Technical Memorandum #2

DATE: March 30, 2011

TO: Liz French – City of Sandy
    Sonya Kazan – ODOT

FROM: John Bosket, PE – DKS Associates
       Michael Tomasini, PE – DKS Associates

SUBJECT: City of Sandy TSP Update: Existing Conditions and Future Needs

This memorandum includes updates for Chapters 3 and 4 of the 2008 Sandy Transportation System Plan (TSP). The original intent of these chapters was for them to be equivalent replacements of the city’s current TSP Chapters 3 and 4. Through the City’s TSP update process, it was determined that these chapters would serve the city better if they were placed in the Technical Appendix as a technical memorandum document the development and technical aspects of the TSP update. The Table of Contents below shows the content included in these two former TSP chapters.

Table of Contents

Chapter 3
Overview ........................................................................................................................................ 3
Study Area ..................................................................................................................................... 3
    Surrounding Land Uses ............................................................................................................ 7
Pedestrians ................................................................................................................................... 10
    Pedestrian Facilities ................................................................................................................ 10
    Sidewalk and Crosswalk Conditions ....................................................................................... 10
    Pedestrian Gaps and Connectivity .......................................................................................... 14
    Transit Accessibility ............................................................................................................... 16
    Pedestrian Volumes ............................................................................................................... 16
    Summary ................................................................................................................................. 19
Bicycles ........................................................................................................................................ 21
    Bicycle Facility Types .......................................................................................................... 21
    Bicycle Gaps and Connectivity .............................................................................................. 22
    Bicycle Volumes .................................................................................................................... 23
    Summary ................................................................................................................................. 23
Other Modes ............................................................................................................................... 25
    Air ........................................................................................................................................ 25
    Rail ........................................................................................................................................ 25
    Water ..................................................................................................................................... 25
    Pipeline/ Transmission Line .................................................................................................... 25
    Motor Vehicles ...................................................................................................................... 26
Chapter 3: Existing Conditions

System Description ........................................................................................................ 26
Motor Vehicle Volumes ............................................................................................... 36
Traffic Operations ....................................................................................................... 45
Traffic Safety .............................................................................................................. 49
Summary of Deficiencies ............................................................................................ 54

Chapter 4
Overview .................................................................................................................. 56
Future Travel Demand Forecasting Methodology ..................................................... 56
  Base Year (2008) Model ....................................................................................... 56
  Future Year (2029) Model ................................................................................... 58
  Key Findings ......................................................................................................... 61
Future Traffic Volumes (2029) ............................................................................... 62
  Future Volumes .................................................................................................... 62
  Congestion Duration ............................................................................................ 65
Future Traffic Operations (2029) .......................................................................... 66
  Intersection Operations ....................................................................................... 66
  Queuing Analysis ................................................................................................. 66
  Signal Warrant Analysis ...................................................................................... 68
Summary of Deficiencies ......................................................................................... 69
  Pedestrian System ............................................................................................... 69
  Bicycle System ..................................................................................................... 70
  Motor Vehicle System .......................................................................................... 70
3. Existing Conditions

Overview

This chapter provides an inventory and evaluation of transportation facilities within the City of Sandy Urban Growth Boundary (UGB) under existing conditions (2008).\textsuperscript{1} The identification of system characteristics and needs under existing conditions will provide baseline data for use in forecasting future conditions and will supplement the future needs assessment in Chapter 4. For this analysis, the following modes of travel were considered:

- Pedestrian
- Bicycle
- Motor Vehicle
- Freight
- Air
- Rail
- Water
- Pipelines and Transmission Lines

Note that transit is being addressed through a separate Transit Master Planning process that is being coordinated with the Transportation System Plan (TSP) update.

Study Area

The City of Sandy has a population of just over 8,000 people and is located in Clackamas County at the intersection of US 26 (Mt. Hood Highway) and OR 211 (Eagle Creek Sandy Highway), between Gresham to the west and Mt. Hood to the east (see Figure 3-1). At the base of Mt. Hood, the foothills terrain both adds to the scenic beauty of the city and creates challenges for land and public infrastructure development due to topographic constraints. The combination of the city’s location and environment constrains options to provide an effective transportation network, especially on US 26, which is the primary transportation corridor in the area. Here, US 26 serves a number of roles, providing access to local Sandy businesses and homes, serving as a major

\textsuperscript{1} Transportation inventories were primarily focused on the arterial and collector roadways.
east/west transportation route between the Portland Metro Area, Mt. Hood, and Central Oregon resorts and recreation, and as the City’s “main street” through the downtown couplet. The relationship of the existing roadway network to the City of Sandy UGB and Urban Reserve areas is illustrated in Figure 3-2.

Mt. Hood National Scenic Byway
Part of the roadway system in Sandy has been designated as part of the Mt. Hood National Scenic Byway. This byway follows a scenic route that starts in Troutdale, traverses through Sandy around Mt. Hood, and ends in Hood River. It offers access to three of Oregon’s unique natural wonders: Multnomah Falls, the Columbia River Gorge, and Mt. Hood. Within the city limits the byway runs along Ten Eyck Road, US 26 and Bluff Road, as can be seen in on Figure 3-2.

Environmental Features and Goal 5 Inventory
The layout of a city’s transportation infrastructure is partially dependent upon the surrounding terrain and water features. There are several locations within the City of Sandy where steep slopes (>25%) are present. Water features in and around the city include the Sandy River to the north of the city and Tickle Creek in the southern area of the city. In Figure 3-3, the existing street network and city boundaries are projected on top of environmental feature setbacks, where slopes are greater than 25%, and around water features.

Local jurisdictions are required by Statewide Planning Goal 5 to adopt plans to protect natural resources and conserve scenic and historic areas and open spaces. Fish and wildlife habitats, historic and cultural scenic viewpoints, sites, scenic waterways, and mineral and aggregate sites are among the natural resources that are protected by Goal 5. The State Historic Preservation Office (SHPO) and the Sandy Historical Society have assembled a list of 14 historic buildings in the City of Sandy. The locations of these buildings along with the other Goal 5 resources and environmental features are identified in Figure 3-3.
Figure 3-3
Environmental Features and Goal 5 Inventory

- Perennial Streams and Tickle Creek (top of bank)
- Pond
- Wetlands
- 25 ft setback on slopes > 25% (FSH Metro 1996)
- 25 ft Wetland Setback
- 50 ft Perennial Stream Setback
- 70 ft Tickle Creek Setback

Legend:
- SHPO Site
- Scenic Viewpoint
- 5’ Contour Lines
- Streets
- Park
- City Limits
- Urban Growth Boundary
- Urban Reserve Area

City of Sandy
TRANSPORTATION SYSTEM PLAN

( FEMA and Shapiro 2001)
Surrounding Land Uses

The distribution of existing and future land uses within the City of Sandy has a direct influence on transportation choices and plays a key role in understanding transportation patterns and traffic volumes.

The intersection of US 26 and OR 211 is in the City’s downtown, which is characterized primarily by high-density commercial development with buildings located close to the highway frontages. Through this area, US 26 is divided into a one-way couplet system (westbound travel along Proctor Boulevard and eastbound travel along Pioneer Boulevard) with a posted speed of 25 mph, on-street parking, marked crosswalks, and curb extensions to create a more pedestrian friendly environment.

Moving away from the downtown, land uses along the west US 26 corridor are a combination of commercial and residential, with most developments on relatively small lots. From University Avenue, there is a transition to large-lot highway commercial development that changes to light industrial and agricultural uses west of 362nd Drive.

Development density in the highway corridor east of the downtown is generally lower, with a small amount of commercial development adjacent to US 26 east of Ten Eyck Road that transitions to residential development near Langensand Road. From Vista Loop Drive, area development is generally agricultural and light industrial uses, although the area on the south side of US 26 near the future intersection of US 26 and Dubarko Drive has future development potential.

The majority of the residential lands in the city are located to the north and south of the US 26 corridor and to the east of Langensand Road that will include mixed use housing with limited commercial development to support the surrounding residential neighborhoods and encourage non-automobile modes of travel.

The orientation of land uses within the City UGB is shown in the zoning and comprehensive plan maps in Figures 3-4 and 3-5, respectively. The zoning map identifies current zoning designations, while the comprehensive plan map shows the zoning designations for future development.
Figure 3-5

Comprehensive Plan

Comprehensive Plan
- Village
- Low Density Residential
- Medium Density Residential
- High Density Residential
- Retail/Commercial
- Industrial

Arterials/Collectors
Local Streets
City Limits
Urban Growth Boundary
Parcels
Urban Reserve Area
Pedestrians

The provision of facilities to support and encourage walking trips is a critical element in creating a livable and sustainable community and a transportation system that can adequately serve those who cannot or prefer not to drive. This section outlines the existing pedestrian network for use in identifying improvements for implementation.

Pedestrian Facilities

The assessment of existing pedestrian conditions began with a complete inventory of pedestrian facilities including: sidewalk locations and conditions, signalized and unsignalized crosswalks, accessibility of crosswalks per Americans with Disabilities Act (ADA) design requirements, locations of multi-use and demand trails, access to activity generators (e.g., schools, parks, libraries, post offices, etc.), and transit accessibility. Figure 3-6 displays the existing pedestrian facilities throughout the city in relation to key activity generators.

The downtown area of Sandy is a large activity generator, with many individual attractions for pedestrians. Centered on US 26 between Bluff Road and Ten Eyck Road, the downtown has been designated a Special Transportation Area (STA) by the Oregon Department of Transportation (ODOT) and the City. This designation is applied to downtowns, central business districts, and main streets, and indicates an emphasis on providing accessibility to community activities, businesses, and residences and strives to facilitate pedestrian movement along and across the highway.

Sidewalk and Crosswalk Conditions

Sidewalks

City design standards for sidewalks require a minimum width of five feet on local streets, and a minimum width of six feet on collector and arterial streets. Along state highways, ODOT design standards require minimum sidewalk widths of six feet, with a wider requirement of eight (if separated from the curb by a buffer strip) to ten feet in STAs.

In general, existing sidewalks meet these standards. However, there is a section along the south side of US 26 between University Avenue and Bluff Road where utility poles are located within the sidewalk, resulting in intermittent partial obstructions. This also occurs on the north side of US 26 eastbound (Pioneer Boulevard) through the downtown couplet. However, an improvement project that is planned to be completed by March of 2009 would remove all overhead utility wires and associated poles from the south side of Pioneer Boulevard through the couplet.

---

2 Multi-use trails are formal, surfaced trails intended for most forms of non-motorized use. Demand trails are informal paths, often of dirt surfacing, worn from frequent use. Demand trails may be located across private property and are not identified as a recommended route of travel, but rather to identify a need that may not be adequately met.
Sidewalk curb ramps at marked crosswalks within the city were evaluated for adequate accessibility per ADA design requirements. The evaluation at each location included measurements of: ramp accessibility (horizontal obstructions), ramp and roadway slopes, presence and design of detectable warnings (raised truncated domes), vertical edges between the pavement surface and the bottom of the ramp, and push-button accessibility at signalized crossings.

Curb ramps were generally well-designed where construction was noticeably more recent. This included ramps at marked crosswalks on city streets and through the downtown on US 26. However, in the downtown couplet, there were several ramps missing detectable warning strips, including:

- South side of Proctor Boulevard/ Alt Avenue crosswalk
- South side of Proctor Boulevard/ Strauss Avenue crosswalk
- South side of Pioneer Boulevard/ Beers Avenue crosswalk
- North and south sides of Pioneer Boulevard/ Junker Street crosswalk

Also, the intersections on US 26 at OR 211 have several deficiencies. At US 26 westbound (Proctor Boulevard) and OR 211, the northeast, southeast, and southwest corners do not provide a landing area between the push buttons and the ramps and there are utility poles, fire hydrants, and street signs that limit accessibility of the ramp from the sidewalk. At the intersection of US 26 eastbound (Pioneer Boulevard) and OR 211, the northeast corner has a utility pole between the curb ramp and the push-button.

In addition, the recently striped crosswalks on the west and south approaches of the Hood Street/ Strauss Avenue intersection are adjoined to older sidewalks and ramps that lack detectable warning strips and level landing areas at the back of the ramp.

Outside of the downtown, deficient curb ramp designs are present at intersections on US 26 from Ruben Lane to the west, where construction likely predates ADA design requirements (i.e., 1990). Deficiencies noted included:

**US 26 at Champion Way**
- No detectable warning strips
- Lack of adequate level landing area on outer ramps
- Broken sidewalk and poor sight distance (vegetation) at eastern-most ramp
- Presence of 2-inch lip between road surface and ramp at western island ramp

**US 26 at 362nd Drive**
- Lack of adequate level landing areas on all ramps
- No detectable warning strip on south ramp of the north-south crosswalk
- No curb or sidewalk on the north side of US 26
US 26 at Industrial Way
- No detectable warning strips on the northeast, northwest, or southwest corners
- Presence of 2-inch lip between road surface and ramp at southeast ramp
- Push buttons on northwest and northeast corners are difficult to reach

US 26 at Ruben Lane
- No detectable warning strips
- Lack of adequate level landing areas on most ramps (only southeast corner and eastern island ramp on the southwest corner are adequate)
- Steep ramp grades on southeast and southwest corners
- Severe algebraic difference between ramp slope and roadway slope (tipping hazard) on southeast and southwest corners
- Push buttons are difficult to reach on all corners
- Crosswalks are not directly accessible by ramps on the northwest and northeast corners, requiring travel in the roadway

Crosswalks
As shown in Figure 3-6, most marked crosswalks within the city are located along US 26. However, there are several others (all unsignalized) along Bluff Road, 362nd Ave., Dubarko Road, Ruben Lane, Jewelberry Ave., and Pleasant St. All marked crossings of US 26 are under signal control, with the exception of crosswalks downtown on Pioneer Boulevard near Beers Avenue and Shelley Avenue and on Proctor Boulevard near Beers Avenue, Strauss Avenue, and Alt Avenue.

In general, the distances between crossing opportunities on US 26 are very long. This makes crossings difficult for pedestrians, which creates a barrier effect and can encourage unprotected mid-block crossings. Pedestrians attempting to cross US 26 in the five-lane sections west and east of the downtown are commonly seen using the two-way left turn lane in the median as a refuge.

Many marked crosswalks currently provide enhanced access to transit stops. While the demand for individual stops, as well as stop locations, may be reevaluated as part of the Sandy Transit Master Plan effort, transit stop locations that might benefit from marked crosswalks or other crossing enhancements include:

- US 26 at University Avenue (previously identified in the US 26 Sandy Gateway Plan)\(^3\)
- Bluff Road at Green Mountain Street

---

\(^3\)Any crossing over an ODOT facility needs to be approved by the State Engineer. ODOT typically prefers pedestrian refuges over other types of marked crossings of multi-lane state highways. A grant for the construction of a pedestrian refuge at this location has been awarded to the city.
Pedestrian Gaps and Connectivity

Connectivity by Roadway Functional Classification
Arterials and collectors typically experience the highest motor vehicle volumes and speeds. Therefore, the provision of separate pedestrian facilities along these routes should generally be given priority. While sidewalks should generally be provided on both sides of a roadway, there may be times when it is impractical given the topography or environmental constraints. Alternatively, where funding is limited, sidewalk could be constructed on one side of the roadway only with the long-range goal being to construct sidewalk on the opposite side as funding becomes available. As shown in Figure 3-6, sidewalk coverage throughout much of the city is generally intermittent, but several key gaps are notable, including:

- North side of US 26 from Royal Lane to the west UGB
- South side of US 26 from University Avenue west to Ruben Lane
- US 26 from Ten Eyck Road to the east UGB
- OR 211 from Pioneer Boulevard to the south UGB;
- Bluff Road from Hood Street to the north UGB
- West side of 362nd Drive from Industrial Way to the south UGB
- Industrial Way from 362nd Drive to US 26
- Sandy Heights Street from Bluff Road to Bodley Court (intermittent)

Also shown in Figure 3-6, most local streets have sidewalks on at least one side of the road. Gaps in the sidewalk system on local streets most commonly occur in areas with vacant land or older development or where topographical/environmental constraints exist. Motor vehicle volumes and speeds on local streets are typically lower than on arterials and collectors, so provision of separate pedestrian facilities on local streets is often a lower priority. However, opportunities to fill these gaps should be taken as they arise, particularly where no facilities are available on either side of the road or as part of new development activity.

Poor street connectivity and long block lengths can also deter walking, as they require extensive amounts of out-of-direction travel. The Transportation Planning Rule (TPR)\(^4\) requires that local governments establish standards for street and access spacing to support safe and convenient walking opportunities. City code 17.100.120 states that a 400-foot block spacing should be used in residential and commercial areas. In areas where it is not practical to extend public streets, other options may be possible, such as the creation of access ways and trail easements for non-motorized travel. City code 17.100.120 states that pedestrian and bicycle access way shall be provided through the middle of the block when block lengths exceed 600 feet.

Connectivity around Schools & Activity Generators
Around the high school, there is adequate sidewalk coverage to the west and south, but to the north the sidewalk only extends as far as Marcy Street (approximately 275 feet from the school). In addition, while there are crosswalks on Bluff Road near the north and south

\(^4\) OAR 660-012-0045(3)
entrances to the school, there is little sidewalk available on the west side of the road. Given the amount of existing and potential future residential development to the north, sidewalk infill along Bluff Road, specifically north of the high school, should be constructed to provide a safe walking route to school. The presence of the sports fields on the west side of Bluff Road furthers the need for additional sidewalks in this area.

In the future, the high school will be relocated to the west side of Bluff Road off of Bell Street (approximately 2,000 feet north of the existing high school). The new high school is expected to open in September 2011. When this occurs, there will continue to be a need to extend sidewalk facilities along Bluff Road in order to provide a pedestrian connection between the new school site and the downtown.

Unlike the high school, the elementary and middle schools are set within a residential neighborhood and are surrounded by low-volume, low-speed local streets. Intermittent sidewalks are present on most area streets, with the most notable gaps including:

- Pleasant Avenue between Scales Avenue and Strauss Avenue (north side of the street)
- Pleasant Avenue between Meinig Avenue and Revenue Avenue (north side of the street)
- Meinig Avenue between Scenic Street and Hood Street (west side of the street)

Street crossing treatments have also been installed around the elementary and middle schools, including crosswalks and curb extensions on Pleasant Avenue at Strauss, Alt, and Smith Avenues and on Strauss Avenue at Hood Street.

Many of the deficiencies in connectivity for other activity generators are the same as those for the schools. Most notably, the lack of sidewalks along Bluff Road make accessing the high school sports fields and the Jonsrud Viewpoint difficult and fails to provide a safe walking route from the large residential areas in the north end of the city to the downtown. Also, access to the elementary and middle school sports fields and the skate park could be improved by filling in sidewalk gaps along Meinig Avenue between Scenic Street and Hood Avenue (primarily on the west side of the street).

The Sandy Vista apartments, located on the northwest corner of the US 26/ Vista Loop Drive (west) intersection, are also a source of significant pedestrian activity between the downtown and the east end of the city. Because of the lack of sidewalks on US 26 east of the downtown, pedestrians are forced to walk on the highway shoulders, which can be as narrow as four feet in some areas.
Transit Accessibility

Research has shown that most people are willing to walk as much as ¼ to ½-mile to reach a transit stop. Therefore, to encourage more transit use, safe and convenient pedestrian facilities should be provided within a minimum of ¼-mile of all transit stops within the city. Figure 3-7 shows the relationship between existing pedestrian facilities and transit routes within the city and outlines a ¼-mile buffer around each transit stop. It should be noted that bicyclists are generally willing to ride much farther than ½-mile to reach transit stops. Therefore, where buses are equipped to transport bicycles, adequate bicycling facilities should be provided within one mile of transit stops.

When examining Figure 3-7, it appears that accessibility to transit stops through provision of sidewalks is relatively good citywide. However, it appears accessibility could be improved by constructing additional sidewalks in the key areas below:

- North side of US 26 from Royal Lane to the west UGB
- Industrial Way from 362nd Drive to US 26
- University Avenue from US 26 to Sunset Street
- Bluff Road from Bell Street to the north UGB
- Vista Loop Drive from US 26 to Ortiz Street

Pedestrian Volumes

Weekday peak hour pedestrian volume counts were collected between the hours of 4:00 and 6:00 p.m. at each study intersection to provide an indication of the usage of existing pedestrian facilities. These volumes have been mapped in Figures 3-8a and 3-8b, which shows the observed hourly pedestrian volume on each intersection approach.

---

EXISTING PM PEAK HOUR BICYCLE AND PEDESTRIAN VOLUMES (2008)

Figure 3-8a

LEGEND
- Study Intersection Number (This Page)
- Study Intersection Number (Next Page)
00 - Bike Volume
B - Traffic Signal
00 - Pedestrian Volume in Striped Crosswalk
00 - Pedestrian Volume
EXISTING PM PEAK HOUR BICYCLE AND PEDESTRIAN VOLUMES (2008)
As shown, pedestrian volumes at most study intersections are fairly low, with most activity occurring downtown. Significant activity was also seen around the signalized crossings on US 26 at Industrial Way and Ruben Lane, which are near transit stops. When comparing the pedestrian volumes in Figure 3-8a with the pedestrian facilities map in Figure 3-6, it appears that pedestrian crossings are occurring along US 26 at the intersections of 362nd Drive and Industrial Way at approaches that do not provide crosswalks or protected crossing phases from the traffic signals.

Summary

A number of key deficiencies exist in the pedestrian network throughout the City of Sandy. Below is a summary of these deficiencies to guide identification and prioritization of improvements to enhance the pedestrian network in the future.

- Sidewalks are partially obstructed by utility poles along the south side of US 26 between University Avenue and Bluff Road, and along the north side of Pioneer Boulevard in the couplet.
- At the intersection on US 26 westbound (Proctor Boulevard) with OR 211 (Meining Avenue), the northeast, southeast, and southwest corners have curb ramps with slopes greater than 5% and do not provide a landing area between the push buttons and the ramps. In addition, there are utility poles, fire hydrants, and street signs that limit accessibility of the ramp from the sidewalk.
- At the intersection of US 26 eastbound (Pioneer Boulevard) with OR 211 (Meining Avenue), the northeast corner has a utility pole between the curb ramp and the push-button.
- With the exception of the downtown area, distances between crossing opportunities on US 26 and OR 211 are very long. This makes crossings difficult for pedestrians, which creates a barrier effect and can encourage unprotected mid-block crossings. As a result, pedestrians attempting to cross US 26 outside the couplet area are commonly seen using the two-way left turn lane in the median as a refuge (a potential hazard) and have been documented to cross US 26 at intersection approaches where no signal protection is provided.
- Several key gaps in the sidewalk system were noted:
  - Gaps on the Arterial Street Network
    - North side of US 26 from Royal Lane to the west UGB
    - South side of US 26 from University Avenue west to Ruben Lane
    - US 26 from Ten Eyck Road to the east UGB
    - OR 211 from Pioneer Boulevard to the south UGB;
    - Bluff Road from Hood Street to the north UGB
    - West side of 362nd Drive from Industrial Way to the south UGB
Gaps on the Collector Street Network

- Industrial Way from 362nd Drive to US 26
- Sandy Heights Street from Bluff Road to Bodley Court (intermittent)

Gaps around schools

- Bluff Road from Hood Street to the north UGB
- Pleasant Avenue between Scales Avenue and Strauss Avenue (north side of the street)
- Pleasant Avenue between Meinig Avenue and Revenue Avenue (north side of the street)
- Meinig Avenue between Scenic Street and Hood Street (west side of the street)

Gaps around other activity generators

- Bluff Road from Hood Street to the north UGB
- Meinig Avenue between Scenic Street and Hood Street (west side of the street)

Gaps around transit stops

- North side of US 26 from Royal Lane to the west UGB
- Industrial Way from 362nd Drive to US 26
- University Avenue from US 26 to Sunset Street
- Bluff Road from Bell Street to the north UGB
- Vista Loop Drive from US 26 to Ortiz Street
Bicycles

Bicycle travel is a cost-effective and environmentally beneficial mode of transportation that not only provides personal health benefits, but is an important element of an overall plan to reduce motor vehicle miles traveled. The Transportation Planning Rule requires bicycle modal elements in Transportation System Plans, and requires the City to plan bikeways for all arterials and major collector streets.

Bicycle Facility Types

The Oregon Bicycle and Pedestrian Plan\(^6\) outlines four different types of bikeways, including:

- shared roadways
- shoulder bikeways
- bike lanes
- multi-use paths

A shared roadway is a facility where motorists and bicycles must share a common travel lane. This type of bikeway requires the motorist to either follow bicycles or pass them using an adjacent lane. Shared roadways are generally only recommended where posted traffic speeds are 25 mph or lower and traffic volumes are less than 3,000 vehicles per day. This is a common design on local streets.

A shoulder bikeway is a paved shoulder suitable for bicycle travel that is not specifically designated for bicycle use. For this type of treatment, a paved shoulder width of at least six feet is preferred, but narrower widths to a minimum of four feet may be used in constrained areas. However, on uphill grades, a minimum width of six feet should be provided to accommodate the additional maneuvering area needed. Shoulder bikeways are most commonly seen in rural areas.

To be considered a bike lane, a paved lane must be specifically designated for use by bicycles. This is commonly done through pavement markings, such as the symbol depicting a bicycle with rider. Bike lanes are recommended for urban arterials and major collectors and are occasionally appropriate in rural areas where bike volumes are high. Bike lanes should not be used on roadways with speeds higher than 55 mph. ODOT design standards\(^7\) require minimum bike lane widths of six feet, with widths as low as five feet allowed in STAs and downtown areas. The City of Sandy does not have a minimum width requirement for bike lanes, but typically uses the Oregon Bicycle and Pedestrian Plan as a guide, which recommends a minimum width of six feet.

A multi-use path is a roadway that is separated from motor vehicle facilities and used by bicyclist, pedestrians, and other non-motorized modes of transportation. City design standards require a minimum right of way width for multi-use paths of 15 feet, with at least eight feet of

---

\(^6\) Oregon Bicycle and Pedestrian Plan, Oregon Department of Transportation, adopted June 14, 1995.

\(^7\) Highway Design Manual, Oregon Department of Transportation, 2003.
paved surface provided. Where a significant amount of bicycle use is anticipated, the minimum paved width is increased to 12 feet. In comparison, the Oregon Bicycle and Pedestrian Plan recommends minimum widths of 10 to 12 feet.

**Bicycle Gaps and Connectivity**

**Connectivity by Roadway Functional Classification**

Designated bike lanes or shoulder bikeways should be provided on urban arterials and major collectors. The locations of Sandy’s existing bike lanes and shoulders are shown on Figure 3-9. By examining this figure, key gaps on the arterial and collector roadway network where the addition of bicycle facilities could improve overall connectivity can be identified. These include:

- OR 211 from Proctor Boulevard to the south UGB
- US 26 from Ten Eyck Road to the east UGB (widening to provide a minimum shoulder of six feet)
- West side of 362nd Drive from Industrial Way to the UGB
- Ten Eyck Road from US 26 to the UGB
- Langensand Road from US 26 to the UGB
- Bluff Road from US 26 to Miller Street
- Bornstedt Road from OR 211 to the UGB
- Dubarko Road from 362nd Drive to Eldridge Drive
- Dubarko Road from Sandy Heights Street to Reich Court

Local streets within Sandy have posted speeds of 25 mph and average daily traffic volumes less than 3,000 and can therefore operate effectively as shared roadways.

**Connectivity around Schools, Activity Centers, and Transit**

Roadways adjacent to the high school, middle school, and elementary school are adequately equipped for bicycle travel. Bluff Road provides a continuous designated bike lane near the high school, while other adjacent roadways to the high school and the roadways adjacent to the middle school and elementary school are all suitable for use as shared roadways. While good bicycle connectivity is present within the vicinity of the schools, connectivity from neighborhoods south of US 26 could be significantly improved by filling in some of the gaps identified above.

Much like the schools, the major activity centers in Sandy have routes that are adequately equipped for bicycle travel. While this makes these locations directly accessible from the transportation system, improving citywide bicycle facilities by addressing the gaps previously identified for arterial and collector roadways would enhance accessibility from locations throughout the city.

Finally, all Sandy Area Metro (SAM) and Sandy Transit Area Rides (STAR) buses currently in use are equipped with bike racks, which facilitates combined transit and bicycle travel.
Again, improving citywide bicycle facilities by addressing the gaps identified above would enhance accessibility to transit stops throughout the city.

**Bicycle Volumes**

Weekday p.m. peak hour bicycle volume counts were taken at the study intersections throughout the city, and are displayed previously in Figures 3-8a and 3-8b. While these figures show bicycle volumes to be very low in these locations, it should be recognized that there may be other routes in the city that are preferred by bicyclists. Furthermore, low bicycle volumes under existing conditions should not be considered as an indicator that bicycle system improvements are not needed; improvements would encourage greater bicycle use.

**Summary**

The following is a summary of existing bicycle system deficiencies that can be used as a guide in determining potential future improvements to complete the bicycle network throughout the city.

- There are key gaps in the provision of bicycle facilities on area roadways, including:
  - OR 211 from Proctor Boulevard to the south UGB
  - US 26 from Ten Eyck Road to the east UGB (widening to provide a minimum shoulder of six feet)
  - West side of 362nd Drive from Industrial Way to the UGB
  - Ten Eyck Road from US 26 to the UGB
  - Langensand Road from US 26 to the UGB
  - Bluff Road from US 26 to Miller Street
  - Bornstedt Road from OR 211 to the UGB
  - Dubarko Road from 362nd Drive to Eldridge Drive
  - Dubarko Road from Sandy Heights Street to Reich Court
Other Modes

Other modes of transportation considered as part of the Sandy Transportation System Plan include air, water, rail, and pipeline transport. At the present time, the City of Sandy is not directly served by any of these modes, but residents and businesses can access them from the surrounding region, which would typically require motor vehicle travel.

Air

Regional, national, and international freight and passenger air travel are provided at the Portland International Airport (PDX), located approximately 25 miles west of the city. PDX is accessible via transit by taking SAM to the Gresham Transit Center, transferring to the MAX Blue Line, and transferring again to the MAX Red Line at the Gateway Transit Center.

Private, corporate, and light aircraft transport are also available at the Troutdale Airport (approximately 15 miles west of the city). Furthermore, five small privately-held landing strips (McKinnon Enterprises, Sandy River landing strip, County Squire Airpark, Eagle Nest Ranch, and Krueger) are located within a five-mile radius of the city.

Rail

Regional, national, and international freight and passenger rail service are available for the residents and businesses of Sandy at several locations in the Portland Metro Region. Freight rail services are available from three national carriers (Burlington Northern Santa Fe Railroad, Union Pacific Railroad, and Southern Pacific Railroad), as well as several other short line freight rail companies. Long-haul passenger rail service is available from Amtrak.

Rail services are also available in Hood River, with passenger service provided by Amtrak. Freight rail is also served in the Columbia River gorge, but there are no intermodal facilities of significance in the area for transferring goods.

Water

Regional, national, and international freight water transport is currently available at the Port of Portland. Tourist-oriented passenger water transport service is also available in the Portland Metro Region.

Pipeline/ Transmission Line

Natural gas service is available in the City of Sandy through feeder lines, but no major transmission pipelines for natural gas, oil, or any other commodity are currently available in the city.
Motor Vehicles

Many local trips within Sandy, and most regional trips from, to, and through the city are made via automobile. This assessment of the existing motor vehicle facilities provides a description of the physical roadway network, how it is being managed, and how it is performing under traffic demands in 2008.

System Description

The motor vehicle system within the City of Sandy includes city streets, county roadways, and state highways. The following sections describe the physical characteristics of the existing motor vehicle facilities as well as their designated management objectives.

Functional Classification

A functional classification system categorizes roadways by the nature of service they are intended to provide. Within any city, there are competing travel needs and varying driver expectations throughout the transportation network. Designating the intended functions of roadways allows for proper design and management to achieve travel objectives and provide a balanced transportation system.

The schematic diagram below is useful for illustrating the competing functionalities of roadway facilities as they relate to access, mobility, multi-modal integration, and facility design. For example, as the level of mobility increases (bottom axis), the provision for non-motor vehicle modes (top axis) decreases accordingly. Similarly, as the provision of access is given priority (left axis), the facility design (right axis) dictates slower speeds, narrower travel ways, and non-exclusive facilities. The goal of assigning functional classes for particular roadways is to provide a suitable balance of these four competing objectives.

The diagram shows that as street classifications progress from local to collector to arterial to freeway (top left corner to bottom right corner) the following occurs:

![Figure 3-10: Roadway Functional Classification Characteristics](image_url)
• **Mobility Increases** – These routes become attractive for longer trips between destinations, experience a greater proportion of freight traffic movement, and have a higher proportion of through traffic.

• **Integration of Pedestrian and Bicycle Modes Decreases** – Provisions for adjoining sidewalks and bike facilities are recommended for the local, collector, and arterial classes. However, the frequency of intersection or mid-block crossings for non-motorized vehicles steadily decreases with higher functional classes. As an example, expressway and freeway facilities typically do not allow pedestrian and bike facilities adjacent to the roadway and crossings are often grade-separated to enhance mobility and safety.

• **Access Decreases** – Provisions for parking, loading, and direct land access are reduced. This occurs through application of parking regulations, access control, and access spacing standards (see opposite axis).

• **Facility Design Standards Increase** – Roadway design standards require increasingly wider and faster facilities leading to exclusive travel ways for autos and trucks only. The opposite end of the scale is the most basic two-lane roadway with unpaved shoulders.

The City of Sandy, Clackamas County, and ODOT all maintain their own functional classification systems with management objectives identified for each classification. The existing functional classification of the roadways, as classified by the City of Sandy, is shown in Figure 3-11, with descriptions of each classification provided in Table 3-1.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Arterial</td>
<td>Three to five lane highway, paved width of 54 feet to 80 feet that operates as a two-way or as a one-way couplet. U.S. 26 would be considered as a fully developed major arterial.</td>
</tr>
<tr>
<td>Minor Arterial</td>
<td>High-volume, intra-city street providing connectivity and parallel features, with limited access control and a paved width of 38 feet to 50 feet, minimum of three lane cross section. The most critical classification for circulation in the urban areas.</td>
</tr>
<tr>
<td>Residential Minor Arterial</td>
<td>A hybrid between minor arterial and collector street which allows moderate to high traffic volumes on streets where over 90 percent of the fronting lots are residential. Intended to provide some relief to the strained arterial system while ensuring a safe residential environment. Paved width of 38 feet to 50 feet, minimum three lane cross section, may include on-street parking.</td>
</tr>
<tr>
<td>Industrial Collector</td>
<td>Minimum of 48 feet paved width with one travel lane and one parking lane in each direction, carries truck traffic in industrial areas.</td>
</tr>
<tr>
<td>Collector</td>
<td>Connector of local street to minor and major arterials, side street of Central Business District, minimum paved width of 36 feet, provides on-street parking.</td>
</tr>
</tbody>
</table>
Figure 3-11

Existing Roadway Functional Classifications

Roadway Functional Classification
- Red: Major Arterial
- Blue: Minor Arterial
- Green: Residential Minor Arterial
- Orange: Collector
- Black: Local Streets
- Light Blue: County Arterial/Collectors
- Clear: Parcels
- Yellow: Urban Reserve Area
- Orange: City Limits
- Purple: Urban Growth Boundary

City of Sandy
TRANSPORTATION SYSTEM PLAN

0 500 1,000 2,000 3,000 4,000 5,000
0 1,000 2,000 3,000 4,000 5,000

Feet

N
Clackamas County’s Rural Functional Classification differs slightly from the City of Sandy’s functional classification plan. The Clackamas County functional classification hierarchy is described in Table 3-2 below.\(^8\)

When comparing the County’s functional classification map to the City’s (Figure 3-11) for major County roadways feeding the City, such as 362\(^{nd}\) Drive, Bornstedt Road, Langensand Road, Ten Eyck Road, Bluff Road, and Kelso Road, it appears that management objectives between these jurisdictions align relatively well. The only notable differences are seen in the designations of Bornstedt Road and Langensand Road, where the City has classified them as minor arterials, but the County has classified them as a collector and local street, respectively. As the sections of these roadways outside of the UGB are annexed into the city in the future, it is likely that improvements will be necessary to meet City design standards for the appropriate functional classification.

<table>
<thead>
<tr>
<th>Classification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeway/Expressway</td>
<td>Serves interregional and intraregional trips. Carries heavy volume at high speed.</td>
</tr>
<tr>
<td>Major Arterial</td>
<td>Carries local and through traffic to and from destinations outside local communities and connects cities and rural centers. Moderate to heavy volume; moderate to high speed.</td>
</tr>
<tr>
<td>Minor Arterial</td>
<td>Connects collectors to higher order roadways. Carries moderate volume at moderate speed.</td>
</tr>
<tr>
<td>Collector</td>
<td>Principle carrier within neighborhoods or single land use areas. Links neighborhoods with major activity centers, other neighborhoods, and arterials. Generally not for through traffic. Low to moderate volume; low to moderate speed. New collectors should intersect minor arterials rather than major arterials.</td>
</tr>
<tr>
<td>Connector</td>
<td>Collects traffic from and distributes traffic to local streets within neighborhoods or industrial districts. Usually longer than local streets. Low traffic volumes and speeds. Primarily serves access and local circulation functions. Not for through traffic. Traffic calming measures may be appropriate. A connector should connect to a collector or minor arterial.</td>
</tr>
<tr>
<td>Local</td>
<td>Provides access to abutting property and connects to higher order roads. New local roads should intersect collectors, connectors, or, if necessary, minor arterials. Traffic calming measures may be appropriate. Not for through traffic.</td>
</tr>
<tr>
<td>Alley</td>
<td>May be public or private, to provide access to the rear of property. Alleys should intersect local roads or connectors. Not for through traffic.</td>
</tr>
</tbody>
</table>

ODOT has classified US 26 as a Statewide Highway. The management objectives for such facilities are typically to provide inter-urban and inter-regional mobility and provide connections to larger urban areas, ports, and major recreation areas that are not directly served by Interstate Highways. In doing so, the intent is to provide for safe and efficient, high-speed, continuous-flow operation.

---

\(^8\) Clackamas County Comprehensive Plan, Chapter 5
US 26 is designated as part of the National Highway System, a state Freight Route, and a federal Truck Route. Furthermore, it is designated as an Expressway by ODOT from 362nd Drive west. The city has expressed a desire to re-evaluate the Expressway designation for US 26 west of 362nd Avenue. These additional designations and their associated management objectives further emphasize a need to prioritize transportation mobility.

In contrast to this, the downtown area encompassing the US 26 couplet of Pioneer and Proctor Boulevards has been designated a Special Transportation Area (STA). In STAs, the primary objective is to provide access to community activities, businesses, and residences and to accommodate pedestrian movement along and across the highway. Public street connections and on-street parking are encouraged and local auto, pedestrian, bicycle, and transit movements to the business district or community center is generally as important as through movement of traffic.

ODOT classifies OR 211 as a District Highway, with an intended function of providing a link between small urban areas and serving local traffic. OR 211 is not designated a state Freight Route or federal Truck Route. The management objective is to provide for safe and efficient, moderate to low-speed operation in urban areas. The City’s adopted Bornstedt Village Plan includes a cross section for OR 211 between Arletha and Bornstedt Roads with two travel lanes and a raised median with left turn bays. The City and ODOT have refined the design to address ODOT Highway Design Manual specifications.

The management objectives associated with the classifications for US 26 and OR 211 assigned by ODOT are consistent with the major arterial classifications assigned by the City.

<table>
<thead>
<tr>
<th>Street Name</th>
<th>Functional Classification</th>
<th>Agency</th>
<th>Number of Travel Lanes</th>
</tr>
</thead>
<tbody>
<tr>
<td>US 26</td>
<td>Major Arterial</td>
<td>State</td>
<td>4/5</td>
</tr>
<tr>
<td>Pioneer Boulevard (US 26)</td>
<td>Major Arterial</td>
<td>City/State*</td>
<td>2</td>
</tr>
<tr>
<td>Proctor Boulevard (US 26)</td>
<td>Major Arterial</td>
<td>City/State*</td>
<td>2</td>
</tr>
<tr>
<td>OR 211</td>
<td>Major Arterial</td>
<td>State</td>
<td>2</td>
</tr>
<tr>
<td>Kelso Road</td>
<td>Minor Arterial</td>
<td>County</td>
<td>2</td>
</tr>
<tr>
<td>362nd Drive</td>
<td>Minor Arterial</td>
<td>City/County</td>
<td>2/3</td>
</tr>
<tr>
<td>Bornstedt Road</td>
<td>Minor Arterial</td>
<td>City/County</td>
<td>2</td>
</tr>
<tr>
<td>Bluff Road</td>
<td>Minor Arterial</td>
<td>City</td>
<td>2</td>
</tr>
<tr>
<td>Ten Eyck Road</td>
<td>Minor Arterial</td>
<td>County</td>
<td>2</td>
</tr>
<tr>
<td>Langensand Road</td>
<td>Minor Arterial</td>
<td>City/County</td>
<td>2</td>
</tr>
<tr>
<td>Dubarko Road</td>
<td>Residential Minor Arterial</td>
<td>City</td>
<td>2</td>
</tr>
<tr>
<td>Industrial Way</td>
<td>Collector</td>
<td>City</td>
<td>2</td>
</tr>
<tr>
<td>Bell Street</td>
<td>Minor Arterial</td>
<td>City</td>
<td>2</td>
</tr>
<tr>
<td>Jewelberry Avenue</td>
<td>Collector</td>
<td>City</td>
<td>2</td>
</tr>
<tr>
<td>Sunset Street</td>
<td>Collector</td>
<td>City</td>
<td>2</td>
</tr>
<tr>
<td>Sandy Heights Road</td>
<td>Collector</td>
<td>City</td>
<td>2</td>
</tr>
<tr>
<td>Meining Avenue</td>
<td>Collector</td>
<td>City</td>
<td>2</td>
</tr>
<tr>
<td>Tupper Road</td>
<td>Collector</td>
<td>City</td>
<td>2</td>
</tr>
<tr>
<td>Jacoby Road</td>
<td>Collector</td>
<td>City</td>
<td>2</td>
</tr>
<tr>
<td>Wolf Drive</td>
<td>Collector</td>
<td>City</td>
<td>2</td>
</tr>
<tr>
<td>Towle Drive</td>
<td>Collector</td>
<td>City</td>
<td>2</td>
</tr>
<tr>
<td>Davis Street</td>
<td>Collector</td>
<td>City</td>
<td>2</td>
</tr>
<tr>
<td>Van Fleet Avenue</td>
<td>Collector</td>
<td>City</td>
<td>2</td>
</tr>
</tbody>
</table>

* ODOT and the City of Sandy have entered into a formal agreement (No. 21319) outlining authorities over improvement, operation, and maintenance of US 26 between Bluff Road and Ten Eyck Road.
Table 3-3 provides an inventory of all arterials and collectors within the city, showing the agency of jurisdiction and the existing number of travel lanes. In general, minor arterials within the city have not been constructed in accordance with the functional classification description, which required a three-lane cross-section.

Roadway Characteristics
Field inventories were conducted to record the characteristics of major roadways in the City of Sandy. The data collected included posted speed limits, intersection traffic controls, lane geometries and configurations, roadway cross sections, and the presence of on-street parking. These characteristics can be used to define roadway capacities and operating speeds and indicate whether roadways are currently designed and managed in accordance with functional classifications.

The inventory of posted speeds and intersection traffic controls throughout the City of Sandy is shown in Figure 3-12. As shown, the majority of the streets in Sandy are posted at 25 mph. Arterial roadways, such as US 26, OR 211, 362nd Drive, and Bluff Road are posted at higher speeds, generally between 35 and 55 mph. All traffic signals within the City of Sandy are along US 26 and are under ODOT jurisdiction. Traffic controls and lane configurations present at selected study intersections throughout the city are provided in the Motor Vehicle Volumes section of this chapter (see Figures 3-16a and 3-16b).

In general, parking is allowed on city streets where the existing right-of-way and cross-section can accommodate parked cars unless specifically prohibited through signing or curb markings, which is done on a case-by-case basis where parking activity has been determined to be undesirable for safety or operational reasons. The frequency of on-street parking is often determined by the presence of nearby attractions and availability of adequate pavement width.

On-street parallel parking is available on the south side of US 26 between Industrial Way and Kate Schmitz Avenue, as well as between University Avenue and approximately 100 feet west of Bluff Road. These areas are not designated for parking, but cars often park on the shoulder where there is adequate width. Marked on-street parking is also generally available along both Pioneer and Proctor Boulevards between Bluff Road and Ten Eyck Road. One-way streets between Proctor and Pioneer, such as Strauss Avenue, Revenue Avenue and Hoffman Avenue, have either marked angle or parallel parking spaces. Streets outside of the downtown area, such as Dubarko Road, Sandy Heights, and Bluff Road, currently have enough width in some segments to accommodate on-street parking. Once Bluff Road north of US 26 is developed to its ultimate cross-section on-street parking will be eliminated.
Figure 3-12

Existing Speed Limits and Traffic Controls

Existing Posted Speeds
- 55 MPH
- 45 MPH
- 40 MPH
- 35 MPH
- 25 MPH

Intersection Control
- Traffic Signals
- All-Way Stop Controlled

Arterials/Collectors (25 MPH unless otherwise shown)
Parcels
City Limits
Urban Growth Boundary
Urban Reserve Area
Access Management

Access Management is a broad set of techniques that balance the need to provide efficient, safe, and timely travel with the ability to allow access to individual destinations. Proper implementation of access management techniques will promote reduced congestion, reduced accident rates, less need for additional highway capacity, conservation of energy, and reduced air pollution.

The City of Sandy, Clackamas County, and ODOT all have adopted access spacing standards. The City of Sandy standards require a minimum of 150 feet between access points on arterials and collectors. Direct access to arterial or collector streets is prohibited if an alternative exists. Shared access points to the collector or arterial streets are required when no alternative access exists. The City also maintains a preferred block length maximum of 400 feet.

Access spacing on many streets within the city does not comply with adopted standards. However, it should be pointed out that in most cases the access spacing on Bluff Road, Dubarko Road, and other minor arterials was established prior to the adoption of spacing standards.

Clackamas County has access spacing guidelines in their Roadway Standards that recommend distances between public streets and driveways of 1,000 feet on major arterials, 600 feet on minor arterials, and 150 feet on collectors (no requirement on local roads).

The ODOT access management standards, as defined in the 1999 Oregon Highway Plan\(^9\) and OAR 734-051 call for minimum distances between access points on the same side of the highway. The standards vary depending on the highway classification and the posted speed as shown in Table 3-4.

<table>
<thead>
<tr>
<th>Facility</th>
<th>Segment</th>
<th>Highway Classification</th>
<th>STA</th>
<th>Posted Speed Limit (mph)</th>
<th>Minimum Access Spacing Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>US 26</td>
<td>19.96 to 22.66</td>
<td>Statewide Expressway</td>
<td>55</td>
<td>2,640 ft *</td>
<td></td>
</tr>
<tr>
<td></td>
<td>22.66 to 23.31</td>
<td>Statewide</td>
<td>45</td>
<td>990 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td>23.31 to 23.81</td>
<td>Statewide</td>
<td>40</td>
<td>990 ft</td>
<td></td>
</tr>
<tr>
<td>Eastbound</td>
<td>23.81 to 24.66</td>
<td>Statewide</td>
<td>Yes</td>
<td>25</td>
<td>**</td>
</tr>
<tr>
<td>Westbound</td>
<td>23.87W to 24.63</td>
<td>Statewide</td>
<td>Yes</td>
<td>25</td>
<td>**</td>
</tr>
<tr>
<td></td>
<td>24.66 to 25.33</td>
<td>Statewide</td>
<td>40</td>
<td>990 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td>25.33 to 38.71</td>
<td>Statewide</td>
<td>55</td>
<td>1,320 ft</td>
<td></td>
</tr>
<tr>
<td>OR 211</td>
<td>5.94 to 5.88</td>
<td>District</td>
<td>25</td>
<td>350 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.88 to 5.62</td>
<td>District</td>
<td>40</td>
<td>500 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.62 to 4.63</td>
<td>District</td>
<td>45</td>
<td>500 ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.63 to 1.30</td>
<td>District</td>
<td>55</td>
<td>700 ft</td>
<td></td>
</tr>
</tbody>
</table>

*Private access on Expressways is discouraged.

** Minimum access management spacing for public road approaches is the existing city block spacing or the city block spacing as identified in the local comprehensive plan. Public road connections are preferred over private driveways and in STAs driveways are discouraged. However, where driveways are allowed and where land use patterns permit, the minimum access management spacing for driveways is 175 feet (55 meters) or mid-block if the current city block is less than 350 feet (110 meters).

Under existing conditions, access spacing on most segments of US 26 does not meet ODOT standards. However, east of the downtown where there is less urban development and fewer highway commercial developments, the access density is considerably lower. On OR 211, access spacing is relatively good, with few driveways or public street intersections between US 26 and Bornstedt Road. The City’s Bornstedt Village Plan calls for public street connections, rather than private driveways, on the south side of OR 211 within the plan area.

To balance the need between access and mobility concerns, ODOT has the option to acquire access control along their facilities. ODOT has previously acquired access control along US 26 from near Orient Drive to Bluff Road and from Ten Eyck Road to near Luzon Lane. Where access control exists, no right of access between the property and the highway remains, as it may have been acquired or eliminated by law. Where no right of access is present, an application for an approach permit cannot be accepted.

Reservations of access represent specific locations where access rights remain, include maximum approach widths allowed, and sometimes include use restrictions. A reservation of access affords the property owner the right to apply for an approach permit, which is reviewed under current ODOT access management regulations (OAR 734-051) but does not guarantee ODOT approval for a driveway at that location for the proposed use of the property. Existing reservations of access can be relocated or slightly modified upon approval from ODOT through a process called an “indenture of access.”

Emergency Routes
The designation of emergency routes is not a required element of a TSP, but is a common practice by first responders to identify critical response routes to destinations throughout the city. Where such routes have been designated, it is important for them to be recognized in the TSP to ensure management objectives do not conflict with emergency vehicle access and efficient travel.

Through discussions with the Sandy Fire Department, there are not currently any specific emergency routes designated through the city. However, first responders typically use the city’s arterial and collector network to reach their destinations.

Pavement Conditions
The City of Sandy maintains records of the pavement condition on all roads under their jurisdiction as part of their ongoing Pavement Management System (PMS). Pavement conditions are rated in a Pavement Condition Index (PCI), where ratings of 0 to 24 are considered “Poor”, 25 to 49 are considered “Fair”, 50 to 69 are considered “Satisfactory”, and 70 to 100 are considered “Good”. Data on pavement conditions is collected by the City and data for US 26 and OR 211 is provided by ODOT. Figure 3-13 shows the PCI ratings for all streets in the city. In general, most of the City streets are in “Good” condition, with pavement on US 26 rated as “Satisfactory”. However, there are three sections of roadway within the city that are considered to be in poor condition: OR 211, Tupper Road north of Sandy Heights Street, and Vista Loop Drive.
Motor Vehicle Volumes

Obtaining and analyzing data describing motor vehicle volumes throughout the city provides an understanding of how the transportation system is being used and whether or not it is adequately serving demand. This section characterizes past and present motor vehicle demands that will be one of the keys to identifying system deficiencies.

Data Collection
To assess area travel patterns, motor vehicle volume data was collected from a variety of sources. Data has been obtained from two Automatic Traffic Recorder (ATR) stations along US 26 that continuously record information related to motor vehicle types and volumes for every hour of the year: the first ATR is located in Gresham (ATR 26-003), approximately 8 miles west of Sandy; the second ATR is located in Rhododendron (03-006), approximately 18 miles east of Sandy.

This data was supplemented with historic 24-hour directional counts on area roadways obtained from ODOT and Clackamas County databases, as well as new 24-hour counts taken at select locations throughout the city.

Finally, manual turn movement counts were collected for study area intersections. Along US 26, counts were collected during the first week of January 2006 on a Friday afternoon between 3:00 and 6:00 p.m., which is reported to be the typical peak period of traffic through the City. An average annual growth rate of 2.5% per year, which has been used for other recent transportation studies, was applied to these counts to reflect traffic volumes for the year 2008. For other study intersections, including those along OR 211, manual counts were collected on an average weekday in May 2008 between 4:00 and 6:00 p.m.

Seasonal Traffic Trends
Because ODOT mobility standards are based on the 30th highest annual hour of traffic volumes (30 HV) experienced within the year, seasonal factors were applied to the January (US 26) and May (OR 211) counts for the year 2008 to better represent volumes seen during that time. To determine when the 30th highest annual hour occurs, data was examined from the two ATR stations to calculate a factor for traffic along US 26. Because there are no ATR stations directly on OR 211, ODOT’s ATR Characteristics Table was used to calculate a factor for that corridor.

Since the ATR stations on US 26 are constantly collecting data year-round, they can be used to assess how traffic volumes change throughout the course of the year. Figure 3-14 provides profiles of traffic volumes from the Gresham and Rhododendron ATR stations through the year 2007. The Gresham ATR shows peak travel occurring in the months of July and August, with seasonal variations no greater than 13% during any month of the year, which is typical of commuter-based travel. However, while the Rhododendron ATR also shows peak travel occurring in July, seasonal variations throughout the year reached nearly 75% during some months, which is common in corridors characterized by recreation-based travel.
While both commuter-based and recreation-based trips are common along US 26, the proximity to the Metro area, developed land within Sandy, and major area roadways (e.g., OR 212, OR 211, Bluff Road, Orient Drive, and Ten Eyck Road), affects the influence of different trip types on travel characteristics. As such, the segment of US 26 west of the downtown is strongly influenced by commuter-based trips. Therefore, a seasonal factor of 1.13, derived from the Gresham ATR, was applied to the January counts to replicate 30th highest hour volumes that occur in July and August.

Because the segment of US 26 east of the downtown is more heavily influenced by recreation-based trips than travel occurring at the Gresham ATR, but still more heavily influenced by commuter-based trips than travel occurring at the Rhododendron ATR, the seasonal factor of 1.23 for this area was derived by averaging the data from both ATRs.

The 30 HV for OR 211 was determined by using an ATR station with similar characteristics from ODOT’s ATR Characteristics Table. Using this methodology, the ATR station at Modoc Point (18-022) was selected, resulting in a seasonal factor of 1.23.

In selecting an analysis time period for City intersections, it was decided that using an average weekday during the school year was more appropriate than using the 30 HV. Therefore, no factoring was applied to the May traffic counts obtained.
Daily Traffic Volumes and Historical Growth
Figure 3-15 displays select count locations throughout the city and shows how traffic volumes have grown since 1994, which represents the “existing conditions” year from the previous Sandy TSP. Due to the availability of data, the locations used to determine traffic growth are primarily on state highways and county roads. On average, traffic volumes throughout the city have grown approximately 2.5% per year.

It can also be seen that traffic volumes are significantly higher along US 26 than on any other corridor in the city. However, as discussed later (see US 26 Through-Travel), most of this traffic is considered to be “through” traffic, with no intention of stopping anywhere within the city. Also, the arterials of OR 211, Bluff Road, 362nd Drive, Dubarko Road, and Ten Eyck Road experience the highest traffic volumes, with relatively low volumes occurring on other streets. In all cases, traffic volumes appear to be consistent with the functional classifications assigned.

It was also noticed through analysis of the 24-hour directional counts that significant peaks in traffic volume occur during the morning period between 7:00 a.m. and 8:00 a.m. on Bluff Road north of Hood Street and on Pleasant Street between Strauss Avenue and Alt Avenue. These peaks are likely the result of activity associated with the schools.

Weekday PM Peak Hour Volumes
As previously described, manual turn movement counts were collected for study area intersections during weekday p.m. peak periods. Along the highway corridors of US 26 and OR 211, seasonal factors were applied to represent the 30th highest hour of traffic volumes in the year. Counts taken on City streets were not factored and represent a typical spring weekday p.m. peak hour. The final traffic volumes developed for the study intersections, which were used in the operations analysis to determine system deficiencies, are displayed in Figures 3-16a and 3-16b.
Figure 3-15

Historic Growth & 24-Hour Count Volumes

City of Sandy
TRANSPORTATION SYSTEM PLAN

<table>
<thead>
<tr>
<th>2007</th>
<th>1994</th>
<th>Percent of Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>3700</td>
<td>30,900</td>
<td>2.4%</td>
</tr>
<tr>
<td>26,900</td>
<td>23,500</td>
<td>2.4%</td>
</tr>
<tr>
<td>26,600</td>
<td>23,800</td>
<td>2.7%</td>
</tr>
<tr>
<td>23,400</td>
<td>22,000</td>
<td>1.6%</td>
</tr>
<tr>
<td>20,400</td>
<td>19,100</td>
<td>1.7%</td>
</tr>
<tr>
<td>13,500</td>
<td>12,900</td>
<td>0.5%</td>
</tr>
<tr>
<td>12,000</td>
<td>11,500</td>
<td>0.4%</td>
</tr>
<tr>
<td>10,400</td>
<td>9,700</td>
<td>7.2%</td>
</tr>
<tr>
<td>8,300</td>
<td>7,700</td>
<td>6.5%</td>
</tr>
<tr>
<td>2,800</td>
<td>2,580</td>
<td>1.2%</td>
</tr>
<tr>
<td>4,800</td>
<td>4,000</td>
<td>2.0%</td>
</tr>
<tr>
<td>3,100</td>
<td>2,700</td>
<td>1.5%</td>
</tr>
<tr>
<td>4,600</td>
<td>3,700</td>
<td>2.4%</td>
</tr>
</tbody>
</table>

Legend:
- Blue: 24-Hour Volume Count (2007)
- Golden: 24-Hour Volume Count (1994)
- Percent of Increase
Figure 3-16b
EXISTING PM PEAK HOUR TRAFFIC VOLUME COUNTS
2008 UPDATE
US 26 Through-Travel

To better understand the nature of trip-making along US 26 through Sandy, an origin-destination (OD) study was performed to assess the number of trips being made during the 30 HV\(^{10}\) that were associated with activities within the city compared to those that are merely passing through. This was accomplished by setting up synchronized video recording stations on US 26 at Orient Drive (west of the city) and at Luzon Lane (east of the city), along with license plate recognition software to identify vehicles passing through each station and to determine the amount of time taken by each vehicle to travel from one station to the next.

The data provided by this survey allows for differentiation between three distinct trip types that comprise the traffic stream on this highway. The three types of trips, which are categorized based on whether their origin and/or destination are internal or external to the study area (i.e., the Sandy UGB), are as follows:

- **Internal-Internal trips**: These trips begin and end within the Sandy UGB and, therefore, would not be recorded at the video stations.

- **Internal-External and External-Internal trips**: These include trips with either an origin or destination in Sandy, with the opposite trip end in a location outside the Sandy UGB. This includes all trips that are ultimately passing through the city, but stop for gas, food, or other services.

- **External-External trips**: This includes trips that do not have an origin or destination in the city. In other words, these are purely “through trips” that do not stop in Sandy.

Trips recorded at both stations were grouped together in 15-minute increments, based on the total amount of time elapsed from when they were recorded at the entry station, and then again at the exit station. For the purposes of this study, external-external type trips (which are assumed to make no stops within the city) were considered to take 15 minutes or less. Trips that last longer were considered to be either an external-internal trip or an internal-external trip, because the person making the trip most likely stopped to do something in the city before leaving.

Table 3-5 shows the number of through vehicles recorded in each direction of travel on US 26, as well as the percentage of the total volume. As can be seen in the table below, most through trips were able to pass entirely through the city within 15 minutes. It is also shown that during this time period, approximately one-third of the trips entering the city on US 26 are traveling through, whether an intermediate stop is made or not.

Of course, it should be recognized that some stops within the city could take longer than one hour and that there are some trips entering from US 26 that leave the city through another route, such as OR 211 or Bluff Road, and such trips would not be reflected in this limited survey.

---

\(^{10}\) The survey was conducted on Friday August 8, 2008, between 4:00 and 5:00 p.m.
### Table 3-5: Through-Trip Characteristics on US 26

<table>
<thead>
<tr>
<th>Time Interval</th>
<th>Eastbound US 26 at Orient drive</th>
<th>Westbound US 26 at Luzon Lane</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Through Trips</td>
<td>Percent of Total Trips</td>
</tr>
<tr>
<td>&lt; 15 min.</td>
<td>333</td>
<td>21%</td>
</tr>
<tr>
<td>15 to 30 min.</td>
<td>67</td>
<td>4%</td>
</tr>
<tr>
<td>30 to 60 min.</td>
<td>18</td>
<td>1%</td>
</tr>
<tr>
<td>Total</td>
<td>418</td>
<td>26%</td>
</tr>
</tbody>
</table>

**Truck Freight**

US 26 is classified as a Statewide Highway on the National Highway System with additional designations as a State Freight Route and Federal Truck Route along its entire length. The ODOT Motor Carrier Transportation Division has designated US 26 through the city as a route that allows over-dimension loads, including those of widths up to 14 feet. Trucks with triple-trailers are allowed to continuously operate along US 26 between Portland and Sandy and are allowed to operate under holiday restrictions between Sandy and Government Camp. There are no bridges with additional weight or width restrictions along US 26 in or around Sandy.

OR 211 has no state or national freight route or truck route classification, and the typical restrictions for height, width, and weight apply to all heavy vehicles using this highway. There are no bridges with additional weight or width restrictions along OR 211 in or around Sandy.

There are no other roadways within the city that have been specifically designated for truck use.

Figure 3-17 shows the corridors within the city where heavy vehicle traffic was recorded during the weekday p.m. peak hour. As can be seen in the figure, the majority of the heavy vehicle traffic was recorded on US 26, which is consistent with the State Freight Route and Federal Truck Route designations. Lesser volumes of heavy vehicle traffic were also recorded along other routes, such as 362nd Drive, Bluff Road, OR 211, and Industrial Way. However, on most city streets, truck traffic is fairly low.
Figure 3-17
Heavy Vehicle Volumes
Weekday PM Peak Hour

City of Sandy
TRANSPORTATION SYSTEM PLAN

- Parcels
- Arterials/Collectors
- Local Streets
- City Limits
- Urban Growth Boundary
- Urban Reserve Area
Traffic Operations

To determine the quality of motor vehicle traffic operations within the City of Sandy, the previously noted data describing the transportation system design and usage was analyzed to determine the performance of key study intersections.

Measures of Effectiveness

Level of service (LOS) is used as a measure of effectiveness for the operation of both signalized and unsignalized intersections. It is similar to a “report card” rating and is based upon average vehicle delay. Level of service A, B, and C indicate conditions where vehicles can move freely. Level of service D and E are progressively worse. Level of service F represents conditions where drivers experience very long delays, often resulting in long queues at intersection approaches. Table 3-6 shows a summary of the level of service ratings as they relate to delay, as identified in the 2000 Highway Capacity Manual.11

<table>
<thead>
<tr>
<th>Level of Service</th>
<th>Signalized Intersection Delay (sec)</th>
<th>Unsignalized Intersection Delay (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&lt; 10</td>
<td>&lt;10</td>
</tr>
<tr>
<td>B</td>
<td>10-20</td>
<td>10-15</td>
</tr>
<tr>
<td>C</td>
<td>20-35</td>
<td>15-25</td>
</tr>
<tr>
<td>D</td>
<td>35-55</td>
<td>25-35</td>
</tr>
<tr>
<td>E</td>
<td>55-80</td>
<td>35-50</td>
</tr>
<tr>
<td>F</td>
<td>&gt;80</td>
<td>&gt;50</td>
</tr>
</tbody>
</table>

Volume to capacity ratios (v/c ratios) are another commonly used means of describing intersection operations. Volume to capacity ratios are comparisons of the actual volume using the intersection (or a particular movement) to the maximum volume that could be served. A v/c ratio greater than 1.0 indicates there is more demand for the intersection than it can adequately serve, which often results in long queues at the approaches.

Mobility Standards

The City of Sandy TSP establishes a mobility standard of LOS D for signalized, as well as unsignalized intersections. Therefore, any intersections found to be operating at LOS E or F would be considered “failing” and in need of mitigation.

The 1999 Oregon Highway Plan (OHP) has established mobility standards based on v/c ratios. The OHP specifies v/c thresholds for each highway classification, reflecting the management objectives for that type of facility. These standards vary with posted speeds and proximity to urban areas. There is also a provision for highways within Special Transportation Areas, such as the US 26 Pioneer-Proctor downtown couplet.

The applicable mobility standard for each intersection is shown in Table 3-7.

---

Intersection Operations
Analysis of existing conditions at study intersections was performed using Synchro, which utilizes the level of service and volume to capacity ratio analysis methodologies outlined in the 2000 Highway Capacity Manual. The analysis was performed using the existing p.m. peak hour volumes, lane configurations, and traffic controls shown in Figures 3-16a and 3-16b. The results are displayed in Table 3-7.

Table 3-7: Weekday PM Peak Hour Intersection Operations (2008)

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Mobility Standard (LOS or v/c)</th>
<th>Average Delay (Seconds)</th>
<th>Level of Service (LOS or v/c)</th>
<th>volume/ capacity ratio (v/c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>City Intersections</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kelso Road/ Bluff Road</td>
<td>D</td>
<td>10.5</td>
<td>A/B</td>
<td>0.15</td>
</tr>
<tr>
<td>Green Mountain/ Bluff Road</td>
<td>D</td>
<td>10.8</td>
<td>A/B</td>
<td>0.09</td>
</tr>
<tr>
<td>Industrial Way East/ 362nd Drive</td>
<td>D</td>
<td>12.7</td>
<td>A/B</td>
<td>0.15</td>
</tr>
<tr>
<td>Dubarko Road/ 362nd Drive</td>
<td>D</td>
<td>10.8</td>
<td>A/B</td>
<td>0.13</td>
</tr>
<tr>
<td>Dubarko Road/ Ruben Lane</td>
<td>D</td>
<td>10.1</td>
<td>A/B</td>
<td>0.12</td>
</tr>
<tr>
<td>Dubarko Road/ Tupper Road</td>
<td>D</td>
<td>9.0</td>
<td>A/A</td>
<td>0.03</td>
</tr>
<tr>
<td>Dubarko Road/ Jacoby Road</td>
<td>D</td>
<td>9.4</td>
<td>A/A</td>
<td>0.05</td>
</tr>
<tr>
<td>Dubarko Road/ Langensand Road</td>
<td>D</td>
<td>9.4</td>
<td>A/A</td>
<td>0.02</td>
</tr>
<tr>
<td>Cascadia Village Drive/ Bornstedt Road</td>
<td>D</td>
<td>12.4</td>
<td>A/B</td>
<td>0.05</td>
</tr>
<tr>
<td>All-Way Stop Controlled Intersections</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial Way West/ 362nd Drive (3-way)</td>
<td>D</td>
<td>9.2</td>
<td>A</td>
<td>0.37</td>
</tr>
<tr>
<td>ODOT Intersections</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US 26/ 362nd Drive</td>
<td>0.70</td>
<td>36.3</td>
<td>D</td>
<td>0.91</td>
</tr>
<tr>
<td>US 26/ Industrial Way</td>
<td>0.70</td>
<td>23.3</td>
<td>C</td>
<td>0.87</td>
</tr>
<tr>
<td>US 26/ Ruben Lane</td>
<td>0.75</td>
<td>33.8</td>
<td>C</td>
<td>0.93</td>
</tr>
<tr>
<td>US 26/ Bluff Road</td>
<td>0.85</td>
<td>24.5</td>
<td>C</td>
<td>0.93</td>
</tr>
<tr>
<td>OR 211/ Proctor Boulevard</td>
<td>0.85</td>
<td>55.3</td>
<td>E</td>
<td>&gt;1.00</td>
</tr>
<tr>
<td>OR 211/ Pioneer Boulevard</td>
<td>0.85</td>
<td>78.8</td>
<td>E</td>
<td>0.88</td>
</tr>
<tr>
<td>US 26/ Ten Eyck Road</td>
<td>0.85</td>
<td>38.1</td>
<td>D</td>
<td>0.88</td>
</tr>
<tr>
<td>2-Way Stop Controlled Intersections</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US 26/ Champion Way</td>
<td>0.70</td>
<td>20.8</td>
<td>A/C</td>
<td>0.11</td>
</tr>
<tr>
<td>US 26/ Langensand Road</td>
<td>0.85</td>
<td>&gt;50.0</td>
<td>A/F</td>
<td>&gt;1.00</td>
</tr>
<tr>
<td>US 26/ Vista Loop West</td>
<td>0.70</td>
<td>18.7</td>
<td>A/C</td>
<td>0.09</td>
</tr>
<tr>
<td>US 26/ Vista Loop East</td>
<td>0.70</td>
<td>14.6</td>
<td>A/B</td>
<td>0.01</td>
</tr>
<tr>
<td>OR 211/ Dubarko Road</td>
<td>0.80</td>
<td>16.9</td>
<td>A/C</td>
<td>0.19</td>
</tr>
<tr>
<td>OR 211/ Bornstedt Road</td>
<td>0.80</td>
<td>12.0</td>
<td>A/B</td>
<td>0.21</td>
</tr>
</tbody>
</table>

Notes: Shaded cells indicate mobility standard is not being met. A/A = major street LOS/ minor street LOS. Signalized and all-way stop delay = average vehicle delay in seconds for entire intersection. 2-Way Stop delay = highest minor street approach delay.

Sandy Transportation System Plan  
Chapter 3: Existing Conditions  
-**FINAL**-  
Page 3-46  
May 2009
According to Table 3-7, all City intersections are currently operating within mobility standards with a level of service B or better.

However, most of the study intersections under ODOT jurisdiction are not meeting mobility standards, including all signalized intersections in the city. Among these, the intersection of US 26 with Proctor Boulevard is particularly congested, with traffic demands exceeding capacity. Among the stop-controlled intersections, only US 26 at Langensand Road was found to exceed mobility standards, with a v/c ratio over 1.0.

Study intersections on OR 211 are operating well within standards.

**Signal Warrant Analysis**
A signal warrant analysis was performed for the unsignalized intersection of US 26 at Langensand Road to determine if side-street volumes are high enough to justify (i.e., warrant) the added delays that would be imposed on mainline traffic by construction of a signal. For this analysis, ODOT preliminary signal warrants were assessed using the p.m. peak hour turn movement volume data collected at this intersection. Because drivers are currently using less than 85% of the capacity available on the northbound right-turn movement, 100% of the northbound right-turn volume was discounted from the analysis in accordance with ODOT analysis procedures. The result of the analysis revealed that the signal is not warranted at the 100% or the 70% warrant level.

Signal warrants were not evaluated for any of the other unsignalized study intersections in the city, as peak hour operating conditions were found to be acceptable and traffic volumes on these stop-controlled approaches were determined by inspection to be too low to meet warrants.

**Queuing Analysis**
An estimate of the 95th percentile vehicle queue for each of the study intersection approach movements was made using SimTraffic modeling software. This value estimates the queue length that would have only a five percent chance of being exceeded during the peak hour and is commonly used for design purposes. Queuing results are summarized in Table 3-8 for intersections experiencing queues that exceeded or approached available storage. Queuing results for all other intersections are included in the technical appendix.

As shown in Table 3-8, queuing is currently only a problem at the signalized intersection along US 26, which were shown failing to meet mobility standards. Queues at unsignalized approaches were generally low.
Table 3-8: 95th Percentile Vehicle Queuing (2008)

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Approach</th>
<th>Movement</th>
<th>Available Queue Length (ft)</th>
<th>Queue Length (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>US 26 @ 362nd Drive</td>
<td>Eastbound</td>
<td>T</td>
<td>3,025</td>
<td>1,050</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>400</td>
<td>525</td>
</tr>
<tr>
<td></td>
<td>Westbound</td>
<td>L</td>
<td>450*</td>
<td>975</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T</td>
<td>1,540</td>
<td>875</td>
</tr>
<tr>
<td></td>
<td>Northbound</td>
<td>L</td>
<td>100</td>
<td>550</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>100</td>
<td>150</td>
</tr>
<tr>
<td>US 26 @ Industrial Way</td>
<td>Eastbound</td>
<td>L</td>
<td>150*</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T</td>
<td>1,540</td>
<td>800</td>
</tr>
<tr>
<td></td>
<td>Westbound</td>
<td>L</td>
<td>150*</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T</td>
<td>1,800</td>
<td>300</td>
</tr>
<tr>
<td></td>
<td>Northbound</td>
<td>L</td>
<td>175</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LT</td>
<td>175</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>Southbound</td>
<td>L</td>
<td>125*</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T</td>
<td>1,800</td>
<td>1,025</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>225</td>
<td>175</td>
</tr>
<tr>
<td>US 26 @ Ruben Lane</td>
<td>Eastbound</td>
<td>L</td>
<td>125*</td>
<td>175</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T</td>
<td>1,210</td>
<td>475</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Northbound</td>
<td>R</td>
<td>25</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>125</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>US 26 @ Bluff Road</td>
<td>Eastbound</td>
<td>L</td>
<td>125*</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T</td>
<td>2,120</td>
<td>1,625</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>125</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>Westbound</td>
<td>L</td>
<td>275</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T</td>
<td>2,650</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>125</td>
<td>175</td>
</tr>
<tr>
<td></td>
<td>Northbound</td>
<td>L</td>
<td>150</td>
<td>275</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L</td>
<td>150</td>
<td>550</td>
</tr>
<tr>
<td>Proctor Boulevard (US 26) @ OR 211</td>
<td>Westbound</td>
<td>T</td>
<td>&gt;5,000</td>
<td>450</td>
</tr>
<tr>
<td></td>
<td>Northbound</td>
<td>LT</td>
<td>275</td>
<td>225</td>
</tr>
<tr>
<td>Pioneer Boulevard (US 26) @ OR 211</td>
<td>Eastbound</td>
<td>T</td>
<td>2,775</td>
<td>1,875</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R</td>
<td>125</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>Northbound</td>
<td>R</td>
<td>125</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>Southbound</td>
<td>L</td>
<td>125</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T</td>
<td>275</td>
<td>100</td>
</tr>
</tbody>
</table>

Notes: Bold type indicates storage is exceeded.
*Left turn storage followed by two-way left turn lane
Traffic Safety
To analyze the history of traffic safety on the transportation network in Sandy, crash data for all streets within the city was obtained from ODOT for the most recent three-year period available (2005-2007). The individual crashes occurring within this three-year period have been mapped in Figure 3-18. To identify potential deficiencies, crash rates for study intersections were assessed, crash rates for sections of US 26 and OR 211 were compared to statewide average crash rates for similar facilities, crash types were analyzed to identify patterns or trends, and ODOT’s Safety Priority Index System was reviewed to identify potentially hazardous locations.

Intersection Crash Rates
Crash rates at study intersections were calculated to identify problem areas in need of mitigation. Because the total number of crashes experienced at an intersection is typically proportional to the number of vehicles entering it, a crash rate describing the frequency of crashes per million entering vehicles (MEV) is used to determine if the number of crashes should be considered high. Using this technique, a crash rate of 1.0 MEV or greater is commonly used to identify when further investigation is warranted. Table 3-9 shows the three-year crash rates at the study intersections.

As shown, all study intersections are operating with relatively low crash rates with the exception of the intersection of OR 211 at Dubarko Road. Based on crash data provided for the last three years, there were eight recorded crashes, all of which were angle-type crashes caused by vehicles entering the intersection from Dubarko Road. Seven of the eight crashes involved vehicles on Dubarko Road attempting to cross OR 211 to continue on Dubarko Road. The severity of the crashes ranged from only property damage to serious injuries.

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Crash Rate (MEV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dubarko Road @ OR 211</td>
<td>1.08</td>
</tr>
<tr>
<td>Langensand Road @ Dubarko Road</td>
<td>0.66</td>
</tr>
<tr>
<td>Pioneer Boulevard @ OR 211</td>
<td>0.38</td>
</tr>
<tr>
<td>Proctor Boulevard @ OR 211</td>
<td>0.33</td>
</tr>
<tr>
<td>US 26 @ Bluff Road</td>
<td>0.29</td>
</tr>
<tr>
<td>US 26 @ 362nd Drive</td>
<td>0.25</td>
</tr>
<tr>
<td>US 26 @ Industrial Way</td>
<td>0.15</td>
</tr>
<tr>
<td>US 26 @ Ruben Lane</td>
<td>0.14</td>
</tr>
<tr>
<td>Dubarko Road @ 362nd Drive</td>
<td>0.13</td>
</tr>
<tr>
<td>Industrial Way West @ 362nd Drive</td>
<td>0.12</td>
</tr>
<tr>
<td>US 26 @ Ten Eyck Road</td>
<td>0.10</td>
</tr>
<tr>
<td>US 26 @ Langensand Road</td>
<td>0.10</td>
</tr>
<tr>
<td>US 26 @ Vista Loop Drive East</td>
<td>0.07</td>
</tr>
<tr>
<td>US 26 @ Vista Loop Drive West</td>
<td>0.03</td>
</tr>
<tr>
<td>Bornstedt Road @ OR 211</td>
<td>0.00</td>
</tr>
<tr>
<td>Industrial Way East @ 362nd Drive</td>
<td>0.00</td>
</tr>
<tr>
<td>Ruben Lane @ Dubarko Road</td>
<td>0.00</td>
</tr>
<tr>
<td>Cascadia Village Drive @ Bornstedt Road</td>
<td>0.00</td>
</tr>
<tr>
<td>Jacoby Road @ Dubarko Road</td>
<td>0.00</td>
</tr>
<tr>
<td>Green Mountain Street @ Bluff Road</td>
<td>0.00</td>
</tr>
<tr>
<td>Kelso Road @ Bluff Road</td>
<td>0.00</td>
</tr>
<tr>
<td>Dubarko Road @ Tupper Road</td>
<td>0.00</td>
</tr>
<tr>
<td>US 26 @ Champion Way</td>
<td>0.00</td>
</tr>
</tbody>
</table>
Figure 3-18
Crash Locations (2005 - 2007)

City of Sandy
TRANSPORTATION SYSTEM PLAN

- Crash Location
- SPIS Locations
- City Limits
- Urban Growth Boundary
- Urban Reserve Area
- Arterials/Collectors
- Local Streets

Legend:
- Parcels

Map shows crash locations within the City of Sandy, indicating the density and distribution of crashes over the years 2005 to 2007. The map includes various road networks and urban boundaries to provide a comprehensive view of the transportation system.
This trend may be associated with the nature of traffic movement at this location where vehicles from the stop-controlled Dubarko Road approaches must cross or enter OR 211, which is operating at relatively high speeds, with topographic impediments to sight distance, and the lack of left turn lanes on OR 211. With a limited number of crossings provided along OR 211, this trend could continue as more land develops to the east along Dubarko Road. However, there is a safety project on ODOT’s Draft Statewide Transportation Improvement Program (anticipated construction by 2013) planned for this intersection to address this condition that is described as including improvements to geometry, illumination, sight distance, and channelization.

Another intersection that has been identified as having sight distance restrictions is the intersection of Arletha Court at OR 211. The combination of several large trees and a horizontal curve in OR 211 reduce the available sight distance for vehicle

**Corridor Crash Rates**

Crash rates identifying the number of crashes per million vehicle-miles traveled for specified sections of US 26 and OR 211, as well as statewide average crash rates for various facility types, were obtained from ODOT’s 2007 *State Highway Crash Rate Tables*.

Highway sections analyzed in these tables are categorized by surrounding area (e.g., urban city, suburban, rural) and functional classification to provide a basis for comparison between various facilities.

For the comparison to statewide averages, US 26 is classified as a non-freeway principal arterial through an urban city area and OR 211 is classified as a non-freeway minor arterial through an urban city area. Predetermined highway sections with assumed area types are provided in the crash rate tables with crash rates calculated for each section, as well as for groups of contiguous sections within the same area type. Some of the sections provided in the ODOT crash tables were short (less than one mile in length), resulting in a less reliable crash rate. Therefore, some sections were combined to provide a more accurate representation of crash activity along the evaluated roadways. The reported crash rates along segments of US 26 and OR 211 are shown in Table 3-10.

Crash rates along US 26 to the west and east of the downtown couplet are far below statewide averages for similar facilities, while crash rates within the couplet are consistently above statewide averages. The higher rate of crashes in the couplet could be due to several factors. First, it should be recognized that this section is only ¾ of a mile long and that crash rate calculations for segments shorter than one mile in length often appear inflated. However, this area is also characterized by a much different roadside environment than other sections of US 26 and has a significantly different design.

---


13 The classifications chosen to represent these facilities are not intended to reflect their actual functional classification as designated in the Sandy TSP, but to appropriately categorize them among similar facilities across the state by design and volume characteristics.
Within the couplet area, travel is limited to one-way movements along the mainline, on-street parking is available, uncontrolled pedestrian crosswalks are present, and the roadside environment is densely developed with retail and service businesses, features which create a pedestrian-friendly downtown. The amount of activity surrounding this corridor triggers many potential conflicts for motorists to negotiate, such as pedestrian crossings, vehicles entering and exiting driveways, and parking maneuvers, which in combination can result in a higher frequency of crashes.

In addition, crash rates along OR 211 have been significantly higher than the statewide averages for each of the three years examined. However, Figure 3-18 shows that most crashes have been occurring at intersections, specifically at Dubarko Road and OR 211. This is an indication that the focus on safety issues should be on those specific locations rather than on the OR 211 corridor as a whole.

### Table 3-10: Highway Segment Crash Rates

<table>
<thead>
<tr>
<th>Section Limits (Milepoints)</th>
<th>Section Description</th>
<th>Crashes per Million Vehicles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2007</td>
</tr>
<tr>
<td><strong>Statewide Average Rate (Urban Principal Arterials)</strong></td>
<td></td>
<td>2.37</td>
</tr>
<tr>
<td><strong>MP 22.49-23.87</strong></td>
<td>US 26: West City Limits – Bluff Rd</td>
<td>1.25</td>
</tr>
<tr>
<td><strong>MP 23.87 to 24.61</strong></td>
<td>US 26: Begin Couplet to End Couplet EB</td>
<td>3.39</td>
</tr>
<tr>
<td><strong>MP 23.87 to 24.61</strong></td>
<td>US 26: Begin Couplet to End Couplet WB</td>
<td>3.65</td>
</tr>
<tr>
<td><strong>MP 24.61-25.57</strong></td>
<td>US 26: End Couplet to East City Limits</td>
<td>0.27</td>
</tr>
<tr>
<td><strong>Statewide Average Rate (Suburban Minor Arterials)</strong></td>
<td></td>
<td>1.09</td>
</tr>
<tr>
<td><strong>MP 4.77 to 5.39</strong></td>
<td>OR 211: Suburban Area to Urban City</td>
<td>2.32</td>
</tr>
<tr>
<td><strong>Statewide Average Rate (Urban Minor Arterials)</strong></td>
<td></td>
<td>2.61</td>
</tr>
<tr>
<td><strong>MP 5.39 to 5.94</strong></td>
<td>OR 211: Urban City to US 26 (Proctor Ave)</td>
<td>5.72</td>
</tr>
</tbody>
</table>

Note: Bold type indicates that the crash rate experienced exceeds the statewide average crash rate for similar facilities.

### Crash Characteristics

Individual crash types were examined throughout the city to see if any patterns would emerge. Figure 3-19 breaks down the crash types and severities experienced, with percentages of each shown. Most crashes involved rear-end (41%) or turning (25%) collisions and crash severities are typically low, with approximately 89% of all crashes involving only property damage or minor injuries.

Further analysis of the crash data showed that there were 10 pedestrian related crashes within the last three years, with located relatively close to schools and/or the downtown area. Three of the crashes occurred on Bluff Road near the high school, with all crashes involving pedestrians under the age of 18, two of which occurred during school hours. One crash involved both a driver and pedestrian under the age of 18. It should be pointed out that crash
rates around high schools tend to be higher due to the larger numbers of inexperienced drivers and tend to be higher during arrival/dismissal times when students, parents and school busses concentrate around the school. One crash occurred on Pleasant Street near the middle and elementary schools during school hours that also involved a pedestrian under the age of 18. The remaining six pedestrian crashes occurred within the downtown area, with pedestrians of varying ages.

Figure 3-19: Crash Characteristics (2005-2007)

<table>
<thead>
<tr>
<th>Crash Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>REAR</td>
<td>41%</td>
</tr>
<tr>
<td>SS-O</td>
<td>10%</td>
</tr>
<tr>
<td>FIXED</td>
<td>7%</td>
</tr>
<tr>
<td>OTHER</td>
<td>6%</td>
</tr>
<tr>
<td>BACK</td>
<td>4%</td>
</tr>
<tr>
<td>TURN</td>
<td>25%</td>
</tr>
<tr>
<td>ANGLED</td>
<td>7%</td>
</tr>
<tr>
<td>FIXED</td>
<td>7%</td>
</tr>
<tr>
<td>SS-O</td>
<td>10%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Crash Severity</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>PDO</td>
<td>65%</td>
</tr>
<tr>
<td>INJC</td>
<td>24%</td>
</tr>
<tr>
<td>INJB</td>
<td>10%</td>
</tr>
<tr>
<td>INJA</td>
<td>1%</td>
</tr>
</tbody>
</table>

Key:
- REAR: Rear end
- SS-O: Sideswipe – overtaking
- FIXED: Fixed object or other object
- TURN: Turn movement
- BACK: Backing
- OTHER: Miscellaneous
- INJA: Incapacitating Injury
- INJB: Non-Incapacitating Injury
- INJC: Possible Injury
- PDO: Property Damage Only

SPIS Ratings
The crash analysis was supplemented by a review of ODOT Safety Priority Index System listings for locations along US 26 and OR 211 ranked among the state’s top 10% of hazardous locations. The Safety Priority Index System (SPIS) is a method developed by ODOT for identifying hazardous locations on state highways, with the score based on three years of crash data as well as crash frequency, rate, and severity. ODOT bases its SPIS on 0.10-mile segments to account for variances in how crash locations are reported. This rating provides a general comparison of the overall safety of the highway based on crash information for all highway segments throughout the state.

According to ODOT 2008 SPIS ratings, only two locations within the city rate within the top 10% of SPIS sites: the intersection of US 26 (Pioneer Boulevard) at OR 211 and the intersection of OR 211 at Dubarko Road. At the intersection of US 26 (Pioneer Boulevard) with OR 211, the majority of the crashes involved rear-end-type crashes (71%), which are most likely a result of vehicles being rear-ended while slowing down or stopping for the signal at the intersection. Some of the crash activity at this location may also be related to the
factors previously described that are associated with the conflicts introduced by the downtown environment (e.g., on-street parking, pedestrian crossings, and access points).

The intersection of OR 211 at Dubarko Road has previously been identified as having a high crash rate.

The SPIS locations along with the locations of all crashes within the city are shown in Figure 3-18.

**Summary of Deficiencies**

The following is a summary of key deficiencies noted in the motor vehicle network that can be utilized as a guide in determining potential future roadway improvements.

- In general, minor arterials within the city have not been constructed in accordance with the functional classification description, which required a three-lane cross-section.

- Access spacing on many streets within the city, including state highways, does not comply with adopted standards. However, it should be pointed out that in most cases the access spacing on Bluff Road, Dubarko Road, and other minor arterials was established prior to the adoption of spacing standards.

- Poor pavement conditions are present on OR 211, Tupper Road north of Sandy Heights Street, and Vista Loop Drive.

- US 26 is a critical route for freight, both locally and statewide. However, it has also been shown to be heavily congested.

- All signalized intersections along US 26 are heavily congested during the 30th highest hour of the year and do not comply with ODOT adopted mobility standards. Furthermore, the following intersections currently experience vehicle queues that approach or exceed the available storage:
  - US 26 @ 362nd Drive
  - US 26 @ Industrial Way
  - US 26 @ Ruben Lane
  - US 26 @ Bluff Road
  - US 26 (Pioneer Boulevard) @ OR 211
  - US 26 (Proctor Boulevard) @ OR 211
  - US 26 @ Ten Eyck Road

- The unsignalized intersection on US 26 at Langensand Road does not comply with ODOT adopted mobility standards and does not currently meet warrants for signalization.
The intersections on US 26 (both Pioneer and Proctor Boulevards) at OR 211 rate among the top 10% of hazardous ODOT SPIS locations.

The intersection of OR 211 at Dubarko Road has a relatively high crash rate and is rated among the top 10% of hazardous ODOT SPIS locations.

Intersection sight distance concerns have been noted at the intersections of OR 211/Dubarko Road and OR 211/Arletha Court.

The frequency of crashes along US 26 is higher within the downtown couplet than on other segments to the west and east.

There have been a number of pedestrians struck by motor vehicles near the schools, including three school-age children during school hours, and in the downtown area.
4. Future Needs

Overview

Future transportation system needs through the TSP horizon year of 2029 were projected by building on the inventory and assessment of existing conditions and accounting for the additional impact of forecasted travel demand associated with regional and local growth. This chapter explains the underlying assumptions used in forecasting future trip growth and identifies transportation system deficiencies through the year 2029, which will act as a baseline for developing and prioritizing improvement alternatives.

Future Travel Demand Forecasting Methodology

The process of developing future traffic volumes included the establishment of key assumptions affecting trip growth through the city and the application of those assumptions to a model framework that uses the relationship between transportation and land use to assign trips to the roadway network. This required the development of two model scenarios: 1) a base year (2008) scenario calibrated to replicate existing conditions, and 2) a future year (2029) scenario constructed by applying growth assumptions to the base year scenario. The process for developing these model scenarios and the assumptions used are described below.

Base Year (2008) Model

The traffic forecasting tool used (referred to as the “model” herein) was an automated version of the cumulative analysis methodology described in ODOT’s Transportation Planning Analysis Unit Analysis Procedures Manual. The fundamental steps in developing the base year model scenario included:

- **Construction of a Street Network:** The street network for the base year model was developed from field inventories describing lane geometries, posted speeds, street lengths, and traffic control characteristics (stop signs, traffic calming devices, and signal timing).

- **Division of Lands into Transportation Analysis Zones:** Transportation Analysis Zones (TAZs) are used to group areas of land with similar trip-making characteristics. For this model, the city was separated into 40 TAZs, with boundaries established by major streets, topographical and environmental constraints, and zoning designations. The TAZ system developed can be seen in Figures 4-2 and 4-3.
• **Defining Land Use Characteristics:** Within each TAZ, existing land uses were identified through field inventories and aerial photographs and used to estimate the number of households and employees present. This information was used as the basis for defining trip generation and distribution estimates throughout the city. Control totals for citywide housing and employment were taken from the *City of Sandy Urbanization Study*,\(^\text{15}\) which estimated that there were 3,625 households and 4,327 employees within the urban growth boundary (UGB) in the year 2008. Employment types were separated into retail, service, other (generally industrial and office), and education categories, with selected employers interviewed to improve the accuracy of employee estimates.

• **Estimation of Through Trips:** Trips within the City of Sandy were separated into categories including those beginning and ending their trip outside of the city, those with one end of their trip within the city and the other outside of the city, and those beginning and ending their trip inside the city. These trip categories are referred to as external-external trips, internal-external or external-internal trips, and internal-internal trips, respectively. The identification of through trips, or external-external trips, along US 26 was aided through the origin-destination survey described in Chapter 3.

• **Establishing Trip Origins and Destinations for TAZs:** Inbound and outbound motor vehicle trips for each TAZ were estimated by associating trip generation characteristics with household and employment types. Trip generation characteristics were taken from *Trip Generation*,\(^\text{16}\), which includes a national database relating trip making characteristics to various land use types. These characteristics were entered into a matrix used to match trips between TAZs using the relative number of attractions.

• **Assignment of Trips throughout the City:** The VISUM modeling software was used to route trips between TAZs and external destinations across the area street network. The model selected the route of travel by choosing the path that offered the shortest travel time between trip ends. The calculation of travel times through the network was performed over dozens of iterations, using several attributes including speed, intersection delay, and street capacity.

• **Calibration to Replicate Existing Conditions:** Creating a base year model that can accurately represent existing conditions provides for a foundation upon which to construct a new model that can reasonably estimate future conditions. This process involved several iterations where model trip assignments on intersection turn movements and street links were compared to actual counts obtained in the field. Parameters in the model, such as trip generation rates, speeds, and street capacities, were incrementally adjusted until the base year model could produce reasonable replications of actual conditions in the year 2008.

---
\(^{15}\) *City of Sandy Urbanization Study*, ECONorthwest, January 2009.

Future Year (2029) Model

Using the calibrated base year model as a foundation, a future year model for the year 2029 was developed using traffic volume growth estimates for key roadways and housing and employment growth projections for the City of Sandy. The fundamental steps in developing the future year model scenario included:

- **Accounting for Transportation System Changes:** Before future trips are assigned to the street network, any planned changes to the street network that are not present in the base year model must be incorporated into the future model. Due to the uncertainty surrounding the ability of the City to fund transportation system improvements, it was preferred to use the existing network as a base for identifying needed improvements.

- **Estimating Future Growth in Through Trips and at External Nodes:** Growth on roadways surrounding the city that act as key gateways was estimated by calculating annual growth rates from historic count databases. For County facilities, historic traffic volume counts were obtained from Clackamas County’s traffic counting program webpage. For US 26 and OR 211, annual growth rates were calculated from projections included in ODOT’s Future Traffic Volume Tables. Through trip growth on US 26 was estimated using the origin-destination survey results in combination with the total highway growth projections from the Future Volume Tables.

Table 4-1 shows the calculated annual growth rates for county and state facilities. It should be noted that a minimum one percent growth rate was applied to avoid underestimating future traffic volumes.

<table>
<thead>
<tr>
<th>Facility</th>
<th>Location</th>
<th>Average Annual Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>County Facilities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orient Drive</td>
<td>North of Kelso Road</td>
<td>1.9%</td>
</tr>
<tr>
<td>Kelso Road</td>
<td>West of Bluff Road</td>
<td>3.3%</td>
</tr>
<tr>
<td>Bluff Road</td>
<td>South of Serban Road</td>
<td>1.0%</td>
</tr>
<tr>
<td>Ten Eyck Road</td>
<td>North of US 26</td>
<td>1.0%</td>
</tr>
<tr>
<td>Bornstedt Road</td>
<td>North of Trubel Road</td>
<td>1.0%</td>
</tr>
<tr>
<td>362nd Drive</td>
<td>North of OR 211</td>
<td>4.8%</td>
</tr>
<tr>
<td><strong>State Facilities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US 26 (West)</td>
<td>West of Orient Drive</td>
<td>2.3%</td>
</tr>
<tr>
<td>US 26 (East)</td>
<td>East of Vista Loop Drive</td>
<td>2.6%</td>
</tr>
<tr>
<td>OR 211</td>
<td>West of 362nd Drive</td>
<td>4.8%</td>
</tr>
</tbody>
</table>

---

17 http://www.clackamas.us/roads/adt.htm
18 http://www.oregon.gov/ODOT/TD/TP/docs/TADR/2027FVT.pdf
● **Estimating Future Growth Housing & Employment:** Growth estimates for housing and employment within the city were taken from the recently completed *City of Sandy Urbanization Study*, which used these estimates to project needs for developable land through the year 2029. According to this study, by the year 2029, there will be approximately 1,156 additional households within the urban growth boundary and approximately 1,642 additional employees. The growth in housing and employment in Sandy is illustrated in Figure 4-1.

![Figure 4-1: Existing and Future Household and Employment Totals in Sandy](image)

● **Allocating Future Land Uses:** Projected growth in housing and employment was allocated among the TAZs based on comprehensive plan zoning designations and the amount of vacant and buildable lands. The resulting allocations of housing and employment growth across the city are shown in Figures 4-2 and 4-3, respectively.

● **Distributing and Assigning Trips through the City:** Trips in the future model were distributed between TAZs and assigned to the transportation network using the same methodology described for the base year model.

● **Validating Results:** Unlike the base year model, the future year model cannot be compared to actual traffic counts to test the validity of the results. Instead, it relies on the calibration used for the base year model upon which it was built and post-processing of the output to ensure results are reasonable and significant changes in travel patterns are justified. As part of this post-processing effort, changes in traffic volumes between the base and future year models are assessed across screenlines and the network as a whole to ensure growth projections are within reasonable limits and that the area roadways are being used in a logical manner.
Key Findings

When the base and future year models were completed, the growth in traffic volumes shown between the two models was applied to the 30th highest hour annual volumes and weekday p.m. peak hour volumes developed in Chapter 3 for the study intersections. While the traffic volumes and system operation in 2029 will be discussed in detail later in this chapter, future model results indicate that congestion along US 26 will be significantly increased. As a result, the model predicts traffic will divert to the following routes:

- Some of the traffic traveling between OR 211 and US 26 diverts to Dubarko Road and Langensand Road to reach the highway.

- Some of the traffic traveling between the southwest area of the city and US 26 eastbound diverts to OR 211, Dubarko Road, Langensand Road, and 362nd Drive to avoid using US 26.

- Some of the traffic traveling between Bluff Road north of the city and US 26 eastbound diverts through Hood Street and Pleasant Avenue to avoid the downtown couplet.

- Some eastbound traffic on US 26 diverts to 362nd Drive and Industrial Way to attempt to bypass some of the US 26 queuing.

- Other diversion routes used by US 26 eastbound traffic included Ruben Lane to Sandy Heights Street to Tupper Road to OR 211, as well as Bluff Road to Strawbridge Parkway to Tupper Road to OR 211.
Future Traffic Volumes (2029)

Using the previously described methodology, design hour traffic volumes for the year 2029 were forecast across study intersections, representing the future 30th highest annual hour of the year on the highways and the average weekday p.m. peak hour on the city streets. The resulting volumes are described below.

Future Volumes

Most of the traffic growth in the study area is forecast for the US 26 corridor (see Figure 4-4), with annual growth rates ranging from 1.2% to 2.7%. Notable growth also occurred on OR 211 and 362nd Drive. However, a significant amount of the growth experienced on OR 211 and 362nd Drive appears to be related to traffic diversions around US 26 congestion. Traffic growth on city streets was generally low, with the exception of a few corridors (i.e., 362nd Drive, Dubarko Road, Langensand Road, Sandy Heights Street, Tupper Road, Ten Eyck Road, and Pleasant Avenue) that may be impacted by diversions around US 26. As alternatives to relieve congestion on US 26 are evaluated, trip growth on city streets should be reassessed.

The forecasted design hour volumes for the year 2029, which were used in the analysis of future operations and needs, are displayed for each study intersection in Figures 4-5a and 4-5b.
City of Sandy
TRANSPORTATION SYSTEM PLAN

FUTURE 2029
WEEKDAY PM PEAK HOUR
TRAFFIC VOLUMES

Figure 4-5a

LEGEND
- Study Intersection Number (This Page)
- Study Intersection Number (Next Page)
- Lane Configuration
- Stop Sign
- Traffic Signal

- PM Peak Hour Traffic Volume

- Left-Thru-Right

US 26 @ Champion Wy
US 26 @ 362nd Dr
US 26 @ Industrial Wy
US 26 @ Ruben Ln
US 26 @ Bluff Rd
Kelso Rd @ Bluff Rd
Green Mountain St @ Bluff Rd
Industrial Way East @ 362nd Dr
Industrial Way West @ 362nd Dr
Dubarko Rd @ 362nd Dr
Ruben Ln @ Dubarko Rd

Figure - Study Intersection Number (This Page)
Figure - Study Intersection Number (Next Page)
- Lane Configuration
- Stop Sign
- Traffic Signal

- PM Peak Hour Traffic Volume

- Left-Thru-Right

US 26 @ Champion Wy
US 26 @ 362nd Dr
US 26 @ Industrial Wy
US 26 @ Ruben Ln
US 26 @ Bluff Rd
Kelso Rd @ Bluff Rd
Green Mountain St @ Bluff Rd
Industrial Way East @ 362nd Dr
Industrial Way West @ 362nd Dr
Dubarko Rd @ 362nd Dr
Ruben Ln @ Dubarko Rd

Figure 4-5a
WEEKDAY PM PEAK HOUR
TRAFFIC VOLUMES

Figure 4-5a
WEEKDAY PM PEAK HOUR
TRAFFIC VOLUMES
**Congestion Duration**

As evidenced by existing and future traffic patterns, US 26 is the critical transportation corridor in the study area. While the analysis of the peak hour operating conditions provides an evaluation of mobility standards and frames design criteria, it does not indicate how long congestion will be present. The understanding of congestion duration is particularly important in corridors such as US 26 where over-capacity conditions are known to exist.

To gauge the approximate duration of congestion that would be experienced in 2029, traffic volume profiles over a 24-hour period were created using counts collected under existing conditions. To project future volumes for all hours in this profile, the rate of growth found to occur between the future design hour and the same hour under existing conditions was applied to volumes measured during all hours under existing conditions. For this evaluation, the intersection on US 26 at Bluff Road was selected, as it maintains some of the highest traffic volumes in the corridor and represents a key bottleneck in the system.

Figure 4-6 presents the hourly volume profile on US 26 under both existing and future conditions. To indicate when congested conditions would occur, a capacity ceiling was overlaid on the chart using the maximum total entering volume that can be served by the intersection (representing a v/c = 1.0). It should be recognized when considering this information that when traffic volumes exceed capacity the actual duration of congestion may be longer than shown because of the time needed for the system to recover from the “breakdown” that has occurred. Also, any unserved demand in a given hour will either be pushed to the following hour or could avoid the corridor altogether.

![Figure 4-6: Congestion Duration on US 26 at Bluff Road](image-url)
As shown in this figure, the p.m. peak period currently experiences higher traffic volumes than the a.m. peak period, with peak hour volumes between 5:00 and 6:00 p.m. approaching capacity. However, by 2029, there will be at least seven hours of the day where traffic demands will exceed system capacity (v/c > 1.0), beginning as early as 8:00 a.m.

An additional line was overlaid on the chart to indicate approximately how many hours of the day would experience conditions that failed to meet ODOT’s mobility standard (v/c ≤ 0.85). Under existing conditions, there are approximately three hours during the p.m. peak period where mobility standards are not being met. However, by 2029, this condition would occur for at least 10 hours, beginning at 7:00 a.m. and continuing until sometime after 7:00 p.m. when the system has recovered.

**Future Traffic Operations (2029)**

The analysis of forecasted conditions in the year 2029 was essentially a no-build scenario, using the same transportation infrastructure that is in place under existing conditions to serve future traffic volumes. This provides for a “needs assessment” that can be used to identify and prioritize transportation system improvements. Using these assumptions, the 2029 design hour traffic volumes were applied to study area intersections and re-analyzed, using the same methodology employed for existing conditions to assess future operations.

**Intersection Operations**

Table 4-2 displays the results of this analysis. As shown, city intersections will continue to operate within adopted mobility standards, with the exception of the all-way stop controlled intersection of 362nd Drive at Industrial Way West and the 2-way stop controlled intersection of 362nd Drive at Dubarko Road. Both intersections degrade to LOS E.

Under existing conditions, many of the intersections along the state highways fail to meet adopted mobility standards. This included all signalized intersections along US 26, as well as the two-way stop controlled intersection on US 26 at Langensand Road. In the future, as traffic demand and congestion increases, operations at the signalized intersections along US 26 will be degraded further. In addition, all stop-controlled intersections in the east US 26 corridor, including those at Langensand Road, West Vista Loop Drive, and East Vista Loop Drive, as well as the intersection on OR 211 at Dubarko Road, will fail to meet mobility standards.

**Queuing Analysis**

An estimate of the 95th percentile vehicle queue for each of the study intersection approach movements was made using SimTraffic modeling software. Due to the level and duration of congestion along US 26, accurate queuing estimates cannot be made. Under these conditions, very long queues along the US 26 mainline should be expected for several hours of the day. Also, turn lane storage lengths at intersections will either be inadequate or the turn lanes will be frequently blocked by through traffic, leaving them underutilized.
### Table 4-2: Weekday PM Peak Hour Intersection Operations (2029)

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Mobility Standard (LOS or v/c)</th>
<th>Existing 2008</th>
<th>Future 2029 No Build</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average Delay (Seconds)</td>
<td>Level of Service (LOS)</td>
<td>volume/capacity ratio (v/c)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>City Intersections</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kelso Road/Bluff Road</td>
<td>D</td>
<td>10.5 A/B</td>
<td>0.15</td>
</tr>
<tr>
<td>Green Mountain/Bluff Road</td>
<td>D</td>
<td>10.8 A/B</td>
<td>0.09</td>
</tr>
<tr>
<td>Industrial Way East/362nd Drive</td>
<td>D</td>
<td>12.7 A/B</td>
<td>0.15</td>
</tr>
<tr>
<td>Dubarko Road/362nd Drive</td>
<td>D</td>
<td>10.8 A/B</td>
<td>0.13</td>
</tr>
<tr>
<td>Dubarko Road/Ruben Lane</td>
<td>D</td>
<td>10.1 A/B</td>
<td>0.12</td>
</tr>
<tr>
<td>Dubarko Road/Tupper Road</td>
<td>D</td>
<td>9.0 A/A</td>
<td>0.03</td>
</tr>
<tr>
<td>Dubarko Road/Langensand Road</td>
<td>D</td>
<td>9.4 A/A</td>
<td>0.05</td>
</tr>
<tr>
<td>Cascadia Village Dr/Bornstedt Rd</td>
<td>D</td>
<td>12.4 A/B</td>
<td>0.05</td>
</tr>
<tr>
<td><strong>All-Way Stop Controlled Intersections</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial Way West/362nd Drive</td>
<td>D</td>
<td>9.2 A</td>
<td>0.37</td>
</tr>
<tr>
<td><strong>Signal Controlled Intersections</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US 26/362nd Drive</td>
<td>0.70</td>
<td>36.3 D</td>
<td>0.91</td>
</tr>
<tr>
<td>US 26/Industrial Way</td>
<td>0.70</td>
<td>23.3 C</td>
<td>0.87</td>
</tr>
<tr>
<td>US 26/Ruben Lane</td>
<td>0.75</td>
<td>33.8 C</td>
<td>0.93</td>
</tr>
<tr>
<td>US 26/Bluff Road</td>
<td>0.85</td>
<td>24.5 C</td>
<td>0.93</td>
</tr>
<tr>
<td>OR 211/Proctor Boulevard</td>
<td>0.85</td>
<td>55.3 E</td>
<td>&gt;1.00</td>
</tr>
<tr>
<td>OR 211/Pioneer Boulevard</td>
<td>0.85</td>
<td>78.8 E</td>
<td>0.88</td>
</tr>
<tr>
<td>US 26/Ten Eyck Road</td>
<td>0.85</td>
<td>38.1 D</td>
<td>0.88</td>
</tr>
<tr>
<td><strong>2-Way Stop Controlled Intersections</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US 26/Champion Way</td>
<td>0.70</td>
<td>20.8 A/C</td>
<td>0.11</td>
</tr>
<tr>
<td>US 26/Langensand Road</td>
<td>0.85</td>
<td>&gt;50.0 A/F</td>
<td>&gt;1.00</td>
</tr>
<tr>
<td>US 26/Vista Loop West</td>
<td>0.70</td>
<td>18.7 A/C</td>
<td>0.09</td>
</tr>
<tr>
<td>US 26/Vista Loop East</td>
<td>0.70</td>
<td>14.6 A/B</td>
<td>0.01</td>
</tr>
<tr>
<td>OR 211/Dubarko Road</td>
<td>0.85</td>
<td>16.9 A/C</td>
<td>0.19</td>
</tr>
<tr>
<td>OR 211/Bornsted Road</td>
<td>0.80</td>
<td>12.0 A/B</td>
<td>0.21</td>
</tr>
</tbody>
</table>

**Notes:**
- Shaded cells indicate mobility standard is not being met.
- A/A= major street LOS/ minor street LOS
- Signalized and all-way stop delay = average vehicle delay in seconds for entire intersection
- 2-Way Stop delay = highest minor street approach delay
The congestion on US 26 also impacts queuing estimates at nearby intersections surrounding the highway, such as 362nd Drive at Industrial Way and Dubarko Road at Ruben Lane, making them unreliable. However, reasonable estimates could be made at city intersections farther away from US 26. In contrast to US 26, city intersections continue to operate relatively well, with no significant queuing noticed.

Queuing results for study intersections are included in the technical appendix.

**Signal Warrant Analysis**

Unsignalized study intersections that fail to meet adopted mobility standards in 2029 were evaluated for potential signalization using ODOT Preliminary Signal Warrants. These warrants are intended for use in determining whether signalization of an intersection would be justified at a time in the future. However, even where the preliminary warrants are met, actual conditions will need to be evaluated before signal construction is authorized by ODOT or the City.

The intersections evaluated and the results of the analysis are discussed below. It should be recognized that as alternatives are tested to address deficiencies, travel patterns through the city may change and could potentially affect the signalization needs of intersections evaluated under No-Build conditions.

- **362nd Drive at Industrial Way West:** The minor street volumes on Industrial Way West were too low to justify signalization. A roundabout could be an effective treatment and should be considered during alternatives evaluation. However, the required geometrics may be difficult to achieve given the current right-of-way constraints.

- **362nd Drive at Dubarko Road:** The minor street volumes on Dubarko Road were too low to justify signalization. A roundabout could be an effective treatment and should be considered during alternatives evaluation. However, the required geometrics may be difficult to achieve given the current right-of-way constraints.

- **OR 211 at Dubarko Road:** The minor street volumes on Dubarko Road were too low to meet signal warrants. However, they were very near the warrant threshold. While the recent crash history should be considered when assessing the need for signalization at this location, ODOT’s planned safety project to improve sight distance and channelization may be adequate. Therefore, this intersection should continue to be considered for signalization in the future.

- **US 26 at Langensand Road:** The minor street volumes on Langensand Road were too low to meet signal warrants.

- **US 26 at Vista Loop Drive West:** The minor street volumes on Vista Loop Drive West were too low to meet signal warrants.

- **US 26 at Vista Loop Drive East:** The minor street volumes on Vista Loop Drive East were too low to meet signal warrants.
Summary of Deficiencies

To provide a complete list of transportation system needs within the City of Sandy through the year 2029, a comprehensive summary of deficiencies for all modes noted under existing and future conditions is provided below.

Pedestrian System

- Sidewalks are partially obstructed by utility poles along the south side of US 26 between University Avenue and Bluff Road, and along the north side of Pioneer Boulevard in the couplet.
- At the intersection on US 26 westbound (Proctor Boulevard) with OR 211 (Meining Avenue), the northeast, southeast, and southwest corners have curb ramps with slopes greater than 5% and do not provide a landing area between the push buttons and the ramps. In addition, there are utility poles, fire hydrants, and street signs that limit accessibility of the ramp from the sidewalk.
- At the intersection of US 26 eastbound (Pioneer Boulevard) with OR 211 (Meining Avenue), the northeast corner has a utility pole between the curb ramp and the push-button.
- With the exception of the downtown area, distances between crossing opportunities on US 26 and OR 211 are very long. This makes crossings difficult for pedestrians, which creates a barrier effect and can encourage unprotected mid-block crossings. As a result, pedestrians attempting to cross US 26 outside the couplet area are commonly seen using the two-way left turn lane in the median as a refuge and have been documented crossing US 26 at intersection approaches where no signal protection is provided.
- Several key gaps in the sidewalk system were noted as follows:
  
  Gaps on the Arterial Street Network
  - North side of US 26 from Royal Lane to the west UGB
  - South side of US 26 from University Avenue west to Ruben Lane
  - US 26 from Ten Eyck Road to the east UGB
  - OR 211 from Pioneer Boulevard to the south UGB;
  - Bluff Road from Hood Street to the north UGB
  - West side of 362nd Drive from Industrial Way to the south UGB

  Gaps on the Collector Street Network
  - Industrial Way from 362nd Drive to US 26
  - Sandy Heights Street from Bluff Road to Bodley Court (intermittent)
Gaps around schools
  o Bluff Road from Hood Street to the north UGB
  o Pleasant Avenue between Scales Avenue and Strauss Avenue (north side of the street)
  o Pleasant Avenue between Meinig Avenue and Revenue Avenue (north side of the street)
  o Meinig Avenue between Scenic Street and Hood Street (west side of the street)

Gaps around other activity generators
  o Bluff Road from Hood Street to the north UGB
  o Meinig Avenue between Scenic Street and Hood Street (west side of the street)

Gaps around transit stops
  o North side of US 26 from Royal Lane to the west UGB
  o Industrial Way from 362nd Drive to US 26
  o University Avenue from US 26 to Sunset Street
  o Bluff Road from Bell Street to the north UGB
  o Vista Loop Drive from US 26 to Ortiz Street

Bicycle System
  - There are key gaps in the provision of bicycle facilities on area roadways, including:
    o OR 211 from Proctor Boulevard to the south UGB
    o US 26 from Ten Eyck Road to the east UGB (widening to provide a minimum shoulder of six feet)
    o West side of 362nd Drive from Industrial Way to the UGB
    o Ten Eyck Road from US 26 to the UGB
    o Langensand Road from US 26 to the UGB
    o Bluff Road from US 26 to Miller Street
    o Bornstedt Road from OR 211 to the UGB
    o Dubarko Road from 362nd Drive to Eldridge Drive
    o Dubarko Road from Sandy Heights Street to Reich Court

Motor Vehicle System
  Existing Conditions (2008)
    - In general, minor arterials within the city have not been constructed in accordance with the functional classification in the adopted TSP, which requires a three-lane cross-section.
    - Access spacing on many streets within the city, including state highways, does not comply with adopted standards. However, it should be pointed out that in most cases the access spacing on Bluff Road, Dubarko Road, and other minor arterials was established prior to the adoption of City and ODOT spacing standards.
• Poor pavement conditions are present on OR 211, Tupper Road north of Sandy Heights Street, and Vista Loop Drive.

• US 26 is a critical route for freight, both locally and statewide. However, it has also been shown to be heavily congested.

• All signalized intersections along US 26 are heavily congested during the 30th highest hour of the year and do not comply with ODOT adopted mobility standards. Furthermore, the following intersections currently experience vehicle queues that approach or exceed the available storage:
  o US 26 @ 362nd Drive
  o US 26 @ Industrial Way
  o US 26 @ Ruben Lane
  o US 26 @ Bluff Road
  o US 26 (Pioneer Boulevard) @ OR 211
  o US 26 (Proctor Boulevard) @ OR 211
  o US 26 @ Ten Eyck Road

• The unsignalized intersection on US 26 at Langensand Road does not comply with ODOT adopted mobility standards and does not currently meet warrants for signalization because of low traffic volume on Langensand Road.

• Under existing conditions, there are approximately three hours during the p.m. peak period where mobility standards are not being met along US 26.

• The intersections on US 26 (both Pioneer and Proctor Boulevards) at OR 211 rate among the top 10% of hazardous ODOT SPIS locations.

• The intersection of OR 211 at Dubarko Road has a relatively high crash rate and is rated among the top 10% of hazardous ODOT SPIS locations.

• The frequency of crashes along US 26 is higher within the downtown couplet than on other segments to the west and east.

• There have been a number of pedestrians struck by motor vehicles near the schools, including three school-age children during school hours, and in the downtown area.

Future Conditions (2029)
• In response to heavy congestion along US 26 in 2029 under No-Build conditions, the model indicates traffic will divert to the following routes.
  o Some of the traffic traveling between OR 211 and US 26 diverts to Dubarko Road and Langensand Road to reach the highway.
  o Some of the traffic traveling between the southwest area of the city and US 26 eastbound diverts to OR 211, Dubarko Road, Langensand Road, and 362nd Drive to avoid using US 26.
Some of the traffic traveling between Bluff Road north of the city and US 26 eastbound diverts through Hood Street and Pleasant Avenue to avoid the downtown couplet.

Some eastbound traffic on US 26 diverts to 362nd Drive and Industrial Way to attempt to bypass some of the US 26 queuing.

Other diversion routes used by US 26 eastbound traffic included Ruben Lane to Sandy Heights Street to Tupper Road to OR 211, as well as Bluff Road to Strawbridge Parkway to Tupper Road to OR 211.

- By 2029, on US 26 there will be at least seven hours of the day where traffic demands will exceed system capacity (v/c > 1.0), beginning as early as 8:00 a.m.

- By 2029, mobility standards for US 26 would not be met for at least 10 hours, beginning at 7:00 a.m. and continuing until sometime after 7:00 p.m. when the system has recovered.

- City intersections will continue to operate within adopted mobility standards, with the exception of the all-way stop controlled intersection of 362nd Drive at Industrial Way West and the 2-way stop controlled intersection of 362nd Drive at Dubarko Road. Both intersections degrade to LOS E.

- In the future, operations at the signalized intersections along US 26 will be degraded further. In addition, all stop-controlled intersections in the east US 26 corridor, including those at Langensand Road, West Vista Loop Drive, and East Vista Loop Drive, as well as the intersection on OR 211 at Dubarko Road, will fail to meet mobility standards. Signal warrants thresholds at these intersections are not projected to be met by 2029; due to low minor street traffic volume.

- Very long queues along the US 26 mainline should be expected for several hours of the day. Also, turn lane storage lengths at intersections will either be inadequate or the turn lanes will be frequently blocked by through traffic, leaving them underutilized.

- The congestion on US 26 also impacts queuing at nearby intersections surrounding the highway, such as 362nd Drive at Industrial Way and Dubarko Road at Ruben Lane.