Chapter 18: Environmental Considerations

Introduction

This chapter was originally prepared in spring 2007 to establish environmental baseline conditions in the Bend Metropolitan Planning Organization (BMPO) boundary for the development of the Bend Metropolitan Transportation Plan (MTP). This chapter was refined in summer 2014 as part of the MTP update. This update consisted of reviewing National Environmental Policy Act (NEPA) documentation prepared within the BMPO boundary since 2007 for applicable information, referencing actions completed since 2007, and collecting readily available online data. Most of the chapter and all the maps refer to information collected in 2007. A comprehensive update to this chapter is anticipated to occur in 2015.

The Environmental Considerations chapter is a requirement of the federal transportation legislation. In 2007, this federal legislation was Safe, Accountable, Flexible, Efficient Transportation Equity Act – A Legacy for Users. It remains a requirement under the 2012 Moving Ahead for Progress in the 21st Century Act [MAP-21]). MAP-21 requires that the BMPO long-range transportation plan include a discussion of the types of potential environmental mitigation activities and potential areas to carry out these activities, including activities that may have the greatest potential to restore and maintain the environmental functions affected by the plan. Addressing environmental considerations early in the transportation planning process ensures environmental impacts from transportation projects are minimized reducing overall project costs and impacts. This chapter:

1 Identifies existing environmental features within the BMPO boundary using maps and text.
2 Compares proposed transportation projects to the environmental conditions and identifies any potential conflicts that could result from the plan.
3 Identifies activities that may have the greatest potential to restore and maintain the environmental functions affected by the transportation plan.

MAP-21 requires that jurisdictions develop these analyses in discussion with Federal, State, and tribal wildlife, land management, and regulatory agencies.

This chapter should to be used as a starting point for analyzing the environmental consequences of transportation projects. When projects are proposed, this chapter should be reviewed to determine if there are potential environmental conflicts. If potential conflicts are identified, further information will be needed and further consultations with agencies with jurisdiction may be required.

Chapter Organization

The BMPO Environmental Considerations Chapter is a map-based product. The chapter is divided into ten sections with numerous specially developed maps to aid in

analysis of resource identification. In 2007, GIS data layers were secured from a wide variety of sources and combined into maps that illuminate baseline conditions for resources in 2007, and the maps aid in conflict identification. The maps are located in Appendix F and the supporting metadata is in Appendix F. The chapter is divided into the following ten sections:

- Land Use & Infrastructure
- Water Resources
- Fish, Wildlife & Habitat Resources
- Hazards
- Climate Change
- Air Quality
- Scenic Resources
- Historic and Cultural Preservation
- Recreation Resources
- Environmental Justice
- Noise

Each of the above sections is structured with the following headings: Summary, Methodology, Findings, and Recommendations. Below is an outline of what the reader can expect to learn in each section.

Summary: The summary gives the reader a very quick overview of what the section includes and any identified conflicts and recommended actions. It includes:

- A definition of what the section includes.
- A brief summary of data collected and agencies consulted.
- Identification of other sections that should be reviewed concurrently.
- Highlights of findings – resources and impacts identified.
- Highlights of recommendations.

Methodology: This section is designed to give the reader details on the type of data collected and agencies contacted for the original development of this chapter in 2007. This section has the following parts:

- List of agencies consulted
- Table of documents reviewed
- Table of maps developed with data layers and sources identified
- Missing, unavailable or inadequate data identified.

The majority of information is derived from available data. However, all of the maps are new compilations of data collected in 2007 layered to allow for a more comprehensive look at potential impacts of the transportation plan.

Findings: This section provides the reader with information about what resources were identified in the study area and how they might be impacted. It includes:

- Identification of environmental or cultural resources.
- Identification of regulations or protections in place.
- Identification of potential conflicts between resources and proposed transportation projects.

Recommendations: The section provides recommended activities to avoid, reduce or minimize identified conflicts with the transportation plan. This section includes:

- Identification of activities that may have the greatest potential to restore and maintain the environmental functions affected by the transportation plan
- Identification of further work to be accomplished in updates of this document.

Coordination

During the initial development of the Environmental Considerations Chapter in 2007, the BMPO coordinated with numerous agencies. Coordination involved consultations and meetings, contact via email, phone or letter, website database searches, or presentations to the following agencies:

- Bureau of Land Management (BLM)
- Burns-Paiute Tribe*
- City of Bend
- Confederated Tribes of Warm Springs
- Deschutes County
- Klamath Tribe*
- Oregon Department of Environmental Quality (DEQ)
- Oregon Department of Fish and Wildlife (ODFW)
- Oregon Department of Land and Conservation (DLCD)
- Oregon Department Of State Lands (DSL)
- Oregon Department of Transportation (ODOT)
- Oregon State Historic Preservation Office (SHPO)
- U.S. Army Corps of Engineers (USACE)
- U.S. Department of Commerce, National Marine Fisheries Service (NMFS)
- U.S. Department of Transportation Federal Highway Administration (FHWA)
- U.S. Environmental Protection Agency (EPA)
- U.S. Fish and Wildlife Service (USFWS)
- Upper Deschutes Watershed Council (UDWC)
- U.S. Forest Service, Deschutes National Forest

*no response received

A presentation was given to Oregon's state and federal transportation and environmental agencies (called CETAS, Collaborative Environmental and Transportation Agreement for Streamlining) on May 15, 2007, to share preliminary

elements of this chapter and receive comment. The members present at the meeting are listed below and the minutes of the meeting are in Appendix F.

Hal Gard, ODOT	Susan Haupt, ODOT	Michelle Eraut, FHWA
Yvonne Vallette, EPA	Charlotte Kucera, NMFS	David Leal, USFWS
Joyce Cohen, ODOT	Eric Metz, DSL	Michael Turaski, USACE
Corey Saxon, DEQ	Mollie Manion, SHPO	Art Marin, ODFW

Highlights of Results

The BMPO encompasses 47 square miles and includes two jurisdictions – the City of Bend and Deschutes County. The entire City and its Urban Growth Boundary are contained within the BMPO with County land forming a ring around the BMPO. The population of the area is estimated to be 83,794 in 2010 per U.S. Census data for the Bend urban area. While the BMPO is highly scenic and has significant environmental resources, there are relatively few identified conflicts between the proposed transportation projects and environmental resources. This is primarily due to the small number of rivers, streams and wetlands; an historic absence of anadromous fish; and the nature of the transportation projects proposed. The transportation projects proposed consist primarily of improvements to existing roads. There are few new roads proposed. This could change in the future and the information in this document and the map layers gathered should provide information necessary for analysis of future planning efforts. The major environmental conflict from transportation projects is stormwater runoff. Stormwater runoff impacts fish and wildlife, water quality, and results in flooding of major intersections. Other potential conflicts include wildlife crossings, air quality and climate change and restricted lands. Recommendations to avoid, reduce or mitigate identified conflicts include employing the best management practices in the City of Bend Integrated Stormwater Management Plan and the Stormwater Master Plan, maintaining wildlife linkages, adopting the transportation actions identified in the Oregon Strategy for Greenhouse Gas Reduction, and identifying all 4(f) and 6(f)(3) properties prior to pursuing transportation projects.

Overarching Recommended Policies

See also the specific recommendations at the end of each section of this report.

1. Potential impacts to the environment including, but not limited to air, water resources, fish, wildlife, native plants and habitat, and scenic resources shall be identified and considered in the initial planning stages of any BMPO transportation project and prior to funding and design of the project.

2. Potential impacts to cultural resources including but not limited to recreation, environmental justice, historic sites and archeological sites shall be identified and considered in the initial planning stages of any BMPO transportation project and prior to funding and design of the project.

3. Potential impacts to either the environmental or cultural resources from proposed BMPO transportation plans shall be evaluated through consultation with appropriate federal, state, tribal and local agencies.

4. Minimizing adverse impacts shall be evaluated in the following priority order:
    a) Avoid adverse impacts by not taking an action.
    b) Minimizing impacts by limiting the degree of action.
    c) Rectifying by repairing, rehabilitating, or restoring the affected environment.
    d) Reducing or eliminating impacts over time through preservation and maintenance activities.
    e) Compensating for an impact by replacing or providing substitute resources or environments. In most mitigation agreements, more of a resource or habitat must be provided than was originally present. Ratios greater than 1:1 are required in part to compensate for unrealized losses and the inability of technology to completely restore the natural environment.

5. All mitigation measures shall include the following items to be adopted concurrently with the mitigation measure:
    a) A funding mechanism sufficient to provide adequate funding, calculated from an average annual budget, to support the on-going maintenance needs of the mitigation, for the life of the mitigation. Mechanism could include performance bonds, endowment, taxing districts or other methods.
    b) On-going funding shall include, but is not limited to, on-going facility maintenance, equipment replacement costs, personnel, public education, and monitoring costs for the life of the mitigation.
    c) A monitoring and evaluation program with measurable goals, sufficient to determine if the mitigation is working or not.
    d) Adaptive management protocols with milestones for implementation tied to the monitoring and evaluation program.
    e) Enforcement mechanism with penalties sufficient to cover costs.

Recommendations at a Glance

Each of the recommendations below is found at the end of the appropriate section. They are shown here for a quick overview.

Water Resources

To avoid or mitigate potential impacts to water quality it is recommended that the best management practices in the City of Bend Integrated Stormwater Management Plan and the Stormwater Master Plan be employed when building or retrofitting transportation projects.

Future Work to be Completed

- Identify all service stations and define specific transportation routes for fuel delivery. Prioritize stormwater management along those routes.
- Identify and define specific transportation routes for transportation of hazardous materials. Prioritize stormwater management along those routes.
- Map the remaining 25 drainage areas of concern for flooding on Map 5, Water Quality.

Fish, Wildlife and Habitat

Habitat

Design transportation projects to avoid and minimize the destruction of significant natural resources wherever possible. See general policies for more.

Bull trout and redband trout

Identify and explore methods to protect, restore, and maintain suitable habitat conditions for bull trout and redband trout for all transportation projects, especially those near the Deschutes River or Tumalo Creek, including the following:

- Maintain or improve water quality.
- Stabilize roads, crossings, and other sources of sediment delivery.
- Identify fish passage barriers or sites of entrainment and implement tasks to provide passage and eliminate entrainment.
- Screen water diversions and irrigation ditches.
- Restore connectivity and opportunities for migration by securing instream flows and/or water rights.

Invasive species

- Design transportation projects to prevent the spread of noxious weed species.

Wildlife Linkages

The design of new transportation projects and the retrofit of existing projects shall include the identification of any wildlife movement issues and a review of best management practices to facilitate wildlife movement to improve human and wildlife safety, decrease habitat fragmentation and property damage. Include mapped wildlife movement areas of concern upon their completion by Oregon Department of Fish and Wildlife.

Hazards

Future Work to be Completed

There may be additional activities recommended for specific species including bats that should be identified.

- Consideration of wildfire and other emergency evacuation routes should be taken into account in the design of transportation projects.
- Further investigation of the issues involved with railroad transport should be conducted, specifically the potential for toxic releases and railroad maintenance.
- Transportation projects near Tumalo Creek should analyze potential flooding impacts and channel migration potential and develop mitigation if impacts are identified.

Climate Change

In 2011, the Land Conservation and Development Commission (LCDC) adopted per capita GHG emission reduction targets for light-duty vehicles for all six metropolitan areas within Oregon. The target for the Bend MPO is to reduce emissions 18% per

person from 2005 levels by year 2035 (Oregon Administrative Rule [OAR] 660-044 – Metropolitan Greenhouse Gas Reduction Targets).

The Bend MPO should consider adopting the transportation actions identified in the Oregon Strategy for Greenhouse Gas Reduction that are appropriate for the BMPO.

Mitigations measures from the Oregon Strategy for Greenhouse Gas Reduction are designed to reduce greenhouse gas emissions from consumption of fossil fuels by displacing conventional combustion engines with hybrid, electric and other technological/fuel options, and to guide land use choices, especially in Oregon's urban areas, toward more efficient choices including higher densities, transit options, mixed-use neighborhoods, and common wall dwelling designs. Mitigations should be updated as new information becomes available. Among the recommend actions outlined in the report that may be appropriate for the BMPO are:

- Integrate land use and transportation decisions with greenhouse gas consequences.
- Promote alternative fuels use and production.
- Incorporate greenhouse gas emission impacts into transportation planning decisions.
- Promote better management and use of parking
- Support and implement demand management programs
- Encourage bicycling and walking for short trips
- Support development of carsharing programs
- Support development of more sustainable funding sources to support maintenance and operation of the transportation system
- Set up traffic engineering "Best Practices"
- Improve mass transit and inter-city transit links.

Other recommendations:

- Work with the City of Bend to conduct a carbon inventory and consider crafting a comprehensive carbon emissions reduction plan.

Air Quality

To analyze the impact of proposed transportation projects to air quality:

- Use the transportation demand model, the complimentary air quality models, and the emissions inventory to assess the air quality impacts of transportation system improvements.

See also the recommendations in the Climate Change section of this report for other actions that will mitigate air quality conflicts.

Scenic Resources

- For all transportation projects, review the Scenic Resources map and identify and potential conflicts.

- For the Cooley Road extension project: Design the project to avoid impacts to the State Scenic Waterway and the County Landscape Zone.

Historic and Cultural

- Consult with the Bend Landmarks Commission and the State Historic Preservation Office on a case-by-case basis for each proposed transportation project to determine if there is the presence of any historic or archaeological resources or Section 4(f) properties.
- For any Section 4(f) properties identified, property boundaries shall be defined (including any structures) and jurisdictional responsibilities identified. The BMPO shall work with the responsible jurisdiction to avoid impacts to the 4(f) properties according to federal requirements.

Recreation Resources

In the early stages of planning for transportation projects in the BMPO, a survey should be conducted to identify all 4(f) and 6(f)(3) properties. Property boundaries defined and jurisdictional responsibilities should be identified. The BMPO should work with the responsible jurisdiction to avoid, reduce or minimize impacts to the 4(f) or 6(f)(3) properties consistent with requirements outlined in the respective regulations.

Environmental Justice

Avoid, minimize, or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects, on minority populations and low-income populations.

Ensure that the long-range transportation plan and the transportation improvement program comply with federal Title VI requirements.

Future work to be Completed

- Conduct further analysis as new census data becomes available.
- Identify residential, employment, and transportation patterns of low-income and minority populations so that their needs can be identified and addressed, and the benefits and burdens of transportation investments can be fairly distributed.
- As resources allow, conduct an environmental justice/Title VI of the Civil Rights Act of 1964 assessment of the BMPO Transportation Improvement Program and Public Participation Plan.[1]
- As resources allow, update the BMPO Public Participation Plan prepared in 2009, which encourages participation and engagement of minority and low-income populations in transportation decision-making, such as by providing Spanish translations of printed materials and at meetings if needed.

[1] Any agency receiving federal funding must comply with Title VI of the Civil Rights Act of 1964 and Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations). An assessment would evaluate the consistency of TIP and Public Participation Plan with Title VI and Executive Order 12898.

Land Use & Infrastructure

Summary

The Land Use and Infrastructure section of this chapter provides an introduction to the BMPO area. The BMPO includes two jurisdictions – the City of Bend and Deschutes County. The entire city and its Urban Growth Boundary are contained within the BMPO with County land forming a ring around the BMPO. Three maps provide background information for this report. Map 1 is a relief map of the area; Map 2 is a zoning map with both City of Bend and Deschutes County zones; and Map 3 is a map of utilities including sewer lines and other infrastructure. While the BMPO is highly scenic and has significant environmental resources, the proposed transportation projects have relatively few identified conflicts between the proposed transportation projects and the resources. This is primarily due to the small number of rivers, streams and wetlands, historical absence of anadromous fish, and the nature of the transportation projects proposed.

Methodology

The following agencies were the primary resources for this section although other agencies, organizations and individuals may also have been contacted.

- City of Bend
- Deschutes County

The following were the primary documents reviewed for this section:

Title	Source	Date
Collection System Master Plan, Final Report	City of Bend	2006
City of Bend General Plan & Zoning Code	City of Bend	1998, 2006
Deschutes County Comprehensive Plan & Zoning Code	Deschutes County	2005, 2001
Community Profile and Trends Report, Bend 2030, Our Community Vision	City of Bend	2006

Documents focused on specific parcels of land or areas within the BMPO were also reviewed including:

Title	Source	Date
Draft Stevens Road Tract Master Plan	Cogan Owens Cogan, LLC et. al. for the Oregon Department of State Lands	December 1, 2005
Reed Market Corridor Study, Draft Existing Conditions Technical Report	Parametrix, Inc., for City of Bend	June 2005
Juniper Ridge Concept Plan	Otak, for City of Bend	August 2005
Bend Parkway Final Environmental Impact Statement	Oregon Department of Transportation	August 1992
City of Bend Central Area Plan	City of Bend	2007
Murphy Road Corridor Project, Existing Conditions and Deficiencies	CH2M Hill, for City of Bend	December 2006

Digital data layers were combined to create maps depicting information available in 2007. The following are the map titles along with the data layers shown and the source of the data. For details on the metadata see Appendix F.

Map #	Map Name	Data Layer	Source
1	Relief Map	Hillside Relief	Deschutes County
2	Zoning	City Zoning	City of Bend
		County Zoning	Deschutes County
3	Utilities	Proposed Gravity Interceptors	City of Bend
3	Utilities	Pressure Mains 10" and over	City of Bend
3	Utilities	Gravity Mains 10" and over	City of Bend
3	Utilities	Water lines over 8"	City of Bend
3	Utilities	Avion Water Lines Over 8"	Avion Water District

Findings

The BMPO encompasses 47 square miles, most of which is within the City of Bend city limits with a ring of Deschutes County land surrounding the City. The area is located in the high desert, which receives an annual average of 11.6 inches of rain and 34 inches of snow. The City of Bend averages about ten days per year with temperatures over 90 ºF with winter lows between 20 ºF and 30 ºF on average. The area is defined by the Cascade Mountain range to the west (which receives a mean annual precipitation of 140 inches), the desert to the east, and the Deschutes River running north and south through the middle of the planning area. The population of the BMPO area was approximately 83,796 in 2010 (per U.S. Census data for the Bend urban area). The area was among the fastest growing areas in the nation between 2000 and 2010. Highway 97 runs north and south and Highway 20 runs east and west through the BMPO.

While there are significant environmental resources in the BMPO, they are relatively confined geographically. For example, there are only two water bodies in the BMPO, the Deschutes River and Tumalo Creek, and no identified wetlands other than those associated with the riparian areas along the Deschutes River within the city limits. There are no anadromous fish (they are blocked naturally by Big Falls north of the BMPO). Bull trout and bald eagle are two species with recovery plans in the region. Stormwater is a big concern for the area, which received a National Pollution Discharge Elimination System Stormwater Discharge Permit in February 2007. There are two historic districts and hundreds of historic buildings in the BMPO but they are not anticipated to be impacted by the proposed projects. There are many archeological sites, only a few of which are identified on the map. Most archeological sites will have to be identified on a case-by-case basis as projects are proposed. Transportation projects proposed in the BMPO are primarily related to improvements to existing intersections and roads.

Recommendations
There are no activities proposed for this section, which provides general background information.

Water Resources

Summary
The Water Resources section of this chapter focuses on quality and quantity of surface and groundwater in the BMPO and includes public health issues affecting drinking water. Data were gathered from a wide variety of sources including the Department of Environmental Quality, the City of Bend Public Works Department, and the Upper Deschutes Watershed Council. Documents reviewed include stormwater plans and permits, subbasin assessments and other water-related documents. This section should be reviewed along with the section on Fish, Wildlife and Habitat, as water issues discussed in this section are closely related. There are four maps pertaining to this section. They are: Map 4 - Stormwater; Map 5 - Water Quality; Map 6 - Environmental Health; and Map 7 - Irrigation Service Areas.

This is probably one of the more complex and important sections of this chapter in part due to the emerging stormwater management and water quality activities underway at this time, and the complicated nature of the interplay of surface and groundwater in the area. Impacts resulting from over 100 years of stormwater discharges to the Deschutes River and underground through injection wells, along with heavy manipulation of the river flows using dams and irrigation diversions are identified in this section. To avoid or mitigate potential impacts to water quality it is recommended that the best management practices in the City of Bend Integrated Stormwater Management Plan and the Stormwater Master Plan be employed when building or retrofitting transportation projects.

Methodology

The following agencies were the primary resources for this section although other agencies, organizations and individuals were contacted.

- Central Oregon Intergovernmental Council
- City of Bend
- Oregon Department of Environmental Quality
- Oregon Water Resources Department
- Upper Deschutes Watershed Council

The following were the primary documents reviewed for this section:

Title	Source	Date
Central Oregon Stormwater Manual	Central Oregon Intergovernmental Council	May 2007
City of Bend Water Quality Monitoring Project: Technical Report 2004	City of Bend, Upper Deschutes Watershed Council	June 2005
City of Bend Public Works Department Stormwater Master Plan Project Fact Sheet	City of Bend	January 2007
City of Bend Stormwater Master Plan	City of Bend	August 2014
Integrated Stormwater Management Plan	City of Bend, Public Works Department	November 2006
National Pollution Discharge Elimination System Stormwater Discharge Permit	Oregon Department of Environmental Quality	February 26, 2007
NPDES Permit for Stormwater Discharges: Permit Evaluation Report and Fact Sheet for the City of Bend	Oregon Department of Environmental Quality	2007
Oregon Department of Environmental Quality website - Leaking Underground Storage Tank (LUST) Cleanup Site Database	Oregon Department of Environmental Quality	July 2014
Oregon's Phase II Municipal Stormwater Program - Fact Sheet	Oregon Department of Environmental Quality	November 26, 2006
The Bend Riverway, A Community Vision	Bend Park and Recreation Foundation	July 1999
United States Department of the Interior Geological Survey	U.S. Geological Survey	2001
Upper Deschutes Subbasin Assessment	Upper Deschutes Watershed Council	August 2003

Digital data layers were combined to create maps depicting environmental information for water resources in 2007. The following are the map titles along with the data layers shown and the source of the data. For details on the metadata see Appendix F.

Map #	Map Title	Data Layer	Data Source
4	**Stormwater**	Catch Basins, Drill Holes, Dry Wells	City of Bend; Deschutes County
		River Discharges	City of Bend
5	**Water Quality**	Impacted water data (303[d])	Department of Environmental Quality 2002
		Sub basin Delineation	City of Bend
		Drainage Problem Areas	City of Bend
6	**Environmental Health**	Public Drinking Water Wells, and Well Protection Areas	City of Bend
		Railroads	Deschutes County
		Water Service Area - Avion	Avion Water
		Water Service Area - City	City of Bend
		Water Service Area - Roats	Roats Water District
		Location of Service Stations	Deschutes County
7	**Irrigation Service Areas**	Canals	Deschutes County
		Irrigated Land – Arnold Irrigation District	Geo-Spatial Solutions
		Irrigated Land - Central Oregon Irrigation District	Central Oregon Irrigation District
		Irrigated Land – Swalley Irrigation District	Deschutes County
		Irrigated Land – Tumalo Irrigation District	Deschutes County

Notes about the Data

A data layer from 2002 from the Oregon Department of Environmental Quality is included on Map 5. The data layer does not exactly match the data in the table, which is more current than the map. (The map does not show that Tumalo Creek is water quality impaired for temperature.)

Not all of the service stations are identified on Map 6 and areas zoned for service stations are not identified.

See Appendix F for more information on the metadata for these maps.

Findings

Surface Water

The BMPO encompasses approximately 47 square miles much of which is impervious surface. The average annual precipitation in the area is 11.6 inches with 34 inches of snowfall on average. There are two natural surface water bodies in the BMPO: the Deschutes River which runs north and south through the middle of the area, and Tumalo Creek which crosses the northwest corner of the BMPO.

The Deschutes River is 252 miles long from its headwaters in the Cascade Mountains, with about 14 miles of the river within the BMPO boundary. The Deschutes River originates at Little Lava Lake, which is supplied with water from subsurface flows and springs. The volcanic soils in the area have a high level of permeability that allows precipitation to sink easily into the ground and eventually reach the water table. Before dams were constructed, the Deschutes had a flow regime described in 1914 by the U.S. Reclamation Service, which stated in a report, “The flow of the river is one of the most uniform of all streams in the United States, not only from month to month, but also from year to year.”

The Deschutes River is primarily a spring-fed system and the groundwater is linked to surface water, which significantly affects the surface flows. Groundwater is discharged downstream of the BMPO in very significant amounts (a 10-fold increase has been measured between river mile 138 and 120) which alters the hydrology of the surface water.

As early as 1901 irrigation diversions were beginning to be constructed on the Deschutes, and by 1920 there were four dams and five diversions within the BMPO and one diversion (Arnold Irrigation District) just upstream from the BMPO boundary. Near the headwaters of the Deschutes, Crane Prairie Dam began regulating the water flow in the river in the 1920’s and Wickiup Dam began regulating water flow in 1949, disrupting the naturally stable year-round flows. Winter water storage and summer water releases at Wickiup Reservoir, in combination with downstream diversions, contribute to significant fluctuations in flow levels. In the vicinity of the BMPO, summer high flows above the BMPO boundary reach 2,100 cubic feet per second (cfs) while below the BMPO boundary flows are reduced to as low as 30 cfs. This dramatic fluctuation in flow has been linked to a variety of water quality impacts.

Irrigation canals are common throughout the BMPO. They intersect the transportation system by crossing roads in many locations and may significantly increase the cost of transportation projects over or near canals. The cost may be prohibitive and cause projects to be rerouted to other areas.

Tumalo Creek is a much smaller creek with fewer diversions than the Deschutes. It originates from springs and snowmelt in the Cascade Mountains west of Bend. The creek is a tributary of the Deschutes River joining it just outside the north BMPO boundary. Drinking water diversions from Bridge Creek (a tributary of Tumalo Creek upstream) and irrigation diversions severely limit summer streamflow. During the peak of the irrigation season and during winter stock runs, more than 90% of the in-stream flow is often diverted (Jones, 2005). The Deschutes River Conservancy has implemented innovative methods, such as irrigation season leasing and water rights transfers and conservation projects, to improve streamflow and improve water quality in the Deschutes River.

Groundwater

The geology and hydrology, including the connection between surface water and the underground movement of water, is very complex and unique in Central Oregon. The report Ground-Water Hydrology of the Upper Deschutes Basin, Oregon prepared by the U.S. Geological Survey in 2001 (Gannett, 2001) states that groundwater and surface water are directly linked in the Deschutes Basin and removal of groundwater will ultimately diminish stream flow in some parts of the river (Fick, 2007, Yake, 2003). The link between surface and groundwater is important to consider in discussing downstream and regional impacts from transportation projects in the BMPO.

In general, the geology of the area includes lava beds that sit on top of several hundred feet of volcanic and sedimentary rocks. The subsurface geology of the upper Deschutes Subbasin defines and directs the storage and flow of groundwater. Although basalt itself is not very permeable, the fractures and joints between lava flows do allow a substantial amount of water to pass through (Bastasch, 1998). Soils in the subbasin are generally very shallow and highly permeable. In many areas, these soils are underlain by large areas of impermeable consolidated pumice, which prevents infiltration (Fick, 2007).

Adding to the complexity of this river system are the diversions of the Deschutes River and Tumalo Creek for irrigation and the many miles of unlined canals. These canals leak approximately 46% of the water diverted from the river back into the groundwater, which may contribute almost 13% to annual groundwater recharge in the area (Gannett, 2001). River flow is diminished between where the irrigation water is withdrawn and where it rejoins the river through the groundwater connection. The distance may be many miles apart.

The groundwater is recharged by a combination of precipitation, canal leakage, infiltration of applied irrigation water that percolates below the root zone, and leakage from streams. There is a strong connection between the amounts of precipitation and groundwater recharge rates. Approximately 84% of recharge due to infiltration of precipitation in the Deschutes Basin occurs between November and April from snowfall in the High Cascades, (Gannett, 2001).

Drinking Water

There are two aquifers underlying the BMPO. A deep underground river-like aquifer moves from the southwest across the BMPO to the northeast. At a depth of approximately 300 feet or more, this aquifer is the source of about half of the City of Bend's drinking water (Map 6). Shallow aquifers are located above the deep or "principal" aquifer but are not a source of municipal drinking water. However, there are many non-municipal water wells that withdraw from this shallow aquifer. Many of these shallow aquifers are fed by canal leakage (Fick, 2007).

Approximately half of the City's potable water is obtained from water wells tapping the deep aquifer and this amount of withdrawal is expected to grow in the future. Yields from wells in the area may be as high as 2,000 gallons per minute. Most municipal wells have yields in the 750 to 2000 gallons per minute range (Yake, 2003). The general

water table ranges from approximately 500 or more feet deep at the City of Bend rising to 200-300 feet deep near Redmond. This is due to a northerly downward sloping trend in the ground surface elevation (Gannett, 2001). Monitoring of the deep groundwater has occurred over the years and none of the data reveal a pattern of drinking water standard violations or significant groundwater quality degradation. However, data from several sources indicates that some nitrate contamination may be occurring (Fick, 2007).

Potential impacts resulting from lack of adequate control methods to prevent hazardous waste spills of fluids from getting into public wells are of concern. These spills could come from fuel deliveries to service stations (Map 6) or from other hazardous materials being transported through the BMPO on Highway 97, surface streets or on the railroad. A review of Map 4 shows the locations of drywells and catchbasins, which number in the thousands and conveys surface water underground. Work is underway to avoid this problem, but currently, if a spill occurs it will have a high likelihood of entering the groundwater and potentially wellhead protection areas. The 3rd street underpass is of particular concern because it is located in a municipal drinking water protection area. A rail car derailment at one of these overpasses (located at 3rd Street, Franklin or Greenwood) could result in a spill that could quickly drain underground and threaten groundwater. Cleanup would be difficult and expensive (Fick, 2007). More on this issue is covered in the next section on Stormwater.

Stormwater

For the past 100 years, sewage, industrial and commercial waste water and stormwater has been discharged underground to shallow aquifers that underlie the BMPO area. This is beginning to change but some of these practices continue today. There has been very little monitoring of the shallower aquifers to determine if they are being contaminated. According to the City of Bend, stormwater injected underground may be posing a threat to the quality of groundwater (City of Bend, 2007).

Currently stormwater is collected and discharged into the Deschutes River, or underground via drywells and drill holes (Map 4). In most cases there is no pretreatment of stormwater prior to discharge. According to City of Bend Public Works Department, the City's stormwater system includes about 13 miles of storm sewers, approximately 20 river outfalls, 3,280 drywells, 1,020 drill holes, and 5,200 catch basins along with a few infiltration ponds, swales, and manufactured treatment devices. The drywells and drill holes are designed to inject stormwater underground. In addition the Department reports that, "The City does not have the flow control facilities necessary for good flood and water quality management" (Stormwater Master Plan Project Fact Sheet, 2007).

Flooding is a frequent and serious problem in the City of Bend, with 30 problem areas identified. Five areas have been identified as the City's top priority to address (Map 5). In many locations throughout the city, systems are not capable of collecting, conveying and disposing of enough stormwater to prevent localized flooding even for 2-year storm events. For larger events, such as severe summer thunderstorms or heavy rainfall on a winter snow pack, flooding is serious enough to cause public safety problems, flood

property and cause land instability. In some areas, the city pumps storm runoff to the sanitary sewer system for a few hours until runoff subsides. This can hydraulically overload the sewage treatment plant and cause operating problems.

Snowmelt and rain-on-snow are serious winter problems for the city. Snow and ice plug drainage inlets and snow that is plowed onto sidewalks and other available areas throughout the city adds to the drainage problems when the snow melts, especially during rain-on-snow events. Also, the city applies cinders to many of its roads during the winter. Although it attempts to sweep these up before they can be washed into drainage systems, the city has problems with the cinders clogging its underground injection systems. Other than catch basins, few drainage systems include sediment removal devices or any other type of pretreatment." Where the railroad passes over 3rd, Franklin, and Greenwood Streets are of particular concern for flooding. The streets below these overpasses are drained underground. These drainage systems frequently fail, causing stormwater to accumulate and block traffic.

The City is currently working on several plans to address water quantity and quality issues and comply with federal and state regulations. The City has adopted an Integrated Stormwater Management Plan which is required by the two permits held by the city: one to regulate discharges to the Deschutes River (National Pollutant Discharge Elimination System (NPDES) Phase II) and another for underground discharges. These regulations and permits require the city to use best management practices to improve stormwater quality.

A Stormwater Master Plan was adopted by the City of Bend in August 2014. The Stormwater Master Plan serves as the oversight plan for addressing stormwater quantity and quality issues. In addition to providing an overall strategy for addressing stormwater concerns, the plan provides a delineation of drainage areas and runoff quantities throughout Bend, and programmatic goals for addressing quantity and quality concerns.

Water Quality

Water quality problems in the Deschutes River result primarily from untreated stormwater discharges, impoundments, and summer low-flows due to irrigation diversions. Within the BMPO, the Deschutes River is currently listed on the Oregon Department of Environmental Quality 303(d) list because portions of the river do not meet state water quality criteria for temperature, pH, dissolved oxygen, turbidity, sedimentation and chlorophyll-a (Table 18-1). The Upper Deschutes Watershed Council monitors Deschutes River water quality for the city to provide data on the presence or absence of stormwater pollutants and to help the City of Bend comply with Clean Water Act regulations.

Because the Deschutes River is 303(d) listed for impaired water quality, the Oregon Department of Environmental Quality (DEQ) is required by the U.S. Environmental Protection Agency to develop Total Maximum Daily Load (TMDL) plans demonstrating what needs to happen in order for the Deschutes River to meet water quality standards.

As part of this process, DEQ will identify organizations or agencies that have legal authority over a sector or source that could be contributing pollutants. These entities will be identified as Designated Management Agencies (DMAs) and will be required to develop a plan identifying specific management strategies that will be implemented to help meet water quality standards. Because the Deschutes River flows through the Urban Growth Boundary, the City of Bend will likely be identified as a DMA by DEQ once TMDLs have been completed. DEQ is currently developing TMDLs for the rivers and streams in the Upper Deschutes.

DEQ has been monitoring Mirror Pond since 1958 at River Mile 164.9. The results are used to indicate general trends in river quality. Results from the data gathered from 2004 to 2013 rate Mirror Pond as “Excellent” in comparison to other rivers in the state, with the trend in water quality remaining consistent.

Tumalo Creek is listed on the DEQ 303(d) list because portions of the creek do not meet state water quality criteria for temperature. Water quality concerns in Tumalo Creek are concentrated in the reach below the Tumalo Feed Canal diversion. Stream flow and water quality within Tumalo Creek are critically important for the health of the middle Deschutes River because Tumalo Creek is the only tributary along 36 miles of the Deschutes River between the City of Bend and Whychus Creek. Therefore, improved streamflow and water quality in Tumalo Creek will improve stream flow and water quality in the middle Deschutes River.

Table 18-1: 303d Listings (2004/2006) in the vicinity of the BMPO Project Area

Water Body	River Miles	Parameter	Season	Criteria
Deschutes River*	168.2 to 189.4	Chlorophyll a	Summer	0.015 mg/l
	116.0 to 222.2	Dissolved Oxygen	January 1 - May 15	Spawning : Not less than 11.0 mg/L or 95% of saturation
	126.4 to 162.6	pH	Fall/Winter/Spring	pH: 6.5 to 8.5
	126.4 to 168.2	pH	Summer	pH: 6.5 to 8.5
	168.2 to 222.2	Sedimentation	Undefined	Narrative**
	110.8 to 223.3	Temperature	Year Around (Non-spawning)	Salmon and trout rearing and migration: 18.0 degrees Celsius 7-day-average maximum
	168.2 to 222.2	Turbidity	Spring/Summer	10% increase Nephelometric Turbidity Units
Tumalo Creek	0.0 to 12.5	Temperature	Year Around (Non-spawning)	Salmon and trout rearing and migration: 18.0 degrees Celsius 7-day-average maximum

* For the Deschutes River, the following descriptions indicate where each of the river mile (RM) breaks are approximately located: RM 116 – Lake Billy Chinook; RM 126.4 – Steelhead Falls; RM 162.6 – North Unit Canal diversion below Bend; RM 168.2 – Central Oregon Canal diversion above Bend; RM 189.4 – Little Deschutes River; RM 222.2 – Wickiup Dam.
**The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry may not be allowed.

Summer high flows at the southern BMPO boundary reach 2,100 cubic feet per second (cfs) while at the northern BMPO boundary flows are reduced to as low as 30 cfs by irrigation withdrawals. This dramatic reduction in flow has been determined to result in a variety of water quality impacts (Jones, 2003). One of the most important effects of this flow modification has been the increased rate of streambank erosion upstream of the BMPO. Once sediment from these eroding streambanks enters the Deschutes River, it is carried downstream to Bend where the sediment deposits behind impoundments. The sedimentation has caused impacts to aesthetics and recreational uses, and provides a substrate for algal and aquatic plant growth. It appears that these impoundments are contributing to increased temperature and increased primary productivity (i.e., algal growth) that are linked to water quality concerns.

Underground Tanks

According to the Oregon Department of Environmental Quality's database for Leaky Underground Storage Tanks (LUST) there is only one active site in Bend (leaky diesel tank). Leaking tanks can pose a water quality concern.

Recommendations
To avoid or mitigate potential impacts to water quality it is recommended that the that the best management practices in the Integrated Stormwater Management Plan and the Stormwater Master Plan be employed when building or retrofitting transportation projects.

Future Work to be Completed

- Identify all service stations and define specific transportation routes for fuel delivery. Prioritize stormwater management along those routes.
- Identify and define specific transportation routes for transportation of hazardous materials. Prioritize stormwater management along those routes.
- Map the remaining 25 drainage areas of concern for flooding on Map 5, Water Quality.

Fish, Wildlife & Habitat Resources

Summary
The Fish, Wildlife and Habitat Resources section of this chapter focuses on the special status or otherwise protected species of fish, wildlife, plants, and critical habitat in the BMPO. Data were gathered from a wide variety of sources including the Oregon Department of Fish and Wildlife, U.S. Fish and Wildlife Service, the Oregon Department of Environmental Quality, the Upper Deschutes Watershed Council and others. Documents reviewed include sub basin assessments, species listings, conservation strategies, regulations on protected lands, recovery plans and more. Three maps pertain to the section. They are Map 8 – Fish Passage; Map 9 – Natural Resource Protection Areas; and Map 10 – Vegetation. This section should be reviewed along with the sections and maps on Water Resources and Scenic Resources because the issues discussed in that section are closely related.

There are relatively few special status fish, wildlife or habitat resources in the BMPO compared with MPO areas west of the Cascades. Historically anadromous fish have not occurred in the area due to natural barriers. Oregon spotted frog and bull trout are federally listed species that may occur in the area, although bull trout have not been observed in the upper Deschutes above Steelhead Falls since the mid-1950's. There are only two naturally occurring bodies of water in the BMPO providing habitat for sensitive riparian and wetland species. However, there are many non-threatened wildlife species seen regularly along the Deschutes River and Tumalo Creek including river otter, beaver, muskrat, mink, osprey, heron, eagle, deer and elk. Water quality may impact fish and wildlife including via temperature, sedimentation, summer low flows below the North Canal Dam, and low winter flows upstream of the dam. Fish passage barriers are numerous. Transportation routes may impede wildlife movement, especially migrating deer and elk herds. Habitat loss has been significant as new

housing developments fill in the BMPO. Avoiding impacts to fish and wildlife and conserving habitat is the highest priority. Recommendations include improving fish passage, water quality and quantity, and habitat restoration.

Methodology
The following agencies were the primary resources for this section although other agencies, organizations and individuals were contacted.

- City of Bend
- Deschutes County
- Oregon Department of Agriculture
- Oregon Department of Fish and Wildlife
- Oregon Department of Transportation
- Oregon Natural Heritage Program
- U.S. Department of Interior, Fish and Wildlife Service

The following were the primary documents reviewed for this section:

Title	Source	Date
City of Bend General Plan and Zoning Code	City of Bend	1998, 2006
Deschutes County Comprehensive Plan and Zoning Code	Deschutes County	2005, 2001
Deschutes Subbasin Plan	Columbia River Basin Fish and Wildlife Program	June 2005
Bull Trout Recovery Plan - Chapter 7 Deschutes Recovery Unit	U.S. Fish and Wildlife Service, Region 1	2002
Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Bull Trout; Final Rule	Department of Interior	Sept. 26, 2005
Endangered and Threatened Wildlife and Plants; Removing the Bald Eagle in the Lower 48 States From the List of Endangered and Threatened Wildlife; Final Rule; Endangered and Threatened Wildlife and Plants; Draft Post–Delisting and Monitoring Plan for the Bald Eagle (Haliaeetus leucocephalus) and Proposed Information Collection; Notice	Department of Interior	July 9, 2007
Federally Listed Threatened, Endangered, Proposed, Candidate Species and Species of Concern Which may occur within Deschutes County, Oregon.	U.S. Fish and Wildlife Service	Based on listing date
Fish and Wildlife Habitat Mitigation Policy	Oregon Administrative Rules	
Noxious Weed List	Deschutes County	
The Oregon Conservation Strategy	Oregon Department of Fish and Wildlife	Feb. 2006
Oregon Natural Heritage - Invertebrates Listing	Oregon Biodiversity Information Center	

Oregon Natural Heritage - NonVascular Plants/Fungi List	Oregon Biodiversity Information Center	
Oregon Natural Heritage - Vertebrate List	Oregon Biodiversity Information Center	
Oregon Natural Heritage Plan	Oregon Natural Heritage Program	2003
Oregon Wildlife Movement Strategies - Focal Species	Oregon Department of Fish and Wildlife	Jan 26, 2007
Rare, Threatened, Endangered Species of Oregon 2004	Oregon Natural Heritage Information Center	May 2004
Redband Trout Status Report	Oregon Department of Fish and Wildlife	Not available
Riparian and Wetland Vegetation of Central and Eastern Oregon	Crowe, E.A., Kovalichik, B.L., and M.J. Kerr	June 2005
Status Review Update for Deferred ESU of West Cost Chinook Salmon	West Coast Chinook Salmon Biological Review Team	July 16, 1999
The Bend Riverway, A Community Vision	Bend Park and Recreation Foundation	July 1999
Upper Deschutes Subbasin Assessment	Upper Deschutes Watershed Council	Aug 2003
USFWS Threatened and Endangered Species Systems (TESS)	U.S. Fish and Wildlife Service	Website
Upper Deschutes River Subbasin Fish Management Plan	Oregon Department of Fish and Wildlife	Oct 1996
Section 4(f) of the Department of Transportation Act	Department of Transportation	1966

Digital data layers were combined to create maps depicting environmental information available in 2007. The following are the map titles along with the data layers shown and the source of the data. For details on the metadata see Appendix F.

Map #	Map Title	Data Layer	Data Source
8	**Fish Passage**	Bridges	Deschutes County
		Dams, Diversions	City of Bend
		Salmonid Habitat	Oregon Department of Fish and Wildlife
9	**Natural Resource Protection Areas**	Bend Local Wetland Inventory	City of Bend
		City River Areas of Special Interest	City of Bend
		City Upland Areas of Special Interest	City of Bend
		City Waterway Overlay Zone	City of Bend
		County Open Space & Conservation Zone	City of Bend
		County Wildlife Area Combining Zone (Elk & Deer)	Deschutes County
		National Wetland Inventory	Deschutes County
		Rivers	Deschutes County
		Streams	Deschutes County

		Eagle Nest Vicinity	Oregon Department of Fish and Wildlife
10	**Vegetation**	Vegetation	Deschutes County

Findings
The Oregon Department of Fish and Wildlife have identified six conservation issues in their Oregon Conservation Strategy. They include:

- Land use changes
- Invasive species
- Changes in flood or fire regimes
- Water quality or quantity
- Institutional barriers
- Barriers to fish and wildlife movement

Transportation projects can impact several of these conservation issues through design, construction and implementation.

Habitat
The Deschutes River and Tumalo Creek provide the only riparian habitat in the BMPO. Much of the riparian corridor is relatively undisturbed to the north and south of the main urban core. There are no wetlands in the BMPO other than those associated with the riparian areas along the Deschutes River. Several of the riparian wetland areas are created artificially by water impoundments. There are a number of areas identified by the National Wetlands Inventory outside the Bend city limits in Deschutes County, but are probably artifacts of mapping and groundtruthing is recommended. Open space, forests and desert, cliffs, caves, and lave tubes, large old ponderosa provide habitat in the uplands. Impacts to habitat include habitat loss and fragmentation from new development and roads. Instream habitat can be impacted by water quality.

Mixed conifer and ponderosa pine communities are common in the western portion of the BMPO while sagebrush, juniper, and sparse ponderosa pine communities occur on the eastern side. Riparian vegetation is dominated by willow, alder and sedges (Map 10) (ODFW, 1996).

There are no state or federal waterfowl or wildlife refuges in the BMPO and therefore no wildlife refuges that are protected by Section 4(f) of the U.S. Department of Transportation Act of 1966.

Fish
There are no anadromous fish species in the Deschutes River above Big Falls at river mile 132, downstream of the BMPO. Big Falls is a barrier to summer steelhead, Chinook salmon, and Pacific lamprey which were historically present up to Big Falls (Map 8).

Bull trout (*Salvelinus confluentus*) is federally listed as threatened (Appendix F). The redband trout (*Oncorhynchus mykiss)* is present in the BMPO and is a federal species of concern. Alteration of the natural river flow regime is caused by irrigation diversions, and the associated effects to aquatic and terrestrial habitat resulted in the extirpation of bull trout and appreciably reduced the redband trout population (Columbia River Basin Fish and Wildlife Program, 2005.)

Historically, bull trout, redband trout, sculpin and whitefish were the indigenous salmonids in this segment of the Deschutes River. Wild fish species currently present are redband trout and mountain whitefish. The Pelton Roundbutte dam complex in 1968 restricted the navigation of salmon and steelhead. The Confederated Tribes of the Warm Springs, Portland General Electric, and many State agencies, Federal agencies, and non-governmental organizations completed a new fish passage system that allows salmon and steelhead to migrate past three Deschutes River dams. This fish passage system will help restore the historical species assemblage in the lower Deschutes (USFWS, 2002). Over $60 million dollars was being spent to bring salmon and steelhead back into the Deschutes and other tributaries below Big Falls (PGE website). The project was completed in 2008 and smolts were reintroduced to Whychus Creek. While the fish will not be able to reach the Deschutes River above Big Falls or Tumalo Creek, the water quality in the BMPO area could affect the downstream fishery.

Bull Trout

In 1998, the U.S. Fish and Wildlife Service listed the Columbia River population of bull trout (*Salvelinus confluentus*) as a threatened species under the Endangered Species Act. Historically, the upper Deschutes provided suitable and plentiful habitat for widespread bull trout populations and they were distributed throughout the Deschutes River basin from the headwaters in the Cascades to the Columbia River. At the time of listing bull trout had been extirpated from their historical habitats in the upper Deschutes above Big Falls (River Mile 132). Critical habitat for Bull Trout has been established in northern Deschutes County, outside the BMPO boundary.

According to the Recovery Plan, the main land and water management activities that depress bull trout populations and degrade habitat include fish passage associated with dams and diversions, and water quantity and quality issues associated with stormwater. Impassable dams and diversion structures isolate and fragment bull trout local populations and adversely impact water quality and quantity. Low flows and seasonally high temperatures probably reduced the river's suitability for bull trout foraging and rearing.

Redband Trout

The redband trout is indigenous to the upper Deschutes subbasin. Redband trout are a subspecies of rainbow trout and steelhead, and are adapted to the arid conditions east of the Cascades. Redband trout spawn in rivers and streams during the spring and require cool, clean, well-oxygenated water for the eggs to survive. Historically, they were found throughout the Upper Deschutes subbasin in waters connected to the Deschutes River and in Tumalo Creek (ODFW, 1996)

According to Oregon Department of Fish and Wildlife's Fish Management Plan, redband distribution in the subbasin today is "fragmented due to dams without fish passage, natural barriers, severe stream flow alterations from irrigation development, chemical treatment projects, and introduction of non-indigenous trout stocks." Redband are found throughout the BMPO on both the Deschutes River and Tumalo Creek and the species is listed as a State Sensitive Species. The introduction of non-native fishes such as brook and brown trout, and habitat changes caused by logging, severe wildfire, grazing, irrigation, dam construction, and urban development have caused dramatic declines in the distribution and abundance of redband trout throughout its range. Low summer flows in the Deschutes downstream from North Canal Dam and warm water temperatures greatly reduce summer rearing areas (ODFW).

Tumalo Creek once provided spawning and rearing habitat for a core redband trout population that migrated from the Deschutes River. Currently, fish passage from the Deschutes River to potential spawning and refuge areas in Tumalo Creek is restricted at the Tumalo Feed Canal diversion but small populations of redband trout occur throughout the Tumalo drainage. Increased summer flows in the lower reach below Tumalo Feed Canal have improved summer water temperatures (Columbia River Basin Fish and Wildlife Program, 2005.)

Fish Passage

The fishery in the Deschutes River and Tumalo Creek was strong with a historic record showing that in 1906 four men fished for four days to harvest 3,400 fish for Bend's Fourth of July. Just a few years later, in 1912, the first hatcheries were built to support a failing fishery. By the early 1920's six irrigation diversions (one is just outside the BMPO's southern boundary) and four dams were in operation in the BMPO area (Map 8.) Most of the structures did not have adequate fish passage. There are a total of 10 identified fish passage barriers upstream of Steelhead Falls at River Mile 128 (Redband Trout Status Report.). Tables 18-2 and 18-3 list the dams and diversions within the BMPO.

Table 18-2: Dams Within the BMPO

Dam Name	Location / Pond Name	Built	Operator	Fish Ladder
Colorado Dam	Colorado Street Bridge / creates unnamed 5.5 acre wetland.	1916	River Bend Limited Partnership	Yes – but not effective. Installed in 1998.
Bend Hydroelectric Project	Just north of Newport Bridge / creates Mirror Pond.	1910	Pacific Power and Light	No. Historically there was a wooden fish ladder.
Steidl Dam	Above 1st Street rapids / creates unnamed pond adjacent to Pioneer Park.	1922	Tumalo Irrigation Dist.	Yes.
North Canal Dam	South of Mt. Washington Blvd. / creates "Swan Pond" in front of Riverview Park.	1914	Jointly managed by COID & Swalley Irrigation Dist.	No.Dam is 33 feet high

Source: Bend Riverway 1999; updated via personal communication ODFW 2007

Table 18-3: Diversions within the BMPO

Diversion Name	Diversion Location	Fish Screen	Typical Summer Maximum Flows
Central Oregon Canal	East side of river ¼ mile north of River Rim development	Yes. Perforated plate screen. Fixed panel with self-cleaning brush. Black paint has camouflaged this screen.	550 cfs
Bend Feed Canal (Tumalo Irrigation Dist.)	West side of river at 1st Street Rapids	Yes. New "state of the art" screen	140 cfs
Swalley Irrigation Canal*	East side of river at North Canal dam	Yes. Upgraded in 2005	115 cfs
North Canal or Pilot Butte Canal*	East side of river at North Canal dam	Yes. Upgraded in 2005	550 cfs
North Unit Main Canal*	East side of river at North Canal dam	Yes. Has a drum screen. Will be upgraded.	800 cfs

COID = Central Oregon Irrigation Dist. TID = Tumalo Irrigation Dist., ODFW = Oregon Dept. of Fish and Wildlife; cfs = cubic feet per second.
Source: Bend Riverway 1999; updated via personal communication ODFW 2007
*shown in same location on Fish Passage Map

Birds

The bald eagle (*Haliaeetus leucocephalus)* was removed as a federally threatened species in 2007. The final delisting rule was published in the Federal Register on July 9, 2007 and became effective 30 days later. The bald eagle is protected under the Bald

and Golden Eagle Protection Act and Migratory Bird Treaty Act. Bald eagles are commonly seen in the BMPO. There is a nest just outside the western boundary of the BMPO (Map 9).

The Northern Spotted Owl *(Strix occidentalis caurina)* is a federally threatened, as is its critical habitat. There is no critical habitat for Northern Spotted Owl in the BMPO.

The yellow-billed cuckoo (*Coccyzus americanus*) is Federally proposed as threatened and has only been seen incidentally in the BMPO. The only known sighting was about 17 years ago (Marx, 2007).

A number of birds are listed as federal Species of Concern (Appendix F) but only the olive-sided flycatcher, willow flycatcher, yellow-breasted chat and Lewis' woodpecker are expected in the BMPO area. The white-headed woodpecker, northern goshawk and ferruginous hawk may pass through the area on occasion. There is no known habitat in the BMPO for greater sage-grouse, a species being considered for listing (Carey, 2007).

Impacts to birds include habitat loss and fragmentation, vehicle movement and other human-caused disturbances.

Mammals

The Gray Wolf (Canis lupus) is the only federally listed mammal that may occur in Deschutes County, but it is very unlikely to be found in the BMPO (Appendix F). It is listed as an endangered species.

One candidate species, the Pacific fisher (*Martes pennanti pacifica)* may occur in the County but it is also unlikely to be found in the BMPO.

No extensive bat surveys have been conducted that cover the BMPO area, but several bats reported as rare and threatened by the Oregon Biodiversity Information Center are known to migrate through and/or nest in the area. There is bat habitat within the BMPO. Lava tubes, caves and bats are specifically mentioned in the Steven's Road Tract master plan on the east side of the BMPO. Other caves, rim rock cliffs, trees and bridges may also provide bat habitat. Impacts to bats may result from habitat loss and insecticide use.

Deer and elk winter range surround the BMPO, primarily to the west and south. There is significant deer migration from the Deschutes National Forest west of the Deschutes River to wintering ranges east of the river identified as the North Paulina, Devil's Garden and Hole in the Ground Ranges (Deschutes County, 2005). Approximately 30,000 to 35,000 mule deer migrate twice a year through and around the BMPO. Elk are commonly found within the BMPO near the southern BMPO boundary. Seasonal wildlife migration and year around movement of elk and deer is a serious concern for the safety and well being of both the animals and people.

Wildlife Movement

Roads pose several concerns including habitat fragmentation and crossing concerns for wildlife, and property damage to cars and personal injury to humans.

As traffic volumes increase, so do the numbers of wildlife crossing issues. In 2012, there were approximately 18,000 (at Pinebrook Boulevard) to 42,000 (at Empire Avenue) vehicles passing through the BMPO on Highway 97 daily and another 14,000 (at 27th Street) to 16,000 (near 3rd Street) vehicles traveling on Highway 20. Approximately 1,250 animals were killed on roadways in Deschutes County in 2006 (Bryant, 2007). Highway 97 has been identified as barrier between summer and winter deer and elk range with 400 deer killed annually in a 50-mile stretch of highway. The deer and elk migrate using a "sheet migration," crossing almost anywhere. In 2006, wildlife encounters with cars were spread fairly evenly up and down the highways. The Oregon Department of Fish and Wildlife has compiled a focal species list for wildlife movement that includes amphibians and reptiles in additions to mammals.

Amphibians and Reptiles

Oregon spotted frog (*Rana pretiosa*) is a federally listed threatened species in Deschutes County. The Cascades frog (*Rana cascadae*) and northern sage lizard (*Sceloporus graciousus graciousus*) are listed as Species of Concern. There are other amphibians and reptiles listed federally for the County (Appendix F) but they are not likely found in the BMPO area. Cascade frog is most commonly found at higher elevations and the spotted frog is typically found farther south, including within the BMPO boundary. Proposed critical habitat for the Oregon spotted frog is within the BMPO – extending along the Deschutes River from the western BMPO boundary to the Colorado Avenue bridge.

Impacts to amphibians and reptiles may occur through habitat loss and fragmentation, invasive species infestations, and water quality degradation.

Invertebrates

There are no federally listed invertebrates in Deschutes County. Invertebrates have been reported by the Oregon Biodiversity Information Center for Deschutes County (Appendix F).

Non-Vascular Plants and Fungi

There are no federally listed non-vascular plants or fungi in Deschutes County. There are, however, numerous liverworts, mosses, lichens and fungi listed by the Oregon Biodiversity Information Center (Appendix F). Impacts to these species can include habitat loss, water and air quality.

Invasive species

The bullfrog (*Rana catesbeiana*), an invasive non-native species is found in the area. Other invasive species such as quagga mussel (*Dreissena bugensis*), zebra mussel (*Dreissena polymorpha*) and fox squirrel (*Sciurus niger*) have not made their way to the BMPO area but their arrival is anticipated. Invasive mollusk species are transported

from one area to another on boats and boat trailers towed from an infested area. In 2007, the BMPO was sprayed for gyspy moth (*Lymantria dispar*). Other non-native invasive insects are present or anticipated to arrive in the coming years. Invasive species common on the west side of Oregon such as nutria and opossum have not been reported in the BMPO area – most likely due to the cold winters. This could change as global climate change affects the seasonal weather.

Plants

A number of vascular plants are listed as federal Species of Concern in Deschutes County (Appendix F). It is unlikely that any of these plants are found within the BMPO (because of their habitat requirements) but as with many plant species, unexpected disjunct occurrences are often found when surveys are conducted (Gilbert, 2007).
There are numerous plants listed by the Oregon Biodiversity Information Center for Deschutes County (Appendix F.) Impacts to plants are primarily from habitat loss through development and from competition by invasive species.

Noxious Weeds

The Deschutes County Board of Commissioners has designated 58 noxious weed species in the County (Appendix F), as of April 2014. A noxious weed is one that is "injurious to public health, agriculture, range, recreation, wildlife, or any public or private property; any weed that impacts and displaces desirable vegetation, such as Threatened and Endangered Plant Species, wildlife habitat, and livestock" (Deschutes County Noxious Weed List). The weeds are ranked A (29 species), B (13 species), and C (16 species) depending on control goals set by the County. Some of the most common include the knapweeds, toadflax, and yellow flag iris. Transportation corridors are a common way to spread noxious species.

Protected Areas

The City of Bend has a number of codes designed to protect natural features and resources. Each of these protected areas is shown on Map 9 and is described below.

City of Bend protects water resources under Chapter 2.7.600 of the City Code in a zone called the Waterway Overlay Zone (WOZ). The code states "The Deschutes River and Tumalo Creek stream corridors within the urban growth boundary of the City of Bend are valuable economic, recreational, scenic and natural resources for the community. The WOZ is intended to conserve and enhance the natural resource values of areas along the Deschutes River and Tumalo Creek within the city."

The WOZ includes the following sub-zones, which provide various types of protection:

- Riparian Corridor – defines minimum setbacks from Deschutes River and Tumalo Creek and significant wetlands.
- Deschutes River Corridor Design Review – design review for building within 100 feet of the river; criteria and process to determine setbacks.
- River Corridor Areas of Special Interest – unique areas (primarily rimrock and canyons) with protection criteria.
- Flood Plain – criteria and process for development in the floodplain.

The City has a Local Wetlands Inventory, however there are only a few significant wetlands in the BMPO and all of them are located in the riparian corridor of the Deschutes River. There are a number of areas identified as wetlands iby the National Wetlands Inventory, but these should be ground truthed as they may be mapping artifacts.

The City of Bend also protects special features in a zone called "Upland Areas of Special Interest Overlay Zone" that is intended to protect valuable natural resources. The zone is described in Chapter 2.7.700 of the City Code as "scattered rock outcrops, stands of trees, and dominant ridges and faults that are typical of the Central Oregon landscape. These areas contain high points or changes in elevation that break the line of sight so that the area retains a feeling of undeveloped open space." The zone defines setbacks and allowed uses of these areas, many of which are on private property.

Deschutes County also has several zones and regulations to protect natural features including the Wildlife Combining Zone and the Open Space Conservation Zone. The County adopted the National Wetlands Inventory to comply with Goal 5.

The purpose of the Open Space and Conservation Zone (Chapter 18.48 of the Deschutes County Code) is to protect designated areas of scenic and natural resources; to restrict development in areas with fragile, unusual or unique qualities; to protect and improve the quality of the air, water and land resources and to plan development that will conserve open space.

The purpose of the Wildlife Area Combining Zone (Chapter 18.88) is to "conserve important wildlife areas in Deschutes County; to protect an important environmental, social and economic element of the area; and to permit development compatible with the protection of the wildlife resource." This zone provides protection for migrating elk and deer primarily through the type and density of allowed uses. This zone is shown on Map 9 with the animal species and herd names. The zone is only in the County jurisdiction and stops at the Bend city limits. It should be noted that the animals do not stop at jurisdictional boundaries.

State and Federal Wild and Scenic Rivers are also protected. Please see the section Scenic Resources in this chapter for more information.

Recommendations

Habitat

Design transportation projects to avoid and minimize the impacts to habitat wherever possible. See general policies for more.

Bull trout, redband trout, and Oregon Spotted frog

Identify and explore methods to protect, restore, and maintain suitable habitat conditions for bull trout, redband trout, and Oregon spotted frog for all transportation

projects, especially those near the Deschutes River or Tumalo Creek, including the following:

- Maintain or improve water quality.
- Stabilize roads, crossings, and other sources of sediment delivery.
- Identify barriers or sites of entrainment and implement tasks to provide passage and eliminate entrainment.
- Screen water diversions and irrigation ditches.
- Restore connectivity and opportunities for migration by securing instream flows and/or water rights.

Invasive species

- Develop measures that prevent invasive species from entering the area on cars, trucks, boats, boat trailers or other vehicles.
- Design transportation projects to prevent the spread of noxious weed species.

Wildlife Linkages

The design of new transportation projects and the retrofit of existing projects shall include the identification of any wildlife movement issues and a review of best management practices to facilitate wildlife movement to improve human and wildlife safety, decrease habitat fragmentation and property damage. Include mapped wildlife movement areas of concern.

Future Work to be Completed

There may be additional activities recommended for specific species including bats that should be identified.

Hazards

Summary

The Hazards section of this chapter focuses on issues related to natural hazards such as earthquake fault lines, floodplains, wildfire areas and surface mines. It includes information on soils, topography and steep slopes. Data were collected from a wide variety of sources including the Federal Emergency Management Agency, Environmental Protection Agency, National Resources Conservation Service, Oregon Department of Environmental Quality and the City of Bend. There are two maps that relate to this section: Map 11: Natural Hazards and Map 12: Soil Conductivity. This section should be reviewed along with the section on Air Quality and also Water Resources, particularly the stormwater data as they are closely linked. There were no identified hazardous waste issues or areas including toxic releases to the air. Existing code addresses potential issues with earthquakes, flooding and landslides. Recommendations are made to ensure consideration of emergency evacuation routes, stream channel movement and potential issues with the railroad.

Methodology

The following agencies were the primary resources for this section although other agencies, organizations and individuals may also have been contacted.

- City of Bend
- Deschutes County
- Environmental Protection Agency
- Federal Emergency Management Agency
- Natural Resources Conservation Service

The following were the primary documents reviewed for this section:

Title	Source	Date
Emergency Operations Plan	Deschutes County Sheriff's Office	November 2003
Deschutes County Code	Deschutes County	2001
Bend City Code	Bend City Code	2006
Preliminary Risk Assessment for Creosote	Environmental Protection Agency	
Critical Areas Ordinance; Best Available Science Volume 1; Chapter 4: Channel Migration Zones	King County Washington	

Digital data layers were combined to create maps depicting environmental information available in 2007. The following are the map titles along with the data layers shown and the source of the data focusing on environmental hazards. See Appendix F for details on the metadata.

Map #	Map Name	Data Title	Data Source
11	**Natural Hazards**	Earthquake Fault Lines	Deschutes County
		FEMA 100 Year Flood	Deschutes County
		Historic Fires	Deschutes County
		Steep slopes >25%	Deschutes County
		Surface Mine Impact Area	Deschutes County
		Surface Mines	Deschutes County Deschutes County
		Topography 100 Foot Contours	Deschutes County
		Topography 50-100 Foot Contours	Deschutes County
12	**Soil Conductivity**	Soil conductivity (permeability)	USDA

See also these maps: Stormwater, Environmental Health and Water Quality, discussed in the Water Resources section of this report.

Findings

The Environmental Protection Agency website was reviewed but no active sites were located in the BMPO on the Toxic Release Inventory or the superfund site (see also Air Quality.)

Wildfire evacuation routes are important to public safety. Transportation projects could conflict with public safety if evacuation routes are not considered. The Natural Hazard

Map (no. 11), shows wildfires that have occurred in the past. More than 20 homes were destroyed in the Awbrey Hall fire in 1990.

Flooding of the Deschutes River occurs very rarely because the river is highly regulated by dams. Flooding occurs when ice dams build up in the winter then break, releasing water. The last flood was in the early 1980's. An ice boom is installed in the river in the winter to prevent the formation of ice dams. Tumalo Creek floods in the spring. The reach of the creek that floods is in Shevlin Park where it is allowed to spill over its banks and it has changed course over the years. Flooding and channel migration may be an issue for transportation projects near the creek. Impacts to the creek and to property can be avoided if they are assessed early on and the project is designed to minimize conflict. The Federal Emergency Management Administration floodplains are shown on Map 11.

Several proposed transportation projects cross earthquake fault lines (Map 11). They are also crossing areas of low soil conductivity (Map 12). This could contribute to stormwater problems (see Water Resources.) Landslides are not common in the BMPO.

Surface Mine Impact Areas are also identified (Map 11) and regulations restrict noise and dust-sensitive uses in the area of a surface mine (Deschutes County Code 18.56.) The purpose of the zone is to protect the surface mining resources of Deschutes County from new development which conflicts with the removal and processing of a mineral and aggregate resource while allowing owners of property near a surface mining site reasonable use of their property. The zone applies to all property located within one-half mile of the boundary of a surface mining zone. This is not anticipated to have any conflicts with proposed transportation projects.

The Burlington Northern Railroad bisects the BMPO in a north-south direction. Conflicts with transportation projects include increased cost of crossing a railroad or avoiding it and potential environmental concerns from toxics transported on the railroad. In addition the Environmental Protection Agency (EPA) is currently reassessing creosote (commonly used in railroad ties) as part of its ongoing re-registration program for older pesticides. The EPA website has a fact sheet with recommended safety precautions advised for the use, removal and disposal of railroad ties.

Recommendations

- Consideration of wildfire hazards and other emergency evacuation routes should be taken into account in the design of transportation projects.

- Further investigation of the issues involved with railroad transport should be conducted, specifically the potential for toxic releases and railroad maintenance.

- Transportation projects near Tumalo Creek should analyze potential flooding impacts and channel migration potential and develop mitigation if impacts are identified.

Climate Change

Summary

The Climate Change section of this chapter focuses on issues relating to predicted changes in the climate in the BMPO area from global warming. Data were gathered from the Oregon Climate Service, Climate Impacts Group, the Governor's Advisory Group on Global Warming and the Oregon Department of Environmental Quality. There are no maps that relate to this section. This section should be reviewed along with the section on Air Quality as they are closely linked. Impacts from transportation include greenhouse gas emissions. Greenhouse gases result primarily from the burning of fossil fuels in vehicles. Mitigations have been identified to reduce greenhouse gasses through the design of transportation projects and the adoption of greenhouse gas reducing tactics. Recommendations include adopting the some key actions identified in the *Oregon Strategy for Greenhouse Gas Reduction*.

Methodology

The following agencies were the primary resources for this section although other agencies, organizations and individuals may also have been contacted.

- Oregon Department of Environmental Quality
- Climate Impacts Group
- Governor's Advisory Group on Global Warming
- Oregon Climate Service

The following were the primary documents reviewed for this section:

Title	Source	Date
2013 Air Quality Data Summaries	DEQ	June 2014
Oregon Strategy for Greenhouse Gas Reduction	Governor's Advisory Group on Global Warming	Dec. 2004 revised
Oregon Climate Service website	Oregon Climate Service	
Climate Impact Group website	Climate Impact Group	
OAR 660-044 (Metropolitan Greenhouse Gas Reduction Targets)	http://www.oregon.gov/LCD/CLIMATECHANGE/pages/metropolitan_greenhouse_gas_reduction_targets.aspx	

No maps were made for this section.

Findings

The Oregon Climate Service includes the BMPO in the South Central Oregon climatic division, which extends from Sisters in the west, Fossil in the north, Malheur in the east and Klamath Falls to the south. The area is described a "vast area of high desert prairie punctuated by a number of mountain ranges and isolated peaks." Most of this region receives relatively low amounts of precipitation with areas near the Cascades including the BMPO area tending to have annual distributions very similar to those in western Oregon: winter precipitation followed by a steady decrease, with lowest monthly

averages in midsummer. The months of July through September are generally the driest of the year throughout the region and often have isolated local thunderstorms. Some months are very wet and others almost completely dry" (Oregon Climate Service website).

Oregon's environment is already being impacted by global climate change. All of our glaciers are receding, some by as much as 60%. Snow pack is down, making it increasingly difficult to find enough water to irrigate farms and maintain adequate flows for fish.

According to the Climate Impact Group's website the climate of the Pacific Northwest has changed during the past 100 years in a number of ways including:

- Region-wide warming of about 1.5°F (0.8°C) in 100 years.
- Increase in precipitation in most of the region.
- Decline in snowpack – especially at lower elevations – since 1950.
- Spring is arriving earlier in the western U.S.

The website further states, "In a future, warmer world, warmer temperatures will result in more winter precipitation falling as rain rather than snow throughout much of the Pacific Northwest, particularly in mid-elevation basins where average winter temperatures are near freezing. This change will result in:

- less winter snow accumulation,
- higher winter streamflows,
- earlier spring snowmelt,
- earlier peak spring streamflow, and
- lower summer streamflows

Global climate models scaled to the Pacific Northwest project an increase in average regional temperatures of 0.5° per decade throughout the 21st century. Temperature increases are expected to occur across all seasons with the largest increases in summer. Changes in annual precipitation are less certain. Most of the models analyzed by the Climate Impact Group show decreases in summer precipitation and increases in winter precipitation with little change in the annual mean.

A declining snowpack could have a significant impact on water resource availability. Substantial reductions in summer streamflow are anticipated in the coming decades and will adversely affect many water users, including farmers who rely on irrigation, resident and anadromous fish, and summertime hydropower production.

If Central Oregon experiences a reduced snowpack or earlier snow melts, there would be a change in run-off patterns for the Little Deschutes River, a tributary of the Deschutes River upstream of the BMPO. Currently, its average peak run off month is May and June. This could be a month earlier in the future. It may also result in higher flows during the winter because of rain rather than snowfall. There may not be a

significant change in the flows of the Deschutes River because most of the run-off occurs through the absorption of snowmelt into the ground and emanating as spring flow later in the summer. For the most part, due to the porous nature of the soils in the Deschutes basin, precipitation in any form at any time of the year is mostly absorbed into the ground. Predicting changes in weather patterns, however, is very uncertain (Gorman, 2007).

Other climate change related impacts in the areas could include:

- Warmer water temperatures in rivers and stream affecting fisheries
- Increase in wild fires
- Change in the composition of forest species
- Increase in noxious non-native species of insect, plants and mammals
- Drought resulting in less water instream for irrigation and fish
- Extinction of local populations
- Loss of biological diversity

According to the Department of Energy "The impacts of such changes on Oregon citizens, businesses and environmental values are likely to be extensive and destructive. Coastal and river flooding, snowpack declines, lower summer riverflows, impacts to farm and forest productivity, energy cost increases, public health effects, and increased pressures on many fish and wildlife species are some of the effects anticipated by scientists at Oregon and Washington universities."

The Oregon Strategy for Greenhouse Gas Reduction states that in 2000, 84% of greenhouse gas emissions in Oregon were Carbon dioxide (CO2). The primary source of CO2 emissions came from burning fossil fuels, such as coal (power plants), gasoline, diesel, and natural gas. There were also emissions from various industrial processes and emissions from municipal and industrial wastes incineration of fossil-fuel derived products.

One-third of Oregon's greenhouse gas emissions are from transportation. Cars, light trucks, sport utility vehicles, buses, large trucks, airplanes, trains and marine vessels all contribute to these emission levels. There are over 3.1 million motor vehicles registered for roadway use in Oregon. Oregonians spend more than $3 billion for transportation fuels each year. In 2011, the Land Conservation and Development Commission (LCDC) adopted per capita GHG emission reduction targets for light-duty vehicles for all six metropolitan areas within Oregon. The target for the Bend MPO is to reduce emissions 18% per person over 2005 levels by year 2035 (OAR 660-044).

In June 2014, the City of Bend received grant from the Oregon Department of Transportation to install a compressed natural gas (CNG) fueling facility. CNG offers lower greenhouse gas emissions than gasoline or diesel. The facility will provide CNG fueling for publicly-owned fleets and the general public. The facility is planned at the City of Bend's public works facility at 575 NE 15th Street.

In July 2007, the City of Bend mayor signed the U.S. Conference of Mayors' Climate Protection Agreement. This agreement sets general goals for the city to reduce pollution, cut energy use and add more sustainable programs.

The BMPO and the City of Bend prepared a Public Transit Plan in 2013 to ensure that improvements necessary to accommodate future public transportation services are pre-located years in advance of implementation and become an integral part of the local planning process, which will promote transit service and support the reduction of greenhouse gas emissions.

Recommendations
Adopt the transportation actions identified in the Oregon Strategy for Greenhouse Gas Reduction that are appropriate for the BMPO.

Mitigations measures from the Oregon Strategy for Greenhouse Gas Reduction are designed to reduce greenhouse gas emissions from consumption of fossil fuels by displacing conventional combustion engines with hybrid, electric and other technological/fuel options, and to guide land use choices, especially in Oregon's urban areas, toward more efficient choices including higher densities, transit options, mixed-use neighborhoods, and common wall dwelling designs. Mitigations should be updated as new information becomes available. Among the recommended actions outlined in the report that may be appropriate for the BMPO are:

- Integrate land use and transportation decisions with greenhouse gas consequences.
- Promote alternative fuel use and production.
- Incorporate greenhouse gas emission impacts into transportation planning decisions.
- Promote better management and use of parking
- Support and implement demand management programs
- Encourage bicycling and walking for short trips
- Support development of carsharing programs
- Support development of more sustainable funding sources to support maintenance and operation of the transportation system
- Set up traffic engineering "Best Practices" (as applicable to the City of Bend's ongoing work on modifying traffic analysis requirements)
- Improve mass transit and inter-city transit links.

An overall recommendation is to work with the City of Bend to conduct a carbon inventory and consider crafting a comprehensive carbon emissions reduction plan.

Air Quality

Summary
This section focuses on air quality in the BMPO. Data were collected primarily from the Oregon Department of Environmental Quality (DEQ) and the U.S. Environmental Protection Agency. Documents reviewed include air emission reports, comprehensive

plans and air quality data. This section should be reviewed with the section on Climate Change and Hazards as they are closely related. Potential conflicts resulting from transportation projects to air quality include increases in carbon monoxide from vehicle emissions and dust from cinders (used for icy road conditions). The primary recommendation is to conduct further analysis of air quality impacts from proposed transportation projects.

Methodology
The following agencies were the primary resources for this section although other agencies, organizations and individuals may also have been contacted.

- U.S. Environmental Protection Agency
- Oregon Department of Environmental Quality

The following were the primary documents reviewed for this section:

Title	Source	Date
Air Emissions Inventory (PM 10 Emission Estimates)	Oregon Department of Environmental Quality	
PM 10 Emissions Estimates, Fugitive Dust Report	Oregon Department of Environmental Quality	June 2005
Deschutes County Comprehensive Plan	Deschutes County	2005
City of Bend General Plan	City of Bend	1998
Environmental Protection Agency TriExplorer website	Environmental Protection Agency	
2013 Air Quality Data Summaries	Oregon Department of Environmental Quality	June 2014

There are no maps for this section.

Findings
According to the 2013 Oregon Air Quality Data Summaries from the DEQ the air pollutants of greatest concern in Oregon are:

- ground-level ozone, commonly known as smog
- fine particulate matter (mostly from wood smoke, other combustion sources, cars and dust) known as PM2.5 (2.5 micrometers and smaller diameter)
- hazardous air pollutants (also called Air Toxics)

Motor vehicles are the primary source of air pollution in Oregon. Although each individual car or truck contributes relatively small amounts of pollution, the sheer number of vehicles makes their total contribution larger than any other single source. Emissions from cars contribute to ground level ozone pollution (smog) especially on hot summer days (DEQ, 2005).

Fine particulate air pollution consists of solid particles or liquid droplets that are less than 10 microns in diameter (PM10) or less than 2.5 microns in diameter (PM2.5). Particles in these size ranges are of great concern because they can be inhaled deeply

into the lungs where they can remain for years. The health effects of particulate matter vary with the size, concentration, and chemical composition of the particles (Oregon Department of Environmental Quality Website).

The Bend General Plan adopted in 1998 notes that in Bend, there are two air pollutants of concern that are monitored on a regular basis. They are carbon monoxide (CO) and very small particulate matter (PM10). Automobile exhaust and other incomplete combustion are typical sources of CO production. A variety of materials such as windblown dust, field and slash burning, wood stove smoke, and road cinders used for winter sanding can produce fine particles that fall into both the PM10 and PM2.5 air pollution category.

The plan further states that, "Although the few occurrences of exceeding these two air quality standards have *not* been of sufficient frequency to have Bend designated as an air quality "non-attainment area," the forecast of significant population and economic growth for Bend and Deschutes County increases concerns about Bend's ability to maintain compliance with the air quality standards" (Bend General Plan, 1998).

Other occurrences or activities affecting air quality in the BMPO include wood burning stoves, winter inversions, cinder particulates (spread on roads to reduce icy conditions) and outdoor burning. Field burning (primarily north of the BMPO) and wildfires also contribute to poor air quality.

The Air Quality Index (AQI) is based on data collected from the Oregon Department of Environmental Quality's air monitors. These raw measurements are converted into AQI values. An AQI value is calculated for each individual pollutant using standard formulas. The highest of the AQI values for the individual pollutants becomes the AQI value for that day. For example, if AQI values were 90 for ozone and 88 for carbon monoxide, the AQI reported would be 90 for the pollutant ozone on that day (DEQ website). Bend has a monitor in Pioneer Park that monitors daily air quality. Table 18-4 shows the AQI for 2013 for the BMPO area.

Table 18-4: 2013 Bend Air Quality Index

AQI Days	All	PM2.5	CO
Good	332	332	153
Moderate	33	33	0
UFSG	0	0	0
Unhealthy	0	0	0
No AQI	0	0	11
Total	365	365	153

Source: DEQ website

Since the year 2000 there has been a general downward trend of PM10, PM 2.5 and carbon monoxide in the Bend area. PM10 standards were exceeded once each in 1996 and 2000.

The fugitive dust portion of the Emission Inventory (EI) was not included in the statewide Emission Inventory for 2002. This is an important piece of the emissions picture. Deschutes Country ranked sixth highest in the state for total fugitive dust, with most dust coming from unpaved roads (Calkins, 2007).

No open debris burning is permitted within the city limits of Bend.

The U.S. Environmental Protection Agency website shows trends for releases from 1988 – 2012 for Deschutes County. Two areas reported releases. They are fugitive air emissions and stack/point source emissions. Fugitive air emissions are all releases to air that are not released through a confined air stream. Fugitive emissions include equipment leaks, evaporative losses from surface impoundments and spills, and releases from building ventilation systems. Stack or point source air emissions occur through confined air streams such as stack, vents, ducts, or pipes. The trend since 1988 has been generally trending sharply downward.

Recommendations
Use the transportation demand model, the complimentary air quality models, and the emissions inventory to analyze the impact of proposed transportation projects to air quality.

See also the recommendations in the Climate Change section of this report for other actions that will mitigate air quality conflicts.

Scenic Resources

Summary
The Scenic Resources section of this chapter focuses on a variety of protected scenic resources in the BMPO. Data were gathered from Deschutes County and Deschutes National Forest and others. Documents reviewed include management plans for the scenic byway and the wild and scenic river segments, county zoning regulations and Oregon statutes and policies. Of the approximately 14 miles of river running through the BMPO, nearly 11 miles are designated scenic. There is one map for this section: Map 13 Scenic Resources. Potential conflicts resulting from transportation projects include degrading scenic resources by building new projects in view corridors and air pollution obscuring views. Potential conflicts have been identified for the Cooley Road Project. Avoiding conflicts with scenic resources is the preferred mitigation.

Methodology
The following agencies were the primary resources for this section although other agencies, organizations and individuals may also have been contacted.

- City of Bend
- Deschutes County
- Deschutes National Forest

The following were the primary documents reviewed for this section:

Title	Source	Date
Cascade Lakes Scenic Byway, Corridor Management Plan	U.S. Forest Service	July 1996
Cascade Lakes Scenic Byway, Interpretive Plan	U.S. Forest Service	June 1996
Upper Deschutes Wild and Scenic River and State Scenic Waterway Comprehensive Management Plan	U.S. Forest Service	July 1996
Oregon Administrative Rules 736-040-0073; 736-040-0030; 736-040-0035	State of Oregon	
Oregon Revised Statute Chapter 390.805-995	State of Oregon	

Digital data layers were combined to create maps depicting the existing scenic resources. The following are the map titles along with the data layers shown and the source of the data. For details on the metadata see Appendix F.

Map #	Map Title	Data Layer	Data Source
13	**Scenic Resources**	Cascade Lakes National Scenic Byway	City of Bend (created)
		County Landscape Management Combining Zone	Deschutes County
		County Landscape Management Combining Zone - Water	Deschutes County
		Federal Wild and Scenic Rivers	Deschutes County
		State Scenic Waterways	Deschutes County

All known data necessary for this section was collected. The Federal Wild and Scenic River boundaries may be slightly inaccurate.

Findings

There are significant scenic resources within the BMPO. Views of Three Sisters, Mt. Bachelor, Tumalo Mountain and Broken Top along with the Deschutes River are all visible and prominent from the BMPO. Numerous protections exist for scenic resources including:

- County Landscape Management zones
- Cascade Lakes National Scenic Byway
- State Scenic Waterway designation
- Federal Wild and Scenic River designation

These are all protected resources with varying levels of requirements that must be taken into account in all transportation projects. All of the areas are identified on Map 13 and described below.

County Landscape Management Combining Zone

The purposes of Deschutes County's Landscape Management Combining Zone are to maintain scenic and natural resources of the designated areas and to maintain and enhance scenic vistas and natural landscapes as seen from designated roads, rivers or streams[2]. To implement the zone, the County regulates new structures and landscaping to avoid impacts to scenic views from roads, on rimrock and near rivers. The zone applies to all areas within ¼ mile of the roads in the zone and in State Scenic Waterway and the Federal Wild and Scenic River corridor and all areas within 660 feet of rivers and streams otherwise identified as landscape management corridors in the comprehensive plan and the County Zoning Map.

National Scenic Byway

The route on Forest Highway 46 between Bend and Highway 58 is designated as the Cascade Lakes National Scenic Byway. It begins with the Tour Route in Drake Park and follows Galveston to 14th Street. The Byway begins at edge of the Urban Growth Boundary on the way to Mt. Bachelor at the Deschutes National Forest boundary, travels through the Cascade Lakes recreation area adjacent to the Three Sisters Wilderness, and ends at the junction of Road 61 and Highway 58 close to Crescent Lake. It received its designation for its outstanding scenic, natural, and recreational qualities. There are numerous goals for the Byway including the reduction of impacts from billboards and protection of scenic views, wildlife and recreation opportunities. While there are no specific regulations are associated with the Byway, it is a nationally and regionally recognized resource as well as a part of Oregon's state scenic byways program. The U.S. Forest Service administers the program. The Federal Highway Administration administers a program that awards funds competitively each year in the form of merit –based grants covering 80 percent of the project cost and with the requirement that the remaining 20 percent be matched by local, state, other federal or in-kind means. Funds have been secured in the past for projects along the Cascade Lakes National Scenic Byway.

Scenic Waterways and Wild and Scenic River designation

Of the approximately 14 miles of river within the BMPO, about 10.8 miles are designated scenic. There are two sections of State Scenic Waterway in the BMPO – one in the north and the other at the south end of the BMPO, encompassing a total of 8.4 miles (Map 13). The south section enters the BMPO's southern boundary and ends at the Central Oregon Irrigation District diversion. The north section starts just below the North Unit Dam (near Mt. Washington Drive) and continues through the BMPO to the north. Oregon State rules govern the Scenic Waterway program and The Upper Deschutes Wild and Scenic River and State Scenic Waterway Comprehensive Management Plan contains specific rules that address setbacks, building color, vegetation retention, river crossings, screening and timber harvest for the southern section within a ¼ mile of the designated river sections. Oregon Park and Recreation Department administers the program.

[2] See Deschutes County Code (DCC) Chapter 18.84.

There is one stretch of Federal Wild and Scenic River within the BMPO that begins just outside the City of Bend city limits and is about 2.4 miles long within the BMPO. Protection for federal scenic rivers is focused on the "outstandingly remarkable values" that have been identified for the river including geologic, hydrologic, fishery, vegetative, wildlife, cultural, recreational and scenic values. The Upper Deschutes Wild and Scenic River and State Scenic Waterway Comprehensive Management Plan identifies goals, standards and guidelines for each of the values. This program has similar goals to the state program but differs in the type of protection offered. The U.S. Forest Service administers this program.

Potential Conflicts

Potential conflicts from transportation to the scenic resource could come from the building or rebuilding bridges over the river near the designated scenic sections or building roads within a quarter to a half-mile of designated resources. There are potential conflicts identified for the Cooley Road extension project for the State Scenic Waterway and the County Landscape Management Combining Zone.

Recommendations

- For all transportation projects, review the Scenic Resources map and identify and potential conflicts.
- For the Cooley Road extension project: Design the project to avoid impacts to the State Scenic Waterway and the County Landscape Management Combining Zone.

Historic and Cultural Preservation

Summary

The Historic and Cultural Preservation section of this chapter focuses on designated historic and cultural resources in the BMPO. Data were gathered from the several sources including the Deschutes County Historical Landmarks Commission, Bend Landmarks Commission, the Oregon State Historic Preservation Office, the Bureau of Land Management and the Deschutes National Forest. Documents reviewed include websites, regulations, reference materials and maps on historic and cultural resources. Resources identified include two historic districts and other individual resources listed on the National Register of Historic Places. All properties listed on the National Register, properties located in the two historic districts, and other properties that may be eligible for listing on the National Register of Historic Places are subject to Federal Section 4(f) regulations. Map 14: Cultural Resource Protection shows these resources and also some archeological high sensitivity areas. The Oregon State Archaeologist and the Landmarks Commission report that there are many archaeological reports filed about sites in the study area, but they are not available to show on a map. No potential conflicts to the resources resulting from transportation projects were identified, but a request for further review by the Oregon State Historic Preservation Office will be necessary on a case-by-case basis when specific transportation projects are funded. Avoiding conflicts with historic and cultural resources is required, if other alternatives exist, by federal law and is the preferred course of action.

Methodology
The following agencies were the primary resources for this section although other agencies, organizations and individuals may also have been contacted.

- Deschutes County Historical Landmarks Commission
- Bend Landmarks Commission
- Deschutes County
- Oregon State Historic Preservation Office (SHPO)
- U.S. Department of Agriculture, Deschutes National Forest
- Bureau of Land Management

Several conversations were held with the Confederated Tribes of Warm Springs, but no data were collected.

Also contacted by letter and phone with no response:

- Burns-Paiute Tribe
- Klamath Tribe

The following were the primary documents reviewed for this section:

Title	Source	Date
A Cultural Resource Survey of the Deschutes River from Bend to the Deschutes Jefferson County Line, Deschutes County Oregon	Scott, Sara A.	Jan 1986
National Register of Historic Places	National Park Service web site and the Oregon State Historic Preservation Office	2014
City of Bend General Plan, Chapter 3	City of Bend	1998
City of Bend website; Community Development Department Historic Preservation	http://www.ci.bend.or.us/depts/community_development/planning_division/historic_preservation.html	n/a
Section 4(f) of the Department of Transportation Act (49 USC303 and 23 USC 138)	Department of Transportation	1966

Digital data layers were combined to create maps depicting environmental information available in 2007. The following are the map titles along with the data layers shown and the source of the data. For details on the metadata see Appendix F.

Map #	Map Title	Data Layer	Data Source
14	Cultural Resource Protection	Archeological Sites	Bureau of Land Management
		National Register Historic Districts	City of Bend Community Development Department
		Historic Resources	Deschutes County
		Craftsman Bungalows	Des Chutes Historical Center

The State Historic Preservation Office was contacted and they requested that the BMPO contact them on a case-by-case basis for each transportation project rather than attempting to document the entire BMPO area.

Findings

Historic Resources

Based on the Historic Sites Database from the Oregon State Historic Preservation Office data, there are two National Register of Historic Places Historic Districts in the BMPO (Drake Park Historic District and Old Town Historic District), 410 properties that are listed on the National Register of Historic Places as part of these two historic districts, and 26 individually listed properties (including the two historic districts). There are also numerous individually designated historic and cultural buildings and sites (Map 14 and Appendix F). The Bend Landmarks Commission is the review body for projects that may affect a designated cultural or historical site within the City of Bend.

In addition to the listings on the National Register, Bend City Council adopted a list of historic and cultural resources that has been approved by Oregon Land Conservation and Development Commission (Appendix F). Any land use action or building modification to the historic structures on the approved list must be reviewed and approved by the Bend Landmarks Commission. These properties may also be protected by Section 4(f) for transportation projects. Additionally, the Craftsman bungalows identified as potentially eligible for the National Register may also be 4(f) properties (Map 14).

Cultural Resources

There are three tribal nations, which may consider the area where the BMPO is today their usual and accustomed summer camps, hunting and gathering areas. They are the Confederated Tribes of Warm Springs, the Burns Paiute Tribe and the Klamath Tribe. Each Tribe should be contacted on a case-by-case basis as transportation projects move forward. Areas of “high sensitivity” for archaeological sites identified by the Bureau of Land Management’s Prineville Office were also included on Map 14. These mapped resources do not represent all of the archeological resources and case-by-case research and/or surveys will be required. There are over 1,800 significant sites in Deschutes County that have been identified by archaeological reports filed with the State Historic Preservation Office.

Section 4(f)

Section 4(f) of the U.S. Department of Transportation Act provides protection to historic resources from transportation projects. Historic sites listed on or eligible for listing on the National Register of Historic Places are considered “significant” and therefore considered Section 4(f) properties by the Federal Highway Department (FHWA). FHWA projects are prohibited from using land from any significant historic site (publicly or privately owned) unless there is no alternative to the use of land. The proposed action must also include planning to minimize harm to the property that would result from such use. Section 4(f) applies to all archaeological sites on or eligible for inclusion on the National Register, including those discovered during construction. Numerous 4(f) properties are identified within the BMPO. *De minimis* impacts related to historic sites are defined as the determination of either "no adverse effect" or "no historic properties affected" in compliance with Section 106 of the National Historic Preservation Act. (www.state.in.us/dot/div/envassess/manuals/studies/30_section_4f.pdf)

Conflicts

No impacts from transportation projects to any of the historical resources on Map 14 were identified but it will be necessary for each project to consult with the State Historic Preservation Office on a case-by-case basis.

Recommendations

- Consult with the Bend Landmarks Commission, the State Historic Preservation Office, and the tribes on a case-by-case basis for each proposed transportation project to determine if there is the presence of any historical or archeological resources or Section 4 (f) property.
- For any Section 4(f) property identified, property boundaries shall be defined and jurisdictional responsibilities identified. The BMPO shall work with the responsible jurisdiction to avoid impacts to the 4(f) lands according to federal requirements.

Recreation Resources

Summary

The Recreation Resources section of this chapter identifies the recreational facilities, parks and trails within the BMPO. Data were gathered from agencies including the Bend Metro Park and Recreation District, Oregon Parks and Recreation Department, Deschutes County, and the City of Bend. Documents reviewed include comprehensive plans and zoning regulations. This section is related to the sections on Historic and Cultural Resources and Fish and Wildlife Resources because all are provided some protection under Section 4(f) of the U.S. Department of Transportation Act. There are significant recreation resources within the BMPO and they are shown on Map 15: Public Lands and Trails. Conflicts that could potentially result from transportation project include crossing recreational trails and other impacts to recreational lands and facilities. There are minor potential conflicts with parks, primarily in trail crossings. Avoiding impacts to parks and trails consistent with federal and state law is required.

Methodology
The following agencies were the primary resources for this section although other agencies, organizations and individuals may also have been contacted.

- Bend Metro Park and Recreation District
- City of Bend
- Deschutes County
- Oregon Parks and Recreation Department
- U.S. Department of Agriculture, Deschutes National Forest
- U.S. Department of Interior, Bureau of Land Management

The following were the primary documents reviewed for this section:

Title	Source	Date
Bend Metro Park and Recreation Comprehensive Plan	Bend Metro Park and Recreation District	2005
Deschutes County Zoning regulations	Deschutes County	2001
City of Bend General Plan	City of Bend	1998
Section 4(f) of the Department of Transportation Act (49 USC303 and 23 USC 138)	Department of Transportation	1966
Section 6(f)(3) of the Land and Water Conservation Fund	National Park Service	1964
Section 6(f)(3) of the Land and Water Conservation Fund properties	National Park Service	2014

Digital data layers were combined to create a map depicting recreation resource information available in 2007. The following is the map title along with the data layers shown and the main source of the data. For details on the metadata see Appendix F.

Map #	Map Title	Data Layer	Data Source
15	**Public Lands & Trails**	Bend Metro Park and Recreation District Parks and Trails	Bend Metro Park and Recreation District
		Bureau of Land Management lands	Deschutes County
		City lands	City of Bend
		County lands	Deschutes County
		Other – Federal lands	Deschutes County
		Other Parks	Deschutes County, Bend Metro Park and Recreation District
		State land	Deschutes County
		Trails	City of Bend
		U.S. Forest Service lands	Deschutes County

There are many acres of lands managed by the Bureau of Land Management (BLM) and the Deschutes National Forest surrounding the BMPO. These agencies provided maps and documents regarding these lands, but no recreational lands were identified within the BMPO boundary.

A list of projects that received funding from the federal Land Water Conservation Fund program was available and there are numerous facilities in the BMPO that have received these funds. Further research is needed to determine if the entire park property upon which improvements have been made is affected as many of the LWCF improvements were made in parks that are composed of multiple parcels. Also, some of the parks have changed names or management over the years. There are also 4(f) properties – "significant publicly owned" parks. A list of these properties will require further research.

Findings

The BMPO benefits from an abundance of parks and trails. Numerous agencies provide park land and facilities in the area including Oregon Parks and Recreation Department, Deschutes County and the City of Bend, but the primary provider of parks and trails is the Bend Metro Park and Recreation District which is a separate jurisdiction from the city. The District currently manages 81 parks and natural areas and 65 miles of trail within the BMPO. In addition to all of the recreation land and facilities within the BMPO, the area is surrounded by thousands of acres of lands managed by the Bureau of Land Management (BLM) and the Deschutes National Forest. The Forest/Urban interface lands on Bend's west side are receiving increasing recreation use and pressure as the Bend population has grown and residents demand close to home opportunities. Providing for and managing interface trail connections are of particular concern to the responsible agencies (Ronning, 2007.)

There are two federal acts that provide protection to recreational lands under certain conditions. The provisions for protection are in Section 6(f)(3) of the Land and Water Conservation Fund (LWCF) and in Section 4(f) of the U.S. Department of Transportation Act 1966.

Section 6(f)(3) of the LWCF Act states "No property acquired or developed with assistance under this section shall, without the approval of the Secretary, be converted to other than public outdoor recreation uses. The Secretary shall approve such conversion only if he finds it to be in accord with the then existing Statewide Comprehensive Outdoor Recreation Plan (SCORP) and only upon such conditions as he deems necessary to assure the substitution of other recreation properties of at least equal fair market value and of reasonably equivalent usefulness and location." This "anti-conversion" requirement applies to all parks and other sites that have been the subject of Land and Water grants of any type, whether for acquisition of parkland, development or rehabilitation of facilities. In many cases, even a relatively small LWCF grant (e.g., for development of a picnic shelter) in a park of hundreds or even thousands of acres provides anti-conversion protection to the entire park site (Haupt, 2007).

There are numerous recreation facilities within the BMPO that have been supported by LWCF monies over the years including the Juniper Swim and Fitness Center, Skyline Sport Park, and Hollinshead Historical Park as well as numerous smaller community and neighborhood park projects. The LWCF program provides matching grants to

States and local governments for the acquisition and development of public outdoor recreation areas and facilities. The LWCF website lists 18 projects funded by the LWCF in the BMPO area (Appendix F) totaling approximately $1,300,000 since 1966, many of which are within the BMPO. Further research will be required to determine the boundaries of each property parcel and if each property meets the requirements for protection from transportation projects.

Section 4(f) of the US Department of Transportation Act also provides protection to recreation lands from transportation projects. Federal Highway Administration projects are prohibited from using land from a publicly owned park or recreation area unless there is no feasible and prudent alternative to the use of land. *De minimis* impacts on publicly owned parks, recreation areas, and wildlife and waterfowl refuges are defined as those that do not "adversely affect the activities, features and attributes" of the Section 4(f) resource. The use of land from a publicly owned school playground may require Section 4(f) documentation. If the playground is open to the public and serves either organized or recreational purposes (walk-in activity), it may be subject to section 4(f) if the playground is determined to be significant for recreational purposes. Section 4(f) does not apply to planned trails if the land for the planned trail is not currently publicly owned. Additional criteria would need to be met for Section 4(f) to apply to any planned trail on publicly owned land. There are existing park and recreational resources in the BMPO that qualify as 4(f) properties; however the transportation projects proposed avoid nearly all lands identified on Map 15. The Pine Nursery, a large parcel located in the northeast quadrant of the BMPO is a newly constructed park. This land was formerly managed by the federal government and required two separate acts of congress to transfer it to local jurisdiction. A road improvement is planned through the southwest corner of the property; however the right-of-way agreement with Deschutes County was in place at the time the park and recreation district acquired the property and the park has been designed around the future road improvement.

Recommendations

In the early stages of planning for transportation projects in the BMPO, a survey should be conducted to identify all 4(f) and 6(f)(3) properties in the vicinity of the proposed project. Property boundaries defined and jurisdictional responsibilities should be identified. The BMPO should work with the responsible jurisdiction to avoid, reduce or minimize impacts to the 4(f) or 6(f)(3) properties consistent with requirements outlined in the respective regulations.

Environmental Justice

Summary

The Environmental Justice section of this chapter identifies low-income and minority households within the BMPO as required by Executive Order 12898. Data were collected from agencies including the Federal Highway Administration and the Census Bureau. Documents reviewed include Census information, general information on environmental justice issues and the Executive Order requiring this analysis. Two maps were developed for this section using 2000 U.S. Census data: Map 16, percent of

minority households by census block group and Map 17, percent of low-income households by census block group. Year 2010 U.S. Census data show that there are low-income and minority households within the BMPO, especially along Highway 97. Conflicts that could potentially result from transportation projects include disproportionately high and adverse effects on human and environmental health, including social and economic effects. Recommendations include avoiding, minimizing, or mitigating disproportionately high or adverse human health and environmental effects, including social and economic effects, on minority populations and low-income.

Methodology

The following agencies were the primary resources for this section although other agencies, organizations and individuals may also have been contacted.

- Federal Highway Administration
- Oregon Department of Transportation

The following were the primary documents reviewed for this section:

Title	Source	Date
Memo: FM Larry D. Anderson RE: Environmental Justice	Larry D. Anderson	May 10, 2006
GIS Mapping Report of Environmental Justice Census Characteristics	Randy Johnson, OSU; Alan Kirk, ODOT	October 1, 2004
An Overview of Environmental Justice and Transportation	Federal Highway Administration	May 2000
U.S. Department of Transportation, Environmental Justice website	Federal Highway Administration	
2010 U.S. Census data	U.S. Census Bureau	
2014 U.S. Census Bureau "Quick Facts" for Bend, Oregon	U.S. Census Bureau	

Digital data layers were combined to create maps depicting 2000 U.S. Census information on environmental justice. The following are the map titles along with the data layers shown and the source of the data. For information on the metadata see Appendix F.

Map #	Map Title	Data Layer	Data Source
16	Percent of Minority Households	Minorities	ODOT
17	Low of Income Households	Low income households	ODOT

Findings

Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, 1994) requires that every transportation project nationwide consider the human environment. The Order states, "Each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." In addition, Title VI of the Civil Rights Act of 1964 states,

"No person in the United States shall, on the ground of race, color, or national origin be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance."

There are three fundamental environmental justice principles:

- To avoid, minimize, or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects, on minority populations and low-income populations.
- To ensure the full and fair participation by all potentially affected communities in the transportation decision-making process.
- To prevent the denial of, reduction in, or significant delay in the receipt of benefits by minority and low-income populations.

To certify compliance with Title VI and address environmental justice, MPOs need to:

- Enhance their analytical capabilities to ensure that the long-range transportation plan and the transportation improvement program (TIP) comply with Title VI.
- Identify residential, employment, and transportation patterns of low-income and minority populations so that their needs can be identified and addressed, and the benefits and burdens of transportation investments can be fairly distributed.
- Evaluate and - where necessary - improve their public involvement processes to eliminate participation barriers and engage minority and low-income populations in transportation decision-making. For example, the BMPO focused resources for public involvement to the Latino community for the BMPO transit planning process.

Low income

U.S. Census Bureau American Community Survey data indicates that approximately 12.0% of the total population in the City of Bend lived below the poverty level between 2008 and 2012. More than 15% of persons within the following census tracts lived below the poverty level (2008 to 2012):

- The census tract generally bounded by NW Franklin Avenue to north, NE/SE 9th Street to the east, SE Reed Market Road to the south, and the Deschutes River to the west (15.9% of the total population living below the poverty level).

- The census tract generally bounded by NE Butler Market Road to the north, NE 27th Street to the east, NE Neff Road to the south, and NE 13th Street to the west (18.2% of the total population living below the poverty level).

Minorities

Year 2010 U.S. Census data indicates that 91.3% of Bend's population identified as White alone, and 87.3% identified as White alone, not Hispanic or Latino. 2010 Census data shows that generally the census block groups east of the Deschutes River are all at least 10% minority and the block groups west of the Deschutes River are less than 10% minority. The following block groups in Bend exceeded a minority of population of 20% in 2010:

- The block group generally bounded by SW Wilson Avenue to the north, SW 3rd Street to the east, Central Oregon Canal to south, and SW Bond Street to the west had a minority population of approximately 20.8%.

- The block group generally bounded by the North Canal to the north, NE 12th Street/NE Butler Market Road to the east, NE Revere Street to the south, and NE Boyd Acres Road/NE Studio Drive to the west had a minority population of approximately 22.2%.

- The block group generally bounded by the Central Oregon Canal to the north, 3rd Street to the east, SW Mahogany Street to the south, and SW Brookswood Boulevard to the west had a minority population of approximately 24.9%.

- The block group generally bounded by SE Glenwood Drive to the north, SE 9th Street to the east, SE Wilson Avenue to the south, and SE 3rd Street to the west had a minority population of approximately 33.2%.

Recommendations
Avoid, minimize, or mitigate disproportionately high and adverse human health and environmental effects, including social and economic effects, on minority populations and low-income populations.

Ensure that the long-range transportation plan and the transportation improvement program comply with Title VI.

Future work to be Completed
Conduct further analysis as new census data becomes available, such as through Environmental Justice/Title VI plan updates

Identify residential, employment, and transportation patterns of low-income and minority populations so that their needs can be identified and addressed, and the benefits and burdens of transportation investments can be fairly distributed.

As resources allow, conduct an environmental justice/Title VI assessment of the BMPO TIP and plan.

As resources allow, update the BMPO Public Participation Plan prepared in 2009, which encourages the participation and engagement of minority and low-income populations in transportation decision-making, including by providing Spanish translations of printed materials and at meetings if needed.

Noise

This section will be added as part of a future MTP update.