Chapter 4 Environmental Consequences – Effects on Ecosystems

What is addressed in this chapter?

This chapter describes the existing natural environment and how the alternatives may impact natural resources. This chapter specifically addresses the following elements:

- Earth
- Hazardous Materials
- Water
- Plants and Animals
- Climate Change

Several exhibits within this chapter identify the locations and/or conditions of natural resources. The mapping information used to create these exhibits came from a variety of sources, are intended only as general depictions, and may not be accurate to the parcel level. During the MPD process, natural resources will be analyzed parcel level detail will be analyzed accordingly.
Earth

Geology, Topography, and Soils

1 What are the geologic conditions in the area?

The Villages MPD is located in the Puget Lowlands, within the till ridges and outwash valleys of the Covington Drift Plain to the west and the Cascade Foothills to the east. The near surface geology on the Main Property is dominated by sediment composed of sand, gravel, and till. Till is present at the ground surface on uplands across the Main Property, and underlies much but not all of the recessional outwash plain that surrounds the uplands. Glacial till is also often referred to as “hardpan” and is generally impermeable. Recessional outwash consists of sand and gravel layers and is more permeable than till. Where outwash is close to the surface, it often acts as an aquifer and is a source of water for many shallow wells.

Beneath the surface and near surface sediments is a complex sequence of older, unconsolidated sediments overlying an irregular bedrock surface. Coarse-grained glacial deposits in this vicinity contain a productive aquifer that contributes to the Crisp Creek baseflow. Post-glacial deposits include the large wetland/bog area adjacent to Black Diamond Lake and in the lower Jones Lake to Rock Creek swale, and in smaller amounts within other wetland and stream corridors. Large, off-site mass wasting deposits are located along the northern wall of the Green River Valley. “Mass wasting” deposits are the result of a number of factors including steep slopes, river erosion following melting or recession of the glaciers, rainfall, and groundwater discharge at steep slope faces. These deposits and what created them are important when considering stormwater management.

Similar to the Main Property, the North Property is dominated by sediments consisting of sand, gravel, and till. The majority of the North Property is on upland till; only the northwest corner of the North Property is recessional outwash terrain. Shallow bedrock is assumed to underlie the upland portion of the North Property and either till or shallow bedrock is

What is till?
Till is glacial sediment and is an unsorted mixture of boulders, pebbles, sand, soil, and clay. This material was picked up in the ice and pushed/carried by the glaciers.

What is recessional outwash?
Outwash deposits are found in old glacial meltwater channels and are made up of course sands. Recessional outwash (deposited as glaciers were retreating) often lies on top of glacial till.
assumed to underlie the outwash present on the northwest corner of the site. Post-glacial sediment deposits include smaller deposits made by wetlands and creeks on the till upland.

2 What are the topographic conditions in the area?

The topography of The Villages can generally be divided into three categories corresponding with its geology: till-mantled uplands, outwash terrain, and ice-contact deposits. The uplands are at the highest elevations, the outwash terrain is at the lowest elevations, and ice-contact deposits are found in the middle elevations. Elevations on the till mantled upland portions of The Villages ranges from about 570 feet to about 710 feet. Elevations on the outwash terrain portions of the property range from about 520 feet to 570 feet. Ice-contact deposits, located along the south portion of the Main Property, are characterized by irregular hummocky topography consisting of mounds and closed depressions scattered throughout the area. Elevations on the ice-contact terrain range from about 570 feet to about 595 feet.

On both the Main Property and the North Property, there are some areas of steep slopes in the transition between upland terrain and outwash terrain. Steep slopes (greater than 15 percent) also occur on either side of Black Diamond Lake where elevation drops rapidly from the upland surfaces (elevations 600 to 650 feet) down to the Lake at approximately 560 feet. The southwestern property boundary is near the top of an off-site steep slope, where the elevation drops rapidly from about 600 feet to an elevation of about 480 feet at SW Green Valley Road (see Exhibit 4-1).

3 What are the soil conditions in the area?

The United States Department of Agriculture’s (USDA) Natural Resources Conservation Service (NRCS) maps identify a total of six soil series within the boundaries of the study area. The soils underlying the site are mapped as Alderwood gravelly sandy loam, Everett gravelly sandy loam, Bellingham silt loam, Seattle muck, and the Ragnar-Indianola Association. These units are further broken down into subunits, based on the general slope in the vicinity (Exhibit 4-2).
Exhibits in this EIS are intended to provide a general graphical depiction of built and natural environment conditions and may not be accurate to the parcel level.
Exhibit 4-2
Soils

Exhibits in this EIS are intended to provide a general graphical depiction of built and natural environment conditions and may not be accurate to the parcel level.
The Alderwood gravelly sandy loam unit is described as a moderately well-drained soil on till plains, with a hardpan layer at about 30 inches. The Alderwood soil series is characterized by slow to medium runoff rates with moderately rapid permeability above the hardpan and very slow in the hardpan. The main limitation of this soil series affecting homesites is the seasonal wetness, and erosion is a hazard in steeper areas.

The Everett gravelly sandy loam series is a very deep, well-drained soil forming on terraces and on glacial outwash plains. Permeability is rapid in Everett soils; runoff is slow and the hazard of water erosion is slight. This unit is suited to homesites; however, cut banks are not stable and can be subject to sloughing. Because of the permeability, irrigation is typically needed for lawns and ornamental plantings in summer.

Bellingham silt loam is composed of poorly drained soils that formed in depressions on the upland till plain. Permeability and runoff potential are slow in Bellingham soils and erosion hazards are slight. These soils have severe limitations on recreational, homesite, and engineering type uses (such as roads) due to their seasonal high water table and poor drainage.

The Seattle muck series is typically very poorly drained organic soils that formed in material derived primarily from sedges (a grass-like plant). These soils are located in depressions and valleys on the glacial till plains. Permeability is moderate, and there is almost no erosion potential because the soils typically occur in depressions. If drained, Seattle soils can be used for some crops. The soils series has severe limitations for other agricultural uses, forestry uses, forestry, engineering, homesite, and recreational uses because of the high organic content and high water table.

The Buckley series consists of poorly drained soils; permeability is moderate in the surface layer and slow in the subsoil. There is a seasonal water table at or near the surface in winter. Runoff potential is slow and erosion hazard is slight. These soils have severe limitations on equipment use and engineering, homesite, and recreational uses because of the seasonal high water table and poor drainage.
The Ragnar-Indianola Association is about equal parts Ragnar fine sandy loam and Indianola fine loamy sand. The Ragnar series is made up of well drained sloping to rolling soils on glacial outwash terraces. The Indianola series is made up of somewhat excessively drained soils that formed in sandy, recessional glacial drift terraces. The runoff potential in the Ragnar-Indianola series is moderate to severe, and the erosion hazard is moderate to severe. This soil series can support timber and urban development on slopes less than 15 percent.

Fill soils (those soils not naturally placed) are present across The Villages along old logging roads. The depth of fill soils for logging roads is estimated to be between 1 and 4 feet. The quality, thickness, and compaction of these fill soils is unknown.

4 What risks or hazards are associated with geology, topography, and soils?

Risks associated with geology, topography, and soils generally include erosion hazards, landslide hazards, seismic hazards, volcanic eruptions, and other geologic events. Areas with certain characteristics—for example, specific types of soil or combinations of soils and topography—may be prone to failure and can pose hazards to the health and safety of citizens. This typically happens when incompatible commercial, residential, or industrial development is sited in areas of significant hazard.

Erosion hazard areas typically include those areas that the USDA’s Natural Resources Conservation Service (NRCS) has identified as having a moderate to severe, severe, or very severe rill and inter-rill erosion hazard.

Landslide hazard areas are potentially subject to landslides based on a combination of geologic, topographic, and hydrologic factors. This includes areas susceptible to landslides because of combinations of bedrock, soil, slope, slope-facing direction, structure, hydrology, or other factors.

What is a rill?

A rill is a narrow, shallow incision in the soil resulting from erosion by overland water flow that has been focused into a thin thread.

Photo courtesy of Wikipedia.org.
Seismic hazard areas include areas subject to severe risk of damage as a result of an earthquake-induced ground shaking, slope failure, settlement, soil liquefaction, or surface faulting. The primary cause of earthquake damage in Washington State is ground shaking.

Volcanic hazard areas are areas subject to lava flows, debris avalanches, inundation by debris flows, mudflows, or related flooding resulting from volcanic activity.

5 What are mine hazard areas?

Mine hazard areas are those areas underlain by, adjacent to, or affected by mine workings; such as mine tunnels and air shafts. Mine hazard areas are generally divided into classifications of low hazard, moderate hazard, and severe hazard. These classifications are applied based on the depth below ground of the mine, the presence of sinkholes, and the presence of publically accessible openings, such as mine entries, portals, and mine shafts. The presence of mine waste rock—natural materials discarded as a part of the coal mining process—can also pose risks to the public and affect the hazard classification.

Three areas within The Villages are underlain by abandoned underground coal mine workings. The first area includes portions of the North Property, which are underlain by workings from No. 11 Mine and Mine B. The second and third areas are located on the Main Property, to the northwest and northeast of Black Diamond Lake. These mine workings are part of the No. 14 Mine workings. All mine sites within The Villages are considered low hazard.

Abandoned underground coal mines pose risks to structures and people above them, as well as to those entering mines or nearing mine openings. These hazards include ground subsidence and collapse, and the presence of methane gas or low oxygen environments generally associated with mine openings. No sinkholes or ground subsidence areas have been identified within the study area.
6  How will the alternatives impact geology, topography, and soils?

Erosion Hazard
Shallow surface soils on The Villages properties have been mapped as Alderwood and Everett series soils. In areas with slopes steeper than 15 percent, these soil series are considered to have severe erosion potential. Exhibit 4-4 displays potential erosion hazard areas on the Main Property and on the North Property.

Erosion potential is highest during construction activity, when the vegetative and topsoil layers have been removed, exposing soils directly to precipitation and wind. Alternative 2 includes the construction of stormwater facilities on both the Main Property and the North Property. A very large, off-site stormwater facility is proposed west of the Main Property. Stormwater facilities involving discharge on even moderate slopes can result in severe overland erosion and rilling. Development under any of the alternatives could result in changes to the stormwater flow regime (timing, volume, peak flows, and duration) that could increase erosion in Rock Creek and other onsite streams.

The approximate acreages of disturbance to erosion hazard areas associated with each alternative are summarized in Exhibit 4-3. Alternative 2 includes a proposed elementary school on a development parcel that is located on an abandoned gravel borrow pit. The gravel borrow pit would need to be properly filled prior to school construction to avoid substantial risks to a large, vulnerable population.

Exhibit 4-3
Geologic Hazard Areas – Summary of Impacts

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<tr>
<th>Alternative</th>
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<td>2</td>
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Potential Erosion Hazard Areas

*Erosion hazard mapping based on the City of Black Diamond Sensitive Areas Ordinance; modified by Icicle Creek Engineers, Inc. using updated base map topography.

Exhibits in this EIS are intended to provide a general graphical depiction of built and natural environment conditions and may not be accurate to the parcel level.
Landslide Hazard

Landslide hazard areas are shown in Exhibit 4-5. The potential for landslides can be increased by development activity, including cutting that removes material holding the toe of a slope in place or additional stormwater runoff from impervious surfaces. Development also can place areas of human habitation or activity in areas subject to damage from naturally occurring or human induced landslides.

The majority of The Villages properties do not contain landslide hazard areas. On the Main Property, landslide hazard areas include the northwest and southeast margins of Black Diamond Lake and the Black Diamond Lake Swale. Landslide hazard areas on the North Property include the slope at the transition between upland and lowland portions of the site, which is located in the north portion of the site.

Most of the landslide hazard areas on the Main Property are located in open space under Alternative 2. A proposed roadway running parallel to the southeast margin of Black Diamond Lake under Alternative 2 may fall within a landslide hazard area, which will require additional site-specific analysis. The landslide hazard area on the North Property is located where future commercial/office land uses are proposed under Alternative 2. For the other alternatives, general development areas are presumed to be similar to Alternative 2, although the type and intensity of uses may change.

The approximate acreages of disturbance to landslide hazard areas associated with each alternative are summarized in Exhibit 4-3.

Seismic Hazard

The Villages study area is located in a region of moderate to high earthquake activity, in terms of both the size and frequency of earthquakes. The most significant earthquake related concern, as it relates to the study area, is soil liquefaction. Soil liquefaction occurs because of a loss of soil strength due to strong shaking, and results in a transition of the soil from a solid state to a liquefied state.
Landslide Hazard Areas

*Landslide hazard mapping based on the City of Black Diamond Sensitive Areas Ordinance; modified by Icicle Creek Engineers, Inc. using updated base map topography.

Exhibits in this EIS are intended to provide a general graphical depiction of built and natural environment conditions and may not be accurate to the parcel level.
The Main Property and North Property are not considered susceptible to soil liquefaction during an earthquake, with the exception of small wetland areas where the potential is low. The wetlands are considered sensitive areas and protected under the City’s sensitive areas regulations.

**Volcanic Hazard**

The most severe potential volcanic hazards (lateral blasts, lava flows, ballistic debris, and pyroclastic flows) are not likely to occur in the Black Diamond area due to the distance from Mount Rainier. Lahar flows—dense slurries of water-saturated debris including rock, soils, and trees—are also low, as Black Diamond is not in a valley or low lying area through which semiliquid debris would be transported from a volcanic eruption of Mount Rainier.

Based on analysis of prevailing wind patterns, the United States Geologic Service (USGS) has rated the Black Diamond areas as having a very low annual probability of significant ash accumulation. Therefore, ash-related human health and property concerns are not significant for any of the alternatives.

### 7 What are the City’s requirements for mine hazard areas?

The City’s SAO regulations emphasize identification of potential mine hazards and either avoidance or design practices to minimize impacts to human health and property. The SAO identifies three classes of mine hazard—severe, moderate, and low. The Villages area does not contain severe or moderate mine hazards. Only low mine hazards are further discussed in this section.

Areas of low mine hazard include locations with mines at a depth of more than three hundred feet (or where potential subsidence is limited to specific standards) and no accessible openings or sinkholes within 100 feet. Development in low hazard areas is allowed if risks are no greater than those facing properties that are not located above mines. Vulnerable facilities are not allowed in low hazard areas if there is a feasible alternative location.

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**What are the City’s Requirements for Seismic Hazards?**

The City’s Sensitive Areas Regulations (BDMC19.10.445 provides an approach to seismic hazards that emphasizes identification of potential hazards and design practices to minimize impacts. Where hazards are identified, an assessment report may be required to evaluate geologic characteristics and their susceptibility to damage during a seismic event, as well as describe and evaluate the best available engineering and geological practices that either eliminate or minimize the risk of structural damage or injury resulting from seismic forces.

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**What is lahar?**

A lahar is a type of mudflow or landslide composed of pyroclastic material and water that flows down from a volcano, typically along a river valley.
Mine hazard areas may be declassified based on a detailed, site-specific mine study documenting that mine hazards are equivalent to lands not situated above mines.

8 How do mine hazard areas impact the alternatives?

As illustrated in Exhibit 4-6, The Villages MPD area has a relatively small amount of land that is considered a low mine hazard area, and it is also encumbered by other sensitive areas, such as streams and wetlands and their buffers.

**Alternative 1**
Alternative 1 assumes that The Villages properties will develop consistent with current zoning. This type of development would be characterized by residential and commercial development occurring slowly and incrementally, and avoiding impacts to all regulated sensitive areas. In regard to mine hazard areas, Alternative 1 assumes that low mine hazard areas could be developed with residential uses. Utilizing these assumptions, approximately 36 acres of low-risk mine hazard areas will be developed under Alternative 1.

**Alternative 2**
Alternative 2 represents the Applicant’s proposal under the City’s MPD Ordinance. The land plan submitted for Alternative 2 indicates that small portions of the mine hazard area are proposed for commercial and residential development, which would be regulated by the MPD Development Agreement and the City’s SAO.

**Alternative 3**
Alternative 2 represents the Applicant’s proposal under the City’s MPD Ordinance. The land plan developed to represent Alternative 3 indicates that small portions of the mine hazard area are proposed for commercial and residential development, which would be regulated by the MPD Development Agreement and the City’s SAO.
Mine Hazard Areas

Exhibit 4-6

Coal mine hazard mapping based on the City of Black Diamond Sensitive Areas Ordinance; modified by Icicle Creek Engineers, Inc. using updated base map topography.

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9 What policies and standards address geologic hazards?

The City of Black Diamond regulates geologically hazardous areas through its SAO regulations. This includes landslide hazard areas, erosion hazard areas, mine hazard areas, and seismic hazard areas. The City also maintains a map that indicates the approximate location and extent of known geologically hazardous areas.

There are two basic strategies for management of geological hazards, depending on the potential risk to life and property: avoidance and management.

- Avoidance is the primary strategy for landslide hazards and the most severe mine hazards.
- Management is the prescribed strategy for erosion hazards and seismic hazards as well as less severe landslide and mine hazards.

The City requires field investigation and reports to accompany any proposal for development in geologically hazardous areas, as outlined in the SAO.

Generally, activities not typically associated with high levels of ground invasion or disturbance, such as passive outdoor recreation, are permitted in geologically sensitive areas. Certain activities that could increase the level of hazard or increase the potential for exposure to hazards, such as trail construction, may be permitted under specific conditions. Some activities are not permitted in geologically sensitive areas at all unless it is proven the activities cannot be located elsewhere, and the proposal will not increase the hazard and the risk to life and property.

In mine hazard areas, where risks have been reduced through documented collapse of subsurface mine features or through remediation such as filling voids, such areas can be declassified (reclassified as not hazardous). In order to characterize hazards and appropriate strategies for remediation and/or management, additional subsurface exploration will be necessary.
10 What measures reduce or avoid impacts on geology and soils?

All of the alternatives include construction within geologic hazard areas of varying levels of risk, and have similar potential to directly impact geology and soils. Under all of the alternatives there is also the potential to eliminate or relocate uses that would otherwise concentrate large numbers of persons, or vulnerable populations, into relatively less risky areas. The alternatives involve similar areas of ground disturbance and therefore have similar potential for construction-related erosion. The City of Black Diamond has the authority under the SAO to require changes in buildable areas and buffers that can mitigate potential hazards under all of the alternatives. Discussion of measures to mitigate for specific impacts to geology and soils is included in the following pages.

Erosion Hazards

Soil erosion can be addressed during site design and construction. During construction, the use of silt fences, hay bales, temporary sediment ponds, truck wash areas, regular road cleaning, and straw mulch or rock coverings can minimize risks associated with erosion. In addition, major earth moving and grading can be limited to the “dry season,” between May and September, to avoid water quality impacts from erosion due to wet soils.

With additional impervious surfaces, the total volume of water discharged to streams and the duration of flows will be increased, which has the potential to increase erosion. However, stormwater management can minimize increased risks of stream erosion by utilizing detention facilities that avoid increases in peak stream flows. Additionally, infiltration of stormwater to permeable soils will help to mitigate erosive flows that might occur in surface water features. Protecting stream banks from disturbance can also reduce the adverse impacts stream erosion in cases where vegetation is an effective means of stabilizing stream banks. Utilizing bridges or appropriately sized culverts for roadway crossings of streams can allow peak-flow high-water events to pass unimpeded and also preserve some normal stream processes.
Landslide Hazards
The most reliable means of avoiding landslide hazards is avoidance of the area and utilizing sufficient setbacks to increase the safety of nearby human uses. Potential landslide areas on the Main Property are proposed to be placed in open space, such as areas surround Black Diamond Lake and the Black Diamond Lake swale. Potential landslide areas on the North Property are proposed for commercial development. If variation to City standards is proposed under any alternative, site-specific geotechnical evaluations may be necessary to determine whether such variation constitutes a potential hazard.

Management of stormwater and groundwater to avoid increases in overland flow or infiltration in areas of potential slope failure can also help avoid water-induced landslides. Extreme care must be taken when considering the location of stormwater ponds, other detention facilities, and stormwater infiltration systems near potential landslide areas.

Seismic Hazards
The effects of strong ground shaking can be mitigated through engineering and design. Typically, single- or two-story wood frame structures like houses perform very well in an earthquake, while unreinforced masonry structures tend to be the most susceptible to damage. Seismic code standards in the International Building Code are designed to mitigate structural damage and prevent collapse.

Mine Hazards
Mine hazards to structures and road and utility crossings can be avoided by designating the most severe hazard areas as open space and by routing roads and utilities to avoid such areas. Even in open space areas, actions may be necessary to avoid hazards to persons using the area for recreational purposes.
Hazardous Materials

1 Are there any potentially contaminated sites in the study area?

Many chemical wastes are persistent in the environment, are harmful to the environment and/or human health, and remain toxic for a very long time. Some of these wastes can also become more concentrated in the tissues of animals higher in the food chain over time, a process known as bio-accumulation. In Washington, about 7,000 facilities and businesses produce more than 117 million pounds of hazardous waste annually.

The Washington State Department of Ecology maintains an identification tool, which includes information on potentially hazardous facilities or sites that are currently or have been of interest to Ecology, and have been or are currently regulated by Ecology. These facilities or sites may include state cleanup sites, voluntary cleanup sites, federal Superfund sites, hazardous waste generators, soil waste facilities, underground storage tanks, dairies, and locations where enforcement actions have occurred. A search of this database indicates there are four facilities/sites of interest in The Villages vicinity; three are located around the Main Property. The fourth is located in the vicinity of the North Property.

Of these four sites, two are classified primarily as potentially contaminated hazardous waste facilities, one is a state cleanup site, and one is an underground storage tank.

Hazardous waste facilities are those that generate any quantity of a dangerous waste (“hazardous waste generator”), or facilities that are required to register with Ecology but that do not directly manage or generate hazardous waste (“hazardous waste other”). Hazardous waste transporters are an example of a facility that would be categorized as “hazardous waste other.” Hazardous waste facilities may also include businesses that store or use certain quantities of hazardous chemicals at any one time (“hazardous waste tier 2”).

What are “persistent” chemicals?
Dioxin, mercury, toxic flame retardants (PBDEs), DDT, and PCBs are among a class of chemicals called persistent toxic chemicals. These chemicals are toxic in small amounts, are long lasting in the environment, and build up in foods, animals, and people.
State cleanup sites include those sites undergoing formal cleanup under state oversight. Underground storage tank sites include the sites with underground storage that Ecology regulates, including gas stations, industries, commercial properties, and government entities. ‘Leaking’ underground storage tank sites are underground storage tank sites that have or have had leaks at one time. Voluntary cleanup sites are those sites where Ecology staff has reviewed independent cleanup reports and provided a written decision about the adequacy of cleanup actions taken. Enforcement sites are those sites where voluntary compliance was not achieved and Ecology has pursued enforcement.

2 How do the alternatives relate to hazardous materials sites?

The impacts of developing on or near hazardous sites or facilities is related to the type and location of the waste, the nature of the development, sensitive uses (such as drinking water wells) in the area, and efforts taken to minimize risk. In many cases, hazardous materials can be removed from a site prior to construction, minimizing future risk to human health.

Of the four facilities/sites in the vicinity, three are still active or include active components. However, none of these sites are located within The Villages properties. As such, none of the alternatives are likely to result in impacts to or be impacted by hazardous waste sites.