3.8 ENVIRONMENTAL HEALTH - ELECTRIC AND MAGNETIC FIELDS

This section provides project-level discussion and analysis of potential health and safety impacts related to power frequency electric and magnetic fields (EMF), which are generated by power lines¹. The study area for this analysis is consistent with the study area used by Power Engineers (2017) (see the Methods for Studying the Affected Environment, to the right), and includes the areas immediately under and adjacent to the transmission lines, including areas within 250 feet from the centerline of the transmission line corridor (Figure 3.8-1). This study area of 250 feet from the centerline of the corridor is the distance generally necessary for magnetic field values to drop down to or near typical background levels of magnetic field strength in most residential settings², and is wider than PSE’s existing right-of-way.

As described in Section 8.6.1.4 of the Phase 1 Draft EIS, extensive health studies have not found a causal link between adverse health effects and EMF from electrical transmission lines. However, while it does not appear that EMF from the project would pose an environmental health hazard, it is analyzed in this document due to public concerns raised during EIS scoping. See the Phase 1 Draft EIS for a full discussion of environmental health studies related to EMF.

Typical magnetic field levels associated with transmission lines for the Energize Eastside project are described in the Phase 1 Draft EIS, but no information was provided for existing conditions because of the programmatic nature of that analysis. This Phase 2 analysis describes both existing conditions for representative areas along the segments and options, and projected magnetic field levels for representative areas.

**Methods for Studying the Affected Environment**

Electric fields that would occur as a result of the Energize Eastside project are described in the Phase 1 Draft EIS and are not further evaluated here. To evaluate changes in magnetic fields that would occur as a result of the project, PSE retained Power Engineers to calculate existing magnetic fields at locations along the transmission line corridor (Power Engineers, 2017). Methodologies used by Power Engineers were reviewed by the EIS Consultant Team to verify compliance with industry standards (Enertech Consultants, 2017a and 2017b). Measured magnetic fields were compared to expected magnetic field levels described in the Phase 1 Draft EIS.

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¹ The term EMF in this section refers to electric and magnetic fields at extreme low frequencies (ELF). EMF can be used in a much broader sense as well, encompassing electromagnetic fields with low or high frequencies. In the ELF range, electric and magnetic fields are not coupled or interrelated the same way that they are at higher frequencies. This is why the term is described as “electric and magnetic fields” and not “electromagnetic fields.”

² Most people in the United States are exposed to magnetic fields that average less than 2 milligauss (mG) in strength, although exposures for each individual vary. Average magnetic field levels within rooms are approximately 1 mG based on several large surveys, while in the immediate area of appliances, the measured values range from 9–20 mG (Severson et al., 1988; Silva et al., 1988). An EPRI study of 992 homes reported the average residential magnetic field value at 0.9 mG (Zaffanella, 1993).
Sources: King County, 2015; Ecology, 2014

**Figure 3.8-1. Study Area for the EMF Analysis**
Sources: King County, 2015; Ecology, 2014

Figure 3.8-1. Study Area for the EMF Analysis (continued)
Figure 3.8-1. Study Area for the EMF Analysis (continued)

Sources: King County, 2015; Ecology, 2014
Bellevue South Segment, Oak 2 Option

Bellevue South Segment, Willow 1 Option

Sources: King County, 2015; Ecology, 2014

Figure 3.8-1. Study Area for the EMF Analysis (continued)
BELLE SOUTH SEGMENT, WILLOW 2 OPTION

Sources: King County, 2015; Ecology, 2014

Figure 3.8-1. Study Area for the EMF Analysis (continued)
Figure 3.8-1. Study Area for the EMF Analysis (continued)
3.8.1 Relevant Plans, Policies, and Regulations

As described in Section 8.2.3 of the Phase 1 Draft EIS, policies addressing EMF exposure are established locally in the City of Bellevue Comprehensive Plan (City of Bellevue, 2015). The City of Redmond also has adopted policies in their Comprehensive Plan related to EMF reduction, which were not identified in the Phase 1 Draft EIS. The policies recommend requiring designs that incorporate known and accepted low-cost technological methods to reduce magnetic fields or the exposure to them, such as line configurations that reduce field strength, sufficient right-of-way widths, and sufficient height of lines from the ground, when siting high-voltage electrical facilities. The policies also recommend a periodic review of the state of scientific research on power frequency EMF and to modify policies and regulations, if warranted, by changing knowledge or new state or federal regulations requiring such changes (Policies UT-67 and UT-68) (City of Redmond, 2011). Section 8.2.3 of the Phase 1 Draft EIS also identifies the only two states in the U.S. that have enacted their own standards for magnetic fields from overhead transmission line: Florida and New York (see Table 8-1 of the Phase 1 Draft EIS). The State of Washington does not have adopted EMF guidelines or standards for electric transmission lines.

There are industry guidelines for limiting magnetic field exposure. Guidelines have been adopted by three organizations:

1. The International Commission on Non-Ionizing Radiation Protection (ICNIRP) is a non-profit organization that provides scientific advice and guidance on the health and environmental effects of electromagnetic radiation (including EMF) to protect people and the environment from detrimental exposure.

2. The American Council of Governmental Industrial Hygienists (ACGIH) is a non-profit organization with the core purpose of advancing occupational and environmental health.

3. The Institute of Electrical and Electronics Engineers (IEEE) Standards Association is a technical professional organization for engineering, computing, and technology information focused on advancing technology for the benefit of humanity.

These three organizations have developed guidelines by for limiting magnetic field exposure based on known biological effects from very high fields, such as occur in some occupations. The guidelines are presented in Tables 3.8-1 to provide context for understanding the calculated magnetic fields for the Energize Eastside project. These guidelines are generally accepted to protect the health of workers and/or the general public based on expert review of the available science. The guidelines are expressed in terms of the maximum levels of exposure that should be allowed for various groups based on the expected length of exposure (typically 8 hours for Occupational and 24 hours for General Public) (WHO, 2002) and the sensitivity of the group. The strength of magnetic fields is measured in units referred to as milligauss (mG).
### Table 3.8-1. Exposure Guidelines and Levels from the ICNIRP, ACGIH, and IEEE

<table>
<thead>
<tr>
<th>Exposure (60 Hz)</th>
<th>Magnetic Field</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ICNIRP Exposure Guidelines</strong></td>
<td></td>
</tr>
<tr>
<td>Occupational</td>
<td>10,000 mG</td>
</tr>
<tr>
<td>General public</td>
<td>2,000 mG</td>
</tr>
<tr>
<td><strong>ACGIH Exposure Guidelines</strong></td>
<td></td>
</tr>
<tr>
<td>Occupational exposure should not exceed:</td>
<td>10,000 mG</td>
</tr>
<tr>
<td>Exposure of workers with cardiac pacemakers should not exceed:</td>
<td>1,000 mG</td>
</tr>
<tr>
<td><strong>IEEE International Committee on Electromagnetic Safety Exposure Levels</strong></td>
<td></td>
</tr>
<tr>
<td>General public should not exceed:</td>
<td>9,040 mG</td>
</tr>
<tr>
<td>Controlled environments should not exceed:</td>
<td>27,100 mG</td>
</tr>
</tbody>
</table>

ACGIH = American Council of Governmental Industrial Hygienists; Hz = hertz; ICNIRP = International Commission on Non-Ionizing Radiation Protection; IEEE = Institute of Electrical and Electronics Engineers; mG = milligauss.

**3.8.2 Magnetic Fields in the Study Area**

Magnetic fields in the study area are associated with existing transmission lines and substations. This includes areas immediately under and adjacent to PSE’s existing corridor with overhead 115 kV transmission lines, as well as the Sammamish, Lakeside, Somerset, and Talbot Hill substations. It also includes areas under and adjacent to existing transmission and distribution lines on the route options in the Bellevue Central and Bellevue South Segments.

Power Engineers, Inc., performed an EMF investigation for the proposed project, titled *Puget Sound Energy, 230 kV Energize Eastside Project, EMF Calculations and Report* in March 2017 (Power Engineers, 2017). The report identified magnetic field strength at 35 representative locations along the project segments based on computer modeling. The analysis compared electric and magnetic fields between the existing and proposed transmission lines.

Magnetic field strength is dependent on the arrangement and spacing of the lines, distance of the lines above ground, and amount of current (amperes) or loading. Certain conductor (wire) arrangements and spacing can reduce or cancel magnetic field levels. Magnetic fields can also be reduced by increasing the operating voltage and reducing the amperage to deliver the same amount of electrical power.

Table 3.8-2 shows calculated magnetic field levels based on 2013–2014 load data for the existing 115 kV transmission lines within the study area. The values presented are based on summer peak and winter peak load data, which, although rare in occurrence, present the highest potential magnetic...
field levels. This ensures that the “worst-case” information is used for purposes of this analysis. Calculated magnetic field levels were computed as a function of distance away from the centerline of the existing transmission line corridor. The results are reported at one meter (3.28 feet) above the ground (based on standard industry practice). The maximum calculated magnetic field levels would typically occur within the transmission line corridor and drop in value at the edge of the transmission ROW. As shown in Table 3.8-2, the calculated magnetic field levels within the existing corridor are well below industry guidelines. They are also within the range of magnetic field levels presented in Section 8.3.5 of the Phase 1 Draft EIS (see overhead peak loads in Figure 8-5). Calculated magnetic field levels are highest in the Renton Segment because of the following two reasons: (1) portions of the segment have three conductors within the corridor, while other segments only have two conductors; and (2) transmission line loads are typically higher between the Talbot Hill and Lakeside substations than between the Sammamish and Lakeside substations, and would continue to be so in the future.

Table 3.8-2. Calculated Magnetic Fields along the Existing Transmission Line Corridor based on 2013–2014 Loading

<table>
<thead>
<tr>
<th>Segment</th>
<th>Maximum</th>
<th>At Edge of Right-of-Way</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Summer Peak (mG)</td>
<td>Winter Peak (mG)</td>
</tr>
<tr>
<td>Redmond</td>
<td>87</td>
<td>83</td>
</tr>
<tr>
<td>Bellevue North</td>
<td>87</td>
<td>83</td>
</tr>
<tr>
<td>Bellevue Central, Existing Corridor</td>
<td>87</td>
<td>83</td>
</tr>
<tr>
<td>Bellevue South, Existing Corridor</td>
<td>102</td>
<td>123</td>
</tr>
<tr>
<td>Newcastle</td>
<td>102</td>
<td>123</td>
</tr>
<tr>
<td>Renton</td>
<td>126</td>
<td>152</td>
</tr>
</tbody>
</table>

1Load data for 2013/2014 were used to be consistent with the study years considered in the initial reports prepared for the Eastside to assess electrical needs.

The study area for EMF contains approximately 4,665 acres of land within King County and the cities of Bellevue, Newcastle, Redmond, and Renton.

Potential EMF exposure levels depend on how long a person is in the vicinity of the existing transmission lines. Land uses in the area generally indicate what population groups are most likely to be exposed to magnetic fields from the existing and proposed transmission lines. In areas with commercial and industrial land uses, exposure would typically be workers, whose exposure limits are subject to occupational safety and health standards based on a standard work week. In residential areas, parks, schools, and other institutions open to the public, the general public is more likely to be
present. The potential length of exposure is greater among the general public in these areas than in an occupational setting. For purposes of this analysis, it was assumed that people in residential settings could be exposed 24 hours a day, 365 days per year. Residential is the most common land use found in the study area, and accounts for 35 percent.

The mix of land uses by segment and option is shown in Table 3.8-3. The table includes pie charts that present each land use as a percentage of the total study area within each segment or option.

**Table 3.8-3. Existing Land Uses in the Study Area**

<table>
<thead>
<tr>
<th>Segment/Option</th>
<th>Existing Land Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Richards Creek Substation</td>
<td>Existing land use in the Richards Creek substation study area is a mix of industrial, institutional, single-family residential, vacant lands, and utility (PSE’s Lakeside substation), and includes a private school (Chestnut Hill Academy) located north of the substation site, adjacent to (and just east of) the Lakeside substation.</td>
</tr>
<tr>
<td>Redmond</td>
<td>The largest categories of existing land use are utility and multi-family.</td>
</tr>
<tr>
<td>Bellevue North</td>
<td>The largest category of existing land use is single-family residential.</td>
</tr>
</tbody>
</table>
### Chapter 3

#### Long-Term (Operation) Impacts and Potential Mitigation

**Bellevue Central, Existing Corridor Option**

The largest category of existing land use is recreation.

![Pie chart showing existing land uses](chart1)

- Single-Family Residential
- Multi-Family Residential
- Commercial (Retail & Office)
- Industrial
- Institutional

**Bellevue Central, Bypass Option 1**

The largest category of existing land use is commercial.

![Pie chart showing existing land uses](chart2)

- Single-Family Residential
- Multi-Family Residential
- Commercial (Retail & Office)
- Industrial
- Institutional

**Bellevue Central, Bypass Option 2**

The largest category of existing land use is commercial.

![Pie chart showing existing land uses](chart3)

- Single-Family Residential
- Multi-Family Residential
- Commercial (Retail & Office)
- Industrial
- Institutional
### Bellevue South, Oak 1 Option
The largest category of existing land use is recreation.

### Bellevue South, Oak 2 Option
The largest categories of existing land use are single-family residential and recreation.

### Bellevue South, Willow 1 Option
The largest category of existing land use is recreation.
<table>
<thead>
<tr>
<th>Segment/Option</th>
<th>Existing Land Uses</th>
</tr>
</thead>
</table>
| Bellevue South, Willow 2 Option | The largest category of existing land use is single-family residential.  

![Pie chart](image)

Bellevue South, Willow 2 Option: The largest category of existing land use is single-family residential.

Newcastle: The largest category of existing land use is vacant lands (some of which are associated with May Creek Park).

![Pie chart](image)

Renton: The largest category of existing land use is vacant land, largely because this category includes large parcels associated with the bed and floodway of the Cedar River.

![Pie chart](image)
During the Phase 2 Draft EIS scoping period, several members of the community expressed concern about EMF exposure at unique sites, such as parks, schools, and daycare facilities. These land uses are unique in that they are non-residential uses, but are places where the general public congregates, sometimes for extended periods of time. Together with residential uses and trails that run along or underneath the transmission line corridor, such unique sites potentially extend the general public’s length of exposure to power frequency EMF. In this analysis, unique sites were considered to include the following: schools, parks, trails, a fire station, and a museum. Table 3.8-4 identifies unique sites within the study area (see Section 3.6.2, Recreation Resources in the Study Area for a list of parks and trails located in or adjacent to the transmission line corridor). There are five sites within 50–150 feet, one site within 50-250 feet, and four sites within 150–250 feet. See Appendix H for a map of these unique uses. These unique sites represent a relatively small portion of the total land uses within the study area.

Table 3.8-4. Sites with Unique Uses within the Study Area

<table>
<thead>
<tr>
<th>Segment/Option</th>
<th>Unique Use</th>
<th>Type</th>
<th>Distance from Transmission Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Redmond</td>
<td>Rose Hill Middle School</td>
<td>School</td>
<td>150–250 ft</td>
</tr>
<tr>
<td>Bellevue Central, Bypass</td>
<td>Chestnut Hill Academy</td>
<td>School</td>
<td>150–250 ft</td>
</tr>
<tr>
<td>Options 1 and 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bellevue Central, Bypass</td>
<td>Bellevue Fire Station 6</td>
<td>Fire Station</td>
<td>50–150 ft</td>
</tr>
<tr>
<td>Options 1 and 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bellevue Central, Bypass</td>
<td>Eastside Heritage Center</td>
<td>Museum</td>
<td>150–250 ft</td>
</tr>
<tr>
<td>Options 1 and 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bellevue Central, Bypass</td>
<td>Asian Pacific Language</td>
<td>School</td>
<td>50–150 ft</td>
</tr>
<tr>
<td>Option 2</td>
<td>School</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bellevue South, all Options</td>
<td>Tyee Middle School</td>
<td>School</td>
<td>50–250 ft</td>
</tr>
<tr>
<td>Bellevue South, Willow 2</td>
<td>Newport Children’s School</td>
<td>School</td>
<td>50–150 ft</td>
</tr>
<tr>
<td>Option</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bellevue South, Oak 2 Option</td>
<td>KinderCare</td>
<td>School</td>
<td>50–150 ft</td>
</tr>
<tr>
<td>Renton</td>
<td>Renton Technical College</td>
<td>School</td>
<td>50–150 ft</td>
</tr>
<tr>
<td>Renton</td>
<td>Sierra Heights Elementary School</td>
<td>School</td>
<td>150–250 ft</td>
</tr>
</tbody>
</table>

Source: Compiled by ESA. from project GIS data.
3.8.3 Long-term (Operation) Impacts Considered

Magnetic field calculations were performed to generally characterize changes in magnetic field levels within the study area that could occur under the No Action Alternative and Alternative 1. Power Engineers calculated potential magnetic field levels from the transmission lines based on the following load current scenarios that were provided by PSE:

1) Average and peak loads for winter 2017/2018 and summer 2018 under the No Action Alternative.
2) Average and peak loads for winter 2017/2018 and summer 2018 under Alternative 1.
3) Average and peak loads for winter 2027/2028 and summer 2028 under the No Action Alternative.
4) Average and peak loads for winter 2027/2028 and summer 2028 under Alternative 1 (Power Engineers, 2017).

To evaluate the worst-case scenario, the EIS presents only the magnetic field levels for winter or summer peak loads (whichever is highest), even though peak loads occur only for a few hours of the day over a few days of each year. The magnetic field strengths calculated based on average loads will be the more common levels expected for the project. Summer peak loads under Alternative 1 are typically 33 percent higher than summer average loads, and winter peak loads are typically 66 percent higher than winter average loads. The EIS presents the peak loads for 2027/2028 for both the No Action and Alternative 1 because loads for Alternative 1 are expected to be at their highest at that time based on projected electrical demand. Electrical load scenarios during 2027/2028 for the No Action Alternative are not anticipated to increase beyond the load scenarios in 2017/2018. Although the electrical demand is projected to increase, the existing transformers feeding the 115 kV lines are not designed to handle more amperage than what would be carried during peak loads in 2017/2018 (Kothapalli, pers. comm., 2017).

Magnetic fields from electrical equipment at the Richards Creek substation were not evaluated because the magnetic fields associated with the overhead transmission lines entering or leaving the substation are anticipated to be higher than the magnetic fields from electrical equipment (EPRI, 2005).

Methods and Approach for Studying the Long-term (Operation) Impacts

Power Engineers calculated potential magnetic fields at 35 representative calculation locations along the transmission line corridor for multiple load current scenarios (Power Engineers, 2017). The methodology and assumptions used by Power Engineers to calculate magnetic fields were reviewed by the EIS Consultant Team to verify compliance with industry standards and verify accuracy and technical soundness of the analysis (Enertech Consultants, 2017a; 2017b). Magnetic field levels for Alternative 1 are presented by segment and option and compared to the No Action Alternative. Magnetic field levels are presented for the winter 2027/2028 and summer 2028 peak periods (whichever is highest) at the centerline of the transmission right-of-way and at the edge of right-of-way.
3.8.3.1 **Magnitude of Impact**

The magnitude of the potential impacts from magnetic fields on environmental health is classified as less-than-significant or significant, defined as follows:

**Less-than-Significant** – Impacts from magnetic fields would be considered less-than-significant if the projected levels are below the guidelines established by the ICNIRP, ACGIH, and the IEEE International Committee on Electromagnetic Safety.

**Significant** – Impacts from magnetic fields would be considered significant if, after mitigation were applied, levels in areas of human exposure could exceed the guidelines established by the ICNIRP, ACGIH, and the IEEE International Committee on Electromagnetic Safety to protect human health.

3.8.4 **Long-term Impacts: No Action Alternative**

Under the No Action Alternative, PSE would continue to operate their existing 115 kV transmission lines as described in Chapter 2. Although the arrangement and spacing of the lines, distance of the lines above ground, and voltage would stay the same, the load (amperes) would change over time to accommodate changes in electrical demand. The change in load would increase the magnetic field levels during winter peak periods and decrease levels during summer peak periods for segments south of the Lakeside substation (Bellevue South, Newcastle, and Renton Segments). The change in load would decrease magnetic field levels during winter and summer peak periods in the segments north of the Lakeside substation (Redmond, Bellevue North, and Bellevue Central Segments).

Table 3.8-5 presents calculated magnetic field levels for the No Action Alternative based on load current scenarios during the winter 2027/2028 and summer 2028. Calculated magnetic field levels were computed as a function of distance away from the centerline of the existing transmission line corridor. The results are reported at one meter (3.28 feet) above the ground (based on standard industry practice). The maximum magnetic field levels would typically occur within the transmission line corridor and drop in value at the edge of the transmission right-of-way. Transmission lines north of the Lakeside substation would have the highest magnetic field levels during the summer peak condition, while transmission lines south of the Lakeside substation would have the highest magnetic field levels during the winter peak condition.

There are no known health effects from power frequency EMF. The magnetic field levels indicate that the existing corridor under the No Action Alternative would have calculated magnetic field levels well below industry guidelines. (Power Engineers, 2017). Therefore, under the No Action Alternative, impacts would be less-than-significant. Please refer to Chapter 8 of the Phase 1 Draft EIS for the complete discussion.
Table 3.8-5. Calculated Magnetic Fields along the Existing Transmission Line Corridor based on 2027–2028 Loading

<table>
<thead>
<tr>
<th>Segments</th>
<th>Maximum</th>
<th>At Edge of Right-of-Way</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Summer Peak (mG)</td>
<td>Winter Peak (mG)</td>
</tr>
<tr>
<td>Redmond</td>
<td>71</td>
<td>27</td>
</tr>
<tr>
<td>Bellevue North</td>
<td>71</td>
<td>27</td>
</tr>
<tr>
<td>Bellevue Central, Existing Corridor</td>
<td>71</td>
<td>27</td>
</tr>
<tr>
<td>Bellevue South, Existing Corridor</td>
<td>61</td>
<td>177</td>
</tr>
<tr>
<td>Newcastle</td>
<td>61</td>
<td>177</td>
</tr>
<tr>
<td>Renton</td>
<td>61–75*</td>
<td>177–219*</td>
</tr>
</tbody>
</table>

*Varies depending on the calculation location.

3.8.5 Long-term Impacts: Alternative 1 (New Substation and 230 kV Transmission Lines)

3.8.5.1 Impacts Common to all Components

All parts of the Energize Eastside project would have associated magnetic fields during operation. Magnetic field levels would vary depending on the electrical load being transmitted and the pole type proposed, including pole height and the arrangement and spacing of the lines.

Magnetic field levels diminish with distance from the source. Therefore, the greater the distance from the centerline of the transmission line, the lower the magnetic field levels. Taller poles would generally result in lower magnetic field levels at the measured height of one meter from the ground than would shorter poles carrying the same power lines. The configuration of lines also affects magnetic field levels, because the field from one line can “cancel out” the field from another line, depending on the geometric arrangement of the lines that make up a complete circuit. The loading (amperes) of the line can vary depending on seasonal electrical demands (winter versus summer), and the operational year (beginning of the project versus in 10-years’ time). For these reasons, the expected magnetic field levels would vary by segment and option, as described in greater detail below.

For each segment and option, the following pages present magnetic field levels as bar graphs for the 35 representative calculation locations. The bar graphs provide the estimated magnetic field levels (in mG) for the highest peak period in 2027/2028 (winter or summer, whichever is highest), at the centerline of the transmission line right-of-way (shown as “Max.”) and at the edge of the right-of-way for both the No Action Alternative and Alternative 1. The magnetic field values would generally drop below 5 mG toward the outermost edge of the study area (see the Power Engineers report for graphs that depict the magnetic field levels as a function of distance). This level of magnetic field strength is higher than typical background levels away from power lines, but lower than the levels in the current transmission corridor. One bar chart is provided for multiple calculation locations when the calculated magnetic field levels are identical across those locations.

Operation of the proposed transmission lines would result in a decrease of magnetic field levels relative to the No Action Alternative for all segments and options that utilize the existing corridor. Magnetic field levels would decrease for the following reasons:

1. The proposed configuration of the phase conductors (wires) is in a vertical arrangement, while the existing structures under the No Action Alternative use a horizontal arrangement. A vertical arrangement results in a narrower magnetic field profile (pole types and wire arrangement are shown in Table 2.1-2).

2. The proposed poles provide a higher minimum clearance for the lowest hanging phase conductors (wires) than the existing structures under the No Action Alternative. Raising phase conductors higher allows more room for magnetic field levels to decrease before they reach the ground.

In locations where Alternative 1 would utilize a new corridor, there would be an increase in magnetic field levels. Portions of the road rights-of-way that Bypass Option 1 and Bypass Option 2 would utilize do not currently have any overhead transmission lines. Therefore, a new source of power frequency EMF would be introduced along Bypass Option 1 and Bypass Option 2. A new source of power frequency EMF would also be introduced along 124th Avenue SE and SE 38th Street as part of...
the Oak 2 Option; and along SE Newport Way as part of the Willow 2 Option because these streets do not currently have any overhead transmission lines. An existing source of power frequency EMF, overhead 115 kV transmission lines, is present along the remaining streets associated with the Oak 1, Oak 2, and Willow 2 Options (SE 30th Street, Richards Road, Factoria Boulevard, Coal Creek Parkway SE). There would be an overall increase in magnetic field levels along these streets because Alternative 1 would result in an overall increase in the number of circuits compared to existing conditions, as well as a larger load current in the line.

Alternative 1 would be consistent with the policies in the Bellevue and Redmond Comprehensive Plans that address EMF exposure because the project design results in reduced magnetic field strength compared to the No Action Alternative in locations where the project would utilize a new corridor. Although no mitigation measures are identified to reduce magnetic field strengths for portions of the project along new corridors, the calculated magnetic field levels would be sufficiently low enough to avoid known health effects, and therefore considered consistent with Bellevue and Redmond policies.

There are no known health effects from power frequency EMF at the levels expected from the No Action Alternative or Alternative 1. For all proposed segments and options in Alternative 1, the calculated magnetic field levels would be at least 1,800 mG below the lowest industry guideline for magnetic field exposure for the general public (Power Engineers, 2017). This includes all of the unique sites listed in Table 3.8-4. Therefore, for all proposed segments and options under Alternative 1, impacts would be less-than-significant. Please refer to Chapter 8 of the Phase 1 Draft EIS for the complete discussion.

---

3 The highest calculated magnetic field level for Alternative 1 would be 174 mG (see Bellevue South Segment). The lowest industry guideline established for general public exposure to magnetic fields is 2,000 mG.
3.8.5.2 Redmond Segment

Relative to the No Action Alternative, magnetic field levels would decrease under Alternative 1 in the Redmond Segment. The calculated magnetic field levels generated by the project along the Redmond Segment would be well below industry guidelines; therefore, impacts would be less-than-significant.
3.8.5.3 Bellevue North Segment

Relative to the No Action Alternative, magnetic field levels would decrease under Alternative 1 in the Bellevue North Segment. The calculated magnetic field levels generated by the project along the Bellevue North Segment would be well below industry guidelines; therefore, impacts would be less-than-significant.
3.8.5.4  Bellevue Central Segment, Existing Corridor Option

Relative to the No Action Alternative, magnetic field levels would decrease under Alternative 1 in the Bellevue Central Segment, Existing Corridor Option. The calculated magnetic field levels generated by the project along the Existing Corridor Option would be well below industry guidelines; therefore, impacts would be less-than-significant.
3.8.5.5  Bellevue Central Segment, Bypass Option 1

Because there are no existing transmission lines along the Bypass Option 1 corridor, Alternative 1 would result in a new source of magnetic fields. The calculated magnetic field levels generated by the project along Bypass Option 1 would be well below industry guidelines; therefore, impacts would be less-than-significant.
3.8.5.6  Bellevue Central Segment, Bypass Option 2

Because there are no existing transmission lines along the Bypass Option 2 corridor, Alternative 1 would result in a new source of magnetic fields. The calculated magnetic field levels generated by the project along Bypass Option 2 would be well below industry guidelines; therefore, impacts would be less-than-significant.
3.8.5.7 Summary: Comparison of Segments and Options, Bellevue Central Segment

In the Bellevue Central Segment, the Bypass Options 1 and 2 would result in a net increase of magnetic field levels compared to the No Action Alternative because the transmission line would follow a new corridor. The Existing Corridor Option would reduce the magnetic field levels compared to the No Action Alternative but would have higher magnetic field levels than Bypass Options 1 and 2. The magnetic field levels for Bypass Options 1 and 2 would be identical, and are well below industry guidelines.

Table 3.8-6. Comparison of Bellevue Central Options, Calculated Magnetic Field Levels

<table>
<thead>
<tr>
<th>Segment / Option</th>
<th>Alternative 1, 2027/2028 Winter Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum</td>
</tr>
<tr>
<td>Existing Corridor</td>
<td>36 mG</td>
</tr>
<tr>
<td>Option</td>
<td></td>
</tr>
<tr>
<td>Bypass Option 1</td>
<td>22 mG*</td>
</tr>
<tr>
<td>Bypass Option 2</td>
<td>22 mG*</td>
</tr>
</tbody>
</table>

*The calculated magnetic field levels shown in the table are associated with the 230 kV lines proposed along a new corridor. The 115 kV line within the existing transmission corridor would remain but would likely have lower magnetic field values than the No Action Alternative.
Relative to the No Action Alternative, magnetic field levels would decrease under Alternative 1 in the Oak 1 Option for portions of the alignment along the existing PSE corridor. The magnetic field levels would increase under Alternative 1 for portions of the alignment along SE 30th Street, Richards Road, Factoria Boulevard, and Coal Creek Parkway, which currently have an overhead 115 kV transmission line and Alternative 1 would add a 230 kV line. The calculated magnetic field levels generated by the project along the Oak 1 Option would be well below industry guidelines; therefore, impacts would be less-than-significant.
3.8.5.9  Bellevue South Segment, Oak 2 Option

Relative to the No Action Alternative, magnetic field levels would decrease under Alternative 1 in the Oak 2 Option for portions of the alignment along the existing PSE corridor. The magnetic field levels would increase under Alternative 1 for portions of the alignment along SE 30th Street, Richards Road, Factoria Boulevard, and Coal Creek Parkway, which currently have an overhead 115 kV transmission line and Alternative 1 would add high-capacity 115 kV lines. Alternative 1 would result in a new source of magnetic fields on 124th Avenue SE and SE 38th Street, which currently do not have an overhead transmission line. The calculated magnetic field levels generated by the project along the Oak 2 Option would be well below industry guidelines; therefore, impacts would be less-than-significant.
3.8.5.10 Bellevue South Segment, Willow 1 Option

Relative to the No Action Alternative, magnetic field levels would decrease under Alternative 1 in the Willow 1 Option. The calculated magnetic field levels generated by the project along the Willow 1 Option would be well below industry guidelines; therefore, impacts would be less-than-significant.
3.8.5.11 Bellevue South Segment, Willow 2 Option (PSE’s Preferred Alignment)

Relative to the No Action Alternative, magnetic field levels would decrease under Alternative 1 in the Willow 2 Option for portions of the alignment along the existing PSE corridor. The magnetic field levels would increase under Alternative 1 for portions of the alignment that utilize a new corridor, including Factoria Boulevard and Coal Creek Parkway, which currently have an overhead 115 kV transmission line and Alternative 1 would add high-capacity 115 kV lines. Alternative 1 would result in a new source of magnetic fields on SE Newport Way, which does not currently have an overhead transmission line. The calculated magnetic field levels generated by the project along the Willow 2 Option would be well below industry guidelines; therefore, impacts would be less-than-significant.
3.8.5.12 Summary: Comparison of Segments and Options, Bellevue South Segment

In the Bellevue South Segment, the Oak 1, Oak 2, and Willow 2 Options would increase magnetic field levels compared to the No Action Alternative where the transmission line follows a new corridor. Willow 1, and the portions of the Oak 1, Oak 2, and Willow 2 Options that follow the existing corridor, would reduce the magnetic field levels compared to the No Action Alternative. The Oak 1 Option would have the highest upper range of magnetic field levels, while the Willow 1 Option would have the lowest upper range of magnetic field levels, and are well below industry guidelines.

Table 3.8-7. Comparison of Bellevue South Options, Calculated Magnetic Field Levels

<table>
<thead>
<tr>
<th>Segment / Option</th>
<th>Alternative 1, 2027/2028 Winter Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum</td>
</tr>
<tr>
<td>Oak 1</td>
<td>88–174*</td>
</tr>
<tr>
<td>Oak 2</td>
<td>27–157</td>
</tr>
<tr>
<td>Willow 1</td>
<td>41–88</td>
</tr>
<tr>
<td>Willow 2</td>
<td>53–157</td>
</tr>
</tbody>
</table>

Note: Magnetic field levels range depending on the calculation location.
*The calculated magnetic field levels shown in the table are associated with the 230 kV lines proposed along a new corridor. The 115 kV line within the existing transmission corridor would remain but would likely have lower magnetic field values than the No Action Alternative.
3.8.5.13 Newcastle Segment

Relative to the No Action Alternative, magnetic field levels would decrease under Alternative 1 in the Newcastle segment. The calculated magnetic field levels generated by the project along the Newcastle Segment would be well below industry guidelines; therefore, impacts would be less-than-significant.
3.8.5.14 Renton Segment

Relative to the No Action Alternative, magnetic field levels would decrease under Alternative 1 in the Renton segment. The calculated magnetic field levels generated by the project along the Renton Segment would be well below industry guidelines; therefore, impacts would be less-than-significant.
3.8.6 Mitigation Measures

No adverse impacts from magnetic fields are expected; therefore, no mitigation is proposed.

As noted in Section 3.9.7, Mitigation Measures (for Pipeline Safety), mitigation for potential corrosion of the pipeline could include optimizing the geometry of the phase conductors in a triangular pattern, which results in higher cancellation of magnetic fields (DNV GL, 2016). If that mitigation is incorporated into the project, it would further reduce magnetic field levels at the ground level from the proposed transmission lines.