transformer at LEE (Alternatives A and B) and at DGB (Alternative C), respectively. The figures show the actual and forecast summer and winter peak loads for the Kelowna area, along with the existing limits for N-1 reliability and the new load thresholds after installation of the additional transformer at each station.

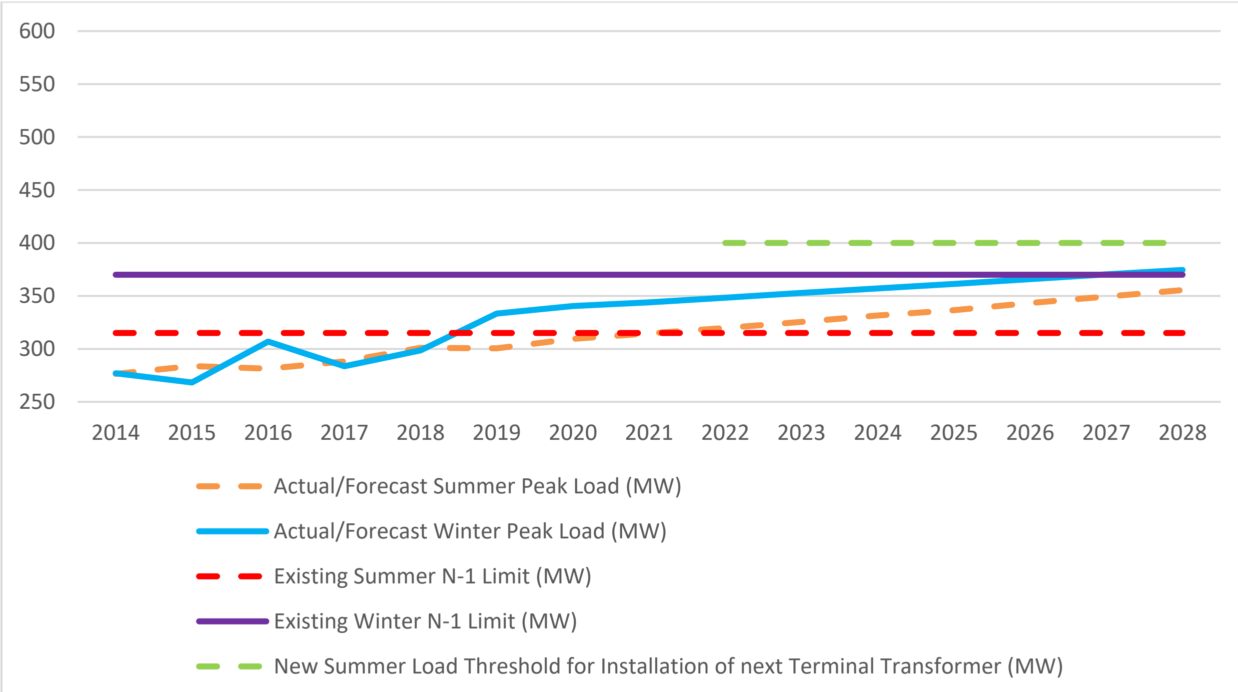
**Figure 4-1: Kelowna Area Peak Loads and N-1 Transformer Limits (LEE Alternatives)**




After installation of an additional transformer at LEE, the next terminal transformer addition would not be required for the Kelowna area until the summer peak load reaches 550 MW, which provides for an incremental emergency capacity of 235 MW.

[23] Figure 4-1 is a reproduction of Figure 3-3.

**Figure 4-2: Kelowna Area Peak Loads and N-1 Transformer Limits (DGB Alternative with 60L and 51L Reconductoring)**




The capacity gain from the DGB alternative would be lower than the LEE alternative, and a second terminal transformer addition would be required for the Kelowna area when summer peak load reaches 400MW, which provides for incremental emergency capacity of 85 MW.

As a result of the load distribution and Kelowna network configuration, undertaking the capacity addition at DGB would also require increasing the capacity of certain 138 kV transmission lines in the Kelowna area. Referring to Figure 3-2, the Sexsmith (SEX), Glenmore (GLE), Duck Lake (DUC), Hollywood (HOL) and Recreation (REC) distribution stations are the more heavily loaded stations in the Kelowna area. DGB has two 138 kV transmission lines compared to four at LEE, and is more distant from the high-load area. Consequently, 60 Line and 51 Line would require reconductoring in order to transmit the incremental capacity installed at DGB. The requirement to reconductor these transmission lines is described further in Section 4.4.3.1.

After installation of an additional 230/138 kV transformer with a rating of 120/160/200 MVA at DGB, and the reconductoring of 60L and 51L transmission lines between DGB and O.K. Mission stations, transmission constraints would remain.

### 4.3.1 Ring Bus versus Split Bus Configuration

The bus configuration utilized in the Project design varies among the alternatives reviewed for the KBTA. Because this is an important factor in determining which alternative is preferable, FBC includes the discussion below as context for the information that follows.

There are a number of possible substation bus configurations, including single bus (which includes split bus), sectionalized single bus, main and transfer bus, ring bus, and breaker-and-a-half. These topology designations all describe the configuration of network elements such as transmission lines or transformers and the breakers and switches that isolate them from or connect them to energized bus segments.

Ring bus is today's minimum industry standard for this type of terminal substation and is FBC's modern standard for a terminal. In a ring bus topology, each transformer or transmission line has its own discrete node in the bus between two breakers. The ring bus configuration increases system reliability since faulty sections of lines can be isolated without affecting the no-fault zones. Ring bus is widely used in industry, and is one of the configurations applied by BC Hydro for 230 kV and 138 kV.

In split bus configuration, each transformer or transmission line is connected to or isolated from the bus by a single breaker.

Breaker-and-a-half or double breaker-double bus configurations provide high levels of reliability, compared to either the ring bus or split bus configurations. However, the cost for construction of these configurations would substantially exceed the cost of ring bus. For this reason, these configurations are not typically used by FBC for terminal stations.

As between the ring bus configuration and the split bus configuration, the ring bus configuration has a number of advantages:

- Research on substation reliability shows that a ring bus configuration results in a more than 50 percent reduction in outage minutes per year as compared to a split bus configuration.[24] Further, a breaker failure on a split bus causes a larger outage than on a ring bus. This is due to the redundant path for power to flow created by the ring configuration.
- The ring bus configuration is easier to maintain and operate than split bus because any single breaker can be taken out of service without the need for bus reconfiguration.
- The ring bus configuration reduces safety risk as compared to split bus because it provides a clear zone of isolation when working on equipment that is free from complex transfer buses and switches.
- The ring bus configuration has less complicated protection and switching schemes than split bus because each transformer and transmission line has its own discrete node in the bus between two breakers.
- The ring bus configuration is less prone to human error when operating, resulting in fewer instances of mis-operation than a split bus. The ring bus configuration is FBC's modern standard and is an industry standard that does not require complex transfers to maintain service when isolating station equipment. A ring bus reduces both the amount of initial training

[24] Daniel Nack, *Reliability of Substation Configurations,* p. 9-12. With calculations adapted from: T.Stao and H. Chang *Composite Reliability Evaluation Model for Different Types of Distribution Systems,* IEEE Transaction on Power Systems, Vol. 18, No.2, May 2003.

required for FBC's station crews and system control centre and the complexity of operating procedures, and therefore reduces the likelihood of an incident since employees will more quickly develop familiarity with this simpler and more standard bus configuration.

### 4.3.2 Current Bus Configuration

The F.A. Lee Terminal Station, which has two 230/138 kV transformers, is presently configured with a 230 kV ring bus and a 138 kV split bus, while DGB, with a single 230/138 kV transformer, has a single 230 kV breaker and is configured with a 138 kV ring bus. LEE was constructed prior to FBC's adoption of ring bus as a standard configuration, meaning that it differs from the ring configurations in service at DGB, Vaseux Lake Terminal, Bentley Terminal, Warfield Terminal, Black Mountain and Duck Lake. Ring bus configurations are also in service at Brilliant Terminal Station and Brilliant Switching Station, which are operated by FBC.

FBC considered both the ring bus and split bus configurations for the KBTA Project.

## 4.4 DISCUSSION OF ALTERNATIVES

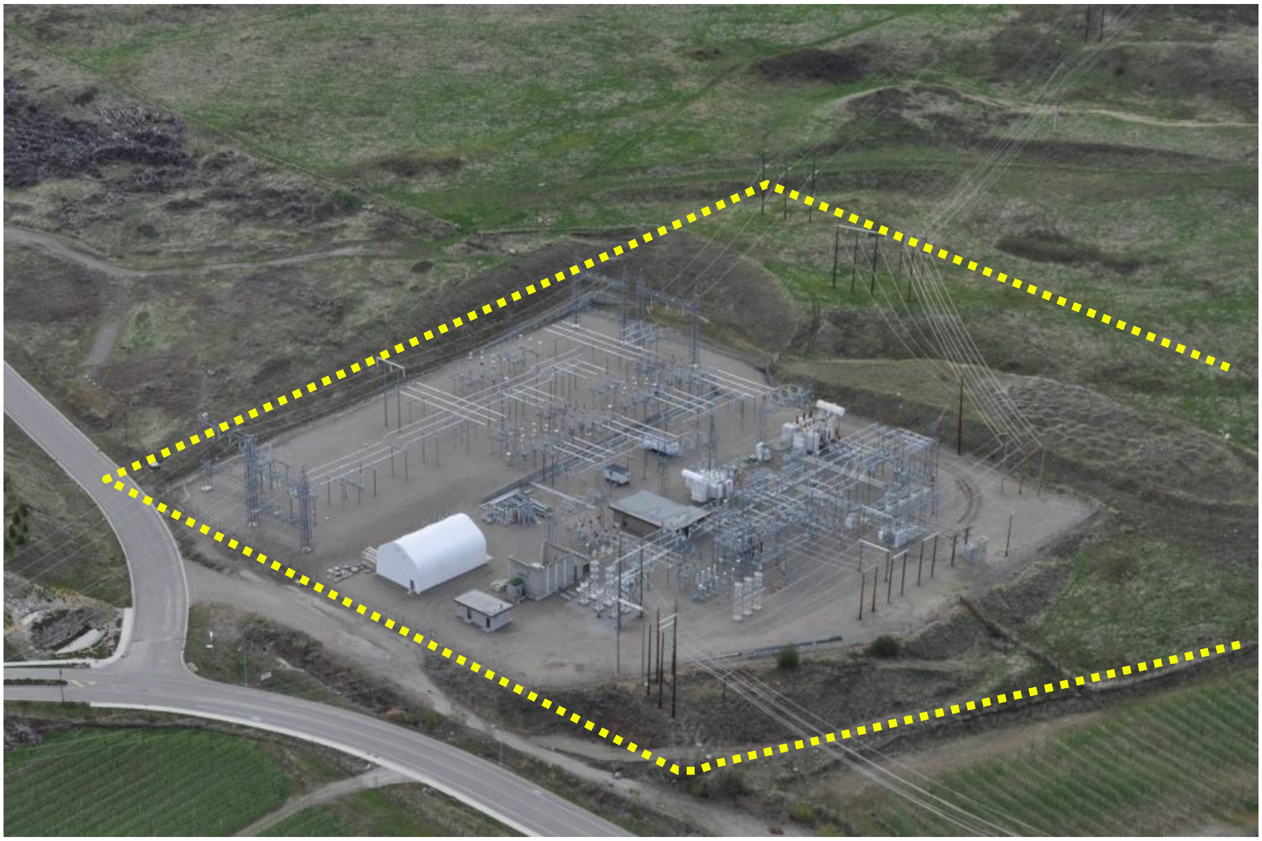
### 4.4.1 Alternative A: Add a Transformer at F.A. Lee Terminal Station (Ring Bus Configuration)

#### *4.4.1.1 Description and Scope*

Alternative A involves installing a new 230/138 kV transformer with a rating of 120/160/200 MVA at LEE, with the existing 138 kV split bus at the station being reconfigured to a ring bus configuration that is an industry standard for this type of terminal.

The existing F.A. Lee Terminal Station is seen below in Figure 4-3 with the approximate property line shown in yellow.

**Figure 4-3: Existing F.A. Lee Terminal Station**



Construction would include the expansion of the existing 230 kV ring bus by one breaker to accommodate the additional transformer. This involves the addition of two new 230 kV circuit breakers (one of which will replace an existing obsolete breaker).

The 138 kV bus would be reconfigured from a split bus to a seven breaker ring bus. This portion of the work would include relocating three existing breakers to new locations, salvaging four existing obsolete breakers, and installing three new breakers. The total 138 kV breaker count would decrease from ten to nine, as there are two 138 kV breakers that are used for switching the existing capacitor banks in addition to those in the new seven breaker ring. The station footprint and fence line would be slightly expanded (while remaining on FBC land) to accommodate the reconfigured bus. Though not part of this Project, the seven breaker ring bus could be converted in future to a nine breaker ring without expanding the bus, creating two additional nodes for connection of new transmission line(s) and/or a 138 kV/13 kV distribution transformer.

The existing 13 kV distribution bus and equipment would be demolished and removed from the station since the distribution supply is being eliminated. Prior to 2009, customers in the northeast area of Kelowna, including part of the Black Mountain area, were served through the tertiary (13 kV) windings of LEE T3 and T4. The majority of this distribution load was transferred to the Black Mountain Substation upon its completion in 2009. The remaining distribution load, which is currently supplied by connections to the tertiary windings of LEE T3, will be served under this alternative by the Sexsmith substation upon completion of the Sexsmith Second Transformer Addition project in late 2020[25]. The removal of distribution feeder load from the LEE T3 tertiary windings will eliminate the risk of damage to the transformers due to faults in the distribution system.

A new control building for the 138 kV bus will also be constructed because the additional relays and metering will not fit in the existing control building (which will remain in service).

A screening wall will be installed along the north side of the substation to improve the visual impact.

#### *4.4.1.2 Cost of the Alternative*

The capital cost of this alternative is $23.288 million (Class 3 Estimate) including removal costs and AFUDC.

The annual gross O&M reduction associated with this option is approximately $0.028 million and is mainly attributable to the avoided maintenance costs associated with the elimination of the 13 kV distribution equipment. Also included is a minor reduction in O&M due to the net reduction of one 138 kV breaker.

### 4.4.2 Alternative B: Add a Transformer at F.A. Lee Terminal Station (Split Bus Configuration)

#### *4.4.2.1 Description and Scope*

Alternative B also involves installing a new 230/138 kV transformer with a rating of 120/160/200 MVA at the F.A. Lee Terminal Station; however, the main difference from Alternative A is that the existing non-standard 138 kV split bus at the station would be extended, as opposed to being replaced with a ring bus configuration.

Although as explained in Section 4.3.2, this station was initially constructed with a split bus, this is not an industry standard for 138 kV bus, nor is it FBC's current standard. The scope for the expansion of the existing 230 kV ring bus is the same as in Alternative A. Two new 230 kV breakers will be installed (one of which will replace an existing obsolete breaker).

In the 138 kV bus, two new breakers will be added (increasing the 138 kV breaker count from ten to twelve), and one existing 138 kV breaker will be replaced. This alternative requires three more 138 kV breakers than Alternative A because a ring bus is a more efficient configuration for the connection of four transmission lines and three transformers. The station footprint and fence line will be expanded slightly (again, on FBC land) to accommodate the reconfigured bus.

[25] In FBC's 2012 Long Term Capital Plan (Integrated System Plan, Volume 1), a number of options to meet increasing distribution load in Kelowna were identified. One was the addition of a distribution transformer at LEE (Section 2.8.21.1). The Sexsmith Second Distribution Transformer Addition (Section 2.8.21.3) was also identified, and was recognized to have the potential to defer the distribution addition at LEE, with construction expected to begin in 2019. Either option would permit the full offloading of distribution load from the LEE transmission transformers.

The existing 13 kV bus and distribution equipment will be demolished from the station as explained in section 4.4.1.1.

A screening wall will be installed along the north side of the substation to improve visual impact.

#### 4.4.2.2 Cost of the Alternative

The capital cost of this alternative is $17.008 million (Class 3 Estimate) including removal costs and AFUDC.

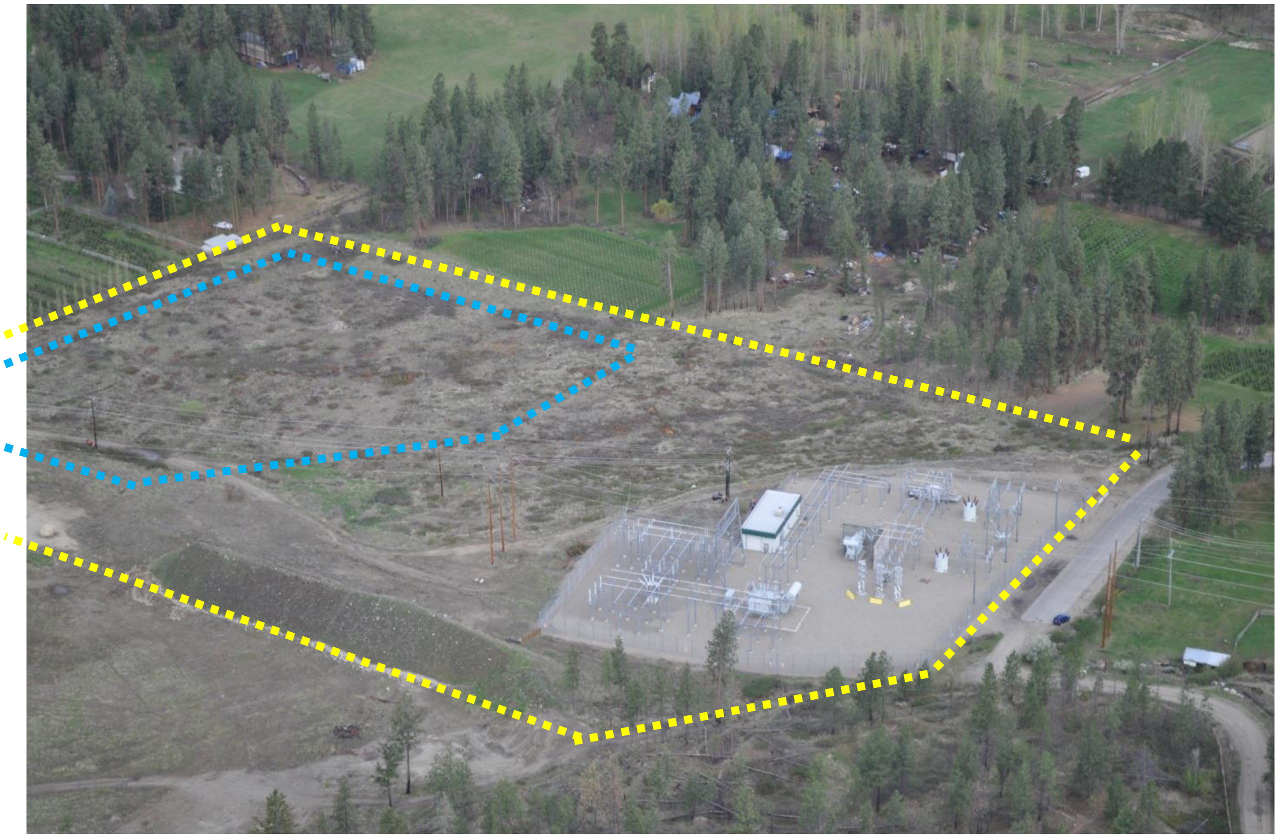
The annual gross O&M reduction associated with this option is approximately $0.023 million and is mainly attributable to the avoided maintenance costs associated with the elimination of the 13 kV distribution equipment. The reduction in O&M is slightly lower than for Alternative A because of maintenance requirements for a net increase of two breakers in the split bus configuration.

### 4.4.3 Alternative C: Add a Transformer at D.G. Bell Terminal Station

#### 4.4.3.1 Description and Scope

Alternative C involves installing a new 230/138 kV transformer with a rating of 120/160/200 MVA at the DG Bell Terminal Station and the reconductoring of 60 Line and 51 Line to OKM. Since there is insufficient space adjacent to the existing 230 kV equipment at DGB, this would require construction of a new 230 kV yard on an undeveloped portion of the land owned by FBC. The existing DG Bell Terminal Station is shown in Figure 4-4 with the approximate property line in yellow and the approximate footprint of the new 230 kV yard in blue.

**Figure 4-4: Existing DG Bell Terminal Station**



Along with installation of the new transformer in the 230 kV yard, the one existing terminal transformer would be relocated. A 230 kV four breaker ring bus would be constructed in the new yard, and the single existing 230 kV breaker would be relocated. In the existing station, the 138 kV ring bus would be modified and two new 138 kV breakers would be installed.

The two yards would need to be interconnected with two 138 kV lines, and the existing 230 kV lines (54 Line and 60 Line) would need to be reconfigured to terminate in the new 230 kV yard.

As explained earlier, due to the distribution of load in the Kelowna area and configuration of the transmission network, this alternative would also require reconductoring of the 138 kV 60L and 51L transmission lines in 2022 in order to provide continued N-1 reliability. As shown in Figure 3-2, 60L runs from DGB to the Benvoulin (BEV) station, while 51L continues from BEV to O.K. Mission (OKM). The total line length from DGB to OKM is approximately 7 km, and existing 477 kcmil conductor would need to be replaced with 1272 kcmil Narcissus conductor.

Even after the addition of a second transformer at DGB and the reconductoring of 51L and 60L, Kelowna area load is forecast to exceed the 138 kV capacity no later than 2036[26]. The addition of a fifth terminal transformer in the Kelowna area would be required at that time. Since this additional

[26] The 2036 timeline assumes only historical growth rates (please refer to section 3.3.2 for a discussion of the potential for higher growth in the Kelowna area, which would have the effect of accelerating the next capacity addition to a date earlier than 2036 and would increase the financial impact of this alternative.

transformer falls within the 40-year period of financial analysis, FBC included the additional transformer cost in its evaluation of this alternative.

#### *4.4.3.2 Cost of the Alternative*

The capital cost of the mew transformer at DGB and the transmission line reconductoring in this alternative is $33.332 million including removal costs and AFUDC. Excluded from the $33.332 million is the capital cost of the next capacity addition in 2036. FBC assumes the cost of that addition to be the same as Alternative A, subject to inflation. These 2036 costs have been included in the 40-year financial analysis of this project for comparability to Alternatives A and B.

The annual gross O&M increase associated with this option is approximately $0.020 million, which is attributable to the required maintenance and testing of five new breakers, the new transformer, and associated equipment.

## 4.5 *EVALUATION OF ALTERNATIVES*

### 4.5.1 Evaluation Criteria

FBC evaluates alternatives based on a consideration of both the technical and financial attributes of each. The comparative technical merits of the alternatives, are summarized in Table 4-1 below. The categories for the technical criteria used in this evaluation are as follows:

1. Meets Single Contingency (N-1) Transmission Planning Criteria: considers the ability to continue to serve all load during the outage of a single element (LEE terminal transformer outage). Also considers the amount of incremental capacity added.

2. Safety and Operability: considers safety risk and the operability of the facilities by FBC employees and contractors working on system repairs, performing routine maintenance, or restoring load during real-time outages. Also considers whether legacy equipment will be removed as part of the project.

3. Potential for Future Expansion: considers the potential for expansion of terminal stations such as the ability to add more transmission lines or distribution substation infrastructure.

4. System Reliability: considers the availability of electrical supply on the transmission and substation facilities.

5. Project Risk: considers Project risks, such as schedule, lands, and unforeseen environmental and archaeological discoveries.

For the three alternatives, each technical criterion was scored either 1 (Fair), 2 (Good), or 3 (Best). The scores for each criteria were then weighted as indicated in Table 4-1 to determine a total technical score for each alternative.

In addition, the following financial criteria are considered and summarized in Table 4.2.

6. O&M Costs: Costs related to maintaining the assets in place.
7. Present Value (PV) of Incremental Revenue Requirement: The discounted value of the revenue requirement over the life of the assets (40 years).
8. Rate Impact: The levelized rate impact over the 40-year period.

**Table 4-1: KBTA Project Alternatives Comparison**

| Evaluation Criteria (Section 4.5.1) | PARAMETERS FOR RATING | WEIGHT | OPTION A RATING | OPTION B RATING | OPTION C RATING | GENERAL COMMENTS / RATIONALE FOR RATING |
|---|---|---|---|---|---|---|
| | **Technical Criteria** | | | | | |
| 1 | N-1 Criteria Considerations | 10% | 3 | 3 | 1 | All alternatives allow FBC to serve load growth in the Kelowna area while continuing to meet N-1 planning criteria. Alternatives A & B provide 235 MW of incremental capacity in the event of a LEE transformer failure, while Alternative C provides only 85 MW of incremental capacity. |
| 2.1 | Safety | 10% | 3 | 1 | 3 | As described in Section 4.3.1, the ring bus configuration in Alternatives A and C reduces safety risk as compared to split bus. |
| 2.2 | Operability | 20% | 3 | 2 | 3 | As described in Section 4.3.1, the ring bus configuration in Alternatives A and C is easier to operate and maintain than split bus. |
| 2.3 | Complexity of protection and switching schemes | 5% | 3 | 1 | 3 | As described in Section 4.3.1, the ring bus configuration in Alternatives A and C reduces the risk of misoperation incidents due to simpler protection and switching schemes. |
| 2.4 | Removal of legacy infrastructure | 5% | 3 | 2 | 1 | Alternatives A & B address end-of-life 13 kV distribution equipment at LEE. Alternative A also addresses obsolete 138 kV breakers at LEE, as four end-of-life breakers are salvaged. |
| 3 | Potential for future expansion | 20% | 3 | 1 | 2 | **Alternative A:** The seven breaker 138 kV ring bus could be converted in future to a nine breaker ring without expanding the bus. A nine breaker ring bus would create two additional nodes for connection of new transmission line(s) and/or a 138 kV/13 kV distribution transformer. **Alternative B**: 138 kV split bus would not provide the ability to add future nodes for the installation of a distribution transformer and/or transmission line(s). **Alternative C:** The construction of the new 230 kV yard leaves ample space for future equipment installation. The removal of 230 kV equipment from the existing station creates space for the installation of future 138 kV equipment. |
| 4 | Reliability | 20% | 3 | 2 | 3 | As described in Section 4.3.1, the ring bus configuration in Alternatives A and C is more reliable than split bus. |
| | **Subtotal Technical Criteria Score** | **90%** | **2.70** | **1.55** | **2.2** | |
| | **Project Risks** | | | | | |
| 5.1 | Schedule Risk | 2.5% | 2 | 3 | 2 | Transformer for all alternatives has a lead-time in excess of a year and will need to be ordered in early design stage. Construction activities for Alternative B are the less complex than Alternatives A and C, so schedule risk is lowest. |
| 5.2 | Lands Risk | 2.5% | 3 | 3 | 3 | Agricultural Land Commission approval is required for station expansion in all alternatives. |
| 5.3 | Environmental Risk | 2.5% | 3 | 3 | 3 | None of the alternatives require environmental permitting. |
| 5.4 | Archaeological Risk | 2.5% | 3 | 3 | 3 | There are no known archaeological sites near LEE or DGB. |
| | Subtotal Risk Criteria | 10.0% | 0.275 | 0.3 | 0.275 | |
| | **Total Technical and Risk Criteria Score (Max 3.0)** | **100%** | **2.98** | **1.85** | **2.48** | |

**Table 4-2: KBTA Project Alternatives Financial Comparison**

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Financial Considerations** | | | | | |
| | | | OPTION A | OPTION B | OPTION C | |
| 6 | Annual O&M Costs | N/A | $0.028M reduction | $0.023M reduction | $0.020M increase | |
| 7 | Present Value Incremental Revenue Requirement | N/A | $23.0M | $17.1M | $44.0M | |
| 8 | Levelized Rate Impact | N/A | 0.39% $0.00045 /kWh | 0.29% $0.00034 /kWh | 0.75% $0.00086 /kWh | |

## 4.6 *PREFERRED ALTERNATIVE AND JUSTIFICATION*

Based on the technical and financial evaluation of the three alternatives considered above, the preferred option is Alternative A, which involves installing a new terminal transformer at LEE and modifying the station to a 138 kV ring bus configuration.

The sections below summarize the evaluation of each alternative against the criteria provide in Section 4.4.

### 4.6.1 Technical Evaluation

All three alternatives would meet the Company's planning criteria to provide N-1 reliability for the Kelowna area upon completion of the Project. Alternatives A, B and C achieve this through the installation of a third transformer at LEE or a second transformer at DGB. Although the reliability associated with Alternative C is expected to exceed that of Alternative B, and would simplify outage planning and facilitate network reconfiguration due to the ring bus configuration, Alternatives A and B both have significant advantages over Alternative C as they do not require any associated transmission line reconductoring. More importantly, Alternatives A and B provide more capacity and do not require the addition of another terminal transformer until the summer peak load reaches 550 MW, whereas Alternative C requires the addition of a terminal transformer when summer peak load reaches 400 MW. Therefore, FBC does not recommend Alterative C as a solution to the Kelowna area capacity constraint on a technical basis. The addition of a new terminal transformer at LEE (Alternatives A and B) is a superior solution to locating it at DGB (Alternative C).

FBC also considers that configuring LEE as a standard ring bus configuration (Alternative A) is a superior solution to expanding the current split bus configuration (Alternative B), concurrent with the addition of the new transformer, for several reasons.

- First, Alternative A provides better reliability associated with the 138 kV ring bus configuration when compared to Alternative B because of the redundant path for power to flow created by the ring configuration. As stated in Section 4.3.1, a breaker failure on a split bus causes a larger outage than on a ring bus; substation reliability research shows that a ring bus configuration provides 50 percent fewer outage minutes per year than a split bus configuration.
- Second, the ring bus configuration simplifies outage planning and maintenance activities, and reduces time required for network reconfiguration, also because of the redundant path. The ring bus reduces safety risks because it provides clear zones of isolation to work on station equipment. The risk of instances of mis-operation is also lower with a ring bus since it does not require complex transfers, and new employees will more quickly become familiar with this simple and standardized bus configuration.
- Finally, Alternative A provides the potential for future expansion to serve continued load growth in the Kelowna area. It would be possible to add up to two additional nodes to the

ring bus, which would permit the connection of additional transmission lines to connect future area substations, transmission customers, and/or local distribution by way of adding a 138 kV/13 kV distribution transformer.

With respect to Project risks, each alternative is dependent on the approximate one-year lead-time for procurement of a new transformer. The schedule risk is more complex and requires transmission line outages for Alternative A. The land risk is lowest for Alternatives A and B because the existing terminal site is utilized and most construction is within the existing station fence. All alternatives have a low risk of encountering unforeseen environmental and archaeological issues during construction phase based on FBC's historical experience in the LEE and DGB terminals. LEE and DGB are outside of City of Kelowna designated development permit areas, and there are no known archaeological sites in the proximity of these stations. A risk assessment for Alternative A is included in Section 5.7.

The technical evaluation in Table 4-1 demonstrates that Alternative A is superior from a technical perspective as it best addresses system needs in the Kelowna area.

### 4.6.2 Financial Evaluation

Alternative C has the highest capital cost of the three alternatives at $32.332 million expressed in $2019. The high capital cost is the result of additional expenditures required for transmission line reconductoring and the future transformer addition identified in Section 4.4.3 above. The high capital cost also leads to a higher PV of revenue requirements and rate impact compared to the other alternatives. Therefore FBC also rejects Alternative C on the basis of the financial evaluation.

Both Alternatives A and B will reduce O&M costs as they address the end-of-life 13 kV distribution equipment which will be demolished out of the station. Alternative A provides the largest O&M reduction, as the ring bus requires fewer 138 kV breakers and associated equipment than the split bus.

With respect to initial capital costs, Alternative B has the lowest initial capital cost and provides similar O&M benefit to Alternative A. As such, this Alternative has the lowest rate impact and PV revenue requirement.

Based on the financial analysis, Alternative B better minimizes the financial impact of the Project as compared to Alternative A.

### 4.6.3 The Preferred Solution is Alternative A

The Company's preferred solution is Alternative A, under which FBC would purchase and install a new 230/138 kV 200 MVA transformer at LEE and would reconfigure the 138 kV bus into an FBC and industry standard ring bus configuration.

From a financial perspective, the rate impact of Alternative A is approximately 0.10 percentage points higher than Alternative B.[27] However, FBC maintains that Alternative A provides a number of technical advantages that justify the additional cost. The difference in the annual bill impact for an average residential customer using 11,000 Kwh is $1.27 between Alternative A and Alternative B.

Of the three alternatives considered, Alternative A provides the best technical solution. It meets the Company's transmission planning criteria, delivers the most reliable, operable and safe final station configuration, and provides better potential for future expansion. On this basis, Alternative A is selected as the preferred solution for the KBTA Project.

[27] (0.39 percent versus 0.29 percent on a levelized basis)

# 5. PROJECT DESCRIPTION

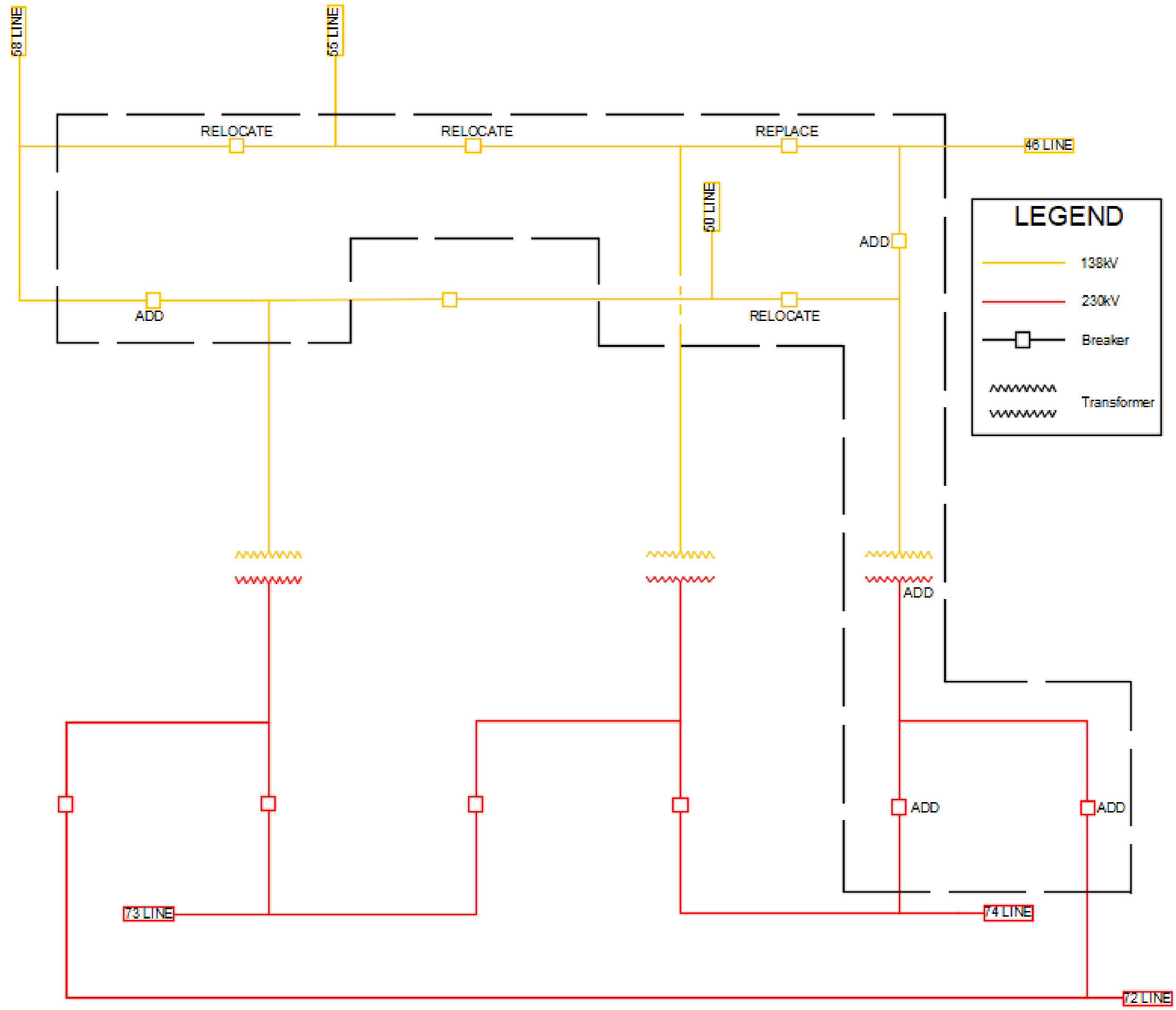
## 5.1 OVERVIEW

As discussed in Section 4.5, the Company's proposal for the KBTA Project requires the installation of a new 230/138 kV transformer at LEE on McCurdy Road in Kelowna, and the reconfiguration of the 138 kV bus at the station to a ring bus configuration that is an industry standard for this type of terminal.

Figure 5-1 shows a simplified single line drawing of the proposed installation. Preliminary drawings showing the detailed single line diagram and general arrangement are included in Confidential Appendix A:

1. Appendix A-1 – General Arrangement – Current Configuration with Demolition Scope;
2. Appendix A-2 – General Arrangement – Proposed Configuration; and
3. Appendix A-3 – Operational Single Line Diagram – Proposed Configuration

**Figure 5-1: LEE Terminal Ring Bus Simplified Single Line Drawing**




The KBTA Project's principal elements, transmission line modifications, distribution line modifications, and station modifications, are described below.

### 5.1.1 Transmission Line Modifications

Preliminary transmission line engineering was completed to support project definition work, and to evaluate structure types and configurations. Transmission system modifications identified for the Project are all within the existing LEE property lines or existing transmission rights-of-way. No acquisitions of land or rights-of-way will be required.

Some existing 138 kV transmission line approaches within the station will need to be re-located within existing land and rights-of-way to improve clearances and to provide space for the required station upgrades.

The proposed transmission modifications are described below:

- Relocate 50L approach to the station approximately 40 metres west to just inside the station's western property line. This will provide additional space within the confines of the station fence for new equipment and address line clearance concerns;
- Re-align 55L approach to the station to just inside the station's south and west property lines. This will provide additional space within the confines of the station fence for new equipment and address line clearance concerns;
- Re-align 46L within the station confines to align with new station equipment expansion towards the north; and
- Re-align 58L to align with new station equipment expansion towards the south.

None of the 230 kV line approaches or alignments in the station will be modified.

### 5.1.2 Distribution Line Modifications

With the transfer of distribution load from LEE to Sexsmith Feeder 6 in 2020, the 13 kV feeders LEE 1 and 2 will no longer be utilized. Distribution lines will be re-aligned as they will be underbuilt on 55L and 50L just inside the station's south and west property lines. The distribution lines will bypass LEE and will run between Sexsmith substation and Black Mountain with a normal open point just west of LEE.

### 5.1.3 Station Modifications

Preliminary station engineering was completed to support Project definition work, and to evaluate different station configurations. The preliminary design provides an indication of the proposed station layout. The design and location will be further defined as part of detailed design after Project approval.

LEE is able accommodate an additional transformer in the northern portion of the site and the existing 230 kV ring bus arrangement has two bays available to complete the required additional node connection. Certain components of the 138 kV system will need to be relocated within the site to provide space for the third transformer 138 kV tie-in and modification of the 138 kV bus into a ring configuration.

Existing 13 kV equipment in the station will be demolished since this distribution load will be supplied from Sexsmith station upon completion of the Sexsmith Second Distribution Transformer project in 2020.

A design summary for the station is provided below;

- Reconfigure the existing 230 kV ring bus to provide an additional node connection point for the new transformer. This involves the addition of two new 230 kV 2000A $SF_6$ (Sulfur

Hexafluoride) type circuit breakers (one of which will replace an existing breaker) and associated disconnects and buswork at the north end of the 230 kV yard;

- Install one new 230/138 kV 120/160/200 MVA transformer along with the necessary foundation and oil containment;
- Demolish existing disused building and transformer structure on the site to provide space for new equipment;
- Reconfigure the existing 138 kV bus into a ring bus configuration to create an additional node connection point for the new transformer and provide other benefits described in Section 4. This involves the installation of three new 138 kV 2000A $SF_6$ type circuit breakers (one of which will replace an existing breaker) and associated disconnects;
- Relocate three existing 138 kV breakers to new locations in the ring bus;
- Relocate the existing 138 kV CAP1 capacitor bank and breaker to provide space for the bus reconfiguration;
- Construct a new 138 kV yard control building with new protection & control panels and equipment and SCADA infrastructure; and
- Demolish existing 13 kV breakers, voltage regulators, switches, and other distribution equipment in the station.

Further detail of the Project scope is included in Confidential Appendix B – Cost Estimates.

## 5.2 *PROJECT ENGINEERING AND DESIGN*

Engineering and detailed design is expected to start immediately upon approval of the Project by the BCUC. Activities will encompass all engineering calculations, validations and drawings required to cover the Project needs. Engineering activities will be organized in order of priority, in relation to the fabrication/procurement lead times and scheduled date for each component to be on the work site.

Engineering packages to be completed are:

- LEE site preparation scope;
- LEE civil scope;
- LEE electrical scope;
- Transmission line realignment; and
- Distribution feeder realignment.

Engineering will be completed either by FBC or by a FBC pre-qualified external engineering firm. Each engineering package completed by external resources will be reviewed and accepted by

FBC Engineering. The application processes for permits and approvals, as identified in Section 5.6, will be initiated. The design phase will be concluded by the final design review and issuance of each Issued for Construction package, planned in stages beginning in the first quarter of 2021.

When the transformer specification is issued to potential vendors during procurement, it will include proactive noise mitigation measures based on the recommendations of the Noise Impact Assessment that is further described in Section 5.5. In order to minimize noise impact for nearby customers, it will include a requirement for the transformer cooling fans to meet an acoustic specification of a maximum of 82 decibels (dBA) at a distance of one meter. Installation of a variable frequency drive (VFD) system on the fans will also be considered in order to reduce overall acoustic impact.

## 5.3 PROJECT MANAGEMENT AND RESOURCES

### 5.3.1 Project Management Office

FBC will have a Project Manager/Owner's Representative who will manage all aspects of the Project including, but not limited to, permitting, engineering, procurement, and construction. The Project Manager is responsible for overseeing all Project activities.

Additionally, FBC will have a Construction Manager on site who will manage the construction activities and resources (both contracted resources and internal resources). The Construction Manager is responsible for all health and safety, quality, environment, schedule, outage staging and planning, and cost controls on site.

The Project Manager will be supported by other members of the FBC Project Management Office as required, such as Project Schedulers, Cost Analysts, and Administration. The Project will also be supported by other Company departments including Occupational Health and Safety, Operations/Network Services, Environment, and Lands. The Project Manager will be responsible for liaising with these other departments as required.

### 5.3.2 Engineering

FBC will have a dedicated Project Engineer and supporting Design Technologists assigned to manage the engineering component of the Project. Supplemental external engineering support will be required to complete various engineering designs, such as geotechnical, site preparation and excavation, concrete foundations and concrete containments.

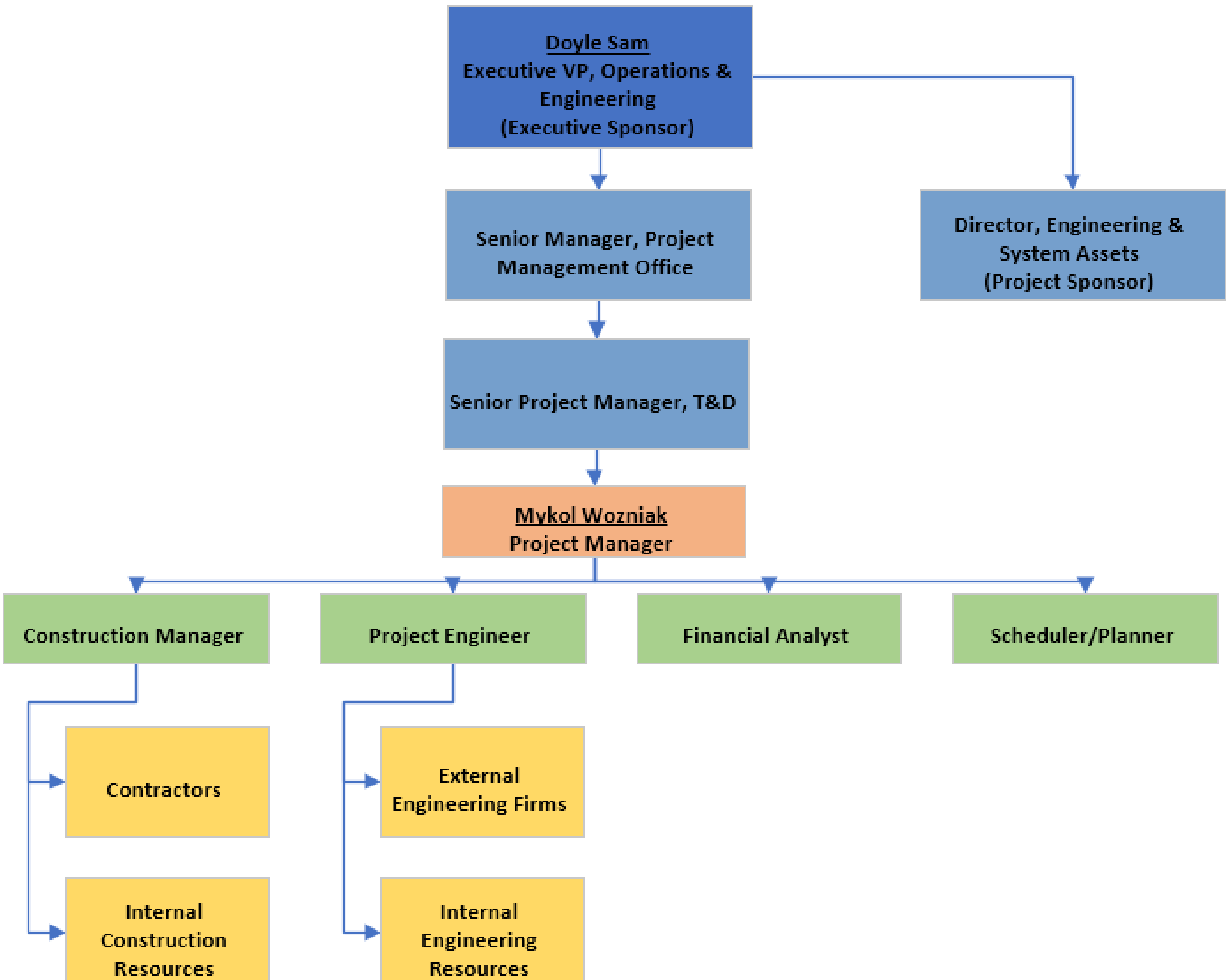
### 5.3.3 Construction Services

All Project activities will be managed directly on site by FBC. Construction work will be tendered and contracted to pre-qualified vendors, with the exception of technical support, outage coordination, and security-sensitive work such as communications, protection, and controls, which will be performed by internal FBC resources. All laydown/storage will be at site and use

FBC's standard project security measures such as locked storage containers and security guard patrol.

An organizational chart for the Project is provided in Figure 5-2.

**Figure 5-2: Organizational Chart**




## 5.4 *PROJECT SCHEDULE*

Engineering and procurement for the Project will begin immediately upon BCUC approval. FBC has standard equipment specifications for equipment relevant to the Project scope, which reduces risk for ordering the long-lead time materials. The longest procurement lead time is for the power transformer, which will be competitively bid, and this process typically takes two to three months to select a supplier and an expected 12 to 16 months for manufacture.

The construction phase of the Project will require important coordination on site and with the System Control Centre (SCC) to complete the removal and installation of various electrical components. Outage windows to operating transmission lines will be scheduled at the start of the project and updated on a bi-weekly basis. This is a standard practice between SCC and the Project Management Office to provide definitive construction periods when outages are required. During times when outages have constraints such as loading or other conflicting outage plans, FBC will plan work to occur during low load periods such as nights and weekends.

The basic sequence of construction is as follows:

1. Transfer 13 kV distribution load from LEE Substation to Sexsmith Substation (with no customer outage disruptions);
2. Remove the existing 13 kV distribution feeder bus and equipment;
3. Re-route existing 55L & 58L by installing temporary and permanent structures;
4. Complete civil installations for both 138 kV and 230 kV areas of the substation;
5. Re-route the 13 kV distribution system underbuild on 55L to underground duct system around LEE Substation;
6. Re-configure ring bus installations for 138 kV and 230 kV bus;
7. Complete new control building installation;
8. Relocate CAP1 capacitor bank; and
9. Energize new equipment and control building onto the system.

The following Project Schedule assumes CPCN Approval by December 31, 2020, approximately 90 days following the end of the regulatory process.

**Figure 5-3: Preliminary Project Schedule**

| Task Name | Duration | Start | Finish |
|---|---|---|---|
| KBTCA Project | 652 days | December 31, 2020 | June 30, 2023 |
| Phase 1 - CPCN Approval | 0 days | December 31, 2020 | December 31, 2020 |
| Approval | 0 days | December 31, 2020 | December 31, 2020 |
| Phase 2 - Engineering for IFC Packages | 369 days | December 31, 2020 | May 31, 2022 |
| Phase 3 - Procurement | 428 days | January 1, 2021 | August 23, 2022 |
| Major Equipment | 287 days | January 1, 2021 | February 7, 2022 |
| Contractors | 428 days | January 1, 2021 | August 23, 2022 |
| Phase 4 - Execution | 606 days | March 5, 2021 | June 30, 2023 |
| Stage 1 - Transmission Line Re-Routes and Station Excavations | 140 days | March 5, 2021 | September 16, 2021 |
| Stage 2 - CAP Bank | 45 days | September 17, 2021 | November 18, 2021 |
| Stage 3 - Bus Re-Configuration | 60 days | November 19, 2021 | February 10, 2022 |
| Stage 4 - CB Relocations | 80 days | February 11, 2022 | June 2, 2022 |
| Stage 5 - Bus Re-Configuration | 50 days | June 3, 2022 | August 11, 2022 |
| Stage 6 - T2 Installation | 50 days | July 15, 2022 | September 22, 2022 |
| Stage 7 - CB11 Install and T2 Energization | 35 days | September 23, 2022 | November 10, 2022 |
| Stage 8 - CB12-1 and T3 | 45 days | October 21, 2022 | December 22, 2022 |
| In Service | 0 days | December 22, 2022 | December 22, 2022 |
| Deficiencies, Clean Up, and Project Close Out | 136 days | December 23, 2022 | June 30, 2023 |

Details of the construction stages identified in Figure 5-3 are provided below.

***Stage 1 Transmission Line Re-Routes and Station Excavation:***

- Additional site development, grading, fencing, ground grid;
- Re-route existing 58L, 55L and 50L approaches to the station;
- Salvage existing 13 kV distribution structures and equipment;
  - Salvage existing T3 and T4 tertiary equipment, except station service transformers;
  - Salvage existing T3 and T4 grounding transformers;
  - Salvage existing Feeder (FDR)1 and FDR2 egress structures and lines;
- Install new 13 kV tertiary metal clad switchgear adjacent to T2, T3 and T4;
- Construct new 138 kV yard control building;
  - Install new protection & control panels and equipment and SCADA infrastructure in new building;
- Relocate Capacitor Bank (CAP)2 protection relays and re-cable and re-commission;
- Remove existing storage facility and demolish concrete slab/foundations;
- Demolish existing disused building and old transformer foundation and walls.

***Stage 2 Capacitor Bank 1 Relocation:***

- Relocate existing CAP1 and associated equipment;

***Stages 3, 4, and 5 Bus Reconfiguration and Circuit Breaker Relocations:***

- Expand and modify 230 kV ring bus to accommodate the new transformer;
- Add two new 230 kV 2000A $SF_6$ breakers;
- Salvage existing Circuit Breaker (CB)1 breaker and associated current transformers;
- Remove existing overhead lightning protection sky wires and provide new lightning masts in 230 kV yard;
- Expand and modify existing 138 kV bus to 7 breaker ring configuration;
  - Salvage four existing 138 kV breakers (CB17, CB18, CBT3M, CBT4M) and associated current transformers;
  - Provide three new 145 kV, 2000A $SF_6$ breakers;
- Provide new lightning masts in 138 kV yard;

- Demolish/salvage existing bus and equipment for 55L, 58L, 46L & 50L;
- Demolish existing 230 kV and 138 kV foundations not required for final bus configuration;

***Stage 6 Transformer Installation:***

- Install new Transformer (T2) foundation, containment and sound/blast wall;
- Installation of new 120/160/200 MVA, 230/138 kV Auto Transformer;

***Stages 7 and 8 Circuit Breaker Installation and Transformer Energization:***

- Complete buswork and install CB11-1 and CB12-1 switches;
- Energize new T2 transformer and re-commission existing T3 transformer.

### 5.4.1 Impact of COVID-19 on Project Schedule

The construction schedule in Figure 5-3 assumes no critical path delays, including those as a result of pandemic-related impacts on supply chain or resources. However, there are risk mitigations available should delays materialize. Mitigations include scheduling float for major equipment supply, construction methodology resequencing, resource levelling and blitzing, overtime and shift rotations, and activity stacking.

During the 2020 COVID-19 pandemic, FBC initiated measures to combat the spread of the virus and ensure health and safety of our workers and contractors. The Company's work is deemed essential, which includes the KBTA Project. Should the COVID-19 pandemic remain a concern during the construction phase, at minimum the approach would be to continue with the measures adopted in 2020, evaluate the risks in accordance with standard health and safety practices, and institute mitigation measures as required.

## 5.5 *ENVIRONMENTAL AND ARCHAEOLOGICAL IMPACTS*

LEE is located within the civic boundaries of the City of Kelowna and therefore subject to local environmental bylaws and development controls. A thorough review of the City of Kelowna's Natural Environment Development Permit Area map and the Hazardous Condition Development Permit Area map confirmed that LEE is outside of the designated development permit areas. Therefore, no additional environmental permitting is required for this Project.

Asbestos is known to exist in the existing disused building to be demolished. A qualified asbestos removal contractor will be engaged in this phase of the Project. FBC will also employ standard containment and other typical construction protective measures.

FBC retained Patching Associates Acoustical Engineering Ltd. (PAAE) to conduct a Noise Impact Assessment (NIA) for the proposed expansion of LEE. The purpose of this NIA is to assess the probable impact of the proposed substation expansion on the study area, which includes the residences that are nearest to the station. Sound measurements were taken at the substation in order to develop a model for the study area. The impact of the proposed future transformer was then modelled based on maximum equipment noise levels that will be set out in the transformer purchase specification. The NIA shows that noise levels at residences in the study area are likely to increase slightly when no transformer fans are running. However, noise levels are likely to decrease under summer peak load conditions since fans are expected to run less frequently due to lower average loading. The target sound level for the assessment was set at 53 dBA (A-weighted decibels) based on Alberta Utilities Commission Rule 012 and the characteristics of the study area. The results of this assessment indicate that the Cumulative Sound Pressure Level is expected to meet the target sound level at all residences in the study area for all scenarios analyzed. As a mitigation measure that will minimize the noise levels at nearby residences, recommendations regarding acoustic specifications for the new transformer fans will be incorporated in the transformer purchase specification. The NIA study can be found in Appendix E.

There are no known archaeological sites in the proximity of LEE; however, care will be taken during construction to ensure that any potential findings are addressed appropriately.

## 5.6 *OTHER APPROVALS REQUIRED*

### City of Kelowna

A municipal building permit will be required for the new control building that will be constructed within the station.

### Ministry of Transportation and Infrastructure Permits

Highways and areas under the jurisdiction of the Ministry of Transportation and Infrastructure may require permits. Once the extent of any transportation impact is determined during detailed design, permits will be prepared and submitted for approval by either FBC or its vendor(s), as required. The terms and conditions outlined in these permits will be adhered to during the construction of the Project.

### Agricultural Land Commission (ALC)

LEE is within the provincial Agricultural Land Reserve, and approval will be required for the station expansion. ALC approval is expected to be granted as the site is approved for non-farm use and the substation expansion will take place entirely on the existing FBC-owned property.

There are no other federal, provincial, or municipal approvals, permits, licenses or authorizations required to complete the Project.

## 5.7 *RISK ASSESSMENT*

FBC has assessed the risk to completing the Project by the in-service date in the fourth quarter of 2022. Circumstances that could delay the Project or increase costs are set out in Table 5-1.

1 **Table 5-1: Risk Register**

| Type of Risk | Risk Description | Mitigating Actions | Likelihood of Occurrence (Low / Medium / High) |
|---|---|---|---|
| Scope | Scope creep due to existing conditions not reflecting that of existing as-built drawings on record | FBC will validate existing conditions on site by surveying and reviewing substation drawings to reflect existing infrastructure | Medium |
| Safety | Contractors not familiar with FBC safe work practices resulting in injury or violations | Selection of contractor with FBC substation experience or train selected contractor prior to work commencing. FBC will provide a CAT 6[28] worker to act as a site safety watch for construction work | Low |
| Quality | Poor quality installations | FBC will have dedicated resources monitoring construction activities as scheduled by the Construction Manager. As well an Inspection & Test plan will be implemented with installation contractor for Hold and Witness points[29] | Low |
| Cost | Raw materials cost increase due to inflation/market value | Purchase all equipment from established suppliers and, where possible, with agreed purchase prices. Competitive tendering will be used to ensure lowest cost at best value products. Contingency may be used in the case of higher than anticipated foreign exchange or raw material escalation | Low |
| | Actual costs of construction higher than estimated | Detailed class three estimate completed for construction | Low |

[28] CAT 6 (Category 6) is a training and authorization level acknowledged by the SCC which allows a Worker to take control of and manage the electrical system. A CAT 6 Worker may also issue Protection and Lockout paperwork to other personnel working on the electrical system, in accordance with FBC's System Safety Lockout Program.

[29] Hold and Witness Points are industry practices for obtaining customer approval on the workmanship and quality of the Goods provided or Services performed. A Hold point requires a written approval from the customer before proceeding to the next step of the manufacturing or construction process. A Witness point requires the physical review, on site by an authorized representative of the customer, of a testing process with the manufacturer or contractor.

| Type of Risk | Risk Description | Mitigating Actions | Likelihood of Occurrence (Low / Medium / High) |
|---|---|---|---|
| Schedule | Availability of resources | External contractors will be used with support from internal FortisBC crews. FBC anticipates availability of qualified external resources | Low |
| | Delivery of services and materials | Schedule and order long lead-time materials in the early stages of the design to allow for ample time for delivery to site before required | Low |
| | Meeting construction windows for transmission outages | In depth planning and scheduling of outages will be used to reduce this risk along with provisions of schedule buffers to mitigate impacts | Low |
| | Scheduling conflicts with other system outages | Early involvement and awareness from all internal groups well before construction to align outage requirements with system constraints | Medium |
| | Project completion delayed | Insert milestones in the contract with contractor and consider implementing liquidated damages or bonus structure to achieve schedule | Medium |
| | Agricultural Land Commission (ALC) approval | Application to ALC for approval of station expansion (the property is currently approved for non-agricultural use) | Low |
| Environment & Archaeological | Contaminated soils around existing oil filled equipment | Early recognition by soil sampling to identify any contaminated areas | Low |
| | Wildfire risk when relocating transmission structures and completing site expansion | In depth planning and scheduling this portion of work outside of wild fire season when possible. The work is confined to the substation property which has limited vegetation | Low |

| Type of Risk | Risk Description | Mitigating Actions | Likelihood of Occurrence (Low / Medium / High) |
|---|---|---|---|
| | Ground water issues may cause construction delays | In depth planning and scheduling work outside of the peak spring runoff times. Review of station environmental ground water survey | Medium |
| | Unforeseen environmental or archaeological discoveries during construction | Early consultation and exploration of unforeseen archaeological sites in the area of construction | Low |

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FBC's analysis concludes that the overall risk to the Project schedule, quality and cost, considering the planned mitigation activities, is low. Any cost impacts that may arise from these risk factors are expected to be manageable within the Project contingency, which is discussed in Section 6.1.4.

## 5.8 SUMMARY

In this section, FBC has described the proposed KBTA Project in detail, including information on Project components, schedule, resource requirements, and risks and management. The Project schedule incorporates required staging of station and transmission line work, and considers seasonal windows for load transfers. Planned risk mitigation activities are in place to keep overall risk to the Project schedule low.

# 6. PROJECT COST AND FINANCIAL EVALUATION

## 6.1 OVERVIEW

The preferred alternative for the Project is Alternative A, the installation of a third transformer at LEE and the modification of the existing 138 kV bus to an FBC-standard ring bus configuration.

The total capital cost of the Project is forecast to be $23.288 million in as spent dollars (including net removal costs of $0.828 million and AFUDC of $1.230 million).

The subsections below provide details on the total Project capital cost, impact on operations and maintenance expense, financial evaluation, accounting treatment and rate impacts associated with the Project.

## 6.2 PROJECT CAPITAL COST ESTIMATE

The cost estimate for the KBTA Project has been developed to a Class 3 degree of accuracy as defined by the Association for the Advancement of Cost Engineering (AACE) Recommended Practice, in accordance with the BCUC's CPCN Guidelines. The expected accuracy of the cost estimate is, as defined in AACE: Low: -10 percent to -20 percent and High: +10 percent to +30 percent.

Table 6-1 presents a summary of the total estimated capital costs for the KBTA Project. A detailed breakdown of the estimated costs for the Project can be found in Confidential Appendix B.

**Table 6-1: Summary of Estimated Project Capital Costs ($ Millions)**

| Item | $ 2019 | $ As-Spent |
|---|---|---|
| Pre-Approval Costs | 0.425 | 0.442 |
| Construction Costs | 17.375 | 18.241 |
| Net Removal Costs | 0.792 | 0.828 |
| Contingency | 2.417 | 2.546 |
| AFUDC | | 1.230 |
| **Total Project Costs** | **21.009** | **23.288** |

### 6.2.1 Pre-Approval Costs

Pre-Approval Project Costs are the estimated costs that will be incurred prior to CPCN approval, for preliminary stage development costs and the costs of the regulatory proceeding. Upon BCUC approval of the CPCN, these costs will be transferred to work in progress and be included in the total Project capital cost.

The preliminary stage development costs are related to expenses incurred by FBC internally and also for engaging third-party consultants for feasibility evaluation, preliminary development and assessment of the potential design and alternatives as required to complete this CPCN

Application. The regulatory-related costs include expenses for legal review, consultant costs, BCUC costs and BCUC-approved intervener costs and are based on the written hearing process proposed in Section 1.3.

### 6.2.2 Construction Costs

The Project is composed of stations work and transmission and distribution lines work. FBC estimated the costs individually for the substation work and the transmission/distribution line work. FBC requested preliminary quotes from potential suppliers to compile the station upgrade estimate. FBC engaged DBS Energy, an engineering consulting company, to provide the transmission and distribution lines estimate. Further detail on these two components is provided in Confidential Appendices B-2 and B-3.

Key assumptions of the estimate include the following:

- Work will be done predominantly by external labour;
- 138 kV Capacitor banks can be shut down one at a time for extended periods;
- Outage windows required for 138 kV transmission lines can be accommodated; and
- Outage windows required for modifications to 230 kV ring bus can be accommodated.

### 6.2.3 Net Removal Costs

The KBTA Project requires the removal of substation and lines equipment. Cost of removal has been estimated in the same manner as construction costs, explained in section 6.2.2.

### 6.2.4 Project Contingency

Contingency has been applied to the Project to account for certain items, conditions, or events which may occur throughout the Project lifecycle. FBC has applied a contingency amount to the estimates (before materials handling and provincial sales tax) of 15 percent for all construction and removal, other than for transmission and distribution line construction at 20 percent, and line removal costs at 7 percent. Contingency amounts that have been applied are based on FBC experience.

### 6.2.5 Allowance for Funds Used During Construction (AFUDC)

FBC's 2020 AFUDC rate is 5.83 percent, which is equal to the after-tax weighted average cost of capital.

### 6.2.6 Price Escalation

The as-spent capital cost estimates in Table 6-1 include an annual price escalation of 2.0 percent over the period of execution based on the Conference Board of Canada Consumer Price Index forecast as of April 2020[30].

## 6.3 *OPERATING AND MAINTENANCE EXPENSE*

FBC expects that the retirement of the 13 kV station equipment will reduce station O&M expenditures by approximately $26 thousand per year in 2019 dollars. The Project is expected to reduce gross O&M expenditures by approximately $28 thousand annually beginning in 2024 As explained in Section 4.4.1.2, the O&M reduction is due to reduced maintenance associated with the elimination of the 13 kV distribution equipment within the substation and a net reduction of one 138 kV breaker.

## 6.4 *FINANCIAL EVALUATION*

The financial evaluation of the Project consists of:

- the incremental cost of service (revenue requirements), present value of the incremental cost of service, rate impact as a percentage of the 2020 Interim Revenue Requirement; and
- The levelized rate impact over a 40-year analysis period.

In the following subsections, FBC explains the accounting treatment of the various components for the Project and provides the results of the revenue requirements model and rate impact.

### 6.4.1 Accounting and Regulatory Treatment

#### *Pre-Approval Costs*

Pre-approval costs of $0.442 million, as described in Section 6.2.1, are being captured in a non-rate base deferral account, financed at FBC's weighted average cost of debt[31]. Upon BCUC approval of the CPCN, these costs will be transferred to work in progress and included in the total Project capital cost.

#### *Construction Costs*

The construction costs for the Project of $18.241 million will be held in Work in Progress, attracting AFUDC. Construction of the Project is scheduled to be completed in multiple phases and the specific assets with construction work completed in each phase will be placed in service when they are commissioned and ready to be used. FBC will transfer the associated capital costs of

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[30] Conference Board of Canada, Provincial Outlook Long-Term Economic Forecast.
[31] FBC's CPCN Projects deferral account was approved by Order G-139-14.

the specific assets that have been placed in service to the appropriate plant asset accounts and include in FBC's rate base on January 1 of the following year. Depreciation of the assets included in FBC's rate base will begin at the start of the year.

The amount and timing of the transfer to the plant asset account for each year is also identified in Confidential Appendix C, Financial Schedule 7.

#### Net Removal Costs

Cost of Removal estimated at $0.828 million for station equipment, net of any recoverable salvage costs, will be charged to Accumulated Depreciation as per FBC's approved treatment. FBC's approved depreciation rates include a provision for recovering the removal costs of assets in each asset class.

#### Retirement of Existing Assets

Included in the analysis to support this Project is $0.351 million of in-service assets with a zero net book value. These assets will be retired when the Project capital enters rate base on January 1, 2023.

#### Operating and Maintenance Expense

At the time of filing, FBC's proposed 2020-2024 Multi Year Rate Plan (MRP)[32] is awaiting BCUC approval. The bulk of FBC's O&M expense under the proposed MRP is determined by escalating a Base O&M amount annually by inflation and customer growth. The assets that are the subject of this Application are included in the Base O&M amount and upon completion of the Project, FBC will pass the O&M savings to customers by adjusting the Base O&M downward by approximately $28 thousand[33].

### 6.4.2 Incremental Revenue Requirements and Rate Impact

The Project construction period is between 2021 and 2022 with the majority of assets entering rate base in 2023. A 40 year cost of service model, equivalent to the life of the assets, was used to evaluate the rate impact. The rate impact in 2024, the year when all assets have been transferred into plant asset accounts is estimated at 0.54 percent. This equates to an annual bill increase of $6.87 for an average residential customer using 11,000 kWh. The levelized 40 year rate impact is 0.39 percent or approximately $0.45 per MWh. The annual bill impact for an average residential customer using 11,000 kWh at the 40 year levelized rate would be approximately $4.96.

## 6.5 SUMMARY

In this section, FBC has described the Project cost estimate, the financial evaluation, accounting treatment, and the estimated rate impact. The Project is estimated to cost $23.288 million in as-

[32] https://www.bcuc.com/ApplicationView.aspx?ApplicationId=667
[33] O&M reduction of $25.6 thousand in $2019, to be escalated according to the MRP base O&M escalation factor.

spent dollars including net removal costs. The levelized rate impact of Alternative A is projected to be 0.39 percent or approximately $0.45 per MWh, and will add approximately $4.96 to the annual bill for the average customer using 11,000 kWh.

# 7. CONSULTATION

## 7.1 GENERAL

Public consultation and communication are integral components of FBC's project development process. FBC has directly engaged the local community, Indigenous communities and local government with respect to the proposed work at the F.A. Lee Terminal Station.

Public consultation began during the pre-submission stage, and consisted primarily of information-sharing with customers and key stakeholders in order to seek feedback on the Project and its potential impacts, and to encourage comments throughout the process as more details became available.

FBC sent out notification letters directly to affected customers and stakeholders and has tracked issues or concerns raised. FBC also engaged Indigenous communities with interest in the area of the Project. The Company will work with customers, stakeholders, and Indigenous communities to address any outstanding items, and will continue to consult with the public as the Project progresses.

## 7.2 KEY STAKEHOLDERS

The Key Stakeholders for the KBTA Project have been identified as:

- City of Kelowna elected officials and staff;
- Residents and businesses at the Tower Ranch subdivision and Tower Ranch Golf & Country Club, and other residents adjacent to or in close proximity to LEE; and
- Indigenous Communities as identified through the Provincial Consultative Areas Database.

## 7.3 CONSULTATION WITH LOCAL GOVERNMENT

FBC contacted City of Kelowna staff and, at their request, provided a brief overview of the Project by email on March 16, 2020. The overview included information about the Project, the purpose for the upgrade, application timelines and how FBC is consulting with local community members and area residents. FBC sent a follow-up letter on March 31, 2020 that included the visual renderings and noise study summary, and offered to provide additional information if needed, or to set up a meeting or Council presentation if required. A response received on March 31, 2020 advised that the City Manager had briefed Council and would be in contact if further information was requested. As of the date of filing, no further information has been requested.

The March 16, 2020 email and follow-up March 31, 2020 letter are included as Appendix D-1.

## 7.4 *CONSULTATION WITH LOCAL RESIDENTS*

With the assistance of the Tower Ranch Community Association (TRCA), FBC has had an opportunity to reach a very high percentage of local residents. The TRCA maintains a contact list covering 100 percent of the residents living in the subdivision, including e-mail addresses. The Company has been able to work through the TRCA to send consultation information directly to the affected customers. This is of particular importance since many of the residents were absent from the area during the consultation phase of the Project.

To date, activities included the following:

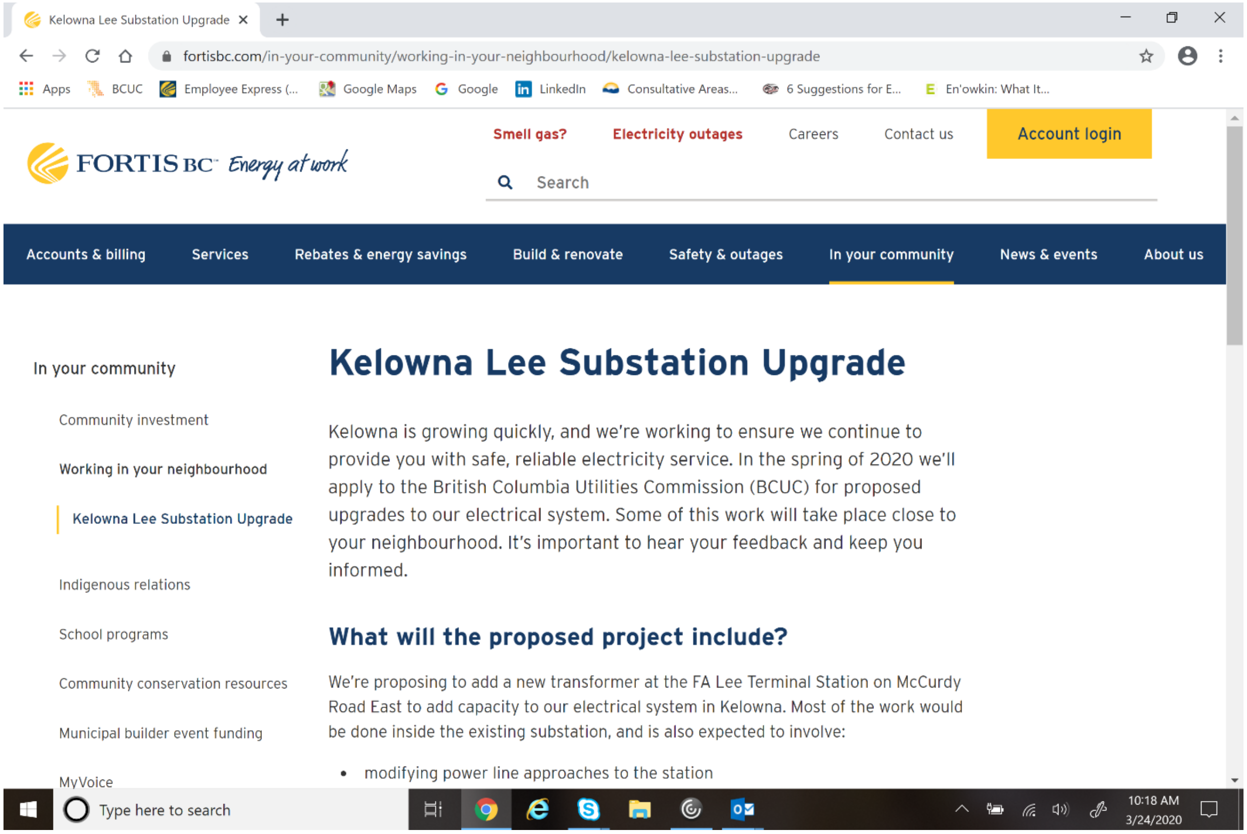
- Development of a Project webpage, providing an email address where questions/ inquiries can be submitted to the Company, and a link to a short survey where residents can provide their input on the Project;
- Sending notification letters to area residents and businesses directly impacted by the Project; and
- Hosting a virtual Town Hall / Information Session for area residents.

### 7.4.1 KBTA Project Webpage

The Project has a dedicated webpage containing information on the Project and includes an opportunity to provide feedback via an online survey. Stakeholders that received the letter discussed in Section 7.4.2 were directed to the Project webpage.

A screenshot of the webpage is shown below and a summary of the five survey responses received to date is included in Appendix D-2.

**Figure 7-1: KBTA Project Webpage Screenshot**




### 7.4.2 Notification Letters

Notification letters were emailed to the TRCA President for distribution to area residents on March 30, 2020. Notification letters were also mailed to the owners of three properties adjacent to the station as well as the two Tower Ranch businesses. The letters provided information about the Project, the regulatory process, how to contact FBC with any questions or concerns, visual renderings of the proposed Project, and a summary of the noise study. Recipients were invited to visit the Project webpage and to complete a short survey to provide feedback. The Company received one direct response to the project email inbox expressing interest in aesthetic improvements and landscaping options.

Sample letters can be found at Appendix D-3.

### 7.4.3 Virtual Town Hall/ Information Session

On April 22, 2020 from 5:00 p.m. to 7:30 p.m., FBC hosted a virtual Town Hall/Information Session with the TRCA President and area residents to provide an additional opportunity for stakeholders to engage directly with Project technical staff, Communications and Regulatory Affairs representatives of FBC. This session was hosted virtually, as a opposed to being an in-person public open house, due to the recent COVID-19 events and the related limitations on public meetings and requirements for social distancing. The format provided for all interested parties to dial in to a conference call and to follow a presentation that each participant had available for viewing.

Prior to the Virtual Town Hall, an agenda was provided to the TRCA for distribution to residents of the Tower Ranch Community, along with the link to the project webpage where the presentation was available. FBC representatives introduced the project at 5:00pm, 6:00pm and 7:00pm and responded to questions from residents that called in at those specific times. Staggering the presentation times allowed for residents to call in at the time that best suited their schedule and offered a format to promote discussion. A copy of the presentation is included as Appendix D-4.

Approximately 12 residents called into the virtual Town Hall event and expressed interest and concerns that echoed the feedback received from the letter and webpage campaigns. The primary topics of discussion focused on:

- Aesthetic improvement options FBC is considering including concrete wall height and colour, as well as vegetative screening;
- Clarification on results of noise study summary and whether noise levels will increase substantially;
- Lighting concerns about the number of lights and times of use;
- The extent to which work would be done within current station footprint or beyond;
- Impacts during construction such as road closures and/or planned outages; and
- Levels of electromagnetic fields post construction.

FBC provided the following information to address each concern raised:

- Aesthetic improvement: FBC is open to feedback on options for concrete wall height and colour that would be acceptable to area residents and complimentary to the neighbourhood aesthetics, as well as consideration of input on vegetative screening;
- Noise: not expected to substantially increase given the change in operation of the station with the load spread across a higher number of transformers;
- Lighting: will be improved for safety purposes and will only be in use when night work is required in the station. FBC confirmed that lighting will not be on 24 hours per day;
- Station work will not require any expansion outside of existing station property. Confirmed a small fence modification will be required on the southwest corner, away from the residential area;
- Construction impacts are expected to be minimal and will be communicated to the residents as outlined in section 7.6; and
- FBC has committed to assess any change in EMF levels that may result from the Project.

The information provided was well received by participants, with FBC either sufficiently addressing the concerns raised and answered questions asked, or agreeing to work collaboratively with the TRCA Board of Directors by creating a focus group to continue discussions as the Project progresses.

Not all decisions related to station aesthetics need to be finalized prior to commencing station planning and construction, and FBC will work in partnership with the TRCA Board to incorporate customer input into design plans for appropriate aesthetic improvements to the extent possible.

## 7.5 *ENGAGEMENT WITH INDIGENOUS COMMUNITIES*

In this section, FBC outlines the Company's engagement of potentially impacted Indigenous communities to date, and details the Company's Indigenous engagement plan going forward.

FBC is committed to developing and maintaining relationships with Indigenous Communities within whose territories we work and operate. In keeping with FBC's Statement of Indigenous principles, the Project team has and intends to:

- uphold a high standard of consultation and engagement; and
- identify potential opportunities for Indigenous procurement, which ensures local Indigenous communities and individuals receive opportunities through the development of the Project.

A list of potentially affected Indigenous communities was developed using the Province of British Columbia's Consultative Areas Database (CAD) to create a comprehensive list of those Indigenous communities whose area of interest is located in the area of the F.A. Lee Terminal Station. The list includes:

- Okanagan Indian Band;
- Penticton Indian Band;
- Okanagan Nation Alliance;
- Lower Similkameen Indian Band;
- Westbank First Nation; and
- Upper Nicola Indian Band

FBC has notified the Indigenous communities identified above by letter to provide information about the Project, contact information and opportunity to request a follow up meeting.

The Project notification letter was emailed on December 19, 2019. A sample letter can be found at Appendix D-5. FBC did not receive any requests for meetings as a result of the notification letter and received only one response deferring further engagement to Okanagan Indian Band and Westbank First Nation as these communities are in closer proximity to the station site.

FBC followed up on April 2, 2020 by sending an update email with a link to the Project webpage, summary of the noise study and visual renderings of the Project. FBC offered to host a virtual Town Hall with the Indigenous communities. Two responses were received, one deferring further engagement to Westbank First Nation; and one requesting additional information on the Project location, which was provided.

Following the filing of this Application, FBC will send a follow up letter to the Indigenous communities advising of the filing and extending another offer to discuss the Project, if requested. FBC will continue to update and engage with Indigenous communities as the Project progresses.

## 7.6 *POST-APPROVAL NOTIFICATIONS*

A follow up construction notification letter will be sent to area residents during Project planning and leading up to construction. This letter will focus on potential impacts related to noise, dust and construction activities and how these issues may be mitigated.

## 7.7 *SUMMARY*

FBC has sought feedback from stakeholders during the pre-submission phase of the project and also engaged Indigenous communities with interest in the area of the Project. The Company will continue to work with customers, stakeholders, and Indigenous communities to address any outstanding items as the Project progresses.

# 8. PROVINCIAL GOVERNMENT ENERGY OBJECTIVES AND FBC'S LONG TERM RESOURCE PLAN

## 8.1 INTRODUCTION

Section 46 (3.1) of the UCA states that in deciding whether to issue a CPCN, the Commission must consider:

(a) the applicable of British Columbia's energy objectives,

(b) the most recent long-term resource plan filed by the public utility under section 44.1, if any, and

(c) the extent to which the application for the certificate is consistent with the applicable requirements under sections 6 and 19 of the Clean Energy Act.

FBC addresses these requirements below.

## 8.2 BRITISH COLUMBIA'S ENERGY OBJECTIVES

With respect to section 46(3.1)(a), British Columbia's energy objectives are provided in the *Clean Energy Act* (CEA). The Company was mindful of these energy objectives when designing the Project and in Table 8-1 below comments on the impacts of the Project on British Columbia's energy objectives, as defined in section 2 of the CEA.

The KBTA Project is required in order to increase the 138 kV transmission capacity in the Kelowna area, and is therefore directly aligned with objectives (c), (h), (k), and (m), as explained in Table 8-1. While not directly affecting the remaining objectives, the KBTA Project does not hamper the advancement of these energy objectives by other projects, initiatives, or proponents.

**Table 8-1: British Columbia's Energy Objectives[34]**

| Item | Objective | Comments |
|---|---|---|
| (a) | to achieve electricity self-sufficiency | Project does not affect the generation or acquisition of electricity |
| (b) | to take demand-side measures and to conserve energy, including the objective of the authority reducing its expected increase in demand for electricity by the year 2020 by at least 66% | Load served by the Project is net of demand side management savings. 66% reduction in demand applies to BC Hydro and is not applicable to the Company |

[34] as set out in the *Clean Energy Act*, Chapter 22, SBC 2010, section 2.

| Item | Objective | Comments |
|---|---|---|
| (c) | to generate at least 93% of the electricity in British Columbia from clean or renewable resources and to build the infrastructure necessary to transmit that electricity | Project infrastructure is for the purpose of transmitting electricity within the province |
| (d) | to use and foster the development in British Columbia of innovative technologies that support energy conservation and efficiency and the use of clean or renewable resources | Load served by the Project is net of demand side management savings;<br>Project does not affect the generation or acquisition of electricity |
| (e) | to ensure the authority's ratepayers receive the benefits of the heritage assets and to ensure the benefits of the heritage contract under the *BC Hydro Public Power Legacy and Heritage Contract Act* continue to accrue to the authority's ratepayers | This objective applies to BC Hydro and is not applicable to the Company |
| (f) | to ensure the authority's rates remain among the most competitive of rates charged by public utilities in North America | This objective applies to BC Hydro and is not applicable to the Company |
| (g) | to reduce BC greenhouse gas emissions:<br>(i) by 2012 and for each subsequent calendar year to at least 6% less than the level of those emissions in 2007,<br>(ii) by 2016 and for each subsequent calendar year to at least 18% less than the level of those emissions in 2007,<br>(iii) by 2020 and for each subsequent calendar year to at least 33% less than the level of those emissions in 2007,<br>(iv) by 2050 and for each subsequent calendar year to at least 80% less than the level of those emissions in 2007, and<br>(v) by such other amounts as determined under the *Climate Change Accountability Act*; | Project does not directly affect GHG emissions but increases available transmission capacity necessary to accommodate incremental load from switching from higher GHG sources of energy to electricity |
| (h) | to encourage the switching from one kind of energy source or use to another that decreases greenhouse gas emissions in British Columbia; | Project increases Kelowna area capacity necessary to accommodate incremental load from switching from higher GHG sources of energy to electricity |
| (i) | to encourage communities to reduce greenhouse gas emissions and use energy efficiently; | Project does not directly affect communities' energy use or GHG emissions |
| (j) | to reduce waste by encouraging the use of waste heat, biogas and biomass; | Project does not affect the generation of electricity |

| Item | Objective | Comments |
|---|---|---|
| (k) | to encourage economic development and the creation and retention of jobs; | Project will benefit the local economy during the construction phase and ensure adequate transmission capacity to support future economic growth. |
| (l) | to foster the development of first nation and rural communities through the use and development of clean or renewable resources; | Project does not affect the generation of electricity |
| (m) | to maximize the value, including the incremental value of the resources being clean or renewable resources, of British Columbia's generation and transmission assets for the benefit of British Columbia | Project increases available transmission capacity for the benefit of FBC's customers |
| (n) | to be a net exporter of electricity from clean or renewable resources with the intention of benefiting all British Columbians and reducing greenhouse gas emissions in regions in which British Columbia trades electricity while protecting the interests of persons who receive or may receive service in British Columbia | Project does not affect the generation or export of electricity |
| (o) | to achieve British Columbia's energy objectives without the use of nuclear power; | Project does not affect the generation of electricity |

## 8.3 FBC's 2016 Long Term Electric Resource Plan

FBC's last Long Term Electric Resource Plan (2016 LTERP) was filed pursuant to section 44.1 of the UCA on November 30, 2016. By Order G-117-18, the BCUC found the 2016 LTERP, for the period through 2024, to be in the public interest and accepted it. The KBTA Project, then referred to as the Kelowna Bulk Transformer Capacity Addition project, was identified in Section 6.3 of the 2016 LTERP, as a required system reinforcement within the 2019-2020 timeframe. The 2016 LTERP explained that its system reinforcement projects were identified on the basis of load forecasting, transmission planning criteria and power flow and other transmission planning studies, and notes also that project timing is reassessed frequently based on updated load forecasts, consequently the timing of projects may be either advanced or delayed.

## 8.4 Sections 6 and 19 of the Clean Energy Act

Sections 6 and 19 of the CEA concern, respectively, electricity self-sufficiency and clean or renewable resources. Sections 6 and 19 apply mainly to BC Hydro, with the following relevance to FBC.

> 6(4) A public utility, in planning in accordance with section 44.1 of the *Utilities Commission Act* for

(a) the construction or extension of generation facilities, and

(b) energy purchases,

must consider British Columbia's energy objective to achieve electricity self-sufficiency.

19(1) To facilitate the achievement of British Columbia's energy objective set out in section 2 (c),

a person to whom this subsection applies

(a) must pursue actions to meet the prescribed targets in relation to clean or renewable resources, and

(b) must use the prescribed guidelines in planning for

(i) the construction or extension of generation facilities, and

(ii) energy purchases.

(2) Subsection (1) applies to

(a) the authority, and

(b) a prescribed public utility, if any, and a public utility in a class of prescribed public utilities, if any.

The KBTA Project does not involve either the construction or extension of generation facilities, nor is FBC a prescribed public utility for the purpose of section 19 of the CEA. Accordingly, sections 6 and 19 of the CEA are not applicable to the KBTA Project.

# 9. CONCLUSION

The Company respectfully submits that the KBTA Project is necessary to maintain reliability of service for the Kelowna load area. Due to ongoing load growth in this area, FBC cannot continue to meet N-1 planning criteria under peak load conditions with existing equipment.

Based on the evaluation of the three feasible alternatives, the Company rejected Alternative C, installation of a new transformer at DGB, on the basis of both technical and financial criteria. Of the two alternatives for LEE, Alternative A (ring bus configuration) provides the best technical solution. The redundancy of the power flows on the ring bus is substantially more reliable than the split bus configuration (Alternative B). This redundancy also simplifies outage planning and reduces time required for network reconfiguration. Alternative A will also allow for future terminal station expansion by adding up to two additional nodes for the connection of transmission lines and/or a distribution transformer. In summary, Alternative A meets the Company's transmission planning criteria by installing a third transformer at LEE, with a 138 kV ring bus configuration, and is the best option in terms of reliability, operability, and potential for expansion.

The Company requests that the BCUC approve the Project as set out in the Application. If the Application is approved, FBC plans to initiate the detailed design, procurement, and construction for the Project in the first quarter of 2021. The project is planned to be completed over three years, with final commissioning/handover for the substation work scheduled to be completed in the fourth quarter of 2022 and project close-out in the second quarter of 2023.

# Appendix A

# ENGINEERING DRAWINGS

**FILED CONFIDENTIALLY**

## Appendix A-1

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## GENERAL ARRANGEMENT
## CURRENT CONFIGURATION WITH DEMOLITION SCOPE

**FILED CONFIDENTIALLY**

## Appendix A-2

## GENERAL ARRANGEMENT
## PROPOSED CONFIGURATION

**FILED CONFIDENTIALLY**

## Appendix A-3

## OPERATIONAL SINGLE LINE DIAGRAM
## PROPOSED CONFIGURATION

**FILED CONFIDENTIALLY**

# Appendix B

# COST ESTIMATES

**FILED CONFIDENTIALLY**

## Appendix B-1

## COST SUMMARY ALTERNATIVE A

**FILED CONFIDENTIALLY**

## Appendix B-2

## STATION COST ESTIMATE ALTERNATIVE A

**FILED CONFIDENTIALLY**

**Appendix B-3**

## LINES COST ESTIMATE ALTERNATIVE A

**FILED CONFIDENTIALLY**

## Appendix B-4

## COST SUMMARY ALTERNATIVE B

**FILED CONFIDENTIALLY**

**Appendix B-5**

## COST SUMMARY ALTERNATIVE C

**FILED CONFIDENTIALLY**

## Appendix C

## FINANCIAL SCHEDULES

**FILED CONFIDENTIALLY**

# Appendix C-1

## FINANCIAL SCHEDULES
## ALTERNATIVE A

**FILED CONFIDENTIALLY**

# Appendix C-2

## FINANCIAL SCHEDULES
## ALTERNATIVE B

**FILED CONFIDENTIALLY**

## Appendix C-3

## FINANCIAL SCHEDULES
## ALTERNATIVE C

**FILED CONFIDENTIALLY**

# Appendix D

# CONSULTATION MATERIALS

# Appendix D-1

# CITY OF KELOWNA NOTIFICATION

**From:** Martens, Shelley
**Sent:** Monday, March 16, 2020 1:34 PM
**To:** rsmith@kelowna.ca
**Subject:** FortisBC Lee Substation Upgrade Project

Hi Ryan,

Thanks for giving me a call back last week. Sorry for the delay in getting this information over to you.

As discussed, FortisBC is proposing a potential Transformer Upgrade Project at the Lee Terminal Substation in the Tower Ranch area. Due to significant growth in the Okanagan region, the addition of a new power transformer will ensure that we can continue to provide reliable power supply to our customers, now and into the future.

The project will include the installation of the new transformer, re-routing some power line approaches to the substation, upgrading site lighting, removing the existing white storage facility and improving the aesthetic appearance around the substation site. The majority of the work will be done inside the substation property. As part of the project, we are also completing both a noise study and visual rendering to help customers better understand our proposed project.

FortisBC will be submitting an application for project approval to the British Columbia Utilities Commission (BCUC) in a few weeks and if the application is approved, we expect the construction work will take place in 2021/2022.

By investing in electrical system upgrades and other improvements to increase system reliability, service and safety, FortisBC can ensure we continue to meet the needs of our more than 160,000 electricity customers. This substation is an integral part of our electrical system that serves the greater Okanagan area.

We will be engaging with area residents and businesses to identify any concerns and to answer questions they might have. We will be providing a link to a project webpage for residents to find up to date information as well a short survey and a project specific email address where they can provide feedback.

An Open House/ Information Session had been planned for mid-April but in light of current events with COVID-19, we will be adjusting our strategy and offering a Telephone Town Hall instead. We hope to be able to host the Info Session at a later date, if needed, but will wait to see how things develop in the coming weeks.

If there is any additional information you need, if you would like to set up a meeting to discuss further, or should a Council presentation be needed, please let me know.

Thanks so much for your time and assistance. Have a great day!

*Shelley Martens*
Community & Indigenous Relations Manager
Shuswap-Nicola-Okanagan-Similkameen
Phone: 250.868.4525
Cell: 250.718.7041

*FortisBC acknowledges and respects Indigenous Peoples in Canada, on whose ancestral territory we all live and work.*

Shelley Martens
Community & Indigenous Relations

FortisBC Inc
1975 Springfield Road
Kelowna, BC V1Y 7V7
www fortisbc com

March 31, 2020

City of Kelowna
1435 Water Street
Kelowna, BC V1Y 1J4

Dear Ryan,

Following up to my email dated March 16, 2020, I'd like to provide additional information to City of Kelowna regarding the potential Transformer Upgrade Project being proposed at Lee Terminal Substation near Tower Ranch.

As mentioned previously, the project includes installing a new transformer, re-routing some power line approaches, upgrading site lighting, removing the existing white storage facility and improving the aesthetic appearance around the site. The majority of work will be done inside the substation property.

To prepare for the project, a noise study was completed and visual renderings created to help residents better understand our proposed project, which are attached for your information. FortisBC will be implementing all recommendations from the noise study.

Due to recent events with COVID 19 and orders from provincial government to reduce public meetings, our plans for an Open House have changed. Our Telephone Conference Call will be held on April 22nd from 5pm to 8pm and you are welcome to call if you're interested in participating. If so, let me know and I can provide the call in details.

We have also created at project webpage that can be found at www.fortisbc.com/kelownasubstation where customers can find information on the project along with a short survey to provide their feedback.

The CPCN application to the British Columbia Utilities Commission (BCUC) is still on track to be submitted in late April 2020, and if approved, construction work will take place in 2021/2022.

By investing in electrical system upgrades and other improvements to increase system reliability, service and safety, FortisBC can ensure we continue to meet the needs of our close to 179,000 electricity customers. This substation is an integral part of our electrical system that serves the greater Okanagan area.

If you have any questions or if you would like to be kept updated on the project, please don't hesitate to contact me.

Sincerely,

Shelley Martens
Community & Indigenous Relations Manager

Visual Renderings of proposed project

March 26, 2020

FortisBC
1975 Springfield Rd, 100
Kelowna, BC
V1Y 7V7

**Noise Impact Assessment Summary Report**
**FortisBC Lee Substation Kelowna Proposed Expansion**

FortisBC (Fortis) retained Patching Associates Acoustical Engineering Ltd. (PAAE) to conduct a Noise Impact Assessment (NIA) for the proposed expansion of the Lee substation facility in Kelowna, BC. This noise impact study was conducted to support a filing within the BC Utilities Commission and as the substation is within the city limits, falls within the City of Kelowna Bylaw 6647 *Noise and Disturbance Control*. As no specific noise guidelines were noted within the BC Utilities Commission, the requirements of the Alberta Utilities Commission (AUC) Rule 012: Noise Control (the Rule) were used as a guideline for analysis and to establish a target noise level for the Lee Substation facility design..

The Lee substation is an existing facility that is located at the corner of McCurdy Road E and Tower Ranch Drive in Kelowna BC. The existing facility is pictured below in Figure 1 and currently has two (2) transformers. FortisBC is proposing to add one (1) additional transformer for a total of three (3). The purpose of the noise impact assessment conducted was to determine the impact of the proposed expansion to residences within the study area.

## Study Methodology

The noise impact assessment consisted of a field visit by PAAE staff in March 2020. Near-field diagnostic measurements were taken with a Sound Intensity Level (SIL) meter to quantify the subject facility Sound Power Level (PWL) in detail.

The near-field measurements were then calibrated with Sound Pressure Level (SPL) measurements taken around the site. Figure 1 below shows the existing transformers already on site, tagged T3 (north transformer) and T4 (south transformer). Measurements were taken both with the cooling fans off and with both banks of the cooling fans turned on.

Figure 1: Transformer T3 (left) and T4 (right)

Four operating scenarios were modelled in the assessment:

1. Existing T3 and T4 transformers with fans off
2. Existing T3 and T4 transformers with fans on (both banks)
3. Existing T3 and T4 transformers with proposed T2 transformer with fans off
4. Existing T3 and T4 transformers with proposed T2 transformer with fans on (both banks)

Four residences were modelled in the assessment, three permanent residences closest to the Lee substation labeled R01 through R03 and one seasonal residence labelled R04. The location of the residences in relation to the substation are pictured below in Figure 2.

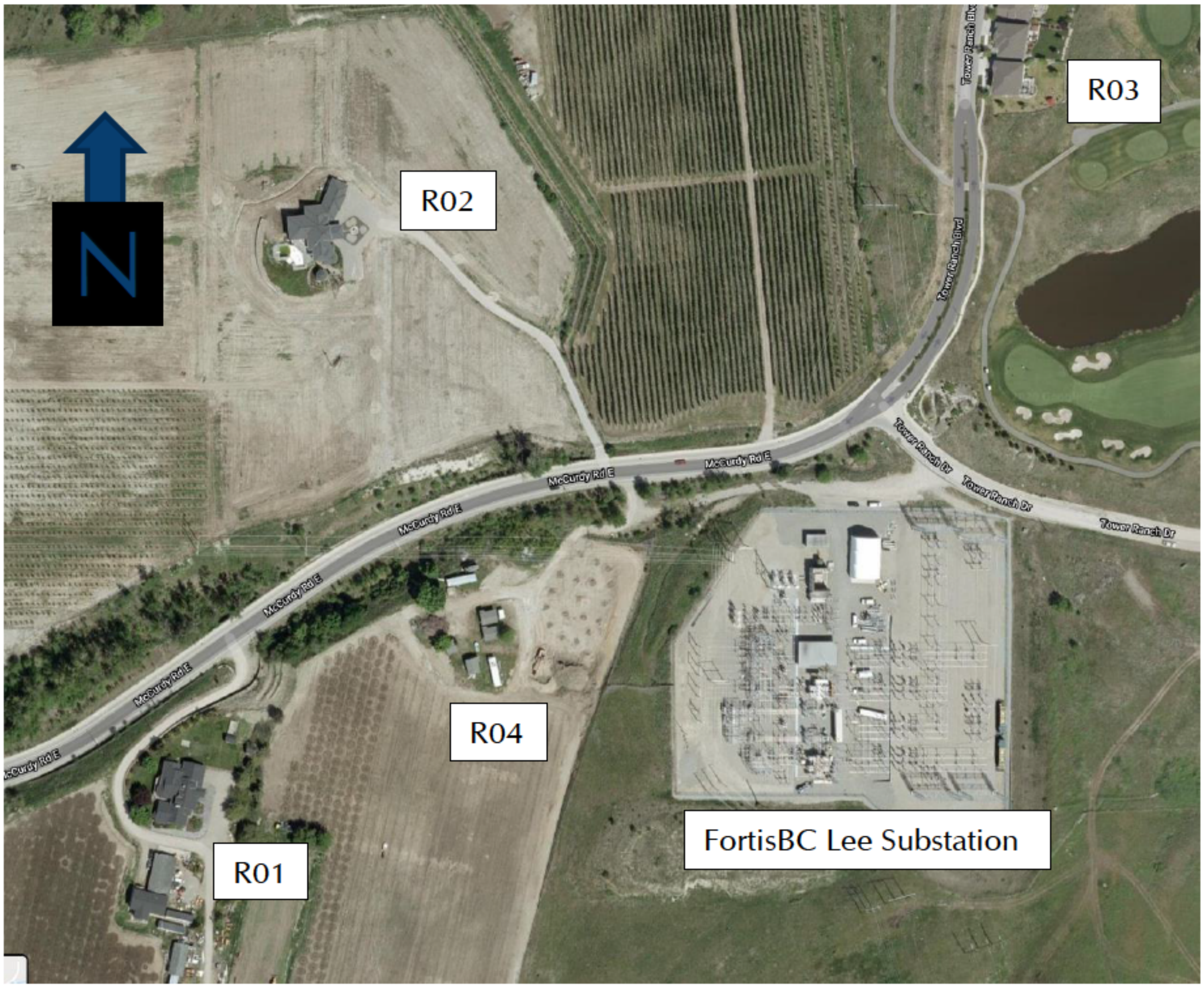



Figure 2: Study Area

## Overall Sound Pressure Levels

Tables 1 and 2 summarize the overall Sound Pressure Levels (SPL) predictions from the model for each receiver in the study area. The Facility SPL is the overall SPL from all the facilities in the study area. The Cumulative Sound Pressure Levels (SPL) includes the contribution of the Facility Sound Pressure Levels (SPL) and the Ambient Sound Levels (ASL).

**Table 1: Overall Sound Pressure Levels - Existing**

| Receiver | Target Sound Level (dBA) | ASL (dBA) | Existing w/o Fans – Scenario One | | | Existing w/ Fans – Scenario Two | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Facility SPL (dBA) | Cumulative SPL (dBA) | Meet the Target | Facility SPL (dBA) | Facility SPL Increase (dBA) | Cumulative SPL (dBA) | Meet the Target |
| R01 | 53.0 | 48.0 | 21.5 | **48.0** | Yes | 24.0 | 2.5 | **48.0** | Yes |
| R02 | 53.0 | 48.0 | 25.7 | **48.0** | Yes | 27.6 | 1.9 | **48.0** | Yes |
| R03 | 53.0 | 48.0 | 28.7 | **48.1** | Yes | 31.1 | 2.4 | **48.1** | Yes |
| R04 | 53.0 | 48.0 | 28.0 | **48.0** | Yes | 33.2 | 5.2 | **48.1** | Yes |

Table 2: Overall Sound Pressure Levels – Existing and Proposed

| Receiver | Target Sound Level (dBA) | ASL (dBA) | Proposed w/o Fans | | | Proposed w/ Fans | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Facility SPL (dBA) | Cumulative SPL (dBA) | Meet the Target | Facility SPL (dBA) | Facility SPL Increase (dBA) | Cumulative SPL (dBA) | Meet the Target |
| R01 | 53.0 | 48.0 | 34.3 | **48.2** | Yes | 35.8 | 1.5 | **48.3** | Yes |
| R02 | 53.0 | 48.0 | 38.2 | **48.4** | Yes | 39.4 | 1.2 | **48.6** | Yes |
| R03 | 53.0 | 48.0 | 43.4 | **49.3** | Yes | 44.5 | 1.1 | **49.6** | Yes |
| R04 | 53.0 | 48.0 | 40.3 | **48.7** | Yes | 43.9 | 3.6 | **49.4** | Yes |

The above results represent worst case sound emissions with fans on, which are higher than the case without fans and the frequency of fan operation is expected to decrease once the load is distributed to the new transformer.

The results indicate that the Cumulative Sound Pressure Level (SPL) is expected to meet the target sound level at all receivers in the study area for all four scenarios analyzed. Sound pressure levels are expected to increase at area residences under worse case operation and are expected to be within the target sound level. See Appendix A for a table of sound levels of familiar noise sources.

Additional study is required to determine the sound levels under typical case conditions and noise mitigation could be considered and applied for the typical case.

## Findings and Recommendations

- Sound levels expected from the expanded substation without the cooling fans running are expected to be below the Ambient Sound Level and well below the target sound level used for this assessment.
- Sound levels expected from the expanded substation under worse case conditions (both banks of fans running on T3 and T4 all night) are expected to be within the target sound level used for this assessment.
- The sound levels under worst case conditions are expected to perceptibly increase in the area, PAAE recommends conducting additional study to confirm the typical operating condition.
- PAAE recommends conducting a field assessment on the expanded substation as part of commissioning process to establish actual noise emissions. If additional noise mitigation measures are required, they can be evaluated, optimized and installed at the conclusion of that study.

# Appendix A: Sound Levels of Familiar Noise Sources

| Source[1] | Sound level (dBA) |
|---|---|
| Bedroom of a country home | 30 |
| Soft whisper at 1.5 m | 30 |
| Quiet office or living room | 40 |
| Moderate rainfall | 50 |
| Inside average urban home | 50 |
| Quiet street | 50 |
| Normal conversation at 1 m | 60 |
| Noisy office | 60 |
| Noisy restaurant | 70 |
| Highway traffic at 15 m | 75 |
| Loud singing at 1 m | 75 |
| Tractor at 15 m | 78-95 |
| Busy traffic intersection | 80 |
| Electric typewriter | 80 |
| Bus or heavy truck at 15 m | 88-94 |
| Jackhammer | 88-98 |
| Loud shout | 90 |
| Freight train at 15 m | 95 |
| Modified motorcycle | 95 |
| Jet taking off at 600 m | 100 |
| Amplified rock music | 110 |
| Jet taking off at 60 m | 120 |
| Air-raid siren | 130 |

Sound Level Generated by Common Appliances

| Source[2] | Sound level at 1 meter (dBA) |
|---|---|
| Freezer | 38-45 |
| Refrigerator | 34-53 |
| Electric heater | 47 |
| Hair clipper | 50 |
| Electric toothbrush | 48-57 |
| Humidifier | 41-54 |
| Clothes dryer | 51-65 |
| Air conditioner | 50-67 |
| Electric shaver | 47-68 |
| Water faucet | 62 |
| Hair dryer | 58-64 |
| Clothes washer | 48-73 |
| Dishwasher | 59-71 |
| Electric can opener | 60-70 |
| Food mixer | 59-75 |
| Electric knife | 65-75 |
| Electric knife sharpener | 72 |
| Sewing machine | 70-74 |
| Vacuum cleaner | 65-80 |
| Food blender | 65-85 |
| Coffee mill | 75-79 |
| Food waste disposer | 69-90 |
| Edger and trimmer | 81 |
| Home shop tools | 64-95 |
| Hedge clippers | 85 |
| Electric lawn mower | 80-90 |

[1] Cottrell, Tom, 1980, Noise in Alberta, Table 1, p.8, ECA80 – 16/1B4 (Edmonton: Environment Council of Alberta).

[2] Reif, Z. F., and Vermeulen, P. J., 1979, "Noise from domestic appliances, construction, and industry," Table 1, p.166, in Jones, H. W., ed., Noise in the Human Environment, vol. 2, ECA79-SP/1 (Edmonton: Environment Council of Alberta).

Taken from British Columbia Noise Control Best Practices Guideline ver 2.1, December 2018

## Appendix D-2

# KBTA PROJECT SURVEY RESULTS

# KBTA Survey Results (as of April 22, 2020)

- *Note 1: Personal information and detail of addresses omitted*
- *Note 2: results #1, #5 & #6 were tests by FBC Information Systems technical staff*

## Question 1: do you have any initial feedback or comments about the project you'd like to share

| Entry # | Date Created | Address - Street Address | Do you have any initial feedback or comments about the project you'd like to share? |
|---|---|---|---|
| 8 | 2020-04-12 09:07:12 | Tower Ranch Dr. | I WOULD LIKE TO UNDERSTAND WHAT YOU WILL BE DOING FOR BEAUTIFYING THE AREA FOR THE RESIDENCES LOOKING STRAIGHT DOWN ON YOUR STATION. WE HAVE A BEAUTIFUL VIEW LOOKING DOWN ON THE CITY & LAKE, AND YOU NEED TO COME TO THE PARTY WITH SOME VERY LARGE TREES AND A BURM, SO YOUR STATION LOOKS BETTER FROM UP ON THE NE SIDES OF YOUR STATION. THE TENT ISN'T EVEN THE ISSUE. IF YOU INSTALL A BURM, AND LARGE TREES, THEY WILL IMPROVE THE VEIW AND KEEP THE NOISE TO EXCEPTABLE LEVELS. |
| 7 | 2020-04-06 09:34:50 | Tower Ranch Dr. | Definitely would like trees planted along the south side to hide the station from Solstice homes. Trees to grow above the top rail fence but not so high as to obscure view of the lower homes in the future. |
| 4 | 2020-04-03 07:14:35 | Split Rail Place | As a have lived in the Tower Ranch subdivision for 10 years now, I wanted to know if there may be any plans to plant any trees along the East side of the Power station to eventually "block" the sight line of the station?<br>I realize the importance of upgrades to support a growing population to service, but the visual impact is what most concern me. |
| 3 | 2020-04-01 11:57:42 | Split Rail Place | I attended a briefing by Fortis about 8 years ago on the project to add a transformer. At the time Fortis agreed to a plan to enhance the visual appearance of the site and this was established as a condition of going forward. Can you please make this plan available, or send me a copy. |
| 2 | 2020-03-31 16:32:35 | Tower Ranch Dr. | |

## Question 2: for this project, what are you most concerned about?

- Construction impacts
- Traffic disruptions
- Environmental
- Visual
- Other

| Entry # | Date Created | Address - Street Address | For this project, what are you most concerned about? |
|---|---|---|---|
| 8 | 2020-04-12 09:07:12 | Tower Ranch Dr. | Visual impacts/station aesthetics |
| 7 | 2020-04-06 09:34:50 | Tower Ranch Dr. | Traffic disruptions |
| 4 | 2020-04-03 07:14:35 | Split Rail Place | Visual impacts/station aesthetics |
| 3 | 2020-04-01 11:57:42 | Split Rail Place | Visual impacts/station aesthetics |
| 2 | 2020-03-31 16:32:35 | Tower Ranch Dr. | Visual impacts/station aesthetics |

## Question 3: For this project, what is most important to you?

- Removal of the storage tent
- Visual
- Service
- Site safety
- Other

| Entry # | Date Created | Address - Street Address | For this project, what is most important to you? |
|---|---|---|---|
| 8 | 2020-04-12 09:07:12 | Tower Ranch Dr. | Visual impacts/ station aesthetics |
| 7 | 2020-04-06 09:34:50 | Tower Ranch Dr. | Visual impacts/ station aesthetics |
| 4 | 2020-04-03 07:14:35 | Split Rail Place | Visual impacts/ station aesthetics |
| 3 | 2020-04-01 11:57:42 | Split Rail Place | Visual impacts/ station aesthetics |
| 2 | 2020-03-31 16:32:35 | Tower Ranch Dr. | Removal of the storage tent |

## Question 4: How would you like to receive communications from us about this project?

- Information session/ open house
- Telephone town hall (conference call)
- Fortisbc.com project webpage
- Hand delivered updates
- Project email updates

| Entry # | Date Created | Address - Street Address | How would you like to receive communication from us during this project? |
|---|---|---|---|
| 8 | 2020-04-12 09:07:12 | Tower Ranch Dr. | Information session/ open house |
| 7 | 2020-04-06 09:34:50 | Tower Ranch Dr. | Project email updates |
| 4 | 2020-04-03 07:14:35 | Split Rail Place | Project email updates |
| 3 | 2020-04-01 11:57:42 | Split Rail Place | Project email updates |
| 2 | 2020-03-31 16:32:35 | Tower Ranch Dr. | Fortisbc.com project webpage |

## Question 5: If we host an info session, would you attend?

| Entry # | Date Created | Address - Street Address | If we host an information session, will you attend? |
|---|---|---|---|
| 8 | 2020-04-12 09:07:12 | Tower Ranch Dr. | Yes |
| 7 | 2020-04-06 09:34:50 | Tower Ranch Dr. | No |
| 4 | 2020-04-03 07:14:35 | Split Rail Place | Yes |
| 3 | 2020-04-01 11:57:42 | Split Rail Place | Yes |
| 2 | 2020-03-31 16:32:35 | Tower Ranch Dr. | No |

## Question 6: Are you interested in participating in our town hall?

| Entry # | Date Created | Address - Street Address | Are you interested in participating in our telephone town hall (conference call) on April 22, 2020? |
|---|---|---|---|
| 8 | 2020-04-12 09:07:12 | Tower Ranch Dr. | Yes |
| 7 | 2020-04-06 09:34:50 | Tower Ranch Dr. | Yes |
| 4 | 2020-04-03 07:14:35 | Split Rail Place | Yes |
| 3 | 2020-04-01 11:57:42 | Split Rail Place | Yes |
| 2 | 2020-03-31 16:32:35 | Tower Ranch Dr. | No |

## Question 7: Are you interested in participating in a future town Hall?

| Entry # | Date Created | Address - Street Address | Are you interested in participating in a telephone town hall (conference call) on a different date? |
|---|---|---|---|
| 8 | 2020-04-12 09:07:12 | Tower Ranch Dr. | Yes |
| 7 | 2020-04-06 09:34:50 | Tower Ranch Dr. | No |
| 4 | 2020-04-03 07:14:35 | Split Rail Place | No |
| 3 | 2020-04-01 11:57:42 | Split Rail Place | Yes |
| 2 | 2020-03-31 16:32:35 | Tower Ranch Dr. | No |

| Entry # | Date Created | Address - Street Address | Compliance with Canada's Anti-Spam Legislation (CASL), we require your consent to communicate with you by email. |
|---|---|---|---|
| 8 | 2020-04-12 09:07:12 | Tower Ranch Dr. | Checked |
| 7 | 2020-04-06 09:34:50 | Tower Ranch Dr. | Checked |
| 4 | 2020-04-03 07:14:35 | Split Rail Place | Checked |
| 3 | 2020-04-01 11:57:42 | Split Rail Place | Checked |
| 2 | 2020-03-31 16:32:35 | Tower Ranch Dr. | Checked |

# Appendix D-3

# LOCAL CUSTOMERS NOTIFICATION

Shelley Martens
Community & Indigenous Relations

FortisBC Inc.
1975 Springfield Road
Kelowna, BC V1Y 7V7
www.fortisbc.com

March 30, 2020

Tower Ranch Resident

FortisBC would like to notify you of a potential Transformer Upgrade Project that we are proposing at the Lee Terminal Substation in your neighbourhood. Due to significant growth in the Okanagan region, the addition of a new power transformer will ensure that we can continue to provide reliable power supply to our customers, now and into the future.

The project includes the installation of the new transformer, re-routing some power line approaches to the substation, upgrading site lighting, removing the existing white storage facility and improving the aesthetic appearance around the substation site. The majority of the work will be done inside the substation property. As part of this letter, we have included both a noise study and visual rendering to help you better understand our proposed project: note that FortisBC will implement all recommendations from the noise study.

FortisBC will be submitting an application for project approval to the British Columbia Utilities Commission (BCUC) in April 2020. If the application is approved, we expect the construction work will take place in 2021/2022.

It is important to us that we work with customers to identify any concerns and to answer questions. We encourage you to visit www.fortisbc.com/kelownasubstation where you will find information on the project along with a short survey where you can provide your feedback. Your input would be greatly appreciated!

FortisBC planned to host an Open House, but due to the recent events with COVID 19 and orders from provincial government to reduce public meetings, we will be hosting a telephone conference call instead. The call is scheduled for April 22nd and we welcome residents to attend and provide feedback by calling 1 (866) 703-3295 and entering Conference ID: 490205 anytime between 5 pm and 8 pm. There is no charge for this call.

We hope to host an in-person Open House at a later date but plans for this will be based on your feedback as well as the evolving situation with COVID-19.

By investing in electrical system upgrades and other improvements to increase system reliability, service and safety, FortisBC can ensure we continue to meet the needs of our close to 179,000 electricity customers. This substation is an integral part of our electrical system that serves the greater Okanagan area.

In the meantime, if you have questions or if you would like to be kept updated on the project, email us at kelowna.substation@fortisbc.com.

Sincerely,

Shelley Martens
Community & Indigenous Relations Manager

Visual Renderings of proposed project

March 26, 2020

FortisBC
1975 Springfield Rd, 100
Kelowna, BC
V1Y 7V7

## Noise Impact Assessment Summary Report
## FortisBC Lee Substation Kelowna Proposed Expansion

FortisBC (Fortis) retained Patching Associates Acoustical Engineering Ltd. (PAAE) to conduct a Noise Impact Assessment (NIA) for the proposed expansion of the Lee substation facility in Kelowna, BC. This noise impact study was conducted to support a filing within the BC Utilities Commission and as the substation is within the city limits, falls within the City of Kelowna Bylaw 6647 *Noise and Disturbance Control*. As no specific noise guidelines were noted within the BC Utilities Commission, the requirements of the Alberta Utilities Commission (AUC) Rule 012: Noise Control (the Rule) were used as a guideline for analysis and to establish a target noise level for the Lee Substation facility design..

The Lee substation is an existing facility that is located at the corner of McCurdy Road E and Tower Ranch Drive in Kelowna BC. The existing facility is pictured below in Figure 1 and currently has two (2) transformers. FortisBC is proposing to add one (1) additional transformer for a total of three (3). The purpose of the noise impact assessment conducted was to determine the impact of the proposed expansion to residences within the study area.

## Study Methodology

The noise impact assessment consisted of a field visit by PAAE staff in March 2020. Near-field diagnostic measurements were taken with a Sound Intensity Level (SIL) meter to quantify the subject facility Sound Power Level (PWL) in detail.

The near-field measurements were then calibrated with Sound Pressure Level (SPL) measurements taken around the site. Figure 1 below shows the existing transformers already on site, tagged T3 (north transformer) and T4 (south transformer). Measurements were taken both with the cooling fans off and with both banks of the cooling fans turned on.

Figure 1: Transformer T3 (left) and T4 (right)

Four operating scenarios were modelled in the assessment:

1. Existing T3 and T4 transformers with fans off
2. Existing T3 and T4 transformers with fans on (both banks)
3. Existing T3 and T4 transformers with proposed T2 transformer with fans off
4. Existing T3 and T4 transformers with proposed T2 transformer with fans on (both banks)

Four residences were modelled in the assessment, three permanent residences closest to the Lee substation labeled R01 through R03 and one seasonal residence labelled R04. The location of the residences in relation to the substation are pictured below in Figure 2.

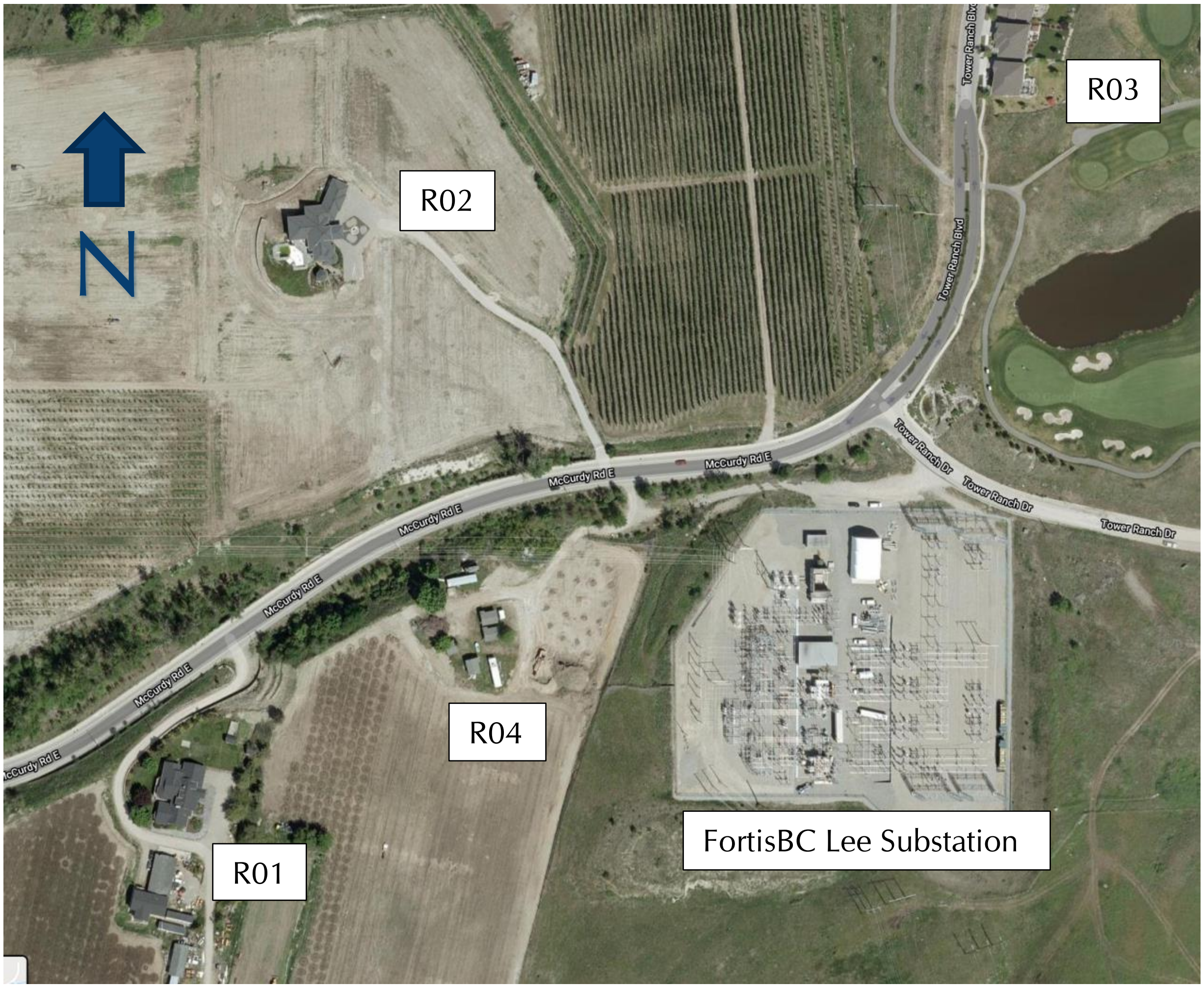



Figure 2: Study Area

## Overall Sound Pressure Levels

Tables 1 and 2 summarize the overall Sound Pressure Levels (SPL) predictions from the model for each receiver in the study area. The Facility SPL is the overall SPL from all the facilities in the study area. The Cumulative Sound Pressure Levels (SPL) includes the contribution of the Facility Sound Pressure Levels (SPL) and the Ambient Sound Levels (ASL).

Table 1: Overall Sound Pressure Levels - Existing

| Receiver | Target Sound Level (dBA) | ASL (dBA) | Existing w/o Fans – Scenario One | | | Existing w/ Fans – Scenario Two | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Facility SPL (dBA) | Cumulative SPL (dBA) | Meet the Target | Facility SPL (dBA) | Facility SPL Increase (dBA) | Cumulative SPL (dBA) | Meet the Target |
| R01 | 53.0 | 48.0 | 21.5 | **48.0** | Yes | 24.0 | 2.5 | **48.0** | Yes |
| R02 | 53.0 | 48.0 | 25.7 | **48.0** | Yes | 27.6 | 1.9 | **48.0** | Yes |
| R03 | 53.0 | 48.0 | 28.7 | **48.1** | Yes | 31.1 | 2.4 | **48.1** | Yes |
| R04 | 53.0 | 48.0 | 28.0 | **48.0** | Yes | 33.2 | 5.2 | **48.1** | Yes |

Table 2: Overall Sound Pressure Levels – Existing and Proposed

| Receiver | Target Sound Level (dBA) | ASL (dBA) | Proposed w/o Fans | | | Proposed w/ Fans | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Facility SPL (dBA) | Cumulative SPL (dBA) | Meet the Target | Facility SPL (dBA) | Facility SPL Increase (dBA) | Cumulative SPL (dBA) | Meet the Target |
| R01 | 53.0 | 48.0 | 34.3 | **48.2** | Yes | 35.8 | 1.5 | **48.3** | Yes |
| R02 | 53.0 | 48.0 | 38.2 | **48.4** | Yes | 39.4 | 1.2 | **48.6** | Yes |
| R03 | 53.0 | 48.0 | 43.4 | **49.3** | Yes | 44.5 | 1.1 | **49.6** | Yes |
| R04 | 53.0 | 48.0 | 40.3 | **48.7** | Yes | 43.9 | 3.6 | **49.4** | Yes |

The above results represent worst case sound emissions with fans on, which are higher than the case without fans and the frequency of fan operation is expected to decrease once the load is distributed to the new transformer.

The results indicate that the Cumulative Sound Pressure Level (SPL) is expected to meet the target sound level at all receivers in the study area for all four scenarios analyzed. Sound pressure levels are expected to increase at area residences under worse case operation and are expected to be within the target sound level. See Appendix A for a table of sound levels of familiar noise sources.

Additional study is required to determine the sound levels under typical case conditions and noise mitigation could be considered and applied for the typical case.

## Findings and Recommendations

- Sound levels expected from the expanded substation without the cooling fans running are expected to be below the Ambient Sound Level and well below the target sound level used for this assessment.
- Sound levels expected from the expanded substation under worse case conditions (both banks of fans running on T3 and T4 all night) are expected to be within the target sound level used for this assessment.
- The sound levels under worst case conditions are expected to perceptibly increase in the area, PAAE recommends conducting additional study to confirm the typical operating condition.
- PAAE recommends conducting a field assessment on the expanded substation as part of commissioning process to establish actual noise emissions. If additional noise mitigation measures are required, they can be evaluated, optimized and installed at the conclusion of that study.

# Appendix A: Sound Levels of Familiar Noise Sources

| Source[1] | Sound level (dBA) |
|---|---|
| Bedroom of a country home | 30 |
| Soft whisper at 1.5 m | 30 |
| Quiet office or living room | 40 |
| Moderate rainfall | 50 |
| Inside average urban home | 50 |
| Quiet street | 50 |
| Normal conversation at 1 m | 60 |
| Noisy office | 60 |
| Noisy restaurant | 70 |
| Highway traffic at 15 m | 75 |
| Loud singing at 1 m | 75 |
| Tractor at 15 m | 78-95 |
| Busy traffic intersection | 80 |
| Electric typewriter | 80 |
| Bus or heavy truck at 15 m | 88-94 |
| Jackhammer | 88-98 |
| Loud shout | 90 |
| Freight train at 15 m | 95 |
| Modified motorcycle | 95 |
| Jet taking off at 600 m | 100 |
| Amplified rock music | 110 |
| Jet taking off at 60 m | 120 |
| Air-raid siren | 130 |

Sound Level Generated by Common Appliances

| Source[2] | Sound level at 1 meter (dBA) |
|---|---|
| Freezer | 38-45 |
| Refrigerator | 34-53 |
| Electric heater | 47 |
| Hair clipper | 50 |
| Electric toothbrush | 48-57 |
| Humidifier | 41-54 |
| Clothes dryer | 51-65 |
| Air conditioner | 50-67 |
| Electric shaver | 47-68 |
| Water faucet | 62 |
| Hair dryer | 58-64 |
| Clothes washer | 48-73 |
| Dishwasher | 59-71 |
| Electric can opener | 60-70 |
| Food mixer | 59-75 |
| Electric knife | 65-75 |
| Electric knife sharpener | 72 |
| Sewing machine | 70-74 |
| Vacuum cleaner | 65-80 |
| Food blender | 65-85 |
| Coffee mill | 75-79 |
| Food waste disposer | 69-90 |
| Edger and trimmer | 81 |
| Home shop tools | 64-95 |
| Hedge clippers | 85 |
| Electric lawn mower | 80-90 |

[1] Cottrell, Tom, 1980, Noise in Alberta, Table 1, p.8, ECA80 – 16/1B4 (Edmonton: Environment Council of Alberta).

[2] Reif, Z. F., and Vermeulen, P. J., 1979, "Noise from domestic appliances, construction, and industry," Table 1, p.166, in Jones, H. W., ed., Noise in the Human Environment, vol. 2, ECA79-SP/1 (Edmonton: Environment Council of Alberta).

Taken from British Columbia Noise Control Best Practices Guideline ver 2.1, December 2018

Shelley Martens
Community & Indigenous Relations

FortisBC Inc.
1975 Springfield Road
Kelowna, BC V1Y 7V7
www.fortisbc.com

March 30, 2020

*Landowner*
*Address*
*Kelowna, BC Postal Code*

FortisBC would like to notify you of a potential Transformer Upgrade Project that we are proposing at the Lee Terminal Substation in your neighbourhood. Due to significant growth in the Okanagan region, the addition of a new power transformer will ensure that we can continue to provide reliable power supply to our customers, now and into the future.

The project includes the installation of the new transformer, re-routing some power line approaches to the substation, upgrading site lighting, removing the existing white storage facility and improving the aesthetic appearance around the substation site. The majority of the work will be done inside the substation property. As part of this letter, we have included both a noise study and visual rendering to help you better understand our proposed project: note that FortisBC will implement all recommendations from the noise study.

FortisBC will be submitting an application for project approval to the British Columbia Utilities Commission (BCUC) in April 2020. If the application is approved, we expect the construction work will take place in 2021/2022.

It is important to us that we work with customers to identify any concerns and to answer questions. We encourage you to visit www.fortisbc.com/kelownasubstation where you will find information on the project along with a short survey where you can provide your feedback. Your input would be greatly appreciated!

FortisBC planned to host an Open House, but due to the recent events with COVID 19 and orders from provincial government to reduce public meetings, we will be hosting a telephone conference call instead. The call is scheduled for April 22nd and we welcome residents to attend and provide feedback by calling 1 (866) 703-3295 and entering Conference ID: 490205 anytime between 5 pm and 8 pm. There is no charge for this call. We hope to host an in-person Open House at a later date but plans for this will be based on your feedback as well as the evolving situation with COVID-19.

By investing in electrical system upgrades and other improvements to increase system reliability, service and safety, FortisBC can ensure we continue to meet the needs of our close to 179,000 electricity customers. This substation is an integral part of our electrical system that serves the greater Okanagan area.

In the meantime, if you have questions or if you would like to be kept updated on the project, email us at kelowna.substation@fortisbc.com.

Sincerely,

Shelley Martens
Community & Indigenous Relations Manager

Visual Renderings of proposed project

March 26, 2020

FortisBC
1975 Springfield Rd, 100
Kelowna, BC
V1Y 7V7

Noise Impact Assessment Summary Report
FortisBC Lee Substation Kelowna Proposed Expansion

FortisBC (Fortis) retained Patching Associates Acoustical Engineering Ltd. (PAAE) to conduct a Noise Impact Assessment (NIA) for the proposed expansion of the Lee substation facility in Kelowna, BC. This noise impact study was conducted to support a filing within the BC Utilities Commission and as the substation is within the city limits, falls within the City of Kelowna Bylaw 6647 *Noise and Disturbance Control*. As no specific noise guidelines were noted within the BC Utilities Commission, the requirements of the Alberta Utilities Commission (AUC) Rule 012: Noise Control (the Rule) were used as a guideline for analysis and to establish a target noise level for the Lee Substation facility design..

The Lee substation is an existing facility that is located at the corner of McCurdy Road E and Tower Ranch Drive in Kelowna BC. The existing facility is pictured below in Figure 1 and currently has two (2) transformers. FortisBC is proposing to add one (1) additional transformer for a total of three (3). The purpose of the noise impact assessment conducted was to determine the impact of the proposed expansion to residences within the study area.

## Study Methodology

The noise impact assessment consisted of a field visit by PAAE staff in March 2020. Near-field diagnostic measurements were taken with a Sound Intensity Level (SIL) meter to quantify the subject facility Sound Power Level (PWL) in detail.

The near-field measurements were then calibrated with Sound Pressure Level (SPL) measurements taken around the site. Figure 1 below shows the existing transformers already on site, tagged T3 (north transformer) and T4 (south transformer). Measurements were taken both with the cooling fans off and with both banks of the cooling fans turned on.

Figure 1: Transformer T3 (left) and T4 (right)

Four operating scenarios were modelled in the assessment:

1. Existing T3 and T4 transformers with fans off
2. Existing T3 and T4 transformers with fans on (both banks)
3. Existing T3 and T4 transformers with proposed T2 transformer with fans off
4. Existing T3 and T4 transformers with proposed T2 transformer with fans on (both banks)

Four residences were modelled in the assessment, three permanent residences closest to the Lee substation labeled R01 through R03 and one seasonal residence labelled R04. The location of the residences in relation to the substation are pictured below in Figure 2.

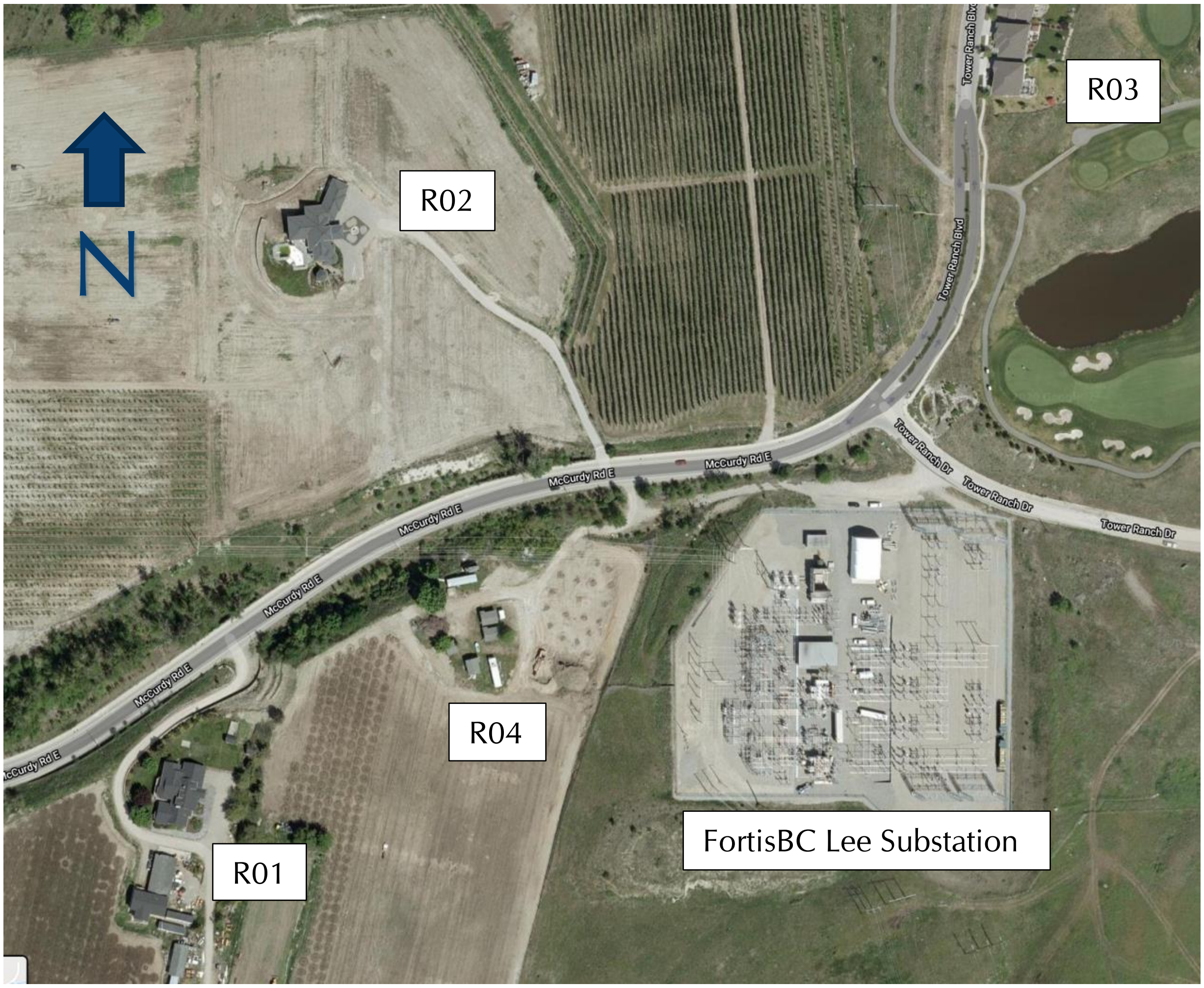



Figure 2: Study Area

## Overall Sound Pressure Levels

Tables 1 and 2 summarize the overall Sound Pressure Levels (SPL) predictions from the model for each receiver in the study area. The Facility SPL is the overall SPL from all the facilities in the study area. The Cumulative Sound Pressure Levels (SPL) includes the contribution of the Facility Sound Pressure Levels (SPL) and the Ambient Sound Levels (ASL).

Table 1: Overall Sound Pressure Levels - Existing

| Receiver | Target Sound Level (dBA) | ASL (dBA) | Existing w/o Fans – Scenario One | | | Existing w/ Fans – Scenario Two | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Facility SPL (dBA) | Cumulative SPL (dBA) | Meet the Target | Facility SPL (dBA) | Facility SPL Increase (dBA) | Cumulative SPL (dBA) | Meet the Target |
| R01 | 53.0 | 48.0 | 21.5 | **48.0** | Yes | 24.0 | 2.5 | **48.0** | Yes |
| R02 | 53.0 | 48.0 | 25.7 | **48.0** | Yes | 27.6 | 1.9 | **48.0** | Yes |
| R03 | 53.0 | 48.0 | 28.7 | **48.1** | Yes | 31.1 | 2.4 | **48.1** | Yes |
| R04 | 53.0 | 48.0 | 28.0 | **48.0** | Yes | 33.2 | 5.2 | **48.1** | Yes |

Table 2: Overall Sound Pressure Levels – Existing and Proposed

| Receiver | Target Sound Level (dBA) | ASL (dBA) | Proposed w/o Fans | | | Proposed w/ Fans | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Facility SPL (dBA) | Cumulative SPL (dBA) | Meet the Target | Facility SPL (dBA) | Facility SPL Increase (dBA) | Cumulative SPL (dBA) | Meet the Target |
| R01 | 53.0 | 48.0 | 34.3 | **48.2** | Yes | 35.8 | 1.5 | **48.3** | Yes |
| R02 | 53.0 | 48.0 | 38.2 | **48.4** | Yes | 39.4 | 1.2 | **48.6** | Yes |
| R03 | 53.0 | 48.0 | 43.4 | **49.3** | Yes | 44.5 | 1.1 | **49.6** | Yes |
| R04 | 53.0 | 48.0 | 40.3 | **48.7** | Yes | 43.9 | 3.6 | **49.4** | Yes |

The above results represent worst case sound emissions with fans on, which are higher than the case without fans and the frequency of fan operation is expected to decrease once the load is distributed to the new transformer.

The results indicate that the Cumulative Sound Pressure Level (SPL) is expected to meet the target sound level at all receivers in the study area for all four scenarios analyzed. Sound pressure levels are expected to increase at area residences under worse case operation and are expected to be within the target sound level. See Appendix A for a table of sound levels of familiar noise sources.

Additional study is required to determine the sound levels under typical case conditions and noise mitigation could be considered and applied for the typical case.

## Findings and Recommendations

- Sound levels expected from the expanded substation without the cooling fans running are expected to be below the Ambient Sound Level and well below the target sound level used for this assessment.
- Sound levels expected from the expanded substation under worse case conditions (both banks of fans running on T3 and T4 all night) are expected to be within the target sound level used for this assessment.
- The sound levels under worst case conditions are expected to perceptibly increase in the area, PAAE recommends conducting additional study to confirm the typical operating condition.
- PAAE recommends conducting a field assessment on the expanded substation as part of commissioning process to establish actual noise emissions. If additional noise mitigation measures are required, they can be evaluated, optimized and installed at the conclusion of that study.

# Appendix A: Sound Levels of Familiar Noise Sources

| Source[1] | Sound level (dBA) |
|---|---|
| Bedroom of a country home | 30 |
| Soft whisper at 1.5 m | 30 |
| Quiet office or living room | 40 |
| Moderate rainfall | 50 |
| Inside average urban home | 50 |
| Quiet street | 50 |
| Normal conversation at 1 m | 60 |
| Noisy office | 60 |
| Noisy restaurant | 70 |
| Highway traffic at 15 m | 75 |
| Loud singing at 1 m | 75 |
| Tractor at 15 m | 78-95 |
| Busy traffic intersection | 80 |
| Electric typewriter | 80 |
| Bus or heavy truck at 15 m | 88-94 |
| Jackhammer | 88-98 |
| Loud shout | 90 |
| Freight train at 15 m | 95 |
| Modified motorcycle | 95 |
| Jet taking off at 600 m | 100 |
| Amplified rock music | 110 |
| Jet taking off at 60 m | 120 |
| Air-raid siren | 130 |

Sound Level Generated by Common Appliances

| Source[2] | Sound level at 1 meter (dBA) |
|---|---|
| Freezer | 38-45 |
| Refrigerator | 34-53 |
| Electric heater | 47 |
| Hair clipper | 50 |
| Electric toothbrush | 48-57 |
| Humidifier | 41-54 |
| Clothes dryer | 51-65 |
| Air conditioner | 50-67 |
| Electric shaver | 47-68 |
| Water faucet | 62 |
| Hair dryer | 58-64 |
| Clothes washer | 48-73 |
| Dishwasher | 59-71 |
| Electric can opener | 60-70 |
| Food mixer | 59-75 |
| Electric knife | 65-75 |
| Electric knife sharpener | 72 |
| Sewing machine | 70-74 |
| Vacuum cleaner | 65-80 |
| Food blender | 65-85 |
| Coffee mill | 75-79 |
| Food waste disposer | 69-90 |
| Edger and trimmer | 81 |
| Home shop tools | 64-95 |
| Hedge clippers | 85 |
| Electric lawn mower | 80-90 |

[1] Cottrell, Tom, 1980, Noise in Alberta, Table 1, p.8, ECA80 – 16/1B4 (Edmonton: Environment Council of Alberta).

[2] Reif, Z. F., and Vermeulen, P. J., 1979, "Noise from domestic appliances, construction, and industry," Table 1, p.166, in Jones, H. W., ed., Noise in the Human Environment, vol. 2, ECA79-SP/1 (Edmonton: Environment Council of Alberta).

Taken from British Columbia Noise Control Best Practices Guideline ver 2.1, December 2018

## Appendix D-4

# VIRTUAL TOWN HALL PRESENTATION

# Kelowna Bulk Transformer Addition Project, Lee Station

## Information Session

April 22, 2020

Energy at work FORTIS BC™

# Who is FortisBC?

FortisBC is an electricity and natural gas distribution utility in the province of BC, a subsidiary of Newfoundland-based Fortis Inc., Canada’s largest private utility company

# Who is FortisBC?

BC's largest energy provider

- more than 2,300 employees
- deliver natural gas, electricity and innovative energy solutions
- 1.2 million customers in 135 communities

# FortisBC Inc.

- Electricity provider for Southern Interior of BC
- Over 175,000 customers
- 7,300 kms of electric lines

- We regularly upgrade our energy infrastructure to safely meet the growing energy needs of our customers – today and tomorrow.

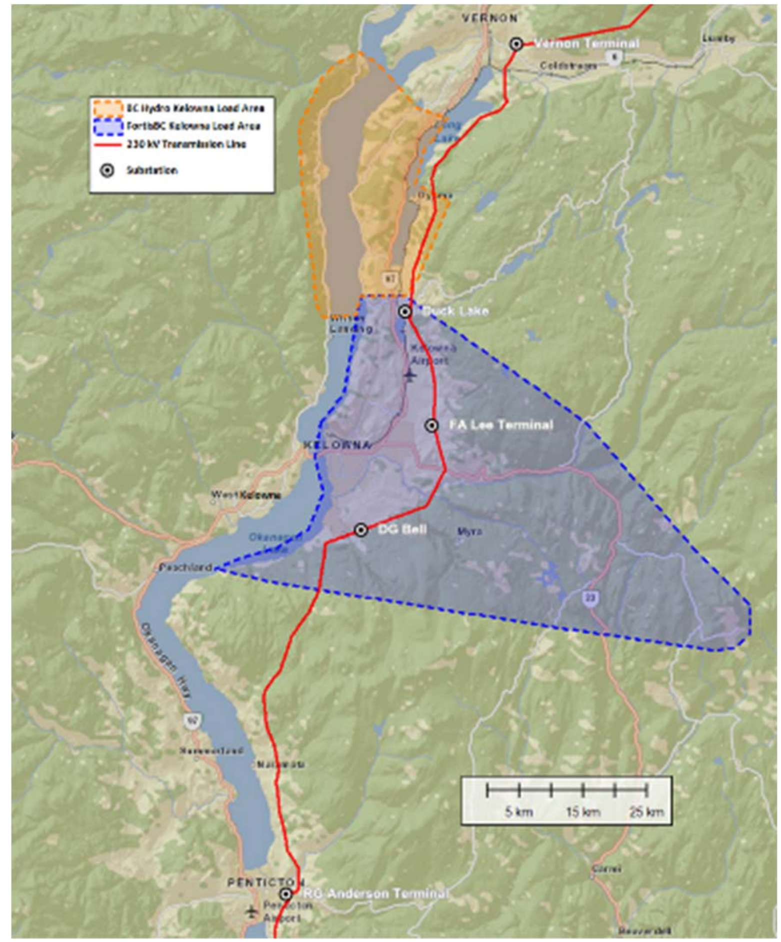
# Kelowna Transformer Addition

- Lee Terminal Substation in service since 1958
- Provides electricity to Kelowna, Lake Country, Big White and Joe Rich
- Significant growth in the Okanagan - ~1.5%/ year

# Project Benefits

Addition of third transformer:

- maintain service reliability
- improved lifespan of station equipment



# Construction Plans

Project includes:

- installation of new transformer
- re-routing several power line approaches
- upgrading site lighting
- removing existing white storage facility tent
- improve aesthetic appearance

The majority of the work will be inside the station

# Site Plan

# Project schedule

- CPCN Filing to BC Utilities Commission - end of April 2020
- Construction start – Q1 2021
- Construction completion – Q2 2023

# Construction Schedule

- Removal of white storage tent – Q1, 2021
- Civil construction – Q1-Q3, 2021
- Install new transformer – Q3, 2022
- Reconfigure station – Q4, 2021 – Q3, 2022
- Project completion – Q2 2023

# Project Impacts

Construction

- Normal work hours

Environmental

Visual

- Addition of solid fence
- Removal of white storage tent and adjacent buildings

No expected outages or interruptions

# Aesthetic improvements

Aesthetic options under consideration:

- Trees
- Upgraded fence

Noise study results

# Questions?

Thank you

Energy at work FORTIS BC™

## Appendix D-5

# INDIGENOUS COMMUNITIES NOTIFICATION

Shelley Martens
Community & Indigenous Relations

FortisBC Inc.
1975 Springfield Road
Kelowna, BC V1Y 7V7
Tel: 250-868-4525
shelley.martens@fortisbc.com
www.fortisbc.com

December 19, 2019

*First Nation*
*Address*
*City, BC  Postal Code*

*Contact/ Email*

FortisBC would like to notify *(First Nation)* of a potential Transformer Upgrade Project that we are considering at the Lee Terminal Substation in Kelowna. Due to significant growth in the Okanagan region, the addition of a new power Transformer will ensure that we can continue to provide sufficient power supply to our customers, now and into the future.

The project will include the installation of the new Transformer, re-routing of some power line approaches to the station, upgrading site lighting, removal of the existing white storage facility and improved aesthetic appearance around the station site. The majority of the work will be done inside the substation property.

FortisBC values your community's input and knowledge of the traditional land use and cultural history in this area and would appreciate any information you would be willing to share. I have attached a map showing the project location for your reference.

FortisBC will be submitting a Certificate of Public Convenience and Necessity (CPCN) application to the British Columbia Utilities Commission (BCUC) in January 2020. If the application is approved, we expect the construction work will take place in 2021/2022.

By investing in electrical system upgrades and other improvements to increase system reliability, service and safety, FortisBC can ensure we meet our more than 160,000 electricity customer's expectations. This Substation is an integral part of our electrical system that services the greater Okanagan area.

Please don't hesitate to contact myself or Matt Mason (matt.mason@fortisbc.com) if you would like more information regarding this project, or if you'd like to schedule a meeting to discuss in more detail.

Sincerely,

Shelley Martens
Community & Indigenous Relations Manager

# Appendix E

# FA LEE TERMINAL STATION NOISE IMPACT STUDY

# Noise Impact Assessment
# FortisBC c/o CIMA+
# City of Kelowna Lee Substation Facility Expansion
# McCurdy Road E and Tower Ranch Drive

Revision 1

Prepared for:
Mike Kooznetsoff
FortisBC

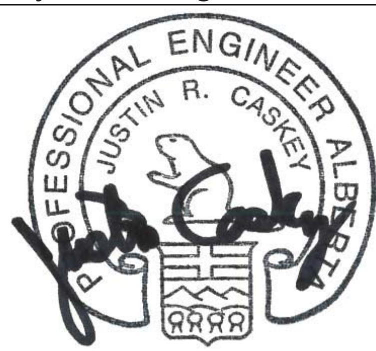
Prepared by:
**Patching Associates Acoustical Engineering Ltd.**
Consultants in Acoustics, Noise Control and Vibration

2020-04-03
Document ID: 5675-NIA-001

## Notice

This report has been prepared by Patching Associates Acoustical Engineering Ltd (PAAE) in response to a specific request for service from, and for the exclusive use of, the Client to whom it is addressed. The findings contained in this report are based, in part, upon information provided by others. The information contained in this study is not intended for the use of, nor is it intended to be relied upon, by any person, firm, or corporation other than the Client to whom it is addressed, with the exception of the applicable regulating authority to whom this document may be submitted. PAAE accepts no liability or responsibility for any damages that may be suffered or incurred by any third party as a result of the use of, reliance on, or any decision made based on this report.

## Professional Authentication

| Project Role: Engineer of Record |
|---|
|  |
| Date: 2020-04-03 |
| Patching Associates Acoustical Engineering Ltd.<br>Permit to Practice:<br>P05273 |
| Title: Principal |
| Name: Justin Caskey, P.Eng. |

## Prepared by:

Analyst and Report Author: Mackenzie Kunz, B.Sc., E.I.T.
Principal In Charge: Justin Caskey, P.Eng., INCE
Project Manager: Jeff Moe

# Executive Summary

FortisBC (Fortis) retained Patching Associates Acoustical Engineering Ltd. (PAAE) to conduct a Noise Impact Assessment (NIA) for the proposed expansion of the Lee substation facility located at the corner of McCurdy Road E and Tower Ranch Drive in Kelowna, BC. This NIA was conducted to support a filing within the BC Utilities Commission and falls within the City of Kelowna Bylaw 6647 *Noise and Disturbance Control*. As no specific noise guidelines were noted within the BC Utilities Commission, the requirements of the Alberta Utilities Commission (AUC) Rule 012: Noise Control (the Rule) were used as a guideline for this analysis and to establish a target sound level for the Lee Substation facility design.

This is an existing facility; the purpose of this NIA is to predict the impact of the proposed substation expansion to residences within the study area.

The method used in the NIA follows the requirements set forth in the Rule.

- The study area and facility physical layouts were determined from drawings obtained from the client, and a field visit by PAAE staff in March 2020.
- The Sound Power Levels (PWL) were determined for all the major study area noise sources through field diagnostic, and previous study on similar units. See Appendix D for a list of all the calculated PWL.
- Field diagnostic measurements were performed on the existing transformers at the Lee Substation with a Sound Intensity Level meter to quantify subject facility PWL in detail. The noise model used for this study was calibrated using reference Sound Pressure Level (SPL) measurements conducted at several locations within the existing facility fence line during the field diagnostic measurements.
- Sound propagation calculations were undertaken using the noise modeling software package CadnaA to determine the facility SPL at the receivers. All calculations were undertaken in linear octave bands.
- The resulting SPL were compared to the target sound level to determine if the subject facility is in compliance with the Rule guidelines. If the Facility SPL exceeds the target sound level, then noise control recommendations are designed to bring the facility SPL down to meet the target for all the receivers in the study area.
- Four operating scenarios were analyzed, the details of the four scenarios are highlighted below;
    1. Existing transformers with fans off
    2. Existing transformers with fans on
    3. Existing transformers and proposed unit during winter days/nights, shoulder season days/nights and summer nights (Fans predicted to run at stage 1 speed and 1% of the time)
    4. Existing transformers and proposed unit during summer days (Fans predicted to run at stage 1 speed and 10% of the time)

The two tables below summarize the overall Sound Pressure Levels (SPL) predictions from the model for each receiver in the study area for the four operating scenarios described above. The Facility SPL is the overall SPL from all the facilities in the study area. The Cumulative SPL includes the contribution of the Facility SPL and the Ambient Sound Levels (ASL).

Overall Sound Pressure Levels - Existing

| Receiver | Target Sound Level (dBA) | ASL (dBA) | Existing w/o Fans – Scenario One | | | Existing w/Stage Two Fans – Scenario Two | | |
|---|---|---|---|---|---|---|---|---|
| | | | Facility SPL (dBA) | Cumulative SPL (dBA) | Meet the Target Sound Level | Facility SPL (dBA) | Cumulative SPL (dBA) | Meet the Target Sound Level |
| R01 | 53.0 | 48.0 | 21.5 | **48.0** | Yes | 34.3 | **48.2** | Yes |
| R02 | 53.0 | 48.0 | 25.7 | **48.0** | Yes | 38.2 | **48.4** | Yes |
| R03 | 53.0 | 48.0 | 28.7 | **48.1** | Yes | 43.4 | **49.3** | Yes |
| R04 | 53.0 | 48.0 | 28.0 | **48.0** | Yes | 40.3 | **48.7** | Yes |

Overall Sound Pressure Levels – Existing and Proposed – Winter & Shoulder Season Days/Nights & Summer Nights

| Receiver | Target Sound Level (dBA) | ASL (dBA) | Facility SPL (dBA) | Cumulative SPL (dBA) | Meet the Target Sound Level |
|---|---|---|---|---|---|
| R01 | 53.0 | 48.0 | 28.5 | **48.0** | Yes |
| R02 | 53.0 | 48.0 | 32.2 | **48.1** | Yes |
| R03 | 53.0 | 48.0 | 37.6 | **48.4** | Yes |
| R04 | 53.0 | 48.0 | 36.8 | **48.3** | Yes |

Overall Sound Pressure Levels – Existing and Proposed – Summer Days

| Receiver | Target Sound Level (dBA) | ASL (dBA) | Facility SPL (dBA) | Cumulative SPL (dBA) | Meet the Target Sound Level |
|---|---|---|---|---|---|
| R01 | 63.0 | 48.0 | 29.3 | **48.1** | Yes |
| R02 | 63.0 | 48.0 | 32.9 | **48.1** | Yes |
| R03 | 63.0 | 48.0 | 38.9 | **48.5** | Yes |
| R04 | 63.0 | 48.0 | 37.6 | **48.4** | Yes |

The results indicate that, as proposed, the Cumulative SPL is expected to meet the target sound level at all receivers in the study area. The most impacted receiver for all operating scenarios is R03, located approximately 270m north northeast from the center of the subject facility. Additional noise control is **not** required for the subject facility to comply with the guidelines established using AUC Rule 012: Noise Control.

One optional noise control scenario was analyzed to lower the predicted SPL at all receivers in the study area. The details can be found in the Noise Control Recommendations section of the report.

# Table of Contents

# Acronyms

| Acronym | Description |
|---|---|
| AADT | Average Annual Daily Traffic |
| AB | Alberta |
| AER | Alberta Energy Regulator |
| ASL | Ambient Sound Level |
| AUC | Alberta Utilities Commission |
| BC | British Columbia |
| BSL | Basic Sound Level |
| dB | Decibel |
| dBA | A-Weighted Decibel |
| dBC | C-Weighted Decibel |
| dBZ | Z-Weighted Decibel or Linear Decibel |
| CSL | Comprehensive Sound Level |
| DIL | Dynamic Insertion Loss |
| ISO | International Organization for Standardization |
| $L_{eq}$ | Energy Equivalent Sound Level |
| LFN | Low Frequency Noise |
| LSD | Legal Subdivision |
| NIA | Noise Impact Assessment |
| NC | Noise Control |
| NR | Noise Reduction |
| OGC | Oil & Gas Commission |
| PSL | Permissible Sound Level |
| PWL | Sound Power Level |
| SPL | Sound Pressure Level |
| TL | Transmission Loss |
| UTM | Universal Transverse Mercator |

# Introduction

FortisBC (Fortis) retained Patching Associates Acoustical Engineering Ltd. (PAAE) to conduct a Noise Impact Assessment (NIA) for the proposed expansion of the Lee substation facility located at the corner of McCurdy Road E and Tower Ranch Drive in Kelowna, BC. This NIA was conducted to support a filing within the BC Utilities Commission and falls within the City of Kelowna Bylaw 6647 *Noise and Disturbance Control*. As no specific noise guidelines were noted within the BC Utilities Commission, the requirements of the Alberta Utilities Commission (AUC) Rule 012: Noise Control (the Rule) were used as a guideline for this analysis and to establish a target sound level for the Lee Substation facility design.

This is an existing facility; the purpose of this NIA is to predict the impact of the proposed substation expansion to residences within the study area.

# Study Area

The subject facility is located at the corner of McCurdy Road E and Tower Ranch Road on the eastern edge of the city of Kelowna, BC.

The study area is located within the city limits of Kelowna and is within 5 km of the Kelowna International Airport. The terrain cover in the study area is very hilly and is mainly farmland with orchards and a golf course surrounding the substation.

There exist no adjacent facilities within the study area. If there were adjacent facilities present, the noise emissions from these adjacent facilities would have been included in this NIA to assess the cumulative sound level as directed by Rule 012.

There are four residences analyzed within this study, labelled as R01 through R04 in the NIA. R04 is a seasonal residence used by orchard workers during growing season.

Figure 1 shows a map of the study area.

Figure 1: Study Area Map

# Noise Criteria

## Primary Overall dBA Analysis

### City of Kelowna Bylaw No. 6647 – Kelowna Noise and Disturbances Control Bylaw

**3.2** – No person being the owner or occupier of real property knowingly shall allow or permit such real property to be used so that noise or sound which emanates therefrom, disturbs the peace, rest, enjoyment, comfort, or convenience of any person or persons in the neighborhood or vicinity.

### BC Utilities Commission

No specific noise guidelines found, Alberta analogue criteria applied for technical basis, see below..

### Alberta Utilities Commission Rule 012 – Noise Control

Noise for energy related facilities in Alberta is regulated through the AUC Rule 012: Noise Control. The regulator sets the target sound level, which is the limit that the Sound Pressure Level (SPL) emanating from the facilities in the study area plus the Ambient Sound Level (ASL) may not exceed over a specified period, as measured at specific locations of interest (the receivers). These allowable limits are dependent on the population density, proximity to heavily traveled transportation routes (motor vehicles, rail and aircraft) and other specified adjustments. The SPL is the sound level received at a specific location. The ASL is the average background sound level not attributable to energy industry facilities. The ASL is assumed to be 5 dBA below the target sound level, as prescribed by the Rule. The receivers are located at the residences existing within 1500 m of the subject facility, or else at the study area boundary.

In this NIA, there are four residences adjacent to the subject facility that were analyzed. The dwelling density per quarter section of land is between 9 dwellings and 160 dwellings, and they are all within 5 km of the Kelowna International Airport and are subject to frequent aircraft flyovers as defined in Rule 012.

The target sound level established is 53 dBA $L_{eq}$ (nighttime) and 63 dBA $L_{eq}$ (daytime), and the ASL is 48 dBA $L_{eq}$ (nighttime) and 58 dBA $L_{eq}$ (daytime) for all receivers in the study area. See Appendix B for the target sound level calculations based on Section 2.1 of the Rule.

## Secondary Low Frequency Noise Analysis

Rule 012 outlines criteria for Low Frequency Noise (LFN) consideration. LFN considers noise that may be satisfactory on a dBA basis but contains a dominant low frequency that may increase annoyance at nearby residences. LFN analysis is considered a "second-stage" investigation by the Directive and is only to be conducted as a specific response to an LFN complaint. According to both Directive 038 and Rule 012, an LFN component exists when:

- the dBC minus dBA sound level is equal to or greater than 20 dB, and
- there is a clear tonal component at a $^{1}/_{3}$ octave frequency of 250 Hz or below.

If an LFN component is identified as per the Rule, then a 5 dBA penalty is added to the measured or predicted SPL. In this analysis, there is no specific LFN complaint from any receiver in the area. Moreover, there is insufficient spectral data available to predict the existence of a tonal component at any of the receiver location. As such, this study evaluates potential LFN for information purposes only, by investigating the predicted dBC-dBA levels at all the receivers.

## Major Equipment

Table 1 gives details of the major equipment found at the subject facility. The details were obtained from the client and field visit by PAAE staff in March 2020. See Appendix C for a plot plan showing the subject facility equipment layout.

Table 1A: Subject Facility Equipment Details

| Equipment Type | Equipment Details |
|---|---|
| Sub-station transformers | • Two (2) existing transformers T3 and T4<br>• One (1) proposed transformer T2<br>Sound pressure level vendor specification;<br>1) At ONAN : 68 dB<br>2) At ONAF2 : 80dB<br>• Building: unenclosed<br>• Sound power levels obtained from field measurements of Medicine Hat North Industrial Substation in 2013 by PAAE staff and on the existing T3 and T4 transformers at the Lee substation and scaled with the ONAN and ONAF2 levels provided by the client above.<br>• All transformers have forced air cooling with two stage fans installed. Fans activate automatically when transformer temperature exceeds a set threshold.<br>• PAAE recommends procuring the proposed transformer cooling fans with an acoustic specification of at most 82 dBA @ 1m. Installation of a VFD system on the fans would also lead to a lower overall acoustic impact on residences in the study area compared to the existing two-stage system on the existing units. |
| Other minor equipment | • Grounding Transformers<br>• Control Building<br>• This equipment was not included in the noise study as noise emissions are expected to be insignificant. |

The client has provided operations data for the loading of the existing T3 and T4 transformers and established average loading and peak loading during different times of the year. When the proposed transformer is installed and operational, the load on the existing transformers will be reduced by 33% each.

Based on the predicted load on the three transformers for the proposed case, the cooling fans are expected to operate as follows:

- During the winter months, shoulder season days and nights and summer nights, less than 1%. This analysis assumes the fans will run 1% of the time during these periods.

- During the summer days when loads are higher, the fans will run 10% of the time.

# Method

The method used in the NIA follows the requirements set forth in Rule 012.

- The study area and facility physical layouts were determined from drawings obtained from the client, and a field visit by PAAE staff in March 2020.
- The Sound Power Levels (PWL) were determined for all the major study area noise sources through field diagnostic, and previous study on similar units. See Appendix D for a list of all the calculated PWL.
- Field diagnostic measurements were performed on the existing transformers at the Lee Substation with a Sound Intensity Level meter to quantify subject facility PWL in detail. The noise model used for this study was calibrated using reference SPL measurements conducted at several locations within the existing facility fence line during the field diagnostic measurements.
- Sound propagation calculations were undertaken using the noise modeling software package CadnaA to determine the facility SPL at the receivers. All calculations were undertaken in linear octave bands.
- The resulting SPL were compared to the target sound level to determine if the subject facility is in compliance with the guidelines established using Rule 012. If the Facility SPL exceed the target sound level, then noise control recommendations are designed to bring the facility SPL down to meet the target sound level for all the receivers in the study area.
- Four operating scenarios were analyzed, the operating scenarios were confirmed with the client using historical loading data. The details of the four scenarios are highlighted below;
    1. Existing two transformers with fans off
    2. Existing two transformers with fans on
    3. Existing two transformers and proposed unit during winter days/nights, shoulder season days/nights and summer nights (Fans predicted to run at stage 1 speed and 1% of the time)
    4. Existing two transformers and proposed unit during summer days (Fans predicted to run at stage 1 speed and 10% of the time)

## Modeling Parameters

Table 2 lists the major parameters used in the noise model. These parameters meet the guideline set forth in the Directive. The modeled conditions produce results representative of meteorological conditions favouring sound propagation (e.g., downwind or mild temperature inversion conditions) during the summer nighttime, as prescribed by the Rule. These conditions do not occur all the time at the receiver and the resulting SPL are expected to be lower than those predicted for most of the time. Therefore, the environmental conditions modeled represent "close-to-worst-case" sound propagation conditions.

Table 2: Modeling Parameters

| Parameter | Value | Description |
|---|---|---|
| Modeling software | CadnaA by Datakustik Version 2020 MR 1 | An advanced noise propagation model that considers geometric spreading, atmospheric sound absorption, ground impedance effects, site topography and geometry, vegetation and environmental conditions. The CadnaA model calculates the contribution level of each noise source at the receiver location in octave bands as well as calculating the overall facility sound level. |
| Standard followed | ISO 9613 | As recommended in the Rule. Specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The published accuracy for this standard is ±3 dBA between 100 m to 1000 m. Accuracy levels beyond 1000 m are not published. |
| Wind Condition | 1 – 5 m/s Downwind | ISO 9613 uses a slight downwind condition from each noise source to each receiver. Wind speed is measured at a height of 3 m to 11 m above ground and covers the acceptable range specified in Rule 012. |
| Ground Absorption Coefficient | 0.0 for water bodies<br><br>0.3 for areas within the plant lease<br><br>0.8 otherwise | The ground cover was modeled as porous ground, except for the ground within the plant boundary that was modelled as packed ground. ISO 9613 classification of porous ground includes ground covered by grass, trees or other vegetation, and any other ground surfaces suitable for growth of vegetation i.e. farmland. For areas with rivers and lakes, the ground cover was modelled as reflective ground. |
| Order of Reflection | 3 | The model calculates reflection effects from the reflective surfaces included in the model. |
| Foliage | Excluded | Not included based on conservative considerations due to the presence of human dwelling residences in the study area. |
| Temperature | 10ºC | Represents typical summer nighttime temperature. |
| Relative Humidity | 80% | Represents typical summer nighttime relative humidity. |
| Topography | Included | Topographical data obtained from Natural Resources Canada. Resolution 1m. |

# Results

## Overall Sound Pressure Levels

Tables 3, 4 and 5 summarize the overall Sound Pressure Levels (SPL) predictions from the model for each receiver in the study area. The Facility SPL is the overall SPL from all the facilities in the study area. The Cumulative SPL includes the contribution of the Facility SPL and the Ambient Sound Levels (ASL).

Table 3: Overall Sound Pressure Levels - Existing

| Receiver | Target Sound Level (dBA) | ASL (dBA) | Existing w/o Fans – Scenario One | | | Existing w/ Fans – Scenario Two | | |
|---|---|---|---|---|---|---|---|---|
| | | | Facility SPL (dBA) | Cumulative SPL (dBA) | Meet the Target Sound Level | Facility SPL (dBA) | Cumulative SPL (dBA) | Meet the Target Sound Level |
| R01 | 53.0 | 48.0 | 21.5 | **48.0** | Yes | 34.3 | **48.2** | Yes |
| R02 | 53.0 | 48.0 | 25.7 | **48.0** | Yes | 38.2 | **48.4** | Yes |
| R03 | 53.0 | 48.0 | 28.7 | **48.1** | Yes | 43.4 | **49.3** | Yes |
| R04 | 53.0 | 48.0 | 28.0 | **48.0** | Yes | 40.3 | **48.7** | Yes |

Table 4: Overall Sound Pressure Levels – Scenario Three - Existing and Proposed – Winter & Shoulder Season Days/Nights & Summer Nights

| Receiver | Target Sound Level (dBA) | ASL (dBA) | Facility SPL (dBA) | Cumulative SPL (dBA) | Meet the Target Sound Level |
|---|---|---|---|---|---|
| R01 | 53.0 | 48.0 | 28.5 | **48.0** | Yes |
| R02 | 53.0 | 48.0 | 32.2 | **48.1** | Yes |
| R03 | 53.0 | 48.0 | 37.6 | **48.4** | Yes |
| R04 | 53.0 | 48.0 | 36.8 | **48.3** | Yes |

Table 5: Overall Sound Pressure Levels – Scenario Four - Existing and Proposed – Summer Days

| Receiver | Target Sound Level (dBA) | ASL (dBA) | Facility SPL (dBA) | Cumulative SPL (dBA) | Meet the Target Sound Level |
|---|---|---|---|---|---|
| R01 | 63.0 | 48.0 | 29.3 | **48.1** | Yes |
| R02 | 63.0 | 48.0 | 32.9 | **48.1** | Yes |
| R03 | 63.0 | 48.0 | 38.9 | **48.5** | Yes |
| R04 | 63.0 | 48.0 | 37.6 | **48.4** | Yes |

The above results indicate that the Cumulative SPL is expected to meet the target sound level at all receivers in the study area for all four scenarios analyzed. The most impacted receiver for all scenarios is R03, located approximately 270m north northeast from the subject facility center. Additional noise control is **not** required for the subject facility to comply with the guidelines established using Rule 012.

Figure 2 shows the noise map of the area with Facility SPL contours for scenario one, that is, the facility noise emissions contours excluding the ASL.

Figure 2: Noise Contour Map – As Existing – Scenario One - Facility SPL

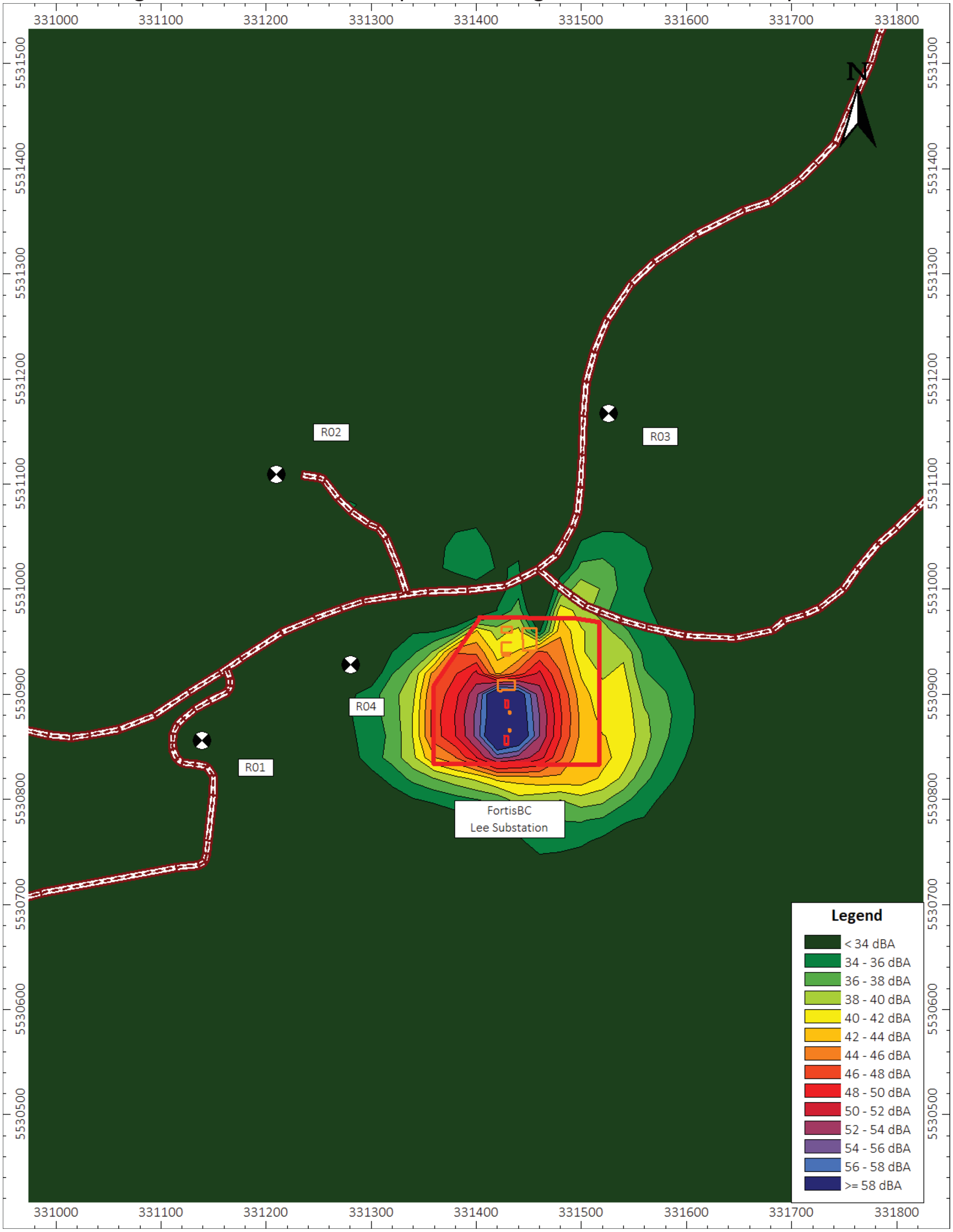


Figure 3 shows the noise map of the area with Facility SPL contours for scenario two, that is, the facility noise emissions contours excluding the ASL.

Figure 3: Noise Contour Map – As Existing – Scenario Two - Facility SPL

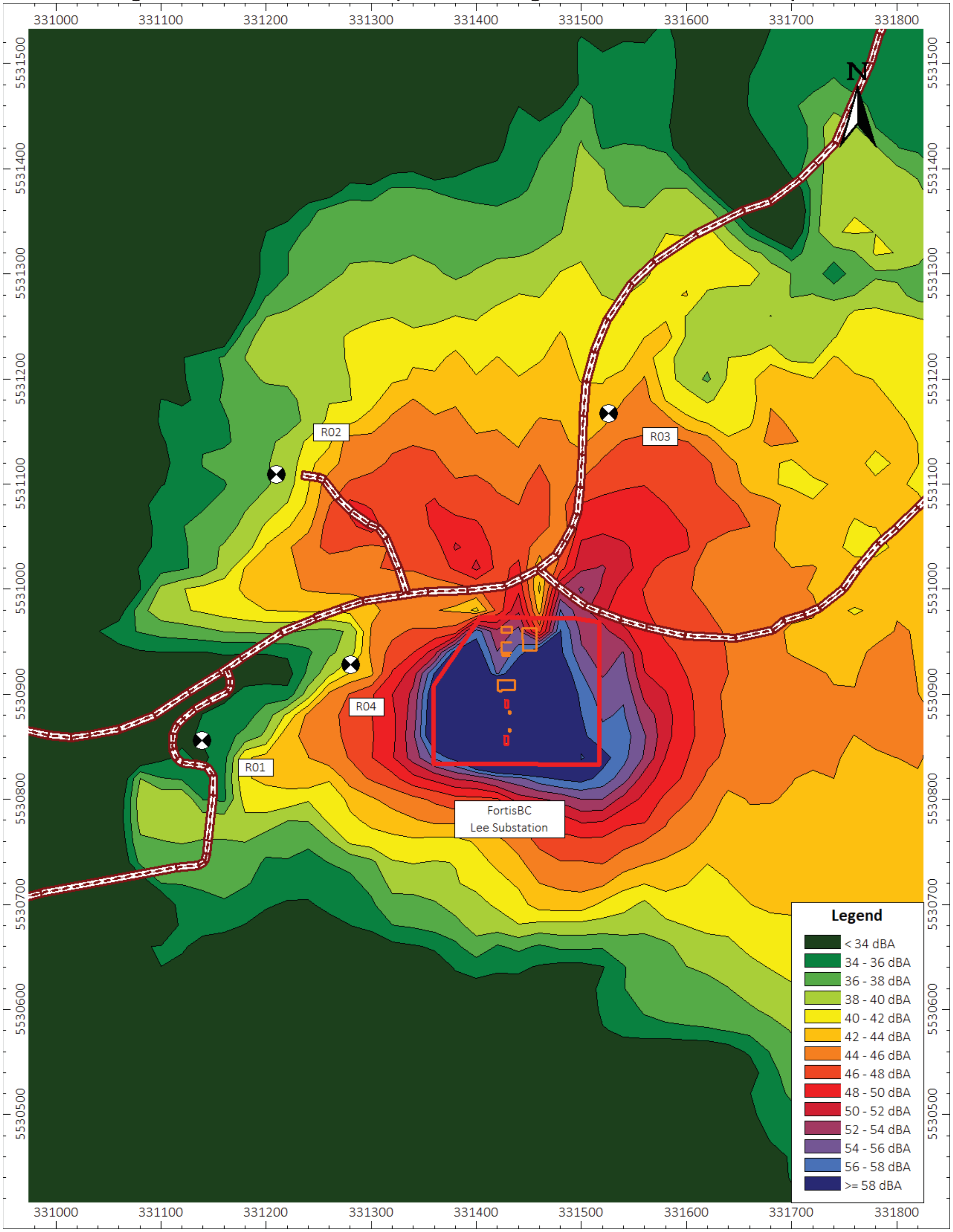


Figure 4 shows the noise map of the area with Facility SPL contours for scenario three, that is, the facility noise emissions contours excluding the ASL.

Figure 4: Noise Contour Map – As Proposed – Scenario Three – Proposed Facility During Winter & Shoulder Season Days/Nights and Summer Nights - Facility SPL

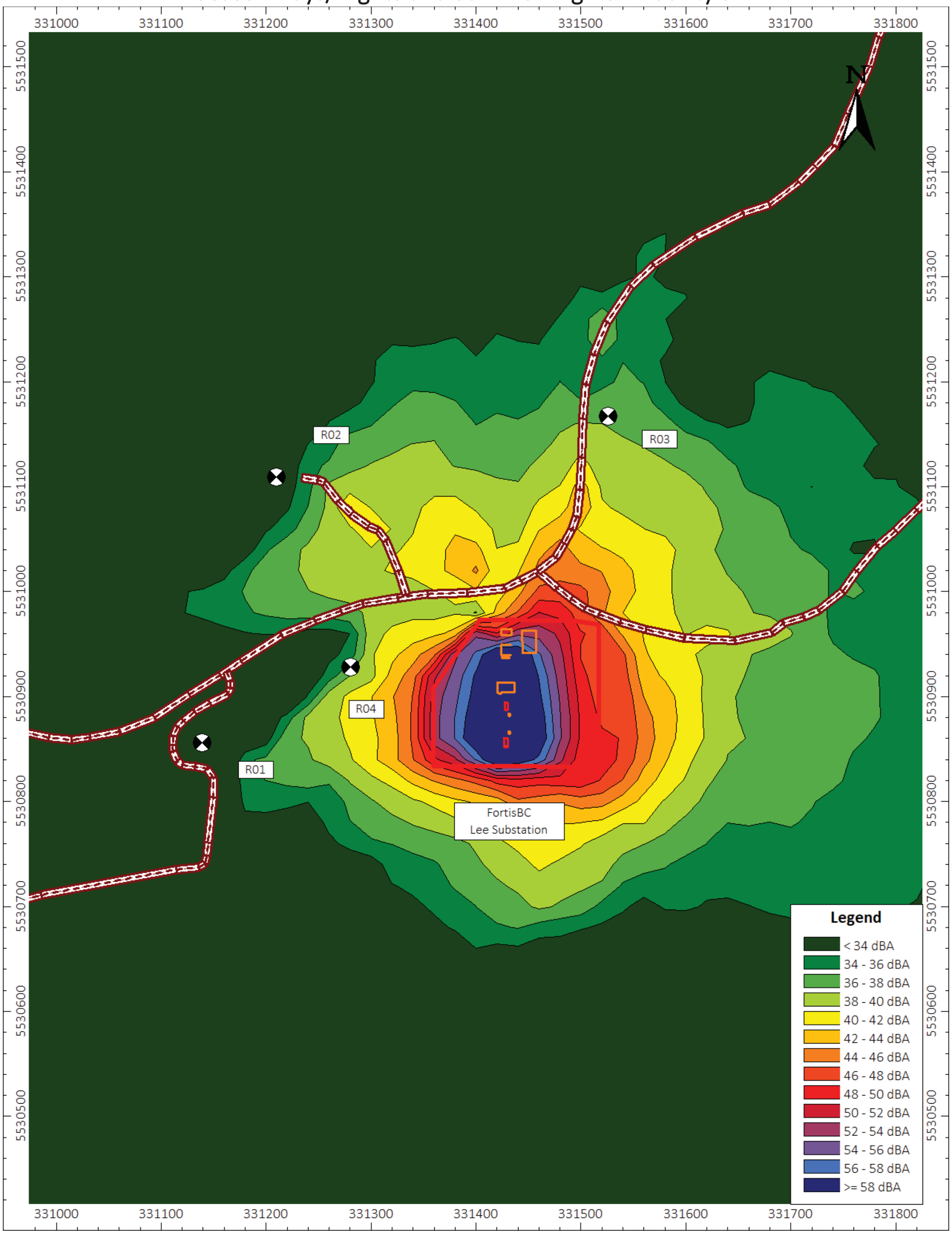
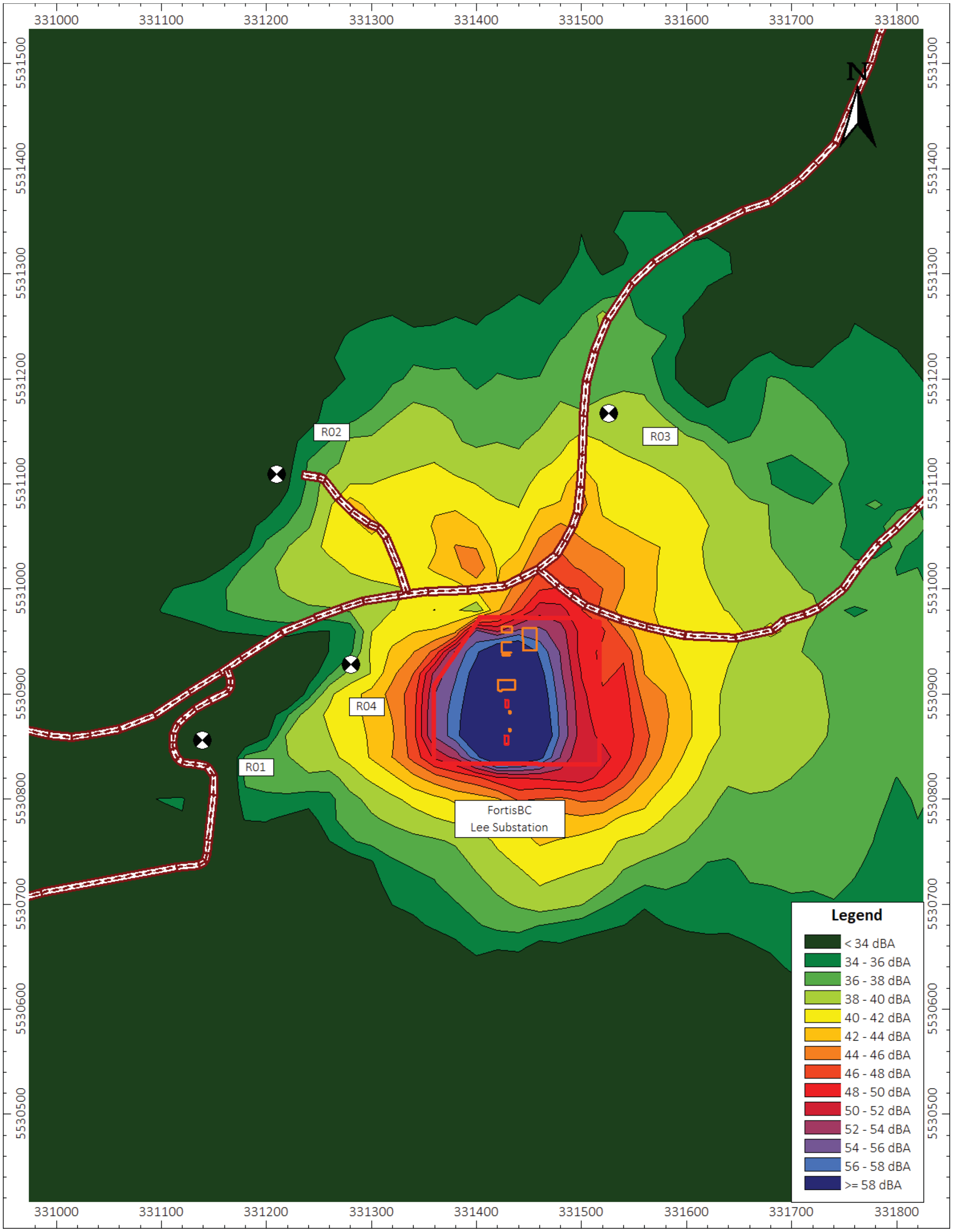


Figure 5 shows the noise map of the area with Facility SPL contours for scenario three, that is, the facility noise emissions contours excluding the ASL.

Figure 5: Noise Contour Map – As Proposed – Scenario Four – Proposed Facility During Summer Days - Facility SPL



## Source Order Ranking

Tables 6a through 6d list the top ten dominant noise sources received at the most impacted receivers for the four scenarios analyzed.

Table 6a: Source Order Ranking - Receiver R03 – Scenario One – Existing w/o Fans

| Rank | Noise Source | SPL (dBA) | dBC-dBA |
|---|---|---|---|
| 001 | T4 Transformer body | 26.2 | 7.3 |
| 002 | T3 Transformer body | 24.9 | 6.4 |
| | Facility SPL | 28.7 | 6.8 |
| | ASL | 48.0 | - |
| | Cumulative SPL | 48.1 | - |
| | Target Sound Level | 53.0 | - |

The above results indicate that the dominant noise comes from the exiting transformer bodies. If any noise control is desired, it should aim at attenuating the dominant noise sources.

Table 6b: Source Order Ranking - Receiver R03 – Scenario Two – Existing w/ Fans

| Rank | Noise Source | SPL (dBA) | dBC-dBA |
|---|---|---|---|
| 001 | T4 Southeast rad intake fans up | 34.5 | 18.6 |
| 002 | T4 Southeast rad side fans up | 33.1 | 15.2 |
| 003 | T4 Transformer body | 32.9 | 7.2 |
| 004 | T4 Northeast rad side fans up | 32.4 | 15.2 |
| 005 | T4 Northeast rad intake fans up | 31.8 | 14.8 |
| 006 | T4 Southeast under rad | 31.5 | 14.5 |
| 007 | T4 East between rad fans up | 31.2 | 7.4 |
| 008 | T3 East between rad fans up | 29.6 | 9.0 |
| 009 | T4 Northwest rad face inlet fans up | 29.3 | 17.3 |
| 010 | T4 Southwest rad face inlet fans up | 29.3 | 21.5 |
| | Facility SPL | 43.4 | 14.9 |
| | ASL | 48.0 | - |
| | Cumulative SPL | 49.3 | - |
| | Target Sound Level | 53.0 | - |

The above results indicate that the dominant noise comes from the existing T4 transformer cooling system and transformer body. If any noise control is desired, it should aim at attenuating the dominant noise sources.

Table 6c: Source Order Ranking - Receiver R03 – Scenario Three – Proposed Facility During Winter & Shoulder Season Days/Nights and Summer Nights

| Rank | Noise Source | SPL (dBA) | dBC-dBA |
|---|---|---|---|
| 001 | T4 Transformer body | 34.7 | 7.6 |
| 002 | T2 Transformer body | 32.1 | 6.3 |
| 003 | T3 Transformer body | 30.3 | 6.0 |
| 004 | T4 Northeast rads intake fans up | 13.3 | 19.2 |
| 005 | T4 Southeast rads intake fans up | 12.9 | 17.2 |
| 006 | T4 East btw rads fans up | 12.8 | 9.3 |
| 007 | T2 East between rads fans up | 11.6 | 8.6 |
| 008 | T4 Northwest rad face inlet fans up | 11.2 | 21.7 |
| 009 | T4 Southeast rad side fans up | 10.1 | 15.2 |
| 010 | T2 Southeast rad face fans up | 9.9 | 7.4 |
| | Facility SPL | 37.6 | 7.8 |
| | ASL | 48.0 | - |
| | Cumulative SPL | 48.4 | - |
| | Target Sound Level | 53.0 | - |

The above results indicate that the dominant noise comes from the transformer bodies. If any noise control is desired, it should aim at attenuating the dominant noise sources.

Table 6d: Source Order Ranking - Receiver R03 – Scenario Four – Proposed Facility During Summer Days

| Rank | Noise Source | SPL (dBA) | dBC-dBA |
|---|---|---|---|
| 001 | T4 Transformer body | 34.7 | 7.6 |
| 002 | T2 Transformer body | 32.1 | 6.3 |
| 003 | T3 Transformer body | 30.3 | 6.0 |
| 004 | T4 Northeast rads intake fans up | 23.3 | 19.2 |
| 005 | T4 Southeast rads intake fans up | 22.9 | 17.2 |
| 006 | T4 East btw rads fans up | 22.8 | 9.3 |
| 007 | T2 East between rads fans up | 21.6 | 8.6 |
| 008 | T4 Northwest rad face inlet fans up | 21.2 | 21.7 |
| 009 | T4 Southeast rad side fans up | 20.1 | 15.2 |
| 010 | T2 Southeast rad face fans up | 19.9 | 7.4 |
| | Facility SPL | 38.9 | 11.3 |
| | ASL | 48.0 | - |
| | Cumulative SPL | 48.5 | - |
| | Target Sound Level | 63.0 | - |

The above results indicate that the dominant noise comes from the transformer bodies. If any noise control is desired, it should aim at attenuating the dominant noise sources.

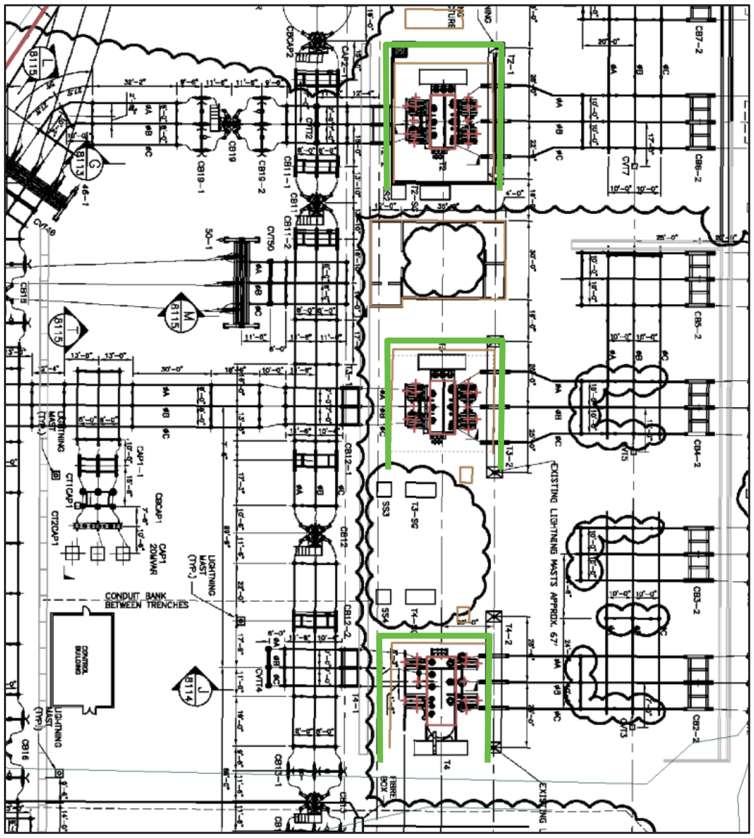
## Noise Control Recommendations (Optional)

Noise control recommendations are designed to bring the facility SPL down at all the receivers in the study area. Table 7 lists the noise control items to reduce the SPL at the most impacted receivers R03 and R04. The Cumulative Noise Reduction (NR) is the total reduction from implementing the noise control items in the order shown. Prior to implementing additional noise mitigation measures PAAE recommends conducting field diagnostic noise measurements.

Table 7: Noise Control Recommendations – Receiver R03 and R04

| Item | Noise Source | Noise Control | Cumulative NR (dBA) | Facility SPL (dBA) | Cumulative SPL (dBA) |
|---|---|---|---|---|---|
| Scenario Three – Winter & Shoulder Season Day/Night & Summer Night – R04 | | | | | |
| - | - | Before Noise Control | - | 37.6 | 48.4 |
| 1 | Transformer Body and Cooling Fans | Install 6m high barrier walls around the proposed T2 and the existing T3 and T4 Transformers. The suggested layout is depicted below in figure 6. | 7.3 | 30.3 | 48.1 |
| Scenario Four – Summer Days – R03 | | | | | |
| - | - | Before Noise Control | - | 38.9 | 48.5 |
| 1 | Transformer Body and Cooling Fans | Install 6m high barrier walls around the proposed T2 and the existing T3 and T4 Transformers. The suggested layout is depicted below in figure 6. | 7.3 | 31.6 | 48.1 |

Figure 6: Suggested Barrier Layout




Additional noise mitigation measures should be considered if there are noise concerns raised after construction and PAAE recommends conducting diagnostic noise measurements during commissioning and prior to installing noise mitigation measures. See Appendix F for the noise control items acoustic specifications. Tables 8 and 9 summarize the overall SPL predictions from the model for each receiver in the study area, once the recommended noise control item above has been implemented for scenarios three and four analyzed within this report.

Table 8: Overall Sound Pressure Levels – After Noise Control – Scenario Three

| Receiver | Target Sound Level (dBA) | ASL (dBA) | Facility SPL (dBA) | Cumulative SPL (dBA) | Noise Reduction (dBA) | Meet the Target Sound Level | dBC-dBA |
|---|---|---|---|---|---|---|---|
| R01 | 53.0 | 48.0 | 28.4 | **48.0** | 0.1 | Yes | 8.4 |
| R02 | 53.0 | 48.0 | 24.8 | **48.0** | 7.4 | Yes | 9.8 |
| R03 | 53.0 | 48.0 | 30.3 | **48.1** | 7.3 | Yes | 8.1 |
| R04 | 53.0 | 48.0 | 33.4 | **48.1** | 3.4 | Yes | 8.6 |

Table 9: Overall Sound Pressure Levels – After Noise Control – Scenario Four

| Receiver | Target Sound Level (dBA) | ASL (dBA) | Facility SPL (dBA) | Cumulative SPL (dBA) | Noise Reduction (dBA) | Meet the Target Sound Level | dBC-dBA |
|---|---|---|---|---|---|---|---|
| R01 | 63.0 | 48.0 | 29.2 | **48.1** | 0.1 | Yes | 11.7 |
| R02 | 63.0 | 48.0 | 25.7 | **48.0** | 7.2 | Yes | 14.0 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| R03 | 63.0 | 48.0 | 31.6 | **48.1** | 7.3 | Yes | 10.8 |
| R04 | 63.0 | 48.0 | 34.2 | **48.2** | 3.4 | Yes | 12.2 |

The above results indicate that, with the noise control has been implemented, the Facility SPL is expected to be reduced for receivers in the study area. Figures 7A and 7B show the noise maps of the area with Facility SPL contours, that is, the facility noise emissions contours excluding the ASL, once the recommended noise control item has been implemented for scenarios three and four respectively.

Figure 7A: Noise Contour Map – After Noise Control – Facility SPL – Scenario Three – Proposed Facility During Winter & Shoulder Season Days/Nights and Summer Nights

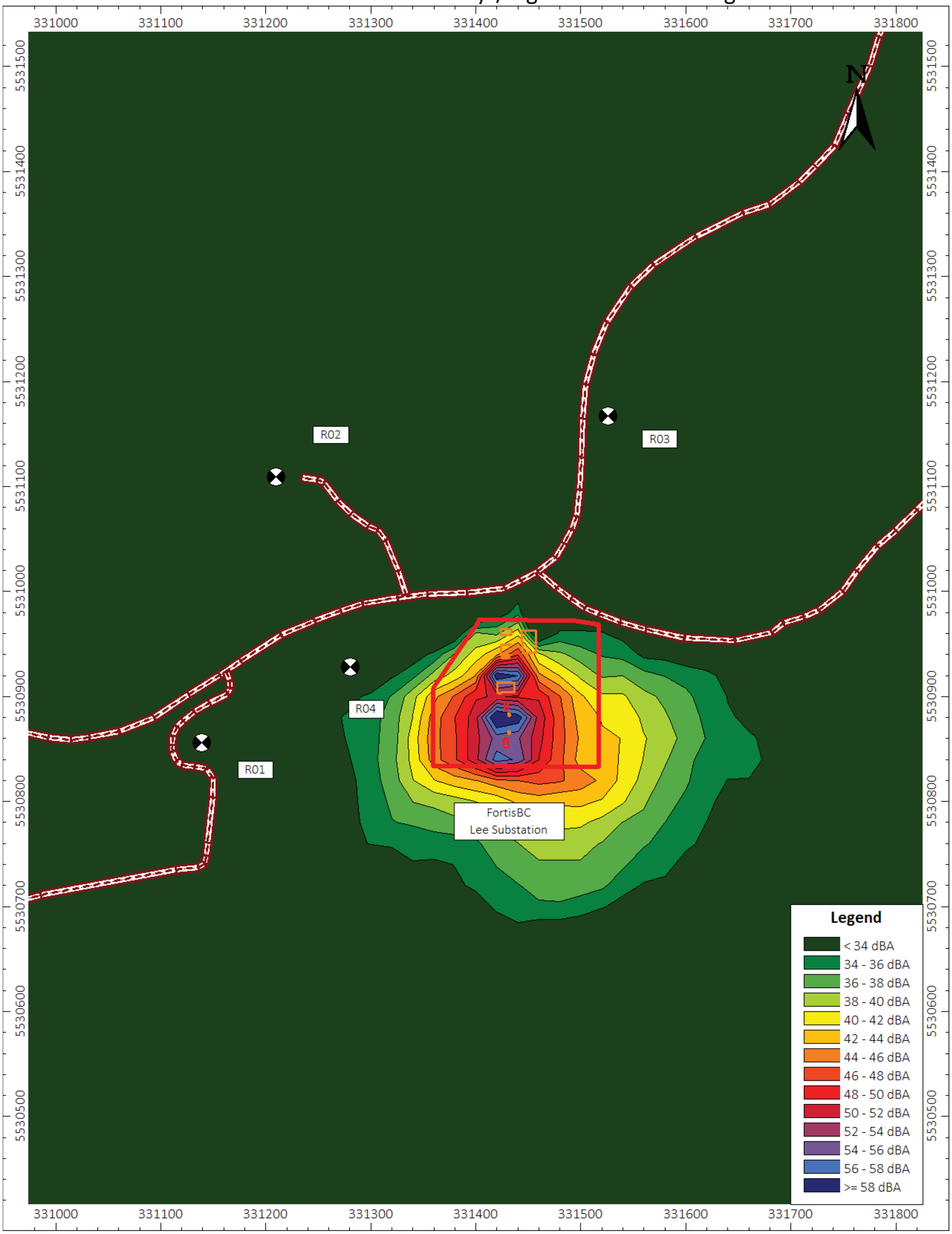
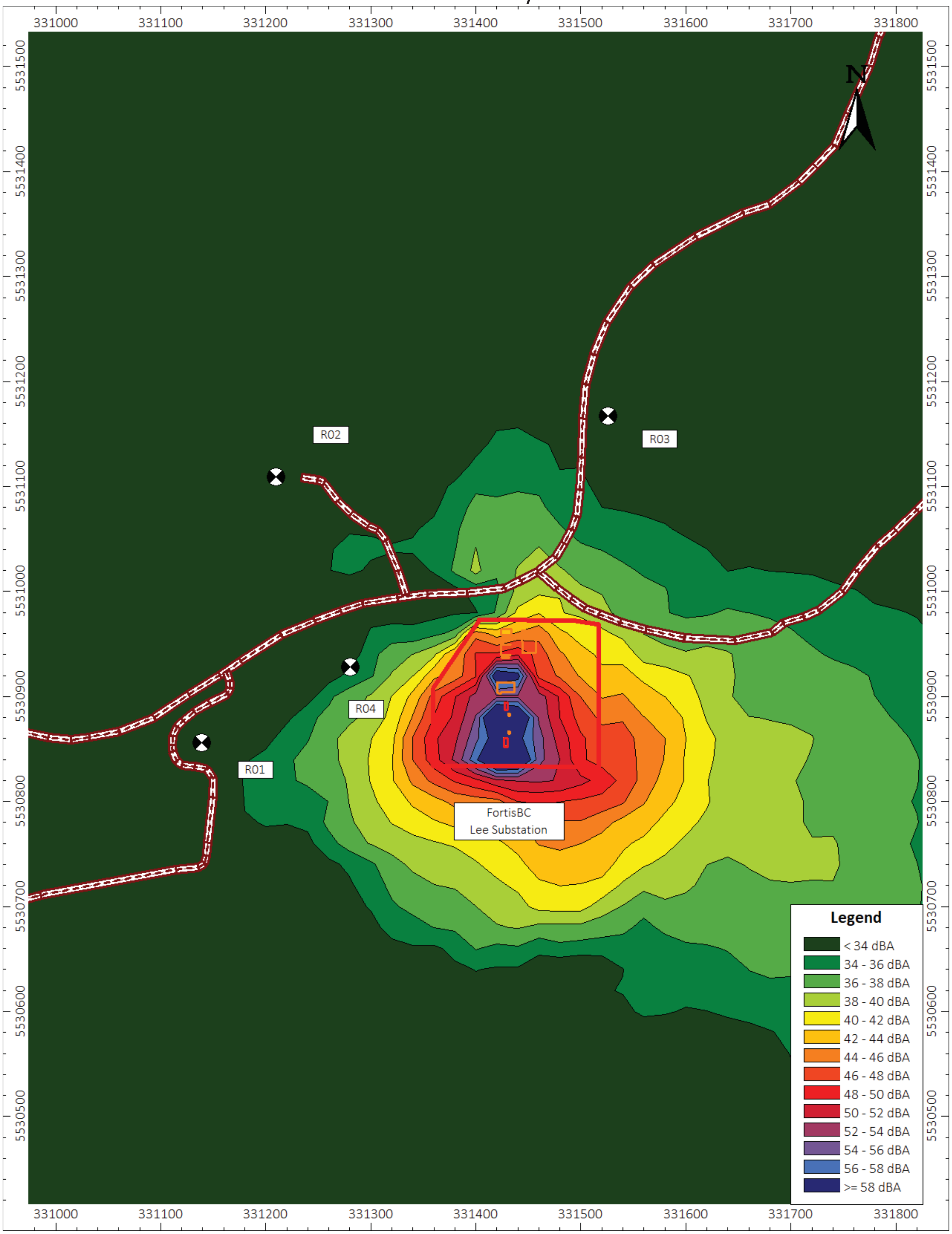


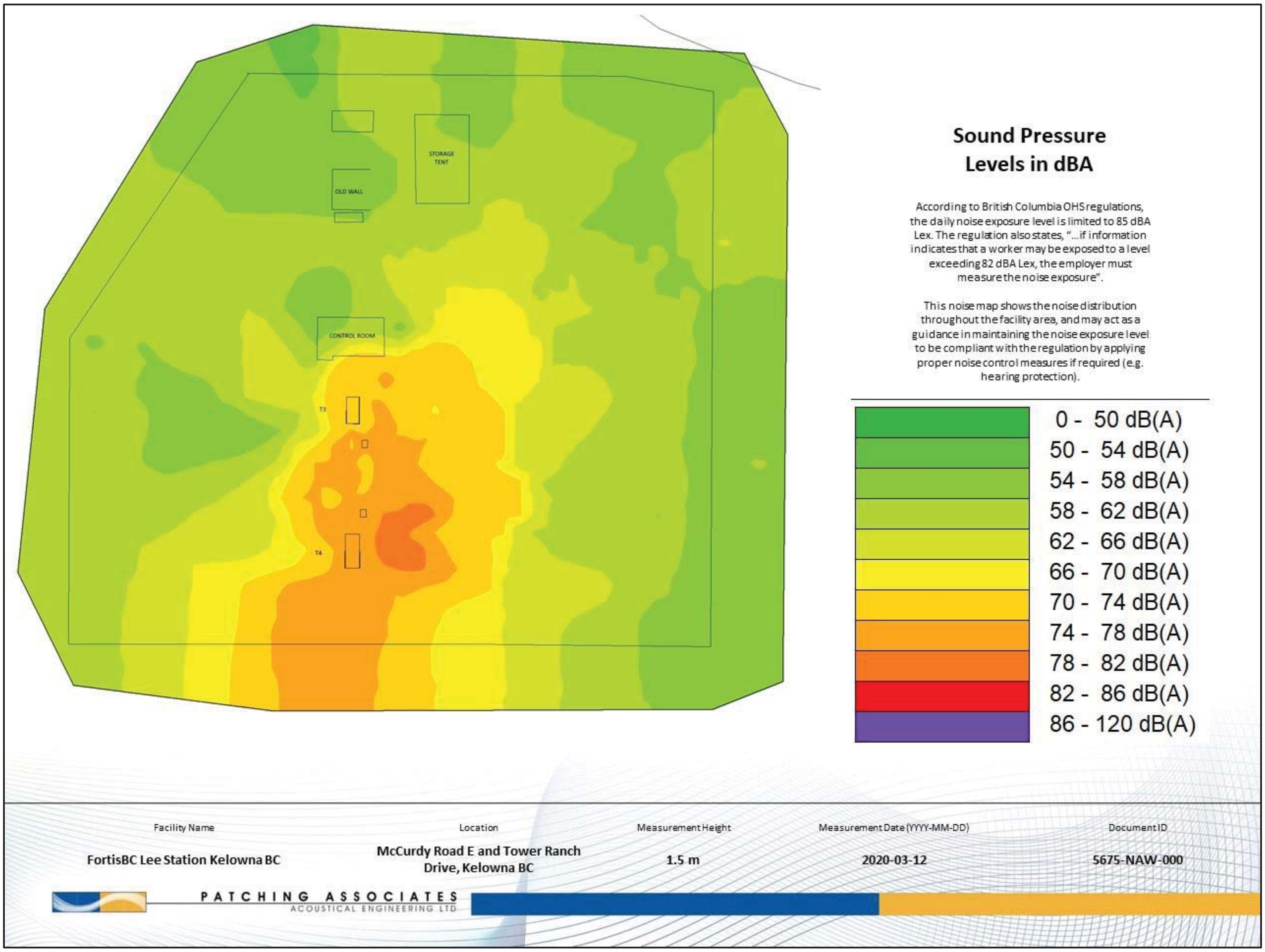
Figure 7B: Noise Contour Map – After Noise Control – Facility SPL – Scenario Four – Proposed Facility During Summer Days



## Near-Field Noise Map

Figure 8 below shows a near-field noise map of the assessed FortisBC Lee Substation during field diagnostic measurements on March 12, 2020. The fans of both existing T3 and T4 transformers were running at full speed during the noise map.

Figure 8: Near-Field Noise Map




## Study Area Measurements

Noise measurements were taken in the area surrounding the substation during the field visit by PAAE staff. The measurements were analyzed, and any non-substation noise was isolated from the recordings. Figure 9 and table 10 below detail the locations of the measurements and the residual sound levels. The fans on the existing transformers were not operating during the survey measurements as the ambient temperature and load conditions were not sufficient for the fans of the transformers to come on.

Figure 9 – Study Area Noise Measurement Locations

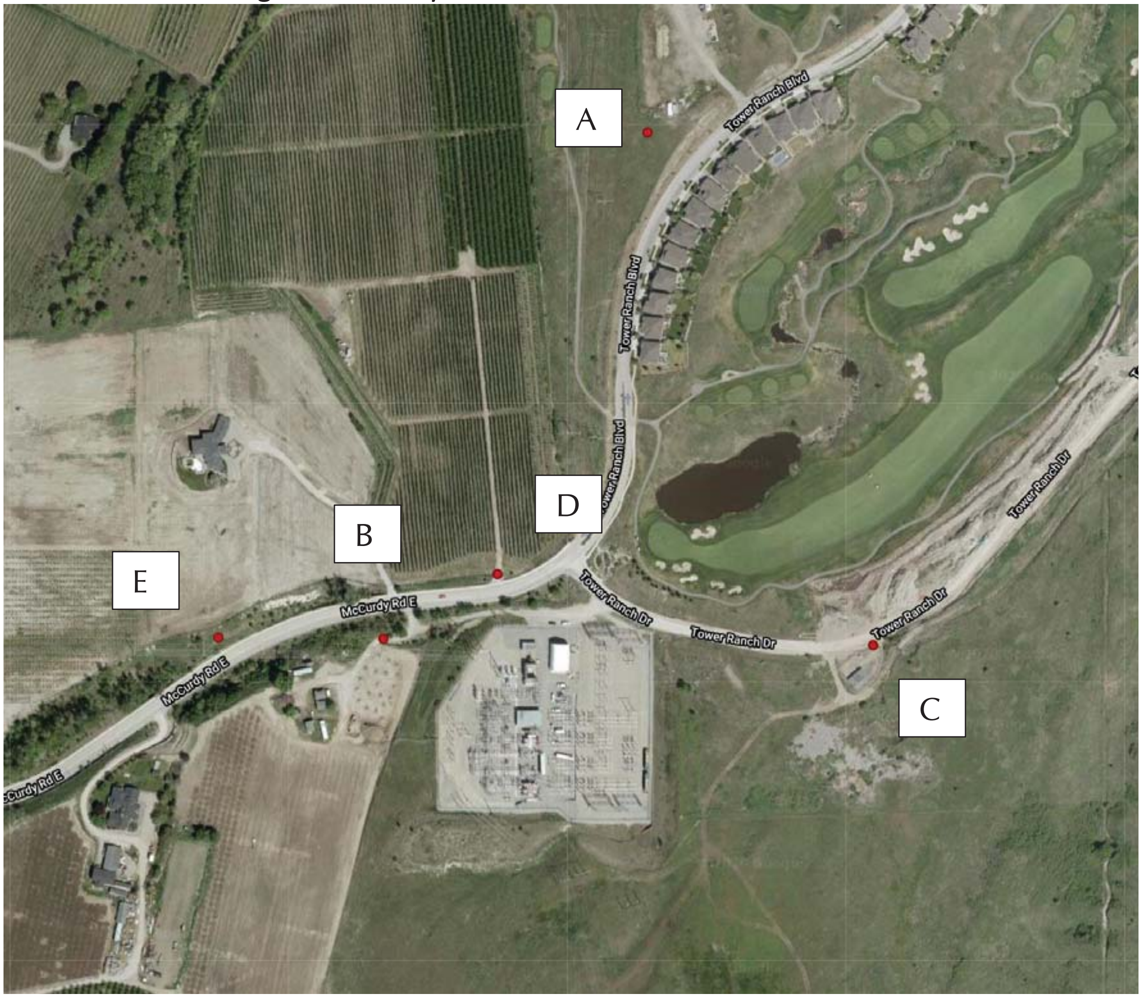



Table 10: Study Area Measurement Results

| Location | Substation Audible | Residual Sound Level (dBA) |
|---|---|---|
| A | No | 34.7 – 35.4 |
| B | Yes | 32.5 – 33.3 |
| C | Yes | 36.5 - 37.2 |
| D | Yes | 38.3 – 39.2 |
| E | No | 36.3 – 36.4 |

## Conclusion

FortisBC (Fortis) retained Patching Associates Acoustical Engineering Ltd. (PAAE) to conduct a Noise Impact Assessment (NIA) for the proposed expansion of the Lee substation facility located at the corner of McCurdy Road E and Tower Ranch Drive in Kelowna, BC. This NIA was conducted to support a filing within the BC Utilities Commission and falls within the City of Kelowna Bylaw 6647 *Noise and Disturbance Control*. As no specific noise guidelines were noted within the BC Utilities Commission, the requirements of the Alberta Utilities Commission (AUC) Rule 012: Noise Control (the Rule) were used as a guideline for this analysis and to establish a target sound level for the Lee Substation facility design.

This is an existing facility; the purpose of this NIA is to predict the impact of the proposed substation expansion to residences within the study area

The results of this assessment indicate that the Cumulative SPL is expected to meet the target sound level at all receivers in the study area for all four scenarios analyzed. The most impacted receiver for all scenarios analyzed is R03, located approximately 270 m north northeast from the center of the subject facility. Additional noise control is **not** required for the proposed substation to meet compliance with the guidelines established using AUC Rule 012.

One optional scenario of noise control was evaluated and details can be found in the Noise Control Recommendations section of the report.

For general technical details on sound levels and analysis, as well as for a best practices approach as recommended by the Directive, see Appendix G.

# References

Alberta Utilities Commission (AUC). 2017. *Rule 012: Noise Control.* Amended June 15, 2017. Calgary, Alberta.

Alberta Transportation: www.transportation.alberta.ca/mapping

DataKustic GmbH (DataKustic). 2018. *Cadna/A Computer Aided Noise Abatement Model*, Munich, Germany.

Google Earth Pro, licensed to Patching Associates Acoustical Engineering Ltd.

International Organization for Standardization (ISO). 1993. *Standard 9613-1, Acoustics – Attenuation of Sound during Propagation Outdoors – Part 1: Calculation of Absorption of Sound by the Atmosphere*, Geneva Switzerland.

International Organization for Standardization (ISO) 1996. *Standard 9613-2, Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation*, Geneva Switzerland.

Natural Resources Canada: www.nrcan.gc.ca

# Appendix A: Glossary

Table A: Glossary

| Term | Description |
|---|---|
| Average Annual Daily Traffic (AADT) | The total volume of vehicle traffic of a highway or road for a year divided by 365 days. |
| Alberta Energy Regulator (AER) | The Alberta Energy Regulator ensures the safe, efficient, orderly, and environmentally responsible development of hydrocarbon resources over their entire life cycle. This includes allocating and conserving water resources, managing public lands, and protecting the environment while providing economic benefits for all Albertans. |
| Ambient sound level (ASL) | The sound pressure level that is a composite of different airborne sounds from many sources far away from and near the point of measurement. The ASL does not include any energy-related industrial component and must be measured without it. The ASL is assumed to be 5 dBA below the determined PSL as per section 2.1 of the Directive. |
| A-weighted sound level (dBA) | The sound level as measured on a sound level meter using a setting that emphasizes the middle frequency components similar to the frequency response of the human ear at levels typical of rural backgrounds in mid frequencies. |
| Bands (full octave or 1/3 octave) | A series of electronic filters separate sound into discrete frequency bands, making it possible to know how sound energy is distributed as a function of frequency. Each octave band has a centre frequency that is double the centre frequency of the octave band preceding it. The 1/3 octave band analysis provides a finer breakdown of sound distribution as a function of frequency. |
| Cumulative SPL | The cumulative sound pressure level from the facilities and the ambient sound level. |
| Comprehensive Sound Level (CSL) | The sound level that is a composite of different airborne sounds from many sources far away from and near the point of measurement. The CSL does include industrial components and must be measured with them, but it should exclude abnormal noise events. The CSL is used to determine whether a facility is in compliance with the Directive. |
| Cumulative noise level | The sound level that is the total contribution of all industrial noise sources (existing and proposed) from EUB-regulated facilities at the receptor. |
| C-weighted sound level (dBC) | The C-weighting approximates the sensitivity of human hearing at industrial noise levels (above about 85 dBA). The C-weighted sound level (i.e., measured with the C-weighting) is more sensitive to sounds at low frequencies than the A-weighted sound level and is sometimes used to assess the low-frequency content of complex sound environments. |
| Daytime | Defined as the hours from 07:00 to 22:00. |
| Deferred facility | Facilities constructed and in operation prior to October 1988. These facilities do not have to demonstrate compliance in the absence of a complaint. This does not exempt them from the requirements but does recognize that they were potentially designed without the same considerations for noise as facilities approved after the date when the first comprehensive noise control directive (ID 88-1) was published and put into effect. |
| Directive 038: Noise Control | Directive 038: Noise Control states the requirements for noise control as they apply to all operations and facilities under the jurisdiction of the Alberta Energy and Utilities Board (EUB). The directive also provides background information and describes an approach to deal with noise problems. This directive is the fifth edition, superseding Interim Directive (ID) 99-8. |
| Energy equivalent sound level (Leq) | The average weighted sound level over a specified period of time. It is a single-number representation of the cumulative acoustical energy measured over a time interval. The time interval used should be specified in brackets following the Leq—e.g., Leq (9) is a 9-hour Leq. If a sound level is constant over the measurement period, the Leq will equal the constant sound level. |
| Emergency | An unplanned event requiring immediate action to prevent loss of life or property. Events occurring more than four times a year are not considered unplanned. |
| Facility SPL | The overall sound pressure level from all the facilities in the study area |

## Table A: Glossary

| Term | Description |
|---|---|
| Heavily Travelled Road | Generally includes highways and any other road where the average traffic count is at least 10 vehicles/hour over the nighttime period. It is acknowledged that highways are sometimes lightly travelled during the nighttime period, which is usually the period of greatest concern. The AER will use the 10 vehicles/hour criterion to determine whether highways qualify as heavily travelled during the nighttime period. |
| Low Frequency Noise (LFN) | Where a clear tone is present below and including 250Hz and the difference between the overall C-weighted sound level and the overall A-weighted sound level exceeds 20 dB. |
| Nighttime | Defined as the hours from 22:00 to 07:00. |
| Noise | Generally associated with the unwanted portion of sound. |
| Noise Impact Assessment (NIA) | An NIA identifies the expected sound level emanating from a facility as measured 15 m from the nearest or most impacted permanently or seasonally occupied dwelling. It also identifies what the permissible sound level is and how it was calculated. |
| Permanent facility | A facility that is in operation for more than two months. |
| Permissible Sound Level (SPL) | The maximum SPL that a facility must not exceed at receivers located within 1500 m from the subject facility fence line. The PSL for each receiver is determined as per section 2.1 of the Directive. |
| Receiver | The location of the residences existing in the NIA study area for which the SPL is determined. In the event that there are no residences existing in the study area, then hypothetical receivers are included at 1500 m from the subject facility fence line. |
| Representative conditions | Those conditions typical for an area and/or the nature of a complaint. For ASLs, these are conditions that portray the typical activities for the area, not the quietest time. For CSLs, these do not constitute absolute worst-case conditions or the exact conditions the complainant has highlighted if those conditions are not easily duplicated. Sound levels must be taken only when representative conditions exist; this may necessitate a survey of extensive duration (two or more consecutive nights). |
| Sound Power Level (PWL) | The sound level emitted. The decibel equivalent of the rate of energy (or power) emitted in the form of noise. The sound power level is given by: $PWL = 10 \times LOG_{10}\left(\frac{Sound\ as\ Power}{W_0}\right)$ Where $W_0 = 10^{-12}$ watts (or 1 pW) |
| Sound Pressure Level (SPL) | The sound level received. The decibel equivalent of the pressure of sound waves at a specific location, which is measured with a microphone. The sound pressure level is given by: $SPL = 10 \times LOG_{10}\left(\frac{Sound\ as\ Pressure}{P_0}\right)$ Where $P_0 = 2 \times 10^{-5}$ Pa (or 20 $\mu$Pa) |
| Subject facility | The energy industry facility which is the object of the NIA. |
| Temporary facility | Any facility that will be in operation less than 60 days. |
| Tonal component | A pronounced peak clearly obvious within the sound level spectrum. |

# Appendix B: Target Sound Level Determination

# AUC Section 2.1: Target Sound Level Determination
## FortisBC Lee Substation at McCurdy Road E and Tower Ranch Drive
## All Receivers in the Study Area

**Basic Nighttime Sound Level**

| Proximity to Transportation | Dwelling Unit Density per ¼ Section of Land: 1 - 8 Dwellings | 9 - 160 Dwellings | >160 Dwellings | Nighttime | Daytime |
|---|---|---|---|---|---|
| Category 1 | 40 | 43 | 46 | | |
| Category 2 | 45 | 48 | 51 | | |
| Category 3 | 50 | 53 | 56 | 53 | 53 |
| Daytime Adjustment | | | | N/A | 10 |
| Basic Sound Levels | | | | 53 | 63 |

**Class A Adjustments**

| Class | Reason for Adjustment | Value (dBA $L_{eq}$) | Nighttime | Daytime |
|---|---|---|---|---|
| A1 | Seasonal Adjustment (Wintertime Operation) | +5 | N/A | N/A |
| A2 | Ambient Monitoring Adjustment | -10 to +10 | N/A | N/A |
| | Class Adjustment = Sum of A1 and A2 (as applicable), but not to exceed a maximum of 10 dBA $L_{eq}$ | | | |
| | Total Class A Adjustments | | 0 | 0 |

**Class B Adjustments**

| Class | Duration of Activity | Value (dBA $L_{eq}$) | Nighttime | Daytime |
|---|---|---|---|---|
| B1 | 1 day | +15 | | |
| B2 | 7 days | +10 | | |
| B3 | < or = to 60 days | +5 | | |
| B4 | > 60 days | 0 | 0 | 0 |
| | Class B Adjustment = one only of B1, B2, B3 or B4 | | | |
| | Class B Adjustment | | 0 | 0 |

| | Nighttime | Daytime |
|---|---|---|
| **Target Sound Level (dBA)** | **53** | **63** |

Category 1: Dwelling units more than 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers.
Category 2: Dwelling units more than 30 m but less than 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers.
Category 3: Dwelling units less than 30 m from heavily travelled roads and/or rail lines and/or subject to frequent aircraft flyovers.

# Appendix C: Subject Facility Plot Plan

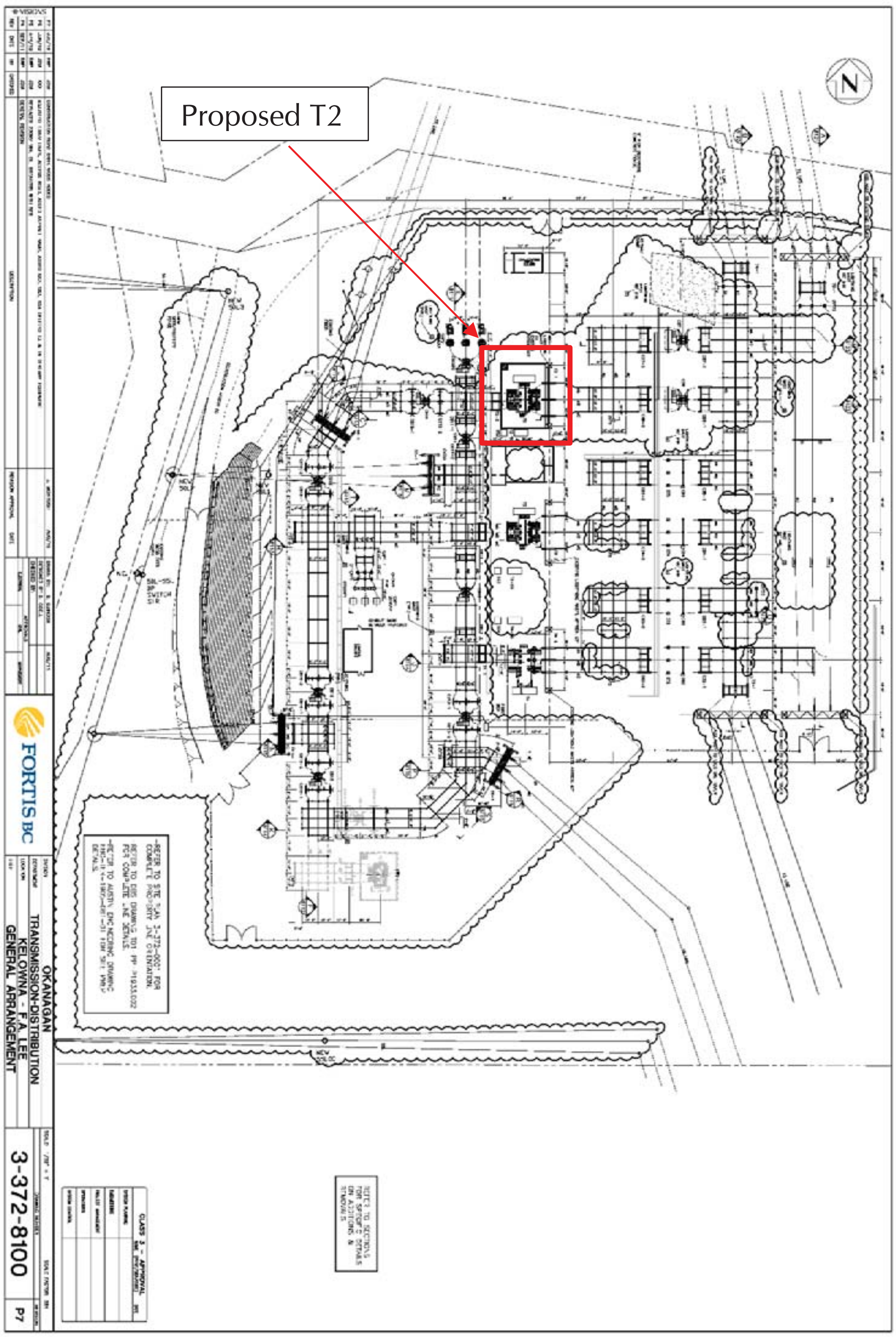



Figure C1: Subject Facility Plot Plan

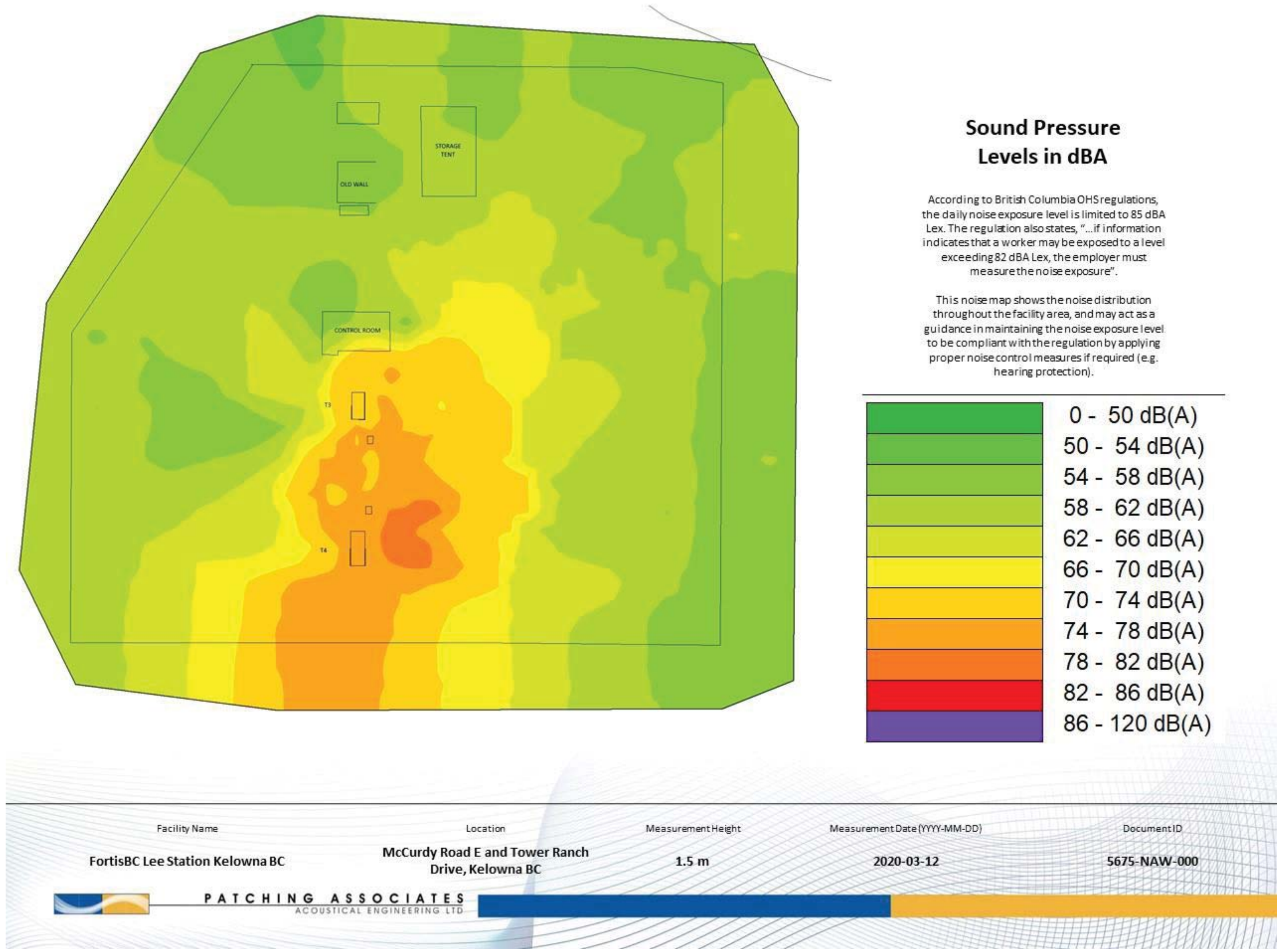



Figure C2: Near-Field Noise Map

# Appendix D: Sound Power Levels

The Sound Power Levels (PWL) were determined for all facility major noise sources. The PWL in linear octave band are presented in the table below.

- For each existing noise source that was operating normally during the field visit, the PWL was obtained from diagnostic measurements in March 2020.
- For each proposed noise source, the PWL was obtained from theory, manufacturer's data, and field measurement of similar units obtained from diagnostic measurements in 2020 and 2013.

Table D: Source Octave Band Sound Power Levels

| Noise Source | Data Source | Linear Octave Band Centre Frequency (dB) | | | | | | | | | Overall (dBA) | Overall (dBC) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 31.5 | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 | | |
| T4 Northeast rad intake fans up | Field | 114 | 104 | 99 | 100 | 97 | 93 | 88 | 84 | 80 | 99 | 112 |
| T4 Transformer body | Field | 81 | 87 | 100 | 99 | 101 | 81 | 72 | 62 | 61 | 98 | 104 |
| T4 East between rad fans up | Field | 98 | 99 | 97 | 99 | 97 | 93 | 88 | 80 | 72 | 98 | 105 |
| T4 Northwest rad face inlet fans up | Field | 115 | 102 | 96 | 97 | 94 | 91 | 88 | 81 | 77 | 96 | 113 |
| T4 Southeast rad intake fans up | Field | 112 | 101 | 97 | 98 | 95 | 91 | 86 | 81 | 78 | 96 | 110 |
| T4 Southwest rad face inlet fans up | Field | 115 | 102 | 96 | 97 | 94 | 91 | 87 | 80 | 76 | 96 | 112 |
| T4 Southeast rad side fans up | Field | 106 | 99 | 97 | 98 | 95 | 90 | 84 | 76 | 70 | 96 | 106 |
| T3 East between rad fans up | Field | 90 | 97 | 93 | 95 | 94 | 90 | 86 | 83 | 80 | 95 | 101 |
| T4 Northeast rad side fans up | Field | 105 | 98 | 96 | 98 | 94 | 89 | 83 | 75 | 69 | 95 | 106 |
| T3 Transformer body | Field | 80 | 76 | 94 | 91 | 97 | 81 | 72 | 58 | 60 | 94 | 99 |
| T4 Southeast under rad | Field | 103 | 97 | 93 | 96 | 93 | 89 | 84 | 76 | 72 | 94 | 104 |
| T4 West between rad fans up | Field | 95 | 93 | 94 | 96 | 93 | 89 | 84 | 75 | 70 | 94 | 101 |
| T4 Northwest rad side | Field | 103 | 98 | 94 | 96 | 93 | 88 | 82 | 73 | 68 | 94 | 104 |
| T4 Northeast under rad | Field | 103 | 96 | 93 | 96 | 92 | 88 | 83 | 75 | 71 | 94 | 103 |
| T4 Southwest rad side | Field | 103 | 98 | 94 | 96 | 93 | 88 | 82 | 73 | 68 | 94 | 104 |
| T4 Northwest under rad | Field | 102 | 96 | 92 | 95 | 92 | 87 | 82 | 75 | 71 | 93 | 102 |
| T3 West between rad fans up | Field | 76 | 101 | 92 | 91 | 91 | 87 | 84 | 82 | 79 | 93 | 102 |

Table D: Source Octave Band Sound Power Levels

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T4 Southwest under rad | Field | 102 | 95 | 92 | 95 | 92 | 87 | 82 | 75 | 70 | 93 | 102 |
| T3 Northeast rad face fans up | Field | 81 | 93 | 94 | 95 | 92 | 86 | 82 | 77 | 70 | 93 | 100 |
| T3 Southeast rad face fans up | Field | 81 | 93 | 94 | 94 | 92 | 86 | 82 | 77 | 70 | 93 | 100 |
| T3 Northwest rad face fans up | Field | 84 | 96 | 92 | 92 | 90 | 86 | 82 | 78 | 72 | 92 | 99 |
| T3 Southwest rad face fans up | Field | 83 | 95 | 92 | 91 | 89 | 85 | 81 | 77 | 71 | 91 | 98 |
| T3 Southeast under rad fans up | Field | 79 | 93 | 88 | 88 | 88 | 83 | 80 | 77 | 75 | 89 | 96 |
| T3 Northeast under rad fans up | Field | 79 | 93 | 88 | 88 | 88 | 83 | 80 | 77 | 75 | 89 | 96 |
| T3 Northwest under rad fans up | Field | 78 | 92 | 87 | 88 | 87 | 83 | 80 | 77 | 74 | 89 | 95 |
| T3 Southwest under rad fans up | Field | 78 | 92 | 87 | 88 | 87 | 83 | 80 | 77 | 74 | 89 | 95 |
| T3 Southeast rad side fans up | Field | 79 | 90 | 93 | 92 | 86 | 79 | 73 | 69 | 66 | 88 | 97 |
| T3 Northeast rad side fans up | Field | 79 | 90 | 93 | 92 | 86 | 79 | 73 | 69 | 66 | 88 | 97 |
| T3 Northwest rad side fans up | Field | 71 | 94 | 89 | 89 | 86 | 80 | 74 | 70 | 67 | 87 | 96 |
| T3 Southwest rad side fans up | Field | 71 | 94 | 89 | 89 | 86 | 80 | 74 | 70 | 67 | 87 | 96 |
| T4 East between rad fans | Field | 68 | 75 | 84 | 88 | 86 | 68 | 60 | 54 | 51 | 85 | 91 |
| T4 West between rad fans | Field | 65 | 70 | 86 | 86 | 82 | 67 | 58 | 50 | 52 | 82 | 90 |
| T3 East between rad fans | Field | 62 | 61 | 80 | 69 | 73 | 59 | 50 | 43 | 46 | 71 | 81 |
| T3 West between rad fans | Field | 62 | 60 | 75 | 70 | 73 | 62 | 51 | 43 | 46 | 71 | 78 |
| Overall PWL | | 121 | 112 | 109 | 110 | 108 | 103 | 98 | 92 | 88 | 109 | 120 |

# Appendix E: Source Order Ranking Tables

Table E1: Source Order Ranking – Scenario Two – Existing w/ Fans - Receiver R03

| Rank | Noise Source | SPL (dBA) | dBC-dBA |
|---|---|---|---|
| 001 | T4 Southeast rad intake fans up | 34.5 | 18.6 |
| 002 | T4 Southeast rad side fans up | 33.1 | 15.2 |
| 003 | T4 Transformer body | 32.9 | 7.2 |
| 004 | T4 Northeast rad side fans up | 32.4 | 15.2 |
| 005 | T4 Northeast rad intake fans up | 31.8 | 14.8 |
| 006 | T4 Southeast under rad | 31.5 | 14.5 |
| 007 | T4 East between rad fans up | 31.2 | 7.4 |
| 008 | T3 East between rad fans up | 29.6 | 9.0 |
| 009 | T4 Northwest rad face inlet fans up | 29.3 | 17.3 |
| 010 | T4 Southwest rad face inlet fans up | 29.3 | 21.5 |
| 011 | T4 Northeast under rad | 28.5 | 12.4 |
| 012 | T3 Southeast rad face fans up | 27.9 | 8.1 |
| 013 | T3 Transformer body | 27.8 | 6.4 |
| 014 | T3 Northeast rad face fans up | 27.4 | 9.1 |
| 015 | T4 West between rad fans up | 27.0 | 7.5 |
| 016 | T4 Northwest rad side | 27.0 | 11.0 |
| 017 | T3 West between rad fans up | 26.9 | 13.6 |
| 018 | T4 Southwest rad side | 26.6 | 11.0 |
| 019 | T4 Northwest under rad | 26.6 | 13.3 |
| 020 | T3 Northwest rad face fans up | 26.1 | 11.0 |
| 021 | T3 Northeast rad side fans up | 22.9 | 10.9 |
| 022 | T3 Southeast rad side fans up | 22.7 | 10.7 |
| 023 | T3 Southeast under rad fans up | 22.5 | 10.7 |
| 024 | T3 Southwest rad face fans up | 21.6 | 13.5 |
| 025 | T3 Northwest rad side fans up | 21.6 | 12.4 |
| 026 | T3 Southwest rad side fans up | 21.4 | 12.3 |
| 027 | T4 East between rad fans | 18.2 | 6.7 |
| 028 | T3 Northeast under rad fans up | 18.1 | 13.9 |
| 029 | T3 Southwest under rad fans up | 17.7 | 11.0 |
| 030 | T4 Southwest under rad | 17.5 | 20.6 |
| 031 | T3 Northwest under rad fans up | 16.7 | 12.5 |
| 032 | T4 West between rad fans | 15.2 | 8.2 |
| | Facility SPL | 43.4 | 14.9 |
| | ASL | 48.0 | - |
| | Cumulative SPL | 49.3 | - |
| | Target Sound Level | 53.0 | - |

Table E2: Source Order Ranking – Scenario Three – Proposed During Winter & Shoulder Season Days/Nights & Summer Nights - Receiver R03

| Rank | Noise Source | SPL (dBA) | dBC-dBA |
|---|---|---|---|
| 001 | T4 Transformer body | 34.7 | 7.6 |
| 002 | T2 Transformer body | 32.1 | 6.3 |
| 003 | T3 Transformer body | 30.3 | 6.0 |
| 004 | T4 Northeast rads intake fans up | 13.3 | 19.2 |
| 005 | T4 Southeast rads intake fans up | 12.9 | 17.2 |
| 006 | T4 East btw rads fans up | 12.8 | 9.3 |
| 007 | T2 East between rads fans up | 11.6 | 8.6 |
| 008 | T4 Northwest rad face inlet fans up | 11.2 | 21.7 |
| 009 | T4 Southeast rad side fans up | 10.1 | 15.2 |
| 010 | T2 Southeast rad face fans up | 9.9 | 7.4 |
| 011 | T4 Southeast under rad | 9.9 | 13.2 |
| 012 | T4 Northeast rad side fans up | 9.4 | 15.2 |
| 013 | T2 Northeast rad face fans up | 8.6 | 8.7 |
| 014 | T4 West between rads fans up | 8.4 | 9.1 |
| 015 | T3 Southeast rad face fans up | 8.4 | 8.1 |
| 016 | T4 Southwest rad side | 7.8 | 14.9 |
| 017 | T3 East between rads fans up | 7.5 | 5.8 |
| 018 | T4 Northeast under rad | 7.4 | 15.3 |
| 019 | T4 Northwest rad side | 7.0 | 8.8 |
| 020 | T4 Northwest under rad | 6.8 | 15.1 |
| 021 | T2 Northeast under rad fans up | 6.3 | 9.7 |
| 022 | T4 Southwest rad face inlet fans up | 6.3 | 21.5 |
| 023 | T3 West between rads fans up | 4.7 | 9.2 |
| 024 | T3 Northeast rad face fans up | 4.5 | 7.1 |
| 025 | T2 West between rads fans up | 4.4 | 14.2 |
| 026 | T3 Southwest rad face fans up | 3.3 | 10.1 |
| 027 | T3 Northwest rad face fans up | 3.2 | 8.0 |
| 028 | T2 Northwest rad face fans up | 2.4 | 12.5 |
| 029 | T4 Southwest under rad | 1.1 | 15.3 |
| | Facility SPL | 37.6 | 7.8 |
| | ASL | 48.0 | - |
| | Cumulative SPL | 48.4 | - |
| | Target Sound Level | 53.0 | - |

## Table E3: Source Order Ranking – Scenario Four – Proposed During Summer Days - Receiver R03

| Rank | Noise Source | SPL (dBA) | dBC-dBA |
|---|---|---|---|
| 001 | T4 Transformer body | 34.7 | 7.6 |
| 002 | T2 Transformer body | 32.1 | 6.3 |
| 003 | T3 Transformer body | 30.3 | 6.0 |
| 004 | T4 Northeast rads intake fans up | 23.3 | 19.2 |
| 005 | T4 Southeast rads intake fans up | 22.9 | 17.2 |
| 006 | T4 East btw rads fans up | 22.8 | 9.3 |
| 007 | T2 East between rads fans up | 21.6 | 8.6 |
| 008 | T4 Northwest rad face inlet fans up | 21.2 | 21.7 |
| 009 | T4 Southeast rad side fans up | 20.1 | 15.2 |
| 010 | T2 Southeast rad face fans up | 19.9 | 7.4 |
| 011 | T4 Southeast under rad | 19.9 | 13.2 |
| 012 | T4 Northeast rad side fans up | 19.4 | 15.2 |
| 013 | T2 Northeast rad face fans up | 18.6 | 8.7 |
| 014 | T4 West between rads fans up | 18.4 | 9.1 |
| 015 | T3 Southeast rad face fans up | 18.4 | 8.1 |
| 016 | T2 Southeast under rad fans up | 18.4 | 7.9 |
| 017 | T4 Southwest rad side | 17.8 | 14.9 |
| 018 | T3 East between rads fans up | 17.5 | 5.8 |
| 019 | T4 Northeast under rad | 17.4 | 15.3 |
| 020 | T4 Northwest rad side | 17.0 | 8.8 |
| 021 | T4 Northwest under rad | 16.8 | 15.1 |
| 022 | T2 Northeast under rad fans up | 16.3 | 9.7 |
| 023 | T4 Southwest rad face inlet fans up | 16.3 | 21.5 |
| 024 | T3 West between rads fans up | 14.7 | 9.2 |
| 025 | T3 Northeast rad face fans up | 14.5 | 7.1 |
| 026 | T2 West between rads fans up | 14.4 | 14.2 |
| 027 | T3 Southeast under rad fans up | 14.3 | 10.6 |
| 028 | T3 Southwest rad face fans up | 13.3 | 10.1 |
| 029 | T3 Northwest rad face fans up | 13.2 | 8.0 |
| 030 | T2 Southeast rad side fans up | 12.9 | 11.3 |
| 031 | T2 Northeast rad side fans up | 12.9 | 11.3 |
| 032 | T2 Northwest rad face fans up | 12.4 | 12.5 |
| 033 | T3 Northeast rad side fans up | 12.3 | 11.3 |
| 034 | T3 Southeast rad side fans up | 12.3 | 11.3 |
| 035 | T2 Southwest under rad fans up | 11.4 | 5.7 |
| 036 | T4 Southwest under rad | 11.1 | 15.3 |
| 037 | T3 Northeast under rad fans up | 11.1 | 9.7 |
| 038 | T2 Southwest rad side fans up | 9.3 | 12.6 |
| 039 | T2 Southwest rad face fans up | 8.1 | 12.7 |
| 040 | T2 Northwest rad side fans up | 8.1 | 13.6 |
| 041 | T3 Southwest under rad fans up | 8.1 | 9.0 |
| 042 | T3 Northwest under rad fans up | 7.4 | 11.0 |
| 043 | T2 Northwest under rad fans up | 6.6 | 13.7 |

Table E3: Source Order Ranking – Scenario Four – Proposed During Summer Days - Receiver R03

| | | | |
|---|---|---|---|
| | Facility SPL | 38.9 | 11.3 |
| | ASL | 48.0 | - |
| | Cumulative SPL | 48.5 | - |
| | Target Sound Level | 53.0 | - |

# Appendix F: Noise Control Acoustic Specifications

## Summary

The table below lists the noise control items designed to reduce the SPL at the residences in the study area.

Noise Control Recommendations

| Item | Noise Source | Noise Control |
|---|---|---|
| 1 | Transformer Body and Cooling Fans | Install a 6m high noise barrier around the T2, T3 and T4 transformer |
| 2 (Recommended) | T2 Cooling Fans | Procure cooling fans meeting the below specifications and install a VFD system |

The specification sheets below report the acoustic specifications for the item listed above. Vendor shall provide the noise suppression equipment which shall meet or exceed the rated acoustic specifications in each octave band as tabulated. Specifications are intended to meet acoustical requirements only; review for durability, constructability, thermal insulation etc. are not included. Vendor shall provide material rated for the adequate temperature, and all other non-acoustical requirements of the application. Client shall provide relevant building drawings.

While the reported specification is preferred so as to optimize the noise reduction at this facility, slight deviations from the specification may be considered. If the reported specification is not easily achievable, Vendor to contact PAAE to develop an alternative feasible specification.

The additional facility equipment information reported in the specification sheet is estimated, and needs to be confirmed by the Vendor prior to ordering and installation.

The following acronyms are used in the specification sheets.

| Acronym | Description |
|---|---|
| α | Absorption Coefficient - Alpha |
| DIL | Dynamic Insertion Loss |
| IL | Insertion Loss |
| NR | Noise Reduction |
| TL | Transmission Loss |

## Noise Barrier

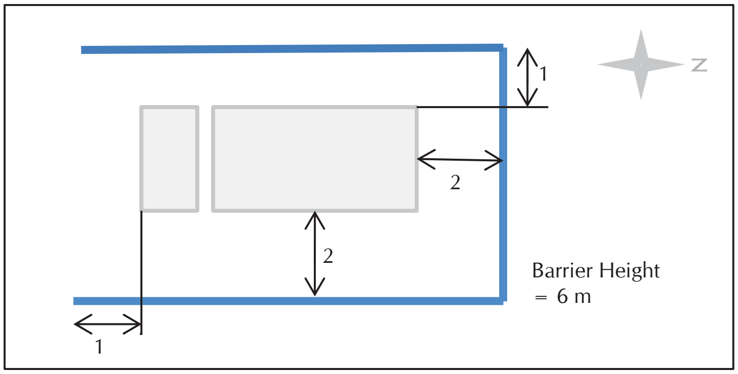
Noise Control Items

| Item | Noise Source | Noise Control |
|---|---|---|
| 1 | Transformer T2, T3 and T4 | Install a Noise Barrier on the west, north and east sides |

Acoustic Specifications

| | Octave Band Centre Frequency (Hz) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 31.5 | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 | 8000 |
| **Rated Transmission Loss (TL) (dB)** | 4 | 7 | 14 | 20 | 24 | 35 | 35 | 39 | 39 |

The barrier should be no further than 2 m away from the transformer, should be at least 6 m high and extend at least 1 m past the edge of the building. The barrier will be U-shaped and standing between the transformers and the nearest residences such as to break line of sight. The barrier shall have a density of at least 10 kg/m$^2$ or 2.05 lb/ft$^2$, and no air leaks or gaps underneath the barrier.




Barrier placement should consider safety and access/egress concerns as well as operational implications. Barriers placed near coolers should be assessed for recirculation and air flow implications as part of detailed design.

Equipment Details

| Equipment Name | Building Details |
|---|---|
| Transformer T2, T3 and T4 | • T2 Building dimensions unspecified.<br>• T3 Building estimated dimensions: 6 m length, 3.2 m width (coolers additional) , 5 m high<br>• T4 Building estimated dimensions: 9 m length, 7.2 m width (coolers additional) , 5 m high<br>• See the plot plan in Appendix C for building location and surroundings |

Transformer T3 (left) and T4 (right)

## Cooler Fan

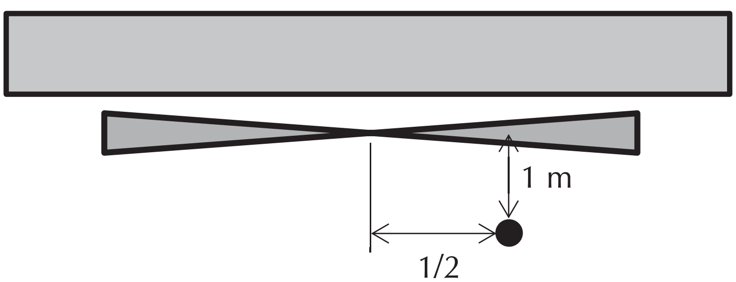
Noise Control Items

| Item | Noise Source | Noise Control |
|---|---|---|
| 2 | Transformer T2 Cooling Fans | Install Low Noise Fans and a Variable Frequency Drive (VFD) |

Acoustic Specifications

The cooler fan shall not create more than **82 dBA** at a distance of 1 metre from the plane of rotation opposite the bundle and measured at the ½ radius point. This limit applies to conditions when the fan is operating at design blade pitch and maximum design speed.

In addition, the cooler supplier shall design the cooler system to include capabilities for variable speed operation that automatically controls the fan speed. The fan speed shall be limited to approximately 80% of design maximum speed between the hours of 22:00 and 7:00 year-round.



# Appendix G: Technical Details and Best Practices Approach

## Technical Details

Sound is the phenomena of vibrations transmitted through air, or other medium such as water or a building structure. The range of pressure amplitudes, intensities, and frequencies of the sound energy is very wide, and many specialized fields have developed using different ranges of these variables, such as room acoustics and medical ultrasound.

Due to the wide range of intensities, which are perceived as sound, standard engineering units become inconvenient. Sound levels are commonly measured on a logarithmic scale, with the level (in decibels, or dB) being proportional to ten times the common logarithm of the sound energy or intensity. Normal human hearing covers a range of about twelve to fourteen orders of magnitude in energy, from the threshold of hearing to the threshold of pain. On the decibel scale, the threshold of hearing is set as zero, written as 0 dB, while the threshold of pain varies between 120 to 140 dB. The most usual measure of sound is the sound pressure level (SPL), with 0 dB SPL set at 2.0 X $10^{-5}$ N/$m^2$ (also written 20 $\mu$Pa), which corresponds to a sound intensity of $10^{-12}$ Watts/$m^2$ (or 1 picoWatt/$m^2$, written 1 pW/$m^2$).

Normal human hearing spans a frequency range from about 20 Hertz (Hz, or cycles per second) to about 20,000 Hz (written 20 kHz). However, the sensitivity of human hearing is not the same at all frequencies. To accommodate the variation in sensitivity, various frequency-weighting scales have been developed. The most common is the A-weighting scale, which is based on the sensitivity of human hearing at moderate levels; this scale reflects the low sensitivity to sounds of very high or very low frequencies. Sound levels measured on the A-weighted scale are written in A-weighted decibels, commonly shown as dBA or dB(A).

Human hearing becomes more sensitive to lower frequency sounds as the level of the sound increases. For this purpose, the C-weighing scale was developed to assess reaction to higher levels sounds. Although the C-weighting scale, or the sound level in dBC, is seldom used on its own, the levels in dBC and dBA are often used together to assess the significance of the low-frequency components of sound. In some cases, a limit is placed on the dBC level at a location in order to limit the amount of low-frequency noise.

When sound is measured using the A-weighting scale, the reading is often called the “Noise level”, to confirm that human sensitivity and reactions are being addressed. A table of some common noise sources and their associated noise levels are shown in the table below.

When the A-weighting scale is not used, the measurement is said to have a “linear” weighting, or to be unweighted, and may be called a “linear” level. As the linear reading is an accurate measurement of the physical (sound) pressure, the term “Sound Pressure Level”, or SPL, is usually (but not universally) reserved for unweighted measurements.

Noise is usually defined as “unwanted sound”, which indicates that it is not just the physical sound that is important, but also the human reaction to the sound that leads to the perception of sound as noise. It implies a judgment of the quality or quantity of sound experienced. As a human reaction to sound is involved, noise levels are usually given in A-weighted decibels (dBA). However, use of the C-weighting scale, usually in combination with the dBA level, is becoming more common as well. An alternate definition of noise is “sound made by somebody else”, which emphasizes that the ability to control the level of the sound alters the perception of noise.

Noise Levels of Familiar Sources

| Source Or Environment | Noise Level (dBA) |
|---|---|
| High Pressure Steam Venting To Atmosphere (3 m) | 121 |
| Steam Boiler (2 m) | 90-95 |
| Drilling Rig (10 m) | 80-90 |
| Pneumatic Drill (15 m) | 85 |
| Pump Jack (10 m) | 68-72 |
| Truck (15 m) | 65-70 |
| Business Office | 65 |
| Conversational Speech (1 m) | 60 |
| Light Auto Traffic (30 m) | 50 |
| Living Room | 40 |
| Library | 35 |
| Soft Whisper (5 m) | 20-35 |

The single number A-weighted level is often inadequate for engineering purposes, although it does supply a good estimate of people’s reaction to a noise environment. As noise sources, control measures, and materials differ in the frequency dependence of their noise responses or production, sound is measured with a narrower frequency bandwidth; the specific methodology varies with the application. For most work, the acoustic frequency range is divided into frequency bands where the center frequency of each band is twice the frequency of the next lower band; these are called “Octave” bands, as their frequency relation is called an “Octave” in music, where the field of acoustics has its roots. For more detailed work, the octave bands, and certain standard octave and 1/3 octave bands have been specified by international agreements.

Where the noise at the receiver is steady, it is easy to assess the noise level. However, both the production of noise at the source and the transmission of noise can vary with time; most noise levels are not constant, either because of the motion of the noise source (as in traffic noise), because the noise source itself varies, or because the transmission of sound to the receiver location is not steady as over long distances. This is almost always the case for environmental noise studies. Several single number descriptors have been developed and are used to assess noise in these conditions.

The most common is the measurement of the “equivalent continuous” sound level, or $L_{eq}$, which is the level of a hypothetical source of a constant level which would give the same total sound energy as is measured during the sampling period. This is the “energy” average noise level. Typical sampling periods are one hour, nighttime (9 hours) or one day (24 hours); the sampling period used must be reported when using this unit.

The greatest value of the $L_{eq}$ is that the contributions of different sources to the total noise level can be assessed, or in a case where a new noise source is to be added to an existing environment, the total noise level from new and old sources can be easily calculated. It is also sensitive to short term high noise levels.

Statistical noise levels are sometimes used to assess an unsteady noise environment. They indicate the levels that are exceeded a fixed percentage of the measurement time period measured. For example, the 10$^{th}$ percentile level, written $L_{10}$, is the levels exceeded 10% of the time; this level is a good measure of frequent noisy occurrences such as steady road traffic. The 90% level, $L_{90}$, is the level exceeded 90% of the time, and is the background level, or noise floor. A steady noise source will modify the background level, while an intermittent noise source such as road or rail traffic will affect the short-term levels only.

One disadvantage with the $L_{eq}$ measure, when used alone, is that nearby loud sources (e.g. dogs barking, or birds singing) can confuse the assessment of the situation when it is the noise from a distant plant that is the concern. For this reason, the equivalent level and the statistical levels can be used together to better understand the noise environment. One such indication is the difference between the $L_{eq}$ and the $L_{90}$ levels. A large difference between the $L_{eq}$ and $L_{90}$, greater than 10 dB, indicates the intrusion of short-term noise events on the general background level. A small difference, less than 5 dB, indicates a very steady noise environment. If the $L_{eq}$ value exceeds the $L_{10}$ value this indicates the presence of significant short-term loud events.

For most noise measurement, instruments are adjusted so that the time response of the instrument is similar to the response of the human ear; this is the “Fast” setting. Measurement with the “Fast” setting therefore assesses the sound environment according to the way humans would hear it and react to it. Where the noise level varies substantially and an average level is wanted without the complexity of and $L_{eq}$ or statistical measurement, the “Slow” setting is used on the sound level meter. The “Slow” setting is also typically used in industrial settings where hearing damage is a concern. Where the noise level changes very rapidly, for example due to impacts or detonations, the “Fast” and “Slow” settings do not respond quickly enough to assess the maximum levels, and the “Impulse” meter setting us used.

The Sound Power Level (abbreviated $L_w$, SWL or PWL) is the decibel equivalent of the total energy emitted from a source in the form of noise. The reference level for the sound power is $10^{-12}$ Watts, or 1 picoWatt (abbreviated pW). The sound power level is given by:

$$L_w, \text{SWL}, \text{PWL} = 10 \times \log_{10} (\text{Emitted Power} / 1 \text{ pW}) \text{ dB}$$

Therefore, a source emitting 1 Watt of power in the form of sound would have a sound power level of 120 dB. Sound power levels can be expressed in terms of frequency bands, an overall linear-weighted level or A-weighted, as is the case for sound pressure levels. However, sound power levels are inherent to the source of noise, whereas the sound pressure level is dependant on the source, but also on the distance from the source and other environmental factors.

Note that according to the acoustical literature (E.g. Noise Control Engineering from Bies and Hanson), the subjective effect of changes in SPL is as follows:

- A 3 dB change is “just perceptible”.
- A 5 dB change is “clearly noticeable”.
- A 10 dB change is “twice as loud or half as loud”.
- A 20 dB change is “much louder or much quieter”.

## Best Practices Approach

The AER encourages licensees to adopt and incorporate a best practices approach to noise management into their facility maintenance and operating procedures. This may include such things as taking regular fence line measurements to determine if there are any significant changes to sound emanating from the facility, orientating fans away from directly facing receivers, closing equipment building doors and windows whenever possible, equipping facility related vehicles including trucks with appropriate mufflers, and where possible, scheduling noisy events during daytime hours of 7 AM to 8 PM in order to reduce potential noise disturbances. Where high noise generating activity like high pressure blowdown or venting would occur, appropriate vent silencer should be fitted on the vent nozzle to minimize noise disturbance.

## Construction Noise

Although there is no specific construction noise level limit detailed by the Directive, there are general recommendations for construction noise mitigation during equipment installation. This includes all activities associated with installation of the proposed new equipment. The document states:

> "While Directive 038 is not applicable to construction noise, licensees should attempt to take the following reasonable mitigating measures to reduce the impact on nearby dwellings of construction noise from new facilities or modifications to existing facilities. Licensees should:
>
> - Conduct construction activity between the hours of 07:00 and 22:00 to reduce the potential impact of construction noise;
> - Advise nearby residents of significant noise-causing activities and schedule these events to reduce disruption to them;
> - Ensure all internal combustion engines are fitted with appropriate muffler systems; and
> - Take advantage of acoustical screening from existing on-site buildings to shield dwellings from construction equipment noise.
>
> Should a valid complaint be made during construction, the licensee is expected to respond expeditiously and take appropriate action to ensure that the issue has been managed responsibly."

The AER encourages licenses to adopt these recommendations into their noise management plan where reasonably practical to minimize potential noise disturbances during construction related activities.

# Appendix F

# DRAFT ORDERS

bcuc
British Columbia
Utilities Commission

Suite 410, 900 Howe Street
Vancouver, BC Canada V6Z 2N3
bcuc.com

P: 604.660.4700
TF: 1.800.663.1385
F: 604.660.1102

**ORDER NUMBER**
**C-xx-xx**

IN THE MATTER OF
the *Utilities Commission Act*, RSBC 1996, Chapter 473

and

FortisBC Inc.
Application for a Certificate of Public Convenience and Necessity for the Kelowna Bulk Transformer Addition Project

**BEFORE:**
[Panel Chair]
Commissioner
Commissioner

on Date

**ORDER**

**WHEREAS:**

A. On April 24, 2020, FortisBC Inc. (FBC) submitted an Application to the British Columbia Utilities Commission (BCUC) for a Certificate of Public Convenience and Necessity (CPCN), pursuant to sections 45 and 46 of the *Utilities Commission Act,* for the Kelowna Bulk Transformer Addition Project (Application);

B. The Application consists of the following (collectively, the Project):

1. Installation of a new 230/138kV, 120/160/200MVA bulk transformer at the F.A. Lee Terminal Station in the City of Kelowna;

2. Required substation modifications inside the F.A. Lee Terminal station;

3. Re-alignment of some existing transmission structures outside the F.A. Lee Terminal station; and

4. Re-alignment of the existing distribution egress within the station;

C. FBC estimates capital cost for the Project in as-spent dollars to be $23.288 million, which includes Allowance for Funds Used During Construction and net removal costs;

D. The Project in-service date is expected to be during the fourth quarter of 2022;

E. FBC requests that certain detailed information relating to Project engineering and cost estimates be treated as confidential due to their commercially sensitive nature, to maintain the safety of FBC's workers and the public, and to maintain the safety and security of FBC assets;

F. On [Date], the BCUC issued Order G-##-20 establishing a written hearing process for the review of the Application; and

G. The BCUC has considered the Application, evidence and submissions and finds that public convenience and necessity require that the Project proceed and the following determinations are warranted.

**NOW THEREFORE** the BCUC orders as follows:

1. Pursuant to sections 45 and 46 of the *Utilities Commission Act*, a CPCN is granted to FBC to construct and operate the Project at the F.A. Lee Terminal Station in the City of Kelowna;

2. FBC is directed to file with the BCUC the following reports, the form of which are to be determined in consultation with BCUC staff:

   a. Within 30 days of the end of each quarterly reporting period, and ending upon the filing of the Final Report, Quarterly Progress Reports on the Project; and

   b. As soon as practicable but no longer than 30 days upon the identification of a material change, including any significant delays or material cost variances, a Material Change Report (which may be filed as part of the Quarterly Progress Report where time permits); and

   c. Within six months of the final in-service date, a Final Report.

3. The BCUC will continue to hold the three appendices listed in the Application cover letter, and Information Requests and responses directly relating to those appendices, as confidential.

**DATED** at the City of Vancouver, in the Province of British Columbia, this (XX) day of (Month Year).

BY ORDER

(X. X. last name)
Commissioner

bcuc
British Columbia
Utilities Commission

Suite 410, 900 Howe Street
Vancouver, BC Canada V6Z 2N3
**bcuc.com**

**P:** 604.660.4700
**TF:** 1.800.663.1385
**F:** 604.660.1102

**ORDER NUMBER**
**G-xx-xx**

IN THE MATTER OF
the *Utilities Commission Act*, RSBC 1996, Chapter 473

and

FortisBC Inc.
Application for a Certificate of Public Convenience and Necessity for the Kelowna Bulk Transformer Addition Project

**BEFORE:**
[Panel Chair]
Commissioner
Commissioner

on Date

**ORDER**

**WHEREAS:**

A. On April 24, 2020, FortisBC Inc. (FBC) submitted an Application to the British Columbia Utilities Commission (BCUC) for a Certificate of Public Convenience and Necessity (CPCN), pursuant to sections 45 and 46 of the *Utilities Commission Act,* for the Kelowna Bulk Transformer Addition Project (Application);

B. The Application consists of the following (collectively, the Project):

   1. Installation of a new 230/138kV, 120/160/200MVA bulk transformer at the F.A. Lee Terminal Station in the City of Kelowna;

   2. Required substation modifications inside the F.A. Lee Terminal station;

   3. Re-alignment of some existing transmission structures outside the F.A. Lee Terminal station; and

   4. Re-alignment of the existing distribution egress within the station;

C. FBC estimates capital cost for the Project in as-spent dollars to be $23.288 million, which includes Allowance for Funds Used During Construction and net removal costs;

D. The Project in-service date is expected to be during the fourth quarter of 2022;

E. FBC requests that certain detailed information relating to Project engineering and cost estimates be treated as confidential due to their commercially sensitive nature, to maintain the safety of FBC's workers and the public, and to maintain the safety and security of FBC assets; and

F. The BCUC has determined that a written public hearing to review the Application is warranted.

**NOW THEREFORE** the BCUC orders as follows:

1. A written hearing is established for the review of the Application in accordance with the Regulatory Timetable attached as Appendix A to this order.

2. Appendices A, B, and C attached to the Application will be held confidential, due to their commercially sensitive nature and to maintain the safety and security of FBC's assets. Interveners may obtain access to this information by executing standard form undertakings of confidentiality.

3. By no later than [DATE], FBC is to publish the Public Notice, attached as Appendix B to this Order, in such appropriate news publications as to provide adequate notice to those parties to the public in the affected service area.

4. The Application, together with any supporting materials, will be available for inspection at the FBC Office at Suite 100, 1975 Springfield Road, Kelowna, BC V1Y 7V7. The Application and supporting materials also will be available on the FortisBC website at www.fortisbc.com and on the BCUC website at www.bcuc.com.

5. Interveners who wish to participate in the regulatory proceeding are to register with the BCUC by completing a Request to Intervene Form, available on the BCUC's website at http://www.bcuc.com/Registration-Intervener-1.aspx by the date established in the Regulatory Timetable attached as Appendix A to this Order and in accordance with the BCUC's Rules of Practice and Procedure adopted by Order G-15-19.

**DATED** at the City of Vancouver, in the Province of British Columbia, this (XX) day of (Month Year).

BY ORDER

(X. X. last name)
Commissioner

Attachment

FortisBC Inc.
Application for a Certificate of Public Convenience and Necessity for the Kelowna Bulk Transformer Addition Project

## REGULATORY TIMETABLE

| Action | Date (2020) |
|---|---|
| FBC publishes Public Notice | Friday, May 29 |
| Intervener Registration | Thursday, June 11 |
| BCUC Information Request (IR) No. 1 | Thursday, June 18 |
| Intervener IR No. 1 | Thursday, June 25 |
| FBC Response to IR No. 1 | Thursday, July 9 |
| BCUC and Intervener IR No. 2 | Thursday, July 30 |
| FBC Response to IR No. 2 | Thursday, August 20 |
| FBC Final Written Submission | Thursday, September 3 |
| Intervener Final Written Submissions | Thursday, September 17 |
| FBC Written Reply Submission | Tuesday, September 29 |

bcuc
British Columbia
Utilities Commission

# PUBLIC NOTICE

## FortisBC Inc. Application for a Certificate of Public Convenience and Necessity for the Kelowna Bulk Transformer Addition Project

On April 24, 2020, FortisBC Inc. applied to the British Columbia Utilities Commission (BCUC) for approval of a Certificate of Public Convenience and Necessity (CPCN), pursuant to sections 45 and 46 of the *Utilities Commission Act*, for the installation of a new bulk transformer at the F.A. Lee Terminal Station in the City of Kelowna and modifications inside and outside the station. FBC states that the Project, estimated at a cost of $23.288 million, is required to maintain adequate transformation capacity in the Kelowna area in the event of the loss of a single system element.

More information on the application can be found at **bcuc.com** on our "Current Proceedings" page, a hard copy of the application is also available for review at the BCUC's office and FEI's head office.

## HOW TO PARTICIPATE

- **Submit a letter of comment**
- **Register as an intervener**

## IMPORTANT DATES

1. **Thursday, June 11, 2020** – Deadline to register as an intervener or file a letter of comment with the BCUC.

For more information on how to participate, please visit our website (**www.bcuc.com/get-involved**) or contact us at the information below.

All submissions will be added to the public record and posted on the BCUC's website.

## GET MORE INFORMATION

**FortisBC Energy Inc. Regulatory Affairs**

16705 Fraser Highway
Surrey, BC Canada V4N 0E8

**E:** gas.regulatory.affairs@fortisbc.com

**P:** 604.592.7664

**British Columbia Utilities Commission**

Suite 410, 900 Howe Street
Vancouver, BC Canada V6Z 2N3

**E**: Commission.Secretary@bcuc.com

**P**: 604.660.4700

## Appendix G

## CONFIDENTIALITY DECLARATION AND UNDERTAKING FORM

# Confidentiality Declaration and Undertaking Form

In accordance with the British Columbia Utilities Commission (BCUC) Rules of Practice and Procedure, please provide a completed form to the party who filed the confidential document and copy Commission Secretary at commission.secretary@bcuc.com. If email is unavailable, please mail the form to the address above.

**Undertaking**

I, _______________, am representing the party ______________________________________ in the matter of

__FortisBC Inc. Application for Approval of a Certificate of Public Convenience and Necessity for Kelowna Bulk Electricity Transformer Project ~ Project No. [xx].__

In this capacity, I request access to the confidential information in the record of this proceeding. I understand that the execution of this undertaking is a condition of an Order of the BCUC, and the BCUC may enforce this Undertaking pursuant to the provisions of the *Administrative Tribunal Act*.

| | |
|---|---|
| **Description of document:** | Documents filed confidentially in the proceeding, in unredacted form. Additional declarations below in order to have access to electronic confidential filings. |

I hereby undertake:

(a) to use the information disclosed under the conditions of the Undertaking exclusively for duties performed in respect of this proceeding;

(b) not to divulge information disclosed under the conditions of this Undertaking except to a person granted access to such information or to staff of the BCUC;

(c) not to reproduce, in any manner, information disclosed under the conditions of this Undertaking except for purposes of the proceeding;

(d) to keep confidential and to protect the information disclosed under the conditions of this Undertaking;

(e) to return to the applicant, _FortisBC Inc.__, all documents and materials containing information disclosed under the conditions of this Undertaking, including notes and memoranda based on such information, or to destroy such documents and materials within fourteen (14) days of the BCUC's final decision in the proceeding; and

(f) to report promptly to the BCUC any violation of this Undertaking.

I hereby undertake, with respect to electronic confidential information (spreadsheets or any and all other confidential information provided in electronic file format):

(g) to receive the electronic files by email;

(h) to ensure the safe protection of confidential electronic documents to protect access; and

(i) to confirm via Email at FortisBC's request that all confidential emails and related files have been permanently deleted from files and filing systems and destroyed within fourteen (14) days of the BCUC's final decision in the proceeding.

Signed at ________ this _____day of__________, 2020__.

Signature: ______________________________

Name (please print): ___________________

Representing (if applicable): _________________________________