DESCHUTES COUNTY INTELLIGENT TRANSPORTATION SYSTEM PLAN

APRIL 2020

Oregon Department of Transportation

DKS

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CHAPTER 1: INTRODUCTION

1.1 REPORT OVERVIEW

This report is an update to the 2011 Deschutes County Intelligent Transportation System (ITS) Plan (2011 ITS Plan). Since the 2011 ITS Plan, ODOT has worked collaboratively with Deschutes County and the cities of Bend, Sisters, Redmond, and La Pine to implement technology solutions to improve safety and management of the transportation system. This update incorporates newly identified needs and operations in the county, embraces advanced technology, prepares for emerging technologies, and provides support for a more integrated, collaborative system of operations and management. This ITS plan integrates Transportation Systems Management and Operations (TSMO) strategies as these are recognized as being crucial to effectively implementing and sustaining ITS projects.

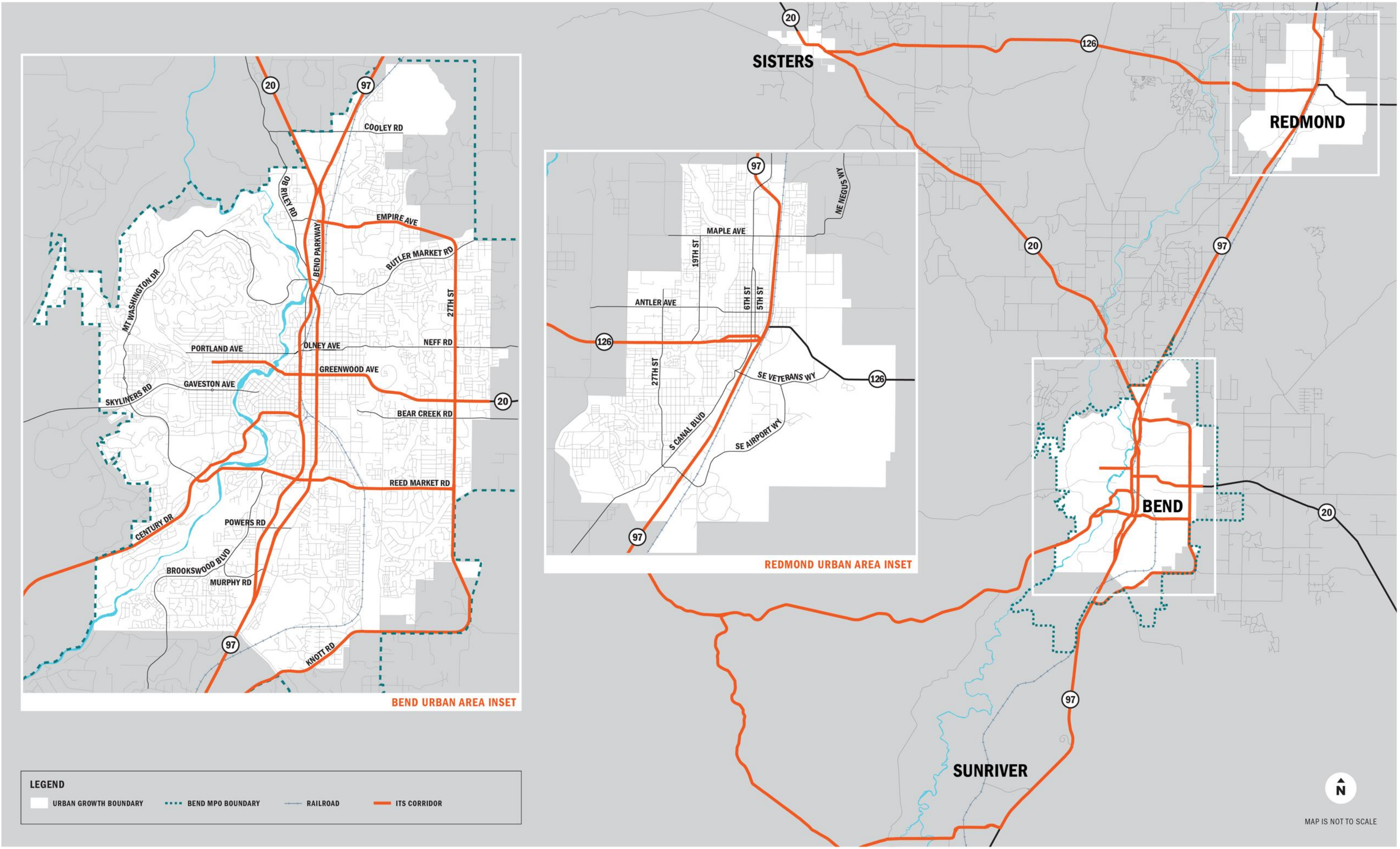
This report includes:

- Executive Summary
- Overview of Current and Future Conditions
- User Needs and Key TSMO Strategies
- Communications Plan
- Deployment Plan including map, project descriptions, and cost estimates
    - The Deployment Plan is also provided separately as a searchable spreadsheet and adjustable cost estimate

1.2 STUDY AREA

Figure 1 illustrates the study area, which encompasses the current boundaries of the Bend Metropolitan Planning Organization (BMPO) and stretches to Redmond, Sisters, Mt. Bachelor, Sunriver and La Pine. Key study corridors are identified on the map as ITS corridors as these have the potential to realize the greatest improvements with ITS strategies.

FIGURE 1. STUDY AREA



CHAPTER 2: CURRENT & FUTURE TRANSPORTATION CONDITIONS

This chapter provides an overview of transportation conditions in the study area. The information was used to facilitate discussions with the stakeholder committee regarding current and expected challenges with potential to be addressed by ITS strategies.

2.1 CURRENT TRAFFIC CONDITIONS

Congested corridor sections/bottlenecks and high collision locations provide the greatest opportunities to implement ITS field elements that will produce a noticeable benefit. Intersections and corridors currently experiencing congestion during peak periods are mapped in Figure 2.

Bend

The Bend Parkway Study (Phase 1) analyzed travel time reliability for the US 97 Corridor through the City of Bend. It found that peak period travel time (4:30 – 5:30 PM) was unreliable on the US 97 study corridor north of Empire Boulevard due to the congested nature of the peak periods at the at-grade intersections, mainly Cooley Road and Robal Road.

US 97 south of Reed Market Road was also unreliable due to the at-grade intersection at Powers Road and the construction that has taken place over the past three years (e.g., Murphy Road interchange).

The US 20/US 97 Business/SE 3rd Street corridor generally experiences worse travel time reliability than the Parkway. The worse reliability is likely due to the frequency of driveways and intersections along that corridor versus the Parkway’s controlled access.

Outside of the Bend and Redmond City Limits, recurrent congestion is limited during peak periods to major highways. The two observed trouble spots are located on Highway 97 in Redmond and Highway 20 through Sisters, summarized below.

Redmond

The 2019 South Redmond Corridor Plan identified the following congested Redmond intersections:

- US 97 at Odem Medo Way
- US 97 at Veterans Way

Additionally, the 2020 Redmond Transportation System Plan (TSP) Existing Conditions Report (currently in process) identified US 97 at Evergreen Avenue as a congested intersection.

Sisters

The 2018 Sisters TSP Refinement Plan identified the following congested Sisters intersections:

- US 20 at Barclay Drive
- US 20 at Pine Street
- US 20 at Elm Street
- US 20 at Locust Street

2.2 FUTURE CONGESTION

Key congested segments forecast by the Bend-Redmond regional travel demand model (year 2040) are mapped in Figure 3. The Bend-Redmond Regional Travel Demand Model (the Model) is the forecast model used by the region. The Model is broken down into transportation analysis zones (TAZs) to tabulate traffic related information. Future congestion was estimated by forecasted changes in household and employment information in the TAZs. Future turn movements generated from the travel demand model were then applied to key intersections and evaluated based on the Highway Capacity Manual measures to estimate queueing and corridor performance.

ODOT's highway deficiencies modeling tool, Highway Economic Requirements System (HERS-ST) was used to estimate changes in travel time reliability under future conditions. HERS-ST analyzes inadequate base capacity, incidents, and traffic control devices to produce performance measures for travel and planning time through the region.

FIGURE 2. EXISTING PROBLEM AREAS

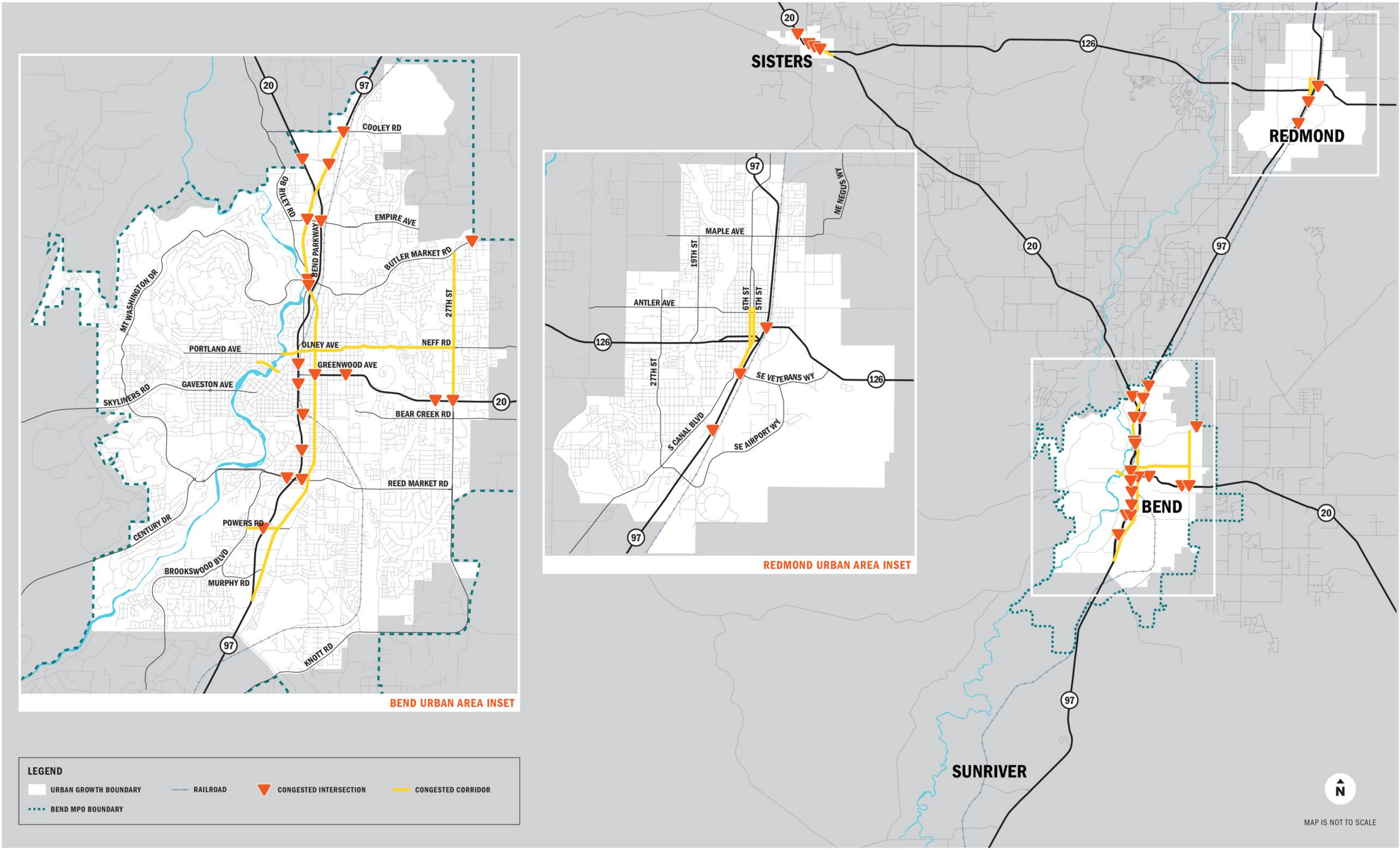
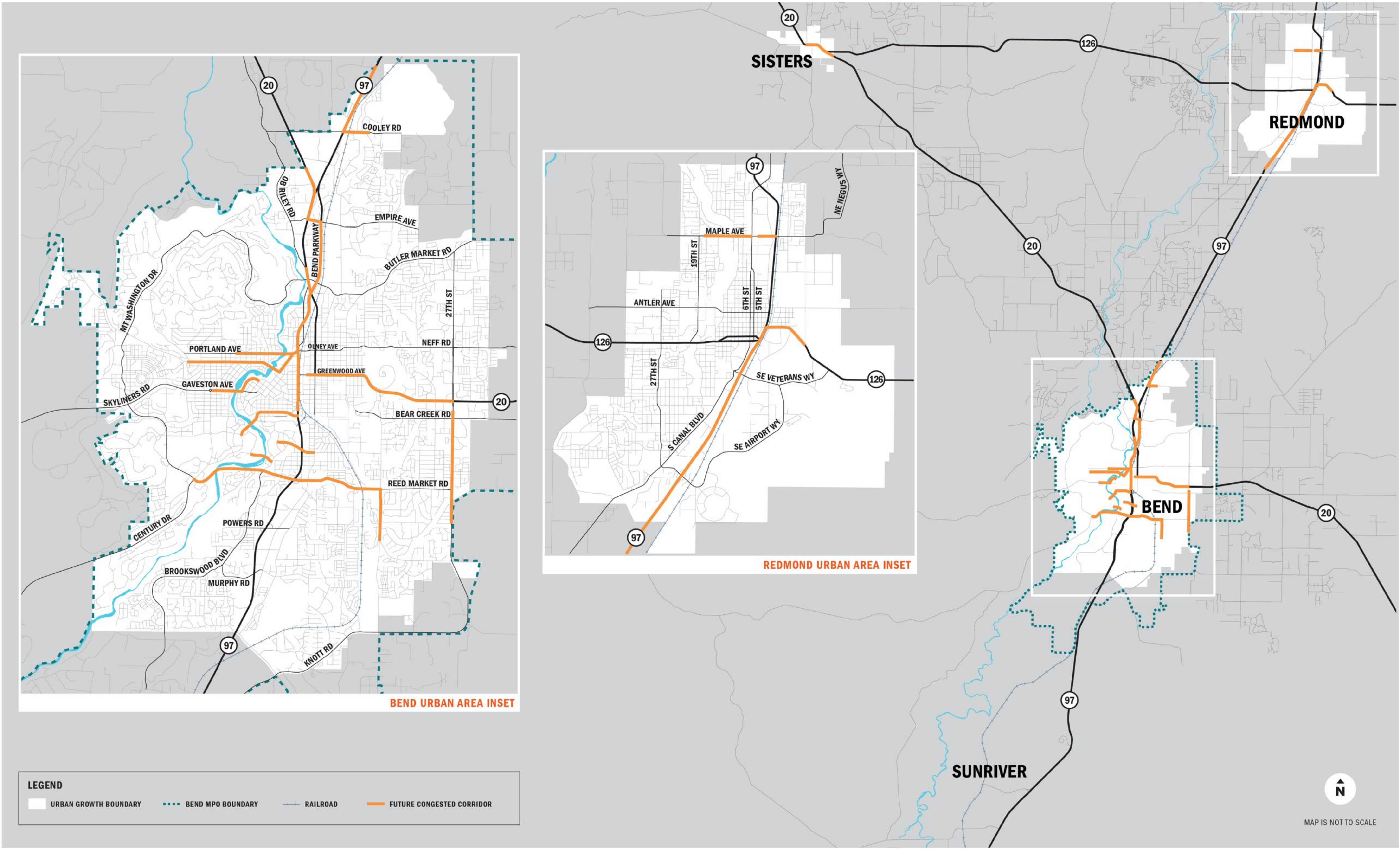


FIGURE 3. FUTURE PROBLEM AREAS



2.3 CRASH SUMMARY

High collision locations throughout the study area are shown in Figure 4. This figure includes ODOT Safety Priority Index System (SPIS) sites (2014 – 2016) for federal and state roadways. The SPIS methodology is described below.

Safety Priority Index System (SPIS)

SPIS uses a ranking methodology to analyze specific locations based on a three-year crash history. Deschutes County also maintains a high collision location database for intersections within the study area.

To identify locations with high collision rates, ODOT developed a Safety Priority Index System (SPIS). For every 0.10-mile section of roadway, a score is given based on three years of motor vehicle collision data with weighting for crash frequency, rate, and severity. Three or more collisions or one or more fatal collisions must have occurred at the same location over the previous three years for a location to be considered a SPIS site. ODOT identifies the top 10 percent SPIS sites every year and evaluates these locations for safety problems.

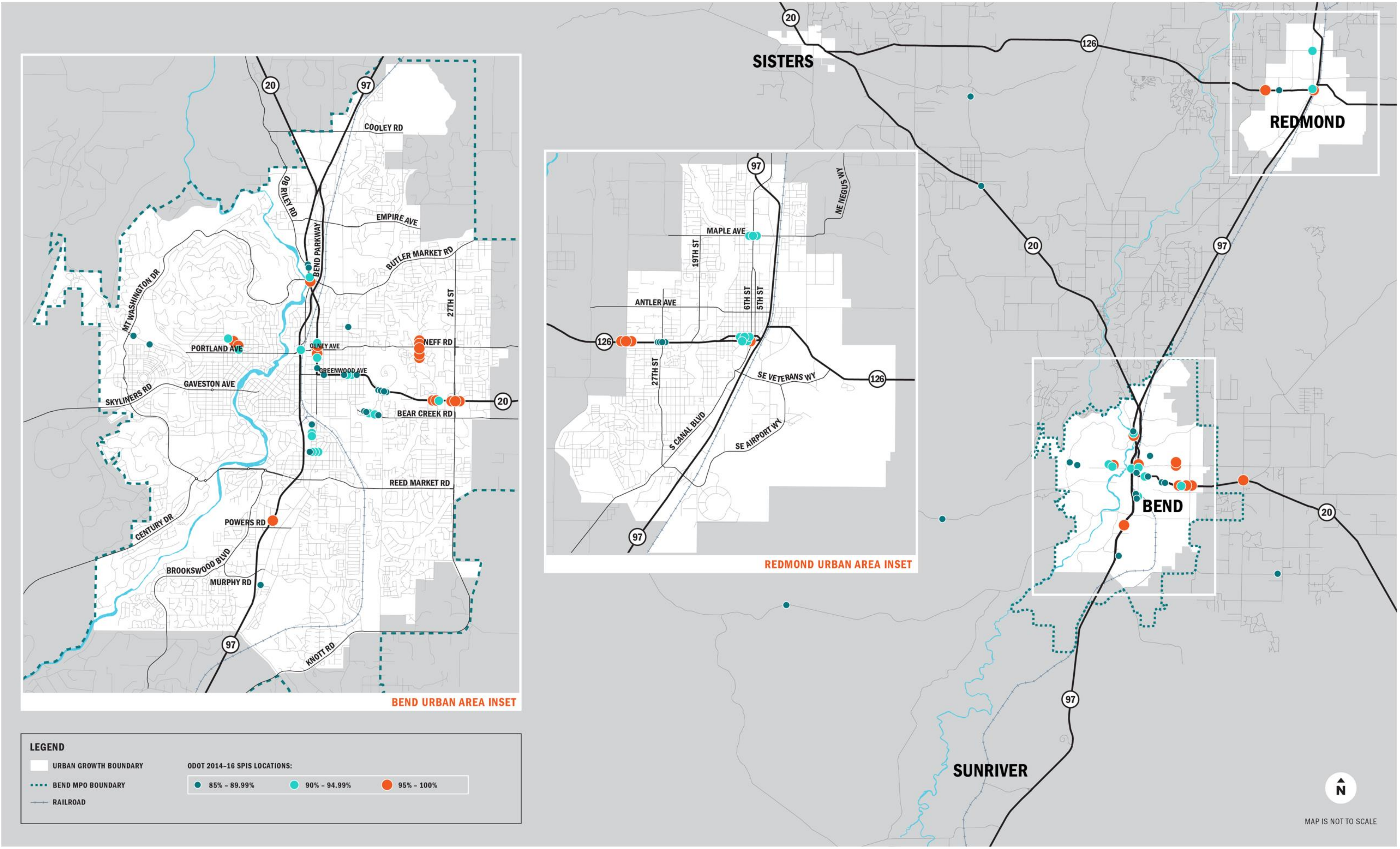
Figure 4 maps the SPIS sites in the region based on the latest data available (years 2014 – 2016) and indicates which are the most severe sites (at the 95th percentile) as well as those falling within the 90th and 85th percentiles.

Safety Corridors

ODOT designates a "Safety Corridor" or a "Truck Safety Corridor" for any state or local highways that have a higher frequency of traffic collisions than the statewide average for a similar roadway type. ODOT strives to improve the safety on these designated corridors through increased law enforcement, engineering improvements, and education efforts. In the past, there were several Safety Corridors in Deschutes County, including Highway 97, Highway 97 Business, Highway 20, and Century Drive. All of these safety corridors have since been successfully decommissioned, as each has proven to be successful in reducing serious traffic crashes and the roadways no longer qualifies under the Safety Corridor Designation Criteria.

The recently completed 2019 Bend Area Transportation Safety Action Plan (TSAP) and 2019 Deschutes County TSAP identified crash trends and issues in the region based on current data and proposed a range of treatments including projects, policies, and programs, to address identified issues. Refer to these documents for detailed reporting and analysis of road safety in the region.

FIGURE 4. HIGH COLLISION LOCATIONS



2.4 TRANSIT

Cascades East Transit (CET) provides bus services for the region, include fixed-routes within Bend, city connectors throughout Central Oregon, recreational shuttles for the public, and Dial-a-Ride service for qualifying persons with disabilities and seniors who qualify as low-income. The CET transit center, Hawthorne Station, is located in Bend and operations centers are located in both Bend and Redmond.

 depicts the existing fixed transit routes, recreational (seasonal) shuttle routes, and micro transit service in the study area.

Key transit ITS elements deployed by CET include:

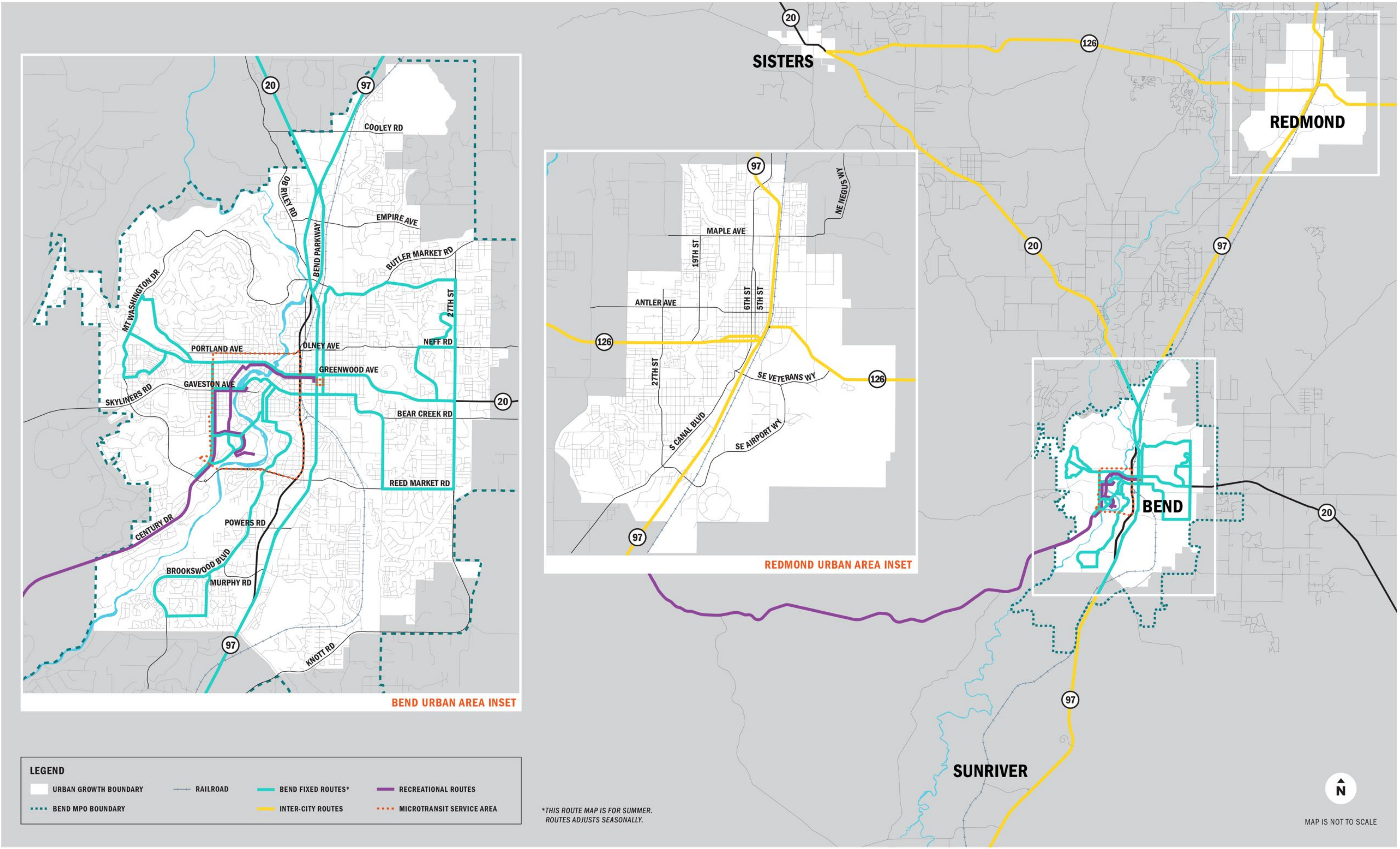
- Google Maps-based online trip planner (https://cascadeseasttransit.com/plan-your-trip/)
- Route, schedule, and real-time status information available on Transit mobile app (https://transitapp.com/), which provides trip planning and real-time arrival predictions
- Automatic vehicle location (AVL) is installed on vehicles fleetwide and is integrated with the computer-aided dispatch (CAD) system
- Electronic fare collection system, including *TouchPass* contactless smart card and mobile app support. Users can purchase and load passes online (https://touchpass.com)

OSU, with assistance from CET, operates *Ride Bend*, a pilot on-demand, app-based transit service available to everyone.

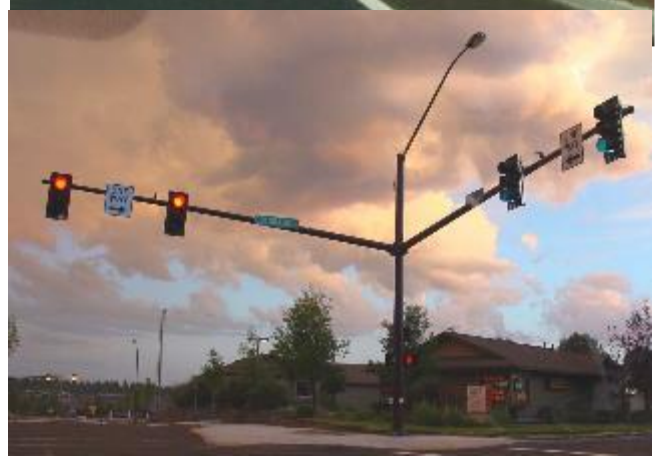
Deschutes County is also served by several private bus carriers that provide daily service to local destinations (Redmond, Mt. Bachelor, Prineville, etc.) and to the Willamette Valley (Portland, Salem, Eugene, etc.):

- Greyhound
- Valley Retriever Bus Lines
- Porter Stage Lines
- The People Mover
- CAC Transportation
- Redmond Airport Shuttle
- Central Oregon Breeze
- Amtrak Thruway Bus Service

FIGURE 5. TRANSIT ROUTES



2.5 TRAFFIC SIGNALS



This section describes the traffic signal equipment used at the 89 signalized intersections in Deschutes County. depicts the existing traffic signals in the study area. The signals are color-coded by the jurisdiction of ownership.

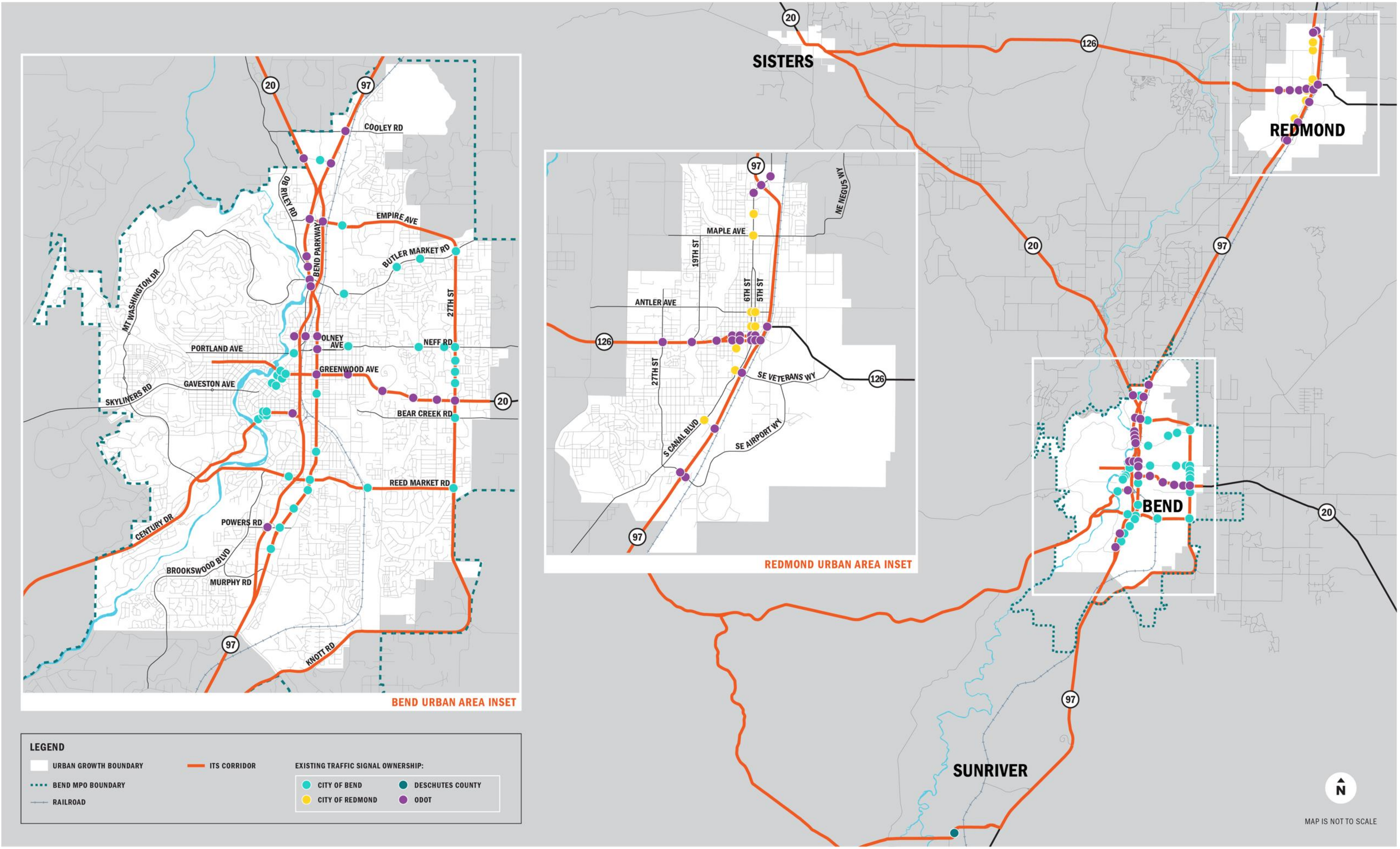
2.5.1 TRAFFIC SIGNAL OPERATIONS

ODOT operates and maintains all of the traffic signals in Bend, Redmond, Sunriver and LaPine through agreements with local agencies. City traffic signals operate with the 2070 controller using Voyage or SCATS software. Northwest Signal is used for individual intersection programming, and TransSuite is used to monitor the signal system. ODOT is transitioning its traffic signal controllers to Advanced Traffic Control (ATC) technology using MaxTime for local controller programming and MaxView for ATC system management and has expired its contract for use of Voyage software and will phase out TransSuite for their detection

2.5.2 EMERGENCY VEHICLE PREEMPTION

The majority of the traffic signals in Deschutes County have full emergency vehicle preemption capability using GTT-Opticom coded infrared (IR) transmitters mounted on emergency vehicles. Most of the preemption equipment in the traffic signal cabinets (discriminators) can be programmed to accept specific vehicle identification codes, thereby allowing preemption only for validated emergency vehicles. The GTT/Opticom system has the capability to provide priority (early green/green extension) for transit vehicles as well. ODOT traffic engineers, using priority control software, have the ability to remotely upload the preemption logs to check for valid preempts.

FIGURE 6. EXISTING TRAFFIC SIGNALS



2.6 ITS SYSTEMS AND EQUIPMENT

Deschutes County has numerous existing intelligent transportation systems and has several existing ITS devices. The following sections describe existing and planned ITS systems and equipment including the Traffic Operations Center (TOC), existing closed-circuit television (CCTV) cameras, dynamic message signs (DMS), traffic count stations (ATR), and weather stations (RWIS). shows the locations of the existing field devices.

2.6.1 ITS SYSTEMS

Deschutes County currently uses a variety of software systems to access and control field devices and to dispatch vehicles. Table 1 provides a summary of the existing software systems and their primary function. Many of the software systems used today are redundant because they are proprietary to the specific vendor for the field device. Additional information about each system is provided under the field device or Center description in this Chapter.

2.6.2 TRANSPORTATION OPERATIONS CENTER (TOC)

ODOT currently operates a Transportation Operations Center (TOC) in the Oregon State Department of Transportation Region 4 Headquarters building. The Transportation Operation Center in Bend serves many functions. A summary of the primary functions performed by the operators is provided below.

- **Incident Management** – Incident detection, response planning, resource tracking and coordination and output to the traveler information systems.
- **Emergency Management** – Includes incident management functions and the implementation of Emergency Operations Plans.
- **Traffic Management** – Control dynamic message signs, highway advisory radio, and dispatch incident responders.
- **Traveler Information** – Place and update incident alerts and road restriction messages on dynamic message signs and highway advisory radio and output to media and TripCheck.
- **Winter Operations** – Monitor the roadway conditions with CCTV and environmental sensors. Coordinate crew assignments and notifications. Place outputs to traveler information systems.
- **Maintenance Operations** – Assist maintenance manager with crew availability and location information and place callouts.

Operators in the center currently must manage field devices using a variety of software packages. For variable message signs alone, the operators have three separate software packages to post messages because each manufacturer has a separate proprietary software package. However, ODOT has upgraded many of the fixed signs to be NTCIP compliant and is migrating to one software package for sign control. In addition, ODOT is currently conducting a Transportation Operations Center System (TOCS) project which intends to integrate the functions of the advanced transportation management systems (ATMS) and the computer aided dispatch (CAD) system. The ultimate intent is to provide an integrated system interface for the management of ODOT assets.

FIGURE 7. EXISTING ITS EQUIPMENT

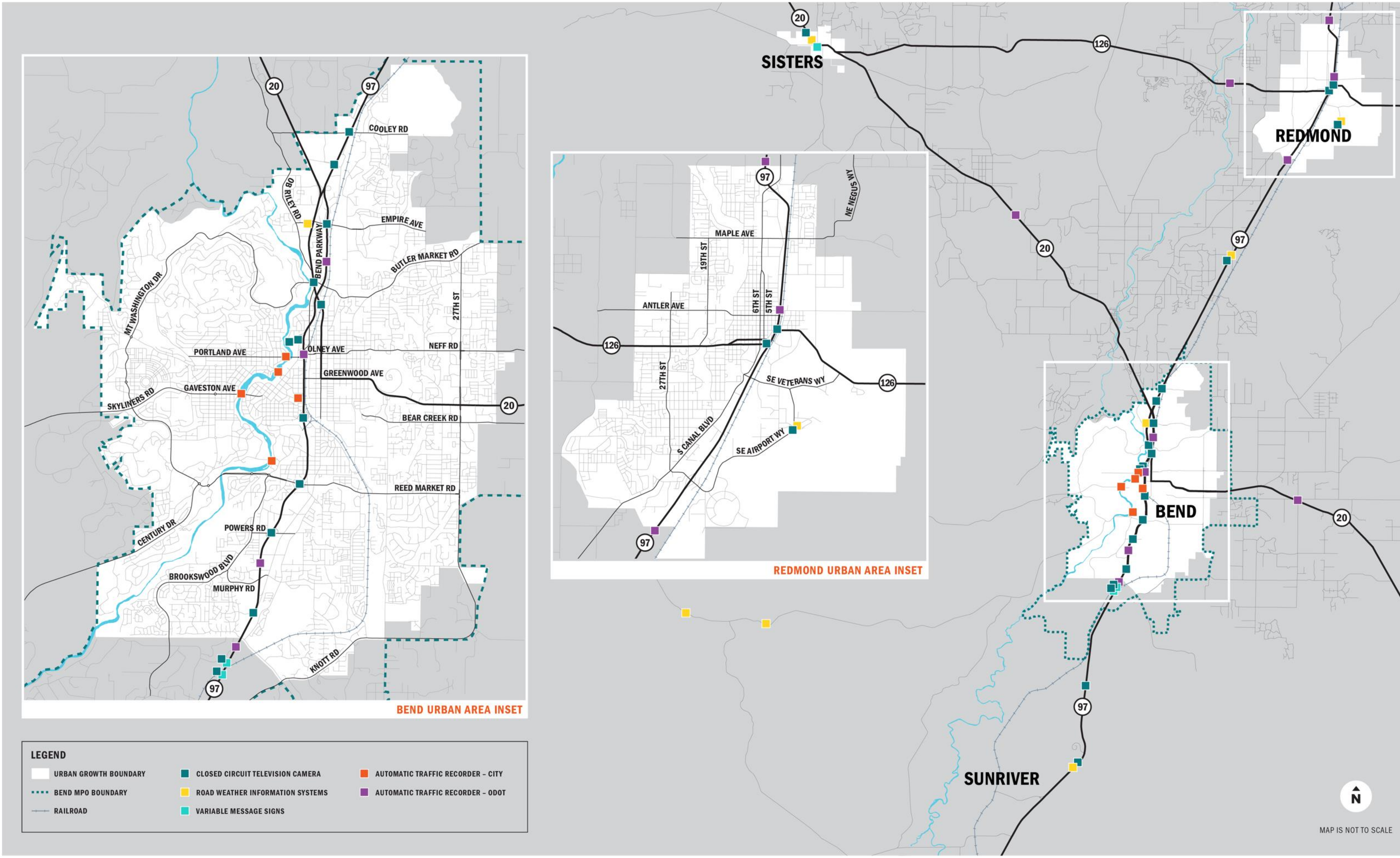


TABLE 1. EXISTING ITS SYSTEMS IN DESCHUTES COUNTY

ELEMENT TYPE	OPERATING AGENCY	PURPOSE
CLOSED-CAPTION TELEVISION (CCTV) CAMERA	ODOT	Remote monitoring
ROAD WEATHER INFORMATION SYSTEM (RWIS)	ODOT	Road weather conditions detection and monitoring
VARIABLE MESSAGE SIGN (VMS)	ODOT	Message sign control
PORTABLE VMS	ODOT	Portable message sign control
HIGHWAY ADVISORY RADIO	ODOT	Radio traveler information messaging
AUTOMATIC TRAFFIC RECORDER (ATR)	ODOT (10) Bend (5)	Traffic volume collection
OSP COMPUTER AIDED DISPATCH	OSP/ODOT	Manage incidents
HIGHWAY TRAFFIC CONDITIONS REPORTING SYSTEM	ODOT	Feeds information to TripCheck
EMERGENCY COMPUTER AIDED DISPATCH	Deschutes County 911	Computer-aided dispatch
TRANSIT CAD	CET	Transit dispatch
FRMS	Bend Fire	Fire records management

2.6.3 CLOSED-CIRCUIT TELEVISION (CCTV) CAMERAS

ODOT operates 20 closed-circuit television (CCTV) cameras to monitor traffic in Sisters, Redmond, Bend, and Mt. Bachelor. The majority of the cameras (16) are located along Highway 97 and Highway 20 from Redmond to Bend to Lava Butte. The remaining four cameras are located on Century Drive near Mt. Bachelor (two), in Sisters on Highway 20, and in Redmond at the Redmond Airport. ODOT posts video images from the existing cameras on the TripCheck website. In addition, ODOT has two portable camera units that can be interfaced to TripCheck.

2.6.4 VARIABLE MESSAGE SIGNS

Variable message signs (VMS) provide motorists with information about traffic congestion, traffic crashes, maintenance operations, adverse weather conditions, roadway conditions, organized events, or other highway features. ODOT operates and maintains three fixed VMS. One is located on Highway 20 at the west edge of Sisters and the other two are located on Highway 97 at the south end of Bend. Additional signs are controlled from the Region 4 TOC but are outside of this project study area.

2.6.5 PORTABLE VARIABLE MESSAGE SIGNS

A portable variable message sign (PVMS), like a VMS, is used to display programmable, dynamic messages to provide travelers with timely warnings, guidance, or notification of approaching roadway conditions. Because they are portable, PVMS are often used for roadway maintenance activities, incident management, other short-term activities, and long-term construction projects.

Region 4 owns and operates several PVMS. All PVMS are NTCIP compliant and are operated using a single software package for PVMS sign control.

2.6.6 AUTOMATIC TRAFFIC RECORDERS

ODOT currently operates 10 automatic traffic recorders (ATR), independent of traffic signals, in Deschutes County to collect volume, speed and occupancy data. Seven ATRs are located on Highway 97, with four located in Bend and three located in Redmond. Two ATRs are located on Highway 20, one east of Bend and one south of Sisters. And one ATR is located on Highway 126, east of Redmond.

Most ODOT ATRs are in-pavement loops designed to detect motor vehicles. The Agency is planning to shift to radar camera technology, which has additional capabilities to detect other road users, including bicycles and pedestrians.

ODOT collects ATR data on an ad hoc by request fashion. No permanent signal count program is in place at this time. The Voyage system (described in Section 2.5.1) pulls two weeks of counts and then Region 1 runs a script for all TransSuite connected signals to add this data to a database.

The City of Bend operates five ATRs. Four are for the river crossings at Portland Ave, Newport Ave, Galveston Ave, and Columbia St. The fifth is at Franklin Ave, west of the Bend Parkway and BNSF railroad undercrossing.

In addition, ODOT and the City of Bend collect vehicle volume information from system detectors at many traffic signals in the City of Bend. Data is currently stored in multiple locations. The Regional Data Warehouse Project (described in Section 6.2) will seek to improve data-sharing capabilities among the agencies.

2.6.7 ROAD WEATHER INFORMATION SYSTEMS (RWIS)

ODOT currently operates and maintains seven weather stations in the Deschutes County region. These devices are located in Sisters on Highway 20, between Redmond and Bend on Highway 97, in Bend on Highway 97, in Redmond at the Redmond Municipal Airport, at Lava Butte (south of Bend) on Highway 97, and two on Century Drive near Mt. Bachelor. All are connected to the RWIS server in Salem. Weather information from the sites is used to identify icy conditions and is posted on TripCheck for traveler information. Specific information types collected by the RWIS varies site-to-site, but typical weather and road condition information includes temperature, wind speed, wind direction, humidity, and road surface temperature.

2.7 COMMUNICATIONS EQUIPMENT

The communications system is one of the most critical components in the deployment of ITS infrastructure. Local agencies must be able to monitor, control, and operate traffic management devices from remote locations and share information in real-time between operations centers to effectively manage the movement of passengers and goods and respond to incidents.

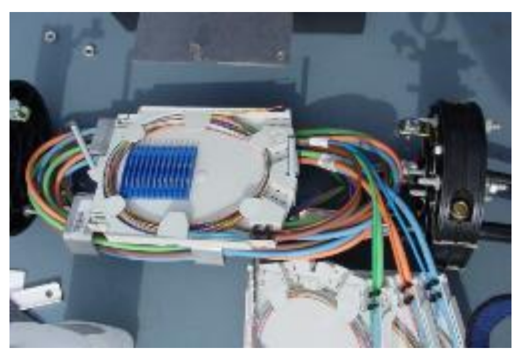
The existing transportation related communications network in Deschutes County consists of a variety of media such as fiber optic cable, twisted-pair copper, radio, cellular telephone, and public agency wireless. The existing agency-owned and leased line communications infrastructure is illustrated in where data is available. Additional communications infrastructure exists, either as part of the Bend Broadband fiber optic network or wireless infrastructure on towers that have not been mapped to maintain security.

The current communications network in Bend is limited but expanding. Leased fiber lines, wireless, and cellular comprise the majority of communications infrastructure, with some twisted pair copper interconnect at certain locations between traffic signals. Communications to the central server is typically provided by leased services. One corridor includes a segment of very high bit-rate digital subscriber line (VDSL) over twisted pair copper. There are only a few cameras and road weather information system (RWIS) stations in Bend. Communications to these cameras are provided by Bend Broadband through an informal agreement and future reliability is uncertain. There is no physical communications plant into the ODOT Region 4 Headquarters building, which houses the Region 4 Traffic Operations Center (TOC) and provides the central interface to the ODOT wide area network, but there are plans to construct communications cable to the ODOT Region 4 building.

Redmond operates an adaptive traffic signal system with communications to nearly all traffic signals. This network includes fiber optic cable, VDSL over twisted pair copper, wireless connections, and a leased cellular backhaul. The cellular backhaul is used to connect the Redmond communications hub to the ODOT wide area network.

2.7.1 FIBER OPTIC INFRASTRUCTURE

There is limited public agency installed fiber optic infrastructure in Deschutes County, but there is a significant center to center fiber optic network as a result of a franchise agreement with Bend Broadband. As part of the franchise agreement, the public agencies received dark fibers where Bend Broadband installed infrastructure. This agreement includes a maximum of 18 drop locations, 10 of which are currently in use. The existing drop locations include fire stations and public agency offices and a Gigabit Ethernet network has been established between these public agency facilities. The existing network includes the City of Bend, Deschutes County, and the City of Redmond. The existing fiber optic network is configured in a “star” configuration with the Bend Broadband facility as the head end.



Fiber optic communications equipment example: a fiber optic splice tray

ODOT is also expanding the extent of its own agency-owned fiber network. Most ODOT projects currently in design include fiber optic communications construction. Additionally, a partnership between Facebook and regional agencies was recently announced, in which Facebook would construct a major fiber optic communications backbone along US 97 from La Pine to Bend to support its operations and provide access and dedicated fibers to ODOT.

Local telecommunications providers in the Bend area include Bend Broadband and Quantum Communications.

2.7.2 COPPER TWISTED-PAIR INFRASTRUCTURE

Most of the twisted-pair infrastructure on the ODOT system has been or is planned to be replaced. ODOT accesses the signal communications via land or cellular phone drops.

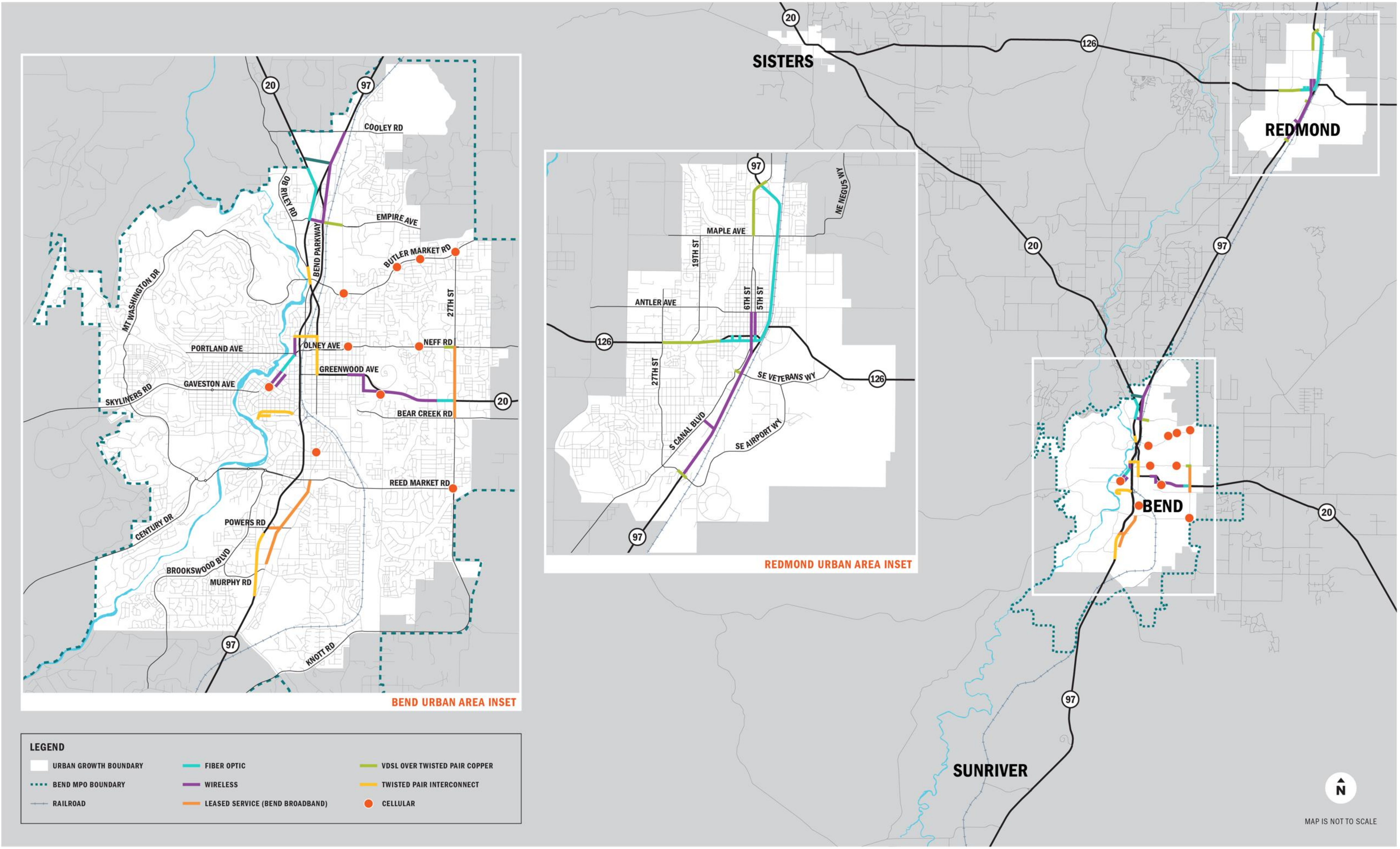
Agencies use VDSL over twisted pair copper cable for locations with low bandwidth requirements where twisted pair copper interconnect is already in place or as an interim lower cost alternative until fiber optic cable can be installed. A significant drawback of twisted pair copper cable is its narrow bandwidth. It is also more sensitive to grounding and interference than analog signals.

2.7.3 WIRELESS NETWORK

ODOT utilizes wireless solutions to extend communications from the end of a hardwire link (fiber optic cable or twisted pair copper cable) to a remote traffic signal or field device as a last mile connection. Bend and Redmond have also implemented public agency wireless networks to extend communications.

Properly designed wireless systems are a viable option where a clear line of sight is available and bandwidth requirements are low. A wireless path analysis was conducted to identify feasible locations for its use. Wireless systems use Ethernet 802.11 on the 4.9 GHz Public Safety Band with a throughput of at least 5.5 Mbps. ODOT holds a statewide license for 4.9 GHz and coordinates wireless deployments internally through the Wireless Regional Planning Committee (RPC 35) to avoid interference. ODOT has a price agreement with a vendor for the purchase of wireless equipment.

Wireless communications example: a radio antenna installed on a signal pole to enable remote communications to the intersection


SISTERS
REDMOND
BEND
SUNRIVER
20
126
97
BEND URBAN AREA INSET
COOLEY RD
EMPIRE AVE
OB RILEY RD
BEND PARKWAY
BUTLER MARKET RD
27TH ST
MT WASHINGTON DR
PORTLAND AVE
OLNEY AVE
NEFF RD
GREENWOOD AVE
GAVESTON AVE
SKYLINERS RD
BEAR CREEK RD
REED MARKET RD
CENTURY DR
POWERS RD
BROOKSWOOD BLVD
MURPHY RD
KNOTT RD
REDMOND URBAN AREA INSET
MAPLE AVE
NE NEGUS WY
19TH ST
ANTLER AVE
6TH ST
5TH ST
27TH ST
SE VETERANS WY
S CANAL BLVD
SE AIRPORT WY
LEGEND
URBAN GROWTH BOUNDARY
BEND MPO BOUNDARY
RAILROAD
FIBER OPTIC
WIRELESS
LEASED SERVICE (BEND BROADBAND)
VDSL OVER TWISTED PAIR COPPER
TWISTED PAIR INTERCONNECT
CELLULAR
N
MAP IS NOT TO SCALE

2.8 EMERGENCY MANAGEMENT

This section describes the emergency management agencies in Deschutes County as well as the strategies used for routine services typically handled by 911, police, fire, and medical agencies and strategies for major emergencies and disasters.

2.8.1 911 CENTER

The Deschutes County 911 center is located in the Deschutes County Sherriff's complex and serves all but one of the local agencies in Deschutes County for call-taking and dispatching. The Oregon State Police are dispatched from the Salem call center. Deschutes County 911 uses a computer-aided dispatch (CAD) system with built-in mapping capabilities that allows for proximity-based dispatching.

The 911 CAD Interconnect project provides a two-way information flow (CCTV camera images, congestion flow map, emergency calls) between the Deschutes County 911 call center, Oregon State Police call center, and ODOT's TOC. The interconnected CAD system allows for faster response times and quicker arrivals on scene due to better information sharing and improved data accuracy (e.g., on specific crash locations and which responders are nearby or en-route).

2.8.2 POLICE, FIRE, AND MEDICAL AGENCIES

Emergency response in Deschutes County is provided by police, fire, ambulance, tow companies and medical agencies. The public sector services are operated by the City of Bend, the City of Redmond, the City of Sisters, Deschutes County, and the Oregon State Police. Other emergency services providers in the area include the Sunriver Fire Department, La Pine Rural Fire Protection District, and Deschutes County Rural Fire Protection District #2. While each of these agencies primarily serves their jurisdiction, the Oregon State Police patrols all of the region's federal and state highways.

The 911 Interconnect project established inter-agency communications with Bend Fire Department, Deschutes County Sherriff, and Oregon State Police. The City of Bend police and the Deschutes County sheriff have mobile data terminals (MDTs) in all of their vehicles, but the Oregon State Police do not. Bend Fire is currently testing two MDTs and pursuing a grant to implement MDTs in all of their fire vehicles. Bend Police have additional plans to provide officers with remote access to the City services using mobile devices.

2.8.3 EMERGENCY MANAGEMENT AGENCY COMMUNICATIONS

Emergency management agencies operating throughout the Deschutes County coordinate dispatch through the 911 Interconnect system. However, the agencies have yet to standardize radio communications protocols, which limits the ability to communicate with one another out in the field. City of Bend Police recently implemented in 800 MHz radio network and other agencies including Deschutes County and ODOT maintain their VHF radio networks. Deschutes County recently procured a portable radio interconnect system, TRP-1000, that can be used to provide communications interoperability between VHF, UHF, 800MHz, 900MHz and trunking talk-groups.

2.8.4 MANAGEMENT OF MAJOR EVENTS, EMERGENCIES AND DISASTERS

The region's most common disaster is wildfires. Responding entities follow the national Incident Command System (ICS) protocols to coordinate activities. The ICS establishes roles and responsibilities for agency personnel that pools resources and coordinates a rapid and flexible emergency response.

During a significant emergency, the Deschutes County Emergency Operations Center (EOC), located at the 911 dispatch building, is activated. Local transportation personnel are responsible for coordinating with the EOC to maintain accessible transportation routes to shelters and to re-route traffic as necessary.

The American Red Cross (ARC) is responsible for providing shelters, which typically include public schools, churches, or other locations. ARC determines which shelter locations to use based on each particular emergency situation. Portable variable message signs are not used during such area evacuations and time is crucial and safe routes can quickly change as fires spread.

The 2017 Solar Eclipse, while not an emergency, required significant planning, coordination and implementation of evacuation-style route planning. An estimated 1,000,000 people arrived in central Oregon to see the eclipse. While traffic was slow and congested, there were no major incidents.

2.9 INCIDENT MANAGEMENT

ODOT currently staffs an incident responder full time in Region 4. The ODOT incident responder coordinates closely with emergency management agencies during incidents and emergency situations and is responsible for maintaining accessible transportation routes and to re-route traffic during incidents.

Since 2016, the county has participated in the statewide Traffic Incident Management (TIM) program and regularly convenes a regional TIM team to coordinate activities and review after action reports.

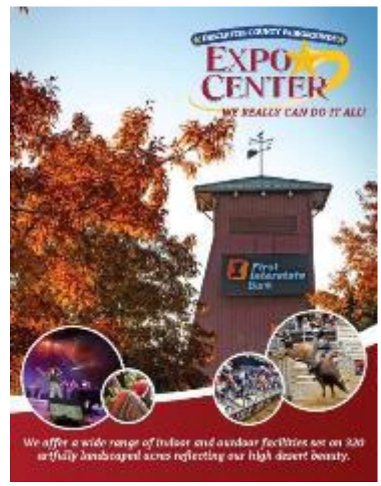
The region currently utilizes a text message-based tow roster communications system to match vehicle in need of towing to an appropriate tow company that is equipped to tow that vehicle. The process involves manually taking a photo of the vehicle and texting it to the tow companies to confirm the company shows up with the right recovery vehicle.

ODOT Region 4 and Deschutes County utilize fixed variable message signs (VMS) located at key traveler decision points (e.g., at the north end of La Pine on Highway 97) to reroute or detour drivers during road closures or incidents that commonly occur during the winter. In addition to these VMS locations, local agencies have other equipment on hand (e.g., portable variable message signs) that can be deployed in the event of an incident or major emergency to support local emergency management agency operations.

Oregon State Police uses drones for accident reconstruction in the majority of fatal accidents.

2.10 SPECIAL EVENTS

The region is a major recreational destination during both the summer and winter seasons. Seasonal traffic has a significant impact on the local transportation system, with significant peaks during key holidays (e.g., traffic to Mt. Bachelor on Presidents Day weekend).



The Deschutes County Fairgrounds and Expo Center, located in Redmond next to the Redmond Airport, is the main special event center within the study area. The annual County Fair creates congestion within Redmond due to a lack of circulation options and the interchange capacity at Highway 97. In addition, the annual Motor Coach rally that creates significant congestion and parking issues within Redmond due to the volume of RVs and the size of the vehicles.

In Bend, the Les Schwab Amphitheater is the primary venue for large outdoor concerts. Events at the Amphitheater and throughout downtown Bend create congestion and parking issues, which are anticipated to intensify as some of the surface parking lots in that area are developed.

2.11 FREIGHT

Deschutes County includes two of Oregon's Strategic Freight Corridors—the Central Oregon Corridor on US 97 and the US 20 Corridor—which are identified in the Oregon Freight Plan (2017). Freight arrives, departs, or passes through the county via truck, train, and air. Most commercial vehicle traffic utilizes state highways, while train traffic travels along the Burlington Northern-Santa Fe Railroad tracks that generally parallel Highway 97 through the study area. Most of the roadway-rail intersections are at-grade through Bend and Redmond, with the exception of the Bend Parkway that is grade separated. The Redmond Roberts Field Airport is located in south Redmond east of Highway 97.

There are two interconnected traffic signals to rail in Deschutes County—US 97 northbound offramp at Revere Ave in Bend and US 97 at Evergreen Avenue in Redmond.

2.12 TRAVELER INFORMATION

ODOT provides most of the traveler information for the Deschutes County area. ODOT provides real-time traveler information through the TripCheck website, 511, social media, variable message signs and portable message signs. ODOT's TripCheck website (www.tripcheck.com) includes camera images, road conditions, weather information, incident maps, and construction activity within the County.

Construction and roadway closure information is currently reported to the public and coordinated with ODOT on an ad hoc basis. The City of Bend posts notices on its public website and inter-agency coordination typically involves direct communications among agency project leaders; but there does not exist a standard regional approach.

2.13 SUMMARY OF RELEVANT DOCUMENTS

A number of regional studies and plans have been compiled in Central Oregon that relate to ITS applications. A review of these documents was conducted to identify potential connections to other agencies and/or planned projects in Deschutes County. This section provides a list of the documents reviewed.

ODOT

- Oregon Statewide TSMO Plan
- 2010 ODOT Region 4 10-year Phased ITS and Communications Plan
- 2010 ODOT Statewide ITS Architecture Plan
- 2019 ODOT Region 4 Data Warehouse Action Plan
- ODOT Traffic Signal Management Plan
- Operations Performance Measures Plan

Deschutes County

- 2011 Deschutes County ITS Plan – Deployment Plan

Cascades East Transit

- Transit Development Plan (in process)

City of Bend

- 2014 Bend North Corridor Study
- 2018 Bend Signal Program Summary

- 2019 Bend Transportation Safety and Action Plan (TSAP)
- Bend Transportation System Plan (TSP) Update (in process)
- US 97 Parkway Plan (in process)

City of Redmond

- Redmond Transportation System Plan (in process)
- 2019 South Redmond Corridor Plan

City of Sisters

- 2018 Sisters Transportation System Plan (TSP) Refinement Plan

CHAPTER 3: USER NEEDS ASSESSMENT

3.1 INTRODUCTION

This chapter provides a summary of transportation system user needs for Deschutes County gathered from project stakeholders through a stakeholder workshop, personal key stakeholder interviews, and mail-out questionnaires. In addition, this chapter also includes a summary of the preliminary strategies and key focus areas that were identified by stakeholders for consideration in the Deployment Plan. The assessment of current and future transportation user needs provides a basis for the development and evaluation of potential ITS projects.

The *Stakeholders and System Users* section identifies the stakeholder and key system users for the Deschutes County ITS plan. These users participated in the stakeholder workshop and individual interviews to identify and confirm key user needs. The *Summary of User Needs* section summarizes these user needs, organized by the following areas of interest:

- Transportation Operations and Management
- Public Transportation Management
- Traveler Information
- Incident & Emergency Management
- Maintenance & Construction Management
- Data Management & Performance Measurement

3.2 STAKEHOLDERS AND SYSTEM USERS

To ensure the success of the Regional ITS Plan for Deschutes County, a coalition of stakeholders and system users was created to gather input and build consensus on regional needs. A workshop was held in July 2019 to gather big-picture user needs and to facilitate discussion between the Plan's stakeholders. The workshop was followed by personal interviews with key stakeholders to discuss and verify the transportation needs that had been identified and to determine any additional needs. A final needs workshop was held in November 2019 to confirm the user needs and preliminary strategies that were captured. Finally, a smart cities workshop, hosted by Bend MPO, was held in December 2020 to brainstorm ways smart cities strategies could be applied to improve transportation in the region.

Output from these meeting was used to refine the goals, needs, and proposed strategies described in this chapter. A separate summary in Appendix D presents the outcome from the smart cities workshop.

Stakeholders include:

- Oregon Department of Transportation (ODOT) Region 4
- Cities of Bend, Redmond, Sisters and La Pine
- Deschutes County
- Bend Metropolitan Planning Organization (BMPO)
- Cascades East Transit (CET)
- Oregon State Police
- Deschutes County 911
- Mt. Bachelor
- Oregon State Forestry Service

3.3 PROJECT MISSION, GOALS, AND OBJECTIVES

To guide the development and ultimate deployment of intelligent transportation systems in Deschutes County, project stakeholders developed a mission statement and accompanying goals and objectives.

3.3.1 MISSION STATEMENT

Deschutes County seeks to improve the safety, security and movement of goods, people, and services for all modes of the transportation network by using advanced technologies, establishing agency coordination, utilizing exiting system capacity and infrastructure, and providing real time traveler information.

3.3.2 GOALS AND OBJECTIVES

The stakeholders identified the following goals and objectives to target delivery of the ITS Plan mission statement.

GOAL	OBJECTIVES
IMPROVE THE SAFETY AND SECURITY OF OUR TRANSPORTATION SYSTEM	Reduce frequency, duration, and effects of incidents for all road users Reduce emergency response times Coordinate incident/security response with other local and regional agencies Coordinate evacuation strategies with other local and regional agencies
IMPROVE THE EFFICIENCY OF THE TRANSPORTATION SYSTEM	Optimize travel time for all transportation system users, including future transit vehicles, commuters, freight, and tourists Reduce travel time variability

	Reduce fuel consumption Reduce environmental impacts Increase vehicle occupancy Improve maintenance and operations efficiencies Reduce Vehicle Miles Traveled Coordinate ITS efforts with existing and future TSM and TDM efforts Provide weather information to transportation agencies to coordinate snow and ice removal Account for and incorporate emerging transportation technologies and business models
PROVIDE IMPROVED TRAVELER INFORMATION	Provide real-time traveler information for all users of the transportation system Provide real-time road condition and weather information at key regional facilities Provide advance and real-time information about construction activities and work zone Provide real-time incident information Disseminate regional and local traveler information by a variety of media Provide traveler information prior to travel decision points Provide one central location for dissemination of all regional and local traveler information
DEVELOP AND DEPLOY COST EFFICIENT ITS INFRASTRUCTURE	Deploy systems that are integrated with existing ITS infrastructure Deploy systems that are integrated with future transportation infrastructure improvements Deploy systems with a high benefit-to-cost ratio Deploy systems that maximize the use of existing infrastructure Integrate deployments with other local and regional projects Coordinate funding opportunities

	Coordinate deployment with existing plans
INTEGRATE REGIONAL ITS PROJECTS WITH LOCAL AND REGIONAL PARTNER	Share infrastructure resources between local and regional agencies Continue to coordinate and integrate projects with other agencies within Deschutes County and Central Oregon Create and build public and private partnerships for ITS deployment, operations, and maintenance
MONITOR TRANSPORTATION PERFORMANCE MEASURES	Develop a transportation database accessible by all local agencies Collect and record multimodal transportation data that is reflective of all road users Maintain a GIS database of the transportation infrastructure, including ITS device Make use of robust third-party performance measurement solutions to provide performance measure aggregation and analytics tools such as dashboards

3.4 SUMMARY OF USER NEEDS

This section contains a summary of transportation system user needs for the Deschutes County region based on input gathered from the user needs workshop and individual stakeholder interviews. These needs and their groupings are consistent with the ODOT Statewide Transportation System Management and Operations (TSMO) Plan[1].

User needs are grouped into the following six categories:

1. Transportation operations & management
2. Public transportation management
3. Traveler information
4. Incident and emergency management
5. Maintenance & construction management
6. Data management and performance measurement

3.4.1 TRANSPORTATION OPERATIONS AND MANAGEMENT

Stakeholders identified the following traffic operations and management needs:

Arterial Management and Traffic Signal Control

- Need to remotely manage and control traffic signals
- Need a robust traffic signal control plan management capability to address a wide range of multimodal operational needs (e.g., coordinated corridor timings for motor vehicles, improved bicycle progression, responsive automatic operations to clear queues)
- Need to monitor and control pedestrian and bicycle crossing aspects of traffic signals in order to facilitate safe pedestrian and bicycle crossings at the intersection
- Need to monitor the status of traffic signal control equipment
- Need to use information from connected vehicles as well as infrastructure detection of multimodal road users to improve the operations of traffic signal control systems
- Need real-time and historic information to improve and update signal timings
- Need to disseminate signal phase and timing data to connected vehicles to facilitate improved movement through intersections
- Need to accommodate repurposed travel lanes/roadway footprint for alternate uses (e.g., part-time restrictions, temporary bus lanes, road diets)
- Need to coordinate parking strategies (e.g., part-time or full-time restrictions) with appropriate transit and signal timing strategies

[1] The ODOT Statewide TSMO Plan is available on the ODOT System Operations and ITS page, accessible here:

https://www.oregon.gov/odot/Maintenance/Pages/Operations.aspx

Highway Management and Coordinated Operations

- Need to actively manage highway traffic on ramps, interchanges, and on the mainline, utilizing tools such as metering, variable speed limits, etc. where warranted
- Need to coordinate highway and arterial operations during incidents that cause travelers to divert
- Need to accommodate repurposed travel lanes/roadway footprint for alternate uses (e.g., bus-on-shoulder, hard-shoulder running)

Special Events Management

- Need to consider Traffic Control Plans for known special events (e.g., Deschutes County Fair, Family Motor Coach Association, Sisters Rodeo)
- Need to incorporate public transportation and shuttle buses into special event management

3.4.2 PUBLIC TRANSPORTATION MANAGEMENT

Stakeholders identified the following public transportation management needs:

Transit Traveler Information

- Need to provide near real-time transit arrival information at bus stops and pre-trip
- Need to expand real-time transit information signs at key locations
- Need to integrate with other Mobility-as-a-Service (MaaS) services

Managing Demand

- Need to attract more choice riders
- Need to incentivize transit use along Century Drive in the winter in partnership with Mt. Bachelor and other regional partners
- Need to run a demand response system that maps and schedules pickups

Operational Performance

- Need to maintain travel time reliability to help achieve ridership targets
- Need transit signal priority and transit corridors
- Need to incorporate arterial traffic and connected vehicle data to optimize transit service operations

Special Events

- Need to consider flexible shared parking options and strategies (e.g., temporary use of school parking lots) during special events and winter season
- Need to ensure quality access for transit vehicles during special events (e.g., temporary dedicated lanes)

Transit Infrastructure

- Need to plan for future transit mobility hubs
- Need to plan for EV charging infrastructure as fleet is eventually moving to electric buses
- Need comprehensive evaluation of the overall power grid to support EV fleet operations

3.4.3 TRAVELER INFORMATION

Stakeholders identified the following needs related to traveler information:

Broadcast Traveler Information

- Need to collect timely, accurate, and reliable traffic, transit, and other road conditions data from multiple sources in order to inform travelers of the latest conditions affecting their travel
  - Key corridors: Century Drive, US 97, US 20, 3rd Street, 27th St, OR 126
  - Potential new information types: real-time information on the directions and length of rail crossing shared with emergency responders and the public
- Need to inform as much of the traveling public as possible using a wide variety of means, including interfacing with third-party services (e.g., social media, navigation and mapping services)
- Need to provide third-party services data on street types and characteristics so they can provide smarter, context-sensitive routing recommendations (e.g., to not direct vehicular traffic through neighborhoods, low-speed streets, or bike boulevards)
- Need to integrate local agency traveler information sources with regional systems (e.g., share Bend CCTV cameras integrated with TripCheck)
- Need to provide en route traveler information using electronic signs that is informative, actionable, and useful

Parking Management

- Need to monitor and report on parking availability in lots, garages, and other parking areas and facilities
- Need to share parking information with local drivers and regional traveler information systems for broader distribution (e.g., interface with Mt. Bachelor parking information system)
- Need curb space management capabilities to balance demand for parking, loading, and other curb uses

3.4.4 INCIDENT & EMERGENCY MANAGEMENT

Stakeholders identified the following needs related to incident and emergency management.

Detect and Verify

- Need to consider emerging technologies to enhance situational awareness (e.g., drones)

- Need to upgrade to an automated system for towing that would improve incident response time and reduce errors
- Need to incorporate TIM observations and input when determining and locating new CCTV cameras and dynamic warning systems
- Need to identify which ITS devices are critical during major events like wildfires and which may be susceptible to electrical outages during such events

Respond

- Need to obtain information from the event scene to support emergency response
- Need to provide response in the field to incidents and emergency situations
- Need to coordinate with other emergency management operations in order to support emergency response
    - Need inter-agency radio communications capabilities to allow responders from different agencies to communicate with one another in the field
- Need to identify opportunities to automate TIM response processes
- Need to identify opportunities for diverting around incidents or emergencies impacting key corridors
- Need to develop integrated corridor management (ICM) strategies for key corridors (e.g., Highway 97)

Inform

- Need to inform travelers of travel impacts due to incidents or emergencies (e.g., road closures, delays, lanes affected) both en-route and pre-trip (e.g., VMS, portable trailers, TripCheck)
- Need to alert drivers when they have entered an incident zone and direct them to change course (merge, change lanes) as needed in order to maintain a safe distance between them and the emergency personnel
- Need to provide advanced information about rail crossings being occupied for incident and emergency response
- Need to provide real-time traffic and incident condition information at 911 centers and with the public
- Need road condition information and video images at operations centers

Evaluate

- Need a shared data platform and dashboard that combines crash information with other potentially relevant information, including weather conditions, traffic volume, holidays, etc. to identify trends and better respond to incidents
- Need to integrate asset management data with regional data platforms and operational systems to improve response planning, including to consider roadway weight restrictions in determining detour routes
- Need to incorporate TIM observations of crash hot spot with SPIS to provide a more accurate assessment of incidents

- Need to provide relevant and specific posted messages on VMS that are informed by observations of incident or emergency responders on the ground

3.4.5 MAINTENANCE & CONSTRUCTION MANAGEMENT

Stakeholders identified the following needs related to maintenance and construction management.

Infrastructure Monitoring

- Need to monitor the condition of transportation-related infrastructure using both fixed and vehicle-based infrastructure monitoring sensors (e.g., to identify potholes, tree-limbs, signs in need of maintenance)

Winter Maintenance

- Need to collect road condition and weather data from multiple sources (e.g., centers, field devices, commercial services, and fleet vehicles) in order to schedule winter maintenance activities, determine geography prioritizations, and track and manage response operations
- Need to process historical data from multiple sources in order to provide enhanced support for winter maintenance operations
- Need to provide winter road maintenance status to other centers
- Need to include sidewalks and bicycle lanes as part of winter maintenance monitoring and clearing operations.

Roadway Maintenance and Construction Coordination

- Need to disseminate maintenance and construction activity to transportation agencies that can utilize it as part of their operations
- Need to coordinate maintenance and construction activities with traffic and other management agencies
- Need to monitor the status of ITS field equipment and coordinate with Traffic Operations on the maintenance of the equipment
- Need to inform public about planned and active road closures and detours (in anticipation of increased construction activity in the region in the next 5 years)

Work Zone Management

- Need to manage work zones and control traffic in areas of the roadway where maintenance, construction, and utility work activities are underway
- Need to inform multimodal travelers of upcoming work zones, including information on detours, reduced speeds, lanes affected, and delays en route
- Need to coordinate work zone information with other agencies (e.g., traveler information, traffic operations, and other maintenance and construction centers)
- Need access and control of field equipment in all maintenance and construction areas, including fixed, portable, and truck-mounted devices supporting both stationary and mobile work zones

- Need to provide alternative routes and guidance for sidewalk closures (e.g., audible messages for ADA needs)

Work Zone Safety Monitoring

- Need to monitor for hazards in the work zone
- Need to provide warnings about hazards in the work zone to maintenance personnel, such as a vehicle moving in a manner that appears to create an unsafe condition

3.4.6 DATA MANAGEMENT & PERFORMANCE MEASUREMENT

Stakeholders identified the following needs related to data management and performance measurement.

Data Management

- Need to define common performance measures that can be measured and shared between partner agencies
- Need to automate data collection (volumes, speed, occupancy, vehicle classification, incidents, preemption calls)
- Need to define common data standards for all data types to ensure accuracy and consistency of analysis across jurisdictions
- Need to share data in a common format
- Need to store data for long term access (historical data)
- Need to be able to query for and receive archive data products containing freeway data, arterial data, parking data, transit and ridesharing data, incident management data, safety-related data, environmental and weather data, vehicle and passenger data, and intermodal operations data
- Need to be able to manage data processing with regard to data archive functions, including data aggregation, data tagging (processed, edited, raw, transformed, etc.), data storage timing and longevity, data quality analysis, data formatting and metadata assignments

Performance Monitoring

- Need to be able to store vehicle data, transit data, weather data, freight data and other transportation-related data to support traffic data analysis, transportation network performance monitoring, transportation planning, safety analyses and research
- Need to process multi-sourced vehicle data to support performance monitoring, infrastructure conditions reporting, and environmental monitoring
- Need a centralized location/single access point to store, access, and process multi-sourced data

3.5 PROPOSED STRATEGIES

Through the user needs interview process, stakeholders highlighted various strategies and areas of focus to address their needs. This Figure 9 highlights the key focus areas and strategies of interest as identified by the Deschutes County ITS Plan stakeholders. These preliminary strategies, organized by functional areas, were refined and used as a basis to define specific projects for the Deployment Plan.

FIGURE 9. KEY ITS AND TSMO STRATEGIES

TRANSPORTATION SYSTEM OPERATIONS AND MANAGEMENT:

- Multi-agency transportation and emergency operations center
- Signal Phase and Timing (SPaT) data shared via the internet
- Active traffic management/ variable speeds
- Traffic monitoring cameras
- Integrated corridor management
- Special event traffic plans
- Advanced railroad grade crossing information
- Advanced Transportation Controller (ATC) upgrades
- Automated Signal Performance Measures (ATSPMs)
- Communications infrastructure gap closure
- Intersection safety analytics system
- Technology for bicycle and pedestrian safety, including bicycle detection and counting, and bicycle signal timing
- Accessible pedestrian signals (APS)
- Ramp metering
- Truck signal priority

PUBLIC TRANSPORTATION MANAGEMENT:

- Mobility management
- Transit signal priority
- Flexible park and rides during special events and throughout the summer
- Real-time transit arrival information
- Low/no emission fleet plan
- Transit pass bundled with other products and electronic payment system enhancements
- Automated passenger counting

TRAVELER INFORMATION:

- Variable message signs
- Regional parking information systems
- En route traveler info with various media (text, 511, etc.)
- Connected vehicles
- Pre-trip information

INCIDENT AND EMERGENCY MANAGEMENT:

- Scenario planning for emergency response
- Strategic planning with signifcant power loss
- Information about roadway constraints on diversion routes
- Rapid response situational awareness capabilities (e.g. drones)
- Centralized emergency vehicle preemption (EVP)
- Evacuation planning, route designation, and enhancements

MAINTENANCE AND CONSTRUCTION MANAGEMENT:

- Smart work zone system (en route warnings)
- Regionwide construction work zone and detour management and monitoring
- Infrastructure monitoring technology
- Enhanced snow plow operations
- Winter road status and work zone status information sharing system

DATA MANAGEMENT AND PERFORMANCE MEASUREMENT:

- Dashboard for regional data warehouse
  - Automated data collection
  - Automated performance reporting
  - Travel time monitoring system
- Open data sharing with statewide clearinghouses
- Open transportation data sharing with regional partner agencies
- Data integration with third-party transportation data providers
- Traffic monitoring video sharing with other agencies

CHAPTER 4: COMMUNICATIONS PLAN

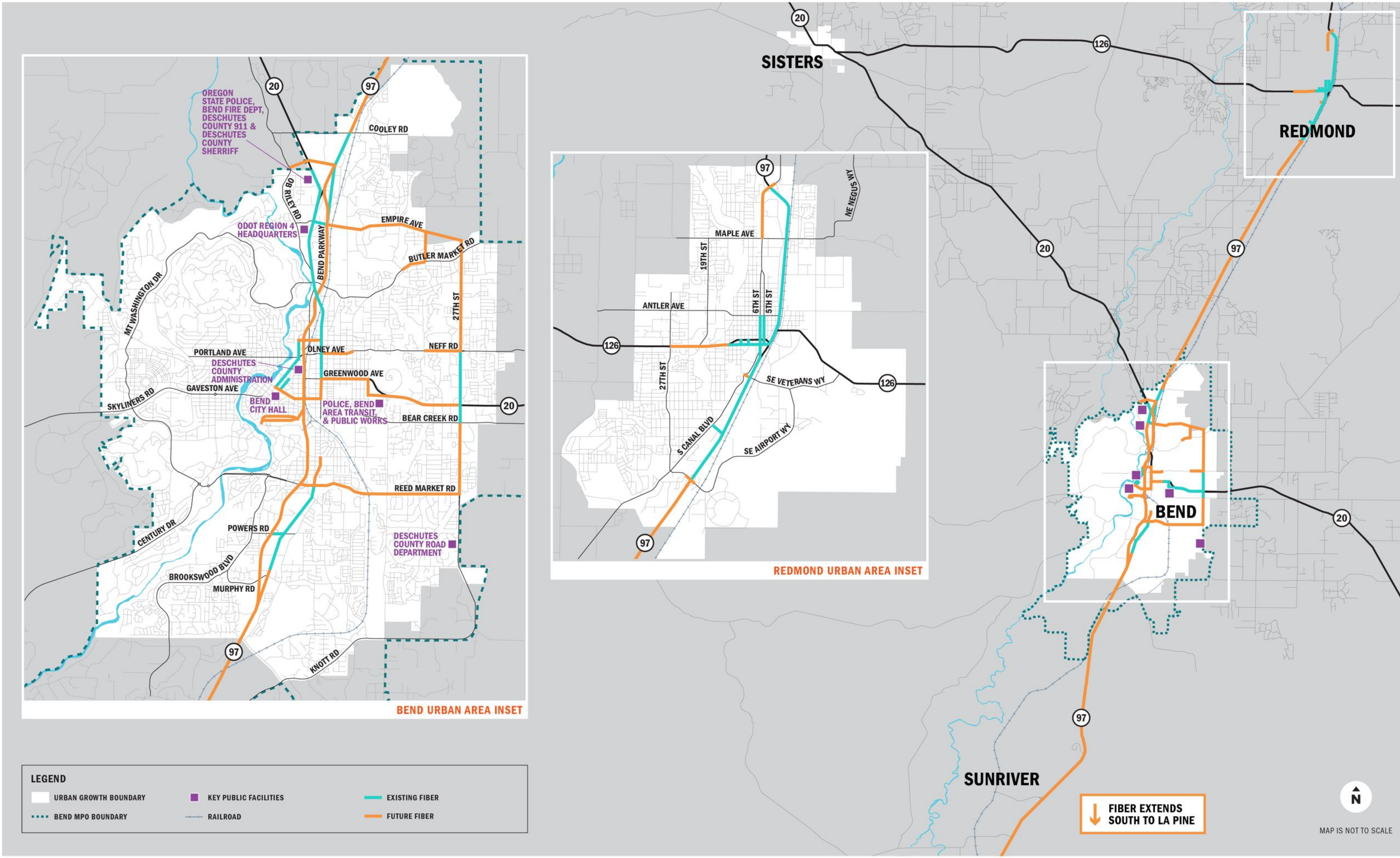
4.1 COMMUNICATIONS INFRASTRUCTURE

This chapter outlines the communications plan for the region that will support transportation requirements for data and video transmission. The communications network will support communications required for ITS deployment between key locations in the region, provide a backbone communications system, as well as a distribution network to reach individual devices and control locations. Fiber optic cable is proposed based on best-fit for communication needs, reliability, growth, standards, and flexibility. Figure 10 shows the updated Communications Plan.

4.1.1 COMMUNICATIONS PLAN GUIDELINES

Guiding principles used in the development of this communications plan are provided here:

- **Reliability:** The system must provide a high level of reliability, achieved through the use of components with a high mean time between failures (MTBF), combined with a redundancy in the network design.
- **Growth:** The network must be expected to grow gracefully. This requires the incorporation of a reasonable amount of unused capacity and a design approach that allows extra capacity to be provided by upgrading the transmission equipment.
- **Standards:** Communications protocols and component selection must use widely accepted standards that minimize ongoing operations and maintenance costs.
- **Flexibility:** The network configuration must be designed to maximize flexibility to accommodate future changes, rearrangements, and equipment changes.
- **Decentralized:** As the network supports several agencies, it must be configured around several centers of control, and allow the control location to be changed according to current needs. This will support the concept for regional data and video sharing.



OREGON STATE POLICE, BEND FIRE DEPT, DESCHUTES COUNTY 911 & DESCHUTES COUNTY SHERRIFF
ODOT REGION 4 HEADQUARTERS
DESCHUTES COUNTY ADMINISTRATION
BEND CITY HALL
POLICE, BEND AREA TRANSIT, & PUBLIC WORKS
DESCHUTES COUNTY ROAD DEPARTMENT
COOLEY RD
EMPIRE AVE
BUTLER MARKET RD
OB RILEY RD
BEND PARKWAY
27TH ST
MT WASHINGTON DR
OLNEY AVE
NEFF RD
PORTLAND AVE
GREENWOOD AVE
GAVESTON AVE
SKYLINERS RD
BEAR CREEK RD
REED MARKET RD
CENTURY DR
POWERS RD
BROOKSWOOD BLVD
MURPHY RD
KNOTT RD
BEND URBAN AREA INSET
MAPLE AVE
19TH ST
NE NEGUS WY
ANTLER AVE
6TH ST
5TH ST
27TH ST
SE VETERANS WY
S CANAL BLVD
SE AIRPORT WY
REDMOND URBAN AREA INSET
SISTERS
REDMOND
BEND
SUNRIVER
FIBER EXTENDS SOUTH TO LA PINE
MAP IS NOT TO SCALE
LEGEND
URBAN GROWTH BOUNDARY
BEND MPO BOUNDARY
KEY PUBLIC FACILITIES
RAILROAD
EXISTING FIBER
FUTURE FIBER

CHAPTER 5: REGIONAL ITS ARCHITECTURE

5.1 REGIONAL ARCHITECTURE OVERVIEW

As part of the update to this ITS plan, stakeholders and the consultant team updated the Deschutes County Regional ITS Architecture. The ITS architecture serves as a resource for inventorying and tracking existing and planned projects in the region. It illustrates how the ITS infrastructure communicates and interconnects different stakeholders and the built environment. This provides a reference for local agencies to support transportation technology deployments. The architecture also identifies needs and high-level concepts for future projects. The Federal Highway Administration (FHWA) also requires that agencies can demonstrate compliance with the ITS architecture for federally funded projects. FHWA provides a detailed description of the ITS architecture and how to use it in their *Regional ITS Architecture Guidance Document*[2].

Since the last Deschutes County Regional ITS Architecture update in 2011, the National ITS Architecture has changed significantly. For instance, the connected and autonomous vehicle service packages have been combined with Turbo Architecture services into the Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT). ARC-IT combined overlapping services between the two architectures and new service packages. Within ARC-IT, regional agencies can use two software packages for ITS architecture updates or systems engineering. ITS architectures can be updated using the Regional Architecture Development for Intelligent Transportation (RAD-IT) software. The Systems Engineering Tool for Intelligent Transportation (SET-IT) can be used for systems engineering activities to support development of specific projects.

The architecture is stored electronically as a database file that can be opened with the free RAD-IT software[3].

Three appendices accompany the Regional Architecture analysis: Stakeholders are identified in Appendix A, Architecture Inventory is identified in Appendix B, and Architecture Service Plans are provided in Appendix C. The service package categories shown in Appendix C contain more specific subcategories that include more detailed descriptions of individual services. For example, Transit Signal Priority is a service package within the Public Transportation group. Service packages along with descriptions can be found on the National ITS Reference Architecture website.

[2] https://ops.fhwa.dot.gov/publications/regitsarchguide/index.htm

[3] https://local.iteris.com/arc-it/html/forms/raditform.php

FIGURE 11. SERVICE PACKAGE GROUPS BY FUNCTION AREA

In addition to service packages, there are various other data elements that must be entered and customized to create the Regional ITS Architecture, including:

- **Stakeholders:** Description of each key stakeholders in the region. Stakeholders may also be clustered into groups.
- **Inventory elements:** All ITS inventory in the region, with each inventory element mapped to a responsible stakeholder and a correlating ITS Architecture subsystem or terminator.
- **Interconnects/Information flows:** Interconnects and information flows denote a level of integration
- **Standards**

5.2 DESCHUTES COUNTY REGIONAL ITS ARCHITECTURE

Figure 12 illustrates the Deschutes County physical architecture. It groups the major physical elements into five classes (Support, Centers, Field, Personal, and Vehicles) and indicates how these elements communicate with one another.

Deschutes County Physical Architecture

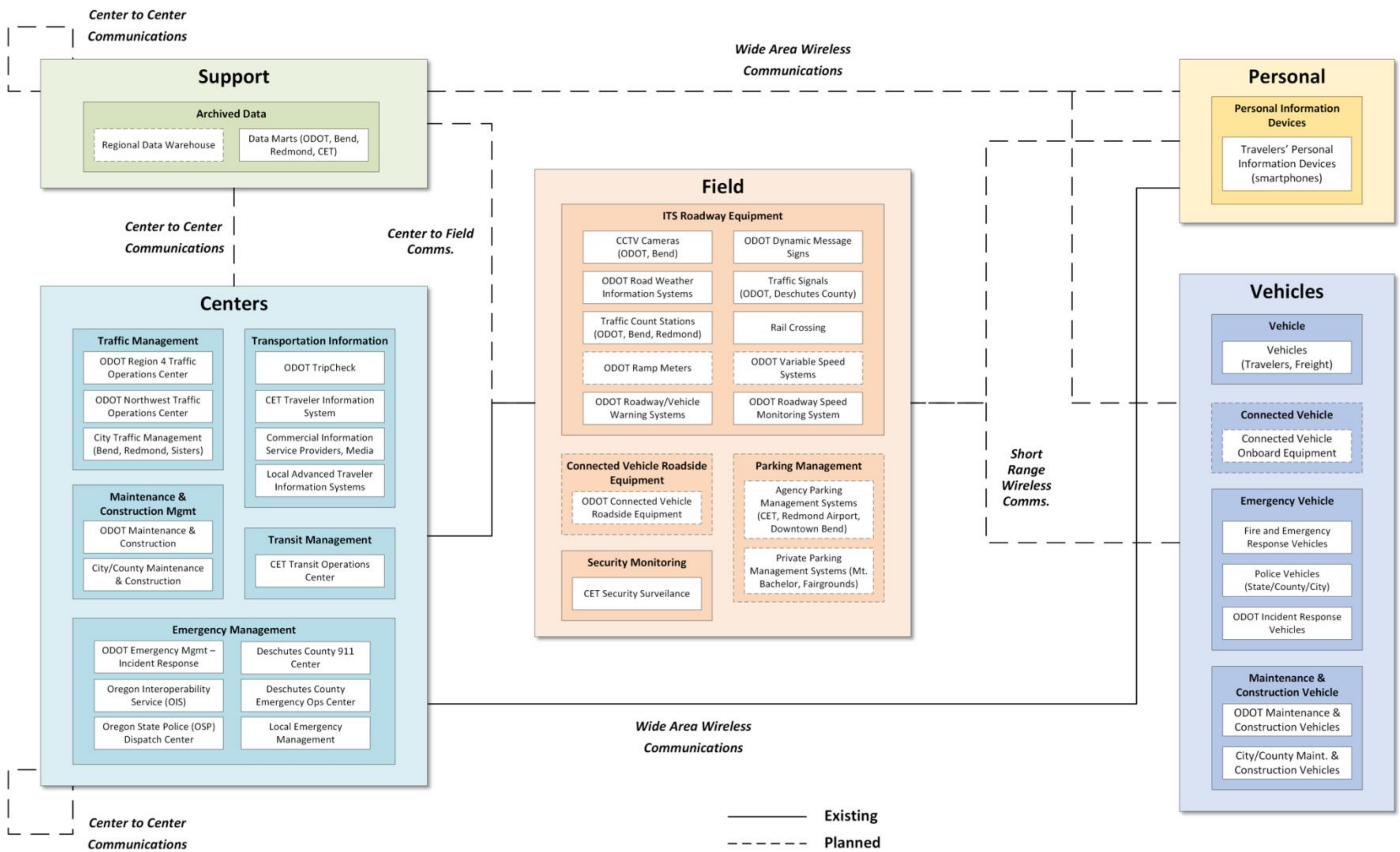


FIGURE 12. DESCHUTES COUNTY PHYSICAL ARCHITECTURE

For the 2019 update, the stakeholders, system inventory, service packages, information flows and standards were all reviewed and evaluated for relevancy. The updated information was gathered through the stakeholder needs assessment process. Details of Stakeholders, Inventory, and Service Packages are provided in the Appendices to this report.

5.3 APPLYING THE ARCHITECTURE: TRANSIT SIGNAL PRIORITY EXAMPLE

Within the Regional ITS Architecture, each identified project includes the stakeholders, inventory elements, services, and functions that are needed. An example is the new service, PT09 Transit Signal Priority.

Figure 13 shows a sample data flow diagram from RAD-IT for the Transit Signal Priority service. While all stakeholders and inventory elements necessary for this service were already existing, new functions had to be established and associated with the elements. For example, the Transit Center Priority Management function had to be associated with CET Transit Management physical object, which enabled the new center-to-center data flows of traffic control priority request and traffic control priority request status to be created between CET Transit Management and ODOT Region 4 Transportation Operations Center.

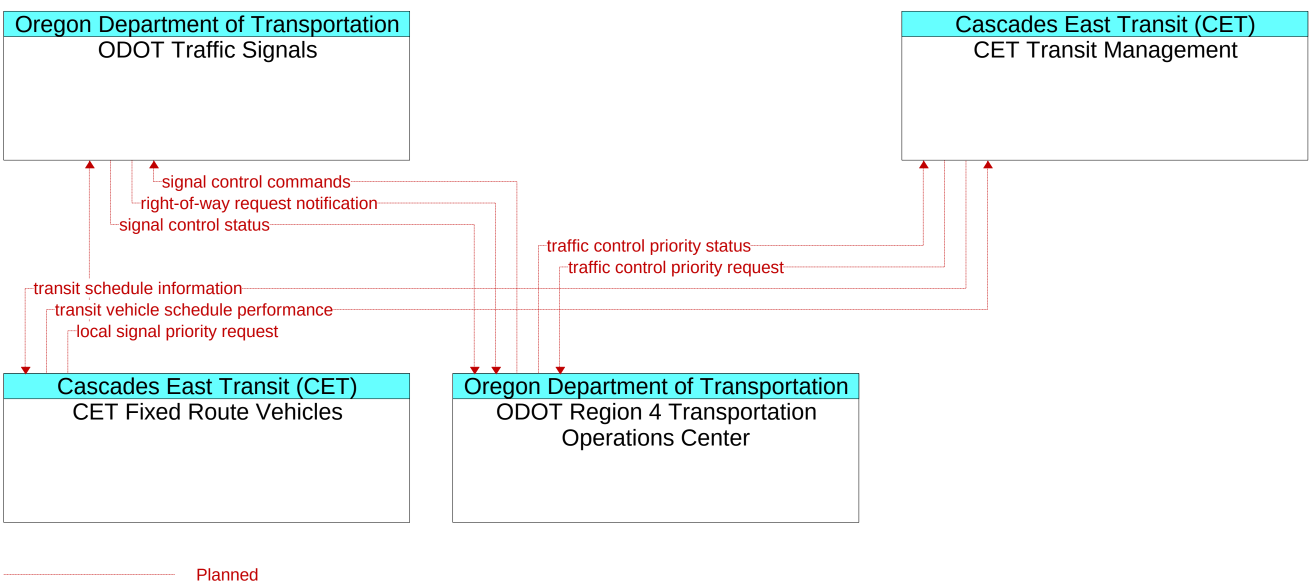


FIGURE 13. CET TRANSIT SIGNAL PRIORITY DATA FLOW DIAGRAM

These diagrams can be generated as needed to provide agencies with documentation for FHWA funding requests and project development activities.

5.4 ITS ARCHITECTURE MAINTENANCE

The ITS Architecture should be a living document that is updated as things change. Common reasons the Deschutes County Regional ITS Architecture will need updating include:

- A stakeholder identifies a new strategy/ITS service that could be implemented to meet a need;
- A stakeholder needs to show a project architecture as part of a project being implemented;
- FHWA updates the National ITS Architecture with new service packages or information flows that should be included in the Treasure Valley; and,
- The region implements a new inventory element not previously identified.

The following describes responsibilities for who updates the Architecture and when:

- **Who?** ODOT will be the keeper and maintainer of the architecture. ODOT will coordinate with local agencies to gather information on new projects and/or other updates that are needed.
- **When?** Once per year. This annual update will coincide with the yearly GIS-based ITS inventory update.

CHAPTER 6: DEPLOYMENT PLAN

6.1 DEPLOYMENT PLAN OVERVIEW

This Deployment Plan retains important, unconstructed projects from the 2011 ITS Plan and identifies new projects based on the user needs reviewed in Chapter 3. As a part of this project, a Smart Cities workshop was conducted to explore how Deschutes County can best prepare for emerging technology. As an outcome of this workshop, a few projects were included under the future Connected and Autonomous vehicles (CAV) applications, and a document called "Smart Cities Transportation Framework" was produced (see Appendix D).

The plan includes project maps, descriptions, and costs. A more detailed description of the projects, dependencies and cost estimates are provided as Appendix E. To find a project, use Figure 16 to identify the location and project number. Go to Appendix E and locate the project number for the detailed information and costs.

The approximate cost for the Deployment Plan projects by lead agency and by category is shown in Figure 14 and Figure 15 below.

FIGURE 14. HIGH LEVEL COST BY LEAD AGENCY

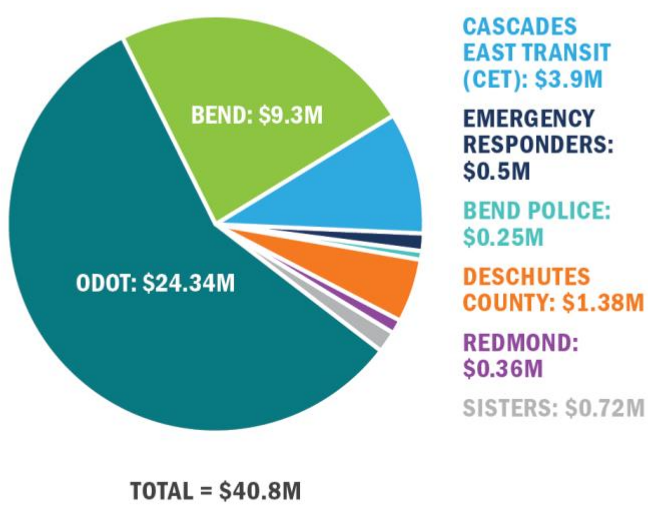
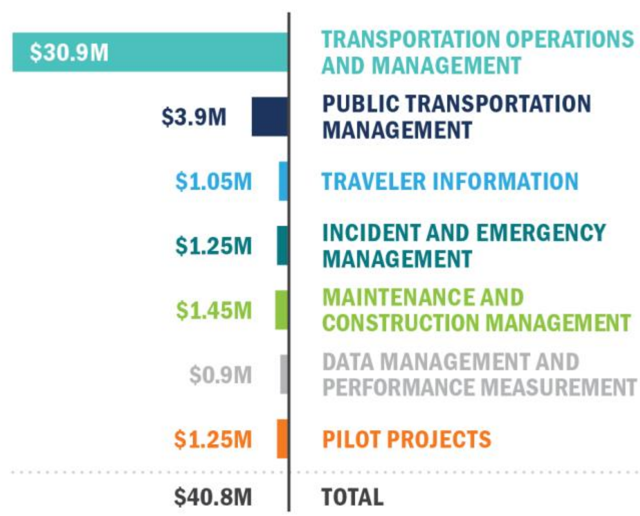


FIGURE 15. HIGH LEVEL COST BY CATEGORY



6.2 DEPLOYMENT PLAN PROJECTS

Projects in the Deployment Plan are organized into two main groups, *Safe and Smart Corridors* and *Regional Projects – Non-Corridor* (described below). Projects recommended in this Deployment Plan are documented in Table 2 and Table 3. provides a map-based view of the Safe and Smart Corridor projects, color-coding and labeling them on a regional map.

The following information is provided for each project:

- Project Number (old and new)
- Project Location (corridor/regional)
- Project Type
- Project Name
- Project Description
- Planning level cost estimate
- Project Dependencies and relativity to Planned Projects
- Lead Agency
- Supporting Agency
- Potential Delivery Options
- Project Status

A note on project numbering: The project numbers in this plan are formatted differently from the 2011 ITS Plan. For the projects that were updated from the previous plan, the "Project No. (Existing, Update, Delete, New)" column provides the amendments (Please refer the table in Appendix E).

The cost estimates included with each project are based on current ITS project experience and costs found through various ITS resources available through the Federal Highway Administration (FHWA) and ITS America. The cost associated with each project includes mark-up for design, mobilization, construction management, and contingency. The operations and maintenance (O&M) costs for each project represent an annual estimated cost once the project has been deployed. The additional staff costs represent an annual estimated cost of staff required to support the projects (e.g. incident responders and TOC operators). illustrate the locations of the corridor ITS deployment plan projects.

6.2.1 SAFE & SMART CORRIDOR PROJECTS

The themes for the corridor projects were to establish safe and smart conditions along the congested or unsafe segments of the corridor. The ITS infrastructure and equipment needed for these projects fell mainly into the categories of Transportation Operations and Management, Traveler Information, and Data Management and Performance Measures.

Some of the ITS strategies that that may be employed on the Safe & Smart corridors are:

- Upgrading to ATC controllers to be able to implement better traffic signal timings along the corridor
- Collecting data for performance monitoring and safety measures through automated traffic signal performance measures (ATSPM) systems
- Enhancing real-time monitoring and detection through CCTV cameras and radar detection
- Provide real-time traffic signal status information to connected vehicles and devices through Signal Phase and Timing (SPaT) applications at the intersection
- Improving the safety of pedestrians and bicyclists through the implementation of pedestrian and bicycle detection, signal timing, and dedicated signals
- Installing regional high-speed fiber optic communications and establishing connection to key signals to enable connectivity and remote monitoring
- Deploying transit signal priority for key transit routes to improve transit speeds and reliability
- Installing variable message signs (VMS) on major arterials to provide travelers important information on road conditions, closures, or other alerts

See Appendix F (Figure 17 and Figure 18) for cut sheet examples of how typical Safe & Smart projects may be laid out, including the kinds of ITS technologies to be deployed and how they may be distributed along a corridor.

TABLE 2. SAFE & SMART CORRIDOR PROJECT LIST

TRANSPORTATION OPERATIONS AND MANAGEMENT					
CORRIDOR PROJECTS					
PROJECT NUMBER	PROJECT NAME	DESCRIPTION	PLANNING LEVEL COST ESTIMATE ($K)	LEAD AGENCY	SUPPORTING AGENCIES
101	3rd Street Safe and Smart Corridor	Install new fiber and conduit Upgrade traffic signal controllers Install CCTV Deploy transit signal priority for CET	$1,390	ODOT	Bend, CET
102	US 97 Safe and Smart Corridor	Install new fiber and conduit Connect to the existing interconnect Upgrade traffic signal controllers Install CCTV Deploy freight signal priority	$1,121	ODOT	Bend

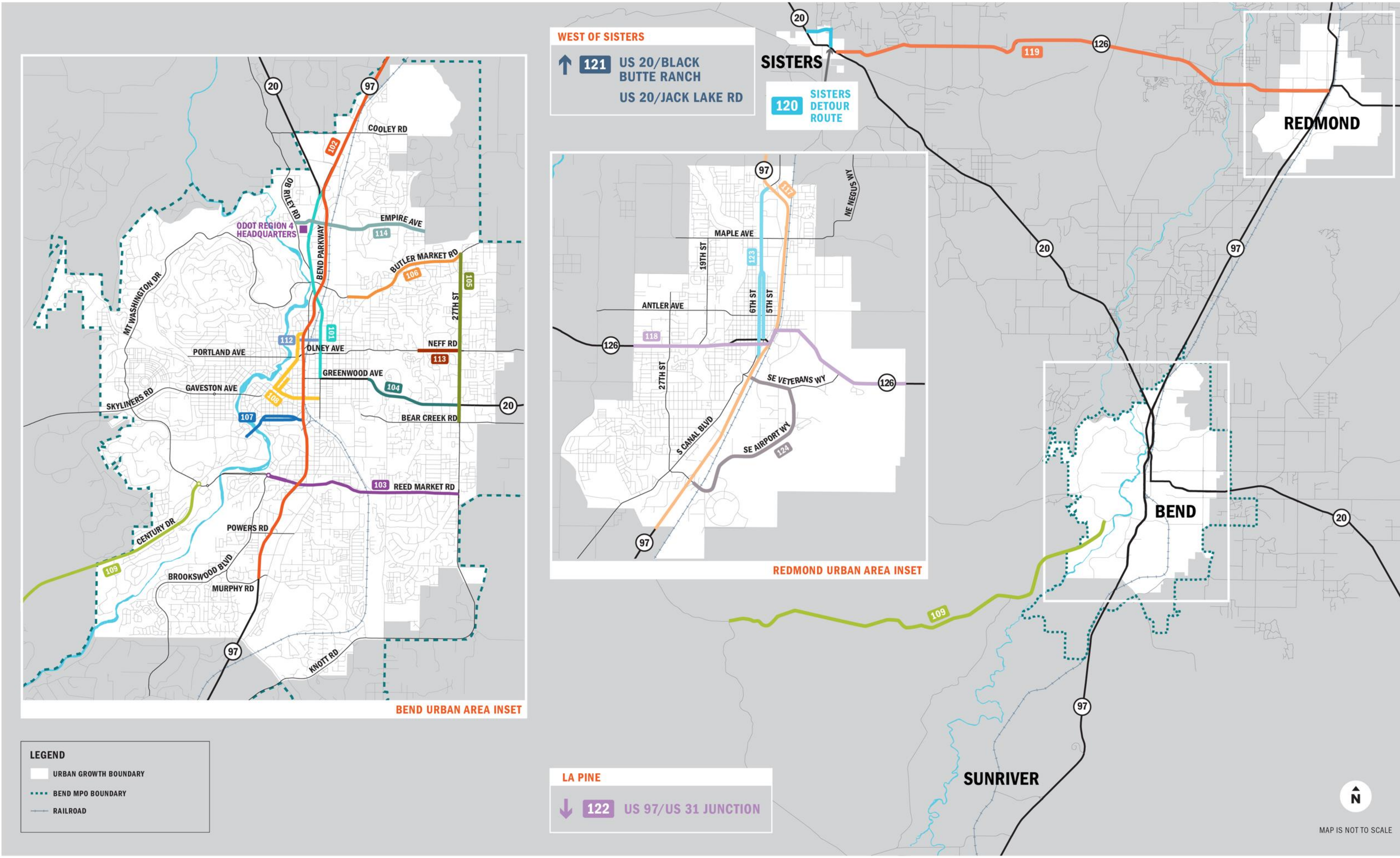
103	Reed Market Road Safe and Smart Corridor	Install new fiber and conduit Connect to the existing interconnect Upgrade traffic signal controllers Install CCTV Install wireless communication Deploy travel time system Integrate rail crossing performance monitoring system	$1,391	ODOT	Bend
104	Hwy 20/Greenwood Ave Smart Corridor	Install new fiber and conduit Connect to the existing interconnect Upgrade traffic signal controllers Install CCTV Deploy travel time system Deploy arterial VMS Deploy weather stations	$2,991	ODOT	Bend
105	27th Street Safe and Smart Corridor	Install new fiber and conduit Upgrade traffic signal controllers Install CCTV	$2,242	Bend	ODOT
106	Butler Market Road Safe and Smart Corridor	Upgrade traffic signal controllers	$426	Bend	ODOT
107	Colorado and Arizona Couplet Safe and Smart Corridor	Install new fiber and conduit Upgrade traffic signal controllers Install CCTV Install travel time system	$1,947	Bend	ODOT
108	Wall Street and Bond Street Fiber Communications	Install new fiber and conduit Upgrade traffic signal controllers	$1,334	Bend	ODOT
109	Century Drive (to Mt. Bachelor) Safety and Efficiency Improvements	Deploy CCTV Deploy VMS Deploy weather stations Deploy dynamic speed limit signs Deploy curve speed warning signs	$3,201	ODOT	Bend, Mt. Bachelor Inc.

110	S. Century Drive (Sunriver to Mt. Bachelor) Safety and Efficiency Improvements	Deploy VMS	$2,045	ODOT	Deschutes County
111	Hwy 97 Active Traffic Management (ATM) and Integrated Corridor Management (ICM)	Deploy travel time system Deploy variable speed limit Deploy video monitoring cameras Deploy VMS Deploy DSS Deploy weather stations	$2,867	ODOT	Bend
112	Revere Ave Fiber Communications	Install new fiber and conduit	Project currently under design. Cost is estimated in that project	Bend	ODOT
113	Neff Road Fiber Communications	Install new fiber and conduit	$350	Bend	ODOT
114	Empire Ave Fiber Communications	Install new fiber and conduit	$1,276	Bend	ODOT
115	Purcell Blvd Fiber Communications	Install new fiber and conduit	$335	Bend	ODOT
116	Hwy 97 (Redmond Parkway) Safety and Efficiency Improvements	Upgrade traffic signal controllers	$675	ODOT	Redmond
117	Highway 97/Redmond Parkway Safe and Smart Corridor	Upgrade traffic signal controllers Install CCTV Deploy travel time system	$274	ODOT	Redmond
118	ORE 126 Safe and Smart Corridor	Install fiber and conduit Upgrade traffic signal controllers Install CCTV Deploy travel time system	$1,227	ODOT	Redmond

119	ORE 126 (Sisters to Redmond) Safety and Efficiency Improvements	Deploy video monitoring cameras Deploy electronic message signs Deploy weather stations	$999	ODOT	Redmond
120	US 20 Sisters Detour System	Install VMS Install CCTV	$524	Sisters	ODOT
121	US 20 West of Sisters RWIS	Install CCTV Install weather stations	$32	ODOT	
122	US 97 - La Pine CCTV	Install CCTV	$32	ODOT	
123	5th St/6th St Couplet Safe and Smart Corridor	Upgrade traffic signal controllers	$359	ODOT	Redmond
124	Deschutes Co Fair Ingress/Egress	Install communications Install CCTV	$1,181	Deschutes County	
REGIONAL PROJECTS					
201	Multi-agency regional operations center	Multi-agency center to conduct transportation and emergency operations	$1,000	ODOT	Bend, Redmond, Deschutes County, OSP
202	Standards development for traffic detection	Define ODOT Region 4-specific standards for intersection detection based on the statewide TSPM effort.	$100	ODOT	
203	City of Bend Traffic Data Collection	Deploy video traffic counting stations at bottleneck locations to monitor traffic and collect traffic volume data. Count stations to collect vehicle volumes, classifications, and speeds	$450	Bend	
204	Special Event Management System (Deschutes County Fairgrounds and Expo Center and Amphitheater)	Deploy traffic signal timing plans Deploy portable dynamic message signs Deploy parking management Deploy public transportation management	$200	Deschutes County	ODOT, Redmond, Bend

205	Special Event Management System (Sisters Event Sites)	Deploy traffic signal timing plans Deploy portable dynamic message signs Deploy parking management Deploy public transportation management	$200	Sisters	ODOT, Deschutes County
206	RWIS Gap Closure Project	Install/ upgrade RWIS	$200	ODOT	
207	CCTV Network Gap Closure Project	Install CCTV	$200	ODOT	
208	Communications Network Gap Closure Project	Complete communications link	$100	ODOT	

FIGURE 16. SAFE & SMART CORRIDOR PROJECTS



6.2.2 REGIONAL PROJECTS – NON-CORRIDOR

The regional projects were divided into five strategies described below. The projects under these strategies were developed to be implemented throughout the County and would require coordination between different stakeholders.

Public Transportation: The projects under public transportation management focus on improving and expanding the services currently provided by the Cascades East Transit (CET). Projects such as establishing mobility hubs in Bend along with real-time transit arrival information and transit signal priority align with the projects developed through the STIP project list. Other projects under this strategy focus on improving the maintenance of the fleet and deploying more automated measures such as electronic payments and data-driven transit station enhancement.

Traveler Information: These project focus on providing more information for the planned real-time regional parking system as well as the parking demand pricing for Bend. These strategies and others such as traveler information kiosks and VMSs for construction and detour information provides valuable information to the public to plan for their trips.

Incident and Emergency Management: These projects focus on automating the information shared between the emergency service providers and ODOT as well as utilization of new technologies such as drones for providing rapid response.

Maintenance and Construction Management: These projects include using smart technologies to make the work zone safer for the construction workers and to improve coordination of maintenance activities within the region with other agencies.

Data Management & Performance Measurement: These projects geared towards developing a regional dashboard for the County. This will serve as a regional data warehouse along with the development of automated measures for collecting performance and safety data.

Pilot Projects: These are projects that provide an opportunity to perform small scale testing of new technologies and applications prior to major implementation.

TABLE 3. REGIONAL (NON-CORRIDOR) PROJECT LIST

PROJECT NUMBER	PROJECT NAME	DESCRIPTION	PLANNING LEVEL COST ESTIMATE ($K)	LEAD AGENCY	SUPPORTING AGENCIES
PUBLIC TRANSPORTATION MANAGEMENT					
301	Maintenance Management System	Upgrade the existing fleet maintenance management system to expand functionality and meet FTA requirements	$40	CET	
302	Transit Security System	Install video monitoring equipment for new Redmond service and integrate with existing transit security system	$135	CET	
303	Mobility Hubs Deployment Plan	Develop a deployment model and implementation plan for regional mobility hubs	$200	CET	ODOT, Bend, Redmond, Private Transportation Service Providers
304	CAD-AVL upgrade	Upgrade current Routematch CAD-AVL solution to improve scheduling and real-time info	$200	CET	
305	Flex park-and-ride lots for special events	Develop operating plans and establish agreements necessary to activate temporary park-and-ride lots	$100	CET	Bend, Redmond, Deschutes County, ODOT
306	Electronic payment integrations	Extend existing electronic fare payment system (TouchPass) to integrate with future systems	$500-$2000	CET	Bend
307	Data-driven transit station enhancement plan	Use automated passenger count data and other real-time data sources to identify high-volume stops and O-D patterns	$250	CET	

308	Transit Signal Priority	Vehicle-side implementation of TSP	$300	CET	Bend, Redmond, ODOT
309	Real-time transit arrival information	Next bus status electronic display boards at key locations.	$500	CET	
310	Software/hardware maintenance and upgrades	Annual cost of maintaining, operating and upgrading hardware and software associated with Transit ITS Projects	$100	CET	
311	Facilities maintenance & labor	Annual cost of maintenance and labor associated with Transit ITS Projects	$100	CET	
TRAVELER INFORMATION					
401	Regional real-time parking information exchange system	Enable real-time parking information exchange between public and private parking systems and traveler information systems	$500	Bend	ODOT, Mt. Bachelor, Redmond Airport
402	Downtown Bend on-street parking demand pricing	Implement variable-rate pricing for on-street permits based on location, demand, and availability of parking.	*TBD*	Bend	
403	Information kiosks at mobility hubs and activity centers	Provide multimodal traveler information kiosks	$250	Bend	
404	Traveler information system enhancements for construction and detour info	Traveler information system enhancements to provide the public better information about planned and active road closures and detours	$300	ODOT	Bend
INCIDENT AND EMERGENCY MANAGEMENT					
501	OID CAD 911 BUS Upgrade	In coordination with ODOT statewide OID upgrade, update interfaces for CAD 911 Interconnect partners	Statewide initiative	ODOT	OSP, Deschutes County 911, Deschutes County, Bend, Redmond

502	Provide Traffic Management System Information at EOCs	Provide an interface between the TOC and/or other traffic management systems and each of the emergency operations centers	$250	ODOT	Bend, Redmond, Deschutes County, Deschutes County 911
503	Rapid response situational awareness capabilities Responder Video System	Integrate mobile video feeds, including from mobile devices, body-worn devices, vehicles, and drones	$100	ODOT	OSP, Deschutes County, Bend, Redmond
504	Centralized Emergency Vehicle Preemption (EVP) and advanced route guidance system	Integration of a modern centralized EVP system with the ODOT traffic signal system	$500	Emergency Responders	ODOT
505	Resiliency analysis of critical systems and infrastructure	Assessment of the impact of power loss events along key corridors or locations with critical systems or devices	$200	ODOT	
506	Scenario planning for Tri-County evacuations, emergencies, and incidents	Develop a Tri-County ICM plan to identify specific routes to use during different evacuation, emergency, and incident conditions	$200	ODOT	Bend, Redmond, OSP, Deschutes County 911, Tri-County Region
MAINTENANCE AND CONSTRUCTION MANAGEMENT					
601	Smart Work Zone Management and Safety Monitoring Systems	Develop standards and an implementation and operating plan for deploying smart work zone safety devices and management techniques	$200	ODOT	Deschutes County, Bend, Redmond
602	Regional work zone and winter maintenance information sharing system	Develop a system to share planned and real-time work zone/maintenance status with other agencies in the region	$300	ODOT	Deschutes County, Bend, Redmond

603	Implement a Maintenance Decision Support System	Multi-agency program to enhance current winter maintenance capabilities by implementing a Maintenance Decision Support System (MDSS)	$750	ODOT	Deschutes County, Bend, Redmond
604	Region-wide RWIS upgrade implementation plan	Develop a prioritization plan for region-wide RWIS improvements	$200	ODOT	
DATA MANAGEMENT AND PERFORMANCE MEASUREMENT					
701	Regional data warehouse	Implement a "one-stop shop" regional data warehouse	$500-$750	ODOT	Deschutes County, Bend, Redmond, ODOT Statewide
702	ATSPM Performance Reporting System	Develop an automated performance reporting system	$150	ODOT	
703	3rd-party travel time data integration	Integrate existing and new travel time data to provide regional travel time data for the Regional Data Warehouse	Statewide Initiative	ODOT	
PILOT PROJECTS					
801	In-Vehicle Communications for Road Weather Conditions	Install short-range communications equipment at weather stations	$250	ODOT	Deschutes County
802	Congestion Warning System	Deploy warning systems devices at entry points	$250	ODOT	Bend, Redmond
803	In-Vehicle Communications for SPaT/MAP and ODOT CV Portal Integration	Install communications technologies to transmit traffic signal timing information to in-vehicle systems	$300	ODOT	Bend, Redmond
804	Automated speed enforcement pilot	Evaluate options for a pilot study for automated enforcement of speeding and red-light running	$250	Bend Police	OSP, Bend, Deschutes County, ODOT

805	Micromobility pilot	Establish policies, data sharing requirements, etc. for mobility providers	$200	Bend	

6.3 DEPLOYMENT PLAN IMPLEMENTATION

Delivering projects in the ITS Deployment Plan will be the responsibility of the lead agencies identified in Tables 2 and 3, of which ODOT has responsibility for the majority of investment. As part of ODOT's ongoing commitment to implementing ITS using TSMO practices, ODOT will convene an ongoing working group to pursue funding, partnerships, and work to improve collaborative practices among lead agencies. The following table shows the action items identified to support the systems and technologies being deployed and enable the agencies to actively manage and operate the transportation system.

TSMO PROGRAM ACTION PLAN	
BUSINESS PROCESSES/ PLANNING AND PROGRAMMING	1. Develop a funding program for the ITS/operations projects 2. Integrate ITS plan into the TSP and MTP 3. Coordinate with planning staff to raise awareness and understanding of operations through ongoing education and training 4. Improve the process for notifying status of incident response
PERFORMANCE MEASURES	1. Coordinate with ODOT statewide for developing performance measure systems 2. Implement the traffic signal management plan for Deschutes County
ORGANIZATION AND STAFFING	1. Create an Operations Program Training Plan 2. Develop a workforce development program highlighting webinars, and ongoing education opportunities
CULTURE	1. Develop an ongoing communication plan to emphasize the importance of operations: * Develop and distribute an annual operations program report * Coordinate with ODOT statewide for annual performance reporting
SYSTEMS AND TECHNOLOGY	(See the project list)
COLLABORATION	1. Facilitate a regular operations group meeting to collaborate on regional projects and grant opportunities 2. Collaborate with the private sector for operations data. Monitor continued improvements in data sources and tools for planning and analysis. Collaborate with ODOT statewide Operations and their progress with data sources and performance monitoring

APPENDICES

Oregon Department of Transportation

DKS

APPENDIX A – REGIONAL ARCHITECTURE STAKEHOLDERS

The stakeholders in the region have remained consistent overall, with only two new stakeholders identified—Facebook and third-party transportation data providers. Facebook was included as a result of the recent partnership with the company to construct a major fiber optic communications backbone in the region. Third-party transportation data provider is a generic stakeholder representing any commercial information service providers that may contribute transportation data or analysis to support regional transportation system management.

STAKEHOLDER	EXISTING	NEW
AMERICAN RED CROSS	✓	
BEND CHAMBER OF COMMERCE	✓	
BEND MPO	✓	
BEND VISITOR AND CONVENTION BUREAU	✓	
CASCADES EAST TRANSIT (CET)	✓	
CENTRAL OREGON VISITORS ASSOCIATION	✓	
CITY OF BEND	✓	
CITY OF BEND POLICE AND FIRE	✓	
CITY OF REDMOND	✓	
CITY OF REDMOND POLICE AND FIRE	✓	
CITY OF SISTERS	✓	
COMMERCIAL INFORMATION SERVICE PROVIDERS	✓	
DESCHUTES COUNTY	✓	
DESCHUTES COUNTY 911	✓	
DESCHUTES COUNTY FAIR AND EXPO CENTER	✓	
DESCHUTES COUNTY SHERIFF	✓	
FACEBOOK		✓
HEAVY RAIL OPERATORS	✓	
LOCAL CARE PROVIDERS	✓	
LOCAL PUBLIC SAFETY DISPATCH AGENCIES	✓	
MAYDAY SERVICE PROVIDERS	✓	

STAKEHOLDER	EXISTING	NEW
MEDIA	✓	
MT. BACHELOR, INC.	✓	
OREGON DEPARTMENT OF TRANSPORTATION	✓	
OREGON STATE POLICE	✓	
REDMOND CHAMBER OF COMMERCE	✓	
RURAL FIRE PROTECTION DISTRICTS	✓	
SISTERS CHAMBER OF COMMERCE	✓	
SUNRIVER CHAMBER OF COMMERCE	✓	
THIRD-PARTY TRANSPORTATION DATA PROVIDERS		✓
TRAVELERS	✓	
US FOREST SERVICE	✓	

APPENDIX B – ARCHITECURE INVENTORY

This update to the ITS architecture includes several new inventory elements, described first. All inventory elements are summarized in the accompanying table.

- **CET Parking Management** – reflecting the need to monitor parking availability in park-and-ride lots and to coordinate deployment of temporary parking facilities during special events
- **CET Transit Signal Priority Management** – representing the systems and equipment necessary to generate and disseminate transit signal priority requests
- **Connected Vehicle Onboard Equipment (OBE)** – representing the connected vehicle (CV) communications and vehicle interface components necessary to support CV communications to vehicles
- **ODOT Connected Vehicle Roadside Equipment (RSE)** – representing the CV communications and roadside device interface components necessary to support CV communications from roadside systems to the Traffic Operations Center and to connected vehicles within wireless range
- **ODOT Ramp Meters** – representing the field infrastructure needed for ramp metering
- **ODOT Region 4 ICM Decision Support System** – representing the central management software and systems necessary to develop diversion routes, signal timings, and other response strategies during incidents and events
- **ODOT Region 4 Regional Data Warehouse** – representing a new system to collect, analyze, and report on multi-source regional transportation data to support operations, planning, and system management
- **ODOT Variable Speed System** – representing the software and infrastructure needed to generate weather- or traffic-responsive variable speeds
- **Private Parking Facility Parking Management** – representing private parking management systems that may exchange parking status information with public systems

INVENTORY ELEMENT	EXISTING	NEW
AMERICAN RED CROSS SHELTERS	✓	
BEND DATA MART	✓	
REGIONAL ARCHIVED DATA MANAGEMENT	✓	
CET DATA MART	✓	
CET DEMAND RESPONSE VEHICLES	✓	
CET FIELD DEVICES	✓	
CET FIXED ROUTE VEHICLES	✓	
CET PARKING MANAGEMENT		✓
CET SECURITY SURVEILLANCE	✓	
CET TRANSIT MANAGEMENT	✓	
CET TRANSIT SIGNAL PRIORITY MANAGEMENT		✓
CET TRAVELER INFORMATION SYSTEM	✓	
BEND PARKING MANAGEMENT	✓	
BEND TRAFFIC COUNT STATIONS	✓	
BEND TRAFFIC MANAGEMENT	✓	
BEND TRAFFIC SIGNALS	✓	
BEND EMERGENCY VEHICLES	✓	
REDMOND DATA MART	✓	
REDMOND TRAFFIC MANAGEMENT	✓	
REDMOND TRAFFIC SIGNALS	✓	
REDMOND EMERGENCY VEHICLES	✓	
SISTERS PARKING MANAGEMENT	✓	
SISTERS TRAFFIC MANAGEMENT	✓	
COMMERCIAL INFORMATION SERVICE PROVIDERS	✓	
CONNECTED VEHICLE ONBOARD EQUIPMENT (OBE)		✓
DESCHUTES COUNTY EMERGENCY OPERATIONS CENTER	✓	

INVENTORY ELEMENT	EXISTING	NEW
DESCHUTES COUNTY TRAFFIC SIGNAL(S)	√	
DESCHUTES COUNTY 911 CENTER	√	
DESCHUTES COUNTY 911 HAZARD ALERT/ADVISORY SYSTEM	√	
DESCHUTES COUNTY FAIRGROUNDS AND EXPO CENTER	√	
DESCHUTES COUNTY SHERIFF VEHICLES	√	
LOCAL EMERGENCY MANAGEMENT	√	
HEAVY RAIL WAYSIDE EQUIPMENT	√	
LOCAL CARE FACILITIES	√	
OREGON INTEROPERABILITY SERVICE (OIS)	√	
CITY/COUNTY MAINTENANCE AND CONSTRUCTION MANAGEMENT	√	
CITY/COUNTY MAINTENANCE AND CONSTRUCTION VEHICLES	√	
LOCAL ADVANCED TRAVELER INFORMATION SYSTEM (ATIS)	√	
LOCAL TOURISM INFORMATION SERVICE PROVIDERS	√	
MAYDAY SERVICES	√	
MEDIA	√	
ODOT CCTV CAMERAS	√	
ODOT CONNECTED VEHICLE ROADSIDE EQUIPMENT (RSE)		√
ODOT DATA MART	√	
ODOT DYNAMIC MESSAGE SIGNS	√	
ODOT EMERGENCY MANAGEMENT - INCIDENT RESPONSE	√	
ODOT HIGHWAY ADVISORY RADIO	√	
ODOT INCIDENT RESPONSE VEHICLES	√	
ODOT MAINTENANCE AND CONSTRUCTION MANAGEMENT	√	
ODOT MAINTENANCE AND CONSTRUCTION VEHICLES	√	
ODOT NORTHWEST TRANSPORTATION OPERATIONS CENTER	√	
ODOT RAMP METERS		√
ODOT REGION 4 ICM DECISION SUPPORT SYSTEM		√
ODOT REGION 4 TRANSPORTATION OPERATIONS CENTER	√	

INVENTORY ELEMENT	EXISTING	NEW
ODOT REGION 4 REGIONAL DATA WAREHOUSE		✓
ODOT REMOTE TRAVELER SUPPORT	✓	
ODOT ROADWAY SPEED MONITORING	✓	
ODOT ROADWAY/VEHICLE WARNING SYSTEM	✓	
ODOT RWIS	✓	
ODOT TRAFFIC CAMERAS	✓	
ODOT TRAFFIC COUNT STATIONS	✓	
ODOT TRAFFIC SIGNAL SYSTEMS	✓	
ODOT TRAFFIC SIGNALS	✓	
ODOT VARIABLE SPEED SYSTEM		✓
TRIPCHECK SYSTEM	✓	
OREGON STATE POLICE DISPATCH CENTER	✓	
OREGON STATE POLICE VEHICLES	✓	
PERSONAL TRAVELER INFORMATION DEVICES	✓	
PRIVATE PARKING FACILITY PARKING MANAGEMENT		✓
TRAVELER CARD	✓	
TRAVELERS	✓	
VEHICLES	✓	

APPENDIX C – ARCHITECTURE SERVICE PACKAGES

Several new service packages are included in the ITS architecture update. These services fulfill planned project needs and involve emerging technologies that should have benefits for regional transportation. The new services include:

- CVO06 Freight Signal Priority
- DM02 Performance Monitoring
- MC05 Roadway Maintenance and Construction
- MC09 Infrastructure Monitoring
- PM04 Regional Parking Management
- PS06 Incident Scene Pre-Arrival Staging Guidance for Emergency Responders
- PS07 Incident Scene Safety Monitoring
- PT09 Transit Signal Priority
- SU01 Connected Vehicle System Monitoring and Management
- SU07 ITS Communications
- SU11 Field Equipment Maintenance
- SU12 Vehicle Maintenance
- ST05 Electric Charging Stations Management
- TM04 Connected Vehicle Traffic Signal System
- TM05 Traffic Metering
- TM09 Integrated Decision Support and Demand Management
- TM20 Variable Speed Limits
- TI06 Dynamic Ridesharing and Shared Use Transportation
- VS05 Curve Speed Warning
- VS08 Queue Warning
- WX03 Spot Weather Impact Warning

The addition of service packages illustrates how the region is growing and maturing in the types of ITS projects under consideration, including areas that have more traditional safety and maintenance systems with newer technologies such as connected vehicle systems. The full list of service packages follows:

AREA	SERVICE PACKAGE	SERVICE PACKAGE NAME
COMMERCIAL VEHICLE OPERATIONS	CVO06	Freight Signal Priority
DATA MANAGEMENT	DM01	ITS Data Warehouse
	DM02	Performance Monitoring
MAINTENANCE AND CONSTRUCTION	MC01	Maintenance and Construction Vehicle and Equipment Tracking
	MC02	Maintenance and Construction Vehicle Maintenance
	MC04	Winter Maintenance
	MC05	Roadway Maintenance and Construction
	MC06	Work Zone Management
	MC07	Work Zone Safety Monitoring
	MC08	Maintenance and Construction Activity Coordination
	MC09	Infrastructure Monitoring
PARKING MANAGEMENT	PM01	Parking Space Management
	PM02	Smart Park and Ride System
	PM04	Regional Parking Management
PUBLIC SAFETY	PS01	Emergency Call-Taking and Dispatch
	PS03	Emergency Vehicle Preemption
	PS04	Mayday Notification
	PS06	Incident Scene Pre-Arrival Staging Guidance for Emergency Responders
	PS07	Incident Scene Safety Monitoring
	PS08	Roadway Service Patrols
	PS10	Wide-Area Alert
	PS12	Disaster Response and Recovery
	PS13	Evacuation and Reentry Management
PUBLIC TRANSPORTATION	PT01	Transit Vehicle Tracking
	PT02	Transit Fixed-Route Operations
	PT03	Dynamic Transit Operations
	PT04	Transit Fare Collection Management
	PT05	Transit Security
	PT06	Transit Fleet Management

AREA	SERVICE PACKAGE	SERVICE PACKAGE NAME
	PT07	Transit Passenger Counting
	PT08	Transit Traveler Information
	PT09	Transit Signal Priority
	PT14	Multi-modal Coordination
SUPPORT	SU01	Connected Vehicle System Monitoring and Management
	SU03	Data Distribution
	SU07	ITS Communications
	SU11	Field Equipment Maintenance
	SU12	Vehicle Maintenance
SUSTAINABLE TRAVEL	ST05	Electric Charging Stations Management
TRAFFIC MANAGEMENT	TM01	Infrastructure-Based Traffic Surveillance
	TM02	Vehicle-Based Traffic Surveillance
	TM03	Traffic Signal Control
	TM04	Connected Vehicle Traffic Signal System
	TM05	Traffic Metering
	TM06	Traffic Information Dissemination
	TM07	Regional Traffic Management
	TM08	Traffic Incident Management System
	TM09	Integrated Decision Support and Demand Management
	TM13	Standard Railroad Grade Crossing
	TM14	Advanced Railroad Grade Crossing
	TM17	Speed Warning and Enforcement
	TM19	Roadway Closure Management
	TM20	Variable Speed Limits
TRAVELER INFORMATION	TI01	Broadcast Traveler Information
	TI02	Personalized Traveler Information
	TI06	Dynamic Ridesharing and Shared Use Transportation
	TI07	In-Vehicle Signage
VEHICLE SAFETY	VS05	Curve Speed Warning

AREA	SERVICE PACKAGE	SERVICE PACKAGE NAME
	VS08	Queue Warning
WEATHER	WX01	Weather Data Collection
	WX02	Weather Information Processing and Distribution
	WX03	Spot Weather Impact Warning

Smart Cities Transportation Framework

WORKSHOP DISCUSSION SUMMARY

The Bend MPO held a workshop on December 16, 2019 to brainstorm how a smart city future can improve transportation in Deschutes County. These ideas do not represent funded or adopted solutions.

This Smart Cities Transportation Framework summarizes key considerations and recommended actions to guide public agency investments in Deschutes County as mobility technologies, service models, and even, new modes continue to evolve.

Smart cities can be larger urban areas, like Bend, and small towns, like La Pine. What makes cities "smart" is the use of technology to collect data, assess what's happening, identify relationships, measure performance, optimize operations, and communicate to us so we can make choices that improve our quality of life.

SMART CITIES PROCESS

COLLECT INFORMATION ABOUT MOBILITY AND OTHER CITY OPERATIONS THROUGH SENSORS, MOBILE DEVICES, AND EXISTING SYSTEMS

COMMUNICATE DATA AND INFORMATION USING WIRED OR WIRELESS NETWORKS

ANALYZE THE DATA TO PROVIDE USEFUL INFORMATION ABOUT THE CITY THROUGH VARIOUS PROCESSING SYSTEMS

SHARE INFORMATION TO CONNECTED CITIZENS, POLICY MAKERS, AND AGENCY MANAGEMENT STAFF

HOW IT WORKS

It's a Saturday in late summer and you're heading from Redmond to Bend to take advantage of sales in the Old Mill District, dip into the Whitewater Park, and then meet friends at a brewery. It's fire and festival season, so trips can have unexpected delays. Thankfully, you've got tech on your side to keep your day on track. You start by telling your navigation system to take you to the Old Mill District in Bend.

- The city traffic signals are timed using historic and real time data to reduce the number of times you use your brakes
- Your navigation system updates your route in real-time based on input from emergency responders, travel speeds of other drivers, construction, weather, visibility and events, so when the fire leaps the road you can detour before getting stuck in a line of traffic
- Connected vehicle communications warn you about the slow moving farm equipment ahead before you can see it through the smoke
- Your parking space is reserved at a mobility hub by your navigation system with fees based on actual time parked. From the mobility hub, you can coordinate a variety of trips: park, gear up at the outdoor sale, shuttle to the Whitewater Park for a few turns on the waves, and bike uptown to meet friends at the brewery

You're used to having an efficient transportation system and it keeps getting better as new technology enters the market. You rely on a safer trip, cost savings and more time to do the things that make Deschutes County the only place you'll ever live.

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Smart Cities Transportation Framework WORKSHOP DISCUSSION SUMMARY

SMART CITIES STRATEGIES CAN HELP:

- Improve reliability and resiliency of the transportation system, supporting economic improvement, efficient services delivery, and an increased quality of life.
- Enhance data sharing and institutional collaboration (e.g., sharing of information on travel, weather, events), supporting more efficient and data-driven, responsive community services.
- Improve coordination with emergency responders, utilities, etc. supporting improved safety, response, and resilience.
- Clarify view of travel patterns provided by real-time data that supports improved traveler information and emergency response.
- Expand and coordinate mobility alternatives, providing traveler options and data for decision making.

FOCUS AREAS FOR TRANSPORTATION

Smart Cities strategies can be effective in addressing the region's safety, mobility, and efficiency goals in these areas:

1 MULTIMODAL AND EMERGING MOBILITY

Implement Mobility Hubs

- Plan locations, capacity needs, and uses
- Integrate wayfinding, transfers, and circulation
- Use hubs as a communication portal during emergencies
- Design with a flexible, modular approach

Explore Mobility as a Service (MaaS)

- Define governance model and organizational structure

Consider the Future of Parking

- Anticipate the need to manage curb space
- Use innovation districts as a way to engage private sector, attract entrepreneurs and startups

2 BIG DATA, ANALYTICS, DASHBOARDS, AND WAREHOUSE

Continue to Develop Shared Data Warehouse

- Continue to expand data sharing capabilities and agreements
- Adopt data standards and best practices
- Form collaborative partnerships and agreements with 3rd party data providers
- Secure private sector data platform solutions
- Establish safety, traffic congestion, travel time, and reliability performance measures

Invest in Workforce Development

- Develop technical skills
- Educate existing staff
- Follow best practices

3 INCIDENT MANAGEMENT, EMERGENCY RESPONSE, AND RESILIENCY

Use Real-Time and Historical Data to Optimize Response

- Identify pre-set regional routes for major events
- Coordinate through a regional operations center
- Share real-time information among response agencies and with the public
- Use performance metrics to continuously improve

Plan for Resiliency in All Investments

- Identify "fall back" options for system failures
- Identify opportunities to use operational systems for event management and response

4 CONNECTED AND AUTOMATED VEHICLES

Prepare for Connected Vehicles

- Expand the communications network
- Upgrade to advanced transportation controllers
- Implement data standards and create common data sets to share connected vehicle data over any communications standard

Monitor Autonomous Vehicle Developments

- Monitor state and federal policies and actions
- Monitor potential impacts to road infrastructure design
- Consider a pilot autonomous vehicle zone
- Develop local and regional policy for autonomous vehicles

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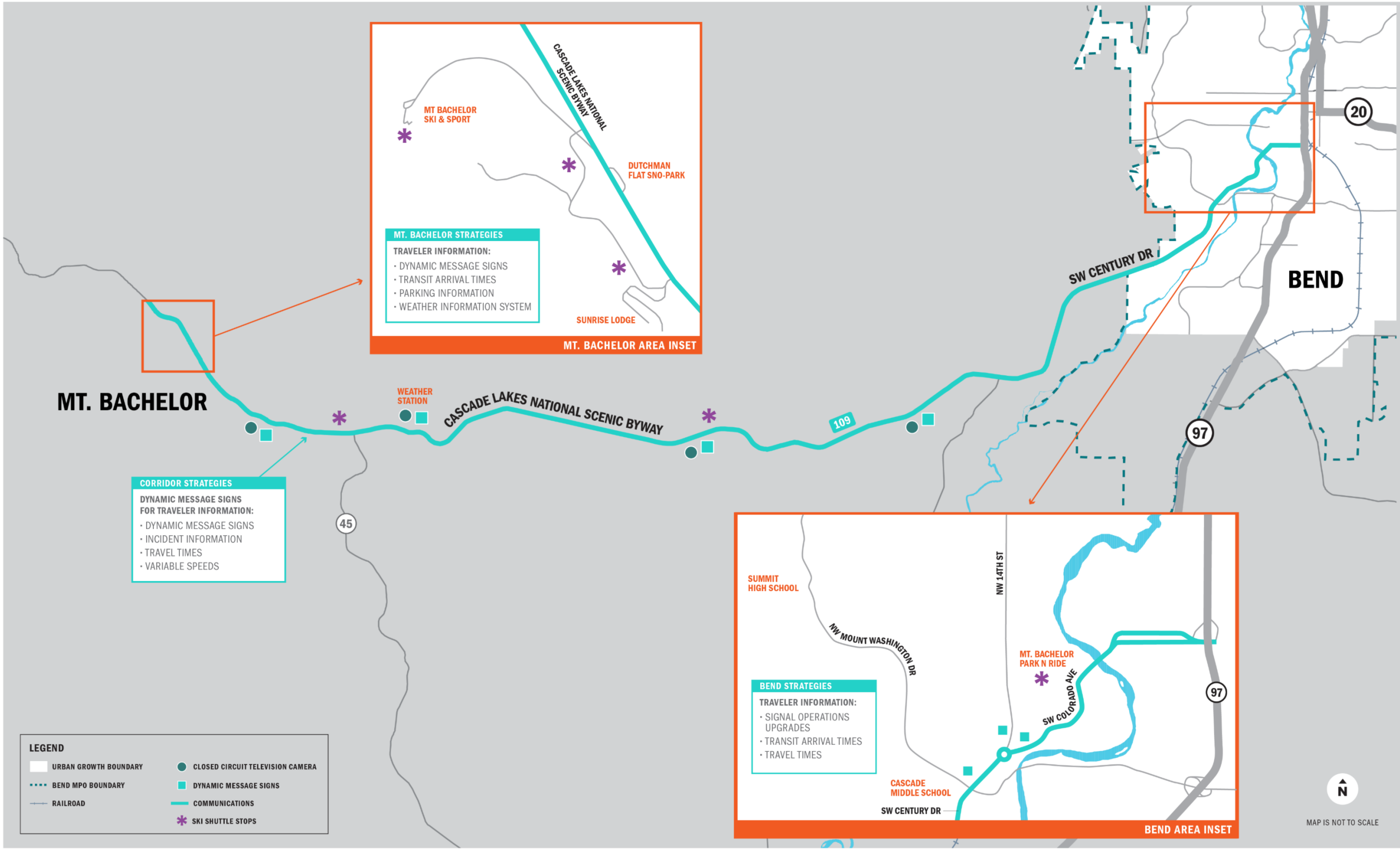
FOR DRAFT – PLEASE SEE SEPARATE EXCEL FILE

FINAL DOCUMENT WILL BE PROVIDED AS A PDF AND INCLUDE THE TABLE PAGES

APPENDIX F – SELECT SAFE & SMART PROJECT CUT SHEETS

The figures shown in this Appendix are two examples of typical Safe & Smart projects. They are representative of the kinds of ITS technologies deployed on Safe & Smart projects and how they may be distributed along a corridor.

Figure 17 depicts Project #109 (Century Drive Safe & Smart Corridor) and Figure 18 depicts Project #102 (US 97 Safe & Smart Corridor).


MT. BACHELOR
BEND
SW CENTURY DR
CASCADE LAKES NATIONAL SCENIC BYWAY
WEATHER STATION
109
45
97
20
CASCADE LAKES NATIONAL SCENIC BYWAY
MT BACHELOR SKI & SPORT
DUTCHMAN FLAT SNO-PARK
SUNRISE LODGE
MT. BACHELOR STRATEGIES
TRAVELER INFORMATION:
• DYNAMIC MESSAGE SIGNS
• TRANSIT ARRIVAL TIMES
• PARKING INFORMATION
• WEATHER INFORMATION SYSTEM
MT. BACHELOR AREA INSET
CORRIDOR STRATEGIES
DYNAMIC MESSAGE SIGNS FOR TRAVELER INFORMATION:
• DYNAMIC MESSAGE SIGNS
• INCIDENT INFORMATION
• TRAVEL TIMES
• VARIABLE SPEEDS
SUMMIT HIGH SCHOOL
NW 14TH ST
NW MOUNT WASHINGTON DR
MT. BACHELOR PARK N RIDE
SW COLORADO AVE
BEND STRATEGIES
TRAVELER INFORMATION:
• SIGNAL OPERATIONS UPGRADES
• TRANSIT ARRIVAL TIMES
• TRAVEL TIMES
CASCADE MIDDLE SCHOOL
SW CENTURY DR
BEND AREA INSET
LEGEND
URBAN GROWTH BOUNDARY
BEND MPO BOUNDARY
RAILROAD
CLOSED CIRCUIT TELEVISION CAMERA
DYNAMIC MESSAGE SIGNS
COMMUNICATIONS
SKI SHUTTLE STOPS
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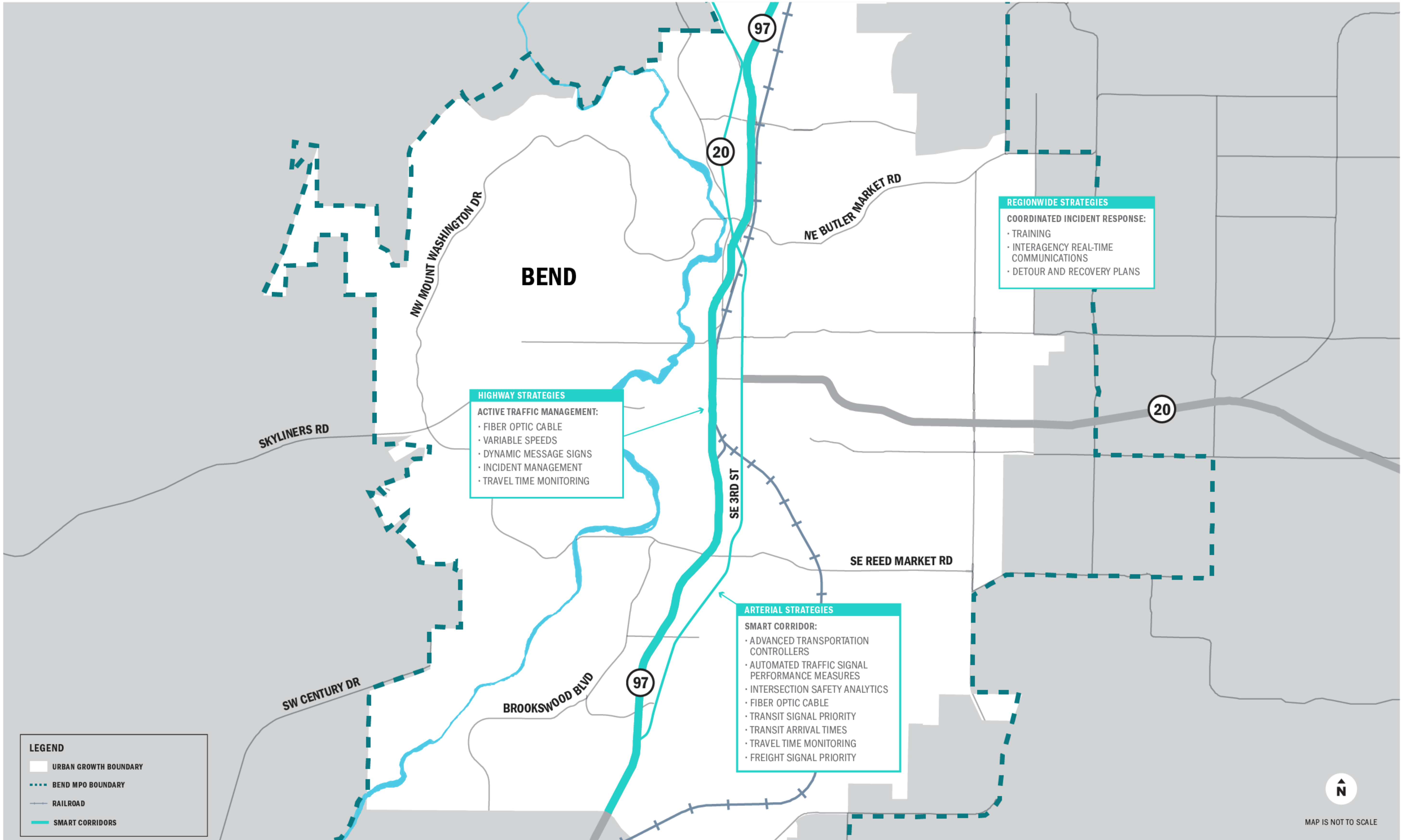
MAP IS NOT TO SCALE


97
20
BEND
NW MOUNT WASHINGTON DR
NE BUTLER MARKET RD
SKYLINERS RD
SE 3RD ST
SE REED MARKET RD
SW CENTURY DR
BROOKSWOOD BLVD
REGIONWIDE STRATEGIES
COORDINATED INCIDENT RESPONSE:
· TRAINING
· INTERAGENCY REAL-TIME COMMUNICATIONS
· DETOUR AND RECOVERY PLANS
HIGHWAY STRATEGIES
ACTIVE TRAFFIC MANAGEMENT:
· FIBER OPTIC CABLE
· VARIABLE SPEEDS
· DYNAMIC MESSAGE SIGNS
· INCIDENT MANAGEMENT
· TRAVEL TIME MONITORING
ARTERIAL STRATEGIES
SMART CORRIDOR:
· ADVANCED TRANSPORTATION CONTROLLERS
· AUTOMATED TRAFFIC SIGNAL PERFORMANCE MEASURES
· INTERSECTION SAFETY ANALYTICS
· FIBER OPTIC CABLE
· TRANSIT SIGNAL PRIORITY
· TRANSIT ARRIVAL TIMES
· TRAVEL TIME MONITORING
· FREIGHT SIGNAL PRIORITY
LEGEND
URBAN GROWTH BOUNDARY
BEND MPO BOUNDARY
RAILROAD
SMART CORRIDORS
N
MAP IS NOT TO SCALE