Chapter 7 Visual Resources

This chapter describes the existing visual resources in the project area, and how the project alternatives could affect these resources. Related information can be found in Chapter 5, Land and Chapter 6, Recreation, and Appendix E, Visual Assessment.

Words in **bold** and acronyms are defined in Chapter 32, Glossary and Acronyms.

7.1 Methodology

The methodology used for this visual resources assessment is based on the BLM's Visual Resource Management (VRM) system. This methodology is effective for evaluating many different types of development, including transmission line projects within rural and urban settings, and is regularly used for visual resource assessments by federal agencies. Visual resources within 5 miles of the action alternatives were inventoried using BLM Visual Resource Inventory methods (BLM 1986a). This distance was used because it represents locations with a potential **foreground** or **middle-ground view**, and the assumed maximum distance at which a transmission line would present a dominant or intrusive presence to the viewer (BLM 1986a). This methodology assesses landscapes according to the attributes described below. Impact levels incorporating these attributes are defined in Section 7.3.1, Impact Levels.

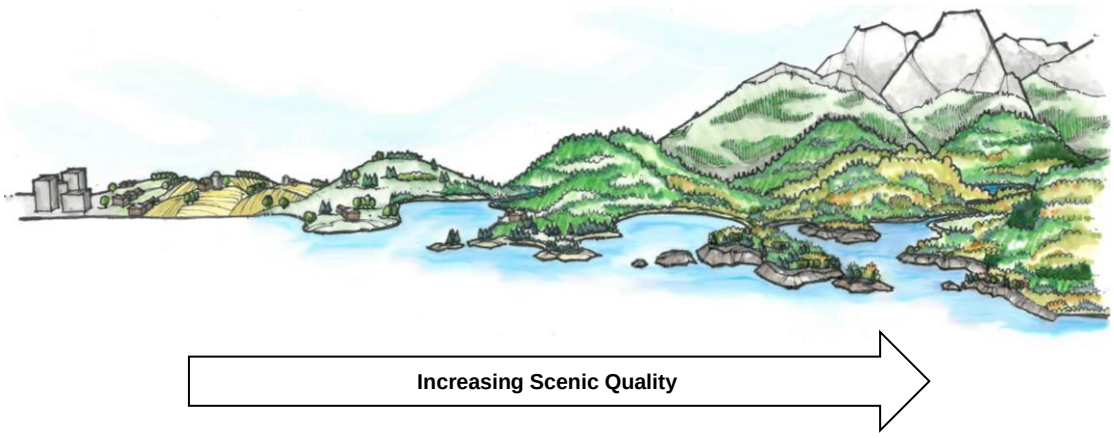
7.1.1 Landscape Rating Determination

The BLM's VRM system rates a landscape's scenic value by combining a rating of the scenic quality of the landscape with the sensitivity rating of the viewers. This landscape rating is then combined with a **contrast rating** of project components to evaluate visual impacts. These ratings are not intended as estimates of beauty.

7.1.1.1 Scenic quality

Scenic quality is a measure of the overall potential appeal of a view. The classification of scenic quality is based on the premise that natural landscapes with greater diversity, and/or containing "distinct" features, are generally considered to have higher scenic quality than landscapes that are more homogenous and/or with more common features (see Figure 7-1).

Figure 7-1 Scenic Quality Illustration



Under BLM's VRM system, the scenic quality of an area is categorized as "high," "medium," or "low," based on several key factors, including landform, vegetation, water, color, influence of adjacent scenery, scarcity, and cultural modifications (i.e., manmade additions to the landscape) (BLM 1986a).

- Landform
    - high vertical relief in prominent cliffs, spires, or massive rock outcrops, or severe surface variation or highly eroded formations including major badlands or dune systems; or dominant and exceptionally striking and intriguing features such as glaciers (high scenic quality);
    - steep canyons, mesas, buttes, cinder cones, and drumlins; or interesting erosional patterns or variety in size and shape of landforms; or features that are interesting though not dominant or exceptional (medium scenic quality);
    - low rolling hills, foothills, or flat valley bottoms; or few or no interesting landscape features (low scenic quality).
- Vegetation
    - a variety of vegetation types in interesting forms, textures, and patterns (high scenic quality);
    - some variety of vegetation, but only one or two major types (medium scenic quality);
    - little or no variety or contrast in vegetation (low scenic quality).
- Water
    - clear and clean appearing, still, or cascading white water that is dominant in the landscape (high scenic quality);
    - flowing, or still, but not dominant in the landscape (medium scenic quality);
    - absent, or present, but not noticeable (low scenic quality).
- Color
    - rich color combinations, variety or vivid color; or pleasing contrasts in the soil, rock, vegetation, water or snow fields (high scenic quality);
    - some intensity or variety in colors and contrast of the soil, rock and vegetation, but not a dominant scenic element (medium scenic quality);
    - subtle color variations, contrast, or interest; generally mute tones (low scenic quality).
- Influence of Adjacent Scenery (beyond the landform being evaluated)
    - adjacent scenery greatly enhances visual quality (high scenic quality);
    - adjacent scenery moderately enhances overall visual quality (medium scenic quality);
    - adjacent scenery has little or no influence on overall visual quality (low scenic quality).
- Scarcity
    - one of a kind; or unusually memorable, or very rare within region. Consistent chance for exceptional wildlife or wildflower viewing, etc. (high scenic quality);
    - distinctive, though somewhat similar to others within the region (medium scenic quality);

  - interesting within its setting, but fairly common within the region (low scenic quality).

- Cultural Modifications (changes to the visual landscape discernable as artificial, such as buildings or roads)
  - modifications add favorably to visual variety while promoting visual harmony (high scenic quality);
  - modifications add little or no visual variety to the area, and introduce no discordant elements (medium scenic quality);
  - modifications add variety but are very discordant and promote strong disharmony (low scenic quality).

7.1.1.2 Viewer Sensitivity levels

Sensitivity is an evaluation of the viewer and not the landscape, and is a way of ranking public concern for visual resources, based on the viewer. The type of user has an influence on visual sensitivity, as perceptions of the landscape tend to vary based on the intended use of the land and related expectations of the user. For example, hikers on a scenic trail may have a higher visual sensitivity than loggers or farm workers who are there as part of their job. Adjacent land use can also influence viewer sensitivity, based on the land use type and viewer expectations. Special places such as parks, natural areas, and designated scenic areas generally have a high level of viewer sensitivity, but sensitivity may depend on the management objectives for the area. Viewer sensitivity can also depend on distance.

The BLM VRM system categorizes sensitivity levels as “high,” “medium,” or “low.” Factors considered include the type of users, amount of use, public interest, adjacent land uses, and special areas. These measures of public concern are intended to be subjective, and have no standard definitions—the definitions are determined by what factors affect sensitivity on specific projects. Viewer sensitivities on this project were determined as follows:

- High viewer sensitivity—a large number of viewers, public use and exposure to the site or area; high public interest; typical viewers are nearby residents with an attachment to the landscape and long duration of their views, and recreational sightseers highly sensitive to changes in scenic quality and **viewsheds** (the visible landscape).
- Medium viewer sensitivity—intermediate viewer numbers, public uses, overall public interest, or adjacent land uses.
- Low viewer sensitivity—sparsely populated areas; few recreational or other public uses; most viewers are non-residents or workers traveling through or working in an area, or viewers from nearby commercial or industrial land uses.

The overall ranking does not necessarily represent an average of all individual factors, since it is possible for certain factors to outweigh others. For example, sensitivity can be affected by the amount of public use and exposure to the public, where a large number of viewers translates to high sensitivity. Sensitivity may also be high if public interest is very high. In such cases, the sensitivity rating may be high, despite other factors being low, indicating a generally high level of concern.

Because the project covers a large geographic area within both densely and sparsely populated areas, sparsely populated locations are generally given a low sensitivity level compared to

densely populated areas, if other factors are equal, because of a low number of viewers. The combination of an area's scenic quality and the sensitivity level of viewers in that area result in the visual resource landscape rating (see Table 7-1), and provide the baseline to determine the visual effects of the alternatives.

Table 7-1 Landscape Rating

Scenic Quality	Viewer Sensitivity		
	High	**Medium**	**Low**
High	High	High	High
Medium	High	Medium	Low
Low	Medium	Low	Low
Source: BLM 1986a (Illustration 11 – Determining Visual Resource Inventory Classes, Manual 8410a)			

7.1.2 Visual Resource Impact Determination

To evaluate the visual impacts from a project, the BLM VRM evaluates the visual attributes of a project compared against the visual resource landscape rating at the locations being described. The comparison is based on the visual contrast elements described below:

- Form—includes structures and movement, relates to the shape of disturbances in contrast to existing landscape shapes.
- Line—relates to the path the eye naturally follows when perceiving differences in landscape shape, color or texture.
- Color—relates to the degree that hue (e.g., red, blue, green), value (e.g., brightness), and chroma (e.g., saturation) contrast with existing landscape colors.
- Texture—relates to the patterns that exist within the larger landscape elements.
- Scale—relates to the proportional size of the object in relation to the field of view.

These elements are then combined into an overall contrast rating as follows: "none" where the element is not visible or perceived; "weak" where the element contrast can be seen but does not attract attention; "moderate" where the element contrast begins to attract attention and begins to dominate the characteristic landscape; or "strong" where the element contrast demands attention, will not be overlooked, and is dominant in the landscape (BLM 1986b).

The overall visual contrast is then combined with the landscape rating (see Table 7-1) to determine a visual impact rating for the area (see Table 7-2).

Table 7-2 Visual Impact Rating

Contrast	Landscape Rating		
	Low	**Medium**	**High**
None	Negligible	Negligible	Negligible
Weak	Low	Low	Moderate
Moderate	Low	Moderate	High
Strong	Moderate	High	High
Source: BLM 1986b			

More information about assessment and impact methodology, and a discussion of the landscape ratings assigned to the action alternatives by segment is in Appendix E.

7.2 Affected Environment

The action alternatives cross five regions with similar types, quality, and quantity of environmental resources: Willapa Hills, Cowlitz/Chehalis Foothills, Western Cascades Lowlands and Valleys, Valley Foothills, and Portland/Vancouver Basin (EPA 2007).

- Willapa Hills: The north end of the project is in the Willapa Hills. The action alternatives cross this region northwest of Castle Rock and parallel to the Cowlitz River, between the Monahan Creek and Baxter Road substation sites. Portions of the alternatives also cross this region between the Monahan Creek site and the Lexington area, and between Castle Rock and Silver Lake, north of Ostrander, Washington. The Willapa Hills are characterized by low, rolling hills and gently sloping mountains with fewer drainages than surrounding areas (EPA 2007). Water features are not prominent in the area. Given the fairly uniform textures and patterns of vegetation, color is also relatively uniform. The consistent vegetation and low rolling hills allow few **long-range views** and do not contribute greatly to scenic quality under BLM's VRM system. The region is relatively sparsely populated, with the neighborhood of Longview Heights to the south and scattered residential residences throughout other areas.
- Cowlitz/Chehalis Foothills: The project crosses the rolling to steeply sloping hills near Chehalis and the relatively flat Cowlitz River Valley. The action alternatives cross this region just east of Lexington, Washington, east of Longview, and north of the Lewis River. The urban areas of Longview/Kelso, Castle Rock and I-5 are in this region. The vegetation textures and patterns are fairly uniform, and visually limit views so that long-range viewing opportunities are rare. There are some color variations in the vegetation, although they do not dominate or create a strong scenic element. Water flows through this area, predominantly along the Cowlitz River, and contributes to scenic quality. The influence of scenery next to the Cowlitz/Chehalis Foothills region is limited due to the few long-range viewing opportunities. The visual characteristics of the Cowlitz/Chehalis Foothills are common in much of southwestern Washington and northwestern Oregon.
- Western Cascades Lowlands and Valleys: This region is characterized by large areas of lowlands and valleys that extend west from the Cascade Range. The action alternatives south of the Kalama River and north of the Washougal River, including most of the

Central and East alternatives, West Option 3, Central Options 2 and 3, and East Options 1, 2, and 3, cross this region. The moderate to steeply sloping hills are predominantly covered by western hemlock (*Tsuga heterophylla*) and Douglas-fir (*Pseudotsuga menziesii*) forests, and many areas have been, or will be, harvested for timber. The area is sparsely populated, but includes the communities of Ariel, Amboy, and Yacolt in the north; Venersborg and Hockinson in the southwest; and Camas and Washougal in the south.

The Western Cascades Lowlands and Valleys have more geographic relief than other regions. The vegetation is fairly consistent and tends to be most varied around rivers and lakes. Although not dominant through most of the area, water contributes to scenic quality around Merwin and Yale lakes and along the banks of rivers and creeks. Color contributes to scenic quality, primarily in autumn. Otherwise, the landscape is dominated by similar shades of green during most of the year.

- Valley Foothills: The action alternatives cross foothills in the Camas area, a transition zone between the Portland/Vancouver Basin to the west and the Western Cascades Lowlands and Valleys to the east. Portions of the action alternatives and options including West Options 1, 2 and 3, and Crossover Option 1 cross this region between Camas, Washington and the Sifton area. The Valley Foothills are drier than the neighboring mountains and have vegetation reflective of this, with Oregon oak (*Quercus garryana*) and Douglas-fir as the native vegetation. Non-native vegetation is more common than native vegetation in the Valley Foothills, as predominant land use is rural residential developments, woodlands, pastures, tree farms, vineyards, and orchards.

  The Valley Foothills region contains low rolling foothills with few dramatic features. There is some variety in the vegetation; however, it is rarely expressed in distinctive forms, textures or patterns. Visible water is rare throughout these foothills and, for the most part, does not contribute to scenic quality in the BLM's VRM system. There are some variations in color that contribute slightly to scenic quality; they are mostly shades of green and are not a dominant scenic element. Adjacent scenery to the Valley Foothills region has little effect on scenic quality, as most is blocked by the topography and vegetation. The scenery found in the Valley Foothills is similar to that found throughout much of southwestern Washington and northwestern Oregon.

- Portland/Vancouver Basin: The Portland/Vancouver Basin contains floodplains and undulating terraces. Portions of the action alternatives and options in Vancouver, Minnehaha, Camas, Washougal, and the Sifton area east of Minnehaha, Washington cross this region. All action alternatives cross this basin before ending at the Sundial substation site. The landforms of the region are dominated by low-relief floodplains with small rolling hills on the eastern edge that do not greatly contribute to scenic quality in the BLM's VRM system. Vegetation is moderately varied in the basin, as the change from rolling hills to floodplains creates more distinctive forms, patterns and textures. The vegetation patterns in the area moderately enhance scenic quality.

  Water in the Portland/Vancouver Basin also moderately enhances scenic quality at select locations surrounding the Columbia and Lewis rivers, and other small creeks. As a scenic element, although it is only visible in select locations, water is a distinctive feature to the viewers of this area. Color variations in the diverse vegetation moderately enhance scenic quality, but do not tend to be a dominant landscape element. Adjacent scenery to the Portland/Vancouver Basin region is generally not

highly visible or has little influence on scenic quality. This type of landscape is similar to other valley and basin areas in southwestern Washington and northwestern Oregon.

7.2.1 West Alternative and Options

The West Alternative originates in the Willapa Hills where the scenic quality is low because of the low topography of shallow, rolling hills with few prominent landscape features; little variation or contrast of vegetation types; color variations of vegetation that are present but not dominant; and limited visibility in most areas such that adjacent scenery does not influence or enhance the viewshed. Water is present, but in general is not cascading or entirely undisturbed by land development, and is not visible from most locations. The alternative continues south through the Cowlitz/Chehalis Foothills where the vegetation has some variety but does not form conspicuous textures or patterns over the rolling hills and meadows; these views of hills and vegetation are relatively uniform across the landscape. Rivers and riparian areas are present and contribute to scenic value, but they are generally obscured from most viewers due to forests and the low topography of the area. Views within the area are common to much of southwest Washington. The alternative passes through the rural and residential communities of West Side Highway and Kelso.

The hills become larger and the population less dense as the route passes into the Western Cascades Lowlands and Valleys. Scenic quality is rated low in this portion of the alternative due to the relatively low topography of the foothills, uniform textures, patterns of color and vegetation that are common to much of southwest Washington, water that is present but not dominant, and the lack of dominant features in the landscape. In most portions of this region, adjacent scenery is not visible or does not enhance the scenic quality due to limited long-range viewing or due to the numerous areas of timber harvest that contribute to disharmony in the landscape. Roads and transmission lines that exist along much of the West Alternative modify the view and can be dominant in areas where forest has been removed.

The alternative crosses the East Fork Lewis River and enters the Portland/Vancouver Basin ecoregion. This portion of the alternative is rated low due to flat terrain and relatively low rolling hills with few or no prominent features. Agricultural fields and rural development are common and modify the scenic quality. Water is present in some locations but is either not visible or not a dominant scenic element. An exception is the East Fork Lewis River system that does contribute to the scenic quality of that area. The river's riparian habitat offers some scenic contributions to the floodplain, meadows and open fields found in the basin. A limited number of parks such as the East Fork Lewis River Greenway also offer local natural landscapes of scenic value.

Dense population and commercial and industrial structures are prominent in the southern portion of the alternative. Scenic quality is generally low in the urban environment due to common views of buildings, bridges, and transportation corridors that are not harmonious with the natural landscape. Larger parks and greenways within the urban environment provide open space and contribute locally to scenic value. Undisturbed open space with native vegetation, such as the Lacamas Prairie Natural Area, add higher scenic value locally. As a major water course, the Columbia River offers scenic quality with islands formed by braided channels and riparian forests adding to the visual character of the metropolitan developed areas.

Local sites of higher scenic value are present along the route, but these are often small or have limited viewing opportunity due to surrounding low topography or tall vegetation. Scenic areas

near larger river systems, such as the complex of green space just north of the Columbia River crossing, including Lacamas Lake Park, the Washougal River Greenway, Lacamas Park Trail, and Goot and Oak parks contribute locally to scenic quality. Because of the limited number of these local sites of higher scenic quality, the overall scenic quality along the West Alternative is rated low.

West Options 1, 2, and 3 all pass through developed areas of Vancouver and Camas and each have a rating of low scenic quality as discussed above for this area. Although there are local sites with natural scenic value and some riparian systems with higher scenic quality, these sites are limited.

Viewer sensitivity along the West Alternative varies locally with land use, but viewer sensitivity is rated high along most of this route. The primary factor affecting viewer sensitivity is the viewer's proximity to the alternative. The West Alternative is relatively close to residential areas for most of its length, although population density varies. At the north end, it passes through rural residential areas northwest of the West Side Highway community where viewer sensitivity is rated medium. Rural residential areas have fewer users of the land, so the amount of use is lower than in more densely populated residential areas. However, public concern for the visual landscape in these areas may be higher because of rural residents' expectation of a less industrialized landscape. Public comments received during the scoping process for this EIS have indicated that residents along the West Alternative are highly sensitive to changes in scenic quality.

As the alternative crosses through the communities of West Side Highway and Kelso, it runs through or close to residential areas where viewer sensitivity is rated high. The alternative then crosses the Coweeman River and again through rural residential areas, with increased viewer sensitivity. As the alternative continues south across the Lewis River, it passes through agricultural land, which tends to have less-sensitive viewers than rural residential land. The density of residences increases south toward Hazel Dell. As the alternative crosses BPA's Ross Complex and shifts to a predominantly east–west direction, it passes through urban residential, commercial, and industrial land already affected by development, including transmission lines. Here, viewer sensitivity is lower because of existing similar development. Crossing Northeast 4th Plain Road and heading southeast toward Mill Plain and Camas, the alternative passes through open space and rural residential areas. Overall, the West Alternative and its options have viewers with a high sensitivity level for two reasons: a large amount of the route is in rural residential land use areas to the north where citizens are more sensitive to the addition of industrial structures; and residents to the south that are close to the right-of-way have expressed concern. The West Alternative and its options have a medium overall landscape rating based on having a low level of scenic quality and an average high viewer sensitivity level.

7.2.2 Central Alternative and Options

The area crossed in the north by the Central Alternative shares many visual characteristics with the West Alternative that result in a low scenic quality rating. Northwest of the Cowlitz River the alternatives are similar with only slight, localized differences. In general, the area has low rolling hills, and some variation in patterns, textures, and colors of vegetation between forested areas and rural residential development and agricultural pastures and cropland; these land uses modify the scenic quality of the area. Water is present but not always visible, except at Castle Rock and along trails on the Cowlitz River floodplain. East of the Cowlitz River, the Central Alternative crosses the Cowlitz/Chehalis Foothills area where numerous timber cuts and logging

roads along the route modify the landscape and contribute to the low scenic quality, except where the alternative crosses Spirit Lake Memorial Highway which adds some local scenic value for motorists. Riparian areas, also, are primary sites of local scenic value, such as at the Coweeman and Kalama river crossings.

The alternative crosses the Western Cascades Lowlands and Valleys where scenic quality is rated medium due to the distinctive nature of Merwin Dam and Lake Merwin, although such dams and reservoirs are not uncommon in the foothills of the Cascades. Texture and color of vegetation has some variety but is generally uniform across the landscape. Vegetation and topography limit views of adjacent scenery in this area. Rural residential and agricultural fields occur south of the lake and are scattered across the general landscape, and become more common farther south. The rolling hills often block adjacent scenery, but when visible these adjacent sites only contribute to a scenic quality rating of low because they are highly modified by timber harvest and logging roads.

Within the Portland/Vancouver Basin scenic quality is generally rated low due to the visual characteristics of the urban environment as described for the West Alternative. Local sites such as the Washougal River crossings do have higher scenic value.

Central Option 1 is in an area of low scenic quality on timber harvest land that has low rolling hills with little variation in texture, color, or pattern of vegetation. Central Option 2 is near Longview and Ostrander where scenic quality is low due to the commercial and industrial nature of the urban environment and development along the I-5 corridor. Most of the scenic quality along Central Option 3 is rated medium because of Merwin Dam and its reservoir and also the East Fork Lewis River at Lucia Falls and Moulton Falls Park; although these types of features are not uncommon in Washington foothills, and they do contribute to the scenery at local sites. The Central Alternative and its options have an overall low scenic quality.

The Central Alternative has generally low viewer sensitivity through the portion southeast of the Cowlitz River and north of the Lewis River. This area is sparsely populated and has limited use. Sensitivity and scenic quality are higher near the Lewis River just west of Lake Merwin through Ariel. West of Amboy and Yacolt, and east of Lewisville and Battle Ground, the alternative is located among rural residential homes and has medium *s*ensitivity. East of Vancouver, the alternative turns east and away from rural residential areas until the alternative passes near the rural residential areas of Camas and into the suburban areas of Camas and Washougal near the Columbia River. The Central Alternative and its options have a low overall landscape rating based on having a low level of scenic quality and an average medium viewer sensitivity level.

7.2.3 East Alternative and Options

The area crossed by the East Alternative originates west of Castle Rock in the Willapa Hills and has visual characteristics similar to the Central Alternative. Scenic quality in this area is low because of the low topography of the shallow, rolling hills with few prominent landscape features; little variation in vegetation type, color, and patterns across the landscape; and in most areas adjacent scenery does not influence the view due to limited visibility except along the Spirit Lake Memorial Highway. The alternative crosses the Cowlitz and Coweeman rivers; at these locales which can be accessed by trails, these rivers contribute to the natural scenic quality. Where the alternative extends across the Cowlitz/Chehalis Foothills, the scenic quality remains low due to low topography with few prominent landscape features, and forest cover that is modified by timber harvest.

In the Western Cascades Lowlands and Valleys ecoregion, scenic quality for the alternative is rated medium. This is due to large areas of undisturbed landscape, especially in the vicinity of the upper Kalama River basin, and more topographic variation and steeper slopes where the alternative crosses between Lake Merwin and Yale Lake, near Canyon Creek, and where it crosses the Tarbell Trail. Adjacent scenery is visible in many areas, moderately enhancing the views.

In the Portland/Vancouver Basin ecoregion just east of Camas, the scenic quality is generally low due to flatter and less varied topography and uniform vegetation patterns. Although water is present, there are only limited and local views of Jones Creek and the Little Washougal River. Closer to Camas and the Columbia River, the scenic quality is the same as discussed for the West and Central alternatives. There are local sites of higher scenic value, but these are often limited and small in size or have limited viewing opportunity due to surrounding topography or vegetation.

East Option 1 is located in the Willapa Hills and Cowlitz/Chehalis Foothills ecoregions and has a low scenic quality rating as described for this area previously. The Cowlitz and Coweeman rivers and their tributaries offer higher scenic quality at local sites. East Option 2 is located in the Western Cascades Lowlands and Valleys ecoregion where scenic quality is rated low due to lower foothills and a landscape modified by timber harvest. East Option 3 crosses the Jones Creek Trail where scenic quality is enhanced locally where water is visible; overall, the scenic quality of this option is low due to the low topography of shallow hills, and vegetation that limits viewing opportunities. The East Alternative and its options have an overall low scenic quality.

At the north end of the East Alternative, viewer sensitivity is low because there are no homes, roads, or recreation areas. Near the north end of Castle Rock, sensitivity increases to medium because the amounts of use and types of users increase. The number of potential viewers increases near SR 504 and I-5. State Route 504 is a designated state scenic drive, and viewer sensitivity is high. East of Castle Rock, viewer sensitivity is low, because there are few residences, roads, or recreation areas. The northern portion of the alternative has low sensitivity for most of its length because there are few homes, few roads, and low levels of use, resulting in an overall viewer sensitivity of medium.

Sensitivity is greater where the alternative crosses Lewis River Road, and extends across the rural residential areas northeast of Ariel, and past the east end of Lake Merwin. South of Lake Merwin, sensitivity is lower, because there are fewer residences close to the alternative. Recreational land use becomes more influential on sensitivity; however, there is not a high amount of use, so sensitivity is low-to-medium. In the rural and residential areas of Camas and Washougal, sensitivity is medium-to-high, depending on the number of residences and their proximity to the East Alternative. The East Alternative and its options have a low overall landscape rating based on having a low level of scenic quality and an average medium viewer sensitivity level.

7.2.4 Crossover Alternative and Options

The area crossed by the Crossover Alternative shares its northern portion with the West Alternative where the overall scenic quality is rated low for the Longview area and along low rolling hills. The middle portion of the alternative is the same as the Central Alternative where scenic quality is rated medium because of the enhanced views in the Merwin Dam, Lake Merwin, Yale Dam, Yale Lake, and Canyon Creek areas. The Crossover Alternative also shares

the portion of its route south of Lake Merwin and Yale Lake with the East Alternative through low rolling foothills where timber harvest and logging roads are noticeable modifications to the landscape that contribute to the overall rating of low scenic quality, although the Tarbell and Jones Creek trails wind through unharvested areas that contribute some local scenic value. The physiographic characteristics and scenic quality of the areas for the overlapping portions of the West, Central and East alternatives are the same for the Crossover Alternative as more fully described for the other alternatives in Sections 7.2.1 through 7.2.3.

Crossover Option 1 is located in Camas where the scenic quality is rated low. Crossover Options 2 and 3 are located in the north near Castle Rock in areas rated as having low scenic value due to the low topography with few interesting landscape features; mostly uniform patterns and colors of vegetation; localized views of water; and development or land uses that modify the landscape. Based on the assessment of the landscape features, the Crossover Alternative and its options have an overall low scenic quality.

Sensitivity varies along the alternative, with land use influencing the level. Near Amboy and Ariel, there are residential users, motorists, and recreational users of the landscape. South of Lake Merwin, viewer sensitivity is lower, as there are fewer residences close to the alternative. Recreational land use becomes more influential on sensitivity; however, there is not a high amount of use, so sensitivity is low-to-medium. Entering the rural and residential areas of Camas and Washougal, sensitivity becomes medium-to-high, depending on the number of residences and their proximity to the alternative. The Crossover Alternative and its options have a low overall landscape rating based on a low level of scenic quality and an average medium viewer sensitivity level.

7.2.5 Substation Sites

The Sundial substation site(Lots 11 and 12) is in an area of low scenic quality, because of the flat relief floodplains; only somewhat varied vegetation (small patches of forest, shrubs, altered wetlands, and open pastures); some water influence; some color variations that are not a dominant scenic feature; no influence from adjacent scenery (due to limited visibility); somewhat distinctive scenery, but still common to floodplain landscape; and negative **cultural modifications** because of its location in an industrial park. The area has medium sensitivity because it is next to the Columbia River, has a high amount of use, there is low public interest in the site, adjacent land use (several existing substations and other industrial buildings) does not greatly influence the sensitivity, and it lacks any special areas or other considerations. The combined low scenic quality and medium sensitivity result in an overall low landscape rating.

The Casey Road substation site is in an area of low scenic quality, based on the low rolling foothills lacking dominant vertical relief or specific interesting landforms; a dense, uniform mixed wood vegetation that is currently partly logged; very little visible water; few color variations; and no influence of adjacent scenery (due to limited visibility). The site is a visual landscape common to the region, and includes negative cultural modifications such as logging activity and the existing transmission corridor. The area has low sensitivity, given the following factors: the type of use does not include residential use, parks, or other sensitive recreational uses; the amount of use is low; there is low public interest; the adjacent land uses do not increase the sensitivity; and there are no special areas. The low scenic quality and medium sensitivity result in an overall low landscape rating.

The Baxter Road substation site sits in a small topographical depression surrounded by vegetation. The site is not visible from sensitive viewpoints. The site is in the same remote area as the Casey Road substation site (about 2.5 miles away), and has the same negative cultural modifications. The scenic quality and sensitivity ratings for both sites are similar, with the same overall low landscape rating.

The Monahan Creek substation site is in an area of low scenic quality, based on the low foothills lacking dominant vertical relief or specific distinct landforms; largely uniform vegetation of mixed wood forest and small open pastures; very little visible influence of water on the landscape; few color variations in the vegetation; and no influence of adjacent scenery (due to limited visibility). The site is a commonly occurring landscape throughout the region, with cultural modifications (buildings and other structures) that have a negative effect on scenic quality. The area has medium sensitivity, given the rural residential usage (near existing residences and along a rural commuter road), amount of use, and public interest. The combined low scenic quality and medium sensitivity result in an overall low landscape rating.

7.3 Environmental Consequences

The evaluation of visual resource impacts is generally based on the BLM VRM system, which evaluates the existing visual landscape in the context of the project features, and how changes are likely to be perceived by viewers. The effect of a new feature on visual quality can be different when placed in remote locations as compared to being placed next to existing disturbances. Remote locations tend to have fewer potential viewers, but are often less disturbed and more natural in appearance, and viewers in remote locations may be more sensitive to potential changes. Sites close or next to existing disturbances tend to be of a lower scenic quality, but often have higher populations with more potential viewers.

To assist with the evaluation of potential visual resource impacts, a series of photographs were taken from viewpoints in the project area (see Map 7-1). Using visual simulations prepared from the photographs presented in this chapter, visual impact was then determined as a function of the landscape classification (based on scenic quality and viewer sensitivity) and the contrast rating, which evaluates how the project features would fit into the existing landscape (i.e., dominate it, attract attention, or would not attract attention).

General impacts that would occur for the action alternatives are discussed below, followed by impacts unique to each alternative.

7.3.1 Impact Levels

Impacts would be **high** where project activities would cause the following:

- Landscape rating is high or medium, and project features dominate the landscape.
- Landscape rating is high, and project features attract attention to the landscape.

Impacts would be **moderate** where project activities would cause the following:

- Landscape rating is high, and project features do not attract attention to the landscape.
- Landscape rating is medium, and project features attract attention to the landscape.
- Landscape rating is low, and project features dominate the landscape.

I-5 Corridor Reinforcement Project

Map 7-1: Viewpoints

Casey Road Substation Site

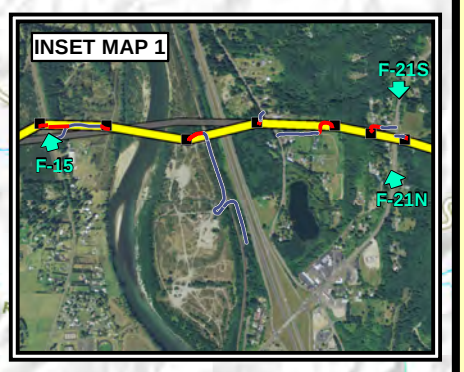
Baxter Road Substation Site

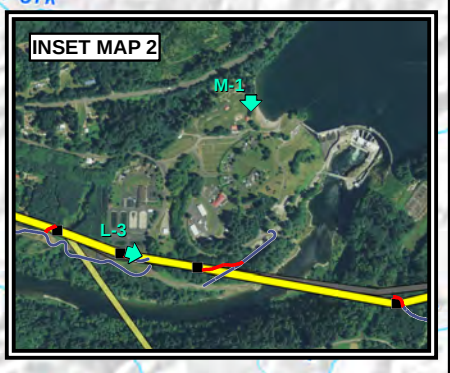
Monahan Creek Substation Site

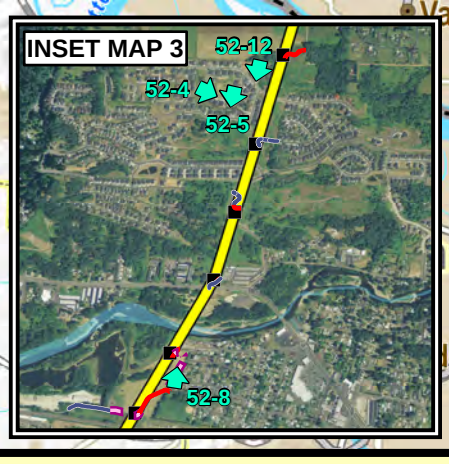
See Inset Map 1

See Inset Map 2

See Inset Map 3







Cowlitz Co

Clark Co

WASHINGTON

OREGON

LEGEND

- Preferred Substation Site
- Other Proposed Substation Sites
- Preferred Alternative - Central Alternative using Central Option 1 (not drawn to scale)
- Other Proposed Alternatives and Options (not drawn to scale)
- Original Central Alternative
- Airport
- City or Town
- Dam
- Urban Area
- County Boundary
- State Boundary
- Viewpoint and View Direction

Note: The Preferred Alternative has been refined to further minimize and avoid impacts to the natural and human environment where possible.

Miles

0 2 4 8

Bonneville Power Administration

Map 7-1: Viewpoints

Impacts would be **low** where project activities would cause the following:

- Landscape rating is medium or low, and project features do not attract attention to the landscape.
- Landscape rating is low, and project features attract attention to the landscape.
- Temporary visual changes from project construction.

No impact would occur where project features are visually negligible or not visible.

7.3.2 Impacts Common to Action Alternatives

7.3.2.1 Construction

Potential visual impacts include temporary visual changes during construction of the towers, conductors, access roads, and substations. Construction activities would create temporary changes in scenery by introducing helicopters, trucks, and heavy equipment such as cranes and bulldozers to the area. Construction activity in any one area would be brief (a few weeks), except at substation sites where construction would occur over many months. Construction crews would be working in localized areas of the transmission line right-of-way and at the substation sites, and would be visible primarily to nearby viewers or those with a direct line of sight to the activity. Installation of towers and stringing of the conductor by helicopter would be visible from a greater distance. The temporary helicopter fly yards on and off the right-of-way would be visible to those close by. The temporary staging areas that would be needed along or near the right-of-way to store materials, equipment, and vehicles would be visible to those in the immediate vicinity. The staging areas, ranging from 5 to 15 acres, would be located within existing developed sites or parking lots, where possible.

Construction activities would create a **low**, temporary visual impact because impacts would be short-term and temporary; right-of-way clearing, and towers and access road construction (a few weeks at a time for any one activity). At substation sites, construction activities would occur over a longer period but impacts would still be **low** since the Baxter and Casey sites are remote and the Sundial site is in an industrial complex. Impacts at the Monahan site may be higher for residents living adjacent or close to the site, or for motorists who use Delameter Road.

7.3.2.2 Operation and Maintenance

Permanent visual changes would be caused by the presence of the towers, conductors, access roads, cleared rights-of-way through forested areas, and from building substations on the landscape. Towers would create an obvious human made or industrial element to the **viewscape**. Where the new line would parallel other transmission lines, the line would not be out of context. In contrast, a new line within new right-of-way would degrade the natural visual quality of the area. While smaller transmission lines can be found in rural landscapes, the size of the towers required to support 500-kV lines are not typical in the project area. Most existing lines are 230-kV or below. Where there are fewer trees (primarily in the western segments), foreground views of the towers would be apparent because they could not be screened by vegetation (for example, in areas where there are no trees along roadsides to block views of towers). In distant views, towers would more readily blend into developed areas with existing rights-of-way.

Because lattice steel towers have spaces between their structural members through which the background can be seen (see Figure 3-1), the towers would blend in with the landscape from a distance where they have a backdrop of hills or vegetation. Weather conditions such as fog and rain further obscure visibility of the towers from a distance. However, towers would be more obvious on top of hills or ridges where they would break the skyline. The galvanized steel towers would appear shiny for 2 to 4 years before they dull from weathering, although conductors would be treated to reduce the shininess of the metal.

The proposed single-, double-, and triple-circuit 500-kV towers would be larger than the towers on existing rights-of-way. In general, new towers would range from 50 to 140 feet taller than existing BPA wood pole structures or lattice steel towers in the area. In some cases, the new towers would replace existing structures and towers, reducing the number of towers and sense of clutter in the landscape, though the new towers would be larger and more obvious. In forested areas, the right-of-way clearing would create additional visual impacts and would make the transmission lines more noticeable from a distance, especially where towers are higher than trees or where the cleared right-of-way can be seen. Where viewpoints allow viewers to see down a cleared right-of-way, the linear nature of the transmission line would be more noticeable than at other viewpoints.

Access roads would also create visual impacts both in the foreground and in the distance, with new roads producing a more evident visual change than the upgrade of existing roads, especially where new roads cut through forested areas or are cut into hillsides. Improving existing roads (widening, blading, or adding gravel) would brighten the roads, and would make them more visible from a distance than they may be currently. Unlike transmission lines, which form straight lines and angles, access roads can curve and follow terrain. In flat areas, roads are not easily seen from a distance, but on steep slopes, especially where cut and fill is needed, roads would likely appear more obvious, unless uneven terrain and surrounding vegetation and trees allows them to be hidden on the hillside.

Maintenance activities would occur on a regular or as needed basis and would be limited to viewers intermittently seeing helicopters, trucks, equipment, and maintenance workers along rights-of-way and access roads. Similar to construction, these activities would be temporary, and would have **no-to-low** temporary impacts on visual resources.

7.3.2.3 Sundial Substation Site

There are no sensitive viewpoints identified with views of the Sundial substation site (Lots 11 and 12). There are many existing transmission lines and two existing substations in the area. The existing industrial land use, with its many industrial operations surrounding the substation site, would provide a consistent visual landscape, and it would be unlikely that a new substation would draw viewer attention. Given the similar existing visual environment and a landscape rating of low, the overall visual impact would be **low**.

7.3.3 Castle Rock Substation Sites

7.3.3.1 Casey Road

Impacts common to action alternatives are in Section 7.3.2. The remaining sections discuss impacts unique to each alternative, and recommended mitigation measures.

The Casey Road substation site is in a remote area of low scenic quality. The site has limited visibility and includes an existing transmission corridor with four large transmission lines. The site has low viewer sensitivity, and is not visible from any sensitive viewpoints. The visual impact of Casey Road Substation would be **low**.

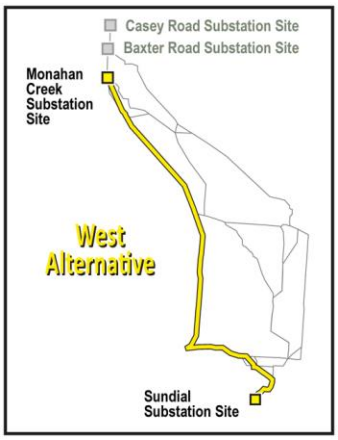
7.3.3.2 Baxter Road

The Baxter Road substation site sits in a small topographical depression in a remote area of low scenic quality. It is surrounded by vegetation, but also includes an existing transmission line corridor through the site. This contributes to low viewer sensitivity and no visibility from any sensitive viewpoints. The visual impact of Baxter Substation would be **low**.

7.3.3.3 Monahan Creek

The Monahan Creek substation site would be visible to surrounding residents and to motorists and commuters along Delameter and Monahan roads. The substation would be within some long-range views; however, the substation would likely dominate the attention of viewers that have a foreground view, including users of Delameter Road. From beyond the immediately adjacent area, foreground vegetation would likely block views of most of the substation depending on the location of the viewer. This site also includes an existing transmission line corridor on several sides. No scenic viewpoints or designated areas would be affected. The substation would likely be visible and attract viewer attention, but not completely dominate the visual character of the landscape. Given the limited visibility of the substation and a landscape rating of low, the visual impact of Monahan Creek Substation would be **low**.

7.3.4 West Alternative



The West Alternative begins at the Monahan Creek substation site (see Section 7.2.1, West Alternative and Options). The views of the West Alternative between the Monahan Creek site and Longview would be partially or fully obstructed by vegetation and some residences. Towers would blend more readily into background views and provide less contrast and a **low** impact, except where residences are close to the transmission line. The alternative would be visible near Delameter Road and from rural residences at several locations along Hazel Dell Road and in the area of Trout Lake Road. The alternative would also be highly visible near Longview, and residents within the residential area at the south end of the West Side Highway neighborhood and across I-5 would also be able to see towers. From residences along the right-of-way, the contrast would be high due to the large scale of the nearby towers.

A portion of the alternative between Longview/Kelso and just north of the Lewis River runs next to existing transmission lines on existing BPA right-of-way, which reduces scenic quality. The alternative crosses I-5 and runs through rural residential areas that decrease in density farther south along the alternative. Some residents would have a view dominated by the project, but most viewers in this area would experience a more distant view with many vegetative visual obstructions; the line would be visible, but would not completely dominate the view. Impacts to visual resources would be **moderate** because of the reduced scenic quality and the contrast of the line being visible but not totally dominant to most viewers. At local sites of higher scenic quality and viewer sensitivity such as at the Kalama, Lewis, and East Fork Lewis river crossings visual impacts would be **moderate-to-high**, especially where the removal of trees within riparian areas make towers more visible. Visual impacts would also be **high** at some local parks such as the East Fork Lewis River Greenway and Pleasant Valley Park where the alternative would have more contrast in a natural area.

Because the alternative would be located in the existing BPA right-of-way, the effect of vegetation clearing, where required, would be less than where a new right-of-way is necessary. However, in many cases where homes are near the existing right-of-way, trees within and just outside the right-of-way block any views of the existing towers. Once the right-of-way is cleared and danger trees are removed, there would be no vegetative buffer between those homes and the existing and new lines; because of their large scale and proximity to viewers, the towers would dominate the view of anyone next to the right-of-way. From slightly farther away, the view would be partially obscured by trees and other houses, which would reduce the visual impact of the project on viewers. Visual impacts would be **moderate** because most views would have many other existing visual alterations in the view, which would dilute viewer sensitivity.

Residents next to newly cleared existing right-of-way would see what appears to be an expanded right-of-way and taller towers, which would draw the attention of the viewer (see Figure 7-2). The typical view from neighborhoods surrounding the right-of-way would include taller, more visible towers above the houses and trees (see Figure 7-3). The typical view from Washington State University's Vancouver campus in Mt. Vista and some areas of Mt. Vista would also include new, taller towers (see Figure 7-4). Visual impacts would be **moderate** because the alternative follows an existing right-of-way that moderates the effect of vegetation clearing and the larger towers would not greatly change the character of the existing view.

The West Alternative continues on the existing right-of-way northeast of Vancouver. Viewers in this area would have an unobstructed view of the project. The project would be visible from the residences along NE Stoney Meadows Drive that back onto the open space and from NE 199th Avenue where some clearing of vegetation would be required and where the alternative crosses the road. Visual impacts would be **moderate** at these sites because of the existing right-of-way. The alternative would be on the south side of the existing right-of-way. The current vegetation buffer between the towers and the residential area around NE 48th Circle would be maintained and visibility from NE 48th Circle would likely be limited.

The project would be visible from the Green Mountain Golf Course, Camp Currie, and by a few residences and motorists along NE 28th Street (see Figure 7-5). The typical view from the golf course would be unobstructed; most residents in the area would have a partially obstructed view. The towers in this area would be about twice as tall as the existing towers, and would draw more attention from nearby viewers. The alternative passes through agricultural fields(on existing right-of-way) with open views but few viewers, and rural residential neighborhoods north of Camas. The project would be highly visible to homes next to the existing right-of-way

and would also be visible to more distant residences. The new, larger towers would begin to dominate the surroundings (see **Error! Reference source not found.**). There would be little change to vegetation in this area because little clearing would be required and the project would be near an existing transmission line. Although the towers would be larger in scale and prominent in some views, overall visual impacts in this area would be **moderate** due to an existing transmission line, little required clearing, and weak contrast in texture. At certain local sites, such as the Lacamas Prairie NAP/NRCA managed by WDNR , visual impacts could be **high** due to the scale of larger towers in a natural area (see Figure 7-7).

The views of the alternative in the Camas and Washougal areas include unobstructed and distant views across the open, rural landscape; close-up views from roads and residences along he existing right-of-way in Camas; and views from SR 14 (Lewis and Clark Highway) (see Figure 7-16 through 7-19). The rebuilt 230-kV lines and new 500-kV towers would be of a different shape and larger than existing towers. This would cause a **moderate** visual impact because the contrast of larger, different shaped towers would be more noticeable due to the proximity to some residential viewers and local sites of higher scenic quality such as parks and community greenspace.

From the Port of Camas – Washougal Marine Park parking lot and adjacent Parker's Landing Historical Park along SR 14 the greater size and shape of the towers would not dominate the view (see Figure 7-8). Although there would be noticeable changes, they would not become dominant when compared to existing conditions. Visual impacts would be **low** because much of this area is rural and agricultural with fewer viewers. Impacts would be **moderate** at local parks and recreational areas where the contrast of larger, different shaped towers in a natural setting would be more noticeable. The West Alternative ends at the Sundial substation site.

Figure 7-2 Viewpoint 25-1: Looking North from NE Salmon Creek Avenue, Salmon Creek (West Alternative)

Existing Conditions

Simulation

Figure 7-3 Viewpoint 25-2: Looking North-Northeast from NE 76th Avenue, Walnut Grove (West Alternative)

Existing Conditions

Simulation

Figure 7-4 Viewpoint 25-3: Looking East from WSU Campus, Vancouver (West Alternative)

Existing Conditions

Simulation

Figure 7-5 Viewpoint 41-1: Looking Northwest from NE 28th Street (West Alternative)

Existing Conditions

Simulation

Figure 7-6 Viewpoint 50-1: Looking Northwest from NE 3rd Street, North of Camas (West Alternative and Crossover Option 1)

Existing Conditions

Simulation

Figure 7-7 Viewpoint 40-1: Looking East-Southeast from Lacamas Heritage Trail Parking Area (West Option 1)

Existing Conditions

Simulation

Figure 7-8 Viewpoint 52-1: Looking North-Northeast from Lewis and Clark Highway, Camas (All Action Alternatives)

Existing Conditions

Simulation

The West Alternative has a uniform low scenic quality rating and high viewer sensitivity. The West Alternative would have a **moderate** impact on visual resources for most of its length with localized areas of **moderate-to-high** impacts near and/or through the Longview/Kelso, Vancouver, and Camas and Washougal areas. This alternative does not affect any recognized scenic areas or viewpoints, but has localized impacts on parks, areas of community greenspace, natural areas such as the Lacamas Prairie, and on a large number of residents. The overall impact of the West Alternative would be **moderate-to-high (**see Table 7-3).

Table 7-3 Visual Impact Summary

Alternatives and Options	Visual Impact
West Alternative	**moderate-to-high**
West Option 1	N/C
West Option 2	+
West Option 3	+
Central Alternative	**low-to-moderate**
Central Option 1	N/C
Central Option 2	+
Central Option 3	+
East Alternative	**low-to-moderate**
East Option 1	+
East Option 2	N/C
East Option 3	N/C
Crossover Alternative	**low-to-moderate**
Crossover Option 1	+
Crossover Option 2	-
Crossover Option 3	-

Notes:
N/C – No net change from the action alternative.
+ Overall impact of option is higher than the impact of segments the option replaces.
- Overall impact of option is lower than the impact of segments the option replaces.

7.3.4.1 West Option 1

West Option 1 would replace a portion of the alternative that follows existing right-of-way just east of Vancouver with an option that is farther west and closer to Vancouver. This portion of the alternative includes replacing one of the existing 230-kV lines with a new double-circuit 500-kV line. The existing 230-kV line and the new line would be placed on new 500-kV towers (see Figure 7-9). The new towers would be taller than the existing towers, but the need for additional right-of-way or clearing would be minimized. West Option 1 would reduce impacts on residents along NE 48th Circle and mitigate the impact on the Green Mountain Golf Course.

This option would also pass through rural fields where homes that back onto the open space along NE Stoney Meadows Drive would have a clear view of the project, since it passes over flat ground with little vegetation. West Option 1 would cross NE Goodwin Road, Camp Currie, and Camas Meadows Golf Course. The view of the project from several residential roads and homes southwest of this option would likely be unobstructed or only partially obstructed.

Impact levels on visual resources would be the same as the West Alternative (see Table 7-3).

7.3.4.2 West Option 2

West Option 2 would replace a portion of the alternative in the rural residential areas north of Camas with an option farther to the east in the same area. With no change in the right-of-way width, the visible changes would come from the larger double-circuit towers (see Figure 7-9). Near NE Zeek Road, larger towers and an increased right-of-way width is needed (see Figure 7-10). Visual impacts for West Option 2 range from low to high along its length depending on the segment. This option would increase the impact on residents along NE 48th Circle from a moderate level to high, avoid the impact on the Green Mountain Golf Course, and transfer the impact on residents along NE 28th Street farther east to Green Mountain Park and a new right-of-way.

This option would increase visual impacts, since the option would increase the amount of high impacts on several residents, would require new right-of-way, and would add line length (see Table 7-3).

Figure 7-9 Viewpoint 48-1: Looking West-Southwest from NE 267th Avenue (West Option 2, Crossover Option 2)

Existing Conditions

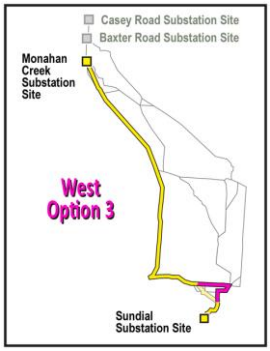
Simulation

Figure 7-10 Viewpoint 51-1: Looking South from NE Zeek Road, Washougal (Central, East, and Crossover Alternatives, and West Options 2 and 3)

Existing Conditions

Simulation

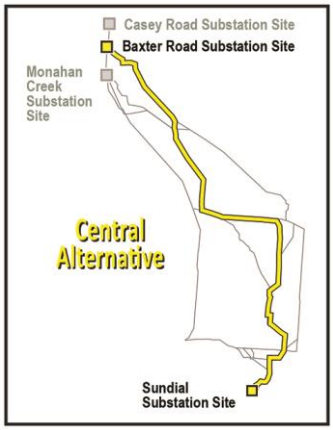
7.3.4.3 West Option 3



West Option 3 would replace a portion of the West Alternative in the rural residential areas north of Camas with a route crossing the rural residential and rural areas farther east. Visual impacts range from low to high along its length depending on the segment. West Option 3 would increase the impact on residents along NE 48th Circle from moderate to high, but avoid the impact on the Green Mountain Golf Course and to residents along NE 28th Street.

This option would increase visual impacts because it would create additional high impacts on several residents and users of Green Mountain Park, would require some new right-of-way, and would add a longer route (see Table 7-3).

7.3.5 Central Alternative



The Central Alternative begins at the Baxter Road substation site (see Section 7.2.2, Central Alternative and Options). The alternative extends southeast and crosses the Cowlitz River Valley north of Castle Rock. It would be visible to motorists and residences west of the Cowlitz River as it crosses West Side Highway (see Figure 7-11), and east of the Cowlitz River as it crosses I-5, and Spirit Lake Memorial Highway (SR 504) (see Figure 7-12 and Figure 7-13). It would be visible to residences surrounding Bond Road and on the east side of I-5 as it extends south along the slopes on the east side of the valley.

The alternative continues southeast through sparsely populated land with few potential viewers where visual impacts are **low** until it crosses the Lewis River near Ariel. The alternative would likely be visible from some residences in Ariel and along the Lewis River with few unobstructed and more distant views. The alternative runs east from Ariel, where potential views exist from some parts of Lake Merwin, which is popular for boating, swimming, and other types of water-based recreation, and the recreation areas near Merwin Dam (see Figure 7-14) and Merwin Hatchery (see Figure 7-15). There are also a few rural residences south of the lake. The combination of sensitive viewers, higher scenic resources, and sparse population causes a **moderate** impact in this area. At this point, the alternative turns south through sparsely populated land with few rural residences; visual impacts in this area would be **low**. In the vicinity of NE Zeek Road, the alternative enters the rural residential areas north of Camas and its larger towers would typically be viewed from residences or roads (see Figure 7-10). This area of sparse population and rural land use would have few potential viewers and visual impacts would be **low.**

The alternative crosses the towns of Camas and Washougal and over the Columbia River to its southern end at the Sundial substation site. Though there are residential viewers within Camas and Washougal, the alternative follows an existing right-of-way within the context of suburban and industrial land uses before crossing the Columbia River (see Figure 7-16, Figure 7-17, Figure 7-18, and Figure 7-19). This portion of the line has **moderate** visual impacts because the contrast of larger, different shaped towers would be more noticeable due to the proximity to

some residential viewers and local sites of higher scenic quality such as parks and community greenspace.

Because most of the Central Alternative runs generally through sparsely populated land with few sensitive viewers and low scenic quality, most impacts are **low**, with a few **moderate** impacts around Ariel, Lake Merwin, Camas and Washougal where natural areas and residents are close to the right-of-way. Residents near pulling and tensioning sites containing trees may also lose the vegetative buffer until it grows back over time. Of the 40 acres of pulling and tensioning sites identified along the entire route, about 8 acres are forested that are not in commercial private timber lands. The overall visual impact of the Central Alternative would be **low-to-moderate** (see Table 7-3).

Figure 7-11 Viewpoint F-15: Looking North along Westside Highway near Castle Rock (Central and East Alternatives)

Existing Conditions

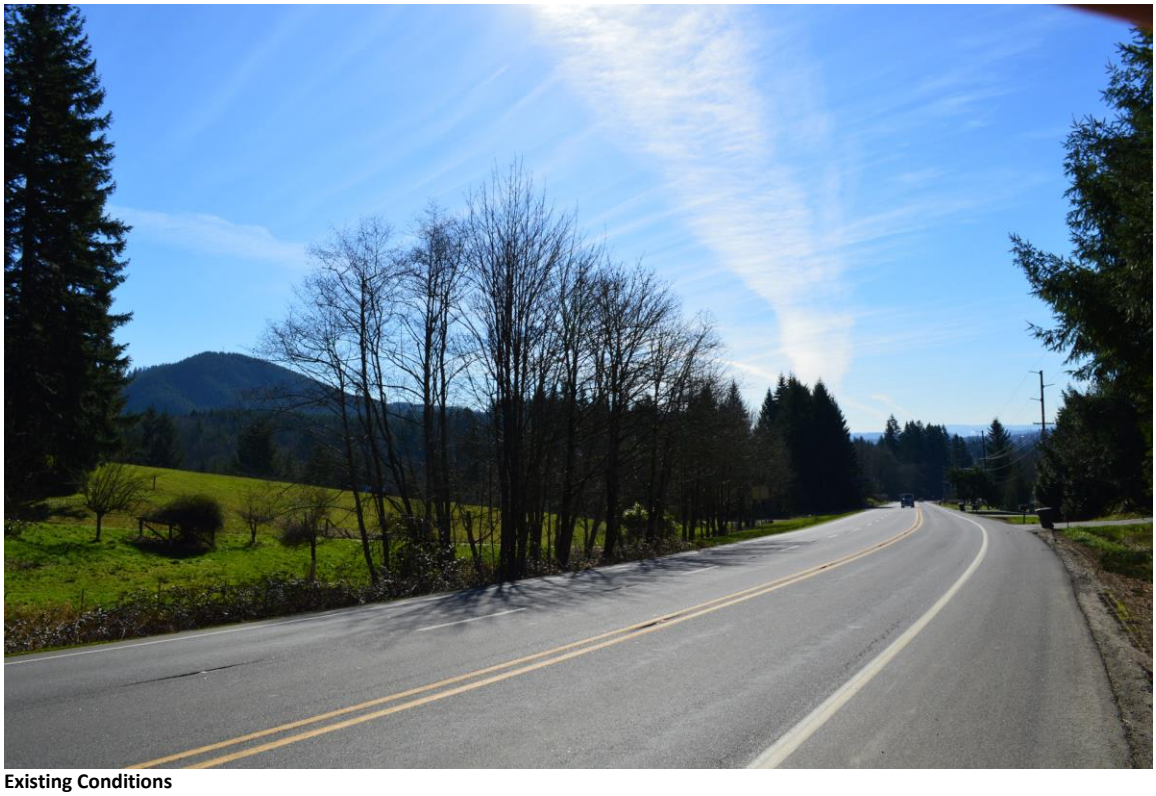
Simulation

Figure 7-12 Viewpoint F-21N: Looking North along Spirit Lake Memorial Highway near Castle Rock (Central and East Alternatives)

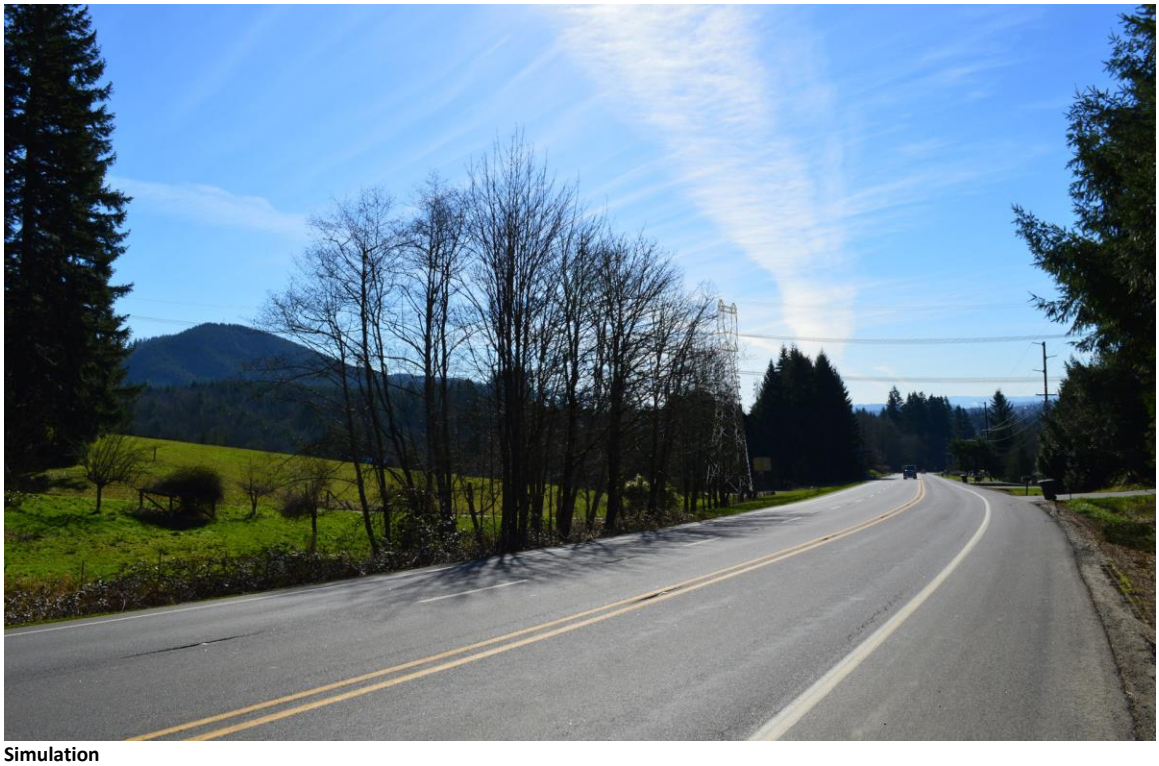
Existing Conditions

Simulation

Figure 7-13 Viewpoint F-21S: Looking South along Spirit Lake Memorial Highway near Castle Rock (Central and East Alternatives)



Existing Conditions



Simulation

Figure 7-14 Viewpoint M-1: Looking South near Swimming Beach at Lake Merwin, Ariel (Central and Crossover Alternatives)

Existing Conditions

Simulation

Figure 7-15 Viewpoint L-3: Looking East from Parking Area near Merwin Hatchery, Ariel (Central and Crossover Alternatives)

Existing Conditions

Simulation

Figure 7-16 Viewpoint 52-8: Looking North near SE 2nd Avenue, Camas (All Action Alternatives)

Existing Conditions

Simulation

Figure 7-17 Viewpoint 52-4: Looking Southeast on W 5th Street towards Mt. Hood near Lookout Ridge, Washougal (All Action Alternatives)

Existing Conditions

Simulation

Figure 7-18 Viewpoint 52-5: Looking South over Columbia River on W 5th Street near Lookout Ridge, Washougal (All Action Alternatives)

Existing Conditions

Simulation

Figure 7-19 Viewpoint 52-12: Looking South over Columbia River on W Empress Street near Lookout Ridge, Washougal (All Action Alternatives)

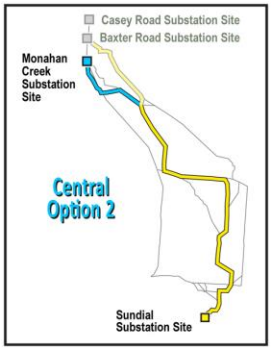
Existing Conditions

Simulation

7.3.5.1 Central Option 1

Central Option 1 would begin at the Casey Road substation site and the transmission line would cross unpopulated land with few distinctive viewpoints. Impact levels on visual resources would be the same as the Central Alternative (see Table 7-3).

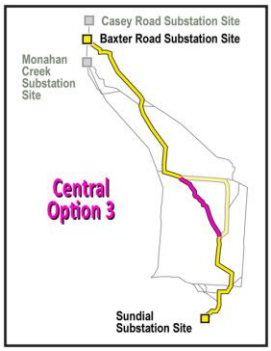
7.3.5.2 Central Option 2



Central Option 2 would begin at the Monahan Creek substation site and would remove the portion of the Central Alternative crossing the Cowlitz River north of Castle Rock and running farther to the southeast. This option would add a new route running southeast from the Monahan Creek site through sparsely populated land, crossing the unincorporated community of West Side Highway next to SR 411, the Cowlitz River and I-5, and running through largely unpopulated land toward the east. The option would remove visual impacts to the area north of Castle Rock, but would introduce **high** impacts in the West Side Highway area. Central Option 2 also replaces the Baxter Road substation site, which would create low impacts, with the Monahan Creek substation site, which would create **moderate** impacts.

Impact levels on visual resources would increase from levels for the Central Alternative (see Table 7-3).

7.3.5.3 Central Option 3



Central Option 3 would replace the Lewis River crossing near Ariel and a portion of the Central Alternative between Ariel and Venersborg, with a downstream river crossing and a new route running directly southeast from Ariel through rural residential areas toward Venersborg. The crossing of the Lewis River near Ariel is in a visually sensitive area. Both the river and nearby Lake Merwin attract recreational users who are likely more sensitive to potential changes to the visual landscape. From Ariel, the view across the river to the south side of the valley would likely be partially obstructed by foreground vegetation. Where views are possible, the towers and right-of-way clearing would be noticeable, but not dominant, as the option climbs the hill on the south side of the Lewis River.

Towers would be visible near a swimming beach within the recreational area at Lake Merwin (see Figure 7-14). The new Lewis River crossing and the crossing more to the east that it replaces have similar visual impacts. This option does introduce a new right-of-way through rural residential areas southeast of Ariel, which has a higher visual impact than the segments it replaces. Visual impact at local sites, such as Lucia Falls and Moulton Falls Park at the East Fork Lewis River, would be **moderate** due to higher scenic quality and viewer sensitivity because the alternative would have greater contrast against the existing view. Potential viewing locations in this area would include rural residential homes and SR 503.

Impact levels on visual resources would increase from the Central Alternative (see Table 7-3).

7.3.6 East Alternative

The East Alternative begins at the Baxter Road substation site. The alternative runs southeast and crosses the Cowlitz River valley north of Castle Rock. Where it crosses the river and travels south along the slopes on the east side of the valley, locations with potential views of the alternative include residences east of the Cowlitz River, I-5 and SR 504, and roads and residences surrounding Bond Road on the east side of I-5. Although sparsely populated, the alternative would cause **moderate** impacts at local sites due to the scenic quality of the river crossing and views from SR 504, and the sensitivity of nearby residences.

The alternative then runs farther southeast through unpopulated land toward Yale where it crosses SR 503. In this area, the alternative would likely be visible from some rural residences along the highway (see Figure 7-20). The alternative then runs south through unpopulated land and the Yacolt Burn State Forest until it enters rural residential areas north of Camas in the vicinity of NE Zeek Road. Typical views in this area would be from residences or roads (see Figure 7-10) with **low** impacts due to the lower scenic value, unpopulated areas, and existing transmission lines near Camas.

Within the Yacolt Burn State Forest, the East Alternative would pass near or over several trails popular with motorized trail users and hikers, bikers, and equestrians. These trails include the Jones Creek Trail, Jones Creek Connector A, Jones Creek Connector B, and Tarbell Trail. Impacts here are **moderate** overall, and range locally from **high** where cleared right-of-way crosses the trail (which is a location of high viewer sensitivity), to **moderate** where the line can be seen from some trail viewpoints, to **low** where trees along the trails obscure views of the line.

The alternative crosses the cities of Camas and Washougal, and the Columbia River, and ends at the Sundial substation site. Though there are residential viewers within Camas and Washougal, the alternative is in the existing BPA right-of-way within the context of suburban and industrial land uses before crossing the Columbia River (see Figure 7-16, Figure 7-17, Figure 7-18, and Figure 7-19). This portion of the line is rated as having **moderate** visual impacts where the contrast of larger, different shaped towers would be more noticeable due to the proximity to some residental viewers and local sites of higher scenic quality such as parks and community greenspace.

Because most of the East Alternative runs through sparsely populated or unpopulated land, most impacts are **low** (although residents in the area would be sensitive to the changes). A few **moderate** impacts occur to the north; in and around Camas and Washougal where there are nearby residents, parks and community greenspace; and through the Yacolt Burn area. The overall impact of the East Alternative would be **low-to-moderate** (see Table 7-3).

Figure 7-20 Viewpoint K-1: Looking East-Southeast from Yale Bridge Road, Ariel (East Alternative)

Existing Conditions

Simulation

7.3.6.2 East Option 1

East Option 1 begins at the Monahan Creek substation site and would remove the portion of the East Alternative crossing the Cowlitz River north of Castle Rock. East Option 1 would use segments southeast of the Monahan Creek substation site that run through sparsely populated land, cross the Cowlitz River and I-5 and run through largely unpopulated land toward the east. The option would remove visual impacts in the area north of Castle Rock, but would introduce impacts where it crosses the Cowlitz River farther south, and would be visible from several residences. East Option 1 also replaces the Baxter Road substation site, which would create **low** impacts, with the Monahan Creek substation site, which would create **moderate** impacts.

East Option 1 would have a slightly higher impact on visual resources because of the substation site used (see Table 7-3).

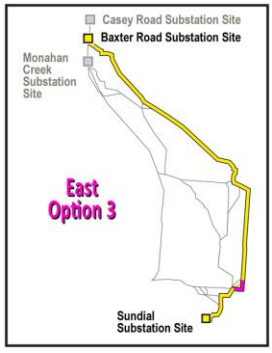
7.3.6.3 East Option 2

East Option 2 would replace a portion of the East Alternative between Yale and the rural residential areas north of Camas with a similarly rated route farther to the west. This option could remove some visual impacts on outdoor and recreational users east of the East Alternative, but would also introduce additional impacts on rural residences along the option's route.

Impact levels on visual resources would be the same as the East Alternative (see Table 7-3).

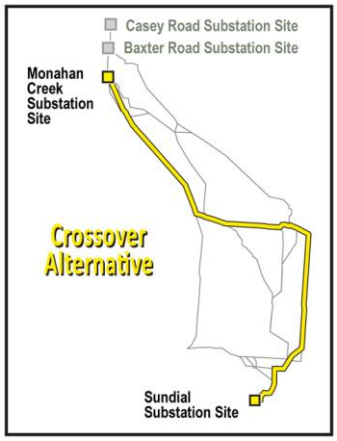
7.3.6.4 East Option 3

East Option 3 would replace a short portion of the alternative in unpopulated land with a new route through unpopulated land. Impact levels on visual resources would be the same as the East Alternative (see Table 7-3).



7.3.7 Crossover Alternative

The Crossover Alternative begins at the Monahan Creek substation site, and follows the same path as the West Alternative to a point north of the Lewis River. Similar to the West Alternative (see Section 7.2.1, West Alternative and Options), most views between the Monahan Creek site and the Longview area would be partially or fully obstructed by vegetation and, in some cases, residences. The new transmission line would be visible near Delameter Road and from some rural residences in a few locations along Hazel Dell Road and rural residences near Trout Lake Road. The transmission line would run next to existing lines on existing BPA right-of-way, between Longview/Kelso and



just north of the Lewis River. East of I-5, the Crossover Alternative runs through rural residential areas decreasing in density farther south. Some residents would have a view dominated by the project, but the experience of most viewers in this area would be slightly more distant with many vegetative visual obstructions; the line would be visible, but would not completely dominate the view. In general, visual impacts would be **moderate** for the northern part of this alternative because of the reduced scenic quality and the contrast of the line being visible but not totally dominant to most viewers. At local sites of higher scenic quality and viewer sensitivity such as the Kalama River crossing, visual impacts would be **moderate-to-high**, especially where the removal of trees within riparian areas make towers more visible.

The Crossover Alternative crosses the Lewis River near Ariel, farther east than the West Alternative's crossing. The alternative would likely be visible from some residences in Ariel and along the Lewis River. However, there would be few unobstructed and more distant views. As the alternative runs east from Ariel, potential views exist from some parts of Lake Merwin, some rural residences south of the lake which is popular for boating, swimming, and other types of water-based recreation (see Figure 7-14), and Merwin Hatchery (see Figure 7-15). The combination of sensitive viewers, higher scenic resources, and sparse population causes a **moderate** impact in this area.

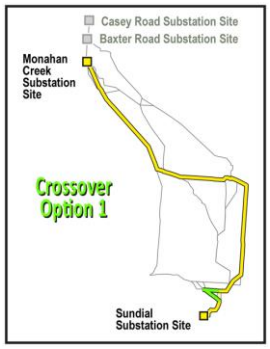
The alternative then runs south through unpopulated land and the Yacolt Burn State Forest. Within the Yacolt Burn State Forest, the Crossover Alternative would pass near or over several trails popular with motorized trail users and hikers, bikers, and equestrians. These trails include the Jones Creek Trail, Jones Creek Connector A, Jones Creek Connector B, and Tarbell Trail. Impacts here are **moderate** overall, and range locally from **high** where cleared right-of-way crosses the trail (which is a location of high viewer sensitivity), to **moderate** where the line can be seen from some trail viewpoints, to **low** where trees along the trails obscure views of the line.

In the vicinity of NE Zeek Road, the alternative enters the rural residential areas north of Camas where typical views would be from residences or roads, and larger towers are needed (see Figure 7-10). The alternative crosses the cities of Camas and Washougal, and the Columbia River and ends at the Sundial substation site. Though there are residential viewers within Camas and Washougal, the alternative follows an existing right-of-way within the context of suburban and industrial land uses before crossing the Columbia River (see Figure 7-16, Figure 7-17, Figure 7-18, and Figure 7-19). This portion of the line is rated as having **moderate** visual impacts where the contrast of larger, different shaped towers would be more noticeable due to the proximity to some residental viewers and local sites of higher scenic quality such as parks and community greenspace.

This portion of the alternative south of the Lewis River has somewhat greater (**moderate**) effects because of the sensitive viewers from the Lewis River area and Lake Merwin, although the final portion through Camas and the Columbia River crossing follow existing lines and rights-of-way.

The Crossover Alternative would have a **low-to-moderate** visual impact for most of its length. Localized visual impacts to a limited number of residences would likely be found in the community of West Side Highway. This alternative does not impact any recognized scenic areas or viewpoints, but has localized impacts on parks and areas of community greenspace. The overall impact of the Crossover Alternative would be **low-to-moderate** (see Table 7-3).

7.3.7.1 Crossover Option 1



Crossover Option 1 would remove a portion of the alternative crossing north–south through rural residential areas north of Camas between NE Zeek Road and SE 23rd Street, and replace it with a route running west along an existing right-of-way until about NE 232nd Avenue, then southeast through more natural areas of the Lacamas area, open fields and more rural residential areas (see Figure 7-7). The option would remove visual impacts in the areas around NE Zeek Road and NE Blair Road; however, it would introduce additional impacts on the residences in the area around NE 267th Avenue (see Figure 7-9). With no change in the right-of-way width, visible changes would result from the larger double-circuit towers. The new, larger towers would dominate the surroundings. There would be little change to vegetation in this area because little clearing would be required and the project would be near an existing transmission line.

Crossover Option 1 would have a higher impact on visual resources because it adds a new route that, while rated the same as the route it replaces, is longer (see Table 7-3).

7.3.7.2 Crossover Options 2 and 3

Crossover Option 2 would begin at the Baxter Road substation site and the new transmission line would cross sparsely populated land. The option does add additional segments, but would use a substation site with potentially lower visual impacts than the Monahan Creek substation site. Crossover Option 3 is similar, except that parts of the route would require additional right-of-way parallel to the existing line instead of within the right-of-way.

Crossover Options 2 and 3 would have lower impacts on visual resources than the alternative because of the different substation location (see Table 7-3).

7.3.8 Recommended Mitigation Measures

Mitigation measures are included as part of the project (see Table 3-2). BPA is considering the following additional mitigation measures to further reduce or eliminate adverse impacts on visual resources by the action alternatives. If implemented, these measures would be completed before, during, or immediately after project construction unless otherwise noted.

- Site new towers next to or near existing towers and use a similar tower type. This would lessen visual clutter that can occur when different types of towers are visible in a vast open landscape.
- Site new towers to take advantage of existing screening offered by topography or vegetation, e.g., avoid ridgetops where practicable.

- Set towers back from road crossings, to minimize intrusion on views along road corridors.
- Preserve existing vegetation along the roadway to screen transmission lines and towers. Allow dense masses of shrubs to grow parallel to the roadway where the transmission line right-of-way crosses.
- Revegetate cleared areas as soon as possible after construction.
- Minimize access road placement in highly sensitive areas.
- Follow FAA safety requirements for tower lighting and marker balls.

7.3.9 Unavoidable Impacts

After mitigation, vegetation clearing, transmission towers, access roads and substations would still be visible to residents, motorists, and recreationists from many locations.

7.3.10 No Action Alternative

Under the No Action Alternative, existing visual resource conditions would continue (see Section 7.2, Affected Environment). Transmission lines in existing rights-of-way, substations, and access roads would continue to be visible to surrounding viewers. In areas without existing transmission lines, other existing and future alterations would continue to occur, such as commercial forest harvest, urban development, and road and rail operation and expansion.

Chapter 8 Electric and Magnetic Fields

This chapter defines **electric and magnetic fields** and discusses typical field levels, what factors affect field strength, safety standards (if any), and expected average and maximum fields along the action alternatives. It also discusses potential corona-caused interference with broadcast radio or television (TV) signals and implanted medical devices.

Words in bold and acronyms are defined in Chapter 32, Glossary and Acronyms.

8.1 Affected Environment

Electric and magnetic fields (EMF) exist everywhere electricity is used. Fields vary widely throughout the project area, depending on proximity to electronic devices or electrical lines and intervening landscape or walls. In general, existing EMF levels are higher in developed areas with electrical lines and buildings with electrical wiring, electrical equipment, and appliances.

Transmission lines, like all electric devices, produce EMF. **Current**, the flow of electric charge in a wire, produces the magnetic field. Voltage, the force that drives the current, is the source of the electric field. The strength of EMF around existing lines throughout the project area depends on the design of the electrical line and distance from it.

Corona is caused by strong electric fields at the surface of conductors. Throughout the project area, corona can occur on existing transmission lines during foul weather when the conductors are wet. Corona produces audible noise (see Chapter 9, Noise) and electromagnetic interference (static) that can affect AM radio or broadcast TV signals. The level of interference depends on the distance that the radio or TV is from the transmission line and the strength of the radio or TV signal being received. Signal reception is dependent on the strength of the signal generated from the radio or TV tower, and the distance from that tower to the receiver. In general, remote rural areas are farther from tower transmitters and more likely to receive a weak signal. This does not apply to reception via cable or satellite TV or radio, or FM radio frequencies. Generally, interference from corona would be higher if the radio or TV is closer to the transmission line but less if the signal is weaker.

8.1.1 Electric Fields

Electric fields are measured in **volts** per meter (V/m) or **kilovolts** per meter (kV/m). Throughout a home, the average electric field strength from wiring and appliances can range from 5 to 20 V/m, but is often less than 10 V/m (Bracken 1990). Localized fields near a small household appliance can range from 30 to 60 V/m, but field strengths drop off sharply with distance from the source. Electric-field levels in public buildings such as shops, offices, and malls are comparable with residential levels. Outdoor electric fields in publicly accessible places can range from 1 V/m to 12 kV/m, with the higher fields present near high-voltage transmission lines of 500 kV or greater. Electric field strength is reduced by objects such as walls and vegetation.

General guidelines for both electric and magnetic field exposure have been established by several national and international organizations (see Appendices F and G). Electric field

guidelines for public exposure range from 4.2 to 5 kV/m. In one guideline, the limit on transmission line rights-of-way is 10 kV/m. Occupational exposure guidelines (i.e., for employees in the workplace) range from 8.3 to 25 kV/m. There are no national standards for electric fields from transmission lines, and the state of Washington has no electric field limit. Oregon's Energy Facility Siting Council (EFSC) has established a limit of 9 kV/m within the right-of-way (there is no edge of right-of-way limit). BPA requires new transmission lines to meet its electric field guideline of 9 kV/m maximum on the right-of-way and 2.5 kV/m maximum at the edge of the right-of-way. BPA also specifies maximum-allowable electric field strengths of 5 kV/m for road crossings, 3.5 kV/m for shopping center parking lots, and 2.5 kV/m for commercial and industrial parking lots.

8.1.2 Magnetic Fields

Magnetic fields are measured in units of **gauss** (G) or **milligauss** (mG), with 1 G being equal to 1,000 mG. Average magnetic field strength in most homes (away from electrical appliances and wiring) is typically less than 2 mG. However, appliances carrying high current or those with high-torque motors, such as microwave ovens, vacuum cleaners or hair dryers, may generate fields of tens or hundreds of milligauss directly around them (see Table 8-1). Office workers operating electric equipment and industrial workers can be exposed to similar or higher magnetic field levels. Outdoor magnetic fields in publicly accessible places can range from less than 1 mG to about 1,000 mG (i.e., about 1 G), with the highest levels localized near devices powered by large electric motors.

Table 8-1 Typical Magnetic Field Levels

Appliance[1]	Magnetic Field Range (mG)[2]
Can Opener	40–300
Vacuum Cleaner	20–200
Microwave Oven	1–200
Hairdryer	0.1–70
Power Drill	20–40
Television	0–20
Computer Monitor	2–6

Notes:
1. Applies to plug-in devices.
2. At a distance of 1 foot.
Source: NIEHS 2002

Like electric fields, magnetic fields fall off with distance from the source. Unlike electric fields, however, magnetic field strength is not reduced by intervening common objects such as walls and vegetation. Consequently, though appliances can produce high localized magnetic fields, transmission lines serving neighborhoods and distribution lines serving individual homes or businesses can contribute to longer-term magnetic field exposure at much lower levels.

There are no national standards for magnetic fields, and Oregon, Washington and BPA do not have magnetic field limits for transmission lines. Guidelines created by national and international organizations range from 833 to 9,040 mG for public magnetic-field exposure and from 4,200 to 27,100 mG for occupational magnetic-field exposure (see Appendices F and G).

8.1.3 Electromagnetic Interference

If corona is present at the surface of transmission line conductors, it generates electromagnetic interference that can affect reception of broadcast radio and TV signals close to the right-of-way. This affects only conventional broadcast radio and TV receivers operating at lower frequencies (AM radio and TV channels 2 to 6). With the introduction of digital television technology, the broadcast frequencies for affected channels have been raised and corona interference with these television signals is no longer a potential problem. Satellite and cable TV systems are not affected, nor are FM radio signals.

Electromagnetic interference is generally from transmission lines operating at voltages of 345 kV or higher. However, sparks occurring in gaps between loose hardware and loose wires on distribution lines and low-voltage wood-pole transmission lines are a more common (95 percent) source of interference than corona from high-voltage electrical systems (USDOE 1980). This gap-type interference is primarily a fair-weather phenomenon and is easily remedied by line maintenance, relocation of a radio or TV antenna, or use of a directional antenna.

In the U.S., electromagnetic interference from transmission systems is governed by the Federal Communications Commission (FCC), which requires the operator of any device that causes "harmful interference" to take prompt steps to eliminate it (FCC 1988; see also Appendix F). There are no state limits for electromagnetic interference.

8.2 Environmental Consequences

General electric and magnetic field effects are discussed below, followed by specific electric and magnetic field calculations and discussion for each action alternative.

8.2.1 Impact Levels

Impacts would be **high** where project activities would cause the following:

- The electric field levels would induce a large enough current on objects on the right-of-way to exceed limits set by the National Electric Safety Code (NESC)
- Shocks would approach dangerous levels

Impacts would be **moderate** where project activities would cause the following:

- The electric field levels would violate BPA policies, but meet the NESC
- Shocks would be unpleasant, but would not be dangerous

Impacts would be **low** where project activities would cause the following:

- The electric field levels would meet BPA policies and the NESC
- Perceptible nuisance shocks may occur when touching metallic objects on the right-of-way; these shocks would not be hazardous, but may still cause discomfort

No impact would occur if shocks were not perceptible or electric field levels would not increase over existing levels.

Because studies have provided insufficient or inconclusive evidence about the potential health impacts of magnetic fields (see Section 8.2.2.2, Magnetic Fields), and because there are no national or regional standards for magnetic fields, BPA has not defined impact levels for magnetic fields.

8.2.2 Impacts Common to Action Alternatives

8.2.2.1 Electric Fields

Transmission lines, like all electrical wiring, can cause serious electric shocks if certain precautions are not taken. All BPA lines are designed and built to meet or exceed the NESC, which specifies the minimum allowable distance between conductors and the ground or other objects. These requirements determine the minimum distance to the edge of the right-of-way and the minimum height of the line, that is, the closest point that houses, other buildings, and vehicles are allowed to the line. These clearances are specified to prevent harmful shocks to workers and the public.

BPA also does not permit any uses within rights-of-way that are unsafe or might interfere with safely constructing, operating, or maintaining the transmission facilities. These restrictions are part of the legal rights BPA acquires for its transmission line easements.

However, people working or living near transmission lines must also take certain precautions. In general, when under a transmission line, a person should never put themselves or any object higher than 14 feet above ground. For example, it is important never to bring conductive materials—including TV antennas, irrigation pipes or water streams from an irrigation sprinkler—too close to the conductors as serious shocks or electrocution can occur. Also, vehicles should not be refueled under or near conductors. A free BPA booklet describes safety precautions for people who live or work near transmission lines (see *Living and Working Safely around High-Voltage Transmission Lines* available at: http://www.bpa.gov/news/pubs/GeneralPublications/lusi-Living-and-working-safely-around-high-voltage-power-lines.pdf.

Besides serious shocks, transmission lines can also cause nuisance shocks when a grounded person touches an ungrounded object under or near a line, or when an ungrounded person touches a grounded object. BPA takes additional precautions to minimize nuisance shocks. Fences and other metal structures on and near the right-of-way would be grounded during construction. After construction, BPA would respond to any complaints and install or repair grounding as needed. Nuisance shocks from mobile objects that cannot be grounded permanently are minimized by conductor clearance codes and design practices, such as BPA's 5 kV/m electric field requirement for road crossings and 2.5 to 3.5 kV/m limit for parking lots.

For the action alternatives, standard minimum clearance of the conductors above ground would be 35 feet at a conductor temperature of 122°F (50°C). This standard minimum clearance would also ensure that the BPA criterion for maximum electric fields of 9 kV/m at 50°C is met.

Because of the many precautions BPA would take to minimize the risk of serious or nuisance shocks to nearby residents and passers-by, the project would create **no-to-low** impacts.

8.2.2.2 Magnetic Fields

Decades of scientific studies are inconclusive as to whether magnetic fields can potentially cause health effects. A review of these studies and their implications for health-related effects is provided in Appendices G and G1. In summary, the scientific studies and reviews of research on the potential health effects of power line electric and magnetic fields have found there is insufficient evidence to conclude exposure to either field leads to long-term health effects, such as adult cancer, neurodegenerative diseases (such as Alzheimer's or Lou Gehrig's disease), or adverse effects on reproduction, pregnancy, or growth and development of an embryo. Uncertainties do remain about possible links between childhood leukemia and childhood magnetic field exposures at levels greater than 3-4 mG. There are also suggestions that short-term exposures to magnetic fields greater than 16 mG may be related to an increased risk of miscarriage. However, animal and cellular studies provide limited support for the idea that statistical associations observed in epidemiology studies reflect a causal relationship between magnetic field exposure and an increased risk of childhood cancer or miscarriage.

An increase in public exposure to magnetic fields could occur if the project causes field level increases and if residences or other structures draw people to these areas. The predicted field levels discussed under each action alternative are only indicators of how the project would affect the overall magnetic field environment. They are not measures of risk or impacts on health. No impact levels are stated because, unlike in other resource chapters in this EIS, no basis exists for determining them (see Section 8.2.1, Impact Levels).

8.2.2.3 Implanted Medical Devices

Because EMF from various sources (including automobile ignitions, appliances and possibly transmission lines) can interfere with implanted cardiac pacemakers, manufacturers are now designing devices to be immune from such interference. However, a few models of older pacemakers still in use could be affected by EMF from transmission lines. Many pacemaker models are unaffected by fields larger than those found under transmission lines.

No government EMF limits exist to guide pacemaker wearers. However, because of the known potential for interference with some older pacemakers, EMF field limits for pacemaker wearers in occupational areas have been established by the American Conference of Governmental Industrial Hygienists (ACGIH). The ACGIH recommends that, if unsure about their pacemakers, wearers of these and similar medical-assist devices should limit their exposure to electric fields of 1 kV/m or less and to magnetic fields of 1,000 mG or less (ACGIH 2009).

Electric fields from the proposed 500-kV line would generally meet ACGIH limits beyond about 35 feet from the edge of the rights-of-way. Wearers of pacemakers and similar medical-assist devices are discouraged from unshielded right-of-way use. A driver or passenger in an automobile under the line would be shielded from the electric field. Magnetic fields would be well below ACGIH limits. For additional discussion about potential interference with implanted devices, see Appendices F, F1, G and G1.

8.2.2.4 Electromagnetic Interference

For each action alternative, potential corona-caused electromagnetic interference levels that could affect radio or TV reception were calculated for fair and foul weather conditions (see Appendices F and F1). Radio interference calculations show that levels would be at or below

acceptable limits for avoiding interference. TV interference levels would be comparable to, or less than, interference levels from other BPA 500-kV lines.

Recent conversion to digital television technology has made TV reception much less susceptible to corona-generated interference. Because of this conversion, the lower-channel stations (Channels 2 to 6), where interference could occur, now transmit at higher frequencies where corona-generated interference has not been a problem. The likelihood of TV interference due to corona is greatly reduced from just a few years ago and is anticipated to occur very rarely, if at all, along the right-of-way. The bundle of three conductors used for each phase of the proposed 500-kV transmission line would also minimize corona generation and further prevent radio and TV interference. In the event interference does occur, BPA has a mitigation program to correct it and would restore reception to the same or better quality.

Corona-generated interference can conceivably cause disruption on other communications bands. However, interference is unlikely with newer devices (satellite internet, cell phones and GPS units) that operate with digital signals and at frequencies well above those where corona-generated interference is prevalent. Mobile-radio communications are not susceptible to transmission-line interference because they are generally frequency modulated (FM). In the unlikely event that interference occurs with these or other communications, mitigation can be achieved with the same techniques used for TV and AM radio interference. To comply with FCC regulations, BPA would work with owners and operators of communications facilities along the action alternatives to identify and implement mitigation measures in the event of interference from the new line.

Magnetic fields can also distort images on older video display monitors with cathode ray tubes. This is unlikely to occur at magnetic field levels found very close to (within about 100 feet of) the transmission line right-of-way. If these effects occur, such interference can be remedied by moving the monitor to another location or replacing it with a contemporary flat-panel device such as a liquid-crystal or plasma display. The latter are not affected by magnetic fields.

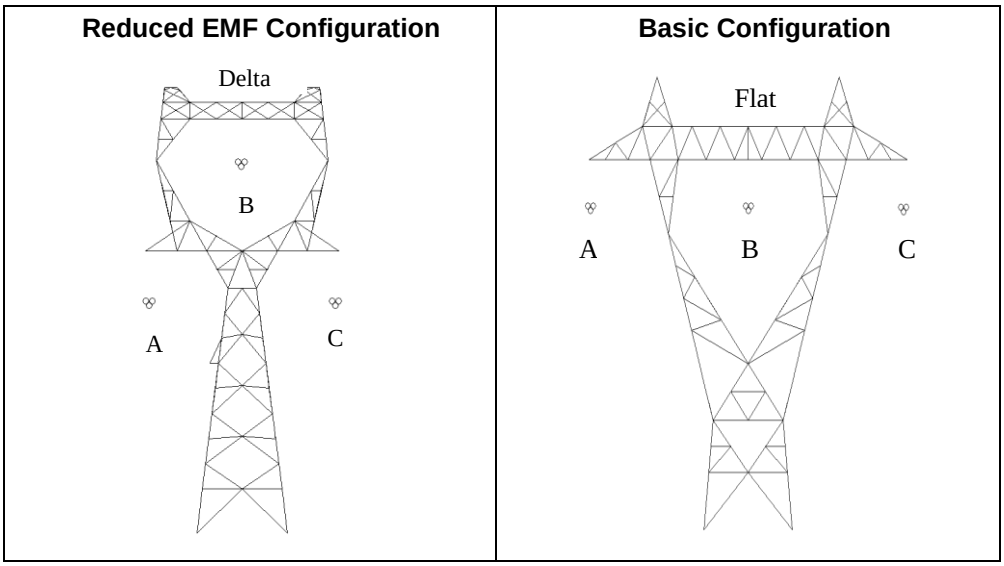
8.2.2.5 Designing Lines to Reduce EMF

When BPA builds new high-voltage 500-kV transmission lines, the agency designs them using “EMF mitigation” techniques to keep EMF exposure as low as reasonably achievable, while maintaining system reliability.

For example, BPA uses “delta configuration” tower designs for single-circuit lines, where the three phase conductor bundles (called A, B, and C) are positioned in a triangular shape (two on the bottom, one on top) (see Figure 8-1). This configuration provides for more EMF cancellation effects than the more traditional “flat configuration,” where the three phase conductor bundles are arranged horizontally and all are at the same height above ground.

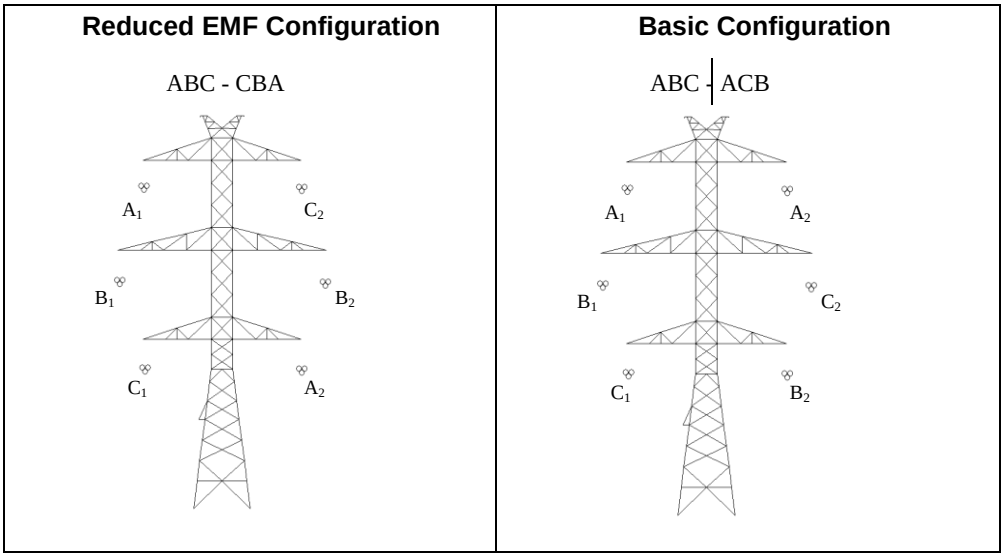
For double-circuit lines (two transmission line circuits on the same tower; six phase conductor bundles instead of three), BPA uses a “phase-optimization” approach to minimize EMF levels, when feasible. Generally, three phase conductor bundles of one line circuit are placed vertically on the left side of the tower and the three phase conductor bundles of the other circuit are placed vertically on the right side (see Figure 8-2). Such phasing arrangements for the two circuits can result in some EMF cancellation. The actual reduction of electric fields depends on the circuit voltages; the reduction of magnetic fields depends on the direction of the power flow and magnitude of the current.

Figure 8-1 Single-Circuit Tower Design to Reduce EMF



For the few short segments where triple-circuit towers would be required, each segment would be individually considered to minimize EMF.

Figure 8-2 Double-Circuit Tower Design to Reduce EMF



8.2.2.6 Substation Sites

Both electric and magnetic fields at the perimeter of the Sundial substation site and any Castle Rock substation site would reflect fields generated by the new 500-kV line, with the same magnitudes and impacts (see Section 8.2.2, Impacts Common to Action Alternatives). Within several hundred feet of the transmission line or substation fence, these fields would dissipate to ambient levels.

8.2.3 EMF Calculations

Impacts common to action alternatives are in Section 8.2.2. The remaining sections discuss methods used to calculate electric and magnetic fields, impacts unique to each alternative, and recommended mitigation measures.

EMF levels were calculated for every line section within route segments for each alternative and option (see Appendices F and F1). The information in Appendices F and F1 can be used to pinpoint predicted EMF levels at properties along any of the action alternatives. The average of these field levels was computed across the length of the action alternatives to provide an overall measure of EMF for each alternative and option.

8.2.3.1 Electric Fields

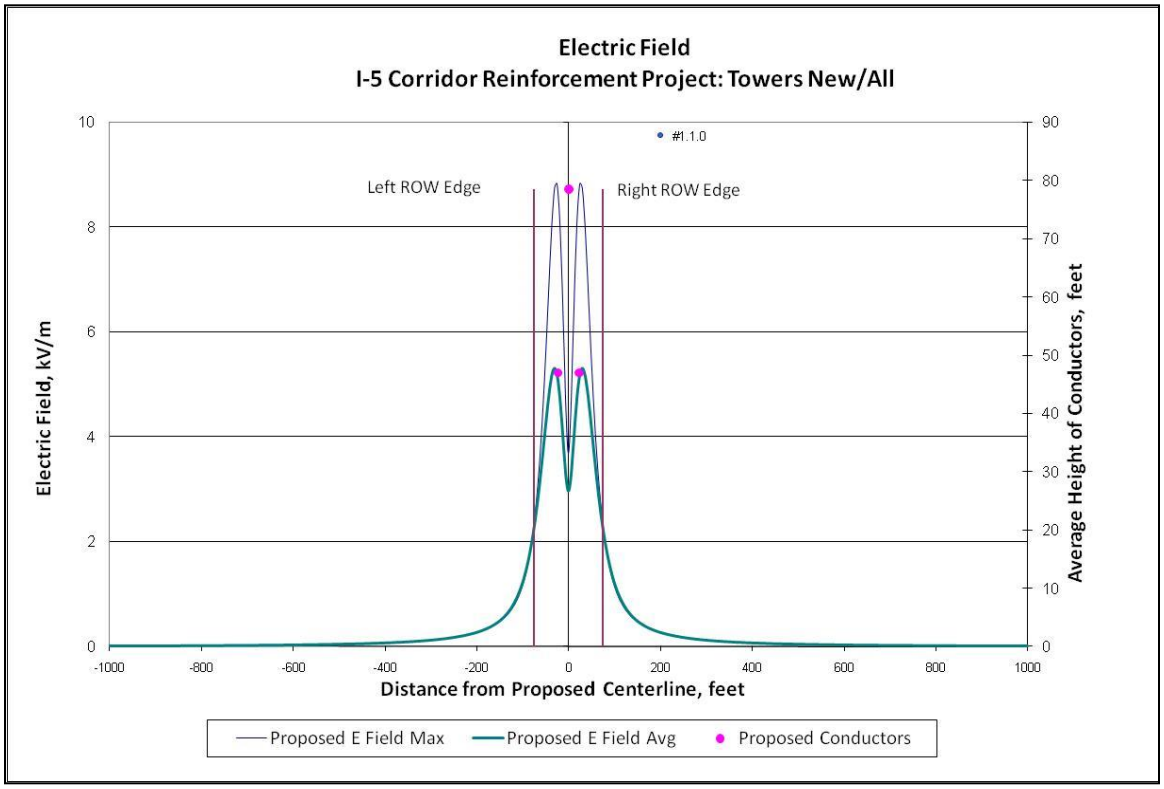
Electric fields for each route segment, and for each line section within a segment, were calculated for their value on the right-of-way and their value at the edge of the right-of-way. Fields at these two locations were calculated under two operating scenarios that result in different conductor heights (and therefore different potential field strengths) above ground.

The first scenario produces the lowest allowed conductor height of 35 feet. It assumes a conductor temperature of 122°F (50°C) and that the line is operating at maximum voltage (550 kV) and carrying maximum current (1,080 Amperes [A]). Though this allows maximum electric fields to be calculated directly under the line and at the edge of right-of-way, it represents a situation that would rarely occur. Actual line height is generally above minimum clearance levels, actual voltage is generally lower than maximum, and vegetation within and near the edge of the right-of-way tends to shield electric fields at ground level. Electric fields calculated under this scenario are considered maximum levels.

The second scenario assumes an average conductor height of 47 feet (averaged along an entire span) and average current (324 A), but still assumes a maximum voltage (550 kV) to ensure conservative calculations (highest possible electric field levels under average conditions). These conditions more closely correspond to normal operating conditions with lower temperatures and average currents. Electric fields calculated under this scenario are considered average levels.

To provide summary measures of the fields for each alternative and option, the edge of right-of-way fields from all segments in alternatives and options were combined in a length-weighted average. (In the length-weighted average, the fields for the longest/shortest segments are given the most/least weight, respectively, in computing average values.) The results summarize the field levels on and at the edge of the right-of-way under extreme (maximum) and normal (average) conditions by alternative and option. (See Figure 8-3 for a visual example of maximum and average [normal] electric fields along all portions of action alternatives on new right-of-way. See figures in Appendices F and F1 for fields created in route segments on existing right-of-way.)

Figure 8-3 Electric Fields Surrounding the Transmission Line on New Right-of-Way[1]

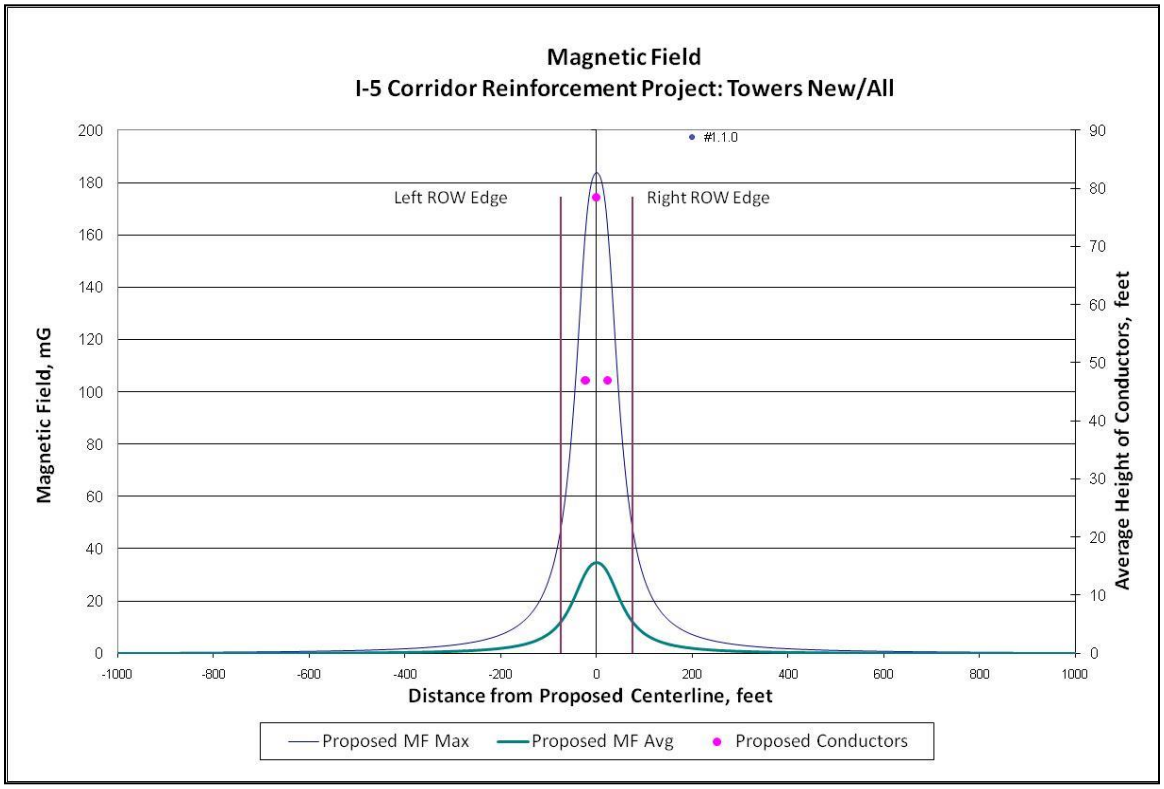


[1] This is identified as field calculation 1.1.0 in the tables in Appendix F, where the numeric values can be found.
Source: Bracken 2011 (see Appendix F).

8.2.3.2 Magnetic Fields

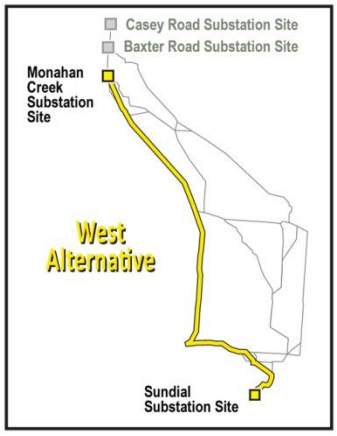
Maximum and average magnetic fields were calculated using the same two operating scenarios as for electric fields. As with electric fields, the summary measures for alternatives and options represent length-weighted averages over all segments in the alternative or option. (See Figure 8-4 for a visual example of maximum and average [normal] magnetic fields along all route segments in new right-of-way. See figures in Appendices F and F1 for fields created along route segments in existing right-of-way.) These calculations take into consideration that portions of the action alternatives would share rights-of-way with existing lines, or in some cases could replace those lines. In other words, they represent the total projected magnetic fields along the rights-of-way, not net gains or losses in fields.

Figure 8-4 Magnetic Fields Surrounding the Transmission Line on New Right-of-Way[1]

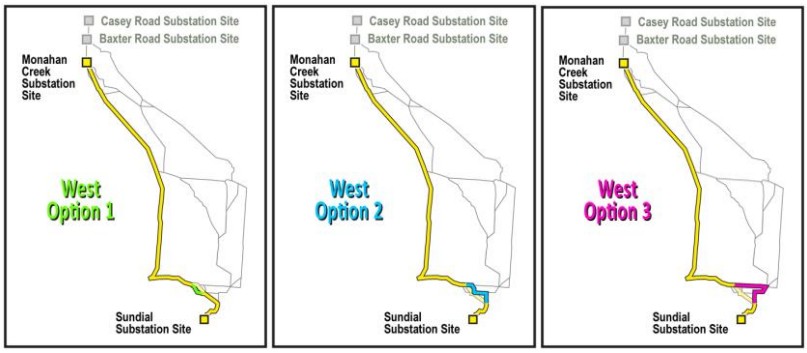


[1] This is identified as field calculation 1.1.0 in the tables in Appendix F, where the numeric values can be found.
Source: Bracken 2011 (see Appendix F).

8.2.4 West Alternative and Options



The West Alternative and options would be mostly in (98 percent) an existing right-of-way, which crosses the highest proportion (17 percent) of populated area compared to the other action alternatives—about 7 percent urban/suburban and 10 percent rural areas. Most of the rural area is undeveloped. Beyond the right-of-way, from the right-of-way edge out to 1,000 feet on either side of the line, the West Alternative and options would be located near a greater percentage of property zoned for residential use than the other action alternatives: about 46 percent. As a result, a greater number of people would live near or pass by the West Alternative and options than the other action alternatives. (This is also substantiated by housing counts—see Table 5-1.)



Length-weighted maximum electric fields on the rights-of-way for the West Alternative and options would range from 8.8 to 8.9 kV/m (see Table 8-2).

Table 8-2 West Alternative and Options—Length-Weighted Average Electric and Magnetic Field Levels

West Alternative				Electric Field (kV/m)		Magnetic Field (mG)	
Right-of-Way	**Length (miles)**	**Field Location**	**Field Descriptor[1]**	**Proposed Action**	**No Action**	**Proposed Action**	**No Action**
New	1.4	On right-of-way	Average	5.3	—	35	—
			Maximum	8.8		184	
		Edge of right-of-way	Average	2.3		12	
			Maximum	2.3		48	
Existing	64.2	On right-of-way	Average	5.4	2.0	36	24
			Maximum	8.8	3.8	182	134
		Edge of right-of-way	Average	1.4	0.5	10	5
			Maximum	1.4	0.5	36	21
West Option 1[2]				**Electric Field (kV/m)**		**Magnetic Field (mG)**	
Right-of-Way	**Length (miles)**	**Field Location**	**Field Descriptor[1]**	**Proposed Action**	**No Action**	**Proposed Action**	**No Action**
New	2.0	Same as new right-of-way values shown above for West Alternative					
Existing	1.1	On right-of-way	Average	5.6	2.3	28	19
			Maximum	8.9	4.6	139	94
		Edge of right-of-way	Average	0.6	0.6	10	4
			Maximum	0.6	0.5	35	13
West Option 2				**Electric Field (kV/m)**		**Magnetic Field (mG)**	
Right-of-Way	**Length (miles)**	**Field Location**	**Field Descriptor[1]**	**Proposed Action**	**No Action**	**Proposed Action**	**No Action**
New	1.7	Same as new right-of-way values shown above for West Alternative					
Existing	7.3	On right-of-way	Average	5.6	2.4	35	32
			Maximum	8.8	4.4	158	119
		Edge of right-of-way	Average	1.0	0.8	10	8
			Maximum	1.1	0.8	34	23
West Option 3				**Electric Field (kV/m)**		**Magnetic Field (mG)**	
Right-of-Way	**Length (miles)**	**Field Location**	**Field Descriptor[1]**	**Proposed Action**	**No Action**	**Proposed Action**	**No Action**
New	1.5	Same as new right-of-way values shown above for West Alternative					
Existing	11.5	On right-of-way	Average	5.6	2.8	41	43
			Maximum	8.8	5.2	163	136
		Edge of right-of-way	Average	1.3	0.6	12	9
			Maximum	1.3	0.5	35	21

Notes:
1. All field descriptors are segment-length-weighted means of the fields on or at the edge of the right-of-way. The values for the edge of right-of-way are computed from fields on both sides of the route. Average electric fields are computed for maximum voltages and average clearances along the route; likewise, average magnetic fields are computed for average currents and average clearances. Maximum electric fields are computed for maximum voltages and minimum clearances; maximum magnetic fields are computed for maximum currents and minimum clearances.
2. The field levels for all West options are very similar to those in the segments they would replace. The inclusion of one of these options would not significantly affect the overall mean field levels for the alternative.
Source: Bracken 2011 (see Appendix F).

These values, which occur only in small areas directly beneath conductors at the lowest clearance, meet BPA's criterion for maximum electric fields of 9 kV/m. The maximum fields for all route segments and line sections within segments would also meet the BPA criterion. Under normal (average) conditions, using length-weighted averages, the highest fields would range from 5.3 to 5.6 kV/m.

At the edge of the right-of-way, using length-weighted averages for both extreme (maximum) and normal (average) conditions, electric fields for the West Alternative and options would range from 0.6 to 1.4 kV/m on existing right-of-way and 2.3 kV/m on new right-of-way, meeting BPA's guidelines of 2.5 kV/m. (Maximum and average electric field calculations for individual route segments and line sections within segments can be found in Appendix F.) These electric field levels would be comparable to or less than those from existing 500-kV lines in the area and elsewhere, and would cause **no-to-low** impacts (see Section 8.2.2.1, Electric Fields).

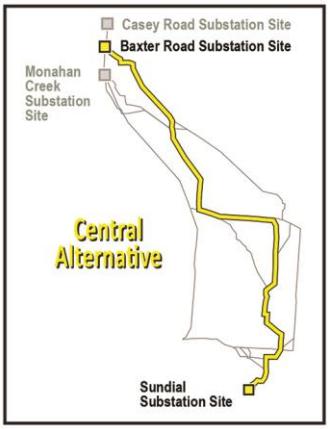
Using length-weighted averages, maximum magnetic fields on the rights-of-way for the West Alternative and options would range from 139 to 182 mG on existing right-of-way (184 mG on new right-of-way). Under normal (average) conditions, the highest magnetic fields would range from 28 to 41 mG (35 mG on new right-of-way).

At the edge of rights-of-way, using length-weighted averages, the maximum magnetic fields for the West Alternative and options would range from 34 to 36 mG; under normal conditions, the highest fields would range from 10 to 12 mG (see Table 8-2). (Magnetic field calculations under maximum and normal conditions, for individual route segments and line sections within segments, can be found in Appendix F.) If more than one line is present in a segment, the maximum and normal fields would depend on the relative electrical phasing of the conductors and the relative direction of power flow in the lines.

Beyond the edge of rights-of-way, magnetic fields decrease quickly with distance. For example, a maximum magnetic field of 48 mG at the edge of right-of-way (75 feet from centerline) would drop to 13 mG at a distance of 150 feet from centerline, and to 3 mG at 300 feet. For the same example, the average field would drop from 12 mG at the edge of the right-of-way to 4 mG at 150 feet, and to 1 mG at 300 feet. This means that beyond a few hundred feet, transmission line magnetic fields approach common ambient levels and would be far less than those encountered near common household appliances or directly under the line.

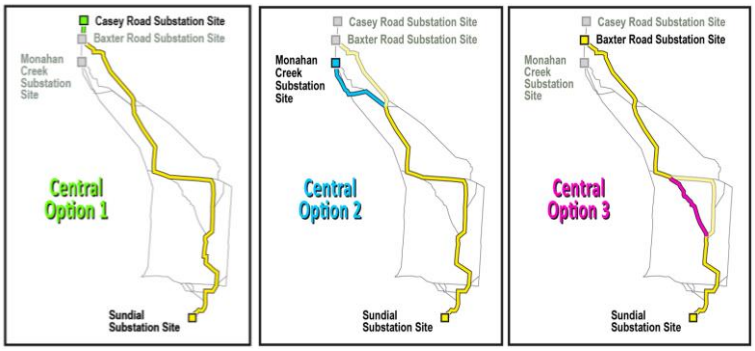
8.2.5 Central Alternative and Options

The Central Alternative and options would mostly use new right-of-way (about 87 percent) that would cross predominantly forest land (around 90 percent of land use crossed). Only 4 percent of the land crossed by the right-of-way would be populated—2 percent urban/suburban and 2 percent rural areas (4 percent for Central Option 2). About 14 percent of the land beyond the right-of-way (out to 1,000 feet) is zoned for residential use. Fewer people would live near or pass by this action alternative than the West Alternative.



Using length-weighted averages, the maximum electric fields on the rights-of-way for the Central Alternative and options would

range from 8.8 to 9.0 kV/m (see Table 8-3), meeting BPA's criterion for maximum electric fields of 9 kV/m. The maximum fields for all route segments and line sections within segments would also meet the BPA criterion. Under normal (average) conditions, the highest fields would range from 5.3 to 5.5 kV/m.



At the edge of the right-of-way, using length-weighted averages, the maximum electric fields for the Central Alternative and options would range from 1.2 to 2.4 kV/m (2.3 kV/m on new right-of-way) under both extreme (maximum) and normal (average) conditions. Some route segments and line sections have values that are higher than BPA's current guidelines of 2.5 kV/m at the edge of the right-of-way, however, they would not change from existing conditions. (Maximum and average electric field calculations for individual route segments and line sections within segments can be found in Appendices F and F1.) Like the West Alternative, these electric field levels would be comparable to or less than those from existing 500-kV lines in the area and elsewhere, with a similar **no-to-low** impact.

Using length-weighted averages, the maximum magnetic fields on the rights-of-way for the Central Alternative and options would range from 180 to 257 mG (184 mG on new right-of-way). Under normal (average) conditions, the highest magnetic fields would range from 34to 62 mG (35 mG on new right-of-way).

At the edge of rights-of-way, using length-weighted averages, the maximum magnetic fields for the Central Alternative and options would range from 27 to 59 mG; under normal conditions, the highest fields would range from 7 to 15 mG (see Table 8-3). (Magnetic field calculations under maximum and normal conditions, for individual route segments and line sections within segments, can be found in Appendices F and F1.) Maximum and average fields depend on the number of transmission lines present, the relative electrical phasing of the conductors and the relative direction of power flow in the lines. Beyond the edge of rights-of-way, magnetic fields would decrease quickly with distance, approaching common ambient levels within a few hundred feet. This means that beyond a few hundred feet, transmission line magnetic fields approach common ambient levels and would be far less than those encountered near common household appliances or directly under the line.

Table 8-3 Central Alternative and Options—Length-Weighted Average Electric and Magnetic Field Levels[3]

Central Alternative				Electric Field, kV/m		Magnetic Field, mG	
Right-of-Way	**Length (miles)**	**Field Location**	**Field Descriptor**	**Proposed Action**	**No Action**	**Proposed Action**	**No Action**
New	69.7 (69.5)	On right-of-way	Average	5.3 (5.3)	—	35 (35)	—
			Maximum	8.8 (8.8)		184 (184)	
		Edge of right-of-way	Average	2.3 (2.3)		12 (12)	
			Maximum	2.3 (2.3)		48 (48)	
Existing	10.6 (6.8)	On right-of-way	Average	5.3 (5.4)	2.1 (2.1)	34 (33)	31 (31)
			Maximum	8.8 (8.9)	3.8 (3.8)	180 (175)	134 (135)
		Edge of right-of-way	Average	1.2 (1.1)	1.0 (1.0)	8 (9)	12 (11)
			Maximum	1.2 (1.1)	1.1 (1.0)	29 (32)	37 (36)
Central Option 1[2]				**Electric Field, kV/m**		**Magnetic Field, mG**	
Right-of-Way	**Length (miles)**	**Field Location**	**Field Descriptor[1]**	**Proposed Action**	**No Action**	**Proposed Action**	**No Action**
New	0	Same as edge of right-of-way values shown above for Central Alternative					
Existing	2.3 (0.0)	On right-of-way	Average	5.5 (5.5)	5.5 (5.5)	62 (62)	49 (49)
			Maximum	9.0 (9.0)	9.0 (9.0)	257 (257)	235 (235)
		Edge of right-of-way	Average	2.3 (2.3)	1.4 (1.4)	15 (15)	10 (10)
			Maximum	2.4 (2.4)	1.5 (1.5)	59 (59)	40 (40)
Central Option 2				**Electric Field, kV/m**		**Magnetic Field, mG**	
Right-of-Way	**Length (miles)**	**Field Location**	**Field Descriptor[1]**	**Proposed Action**	**No Action**	**Proposed Action**	**No Action**
New	15.0	Same as edge of right-of-way values shown above for Central Alternative					
Existing	0.4	On right-of-way	Average	5.5	2.0	34	11
			Maximum	8.8	3.7	180	78
		Edge of right-of-way	Average	1.6	0.7	7	3
			Maximum	1.7	0.8	27	15
Central Option 3				**Electric Field, kV/m**		**Magnetic Field, mG**	
Right-of-Way	**Length (miles)**	**Field Location**	**Field Descriptor[1]**	**Proposed Action**	**No Action**	**Proposed Action**	**No Action**
New	14.9	Same as edge of right-of-way values shown above for Central Alternative					
Existing	0	On right-of-way	Average	—	—	—	—
			Maximum				
		Edge of right-of-way	Average				
			Maximum				

Notes:

1. All field descriptors are segment-length-weighted means of the fields on or at the edge of the right-of-way. The values for the edge of right-of-way are computed from fields on both sides of the route. Average electric fields are computed for maximum voltages and average clearances along the route; likewise, average magnetic fields are computed for average currents and average clearances. Maximum electric fields are computed for maximum voltages and minimum clearances; maximum magnetic fields are computed for maximum currents and minimum clearances.

2. The segments in the Central options do not replace any existing segments. Using one of these options would not significantly affect average field levels for the alternative. However, there would be localized increases in magnetic fields for Central Option 1.

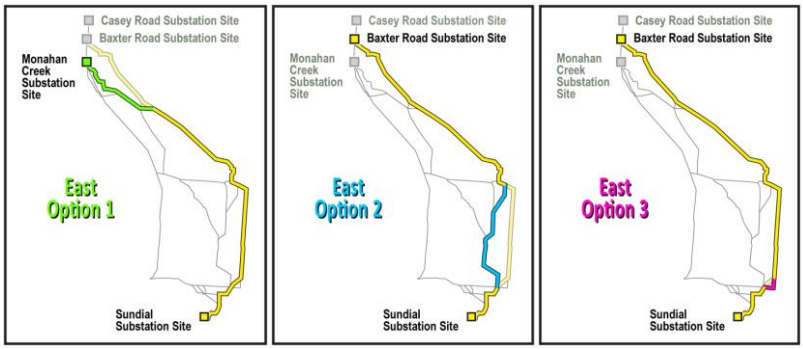
3. Impact numbers not shown in parentheses reflect updated data, assumptions, and design refinements; impact numbers shown in parentheses are from the Draft EIS.

Sources: Bracken 2011, Exponent 2015a (see Appendices F and F1).

8.2.6 East Alternative and Options

Similar to the Central Alternative, the East Alternative and options would primarily use new right-of-way (about 90 percent) that would mostly cross forest land (around 90 percent of land use crossed). Only 3 percent of the land crossed by the right-of-way would be populated—about 1 percent urban/suburban and 2 percent rural areas (4 percent for East Option 1). About 7 percent of the land beyond the right-of-way (out to 1,000 feet) is zoned for residential use, the lowest of all action alternatives. Fewer people would live near or pass by this action alternative than the West Alternative.

Using length-weighted averages, maximum electric fields on the rights-of-way for the East Alternative and options would range from 8.8 to 8.9 kV/m (see Tables 8-4), meeting BPA's criterion of 9 kV/m. The maximum fields for all route segments and line sections within segments would also meet the BPA criterion. Under normal (average) conditions, the highest fields would range from 5.3 to 5.7 kV/m.



At the edge of the right-of-way, using length-weighted averages electric fields for the East Alternative and options would range from 1.1 to 1.4 kV/m on existing right-of-way (2.3 kV/m on new right-of-way) under both extreme (maximum) and normal (average) conditions, meeting BPA's guidelines of 2.5 kV/m. (Maximum and average electric field calculations for individual route segments and line sections within segments can be found in Appendix F.) Similar to the other action alternatives, these electric field levels would be comparable to or less than those from existing 500 kV lines in the area and elsewhere, with a similar **no-to-low** impact.

Maximum magnetic fields on the rights-of-way for the East Alternative and options, using length-weighted averages, would range from 174 to 186 mG (184 mG on new right-of-way). Under normal (average) conditions, the highest magnetic fields would range from 32 to 53 mG (35 mG on new right-of-way). At the edge of rights-of-way, using length-weighted averages, the maximum magnetic fields for alternatives and options would range from 27 to 48 mG; under normal conditions, the highest fields would range from 6 to 12 mG (see Table 8-4). (Magnetic field calculations under maximum and normal conditions, for individual route segments and line sections within segments, can be found in Appendix F.) Maximum and normal fields would depend on the number of transmission lines present, their relative phasing and direction of power flow. Beyond the edge of rights-of-way, magnetic fields decrease quickly with distance, approaching common ambient levels within a few hundred feet.

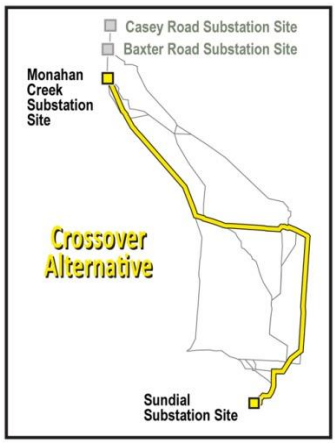
This means that beyond a few hundred feet, transmission line magnetic fields approach common ambient levels and would be far less than those encountered near common household appliances or directly under the line.

Table 8-4 East Alternative and Options—Length-Weighted Average Electric and Magnetic Field Levels

East Alternative				Electric Field (kV/m)		Magnetic Field (mG)	
Right-of-Way	**Length (miles)**	**Field Location**	**Field Descriptor[1]**	**Proposed Action**	**No Action**	**Proposed Action**	**No Action**
New	67.7	On right-of-way	Average	5.3	—	35	—
			Maximum	8.8		184	
		Edge of right-of-way	Average	2.3		12	
			Maximum	2.3		48	
Existing	6.8	On right-of-way	Average	5.4	2.1	32	31
			Maximum	8.9	3.8	174	135
		Edge of right-of-way	Average	1.1	1.0	9	11
			Maximum	1.1	1.0	32	36
East Option 1[2]				**Electric Field (kV/m)**		**Magnetic Field (mG)**	
Right-of-Way	**Length (miles)**	**Field Location**	**Field Descriptor[1]**	**Proposed Action**	**No Action**	**Proposed Action**	**No Action**
New	17.6	Same as edge of right-of-way values shown above for East Alternative					
Existing	0	On right-of-way	Average	—	—	—	—
			Maximum				
		Edge of right-of-way	Average				
			Maximum				
East Option 2				**Electric Field (kV/m)**		**Magnetic Field (mG)**	
Right-of-Way	**Length (miles)**	**Field Location**	**Field Descriptor[1]**	**Proposed Action**	**No Action**	**Proposed Action**	**No Action**
New	23.5	Same as edge of right-of-way values shown above for East Alternative					
Existing	0	On right-of-way	Average	—	—	—	—
			Maximum				
		Edge of right-of-way	Average				
			Maximum				
East Option 3				**Electric Field (kV/m)**		**Magnetic Field (mG)**	
Right-of-Way	**Length (miles)**	**Field Location**	**Field Descriptor[1]**	**Proposed Action**	**No Action**	**Proposed Action**	**No Action**
New	1.9	Same as edge of right-of-way values shown above for East Alternative					
Existing	1.8	On right-of-way	Average	5.7	2.9	53	48
			Maximum	8.8	5.3	186	133
		Edge of right-of-way	Average	1.2	0.2	6	4
			Maximum	1.4	0.2	27	8

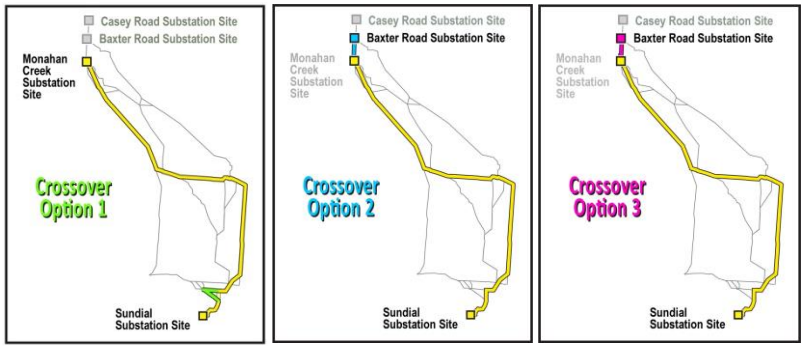
Notes:
1. All field descriptors are segment- length-weighted means of the fields on or at the edge of the right-of-way. The values for the edge of right-of-way are computed from fields on both sides of the route. Average electric fields are computed for maximum voltages and average clearances along the route; likewise, average magnetic fields are computed for average currents and average clearances. Maximum electric fields are computed for maximum voltages and minimum clearances; maximum magnetic fields are computed for maximum currents and minimum clearances.
2. The segments in the East options do not replace any existing segments. Using one of these options would not significantly affect average field levels for the alternative.
Source: Bracken 2011 (see Appendix F).

8.2.7 Crossover Alternative and Options



The Crossover Alternative and options would require about 55 percent new right-of-way that would mostly cross forest land (about 76 percent). About 8 percent of the land crossed by right-of-way would be populated—1 percent urban/suburban and 7 percent rural areas. About 14 percent of the land beyond the right-of-way (out to 1,000 feet) is zoned for residential use, similar to the Central Alternative. Fewer people would live near or pass by this action alternative than the West Alternative.

Using length-weighted averages, maximum electric fields on the rights-of-way for the Crossover Alternative and options would range from 8.8 to 8.9 kV/m (see Table 8-5), meeting BPA's criterion of 9 kV/m. The maximum fields for all route segments and line sections within segments would also meet the BPA criterion. Under normal (average) conditions, the highest fields would range from 5.3 to 5.8 kV/m.



At the edge of the right-of-way, using length-weighted averages, electric fields for the Crossover Alternative and options would range from 0.9 to 2.3 kV/m (2.3 kV/m on new right of way) under both extreme (maximum) and normal (average) conditions, meeting BPA's guidelines of 2.5 kV/m. (Maximum and average electric field calculations for individual route segments and line sections within segments can be found in Appendix F.) Like the other action alternatives, these electric field levels would be comparable to or less than those from existing 500-kV lines in the area and elsewhere, with a similar **no-to-low** impact.

Maximum magnetic fields on the rights-of-way for the Crossover Alternative and options, using length-weighted averages, would range from 150 to 276 mG (184 mG on new right-of-way). Under normal (average) conditions, the highest magnetic fields would range from 29 to 68 mG (35 mG on new right-of-way).

At the edge of rights-of-way using length-weighted averages, the maximum magnetic fields for alternatives and options would range from 26 to 52 mG; under normal conditions, the highest fields would range from 7 to 14 mG (see Table 8-5). (Magnetic field calculations under maximum and normal conditions, for individual route segments and line sections within segments, can be found in Appendix F.) Maximum and normal fields would depend on the number of transmission lines present, their relative phasing and direction of power flow. Beyond the edge of rights-of-way, magnetic fields decrease quickly with distance, approaching common ambient levels within a few hundred feet. This means that beyond a few hundred feet, transmission line magnetic fields approach common ambient levels and would be far less than those encountered near common household appliances or directly under the line.

Table 8-5 Crossover Alternative and Options—Length-Weighted Average Electric and Magnetic Field Levels

Crossover Alternative				Electric Field (kV/m)		Magnetic Field (mG)	
Right-of-Way	**Length (miles)**	**Field Location**	**Field Descriptor[1]**	**Proposed Action**	**No Action**	**Proposed Action**	**No Action**
New	42.7	On right-of-way	Average	5.3	—	35	—
			Maximum	8.8		184	
		Edge of right-of-way	Average	2.3		12	
			Maximum	2.3		48	
Existing	29.7	On right-of-way	Average	5.4	2.0	34	17
			Maximum	8.9	3.7	182	96
		Edge of right-of-way	Average	1.3	0.5	7	3
			Maximum	1.3	0.5	26	12
Crossover Option 1[2]				**Electric Field (kV/m)**		**Magnetic Field (mG)**	
Right-of-Way	**Length (miles)**	**Field Location**	**Field Descriptor[1]**	**Proposed Action**	**No Action**	**Proposed Action**	**No Action**
New	0.7	Same as edge of right-of-way values shown above for Crossover Alternative					
Existing	6.6	On right-of-way	Average	5.5	1.5	29	11
			Maximum	8.8	2.8	150	63
		Edge of right-of-way	Average	0.9	0.3	9	2
			Maximum	0.9	0.3	34	24
Crossover Option 2				**Electric Field (kV/m)**		**Magnetic Field (mG)**	
Right-of-Way	**Length (miles)**	**Field Location**	**Field Descriptor[1]**	**Proposed Action**	**No Action**	**Proposed Action**	**No Action**
New	0	Same as edge of right-of-way values shown above for Crossover Alternative					
Existing	4.1	On right-of-way	Average	5.8	5.5	68	49
			Maximum	8.8	9	270	235
		Edge of right-of-way	Average	1.9	2.1	14	16
			Maximum	2.1	2.1	51	57
Crossover Option 3				**Electric Field (kV/m)**		**Magnetic Field (mG)**	
Right-of-Way	**Length (miles)**	**Field Location**	**Field Descriptor[1]**	**Proposed Action**	**No Action**	**Proposed Action**	**No Action**
New	0	Same as edge of right-of-way values shown above for Crossover Alternative					
Existing	4.2	On right-of-way	Average	5.8	5.5	68	49
			Maximum	8.9	9	276	235
		Edge of right-of-way	Average	2.2	1.6	13	12
			Maximum	2.3	1.7	52	45

Notes:
1. All field descriptors are segment-length-weighted means of the fields on or at the edge of the right-of-way. The values for the edge of right-of-way are computed from fields on both sides of the route. Average electric fields are computed for maximum voltages and average clearances along the route; likewise, average magnetic fields are computed for average currents and average clearances. Maximum electric fields are computed for maximum voltages and minimum clearances; maximum magnetic fields are computed for maximum currents and minimum clearances.
2. The segments in the Crossover options do not replace any existing segments. Using one of these options would not significantly affect average field levels for the alternative. However, there would be localized increases in the magnetic fields for Crossover Options 2 and 3.
Source: Bracken 2011 (see Appendix F).

8.2.8 Recommended Mitigation Measures

Mitigation measures included as part of the project are identified in Table 3-2. More information on how BPA minimizes EMF levels through project design is provided in Section 8.2.2.5, Designing Lines to Reduce EMF. No additional mitigation measures have been identified at this time.

8.2.9 Unavoidable Impacts

Once built, the proposed line could cause accidental injury from electric shock if someone were to bring conductive material too close to the lines within the right-of-way. Electric fields on the right-of-way also have the potential to create nuisance shocks on the right-of-way. There is a theoretical possibility that electric fields could interfere with older model implanted cardiac pacemakers worn by persons walking (or otherwise not shielded) under the line or within 35 feet from the edge of the right-of-way.

EMF levels directly under the lines and in the rights-of-way could be higher than ambient levels, but would meet all applicable regulations and standards and would dissipate quickly with increasing distance beyond the transmission line right-of-way.

8.2.10 No Action Alternative

Under the No Action Alternative, no new transmission lines or substations would be constructed and the voltage on existing lines would not change. There would be no change in electric fields, shock potential, or radio and TV interference throughout the project area. However, magnetic fields near existing lines would increase as loads on these lines increase. Impacts from maintenance of existing lines and substations would continue unchanged.

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Chapter 9 Noise

This chapter describes current noise sources and levels in the project area, and noise levels that may be created by the construction, operation and maintenance of the action alternatives.

Words in **bold** and acronyms are defined in Chapter 32, Glossary and Acronyms.

9.1 Affected Environment

9.1.1 Noise Definitions and Limits

Noise is commonly defined as unwanted sound that disrupts normal human activities or diminishes the quality of the human environment. Transient noise sources, such as passing aircraft or motor vehicles, produce noise usually of short duration. Stationary sources such as urban freeways, commercial and industrial facilities, and transmission lines, substations and transformers can emit noise over a longer period. Ambient noise at any one location is all noise generated by typical sources such as traffic, neighboring businesses or industries, and weather (wind or rain). The ambient noise level is typically a mix of noise from natural and manmade sources that may be near or distant.

Noise is usually expressed in **decibels** on the A-weighted scale (dBA), which corresponds to how humans hear sound (see Table 9-1 for typical noise levels for common sources, expressed in dBA). Noise exposure depends on the amount of time an individual spends near the source and distance from the source.

Table 9-1 Common Noise Levels

Noise Source or Effect	Sound Level (dBA[1])
Rock-and-roll band	110
Truck at 50 feet	80
Gas lawnmower at 100 feet	70
Normal conversation indoors	60
Moderate rainfall on foliage	50
BPA 500-kV transmission line	49[2]
Refrigerator	40
Bedroom at night	25

Notes:
1. Decibels (A-weighted)
2. Reflects typical noise levels at the edge of right-of-way during foul weather, when **corona** is most likely to be present.

Sources: USDOE 1986, 1996

The federal government and some states have established noise limits. At the federal level, the EPA has established a guideline of 55 dBA for an average day-night noise level (L_{dn}) in outdoor areas (EPA 1978). Washington has similar limits of maximum permissible noise levels of 60 dBA (L_{dn}) and 50 dBA (night-time) to intrude into residential property (WAC 173-60). These levels apply to new transmission lines that operate continuously. Oregon allows an L_{50} noise level of

ambient +10 dBA (not to exceed 55 dBA) in daytime and ambient +10 dBA (not to exceed 50 dBA) at night, assuming a new noise source on a previously unused site (OAR 340-035). The cities and counties crossed by the action alternatives either do not have established noise limits or defer to the states or the federal government for noise limits.

BPA has established a transmission line design criterion for corona-generated noise (L_{50}, foul weather; refers to a sound level exceeded 50 percent of the time) of 50 dBA at the edge of the right-of-way for new transmission lines (USDOE 2010). An exception to the 50 dBA criterion is allowed when there is an existing line (or lines) on the right-of-way with noise levels above 50 dBA. In such cases, a new line may not cause the L_{50} noise level to increase by more than 3 dBA over current levels. Likewise, BPA's design criterion for substation noise is 50 dBA at a substation property line. Besides meeting Washington's code limits, these design criteria are considered to be consistent with Oregon's regulatory limits.

9.1.2 Existing Noise

Throughout the project area, noise levels can vary widely. Ambient noise levels may be intermittently high in urban areas such as Longview and Vancouver, Washington, particularly near industrial and commercial uses and highways, but consistently low or moderate elsewhere, depending on suburban and rural population, wind levels, aircraft traffic, and recreation (authorized or unauthorized), forest, or agricultural activities.

In some areas, existing transmission lines may contribute to this noise. This is particularly true of higher voltage (345-kV or higher) lines built before 1978, when noise limits were being established by Washington and Oregon. During foul weather, these older transmission lines can generate noise, which is created by corona. Corona is the partial electrical breakdown of the insulating properties of air around the conductors of a transmission line. Corona-generated noise is usually heard as a hissing or crackling sound accompanied by a hum under certain conditions. The occurrence rate of foul weather is expected to vary along the route. Based on hourly meteorological records available from the National Climatic Data Center (NOAA 2014) between 2005 and 2013, the average foul weather rate varies between about 26 and 34 percent in different portions of the route. Other privately-collected data indicated the rate of foul weather varied from 32 to 51 percent during the same period (Akely 2014, Manwell 2014, Olson 2014).

Currently, high-voltage transmission line conductors are designed to be corona free under ideal conditions. Nonetheless, noise from transmission lines still can occur when conductors are wet during foul weather (periods of rain, fog, snow, or icing). On rare occasions, insects and dust on conductors also can cause occasional corona during fair weather.

Some existing substations in the project area may contribute noise as well, mainly caused by transformer equipment that creates a 120-Hz (less than 50 dBA) hum or the infrequent sound of opening and closing circuit breakers.

9.2 Environmental Consequences

General impacts that would occur for all action alternatives, and impacts by specific action alternatives, are defined and discussed below.

9.2.1 Impact Levels

Impacts would be **high** where project activities would cause the following:

- Construction activities would be temporary and infrequent, but increase ambient noise levels in a localized area over a longer period of time or a larger geographical area over a shorter period of time.
- Corona noise would consistently exceed allowed L_{50} levels (per noise criteria and limits).

Impacts would be **moderate** where project activities would cause the following:

- Construction activities would be temporary and infrequent, but increase ambient noise levels in a localized area over a shorter period of time.
- Corona noise is expected to increase existing noise levels and would occasionally exceed allowed L_{50} levels (per noise criteria and limits).
- Maintenance activities would be temporary and infrequent and include the use of loud equipment or power equipment, causing ambient noise levels to increase in a localized area over a short period of time.

Impacts would be **low** where project activities would cause the following:

- Construction activities would be temporary and infrequent, but increase ambient noise levels immediately adjacent to the construction site.
- Corona noise is expected to increase existing noise levels slightly, but that increase would barely be discernible (within 3 dBA of existing levels) and would meet allowed L_{50} levels (per noise criteria and limits).
- Maintenance activities would be temporary and infrequent, but increase ambient noise levels in a localized area over a short period of time.

No impact would occur if corona noise or noise from construction and maintenance activities is expected to cause no increase in existing noise levels.

9.2.2 Impacts Common to Action Alternatives

9.2.2.1 Construction

Construction of the transmission line, substations, and access roads would generate temporary noise that could affect nearby residences, business owners, employees and customers, visitors and recreationists. Though project construction would occur over 30 months, most transmission line construction activities would last only days or a few weeks at any one location, a **low-to-moderate** impact. Noise impacts from construction of the 500-kV substations, which would take up to 3 years and would occur at the substation locations the entire time, would cause **moderate-to-high** impacts. Potentially loud equipment would not be used during all construction phases.

Although daytime construction activities are excluded from noise limits and line construction activities would be temporary, BPA did evaluate these noise impacts. The project would be built

primarily using conventional construction equipment (see Table 9-2). Construction activities that would create noise include right-of-way clearing, access road construction and improvement, substation pad grading, excavation for tower footings, assembling and lifting towers into place, helicopter assistance during tower installation and stringing of conductors, and blasting in bedrock (if needed).

Table 9-2 Construction Equipment Noise Levels

Type of Equipment	Maximum dBA[1] at 50 Feet
Road Grader	85
Bulldozers	85
Heavy Trucks	88
Backhoe	80
Pneumatic Tools	85
Crane	85
Combined Equipment	89

Notes:
1. Decibels (A-weighted).
Source: Thalheimer 1996

When determining noise levels, an equivalent sound level (L_{eq}) is generally accepted as the average sound level perceived by the human ear from any noise source. The overall noise caused by conventional construction equipment is estimated to be 89 dBA L_{eq} at 50 feet, dissipating with distance (see Table 9-3).

Table 9-3 Construction Equipment Noise Levels by Distance from Construction Site

Distance from Construction Site (feet)	Hourly L_{eq} (dBA[1])
50	89
100	83 (similar to truck at 50 feet)
200	77
400	71 (similar to gas lawnmower at 100 feet)
800	65
1,600	59 (similar to indoor conversation)

Notes:
1. Decibels (A-weighted)
Assumptions: Equipment used was one each—grader, bulldozer, heavy truck, backhoe, pneumatic tools, concrete pump, crane. Reference noise level of 89 dBA (L_{eq}). Distance for the reference noise level: 50 feet. Noise **attenuation** rate: 6 dBA/doubling of distance. This calculation does not include the effects, if any, of local shielding or atmospheric attenuation.

A helicopter may be used to assist with tower installation. A loaded cargo helicopter flying 250 feet away produces about 95 dBA, which is the same amount of noise produced by a diesel locomotive 100 feet away (Helicopter Association International 1993). If a helicopter is used, towers would be preassembled at one or more central staging areas and helicopter fly yards and then transferred by helicopter to tower sites. The helicopter would hover for 2 to 5 minutes per tower as it picked up each tower section, and would then hover at each tower site for 2 to 10 minutes during a 1-hour period while the tower is placed on the foundation. Helicopters would also travel between the work area and helicopter fly yards to transport materials, workers, and refuel. These fly yards could be within or outside the right-of-way.

Noise generated during construction would depend on the equipment being used, tasks being performed, and nearby topography. In general, construction of the transmission line would produce temporary elevated noise levels that would be heard by people living or working throughout the project area. People living in more rural areas (the predominant land use crossed by the action alternatives) may hear the noise from greater distances while those in more urban areas may not hear the noise over other urban sounds. The short duration of noise from construction activities, the limited number of days or weeks it may occur in any one location, and its presence only during daytime hours would mean overall **low-to-moderate** impacts. Residents, recreationists, and workers near substation sites, particularly residents near the Monahan Creek substation site, may experience **moderate-to-high** noise impacts because construction activities would occur over a longer period.

Blasting could be required in rocky areas where conventional excavation for tower footings or substation facilities would be impractical. Where blasting might occur, the explosion would produce a short noise like a thunderclap that could be audible for a mile or more. These disturbances would be **high** impacts, but temporary and infrequent.

9.2.2.2 Transmission Line Operation and Maintenance

Once operating, the impact of corona-generated audible noise by the project depends on the level of corona noise, the level of ambient noise, and proximity to the new transmission line. Corona noise itself depends on voltage, line configuration, the number of transmission lines sharing the right-of-way, and weather. Also, for a few months after construction, residual grease or oil can cause water to bead up on the surface of conductors, producing temporarily higher levels of audible noise. Though foul weather may induce corona, it can also mask it by increasing ambient noise (due to wind or heavy rain hitting foliage). Also during such conditions, people are more likely to be indoors where sound from nearby transmission lines would be reduced. Both these factors reduce corona-generated noise even in populated areas, where ambient noise levels tend to be higher.

Potential corona noise levels for the project at the edges of transmission line rights-of-way were calculated and then compared with BPA's design criteria, state noise limits, and federal noise guidelines. (Methodology used for calculations, and detailed calculations within each action alternative can be found in Appendices F and F1.)

Corona activity also increases with altitude. For every 1,000-foot gain in elevation, noise generally increases by 1 dBA. For the action alternatives, 62 percent of transmission line conductors would be at elevations below 1,000 feet; 94 percent would be below 2,000 feet (see Figure 20-1) (along the Preferred Alternative about 49 percent of spans are below an elevation of 1,000 feet and 99 percent are below 2,000 feet). Most of the population along the action alternatives is at lower elevations.

Since all design criteria and noise limits would be met, there would be **no-to-low** impacts from transmission line operation.

Each tower and line would be inspected by field crews at least once annually. Twice a year a helicopter would patrol the transmission line corridor to look for problems. If repairs are needed, field vehicles would be dispatched to access trouble spots.

BPA would also need to maintain vegetation along the line for safe operation and to allow access to the line. This can require using chainsaws, roller choppers, and brush hogs. Before conducting vegetation maintenance, BPA would typically send notices to landowners.

Occasional maintenance activities along the line would generate infrequent and temporary higher noise levels that would generally be a **low** impact. The exception would be when loud equipment such as chainsaws may be required, causing a temporary **moderate** impact.

9.2.2.3 Substation Operation and Maintenance

Audible noise levels at the proposed substations would predominantly reflect foul weather corona noise from incoming and outgoing transmission lines (see Section 9.2.2.2, Transmission Line Operation and Maintenance). Though transformers can hum, no transformers would be installed at the substations for this project. The operation of circuit breakers can generate a loud but short, temporary, burst of noise, a **low** impact. **No** noise impacts would occur from most maintenance activities inside the substation.

Like transmission lines, substations are continually inspected. Helicopters doing routine aerial inspections as described above would also fly over substations. Maintenance crews on the ground would inspect and fix any problems identified and conduct routine maintenance. Vegetation inside and outside the substations is strictly controlled similar to transmission line rights-of-way. Any noise generated by these actions would be a temporary, **low** impact.

9.2.2.4 Sundial Substation Site

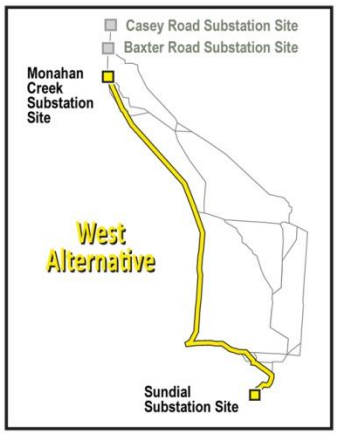
Development of the substation, access roads, and line changes for either Lot 11 or Lot 12 would occur on undeveloped urban land, within an industrial complex and close to two airports. Sundial Substation would meet BPA's 50 dBA design criteria at the substation perimeter and all state noise limits and federal guidelines. As described above, there would be **no-to-moderate** impacts during construction and operation and maintenance of the substation.

9.2.3 Castle Rock Substation Sites

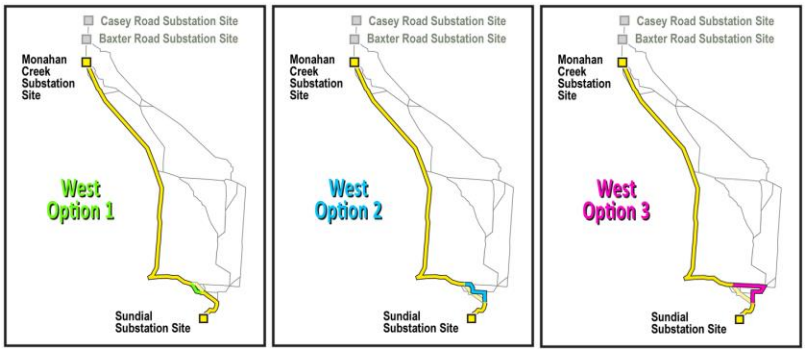
The proposed substation sites, which would be on forest land (Casey Road and Baxter Road), and open space and rural land (Monahan Creek) would meet BPA's 50 dBA design criteria at the substation perimeters and all state noise limits and federal guidelines. There would be **no-to-moderate** impacts during construction and operation and maintenance of these substations. Noise impacts could be considered higher at the Monahan Creek site since it is surrounded by residential land uses.

Impacts common to action alternatives are in Section 9.2.2. The remaining sections discuss impacts unique to each alternative, and recommended mitigation measures.

9.2.4 West Alternative and Options



The West Alternative and its options would meet all design criteria and noise limits, and would have **no-to-low** impacts from transmission line noise. The West Alternative and options would use predominantly (98 percent) existing right-of-way with the remaining using new right-of-way (i.e., areas with no existing transmission lines), crossing predominantly forest land and rivers, lakes and wetlands (51 percent) and agricultural land (33 percent). The West Alternative would cross slightly more urban, suburban, and rural development areas (17 percent) than the other action alternatives. Beyond the right-of-way—from the right-of-way edge out to 1,000 feet on either side of the line—the West Alternative and options would also cross near a greater percentage of property zoned for residential use: about 46 percent.



In new right-of-way, L_{50} audible noise levels at the edge would be 47 dBA (see Table 9-4). This level would drop about 3 dBA for every doubling of distance away from the line; e.g., a 47 dBA level at the edge of right-of-way would drop to 44 dBA at 150 feet and to 40 dBA by 330 feet from the centerline. Consequently most, if any, noise impacts occur within about 300 feet of the edge of the right-of-way.

Based on the summaries of length-weighted foul weather audible noise levels on existing right-of-way, the West Alternative and options would create increases in potential corona noise up to 7 dBA (West Alternative would be 5 dBA). Even with these increases, the alternative and options would still meet BPA's 50 dBA design criteria and the statutory limits established in Oregon and Washington.

Some individual route segments within the West Alternative would exceed 50 dBA, but are not seen in the averages in Table 9-4. These segments are identified in tables in Appendix F. In all cases where the 50 dBA criterion could be exceeded, the change from existing noise levels would differ by at most 3 dBA.

Even assuming a 60 percent foul weather rate, the West Alternative and options would meet the EPA's 55 dBA guideline for L_{dn} beyond 150 feet from the edge of the right-of-way. During fair weather, which occurs most of the time, audible noise levels at the edge of the right-of-way would be about 20 dBA lower if corona were present at all.

Land uses crossed by the action alternatives, and zoning within 1,000 feet of the transmission line, provide information about the relative differences (or similarities) among alternatives (Golder 2011). However, noise impacts from the alternatives were not weighted by land use or zoning crossed because there is not an established relationship between the two. People living in populated areas may be more adapted to higher ambient noise levels and so may be less sensitive to additional audible noise. Conversely, people in more sparsely populated areas may be more sensitive to added noise.

Table 9-4 Summary of Length-Weighted L_{50} Foul Weather Audible Noise Levels[3]

		Audible Noise (dBA) at Edge of Right-of-Way[1]				Audible Noise (dBA) at Edge of Right-of-Way[1]	
Right-of-Way	**Length (miles)[2]**	**Proposed Action**	**No Action**	**Right-of-Way**	**Length (miles)[2]**	**Proposed Action**	**No Action**
West Alternative				**Central Alternative**			
New	1.4	47	—	New	69.7 (69.5)	47 (47)	—
Existing	64.2	48	43	Existing	10.6 (6.8)	48 (47)	42 (42)
West Option 1				**Central Option 1**			
New	2.0	47	—	New	0 (0)	—	—
Existing	1.1	47	40	Existing	2.3 (2.5)	53 (53)	52 (52)
West Option 2				**Central Option 2**			
New	1.7	47	—	New	15	47	—
Existing	7.3	49	47	Existing	0.4	47	41
West Option 3				**Central Option 3**			
New	1.5	47	—	New	14.9	47	—
Existing	11.5	50	49	Existing	0	—	—
East Alternative				**Crossover Alternative**			
New	67.7	47	—	New	42.7	47	—
Existing	6.8	47	41	Existing	29.7	48	40
East Option 1				**Crossover Option 1**			
New	17.6	47	—	New	0.7	47	—
Existing	0	—	—	Existing	6.6	47	37
East Option 2				**Crossover Option 2**			
New	23.5	47	—	New	0	—	—
Existing	0	—	—	Existing	4.1	56	57
East Option 3				**Crossover Option 3**			
New	1.9	47	—	New	0	—	—
Existing	1.8	50	48	Existing	4.2	54	54

Notes:

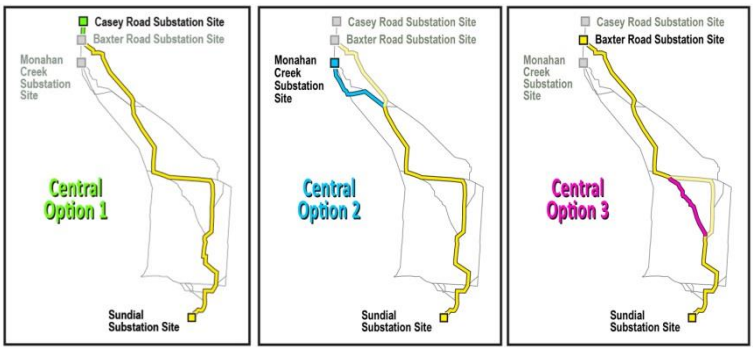
1. Audible noise levels are the length-weighted means of the L_{50} foul weather levels at the edge of the right-of-way. The highest average value from the two edges is shown. Audible noise levels are computed for average voltages and average conductor heights.
2. The total lengths include only those segments used in the calculation of averages and, in some cases, are slightly less than the lengths in Table 4-1.
3. Impact numbers not shown in parentheses reflect updated data, assumptions, and design refinements; impact numbers shown in parentheses are from the Draft EIS.

Sources: Bracken 2011, Exponent 2015a (see Appendices F and F1)

In quieter, open space areas, hikers on trails that cross the West Alternative's and options' right-of-way would experience temporarily higher noise levels (see Appendix F). Off the right-of-way, potential L_{50} foul weather corona noise created by the West Alternative would generally be well below the 55 dBA level that can interfere with speech outdoors. In a few segments where existing noise levels are already above 50 dBA, the West Alternative could create L_{50} levels near or slightly above 55 dBA.

9.2.5 Central Alternative and Options

The Central Alternative and its options would meet all design criteria and noise limits, and would have **no-to-low** impacts from transmission line noise. The Central Alternative and options would primarily use new right-of-way (about 87 percent), which would cross predominantly forest land and rivers, lakes and wetlands (about 90 percent of land use crossed). Only 4 percent of the land crossed by the Central Alternative's and options' right-of-way would be in urban, suburban, or rural development areas. Beyond the right-of-way (out to 1,000 feet on both sides), the percentage of nearby residential property is also small: about 14 percent is zoned residential.



In new right-of-way, L_{50} audible noise levels at the edge would be 47 dBA. This level would drop about 3 dBA for every doubling of distance away from the line; e.g., a 47 dBA level at the edge of right-of-way would drop to 44 dBA at 150 feet and to 40 dBA by 330 feet from the centerline. Consequently most, if any, noise impacts occur within about 300 feet of the edge of the right-of-way.

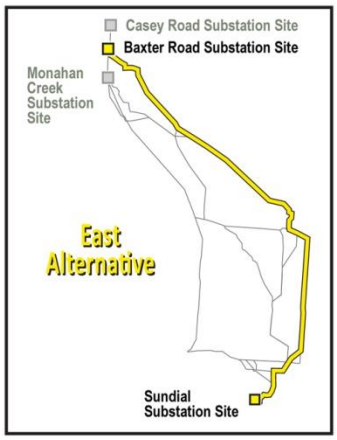
Based on the summaries of length-weighted foul weather audible noise levels (see Table 9-4), when on existing right-of-way, the Central Alternative and options would create increases in potential corona noise up to 6 dBA. Even with the increases, the Central Alternative and Central Option 2 and 3 would still meet BPA's 50 dBA design criteria and the statutory limits established in Oregon and Washington.

Central Option 1, where older lines would remain on the right-of-way, would exceed the 50 dBA criterion for L_{50} levels in a small area (about 2.3 miles), but would meet the second criterion—falling within the maximum 3 dBA increase allowed.

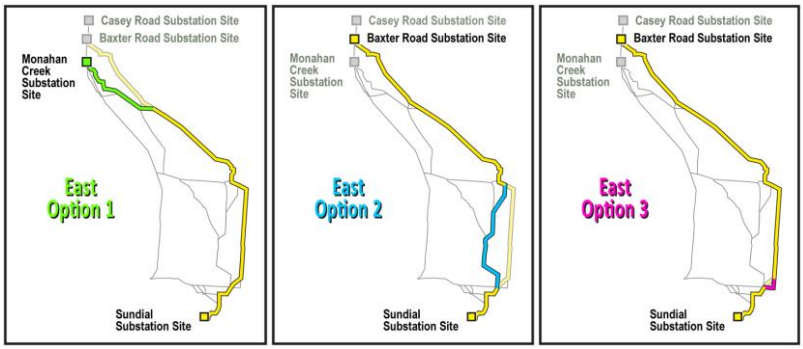
Even assuming a 60 percent foul weather rate, the Central Alternative and options would meet the EPA's 55 dBA guideline for L_{dn} beyond 150 feet from the edge of the right-of-way. During fair weather, which occurs most of the time, audible noise levels at the edge of the right-of-way would be about 20 dBA lower if corona were present at all. For example, in quieter open space areas, hikers on trails that cross the Central Alternative's and options' right-of-way would experience temporarily higher noise levels (see Appendices F and F1). Off the right-of-way, potential L_{50} foul weather corona noise created by the Central Alternative would generally be well below the 55 dBA level that can interfere with speech outdoors. In a few segments where existing noise levels are already above 50 dBA, the Central Alternative could create L_{50} levels near or slightly above 55 dBA.

9.2.6 East Alternative and Options

The East Alternative and its options would meet all design criteria and noise limits, and would have **no-to-low** impacts from transmission line noise. The East Alternative and options would primarily use new right-of-way (about 90 percent), which would cross predominantly forest land and rivers, lakes, and wetlands (about 90 percent of land use crossed). Only 4 percent of the land crossed by the East Alternative's and options' right-of-way would be in urban, suburban, or rural development areas. Beyond the right-of-way (out to 1,000 feet), the percentage of nearby residential property is the lowest of all action alternatives: about 7 percent is zoned residential.



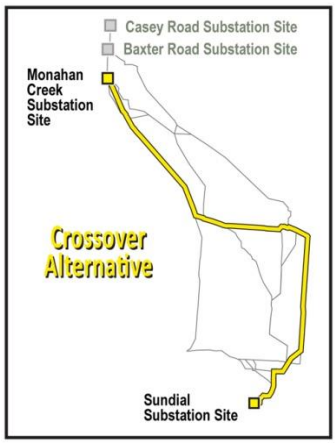
In new right-of-way, L_{50} audible noise levels at the edge would be 47 dBA. This level would drop about 3 dBA for every doubling of distance away from the line; e.g., a 47 dBA level at the edge of right-of-way would drop to 44 dBA at 150 feet and to 40 dBA by 330 feet from the centerline.



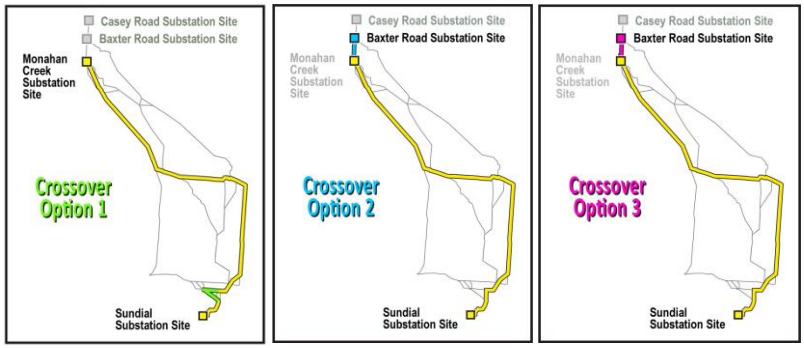
Based on the summaries of length-weighted foul weather audible noise levels (see Table 9-4), when on existing right-of-way, the East Alternative and options would create increases in potential corona noise up to 6 dBA. Even with the increases, the alternative and options would still meet BPA's 50 dBA design criteria and the statutory limits established in Oregon and Washington.

Even assuming a 60 percent foul weather rate, the East Alternative and options would meet the EPA's 55 dBA guideline for L_{dn} beyond 150 feet from the edge of the right-of-way. During fair weather, which occurs most of the time, audible noise levels at the edge of the right-of-way would be about 20 dBA lower if corona were present at all. For example, in quieter open space areas, hikers on trails that cross the East Alternative's and options' right-of-way would experience temporarily higher noise levels (see Appendix F). Off the right-of-way, potential L_{50} foul weather corona noise created by the East Alternative would generally be well below the 55 dBA level that can interfere with speech outdoors. In a few segments where existing noise levels are already above 50 dBA, the East Alternative could create L_{50} levels near or slightly above 55 dBA.

9.2.7 Crossover Alternative and Options



The Crossover Alternative, Crossover Option 1, and Crossover Option 3 would meet all design criteria, and would have **no-to-low** impacts from transmission line noise. The Crossover Alternative and options would require about 58 percent new right-of-way, which would cross predominantly forest land and rivers, lakes, and wetlands (about 76 percent). About 8 percent of the land crossed by the Crossover Alternative's and options' right-of-way would be urban, suburban, and rural development areas. Beyond the right-of-way (out to 1,000 feet), the Crossover Alternative and options would cross near about 14 percent residential-zoned land.



In new right-of-way, L_{50} audible noise levels at the edge would be 47 dBA. This level would drop about 3 dBA for every doubling of distance away from the line; e.g., a 47 dBA level at the edge of right-of-way would drop to 44 dBA at 150 feet and to 40 dBA by 330 feet from the centerline. Consequently most, if any, noise impacts occur within about 300 feet of the edge of the right-of-way.

Based on the summaries of length-weighted foul weather audible noise levels (see Table 9-4), when on existing right-of-way, the Crossover Alternative and options would create increases in potential corona noise up to 10 dBA (Crossover Alternative would be 8 dBA). Even with the increases, the Crossover Alternative and Crossover Option 1 would still meet BPA's 50 dBA design criteria and the statutory limits established in Oregon and Washington.

Crossover Option 2 and 3, where older lines would remain on the right-of-way, would exceed the 50 dBA criterion for L_{50} levels, but would meet the second criterion—falling within the maximum 3 dBA increase allowed.

Even assuming a 60 percent foul weather rate, the Crossover Alternative and options would meet the EPA's 55 dBA guideline for L_{dn} beyond 150 feet from the edge of the right-of-way. During fair weather, which occurs most of the time, audible noise levels at the edge of the right-of-way would be about 20 dBA lower if corona were present at all. For example, in quieter open space areas, hikers on trails that cross the Crossover Alternative's and options' right-of-way would experience temporarily higher noise levels (see Appendix F). Off the right-of-way, potential L_{50} foul weather corona noise created by the Crossover Alternative would generally be well below the 55 dBA level that can interfere with speech outdoors. In a few segments where existing noise levels are already above 50 dBA, the Crossover Alternative could create L_{50} levels near or slightly above 55 dBA.

9.2.8 Recommended Mitigation Measures

Mitigation measures included as part of the project have been identified (see Table 3-2). BPA is considering the following additional mitigation measure to further reduce or eliminate adverse noise impacts by the action alternatives:

- Incorporate conductor and line designs that result in acceptable corona performance.

9.2.9 Unavoidable Impacts

After appropriate mitigation actions have been taken, the project would still produce temporary noise impacts during construction and maintenance. Corona noise would also periodically be heard along the right-of-way during foul weather. If an alternative is chosen that occupies new right-of-way, an unavoidable new source of noise from operation of the line would occur. New sources of noise may also occur on new rights-of-way from unauthorized uses such as ATVs, snowmobiles, and target practice.

9.2.10 No Action Alternative

Under the No Action Alternative, current transmission line noise levels at the edges of existing rights-of-way would continue to range from ambient to 57 dBA throughout the project area (see Table 9-4). There are 20 existing BPA, utility and privately owned transmission lines in the area. The highest corona noise levels occur on older 500-kV lines.

Noise impacts from maintenance of existing lines, substations, and access roads would continue unchanged. Also, noise impacts that may be occurring from unauthorized access and use of existing BPA rights-of-way in the project area would likely continue to occur unless actions were developed and implemented to prevent the unauthorized access and use.

Chapter 10 Health and Safety

This chapter describes existing health and safety conditions in the project area, and how the project alternatives could affect public health and safety.

Words in **bold** and acronyms are defined in Chapter 32, Glossary and Acronyms.

10.1 Affected Environment

Transmission facilities provide electricity for heating, lighting, and other services essential for public health and safety. If not constructed, operated, and maintained properly, however, these same facilities could pose risks to humans—including electrocution, fire, collision with aircraft and watercraft, and exposure to **toxic and hazardous substances.** Transmission facilities can also become a target for vandalism, sabotage, and terrorism. BPA designs its facilities to meet safety requirements to prevent or reduce these risks. These measures include maintaining proper clearances between transmission lines and the ground, roadways and vegetation, and preventing inappropriate use of rights-of-way.

10.1.1 Public Health and Safety

Many people live, recreate, and work in the project area along existing transmission lines, access roads, and substations (see Map 1-2 and Section 2.2, Developing Route Segments and Substation Sites). These existing facilities are in rural and heavily populated residential areas, in parks and other recreation areas, in commercial and industrial areas, and in areas used for agriculture and timber harvest. BPA maintains its existing facilities to ensure maximum safety. This includes twice annual inspections by helicopter, and annual inspections by ground crews.

10.1.2 Toxic and Hazardous Substances

Portions of the action alternatives are in rural, undeveloped areas where the risk of encountering unreported **hazardous waste** sites or unreported contamination is possible but highly unlikely. These sites may include illegal dump sites, illicit drug labs, buried drum sites, unreported chemical spills, abandoned industrial properties, or old landfills. In more developed areas, including urban areas, contaminated sites are generally identified and listed with regulatory agencies.

Three hazardous waste and contaminated sites reported to environmental regulatory agencies (U.S. Environmental Protection Agency [EPA], Washington State Department of Ecology [Ecology], Oregon Department of Environmental Quality [ODEQ], and local health departments) are crossed by one or more of the action alternatives:

- BPA's Ross Complex: West Alternative
- International Paper Company Mill and Solid Waste Site: Central Alternative
- Reynolds Metals Site: all action alternatives

10.1.2.1 BPA Ross Complex

BPA's Ross Complex was established on a 200-acre site north of Vancouver, Washington in 1939 and houses one of the control centers for BPA's transmission system. The West Alternative route enters BPA's Ross Complex from the north on existing right-of-way, turns east, and follows the existing right-of-way as it leaves the Ross Complex (see Figure 10-1).

The BPA Ross Complex was listed on the National Priorities List (NPL) in 1989 for contamination present in soil and groundwater that included **polychlorinated biphenyls** (**PCB**s), **polycyclic aromatic hydrocarbons** (**PAH**s) and **pentachlorophenol** (**PCP**). After completing cleanup actions and implementing institutional controls, the BPA Ross Complex was delisted from the NPL in 1996. Contaminants remain in selected areas, but institutional and engineering controls including clean fill soil caps, and land use restrictions, continue to protect human health and the environment (EPA 2010a).

The BPA Ross Complex has five designated institutional control areas numbered 1 through 5 (see Figure 10-1). Institutional controls are defined as administrative actions taken to reduce the potential for exposure to hazardous substances and may include use restrictions, environmental monitoring requirements, and site access and security measures. Institutional Control Area No. 5 is within existing right-of-way and under an existing access road proposed to be improved.

10.1.2.2 International Paper Company Mill/Solid Waste Site

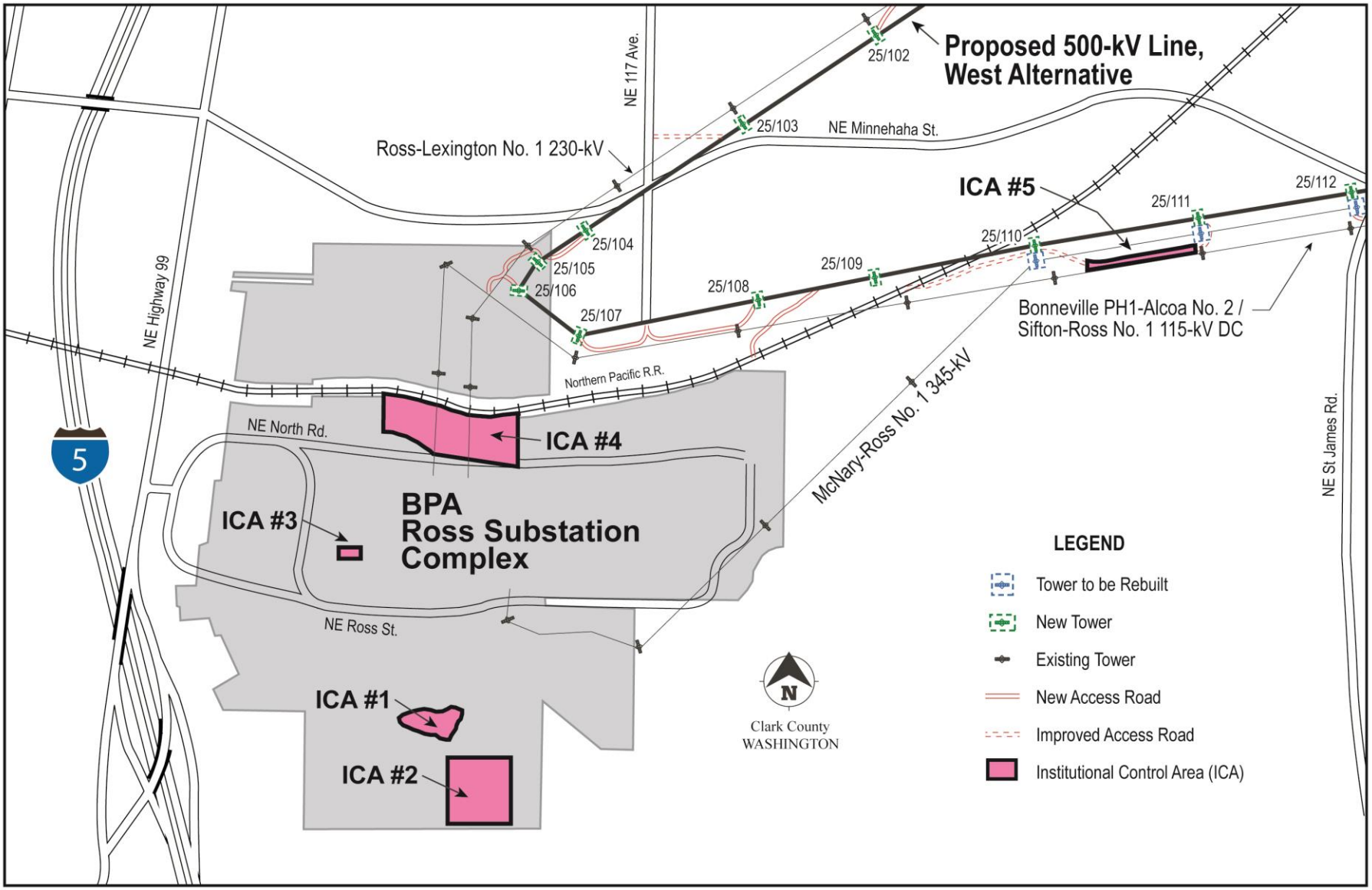
The former International Paper Company site is a state-listed hazardous waste site near Chelatchie, Washington about 23 miles northeast of Vancouver, Washington. It includes the mill site and adjacent (solid waste site) landfill. A small section of the Central Alternative route crosses the western portion of the former mill site.

International Paper Company operated a plywood mill and sawmill at this site from 1960 until the mill was closed in 1979 (The Columbian 2011). Ecology performed a Site Hazard Assessment (SHA) of the adjacent landfill and placed it on the Hazardous Sites List in 1996. Ecology placed the mill site on the list in 1997.

Ecology uses the Washington Ranking Method (WARM) to estimate the potential threat a site poses to human health and the environment if not cleaned up. Sites are ranked relative to each other on a scale of 1 to 5, with 1 representing the highest level of concern and 5 the lowest. The mill site was ranked 5. The landfill was ranked 2. At the mill site, suspected contaminants in soil are PCBs, petroleum products, and PAHs. At the landfill, confirmed contaminants in soil are PCBs, and suspected contaminants in soil are petroleum products and PAHs. At both sites, suspected contaminants in sediment and surface water are PAHs.

In 1997, the mill property owner hired an environmental contractor to excavate and remove the contaminated soil to an onsite land-farming and bioremediation treatment process facility to reduce contaminants to acceptable levels.

Figure 10-1 BPA Ross Complex



10.1.2.3 Reynolds Metals Company Site

The Reynolds Metals Company (RMC) site is an active NPL or "Superfund" site about 20 miles east of Portland and about 1 mile north of Troutdale on Port of Portland property. The proposed Sundial substation site is on part of this Superfund site, requiring the transmission line route for all action alternatives to cross a portion of it.

Reynolds Metals Company operated as a primary aluminum reduction plant where aluminum was produced from the raw material alumina. The aluminum plant occupied about 108 acres of the 800-acre RMC site. The plant operated from 1941 until fall 2000 when it was closed by its owner Alcoa. The plant buildings were demolished from 2003 through January 2006. The Port of Portland acquired the site from Alcoa in 2008.

The RMC site was placed on the NPL in December 1994. Cleanup of several waste areas began in 2003. Cleanup of fluoride-contaminated groundwater began in 2005. Plant demolition and additional soil cleanup was done between 2003 and 2006.

In 2006, the RMC site was divided into four areas for post-demolition investigation and evaluation of site soil conditions (see Figures 10-2A and 10-2B). Three of these areas could be affected by the project:

- Fairview Farms (location of Sundial Substation [Lots 11 and 12], new line, connector lines, access roads, and non-BPA lines to be removed and/or re-routed [see Figures 4-2A and 4-2B for more project detail])
- Outside the Dike (location of connector lines and access roads)
- East Area (former plant, location of connector lines)

Early cleanup actions at Fairview Farms between 1995 and 2002 included excavating and disposing of 150 tons of debris from four piles to a permitted off-site disposal facility. Cleanup actions within the Outside the Dike area between 1993 and 2001 included the excavation and removal of 93,854 tons of process residue and sediment from the Company Lake portion of this area. Extensive removal actions within the East Area included the main RMC plant. Remedial actions within the northwestern portion of the East Area included the removal of a wooden wastewater pipeline and 28 tons of material.

Groundwater contamination at the RMC site was caused by fluoride leaching from former waste areas at the East Area (former plant) and the Outside the Dike area. Source areas of groundwater contamination were removed during remedial actions between 2002 and 2005. A fluoride-contaminated groundwater plume (northern plume) remained at depths from 30 to 100 feet below ground surface. An extraction/production well system was installed in 2005. The final selected remedy is documented in the 2006 Record of Decision issued by EPA and concurred with by ODEQ. Ongoing remedial action includes operation of the extraction/production well system in a former scrap yard area in the East Area. Since the time of installation, the concentration levels in some monitoring wells near the source areas have begun to show a downward trend.

The post-demolition risk assessment (RA) done in 2006 addressed possible future land use of the area as a mixed-use general industrial complex consistent with existing industrial zoning. The RA considered the potential for soil exposure to future site users: site trespassers,

recreational users, construction workers, excavation/trench workers, and standard occupational workers. The RA's human health risk assessment concluded that soils within all three areas were within the EPA's and ODEQ's acceptable risk range for all contaminants. EPA, the lead agency for the site, conducts 5-year reviews, most recently in 2013, to ensure continued implementation of the Record of Decision.

In 2005, the Port of Portland entered into a prospective purchase agreement with the ODEQ to purchase the property. The agreement was documented and finalized by a Consent Judgment in 2007, which the Port entered into for the purpose of resolving any liability for pre-acquisition releases of hazardous substances on or from the property in return for undertaking certain obligations (primarily implementing the engineering and institutional controls required by the Record of Decision and to run with the property). The Port would also develop the property as an industrial park for commercial and industrial uses consistent with these commitments. Phase I of the Troutdale Reynolds Industrial Park was developed by FedEx with a state-of-the-art distribution center. The Port is currently installing the infrastructure to develop Phases II and III.

Figure 10-2A Reynolds Metal Company Site using Sundial Substation Site—Lot 11

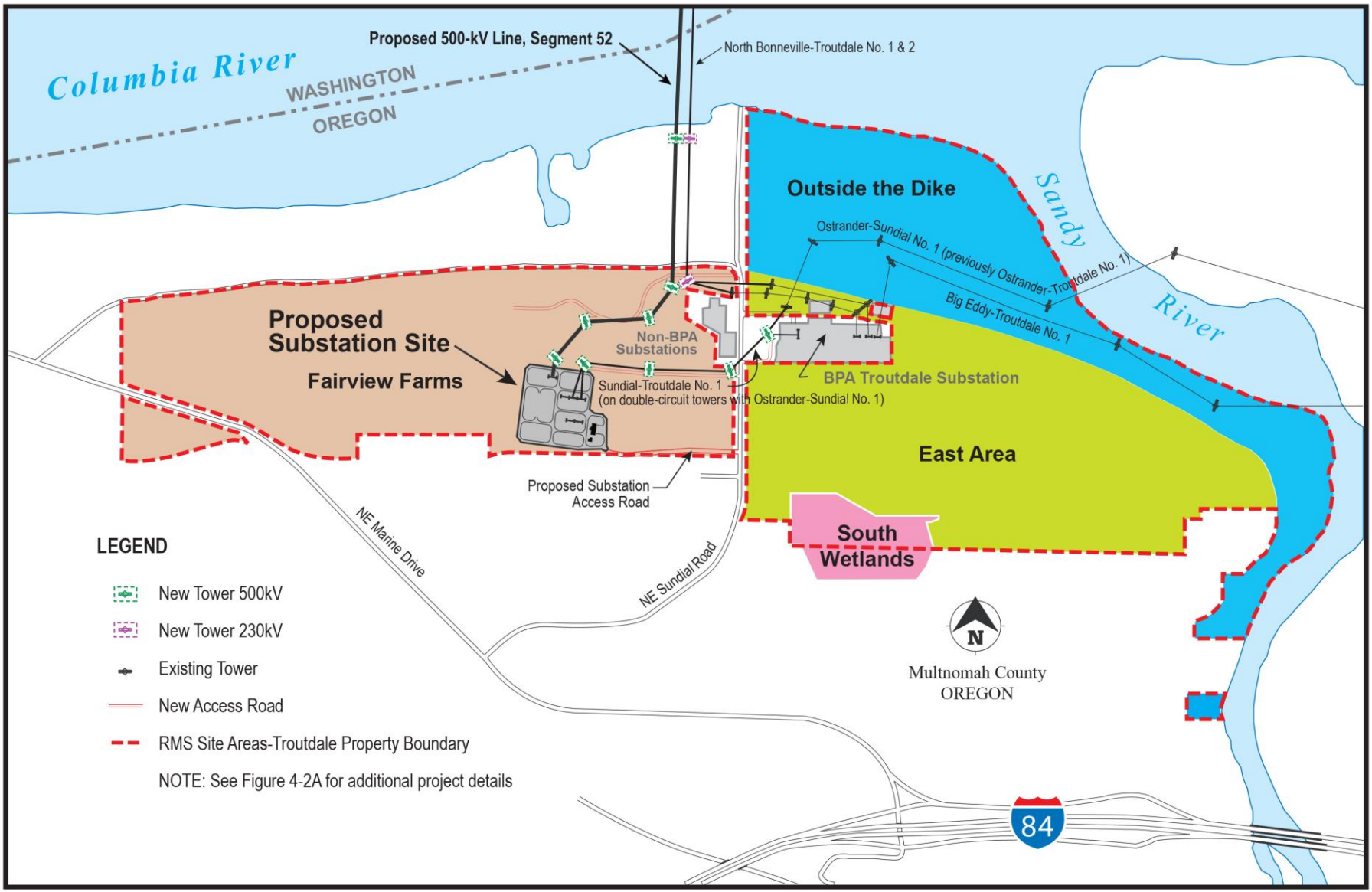
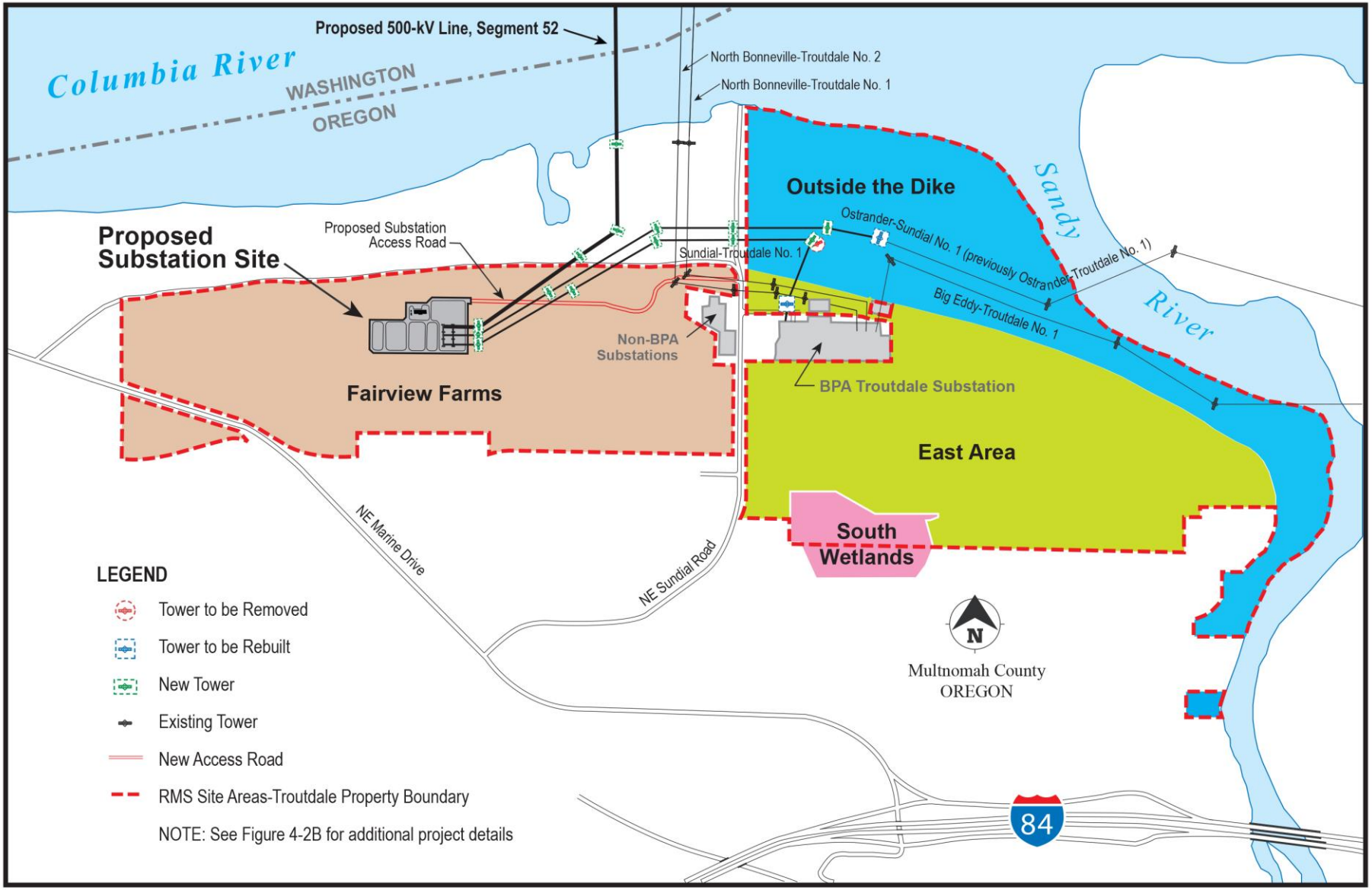


Figure 10-3B Reynolds Metal Company Site using Sundial Substation Site—Lot 12



10.1.3 Fire

Potential fire hazards in the project area are both natural and human-caused. Fire danger is highest in the summer months because of higher temperatures and lower rainfall amounts. Forest fires have historically occurred in the project area, including the 1902 Yacolt Burn, which was the largest fire recorded in Washington (Wilma 2003). Portions of the action alternatives pass through forest under the jurisdiction of the WDNR or are privately-owned.

Fire protection in the project area is provided by several city fire departments (e.g., Camas, Kelso, Longview, and Vancouver); several fire protection districts in Cowlitz, Clark, and Multnomah counties, and WDNR. Fire protection districts in rural areas are staffed mostly by volunteer firefighters. WDNR provides response to wild land fires within sparsely or unpopulated forest areas not served by fire protection districts. If a wild land fire or other emergency exceeds the capacity of local jurisdictions, the Washington State Fire Service Resource Mobilization Plan is implemented to provide personnel, equipment, and other logistical resources from around the state (WDNR 2010b).

10.1.4 Air and Water Transportation

Aircraft, including private airplanes, helicopters, and commercial aviation, use the airspace above the project area (see Chapter 12, Transportation). Several private airports, airstrips, and general aviation airports are within the project area, including the following: Pearson Field, Grove Field, Green Mountain Airport, and Goheen Airport in Clark County (SWRTC 2008); Southwest Washington Regional airport near Kelso in Cowlitz County; and Portland-Troutdale Airport in Multnomah County. Portland International Airport (PDX) is a regional airport in Portland with domestic and international passenger and freight service.

Because of their height, transmission towers can pose a hazard to aircraft. Any towers taller than 200 feet (generally, some double-or triple-circuit towers and towers used at river crossings) and transmission lines exceeding that height are considered an obstruction by the Federal Aviation Administration (FAA) and may require flashing warning lights for aircraft safety. Shorter towers and line clearances can also be considered obstructions depending on their proximity to airport runways. As obstructions, they must be marked according to FAA rules, which may require installing lighting on each tower and marker balls on conductors across spans (FAA 2000) (see Section 3.7, Obstruction Lighting and Marking).

The Columbia River from Vancouver, Washington to Lewiston, Idaho is a 355-mile-long inland barge channel maintained at a minimum depth of 14 feet. Downstream of the mouth of the Willamette River, the Columbia River is dredged to a depth of 44 feet for large ships. Ten million tons of commercial cargo each year passes by the project where it crosses the Columbia River (Pacific Northwest Waterways Association 2010). The Columbia River also has recreational boating and other watercraft traffic.

10.1.5 Acts of Vandalism, Sabotage, and Terrorism

Although infrequent, vandalism and theft at BPA facilities has occurred in the past. Typical vandalism includes removing bolts and copper grounding straps and other copper wire, and shooting at towers, transmission lines, and insulators. Vandalism and theft at BPA facilities may continue in the future and never be entirely eliminated. BPA estimates theft and vandalism

directly costs ratepayers $500,000 to $1 million per year to replace stolen or damaged equipment (see Chapter 23, Intentional Destructive Acts). Lost revenue and economic losses to electricity consumers from power interruption adds "indirect costs" (Blair 2009).

10.1.6 Vegetation Management

Managing vegetation around transmission facilities is necessary for a variety of reasons, including keeping electricity from transmission lines and other electrical equipment from flashing to the ground, preventing trees from falling into towers and conductors, reducing fire risk in the right-of-way, and ensuring access to tower sites. This same vegetation management can potentially harm humans, wildlife or crops unless appropriate practices are followed. Exposure to herbicides, traveling on unimproved roads, felling or topping trees, using sharp tools, machinery and heavy equipment, and working around high voltage transmission lines and transformers can create health and safety risks.

BPA's vegetation management is guided by its Transmission System Vegetation Management Program EIS (BPA 2002). BPA adopted an integrated vegetation management strategy for controlling vegetation along its transmission line rights-of-way. This strategy involves choosing the appropriate method for controlling the vegetation based on its type and density, the natural resources present at a particular site, landowner requests, regulations, and costs. BPA may use a number of different methods: manual (hand-pulling, clippers, chainsaws), mechanical (roller-choppers, brush-hogs), biological (insects or fungus for attacking noxious weeds), and herbicides (Thompkins 2011). All herbicides sold and distributed in the U.S. must be registered with EPA. This means that EPA must conclude that they can be used without posing unreasonable risks to people or the environment, based on scientific evidence.

BPA's vegetation management program is based on National Electric Safety Code (NESC) requirements. The NESC requires tree trimming and removal to prevent "…grounding of the circuit through the tree." Electric contact between a tree and an energized conductor can occur even when the two do not touch. In the case of high-voltage lines, electricity can arc across an air gap. The distance varies with the voltage at which the line is operated. BPA has established minimum distances that a tree can be to a transmission line. The NESC also designates how close a worker can come to energized lines.

10.2 Environmental Consequences

General impacts that would occur for all action alternatives are discussed below, followed by impacts unique to each alternative.

10.2.1 Impact Levels

Impacts would be **high** where project activities would cause the following:

- Create a permanent and known health and safety condition

Impacts would be **moderate** where project activities would cause the following:

- Create a known but rare or infrequent health and safety condition

Impacts would be **low** where project activities would cause the following:

- Create a risk to health and safety that could largely be mitigated

No impact would occur where there is no possible risk to human health and safety.

10.2.2 Impacts Common to Action Alternatives

10.2.2.1 Construction

All construction activities would be guided by site- and task-specific safety plans prepared by BPA and its contractors.

Public Health and Safety

Safeguarding worker and public health and safety during construction is a priority for BPA. BPA would construct this project over a 5-year (60-month) period from 2017 to 2021. The initial phases would involve surveying, and acquiring land in fee and easements. Construction activities would include vegetation clearing on and off right-of-way; road, tower, and substation construction; installing conductors, counterpoise, ground wire, and fiber optic cable; connecting the new line and other existing lines to the new substations; and tower site restoration including reseeding disturbed areas. The completed transmission line could be located in forested land, in sparsely populated areas, or in or near highly populated urban areas. The line would cross highways, local roads, railroads, and rivers and streams.

Heavy equipment, cranes, helicopters, fuels, and blasting materials would be used during construction and installation of towers, conductors, fiber optic cable, counterpoise, ground wire, substations, and access roads. Materials would be stored and possibly assembled at staging areas and helicopter fly yards. The general public would not be allowed in staging areas, helicopter fly yards, or construction areas and would not be at risk of injury. **No** impacts would occur. By following all safety requirements and implementing mitigation measures, construction activities would create temporary, **low** impacts to worker health and safety.

The road system used by construction crews would be a mix of public, private, and BPA access roads across public and private land. Access roads would be needed to every tower site, requiring new or widened roads where they do not already exist. Some roads that could be used for construction are currently used for timber harvest activities by private timber companies and WDNR. Residents use other roads for daily commutes within their communities.

Increased traffic on highways and roads during construction could create potential safety issues to the public. BPA and its contractors would adhere to safety standards by developing traffic control plans as required or needed, obtaining permits where required, using flaggers, and properly handling fuels or other hazardous materials. Additional traffic during construction would be temporary. Impacts to public health and safety from increased traffic would be **low**.

Toxic and Hazardous Substances

Construction activities would require small quantities of toxic and hazardous substances and would generate small quantities of hazardous waste. These substances may include fuels (diesel, gasoline), lubricants, hydraulic fluids, other petroleum products, antifreeze, paints,

wood preservatives, cleaning products, and herbicides. Resulting hazardous or other regulated waste may include used oil, used oily rags, or other used fluids and wastes. BPA would follow strict internal procedures and comply with all health and safety regulations for handling toxic and hazardous substances and hazardous waste. If a spill occurs, BPA would respond and remove the spilled material immediately and restore the area. Because of the small quantities of toxic and hazardous substances generated and the unlikely occurrence of spills, **no-to-low** impacts would occur.

Unreported (non-BPA) hazardous waste sites may be encountered anywhere along the action alternatives during construction and may pose a potential risk and liability to BPA. If contaminated media (soil, surface water, or groundwater) is encountered during construction, work would be stopped, and a qualified environmental specialist would be contacted to evaluate conditions. The environmental specialist would characterize the nature and extent of contamination to evaluate the threat to human health and the environment. Appropriate remedial actions, including notifications to the appropriate environmental regulatory agencies (EPA, Ecology, ODEQ, and local health departments), and approvals by the appropriate agency would be implemented to reduce the hazards to safe levels so that construction work could proceed.

Because BPA would initiate prompt response and cleanup activities, **no**-**to-low** impacts would occur from unreported hazardous waste sites.

Fire

Construction activities would require vehicles and equipment that could increase the risk of fire in fire-prone wild land areas. Vehicles would be equipped with fire suppression equipment, including shovels, fire extinguishers, and a water supply. Construction activities would be coordinated with the responsible local fire agency for advisories on fire danger and to establish guidelines and communications. Workers would also follow all guidelines and plans developed by the underlying landowner. BPA and its contractors would develop site-specific safety plans that would include a section on fire safety, required fire suppression equipment, and local fire and emergency contacts (Hoffman 2011). Because BPA and its contractors would use proper precautions and be aware of conditions during construction, impacts would be **low**.

10.2.2.2 Operation and Maintenance

Public Health and Safety

Transmission lines can cause serious electric shocks if certain precautions are not taken. These precautions include building the lines to minimize shock hazard. Action alternatives would cross highways, railroads, and rivers. For safety reasons, all existing and new BPA lines are designed and constructed in accordance with NESC. NESC specifies the minimum allowable distance between the lines and the ground, and BPA clearance standards are equal to or greater than NESC. These requirements determine the edge of the right-of-way and the height of the line, that is, the closest point that houses, other buildings, and vehicles are allowed to the line.

For the proposed 500-kV line, standard minimum clearance of the conductor above the ground is 29 feet. The clearance requirement over highways is 45.5 feet; other clearances (railroads, rivers, trees, etc.) are determined on a case-by-case basis. The action alternatives would be designed to meet or exceed these requirements.

BPA does not permit any uses of the right-of-way that are unsafe or might interfere with constructing, operating, or maintaining the transmission facilities. These restrictions are part of the legal rights BPA acquires for its transmission line easements. Because land use restrictions established through easements with landowners and NESC requirements would minimize hazards from operations of the line and substations, impacts would be **low**.

Vehicles and helicopters are used to perform required tasks along the line, roads, and at substations. Activities include safety inspections and inspections for encroachments, repair, and vegetation management. Similar to construction, the general public would not be allowed in areas where maintenance activities are occurring and would not be at risk of injury. **No** impacts would occur. By following all safety requirements and implementing mitigation measures, maintenance activities would create temporary, **low** impacts to worker health and safety.

Living and Working Safely Around High-Voltage Transmission Lines

Though BPA designs its lines for safety, people must take certain precautions if they live next to transmission lines or find themselves playing, recreating, or working under or near transmission lines. For example, it is important never to bring conductive materials—including TV antennas, irrigation pipes or water streams from an irrigation sprinkler—too close to the conductors. Also, vehicles should not be refueled under or near conductors. A free BPA booklet is available that describes safety precautions for people who live or work near transmission lines (see *Living and Working Safely Around High-Voltage Transmission Lines* at http://www.bpa.gov/corporate/pubs/Public_Service/LivingAndWorking.pdf).

Maintenance vehicles would travel along the same road system used for construction. Increased traffic on roads because of sporadic maintenance activities would be negligible and subsequent impacts to public health and safety would not occur or would be **low**.

Unauthorized access or trespass could increase the risk of fire, accidents, and illegal dumping, which could affect public health and safety. Because BPA would use signs, locked gates at some access roads, and otherwise limit access to the right-of-way, impacts to public health and safety from unauthorized public access and use would be **low**.

Toxic and Hazardous Substances

Impacts to public health and safety from toxic and hazardous substances used during operation and maintenance of the transmission line and substations would be the same as for construction.

Some equipment at the new substations may contain diesel and other types of oil, including gas circuit breakers that contain small amounts of hydraulic oil (see Chapter 3, Project Components). Any oil-containing equipment would be designed with proper containment and spill control devices as required. BPA would prepare a site-specific Spill Prevention Control and Countermeasures (SPCC) plan for the new substations if regulatory volumes for oil are met and if it is determined that the substations are located in areas where there is drainage connectivity to waters of the U.S. These plans are specific to each substation and include the location of oil-containing equipment, volume of oil contained in the equipment, spill containment and controls, and the location and types of spill response equipment. Spills, if they occur, would be promptly cleaned up. **No-to-low** impacts from oil-containing equipment would occur because of containment, controls, and response actions. Impacts, if any, would be temporary because response would likely be quick and effective.

Fire

BPA follows its Transmission System Vegetation Management Program to maintain safe clearances between vegetation and transmission lines in accordance with NESC requirements. These strict guidelines also prevent fires that could occur from electricity arcing from conductors to treetops or from trees (danger trees) falling into the conductors. Trees that need to be cleared from the right-of-way and any that could fall into the line (danger trees) for various reasons are marked and removed. Impacts would be **low** because the right-of-way would be maintained with safe clearances and distances in accordance with BPA's Transmission System Vegetation Management Program and NESC requirements.

Routine maintenance on transmission facilities is typically done in the warmer months when fire danger can be high. All maintenance vehicles are equipped with fire safety equipment. BPA would follow all fire safety requirements that may be in place by large public or private commercial landowners or managers, including WDNR, PacifiCorp, Sierra Pacific Holding Company, Weyerhaeuser Columbia Timberlands, and Weyerhaeuser Company. For these reasons, impacts would be **low**.

Air and Water Transportation

A single-circuit 500-kV tower would average between 120 and 150 feet tall, depending on terrain and right-of-way configurations along each action alternative. The tallest towers at the Columbia River crossing (there are six existing transmission lines that cross the river at this location) could be a little over 305 feet tall. This additional height would be required to keep conductors high enough over the river to allow for river traffic under the line. FAA regulations generally prohibit aircraft from flying below an elevation of 500 feet. Most towers and conductors would be less than 500 feet tall except in areas where the new line might cross steep canyons. Near airports and flight paths, the FAA may require BPA to add obstruction lighting (see Section 3.7, Obstruction Lighting and Marking). BPA is coordinating with the FAA and most towers are designed and would be constructed in accordance with FAA guidelines (FAA 2000). For those taller towers at the Columbia River crossing that are closer to the Troutdale and Portland International airports, and taller towers at the Cowlitz River crossing, BPA is working closely with FAA on their review of the project design. Input from pilots would also be sought as required by the FAA review process. As mentioned, obstruction lighting would be considered in the review; also, possible flight pattern changes. Because of this close coordination with the FAA, safety impacts to air transportation would be **low-to-moderate**.

Columbia River crossing towers would be placed on a high point in the river bottom at Ione Reef. This location is not in the river channel or otherwise in the navigable portion of the river, which would avoid water transportation safety issues (see Chapter 12, Transportation). BPA would notify the United States Coast Guard (USCG) and the Corps and construct towers in accordance with USCG and Corps guidelines. BPA would obtain a Section 10 permit from the Corps and adhere to marking requirements of the USCG and the Corps. A Section 10 permit is required for work in, over, or under navigable waters of the U.S. Because the project would not place towers within the navigable portion of the Columbia River, **no-to-low** safety impacts would occur to commercial and recreational river traffic.

Acts of Vandalism, Sabotage, and Terrorism

Any vandalism or theft at the proposed BPA facilities would have the potential to compromise the safety of equipment and utility workers, causing electrocution, fires, and possibly disrupting power. However, these risks are extremely low since the more frequent occurrences are minor acts of vandalism or theft that are quickly repaired and have little to no effect on transmission facility operations or worker safety, and major acts of vandalism, theft, sabotage, or terrorism are rare (see Chapter 23, Intentional Destructive Acts). In addition, BPA uses helicopters to patrol and inspect the 15,000-mile federal transmission system in the Pacific Northwest. Helicopter inspection of the new line would occur twice a year. Helicopter teams look for damaged insulators, damaged support members, washed-out roads, hazardous vegetation, encroachments and problems indicating that a repair may be needed. Aerial inspections are typically followed by annual ground inspections for each line. BPA follows NERC guidelines for security including the reporting of threats and incidents.

The risk from theft, vandalism, or acts of sabotage and terrorism would be **low-to-moderate**. If some acts of sabotage and terrorism occur, they could create significant damage and power disruption, but the possibility of such acts causing catastrophic results is remote given past experience and routine inspections. Damage from theft, vandalism, or acts of sabotage and terrorism, if any, would be temporary. Damage would be repaired and power restored as quickly as possible.

Vegetation Management

Vegetation would be managed along existing and new rights-of-way for safe operation of the line and substations and to allow access to the transmission line. Any action alternative would need continual vegetation maintenance because of its location west of the Cascade Mountains where the climate is conducive to rapid and dense vegetation growth.

The action alternatives would cross public and private land on existing and new rights-of-way that would require vegetation clearing. Incompatible vegetation such as trees would not be allowed to grow within the transmission line right-of-way unless the trees are in deep canyons or steep valleys. Tall (stable or unstable) trees that grow outside of the right-of-way that are considered a present or future hazard to the line and could fall into, grow into, or bend into the line would also be removed. In deep valleys with sufficient clearance between the tops of the trees and the conductors, trees could be left in place. At tower sites, all trees, snags, brush, and stumps (more than 22 inches in diameter) would be felled and removed, including root systems, from a 50-foot by 50-foot area (see Section 3.11, Vegetation Clearing). Cleared vegetation would be shredded and scattered onsite, composted in the right-of-way, or hauled off site using project access roads.

Workers using manual and mechanical methods for vegetation control are subject to accidents involving falling trees, heavy machinery, chains saws, or moving over rough terrain. Workers would be trained to use heavy machinery and chainsaws and would be equipped with all appropriate personal protective equipment necessary for each task and piece of equipment. BPA would follow strict standard safety procedures and all regulations regarding worker safety. The general public would not be allowed in areas where vegetation management is occurring and would not be at risk of injury.

The application of herbicides may expose workers if handled carelessly. Workers would be licensed as an applicator in the respective state either by the Washington State Department of Agriculture (WSDA) or the Oregon Department of Agriculture (ODA). Workers would be trained to apply herbicides and use application equipment and equipped with all appropriate personal protective equipment necessary for each task and piece of equipment. BPA would strictly follow standard safety procedures and all regulations regarding worker safety and would be guided by its Transmission System Vegetation Management Program EIS (BPA 2001).

The general public may be exposed to herbicides through drift or spills. BPA notifies known landowners when a vegetation management or herbicide project is being planned and scheduled to allow for responses back to BPA with concerns, questions, or directives for herbicide spraying on their property. Landowner response might include information to help BPA determine appropriate application methods and mitigation measures (such as herbicide-free buffer zones around springs or wells; or organic food farms, aquaculture facilities, or other sensitive areas). When landowners request that herbicides not be applied on their property, BPA has complied with those requests, and works with property owners to strategize non-chemical ways to deal with vegetation hazards on the right-of-way (i.e., noxious weed management plans, replacement vegetation efforts) that works for both the landowner and BPA.

To avoid impacts to domestic water supply wells and other domestic water sources, BPA would strictly follow the guidelines set forth in its Transmission System Vegetation Management Program including maintaining adequate buffers and herbicide-free zones around any potential water sources (see Chapter 15, Water).

BPA continues to fine tune vegetation efforts by communicating intended maintenance practices to landowners and providing an opportunity to respond and help design vegetation management techniques consistent with reliable transmission lines and current landowner practices on managing their land. Site-specific vegetation management plans are created to consider different land management efforts and techniques on different parcels of land, incorporating comments and suggestions from property owners/managers to ensure vegetation is managed in a manner acceptable to both parties.

Because BPA would implement effective controls according to BPA's Transmission System Vegetation Management Program EIS and is committed to working with existing landowners to accommodate their concerns and needs, impacts would be **low**.

Extreme Weather Events

Extreme weather events, such as wind, ice, etc., are rare in BPA's service territory, but can occur and could cause a lattice steel tower to fail. Because lattice steel towers are connected to each other with conductors, if one tower fails it puts stresses on surrounding towers, which can sometimes cause nearby towers to collapse. BPA uses tower designs that help prevent this cascading effect from occurring.

Towers are designed to take some longitudinal loading, which occurs either when a wire breaks or a tower fails. This limits potential damage to only a few towers. The lattice-steel towers are designed to withstand 120 mph winds, which can be created by tornadoes, microbursts and downbursts.

On average 800 to 1,000 tornadoes occur within the contiguous U.S. each year. For a 30-year period (1950-1980) the total number of reported tornadoes was recorded and compiled on a 1 degree latitude by 1 degree longitude (1 degree square contains about 4,000 square miles) map (Wong 2009). In Washington and Oregon, 53 tornadoes were recorded over this period, which is quite low compared to other states. Another study observed that over a 63-year period (1916-1978), 86 percent of tornadoes were scaled as F2 or less (Wong 2009). The F scale, FPP, was developed to categorize tornadoes by their intensity and size. A class F2 has a gust speed range between 113 mph and 157 mph. The economics of designing for the higher gust speeds to prevent a rare event is impractical and would increase rates paid by customers.

River crossing towers are designed to higher standards because they are critical to the system. These towers are designed with an additional 20 percent overload (factor of safety) for reliability.

To help prevent trees from falling onto the transmission lines during extreme weather, trees considered a danger to the transmission line are removed (see Section 3.11, Vegetation Clearing). Also, breakers in the substations keep the power from staying on in the event of a downed transmission line.

Icing events can occur in the Northwest. Washington and Oregon typically have between 0.25 inches and 0.5 inches of radial glaze ice occur every 50 years, depending on the geographic area. The Columbia Gorge can have glaze ice up to 1.25 inches thick. BPA uses an extreme icing load case that is two times the 50-year icing amounts.

Though BPA cannot design for every conceivable loading combination, design standards cover a high probability of events that are likely to occur within the area. If an extreme weather event occurred in an area occupied by the proposed transmission line, nearby residents and others close to the affected towers could be at risk from the physical parts of a tower collapsing, and power disruption. Automatic systems at substations would de-energize the lines, reducing the potential risk of injury from energized lines. The transmission line would be on a cleared right-of-way where buildings and other structures are not allowed, reducing the risk of damage to occupied residences and other buildings. Any potential damage from extreme weather events would be temporary, but could include power loss (see also Chapter 23, Intentional Destructive Acts). The towers and conductors would be repaired and power restored as quickly as possible. Because a new transmission line would create a known but rare or infrequent risk to public health and safety during an extreme weather event, impacts would be **moderate.**

10.2.2.3 Sundial Substation Site

The Sundial substation site (Lots 11 and 12), the end of Segment 52 south of the Columbia River, and connector lines between Lots 11 or 12 and BPA's existing Troutdale Substation would be constructed within three areas of the RMC site (see Section 10.1.2.3, Reynolds Metals Company Site). The post-demolition RA human health risk assessment conducted in 2006 concluded that soils in the three areas were within the EPA's and ODEQ's acceptable risk range for all contaminants. Regardless, special care may need to be taken during excavation for the substation and towers. Before construction work would begin, EPA and ODEQ would be notified and plans would be in place to address and mitigate any known or potential areas of contamination that may be encountered. Because information about known contaminants is available for the three sites, debris and contaminated soil has been removed, and the existing health risk levels are considered acceptable by EPA and ODEQ, impacts would be **low**.

10.2.3 Castle Rock Substation Sites

The impacts on public health and safety from the substation sites near Castle Rock would be the same as those listed in Section 10.2.2, Impacts Common to Action Alternatives.

Impacts common to action alternatives are in Section 10.2.2. The remaining sections discuss impacts unique to each alternative, and recommended mitigation measures.

10.2.4 West Alternative and Options

The West Alternative includes 600 feet of improved access road within Institutional Control Area No. 5 of BPA's Ross Complex (see Section 10.1.2.1, BPA Ross Complex, and Figure 10-1). New towers (towers 25/110 and 25/111) would be constructed nearby. Road improvement would typically include blading the existing road and applying additional rock if needed. Because of this site, BPA would not do any blading and would only add rock to the road surface. For towers, BPA would position temporary tower disturbance areas so that they did not interfere with the site. During construction and maintenance activities, BPA's environmental specialist at the Ross Complex would be notified of these activities and alerted to any changes. EPA and WDOE would be notified of the proposal and BPA would carry out any recordkeeping requirements as required. As long as the existing cap at Institutional Control Area No. 5 is not disturbed during construction or maintenance activities, there would be **no** impact to the site. Where the West Alternative shares Segment 52 (crossing the Reynolds Metals site) with other alternatives, it would have a **low** hazardous substance impact, the same as the Sundial substation site.

10.2.5 Central Alternative and Options

The Central Alternative includes a portion of Segment 28, east of Amboy and Yacolt, and one tower (Tower 28/9) on the western edge of the former International Paper Company Mill site (see Section 10.1.2.2, International Paper Company Mill and Solid Waste Site). This location is likely not within areas potentially contaminated by prior mill operations. Available information on the International Paper Company from the Department of Ecology has been reviewed. The level of impact at this location would be **low** because previous assessments indicated limited contamination, the contaminated soils have been removed, and the proposed route largely avoids areas of the mill site where historic operations occurred. In any case, the site would be investigated further and would be mitigated if the Central Alternative is selected to be built. Where the Central Alternative shares Segment 52 (crossing the Reynolds Metals site) with other alternatives, it would also have a **low** hazardous substance impact.

10.2.6 East and Crossover Alternatives and Options

The impacts on public health and safety from the East Alternative and the Crossover Alternative would be the same as those listed in Section 10.2.2, Impacts Common to Action Alternatives. Where these alternatives share Segment 52 (crossing the Reynolds Metals site) with other alternatives, it would also have a **low** hazardous substance impact.

10.3 Recommended Mitigation Measures

Mitigation measures included as part of the project have been identified (see Table 3-2). BPA is considering the following additional mitigation measures to further reduce or eliminate adverse public health and safety impacts by the action alternatives. If implemented, these measures would be completed before, during, or immediately after project construction unless otherwise noted.

- Notify the USCG and their Notice to Mariners of the planned construction schedule for building the line across the Columbia River.
- Notify property owners and adjacent landowners of the type and frequency of potential herbicide application to avoid conflicts, such as chemical applications next to organic farms or similar uses.
- Carry fire suppression equipment in all vehicles and follow all fire safety requirements that may be in place by large public or private landowners, including WDNR.
- Continue to be in contact with the Reynolds Metals Site Manager at EPA and the Environmental Engineer at Oregon DEQ. As the agreements for the Reynolds Metals Superfund Site dictate, BPA will fully comply with all requirements during both construction and operation and maintenance.

10.3.1 Unavoidable Impacts

Constructing and maintaining transmission lines, substations, and access roads include some activities that increase the risk of injury to workers. Workers would follow all required safety requirements and precautions; however, accidents may still occur. Likewise, during some construction and maintenance activities, minor increases in traffic accident risk due to additional traffic on area roads may occur. Although infrequent, acts of vandalism and sabotage would likely continue to occur with varying impacts to the perpetrator, BPA personnel who respond to these emergencies, and the general public.

10.3.2 No Action Alternative

If the project were not built, the health and safety impacts related to the proposed project would not occur. However, the already existing health and safety conditions in the project area would continue to present health and safety risks to individuals in the area. In addition, because reinforcement of the BPA transmission system would not occur under the No Action Alternative, this alternative could eventually lead to diminished reliability of the existing transmission system as loads continue to grow. If this eventually leads to brownouts and possibly blackouts, it could disrupt essential public safety services that rely on adequate and continuous electrical power.

Chapter 11 Socioeconomics

This chapter describes socioeconomic conditions and resources in the project area, and how the project alternatives could affect these conditions and resources. Related information can be found in Chapter 1, Purpose and Need; Chapter 5, Land; Chapter 6, Recreation; Chapter 7, Visual Resources; Chapter 8, EMF; and Appendix H, Environmental Justice Tables.

Words in **bold** and acronyms are defined in Chapter 32, Glossary and Acronyms.

11.1 Affected Environment

Socioeconomic conditions and resources include population and housing, employment and income, public services, utilities and infrastructure, government revenue, property values, and land-generated income such as agricultural production and private timber production. In addition, existing quality of life and other values important to individuals who live or visit the project area are considered.

11.1.1 Population and Housing

About 1.28 million people live in Cowlitz, Clark, and Multnomah counties, in communities ranging from concentrated urbanized areas to sparsely populated rural areas. The population of the cities and towns in the project area range from about 1,600 in Yacolt to about 164,000 in Vancouver (see Table 11-1).

Table 11-1 Populations of Counties, Cities, and Towns, 2013

Geographic Area	Population
Cowlitz County	**102,110**
Castle Rock	2,263
Kelso	11,878
Longview	36,656
Clark County	**432,549**
Amboy	1,224
Battle Ground	17,797
Brush Prairie	2,780
Camas	19,998
Hockinson	4,805
Vancouver	164,111
Yacolt	1,581
Multnomah County	**747,641**
Fairview	9,003
Troutdale	16,188
Total	**1,282,300**
Source: U.S. Census Bureau 2013a	

In 2013, in Cowlitz County about 58 percent lived in the incorporated cities of Castle Rock, Kelso, Longview, Kalama, and Woodland (Washington State Office of Financial Management [OFM] 2013). The population of these cities ranged from about 2,363 (Castle Rock) to about 36,656 (Longview) (see Table 11-1). For Cowlitz County, about 43 percent of the people lived in rural, unincorporated communities such as Yale, Lexington, Ariel, or Cougar, or in rural county areas (OFM 2013; Cowlitz County 2010a).

In 2013, half of the people in Clark County lived in the incorporated cities of Battle Ground, Camas, La Center, Ridgefield, Vancouver, Washougal, Woodland, and Yacolt (OFM 2013). The largest city in Clark County is Vancouver, with about 164,000 people (see Table 11-1). In 2013, about half of the people in Clark County lived in rural, unincorporated areas, such as Amboy, Brush Prairie, Chelatchie Prairie, Fargher Lake, Hockinson, and Meadow Glade (OFM 2013a).

The current populations of Clark (over 400,000) and Cowlitz (over 100,000) counties are expected to increase by over 25 percent between 2010 and 2030 (OFM 2012). This would be a population increase of more than 110,000 for Clark County and 25,000 for Cowlitz County. The current population of Multnomah County (over 700,000) is expected to increase by about 18 percent between 2015 and 2035 (Oregon Office of Economic Analysis 2013).

Temporary housing in Cowlitz, Clark, and Multnomah counties includes rental housing, hotel/motel accommodations, and campgrounds and RV parks. The 2013 vacancy rate in the Portland-Vancouver-Beaverton Metropolitan Statistical Area for rental housing was about 4.3 percent (U.S. Census Bureau 2013b). At this rate, there likely were about 14,500 housing units available for rent in 2013 (U.S. Census Bureau 2013b). Temporary accommodations are plentiful in the Portland-Vancouver metropolitan area and in Kelso and Longview, Washington, but are more limited in the communities in the eastern portions of the project area. More than 1,000 hotel and motel rooms are available in Cowlitz County. Clark County offers more than 2,500 hotel and motel rooms, and Multnomah County more than 15,000. Availability fluctuates throughout the year, with more demand for temporary lodging in the outlying areas during the summer. Permanent housing availability per county is not discussed due to the short-term nature of construction employment, although many thousands of homes are available in all three counties.

11.1.2 Employment and Income

In 2013, more than 3.3 million people age 16 and over were employed in the Seattle-Tacoma-Olympia and Portland-Vancouver-Beaverton metropolitan areas, which include Clark, Cowlitz, and Multnomah counties and the larger economic regions they are related to (U.S. Bureau of Economic Analysis 2014a). Employment in this regional labor market is well-distributed across a variety of industries. The largest shares of employment in individual sectors are in government and wholesale and retail trade, at 14 percent each. Health care services and manufacturing each employ 9 percent of the region's labor. Professional services, construction, and accommodation and food sectors each employ 7 percent. Real estate, finance and insurance; arts, entertainment, and recreation; and farm sectors each represent 5 percent or less of overall employment (U.S. Bureau of Economic Analysis 2014b). The annual unemployment rate in the metropolitan areas analyzed ranged from 4.9 to 8.6 percent in 2014 (U.S. Bureau of Labor Statistics 2014). In 2011, economists expected the unemployment rate in the region to fall gradually in future years (Williams 2011), which it has since the Draft EIS was released. The Congressional Budget Office projects the unemployment rate could fall to nearly 5.5 percent by 2020 (Hall 2015).

The average total compensation per worker is about $76,000 for local-government workers in Cowlitz County, $85,000 in Clark County, and $94,000 in Multnomah County. These amounts include both the average wage and the costs of benefits (U.S. Department of Labor, Bureau of Labor Statistics, 2015a, 2015b).

In 2013, the average per-capita income across the metropolitan areas ranged from about $36,000 to $55,000, and the total personal income across all areas was about $315 billion. Average per capita income in 2013 was about $40,500 in Clark County and about $36,000 in Cowlitz County (U.S. Bureau of Economic Analysis 2014a).

11.1.3 Public Services and Infrastructure

Fire protection in the cities and towns is provided by municipal fire departments in Vancouver, Camas, and Longview, Washington, and Gresham, Oregon (also serves Troutdale and Fairview); the remaining towns rely on rural fire districts. All districts have mutual aid agreements with surrounding departments and districts, and, in the event of a large or unusual emergency, a district would likely call in additional personnel and equipment from neighboring districts. WDNR provides fire protection for more than 12 million acres of state lands. WDNR has mutual aid agreements with most county fire districts, local departments, and other state agencies.

Municipal police departments are located in Castle Rock, Kelso, Longview, Battle Ground, Camas, and Vancouver, Washington, and Fairview and Troutdale, Oregon, and each county has a sheriff's office. The Washington State Patrol has law-enforcement authority throughout the state of Washington, and the Oregon State Police has authority throughout Oregon. In Oregon, the Multnomah County Sheriff's Office would coordinate with the U.S. Coast Guard and the Portland Harbor Master as appropriate for incidents involving the Columbia River. If a large disaster or other event exceeding the resources of any affected department occurred, neighboring departments would share and coordinate resources. Many departments have experienced budget cuts in recent years, and have lost staff or have limited capacity to investigate and respond to incidents in some areas, especially those far from administrative centers or requiring specialized equipment or vehicles.

Water and wastewater services are provided by city and county utilities and local water and sewer utility districts. Water in rural areas or outside of various utility districts is provided by private wells and well systems, sometimes serving multiple users. Wastewater control in areas without sewer districts is provided by septic tanks, drain fields, and holding tanks.

Please see Chapter 5, Land, for a discussion of schools in the project area.

11.1.4 Government Revenue

State, county, and local governments rely on a variety of taxes and revenue sources to fund public services and programs.

11.1.4.1 Tax Revenue

Different forms of tax revenue include the following:

Sales and Use Tax

Washington's principal source of tax revenue is the retail sales and use tax, which yielded almost $8 billion in fiscal year 2014. The sales tax is paid for goods and services purchased within Washington. The use tax is paid when goods and services are purchased outside of Washington, but used within the state. Sales tax rates vary throughout the project area since counties and cities can add to the base state tax rate of 6.5 percent (1.2 to 1.9 percent additional tax depending on location in Clark or Cowlitz counties). The yield of the retail sales tax to city and county governments in Clark and Cowlitz counties was about $130 million in 2014 (Washington Department of Revenue 2014a). Oregon does not assess a sales tax.

Business and Occupation Taxes and Income Taxes

Washington has state and local business and occupation (B&O) taxes in lieu of an income tax. The cities of Longview and Kelso also assess B&O taxes at a rate of 0.1 percent of gross operating revenue for most businesses. In Oregon, businesses and corporations pay income taxes at the state, and in some cases, the local level. The state assesses personal income taxes based on a rate that varies depending on filing status and level of income, but ranges from 5 to 11 percent of taxable income (Oregon Department of Revenue 2009). Corporations doing business in Oregon pay an excise tax on net income. Corporations not doing business in Oregon, but with income from an Oregon source, also pay income tax. Multnomah County assesses a tax rate of 1.45 percent on the net income of firms doing business in the county (City of Portland 2011). Employers within the Tri-Met District Boundary (which includes most of Multnomah County) pay a 0.7237 percent payroll tax on the wages of their workers (Tri-Met 2014). BPA, as a federal agency, is exempt from paying Washington's B&O tax and Oregon's income tax.

Lodging Tax

Washington and Oregon charge lodging taxes, such as the 2-3 percent charges in Cowlitz and Clark counties, and up to 13.5 percent in Multnomah County.

Timber Harvest Tax

In Washington, timberland owners pay a 5 percent excise tax on the stumpage value (the price paid for standing trees intended for harvest) when timber is harvested. The revenue is split, with 4 percent going to the county where harvest occurs and 1 percent to the state general fund. Distributions of the timber excise tax in 2014 produced about $3.5 million for Cowlitz County and about $1 million for Clark County (Washington Department of Revenue 2014b).

Property Tax

Real and personal property are subject to property tax in Oregon and Washington. Real property includes land and any improvements, such as buildings attached to the land. It also includes transmission line rights-of-way, if established by an easement, because the property owner retains ownership of the land, and pays property tax on it. Personal property is not affixed to the land. In Washington, local governments administer the property tax. Property tax

collections in calendar year 2013 in Cowlitz County were about $104 million and in Clark County about $505 million (Washington Department of Revenue 2014c). Property tax collections in fiscal year 2013-2014 in Multnomah County were about $1 billion (Multnomah County Department of Assessment and Taxation 2014).

Other Taxes

Other taxes include fuel taxes, license taxes, and real estate excise taxes.

11.1.4.2 Revenue from Washington State Trust Lands

Land within the project area held in trust by the State of Washington (WDNR) provides revenue for separate trusts managed for various public services, such as public schools, the capitol campus, and other state institutions. The revenue generated for each of those trusts from timber harvested statewide ranged from $6 million to $71 million in fiscal year 2014 (see Table 11-2). With the exception of the State Forest Land Trust, revenue generated from trees harvested in a particular county would not necessarily benefit the services in that county. A portion of the revenue from timber harvests on land in the State Forest Land Trust (the last row in Table 11-2) is distributed back to counties where timber harvests occur.

Table 11-2 Washington State Trust Land Beneficiaries, Acres, and Timber Sales Statewide, 2014

Trust[1]	Beneficiaries	Acres Harvested[2]	Volume Harvested (MBF)[2]	Value of Sales[3] ($ millions)
Capitol Building Trust	State Capitol Campus	840	28,949	9
Charitable, Educational, Penal, and Reformatory Institutions Trust	WA State Institutions	641	19,228	6
Common School Trust	Public Schools (K-12)	7,869	153,056	45
Agricultural School Trust and Scientific School Trust	WA State University	1,350	38,493	11
State Forest Lands (Clark, Cowlitz)	County, State General Fund, WDNR	1,029	34,596	71
Total		**11,729**	**274,322**	**142**

Notes:
MBF = thousand board feet
1. Includes only trusts with land in the project area.
2. Statewide amounts, except State Forest Lands, which includes only State Forest Transfer and State Forest Purchase Lands in Clark and Cowlitz counties.
3. Statewide amounts.
Sources: WDNR 2014a, 2014b

The county-level distributions vary from year to year, depending on harvest levels, prices, and other factors. Stumpage values for softwood timber in the Pacific Northwest in 2014 averaged about $350 per thousand board feet (WDNR 2014b). Over the last 50 years, inflation-adjusted timber prices have fluctuated from a low of around $100 to a high of over $500, with a long-term average of about $222 in inflation-adjusted dollars (Haynes, et al. 2007, 2008). In recent years, distributions from the State Forest Land Trust to counties have averaged around 70 percent of total county-level timber-harvest revenues (Saunders 2010, 2012). Of the State

Forest Lands Trust's fiscal year 2014 revenues, about $9 million went to Clark County and about $900,000 went to Cowlitz County (WDNR 2014b).

11.1.5 Property Value

The value of property can be measured in several ways. The price at which property is bought and sold under competitive conditions determines the market price. County assessors assess the value of real property for tax-collection purposes. Assessors estimate the value of residential properties based on the recent sale price of nearby, similar properties. They estimate the value of most commercial and industrial properties based on the potential use or revenue-generating potential of the property (Washington Department of Revenue 2005). The assessed value of real property in 2013 was about $8 billion in Cowlitz County, $39 billion in Clark County, and $61 billion in Multnomah County (Washington Department of Revenue 2014c; Multnomah County Department of Assessment and Taxation 2014). Due to market adjustments from the 2009 recession, the market value of property has generally trended downward because of foreclosures, financing difficulties, unemployment, sluggish economic conditions, reduced demand, and excess housing supply. Although economies are improving, Cowlitz and Clark counties have shown only 5 percent and 10 percent population growth, respectively, from 2005 to 2013 (U.S. Census Bureau 2015). Homeowners have often found themselves with mortgage balances higher than the value of their home.

In addition to fee-owned property, BPA has existing easements in the project area that were obtained when the existing transmission lines were built. These easements, depending on the original agreement, allow BPA to use but not own the land, and restrict the types of activities and uses allowed in the right-of-way. Typically, a transmission line easement specifies the present and future right of BPA to clear the easement area (both on and off the right-of-way) of all types of incompatible vegetation. In many cases, the landowner has been able to reserve the right to grow and maintain non-woody, low-growing plants, such as annual agricultural crops or vegetative cover that do not require structural support. The transmission line easement also specifies the present and future right to clear the right-of-way of any and all structures, above and below ground improvements or infrastructure, and fire and electrical hazards. BPA has compensated landowners for such easement rights.

Building BPA's existing transmission lines may have changed other uses of some properties depending on a line's location and the shape and size of, and improvements on the property. If the easement effectively severed an area (stranded use) from the remaining property, then payment was made for that damage at the time the easement was secured (severance damage). This and other factors were considered to determine the loss in value within and outside of a specific easement area.

11.1.6 Agricultural Production

Agricultural land makes up about 10 percent of the total land area in Cowlitz, Clark, and Multnomah counties: about 5 percent (39,009 acres) in Cowlitz County, about 18 percent (74,758 acres) in Clark County, and about 10 percent (29,983 acres) in Multnomah County. Of the total land in agriculture about 39 percent is harvested cropland (USDA NASS 2014a, 2014b). The amount of land in agriculture has decreased in these counties over the past two decades by about 17 percent. The 2012 Census of Agriculture identified 3,019 farms which, on average, are about 50 acres each (U.S. Department of Agriculture 2014a, 2014b). Crops grown in the project

area include forage for livestock such as hay, nursery stock, grapes, berries, and Christmas trees. Livestock production within the project area includes poultry and cattle (Washington State Department of Agriculture 2009) (see Chapter 5, Land).

In 2012, crops in Cowlitz, Clark, and Multnomah counties produced about $148 million in revenues. Although the total value of agricultural production was positive in each of these counties, the number of farms with net losses exceeded the number of farms with net gains in each county. Besides generating revenue from production directly, agricultural lands and farms contribute to the region's economy by providing open space and other valuable amenities that contribute to the quality of life for residents and visitors.

11.1.7 Private Timber Production

Lands used for private timber production make up about 47 percent of the land area in Cowlitz, Clark, and Multnomah counties: 64 percent (477,600 acres) in Cowlitz County (Cowlitz County Planning Division 1976), 38 percent (159,500 acres) in Clark County (Clark County Community Planning Office 2010) and 15 percent (45,400 acres) in Multnomah County (Multnomah County 2007).

Private timberland owners harvested about 263 million board feet of timber from about 4,500 acres in Cowlitz, Clark, and Multnomah counties in 2013, about 75 percent of the total timber harvest in these counties (WDNR 2013; Oregon Department of Forestry 2014). About 81 percent of this timber was harvested in Cowlitz County. Stumpage values for softwood timber in the Pacific Northwest in 2014 averaged about $350 per thousand board feet (Zhou 2013). Over the last 50 years, inflation-adjusted timber prices have fluctuated from a low of around $100 to a high of over $500, with a long-term average of about $222 in inflation-adjusted dollars (Haynes et al. 2007; Haynes 2008).

11.1.8 Community Values

This section discusses existing values important to the community that were identified by members of the public in scoping and Draft EIS comments. Included in this discussion are community values such as quality of life, property-related amenities, recreation and tourism, the natural environment, transmission system reliability, and public health and safety.

11.1.8.1 Quality of Life

Many people who live in the project area have identified the rural character of the landscape, deeply-rooted family history, small, close-knit communities, high-quality public services, and distance from industrial development and "the tell-tale signs of civilization" as defining the quality of life they enjoy. These attributes are recognized by economists as being important to a person's quality of life. Economists identify different categories of goods and services that increase personal well-being in different ways, both directly and indirectly as inputs to the production of other valuable goods and services. Common categories include human capital (e.g., knowledge and skills), human-built capital (e.g., roads, buildings, utilities), social capital (e.g., laws, cultural norms, relationships), and natural capital (e.g., rivers, forests, soil, and air) (O'Sullivan and Sheffrin 2001; Case and Fair 2004).

The region's stock of natural capital—its natural environment—produces many types of goods and services that contribute to the quality of life of residents and visitors. These goods and

services, such as scenic views, open space, and opportunities for solitude, quiet, and recreation, directly improve the well-being of people who enjoy them as they live, work, and visit nearby. The region's stock of social capital also influences the quality of life. Social scientists define social capital as the network of connections that individuals build within a community that creates reciprocity with, and trust in, members of that community and institutions that represent their interests (Ritchie and Gill 2004). Events or issues that could generate change in communities can affect their stock of social capital and the quality of life of their residents.

Changes that highlight value differences within communities about economic development, environmental quality, and perceptions of risks and benefits can generate corrosive community reactions that may strain existing interpersonal relationships and erode existing stocks of social capital (Marshall et al. 2004; Freudenburg 1997). Changes that adversely affect social capital may reduce a community's ability and capacity to work efficiently to address a wide range of challenges and disruptions, reducing quality of life in the community.

11.1.8.2 Property-Related Amenities

Individuals enjoy benefits from amenities in the natural environment surrounding their homes, such as scenic views, solitude and quiet, a sense of safety, and a sense of privacy. Visitors also enjoy these benefits. Some of the value of these amenities is included in the market price of property. In some cases, however, the market price may not fully account for the value people derive from property-related amenities. The characteristics of the property-related amenities vary considerably throughout the area, from property to property, and from individual to individual. This variation makes the property-related amenities difficult to describe in detail. A particular amenity, e.g., sense of privacy, may be important to one property owner, but not to their neighbor, or may make an important contribution to the market price of one property but not to others nearby. In general, natural and landscaped amenities are important to property owners in rural, urban and suburban areas, and may contribute to the value people derive from their property.

11.1.8.3 Recreation and Tourism

Economists estimate the value of recreational services by looking at two factors: the amount of money people spend to participate in a recreational activity, and the difference (called consumer surplus) between what they are willing to spend and what they actually spend. The recreational goods people purchase include everything from permits and equipment, such as hunting rifles and fishing rods, to the gas, food, and lodging purchased during a recreational trip. Travel-related spending in the three counties ranged from about $142 million in Cowlitz County in 2009 (adjusted to 2014 dollars) to about $3.4 billion in Multnomah County in 2014 (Washington Department of Commerce 2010; Oregon Tourism Commission 2015). Consumer surplus is important because it registers improvements in economic well-being: if someone can pay just a little to enjoy fishing, boating, or some other activity that is of high value to them, then he or she is economically better off.

The average consumer surplus per person per day for common recreational activities in the project area ranges from $28 for hiking to $90 for wildlife watching (Loomis 2005, adjusted to 2014 dollars). The economic importance of recreation is increasing in importance overall: more people are recreating more often, and willing to pay greater amounts to do so. In recent years the amount people are willing to pay per person for a day of outdoor recreation has grown faster than inflation, about $1 per year (Rosenberger and Loomis 2001). Expenditures are

important because they generate jobs and income in the communities where they occur. The opportunity to enjoy large increases in consumer surplus can influence some households to locate near the area's recreational resources, with indirect effects on the area's labor and consumer-spending markets.

11.1.8.4 Natural Environment

Visual resources, water resources, wetlands, vegetation, wildlife, and fish are present in the project area (see Chapters 7, Visual; 15, Water; 16, Wetlands; 17, Vegetation; 18, Wildlife; and 19, Fish). These resources contribute to personal well-being in several ways, including the following:

- Knowing that they exist
- Having the option to enjoy them directly
- Ensuring that their children enjoy them in the future
- Engaging in recreation, subsistence hunting, sightseeing, or some other direct use

Some of the species found in the area, including the Northern spotted owl and several species of Pacific salmon, have received federal threatened or endangered status. Many people place a considerable value on the continued survival of such species. The value placed by residents on protecting threatened, endangered, and rare species similar to those that might be found in the area ranges from $50 to $150 per year per household, depending on the species (Richardson and Loomis 2009, adjusted to 2014 dollars). Research suggests that a household's willingness to pay to protect sensitive plant species generally is lower than the willingness to pay for mammals and birds, but likely higher than their willingness to pay for insects or reptiles (Martin-Lopez, et al. 2007).

11.1.8.5 Transmission System Reliability

A reliable supply of electricity is an important contributor to the quality of life of the region's residents and the stability of its economy. The Pacific Northwest currently enjoys a reliable supply of electricity at rates lower than those paid in many parts of the country. Considerable uncertainty surrounds the specific value of reliable electricity and the costs of unreliable electricity, especially at a local level (Eto et al. 2001). National estimates suggest that the annual cost of power interruptions in the U.S. is around $100 billion per year, with most of the cost concentrated in the commercial and industrial sectors. The cost to the Pacific Northwest is estimated at over $3 billion per year (LaCommare and Eto 2004, adjusted to 2014 dollars).

The cost of power interruptions manifests in different ways across commercial, industrial, municipal, and residential customers, and the public that depends on the goods and services electric power sustains. Commercial, industrial and municipal customers may experience costs when infrastructure, such as machinery, computers, and networks, stops functioning. Commercial and industrial customers may lose revenues and incur unexpected labor and material costs. Some revenues lost during an outage may be partially or wholly offset if, for example, workers work overtime after an outage to meet deadlines, or customers delay rather than cancel purchases. Residential customers may incur direct costs for items such as batteries, eating out, and food spoilage, and intangible costs such as the time required to reset appliances, disruptions in plans, and anxiety about power outages. The public may experience costs when traffic lights, elevators, and other public infrastructure fails, causing delays and increasing the

risk of accidents. The average cost a U.S. residential electricity customer incurs from a power outage ranges from about $2.40 for momentary disruptions to $3.20 for sustained interruptions, per outage, in 2014 dollars. The average cost per outage for a commercial customer ranges from almost $800 to $1,400, and the average cost to an industrial customer ranges from almost $2,500 to $5,500, in 2014 dollars (LaCommare and Eto 2004).

11.1.8.6 Public Health and Safety

Between 2003 and 2007, annual fatality rates among workers who installed and repaired transmission lines in the U.S. fluctuated between 11 and 20 per 100,000 workers. During this period, these workers experienced injuries at a rate of between 4 and 5 per 100 workers per year, and job-related illnesses at a rate between 0.4 and 1 per 100 workers per year. Twenty-four workers had fatal injuries in power/communications construction in 2010 (U.S. Department of Labor, Bureau of Labor Statistics 2012). The most common causes of injury or illness were overexertion, contact with equipment and other objects, and falls (U.S. Department of Labor, Bureau of Labor Statistics 2009).

Transmission lines and electrical substations generate EMF, which many people perceive as risks to their personal health and well-being, or they are concerned about radio and TV interference. The perceived health implications of EMF often generate controversy among people living or working near transmission lines. Most people in the U.S. are continually exposed to EMF, which are present wherever electricity flows. Many studies have investigated the possibility of health risks from exposure to EMF, but few have found conclusive evidence that any exist (von Winterfeldt et al. 2004; Florig 1992) (see Chapter 8, Electric and Magnetic Fields and Appendices F, F1, G, and G1).

11.1.9 Environmental Justice

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations states that each federal agency shall identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low income populations. The Order further stipulates that the agencies conduct their programs and activities in a manner that does not have the effect of denying persons access to public information on, or excluding persons from participation in, matters relating to human health or the environment, or subjecting persons to discrimination because of their race, color, or national origin.

Guidelines provided by the Council on Environmental Quality (CEQ) (1997) and the EPA (1998) indicate that a minority community may be defined where either 1) the minority population comprises more than 50 percent of the total population of a defined group, or 2) the minority population of the affected area is meaningfully greater than the minority population in the general population of an appropriate benchmark region used for comparison (such as a city, county, or state). Minority communities may consist of a group of individuals living in geographic proximity to one another, or a geographically dispersed set of individuals who experience common conditions of environmental effect. Further, a minority population exists if there is “more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the above-stated thresholds” (CEQ 1997).

The CEQ and EPA guidelines indicate that low income populations should be identified based on the annual statistical poverty thresholds established by the U.S. Census Bureau. Like minority

populations, low income communities may consist of individuals living in geographic proximity to one another, or a geographically dispersed set of individuals who would be similarly affected by the proposed action or program. The U.S. Census Bureau defines a poverty area as a census tract or block numbering area where at least 20 percent of residents are below the poverty level (U.S. Census Bureau 2013e).

Both the CEQ and EPA guidelines note that larger and more populated geographic areas may have the effect of "masking" or "diluting" the presence of concentrations of minority and low income populations (CEQ 1997, EPA 1998). The three potentially affected counties (Cowlitz, Clark, and Multnomah) encompass large areas, ranging in size from 466 to 1,166 square miles. The potential existence of "high concentration pockets" of minority communities in the vicinity of the action alternatives was evaluated by reviewing 2010 Census data at the block group level. A block group is a smaller geographic subdivision of a census tract and typically contain between 3,000 and 6,000 people. Poverty-level information was evaluated by reviewing data at the census tract level (poverty data at the block group level was not available) from the most recent data available: 5-year estimates of poverty levels (for the past 12 months) for the 2013 American Community Survey (U.S. Census Bureau 2013d).

BPA completed the analysis of minority of low-income population groups with the following approach and assumptions:

- Using CEQ criteria, BPA defines a census block group as minority if that block group is more than 50 percent minority, or if the block group is less than 50 percent minority overall, but over 50 percent higher than the county as a whole. For example, if the county minority population is 20 percent, a block group would be considered minority if it is greater than 30 percent (50 percent higher than the county as a whole). Total minority population is combined in the evaluation.
- For an analysis of poverty levels, BPA considers a census **tract** low income if that census tract reports 20 percent or more of the population below the poverty level. BPA also considers a census tract low income if the poverty level, regardless of its rate, was 50 percent higher than the county poverty level.

11.1.9.1 Minority Populations

As reported in 2010, Cowlitz County had a minority population of about 14 percent, with 8 percent identifying as Hispanic or Latino, 1.6 percent identifying as Asian or Pacific Islander, 1.3 percent identifying at Native American or Alaskan Native, less than 1 percent identifying as Black or African American, and almost 86 percent identifying as White alone. The remaining percentage identified as some other race alone or of two or more races (see Table 11-3).

Clark County reported a minority population of about 18 percent, with about 8 percent identifying as Hispanic or Latino, 4.7 percent identifying as Asian or Pacific Islander, 2 percent identifying as Black or African American, less than 1 percent identifying at Native American or Alaskan Native, and almost 82 percent identifying as White alone. The remaining percent identified as some other race alone or of two or more races (see Table 11-3).

Overall, the state of Washington was more diverse than counties in the project area, reporting a minority population of about 27.5 percent, with 11 percent identifying as Hispanic or Latino, 8 percent identifying as Asian or Pacific Islander, 3 percent identifying as Black or African American, and 1 percent identifying at Native American or Alaskan Native (see Table 11-3), and

72.5 percent identifying as White alone. The remaining percent identified as some other race alone or of two or more races (see Table 11-3).

Multnomah County had a minority population of about 28 percent, with an Hispanic or Latino population of about 11 percent, 7 percent identifying as Asian or Pacific Islander, 5.4 percent identifying as Black or African American, less than 1 percent identifying as Native American or Alaskan Native, 72.1 percent identifying as White alone, and almost 4 percent identifying as some other race alone or as two or more races. Comparatively, the state of Oregon was less diverse than Multnomah County, reporting a minority population of about 21.5 percent, with 12 percent identifying as Hispanic or Latino, 4 percent identifying as Asian or Pacific Islander, 2 percent identifying as Black or African American, 1 percent identifying as Native American or Alaskan Native, 78.5 percent identifying as White alone, and 3 percent identifying as some other race alone or as two or more races (see Table 11-3).

Table 11-3 Race and Ethnicity by Aggregated Block Groups,[1] County, and State

Geographic Area[2]	Total Population	Percent of Total Population							
		Minority Population	White	American Indian or Alaskan Native	Asian or Pacific Islander	Black or African American	Hispanic or Latino	Some Other Race Alone	Two or More Races
Washington State	**6,724,540**	**27.5**	**72.5**	**1.3**	**7.7**	**3.4**	**11.2**	**0.2**	**3.7**
Cowlitz County	102,410	14.2	85.8	1.3	1.6	0.6	7.8	0.1	2.9
Aggregated Block Groups Crossed by the Project	30,237	9.5	90.5	1.2	1.0	0.3	4.4	0.1	2.5
Clark County	425,363	18.2	81.8	0.7	4.7	1.9	7.6	0.2	3.3
Aggregated Block Groups Crossed by the Project	84,994	13.7	86.3	0.7	3.4	1.3	5.5	0.2	2.7
Oregon State	**3,831,074**	**21.5**	**78.5**	**1.1**	**4.0**	**1.7**	**11.8**	**0.1**	**2.9**
Multnomah County	735,334	27.9	72.1	0.8	7.0	5.4	10.9	0.2	3.6
Aggregated Block Groups Crossed by the Project	3,821	28.6	71.4	0.6	12.7	4.3	7.7	0.1	3.2

Notes:

1. Data compiled as part of the 2010 Census are the most recent available data at the census block group level.
2. There are 80 block groups (representing 43 census tracts) crossed by the I-5 Project. Block groups were aggregated at the county level. See Appendix H for specific block-level data.

Sources: BPA 2015, U.S. Census Bureau 2010

Block groups crossed by the transmission line right-of-way, access roads, and substations were aggregated within their representative counties (see Table 11-3; individual block group data is in Appendix H). The Cowlitz County aggregate had a minority population of 9.5 percent, and the Clark County aggregate had a minority population of about 14 percent. One block group out of 25 in Cowlitz County (Block Group 2 in Census Tract 13, just north of Kelso, Washington)

reported a minority population greater than 50 percent above the county minority population. Two block groups out of 53 in Clark County (Block Groups 3 and 4 in Census Tract 407.03, northeast of the I-205-WA SR 500 interchange) reported a minority population greater than 50 percent above the county minority population. Overall, the percentages of minority populations in the aggregated block groups crossed by the project in Washington were less than the corresponding county minority populations (and less than the minority population of Washington).

The block groups crossed by the project in Multnomah County had an aggregated minority population of 28.6 percent. The minority population percentages for aggregated block groups crossed by the project in Multnomah County were therefore greater than the minority population percentage of Multnomah County (and the minority rate of Oregon), but were not 50 percent greater than the county minority population.

Of the 80 block groups analyzed (representing 43 census tracts) using CEQ criteria, three minority populations in Cowlitz and Clark counties were identified. These are crossed by the West Alternative and/or Crossover Alternative.

11.1.9.2 Low-Income Populations

BPA considers a low-income census tract equivalent to a poverty area, as defined by the U.S. Census Bureau (a census tract where at least 20 percent of residents are below the poverty level). BPA includes in the definition of poverty areas census tracts where the poverty level, regardless of its rate, was 50 percent higher than the respective county poverty level as reported by the American Community Survey for 2009-2013, an annual calculation of state-specific poverty information by the U.S. Census.

Median household income in Cowlitz County was $47,596, with a poverty rate of 17.6 percent (see Table 11-4). Median household income in Clark County was $58,225, with a poverty rate of 12.4 percent. Comparatively, Washington had a median household income of $59,478 in 2009-2013, higher than Cowlitz and Clark counties, and 13.4 percent of its population below the poverty level.

Data for census tracts crossed by the project were aggregated within their representative counties (population data were added across census tracts, household income data were averaged across census tracts). The aggregated Cowlitz County census tracts crossed by the project reported a median household income of $56,151, which was higher than the overall Cowlitz County median household income. About 11 percent of the population of Cowlitz County census tracts crossed by the project was below the poverty level, which was lower than the overall poverty rate in the county. Census Tract 13 (just north of Kelso, Washington) reported almost 28 percent of the population below the poverty level, a value greater than 50 percent above the Cowlitz County poverty rate.

Table 11-4 Income and Poverty Status by Census Tract,[1] County, and State

Geographic Area[2]	Total Population for whom Poverty Level is Assessed	5-Year Estimate of Median Household Income ($) for the Past 12 Months	5-Year Estimated Population below the Poverty Level for the Past 12 Months	Percent of Population below the Poverty Level (%)
Washington State	**6,686,172**	**59,478**	**893,211**	**13.4**
Cowlitz County	100,782	47,596	17,750	17.6
Aggregated Census Tracts Crossed by the Project	46,620	56,151	5,238	11.2
Clark County	428,222	58,225	53,164	12.4
Aggregated Census Tracts Crossed by the Project	135,135	66,049	14,441	10.7
Oregon State	**3,793,058**	**50,229**	**614,778**	**16.2**
Multnomah County	732,970	52,511	130,507	17.8
Census Tract 102 (Crossed by the Project)	5,638	57,683	794	14.1

Notes:

1. These data compiled as part of the 2013 American Community Survey are the most recent available data at the census tract level.
2. There are 43 census tracts crossed by the I-5 Project. Census tracts were aggregated at the county level. See Appendix H for specific census tract-level data.

Sources: BPA 2015; U.S. Census Bureau 2013a, 2013b, 2013c, 2013d

In Clark County, the median household income of census tracts crossed by the project was $66,049, with an average poverty rate in those tracts of almost 11 percent. The aggregated census tracts reported a higher median income and a lower poverty rate than Clark County overall. However, four census tracts out of 32 crossed by the project in Clark County (Census Tracts 407.06, 411.04, and 413.12, northeast of the Interstate 205-WA State Route 500 interchange, and 415 in downtown Camas, Washington) reported low-income populations (see Appendix H for individual census tract data).

Multnomah County had a median household income of $52,511 in 2013, with 17.8 percent of its population below the poverty level. There is only one census tract within Multnomah County in the project area. This census tract reported a median household income higher than the county median at $57,683, and a lower poverty level of about 14 percent. Comparatively, Oregon had a median household income of $50,229, with about 16 percent of its population below the poverty level.

Overall, although five out of the 43 census tracts crossed by the project reported low-income populations in 2013, the median incomes of the block groups crossed by the project were higher than the respective county incomes, and poverty rates in those census tracts were lower than the county (and state) poverty rates. Of the five census tracts, four are near the West Alternative or Crossover Alternative, or both, and one in Kelso, Washington, would be crossed by all action alternatives.

11.2 Environmental Consequences

General impacts that would occur for the action alternatives are discussed below, followed by impacts unique to each alternative.

11.2.1 Impact Levels

Impacts would be **high** where project activities would cause the following:

- A reduction in the supply of housing or the capacity of public services, utilities, or infrastructure required to satisfy demand
- A reduced level of government revenues by an amount sufficient to reduce the capacity of public services or infrastructure
- A change to the market price of agricultural products or timber at the regional or national level
- A permanent, disproportionate impact to a low income or minority population
- A full percentage point of change to the rate of unemployment

Impacts would be **moderate** where project activities would cause the following:

- A substantially increased level of use of existing stocks of housing, utilities, and public services and infrastructure
- A measurably reduced level of government revenues, but by an amount that does not degrade the capacity of public services and infrastructure
- A change to the market price of agricultural products or timber at the local level
- A disproportionate impact during construction to a low income or minority population
- A half percentage-point change to the rate of unemployment

Impacts would be **low** where project activities would cause the following:

- Little effect on the supply of or level of use of housing or utilities, public services and infrastructure, government revenues, or the market prices of agricultural products or timber
- A 1/10 of 1 percent change in the unemployment rate

No impact would occur where project activities would have no effect on the supply of or level of use of housing or public services and infrastructure, government revenues, or the market prices of agricultural products or timber; no disproportionate effect to a low income or minority population; and an imperceptible change to the unemployment rate.

11.2.2 Impacts Common to Action Alternatives

11.2.2.1 Population and Housing

At the peak of construction, the project would employ about 200 construction workers; about 150 of these workers would be from outside the local area. These non-local workers would temporarily increase local populations by about 180 persons (assuming some non-local workers would be accompanied by their families). Many of the construction workers would provide their own housing, such as campers or trailers, but require a place to park them; others would require motel rooms, rentals and other temporary housing. There would be a short-term increase in the demand for temporary housing in the project area, but existing temporary housing near the project (see Section 11.1.1, Population and Housing) would be sufficient to accommodate non-local workers and their families without creating a discernable change in availability, a **no-to-low** impact on housing during construction. Existing BPA staff would operate and maintain the new transmission line and associated facilities, so there would be **no** long-term impact on the population and the demand for housing.

11.2.2.2 Employment and Income

Construction activities would create a short-term increase in employment; at the peak of construction, the project would directly provide about 200 jobs. Indirect impacts would also occur as construction-related workers and suppliers spend their earnings on goods and services in the area, generating additional demand for labor, but these effects likely would be too small to be discernible relative to the size of the regional economy. If construction occurs during a period with low unemployment (not the current condition), workers would likely come from other projects and the net impact on local employment would be near zero. If construction occurs during a period of high unemployment, local, skilled workers could be hired, and the net impact on regional employment would be about 200 jobs (about 0.006 percent of the labor force in the region). Based on the current rate of unemployment in the economic area (about 200,000 unemployed), the jobs provided by the project would not cause a perceptible change in this rate. This change would be imperceptible even if all jobs were new jobs; in the case of this project, some of the workers will already be employed, so the project would have no impact on unemployment.

Construction activities would cause a short-term increase in income through construction-related spending on labor, materials, and land. The project would involve increased expenditures of about $16 million for existing BPA contractors and staff, and $240 million on wages and benefits for non-BPA contract workers, of which about $60 million would go to workers from within the area and $180 million would go to workers from elsewhere. Additional direct income would be generated for business owners, landowners, and workers from expenditures of about $175 million for construction materials and an additional undetermined amount for land and easement acquisitions. The overall direct impact on income for the entire construction period would be equivalent to about 0.13 percent of total personal income in the area in 2013. This is barely measureable and a **low** impact. Indirect increases in income would occur as those receiving income spend it locally on goods and services. The indirect impact likely would be smaller than the direct impact on income.

During operation and maintenance, the project would have **no** long-term direct impact on employment and **no** impact on private income, as BPA plans to operate and maintain the new

transmission line with existing staff. The project could have long-term, indirect effects on employment, such as effects on the flow of goods and services, such as timber from the lands occupied or affected by the right-of-way, substations, and access roads. These would occur as the project converts existing timberlands and the net flow of timber to local mills decreases. The direct jobs multiplier for lumber and wood products in Washington in 2012 was nine jobs per million board feet of harvest (Zhou 2013). Because timberland owners may respond to decreases in harvest from the right-of-way by harvesting elsewhere, the project's net impact on jobs in the regional wood-products sector is unknown. However, any changes would likely be too small to be discernable relative to the size of the regional economy and regional timber markets. By improving the reliability of electricity delivery in the region, the project would encourage businesses that need high-quality power to locate and invest in the area, which could provide jobs. Improved reliability would allow commercial, industrial, and residential consumers to avoid costs from power interruptions.

11.2.2.3 Public Services and Infrastructure

Given the nature of the project, overall long-term impacts on most, if not all, public service and infrastructure providers from the project likely would be too small to be discernible. Because the project would not permanently increase employment or population in the area, no overall impact to schools, police, fire, or medical services would occur. However, during project construction activities, there could be temporary and periodic higher demand for some public services.

Serious construction-related accidents would increase the demand for emergency medical, police, and fire services. This could cause short-term, localized decreases in the ability of these service providers to meet existing demands if such demands exceeded current capacity. Similarly, during operation and maintenance activities, any project-related accidents that occur could temporarily increase demand for emergency medical, police, and fire services in remote locations, again resulting in short-term, localized decreases in the ability of service providers to meet existing demand if such demands exceeded current capacity. However, most of the time there would be no impacts.

During construction, water would be used as the main method of dust control on access roads, and at tower and substation sites. Water is mixed with backfill to bring the soil to the right moisture content for compaction. Water is also used for fire prevention in areas where dry grasses create a fire hazard. Water would be taken from a permitted local source, either from landowners or municipalities, to minimize haul distance and costs. Because a permit is required, a local municipality can evaluate in advance whether they can meet this added demand and would not likely approve the permit if the supply was not available.

The Castle Rock substation sites would not have water or sewage utilities so no wastewater would be generated. The Sundial substation site would require water and sewage supply and treatment and these facilities would be designed and coordinated with the local municipality, Troutdale.

Impacts on public services and infrastructure that do materialize likely would be **low**, as they would not diminish the supply of services and infrastructure for other purposes.

11.2.2.4 Government Revenue

Short-term increases in government revenue would result from taxes on direct and indirect project-related spending during construction, and from the harvest of the existing stock of privately owned timber in and near the existing and new right-of-way, substations, and access roads. Additional short-term increases in revenue to state trusts would occur if the project results in the harvest of timber from trust lands that otherwise would not be harvested until later. Some of the timber-related increase would be offset if state and private timberland managers decided to reduce harvest on other lands.

The project could cause long-term decreases in government revenue by diminishing the base value of property subject to property taxation, reducing future timber-related revenue from state trust lands, and decreasing future revenue from taxes on private timber harvests and some agricultural products.

Overall, the project-related spending during construction and maintenance would have **no** adverse impact on tax revenue for Cowlitz, Clark, and Multnomah counties. The long-term decrease in timber-harvest tax revenue during operation may, in some years, exceed either Cowlitz or Clark county average annual compensation cost per one employee and have a **high** impact on the two counties.

Tax Revenue from Project-Related Spending

As a federal government agency, BPA is exempt from taxes on project-related expenditures. Its contractors are not exempt, and would pay applicable taxes on project-related purchases. These direct expenditures and subsequent spending of project-related earnings by workers and contractors would create short-term, indirect increases in revenue for Oregon, Washington, and the counties and local jurisdictions in the project area, from several sources: sales and use taxes (in Washington), income taxes (in Oregon), lodging tax, timber harvest tax, property tax, fuel tax, and real estate excise tax. It is expected that the contractor would pay property owners a rental fee to use their land for staging areas and helicopter fly yards for the entire construction period.

Sales and Use Tax

Washington would assess sales or use taxes on materials purchased for the project. Whether it assesses sales or use tax would depend on where the materials are purchased (in Washington or another state), who purchases them (BPA on behalf of a project contractor, or directly by project contractors), and where the materials are installed (in Washington or Oregon). Assuming sales or use taxes are paid on the full cost of the project's materials, which BPA currently estimates at about $100 million, Washington would collect sales and use taxes on project materials of about $8 million. This amounts to about 0.1 percent of the total sales and use tax collections in Washington in 2014.

Workers who spend personal income earned from the project on goods and services they purchase in Washington would also pay sales taxes. BPA expects to spend about $88 million on wages and benefits for contract workers. Assuming that most of the workers on the project from within the region come from Washington and spend all of their income in Washington, and workers from outside the region spend half of their income in Washington, sales tax collections directly stemming from workers' spending would be about $4.3 million over the life of the

project. This amounts to about 0.05 percent of the total sales and use tax collections in Washington in 2014.

The project would preclude the production of some agricultural crops, such as nursery stock and Christmas trees, which are subject to sales and use tax if sold retail in Washington. If all these crops are sold in Washington and none are exported, the value of retail sales tax that would have been collected except for this project (using the West Alternative, where the largest impact would occur), would be about $2 million, or about 0.025 percent of total sales and use tax collections in Washington in 2014. If 10 percent of Christmas trees were sold in Washington (Pacific Northwest Christmas Tree Association 2012), actual lost sales tax revenue for trees would be about $29,000. Adding this amount to lost tax revenue from nursery stock (assuming all stock is sold locally which is unlikely) would be about $1.3 million. Of this amount, for the West Alternative, about $300,000 would be lost tax revenue to local governments (around $6,000 for the Central and Crossover alternatives, and about $2,000 for the East Alternative) and the rest to the state. Other crops affected by the project, regardless of the action alternative, such as blueberries, are food crops (including hay used as animal feed) meant for human consumption, and are not subject to the sales and use tax.

Income Tax

Workers living in Oregon and non-residents working in Oregon who meet minimum Oregon-earned income thresholds would pay Oregon income taxes. The amount of income tax collected from this project would depend on the number of workers from Oregon and the amount of project-related labor income earned in Oregon. Assuming all workers from the region were from Oregon and 25 percent of the non-resident workers' income was earned and taxable in Oregon, the project would cause $3.2 million in income tax for Oregon over the life of the project. This amounts to about 0.02 percent of the total personal income-tax collected in 2013. To the extent that corporations working on the project pay income taxes in Oregon and business and occupation (B&O) taxes in Washington, the amount of tax collections would be somewhat higher, although the amount of corporate income or gross receipts that would be attributable to the project is difficult to determine, given available information. Businesses in Washington involved in retailing, wholesaling, or manufacturing agricultural products may pay less B&O tax each year if the reduction in crop production reduces their gross receipts. Similarly, businesses involved in retailing, wholesaling, or manufacturing timber products may pay more or less B&O tax if the project increases or decreases their gross receipts.

Lodging Tax

Workers who stay in temporary lodging in Oregon or Washington would pay lodging taxes. Assuming all non-resident workers seek temporary housing in hotels in Cowlitz and Clark counties during the work week (5 days) for the duration of the project (18 months), and the average rate paid is $50 per night, about $67,500 in lodging tax would be collected over the life of the project. This amounts to about 4 percent of the total lodging tax collected in Clark and Cowlitz counties in 2014.

Timber Harvest Tax

The project may cause a short-term, direct increase in the timber-harvest tax revenue of affected counties and the state government in Washington by triggering harvest of the existing mature timber stock on private lands in and near the new right-of-way, and for the substations

and access roads. Depending on economic feasibility, either the grower/landowner would harvest the timber themselves, or, BPA would harvest the timber after an appraisal is completed and an easement is negotiated and secured. Harvest of existing mature timber stock on existing BPA right-of-way would likely not contribute to an increase in tax revenue as this timber may be owned outright by BPA through fee-owned title or owned by BPA as reflected in existing easement language. As a federal agency, BPA does not pay taxes and there would be no timber-harvest tax revenue generated in these cases.

Any increases in revenue would be offset if, because of the unplanned harvest on the cleared lands, landowners decide not to harvest trees on other lands. The project would create a long-term decrease in timber-harvest tax revenue by precluding future timber production on these lands, except for timber harvested as danger trees or for pulling and tensioning sites, where trees would be allowed to grow back. The short-term, direct increase and the long-term direct decrease in tax revenue for each action alternative are presented in Sections 11.2.3 through 11.2.7.

Property Tax

BPA would acquire land rights (easements) from private property owners for constructing, operating, and maintaining the transmission line and access roads. The property owner would retain ownership of the property and continue to pay property tax on the entire parcel, including the land within BPA's easement. BPA would purchase property for its substations (and possibly substation access roads) in Cowlitz and Multnomah counties. Federal and state agencies are exempt from paying local property taxes, so the counties would not collect property taxes on the property acquired in fee for the substation and substation access roads.

Direct decreases in property taxes would occur for properties BPA acquires and removes from the tax rolls. The value of property tax collections to Cowlitz County for the Baxter Creek substation site was $1,109 in 2014. The value of collections to Cowlitz County for the Monahan Creek substation site (both parcels combined) was $1,529 in 2014. Additional decreases in property taxes may occur if county assessors lower the assessed value of a property in response to BPA securing an easement that constrains use of the property (severance, loss of use, etc.). Indirect decreases in property taxes could occur for nearby residential properties if assessors reduce the assessed value of a property in response to a project-related reduction in the quality of amenities or income-generating potential of the site (for commercial properties). BPA has not been presented with any evidence on previous projects that this has occurred. Increases in property tax collections may occur if agricultural or timberland currently assessed under Washington's Current Use Special Valuation (CUSV) program is reassessed as non-productive and ineligible for tax exemptions under the CUSV program.

Data are insufficient to determine how much property may be subject to any of these types of reassessment, or what the net effect on property tax collections would be. Property tax reductions would occur if the project reduces the market value below the current assessed value, and the county reassessed the property. In 2010, the Clark County Assessor's office completed a study that specifically considered whether property values had been affected along potential route segments for the I-5 Project as a result of BPA's announcement that these route segments were being considered for the proposed project. Based on 2009 property sales data, this study found that no significant impact on market values from the consideration of these route segments for the proposed project had occurred. The 2009 sale prices appeared higher than the assessed value for the majority of transactions. Clark County recognized this data as an

indicator that the proposed project had not affected property sales and that adjustments to property value based on a property's potential proximity to the project would not be needed (Clark County Assessor's Office 2010).

Available data are insufficient to fully quantify the impacts, but even if the project impacted the value of some properties as described below in Section 12.2.2.5, Property Values, the project's overall impact on property tax revenues likely would be too small to have a discernible effect, relative to the influence of other factors, such as population and economic growth, and new development, and given that the area directly affected by the project is small compared to the total area of the affected counties (for more discussion of the project's potential impact on property values, see Section 11.2.2.5, Property Values).

Fuel Tax

Undoubtedly some amount of tax would be collected from fuel consumption. The amount attributable to the project would depend on consumption and future fuel prices at the time of consumption; the actual amount cannot be reliably estimated from the data that is currently available.

Real-Estate Excise Tax

The value of compensation paid to private landowners in Washington for easements and land purchased for the project would be subject to Washington's real estate excise tax (WAC 458-61A-111) unless the property is taken under condemnation or the imminent threat of condemnation. The amount of tax collected would vary depending on the amount of compensation negotiated for land and easements and their location.

Revenue from Washington State Trust Lands

WDNR manages state trust lands to provide revenue for several trusts, primarily by producing timber. The project may create a short-term increase in the trusts' revenue from these lands by triggering the harvest of existing mature timber stock in and adjacent to new right-of-way and on any lands that would be occupied by a substation or access roads. Harvest of existing timber stock on existing right-of-way would likely not contribute to an increase in revenue for state trusts because this timber may be owned outright by BPA through fee-owned title or owned by BPA as reflected in the existing easement language.

The value of short-term increases in government revenue for each action alternative and substation site is quantified in Sections 11.2.3 through 11.2.7. Several assumptions are used to quantify the value of the trees that would be removed for construction of the project:

- The number of acres of timber managed by WDNR that would intersect with the proposed right-of-way, access roads, and substation sites (based on GIS analysis)
- The average volume of timber per acre, specific to WDNR-managed land in Clark and Cowlitz counties: 5,144.7 cubic feet per acre (U.S. Forest Service 2014)
- The percent of volume sold as merchantable timber, on average from public lands: 80 percent
- Value per MBF based on the stumpage price for Washington WDNR-managed timber sold in 2014: $363.74/MBF (WDNR 2014b)

An additional, but currently unknown, number of trees would be cut adjacent to the right-of-way for safety purposes (danger trees) temporary access roads, staging areas, helicopter fly yards, and pulling and tensioning sites. This additional harvest would increase short-term revenue somewhat beyond the values reported in Sections 11.2.3 through 11.2.7. Any increase in revenue would be offset if WDNR decided to reduce harvest on other lands in response to the project-related harvest, but the extent of the offset is unknown. Additional revenue would come from BPA's payment of compensation for any state trust lands acquired for the project or for the easements themselves on trust lands. The appraisal process would also consider whether the transmission facilities would diminish the utility of a portion of the timberland property if the line effectively severs this area from the remaining property (severance damage).

The project would create long-term decreases in government revenue generated from state trust lands in three ways:

- Elimination or reduction of timber production on WDNR-managed timberlands that would be cleared in or next to the new right-of-way or for the substations and access roads
- Increase in the costs of managing WDNR-managed timberland near the new right-of-way, resulting, for example, from project-related restrictions on timber-harvest techniques, such as cable logging, or increases in risks to safety from logging near the right-of-way, the need for setback and offset distances of guy line cables to the right-of-way, and a potential for reconstructing existing landings outside of the right-of-way due to harvest restriction
- Reduction in the ability of WDNR managers to generate additional types of revenue, such as from growing trees to sequester carbon, on the cleared lands

The long-term decreases in government revenue for each action alternative, related to the impacts described in the first bullet above, are quantified in Sections 11.2.3 through 11.2.7. Measuring the impact requires converting the future impacts on timber-harvest revenue to an equivalent, single number, called the present value. This is done by calculating a perpetual annuity (which assumes timber would be harvested on rotation indefinitely). The perpetual annuity assumes average annual revenue per acre per year of about $234, based on these assumptions:

- The number of acres of timber managed by WDNR that would intersect with the proposed right-of-way, access roads, and substation sites, where trees would not be allowed to grow after construction is complete (based on GIS analysis)
- The average volume of timber per acre, specific to WDNR-managed land in Clark and Cowlitz counties: 5,144.7 cubic feet per acre (U.S. Forest Service 2014)
- The allowable annual harvest per acre, using Von Mantel's formula for calculating the sustained annual yield, assuming a rotation length of 80 years (5,144.7/(80/2)): 128.62
- Value per MBF, based on the stumpage price for Washington WDNR-managed timber sold in 2014 (assuming a constant price in real terms over time): $363.74/MBF (WDNR 2014b)
- A discount rate of 4 percent per year (Row, Kaiser and Sessions 1981)

These assumptions result in a calculated present value of a perpetual annuity of about $5,848 per acre. Data are unavailable to quantify the decrease in government revenue from the impacts associated with increased logging and management costs for land adjacent to the project, or management goals other than harvest. To the extent that each of these impacts occurs, potential mitigation for the decrease in government revenue is discussed in Section 11.2.8, Recommended Mitigation Measures.

The project likely would have **no** impact on the price of timber in regional markets because of offsetting changes from other timberland owners, although it may decrease the price at the local level temporarily during construction (a **low** impact). The response of other landowners would extend the actual impacts to a broader region than just locally. The decrease in revenue during operation may, in some years, exceed either Cowlitz or Clark county's average compensation cost per employee and have a **high** impact on the two counties.

11.2.2.5 Property Values

The proposed transmission line is not expected to have long-term impacts on property values in the area for a variety of reasons. Whenever land uses change, the concern is often raised about the effect the change may have on property values nearby. Zoning and permits are the primary means by which most local governments protect property values. By restricting some uses, or permitting them only under certain conditions, conflicting uses are avoided. Some residents consider transmission lines to be an incompatible use adjacent to residential areas. Nonetheless, the presence of transmission lines in residential areas is fairly common.

Appraisals conducted by licensed appraisers are the mechanism used to estimate property values. Factors such as size, amenities, condition and the selling price of comparable properties are generally used for such appraisals.

The question of whether nearby transmission lines can affect residential property values has been studied many times in the United States and Canada over the last 20 years or so, with mixed results. In the 1990s, BPA contributed to the research when it looked at the sale of 296 pairs of residential properties in the Portland, Oregon and Vancouver, Washington, metropolitan areas and in King County, Washington. The study evaluated subject properties adjoining 16 BPA high-voltage transmission lines (115-500 kV) and compared them with similar comparable property sales located away from transmission lines. All sales were in 1990 and 1991. Study results showed that the subjects in King County were worth about 1 percent less than their matched comparable sales, and the Portland/Vancouver area subjects were worth 1.46 percent more to 1.05 percent less (Cowger and Bottemiller 1996).

BPA updated this study in 2000 using 1994 to 1995 sales data, reviewing the sales of 260 pairs of residential properties in the King County and Portland/Vancouver metropolitan areas. The residential sales analysis identified a small but negative impact of from 0 to 2 percent for those properties adjacent to the transmission lines as compared to those where no transmission lines were present. Although this study identified a negative effect, the results are similar to the earlier study and the differences are relatively small (Bottemiller, et al. 2000). In 2003, the Appraisal Journal published a BPA article titled, "Further Analysis of Transmission Line Impact on Residential Property Values" (Wolverton and Bottemiller 2003). This article concluded that the data did not support a finding of a price effect on properties abutting high voltage transmission line rights-of-way.

Other studies include "High-Voltage Transmission Lines: Proximity, Visibility, and Encumbrances Effects," by James Chalmers and Frank Voorvaart, published in The Appraisal Journal in 2009. This article concluded that half of the major studies evaluating property value effects from high voltage lines found no effect; the other half found property value declines of 3 to 6 percent, generally not beyond 200 to 300 feet from the lines, with declines dissipating over time.

BPA re-examined the potential impact of transmission lines on residential property values in urban areas. Based on a study of home sales between 2005 to 2007 (on homes sold adjacent to high voltage lines [115-500 kV] and comparable homes sold away from lines), the finalized findings for the new study in the Portland area (including Clark County, Washington, and Clackamas and Washington counties, Oregon) indicate declines in the overall average residential property values ($291,122) of 1.65 percent. The Seattle metro area (King County, Washington) in the new study indicated a decline of 2.43 percent in the overall average priced home. However, higher-priced homes in the Seattle study with average selling prices of $1,035,105 indicated a decline of 11.23 percent (Bottemiller 2012). The Seattle study, after the higher-priced homes were removed, indicated a decline in the average priced home ($366,866) of 0.64 percent.

For rural areas, a 2010 study involved several hundred sales of rural land in various locations across central Wisconsin that considered the placement of the easement across the tract (Jackson 2010). Four location categories were used: middle, edge, clipping, and diagonal. The results indicated that property sales diminished by about 4 percent for the middle pattern and 2 percent for the diagonal pattern. No diminished property value was observed for either the edge or clipping pattern sales. An Appraisal Journal article in the Winter 2012 edition entitled "High-voltage Transmission Lines and Rural, Western Real Estate Values," authored by James A. Chalmers, concluded "The research reported here is certainly consistent with the findings in the published literature that property value effects cannot be presumed and are generally infrequent."

Studies of impacts during periods of physical change, such as new transmission line construction, generally have revealed greater short-term than long-term impacts. However, most studies have concluded that other factors, such as general location, size of property, improvements, condition, amenities, and supply and demand factors in a specific market area are far more important criteria than the presence or absence of transmission lines in determining the value of residential real estate. The Clark County Assessor's office study conducted in 2010, referenced above, tends to support this conclusion.

The new transmission line would cross over or near current and potential future residential areas depending on the alternative (see Chapter 5, Land). A temporary decrease in property values (and salability) might occur on an individual basis as a result of the new transmission line for these and potentially for nearby properties along the action alternatives. However, these decreases would be highly variable, individualized, and unpredictable. Constructing the transmission line is expected to have **no** appreciably measurable impact on long-term residential property values along the action alternatives or in the general vicinity. Non-project impacts, along with other general market factors, are already reflected in the market value of properties in the area.

Timberlands cleared in or near the right-of-way that remain cleared and unable to produce timber would decrease in value because growing timber for production and revenue would be prohibited. In addition, if the right-of-way crossed in an orientation that separates a portion of

a parcel from another and it cannot be used as before (e.g., a "stranded [or severed] use"), the value of the whole parcel could be diminished. BPA would provide compensation to the owners of property BPA acquires or for which it secures an easement, or for other properties where the project would impair the owner's reasonable use of the property. BPA would pay market value to nonfederal landowners established through the appraisal process for any new land rights required for this project. The appraisal process takes all factors affecting value into consideration, including the impact of transmission lines on property value. The appraisals may reference studies conducted on similar properties to support their conclusions. The strength of any appraisal depends on the individual analysis of the property, using neighborhood-specific market data to determine market value. Current sales at the time of appraisal reflecting economic conditions present in the market place at that time would be used, creating an appraisal that reflects appropriate value trends. Compensation for removing vegetation for new rights-of-way would be determined through the appraisal process for the new easement. For existing BPA rights-of-way, BPA would not pay for trees if they are already owned by BPA either through fee-owned title or through the existing easement. Payment for trees off the existing right-of-way, for example, danger trees, would depend on the terms of the existing easement.

Where BPA needs to acquire easements for additional access roads, and the landowner is the only other user, market compensation is generally 50 percent of the road's full fee value. If other landowners share the access road, compensation is usually something less than 50 percent. For fully improved roads, the appraiser prepares an appraisal of the easement reflecting the current improved condition of the road together with the land value beneath the road. If BPA acquires an easement for the right to construct a new access road and the landowner has equal benefit and need of the access road, market compensation is generally 50 percent of full fee value of the land; if the landowner has little or no use for the new access road to be constructed, market compensation for the easement is generally close to full fee value of the land.

BPA projects rarely require relocating residents, businesses, or farm operations. Occasionally, personal property such as farm equipment or stored materials must be moved. Reasonable and necessary expenses for relocation of these items are fully reimbursable, unless the appraiser deems these items to be realty and compensated for in the property appraisal. BPA ensures that the landowner is fully informed of the relocation process if it appears that relocation would be necessary. The Federal Highway Administration's brochure entitled "Your Rights and Benefits as a Displaced Person," is available at the following website:
http://www.fhwa.dot.gov/real_estate/publications/rights/

The Uniform Relocation Assistance and Real Property Acquisition Policies Act calls for fair and equitable treatment of those whose real property would be acquired or who would be displaced as a result of the project. In general, the act limits BPA to paying compensation equal to the fair market value of land purchased for the project or for the diminution in fair market value resulting from an easement or impairment of use. BPA may pay more than fair market value for a residential property if its current market value is less than the sum of mortgage and related debt the owner owes on it. That is, BPA would take into consideration current economic conditions. BPA would not pay compensation to owners of other property, such as residences outside but near the right-of-way, if they should experience a decline in market value.

BPA considers condemnation (exercising the power of eminent domain) as a last resort, and avoids using it as much as possible. BPA's standard practice is to negotiate a mutually acceptable purchase agreement for new easements from landowners for the land rights needed

for the transmission lines, access roads, and substations. If, after good faith negotiations, BPA and a landowner are unable to agree on terms of a purchase, BPA would ask the U.S. Department of Justice to begin condemnation proceedings in the U.S. District Court on its behalf. A landowner may request that the condemnation process be used if they are unwilling to negotiate. In very limited cases, adjustments to right-of-way location may be made or feasible alternative means of access may be found.

11.2.2.6 Agricultural Production

The project would create short-term and long-term decreases in revenue farmers earn from agricultural production on lands directly affected by the project, if such production were prohibited. The decrease may be offset if a farmer is allowed to grow a substitute, less-profitable crop, but insufficient information exists to determine the size of this offset.

Construction of towers and access roads would permanently remove land from agricultural production. Operation of the new line may permanently restrict landowners' option to grow certain crops on the right-of-way. For agricultural land within existing BPA easements, the landowners may be able to reserve the right to grow and maintain non-woody, low-growing plants, such as annual row crops or vegetative cover that do not require structural support. For the purpose of this analysis, production of hay and silage, strawberries, and some nursery crops could be allowed within the right-of-way. Blueberries, grapes, and Christmas trees would not be allowed. If landowners desire to grow woody plants, structure-supported crops, or generally incompatible vegetation on an existing BPA right-of-way, they would need to contact BPA and secure a written agreement allowing such use if BPA determines that such use is safe and does not, or would not, cause any interference with the safe operation of the lines. The landowner would be restricted from planting any agricultural crops or vegetative cover including trees, shrubs, brush, or other vegetation covered by the reservation or written agreement within a 50-foot radius of all poles and towers.

Construction and maintenance of the project could cause crop damage, a temporary impact. BPA would assess and pay for any damage it caused according to the easement agreement. Typically there is little decrease in productivity or increase in management costs on agricultural land next to towers and access roads, or within the right-of-way for crops that are allowed to remain. If it were necessary to modify an irrigation system due to the construction of the transmission facilities, the appraisal process would include an estimate of the cost. If the landowner has reserved rights or entered into an agreement with BPA to grow crops within the right-of-way, the landowner would be responsible for the control of noxious weeds within the right-of-way if these weeds were not introduced by project construction. BPA does not conduct aerial spraying of herbicides, so drift is not an issue for agricultural production on land next to the right-of-way.

The project likely would have **no** impact on the overall demand, supply, or price of crops in the regional agricultural markets, although noticeable, but **low** impacts may occur if the affected lands would have produced solely for a niche market, such as locally grown, organic produce. Affected farmers may feel that the impact on their operations is larger, relative to the scale of their operations, than the overall market impact.

The short-term losses of production during construction activities and long-term decreases in revenue from agricultural land permanently removed from production for each action alternative are quantified in Sections 11.2.3 through 11.2.7. The analysis of long-term losses

assumes that the crop currently grown in the right-of-way would have been grown in perpetuity, and annual revenues are discounted at an annual rate of about 1.4 percent (U.S. Office of Management and Budget 2015). Potential tax impacts from revenue changes are discussed in Section 11.2.2.4, Government Revenue.

11.2.2.7 Private and Public Non-WDNR Timber Production

The project may create a short-term increase and a long-term decrease in the revenue derived from timber production on private land and public land owned by local governments (City of Camas) for timber production. The short-term increase may occur if existing mature timber that otherwise would continue to grow would, instead, be harvested on lands that would be cleared in or adjacent to new right-of-way and on any lands that would be occupied by a substation or access roads. This would likely be the case where it is economically feasible for large commercial growers to harvest the timber themselves. For growers with smaller holdings, it may not be feasible to harvest the timber themselves; in this case, BPA would harvest the timber after an appraisal is completed and an easement is negotiated and secured. Landowners in this situation would experience increased revenue from BPA's payment rather than through direct timber harvest. Harvest of existing timber stock on existing right-of-way would likely not contribute to an increase in revenue for the landowner because this timber may be owned outright by BPA through fee-owned title or owned by BPA as reflected in existing easement language.

The values of short-term increases in revenue for each action alternative are quantified in Sections 11.2.3 through 11.2.7. Several assumptions are used to quantify the value of the trees that would be removed for construction of the project:

- The number of acres of timber by landowner that would intersect with the proposed right-of-way, access roads, and substation sites (based on GIS analysis)
- The average volume of timber per acre, specific to public or private land in Clark and Cowlitz counties: 5,144.7 cubic feet per acre for public land and 3,305.6 cubic feet per acre for private land (U.S. Forest Service 2014)
- The percent of volume sold as merchantable timber, on average from public lands and private lands: 80 percent and 45 percent, respectively
- Value per MBF, based on the stumpage price for Washington WDNR-managed timber sold in 2014: $363.74/MBF (WDNR 2014b)

An additional, but currently unknown, number of trees would be cut adjacent to the right-of-way for safety purposes (danger trees), temporary access roads, staging areas, helicopter fly yards, and pulling and tensioning sites. This additional harvest would increase short-term revenue somewhat beyond the values reported in Sections 11.2.3 through 11.2.7. Any short-term increases in revenue could be offset if, because of the unplanned harvest on the cleared lands, landowners decide not to harvest trees on other lands. Additional revenue would come from BPA's payment of compensation for any lands acquired for the project or for the easements themselves on private or public timberlands. The appraisal process would also consider whether the transmission facilities would diminish the utility of a portion of the timberland property if the line effectively severs this area from the remaining property (severance damage).

The project would create long-term decreases in revenue derived from timber production in three ways:

- Elimination or reduction of timber production on private or public timberlands lands that would be cleared in or next to the new right-of-way or for the substations and access roads
- Increase in the costs of managing private or public timberland near the new right-of-way, resulting, for example, from project-related restrictions on timber-harvest techniques, such as cable logging, greater risks to safety from logging near the right-of-way, the need for setback and offset distances of guy line cables to the right-of-way corridor, and a potential for reconstructing existing landings outside of the right-of-way due to harvest restriction
- Elimination or reduction of the potential to generate non-harvest related revenue (e.g., payments for ecosystem services, such as carbon sequestration or habitat protection) on private timberlands that would be cleared in or next to the new right-of-way or for the substations and access roads

The long-term decreases in revenue for each action alternative, related to the impacts described in the first bullet above, are quantified in Sections 11.2.3 through 11.2.7. Measuring the impact entails converting the future impacts on timber-harvest revenue to an equivalent, single number, called the present value. This is done by calculating a perpetual annuity (which assumes timber would be harvested on rotation indefinitely). The perpetual annuity assumes average annual revenue per acre per year of about $234 for public timberlands and $301 for private timberlands, based on these assumptions:

- The number of acres of timber owned by public and private landowners that would intersect with the proposed right-of-way, access roads, and substation sites, where trees would not be allowed to grow after construction is complete (based on GIS analysis)
- The average volume of timber per acre, specific to public or private land in Clark and Cowlitz counties: 5,144.7 cubic feet per acre for public land and 3,305.6 cubic feet per acre for private land (U.S. Forest Service 2014)
- The allowable annual harvest per acre, using Von Mantel's formula for calculating the sustained annual yield, assuming a rotation length of 80 years for public and 40 years for private timberlands (inventory per acre divided by rotation length/2): 128.62 and 165.28, respectively
- Value per MBF, based on the stumpage price for Washington WDNR-managed timber sold in 2014 (assuming a constant price in real terms over time): $363.74/MBF (WDNR 2014b)
- A discount rate of 4 percent per year (Row, Kaiser and Sessions 1981)

These assumptions result in a calculated present value (as a perpetual annuity) of about $5,848 per acre for public timberlands and $7,515 per acre for private timberlands. The decrease in revenue is reported for the acres of trees within right-of-way newly acquired for this project. For existing right-of-way, BPA likely has already negotiated compensation for forgone future revenue from timber production. Data are unavailable to quantify the decrease in government revenue from the impacts associated with increased logging and management costs for land

adjacent to the project, or management goals other than harvest. To the extent that each of these impacts occurs, potential mitigation for the decrease in government revenue is discussed in Section 11.2.8, Recommended Mitigation Measures.

The project likely would have **no** impact on the price of timber in regional markets, although it may decrease the price at the local level temporarily during construction (a **low** impact). Actual impact would depend not just on the project's direct impact on the timber-harvest level, but also on the extent to which forest landowners adjust harvest on other lands in response.

11.2.2.8 Community Values

BPA received many comments about the potential effects the project could have on existing quality of life and other values. The following sections evaluate how the alternatives could generally affect people who hold these values.

Quality of Life

The project could affect the well-being of residents by altering the supply of amenities, such as cohesive neighborhoods and the natural environment, that reflect the area's social capital (productive relationships among individuals and entities) and natural capital (the natural environment). The project, itself a form of human-built capital, could directly affect the level of social capital and natural capital in the project area. The project could create long-term increases in well-being, for example, if it increases the value of amenities, such as by promoting greater goodwill among citizens having an interest in the project. It could cause long-term decreases in well-being, for example, if it generates discord between individuals with different views about the project's desirability.

Property-Related Amenities

The project would cause short-term decreases in the value of amenities, such as peace and quiet, for residents that would be affected by increased noise, traffic, and other aspects of construction. It would cause long-term decreases in the value of amenities, such as being close to forested open space and far from industrialized lands, for residents of properties near the transmission line, substations, and access roads.

Public Health and Safety

The project could create a short-term decrease in the economic well-being of workers or others who experience a project-related illness or accident during the construction period. Fatalities or chronic conditions from project-related illnesses and accidents could cause long-term decreases in well-being for construction workers and their families. Industry-wide illness and fatality rates suggest workers could experience about nine injuries, one illness, and a small chance of a fatality directly from working on the project during the year with the peak level of activity, with lower levels during periods with less intense activity (U.S. Department of Labor, Bureau of Labor Statistics 2009). The public could experience accidental injuries or deaths during construction and operation of the transmission line and substations. The economic costs of injuries, illnesses, and deaths could be large to individuals and their families, but likely would not have a discernible effect on the overall value of safety and health for the public.

The project would create a long-term decrease in the well-being of landowners, residents, workers, and visitors who perceive that the project would expose them to higher risks from EMF, electrocution, and project-related accidents.

Recreation and Tourism

The project would cause a short-term, temporary decrease in the value of recreational activities on affected lands and waters as construction displaces or interferes with recreation. It would cause a long-term, permanent increase in the value some people derive from recreational activities where new or improved access roads enhance accessibility or other qualities people desire (e.g., improved visibility or hunting quality from clearings). The project would cause a long-term permanent decrease in the value some people derive from recreational activities if the project diminishes accessibility, visual aesthetics, sense of solitude, or other characteristics people desire or currently enjoy (see Chapter 6, Recreation).

Changes in the value of recreational opportunities resulting from the project would affect the behavior of recreationists, who likely would make fewer visits to areas they perceive as having lower value and more visits to areas they perceive as having higher value. Where the right-of-way and access roads would cross forest habitat, for example, wildlife watchers may make fewer trips to see species that depend on nonfragmented forest and more trips to see those that prefer forest edges. The changes in behavior may occur entirely within the project area or they may extend beyond its boundaries. In response to any reduction in the value of hiking opportunities in the area, for example, some hikers might decide to go hiking on other unaffected trails within the project area, or choose to travel to trails outside of the project area. To the extent that the project's effects on recreation resources lead recreationists to alter their spending patterns, it would affect levels of sales, employment, and earnings in related businesses and government agencies that collect revenue from recreational fees and spending.

Natural Environment

The project would cause long-term decreases in the value of the benefit some people enjoy from the existence of the plants, animals, and other resources that the project would affect. Some impacts would occur through the reduced value of recreation and tourism, as described above. Additional decreases in value would occur from and via increased costs for taxpayers, landowners, and others to anticipate, monitor, and respond to impacts to the natural environment.

Transmission System Reliability

The project would create long-term increases in the contribution of BPA's transmission system to the economic well-being of electricity consumers. The project would allow BPA to meet its obligations to provide firm transmission service to its customers. By improving the reliability of electricity delivery in the region, the project would encourage businesses that need high-quality power to locate and invest in the area, which could provide jobs. Improved reliability would allow commercial, industrial, and residential consumers to avoid costs from power interruptions, such as a business losing revenues when it must cease production, residents losing food to spoilage, or police responding to accidents when traffic controls fail.

11.2.2.9 Environmental Justice

Evaluating whether a proposed action could have disproportionately high and adverse impacts on minority or low income populations typically involves: 1) identifying any potential high and adverse environmental or human health impacts, 2) identifying any minority or low income communities within the potential high and adverse impact areas, and 3) examining the spatial distribution of any minority or low income communities to determine if they would be disproportionately affected by these impacts.

Identified minority and low-income populations are described in Section 11.1.9, Environmental Justice. BPA completed the analysis of impacts to minority or low-income population groups with the following approach and assumptions:

- Impacts are considered disproportionate if they affect minority or low income populations at higher rates than respective county minority or low income populations. In other words, if the populations impacted by the project are reported as minority or low income at greater rates than county populations, those minority or low income populations are considered disproportionately impacted by the project. State data was also presented in Section 11.1.9, but the comparison to county-level data avoids the "masking" or "diluting" of the presence of minority and low income populations, per CEQ and EPA guidelines.
- Disproportionate impacts to minority or low income populations do not occur if there are no minority populations crossed by the project (as compared to county data).
- BPA did not evaluate level of impact if minority or low-income populations were identified, but were not disproportionately impacted by the project.

Using CEQ criteria, three minority populations in Cowlitz and Clark counties were identified out of the 80 block groups (representing 43 census tracts) crossed by the project. The spatial distribution and number of minority populations, compared with the entire project and affected block groups and counties, indicate these minority populations would not be disproportionately impacted by the project.

Overall, although five out of the 43 census tracts crossed by the project reported low-income populations in 2013, the median household incomes of these census tracts were higher than the respective county incomes, and poverty rates in these census tracts were lower than the county (and state) poverty rates. The spatial distribution of low-income census tracts, compared with the entire project and affected census tracts and counties, indicate these populations would not be disproportionately impacted by the project.

Because none of the action alternatives would have a disproportionate impact on identified minority or low-income populations, impact levels were not evaluated.

Environmental Justice, according to the EPA (2015c), is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that "no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, governmental, and commercial operations or policies." Meaningful involvement means that "people have an opportunity to participate in decisions about activities that may affect their environment and/or

health, the public's contribution can influence the regulatory agency's decision, public concerns will be considered in the decision making process, and the decision makers seek out and facilitate the involvement of those potentially affected."

To that end, BPA has considered all input from persons or groups regardless of race, income status, or other social and economic characteristics. Public scoping was held for the project and included an extended public comment period. Interested parties were encouraged to provide written comments on the Draft EIS via the project website, U.S. mail, or fax, and telephone (see Section 1.6, Public Involvement and Major Issues). All comments received were posted on the project website: http://www.bpa.gov/goto/i-5 and have been addressed in this Final EIS (see Volume 3, Comments and Responses).

BPA has engaged public stakeholders and potentially affected populations to incorporate the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income in the I-5 project area, in compliance with the goals and procedures of Executive Order 12898.

11.2.2.10 Sundial Substation Site

As discussed in Chapter 3 of this EIS, BPA is in the process of discussions with the Port of Portland to purchase Lots 11 and 12 within the Port's Troutdale Reynolds Industrial Park, in Multnomah County. BPA is interested in purchasing these lots for potential long-term transmission system needs, regardless of whether a decision is made to build the I-5 project. Either one of these two options could be used for the Sundial Substation. Since BPA is a federal agency, it does not pay property taxes to Multnomah County. Acquisition by BPA of Lots 11 and 12 would cause a long-term decrease in revenue to the county, a **moderate** impact, although it likely would not diminish the county's workforce and infrastructure.

11.2.3 Castle Rock Substation Sites

11.2.3.1 Casey Road

Impacts common to action alternatives are in Section 11.2.2. The remaining sections discuss impacts unique to each alternative, and recommended mitigation measures.

BPA would purchase the property for the Casey Road site and access road from the state of Washington through WDNR. WDNR manages the property for timber harvest and it also is classified as farmland of statewide importance. Portions of the property have been recently logged. Timber harvested from the site during construction would create a short-term increase of about $282,035 in timber-harvest revenue from state trust lands (see Section 11.2.2.4, Government Revenue, for assumptions). Logging this timber would produce revenues for the Scientific Schools Trust and State Forest Lands. Some of the increase would be offset if timberland managers decide to reduce harvest on other lands. Converting this property from state trust land to a substation site would cause a long-term decrease in state revenue from forgone future harvests with a total present value of $220,344 (see Section 11.2.2.4 for assumptions). The loss of future tax revenues from the site could have a **moderate** impact on Cowlitz County's ability to meet all demands for public services, although it would not diminish the county's workforce and infrastructure.

11.2.3.2 Baxter Road

BPA would purchase the property for the substation site and access road from Sierra Pacific Industries. The property is classified as farmland of statewide importance and is used for timber harvest. Sierra Pacific Industries paid $1,109 in property taxes for the parcel to Cowlitz County in 2014. This represented about 0.001 percent of total property tax collections in Cowlitz County in 2014. Because BPA would not pay property taxes once it acquires the property, the project would cause a long-term decrease in annual property tax collections in Cowlitz County.

During construction, timber harvests from clearing the site would increase timber-harvest tax revenue by about $5,000 for Cowlitz County and about $1,300 in state revenue. Precluding future timber harvests on the site during operation would cause a long-term decrease in state and county timber-harvest taxes, with a total present value of about $14,000 for Cowlitz County and about $3,500 for the state.

Timber harvests from clearing the site would also cause a short-term increase of about $127,718 in the revenue derived from timber production on private land (see Section 11.2.2.7, Private and Non-WDNR Public Timber Production, for assumptions). Some of the increase would be offset if timberland managers decide to reduce harvest on other lands. Converting the land from private timber production would cause a long-term decrease in revenue for Sierra Pacific Industries, with a present value of about $354,771 from forgone future timber harvests (see Section 11.2.2.7, Private and Non-WDNR Public Timber Production, for assumptions).

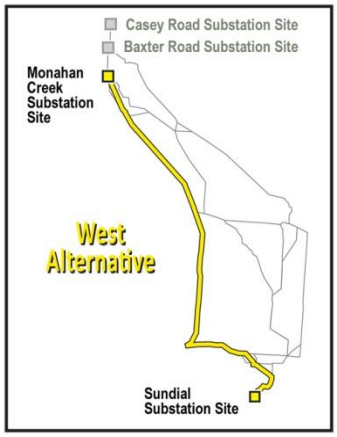
Loss of future tax revenues from the site could have a **moderate** impact on Cowlitz County's ability to meet all demands for public services, although it would not diminish the county's workforce and infrastructure. The change in timber production likely would have no impact on market prices for timber.

11.2.3.3 Monahan Creek

BPA would purchase the property for the substation and access road. The property is classified as farmland of statewide importance and prime farmland. Trees cover portions of the property; other portions are used for grazing. The landowners paid $1,529 in property taxes to Cowlitz County in 2014. This amount was about 0.001 percent of total property tax collections in Cowlitz County in 2014. Because BPA would not pay property taxes once it would acquire the property, the project would create a long-term decrease in annual property tax collections in Cowlitz County. The loss of future property tax revenues could have a **low** impact on Cowlitz County's ability to meet all demands for public services, although it would not diminish the county's workforce and infrastructure.

11.2.4 West Alternative and Options

The only socioeconomic factors that would vary under the West Alternative and its options are government revenue, agricultural production, and private timber production. This is also true of the other three alternatives and their options. Accordingly, the following discussions of the action alternatives focus on these three socioeconomic factors.

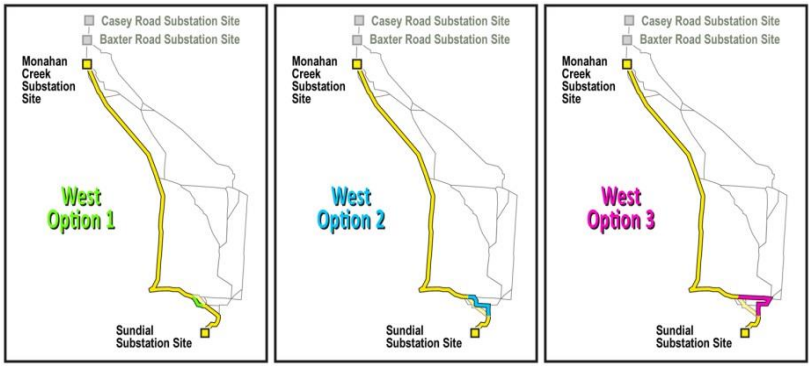


11.2.4.1 Government Revenue

The West Alternative would affect government revenue in Washington from state trust lands and from timber-harvest taxes.

Washington State Trust Land Revenue

During construction, the West Alternative would cause an increase of about $4,096 in timber-harvest revenue from state trust lands by triggering harvest of existing mature timber stock on lands cleared for the project (see Table 11-5).



Greater increases during construction would occur for West Option 3. Some of the increase would be offset if timberland managers decide to reduce harvest on other lands. The increase would be somewhat greater than the values calculated here if BPA needs to clear danger trees, or for temporary access roads, staging areas, helicopter fly yards, and pulling and tensioning sites. The actual increase could be greater or less than the total increase calculated here, depending on how actual conditions on the ground deviate from average and assumed conditions (see Section 11.2.2.4, Government Revenue, for assumptions). The short-term increase in revenue during construction is a small change (a fraction of a percent) compared to the annual statewide revenue for the trusts, which was $142 million in 2014.

Table 11-5 Value of Timber Cleared From State Trust Lands (in 2014 dollars)[1,2,3]

Alternatives and Options	Trust							Total
	Capitol Building	Insti-tutions[4]	Common School	Agri-cultural	Scientific School	State Forest Lands[5]		
						Clark	Cowlitz	
West Alternative	**$0**	**$0**	**$4,096**	**$0**	**$0**	**$0**	**$0**	**$4,096**
West Option 1	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
West Option 2	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
West Option 3	N/C	N/C	+$59,713	N/C	N/C	N/C	N/C	+$59,713
Central Alternative[6]	**$318,838 ($262,359)**	**$230,682 ($244,915)**	**$1,124,903 ($1,186,818)**	**$3,889 ($3,214)**	**$168,308 ($174,984)**	**$1,268,972 (1,468,396)**	**$209,500 ($209,599)**	**$3,325,092 ($3,550,284)**
Central Option 1[6]	N/C (N/C)	N/C (N/C)	+$67,933 (+$21,761)	+$16,586 (N/C)	+$48,283 (+$134,096)	N/C (N/C)	+$288,786 (+$292,499)	+$421,588 (+$448,356)
Central Option 2	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
Central Option 3	N/C	N/C	-$119,515	N/C	N/C	-$585,899	N/C	-$705,414
East Alternative	**$71,430**	**$0**	**$472,439**	**$0**	**$2,867**	**$530,748**	**$488,558**	**$1,566,043**
East Option 1	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
East Option 2	+$88,279	N/C	+$165,563	N/C	-$2,867	+$376,091	N/C	+$627,066
East Option 3	N/C	N/C	+$170,925	N/C	N/C	+$212,988	N/C	+$383,913
Crossover Alternative	**$71,430**	**$0**	**$827,650**	**$0**	**$84,618**	**$1,092,305**	**$209,599**	**$2,285,603**
Crossover Option 1	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
Crossover Option 2	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
Crossover Option 3	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C

Notes:

N/C – No net change from the action alternative

1. The value for each option represents the net change from the action alternative. It was calculated as the total value added by the option minus the total value in the segments the option replaces.
2. Calculated for timber that would be cleared from the right-of-way, substations, and access roads.
3. Totals may not sum due to rounding. See Section 11.2.2.4, Government Revenue, for assumptions used to quantify these values.
4. Includes charitable, educational, penal, and reformatory institutions.
5. Represents the revenue from timber harvests in Clark and Cowlitz counties; actual revenue impacts to the counties would vary depending on a variety of factors that are adjusted annually. In recent years, counties received about 70 percent of total harvest revenue from State Forest Lands.
6. Impact numbers not shown in parentheses reflect updated data, assumptions, and design refinements; impact numbers shown in parentheses reflect updated data and assumptions using the Draft EIS design.

Sources: BPA 2015; Corelogic 2015; Herrera 2010; Warren 2009; WDNR 2014a, 2014b

Over the life of the project, the West Alternative would decrease revenue from future timber harvests that would have occurred on land required for the project, with a net present value of about $3,200 (see Table 11-6). Greater decreases would occur with West Option 3. The impact would be slightly greater than the values calculated here if BPA continues to clear danger trees. The actual impact could be greater or less than the total increase calculated here, depending on how actual conditions on the ground deviate from average and assumed conditions (see Section 11.2.2.4, Government Revenue, for assumptions). On an annualized basis, the long-term decrease likely would be small, relative to the annual statewide timber sales for each trust.

The revenue reduction likely would have a **moderate** impact on Cowlitz County's ability to meet all demands for public services, although it would not diminish the county's workforce and infrastructure.

Table 11-6 Net Present Value of Revenue from Future Timber Harvests that Would Have Occurred on State Trust Lands but for the Project (in 2014 dollars)[1,2,3,4]

Alternatives and Options	Trust							Total
	Capitol Building	Insti-tutions[5]	Common School	Agri-cultural	Scientific School	State Forest Lands[6]		
						Clark	Cowlitz	
West Alternative	**$0**	**$0**	**$3,200**	**$0**	**$0**	**$0**	**$0**	**$3,200**
West Option 1	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
West Option 2	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
West Option 3	N/C	N/C	+$46,651	N/C	N/C	N/C	N/C	+$46,651
Central Alternative[7]	**$249,097 ($204,972)**	**$180,224 ($191,344)**	**$878,848 ($927,219)**	**$3,038 ($2,511)**	**$131,493 ($136,709)**	**$991,404 ($1,147,207)**	**$163,675 ($163,753)**	**$2,597,779 ($2,773,714)**
Central Option 1[7]	N/C (N/C)	N/C (N/C)	+$53,074 (+$17,001)	+$12,958 (N/C)	+$37,722 (+$104,764)	N/C (N/C)	+$225,618 (+$228,519)	+$329,372 (+$350,285)
Central Option 2	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
Central Option 3	N/C	N/C	-$93,373	N/C	N/C	-$457,742	N/C	-$551,115
East Alternative	**$55,806**	**$0**	**$369,100**	**$0**	**$2,240**	**$414,655**	**$381,693**	**$1,223,495**
East Option 1	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
East Option 2	+$68,969	N/C	+$129,349	N/C	-$2,240	+$293,827	N/C	+$489,905
East Option 3	N/C	N/C	+$133,538	N/C	N/C	+$166,400	N/C	+$299,938
Crossover Alternative	**$55,806**	**$0**	**$646,614**	**$0**	**$66,109**	**$853,380**	**$163,753**	**$1,785,662**
Crossover Option 1	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
Crossover Option 2	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
Crossover Option 3	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C

Notes:

N/C – No net change from the action alternative

1. The value for each option represents the net change from the action alternative. It was calculated as the total value added by the option minus the total value in the segments the option replaces.
2. Calculated for timber that would be cleared from the right-of-way, substations, and access roads.
3. Totals may not sum due to rounding. See Section 11.2.2.4, Government Revenue, for assumptions used to quantify these values.
4. Calculated in perpetuity.
5. Includes charitable, educational, penal, and reformatory institutions.
6. Represents the revenue from forgone timber harvests in Clark and Cowlitz counties; actual revenue impacts to the counties would vary depending on a variety of factors that are adjusted annually. In recent years, counties received about 70 percent of total harvest revenue from State Forest Lands.
7. Impact numbers not shown in parentheses reflect updated data, assumptions, and design refinements; impact numbers shown in parentheses reflect updated data and assumptions using the Draft EIS design.

Sources: BPA 2015; Corelogic 2015; Herrera 2010; Warren 2009; WDNR 2014a, 2014b

Tax Revenue from Private Timber Harvest

During construction, the West Alternative would cause an increase of about $24,932 (see Table 11-7) in the timber-harvest tax revenue of affected counties and the state government in Washington by triggering harvest of existing mature timber stock on private lands cleared for the project. This near-term increase would be the same with West Options 1 and 2, but larger with West Option 3. The West Alternative also would cause a long-term decrease in timber-harvest tax revenue during operation, by precluding future timber production on the cleared lands, with a total net present value of about $69,257 (see Table 11-8). This long-term decrease would be the same with West Options 1 and 2, but larger with West Option 3. The short-term increase and long-term decrease in timber-tax revenue would represent small changes compared to the annual tax-revenue collections from harvests in Clark and Cowlitz counties.

The revenue reduction likely would have a **moderate** impact on Cowlitz County's ability to meet all demands for public services, although it would not diminish the county's workforce and infrastructure. The change in timber production likely would have no impact on market prices for timber.

Table 11-7 Value of Tax Revenue from Timber Cleared from Private Timberlands (in 2014 dollars)[1,2,3]

Alternatives and Options	Tax Revenue Recipient			Total
	Cowlitz County	Clark County	State of Washington	
West Alternative	**$19,871**	**$0**	**$4,986**	**$24,932**
West Option 1	N/C	N/C	N/C	N/C
West Option 2	N/C	N/C	N/C	N/C
West Option 3	N/C	+$6,347	+$1,587	+$7,933
Central Alternative[4]	**$73,159 ($72,043)**	**$37,220 ($38,346)**	**$27,597 ($27,597)**	**$137,974 ($137,986)**
Central Option 1[4]	-$2,514 (-$2,250)	N/C (N/C)	-$628 (-$563)	-$3,142 (-$2,813)
Central Option 2	-$8,423	N/C	-$2,106	-$10,529
Central Option 3	-$537	-$12,923	-$3,365	-$16,825
East Alternative	**$91,999**	**$45,740**	**$34,435**	**$172,174**
East Option 1	-$9,426	N/C	-$2,356	-$11,782
East Option 2	N/C	-$9,287	-$2,322	-$11,608
East Option 3	N/C	-$1,397	-$349	-$1,746
Crossover Alternative	**$20,519**	**$52,976**	**$18,374**	**$91,868**
Crossover Option 1	N/C	N/C	N/C	N/C
Crossover Option 2	+$6,123	N/C	+$1,531	+$7,654
Crossover Option 3	+$10,543	N/C	+$2,636	+$13,179

Notes:
N/C – No net change from the action alternative
1. The value for each option represents the net change from the action alternative. It was calculated as the total value added by the option minus the total value in the segments the option replaces.
2. Calculated for timber that would be cleared from the right-of-way and access roads.
3. Totals may not sum due to rounding.
4. Impact numbers not shown in parentheses reflect updated data, assumptions, and design refinements; impact numbers shown in parentheses reflect updated data and assumptions using the Draft EIS design.
Sources: BPA 2015; Clark County 2015b; Corelogic 2015; Cowlitz County 2015b; Herrera 2010; Warren 2009; WDNR 2014a, 2014b

Table 11-8 Net Present Value of Tax Revenue From Future Timber Harvests that Would Have Occurred on Private Timberlands but for the Project (in 2014 dollars)[1,2,3,4]

Alternatives and Options	Tax Revenue Recipient			Total
	Cowlitz County	Clark County	State of Washington	
West Alternative	**$55,198**	**$208**	**$13,851**	**$69,257**
West Option 1	N/C	N/C	N/C	N/C
West Option 2	N/C	N/C	N/C	N/C
West Option 3	N/C	+$17,630	+$4,407	+$22,037
Central Alternative[5]	**$203,219 ($200,119)**	**$103,390 ($106,517)**	**$76,652 ($76,659)**	**$383,261 ($383,295)**
Central Option 1[5]	-$6,983 (-$6,250)	N/C (N/C)	-$1,746 (-$1,563)	-$8,729 (-$7,813)
Central Option 2	-$23,399	N/C	-$5,850	-$29,248
Central Option 3	-$1,492	-$35,897	-$9,347	-$46,736
East Alternative	**$255,553**	**$127,055**	**$95,652**	**$478,260**
East Option 1	-$26,183	N/C	-$6,546	-$32,728
East Option 2	N/C	-$25,796	-$6,449	-$32,245
East Option 3	N/C	-$3,881	-$970	-$4,851
Crossover Alternative	**$56,996**	**$147,156**	**$51,038**	**$255,190**
Crossover Option 1	N/C	N/C	N/C	N/C
Crossover Option 2	+$17,009	N/C	+$4,252	+$21,261
Crossover Option 3	+$29,286	N/C	+$7,322	+$36,608

Notes:

N/C – No net change from the action alternative

1. The value for each option represents the net change from the action alternative. It was calculated as the total value added by the option minus the total value in the segments the option replaces.
2. Calculated for timber that would be cleared from the right-of-way and access roads.
3. Totals may not sum due to rounding.
4. Calculated in perpetuity.
5. Impact numbers not shown in parentheses reflect updated data, assumptions, and design refinements; impact numbers shown in parentheses reflect updated data and assumptions using the Draft EIS design.

Sources: BPA 2015; Clark County 2015b; Corelogic 2015; Cowlitz County 2015b; Herrera 2010; Warren 2009; WDNR 2014a, 2014b

11.2.4.2 Agricultural Production

During construction, the West Alternative would cause a decrease in revenue of about $458,800 by removing crops both inside and outside of the right-of-way (see Table 11-9). Some of this removal would be temporary; for example, crops removed for a temporary access road across an agricultural field needed for access to the right-of-way. The decrease would be larger with West Options 1, 2, and 3. This represents a small proportion of the annual agricultural production revenues in Cowlitz, Clark, and Multnomah counties (about 0.3 percent of the revenue generated in 2012, in 2014 dollars). The decrease could be a greater proportion of agricultural revenue for individual landowners.

Over the life of the project, operation of the West Alternative would cause a decrease in revenue, with a net present value of about $4.5 million, by permanently eliminating landowners' ability to produce crops within the tower footprints (see Table 11-10). This long-term decrease

would be larger with West Options 1, 2 and 3. Landowners may not grow crops over 4 feet or crops requiring support structures within the entire right-of-way. Assuming landowners stop growing these crops in the right-of-way, the West Alternative would cause an additional long-term decrease in revenue, with a net present value of about $20.5 million (see Table 11-10). The decrease would be the same under all options. The long-term decrease would be small, relative to the annual value of agricultural production in Cowlitz, Clark, and Multnomah counties. The decrease could be proportionally more significant for an individual landowner.

The change in agricultural production likely would have **no** impact on regional prices for agricultural products. At the local level, impacts could be **low-to-moderate** if local prices for a particular product are affected by limited supply.

Table 11-9 Value of Crops Removed from Production During Construction (in 2014 dollars)[1,2,3,4]

Alternatives and Options	Type of Crop							Total
	Blue-berries	Christmas Trees	Field Corn	Grapes[5]	Hay/ Silage	Nursery Stock	Pasture	
West Alternative	**$0**	**$64,100**	**$0**	**$93,600**	**$6,200**	**$287,100**	**$7,700**	**$458,800**
West Option 1	N/C	N/C	N/C	N/C	+$60	N/C	+$30	+$90
West Option 2	N/C	N/C	N/C	N/C	-$820	N/C	+$1,300	+$400
West Option 3	N/C	N/C	N/C	N/C	-$520	N/C	+$740	+$200
Central Alternative[6]	**$0 ($0)**	**$100 ($2,300)**	**$1,270 ($21,000)**	**$0 ($0)**	**$400 ($1,100)**	**$0 ($0)**	**$900 ($900)**	**$2,700 ($25,300)**
Central Option 1[6]	N/C (N/C)	N/C (N/C)	N/C (N/C)	N/C (N/C)	N/C (N/C)	N/C (N/C)	N/C (N/C)	N/C (N/C)
Central Option 2	N/C	N/C	N/C	N/C	-$100	N/C	+$1,000	+$800
Central Option 3	+$35,000	N/C	N/C	N/C	+$500	N/C	+$300	+$35,900
East Alternative	**$0**	**$0**	**$21,000**	**$0**	**$1,000**	**$0**	**>$0**	**$22,000**
East Option 1	N/C	N/C	N/C	N/C	-$100	N/C	+$500	+400
East Option 2	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
East Option 3	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
Crossover Alternative	**$0**	**$2,300**	**$21,000**	**$0**	**$1,000**	**$0**	**$1,800**	**$26,000**
Crossover Option 1	N/C	N/C	-$700	N/C	+$1,800	N/C	+$1,400	+$2,500
Crossover Option 2	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
Crossover Option 3	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C

Notes:

N/C – No net change from the action alternative

1. The value for each option represents the net change from the action alternative. It was calculated as the total value added by the option minus the total value in the segments the option replaces.
2. Calculated for crops that would be cleared from the right-of-way and access roads.
3. Totals may not sum due to rounding.
4. Calculated in perpetuity.
5. Grapes are the crop produced on land the Washington State Department of Agriculture data classifies as a vineyard.
6. Impact numbers not shown in parentheses reflect updated data, assumptions, and design refinements; impact numbers shown in parentheses reflect updated data and assumptions using the Draft EIS design.

Sources: BPA 2015; Cross et al. 1991; Julian et al. 2011; Seavert and Horneck 2014; USDA NASS 2014a, 2014b; Washington State Department of Agriculture 2013

Table 11-10 Net Present Value of Revenue from Crops that Farmers Would Have Grown but for the Project (in 2014 dollars)[1,2,3]

Alternatives and Options	Type of Crop							Total
	Blue-berries	Christ-mas Trees	Field Corn	Grapes[4]	Hay/ Silage	Nursery Stock	Pasture	
Crops on Land that Would be Occupied by Tower Footprints and Access Roads within and outside Right-of-Way								
West Alternative	**$0**	**$564,000**	**$0**	**$1,012,000**	**$57,700**	**$2,780,000**	**$66,400**	**$4,480,000**
West Option 1	N/C	N/C	N/C	N/C	-$1,300	N/C	+$2,700	+$1,500
West Option 2	N/C	N/C	+$129,100	N/C	+$4,700	N/C	+$11,900	+$133,100
West Option 3	N/C	N/C	+$267,200	N/C	+$4,300	N/C	+$3,800	+$262,100
Central Alternative[6]	**$0 ($0)**	**$5,410 ($130,000)**	**$301,700 ($267,200)**	**$0 ($0)**	**$14,500 ($17,000)**	**$0 ($0)**	**$12,800 ($15,100)**	**$334,400 ($428,500)**
Central Option 1[6]	N/C (N/C)	N/C (N/C)	N/C (N/C)	N/C (N/C)	N/C (N/C)	N/C (N/C)	N/C (N/C)	N/C (N/C)
Central Option 2	N/C	N/C	N/C	N/C	-$4,400	N/C	+$4,300	-$100
Central Option 3	+$553,700	N/C	N/C	N/C	+$3,400	N/C	-$400	+$556,700
East Alternative	**$0**	**$0**	**$267,200**	**$0**	**$17,300**	**$0**	**$2,700**	**$287,200**
East Option 1	N/C	N/C	N/C	N/C	- $4,400	N/C	+$5,800	+ $1,440
East Option 2	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
East Option 3	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
Crossover Alternative	**$0**	**$130,200**	**$267,200**	**$0**	**$12,600**	**$0**	**$21,800**	**$110,000**
Crossover Option 1	N/C	N/C	-$37,800	N/C	+$11,500	N/C	+$14,400	-$11,900
Crossover Option 2	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
Crossover Option 3	N/C	N/C	N/C	N/C	N/C	N/C	N/C	N/C
Crops not Allowed in the Right-of-Way[5]								
West Alternative	**$0**	**$3,020,700**		**$4,218,800**		**$13,263,700**		**$20,502,500**
West Option 1	N/C	N/C		N/C		N/C		N/C
West Option 2	N/C	N/C		N/C		N/C		N/C
West Option 3	N/C	N/C		N/C		N/C		N/C
Central Alternative[6]	**$0 ($0)**	**$0 ($0)**		**$0 ($0)**		**$0 ($0)**		**$0 ($0)**
Central Option 1[6]	N/C (N/C)	N/C (N/C)		N/C (N/C)		N/C (N/C)		N/C (N/C)
Central Option 2	N/C	N/C		N/C		N/C		N/C
Central Option 3	+$1,330,200	N/C		N/C		N/C		+$1,330,200
East Alternative	**$0**	**$0**		**$0**		**$0**		**$0**
East Option 1	N/C	N/C		N/C		N/C		N/C
East Option 2	N/C	N/C		N/C		N/C		N/C
East Option 3	N/C	N/C		N/C		N/C		N/C

Alternatives and Options	Type of Crop							Total
	Blue-berries	Christ-mas Trees	Field Corn	Grapes[4]	Hay/ Silage	Nursery Stock	Pasture	
Crops not Allowed in the Right-of-Way[5]								
Crossover Alternative	**$0**	**$0**		**$0**		**$0**		**$0**
Crossover Option 1	N/C	N/C		N/C		N/C		N/C
Crossover Option 2	N/C	N/C		N/C		N/C		N/C
Crossover Option 3	N/C	N/C		N/C		N/C		N/C

Notes:

N/C – No net change from the action alternative

1. The value for each option represents the net change from the action alternative. It was calculated as the total value added by the option minus the total value in the segments the option replaces.
2. Totals may not sum due to rounding.
3. Calculated in perpetuity.
4. Grapes are the crop produced on land the Washington State Department of Agriculture data classifies as a vineyard.
5. Calculated in perpetuity; field corn, hay/silage, and pasture allowed to grow in the right-of-way.
6. Impact numbers not shown in parentheses reflect updated data, assumptions, and design refinements; impact numbers shown in parentheses reflect updated data and assumptions using the Draft EIS design.

Sources: BPA 2015; Cross et al. 1991; Julian et al. 2011; Seavert and Horneck 2014; USDA NASS 2014a, 2014b; Washington State Department of Agriculture, 2013

11.2.4.3 Private and Non-WDNR Public Timber Production

Construction of the West Alternative would cause an increase of about $499,592 (see Table 11-11) in the revenue derived from timber production on private and public land owned by local governments (City of Camas) by triggering harvest of existing mature timber stock on lands that would be cleared for the project. This short-term increase would be the same with West Option 1, and larger with West Options 2 and 3. Some of the increase would be offset if timberland managers decide to reduce harvest on other lands. The increase would be somewhat greater than the values calculated here if BPA needs to clear danger trees, or for temporary access roads, staging areas, helicopter fly yards, and pulling and tensioning sites. The actual increase could be greater or less than the total increase calculated here, depending on how actual conditions on the ground deviate from average and assumed conditions (see Section 11.2.2.7, Private and Non-WDNR Public Timber Production, for assumptions).

Over the life of the project, the West Alternative would cause a long-term decrease in revenue, with a net present value of about $1.4million (see Table 11-12), from timber harvests that would have occurred, but for the project, on private and City of Camas timberlands. The increase would be the same with West Option 1, and larger with West Options 2 and 3. The impact would be slightly greater than the values calculated here if BPA continues to clear danger trees, or for temporary access roads, staging areas, helicopter fly yards, and pulling and tensioning sites. The actual impact could be greater or less than the total increase calculated here, depending on how actual conditions on the ground deviate from average and assumed conditions (see Section 11.2.2.7, Private and Non-WDNR Public Timber Production, for assumptions). The decrease in timber production likely would have no impact on market prices for timber.

Table 11-11 Value of Timber Cleared from Private and Non-WDNR Public Timberlands (in 2014 Dollars)[1,2,3,4]

Alternatives and Options	Weyerhaeuser Columbia Timberlands LLC	PacifiCorp[5]	Sierra Pacific Industries	Weyer-haeuser Company	Other Private	City of Camas	Total
West Alternative	**$103,397**	**N/C**	**N/C**	**$83,871**	**$311,382**	**$942**	**$499,592**
West Option 1	N/C	N/C	N/C	N/C	N/C	N/C	$0
West Option 2	N/C	N/C	N/C	N/C	+$220	N/C	+$220
West Option 3	+$64,565	N/C	N/C	N/C	+$94,101	N/C	+$158,666
Central Alternative[6]	**$905,339 ($891,745)**	**$58,454 ($54,159)**	**$194,381 ($184,806)**	**$1,097,137 ($1,058,493)**	**$504,170 ($570,522)**	**$72,787 ($64,284)**	**$2,832,269 ($2,824,010)**
Central Option 1[6]	N/C (-$4,993)	N/C (N/C)	-$62,850 (-$51,524)	N/C (N/C)	N/C (+$266)	N/C (N/C)	-$62,850 (-$56,252)
Central Option 2	-$274,304	N/C	-$184,806	-$16,910	+$265,433	N/C	-$210,587
Central Option 3	+$69,007	-$43,934	N/C	-$312,998	-$48,577	N/C	-$336,502
East Alternative	**$801,692**	**$144,037**	**$184,806**	**$2,011,983**	**$300,955**	**$137,084**	**$3,580,557**
East Option 1	-$318,675	N/C	-$184,806	+$86,631	+$181,208	N/C	-$235,643
East Option 2	-$59,271	N/C	N/C	-$234,303	+$61,408	-$72,794	-$304,960
East Option 3	-$34,926	N/C	N/C	N/C	N/C	-$129,210	-$164,135
Crossover Alternative	**$373,628**	**$128,200**	**N/C**	**$832,627**	**$502,914**	**$137,078**	**$1,974,447**
Crossover Option 1	N/C	N/C	N/C	N/C	N/C	N/C	N/C
Crossover Option 2	+$6,157	N/C	+$143,191	N/C	+$3,734	N/C	+$153,081
Crossover Option 3	+$10,941	N/C	+$185,509	+$22,349	+$44,778	N/C	+$263,577

Notes:

N/C – No net change from the action alternative

1. The value for each option represents the net change from the action alternative. It was calculated as the total value added by the option minus the total value in the segments the option replaces.
2. Calculated for timber that would be cleared from the right-of-way and access roads.
3. Totals may not sum due to rounding.
4. See Section 11.2.2.7, Private Timber Production, for assumptions used to quantify these values.
5. PacifiCorp harvests timber for wildlife habitat on its mitigation lands.
6. Impact numbers not shown in parentheses reflect updated data, assumptions, and design refinements; impact numbers shown in parentheses reflect updated data and assumptions using the Draft EIS design.

Sources: BPA 2015, Clark County 2015b, Corelogic 2015, Cowlitz County 2015b, Herrera 2010, Warren 2009, WDNR 2014b

Table 11-12 Net Present Value of Revenue from Future Timber Harvests that Would Have Occurred on Private and Non-WDNR Public Timberlands but for the Project (in 2014 dollars)[1,2,3,4,5]

Alternatives and Options	Weyerhaeuser Columbia Timberlands LLC	PacifiCorp[6]	Sierra Pacific Industries	Weyer-haeuser Company	Other Private	City of Camas	Total
West Alternative	**$287,213**	**N/C**	**N/C**	**$232,976**	**$864,950**	**$736**	**$1,385,875**
West Option 1	N/C	N/C	N/C	N/C	N/C	N/C	N/C
West Option 2	N/C	N/C	N/C	N/C	+$611	N/C	+$611
West Option 3	+$179,348	N/C	N/C	N/C	+$261,392	N/C	+$440,740
Central Alternative[7]	**$2,514,831 ($2,477,071)**	**$162,372 ($150,443)**	**$539,948 ($513,350)**	**$3,047,604 ($2,940,258)**	**$1,400,473 ($1,584,783)**	**$56,866 ($50,223)**	**$7,722,094 ($7,716,128)**
Central Option 1[7]	N/C (-$13,871)	N/C (N/C)	-$174,582 (-$143,123)	N/C (N/C)	N/C (+$739)	N/C (N/C)	-$174,582 (-$156,255)
Central Option 2	-$761,954	N/C	-$513,350	-$46,973	+$737,314	N/C	-$584,964
Central Option 3	+$191,686	-$122,040	N/C	-$869,438	-$134,935	N/C	-$934,727
East Alternative	**$2,226,923**	**$400,103**	**$513,350**	**$5,588,841**	**$835,987**	**$107,099**	**$9,672,304**
East Option 1	-$885,209	N/C	-$513,350	+$240,641	+$503,354	N/C	-$654,564
East Option 2	-$164,641	N/C	N/C	-$650,843	+$170,579	-$56,871	-$701,776
East Option 3	-$97,016	N/C	N/C	N/C	N/C	-$100,947	-$197,963
Crossover Alternative	**$1,037,856**	**$356,111**	**N/C**	**$2,312,852**	**$1,396,985**	**$107,094**	**$5,210,898**
Crossover Option 1	N/C	N/C	N/C	N/C	N/C	N/C	N/C
Crossover Option 2	+$17,101	N/C	+$397,752	N/C	+$10,372	N/C	+$425,225
Crossover Option 3	+$30,391	N/C	+$515,303	+$62,081	+$124,383	N/C	+$732,158

Notes:

N/C – No net change from the action alternative

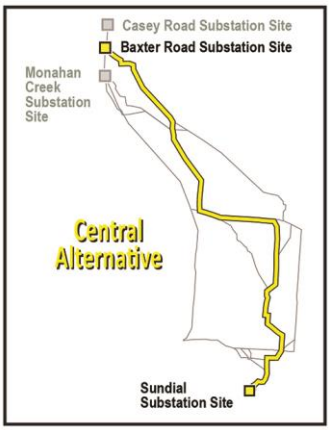
1. The value for each option represents the net change from the action alternative. It was calculated as the total value added by the option minus the total value in the segments the option replaces.
2. Calculated for timber that would be cleared from the right-of-way and access roads.
3. Totals may not sum due to rounding.
4. See Section 11.2.2.7, Private Timber Production, for assumptions used to quantify these values.
5. Calculated in perpetuity.
6. PacifiCorp harvests timber for wildlife habitat on its mitigation lands.
7. Impact numbers not shown in parentheses reflect updated data, assumptions, and design refinements; impact numbers shown in parentheses reflect updated data and assumptions using the Draft EIS design.

Sources: BPA 2015, Clark County 2015b, Corelogic 2015, Cowlitz County 2015b, Herrera 2010, Warren 2009, WDNR 2014b

11.2.5 Central Alternative and Options

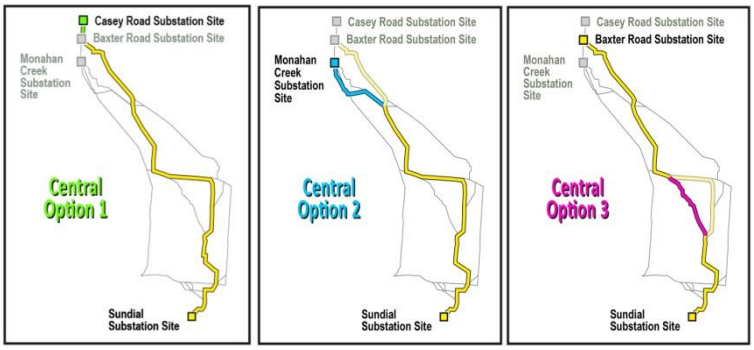
11.2.5.1 Government Revenue

The Central Alternative would affect government revenue in Washington from state trust lands and from timber-harvest taxes.



Washington State Trust Lands Revenue

During construction, the Central Alternative would cause an increase of about $3,325,092 (see Table 11-5) in timber-harvest revenue from state trust lands by triggering harvest of mature timber stock on lands cleared for the project. This short-term increase in revenue represents a **small** change (about 2 percent) compared to the annual revenue from timber sales for the trusts statewide, which was $142 million in 2014. Trees harvested on State Forest Lands Trust land would increase near-term revenue for the state, as well as Clark and Cowlitz counties, which are beneficiaries of this trust. An additional 13 acres of WDNR-managed timberland would be cut for pulling and tensioning sites, and would grow back. This could increase revenue slightly, or could have no effect if other cuts are deferred.



Larger increases during construction would occur for Central Option 1, but smaller increases for Central Option 3 (there would be no change for Central Option 2). The increase would be somewhat greater than the values calculated here if BPA needs to clear danger trees, or for temporary access roads, staging areas, helicopter fly yards, and pulling and tensioning sites. The actual increase for each individual landowner could be greater or less than the total increase calculated here, depending on how actual conditions on the ground deviate from average and assumed conditions (see Section 11.2.2.4, Government Revenue, for assumptions).

Over the life of the project, the Central Alternative would create a long-term decrease in revenue, with a net present value of about $2,597,779 (see Table 11-6) from forgone future harvests on the cleared lands. Greater decreases would occur for Central Option 1, but smaller decreases for Central Option 3. On an annualized basis, the long-term decrease likely would be small, relative to the annual statewide timber sales for each trust. The decrease in annual revenue would have a **high** impact on Cowlitz County or Clark County if it exceeds the average annual compensation cost per one worker and triggers a reduction in workforce or infrastructure available for providing public services.

Tax Revenue from Private Timber Harvest

Construction of the Central Alternative would cause a short-term increase of about $137,974 (see Table 11-7) in the timber-harvest tax revenue of affected counties and the state

government in Washington, by triggering harvest of existing mature timber stock on private lands cleared for the project. The increase would be smaller with Central Options 1, 2, and 3. The Central Alternative would cause a long-term decrease in timber-harvest tax revenue during operation, by precluding future timber production on the cleared lands, with a total net present value of about $383,261 (see Table 11-8). The decrease would be smaller with the central options. The short-term increase and long-term decrease in timber tax revenue would represent small changes compared to the annual tax-revenue collections from harvests in Cowlitz and Clark counties. The decrease in annual revenue would have a **high** impact on Cowlitz County or Clark County if it exceeds the average annual compensation cost per one worker and triggers a reduction in workforce or infrastructure available for providing public services.

11.2.5.2 Agricultural Production

Construction of the Central Alternative would cause a short-term decrease in revenue of about $2,700 by removing crops both inside and outside of the right-of-way (see Table 11-9). Some of this removal would be temporary; for example, crops removed for a temporary access road across an agricultural field needed for access to the right-of-way. The decrease would be larger with Central Options 2 and 3. This represents a tiny proportion of the annual agricultural production revenues in Cowlitz, Clark, and Multnomah counties (about 0.002 percent of the revenue generated in 2012, in 2014 dollars, a level unlikely to be discernible in the regional economy). The decrease could be a greater proportion of agricultural revenue for individual landowners.

Operation of the Central Alternative would cause a long-term decrease in revenue, with a present value of about $334,400, by permanently eliminating landowners' ability to produce crops within the tower footprints (see Table 11-10). The decrease would be smaller with Central Option 2, but larger with Central Option 3. Landowners may not grow crops over 4 feet or crops requiring support structures within the entire right-of-way. Assuming landowners stop growing these crops in the right-of-way, the Central Option 3 would cause an additional long-term decrease in revenue, with a present value of about $1,330,200 (see Table 11-10). There would be no impact from crops not being allowed in the right-of-way from the Central Alternative. The long-term decrease would be small, relative to the annual value of agricultural production in Cowlitz, Clark, and Multnomah counties. The decrease could be proportionally more significant for an individual landowner. The change in agricultural production likely would have no impact on regional prices for agricultural products. At the local level, impacts could be **low-to-moderate** if local prices for a particular product are affected by limited supply.

11.2.5.3 Private and Non-WDNR Public Timber Production

Construction of the Central Alternative would cause a short-term increase of about $2,832,269 (see Table 11-11) in the revenue derived from timber production on private and public land owned by local governments (City of Camas) by triggering harvest of existing mature timber stock on lands that would be cleared for the project. The increase would be smaller under Central Options 1, 2, and 3. Some of the increase would be offset if timberland managers decide to reduce harvest on other lands. Over the life of the project, operation of the Central Alternative would cause a long-term decrease in revenue, with a net present value of about $7,722,094 (see Table 11-12), from forgone future timber harvests on the cleared lands. The decrease would be smaller under Central Options 1, 2, and 3. The impact would be slightly greater than the values calculated here if BPA continues to clear danger trees, or for temporary

access roads, staging areas, helicopter fly yards, and pulling and tensioning sites. The actual impact could be greater or less than the total increase calculated here, depending on how actual conditions on the ground deviate from average and assumed conditions (see Section 11.2.2.7, Private and Non-WDNR Public Timber Production, for assumptions). The change in timber production likely would have no impact on market prices for timber.

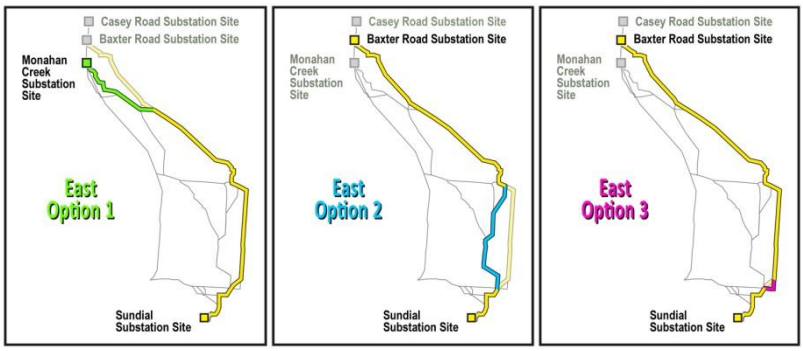
11.2.6 East Alternative and Options

11.2.6.1 Government Revenue

The East Alternative would affect government revenue in Washington from state trust lands and from timber-harvest taxes.

Washington State Trust Land Revenue

Construction of the East Alternative would cause a short-term increase of about $1,566,043 (see Table 11-5) in timber-harvest revenue from state trust lands by triggering harvest of existing mature timber stock on lands cleared for the project. This increase in revenue represents a small change (about 1 percent), compared to the annual revenue from timber sales for the trusts statewide, which was $142 million in 2014. Trees harvested on State Forest Lands Trust land would increase near-term revenue for the state, as well as Clark and Cowlitz counties, which are beneficiaries of this trust.



The increase would be larger under East Options 2 and 3. Some of the increase would be offset if timberland managers decide to reduce harvest on other lands. The increase would be somewhat greater than the values calculated here if BPA needs to clear danger trees, or for temporary access roads, staging areas, helicopter fly yards, and pulling and tensioning sites. The actual increase for each individual landowner could be greater or less than the total increase calculated here, depending on how actual conditions on the ground deviate from average and assumed conditions (see Section 11.2.2.4, Government Revenue, for assumptions).

Over the life of the project, operation of the East Alternative would cause a long-term decrease in revenue, with a net present value of about $1,223,495 (see Table 11-6) from forgone future harvests on the cleared lands. The decrease would be larger under East Options 2 and 3. Overall, the project-related spending during construction and maintenance would have no adverse impact on tax revenue for Cowlitz, Clark, and Multnomah counties. The long-term decrease in timber-harvest tax revenue during operation may, in some years, exceed either Cowlitz or Clark county average annual compensation cost per one employee and have a **high** impact on the two counties.

Tax Revenue from Private Timber Harvest

Construction of the East Alternative would cause a short-term increase of about $172,174 (see Table 11-7) in the timber-harvest tax revenue of affected counties and the state government in Washington, by triggering harvest of existing mature timber stock on private lands cleared for the project. Over the life of the project, the East Alternative would cause a long-term decrease in timber-harvest tax revenue during operation, by precluding future timber production on the cleared lands, with a total net present value of about $478,260 (see Table 11-8). Both the short-term increase and the long-term decrease would be smaller under each of the options. The short-term increase and long-term decrease in timber-tax revenue would represent small changes compared to the annual tax-revenue collections from harvests in Cowlitz and Clark counties. Overall, the project-related spending during construction and maintenance would have no adverse impact on tax revenue for Cowlitz, Clark, and Multnomah counties. The long-term decrease in timber-harvest tax revenue during operation may, in some years, exceed either Cowlitz or Clark county average annual compensation cost per one employee and have a **high** impact on the two counties.

11.2.6.2 Agricultural Production

Construction of the East Alternative would cause a short-term decrease in revenue of about $22,000 by removing crops both inside and outside of the right-of-way (see Table 11-9). Some of this removal would be temporary; for example, crops removed for a temporary access road across an agricultural field needed for access to the right-of-way. The decrease would be larger with East Option 1, but the same with East Options 2 and 3. This represents a small proportion of the annual agricultural production revenues in Cowlitz, Clark, and Multnomah counties (about 0.015 percent of the revenue generated in 2012, in 2014 dollars, a level unlikely to be discernible in the regional economy). The decrease could be a greater proportion of agricultural revenue for individual landowners.

Operation of the East Alternative would cause a long-term decrease in revenue, with a present value of about $287,200, by permanently eliminating landowners' ability to produce crops within the tower footprints (see Table 11-10). The decrease would be larger with East Option 1, and unchanged with East Options 2 and 3. Landowners may not grow crops over 4 feet or crops requiring support structures within the entire right-of-way. Assuming landowners stop growing these crops in the right-of-way, the East Option would not cause an additional long-term decrease in revenue (see Table 11-10). The long-term decrease would be small, relative to the annual value of agricultural production in Cowlitz, Clark, and Multnomah counties. The decrease could be proportionally more significant for an individual landowner. The change in agricultural production likely would have no impact on regional prices for agricultural products. At the local level, impacts could be **low-to-moderate** if local prices for a particular product are affected by limited supply.

11.2.6.3 Private and Non-WDNR Public Timber Production

During construction, the East Alternative would cause a short-term increase of about $3,580,557 (see Table 11-11) in revenue derived from timber production on private and public land owned by local governments (City of Camas) by triggering harvest of existing mature timber stock on lands that would be cleared for the project. The increase would be smaller under each of the options. Some of the increase would be offset if timberland managers decide to reduce harvest on other lands. The East Alternative would cause a long-term decrease in revenue, with a net

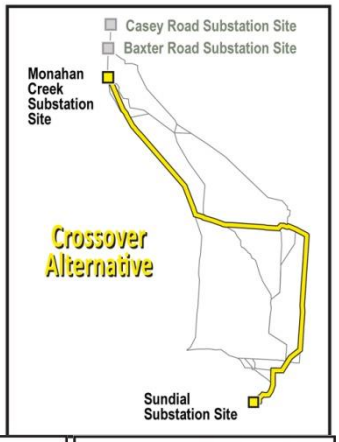
present value of about $9,672,304 (see Table 11-12), from forgone future timber harvests on the cleared lands. The decrease would be smaller under each of the options. The impact would be slightly greater than the values calculated here if BPA continues to clear danger trees, or for temporary access roads, staging areas, helicopter fly yards, and pulling and tensioning sites. The actual impact could be greater or less than the total increase calculated here, depending on how actual conditions on the ground deviate from average and assumed conditions (see Section 11.2.2.7, Private and Non-WDNR Public Timber Production, for assumptions). The change in timber production likely would have no impact on market prices for timber.

11.2.7 Crossover Alternative and Options

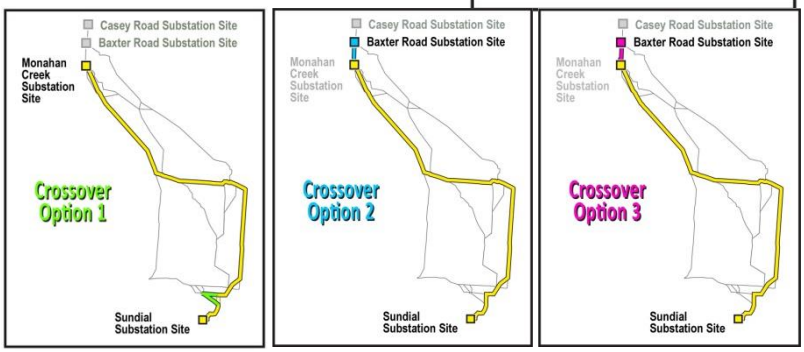
11.2.7.1 Government Revenue

The Crossover Alternative would affect government revenue in Washington from state trust lands and from timber-harvest taxes.

Washington State Trust Lands Revenue



During construction, the Crossover Alternative would cause an increase of about $2,285,603 (see Table 11-5) in timber-harvest revenue from state trust lands by triggering harvest of existing mature timber stock on lands cleared for the project. This short-term increase in revenue represents a small change (about 1.5 percent) compared to the annual revenue from timber sales for each trust statewide, which was $142 million in 2014. Trees harvested on State Forest Lands Trust land would increase near-term revenue for the state, as well as Clark and Cowlitz counties, which are beneficiaries of this trust.



The increase would be the same under each of the options. Some of the increase would be offset if timberland managers decide to reduce harvest on other lands. The increase would be somewhat greater than the values calculated here if BPA needs to clear danger trees, or for temporary access roads, staging areas, helicopter fly yards, and pulling and tensioning sites. The actual increase for each individual landowner could be greater or less than the total increase calculated here, depending on how actual conditions on the ground deviate from average and assumed conditions (see Section 11.2.2.4, Government Revenue, for assumptions).

Over the life of the project, the Crossover Alternative would cause a decrease in revenue, with a net present value of about $1,785,662 (see Table 11-6) from forgone future harvests on the cleared lands. This long-term decrease would the same under each of the options. On an annualized basis, the long-term decrease likely would be small, relative to the annual statewide timber sales for each trust.

Overall, the project-related spending during construction and maintenance would have no adverse impact on tax revenue for Cowlitz, Clark, and Multnomah counties. The long-term decrease in timber-harvest tax revenue during operation may, in some years, exceed either Cowlitz or Clark county average annual compensation cost per one employee and have a **high** impact on the two counties.

Tax Revenue from Private Timber Harvest

During construction, the Crossover Alternative would cause an increase of about $91,868 (see Table 11-7) in the timber-harvest tax revenue of affected counties and the state government in Washington, by triggering harvest of existing mature timber stock on private lands cleared for the project. The Crossover Alternative would cause a long-term decrease in timber-harvest tax revenue during operation, by precluding future timber production on the cleared lands, with a total net present value of about $255,190 (see Table 11-8). Both the short-term increase and the long-term decrease would be larger under Crossover Options 2 and 3. Increases and decreases in timber-tax revenue would represent small changes relative to annual tax revenue collections from harvests in Cowlitz and Clark counties.

Overall, the project-related spending during construction and maintenance would have no adverse impact on tax revenue for Cowlitz, Clark, and Multnomah counties. The long-term decrease in timber-harvest tax revenue during operation may, in some years, exceed either Cowlitz or Clark county average annual compensation cost per one employee and have a **high** impact on the two counties.

Agricultural Production

During construction, the Crossover Alternative would cause a decrease in agriculture crop revenue of about $26,000 by removing crops both inside and outside of the right-of-way (see Table 11-9). Some of this removal would be temporary; for example, crops removed for a temporary access road across an agricultural field needed for access to the right-of-way. The decrease would be larger with Crossover Option 1. This represents a small proportion of the annual agricultural production revenues in Cowlitz, Clark, and Multnomah counties (about 0.018 percent of the revenue generated in 2012, in 2014 dollars, a level unlikely to be discernable in the regional economy). The decrease could be a greater proportion of agricultural revenue for individual landowners.

Over the life of the project, the Crossover Alternative would cause a decrease in revenue, with a present value of about $110,000, by permanently eliminating landowners' ability to produce crops within the tower footprints (see Table 11-10). This long-term decrease would be larger with Crossover Option 1. Landowners may not grow crops over 4 feet or crops requiring support structures within the entire right-of-way. Assuming landowners stop growing these crops in the right-of-way, the Crossover Alternative would cause no additional long-term decrease in revenue. The long-term decrease would be small, relative to the annual value of agricultural production in Cowlitz, Clark, and Multnomah counties. The decrease could be proportionally more significant for an individual landowner, although landowners who grow new crops less than 4 feet high can make up for a part of that revenue. The change in agricultural production likely would have no impact on regional prices for agricultural products. At the local level, impacts could be **low-to-moderate** if local prices for a particular product are affected by limited supply.

11.2.7.2 Private and Non-WDNR Public Timber Production

During construction, the Crossover Alternative would cause an increase of about $1,974,447 (see Table 11-11) in the revenue derived from timber production on private and public land owned by local governments (City of Camas) by triggering harvest of existing mature timber stock on lands cleared for the project. The increase would be larger under Crossover Options 2 and 3. Some of the increase would be offset if timberland managers decide to reduce harvest on other lands in response to project-induced timber harvest. The increase for each individual landowner could be greater or less than the total increase.

Over the life of the project, the Crossover Alternative would cause a long-term decrease in revenue, with a present value of about $5,210,898 (see Table 11-12), from forgone future timber harvests on the cleared lands. The decrease would be larger under Crossover Options 2 and 3. The impact would be slightly greater than the values calculated here if BPA continues to clear danger trees, or for temporary access roads, staging areas, helicopter fly yards, and pulling and tensioning sites. The actual impact could be greater or less than the total increase calculated here, depending on how actual conditions on the ground deviate from average and assumed conditions (see Section 11.2.2.7, Private and Non-WDNR Public Timber Production, for assumptions). The change in timber production likely would have no impact on market prices for timber.

11.2.8 Recommended Mitigation Measures

Mitigation measures included as part of the project are identified in Table 3 2. BPA is considering the following additional mitigation measures to further reduce or eliminate adverse socioeconomic impacts by the action alternatives. If implemented, these measures would be completed before, during, or immediately after project construction unless otherwise noted.

- Where appropriate, site transmission facilities to avoid WDNR lands planned for wind farms or other income generating opportunities.
- Use the Federal Highway Administration's Temporary Waiver to address relocations where landowners may owe more money than their house is worth, and BPA requires them to sell and relocate. The purpose of the temporary waiver is to make the landowner whole so that they can move into comparable housing. The temporary waiver is in effect until December 31, 2012. BPA could make the decision to continue to use this process even if the Federal Highway Administration decides not to extend it after 2012.
- Compensate the state trusts, using the appraisal process, to establish market value for state timber trust lands within the right-of-way and for access roads. Alternately, consider purchasing and donating similar timberlands elsewhere that would provide the same unencumbered market value as the affected lands.
- Compensate owners, using the appraisal process, to establish market value for private timberlands lands within the right-of-way and for access roads. Alternately, consider purchasing and donating similar timberlands elsewhere that would provide the same unencumbered market value as the affected lands.
- Compensate owners using the appraisal process to establish market value for agricultural related lands within the right-of-way and for access roads. Alternately,

consider purchasing and donating similar agricultural lands elsewhere that would provide the same unencumbered market value as the affected lands.

- Compensate landowners using the appraisal process to establish the market value for any demonstrated increases in management costs related to the project right-of-way, substations, access roads, and other project-related factors.
- Minimize construction, operation, and maintenance activities around agricultural land or timberland during active production or harvest periods.

11.2.9 Unavoidable Impacts

After appropriate mitigation actions have been taken, assuming they would be implemented in full, the project could still produce several unavoidable impacts. The project could decrease human health and safety because of the risks of accidents for workers and the public. The project also could decrease the perceived value of some elements of natural and social capital that contribute to the social and economic well-being of some households, businesses, communities, or groups. If mitigation does not fully address other direct and indirect costs of the project (e.g., future earnings from displaced activities such as timber harvest or agricultural production), these unaddressed costs would become unavoidable impacts.

11.2.10 No Action Alternative

Without the project, the changes to revenues and expenditures, and the resulting socioeconomic impacts discussed in this chapter, would not occur. Trees inside and next to the project's right-of-way and access roads in forest lands would likely eventually be harvested, providing revenue for state trusts and private producers, and tax revenue for states and counties. Agricultural land inside and next to the project's right-of-way and access roads could eventually be developed for residential or commercial purposes, or used to grow trees or crops as they are today. New development, changes in land use, wildfire, or other natural or human-induced events may affect the views, sense of solitude, or other amenities current property owners or others within the project area enjoy. The specific timing, nature, or characteristics of these and other changes are impossible to predict.

Without the project, in the short-term, increased congestion on the region's transmission grid could directly increase the costs of using the existing transmission system (see Chapter 1, Purpose and Need). In the long-term, increased congestion would likely generate direct and indirect costs to electricity consumers by reducing transmission-system reliability in parts of Washington and Oregon. The costs of electricity outages to residential, commercial, and industrial customers are described in Section 11.1.8.5, Transmission System Reliability. Reduced reliability could contribute to some firms' decisions to relocate from Washington and Oregon to other states, resulting in fewer employment opportunities and reduced income for workers in Washington and Oregon. It also could cause companies that may be considering investing or locating in the region to make investments elsewhere, reducing the potential for long-term economic growth.

Increased incidence of brownouts could cause some residential and commercial property owners to invest in back-up electricity generators, incurring costs they otherwise would avoid. These investments, however, could increase the employment opportunities and incomes for workers and business owners who specialize in the sale and installation of such equipment, potentially offsetting some of the adverse employment-and income-related consequences of

not investing in the project. Increased frequency of major disruptions in electricity service could also increase response times and reduce the availability of law-enforcement and fire-protection services for handling routine emergencies. These effects could diminish the quality of life for residents in the region.

Chapter 12 Transportation

This chapter describes existing transportation resources in the project area, and how the project alternatives could affect these resources. Related information on emissions can be found in Chapter 21, Air Quality and Chapter 22, Greenhouse Gases.

Words in **bold** and acronyms are defined in Chapter 32, Glossary and Acronyms.

12.1 Affected Environment

The transportation system in the project area includes public highways and roads, private logging and other private local roads, public transit, railroads, public and private airports and airstrips, and marine traffic (see Maps 12-1A through 12-1D).

12.1.1 Highways, State Routes, and Local Roads

Regional highway access to the project area is provided by I-5, the major north/south interstate freeway serving the west coast of the United States from southern California north through Oregon and Washington to the Canadian border (see Maps 12-1A through 12-1D). I-5 crosses the Columbia River between Oregon and Washington over the Interstate Bridge. I-205 was constructed as a bypass facility through the Portland/Vancouver metropolitan area and crosses the Columbia River over the Glenn Jackson Bridge. In Oregon, I-84 provides access to the general vicinity of Troutdale (SWRTC 2008).

Several state routes provide access to the project area including SR 14, SR 411, SR 500, SR 502, and SR 503. SR 14 provides the main east-west access from southwest to southeast Washington along the north bank of the Columbia River. SR 411, also commonly referred to in the project area as the West Side Highway, serves Longview, Kelso, the West Side Highway community, and Castle Rock, Washington (see Map 12-1A). The West Side Highway parallels the Cowlitz River and I-5, beginning at an interchange with SR 432 in Longview and traveling north past a spur route, under SR 4, and across the Cowlitz River It then becomes concurrent with I-5 Business in Castle Rock and ends at the interchange with I-5, I-5 Business, and SR 504 (SWRTC 2008).

SR 500 allows for east-west travel across Clark County (see Map 12-1D). It crosses I-205, provides access to the Orchards area, and traverses rural Clark County to the Camas urban area. SR 500 intersects SR 14 in Camas and carries traffic to and from the Westfield Vancouver shopping mall. SR 502 extends from the I-5/NE 179th Street interchange northward to NE 219th Street, where it turns eastward toward Battle Ground. SR 503 extends northward from its intersection with SR 500 and carries traffic between the Vancouver urban area and north through Battle Ground. SR 503 extends into Cowlitz County (SWRTC 2008).

Hundreds of county roads exist in the project area. In addition to the named and improved roads, many other roads exist in remote areas of Clark and Cowlitz counties. Examples of these other roads include private logging roads and roads used to access private property. Roads within cities and towns are typical cross streets found in urban areas (see Maps 12-1A through 12-1D).

12.1.2 Public Transit

The Cowlitz Transit Authority provides bus service to Kelso and Longview through its Community Urban Bus Service (CUBS). Other areas of Cowlitz County have limited public transportation opportunities. CUBS connects with the rural service provided by Lower Columbia Community Action Council, Columbia County Rider, and Wahkiakum on the Move, at the Transit Transfer Facility.

Clark County Public Transportation Benefit Authority (C-TRAN) provides public transit service in Clark County and into Oregon. C-TRAN's service boundary (effective June 1, 2005) includes the City of Vancouver, its urban growth boundary, and the city limits of Battle Ground, Camas, La Center, Ridgefield, Washougal, and the Town of Yacolt. C-TRAN operates a fixed route bus system on urban and suburban routes, and commuter bus service to Portland, Oregon and some service to downtown Vancouver and MAX light rail with three reservation-based connector routes serving Camas, Ridgefield, and La Center (SWRTC 2008).

12.1.3 Railroads

Passenger and freight rail lines operate in the project area (see Maps 12-1A through 12-1D). Burlington Northern Santa Fe (BNSF) owns two mainline rail lines that carry freight and passengers through Cowlitz and Clark counties. The BNSF Seattle/Vancouver line has 70 to 80 trains operating along the I-5 corridor each day, and the BNSF Vancouver/Eastern Washington line handles about 40 trains per day (SWRTC 2008). Clark County also owns the 33-mile short line Lewis and Clark Railroad (also known as the Portland Vancouver Junction Railroad, the Chelatchie Prairie Railroad, or the Clark County Railroad). Amtrak's Cascades and Coast Starlight lines provide service between Portland/Vancouver and Kelso and to cities north and south of the area. Amtrak's Empire Builder provides passenger service between Portland and Chicago and runs east-west along the north side of the Columbia River in Clark County. Union Pacific (UP) rail lines run close to the project area where they enter Troutdale from the east and split into two routes approaching Portland.

12.1.4 Airports

The Southwest Washington Regional Airport (also known at the Kelso-Longview Airport) (see Map 12-1A) and the Woodland State Airport are the only public airports in Cowlitz County. The Kelso-Longview Airport is a general aviation airport on 109 acres owned by the City of Kelso. The airport has 70 hangars, 46 tie-downs, and one 4,391-foot runway. The Woodland State Airport has one 1965-foot runway. There are several private airstrips and heliports in Cowlitz County, including Cougar Flat Airstrip and Flying K Ranch near Castle Rock; Cougar Heliport, Lewis River Golf Course Airport, and Mount St Helen's Aero Ranch Airport in the vicinity of Lake Merwin and Yale Lake; and St. Johns Medical Center Heliport and Walters Arv Ultralight Airport in the Longview-Kelso area (see Map 12-1A through 12-1C).

General aviation airports in Clark County include the historic Pearson Field and Grove Field. Pearson Field, operated by the City of Vancouver, is 2 miles southeast of downtown Vancouver off SR 14 on 134 acres owned by the National Park Service (NPS) (see Map 12-1D). Over 170 aircraft are based at Pearson Field, with about 30 percent corporate-owned. The airport has one 3,275-foot runway. Pearson Field is part of the Vancouver National Historic Reserve Historic District, listed on both the National Register of Historic Places and the Washington

I-5 Corridor Reinforcement Project

Map 12-1A: Transportation Resources

Casey Road Substation Site

Baxter Road Substation Site

Monahan Creek Substation Site

Rock Creek
Baxter Creek
Monahan Creek
Arkansas Creek
Delameter Creek
Leckler Creek
Cowlitz River
Toutle River
Spirit Lake Memorial Hwy
Silver Lake
Ostrander Creek
South Fork Ostrander Creek
Coweeman River
Goble Creek
Kalama River
Columbia River
Lower Columbia River Hwy
Burlington Northern Santa Fe
Westside Hwy
Pacific Way
38th Ave
30th Ave
Beach Ave
15th Ave
7th Ave
Allen St
Grade St
S Kelso Dr
Talley Way
Nevada Dr
Columbia And Cowlitz Hwy
Industrial Way

Flying K Ranch Airport
Cougar Flats Airstrip
St. Johns Medical Center Heliport
Kelso-Longview Airport
Walters Arv Ultralight Airport

Castle Rock
Lexington
Ostrander
Longview/Kelso
Rainier

Cowlitz Co
Columbia Co

5
411
504
4
432
433
30

LEGEND

- Preferred Substation Site
- Other Proposed Substation Sites
- Preferred Alternative - Central Alternative using Central Option 1 (not drawn to scale)
- Other Proposed Alternatives and Options (not drawn to scale)
- Original Central Alternative
- New Access Roads
- Existing Public or Private Roads to be Improved
- Existing Roads that could be used for Construction
- Temporary Roads
- Airport
- City or Town
- Dam
- Urban Area
- County Boundary
- State Boundary

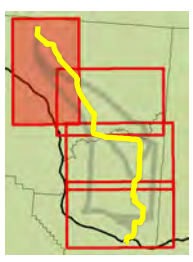
Note: The Preferred Alternative has been refined to further minimize and avoid impacts to the natural and human environment where possible.

- Interstates and US Highways
- State Highways
- Major Roads
- Streets
- Railroads

Miles
0 0.75 1.5 3

N W E S

Bonneville POWER ADMINISTRATION



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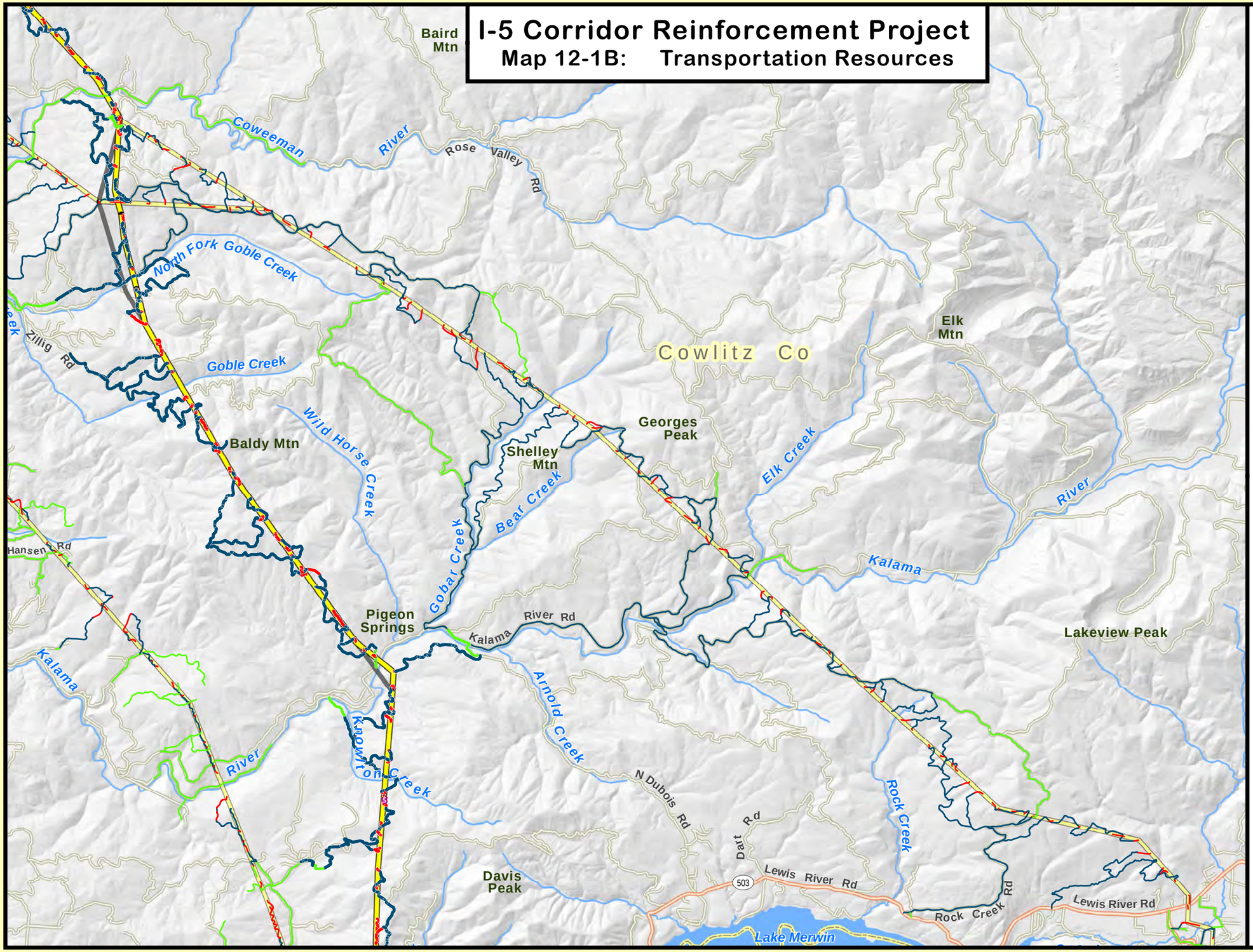
Map 12-1A: Transportation Resources

I-5 Corridor Reinforcement Project

Map 12-1B: Transportation Resources



LEGEND

- Preferred Substation Site
- Other Proposed Substation Sites
- Preferred Alternative - Central Alternative using Central Option 1 (not drawn to scale)
- Other Proposed Alternatives and Options (not drawn to scale)
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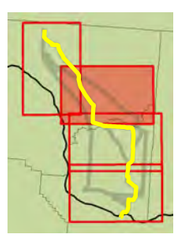
- Interstates and US Highways
- State Highways
- Major Roads
- Streets
- Railroads

Miles

0 0.75 1.5 3

Bonneville Power Administration



Map 12-1B: Transportation Resources

I-5 Corridor Reinforcement Project

Map 12-1C Transportation Resources

LEGEND

- Preferred Substation Site
- Other Proposed Substation Sites
- Preferred Alternative - Central Alternative using Central Option 1 (not drawn to scale)
- Other Proposed Alternatives and Options (not drawn to scale)
- Original Central Alternative
- New Access Roads
- Existing Public or Private Roads to be Improved
- Existing Roads that could be used for Construction
- Temporary Roads
- Airport
- City or Town
- Dam
- Urban Area
- County Boundary
- State Boundary

Note: The Preferred Alternative has been refined to further minimize and avoid impacts to the natural and human environment where possible.

- Interstates and US Highways
- State Highways
- Major Roads
- Streets
- Railroads

Miles
0 0.75 1.5 3

Bonneville Power Administration

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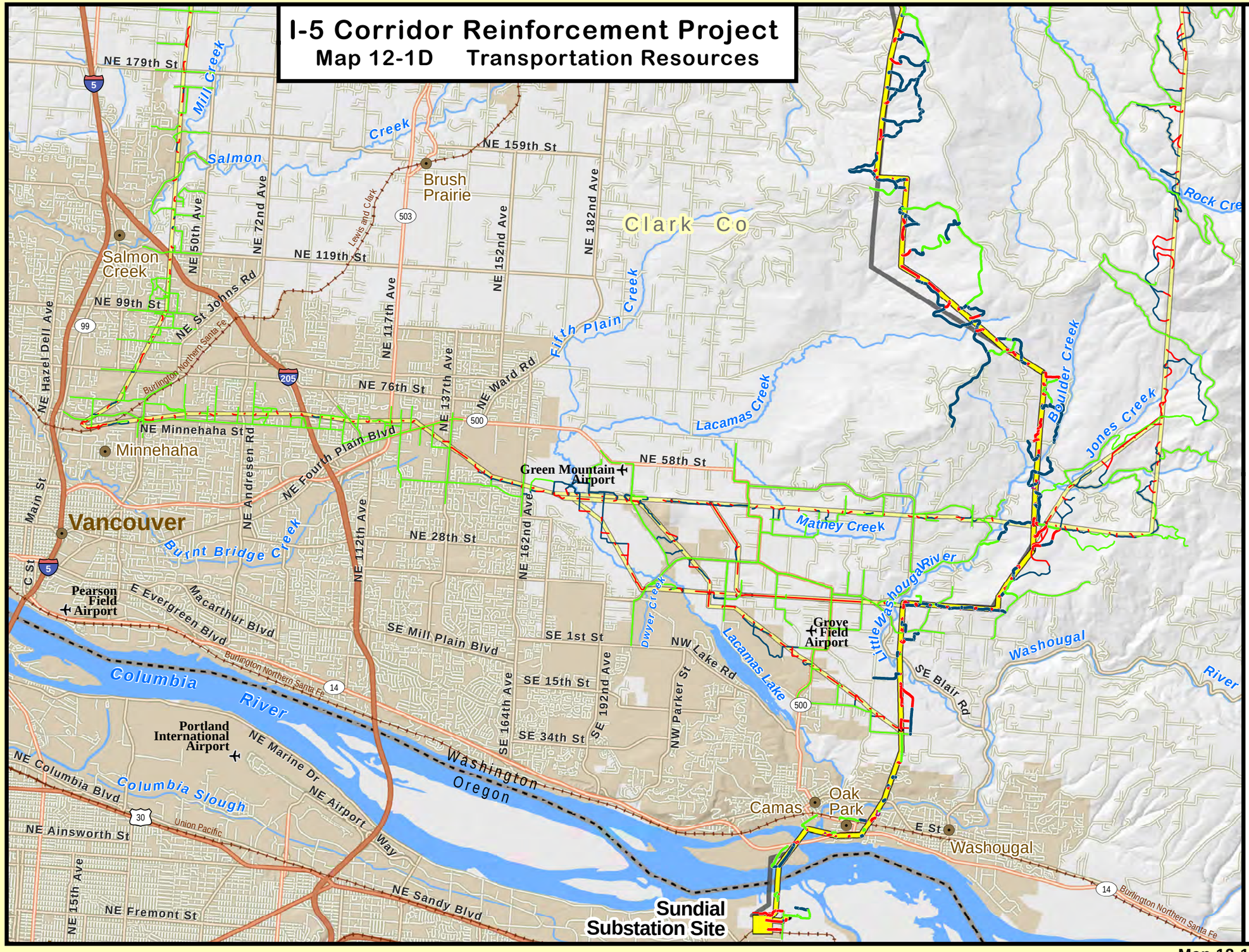
I-5 Corridor Reinforcement Project

Map 12-1D Transportation Resources



LEGEND

- Preferred Substation Site
- Other Proposed Substation Sites
- Preferred Alternative - Central Alternative using Central Option 1 (not drawn to scale)
- Other Proposed Alternatives and Options (not drawn to scale)
- Original Central Alternative
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- State Boundary

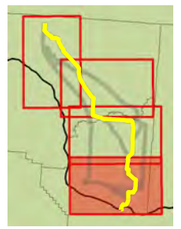
Note: The Preferred Alternative has been refined to further minimize and avoid impacts to the natural and human environment where possible.

- Interstates and US Highways
- State Highways
- Major Roads
- Streets
- Railroads

Miles

0 0.75 1.5 3

Bonneville Power Administration



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Map 12-1D Transportation Resources

Heritage Register (Houser 2011). Grove Field is a Basic Utility Stage I Airport operated by the Port of Camas/Washougal, located in the Fern Prairie area 5 miles north of Camas. Grove Field has a 2,710-foot runway and hangar space for over 60 aircraft (AirNav 2011; SWRTC 2008).

There are also a number of private airports in Clark County, including Green Mountain Airport in Vancouver and Goheen Airport near Battle Ground (see Map 12-1D). Green Mountain Airport is a 23-acre facility 9 miles east of downtown Vancouver that has a 2,000-foot runway, six hangars, and 10 tie-downs. Goheen Airport is 3 miles north of Battle Ground. It has one 2,565-foot turf runway and provides a base for 18 airplanes. Other private airports and airstrips operate in Amboy, near the East Lewis River crossing of the West Alternative, near the Lewis River crossing of the East Alternative, Battle Ground, Brush Prairie, Camas, Vancouver, and Washougal (AirNav 2011; SWRTC 2008).

Portland International Airport (PDX) is a regional airport in Portland, Oregon with domestic and international passenger and freight service, operated by the Port of Portland (see Map 12-1D). PDX has three runways at 11,000 feet, 9,825 feet and 6,000 feet. In 2006, PDX served 14 million passengers. About 23,000 short tons of air freight moves through the airport per month. The Port of Portland also operates Portland-Troutdale Airport, which is southeast of the proposed Sundial substation site. The airport has one 5,399-foot runway and over 150 aircraft are based there (AirNav 2011; SWRTC 2008).

12.1.5 Marine Traffic

The Columbia River is a major pathway for marine traffic in the region, helping to connect ports as far inland as Lewiston, Idaho with the Pacific Ocean. Like the rest of the river, general marine traffic occurs at the location of the proposed transmission line crossing of the Columbia River north of Troutdale. Large cargo ships and commercial marine traffic stop downriver at Terminal Six near the City of Vancouver, Washington where the river is dredged up to a depth of 43 feet. Other tug and barge activity can continue to move upriver past the site of the transmission line crossing of the Columbia River to ports along the Columbia and Snake rivers if their hulls can clear the 14 foot minimum depth of the inland barge channel.

Recreational boating occurs on the Columbia River and also on other major rivers, like the Cowlitz and Lewis rivers, and their tributaries within the project area. Recreational boating also occurs on Yale Lake and Lake Merwin. Some small aircraft also use local lakes and rivers.

12.2 Environmental Consequences

General impacts common to all action alternatives are discussed below, followed by impacts unique to each alternative.

12.2.1 Impact Levels

Impacts would be **high** where project activities would cause the following:

- Sustained increases in traffic levels on local or regional roads or highways, or sustained disruptions or delays to, or stopping these or other transportation resources such as public transit, railroads, airports or marine traffic.

Impacts would be **moderate** where project activities would cause the following:

- Occasional increases in traffic levels on local or regional roads or highways, or intermittent disruptions or delays to these or other transportation resources such as public transit, railroads, airports or marine traffic.

Impacts would be **low** where project activities would cause the following:

- Rare increases in traffic levels on or damage to local or regional roads or highways, or rare effects on other transportation modes such as public transit, railroads, airports or marine traffic.

No impact would occur to transportation resources if there is no effect on vehicle traffic or on other transportation resources such as public transit, railroads, airports or marine traffic.

12.2.2 Impacts Common to Action Alternatives

12.2.2.1 Construction

Highways, State Routes, and Local Roads

Impacts to transportation would include increased traffic and potential delays to motorists along transportation corridors from substation or line construction activities, transport of construction equipment and supplies, improvements to segments of public or private roads, and construction of new access roads if they are near or intersect with public or private roads.

Temporary and intermittent disruptions to traffic flow on roads would occur during the 30-month construction period where heavy equipment and materials are transported on local roads for construction of new or improved access roads, clearing of existing or new rights-of-way, and construction of towers and substations. Traffic could be interrupted or slowed for brief periods of time from construction vehicles entering or exiting access roads or blasting near a road (to protect cars from flying debris). Also, there would be a short-term traffic delay, or detour required, where the right-of-way crosses I-5 and other highways or smaller roadways and the conductors are strung via helicopter or caterpillar pull. A traffic control plan would be developed for submittal to the appropriate city, county, or state road or highway departments. Disruptions would be scheduled, short term, and intermittent and existing roads could likely accommodate these short periods of increased traffic causing a **moderate** impact during construction.

Both light and heavy-duty vehicles would access construction sites on rights-of-way, substation sites, and areas where there would be new and improved access roads. Equipment and materials would be transported to staging areas, helicopter fly yards, and construction sites via semi-trucks. Staging areas and helicopter fly yards would be along or near rights-of-way. Because the number and location of construction spreads (crews and equipment required) has not been determined yet, the origins of the contractors and their workers hired to construct facilities, and equipment suppliers and staging area and helicopter fly yard locations are unknown. However, the approximate size of the work force is known (see Chapter 3, Project Components and Chapter 11, Socioeconomics), and BPA has estimated the approximate number of trucks required during construction. A limited increase in daily traffic volume on highways would occur, with an estimate of 45 vehicles per day anticipated to deliver workers, materials,

and equipment to construction sites. With an estimated average of 100 commute miles per day per vehicles, the 45 vehicle trips would result in about 4,500 miles per day driven on highways, state routes, and local roads. The addition of these vehicles could interrupt or slow traffic for certain periods of time. This would be a **moderate** impact.

Existing local, private roads or public roads and highways would be used during construction for transport of materials and construction crews, including I-5, I-205, I-84, SR 14, SR 500, SR 503, and SR 411 (see Maps 12-1A through 12-1D).

Construction scheduling is complicated and dependent on many different factors. Crews can be located in several different areas of the project at the same time working on different activities. This can cause traffic congestion over a broad area. Sometimes, activities can occur concurrently so while one crew can finish up with clearing or road construction, another crew may move in right behind them to begin line construction. This can cause prolonged congestion on roads in one area. At other times, a crew might, for example, construct 10 miles of transmission line in about 4 months and be done in that area for quite some time until another crew comes in to start another activity in the area. This allows traffic congestion to dissipate for a period of time.

Trucks carrying heavy construction materials and equipment could damage existing roads if they are not adequate for this use. All loads transported on state and county roads would be within legal size and load limits, or have valid oversize or weight permits. BPA would repair any damage to existing roads to their original or better condition, following construction. Project vehicles could track dust, soils and other materials from construction sites onto public roads. Erosion control measures would include stabilization of construction entrances and exits to prevent sediment from being transported onto adjacent roadways (see Chapter 14, Geology and Soils, and Chapter 15, Water). With appropriate size and load limits, truck operation effects on existing roads would be a **low** impact.

Development of access roads would include improving existing BPA access roads, improving existing county roads if needed, building new access roads, and potentially constructing and removing temporary access roads to tower sites within agricultural fields. Improvements to existing roads could involve clearing brush, grading and laying down gravel, widening roads, smoothing out curves, and adding or replacing culverts, ditches, rolling-dips, or water bars. New and improved access road-related impacts to other resources such as land use, visual resources, cultural resources, soils, water resources, wetlands, vegetation, wildlife, and fish are discussed in the resource-specific chapters in this EIS.

Public Transit, Railroads, Airports, and Marine Traffic

Construction activities would have **no-to-low** impacts on public transit services because the activities would be temporary, and because any necessary service disruption would be coordinated with the applicable transit agency before construction.

Crossings of railroads would be timed to avoid interrupting freight train or passenger service, and if necessary, appropriate coordination and crossing permits would be obtained from the affected railroad operator. Construction would result in **no-to-low** impact on rail.

The FAA requires that project designs be submitted for approval if a proposed structure or conductor/ground-wire would be constructed 200 feet or more above the ground or water, or if any part of the proposed transmission line would be within a prescribed distance of an airport (Melzer 2010). Such structures may require marking with special lighting, paint, or marker balls, as directed by the FAA (see Section 3.7, Obstruction Lighting and Marking). The Columbia River transmission line crossing would require construction of towers up to 305 feet tall (see Chapter 3, Figure 3-1) on the banks of the river and on a high point in the river bottom at Ione Reef. These towers and lines would require review by the FAA, and would meet applicable FAA lighting and marking requirements. Because some towers close to airports are proposed to be over 200 feet, the project could create **no-to-low** impacts on airports.

Towers at Ione Reef would not be in the river channel, which would help to avoid marine traffic. Interruptions and delays related to tower construction would be temporary. BPA would follow United States Coast Guard notification and marking requirements. Small private recreational boats would be diverted from construction activities. As with small crafts on the Columbia River, boaters would be diverted from any other navigable river crossing construction activities. **No-to-low** impact would occur to commercial and recreational boat traffic because river crossing construction activities would be short term.

12.2.2.2 Operation and Maintenance

Highways, State Routes, and Local Roads

Once the line is operating, project-related traffic on any roads would be minimal and infrequent. Maintenance traffic would normally be a few maintenance vehicles along the right-of-way several times a year and helicopters flying overhead twice a year. These infrequent activities would not negatively affect roads or traffic along any of the action alternatives over the life of the project. Large vehicles such as flatbed trucks or a crane may be required to replace or repair the transmission line and towers on occasion, which could cause minor disruption to local traffic for brief periods. This would be a temporary, **no-to-low** impact.

Public Transit, Railroads, Airports, and Marine Traffic

Operation of the project would not require any activities that could affect public transit or rail lines or schedules, so there would be **no** impact on these transportation resources. Maintenance activities could cause minor disruption to local traffic or rail lines or schedules for brief periods depending on the activity. This would be a temporary, **no-to-low** impact.

Where transmission lines are near airports and where towers and conductors are above a certain height, aviation safety requirements must be determined by the FAA. Maintenance activities within any airport's airspace or airport approaches would conform to FAA requirements causing **no** impact to airport operations.

Transmission line crossings of all navigable rivers, including the Columbia River, would be high enough that recreational boats and marine traffic (barge and vessel) would pass under unhindered causing **no** impact on marine traffic during operations. Any maintenance work at these crossings would occur infrequently and would not substantially interfere with or disrupt recreational boating and marine traffic. At most, any recreational boats or marine traffic present during maintenance would be temporarily diverted away from any in-water maintenance activities, a **no-to- low** impact.

12.2.2.3 Sundial Substation Site

Impacts common to action alternatives are in Section 12.2.2. The remaining sections discuss impacts unique to each alternative, and recommended mitigation measures.

Construction work at either of the two options at the Sundial Substation site (Lot 11 or Lot 12) may disrupt traffic on local roads including Sundial Road within the Port of Portland industrial complex as equipment and trucks enter or exit the substation site. The main access to the industrial park is Sundial Road, which would also be the main access used for construction. The work would create temporary and short-term disruptions and delays to existing truck traffic and workers entering and exiting the industrial park. Because of the industrial nature of the site, traffic disruptions are not uncommon but temporary delays would continue over an extended period causing **moderate** impacts.

Sundial Substation would not be a manned substation. During operation, BPA personnel would visit the substation infrequently. Maintenance activities at the substation would also occur infrequently. Because traffic volumes for these activities would be low, substation maintenance would cause **no-to-low** impacts on traffic and roads in the industrial complex.

As described above, near airports and flight paths, and for towers over 200 feet tall, the FAA may require that BPA add lighting to the towers (see Section 3.7, Obstruction Lighting and Marking). BPA would notify the FAA and construct and illuminate towers in accordance with FAA guidelines (FAA 2000). Because some towers close to the Portland International or Portland-Troutdale airports are proposed to be over 200 feet, the project could create **no-to-low** impacts.

12.2.3 Castle Rock Substation Sites

12.2.3.1 Casey Road

This site is relatively remote and a new road would be built to access the substation site from Casey Road and West Side Highway (SR 411). Improvements (rocking and paving) would be made to Casey Road, which is used regularly by a few local homeowners, but otherwise used infrequently by the public and logging trucks. Construction activities could periodically interrupt or slow traffic for long periods as fill material is transported to the substation site, a **moderate** impact. Most of the time, however, construction impacts would be **low** because, while vehicle trips would be fairly frequent during construction of the substation, these trips and other construction activities would be pre-scheduled and logging activities could possibly be scheduled around these activities. Similar to Sundial Substation, Casey Road Substation would also be unmanned and maintenance activities would be scheduled and infrequent, a **no-to-low** impact.

12.2.3.2 Baxter Road

Similar to the Casey Road site, the Baxter Road site is relatively remote but logging activities do occur around this site. Some rural residential homes occur along Beebe Road, a rural road off West Side Highway (SR 411) leading to the substation site. Construction and maintenance-related traffic and delays would cause temporary delays to logging trucks in the area. This would be a **low** impact because while vehicle trips would be fairly frequent during construction of the substation, these trips and other construction activities would be scheduled and logging

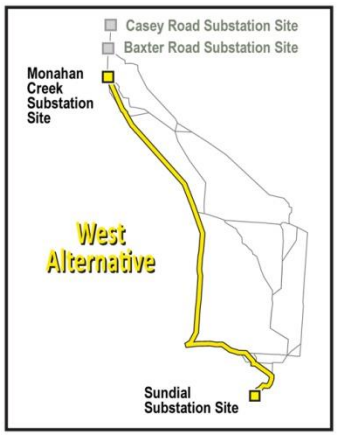
activities could possibly be scheduled around these activities. Construction-related vehicles using Beebe Road and the West Side Highway (SR 411) could interrupt or slow traffic for long periods as fill material is transported to the substation site, a **moderate** impact. Similar to the Sundial and Casey Road substations, Baxter Road would also be unmanned and maintenance activities would be scheduled and infrequent, a **no-to-low** impact.

12.2.3.3 Monahan Creek

The Monahan Creek site is not as remote as the Casey Road and Baxter Road sites but would require much less access road work. The substation site is directly off Delameter Road. Traffic delays would occur mostly to local commuters on this road during substation construction. Temporary increases in vehicle trips transporting construction material to and from the site would occur. Traffic delays would occur from vehicles slowing to observe construction activities and infrequent detours may be required for safety reasons. Temporary traffic delays or detours would cause **moderate** impacts. Operation and maintenance activities would cause **no-to-low** impacts to traffic because the substation would be unmanned and maintenance activities would be scheduled and infrequent.

12.2.4 West Alternative

The West Alternative would cross several highways and state routes (I-5, I-205, SR 14, SR 411, SR 500, SR 502, and SR 503), and many other roads, including public arterials (Pacific Avenue, Hansen Road, Lewis River Road, NE 399th Street, NE 219th Street, NE 179th Street, NE 119th Street, NE Saint Johns Road, NE Andresen Road, NE Fourth Plain Boulevard, and NE 58th Street), and private access roads. The alternative would also cross railroads (BNSF Railway, Columbia and Cowlitz Railway, and Portland-Vancouver Junction Railroad), and would be within 5,000 feet of three airports (Green Mountain Airport, Grove Field Airport, and Portland-Troutdale Airport) and a small grass airstrip near the East Lewis River crossing, just west of the existing BPA right-of-way (see Maps 12-1A though 12-1D).



The West Alternative would need the fewest miles of new (30) and improved (34) access roads of all the action alternatives (see Table 12-1).

The West Alternative could use about 174 miles of existing roads in the project area during construction and long-term maintenance to access the right-of-way and substations, including highways, state routes, public arterials, and private roads (see Maps 12-1A though 12-1D and Table 12-2). Construction vehicles can include cars and pickup trucks transporting workers and crews to the construction site or can include larger vehicles like bucket trucks and flatbeds that are transporting cranes, backhoes, bulldozer, and other large pieces of equipment to the site (see Section 3.14, Construction Schedule and Work Crews). While construction is temporary, crews can remain in an area completing a particular clearing or construction activity for a few weeks. A new or the same crew can then return to the same area many months later to start a new phase of construction or construction activity (see Section 3.14). At this time, these roads have been identified as a possibility for use during construction and long-term maintenance of the project because of their proximity to the alternative. If BPA decides to build the project and at the time of construction, the chosen contractor would decide which roads actually meet

construction requirements, are available for use, and would provide the most efficient access to the project. At that time, required permits, road improvements, and easements would be completed to secure road use and utility (e.g., railroad) crossings.

New and improved roads within rights-of-way would have **no** impact on transportation because they would not be public. These same roads though may provide unintended access from trespassers and cause unauthorized uses (see Chapter 5, Land). New and improved roads outside of the right-of-way may affect local transportation during operation by improving some existing roads currently used for other purposes. New roads might encourage traffic in areas where there was none before. Generally, these roads would have a **low-to-moderate** impact on local traffic depending on length of construction activities in a particular area and if these activities cause delays or detours. Because of the infrequent nature of maintenance activities during the operation of the line, **no-to-low** impacts would occur during these activities.

Table 12-1 Length of New and Improved Access Roads

Alternatives and Options	Within Existing or Proposed Right-of-Way (miles)[1]		Outside Existing or Proposed Right-of-Way (miles)[1]	
	New Access Roads	Improved Access Roads	New Access Roads	Improved Access Roads
West Alternative	**20**	**14**	**10**	**20**
West Option 1	N/C	-1	+1	N/C
West Option 2	+2	+1	N/C	-2
West Option 3	+1	+2	+1	N/C
Central Alternative[2]	**17 (16)**	**9 (9)**	**14 (25)**	**113 (109)**
Central Option 1[2]	+1 (+1)	+3 (+3)	+3 (+1)	+11 (+11)
Central Option 2	+1	-2	+2	-7
Central Option 3	N/C	-1	N/C	-8
East Alternative	**13**	**12**	**21**	**161**
East Option 1	+2	-4	N/C	-7
East Option 2	+1	-1	-3	-26
East Option 3	N/C	N/C	-1	N/C
Crossover Alternative	**15**	**14**	**19**	**78**
Crossover Option 1	+3	N/C	N/C	+1
Crossover Option 2	+1	+5	N/C	+4
Crossover Option 3	+1	+6	N/C	+4

Notes:

N/C – No net change from the action alternative.

1. The value for each option represents the net change from the action alternative. It was calculated as the miles of new or improved roads in the option minus the miles of new or improved roads in the segments the option replaces.

2. Impact numbers not shown in parentheses reflect updated data, assumptions, and design refinements; impact numbers shown in parentheses are from the Draft EIS.

Sources: BPA 2012, 2015

Table 12-2 Existing Roads That Could Be Used for Construction

Alternatives and Options	Existing Roads (miles)[1]
West Alternative	**173.6**
West Option 1	-1.0
West Option 2	+7.6
West Option 3	+16.9
Central Alternative[2]	**31.3 (180.7)**
Central Option 1[2]	+7.0 (-2.2)
Central Option 2	-25.9
Central Option 3	+4.6
East Alternative	**154.6**
East Option 1	-12.0
East Option 2	+25.4
East Option 3	+1.1
Crossover Alternative	**147.6**
Crossover Option 1	+11.7
Crossover Option 2	+10.0
Crossover Option 3	+10.2

Note:

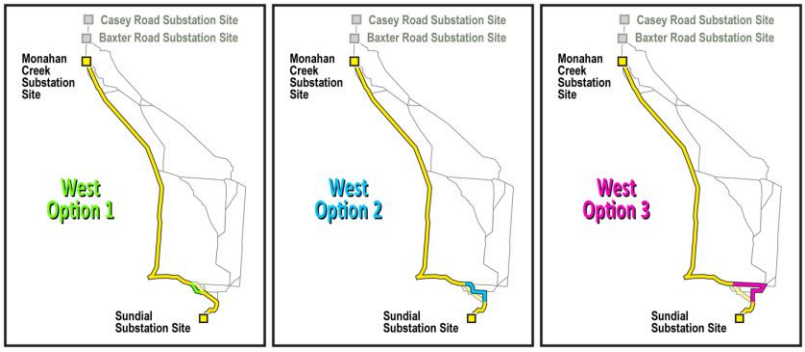
1. The value for each option represents the net change from the alternative. It was calculated as the miles added by the option minus the miles in the segments the option replaces.

2. Impact numbers not shown in parentheses reflect updated data, assumptions, and design refinements; impact numbers shown in parentheses are from the Draft EIS.

Sources: BPA 2012, 2015

12.2.4.1 West Options 1, 2, and 3

Most of the same existing access roads or types of roads would be used for any of the options in areas with developed roadways with urban traffic patterns. West Option 3 would potentially use more existing roads than the West Alternative, including SE Blair Road and NE 58th Street. Construction traffic would be temporary and minor compared to existing traffic in the area and maintenance traffic would be much less.



Impact levels on transportation would be the same as the West Alternative.

12.2.5 Central Alternative

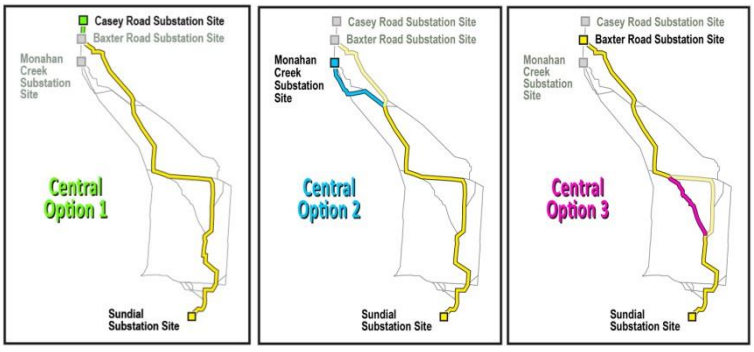
The Central Alternative would cross several highways and state routes (I-5, I-205, SR 14, SR 411, SR 500, SR 502, SR 503, and SR 504), many other roads, including public arterials (Zillig Road, Lewis River Road, NE Yale Bridge Road, and SE Blair Road), and private access roads, including transit routes for timber harvest and private property access. The alternative would also cross railroads (BNSF Railway, Columbia and Cowlitz Railway, and Portland Vancouver Junction Railroad), and would be within 5,000 feet of the Portland-Troutdale Airport (see Maps 12-1A though 12-1D).

The Central Alternative would need 31 miles of new access roads and 122 miles of improved access roads outside the right-of-way (see Table 12-1). Much of the Central Alternative is more rural than the West Alternative with fewer existing roadways and somewhat less overall roadway capacity to accept construction traffic, although existing traffic is likely to be less than the West Alternative.

The Central Alternative could use about 31 miles of existing roads in the project area (see Table 12-2 and Maps 12-1A through 12-1D). Similar to the West Alternative, construction and maintenance crews would use any number of these roads at different times to access right-of-way, towers, or substation sites. The construction contractor would identify these roads for use at the time of construction (see Section 12.2.4, West Alternative).

Similar to those described in impacts common to action alternatives and the West Alternative, new and improved roads within rights-of-way would have **no** impact on transportation because they would not be public. These same roads though may provide unintended access from trespassers and cause unauthorized uses (see Chapter 5, Land). New and improved roads outside of the right-of-way may affect local transportation during operation by improving some existing roads currently used for other purposes. New roads might encourage traffic in areas where there was none before. Generally, these roads would have a **low-to-moderate** impact on local traffic depending on length of construction activities in a particular area and if these activities cause delays or detours. Because of the infrequent nature of maintenance activities during the operation of the line, **no-to-low** impacts would occur during these activities.

12.2.5.1 Central Options 1, 2, and 3



Central Option 1 would not add any additional crossings of public roads although many logging roads would be crossed. Central Option 2 would add a crossing of SR 411 and remove the crossing of SR 504. Central Option 3 would use additional local roads, including NE Cedar Creek Road, and NE 379th Street. Differences in impacts of the options compared to the Central

Alternative would be temporary or intermittent, and would not cause a significant change in transportation impacts.

Impact levels on transportation would be the same as the Central Alternative.

12.2.6 East Alternative

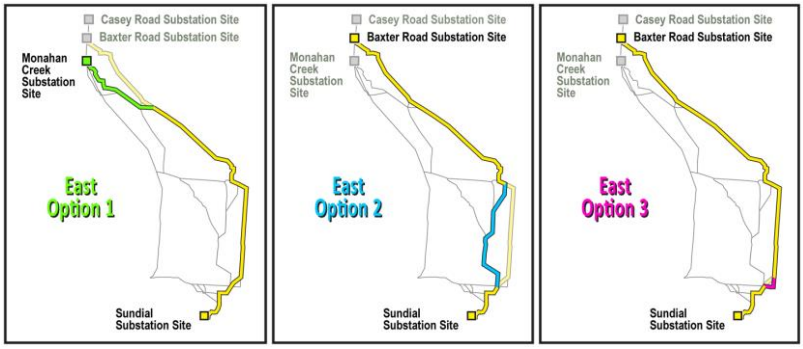
Similar to the West and Central Alternative, the East Alternative would cross several highways and state routes (I-5, SR 14, SR 503, and SR 504) and many other roads, including public arterials (Rock Creek Road, Lewis River Road, Yale Bridge Road, and SE Blair Street), and private access roads, including transit routes for timber harvest and private property access. The alternative would also cross the BNSF Railway and the Columbia and Cowlitz Railway. It is also within 5,000 feet of a small paved private airstrip just south of the Lewis River crossing and the Portland-Troutdale Airport (see Maps 12-1A though 12-1D).

Much of the East Alternative is more rural than the West Alternative with fewer existing roadways and generally less overall capacity to accept construction traffic based on the number and design capacity of roads. Existing traffic on those roads is correspondingly less. The East Alternative would need 34 miles of new access roads, similar to the Crossover Alternative, and 173 miles of improvements to access roads—more than any other alternative (see Table 12-1).

The East Alternative could use about 155 miles of existing roads in the project area (see Table 12-2 and Maps 12-1A through 12-1D). Similar to the previous alternatives, construction crews would use any number of these roads at different times to access right-of-way, towers, or substations.

Similar to those described in impacts common to action alternatives and the previous alternatives, new and improved roads within rights-of-way would have **no** impact on transportation because they would not be public. These same roads though may provide unintended access from trespassers and cause unauthorized uses (see Chapter 5, Land). New and improved roads outside of the right-of-way may affect local transportation during operation by improving some existing roads currently used for other purposes. New roads might encourage traffic in areas where there was none before. Generally, these roads would have a **low-to-moderate** impact on local traffic depending on length of construction activities in a particular area and if these activities cause delays or detours. Because of the infrequent nature of maintenance activities during the operation of the line, **no-to-low** impacts would occur during these activities.

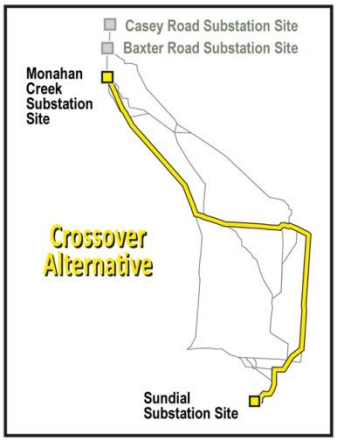
12.2.6.1 East Options 1, 2, and 3



Similar to Central Option 2, East Option 1 would cross West Side Highway, but remove the crossing of SR 504. East Option 2 would require 2 fewer miles of new access roads and 27 fewer miles of improved access roads. East Option 3 would add about 1 mile of existing roads. Differences in impacts compared to the East Alternative would be temporary or intermittent, and insignificant.

Impact levels on transportation would be the same as the East Alternative.

12.2.7 Crossover Alternative

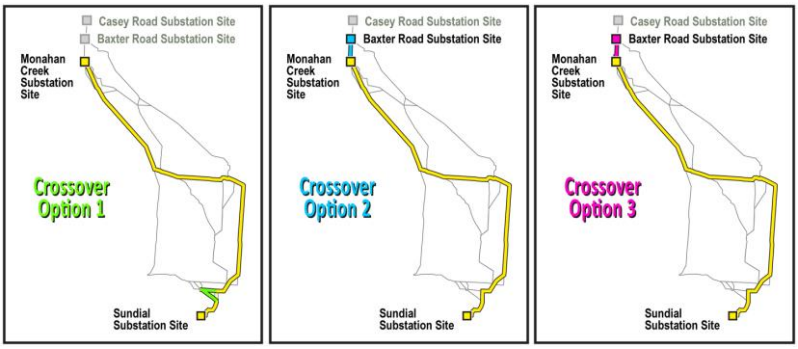


Transportation impacts along this alternative would be the same as those along the northern portion of the West Alternative north of the Lewis River, and the southern portion of the East Alternative south of Yale Dam. Where the Crossover Alternative runs west to east, transportation impacts would be the same as those for the Central Alternative between the Merwin and Yale dams. Much of the Crossover Alternative is more rural than the West Alternative with fewer existing roadways and less overall capacity to accept construction traffic, although less existing traffic is likely to occur here than near the West Alternative. The Crossover Alternative would need 34 miles of new access roads, similar to the East Alternative, and would need 92 miles of improvement to access roads (see Table 12-1).

The Crossover Alternative could use about 148 miles of existing roads in the project area (see Table 12-2 and Maps 12-1A through 12-1D). Similar to other action alternatives, construction crews would use any number of these roads at different times to access right-of-way, towers, or substation sites.

Similar to those described in impacts common to action alternatives and the previous alternatives, New and improved roads within rights-of-way would have **no** impact on transportation because they would not be public. These same roads though may provide unintended access from trespassers and cause unauthorized uses (see Chapter 5, Land). New and improved roads outside of the right-of-way may affect local transportation during operation by improving some existing roads currently used for other purposes. New roads might encourage traffic in areas where there was none before. Generally, these roads would have a **low-to-moderate** impact on local traffic depending on length of construction activities in a particular area and if these activities cause delays or detours. Because of the infrequent nature of maintenance activities during the operation of the line, **no-to-low** impacts would occur during these activities.

12.2.7.1 Crossover Options 1, 2, and 3



Crossover Option 1 would add 3 miles of new access road, and 1 mile of improved access road. By extending the right-of-way from the Monahan Creek substation site to the Baxter Creek substation site, Crossover Option 2 and Crossover Option 3 would cross additional roads mostly used for logging activities. Crossover Options 2 and 3 would require improvements of 9 to 10 more miles of access road. Differences in impacts compared to the Crossover Alternative would be minor.

Impact levels on transportation would be the same as the Crossover Alternative.

12.2.8 Recommended Mitigation Measures

Mitigation measures included as part of the project are identified in Table 3-2. BPA is considering the following additional mitigation measure to further reduce or eliminate adverse transportation impacts by the action alternatives. If implemented, this measure would be completed prior to, during, or immediately after project construction unless otherwise noted.

- Notify interested parties of construction and maintenance activities and schedules and traffic delays and detours.

12.2.9 Unavoidable Impacts

Unavoidable transportation impacts remaining after mitigation would be temporary delays, detours, and interruption to local traffic during construction and even less traffic during maintenance activities.

12.2.10 No Action Alternative

The No Action Alternative would have **no** impact on transportation because no new transmission lines, towers, access roads, or substations would be constructed. Transportation resources would likely expand through future development, but temporary impacts from operation and maintenance of existing transmission lines and substations in the project area would continue unchanged on current road systems.

Chapter 13 Cultural Resources

This chapter describes cultural resources in the project area, and how the project alternatives could affect these resources.

Words in **bold** and acronyms are defined in Chapter 32, Glossary and Acronyms.

13.1 Affected Environment

Cultural resources are nonrenewable resources associated with human occupation or activity related to history, architecture, archaeology, engineering, and culture. **Historic properties**, as defined by 36 CFR 800, the implementing regulations of the National Historic Preservation Act (NHPA), are a subset of cultural resources that are eligible for inclusion in the National Register of Historic Places (NRHP). They are defined as any district, site, building, structure, or object important in human history at the national, state, or local level. Historic properties include both historic and **pre-contact** resources. Pre-contact resources are those that pre-date contact between Euro-Americans and Native Americans.

Previous cultural resource studies have been completed in certain portions of the project area resulting in the identification of known cultural resources. However, given its size, most of the project area has not been surveyed for cultural resources making it likely there are undiscovered cultural resources in the project area. The probability of encountering undiscovered cultural resources along the action alternatives varies. Topographic features and known sites are strong predictors of the presence of cultural resources (e.g., cultural sites are more common in flat areas near water sources). The distribution of both known and unknown cultural resources along the action alternatives is likely to be unequal because specific landforms and water bodies vary among the alternatives. For example, relatively flat land next to a river with historic fish runs, or near a natural travel corridor where historic Indian place names are found would have a greater likelihood of cultural resources than steep slopes or uplands away from a river or stream.

Based on existing models, the location of known cultural sites, and land features, BPA developed a predictive analysis of the likelihood of encountering previously undiscovered cultural resources for each action alternative (see Section 13.2.2.1, Predictive Analysis and Cultural Resource Sensitivity Scores). The results of the Predictive Analysis for each action alternative were taken into consideration in the selection of the Preferred Alternative (Central Alternative using Central Option 1). Cultural surveys were done for the Preferred Alternative to identify archaeological and historic resources (see Section 13.1.2, Pre-Contact and Historic Archaeological Sites and Section 13.1.4, Historic Resources).

The project is within three **physiographic regions** primarily in Washington, with a small portion in Oregon: the Willapa Hills, Southern Cascades, and the Portland Basin. The archaeological record indicates that this area has been occupied by human populations for at least 10,000 years (Ozbun, et al. 2011). The project extends through lands traditionally inhabited by two Native American groups: the Cowlitz and the Chinook. Most of the project area is within the traditional territory of the Cowlitz, which includes a large portion of inland southwest Washington from the Columbia River to the foothills of the Cascade Range. The area was also traditionally frequented by the Klickitat who historically resided east of the Cascade Range, but ventured into southwest Washington to procure root crops and berries and occasionally resided in Cowlitz territory. During the winter, Cowlitz villages of four to five houses and 30 to

50 people and sometimes up to 300 people were established along the Cowlitz River from its confluence with the Columbia River to 40 miles upstream. Some people would stay in the villages year round, but most left in May and traveled to prairies to collect and process roots. Seasonal fishing camps were also established to catch salmon and other fish (Ozbun, et al. 2011).

The southern end of the project is within the traditional territory of the Chinookan group known as the Multnomah. Their territory extended just south of the mouth of the Kalama River to the vicinity of the Sandy River. Chinook villages were also near the Columbia River between the mouths of the Cowlitz and Washougal rivers. Chinook winter villages tended to be larger than those of the neighboring Cowlitz. The Chinook wintered in cedar-gabled structures usually occupied by two to four related families, but households of 10 or more families were also known to occur. In early spring, families would leave the villages for seasonal camps where they gathered and processed resources. Important fish resources included salmon, sturgeon, steelhead, and eulachon. Important plant resources included roots, mainly wapato and camas, and berries (Ozbun, et al. 2011).

The arrival of Europeans and other non-Native Americans in the Pacific Northwest in the late eighteenth century greatly altered the traditional native way of life. Disease, traders, missionaries, and new technology had considerable impacts on the Native American people. Diseases such as malaria are estimated to have decimated native populations by 30 percent or more by the early 1800s. The fur trade introduced new goods and new modes of exchange into complex traditional trading systems. By about 1810, posts were established in the interior regions from the Pacific coast, and these posts were the first permanent non-Native American settlements in the region. The British Hudson's Bay Company (HBC) dominated this trade by the 1820s and continued to be the primary foreign presence in the region until the 1850s. Fort Vancouver in modern Vancouver, Washington, was the regional headquarters of the HBC fur trade empire (Ozbun, et al. 2011).

By 1846, most Euro-American settlements in the area were south of the Columbia River, or in areas along the Deschutes in central Oregon, and Cowlitz and Skookumchuck rivers in southwestern Washington. American settlements became commonplace in the 1850s after the establishment of the Oregon Territory in 1848, which gave inhabitants legal claims and rights, as did the passage of the Donation Land Claim Act by Congress in 1850. This increase in Euro-American settlements led to attempts to establish treaties between the settlers and the Tribes. In 1855, Isaac Stevens, the Washington Territorial Governor, tried to persuade the Chinook, Cowlitz, and other groups in Western Washington to cede most of their lands to the U.S. Government. This attempt was unsuccessful and no treaties were signed with the Chinook or the Cowlitz. Some Chinookan groups who resided in Oregon did sign a treaty with the Oregon Superintendent of Indian Affairs in 1851, but this treaty was never ratified. This left most Chinookan groups and all Cowlitz groups without a treaty with the U.S. government for lands (Ozbun, et al. 2011).

By the 20th Century, BPA was created in 1937 during the Great Depression to transmit and market Columbia River hydropower generated by the Bonneville and Grand Coulee dams. The impact of BPA on the Pacific Northwest, which saw 3,000 circuit miles of transmission lines constructed and interwoven into existing transmission lines from 1939 to 1945, was immense. During World War II, BPA's "Master Grid" energized important wartime industries such as shipyards in Portland and Vancouver, and airplane plants in the Puget Sound region (Kramer 2009). BPA played a major role in the promotion of public power in the Pacific

Northwest, leading to the formation of public utility districts and, with the Rural Electrification Administration, many rural cooperatives. Such efforts delivered low-cost power, expanded electric service regionally, and contributed to the modernization and growth of small Pacific Northwest communities in the years following World War II (Kramer 2009).

13.1.1 Area of Potential Effect

As defined by the National Historic Preservation Act (NHPA), the **area of potential effects** (APE) is the geographic area where historic properties could be directly and/or indirectly impacted as a result of the project. The APE for each action alternative is 0.5 mile on either side of the transmission line centerline and includes the existing and proposed rights-of-way, varying acreage for the four substation sites: (Sundial [Lots 11 and 12] 62 acres; Casey Road 100 acres; Baxter 47 acres; Monahan 67 acres), and the proposed new and improved access roads outside the transmission line right-of-way. Also included in the APE are areas identified for fiber installation, pulling and tensioning sites, temporary access roads, and danger tree removal.

13.1.2 Pre-Contact and Historic Archaeological Sites

Background research on previous work done within the APE for each action alternative indicated that a total of 39 **archaeological resources** have been previously documented. This includes 33 archaeological resources recorded in the Washington Department of Archaeology and Historic Preservation (DAHP) database and six resources identified in previous survey reports, but not officially recorded. These 39 archaeological resources consist of 17 pre-contact sites, 17 **historic sites**, and five multi-component sites (i.e., where both pre-contact and historic cultural materials are present). The pre-contact sites include four village locations, 10 **lithic** scatter sites, and three isolated artifact (i.e., a single artifact) sites. The 17 recorded historic sites include two farmstead sites, two abandoned roads, five cemeteries, two grave markers, one debris scatter, one mine, one rock feature site, one aircraft crash site, one hydroelectric site, and one site consisting of irrigation system remnants (Ozbun, et al. 2011).

Many of the recorded pre-contact sites are near major waterways including Lacamas Lake, the Washougal River, and the Columbia River. Fewer archaeological sites have been identified in upland areas in the eastern and northern portions of the project area. Similarly, few archaeological sites have been identified for the eastern and northern portions of the action alternatives. However, fewer archaeological surveys have been conducted in these areas. Most known archaeological resources are located along southern portions of the actions alternatives, specifically segments 25, 40, and 52, an indication of both the importance of certain areas within these segments to pre-contact and historic populations and that more cultural resource studies have been conducted in these areas (Ozbun, et al. 2011).

Pedestrian surveys were done within the APE for the Preferred Alternative – the Central Alternative using Central Option 1 – to identify resources within a direct impact area 500 feet wide (250 feet either side of transmission line centerline) along the existing and proposed right-of-way, varying acreage for the substation sites, and 50 feet wide (25 feet either side of road centerline) for the proposed new and improved access roads outside the transmission line right-of-way. Previously recorded and new archaeological resources were identified (see Table 13-1). Surveys will continue for the Preferred Alternative as permission to access

previously inaccessible properties is granted; and to the extent necessary in any areas where the route for this alternative is refined.

Table 13-1 Identified Archaeological Resources within the APE for the Central Alternative using Central Option 1[1]

Site Type	Sites	Isolates[2]
Newly Identified		
Prehistoric	5	8
Historic	6	4
Multicomponent	0	1
Previously Identified		
Prehistoric	5	0
Historic	3[3]	0
Multicomponent	1[4]	0
Total	**20**	**13**

Notes:

1. Unless otherwise noted, sites have not been evaluated for eligibility for listing on the NRHP.
2. All isolates identified do not have the potential to contribute important information to the area's history and should be considered not eligible for listing in the NRHP.
3. One of these three previously identified historic sites is not eligible for listing in the NRHP.
4. Eligible for listing in the NRHP.

13.1.3 Traditional Cultural Properties

The NHPA requires federal agencies to consult with tribal and other cultural communities to identify Traditional Cultural Properties that may be affected by federal undertakings. A **Traditional Cultural Property** (TCP) is a property type that may be eligible for listing on the NRHP. Similar to other potentially eligible property types, the significance and eligibility of a TCP is "derived from the role the property plays in a community's historically rooted beliefs, customs and practices" (Parker and King 1998). These sites are important in maintaining a community's historic identity and help preserve and perpetuate traditional knowledge and culture. The nature of a TCP depends on the meaning given to it by the living cultural community, and that community must play a central role in the identification, evaluation, and treatment of the property (Hutt 2006).

Traditional Cultural Properties may be a single site, a district, or a cultural landscape. They may be archaeological, historic or **ethnographic** in nature. Ethnographic is defined here as identifying with a specific culture or group. The TCP setting is variable and may include urban neighborhoods, rural communities, natural settings, or prominent landform features. A wide range of community resources important to ethnic groups throughout the United States are considered TCPs, including communities such as the German Village in Columbus, Ohio, or Chinatown in Honolulu, Hawaii. In the Pacific Northwest, much of the focus of TCP evaluation has been on American Indian communities, and the 1992 amendment to the NRHP specifically notes that properties of religious and cultural significance to Indian Tribes may be determined to be eligible for listing on the NRHP (16 USC 470a(d)(6)(A)).

Many Native American communities displaced from their traditional homelands by European settlement maintain ongoing cultural links with their historic traditional use areas. They

recognize TCPs that are often outside of their modern reservation settings based on pre-European contact settlement and subsistence activities. These TCPs include traditional hunting areas, plant gathering and fishing sites, village locations, archaeological sites, rock image sites, places of historical importance, places that are featured in tribal legends, historic trails, burial grounds, ceremonial use areas, and sacred landscapes. Many variables can contribute to a sacred landscape, such as **myth-time stories** attached to the location. These stories detail creation beliefs for the Tribes and hold religious significance. Sacred landscapes have a strong socio-cultural connection to tribal people.

There are 27 locations classified as ethnographic cultural resources either within or within the immediate vicinity of the action alternatives. Ethnographic resources include many listed from ethnographic research and historic documents (e.g., maps) and others identified in consultation with the Cowlitz Indian Tribe. Nine locations classified as ethnographic cultural resources within the immediate vicinity of the action alternatives were identified by the Confederated Tribes of Grand Ronde.

These resources are specific locales with particular cultural significance to the Tribes. Should BPA decide to build this project and select an alternative that may impact one or more of these ethnographic resources, BPA would seek to avoid the resource, or determine its eligibility as a TCP and consult to address any unavoidable adverse effects.

13.1.4 Historic Resources

There are 16 previously recorded historic resources within the APE for each action alternative. **Historic resources** are defined as extant buildings, structures and objects, or districts that will meet the minimum age requirement for eligibility for listing in the NRHP within 5 years. A resource must be at least 50 years old to be eligible, must have historic significance under one or more designated criteria, and it must have retained its integrity. Of the 16 historic resources identified, three have been determined eligible for the NRHP, five have been determined not eligible and eight have not been evaluated. BPA's transmission network, which includes all existing BPA transmission lines and facilities constructed up to 1974, is a historic resource that is considered to be eligible to the NRHP.

An historic resource survey was done along the Preferred Alternative – the Central Alternative using Central Option 1 -- to further identify resources within a study area of 0.5 mile on either side of the transmission line centerline (see Table 13-2). Surveys will continue for the Preferred Alternative as permission to access previously inaccessible properties is granted; and to the extent necessary in any areas where the route for this alternative is refined.

Table 13-2 Identified Historic Resources along the Central Alternative using Central Option 1

Resource Location	Not Eligible For Listing to the NRHP	Eligible for Listing to the NRHP	Listed in the NRHP	Unevaluated	Total
Within transmission line right-of-way, access roads, or substations	32	26	0	2	**60**
Outside transmission line right-of-way, access roads, or substation	771	55	2	5	**833**
Total	**803**	**81**	**2**	**7**	**893**

13.2 Environmental Consequences

General impacts that would occur for the action alternatives are discussed below (including a discussion of the predictive analysis), followed by impacts unique to each alternative.

13.2.1 Impact Levels

Impacts are anticipated to be **high** where project activities would cause the following:

- adversely affect NRHP eligible sites or "**red-flags**" (cultural resources to which potential effects are considered difficult or impossible to avoid)

Impacts are anticipated to be **moderate** where project activities would cause the following:

- adversely affect any known archeological or historic resources that have not yet been evaluated as eligible to the NRHP

Impacts are anticipated to be **low** where project activities would cause the following:

- affect a cultural resource determined to be ineligible to the NRHP

Impact levels are based on available information or on the potential of an area or site to have cultural resources that could be affected. Once a route is selected, BPA will evaluate impacts to identified resources following NHPA regulations.

13.2.2 Impacts Common to Action Alternatives

Clearing for the new right-of-way, pulling and tensioning sites, temporary access roads, staging areas, helicopter fly yards, and danger trees; and construction of substations, towers, counterpoise installation, access road improvements and new road construction, and limited installation of wood poles for fiber optic cable (fiber would generally be installed on the towers) have the potential to damage or destroy any cultural resources that are present. Visual elements that alter the character or setting of cultural resource sites are forms of disturbance, as are direct physical impacts to site integrity. Increased access to cultural resources from project construction, operation, and maintenance can increase vandalism and looting.

If existing substations, transmission lines and towers that are eligible for listing on the NRHP are altered or replaced as part of the project, there could be an adverse effect on these properties based on the historic nature of some of BPA's infrastructure.

BPA attempts to avoid known sites whenever possible and uses trained cultural resource monitors on large-scale projects to ensure unidentified sites are not inadvertently affected. Sites are identified using several methods including archaeology, oral history, and historical research. Archaeological sites would be delineated both by surface observations and subsurface testing before construction to avoid physically disturbing sites during construction. Appropriate mitigation procedures would be in place to stop construction activities and determine protective measures (e.g., avoidance) if artifacts are found (see Table 3-2). Unknown sites should not be disturbed with these procedures in place.

Operation and maintenance of the transmission line and substations would not directly affect cultural resources as the area will have been surveyed before project construction and any impacts to the sites will have been previously determined and mitigated if needed. Maintenance of towers or access roads would not affect known resources. If any maintenance activities need to occur outside of tower locations or off access roads, a review of sensitive areas would be required to avoid disturbing cultural resources.

13.2.2.1 Predictive Analysis and Cultural Resource Sensitivity Scores

Given the general inaccessibility of the proposed routes for the action alternatives and the extensive area covered by the APE, BPA developed a predictive analysis to assess the potential for cultural resources along each alternative. A background review and literature search was performed for the route segments, access roads and substation sites. The review included environment, archaeology, **ethnography**, and history data within the APE. Cultural resource data specific to the segments, access roads and substations were then compiled to estimate the cultural sensitivity of each action alternative. Using the Washington Statewide Predictive Model and known cultural resources, each individual route segment was given a cultural sensitivity "score." The cultural sensitivity score provides a basis for comparison among the action alternatives and reflects both the number and significance of known cultural resources within each route segment and for each substation, as well as the probability of encountering previously undiscovered cultural resources.

The Washington Statewide Predictive Model uses environmental variables such as elevation, slope, soils, aspect, proximity to water, surface geology, and landforms as predictors of cultural resources. The model also uses background data compiled from the Washington State DAHP database and the Oregon State Historic Preservation Office (SHPO) database, and other historic materials such as Sanborn Fire Insurance maps and Metsker maps.

Information was also compiled from ethnographic research and historic documents, and from the Cowlitz Indian Tribe. The Cowlitz identified specific areas of importance to them that were flagged for the analysis.

BPA calculated sensitivity scores for each alternative and option to determine which of the action alternatives may have a higher likelihood of cultural resource impacts. The four background areas noted above (environmental, archaeological, ethnographic and historic) were studied independently to determine their "raw" scores, which were then added together for a

total score for each segment and then each alternative and option. Each variable was given a number on a scale of 0-100, "normalized" within its variable, and then these four values were calculated to get a median score for each segment. The route segments were then added together to give a total score for each alternative and option (see Table 13-3). Access roads were assigned to route segments for the calculation of the cultural sensitivity scores. Substation site scores were calculated separately and then added to the alternative or option scores. The higher the sensitivity score, the more likely there are cultural resources located in the alternative or option. A complete description of the scoring system is in Appendix I.

Table 13-3 Cultural Resource Sensitivity Scores[1, 2]

Alternatives and Options	Cultural Sensitivity Score	Previously Identified Sites within the APE for the Action Alternatives		
		Archaeological	Historic	Ethnographic
West Alternative	**498**	**27**	**18**	**13**
West Option 1	+21	+1	N/C	N/C
West Option 2	+53	-6	-5	-1
West Option 3	+42	-4	N/C	N/C
Central Alternative	**435**	**17**	**1**	**5**
Central Option 1	+12	-1	N/C	+3
Central Option 2	+51	-1	+3	+6
Central Option 3	-26	N/C	+4	N/C
East Alternative	**394**	**14**	**6**	**12**
East Option 1	+11	-1	N/C	-2
East Option 2	+31	+3	N/C	+1
East Option 3	-5	N/C	N/C	N/C
Crossover Alternative	**463**	**12**	**9**	**8**
Crossover Option 1	+57	-1	N/C	+3
Crossover Option 2	+35	+1	N/C	+2
Crossover Option 3	+34	+1	N/C	+2

Notes:

1. The scores for each option represent the net change from the action alternative. They were calculated as the total score of the option's segments minus the total score of the segments the option replaces.

2. Substation sites are included in the sensitivity scores.

Source: AINW 2011

13.2.2.2 Sundial Substation Site

The two options for the Sundial Substation site (Lots 11 and 12) each have a cultural sensitivity score of 25. This site has a very low probability for intact buried deposits of archaeological resources, due to the site's location in a previously-disturbed industrial area near other substations, and because the presence of existing transmission lines makes it more likely archaeological resources have been damaged or destroyed by construction of the existing infrastructure. Archaeological surveys of the Sundial site (Lots 11 and 12) identified one

isolated archaeological find. The probability of identifying historic resources at the Sundial Substation site is high because it is close to BPA's Troutdale Substation, a historic property that has been determined eligible to the NRHP. During the historic resource survey of the site, 12 historic resources were identified. Because the historic Troutdale Substation could be affected by potential visual impacts caused by the project, impacts at the Sundial site are likely to be moderate.

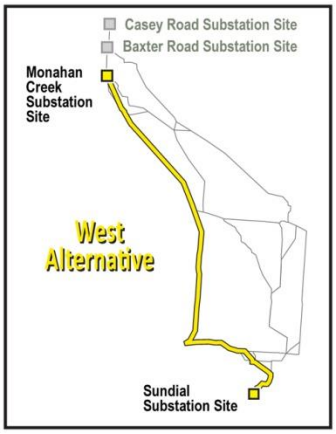
13.2.3 Castle Rock Substation Sites

Impacts common to action alternatives are in Section 13.2.2. The remaining sections discuss impacts unique to each alternative, and recommended mitigation measures.

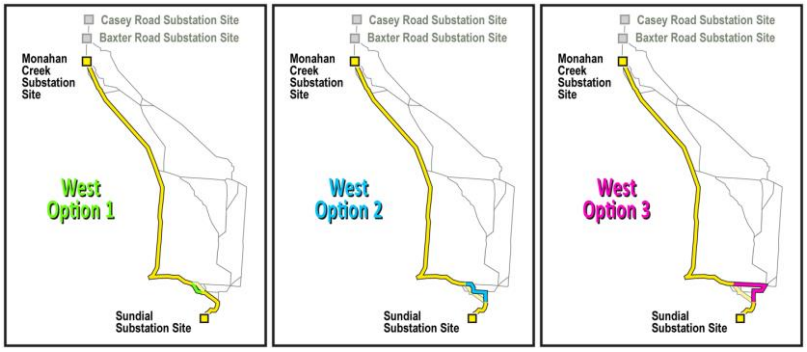
The Monahan Creek and Baxter Road sites have the same cultural sensitivity score of 24. This higher score is likely due to their proximity to creeks. The Casey Road site has the lowest score at 15. The three substation sites are in remote areas that have been previously logged and are next to existing transmission lines that may have disturbed archaeological resources previously. Logging activities and transmission lines in the area may also contribute to a higher possibility that historic resources are present (i.e., historic transmission lines and historic logging camps). Because there are historic transmissions lines present in the area of the Monahan Creek, Casey Road and Baxter Road sites, impacts are anticipated to be **moderate**.

13.2.4 West Alternative and Options

The West Alternative is the most likely culturally sensitive action alternative because it crosses areas within large population centers that contain a greater number of known sites (see Table 13-1). A greater number of sites are known probably because more cultural surveys have been completed in these areas compared to the other alternatives, and also because the areas are more suitable for habitation because of environmental factors (i.e., access to resources, and flatter topography).



Segments in the southern half of the West Alternative have the highest probability of cultural resources present (segments 25, 40, 46, and 52). These segments are in highly populated areas containing a number of previously recorded sites. Segments that have resources at proposed tower sites are 2, 4, 9, 25, 36b, 41, 45, 50, and 52. In Segment 25, known sites that could be disturbed by towers include a trail, a historic grave marker, an ethnographic fishing location, a cemetery, a lithic scatter, and an ethnographic prairie. Segment 4 has ethnographic village sites, the historic Northern Pacific Railroad site, and the Ostrander Tunnel and Portal. Segment 52 (the southernmost segment



common to all action alternatives) has a lithic scatter, a historic site, and the Parkersville site, which is listed on the NRHP. The other segments also have sites that include trails, and ethnographic villages.

West Option 1 removes three segments with known cultural resources and substitutes two segments with known resources. Segment 40 has resources including a historic road and a historic grave marker. Segment 46 has some of the same resources, including the same historic marker.

West Option 2 removes the same three segments as West Option 1 and also removes Segment 50; all four removed segments have towers proposed at known cultural resource locations. However, West Option 2 adds four new segments which also have cultural resources at proposed towers sites: segments 36, 36a, 37, and 43. These resources include a village and ethnographic prairie.

West Option 3 removes four segments that have proposed towers at known cultural resources and adds three segments (36, 36a and 37) that have known resources at tower sites.

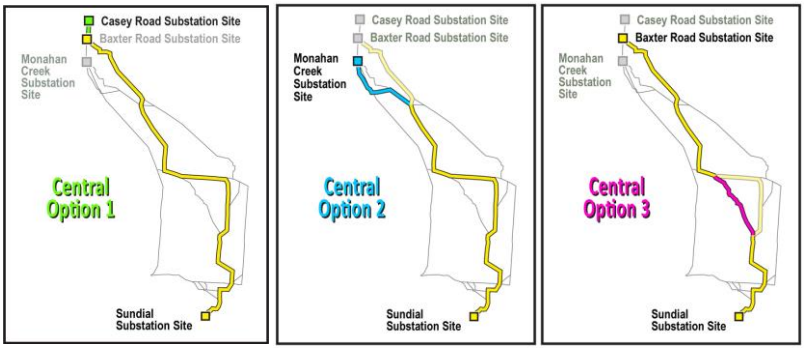
Because the West Alternative and its options have NRHP eligible sites or red-flags at proposed tower locations, have unevaluated sites at tower locations and have historic transmission resources that may be impacted by project activities, the West Alternative and its options are anticipated to create **moderate-to-high** impacts on cultural resources.

13.2.5 Central Alternative and Options

The Central Alternative has the second lowest cultural sensitivity score. This is partially because this alternative is in a less-populated area with fewer previous surveys completed. The segments that have the highest score and are more likely to have cultural resources that could be affected are segments 4 and 52.

The Central Alternative has five segments (10, 28, 52, B and F) that have known cultural resources at proposed tower locations. These resources include trails, villages, and lithic scatters.

Central Option 1 adds Segment A, which has the same trail at a tower location as segments B and F. Central Option 2 removes these two segments, but adds three other segments that could also cause impacts to resources because of tower location (segments 1, 4, and 5). These resources include an ethnographic village site.



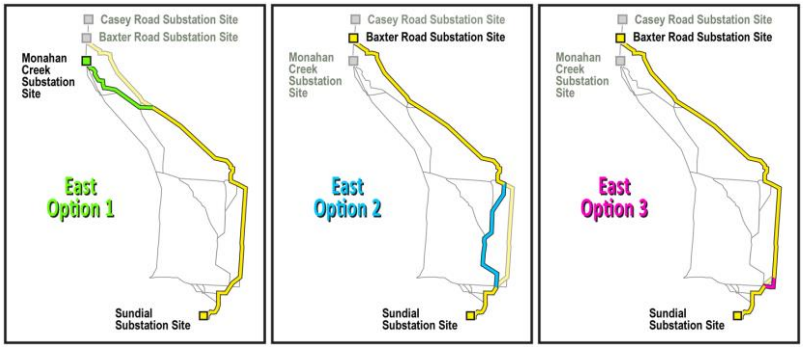
Central Option 3 removes Segment 28 that has known resources (ethnographic trail and prairie) at proposed tower locations and adds Segment 30, which also has a proposed tower on the same ethnographic trail.

Because the Central Alternative has historic BPA transmission lines present and the Central Alternative and its options have NRHP eligible sites or red flags located at proposed towers, the Central Alternative and its options are anticipated to create **moderate-to-high** impacts to cultural resources. Recent archaeological and historic resource surveys that were done for the Central Alternative and Central Option 1 (see Tables 13.1 and 13.2) came to the same conclusion; significant historic resources may be affected within this corridor, both directly and indirectly, from project construction.

13.2.6 East Alternative and Options

The East Alternative has the lowest cultural sensitivity score, likely because it does not cross through as many highly populated areas, is in an area with more topography, steeper slopes and higher elevations, and is less likely to have been used by Tribes as often as the other action alternatives. Two segments that have a higher probability of affecting cultural resources are segments 3 and 52. Segment 3 has two ethnographic resources that could be affected by tower construction. Segment 52 is common to all alternatives (see Section 13.2.4, West Alternatives and Options).

Although the East Alternative has the lowest probability to affect cultural resources, it does have towers proposed at known cultural resources. These are in segments 52, B, F, K, O, and W. These known resources include historic military roads, trails, and lithic scatters.

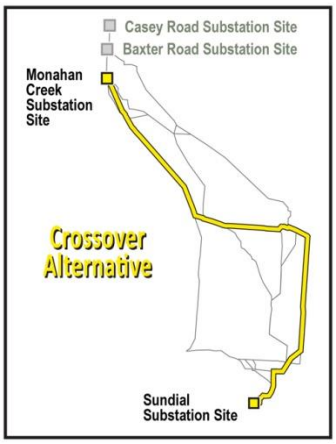


For East Option 1, which has a higher sensitivity score than the East Alternative segments it replaces, segments B and F are removed and are replaced by segments 3, 7, 11, and J. Segment 3 has several known cultural resources and has a high sensitivity score. Segment 3 is the only new segment that has known cultural resources that may be affected by direct tower impacts (village site).

For East Option 2 segments O, Q, and S are removed and replaced by segments U, V, P, 35, and T, but only one of the added segments (Segment U) has a known cultural site that may be affected by a proposed tower (trail). East Option 3 adds only one segment (Segment R), which replaces Segment Q, resulting in nearly the same sensitivity score. There are no known sites at proposed tower locations.

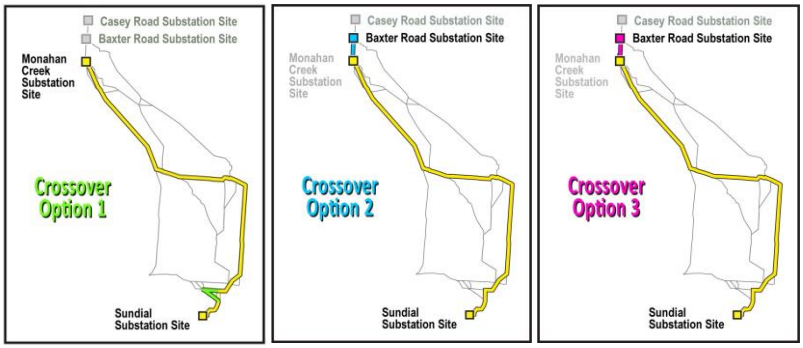
Because the East Alternative and its options have NRHP sites or red-flags at proposed tower locations, unevaluated sites at proposed tower locations, and areas where BPA's historic transmission system is present, the East Alternative and its options are anticipated to create **moderate-to-high** impacts to cultural resources.

13.2.7 Crossover Alternative Options



The Crossover Alternative has the second highest cultural sensitivity score. The likely reason for the higher score is that this alternative has a number of segments that occur in highly-populated areas and more surveys have been conducted in those areas. The segments that have the highest probability of impacts to cultural resources are the same as the Central Alternative: segments 4 and 52. South of Segment 4, the probability for impact to cultural resources lowers dramatically (see Sections 13.2.4, West Alternative and Options, and 13.2.5, Central Alternative and Options).

Within the Crossover Alternative, seven segments have towers proposed at known cultural resources: segments 2, 4, 9, 52, N, O, and W. Resources that could be affected by the proposed towers are the same from segment to segment and include trails, village sites, and lithic scatters.



For Crossover Option 1, segments 47, 48, and 50 replace Segment 51. Segments 47 and 50 both have towers that may impact sites (ethnographic prairies and a village site).

For Crossover Option 2, segments C and E are added and only Segment C has a tower where it could affect a historic military road. Crossover Option 3 adds segments D and E. A proposed tower affecting the historic military road is in both segments.

Because the Crossover Alternative and its options have NRHP sites or red flags at proposed tower locations, unevaluated sites and historic transmission infrastructure, the Crossover Alternative and its options are anticipated to create **moderate-to-high** impacts to cultural resources.

13.2.8 Recommended Mitigation Measures

Mitigation measures included as part of the project are identified in Table 3-2. BPA is considering the following additional mitigation measures to further reduce or eliminate adverse cultural resource impacts by the action alternatives. If implemented, these measures would be completed before, during, or immediately after project construction unless otherwise noted.

- Locate transmission towers and access roads to avoid impacting cultural resources (historical and archaeological resources), where possible.
- Use existing access roads where possible to limit possibility of new disturbances.

- Consult with Washington DAHP, Oregon State Historic Preservation Office (SHPO), the Quinault Indian Nation, the Nez Perce Tribe, the Cowlitz Indian Tribe, the Confederated Tribes of the Chehalis, the Confederated Tribes of the Grande Ronde, the Confederated Tribes of the Umatilla Indian Reservation, the Confederated Tribes of the Warm Springs Reservation of Oregon, the Confederated Tribes and Bands of the Yakama Nation, as required.
- Develop an Inadvertent Discovery Plan that details crew member responsibilities for reporting in the event of a discovery during construction. This plan should include directives to stop work immediately and notify local law enforcement officials (if appropriate), appropriate BPA personnel, Tribes, and Washington DAHP or Oregon SHPO if cultural resources are discovered.
- BPA would notify WDNR if an inadvertent discovery occurs on its land.
- Ensure cultural resources monitors are present during construction in an area of known cultural resources to monitor sites and to prevent unauthorized collection of cultural material.
- Prepare a mitigation plan to protect sites if final placement of project facilities may cause unavoidable adverse impacts to a significant cultural resource.

13.2.9 Unavoidable Impacts

Some effects of the project may not be physical or direct in nature. The new transmission line could affect the viewshed of nearby sites or culturally significant areas that have yet to be identified. While these effects could be partially mitigated by various construction methods, including double-circuiting, they cannot be eliminated completely. BPA will continue to conduct studies (including additional cultural resource surveys on the Preferred Alternative if needed and if access is available) and consult with appropriate entities to identify resources and the effects that could result from each action alternative.

13.2.10 No Action Alternative

The No Action Alternative would have no impact on cultural resources in the project area because no new transmission lines, towers, access roads, or substations would be constructed. Impacts from operation and maintenance of existing lines and substations would remain unchanged. Impacts from disturbances from other activities in the area such as logging, land development, and transportation and other infrastructure improvements would continue.

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