City *of* Tigard, Oregon

2035 | TSP Technical Appendix

VOLUME 3 OF 3

March 2010

TIGARD

City of Tigard

2035 Transportation System Plan

Volume 3 of 3
Technical Appendix

Tigard, Oregon

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Technical Memo #1

Plans and Policy Review

Angelo planning group

LAND USE PLANNING • TRANSPORTATION PLANNING • PROJECT MANAGEMENT

Memorandum

Date: **June 25, 2009**

To: Project Management Team and Technical Advisory Committee

cc: Beth Wemple and Jamie Parks, Kittelson & Associates

From: DJ Heffernan, Angelo Planning Group

Shayna Rehberg, Angelo Planning Group

Re: Tigard Transportation System Plan Update
Technical Memorandum 2.2 – Document Review and Issues Report

I. Executive Summary

This memorandum provides an overview of state, regional, and local documents that form the regulatory framework for transportation planning in the City of Tigard. It also presents a report on issues related to consistency and compliance with applicable state and regional transportation plans and requirements.

Section II presents the document review. The documents reviewed are those identified in the scope of work. Although each document reviewed may contain many policies, strategies, standards and guidelines, only the policies and information pertinent to the City of Tigard and updating its Transportation System Plan (TSP) are included.

Section III of this memorandum, the "Issues Report," assesses the consistency of the current Tigard TSP with the documents reviewed in Section II, with a focus on the Transportation Planning Rule and the addition of Metro Regional Framework Plan and Functional Plan requirements. Table 8 reviews the requirements of TPR Section -0020, Elements of Transportation System Plans and identifies whether the City's current TSP complies. Table 8 also reviews the requirements of TPR Section -0045, Implementation of the Transportation System Plan, and Section -0060, Plan and Land Use Regulation Amendments, and identifies whether the City's adopted regulations comply. Based on the findings of the Issues Report, preliminary recommendations for amendments to the Tigard TSP and Community Development Code are presented below and at the conclusion of Section III.

TSP Policies

1. Provide for coordinating the review of land use applications with ODOT for properties that are adjacent to state road facilities.
2. Establish policies to support adding new construction and major modifications of transportation facilities as reviewable land use decisions.
3. Consider adding policies and related strategies to more specifically address water, natural areas, and environmental quality. Refer to regional resources being developed regarding the relationship between climate change, effects on water resources, flood hazard areas,

and transportation facilities, and create the basis and support for low-impact development practices including "green streets."

4. Add policies to support coordination of development and needed transportation facilities, and developing land uses that are appropriate for the classification of adjacent transportation facilities.
5. Add policies recognizing the Centers and Employment Areas, as designated in the Metro 2040 Concept, in the city.
6. Establish policies and related strategies for access management, including support for access modifications that bring access points into compliance, or closer to compliance, with ODOT and other applicable standards.
7. Develop policies to assist in establishing criteria to prioritize projects from the TSP.

TSP Modal and Other Elements

1. Continue developing projects and programs that make transportation options (namely walking, bicycling, and taking transit) more viable including complete and continuous walking and bicycling systems.
2. Use connections to transit as a criterion for evaluating not only pedestrian projects but bicycle projects.
3. Identify the needs of the transportation dependent and disadvantaged in the city.
4. Address Safe Routes to School programs.
5. Further develop transit information and technology improvements for the transit plan project list.
6. Make sure the street design standards and cross-sections presented in the TSP are consistent with those included in the City's Community Development Code (TCDC 18.810). Consider including Metro regional design overlay guidelines and overlay designations in the TSP.
7. Make sure access management standards presented in both the TSP and Community Development Code (TCDC 18.705.030) are consistent.
8. Address local delivery truck traffic in the city.
9. Evaluate whether the general categories "intersection safety enhancements" and "pedestrian crossings" in the 2002 TSP road improvement project list are needed or whether the list can be made up entirely of specific projects.
10. Pavement in the city is rated "good", "fair" and "poor," and consider rating other modal elements of the transportation system similarly, per the TPR.
11. Update descriptions of a city pavement management system that was being developed at the time of the last TSP.
12. Include mobility standards in the TSP. There are currently standards adopted for the Metro region (and included in the updated OHP) and the 2002 TSP presents transit service using level-of-service standards. Explore and potentially expand standards to address the pedestrian and bicycling systems.
13. Develop parking management plans for Centers and Employment Areas in the city. Consider developing residential parking districts, addressed in the TPR.
14. To expand the discussion of safety in the TSP, address safety education and alternate intersection treatments such as roundabouts.
15. Address the role of transportation facilities in environmental quality in the city. Consider adding standards for "green streets" and other development practices that are low-impact and mitigate water quality and flood concerns.
16. Address coordination of transportation planning in concept planning.

17. Be more specific about TDM and TSM measures that the City will commit to in order to conserve energy and maximize the transportation system and public investment. Include more energy efficient utility infrastructure improvements, such as LED lighting and signal replacement, in the TSM plan. Establish standards or benchmarks for TDM and TSM measures consistent with Metro's TSMO Plan.
18. Prepare a city ITS plan that coordinates local system operations with state and regional operation plans. Establish standards or benchmarks for ITS measures consistent with ODOT's Region 1 ITS Plan and Metro's TSMO Plan.
19. Identify land use regulations and code amendments needed to implement the TSP and include these in the implementation/funding element of the TSP.
20. In order to support creating a list of "financially constrained" or "reasonably likely" projects, identify funding sources for projects in the funding element of the TSP, or establish criteria by which to prioritize projects.
21. Report new funding sources or progress in developing funding sources identified as potential sources in the last TSP.

Community Development Code

1. Establish use regulations for transportation facilities – including roads, modifications to roads, transit facilities, bicycle facilities, and pedestrian facilities – in the City's land use districts.
2. Establish procedures for transportation project permitting or consolidated review.
3. Address coordinated review of land use applications with ODOT for properties that are adjacent to state road facilities.
4. Site review criteria in TCDC 18.360.090(11) require that provisions be made for transit for development proposed within 500 feet of an existing or planned transit line. The criteria do not include road geometrics and on-road parking restrictions, as addressed in the TPR, and consider whether to include these elements.
5. Evaluate whether to make provisions for pedestrian districts and, in terms of transit, building proximity to transit stops, pedestrian plazas at stops, accessible landing pads, easements for shelters, and transit stop lighting in the code.
6. Refer to local connectivity plans in the TSP as approval criteria in the code for land divisions and in the street improvement standards.
7. Explicitly address consistency with transportation standards in criteria for quasi-judicial amendments to the Development Code and zoning map, listed in TCDC 18.380.030(B).
8. Include procedures and criteria for legislative amendments to the Comprehensive Plan in the code.
9. Establish criteria consistent with TPR Section –0060 in decision-making considerations for Type IV legislative procedures established in TCDC 18.390.060(G).
10. Specify minimizing adverse impacts or protecting transportation facilities as development approval criteria in TCDC 18.430.
11. Make sure the access management standards in TCDC 18.705.030(H) are consistent with those in the TSP.
12. Consider adding conditional on-street parking credits for off-street parking requirements.
13. Address parking in large free surface parking lots that serve more than one use in the maximum off-street parking requirements.
14. Once transportation facilities, including transit amenities and facilities are incorporated into use regulations in the land use/zoning districts, add bicycle parking requirements for transit stations and park-and-ride lots.
15. Remove maximum parking requirements for bicycle parking.

16. Add code language to support "skinny street" cross-sections shown in Figures 18.810.4 – 18.810.6, and provide more guide or requirements for their usage.
17. Articulate a connection between the findings of traffic studies required by TCDC 18.810.030(AC) and potential conditions of development approval.

Comprehensive Plan/Community Development Code

1. Evaluate zoning along existing and planned transit routes in the city. Existing zoning is a combination of mixed-use commercial, residential, and employment (MUC, MUR, and MUE), R-12 and R-25, and C-P, C-G, and CBD. The mixed-use zones, residential zones, and CBD allow for densities that are transit-supportive. However, other than the MUR and CBD zones, these zones do not allow mixed uses that are particularly transit-oriented (a mix of commercial and residential in buildings) and some allow very auto-oriented uses that are not transit-supportive. Consider amending use regulations in these districts or re-zoning to create more transit-supportive zoning in these transit corridors.

Projects

Evaluate the TSP project list to address the projects found in the document review but not in the 2002 TSP.

1. **2008-2011 STIP**
    a. A Bicycle/Pedestrian program multi-use trail project
    b. A Transportation Enhancement program set of streetscape improvements in Downtown Tigard.
2. **2008 RTP** – See Tables 12 and 13 (starting on p. 71). Also consult special plans including Metro's High Capacity Transit (HCT), Transportation Systems Management & Operations (TSMO), and Freight Plans.
3. **Highway 217 Corridor Study**
    a. 72nd Avenue interchange improvements
    b. OR 99W interchange improvements
    c. Scholls Ferry/Greenburg Road interchange improvements
    d. Specify number of lanes of Hall Boulevard widening south of Locust.
    e. Improvements on all overcrossings
    f. A bicycle/pedestrian overcrossing to the Fanno Creek Trail
    g. A connection to the Washington Square trail
    h. An I-5/72nd Avenue path
4. **TriMet TIP**
    a. Corridor study in the Barbur Boulevard/Highway 99W corridor for bus rapid transit and light rail transit
    b. Bus line 76-Beaverton/Tualatin (Hall Boulevard) upgraded to Frequent Service
    c. Coordination between the City and TriMet for investing in sidewalks, crossings, lighting, shelters, benches, and bus stop spacing improvements for the frequent service upgrade
    d. Revised bus service to better coordinate with WES service
    e. Improvements for the Tigard Transit Center Station, including 100 park-and-ride spaces, support for connections with five bus lines, and recommendations from a local plan (capital projects such as shelters, benches, and sidewalks and additional transit service on Bonita Road)

f. Added service on 72nd Avenue in order to connect businesses on 72nd Avenue with commuter rail and to better serve the Sequoia Parkway employment area

2. Tigard Downtown Improvement Plan

a. Street design and function improvements for Burnham, Main, Commercial, and Scoffins, and gateway improvements for Scoffins, Main, Garden Place, and Tigard Street as part of the plan's Streetscape Enhancement Program
b. Walkways in the Green Corridor/Urban Creek area
c. Street improvements on Ash Avenue from the planned park-and-ride to Fanno Creek, including a new bike and pedestrian bridge and extension of Ash Avenue from Burnham to the park-and-ride
d. Coordination with City Pedestrian and Bicycle Plans on access related to Downtown
e. Draft design requirements and guidelines for "Green Street" street treatments
f. New cross-sections for Hall Boulevard and OR 99W (collaboration with ODOT)
g. Highway Design Manual street design guidelines blending features of both ODOT and Metro Street design requirements
h. Parking Management Plan once Downtown begins to significantly grow and prior to any structured parking
i. Construction of an at-grade railroad crossing (collaboration with Portland & Western Railroad and the ODOT Rail Division).

3. Washington Square Regional Plan

a. More frequent bus service to the Regional Center
b. Washington Square transit center improvements
c. A local circulator
d. Overcrossing to connect Nimbus to Locust
e. Improvement of Oak/Lincoln/Locust collector system
f. Evaluation of whether new bikeways can be designated in the Regional Center

4. Highway 99W Improvement and Management Plan

a. Raised medians along 40% of the OR 99W corridor in Tigard at locations north of Gaarde/McDonald Street
b. An Access Management Plan with a focus on driveway management for properties with multiple driveways, with access to side streets, or within 200 feet of intersections
c. Sidewalks where there are gaps in the system in the study area corridor.
d. Sidewalk upgrades to have four-foot landscaping strips and eight-foot pedestrian zones
e. Signalized pedestrian activated crossing at the intersection with Watkins Avenue
f. Six-foot bike lanes where there are gaps in the system in the corridor
g. Signage for sections where bicyclists need to share the sidewalk with pedestrians
h. Transit improvements: relocation of bus stops and queue bypasses at five intersections (68th Avenue, Dartmouth Avenue, Hall Boulevard, Walnut Street, and Gaarde, McDonald Street)
i. Widening of the following intersections to allow for new turn or through lanes and/or transit queue bypass lanes:
    i. 68th Avenue – transit bypass lane
    ii. Dartmouth Avenue – transit bypass lane, southbound through lane
    iii. Hall Boulevard – bypass lane, westbound turn lane. The TSP includes a westbound right-turn lane and right-turn lane overlap in its intersection improvements list (Chapter 8).
    iv. Greenburg Road – eastbound/westbound left-turn lanes

v. Gaarde/McDonald – transit bypass lane, northbound/southbound left-turn lanes, eastbound/westbound through lanes, eastbound/westbound left-turn lanes. The TSP includes a 2nd northbound left-turn lane in its intersection improvements list (Chapter 8).
vi. Canterbury – westbound left-turn lane
vii. Durham Road – northbound left turn lane.

5. **General project recommendations –** Projects related to low-impact development, projects that serve the Centers and Employment Areas in the city, and projects in the north and west areas of the city where most annexations have occurred.

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II. Plan and Policy Review

The following documents were reviewed for policies, standards, guidelines, projects and programs applicable to the City's transportation planning process and updated TSP. They are documents specified in the project scope.

State/ODOT

- Oregon Statewide Planning Goals (1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14)
- Oregon Transportation Planning Rule (OAR 660-012)
- Oregon Access Management Rule (OAR 734-051)
- Oregon Transportation Plan
- Oregon Highway Plan
- ODOT Highway Design Manual
- 2008-2011 State Transportation Improvement Program (STIP)
- 2008 Transportation System Planning Guidelines

County/Regional Plans

- Metro 2040 Growth Concept
- Metro 2035 Regional Transportation Plan (RTP)
- Metro Evaluation of Potential Measures for Achieving Modal Targets
- Metro Highway 217 Study
- TriMet Investment Plan
- TriMet Elderly and Disabled Plan
- Washington County Transportation Plan

Local Plans and Ordinances

- City of Tigard 2002 Transportation System Plan (TSP)
- City of Tigard Comprehensive Plan
- City of Tigard Community Development Code
- City of Tigard Downtown Improvement Plan
- City of Tigard Washington Square Regional Center Plan
- City of Tigard Highway 99W Improvement and Management Plan
- City of Tigard Capital Improvement Plan (CIP)
- City of Tigard Annexations

STATE OF OREGON/ODOT

Statewide Planning Goals

Statewide Planning Goal 1: Citizen Involvement

Goal 1, Citizen Involvement, requires jurisdictions that develop, adopt, and update comprehensive plans to provide the "opportunity for citizens to be involved in all phases of the planning process." According to the goal, the planning process includes the preparation of plans and implementation measures, plan and implementation measure adoption, and minor and major amendments to adopted plans. Technical information associated with the planning process must be available to citizens in an understandable form, and accessible ways of feedback must also be available.

The Tigard TSP update must follow these requirements in the series of meetings, hearings, and outreach measures that will be a part of the update process. There are a set of four meetings scheduled for the project Technical Advisory Committee (TAC), Citizen Advisory Committee (CAC), and the public. Additionally, there will be hearings held by the Planning Commission and City Council during the adoption process, which will be open to the public.

Statewide Planning Goal 2: Land Use Planning

Goal 2, Land Use Planning, requires that a land use planning process and policy framework be established as a basis for all decisions and actions relating to the use of land. Goal 2 is important for four reasons. Goal 2 requires planning coordination between those local governments and state agencies "which have programs, land ownerships, or responsibilities within the area included in the plan." In the case of the Tigard TSP update, Goal 2 requires coordination between the City of Tigard, Washington County, Metro, TriMet, and ODOT, each with a combination of land use planning and transportation facility or service responsibilities in the planning area.

Statewide Planning Goal 5: Natural Resources, Scenic and Historic Areas, and Open Spaces

The purpose of Goal 5, Natural Resources, Scenic and Historic Areas, and Open Spaces, is to "protect natural resources and conserve scenic and historic areas and open spaces." This goal requires local governments to inventory natural and cultural resources in their jurisdictions and to develop and adopt programs to conserve and protect them. Amongst the resources to be inventoried are: riparian corridors, wetlands, federal Wild and Scenic Rivers, state Scenic Waterways, groundwater resources, wildlife habitat (e.g. upland habitat in addition to riparian habitat), natural areas, wilderness areas, open spaces, scenic views and sites, mineral and aggregate resource areas, energy sources, and historic and cultural areas. Suggestions for implementing conservation and protection of these resources include fee acquisition, development rights acquisition, easements, preferential tax assessment, and clustered development.

There are several Goal 5 resources in Tigard that are bridged by or adjacent to transportation facilities in the City. Goal 5 resources on land in the City has been identified and mapped, and these resources are discussed in more detail in the section of this memorandum on the City's Comprehensive Plan and its Goal 5 Element.

Statewide Planning Goal 6: Air, Water and Land Resources Quality

Jurisdictions must comply with state and federal environmental agency regulations. Goal 6, Air, Water and Land Resources Quality, calls for jurisdictions to "maintain and improve the quality of the air, water and land resources of the state." Waste and process discharges within a jurisdiction may not exceed the carrying capacity of the local air shed and water shed in the long-term, nor degrade the quality or otherwise threaten the availability of the air shed and water shed services.

This goal and corresponding policies in the City's Comprehensive Plan must be taken into account in developing and selecting preferred alternatives and implementation measures in the Tigard TSP update.

Statewide Planning Goal 7: Areas Subject to Natural Hazards

Goal 7, Areas Subject to Natural Hazards, was adopted to "protect people and property from natural hazards." The goal requires local jurisdictions to adopt comprehensive plans, including inventories, policies, and implementation measures, for identifying natural hazard areas and prohibiting or limiting development in these areas. Although local jurisdictions may define others, the goal defines natural hazard areas as those subject to floods, tsunamis, landslides, coastal erosion, earthquakes and related activities, and wildfires.

Similar to Goal 5 resources, natural hazards will need to be identified in the planning area as part of the TSP update process. In Tigard, stream flooding and steep slopes constitute the primary natural hazards.

Statewide Planning Goal 8: Recreational Needs

Goal 8, Recreational Needs, was adopted to "satisfy the recreational needs of the citizens of the state and visitors, where appropriate, to provide for the siting of necessary recreational facilities including destination resorts." The goal requires that local government conduct comprehensive recreational planning by identifying recreational needs, planning for facilities in sufficient quantities and locations to meet these needs, and working with private companies and other partners in meeting these needs. This goal will apply to the TSP update insofar as multi-use trails and other paths function as both transportation facilities and recreational opportunities.

Statewide Planning Goal 9: Economic Development

The intent of Goal 9, Economic Development, is to "provide adequate opportunities throughout the state for a variety of economic activities vital to the health, welfare, and prosperity of Oregon's citizens." Local comprehensive plans and policies must support this goal and should include an assessment of the jurisdiction's existing economic conditions and comparative advantages, policies generally and specifically addressing economic development and development opportunities, provide an adequate supply of sites with characteristics suitable for a variety of employment and economic development, and limit development around identified industrial sites to that which is compatible with uses allowed on the sites. The goal suggests implementation measures such as tax incentives and disincentives, preferential assessments, land use regulations, capital improvement planning and programming, and fee or partial fee acquisition.

The TSP must demonstrate the ways in which the preferred alternatives and projects selected for the TSP update support this goal and the economic development policies adopted in the City's Comprehensive Plan. There are target areas, such as Downtown Tigard, that are a focus for both economic development and transportation investment.

Statewide Planning Goal 10: Housing

Goal 10, Housing, forms the basis for requiring a 20-year supply of land for housing – among other uses – within a city's or metropolitan planning organization's Urban Growth Boundary (UGB). The goal states that "plans shall encourage the availability of adequate numbers of needed housing units at price ranges and rent levels which are commensurate with the financial capabilities of Oregon households and allow for flexibility of housing location, type and density." UGB expansions in Tigard made recently and those that may be made in the next 20 years in order to

provide sufficient amounts and types of housing must be coordinated with transportation planning, a coordination also addressed by Goal 11, Public Facilities.

Statewide Planning Goal 11: Public Facilities

Public facilities that are named in Statewide Planning Goal 11 include water, sewer, solid waste, and transportation facilities. Goal 11 establishes the requirement for the preparation of public facility plans for jurisdictions with populations greater 2,500. The public facility plan or plans are supporting documents to the jurisdiction's comprehensive plan. As such, a TSP effectively serves as a jurisdiction's public facility plan for transportation, although a TSP becomes an element of the comprehensive plan, not just a supporting document.

Transportation system planning is addressed further by Statewide Planning Goal 12 and the TPR. However, Goal 11 is important in calling for the coordination between planning for various public facilities and between the state and agencies and jurisdictions that it provides with funding for water, sewer, solid waste, and transportation facility planning and development. The goal also recognizes the balance between not using public facilities to inappropriately or prematurely urbanize an area and providing adequate public facilities to developing areas or allowing public facilities to influence planning for the density and types of development.

Statewide Planning Goal 12: Transportation

Statewide Planning Goal 12, Transportation, requires cities, counties, metropolitan planning organizations, and ODOT to provide and encourage a safe, convenient, and economic transportation system. This is accomplished through development of transportation system plans (TSPs) based on inventories of local, regional, and state transportation needs.

Goal 12 is implemented through OAR 660, Division 12, the Transportation Planning Rule (TPR). The TPR contains numerous requirements governing transportation planning and project development. The TPR requires local governments to adopt land use regulations consistent with state and federal requirements "to protect transportation facilities, corridors and sites for their identified functions OAR 660-012-0045(2)." This policy is achieved through a variety of measures, including:

- Access control measures that are consistent with the functional classification of roads and consistent with limiting development on rural lands to rural uses and densities;
- Standards to protect future operations of roads;
- A process for coordinated review of future land use decisions affecting transportation facilities, corridors or sites;
- A process to apply conditions to development proposals in order to minimize impacts and protect transportation facilities, corridors or sites;
- Regulations to provide notice to ODOT of land use applications that require public hearings, involve land divisions, or affect private access to roads; and
- Regulations assuring that amendments to land use designations, densities and design standards are consistent with the functions, capacities and performance standards of facilities identified in the TSP. (See also OAR 660-012-0060.)

The Land Conservation and Development Commission (LCDC) rules implementing Goal 12 do not regulate access management. OAR 734, Chapter 51 (OAR 734-051) was adopted to address access management and it is expected that ODOT, as part of this project, will engage in access management consistent with its Access Management Rule. The Access Management Rule is address later in this section of the memorandum.

The TPR requires local governments to adopt land use regulations consistent with state and federal requirements "to protect transportation facilities, corridors, and sites for their identified functions OAR 660-012-0045(2)." A review of the compliance of Tigard's current TSP with these and other TPR provisions is presented in Section III of this memorandum.

Statewide Planning Goal 13: Energy Conservation

The objective of Goal 13 is to conserve energy. This goal requires land and land uses to "be managed and controlled so as to maximize the conservation of all forms of energy, based upon sound economic principles." While land use planning can support transportation alternatives and measures to conserve energy, provisions for viable transportation alternatives and energy-conserving measures must also be made in the update of the City's TSP.

Statewide Planning Goal 14: Urbanization

Goal 14 regulates urban growth boundaries. The goal provides that establishment and change of a UGB shall be based upon consideration of the following four factors:

1. Efficient accommodation of identified land needs;
2. Orderly and economic provision of public facilities and services;
3. Comparative environmental, energy, economic, and social consequences;
4. Compatibility of the proposed urban uses with nearby agricultural and forest activities occurring on farm and forest land outside the UGB.

The orderly and economic provision of transportation facilities in cities is regulated largely by the TPR, also addressed elsewhere in this memorandum. In Section –0045 of the TPR, Implementation of the Transportation System Plan, the rule requires that local governments revise their land use regulations to implement the TSP. The following is a summary of the requirements:

- Amend land use regulations to reflect and implement the TSP.
- Adopt land use or subdivision ordinance measures, consistent with applicable federal and state requirements, to protect transportation facilities, corridors and sites for their identified functions, to include the following topics:
    - access management and control;
    - protection of public use airports;
    - coordinated review of land use decisions potentially affecting transportation facilities;
    - conditions to minimize development impacts to transportation facilities;
    - regulations to provide notice to public agencies providing transportation facilities and services of land use applications that potentially affect transportation facilities;
    - regulations assuring that amendments to land use applications, densities, and design standards are consistent with the Transportation System Plan.
- Adopt land use or subdivision regulations for urban areas and rural communities to provide safe and convenient pedestrian and bicycle circulation and bicycle parking, and to ensure that new development provides on-site streets and accessways that provide reasonably direct routes for pedestrian and bicycle travel.
- In MPO areas, adopt land use and subdivision regulations to reduce reliance on the automobile.
- Identify improvements to facilitate bicycle and pedestrian trips in developed areas.
- Establish street standards that minimize pavement width and total right-of-way.

The current Tigard TSP is audited according to these requirements in Section III, and the updated TSP will need to respond to the audit findings.

Transportation Planning Rule (OAR 660-012) (last amended 2005)

Statewide Planning Goal 12, Transportation, requires cities, counties, metropolitan planning organizations, and ODOT to provide and encourage a safe, convenient, and economic transportation system. This is accomplished through development of Transportation System Plans (TSPs) based on inventories of local, regional and state transportation needs. Goal 12 requirements state that transportation plans shall:

- *consider all modes of transportation, including pedestrian, bicycle, highway, rail, mass transit, air, water, and pipeline*
- *be based upon an inventory of local, regional, and state transportation needs*
- *consider the differences in social consequences that would result from utilizing differing combinations of transportation modes*
- *avoid principal reliance on any one mode of transportation*
- *minimize adverse social, economic, and environmental impacts and costs and conserve energy*
- *meet the needs of the transportation disadvantaged*
- *facilitate the flow of goods and services so as to strengthen the local and regional economy*
- *conform with local and regional comprehensive land use plans*
- *be developed, adopted, amended and implemented in accordance with the standards set out in OAR 660, Division 12.*

In 1991, the LCDC, with concurrence from ODOT, adopted the Transportation Planning Rule, OAR 660 Division 12, to implement Statewide Planning Goal 12. The TPR requires cities with a population of 2,500 or greater to prepare and adopt a TSP. All counties are also required to prepare and adopt a TSP. The elements required in a TSP pursuant to Section -0020 are addressed in greater detail in Section III of this memorandum. The elements include:

- *A determination of transportation needs (per OAR 660-012-030);*
- *A road plan of arterial, collector, and local streets, standards for each functional classification, and between functional classifications in local, regional, and state transportation plans. The road plan and standards must show connections of existing and planned streets, and connections to community destinations;*
- *A public transportation plan;*
- *A bicycle and pedestrian plan;*
- *An air, rail, water, and pipeline transportation plan;*
- *Policies and land use regulations for TSP implementation (per OAR 660-012-045);and*
- *A transportation financing program.*

The Tigard TSP update is intended to address all TSP elements as needed, including the road plan, bicycle and pedestrian plan, transit plan, implementation policies, land use regulations, and a financing program.

OAR Section 660-12-0045, Implementation of the TSP, requires local governments to adopt land use regulations consistent with state and federal requirements "to protect transportation facilities,

corridors, and sites for their identified functions." Requirements from Section -0045 are outlined below:

- Amend land use regulations to reflect and implement the Transportation System Plan.
- Adopt land use or subdivision ordinance measures, consistent with applicable federal and state requirements, to protect transportation facilities, corridors and sites for their identified functions, to include the following topics:
  - access management and control;
  - standards to protect future road and transit operations;
  - protection of public use airports;
  - coordinated review of land use decisions potentially affecting transportation facilities;
  - conditions to minimize development impacts to transportation facilities;
  - regulations to provide notice to public agencies providing transportation facilities and services of land use applications that potentially affect transportation facilities; and
  - regulations assuring that amendments to land use applications, densities, and design standards are consistent with the Transportation System Plan.
- Adopt land use or subdivision regulations for urban areas and rural communities to provide safe and convenient pedestrian and bicycle circulation and bicycle parking, and to ensure that new development provides on-site streets and accessways that provide reasonably direct routes for pedestrian and bicycle travel.
- Identify improvements to facilitate bicycle and pedestrian trips in developed areas, which provide safer and more direct access within and between residential areas and neighborhood activity centers such as constructing walkways between cul-de-sacs and adjacent roads, walkways between buildings, and access between adjacent lots and uses.
- Establish street standards that minimize pavement width and total right-of-way.

Access Management Rule (OAR 734-051)

Oregon Administrative Rule 734-051 defines the State's role in managing access to highway facilities in order to maintain functional use and safety and to preserve public investment. The provisions in the OAR apply to the roadways under Oregon State jurisdiction within the City of Tigard, namely Interstate Highway 5 (I-5) and OR 99W, OR 141, OR 210, and OR 217. The access management rules include spacing standards for varying types of state roadways.[1] It also lists criteria for granting right of access and approach locations onto state highway facilities.

The spacing standards for OR 99W (Statewide Highway) and for OR 141/Hall Boulevard and OR 210/Scholls Ferry Road (District Highways) are presented in Tables 1 and 2 below.

Table 1. Spacing Standards for Urban Non-Designated Statewide Highways

Posted Speed (mph)	Spacing (feet)
55 and higher	1,320
50	1,100
40-45	990
30-35	720
25 and lower	520

[1] "Spacing Standards" mean Access Management Spacing Standards as set forth in OAR 734-051-0115 and specified in Tables 2, 3, and 4, adopted and made a part of Division 51 rules.
These standards are also included in the updated 2006 Oregon Highway (OHP). Tables 12, 13, 14, and 15 in Appendix C present spacing standards for Interchanges, Statewide Highways, Regional, and District Highways.

Table 2. Spacing Standards for Urban Non-Designated District Highways

Posted Speed (mph)	Spacing (feet)
55 and higher	700
50	550
40-45	500
30-35	350
25 and lower	350

For the section of OR 141/Hall Boulevard that is designated as a Special Transportation Area (STA) (MP 2.84-3.84), the following standards apply:

> *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 or mid-block if the current city block is less than 350 feet.*[2]

Oregon Transportation Plan (2006)

Originally adopted in 1992, the Oregon Transportation Plan (OTP) is a policy document developed by ODOT in response to federal and state mandates for systematic planning for the future of Oregon's transportation system. The OTP is intended to meet statutory requirements in ORS 184.618(1) to develop a state transportation policy and comprehensive long-range plan for a multi-modal transportation system that addresses economic efficiency, orderly economic development, safety, and environmental quality. The 2006 OTP expands on the policy objectives of the 1992 plan, with an emphasis on maintaining assets in place, optimizing existing system performance through technology and better system integration, creating sustainable funding, and investing in strategic capacity enhancements.[3]

The OTP's goals, policies and strategies guide the development of state multimodal, modal/topic and facility plans, and regional and local transportation system plans.[4] The OTP provides the framework for prioritizing transportation improvements and funding, but it does not identify specific projects for development.[5] As required by Oregon and federal statutes, the OTP guides development and investment in the transportation system through:

- Transportation goals and policies,
- Transportation investment scenarios and an implementation framework, and
- Key initiatives to implement the vision and policies.

[2] OHP, Appendix C, Tables 13, 14, and 15, Footnote 6.

[3] The OTP defines "asset management" as a "systematic process of maintaining, upgrading and operating physical assets cost-effectively. It combines engineering principles with sound business practices and economic theory, and it provides tools to facilitate a more organized, logical approach to decision-making. Asset management provides a framework for handling both short- and long-range planning."

[4] Modal or topic plans, as developed by ODOT and other state agencies, include plans for aviation, bicycle and pedestrian facilities, highways, marine ports and waterways, public transportation and rail.

[5] Projects are identified through facility plans and regional and local transportation system plans, and sometimes through modal plans.

Goals in the OTP include: Mobility and Accessibility; Management of the System; Economic Vitality; Sustainability; Safety and Security; Funding the Transportation System; and Coordination, Communication and Cooperation. Policies and strategies under many of these goals emphasize increasing coordination and cooperation among federal and state agencies, regional and local governments and private entities to achieve these goals.

The Implementation Framework section of the OTP describes the implementation process and how state multimodal, modal/topic plans, regional and local transportation system plans and master plans will further refine the OTP's broad policies and investment levels. Local transportation system plans can further OTP implementation by defining standards, instituting performance measures, and requiring that operational strategies be developed.[6]

The Implementation section also describes three investment levels, examples of the investment priorities for each level of investment, and their impacts on the transportation system. These levels are described as "flat funding" (Level 1), "maintaining and improving existing infrastructure" (Level 2), and "expanding facilities and services" (Level 3). The recommendation in the OTP is for the State to invest at levels closer to Level 3 "in order to be competitive economically and to have the transportation infrastructure and services that allow communities to function well."

Finally, a list of "key initiatives" describes the OTP's implementation priorities. The key initiatives frame plan implementation and reflect the directions of the OTP including system optimization, integration of transportation modes, integration of transportation, land use, the environment and the economy, and the need to make strategic investments using a sustainable funding structure. The key initiatives strive to create a sustainable funding plan using both traditional and new revenue sources.

Oregon Highway Plan (1999, last amended 2006)

The Oregon Highway Plan (OHP), an element and modal plan of the state's comprehensive transportation plan (OTP), guides the planning, operations, and financing of ODOT's Highway Division. Policies in the OHP emphasize the efficient management of the highway system to increase safety and maximize highway capacity, partnerships with other agencies and local governments, and the use of new techniques to improve road safety and capacity. These policies also link land use and transportation, set standards for highway performance and access management, and emphasize the relationship between state highways and local road, bicycle, pedestrian, transit, rail, and air systems.

The Oregon Transportation Commission (OTC) adopted the OHP in 1999 and in July 2006, ODOT published an update that includes amendments made from November 1999 through January 2006. The updated Tigard TSP will need to be consistent with the OHP and its amendments. The policies found within the OHP that apply to state facilities in the City of Tigard include:

Policy 1A: State Highway Classification System;

Policy 1B: Land Use and Transportation;

Policy 1C: State Highway Freight System;

[6] As stated in the Implementation section of the OTP, requirements for regional and local transportation system plans (TSPs) are found in the Transportation Planning Rule (OAR 660-012). Regional and local TSPs must be consistent with the State TSP (the OTP), state multimodal, modal/topic, and transportation facility plans.

Policy 1F: Highway Mobility Standards;

Policy 1G: Major Improvements;

Policy 2B: Off-System Improvements;

Policy 2E: Intelligent Transportation Systems

Policy 2F: Traffic Safety;

Policy 3A: Classification and Spacing Standards;

Policy 3B: Medians;

Policy 3C: Interchange Access Management Areas;

Policy 4A: Efficiency of Freight Movement;

Policy 4B: Alternative Passenger Modes;

Policy 4C: High-Occupancy Vehicle (HOV) Facilities;

Policy 4D: Transportation Demand Management;

Policy 4E: Park and Ride Facilities; and

Policy 5A: Environmental Resources.

Policy 1A: State Highway Classification System
The state highway classification system includes five classifications: Interstate, Statewide, Regional, District, and Local Interest Roads. In addition, there are four special purpose categories that overlay the basic classifications: special land use areas, statewide freight route, scenic byways, and lifeline routes. These special designations supplement the highway classification system and are used to guide management, needs analysis, and investment decisions on the highway system.

There is one Interstate Highway (I-5), two Statewide Highways (OR 217 and OR 99W), and two District Highways (OR 141 and OR 210) in the City of Tigard. I-5 and OR 210 run along the border of the city. I-5 and the two Statewide Highways are all Freight Routes and part of the National Highway System (NHS).

Policy 1A defines Interstate and Statewide Highways as follows:

> *Interstate Highways (NHS) provide connections to major cities, regions of the state, and other states. A secondary function in urban areas is to provide connections for regional trips within the metropolitan area. The Interstate Highways are major freight routes and their objective is to provide mobility. The management objective is to provide for safe and efficient high-speed continuous-flow operation in urban and rural areas.*
>
> *Statewide Highways (NHS) typically 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. A secondary function is to provide connections for intra-urban and intra-regional trips. The management objective is to provide safe and efficient, high-speed, continuous-flow operation. In constrained and urban areas, interruptions to flow should be minimal. In constrained and urban areas, interruptions to flow should*

> *be minimal. Inside Special Transportation Areas (STAs), local access may also be a priority.*

The federal Intermodal Surface Transportation Efficiency Act of 1991 required the establishment of a National Highway System (NHS) to provide an interconnected system of principal arterial routes that will serve "interstate and inter-regional travel." ODOT has an obligation to ensure that the NHS in Oregon adequately performs this function of serving a larger geographic area.

Not part of the NHS, District Highways are defined in Policy 1A as follows:

> *District Highways are facilities of county-wide significance and function largely as county and city arterials or collectors. They provide connections and links between small urbanized areas, rural centers and urban hubs, and also serve local access and traffic. The management objective is to provide for safe and efficient, moderate to high-speed continuous-flow operation in rural areas reflecting the surrounding environment and moderate to low-speed operation in urban and urbanizing areas for traffic flow and for pedestrian and bicycle movements. Inside STAs, local access is a priority.*

Policy 1B: Land Use and Transportation
This policy recognizes the role of both the State and local governments related to the state highway system and calls for a coordinated approach to land use and transportation planning. Special Transportation Areas (STAs), Urban Business Areas (UBAs) and Commercial Centers (CCs) are included as action items under this policy. Within STAs and UBAs, highways may be managed to provide a greater level of local access than ODOT standards would otherwise allow.

An STA in Tigard was adopted in 2004, along its northern border in the Washington Square Regional Center. One mile of OR 141 (Hall Boulevard), a District Highway, was designated from MP 2.84 at Scholls Ferry Road to MP 3.84 at SW Hemlock Street.

Policy 1C: State Highway Freight System
This policy recognizes the need for the efficient movement of freight through the state. In Tigard, I-5, OR 217, and OR99W are designated State Highway Freight Routes.

Policy 1F: Highway Mobility Standards Access Management Policy
This policy addresses state highway performance expectations for planning and plan implementation or amendment, as well as providing guidance for managing access and traffic control systems. Action 1F.1 states that highway mobility standards apply to all state highway sections; for areas outside of the Portland Metro area, the maximum volume to capacity ratios for peak hour operating conditions in Table 6 apply. Action 1F.5 states that, where the volume-to-capacity (v/c) ratio is worse than the identified standards in the OHP and transportation improvements are not planned, the performance standard for the highway shall be to improve performance as much as feasible and to at least avoid further degradation of performance if measures to improve performance are infeasible.

The policy allows for the adoption of alternative highway mobility standards in cases such as metropolitan areas trying to strictly manage their growth, STAs, and in areas with unique environmental and land use constraints. Alternative standards have been adopted in the Portland metropolitan region.

Policy 1G: Major Improvements
This policy requires maintaining performance and improving safety by improving efficiency and management before adding capacity.

Policy 2B: Off-System Improvements
This policy recognizes that the state may provide financial assistance to local jurisdictions to make improvements to local transportation systems if the improvements would provide a cost-effective means of improving the operations of the state highway system.

Policy 2E: Intelligent Transportation Systems (ITS)
This policy seeks to improve the safety and efficiency of transportation facilities, and to generally maximize operations in a cost-effective way. The policy requires coordination with the Oregon Intelligent Transportation Systems Strategic Plan.

The 2002 Tigard TSP addresses ITS elements specified in Policy 2E. The plan refers to ramp meters that ODOT has planned for all I-5 and OR 217 on-ramps within Tigard, noting that the OR 217 ramps in Tigard are now all metered. The Tigard TSP calls for coordination between the City and ODOT in developing ramp meter bypass lanes for high occupancy vehicles and transit.

The TSP also acknowledges Advanced Traffic Management Systems (ATMS) measures such as "smart" ramp meters, automated vehicle performance responsive facilities, improved traffic signal systems, improved transit priority, and improved trip information that is available before making a vehicle trip. The plan envisions that some of this information will be produced by Tigard, but most will be developed by ODOT or other private and public ITS partners.

Policy 2F: Traffic Safety
This policy emphasizes the state's efforts to improve safety of all users of the highway system. Action 2F.4 addresses the development and implementation of the Safety Management System to target resources to sites with the most significant safety issues.

Policy 3A: Classification and Spacing Standards
This policy addresses the location, spacing, and type of road and street intersections and approach roads on state highways. It includes standards for each highway classification. The adopted standards are found in Appendix C of the Oregon Highway Plan; generally, the minimum access spacing distance increases as either the highway's importance or posted speed increases. The access management spacing standards established in the OHP are implemented by OAR 734, Division 51.[7]

Policy 3B: Medians
This policy establishes the state's criteria for the placement of medians. It includes Action 3B.3 which requires the consideration of non-traversable medians for modernization of all urban, multi-lane Statewide (National Highway System) Highways. The criteria for consideration include:

- Forecasted average daily traffic greater than 28,000 vehicles per day during the 20-year planning period;

[7] Oregon Revised Statute (OAR) 734, Division 51, was amended in September 2005 to be consistent with August 2005 OHP revisions to Policy 1B. Specifically, the spacing standards in OAR 734-051 were amended to be consistent with the OHP tables in Appendix C, Access Management Standards.

- A higher-than-average accident rate;
- Pedestrian crossing safety issues; and
- Topographic and alignment issues resulting in inadequate left-turn sight distances.

Policy 3C: Interchange Access Management Areas
This policy calls for planning and management of grade-separated interchange areas for safe and efficient function of the interchange and surrounding road network. Interchange Area Management Plans (IAMPs) are required in the case of new construction or reconstruction of an interchange. There are two existing I-5 interchanges along the eastern border of Tigard- one at OR 217 and the other at Upper Boones Ferry Road.

Policy 4A: Efficiency of Freight Movement
This policy emphasizes the need to maintain and improve the efficiency of freight movement on the state highway system. I-5, OR 217, and OR 99W are designated State Highway Freight Routes.

Policy 4B: Alternative Passenger Modes
This policy encourages the development of alternative passenger services and systems as part of broader corridor strategies and promotes the development of alternative passenger transportation services located off the highway system to help preserve the performance and function of the state highway system. The existing Tigard TSP includes plan elements for bicycle, pedestrian, and transit planning to provide transportation alternatives in the city.

Policy 4C: High-Occupancy Vehicle (HOV) Facilities
This policy supports the use of HOV lanes and facilities to improve highway efficiency in areas where travel demand, land use, and transportation alternatives like transit are supportive of such facilities. HOV facilities are to work to support other HOV facilities and other elements of the multimodal transportation system. While HOV lanes do not currently existing in Tigard, the 2002 Tigard TSP generally discusses them as a means of Transportation Demand Management (TDM) and more particularly discusses them as a potential use on OR 217.

Policy 4D: Transportation Demand Management
This policy establishes the state's interest in supporting demand management strategies that reduce peak period single occupant vehicle travel, thereby improving the flow of traffic on the state highway system. There is a chapter in the 2002 Tigard TSP dedicated to TDM.

Policy 4E: Park and Ride Facilities
This policy seeks to maximize the existing transportation system and passenger capacity by supporting and developing park-and-ride facilities. The Tigard 2002 TSP addresses new park and ride facilities in terms of considering the alternative of constructing commuter rail to the west of Tigard, serving Sherwood, Newberg, Yamhill County, and to the coast, in order to alleviate traffic and congestion on OR 99W. Large park and ride facilities would be needed to support this rail.

Policy 5A: Environmental Resources
This policy intends to protect the natural and built environment – including air quality, fish and wildlife habitat, migration routes, vegetation, and water resources from impacts from state highways and ODOT facilities. Roadways cross Fanno Creek in Tigard, a significant natural resource in the city. Impacts to this creek system, the Tualatin River (at the southern border of the city), and other identified resources must be avoided or mitigated by any proposed construction or reconstruction projects in Tigard and its TSP.

ODOT Highway Design Manual (2003)

The Highway Design Manual includes ODOT standards and procedures for the location and design of new construction, major reconstruction, and resurfacing, restoration or rehabilitation (3R) projects. The Highway Design Manual is used for all projects that are located on state highways. The following elements in the manual should be referred to in developing projects or any implementation measures in the Tigard TSP update affecting state facilities in the city.

- Chapter 4 (Right-of-Way) – procedures for land acquisition, easements, and access control;
- Chapter 5 (General Design Standards) – design speed for urban non-freeways and non-expressways, sight distance, vertical and horizontal alignment, roadbed cross-sections including shoulders, travel lanes, and medians, non-freeway median design, clearance, guardrail and concrete barriers, and access management;
- Chapter 8 (Urban highways) – expressways, urban arterials, design speed, OHP designations, existing plans, STAs and UBAs and CCs, non-designated urban highways that are suburban/fringe, developed, or in a traditional downtown/central business district, lane widths, pedestrian and bike facilities, parking, medians, access management;
- Chapter 9 (Intersection and Interchange Design) – general design considerations, signalized and unsignalized intersections, roundabouts;
- Chapter 10 (Special Design Elements) - hydraulics and geotechnical design, environmental studies, transportation analysis, permit types; and
- Chapter 11 (Pedestrian and Bicycle) - general guidance for facilities on rural and urban highways, reference to the Oregon Pedestrian and Bicycle Plan.

The design standards in the manual will be integrated into the detailed design and engineering that will occur for projects once they are adopted as part of the TSP and are programmed as part of the City's Capital Improvement Program (CIP) for transportation.

State Transportation Improvement Program (STIP)

The State Transportation Improvement Program (STIP) is the programming and funding document for transportation projects and programs statewide. The projects and programs undergo a selection process managed by ODOT Regions or ODOT central offices. The document covers a period of four years and is updated every two years. There are six projects – a mixture of roadway capacity projects and bike and pedestrian facilities – that are programmed in Tigard in the Final 2008-2011 STIP, shown in Table 3. The final three projects in the table are not located within the city but are major projects that are nearby and will affect the city's transportation system.

Table 3. 2008-2011 Final Approved STIP

Project Roadway	Project Location	Project Description	Project Type	Project Cost	Project Year
OR 99W	64th Ave to Canterbury Ln (MP 7.00 to MP 10.80)	Construct sidewalks to fill gaps in network	BIKEPED	$691,000	2009
OR 99W	Hall Blvd (MP 8.69 to MP 8.93)	Widen intersection and improve access management for safety	MODERN	$6.3 million	2008

Project Roadway	Project Location	Project Description	Project Type	Project Cost	Project Year
Washington Square Regional Center Trail	Hall Blvd to Greenburg Rd	Construct multi-use trail	BIKEPED	$432,000	2011
Main St	Rail Corridor to OR 99W	Green street retrofit, pedestrian amenities, streetlights	TE	$2.8 million	2011
SW Greenburg Rd	Washington Square/ Tiedeman	Widen road to five lanes	MODERN	$1.9 million	2011
Fanno Creek Trail	Hall Blvd Crossing	Project development prior to construction	BIKE PED	$401,000	2010
I-5/OR 99W Connector	I-5 to OR 99W	Connector road to alleviate congestion	MODERN	$25.8 million	2009
OR 217	US 26 to Tualatin Valley Highway (MP 0 to MP 1.47)	Widen hwy and structures, complete ramp work	MODERN	$37.9 million	2008
OR 217	Beaverton-Hillsdale Highway to SW Allen Blvd	Preliminary design and engineering for widening	MODERN	$416,000	2011

Projects in the 2008-2011 STIP overlap into the 2010-2013 Draft STIP. These projects include: preliminary design and engineering for the widening of OR 217 from Beaverton-Hillsdale Highway to SW Allen Boulevard, the Hall Boulevard Crossing for the Fanno Creek Trail, and Main Street improvements from the rail corridor to OR 99W. Two new projects in the 2008-2011 STIP are new off-ramp lanes at I-5/OR 99W- one onto northbound OR 99W from 60th Avenue to Barbur Boulevard and the other an additional lane on the I-5 southbound ramp to OR 99W, from 68th to 64th Avenue. Both are slated for construction to being in 2012.

Transportation System Plan Guidelines (2008)

ODOT's Transportation System Plan Guidelines comprise four chapters that give an overview of transportation system planning (Chapter 1), guidance for the preparation of a jurisdiction's first TSP and of TSP updates (Chapters 2 and 3), and policy guidance on transportation and land use issues in a series of technical appendices (Chapter 4). The 2008 Guidelines differ from the 2001 Guidelines in that they focus more on TSP updates, make stronger connections between local transportation needs and the availability of transportation funding, and provide more guidance related to mobility standards, the OTP, and project financing in the technical appendices, in addition to new electronic links throughout the document for easy access to additional resources.

The chapter on TSP updates is divided into three steps: determining if an update is needed and scoping the update project; preparing an assessment; and addressing recent regulatory and

policy changes. The last two steps are relevant to the Tigard TSP update, at this point in the planning process.

In generally assessing the Tigard TSP and scoping the update project, it was determined that the TSP should be assessed for whether it accommodates revisions made to the OTP, TPR, and Regional Transportation Plan (RTP) since the TSP's adoption in 2002. An assessment of the Tigard TSP for compliance with the OTP, TPR, and Metro regional provisions will be presented in the "Issues Report" section (Section III) of this memorandum. The project scope also identifies the City's start on periodic review and update of its Comprehensive Plan in April 2008 as impetus for the TSP update. Changing conditions in the city since adoption of the 2002 TSP include a UGB amendment for Bull Mountain, annexations, significant development, growing demands on the transportation system, a transportation system constrained in its expansion, and a growing need for TDM and transportation system management (TSM). The 2002 TSP was founded on data from 1999 and earlier.

The TSP Guidelines walk users through addressing regulatory, policy, and statutory changes. As is described in the earlier section in this memorandum on the OTP, the 2006 update emphasizes maintaining assets in place, optimizing existing system performance through technology and better system integration, creating sustainable funding, and investing in strategic capacity enhancements. Amendments to the OHP include changes to Policy 1B (Land Use and Transportation), which requires a management plan for STAs on state highways that are also designated as State Freight Routes. (Note: the STA for Washington Square is not on a designated Freight Route.) Revisions to Policy 1F (Mobility Standards) allow for the adoption of alternative mobility standards in metropolitan regions or parts of the region. Alternative standards have been adopted for the Portland metropolitan region.[8] Policy 1H (Bypasses) was revised to recommend a refinement plan or NEPA process for selecting alternative designs and locations, which would apply to the I-5/99W Connector project, which has already begun a NEPA process. OHP Appendix C (Access Management Spacing Standards) was revised in 2004 to be consistent with amendments to the Access Management Rule, OAR 734-051 (reviewed earlier in this memorandum).

Amendments to the TPR have bearing on the Tigard TSP update and any potential Comprehensive Plan amendments in the city. Revised MPO requirements in Section -0016 address coordination between local TSPs and RTPs in MPO areas and alternative standards. Section -0050 (Project Development) revisions protect determinations of need, mode, function and general location for projects identified in TSPs. Revisions to Section -0060, relating to plan amendments, include the following:

[8] Alternative mobility standards for the Portland metropolitan region are presented in terms of volume-to-capacity (V/C) ratios in Table 7 under Policy 1F in the updated OHP. The standards are divided into the 1st and 2nd consecutive hours of highest traffic volumes. The following maximum V/C ratios apply to Tigard. (See the memorandum section on the Metro 2040 Growth Concept for descriptions of the land use designations below).

- 1.1 V/C for 1st hour and 0.99 V/C for 2nd hour for Regional Centers, Town Centers, Main Streets, and Station Communities.
- 0.99 V/C for 1st hour and 2nd hour for I-5 (Marquam Bridge to Wilsonville), OR 217, Corridors (Hall Boulevard/OR 141 and Scholls Ferry Road/OR 210), Industrial Areas, Employment Areas, and Inner Neighborhoods. This standard for I-5 and OR 217 are for interim purposes; refinement plans for these corridors are required in the RTP and will recommend performance measurements and policies for each corridor.
- 0.95 V/C for 1st hour for OR 99W (I-5 to Tualatin Road). This is classified as an "area of special concern", and the OHP mobility standard will apply to this area until an alternative performance measure is adopted in local plans and approved by the Oregon Transportation Commission.

- *Require local jurisdictions to balance the need for development with the need for transportation improvements;*
- *Address "significant effect" by establishing the end of the planning period as the measure for determining whether proposed amendments would cause an imbalance between development and the transportation network serving that development;*
- *Identify the transportation improvements that a local government can consider in determining whether a proposed amendment will significantly affect transportation facilities; and*
- *Identify methods for local jurisdictions to determine whether or not a needed transportation facility is reasonably likely to be provided within the planning horizon.*

COUNTY/REGIONAL PLANS

Metro 2040 Growth Concept

The Metro 2040 Growth Concept was developed in the 1990s in response to growth pressure on the UGB. The 2040 Concept represents a blending of alternatives being considered that ranged from significant UGB expansion to no expansion. It envisions growth in centers and corridors, emphasizes redevelopment and infill, and allows for modest UGB expansions over a 50-year period. The 2040 Concept is illustrated in a Growth Concept map of the region, made up of a series of centers, corridors, and other land use designations. Several of the 2040 Concept designations are found in Tigard, and the following are summaries of the policy direction given these designations.

Regional Center
The Washington Square Regional Center is one of seven Regional Centers, and is designed – along with Downtown Beaverton – to serve the eastern Washington County market area. Regional Centers feature compact development, infill and redevelopment, and multi-modal road networks and services. Transit improvements include high-capacity transit between the center and the Central City (Downtown Portland). A dense multi-modal road network of arterials and collectors connect the Regional Center to the surrounding neighborhoods and to other centers.

Town Center
The Tigard Town Center is focused around historic downtown Tigard, OR 217, OR 99W, and the WES commuter and freight rail line. Town Centers are smaller than Regional Centers and are designed to serve populations in the tens of thousands of people. Like Regional Centers, they feature compact development and high-quality transit service. Town Centers provide at least local retail stores and services, intended to provide shopping, employment, cultural and recreational opportunities for local residents. Some of the designated centers originated as traditional downtowns, while some are anticipated to shift from auto-oriented places to more multi-modal and complete community centers. Many are planned to feature regional specialties, such as the office center that is planned for the Cedar Mill Town Center.

Corridor
There are designated corridors along OR 210 (Scholls Ferry) and OR 141 (Hall Blvd). Corridors are not designed to be as densely developed as centers but do feature high-quality pedestrian environments and transit service. Examples of corridor development include rowhouses, duplexes and one- to three-story office and retail buildings. Corridors may either be strips of higher density development along arterials or more nodal development at major intersections of arterials that include higher quality pedestrian environments, transit service, and connections to surrounding neighborhoods. Both patterns of development must allow a range of uses and high-density development than the surrounding neighborhoods.

Station Community
Station communities in Tigard are designated around the WES commuter rail stop at the intersection of the rail line and OR99W and a potential high-capacity transit station on OR 99W. Both areas lie southwest of the designated Tigard Town Center along OR 99W. Station communities are intended for nodal development focused around high-capacity transit stations and high-quality pedestrian environments. They include the area around the station for roughly a half mile and are planned for the highest density of development outside of centers.

Main Street
A Main Street is designated connecting the Tigard Town Center area to the Station Communities along OR 99W. Main Streets are based on the traditional streets that featured transit and clustered business and civic uses in the early 1900s. They serve the surrounding neighborhoods and may feature a regional specialization such as dining, entertainment, or shopping that attracts people from the region outside of the surrounding neighborhoods.

Employment Area and Industrial Area
An Employment Area is identified at the interchange of OR 217 and I-5 and between I-5 and the rail corridor in Tigard, including two industrial areas adjacent to the rail corridor. Industrial Areas in particular have access to a high-quality freight transportation system and are planned primarily for industrial uses, although supportive uses may be allowed when limited in size and location and designed to serve the industrial uses. Employment Areas feature various types of employment and may include residential uses and limited commercial uses intended to serve the employees and residents of that immediate area.

Parks and Open Space
Parks and Open Space are designated along Fanno Creek and other creek systems in Tigard. These areas include parks, stream and trail corridors, wetlands and floodplains, largely undeveloped upland areas, and areas of compatible low-density residential development. Many of these natural areas already have significant land set aside as open space.

Because this designation, at least in concept, removes these areas from being urbanizable, UGB capacity must be calculated without these areas. These areas and significant rural reserve areas are designated high priority for purchase as parks and open space, through programs such as Metro's Open Spaces Acquisition program. Metro Functional Plan provisions that protect critical fish and wildlife habitat areas without conflicting with housing and economic goals protect environmentally critical areas, support compatible development of sensitive areas, and allow transfer of development rights from protected natural areas to more developable lands.

Neighborhood
The rest of Tigard is generally designated as Inner Neighborhood. Neighborhoods are essential to the 2040 Concept, make up a large part of the region, and include both Inner and Outer Neighborhood designations. Inner Neighborhoods are designated in areas that are primarily residential with access to employment and commercial uses. Lot sizes are smaller and provide better access to jobs and shopping than Outer Neighborhood, which are farther away from employment centers and have larger lot sizes and lower densities.

Metro 2035 Regional Transportation Plan (RTP)

The federal component and update of the Regional Transportation Plan (RTP) was approved by the Metro Council and Joint Policy Advisory Committee (JPAC) in December 2007. The US Department of Transportation approved it in February 2008, following approval of air-quality analysis. The update was spurred by regulatory changes made by the Safe, Accountable, Flexible and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU).

As described on the plan's website, a full RTP update – the 2035 RTP – will "address regional, state and federal planning requirements; issues identified in the 2005 Cost of Congestion Study; and recommendations from two concurrent processes to plan for freight and goods movement in the region and efficient management of the existing regional transportation system." There are three studies being undertaken as part of the RTP update that may directly affect the Tigard TSP: *High Capacity Transit System Plan (HCT)*, *Transportation System Management and Operations Plan (TSMO),* and the *Freight Plan.* These will need to be examined as the TSP planning process unfolds.

There are 24 projects in Tigard included in the 2035 RTP Financially Constrained System List of Projects and Programs. They are presented below in Table 4. While not in Tigard, the last three projects in Table X – the I-5/99W Connector and OR 217 widening – are major projects that will affect traffic and the transportation system in Tigard.

Table 4. 2035 RTP Financially Constrained System List – Projects and Programs in Tigard

Project Name	Project Location	Project Description	Project Cost (Year of Expenditure $)	Project Time
Washington Square Connectivity Improvements	Local street locations	Increase local street connections at Washington Square Center based on recommendations in Regional Center Plan	$14.0 million	2018-2025
OR 217 Overcrossing – Cascade Plaza	Nimbus to Locust	Provide a new connection from Nimbus to Washington Square south of Scholls Ferry Road	$10.5 million	2018-2025
Greenburg Rd Improvements, South	Shady Lane to North Dakota	Widen to 5 lanes with bikeways and sidewalks, including bridge replacement	$21.2 million	2008-2017
Washington Square Regional Center Pedestrian Improvements	Various locations	Improve sidewalks, lighting, crossings, bus shelters, and benches	$11.6 million	2018-2025
Greenburg Rd Improvements	Tiedeman Ave to OR 99W	Widen to 5 lanes	$30.4 million	2018-2025
OR 217 Overcrossing	Hunziker Rd to 72nd Ave	Re-align Hunziker Rd to meet Hampton Street at 72nd Ave and remove existing 72nd/Hunziker Rd intersection	$19.5 million	2018-2025
Durham Rd Improvements	Upper Boones Ferry Rd to Hall Blvd	Widen to 5 lanes	$31.2 million	2008-2017
Walnut St Extension	OR 99W to	Extend street east of OR 99W	$5.6 million	2008-2017

Project Name	Project Location	Project Description	Project Cost (Year of Expenditure $)	Project Time
	Hunziker Rd	to connect to Hunziker Rd (PE phase)		
72nd Ave Improvements	OR 99W to Hunziker Rd	Widen to 5 lanes with bikeways and sidewalks, including bridge replacement	$75.4 million	2008-2017
Dartmouth St Improvements	72nd Ave to 68th Ave	Widen to 4 lanes with turn lanes and sidewalks	$6.5 million	2008-2017
Tigard Town Center Pedestrian Improvements	Throughout Town Center area	Improve sidewalks, lighting, crossings, bus shelters and benches throughout the Town Center including OR 99W, Hall Blvd, Main St, Hunziker, Walnut, and neighborhood streets	$9.9 million	2018-2025
Nimbus Ave Extension	Nimbus Ave to Greenburg Rd	2 lane extension with sidewalks and bike lanes	$9.5 million	2018-2025
Washington Square Regional Center	Hall Blvd to OR 217	Complete shared-use path construction	$2.7 million	2008-2017
Durham Rd Improvements	Hall Blvd to OR 99W	Widen to 5 lanes with bikeways and sidewalks	$61.8 million	2018-2025
Regional Trail Gap Closure	Various locations on trails	Fill in gaps in regional trail network, including Fanno Creek, Washington Square Loop and Westside Trails	$10.2 million	2008-2017
72nd Ave Intersection Improvements	OR 99W to Upper Boones Ferry	SB right turn lane, NB right turn overlap at OR 99W and 72nd; SB or EB right turn lane at 72nd/Hampton/Huziker	$3.0 million	2008-2017
Upper Boones Ferry Intersection	Durham Rd to I-5	Reconfigure intersection of Durham & Upper Boones Ferry to create a through route between Durham and I-5/Carmen Interchange; 2nd NB turn lane at 72nd/Carmen; 72nd/Boones Ferry given Boones Ferry/72nd widened to five lanes; EB right turn lane at Carmen/I-5 SB	$14.3 million	2008-2017
Greenburg Intersection Improvements	Hall Blvd to Tiedeman Ave	2nd NB turn lane, modify signal timing at Greenburg/Oleson/Hall; install boulevard treatment at Greenburg/Washington Square Rd; improve geometry/alignment and extend cycle length at intersection of Greenburg/Tiedeman	$14.1 million	2008-2017
OR 99W Intersection Improvements	68th Ave to Beef Bend Road	Provide increased capacity at priority intersections, including bus queue bypass lanes in some locations, improved	$29.1 million	2008-2017

Project Name	Project Location	Project Description	Project Cost (Year of Expenditure $)	Project Time
		sidewalks, priority pedestrian crossings, and an access management plan, while retaining existing 4/5-lane facility from I-5 to Durham Rd		
Scholls Ferry ATMS	From Hall Blvd to Murray Blvd	Install integrated surveillance and management equipment	$1.6 million	2008-2017
Scholls Ferry Rd Improvements	From OR 217 to 121st Ave	Widen to 7 lanes with bike lanes and sidewalks	$40.0 million	2018-2025
Washington Square Regional Center Pedestrian Improvements	In Washington Square Regional Center	Complete 7,400 feet of sidewalk improvements	$13.3 million	2008-2017
Locust Ave Bike	From Hall Blvd to 80th Ave	Complete 1,650 feet of bike lanes in Regional Center	$5.1 million	2008-2017
Greenburg Rd Bike	From Hall Blvd to OR 217	Complete 3,400 feet of bike lanes in Regional Center	$5.3 million	2008-2017
I-5/99W Connector Phase 1	From OR 99W to I-5	Conduct study, complete environmental design work and NEPA for I-5 to OR 99W Connector and acquire ROW	$148.8 million	2008-2017
OR 217 Widening	From US 26 to OR 8/Tualatin Valley Highway	Widen OR 217 and structures	$55.8 million	2008-2017
OR 217 Braided Ramps	From Beaverton-Hillsdale Hwy to Allen Blvd	Braid OR 217 ramps between Beaverton-Hillsdale Hwy and Allen Blvd in both directions	$117.8 million	2008-2017

Metro Evaluation of Potential Measures for Achieving Modal Targets (2005)

The RTP has established 2040 Non-Single Occupancy Vehicle (Non-SOV) Targets in order to comply with TPR requirements to reduce vehicle miles traveled (VMT) per capita. The targets are established in terms of Metro 2040 Growth Concept design types. The targets that apply to Tigard are 45-55% non-SOV mode splits in Regional Centers, Town Centers, Main Streets, Station Communities, and Corridors, and 40-45% non-SOV mode splits in Industrial Areas, Employment Areas, and Inner Neighborhoods.

The targets were intended as goals for jurisdictions in Metro's boundary, and the jurisdictions are required to implement the following measures in order to work toward 2040 modal targets:

1. *Adopt 2040 modal targets in local Transportation System Plan (TSP) policies.*
2. *Adopt street connectivity plans and implementing ordinances.*
3. *Adopt maximum parking ratios to implement the parking requirements of Title 2 of the Urban Growth Management Functional Plan.*
4. *Form and support transportation management associations (TMAs) where appropriate.*
5. *Adopt fareless area transit policies in regional centers.*
6. *Adopt transit strategies, including planning for adequate transit facilities and service; pedestrian facility planning and infrastructure that support transit use; location and design of*

buildings in transit zones that encourage transit use; and adoption of a transit system map, consistent with Metro requirements.

The RTP also recommends employer-based strategies and various measures related to land use, transit, bicycling, walking, and parking that may be implemented by local jurisdictions to help achieve the modal targets. The Oregon Department of Environmental Quality requires companies and agencies having more than 100 employees to implement Employee Commute Options (ECO) programs to reduce single-occupancy vehicle (SOV) commute trips.

The TPR requires Metro and other Metropolitan Planning Organizations to evaluate the effectiveness of these measures. The Evaluation of Potential Measures for Achieving Modal Targets was developed to address that requirement. The evaluation includes an assessment of current requirements and strategies, research on other strategies, and ultimately recommendations for future RTP requirements. Research found that the measures that had been studied and been most effective in reducing SOV trips were transportation-efficient development, parking pricing, area-wide application of peak-period or mileage-based pricing strategies, park-and-ride and carpool facilities, and end-of-trip facilities for pedestrians and bicyclists. Other measures that resulted in either higher ridership or walking and bicycling rates, or reductions in VMT were high capacity transit, carsharing, bikeway improvements, traffic calming, congestion pricing, and marketing and promotion.

The evaluation makes the following recommendations for future RTP revisions and requirements:

- Remove formation and support of TMAs and adoption of fareless areas as requirements, but recommend them as optional strategies where they are feasible and likely to be effective.
- Require transportation-efficient development through compliance with Metro Functional Plan and related requirements.
- Require construction of bicycle and pedestrian improvements in compliance with state and federal regulations, and consistent with local TSPs and regional guidelines. Projects that improve connectivity of the bicycle and pedestrian system and access to transit should be prioritized.
- Require frequent and comprehensive transit service by TriMet and other transit agencies.
- Require support and promotion of employer-based TDM strategies.
- Require support for employers to eliminate employer-subsidized parking and/or support for parking cash-out, preferred HOV-parking or other parking pricing strategies. Local governments also could be required or encouraged to implement these strategies for their own employees.
- Require support and coordination of Safe Routes to School programs and projects. Metro should support this requirement by seeking and securing funding and providing technical assistance.

The report also recommends a set of optional strategies related to transit, parking, transportation system management and employer-based programs, bicycling and walking, and pricing, including bus service improvements, developing high-capacity transit, providing end-of-trip facilities, using individualized marketing, and mileage-based insurance and fees.

In measuring performance and monitoring compliance, the report recommends that Metro lead efforts to gauge progress toward meeting modal targets both regionwide and in specific locations such as centers and corridors, using tools like regional travel models and travel behavior surveys. The evaluation also suggests that TriMet and local jurisdictions conduct their own surveys to assess the effectiveness of measures for achieving modal targets. It is recommended that compliance be monitored in some of the following ways: Metro's review of local TSPs and updates; creation of a

region-wide bicyclist and pedestrian count database and requirements for each local jurisdiction to track and report on bicyclist and pedestrian count progress at specified locations or nodes; and review and reporting of efforts by local jurisdictions and others to track progress in implementing optional strategies to meet modal targets, including surveys, traffic counts, and park-and-ride usage.

Metro Highway 217 Corridor Study (2006)

In February 2006, the Metro Council adopted the Highway 217 Corridor Transportation Plan recommendations by resolution. The recommendations were the result of deliberations of the plan's Policy Advisory Committee (PAC) and Metro's standing Joint Policy Advisory Committee on Transportation (JPACT). The Council directed Metro staff to lead planning and project development based on the plan recommendations, to prepare RTP amendments consistent with the recommendations, and to coordinate local plan amendments, planning work, and project development with other jurisdictions based on the recommendations.

Below is a summary of the recommendations by topic and the work associated with implementing them.

Highway 217 Traffic Lanes

- Two options for a third lane in each direction – general purpose lanes and toll lanes – should be advanced for further consideration.
- The RTP and financially constrained project list should be amended to include project development for a third lane.
- Program an Environmental Impact Statement (EIS) in the 2008-2011 STIP. The National Environmental Protection Act (NEPA) and EIS process is an opportunity to evaluate financing strategies and determine whether the lanes should be general purpose or toll lanes.

Highway 217 Interchanges

- Proposed interchange improvements should be further evaluated through the NEPA/EIS process.
- Proposed interchange improvements are generally prioritized in three tiers, although their design and construction may occur in a different order than as prioritized depending on findings from the NEPA process, local transportation needs, and available funding.
- In Tigard, proposed interchange projects include: Scholls Ferry/Greenburg Road ramp braids and Greenburg Road interchange improvements that are prioritized as second tier projects; and SW 72nd Avenue interchange improvements and turn lanes, and Highway 99W access lanes, widening, and turn lanes as third tier projects.
- Local transportation plans and the RTP need to be amended to include the interchange projects, presumably through the process of preparing interchange area management plans (IAMP) for these special transportation facilities.

Arterials in the Highway 217 Corridor

- Evaluate north-south arterial improvements as part of local TSP updates.
- In Tigard, proposed arterial projects include: widening Greenburg Road to five lanes from Tiedeman to Highway 99W (RTP Project 6031) and widening Hall Boulevard to five lanes from Scholls Ferry Road to Highway 99W (RTP Projects 6013 and 6030 North).
- Secure funding for these projects through the Metropolitan Transportation Improvement Program (MTIP) process

- Consider seeking to include other arterial improvements (from a preliminary project list evaluated by the PAC) in the next RTP Financially Constrained Plan.

Bicycle and Pedestrian Facilities

- Complete projects that form north-south routes.
- There are not projects in the Financially Constrained RTP or the Priority RTP System located in Tigard as identified in the recommendations. However, the following projects in Tigard are included in the recommendations for RTP updates: improvements (unspecified) on Hunziker Street from Hall Boulevard to 72nd Avenue, a multi-use path connecting I-5 to SW 72nd Avenue, pedestrian path/walkway improvements on all improved viaducts crossing Highway 217, a bicycle/pedestrian connection over Highway 217 or as part of overcrossing improvements to the Fanno Creek Region Trail; and a connection to the Washington Square Regional Center trail.
- Secure funding for the improvements once they are incorporated into the RTP.

Transit

- Increase transit service in the Highway 217 corridor
- Explore express bus service on the highway, expanded commuter rail service, and other transit services for inclusion in RTP updates and TriMet's Transit Investment Plan.
- Secure funding for an EIS and evaluate transit service improvement options through that process.

Funding

- ODOT and Metro should be responsible for developing a financing strategy for the Highway 217 project(s).
- ODOT, Metro, and local jurisdictions should consider seeking federal earmarks for Highway 217 projects.
- ODOT should advocate including the Highway 217 project in the Oregon Innovative Partnership Program in order to explore private sector involvement in project financing.
- JPACT should consider nominating Highway 217 projects for the list of Highways of Statewide Significant if the Oregon Transportation Commission decides to revisit and revise the list.
- ODOT, Metro, and local jurisdictions should advocate including priority Highway 217 interchanges or other Highway 217 project elements in state, regional, or local transportation funding measures.
- ODOT, Metro, and local jurisdictions should seek funding for a corridor study of I-5 between Highway 217 and Wilsonville.

TriMet Investment Plan (FY 2009)

The Transit Investment Plan (TIP) is a five-year investment plan that is updated annually. The projects and programs in the TIP respond to regional transportation and livability goals and plans. In particular, the TIP implements the transit element of the RTP. The TIP refers to its investment strategy as the "Total Transit System," which is designed to meet current service demands, to support development envisioned in the 2040 Concept and Regional Framework Plan, and to achieve the ridership goals established in the RTP.

The TIP is organized by four priorities:

1. *Build the Total Transit System – Enhance customer information, access to transit, stop amenities, frequency, reliability, passenger comfort, safety and security.*

2. *Expand high-capacity transit – Invest in MAX Light Rail, Commuter Rail and Streetcar service along key corridors to connect Regional Centers.*
3. *Expand frequent service – Add routes to TriMet's network of bus lines than run every 15 minutes or better, every day.*
4. *Improve local service – Work with local jurisdictions to improve transit service in specific local areas.*

The following projects or programs identified under the TIP priorities affect Tigard.

Build the Total Transit System
The bicycle parking plan for the commuter rail Westside Express Service (WES) is being revised to expand bicycle parking. There will be 162 bicycle parking spaces available at stations when service begins in spring 2009. This relates to another project to develop and implement a TriMet Bike Facilities Plan to improve bicycle parking at stations, including short-term and long-term parking and services or facilities that allow customers to have a bicycle at each end of their trip.

Expand high-capacity transit
TriMet has conducted preliminary alignment studies in the Barbur Boulevard/Highway 99W corridor for bus rapid transit and light rail transit. High-capacity transit in this corridor would connect to commuter rail and help alleviate growing congestion on I-5. Metro has recommended the corridor for a corridor study but resources have not yet been identified or secured for the study.

Expand frequent service
Bus line 76-Beaverton/Tualatin (Hall Boulevard) is proposed to upgrade to Frequent Service. This would provide more capacity at the times not served by WES – midday, evenings, and weekends. Frequent service would help serve local trips; of all transit trips tracked in Tigard, about a third of them travel within the city or to Beaverton. The TIP also acknowledges coordination that is already underway between TriMet and the City, investing in sidewalks, crossings, lighting, shelters, benches, and bus stop spacing improvements in preparation for Frequent Service. Frequent Service itself is contingent upon the availability of additional operating funding.

Improve local service
The TIP generally identifies revisions to bus service to better coordinate with WES service. Also, the Tigard Transit Center Station is planned for 100 park-and-ride spaces and connections with five bus lines. The area is the subject of a local area plan that TriMet and the City developed together. The plan proposed 11 capital projects (e.g. shelters, benches, sidewalks) and recommended transit service to be added on Bonita Road, a low-income area with a lot of multi-family housing. Bus service will be rerouted along Bangy Road and Bonita Road, connecting Tigard and the Kruse Way employment area, contingent upon available funding. Service on 72nd Avenue is also recommended in order to connect businesses on 72nd Avenue with commuter rail and to better serve the Sequoia Parkway employment area. This bus service would be provided by extending a nearby bus line but is also contingent upon available operating funding.

TriMet Elderly and Disabled Plan (Updated 2009)

This plan was developed with the assistance of the Special Transportation Fund Advisory Committee (STFAC), a committee appointed by the TriMet Board of Directors to advise the agency in making recommendations for State STF grants and to develop a transportation plan for the elderly and people with disabilities. The committee is comprised of individuals who are elderly and/or have

disabilities and staff from county aging and disability services and representatives from Ride Connection, a network of over 30 service providers.

The STFAC developed the following vision statement for the Elderly and Disable Plan:

> *Guide transportation investments toward a full range of options for elders and people with disabilities, foster independent and productive lives, strengthen community connections, and strive for continual improvement of services through coordination, innovation, and community involvement.*

Implementation measures in the plan are divided into those that have no cost or are low-cost and can be implemented in a short time frame; those that are recommended for funding in FY06-07; and long-term strategies that require more time or money to develop and implement. Additionally, the plan recommends policies for the RTP that address service coordination, innovation, extent and accessibility, community involvement, and supportive land use planning.

The no-cost and low-cost implementation measures include a community assessment of walkability and accessibility, development of "aging-friendly" design guidelines to be added to the FHWA Guidelines, and a number of outreach measures and informational services accessed online or by phone. Projects and programs proposed for FY06-07 range from driving classes and a driver pool to be shared amongst service providers to an online accessible vehicle and ride reservation system, connection services to fixed route transit, and a peer program of riding "buddies" for transit. Long-term measures include development of a Pedestrian Master Plan that identifies safe and accessible routes to transit and around the community, targeted transit marketing, several coordination and integration projects amongst existing service providers, and free fixed route transit for paratransit riders that forego paratransit (LIFT) trips.

The plan designates the organizations or agencies that should be responsible for the implementation measures. Other than general coordination on a few of the recommendations (e.g. FHWA Guidelines and Pedestrian Master Plan), TriMet and Ride Connection are designated as responsible for most of the measures. Tigard and other cities in the region are not specifically called out for implementation responsibility.

Washington County 2020 Transportation Plan

The Washington County 2020 Transportation Plan is the long-range planning document for transportation facilities in Washington County. The plan supports land use plans in adopted community plans and city comprehensive plans. It also designed to be consistent with provisions of the RTP and TPR.

The TSP study area is made up primarily of land inside the city limits of Tigard. However, there is land in the study area outside the City, but inside the UGB, in unincorporated Washington County. The Washington County Transportation Plan must be referred to for planning and project development on county transportation facilities in the study area, both inside and outside the City of Tigard.

There are five county facilities within the City of Tigard and the TSP study area:

- Greenburg Road from OR 217 to Oleson
- Scholls Ferry Road (OR 210) from the railroad to the western city limits
- Barrows Road

- Bull Mountain Road
- Beef Bend Road.

The Transportation Plan includes policies addressing the roadway, transit system, demand management, pedestrians, bicycles, roadway freight, water, air, rail, pipeline, funding, implementation and monitoring.

Policy 6 (Roadway System Policy) of the Roadway Element identifies the Washington Square Regional Center and OR 99W from I-5 to Durham Road as "deficiency areas." The plan asserts that, while Washington Square is not designated as an Area of Special Concern in the RTP and is the focus of ongoing planning work, it is an area anticipated to have significant congestion in the future. OR 99W from I-5 to Durham Road, however, is identified in the RTP as an Area of Special Concern and, although extensively studied, proposed improvements are not projected to create enough capacity to meet the demand. As deficiency areas, these areas are expected to exceed the target and acceptable mobility performance measures established in the Transportation Plan.[9] Strategies to improve mobility performance in deficiency areas will be developed and evaluated on a case-by-case basis.

The Transportation Plan does not provide access management and spacing standards. According to Strategy 7.5 under Policy 7 (Transportation System Management) of the Roadway Element, access management and spacing standards are to be implemented as they are established in the Community Development Code.

Strategy 10.10 under Policy 10 (Functional Classification Policy) of the Roadway Element identifies special study areas in the Tigard vicinity where function or alignment had not been settled. These include OR 217 and I-5 from OR 217 to Wilsonville. OR 217 was identified in the RTP as a study corridor at the time the County Transportation Plan was developed. This corridor is explored in greater detail in the section of this memorandum on the Metro Highway 217 Corridor Study and recommendations. I-5 from OR 217 to Wilsonville was also identified in the RTP as a study corridor. Even with planning assumptions of four lanes in each direction plus auxiliary lanes, segments on the freeway and ramp connections still exceed mobility standards, indicating the need for additional study and proposed improvements.

Policy 10 also provides design parameters for roads according to functional classification. Table 6 presents the number of lanes, maximum right-of-way width, maximum paved width, and whether bike lanes are required for classifications including Principal Arterials, Arterials, Collectors, Special Area Collectors, Neighborhood Routes, Special Area Neighborhood Routes, Commercial/Industrial, Special Area Commercial, Local, and Special Area Local.

Figure 3 in the Roadway Element is a map of roads in the county with Regional Street Design Overlays. These overlays are part of instituting the 2040 Concept design types. Several roads in Tigard are designated with either a Boulevard or Street Design Overlay designation, and in some cases the designations switch on the same roadway depending on the road segment.

[9] Table 5 under Policy 6 of the Transportation Plan presents the maximum volume-to-capacity ratios (V/C) that are targeted and accepted in Washington County. Target performance measures for Regional Centers, Town Centers, Main Streets, and Station Communities (2040 Concept design types) are 0.99 for the 1st hour and 0.9 for the 2nd hour, and 0.9 for both the 1st and 2nd hour in other urban areas. Acceptable performance measures for the 2040 Concept design types are 0.99 for both the1st and 2nd hour, and 0.99 for the 1st hour and 0.9 for the 2nd hour in other urban areas. For state facilities, these measures are superceded by the alternative mobility standards adopted for the Portland metropolitan region in the updated OHP. (See Footnote 7.)

- Boulevards – Scholls Ferry Road, Hall Boulevard, Greenburg Road, OR 99W, Walnut Street.
- Streets – Scholls Ferry Road, 121st Avenue, Hall Boulevard, Greenburg Road, OR 99W, Walnut Street, Dartmouth Street, Hunziker Street, Burnham Street, Gaarde Street, McDonald Street, Beef Bend Road, Durham Road.

These Boulevard and Street Regional Design Overlays are characterized by the following guidelines:

> *Boulevards may have three or more lanes and may include landscaped medians, on-street parking, landscape buffered sidewalks and enhanced pedestrian crossings. These roadways also include bicycle lanes and wide sidewalks that can accommodate transit enhancements such as benches or bus shelters. Boulevard intersections may include broad sidewalks up to 12 feet in width as well as special lighting and crossing features to improve pedestrian, bicycle and transit safety and accessibility.*
>
> *Streets may range from two to more than four travel lanes and may include continuous two-way left-turn lanes or median treatments, with landscaping where possible, bike lanes, and landscape-buffered sidewalks of six or more feet. Streets include pedestrian crossings at all intersections and may include special crossing amenities at major intersections.*

The Transportation Plan states that specific treatments and designs for roads that are designated on the Regional Street Design Overlay map will be decided during the project development or development review process.

LOCAL PLANS AND ORDINANCES

City of Tigard Transportation System Plan (2002)

The City of Tigard Transportation System Plan (TSP) was adopted in 2002 as the City's 20-year comprehensive plan for transportation planning, projects, and programs. Once adopted, TSPs are elements of a City's Comprehensive Plan, replacing the original transportation element of the Comprehensive Plan. The 2002 TSP was developed to fulfill the Goal 12 and TPR requirement, to plan for substantial growth expected over a 20 year horizon, and to address the Regional Transportation Plan (RTP) that was adopted in 2000, amendments to the Oregon Highway Plan, and new funding opportunities.

The Tigard TSP establishes goals and policies to guide transportation planning in the City. It reports on existing conditions and estimates transportation needs based on traffic forecasts. Based on these needs, the TSP presents plans and recommended projects by mode, as well as a general transportation demand management program and a financing plan. The Tigard TSP is addressed in more detail as it is assessed in the issues report (Section III) of this memorandum. The TSP is evaluated using provisions of the TPR and the other background documents reviewed in this section.

City of Tigard 2027 Comprehensive Plan (2007)

The City's Comprehensive Plan is its central long-term land-use planning document. The Comprehensive Plan establishes policies that guide growth, development, and conservation of resources within the city. The plan's land use planning elements inevitably interact with, influence, and are influenced by transportation planning in the city. Several of the plan's goals, policies, and recommended implementation measures relate to the city's transportation system. They are presented below.

A number of policies and implementation measures established under Goal 2 (Land Use Planning) require land use planning and development that support transportation alternatives and more efficient use of transportation infrastructure, and that compensate for their impacts on the transportation system. The policies emphasize coordination and currency of urbanization and transportation facilities.

> *Goal 2.1 Maintain an up-to-date Comprehensive Plan, implementing regulations and action plans as the legislative foundation of Tigard's land use planning program.*
>
> *<u>Policies</u>*
> *5. The City shall promote intense urban level development in Metro-designated Centers and Corridors, and employment and industrial areas.*
> *8. The City shall require appropriate public facilities are made available, or committed, prior to development approval and are constructed prior to, or concurrently with, development occupancy.*
> *9. The City may, upon determining it is in the public interest, enter into development agreements to phase the provision of required public facilities and services and/or payment of impact fees and/or other arrangements that assure the integrity of the infrastructure system and public safety.*
> *10. The City shall institute fees and charges to ensure development pays for development related services and assumes the appropriate costs for impacts on the transportation and other public facility systems.*
> *13. The City shall plan for future public facility expansion for those areas within its Urban Planning Area that can realistically be expected to be within the City limits during the planning period.*
> *15. In addition to other Comprehensive Plan goals and policies deemed applicable, amendments to Tigard's Comprehensive Plan/Zone Map shall be subject to the following specific criteria:*
>
> > *A. Transportation and other public facilities and services shall be available, or committed to be made available, and of sufficient capacity to serve the land uses allowed by the proposed map designation;*
> > *B. Development of land uses allowed by the new designation shall not negatively affect existing or planned transportation or other public facilities and services;*
>
> *23. The City shall require new development, including public infrastructure, to minimize conflicts by addressing the need for compatibility between it and adjacent existing and future land uses.*
>
> *<u>Recommended Action Measures</u>*

i. Work with the Oregon Department of Transportation (ODOT), Metro, Washington County, and others to develop means to equitably assign costs to new development for its impacts on the interstate and intra-regional freeway and arterial system.
iv. Develop and periodically update Citywide Public Facilities and Transportation System Plans (PFP, TSP) to guide the location, financing, and timing of future public facilities. Coordinate the preparation and adoption of these Plans with other affected jurisdictions and agencies.
ix. Actively participate and engage with other Portland Metropolitan Area jurisdictions and agencies to represent Tigard's interest involving region-wide land use, transportation, natural resource, and public facility issues.
x. Implement incentive and redevelopment programs to utilize urban land and existing public facilities more efficiently.
xi. Review transportation and other public facility plans and projects to address potential negative aesthetic or operational impacts on neighborhoods and take mitigating action when necessary.

An inventory of Goal 5 (Natural Resources) resources found that that the City of Tigard has 588 acres of habitat designated as "highest" value, which are defined by Metro as Class I and II riparian resources within the Clean Water Services Vegetated Corridor. The area of the entire City is roughly 7,565 acres, so the "highest value" resources constitute about 8% of the City. There are another roughly 370 acres of Class I and II riparian habitat outside the Clean Water Services Vegetated Corridor that are designated as "moderate" value (approximately 5% of the City's area). About 420 acres of non-Class I and II riparian resources in Tigard are designated as "lower" value, including both upland and lower-value riparian habitat areas (approximately 6% of the City's area).

A map of Significant Habitat Areas in Tigard was produced by the City in November 2008. The map depicts slopes over 25%, water bodies, and highest, moderate, and lower value habitat areas. The area boundaries are general and are to be used to determine whether a site-specific delineation is required. The mapping was prepared during the Economic Social Environmental and Energy (ESEE) analysis conducted by the Tualatin Basin Partners for Natural Place. The habitat area values (highest, moderate, and lower) apply to the ways in which uses may be limited as part of the Allow-Limit-Prohibit framework for natural resource conservation and protection in the basin. The major habitat areas surround the Tualatin River, Fanno Creek, and its tributaries. These areas are crossed by OR 217, Hall Boulevard (OR 141), OR 99W, Scholls Ferry Road (OR 210), Walnut Street, Gaarde Street, Durham Road, and a number of local roads. Steep slopes around creek systems are concentrated in the western part of the city, around Bull Mountain. Connections between habitat areas may serve as parks and trails.

Goal 5.1 Protect natural resources and the environmental and ecological functions they provide and, to the extent feasible, restore natural resources to create naturally functioning systems and high levels of biodiversity.
Policies
2. The City shall demonstrate leadership in natural resource protection through the use of sustainable building practices and low impact development strategies, to the extent feasible, on all City projects.
4. The City shall actively coordinate and consult with landowners, local stakeholders, and governmental jurisdictions and agencies regarding the inventory, protection, and restoration of natural resources.

10. The City shall complete a baseline inventory of significant natural resources and update or improve it as necessary, such as at the time of Comprehensive Plan Periodic Review, changes to Metro or State programs, or to reflect changed conditions, circumstances, and community values.
13. The City shall identify, preserve, and create linkages between wildlife habitat areas, to the extent feasible, as a key component of parks, open space, and surface water management plans.

The role of transportation planning and management in reducing pollution and improving environmental health is called out in policies and implementation measures for Goal 6 (Environmental Quality).

Goal 6.1 Reduce air pollution and improve air quality in the community and region.

Policies
5. The City shall cooperate with other public agencies to minimize localized transportation impacts to air quality through intersection improvements, access management, intelligent transportation systems, etc.

Recommended Action Measures
ii. Adopt and implement development regulations that include provisions or incentives for alternative transportation use, particularly in Metro designated corridors and centers.
iii. Perform a sidewalk inventory that results in a Citywide GIS layer to be used for gap analysis and the creation of a sidewalk improvement plan.
iv. Identify neighborhoods underserved by public transit and seek improvement to service in these areas.
v. Pursue funding for transportation related projects that would reduce congestion by improving flow, but not by increasing capacity.

Goal 6.2 Ensure land use activities protect and enhance the community's water quality.

Policies
7. The City shall investigate and use, to the extent practical, measures that limit the community's effective impervious area.
8. The City shall lead by example and develop green concepts for stormwater management at City facilities.
9. The City shall encourage the Oregon Department of Transportation and Washington County to improve the quality of stormwater run-off from their facilities.

Goal 8 (Parks, Recreation, Trails and Open Space) provides the basis for creating a multi-use path system that ultimately could be used for both recreation and more utilitarian transportation.

Goal 8.2 Create a Citywide network of interconnected on- and off-road pedestrian and bicycle trails.

Policies

1. The City shall create an interconnected regional and local system of on- and off-road trails and paths that link together neighborhoods, parks, open spaces, major urban activity centers, and regional recreational opportunities utilizing both public property and easements on private property.
2. The City shall design and build greenway trails and paths to minimize their impact on the environment, including on wildlife corridors and on rare, and state or federally listed species.

Recommended Action Measures
i. Complete a trail system master plan to guide the development of the trail system and facilitate progress toward its completion.
ii. Complete a Citywide inventory and prioritization of opportunities for short pathway connections that increase bicycle and pedestrian connectivity and complement the greenway and on-street bicycle/pedestrian systems.
iv. Add to the park system master plan map:
A. The Tigard portions of two "regionally significant" trails (the Westside Trail (formerly, the Powerline Trail) and the Washington Square Loop Trail); and
B. The on- and off-street route identified by the citizen groups that connects the Washington Square Loop Trail with the Portland Urban Trail Number 5, which ends at SW Dickinson and SW 65th.

Goal 9 (Economic Development) recognizes the role that transportation plays in supporting business and general livability in Tigard.

Goal 9.3 Make Tigard a prosperous and desirable place to live and do business.

Policies
1. The City shall focus a significant portion of future employment growth and high-density housing development in its Metro-designated Town Center (Downtown); Regional Center (Washington Square); High Capacity Transit Corridor (Hwy 99W); and the Tigard Triangle.
3. The City shall commit to improving and maintaining the quality of community life (pubic safety, education, transportation, community design, housing, parks and recreation, etc.) to promote a vibrant and sustainable economy.

Goal 13 (Energy Conservation) charges the City with leading energy conservation efforts through its land use and transportation planning.

Goal 13.1 Reduce energy consumption.

Policies
1. The City shall promote the reduction of energy consumption associated with vehicle miles traveled through:
A. land use patterns that reduce dependency on the automobile;
B. public transit that is reliable, connected, and efficient; and
C. bicycle and pedestrian infrastructure that is safe and well connected.

Goal 14 (Urbanization) recognizes the value of protecting existing neighborhoods and supporting the development and infill of urban centers as a way of managing growth and making efficient use of public investments.

Goal 14.3. Promote Tigard citizens' interests in urban growth boundary expansion and other regional and state growth management decision.

Policies
3. The City shall maintain the low-density residential character of its existing single family residential neighborhoods and accommodate more intense urban land uses in its regional and town centers and within major transportation corridors to be consistent with Statewide Planning Goals and the Metro Framework Plan.

Recommended Action Measures
v. Take an active role in discussions relating to state and regional efforts to develop equitable ways to fund public infrastructure needed to better provide for existing needs and support projected employment and population growth.

Goal 15 (Special Planning Areas – Downtown) is dedicated to the redevelopment of downtown and focuses on ways in which transportation improvements will make downtown vibrant and successful.

Goal 15.1 The City will promote the creation of a vibrant and active urban village at the heart of the community that is pedestrian oriented, accessible by many modes of transportation, recognizes natural resources as an asset, and features a combination of uses that enable people to live, work, play, and shop in an environment that is uniquely Tigard.

Goal 15.4 Develop comprehensive street and circulation improvements for pedestrians, automobiles, bicycles, and transit.

Policies
1. The downtown shall be served by a complete array of multi-modal transportation services including auto, transit, bike, and pedestrian facilities.
2. The downtown shall be Tigard's primary transit center for rail and bus transit service and supporting land uses.
3. The City, in conjunction with TriMet, shall plan for and manage transit user parking to ensure the downtown is not dominated by "park and ride" activity.
4. Recognizing the critical transportation relationships between the downtown and surrounding transportation system, especially bus and Commuter Rail, Highway 99W, Highway 217 and
Interstate 5, the City shall address the downtown's transportation needs in its Transportation System Plan and identify relevant capital projects and transportation management efforts.
5. Streetscape and public area design shall focus on creating a pedestrian friendly environment without the visual dominance by automobile-oriented uses.
6. The City shall require a sufficient, but not excessive, amount of parking to provide for downtown land uses. Joint parking arrangements shall be encouraged.

Recommended Action Measures
i. Develop comprehensive street and circulation improvements for pedestrians, automobiles, bicycles, and transit.

ii. Develop a circulation plan that emphasizes connectivity to, from, and within the downtown in the design and improvement of the area's transportation system, including developing alternative access improvements to downtown, such as connections across Hwy 99W.
iii. Address public safety and land use compatibility issues in the design and management of the downtown's transportation system.
iv. Investigate assigning different roadway designations within the general area of the downtown as means to support transportation access to Town Center development such as the Oregon Department of Transportation's Special Transportation Area (STA) and Urban Business Area (UBA).
v. Implement an integrated downtown pedestrian streetscape and landscape plan.
vi. Acquire property and easements to implement streetscape and landscape plans, and develop needed streets, pathways, entrances to the Commuter Rail Park and Ride lot, and bikeways.
vii. Express the themes of an urban village and green heart by utilizing the "unifying elements" palette from the Streetscape Design Plan to design streetscape improvements.
viii. Emphasize sustainable practices in street design through innovative landscaping and stormwater management, and provision of multimodal infrastructure.
ix. Encourage sustainability features in the design of Downtown buildings.
x. Encourage the formation of a Downtown Parking and Transportation Management Association.
xi. Incorporate the Downtown's public investment / facility needs into the City's Public Facility Plan and implementing Community Investment Plan.

City of Tigard Community Development Code (last updated 2008)

Development codes implement the land use plan established in jurisdictions' Comprehensive Plans. There are several sets of provisions in the City of Tigard's Community Development Code that are transportation-related and regulate transportation facilities and improvements in the city. These provisions are found in the following code sections:

- 18.400 Land Division
- 18.600 Community Plan Area Standards
- 18.700 Specific Development Standards
- 18.800 Street and Utility Improvement Standards.

In **Section 18.400 (Land Division)**, approval criteria for land divisions require that adequate public facilities be available to serve the proposal. Final plat approval criteria for subdivisions require that roads for private use shown on the preliminary plat be approved by the City and that roads for public use be dedicated to the City.

Section 18.600 (Community Plan Area Standards) establishes special design standards for the Tigard Triangle, Washington Square Regional Center, and Durham Quarry, with a sub-section reserved for Tigard Town Center. The standards for the Tigard Triangle require that one of two street connectivity options be used in designing and constructing transportation facilities. Site design standards for the area regulate building orientation toward roads, setbacks from road rights-of-way, connecting walkways, and parking location and landscaping. Similarly, special street connectivity

and site design standards are provided for Washington Square Regional Center. Further, this code sub-section specifies that street and accessway design standards shall be dictated by the Recommended Roadway Functional Classification Map and Street Cross Sections in the Washington Square Regional Center Plan. Finally, special development standards for the Durham Quarry include access standards and design compatibility standards that address parking and orientation of front facades and main entrances toward roadways.

Section 18.700 (Specific Development Standards) regulates access, egress, and circulation. The provisions address joint access, public street access, required walkway location, and inadequate or hazardous access. There are tables provided for the vehicular access and egress requirements for residential, commercial, and industrial uses; the requirements address the minimum number of driveways, minimum access width, and minimum pavement width per number of units for residential uses and number of required parking spaces for non-residential uses.

Section 18.700 also regulates "sensitive lands," which are generally associated with waterways, wetlands, and steep slopes. In the sub-section's special provisions, roads, multi-use paths may take exception to setback requirements to cross or be located in a vegetated corridor given some conditions. Roads and driveways can be maintained, altered, or expanded in the setback as long as they comply with other City and Clean Water Services regulations and do not encroach further into the vegetated corridor. The sub-section on permits provides additional requirements for multi-use pathways on sensitive lands.

Off-Street Parking and Loading Requirements are presented in Section 18.765. The section addresses general provisions, general design standards, bicycle parking design standards, parking structure design standards, and minimum and maximum off-street parking requirements. The sub-section on off-street loading requirements includes visual clearance area regulations.

Section 18.800 (Street and Utility Improvement Standards) regulates a number of transportation facilities and related topics. It establishes block design and size requirements. A sub-section on lots dictates the relationship of lots to streets, including frontage, through lots, side lot lines, and large lots that must be configured to allow for future streets. Sidewalk regulations include provisions for location, widths, planter strips, maintenance, and facilities in the central business district. Provisions for bikeways and pedestrian pathways focus on location and widths.

The major sub-section of 18.800 addresses streets. New rights-of-way, existing rights-of-way, minimum right-of-way and street widths, access easements, access to arterials and collectors, street alignment and connections, intersection angles, grades and curves, curbs, curb cuts, ramps, driveways, private street, traffic signals, street lights, traffic calming, and traffic studies are among the numerous provisions of this sub-section.

Minimum right-of-way and street widths are established for arterials, collectors, neighborhood routes, local industrial or commercial roads, local residential roads, cul-de-sacs, and alleys. Table 18.810.1 presents the minimum widths for right-of-way, pavement, lanes, on-street parking, landscape strip, and medians, as well as the number of lanes, according to functional classification. For local residential streets, "skinny street" roadway widths are permitted where cross section and review criteria are met. Figures 18.810.1 to 18.810.6 provide cross-section diagrams.

For street alignment and connections, full street connections that are spaced no more than 530 feet apart are required, with exceptions for barriers. Design standards for Private streets will be

established by the City Engineer. A developer may be required to provide traffic calming measures, or pay into a fund to help pay for traffic calming measures, if the City Engineer determines that the additional traffic from the development creates the need for the measures.

Finally, **Section 18.500 (Zoning Districts)** addresses uses permitted in the City's residential, commercial, and industrial zones. However, transportation facilities were not found among the uses listed in the City's code. This issue, as it relates to TPR compliance, is discussed further in Section III of this memorandum.

City of Tigard Downtown Improvement Plan (2005)

The Tigard Downtown Improvement Plan (TDIP) was a planning project funded by the State's Transportation Growth Management (TGM) program, and was completed in 2005. It states its purpose in four parts.

1. *First and foremost, the TDIP is a downtown "improvement" plan, one that builds upon the good "bones" of the current Downtown area, and that builds upon the sound foundation of community-based planning for the area.*
2. *Second, the TDIP is intended to serve as the "master conceptual plan" for the Downtown neighborhood, as envisioned by the Tigard comprehensive Plan.*
3. *Third, the TDIP is intended to meet the objectives of the Metro Functional Plan, as that plan designates Tigard's downtown area as a Town Center.*
4. *Finally, the overarching objective of the Plan is to ensure that Downtown Tigard will serve the community's stated future needs for an active, mixed use "urban village".*

The Preferred Design Alternative is a conceptual design plan that responds to the environmental, market, and transportation challenges faced in downtown Tigard. The Preferred Alternative is made up of "development types," a generalization of zones, and of "catalyst projects," which are intended to stimulate investment in the area. Catalyst projects that are transportation-related include the Streetscape Enhancement Program, the Green Corridor/Urban Creek, the Hall Boulevard Downtown Gateway, and the Ash Avenue Downtown Improvement.

- The **Streetscape Enhancement Program** would develop a streetscape design theme for Downtown and would focus on street design and function improvements for Burnham, Main, Commercial, and Scoffins, and gateway improvements for Scoffins, Main, Garden Place, and Tigard Street.
- The **Green Corridor/Urban Creek** would be comprised of creek and water features accompanied by plazas, open spaces, walkways, and landscaping.
- The Hall Boulevard intersection with OR 99W is a gateway to Downtown, and a regional mid-sized retail business with parking and a public plaza is proposed to reinforce it as the **Hall Boulevard Downtown Gateway**.
- The **Ash Avenue Downtown Improvement** focuses on street and public space improvements for Ash Avenue from the planned park-and-ride to Fanno Creek. A new bike and pedestrian bridge, a creek overlook, and extension of Ash Avenue from Burnham to the park-and-ride are proposed.

Other implementation recommendations – transportation system improvements, code amendments, and financing – were developed to support the Preferred Design Alternative. Transportation system improvements are divided into short-term and long-term proposals for the City.

Short-term Transportation Improvements

- Continue implementing the plans, projects and policies identified in the adopted TSP.
- Determine alternative Downtown Access Improvements. If the recommended access improvements do not include an extension of Ash Avenue across Fanno Creek, then the TSP needs to be updated to remove this project.
- Review City Pedestrian and Bicycle Plans for the access they grant to, from, and within Downtown.
- Draft design requirements and guidelines for "Green Street" street treatments.
- Collaborate with ODOT to develop new cross-sections for Hall Boulevard and OR 99W
- Collaborate with ODOT and Metro to develop Highway Design Manual street design guidelines blending features of both ODOT and Metro Street design requirements.

Long-term Transportation Improvements

- Develop a Parking Management Plan once Downtown begins to significantly grow and prior to building any structure parking.
- Implement the results of the Downtown Access Improvements study.
- Work with Portland & Western Railroad and the ODOT Rail Division to convert to an at-grade railroad crossing.

Code amendments under consideration were the creation of new zones for the Tigard Town Center, including the Town Center-Central Business District (TC-CBD), Town Center-Mixed Use Commercial (TC-MUC), Town Center-Mixed Use Employment (TC-MUE), and Town Center-Mixed Use Residential (TC-MUR). Additionally, overlay districts were recommended for the Green Corridor/Urban Creek and Fanno Creek Open Space. In terms of financing, using the available tools of land assembly, tax abatements, and grants was most highly recommended. Establishing new tools – namely, urban renewal districts and business/local improvement districts – were also recommended.

The list of recommended actions and projects were compiled in the TDIP's appendices (Implementation Action Plan Technical Memorandum). The actions and projects were categorized and prioritized in terms of periods of time. The short-term actions that were prioritized for the three years following the plan's completion were coordinated with the City's Capital Improvements Program (CIP).

City of Tigard Washington Square Regional Center Plan (1999)

The Washington Square Regional Center Plan was developed to implement the 2040 Growth Concept adopted by Metro Council in 1995. A Washington Square Regional Center Task Force was formed, and it agreed on the following vision statements for the plan:

- *The Washington Square Regional Center is a vital regional center serving the needs of Washington County residents.*
- *Preserve residential neighborhoods.*
- *Offer an innovative transportation service that makes it easy for people to reach their destinations.*
- *Focus on Washington Square Mall as a community resource.*
- *Feature a linked greenbelt of parks and open space easily reached by residents and employees.*

As established in the vision, the plan would address innovative and accessible transportation services. Recommended transportation improvements include the following:

1. Develop a "Transit Access and Action Plan" with TriMet, and explore more frequent bus service, transit center improvements, commuter rail, and a local circulator.
2. Connect Nimbus Drive to the Washington Square Mall with an OR 217 overcrossing, with two lanes with bicycle and pedestrians facilities.
3. Extend Nimbus Drive to Greenburg Road.
4. Connect Nimbus Drive to Locust with an OR 217 overcrossing, two lanes with bicycle and pedestrians facilities (similar to a recommendation already in the RTP).
5. Improve the collector system at Oak/Lincoln/Locust.
6. Widen Hall Boulevard to three lanes from Oleson to southern end of Regional Center. Acquire right-of-way for five lanes, as planned in the RTP, but expand only to three lanes for now.
7. Improve OR 217 interchanges at Scholls Ferry Road and Hall Boulevard and specify improvements with Metro Highway 217 study.
8. Identify new bikeways to connect to existing bikeways and community destinations, plan and build off-street bike paths parallel to arterials and collectors where there is not capacity for on-street facilities, and extend the Fanno Creek Bikeway to the east along Ash Creek.

City of Tigard Highway 99W Improvement and Management Plan (2007)

The Highway 99W Improvement and Management Plan was completed by the City and a consultant team in 2007 and was funded by a grant from the Transportation and Growth Management (TGM) program. A variety of responses to projected growing demand and deteriorating operations on OR 99W had been identified in the RTP, including plans for mixed-use development and other land use and transportation measures designed to mitigate growth. The Highway 99W Improvement and Management Plan addresses transportation measures called for in the RTP for the portion of the highway reaching from the I-5 interchange to SW Durham Road.

A process involving the project team, Technical Advisory Committee (TAC), Citizen Advisory Committee (CAC), and the general public resulted in three alternatives – Alternative A (Partial Widening), Alternative B (Access Management Strategy), and Alternative C (Full Widening). Given evaluation criteria that included safety and convenience for alternative modes, adequate vehicle storage (queuing), freight accessibility, access spacing standards, and minimized property impacts and cost, Alternative B (Access Management) emerged as the preferred concept.

Features of Alternative B (Access Management) include:

- Access would be more strictly managed throughout the study area corridor rather than just at the interchange areas around I-5 and OR 217.
- Concept implementation relies primarily on two types of access management: raised medians and driveway closures, consolidation, or relocation.
- Raised medians are proposed along 40% of the study area corridor at locations north of Gaarde/McDonald Street. Drivers would be allowed to make U-turns at intersections, but additional width may be required and this will be addressed during preliminary design and engineering. Final design and implementation needs to be coordinated with Tualatin Valley Fire and Rescue to assure acceptable emergency vehicle access.
- Driveway management evaluated in the alternatives analysis focused on properties with multiple driveways, with access to side streets, or within 200 feet of intersections. This management measure is only in the planning stages and a formal Access Management Plan

still needs to be developed, which can be done in conjunction with construction project development or on its own.

- For pedestrians and bicyclists, install sidewalks where there are gaps in the system in the study area corridor, upgrade sidewalks to have four-foot landscaping strips and eight-foot pedestrian zones, and install a signalized pedestrian activated crossing at the intersection with Watkins Avenue. Install six-foot bike lanes where there are gaps in the system and sign sections where bicyclists need to share the sidewalk with pedestrians.
- Transit improvements include relocation of bus stops and queue bypasses at five intersections (68th Avenue, Dartmouth Avenue, Hall Boulevard, Walnut Street, and Gaarde, McDonald Street)
- Although this alternative does not feature the type of roadway widening proposed by the other alternatives, it does propose widening the following intersections to allow for new turn or through lanes and/or transit queue bypass lanes:
    - 68th Avenue – transit bypass lane
    - Dartmouth Avenue – transit bypass lane, southbound through lane
    - Hall Boulevard – bypass lane, westbound turn lane
    - Greenburg Road – eastbound/westbound left-turn lanes
    - Gaarde/McDonald – transit bypass lane, northbound/southbound left-turn lanes, eastbound/westbound through lanes, eastbound/westbound left-turn lanes
    - Canterbury – westbound left-turn lane
    - Beef Bend Road – southbound right-turn lane
    - Durham Road – northbound left turn lane.

According to City staff, the TSP update will incorporate recommendations from the plan. One major change will be that OR 99W will be designated for five lanes throughout the city, instead of seven lanes as indicated for segments of the highway in the Washington County Transportation Plan RTP.

City of Tigard Capital Improvement Program (2008-2013)

The City of Tigard's Capital Improvement Program (CIP) schedules and budgets infrastructure projects for five-year periods. The City's CIP for transportation projects includes 30 projects. These projects are being funded by Gas Tax, Street Maintenance Fee, and Traffic Impact Fee (transportation Systems Development Charge) proceeds.

Table 5. Tigard Transportation Budget (FY 2008-2009)

Funding Source	Budgeted Amount
State Gas Tax Share	$2,213,500
Street Maintenance Fee	$800,000
City Gas Tax	$672,000
Traffic Impact Fees	$620,000
TOTAL	$4,305,500

Source: City of Tigard

Not all of the projects in the CIP have identified funding yet. The cost of the projects with identified and allocated funding from 2008-2013 are estimated to cost about $4.4 million.

The projects include paving, street improvements, intersection improvements, sidewalks and other pedestrian facilities (bridge and crosswalks), beacons and lighting systems in school areas, a gateway for Main Street and Downtown Tigard, and a local improvement district (LID) for Tigard

Triangle. Most of the smaller, less expensive projects are fully funded. The five largest, most expensive projects are outlined below.[10]

Table 6. Sample of CIP Projects in Tigard (2008-2013)

Project Name	Project Description	Cost
Pavement Maintenance Program	• Paving unpaved parts of road (e.g. narrow travel lane, shoulder), then re-paving.	Total cost $6.4 million • $150,000 Gas Tax • $4.4 million Street Maintenance Fee • $1.8 million Unfunded
Greenburg Road/OR 99W intersection	• Add dedicated left-turn lanes on Greenburg Road and Main Street • Provide dedicated through movement across intersection from side streets • Retain right-turn lanes on streets • Build additional EB through lane on OR 99W from viaduct east through intersection • Funding for ROW acquisition, design and engineering, environmental, and construction	Total cost $5.6 million • Water fund $15,000 • City Gas Tax $3.4 million • Unfunded $2.2 million
Street improvements on Walnut Street from 116th to Tiedeman	• Widen and construct • Design and engineering, construction	Total cost $4.4 million • Water Fund $170,000 • Traffic Impact Fee $1.7 million • Unfunded $2.5 million
Street improvements on 72nd Avenue from Dartmouth to OR 99W	• Widen street, improve vertical sight distance, upgrade storm drain, extend sewer, underground existing utilities, sidewalks and bike lanes • Land/ROW acquisition, design and engineering, and construction	Total cost $3.9 million • Underground Utility $150,000 • Unfunded $3.8 million
Street improvements on 121st from Whistler to Tippit	• Acquire remaining rights-of-way, pave width of 44 feet, stripe three lanes with bike lanes and construct sidewalks • Acquisition and construction	$3.8 million • Completely unfunded

Since the 2002 TSP, four street projects, seven intersection projects, and five pedestrian projects have been constructed at sites around the city. The street projects include road widening, adding sidewalks and bike lanes, and building a new street, and the intersection projects consisted mainly of new traffic signals, turn lanes, and raised medians as well as signal coordination. Pedestrian-activated crosswalk lights and new sidewalks were among the pedestrian projects. According to the City, there are also five projects under design, shown below in Table 7.

Table 7. City Transportation Projects Currently Under Design (February 2009)

Street	Location	Project Description	Construction Year
Burnham St	From Hall Blvd to Main St	Street reconstruction and widening	2009
Durham Rd	Tigard High School/ 88th Ave	Pedestrian-actuated crosswalk lights	2009

[10] The full list and description of CIP projects can be viewed at: http://www.tigard-or.gov/city_hall/departments/engineering/cip_projects/docs/2008_cip/streets.pdf.

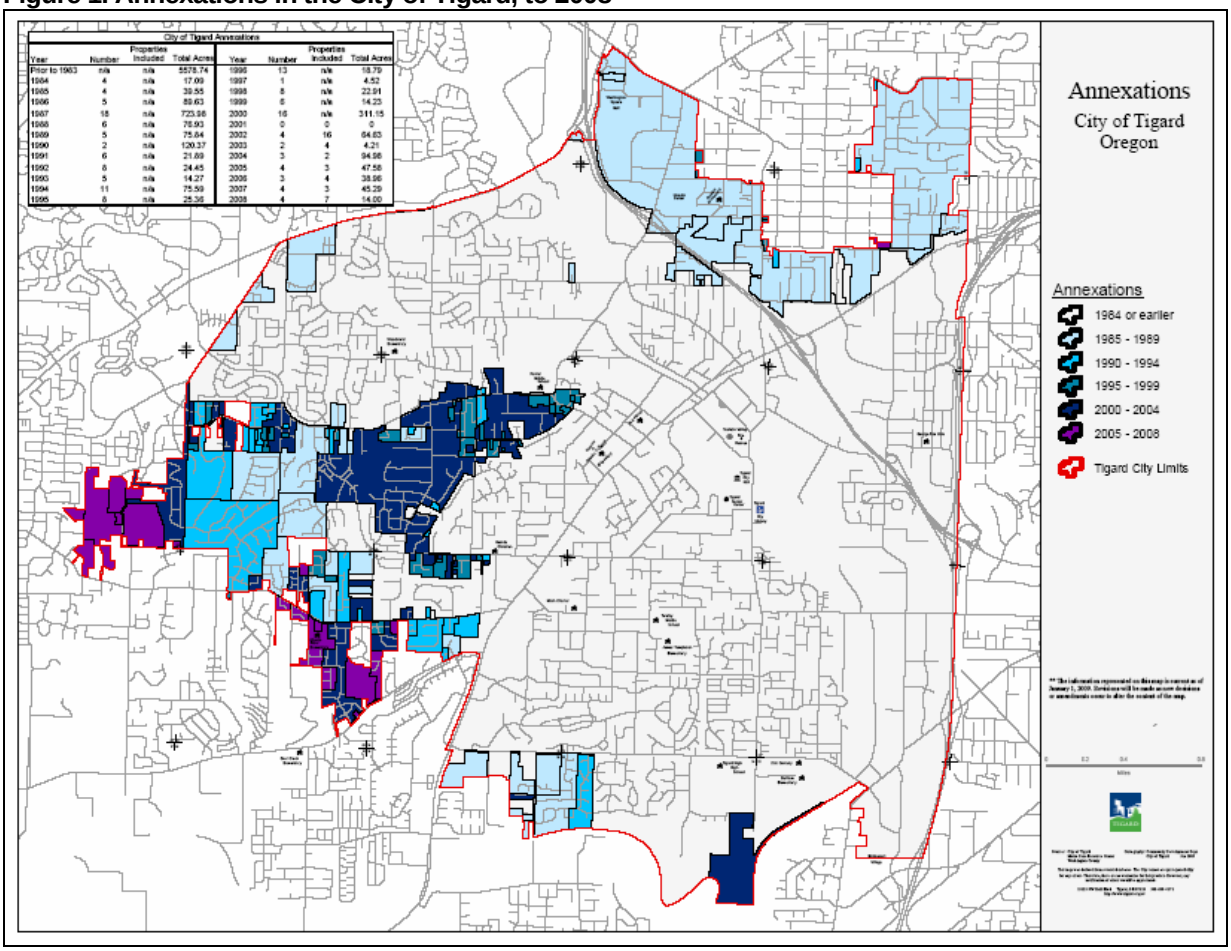
Street	Location	Project Description	Construction Year
Hall Blvd	From Bonita Rd to 500 feet north	New sidewalk	2009
Hwy 99W / Hall Blvd Intersection		Major intersection reconstruction	2010
Hwy 99W / Greenburg Rd / Main St Intersection		Major intersection reconstruction	2010

Source: City of Tigard

City of Tigard Annexations

A map of annexations in the City of Tigard up to 2008 shows a concentration of annexations in the northern and western parts of the city (Figure 1).

Figure 1. Annexations in the City of Tigard, to 2008



Source: City of Tigard

The annexations to the north are focused around Washington Square Regional Center, and were brought in between 1985-1989. The annexations to the west lie between Scholls Ferry Road (OR 210) and OR 99W, reaching west towards Bull Mountain. The general progression of annexation here, however, did not move linearly to the west, and annexation dates here range from the period of 1985-1999 to the period of 2005-2008. Approximately 1,990 acres have been added to the city since

1983, when the city area stood at about 5,580 acres. The largest annexations occurred in 1987 (724 acres) and 2000 (311 acres).

III. Issues Report

This issues report section assesses the Tigard TSP for inconsistencies or potential issues of compliance with regulatory and background documents summarized in Section II of this memorandum. These inconsistencies and potential issues are indicated in bold text and then compiled at the end of this section. The assessment of consistency and compliance focuses in particular on the Transportation Planning Rule (TPR), OAR 660-012, because of the rule's direct regulation of Transportation System Plans (TSPs) and related ordinances.

Oregon Statewide Planning Goals

- Goal 1 (Citizen Involvement) – The Tigard TSP should comply with this goal through its series of Technical Advisory Committee (TAC) meetings, Citizen Advisory Committee (CAC) meetings, public forums, and public hearings to be held by the Planning Commission and City Council during the adoption process.
- Goal 2 (Land Use Planning) – Goal 2 requires planning coordination between the City, Washington County, Metro, TriMet, ODOT, and any other relevant agencies. While its TSP policies call for coordination with the plans of other agencies, **neither the Comprehensive Plan/TSP, nor the Community Development Code provide for coordinating the review of land use applications with ODOT for properties that are adjacent to state road facilities**. This is also addressed in the TPR analysis later in this section.
- Goal 5 (Natural Resources, Scenic and Historic Areas, and Open Spaces) and Goal 6 (Air, Water and Land Resources Quality) – These goals are better addressed in the sub-section on the City's Comprehensive Plan.
- Goal 7 (Areas Subject to Natural Hazards) – This goal applies to the Tigard TSP insofar as the existing and planned transportation system overlaps with areas of steep slopes or prone to flooding or wildfires.
- Goal 8 (Recreational Needs) – This goal relates to the Tigard TSP mainly in terms of multi-use paths and building local connectivity to parks and recreation destinations within the community. These needs are sufficiently addressed in the projects proposed in Chapters 5 (Pedestrian) and 6 (Bicycle), and in connectivity plans proposed in Chapter 8 (Motor Vehicles).
- Goal 9 (Economic Development) – The Tigard TSP does propose projects in its Pedestrian Action Plan, Bicycle Action Plan, Future Street Improvements, and Future Intersection Improvements that support existing and developing business centers in town, including Downtown/Town Center, Washington Square Regional Center, the OR 99W corridor, and the Tigard Triangle.
- Goal 10 (Housing), Goal 11 (Public Facilities), and Goal 14 (Urbanization) – All of these goals require coordination of urbanization and provision of public facilities including transportation, and discourage the premature urbanization of areas for which adequate public facilities cannot be provided. The Tigard TSP does not propose transportation facilities outside its urban area or facilities that are not appropriately classified to the surrounding existing and planned land uses.
- Goal 12 (Transportation) – This goal is implemented through the Oregon Transportation Planning Rule, which is covered in more detail later in this section.
- Goal 13 (Energy Conservation) – The Tigard TSP does provide for transportation alternatives in its pedestrian, bicycle, and transit elements, as well as generally describe transportation demand and system management techniques in Chapters 8 (Motor Vehicles) and 10 (Transportation Demand management). **The Tigard TSP must continue to make**

transportation options more viable and to be more specific about transportation demand management and system management techniques that it will pursue in order to conserve energy.

Oregon Transportation Planning Rule (TPR)

The Oregon Transportation Planning Rule (TPR) – or OAR 660, Division 12 – underwent a series of amendments since the Tigard TSP was adopted in 2002. The amendments focused on the purpose statement, Section -0016 (Coordination with Federally-Required Regional Transportation Plans in Metropolitan Areas), Section -0050 (Transportation Project Development), and Section -0060 (Plan and Land Use Regulation Amendments). The relevant provisions of these sections and their relationship to the Tigard TSP are presented below.

1. OAR 660-012-0016 – Coordination with Federally-Required Regional Transportation Plans in Metropolitan Areas

   (a) Make a finding that the proposed regional transportation plan amendment or update is consistent with the applicable provisions of adopted regional and local transportation system plan and comprehensive plan and compliant with applicable provisions of this division; or
   (b) Adopt amendments to the relevant regional or local transportation system plan that make the regional transportation plan and the applicable transportation system plans consistent with one another.

Consistency with Regional Transportation Plan (RTP) updates is addressed later in this section of the memorandum.

2. 660-012-0050 – Transportation Project Development

   (3) Project development addresses how a transportation facility or improvement authorized in a TSP is designed and constructed. This may or may not require land use decision-making. The focus of project development is project implementation, e.g. alignment, preliminary design and mitigation of impacts. During project development, projects authorized in an acknowledged TSP shall not be subject to further justification with regard to their need, mode, function, or general location. For purposes of this section, a project is authorized in a TSP where the TSP makes decisions about transportation need, mode, function and general location for the facility or improvement as required by this division.

This essentially "protects" projects that are included in TSPs from additional decision-making and challenges, and should save the City the administrative burden associated with additional decision-making and challenges. This provision only applies, however, when project need, mode, function, and general location is identified. The Tigard TSP addresses these requirements, with a few small exceptions.

Project mode, function, and general location are identified in modal chapters (Chapters 5-8) and summarized in Tables 11-4 to 11-7 in Chapter 11 (Funding/Implementation). **There is an exception for intersection safety enhancements ($20 million) and pedestrian crossings ($8 million), whose locations are only described as "several locations."** Need for the projects is established

in Chapters 3 and 4 (Existing and Future Conditions) and the modal chapters – Chapters 5-8 (Pedestrian, Bicycle, Transit, and Motor Vehicles).

3. 660-012-0060 – Plan and Land Use Regulation Amendments

Amendments to this section:

- *Require local jurisdictions to balance the need for development with the need for transportation improvements;*
- *Address "significant effect" by establishing the end of the planning period as the measure for determining whether proposed amendments would cause an imbalance between development and the transportation network serving that development; and*
- *Identify the transportation improvements that a local government can consider in determining whether a proposed amendment will significantly affect transportation facilities.*

"Significant effect" would be determined in Tigard according to the end of the TSP's planning period, 2022 in the case of the 2002 TSP. "Planned" facilities that can be used in evaluating significant effect include those in the Statewide Transportation Improvement Program (STIP), the Metropolitan Transportation Improvement Program (MTIP), and the financially constrained Regional Transportation Plan (RTP); those in the Tigard TSP or CIP for which funding is identified and assigned; and projects for which ODOT, Metro, Washington County, or the City can provide a statement that their funding in the planning period is "reasonably likely." **The funding element of Tigard's TSP (Chapter 11) does not identify funding per project and the 2008-2013 CIP does not have funding available for all the projects on its list.** However, the CIP projects that do have full funding identified could be used for evaluating significant effects.

The Tigard TSP is assessed against provisions of Sections -0020 (Elements of TSPs), -0045 (Implementation of the TSP), and -0060 (Plan and Land Use Regulation Amendments) in the tables below.

Table 8. Tigard TSP/TPR Compliance

Elements of Transportation System Plans (OAR 660-12-0020)	**Findings and TPR Compliance**
(2) The TSP shall include the following elements:	
(a) A determination of transportation needs as provided in OAR 660-012-0030;	Motor vehicle, pedestrian, bicycle, and transit needs are forecast and addressed for the next 20 years. Truck traffic is generally addressed and only as through-traffic and **not in terms of local delivery**. Other modes (water, air, rail, and pipeline transportation) are largely not applicable in the city, and are addressed in later provisions of this sub-section.
(b) A road plan for a system of arterials and collectors and standards for the layout of local streets and other important non-collector street connections. Functional classifications of roads in regional and local TSP's shall be consistent with	The road plan in Chapter 8 of the existing TSP (Motor Vehicles) includes a proposed functional classification system (Figure 8-3) that was developed in compliance with Washington County's, Metro's, and ODOT's systems and added a local classification

Table 8. Tigard TSP/TPR Compliance	
Elements of Transportation System Plans (OAR 660-12-0020)	**Findings and TPR Compliance**
functional classifications of roads in state and regional TSP's and shall provide for continuity between adjacent jurisdictions. The standards for the layout of local streets shall provide for safe and convenient bike and pedestrian circulation necessary to carry out OAR 660-012-0045(3)(b). New connections to arterials and state highways shall be consistent with designated access management categories. The intent of this requirement is to provide guidance on the spacing of future extensions and connections along existing and future streets which are needed to provide reasonably direct routes for bicycle and pedestrian travel. The standards for the layout of local streets shall address:	of "neighborhood route" in order to capture the function between collectors and local residential streets (Figure 8-4). Changes to prior classifications are presented in Table 8-1. Proposed cross-sections and design guidelines are shown in Figures 8-8 to 8-10 and in Table 8-2.
(A) Extensions of existing streets; (B) Connections to existing or planned streets, including arterials and collectors; and (C) Connections to neighborhood destinations.	Figure 8-4 shows a road extension for the neighborhood route system. Figure 8-5 shows the planned addition of right-of-way to the Tigard road system. Figures 8-12 to 8-17 illustrate extensions of local roads and paths for motor vehicle and pedestrian connectivity. Figure 8-19 shows the 20-year plan for road extensions and road widening on collector and arterial roads in Tigard.
(c) A public transportation plan which: (A) Describes public transportation services for the transportation disadvantaged and identifies service inadequacies; (B) Describes intercity bus and passenger rail service and identifies the location of terminals; (C) For areas within an urban growth boundary which have public transit service, identifies existing and planned transit trunk routes, exclusive transit ways, terminals and major transfer stations, major transit stops, and park-and-ride stations. Designation of stop or station locations may allow for minor adjustments in the location of stops to provide for efficient transit or traffic operation or to provide convenient pedestrian access to adjacent or nearby uses.	Figure 7-2 in Chapter 7 (Transit) of the TSP identifies transit supportive zoning within the city that is not within the ¼-mile service area of transit lines. Minimum densities in some city zones that are in transit service areas are lower than optimal. Existing service and other service needs are generally described in Chapter 7. Improvements identified in the Action Plan and potential projects list (Table 7-2 and Figure 7-4) are a mixture of operations and capital improvements, including park-and-ride lots, pedestrian districts, commuter rail, a new transit center, improvements of stops and amenities, pedestrian connections, greater frequency, and new routes. Other than a policy addressing ADA accessibility, **services and service needs for the transportation dependent or disadvantaged are not identified**.
(d) A bicycle and pedestrian plan for a network of bicycle and pedestrian routes throughout the planning area. The network and list of facility	The TSP includes both a Pedestrian Plan (Chapter 5) and Bicycle Plan (Chapter 6). The pedestrian plan prioritizes "filling in network gaps, connections to schools, parks

Table 8. Tigard TSP/TPR Compliance	
Elements of Transportation System Plans (OAR 660-12-0020)	**Findings and TPR Compliance**
improvements shall be consistent with the requirements of ORS 366.514;	and activity centers, and coordination of land use approval process to provide sidewalks and links to existing sidewalks." The bicycle plan builds on the existing bike lane network, focusing lanes on higher classification roads. Both plans include action plans with projects that are prioritized for funding. Both action plans include projects that are both inside and outside of road rights-of-way.
(e) An air, rail, water and pipeline transportation plan which identifies where public use airports, mainline and branchline railroads and railroad facilities, port facilities, and major regional pipelines and terminals are located or planned within the planning area. For airports, the planning area shall include all areas within airport imaginary surfaces and other areas covered by state or federal regulations;	Chapter 9 (Other Modes) addresses air, rail, water, and pipeline. The chapter describes airports in the region, but there are no airports in Tigard. There is branchline freight rail operated by Portland & Western (P&W) and planned for (and operating with) commuter rail; crossing improvements are also identified. There are water recreation resources in the city, but no existing or planned water transportation. Last, there are existing gas lines, and no plans for new or expanded pipelines.
(f) For areas within an urban area containing a population greater than 25,000 persons a plan for transportation system management and demand management;	Chapter 10 (Transportation Demand Management) presents TDM strategies and provides a general TDM plan for the city. Chapter 8 provides a series of intersection and signal improvements. It describes ITS management techniques and generally describes ramp metering and ATMS projects/programs to be undertaken in the region and the city, **although these projects/programs are not necessarily presented as a "plan."**
(g) A parking plan in MPO areas as provided in OAR 660-012-0045(5)(c);	It does not necessarily rise to the level of "plan," but parking is addressed in Chapter 8 (Motor Vehicles) and the City's Development Code. Bicycle parking and motor vehicle parking maximums were adopted into the City's code to comply with the TPR and Title 2 of Metro's Functional Plan.
(h) Policies and land use regulations for implementing the TSP as provided in OAR 660-012-0045;	Transportation-related policies are established in Chapter 2 of the Tigard TSP. **The TSP implementation chapter (Chapter 11), however, does not include implementing land use regulations.** There is one proposed code amendment in the chapter on transit (Chapter 7).

Table 8. Tigard TSP/TPR Compliance	
Elements of Transportation System Plans (OAR 660-12-0020)	**Findings and TPR Compliance**
	Section -0045 is addressed in more detail in the next section of this table.
(i) For areas within an urban growth boundary containing a population greater than 2,500 persons, a transportation financing program as provided in OAR 660-012-0040.	Financing is addressed in Chapter 11 of the TSP (Funding and Implementation). The chapter provides information on the cost of proposed TSP projects (Table 11-8), potential funding and funding eligible by project type (Tables 11-1 and 11-9), estimated revenue for the next 20 years (Table 11-10). **The chapter does not prioritize the projects or establish policies for prioritizing the projects.**
(3) Each element identified in subsections (2)(b)-(d) of this rule shall contain: (a) An inventory and general assessment of existing and committed transportation facilities and services by function, type, capacity and condition:	Existing transportation system conditions are described in Chapter 3 (Existing Conditions) of the TSP. Transportation facility inventories are provided in the separate modal chapters: Chapter 5 (Pedestrian Plan), Chapter 6 (Bicycle Plan), Chapter 7 (Transit), and Chapter 8 (Motor Vehicles).
(A) The transportation capacity analysis shall include information on: (i) The capacities of existing and committed facilities; (ii) The degree to which those capacities have been reached or surpassed on existing facilities; and (iii) The assumptions upon which these capacities are based.	Chapter 3 (Existing Conditions) of the TSP includes PM peak hour intersection level-of-service conditions for major intersections in the city for 1994, 1997, and 1999. The methodology is explained.
(B) For state and regional facilities, the transportation capacity analysis shall be consistent with standards of facility performance considered acceptable by the affected state or regional transportation agency;	The City uses alternative mobility standards adopted for the Metro region and approved by the State.
(C) The transportation facility condition analysis shall describe the general physical and operational condition of each transportation facility (e.g., very good, good, fair, poor, very poor).	In Chapter 8 (Motor Vehicles), the TSP does rate the pavement condition for the road system's arterials and collectors in terms of "good", "fair", and "poor" (Figure 8-23). **Other transportation facilities and operations are not rated this way**.
(3)(b) A system of planned transportation facilities, services and major improvements. The system shall include a description of the type or functional	The proposed functional classification map is provided in Figure 8-2 in Chapter 8 (Motor Vehicles). Master plan projects, action plan projects,

Table 8. Tigard TSP/TPR Compliance	
Elements of Transportation System Plans (OAR 660-12-0020)	**Findings and TPR Compliance**
classification of planned facilities and services and their planned capacities and performance standards;	access management strategies, and other proposed implementation measures presented in Chapter 8 are projected to improve road capacity and performance, although the improvements are not quantified.

Implementation of the TSP (OAR 660-12-0045)	**Findings and TPR Compliance**
(1) Each local government shall amend its land use regulations to implement the TSP.	
(b) To the extent, if any, that a transportation facility, service, or improvement concerns the application of a comprehensive plan provision or land use regulation, it may be allowed without further land use review if it is permitted outright or if it is subject to standards that do not require interpretation or the exercise of factual, policy or legal judgment.	**The City of Tigard Community Development Code (TCDC) does not establish use regulations for transportation facilities – including roads, modifications to roads, transit facilities, bicycle facilities, and pedestrian facilities – in City's land use districts.** Railroad lines and rail yards are the only transportation facilities addressed in the use regulations.
(c) Local governments shall provide a review and approval process that includes notice to affected transportation facility and service providers, MPOs and ODOT, consistent with 660-012-0050 (Transportation Project Development). Local governments shall amend regulations to provide for consolidated review of land use decisions required to permit a transportation project.	Chapter 18.390 (Decision-Making Procedures) of the City's Community Development Code provides for notice to affected providers in TCDC 18.390.040(C) and (E) for Type II procedures, TCDC 18.390.050(C) for Type III procedures, and TCDC 18.390.060(D) for Type IV procedures. Access reports are required for all new development proposals to demonstrate compliance with stacking, sight distance, and deceleration standards as adopted by the road authority. **However, there is not a set of special procedures for transportation project permitting or consolidated review.**
(2) Local governments shall adopt land use or subdivision ordinance regulations, consistent with applicable federal and state requirements, to protect transportation facilities for their identified functions.	
(a) Access control measures.	General local access standards are established in TCDC 18.705.030(H) and in Chapter 8 of the TSP. The code provisions require an access management report to be prepared for all new development in order to show compliance with the standards adopted by the agency with jurisdiction over that roadway.

Implementation of the TSP **(OAR 660-12-0045)**	**Findings and TPR Compliance**
(b) Standards to protect the future operations of roadways and transit corridors	As addressed by the previous provisions, access control measures are included in the City's code and TSP. Traffic studies for development proposals that generate a specified amount of trips, have transportation issues determined by the City Engineer, or other specified special conditions are required pursuant to TCDC 18.810.030(AC). These studies, in addition to required access management reports, are important tools for protecting roadway operations. **Performance or mobility standards are not established in the City's code or TSP. These are alternative standards adopted for the Metro region and included in the updated Oregon Highway Plan (OHP).**
(c) Control of land use around public use airports	Not applicable
(d) Coordinated review of future land use decisions affecting transportation facilities, corridors or sites	**The City's code does not currently provide a review process for transportation facility permitting or a process for coordinated review of future land use decisions that affect transportation facilities.**
(e) Process to apply conditions to development proposals in order to minimize impacts and protect transportation facilities	Approval criteria for preliminary subdivision plats in TCDC 18.430.040(A) include connectivity with adjacent existing and planned street systems. Conditions of approval for preliminary plats may include any terms necessary to comply with the Comprehensive Plan and other City ordinances and regulations, pursuant to TCDC 18.430.040(B). **Minimizing adverse impacts or protecting transportation facilities are not specified as development approval criteria in TCDC 18.430.** Studies of impacts on public facilities including the transportation system are explicit application requirements for Type II and III procedures (TCDC 18.390). Mitigation and other improvements must be identified for impacts determined in the study. **TCDC 18.810.030(AC) requires traffic studies under certain conditions, but does not articulate a connection between the findings of the studies and**

Implementation of the TSP **(OAR 660-12-0045)**	**Findings and TPR Compliance**
	potential conditions of development approval.
(f) Regulations to provide notice to public agencies providing transportation facilities and services, MPOs, and ODOT of: land use applications that require public hearings, subdivision and partition applications, applications which affect private access to roads, applications within airport noise corridor and imaginary surfaces which affect airport operations.	TCDC 18.390.040(C), TCDC 18.390.050(C), and TCDC 18.390.060(D) require notice to affected agencies for Type II, Type III, and Type IV procedures. Notice is required for pending decisions by the Director for Type II procedures, and notice is required for public hearings for Type III and Type IV procedures. Subdivision and partition proposals, applications affecting private access roads, and applications in airport areas are subject to these notice requirements if they are determined to be Type II, III, or IV decision procedures.
(g) Regulations assuring amendments to land use designations, densities, design standards are consistent with the function, capacities, and levels of service of facilities designated in the TSP.	Criteria for quasi-judicial amendments to the Development Code and zoning map, listed in TCDC 18.380.030(B), generally require compliance with the Comprehensive Plan, Comprehensive Plan designations, and other applicable implementing ordinances. **They do not explicitly address consistency with transportation standards.** **The code does not include criteria for legislative amendments or amendments to the Comprehensive Plan.**
(3) Local governments shall adopt land use or subdivision regulations for urban areas and rural communities as set forth in 660-012-0040(3)(a-d):	
(a) Provide bicycle parking in multifamily developments of 4 units or more, new retail, office and institutional developments, transit transfer stations and park-and-ride lots	TCDC 18.765.050 establishes bicycle parking design standards including location, access, cover, paving, rack and area design, and quantity. Table 18.765.2 presents minimum and maximum off-street vehicle and bicycle parking requirements. **Transit stations and park-and-ride lots are not specified uses and, therefore, do not have City bicycle parking requirements assigned to them.**
(b) Provide "safe and convenient" (per subsection 660-012-0045.3(d)) pedestrian and bicycle connections from new subdivisions/multifamily development to neighborhood activity centers; bikeways are required along arterials and major collectors; sidewalks are required along arterials, collectors, and most local streets in urban areas except controlled access roadways	Sidewalks built to City standards are required on at least one side of the street for industrial and private streets, and on both sides of the street on all other streets, pursuant to TCDC 18.810.070(A). Bike lanes are required on arterials, collectors, and neighborhood routes. Specifications for sidewalks and bike lanes are given in the street design standards presented in Table 18.810.1 and Figures 18.810.1-18.810.6 in TCDC 18.810.030 (Streets). Preliminary subdivision plat approval criteria in TCDC 18.430.040(A) require that proposed roads

Implementation of the TSP **(OAR 660-12-0045)**	**Findings and TPR Compliance**
	connect and conform to the existing and planned roads of adjacent development. This requirement is reinforced by general provisions in TCDC 18.705 (Access, Egress, and Circulation) that require walkways between developments when practicable. Improvements recommended in the TSP are based on the strategy of connecting community destinations, but this provision is not explicitly required in the City's code. (Note: requiring such connections, when the community activity centers are not adjacent to proposed development sites, may not be justified according to "rough proportionality" legal criteria.)
(c) Off-site road improvements required as a condition of development approval must accommodate bicycle and pedestrian travel, including facilities on arterials and major collectors	Street design standards presented in Table 18.810.1 and Figures 18.810.1-18.810.6 in the City's code will guide off-site road improvements, and include sidewalks on all roads and bike lanes on arterials, collectors, and neighborhood routes.
(e) Provide internal pedestrian circulation within new office parks and commercial developments	Internal pedestrian circulation is required for all new development and conditionally for reconstruction and changes in use, pursuant to TCDC 18.705.030(F).
(4) To support transit in urban areas containing a population greater than 25,000, where the area is already served by a public transit system or where a determination has been made that a public transit system is feasible, local governments shall adopt land use and subdivision regulations as provided in (a)-(g) below: (a) Transit routes and transit facilities shall be designed to support transit use through provision of bus stops, pullouts and shelters, optimum road geometrics, on-road parking restrictions and similar facilities, as appropriate;	Site review criteria in TCDC 18.360.090(11) require that provisions be made for transit for development proposed within 500 feet of an existing or planned transit line. The sub-section also specifies that the applicant may be required to provide a shelter, turnout, or pathway connections to stops/shelters. **Road geometrics and on-road parking restrictions are not addressed in these code provisions, but this does not necessarily mean that the code is not in compliance with this requirement.**
(b) New retail, office and institutional buildings at or near major transit stops shall provide for convenient pedestrian access to transit through the measures listed in (A) and (B) below. (A) Walkways shall be provided connecting building entrances and streets adjoining the site; (B) Pedestrian connections to adjoining properties shall be provided except where such a connection is impracticable as	Street and sidewalk standards in TCDC 18.810 (Street and Utility Improvement Standards) require safe and direct connections to transit stops/facilities. Walkway standards in TCDC 18.705 (Access, Egress, and Circulation) require connections between building entrances. Walkways must be provided between buildings on a site and to connect to new and existing developments and adjacent developments. TCDC 18.810 provides for the stubbing of streets.

Implementation of the TSP **(OAR 660-12-0045)**	**Findings and TPR Compliance**
provided for in OAR 660-012-0045(3)(b)(E). Pedestrian connections shall connect the on site circulation system to existing or proposed streets, walkways, and driveways that abut the property. Where adjacent properties are undeveloped or have potential for redevelopment, streets, accessways and walkways on site shall be laid out or stubbed to allow for extension to the adjoining property; (C) In addition to (A) and (B) above, on sites at major transit stops provide the following: (i) Either locate buildings within 20 feet of the transit stop, a transit street or an intersecting street or provide a pedestrian plaza at the transit stop or a street intersection; (ii) A reasonably direct pedestrian connection between the transit stop and building entrances on the site; (iii) A transit passenger landing pad accessible to disabled persons; (iv) An easement or dedication for a passenger shelter if requested by the transit provider; and (v) Lighting at the transit stop.	Its sidewalk standards require that sidewalks be constructed in a way as to be able to connect to other important community destinations. Major transit stops are identified in the transit planning maps in Chapter 7 (Transit) of the 2002 TSP. **Building proximity to transit stops, pedestrian plazas at stops, accessible landing pads, easements for shelters, and transit stop lighting are not addressed by Tigard's code.**
(c) Local governments may implement (4)(b)(A) and (B) above through the designation of pedestrian districts and adoption of appropriate implementing measures regulating development within pedestrian districts. Pedestrian districts must comply with the requirement of (4)(b)(C) above;	**Pedestrian districts are not addressed in Tigard's code.**
(d) Designated employee parking areas in new developments shall provide preferential parking for carpools and vanpools;	TCDC 18.765 (Off-Street Parking and Loading Requirements) provides for preferential parking for carpool and vanpools for parking areas with at least 20 parking spaces.
(e) Existing development shall be allowed to redevelop a portion of existing parking areas for	Although the area or location of the development is not specified, the City's Off-Street Parking and

Implementation of the TSP **(OAR 660-12-0045)**	**Findings and TPR Compliance**
transit-oriented uses, including bus stops and pullouts, bus shelters, park and ride stations, transit-oriented developments, and similar facilities, where appropriate;	Loading Requirements (TCDC 18.765) do allow for required parking reductions of up to 20% when transit-related facilities and transit-oriented development are constructed.
(f) Road systems for new development shall be provided that can be adequately served by transit, including provision of pedestrian access to existing and identified future transit routes. This shall include, where appropriate, separate accessways to minimize travel distances;	Road dimensions presented in Table 18.810.1 and Figures 18.810.1 – 18.810.3 for arterials, collectors, and neighborhood routes allow for transit. Street and sidewalk standards in TCDC 18.810 (Street and Utility Improvement Standards) require safe and direct connections to transit stops/facilities. Pedestrian connections from buildings and sites to the streets and transit are also required by TCDC 18.705 (Access, Egress, and Circulation).
(g) Along existing or planned transit routes, designation of types and densities of land uses adequate to support transit.	Zoning along existing and planned transit routes is a combination of mixed-use commercial, residential, and employment (MUC, MUR, and MUE), R-12 and R-25, and C-P, C-G, and CBD. The densities allowed in these zones support transit, although some of the allowed uses are auto-oriented and not as transit-supportive.
(5) In MPO areas, local governments shall adopt land use and subdivision regulations to reduce reliance on the automobile which: (a) Allow transit-oriented developments (TODs) on lands along transit routes;	Zoning along existing and planned transit routes is a combination of mixed-use commercial, residential, and employment (MUC, MUR, and MUE), R-12 and R-25, and C-P, C-G, and CBD. The mixed-use zones, residential zones, and CBD allow for densities that are transit-supportive. **However, other than the MUR and CBD zones, these zones do not allow mixed uses that are particularly transit-oriented (a mix of commercial and residential in buildings) and some allow very auto-oriented uses that do not support as friendly a transit environment.**
(b) Implements a demand management program to meet the measurable standards set in the TSP in response to 660-012-0035(4);	**The Tigard TSP and code do not establish measurable standards for a demand management program.**
(c) Implements a parking plan which: (A) Achieves a 10% reduction in the number of parking spaces per capita in the MPO area over the planning period. This may be accomplished through a combination of restrictions on development of new parking spaces and requirements that	The City's minimum and maximum parking requirements (found in TCDC 18.765) are modeled after Metro requirements and satisfy the provisions of this TPR section.

Implementation of the TSP **(OAR 660-12-0045)**	**Findings and TPR Compliance**
existing parking spaces be redeveloped to other uses; (B) Aids in achieving the measurable standards set in the TSP in response to OAR 660-012-0035(4); (C) Includes land use and subdivision regulations setting minimum and maximum parking requirements in appropriate locations, such as downtowns, designated regional or community centers, and transit oriented-developments; and (D) Is consistent with demand management programs, transit-oriented development requirements and planned transit service.	
(e) Require all major industrial, institutional, retail and office developments to provide either a transit stop on site or connection to a transit stop along a transit trunk route when the transit operator requires such an improvement.	Site review criteria in TCDC 18.360.090(11) require that provisions be made for transit for development proposed within 500 feet of an existing or planned transit line. The sub-section also specifies that the applicant may be required to provide a shelter, turnout, or pathway connections to stops/shelters.
(6) As part of the pedestrian and bicycle circulation plans, local governments shall identify improvements to facilitate bicycle and pedestrian trips to meet local travel needs in developed areas.	Pedestrian and bicycle system improvements are presented in Chapters 5 and 6 of the existing TSP, as well as plans for improving local connectivity in Chapter 8 (Motor Vehicles).
(7) Local governments shall establish standards for local streets and accessways that minimize pavement width and total ROW consistent with the operational needs of the facility.	Narrow street design standards for low-volume streets are provided in the City's code, but not in the existing TSP. (Narrow streets are discussed as a means of neighborhood traffic management, but cross-sections for them are not provided as they are with the other street standards in the code.) "Skinny street" cross-sections are provided in Figures 18.810.4 – 18.810.6, according to volumes and right-of-way widths. **However, additional code language is not provided to reinforce these standards or guide or require their usage.**

Plan and Land Use Regulation Amendments **(OAR Section 660-12-0060)**	**Finding and TPR Compliance**
Amendments to functional plans, acknowledged comprehensive plans, and land	Policy 15(B) under Goal 2.1 (Land Use Planning) in the City's Comprehensive Plan provides the part of the

use regulations that significantly affect an existing or planned transportation facility shall assure that allowed land uses are consistent with the identified function, capacity, and performance standards of the facility.	policy foundation for adopting local provisions consistent with Section -0060: "Development of land uses allowed by the new designation shall not negatively affect existing or planned transportation or other public facilities and services." **However, criteria consistent with Section -0060 are not specified or included in decision-making considerations for Type IV legislative procedures established in TCDC 18.390.060(G).**

Oregon Access Management Rule (OAR 734-051)

The City's code (TCDC 18.705 – Access, Egress, and Circulation) also requires an access report for all new development that demonstrates compliance with ODOT, County, City, and AASHTO standards as applicable. The access management section in Chapter 8 (Motor Vehicles) of the TSP directs the City to use ODOT and Washington County access management standards on arterials and collectors in the city that are under their jurisdiction. **The TSP, however, does not include policies or objectives for access management, including support for access modifications that bring the access points into compliance, or closer to compliance, with ODOT standards.**

Oregon Transportation Plan (OTP)

Updates to the Oregon Transportation Plan (OTP) emphasized the following principles:

- Maintaining existing facilities
- Optimizing existing system performance through technology and better system integration
- Investing in strategic capacity enhancements
- Creating sustainable funding.

A rating of pavement on Tigard's collectors and arterials is provided in the 2002 TSP as is the 1996-2001 street maintenance budget. The pavement rating was contracted out and represents a basis for building a Pavement Management System in the city. **The TSP update should address progress in developing the Pavement Management System.**

Signals and other intersection improvements, access management, and ITS elements all work toward optimizing the existing system. Signal and intersection improvements proposed in Tigard are presented in Tables 8-8 and 8-9 and in Figure 8-21 of Chapter 8 (Motor Vehicles) in the TSP. The chapter also describes the ITS proposals for the Tigard area, including ramp metering at all ramps on OR 217 and I-5 to be installed by ODOT and coordinated between the City and ODOT, and development of an ATMS according to a regional plan and for which the City will provide data.

A master plan for road improvements (Table 8-7) and master plans and action plans for pedestrian, bicycle and transit improvements represent strategic investments in the capacity of the city's transportation system, especially given limited right-of-way and roadway widening opportunities.[11]

[11] The master plans and action plans for the pedestrian, bicycle, and transit elements are found in the TSP as follows:

Chapter 11 (Funding/Implementation) of the 2002 TSP identifies a number of new funding sources and opportunities. **The TSP update should re-visit these funding prospects, and describe which are being developed.**

Oregon Highway Plan (OHP)

Updates have been made to the Oregon Highway Plan (OHP) since the Tigard TSP was adopted in 2002. An overview of the updates and their bearing on the Tigard TSP are presented below.

1. Policy 1B (Land Use and Transportation) was amended to require a management plan for designated Special Transportation Areas (STAs) on state highways that are also designated as State Freight Routes. There is a STA designated along Hall Boulevard (OR 141) in the Washington Square Regional Center in Tigard. However, it is not also designated as a Freight Route, so this amendment does not apply to Tigard.

2. Policy 1F (Mobility Standards) was revised to allow for the adoption of alternative mobility standards in metropolitan regions or parts of the region. The following alternative standards have been adopted for the Portland metropolitan region.

   (a) 1.1 V/C for 1st hour and 0.99 V/C for 2nd hour for Regional Centers, Town Centers, Main Streets, and Station Communities.
   (b) 0.99 V/C for 1st hour and 2nd hour for I-5 (Marquam Bridge to Wilsonville), OR 217, Corridors (Hall Boulevard/OR 141 and Scholls Ferry Road/OR 210), Industrial Areas, Employment Areas, and Inner Neighborhoods. (This standard for I-5 and OR 217 are for interim purposes; refinement plans for these corridors are required in the RTP and will recommend performance measurements and policies for each corridor.)
   (c) 0.95 V/C for 1st hour for OR 99W (I-5 to Tualatin Road). This is classified as an "area of special concern", and the OHP mobility standard will apply to this area until an alternative performance measure is adopted in local plans and approved by the Oregon Transportation Commission.

3. Appendix C (Access Management Spacing Standards) was revised in 2004 to be consistent with amendments to the Access Management Rule, OAR 734-051. The access management section of Chapter 8 (Motor Vehicles) refers to ODOT standards as included in the TSP appendix. References in the updated TSP and appendix must be consistent with the following spacing standards.

   The spacing standards for OR 99W (Statewide Highway) and for OR 141/Hall Boulevard and OR 210/Scholls Ferry Road (District Highways) are presented in Tables 9 and 10 below.

Table 9. Spacing Standards for Urban Non-Designated Statewide Highways

Posted Speed (mph)	Spacing (feet)
55 and higher	1,320
50	1,100
40-45	990
30-35	720

pedestrian master plan in Figure 5-1 and pedestrian action plan in Table 5-2; bicycle master plan in Figure 6-2 and bicycle action plan in Figure 6-3 and Table 6-4; and transit master plan in Figure 7-3 and transit action plan in Table 7-2 and Figure 7-4.

Posted Speed (mph)	Spacing (feet)
25 and lower	520

Table 10. Spacing Standards for Urban Non-Designated District Highways

Posted Speed (mph)	Spacing (feet)
55 and higher	700
50	550
40-45	500
30-35	350
25 and lower	350

For the section of OR 141/Hall Boulevard that is designated as a Special Transportation Area (STA) (MP 2.84-3.84), the following standards apply:

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 or mid-block if the current city block is less than 350 feet.[12]

ODOT Highway Design Manual

The Highway Design Manual is used for developing and designing projects on state facilities. Because these steps come after projects are proposed in the TSP, assessing the TSP for consistency and compliance with this document is not necessarily practicable.

2008-2011 State Transportation Improvement Program (STIP)

The only two projects in Tigard in the 2008-2011 STIP that do not appear in the 2002 TSP are a Bicycle/Pedestrian program multi-use trail project and a Transportation Enhancement program set of streetscape improvements in Downtown Tigard.

Table 11. STIP Projects not in the Tigard TSP

Project Roadway	Project Location	Project Description	Project Type	Project Cost	Project Year
Washington Square Regional Center Trail	Hall Blvd to Greenburg Rd	Construct multi-use trail	BIKEPED	$432,000	2011
Main St	Rail Corridor to OR 99W	Green street retrofit, pedestrian amenities, streetlights	TE	$2.8 million	2011

[12] OHP, Appendix C, Tables 13, 14, and 15, Footnote 6.

2008 Transportation System Planning Guidelines

The TSP Guidelines direct TSP updates to address recent policy and regulatory changes, and calls out recent changes to the OTP, OHP, and TPR. These documents and an assessment of the Tigard TSP for consistency with them are provided in other sub-sections of this section of the memorandum.

Metro 2040 Growth Concept

The 2040 Growth Concept is implemented through Metro's Regional Framework Plan, Growth Management Functional Plan, and Regional Transportation Plan. Please refer to the following sub-sections for an assessment of the consistency of the Tigard TSP with these documents.

Metro Regional Framework Plan

This document is established as the responsibility of the Metro Council to enact. It was not specified in the project scope for review in Section II of this memorandum. However, the Regional Framework Plan is one of the implementing documents for the 2040 Concept and, in that way, it has bearing on the Tigard TSP and other City plans and regulations. Below is an assessment of the consistency of the Tigard TSP with the direction the Framework Plan provides in Chapter 2 (Transportation).

Public involvement and notice in transportation planning and decision-making
As described for Statewide Planning Goal 1, the Tigard TSP will be updated using a series of Technical Advisory Committee (TAC) and Citizen Advisory Committee (CAC) meetings, public forums, and public hearings to be held by the Planning Commission and City Council during the adoption process.

Intergovernmental coordination in transportation planning
Existing TSP policies under Goal 7 (Coordination) call for coordination of transportation and other pertinent plans of affected agencies. **However, neither the TSP policies nor the City's Development Code establish coordinated review of future land use decisions that affect transportation facilities.**

Implementation of the 2040 Concept and regional street designs
The TSP policies in Chapter 2 (Goals and Policy) and cross-sections in Chapter 8 (Motor Vehicles) support the regional 2040 Concept and street designs, as do documents supplementing the TSP/Comprehensive Plan such as the Tigard Downtown Improvement Plan. **However, more as a "housekeeping" matter, street designs proposed in the TSP are not entirely consistent with those presented in the City's Street Improvement Standards (TCDC 18.810).**

Transportation planning and development that is consistent with regional policies, land use plans, and adjacent land use patterns

The 2002 Tigard TSP was developed following adoption of the 2040 Growth Concept and 2000 RTP and is consistent with those plans. **This is not a matter for the TSP, but the City's existing zoning does not consistently allow for the mixed and transit-oriented uses that should be adjacent to transit corridors designated in the RTP and reflected in the 2002 TSP.**

Transportation that is accessible, particularly to those with special needs, and connects those who are economically disadvantaged to employment and social services

Other than an ADA policy under Goal 5 (Accessibility), **the TSP does not explicitly address populations with special needs or economic advantages.**

Transportation safety improvements and education
Goal 3 and its policies in the TSP address safety, and Chapter 8 (Motor Vehicles) of the TSP addresses safety improvements in terms of text, proposed street improvements, intersection improvements, and signalization. **The TSP does not address alternate intersection treatments such as roundabouts and safety education.**

Environmental and water quality
Policies and programs in the TSP do not specifically address environmental and water quality. However, appropriate environmental and natural resource review should take place given the City's Comprehensive Plan goals and development process requirements. As discussed in the TPR analysis, though, **there are no processes established in the City's code for transportation facility permitting. In addition, there are emerging regional resources concerning the effect of climate change on water resources and potential changes in flood hazard risk that the city may wish to reference in city policy with regard to the design of transportation facilities in flood-prone areas.**

Energy efficiency
Goals 1 and 2 (Livability and Balanced Transportation System) respond to the need for transportation alternatives, which save fuel consumption and energy. The TSP's master plans and action plans for pedestrians, bicycles, and transit reinforce these, as does its general plan for TDM (Chapter 10). Roadway improvements and transportation system management discussed in Chapter 8 also address conservation of energy. **The TSP must continue to improve the viability of transportation alternatives and should be more specific about ways in which the City will support and implement TDM. In addition, the city's capital improvement program does not include measures for investing in more energy efficient utility infrastructure, such as LED lighting and signals replacement. The city has not prepared an ITS plan for improving system management and performance and coordinating local system operations with state and regional operation plans.**

Local connectivity
Local connectivity plans are provided in the TSP (Chapter 8) and supported in policies under Goal 5 (Accessibility). **While also not a matter for the TSP, these plans should be referenced in the approval criteria in the City's code for land divisions and in the standards for street improvements.**

Connections between centers and community destinations
These connections are also supported by the local connectivity plans in Chapter 8 (Motor Vehicles). They are also supported by the proposed street improvements in Chapter 8 and the pedestrian, bicycle, and transit master plans and action plans in Chapters 5, 6, and 7, all of which are founded on policies under Goal 1 (Livability), Goal 2 (Balanced Transportation System), and Goal 5 (Accessibility). Connections between community destinations are also required in street and sidewalk standards in TCDC 18.810 and in provisions in TCDC 18.705 (Access, Egress, and Circulation).

Improved public transit service, information, and promotion
The TSP proposes transit service and facility improvements in Chapter 7 (Transit). It generally includes information services in proposed transit stop amenities. **The transit plan does not**

specifically promote these measures. This is either the responsibility of TriMet or a shared responsibility between TriMet and the City. Regardless, recognition of the need for improved transit information at transit stops should be included in plan policy.

Protection and improvement of the freight transportation network
The TSP identifies existing and key freight corridors in the city in Chapter 8 (Motor Vehicles) and proposed road improvements in that chapter will serve all modes including freight trucks. **The TSP does not address local deliveries in Chapter 8 or plans for rail freight in Chapter 9 (Other Modes).**

Continuous, safe, and convenient bicycle and pedestrian networks
These networks are supported by policies under Goal 1 (Livability), Goal 2 (Balanced Transportation System), and Goal 5 (Accessibility) of the TSP, and by the master plans and action plans in Chapter 5 (Pedestrian) and Chapter 6 (Bicycle). **Discontinuous bicycle and pedestrian networks are a persistent problem in most Oregon communities and an area where TSPs can improve and continue to do more.**

Transportation system management, pricing, and maintenance
The TSP describes its strategies for transportation system management and these are reflected, in part, by an ATMS project programmed for Scholls Ferry Road/OR 210 in the RTP. Maintenance and the beginning stages of developing a Pavement Management System are addressed in Chapter 8 (Motor Vehicles). **The TSP update should include an update on the development of the Pavement Management System and any other maintenance management tools.** Roadway pricing is discussed in Chapter 11 (Funding/Implementation) as a potential funding mechanism in the future.

Transportation Demand Management
The TSP includes a discussion of TDM strategies in Chapter 10. While responsibility for these strategies is shared amongst agencies and organizations in the city, **the TSP should be more specific about TDM strategies it is going to implement. Metro and ODOT may provide resources that the city can reference for measures it can promote in this regard.**

Parking management that optimizes public and commercial parking in centers and around main streets
Chapter 8 (Motor Vehicles) reports on the parking measures implemented by the City's code that comply with the TPR and the RTP. **As the city continues to grow, parking management plans will need to be developed (this need is referenced in both the Washington Square Regional Center Plan and Tigard Downtown Improvement Plan). This should be addressed in this TSP update and future updates as needed.**

Metro Regional Growth Management Functional Plan

This document was not specified in the project scope for review in Section II of this memorandum. However, elements of the Regional Growth Management Functional Plan apply to long-range transportation planning in Tigard, and where transportation planning overlaps with land use planning in centers and new urban areas.

Title 2 – Regional Parking Policy
(Metro Code Sections 3.07.210 – 3.07.220)

TCDC 18.765 (Off-Street Parking and Loading Requirements) does not permit on-street or fleet parking toward minimum parking requirements. Parking spaces in parking structures, paid parking, designated carpool/vanpool or disabled-accessible parking, or fleet parking are not counted toward maximum parking requirements. **Receiving credits for on-street parking under certain conditions should be considered.**

Reductions in minimum parking requirements up to 20% are allowed for development that provides transit-related facilities and amenities or for otherwise transit-oriented development. Adjustments are allowed for transit and demand management techniques proven to be effective in reducing vehicle trips and to not have adverse impacts on surrounding uses (TCDC 18.370.020(C)(7)(a)).

The code establishes minimum and maximum parking requirements for motor vehicle and bicycle parking. **Maximum parking requirements should not be applied to bicycle parking.**

The TSP and related City ordinances are also assessed according to the following parking provisions in Title 2.

- Minimums and maximums per ratios in Table 3.07-2 – The City has adopted consistent minimum and maximum vehicle parking requirements in TCDC 18.765 (Off-Street Parking and Loading Requirements).
- A and B zones in the parking requirements in which A zones have bus service within ¼ mile or rail service within ½ mile (for service with peak headways of 20 minutes or less) – The City's parking requirements are distinguished between A and B zones.
- Parking adjustments or variances – Parking adjustments or variances are allowed in TCDC 18.765 (Off-Street Parking and Loading Requirements) and in TCDC 18.370 (Variances and Adjustments).
- Free surface parking spaces subject to maximum parking requirements – **The City's code does not specifically address large free surface parking areas that serve more than one use or how the spaces in these parking lots would be counted toward the maximum spaces allowed for individual uses in the area.**
- Exemptions from maximum requirements – The code (TCDC 18.765) does make allowances for exemptions from maximum requirements.
- Residential parking districts shall be allowed for in the Comprehensive Plan or Community Development Code (parking management plan – A parking management plan is a long-term project recommended in the 2005 Tigard Downtown Improvement Plan, and parking strategies are identified in the 1999 Washington Square Regional Center Plan (including residential priority parking). **However, residential parking districts are not established in either the TSP or the City's code.**
- Street design features for driveways and internal circulation in parking areas larger than three acres – Design features for large parking areas are not addressed specifically in the City's code for parking, access, subdivisions, or site development, or Washington Square design requirements. Chapter 18.705 (Access, Egress, and Circulation) requires some design standards for walkways in parking areas. Walkways in parking areas must be at least four feet wide, free of obstructions, and ADA compliant. They must be separated vertically by six inches (curb) or horizontally by three feet from vehicle travel areas.

Title 6 – Central City, Regional Centers, Town Centers and Station Communities
(Metro Code Sections 3.07.610 – 3.07.650)

Title 6 requires that a strategy for the enhancement of Centers be developed by 2008, and that the strategy include the following elements.

- Identify physical and regulatory barriers
- Establish an expedited review process
- Establish development incentives
- Protect Industrial and Employment Areas
- Identify Neighborhood Centers to serve Inner and Outer Neighborhoods
- Develop a work plan and schedule.

The 2005 Tigard Downtown Improvement Plan and 1999 Washington Square Regional Center Plan identified regulatory barriers and protect Industrial and Employment Areas, when applicable. However, neither plan established clear development incentives, led to the creation of an expedited review procedure in the City's code specifically for development in Centers, or provided more than a general work plan and schedule. (Inner and Outer Neighborhoods and Neighborhood Centers are not in the scope of these plans.)

Title 11 – Planning for New Urban Areas
(Metro Code Sections 3.07.1105 – 3.07.1140)
Title 11 regulates new urban areas, areas added to UGBs. In the interim between the UGB amendment and comprehensive planning for the area, Title 11 prohibits amendments to land use designations that allow for more intense development than is allowed by comprehensive plan designations that were in place at the time of the UGB amendment. It also prohibits land divisions into parcels less than 20 acres.

Title 11 establishes concept planning requirements that must be completed for new urban areas. Required elements of a concept plan include the following:
- Annexation plan
- Average residential density of at least 10 units per net developable acre, with conditions for exceptions
- Land for residential, commercial, and industrial uses that in part or in whole meets land needs identified in urbanization studies done to justify the UGB amendment
- Identification and mapping of areas of natural resource and hazards protection
- A conceptual transportation plan consistent with RTP and 2040 Growth Concept, protecting natural resources identified in acknowledged comprehensive plans or as required by Title 3, with cost estimates and potential funding sources
- Urban growth diagram.

West of Tigard, the Bull Mountain area was added to the UGB in 2002. Although the area is under Washington County jurisdiction and the County is overseeing its concept planning, **the Tigard TSP update should coordinate with concept planning, and particularly conceptual transportation and public facilities planning, being done for the area.**

Metro Regional Transportation Plan (RTP)

The Regional Transportation Plan (RTP) includes both policies and proposed projects and programs to be implemented for the region over at least a 20-year planning horizon. The 2000 RTP was the first plan to reflect the principles and design types of the 2040 Growth Concept. The 2004 update did not revise policies from the 2000 RTP. Therefore, the 2002 Tigard TSP that was found in compliance with the 2000 RTP is still in compliance in terms of policies. For the 2004 RTP update, the financially constrained revenue forecast and project list were updated, and air quality conformance analyses were performed. Changes were also made to the classifications on the RTP

System Map but these changes were made to reflect adopted TSPs and corridor study findings and, so, should be consistent with Metro area TSPs.

The 2008 RTP update is not complete. The federal financially constrained project list was adopted in 2008, and the remaining review and update will occur in 2009. Assessing the 2002 Tigard TSP for consistency with the RTP, thus, entails comparing project lists in the two documents.

The following projects appear in the 2008 RTP and either are not included in the 2002 Tigard TSP or differ in project specifications as noted in the tables below.

Table 12. 2008 RTP Road Projects

Project Name	Project Location	Project Description	Project Cost (Year of Expenditure $)	Project Time
Washington Square Connectivity Improvements	Local street locations	Increase local street connections at Washington Square Center based on recommendations in Regional Center Plan	$14.0 million	2018-2025
OR 217 Overcrossing	Hunziker Rd to 72nd Ave	Re-align Hunziker Rd to meet Hampton Street at 72nd Ave and remove existing 72nd/Hunziker Rd intersection	$19.5 million	2018-2025
Dartmouth St Improvements	72nd Ave to 68th Ave	Widen to 4 lanes with turn lanes and sidewalks *NOTE: The TSP proposes widening Dartmouth to 5 lanes from I-5 to OR 99W*	$6.5 million	2008-2017
Durham Rd Improvements	Hall Blvd to OR 99W	Widen to 5 lanes with bikeways and sidewalks *NOTE: The TSP proposes widening from Hall to Upper Boones Ferry plus reserving ROW west of Hall*	$61.8 million	2018-2025
OR 99W Intersection Improvements	68th Ave to Beef Bend Road	Provide increased capacity at priority intersections, including bus queue bypass lanes in some locations, improved sidewalks, priority pedestrian crossings, and an access management plan, while retaining existing 4/5-lane facility from I-5 to Durham Rd *NOTE: Transit bypass lanes, priority ped crossings, and an access management plan are not specified in the TSP. Also the TSP proposes 7 lanes from I-5 to Greenburg Rd instead of 4-5 lanes from I-5 to Durham Rd.*	$29.1 million	2008-2017

Table 13. 2008 RTP Bicycle and Pedestrian Projects

Project Name	Project Location	Project Description	Project Cost (Year of Expenditure $)	Project Time
Tigard Town Center Pedestrian Improvements	Throughout Town Center area	Improve sidewalks, lighting, crossings, bus shelters and benches throughout the Town Center including OR 99W, Hall Blvd, Main St, Hunziker, Walnut, and neighborhood streets *NOTE: Sidewalks on Burnham from Main to Hall are in the TSP, but otherwise these improvements are not in the TSP.*	$9.9 million	2018-2025
Washington Square Regional Center Pedestrian Improvements	Various locations	Improve sidewalks, lighting, crossings, bus shelters, and benches *NOTE: The TSP Pedestrian Action Plan only generally refers to pedestrian improvements in Washington Square (RTP 6022).*	$11.6 million	2018-2025
Washington Square Regional Center	Hall Blvd to OR 217	Complete shared-use path construction *NOTE: This is not included in the TSP unless it is part of the general category of pedestrian improvements identified for Washington Square (RTP 6022).*	$2.7 million	2008-2017
Regional Trail Gap Closure	Various locations on trails	Fill in gaps in regional trail network, including Fanno Creek, Washington Square Loop and Westside Trails *NOTE: Only the Fanno Creek Trail from Tualatin River to City Hall, OR 99W to Tigard is included in the TSP.*	$10.2 million	2008-2017
Locust Ave Bike	From Hall Blvd to 80th Ave	Complete 1,650 feet of bike lanes in Regional Center	$5.1 million	2008-2017

Also the City has indicated that it wants to keep a five-lane cross-section for OR 99W through the city, and will incorporate this and recommendations from the Highway 99W Improvement and Management Plan into the TSP update. It will seek to replace any references in the RTP to seven lanes for OR 99W in the city to five lanes.

Metropolitan Transportation Improvement Program (MTIP)

The Metropolitan Transportation Improvement Program (MTIP) is the four-year transportation programming document for the region. It was not included in the project scope to be reviewed in Section II of this memorandum. However, review of its projects is captured in the review of the 2008-2011 STIP because the 2008-2011 MTIP, adopted by Metro Resolution 07-3825, was entirely incorporated into the STIP. The 2010-2013 MTIP is being developed and final adoption is set for August 2009. Prior to that, a final decision on projects that will receive regional flexible funds is scheduled for March 2009.

Metro Evaluation of Potential Measures for Achieving Modal Targets

The City of Tigard has adopted the measures that Metro required when it first established modal targets (the measures are outlined in Section II of this memorandum). The evaluation of modal target measures yielded the recommendations below, and following the recommendations is an assessment of Tigard's TSP and related ordinances.

Require construction of bicycle and pedestrian improvements in compliance with state and federal regulations, and consistent with local TSPs and regional guidelines. Projects that improve connectivity of the bicycle and pedestrian system and access to transit should be prioritized.

The TSP includes pedestrian and bicycle master plans and action plans that improve the pedestrian and bicycle networks. Provisions in the code – street and sidewalk standards in TCDC 18.810 – require that pedestrian connections be provided from sites to adjacent transit facilities and in the direction of important community destinations. After going through an evaluation process, projects chosen for the master plans and action plans were chosen on the basis of filling in network gaps and connecting community destinations. **Connections to transit was a criteria used to prioritize projects for pedestrian plans but not for bicycle plans.**

Require frequent and comprehensive transit service by TriMet and other transit agencies.
The City may participate and offer input in TriMet's annual transit service plan process. Additional and more frequent service are improvements specified in the TSP's transit plan (Chapter 7), but the City does not ultimately have power or responsibility over these improvements.

Require support and promotion of employer-based TDM strategies.
Require support for employers to eliminate employer-subsidized parking and/or support for parking cash-out, preferred HOV-parking or other parking pricing strategies. Local governments also could be required or encouraged to implement these strategies for their own employees.
The TSP's TDM plan (Chapter 10) calls for the City to support the TDM efforts of Oregon DEQ, ODOT, Metro, TriMet, Washington County, and the local Transportation Management Association, Westside Transportation Alliance. The TDM plan discusses the potential need for the City to develop its own version of the Oregon DEQ Employee Commute Options (ECO) program but identifies that as a potential need in the future. **The TDM plan does not specifically call for City support of employer TDM measures or identify ways of offering that support.**

Require support and coordination of Safe Routes to School programs and projects.
Goal 3 (Safety) in the TSP includes a policy addressing safe routes to school. Projects in both the Pedestrian Action Plan and Bicycle Master Plan were prioritized based on the connections that the projects provided to schools and other important community locations. **Safe Routes to School programs are not included in the TSP.**

Metro Highway 217 Study

The Highway 217 study made the project recommendations below, and project descriptions are followed by comparisons to the Tigard TSP.

Highway 217 Traffic Lanes

- Two options for a third lane in each direction – general purpose lanes and toll lanes – should be advanced for further consideration in the National Environmental Protection Act (NEPA) and EIS process to evaluate financing strategies and determine whether the lanes should be general purpose or toll lanes.

The TSP specifies widening OR 217 to three lanes plus auxiliary lanes in each direction from US 26 to 72nd Avenue.

Highway 217 Interchanges

- In Tigard, proposed interchange projects include: Scholls Ferry/Greenburg Road ramp braids and Greenburg Road interchange improvements that are prioritized as second tier projects; and SW 72nd Avenue interchange improvements and turn lanes, and Highway 99W access lanes, widening, and turn lanes as third tier projects.

The TSP includes improvements to southbound ramps at the SW 72nd/OR 217 interchange in its list of intersection improvements as well improvements to northbound and southbound ramps and other intersection improvements for the OR 99W/OR 217 interchange. The TSP roadway project list also includes replacement of northbound ramps at 72nd/OR 217, extension of 68th Avenue to meet OR 217, with right-in/right-out-only access to 68th Avenue from OR 217 and a new interchange between 72nd and Bangy Road. **Otherwise, the recommended 72nd Avenue, OR 99W, and Scholls Ferry/Greenburg Road interchange improvements are not included in the TSP. Resolving this inconsistency should be addressed in the TSP update.**

Arterials in the Highway 217 Corridor

- Widening Greenburg Road to five lanes from Tiedeman to Highway 99W (RTP Project 6031)
- Widening Hall Boulevard to five lanes from Scholls Ferry Road to Highway 99W (RTP Projects 6013 and 6030 North).

The TSP includes widening Greenburg Road to five lanes from Tiedeman to OR 99W, and Hall Boulevard to five lanes from Scholls Ferry to Locust and to **an unspecified number of lanes south of Locust**.

Bicycle and Pedestrian Facilities

- Improvements (unspecified) on Hunziker Street from Hall Boulevard to 72nd Avenue
- A multi-use path connecting I-5 to SW 72nd Avenue
- Pedestrian path/walkway improvements on all improved viaducts crossing Highway 217
- A bicycle/pedestrian connection over Highway 217 to the Fanno Creek Region Trail; and
- A connection to the Washington Square Regional Center trail.

The TSP calls for new overcrossings of OR 217 to the Washington Square Regional Center, one north and one south of Scholls Ferry Road/OR 210, which would presumably include sidewalk improvements, but does not address existing overcrossings. The TSP also includes pedestrian and bicycle facility improvements on Hunziker from Hall Boulevard to 72nd Avenue, and Fanno Creek Trail improvements. Otherwise, **improvements on all overcrossings, a bicycle/pedestrian overcrossing to the Fanno Creek Trail, a connection to the Washington Square trail, and an I-5/72nd Avenue path are not included in the TSP. Resolving this inconsistency should be addressed in the TSP update.**

Transit

- Increase transit service in the Highway 217 corridor

The future transit service coverage map in the TSP transit element (Chapter 7) shows more transit coverage but less level-of-service "A" coverage in the OR 217 corridor than in the existing coverage map. However, the planned addition of commuter rail in the corridor, although headways are not technically "frequent", will create a higher-speed, quality transit option in the corridor.

TriMet Investment Plan

None of the improvements below are called for in the Tigard TSP.

Build the Total Transit System

- **Expand bicycle parking for the commuter rail Westside Express Service (WES) beyond what was in the original plan so that there will be 162 bicycle parking spaces available at stations when service begins in spring 2009.**

Expand high-capacity transit

- **Program and conduct a corridor study in the Barbur Boulevard/Highway 99W corridor for bus rapid transit and light rail transit.**

Expand frequent service

- **Upgrade bus line 76-Beaverton/Tualatin (Hall Boulevard) is proposed to upgrade to Frequent Service (will require additional operating funding).**
- **Coordinate (the City and TriMet) for investing in sidewalks, crossings, lighting, shelters, benches, and bus stop spacing improvements for the frequent service upgrade.**

Improve local service

- **Generally revise bus service to better coordinate with WES service.**
- **Plan for and improve the Tigard Transit Center Station, including 100 park-and-ride spaces, support for connections with five bus lines, and recommendations from a local plan (capital projects such as shelters, benches, and sidewalks and additional transit service on Bonita Road).**
- **Add service on 72nd Avenue in order to connect businesses on 72nd Avenue with commuter rail and to better serve the Sequoia Parkway employment area.**

TriMet Elderly and Disabled Plan

Figure 7-1 provides the strategies to implement the Elderly and Disabled Plan. However, the strategies do not specifically identify Tigard or the cities in the region as partners in the strategies, so the City should review the strategies to identify opportunities to contribute.

Some potential opportunities to contribute include: partnering in an online accessible vehicle and ride reservation system (e.g. providing a link on the City's website); supporting a peer program of riding "buddies" for transit; assisting TriMet in developing a Pedestrian Master Plan that identifies safe and accessible routes to transit and around the community; and sponsoring and participating in targeted transit marketing.

Washington County Transportation Plan

The following are Washington County roads in Tigard, and any improvements identified in the TSP update affecting these roadways must be coordinated with the County.

- Greenburg Road from OR 217 to Oleson
- Scholls Ferry Road (OR 210) from the railroad to the western city limits
- Barrows Road
- Bull Mountain Road
- Beef Bend Road.

Policy 10 in the Roadway Element of the County's Transportation Plan includes design parameters. Regional Street Design Overlays are established in the plan as part of implementing the 2040 Growth Concept. Regional Street Design Overlays apply to the roads below and improvements proposed to the following roads in the TSP update must be made according to the overlay guidelines, and **the design overlay guidelines and overlay designations should be considered for inclusion in the Tigard TSP**.

- Boulevards – Scholls Ferry Road, Hall Boulevard, Greenburg Road, OR 99W, Walnut Street.
- Streets – Scholls Ferry Road, 121st Avenue, Hall Boulevard, Greenburg Road, OR 99W, Walnut Street, Dartmouth Street, Hunziker Street, Burnham Street, Gaarde Street, McDonald Street, Beef Bend Road, Durham Road.

Policy 6 (Roadway System Policy) of the Roadway Element in the Transportation Plan identifies the Washington Square Regional Center and OR 99W from I-5 to Durham Road as "deficiency areas."

- The TSP includes pedestrian improvements within Washington Square Regional Center and improvements for Greenburg Road and Hall Boulevard adjacent to Washington Square, including bicycle and pedestrian improvements.
- The TSP proposes bicycle improvements along the length of OR 99W in the city and pedestrian improvements along portions of it. The street improvements plan calls for widening OR 99W to seven lanes from I-5 to Greenburg Road and traffic signal coordination and management on OR 99W from I-5 to Durham Road. The intersection improvements plan identifies the intersections of OR 99W and Main Street/Greenburg Road, Hall Boulevard, OR 217, Dartmouth Road, 72nd Avenue, 68th Avenue, McDonald Road/Gaarde Road, Beef Bend Road, and Walnut Street.

The City has indicated that it wants to keep a five-lane cross-section for OR 99W through the city, and will incorporate this and recommendations from the Highway 99W Improvement and Management Plan into the TSP update. It will seek to replace any references in the RTP to seven lanes for OR 99W in the city to five lanes.

City of Tigard Comprehensive Plan

Following are recommendations for making the TSP more consistent with goals and policies in the City's Comprehensive Plan.

6. Goal 2 – This goal emphasizes the provision of sufficient public facilities – including transportation – for development in Tigard. It calls for development to provide these facilities according to its impacts and for proposed land uses to be appropriate to the classification of adjacent transportation facilities. **These principles should be reflected in TSP policies.**

7. Goal 5 – Policies under Goal 1 (Livability) and Goal 7 (Coordination) generally address respect for natural areas and coordination with other City plans. **TSP policies could be amended to be more specific about the natural areas in the City and the transportation system's relationship with them.**
8. Goal 6 – Related to Goal 5 in the Comprehensive Plan, **the TSP should specify ways in which it will respect the natural systems of the city. In particular, policies and projects related to low-impact development should be identified.**
9. Goal 9 – Policies and strategies under this goal focus on the "Tigard Triangle" and the Town Center (Downtown), Regional Center (Washington Square), and High Capacity Transit Corridor (Hwy 99W) as designated by Metro. **The TSP should distinguish policies and projects that specifically serve the Centers and Employment Areas in the city.**

City of Tigard Community Development Code

The TSP and Tigard Community Development Code (TCDC) have been found to be largely consistent. The main recommendations for improving TSP consistency with the code include those identified in the sub-section on TPR compliance and the following:

- Road cross-sections – Cross-sections are presented in both Chapter 8 of the TSP and TCDC 18.810.030. **Cross-sections in the TSP currently do not include all the cross-sections shown in the code.**
- Access management – Similarly, access management standards are presented in Chapter 8 of the TSP and TCDC 18.705.030(H). **The standards in both documents need to be the same in specifications and cover the same extent.**

City of Tigard Downtown Improvement Plan

The TSP update should evaluate projects recommended in the Downtown Improvement Plan.

- **Street design and function improvements for Burnham, Main, Commercial, and Scoffins, and gateway improvements for Scoffins, Main, Garden Place, and Tigard Street as part of the plan's Streetscape Enhancement Program**
- **Walkways in the Green Corridor/Urban Creek area**
- **Street improvements on Ash Avenue from the planned park-and-ride to Fanno Creek, including a new bike and pedestrian bridge and extension of Ash Avenue from Burnham to the park-and-ride**
- **Coordination with City Pedestrian and Bicycle Plans on access related to Downtown**
- **Draft design requirements and guidelines for "Green Street" street treatments**
- **New cross-sections for Hall Boulevard and OR 99W (collaboration with ODOT)**
- **Highway Design Manual street design guidelines blending features of both ODOT and Metro Street design requirements**
- **Parking Management Plan once Downtown begins to significantly grow and prior to any structured parking**
- **Construction of an at-grade railroad crossing (collaboration with Portland & Western Railroad and the ODOT Rail Division).**

City of Tigard Washington Square Regional Center Plan

The following assesses the TSP relationship to transportation recommendations made in the Regional Center Plan.

Develop a "Transit Access and Action Plan" with TriMet, and explore more frequent bus service, transit center improvements, commuter rail, and a local circulator.

The TSP identifies more frequent bus service in general and commuter rail has been constructed. **The TSP should specify more frequent bus service to the Regional Center and address Washington Square transit center improvements and a local circulator.**

Connect Nimbus Drive to the Washington Square Mall with an OR 217 overcrossing, with two lanes with bicycle and pedestrians facilities.
Extend Nimbus Drive to Greenburg Road.

The TSP road improvement project list includes new overcrossings and connections to Washington Square, and the extension of Nimbus Drive.

Connect Nimbus Drive to Locust with an OR 217 overcrossing, two lanes with bicycle and pedestrians facilities (similar to a recommendation already in the RTP).

While the TSP identifies new overcrossings to Washington Square – one north of and one south of Scholls Ferry Road – **this particular Nimbus to Locust connection is not identified in the TSP**.

Improve the collector system at Oak/Lincoln/Locust.

This improvement is not included in the TSP.

Widen Hall Boulevard to three lanes from Oleson to southern end of Regional Center. Acquire right-of-way for five lanes, as planned in the RTP, but expand only to three lanes for now.

The TSP road improvement project list includes widening of Hall Boulevard.

Improve OR 217 interchanges at Scholls Ferry Road and Hall Boulevard and specify improvements with Metro Highway 217 study.

The TSP's consistency with the Highway 217 study recommendations is addressed in an earlier sub-section of this memorandum.

Identify new bikeways to connect to existing bikeways and community destinations, plan and build off-street bike paths parallel to arterials and collectors where there is not capacity for on-street facilities, and extend the Fanno Creek Bikeway to the east along Ash Creek.

Bicycle improvements are identified for Hall Boulevard and Greenburg Road in the TSP as well as general improvements for the Fanno Creek multi-use trail. **Determine whether new bikeways in the Regional Center can be designated.**

City of Tigard Highway 99W Improvement and Management Plan

The following are recommendations from the Improvement and Management Plan to be included in the TSP.

- **Raised medians are proposed along 40% of the OR 99W corridor in Tigard at locations north of Gaarde/McDonald Street.**
- **Develop an Access Management Plan with a focus on driveway management for properties with multiple driveways, with access to side streets, or within 200 feet of intersections.**
- **Install sidewalks where there are gaps in the system in the study area corridor.** The TSP Pedestrian Plan identifies from McDonald south on OR 99W for sidewalk improvements.
- **Upgrade sidewalks to have four-foot landscaping strips and eight-foot pedestrian zones, and install a signalized pedestrian activated crossing at the intersection with Watkins Avenue.**
- **Install six-foot bike lanes where there are gaps in the system**. The TSP Bicycle Master Plan proposes lanes east of 68th Avenue, in the Tigard Town Center area, and south of McDonald on OR 99W. **Sign sections where bicyclists need to share the sidewalk with pedestrians.**
- **Transit improvements include relocation of bus stops and queue bypasses at five intersections (68th Avenue, Dartmouth Avenue, Hall Boulevard, Walnut Street, and Gaarde, McDonald Street).**
- **Widen the following intersections to allow for new turn or through lanes and/or transit queue bypass lanes:**
    - **68th Avenue – transit bypass lane**
    - **Dartmouth Avenue – transit bypass lane, southbound through lane**
    - **Hall Boulevard – bypass lane**, westbound turn lane. The TSP includes a westbound right-turn lane and right-turn lane overlap in its intersection improvements list (Chapter 8).
    - **Greenburg Road – eastbound/westbound left-turn lanes**
    - **Gaarde/McDonald – transit bypass lane, northbound/southbound left-turn lanes, eastbound/westbound through lanes, eastbound/westbound left-turn lanes.** The TSP includes a 2nd northbound left-turn lane in its intersection improvements list (Chapter 8).
    - **Canterbury – westbound left-turn lane**
    - Beef Bend Road – southbound right-turn lane. This is included in the TSP intersection improvements list (Chapter 8).
    - **Durham Road – northbound left turn lane.**

City of Tigard Capital Improvement Plan (CIP)

The funding element of the 2002 TSP addresses the same sources of transportation funding identified by the City and in the 2008-2013 CIP. Projects in future CIPs will be drawn from the list of projects developed during the TSP update.

City of Tigard Annexations

The concentration of annexations in the north and west areas of the city suggest that **these are areas where the focus of the TSP update should be on new project development.**

Summary of Recommendations for TSP and Code Amendments

Based on the findings of the issues report, the following are preliminary recommendations for amendments to the Tigard TSP and Community Development Code.

TSP Policies

1. Provide for coordinating the review of land use applications with ODOT for properties that are adjacent to state road facilities.
2. Establish policies to support adding new construction and major modifications of transportation facilities as reviewable land use decisions.
3. Consider adding policies and related strategies to more specifically address water, natural areas, and environmental quality. Refer to regional resources being developed regarding the relationship between climate change, effects on water resources, flood hazard areas, and transportation facilities, and create the basis and support for low-impact development practices including "green streets."
4. Add policies to support coordination of development and needed transportation facilities, and developing land uses that are appropriate for the classification of adjacent transportation facilities.
5. Add policies recognizing the Centers and Employment Areas, as designated in the Metro 2040 Concept, in the city.
6. Establish policies and related strategies for access management, including support for access modifications that bring access points into compliance, or closer to compliance, with ODOT and other applicable standards.
7. Develop policies to assist in establishing criteria to prioritize projects from the TSP.

TSP Modal and Other Elements

22. Continue developing projects and programs that make transportation options (namely walking, bicycling, and taking transit) more viable including complete and continuous walking and bicycling systems.
23. Use connections to transit as a criterion for evaluating not only pedestrian projects but bicycle projects.
24. Identify the needs of the transportation dependent and disadvantaged in the city.
25. Address Safe Routes to School programs.
26. Further develop transit information and technology improvements for the transit plan project list.
27. Make sure the street design standards and cross-sections presented in the TSP are consistent with those included in the City's Community Development Code (TCDC 18.810). Consider including Metro regional design overlay guidelines and overlay designations in the TSP.
28. Make sure access management standards presented in both the TSP and Community Development Code (TCDC 18.705.030) are consistent.
29. Address local delivery truck traffic in the city.
30. Evaluate whether the general categories "intersection safety enhancements" and "pedestrian crossings" in the 2002 TSP road improvement project list are needed or whether the list can be made up entirely of specific projects.
31. Pavement in the city is rated "good", "fair" and "poor," and consider rating other modal elements of the transportation system similarly, per the TPR.
32. Update descriptions of a city pavement management system that was being developed at the time of the last TSP.
33. Include mobility standards in the TSP. There are currently standards adopted for the Metro region (and included in the updated OHP) and the 2002 TSP presents transit service using level-of-service standards. Explore and potentially expand standards to address the pedestrian and bicycling systems.

34. Develop parking management plans for Centers and Employment Areas in the city. Consider developing residential parking districts, addressed in the TPR.
35. To expand the discussion of safety in the TSP, address safety education and alternate intersection treatments such as roundabouts.
36. Address the role of transportation facilities in environmental quality in the city. Consider adding standards for "green streets" and other development practices that are low-impact and mitigate water quality and flood concerns.
37. Address coordination of transportation planning in concept planning.
38. Be more specific about TDM and TSM measures that the City will commit to in order to conserve energy and maximize the transportation system and public investment. Include more energy efficient utility infrastructure improvements, such as LED lighting and signal replacement, in the TSM plan. Establish standards or benchmarks for TDM, using ODOT and Metro as resources for TDM measures and metrics.
39. Prepare a city ITS plan that coordinates local system operations with state and regional operation plans.
40. Identify land use regulations and code amendments needed to implement the TSP and include these in the implementation/funding element of the TSP.
41. In order to support creating a list of "financially constrained" or "reasonably likely" projects, identify funding sources for projects in the funding element of the TSP, or establish criteria by which to prioritize projects.
42. Report new funding sources or progress in developing funding sources identified as potential sources in the last TSP.

Community Development Code

18. Establish use regulations for transportation facilities – including roads, modifications to roads, transit facilities, bicycle facilities, and pedestrian facilities – in the City's land use districts.
19. Establish procedures for transportation project permitting or consolidated review.
20. Address coordinated review of land use applications with ODOT for properties that are adjacent to state road facilities.
21. Site review criteria in TCDC 18.360.090(11) require that provisions be made for transit for development proposed within 500 feet of an existing or planned transit line. The criteria do not include road geometrics and on-road parking restrictions, as addressed in the TPR, and consider whether to include these elements.
22. Evaluate whether to make provisions for pedestrian districts and, in terms of transit, building proximity to transit stops, pedestrian plazas at stops, accessible landing pads, easements for shelters, and transit stop lighting in the code.
23. Refer to local connectivity plans in the TSP as approval criteria in the code for land divisions and in the street improvement standards.
24. Explicitly address consistency with transportation standards in criteria for quasi-judicial amendments to the Development Code and zoning map, listed in TCDC 18.380.030(B).
25. Include procedures and criteria for legislative amendments to the Comprehensive Plan in the code.
26. Establish criteria consistent with TPR Section –0060 in decision-making considerations for Type IV legislative procedures established in TCDC 18.390.060(G).
27. Specify minimizing adverse impacts or protecting transportation facilities as development approval criteria in TCDC 18.430.
28. Make sure the access management standards in TCDC 18.705.030(H) are consistent with those in the TSP.
29. Consider adding conditional on-street parking credits for off-street parking requirements.

30. Address parking in large free surface parking lots that serve more than one use in the maximum off-street parking requirements.
31. Once transportation facilities, including transit amenities and facilities are incorporated into use regulations in the land use/zoning districts, add bicycle parking requirements for transit stations and park-and-ride lots.
32. Remove maximum parking requirements for bicycle parking.
33. Add code language to support "skinny street" cross-sections shown in Figures 18.810.4 – 18.810.6, and provide more guide or requirements for their usage.
34. Articulate a connection between the findings of traffic studies required by TCDC 18.810.030(AC) and potential conditions of development approval.

Comprehensive Plan/Community Development Code

2. Evaluate zoning along existing and planned transit routes in the city. Existing zoning is a combination of mixed-use commercial, residential, and employment (MUC, MUR, and MUE), R-12 and R-25, and C-P, C-G, and CBD. The mixed-use zones, residential zones, and CBD allow for densities that are transit-supportive. However, other than the MUR and CBD zones, these zones do not allow mixed uses that are particularly transit-oriented (a mix of commercial and residential in buildings) and some allow very auto-oriented uses that are not transit-supportive. Consider amending use regulations in these districts or re-zoning to create more transit-supportive zoning in these transit corridors.

Projects

Evaluate the TSP project list to address the projects found in the document review but not in the 2002 TSP.

5. **2008-2011 STIP**
    a. A Bicycle/Pedestrian program multi-use trail project
    b. A Transportation Enhancement program set of streetscape improvements in Downtown Tigard.
6. **2008 RTP** – See Tables 12 and 13 (starting on p. 71).
7. **Highway 217 Corridor Study**
    a. 72nd Avenue interchange improvements
    b. OR 99W interchange improvements
    c. Scholls Ferry/Greenburg Road interchange improvements
    d. Specify number of lanes of Hall Boulevard widening south of Locust.
    e. Improvements on all overcrossings
    f. A bicycle/pedestrian overcrossing to the Fanno Creek Trail
    g. A connection to the Washington Square trail
    h. An I-5/72nd Avenue path
8. **TriMet TIP**
    a. Corridor study in the Barbur Boulevard/Highway 99W corridor for bus rapid transit and light rail transit
    b. Bus line 76-Beaverton/Tualatin (Hall Boulevard) upgraded to Frequent Service
    c. Coordination between the City and TriMet for investing in sidewalks, crossings, lighting, shelters, benches, and bus stop spacing improvements for the frequent service upgrade
    d. Revised bus service to better coordinate with WES service

e. Improvements for the Tigard Transit Center Station, including 100 park-and-ride spaces, support for connections with five bus lines, and recommendations from a local plan (capital projects such as shelters, benches, and sidewalks and additional transit service on Bonita Road)
f. Added service on 72nd Avenue in order to connect businesses on 72nd Avenue with commuter rail and to better serve the Sequoia Parkway employment area

10. Tigard Downtown Improvement Plan

a. Street design and function improvements for Burnham, Main, Commercial, and Scoffins, and gateway improvements for Scoffins, Main, Garden Place, and Tigard Street as part of the plan's Streetscape Enhancement Program
b. Walkways in the Green Corridor/Urban Creek area
c. Street improvements on Ash Avenue from the planned park-and-ride to Fanno Creek, including a new bike and pedestrian bridge and extension of Ash Avenue from Burnham to the park-and-ride
d. Coordination with City Pedestrian and Bicycle Plans on access related to Downtown
e. Draft design requirements and guidelines for "Green Street" street treatments
f. New cross-sections for Hall Boulevard and OR 99W (collaboration with ODOT)
g. Highway Design Manual street design guidelines blending features of both ODOT and Metro Street design requirements
h. Parking Management Plan once Downtown begins to significantly grow and prior to any structured parking
i. Construction of an at-grade railroad crossing (collaboration with Portland & Western Railroad and the ODOT Rail Division).

11. Washington Square Regional Plan

a. More frequent bus service to the Regional Center
b. Washington Square transit center improvements
c. A local circulator
d. Overcrossing to connect Nimbus to Locust
e. Improvement of Oak/Lincoln/Locust collector system
f. Evaluation of whether new bikeways can be designated in the Regional Center

12. Highway 99W Improvement and Management Plan

a. Raised medians along 40% of the OR 99W corridor in Tigard at locations north of Gaarde/McDonald Street
b. An Access Management Plan with a focus on driveway management for properties with multiple driveways, with access to side streets, or within 200 feet of intersections
c. Sidewalks where there are gaps in the system in the study area corridor.
d. Sidewalk upgrades to have four-foot landscaping strips and eight-foot pedestrian zones
e. Signalized pedestrian activated crossing at the intersection with Watkins Avenue
f. Six-foot bike lanes where there are gaps in the system in the corridor
g. Signage for sections where bicyclists need to share the sidewalk with pedestrians
h. Transit improvements: relocation of bus stops and queue bypasses at five intersections (68th Avenue, Dartmouth Avenue, Hall Boulevard, Walnut Street, and Gaarde, McDonald Street)
i. Widening of the following intersections to allow for new turn or through lanes and/or transit queue bypass lanes:
    i. 68th Avenue – transit bypass lane
    ii. Dartmouth Avenue – transit bypass lane, southbound through lane

iii. Hall Boulevard – bypass lane, westbound turn lane. The TSP includes a westbound right-turn lane and right-turn lane overlap in its intersection improvements list (Chapter 8).
iv. Greenburg Road – eastbound/westbound left-turn lanes
v. Gaarde/McDonald – transit bypass lane, northbound/southbound left-turn lanes, eastbound/westbound through lanes, eastbound/westbound left-turn lanes. The TSP includes a 2nd northbound left-turn lane in its intersection improvements list (Chapter 8).
vi. Canterbury – westbound left-turn lane
vii. Durham Road – northbound left turn lane.

13. **General project recommendations –** Projects related to low-impact development, projects that serve the Centers and Employment Areas in the city, and projects in the north and west areas of the city where most annexations have occurred.

Technical Memo #2

Goals and Objectives

Updated Tigard TSP
Chapter 2 Goals & Policies

Date: June 30, 2009 Project #: 9473

To: Project Management Team
Technical Advisory Committee
Community Advisory Committee

From: Beth Wemple, P.E. , Judith Gray, and Michael Houston, Kittelson & Associates, Inc.

cc: Peter Koonce, P.E., Kittelson & Associates, Inc.

These goals and policies will be used to guide the development of the Tigard Updated TSP. The goals and policies listed in this document are based upon prior plans adopted by the City of Tigard, including the 2002 TSP and the comprehensive plan. They also address regional and statewide planning requirements, as described in the State Transportation Planning Rule (TPR) and Metro's Functional Plan guidelines for the 2040 Growth Concept.

Following review by the project management team (PMT), the technical advisory committee (TAC), and the community advisory committee (CAC), this document will form "Chapter 2 – Goals & Policies" of the Updated TSP.

Goals & Policies

These goals and policies have been developed to guide the City's long range vision of transportation system needs. They build upon prior plans adopted by the City of Tigard as well as regional and statewide planning rules. Specifically, the State Transportation Planning Rule (TPR), Metro's Functional Plan guidelines for the 2040 Growth Concept, and previously adopted City of Tigard comprehensive plan policies requiring a multi-modal and balanced approach to transportation policy, addressing walking, bicycling, transit, rail, truck and other modes as well as automobile travel. These goals and policies are a result of widespread work by staff and the consultant team and reflect the guidance of the Tigard Planning Commission, a Technical Advisory Committee (TAC), and a Citizens Advisory Committee (CAC).

The framework of the City of Tigard TSP Goals and Policies includes the following general goals:

Goal 1 – Transportation and Land Use Planning Coordination

Goal 2 – Transportation Efficiency

Goal 3 – Multi-Modal Transportation System

Goal 4 – Safe Transportation System

Goal 5 – Inter-agency Coordination

The goals are general statements indicating a desired end. Related policies are listed under each goal. The policies are statements identifying Tigard's position and a definitive course of action that will contribute to achieving the goal. Figure 2-1 provides an outline of the relationship between goals, policies, actions and implementation. The TSP addresses the top three elements identified in Figure 2-1. The policies are not implementable as a land use action without inclusion in land use regulations.[1] Therefore, land use regulations should reflect the transportation framework laid out in this chapter of the Updated TSP.

[1] ORS 197.175(2); ORS 197.195(1).

From Vision to Action

- Public Input
- Comprehensive Plan
- Transportation Planning Rule
- Metro Functional Plan
- Washington County Transportation Plan

GOALS

Simple brief guiding statements

↓

POLICY

Brief statements that focus on how goals will be met including measures of effectiveness and/or standards

↓

ACTION

Recommended plans, maps, improvements & studies that implement policy

↓

- **DESIGN MANUAL**
- **STANDARD DRAWINGS**
- **DEVELOPMENT CODE**

Specific standards for implementation

Figure 2-1

Goals and Policies Relationship

TIGARD

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http://www.tigard-or.gov

GOAL 1 – TRANSPORTATION & LAND USE PLANNING COORDINATION

Coordinate mutually supportive land use and transportation plans to enhance the livability of the community.

Policies

1. The City shall plan for a transportation system that meets current community needs and anticipated growth and development.

2. The City shall prioritize transportation projects according to community benefit, such as safety, performance, and accessibility, as well as the associated costs and impacts.

3. The City shall maintain and enhance transportation functionality by emphasizing multi-modal travel options for all types of land uses.

4. The City shall promote land uses and transportation investments that promote balanced transportation options.

5. The City shall develop plans for major transportation corridors and provide appropriate land uses in and adjacent to those corridors.

6. The City shall support land use patterns that reduce greenhouse gas emissions and preserve the function of the transportation system.

7. The City shall strive to protect the natural environment from impacts derived from transportation facilities.

8. The City shall mitigate impacts to the natural environment associated with proposed transportation construction or reconstruction projects.

9. The City shall work with private and public developers to provide access via a safe, efficient, and balanced transportation system.

10. The City shall require all development to meet adopted transportation standards or provide appropriate mitigations as determined by the Community Development Director.

GOAL 2 – TRANSPORTATION EFFICIENCY

Develop and maintain a transportation system for the efficient movement of people and goods.

Policies

1. The City shall manage the transportation system to support desired economic development activities.

2. The City shall design arterial routes, highway access, and adjacent land uses in ways that facilitate the efficient movement of people, goods and services.

3. The City shall cooperate with the railroads in facilitating rail freight service to those commercial and industrial businesses within the city that depend on railroad service.

4. The City shall develop and maintain an efficient arterial grid system that provides access within the City, and serves through traffic in the City.

5. The City shall use strategies for access management, including the support of modifications that bring access points into compliance or closer to compliance with applicable standards.

6. The City shall adopt and maintain transportation performance measures.

7. The City shall require the provision of appropriate parking in balance with other transportation modes.

8. The City shall design local streets to encourage a reduction in trip length by providing connectivity and limiting out-of-direction travel.

9. The City shall strive to increase non-single occupant vehicle mode shares through vehicle trip reduction strategies, such as those outlined in the Regional Transportation Plan.

10. The City shall design the transportation system to provide connectivity between Metro designated centers, corridors, employment and industrial areas.

GOAL 3 – MULTI-MODAL TRANSPORTATION SYSTEM

Provide an accessible, multi-modal transportation system that meets the mobility needs of the community.

Policies

1. The City shall design and construct transportation facilities to meet the requirements of the Americans with Disabilities Act.

2. The City shall develop and maintain neighborhood and local connections to provide efficient circulation in and out of the neighborhoods.

3. The City shall require development adjacent to transit routes to provide direct pedestrian accessibility.

4. The City shall develop and implement public street standards that recognize the multi-purpose nature of the street right-of-way.

5. The City shall design all public streets within Tigard to encourage pedestrian and bicycle travel.

6. The City shall require sidewalks to be constructed in conjunction with private development and consistent with adopted plans.

7. The City shall require and/or facilitate the construction of off-street trails to develop pedestrian and bicycle connections that cannot be provided by a street.

8. The City shall require appropriate access to bicycle and pedestrian facilities for all schools, parks, public facilities, and commercial areas.

9. The City of Tigard shall continue to support the existing commuter rail and the development of high-capacity transit connections to regional destinations.

Goal 4 – Safe Transportation System

Maintain and improve transportation system safety.

Policies

1. The City shall maintain a neighborhood traffic management program to addresses issues of excessive speeding and through traffic on local residential streets.

2. The City shall require safe routing of hazardous materials consistent with federal and state guidelines.

3. The City shall collaborate with appropriate agencies to provide safe, secure, connected, and desirable pedestrian, bicycle, and public transit facilities.

4. The City shall consider the intended uses of a street during the design to promote safety, efficiency, and multi-modal needs.

5. The City shall develop access management strategies for arterial and collector streets to improve safety in the community.

6. The City shall make street maintenance a funding priority.

7. The City shall monitor, prioritize, and mitigate high accident locations within the community.

8. The City shall require new transportation facilities, and retrofit existing facilities, to meet adopted lighting standards.

9. The City shall require new development to provide safe access to and from a publicly dedicated street.

Goal 5 – Inter-agency Coordination

Coordinate planning, development, operation, and maintenance of the transportation system with appropriate agencies.

Policies

1. The City shall coordinate and cooperate with adjacent agencies , when necessary, to develop transportation projects which benefit the region as a whole, in addition to the City of Tigard.

2. The City shall collaborate with other transportation providers to develop, operate, and maintain intelligent transportation systems, including coordination of traffic signals.

3. The City shall coordinate with TriMet, and/or any other transit providers serving Tigard, to improve transit service to, from, through, and within Tigard.

Technical Memo #3

Base Year Conditions Analysis

Chapter 3 Base Year Conditions Analysis

Updated Tigard TSP

Date: June 30, 2009 Project #: 9473

To: Project Management Team
Technical Advisory Committee
Community Advisory Committee

From: Beth Wemple, P.E. and Judith Gray, Kittelson & Associates, Inc.

cc: Peter Koonce, P.E., Kittelson & Associates, Inc.

This document summarizes the transportation system serving Tigard in the base year (2008-2009). At this stage in the process of developing the Updated Tigard Transportation System Plan (TSP), this document serves as the *existing conditions* report. This existing conditions analysis establishes the base condition upon which a forecast conditions analysis will be built, which will be integral to identifying the future system needs and deficiencies.

Following review by the project management team (PMT), the technical advisory committee (TAC), and the community advisory committee (CAC), this document will form "Chapter 3 – Base Year Conditions" of the Updated TSP. For reference, the following list summarizes the figures presented in the document.

- Figure 3-1. Transportation System Plan Boundaries
- Figure 3-2. Zone Designations, 2007 Comp Plan
- Figure 3-3. Roadway Jurisdictions, 2009
- Figure 3-4. Functional Classifications, 2002 TSP
- Figure 3-5. Roadways With More Than Two Lanes, 2009
- Figure 3-6. Four-Lane Arterial Connectivity
- Figure 3-7. Speed Zones, 2009
- Figure 3-8. Signalized Intersections, 2009
- Figure 3-9. Pedestrian Facilities, 2009
- Figure 3-10. Bicycle Facilities, 2009
- Figure 3-11. Transit Routes, 2009
- Figure 3-12. 2008 Link Traffic Volumes
- Figure 3-13. Truck Facilities, 2009
- Figure 3-14. Peak Period Truck Volumes, 2009
- Figure 3-15. Peak Period Pedestrian Counts, 2009
- Figure 3-16. Peak Period Bicycle Counts, 2009
- Figure 3-17. Arterial Level-of-Service Weekday AM
- Figure 3-18. Arterial Level-of-Service Weekday Midday
- Figure 3-19. Arterial Level-of-Service Weekday PM
- Figure 3-20. Arterial Level-of-Service Weekend Midday
- Figure 3-21. Highway 99W Corridor Operations (1)
- Figure 3-22. Highway 99W Corridor Operations (2)
- Figure 3-23. Scholls Ferry Road Corridor Operations
- Figure 3-24. Hall Boulevard Corridor Operations
- Figure 3-25. Greenburg Road Corridor Operations
- Figure 3-26. 72nd Avenue Corridor Operations
- Figure 3-27. Upper Boones Ferry Corridor Operations
- Figure 3-28. Walnut Street Corridor Operations
- Figure 3-29. Environmental Resources, 2009
- Figure 3-30. Minority Population, 2009
- Figure 3-31. Low-Income Population, 2009
- Figure 3-32. Senior Population, 2009
- Figure 3-33. Non-English Speaking Population, 2009
- Figure 3-34. Disability Population, 2009

The technical appendices detailing the system analyses will be provided as a separate document for the Chapter 3 Base Year Conditions Analysis and, ultimately, as a separate volume to the adopted Updated TSP. The following appendices are provided for this chapter.

A. Typical Street Cross-Sections from the 2002 Transportation System Plan

B. Local Street Connectivity Figures

C. Tigard Traffic Signal Ownership Table

D. 2008 Base Year Lane Configurations

E. Travel Time Data

F. 2008 Base Year Intersection Operations and Queuing Analyses, Weekday PM Peak Hour

G. 2008 Base Year Intersection Operations and Queuing Analyses, Weekday AM Peak Hour

H. 2008 Base Year Intersection Operations and Queuing Analyses, Saturday Mid-Day Peak Hour

I. Signal Warrant Analysis Worksheets

Base Year Conditions Analysis (2008-09)

This chapter summarizes the transportation system serving Tigard in the base year (2008-2009). A detailed inventory of roadways (arterials or collectors) and pedestrian, bicycle, and public transportation facilities, demand and usage, is provided in this chapter. Rail, air, pipeline, and water modes are also summarized in this chapter.

To understand base year travel patterns, trends and conditions in Tigard traffic volumes, crash data, pedestrian and bicycle volumes, truck travel, and transit ridership were collected and evaluated. These data are presented as a reference point for staff, citizens, and other users of the TSP. Where applicable, these data were also compared to historic data in order to capture meaningful trends in travel patterns and issues. Major findings and trends are summarized in this chapter. *Details of the transportation system inventory and analyses are included in Volume 2: Technical Appendix.*

This chapter begins with a summary of the status of projects identified in the 2002 TSP. This is followed by a general description of the context for the plan, including the plan boundaries, land use designations, and the role in the regional transportation system. The remainder of the chapter includes the following:

- An inventory of the 2008-09 transportation system, including the street system, pedestrian and bicycle facilities, and transit service;
- Base year transportation conditions, including traffic operations on key corridors, as well as pedestrian, bicycle, and truck traffic on the roadways.
- Identification of basic facilities and operations for rail, air, water, and pipeline transportation modes serving Tigard; and,
- An overview of environmental resources and socioeconomic demographics that should be incorporated in the identification and evaluation of transportation solutions.

BACKGROUND

Since the 2002 TSP was adopted, several of the recommended projects have been completed. Tables 3-1 through 3-4 identify the projects from the 2002 TSP that have been completed.

Table 3-1 Street Projects

Street	From	To	Description	Construction Date
Gaarde Street	121st Avenue	Highway 99W	Widen to three lanes with sidewalks/bike lanes	2004
Wall Street	Hall Boulevard	300 feet East of Hall Boulevard	Construct new street and signal at Hall Boulevard to serve as entrance to library and Condo Complex; Was first piece of then-planned Wall Street connection to Hunziker Street	2006
Walnut Street	135th Avenue	121st Avenue	Widen to three lanes with sidewalks/bike lanes	2005
Hall Blvd	Wall Street	Fanno Creek	Half-street improvement on east side of Hall Boulevard along the City Library	2004

Table 3-2 Intersection Projects

Street	Location	Description	Construction Date
Durham Road	98th Avenue	Traffic signal and turn lanes	2003
McDonald Street	East of Highway 99W	Widen to add a new westbound turn lane; Add raised median; Construct sidewalks on both sides	2005
Durham Road	108th Avenue	New traffic signal and turn lanes	2007
Bonita Road	74th Avenue	New traffic signal and median; Signal coordinated with railroad crossing	2008
Main Street	Commercial Street (West Side)	Raised median limits Commercial Street to right-in/right-out	2008
Highway 99W	Bull Mountain Road	Add eastbound right turn lane	2007
Hall Boulevard	Wall Street	Install signal at Hall Boulevard/Wall Street intersection; Construct new Library entrance	2005

Table 3-3 Pedestrian Projects

Street	Location	Description	Construction Date
121st Avenue	Springwood Drive	Pedestrian-actuated in-pavement crosswalk lights	2002
Walnut Street	Grant Avenue	Pedestrian-actuated pole-mounted crosswalk lights	2003
Bonita Road	Milton Court	Pedestrian-actuated in-pavement crosswalk lights	2003
Hall Boulevard	Highway 99W (Pfaffle Street)	construct new sidewalks	2004
121st Avenue	Katherine Street	Pedestrian-actuated in-pavement crosswalk lights	2007

Table 3-4 Projects in Design Process

Street	From	To	Description	Planned Construction Date
Corridor/Street Segment Project				
Hall Boulevard	Bonita Road	500 feet north	Construct new sidewalk	2009
Burnham Street	Hall Boulevard	Main Street	Street reconstruction and widening	2009
Intersection Project				
Durham Road/88th Avenue - Tigard High Access			Pedestrian-actuated crosswalk lights	2009
Highway 99W/Hall Boulevard			Major intersection reconstruction	2010
Highway 99W/Greenburg Road-Main Street			Major intersection reconstruction	2010

PLAN AREA

The City of Tigard is located within urban Washington County and the three county (Multnomah, Clackamas, and Washington Counties) Metro Service District. Tigard's current boundaries are generally defined by Scholls Ferry Road to the North, I-5 to the East, the Tualatin River to the South, and SW Barrows Road and a saw-toothed line extending as far as SW 154th Avenue to the West.

Figure 3-1 presents a map showing the Tigard Urban Planning Area, which incorporates the City of Tigard and sections of unincorporated Washington County. The Highway 217 interchange at Scholls Ferry Road is also shown in the figure even though it is in the City of Beaverton, but is included in this study because its operations effect adjacent intersections within Tigard.

Directly west of the Tigard planning area is the West Bull Mountain Planning Area (Areas 63 and 64) which was brought into the urban growth boundary in 2002. That area is being planned under a separate effort being led by Washington County and is, therefore, excluded from the Tigard planning area.

LAND USES

The types and densities of land uses are major determinants of traffic demand and travel patterns. The zone designations in the 2007 Comprehensive Plan are shown in Figure 3-2. The main commercial land use areas are located in Washington Square, the Highway 99W corridor, the Tigard Triangle area, and downtown Tigard. The majority of Tigard is zoned for residential uses, and most of the City is comprised of single-family residential development. Connecting these residential areas to one another and to commercial, employment, recreational, and transit destinations is a key concern for building a more efficient transportation network that reduces trip distances.

REGIONAL CONTEXT

While the Tigard Updated TSP focuses on the transportation system within the Tigard Urban Planning Area, the transportation facilities within the TSP area also have an important role in the regional transportation system. Three major regional transportation facilities traverse the City of Tigard: Interstate 5, Highway 217, and Highway 99W. All of these facilities are designated Freight Routes in the Oregon Highway Plan (OHP, Reference 1). The WES commuter rail began operating in February 2009. WES operates on weekdays between approximately 5 a.m. to 10 a.m. and 3 p.m. to 8 p.m., connecting Beaverton to Wilsonville, with stops at the Hall/Nimbus station, Tigard Transit Center, and Tualatin Station.

Freight Conditions

The Metro regional travel demand model estimates travel demand and traffic operations on significant roadways and corridors in the region. The estimates are developed for weekday mid-day and p.m. peak period conditions and are available for base year 2005 and forecast 2035.

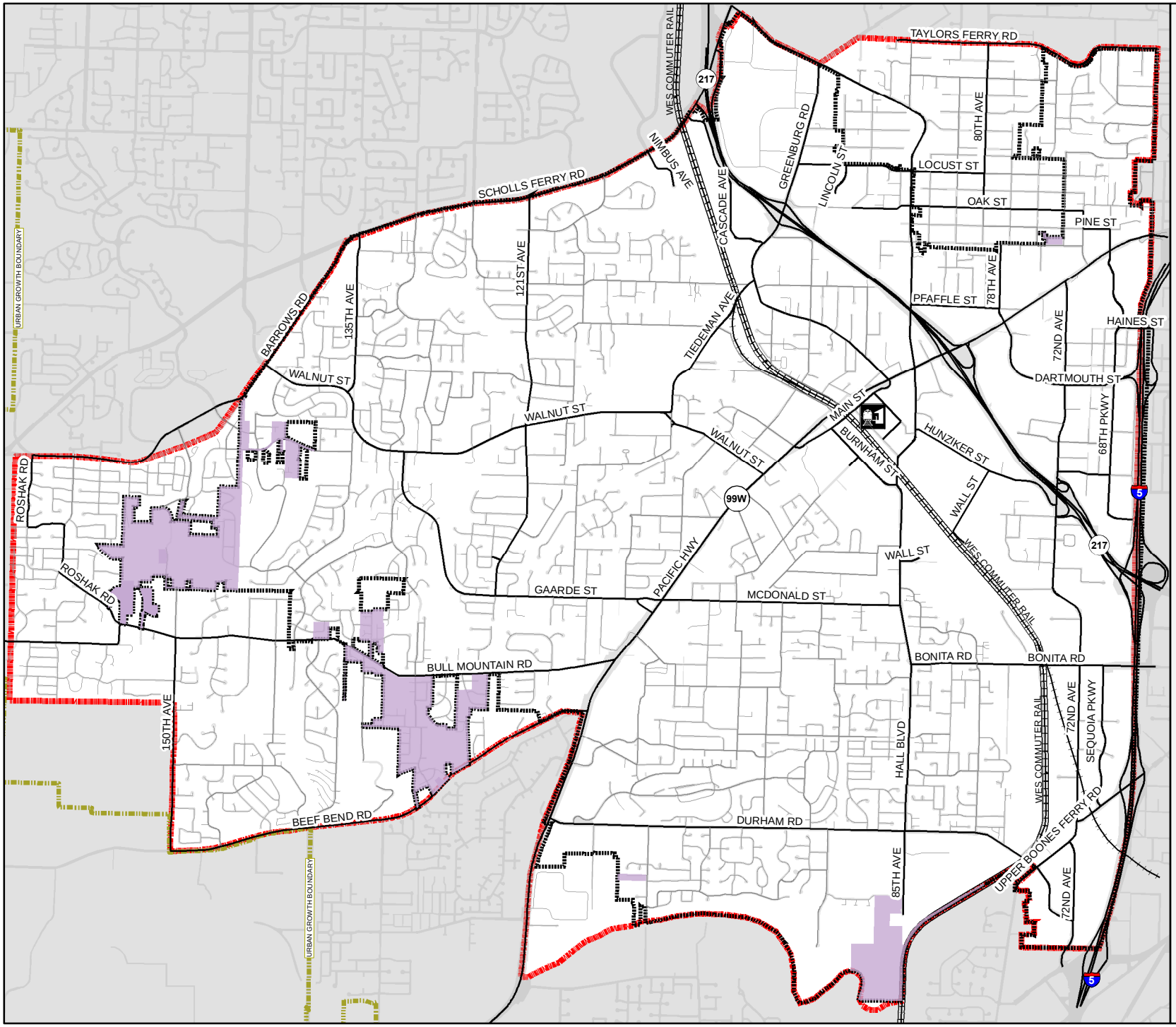

Figure 3-1

Transportation System Plan Boundaries

Tigard Urban Planning Area

LEGEND

- Tigard City Boundary
- Urban Planning Area
- Recent City Annexations

Other Map Elements

- WES Rail Line
- WES Station
- Rail Lines

** The information represented on this map is current as of February 2, 2009. Revisions will be made as new decisions or amendments occur to alter the content of the map.

TIGARD

N

0 0.15 0.3 0.6
Miles

Sources: City of Tigard
Metro Data Resource Center
Washington County
June 2009

This map was derived from several databases. The City cannot accept responsibility for any errors. Therefore, there are no warranties for this product. However, any notification of errors would be appreciated.

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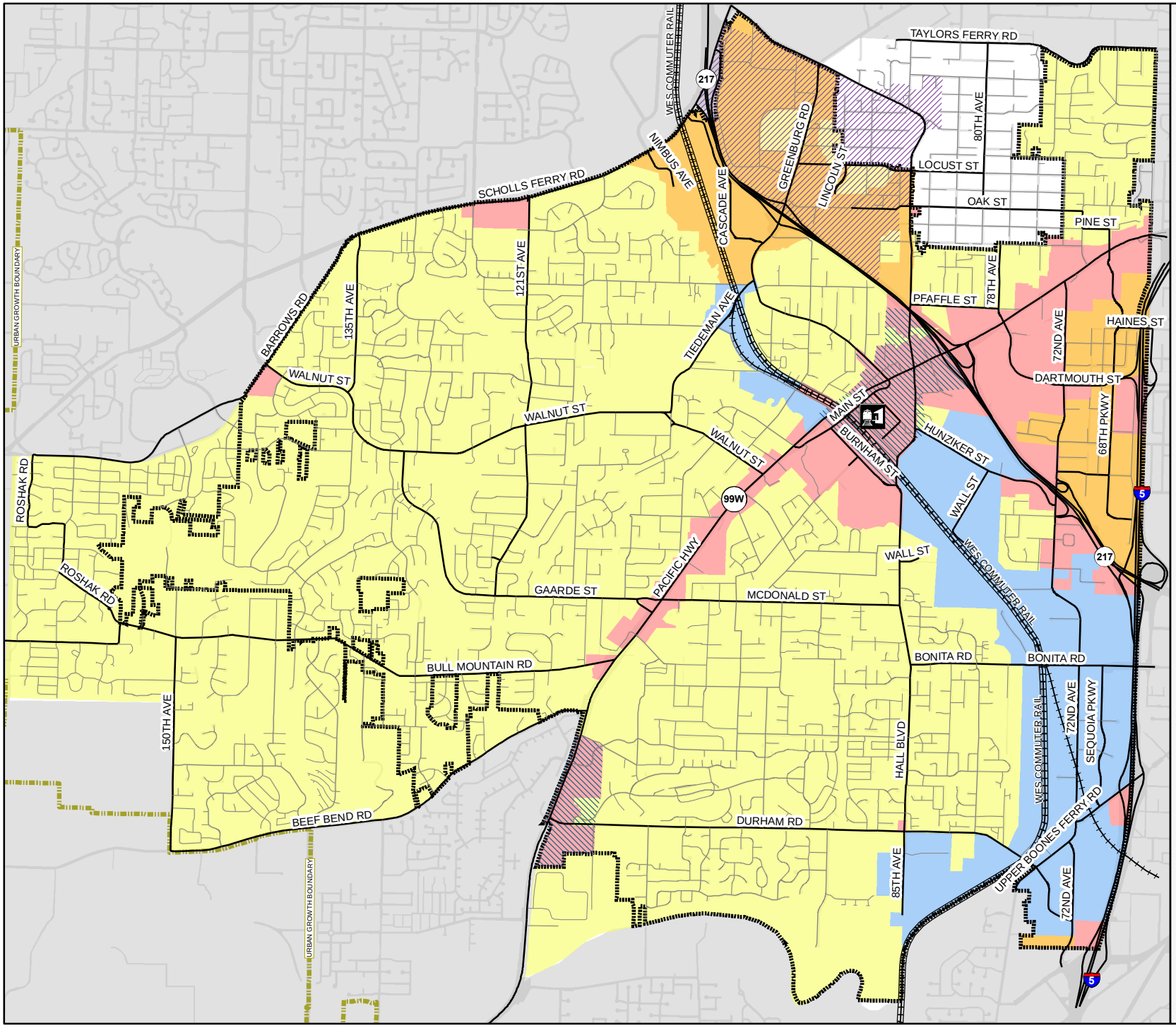

Figure 3-2

Zone Designations 2007 Comp Plan

Tigard Urban Planning Area

LEGEND

- Commercial
- Industrial
- Mixed Use
- Residential
- Regional Center
- Town Center

Other Map Elements

- Tigard City Boundary
- WES Rail Line
- WES Station
- Rail Lines

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TIGARD

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0 0.15 0.3 0.6 Miles

Sources: City of Tigard
Metro Data Resource Center
Washington County
June 2009

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The model shows that volume-to-capacity (v/c) ratios within the corridors are generally lower during the mid-day when compared to the p.m. peak period, but are still in the range of 0.80 to 0.90 in most areas. However, at the interchanges there tends to be greater areas of over-capacity conditions during the evening peak. Specifically, the Highway 217/Highway 99W interchange is currently over capacity during the weekday p.m. peak period, whereas mid-day v/c ratios are between 0.80 and 1.00 during the mid day.

The comparison of mid-day versus p.m. peak periods provides some illustration of the impacts of peak period congestion. During the mid-day when congestion impacts are lower, freight traffic represents a greater proportion of traffic compared to commuter trips.

Mobility Corridors

As part of the 2035 Regional Transportation Plan Update (Reference 2), Metro has defined regional corridors that, while anchored by major roadway facilities, also encompass local streets and multi-modal facilities. The Regional Mobility Corridor system is still being developed as of this writing. Metro's *Draft Mobility Corridor Atlas* (April 2009) identified the following four corridors connecting to Tigard:

- Corridor 2: I-5 connecting Tigard to Portland Central City.
- Corridor 2: I-5 connecting Tigard to Tualatin.
- Corridor 19: Highway 217 connecting Tigard to Beaverton and Hillsboro (via Highway 26).
- Corridor 20: Highway 99W connecting Tigard to Sherwood-Newberg.

By identifying and managing more broadly defined corridors, Metro hopes to shift transportation planning away from a focus on facilities and toward a focus on providing connections using a system of mode options. As the Tigard Updated TSP looks toward transportation for local access and circulation, long-range planning and management should be consistent with the framework established by the 2035 Regional RTP Update (RTP), including the mobility corridors.

STREET SYSTEM

Highways and streets are the primary means of mobility to, from, within, and through Tigard. The roads serve not only vehicle trips but also pedestrians, bicyclists, and transit modes. Based on the requirements of Oregon's Transportation Planning Rule (TPR, Reference 3), only those streets designated as collectors and arterials and intersections of these streets are studied in detail in the TSP. In some cases local street issues are also discussed where they pertain to issues beyond local land use access, such as street connectivity or safety issues.

This section provides a summary of roadway jurisdictions and functional classifications. This is followed by descriptions of major roadways serving Tigard and summaries of significant system characteristics, such as the number of travel lanes, general access management conditions, roadway spacing and connectivity, speed limits and intersection traffic control.

Jurisdiction

Public roads within the Tigard Urban Planning Area are under the jurisdiction (ownership) of: the City of Tigard, Washington County and the Oregon Department of Transportation (ODOT). Table 3-5 lists collectors and arterials within the Tigard Urban Planning Area that are *not* under City of Tigard jurisdiction. Figure 3-3 shows the jurisdiction of all roadways within the Tigard Urban Planning Area.

Table 3-5
Washington County and ODOT Roadways, Within the Tigard Urban Planning Area

Roadway	Jurisdiction
I-5	ODOT
Highway 217	ODOT
Highway 99W	ODOT
Hall Boulevard	ODOT
Scholls Ferry Road	Washington County*
Beef Bend Road	Washington County
Barrows Road	Washington County**
Bull Mountain Road	Washington County
Greenburg Road (North of Highway 217)	Washington County
Roshak Road	Washington County
Locust Street (East of Hall Boulevard)	Washington County
Oak Street (East of Hall Boulevard)	Washington County
80th Avenue	Washington County
150th Avenue	Washington County

* Scholls Ferry Road between the WES Commuter Rail and Hall Boulevard is under ODOT jurisdiction.
** Barrows Road between the western Scholls Ferry Road/Barrows Road intersection and approximately 100 feet east of Murray Boulevard is under City of Beaverton jurisdiction.

As shown in the table and figure, there are several higher order facilities that are not under the jurisdiction of the City. Improvements to these roadways are subject to the policies, requirements, and standards of the managing jurisdiction. Each jurisdiction is responsible for the following:

- Determining the road's functional classification;
- Defining the roadway's major design and multi-modal features;
- Maintenance; and,
- Approving construction and access permits.

Coordination is required among the jurisdictions to ensure that the transportation system is planned, maintained, and expanded to safely meet the needs of travelers in the area.

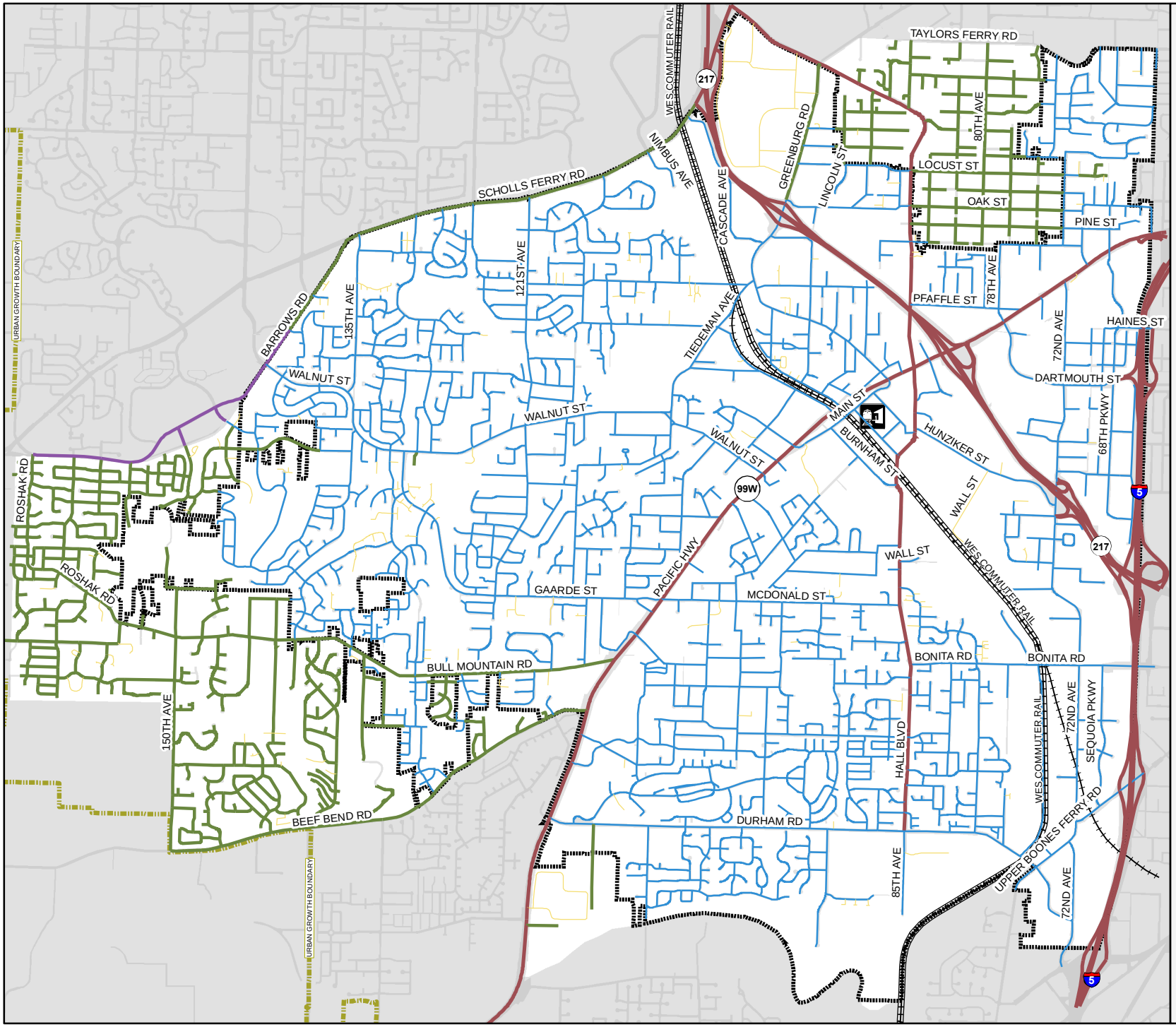

Figure 3-3

Roadway Jurisdictions 2009

Tigard Urban Planning Area

LEGEND

- City of Tigard
- ODOT
- Washington County
- City of Beaverton
- Private Roadway
- Other Jurisdictions

Other Map Elements

- Tigard City Boundary
- WES Rail Line
- WES Station
- Rail Lines

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Roadway Functional Classification

A roadway's functional classification determines its role in the transportation system, as well as right-of-way requirements, dimensions of roadway features (e.g. lane width, sidewalk width, bike lane width), driveway (access) spacing requirements, and landscaping provisions. Functional classifications from the 2002 TSP are presented below and are shown in Figure 3-4.

Freeway

Freeways are state facilities that provide the highest level of regional mobility and connectivity. These roadways usually extend across several jurisdictions and are often characterized by limited access points and high travel speeds. In Tigard, I-5 and Highway 217 are access controlled freeways.

Arterial Streets

Arterial streets serve to connect and support the Freeway and Principal Arterial system. These streets link major commercial, residential, industrial, and institutional areas. Arterial streets are typically spaced about one mile apart, and maintain mobility as a priority. Access control is important on arterial routes, but not to the extent of Principal Arterial systems. Many of these routes connect to cities surrounding Tigard and commonly provide access to freeways via interchanges.

Collector Streets

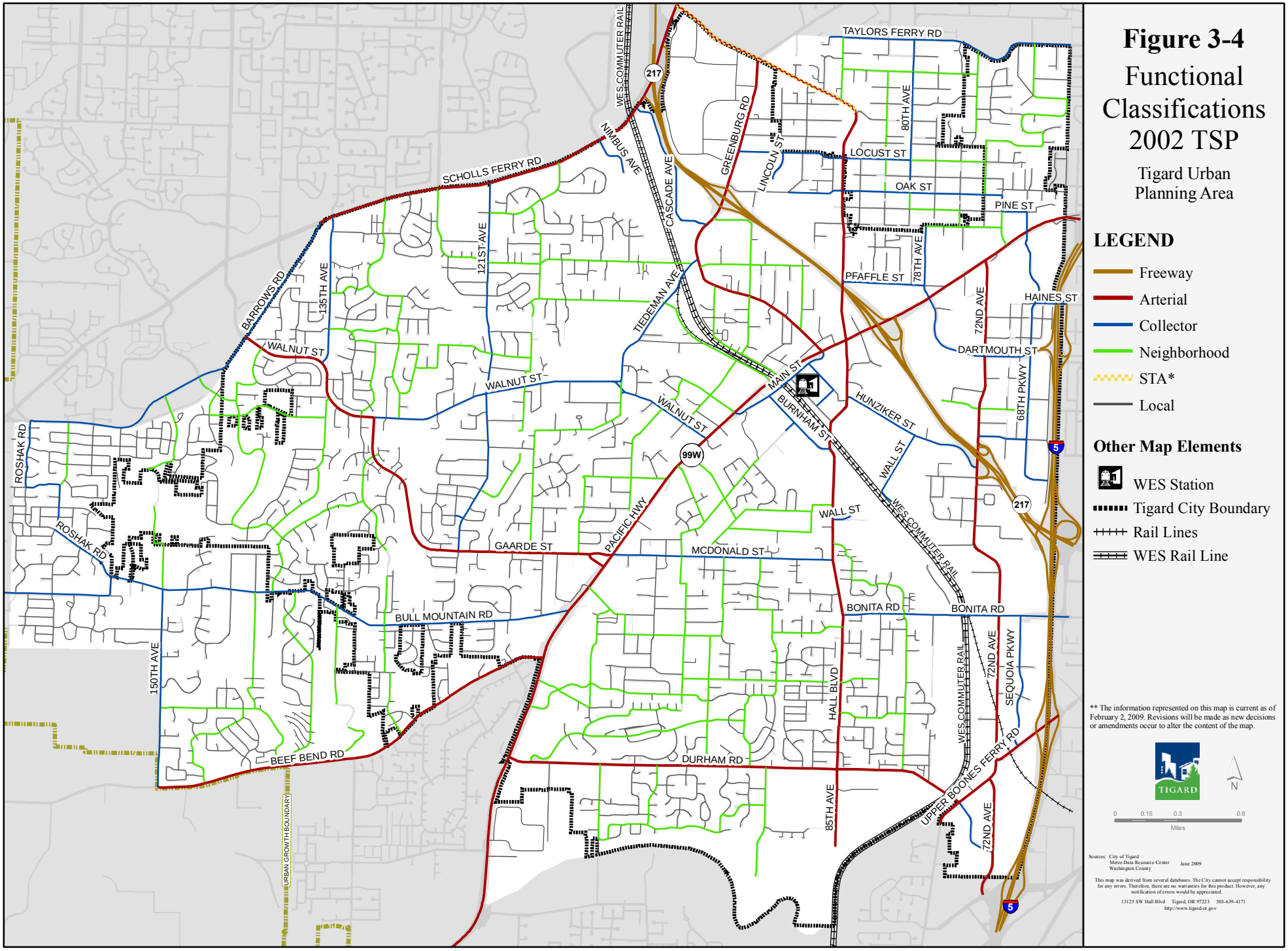
Collector streets provide both access and mobility within and between residential and commercial/industrial areas. Collectors differ from arterials in that they provide more of a intra-city circulation function, do not require as extensive control of access (compared to arterials), and provide access to residential neighborhoods. These roadways distribute trips to and from the neighborhood and local street system.

Neighborhood Routes

Neighborhood routes are usually long relative to local streets and provide connectivity to collectors or arterials. Neighborhood routes have greater connectivity and are used by residents in the area to get into and out of the neighborhood, but do not serve citywide/large area circulation. Neighborhood Routes are typically about a quarter to a half mile in total length. Traffic from cul-de-sacs and other local streets may connect to neighborhood routes for access to higher order streets.

Local Streets

Local Streets have the primary function of providing access to immediate adjacent land. These streets typically have several driveways and are not intended for long-distance trips. Through traffic on local streets is discouraged by design.



* Special Transportation Area

In addition, Washington County and ODOT have separate functional classification systems. The functional classification of the major collector and arterial roadways in Tigard, including those under ODOT and County jurisdiction, are shown in Table 3-6.

Table 3-6 Functional Classifications Designations

Roadway	Tigard 2002 TSP	Washington County	1999 Oregon Highway Plan
Interstate-5	Freeway	Freeway	Interstate Highway
Highway 217	Freeway	Freeway	Statewide Highway
Highway 99W	Arterial	Arterial	Statewide Highway
Hall Boulevard	Arterial	Arterial	District Highway
Scholls Ferry Road	Arterial	Arterial	District Highway
Beef Bend Road	Arterial	Arterial	Not Identified
Greenburg Road	Arterial	Arterial	Not Identified
Durham Road	Arterial	Arterial	Not Identified
Gaarde Street	Arterial	Arterial	Not Identified
72nd Avenue	Arterial	Arterial	Not Identified
Upper Boones Ferry Road	Arterial	Arterial	Not Identified
Walnut Street (west of Gaarde St)	Arterial	Arterial	Not Identified
Walnut Street (east of Gaarde St)	Collector	Collector	Not Identified
Bonita Road	Collector	Collector	Not Identified
McDonald Street	Collector	Collector	Not Identified
Tiedeman Avenue	Collector	Collector	Not Identified
121st Avenue	Collector	Collector	Not Identified
135th Avenue	Collector	Collector	Not Identified
150th Avenue	Collector	Collector	Not identified
Roshak Road	Collector	Collector	Not Identified
Locust Street	Collector	Collector	Not Identified
Oak Street	Collector	Collector	Not Identified
Bull Mountain Road	Collector	Collector	Not Identified
Dartmouth Street	Collector	Collector	Not Identified
Barrows Road (South of Walnut Street/Murray Boulevard)	Collector	Collector	Not Identified
Barrows Road (North of Walnut Street/Murray Boulevard)	Collector	Neighborhood Route	Not Identified
Pfaffle Street	Collector	Neighborhood Route	Not Identified

Roadway Design Standards

The 2002 TSP identifies the design standards for roadway cross-section elements (e.g. lane width, sidewalk width), which are frequently associated with specific functional classifications and surrounding land uses. These are summarized in Table 3-7. *The typical street cross sections from the 2002 TSP are provided in the technical appendix for reference.*

Table 3-7 Street Cross Section Characteristics, 2002 TSP

Roadway Element	Design Standard
Vehicle Lane Widths *Minimum Widths*	• Truck Route = 12 feet • Bus Route = 11 feet • Arterial = 12 feet • Collector = 11 feet • Neighborhood = 10 feet • Local = 9 to 10 feet (9 feet would be used in conjunction with on-street parking) • Turn Lane = 12 feet[1]
On-Street Parking	• 8 feet[2]
Bicycle Lanes *Minimum Widths*	• New Construction = 6 feet • Reconstruction = 5 to 6 feet
Curb Extensions for Pedestrians	• Consider on any Metro designated Pedestrian Master Plan Route
Sidewalks *Minimum Widths*	• Local = 5 feet with landscaping strip; 6 feet if against curb • Neighborhood = 5 feet; 6 feet if against curb • Collector = 6 to 8 feet; greater width for high pedestrian volumes • Arterial = 6 to 10 feet; greater width for high pedestrian volumes
Landscape Strips	• Residential/Neighborhood = Required • Collector/Arterial = Required
Medians	• 5-Lane = Required • 3-Lane = Optional
Neighborhood Traffic Management	• Local = Should not be necessary • Neighborhood = Consider[3] • Collectors = Under Special Conditions • Arterials = Only under Special Conditions
Transit	• Arterial/collectors = Appropriate • Neighborhood = Only in special circumstances
Turn Lanes	• When Warranted
Access Control	• See later section for Arterials and Collectors

[1] In constrained conditions on collectors, neighborhood and local routes, a minimum width of 10 feet may be considered (except on bus routes)

[2] For 32-foot streets, the City recognizes that there will not be 20 feet of unobstructed pavement.

[3] Consider retrofitting existing streets. New neighborhood streets should be designed for appropriate travel speeds

Roadway Travel Lanes

Figure 3-5 provides a summary of the number of through lanes on each of the arterial and collector streets in Tigard. The figure shows the roadways that have three or five-lane cross-sections in 2009. These are usually higher order roadways that carry higher traffic volumes than other roadways in the study area. In addition, these roadways frequently carry higher volumes of bus, bicycle, and pedestrian traffic. All other roadways have two lanes.

Access Management

The Oregon Transportation Planning Rule (TPR) defines access management as a set of measures regulating access to streets, roads, and highways, from public roads and private driveways. The TPR requires that new connections to arterials and state highways be consistent with designated access management categories.

Access management standards vary depending on the functional classification and purpose of a given roadway. Roadways on the higher end of the functional classification system (i.e., arterials and collectors) tend to have higher spacing standards, while facilities such as neighborhood routes and local streets allow more closely spaced access points. Chapter 18.705 of the Tigard Development Code identifies access requirements and restrictions. The minimum spacing of streets or driveways is summarized in Table 3-8. The code does not include a spacing standard for Neighborhood Routes.

Table 3-8 City of Tigard Access Spacing Standards

Roadway Classification	Public Street	Driveway
Arterial	600 feet	600 feet
Collector	200 feet	200 feet
Local	125 feet	n/a

The OHP identifies access management spacing standard for highways. Table 3-9 shows ODOT's spacing standards for state highways in Tigard.

Table 3-9 ODOT Access Spacing Standards

Highway Type	Roadway	Speed Limit	Spacing Standard
Statewide	Highway 99W	35 mph	720 feet
	Highway 99W	45 mph	990 feet
District	Hall Boulevard	30 mph	350 feet
	Hall Boulevard	35 mph	350 feet
	Hall Boulevard	40 mph	500 feet

Based on the above tables, the spacing standards for Highway 99W and Hall Boulevard are not consistent between the City and OHP standards. Because these roadways are under ODOT jurisdiction, the OHP spacing standards would apply in these locations.

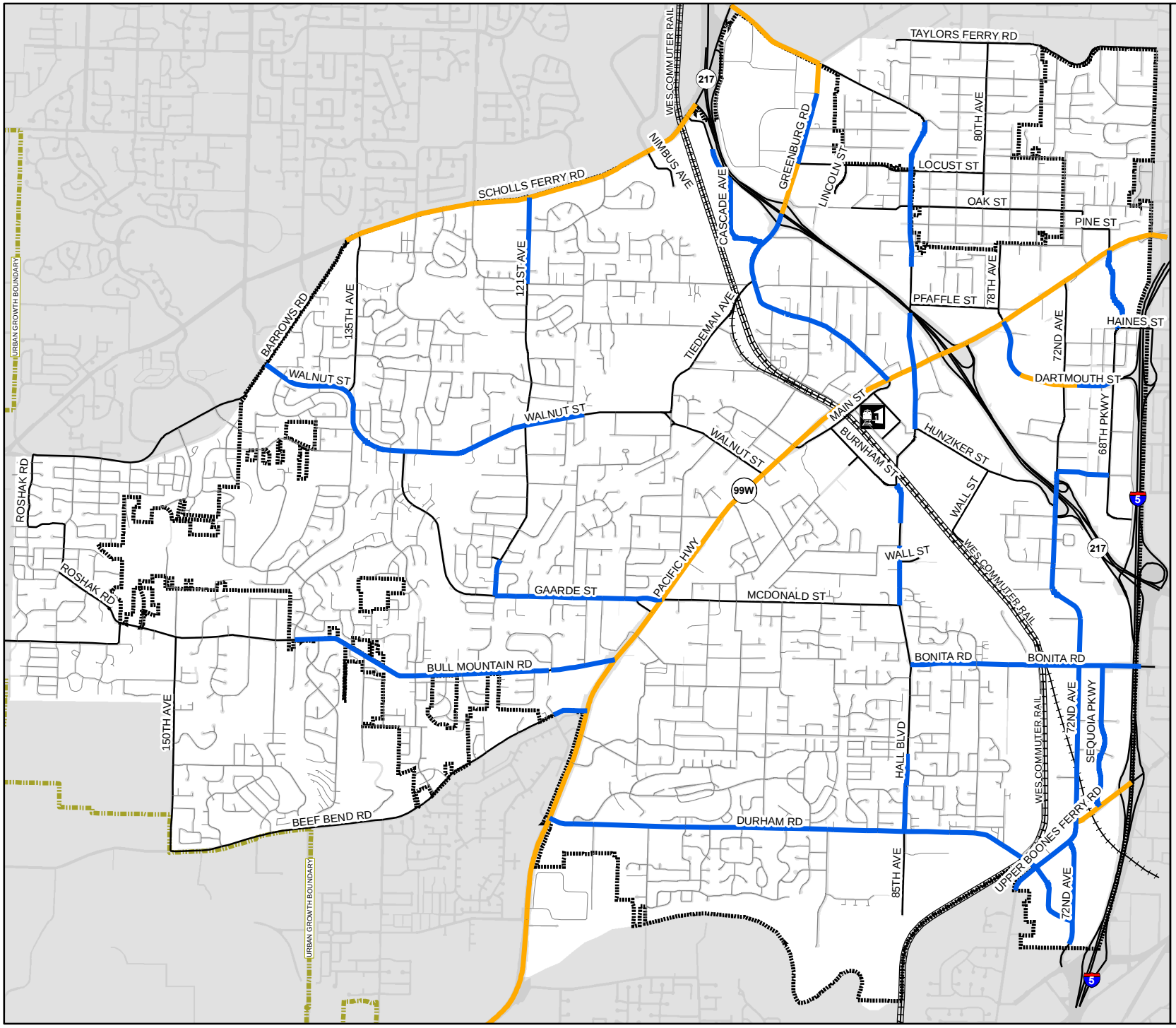


Figure 3-5

Roadways With More Than Two Lanes, 2009

Tigard Urban Planning Area

LEGEND

- Roadways with 3 Lanes
- Roadways with 5 Lanes

Other Map Elements

- Tigard City Boundary
- WES Rail Line
- WES Station
- Rail Lines

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The access spacing standards shown in Tables 3-8 and 3-9 typically apply to new development or redevelopment; existing accesses are usually allowed to remain as long as the land use does not change. As a result, achieving planned access management is a long-term process in which the desired access spacing to a street slowly evolves over time as redevelopment occurs.

Roadway Spacing for Connectivity

While the access spacing standards described above typically establish minimum distances between intersections in order maintain safe and efficient traffic operations, these must be balanced with the need to provide a well-connected street network for efficient mobility. The RTP regional street and throughway network concept calls for regional four-lane arterials to be spaced every one mile, while acknowledging the realities of natural boundaries and existing infrastructure. Figure 3-6 highlights the regional four-lane arterials in Tigard and general areas with poor connectivity.

As the figure shows, there is good arterial spacing in the northeast part of Tigard, where Highway 217, OR 99W, and Scholls Ferry Road provide regional connections. However, the areas away from these arterials on the western side of the City have poor connectivity. The corridor containing Highway 217, the WES line tracks, and Fanno Creek poses a significant barrier to east-west travel options.

Similar to the connectivity guidelines for arterials, the RTP identifies collector and local streets as general access facilities for neighborhood circulation and support of the regional transportation network. The RTP recommends a maximum spacing of one-tenth of a mile for local streets in order to encourage local traffic to use these streets instead of higher order facilities. *Locations where collector roadways and local streets in Tigard do not meet this connectivity standard are identified in the figures provided in the technical appendix.*

Posted Speed Limits

Speed zones on arterials and collectors within the City of Tigard are summarized in Figure 3-7. Speed zones are set by ODOT's State Traffic Engineer. Speed zones for city streets, county roads and state highways passing through cities are set based on operational considerations, which includes factors such as roadway width, surface, lanes, shoulders, signals, intersections, roadside development, parking, accidents and 85th percentile speed. Oregon's State Speed Control Board (SSCB) hears appeals on ODOT speed zone decisions.

Traffic Control

Tigard has 79 signalized intersections, with the majority on arterial streets. The locations of the existing traffic signals (as of year 2009) are shown in Figure 3-8. Of the 79 signals in the City of Tigard, 47 are owned and maintained by ODOT. The rest are owned by either the City of Tigard or Washington County. In general, the jurisdiction which owns the signals also maintains them. However, on sections of 72nd Avenue, Main Street, Walnut Street and Durham Road the City of Tigard owns the signals while Washington County maintains them. *A complete list of the ownership and maintenance of the signals in Tigard is provided in the technical appendix.*

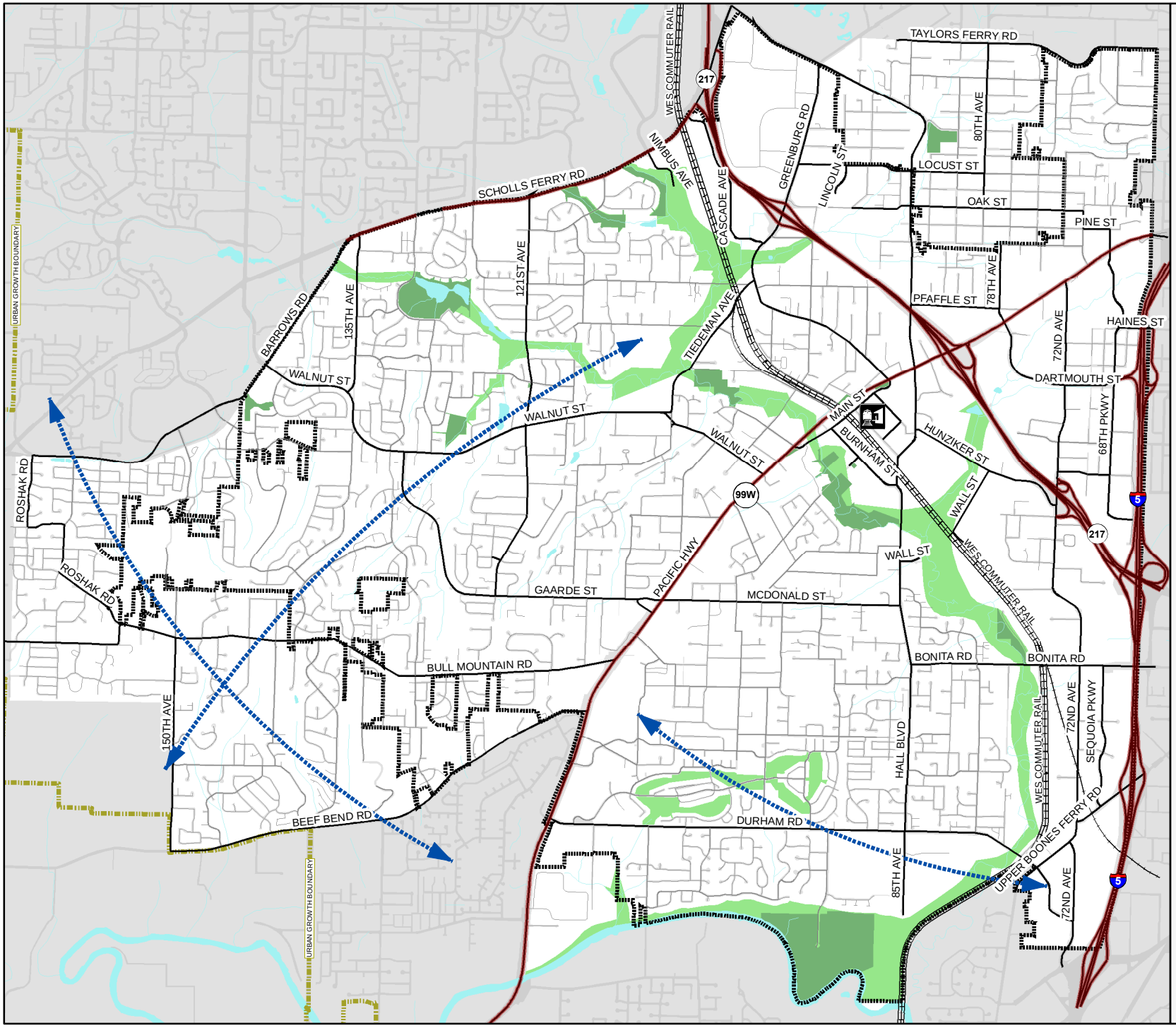

Figure 3-6

Four-Lane Arterial Connectivity

Tigard Urban Planning Area

LEGEND

- Regional Arterials
- Poor Connectivity

Other Map Elements

- Tigard City Boundary
- WES Rail Line
- WES Station
- Rail Lines

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TIGARD

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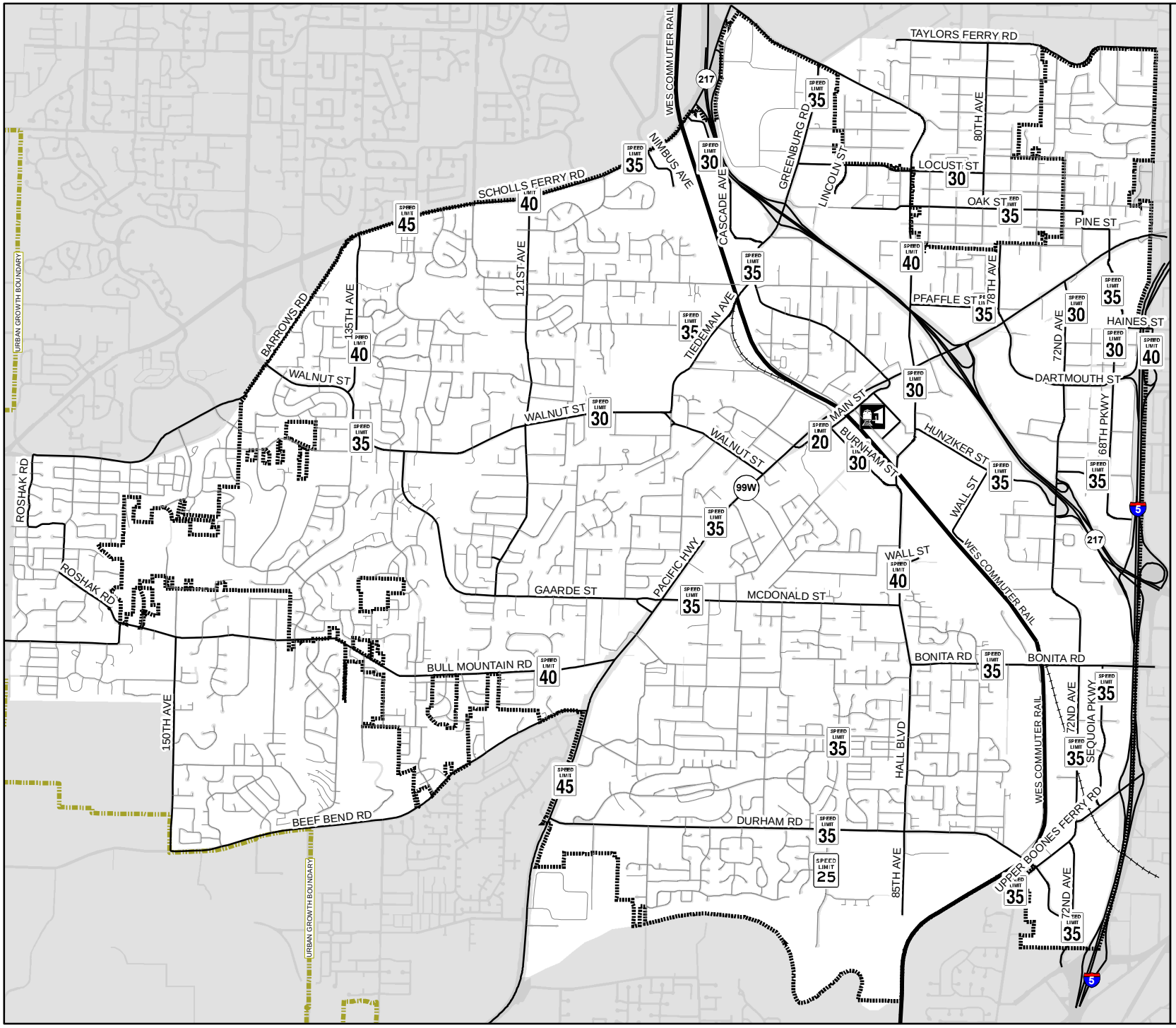
Figure 3-7

Speed Zones 2009

Tigard Urban Planning Area



LEGEND

- Existing Speed Zone
- Tigard City Boundary
- WES Rail Line
- WES Station
- Rail Lines

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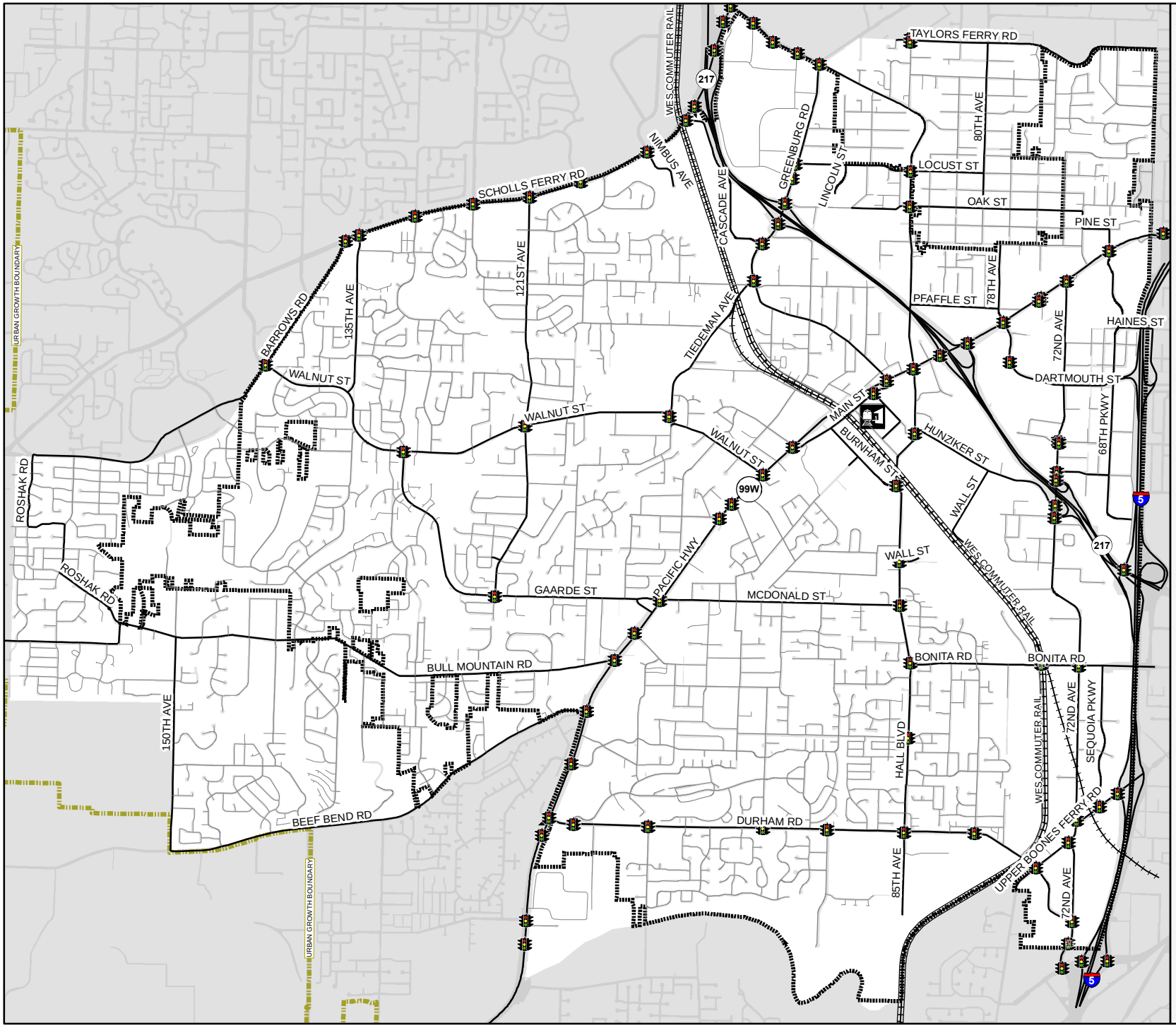

Figure 3-8

Signalized Intersections 2009

Tigard Urban Planning Area

LEGEND

Traffic Signal

Other Map Elements

Tigard City Boundary

WES Rail Line

WES Station

Rail Lines

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There are five key coordinated systems within the City. These are:

- Highway 99W throughout the City;
- 72nd Avenue between Highway 217 southbound ramps and Hampton Street;
- Scholls Ferry Road throughout the City;
- Greenburg Road between Highway 217 southbound ramps and Locust Street; and,
- Upper Boones Ferry Road between Sequoia Parkway and Durham Road.

Coordinated signal systems are an example of Transportation System Management (TSM) methods for enhancing the capacity of an existing system through improvements in operations. Other TSM examples are provided later in this chapter.

PEDESTRIAN SYSTEM

The pedestrian system within Tigard includes sidewalks, multi-use paths, and pedestrian only paths. The Tigard street cross section standards include sidewalks on both sides of all public streets, excluding alleys. However, many streets built prior to the standards do not provide sidewalks. The existing sidewalks, multi-use paths, and pedestrian-only paths are shown in Figure 3-9.

As the figure shows, most of the arterials and collectors have sidewalks on one or both sides of the street, but there are several discontinuous sections of sidewalks on McDonald Street, Bull Mountain Road, and others. Tigard's off-street trails are generally concentrated along several greenways located within the City, the most notable of these is the Fanno Creek Greenway which traverses the full length of the City. In addition to Fanno Creek, significant trails are located along the Tualatin River and the Pathfinder-Genesis Trail.

Pedestrian System Designations

The City of Tigard does not currently have an adopted pedestrian plan. The 2035 Metro RTP Update includes pedestrian designations that encourage the development of a well-connected high-quality pedestrian environment. The guidance in the RTP recognizes the importance of transit facilities for encouraging walking trips on the transit/mixed-use corridors, while multi-use facilities provide pedestrians with dedicated space for travel. Short distance trips are most attractive to pedestrians, and this environment is often found in the Regional and Town Centers in the area. Table 3-10 summarizes the Metro pedestrian designations in Tigard.

Table 3-10 Pedestrian Designations from the 2035 RTP Update

Transit / Mixed-Use Corridors	Multi-use Facility with Pedestrian Function	Pedestrian Districts
Highway 99W	Fanno Creek	Washington Square Regional Center
Hall Boulevard	Tualatin River	Tigard Downtown Town Center
Scholls Ferry Road	Powerlines	King City Town Center
Hunziker Street	Hunziker to Lake Oswego	

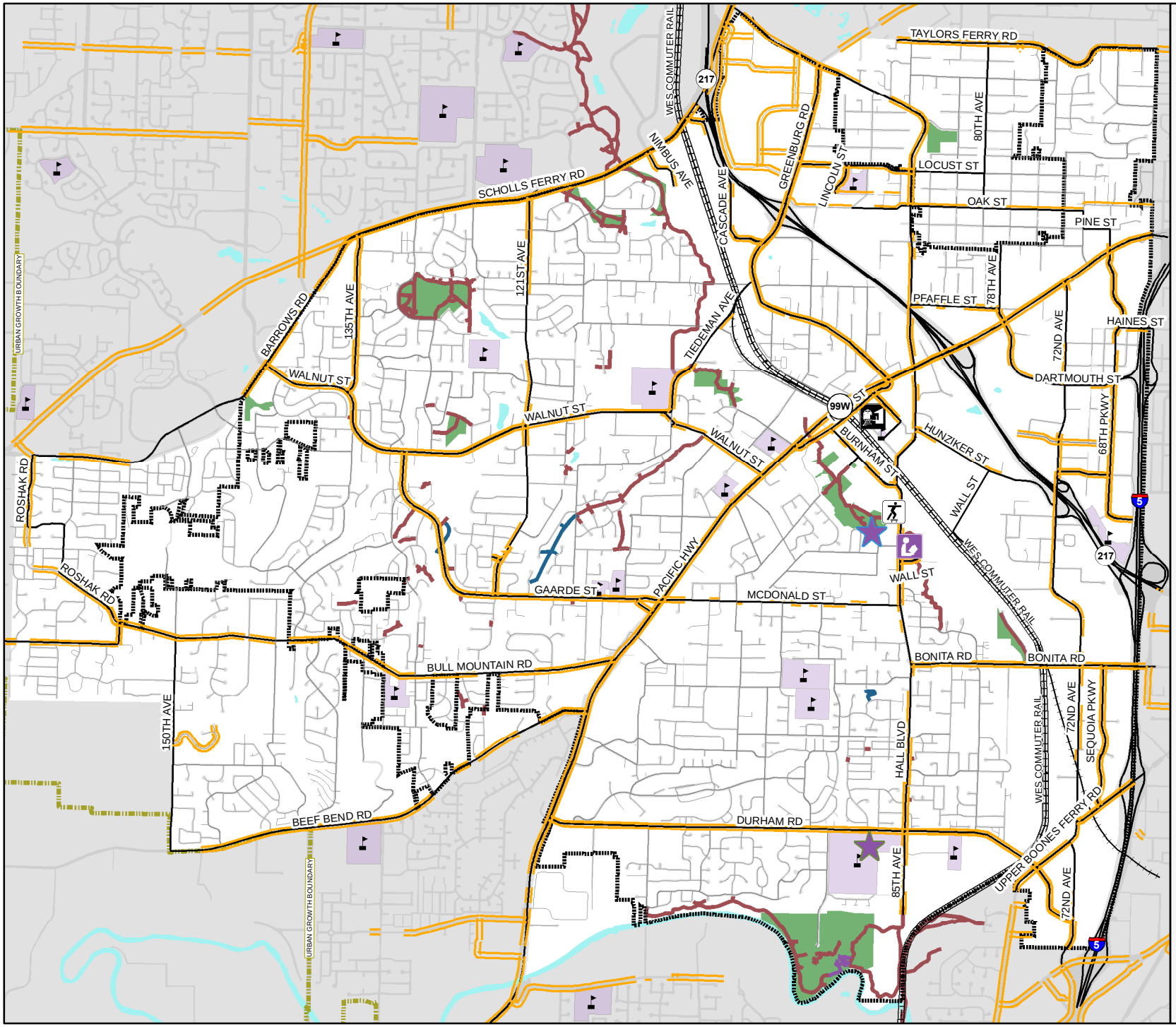

Figure 3-9

Pedestrian Facilties 2009

Tigard Urban Planning Area

LEGEND

Pedestrian Facilities

- Sidewalks
- Multi-Use Paved
- Multi-Use Unpaved
- Barkdust Path

Pedestrian Generators

- Schools
- City Library
- Tigard Swim Center
- Tigard Senior Center
- Tigard Skate Park
- Parks

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- WES Station

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BICYCLE SYSTEM

Bicycle use in Tigard is generally used for recreational, school and commuting purposes. Bicycles are permitted on all roadways in Tigard and streets with lower traffic volumes. Existing bike lanes and off-street multi-use paths are shown in Figure 3-10. No information on bicycle parking was available.

While the existing bicycle facilities serving Tigard create a fairly extensive network, in many instances there are short gaps or other conditions that reduce the quality and/or safety of bicycling. For example, there are short gaps in the bicycle lanes on Highway 99W near 72nd Avenue and on sections of Walnut Street and Bonita Road. Further, the existence of designated bicycle lanes does not always indicate a high quality bicycle route. High motor vehicle volumes and travel speeds can contribute to an unsafe environment for riding. Other issues may arise from inadequate or inconsistent lane widths, poor pavement conditions, or debris in the bike lanes.

Bicycle System Designations

Metro has made several bicycle designations as part of the Regional Bicycle System in the 2035 RTP. The designations encourage the development of a regional bikeway system to provide both mobility and accessibility for cyclists. Arterial facilities often provide the most direct route between destinations, and the regional corridors for bikes identify the arterials suited for bicycle travel. Lower volume connector streets provide greater access for bicyclists, while off-street facilities allow for cyclists to ride separate from roadway vehicles. Table 3-11 identifies the designations for streets in Tigard.

Table 3-11 Bicycle Designations from the 2035 RTP

Regional Access	Regional Corridor (on-street)	Community Connector	Regional Corridor Off-Street
Hall Boulevard to Greenberg Road to Main Street to Hunziker Street	Walnut Street Scholls Ferry Road Hall Boulevard Highway 99W Hall-Durham-Boones	72nd Avenue Bonita Road-McDonald Street Carman Street–Durham Road	Fanno Creek Tualatin River Powerlines Hunziker Street to Lake Oswego through I-5/Highway 217

The City of Tigard does not currently have a bicycle plan in place for designating bike routes in the City. Washington County and several adjacent cities have adopted bicycle maps that identify the opportunities for interconnection between jurisdictions. A bicycle map identifying roadways with bike lanes, off-street pathways, and low-volume streets could be developed to improve bicycling in Tigard. Designated bicycle routes that connect to the City of Tigard include the following:

- The Washington County Transportation Plan shows on-street bicycle routes on Highway 99W, Scholls Ferry Road, Hall Boulevard, Greenberg Road, Durham Road, Walnut/Gaarde/McDonald, Oak Street and Locust Street.

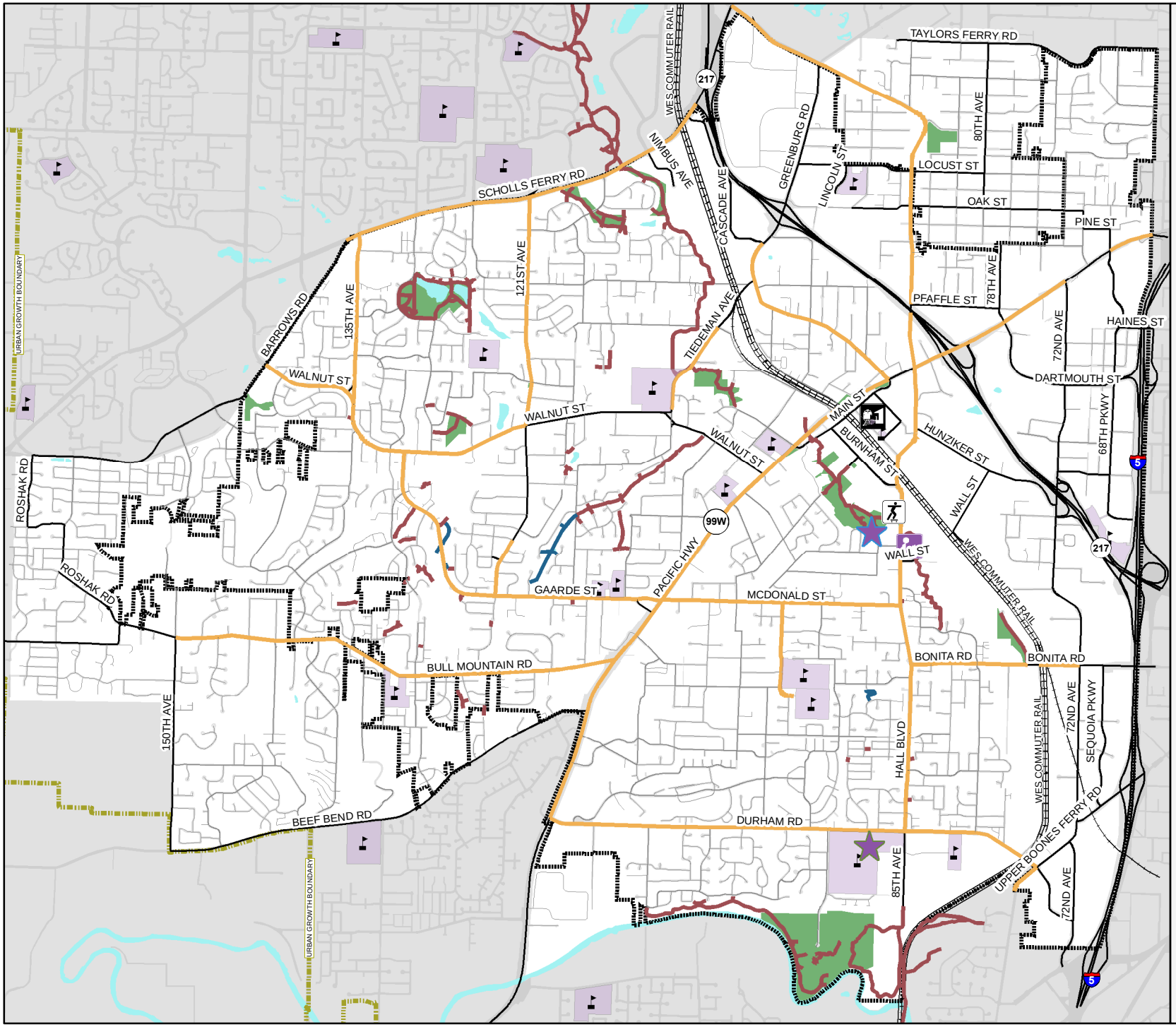

Figure 3-10

Bicycle Facilities 2009

Tigard Urban Planning Area

LEGEND

Bicycle Facilities

- Bicycle Lanes
- Multi-Use Unpaved
- Barkdust Path

Bicycle Generators

- Schools
- City Library
- Tigard Swim Center
- Tigard Senior Center
- Tigard Skate Park
- Parks

Other Map Elements

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- WES Rail Line
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- The City of Beaverton designates Murray Boulevard (which links to Walnut Street), Scholls Ferry Road, Barrows Road, 125th Avenue (which links to North Dakota Street at Scholls Ferry Road), Nimbus Avenue and Cascade Avenue as bike lanes/bikeways. Oleson Road, which connects to Greenberg Road, is also designated as a bike route in the Beaverton planning area.
- The City of Portland designates Barber Boulevard as a City Bikeway, which connects to Highway 99W in Tigard.
- The City of Lake Oswego designates Bonita Road and Carman Drive as bike lanes or pathways. These routes would link in Tigard to Bonita/McDonald and Carman/Durham. The City of Lake Oswego also designates Kruse Way as a bicycle route, however there is not a good connection to bicycle routes in Tigard.

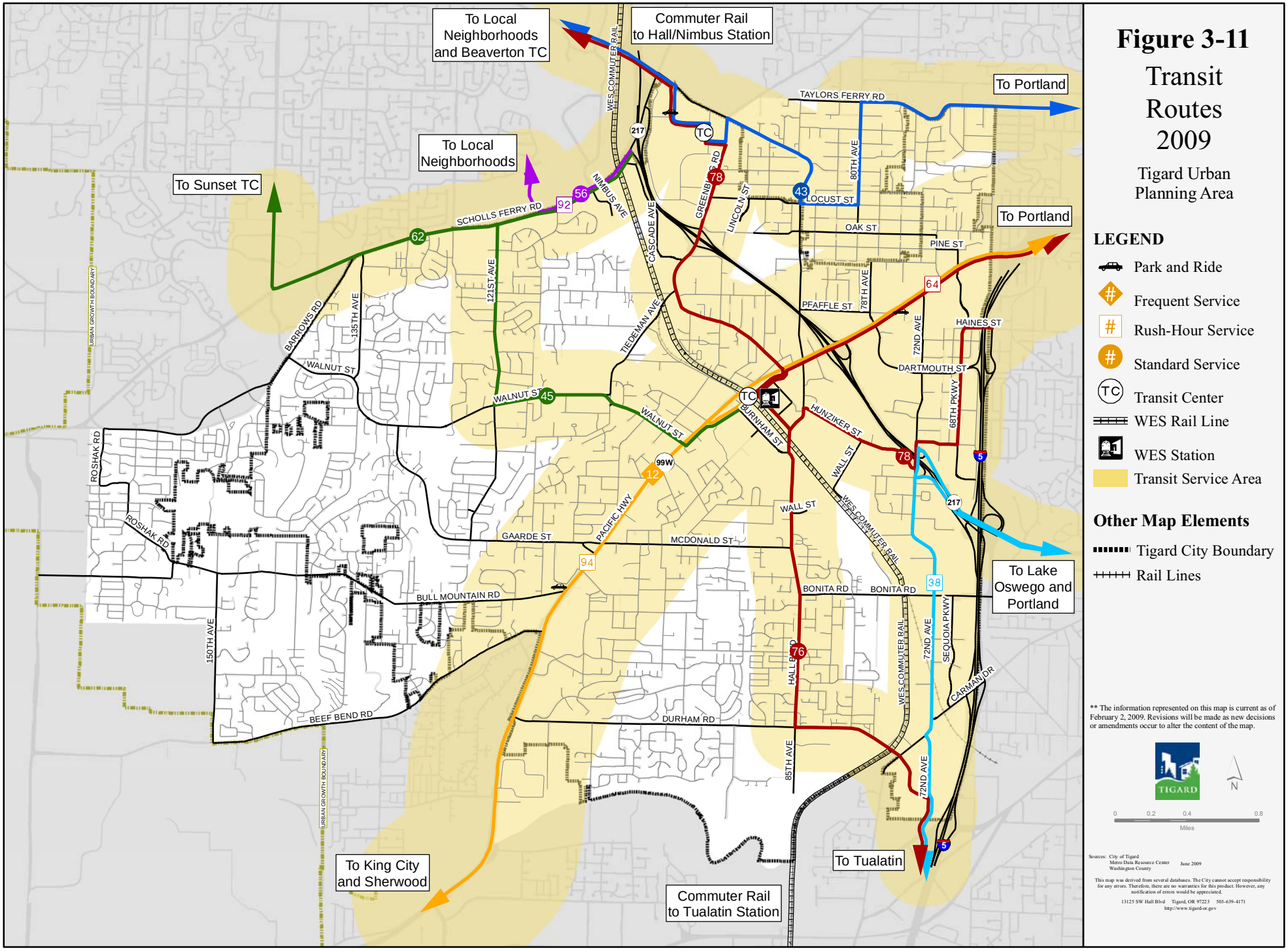
TRANSIT SYSTEM

Fixed route service is provided in the City of Tigard by TriMet. Figure 3-11 shows the routes passing through Tigard. There are two transit centers and four rush-hour routes, two of which are designated "express" routes. Rush-hour routes have a limited number of stops, as compared to other bus service. For example, coming from Portland during the evening rush hour, Route 94 Express stops only at the Tigard Cinemas and Greenburg Road before it begins making regular stops at Walnut/Highway 99W. Also coming from Portland during the evening rush hour, route 92 Express does not stop before reaching the Progress Park & Ride station, where it begins making regular stops. As shown in Table 3-12 TriMet bus routes generally operate on three different schedules.

Table 3-12 TriMet Service and Average Headways

Service Type	Tigard Route	Weekday		Weekend	
		Peak Periods	Off Peak Periods	Peak Periods	Off Peak Periods
Frequent Bus Service	12	15 minutes (7 a.m. to 10 p.m.)	30 minutes	15 minutes (9 a.m. to 9 p.m.)	60 minutes
Standard bus Service	43, 45, 56, 62, 76, 78	30 minutes (6 a.m. to 6 p.m.)	60 minutes	30 minutes (9 a.m. to 6 p.m.)	60 minutes
Rush-Hour Bus Service	38, 64, 92, 94	30 minutes (6 a.m. to 8 a.m.) Inbound to Portland	No Service	No Service	
		30 minutes (4 p.m. to 6 p.m.) Outbound to Tigard	No Service	No Service	
Commuter Rail Service	WES	30 minutes (5 a.m. to 10 a.m. & 3 p.m. to 8 p.m.)	No Service	No Service	

Notes: Peak headways are the most frequent headway during the peak hours and off-peak headways are the least frequent headway during hours other than peak times. Exact headways will vary by route and time.



Notes: Transit service area is 1/4 mile from standard and rush hour service routes and 1/2 mile from frequent service routes

* Waiting for major bus stop data from TriMet

In addition to the existing bus routes serving Tigard, TriMet introduced WES (Westside Express Service) Commuter Rail service in February 2009 which connects communities on the southwest side of the metro area to the Beaverton Transit Center. The rail line makes connections in Wilsonville, Tualatin, Tigard, Hall/Nimbus, and Beaverton. The Tigard stop is located at the Tigard Transit Center, just southeast of 99W at Commercial Street. Service is provided weekdays at half-hour frequency during the morning and evening commute periods.

Transit Service Evaluation

The transit system serving Tigard was evaluated according to methodologies contained in the *Transit Capacity and Quality of Service Manual* (TCQSM, Reference 4). The TCQSM is a nationally-recognized manual for transit systems and establishes criteria for determining level-of-service (LOS) based on service frequency and the number of service hours.

The TCQSM can be used to assess transit quality of service from the passenger's point-of-view, based on several factors relating to the availability of transit service and the comfort and convenience of transit service. These factors, such as service frequency, are graded on an "A" to "F" LOS scale, similar to the scale for vehicles. Many of the quality of service measures are best applied on an origin-destination basis, as more than one transit route may serve a particular pair of origins and destinations, and some routes may only operate during peak hours only, but provide good service at those times. Tables 3-13 through 3-16 provide levels of service related to transit availability in Tigard.

Service Frequency

Tables 3-13 and 3-14 provide *service frequency LOS* for to or from the Tigard Transit Center and Washington Square—the portion of the City with the best transit service—to major destinations in the Portland area. The level-of-service measures correspond to average headways between bus arrivals. LOS "A" indicates average headways of less than ten minutes and LOS "F" indicates that headways are at intervals greater than one hour.

Table 3-13 Service Frequency LOS from Tigard Transit Center

Destination	Routes	Weekday Ridership in Tigard	Weekday Peak	Weekday Midday Off-Peak	Weekday Evening	Weekend Peak	Weekend Off-Peak
Downtown Portland*	12, 45, 94	4,601	A	C	D	B	D
Washington Square	45, 76, 78	5,916	C	D	E	E	E
Beaverton TC*	76, 78	5,598	D	D	E	D	E
Lake Oswego TC	78	2,610	D	D	E	E	E
Sherwood*	12, 94	4,283	A	C	D	B	D
Tualatin	76	2,988	D	D	E	D	E
Marquam Hill	64	62	C	F**	F**	F**	F**
Gresham	12	3,762	B	C	D	B	D

* Multiple bus routes ** No service during these time periods.

Table 3-14 Service Frequency LOS from Washington Square

Destination	Routes	Weekday Ridership in Tigard	Weekday Peak	Weekday Midday Off-Peak	Weekday Evening	Weekend Peak	Weekend Off-Peak
Downtown Portland*	43, 45, 56	1,130	B	D	E	E	E
Tigard TC*	43, 45, 78	3,191	C	D	E	E	E
Beaverton TC*	76, 78	5,598	D	D	E	E	E
Lake Oswego TC	78	2,610	D	D	E	E	E
Sunset TC	62	1,394	C	D	E	D	E
Tualatin	76	2,988	D	D	E	D	E

* Multiple bus routes

As the tables show, in terms of service frequency, service is typically better during the weekday peak periods as compared to other periods. LOS ranges from "A" to "D" during weekday peak periods and from "D" to "E" during most of the other periods.

For destinations served by frequent service buses (Route 12), including downtown Portland, Sherwood and Gresham, LOS "A" and "B" are available during weekday and weekend peak periods, and LOS is acceptable throughout the rest of the time periods. Services are considerably better than destinations covered only by standard and rush-hour service buses.

Hours of Service

Tables 3-15 and 3-16 provide hours of service LOS from Tigard Transit Center and Washington Square to the same destinations, measuring the number of hours during the day when service is available to a particular destination. The hours-of-service evaluation is relevant only for those hours when service is provided at least hourly. In the analysis, LOS "A" indicates that service is provided during 19 or more hours per day; LOS "F" indicates that service is provided during three or fewer hours of the day.

Table 3-15 Hours-of-Service LOS from Tigard Transit Center

Destination	Routes	Weekday Ridership in Tigard	Weekday	Saturday	Sunday
Downtown Portland*	12, 45, 94	4,601	A	A	A
Washington Square TC*	45, 76, 78	5,916	B	B	C
Beaverton TC*	76, 78	5,598	B	B	C
Lake Oswego TC	78	2,610	B	B	B
Sherwood*	12, 94	4,283	B	B	B
Tualatin	76	2,988	B	C	E
Marquam Hill	64	62	F	F	F
Gresham	12	3,762	B	C	C

* Multiple bus routes

As Table 3-15 shows, based on hours of service, most of the origin/destination pairs operate at LOS "A", "B", or "C" during most of the study periods. The main exception is Marquam Hill which is only served by rush-hour service. The table shows that the Tigard Transit Center operates with LOS "B" or "C" for all of the routes shown, with the exception of Sunday service to Tualatin.

Table 3-16 Hours-of-Service LOS from Tigard Transit Center

Destination	Routes	Weekday Ridership in Tigard	Weekday	Saturday	Sunday
Downtown Portland *	43, 45, 56	1,130	B	B	C
Tigard TC*	45, 76, 78	3,191	B	B	C
Beaverton TC*	76, 78	5,598	B	B	C
Lake Oswego TC	78	2,610	B	B	C
Sunset TC	62	1,394	B	C	C
Tualatin	76	2,988	C	C	E

* Multiple bus routes

Transit Service Coverage

Figure 3-11 shows the "service area" for each transit route, which include areas within one-quarter mile from regular or peak hour service, and one-half mile from frequent service routes. The figure shows that while most of the routes serving Tigard operate with relatively high levels of service, there remain significant portions of the City that are not served, including large residential neighborhoods. Major corridors that are not served by regular transit routes include the Gaarde-McDonald-Bonita Road corridor; Durham Road service is provided only east of Hall Boulevard; and Walnut Street is served only between Highway 99W and Scholls Ferry Road. Also, there are no routes serving Bull Mountain Road or Beef Bend Road.

Transit Ridership and Productivity

TriMet maintains productivity measures for bus lines in order to monitor the effectiveness of transit service and evaluate potential investments. Key indicators include *boarding rides per vehicle hour* (br/hr) (i.e. one boarding ride per vehicle hour means that there was one person on the bus for one hour of service). For the system in the year 2008, the average boarding rides per vehicle hour is 32 br/hr, with the highest performance measure at 54 br/hr (Route 73 Killingsworth-82nd Avenue). TriMet considers the minimum threshold for new bus service to be 15 br/hr, and any existing service that drops below 15 br/hr is considered a low performing line for the agency.

A comparison of 1999 and 2008 transit ridership in Tigard is summarized in 0, along with the 2008 boarding rides per vehicle hour for each route. The table indicates there were approximately 12,650 daily transit riders in Tigard in 2008, reflecting a 34-percent increase in ridership since 1999. As the table shows, two routes in Tigard operate below the 15 br/hr threshold: Routes 43 and 38 operate at 11 br/hr and 14 br/hr, respectively. As such, these would be considered low performing routes.

Table 3-17 Weekday Transit Ridership Summary

Route	2008 Br/hr	Dir	1999			2008		
			Ons*	Offs*	Total	Ons*	Offs*	Total
12 Barbur	33	NB	386	1,017	1,403	1,287	627	1,848
		SB	894	389	1,283	594	1,254	1,914
38 Boones Ferry	14	SB	9	37	46	5	25	30
		NB	29	16	45	18	11	29
43 Taylors Ferry	11	WB	20	158	178	34	103	137
		EB	148	24	172	95	31	126
44 King City	38	NB	110	84	194	Route currently operates outside Tigard		
		SB	19	45	64			
45 Garden Home	16	WB	65	252	317	28	135	163
		EB	235	71	306	123	32	155
56 Scholls Ferry	28	SB	3	300	303	7	272	279
		NB	303	2	305	261	9	270
62 Murray Blvd	27	EB	94	430	524	132	548	680
		WB	418	107	525	549	165	714
64 Marquam-Tig	25	NB	4	36	40	1	19	20
		SB	41	1	42	41	1	42
76 Tig-Tual	38	SB	377	530	907	718	1,124	1,842
		NB	552	357	909	635	511	1,146
78 Beav-LO	32	SB	252	498	750	563	1,142	1,705
		NB	419	225	644	550	355	905
92 S. Beav Exp	19	WB	13	103	116	4	57	61
		EB	138	10	148	60	3	63
94 Pac Hwy Exp	23	WB	Not in operation			28	245	273
		EB				228	20	248
95 Tig I-5 Exp	n/a	WB	12	117	129	Route no longer in operation		
		EB	104	2	106			
TOTAL			**4,645**	**4,811**	**9,456**	**5,961**	**6,689**	**12,650**

Notes: br/hr: boarding rides per vehicle hour

*Ons and Offs correspond to daily boardings and alightings, respectively
N/A: Not available
Source: TriMet Passenger Census

TRANSPORTATION MANAGEMENT MEASURES

Transportation Demand Management (TDM) and Transportation Systems Management (TSM) are both approaches that seek to improve transportation conditions with a focus on system management (e.g. improved transit signal coordination, intersection improvements for additional efficiency), rather than large capacity expansions. There may be some overlaps between TDM and TSM; however, as the names imply, TDM focuses on managing/reducing auto demand and increasing the demand for biking, walking, and transit use, where the emphasis of TSM is to enhance capacity through operational improvements.

Transportation Demand Management

Transportation Demand Management (TDM) refers to any methods intended to mitigate congestion by shifting travel demand to alternative travel modes, to less congested times of day, or to locations with more available capacity. Some common examples of TDM strategies include programs such as carpool matching assistance or flexible work shifts; direct financial incentives such as transit subsidies; or facility or service improvements, such as bicycle lockers or increased bus service. The TPR requires jurisdictions within metropolitan planning organizations (MPOs) to take steps to reduce reliance on cars. As was noted in Chapter 2, the RTP establishes a Non-Single Occupant Vehicle (SOV) goal of 45 percent to 55 percent by year 2040 for design types identified in the Metro 2040 Growth Concept design type designations (central city, regional centers, town centers, station communities, main streets, and corridors).

The City does not have a dedicated TDM program, however, the Westside Transportation Alliance (WTA) is a transportation management association (TMA) serving Washington County. The WTA assists employers in developing, implementing, and monitoring programs to reduce commute trips by SOV. The City of Tigard is a member of the WTA, as are most neighboring jurisdictions and many private employers. While the emphasis at WTA is to help employers create TDM programs, the WTA web site provides an "information hub" that individuals can use to find out about a myriad of travel options, including transit service, park-and-ride lots, bicycling, carpool matching, and other services.

Tracking Non-SOV Progress

Based on information derived from Metro's regional travel demand model, the Non-SOV share for Tigard was approximately 50 percent in 2005. It is not possible to make a direct comparison between the 2005 Non-SOV share and the targets in the RTP because the method for calculating SOV has changed since the original targets were established[1]. Updated targets are being developed as part of the 2035 RTP Update. However, the existing estimate of Non-SOV trips is based on the updated definition and can be used as a basis to track progress once the targets are updated.

[1] The definition of carpools in the original 2040 Growth Concept identified vehicles driven by parents carrying one or more of their children to school or daycare as SOV trips. This definition is being revised in the 2035 RTP Update so that such vehicles will now be considered carpools, and therefore non-SOV trips.

Transportation System Management

TSM measures seek to mitigate congestion by enhancing operations of existing facilities. TSM measures are diverse and can range from access management and added turn lanes at intersections, to parking management and variable message signs. Other types of TSM measures include incident management, work zone management strategy, and traffic monitoring and information systems.

As was identified earlier, many of the traffic signals in Tigard are part of coordinated systems that are timed to support efficient flow of traffic along major corridors. There are also plans to upgrade signal controllers with new technology that is responsive to current roadway conditions. Such measures optimize the efficiency of traffic flow, thereby improving operations within the existing roadway. Existing TSM measures being used in Tigard are limited. However, the RTP Update (currently in progress) focuses on TSM as a significant strategy for managing major corridors, including Highway 99W, Highway 217, and I-5.

2008 TRAFFIC CONDITIONS

This section describes the demands on the transportation system and the operations for base year conditions. The traffic conditions analysis focuses on major corridors with an overview of traffic volumes, including truck, pedestrian, and bicycle volumes. This is followed by an evaluation of operations along major Tigard corridors and an overview of crash history at Tigard intersections.

Traffic Volumes

A detailed inventory of traffic volumes was conducted in the summer and fall of 2008. The counts included daily traffic volumes on key roadways as well as intersection counts during the weekday p.m. peak period. At certain intersections, weekday a.m. and Saturday mid-day peak period counts were also collected. Pedestrian, bicycle, and truck volumes were collected at specific intersections. The traffic volume counts were supplemented with traffic volume data from ODOT's Traffic Data section. The following provides a summary of this data.

The link volumes and average daily traffic (ADT) for key roadways are shown in Figure 3-12. The figure shows that among non-freeway roadways, Highway 99W carries the highest traffic volume with nearly 51,000 vehicles per day near the I-5 interchange. Scholls Ferry Road and Hall Boulevard also carry high traffic volumes, particularly near the Highway 217 interchange (all 2007 counts were obtained from ODOT's data section).

Truck Routes and Volumes

Principal truck routes in Tigard (as identified by Washington County) include I-5, Highway 217, Highway 99W, and some arterial streets. This system provides connections with truck routes serving areas within and outside of Tigard making efficient truck movement and the delivery of raw materials, goods, services and finished products possible. The designated truck routes are shown in Figure 3-13. These routes are generally found in and serve areas where there are concentrations of commercial and/or industrial land uses. Figure 3-14 shows peak period truck volumes at key study intersections.

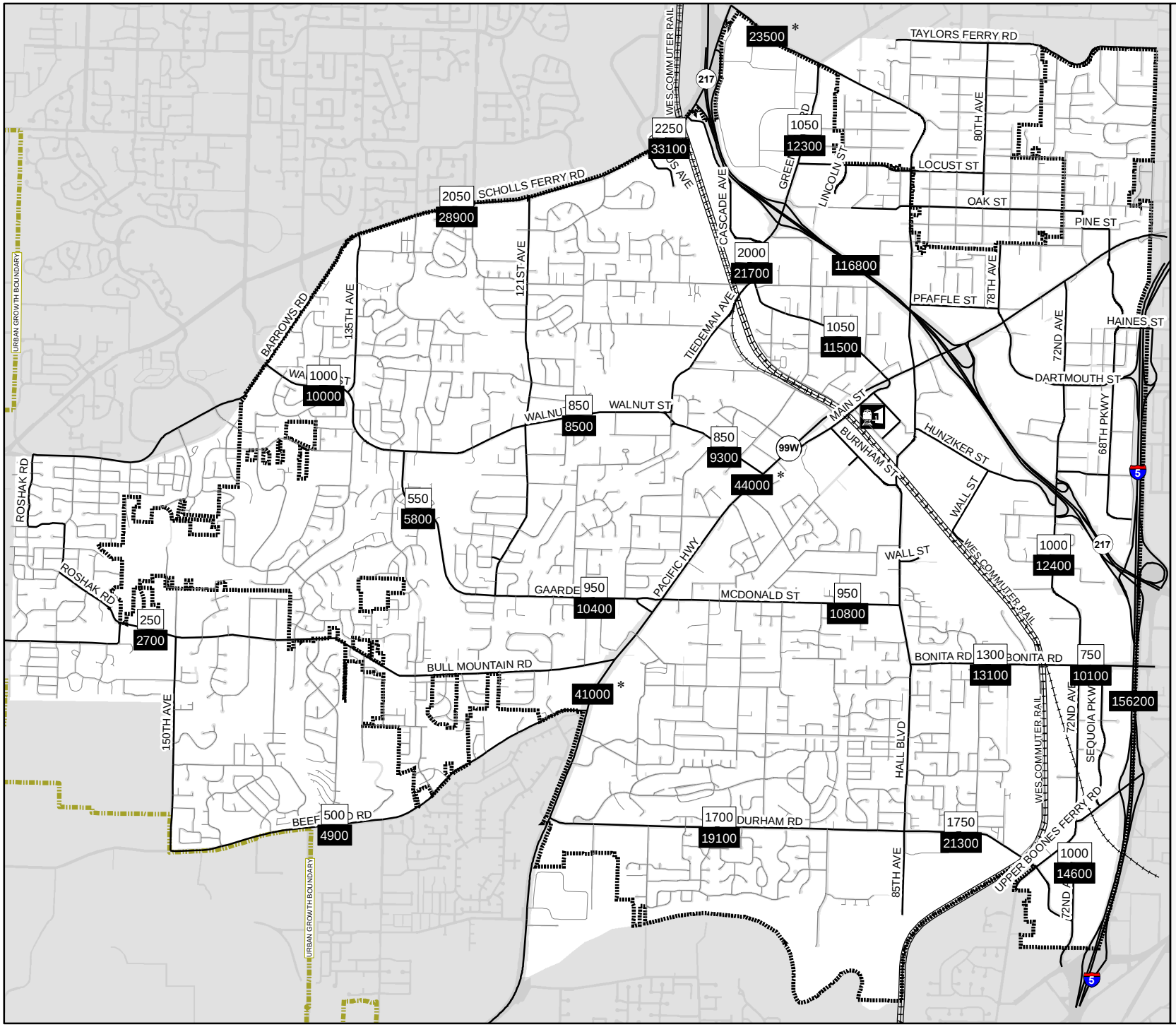


Figure 3-12

2008 Link Traffic Volumes

Tigard Urban Planning Area

LEGEND

- # PM Peak Hour Volume
- # Average Daily Traffic

Other Map Elements

- Rail Lines
- Tigard City Boundary
- WES Station
- WES Rail Line

** The information represented on this map is current as of February 2, 2009. Revisions will be made as new decisions or amendments occur to alter the content of the map.

TIGARD

N

0 0.15 0.3 0.6 Miles

Sources: City of Tigard
Metro Data Resource Center
Washington County
June 2009

This map was derived from several databases. The City cannot accept responsibility for any errors. Therefore, there are no warranties for this product. However, any notification of errors would be appreciated.

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* Source: ODOT Traffic Volume Tables, 2007

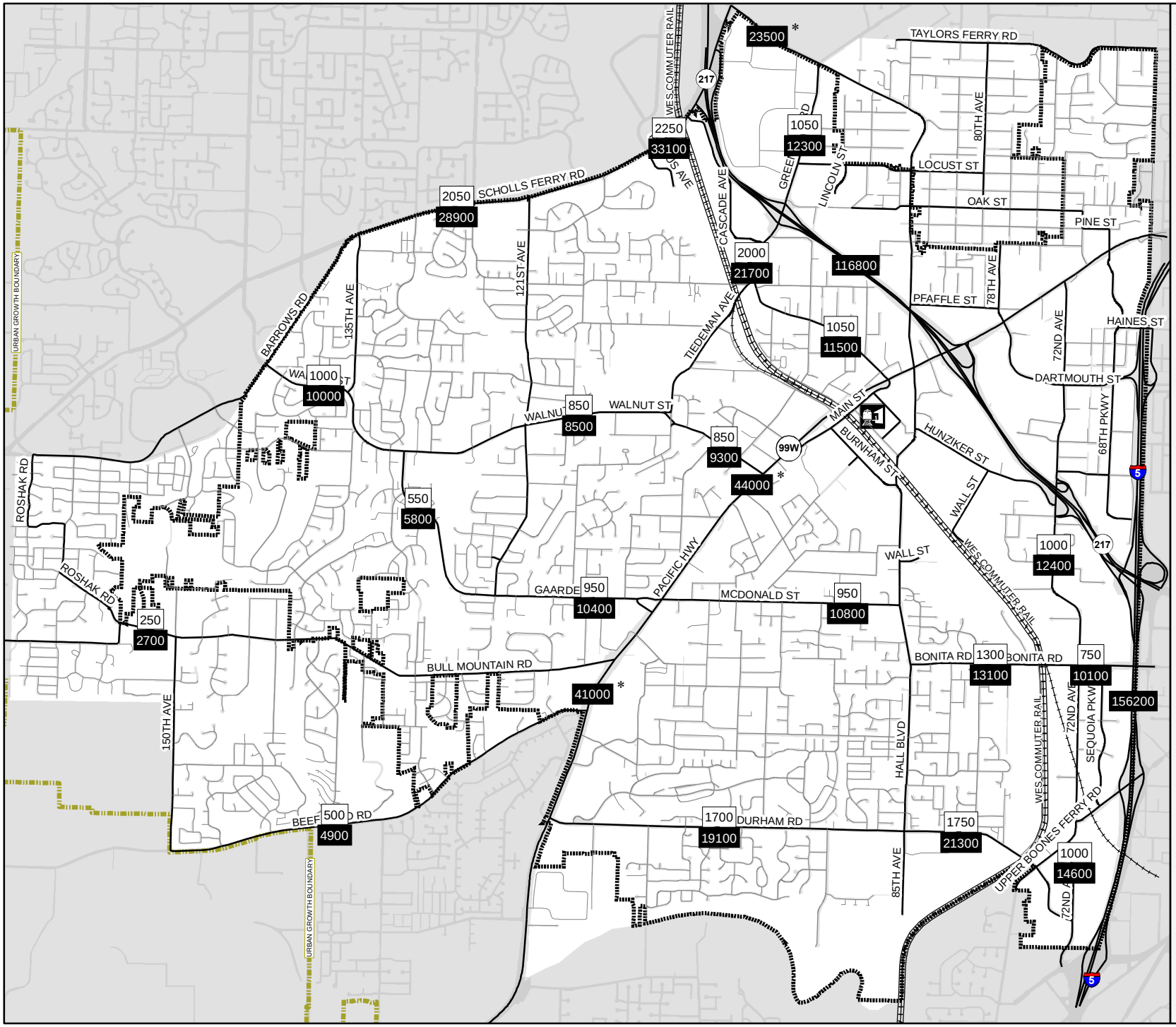

Figure 3-12

2008 Link Traffic Volumes

Tigard Urban Planning Area

LEGEND

- # PM Peak Hour Volume
- # Average Daily Traffic

Other Map Elements

- Rail Lines
- Tigard City Boundary
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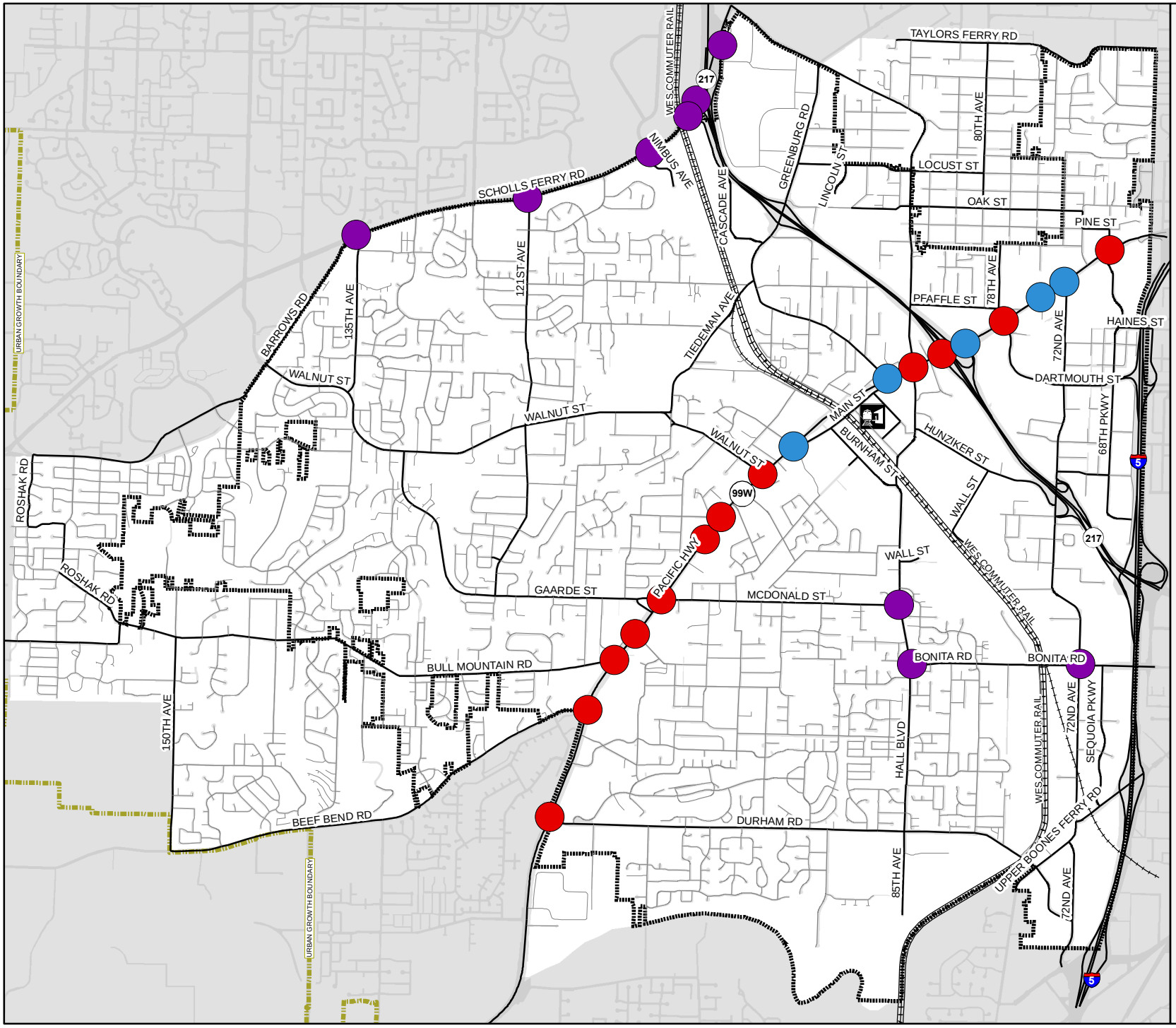

Figure 3-14

Peak Period Truck Volumes 2009

Tigard Urban Planning Area

LEGEND

Through Truck Volumes

- 50 to 99 Trucks
- 100 to 149 Trucks
- 150+ Trucks

Other Map Elements

- Tigard City Boundary
- WES Rail Line
- WES Station
- Rail Lines

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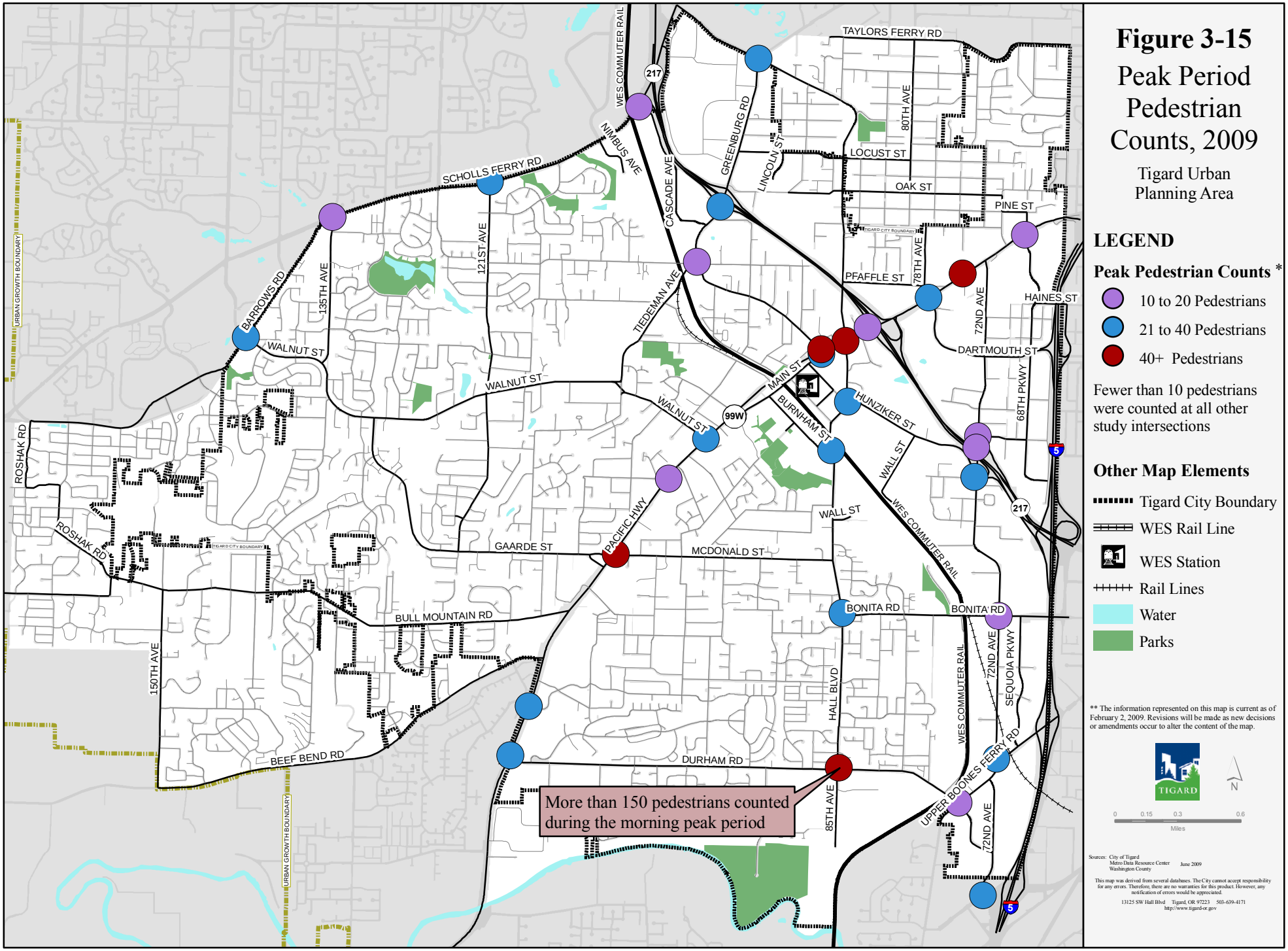
Figure 3-14 shows that among the study roadways the highest volume of truck traffic is found on Highway 99W. Scholls Ferry Road and Hall Boulevard also carry relatively high truck volumes. All three of these roadways are freight routes.

Pedestrian Volumes

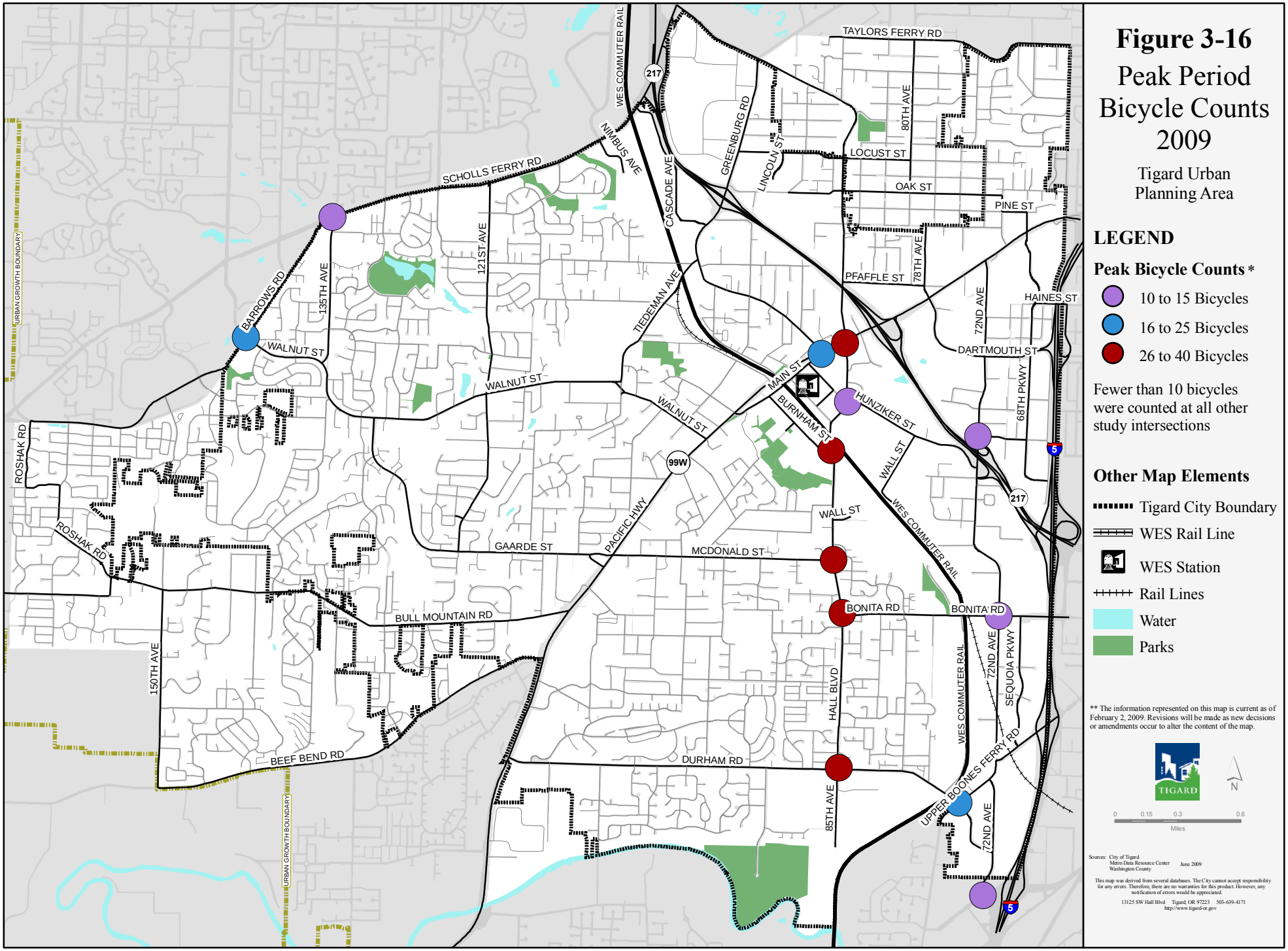
Pedestrian counts at study intersections indicated a number of pedestrians present during the morning and evening peak periods. Pedestrian counts at intersections with more than ten pedestrians counted over a two-hour period of time (either 7-9 a.m. or 4-6 p.m.) are summarized in Figure 3-15. The counts were conducted in spring and summer of 2008. The figure shows several intersections on Highway 99W with more than 40 pedestrians over a two-hour a.m. or p.m. peak period during a weekday. The highest volume of pedestrians was observed at the SW Hall/SW Durham Road intersection near Tigard High School. At this location, there were approximately 150 pedestrians during the two-hour morning peak period.

Bicycle Volumes

Bicycle counts at study intersections indicated a number of bicycles present during the morning and evening peak periods. Intersections with more than ten bicycles counted over a two-hour period of time (either 7-9 a.m. or 4-6 p.m.) are shown in Figure 3-16. As the figure shows, peak period bicycle traffic is relatively light at the most of the study intersections. However, 26 to 40 bicycles were observed during peak periods along most of the Hall Boulevard corridor, where bicycle travel was highest. The bicycle counts were conducted in the spring and summer of 2008, along with the pedestrian counts.



* Number of pedestrians counted during the highest morning or evening two-hour peak period during a weekday



* Number of bicycles counted during the highest morning or evening two-hour peak period during a weekday

KEY CORRIDOR TRAFFIC OPERATIONS

The evaluation of 2008 base year traffic conditions includes arterial level-of-service as well as intersection operations analysis. The analyses were conducted in accordance with the procedures described in the 2000 *Highway Capacity Manual* (HCM, Reference 5).

Arterial Level of Service (LOS)

The arterial level-of-service (LOS) analysis provides as an indication of traffic conditions along a corridor segment. The arterial LOS is determined for directional travel along defined street segments by comparing the observed travel time to the free flow speed (FFS) along roadways of like parameters. Arterial LOS was analyzed using travel time studies conducted by City of Tigard staff in the spring of 2008. The arterial LOS for weekday a.m., midday, and p.m. conditions are depicted in Figures 3-17, -18, and -19. These are followed by Figure 3-20, which shows the arterial LOS for Saturday and Sunday midday conditions. *The travel time data are provided in the appendix.*

Weekday AM Peak Period Arterial LOS

The weekday morning travel time runs were conducted between 7:00 and 8:30 a.m. Figure 3-17 shows that during this time, many of the arterial segments currently operate at LOS D or better. There are several sections that operate at LOS E or F. In general these tend to be located near the freeway interchanges or at approaches to Highway 99W or other major roads. The specific segments operating at LOS E or F include the following:

- Eastbound Scholls Ferry Road between 121st Avenue and Nimbus Avenue
- Southbound Greenburg Road between Tiedeman and Highway 99W
- Eastbound Walnut Street approaching Highway 99W
- Northbound Highway 99W approaching Gaarde-McDonald; and between Walnut and Highway 217
- Northbound Hall Boulevard between Burnham Street and Highway 99W
- Eastbound Durham Road approaching Hall Boulevard
- Eastbound and westbound Upper Boones Ferry Road approaching 72nd Avenue.

Weekday Midday Arterial LOS

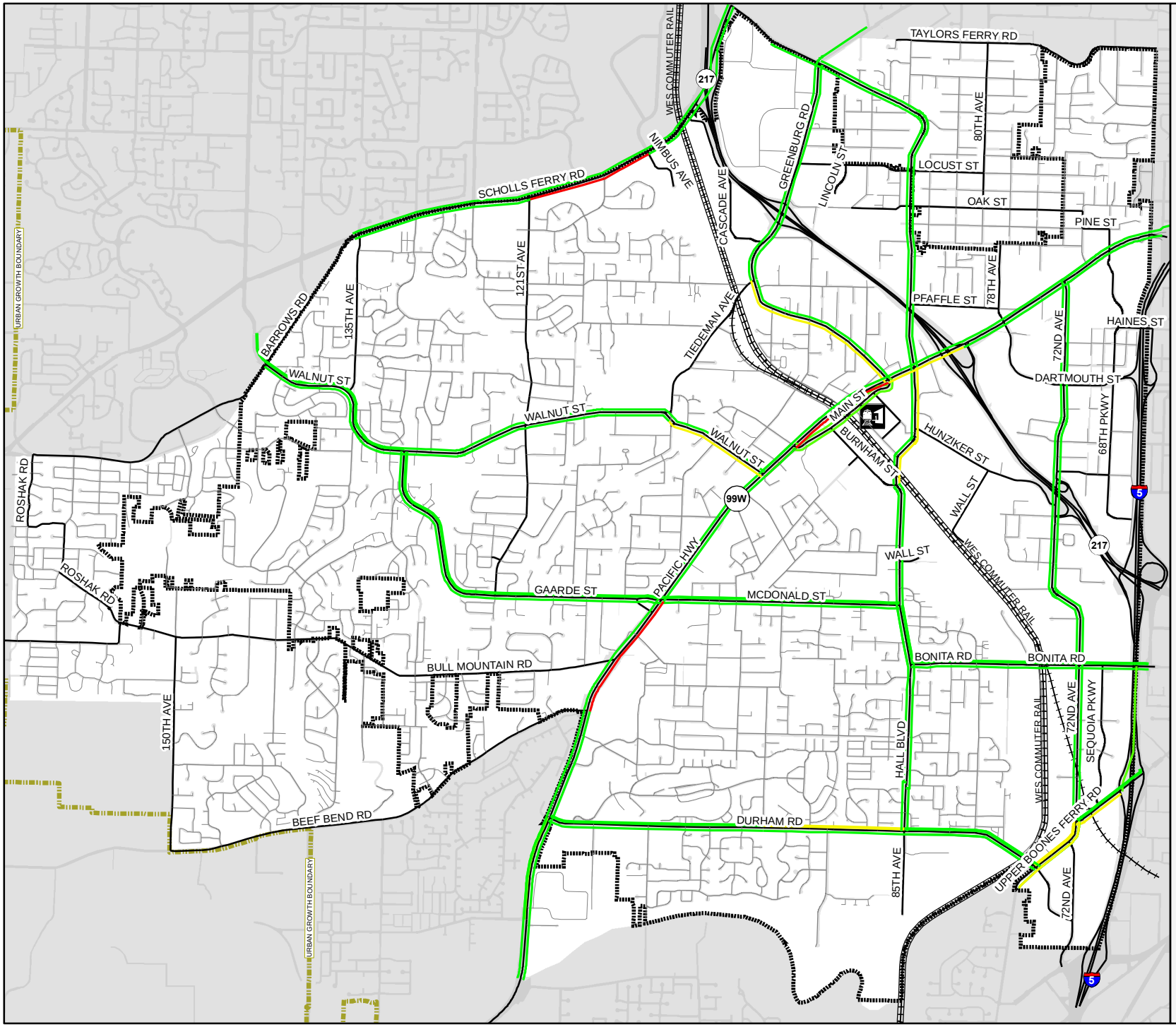
The weekday midday travel time runs were conducted between 11:30 a.m. and 4:00 p.m. Some of the a.m. peak congestion carries over into the midday, though typically at a reduced level. In particular, the eastbound direction of Highway 99W continued to operate at LOS F based on travel time data. The road segments operating at LOS F or LOS E are listed below.

- Northbound Highway 99W between Walnut and Highway 217
- Northbound Hall Boulevard between Burnham Road and Highway 99W
- Southbound I-5 ramp and westbound Upper Boones Ferry Road approaching 72nd Avenue

Figure 3-17

Arterial Level of Service Weekday AM

Tigard Urban Planning Area



LEGEND

Arterial LOS

- LOS F
- LOS E
- LOS A to D

Other Map Elements

- WES Rail Line
- WES Station
- Rail Lines
- Tigard City Boundary

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TIGARD

N

0 0.15 0.3 0.6 Miles

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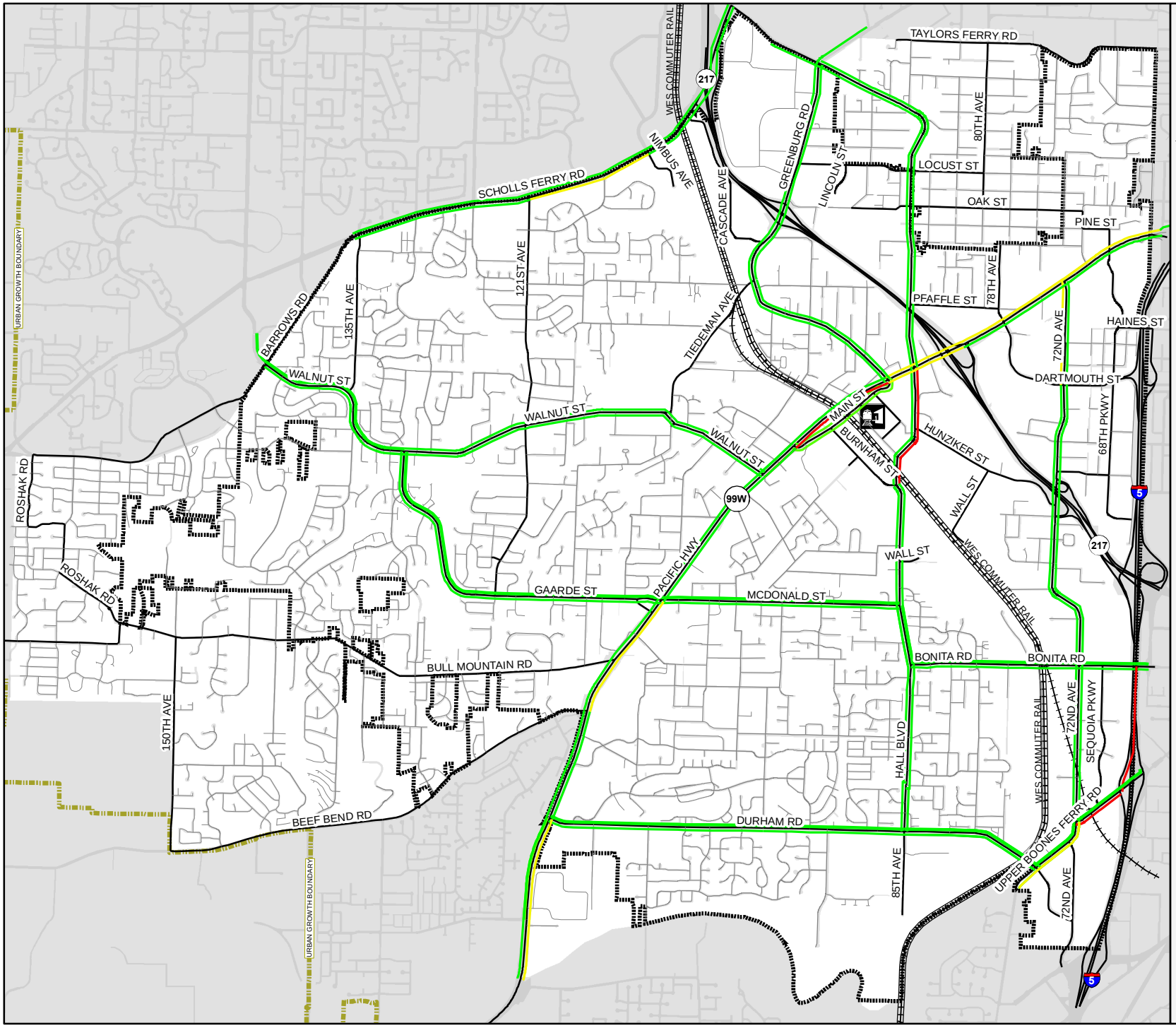

Figure 3-18

Arterial Level of Service Weekday Midday

Tigard Urban Planning Area

LEGEND

Arterial LOS

- LOS F
- LOS E
- LOS A to D

Other Map Elements

- WES Rail Line
- WES Station
- Rail Lines
- Tigard City Boundary

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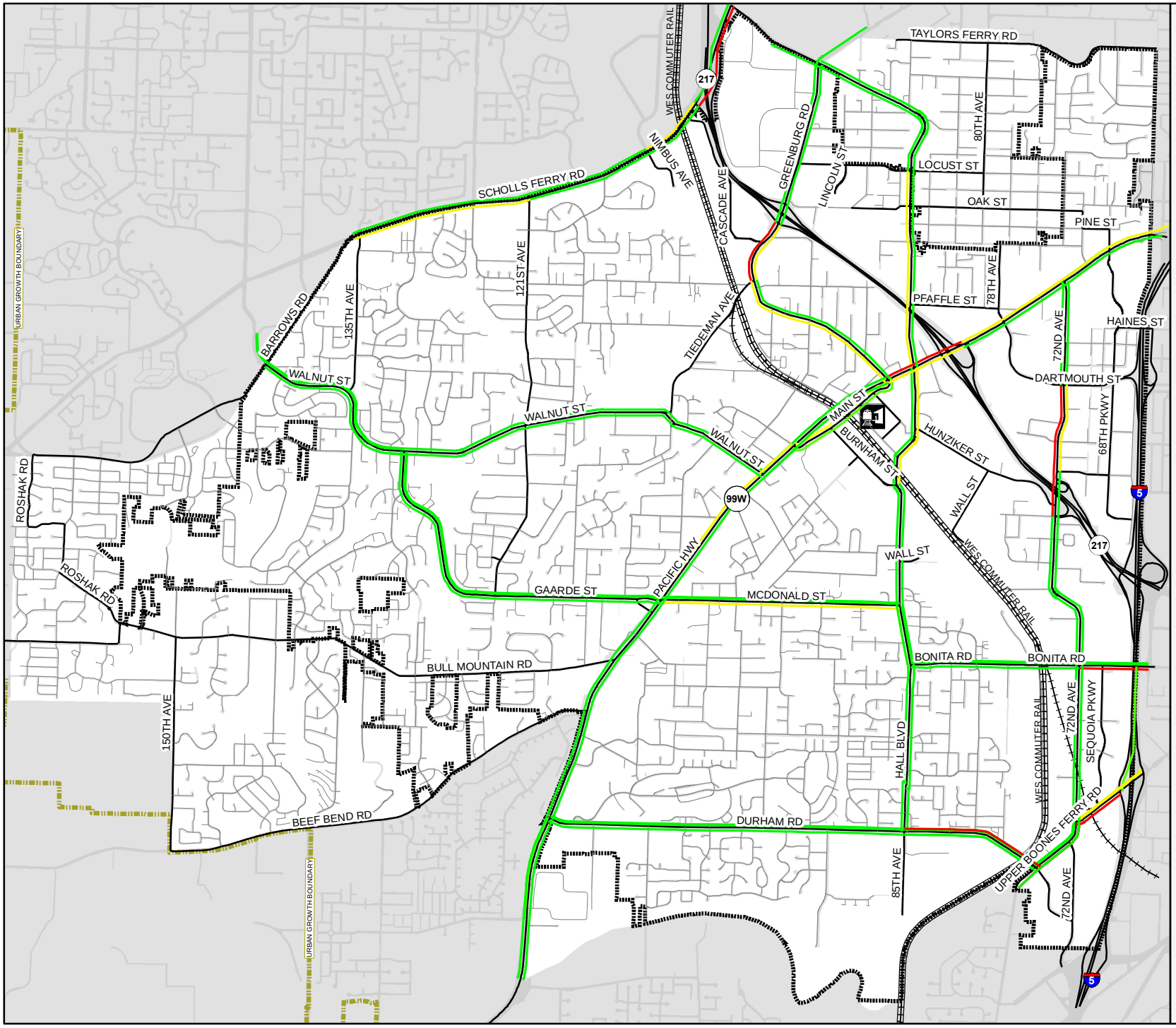

Figure 3-19

Arterial Level of Service Weekday PM

Tigard Urban Planning Area

LEGEND

Arterial LOS

- LOS F
- LOS E
- LOS A to D

Other Map Elements

- WES Rail Line
- WES Station
- Rail Lines
- Tigard City Boundary

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TIGARD

N

0 0.15 0.3 0.6 Miles

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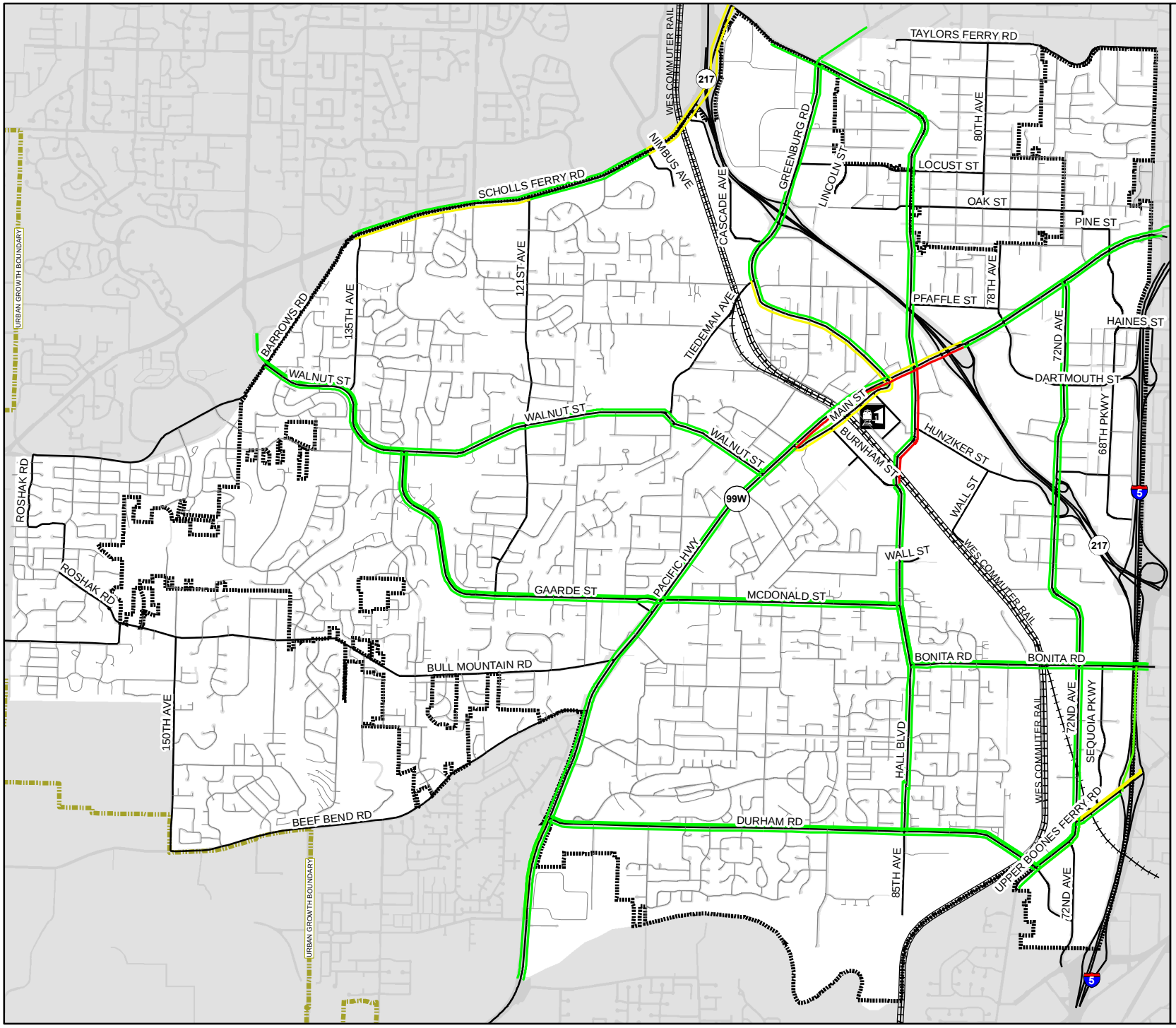

Figure 3-20

Arterial Level of Service Saturday Midday

Tigard Urban Planning Area

LEGEND

Arterial LOS

- LOS F
- LOS E
- LOS A to D

Other Map Elements

- WES Rail Line
- WES Station
- Rail Lines
- Tigard City Boundary

** The information represented on this map is current as of February 2, 2009. Revisions will be made as new decisions or amendments occur to alter the content of the map.

TIGARD

N

0 0.15 0.3 0.6 Miles

Sources: City of Tigard
Metro Data Resource Center
Washington County
June 2009

This map was derived from several databases. The City cannot accept responsibility for any errors. Therefore, there are no warranties for this product. However, any notification of errors would be appreciated.

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- Southbound Highway 99W from I-5 to Greenburg Road
- Northbound Highway 99W approaching Durham Road, approaching Gaarde-McDonald Streets, and from Greenburg Road through the Highway 217 interchange
- Southbound Hall Boulevard between Highway 99W and Dartmouth Street
- Eastbound Scholls Ferry Road between 121st Avenue and Nimbus Avenue

Weekday PM Arterial LOS

Travel time runs for the weekday evening peak period were conducted between 4:00 and 6:00 p.m. Figure 3-19 shows several corridor segments operating at LOS E or F. The figure shows several of the short segments operating at LOS F are at or near crossings of Highway 217 and I-5. This illustrates the effect of limited crossing opportunities channeling all travel demand to a few locations, combined with the heavy demand for freeway access at these locations. Segments operating at LOS E or F are listed below.

- Southbound Highway 99W between Gaarde-McDonald Streets and I-5, and northbound between Greenburg Road and Highway 217
- Southwestbound Main Street for the entire length
- Southbound Greenburg Road and southbound Hall Boulevard approaching Highway 99W
- Greenburg Road in both directions south of the Highway 217 ramps
- Northbound Hall Boulevard between Burnham Road and Highway 99W, and also between Bonita Road and McDonald Street.
- 72nd Avenue between Dartmouth Street and Highway 217 ramps
- Westbound Bonita Road between I-5 and 72nd Avenue
- Westbound Upper Boones Ferry Road between the I-5 ramp and Durham Road
- Eastbound Scholls Ferry Road between 135th and 121st, and through the Highway 217 interchange.

Saturday Midday Arterial LOS

The Saturday midday travel time runs were conducted between 11:30 a.m. and 4:00 p.m. The resulting arterial LOS findings are shown in Figure 3-20. The figure shows that most segments operate acceptably during the Saturday midday. Exceptions are noted below:

- Northbound Highway 99W between Walnut and the Highway 217 ramps
- Northbound Hall Boulevard between Burnham Street and Highway 99W
- Both directions of Schools Ferry Road near the Highway 217 ramps
- Eastbound Scholls Ferry Road between 135th and 121st Avenues
- Southbound Greenburg Road approaching Highway 99W
- Eastbound Upper Boones Ferry Road from Durham Road through the I-5 interchange

Summary of Arterial LOS

The review of the arterial LOS analysis shows that several corridor segments operate at LOS E or LOS F during multiple study periods. Some of the arterial segments with the most persistent operating issues are:

- Northbound Highway 99W from Gaarde-McDonald Streets through the Highway 217 interchange operates at LOS F during the weekday a.m. and midday, and during the weekend midday.
- During the weekday midday and p.m., segments of southbound Highway 99W operate at LOS E or F between I-5 and Greenburg Road.
- Southbound Greenburg Road operates at LOS E during the weekday a.m. and p.m. peak periods, as well as during the weekend midday.
- Northbound Hall Boulevard between Burnham Street and Highway 99W operates at LOS E or F during all study periods.
- Segments of Westbound and eastbound Upper Boones Ferry Road operate at LOS E or F during all study periods.
- During all study periods, some segment of Scholls Ferry Road operates at LOS E or F.
- The entire length of Main Street operates at LOS E during the weekday p.m. (westbound) and weekday midday (eastbound) periods.

Intersection Operations Analysis

The HCM methodology provides a measure of LOS which represents the average delay experienced by drivers at an intersection and also reports a volume-to-capacity (v/c) ratio which describes the amount of capacity that is used at the intersection. This section focuses on the v/c ratios resulting from the HCM analysis. The OHP requires a maximum v/c ratio of 0.95 for Highway 99W and 0.85 at freeway ramp terminals.

In congested intersections or corridors, intersection analysis can result in misleading findings because the analysis is based on vehicles that get through the intersection, but does not capture unmet travel demand (i.e. queue spillback). The analysis does not capture the impacts on operations when downstream intersection queues spill back along the corridor. In order to accurately reflect such congested conditions, the findings of the HCM operations analysis are supplemented with field observations in order to identify locations where specific congested locations impact upstream intersections. For each of the corridors, the weekday p.m. peak hour intersection operations are depicted in combination with capacity or queuing issues observed under typical conditions. Where noted, the a.m. peak hour and Saturday midday peak hour periods were additionally evaluated. *Details of the intersection analyses for all time periods evaluated are included in Appendices D through F.*

The following sections review the performance of key corridors in Tigard. The corridors (routes) include Highway 99W, Scholls Ferry Road, Hall Boulevard, Greenburg Road, 72nd Avenue, Upper Boones Ferry Road, and Walnut Street. The evaluations include peak hour intersection operations,

queuing estimates, travel time surveys, and general observations. For Highway 99W a diverted demand analysis was also conducted which estimates the degree of traffic that may be diverting onto other roadways to avoid congestion on Highway 99W.

Highway 99W

Highway 99W in Tigard is a five-lane roadway carrying up to 51,000 vehicles per day through the City. The roadway is characterized by numerous access points serving commercial properties, which are the predominant land uses. Figures 3-18 and 3-19 summarize the intersection operations for signalized intersections along Highway 99W during the 2008 weekday p.m. peak hour. The table shows that Saturday conditions were analyzed at most intersections between SW Gaarde-SW McDonald Streets and SW 68th Parkway; Weekday a.m. peak hour conditions were evaluated at the intersections of Highway 99W with SW Greenburg Road and with SW Hall Boulevard.

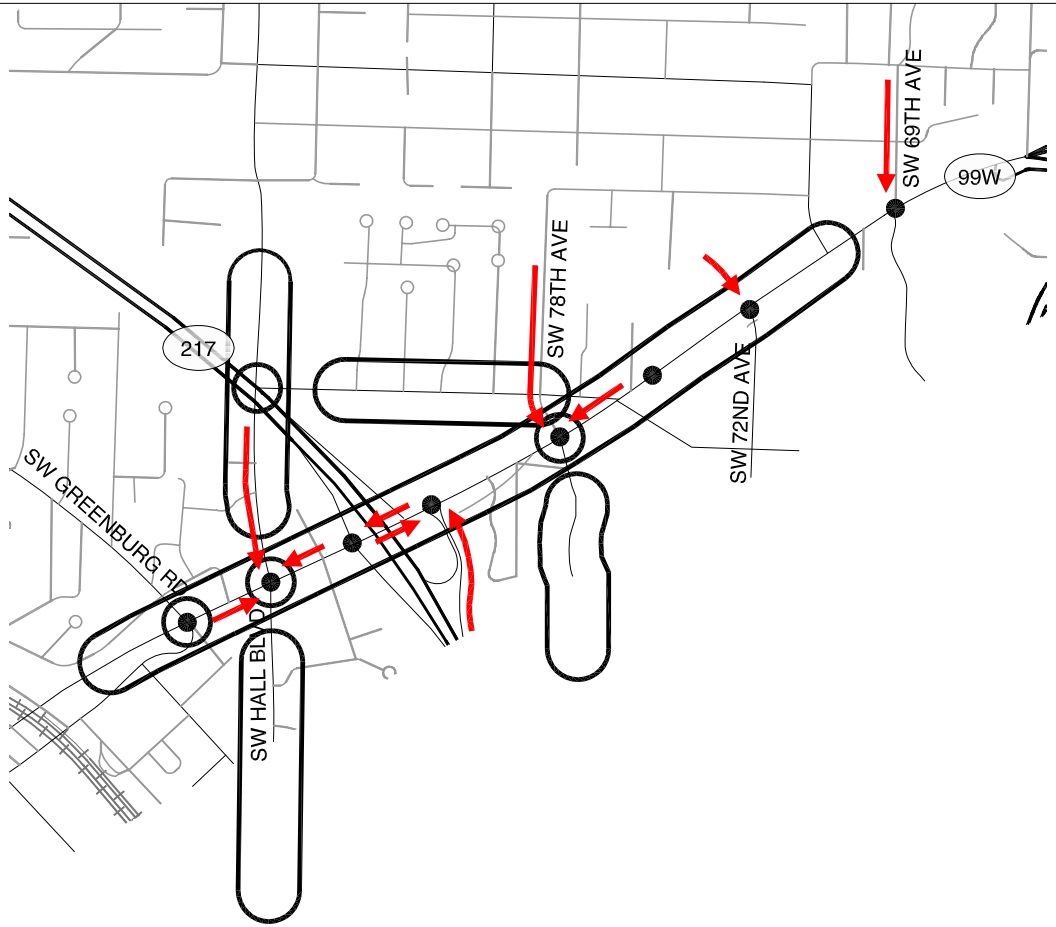
Figures 3-21 and 3-22 show that there are congestion issues along much of the Highway 99W corridor. The intersection operations analysis revealed capacity issues at several intersections along the highway. During the weekday p.m. peak hour, congested conditions are typically observed between Greenburg Road in most locations between Durham Road and 72nd Avenue.

The intersections at SW Greenburg Road and SW Hall Boulevard both act as bottlenecks. These bottlenecks can cause traffic to back up and can reduce capacity at upstream intersections; as a result, peak hour traffic is frequently stop-and-go between SW 72nd Avenue and SW Greenburg Road. In addition to queuing issues on Highway 99W, there is significant queuing on SW Hall Boulevard at both approaches to Highway 99W.

The Highway 99W/SW Gaarde Street-SW McDonald Street operates at capacity during the weekday p.m. peak hour. Based on field observations, this intersection is frequently over-capacity, with significant side street queues.

The intersection analysis reports that the Highway 99W intersections at SW Royalty Parkway and SW Durham Road are operating with a poor LOS and at a very high v/c ratio. This is consistent with field observations.

The intersection analyses for weekday a.m. and Saturday mid-day peak periods indicate that the weekday p.m. peak hour is the critical period for most intersections. Exceptions include the Highway 99W/SW Hall Boulevard intersection, which operates at capacity during the weekday a.m. peak hour. During the Saturday mid-day peak hour, the exception is Highway 99W/Highway 217 SB Ramps operate at capacity.



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LEGEND

STUDY INTERSECTIONS

ANALYSIS FINDINGS

DIRECTIONAL QUEUING

INTERSECTION CAPACITY ISSUES

OBSERVATIONS

ARTERIAL CONGESTION

INTERSECTION OPERATIONS ISSUES

HIGHWAY 99W (1 OF 2)
WEEKDAY PM PEAK HOUR TRAFFIC CONDITIONS
TIGARD, OREGON

FIGURE **3-21**

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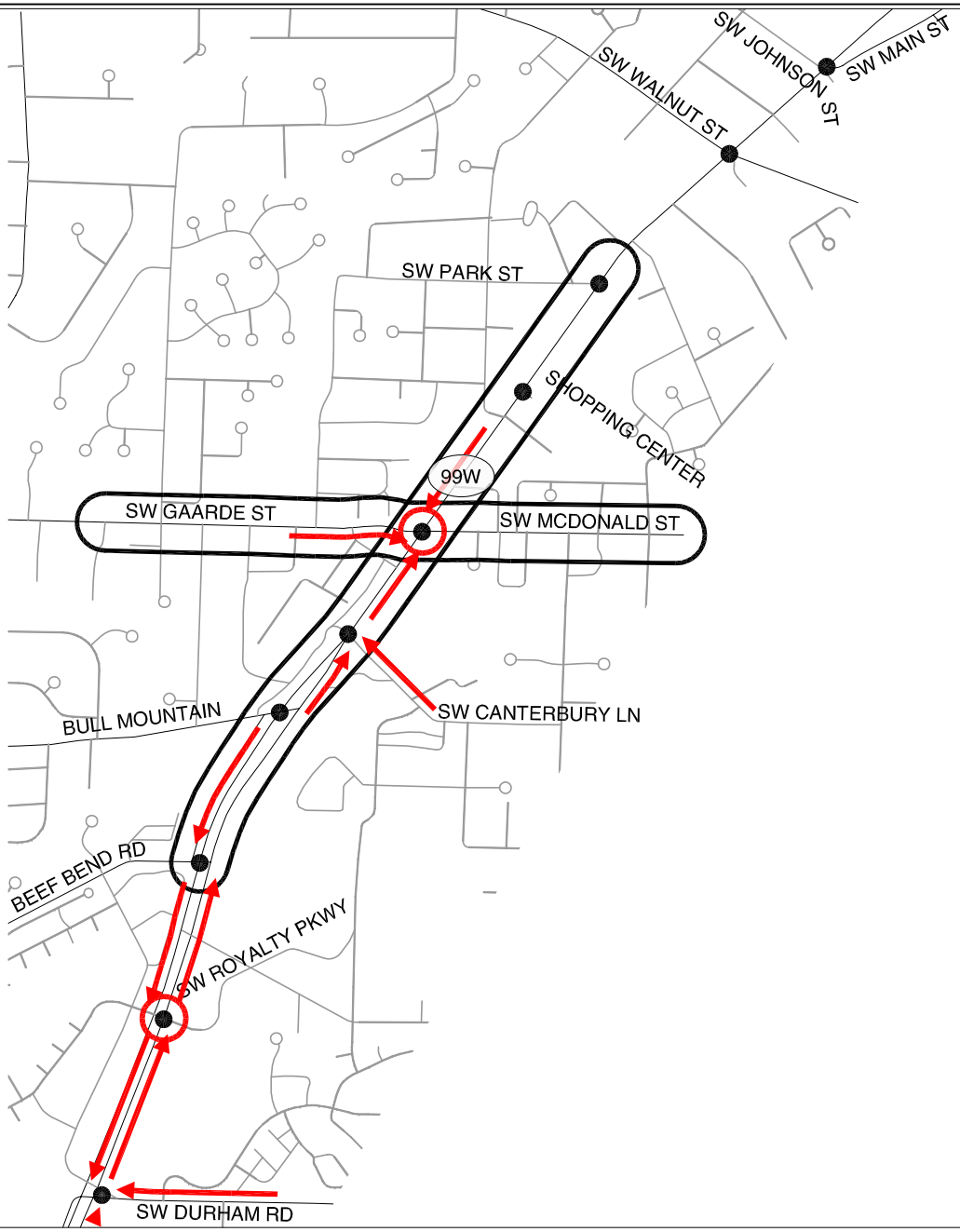

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LEGEND

- STUDY INTERSECTIONS

ANALYSIS FINDINGS

- DIRECTIONAL QUEUING
- INTERSECTION CAPACITY ISSUES

OBSERVATIONS

- ARTERIAL CONGESTION
- INTERSECTION OPERATIONS ISSUES

HIGHWAY 99W (1 OF 2)
WEEKDAY PM PEAK HOUR TRAFFIC CONDITIONS
TIGARD, OREGON

FIGURE **3-22**

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Highway 99W Diverted Traffic Analysis

Highway 99W carries traffic through Tigard, serving thousands of daily trips on the five-lane facility. As was shown by the arterial LOS analysis as well as the intersection analysis described above, the highway is frequently congested. In order to determine whether the capacity constraints are resulting in travel demand diverting to other roadways, a diversion analysis was performed on the corridor to analyze what the potential increase in traffic would be if more capacity was added to the highway. Using 2005 p.m. peak period traffic volumes from the regional travel demand model, two network scenarios were evaluated: the existing five-lane configuration and a nine-lane configuration.

The analysis showed that with the increase in capacity from the added travel lanes, the vehicles using Highway 99W would increase by approximately 25 to 45 percent increase in the northbound direction; and southbound traffic would increase in the range of 20 to 35 percent. A corresponding decline in traffic would occur on alternative routes. In particular, peak direction (westbound) traffic on the McDonald-Hall-Bonita corridor would decline by approximately 10 percent; on Durham Road, the westbound traffic would decline by 12 to 14 percent.

Scholls Ferry Road

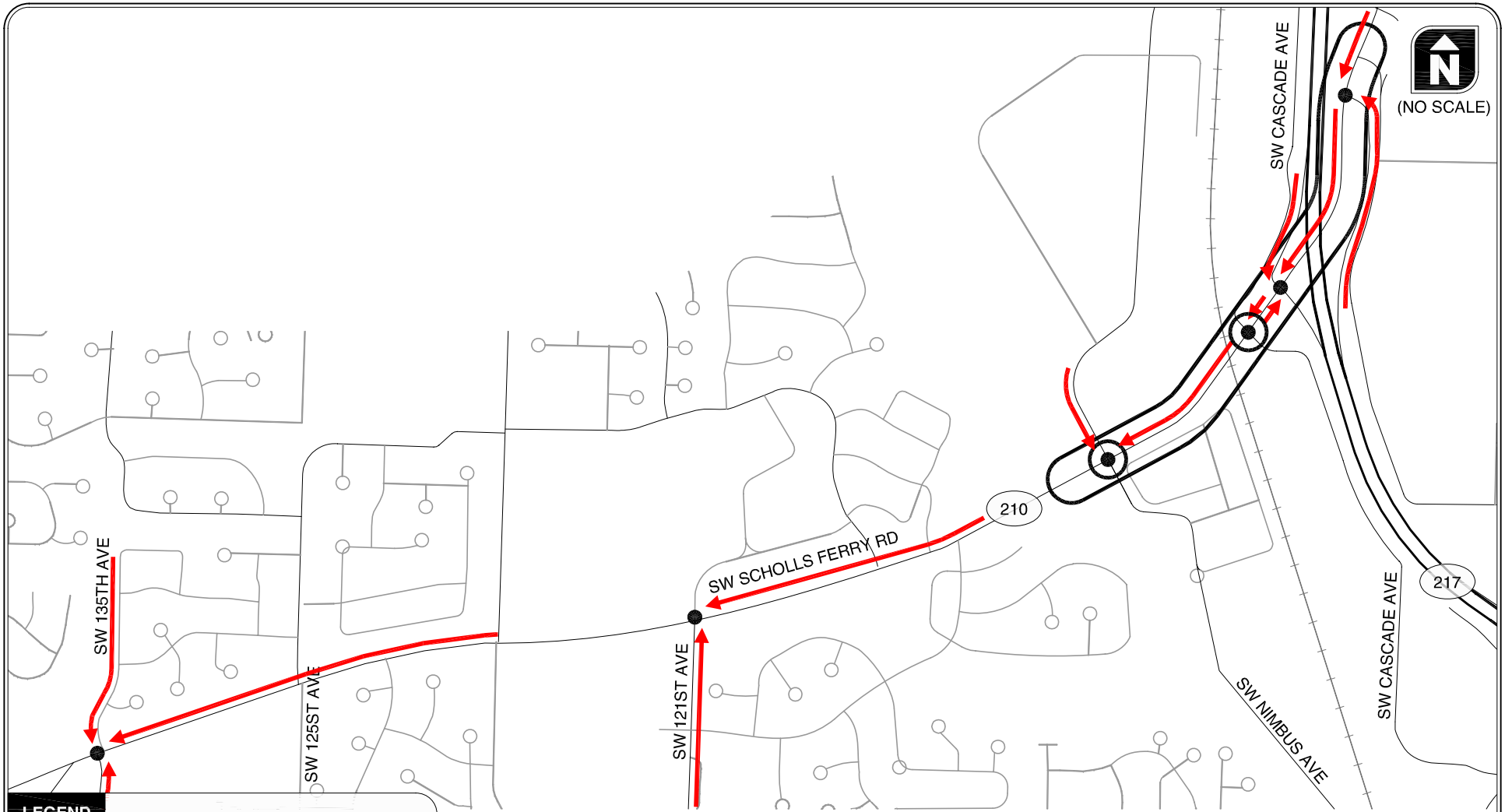
Scholls Ferry Road serves as a border between Tigard and Beaverton and is under the jurisdiction of ODOT and Washington County. The 2008 weekday p.m. peak hour intersection operations are summarized in Figure 3-23.

Much of the congestion along SW Scholls Ferry Road is associated with the close spacing of high volume, signalized intersections near the Highway 217 interchange. Queues at Nimbus Avenue and Cascade Avenue back into the freeway ramp intersections, causing stop-and-go traffic in the peak direction throughout much of the corridor. Queuing also occurs on the side streets, including 135th Avenue and 121st Avenue.

Hall Boulevard

SW Hall Boulevard (Highway No. 141) connects Beaverton and Tualatin via Washington Square Regional Center in Tigard, with two crossings of Highway 217. Weekday p.m. peak hour intersection analyses were conducted at six intersections south of Highway 217. Intersection operations analyses are summarized in Figure 3-24.

The intersection analyses show that the Hall Boulevard intersections at McDonald Street and Bonita Road are over capacity during the weekday p.m. peak hour. This is consistent with field observations. There are significant northbound left-turn queues at Hall Boulevard, with queues sometimes extending to Bonita Road. There are also considerable westbound queues on Bonita Road approaching Hall Boulevard, as Bonita Road is a major route for westbound traffic crossing Highway 217 and Fanno Creek.



LEGEND

- STUDY INTERSECTIONS

ANALYSIS FINDINGS

- DIRECTIONAL QUEUING
- INTERSECTION CAPACITY ISSUES

OBSERVATIONS

- ARTERIAL CONGESTION
- INTERSECTION OPERATIONS ISSUES

SW SCHOLLS FERRY ROAD
WEEKDAY PM PEAK HOUR TRAFFIC CONDITIONS
TIGARD, OREGON

FIGURE **3-23**

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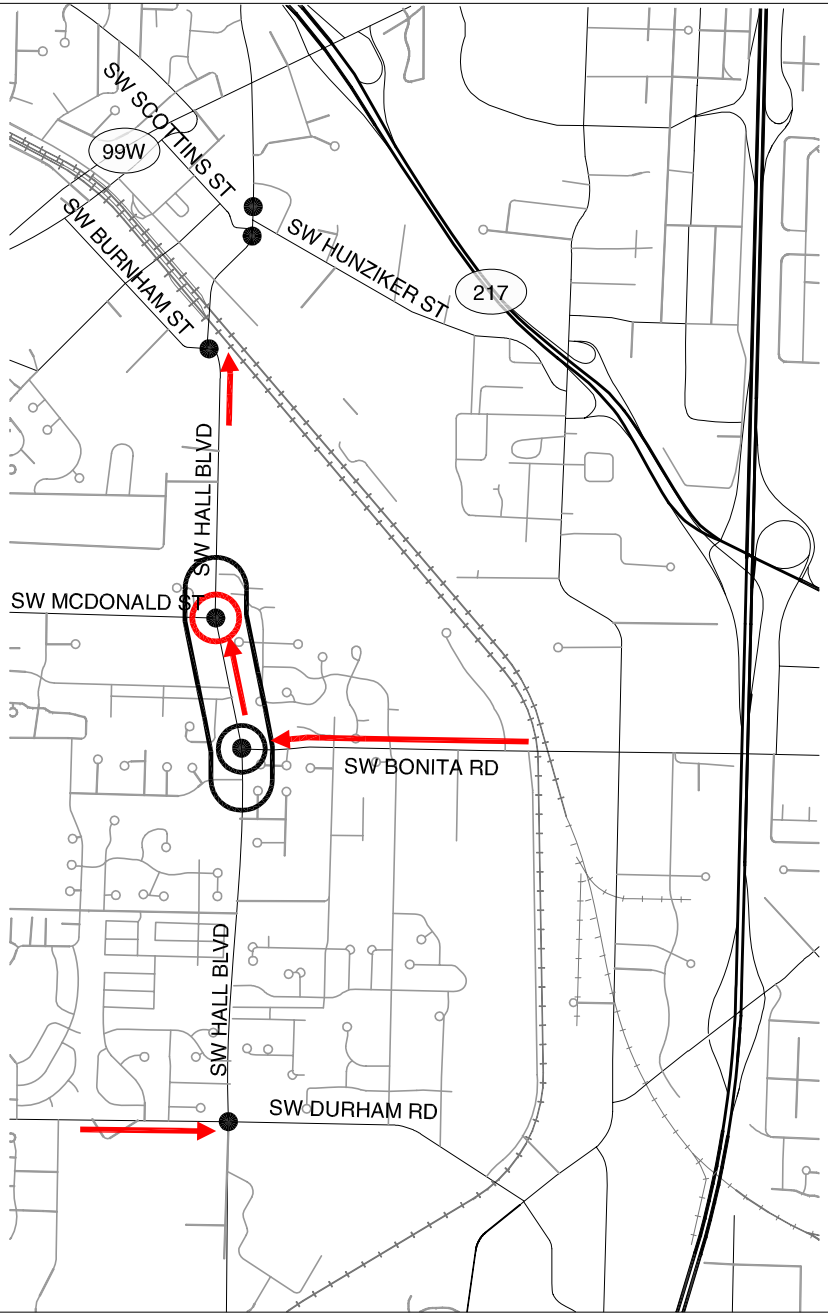

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LEGEND

- STUDY INTERSECTIONS

ANALYSIS FINDINGS

- DIRECTIONAL QUEUING
- INTERSECTION CAPACITY ISSUES

OBSERVATIONS

- ARTERIAL CONGESTION
- INTERSECTION OPERATIONS ISSUES

SW HALL BLVD
WEEKDAY PM PEAK HOUR TRAFFIC CONDITIONS
TIGARD, OREGON

FIGURE **3-24**

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The intersection analysis showed the SW Hall Boulevard/SW Durham Road intersection operates acceptably during the a.m. and p.m. peak periods. However, the queuing analyses during the p.m. peak hour shows significant queuing in the westbound direction. This is consistent with field observations.

The weekday a.m. peak hour analysis at the SW Hall Boulevard/SW Durham Road intersection indicate that the morning peak hour is the critical time period for this intersection. During the weekday a.m. peak hour the intersection operates at LOS E with a v/c ratio of 0.92. The analysis indicates extensive queuing in the eastbound and southbound approaches.

Greenburg Road

Greenburg Road is an arterial roadway connecting Hall Boulevard to Highway 99W and traversing the eastern boundary of the Washington Square Regional Center. The intersection operations for the weekday p.m. peak hour are summarized in Figure 3-25.

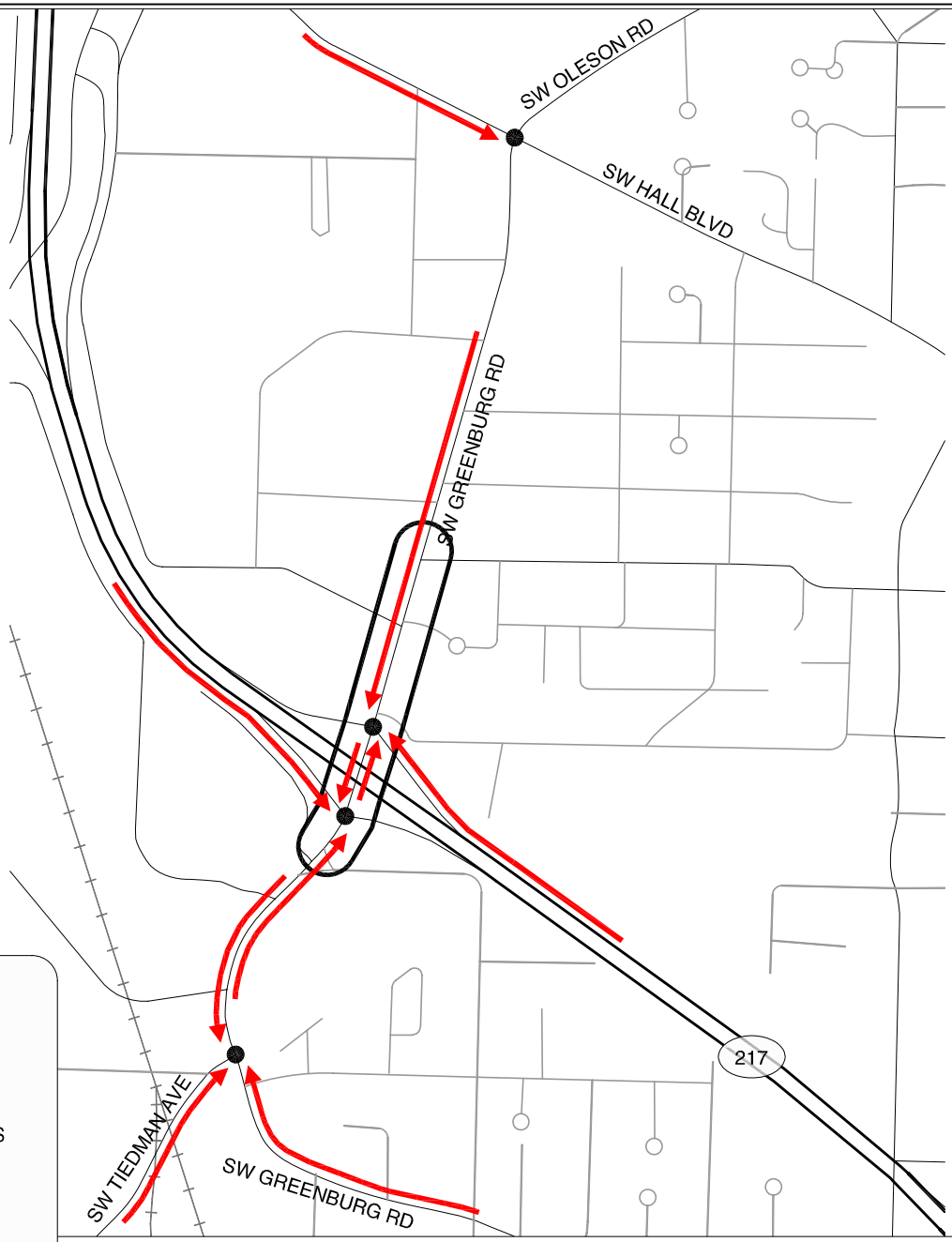
As shown in Figure 3-25, the operational analysis revealed considerable queuing along Greenburg Road between Tiedman Avenue and Hall Boulevard. There are four relatively closely spaced, high volume signalized intersections between the Highway 217 southbound ramps and SW Locust Road (inclusive). Also, there is a double left-turn lane at the southbound approach to the Highway 217 southbound ramps, but lane utilization is not well balanced; therefore, the dual turn lanes do not operate as efficiently in the field as the analysis suggests. Due to high traffic volumes accessing the freeway and the retail areas around Washington Square, there is considerable congestion throughout the corridor.

The analysis of Saturday conditions showed that during mid-day peak hour conditions the intersections operate better than during the weekday p.m. peak hour. However, weekend traffic operations are considerably worse during the winter holiday shopping season.

SW 72nd Avenue

SW 72nd Avenue is a north-south arterial connecting Highway 99W with Tualatin and Durham at Lower Boones Ferry Road and Bridgeport Village. With numerous connections to I-5 (Highway 99W, Dartmouth Street, Highway 217, Upper Boones Ferry-Carman, and Bridgeport Road), 72nd Avenue is sometimes used as a cut-through route when I-5 is congested. The intersection operations evaluation for weekday p.m. peak hour conditions are summarized in Figure 3-26

As shown in Figure 3-26, the analysis of weekday p.m. peak hour intersection operations revealed that 72nd Avenue is at or exceeding capacity at the intersections with Dartmouth Street and at Bonita Road. The 72nd Avenue/Dartmouth Street intersection is currently a 4-way stop controlled intersection. Signal warrants are met under existing conditions. If the intersection were signalized, it would operate acceptably. *The signal warrant evaluation is summarized in the technical appendix.*



LEGEND

STUDY INTERSECTIONS

ANALYSIS FINDINGS

DIRECTIONAL QUEUING

INTERSECTION CAPACITY ISSUES

OBSERVATIONS

ARTERIAL CONGESTION

INTERSECTION OPERATIONS ISSUES

SW GREENBURG ROAD
WEEKDAY PM PEAK HOUR TRAFFIC CONDITIONS
TIGARD, OREGON

FIGURE **3-25**

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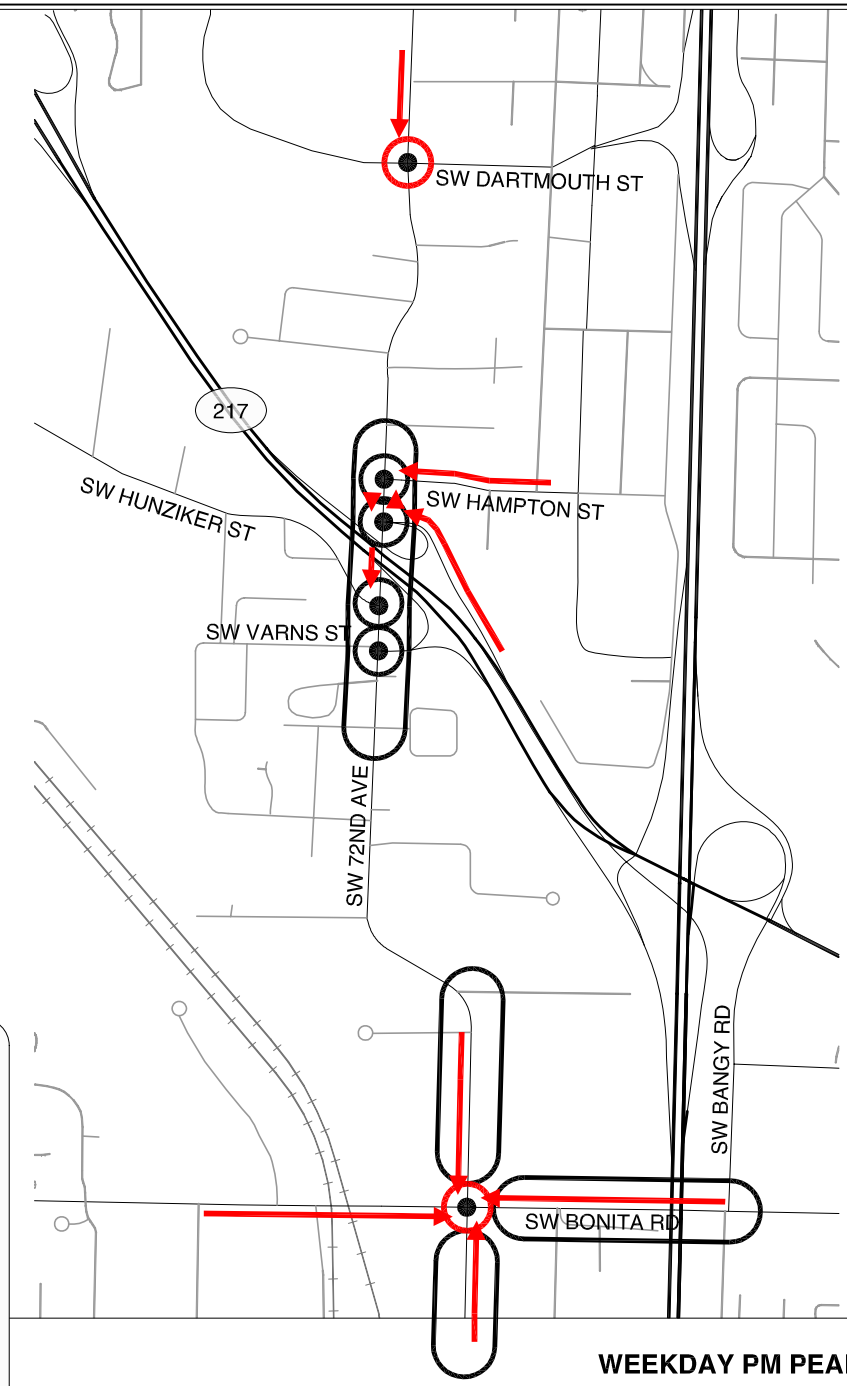

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LEGEND

- STUDY INTERSECTIONS

ANALYSIS FINDINGS

- DIRECTIONAL QUEUING
- INTERSECTION CAPACITY ISSUES

OBSERVATIONS

- ARTERIAL CONGESTION
- INTERSECTION OPERATIONS ISSUES

SW 72ND AVE
WEEKDAY PM PEAK HOUR TRAFFIC CONDITIONS
TIGARD, OREGON

FIGURE **3-26**

KITTELSON & ASSOCIATES, INC.
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Queues at the 72nd Avenue/Bonita Road intersection are extensive, especially in the westbound direction. During the weekday p.m. peak hour, queues frequently back up as far as Bangy Street, approximately 1,600 feet to the east.

The intersection analysis indicates that the intersections between Hampton Street and the Southbound Highway 217 Ramps–Varns Street (inclusive) operate acceptably. However, as previously noted, the analytical methods do not capture the downstream impacts of congested intersections. It is known from field observations that this section of 72nd Avenue, this section of the corridor is frequently congested due to the close spacing of signalized intersections.

Upper Boones Ferry Road

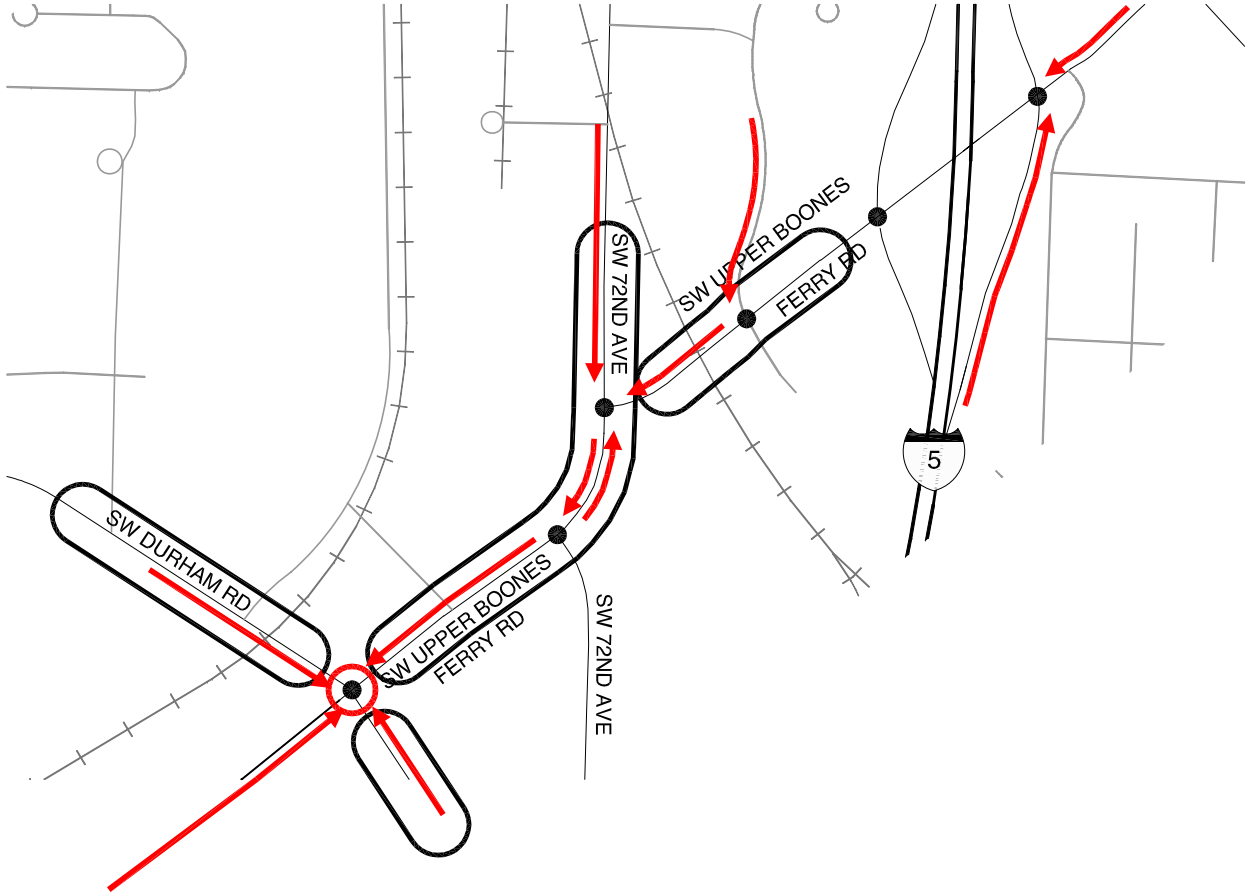
Upper Boones Ferry Road is a three-to-five lane arterial through Tigard, connecting to Tualatin to the south and to I-5 at the northern end within Tigard. At the I-5 interchange, Upper Boones Ferry Road becomes Carman Road and connects to Lake Oswego and to Kruse Way. The intersection weekday p.m. peak hour traffic operations are depicted in Figure 3-27.

Figure 3-27 shows that the SW Upper Boones Ferry Road/SW Durham Road intersection is operating at capacity during the p.m. peak hour. Based on extensive queues observed on both Durham Road approaches and on the northern Upper Boones Ferry Road approach, it appears likely that the intersection is not accommodating all demand and that the intersection is over capacity during the peak hour. Southwest bound queues extend past the 72nd Avenue intersection, interfering with operations at that location.

In addition to queues at the Upper Boones Ferry Road/Durham Road intersection, there is considerable queuing and congestion on most sections of this corridor during the weekday p.m. peak hour.

Walnut Street

SW Walnut Street is a three-lane arterial between SW Barrows Road and SW Gaarde Street; and a collector between SW Gaarde Street and Highway 99W. The weekday p.m. peak hour intersection conditions are depicted in Figure 3-27. As the figure shows, congestion has been observed at the Walnut Street/135th Avenue intersection, especially in the westbound direction. The City recently installed a westbound right-turn lane to increase capacity for this direction. A preliminary signal warrant analysis indications that the warrants are met at this intersection under 2008 base year conditions. However, a more thorough study should be conducted to determine whether the capacity issues extend beyond the peak period. A traffic signal at this location would improve peak hour conditions, but may be detrimental during other times of the day. *The signal warrant evaluation is summarized in the technical appendix.*



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LEGEND

- STUDY INTERSECTIONS

ANALYSIS FINDINGS

- DIRECTIONAL QUEUING
- INTERSECTION CAPACITY ISSUES

OBSERVATIONS

- ARTERIAL CONGESTION
- INTERSECTION OPERATIONS ISSUES

SW UPPER BOONES FERRY ROAD
WEEKDAY PM PEAK HOUR TRAFFIC CONDITIONS
TIGARD, OREGON

FIGURE **3-27**

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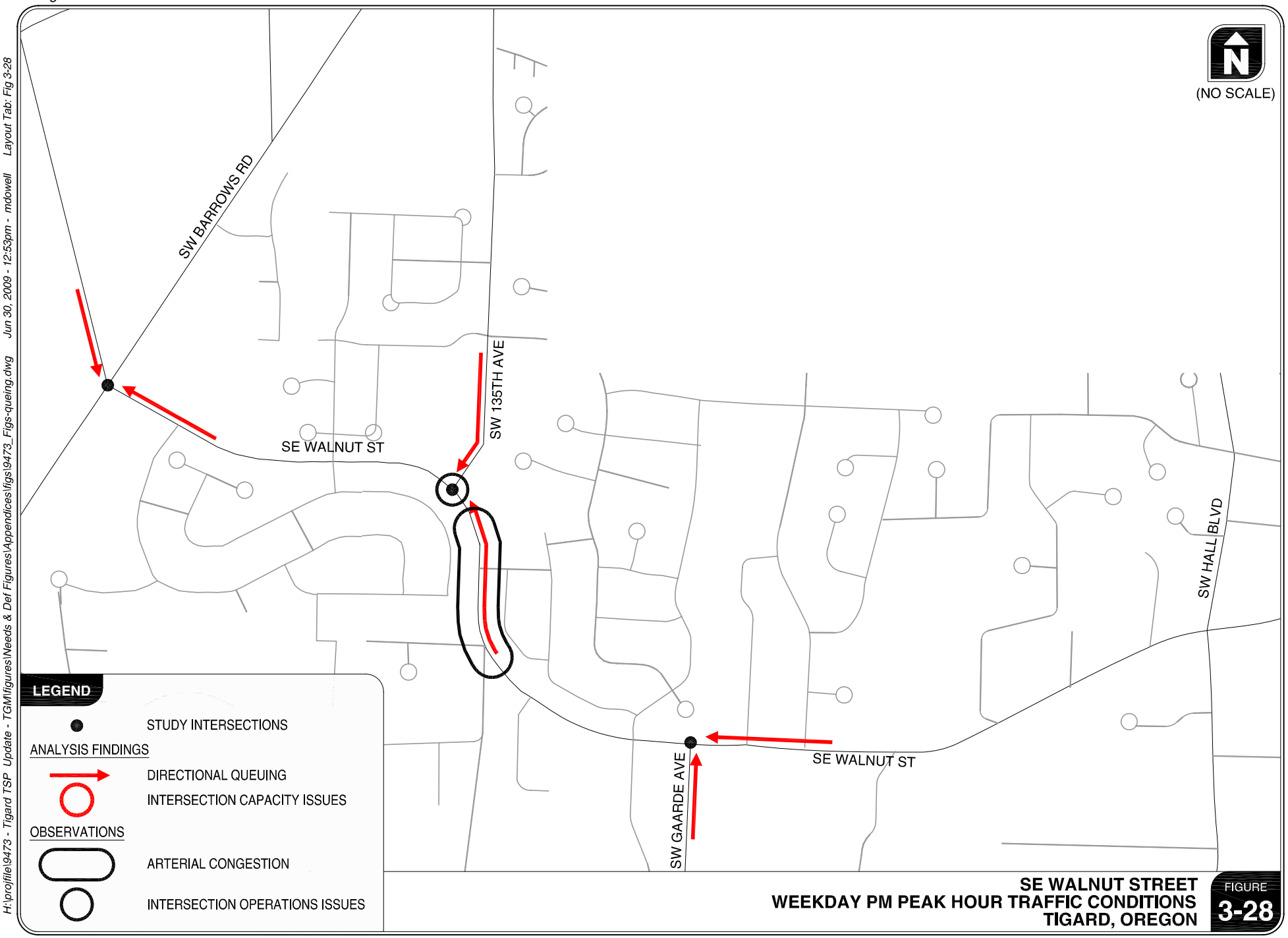

SE WALNUT STREET
WEEKDAY PM PEAK HOUR TRAFFIC CONDITIONS
TIGARD, OREGON

FIGURE **3-28**

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COLLISION HISTORY

The evaluation of the collision history in the study area was undertaken using four sources. An initial evaluation of intersection crashes was conducted using crash data maintained by the City of Tigard and crash data obtained from ODOT. Table 3-18 and Table 3-19 summarize the crash data obtained from these two sources.

Additionally, ODOT and Washington County both maintain indexes of high priority safety locations. ODOT and Washington County, evaluate crash histories in Tigard with a broader context, and compare intersections in Tigard with other locations in each jurisdiction. The ODOT SPIS list is summarized below in Table 3-20.

Washington County is responsible for roadways in the county, which includes both higher and lower order facilities. The SPIS list for Washington County includes several locations on arterials such as Scholls Ferry Road and Greenburg Road, but often at intersections with lower order facilities. Table 3-21 lists those locations, as compared to other county roadways.

City of Tigard Crash Records Summary

The City of Tigard maintains a crash database for the intersections in the city, and is currently updated through September 30, 2007. Table 3-18 summarizes the intersections with the highest number of crashes from the period between January 1, 2005 and September 30, 2007.

As shown in the table, several of the intersections with the highest frequency of crashes are located on Highway 99W. At the intersections shown in the table, one fatality was recorded at the Highway 99w/Highway 217 NB Ramps in 2006.

Supplemental Data Analysis

Crash data was obtained from ODOT for the period January 1, 2003 through December 31, 2007 for the 50 project area intersections. Table 3-19 shows the ten intersections with the highest number of crashes reported during that time. During this period, there was one fatality recorded at the SW Scholls Ferry Road/SW 121st Avenue intersection. A driver on SW Scholls Ferry Road hit a pedestrian who disregarded the signal and was crossing the street. It occurred late at night. It should be noted that SW Scholls Ferry Road/SW 121st Avenue intersection is not among the top ten highest crash intersections. *The complete crash data set can be provided upon request.*

Table 3-18 City of Tigard Crash Data Summary, January 1, 2005-September 30, 2007

Intersection	# Crashes	Severity	
		PDO	Injury
Highway 99W/Gaarde Street-McDonald Street	82	56	26
Highway 99W/Hall Boulevard	65	39	26
Highway 99W/Greenburg Road-Main Street-	48	22	26
Highway 99W/72nd Avenue	44	26	18
Highway 99W/Dartmouth Street-78th Avenue-	38	21	17
Highway 99W/Highway 217 NB Ramps	33	23	13*
Highway 99W/Bull Mountain Road	36	18	18
Greenburg Road/Highway 217 NB Ramps	36	19	15
Highway 99W/Royalty Parkway	34	16	16
Scholls Ferry Road/North Dakota Street	32	17	15
Upper Boones Ferry Road/I-5 SB Ramps	31	17	14
Highway 99W/Walnut Street	30	16	14
Highway 99W/Durham Road	30	15	15
Highway 99W/ Highway 217 SB Ramps	28	16	12
Highway 99W/Garden Place – Warner Avenue	26	12	14
72nd Avenue/Highway 217 NB Ramps	25	17	8
Scholls Ferry Road/Cascade Avenue	24	11	13
Highway 99W/68th Parkway – 69th Avenue	24	19	5
72nd Avenue/Bonita Road	22	11	11
Scholls Ferry Road/Nimbus Avenue	22	12	10

* There was one fatality recorded at this intersection

As shown in the table, out of the ten intersections with the highest crash frequencies, all were located on Highway 99W, Scholls Ferry Road, or Upper Boones Ferry Road. The table also shows that the rear-end collisions have been the predominant type of collision, especially on Highway 99W. This is often the case with over-saturated intersections, as drivers can more aggressively try to clear an intersection. The second most common type of collision involved turning movements. This may be related to turning at the intersection or at nearby private access points.

Table 3-19 Intersection Crash History (2003 to 2007)

Intersection	# Crashes	Collision Type					Severity		
		Rear-end	Turning	Angle	Side-swipe	Other	PDO	Injury	Fatality
Scholls Ferry Rd/Cascade Ave	51	17	16	17	0	1	25	26	0
OR 99W/Gaarde St	48	35	10	1	2	0	33	15	0
OR 99W/Greenburg Rd	46	34	8	2	1	1	24	22	0
OR 99W/72nd Ave	41	18	20	1	0	2	28	13	0
OR 99W/Hall Blvd	39	23	8	4	2	2	24	15	0
OR 99W/Bull Mountain Rd	27	18	8	0	0	1	15	12	0
OR 99W/Royalty Pkwy	27	13	12	2	0	0	12	15	0
Scholls Ferry Rd/135th Ave	26	17	5	3	0	1	14	12	0
Upper Boones Ferry Rd/72nd Ave	23	15	6	0	1	1	12	11	0
Upper Boones Ferry Rd/Sequoia Pkwy	23	9	10	2	0	2	14	9	0

ODOT SPIS Analysis

ODOT maintains the Statewide Priority Index System (SPIS) for identifying locations on state highways where consideration should be given to implementing improvements to reduce crash frequency. The SPIS index mathematically combines crash frequency, crash rate, and crash severity to yield one score per location. A roadway segment becomes a SPIS site if a location has three or more crashes or one or more fatal crashes over the three-year period. Under this method, all state highways are analyzed in 0.10 mile segments to determine SPIS sites. Each year, a list is generated of the top ten percent of SPIS sites, and the top 5 percent of sites are further investigated for safety issues. Table 3-20 identifies the eighteen ODOT 2008 SPIS sites located in Tigard.

As shown in the table, there are several locations on ODOT's SPIS list that were also identified in Table 3-19 with high crash frequencies. Specifically, the following intersections are identified in both Table 3-19 and Table 3-20: the Highway 99W intersections with SW 72nd Avenue, SW Hall Boulevard, SW Greenburg Road, SW Gaarde Street, SW Bull Mountain Road, and SW Royalty Parkway; and, SW Scholls Ferry Road/SW Cascade Avenue.

Table 3-20 ODOT SPIS Listing 2008

Intersection	SPIS Score	# Crashes	Ranking
Highway 99W/SW 64th Avenue/I-5 Southbound Ramps	80.37	41	5%
Highway 99W/SW 72nd Avenue	77.29	49	5%
Highway 99W/SW Garden Place (SW Warner Avenue)	77.18	53	5%
SW Scholls Ferry Road/SW Cascade Avenue SB Ramp	71.60	56	5%
Highway 99W/SW Walnut Street	59.86	25	5%
Highway 99W/SW Gaarde Street/McDonald Street	59.42	48	5%
Highway 99W/SW Durham Road (SW 116th Avenue)	57.47	35	5%
Highway 99W/SW 78th Avenue	56.86	26	5%
Highway 99W/SW Royalty Parkway	56.08	33	5%
Highway 99W/SW Greenburg Road	55.97	32	5%
I-5 Northbound Ramp/SW Upper Boones Ferry Road	55.93	27	5%
I-5 Southbound Ramp/SW Upper Boones Ferry Road	55.09	22	5%
Highway 217/Highway 99W WB Ramp	55.04	11	5%
I-5 Northbound Off-Ramp/North of SW Bonita Road	53.04	22	10%
Highway 99W/SW Canterbury Lane	52.82	20	10%
Highway 99W/SW Fischer Road	50.38	27	10%
Highway 99W/SW Beef Bend Road	49.82	20	10%
Highway 99W/SW Bull Mountain Road	47.12	26	10%

Source: 2008 Oregon Department of Transportation Top 5% and 10% SPIS sites

Washington County SPIS

Washington County also maintains a separate SPIS listing that ranks 275 high accident locations county-wide. In Washington County the SPIS number and rank are based upon the number, rate and severity of accidents at a particular location. The 2004-2006 listing is the most current. Table 3-21 shows the Washington County SPIS sites in the City of Tigard which have a SPIS score above the threshold for further investigation. The table also shows the previous SPIS ranking (years 2002-2004) and SPIS ranking identified in the previous TSP (1997-1999).

Table 3-21 Washington County Safety Priority Index System (SPIS) Intersection Ranking

Intersection	2004-2006 SPIS		Past Rankings	
	# Crashes	Ranking	2002-2004 Ranking	1997-1999 Ranking
SW Scholls Ferry Rd/SW 121st Ave-Boones Bend Dr	40	**27**	14	52
Highway 99W/SW Bull Mountain Rd	40	**48**	66	33
SW Scholls Ferry Road/SW 125th Ave	29	**50**	45	139
SW Scholls Ferry Road/SW Conestoga Drive	27	**58**	24	143
SW Scholls Ferry Road/SW 135th Avenue	36	**59**	116	77
SW Scholls Ferry Road/SW Nimbus Avenue	46	**60**	19	9
SW Greenburg Road/SW Washington Square Road	22	**63**	157	-
Highway 99W/SW Beef Bend Road	23	**65**	101	36
SW Scholls Ferry Road/SW Barrows Road (East)	26	**108**	52	74
SW Hall Boulevard/SW Locust Street	17	**149**	259	208
SW Hall Boulevard/SW Hemlock Street	4	**164**	-	-
SW Durham Road/SW 113th Avenue	4	**197**	-	-
SW Barrows Rd/SW 154th Avenue	8	**245**	-	-
SW Hall Boulevard/SW Greenburg Rd – SW Oleson Road	10	**252**	136	94
SW Greenburg Road/SW Locust Street	9	**267**	-	92

Sources: 2004-2006 Washington County Safety Priority Index System (SPIS) List
2002-2004 Washington County Safety Priority Index System (SPIS) List
1997-1999 Washington County Safety Priority Index System (SPIS) List

As shown in the table, the top ten intersections for the 2004-2006 rankings (with the exception of the SW Greenburg Road/SW Washington Square Road intersection) have consistently been on the Washington County SPIS list, as shown in the historical rankings.

The Highway 99W/SW Bull Mountain Road intersection appears on all three of the tables above, indicating the importance of this intersection to local and state jurisdictions. There was a recent eastbound right-turn lane project completed that may improve safety at the intersection; its effects are not shown in the available data. Several other intersections appear on two of the tables above, indicating potential safety issues at locations pertinent to different jurisdictions.

ACCESS TO SCHOOLS

There are a number of schools in Tigard where the surrounding roadways create barriers for access due to limited width and pedestrian facilities. The following issues were noted in the 2002 TSP and are updated with current information:

- Metzger Elementary: Adequacy of walking paths and adjacent street width
- Mary Woodward School: Difficult for traffic circulation due to school-related congestion

- Fowler Intermediate School: Access from both Walnut Street, which does not have sidewalks, and on Tiedeman Avenue
- Tigard High School: Driveway spacing conflicts
- Templeton Elementary School/Twuality Middle School: Adequacy of sidewalks

The City is continuing to work with the school district to identify remedies to these issues within the context of a Safe Routes to School program.

RAIL

Railroad tracks traverse Tigard from its northern boundary to the southeast. There are two adjacent but separate tracks south from north of North Dakota Street to Bonita Road. South of Bonita Road, one set of tracks crosses the Tualatin River to Tualatin and the other set of tracks turns east to Lake Oswego. They are both owned by Portland & Western (P&W), a sister company of Willamette & Pacific (W&P) Railroad.

TriMet introduced WES (Westside Express Service) Commuter Rail service in February 2009 which connects communities on the southwest side of the metro area to the Beaverton Transit Center. The rail line makes connections in Wilsonville, Tualatin, Tigard, Hall/Nimbus, and Beaverton. The Tigard stop is located at the Tigard Transit Center, just southeast of 99W at Commercial Street. Service is provided weekdays at half-hour frequency during the morning and evening commute periods. During the month of April 2009, average weekly WES trips totaled to 5,850 boardings.

AIR

Tigard is served by the Portland International Airport, located in Northeast Portland on the Columbia River. The Portland International Airport is a major air transportation and freight facility, which serves Oregon and Southwest Washington. It provides a base for over twenty commercial airlines and air freight operations. The Port of Portland reported that 14.3 million passengers were served at the Portland International Airport in 2008.

Tigard is also served by the Portland-Hillsboro Airport, a general aviation facility located in the north central portion of the City. The airport facility is owned and operated by the Port of Portland as part of the Port's general aviation reliever system of airports. The Port of Portland maintains a Master Plan for this facility which was most recently updated in the winter of 2005.

WATER

The Tualatin River is located along the southern border of Tigard. It is used primarily for recreational purposes and is not considered a navigable waterway for commercial vessels. No policies or recommendations in this area of transportation are provided.

PIPELINE

There are high pressure natural gas feeder lines owned and operated by Northwest Natural Gas Company along several routes in Tigard.

ENVIRONMENTAL RESOURCES

This section summarizes current environmental resources within the Tigard Urban Planning Area in order to avoid and limit adverse impacts on them in developing TSP projects and other implementation measures for the TSP update. The environmental conditions depicted and described in this section are planning level and do not replace the more rigorous and detailed level of analysis that must occur as part of project development or land use applications involving discrete sites in the city in the future. The data used to identify environmental resources are drawn primarily from the 2008 Regional Land Information System (RLIS).

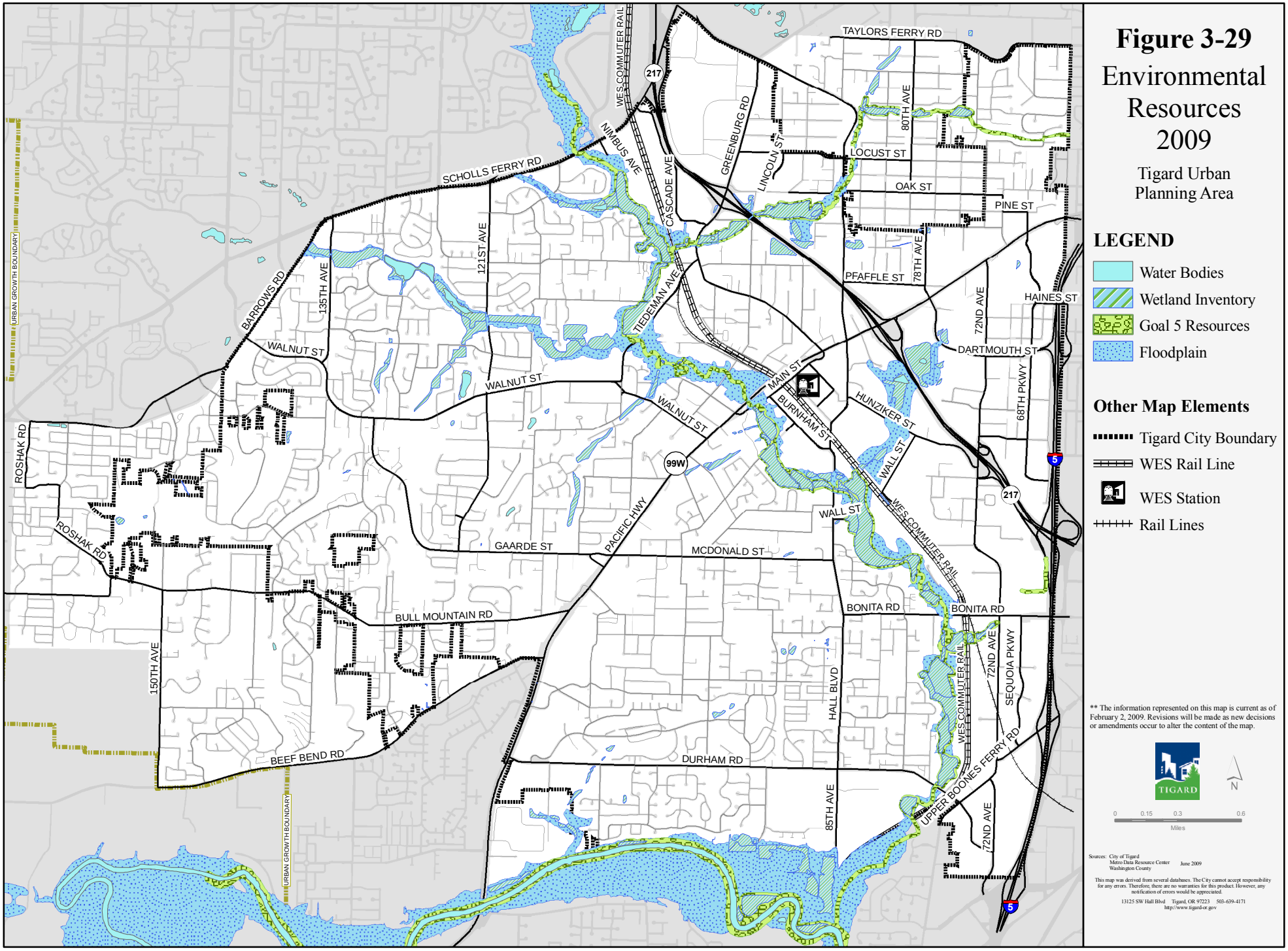
Regionally Significant Fish and Wildlife Habitat

Figure 3-29 displays regionally significant fish and wildlife habitat that were identified as Goal 5 resources by Metro in 2005. Metro staff developed the Goal 5 inventory based on the best existing science and data at the time and input from local agencies, resource agencies, technical review committees, and the public. Metro staff conducted fieldwork to validate and adjust the inventory. The habitat resources in the inventory were then ranked in importance based on their capacity to provide benefits to fish and wildlife. Those levels of importance, however, are not included in the data layer received from the City and shown in Figure 3-26.

The Goal 5 resources identified in Tigard are primarily associated with the Fanno Creek system, which is a tributary of the Tualatin River that passes through Tigard on its journey to the south. There are several points at which existing major transportation facilities in Tigard – collector and arterial roads and WES Commuter Rail – cross through Goal 5 inventory resources in the Fanno Creek Basin. Locations include:

- Scholls Ferry Road, just west of WES Commuter Rail, on the northern border of the city
- An approximately one-mile segment of the creek system that is crossed by several transportation facilities including, from west to east, WES Commuter Rail, Greenburg Road, Highway 217, and Hall Boulevard
- Tiedeman Avenue, between Tigard Street and Walnut Street
- Highway 99W and Main Street, in the Downtown Tigard area
- Hall Boulevard, between WES Commuter Rail and McDonald Street
- Durham Road, directly northwest of WES Commuter Rail and the southern border of the City.

The maps showing locations where transportation facilities and Goal 5 resources overlap will be consulted as projects and other implementation measures for the Tigard TSP Update are developed.



Sources: City of Tigard, Metro 2008 RLIS Lite

Floodplain and Wetlands

Floodplain and wetlands data also are displayed in Figure 3-29. Floodplain data are drawn from the 2008 RLIS geographic database. The data are based on original 1992 Federal Emergency Management Agency (FEMA) 100-year floodplain data with updates in 2001 from local Goal 5 mapping efforts and in 2004 from Tualatin Basin floodplain surveys. The wetland data layer combines the National Wetland Inventory (NWI) data compiled by U.S. Fish and Wildlife Service and local government updates.

Intersection of these habitat resources and major transportation facilities basically correspond with the same locations identified above, with the addition of the following:

- Barrows Road, between 135th Avenue and Walnut Street, on the northwestern border of the City
- Highway 217, between 72nd Avenue and Highway 99W.

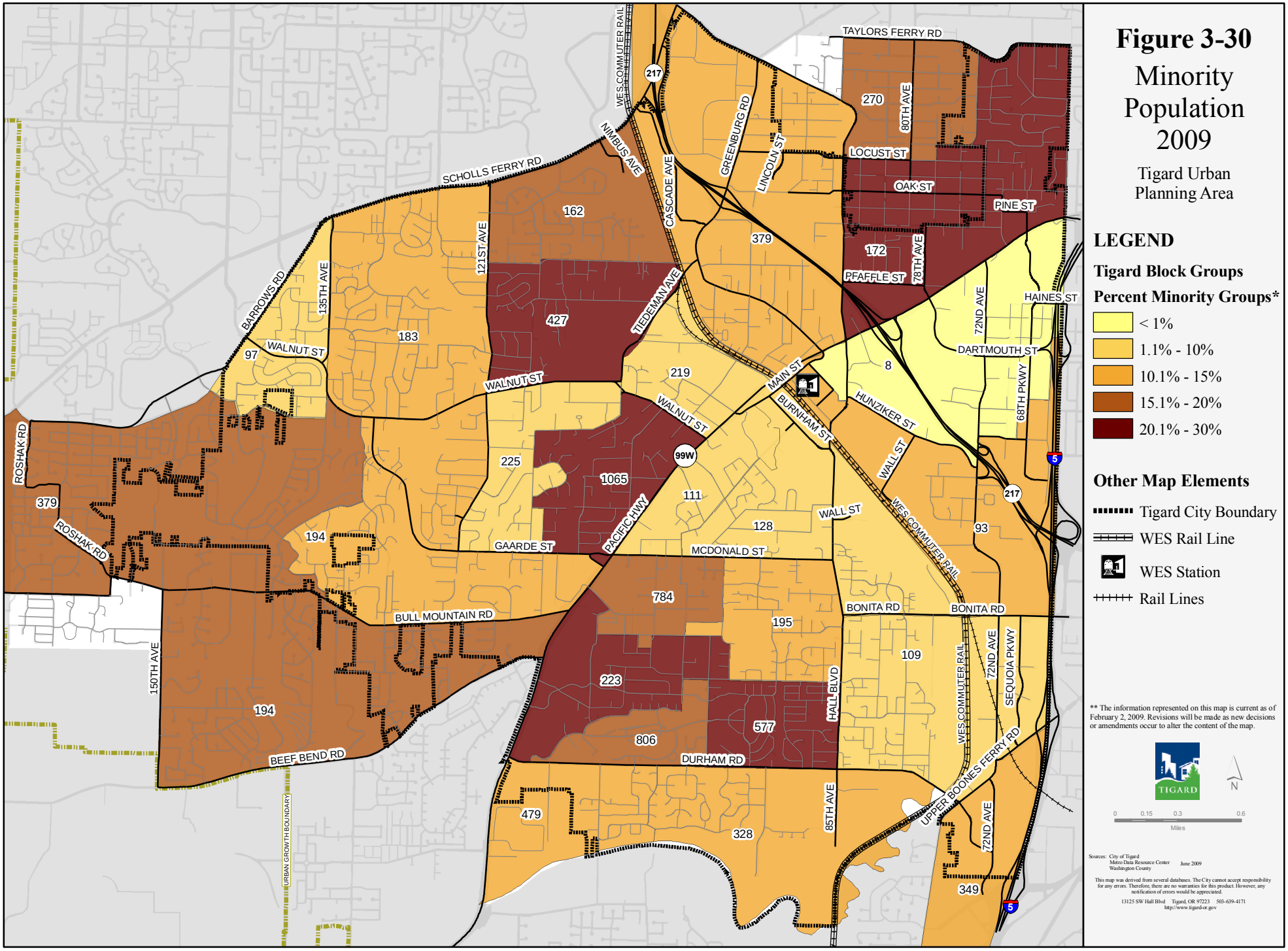
SOCIOECONOMIC CONDITIONS

The identification of socioeconomic conditions relates to environmental justice concerns for the purpose of meeting the needs and avoiding undue adverse impacts to these populations when examining future projects and needs. In order to receive federal funding for transportation improvements, cities must demonstrate that proposed projects or programs do not discriminate against people based on race, color, national origin, age, sex, disability, religion, or income. In the context of preparing for possible transportation improvement projects, the socioeconomic conditions in terms of the following sensitive populations were identified:

- Minority groups – people who did not self-identify as White-Non Hispanic
- Low-income residents – people who earned between 0 and 1.99 times the federal poverty level in 1999
- Seniors – people 65 years of age or older in 2000
- Non-English speakers – people who stated that they did not speak any English at all in 2000
- People with disabilities – people 5 years or older with any type of disability: sensory, physical, mental, self-care, go-outside-the-home, or employment.

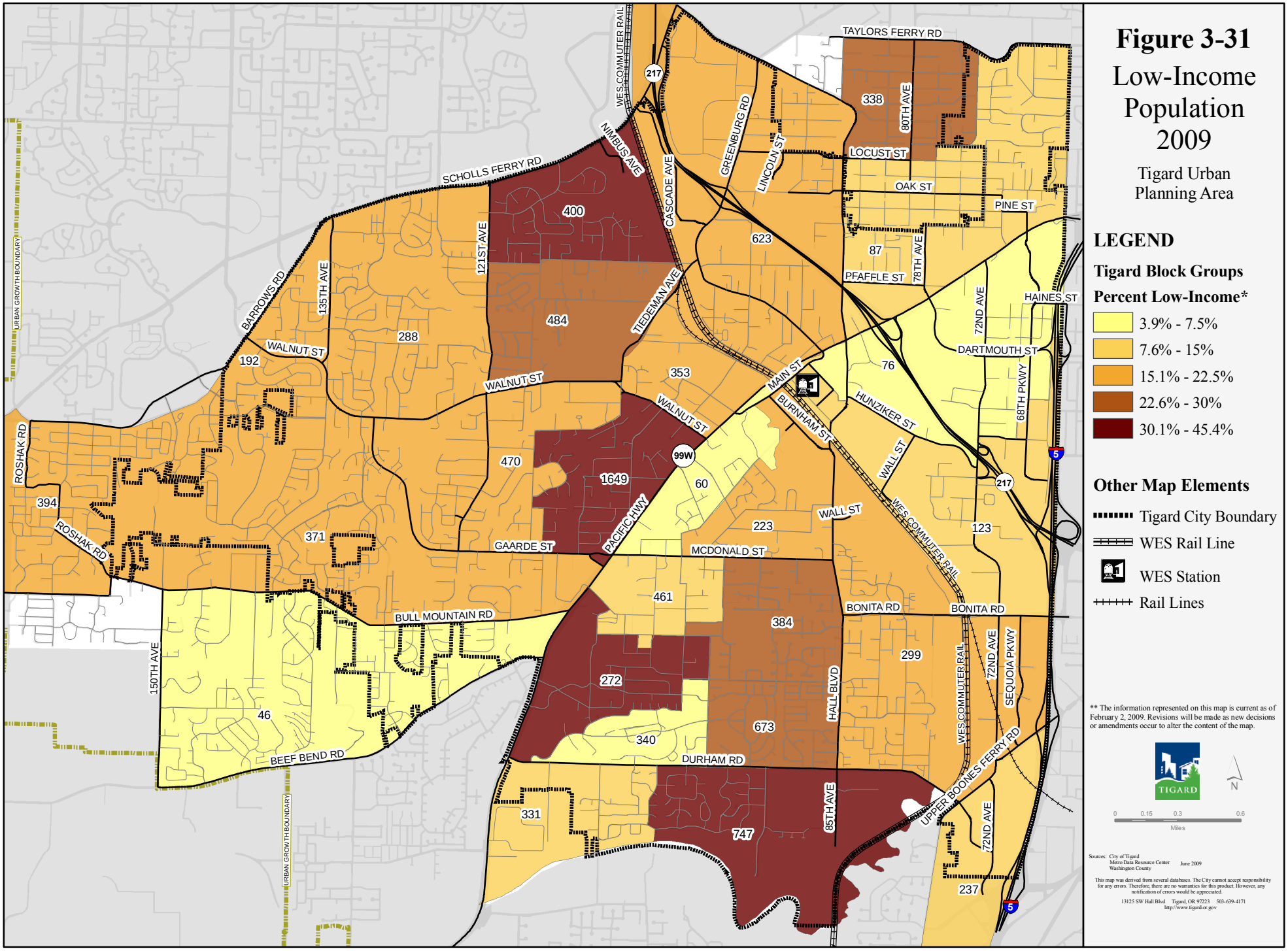
The data displayed in Figures 3-30 through 3-34 are derived from 2000 Census data for Block Groups in the City of Tigard, the most detailed level of Census geography for which some of this data are available. The boundaries of the Block Groups do not perfectly coincide with the Tigard TSP Plan area.[2] Yet they effectively illustrate variation in socioeconomic conditions across the city.

[2] There are small areas between Oleson Road and Hall Boulevard and between Bull Mountain Road and 150th Avenue that are in the study area but outside of the Block Groups, and then a Block Group near the I-5/Boones Ferry Road interchange that extends beyond the study area.



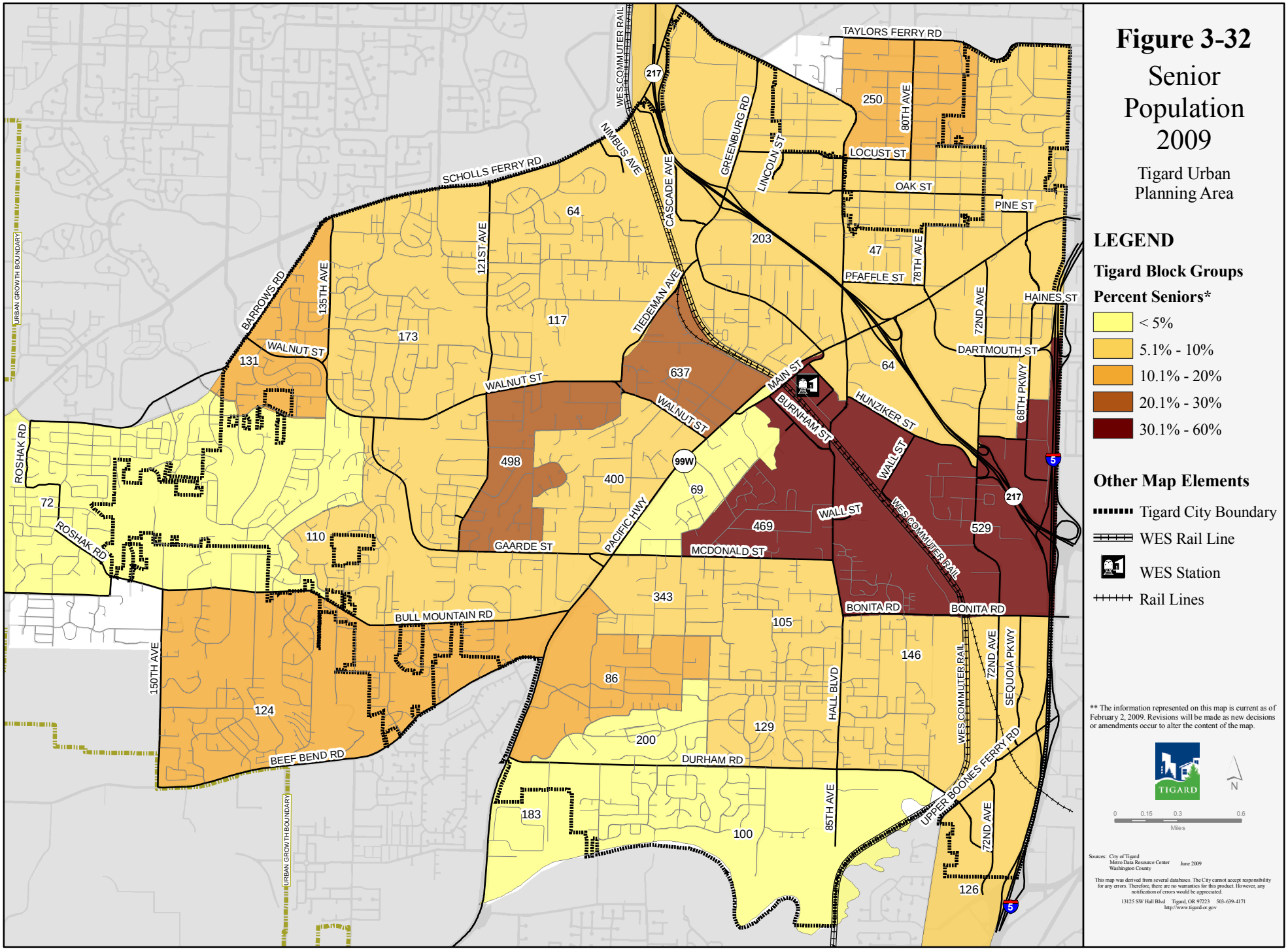
* Persons who did not self-identify as White-Non Hispanic as a percent of all block group residents

Note: Numbers shown on the map represent the total minority population in the Census Block Group, Sources: 2000 Census, 2008 RLIS Lite



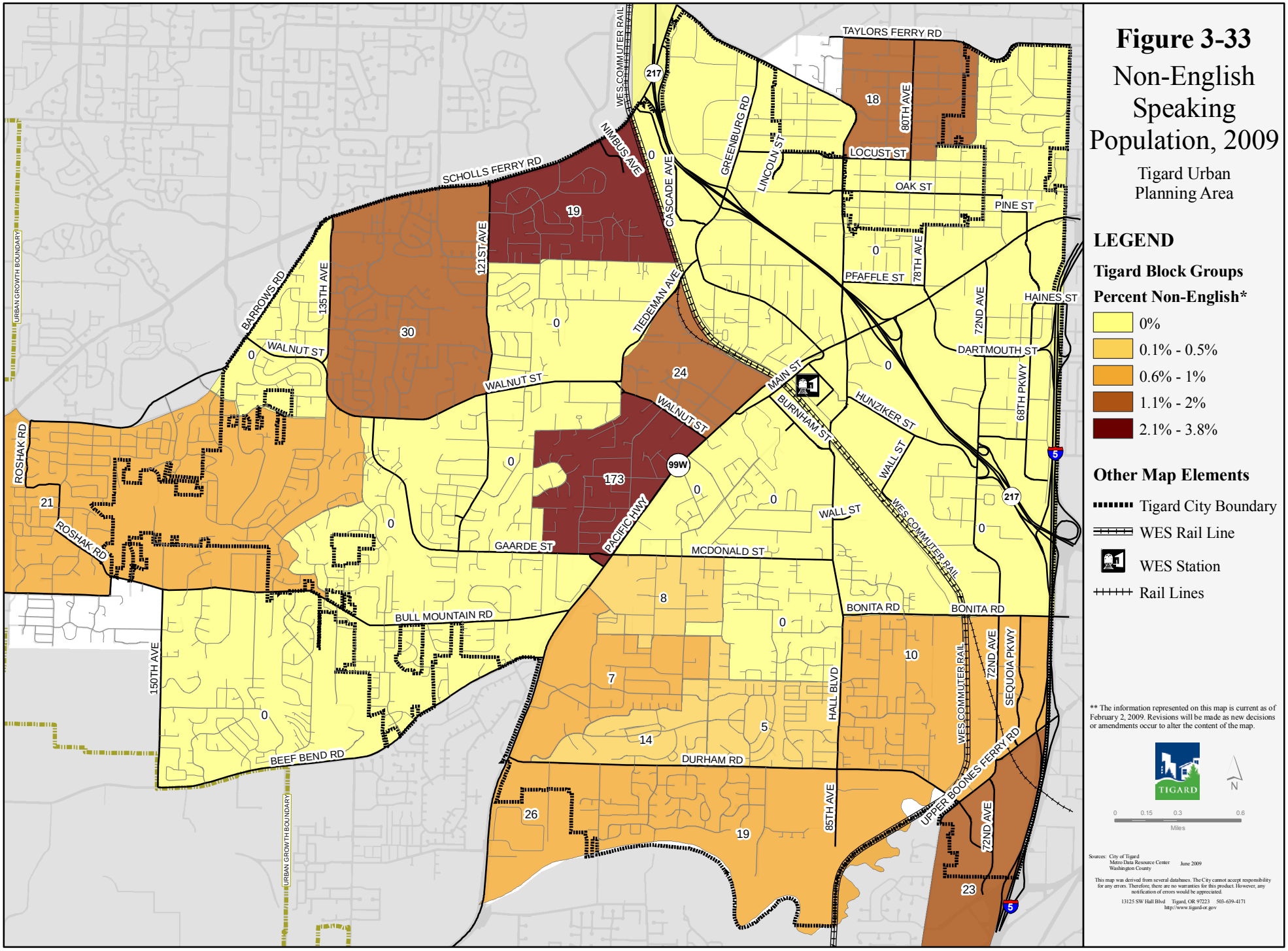
* Persons who earned between 0 and 1.99 times the Federal Poverty Level in 1999 as a percent of all block group residents

Note: Numbers shown on the map represent the total number of low-income residents in the Census Block Group, Sources: 2000 Census, 2008 RLIS Lite



* Persons 65 years of age or older in 2000 as a percent of all blockgroup residents

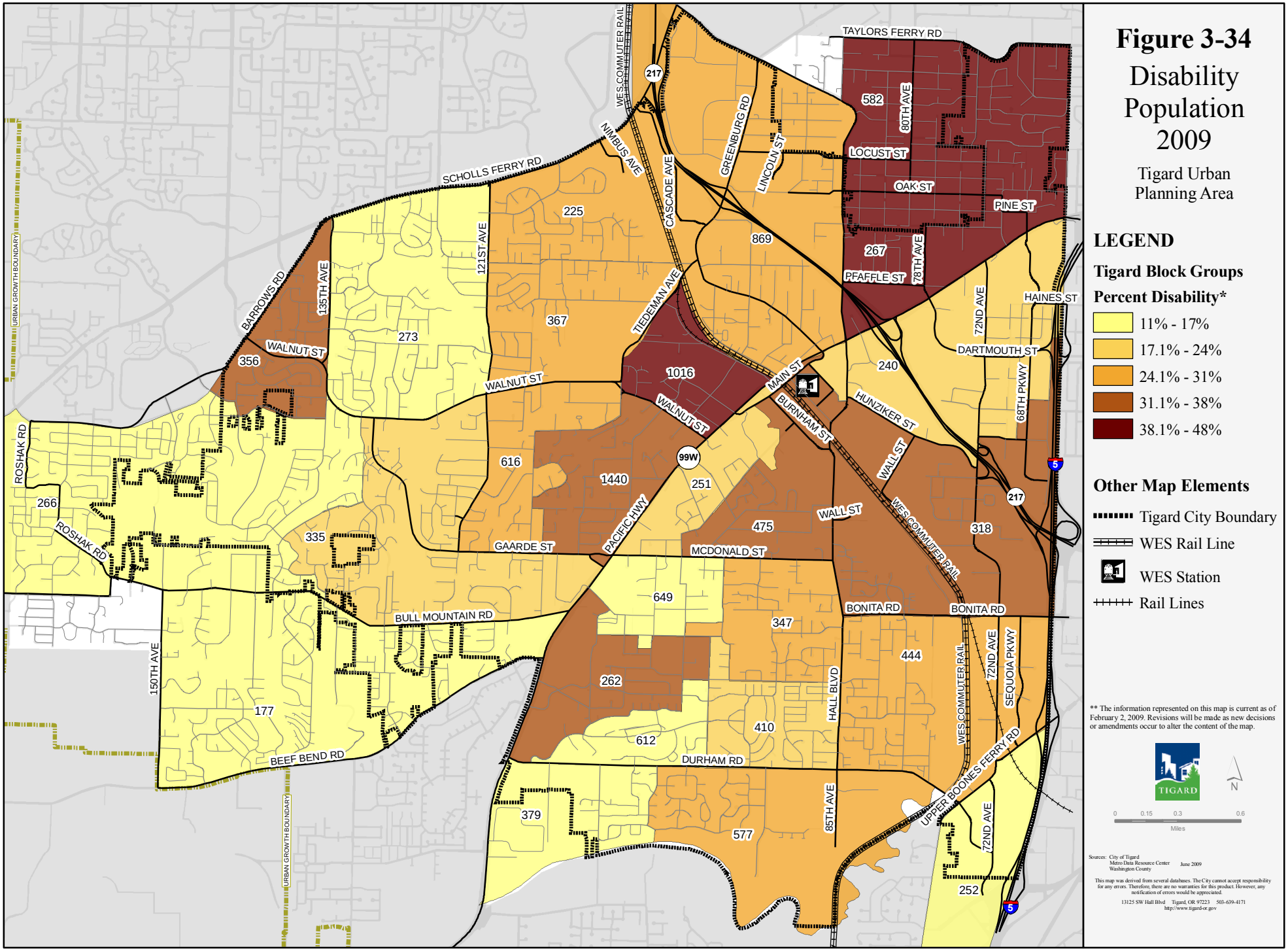
Note: Numbers shown on the map represent the total number of people age 65 and older in the Census Block Group, Sources: 2000 Census, 2008 RLIS Lite



* Persons who state that they did not speak any English at all in 2000 as a percent of all block group residents over age 5

Note: Numbers shown on the map represent the total number of non-English speakers in the Census Block Group

Sources: 2000 Census, 2008 RLIS Lite



* All persons 5 years or older with any type of disability: sensory, physical, mental, self-care, go-outside-the-home, or employment, as a percent of all block group residents
Note: Numbers shown on the map represent the total number of people with disabilities in the Census Block Group
Sources: 2000 Census, 2008 RLIS Lite

Table 3-22 presents the size of these populations and their percentage as a proportion of the total population in the City of Tigard.

Table 3-22 Population Counts and Percentages in the City of Tigard

Population	Count	Percent
Minority	6,420	15.6%
Low-income	7,490	19.1%
Seniors	4,275	10.4%
Non-English Speakers	320	0.8%
People with Disabilities	9,400	24.7%

Source: 2000 Census, Summary File 3 (SF#) – Sample Data.
Note: Population counts are rounded to the nearest five.

Other than identifying those Block Groups with the highest numbers and concentrations of these populations, comparing numbers and percentages of individual populations between Block Groups and the City overall offers a way of identifying areas of socioeconomic sensitivity in the city. Using these methods, the following observations can be made.

- The highest concentrations of minority groups, ranging from roughly 24 to 28 percent, are found in the Block Groups along Highway 217 and along Highway 99W immediately southwest of the highway. Those concentrations generally correspond with Block Groups containing the highest poverty rate; three of the Block Groups have low-income rates of 33-45 percent compared to 19 percent citywide. These Block Groups also include older established neighborhoods with smaller lot sizes and higher-density housing located near major transportation corridors. Higher-density housing and smaller lot sizes tend to provide more affordable housing, thus attracting lower-income residents.
- There are high numbers of minority residents in Block Groups in the western and northwestern part of the city, where the city transitions to rural and agricultural uses. It is possible that agricultural workers represent the high numbers of minority residents here.
- There also are high numbers of low-income residents in the northwestern part of the city, perhaps also corresponding to potential agricultural workers living in that area. The explanation for the high number of low-income residents in the Block Group at the southeastern edge of the city and extending well south of the city along the west side of I-5 is less apparent but may be related proximity in a major freeway corridor, which contains less desirable housing for more affluent residents and also features higher-density, more affordable housing.
- Block Groups with high concentration of non-English speakers are similar to the patterns for minority and low-income populations in the city. In contrast, however, the total numbers and percentages are much lower than these other populations and the non-English speaking population is primarily concentrated in one Block Group in the Highway 217 corridor, around Greenburg Road and the Washington Square area, where over half of the city's non-English speakers reside.

- There are generally higher concentrations of the senior population closer in to the core of the city (near Downtown and along the Highway 217 corridor and Highway 99W corridor southwest of Highway 217) and lower concentrations toward the fringes of the city with newer development. The highest concentrations of senior residents, however, occur in the southern portion of the city between Highway 99W and Durham Road. This area of the City and Highway 99W is close to King City, which has a large senior population. There also may be assisted living or other care facilities in these Block Groups that account for such high elderly concentrations. The percentage of seniors in these Block Groups range from 30-60 percent, compared to a city average of 10 percent.
- The type of disabilities surveyed in the Census include a wide range, and the total number and percentage of people with disabilities in the city is relatively high – 9,400 residents, almost 25 percent. The numbers and percentages of people with disabilities per Block Group somewhat follow patterns shown by other populations. There are large numbers in the southern part of the city between Highway 99W and Durham Road, where high numbers and percentages of senior residents are found, which is to be expected.
- Large numbers of people with disabilities also occur where concentrations of minority, low-income, and non-English-speaking residents are found in the Washington Square area as well as in the western/northwestern part of the city, where other high numbers of low-income and minority residents occur. This relationship of disabilities to low income – particularly if the disability affects a person's ability to work – is predictable, but the relationship between minority and non-English-speaking populations is less clear.

REFERENCES

1. ODOT. *Oregon Highway Plan*. July 2006 update.
2. Metro. *2035 Regional Transportation Plan*. January 2008.
3. ODOT. *Transportation Planning Rule Guidelines*. April 2006.
4. Transportation Research Board. *Transit Capacity and Quality of Service Manual*. 2003.
5. Transportation Research Board. *Highway Capacity Manual*. 2000.

Tigard Updated TSP
Chapter 3 Base Year (2008-2009) Conditions Analysis
Technical Appendices

List of Appendices

A. Typical Street Cross-Sections from the 2002 Transportation System Plan

B. Local Street Connectivity Figures

C. Tigard Traffic Signal Ownership Table

D. 2008 Base Year Intersection Lane Configurations and Control Devices

E. Travel Time Data

F. 2008 Base Year Intersection Operations and Queuing Analyses, Weekday PM Peak Hour

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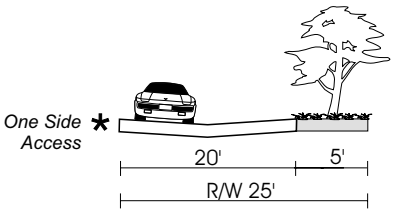
I. Signal Warrant Analysis Worksheets

Appendix A

Typical Street Cross-Sections from the 2002 Transportation System Plan

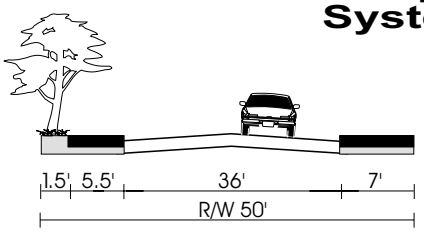
CITY OF TIGARD

Transportation System Plan

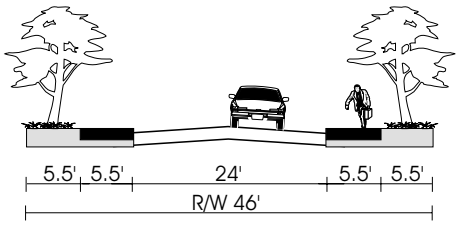


Alley

(No parking)



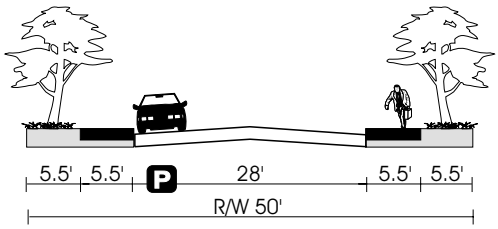
Industrial/Commercial Local



Cul-de-sac/Residential Local Street

<200 vpd

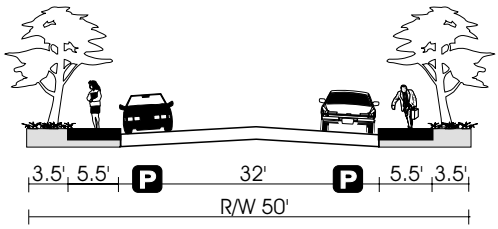
(No parking)



Residential Local Street/Cul-de-sac

One Side On-street Parking

<500 vpd



On-street Parking

<1500 vpd *

If parking on both sides, block length not to exceed 600 feet

Notes:

1. *Selection of placement of sidewalk and planter strip specific to application.*
2. *Width of curb is included in sidewalk width when adjacent to street.*
3. *Samples show the desirable applications given number of lanes; minimum standards can be applied case by case.*
4. *Actual width of street and sidewalk area can be adjusted within R/W based on modal priorities and adjacent land use.*
5. *Volume guides represent estimated Full Buildout Conditions, not just existing or project needs.*
6. *The 36' street shall be used in any area adjacent to commercial or industrial zoning. Sidewalk would be 7' curb tight in Commercial areas and 5.5' for Industrial areas (cross section shows both samples).*
7. *Where existing street curb to curb widths vary from those shown, the minimum length of new cross section should be (or have the potential to be) 500 feet contiguous.*

P *- On-street Parking*

<1500 vpd *- Guide for Traffic Volume Per Day (does not require conversion of existing routes)*

* *Where volume exceeds 1500 vpd, this cross section may still be utilized however land use actions or roadway projects impacting such streets may require additional connectivity to reduce volume and/or neighborhood traffic management measures to reduce impacts.*

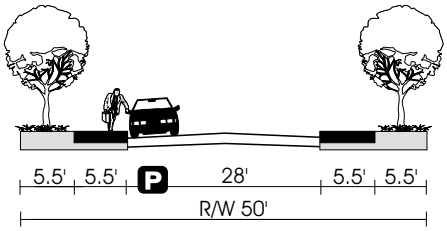
Criteria

Vehicle Lane Widths: *(minimum widths)*	*9 to 10 ft.*
On-Street Parking	*8 ft.*
Sidewalks: *(minimum width)*	*5 ft.*
Landscape Strips:	*Where Appropriate*
Neighborhood Traffic Management:	*Should not be necessary (under special conditions & over 1500 vpd)*

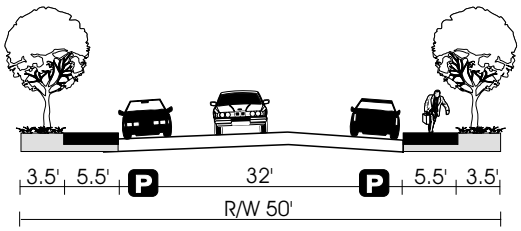
Figure 8-8

ALLEY, CUL-DE-SAC AND LOCAL STREET SAMPLE STREET CROSS SECTIONS REQUIRED ROW WIDTH

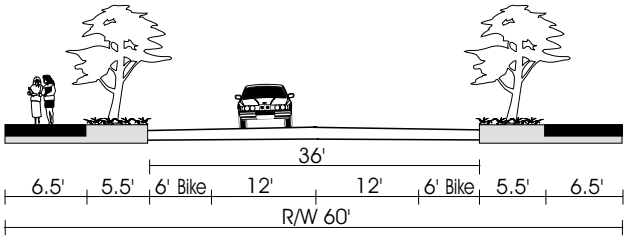
CITY OF TIGARD
Transportation System Plan



No Parking on One Side



With Parking on Both Sides



With Bike Lanes / No Parking

Notes:

1. *Selection of placement of sidewalk and planter specific to application.*
2. *Width of curb is included in sidewalk width when adjacent to street.*
3. *Samples show the desirable applications given number of lanes; minimum standards can be applied case by case.*
4. *Actual width of street and sidewalk area can be adjusted within R/W based on modal priorities and adjacent land use.*
5. *These are guidelines for future neighborhood route development and does not require changes/conversion to existing streets.*

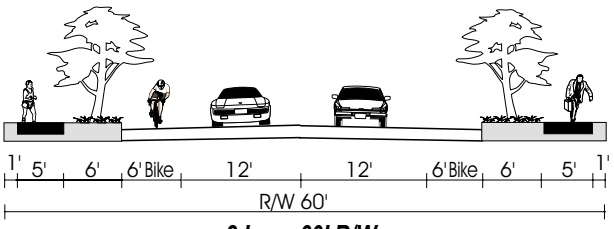
Criteria

Vehicle Lane Widths: *(minimum widths)*	*9-10 ft.*
On-Street Parking	*8 ft.*
Curb Extensions for Pedestrians:	*Consider on Pedestrian Routes*
Sidewalks: *(minimum width)*	*5 ft.*
Landscape Strips:	*Where Appropriate*
Neighborhood Traffic Management:	*Appropriate when Warranted*

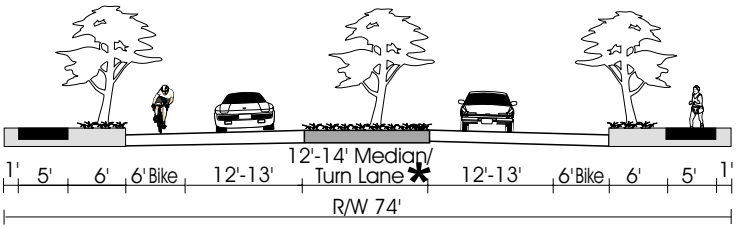
P - *On-street Parking*

Figure 8-9
NEIGHBORHOOD
SAMPLE STREET CROSS SECTIONS
REQUIRED ROW WIDTH

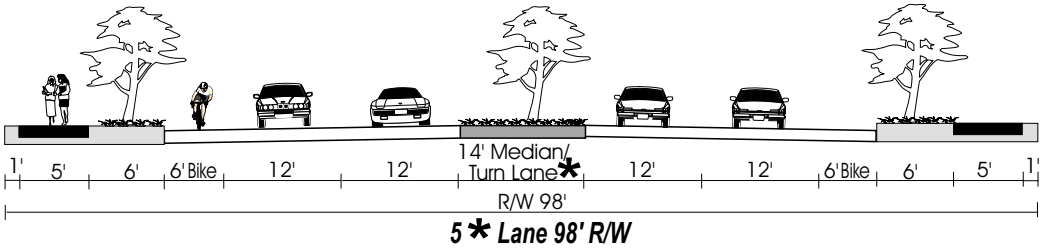
CITY OF TIGARD
Transportation System Plan



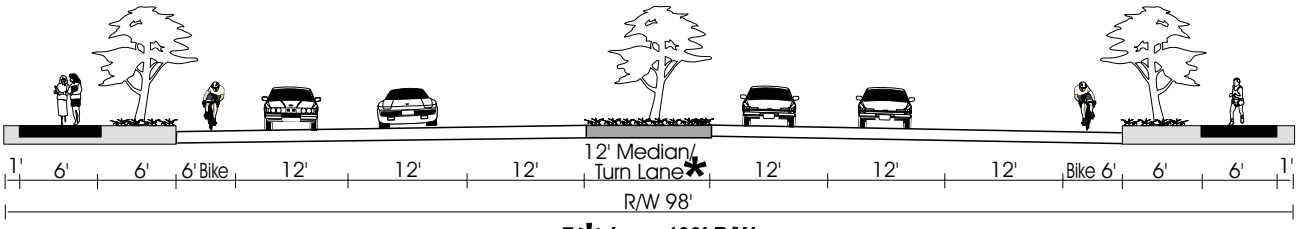
2 Lane 60' R/W



3* Lane 74' R/W



5* Lane 98' R/W



7* Lane 122' R/W

Criteria

Vehicle Lane Widths: *(minimum widths)* ***Collector***	*Truck Route = 12 ft.* *Bus Route = 12 ft.* *11 ft. (12 ft. Preferred)* *10-11 ft.*
On Street Parking:	*None (with few existing exceptions)*
Bicycle Lanes: *(minimum widths)*	*New Construction = 6 ft.* *Reconstruction = 5 to 6 ft.*
Sidewalks: *(minimum width)*	*5-13 ft. Consider Curb Extensions on Ped Routes*
Landscape Strips:	*Required*
Medians:	*5/7 Lane = Required* *3 Lane = Optional*
Neighborhood Traffic Management:	*Only Under Special Conditions: Selected Measures*

** Note that, sidewalk widths above 6 ft. may require additional right-of-way. Where appropriate, the median/lane may not be provided resulting in 2,4 and 6 lane cross sections. The removal of the center turn lane must consider both safety and pedestrian needs.*

Figure 8-10
ARTERIAL AND COLLECTOR SAMPLE STREET CROSS SECTIONS REQUIRED ROW WIDTH

Appendix B

Local Street Connectivity Figures

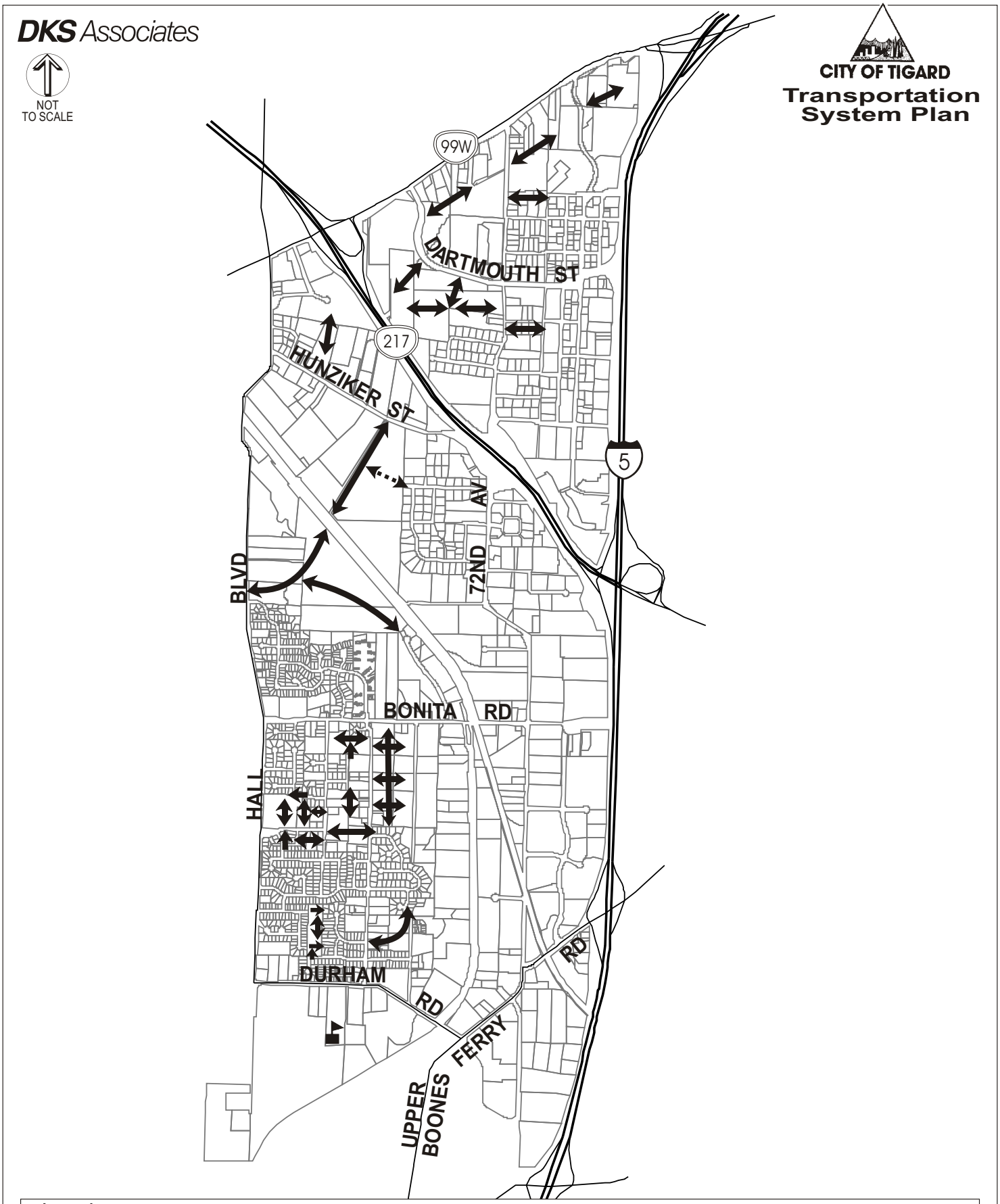
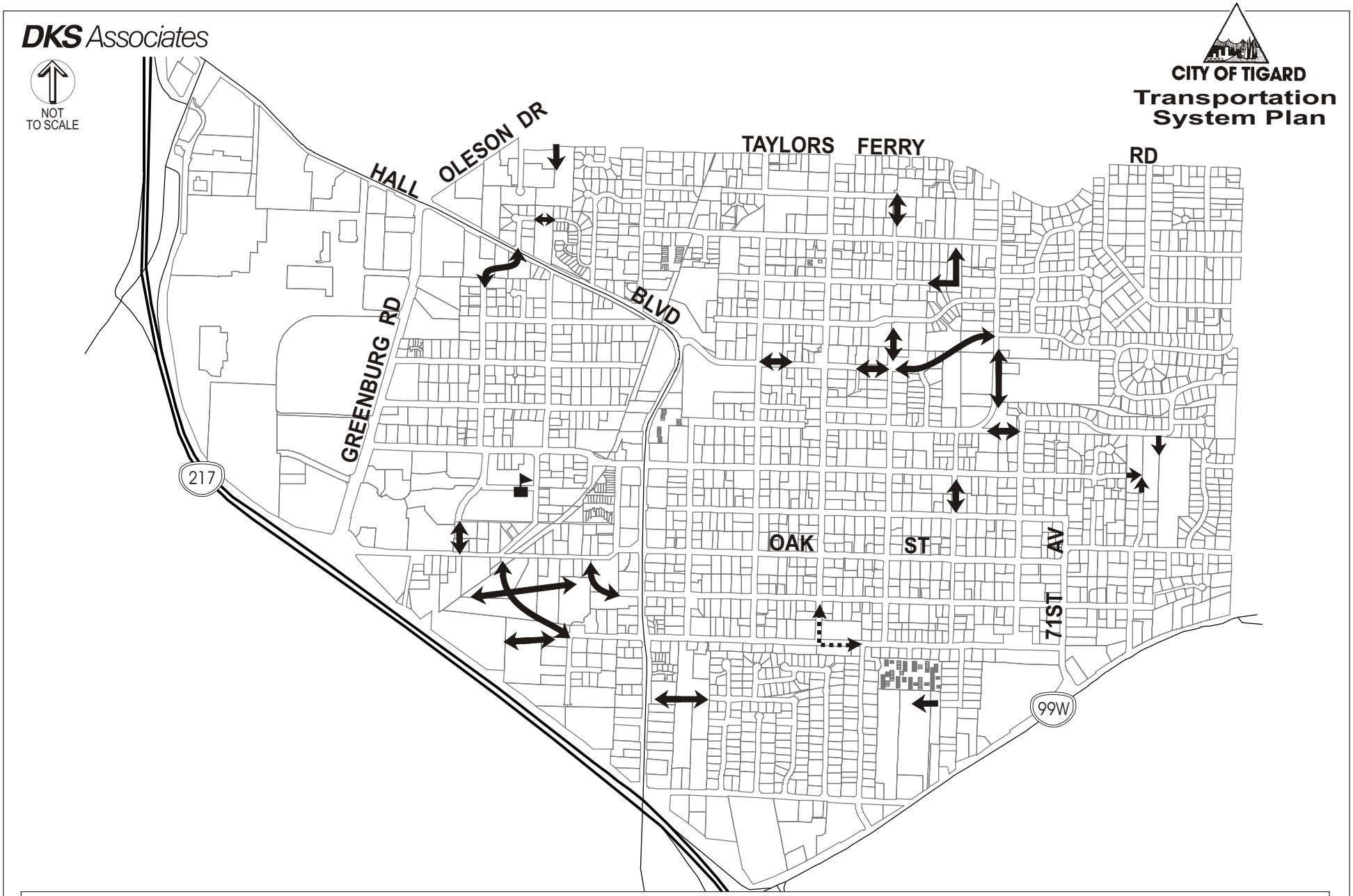


Figure 8-12
LOCAL STREET CONNECTIVITY
East Tigard



Legend

- Stub End Street
- Pedestrian Connection
- School Site

Figure 8-13
LOCAL STREET CONNECTIVITY
Metzger

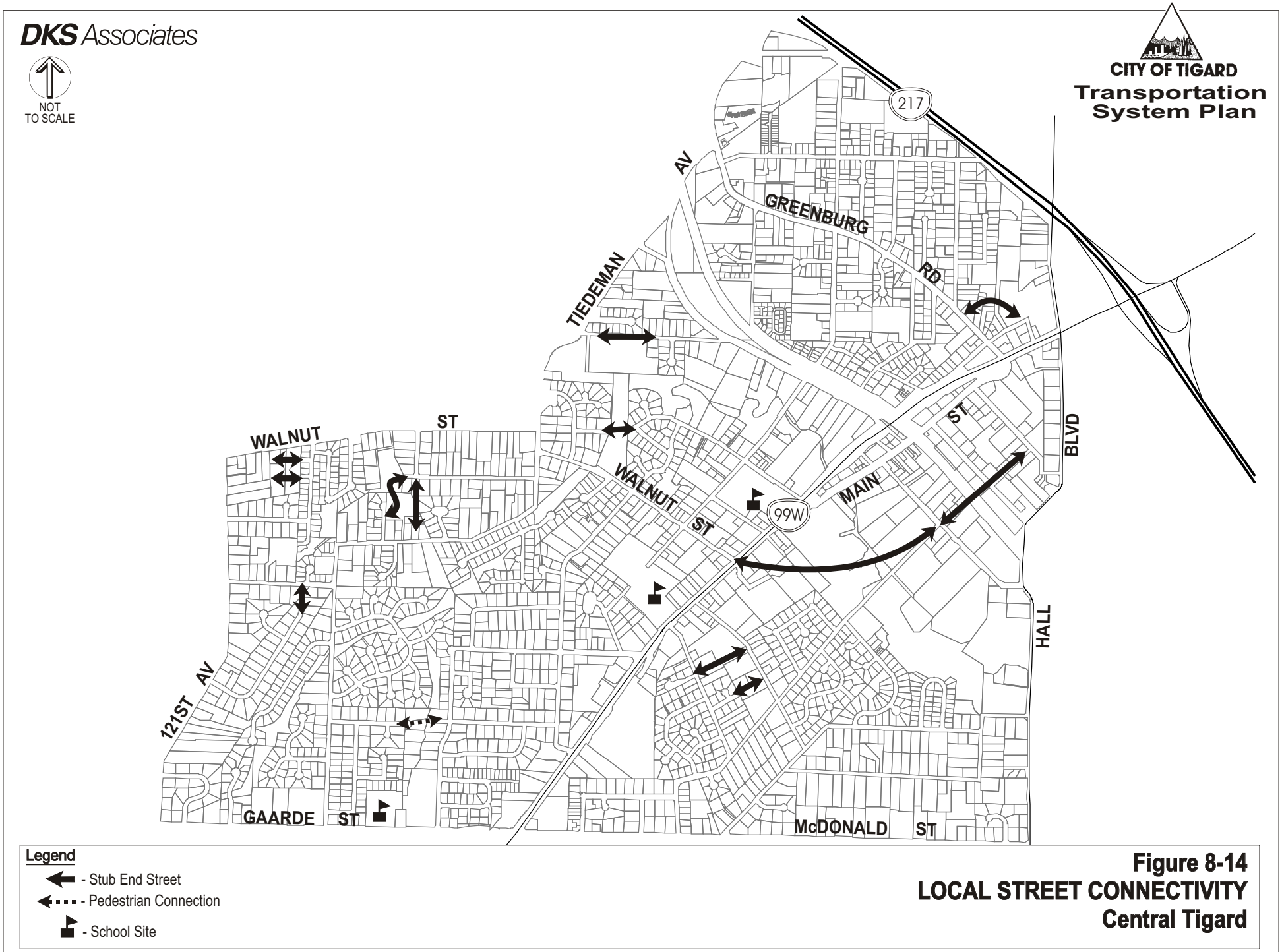
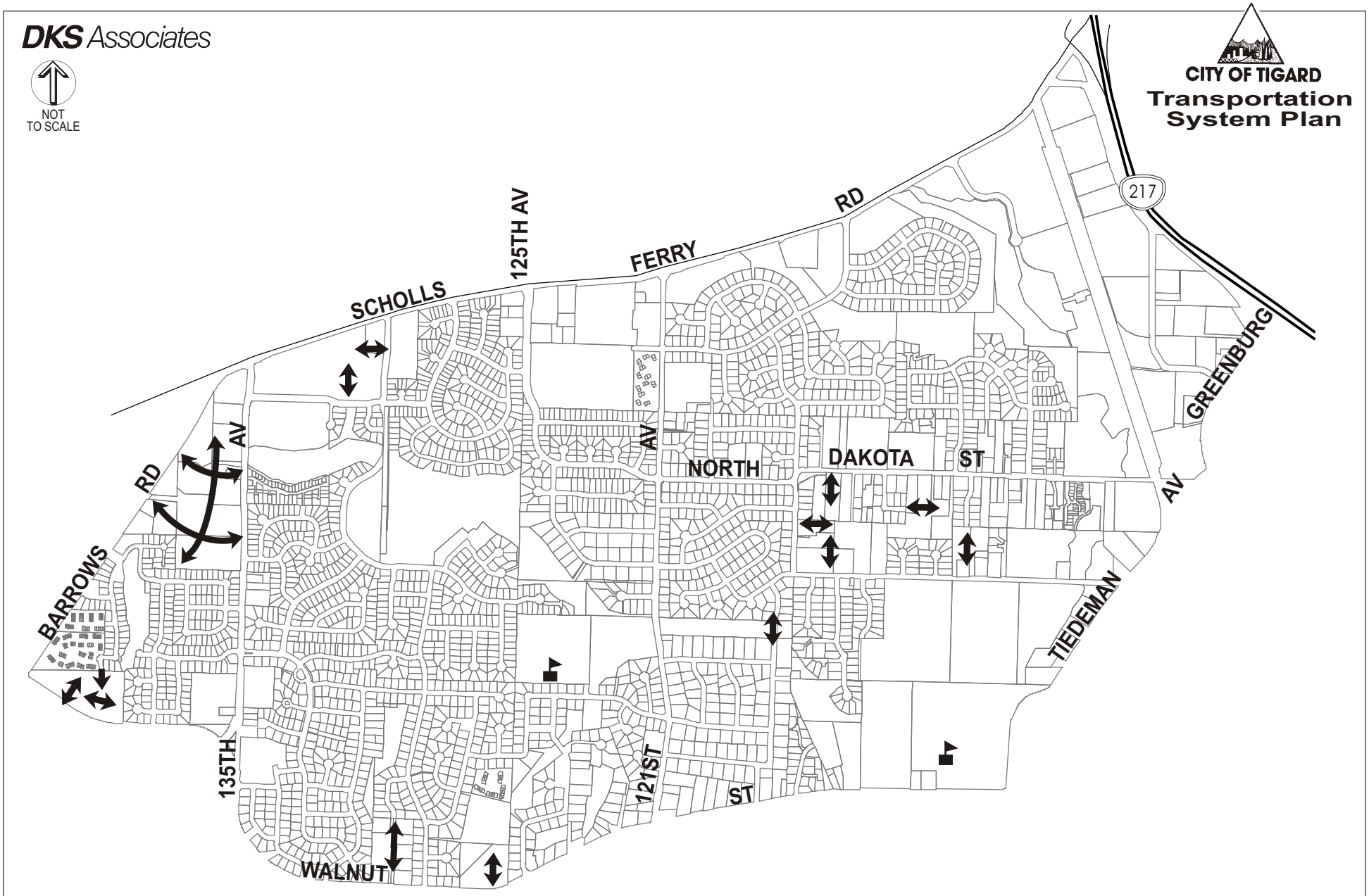


Figure 8-14
LOCAL STREET CONNECTIVITY
Central Tigard



Legend

- Stub End Street
- Pedestrian Connection
- School Site

Figure 8-15
LOCAL STREET CONNECTIVITY
North Dakota

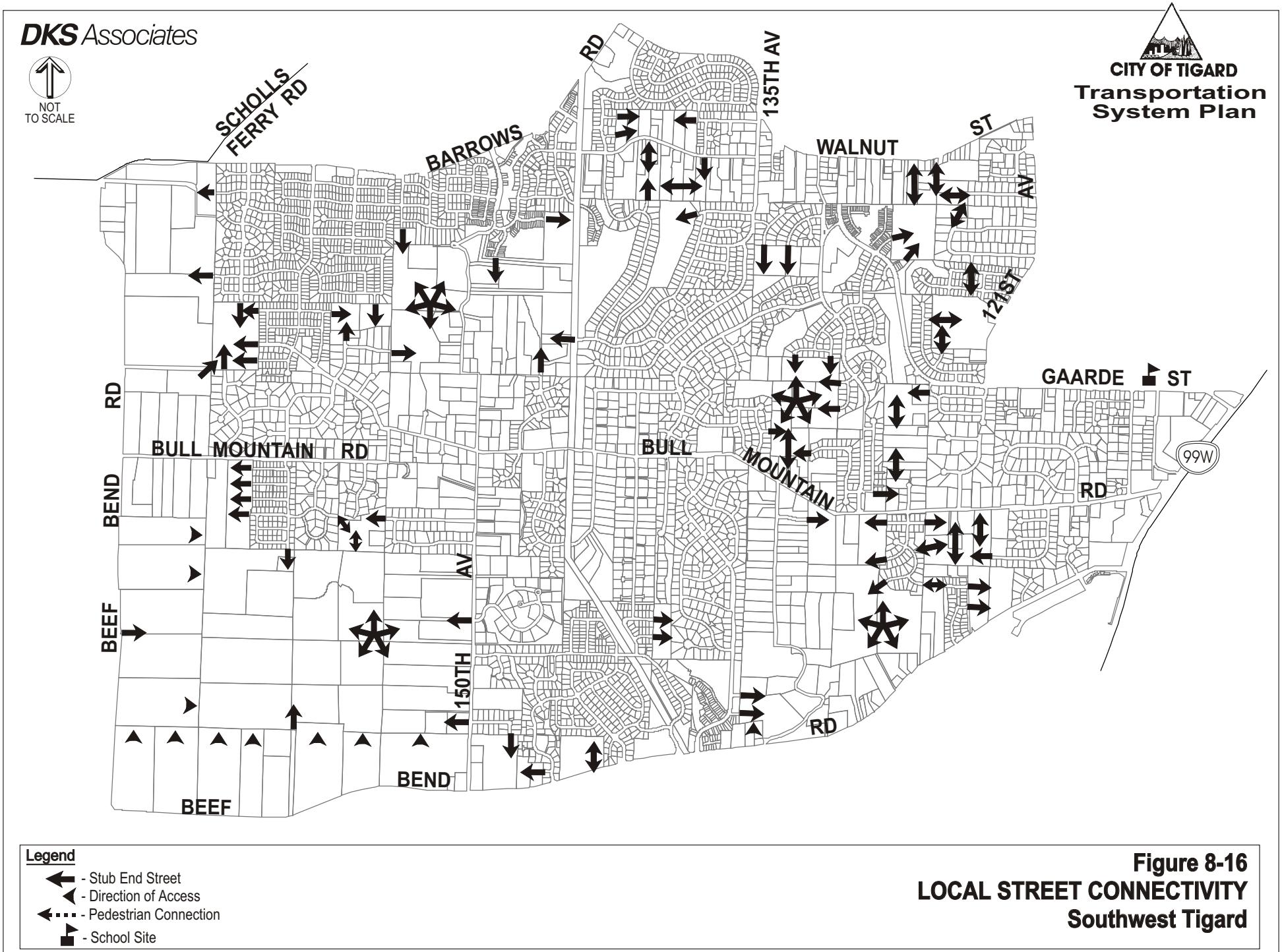
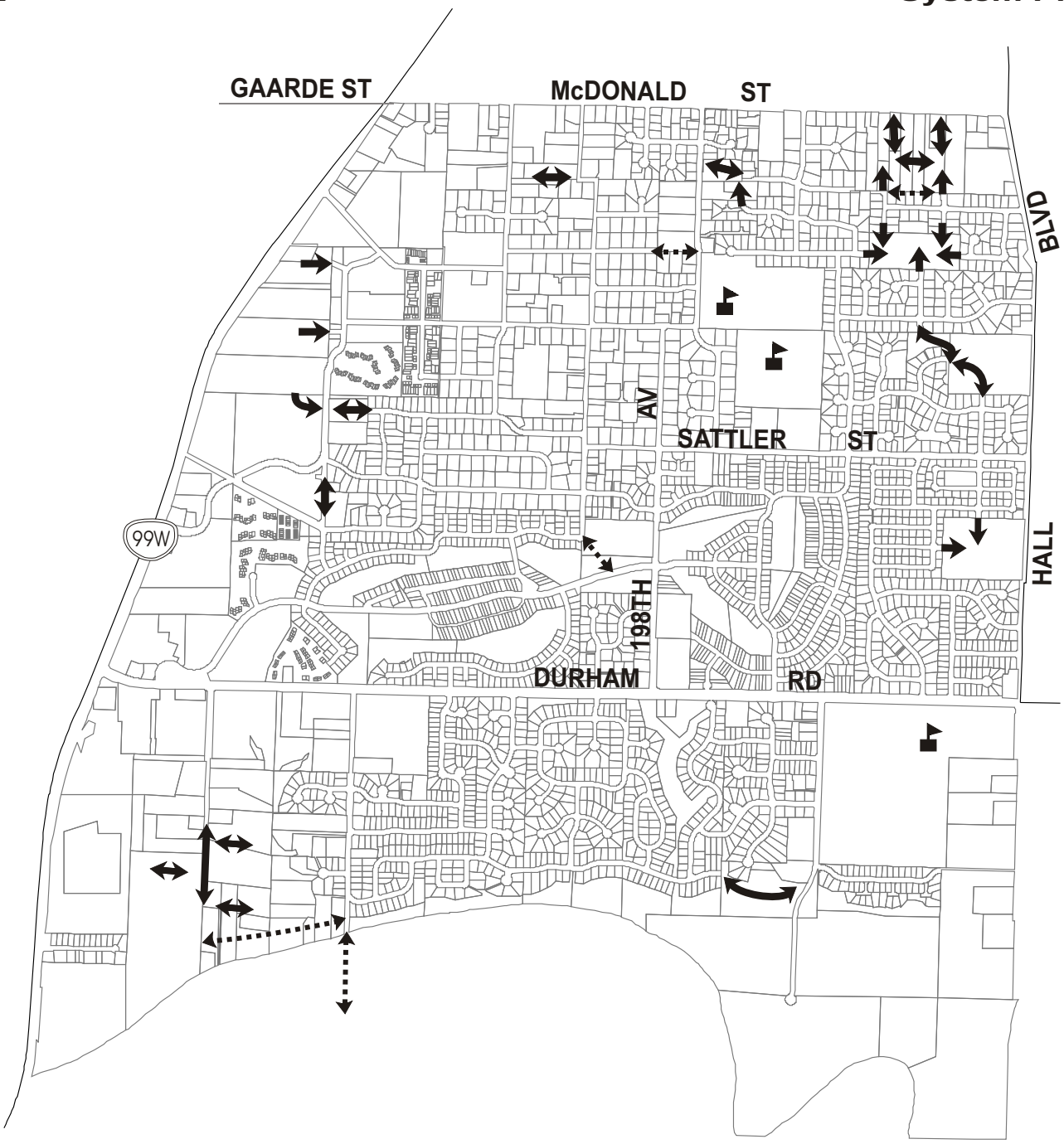


Figure 8-16
LOCAL STREET CONNECTIVITY
Southwest Tigard

DKS Associates

NOT TO SCALE

CITY OF TIGARD
Transportation System Plan



Legend
- Stub End Street
- Pedestrian Connection
- School Site

Figure 8-17
LOCAL STREET CONNECTIVITY
South Tigard

Appendix C Tigard Traffic Signal Ownership Table

OBJECTID	UNITID	CONTRLOC	PHASING_NS	PHASING_EW	STREET1	STREET2	OWNER	MAINT	SOURCE
295	11020	SE			121ST AVE	GAARDE ST			
296	11021		PRPE		121ST AVE	GAARDE ST			OSD
297	11022			PRPRO	121ST AVE	GAARDE ST			OSD
298	11023		PRPE		121ST AVE	GAARDE ST			OSD
299	11024			PRPE	121ST AVE	GAARDE ST			OSD
16	10020	NW			121ST AVE	SCHOLLS FERRY RD	WASCO	COB	
329	10021				121ST AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
330	10022				121ST AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
331	10023				121ST AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
332	10024				121ST AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
15	10010	NW			121ST AVE	WALNUT ST	COT	WASCO	
216	10011		PRPE		121ST AVE	WALNUT ST	COT	WASCO	OSD
217	10012			PRPE	121ST AVE	WALNUT ST	COT	WASCO	OSD
218	10013		PRPE		121ST AVE	WALNUT ST	COT	WASCO	OSD
219	10014			PRPE	121ST AVE	WALNUT ST	COT	WASCO	OSD
44	10040	NE			125TH AVE	CONESTOGA DR	COB	COB	
382	10041				125TH AVE	CONESTOGA DR	COB	COB	OSD
383	10042				125TH AVE	CONESTOGA DR	COB	COB	OSD
384	10043				125TH AVE	CONESTOGA DR	COB	COB	OSD
385	10044				125TH AVE	CONESTOGA DR	COB	COB	OSD
14	10050	SE			125TH AVE	SCHOLLS FERRY RD	WASCO	COB	
333	10051				125TH AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
334	10052				125TH AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
335	10053				125TH AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
336	10054				125TH AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
13	10060	SE			130TH AVE	SCHOLLS FERRY RD	WASCO	COB	
337	10061				130TH AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
338	10062				130TH AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
339	10063				130TH AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
340	10064				130TH AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
12	10070	SE			135TH AVE	SCHOLLS FERRY RD	WASCO	COB	
341	10071				135TH AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
342	10072				135TH AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
343	10073				135TH AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
344	10074				135TH AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
72	10160	SW			72ND AVE	BEVELAND ST	COT	WASCO	
291	10161		PRPE		72ND AVE	BEVELAND ST	COT	WASCO	OSD
292	10162			PRPE	72ND AVE	BEVELAND ST	COT	WASCO	OSD
293	10163				72ND AVE	BEVELAND ST	COT	WASCO	OSD
294	10164				72ND AVE	BEVELAND ST	COT	WASCO	OSD
23	10090	NE			72ND AVE	BONITA RD	COT	WASCO	
168	10093		PRPE		72ND AVE	BONITA RD	COT	WASCO	OSD
169	10094			PRPRO	72ND AVE	BONITA RD	COT	WASCO	OSD
170	10091		PRPRO		72ND AVE	BONITA RD	COT	WASCO	OSD
171	10092			PRPE	72ND AVE	BONITA RD	COT	WASCO	OSD
6	10120	NE			72ND AVE	BRIDGEPORT RD	COT	WASCO	
123	10123			PRPRO	72ND AVE	BRIDGEPORT RD	COT	WASCO	OSD
124	10122		PRPE		72ND AVE	BRIDGEPORT RD	COT	WASCO	OSD
125	10121			PRPE	72ND AVE	BRIDGEPORT RD	COT	WASCO	OSD
126	10124		PRPE		72ND AVE	BRIDGEPORT RD	COT	WASCO	OSD
75	10170	SE			72ND AVE	CARMEN DR	COT	WASCO	
127	10173		PRPRO		72ND AVE	CARMEN DR	COT	WASCO	OSD
128	10171		PRPE		72ND AVE	CARMEN DR	COT	WASCO	OSD
129	10174			PRPE	72ND AVE	CARMEN DR	COT	WASCO	OSD
130	10172			PRPRO	72ND AVE	CARMEN DR	COT	WASCO	OSD
22	10080	NW			72ND AVE	DURHAM RD	COT	WASCO	
154	10084			PEPRO	72ND AVE	DURHAM RD	COT	WASCO	OSD
155	10081		PRPE		72ND AVE	DURHAM RD	COT	WASCO	OSD
156	10082			PERM	72ND AVE	DURHAM RD	COT	WASCO	OSD
157	10083		PRPE		72ND AVE	DURHAM RD	COT	WASCO	OSD
5	10110	NE			72ND AVE	HAMPTON S	COT	WASCO	
177	10113		PRPRO		72ND AVE	HAMPTON S	COT	WASCO	OSD
178	10112			PROT	72ND AVE	HAMPTON S	COT	WASCO	OSD
179	10111		PRPE		72ND AVE	HAMPTON S	COT	WASCO	OSD
46	10130	SW			72ND AVE	HUNZIKER RD	ODOT	ODOT	
162	10132		PRPE		72ND AVE	HUNZIKER RD	ODOT	ODOT	OSD
163	10133			PROT	72ND AVE	HUNZIKER RD	ODOT	ODOT	OSD
164	10131		PROT		72ND AVE	HUNZIKER RD	ODOT	ODOT	OSD
47	10140	NE			72ND AVE	HWY 217 72ND RAMP	ODOT	ODOT	
288	10141		PRPE		72ND AVE	HWY 217 72ND RAMP	ODOT	ODOT	OSD
289	10142			PROT	72ND AVE	HWY 217 72ND RAMP	ODOT	ODOT	OSD
290	10143		PRPRO		72ND AVE	HWY 217 72ND RAMP	ODOT	ODOT	OSD
63	10150	NW			72ND AVE	VARNS/HWY 217	ODOT	ODOT	
159	10152			PRPRO	72ND AVE	VARNS/HWY 217	ODOT	ODOT	OSD
160	10151		PRPE		72ND AVE	VARNS/HWY 217	ODOT	ODOT	OSD
161	10153		PRPRO		72ND AVE	VARNS/HWY 217	ODOT	ODOT	OSD
305	10154			PRPE	72ND AVE	VARNS/HWY 217	ODOT	ODOT	OSD
20	10180	NW			92ND AVE	DURHAM RD	COT	WASCO	
135	10183			PRPE	92ND AVE	DURHAM RD	COT	WASCO	OSD
136	10182		PRPRO		92ND AVE	DURHAM RD	COT	WASCO	OSD
137	10181			PRPE	92ND AVE	DURHAM RD	COT	WASCO	OSD
89	10190	NW			98TH AVE	DURHAM RD	COT	COT	
138	10192			PRPRO	98TH AVE	DURHAM RD	COT	COT	OSD
139	10191		PRPRO		98TH AVE	DURHAM RD	COT	COT	OSD
140	10193			PRPE	98TH AVE	DURHAM RD	COT	COT	OSD
94	10230				99W	124TH AVE	ODOT	ODOT	
84	10200	NW			99W	217 HWY	ODOT	ODOT	
234	10201		PRPRO		99W	217 HWY	ODOT	ODOT	OSD
235	10202			PRPE	99W	217 HWY	ODOT	ODOT	OSD
236	10203		PRPE		99W	217 HWY	ODOT	ODOT	OSD
25	10240	SW			99W	68TH AV	ODOT	ODOT	
250	10241		PRPE		99W	68TH AV	ODOT	ODOT	OSD
251	10242			PRPE	99W	68TH AV	ODOT	ODOT	OSD
252	10243		PRPE		99W	68TH AV	ODOT	ODOT	OSD
253	10244			PRPE	99W	68TH AV	ODOT	ODOT	OSD
30	10290	NW			99W	72ND AVE	ODOT	ODOT	
246	10291		PRPE		99W	72ND AVE	ODOT	ODOT	OSD
247	10292			PRPE	99W	72ND AVE	ODOT	ODOT	OSD

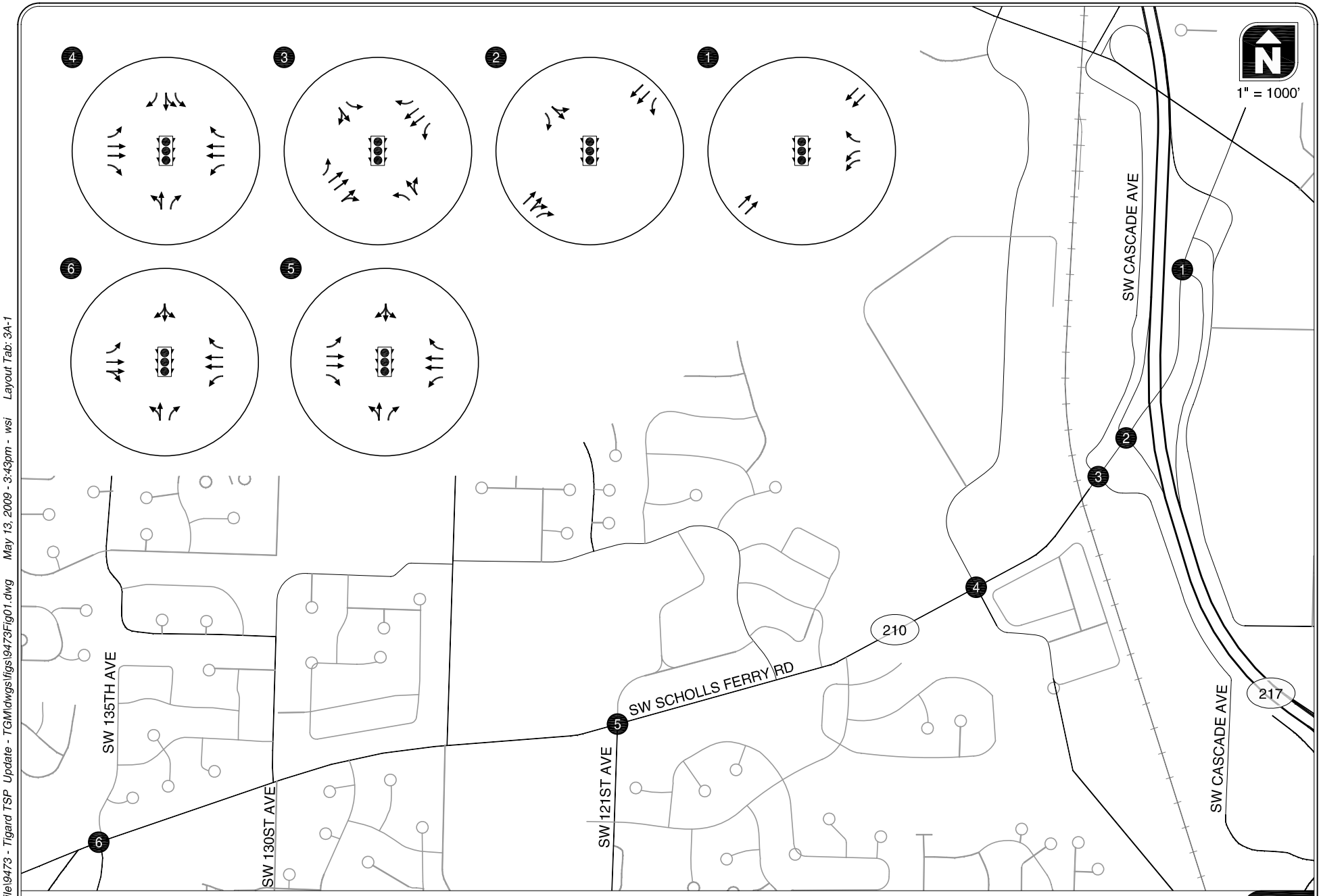
OBJECTID	UNITID	CONTRLOC	PHASING_NS	PHASING_EW	STREET1	STREET2	OWNER	MAINT	SOURCE
248	10293		PRPRO		99W	72ND AVE	ODOT	ODOT	OSD
249	10294			PRPRO	99W	72ND AVE	ODOT	ODOT	OSD
56	10410	NE			99W	74TH AVE	ODOT	ODOT	
243	10414				99W	74TH AVE	ODOT	ODOT	OSD
244	10411			PRPE	99W	74TH AVE	ODOT	ODOT	OSD
245	10412		PROT		99W	74TH AVE	ODOT	ODOT	OSD
287	10413			PRRO	99W	74TH AVE	ODOT	ODOT	OSD
26	10250	SW			99W	78TH AV	ODOT	ODOT	
239	10251		PRPE		99W	78TH AV	ODOT	ODOT	OSD
240	10252			PRPE	99W	78TH AV	ODOT	ODOT	OSD
241	10253		PRPRO		99W	78TH AV	ODOT	ODOT	OSD
242	10254			PRPE	99W	78TH AV	ODOT	ODOT	OSD
27	10260	NW			99W	BEEF BEND RD	ODOT	ODOT	
186	10261		PRPE		99W	BEEF BEND RD	ODOT	ODOT	OSD
187	10264			PRPE	99W	BEEF BEND RD	ODOT	ODOT	OSD
188	10262		PRPE		99W	BEEF BEND RD	ODOT	ODOT	OSD
189	10263		PRPE		99W	BEEF BEND RD	ODOT	ODOT	OSD
66	10400	NW			99W	BULL MOUNTAIN RD	ODOT	ODOT	
190	10404			PROT	99W	BULL MOUNTAIN RD	ODOT	ODOT	OSD
191	10402		PRPRO		99W	BULL MOUNTAIN RD	ODOT	ODOT	OSD
192	10403		PRPE		99W	BULL MOUNTAIN RD	ODOT	ODOT	OSD
193	10401				99W	BULL MOUNTAIN RD	ODOT	ODOT	OSD
58	10430	SW			99W	CANTERBURY LN	ODOT	ODOT	
194	10431		PRPRO		99W	CANTERBURY LN	ODOT	ODOT	OSD
195	10432			PRPRO	99W	CANTERBURY LN	ODOT	ODOT	OSD
196	10433		PRPRO		99W	CANTERBURY LN	ODOT	ODOT	OSD
197	10434			PRPRO	99W	CANTERBURY LN	ODOT	ODOT	OSD
28	10270	NE			99W	DURHAM RD	ODOT	ODOT	
148	10272			PRPRO	99W	DURHAM RD	ODOT	ODOT	OSD
149	10271		PRPE		99W	DURHAM RD	ODOT	ODOT	OSD
150	10276				99W	DURHAM RD	ODOT	ODOT	OSD
151	10275			PRPE	99W	DURHAM RD	ODOT	ODOT	OSD
152	10274		PRPE		99W	DURHAM RD	ODOT	ODOT	OSD
153	10273		PRPE		99W	DURHAM RD	ODOT	ODOT	OSD
29	10280				99W	FISCHER RD	ODOT	ODOT	
308	11040	NE			99W	GARRETT ST	ODOT	ODOT	
309	11041		PRPE		99W	GARRETT ST	ODOT	ODOT	OSD
310	11042		PRPE		99W	GARRETT ST	ODOT	ODOT	OSD
31	10310	SW			99W	GREENBURG RD	ODOT	ODOT	
226	10311		PRPE		99W	GREENBURG RD	ODOT	ODOT	OSD
227	10312			PRPRO	99W	GREENBURG RD	ODOT	ODOT	OSD
228	10313		PRPRO		99W	GREENBURG RD	ODOT	ODOT	OSD
229	10314			PRPE	99W	GREENBURG RD	ODOT	ODOT	OSD
32	10320	NW			99W	HALL BLVD	ODOT	ODOT	
230	10301		PRPRO		99W	HALL BLVD	ODOT	ODOT	OSD
231	10302			PRPE	99W	HALL BLVD	ODOT	ODOT	OSD
232	10303		PRPRO		99W	HALL BLVD	ODOT	ODOT	OSD
233	10304			PRPE	99W	HALL BLVD	ODOT	ODOT	OSD
33	10330	SE			99W	HWY 217 NORTHBOUND ON/OFF RAMP	ODOT	ODOT	
237	10333		PRPRO		99W	HWY 217 NORTHBOUND ON/OFF RAMP	ODOT	ODOT	OSD
238	10334			PRPRO	99W	HWY 217 NORTHBOUND ON/OFF RAMP	ODOT	ODOT	OSD
306	10331			PRPE	99W	HWY 217 NORTHBOUND ON/OFF RAMP	ODOT	ODOT	OSD
307	10332		PRPRO		99W	HWY 217 NORTHBOUND ON/OFF RAMP	ODOT	ODOT	OSD
85	10210				99W	I-5	ODOT	ODOT	
86	10220				99W	I-5	ODOT	ODOT	
34	10340	NW			99W	JOHNSON ST	ODOT	ODOT	
210	10341		PRPE		99W	JOHNSON ST	ODOT	ODOT	OSD
211	10342			PRPRO	99W	JOHNSON ST	ODOT	ODOT	OSD
212	10343		PRPRO		99W	JOHNSON ST	ODOT	ODOT	OSD
213	10344			PRPE	99W	JOHNSON ST	ODOT	ODOT	OSD
35	10350				99W	KING CITY	ODOT	ODOT	
36	10360	SW			99W	MCDONALD ST	ODOT	ODOT	
198	10361		PRPRO		99W	MCDONALD ST	ODOT	ODOT	OSD
199	10362			PRPE	99W	MCDONALD ST	ODOT	ODOT	OSD
200	10363		PRPE		99W	MCDONALD ST	ODOT	ODOT	OSD
201	10364			PRPE	99W	MCDONALD ST	ODOT	ODOT	OSD
37	10370	SE			99W	PARK ST	ODOT	ODOT	
202	10371		PRPE		99W	PARK ST	ODOT	ODOT	OSD
203	10372			PRPRO	99W	PARK ST	ODOT	ODOT	OSD
204	10373		PRPE		99W	PARK ST	ODOT	ODOT	OSD
205	10374			PRPE	99W	PARK ST	ODOT	ODOT	OSD
38	10380	SW			99W	ROYALTY PKWY	ODOT	ODOT	
181	10381		PRPRO		99W	ROYALTY PKWY	ODOT	ODOT	OSD
182	10382			PRPE	99W	ROYALTY PKWY	ODOT	ODOT	OSD
183	10383		PRPRO		99W	ROYALTY PKWY	ODOT	ODOT	OSD
184	10384			PRPRO	99W	ROYALTY PKWY	ODOT	ODOT	OSD
185	10385				99W	ROYALTY PKWY	ODOT	ODOT	OSD
57	10420				99W	TIGARD TO	ODOT	ODOT	
39	10390	SE			99W	WALNUT ST	ODOT	ODOT	
206	10391		PRPE		99W	WALNUT ST	ODOT	ODOT	OSD
207	10392			PRPE	99W	WALNUT ST	ODOT	ODOT	OSD
208	10393		PRPE		99W	WALNUT ST	ODOT	ODOT	OSD
209	10394			PRPRO	99W	WALNUT ST	ODOT	ODOT	OSD
1	10440				BARROWS RD	SCHOLLS FERRY RD	WASCO	COB	
2	10450				BARROWS RD	SCHOLLS FERRY RD	WASCO	WASCO	
345	10441				BARROWS RD	SCHOLLS FERRY RD	WASCO	COB	OSD
346	10442				BARROWS RD	SCHOLLS FERRY RD	WASCO	COB	OSD
347	10443				BARROWS RD	SCHOLLS FERRY RD	WASCO	COB	OSD
348	10444				BARROWS RD	SCHOLLS FERRY RD	WASCO	COB	OSD
11	10470				BEEF BEND RD	BULL MOUTAIN RD	WASCO	WASCO	
10	10460				BEEF BEND RD	SCHOLLS FERRY RD	WASCO	WASCO	
24	10480				BOONES FERRY RD	BRIDGEPORT RD	ODOT	WASCO	
7	10500	SE			CARMEN ST	SEQUOIA PKWY	COT	WASCO	
131	10503		PRPE		CARMEN ST	SEQUOIA PKWY	COT	WASCO	OSD
132	10502			PRPRO	CARMEN ST	SEQUOIA PKWY	COT	WASCO	OSD
133	10501		PRPRO		CARMEN ST	SEQUOIA PKWY	COT	WASCO	OSD
134	10504			PRPE	CARMEN ST	SEQUOIA PKWY	COT	WASCO	OSD
19	10510	NW			CASCADE AVE	GREENBURG RD	COT	WASCO	

OBJECTID	UNITID	CONTRLOC	PHASING_NS	PHASING_EW	STREET1	STREET2	OWNER	MAINT	SOURCE
280	10511		PRPE		CASCADE AVE	GREENBURG RD	COT	WASCO	OSD
281	10512			PRPE	CASCADE AVE	GREENBURG RD	COT	WASCO	OSD
282	10513		PRPE		CASCADE AVE	GREENBURG RD	COT	WASCO	OSD
283	10514			PRPE	CASCADE AVE	GREENBURG RD	COT	WASCO	OSD
314	10520	SW			DARTMOUTH ST	COSTCO STORE ACCESS	COT	COT	
315	10521		PRPRO		DARTMOUTH ST	COSTCO STORE ACCESS	COT	COT	OSD
316	10522		PRPE		DARTMOUTH ST	COSTCO STORE ACCESS	COT	COT	OSD
317	10523			PRPRO	DARTMOUTH ST	COSTCO STORE ACCESS	COT	COT	OSD
92	10530	NE			DURHAM RD	108TH AVE	COT	COT	
141	10533			PRPRO	DURHAM RD	108TH AVE	COT	COT	OSD
142	10531			PRPE	DURHAM RD	108TH AVE	COT	COT	OSD
143	10532		PRPRO		DURHAM RD	108TH AVE	COT	COT	OSD
76	10540	NE			DURHAM RD	79TH AVE	COT	WASCO	
115	10543		PRPE		DURHAM RD	79TH AVE	COT	WASCO	OSD
116	10542			PRPE	DURHAM RD	79TH AVE	COT	WASCO	OSD
117	10541		PRPE		DURHAM RD	79TH AVE	COT	WASCO	OSD
118	10544			PRPE	DURHAM RD	79TH AVE	COT	WASCO	OSD
17	10550	NW			DURHAM RD	SUMMERFIELD DR	COT	WASCO	
144	10553		PRPRO		DURHAM RD	SUMMERFIELD DR	COT	WASCO	OSD
145	10552			PRPE	DURHAM RD	SUMMERFIELD DR	COT	WASCO	OSD
146	10551		PRPRO		DURHAM RD	SUMMERFIELD DR	COT	WASCO	OSD
147	10554			PRPE	DURHAM RD	SUMMERFIELD DR	COT	WASCO	OSD
83	10590	SW			GREENBURG RD	217 HWY	ODOT	ODOT	
274	10591		PRPE		GREENBURG RD	217 HWY	ODOT	ODOT	OSD
275	10592			PRPRO	GREENBURG RD	217 HWY	ODOT	ODOT	OSD
276	10593		PRPE		GREENBURG RD	217 HWY	ODOT	ODOT	OSD
68	10570	SE			GREENBURG RD	LOCUST ST	WASCO	WASCO	
266	10571		PRPE		GREENBURG RD	LOCUST ST	WASCO	WASCO	OSD
267	10573			PRPE	GREENBURG RD	LOCUST ST	WASCO	WASCO	OSD
268	10572			PRPRO	GREENBURG RD	LOCUST ST	WASCO	WASCO	OSD
18	10560	SE			GREENBURG RD	TIEDEMAN AVE	COT	WASCO	
284	10561		PRPRO		GREENBURG RD	TIEDEMAN AVE	COT	WASCO	OSD
285	10562			PRPE	GREENBURG RD	TIEDEMAN AVE	COT	WASCO	OSD
286	10563		PRPRO		GREENBURG RD	TIEDEMAN AVE	COT	WASCO	OSD
82	10580	NW			GREENBURG RD	WASHINGTON SQUARE RD	WASCO	WASCO	
269	10581		PRPE		GREENBURG RD	WASHINGTON SQUARE RD	WASCO	WASCO	OSD
270	10582			PRPRO	GREENBURG RD	WASHINGTON SQUARE RD	WASCO	WASCO	OSD
271	10584		PRPE		GREENBURG RD	WASHINGTON SQUARE RD	WASCO	WASCO	OSD
272	10585			PRPRO	GREENBURG RD	WASHINGTON SQUARE RD	WASCO	WASCO	OSD
273	10583		PROT		GREENBURG RD	WASHINGTON SQUARE RD	WASCO	WASCO	OSD
51	10690	SW			HALL BLVD	BONITA RD	ODOT	ODOT	
104	10693		PERM		HALL BLVD	BONITA RD	ODOT	ODOT	OSD
105	10691		PRPE		HALL BLVD	BONITA RD	ODOT	ODOT	OSD
106	10692			PRPRO	HALL BLVD	BONITA RD	ODOT	ODOT	OSD
50	10680	SW			HALL BLVD	BURNHAM ST	ODOT	ODOT	
96	10683		PRPE		HALL BLVD	BURNHAM ST	ODOT	ODOT	OSD
97	10681		PRPRO		HALL BLVD	BURNHAM ST	ODOT	ODOT	OSD
158	10682			PRPRO	HALL BLVD	BURNHAM ST	ODOT	ODOT	OSD
41	10750	NW			HALL BLVD	CASCADE AVE	ODOT	COB	
378	10752				HALL BLVD	CASCADE AVE	ODOT	COB	OSD
379	10753				HALL BLVD	CASCADE AVE	ODOT	COB	OSD
380	10754				HALL BLVD	CASCADE AVE	ODOT	COB	OSD
381	10751				HALL BLVD	CASCADE AVE	ODOT	COB	OSD
55	10740	NW			HALL BLVD	DURHAM RD	COT	WASCO	
111	10743		PERM		HALL BLVD	DURHAM RD	COT	WASCO	OSD
112	10742			PRPRO	HALL BLVD	DURHAM RD	COT	WASCO	OSD
113	10741		PRPRO		HALL BLVD	DURHAM RD	COT	WASCO	OSD
114	10744			PRPE	HALL BLVD	DURHAM RD	COT	WASCO	OSD
80	10630	SE			HALL BLVD	ELIANDER LN	ODOT	ODOT	
359	10631				HALL BLVD	ELIANDER LN	ODOT	ODOT	OSD
360	10632				HALL BLVD	ELIANDER LN	ODOT	ODOT	OSD
361	10633				HALL BLVD	ELIANDER LN	ODOT	ODOT	OSD
362	10634				HALL BLVD	ELIANDER LN	ODOT	ODOT	OSD
53	10720	SW			HALL BLVD	GREENBURG RD	ODOT	ODOT	
262	10721		PRPRO		HALL BLVD	GREENBURG RD	ODOT	ODOT	OSD
263	10722			PRPE	HALL BLVD	GREENBURG RD	ODOT	ODOT	OSD
264	10723		PRPE		HALL BLVD	GREENBURG RD	ODOT	ODOT	OSD
265	10724			PRPRO	HALL BLVD	GREENBURG RD	ODOT	ODOT	OSD
42	10760				HALL BLVD	GREENWAY AVE	COB	COB	
370	10761				HALL BLVD	GREENWAY AVE	COB	COB	OSD
371	10762				HALL BLVD	GREENWAY AVE	COB	COB	OSD
372	10763				HALL BLVD	GREENWAY AVE	COB	COB	OSD
373	10764				HALL BLVD	GREENWAY AVE	COB	COB	OSD
48	10660	NE			HALL BLVD	LOCUST ST	ODOT	ODOT	
258	10661		PRPE		HALL BLVD	LOCUST ST	ODOT	ODOT	OSD
259	10662			PRPRO	HALL BLVD	LOCUST ST	ODOT	ODOT	OSD
260	10663		PRPRO		HALL BLVD	LOCUST ST	ODOT	ODOT	OSD
261	10664			PRPRO	HALL BLVD	LOCUST ST	ODOT	ODOT	OSD
54	10730	NE			HALL BLVD	MCDONALD ST	ODOT	ODOT	
101	10733		PERM		HALL BLVD	MCDONALD ST	ODOT	ODOT	OSD
102	10734			PERM	HALL BLVD	MCDONALD ST	ODOT	ODOT	OSD
103	10731		PERM		HALL BLVD	MCDONALD ST	ODOT	ODOT	OSD
180	10732			PERM	HALL BLVD	MCDONALD ST	ODOT	ODOT	OSD
59	10650	NW			HALL BLVD	NIMBUS AVE	COB	COB	
374	10651				HALL BLVD	NIMBUS AVE	COB	COB	OSD
375	10652				HALL BLVD	NIMBUS AVE	COB	COB	OSD
376	10653				HALL BLVD	NIMBUS AVE	COB	COB	OSD
377	10654				HALL BLVD	NIMBUS AVE	COB	COB	OSD
74	10620	SE			HALL BLVD	OAK ST	ODOT	ODOT	
254	10621		PRPE		HALL BLVD	OAK ST	ODOT	ODOT	OSD
255	10622			PERM	HALL BLVD	OAK ST	ODOT	ODOT	OSD
256	10623		PRPE		HALL BLVD	OAK ST	ODOT	ODOT	OSD
257	10624			PERM	HALL BLVD	OAK ST	ODOT	ODOT	OSD
81	10640	NE			HALL BLVD	PALMBLAD RD	ODOT	ODOT	
366	10641				HALL BLVD	PALMBLAD RD	ODOT	ODOT	OSD
367	10642				HALL BLVD	PALMBLAD RD	ODOT	ODOT	OSD
368	10643				HALL BLVD	PALMBLAD RD	ODOT	ODOT	OSD
369	10644				HALL BLVD	PALMBLAD RD	ODOT	ODOT	OSD

OBJECTID	UNITID	CONTRLOC	PHASING_NS	PHASING_EW	STREET1	STREET2	OWNER	MAINT	SOURCE
73	10610	SW			HALL BLVD	SATTLER ST	ODOT	ODOT	
107	10613		PRPE		HALL BLVD	SATTLER ST	ODOT	ODOT	OSD
108	10612			PRPE	HALL BLVD	SATTLER ST	ODOT	ODOT	OSD
109	10611		PRPE		HALL BLVD	SATTLER ST	ODOT	ODOT	OSD
110	10614			PRPE	HALL BLVD	SATTLER ST	ODOT	ODOT	OSD
49	10670	SE			HALL BLVD	SCOFFINS ST	ODOT	ODOT	
172	10673			PRPRO	HALL BLVD	SCOFFINS ST	ODOT	ODOT	OSD
173	10674				HALL BLVD	SCOFFINS ST	ODOT	ODOT	OSD
174	10671				HALL BLVD	SCOFFINS ST	ODOT	ODOT	OSD
175	10675		PROT		HALL BLVD	SCOFFINS ST	ODOT	ODOT	OSD
176	10672		PERM		HALL BLVD	SCOFFINS ST	ODOT	ODOT	OSD
313	10676			PRPE	HALL BLVD	SCOFFINS ST	ODOT	ODOT	OSD
52	10700	SE			HALL BLVD	TARGET STORE ACCESS DRIVE	ODOT	ODOT	
363	10701				HALL BLVD	TARGET STORE ACCESS DRIVE	ODOT	ODOT	OSD
364	10702				HALL BLVD	TARGET STORE ACCESS DRIVE	ODOT	ODOT	OSD
365	10703				HALL BLVD	TARGET STORE ACCESS DRIVE	ODOT	ODOT	OSD
95	10600	NE			HALL BLVD	WALL ST	COT	COT	
98	10603		PRPE		HALL BLVD	WALL ST	COT	COT	OSD
99	10602			PRPRO	HALL BLVD	WALL ST	COT	COT	OSD
100	10601		PRPE		HALL BLVD	WALL ST	COT	COT	OSD
62	10780	NE			HWY 217	GREENBURG RD	ODOT	ODOT	
277	10781		PROT		HWY 217	GREENBURG RD	ODOT	ODOT	OSD
278	10782		PRRO		HWY 217	GREENBURG RD	ODOT	ODOT	OSD
279	10783			PRRO	HWY 217	GREENBURG RD	ODOT	ODOT	OSD
61	10770	SE			HWY 217	I-5 SB OFF RAMP	ODOT	ODOT	
165	10772				HWY 217	I-5 SB OFF RAMP	ODOT	ODOT	OSD
166	10774				HWY 217	I-5 SB OFF RAMP	ODOT	ODOT	OSD
167	10773				HWY 217	I-5 SB OFF RAMP	ODOT	ODOT	OSD
390	10771				HWY 217	I-5 SB OFF RAMP	ODOT	ODOT	OSD
90	10800				LOWER BOONES FERRY RD	72ND AVE	ODOT	ODOT	
64	10790				LOWER BOONES FERRY RD	I-5 NORTHBOUND ON/OFF RAMP	ODOT	ODOT	
91	10810				LOWER BOONES FERRY RD	I-5 SOUTH	ODOT	ODOT	
21	10820	SE			MAIN ST	SCOFFINS ST	COT	WASCO	
223	10822			PRPE	MAIN ST	SCOFFINS ST	COT	WASCO	OSD
224	10821		PRPE		MAIN ST	SCOFFINS ST	COT	WASCO	OSD
225	10823		PRPRO		MAIN ST	SCOFFINS ST	COT	WASCO	OSD
67	10830	NE			NIMBUS AVE	SCHOLLS FERRY RD	WASCO	COB	
318	10831				NIMBUS AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
319	10832				NIMBUS AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
320	10833				NIMBUS AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
321	10834				NIMBUS AVE	SCHOLLS FERRY RD	WASCO	COB	OSD
78	10870	SW			SCHOLLS FERRY RD	217 OFF R	ODOT	ODOT	
386	10871				SCHOLLS FERRY RD	217 OFF R	ODOT	ODOT	OSD
387	10872				SCHOLLS FERRY RD	217 OFF R	ODOT	ODOT	OSD
388	10874				SCHOLLS FERRY RD	217 OFF R	ODOT	ODOT	OSD
389	10873				SCHOLLS FERRY RD	217 OFF R	ODOT	ODOT	OSD
40	10920	NW			SCHOLLS FERRY RD	CASCADE AVE	ODOT	ODOT	
322	10921				SCHOLLS FERRY RD	CASCADE AVE	ODOT	ODOT	OSD
323	10922				SCHOLLS FERRY RD	CASCADE AVE	ODOT	ODOT	OSD
324	10923				SCHOLLS FERRY RD	CASCADE AVE	ODOT	ODOT	OSD
325	10924				SCHOLLS FERRY RD	CASCADE AVE	ODOT	ODOT	OSD
70	10860	NW			SCHOLLS FERRY RD	CONESTOGA DR	WASCO	COB	
326	10861				SCHOLLS FERRY RD	CONESTOGA DR	WASCO	COB	OSD
327	10862				SCHOLLS FERRY RD	CONESTOGA DR	WASCO	COB	OSD
328	10863				SCHOLLS FERRY RD	CONESTOGA DR	WASCO	COB	OSD
8	10890				SCHOLLS FERRY RD	CRESTWOOD DR	WASCO	WASCO	
69	10850				SCHOLLS FERRY RD	CRYSTAL ST	WASCO	COB	
43	10910	NW			SCHOLLS FERRY RD	HALL BLVD	ODOT	ODOT	
355	10911				SCHOLLS FERRY RD	HALL BLVD	ODOT	ODOT	OSD
356	10912				SCHOLLS FERRY RD	HALL BLVD	ODOT	ODOT	OSD
357	10913				SCHOLLS FERRY RD	HALL BLVD	ODOT	ODOT	OSD
358	10914				SCHOLLS FERRY RD	HALL BLVD	ODOT	ODOT	OSD
9	10900				SCHOLLS FERRY RD	HOMESTEAD LN	WASCO	WASCO	
65	10840				SCHOLLS FERRY RD	HOMESTEAD LN	WASCO	COB	
88	10940				SCHOLLS FERRY RD	MURRY BLVD	WASCO	COB	
93	10920	NE			SCHOLLS FERRY RD	PROGRESS RAMP	ODOT	ODOT	
349	10921				SCHOLLS FERRY RD	PROGRESS RAMP	ODOT	ODOT	OSD
350	10922				SCHOLLS FERRY RD	PROGRESS RAMP	ODOT	ODOT	OSD
351	10923				SCHOLLS FERRY RD	PROGRESS RAMP	ODOT	ODOT	OSD
87	10930				SCHOLLS FERRY RD	TEAL BLVD	WASCO	COB	
79	10880	SW			SCHOLLS FERRY RD	WASHINGTON SQUARE RD	ODOT	ODOT	
352	10881				SCHOLLS FERRY RD	WASHINGTON SQUARE RD	ODOT	ODOT	OSD
353	10882				SCHOLLS FERRY RD	WASHINGTON SQUARE RD	ODOT	ODOT	OSD
354	10883				SCHOLLS FERRY RD	WASHINGTON SQUARE RD	ODOT	ODOT	OSD
3	10950				TAYLORS FERRY RD	WASHINGTON DR	WASCO	WASCO	
4	10960				TAYLORS FERRY RD	WASHINGTON DR	WASCO	WASCO	
60	10980	NE			UPPER BOONES FERRY RD	DURHAM RD	COT	WASCO	
119	10982			PRPE	UPPER BOONES FERRY RD	DURHAM RD	COT	WASCO	OSD
120	10981		PRPE		UPPER BOONES FERRY RD	DURHAM RD	COT	WASCO	OSD
121	10984			PRPE	UPPER BOONES FERRY RD	DURHAM RD	COT	WASCO	OSD
122	10983		PRPE		UPPER BOONES FERRY RD	DURHAM RD	COT	WASCO	OSD
45	10970	NW			UPPER BOONES FERRY RD	I-5 ON/OFF RAMP	ODOT	ODOT	
391	10971				UPPER BOONES FERRY RD	I-5 ON/OFF RAMP	ODOT	ODOT	OSD
392	10972				UPPER BOONES FERRY RD	I-5 ON/OFF RAMP	ODOT	ODOT	OSD
393	10973				UPPER BOONES FERRY RD	I-5 ON/OFF RAMP	ODOT	ODOT	OSD
394	10974				UPPER BOONES FERRY RD	I-5 ON/OFF RAMP	ODOT	ODOT	OSD
300	11030	SW			WALNUT ST	BARROWS RD			
301	11031		PRPE		WALNUT ST	BARROWS RD			OSD
302	11032			PRPE	WALNUT ST	BARROWS RD			OSD
303	11033		PRPE		WALNUT ST	BARROWS RD			OSD
304	11034			PRPRO	WALNUT ST	BARROWS RD			OSD
77	11000	NE			WALNUT ST	GAARDE ST	COT	WASCO	
220	11001			PRPE	WALNUT ST	GAARDE ST	COT	WASCO	OSD
221	11002		PRPRO		WALNUT ST	GAARDE ST	COT	WASCO	OSD
222	11003			PRPRO	WALNUT ST	GAARDE ST	COT	WASCO	OSD
71	11010	NE			WALNUT ST	TIEDEMAN AVE	COT	WASCO	
214	11012			PRPE	WALNUT ST	TIEDEMAN AVE	COT	WASCO	OSD
215	11011		PRPE		WALNUT ST	TIEDEMAN AVE	COT	WASCO	OSD

OBJECTID	UNITID	CONTRLOC	PHASING_NS	PHASING_EW	STREET1	STREET2	OWNER	MAINT	SOURCE
311	11013		PRPE		WALNUT ST	TIEDEMAN AVE	COT	WASCO	OSD
312	11014			PRPE	WALNUT ST	TIEDEMAN AVE	COT	WASCO	OSD

Appendix D 2008 Base Year Intersection Lane Configurations and Control Devices



2009 LANE CONFIGURATIONS & TRAFFIC CONTROL DEVICES
SW SCHOLLS FERRY ROAD
TIGARD, OREGON

FIGURE **3A-1**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 3:43pm - wsi Layout Tab: 3A-1

2009 LANE CONFIGURATIONS & TRAFFIC CONTROL DEVICES
SE WALNUT STREET
TIGARD, OREGON

FIGURE **3A-2**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

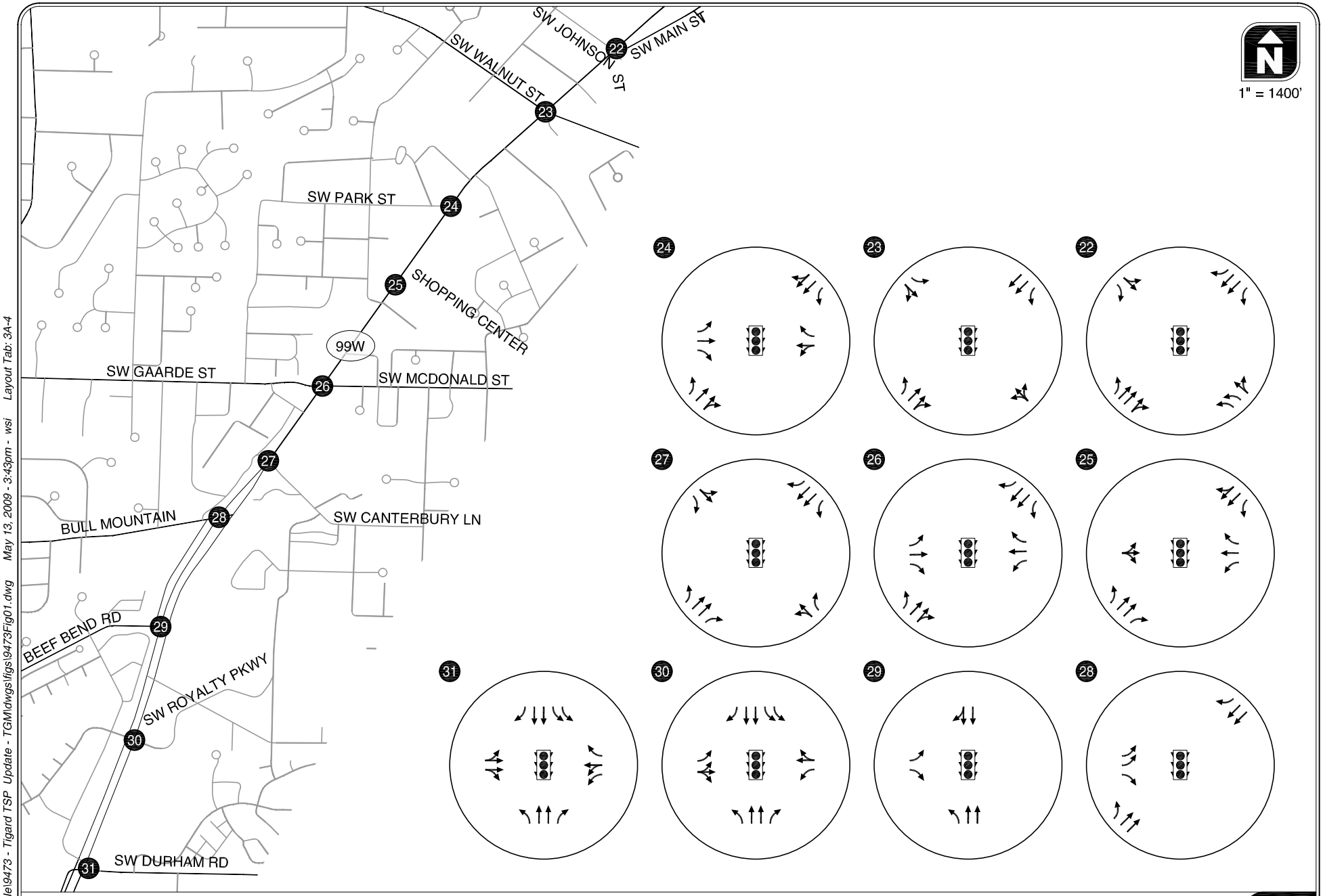
H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 3:43pm - wsi Layout Tab: 3A-2

2009 LANE CONFIGURATIONS & TRAFFIC CONTROL DEVICES
OR-99W
TIGARD, OREGON

FIGURE **3A-3**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 3:43pm - wsi Layout Tab: 3A-3

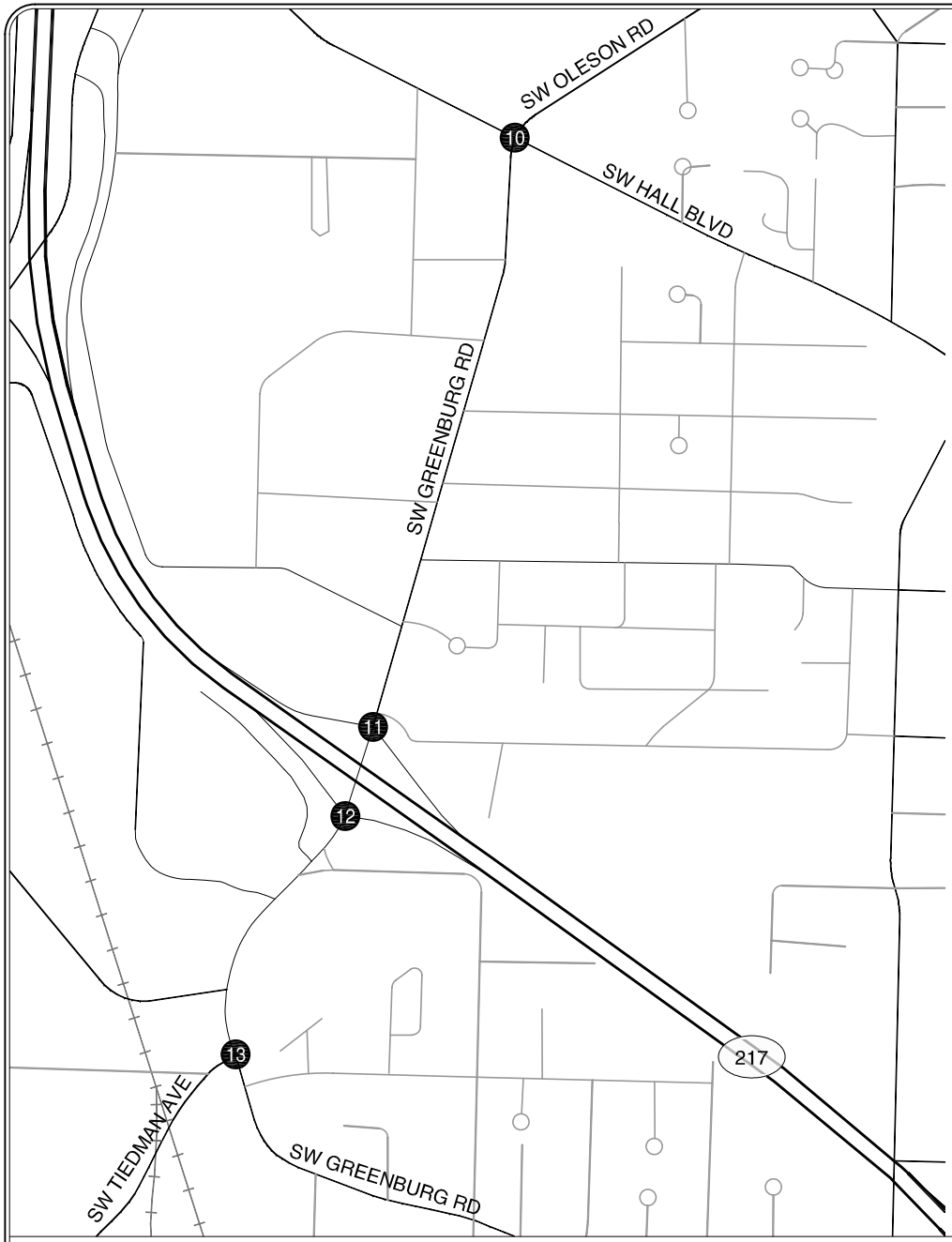


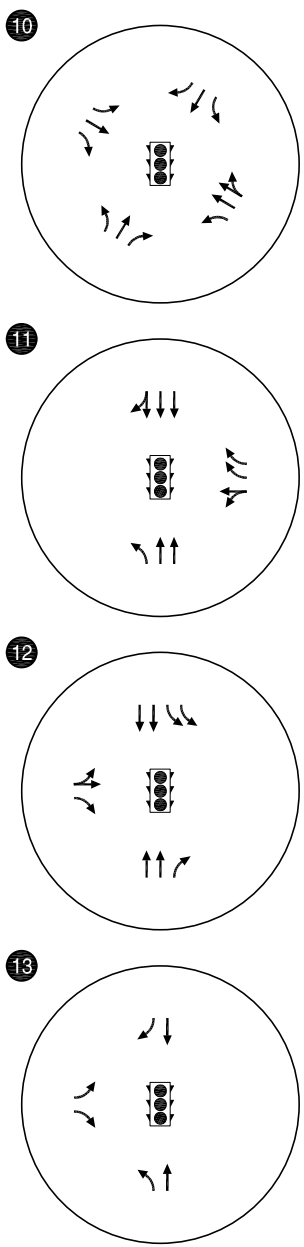
2009 LANE CONFIGURATIONS & TRAFFIC CONTROL DEVICES
OR-99W
TIGARD, OREGON

FIGURE **3A-4**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 3:43pm - wsi Layout Tab: 3A-4





1" = 1000'

2009 LANE CONFIGURATIONS & TRAFFIC CONTROL DEVICES
SW GREENBURG ROAD
TIGARD, OREGON

FIGURE **3A-5**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

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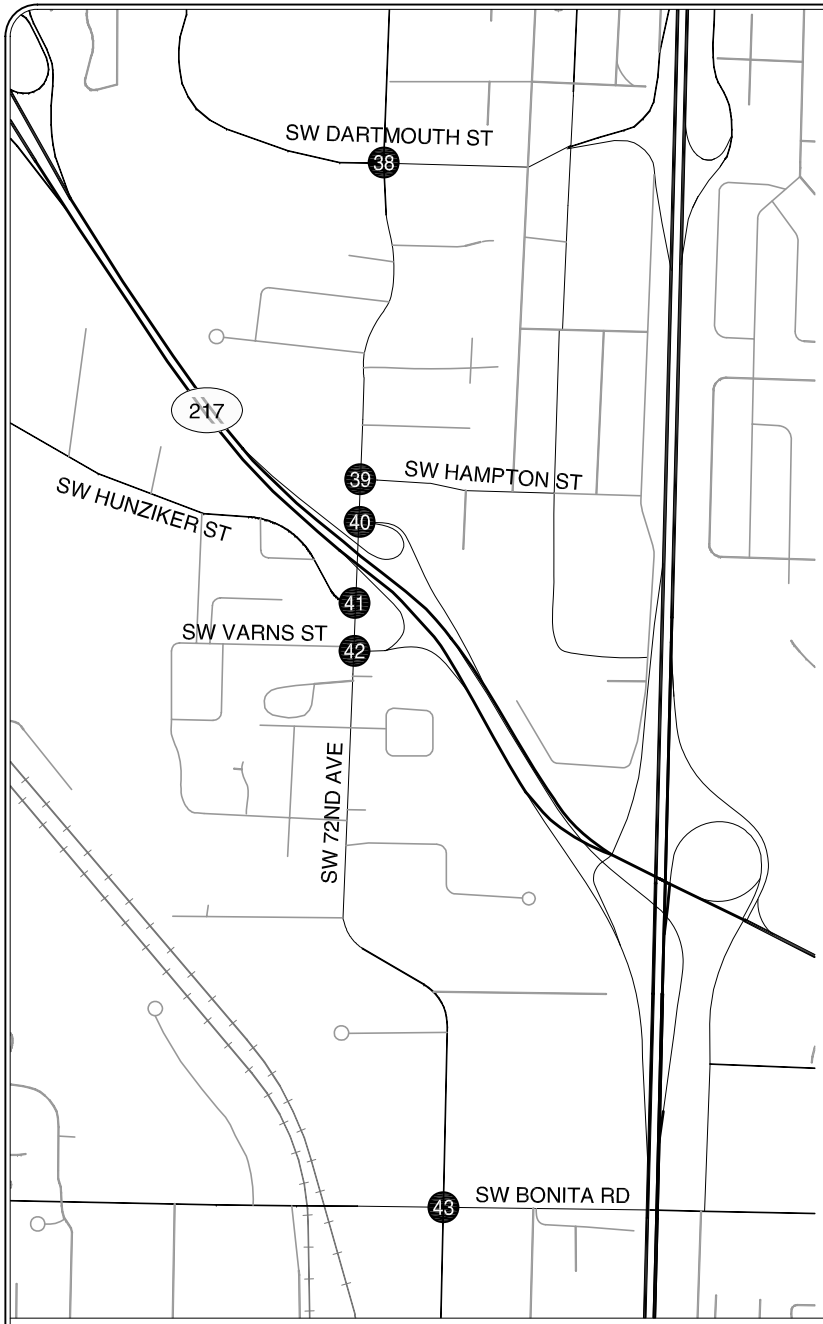
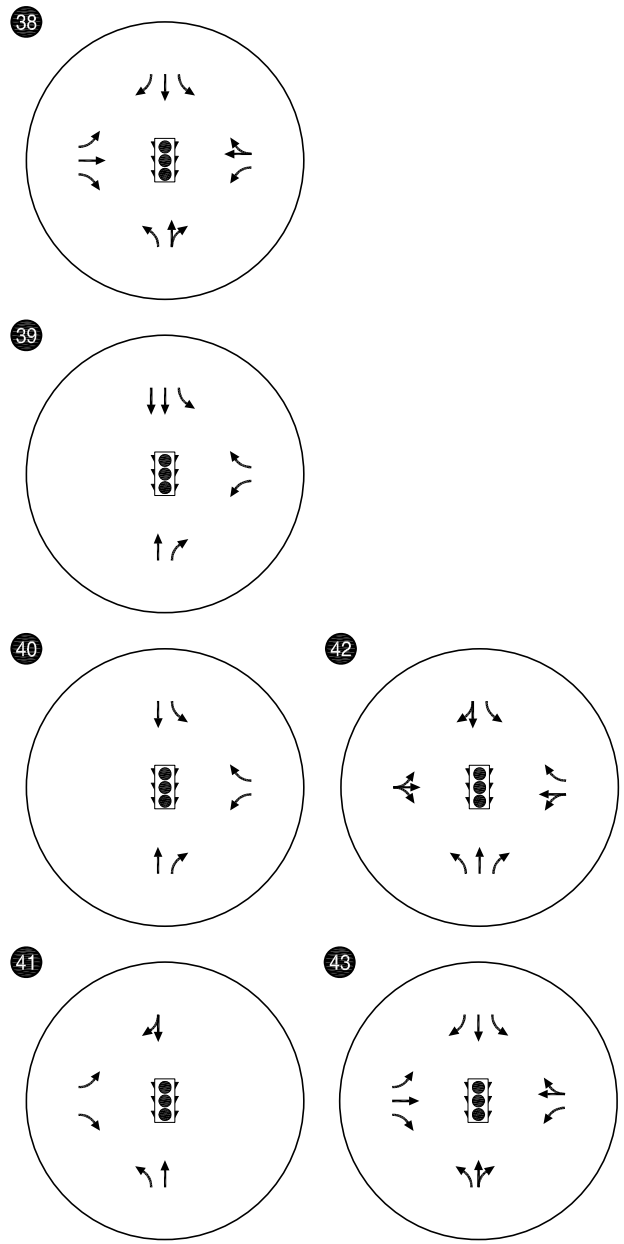
2009 LANE CONFIGURATIONS & TRAFFIC CONTROL DEVICES
SW HALL BLVD
TIGARD, OREGON

FIGURE **3A-6**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\projfile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg Jun 17, 2009 - 4:54pm - wsi Layout Tab: 3A-6





N

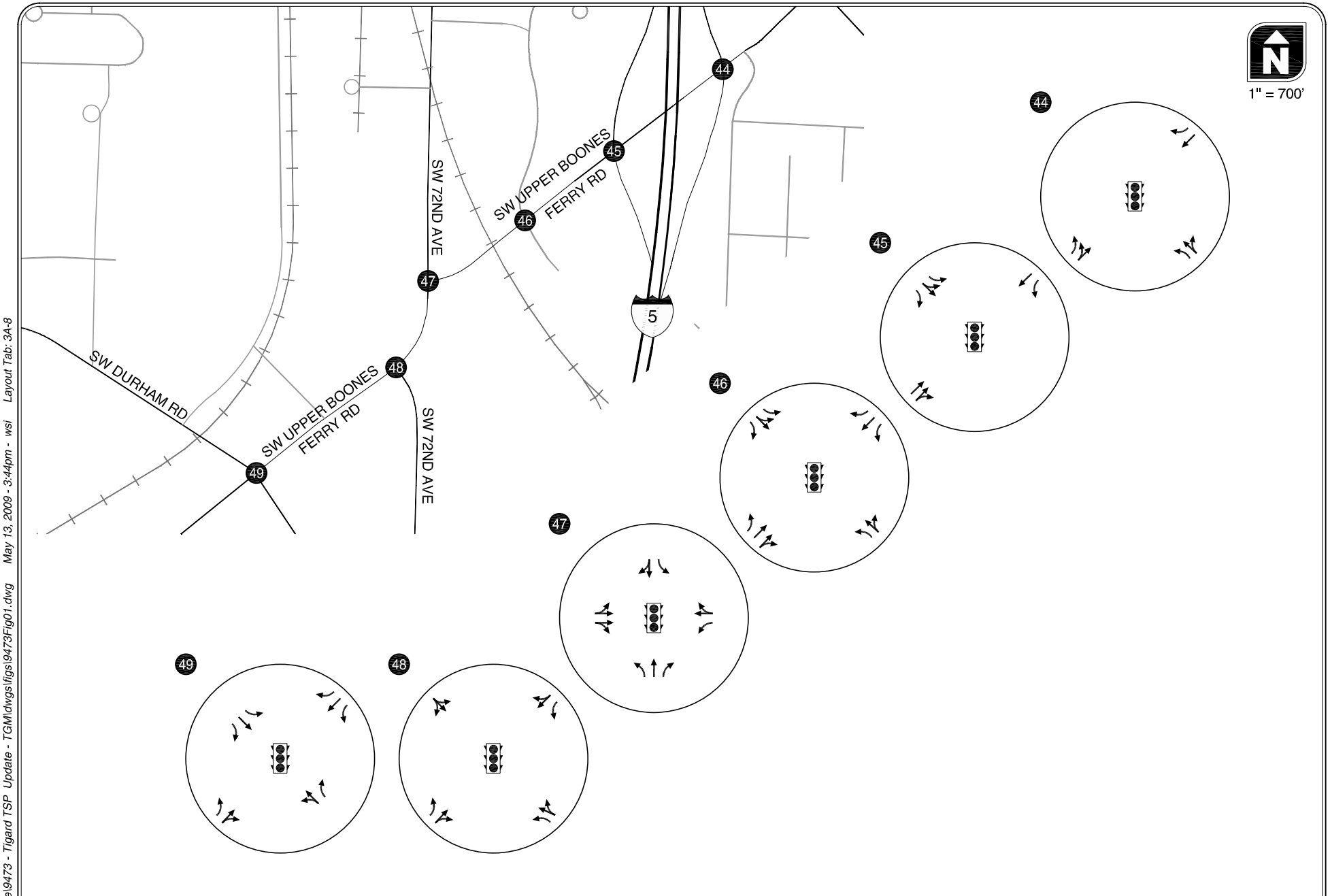
1" = 1200'

2009 LANE CONFIGURATIONS & TRAFFIC CONTROL DEVICES
SW 72ND AVE
TIGARD, OREGON

FIGURE **3A-7**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg Jun 17, 2009 - 4:50pm - wsi Layout Tab: 3A-7



EXISTING TRAFFIC CONDITIONS
SW UPPER BOONES FERRY ROAD
TIGARD, OREGON

FIGURE **3A-8**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

Appendix E Travel Time Data

City of Tigard

Travel Time Studies
2009 TSP Update
Note: For intersections, record the time as you cross the far crosswalk and clear the intersection

	Average Speed (mph)			
	Weekday AM Peak	**Weekday PM Peak**	**Weekend Mid-Day Peak**	**Weekday Mid-Day Peak**
Tualatin River Bridge (Center)				
Durham Road	31.57	29.18	24.30	19.40
Beef Bend Road	34.65	26.31	24.27	36.41
Gaarde Street / McDonald Street	14.80	27.90	21.99	18.67
Walnut Street	25.82	26.33	22.84	26.44
Greenburg Road	10.42	19.35	6.50	10.11
Hwy 217 Northbound Ramps	16.22	13.13	8.33	13.86
72nd Avenue	32.40	22.04	22.97	25.76
64th Avenue (I-5 Southbound Ramps)	28.59	20.63	22.15	32.26
I-5 Southbound at sign for McMinnville				
64th Avenue (I-5 Southbound Ramps)	42.66	18.38	27.99	26.20
72nd Avenue	33.58	14.48	18.89	16.13
Hwy 217 Northbound Ramps	32.18	15.02	24.83	16.15
Greenburg Road	34.68	11.09	15.75	16.72
Walnut Street	21.60	21.52	24.37	26.76
Gaarde Street / McDonald Street	30.04	16.51	21.77	26.44
Beef Bend Road	30.15	33.61	35.27	33.55
Durham Road	36.17	37.29	25.02	21.27
Tualatin River Bridge (Center)	32.90	27.84	26.53	25.55
Tigard/Durham City Limits on Upper Boones Ferry				
Hall/Durham Intersection	18.78	8.61	22.02	16.34
Bonita Road	24.28	28.12	27.83	23.25
Burnham Street	29.94	26.88	32.41	31.10
Highway 99W	13.97	12.18	7.56	7.70
Locust Street	30.01	28.29	31.51	29.69
Greenburg Road	25.66	26.44	26.65	25.44
Target driveway				
Locust Street	30.81	26.47	26.62	24.10
Highway 99W	22.47	11.30	19.53	15.91
Burnham Street	23.92	23.84	20.68	17.28
Bonita Road	25.81	17.80	27.18	27.92
Hall/Durham Intersection	19.71	19.23	25.98	26.09
Right on Upper Boones Ferry	19.62	23.12	31.62	19.47
Tigard/Durham City Limits on Upper Boones Ferry				
Northern 72nd/Upper Boones Ferry Intersection	11.80	15.91	17.16	13.91
Bonita Road	29.74	27.65	27.77	25.41
Cherry Drive	38.80	33.92	29.34	31.57
Hampton Street	21.75	15.62	24.85	18.32
Dartmouth Street	20.62	13.14	23.69	23.22
Right on Hwy 99W	23.95	17.89	24.45	21.62
Highway 99W at 69th Avenue				
Dartmouth Street	19.81	14.54	19.98	13.12
Highway 217 SB Ramp / Varns St	23.57	9.41	25.28	21.14
Bonita Road	25.95	22.73	26.90	25.77
Northern 72nd/Upper Boones Intersection	32.67	22.11	30.09	25.78
Upper Boones/Durham Rd Intersection	15.82	7.87	13.56	16.29

Murray /Springbrook Intersection				
Right on Gaarde Street	23.26	23.07	27.85	23.83
Highway 99W	20.59	19.61	24.21	26.11
Right on Hall from McDonald	32.74	29.45	30.34	26.79
Left on Bonita from Hall	21.71	16.99	22.41	21.61
72nd Avenue	22.67	17.79	31.02	24.51
Bangy Road	31.11	18.23	26.17	25.45
Bonita Rd at Bangy Road				
72nd Avenue	23.60	8.86	22.18	15.13
Right on Hall Blvd	26.97	23.52	30.18	30.25
Left on McDonald St	16.99	11.36	19.44	20.25
Highway 99W	21.40	11.66	19.04	20.95
Left on Walnut from Gaarde	29.70	30.51	29.55	29.86
Walnut through Barrows Intersection	26.21	19.53	25.97	24.34
Walnut/132nd				
Walnut/Tiedeman	25.03	26.41	28.71	27.87
Left on Hwy 99W from Walnut	10.98	14.18	14.30	16.43
Right on Main from Hwy 99W	24.22	22.95	23.89	25.08
Greenburg Rd Northwest of Hwy 99W	9.53	10.33	8.88	9.49
Tiedeman Ave	29.96	28.30	31.17	30.09
Greenburg Rd North of Hwy 217 SB Ramps	15.78	11.79	15.15	14.81
Greenburg Rd North of Hall Blvd	18.74	14.66	16.98	18.19
Oleson Road at 90th Ave				
Greenburg Rd/Hwy 217 Southbound Ramps	15.07	19.10	18.25	17.94
Tiedeman Ave	19.20	9.98	17.05	20.38
Main Street southeast of Hwy 99W	11.83	13.19	13.76	16.08
Hwy 99W south of Main/Johnson	11.42	7.68	10.55	10.94
Right on Walnut Street	21.41	16.03	21.28	17.38
Walnut/Tiedeman	21.68	21.73	24.91	23.12
Walnut/Gaarde	27.10	23.23	28.94	28.42
Hwy 99W northbound through Fisher Rd				
Right on Durham from 99W	32.75	27.69	30.26	28.58
Durham/98th	31.12	27.62	27.07	28.58
Durham/Hall	11.11	19.91	24.15	22.68
Left on Upper Boones from Durham	18.11	19.52	22.37	20.85
Right on Upper Boones from 72nd	13.87	20.80	24.94	15.08
I-5 (Exit 291) Northbound Ramp Meter	16.43	11.68	13.82	16.12
I-5 southbound under Bonita Bridge				
Right on Upper Boones from Ramp	35.78	37.50	49.39	9.53
Upper Boones/72nd (northern intersection)	10.57	4.67	19.47	9.53
Right on Durham Rd from Upper Boones Ferry	25.44	7.32	23.57	13.86
Durham/Hall	24.07	14.39	31.81	21.48
Durham/98th	26.31	19.97	26.62	25.18
Left on Highway 99W from Durham Rd	22.88	15.21	19.93	19.18

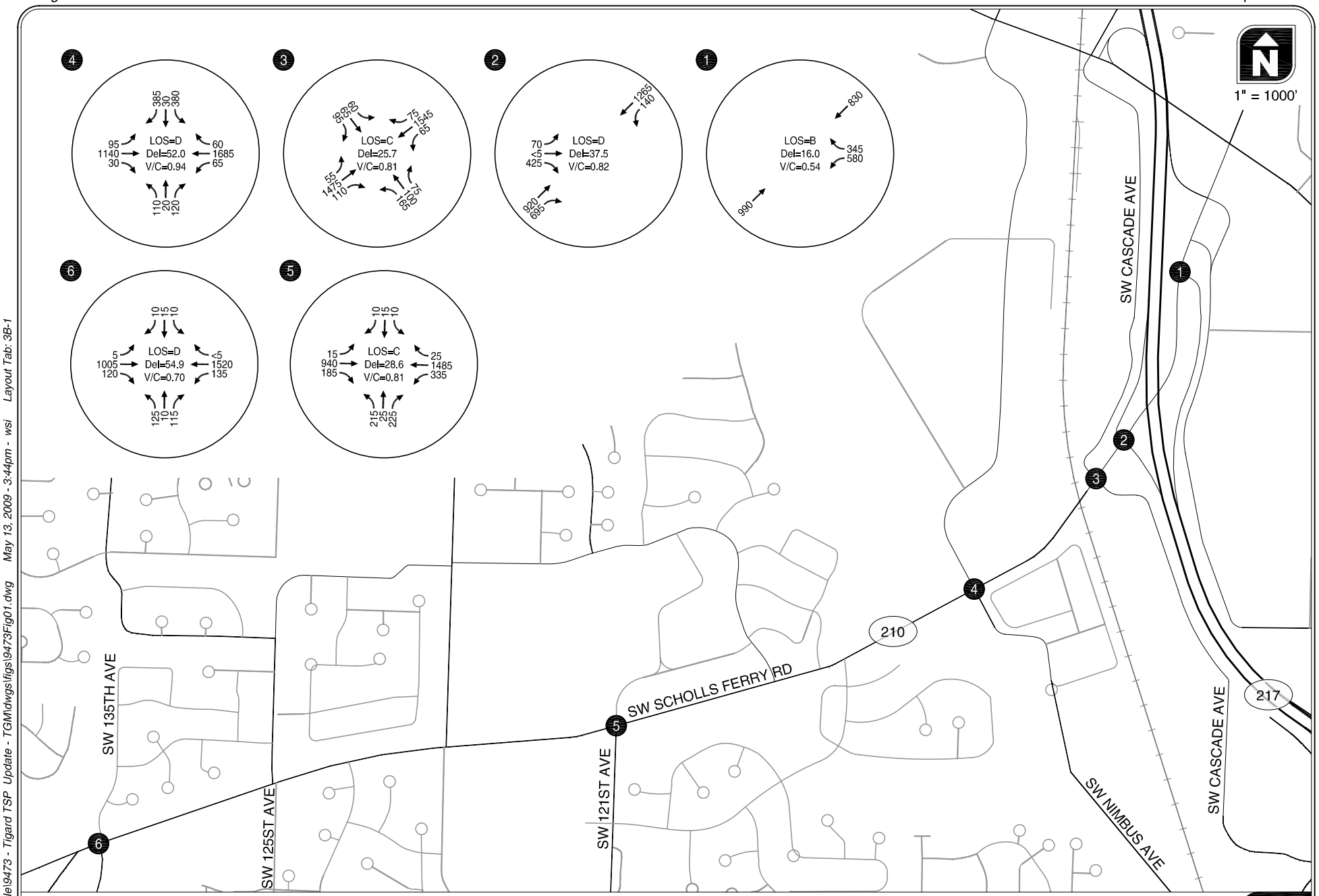
Corridor 7: Scholls Ferry Rd Southbound

Hall Blvd				
Hwy 217 Southbound Ramps	20.92	18.06	16.16	31.97
Nimbus Ave	20.06	15.29	15.11	29.30
121st Ave	29.59	17.62	23.99	35.43
Barrows Rd	28.49	18.13	20.37	30.96

Corridor 7: Scholls Ferry Rd Northbound

Date				
Start Time				
Barrows Rd				
121st Ave	19.85	15.60	14.08	17.30
Nimbus Ave	12.28	24.86	25.09	15.53
Hwy 217 Southbound Ramps	21.66	26.20	16.52	22.96
Hall Blvd	19.66	12.53	15.37	24.73

Appendix F 2008 Base Intersection Operations and Queuing Analyses, Weekday PM Peak Hour



EXISTING TRAFFIC CONDITIONS, WEEKDAY PM PEAK HOUR
SW SCHOLLS FERRY ROAD
TIGARD, OREGON

FIGURE **3B-1**

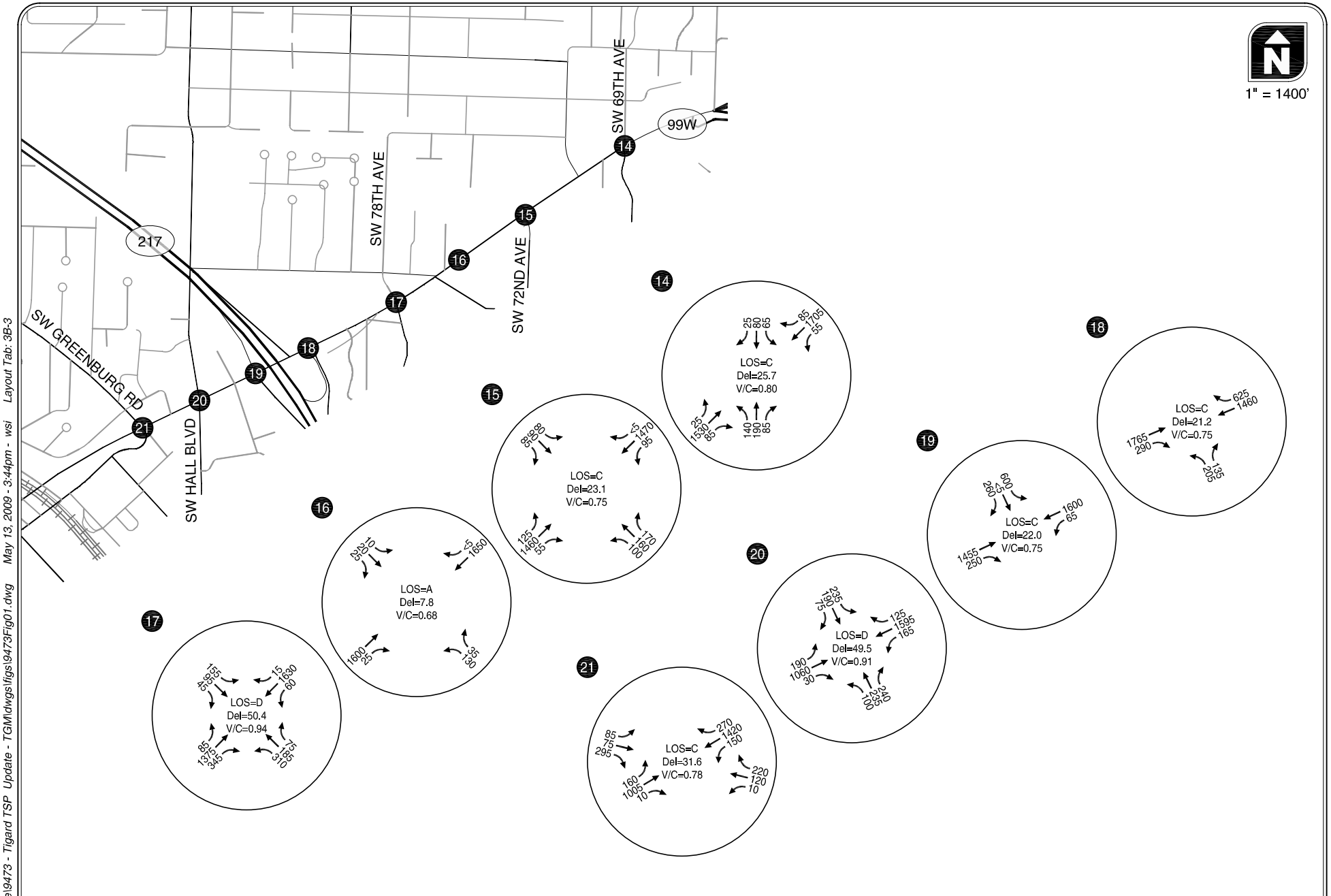
KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

EXISTING TRAFFIC CONDITIONS, WEEKDAY PM PEAK HOUR
SE WALNUT STREET
TIGARD, OREGON

FIGURE **3B-2**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

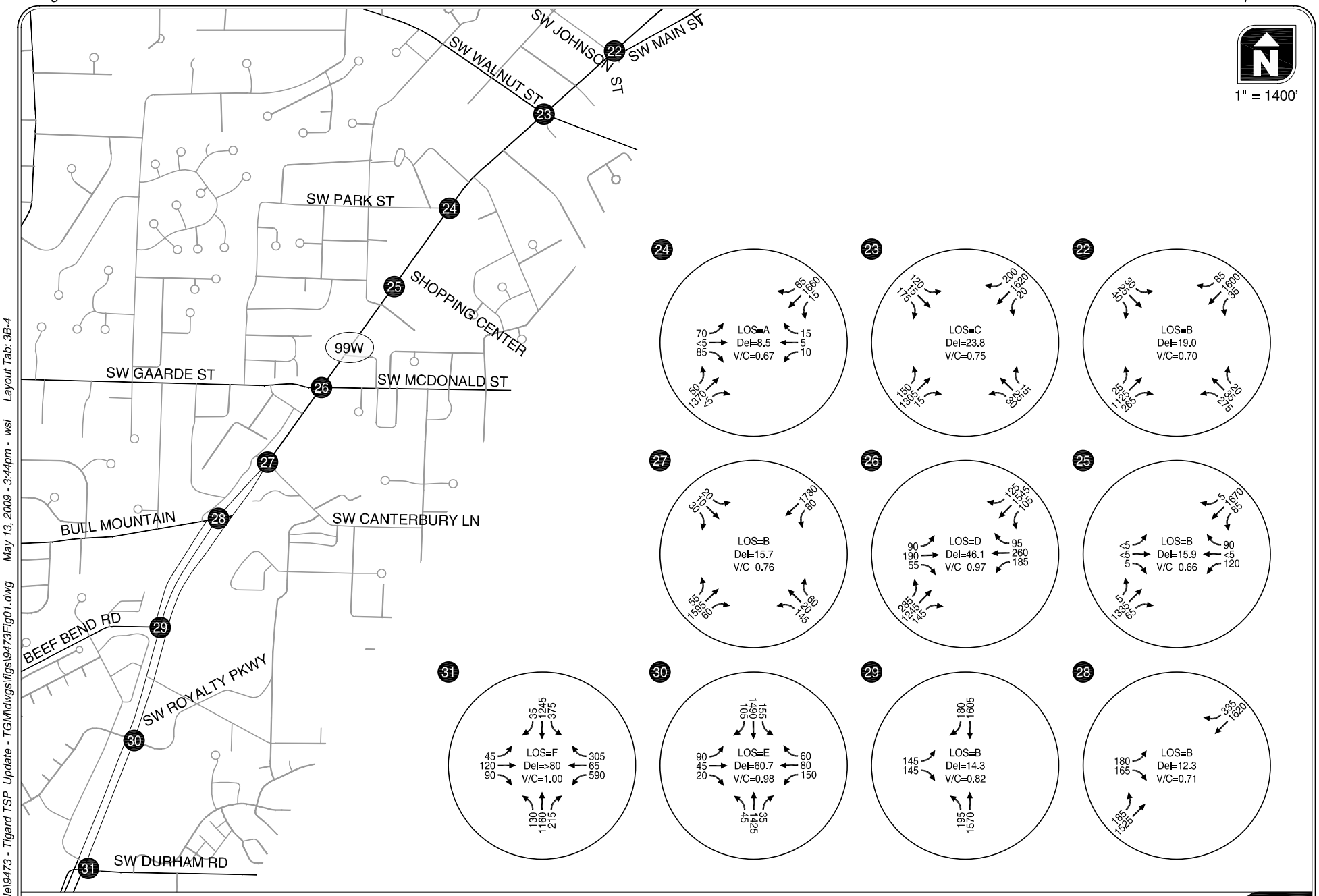
H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 3:44pm - wsi Layout Tab: 3B-2



EXISTING TRAFFIC CONDITIONS, WEEKDAY PM PEAK HOUR
OR-99W
TIGARD, OREGON

FIGURE **3B-3**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

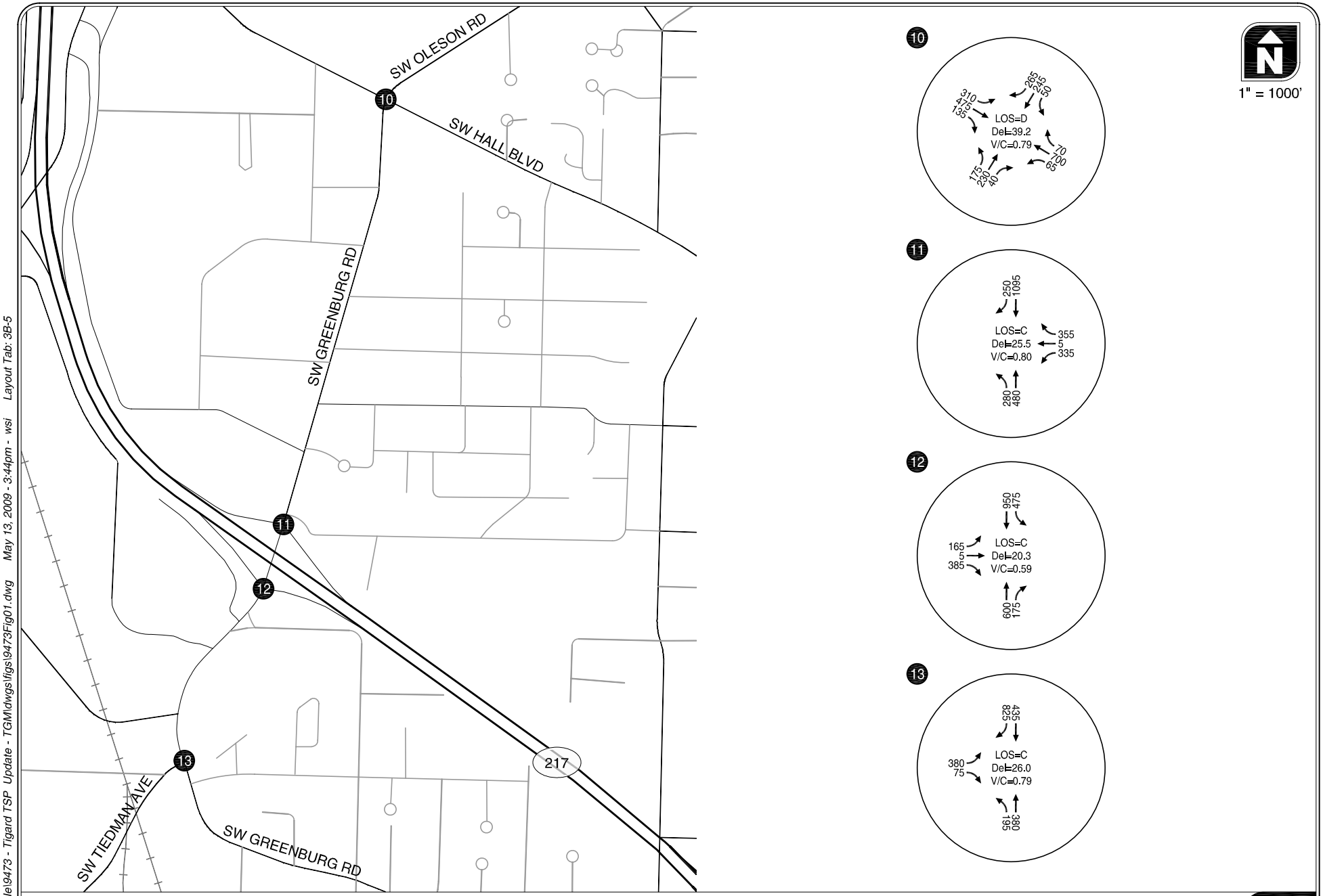


EXISTING TRAFFIC CONDITIONS, WEEKDAY PM PEAK HOUR
OR-99W
TIGARD, OREGON

FIGURE **3B-4**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

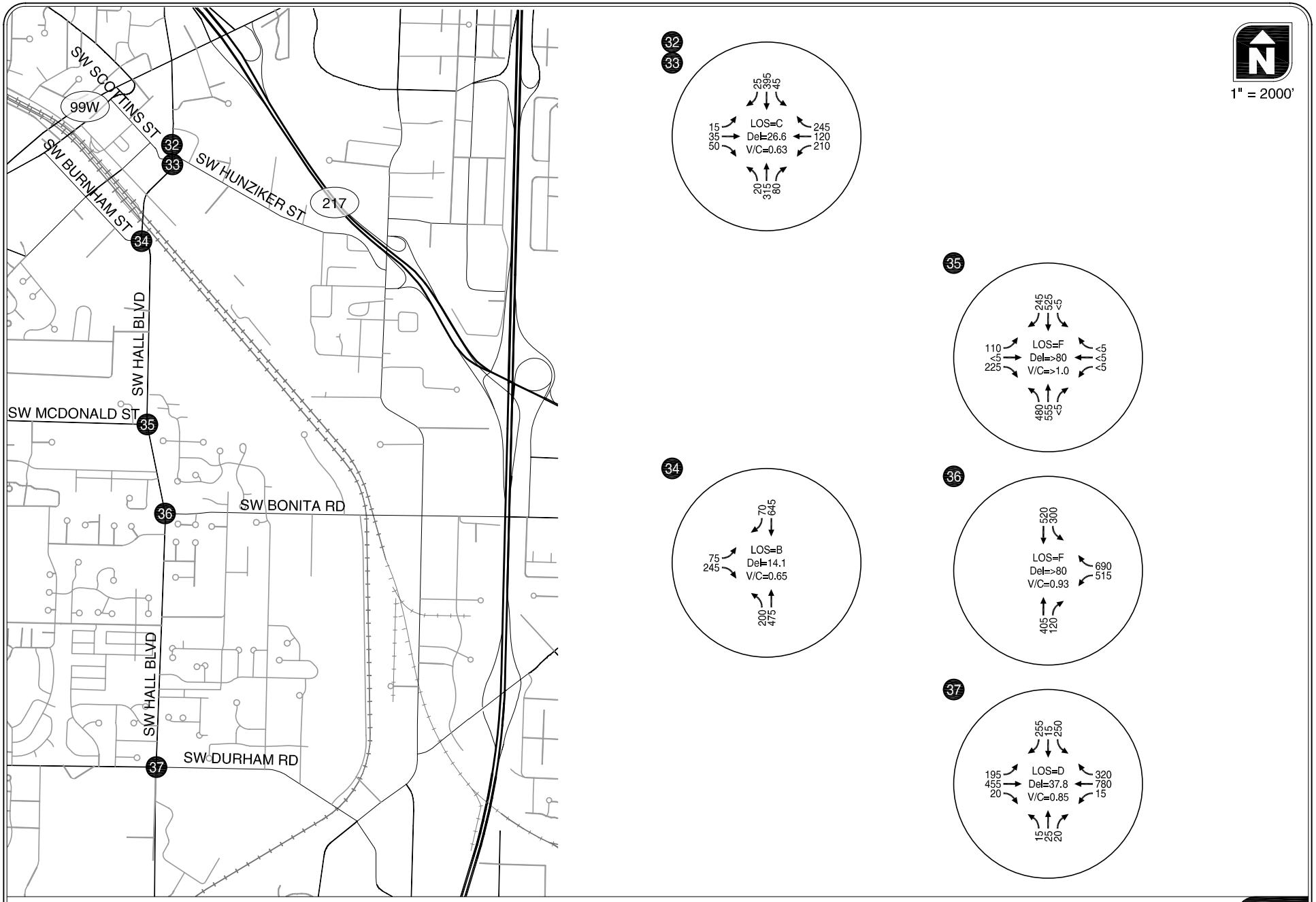
H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 3:44pm - wsi Layout Tab: 3B-4



EXISTING TRAFFIC CONDITIONS, WEEKDAY PM PEAK HOUR
SW GREENBURG ROAD
TIGARD, OREGON

FIGURE **3B-5**

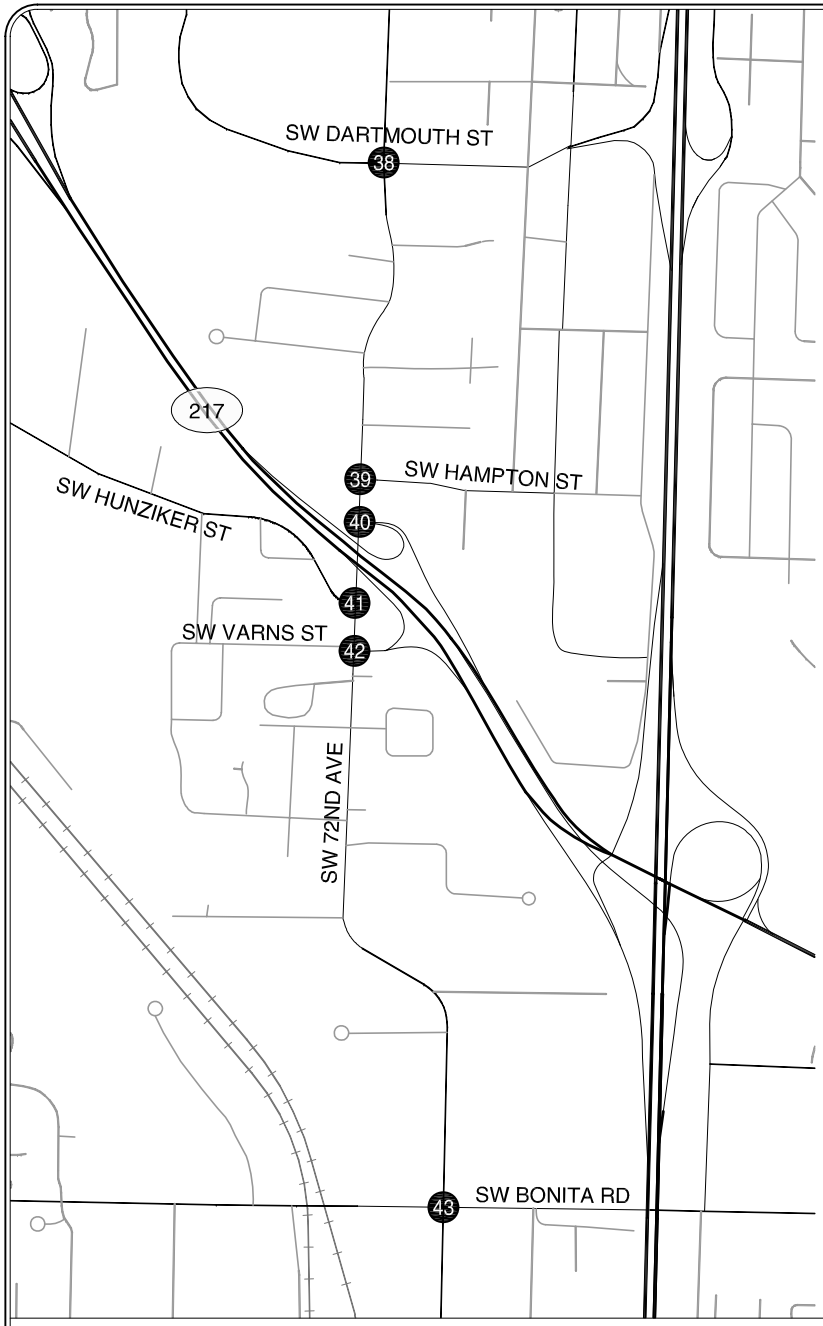
KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

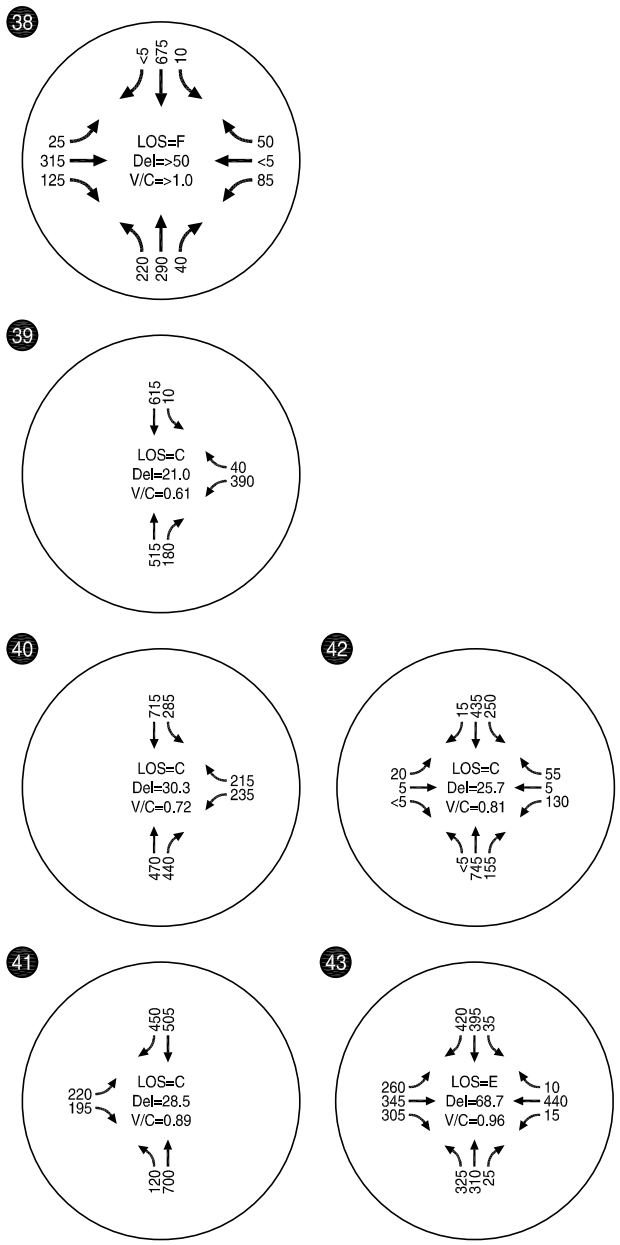


EXISTING TRAFFIC CONDITIONS, WEEKDAY PM PEAK HOUR
SW HALL BLVD
TIGARD, OREGON

FIGURE **3B-6**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING





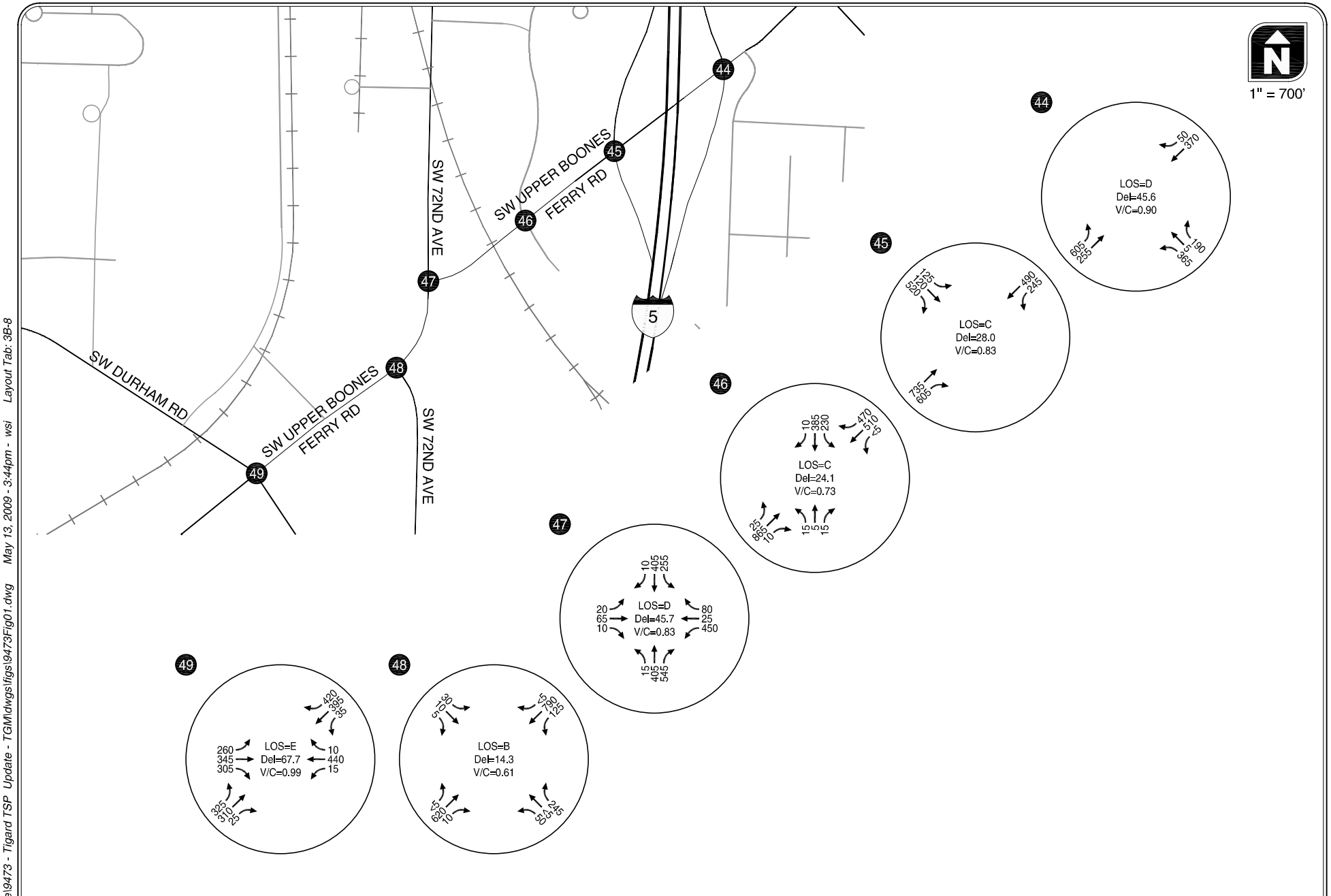
1" = 1200'

EXISTING TRAFFIC CONDITIONS, WEEKDAY PM PEAK HOUR
SW 72ND AVE
TIGARD, OREGON

FIGURE **3B-7**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 3:44pm - wsi Layout Tab: 3B-7



EXISTING TRAFFIC CONDITIONS, WEEKDAY PM PEAK HOUR
SW UPPER BOONES FERRY ROAD
TIGARD, OREGON

FIGURE **3B-8**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 3:44pm - wsi Layout Tab: 3B-8

SW Scholls Ferry Road

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
SW Scholls Ferry Rd. & OR 217 NB Ramp	WBL	1200	2050
	WBR	300	600
	NET	175	350
	SWT	925	1450
SW Scholls Ferry Rd. & OR 217 SB Ramp	EBLT	50	125
	EBR	525	775
	NET	225	325
	NETR	225	325
	NER	150	275
	SWL	100	175
	SWT	1325	1475
SW Scholls Ferry Rd. & SW Cascade Ave.	EBL	75	150
	EBTR	275	625
	WBL	175	225
	WBTR	600	1350
	NBL	75	125
	NBT	250	450
	NBTR	200	350
	SBL	50	125
	SBT	300	325
	SBR	25	50
SW Scholls Ferry Rd. & SW Nimbus Ave.	EBL	125	225
	EBT	325	625
	EBR	25	100
	WBL	50	125
	WBT	1025	1450
	WBR	25	125
	NBLT	150	325
	NBR	75	175
	SBL	275	775
	SBLT	375	925
	SBR	475	1075
SW Scholls Ferry Rd. & SW 121st Ave.	EBL	300	525
	EBT	25	75
	EBR	75	200
	WBL	150	200
	WBT	2050	3675
	WBR	25	100
	NBLT	675	1475
	NBR	450	1375
	SBLTR	50	100

Location	***Approach***	***Average Queue Storage (feet)***	***95th – Percentile Queue Storage (feet)***
SW Scholls Ferry Rd. & SW 135th Ave.	EBL	25	50
	EBT	150	225
	EBTR	175	250
	WBL	100	200
	WBT	3600	4950
	NBLT	2275	4000
	NBR	2725	4475
	SBLTR	600	1100

SW Walnut Street

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
SW Walnut St. & SW Barrows St.	EBL	50	125
	EBT	1300	2100
	EBR	150	250
	WBL	425	450
	WBTR	1950	2575
	NBL	125	575
	NBTR	175	650
	SBL	25	75
	SBTR	75	250
SW Walnut St. & SW 135th Ave.	SEL	50	125
	SET	400	1625
	NWTR	1775	3100
	SWL	75	175
	SWR	1025	2675
SW Walnut St. & SW Gaarde St	EBT	100	175
	EBR	75	125
	WBL	75	175
	WBT	1425	2675
	NBL	1250	2450
	NBR	50	150

SW Greenburg Road

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
SW Greenburg Rd & SW Hall Blvd. / SW Oleson Rd.	EBL	375	425
	EBT	1750	2125
	EBR	50	125
	WBL	50	100
	WBT	150	250
	WBTR	150	275
	NBL	75	175
	NBT	100	200
	NBR	25	75
	SBL	50	150
	SBT	275	500
	SBR	100	175
SW Greenburg Rd. & OR 217 NB Ramp	WBLT	225	250
	WBR	1850	1850
	NBL	175	200
	NBT	500	525
	SBT	825	1900
	SBTR	700	1775
SW Greenburg Rd. & OR 217 SB Ramp	EBLT	1325	2175
	EBR	250	450
	NBT	1175	2000
	NBR	25	100
	SBL	450	625
	SBT	375	675
SW Greenburg Rd. & SW Tiedeman Ave.	EBL	300	350
	EBR	1250	2600
	NBL	350	725
	NBT	725	1950
	SBT	325	1000
	SBR	175	350

OR 99W

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
OR 99W & SW 68th Pkwy	NBL	425	850
	NBT	325	750
	NBR	75	125
	SBL	125	175
	SBTR	475	1075
	NEL	50	100
	NET	375	600
	NETR	450	675
	SWL	75	150
	SWT	450	800
	SWTR	500	850
OR 99W & SW 72nd Ave.	SEL	100	125
	SETR	700	1200
	NWL	100	150
	NWT	350	825
	NWR	100	175
	NEL	125	225
	NET	125	225
	NER	25	50
	SWL	75	150
	SWT	450	800
	SWTR	500	800
OR 99W & SW 74th Ave.	SELTR	75	125
	NWL	75	100
	NWR	225	550
	NELT	75	250
	NETR	125	325
	SWLT	150	400
	SWTR	150	425
OR 99W & SW Dartmouth St.	EBL	100	175
	EBT	300	575
	EBR	100	275
	WBL	75	150
	WBT	625	950
	WBTR	675	975
	NBL	200	350
	NBTR	300	375
	SBL	600	1050
	SBTR	300	900

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
OR 99W & OR 217 NB Ramp	EBT	300	650
	EBR	50	150
	WBT	375	725
	WBR	150	350
	NBL	1075	1300
	NBR	150	250
OR 99W & OR 217 SB Ramp	EBT	200	400
	EBR	50	100
	WBL	75	175
	WBT	250	450
	SBL	275	325
	SBLT	1050	1200
	SBR	200	350
OR 99W & SW Hall Blvd.	EBL	250	375
	EBT	300	650
	EBTR	275	600
	WBL	225	325
	WBT	400	650
	WBTR	275	525
	NBLT	275	300
	NBR	1175	1700
	SBL	450	1150
	SBTR	575	1200
OR 99W & SW Greenburg Rd.	EBL	150	250
	EBT	225	625
	EBTR	200	550
	WBL	150	225
	WBT	200	400
	WBR	25	125
	SELT	200	650
	SER	150	375
	NWLT	150	350
	NWR	150	350

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
OR 99W & SW Johnson St.	SELT	100	175
	SER	50	100
	NWL	125	200
	NWTR	100	275
	NEL	50	100
	NET	375	700
	NER	75	150
	SWL	100	400
	SWT	225	675
	SWR	25	100
OR 99W & SW Walnut St.	SEL	125	200
	SETR	175	400
	NWLTR	75	150
	NEL	125	200
	NET	275	500
	NETR	300	500
	SWL	50	75
	SWT	450	850
	SWR	50	100
OR 99W & SW Park St.	EBL	100	150
	EBT	25	100
	EBR	25	25
	WBLT	25	75
	WBR	25	50
	NEL	75	125
	NET	100	350
	NETR	100	350
	SWL	25	50
	SWT	150	500
	SWTR	175	525
OR 99W & Shopping Center Drwy	EBLR	25	50
	WBL	75	125
	WBLT	75	125
	WBR	50	100
	NEL	25	25
	NET	325	600
	NER	50	125
	SWL	75	125
	SWT	350	850
	SWTR	375	850

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
OR 99W & SW Gaarde St.	EBL	125	300
	EBT	550	1150
	EBR	25	75
	WBL	125	250
	WBT	250	675
	WBR	50	175
	NEL	425	550
	NET	650	1225
	NETR	575	1100
	SWL	100	150
	SWT	650	1050
	SWR	50	125
OR 99W & SW Canterbury Ln	SELT	50	125
	SER	50	100
	NWLT	25	25
	NWR	825	1050
	NEL	50	125
	NET	100	175
	NER	375	775
	SWL	25	75
	SWT	100	250
	SWR	250	675
OR 99W & SW Bull Mountain Rd.	EBL	425	875
	EBR	50	75
	NEL	225	375
	NET	400	900
	SWT	300	650
	SWR	75	200
OR 99W & SW Beef Bend Rd.	EBL	225	375
	EBR	125	300
	NBL	200	275
	NBT	575	1200
	SBT	500	1300
	SBTR	525	1325

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
OR 99W & SW Royalty Pkwy.	EBL	100	200
	EBLTR	150	325
	WBL	425	575
	WBTR	1100	2075
	NBL	75	175
	NBT	475	1075
	NBR	25	100
	SBL	150	325
	SBT	650	1350
	SBR	50	125
OR 99W & SW 114th Ave.	EBLT	325	600
	EBTR	225	475
	WBL	400	500
	WBLT	1400	2925
	WBR	1150	2850
	NBL	275	325
	NBT	1425	2500
	NBR	75	175
	SBL	325	450
	SBT	1025	1800
	SBR	25	100

SW Hall Boulevard

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
SW Hall Blvd. & SW Scoffins St.	EBLTR	150	350
	WBLT	250	475
	WBR	350	775
	NBL	25	50
	NBTR	275	450
	SBL	50	100
	SBTR	175	300
SW Hall Blvd. & SW Burham St.	EBL	100	175
	EBR	200	650
	NBL	100	150
	NBT	375	1325
	SBT	250	475
	SBR	25	125
SW Hall Blvd. & SW McDonald St.	EBLT	125	250
	EBR	125	200
	WBLTR	25	25
	NBL	1100	1625
	NBTR	1075	1725
	SBL		25
	SBTR	350	650
SW Hall Blvd. & SW Bonita Rd.	WBL	3025	4850
	WBR	3000	4975
	NBT	625	1800
	NBR	75	225
	SBL	175	275
	SBT	150	375

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
SW Hall Blvd. & SW Durham Rd.	EBL	150	275
	EBTR	175	550
	WBL	25	125
	WBT	750	1775
	WBR	150	300
	NBLTR	50	125
	SBL	150	225
	SBTR	75	150

SW 72nd Avenue

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
SW 72nd Ave. & SW Dartmouth St.	EBL	125	325
	EBT	225	500
	EBR	200	600
	WBL	50	100
	WBTR	50	75
	NBL	125	200
	NBTR	175	300
	SBL	1325	1675
	SBT	1675	2125
SW 72nd Ave. & SW Hampton St.	WBL	125	150
	WBR	1100	1250
	NBT	150	275
	NBR	50	100
	SBL	25	50
	SBT	150	325
SW 72nd Ave. & OR 217 NB Ramp	WBL	650	1125
	WBR	150	200
	NBT	125	250
	NBR	100	200
	SBL	150	225
	SBT	150	275
SW 72nd Ave. & SW Hunziker St.	EBL	175	250
	EBR	125	325
	NBL	100	175
	NBT	50	75
	SBTR	400	575

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
SW 72nd Ave. & OR 217 SB Ramp	EBLTR	25	75
	WBLT	125	200
	WBR	50	100
	NBL	25	25
	NBT	300	600
	NBR	75	200
	SBL	125	200
	SBTR	100	250
SW 72nd Ave. & SW Bonita Rd.	EBL	1125	2100
	EBT	1100	2250
	EBR	125	275
	WBL	25	100
	WBTR	1050	1925
	NBL	175	200
	NBTR	2125	4000
	SBL	475	1400
	SBT	900	1700
	SBR	225	325

Upper Boones Ferry Road

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
Upper Boones Ferry Rd. & I5 NB Ramp	NWL	225	250
	NWTR	1350	1900
	NEL	225	400
	NELT	275	450
	SWT	475	1025
	SWR	50	75
Upper Boones Ferry Rd. & I5 SB Ramp	SELT	250	750
	SER	225	750
	NET	375	600
	NETR	425	575
	SWL	200	300
	SWT	225	625
Upper Boones Ferry Rd. & SW Sequoia Pkwy	NBL	25	50
	NBTR	25	75
	SBL	200	350
	SBLT	600	1025
	SBR	175	675
	NEL	25	75
	NET	125	225
	NETR	150	250
	SWL	25	25
	SWT	350	600
	SWR	225	450
Upper Boones Ferry Rd. & SW 72nd Ave. (North)	EBLT	50	100
	EBTR	50	100
	WBL	300	400
	WBTR	375	775
	NBL	25	75
	NBT	350	675
	NBR	150	275
	SBL	525	950
	SBTR	550	1450

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
Upper Boones Ferry Rd. & SW 72nd Ave. (South)	SELTR	100	200
	NWLT	100	425
	NWR	200	550
	NEL	25	25
	NETR	275	675
	SWL	100	125
	SWTR	400	775
Upper Boones Ferry Rd. & SW Durham Rd.	EBL	200	275
	EBT	425	1250
	EBR	125	250
	WBL	25	100
	WBTR	1725	2950
	NEL	225	275
	NETR	2150	2975
	SWL	50	100
	SWT	625	975
	SWR	225	325

HCM Signalized Intersection Capacity Analysis
1: OR 217 NB Ramp & SW Scholls Ferry Rd

5/8/2009

Movement	WBL	WBR	NET	NER	SWL	SWT
Lane Configurations						
Volume (vph)	581	344	992	0	0	828
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5			4.5
Lane Util. Factor	0.97	1.00	0.95			0.95
Frpb, ped/bikes	1.00	0.98	1.00			1.00
Flpb, ped/bikes	1.00	1.00	1.00			1.00
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3467	1568	3539			3574
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3467	1568	3539			3574
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	618	366	1055	0	0	881
RTOR Reduction (vph)	0	77	0	0	0	0
Lane Group Flow (vph)	618	289	1055	0	0	881
Confl. Peds. (#/hr)	5	5		5		
Heavy Vehicles (%)	1%	1%	2%	2%	1%	1%
Turn Type		Perm				
Protected Phases	4		6			2
Permitted Phases		4				
Actuated Green, G (s)	19.3	19.3	52.2			52.2
Effective Green, g (s)	19.3	19.3	52.2			52.2
Actuated g/C Ratio	0.24	0.24	0.65			0.65
Clearance Time (s)	4.0	4.0	4.5			4.5
Vehicle Extension (s)	2.3	2.3	4.2			4.2
Lane Grp Cap (vph)	836	378	2309			2332
v/s Ratio Prot	0.18		c0.30			0.25
v/s Ratio Perm		c0.18				
v/c Ratio	0.74	0.77	0.46			0.38
Uniform Delay, d1	28.0	28.2	6.9			6.4
Progression Factor	1.00	1.00	1.00			1.00
Incremental Delay, d2	3.1	8.4	0.7			0.5
Delay (s)	31.2	36.6	7.5			6.9
Level of Service	C	D	A			A
Approach Delay (s)	33.2		7.5			6.9
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	16.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	69.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	72	1	425	0	0	0	0	920	697	142	1267	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0					5.0	5.0	4.0	5.0	
Lane Util. Factor		1.00	1.00					0.91	0.91	1.00	0.95	
Frpb, ped/bikes		1.00	0.98					1.00	0.98	1.00	1.00	
Flpb, ped/bikes		0.99	1.00					1.00	1.00	1.00	1.00	
Frt		1.00	0.85					0.97	0.85	1.00	1.00	
Flt Protected		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1795	1581					3286	1411	1787	3574	
Flt Permitted		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1795	1581					3286	1411	1787	3574	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	78	1	462	0	0	0	0	1000	758	154	1377	0
RTOR Reduction (vph)	0	0	21	0	0	0	0	13	293	0	0	0
Lane Group Flow (vph)	0	79	441	0	0	0	0	1207	245	154	1377	0
Confl. Peds. (#/hr)	5		5				5		5	5		5
Heavy Vehicles (%)	0%	0%	0%	2%	2%	2%	2%	2%	2%	1%	1%	1%
Turn Type	Perm		Perm						Perm	Prot		
Protected Phases		8						6		5	2	
Permitted Phases	8		8						6			
Actuated Green, G (s)		38.4	38.4					54.6	54.6	14.0	72.6	
Effective Green, g (s)		38.4	38.4					54.6	54.6	14.0	72.6	
Actuated g/C Ratio		0.32	0.32					0.46	0.46	0.12	0.60	
Clearance Time (s)		4.0	4.0					5.0	5.0	4.0	5.0	
Vehicle Extension (s)		2.3	2.3					4.1	4.1	2.3	4.1	
Lane Grp Cap (vph)		574	506					1495	642	208	2162	
v/s Ratio Prot								c0.37		c0.09	0.39	
v/s Ratio Perm		0.04	c0.28						0.17			
v/c Ratio		0.14	0.87					0.81	0.38	0.74	0.64	
Uniform Delay, d1		29.0	38.5					28.2	21.6	51.2	15.2	
Progression Factor		1.00	1.00					1.02	3.73	1.00	1.00	
Incremental Delay, d2		0.1	14.9					4.1	1.5	12.2	1.4	
Delay (s)		29.1	53.4					32.7	81.8	63.5	16.7	
Level of Service		C	D					C	F	E	B	
Approach Delay (s)		49.8			0.0			47.7			21.4	
Approach LOS		D			A			D			C	

Intersection Summary			
HCM Average Control Delay	37.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	69.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	62	67	96	164	98	77	57	1475	111	64	1546	75
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	5.0		4.0	5.0	5.0
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.91		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.99		1.00	0.99		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.91		1.00	0.93		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1779	1695		1778	1742		1770	5021		1787	3574	1547
Flt Permitted	0.45	1.00		0.48	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	846	1695		899	1742		1770	5021		1787	3574	1547
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	69	74	107	182	109	86	63	1639	123	71	1718	83
RTOR Reduction (vph)	0	45	0	0	24	0	0	6	0	0	0	7
Lane Group Flow (vph)	69	136	0	182	171	0	63	1756	0	71	1718	76
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	2%	2%	2%	1%	1%	1%
Turn Type	Perm			Perm			Prot			Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								6
Actuated Green, G (s)	25.8	25.8		25.8	25.8		7.9	73.8		7.4	73.3	73.3
Effective Green, g (s)	25.8	25.8		25.8	25.8		7.9	73.8		7.4	73.3	73.3
Actuated g/C Ratio	0.22	0.22		0.22	0.22		0.07	0.62		0.06	0.61	0.61
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	5.0		4.0	5.0	5.0
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.3	4.1		2.3	4.1	4.1
Lane Grp Cap (vph)	182	364		193	375		117	3088		110	2183	945
v/s Ratio Prot		0.08			0.10		0.04	0.35		c0.04	c0.48	
v/s Ratio Perm	0.08			c0.20								0.05
v/c Ratio	0.38	0.37		0.94	0.46		0.54	0.57		0.65	0.79	0.08
Uniform Delay, d1	40.3	40.2		46.4	41.0		54.3	13.7		55.0	17.5	9.6
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		0.91	1.26	1.05
Incremental Delay, d2	1.0	0.5		48.3	0.6		3.2	0.8		8.0	2.3	0.1
Delay (s)	41.2	40.7		94.7	41.6		57.4	14.4		57.7	24.3	10.1
Level of Service	D	D		F	D		E	B		E	C	B
Approach Delay (s)		40.8			67.3			15.9			24.9	
Approach LOS		D			E			B			C	

Intersection Summary			
HCM Average Control Delay	25.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	79.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	94	1141	32	65	1686	60	109	19	118	382	31	387
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00		1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.96		1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00	0.95	0.96	1.00
Satd. Flow (prot)	1770	3539	1547	1787	3574	1541		1787	1552	1681	1698	1552
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00	0.95	0.96	1.00
Satd. Flow (perm)	1770	3539	1547	1787	3574	1541		1787	1552	1681	1698	1552
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	99	1201	34	68	1775	63	115	20	124	402	33	407
RTOR Reduction (vph)	0	0	10	0	0	9	0	0	110	0	0	336
Lane Group Flow (vph)	99	1201	24	68	1775	54	0	135	14	217	218	71
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	2%	2%	2%	2%	2%	2%
Turn Type	Prot		Perm	Prot		Perm	Split		Perm	Split		Perm
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases			2			6			8			4
Actuated Green, G (s)	12.8	69.8	69.8	12.0	69.0	69.0		15.7	15.7	22.5	22.5	22.5
Effective Green, g (s)	12.8	69.8	69.8	12.0	69.0	69.0		15.7	15.7	22.5	22.5	22.5
Actuated g/C Ratio	0.09	0.48	0.48	0.08	0.48	0.48		0.11	0.11	0.16	0.16	0.16
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	2.4	3.1	3.1	2.6	3.1	3.1		1.6	1.6	1.6	1.6	1.6
Lane Grp Cap (vph)	157	1715	750	149	1713	738		195	169	263	265	243
v/s Ratio Prot	0.06	c0.34		0.04	c0.50			c0.08		c0.13	0.13	
v/s Ratio Perm			0.02			0.04			0.01			0.05
v/c Ratio	0.63	0.70	0.03	0.46	1.04	0.07		0.69	0.08	0.83	0.82	0.29
Uniform Delay, d1	63.3	28.9	19.4	62.9	37.5	20.2		61.8	57.7	58.8	58.8	53.7
Progression Factor	0.99	0.46	0.08	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.7	2.0	0.1	1.7	31.7	0.2		8.3	0.1	17.8	17.5	0.2
Delay (s)	68.3	15.3	1.6	64.6	69.2	20.4		70.1	57.7	76.6	76.3	54.0
Level of Service	E	B	A	E	E	C		E	E	E	E	D
Approach Delay (s)		18.9			67.5			64.2			65.6	
Approach LOS		B			E			E			E	

Intersection Summary			
HCM Average Control Delay	52.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	144.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	95.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
5: SW Scholls Ferry Rd & SW 121st Ave

5/8/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	15	939	184	334	1484	25	213	23	226	11	16	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00		1.00	1.00		1.00	
Frpb, ped/bikes	1.00	1.00	0.96	1.00	1.00	0.96		1.00	0.98		0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00		0.99	1.00		1.00	
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85		0.97	
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.98	
Satd. Flow (prot)	1770	3539	1521	1787	3574	1534		1770	1552		1760	
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.72	1.00		0.87	
Satd. Flow (perm)	1770	3539	1521	1787	3574	1534		1330	1552		1562	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	16	1010	198	359	1596	27	229	25	243	12	17	10
RTOR Reduction (vph)	0	0	59	0	0	3	0	0	190	0	8	0
Lane Group Flow (vph)	16	1010	139	359	1596	24	0	254	53	0	31	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	2%	2%	2%	2%	2%	2%
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		
Protected Phases	5	2		1	6			8			4	
Permitted Phases			2			6	8		8	4		
Actuated Green, G (s)	6.0	58.7	58.7	35.9	88.6	88.6		31.4	31.4		31.4	
Effective Green, g (s)	6.0	58.7	58.7	35.9	88.6	88.6		31.4	31.4		31.4	
Actuated g/C Ratio	0.04	0.41	0.41	0.25	0.62	0.62		0.22	0.22		0.22	
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0		6.0	
Vehicle Extension (s)	1.6	3.1	3.1	2.6	3.1	3.1		1.6	1.6		2.3	
Lane Grp Cap (vph)	74	1443	620	446	2199	944		290	338		341	
v/s Ratio Prot	0.01	0.29		c0.20	c0.45							
v/s Ratio Perm			0.09			0.02		c0.19	0.03		0.02	
v/c Ratio	0.22	0.70	0.22	0.80	0.73	0.02		0.88	0.16		0.09	
Uniform Delay, d1	66.7	35.4	27.8	50.8	19.3	10.8		54.4	45.6		44.9	
Progression Factor	1.00	1.00	1.00	0.73	0.43	0.30		1.00	1.00		1.00	
Incremental Delay, d2	0.5	2.8	0.8	3.7	0.8	0.0		23.6	0.1		0.1	
Delay (s)	67.3	38.2	28.7	40.7	9.0	3.3		78.0	45.7		45.0	
Level of Service	E	D	C	D	A	A		E	D		D	
Approach Delay (s)		37.0			14.7			62.2			45.0	
Approach LOS		D			B			E			D	

Intersection Summary			
HCM Average Control Delay	28.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	144.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	79.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	5	1005	119	133	1518	0	125	12	115	9	13	12
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	
Lane Util. Factor	1.00	0.95		1.00	0.95			1.00	1.00		1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	0.98		0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			0.99	1.00		1.00	
Frt	1.00	0.98		1.00	1.00			1.00	0.85		0.95	
Flt Protected	0.95	1.00		0.95	1.00			0.96	1.00		0.99	
Satd. Flow (prot)	1770	3470		1787	3574			1768	1553		1735	
Flt Permitted	0.95	1.00		0.95	1.00			0.72	1.00		0.93	
Satd. Flow (perm)	1770	3470		1787	3574			1327	1553		1639	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	5	1081	128	143	1632	0	134	13	124	10	14	13
RTOR Reduction (vph)	0	7	0	0	0	0	0	0	76	0	8	0
Lane Group Flow (vph)	5	1202	0	143	1632	0	0	147	48	0	29	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	2%	2%	2%	2%	2%	2%
Turn Type	Prot			Prot		Perm	Prot		Perm	Prot		
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases						6			4			
Actuated Green, G (s)	1.4	42.3		13.7	54.6			46.0	46.0		46.0	
Effective Green, g (s)	1.4	42.3		13.7	54.6			46.0	46.0		46.0	
Actuated g/C Ratio	0.01	0.35		0.11	0.46			0.38	0.38		0.38	
Clearance Time (s)	6.0	6.0		6.0	6.0			6.0	6.0		6.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0		3.0	
Lane Grp Cap (vph)	21	1223		204	1626			509	595		628	
v/s Ratio Prot	0.00	0.35		c0.08	c0.46							
v/s Ratio Perm								c0.11	0.03		0.02	
v/c Ratio	0.24	0.98		0.70	1.00			0.29	0.08		0.05	
Uniform Delay, d1	58.8	38.5		51.2	32.7			25.7	23.5		23.2	
Progression Factor	1.00	1.00		1.00	1.00			1.00	1.00		1.00	
Incremental Delay, d2	5.8	21.9		10.4	23.2			0.3	0.1		0.0	
Delay (s)	64.6	60.4		61.5	55.9			26.0	23.6		23.3	
Level of Service	E	E		E	E			C	C		C	
Approach Delay (s)		60.4			56.4			24.9			23.3	
Approach LOS		E			E			C			C	

Intersection Summary			
HCM Average Control Delay	54.9	HCM Level of Service	D
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	75.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
7: SW Walnut St & SW Barrows St

5/8/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	14	221	158	316	182	67	64	195	178	39	232	9
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	4.5	4.5	4.5		4.5	5.5		4.5	5.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	0.99		1.00	0.98		1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.96		1.00	0.93		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1787	1881	1559	1787	1795		1770	1701		1787	1868	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1787	1881	1559	1787	1795		1770	1701		1787	1868	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	16	246	176	351	202	74	71	217	198	43	258	10
RTOR Reduction (vph)	0	0	133	0	10	0	0	22	0	0	1	0
Lane Group Flow (vph)	16	246	43	351	266	0	71	393	0	43	267	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	2%	2%	2%	1%	1%	1%
Turn Type	Prot		pm+ov	Prot			Prot			Prot		
Protected Phases	7	4	5	3	8		5	2		1	6	
Permitted Phases			4									
Actuated Green, G (s)	2.2	18.9	26.5	15.1	31.8		7.6	50.8		3.9	47.1	
Effective Green, g (s)	2.2	18.9	26.5	15.1	31.8		7.6	50.8		3.9	47.1	
Actuated g/C Ratio	0.02	0.18	0.25	0.14	0.30		0.07	0.47		0.04	0.44	
Clearance Time (s)	4.5	4.5	4.5	4.5	4.5		4.5	5.5		4.5	5.5	
Vehicle Extension (s)	0.2	0.2	0.2	0.2	0.2		0.2	1.2		0.2	1.2	
Lane Grp Cap (vph)	37	330	449	251	530		125	802		65	817	
v/s Ratio Prot	0.01	c0.13	0.01	c0.20	0.15		c0.04	c0.23		0.02	0.14	
v/s Ratio Perm			0.02									
v/c Ratio	0.43	0.75	0.10	1.40	0.50		0.57	0.49		0.66	0.33	
Uniform Delay, d1	52.1	42.1	31.4	46.3	31.4		48.5	19.5		51.2	19.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.9	7.8	0.0	201.7	0.3		3.5	2.1		17.8	1.1	
Delay (s)	55.1	49.9	31.4	248.0	31.7		52.0	21.7		69.1	21.0	
Level of Service	E	D	C	F	C		D	C		E	C	
Approach Delay (s)		42.6			152.8			26.1			27.6	
Approach LOS		D			F			C			C	

Intersection Summary			
HCM Average Control Delay	72.9	HCM Level of Service	E
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	107.7	Sum of lost time (s)	19.0
Intersection Capacity Utilization	71.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Level Of Service Computation Report
2000 HCM Unsignalized Method (Future Volume Alternative)

Intersection #8 SW Walnut St/ SW 135th Ave

Average Delay (sec/veh): 12.7 Worst Case Level Of Service: F[62.9]

Street Name:	SW 135th Ave									SW Walnut St									
Approach:	North Bound					South Bound				East Bound					West Bound				
Movement:	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R	L	-	T	-	R
Control:	Stop Sign					Stop Sign					Uncontrolled					Uncontrolled				
Rights:	Include					Include					Include					Include				
Lanes:	0	0	0	0	0	1	0	0	0	1	1	0	1	0	0	0	0	0	1	0
Volume Module:																				
Base Vol:	0	0	0			143	0			136	104		381		0	0		545		151
Growth Adj:	1.00	1.00	1.00			1.00	1.00			1.00	1.00		1.00		1.00	1.00		1.00		1.00
Initial Bse:	0	0	0			143	0			136	104		381		0	0		545		151
Added Vol:	0	0	0			0	0			0	0		0		0	0		0		0
PasserByVol:	0	0	0			0	0			0	0		0		0	0		0		0
Initial Fut:	0	0	0			143	0			136	104		381		0	0		545		151
User Adj:	1.00	1.00	1.00			1.00	1.00			1.00	1.00		1.00		1.00	1.00		1.00		1.00
PHF Adj:	0.95	0.95	0.95			0.95	0.95			0.95	0.95		0.95		0.95	0.95		0.95		0.95
PHF Volume:	0	0	0			151	0			143	109		401		0	0		574		159
Reduct Vol:	0	0	0			0	0			0	0		0		0	0		0		0
FinalVolume:	0	0	0			151	0			143	109		401		0	0		574		159
Critical Gap Module:																				
Critical Gp:	xxxxx	xxxx	xxxxx			6.4	xxxx			6.2	4.1	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
FollowUpTim:	xxxxx	xxxx	xxxxx			3.5	xxxx			3.3	2.2	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Capacity Module:																				
Cnflict Vol:	xxxx	xxxx	xxxxx			1283	xxxx			663	738	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Potent Cap.:	xxxx	xxxx	xxxxx			182	xxxx			461	868	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Move Cap.:	xxxx	xxxx	xxxxx			163	xxxx			457	865	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Volume/Cap:	xxxx	xxxx	xxxx			0.92	xxxx			0.31	0.13	xxxx	xxxx	xxxx	xxxx	xxxx				
Level Of Service Module:																				
2Way95thQ:	xxxx	xxxx	xxxxx			6.8	xxxx			1.3	0.4	xxxx	xxxxx	xxxx	xxxx	xxxxx				
Control Del:	xxxxx	xxxx	xxxxx			107.0	xxxx			16.4	9.8	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
LOS by Move:	*	*	*			F	*			C	A	*	*	*	*	*				
Movement:	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT	LT	-	LTR	-	RT
Shared Cap.:	xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx			xxxx	xxxx	xxxxx	xxxx	xxxx	xxxxx				
SharedQueue:	xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Shrd ConDel:	xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx			xxxxx	xxxx	xxxxx	xxxxx	xxxx	xxxxx				
Shared LOS:	*	*	*			*	*			*	*	*		*	*					
ApproachDel:	xxxxxx					62.9					xxxxxx				xxxxxx					
ApproachLOS:	*					F					*				*					

Note: Queue reported is the number of cars per lane.

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	254	215	164	480	284	98
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	4.5	3.5	4.5	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.97	1.00	1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	1881	1544	1805	1900	1787	1541
Flt Permitted	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (perm)	1881	1544	1805	1900	1787	1541
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	270	229	174	511	302	104
RTOR Reduction (vph)	0	110	0	0	0	82
Lane Group Flow (vph)	270	119	174	511	302	22
Confl. Peds. (#/hr)		5	5		5	5
Heavy Vehicles (%)	1%	1%	0%	0%	1%	1%
Turn Type		Perm	Prot			Perm
Protected Phases	2		1	6	8	
Permitted Phases		2				8
Actuated Green, G (s)	52.0	52.0	14.7	70.2	21.3	21.3
Effective Green, g (s)	52.0	52.0	14.7	70.2	21.3	21.3
Actuated g/C Ratio	0.52	0.52	0.15	0.70	0.21	0.21
Clearance Time (s)	4.5	4.5	3.5	4.5	4.0	4.0
Vehicle Extension (s)	2.2	2.2	3.5	2.7	2.0	2.0
Lane Grp Cap (vph)	978	803	265	1334	381	328
v/s Ratio Prot	0.14		c0.10	c0.27	c0.17	
v/s Ratio Perm		0.08				0.01
v/c Ratio	0.28	0.15	0.66	0.38	0.79	0.07
Uniform Delay, d1	13.5	12.5	40.3	6.1	37.3	31.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.7	0.4	6.0	0.8	10.1	0.0
Delay (s)	14.2	12.9	46.3	6.9	47.4	31.5
Level of Service	B	B	D	A	D	C
Approach Delay (s)	13.6			16.9	43.3	
Approach LOS	B			B	D	

Intersection Summary			
HCM Average Control Delay	22.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	7.5
Intersection Capacity Utilization	49.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	311	477	134	67	702	69	174	230	42	51	243	263
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.0	4.5	4.5	4.0	4.5	4.5
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1787	1881	1570	1787	3517		1805	1900	1585	1787	1881	1569
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1787	1881	1570	1787	3517		1805	1900	1585	1787	1881	1569
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	334	513	144	72	755	74	187	247	45	55	261	283
RTOR Reduction (vph)	0	0	68	0	6	0	0	0	33	0	0	231
Lane Group Flow (vph)	334	513	76	72	823	0	187	247	12	55	261	52
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	0%	0%	0%	1%	1%	1%
Turn Type	Prot		Perm	Prot			Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2						8			4
Actuated Green, G (s)	22.5	47.6	47.6	7.0	32.1		14.1	27.9	27.9	5.5	19.3	19.3
Effective Green, g (s)	22.5	47.6	47.6	7.0	32.1		14.1	27.9	27.9	5.5	19.3	19.3
Actuated g/C Ratio	0.21	0.45	0.45	0.07	0.31		0.13	0.27	0.27	0.05	0.18	0.18
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.0	4.5	4.5	4.0	4.5	4.5
Vehicle Extension (s)	2.3	4.0	4.0	2.3	4.0		2.3	2.3	2.3	2.3	2.3	2.3
Lane Grp Cap (vph)	383	853	712	119	1075		242	505	421	94	346	288
v/s Ratio Prot	c0.19	0.27		0.04	c0.23		c0.10	0.13		0.03	c0.14	
v/s Ratio Perm			0.05						0.01			0.03
v/c Ratio	0.87	0.60	0.11	0.61	0.77		0.77	0.49	0.03	0.59	0.75	0.18
Uniform Delay, d1	39.9	21.6	16.5	47.7	33.0		43.9	32.5	28.5	48.6	40.6	36.2
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	18.8	3.1	0.3	6.6	5.2		13.4	0.4	0.0	6.8	8.4	0.2
Delay (s)	58.6	24.7	16.8	54.3	38.2		57.3	33.0	28.5	55.5	49.0	36.4
Level of Service	E	C	B	D	D		E	C	C	E	D	D
Approach Delay (s)		35.0			39.5			42.1			43.6	
Approach LOS		C			D			D			D	

Intersection Summary			
HCM Average Control Delay	39.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	105.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	76.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	333	4	355	281	481	0	0	1093	248
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0	4.0	4.0	4.5			4.5	
Lane Util. Factor					1.00	0.88	1.00	0.95			0.91	
Frpb, ped/bikes					1.00	0.97	1.00	1.00			0.99	
Flpb, ped/bikes					0.99	1.00	1.00	1.00			1.00	
Frt					1.00	0.85	1.00	1.00			0.97	
Flt Protected					0.95	1.00	0.95	1.00			1.00	
Satd. Flow (prot)					1783	2734	1787	3574			4964	
Flt Permitted					0.95	1.00	0.95	1.00			1.00	
Satd. Flow (perm)					1783	2734	1787	3574			4964	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	0	370	4	394	312	534	0	0	1214	276
RTOR Reduction (vph)	0	0	0	0	0	307	0	0	0	0	35	0
Lane Group Flow (vph)	0	0	0	0	374	87	312	534	0	0	1455	0
Confl. Peds. (#/hr)				5		5	5					5
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Turn Type				Perm		Perm	Prot					
Protected Phases					4		1	6			2	
Permitted Phases				4		4						
Actuated Green, G (s)					18.2	18.2	17.5	55.3			33.8	
Effective Green, g (s)					18.2	18.2	17.5	55.3			33.8	
Actuated g/C Ratio					0.22	0.22	0.21	0.67			0.41	
Clearance Time (s)					4.0	4.0	4.0	4.5			4.5	
Vehicle Extension (s)					0.2	0.2	0.2	0.2			0.2	
Lane Grp Cap (vph)					396	607	381	2410			2046	
v/s Ratio Prot							c0.17	0.15			c0.29	
v/s Ratio Perm					0.21	0.03						
v/c Ratio					0.94	0.14	0.82	0.22			0.71	
Uniform Delay, d1					31.4	25.6	30.7	5.1			20.0	
Progression Factor					1.00	1.00	0.74	0.69			1.00	
Incremental Delay, d2					30.9	0.0	11.6	0.2			2.1	
Delay (s)					62.3	25.7	34.5	3.7			22.2	
Level of Service					E	C	C	A			C	
Approach Delay (s)		0.0			43.5			15.1			22.2	
Approach LOS		A			D			B			C	

Intersection Summary			
HCM Average Control Delay	25.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	82.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	71.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	164	7	384	0	0	0	0	598	173	476	950	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0					4.5	4.5	4.0	4.5	
Lane Util. Factor		1.00	1.00					0.95	1.00	0.97	0.95	
Frpb, ped/bikes		1.00	0.98					1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00	1.00					1.00	1.00	1.00	1.00	
Frt		1.00	0.85					1.00	0.85	1.00	1.00	
Flt Protected		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1787	1573					3539	1554	3467	3574	
Flt Permitted		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1787	1573					3539	1554	3467	3574	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	174	7	409	0	0	0	0	636	184	506	1011	0
RTOR Reduction (vph)	0	0	117	0	0	0	0	0	99	0	0	0
Lane Group Flow (vph)	0	181	292	0	0	0	0	636	85	506	1011	0
Confl. Peds. (#/hr)	5		5						5	5		
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	2%	2%	2%	1%	1%	1%
Turn Type	Perm		Perm						Perm	Prot		
Protected Phases		8						6		5	2	
Permitted Phases	8		8						6			
Actuated Green, G (s)		16.5	16.5					38.1	38.1	14.9	57.0	
Effective Green, g (s)		16.5	16.5					38.1	38.1	14.9	57.0	
Actuated g/C Ratio		0.20	0.20					0.46	0.46	0.18	0.70	
Clearance Time (s)		4.0	4.0					4.5	4.5	4.0	4.5	
Vehicle Extension (s)		0.2	0.2					0.2	0.2	0.2	0.2	
Lane Grp Cap (vph)		360	317					1644	722	630	2484	
v/s Ratio Prot								0.18		c0.15	c0.28	
v/s Ratio Perm		0.10	c0.19						0.06			
v/c Ratio		0.50	0.92					0.39	0.12	0.80	0.41	
Uniform Delay, d1		29.1	32.1					14.3	12.4	32.1	5.3	
Progression Factor		1.00	1.00					1.00	1.00	0.70	0.57	
Incremental Delay, d2		0.4	29.9					0.7	0.3	4.5	0.3	
Delay (s)		29.5	62.0					15.0	12.8	26.8	3.3	
Level of Service		C	E					B	B	C	A	
Approach Delay (s)		52.0			0.0			14.5			11.2	
Approach LOS		D			A			B			B	

Intersection Summary			
HCM Average Control Delay	20.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	82.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	71.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	381	74	193	381	436	826
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.5	4.5	4.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.98	1.00	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1553	1770	1863	1863	1538
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1770	1553	1770	1863	1863	1538
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	428	83	217	428	490	928
RTOR Reduction (vph)	0	45	0	0	0	467
Lane Group Flow (vph)	428	38	217	428	490	461
Confl. Peds. (#/hr)	5	5	5			5
Turn Type		pm+ov	Prot			Perm
Protected Phases	8	1	1	6	2	
Permitted Phases		8				2
Actuated Green, G (s)	22.9	36.0	13.1	46.8	29.7	29.7
Effective Green, g (s)	22.9	36.0	13.1	46.8	29.7	29.7
Actuated g/C Ratio	0.29	0.46	0.17	0.60	0.38	0.38
Clearance Time (s)	4.0	4.0	4.0	4.5	4.5	4.5
Vehicle Extension (s)	3.5	2.2	2.2	3.7	3.7	3.7
Lane Grp Cap (vph)	518	794	297	1115	708	584
v/s Ratio Prot	c0.24	0.01	c0.12	0.23	0.26	
v/s Ratio Perm		0.02				c0.30
v/c Ratio	0.83	0.05	0.73	0.38	0.69	0.79
Uniform Delay, d1	25.8	11.6	30.9	8.2	20.4	21.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.6	0.0	8.0	0.3	3.1	7.3
Delay (s)	36.4	11.7	38.9	8.5	23.5	28.8
Level of Service	D	B	D	A	C	C
Approach Delay (s)	32.4			18.7	26.9	
Approach LOS	C			B	C	

Intersection Summary			
HCM Average Control Delay	26.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	78.2	Sum of lost time (s)	12.5
Intersection Capacity Utilization	69.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	140	191	83	66	82	27	24	1531	83	56	1705	84
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	0.99	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.96		1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1794	1900	1583	1796	1820		1770	3505		1770	3508	
Flt Permitted	0.55	1.00	1.00	0.30	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1036	1900	1583	572	1820		1770	3505		1770	3508	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	149	203	88	70	87	29	26	1629	88	60	1814	89
RTOR Reduction (vph)	0	0	45	0	8	0	0	2	0	0	2	0
Lane Group Flow (vph)	149	203	43	70	108	0	26	1715	0	60	1901	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Perm		Perm	Perm			Prot			Prot		
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		8	4								
Actuated Green, G (s)	21.3	21.3	21.3	21.3	21.3		4.8	91.3		14.4	100.9	
Effective Green, g (s)	21.3	21.3	21.3	21.3	21.3		4.8	91.3		14.4	100.9	
Actuated g/C Ratio	0.15	0.15	0.15	0.15	0.15		0.03	0.65		0.10	0.72	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	5.0		4.0	5.0	
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.3	4.8		2.3	4.8	
Lane Grp Cap (vph)	158	289	241	87	277		61	2286		182	2528	
v/s Ratio Prot		0.11			0.06		0.01	c0.49		0.03	c0.54	
v/s Ratio Perm	c0.14		0.03	0.12								
v/c Ratio	0.94	0.70	0.18	0.80	0.39		0.43	0.75		0.33	0.75	
Uniform Delay, d1	58.7	56.3	51.7	57.3	53.5		66.3	16.6		58.3	11.9	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.06	1.01		1.00	1.00	
Incremental Delay, d2	54.5	7.0	0.3	39.0	0.7		2.2	1.8		0.6	2.1	
Delay (s)	113.3	63.3	52.0	96.3	54.1		72.6	18.6		58.9	14.0	
Level of Service	F	E	D	F	D		E	B		E	B	
Approach Delay (s)		78.0			70.0			19.4			15.4	
Approach LOS		E			E			B			B	

Intersection Summary			
HCM Average Control Delay	25.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	77.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	81	91	84	102	162	172	127	1459	53	94	1470	22
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	5.0	5.0	4.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95	1.00	0.97	0.95	
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.99	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.93		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1796	1746		1779	1881	1577	1770	3539	1553	3433	3529	
Flt Permitted	0.41	1.00		0.37	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	771	1746		695	1881	1577	1770	3539	1553	3433	3529	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	87	98	90	110	174	185	137	1569	57	101	1581	24
RTOR Reduction (vph)	0	23	0	0	0	27	0	0	17	0	1	0
Lane Group Flow (vph)	87	165	0	110	174	158	137	1569	40	101	1604	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	2%	2%	2%	2%	2%	2%
Turn Type	Perm			Perm		pm+ov	Prot		Perm	Prot		
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases	4			8		8			2			
Actuated Green, G (s)	23.0	23.0		23.0	23.0	31.8	17.0	95.2	95.2	8.8	87.0	
Effective Green, g (s)	23.0	23.0		23.0	23.0	31.8	17.0	95.2	95.2	8.8	87.0	
Actuated g/C Ratio	0.16	0.16		0.16	0.16	0.23	0.12	0.68	0.68	0.06	0.62	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	5.0	5.0	4.0	5.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.3	2.3	4.8	4.8	2.3	4.8	
Lane Grp Cap (vph)	127	287		114	309	403	215	2407	1056	216	2193	
v/s Ratio Prot		0.09			0.09	0.02	0.08	c0.44		0.03	c0.45	
v/s Ratio Perm	0.11			c0.16		0.08			0.03			
v/c Ratio	0.69	0.57		0.96	0.56	0.39	0.64	0.65	0.04	0.47	0.73	
Uniform Delay, d1	55.1	54.0		58.1	53.9	45.9	58.6	12.9	7.4	63.3	18.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	0.71	0.21	0.12	1.01	0.92	
Incremental Delay, d2	13.1	2.3		72.6	1.9	0.4	3.7	1.0	0.0	0.6	1.4	
Delay (s)	68.2	56.2		130.7	55.8	46.3	45.4	3.8	1.0	64.5	18.4	
Level of Service	E	E		F	E	D	D	A	A	E	B	
Approach Delay (s)		60.0			69.6			6.9			21.1	
Approach LOS		E			E			A			C	

Intersection Summary			
HCM Average Control Delay	23.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	78.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	12	18	23	128	0	37	1	1600	23	1	1650	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0		4.0		5.0			5.0	
Lane Util. Factor		1.00		0.97		1.00		0.95			0.95	
Frpb, ped/bikes		0.98		1.00		0.98		1.00			1.00	
Flpb, ped/bikes		0.99		1.00		1.00		1.00			1.00	
Frt		0.94		1.00		0.85		1.00			1.00	
Flt Protected		0.99		0.95		1.00		1.00			1.00	
Satd. Flow (prot)		1724		3502		1581		3530			3537	
Flt Permitted		0.99		0.95		1.00		0.95			0.95	
Satd. Flow (perm)		1724		3502		1581		3369			3376	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	14	20	26	145	0	42	1	1818	26	1	1875	5
RTOR Reduction (vph)	0	22	0	0	0	15	0	0	0	0	0	0
Lane Group Flow (vph)	0	38	0	145	0	27	0	1845	0	0	1881	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Perm			Prot		custom	Perm			Perm		
Protected Phases		4		3				2			6	
Permitted Phases	4					8	2			6		
Actuated Green, G (s)		7.0		10.5		21.5		109.5			109.5	
Effective Green, g (s)		7.0		10.5		21.5		109.5			109.5	
Actuated g/C Ratio		0.05		0.08		0.15		0.78			0.78	
Clearance Time (s)		4.0		4.0		4.0		5.0			5.0	
Vehicle Extension (s)		2.3		2.3		2.3		4.8			4.8	
Lane Grp Cap (vph)		86		263		243		2635			2641	
v/s Ratio Prot				c0.04								
v/s Ratio Perm		0.02				0.02		0.55			c0.56	
v/c Ratio		0.44		0.55		0.11		0.70			0.71	
Uniform Delay, d1		64.6		62.5		51.0		7.3			7.5	
Progression Factor		1.00		1.00		1.00		0.51			0.31	
Incremental Delay, d2		2.1		1.8		0.1		1.1			1.2	
Delay (s)		66.7		64.2		51.1		4.9			3.5	
Level of Service		E		E		D		A			A	
Approach Delay (s)		66.7			61.3			4.9			3.5	
Approach LOS		E			E			A			A	

Intersection Summary			
HCM Average Control Delay	7.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	67.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	86	1373	346	58	1632	17	311	187	76	153	97	44
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0		4.5	4.5		4.5	3.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		0.97	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	0.99		1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		0.99	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.96		1.00	0.95	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1550	1752	3498		3460	1805		1787	1781	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.66	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1550	1752	3498		2410	1805		1787	1781	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	91	1461	368	62	1736	18	331	199	81	163	103	47
RTOR Reduction (vph)	0	0	134	0	0	0	0	11	0	0	11	0
Lane Group Flow (vph)	91	1461	234	62	1754	0	331	269	0	163	139	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	0%	0%	0%	1%	1%	1%
Turn Type	Prot		Perm	Prot			Perm			Prot		
Protected Phases	5	2		1	6			8		7	4	
Permitted Phases			2				8					
Actuated Green, G (s)	11.3	85.5	85.5	8.5	82.7		16.5	16.5		11.5	34.0	
Effective Green, g (s)	11.3	85.5	85.5	8.5	82.7		16.5	16.5		11.5	34.0	
Actuated g/C Ratio	0.08	0.61	0.61	0.06	0.59		0.12	0.12		0.08	0.24	
Clearance Time (s)	4.0	5.0	5.0	4.0	5.0		4.5	4.5		4.5	3.0	
Vehicle Extension (s)	2.3	4.8	4.8	2.3	4.8		2.3	2.3		2.3	0.5	
Lane Grp Cap (vph)	143	2161	947	106	2066		284	213		147	433	
v/s Ratio Prot	c0.05	c0.41		0.04	c0.50			c0.15		c0.09	0.08	
v/s Ratio Perm			0.15				0.14					
v/c Ratio	0.64	0.68	0.25	0.58	0.85		1.17	1.26		1.11	0.32	
Uniform Delay, d1	62.4	18.1	12.5	64.0	23.5		61.8	61.8		64.2	43.5	
Progression Factor	1.11	0.92	1.87	0.89	0.83		1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.1	1.2	0.4	4.5	3.4		105.9	151.0		106.4	0.2	
Delay (s)	74.4	17.9	23.7	61.7	22.9		167.6	212.8		170.7	43.7	
Level of Service	E	B	C	E	C		F	F		F	D	
Approach Delay (s)		21.7			24.2			188.3			109.8	
Approach LOS		C			C			F			F	

Intersection Summary			
HCM Average Control Delay	50.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	23.0
Intersection Capacity Utilization	88.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1765	290	0	1462	623	203	0	135	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0	5.0	4.0		4.0			
Lane Util. Factor		0.95	1.00		0.95	1.00	1.00		1.00			
Frpb, ped/bikes		1.00	0.98		1.00	0.98	1.00		0.98			
Flpb, ped/bikes		1.00	1.00		1.00	1.00	0.99		1.00			
Frt		1.00	0.85		1.00	0.85	1.00		0.85			
Flt Protected		1.00	1.00		1.00	1.00	0.95		1.00			
Satd. Flow (prot)		3539	1546		3539	1546	1754		1551			
Flt Permitted		1.00	1.00		1.00	1.00	0.95		1.00			
Satd. Flow (perm)		3539	1546		3539	1546	1754		1551			
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	0	1898	312	0	1572	670	218	0	145	0	0	0
RTOR Reduction (vph)	0	0	36	0	0	195	0	0	113	0	0	0
Lane Group Flow (vph)	0	1898	276	0	1572	475	218	0	32	0	0	0
Confl. Peds. (#/hr)	5		5	5		5	5		5			
Turn Type			Perm			Perm	custom		custom			
Protected Phases		2			6							
Permitted Phases			2			6	4		4			
Actuated Green, G (s)		99.3	99.3		99.3	99.3	23.7		23.7			
Effective Green, g (s)		99.3	99.3		99.3	99.3	23.7		23.7			
Actuated g/C Ratio		0.71	0.71		0.71	0.71	0.17		0.17			
Clearance Time (s)		5.0	5.0		5.0	5.0	4.0		4.0			
Vehicle Extension (s)		4.8	4.8		4.8	4.8	2.3		2.3			
Lane Grp Cap (vph)		2510	1097		2510	1097	297		263			
v/s Ratio Prot		c0.54			0.44							
v/s Ratio Perm			0.18			0.31	c0.12		0.02			
v/c Ratio		0.76	0.25		0.63	0.43	0.73		0.12			
Uniform Delay, d1		12.8	7.2		10.6	8.5	55.2		49.3			
Progression Factor		0.85	0.95		1.44	5.18	1.00		1.00			
Incremental Delay, d2		1.6	0.4		0.6	0.6	8.3		0.1			
Delay (s)		12.4	7.2		15.9	44.9	63.4		49.4			
Level of Service		B	A		B	D	E		D			
Approach Delay (s)		11.7			24.6			57.8			0.0	
Approach LOS		B			C			E			A	

Intersection Summary			
HCM Average Control Delay	21.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	67.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1455	248	65	1600	0	0	0	0	600	0	262
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0	4.0	5.0					4.0	4.0	4.0
Lane Util. Factor		0.95	1.00	1.00	0.95					0.95	0.95	1.00
Frpb, ped/bikes		1.00	0.96	1.00	1.00					1.00	1.00	0.98
Flpb, ped/bikes		1.00	1.00	1.00	1.00					0.99	0.99	1.00
Frt		1.00	0.85	1.00	1.00					1.00	1.00	0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95	0.95	1.00
Satd. Flow (prot)		3505	1510	1770	3539					1669	1669	1553
Flt Permitted		1.00	1.00	0.95	1.00					0.95	0.95	1.00
Satd. Flow (perm)		3505	1510	1770	3539					1669	1669	1553
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1532	261	68	1684	0	0	0	0	632	0	276
RTOR Reduction (vph)	0	0	28	0	0	0	0	0	0	0	0	28
Lane Group Flow (vph)	0	1532	233	68	1684	0	0	0	0	316	316	248
Confl. Peds. (#/hr)			5	5						5		5
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Turn Type			Perm	Prot						Perm		Perm
Protected Phases		2		1	6						4	
Permitted Phases			2							4		4
Actuated Green, G (s)		87.9	87.9	8.5	100.4					30.6	30.6	30.6
Effective Green, g (s)		87.9	87.9	8.5	100.4					30.6	30.6	30.6
Actuated g/C Ratio		0.63	0.63	0.06	0.72					0.22	0.22	0.22
Clearance Time (s)		5.0	5.0	4.0	5.0					4.0	4.0	4.0
Vehicle Extension (s)		4.8	4.8	2.5	4.8					2.3	2.3	2.3
Lane Grp Cap (vph)		2201	948	107	2538					365	365	339
v/s Ratio Prot		c0.44		0.04	c0.48							
v/s Ratio Perm			0.15							c0.19	0.19	0.16
v/c Ratio		0.70	0.25	0.64	0.66					0.87	0.87	0.73
Uniform Delay, d1		17.2	11.5	64.2	10.7					52.7	52.7	50.9
Progression Factor		0.48	0.31	1.18	0.75					1.00	1.00	1.00
Incremental Delay, d2		1.4	0.5	8.1	1.1					18.5	18.5	7.2
Delay (s)		9.7	4.1	84.2	9.1					71.2	71.2	58.1
Level of Service		A	A	F	A					E	E	E
Approach Delay (s)		8.9			12.1			0.0			67.2	
Approach LOS		A			B			A			E	

Intersection Summary			
HCM Average Control Delay	22.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	72.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	192	1058	30	164	1593	125	99	234	241	235	190	76
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0			4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.91			1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	0.98	1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	0.99			1.00	0.85	1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00			0.99	1.00	0.95	1.00	
Satd. Flow (prot)	1752	3487		1770	5016			1854	1568	1787	1790	
Flt Permitted	0.95	1.00		0.95	1.00			0.99	1.00	0.95	1.00	
Satd. Flow (perm)	1752	3487		1770	5016			1854	1568	1787	1790	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	200	1102	31	171	1659	130	103	244	251	245	198	79
RTOR Reduction (vph)	0	1	0	0	6	0	0	0	179	0	10	0
Lane Group Flow (vph)	200	1132	0	171	1783	0	0	347	72	245	267	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	1%	1%	1%	1%	1%	1%
Turn Type	Prot			Prot			Split		Perm	Split		
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases									8			
Actuated Green, G (s)	17.0	60.2		14.8	58.0			27.0	27.0	21.0	21.0	
Effective Green, g (s)	17.0	60.2		14.8	58.0			27.0	27.0	21.0	21.0	
Actuated g/C Ratio	0.12	0.43		0.11	0.41			0.19	0.19	0.15	0.15	
Clearance Time (s)	4.0	5.0		4.0	5.0			4.0	4.0	4.0	4.0	
Vehicle Extension (s)	2.3	4.8		2.3	4.8			2.3	2.3	2.3	2.3	
Lane Grp Cap (vph)	213	1499		187	2078			358	302	268	269	
v/s Ratio Prot	c0.11	0.32		0.10	c0.36			c0.19		0.14	c0.15	
v/s Ratio Perm									0.05			
v/c Ratio	0.94	0.76		0.91	0.86			0.97	0.24	0.91	0.99	
Uniform Delay, d1	61.0	33.7		62.0	37.3			56.1	47.8	58.6	59.4	
Progression Factor	1.36	0.52		1.15	0.72			1.00	1.00	1.00	1.00	
Incremental Delay, d2	39.0	3.0		34.5	3.7			38.8	0.2	32.8	52.4	
Delay (s)	122.1	20.5		105.6	30.4			94.9	48.0	91.4	111.8	
Level of Service	F	C		F	C			F	D	F	F	
Approach Delay (s)		35.7			37.0			75.2			102.2	
Approach LOS		D			D			E			F	

Intersection Summary			
HCM Average Control Delay	49.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	91.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	162	1005	9	152	1419	271	87	74	296	11	119	220
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0	5.0		4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00		1.00	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98		1.00	0.98		1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00	1.00		1.00	1.00
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.97	1.00		1.00	1.00
Satd. Flow (prot)	1752	3499		1770	3539	1544		1814	1549		1819	1521
Flt Permitted	0.95	1.00		0.95	1.00	1.00		0.97	1.00		1.00	1.00
Satd. Flow (perm)	1752	3499		1770	3539	1544		1814	1549		1819	1521
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	171	1058	9	160	1494	285	92	78	312	12	125	232
RTOR Reduction (vph)	0	0	0	0	0	87	0	0	273	0	0	209
Lane Group Flow (vph)	171	1067	0	160	1494	198	0	170	39	0	137	23
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	2%	2%	2%	4%	4%	4%
Turn Type	Prot			Prot		Perm	Split		Perm	Split		Perm
Protected Phases	5	2		1	6		4	4		8	8	
Permitted Phases						6			4			8
Actuated Green, G (s)	18.1	75.7		15.9	73.5	73.5		17.5	17.5		13.9	13.9
Effective Green, g (s)	18.1	75.7		15.9	73.5	73.5		17.5	17.5		13.9	13.9
Actuated g/C Ratio	0.13	0.54		0.11	0.52	0.52		0.12	0.12		0.10	0.10
Clearance Time (s)	4.0	5.0		4.0	5.0	5.0		4.0	4.0		4.0	4.0
Vehicle Extension (s)	2.3	4.8		2.3	4.8	4.8		2.3	2.3		2.3	2.3
Lane Grp Cap (vph)	227	1892		201	1858	811		227	194		181	151
v/s Ratio Prot	c0.10	0.30		0.09	c0.42			c0.09			c0.08	
v/s Ratio Perm						0.13			0.03			0.02
v/c Ratio	0.75	0.56		0.80	0.80	0.24		0.75	0.20		0.76	0.15
Uniform Delay, d1	58.8	21.2		60.5	27.3	18.1		59.1	55.0		61.4	57.7
Progression Factor	1.03	0.34		0.53	0.27	0.02		1.00	1.00		1.27	3.28
Incremental Delay, d2	10.5	1.0		10.6	1.6	0.2		11.7	0.3		15.0	0.3
Delay (s)	71.2	8.2		42.6	9.1	0.5		70.8	55.3		93.3	189.3
Level of Service	E	A		D	A	A		E	E		F	F
Approach Delay (s)		16.9			10.6			60.8			153.6	
Approach LOS		B			B			E			F	

Intersection Summary			
HCM Average Control Delay	31.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	77.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	32	26	40	273	37	18	26	1126	264	37	1602	87
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor		1.00	1.00	0.97	1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes		1.00	0.98	1.00	0.99		1.00	1.00	0.98	1.00	1.00	0.96
Flpb, ped/bikes		1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85	1.00	0.95		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.97	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1795	1534	3400	1741		1752	3505	1537	1770	3539	1515
Flt Permitted		0.97	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		1795	1534	3400	1741		1752	3505	1537	1770	3539	1515
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	33	27	41	281	38	19	27	1161	272	38	1652	90
RTOR Reduction (vph)	0	0	39	0	12	0	0	0	71	0	0	15
Lane Group Flow (vph)	0	60	2	281	45	0	27	1161	201	38	1652	75
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%	3%	2%	2%	2%
Turn Type	Split		Perm	Split			Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4						2			6
Actuated Green, G (s)		8.0	8.0	29.0	29.0		4.9	78.6	78.6	7.4	81.1	81.1
Effective Green, g (s)		8.0	8.0	29.0	29.0		4.9	78.6	78.6	7.4	81.1	81.1
Actuated g/C Ratio		0.06	0.06	0.21	0.21		0.04	0.56	0.56	0.05	0.58	0.58
Clearance Time (s)		4.0	4.0	4.0	4.0		4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)		2.3	2.3	2.3	2.3		2.3	4.8	4.8	2.3	4.8	4.8
Lane Grp Cap (vph)		103	88	704	361		61	1968	863	94	2050	878
v/s Ratio Prot		c0.03		c0.08	0.03		0.02	c0.33		0.02	c0.47	
v/s Ratio Perm			0.00						0.13			0.05
v/c Ratio		0.58	0.03	0.40	0.12		0.44	0.59	0.23	0.40	0.81	0.09
Uniform Delay, d1		64.4	62.3	48.0	45.2		66.2	20.1	15.5	64.2	23.2	13.0
Progression Factor		1.00	1.00	0.78	0.73		0.95	1.23	1.68	0.69	0.17	0.01
Incremental Delay, d2		6.2	0.1	1.5	0.6		2.5	1.1	0.5	1.0	1.7	0.1
Delay (s)		70.6	62.4	39.1	33.7		65.3	25.9	26.5	45.5	5.6	0.2
Level of Service		E	E	D	C		E	C	C	D	A	A
Approach Delay (s)		67.2			38.2			26.8			6.2	
Approach LOS		E			D			C			A	

Intersection Summary			
HCM Average Control Delay	19.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	75.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	121	13	177	31	25	16	150	1303	16	21	1622	199
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0		4.0	5.0		4.0	5.0	5.0
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.98			0.99		1.00	1.00		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.86			0.97		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	1571			1772		1752	3496		1752	3505	1501
Flt Permitted	0.95	1.00			0.98		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1770	1571			1772		1752	3496		1752	3505	1501
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	126	14	184	32	26	17	156	1357	17	22	1690	207
RTOR Reduction (vph)	0	165	0	0	8	0	0	0	0	0	0	19
Lane Group Flow (vph)	126	33	0	0	67	0	156	1374	0	22	1690	188
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	3%	3%	3%	3%	3%	3%
Turn Type	Split			Split			Prot			Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases												6
Actuated Green, G (s)	14.7	14.7			10.0		20.5	93.8		4.5	77.8	77.8
Effective Green, g (s)	14.7	14.7			10.0		20.5	93.8		4.5	77.8	77.8
Actuated g/C Ratio	0.10	0.10			0.07		0.15	0.67		0.03	0.56	0.56
Clearance Time (s)	4.0	4.0			4.0		4.0	5.0		4.0	5.0	5.0
Vehicle Extension (s)	2.3	2.3			2.3		2.3	4.8		2.3	4.8	4.8
Lane Grp Cap (vph)	186	165			127		257	2342		56	1948	834
v/s Ratio Prot	c0.07	0.02			c0.04		0.09	c0.39		0.01	c0.48	
v/s Ratio Perm												0.13
v/c Ratio	0.68	0.20			0.52		0.61	0.59		0.39	0.87	0.23
Uniform Delay, d1	60.4	57.3			62.7		56.0	12.6		66.4	26.7	15.8
Progression Factor	1.00	1.00			1.00		0.74	0.83		1.14	0.75	0.52
Incremental Delay, d2	8.1	0.4			2.5		2.8	1.0		1.8	3.9	0.4
Delay (s)	68.5	57.6			65.2		44.0	11.3		77.2	24.0	8.7
Level of Service	E	E			E		D	B		E	C	A
Approach Delay (s)		61.9			65.2			14.7			22.9	
Approach LOS		E			E			B			C	

Intersection Summary			
HCM Average Control Delay	23.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	86.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	69	2	84	12	5	13	51	1369	2	15	1662	63
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0	4.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00	1.00		1.00	1.00	1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.98		1.00	0.98	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	0.99	1.00	1.00		0.99	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00	1.00		0.97	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1772	1881	1566		1769	1536	1752	3504		1752	3481	
Flt Permitted	0.75	1.00	1.00		0.84	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1391	1881	1566		1532	1536	1752	3504		1752	3481	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	73	2	89	13	5	14	54	1456	2	16	1768	67
RTOR Reduction (vph)	0	0	81	0	0	13	0	0	0	0	1	0
Lane Group Flow (vph)	73	2	8	0	18	1	54	1458	0	16	1834	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	1%	1%	1%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Turn Type	Perm		Perm	Perm		Perm	Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8						
Actuated Green, G (s)	11.9	11.9	11.9		11.9	11.9	8.0	112.1		3.0	107.1	
Effective Green, g (s)	11.9	11.9	11.9		11.9	11.9	8.0	112.1		3.0	107.1	
Actuated g/C Ratio	0.08	0.08	0.08		0.08	0.08	0.06	0.80		0.02	0.76	
Clearance Time (s)	4.0	4.0	4.0		4.0	4.0	4.0	5.0		4.0	5.0	
Vehicle Extension (s)	2.3	2.3	2.3		2.3	2.3	2.3	4.8		2.3	4.8	
Lane Grp Cap (vph)	118	160	133		130	131	100	2806		38	2663	
v/s Ratio Prot		0.00					c0.03	0.42		0.01	c0.53	
v/s Ratio Perm	c0.05		0.00		0.01	0.00						
v/c Ratio	0.62	0.01	0.06		0.14	0.01	0.54	0.52		0.42	0.69	
Uniform Delay, d1	61.9	58.7	58.9		59.3	58.7	64.2	4.8		67.6	8.2	
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	0.40		0.89	0.54	
Incremental Delay, d2	7.4	0.0	0.1		0.3	0.0	3.3	0.6		2.4	0.8	
Delay (s)	69.3	58.7	59.0		59.6	58.7	67.3	2.5		62.3	5.3	
Level of Service	E	E	E		E	E	E	A		E	A	
Approach Delay (s)		63.6			59.2			4.8			5.7	
Approach LOS		E			E			A			A	

Intersection Summary			
HCM Average Control Delay	8.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	74.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	1	0	5	120	1	88	4	1333	66	87	1668	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0	4.0	4.0	5.0	5.0	4.0	5.0	
Lane Util. Factor		1.00		0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		0.90		1.00	1.00	0.98	1.00	1.00	0.96	1.00	1.00	
Flpb, ped/bikes		1.00		0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		0.89		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.99		0.95	0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1510		1683	1689	1566	1752	3505	1512	1752	3504	
Flt Permitted		1.00		0.75	0.73	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1523		1335	1286	1566	1752	3505	1512	1752	3504	
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	1	0	5	128	1	94	4	1418	70	93	1774	3
RTOR Reduction (vph)	0	5	0	0	0	86	0	0	14	0	0	0
Lane Group Flow (vph)	0	1	0	64	65	8	4	1418	56	93	1777	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	3%	3%	3%	3%	3%	3%
Turn Type	Perm			Perm		Perm	Prot		Perm	Prot		
Protected Phases		7			8		5	2		1	6	
Permitted Phases	7			8		8			2			
Actuated Green, G (s)		2.0		11.9	11.9	11.9	1.2	86.9	86.9	22.2	107.9	
Effective Green, g (s)		2.0		11.9	11.9	11.9	1.2	86.9	86.9	22.2	107.9	
Actuated g/C Ratio		0.01		0.08	0.08	0.08	0.01	0.62	0.62	0.16	0.77	
Clearance Time (s)		4.0		4.0	4.0	4.0	4.0	5.0	5.0	4.0	5.0	
Vehicle Extension (s)		4.8		2.3	2.3	2.3	2.3	4.8	4.8	2.3	2.3	
Lane Grp Cap (vph)		22		113	109	133	15	2176	939	278	2701	
v/s Ratio Prot							0.00	c0.40		0.05	c0.51	
v/s Ratio Perm		c0.00		0.05	c0.05	0.01			0.04			
v/c Ratio		0.05		0.57	0.60	0.06	0.27	0.65	0.06	0.33	0.66	
Uniform Delay, d1		68.1		61.6	61.7	58.9	69.0	16.9	10.5	52.3	7.5	
Progression Factor		1.00		1.00	1.00	1.00	1.04	1.03	0.54	0.73	0.78	
Incremental Delay, d2		1.8		4.6	6.6	0.1	3.6	1.0	0.1	0.3	0.9	
Delay (s)		69.8		66.2	68.3	59.0	75.7	18.4	5.8	38.7	6.8	
Level of Service		E		E	E	E	E	B	A	D	A	
Approach Delay (s)		69.8			63.8			18.0			8.4	
Approach LOS		E			E			B			A	

Intersection Summary			
HCM Average Control Delay	15.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	71.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	89	188	57	187	262	95	286	1245	144	107	1544	126
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	5.0		4.0	5.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1787	1881	1566	1787	1881	1563	1752	3437		1770	3539	1526
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1787	1881	1566	1787	1881	1563	1752	3437		1770	3539	1526
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	93	196	59	195	273	99	298	1297	150	111	1608	131
RTOR Reduction (vph)	0	0	41	0	0	85	0	6	0	0	0	24
Lane Group Flow (vph)	93	196	18	195	273	14	298	1441	0	111	1608	107
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	3%	3%	3%	2%	2%	2%
Turn Type	Prot		Perm	Prot		Perm	Prot			Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8						6
Actuated Green, G (s)	15.0	18.8	18.8	16.2	20.0	20.0	21.0	74.6		13.4	67.0	67.0
Effective Green, g (s)	15.0	18.8	18.8	16.2	20.0	20.0	21.0	74.6		13.4	67.0	67.0
Actuated g/C Ratio	0.11	0.13	0.13	0.12	0.14	0.14	0.15	0.53		0.10	0.48	0.48
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	5.0		4.0	5.0	5.0
Vehicle Extension (s)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	4.8		2.3	4.8	4.8
Lane Grp Cap (vph)	191	253	210	207	269	223	263	1831		169	1694	730
v/s Ratio Prot	0.05	0.10		c0.11	c0.15		c0.17	0.42		0.06	c0.45	
v/s Ratio Perm			0.01			0.01						0.07
v/c Ratio	0.49	0.77	0.09	0.94	1.01	0.06	1.13	0.79		0.66	0.95	0.15
Uniform Delay, d1	58.9	58.6	53.1	61.4	60.0	51.9	59.5	26.3		61.1	34.9	20.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	0.76	0.46		1.20	0.67	0.56
Incremental Delay, d2	1.1	13.0	0.1	46.0	58.7	0.1	89.2	2.7		6.0	10.8	0.3
Delay (s)	60.0	71.5	53.2	107.4	118.7	52.0	134.6	14.9		79.4	34.1	11.7
Level of Service	E	E	D	F	F	D	F	B		E	C	B
Approach Delay (s)		65.4			103.2			35.3			35.3	
Approach LOS		E			F			D			D	

Intersection Summary			
HCM Average Control Delay	46.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	94.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	21	12	30	146	22	62	56	1594	59	78	1781	25
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes		1.00	0.98		1.00	0.98	1.00	1.00	0.96	1.00	1.00	0.96
Flpb, ped/bikes		1.00	1.00		0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.97	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1816	1568		1809	1583	1752	3505	1510	1770	3539	1525
Flt Permitted		0.65	1.00		0.73	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		1226	1568		1378	1583	1752	3505	1510	1770	3539	1525
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	22	12	31	151	23	64	58	1643	61	80	1836	26
RTOR Reduction (vph)	0	0	27	0	0	39	0	0	8	0	0	6
Lane Group Flow (vph)	0	34	4	0	174	25	58	1643	53	80	1836	20
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	1%	1%	1%	0%	0%	0%	3%	3%	3%	2%	2%	2%
Turn Type	Perm		Perm	Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		4	8		8			2			6
Actuated Green, G (s)		20.1	20.1		20.1	20.1	8.2	96.0	96.0	10.9	98.7	98.7
Effective Green, g (s)		20.1	20.1		20.1	20.1	8.2	96.0	96.0	10.9	98.7	98.7
Actuated g/C Ratio		0.14	0.14		0.14	0.14	0.06	0.69	0.69	0.08	0.70	0.70
Clearance Time (s)		4.0	4.0		4.0	4.0	4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)		2.3	2.3		2.3	2.3	2.3	4.8	4.8	2.3	4.8	4.8
Lane Grp Cap (vph)		176	225		198	227	103	2403	1035	138	2495	1075
v/s Ratio Prot							0.03	0.47		c0.05	c0.52	
v/s Ratio Perm		0.03	0.00		c0.13	0.02			0.04			0.01
v/c Ratio		0.19	0.02		0.88	0.11	0.56	0.68	0.05	0.58	0.74	0.02
Uniform Delay, d1		52.8	51.5		58.8	52.2	64.2	13.0	7.2	62.3	12.7	6.2
Progression Factor		1.00	1.00		1.00	1.00	0.99	0.72	0.62	0.99	0.49	0.78
Incremental Delay, d2		0.3	0.0		32.2	0.1	4.4	1.4	0.1	1.9	0.9	0.0
Delay (s)		53.1	51.5		91.0	52.3	67.7	10.8	4.5	63.5	7.1	4.8
Level of Service		D	D		F	D	E	B	A	E	A	A
Approach Delay (s)		52.4			80.6			12.4			9.4	
Approach LOS		D			F			B			A	

Intersection Summary			
HCM Average Control Delay	15.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	80.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NEL	NET	SWT	SWR
Lane Configurations						
Volume (vph)	182	163	186	1527	1621	336
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	5.0	5.0	5.0
Lane Util. Factor	0.97	1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	0.98	1.00	1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	3400	1532	1752	3505	3539	1520
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	3400	1532	1752	3505	3539	1520
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	190	170	194	1591	1689	350
RTOR Reduction (vph)	0	97	0	0	0	34
Lane Group Flow (vph)	190	73	194	1591	1689	316
Confl. Peds. (#/hr)	5	5	5			5
Heavy Vehicles (%)	3%	3%	3%	3%	2%	2%
Turn Type		Perm	Prot			Perm
Protected Phases	4		5	2	6	
Permitted Phases		4				6
Actuated Green, G (s)	13.1	13.1	21.2	117.9	92.7	92.7
Effective Green, g (s)	13.1	13.1	21.2	117.9	92.7	92.7
Actuated g/C Ratio	0.09	0.09	0.15	0.84	0.66	0.66
Clearance Time (s)	4.0	4.0	4.0	5.0	5.0	5.0
Vehicle Extension (s)	2.3	2.3	2.3	4.8	4.8	4.8
Lane Grp Cap (vph)	318	143	265	2952	2343	1006
v/s Ratio Prot	c0.06		c0.11	0.45	c0.48	
v/s Ratio Perm		0.05				0.21
v/c Ratio	0.60	0.51	0.73	0.54	0.72	0.31
Uniform Delay, d1	60.9	60.4	56.7	3.2	15.3	10.1
Progression Factor	1.00	1.00	0.98	0.12	0.45	0.27
Incremental Delay, d2	2.3	1.9	7.6	0.6	1.3	0.6
Delay (s)	63.2	62.3	63.1	1.0	8.1	3.3
Level of Service	E	E	E	A	A	A
Approach Delay (s)	62.8			7.7	7.3	
Approach LOS	E			A	A	

Intersection Summary			
HCM Average Control Delay	12.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	72.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	144	147	195	1569	1607	180
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	5.0	5.0	
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	
Frpb, ped/bikes	1.00	0.98	1.00	1.00	1.00	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.98	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1770	1556	1752	3505	3439	
Flt Permitted	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (perm)	1770	1556	1752	3505	3439	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	150	153	203	1634	1674	188
RTOR Reduction (vph)	0	136	0	0	6	0
Lane Group Flow (vph)	150	17	203	1634	1856	0
Confl. Peds. (#/hr)	5	5	5			5
Heavy Vehicles (%)	2%	2%	3%	3%	3%	3%
Turn Type		Perm	Prot			
Protected Phases	4		5	2	6	
Permitted Phases		4				
Actuated Green, G (s)	15.3	15.3	21.0	115.7	90.7	
Effective Green, g (s)	15.3	15.3	21.0	115.7	90.7	
Actuated g/C Ratio	0.11	0.11	0.15	0.83	0.65	
Clearance Time (s)	4.0	4.0	4.0	5.0	5.0	
Vehicle Extension (s)	2.3	2.3	2.3	4.5	4.5	
Lane Grp Cap (vph)	193	170	263	2897	2228	
v/s Ratio Prot	c0.08		c0.12	0.47	c0.54	
v/s Ratio Perm		0.01				
v/c Ratio	0.78	0.10	0.77	0.56	0.83	
Uniform Delay, d1	60.7	56.1	57.2	4.0	18.9	
Progression Factor	1.00	1.00	0.75	0.86	0.41	
Incremental Delay, d2	16.7	0.1	9.7	0.6	2.7	
Delay (s)	77.4	56.3	52.9	4.0	10.5	
Level of Service	E	E	D	A	B	
Approach Delay (s)	66.7			9.4	10.5	
Approach LOS	E			A	B	

Intersection Summary			
HCM Average Control Delay	14.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	83.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	88	47	18	148	79	58	45	1424	33	157	1492	105
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0		5.0	5.0		4.5	5.0	5.0	4.5	5.0	5.0
Lane Util. Factor	0.95	0.95		1.00	1.00		1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	0.99		1.00	1.00	0.98	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.97		1.00	0.94		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.99		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1708	1719		1781	1742		1770	3539	1549	3400	3505	1514
Flt Permitted	0.67	0.91		0.29	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1196	1581		536	1742		1770	3539	1549	3400	3505	1514
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	93	49	19	156	83	61	47	1499	35	165	1571	111
RTOR Reduction (vph)	0	7	0	0	19	0	0	0	7	0	0	19
Lane Group Flow (vph)	77	77	0	156	125	0	47	1499	28	165	1571	92
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	0%	0%	0%	1%	1%	1%	2%	2%	2%	3%	3%	3%
Turn Type	Perm			Perm			Prot		Perm	Prot		Perm
Protected Phases		8			7		5	2		1	6	
Permitted Phases	8			7					2			6
Actuated Green, G (s)	12.7	12.7		14.0	14.0		7.4	82.3	82.3	11.5	86.4	86.4
Effective Green, g (s)	12.7	12.7		14.0	14.0		7.4	82.3	82.3	11.5	86.4	86.4
Actuated g/C Ratio	0.09	0.09		0.10	0.10		0.05	0.59	0.59	0.08	0.62	0.62
Clearance Time (s)	5.0	5.0		5.0	5.0		4.5	5.0	5.0	4.5	5.0	5.0
Vehicle Extension (s)	2.3	2.3		2.3	2.3		2.3	4.5	4.5	2.3	4.5	4.5
Lane Grp Cap (vph)	108	143		54	174		94	2080	911	279	2163	934
v/s Ratio Prot					0.07		0.03	0.42		c0.05	c0.45	
v/s Ratio Perm	c0.06	0.05		c0.29					0.02			0.06
v/c Ratio	0.71	0.54		2.89	0.72		0.50	0.72	0.03	0.59	0.73	0.10
Uniform Delay, d1	61.9	60.8		63.0	61.1		64.5	20.6	12.1	62.0	18.6	10.9
Progression Factor	1.00	1.00		1.00	1.00		0.90	1.03	1.48	1.18	0.40	0.53
Incremental Delay, d2	17.9	2.6		898.2	11.9		1.5	1.3	0.0	1.5	1.3	0.1
Delay (s)	79.8	63.4		961.2	73.0		59.5	22.5	17.9	74.9	8.8	5.9
Level of Service	E	E		F	E		E	C	B	E	A	A
Approach Delay (s)		71.3			534.9			23.5			14.5	
Approach LOS		E			F			C			B	

Intersection Summary			
HCM Average Control Delay	60.7	HCM Level of Service	E
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	19.5
Intersection Capacity Utilization	79.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	43	121	89	592	67	304	128	1159	216	375	1246	37
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0	4.0	4.5	5.5	5.5	4.5	5.5	5.5
Lane Util. Factor		0.95		0.95	0.95	1.00	1.00	0.95	1.00	0.97	0.95	1.00
Frpb, ped/bikes		0.99		1.00	1.00	0.98	1.00	1.00	0.98	1.00	1.00	0.96
Flpb, ped/bikes		1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.95		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.99		0.95	0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		3327		1692	1713	1572	1752	3505	1535	3400	3505	1510
Flt Permitted		0.55		0.59	0.60	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		1859		1055	1072	1572	1752	3505	1535	3400	3505	1510
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	44	123	91	604	68	310	131	1183	220	383	1271	38
RTOR Reduction (vph)	0	52	0	0	0	252	0	0	64	0	0	20
Lane Group Flow (vph)	0	206	0	332	340	58	131	1183	156	383	1271	18
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	3%	3%	3%	3%	3%	3%
Turn Type	Perm			Perm		Perm	Prot		Perm	Prot		Perm
Protected Phases		3			4		5	2		1	6	
Permitted Phases	3			4		4			2			6
Actuated Green, G (s)		17.8		26.2	26.2	26.2	12.8	54.5	54.5	23.5	65.2	65.2
Effective Green, g (s)		17.8		26.2	26.2	26.2	12.8	54.5	54.5	23.5	65.2	65.2
Actuated g/C Ratio		0.13		0.19	0.19	0.19	0.09	0.39	0.39	0.17	0.47	0.47
Clearance Time (s)		4.0		4.0	4.0	4.0	4.5	5.5	5.5	4.5	5.5	5.5
Vehicle Extension (s)		2.3		2.3	2.3	2.3	2.3	4.5	4.5	2.3	4.5	4.5
Lane Grp Cap (vph)		236		197	201	294	160	1364	598	571	1632	703
v/s Ratio Prot							0.07	c0.34		0.11	c0.36	
v/s Ratio Perm		c0.11		0.31	c0.32	0.04			0.10			0.01
v/c Ratio		0.87		1.69	1.69	0.20	0.82	0.87	0.26	0.67	0.78	0.03
Uniform Delay, d1		60.0		56.9	56.9	48.0	62.5	39.4	29.1	54.6	31.4	20.2
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00	1.00	0.72	0.57	0.37
Incremental Delay, d2		27.3		329.4	331.7	0.2	25.9	7.6	1.1	1.1	1.5	0.0
Delay (s)		87.3		386.3	388.6	48.2	88.3	47.1	30.1	40.3	19.3	7.4
Level of Service		F		F	F	D	F	D	C	D	B	A
Approach Delay (s)		87.3			280.4			48.2			23.8	
Approach LOS		F			F			D			C	

Intersection Summary			
HCM Average Control Delay	92.2	HCM Level of Service	F
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.5
Intersection Capacity Utilization	86.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	14	36	52	208	119	243	22	315	79	43	395	27
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0		3.0	4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes		0.98			1.00	0.97	1.00	0.99		1.00	1.00	
Flpb, ped/bikes		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Frt		0.93			1.00	0.85	1.00	0.97		1.00	0.99	
Flt Protected		0.99			0.97	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1695			1805	1535	1752	1779		1770	1842	
Flt Permitted		0.99			0.97	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1695			1805	1535	1752	1779		1770	1842	
Peak-hour factor, PHF	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.92
Adj. Flow (vph)	16	41	60	239	137	279	25	362	91	49	454	29
RTOR Reduction (vph)	0	34	0	0	0	201	0	8	0	0	2	0
Lane Group Flow (vph)	0	83	0	0	376	78	25	445	0	49	481	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	3%	3%	3%	2%	2%	2%
Turn Type	Split			Split		Perm	Prot			Prot		
Protected Phases	3	3		4	4		5	2		1	6	
Permitted Phases						4						
Actuated Green, G (s)		7.6			20.8	20.8	1.3	27.2		4.2	29.1	
Effective Green, g (s)		7.6			20.8	20.8	1.3	27.2		4.2	29.1	
Actuated g/C Ratio		0.10			0.28	0.28	0.02	0.36		0.06	0.39	
Clearance Time (s)		4.0			4.0	4.0	4.0	4.0		3.0	4.0	
Vehicle Extension (s)		2.3			2.3	2.3	3.0	4.5		2.3	4.5	
Lane Grp Cap (vph)		172			502	427	30	647		99	717	
v/s Ratio Prot		c0.05			c0.21		0.01	0.25		c0.03	c0.26	
v/s Ratio Perm						0.05						
v/c Ratio		0.48			0.75	0.18	0.83	0.69		0.49	0.67	
Uniform Delay, d1		31.7			24.6	20.5	36.6	20.2		34.3	18.9	
Progression Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		1.2			5.6	0.1	95.9	3.6		2.3	2.9	
Delay (s)		33.0			30.2	20.6	132.5	23.7		36.5	21.8	
Level of Service		C			C	C	F	C		D	C	
Approach Delay (s)		33.0			26.1			29.4			23.2	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	26.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	74.8	Sum of lost time (s)	11.0
Intersection Capacity Utilization	60.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	73	245	199	475	647	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99	1.00	1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1752	1552	1787	1881	1863	1538
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (perm)	1752	1552	1787	1881	1863	1538
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	78	261	212	505	688	74
RTOR Reduction (vph)	0	132	0	0	0	37
Lane Group Flow (vph)	78	129	212	505	688	37
Confl. Peds. (#/hr)	5	5	5			5
Heavy Vehicles (%)	3%	3%	1%	1%	2%	2%
Turn Type		pm+ov	Prot			Perm
Protected Phases	8	1	1	6	2	
Permitted Phases		8				2
Actuated Green, G (s)	7.1	20.5	13.4	50.5	33.1	33.1
Effective Green, g (s)	7.1	20.5	13.4	50.5	33.1	33.1
Actuated g/C Ratio	0.11	0.31	0.20	0.77	0.50	0.50
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	2.3	2.3	2.3	6.0	6.0	6.0
Lane Grp Cap (vph)	190	580	365	1448	940	776
v/s Ratio Prot	c0.04	0.05	c0.12	0.27	c0.37	
v/s Ratio Perm		0.04				0.02
v/c Ratio	0.41	0.22	0.58	0.35	0.73	0.05
Uniform Delay, d1	27.3	16.7	23.6	2.4	12.8	8.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.8	0.1	1.8	0.4	4.1	0.1
Delay (s)	28.1	16.8	25.3	2.8	16.8	8.3
Level of Service	C	B	C	A	B	A
Approach Delay (s)	19.4			9.5	16.0	
Approach LOS	B			A	B	

Intersection Summary			
HCM Average Control Delay	14.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	65.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	61.5%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	108	0	227	1	1	1	480	556	1	1	526	244
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0		4.0	5.0		5.0	5.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	
Frpb, ped/bikes		1.00	0.96		0.99		1.00	1.00		1.00	0.99	
Flpb, ped/bikes		0.98	1.00		1.00		1.00	1.00		0.99	1.00	
Frt		1.00	0.85		0.96		1.00	1.00		1.00	0.95	
Flt Protected		0.95	1.00		0.98		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1706	1496		1720		1752	1844		1770	1772	
Flt Permitted		0.76	1.00		0.94		0.95	1.00		0.42	1.00	
Satd. Flow (perm)		1358	1496		1645		1752	1844		791	1772	
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	123	0	258	1	1	1	545	632	1	1	598	277
RTOR Reduction (vph)	0	0	224	0	1	0	0	0	0	0	13	0
Lane Group Flow (vph)	0	123	34	0	2	0	545	633	0	1	862	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	4%	4%	4%	2%	2%	2%	3%	3%	3%	1%	1%	1%
Turn Type	Perm		Perm	Perm			Prot			Perm		
Protected Phases		8			4		1	6			2	
Permitted Phases	8		8	4						2		
Actuated Green, G (s)		14.3	14.3		14.3		21.0	85.1		60.1	60.1	
Effective Green, g (s)		14.3	14.3		14.3		21.0	85.1		60.1	60.1	
Actuated g/C Ratio		0.13	0.13		0.13		0.19	0.79		0.55	0.55	
Clearance Time (s)		4.0	4.0		4.0		4.0	5.0		5.0	5.0	
Vehicle Extension (s)		2.3	2.3		2.3		2.3	4.7		4.7	4.7	
Lane Grp Cap (vph)		179	197		217		339	1448		439	982	
v/s Ratio Prot							c0.31	0.34			c0.49	
v/s Ratio Perm		c0.09	0.02		0.00					0.00		
v/c Ratio		0.69	0.17		0.01		1.61	0.44		0.00	0.88	
Uniform Delay, d1		44.9	41.8		40.9		43.7	3.8		10.8	21.0	
Progression Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2		9.1	0.2		0.0		286.8	1.0		0.0	10.9	
Delay (s)		54.0	42.0		40.9		330.5	4.8		10.8	31.9	
Level of Service		D	D		D		F	A		B	C	
Approach Delay (s)		45.9			40.9			155.5			31.9	
Approach LOS		D			D			F			C	

Intersection Summary			
HCM Average Control Delay	93.8	HCM Level of Service	F
HCM Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	108.4	Sum of lost time (s)	13.0
Intersection Capacity Utilization	92.9%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	514	691	407	119	300	521
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	5.0	5.0	4.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.99	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1570	1810	1510	1770	1863
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1570	1810	1510	1770	1863
Peak-hour factor, PHF	0.88	0.88	0.88	0.88	0.88	0.88
Adj. Flow (vph)	584	785	462	135	341	592
RTOR Reduction (vph)	0	131	0	80	0	0
Lane Group Flow (vph)	584	654	462	55	341	592
Confl. Peds. (#/hr)	5	5		5	5	
Heavy Vehicles (%)	2%	2%	5%	5%	2%	2%
Turn Type		pm+ov		Perm	Prot	
Protected Phases	4	5	6		5	2
Permitted Phases		4		6		
Actuated Green, G (s)	20.0	45.0	40.0	40.0	25.0	69.0
Effective Green, g (s)	20.0	45.0	40.0	40.0	25.0	69.0
Actuated g/C Ratio	0.20	0.46	0.41	0.41	0.26	0.70
Clearance Time (s)	4.0	4.0	5.0	5.0	4.0	5.0
Vehicle Extension (s)	2.3	2.3	4.7	4.7	2.3	4.7
Lane Grp Cap (vph)	361	785	739	616	452	1312
v/s Ratio Prot	c0.33	c0.21	c0.26		0.19	0.32
v/s Ratio Perm		0.20		0.04		
v/c Ratio	1.62	0.83	0.63	0.09	0.75	0.45
Uniform Delay, d1	39.0	23.2	23.0	17.8	33.7	6.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	290.5	7.4	4.0	0.3	6.5	1.1
Delay (s)	329.5	30.6	27.0	18.1	40.2	7.4
Level of Service	F	C	C	B	D	A
Approach Delay (s)	158.1		25.0			19.4
Approach LOS	F		C			B

Intersection Summary			
HCM Average Control Delay	86.0	HCM Level of Service	F
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	98.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	77.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	194	457	19	13	779	318	14	24	18	250	15	255
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5	4.5		4.0		4.5	4.5	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.93		0.98		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85		0.96		1.00	0.86	
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.99		0.95	1.00	
Satd. Flow (prot)	1752	1834		1770	1863	1478		1703		1787	1615	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		0.99		0.95	1.00	
Satd. Flow (perm)	1752	1834		1770	1863	1478		1703		1787	1615	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	202	476	20	14	811	331	15	25	19	260	16	266
RTOR Reduction (vph)	0	1	0	0	0	89	0	14	0	0	218	0
Lane Group Flow (vph)	202	495	0	14	811	242	0	45	0	260	64	0
Confl. Peds. (#/hr)	15					15			6	6		
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	3%	3%	3%	1%	1%	1%
Turn Type	Prot			Prot		Perm	Split			Split		
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						
Actuated Green, G (s)	16.5	67.2		2.7	53.4	53.4		6.7		20.8	20.8	
Effective Green, g (s)	16.5	67.2		2.7	53.4	53.4		6.7		20.8	20.8	
Actuated g/C Ratio	0.14	0.59		0.02	0.47	0.47		0.06		0.18	0.18	
Clearance Time (s)	4.0	4.5		4.0	4.5	4.5		4.0		4.5	4.5	
Vehicle Extension (s)	3.0	1.0		3.0	2.2	2.2		2.5		2.5	2.5	
Lane Grp Cap (vph)	253	1077		42	870	690		100		325	294	
v/s Ratio Prot	c0.12	0.27		0.01	c0.44			c0.03		c0.15	0.04	
v/s Ratio Perm						0.16						
v/c Ratio	0.80	0.46		0.33	0.93	0.35		0.45		0.80	0.22	
Uniform Delay, d1	47.3	13.3		55.0	28.8	19.4		52.1		44.8	39.9	
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	
Incremental Delay, d2	16.0	0.1		4.6	16.3	0.2		2.3		12.8	0.3	
Delay (s)	63.3	13.5		59.6	45.1	19.6		54.4		57.6	40.2	
Level of Service	E	B		E	D	B		D		E	D	
Approach Delay (s)		27.9			38.0			54.4			48.5	
Approach LOS		C			D			D			D	

Intersection Summary			
HCM Average Control Delay	37.8	HCM Level of Service	D
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	114.4	Sum of lost time (s)	17.0
Intersection Capacity Utilization	83.1%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Level Of Service Computation Report
2000 HCM 4-Way Stop Method (Future Volume Alternative)

Intersection #38 SW 72nd Ave/ SW Dartmouth St

Cycle (sec):	100	Critical Vol./Cap.(X):	1.898
Loss Time (sec):	0 (Y+R=4.0 sec)	Average Delay (sec/veh):	179.3
Optimal Cycle:	0	Level Of Service:	F

Street Name:	SW 72nd Ave						SW Dartmouth St					
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L - T - R			L - T - R			L - T - R			L - T - R		
Control:	Stop Sign			Stop Sign			Stop Sign			Stop Sign		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Lanes:	1 0 0	1 0	0	1 0 1	0	1	1 0 1	0	1	1 0 0	1	0
Volume Module:												
Base Vol:	219	291	40	12	677	1	26	313	126	84	1	52
Growth Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Initial Bse:	219	291	40	12	677	1	26	313	126	84	1	52
Added Vol:	0	0	0	0	0	0	0	0	0	0	0	0
PasserByVol:	0	0	0	0	0	0	0	0	0	0	0	0
Initial Fut:	219	291	40	12	677	1	26	313	126	84	1	52
User Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
PHF Adj:	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
PHF Volume:	249	331	45	14	769	1	30	356	143	95	1	59
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	249	331	45	14	769	1	30	356	143	95	1	59
PCE Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
MLF Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
FinalVolume:	249	331	45	14	769	1	30	356	143	95	1	59
Saturation Flow Module:												
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	0.88	0.12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.02	0.98
Final Sat.:	421	399	55	371	405	423	382	407	440	364	8	406
Capacity Analysis Module:												
Vol/Sat:	0.59	0.83	0.83	0.04	1.90	0.00	0.08	0.87	0.33	0.26	0.15	0.15
Crit Moves:		****			****			****		****		
Delay/Veh:	22.5	38.1	38.1	12.4	434	10.9	12.8	47.5	14.6	15.5	12.5	12.5
Delay Adj:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
AdjDel/Veh:	22.5	38.1	38.1	12.4	434	10.9	12.8	47.5	14.6	15.5	12.5	12.5
LOS by Move:	C	E	E	B	F	B	B	E	B	C	B	B
ApproachDel:		31.9			425.8			36.6			14.3	
Delay Adj:		1.00			1.00			1.00			1.00	
ApprAdjDel:		31.9			425.8			36.6			14.3	
LOS by Appr:		D			F			E			B	
AllWayAvgQ:	1.3	3.5	3.5	0.0	47.5	0.0	0.1	4.1	0.5	0.3	0.2	0.2

Note: Queue reported is the number of cars per lane.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	388	38	513	178	12	614
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	3.5	4.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	0.95
Frpb, ped/bikes	1.00	0.98	1.00	0.97	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1551	1863	1531	1770	3539
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1551	1863	1531	1770	3539
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	417	41	552	191	13	660
RTOR Reduction (vph)	0	29	0	81	0	0
Lane Group Flow (vph)	417	12	552	110	13	660
Confl. Peds. (#/hr)	5	5		5	5	
Turn Type		Perm		Perm	Prot	
Protected Phases	4		6		5	2
Permitted Phases		4		6		
Actuated Green, G (s)	28.9	28.9	57.7	57.7	1.4	62.6
Effective Green, g (s)	28.9	28.9	57.7	57.7	1.4	62.6
Actuated g/C Ratio	0.29	0.29	0.58	0.58	0.01	0.63
Clearance Time (s)	4.0	4.0	4.5	4.5	3.5	4.5
Vehicle Extension (s)	2.5	2.5	4.3	4.3	2.5	4.3
Lane Grp Cap (vph)	512	448	1075	883	25	2215
v/s Ratio Prot	c0.24		c0.30		c0.01	0.19
v/s Ratio Perm		0.01		0.07		
v/c Ratio	0.81	0.03	0.51	0.12	0.52	0.30
Uniform Delay, d1	33.1	25.5	12.7	9.6	49.0	8.6
Progression Factor	1.00	1.00	1.22	2.44	1.00	1.00
Incremental Delay, d2	9.4	0.0	1.5	0.3	14.1	0.3
Delay (s)	42.5	25.5	17.1	23.7	63.0	8.9
Level of Service	D	C	B	C	E	A
Approach Delay (s)	40.9		18.8			10.0
Approach LOS	D		B			A

Intersection Summary			
HCM Average Control Delay	21.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	55.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	236	217	471	441	286	716
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.98	1.00	0.98	1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1752	1538	1863	1544	1787	1881
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1752	1538	1863	1544	1787	1881
Peak-hour factor, PHF	0.88	0.88	0.92	0.92	0.92	0.92
Adj. Flow (vph)	268	247	512	479	311	778
RTOR Reduction (vph)	0	202	0	231	0	0
Lane Group Flow (vph)	268	45	512	248	311	778
Confl. Peds. (#/hr)	5	5		5	5	
Heavy Vehicles (%)	3%	3%	2%	2%	1%	1%
Turn Type		Perm		Perm	Prot	
Protected Phases	4		6		5	2
Permitted Phases		4		6		
Actuated Green, G (s)	17.7	17.7	51.8	51.8	18.0	73.8
Effective Green, g (s)	17.7	17.7	51.8	51.8	18.0	73.8
Actuated g/C Ratio	0.18	0.18	0.52	0.52	0.18	0.74
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	2.3	2.3	4.5	4.5	2.3	4.5
Lane Grp Cap (vph)	310	272	965	800	322	1388
v/s Ratio Prot	c0.15		0.27		c0.17	c0.41
v/s Ratio Perm		0.03		0.16		
v/c Ratio	0.86	0.16	0.53	0.31	0.97	0.56
Uniform Delay, d1	40.0	34.9	16.0	13.8	40.7	5.9
Progression Factor	1.00	1.00	0.99	2.41	0.98	0.66
Incremental Delay, d2	21.0	0.2	1.7	0.8	38.9	0.7
Delay (s)	60.9	35.0	17.6	34.2	78.9	4.6
Level of Service	E	D	B	C	E	A
Approach Delay (s)	48.5		25.7			25.8
Approach LOS	D		C			C

Intersection Summary			
HCM Average Control Delay	30.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	64.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	218	197	118	699	503	451
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	0.97	1.00	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.94	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1770	1530	1787	1881	1718	
Flt Permitted	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (perm)	1770	1530	1787	1881	1718	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	234	212	127	752	541	485
RTOR Reduction (vph)	0	178	0	0	31	0
Lane Group Flow (vph)	234	34	127	752	995	0
Confl. Peds. (#/hr)	5	5	5			5
Heavy Vehicles (%)	2%	2%	1%	1%	2%	2%
Turn Type		Perm	Prot			
Protected Phases	8		1	6	2	
Permitted Phases		8				
Actuated Green, G (s)	16.2	16.2	9.5	75.8	62.3	
Effective Green, g (s)	16.2	16.2	9.5	75.8	62.3	
Actuated g/C Ratio	0.16	0.16	0.10	0.76	0.62	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	2.3	2.3	2.3	4.2	4.2	
Lane Grp Cap (vph)	287	248	170	1426	1070	
v/s Ratio Prot	c0.13		c0.07	0.40	c0.58	
v/s Ratio Perm		0.02				
v/c Ratio	0.82	0.14	0.75	0.53	0.93	
Uniform Delay, d1	40.5	35.9	44.1	4.9	16.9	
Progression Factor	1.00	1.00	1.45	0.14	1.31	
Incremental Delay, d2	15.6	0.1	9.6	0.9	12.5	
Delay (s)	56.1	36.1	73.6	1.5	34.7	
Level of Service	E	D	E	A	C	
Approach Delay (s)	46.6			11.9	34.7	
Approach LOS	D			B	C	

Intersection Summary			
HCM Average Control Delay	28.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	83.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	18	4	1	132	4	53	2	746	156	249	435	16
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes		1.00			1.00	0.99	1.00	1.00	0.97	1.00	1.00	
Flpb, ped/bikes		1.00			0.99	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		0.99			1.00	0.85	1.00	1.00	0.85	1.00	0.99	
Flt Protected		0.96			0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1756			1766	1573	1787	1881	1551	1787	1869	
Flt Permitted		0.77			0.71	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1410			1321	1573	1787	1881	1551	1787	1869	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	20	4	1	147	4	59	2	829	173	277	483	18
RTOR Reduction (vph)	0	1	0	0	0	36	0	0	60	0	1	0
Lane Group Flow (vph)	0	24	0	0	151	23	2	829	113	277	500	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	1%	1%	1%	1%	1%	1%
Turn Type	Perm			Perm		pm+ov	Prot		Perm	Prot		
Protected Phases		8			4	5	1	6		5	2	
Permitted Phases	8			4		4			6			
Actuated Green, G (s)		16.4			16.4	38.6	1.1	49.4	49.4	22.2	70.5	
Effective Green, g (s)		16.4			16.4	38.6	1.1	49.4	49.4	22.2	70.5	
Actuated g/C Ratio		0.16			0.16	0.39	0.01	0.49	0.49	0.22	0.70	
Clearance Time (s)		4.0			4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)		2.5			2.5	2.3	2.3	4.2	4.2	2.3	4.2	
Lane Grp Cap (vph)		231			217	670	20	929	766	397	1318	
v/s Ratio Prot						0.01	0.00	c0.44		c0.15	0.27	
v/s Ratio Perm		0.02			c0.11	0.01			0.07			
v/c Ratio		0.10			0.70	0.03	0.10	0.89	0.15	0.70	0.38	
Uniform Delay, d1		35.6			39.4	19.1	49.0	22.9	13.8	35.8	5.9	
Progression Factor		1.00			1.00	1.00	1.00	1.00	1.00	0.77	0.61	
Incremental Delay, d2		0.1			8.6	0.0	1.3	12.7	0.4	2.8	0.5	
Delay (s)		35.7			48.1	19.1	50.2	35.6	14.2	30.3	4.1	
Level of Service		D			D	B	D	D	B	C	A	
Approach Delay (s)		35.7			39.9			32.0			13.4	
Approach LOS		D			D			C			B	

Intersection Summary			
HCM Average Control Delay	25.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	72.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	258	345	306	13	440	10	324	310	25	34	395	422
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5	5.0	5.0	3.5	5.0		3.5	5.0		3.5	5.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.96	1.00	1.00		1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1526	1770	1855		1770	1837		1770	1863	1549
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1770	1863	1526	1770	1855		1770	1837		1770	1863	1549
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	280	375	333	14	478	11	352	337	27	37	429	459
RTOR Reduction (vph)	0	0	161	0	1	0	0	2	0	0	0	234
Lane Group Flow (vph)	280	375	172	14	488	0	352	362	0	37	429	225
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Turn Type	Prot		Perm	Prot			Prot			Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	20.1	58.4	58.4	2.9	41.2		33.7	65.9		6.9	39.1	39.1
Effective Green, g (s)	20.1	58.4	58.4	2.9	41.2		33.7	65.9		6.9	39.1	39.1
Actuated g/C Ratio	0.13	0.39	0.39	0.02	0.27		0.22	0.44		0.05	0.26	0.26
Clearance Time (s)	3.5	5.0	5.0	3.5	5.0		3.5	5.0		3.5	5.0	5.0
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.5	4.3		2.5	4.3	4.3
Lane Grp Cap (vph)	235	720	590	34	506		395	801		81	482	401
v/s Ratio Prot	c0.16	0.20		0.01	c0.26		c0.20	0.20		0.02	c0.23	
v/s Ratio Perm			0.11									0.15
v/c Ratio	1.19	0.52	0.29	0.41	0.96		0.89	0.45		0.46	0.89	0.56
Uniform Delay, d1	65.5	35.6	32.1	73.3	54.2		56.9	29.9		70.3	53.9	48.6
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	120.3	0.5	0.2	5.8	31.0		21.4	0.6		3.0	18.8	2.4
Delay (s)	185.8	36.1	32.3	79.1	85.2		78.3	30.6		73.2	72.7	51.0
Level of Service	F	D	C	E	F		E	C		E	E	D
Approach Delay (s)		77.2			85.0			54.0			62.0	
Approach LOS		E			F			D			E	

Intersection Summary			
HCM Average Control Delay	68.7	HCM Level of Service	E
HCM Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	151.1	Sum of lost time (s)	17.0
Intersection Capacity Utilization	91.8%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	0	0	0	363	3	192	605	253	0	0	371	51
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				5.0	5.0		4.5	4.5			4.5	4.5
Lane Util. Factor				1.00	1.00		0.95	0.95			1.00	1.00
Frpb, ped/bikes				1.00	0.97		1.00	1.00			1.00	0.98
Flpb, ped/bikes				1.00	1.00		1.00	1.00			1.00	1.00
Frt				1.00	0.85		1.00	1.00			1.00	0.85
Flt Protected				0.95	1.00		0.95	0.98			1.00	1.00
Satd. Flow (prot)				1752	1522		1698	1751			1881	1568
Flt Permitted				0.95	1.00		0.95	0.98			1.00	1.00
Satd. Flow (perm)				1752	1522		1698	1751			1881	1568
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	0	0	0	408	3	216	680	284	0	0	417	57
RTOR Reduction (vph)	0	0	0	0	155	0	0	0	0	0	0	13
Lane Group Flow (vph)	0	0	0	408	64	0	476	488	0	0	417	44
Confl. Peds. (#/hr)				5		5	5					5
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	1%	1%	1%	1%	1%	1%
Turn Type				Split			Split					Perm
Protected Phases				4	4		6	6			2	
Permitted Phases												2
Actuated Green, G (s)				21.1	21.1		20.3	20.3			19.6	19.6
Effective Green, g (s)				21.1	21.1		20.3	20.3			19.6	19.6
Actuated g/C Ratio				0.28	0.28		0.27	0.27			0.26	0.26
Clearance Time (s)				5.0	5.0		4.5	4.5			4.5	4.5
Vehicle Extension (s)				2.3	2.3		4.2	4.2			4.2	4.2
Lane Grp Cap (vph)				493	428		460	474			492	410
v/s Ratio Prot				c0.23	0.04		c0.28	0.28			c0.22	
v/s Ratio Perm												0.03
v/c Ratio				0.83	0.15		1.03	1.03			0.85	0.11
Uniform Delay, d1				25.2	20.2		27.4	27.4			26.3	21.1
Progression Factor				1.00	1.00		0.75	0.75			1.00	1.00
Incremental Delay, d2				10.6	0.1		39.9	37.9			13.4	0.2
Delay (s)				35.9	20.3		60.4	58.4			39.7	21.2
Level of Service				D	C		E	E			D	C
Approach Delay (s)		0.0			30.4			59.4			37.5	
Approach LOS		A			C			E			D	

Intersection Summary			
HCM Average Control Delay	45.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	78.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	125	120	522	0	0	0	0	733	606	245	489	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0					4.5		5.0	4.5	
Lane Util. Factor		1.00	0.88					0.95		1.00	1.00	
Frpb, ped/bikes		1.00	0.96					0.99		1.00	1.00	
Flpb, ped/bikes		0.99	1.00					1.00		1.00	1.00	
Frt		1.00	0.85					0.93		1.00	1.00	
Flt Protected		0.98	1.00					1.00		0.95	1.00	
Satd. Flow (prot)		1825	2711					3258		1770	1863	
Flt Permitted		0.98	1.00					1.00		0.95	1.00	
Satd. Flow (perm)		1825	2711					3258		1770	1863	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	132	126	549	0	0	0	0	772	638	258	515	0
RTOR Reduction (vph)	0	0	438	0	0	0	0	166	0	0	0	0
Lane Group Flow (vph)	0	258	111	0	0	0	0	1244	0	258	515	0
Confl. Peds. (#/hr)	5		5						5	5		
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Turn Type	Perm		Perm							Prot		
Protected Phases		8						6		5	2	
Permitted Phases	8		8									
Actuated Green, G (s)		15.2	15.2					30.5		14.8	50.3	
Effective Green, g (s)		15.2	15.2					30.5		14.8	50.3	
Actuated g/C Ratio		0.20	0.20					0.41		0.20	0.67	
Clearance Time (s)		5.0	5.0					4.5		5.0	4.5	
Vehicle Extension (s)		2.3	2.3					4.2		2.3	4.2	
Lane Grp Cap (vph)		370	549					1325		349	1249	
v/s Ratio Prot								c0.38		c0.15	0.28	
v/s Ratio Perm		0.14	0.04									
v/c Ratio		0.70	0.20					0.94		0.74	0.41	
Uniform Delay, d1		27.8	24.9					21.4		28.3	5.6	
Progression Factor		1.00	1.00					1.00		1.27	0.43	
Incremental Delay, d2		5.0	0.1					13.9		4.6	0.6	
Delay (s)		32.7	25.0					35.3		40.4	3.0	
Level of Service		C	C					D		D	A	
Approach Delay (s)		27.4			0.0			35.3			15.5	
Approach LOS		C			A			D			B	

Intersection Summary			
HCM Average Control Delay	28.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	14.5
Intersection Capacity Utilization	78.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	13	7	17	230	385	11	23	867	10	2	511	470
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	6.0		4.0	6.0	6.0
Lane Util. Factor	1.00	1.00		0.95	0.95	1.00	1.00	0.95		1.00	1.00	1.00
Frpb, ped/bikes	1.00	0.97		1.00	1.00	0.97	1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.90		1.00	1.00	0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1805	1649		1681	1765	1536	1787	3567		1765	1863	1537
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1805	1649		1681	1765	1536	1787	3567		1765	1863	1537
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	14	8	18	250	418	12	25	942	11	2	555	511
RTOR Reduction (vph)	0	17	0	0	0	8	0	1	0	0	0	311
Lane Group Flow (vph)	14	9	0	225	443	4	25	952	0	2	555	200
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	0%	0%	0%	2%	2%	2%	1%	1%	1%	2%	2%	2%
Turn Type	Split			Split		Perm	Prot			Prot		Perm
Protected Phases	8	8		4	4		5	2		1	6	
Permitted Phases						4						6
Actuated Green, G (s)	3.5	3.5		25.6	25.6	25.6	2.4	32.5		0.9	31.0	31.0
Effective Green, g (s)	3.5	3.5		25.6	25.6	25.6	2.4	32.5		0.9	31.0	31.0
Actuated g/C Ratio	0.04	0.04		0.32	0.32	0.32	0.03	0.40		0.01	0.39	0.39
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)	3.0	3.0		2.5	2.5	2.5	2.5	4.6		2.5	4.6	4.6
Lane Grp Cap (vph)	78	72		535	561	488	53	1440		20	717	592
v/s Ratio Prot	c0.01	0.01		0.13	c0.25		c0.01	0.27		0.00	c0.30	
v/s Ratio Perm						0.00						0.13
v/c Ratio	0.18	0.12		0.42	0.79	0.01	0.47	0.66		0.10	0.77	0.34
Uniform Delay, d1	37.1	37.0		21.6	25.0	18.8	38.4	19.5		39.4	21.7	17.5
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.1	0.8		0.4	7.0	0.0	4.8	1.4		1.6	5.9	0.6
Delay (s)	38.2	37.8		22.0	32.0	18.8	43.2	20.9		41.0	27.6	18.1
Level of Service	D	D		C	C	B	D	C		D	C	B
Approach Delay (s)		37.9			28.5			21.5			23.1	
Approach LOS		D			C			C			C	

Intersection Summary			
HCM Average Control Delay	24.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	80.5	Sum of lost time (s)	18.0
Intersection Capacity Utilization	58.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	20	63	10	451	26	78	13	403	543	253	405	11
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.5	4.5		4.0	4.5	4.5	4.0	4.5	
Lane Util. Factor		0.95		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes		0.99		1.00	0.98		1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frt		0.98		1.00	0.89		1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.99		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		3425		1770	1615		1770	1863	1554	1752	1836	
Flt Permitted		0.99		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		3425		1770	1615		1770	1863	1554	1752	1836	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	21	66	10	470	27	81	14	420	566	264	422	11
RTOR Reduction (vph)	0	9	0	0	57	0	0	0	384	0	1	0
Lane Group Flow (vph)	0	88	0	470	51	0	14	420	182	264	432	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	3%	3%	3%
Turn Type	Split			Split			Prot		Perm	Prot		
Protected Phases	4	4		8	8		1	6		5	2	
Permitted Phases									6			
Actuated Green, G (s)		4.9		25.8	25.8		1.0	27.6	27.6	10.5	37.1	
Effective Green, g (s)		4.9		25.8	25.8		1.0	27.6	27.6	10.5	37.1	
Actuated g/C Ratio		0.06		0.30	0.30		0.01	0.32	0.32	0.12	0.43	
Clearance Time (s)		4.0		4.5	4.5		4.0	4.5	4.5	4.0	4.5	
Vehicle Extension (s)		1.5		3.0	3.0		1.0	3.5	3.5	1.0	3.5	
Lane Grp Cap (vph)		196		532	486		21	599	500	214	794	
v/s Ratio Prot		c0.03		c0.27	0.03		0.01	c0.23		c0.15	0.24	
v/s Ratio Perm									0.12			
v/c Ratio		0.45		0.88	0.11		0.67	0.70	0.36	1.23	0.54	
Uniform Delay, d1		39.1		28.6	21.7		42.2	25.5	22.4	37.7	18.1	
Progression Factor		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.6		15.9	0.1		47.8	3.8	0.5	138.8	0.9	
Delay (s)		39.7		44.5	21.8		90.1	29.3	22.9	176.4	18.9	
Level of Service		D		D	C		F	C	C	F	B	
Approach Delay (s)		39.7			40.2			26.5			78.6	
Approach LOS		D			D			C			E	

Intersection Summary			
HCM Average Control Delay	45.7	HCM Level of Service	D
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	85.8	Sum of lost time (s)	17.0
Intersection Capacity Utilization	77.7%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

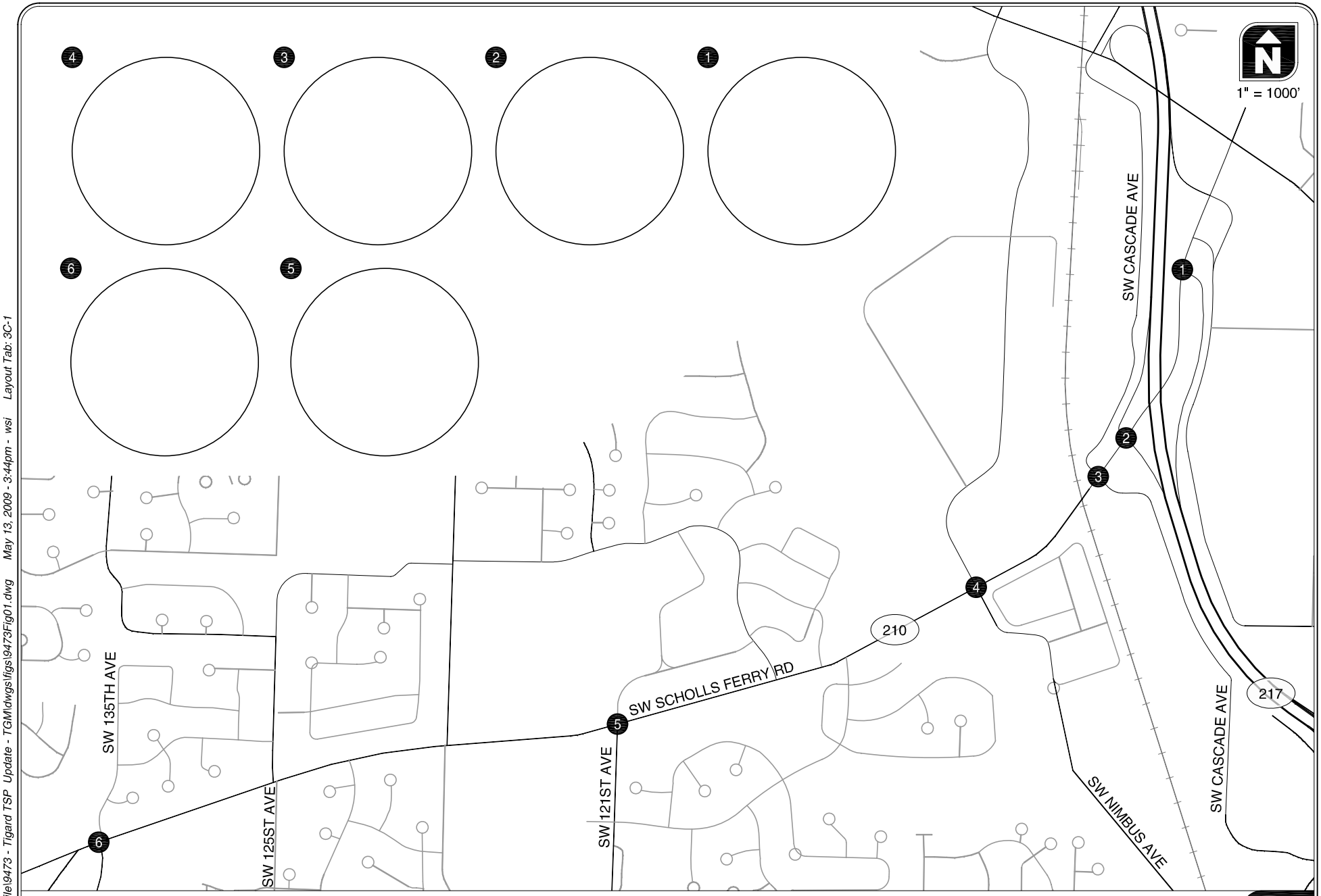
Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	31	12	6	48	1	244	2	618	9	126	790	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes		0.99			1.00	0.97	1.00	1.00		1.00	1.00	
Flpb, ped/bikes		0.99			0.99	1.00	1.00	1.00		1.00	1.00	
Frt		0.98			1.00	0.85	1.00	1.00		1.00	1.00	
Flt Protected		0.97			0.95	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1790			1743	1521	1782	1876		1770	1862	
Flt Permitted		0.79			0.81	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1456			1483	1521	1782	1876		1770	1862	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	34	13	7	53	1	271	2	687	10	140	878	1
RTOR Reduction (vph)	0	4	0	0	0	236	0	0	0	0	0	0
Lane Group Flow (vph)	0	50	0	0	54	35	2	697	0	140	879	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	0%	0%	0%	3%	3%	3%	1%	1%	1%	2%	2%	2%
Turn Type	Perm			Perm		Perm	Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8		8						
Actuated Green, G (s)		8.3			8.3	8.3	0.5	35.4		7.8	42.7	
Effective Green, g (s)		8.3			8.3	8.3	0.5	35.4		7.8	42.7	
Actuated g/C Ratio		0.13			0.13	0.13	0.01	0.56		0.12	0.67	
Clearance Time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)		2.0			2.0	2.0	1.0	5.0		1.5	5.0	
Lane Grp Cap (vph)		190			194	199	14	1046		217	1252	
v/s Ratio Prot							0.00	0.37		c0.08	c0.47	
v/s Ratio Perm		0.03			c0.04	0.02						
v/c Ratio		0.26			0.28	0.18	0.14	0.67		0.65	0.70	
Uniform Delay, d1		24.8			24.9	24.6	31.3	9.9		26.5	6.5	
Progression Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		0.3			0.3	0.2	1.7	2.1		4.9	2.3	
Delay (s)		25.1			25.2	24.7	33.0	12.0		31.4	8.7	
Level of Service		C			C	C	C	B		C	A	
Approach Delay (s)		25.1			24.8			12.1			11.8	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM Average Control Delay	14.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	63.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	65.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	258	345	306	13	440	10	324	310	25	34	395	422
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.5		5.0	5.5	5.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	1863	1529	1787	1873		1770	1837		1770	1863	1535
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1770	1863	1529	1787	1873		1770	1837		1770	1863	1535
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	274	367	326	14	468	11	345	330	27	36	420	449
RTOR Reduction (vph)	0	0	194	0	1	0	0	2	0	0	0	293
Lane Group Flow (vph)	274	367	132	14	478	0	345	355	0	36	420	156
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	2%	2%	2%	2%	2%	2%
Turn Type	Prot		Perm	Prot			Prot			Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	23.3	52.5	52.5	3.0	32.2		21.0	48.1		5.5	32.6	32.6
Effective Green, g (s)	23.3	52.5	52.5	3.0	32.2		21.0	48.1		5.5	32.6	32.6
Actuated g/C Ratio	0.18	0.41	0.41	0.02	0.25		0.16	0.37		0.04	0.25	0.25
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.5		5.0	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	5.0		3.0	5.0	5.0
Lane Grp Cap (vph)	318	755	619	41	465		287	682		75	469	386
v/s Ratio Prot	c0.15	0.20		0.01	c0.26		c0.19	0.19		0.02	c0.23	
v/s Ratio Perm			0.09									0.10
v/c Ratio	0.86	0.49	0.21	0.34	1.03		1.20	0.52		0.48	0.90	0.41
Uniform Delay, d1	51.6	28.6	25.1	62.3	48.7		54.3	31.8		60.7	46.9	40.4
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	20.6	0.5	0.2	4.9	49.2		119.4	1.4		4.8	20.4	1.5
Delay (s)	72.1	29.1	25.3	67.3	97.9		173.7	33.1		65.4	67.2	41.9
Level of Service	E	C	C	E	F		F	C		E	E	D
Approach Delay (s)		40.0			97.0			102.2			54.6	
Approach LOS		D			F			F			D	

Intersection Summary			
HCM Average Control Delay	67.7	HCM Level of Service	E
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	129.6	Sum of lost time (s)	20.5
Intersection Capacity Utilization	94.7%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Appendix G 2008 Base Year Intersection Operations and Queuing Analyses, Weekday AM Peak Hour



EXISTING TRAFFIC CONDITIONS, WEEKDAY AM PEAK HOUR
SW SCHOLLS FERRY ROAD
TIGARD, OREGON

FIGURE **3C-1**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

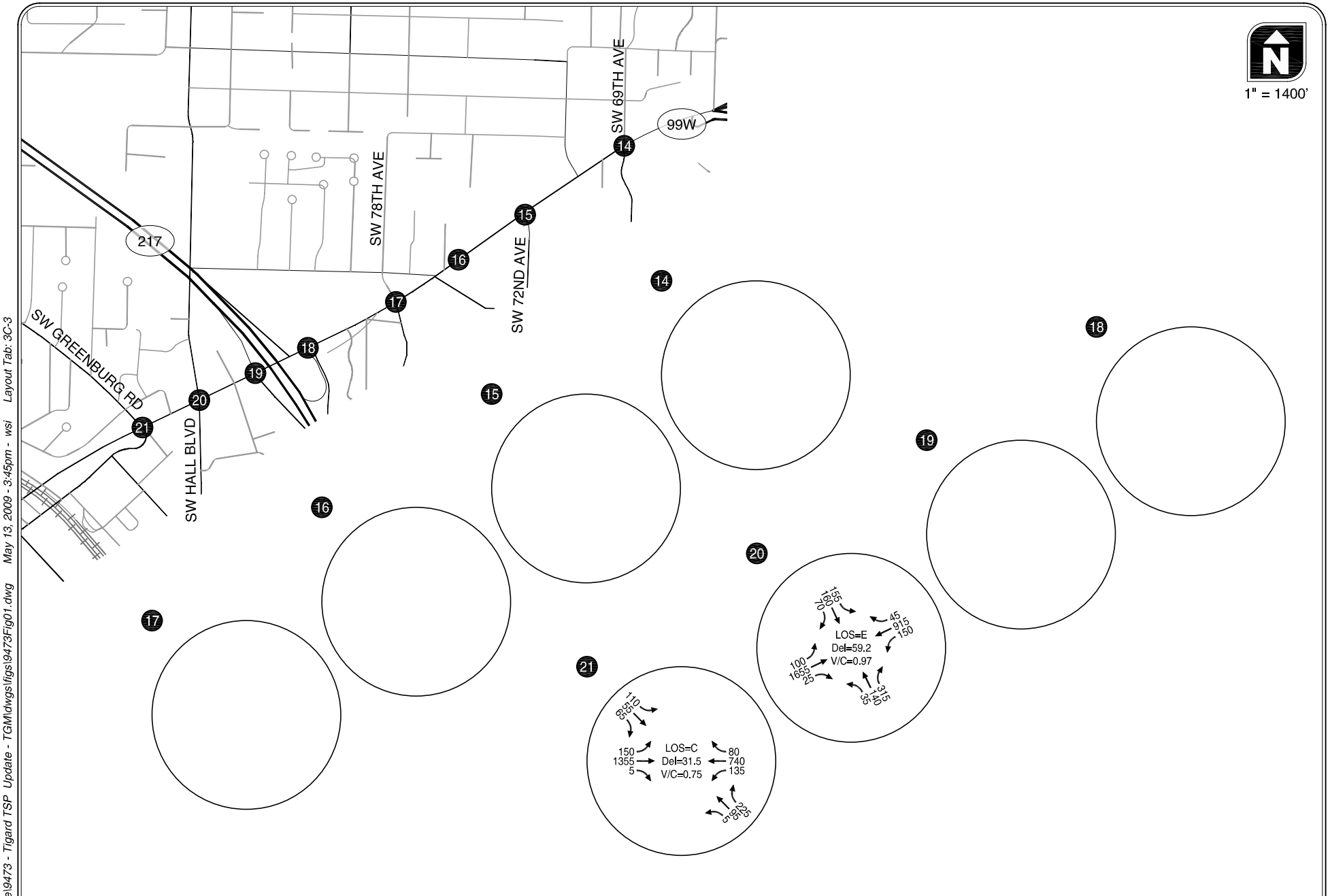
H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 3:44pm - wsi Layout Tab: 3C-1

EXISTING TRAFFIC CONDITIONS, WEEKDAY AM PEAK HOUR
SE WALNUT STREET
TIGARD, OREGON

FIGURE **3C-2**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 3:44pm - wsi Layout Tab: 3C-2

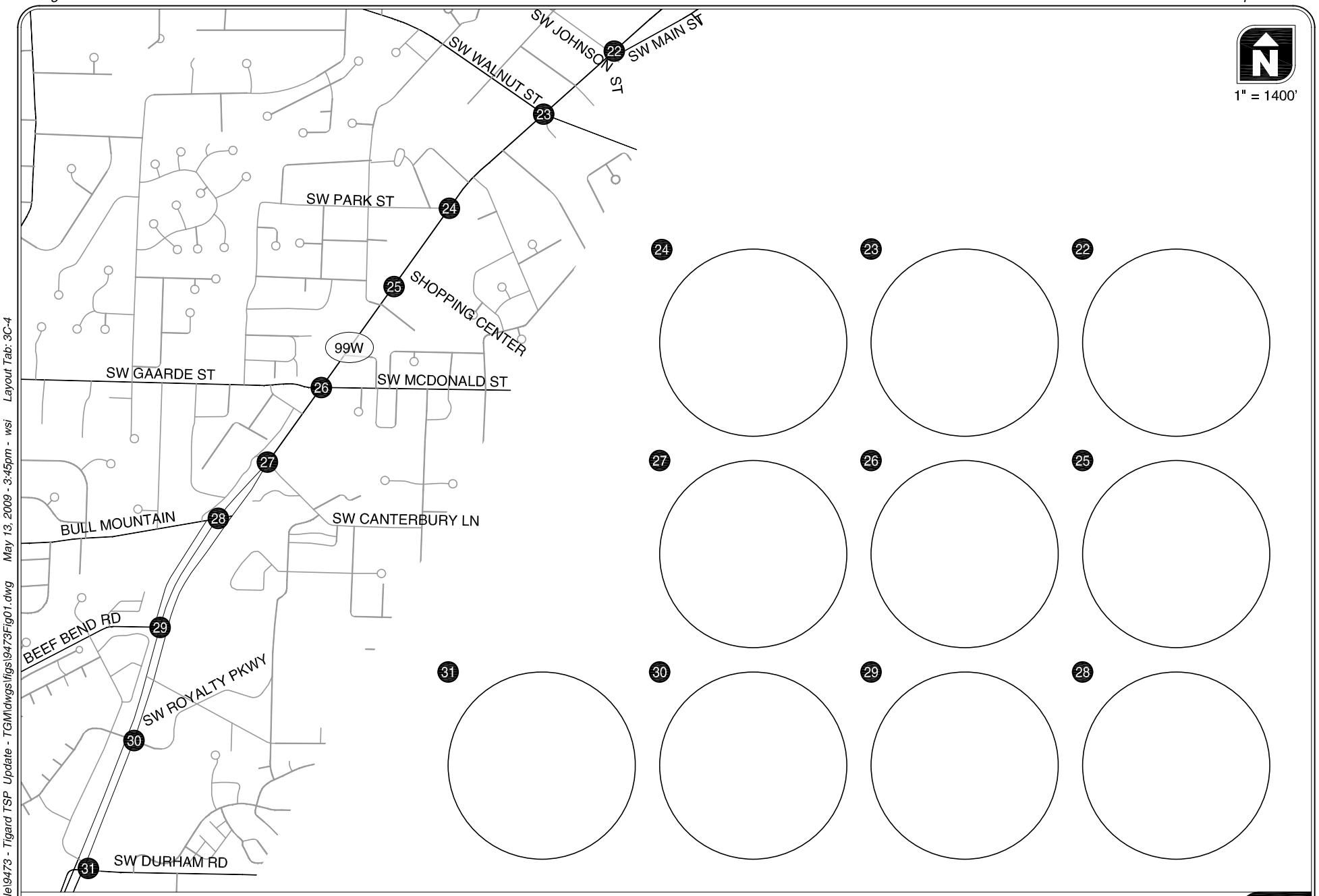


EXISTING TRAFFIC CONDITIONS, WEEKDAY AM PEAK HOUR
OR-99W
TIGARD, OREGON

FIGURE **3C-3**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 3:45pm - wsi Layout Tab: 3C-3

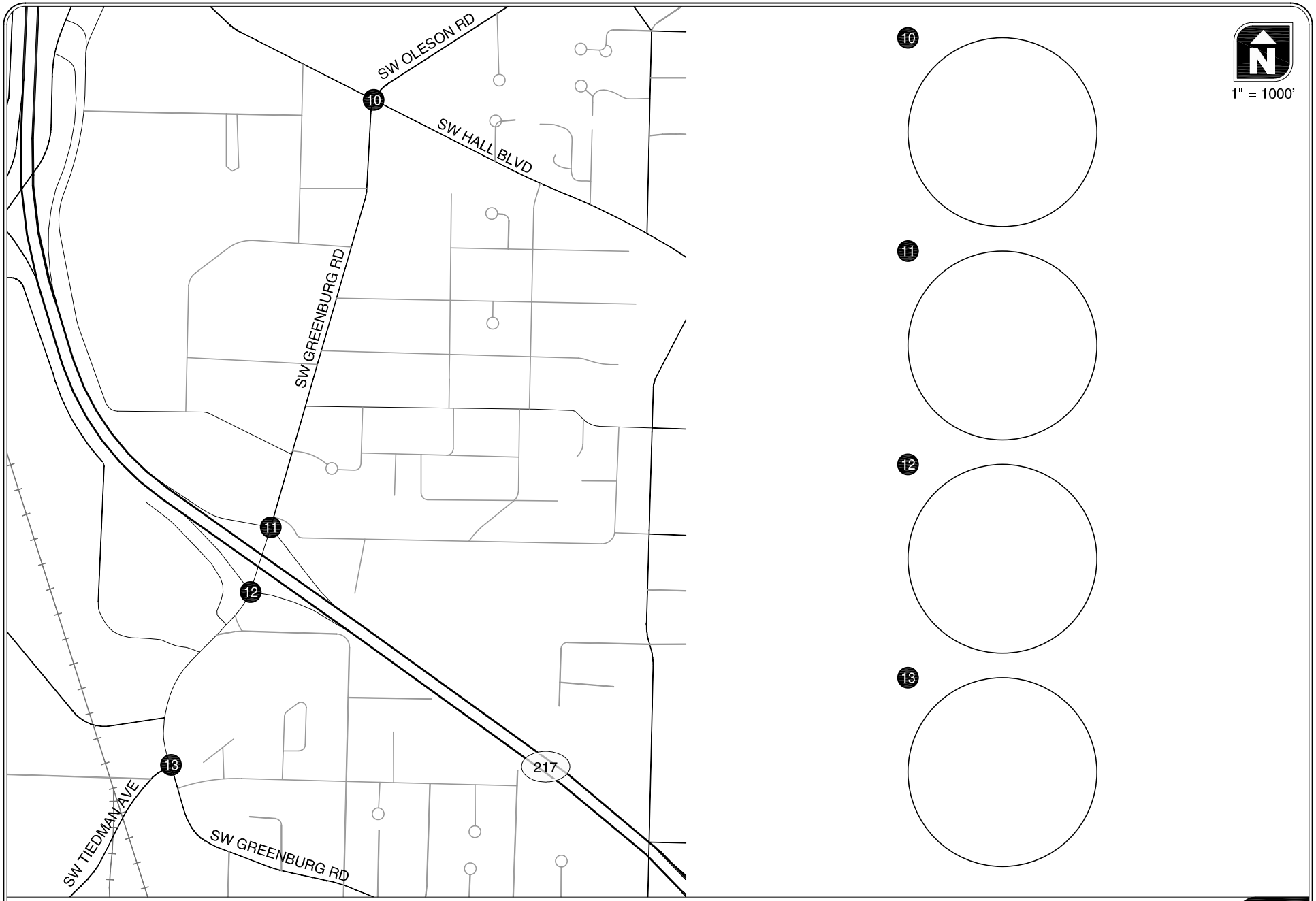


EXISTING TRAFFIC CONDITIONS, WEEKDAY AM PEAK HOUR
OR-99W
TIGARD, OREGON

FIGURE **3C-4**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 3:45pm - wsi Layout Tab: 3C-4

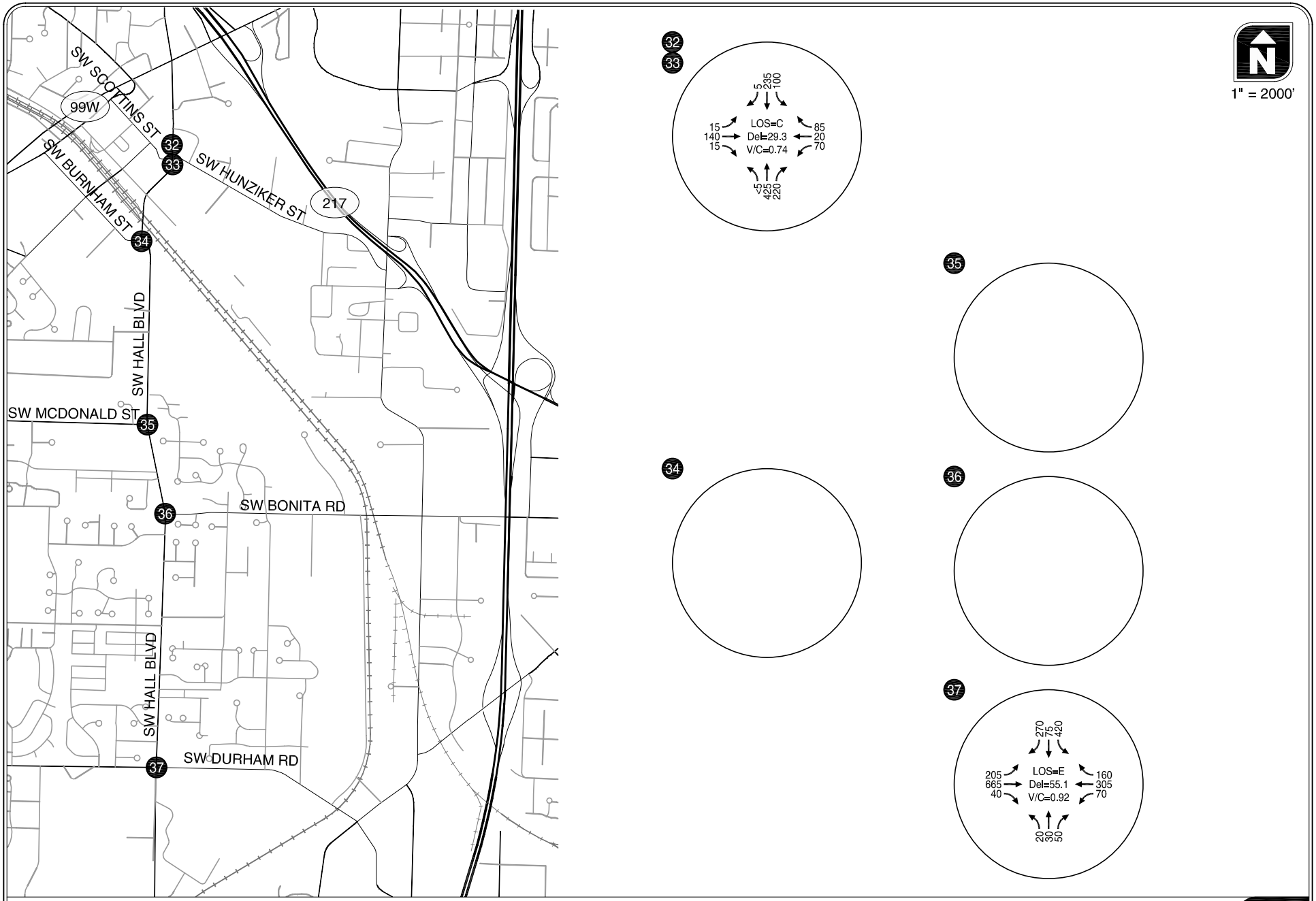


EXISTING TRAFFIC CONDITIONS, WEEKDAY AM PEAK HOUR
SW GREENBURG ROAD
TIGARD, OREGON

FIGURE **3C-5**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 3:45pm - wsi Layout Tab: 3C-5



EXISTING TRAFFIC CONDITIONS, WEEKDAY AM PEAK HOUR
SW HALL BLVD
TIGARD, OREGON

FIGURE **3C-6**

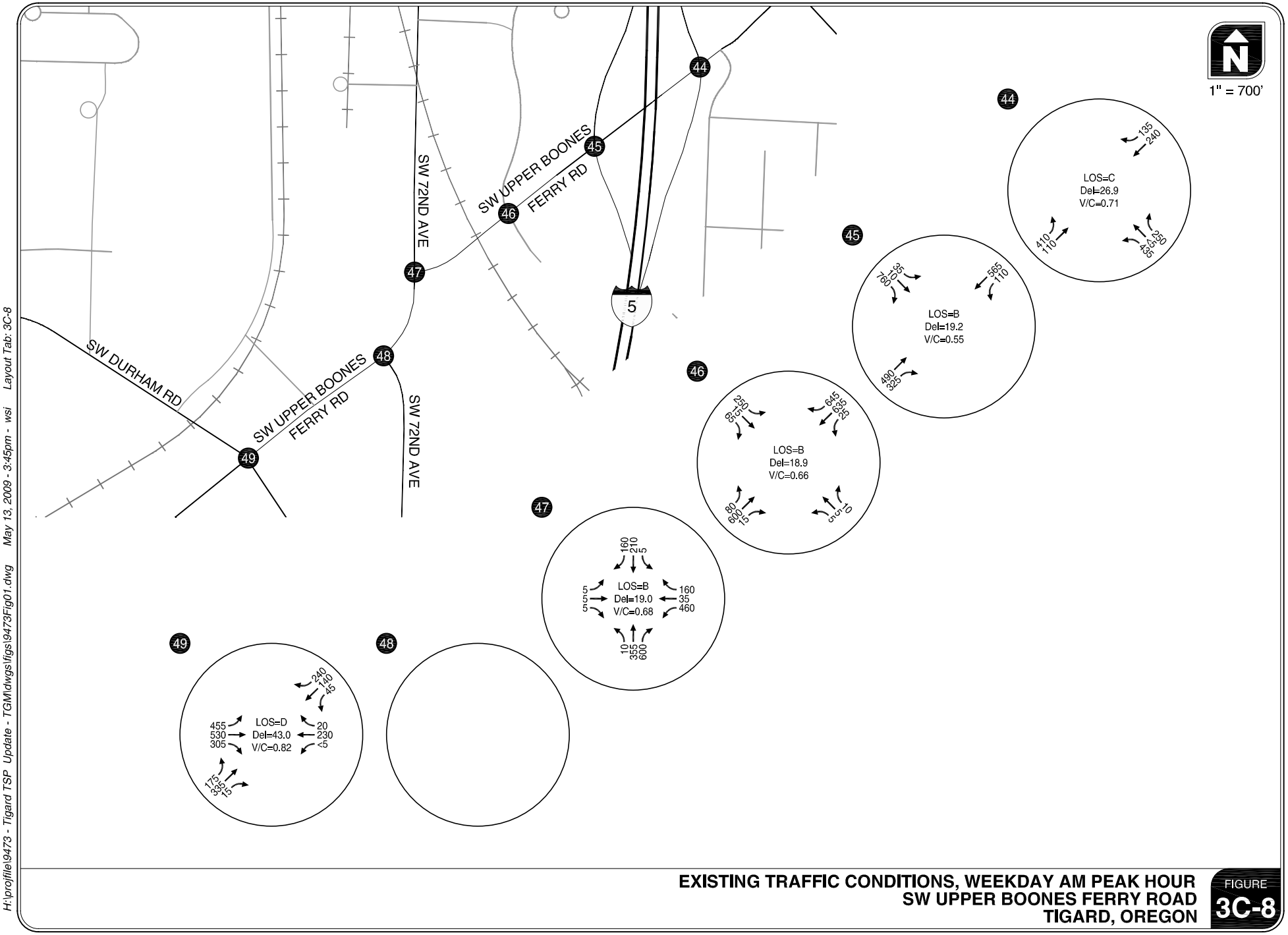
KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

EXISTING TRAFFIC CONDITIONS, WEEKDAY AM PEAK HOUR
SW 72ND AVE
TIGARD, OREGON

FIGURE
3C-7

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 4:18pm - wsi Layout Tab: 3C-7



EXISTING TRAFFIC CONDITIONS, WEEKDAY AM PEAK HOUR
SW UPPER BOONES FERRY ROAD
TIGARD, OREGON

FIGURE **3C-8**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 3:45pm - wsi Layout Tab: 3C-8

SW Scholls Ferry Road

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
OR 99W & SW Hall Blvd.	EBL	150	275
	EBT	525	850
	EBTR	525	850
	WBL	250	350
	WBT	275	425
	WBTR	75	200
	NBLT	250	350
	NBR	850	1625
	SBL	225	450
	SBTR	450	550
OR 99W & SW Greenburg Rd.	EBL	150	250
	EBT	750	925
	EBTR	750	925
	WBL	150	250
	WBT	275	475
	WBR	25	100
	SELT	275	350
	SER	75	175
	NWLT	100	200
	NWR	225	350

SW Hall Boulevard

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
SW Hall Blvd. & SW Scoffins St.	EBLTR	175	350
	WBLT	75	150
	WBR	50	125
	NBL	25	25
	NBTR	175	175
	SBL	75	150
	SBTR	75	175
SW Hall Blvd. & SW Durham Rd	EBL	225	400
	EBTR	2425	4450
	WBL	75	175
	WBT	225	425
	WBR	100	200
	NBLTR	100	175
	SBL	1175	2025
	SBTR	1125	2100

SW 72nd Avenue

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
SW 72nd Ave. & OR 217 NB Ramp	WBL	375	375
	WBR	150	200
	NBT	300	500
	NBR	100	300
	SBL	50	100
	SBT	100	150
SW 72nd Ave. & SW Hunziker St.	EBL	225	275
	EBR	1375	2250
	NBL	125	200
	NBT	150	250
	SBTR	300	550
SW 72nd Ave. & OR 217 SB Ramp	EBLTR	50	100
	WBLT	675	1425
	WBR	175	225
	NBL	25	25
	NBT	250	550
	NBR	50	175
	SBL	150	225
	SBTR	175	275

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
SW 72nd Ave. & SW Bonita Rd.	EBL	1450	2100
	EBT	1500	2025
	EBR	150	325
	WBL	75	125
	WBTR	200	325
	NBL	75	125
	NBTR	375	650
	SBL	50	125
	SBT	150	275
	SBR	50	125

Upper Boones Ferry Road

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
Upper Boones Ferry Rd. & I5 NB Ramp	NWL	225	250
	NWTR	1225	2275
	NEL	125	225
	NELT	175	250
	SWT	225	325
	SWR	25	75
Upper Boones Ferry Rd. & I5 SB Ramp	SELT	50	100
	SER	125	250
	NET	25	75
	NETR	50	125
	SWL	100	150
	SWT	100	250
Upper Boones Ferry Rd. & SW Sequoia Pkwy	NBL	100	275
	NBTR	850	925
	SBL	475	1125
	SBLT	25	100
	SBR	1025	1025
	NEL	25	50
	NET	25	25
	NETR	25	50
	SWL	125	150
	SWT	275	550
	SWR	50	225
Upper Boones Ferry Rd. & SW 72nd Ave. (North)	EBLT	25	25
	EBTR	25	50
	WBL	225	350
	WBTR	75	175
	NBL	25	50
	NBT	125	200
	NBR	100	175
	SBL	25	25
	SBTR	150	250

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
Upper Boones Ferry Rd. & SW Durham Rd.	EBL	225	275
	EBT	2575	4025
	EBR	125	275
	WBL	25	25
	WBTR	200	350
	NEL	150	250
	NETR	250	475
	SWL	50	100
	SWT	100	200
	SWR	75	150

HCM Signalized Intersection Capacity Analysis
20: OR 99W & SW Hall Blvd

6/10/2009

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	100	1653	25	148	915	44	37	139	315	155	162	72
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0			4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.91			1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	0.98	1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	0.99			1.00	0.85	1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00			0.99	1.00	0.95	1.00	
Satd. Flow (prot)	1736	3461		1687	4806			1774	1486	1736	1732	
Flt Permitted	0.95	1.00		0.95	1.00			0.99	1.00	0.95	1.00	
Satd. Flow (perm)	1736	3461		1687	4806			1774	1486	1736	1732	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	104	1722	26	154	953	46	39	145	328	161	169	75
RTOR Reduction (vph)	0	1	0	0	4	0	0	0	172	0	13	0
Lane Group Flow (vph)	104	1747	0	154	995	0	0	184	156	161	231	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	4%	4%	4%	7%	7%	7%	6%	6%	6%	4%	4%	4%
Turn Type	Prot			Prot			Split		Perm	Split		
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases									8			
Actuated Green, G (s)	12.0	63.2		12.0	63.2			13.8	13.8	14.0	14.0	
Effective Green, g (s)	12.0	63.2		12.0	63.2			13.8	13.8	14.0	14.0	
Actuated g/C Ratio	0.10	0.53		0.10	0.53			0.12	0.12	0.12	0.12	
Clearance Time (s)	4.0	5.0		4.0	5.0			4.0	4.0	4.0	4.0	
Vehicle Extension (s)	2.3	4.8		2.3	4.8			2.3	2.3	2.3	2.3	
Lane Grp Cap (vph)	174	1823		169	2531			204	171	203	202	
v/s Ratio Prot	0.06	c0.50		c0.09	0.21			0.10		0.09	c0.13	
v/s Ratio Perm									c0.11			
v/c Ratio	0.60	0.96		0.91	0.39			0.90	0.91	0.79	1.14	
Uniform Delay, d1	51.7	27.1		53.5	17.0			52.4	52.5	51.6	53.0	
Progression Factor	1.31	1.60		1.00	1.00			1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.9	10.3		44.1	0.5			36.8	44.3	18.1	106.9	
Delay (s)	70.8	53.8		97.6	17.4			89.2	96.8	69.7	159.9	
Level of Service	E	D		F	B			F	F	E	F	
Approach Delay (s)		54.7			28.1			94.1			124.0	
Approach LOS		D			C			F			F	

Intersection Summary			
HCM Average Control Delay	59.2	HCM Level of Service	E
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	92.8%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	150	1354	4	135	739	82	108	57	65	7	94	224
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0	5.0		4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00		1.00	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98		1.00	0.98		1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00	1.00		1.00	1.00
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.97	1.00		1.00	1.00
Satd. Flow (prot)	1736	3469		1703	3406	1489		1752	1507		1770	1480
Flt Permitted	0.95	1.00		0.95	1.00	1.00		0.97	1.00		1.00	1.00
Satd. Flow (perm)	1736	3469		1703	3406	1489		1752	1507		1770	1480
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	156	1410	4	141	770	85	112	59	68	7	98	233
RTOR Reduction (vph)	0	0	0	0	0	42	0	0	59	0	0	212
Lane Group Flow (vph)	156	1414	0	141	770	43	0	171	9	0	105	21
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	4%	4%	4%	6%	6%	6%	5%	5%	5%	7%	7%	7%
Turn Type	Prot			Prot		Perm	Split		Perm	Split		Perm
Protected Phases	5	2		1	6		4	4		8	8	
Permitted Phases						6			4			8
Actuated Green, G (s)	15.4	63.4		12.8	60.8	60.8		16.2	16.2		10.6	10.6
Effective Green, g (s)	15.4	63.4		12.8	60.8	60.8		16.2	16.2		10.6	10.6
Actuated g/C Ratio	0.13	0.53		0.11	0.51	0.51		0.13	0.13		0.09	0.09
Clearance Time (s)	4.0	5.0		4.0	5.0	5.0		4.0	4.0		4.0	4.0
Vehicle Extension (s)	2.3	4.8		2.3	4.8	4.8		2.3	2.3		2.3	2.3
Lane Grp Cap (vph)	223	1833		182	1726	754		237	203		156	131
v/s Ratio Prot	0.09	c0.41		c0.08	0.23			c0.10			c0.06	
v/s Ratio Perm						0.03			0.01			0.01
v/c Ratio	0.70	0.77		0.77	0.45	0.06		0.72	0.05		0.67	0.16
Uniform Delay, d1	50.1	22.5		52.2	18.9	15.0		49.7	45.2		53.0	50.6
Progression Factor	1.00	1.00		0.73	0.86	1.14		1.00	1.00		1.00	1.00
Incremental Delay, d2	8.1	3.2		15.9	0.3	0.1		9.4	0.1		9.4	0.3
Delay (s)	58.2	25.7		53.8	16.6	17.2		59.1	45.2		62.4	50.9
Level of Service	E	C		D	B	B		E	D		E	D
Approach Delay (s)		29.0			21.9			55.2			54.5	
Approach LOS		C			C			E			D	

Intersection Summary			
HCM Average Control Delay	31.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	73.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	13	142	13	69	22	84	2	426	218	98	233	5
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0		3.0	4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Frpb, ped/bikes		1.00			1.00	0.97	1.00	0.99		1.00	1.00	
Flpb, ped/bikes		1.00			1.00	1.00	0.99	1.00		1.00	1.00	
Frt		0.99			1.00	0.85	1.00	0.95		1.00	1.00	
Flt Protected		1.00			0.96	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1832			1664	1420	1716	1717		1736	1820	
Flt Permitted		1.00			0.96	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1832			1664	1420	1716	1717		1736	1820	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	14	154	14	75	24	91	2	463	237	107	253	5
RTOR Reduction (vph)	0	3	0	0	0	81	0	14	0	0	0	0
Lane Group Flow (vph)	0	179	0	0	99	10	2	686	0	107	258	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	2%	2%	2%	10%	10%	10%	4%	4%	4%	4%	4%	4%
Turn Type	Split			Split		Perm	Prot			Prot		
Protected Phases	3	3		4	4		5	2		1	6	
Permitted Phases						4						
Actuated Green, G (s)		12.8			10.4	10.4	0.7	43.7		8.6	50.6	
Effective Green, g (s)		12.8			10.4	10.4	0.7	43.7		8.6	50.6	
Actuated g/C Ratio		0.14			0.11	0.11	0.01	0.48		0.10	0.56	
Clearance Time (s)		4.0			4.0	4.0	4.0	4.0		3.0	4.0	
Vehicle Extension (s)		2.3			2.3	2.3	3.0	4.5		2.3	4.5	
Lane Grp Cap (vph)		259			191	163	13	829		165	1018	
v/s Ratio Prot		c0.10			c0.06		0.00	c0.40		c0.06	0.14	
v/s Ratio Perm						0.01						
v/c Ratio		0.69			0.52	0.06	0.15	0.83		0.65	0.25	
Uniform Delay, d1		37.0			37.7	35.7	44.6	20.1		39.5	10.2	
Progression Factor		1.00			1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2		6.8			1.5	0.1	5.5	7.4		7.1	0.2	
Delay (s)		43.8			39.2	35.8	50.1	27.6		46.6	10.5	
Level of Service		D			D	D	D	C		D	B	
Approach Delay (s)		43.8			37.5			27.6			21.1	
Approach LOS		D			D			C			C	

Intersection Summary			
HCM Average Control Delay	29.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	90.5	Sum of lost time (s)	15.0
Intersection Capacity Utilization	70.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	204	667	41	70	307	160	22	30	49	422	77	272
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5		4.0	4.5	4.5		4.0		4.5	4.5	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.67		0.98		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85		0.93		1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.99		0.95	1.00	
Satd. Flow (prot)	1736	1811		1703	1792	1015		1503		1703	1583	
Flt Permitted	0.95	1.00		0.95	1.00	1.00		0.99		0.95	1.00	
Satd. Flow (perm)	1736	1811		1703	1792	1015		1503		1703	1583	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	215	702	43	74	323	168	23	32	52	444	81	286
RTOR Reduction (vph)	0	2	0	0	0	112	0	29	0	0	96	0
Lane Group Flow (vph)	215	743	0	74	323	56	0	78	0	444	271	0
Confl. Peds. (#/hr)	108					108			6	6		
Heavy Vehicles (%)	4%	4%	4%	6%	6%	6%	14%	14%	14%	6%	6%	6%
Turn Type	Prot			Prot		Perm	Split			Split		
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases						6						
Actuated Green, G (s)	18.3	48.0		6.0	35.7	35.7		10.5		25.2	25.2	
Effective Green, g (s)	18.3	48.0		6.0	35.7	35.7		10.5		25.2	25.2	
Actuated g/C Ratio	0.17	0.45		0.06	0.33	0.33		0.10		0.24	0.24	
Clearance Time (s)	4.0	4.5		4.0	4.5	4.5		4.0		4.5	4.5	
Vehicle Extension (s)	3.0	1.0		3.0	2.2	2.2		2.5		2.5	2.5	
Lane Grp Cap (vph)	298	815		96	600	340		148		402	374	
v/s Ratio Prot	c0.12	c0.41		0.04	0.18			c0.05		c0.26	0.17	
v/s Ratio Perm						0.06						
v/c Ratio	0.72	0.91		0.77	0.54	0.17		0.53		1.10	0.72	
Uniform Delay, d1	41.8	27.4		49.7	28.8	25.0		45.7		40.8	37.5	
Progression Factor	1.00	1.00		1.00	1.00	1.00		1.00		1.00	1.00	
Incremental Delay, d2	8.3	14.1		30.9	0.6	0.1		2.6		76.2	6.4	
Delay (s)	50.1	41.5		80.6	29.4	25.1		48.3		117.0	43.9	
Level of Service	D	D		F	C	C		D		F	D	
Approach Delay (s)		43.5			34.8			48.3			83.9	
Approach LOS		D			C			D			F	

Intersection Summary			
HCM Average Control Delay	55.1	HCM Level of Service	E
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	106.7	Sum of lost time (s)	17.0
Intersection Capacity Utilization	82.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (vph)	322	325	750	202	38	406
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.85	1.00	0.85	1.00	1.00
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1736	1553	1845	1568	1719	1810
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1736	1553	1845	1568	1719	1810
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	343	346	798	215	40	432
RTOR Reduction (vph)	0	218	0	76	0	0
Lane Group Flow (vph)	343	128	798	139	40	432
Heavy Vehicles (%)	4%	4%	3%	3%	5%	5%
Turn Type		Perm		Perm	Prot	
Protected Phases	4		6		5	2
Permitted Phases		4		6		
Actuated Green, G (s)	18.0	18.0	64.5	64.5	5.0	73.5
Effective Green, g (s)	18.0	18.0	64.5	64.5	5.0	73.5
Actuated g/C Ratio	0.18	0.18	0.64	0.64	0.05	0.74
Clearance Time (s)	4.0	4.0	4.5	4.5	4.0	4.5
Vehicle Extension (s)	2.3	2.3	4.5	4.5	2.3	4.5
Lane Grp Cap (vph)	312	280	1190	1011	86	1330
v/s Ratio Prot	c0.20		c0.43		c0.02	0.24
v/s Ratio Perm		0.08		0.09		
v/c Ratio	1.10	0.46	0.67	0.14	0.47	0.32
Uniform Delay, d1	41.0	36.6	11.1	6.9	46.2	4.6
Progression Factor	1.00	1.00	1.46	2.70	1.00	1.00
Incremental Delay, d2	80.3	0.7	2.1	0.2	2.3	0.2
Delay (s)	121.3	37.3	18.3	18.8	48.5	4.9
Level of Service	F	D	B	B	D	A
Approach Delay (s)	79.1		18.4			8.6
Approach LOS	E		B			A

Intersection Summary			
HCM Average Control Delay	35.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	66.7%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	273	287	125	699	493	235
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	0.97	1.00	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.85	1.00	1.00	0.96	
Flt Protected	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (prot)	1687	1459	1736	1827	1681	
Flt Permitted	0.95	1.00	0.95	1.00	1.00	
Satd. Flow (perm)	1687	1459	1736	1827	1681	
Peak-hour factor, PHF	0.89	0.89	0.89	0.89	0.89	0.89
Adj. Flow (vph)	307	322	140	785	554	264
RTOR Reduction (vph)	0	264	0	0	17	0
Lane Group Flow (vph)	307	58	140	785	801	0
Confl. Peds. (#/hr)	5	5	5			5
Heavy Vehicles (%)	7%	7%	4%	4%	7%	7%
Turn Type		Perm	Prot			
Protected Phases	8		1	6	2	
Permitted Phases		8				
Actuated Green, G (s)	18.0	18.0	9.7	74.0	60.3	
Effective Green, g (s)	18.0	18.0	9.7	74.0	60.3	
Actuated g/C Ratio	0.18	0.18	0.10	0.74	0.60	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	2.3	2.3	2.3	4.2	4.2	
Lane Grp Cap (vph)	304	263	168	1352	1014	
v/s Ratio Prot	c0.18		c0.08	0.43	c0.48	
v/s Ratio Perm		0.04				
v/c Ratio	1.01	0.22	0.83	0.58	0.79	
Uniform Delay, d1	41.0	35.0	44.4	5.9	15.0	
Progression Factor	1.00	1.00	1.10	0.60	1.11	
Incremental Delay, d2	54.1	0.2	24.2	1.5	4.9	
Delay (s)	95.1	35.3	72.8	5.1	21.6	
Level of Service	F	D	E	A	C	
Approach Delay (s)	64.5			15.3	21.6	
Approach LOS	E			B	C	

Intersection Summary			
HCM Average Control Delay	30.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	72.5%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	19	7	6	295	0	348	1	457	84	165	607	8
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0			4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor		1.00			1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes		1.00			1.00	0.99	1.00	1.00	0.97	1.00	1.00	
Flpb, ped/bikes		1.00			0.99	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		0.97			1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.97			0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1626			1759	1566	1671	1759	1450	1671	1755	
Flt Permitted		0.79			0.73	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1321			1358	1566	1671	1759	1450	1671	1755	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	21	8	7	328	0	387	1	508	93	183	674	9
RTOR Reduction (vph)	0	5	0	0	0	110	0	0	51	0	0	0
Lane Group Flow (vph)	0	31	0	0	328	277	1	508	42	183	683	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	10%	10%	10%	2%	2%	2%	8%	8%	8%	8%	8%	8%
Turn Type	Perm			Perm		pm+ov	Prot		Perm	Prot		
Protected Phases		8			4	5	1	6		5	2	
Permitted Phases	8			4		4			6			
Actuated Green, G (s)		29.2			29.2	42.4	1.1	45.6	45.6	13.2	57.7	
Effective Green, g (s)		29.2			29.2	42.4	1.1	45.6	45.6	13.2	57.7	
Actuated g/C Ratio		0.29			0.29	0.42	0.01	0.46	0.46	0.13	0.58	
Clearance Time (s)		4.0			4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)		2.5			2.5	2.3	2.3	4.2	4.2	2.3	4.2	
Lane Grp Cap (vph)		386			397	727	18	802	661	221	1013	
v/s Ratio Prot						0.05	0.00	c0.29		c0.11	c0.39	
v/s Ratio Perm		0.02			c0.24	0.13			0.03			
v/c Ratio		0.08			0.83	0.38	0.06	0.63	0.06	0.83	0.67	
Uniform Delay, d1		25.7			33.0	19.8	48.9	20.8	15.2	42.3	14.6	
Progression Factor		1.00			1.00	1.00	1.00	1.00	1.00	0.85	0.88	
Incremental Delay, d2		0.1			12.9	0.2	0.8	3.8	0.2	15.1	2.4	
Delay (s)		25.7			45.9	20.0	49.7	24.6	15.4	51.1	15.3	
Level of Service		C			D	B	D	C	B	D	B	
Approach Delay (s)		25.7			31.9			23.2			22.8	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	25.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	68.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	262	597	259	43	178	82	45	344	154	54	237	139
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.5	5.0	5.0	3.5	5.0		3.5	5.0		3.5	5.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.95		1.00	0.95		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1752	1845	1568	1770	1775		1687	1693		1641	1727	1468
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1752	1845	1568	1770	1775		1687	1693		1641	1727	1468
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	276	628	273	45	187	86	47	362	162	57	249	146
RTOR Reduction (vph)	0	0	72	0	10	0	0	8	0	0	0	92
Lane Group Flow (vph)	276	628	201	45	263	0	47	516	0	57	249	54
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	7%	7%	7%	10%	10%	10%
Turn Type	Prot		Perm	Prot			Prot			Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	25.9	51.8	51.8	7.0	32.9		7.3	47.7		8.1	48.5	48.5
Effective Green, g (s)	25.9	51.8	51.8	7.0	32.9		7.3	47.7		8.1	48.5	48.5
Actuated g/C Ratio	0.20	0.39	0.39	0.05	0.25		0.06	0.36		0.06	0.37	0.37
Clearance Time (s)	3.5	5.0	5.0	3.5	5.0		3.5	5.0		3.5	5.0	5.0
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.5	4.3		2.5	4.3	4.3
Lane Grp Cap (vph)	345	726	617	94	444		94	614		101	636	541
v/s Ratio Prot	c0.16	c0.34		0.03	0.15		0.03	c0.30		c0.03	0.14	
v/s Ratio Perm			0.13									0.04
v/c Ratio	0.80	0.87	0.33	0.48	0.59		0.50	0.84		0.56	0.39	0.10
Uniform Delay, d1	50.4	36.7	27.8	60.5	43.5		60.4	38.5		60.0	30.7	27.2
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	12.1	10.4	0.2	2.8	1.8		3.0	10.5		5.7	0.6	0.1
Delay (s)	62.5	47.1	28.0	63.3	45.2		63.4	49.0		65.8	31.3	27.4
Level of Service	E	D	C	E	D		E	D		E	C	C
Approach Delay (s)		46.3			47.8			50.1			34.4	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM Average Control Delay	45.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	131.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	80.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	0	0	0	437	1	251	412	110	0	0	238	135
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)				5.0	5.0		4.5	4.5			4.5	4.5
Lane Util. Factor				1.00	1.00		0.95	0.95			1.00	1.00
Frpb, ped/bikes				1.00	0.97		1.00	1.00			1.00	0.98
Flpb, ped/bikes				1.00	1.00		1.00	1.00			1.00	1.00
Frt				1.00	0.85		1.00	1.00			1.00	0.85
Flt Protected				0.95	1.00		0.95	0.97			1.00	1.00
Satd. Flow (prot)				1736	1504		1618	1655			1881	1568
Flt Permitted				0.95	1.00		0.95	0.97			1.00	1.00
Satd. Flow (perm)				1736	1504		1618	1655			1881	1568
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	0	0	0	470	1	270	443	118	0	0	256	145
RTOR Reduction (vph)	0	0	0	0	187	0	0	0	0	0	0	115
Lane Group Flow (vph)	0	0	0	470	84	0	279	282	0	0	256	30
Confl. Peds. (#/hr)				5		5	5					5
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	6%	6%	6%	1%	1%	1%
Turn Type				Split			Split					Perm
Protected Phases				4	4		6	6			2	
Permitted Phases												2
Actuated Green, G (s)				23.0	23.0		22.3	22.3			15.7	15.7
Effective Green, g (s)				23.0	23.0		22.3	22.3			15.7	15.7
Actuated g/C Ratio				0.31	0.31		0.30	0.30			0.21	0.21
Clearance Time (s)				5.0	5.0		4.5	4.5			4.5	4.5
Vehicle Extension (s)				2.3	2.3		4.2	4.2			4.2	4.2
Lane Grp Cap (vph)				532	461		481	492			394	328
v/s Ratio Prot				c0.27	0.06		c0.17	0.17			c0.14	
v/s Ratio Perm												0.02
v/c Ratio				0.88	0.18		0.58	0.57			0.65	0.09
Uniform Delay, d1				24.7	19.1		22.4	22.3			27.1	23.9
Progression Factor				1.00	1.00		0.61	0.61			1.00	1.00
Incremental Delay, d2				15.7	0.1		4.5	4.2			4.3	0.2
Delay (s)				40.4	19.2		18.1	17.9			31.4	24.1
Level of Service				D	B		B	B			C	C
Approach Delay (s)		0.0			32.7			18.0			28.8	
Approach LOS		A			C			B			C	

Intersection Summary			
HCM Average Control Delay	26.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	64.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	33	11	758	0	0	0	0	489	326	111	564	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0					4.5		5.0	4.5	
Lane Util. Factor		1.00	0.88					0.95		1.00	1.00	
Frpb, ped/bikes		1.00	0.96					0.99		1.00	1.00	
Flpb, ped/bikes		0.99	1.00					1.00		1.00	1.00	
Frt		1.00	0.85					0.94		1.00	1.00	
Flt Protected		0.96	1.00					1.00		0.95	1.00	
Satd. Flow (prot)		1765	2658					3166		1770	1863	
Flt Permitted		0.96	1.00					1.00		0.95	1.00	
Satd. Flow (perm)		1765	2658					3166		1770	1863	
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	35	12	815	0	0	0	0	526	351	119	606	0
RTOR Reduction (vph)	0	0	404	0	0	0	0	109	0	0	0	0
Lane Group Flow (vph)	0	47	411	0	0	0	0	768	0	119	606	0
Confl. Peds. (#/hr)	5		5						5	5		
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	6%	6%	6%	2%	2%	2%
Turn Type	Perm		Perm							Prot		
Protected Phases		8						6		5	2	
Permitted Phases	8		8									
Actuated Green, G (s)		15.4	15.4					36.5		8.6	50.1	
Effective Green, g (s)		15.4	15.4					36.5		8.6	50.1	
Actuated g/C Ratio		0.21	0.21					0.49		0.11	0.67	
Clearance Time (s)		5.0	5.0					4.5		5.0	4.5	
Vehicle Extension (s)		2.3	2.3					4.2		2.3	4.2	
Lane Grp Cap (vph)		362	546					1541		203	1244	
v/s Ratio Prot								0.24		0.07	c0.33	
v/s Ratio Perm		0.03	c0.15									
v/c Ratio		0.13	0.75					0.50		0.59	0.49	
Uniform Delay, d1		24.3	28.0					13.0		31.5	6.1	
Progression Factor		1.00	1.00					1.00		1.36	0.13	
Incremental Delay, d2		0.1	5.4					1.2		2.2	0.9	
Delay (s)		24.4	33.4					14.2		45.2	1.8	
Level of Service		C	C					B		D	A	
Approach Delay (s)		32.9			0.0			14.2			8.9	
Approach LOS		C			A			B			A	

Intersection Summary			
HCM Average Control Delay	19.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	9.5
Intersection Capacity Utilization	64.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	251	13	66	7	6	10	81	598	16	23	636	644
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	6.0		4.0	6.0	6.0
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00		1.00	0.95		1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	0.96		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.91		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	0.96	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1588	1599	1450	1736	1595		1805	3593		1736	1827	1507
Flt Permitted	0.95	0.96	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1588	1599	1450	1736	1595		1805	3593		1736	1827	1507
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	273	14	72	8	7	11	88	650	17	25	691	700
RTOR Reduction (vph)	0	0	61	0	11	0	0	1	0	0	0	267
Lane Group Flow (vph)	142	145	11	8	7	0	88	666	0	25	691	433
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	8%	8%	8%	4%	4%	4%	0%	0%	0%	4%	4%	4%
Turn Type	Split		Perm	Split			Prot			Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	12.5	12.5	12.5	2.4	2.4		7.5	48.7		2.6	43.8	43.8
Effective Green, g (s)	12.5	12.5	12.5	2.4	2.4		7.5	48.7		2.6	43.8	43.8
Actuated g/C Ratio	0.15	0.15	0.15	0.03	0.03		0.09	0.58		0.03	0.52	0.52
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	6.0		4.0	6.0	6.0
Vehicle Extension (s)	2.5	2.5	2.5	3.0	3.0		2.5	4.6		2.5	4.6	4.6
Lane Grp Cap (vph)	236	237	215	49	45		161	2078		54	950	784
v/s Ratio Prot	0.09	c0.09		c0.00	0.00		c0.05	0.19		0.01	c0.38	
v/s Ratio Perm			0.01									0.29
v/c Ratio	0.60	0.61	0.05	0.16	0.16		0.55	0.32		0.46	0.73	0.55
Uniform Delay, d1	33.5	33.6	30.8	39.9	39.9		36.7	9.2		40.1	15.6	13.6
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	3.6	4.0	0.1	1.6	1.7		3.0	0.2		4.5	3.2	1.3
Delay (s)	37.1	37.5	30.8	41.5	41.6		39.7	9.3		44.6	18.8	14.9
Level of Service	D	D	C	D	D		D	A		D	B	B
Approach Delay (s)		36.0			41.6			12.9			17.3	
Approach LOS		D			D			B			B	

Intersection Summary			
HCM Average Control Delay	18.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	84.2	Sum of lost time (s)	18.0
Intersection Capacity Utilization	64.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

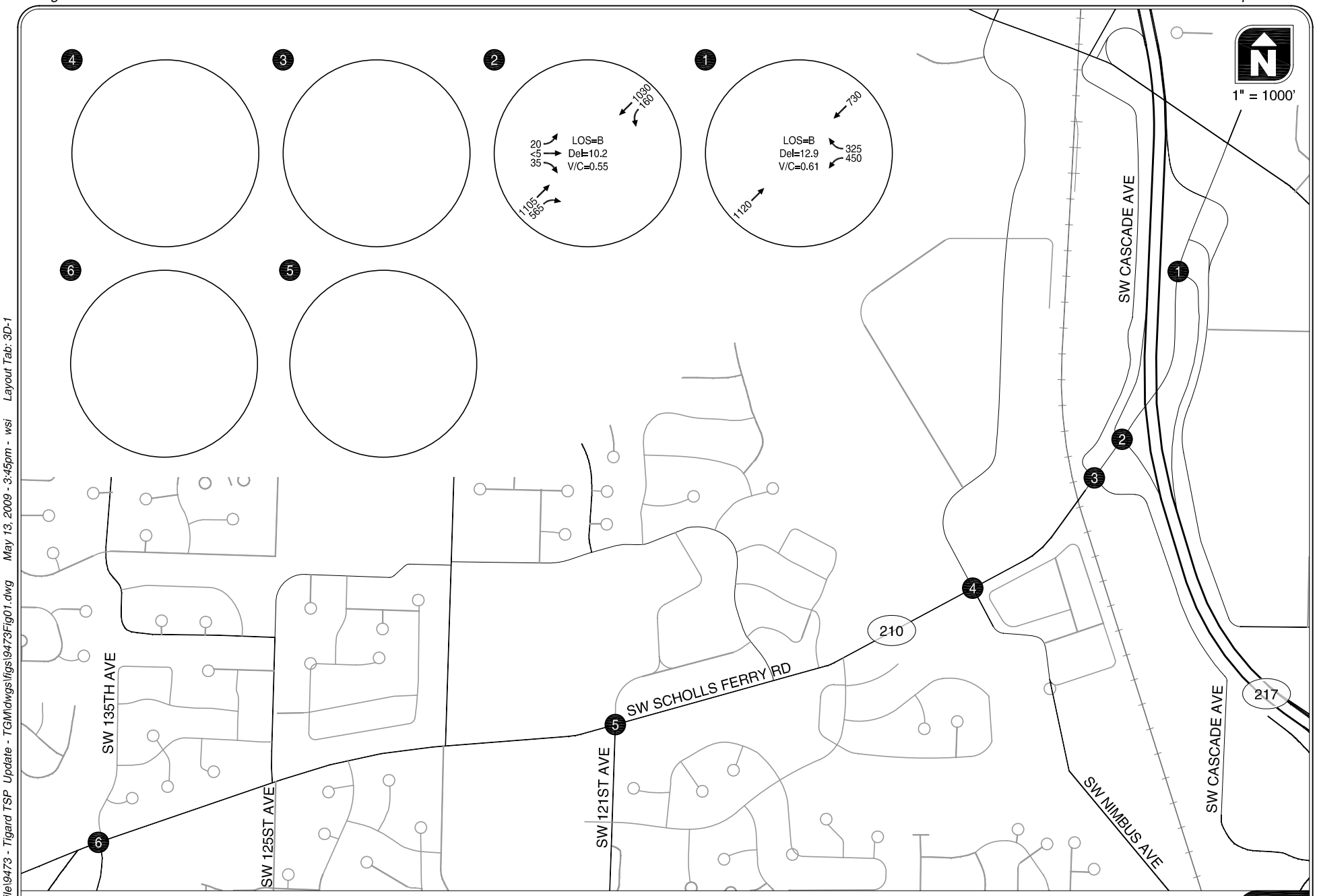
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	3	4	5	458	35	158	8	354	600	6	209	159
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.5	4.5		4.0	4.5	4.5	4.0	4.5	
Lane Util. Factor		0.95		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes		0.93		1.00	0.98		1.00	1.00	0.98	1.00	0.99	
Flpb, ped/bikes		1.00		1.00	1.00		0.91	1.00	1.00	1.00	1.00	
Frt		0.94		1.00	0.88		1.00	1.00	0.85	1.00	0.94	
Flt Protected		0.99		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		3035		1736	1566		1567	1810	1513	1622	1582	
Flt Permitted		0.99		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		3035		1736	1566		1567	1810	1513	1622	1582	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	3	4	5	467	36	161	8	361	612	6	213	162
RTOR Reduction (vph)	0	5	0	0	98	0	0	0	415	0	26	0
Lane Group Flow (vph)	0	7	0	467	99	0	8	361	197	6	349	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	2%	2%	2%	4%	4%	4%	5%	5%	5%	11%	11%	11%
Turn Type	Split			Split			Prot		Perm	Prot		
Protected Phases	4	4		8	8		1	6		5	2	
Permitted Phases									6			
Actuated Green, G (s)		0.6		24.5	24.5		0.6	20.2	20.2	0.6	20.2	
Effective Green, g (s)		0.6		24.5	24.5		0.6	20.2	20.2	0.6	20.2	
Actuated g/C Ratio		0.01		0.39	0.39		0.01	0.32	0.32	0.01	0.32	
Clearance Time (s)		4.0		4.5	4.5		4.0	4.5	4.5	4.0	4.5	
Vehicle Extension (s)		1.5		3.0	3.0		1.0	3.5	3.5	1.0	3.5	
Lane Grp Cap (vph)		29		676	610		15	581	486	15	508	
v/s Ratio Prot		c0.00		c0.27	0.06		c0.01	0.20		0.00	c0.22	
v/s Ratio Perm									0.13			
v/c Ratio		0.24		0.69	0.16		0.53	0.62	0.40	0.40	0.69	
Uniform Delay, d1		30.9		16.0	12.5		31.0	18.1	16.7	31.0	18.6	
Progression Factor		1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2		1.6		3.1	0.1		17.0	2.2	0.7	6.3	4.0	
Delay (s)		32.5		19.1	12.6		48.0	20.3	17.3	37.2	22.6	
Level of Service		C		B	B		D	C	B	D	C	
Approach Delay (s)		32.5			17.2			18.7			22.8	
Approach LOS		C			B			B			C	

Intersection Summary			
HCM Average Control Delay	19.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	62.9	Sum of lost time (s)	17.0
Intersection Capacity Utilization	60.5%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	455	530	306	2	228	20	173	334	17	44	138	241
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.5		5.0	5.5	5.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.97	1.00	1.00		1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1752	1845	1515	1719	1782		1736	1811		1736	1827	1507
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1752	1845	1515	1719	1782		1736	1811		1736	1827	1507
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	479	558	322	2	240	21	182	352	18	46	145	254
RTOR Reduction (vph)	0	0	107	0	2	0	0	1	0	0	0	207
Lane Group Flow (vph)	479	558	215	2	259	0	182	369	0	46	145	47
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	3%	3%	3%	5%	5%	5%	4%	4%	4%	4%	4%	4%
Turn Type	Prot		Perm	Prot			Prot			Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4									6
Actuated Green, G (s)	35.7	60.4	60.4	1.1	25.8		17.4	32.6		7.1	22.3	22.3
Effective Green, g (s)	35.7	60.4	60.4	1.1	25.8		17.4	32.6		7.1	22.3	22.3
Actuated g/C Ratio	0.29	0.50	0.50	0.01	0.21		0.14	0.27		0.06	0.18	0.18
Clearance Time (s)	5.0	5.0	5.0	5.0	5.0		5.0	5.5		5.0	5.5	5.5
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	5.0		3.0	5.0	5.0
Lane Grp Cap (vph)	514	916	752	16	378		248	485		101	335	276
v/s Ratio Prot	c0.27	0.30		0.00	c0.15		c0.10	c0.20		0.03	0.08	
v/s Ratio Perm			0.14									0.03
v/c Ratio	0.93	0.61	0.29	0.12	0.68		0.73	0.76		0.46	0.43	0.17
Uniform Delay, d1	41.8	22.1	18.0	59.8	44.2		49.9	41.0		55.4	44.1	41.9
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	23.9	1.2	0.2	3.5	5.1		10.7	8.0		3.2	1.9	0.6
Delay (s)	65.7	23.3	18.2	63.3	49.3		60.6	48.9		58.7	46.0	42.5
Level of Service	E	C	B	E	D		E	D		E	D	D
Approach Delay (s)		37.0			49.4			52.8			45.3	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM Average Control Delay	43.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	121.7	Sum of lost time (s)	20.5
Intersection Capacity Utilization	78.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Appendix H 2008 Base Year Intersection Operations and Queuing Analyses, Saturday Mid-Day Peak Hour

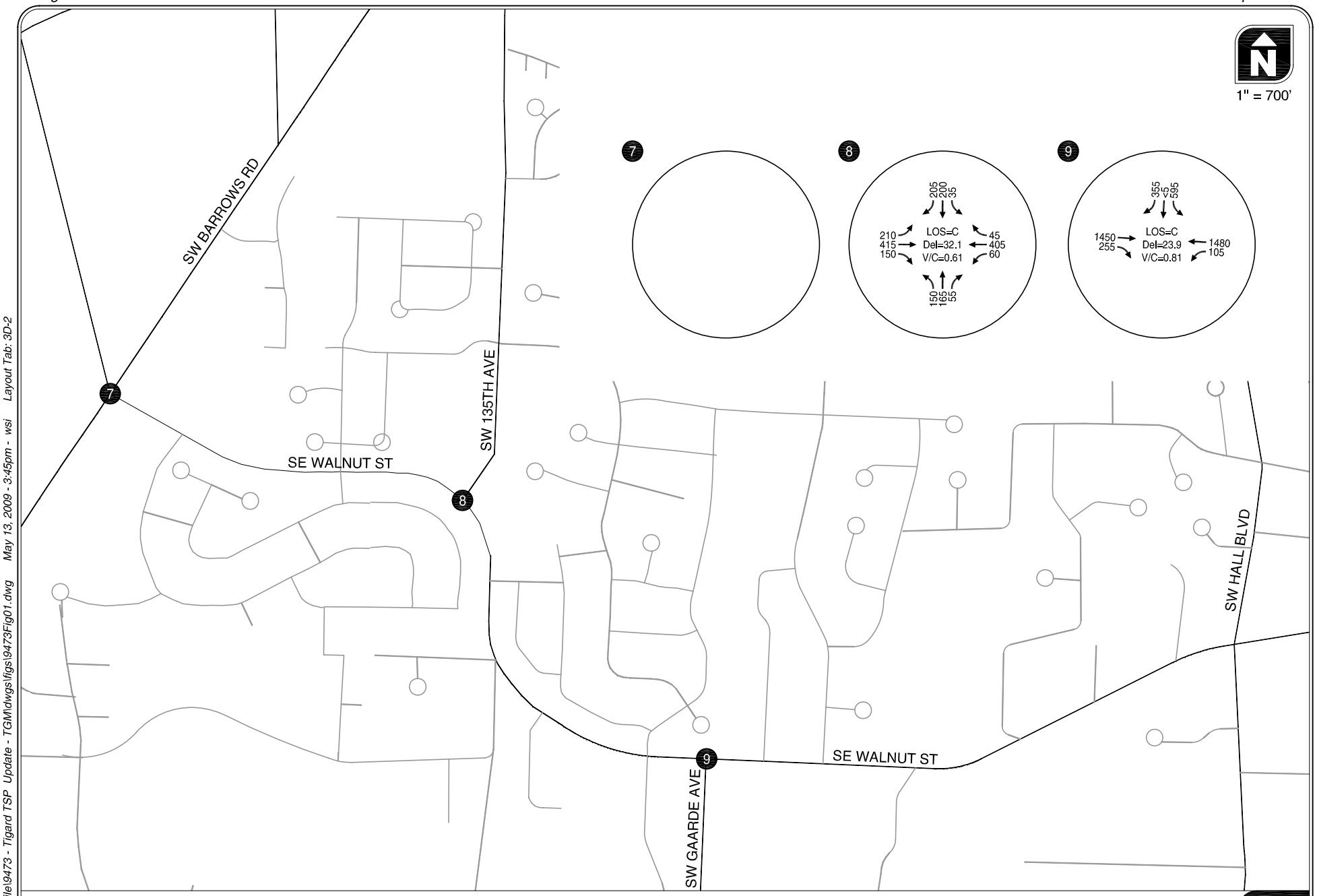


EXISTING TRAFFIC CONDITIONS, SATURDAY MIDDAY PEAK HOUR
SW SCHOLLS FERRY ROAD
TIGARD, OREGON

FIGURE **3D-1**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 3:45pm - wsi Layout Tab: 3D-1

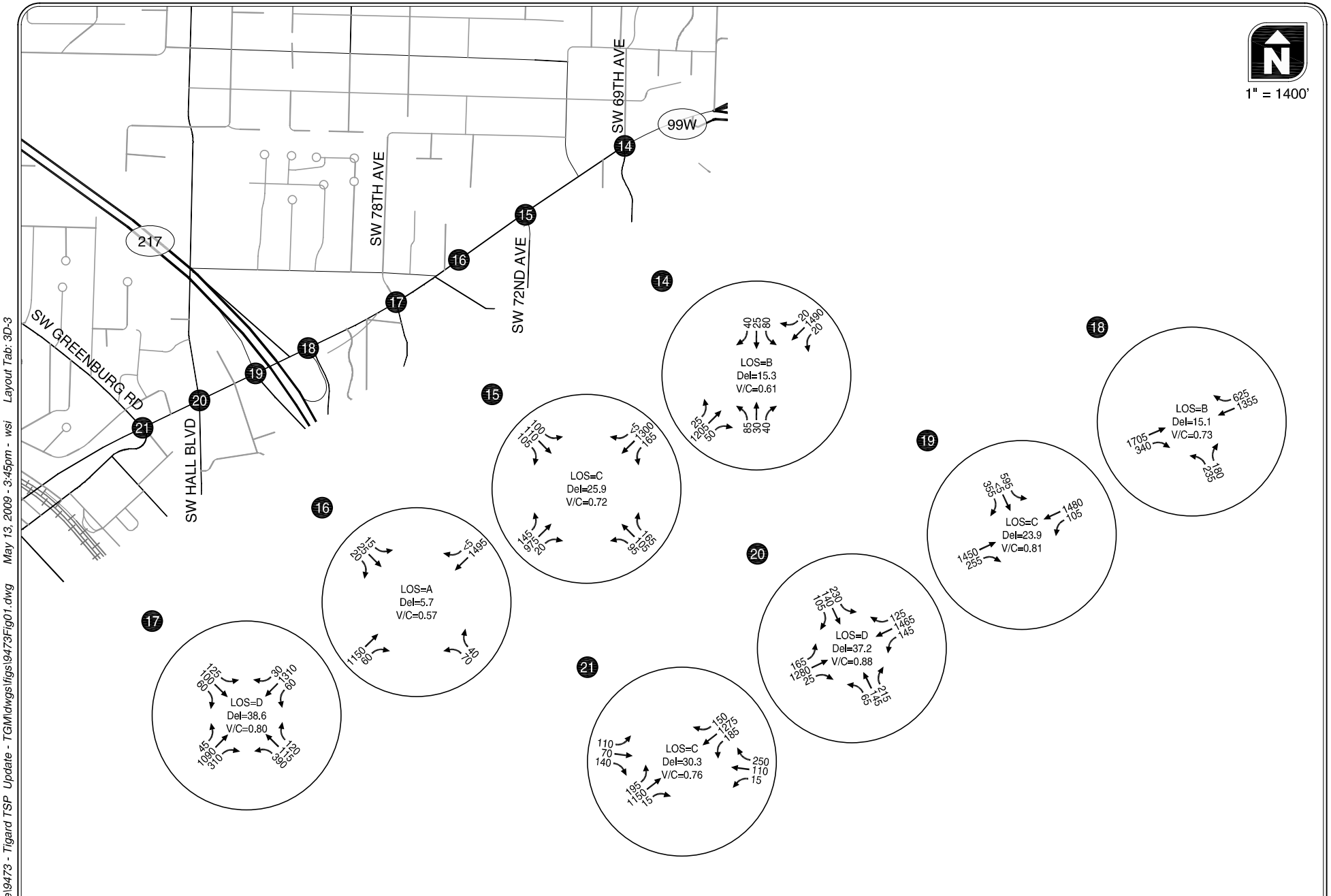


EXISTING TRAFFIC CONDITIONS, SATURDAY MIDDAY PEAK HOUR
SE WALNUT STREET
TIGARD, OREGON

FIGURE **3D-2**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 3:45pm - wsi Layout Tab: 3D-2

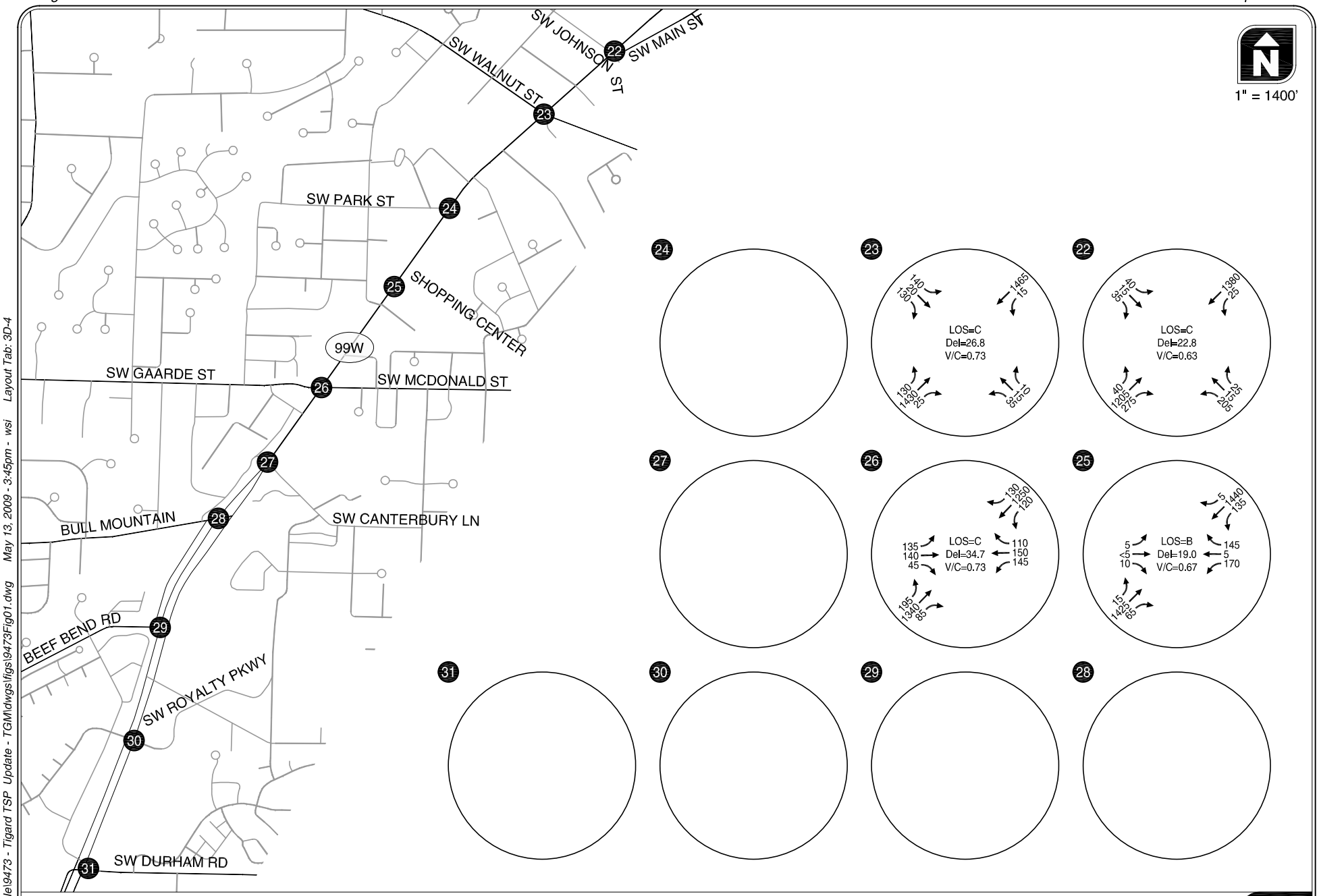


EXISTING TRAFFIC CONDITIONS, SATURDAY MIDDAY PEAK HOUR
OR-99W
TIGARD, OREGON

FIGURE **3D-3**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 3:45pm - wsi Layout Tab: 3D-3



EXISTING TRAFFIC CONDITIONS, SATURDAY MIDDAY PEAK HOUR
OR-99W
TIGARD, OREGON

FIGURE **3D-4**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

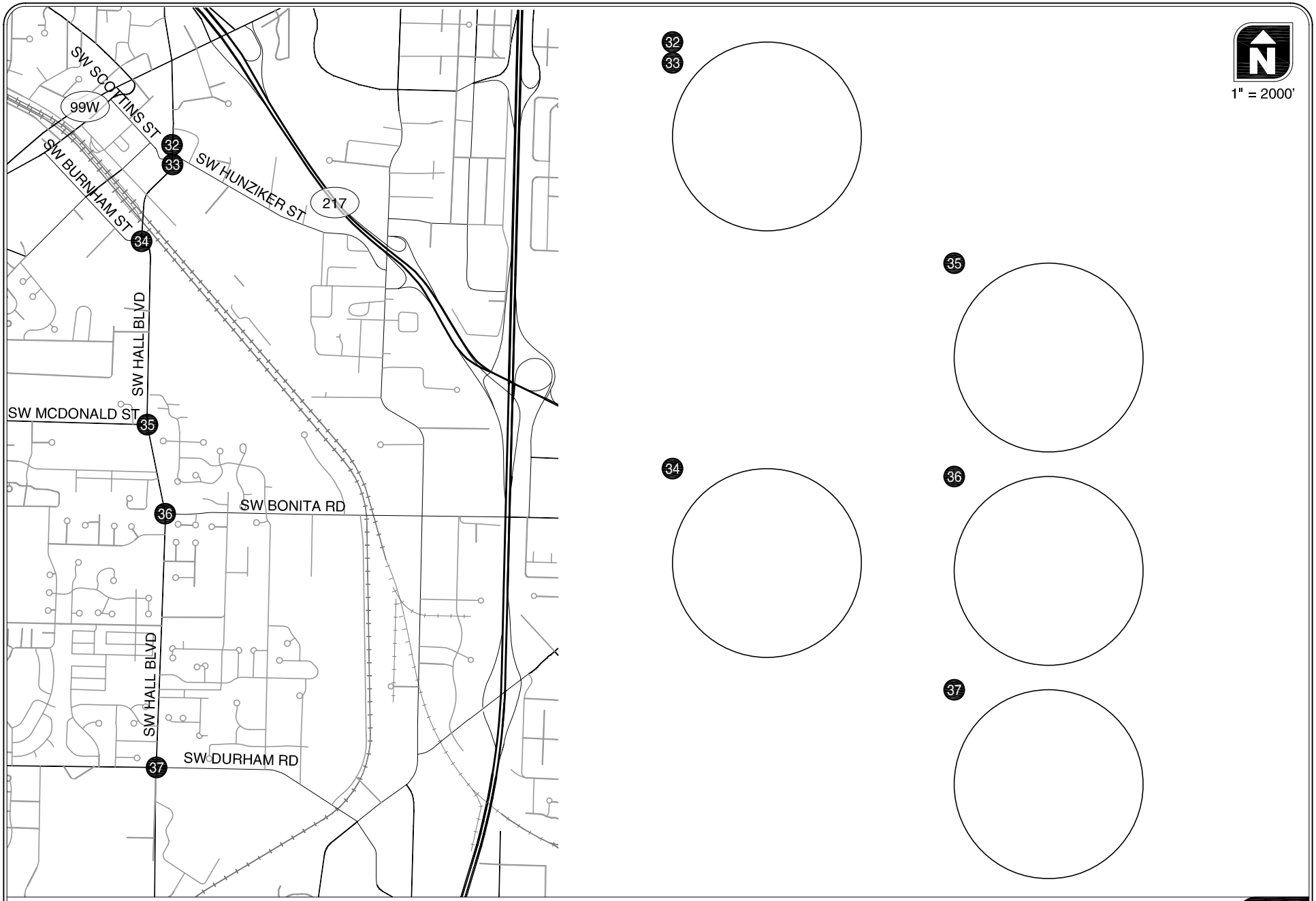
H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 3:45pm - wsi Layout Tab: 3D-4

EXISTING TRAFFIC CONDITIONS, SATURDAY MIDDAY PEAK HOUR
SW GREENBURG ROAD
TIGARD, OREGON

FIGURE **3D-5**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 3:45pm - wsi Layout Tab: 3D-5

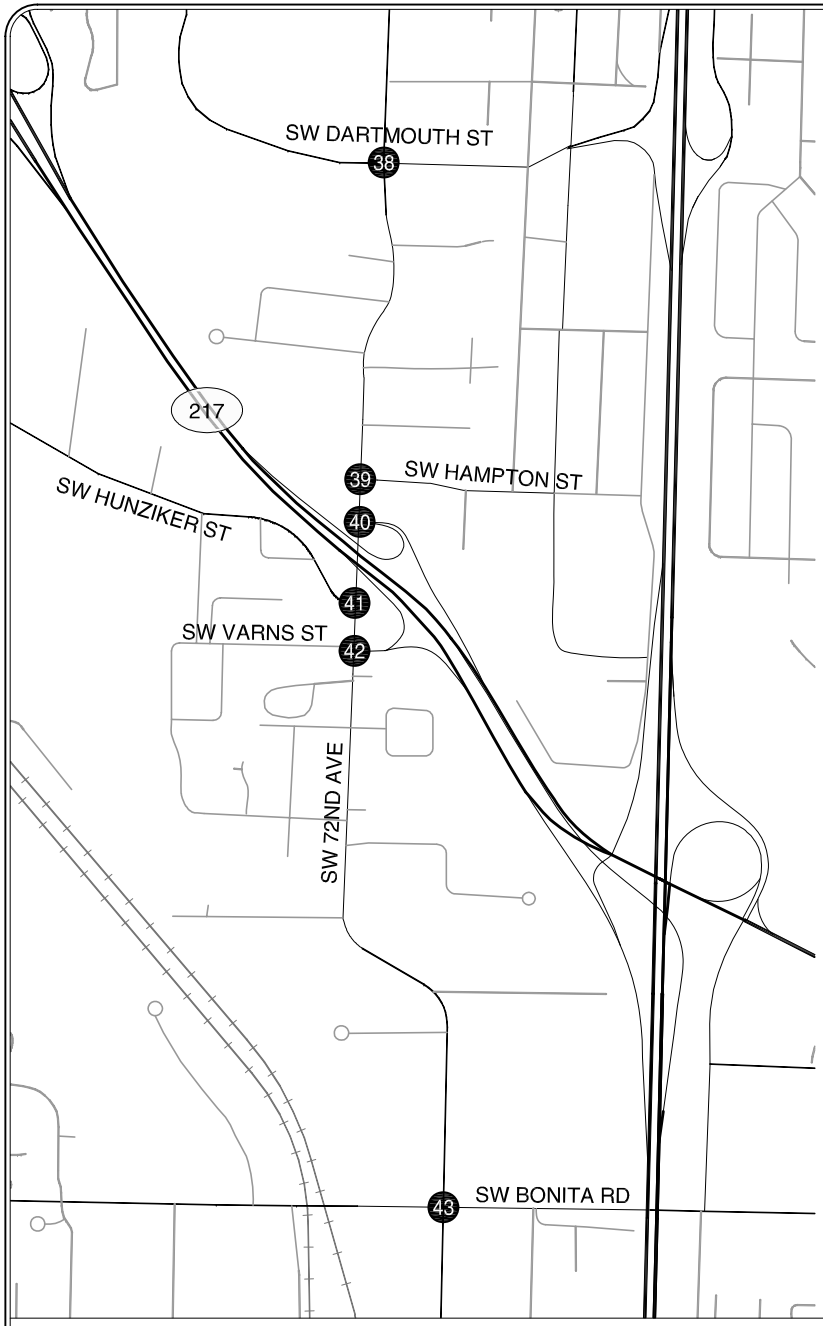


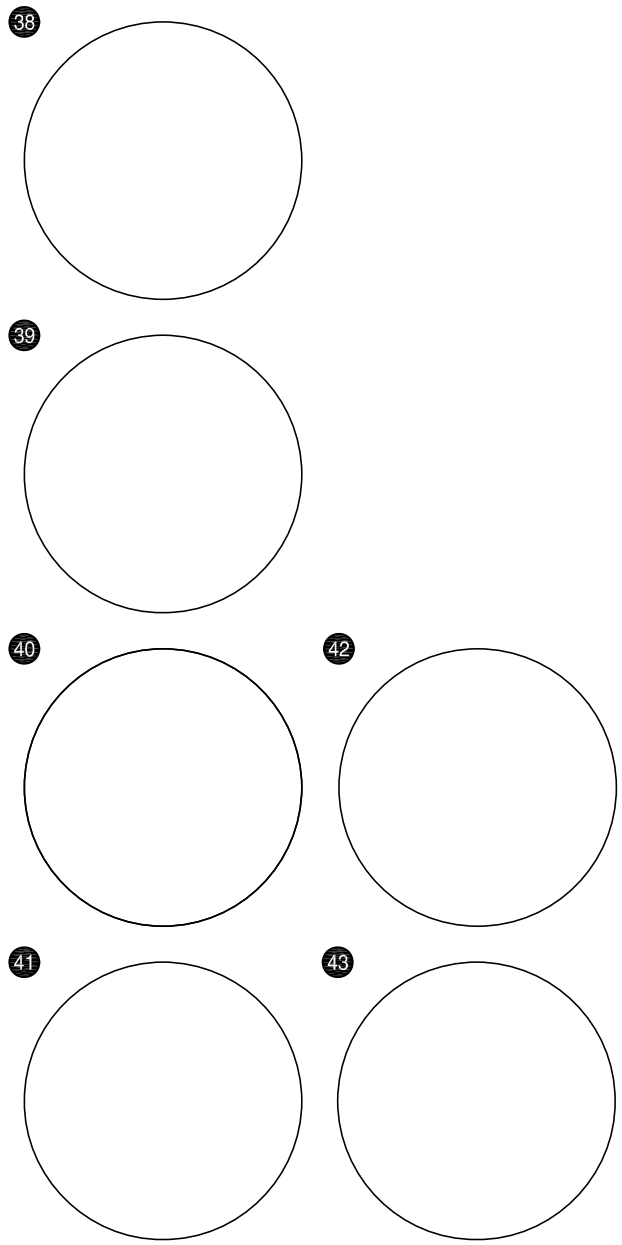
EXISTING TRAFFIC CONDITIONS, SATURDAY MIDDAY PEAK HOUR
SW HALL BLVD
TIGARD, OREGON

FIGURE **3D-6**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 4:18pm - wsi Layout Tab: 3D-6





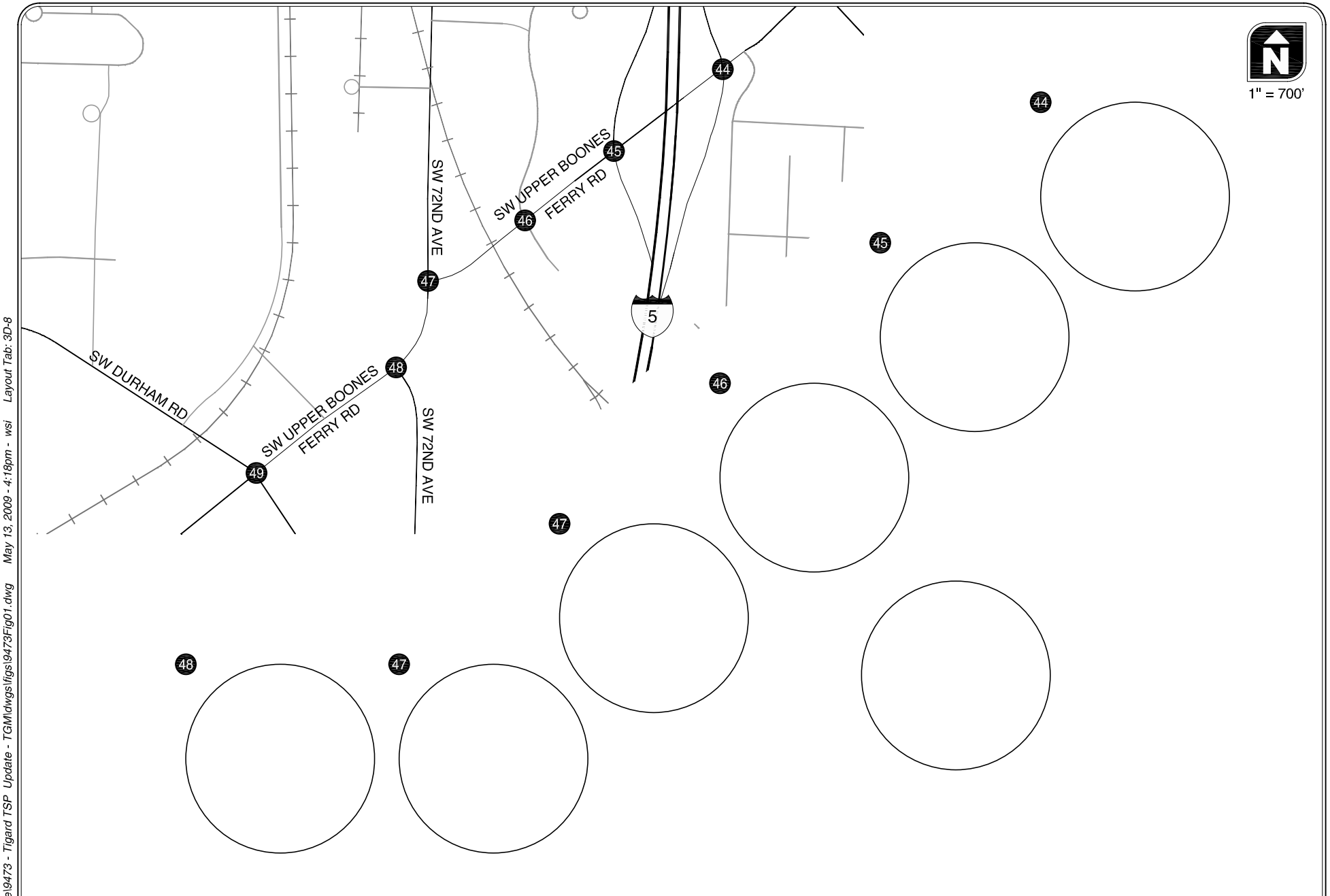
1" = 1200'

EXISTING TRAFFIC CONDITIONS, SATURDAY MIDDAY PEAK HOUR
SW 72ND AVE
TIGARD, OREGON

FIGURE **3D-7**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 4:18pm - wsi Layout Tab: 3D-7



EXISTING TRAFFIC CONDITIONS, SATURDAY MIDDAY PEAK HOUR
SW UPPER BOONES FERRY ROAD
TIGARD, OREGON

FIGURE **3D-8**

KITTELSON & ASSOCIATES, INC.
TRANSPORTATION ENGINEERING / PLANNING

H:\profile\9473 - Tigard TSP Update - TGM\dwgs\figs\9473Fig01.dwg May 13, 2009 - 4:18pm - wsi Layout Tab: 3D-8

SW Scholls Ferry Road

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
SW Scholls Ferry Rd. & OR 217 NB Ramp	WBL	125	175
	WBR	125	225
	NET	200	375
	SWT	100	150
SW Scholls Ferry Rd. & OR 217 SB Ramp	EBLT	25	75
	EBR	25	75
	NET	150	200
	NETR	150	200
	NER	75	175
	SWL	125	150
	SWT	125	325

SW Greenburg Road

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
SW Greenburg Rd & SW Hall Blvd. / SW Oleson Rd.	EBL	200	325
	EBT	200	400
	EBR	50	175
	WBL	50	100
	WBT	75	150
	WBTR	100	175
	NBL	100	200
	NBT	100	200
	NBR	50	75
	SBL	50	75
	SBT	175	300
	SBR	75	100
SW Greenburg Rd. & OR 217 NB Ramp	WBLT	225	275
	WBR	1150	1875
	NBL	175	200
	NBT	450	650
	SBT	1225	2375
	SBTR	1000	2225
SW Greenburg Rd. & OR 217 SB Ramp	EBLT	800	1625
	EBR	200	425
	NBT	225	475
	NBR	50	125
	SBL	475	575
	SBT	350	675

OR 99W

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
OR 99W & SW 68th Pkwy	NBL	100	175
	NBT	50	75
	NBR	50	75
	SBL	75	150
	SBTR	75	175
	NEL	50	100
	NET	250	500
	NETR	275	525
	SWL	25	75
	SWT	250	450
	SWTR	300	500
OR 99W & SW 72nd Ave.	SEL	75	125
	SETR	625	1350
	NWL	100	150
	NWT	150	425
	NWR	75	150
	NEL	125	225
	NET	150	275
	NER	25	50
	SWL	125	200
	SWT	400	675
	SWTR	425	675
OR 99W & SW 74th Ave.	SELTR	75	125
	NWL	50	100
	NWR	50	125
	NELT	100	225
	NETR	150	300
	SWLT	100	250
	SWTR	125	250
OR 99W & SW Dartmouth St.	EBL	75	125
	EBT	275	500
	EBR	100	225
	WBL	75	125
	WBT	275	475
	WBTR	325	550
	NBL	250	300
	NBTR	175	275
	SBL	125	225
	SBTR	125	225

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
OR 99W & OR 217 NB Ramp	EBT	375	720
	EBR	75	175
	WBT	225	450
	WBR	125	275
	NBL	1175	1850
	NBR	150	250
OR 99W & OR 217 SB Ramp	EBT	325	550
	EBR	50	125
	WBL	125	225
	WBT	375	650
	SBL	275	325
	SBLT	1100	1350
	SBR	250	350
OR 99W & SW Hall Blvd.	EBL	250	375
	EBT	425	725
	EBTR	450	750
	WBL	200	325
	WBT	325	625
	WBTR	225	475
	NBLT	275	325
	NBR	575	900
	SBL	950	1825
	SBTR	950	1800
OR 99W & SW Greenburg Rd.	EBL	200	250
	EBT	875	2075
	EBTR	825	2050
	WBL	150	225
	WBT	225	475
	WBR	25	125
	SELT	200	325
	SER	75	125
	NWLT	125	225
	NWR	175	275

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
OR 99W & SW Johnson St.	SELT	75	125
	SER	50	75
	NWL	50	125
	NWTR	25	75
	NEL	50	100
	NET	500	900
	NER	75	175
	SWL	25	125
	SWT	250	425
	SWR	25	75
OR 99W & SW Walnut St.	SEL	150	225
	SETR	175	375
	NWLTR	75	150
	NEL	125	200
	NET	325	575
	NETR	350	600
	SWL	25	75
	SWT	425	725
	SWR	25	75
OR 99W & Shopping Center Drwy	EBLR	25	75
	WBL	100	150
	WBLT	100	175
	WBR	100	150
	NEL	25	75
	NET	275	550
	NER	25	100
	SWL	100	125
	SWT	550	825
	SWTR	550	825

Location	Approach	Average Queue Storage (feet)	95th – Percentile Queue Storage (feet)
OR 99W & SW Gaarde St.	EBL	175	300
	EBT	275	600
	EBR	25	75
	WBL	175	325
	WBT	425	1050
	WBR	125	350
	NEL	400	550
	NET	375	650
	NETR	350	650
	SWL	125	175
	SWT	625	1050
	SWR	50	150

HCM Signalized Intersection Capacity Analysis
1: OR 217 NB Ramp & SW Scholls Ferry Rd

5/8/2009

Movement	WBL	WBR	NET	NER	SWL	SWT
Lane Configurations						
Volume (vph)	451	323	1122	0	0	732
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.5			4.5
Lane Util. Factor	0.97	1.00	0.95			0.95
Frpb, ped/bikes	1.00	0.98	1.00			1.00
Flpb, ped/bikes	1.00	1.00	1.00			1.00
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3467	1570	3574			3574
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3467	1570	3574			3574
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	485	347	1206	0	0	787
RTOR Reduction (vph)	0	41	0	0	0	0
Lane Group Flow (vph)	485	306	1206	0	0	787
Confl. Peds. (#/hr)	5	5		5	5	
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%
Turn Type		Perm				
Protected Phases	4		6			2
Permitted Phases		4				
Actuated Green, G (s)	16.8	16.8	40.3			40.3
Effective Green, g (s)	16.8	16.8	40.3			40.3
Actuated g/C Ratio	0.26	0.26	0.61			0.61
Clearance Time (s)	4.0	4.0	4.5			4.5
Vehicle Extension (s)	2.3	2.3	4.2			4.2
Lane Grp Cap (vph)	888	402	2196			2196
v/s Ratio Prot	0.14		c0.34			0.22
v/s Ratio Perm		c0.19				
v/c Ratio	0.55	0.76	0.55			0.36
Uniform Delay, d1	21.1	22.5	7.4			6.3
Progression Factor	1.00	1.00	1.00			1.00
Incremental Delay, d2	0.5	7.8	1.0			0.5
Delay (s)	21.6	30.3	8.4			6.7
Level of Service	C	C	A			A
Approach Delay (s)	25.2		8.4			6.7
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	12.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	65.6	Sum of lost time (s)	8.5
Intersection Capacity Utilization	63.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	19	0	37	0	0	0	0	1103	564	160	1028	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0					5.0	5.0	4.0	5.0	
Lane Util. Factor		1.00	1.00					0.91	0.91	1.00	0.95	
Frpb, ped/bikes		1.00	0.98					1.00	0.98	1.00	1.00	
Flpb, ped/bikes		0.99	1.00					1.00	1.00	1.00	1.00	
Frt		1.00	0.85					0.99	0.85	1.00	1.00	
Flt Protected		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1774	1568					3393	1427	1787	3574	
Flt Permitted		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1774	1568					3393	1427	1787	3574	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	21	0	40	0	0	0	0	1199	613	174	1117	0
RTOR Reduction (vph)	0	0	37	0	0	0	0	2	182	0	0	0
Lane Group Flow (vph)	0	21	3	0	0	0	0	1264	364	174	1117	0
Confl. Peds. (#/hr)	5		5						5	5		
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	1%	1%	1%	1%	1%	1%
Turn Type	Perm		Perm						Perm	Prot		
Protected Phases		8						6		5	2	
Permitted Phases	8		8						6			
Actuated Green, G (s)		7.7	7.7					65.0	65.0	14.3	83.3	
Effective Green, g (s)		7.7	7.7					65.0	65.0	14.3	83.3	
Actuated g/C Ratio		0.08	0.08					0.65	0.65	0.14	0.83	
Clearance Time (s)		4.0	4.0					5.0	5.0	4.0	5.0	
Vehicle Extension (s)		2.3	2.3					4.1	4.1	2.3	4.1	
Lane Grp Cap (vph)		137	121					2205	928	256	2977	
v/s Ratio Prot								c0.37		c0.10	0.31	
v/s Ratio Perm		0.01	0.00						0.25			
v/c Ratio		0.15	0.03					0.57	0.39	0.68	0.38	
Uniform Delay, d1		43.1	42.7					9.8	8.2	40.7	2.0	
Progression Factor		1.00	1.00					1.00	1.00	1.00	1.00	
Incremental Delay, d2		0.3	0.0					1.1	1.2	6.0	0.4	
Delay (s)		43.4	42.7					10.9	9.5	46.7	2.4	
Level of Service		D	D					B	A	D	A	
Approach Delay (s)		43.0			0.0			10.4			8.4	
Approach LOS		D			A			B			A	

Intersection Summary			
HCM Average Control Delay	10.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	63.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	94	1141	32	65	1686	60	109	19	118	382	31	387
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95	1.00		1.00	1.00	0.95	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.97		1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00	0.95	0.96	1.00
Satd. Flow (prot)	1770	3539	1556	1787	3574	1554		1782	1558	1676	1693	1558
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.55	1.00	0.67	0.67	1.00
Satd. Flow (perm)	1770	3539	1556	1787	3574	1554		1015	1558	1183	1178	1558
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	99	1201	34	68	1775	63	115	20	124	402	33	407
RTOR Reduction (vph)	0	0	20	0	0	21	0	0	93	0	0	126
Lane Group Flow (vph)	99	1201	14	68	1775	42	0	135	31	217	218	281
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	2%	2%	2%	2%	2%	2%
Turn Type	Prot		Perm	Prot		Perm	Perm		Perm	Perm		Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases			2			6	8		8	4		4
Actuated Green, G (s)	8.9	30.3	30.3	5.7	27.1	27.1		18.0	18.0	18.0	18.0	18.0
Effective Green, g (s)	8.9	30.3	30.3	5.7	27.1	27.1		18.0	18.0	18.0	18.0	18.0
Actuated g/C Ratio	0.12	0.42	0.42	0.08	0.38	0.38		0.25	0.25	0.25	0.25	0.25
Clearance Time (s)	6.0	6.0	6.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	6.0
Vehicle Extension (s)	2.4	3.1	3.1	2.6	3.1	3.1		1.6	1.6	1.6	1.6	1.6
Lane Grp Cap (vph)	219	1489	655	141	1345	585		254	390	296	295	390
v/s Ratio Prot	c0.06	c0.34		0.04	c0.50							
v/s Ratio Perm			0.01			0.03		0.13	0.02	0.18	c0.19	0.18
v/c Ratio	0.45	0.81	0.02	0.48	1.32	0.07		0.53	0.08	0.73	0.74	0.72
Uniform Delay, d1	29.3	18.3	12.2	31.7	22.4	14.4		23.4	20.7	24.8	24.8	24.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.0	4.8	0.1	2.0	149.2	0.2		1.1	0.0	7.8	8.1	5.5
Delay (s)	30.3	23.1	12.2	33.8	171.6	14.6		24.4	20.7	32.6	32.9	30.2
Level of Service	C	C	B	C	F	B		C	C	C	C	C
Approach Delay (s)		23.3			161.5			22.6			31.5	
Approach LOS		C			F			C			C	

Intersection Summary			
HCM Average Control Delay	85.6	HCM Level of Service	F
HCM Volume to Capacity ratio	1.12		
Actuated Cycle Length (s)	72.0	Sum of lost time (s)	24.0
Intersection Capacity Utilization	95.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	210	417	152	61	406	46	149	164	53	36	200	204
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.5	4.5	4.0	4.5		4.0	4.5	4.5	4.0	4.5	4.5
Lane Util. Factor	1.00	1.00	1.00	1.00	0.95		1.00	1.00	1.00	1.00	1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	1.00	0.98	1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1787	1881	1570	1787	3510		1787	1881	1570	1787	1881	1569
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1787	1881	1570	1787	3510		1787	1881	1570	1787	1881	1569
Peak-hour factor, PHF	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93
Adj. Flow (vph)	226	448	163	66	437	49	160	176	57	39	215	219
RTOR Reduction (vph)	0	0	87	0	7	0	0	0	42	0	0	180
Lane Group Flow (vph)	226	448	76	66	479	0	160	176	15	39	215	39
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Turn Type	Prot		Perm	Prot			Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases			2						8			4
Actuated Green, G (s)	16.4	45.1	45.1	7.1	35.8		13.1	25.9	25.9	4.9	17.7	17.7
Effective Green, g (s)	16.4	45.1	45.1	7.1	35.8		13.1	25.9	25.9	4.9	17.7	17.7
Actuated g/C Ratio	0.16	0.45	0.45	0.07	0.36		0.13	0.26	0.26	0.05	0.18	0.18
Clearance Time (s)	4.0	4.5	4.5	4.0	4.5		4.0	4.5	4.5	4.0	4.5	4.5
Vehicle Extension (s)	2.3	4.0	4.0	2.3	4.0		2.3	2.3	2.3	2.3	2.3	2.3
Lane Grp Cap (vph)	293	848	708	127	1257		234	487	407	88	333	278
v/s Ratio Prot	c0.13	c0.24		0.04	0.14		c0.09	0.09		0.02	c0.11	
v/s Ratio Perm			0.05						0.01			0.02
v/c Ratio	0.77	0.53	0.11	0.52	0.38		0.68	0.36	0.04	0.44	0.65	0.14
Uniform Delay, d1	40.0	19.8	15.8	44.8	23.9		41.5	30.3	27.7	46.2	38.2	34.7
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	11.2	2.4	0.3	2.2	0.9		7.0	0.3	0.0	2.1	3.5	0.1
Delay (s)	51.2	22.1	16.1	47.0	24.7		48.4	30.6	27.7	48.3	41.8	34.9
Level of Service	D	C	B	D	C		D	C	C	D	D	C
Approach Delay (s)		28.8			27.4			37.4			39.1	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM Average Control Delay	32.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	66.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	230	1	598	174	532	0	0	995	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)					4.0	4.0	4.0	4.5			4.5	
Lane Util. Factor					1.00	0.88	1.00	0.95			0.91	
Frpb, ped/bikes					1.00	0.97	1.00	1.00			1.00	
Flpb, ped/bikes					1.00	1.00	1.00	1.00			1.00	
Frt					1.00	0.85	1.00	1.00			1.00	
Flt Protected					0.95	1.00	0.95	1.00			1.00	
Satd. Flow (prot)					1801	2762	1787	3574			5136	
Flt Permitted					0.95	1.00	0.95	1.00			1.00	
Satd. Flow (perm)					1801	2762	1787	3574			5136	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	0	0	0	237	1	616	179	548	0	0	1026	0
RTOR Reduction (vph)	0	0	0	0	0	451	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	238	165	179	548	0	0	1026	0
Confl. Peds. (#/hr)				5		5	5					5
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	1%	1%	1%	1%	1%	1%
Turn Type				Perm		Perm	Prot					
Protected Phases					4		1	6			2	
Permitted Phases				4		4						
Actuated Green, G (s)					14.4	14.4	10.7	57.1			42.4	
Effective Green, g (s)					14.4	14.4	10.7	57.1			42.4	
Actuated g/C Ratio					0.18	0.18	0.13	0.71			0.53	
Clearance Time (s)					4.0	4.0	4.0	4.5			4.5	
Vehicle Extension (s)					0.2	0.2	0.2	0.2			0.2	
Lane Grp Cap (vph)					324	497	239	2551			2722	
v/s Ratio Prot							c0.10	0.15			c0.20	
v/s Ratio Perm					0.13	0.06						
v/c Ratio					0.73	0.33	0.75	0.21			0.38	
Uniform Delay, d1					31.0	28.6	33.4	3.9			11.0	
Progression Factor					1.00	1.00	0.85	1.29			1.00	
Incremental Delay, d2					7.2	0.1	10.2	0.2			0.4	
Delay (s)					38.2	28.7	38.6	5.2			11.4	
Level of Service					D	C	D	A			B	
Approach Delay (s)		0.0			31.4			13.4			11.4	
Approach LOS		A			C			B			B	

Intersection Summary			
HCM Average Control Delay	18.5	HCM Level of Service	B
HCM Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	54.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	197	2	279	0	0	0	0	509	242	530	695	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0					4.5	4.5	4.0	4.5	
Lane Util. Factor		1.00	1.00					0.95	1.00	0.97	0.95	
Frpb, ped/bikes		1.00	0.98					1.00	0.98	1.00	1.00	
Flpb, ped/bikes		1.00	1.00					1.00	1.00	1.00	1.00	
Frt		1.00	0.85					1.00	0.85	1.00	1.00	
Flt Protected		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1785	1573					3574	1569	3467	3574	
Flt Permitted		0.95	1.00					1.00	1.00	0.95	1.00	
Satd. Flow (perm)		1785	1573					3574	1569	3467	3574	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	203	2	288	0	0	0	0	525	249	546	716	0
RTOR Reduction (vph)	0	0	237	0	0	0	0	0	123	0	0	0
Lane Group Flow (vph)	0	205	51	0	0	0	0	525	126	546	716	0
Confl. Peds. (#/hr)	5		5						5	5		
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	1%	1%	1%	1%	1%	1%
Turn Type	Perm		Perm						Perm	Prot		
Protected Phases		8						6		5	2	
Permitted Phases	8		8						6			
Actuated Green, G (s)		11.8	11.8					40.4	40.4	15.3	59.7	
Effective Green, g (s)		11.8	11.8					40.4	40.4	15.3	59.7	
Actuated g/C Ratio		0.15	0.15					0.50	0.50	0.19	0.75	
Clearance Time (s)		4.0	4.0					4.5	4.5	4.0	4.5	
Vehicle Extension (s)		0.2	0.2					0.2	0.2	0.2	0.2	
Lane Grp Cap (vph)		263	232					1805	792	663	2667	
v/s Ratio Prot								c0.15		c0.16	0.20	
v/s Ratio Perm		0.11	0.03						0.08			
v/c Ratio		0.78	0.22					0.29	0.16	0.82	0.27	
Uniform Delay, d1		32.8	30.0					11.5	10.7	31.1	3.2	
Progression Factor		1.00	1.00					1.00	1.00	0.72	0.85	
Incremental Delay, d2		12.5	0.2					0.4	0.4	7.4	0.2	
Delay (s)		45.3	30.2					11.9	11.1	29.8	3.0	
Level of Service		D	C					B	B	C	A	
Approach Delay (s)		36.5			0.0			11.6			14.6	
Approach LOS		D			A			B			B	

Intersection Summary			
HCM Average Control Delay	17.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	54.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	86	28	40	78	25	42	27	1206	48	20	1490	22
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	5.0		4.0	5.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	0.99		1.00	1.00		1.00	1.00	
Flpb, ped/bikes	0.99	1.00	1.00	0.99	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	0.91		1.00	0.99		1.00	1.00	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1774	1881	1567	1756	1666		1770	3514		1770	3530	
Flt Permitted	0.66	1.00	1.00	0.74	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1237	1881	1567	1365	1666		1770	3514		1770	3530	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	91	29	42	82	26	44	28	1269	51	21	1568	23
RTOR Reduction (vph)	0	0	38	0	39	0	0	1	0	0	0	0
Lane Group Flow (vph)	91	29	4	82	31	0	28	1319	0	21	1591	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Turn Type	Perm		Perm	Perm			Prot			Prot		
Protected Phases		8			4		5	2		1	6	
Permitted Phases	8		8	4								
Actuated Green, G (s)	14.8	14.8	14.8	14.8	14.8		4.9	96.8		14.4	106.3	
Effective Green, g (s)	14.8	14.8	14.8	14.8	14.8		4.9	96.8		14.4	106.3	
Actuated g/C Ratio	0.11	0.11	0.11	0.11	0.11		0.04	0.70		0.10	0.76	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	5.0		4.0	5.0	
Vehicle Extension (s)	2.5	2.5	2.5	2.5	2.5		2.3	4.8		2.3	4.8	
Lane Grp Cap (vph)	132	200	167	145	177		62	2447		183	2700	
v/s Ratio Prot		0.02			0.02		0.02	c0.38		0.01	c0.45	
v/s Ratio Perm	c0.07		0.00	0.06								
v/c Ratio	0.69	0.14	0.03	0.57	0.17		0.45	0.54		0.11	0.59	
Uniform Delay, d1	59.9	56.4	55.6	59.0	56.5		65.7	10.3		56.5	7.0	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	12.9	0.2	0.0	4.1	0.3		3.0	0.9		0.2	1.0	
Delay (s)	72.7	56.6	55.7	63.1	56.9		68.8	11.1		56.7	8.0	
Level of Service	E	E	E	E	E		E	B		E	A	
Approach Delay (s)		65.4			60.2			12.3			8.6	
Approach LOS		E			E			B			A	

Intersection Summary			
HCM Average Control Delay	15.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	139.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	62.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	100	108	107	95	106	165	143	977	22	163	1298	39
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	5.0	5.0	4.0	5.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	0.95	1.00	0.97	0.95	
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.99	1.00	1.00	0.98	1.00	1.00	
Flpb, ped/bikes	0.99	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	0.93		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1761	1706		1780	1881	1580	1752	3505	1540	3433	3520	
Flt Permitted	0.60	1.00		0.31	1.00	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1115	1706		574	1881	1580	1752	3505	1540	3433	3520	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	103	111	110	98	109	170	147	1007	23	168	1338	40
RTOR Reduction (vph)	0	31	0	0	0	70	0	0	8	0	2	0
Lane Group Flow (vph)	103	190	0	98	109	100	147	1007	15	168	1376	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	2%	2%	2%	1%	1%	1%	3%	3%	3%	2%	2%	2%
Turn Type	Perm			Perm		pm+ov	Prot		Perm	Prot		
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases	4			8		8			2			
Actuated Green, G (s)	19.8	19.8		19.8	19.8	30.3	17.0	76.7	76.7	10.5	70.2	
Effective Green, g (s)	19.8	19.8		19.8	19.8	30.3	17.0	76.7	76.7	10.5	70.2	
Actuated g/C Ratio	0.16	0.16		0.16	0.16	0.25	0.14	0.64	0.64	0.09	0.59	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	5.0	5.0	4.0	5.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5	2.3	2.3	4.8	4.8	2.3	4.8	
Lane Grp Cap (vph)	184	281		95	310	452	248	2240	984	300	2059	
v/s Ratio Prot		0.11			0.06	0.02	c0.08	0.29		0.05	c0.39	
v/s Ratio Perm	0.09			c0.17		0.04			0.01			
v/c Ratio	0.56	0.68		1.03	0.35	0.22	0.59	0.45	0.01	0.56	0.67	
Uniform Delay, d1	46.1	47.1		50.1	44.4	35.5	48.3	11.0	7.9	52.5	17.0	
Progression Factor	1.00	1.00		1.00	1.00	1.00	0.70	0.47	0.32	1.00	1.00	
Incremental Delay, d2	2.9	5.7		101.2	0.5	0.1	2.6	0.6	0.0	1.7	1.7	
Delay (s)	49.0	52.8		151.3	44.9	35.6	36.6	5.8	2.5	54.3	18.7	
Level of Service	D	D		F	D	D	D	A	A	D	B	
Approach Delay (s)		51.6			68.4			9.6			22.6	
Approach LOS		D			E			A			C	

Intersection Summary			
HCM Average Control Delay	25.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	77.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	16	23	22	72	0	41	1	1148	60	3	1497	2
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0		4.0		5.0			5.0	
Lane Util. Factor		1.00		0.97		1.00		0.95			0.95	
Frpb, ped/bikes		0.99		1.00		0.98		1.00			1.00	
Flpb, ped/bikes		0.99		1.00		1.00		1.00			1.00	
Frt		0.95		1.00		0.85		0.99			1.00	
Flt Protected		0.99		0.95		1.00		1.00			1.00	
Satd. Flow (prot)		1731		3502		1583		3474			3538	
Flt Permitted		0.99		0.95		1.00		0.95			0.95	
Satd. Flow (perm)		1731		3502		1583		3315			3373	
Peak-hour factor, PHF	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Adj. Flow (vph)	17	24	23	75	0	43	1	1196	62	3	1559	2
RTOR Reduction (vph)	0	19	0	0	0	37	0	2	0	0	0	0
Lane Group Flow (vph)	0	45	0	75	0	6	0	1257	0	0	1564	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	1%	1%	1%	0%	0%	0%	3%	3%	3%	2%	2%	2%
Turn Type	Perm			Prot		custom	Perm			Perm		
Protected Phases		4		3				2			6	
Permitted Phases	4					8	2			6		
Actuated Green, G (s)		7.0		6.2		17.2		93.8			93.8	
Effective Green, g (s)		7.0		6.2		17.2		93.8			93.8	
Actuated g/C Ratio		0.06		0.05		0.14		0.78			0.78	
Clearance Time (s)		4.0		4.0		4.0		5.0			5.0	
Vehicle Extension (s)		2.3		2.3		2.3		4.8			4.8	
Lane Grp Cap (vph)		101		181		227		2591			2637	
v/s Ratio Prot				c0.02								
v/s Ratio Perm		0.03				0.00		0.38			c0.46	
v/c Ratio		0.45		0.41		0.03		0.49			0.59	
Uniform Delay, d1		54.6		55.1		44.2		4.6			5.3	
Progression Factor		1.00		1.00		1.00		0.65			0.24	
Incremental Delay, d2		1.8		0.9		0.0		0.5			0.7	
Delay (s)		56.5		56.0		44.2		3.5			2.0	
Level of Service		E		E		D		A			A	
Approach Delay (s)		56.5			51.7			3.5			2.0	
Approach LOS		E			D			A			A	

Intersection Summary			
HCM Average Control Delay	5.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	61.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	47	1092	309	62	1308	31	389	117	121	127	102	62
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0	5.0	4.0	5.0		4.5	4.5		4.5	3.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		0.97	1.00		1.00	1.00	
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00		1.00	0.99		1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		0.99	1.00		1.00	1.00	
Frt	1.00	1.00	0.85	1.00	1.00		1.00	0.92		1.00	0.94	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	3539	1552	1770	3524		3467	1736		1787	1762	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.65	1.00		0.95	1.00	
Satd. Flow (perm)	1770	3539	1552	1770	3524		2377	1736		1787	1762	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	48	1114	315	63	1335	32	397	119	123	130	104	63
RTOR Reduction (vph)	0	0	160	0	1	0	0	31	0	0	18	0
Lane Group Flow (vph)	48	1114	155	63	1366	0	397	211	0	130	149	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Turn Type	Prot		Perm	Prot			Perm			Prot		
Protected Phases	5	2		1	6			8		7	4	
Permitted Phases			2				8					
Actuated Green, G (s)	6.8	59.2	59.2	12.8	65.2		18.0	18.0		12.0	36.0	
Effective Green, g (s)	6.8	59.2	59.2	12.8	65.2		18.0	18.0		12.0	36.0	
Actuated g/C Ratio	0.06	0.49	0.49	0.11	0.54		0.15	0.15		0.10	0.30	
Clearance Time (s)	4.0	5.0	5.0	4.0	5.0		4.5	4.5		4.5	3.0	
Vehicle Extension (s)	2.3	4.8	4.8	2.3	4.8		2.3	2.3		2.3	0.5	
Lane Grp Cap (vph)	100	1746	766	189	1915		357	260		179	529	
v/s Ratio Prot	0.03	c0.31		0.04	c0.39			0.12		c0.07	0.08	
v/s Ratio Perm			0.10				c0.17					
v/c Ratio	0.48	0.64	0.20	0.33	0.71		1.11	0.81		0.73	0.28	
Uniform Delay, d1	54.9	22.5	17.1	49.6	20.4		51.0	49.4		52.4	32.1	
Progression Factor	1.17	0.98	3.35	0.70	0.49		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.5	1.3	0.4	0.5	1.9		81.4	16.8		12.4	0.1	
Delay (s)	65.8	23.3	57.9	35.1	12.0		132.4	66.2		64.8	32.2	
Level of Service	E	C	E	D	B		F	E		E	C	
Approach Delay (s)		32.0			13.1			107.3			46.5	
Approach LOS		C			B			F			D	

Intersection Summary			
HCM Average Control Delay	38.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	77.2%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1703	342	0	1357	624	233	0	182	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0		5.0	5.0	4.0		4.0			
Lane Util. Factor		0.95	1.00		0.95	1.00	1.00		1.00			
Frpb, ped/bikes		1.00	0.98		1.00	0.98	1.00		0.98			
Flpb, ped/bikes		1.00	1.00		1.00	1.00	0.99		1.00			
Frt		1.00	0.85		1.00	0.85	1.00		0.85			
Flt Protected		1.00	1.00		1.00	1.00	0.95		1.00			
Satd. Flow (prot)		3539	1546		3539	1546	1756		1553			
Flt Permitted		1.00	1.00		1.00	1.00	0.95		1.00			
Satd. Flow (perm)		3539	1546		3539	1546	1756		1553			
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	0	1738	349	0	1385	637	238	0	186	0	0	0
RTOR Reduction (vph)	0	0	48	0	0	203	0	0	153	0	0	0
Lane Group Flow (vph)	0	1738	301	0	1385	434	238	0	33	0	0	0
Confl. Peds. (#/hr)			5	5		5	5		5			
Turn Type			Perm			Perm	custom		custom			
Protected Phases		2			6							
Permitted Phases			2			6	4		4			
Actuated Green, G (s)		81.8	81.8		81.8	81.8	21.2		21.2			
Effective Green, g (s)		81.8	81.8		81.8	81.8	21.2		21.2			
Actuated g/C Ratio		0.68	0.68		0.68	0.68	0.18		0.18			
Clearance Time (s)		5.0	5.0		5.0	5.0	4.0		4.0			
Vehicle Extension (s)		4.8	4.8		4.8	4.8	2.3		2.3			
Lane Grp Cap (vph)		2412	1054		2412	1054	310		274			
v/s Ratio Prot		c0.49			0.39							
v/s Ratio Perm			0.19			0.28	c0.14		0.02			
v/c Ratio		0.72	0.29		0.57	0.41	0.77		0.12			
Uniform Delay, d1		11.9	7.6		10.0	8.5	47.1		41.6			
Progression Factor		1.25	1.26		0.70	0.82	1.00		1.00			
Incremental Delay, d2		1.2	0.4		0.7	0.8	10.2		0.1			
Delay (s)		16.2	10.0		7.7	7.8	57.2		41.7			
Level of Service		B	A		A	A	E		D			
Approach Delay (s)		15.1			7.7			50.4			0.0	
Approach LOS		B			A			D			A	

Intersection Summary			
HCM Average Control Delay	15.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	67.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1450	253	104	1482	0	0	0	0	595	1	355
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.0	5.0	4.0	5.0					4.0	4.0	4.0
Lane Util. Factor		0.95	1.00	1.00	0.95					0.95	0.95	1.00
Frpb, ped/bikes		1.00	0.97	1.00	1.00					1.00	1.00	0.98
Flpb, ped/bikes		1.00	1.00	1.00	1.00					0.99	0.99	1.00
Frt		1.00	0.85	1.00	1.00					1.00	1.00	0.85
Flt Protected		1.00	1.00	0.95	1.00					0.95	0.95	1.00
Satd. Flow (prot)		3539	1528	1770	3539					1687	1692	1570
Flt Permitted		1.00	1.00	0.95	1.00					0.95	0.95	1.00
Satd. Flow (perm)		3539	1528	1770	3539					1687	1692	1570
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	0	1526	266	109	1560	0	0	0	0	626	1	374
RTOR Reduction (vph)	0	0	37	0	0	0	0	0	0	0	0	36
Lane Group Flow (vph)	0	1526	229	109	1560	0	0	0	0	313	314	338
Confl. Peds. (#/hr)			5	5						5		5
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	2%	2%	2%	1%	1%	1%
Turn Type			Perm	Prot						Perm		Perm
Protected Phases		2		1	6						4	
Permitted Phases			2							4		4
Actuated Green, G (s)		67.6	67.6	11.1	82.7					28.3	28.3	28.3
Effective Green, g (s)		67.6	67.6	11.1	82.7					28.3	28.3	28.3
Actuated g/C Ratio		0.56	0.56	0.09	0.69					0.24	0.24	0.24
Clearance Time (s)		5.0	5.0	4.0	5.0					4.0	4.0	4.0
Vehicle Extension (s)		4.8	4.8	2.5	4.8					2.3	2.3	2.3
Lane Grp Cap (vph)		1994	861	164	2439					398	399	370
v/s Ratio Prot		c0.43		0.06	c0.44							
v/s Ratio Perm			0.15							0.19	0.19	c0.22
v/c Ratio		0.77	0.27	0.66	0.64					0.79	0.79	0.91
Uniform Delay, d1		20.1	13.5	52.7	10.4					43.0	43.0	44.7
Progression Factor		0.46	0.50	0.92	1.31					1.00	1.00	1.00
Incremental Delay, d2		1.6	0.4	7.3	1.1					9.4	9.4	26.1
Delay (s)		10.8	7.2	56.0	14.6					52.4	52.4	70.8
Level of Service		B	A	E	B					D	D	E
Approach Delay (s)		10.2			17.3			0.0			59.3	
Approach LOS		B			B			A			E	

Intersection Summary			
HCM Average Control Delay	23.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	74.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	165	1281	24	147	1467	125	66	143	217	232	139	106
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0			4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.91			1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	0.98	1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00	1.00	1.00	1.00	
Frt	1.00	1.00		1.00	0.99			1.00	0.85	1.00	0.94	
Flt Protected	0.95	1.00		0.95	1.00			0.98	1.00	0.95	1.00	
Satd. Flow (prot)	1736	3459		1687	4777			1765	1489	1736	1694	
Flt Permitted	0.95	1.00		0.95	1.00			0.98	1.00	0.95	1.00	
Satd. Flow (perm)	1736	3459		1687	4777			1765	1489	1736	1694	
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	170	1321	25	152	1512	129	68	147	224	239	143	109
RTOR Reduction (vph)	0	1	0	0	8	0	0	0	192	0	23	0
Lane Group Flow (vph)	170	1345	0	152	1633	0	0	215	32	239	229	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	4%	4%	4%	7%	7%	7%	6%	6%	6%	4%	4%	4%
Turn Type	Prot			Prot			Split		Perm	Split		
Protected Phases	5	2		1	6		8	8		4	4	
Permitted Phases									8			
Actuated Green, G (s)	16.0	56.0		14.1	54.1			16.9	16.9	16.0	16.0	
Effective Green, g (s)	16.0	56.0		14.1	54.1			16.9	16.9	16.0	16.0	
Actuated g/C Ratio	0.13	0.47		0.12	0.45			0.14	0.14	0.13	0.13	
Clearance Time (s)	4.0	5.0		4.0	5.0			4.0	4.0	4.0	4.0	
Vehicle Extension (s)	2.3	4.8		2.3	4.8			2.3	2.3	2.3	2.3	
Lane Grp Cap (vph)	231	1614		198	2154			249	210	231	226	
v/s Ratio Prot	0.10	c0.39		0.09	c0.34			c0.12		c0.14	0.14	
v/s Ratio Perm									0.02			
v/c Ratio	0.74	0.83		0.77	0.76			0.86	0.15	1.03	1.02	
Uniform Delay, d1	50.0	27.9		51.4	27.5			50.4	45.2	52.0	52.0	
Progression Factor	0.65	0.38		1.22	0.73			1.00	1.00	1.00	1.00	
Incremental Delay, d2	7.8	3.8		11.4	1.9			24.8	0.2	68.5	63.9	
Delay (s)	40.1	14.3		73.9	22.0			75.2	45.4	120.5	115.9	
Level of Service	D	B		E	C			E	D	F	F	
Approach Delay (s)		17.2			26.4			60.0			118.1	
Approach LOS		B			C			E			F	

Intersection Summary			
HCM Average Control Delay	37.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	84.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Volume (vph)	197	1152	16	185	1277	150	108	68	142	16	109	248
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	5.0		4.0	5.0	5.0		4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95		1.00	0.95	1.00		1.00	1.00		1.00	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00	0.98		1.00	0.98		1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00		1.00	1.00		1.00	1.00
Frt	1.00	1.00		1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00		0.97	1.00		0.99	1.00
Satd. Flow (prot)	1787	3566		1770	3539	1547		1790	1536		1833	1538
Flt Permitted	0.95	1.00		0.95	1.00	1.00		0.97	1.00		0.99	1.00
Satd. Flow (perm)	1787	3566		1770	3539	1547		1790	1536		1833	1538
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	203	1188	16	191	1316	155	111	70	146	16	112	256
RTOR Reduction (vph)	0	1	0	0	0	66	0	0	126	0	0	231
Lane Group Flow (vph)	203	1203	0	191	1316	89	0	181	20	0	128	25
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	1%	1%	1%	2%	2%	2%	3%	3%	3%	3%	3%	3%
Turn Type	Prot			Prot		Perm	Split		Perm	Split		Perm
Protected Phases	5	2		1	6		4	4		8	8	
Permitted Phases						6			4			8
Actuated Green, G (s)	17.1	58.1		17.1	58.1	58.1		16.3	16.3		11.5	11.5
Effective Green, g (s)	17.1	58.1		17.1	58.1	58.1		16.3	16.3		11.5	11.5
Actuated g/C Ratio	0.14	0.48		0.14	0.48	0.48		0.14	0.14		0.10	0.10
Clearance Time (s)	4.0	5.0		4.0	5.0	5.0		4.0	4.0		4.0	4.0
Vehicle Extension (s)	2.3	4.8		2.3	4.8	4.8		2.3	2.3		2.3	2.3
Lane Grp Cap (vph)	255	1727		252	1713	749		243	209		176	147
v/s Ratio Prot	c0.11	0.34		0.11	c0.37			c0.10			c0.07	
v/s Ratio Perm						0.06			0.01			0.02
v/c Ratio	0.80	0.70		0.76	0.77	0.12		0.74	0.09		0.73	0.17
Uniform Delay, d1	49.8	24.1		49.5	25.4	16.9		49.9	45.4		52.7	49.8
Progression Factor	1.08	0.30		0.72	0.47	0.23		1.00	1.00		1.23	2.82
Incremental Delay, d2	11.9	1.8		7.1	1.5	0.1		10.8	0.1		12.4	0.3
Delay (s)	65.8	9.1		43.0	13.5	4.0		60.7	45.5		77.1	140.8
Level of Service	E	A		D	B	A		E	D		E	F
Approach Delay (s)		17.3			16.0			53.9			119.5	
Approach LOS		B			B			D			F	

Intersection Summary			
HCM Average Control Delay	30.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	73.5%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	38	13	36	207	13	23	38	1203	274	23	1380	30
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0	4.0	4.0		4.0	5.0	5.0	4.0	5.0	5.0
Lane Util. Factor		1.00	1.00	0.97	1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes		1.00	0.98	1.00	0.99		1.00	1.00	0.98	1.00	1.00	0.96
Flpb, ped/bikes		1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt		1.00	0.85	1.00	0.90		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1813	1567	3400	1647		1770	3539	1554	1770	3539	1521
Flt Permitted		0.96	1.00	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		1813	1567	3400	1647		1770	3539	1554	1770	3539	1521
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	39	13	37	213	13	24	39	1240	282	24	1423	31
RTOR Reduction (vph)	0	0	34	0	17	0	0	0	81	0	0	8
Lane Group Flow (vph)	0	52	3	213	20	0	39	1240	201	24	1423	23
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	1%	1%	1%	3%	3%	3%	2%	2%	2%	2%	2%	2%
Turn Type	Split		Perm	Split			Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			4						2			6
Actuated Green, G (s)		8.3	8.3	34.4	34.4		5.2	56.7	56.7	3.6	55.1	55.1
Effective Green, g (s)		8.3	8.3	34.4	34.4		5.2	56.7	56.7	3.6	55.1	55.1
Actuated g/C Ratio		0.07	0.07	0.29	0.29		0.04	0.47	0.47	0.03	0.46	0.46
Clearance Time (s)		4.0	4.0	4.0	4.0		4.0	5.0	5.0	4.0	5.0	5.0
Vehicle Extension (s)		2.3	2.3	2.3	2.3		2.3	4.8	4.8	2.3	4.8	4.8
Lane Grp Cap (vph)		125	108	975	472		77	1672	734	53	1625	698
v/s Ratio Prot		c0.03		c0.06	0.01		0.02	c0.35		0.01	c0.40	
v/s Ratio Perm			0.00						0.13			0.02
v/c Ratio		0.42	0.02	0.22	0.04		0.51	0.74	0.27	0.45	0.88	0.03
Uniform Delay, d1		53.5	52.1	32.6	30.9		56.1	25.7	19.2	57.2	29.4	17.8
Progression Factor		1.00	1.00	0.34	0.42		1.00	1.00	1.00	0.68	0.44	0.79
Incremental Delay, d2		1.3	0.1	0.4	0.1		3.0	3.0	0.9	2.4	4.2	0.0
Delay (s)		54.8	52.1	11.5	13.2		59.2	28.7	20.1	41.5	17.1	14.1
Level of Service		D	D	B	B		E	C	C	D	B	B
Approach Delay (s)		53.7			11.7			27.9			17.4	
Approach LOS		D			B			C			B	

Intersection Summary			
HCM Average Control Delay	22.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	69.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	140	20	128	34	15	8	128	1432	23	17	1466	90
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0		4.0	5.0		4.0	5.0	5.0
Lane Util. Factor	1.00	1.00			1.00		1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	0.98			0.99		1.00	1.00		1.00	1.00	0.96
Flpb, ped/bikes	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.87			0.98		1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00			0.97		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1787	1606			1781		1770	3529		1770	3539	1515
Flt Permitted	0.95	1.00			0.97		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1787	1606			1781		1770	3529		1770	3539	1515
Peak-hour factor, PHF	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Adj. Flow (vph)	149	21	136	36	16	9	136	1523	24	18	1560	96
RTOR Reduction (vph)	0	120	0	0	5	0	0	1	0	0	0	10
Lane Group Flow (vph)	149	37	0	0	56	0	136	1546	0	18	1560	86
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	2%	2%	2%	2%	2%	2%
Turn Type	Split			Split			Prot			Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases												6
Actuated Green, G (s)	16.0	16.0			8.1		21.5	95.8		3.1	77.4	77.4
Effective Green, g (s)	16.0	16.0			8.1		21.5	95.8		3.1	77.4	77.4
Actuated g/C Ratio	0.11	0.11			0.06		0.15	0.68		0.02	0.55	0.55
Clearance Time (s)	4.0	4.0			4.0		4.0	5.0		4.0	5.0	5.0
Vehicle Extension (s)	2.3	2.3			2.3		2.3	4.8		2.3	4.8	4.8
Lane Grp Cap (vph)	204	184			103		272	2415		39	1957	838
v/s Ratio Prot	c0.08	0.02			c0.03		0.08	c0.44		0.01	c0.44	
v/s Ratio Perm												0.06
v/c Ratio	0.73	0.20			0.55		0.50	0.64		0.46	0.80	0.10
Uniform Delay, d1	59.9	56.2			64.2		54.3	12.4		67.6	25.0	14.8
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	11.5	0.3			4.0		0.8	1.3		5.0	3.5	0.2
Delay (s)	71.5	56.5			68.2		55.2	13.7		72.6	28.5	15.1
Level of Service	E	E			E		E	B		E	C	B
Approach Delay (s)		63.8			68.2			17.1			28.2	
Approach LOS		E			E			B			C	

Intersection Summary			
HCM Average Control Delay	26.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	13.0
Intersection Capacity Utilization	78.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	4	0	12	168	3	144	15	1423	66	135	1438	4
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0	4.0	4.0	5.0	5.0	4.0	5.0	
Lane Util. Factor		1.00		0.95	0.95	1.00	1.00	0.95	1.00	1.00	0.95	
Frpb, ped/bikes		0.96		1.00	1.00	0.98	1.00	1.00	0.97	1.00	1.00	
Flpb, ped/bikes		1.00		0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	
Frt		0.90		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	
Flt Protected		0.99		0.95	0.95	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)		1490		1702	1710	1584	1770	3539	1531	1770	3538	
Flt Permitted		0.62		0.75	0.72	1.00	0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)		931		1337	1292	1584	1770	3539	1531	1770	3538	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	4	0	13	177	3	152	16	1498	69	142	1514	4
RTOR Reduction (vph)	0	13	0	0	0	136	0	0	15	0	0	0
Lane Group Flow (vph)	0	4	0	90	90	16	16	1498	54	142	1518	0
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	8%	8%	8%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Perm			Perm		Perm	Prot		Perm	Prot		
Protected Phases		7			8		5	2		1	6	
Permitted Phases	7			8		8			2			
Actuated Green, G (s)		4.0		12.3	12.3	12.3	4.4	73.6	73.6	13.1	82.3	
Effective Green, g (s)		4.0		12.3	12.3	12.3	4.4	73.6	73.6	13.1	82.3	
Actuated g/C Ratio		0.03		0.10	0.10	0.10	0.04	0.61	0.61	0.11	0.69	
Clearance Time (s)		4.0		4.0	4.0	4.0	4.0	5.0	5.0	4.0	5.0	
Vehicle Extension (s)		4.8		2.3	2.3	2.3	2.3	4.8	4.8	2.3	2.3	
Lane Grp Cap (vph)		31		137	132	162	65	2171	939	193	2426	
v/s Ratio Prot							0.01	c0.42		c0.08	0.43	
v/s Ratio Perm		c0.00		0.07	c0.07	0.01			0.04			
v/c Ratio		0.14		0.66	0.68	0.10	0.25	0.69	0.06	0.74	0.63	
Uniform Delay, d1		56.3		51.8	52.0	48.8	56.2	15.6	9.3	51.8	10.4	
Progression Factor		1.00		1.00	1.00	1.00	0.84	0.79	1.23	1.00	1.00	
Incremental Delay, d2		4.1		9.2	11.9	0.2	0.7	1.2	0.1	12.4	1.2	
Delay (s)		60.4		61.0	63.8	49.0	48.1	13.4	11.5	64.2	11.6	
Level of Service		E		E	E	D	D	B	B	E	B	
Approach Delay (s)		60.4			56.3			13.7			16.1	
Approach LOS		E			E			B			B	

Intersection Summary			
HCM Average Control Delay	19.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.67		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	70.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	136	142	46	145	148	110	194	1340	84	119	1252	132
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	5.0		4.0	5.0	5.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95		1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00	0.98	1.00	1.00	0.97	1.00	1.00		1.00	1.00	0.97
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1787	1881	1568	1787	1881	1557	1770	3501		1752	3505	1515
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1787	1881	1568	1787	1881	1557	1770	3501		1752	3505	1515
Peak-hour factor, PHF	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
Adj. Flow (vph)	140	146	47	149	153	113	200	1381	87	123	1291	136
RTOR Reduction (vph)	0	0	42	0	0	102	0	3	0	0	0	36
Lane Group Flow (vph)	140	146	5	149	153	11	200	1465	0	123	1291	100
Confl. Peds. (#/hr)	5		5	5		5	5		5	5		5
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	2%	2%	2%	3%	3%	3%
Turn Type	Prot		Perm	Prot		Perm	Prot			Prot		Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			4			8						6
Actuated Green, G (s)	14.4	12.0	12.0	14.6	12.2	12.2	17.4	62.4		14.0	59.0	59.0
Effective Green, g (s)	14.4	12.0	12.0	14.6	12.2	12.2	17.4	62.4		14.0	59.0	59.0
Actuated g/C Ratio	0.12	0.10	0.10	0.12	0.10	0.10	0.14	0.52		0.12	0.49	0.49
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	5.0		4.0	5.0	5.0
Vehicle Extension (s)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	4.8		2.3	4.8	4.8
Lane Grp Cap (vph)	214	188	157	217	191	158	257	1821		204	1723	745
v/s Ratio Prot	0.08	0.08		c0.08	c0.08		0.11	c0.42		0.07	c0.37	
v/s Ratio Perm			0.00			0.01						0.07
v/c Ratio	0.65	0.78	0.03	0.69	0.80	0.07	0.78	0.80		0.60	0.75	0.13
Uniform Delay, d1	50.4	52.7	48.7	50.5	52.7	48.8	49.4	23.8		50.4	24.5	16.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		0.93	0.89	0.63
Incremental Delay, d2	5.9	17.1	0.0	7.6	20.2	0.1	13.0	3.9		3.2	2.5	0.3
Delay (s)	56.3	69.7	48.8	58.1	72.9	48.9	62.5	27.7		50.2	24.3	10.8
Level of Service	E	E	D	E	E	D	E	C		D	C	B
Approach Delay (s)		61.2			61.0			31.8			25.1	
Approach LOS		E			E			C			C	

Intersection Summary			
HCM Average Control Delay	34.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	77.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

Appendix I Signal Warrant Analysis Worksheets

KITTELSON & ASSOCIATES, INC.
610 SW Alder, Suite 700
Portland, Oregon 97205
(503) 228-5230
Fax: (503) 273-8169

Project #: 9473
Project Name: Tigard TSP Update
Analyst: JWS
Date: 5/12/2009
File: H:\projfile\9473 - Tigard TSP Update - TGM\Excel\[Sig Warrant Walnut & 135th.xls]Data Input
Intersection: SW Walnut St / SW 135th Ave
Scenario: EX PM

Warrant Summary

Warrant	Name	Analyzed?	Met?
#1	Eight-Hour Vehicular Volume	Yes	Yes
#2	Four-Hour Vehicular volume	Yes	Yes
#3	Peak Hour	Yes	Yes
#4	Pedestrian Volume	No	-
#5	School Crossing	No	-
#6	Coordinated Signal System	No	-
#7	Crash Experience	No	-
#8	Roadway Network	No	-

Raw Traffic Volumes

Hour		Major Street		Minor Street	
Begin	End	EB	WB	NB	SB
5:00 PM	6:00 PM	381	696	0	279
2nd	Highest Hour	366	668	0	268
3rd	Highest Hour	358	654	0	262
4th	Highest Hour	305	557	0	223
5th	Highest Hour	290	529	0	212
6th	Highest Hour	259	473	0	190
7th	Highest Hour	240	438	0	176
8th	Highest Hour	229	418	0	167
9th	Highest Hour	183	334	0	134
10th	Highest Hour	171	313	0	126
11th	Highest Hour	171	313	0	126
12th	Highest Hour	164	299	0	120
13th	Highest Hour	149	271	0	109
14th	Highest Hour	137	251	0	100
15th	Highest Hour	137	251	0	100
16th	Highest Hour	133	244	0	98
17th	Highest Hour	76	139	0	56
18th	Highest Hour	42	77	0	31
19th	Highest Hour	38	70	0	28
20th	Highest Hour	15	28	0	11
21st	Highest Hour	11	21	0	8
22nd	Highest Hour	11	21	0	8
23rd	Highest Hour	8	14	0	6
24th	Highest Hour	8	14	0	6

Input Parameters

Volume Adjustment Factor =	1.0
North-South Approach =	Minor
East-West Approach =	Major
Major Street Thru Lanes =	1
Minor Street Thru Lanes =	2
Speed > 40 mph?	No
Population < 10,000?	No
Warrant Factor	100%
Peak Hour or Daily Count?	Peak Hour
Major Street: 4th-Highest Hour / Peak Hour	80%
Major Street: 8th-Highest Hour / Peak Hour	60%
Minor Street: 4th-Highest Hour / Peak Hour	80%
Minor Street: 8th-Highest Hour / Peak Hour	60%

Analysis Traffic Volumes

Hour		Major Street		Minor Street	
Begin	End	EB	WB	NB	SB
5:00 PM	6:00 PM	381	696	0	279
2nd	Highest Hour	366	668	0	268
3rd	Highest Hour	358	654	0	262
4th	Highest Hour	305	557	0	223
5th	Highest Hour	290	529	0	212
6th	Highest Hour	259	473	0	190
7th	Highest Hour	240	438	0	176
8th	Highest Hour	229	418	0	167
9th	Highest Hour	183	334	0	134
10th	Highest Hour	171	313	0	126
11th	Highest Hour	171	313	0	126
12th	Highest Hour	164	299	0	120
13th	Highest Hour	149	271	0	109
14th	Highest Hour	137	251	0	100
15th	Highest Hour	137	251	0	100
16th	Highest Hour	133	244	0	98
17th	Highest Hour	76	139	0	56
18th	Highest Hour	42	77	0	31
19th	Highest Hour	38	70	0	28
20th	Highest Hour	15	28	0	11
21st	Highest Hour	11	21	0	8
22nd	Highest Hour	11	21	0	8
23rd	Highest Hour	8	14	0	6
24th	Highest Hour	8	14	0	6

KITTELSON & ASSOCIATES, INC.
610 SW Alder, Suite 700
Portland, Oregon 97205
(503) 228-5230
Fax: (503) 273-8169

Project #: 9473
Project Name: Tigard TSP Update
Analyst: JWS
Date: 5/12/2009
File: H:\projfile\9473 - Tigard TSP Update - TGM\Excel\[Sig Warrant 72nd & Dartmouth.xls]Data Input
Intersection: SW Walnut St / SW 135th Ave
Scenario: EX PM

Warrant Summary

Warrant	Name	Analyzed?	Met?
#1	Eight-Hour Vehicular Volume	Yes	Yes
#2	Four-Hour Vehicular volume	Yes	Yes
#3	Peak Hour	Yes	Yes
#4	Pedestrian Volume	No	-
#5	School Crossing	No	-
#6	Coordinated Signal System	No	-
#7	Crash Experience	No	-
#8	Roadway Network	No	-

Input Parameters

Volume Adjustment Factor =	1.0
North-South Approach =	Major
East-West Approach =	Minor
Major Street Thru Lanes =	1
Minor Street Thru Lanes =	1
Speed > 40 mph?	No
Population < 10,000?	No
Warrant Factor	100%
Peak Hour or Daily Count?	Peak Hour
Major Street: 4th-Highest Hour / Peak Hour	80%
Major Street: 8th-Highest Hour / Peak Hour	60%
Minor Street: 4th-Highest Hour / Peak Hour	80%
Minor Street: 8th-Highest Hour / Peak Hour	60%

Raw Traffic Volumes

Hour		Major Street		Minor Street	
Begin	End	NB	SB	EB	WB
5:00 PM	6:00 PM	291	677	313	84
2nd	Highest Hour	279	650	300	81
3rd	Highest Hour	274	636	294	79
4th	Highest Hour	233	542	250	67
5th	Highest Hour	221	515	238	64
6th	Highest Hour	198	460	213	57
7th	Highest Hour	183	427	197	53
8th	Highest Hour	175	406	188	50
9th	Highest Hour	140	325	150	40
10th	Highest Hour	131	305	141	38
11th	Highest Hour	131	305	141	38
12th	Highest Hour	125	291	135	36
13th	Highest Hour	113	264	122	33
14th	Highest Hour	105	244	113	30
15th	Highest Hour	105	244	113	30
16th	Highest Hour	102	237	110	29
17th	Highest Hour	58	135	63	17
18th	Highest Hour	32	74	34	9
19th	Highest Hour	29	68	31	8
20th	Highest Hour	12	27	13	3
21st	Highest Hour	9	20	9	3
22nd	Highest Hour	9	20	9	3
23rd	Highest Hour	6	14	6	2
24th	Highest Hour	6	14	6	2

Analysis Traffic Volumes

Hour		Major Street		Minor Street	
Begin	End	NB	SB	EB	WB
5:00 PM	6:00 PM	291	677	313	84
2nd	Highest Hour	279	650	300	81
3rd	Highest Hour	274	636	294	79
4th	Highest Hour	233	542	250	67
5th	Highest Hour	221	515	238	64
6th	Highest Hour	198	460	213	57
7th	Highest Hour	183	427	197	53
8th	Highest Hour	175	406	188	50
9th	Highest Hour	140	325	150	40
10th	Highest Hour	131	305	141	38
11th	Highest Hour	131	305	141	38
12th	Highest Hour	125	291	135	36
13th	Highest Hour	113	264	122	33
14th	Highest Hour	105	244	113	30
15th	Highest Hour	105	244	113	30
16th	Highest Hour	102	237	110	29
17th	Highest Hour	58	135	63	17
18th	Highest Hour	32	74	34	9
19th	Highest Hour	29	68	31	8
20th	Highest Hour	12	27	13	3
21st	Highest Hour	9	20	9	3
22nd	Highest Hour	9	20	9	3
23rd	Highest Hour	6	14	6	2
24th	Highest Hour	6	14	6	2

Technical Memo #4

Transportation
Needs &
Deficiencies

Transportation Needs & Deficiencies

Updated Tigard TSP

Date: August 12, 2009 Project #: 9473

To: Project Management Team

Technical Advisory Committee

Community Advisory Committee

From: Beth Wemple, P.E., Judith Gray, Michael Houston, and Wen Si, Kittelson & Associates, Inc.

cc: Peter Koonce, P.E., Kittelson & Associates, Inc.

The following document summarizes the needs and deficiencies in the transportation system serving Tigard. The needs and deficiencies are based on current conditions as well as forecast future transportation needs, evaluate the effectiveness of planned transportation projects, and identify remaining system deficiencies. The findings of this analysis will be used to identify additional strategies to address the forecast deficiencies.

Following review by the project management team (PMT), the technical advisory committee (TAC), and the community advisory committee (CAC), the document will be used in the development of the individual mode chapters in the updated TSP. The figures included in this document are:

LIST OF FIGURES

For reference, the following list summarizes the figures presented in the document.

- Figure 4-1. Updated Functional Classification
- Figure 4-2. Local Road Connectivity
- Figure 4-3. Forecast growth in Households
- Figure 4-4. Forecast growth in Employment
- Figure 4-5. Travel Demand Growth, 2005 – 2035
- Figure 4-6. Forecast 2035 Scenario 1 – Weekday PM Peak Hour Link and Intersection D/C Ratios
- Figure 4-7. Forecast 2035 Scenario 2 – Weekday PM Peak Hour Link and Intersection D/C Ratios
- Figure 4-8. Pedestrian Facilities and Deficiencies
- Figure 4-9. Bicycle Facilities and Deficiencies
- Figure 4-10. Transit Routes and Service Area

Needs & Deficiencies

This document summarizes the transportation facility types and characteristics in the City of Tigard and identifies transportation deficiencies associated with current system as well as deficiencies arising out of growth in travel demand. The issues identified in this memorandum relate to all motor vehicle, transit, bicycle, and pedestrian travel, as well as roadway capacity constraints on arterial and collector roadways.

The analysis incorporates planned improvements identified in the Draft Regional Transportation Plan Update (RTP, Reference 1) as well as locally adopted improvement plans, including the Washington Square Regional Center Plan (WSRC Plan, Reference 2), and the Tigard 99W Improvement and Management Plan (99W Plan, Reference 3).

The needs and deficiencies analysis is organized as follows:

- Roadway system;
- Motor vehicle capacity deficiencies;
- Pedestrian system;
- Bicycle system;
- Transit system; and,
- Transportation system management (TSM) including travel demand management (TDM).

ROADWAY SYSTEM

Roadways in Tigard are the primary means of mobility for residents, serving the majority of trips over multiple modes. Pedestrians, bicyclists and motorists all use public roads for the vast majority of trips. While the majority of users on roadways tend to be motor vehicles, it is increasingly important to plan, design, and build new roadways in a manner that improves multi-modal access and mobility.

The existing roadway network was reviewed with respect to the functional designations and standards. Individual roadways were reviewed to determine whether designations and standards are appropriate for their current and anticipated functions as well as consistency with the standards and designations of ODOT, Washington County, and other relevant agencies.

Functional Classifications

The functional classifications of roadways define their primary roles in terms of providing mobility and access. An individual street's classification directs the design and management of the roadway, including right of way needs, the number of travel lanes and other cross-section elements, and access management standards. The City of Tigard functional classification policies include the following designations:

- Freeway
- Arterial Streets
- Collector Streets
- Neighborhood Routes
- Local Streets

The 2002 TSP includes a Principal Arterial designation; however, no streets were given that designation. In order to identify any inconsistencies in street classifications, designated arterials and collectors identified in the 2002 Tigard TSP are summarized in Table 4-1, along with the corresponding designations under Washington County, Metro, and ODOT transportation plans.

Washington County roadway classifications are generally consistent with City of Tigard designations. As shown in Table 4-1, there are two roadway segments for which classification differs between the two jurisdictions: Barrows Road (North of Walnut Street/Murray Boulevard) and Pfaffle Street. Both roadways are designated collector streets by the City of Tigard and neighborhood routes by Washington County.

ODOT and Metro only classify roads that are of statewide or regional significance, respectively. These classifications are compatible with Tigard classifications, although the specific titles differ to some degree. ODOT refers to Highway 99W and Highway 217 as Urban Principal Arterials, and Hall Boulevard as an Urban Minor Arterial. The City of Tigard refers to Highway 217 as a freeway, and Highway 99W and Hall Boulevard as Arterials.

Refined Arterial Designations

The Arterial designation in the 2002 TSP includes streets with a wide range of characteristics, including significant intra-regional facilities (e.g., Highway 99W) as well as those that connect existing major streets within Tigard (e.g., Walnut-Gaarde). While the lower order function of Walnut-Gaarde corridor is an essential element of the roadway system, the long-range considerations regarding cross-section design, access control, and other elements may differ considerably from those on Highway 99W. The Principal Arterials and Arterials would be summarized as follows:

- Principal Arterial – Has a significant intra-regional travel role; at least two-travel lanes in each direction.

- Arterial – Provides connection between major generators and roadways in Tigard; cross sections could include 2/3 or 4/5 lanes.

If these definitions are adopted, the roadway classification "Principle Arterial" is recommended for Highway 99W.

In addition to the refinement of arterial classifications, two collector streets identified in the 2002 TSP are recommended to be upgraded to arterials due to their important role in east-west circulation. These are McDonald and Bonita Street. The proposed changes to the functional classification designations are depicted in Figure 4-1.

Table 4-1 Functional Classification Designations

Roadway	Tigard 2002 TSP	Washington County[1]	Metro 2035 RTP[2]	1999 Oregon Highway Plan
Interstate-5	Freeway	Freeway	Principal Arterial	Interstate Highway
Highway 217	Freeway	Freeway	Principal Arterial	Statewide Highway
Highway 99W	Arterial	Arterial	Major Arterial	Statewide Highway
Hall Boulevard	Arterial	Arterial	Minor Arterial	District Highway
Scholls Ferry Road	Arterial	Arterial	Minor Arterial	District Highway
Beef Bend Road	Arterial	Arterial	Minor Arterial	n/a[3]
Greenburg Road	Arterial	Arterial	Minor Arterial	n/a
Durham Road	Arterial	Arterial	Minor Arterial	n/a
Gaarde Street	Arterial	Arterial	Minor Arterial	n/a
72nd Avenue	Arterial	Arterial	Minor Arterial	n/a
Upper Boones Ferry Road	Arterial	Arterial	Minor Arterial	n/a
Walnut Street (West of Gaarde Street)	Arterial	Arterial	Minor Arterial	n/a
Walnut Street (East of Gaarde Street)	Collector	Collector	n/a	n/a
Bonita Road	Collector	Collector	n/a	n/a
McDonald Street	Collector	Collector	n/a	n/a
Tiedeman Avenue	Collector	Collector	n/a	n/a
121st Avenue	Collector	Collector	n/a	n/a
135th Avenue	Collector	Collector	n/a	n/a
150th Avenue	Collector	Collector	n/a	n/a
Roshak Road	Collector	Collector	n/a	n/a
Locust Street	Collector	Collector	n/a	n/a
Oak Street	Collector	Collector	n/a	n/a
Bull Mountain Road	Collector	Collector	n/a	n/a
Dartmouth Street	Collector	Collector	n/a	n/a
Barrows Road (South of Walnut Street/Murray Boulevard)	Collector	Collector	n/a	n/a
Barrows Road (North of Walnut Street/Murray Boulevard)	Collector	Neighborhood Route	n/a	n/a
Pfaffle Street	Collector	Neighborhood Route	n/a	n/a

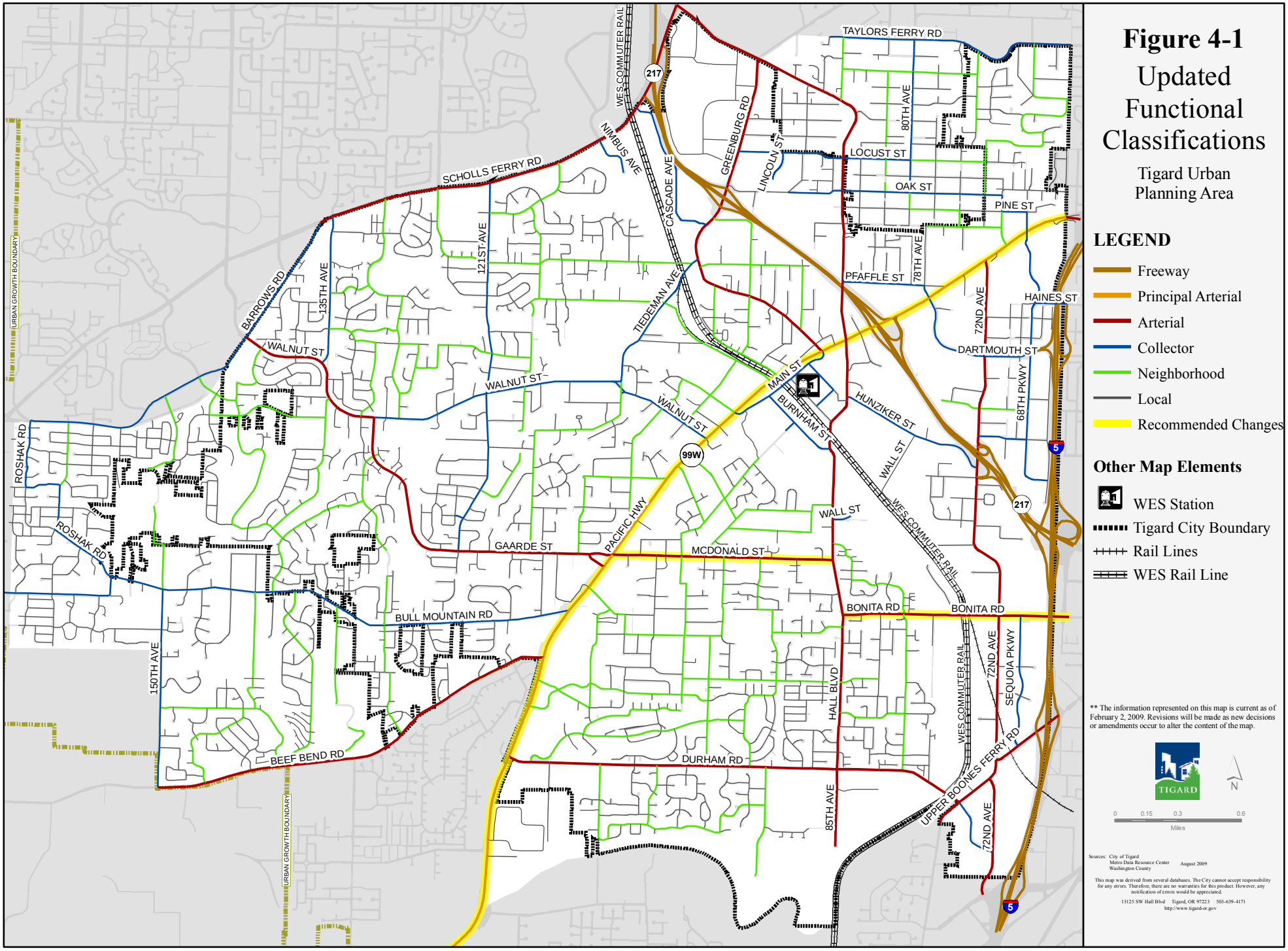
[1] Washington County 2020 Transportation Plan

[2] 2035 Regional Transportation Plan, Final Draft, January 18, 2008.

[3] n/a = not applicable; there is no designation for these roadways in the specified plan.

Downtown Designations

The City of Tigard is embarking on a downtown circulation plan. The street classifications and design standards developed as part of the downtown circulation plan will be incorporated into the Updated TSP.



Note: Streets highlighted in yellow are recommended changes from the 2002 TSP

Street Cross Section Standards

Street design standards are based on the functional and operational characteristics of streets such as traffic volume, operating speeds, and adjacent land uses. Street development based on such standards are intended to ensure that the roadway network will be capable of safely and efficiently serving multimodal travel while also accommodating the orderly development of adjacent lands.

The typical roadway cross sections comprise the following elements: right-of-way, number of travel lanes, parking, bicycle and pedestrian facilities, and other features such as landscape strips. These figures are intended for planning purposes for new road construction, as well as for those locations where it is physically and economically feasible to improve existing streets.

The proposed cross sections reflect the following changes to the standards in the 2002 TSP:

- Incorporate the cross sections identified in the Highway 99W Plan, including:
    - Increase total right of way from 98 feet to 100 feet;
    - Increase sidewalks from 5 feet to 8 feet;
    - Reduce planter strips from 6 feet to 4 feet; and,
    - Increase center turn lane/median from 12 feet to 16 feet.
- Incorporate new cross sections from the forthcoming Downtown Circulation Plan.
- Evaluate opportunities for larger landscape strips (up to 8.5 feet) in order to accommodate more of the trees on the City's approved tree list.
- Provide an option for on-street parking in lieu of bicycle lanes on collector streets in locations where traffic conditions support shared lane.

Access Spacing

An inventory of driveway conditions along Hall Boulevard and Highway 99W was conducted as part of the 2002 TSP. Conditions on Highway 99W were updated as part of the Highway 99W Plan. As summarized in the 2002 TSP and the Highway 99W Plan, the following two major corridors in Tigard have access spacing deficiencies:

- Highway 99W—significant portions of frontage are occupied by commercial land uses and driveways
- Hall Boulevard—large number of private access locations on a major route.

The results indicate that access conditions vary greatly along both roadways. In some segments of Hall Boulevard there are as many as 15 driveways between street intersections. Similarly, Highway 99W has numerous private driveways especially north of SW Gaarde-McDonald Streets.

Access Spacing Standards

Access spacing standards specify the distance between adjacent driveways and public intersections in order to manage the number of vehicle conflict points and enhance roadway capacity and traffic flow. The City of Tigard access spacing standards are provided in Table 4-2, along with spacing standards for Washington County. The relevant spacing standards for ODOT are summarized in Table 4-3. These are followed by discussions of inconsistencies and recommended changes.

Table 4-2 Tigard and Washington County Access Spacing Standards

Street Classification	Tigard Standards[1]		Washington County[2]
	Public street	Driveway	
Principal Arterial[3]	n/a	n/a	n/a
Arterial	600 feet	600 feet	600 feet
Collector	200 feet	200 feet	100 feet
Neighborhood Street[4]	n/a	n/a	50 feet
Local	125 feet	n/a	10 feet between radii; 25 feet if no radii

[1] Tigard standards from 2002 TSP

[2] Washington County 2020 Transportation Plan

[3] Access spacing standards are not currently provided for Principal Arterials

[4] City of Tigard does not currently have an access spacing standard for Neighborhood Streets

As Table 4-2 shows, the City of Tigard access spacing standards for arterials are consistent with Washington County standards. This is relevant for Scholls Ferry Road and Beef Bend Road, which are Washington County roadways designated as arterials by both Tigard and the County. Tigard access spacing standards for collectors are greater than Washington County's. However, none of Tigard's designated collectors are under Washington County jurisdiction; therefore there is no conflict in these standards.

The Oregon Highway Plan (OHP) identifies access management spacing standards for highways under ODOT jurisdiction. ODOT's access spacing standards are a function of roadway classification and posted speed limit. Table 4-3 shows ODOT's spacing standards for Highway 99W and Hall Boulevard in Tigard.

Table 4-3 ODOT Access Spacing Standards

Highway Type	Roadway	Speed Limit	Spacing Standard
Statewide	Highway 99W	35 mph	720 feet
	Highway 99W	45 mph	990 feet
District	Hall Boulevard	30 mph	350 feet
	Hall Boulevard	35 mph	350 feet
	Hall Boulevard	40 mph	500 feet

Hall Boulevard is designated as an arterial by the City of Tigard and District Highway by ODOT. The Tigard spacing standard on arterials is 600 feet, which exceeds ODOT's standards for the roadway. Therefore, the City's access spacing standards for Hall Boulevard meet ODOT standards.

The ODOT standards for Highway 99W require access spacing at 720 or 990 feet, depending on the posted speed limits. These distances are greater than the City's spacing standards for arterials (600 feet), potentially causing uncertainty for new developments on Highway 99W. If the principal arterial designation is adopted and applied to Highway 99W, spacing standards should be consistent with the OHP.

Refined Access Spacing Standards

The access spacing standards in the 2002 TSP omit Principal Arterials and Neighborhood Streets. Table 4-4 shows the standards for Principal Arterial and Neighborhood Streets as well as revisions to Tigard access spacing standards, which have been changed to be consistent with Washington County and ODOT standards.

Table 4-4 Recommended Tigard Access Spacing Standards

Street Classification	Refined City of Tigard Standards[1]	
	Public street	Driveway
Principal Arterial	720-990[2] feet	720-990[2] feet
Arterial	600 feet	600 feet
Collector	200 feet	200 feet
Neighborhood Street[3]	125 feet	n/a
Local	125 feet	n/a

[1] Tigard standards from 2002 TSP including recommended changes

[2] The recommended access spacing standards for Principal Arterials reflect the ODOT spacing requirements in the OHP for Highway 99W, the only roadway recommended for this designation in Tigard

[3] Standard based on 2002 TSP access spacing standard for Local streets

Based on the above tables, the spacing standards for the City of Tigard are consistent between the county and ODOT standards with the recommended changes for Principal Arterials and Neighborhood Streets.

In summary, the following issues were identified with regard to the access spacing standards in the 2002 TSP:

- There is a need to identify a spacing standard for Principal Arterials. Because Highway 99W is the only designated Principal Arterial in Tigard, these standards should defer to ODOT spacing standards for this highway.
- Neighborhood spacing standards should be identified. It is recommended that these standards be consistent with local street standards.

Roadway Connectivity

Roadway connectivity describes the road network characteristics generally related to frequency of and distance between connections to cross streets. A well-connected network minimizes the need for out-of-direction travel while supporting efficient dispersal of travel demand among multiple parallel roadways. The most common example of efficient roadway connectivity is the traditional grid system, with north-south and east-west streets spaced at generally equal distances. In Tigard, the existing major roadways, along with topography, natural resources, and land development patterns preclude this type of network on a large scale. However, it is possible to plan for good connectivity by preserving right of way for future connections and prioritizing funding to alleviate existing and future bottlenecks at key crossing locations.

Arterial Connectivity

The RTP identifies spacing guidelines of one mile between regional four-lane arterials. At a technical level, much of Tigard meets these guidelines for arterial connectivity. Major roadways such as Highway 217, Highway 99W, and Scholls Ferry Road provide regional connections and provide access within Tigard. However, the absence of lower classification parallel through streets focuses excessive demand on only a few major roadways.

In particular, east-west connectivity is severely challenged by Highway 217, the WES commuter rail line, and Fanno Creek. These three generally parallel features provide a significant barrier to east-west connectivity within and across Tigard. SW Scholls Ferry Road and Highway 99W provide major arterial-level crossing opportunities in the northern part of Tigard. However, south of Highway 99W east-west crossing opportunities are limited to Bonita Road and Durham Road, both of which have only one travel lane in each direction. In addition, there are limited lower order crossings of these barriers. This places considerable demand on facilities with relatively limited capacity.

Collector and Local Street Connectivity

In a similar manner, the RTP identifies collector and local streets as general access facilities for neighborhood circulation and support for the regional transportation network. Connectivity at these levels is especially important for local pedestrian and bicycle trips, which are essential to reducing reliance on automobile travel. The RTP recommends a maximum spacing of 1/10 mile for local streets and 1/2 mile for collectors in order to encourage local traffic to use these streets instead of higher order facilities.

Many neighborhood streets systems in Tigard are characterized by numerous cul-de-sacs and stub streets. These can have the effect of limiting traffic speeds and volumes on local streets. However, they also result in indirect travel paths and a reliance on arterials for local trips. In many areas of Tigard, most of the land is built-out along with the associated transportation network; opportunities for new roadway connections are limited and may be very expensive due to natural barriers, terrain, or the built environment. Figure 4-2 illustrates some of the known street stubs and roadway gaps in the Tigard network. As new development occurs, new roadways should be constructed to create a more efficient network consistent with the RTP guidelines.

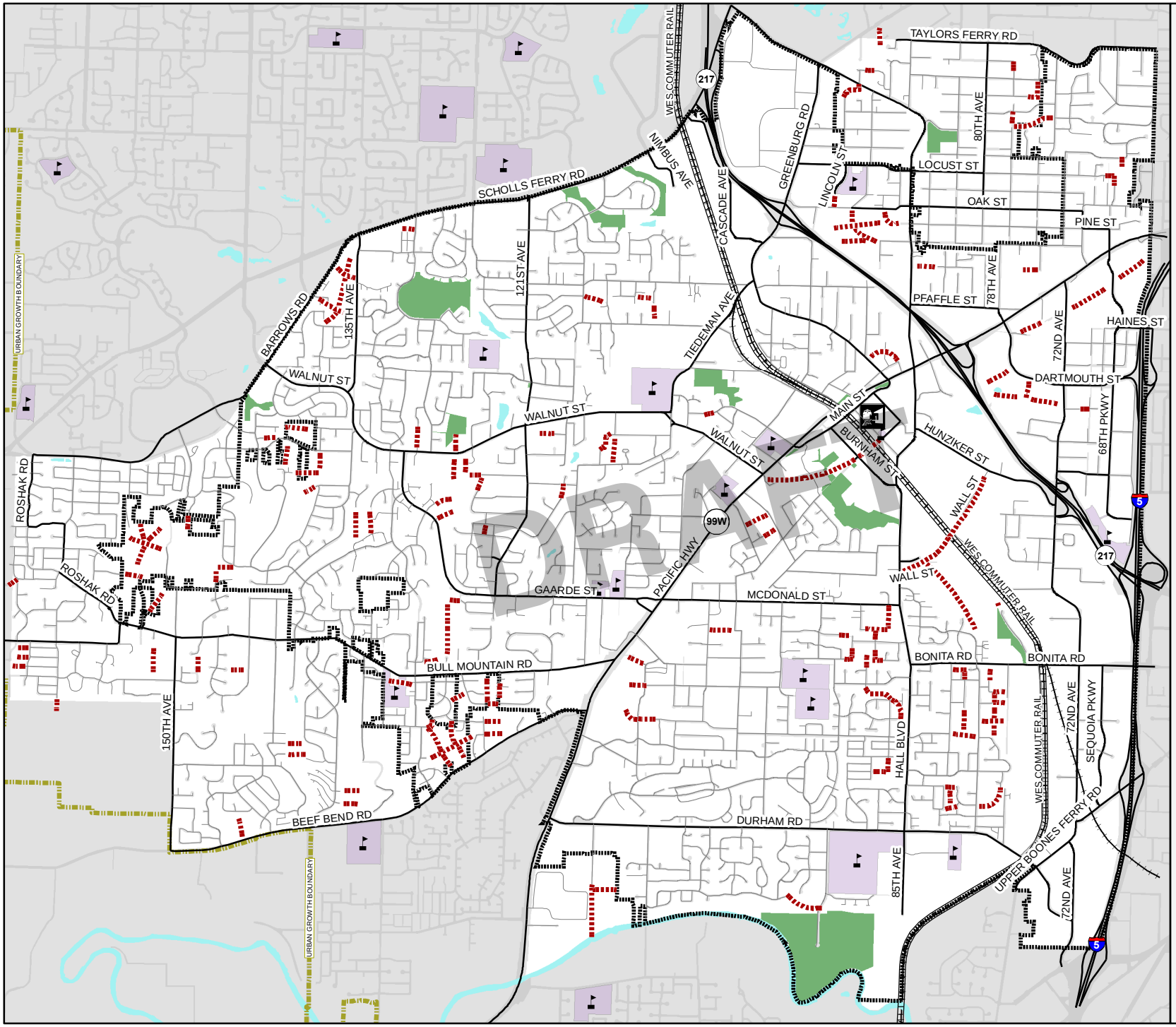


Figure 4-2

Local Road Connectivity

Tigard Urban Planning Area

LEGEND

- Gaps in Connectivity

Other Map Elements

- Tigard City Boundary
- WES Rail Line
- WES Station
- Rail Lines
- Schools

** The information represented on this map is current as of February 2, 2009. Revisions will be made as new decisions or amendments occur to alter the content of the map.

TIGARD

N

0 0.15 0.3 0.6 Miles

Sources: City of Tigard
Metro Data Resource Center
Washington County
August 2009

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The gaps shown in Figure 4-2 are illustrative only. The City does not have an up-to-date inventory of existing street stubs. Such an inventory would be used by staff to identify potential new connections during development review. Figure 4-2 should be used as initial guidance, in conjunction with field verification for specific sites.

FORECAST (YEAR 2035) WEEKDAY PEAK HOUR TRAFFIC OPERATIONS

Year 2035 traffic operations analysis was conducted to identify locations with significant growth in travel demand and capacity deficiencies. The analysis is based on demand-to-capacity ratios for arterial and collector segments for weekday p.m. peak hour conditions. Additionally, intersection analyses were conducted for intersections on Highway 99W within Tigard.

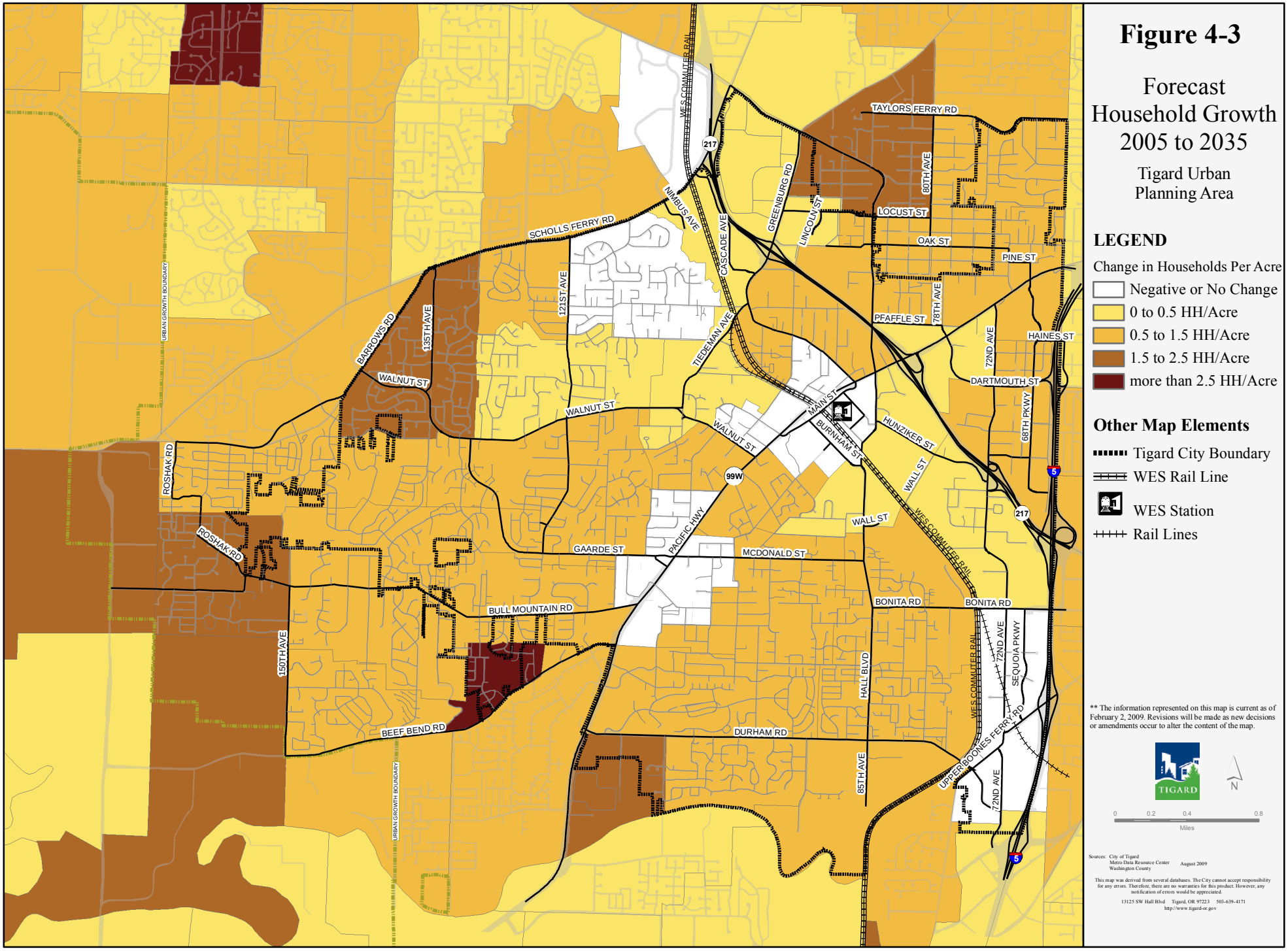
Metro's RTP travel demand model was used to develop the 2035 weekday p.m. peak hour forecasts. For the purposes of the model, the Portland metropolitan area is divided into a number of *traffic analysis zones* (TAZs), which represent areas that contain similar land uses and access similar roadways. The travel forecasting model assigns future traffic to the transportation system based on the level of household and employment growth in each TAZ. Trips are assigned to the transportation system based on the minimum time path; this reflects the fact that travelers will seek the shortest path through the system and may choose to divert their path to avoid congestion during peak periods.

Metro currently uses 2005 household (single family units, mixed-use units) and employment (retail jobs and "other") data as its base and has developed year 2035 household and employment forecasts, which include estimates of future households and employment within Tigard, and in areas that are former urban reserves outside the urban growth boundary. The population and employment data for both 2005 and 2035 for TAZs wholly or partially within the City of Tigard are provided in Attachment A, along with a figure illustrating the TAZ boundaries. Figures 4-3 and 4-4 show the locations of the TAZs in Tigard and indicate the forecast growth in households and employment based on the Metro data.

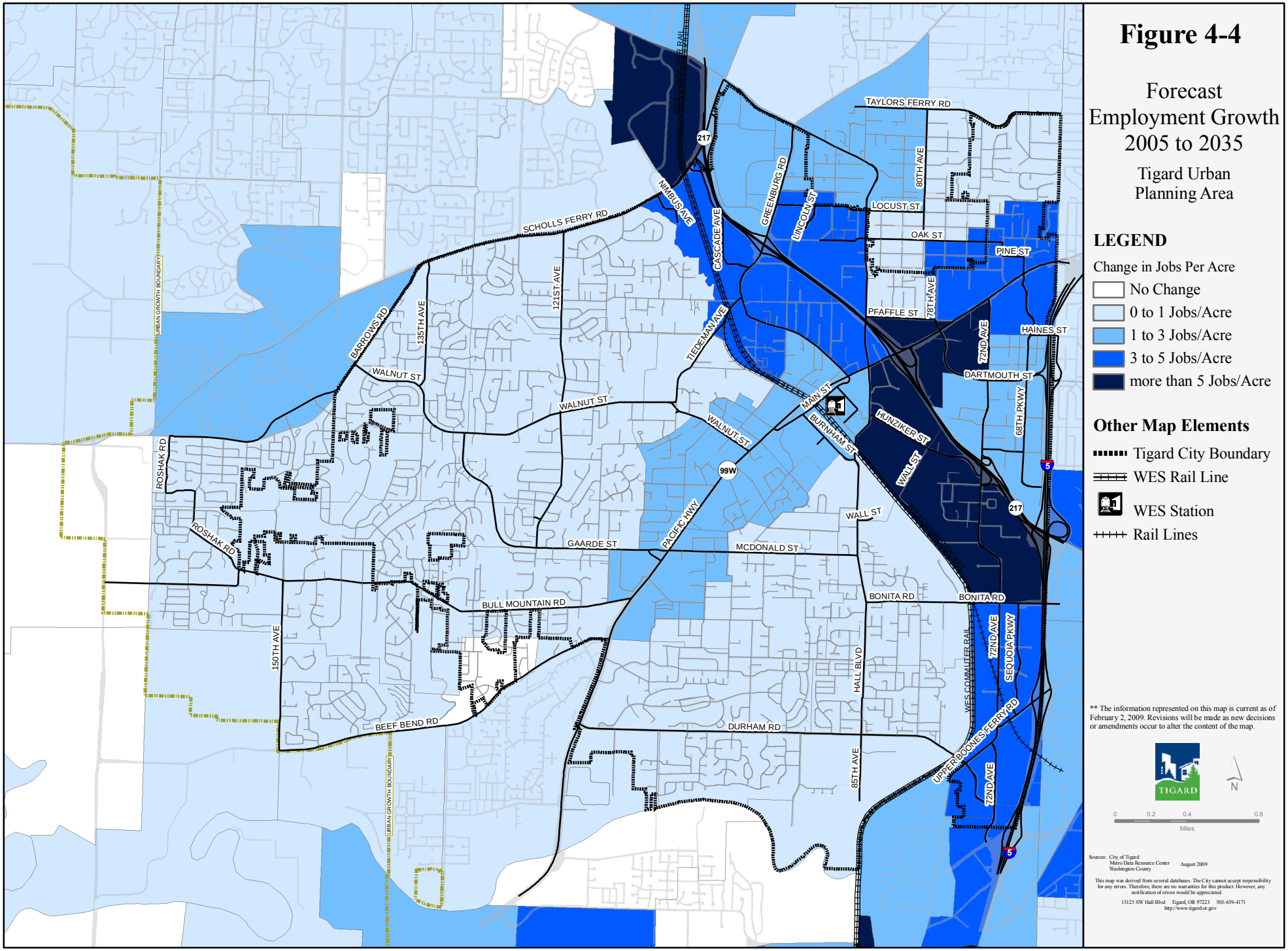
Household Growth

As shown in Figure 4-3, most of the residential growth within Tigard is projected to occur on the west side of Tigard and south in the neighborhoods around Durham Road. There are also smaller pockets of household growth in the northeast corner near the Washington Regional Center. Overall, the Metro model includes a 68 percent increase in households, or an increase of nearly 13,000 throughout Tigard.

An area of significant planned population growth is the West Bull Mountain Planning Area (Areas 63 and 64), which is largely outside of the TSP plan boundary. The model assumes that approximately 3,200 households will be added under the 2035 forecast. However, it should be noted that planning for the area is currently underway; the most recent alternatives indicate that household growth could be approximately fifteen percent greater than forecast in the Metro model, with approximately 3,700 new homes in the Bull Run area.



Note: Forecast household growth is based on data obtained from Metro



Note: Forecast employment growth is based on data obtained from Metro

Not shown in the figures is the planned increase in residential uses in downtown Tigard. The City has adopted plans to significantly increase housing density in downtown, but these projections were not incorporated into the Metro model data. These planned changes in downtown could mitigate the strain on the east-west roadways by shortening home-to-work trips, supporting transit service, and making walk/bike trips more viable for work, shopping, and other activities. Most of the benefits will be realized within downtown, where good connectivity and design will be critical to accommodating diverse travel modes. These benefits will make circulation within downtown more efficient. However, the benefits to the transportation system may be limited if the areas surrounding downtown develop as currently planned.

Employment Growth

Employment growth, as shown in Figure 4-4, is projected to be concentrated along Highway 217 through Tigard, including areas around Washington Regional Center and Tigard Triangle. There is also employment growth projected on sections of Highway 99W, mainly in the eastern part of the City.

Transportation Improvements

The forecast traffic conditions analysis was conducted assuming two alternative transportation network scenarios:

Scenario 1 includes transportation projects that are considered to have a relatively high certainty of being constructed by the 2035 forecast year. These projects are included in the Updated RTP Financially Constrained travel demand model and the Tigard Capital Improvement Plan (CIP). It should be noted that the RTP financially constrained model incorporates a freeway connection between I-5 and Highway 99W south of Tualatin, though the updated preferred alternative is to use a system of arterials. It was determined by the project management team, in consultation with ODOT managers, that this change would not significantly alter travel demand patterns within the Tigard TSP area. Other significant projects include a Highway 217 over-crossing connecting Washington Square Regional Center to Nimbus Drive; Ash Avenue extension over the commuter rail line; and, widening of portions of Dartmouth, Scholls Ferry Road, and Hall Boulevard.

Scenario 2 includes all Scenario 1 projects, as well as projects identified in the 2002 Tigard TSP, the WSRC Plan and the Highway 99W Plan. All of the planned projects were further reviewed and only those determined to be "reasonably feasible" were included. The Scenario 2 analysis evaluates the effectiveness of planned improvements and identifies remaining deficiencies. Because the Highway 99W Plan was recently amended to the Tigard TSP, improvements identified in the final plan were assumed to supersede projects identified in earlier plans. For example, the widening of Highway 99W identified in earlier plans was eliminated from consideration in the Highway 99W Plan project. Therefore it was not included in the analysis. Major Scenario 2 projects include widening of Scholls Ferry Road, Dartmouth Street, and Walnut Street as well as the extension of Hall Boulevard to Tualatin.

Descriptions and locations of individual projects under Scenario 1 and Scenario 2 are provided in Attachment B.

Travel Demand Forecasts

The forecast growth in motor vehicle travel demand during the weekday p.m. peak hour was determined by comparing forecasts for 2035 travel demand to the 2005 base year. The net increase in weekday p.m. peak hour travel demand on the study corridors is depicted in Figure 4-5. As Figure 4-5 shows, forecast 2035 weekday p.m. peak hour travel demand is expected to grow throughout Tigard, with the highest increases on large segments of 72nd Avenue, Durham Road, Gaarde Street, Walnut Street, and Boones Ferry Road.

Traffic Operations Analysis

For the purpose of the traffic analysis, the forecast 2035 traffic volumes were modified according to the procedures described in the National Cooperative Highway Research Program (NCHRP) Report 255 (Reference 4). Directional demand-to-capacity (d/c) ratios were calculated for the key corridors in the plan area. The capacity is based on the link capacity assumptions in the travel demand model.

Scenario 1 Demand-to-Capacity Analysis, Weekday PM Peak Hour

The results of the demand-to-capacity analysis for Scenario 1 are provided in Figure 4-6[1]. In addition to the link analysis, Figure 4-6 also shows the results of the weekday p.m. peak hour intersection operations analysis for signalized intersections on Highway 99W within Tigard. Based on this analysis, if no improvements are made to Tigard roadways other than those identified in the RTP financially constrained plan and if household and job growth occurs as forecast in the Metro model, the following sections of roadways will exceed their capacity during the weekday p.m. peak hour by the year 2035:

- Scholls Ferry Road, westbound from 121st Avenue to 135th Avenue;
- Walnut Street, westbound from Tiedeman to 121st Avenue;
- Walnut Street, eastbound from Barrows to 135th Avenue;
- Nimbus Avenue, northbound from the southern terminus to Scholls Ferry Road;
- Hall Boulevard; southbound from the rail road to Hamlet Street, with additional short sections in the northbound directions;
- 72nd Avenue, southbound from Highway 217 to the southern city boundary;
- 72nd Avenue, northbound just north of Bonita;
- Bonita Road, westbound from 72nd Avenue to Hall Boulevard;

[1] It is important to keep in mind that these figures illustrate travel *demands*, rather than the commonly used *volumes.* This is an important distinction, because a roadway can only serve a traffic volume equal to or less than its capacity. Where traffic demands exceed a roadway's capacity, only a volume equal to that roadway's capacity would actually travel along that roadway; the remaining vehicles would accumulate as a queue that would extend back from the point where demand first exceeded capacity.

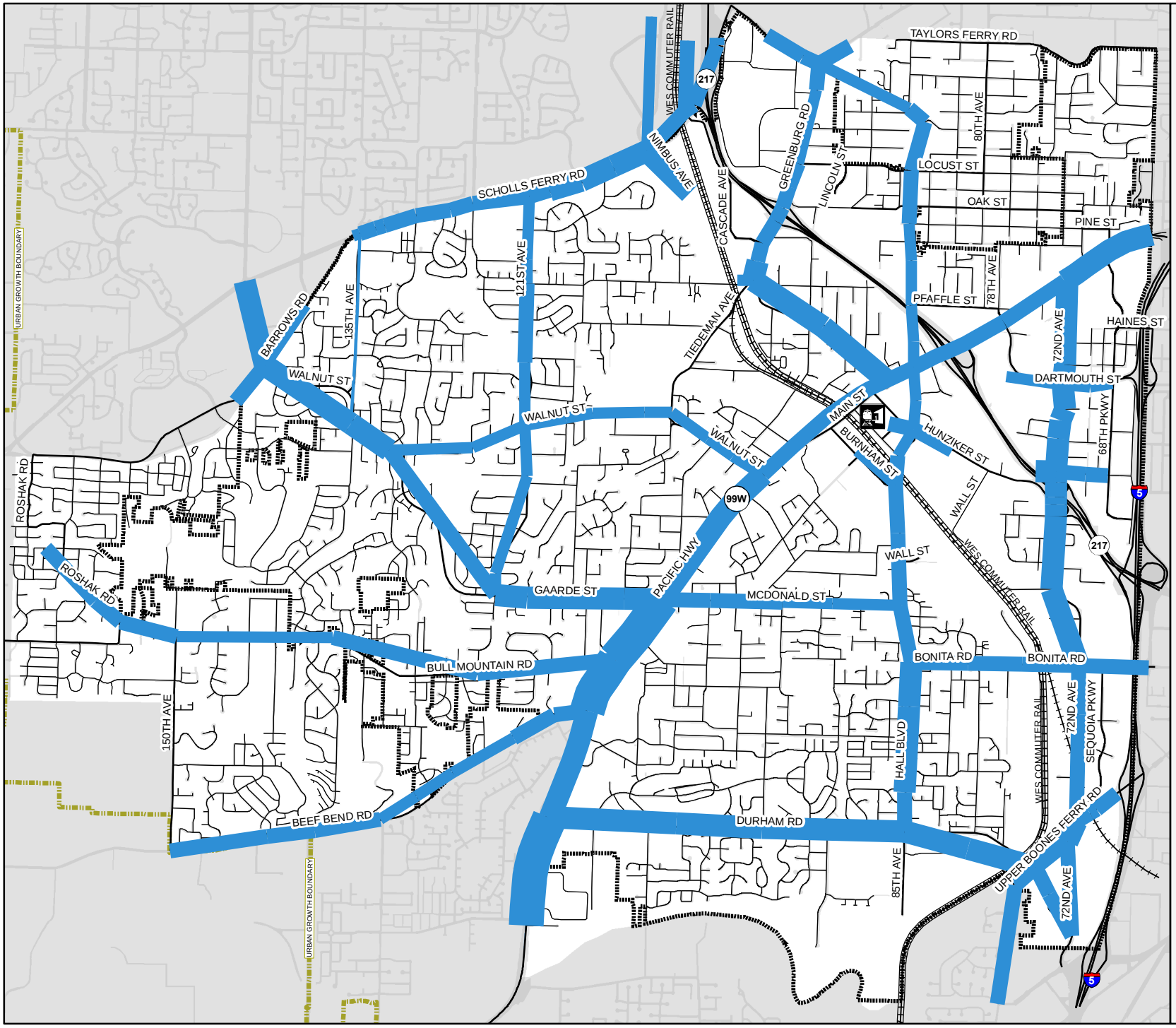


Figure 4-5

Forecast Travel Demand Growth 2005 to 2035

Weekday PM Peak Hour

Tigard Urban Planning Area

LEGEND

Traffic Growth

- Decrease in Demand
- 0 to 500
- 501 to 1,000
- 1,001 to 2,500
- more than 2,500

Other Map Elements

- WES Rail Line
- WES Station
- Rail Lines
- Tigard City Boundary

** The information represented on this map is current as of February 2, 2009. Revisions will be made as new decisions or amendments occur to alter the content of the map.

TIGARD

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0 0.15 0.3 0.6
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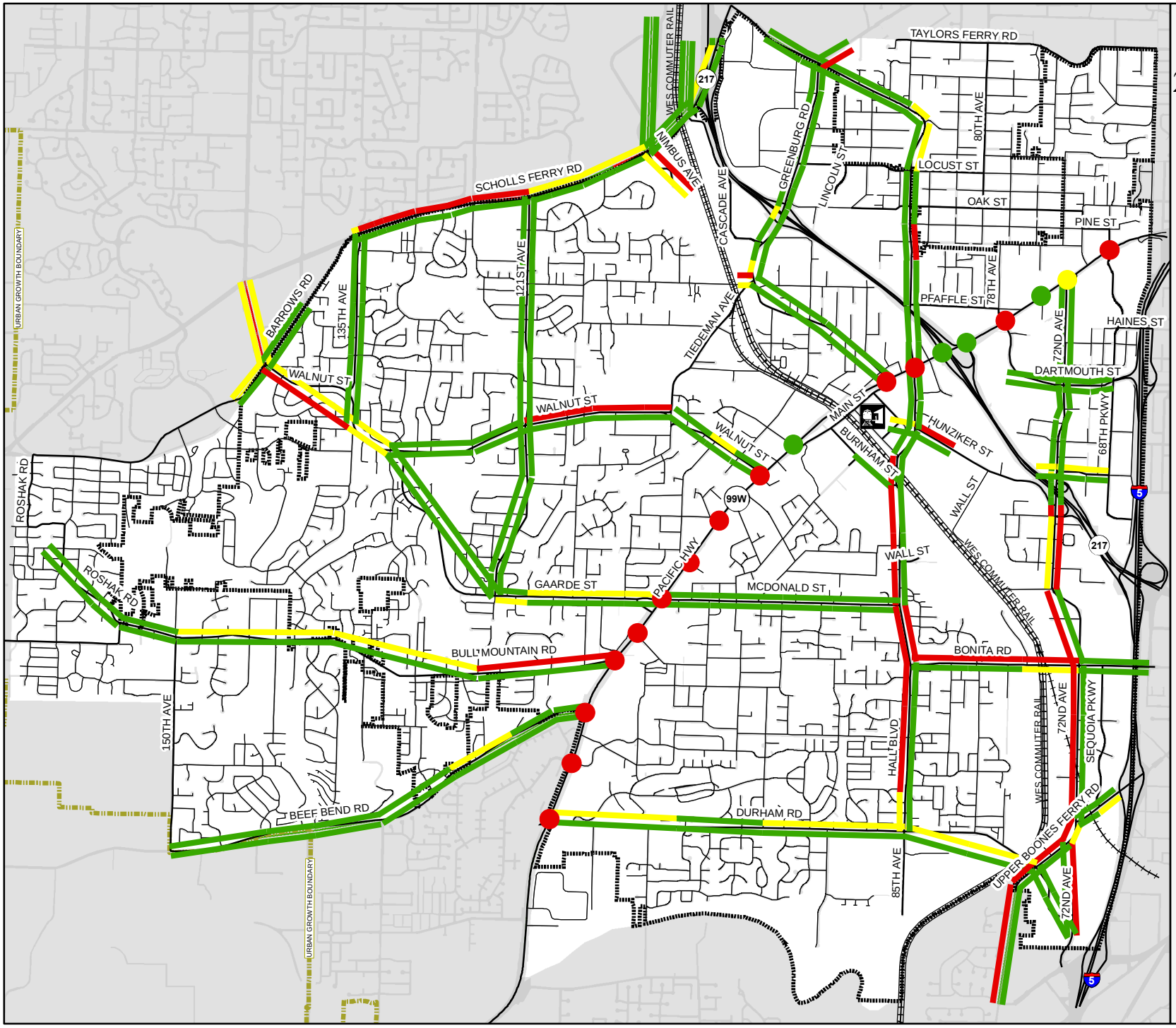

Figure 4-6

2035 Demand-to-Capacity Ratios Scenario 1

Weekday PM Peak Hour

Tigard Urban Planning Area

LEGEND

D/C Ratio

- less than 0.85
- 0.86 to 1.00
- greater than 1.00

Other Map Elements

- Tigard City Boundary
- WES Station
- WES Rail Line
- Rail Lines

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- Bull Mountain Road, westbound from Highway 99W to 125th Avenue; and,
- Upper Boones Ferry Road, southbound from 72nd Avenue to south city limits.

Figure 4-6 also shows that most of the signalized intersections on Highway 99W will exceed their capacity during the weekday p.m. peak hour under year 2035 Scenario 1 conditions. The intersections that are expected to operate with adequate capacity are the intersections at 74th Avenue, both directional ramps at the Highway 217 interchange, and Johnson-Main Street. All other study intersections are forecast to exceed capacity under weekday p.m. peak hour under year 2035 Scenario 1 conditions.

Scenario 2 Capacity Analysis, Weekday PM Peak Hour

As described earlier, Scenario 2 analysis reflects the addition of planned transportation projects in the City of Tigard that were not included in the financially constrained RTP model. These were obtained from the 2002 Tigard TSP along with the WSRC Plan and the Highway 99W Plan, which have been adopted into the TSP. A list of the projects is provided in Attachment B. The projects were incorporated into the travel demand model for 2035 and the travel demand was reassigned to the network reflecting the resulting changes in roadway capacity. The d/c ratios for major Tigard corridors and intersections on Highway 99W are shown in Figure 4-7.

The figure shows the planned Hall Boulevard extension to Tualatin will operate at or near capacity during the weekday p.m. peak hour. The extension of Hall Boulevard into Tualatin would divert southbound traffic from 72nd Avenue and Upper Boones Ferry Road, improving operations on these roadways. However, Hall Boulevard would continue to be over capacity north of Durham Road as well as in the newer section to the south.

In addition, conditions on westbound Scholls Ferry Road would improve with the completion of the widening west of 121st Avenue; however, the improvement will increase overall traffic volumes resulting in some worsening capacity conditions near Nimbus Avenue. There is also minor improvement shown on Highway 99W at the signalized intersections.

Truck Freight

Truck freight travel depends on the roadway conditions on the higher order facilities and designated truck routes through Tigard. I-5, Highway 217, and Highway 99W are designated statewide freight routes, while Hall Boulevard, Beef Bend Road, Scholls Ferry Road, Upper Boones Ferry Road and sections of Durham Road and 72nd Avenue are City of Tigard designated freight routes.

The figure also shows that conditions on westbound Bull Mountain Road approaching 150th Avenue would worsen to an over capacity condition. It should be noted that this reflects a slight increase in traffic (approximately 25 peak hour trips) resulting from the modified trip assignment under Scenario 2. While the increase in traffic was very minor, the link was effectively at capacity under Scenario 1 (d/c = 1.0) so that this slight change triggered the over-capacity condition (d/c = 1.03).

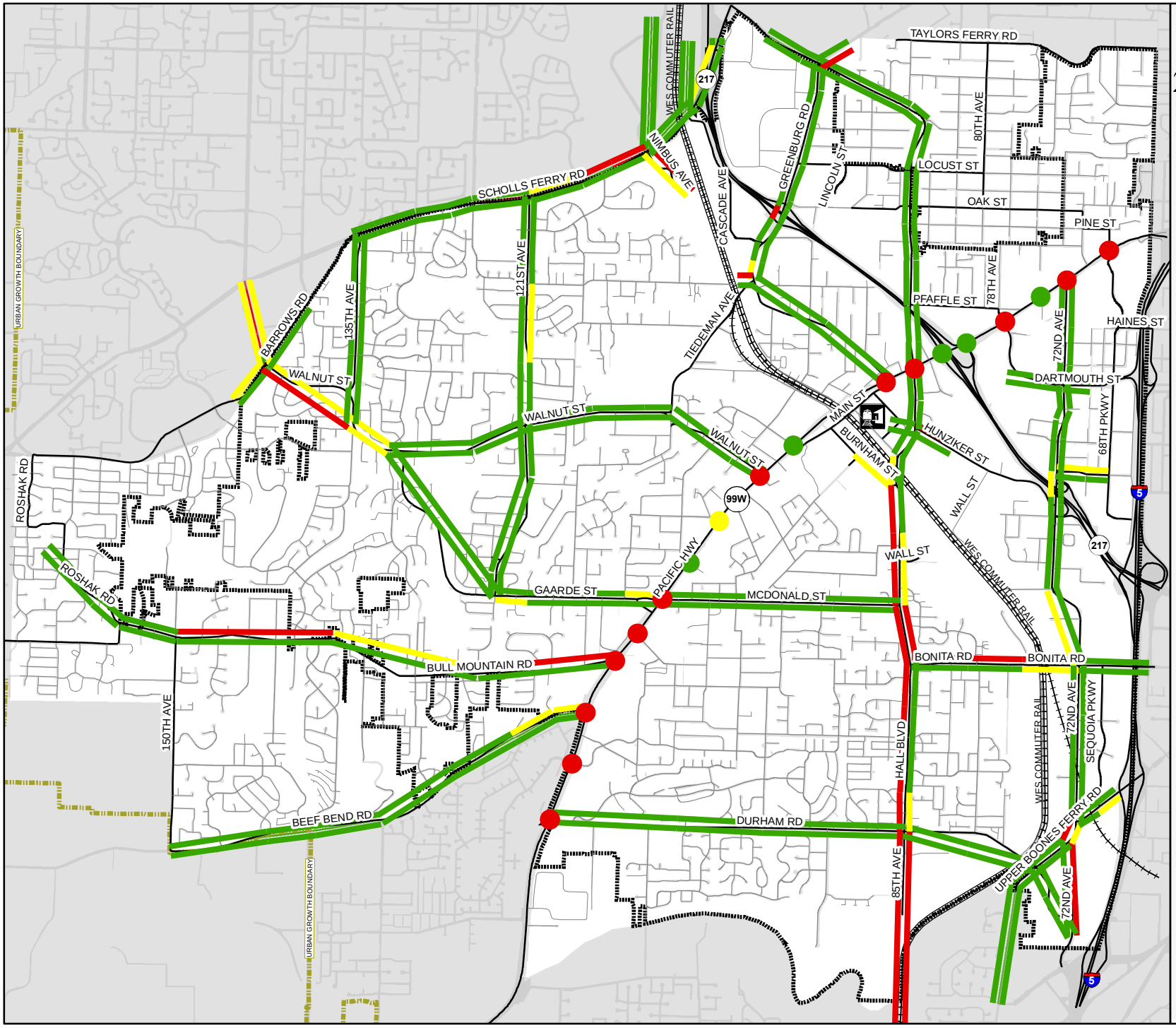

Figure 4-7

2035 Demand-to-Capacity Ratios Scenario 2

Weekday PM Peak Hour

Tigard Urban Planning Area

LEGEND

D/C Ratio

- less than 0.85
- 0.86 to 1.00
- greater than 1.00

Other Map Elements

- WES Rail Line
- WES Station
- Rail Lines
- Tigard City Boundary

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TIGARD

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The designated truck facilities generally have some of the highest traffic volumes of the roadways in the study area. Most traffic operations analyses do not distinguish between vehicle types. Since truck traffic is part of the general traffic stream, trucks experience the same congestion and travel delays as other vehicles. However, compared to passenger vehicle trips, which tend to have the highest demand during the weekday a.m. and p.m. peak periods, truck travel is more evenly distributed throughout the day. As such, an assessment of mid-day conditions compared to peak hour conditions provides some indication of the variability in traffic conditions that truckers tend to experience on Tigard freight routes.

Travel time studies conducted by the City of Tigard identified average travel speeds for weekday a.m., midday, and p.m. periods, as well as weekend conditions. The average travel speeds for each corridor are summarized in Table 4-5. The table also shows the minimum, maximum, and the range of average travel times for the different study periods.

Table 4-5 Travel Time Studies on Tigard Freight Routes

Roadway/Corridor	Direction	Average Travel Speeds (MPH)				Variability (MPH)		
		AM	PM	Weekend	Midday	Min	Max	Range
Highway 99W	Northbound	24	24	19	22	19	24	5
Highway 99W	Southbound	32	22	25	24	22	32	10
Hall Boulevard	Northbound	24	22	26	23	22	26	4
Hall Boulevard	Southbound	24	20	25	22	20	25	5
Durham/Upper Boones	Eastbound	22	22	24	23	22	24	2
Upper Boones/Durham	Westbound	25	18	29	18	18	29	11
Scholls Ferry Rd	Southbound	26	18	20	32	18	32	14
Scholls Ferry Rd	Northbound	18	19	18	19	18	19	2

As Table 4-5 shows, the slowest travel times for most of the major corridors in the City occur during the weekday p.m. peak hour period, though there were some exceptions. The most striking example is northbound travel on Highway 99W, which was the slowest during the weekend observations at 19 mph, compared to 24 mph during weekday peak periods. The table shows greater variability in the southbound direction, with approximately 10 mph difference in average travel speeds when comparing the weekday a.m. and p.m. peak periods. The range is even greater on southbound Scholls Ferry Road, which had travel speeds as low as 18 mph (weekday p.m. peak) and as high as 32 mph during the midday. This variability in travel times on the City's freight routes is especially costly to freight trucks which spend nearly all their productive time in travel and depend on being able to reliably estimate shipment schedules.

Another method for reviewing freight conditions is based on the capacity analysis using the Metro travel demand model. The model does not differentiate truck traffic from passenger cars; however, it provides estimates for weekday mid-day and p.m. peak period conditions for base year 2005 and forecast year 2035. The Metro model reports that volume-to-capacity (v/c) ratios within the corridors are generally lower during the mid-day when compared to the p.m. peak period, but are

still in the range of 0.80 to 0.90 in most areas. This is true under both base year 2005 and 2035 forecast scenarios. Interchange areas tend to have the highest amount of congestion, but this usually occurs during the evening peak period. Specifically, the Highway 217/Highway 99W interchange is currently over-capacity during the weekday p.m. peak period, whereas mid-day v/c ratios are between 0.80 and 1.00 during the midday, when trucks traffic is proportionally higher.

Achieving the greatest traffic operations efficiencies possible on the major corridors within Tigard will benefit freight transportation. Some potential strategies that specifically address freight traffic include truck signal priority or truck only lanes. The prioritization of truck traffic, and therefore the emphasis to place on freight transportation solutions, will be developed with the City of Tigard as part of the system and facilities planning stage of this project (Task 5).

PEDESTRIAN SYSTEM

Pedestrian facilities serve a variety of needs. These include:

- Relatively short trips (under a mile) to major pedestrian attractors, such as schools, parks and open spaces, retail centers, churches, and public facilities, such as libraries, recreation centers, and community centers.
- Recreational trips—for example, jogging or hiking—and circulation within parklands.
- Access to transit (generally trips under ¼ mile to bus stops with regular service or within ½ mile to rail stations or bus stops with frequent service).
- Commute trips, where mixed use development is provided, and people choose to live near where they work.

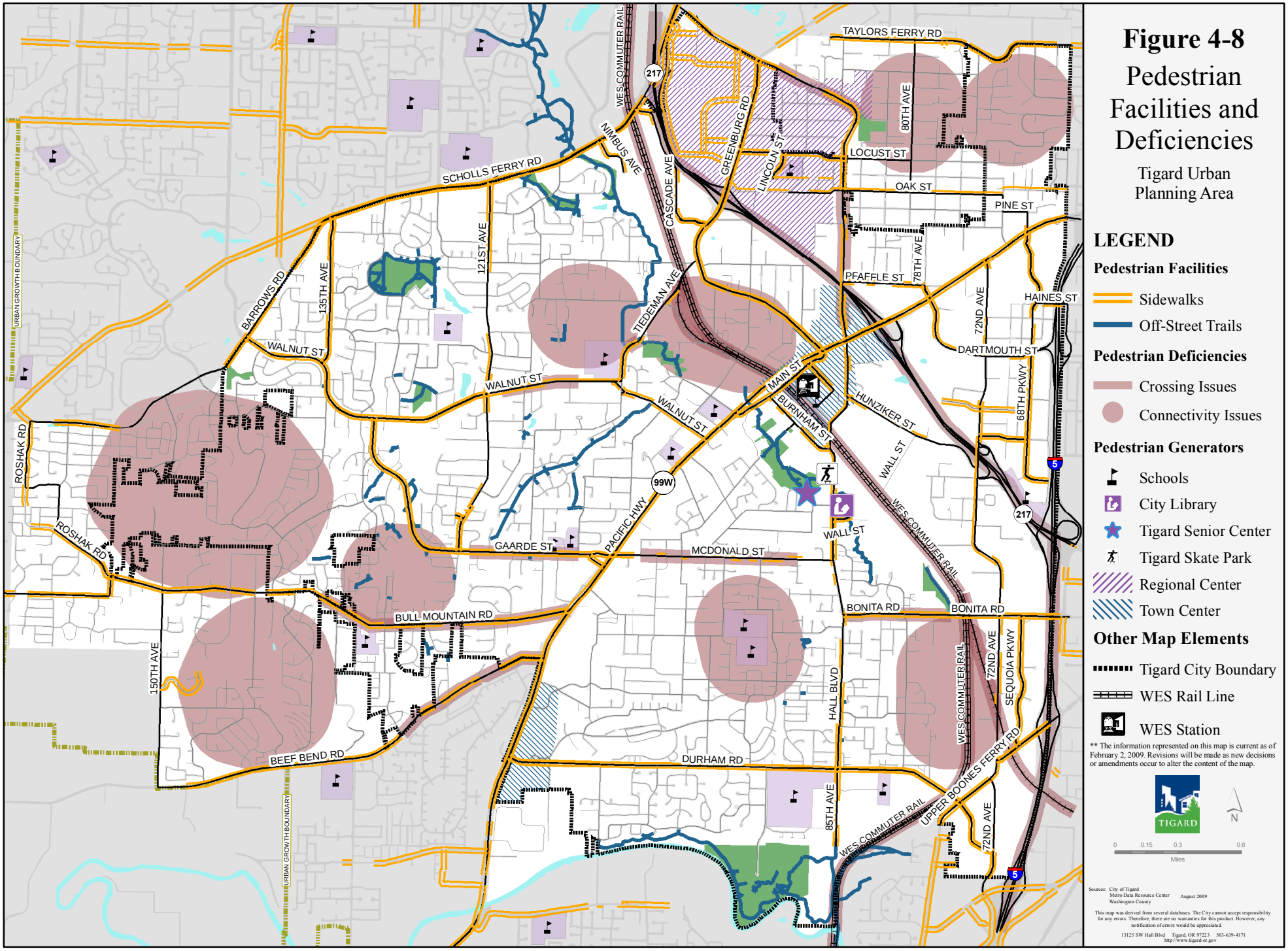
Continuous pedestrian facilities should connect neighborhoods and employment areas to nearby pedestrian attractors, be integrated with transit stops, and separate pedestrians from vehicular traffic. In addition to providing sidewalks along major roadways, opportunities need to be provided at reasonable intervals for pedestrians to cross roadways.

Sidewalks and Trails

The pedestrian system within Tigard includes sidewalks, multi-use paths, and pedestrian only paths. The Tigard street cross section standards include sidewalks on both sides of all public streets, excluding alleys. However, many streets built prior to the standards do not provide sidewalks. The existing sidewalks and off-street paths are shown in Figure 4-8.

As the figure shows, most of the arterials and collectors have sidewalks on one or both sides of the street, but there are several discontinuous sections of sidewalks on McDonald Street, Bull Mountain Road, and Hall Boulevard. These roadways, in addition to others shown in the figure, were identified by City Staff as locations with pedestrian crossing issues.

Tigard's off-street trails are generally concentrated along several greenways located within the City the most notable of these is the Fanno Creek Greenway which traverses the full length of the City. In addition to Fanno Creek, significant trails are located along the Tualatin River and the Pathfinder-Genesis Trail.



Notes: Pedestrian facilities are only shown for arterial and collector streets
Regional and Town Centers are designated Pedestrian Districts in the Draft 2035 Regional Transportation Plan

Other Pedestrian Deficiencies

Figure 4-8 also shows other types of pedestrian issues. Several connectivity issues were also identified by city staff and are shown in Figure 4-8. Most of these areas lack sidewalks and off-street trails for pedestrian use. The City of Tigard completed a study, called the Tigard Trail project, which evaluated the off-street trails in the city. The study provides a list of forty-three recommended off-street trail projects within the city. As these projects are completed, they are expected to support the existing pedestrian network and address several of the connectivity deficiencies identified in this report.

Areas along the WES Commuter Rail and along several streets (Gaarde, McDonald, Bull Mountain, sections of Hall) were identified as locations with challenging crossing conditions for pedestrians. These tend to be streets with relatively high traffic volumes but infrequent signalized intersections or other protected crossing locations.

BICYCLE SYSTEM

Similar to the pedestrian system, bicycle facilities serve a variety of trips. These include:

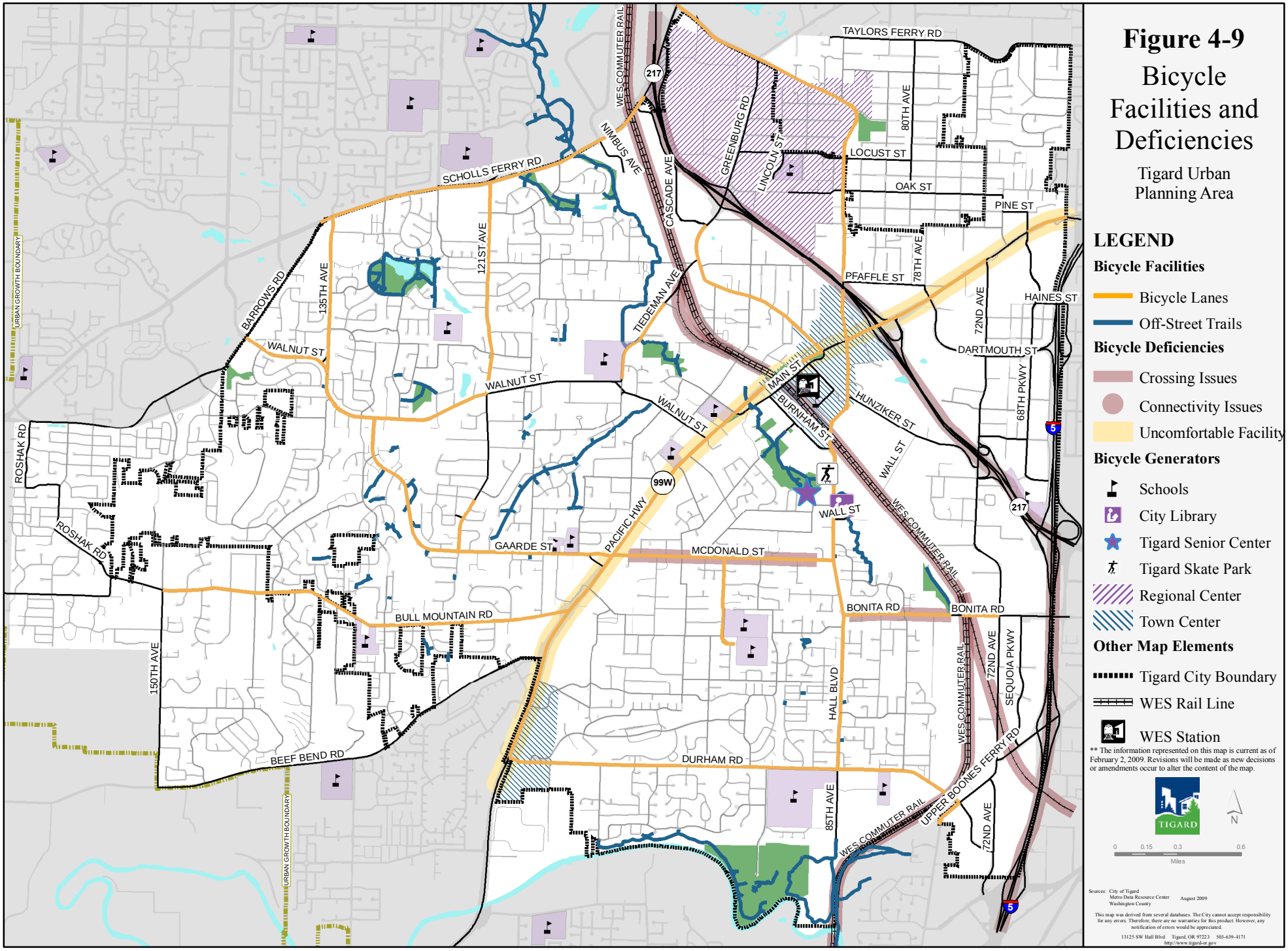
- Trips to major attractors, such as schools, parks and open spaces, retail centers, and public facilities, such as libraries, recreation centers, and community centers, where secure (and preferably covered) bicycle parking is available.
- Commute trips, where changing and showering facilities are provided at the workplace.
- Recreational trips.
- Access to transit, where bicycle storage facilities are available at the stop, or where space is available on bus-mounted bicycle racks.

Facilities needed to develop a comprehensive bicycle system include: bicycle lanes, signing and striping to designate areas for bicycle travel, bicycle accommodation at traffic signals, secure parking, changing facilities and showers at worksites, and even mixed-use pathways.

Bicycle lanes should be provided on major streets where automobile traffic speeds are significantly higher than bicycle speeds. However, allowing bicycle traffic to mix with automobile traffic is acceptable where the average daily traffic (ADT) on a roadway is less than 3,000 vehicles per day, according to the Oregon Bicycle and Pedestrian Plan (Reference 5). Providing bike lanes on local streets would be appropriate where the volume of bicyclists is high, vehicle speeds are higher than 25 miles per hour, or poor sight distance exists.

Deficiencies

Figure 4-9 shows the locations of bicycle lanes along collector and arterial streets, and off-street pathways that are shared with pedestrians within Tigard. For reference, the locations of a number of potential bicycle attractors are also shown, including schools, parks, commercial areas, the library, and the hospital. It can be seen from Figure 4-9 that where bicycle lanes are provided, they are generally provided along both sides of the street.



Note: Bicycle lanes are only shown for arterial and collector streets

As Figure 4-9 shows, most of Tigard's arterials and collectors roadways have continuous bicycle facilities, although there are several gaps in the network. In some locations where bicycle lanes are provided, specific conditions compromise the quality of the bicycle facility. High motor vehicle volumes and travel speeds can contribute to an unsafe or uncomfortable environment for riding. Other issues may arise from inadequate or inconsistent lane widths, poor pavement conditions, or debris in the bike lanes. City staff noted that while 99W does have bicycle lanes, their quality as bicycle facilities is compromised by high traffic volumes, frequent driveways, debris, and general pavement conditions.

A bicycle map identifying roadways with bike lanes, off-street pathways, and low-volume streets would improve bicycling conditions in Tigard. Metro and the adjacent jurisdictions have adopted bicycle maps that identify the opportunities for interconnection between jurisdictions. The City of Tigard has recently secured funding to and plans to establish a Bicycle Advisory Committee to develop a plan for designating bike routes in the City.

TRANSIT

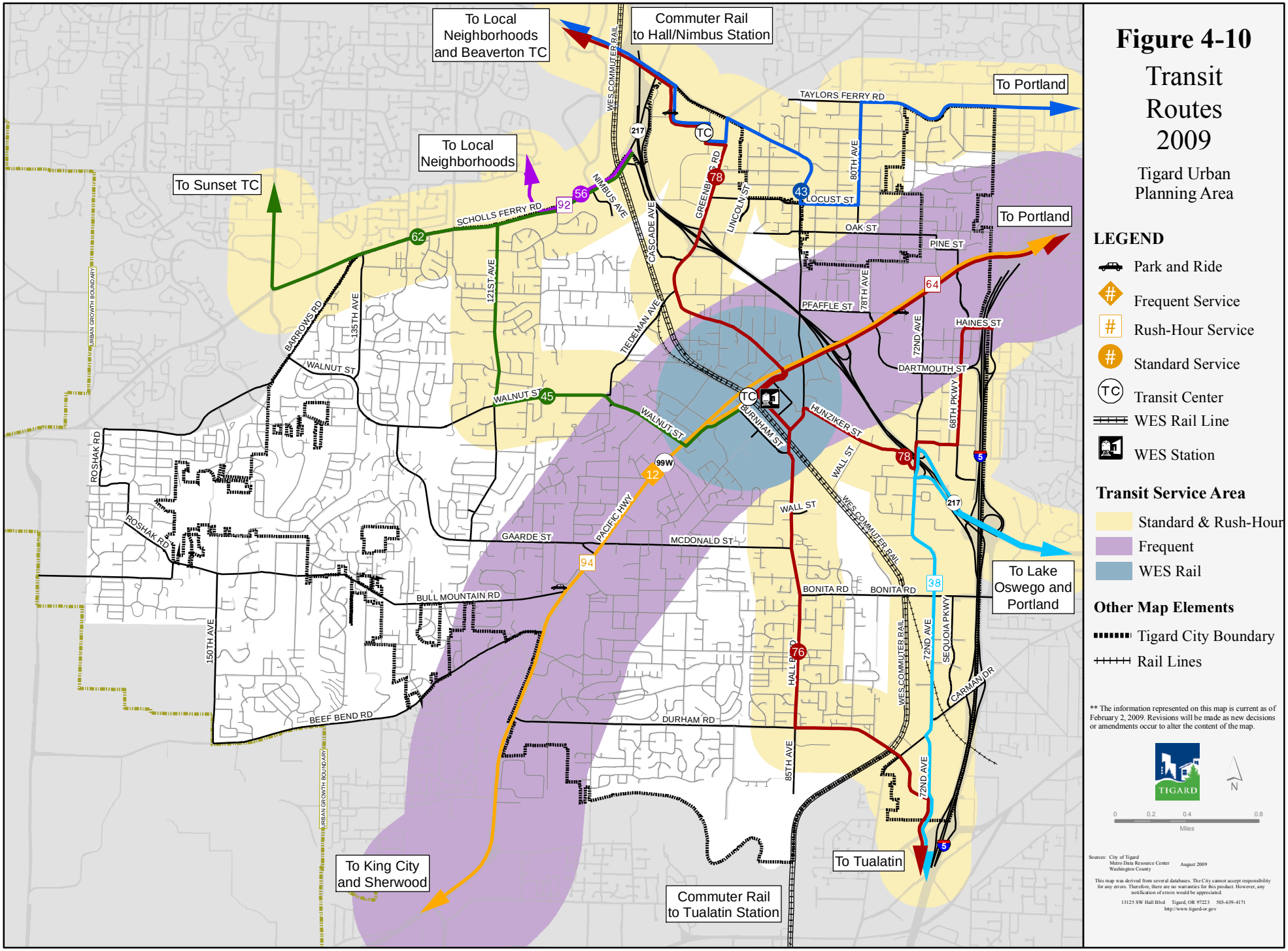
The transit service in Tigard was evaluated from two perspectives:

- A passenger's perspective with regard to general service availability as well as quality of service; and
- A service provider's perspective and how they measure successful transit routes or opportunities.

Tigard Transit Service Coverage (Passenger's Perspective)

Figure 4-10 shows the "service area" for each transit route, which include areas within one-quarter mile from regular or peak hour service, and one-half mile from frequent service routes. The figure shows that while most of the routes serving Tigard operate with relatively high levels of service, there remain significant portions of the City that are not served, including large residential neighborhoods. Major corridors that are not served by regular transit routes include the Gaarde-McDonald-Bonita Road corridor; Durham Road service is provided only east of Hall Boulevard; and Walnut Street is served only between Highway 99W and Scholls Ferry Road. Also, there are no routes serving Bull Mountain Road or Beef Bend Road.

The *Transit Capacity and Quality of Service Manual* (TCQSM, Reference 6) is used to assess transit quality of service from the passenger's point-of-view, based on several factors relating to the availability of transit service and the comfort and convenience of transit service. These factors, such as service frequency, are graded on an "A" to "F" LOS scale, similar to the scale for vehicles. Many of the quality of service measures are best applied on an origin-destination basis, as more than one transit route may serve a particular pair of origins and destinations, and some routes may only operate during peak hours only, but provide good service at those times. Tables 4-6 through 4-9 provide levels of service related to transit availability in Tigard.



Notes: Transit service area is 1/4 mile from standard and rush hour service routes and 1/2 mile from frequent service routes and WES Rail Stations
* Waiting for major bus stop data from TriMet

Service Frequency

Tables 4-6 and 4-7 provide *service frequency LOS* to and from the Tigard Transit Center and Washington Square—the portion of the City with the best transit service—to major destinations in the Portland area. The level-of-service measures correspond to average headways between bus arrivals. LOS "A" indicates average headways of less than ten minutes and LOS "F" indicates that headways are at intervals greater than one hour.

Table 4-6 Service Frequency LOS from Tigard Transit Center

Destination	Routes	Weekday Ridership in Tigard	Weekday Peak	Weekday Midday Off-Peak	Weekday Evening	Weekend Peak	Weekend Off-Peak
Downtown Portland*	12, 45, 94	4,601	A	C	D	B	D
Washington Square TC*	45, 76, 78	5,916	C	D	E	E	E
Beaverton TC*	76, 78	5,598	D	D	E	D	E
Lake Oswego TC	78	2,610	D	D	E	E	E
Sherwood*	12, 94	4,283	A	C	D	B	D
Tualatin	76	2,988	D	D	E	D	E
Marquam Hill	64	62	C	F**	F**	F**	F**
Gresham	12	3,762	B	C	D	B	D

* Multiple bus routes ** No service during these time periods.

Table 4-7 Service Frequency LOS from Washington Square

Destination	Routes	Weekday Ridership in Tigard	Weekday Peak	Weekday Midday Off-Peak	Weekday Evening	Weekend Peak	Weekend Off-Peak
Downtown Portland*	43, 45, 56	1,130	B	D	E	E	E
Tigard TC*	43, 45, 78	3,191	C	D	E	E	E
Beaverton TC*	76, 78	5,598	D	D	E	E	E
Lake Oswego TC	78	2,610	D	D	E	E	E
Sunset TC	62	1,394	C	D	E	D	E
Tualatin	76	2,988	D	D	E	D	E

* Multiple bus routes

As the tables show, in terms of service frequency, service is typically better during the weekday peak periods as compared to other periods. LOS ranges from "A" to "D" during weekday peak periods and from "D" to "E" during most of the other periods.

For destinations served by frequent service buses (Route 12), including downtown Portland, Sherwood and Gresham, LOS "A" and "B" are available during weekday and weekend peak periods, and the LOS is acceptable throughout the rest of the time periods. Services are considerably better than destinations covered only by standard and rush-hour service buses.

Hours of Service

Tables 4-8 and 4-9 provide hours of service LOS from Tigard Transit Center and Washington Square to the same destinations, measuring the number of hours during the day when service is available to a particular destination. The hours-of-service evaluation is relevant only for those hours when service is provided at least hourly. In the analysis, LOS "A" indicates that service is provided during 19 or more hours per day; LOS "F" indicates that service is provided during three or fewer hours of the day.

Table 4-8 Hours-of-Service LOS from Tigard Transit Center

Destination	Routes	Weekday Ridership in Tigard	Weekday	Saturday	Sunday
Downtown Portland*	12, 45, 94	4,601	A	A	A
Washington Square TC*	45, 76, 78	5,916	B	B	C
Beaverton TC*	76, 78	5,598	B	B	C
Lake Oswego TC	78	2,610	B	B	B
Sherwood*	12, 94	4,283	B	B	B
Tualatin	76	2,988	B	C	E
Marquam Hill	64	62	F	F	F
Gresham	12	3,762	B	C	C

* Multiple bus routes

As Tables 4-8 and 4-9 show, based on hours of service, most of the origin/destination pairs operate at LOS "A", "B", or "C" during most of the study periods. The main exception is Marquam Hill which is only served by rush-hour service. The table also shows that the Tigard Transit Center operates with LOS "B" or "C" for all of the routes shown, with the exception of Sunday service to Tualatin.

Table 4-9 Hours-of-Service LOS from Washington Square

Destination	Routes	Weekday Ridership in Tigard	Weekday	Saturday	Sunday
Downtown Portland *	43, 45, 56	1,130	B	B	C
Tigard TC*	45, 76, 78	3,191	B	B	C
Beaverton TC*	76, 78	5,598	B	B	C
Lake Oswego TC	78	2,610	B	B	C
Sunset TC	62	1,394	B	C	C
Tualatin	76	2,988	C	C	E

* Multiple bus routes

Transit Productivity (Service Provider's Perspective)

Indicators of Successful Transit

As the major transit service provider in the Portland Metro area, TriMet has developed a summary of characteristics that tend to be supportive of a successful transit service. Table 4-10 summarizes general characteristics that are or are not considered transit-supportive.

Table 4-10 Transit Characteristics

Characteristic	Works	Doesn't Work
Density	• High	• Low
Street Layout	• Small Blocks • Grid system	• Long, winding streets • Dead-end roads, cul-de-sacs
Mix of Uses	• Mix (commercial, residential, and office uses)	• Single use (e.g. all residential or all industrial)
Pedestrian Environment	• Wide sidewalks • Low volume streets, slow traffic speeds • Good lighting • Street amenities (benches, tree canopy) • Well-marked intersections with signalized crossings	• Narrow sidewalks • High volume streets, fast moving traffic • Poor lighting • No intersection markings and long pedestrian wait times
Site Design	• Buildings front the street and entrances are near the sidewalk	• Building setback from the street and surrounded by surface parking
Parking	• Limited • Fee-based parking	• Abundant • Free

Source: TriMet

As shown in Table 4-10, areas with high density, a mix of uses, and a friendly pedestrian environment contribute to a successful transit system. While there have been investments and other actions to support transit use in Tigard, the majority of the City is characterized by land use patterns, street networks, and densities that are generally not conducive to transit.

Ridership and Productivity Ratings

TriMet maintains productivity measures for bus lines in order to monitor the effectiveness of transit service and evaluate potential investments. Key indicators include *boarding rides per vehicle hour* (br/hr) (i.e. one boarding ride per vehicle hour means that there was one person on the bus for one hour of service). For the system in the year 2008, the average boarding rides per vehicle hour is 32 br/hr, with the highest performance measure at 54 br/hr (Route 73 Killingsworth-82nd Avenue). TriMet considers the minimum threshold for new bus service to be 15 br/hr, and any existing service that drops below 15 br/hr is considered a low performing line for the agency.

A comparison of 1999 and 2008 average transit ridership in Tigard is summarized in Table 4-11, along with the 2008 boarding rides per vehicle hour for each route. The table indicates there were approximately 12,650 daily transit riders in Tigard in 2008, reflecting a 34-percent increase in ridership since 1999. As the table shows, two routes in Tigard operate below the 15 br/hr threshold:

Routes 43 and 38 operate at 11 br/hr and 14 br/hr, respectively. As such, these would be considered low performing routes.

Table 4-11 Weekday Transit Ridership Summary

Route	2008 Br/hr	Dir	1999			2008		
			Ons*	Offs*	Total	Ons*	Offs*	Total
12 Barbur	33	NB	386	1,017	1,403	1,287	627	1,848
		SB	894	389	1,283	594	1,254	1,914
38 Boones Ferry	14	SB	9	37	46	5	25	30
		NB	29	16	45	18	11	29
43 Taylors Ferry	11	WB	20	158	178	34	103	137
		EB	148	24	172	95	31	126
44 King City	38	NB	110	84	194	Route currently operates outside Tigard		
		SB	19	45	64			
45 Garden Home	16	WB	65	252	317	28	135	163
		EB	235	71	306	123	32	155
56 Scholls Ferry	28	SB	3	300	303	7	272	279
		NB	303	2	305	261	9	270
62 Murray Blvd	27	EB	94	430	524	132	548	680
		WB	418	107	525	549	165	714
64 Marquam-Tig	25	NB	4	36	40	1	19	20
		SB	41	1	42	41	1	42
76 Tig-Tual	38	SB	377	530	907	718	1,124	1,842
		NB	552	357	909	635	511	1,146
78 Beav-LO	32	SB	252	498	750	563	1,142	1,705
		NB	419	225	644	550	355	905
92 S. Beav Exp	19	WB	13	103	116	4	57	61
		EB	138	10	148	60	3	63
94 Pac Hwy Exp	23	WB	Not in operation			28	245	273
		EB				228	20	248
95 Tig I-5 Exp	n/a	WB	12	117	129	Route no longer in operation		
		EB	104	2	106			
TOTAL			**4,645**	**4,811**	**9,456**	**5,961**	**6,689**	**12,650**

Notes: br/hr: boarding rides per vehicle hour
*Ons and Offs correspond to daily boardings and alightings, respectively
N/A: Not available
Source: TriMet Passenger Census

TRANSPORTATION SYSTEM MANAGEMENT

Transportation System Management (TSM) measures can mitigate congestion by enhancing operations of existing facilities. TSM measures can range from access management and added turn lanes at intersections to parking management and variable message signs. Other types of TSM measures include incident management, work zone management, and traffic monitoring and information systems. The value of TSM is becoming increasingly important due to the high costs of improvements, limited right-of-way, and an increased emphasis on reducing pollution and greenhouse gases.

The Highway 99W Plan identified several TSM strategies, including access management, transit signal priority, and other improved signal timing measures. As was identified in Chapter 3, many of the traffic signals in Tigard are part of coordinated systems that are timed to support efficient flow of traffic along major corridors. However, the signal control technology at most of the signals is relatively outdated. New signal controller technology is more responsive to real-time roadway conditions. Upgrading the controllers could help to optimize capacity at signalized intersections.

The Metro RTP Update includes TSM strategies for the major transportation corridors in the region, including Highway 99W, Highway 217, and I-5 in Tigard. The potential for application of TSM strategies will be addressed in detail in the Transportation System and Facilities Management task of this project (Task 5).

Transportation Demand Management

Transportation Demand Management (TDM) is a type of TSM strategy that focuses on managing/reducing auto demand and increasing the demand for biking, walking, and transit use. Some common examples of TDM strategies include programs such as carpool matching assistance or flexible work shifts; direct financial incentives such as transit subsidies; or facility or service improvements, such as bicycle lockers or increased bus service.

Tigard's transportation system provides alternatives to Single-Occupancy-Vehicle (SOV) travel through its network of pedestrian, bicycle, and transit facilities and services. However, the City does not have a dedicated TDM program. A TDM program would include coordinated strategies, information, and services designed to support alternative mode travel options. Further, a TDM program would help to identify, prioritize, and promote specific improvements and investments that best meet the needs of the community.

The Westside Transportation Alliance (WTA) is a transportation management association (TMA) serving Washington County. The WTA assists employers in developing, implementing, and monitoring programs to reduce commute trips by SOV. The City of Tigard is a member of the WTA, as are most neighboring jurisdictions and many private employers. While the emphasis at WTA is to help employers create TDM programs, the WTA web site provides an "information hub" that individuals can use to find out about a myriad of travel options, including transit service, park-and-ride lots, bicycling, carpool matching, and other services. There may be the potential to work with the WTA to establish a TDM program for the City.

One element of the program would be tracking progress in reducing SOV mode share. As described in Chapter 3, the RTP recently updated its methodology for calculating SOV. If Tigard adopts a TDM program and begins tracking SOV mode share, the methodology should be consistent with Metro, which established a Non-Single Occupant Vehicle (SOV) goal of 45 percent to 55 percent by year 2040 depending on land use designations.

RAIL

The most relevant potential issues associated with the rail mode include impacts at at-grade rail crossings, including the WES commuter rail line. The City should also seek opportunities to remove private grade crossings along the tracks by providing alternative access to parcels via the public street system.

REFERENCES

1. Metro, *Regional Transportation Plan Update*. Travel Demand Model with Financially Constrained Projects, obtained from Metro May 2009.

2. City of Tigard, *Washington Square Regional Center Plan*, September 1999.

3. DKS Associates, Inc., *Tigard 99W Improvement and Management Plan*, July 2007.

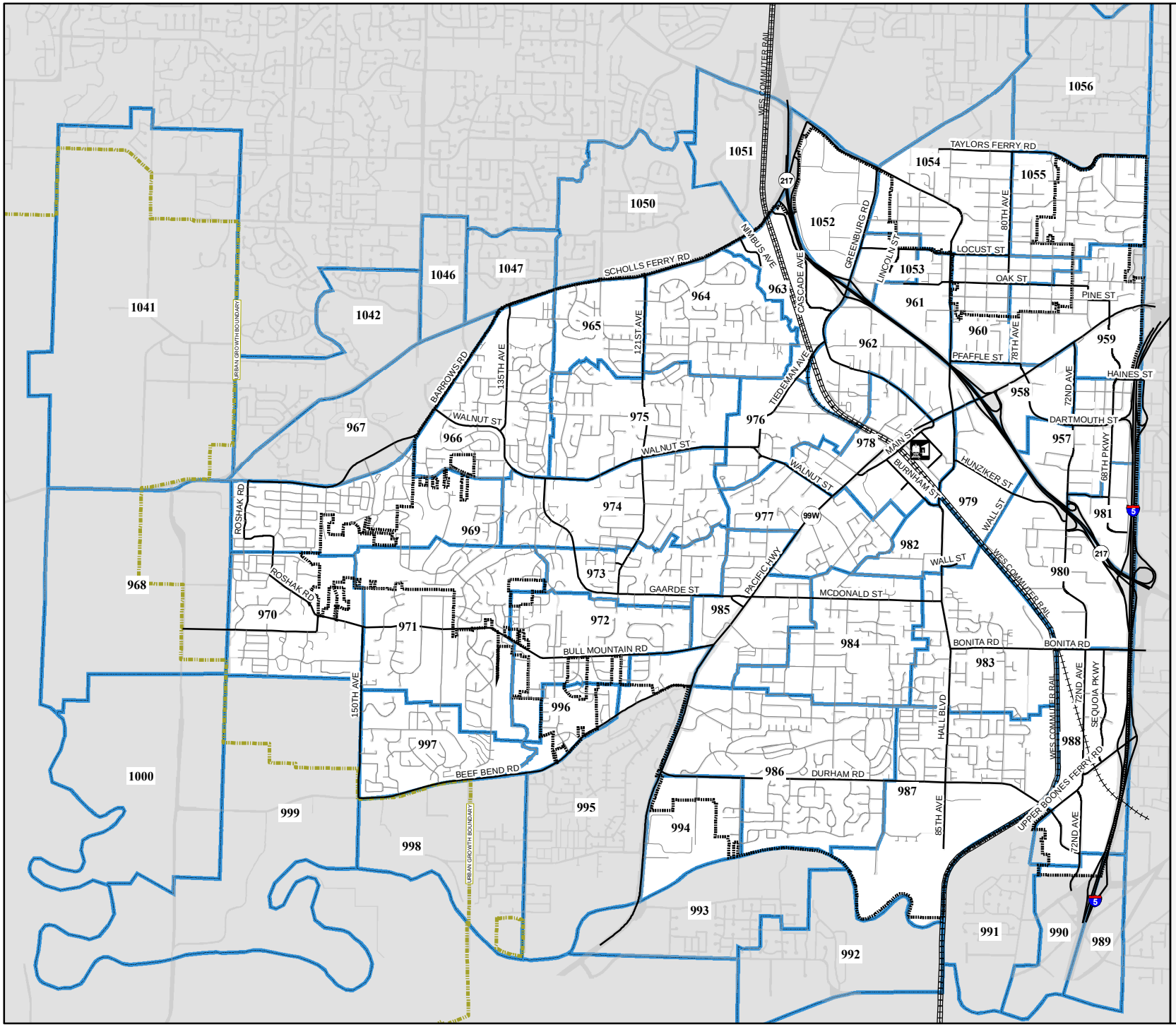
4. Transportation Research Board, *NCHRP Report 255: Highway Traffic Data for Urbanized Area Project Planning and Design.* 1982.

5. Oregon Department of Transportation. *Oregon Bicycle and Pedestrian Plan.* 1995.

6. Transportation Research Board. *Transit Capacity and Quality of Service Manual*. 2003.

Attachment A

TAZ Household and Employment Forecast Summary and
TAZ Map



Transportation Analysis Zones (TAZs)

Tigard Urban Planning Area

LEGEND

TAZ

Other Map Elements

WES Rail Line

WES Station

Rail Lines

Tigard City Boundary

** The information represented on this map is current as of February 2, 2009. Revisions will be made as new decisions or amendments occur to alter the content of the map.

Sources: City of Tigard
Metro Data Resource Center
Washington County
August 2009

This map was derived from several databases. The City cannot accept responsibility for any errors. Therefore, there are no warranties for this product. However, any notification of errors would be appreciated.

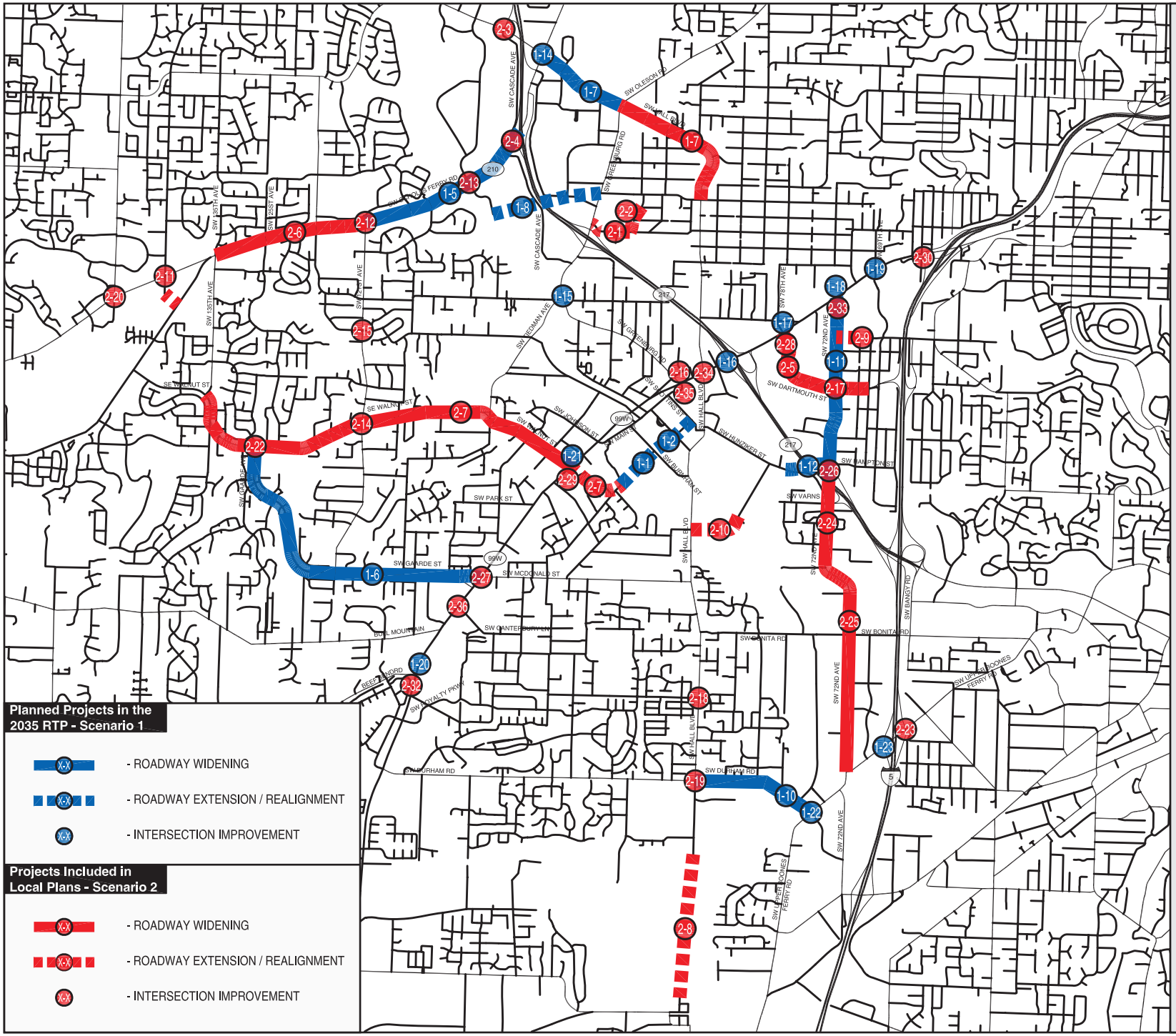
13125 SW Hall Blvd Tigard, OR 97223 503-639-4171
http://www.tigard-or.gov

TAZ Household and Employment Forecast Summary

TAZ	2005		2035		Growth, 2005-2035	
	Households	Employment	Households	Employment	Households	Employment
957	257	1,677	475	3,710	218	2,033
958	91	1,320	135	2,278	44	958
959	664	1,482	1,046	2,566	382	1,084
960	454	95	625	176	171	82
961	255	60	398	514	143	454
962	987	857	1,288	1,599	301	743
963	55	2,030	77	2,774	22	744
964	965	117	955	144	-10	27
965	739	405	821	547	82	142
966	1,788	241	2,327	324	539	83
969	1,114	125	1,432	154	318	29
970	495	70	1,056	80	561	10
971	998	184	1,381	225	383	41
972	425	69	722	91	297	23
973	492	75	658	103	166	28
974	770	52	1,192	59	422	8
975	816	149	935	204	119	55
976	198	300	256	353	58	52
977	796	731	1,082	1,031	286	300
978	891	2,030	661	4,656	-230	2,625
979	27	2,913	43	4,041	16	1,127
980	223	4,160	301	6,378	78	2,219
981	22	2,764	93	4,410	71	1,646
982	140	397	184	497	44	100
983	1,079	840	1,263	1,094	184	254
984	769	241	1,181	330	412	89
985	1,057	703	958	1,056	-99	352
986	2,563	583	3,304	797	741	213
987	860	922	1,450	1,350	590	428
988	0	7,366	0	8,925	0	1,559
994	800	372	1,225	500	425	128
995	2,754	777	3,286	1,142	532	365
996	103	5	484	5	381	0
997	565	67	866	79	301	11
1052	74	5,175	91	8,326	17	3,151
1053	39	3,617	57	6,447	18	2,830
1054	1,153	734	1,768	1,534	615	800
1055	682	29	995	65	313	36

Attachment B

Assumed Transportation Projects in 2035 Travel Demand Models



Planned Transportation Projects (Year 2035)

Tigard Urban Planning Area

TIGARD

Sources: City of Tigard July 2009
Metro Data Resource Center
Washington County

This map was derived from several databases. The City cannot accept responsibility for any errors. Therefore, there are no warranties for this product. However, any notification of errors would be appreciated.

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Attachment B. Scenario 1
2035 Transportation Improvements in Scenario 1
(Financially Constrained RTP)

Project ID	Project Name	Description
Roadway Improvements		
1-1	Ash Ave Extension (Burnham to RR)	The new street connects the future Burnham/ Ash Ave intersection to the new Park and Ride parking lot
1-2	Ash Ave Extension (Fanno Cr./Scoffins)	Determine a feasible alignment Ash Ave extension between Fanno Creek and Scoffins Street. The model includes this new connection.
1-3	I-5 to OR 99W Connector	Connector linking I-5 and OR 99W
1-4	Dartmouth widening	Widen to 5 lanes between OR 99W and I-5 (partial for Scenario 1)
1-5	Scholls Ferry Rd widening	Widen to 7 lanes (both dir) b/w OR 217 and 121st Ave
1-6	Gaarde Street extension and widening	Extend and widen to 3 lanes Walnut to OR 99W; Use Access control and 2 lanes in sensitive areas
1-7	Hall Boulevard Widening	Widen to 5 lanes Scholls Ferry to Greenburg-Oleson intersection
1-8	OR 217 Over-crossing	5 lane over-crossing connecting Nimbus south to Greenburg
1-9	Durham Road Widening	Widen to 5 lanes (total, both directions) between Hall Boulevard and Upper Boones Ferry Road; Reserve right-of-way to the west for 5 lanes
1-10	Durham Road Realignment at Upper Boones Ferry Road intersection	Realign intersection so that Durham Road continues on continuous route to I-5/Carmen interchange-Upper Boones Ferry Road would "tee" into Durham Road/Upper Boones Ferry Road intersection
1-11	72nd Avenue Widening	Widen to 5 lanes: ORE 99W to Hunziker
1-12	Hunziker-Hampton Connection	Realign Hunziker Road to meet Hampton Road at 72nd Avenue—requires over-crossing over ORE 217—removes existing 72nd Avenue/Hunziker intersection
1-13	Taylors Ferry Road Extension	Extend to Oleson Road
Intersection Improvements		
1-14	Greenburg/Oleson/Hall	2nd northbound left turn lane; Extend signal cycle length; Assumes Hall widened to 5 lanes
1-15	Greenburg/Tiedeman	Extend signal cycle length; Improved geometry/alignment
1-16	Highway 217 SB Ramps/Highway 99W	2nd southbound right turn lane; Retain eastbound right turn lane when ORE 99W widened to 7 lanes
1-17	Dartmouth/Highway 99W	Retain eastbound right turn lane when ORE 99W widened to 7 lanes
1-18	72nd/Highway 99W	Southbound right turn lane; Northbound right turn overlap; Change to protected left turn phasing north/south
1-19	68th/Highway 99W	2nd westbound left turn lane; Northbound left turn lane; Southbound left turn lane; Change to protected left turn phasing north/south
1-20	ORE 99W/Beef Bend	Southbound right turn lane (on ORE 99W); Adjust cycle length

1-21	Walnut Street/Highway 99W	Retain westbound right turn lane when ORE 99W is widened to 7 lanes; Change to protected left turn phasing on Walnut
1-22	Durham/Upper Boones Ferry Road	Reconfigure intersection to make through route between Durham and I-5/Carmen interchange
1-23	Carman/I-5 southbound	Eastbound right turn lane

Attachment B. Scenario 2
2035 Transportation Improvements in Scenario 2

Project ID	Project Name	Description
All Scenario 1 Projects		
Roadway Improvements		
2-1	Develop Oak-Lincoln-Locust Street Collector System	Improvements to distribute east/west traffic between Locust and Oak Streets and improve accessibility to Lincoln Center commercial district
2-2	Lincoln Street connection	See above
2-3	Highway 217 Interchange Improvements	SB right-turn lane at Hall Blvd/OR 217 ramp
2-4	Cascade/Scholls Ferry Intersection	Add 2nd northbound left-turn Lane and 2nd westbound left-turn lane at OR 217 NB on- ramp
2-5	Dartmouth widening	Widen to 5 lanes between OR 99W and I-5 (Completed from Scenario 1)
2-6	Scholls Ferry Rd widening	Widen to 7 lanes (both dir) b/w OR 217 and Barrows Rd (Completed from Scenario 1)
2-7	Walnut Boulevard widening	Widen to 3 lanes b/w 135th to OR 99W; Extend Walnut east of OR 99W to meet Ash/Scoffins and Hunziker Streets
2-8	Hall Boulevard extension	Extend south to Tualatin (3 lanes both dir)
2-9	Atlanta Street extension	Extend Atlanta Street west to meet 72nd
2-10	Wall Street connection	New roadway connecting Hunziker St and Hall Boulevard
2-24	72nd Avenue Widening: Hunziker to Bonita	Widen to 5 lanes
2-25	72nd Avenue Widening: Bonita to Durham	Widen to 5 lanes
Intersection Improvements		
2-11	Davies/ Scholls Ferry Rd	Traffic Signal; northbound right-turn Lane; Realign to meet Barrow Rd
2-12	North Dakota/ 125th/ Scholls Ferry Rd	Southbound right-turn lane; Retain westbound right-turn lane when 3rd lane added on Scholls Ferry Rd; Signal timing changes
2-13	Nimbus/Scholls Ferry Rd	Retain eastbound right-turn lane when 3rd lane added on Scholls Ferry Rd; Retain westbound right-turn lane when 3rd lane added on Scholls Ferry Rd; southbound right-turn lane; Reconfigure northbound and southbound lanes to create exclusive left-turn lanes; Change from split phasing to protected left-turn phasing North South
2-14	121st/ Walnut	Traffic signal; northbound, southbound, eastbound, westbound left-turn lanes

2-15	121st/ North Dakota	Traffic signal
2-16	Main/ Greenburg/ OR 99W	Southbound left-turn lane; Retain westbound right-turn lane when OR 99W widened to 7 lanes
2-17	72nd/ Dartmouth	Traffic signal; Assumes 72nd Ave and Dartmouth widened to 5 lanes
2-18	Hall/Sattler/Ross	Traffic Signal; northbound and southbound left-turn lanes
2-19	Hall/Durham	2nd southbound left-turn lane; Widen west of intersection to introduce 5-lane section on Durham
2-20	Murray/ Scholls Ferry Rd	2nd westbound right-turn lane; Add additional southbound lane to achieve 2 southbound left-turn lanes and 2 southbound through lanes; Extend signal cycle length; Changes to protected left-turn phasing north/south and east/west
2-21	Beef Bend/ Scholls Ferry Rd	Eastbound right-turn lane; northbound left-turn lane; eastbound right-turn overlap; change to protected phasing east/west; Change to split phasing north/ south
2-22	Gaarde/Walnut	Traffic signal; eastbound right-turn lane
2-23	Carman/ I-5 northbound	2nd westbound through lane; 2nd northbound left-turn lane; eastbound separate through and left-turn lanes
2-26	OR 217/72nd Ave Interchange Improvements	interchange improvements as needed to accommodate 5 lane section on 72nd Ave and necessary ramp improvements
2-27	Highway 99W/Gaarde/McDonald	New lanes: northbound left-turn; southbound left-turn, eastbound through; westbound through; eastbound left-turn; westbound left-turn lanes
2-28	Highway 99W/Dartmouth	Southbound through lane for 500 ft.
2-29	Highway 99W/Walnut	Westbound left-turn lane
2-30	Highway 99W/I-5 SB	Northbound through lane
2-31	Highway 99W/Durham	Northbound left-turn lane
2-32	Highway 99W/Beef Bend	Southbound right-turn lane
2-33	Highway 99W/72nd Avenue	Southbound right-turn pocket
2-34	Highway 99W/Hall Boulevard	Westbound left-turn lane
2-35	Highway 99W/Greenburg Road	Eastbound left-turn lane; westbound left-turn lane
2-36	Highway 99W/Canterbury	Westbound left-turn lane

WB = westbound; NB = northbound; SB = southbound; EB = eastbound; RT = right turn;

Technical Memo #5

Transportation
Systems Solutions

Draft: Transportation Systems Solutions

Updated Tigard TSP

Date: November 23, 2009 Project #: 9473

To: Project Management Team

Technical Advisory Committee

Citizen Advisory Committee

From: Elizabeth Wemple, P.E., Susan Wright, P.E. and Michael Houston, Kittelson & Associates, Inc.

CC: Peter Koonce, P.E., Kittelson & Associates, Inc.

This report summarizes an evaluation of strategies and projects developed to address existing and anticipated deficiencies in the Tigard transportation system. Improvements include strategies to manage system operations and travel demand, and new facilities to improve capacity and connectivity.

The information included in this memo will be included in separate chapters of the final transportation system plan; however it is presented as a unit here in order to facilitate system considerations, evaluations and development of recommendations. The improvements included in this memorandum address motor vehicle, pedestrian, bicycle, and transit travel modes.

The materials included in this report were reviewed and discussed at the October 14, 2009 TAC and CAC meetings. Input received at those meetings was integrated into the updated craft Transportation Solution memorandum and the draft Transportation System Plan.

The material included in this report is consistent with the deliverables identified in Task 5 of the project contract. With prior agreement from ODOT the TSM/TDM memo and the facilities memo have been combined into this one deliverable.

Because of the length of this report we have provided a table of contents and list of figures for reference.

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Background

This background section of the transportation solutions report provides reference material that will be useful in the discussions and review of the remaining sections of the report. This information includes:

- Summary of 20-year costs and potential revenues from the 2002 TSP;
- Summary of existing and future needs and deficiencies identified in this project; and
- Summary of future travel mode split assumptions from the Metro travel demand model.

2035 ESTIMATED TRANSPORTATION REVENUES

Transportation capital improvements are typically funded through a combination of state, city, and private funds. This section documents Tigard's projected transportation revenues based on historic trend information provided by City of Tigard Staff. In typical years, about half of the total funds are available for capital improvements. The remaining funds are used for operations, maintenance, services and materials.

The City of Tigard currently estimates their revenues for transportation (operating and capital expenses) from 2009 to 2035 to be approximately $5,150,000 per year (2009 dollars). These revenues have come from six primary sources as shown below. Table 5-1 shows a breakdown of the amounts and percentages of forecast annual revenue from each of these sources. As shown forecasted over the 20-year life span of this transportation system plan, approximately $55,000,000 is available for transportation capital expenditures.

Table 5-1 Forecast Transportation Revenues (2009 Dollars)

	Forecast Annual Revenues	Typical Use of Funds (Operating or Capital)	Forecast Annual Capital Revenues	Percentage of Total Forecast Capital Annual Revenues
State Motor Vehicle Fees	$3,000,000[1]	Operating (75%) Capital (25%)	$750,000[1]	27.3%
County Gas Tax	$200,000	Operating (75%) Capital (25%)	$50,000	1.8%
City Gas Tax	$650,000	Capital (100%)	$650,000	23.6%
TIF & TDT	$300,000	Capital (100%)	$300,000	10.9%
MSTIP	$500,000[2]	Capital (100%)	$500,000[2]	18.2%
State/Federal Fees used in City	$500,000[2]	Capital (100%)	$500,000[2]	18.2%
Annual Total	**$5,150,000**		**$2,750,000**	**100%**
0-5 Year Revenues	$25,750,000		**$13,750,000**	
6-10 Year Revenues	$25,750,000		**$13,750,000**	
11-20 Year Revenues	$51,500,000		**$27,500,000**	
20 Year Revenues	**$103,000,000**		**$55,000,000**	

1 Once State Transportation Bill takes full effect in FY 2012/2013
2 Project specific. Amount listed is an estimate based on historical annual average.

SUMMARY OF NEEDS AND DEFICIENCIES

As described in the Technical Memorandum #4: Needs & Deficiencies Analysis, the forecast 2035 traffic conditions reveal roadway capacity deficiencies on several major corridors during a typical weekday p.m. peak hour. Figure 5-1 illustrates roadway capacity deficiencies anticipated in 2035 with the inclusion of improvement projects identified in the 2035 Regional Transportation Plan (RTP) Update and in the City's Capital Improvement Plan (CIP). This is consistent with Scenario 1 in the Needs & Deficiencies report.

In the Needs & Deficiencies Report, the impacts of roadway improvements in the 2002 TSP were evaluated as Scenario 2. Scenario 2 includes all of the Scenario 1 improvements, as well as planned transportation projects in the City of Tigard that were not included in the financially constrained RTP model. These were obtained from the 2002 Tigard TSP, the Washington Square Regional Center Plan, and the Highway 99W Plan, which have been adopted into the TSP. The results of the Scenario 2 analysis are summarized in Figure 5-2.

Forecast Travel Mode Splits

The travel demand forecasts used to analyze future traffic conditions (Figures 5-1 and 5-2) develops estimates of future travel modes as a function of several inputs in the model, including intersection density, transit subsidies, and parking costs. In Tigard, the model shows limited changes in travel mode shares in the 2035 horizon year. The 2005 and 2035 travel mode splits from the model are shown in Table 5-2.

Table 5-2 Tigard Travel Mode Splits (Metro Travel Demand Model)

Travel Mode	Peak Hour		All Day	
	2005	2035	2005	2035
Automobile	94%	93%	94%	93%
Single Occupant Vehicle (SOV)	54%	52%	50%	49%
Drive with Passenger	18%	18%	19%	19%
Vehicle Passenger	22%	23%	24%	25%
Transit	2%	3%	2%	2%
Walk	3%	4%	4%	4%
Bike	1%	1%	1%	1%

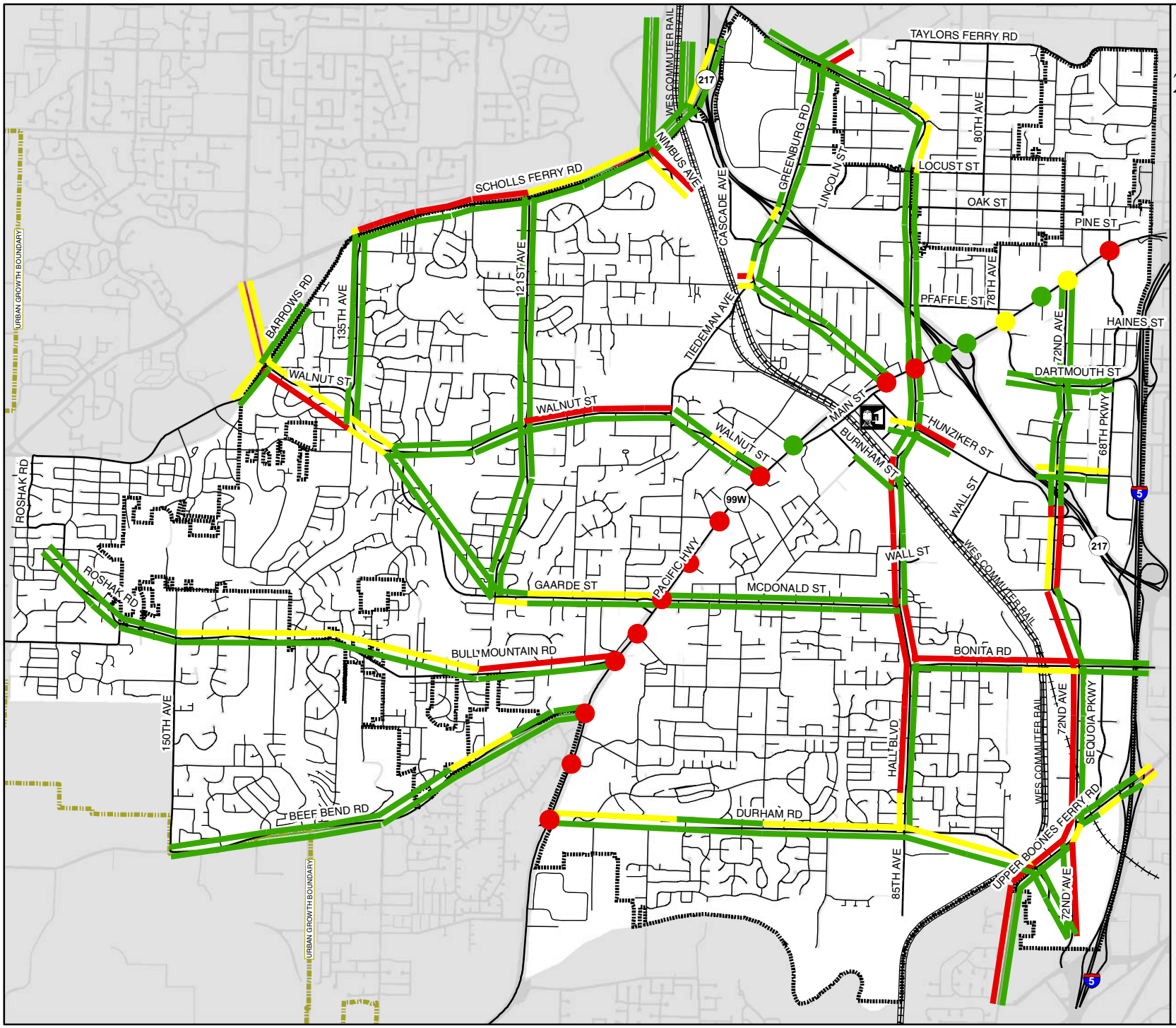

Figure 5-1

2035 Demand-to-Capacity Ratios Scenario 1

Weekday PM Peak Hour

Tigard Urban Planning Area

LEGEND

D/C Ratio

- less than 0.85
- 0.85 to 1.00
- greater than 1.00

Other Map Elements

- WES Rail Line
- Rail Lines
- Tigard City Boundary
- WES Station

** The information represented on this map is current as of February 2, 2009. Revisions will be made as new decisions or amendments occur to alter the content of the map.

TIGARD

N

0 0.15 0.3 0.6
Miles

Sources: City of Tigard
Metro Data Resource Center November 2009
Washington County

This map was derived from several databases. The City cannot accept responsibility for any errors. Therefore, there are no warranties for this product. However, any notification of errors would be appreciated.

13125 SW Hall Blvd Tigard, OR 97223 503-639-4171
http://www.tigard-or.gov

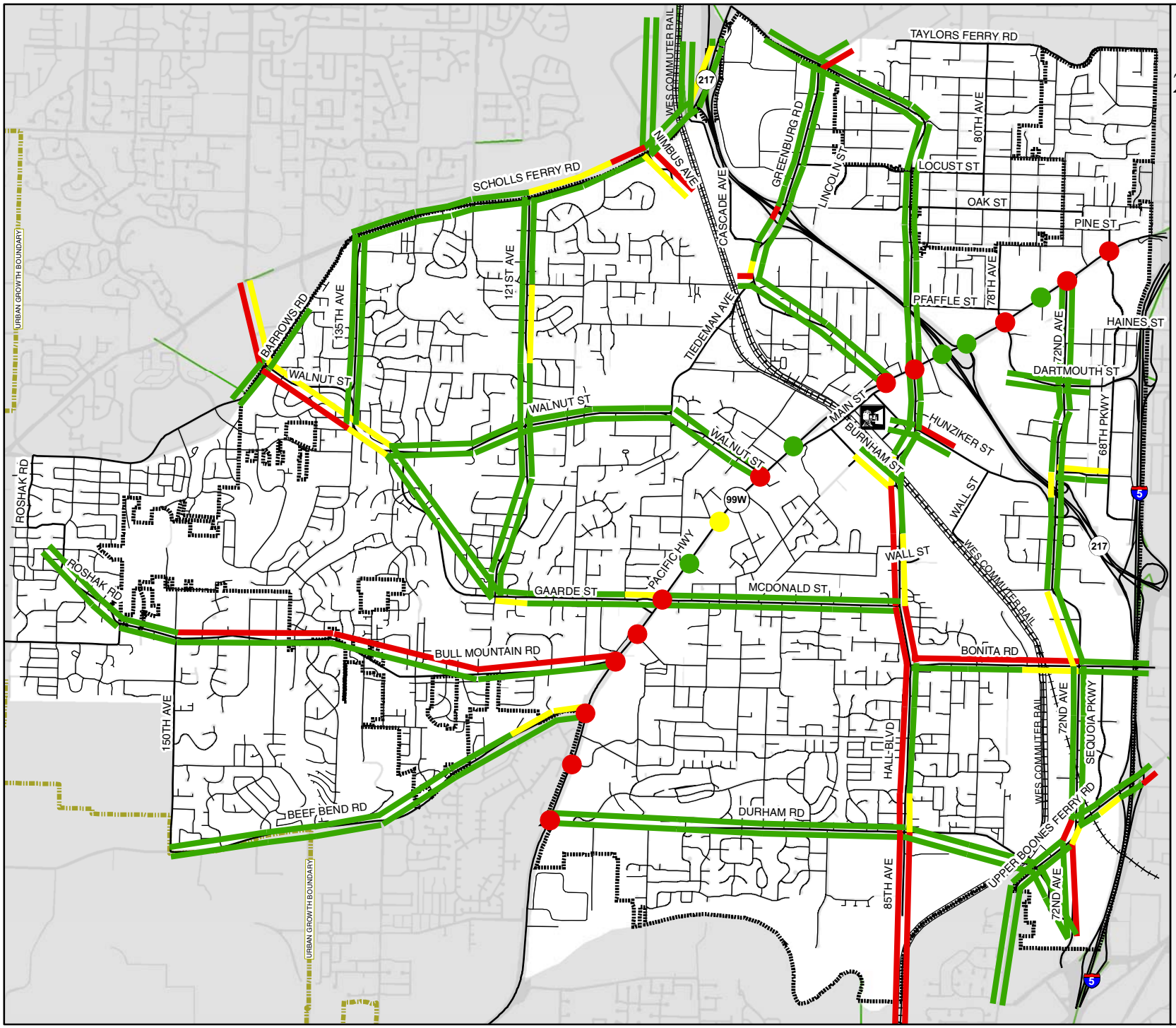

Figure 5-2

2035 Demand-to-Capacity Ratios Scenario 2

Weekday PM Peak Hour

Tigard Urban Planning Area

LEGEND

D/C Ratio

- less than 0.85
- 0.85 to 1.00
- greater than 1.00

Other Map Elements

- WES Rail Line
- WES Station
- Rail Lines
- Tigard City Boundary

** The information represented on this map is current as of February 2, 2009. Revisions will be made as new decisions or amendments occur to alter the content of the map.

TIGARD

N

0 0.15 0.3 0.6 Miles

Sources: City of Tigard
Metro Data Resource Center
Washington County
November 2009

This map was derived from several databases. The City cannot accept responsibility for any errors. Therefore, there are no warranties for this product. However, any notification of errors would be appreciated.

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http://www.tigard-or.gov

As shown in Table 5-2, the proportion of trips made by single occupant vehicle (SOV) is expected to decline only slightly by the year 2035, though they will be in the range of the targets established by the RTP. Still, the table shows that motor vehicle travel will continue to be the travel mode for 93 - percent of travel in Tigard.

Given the significant motor vehicle capacity deficiencies under forecast conditions, an increase in transit, walk, and bike mode shares is essential to the future transportation system in Tigard.

In order to achieve a balanced transportation system, and in compliance with the requirements of the RTP Update, maximum SOV mode shares are proposed for the City of Tigard and designated centers. These are summarized in Table 5-3, along with the SOV shares in the 2005 and 2035 Metro model, and the RTP target for each area type.

Table 5-3 Maximum SOV Mode Shares

Tigard Area	Travel Model		2004 RTP Target
	2005	2035	
Citywide	50%	49%	40-50%
Washington Square Regional Center	47%	46%	45-55%
Tigard Town Center (Downtown)	54%	51%	45-55%
King City Town Center	53%	51%	45-55%
Tigard Triangle	50%	49%	40-50%

While the above is consistent with the RTP and the travel demand model, the City aspires to even lower maximum SOV mode shares. Table 5-4 shows the draft mode targets for the City of Tigard as a whole, and the more aggressive targets for the regional center and town centers.

Table 5-4 City of Tigard Travel Mode Shares

Tigard Area	City Mode Share Goals				
	Maximum SOV	Carpool	Transit	Walk	Bike
Citywide	49%	43%	3%	4%	1%
Washington Square Regional Center	40%	48%	5%	5%	2%
Tigard Town Center (Downtown)	40%	48%	5%	5%	2%
Durham Road Town Center	45%	43%	5%	5%	2%
Tigard Triangle	45%	43%	5%	5%	2%

It is anticipated that the Metro classification of carpool travel will, in the near future, change to include trips which include a parent and one or more child in the car. To date, these are not considered carpool trips. When and if this change is made, the City will need to reconsider their mode split target and monitoring as the number of carpool trips will automatically increase with this reclassification of trips.

Evaluation Criteria for Transportation Improvements

The project goals and objectives were used to develop a set of evaluation criteria that are applied as an initial screening and prioritization of project concepts. Based on the project goals, the criteria were divided into seven categories: multi-modal mobility, system capacity, consistency with local/regional plans, safety, cost-effectiveness, environmental resources, and environmental justice.

The evaluation criteria were applied to new projects, projects recommended for removal from the TSP and projects that were otherwise considered critical or notable. The ratings were assigned qualitatively and were used to support the overall project evaluation. The ratings were not weighted, but were used to assess the overall quality of the project. The rating method used to evaluate the alternatives is described below (Table 5-5):

Table 5-5 Qualitative Rating System

Goal	Rating	Meaning
Multi-Modal Mobility	●	Significantly improves transportation options, or connectivity within a mode
	●	Provides some improvement to transportation options, or connectivity within a mode
	○	Does not change transportation options or connectivity
System Capacity	●	Project improves system capacity
	●	Project does not significantly change system capacity
	○	Project decreases system capacity
Consistency with other jurisdiction Local, Regional Plans	●	Included as part of other local jurisdiction, regional, and/or state plans
	●	Not mentioned in consistent with the intent of other plans
	○	Inconsistent with local jurisdiction, regional, and/or state plans
Safety	●	Provides a safety enhancement in an area with noted safety deficiency or an area with significant pedestrian and/or bicycle traffic.
	●	Provides a safety enhancement to one or more modes of travel.
	○	Provides no improvement or negative impacts to safety for any mode.
Cost -Effectiveness	●	Provides significant increases in mobility compared to the relative cost.
	●	Provides reasonable increase in mobility compared to the cost.
	○	Provides little increase in mobility compared to the cost.
Environmental Resources	●	Enhances parks, wetlands, or other environmentally sensitive areas
	●	Does not impact environmentally sensitive areas
	○	Impacts environmentally sensitive areas
Environmental Justice	●	Enhances transportation options for designated population neighborhoods
	●	No obvious impact designated population neighborhoods
	○	Negatively impacts designated population neighborhoods

ALTERNATIVES ANALYSIS

The general approach outlined in this memorandum is to find a balance of investments and policies that will best serve the current and future transportation needs of the Tigard community, including its role within the regional transportation system. This document includes a discussion of transportation systems improvements and multi-modal facilities plans. These are followed by recommendations specific to areas within Tigard that have unique objectives and constraints. The specific strategies and recommendations are organized as follows:

- Land use measures to encourage development patterns that are supportive of transit, bicycle and walk trips, and that reduce dependence on the automobile.
- Connectivity improvements that minimize the need for out-of-direction travel for all travel modes. Connectivity improvements should enhance the convenience for non-motorized travel modes and should reduce motor vehicle use of regional roadways for local trips.
- Investments in transportation system management (TSM) measures that will optimize traffic operations of the existing roadway system.
- Investments in programmatic measures that support transportation demand management (TDM), such as participation in transportation management associations.
- Policies and programs to implement access management strategies

All of the above improvements could be classified as "systems management" strategies because they are all aimed at improving conditions with a focus on increasing efficiency rather than increasing capacity. In addition to systems management strategies, a set of projects for new or expanded facilities is also provided. These include:

- Bicycle, pedestrian, and transit system improvements to facilitate local and regional travel options.
- Roadway projects to accommodate growth in motorized travel demand.

In some cases, physical infrastructure projects are a part of a TSM strategy. For example, a new roadway link may have the effect of increasing roadway capacity, but may provide a more important benefit of creating a more efficient travel path, thereby relieving constrained conditions elsewhere.

Finally, specific strategies and improvements are provided for the Washington Square Regional Center (WSRC), Tigard Triangle, and Downtown Tigard.

LAND USE

Land use patterns in the City of Tigard and surrounding areas are suburban in character, with residential areas separated from commercial areas and a relatively low density of development overall. The majority of land in Tigard is zoned for residential uses, with commercial zoning primarily along Highway 99W and in the Tigard Triangle, and industrial primarily along the WES commuter rail track south of Highway 99W. The Washington Square Regional Center (WRSC) and

Tigard Triangle also include significant mixed-use zoning. Based on current zoning and growth projections, most residential growth will occur in the west side of Tigard and south in the neighborhoods around Durham and Beef Bend Road. Employment growth is forecast to occur near major roadways, especially near Highway 217.

In addition to zoning and growth forecasts within Tigard, the Bull Mountain area west of Tigard is currently being planned for approximately 4000 additional homes. The travel demand model forecasts approximately 400 new weekday p.m. peak hour trips on Scholls Ferry Road associated with the Bull Mountain area, and another 250 trips on Highway 99W. This traffic growth forecast would be even higher (approximately 300 and 200 respectively) once the model is updated to include the higher residential numbers currently being planned.

Several land use strategies are identified to support the use of non-automobile travel modes while retaining the residential and suburban character throughout most of Tigard.

LU1- Commercial Nodes in Residential Areas

Create commercial nodes within residential neighborhoods to include small restaurants, coffee shops, or neighborhood retail. These neighborhood commercial nodes will provide residents with the opportunity to take non-work trips by bike or walking. This could be accomplished by allowing neighborhood-commercial as a permitted use in residential zones, or through designating specific nodes on the City's comprehensive plan map as neighborhood commercial. The N-C designation currently exists within the City.

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice
●	●	●	●	●	●	●

LU2 – Non-Auto Oriented Development

Encourage non-auto oriented development with mixed uses and higher densities in targeted areas, such as along Highway 99W, in the Downtown[1], and in the WSRC. Mixed use developments have been found to reduce automobile trips by supporting higher frequency transit service and promoting pedestrian and bicycle travel. For Highway 99W, this type of development should be supported in conjunction with the planned Highway 99W Land Use Study for High Capacity Transit which is expected to start in 2010. Non-auto development can be encouraged through various policies such as parking management requirements, density requirements or bonuses, and/or pedestrian, bicycle or transit mode design guides to integrate non-auto mode features and incentives directly into development.

[1] The City's comprehensive plan includes considerably higher residential densities in Downtown, which were not reflected in the Metro model.

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice
●	●	●	●	●	●	●

LU3 – Alternative Mobility Standards

Work with ODOT to develop alternative mobility standards on Highway 99W and at I-5 and Highway 217 interchanges in order to accommodate higher density development patterns along the corridor within Transportation Planning Rule requirements.

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice
●	●	●	●	●	●	●

CONNECTIVITY

As identified in the Needs & Deficiencies Report, east-west connectivity is challenged in Tigard by Highway 217, I-5, the WES commuter/freight rail line, and Fanno Creek. With only a limited number of east-west through routes, there is considerable demand placed on a few roadways.

In addition to the citywide connectivity issues, many neighborhood streets systems in Tigard are characterized by cul-de-sacs and stub streets. These are often desired because they can limit traffic speeds and volumes on local streets. However, they also result in indirect travel paths, longer trips, limitations to pedestrian and bicycle mobility, and a reliance on arterials for local trips. Opportunities for new roadway connections are limited and may be very expensive due to natural barriers, terrain, or the built environment.

An additional negative impact of this development pattern is cut-through travel. With congested arterials, travelers will find less direct, but uncongested routes through neighborhoods. Cut-through travel is often at higher speeds than appropriate for a residential street. This will have a negative impact on livability and, to the extent that cut-through trips occur on a commercial street (e.g. Main Street) this could have a negative impact on local business. As improvements are considered and prioritized, the potential to positively or negatively impact cut-through trips should be considered.

As new development occurs, new roadways should be constructed to create a more efficient network consistent with the RTP guidelines. The City does not have an up-to-date inventory of existing street stubs. Such an inventory would be used by staff to identify potential new connections during development review.

In addition to roadway connectivity, bicycle and pedestrian facilities should be provided to make these travel modes more convenient and efficient. The recently adopted Tigard Neighborhood

Trails Plan identifies 42 off-street trail projects to improve connectivity and reduce out of direction travel. These projects will be implemented by the City as funding becomes available.

C1 – Connectivity Inventory

Create a comprehensive inventory (likely GIS-based) of street stubs and potential future roadway connections. The inventory should identify priority future connections that could be implemented with development or through dedicated public projects.

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice
●	●	●	●	●	●	●

C2 – Spacing Requirements

Evaluate connectivity spacing in the current code and determine recommended spacing for future development in the City.

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice
●	●	●	●	●	●	●

C3 – Developer Connectivity Improvements

Ensure that development code policies require new roadway or multi-modal connections in project mitigations, as appropriate for associated impacts.

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice
●	●	●	●	●	●	●

ACCESS MANAGEMENT

Access management describes a practice of managing the number, placement, and movements of intersections which provide access to adjacent land uses with the traffic flow, safety, capacity, and speed on the surrounding road system. Within developed areas, access management strategies may include shared or consolidated access points, restrictions on access point movements (medians, channelized movements), or closing access points. Access management provides several potential benefits, such as reducing crashes and crash rates and increasing capacity on the main roadway by maintaining vehicle flows and speeds.

In addition, well deployed access management strategies can greatly improve travel conditions for pedestrian and bicycles. Eliminating the number of access points on roadways reduces the number of potential interruptions and conflict points between pedestrians, bicyclists, and cars.

Access management is typically adopted as a policy in development guidelines. It can be extremely difficult to implement an access management program once properties have been developed along a corridor. Cooperation among and involvement of relevant government agencies, business owners, land developers and the public is necessary to establish an access management plan that benefits all roadway users and businesses.

The City has adopted the Highway 99W plan which includes access management policies and programs. The City will pursue this access management plan.

TRANSPORTATION SYSTEM MANAGEMENT

TSM strategies include a wide variety of measures aimed at improving operations of existing transportation facilities. TSM measures can be focused on improving transportation "supply" through enhancing capacity and efficiency, typically with advanced technologies to improve traffic operations. Or they may be focused on reducing transportation demand, through promoting travel options and ongoing programs intended to reduce demand for drive alone trips, especially during peak travel periods. Several TSM strategies are identified for application in Tigard in existing plans, including the RTP Update and the Highway 99W Plan. Some of the key strategies identified for consideration in Tigard are summarized below.

Signal Retiming/Optimization

Signal retiming and optimization refers to updating timing plans to better match prevailing traffic conditions and coordinating signals. Timing optimization can be applied to existing systems or may include upgrading signal technology, including signal communication infrastructure or signal controllers or cabinets. Signal retiming can reduce travel times and be especially beneficial to improving travel time reliability. Signal retiming could also be implemented to improve or facilitate pedestrian movements through intersections by increasing minimum green times to accommodate pedestrian crossing movements during each cycle in high pedestrian or desired pedestrian traffic areas, eliminating the need to push pedestrian crossing buttons. Bicycle movements could be facilitated by installing bicycle detection along major bicycle routes. Signal upgrades often come at a higher cost and usually require further coordination between jurisdictions.

Advanced Signal Systems

Advanced signal systems incorporate various strategies in signal operations to improve the efficiency of a transportation network. Strategies may include coordinated signal operations across jurisdictions as well as centralized control of traffic signals. Advanced signal systems can reduce delay, travel time and the number of stops for vehicles, while potentially increasing average vehicle speed. In addition, these systems may help reduce vehicle emissions and have a high impact on improving travel time reliability.

The detection system, controller hardware, and software required at intersections depend on the signal system strategy. In order to implement an advanced signal system, an inventory of the existing hardware and software on the roadways would be performed. The signal controllers on Highway 99W have recently been updated to type 2070 controllers; however many of the remaining signals in Tigard operate model 170 traffic controllers.

Of the 79 signals in the City of Tigard, 47 are owned and maintained by ODOT; the rest are maintained by Washington County. Coordination with ODOT and Washington County will be necessary for signal upgrades and implementing advanced signal systems. Any strategies that may be implemented would require coordination between the jurisdictions that own and operate the signals.

Advanced signal systems may be applied to several innovative control strategies. The costs of these systems vary as a function of the types of controllers, programming needs and detection needs. Implementing any of these systems in Tigard would require coordination with ODOT and/or Washington County. Alternative signal systems include:

- **Adaptive or active signal control** systems improve the efficiency of signal operations by actively changing the allotment of green time for vehicle movements and reducing the average delay for vehicles. Adaptive or active signal control systems require several vehicle detectors at intersections in order to detect traffic flows adequately, in addition to hardware and software upgrades.
- **Traffic responsive control** uses data collected from traffic detectors to change signal timing plans for intersections. The data collected from the detectors is used by the system to automatically select a timing plan best suited to current traffic conditions. This system is able to determine times when peak-hour timing plans begin or end; potentially reducing vehicle delays.
- **Transit signal priority** systems use sensors to detect approaching transit vehicles and alter signal timings to improve transit performance. This improves travel times for transit, reliability of transit travel time, and overall attractiveness of transit. The City of Portland has the only system of bus priority in the region, which is applied on most of the major arterial corridors throughout the city.
- **Truck signal priority** systems use sensors to detect approaching heavy vehicles and alter signal timings to improve truck freight travel. While truck signal priority may improve travel times for trucks, its primary purpose is to improve the overall performance of intersection operations by clearing any trucks that would otherwise be stopped at the intersection and subsequently have to spend a longer time getting back up to speed. Implementing truck signal priority requires additional advanced detector loops, usually placed in pairs back from the approach to the intersection.

Real-Time Traveler Information

Traveler information consists of collecting and disseminating real-time transportation system information to the traveling public. This includes information on traffic and road conditions, general public transportation and parking information, interruptions due to roadway incidents, roadway maintenance and construction, and weather conditions. Traveler information is collected from roadway sensors, traffic cameras, vehicle probes, and recently media access control (MAC) devices such as cell phones or laptops. Data from these sources are sent to a central system and subsequently disseminated to the public so that drivers track conditions specific to their cars and can provide historical and real-time traffic conditions for travelers.

When roadway travelers are supplied with information on their trips, they may be able to avoid heavy congestion by altering a travel path, delaying the start of a trip, or changing which mode they choose to use. This can reduce overall delay and fuel emissions. Traveler information projects can be prioritized over increasing capacity on roadway, often with high project visibility among the public.

Real-Time Transit Information

Transit agencies or third-party sources can disseminate both schedule and system performance information to travelers through a variety of applications, such as in-vehicle, wayside, or in-terminal dynamic message signs, as well as the Internet or wireless devices. Coordination with regional or multimodal traveler information efforts can increase the availability of this transit schedule and system performance information. TriMet has implemented this through its Transit Tracker system.

These systems enhance passenger convenience and may increase the attractiveness of transit to the public by encouraging travelers to consider transit as opposed to driving alone. They do require cooperation and integration between agencies for disseminating the information.

Transportation Demand Management (TDM)

Transportation or travel demand management (TDM) can be considered an example of a TSM strategy because it improves the efficiency of a given transportation system without necessarily increasing roadway capacity. TDM describes a wide range of measures designed to reduce motor vehicle travel, especially during peak hours, by influencing the mode choice, automobile occupancy, or time of travel. TDM measures are addressed in more detail in a later section.

ACCESS MANAGEMENT AND TSM APPLICATION IN TIGARD

The access management and TSM strategies recommended for implementation in Tigard are summarized in Table 5-6. These include strategies identified in the RTP Update, the Highway 99W Plan, the 2002 TSP, and also strategies identified for the TSP Update.

Table 5-6 TSM and Access Management Strategies for Tigard

Roadway	Strategy	Estimated Benefit	Source
Highway 217	Transit priority treatment	5% Increase in Capacity	Metro Draft TSMO Plan
	Real time information at Scholls Ferry Road, Hall Blvd and Greenburg Rd interchanges, tied to parking availability at Washington Square Mall during peak days.		Tigard TSP Update
	Enhanced data collection		Tigard 2010 TSP Update
Highway 99W	Active Corridor Management, including upgrade of signal controllers, wireless detection, and updated timing plans.	10% Increase in Capacity	Currently underway by ODOT/City
	Transit priority, with queue bypasses at several locations		Highway 99W Plan
	Access management		Highway 99W Plan
	High capacity transit		Regional High Capacity Transit System Plan
Scholls Ferry Road	Install integrated corridor management equipment.	5% Increase in Capacity	RTP FC project list (10602), $1,109,000
	Arterial corridor management with adaptive signal timing and transit signal priority		Metro Draft TSMO Plan
Hall Boulevard	Arterial corridor management with transit priority	5% Increase in Capacity	Metro Draft TSMO Plan
	Access management		Tigard 2002 TSP
72nd Avenue	Arterial corridor management	5% Increase in Capacity	Metro Draft TSMO Plan
	Truck signal priority south of Highway 217		Tigard 2010 TSP Update
Durham Road	Arterial corridor management	5% Increase in Capacity	Metro Draft TSMO Plan

Implementation of the TSM strategies identified in Table 5-6 will require coordination with ODOT and Washington County, which operate the traffic signals in the City of Tigard.

The effectiveness of the access management and TSM strategies summarized in Table 5-6 were evaluated using the regional travel demand model. While the model does not capture each specific access management and TSM measures, the analysis of the measures was conducted by assigning an increase in capacity along each corridor to reflect the optimized efficiency of corridor. Capacity increases applied to each corridor ranged from five to ten percent, depending on the extent of TSM implementation identified. The changes in estimated travel times along each of the corridors are summarized in Table 5-7.

Table 5-7 Travel Time Savings from TSM Strategies, 2035 Weekday PM Peak Period

Corridor	From/To	Direction	Capacity Improvement	Initial Travel Times (sec)	Improved Travel Times (sec)	Percentage of Improvement
Highway 99W	68th to Durham	WB	10%	504	488	-3.2%
		EB	10%	459	450	-2.0%
Scholls Ferry Road	Cascade to Barrows	WB	5%	190	188	-1.1%
		EB	5%	166	166	0.0%
Hall Boulevard	Greenburg to Durham	SB	5%	542	530	-2.2%
		NB	5%	482	477	-1.0%
72nd Avenue	Dartmouth to Upper Boones Ferry	SB	5%	330	322	-2.4%
		NB	5%	294	292	-0.7%
Durham Road	Highway 99W to Upper Boones Ferry Road	WB	5%	291	285	-2.1%
		EB	5%	260	260	0

Table 5-7 shows that the potential benefits from the access management and TSM strategies are improved travel times along these corridor segments by up to 3.2 percent during a forecast 2035 weekday p.m. peak period. It is possible that some corridors could see greater travel time savings if specific systems are managed to achieve this specific outcome.

Metro has a Draft Regional Transportation Systems Management and Operations (TSMO) Plan that incorporates many of the above strategies including 72nd Avenue, Durham Road, Highway 99W, Hall Boulevard, and Scholls Ferry Road. These are shown in Table 5-8. In addition, the Metro Draft TSMO Plan includes TSM projects on Upper Boones Ferry Road. The Metro TSMO Plan also includes Travel Demand Management Projects which are discussed in the following section. The complete list of TSMO projects for the Regional Mobility Corridors in Tigard are provided in Appendix A.

Table 5-8 Tigard TSM Projects in the Metro TSMO Plan

Project/Program Name	Project Description	Total Cost
ACM[1] on Upper Boones Ferry Road (Corridor #2)	Improve arterial operations by expanding traveler information and upgrading traffic signal equipment and timings. Install upgraded traffic signal controllers, establish communications to the central traffic signal system, provide arterial detection (including bicycle detection where appropriate) and routinely update signal timings. Provide real-time and forecasted traveler information on arterial roadways including current roadway conditions, congestion information, travel times, incident information, construction work zones, current weather conditions and other events that may affect traffic conditions. Also includes on-going maintenance and parts replacement.	$1,300,000 (C[2]) $25,000 (O[3])
ACM on Upper Boones Ferry Road (Corridor #19)		$1,300,000 (C) $25,000 (O)
ACM on 72nd Avenue (Corridor #2)		$1,600,000 (C) $30,000 (O)
ACM on 72nd Avenue (Corridor #19)		$1,700,000 (C) $35,000 (O)
ACM on Durham Road(Corridor #2)		$1,400,000 (C) $30,000 (O)
ACM on Durham Road (Corridor #19)		$1,500,000 (C) $30,000 (O)
ACM with Adaptive Signal Timing and Transit Priority Treatment on Highway 99W (from Downtown Portland past Highway 217)	Includes the ACM with both adaptive signal timing and transit priority treatment	$3,400,000 (C) $70,000 (O)
ACM with Transit Priority Treatment on Hall Boulevard (Corridor #2)	Includes the ACM project with transit signal priority added to traffic signals along a facility	$3,700,000 (C) $70,000 (O)
ACM with Transit Priority Treatment on Hall Boulevard (Corridor #19)		$1,900,000 (C) $40,000 (O)
ACM with Transit Priority Treatment on Scholls Ferry Road (from Hall Boulevard to the Beaverton-Hillsdale Highway)		$1,700,000 (C) $35,000 (O)
ACM with Transit Priority Treatment on Scholls Ferry Road (from River Road to Hall Boulevard)		$4,200,000 (C) $80,000 (O)
ACM with Transit Priority Treatment on Highway 99W (from Highway 217 to 124th Avenue)		$4,200,000 (C) $80,000 (O)

Notes: [1] ACM - Arterial Corridor Management
[2] C - Capital Cost
[3] O - Operating and Maintenance Cost

TRANSPORTATION DEMAND MANAGEMENT

TDM measures include any method intended to shift travel demand from single occupant vehicles to non-auto modes or carpooling, travel at less congested times of the day, or to locations with more available vehicle capacity. Some common examples of TDM strategies include programs such as carpool matching assistance or flexible work shifts; parking management strategies; direct financial incentives such as transit subsidies; or facility or service improvements, such as bicycle lockers or increased bus service.

Some of the most effective TDM strategies are best implemented by employers and are aimed at encouraging non-SOV commuting. Strategies include preferential carpool parking, subsidized transit passes, and flexible work schedules. Cities and other public agencies can play a critical role in support of TDM through provision of facilities and services, as well as development policies that encourage TDM.

While many TDM strategies are most effectively implemented by employers, there are numerous strategies that cities can implement or support with other agencies. These include access management and connectivity strategies that are more often associated with roadway elements of planning. Other strategies include provision of facilities (sidewalks, bicycle lanes, transit amenities) and management of existing resources (parking). Another critical role that cities play is in the policies related to development activities. Through support, incentive, and mandate, cities can ensure that new development supports a balanced transportation system. Several broad TDM strategies are summarized in Table 5-9. The table also identifies typical implementation roles.

Table 5-9 TDM Strategies and Typical Implementing Roles

TDM Strategy	City	Transportation Management Association	Developers	TriMet	Employers	Metro	State
Public parking management	P		S	S	S		
Flexible parking requirements	P		S		S		
Access management *	P					S	P
Connectivity standards*	P		S			S	P
Pedestrian facilities	P		S		S		S
Bicycle facilities	P		S				S
Transit stop amenities	S		S	P		S	
Parking management	P		S		S		
Limited parking requirements	P		S			S	
Carpool match services	S	P			S		
Parking cash out		S		S	P		
Subsidized transit passes				S	P	S	
Carsharing program support	P	S	S	S	S		

P: Primary role;
S: Secondary/Support role
* Primary implementation depends on roadway jurisdiction

Metro has a Draft Regional Transportation Systems Management and Operations (TSMO) Plan that incorporates many of the above strategies including parking management, providing more bicycle facilities, and supporting Transportation Management Associations (TMAs). Examples are shown in Table 5-10. *The complete list of TSMO projects for the Regional Mobility Corridors in Tigard are provided in Appendix A.*

Table 5-10 Tigard TDM Projects in the Metro TSMO Plan

Project/Program Name	Project Description	Total Cost
Individualized Marketing in the Tigard Town Center and adjacent neighborhoods	Implement and/or support intensive outreach to targeted neighborhoods that encourages use of travel options through delivery of local travel options information and services to interested residents. (In support of Portland/Multnomah County Climate Change Action Plan.)	$0 (C[1]) $500,000 (O[2])
Transportation Management Associations (TMA)	Support public-private partnerships in regional or town centers that assist employees and/or residents increase use of travel options. Westside Transportation Alliance serves employers	$0 (C) $300,000 (O)
Parking Management at the Washington Square Regional Center	Convene stakeholders to plan and implement parking management strategies. Ideally this action raises revenues to expand TDM solutions	$0 (C) $200,000 (O)* (*100,000 over the next 1-5 years, and 100,000 over the next 6-10 years)
Parking Management at the Tigard Town Center		$0 (C) $200,000 (O)* (*100,000 over the next 1-5 years, and 100,000 over the next 6-10 years)
Bike Sharing at transit oriented developments, large employers, colleges, hotels, and significant transit stops in the Beaverton to Tigard Corridor	Provide funding to implement bikes for loan or rent	$100,000 (C) $50,000 (O)

Notes: [1] C - Capital Cost
[2] O - Operating and Maintenance Cost

The City of Tigard does not have a dedicated TDM program, however, the Westside Transportation Alliance (WTA) is a transportation management association (TMA) serving Washington County. The WTA assists employers in developing, implementing, and monitoring programs to reduce commute trips by SOV. The City of Tigard is a member of the WTA, as are most neighboring jurisdictions and many private employers. While the emphasis at WTA is to help employers create TDM programs, the WTA web site provides an "information hub" that individuals can use to find out about a myriad of travel options, including transit service, park-and-ride lots, bicycling, carpool matching, and other services.

Specific Strategies the City of Tigard could implement include:

TDM 1 Develop and implement a comprehensive TDM program

1a - Establish Mode Split Targets

The City of Tigard intends to adopt non-single occupant vehicle mode split targets that are more aggressive than the targets currently adopted by Metro. Table 5-4 shows the targets planned for the City as a whole, downtown Tigard, and the *2040 Centers* in Tigard.

1b - Hire or designate a TDM Coordinator

Designate a staff TDM Coordinator to develop city wide TDM programs, develop and implement TDM programs for City staff, and as appropriate participate in *Westside Transportation Alliance* and support the development of local Transportation Management Associations (See Tigard Triangle special area discussion).

1c – Conduct surveys to identify and track mode splits

Develop a program to identify and track existing travel modes within the City as a whole, downtown Tigard, and the *2040 Centers* in Tigard. Conduct surveys regularly (e.g. every three years) in order to track progress in TDM implementation.

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost-Effectiveness	Environmental Resources	Environmental Justice
●	●	●	●	●	●	●

TDM 2 Review and update development requirements to integrate TDM supportive policies

Review existing development code requirements to identify policies and requirements to support TDM. Policies could be implemented or modified to include parking management (e.g. shared parking, carpool parking, pricing), pedestrian and bicycle infrastructure, bicyclist end of trip facilities (e.g. lockers, showers, changing rooms), employer TDM programs, transit subsidies, and/or shuttle programs.

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost-Effectiveness	Environmental Resources	Environmental Justice
●	●	●	●	●	●	●

TDM 3 Develop and Implement Program Similar to "Portland Smart Trips"

With a Staff member dedicated to TDM, the City of Tigard could develop and implement a program similar to the City of Portland "SmartTrips" program.

Smart Trips is an individualized marketing program modeled on "TravelSmart" which is a program in Australia and Europe to reduce drive-alone trips and increase walking, bicycling, transit, and carpool trips. The individualized marketing methodology hand-delivers packets of information to residents who wish to learn more about all their transportation options including transit, walking, bicycling, carpooling, car sharing, and combining trips in their neighborhoods. Key components feature biking and walking maps and organized activities that get people out in

their neighborhoods or places of employment to shop, work, and discover how many trips they can easily, conveniently, and safely make without using a car. Success is tracked by evaluating qualitative and quantitative results from surveys and other performance measures[2].

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost-Effectiveness	Environmental Resources	Environmental Justice
○	○	●	●	●	●	●

Additional Projects for Consideration

Tigard Transit Connector

As development revives and accelerates in Downtown and in the Tigard Triangle, and in connection with the upcoming High Capacity Transit planning, the City of Tigard should consider implementing local connector transit service. This service could connect the Tigard Triangle to Downtown, and/or the Washington Square Mall. The service should have schedules coordinated with other transit service (e.g. WES and Tri-Met bus service) to and from Tigard. Another option for a local transit connector would be to provide an intra-city connection between the Tigard Triangle and the Walnut/Barrows Road intersection. The primary purpose of this connection would be to provide local access to the Tigard Triangle through the residential neighborhoods, with a potential connection to Highway 99W. Because these routes wouldn't significantly enhance regional service, it may be most appropriate for Tigard to lead the implementation of this service with support from TriMet. Partial funding could potentially be provided through the Tigard Triangle LID.

PEDESTRIAN

Pedestrian facilities are the elements of the network that enable people to walk safely and efficiently on the transportation system. These facilities include facilities for pedestrian connectivity (sidewalks, mixed-use trails) as well as safe crossing locations (unmarked and marked crosswalks, crossing beacons, pedestrian refuge islands). Each plays a role in developing a comprehensive pedestrian network which can promote both walking trips and multi-modal trips such as using a combination of walking and transit to complete a trip.

The pedestrian system within Tigard includes sidewalks, multi-use paths, and pedestrian only paths. Arterials and collectors in Tigard generally provide sidewalks alongside the roadway, but there are gaps in the system and locations where there are opportunities to improve pedestrian facilities. Pedestrian improvements should be prioritized based on their ability to complete connections between places that generate pedestrian trips such as schools and housing; housing and transit stops; and, employment and transit stops.

[2] Case Study of City of Portland SmartTrips Program http://www.walkinginfo.org/library/details.cfm?id=3961

Multi-use path projects are discussed in a subsequent section because of their utility for both pedestrians and bicyclists.

Types of Pedestrian Facilities

Ideally, all streets in the Tigard transportation network would have sidewalks on both sides, and current City of Tigard development standards require that sidewalks are included as a part of new construction. However, sidewalks are often present on only one side of the roadway or contain several gaps in continuity. Accordingly, the pedestrian facility projects in Tigard have been separated into two categories: sidewalks - both sides of the street, and sidewalks - fill in the gaps.

Sidewalks—both sides of street – These projects consist of installing sidewalks on both sides of existing roadways, which do not provide sidewalks or parallel multi-use pathways. These projects may require additional right-of-way.

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice
●	●	●	●	●	●	●

Sidewalks—fill in gaps – These projects include completing pedestrian facilities on sidewalks that are discontinuous or have short gaps on one side of the street or both.

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice
●	●	●	●	●	●	●

Table 5-11 summarize the proposed pedestrian improvements.

Pedestrian Crossings

Pedestrian crossing locations allow for walking trips to connect across facilities to continue along pedestrian facilities. In addition to the need for sidewalks along arterial and collector roadways, there are several high-volume roadways that bisect Tigard and need improvements to increase the ease and safety of pedestrian crossings. In particular, the rail corridor near Highway 217 in Tigard is difficult for pedestrians to cross due to infrequent crossings, which may not include proper pedestrian facilities. Access across the railroad tracks is increasingly important, with the introduction of WES commuter rail service.

Several streets (Gaarde, McDonald, Bull Mountain, sections of Hall) were identified as locations with challenging crossing conditions for pedestrians. These tend to be streets with relatively high traffic volumes, but infrequent signalized intersections or other protected crossing locations. While the state of Oregon considers all unsignalized intersections legal crosswalks, and motor vehicles are required to yield the right of way to pedestrians to allow them to cross, there are still challenges for pedestrians at these locations. Compliance is not consistent and pedestrians may have difficulty

crossing higher volume roadways. There are several different types of pedestrian crossing treatments available, each applicable under a different range of factors.

A brief description of the various pedestrian crossing types is provided below along with the evaluation criteria for each type of facility.

Grade-Separated Crossing – Grade-separated crossings are either underpasses or overpasses that allow pedestrians to entirely avoid conflicts with automobiles when crossing a busy roadway. When used as part of a multi-use path, grade-separated crossings also accommodate bicycles. Grade-separated crossings are necessary wherever pedestrian crossings of freeways are constructed and in other limited circumstances, such as railroad crossings. However, they are often perceived as unsafe (especially under-crossings), and may result in significant out-of-direction travel for pedestrians, grade-separated crossings should be used sparingly. Grade-separated crossings can be relatively expensive to build.

As shown in the evaluation criteria summary below, grade separated crossings can enhance multi-modal mobility and safety but may not be as cost effective as other potential alternatives.

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice
●	●	●	●	○	○	●

Pedestrian Hybrid Signal – The pedestrian hybrid signal is a pedestrian-actuated hybrid signal that would interrupt traffic on the mainline to provide a protected crossing for pedestrians at an unsignalized location. Pedestrian hybrid signals have been recommended for inclusion in the upcoming edition of the MUTCD, and final approval is not likely until 2010. Until then use of the hybrid signals are subject to the experimental MUTCD approval process. Warrants for the installation of pedestrian-actuated hybrid signals have been proposed based on the number of pedestrians per hour (PPH), vehicles per hour on the roadway for the crossing, and the length of the crosswalk. Thresholds are available for two types of roadways: locations where prevailing speeds are above 35 mph and locations where prevailing speeds are below 35 mph.

Pedestrian Hybrid Signal Example

As shown in the evaluation criteria summary below, pedestrian hybrid signals can enhance multi-modal mobility and safety.

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice
●	◍	◍	●	●	◍	●

Signalized Intersection – This option would require review of signal warrants according to the MUTCD (Reference 2) to determine if a signal is warranted at an intersection based on the number of pedestrian crossings. The MUTCD requires pedestrian crossing volumes of 190 pedestrians during one peak hour, or 100 or more during each of four hours. These conditions are relatively rare, but in Tigard they may exist near public schools.

As shown in the evaluation criteria summary below, signalized intersections can enhance multi-modal mobility and safety but may not be as cost effective as other potential alternatives.

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice
●	◍	◍	●	○	◍	●

Rectangular Rapid Flashing Beacon – RRFBs consist of user-actuated amber LEDs, which have an irregular flash pattern similar to emergency flashers on police vehicles. These supplement warning signs at unsignalized intersections or mid-block crosswalks. As shown in the evaluation criteria summary below, RRFBs can enhance multi-modal mobility and safety.

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice
●	●	●	●	●	●	●

Raised Pedestrian Refuge – This option provides a pedestrian refuge in the roadway median, allowing a two-stage crossing to occur if needed. The *ODOT Traffic Manual* (Reference 1) states that for state highways a raised median, in combination with a marked crosswalk is desired when average daily traffic (ADT) volumes are greater than 10,000.

As shown in the evaluation criteria summary below, raised pedestrian refuges provide enhanced multi-modal mobility, safety, and provide benefits to populations in environmental justice areas.

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice
●	●	●	●	●	●	●

Marked Crosswalks – Marked crosswalks are painted roadway markings that indicate the location of a crosswalk to motorists. Marked crosswalks can be accompanied by signs, curb extensions and/or median refuge islands, and may occur at intersections or at mid-block locations. By increasing the visibility of crosswalks, marked crosswalks can improve driver yield rates to pedestrians on many facilities. In general, median refuge islands should be included with marked crosswalks to improve pedestrian safety wherever crossing distances are significant, pedestrian volumes are above average, vehicle speeds are above a residential standard, vehicle volumes make full crossings difficult, physical space is available, and/or pedestrians in the area are incapable of full crossings at standard pedestrian rates of speed.

Marked Crosswalk Example

Research has shown that marked crosswalks in certain situations do not improve pedestrian safety and can even make it worse. Recent research indicates that on multi-lane roadways (more than two lanes), marked crosswalks should not be installed without accompanying treatments (e.g., signalization) when traffic volumes exceed 12,000 ADT (no median refuge island) or 15,000 ADT (with median island).[3]

As shown in the evaluation criteria summary below, if applied appropriately, marked crosswalks can enhance multi-modal mobility and safety.

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice
●	●	●	●	●	●	●

Unmarked Crosswalks – Under Oregon law, pedestrians have the right-of-way at any unsignalized intersection. On narrow, low-speed streets unmarked crosswalks are generally sufficient for pedestrians to cross the street safely, as the low-speed environment makes drivers more responsive to the presence of pedestrians. However, drivers are less likely to yield to pedestrians at unmarked

[3] Zegeer, C., et. al. *Safety Effects of Marked versus Unmarked Crosswalks at Uncontrolled Locations: Final Report and Recommended Guidelines,* Report No. HRT-04-100. Federal Highway Administration. Washington, DC. September 2005.

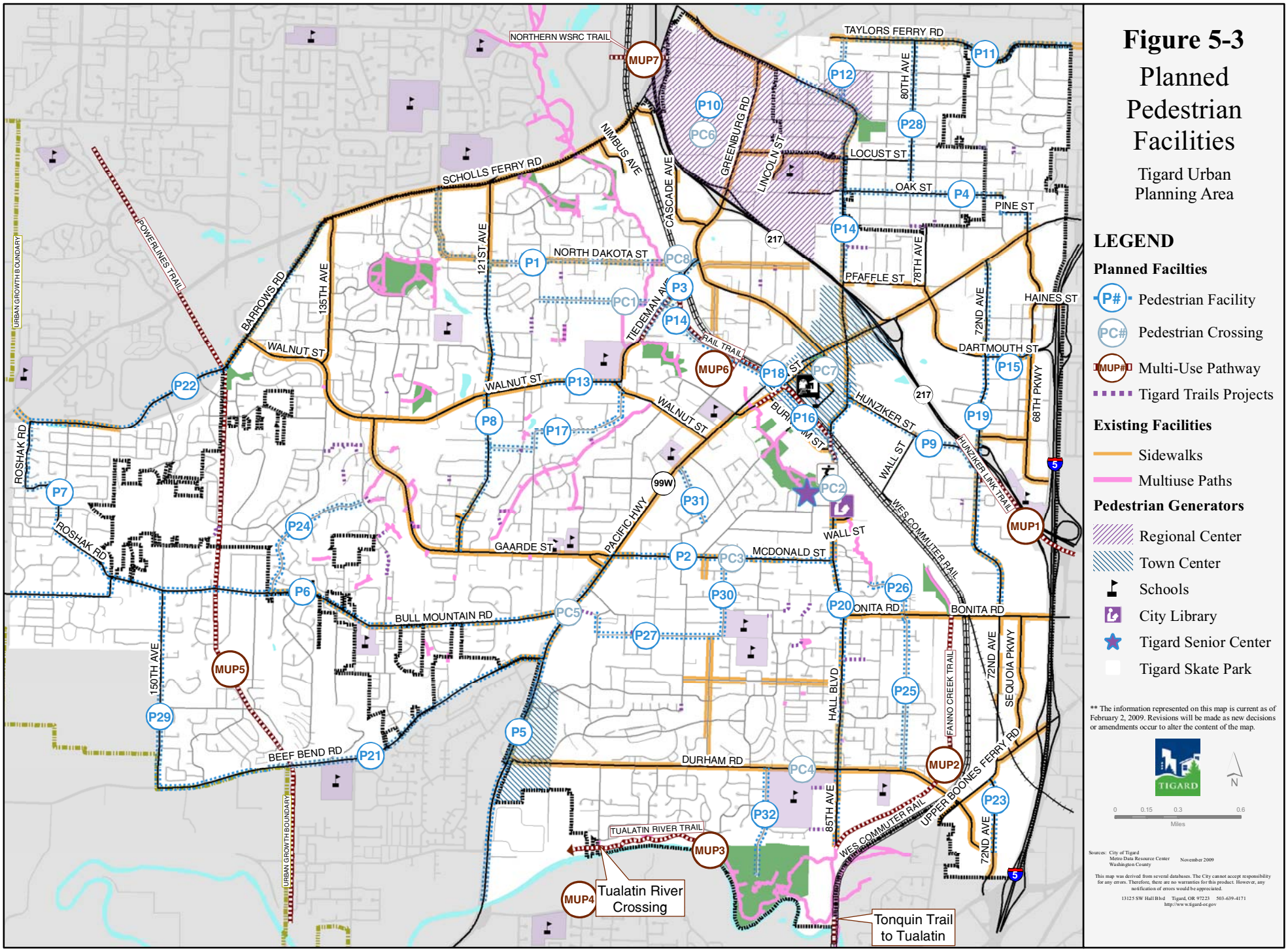
crosswalks on high-speed and/or high-volume roadways, even when the pedestrian has stepped onto the roadway. In these situations, pedestrian crossing facilities are needed to delineate the pedestrian right-of-way and remind drivers that they must yield when pedestrians are present.

Unmarked Crosswalk Example

As shown in the evaluation criteria summary below, unmarked cross-walks have little to no impact to multi-modal mobility, system capacity, environmental resources.

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice
●	●	●	●	●	●	●

Figure 5-3 and Table 5-11 summarize the proposed pedestrian crossing enhancement projects.



Notes: Pedestrian facilities are only shown for arterial and collector streets
Regional and Town Centers are designated Pedestrian Districts in the Draft 2035 Regional Transportation Plan

Table 5-11 Pedestrian Improvement Projects

No.	Source	Project Roadway	From	To	Description	Total Cost (2009$)	Priority	Jurisdiction
Sidewalk Gap Projects								
P1	2002 TSP	North Dakota Street	121st Avenue	Greenburg Road	Complete gaps in sidewalk, mainly on south side of street	$493,992	High	Tigard
P2	2002 TSP	McDonald Street	Highway 99W	Hall Boulevard	Complete gaps in sidewalk on alternating sides of street	Shared	High	Tigard
P5	2002 TSP	ORE 99W	McDonald Street	South City Limits	Complete gaps in sidewalk south of King City Town Center	$1,073,897	High	ODOT
P6	2002 TSP	Bull Mountain Road	Highway 99W	West City Limits	Complete gaps in sidewalk between Hazeltree Terrace and 120th Place	$2,577,352	Medium	WACO
P7	2002 TSP	Roshak Road	Bull Mountain Road	Barrows Road	Complete gaps in sidewalk, mainly between 158th Terrace and Bull Mountain Road	$644,338	Medium	Tigard
P10	2002 TSP	WSRC	Pedestrian Improvements		General pedestrian improvements included in the RTP	$8,683,800	Medium	Private
P13	2002 TSP	Walnut Street	114th Terrace	Tiedeman Avenue	Complete gaps in sidewalk opposite the middle school on Walnut Street	Shared	High	Tigard
P14	2002 TSP	Hall Boulevard	Oak Street	Pfaffle Street	Complete gaps in sidewalk, mainly north of the WSRC and south of Oak Street	Shared	High	ODOT
P19	2002 TSP	72nd Avenue	Highway 99W	Bonita Road	Complete gaps in sidewalk on alternating sides of street	Shared	Medium	Tigard
P20	2002 TSP	Hall Boulevard	North of Hunziker Street	South City Limits	Complete gaps in sidewalk on alternating sides of street	Shared	Medium	ODOT
P22	2002 TSP	Barrows Road	Walnut Street	Scholls Ferry Road	Complete gaps in sidewalk on both sides of street near 105th Avenue	$2,040,404	Medium	WACO/ Beaverton
Total Sidewalk Gap Project Costs						**$15,513,783**		
New Sidewalk Projects								

No.	Source	Project Roadway	From	To	Description	Total Cost (2009$)	Priority	Jurisdiction
P3	2002 TSP	Tiedeman Avenue	Walnut Street	Greenburg Road	Install sidewalk on both sides of street	$429,559	High	Tigard
P4	2002 TSP	Oak Street	Hall Boulevard	71st Avenue	Install sidewalk on both sides of street	$1,073,897	High	WACO
P8	2002 TSP	121st Avenue	Gaarde Street	North Dakota Street	Install sidewalk on both sides of street	Shared	Medium	Tigard
P9	2002 TSP	Hunziker Street	Hall Boulevard	72nd Avenue	Install sidewalk on both sides of street	$536,948	Medium	Tigard
P11	2002 TSP	Taylor's Ferry Rd	Washington Drive	62nd Avenue	Install sidewalk on both sides of street	$2,147,793	Low	WACO
P12	2002 TSP	Washington Drive	Hall Boulevard	Taylors Ferry Road	Install sidewalk on both sides of street	$429,559	Low	WACO
P15	2002 TSP	Dartmouth Street	72nd Avenue	68th Avenue	Complete gaps in sidewalk on the north side of the street	Shared	High	Tigard
P16	2002 TSP	Tigard Street	115th Street	Hall Boulevard	Install sidewalk on both sides of street	$966,507	High	Tigard
P17	2002 TSP	Fonner Street	Walnut Street	121st Avenue	Install sidewalk on both sides of street	$536,948	High	Tigard
P18	2002 TSP	Commercial Street	Main Street	Lincoln Street	Install sidewalk on both sides of street	$107,390	High	Tigard
P21	2002 TSP	Beef Bend Road	Highway 99W	Scholls Ferry Road	Install sidewalk on both sides of street	$1,073,897	Medium	WACO
P23	2002 TSP	72nd Avenue	Upper Boones Ferry Road	Durham Road	Install sidewalk on both sides of street	Shared	Low	Tigard
P24	New	Benchview Terrace	Greenview Drive	Bull Mountain Road	Install sidewalk on both sides of street	$280,000	Medium	Tigard
P25	New	79th Avenue	Bonita Road	Durham Road	Install sidewalk on both sides of street	$180,000	Medium	Tigard
P26	New	Fanno Creek Drive	Fanno Creek Trailhead	Bonita Road	Install sidewalk on both sides of street	$10,000	Medium	Tigard
P27	New	Murdock Street/ 103rd Avenue Canterbury Lane	96th Avenue	Highway 99W	Install sidewalk on both sides of street	$210,000	Medium	Tigard

No.	Source	Project Roadway	From	To	Description	Total Cost (2009$)	Priority	Jurisdiction
P28	New	80th Avenue	Taylor's Ferry Road	Oak Street	Install sidewalk on both sides of street	$250,000	Medium	WACO
P29	New	150th Avenue	Bull Mountain Road	Beef Bend Road	Install sidewalk on both sides of street	$320,000	Medium	WACO
P30	New	97th Avenue	McDonald Street	Murdock Street	Install sidewalk on both sides of street	$40,000	Medium	Tigard
P31	New	Garrett Street	Highway 99W	Ash Avenue	Install sidewalk on both sides of street	$70,000	Medium	Tigard
P32	New	92nd Avenue	Durham Road	Cook Park	Install sidewalk on both sides of street	$110,000	Medium	Tigard
Total New Sidewalk Project Costs						**$8,772,498**		
Marked Crosswalk Projects								
PC1	New	Tigard Street at Fanno Creek Trailheads			Install signing and striping at the existing unmarked mid-block crosswalk located on Tigard Street between 107th Place and Tiedeman Avenue	$50,000	Medium	Tigard
PC2	New	Hall Boulevard at Fanno Creek Trailhead			Install signing and striping at the existing unmarked mid-block crosswalk located on Hall Boulevard between Burnham Street and O'Mara Street	$50,000	Medium	Tigard
PC3	New	McDonald Street/ 97th Avenue			Improve signing and striping at the existing crosswalk at unsignalized intersection; consider installing a RRFB if further compliance is required	$150,000	High	Tigard
PC4	New	Durham Road/ Tigard High School			Install signing, striping, and lighting at the existing unmarked crosswalk on Durham Road near 87th Avenue	$100,000	High	Tigard
Total Marked Crosswalk Project Costs						**$350,000**		
Raised Pedestrian Refuge and Marked Crosswalk Projects								

No.	Source	Project Roadway	From	To	Description	Total Cost (2009$)	Priority	Jurisdiction
PC5	New	Highway 99W/ Bull Mountain Road			Improve signing and striping at the existing signalized crosswalk; raise and upgrade existing refuge island	$130,000	Medium	ODOT/ WACO
PC6[1]	2002 TSP	Washington Square Regional Center Pedestrian Improvements[1]			General Crossing Improvements Install crossing improvements as required for pedestrian safety	$5,720,000	Medium	Tigard
PC7[2]	2002 TSP	Tigard Town Center Pedestrian Improvements[2]			Improve Sidewalks, lighting, crossings, bus shelters and benches throughout the Town Center including: Highway 99W, Hall Blvd, Main Street, Hunziker, Walnut and neighborhood streets	$4,882,000	Medium	Tigard
Total Pedestrian Refuge and Marked Crosswalk Project Costs						**$10,732,000**		
Grade-Separated Crossing Project								
PC8	New	North Dakota Street			Install a pedestrian bridge on North Dakota Street at the railroad crossing	$600,000	Low	Tigard/ ODOT Rail
Total for Grade-Separated Crossing Projects						**$600,000**		
Total for Pedestrian Projects						**$35,968,279**		

New Sidewalk Projects

Project #P24: Benchview Terrace Sidewalk Installation

This project would provide sidewalks on Benchview Terrace between Greenview Drive and Bull Mountain Road. Sidewalks on Benchview Terrace will connect to existing and planned facilities on Bull Mountain Road, and to an existing multiuse path at the Benchview Terrace/Greenview Drive intersection.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
P24	●	●	●	●	●	○	●	Yes

Projects #P25 and P26: 79th Avenue and Fanno Creek Drive Sidewalk Installation

Projects #P25 and P26 provide pedestrian facilities on 79th Avenue and Fanno Creek Drive between Durham Road and a trailhead for the Fanno Creek Trail. While Hall Boulevard currently has sidewalks, this connection will provide another option for pedestrians. Additionally, these projects will aid pedestrian access to one of the City's greenways.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
P25-P26	●	●	●	●	●	●	●	Yes

Project #P27: Murdock Street/103rd Avenue/Canterbury Sidewalk Installation

Project #P27 provides sidewalks on a connection that includes Murdock Street, 103rd Avenue, and Canterbury Lane. This project will connect the South Tigard neighborhood to the Highway 99W corridor. In particular, this project connects directly to schools in neighborhood. This project is adjacent to an environmental justice area and would enhance pedestrian mobility and safety.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
27	●	●	●	●	●	●	●	Yes

Project #P28: 80th Avenue Sidewalk Installation

This project provides sidewalks on 80th Avenue in the neighborhoods adjacent to Washington Square Regional Center and complements existing sidewalks on Taylor's Ferry Road, to the north, and planned sidewalks on Oak Street, to the south.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
28	●	●	●	●	●	●	●	Yes

Project #P29: 150th Avenue Sidewalk Installation

Project #P29 provides sidewalks on 150th Avenue from Beef Bend Road to Bull Mountain Road. This north-south connection on the western edge of the Tigard Urban Planning Area will support future growth and demand for pedestrian facilities as the surrounding neighborhoods develop.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
29	●	●	●	●	●	●	●	Yes

Projects #P30: 97th Avenue Sidewalk Installation

This project will provide a direct connection to local schools south of McDonald Street on 97th Avenue to Murdock Street. This project is adjacent to an environmental justice area and would enhance pedestrian mobility and safety.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
30	●	●	●	●	●	●	●	Yes

Project #P31: Garrett Street Sidewalk Installation

This project will provide a direct connection to local schools and the Highway 99W corridor on Garrett Street from Highway 99W to Ash Avenue.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
31	●	●	●	●	●	●	●	Yes

Project #P32: 92nd Avenue Sidewalk Installation

This project will provide sidewalks on 92nd Avenue from Durham Road to Cook Park, approximately one half-mile to the south. In addition to connecting the riverside park with existing

sidewalks on Durham Road, this project is adjacent to Tigard High school and provides a connection to the multiuse pathway network in Cook Park. Since this project is adjacent to and partly a park, it will likely have an effect on the existing environmental resources located there.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
32	●	●	●	●	●	○	●	Yes

New Pedestrian Crossing Projects

Projects #PC1 and PC2: Marked Crosswalks at Mid-Block Crossings

Project #PC1 and PC2 provide marked pedestrian crossings at mid-block locations at trailheads for the Fanno Creek Trail. The pedestrian crossing on Tigard Street between 107th Place and Tiedeman Avenue is currently difficult for pedestrians wishing to continue on the Fanno Creek Trail. Additionally, the Tigard Trails Plan identifies this location for crossing improvements and recommends a short trail in the vicinity.

The Hall Boulevard crossing, located between Burnham Street and O'Mara Street, also provides enhance pedestrian crossings for the Fanno Creek Trail. This mid-block crosswalk is also near several pedestrian generators including the Tigard Skate Park and City Library.

Both of these projects will increase the attractiveness of walking and greatly improve safety at these locations.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
1-2	●	●	●	●	●	●	●	Yes

Project #PC3: McDonald Street/97th Avenue Intersection Pedestrian Crossing

This project is to install marked pedestrian crossings at the McDonald Street/97th Avenue intersection. The intersection is currently an unmarked crossing and was identified by the City as a location with difficult crossings for pedestrians. With sidewalk projects on McDonald Street and 97th Avenue, providing a striped crossing at the intersection would greatly benefit the accessibility for pedestrians.

This intersection should be monitored after striped crosswalks are installed as a potential location for an RRFB. Additionally, this location is an environmental justice area for the senior population and would enhance their mobility by improving pedestrian safety.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
3	●	◐	◐	●	◐	◐	●	Yes

Project #PC4: Durham Road Pedestrian Crossing at Tigard High School

This project is to install marked pedestrian crossings at the Durham Road/87th Avenue intersection. The intersection is currently an unmarked crossing and was identified by the City as a location with difficult crossings for pedestrians. The surrounding area includes Tigard High School and the Hall Boulevard/Durham Road intersection, which had the highest number of pedestrians counted of all the study intersections.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
4	●	◐	◐	●	◐	◐	●	Yes

Project #PC5: Highway 99W/Bull Mountain Road Intersection Pedestrian Crossing

Project #PC5 includes installing marked pedestrian crossings at the Highway 99W/Bull Mountain Road intersection. This intersection is currently an unmarked crossing and was identified by the City as a location with difficult crossings for pedestrians.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
5	●	◐	◐	●	○	◐	●	Yes

Project #PC8: North Dakota Street Grade-Separated Crossing

This .project would provide a grade-separated pedestrian crossing on North Dakota Street, across the existing railroad tracks. This would increase the available space for pedestrians and improve safety by eliminating a current at-grade crossing of the railroad tracks.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
8	●	●	◐	●	○	○	◐	Yes

BICYCLE

Bicycle facilities are the elements of the network that enable cyclists to safely and efficiently travel on the transportation system. These facilities include public infrastructure (bicycle lanes, mixed-use trails, signage and striping) as well as off-road facilities (secure parking, changing rooms and showers at worksites). Each plays a role in developing a comprehensive bicycle network.

Many different bicycle facility types are needed to create a complete bicycle network that connects people to their destinations and allows cyclists to feel safe riding. Currently, Tigard's bicycle network primarily includes bicycle lanes, shared roadways and multi-use paths. Multi-use path improvements are discussed in a subsequent section because of their utility for both pedestrians and bicyclists.

In some locations where bicycle lanes are provided, specific conditions compromise the quality of the bicycle facility, such as high motor vehicle volumes and travel speeds. In these locations, wider bike lanes or buffers (wider striping, barriers, or medians) separating bicycles from vehicle traffic may be appropriate.

Other roadways with lower vehicle volumes may not require bicycle lanes for cyclists, but may benefit instead from low-traffic bikeway treatments to create what is known as a bike boulevard. Bike boulevards are generally parallel to roadways with high mobility for vehicles and are designed to connect similar destinations to the parallel road. Treatments along the roadway are designed to benefit bicycle mode of travel including through lanes only for bikes, switching two-way stop signs to side-street traffic, and wayfinding signs for riders.

Types of Bicycle Facilities

A brief description of the various bicycle facility types is provided below along with the evaluation criteria for each type of facility. These evaluations were used to support the project ranking shown in Table 5-12

Bicycle lane – Bicycle lanes are striped lanes on the roadway dedicated for the exclusive use of bicycles. Typically, bicycle lanes are placed at the outer edge of pavement (but to the inside of right-turn lanes and/or on-street parking). Bicycle lanes improve bicycle safety, improve cyclist security, and if comprehensive can provide direct connections between origins and destinations. However, inexperienced cyclists often feel uncomfortable riding on busy streets, even when they include bicycle lanes. City of Tigard street standards include bicycle lanes on all arterials and collectors.

Example Bicycle Lane

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice
●	●	●	●	●	●	●

Low-traffic bikeway (bike boulevard) – Low-traffic bikeways are also known as bike boulevards and provide high-quality bicycle facilities on continuous street corridors with low vehicular traffic volumes. Typically, low-traffic bikeways are made from existing local streets, which are reconfigured to prioritize bicycle trips and reduce through automobile trips. Local automobile access is retained. Bicycling conditions are improved by reducing stop signs to a minimum along the route and providing wayfinding information specific to bicyclists. Traffic calming is often used to slow automobile speeds and eliminate the cut-through automobile traffic that the removal of stop signs would otherwise attract.

Low-traffic Bikeway Example

Low-traffic bikeways are best used when they parallel major roadways and can provide cyclists with a low-volume alternative route. Low-traffic bikeways are used extensively in Portland, and recent rider surveys there indicate that cyclists overwhelmingly prefer them compared to major streets with bicycle lanes.

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice
●	●	●	●	●	●	●

Shared-lane Pavement Marking – Shared-lane pavement markings (often called "sharrows") are a tool designed to help accommodate bicyclists on roadways where bicycle lanes are desirable but infeasible to construct. The sharrow marking indicates a shared roadway space, and are typically centered approximately 4 feet from the edge of the travelway to encourage cyclists to ride further away from parked and parking cars and/or the curb. Typically, sharrows are suitable on roadways with fewer than 3,000 ADT. Shared-lane pavement markings have been extensively applied in several cities, including San Francisco, Portland, and Corvallis. Shared-lane pavement markings have been recommended for inclusion in the upcoming edition of the MUTCD. Final approval of new MUTCD is not likely until 2010; until then use of shared-lane pavement markings are subject to the experimental process set forth in Section 1A.10 of the current MUTCD.

Examples of Shared-lane Pavement Markings

Multi-Modal Mobility	System Capacity	Consistency w/ other Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice
●	●	●	●	●	●	●

Shared-roadway – Any roadway without dedicated bicycle facilities is a shared roadway. In Tigard, shared roadways include all public streets without striped bicycle lanes. Where traffic volumes are low, shared roadways are generally safe and comfortable facilities for cyclists. However, the ODOT *Bicycle and Pedestrian Plan*[5] does not recommend shared roadways where automobile volumes or vehicle speeds are high. Thresholds for where shared-lanes are appropriate are based on several factors, including land-use and grade. Generally, bike lanes are preferred on most roadways with greater than 3,000 ADT or with a speed limit greater than 25 mph. For these roadways, dedicated bicycle facilities, typically bicycle lanes, are recommended.

Multi-Modal Mobility	System Capacity	Consistency w/ Other Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice
●	●	●	●	●	●	●

[5] Oregon Department of Transportation. *Oregon Bicycle and Pedestrian Plan*. Salem, Oregon. June 1995.

Bicycle Crossings and Off-Road Facilities

Bicycle crossing treatments are used to connect bike facilities at intersections with high vehicle volumes, trailheads, or other bike routes. Typical treatments include bicycle detectors at traffic signals, bicycle only signals, or preferential movements for bicyclists such as only allowing bikes to make a through movement.

Many traffic signals in Tigard are actuated signals, meaning that green indications are only given to a movement when the signal detects the presence of a vehicle. However, actuating a signal as a cyclist is difficult if no indication is given of the location of detection equipment. Pavement markings should be used, including actuated left-turn lanes, to show cyclists where to stand to actuate a signal. Additionally, the sensitivity of all loop detectors should be set to allow for bicycle activation.

Bicyclists also benefit from several other types of bicycle support facilities, such as secure bicycle parking, either open or covered U-shaped racks, and storage lockers for clothing and gear. The City currently requires bicycle parking included in new development as a condition of approval and TriMet buses are outfitted with bicycle racks that allow cyclists to bring their bikes with them on transit. Allowing bicycles on transit vehicles increases the range of trips possible by both transit and bicycling, and reduces cyclists' fears of being stranded in the event of a mechanical or physical breakdown.

Tigard currently provides several types of bicycle crossing treatments and has open-air bicycle racks in the downtown, at the Tigard Transit Center, at the WSRC and other locations throughout Tigard. However, there are additional locations that require enhanced bicycle crossings or other facilities. Table 5-12 summarizes the proposed bicycle crossing and facility improvements. The evaluation criteria as well as additional input from the City and TAC and CAC will be used to determine a final priority list for bicycle crossing projects.

Project Lists

The 2002 TSP, the Tigard CIP, and the RTP identify bicycle and pedestrian improvement projects. *Projects from the Tigard CIP and RTP are provided in Technical Appendix B for reference and context for the recommended bicycle and, as discussed in the next section, pedestrian projects.* It should be noted that there are also many roadway improvements in the CIP and RTP that include bicycle lanes and pedestrian facilities; however, only the projects that do not also include enhanced vehicle capacity are included in these tables.

Table 5-12 shows new bicycle projects identified from the existing TSP and new projects developed to address deficiencies identified in the TSP process. The evaluation criteria, as well as the bicycle priorities from the existing TSP will be used to determine a final priority list for bicycle projects. The bicycle improvement list will be refined after the roadway project list is finalized, as there is significant overlap between the identified roadway needs and bicycle needs. Figure 5-4 shows the recommended bicycle improvements.

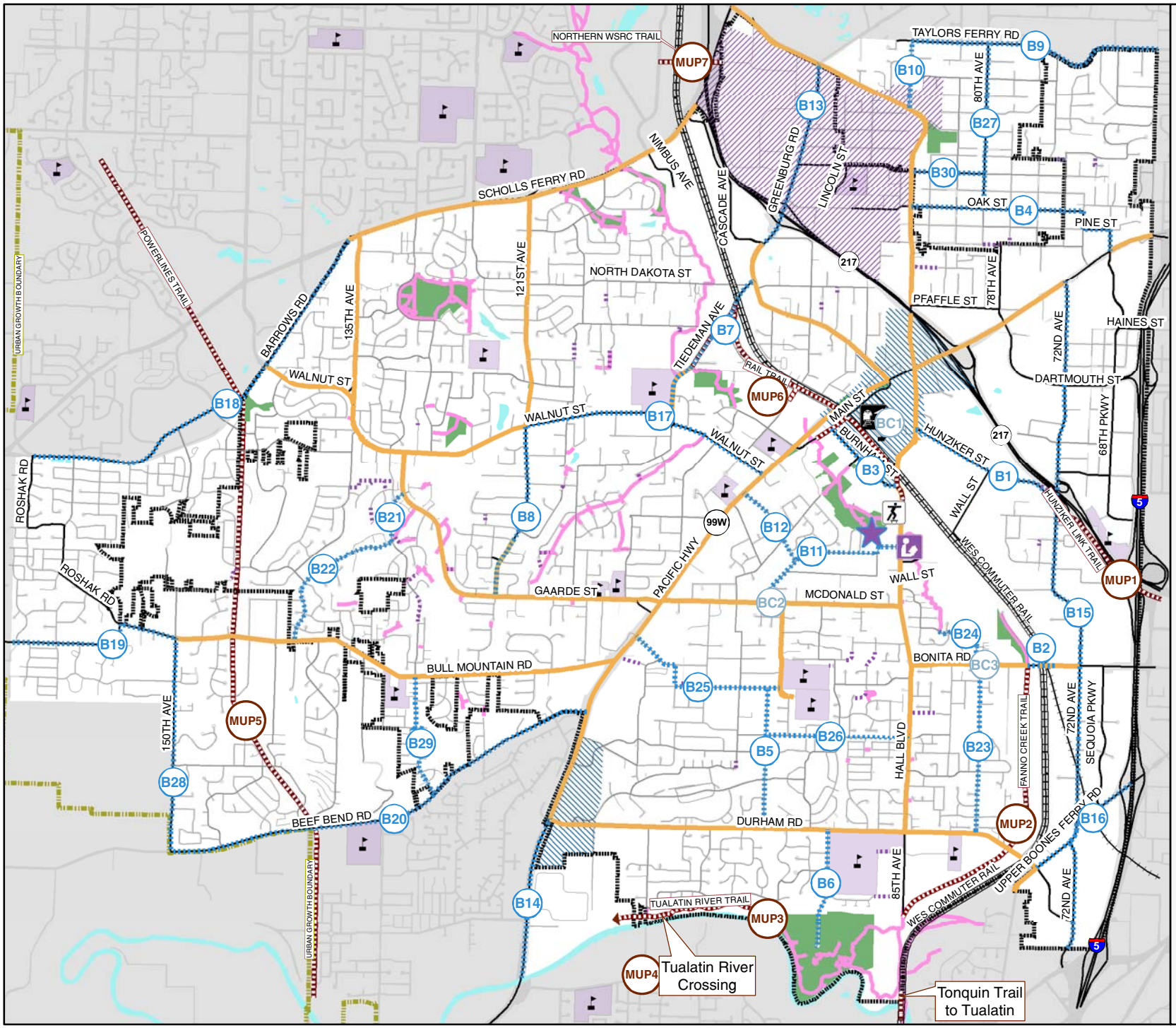


Figure 5-4

Planned Bicycle Facilities

Tigard Urban Planning Area

LEGEND

Planned Facilities

- B# Bicycle Facility
- BC# Bicycle Crossing
- MUP# Multi-Use Pathway
- Tigard Trails Projects

Existing Facilities

- Bike Lanes
- Multiuse Paths

Bicycle Generators

- Regional Center
- Town Center
- Schools
- City Library
- Tigard Senior Center
- Tigard Skate Park

** The information represented on this map is current as of February 2, 2009. Revisions will be made as new decisions or amendments occur to alter the content of the map.

TIGARD

N

0 0.15 0.3 0.6
Miles

Sources: City of Tigard
Metro Data Resource Center
Washington County
November 2009

This map was derived from several databases. The City cannot accept responsibility for any errors. Therefore, there are no warranties for this product. However, any notification of errors would be appreciated.

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http://www.tigard-or.gov

Table 5-12 Bicycle Connectivity Improvement Projects

No.	Consistency with Prior Plans	Project Roadway	From	To	Description	Total Cost (2009$)	Priority	Jurisdiction
Bike Lane								
B1	2002 TSP	Hunziker Street	Hall Boulevard	72nd Avenue	Install bike lanes on both sides of street	$536,948	High	Tigard
B2	2002 TSP	Bonita Road	72nd Avenue	West of 72nd Avenue	Install bike lanes on both sides of street	Shared	High	Tigard
B3	2002 TSP	Burnham Street	Main Street	Hall Boulevard	Install bike lanes on both sides of street	$289,952	High	Tigard
B4	2002 TSP	Oak Street	Hall Boulevard	71st Avenue	Install bike lanes on both sides of street	$644,338	High	WACO
B5	2002 TSP	98th Avenue	Murdock Street	Durham Road	Install bike lanes on both sides of street	$590,643	High	Tigard
B6	2002 TSP	92nd Avenue	Durham Road	Cook Park	Install bike lanes on both sides of street	$579,904	High	Tigard
B7	2002 TSP	Tiedeman Avenue	Greenburg Road	Tigard Avenue	Install bike lanes on both sides of street	Shared	Medium	Tigard
B8	2002 TSP	121st Avenue	Walnut Street	Iron Mt Boulevard	Install bike lanes on both sides of street	Shared	Low	Tigard
B9	2002 TSP	Taylor's Ferry Road	Washington Drive	City Limits	Install bike lanes on both sides of street	$1,073,897	Low	WACO
B10	2002 TSP	Washington Drive	Hall Boulevard	Taylor's Ferry Road	Install bike lanes on both sides of street	$214,779	Low	WACO
B11	2002 TSP	O'Mara Street	McDonald Street	Hall Boulevard	Install bike lanes on both sides of street	$590,643	Low	Tigard
B12	2002 TSP	Frewing Street	ORE 99W	O'Mara Street	Install bike lanes on both sides of street	$322,169	Low	Tigard
B13	2002 TSP	Greenburg Road	Hall Boulevard	Cascade Avenue	Install bike lanes on both sides of street	$501,152	High	WACO/ ODOT
B14	2002 TSP	ORE 99W	Durham Road	South City Limits	Install bike lanes on both sides of street	$2,792,131	High	ODOT
B15	2002 TSP	72nd Avenue	Highway 99W	South City Limits	Install bike lanes on both sides of street	Shared	Medium	Tigard

No.	Consistency with Prior Plans	Project Roadway	From	To	Description	Total Cost (2009$)	Priority	Jurisdiction
B16	2002 TSP	Upper Boones Ferry Road	I-5	Durham Road	Install bike lanes on both sides of street	Shared	Medium	Tigard
B17	2002 TSP	Walnut Street	ORE 99W	121st Street	Install bike lanes on both sides of street	Shared	Medium	Tigard
B18	2002 TSP	Barrows Road	Scholls Ferry Road	Scholls Ferry Road	Install bike lanes on both sides of street	$1,933,014	Medium	WACO/ Beaverton
B19	2002 TSP	Bull Mountain Road	150th Avenue	West City Limits	Install bike lanes on both sides of street	$1,181,286	Low	WACO
B20	2002 TSP	Beef Bend Road	ORE 99W	West City Limits	Install bike lanes on both sides of street	$1,718,235	Low	WACO
Total Bike Lane Project Costs						**$12,969,091**		
Low-Traffic Bikeway								
B21	New	Greenfield Drive	Gaarde Street	Benchview Terrace	Install bike boulevard treatments	$40,000	Medium	Tigard
B22	New	Benchview Terrace	Greenview Drive	Bull Mountain Road	Install bike boulevard treatments	$120,000	Medium	Tigard
B23	New	79th Avenue	Bonita Road	Durham Road	Install bike boulevard treatments	$130,000	Medium	Tigard
B24	New	Fanno Creek Drive	Fanno Creek Trailhead	Bonita Road	Install bike boulevard treatments	$100,000	Medium	Tigard
B26	New	Sattler Street	Hall Boulevard	98th Avenue	Install bike boulevard treatments	$100,000	Medium	Tigard
B27	New	80th Avenue	Taylor's Ferry Road	Oak Street	Install bike boulevard treatments	$120,000	Medium	WACO
B29	New	Greenfield Drive	Bull Mountain Road	Beef Bend Road	Install bike boulevard treatments	$90,000	Medium	Tigard
B30	New	Locust Street	Hall Boulevard	80th Avenue	Install bike boulevard treatments	$50,000	Medium	WACO
Total Low-Traffic Bikeway Project Costs						**$750,000**		
Shared-lane Markings								
B25	New	Murdock Street/ 103rd Avenue	96th Avenue	Highway 99W	Install shared-roadway pavement	$10,000	High	Tigard

No.	Consistency with Prior Plans	Project Roadway	From	To	Description	Total Cost (2009$)	Priority	Jurisdiction
					markings on both sides of street			
B28	New	150th Avenue	Bull Mountain Road	Beef Bend Road	Install shared-roadway pavement markings on both sides of street	$10,000	High	WACO
Total Shared-Lane Marking Project Costs						**$20,000**		
Bicycle Crossing and Facility Improvement Projects								
BC1/ TP1	New	Tigard Transit Center			Off-Road Facility Additional Bike Racks Covered Bike Lockers	$23,000[1]	Medium	Tigard/ TriMet
BC2	New	McDonald Street connections between 97th Avenue and O'Mara Street			Crossing Improvement	$10,000	High	Tigard
BC3	New	Bonita Road/ 79th Avenue			Crossing Improvement	$5,000	High	Tigard
BC4	New	Tiedeman at Fanno Creek Trail			Crossing improvements. Near term curb cuts and pavement markings.	$10,000	High	Tigard
Total Bicycle Crossings and Facility Improvement Project Costs						**$48,000**		
Total Bicycle Project Costs						**$13,727,091**		

Notes: Costs are factored from the 2002 TSP costs based on the ODOT Highway Construction Cost Trends for year 2008
[1] Cost not included in bike project total, but instead under the transit project costs total

New Bicycle Facility Projects

Projects #B21 and B22: Greenfield Drive and Benchview Terrace Bike Boulevard Installation

These two projects provide a north-south connection between existing bicycle lanes on Gaarde Street and Bull Mountain Road, two east-west roadways. This project expands the bicycle network in the western portion of the City by providing bike boulevard treatments on one of the few through-roadway connections between Gaarde Street and Bull Mountain Road.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
B21-B22	●	●	◉	●	●	○	◉	Yes

Projects #B23 and #B24: 79th Avenue and Fanno Creek Drive Bike Boulevard Installation

Project #B23 provides a parallel bike facility to Hall Boulevard, approximately four blocks west, between Bonita Road and Durham Road. While Hall Boulevard currently has bike lanes, this connection will provide another option for cyclists. Additionally, in combination with project #B24, which provides a bicycle connection from Bonita Road to a trailhead for the Fanno Creek Trail, B23 provides access to one of the City's greenways.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
B23-B24	●	●	◉	●	●	◉	◉	Yes

Project #B25: Murdock Street/103rd Avenue Shared-Lane Markings

Project #B25 provides shared-lane markings on Murdock Street and 103rd Avenue to connect bike lanes on Highway 99W to the South Tigard neighborhood. In particular, this project connects directly to schools.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
B25	●	◉	◉	●	●	◉	●	Yes

Project #B26: Sattler Street Bike Boulevard Installation

Project #B26 provides bicycle boulevard treatments on Sattler Street to connect bike lanes on Hall Boulevard to the South Tigard neighborhood. In particular, this project connects directly to schools in neighborhood.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
B26	●	●	●	●	●	●	●	Yes

Projects #B27 and B30: 80th Avenue and Locust Street Bike Boulevard Installation

These projects provide bicycle facilities in the neighborhoods adjacent to Washington Square Regional Center, and complement existing bike lanes on Hall Boulevard, through direct connections and parallel facilities.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
B27 & B30	●	●	●	●	●	●	●	Yes

Project #B28: 150th Avenue Shared-Lane Markings

Project #B28 provides shared-lane pavement markings on 150th Avenue from Beef Bend Road to Bull Mountain Road. This north-south connection on the western edge of the Tigard Urban Planning Area will support future growth and demand for bicycle facilities as the surrounding neighborhoods develop.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
B28	●	●	●	●	●	●	●	Yes

Project #B29: Greenfield Drive Bike Boulevard Installation

Project #B29 provides bike boulevard treatments on Greenfield Drive from Beef Bend Road to Bull Mountain Road. This will provide another north-south connection between these two roadways.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
B29	●	●	●	●	●	○	●	Yes

New Bicycle Crossing Projects

Project #BC1: Tigard Transit Center Bicycle Hub Improvements

See Project #1 in Transit Projects Section

Project #BC2: McDonald Street connections between 97th Avenue and O'Mara Street Bicycle Improvements

This project includes additional upgrades to the existing wide shoulder on McDonald Street for bicycles. Currently, a bike lane is striped in the westbound direction and a wide-shoulder is provided in eastbound direction from O'Mara Street to 97th Avenue. This project includes formalizing the eastbound shoulder with bike lane markings and signing to ensure motorists are aware of the presence of bicycles. It also includes the addition of a sign in the eastbound direction at 97th Avenue indicating that bikes will be entering the travel lane, as the additional shoulder width drops after the intersection.

This project is recommended

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
11	●	●	●	●	●	●	●	Yes

Project #BC3: Bonita Road/79th Avenue Bicycle Improvements

This project includes the installation of advanced warning signs on Bonita Road, notifying drivers and cyclists of a bicycle crossing ahead. High volumes of cyclists are anticipated to use 79th Avenue as a north-south connection to the Fanno Creek Trailhead, approximately one-half mile north of the intersection.

This project is recommended

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
11	●	●	●	●	●	●	●	Yes

Project #BC4: Tiedeman Avenue at Fanno Creek Trail

This project includes crossing improvements at Tiedeman Avenue between 106th Drive and Tigard Street where the Fanno Creek Trail intersects with the roadway. Bike lanes and sidewalks are provided in the vicinity, but there is not a suitable ramp to cross the street. This project will provide curb cuts to allow for bikes to smoothly cross Tiedeman Avenue to access either side of the trailhead.

This project is recommended

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
11	●	●	●	●	●	●	●	Yes

MULTI-USE PATHWAYS

Multi-use pathways are other facilities dedicated to pedestrians and bicyclists. These pathways have an integral role in recreation, commuting, and accessibility for residents. Tigard's off-street trails are generally concentrated along several greenways located within the City, the most notable of these is the Fanno Creek Greenway which traverses the full length of the City. Trails are also located along the Tualatin River and the Pathfinder-Genesis Trail. Additionally, planned regional pathways are being developed to connect Tigard with other communities in the Portland metro area. While these pathways serve and connect several neighborhoods in Tigard, there are some remaining gaps in these facilities.

The Tigard Neighborhood Trails Plan focuses on multi-use pathways at a neighborhood scale, and developed a list of 42 recommended projects that are generally one to two blocks in length. These projects seek to improve opportunities for walking, bicycling and using transit by creating short cut-through route that provide access to local destinations. *A complete list of the projects from the Neighborhood Trails Plan is included in Appendix C.* The plan has been adopted and the city will implemented trails from this plan as funding and opportunities become available.

While the Neighborhood Trails plan addressed short, local connections, there are additional city and region-wide multi-use trails that are in various stages of planning and construction. In particular, the Tiedeman/Main Rail Trail has been identified for converting a nearly three-quarter mile inactive railroad right-of-way located adjacent to Tigard Street. The trail would extend between Tiedeman and Main Streets. Conversion to multi-use trail will provide benefits including

- providing children and seniors a safe, off-street alternative to the adjacent Tigard Street, which does not have sidewalks along eighty per cent of its length and also includes a narrow, substandard bike lane on only one side;
- providing a safe, traffic-free path for all walkers, joggers, cyclists, and others to exercise and enjoy the outdoors;
- giving the downtown an economic stimulus by providing a new off-street transportation route to downtown businesses of all kinds; and,
- providing direct, non-motorized access to the bus and commuter rail transit station located opposite to the corridor connects to Main Street.

The City is also preparing to initiate a Transportation Growth Management (TGM) study to evaluate the longer regional pathways that traverse the City. This plan will assess existing gaps in the trail network and establish a plan to fill-in these sections. It will serve as a companion to the Neighborhood Trails Plan.

Table 5-13 summarizes the planned multi-use pathways in Tigard. The evaluation criteria as well as additional input from the City will be used to determine a final priority list for multi-use pathway projects.

Table 5-13 Multi-Use Pathway Projects

No.	Consistency with Other Plans	Intersection/ Location	Description	Total Cost (2009$)	Priority
MUP1	2002 TSP	Hunziker Link to Lake Oswego	Linkage to Kruse Way Trail in Lake Oswego	$2,010,000	Medium
MUP2	2002 TSP	Fanno Creek Trail	Complete gaps along the Fanno Creek multiuse path from the Tualatin River to City Hall and from Highway 99W to Tigard Street	$1,440,000	Medium
MUP3	2002 TSP	Tualatin River Trail	Complete multiuse path from Cook Park to the Powerlines Corridor	$260,000	Medium
MUP4	2002 TSP	Tualatin River Crossing	New bridge crossing north-south over the Tualatin River near 108th Avenue	$740,000	Medium
MUP5	2002 TSP	Powerlines Corridor	New regional multiuse path, and in Tigard will connect from Beaverton to the Tualatin River Trail	$1,920,000	Medium
MUP6	New	Tiedeman Avenue/ Main Street Rail Trail	Convert a segment of inactive railroad right-of-way adjacent to Tigard Street from Tiedeman Avenue to Main Street to a multiuse path	$1,250,000	High
MUP7	2002 TSP/ New	Northern Washington Square Regional Center Crossing	New pedestrian and bicycle pathway to the WSRC, from Nimbus Avenue to Scholls Ferry Road	$3,700,000	Medium
Total for Multi-Use Pathway Projects				**$11,320,000**	

[1] Source: Metro 2035 RTP

New Project

Project#MUP6: Tiedeman Avenue/Main Street Rail Trail

For some time, the City has been a proponent of using of the inactive railroad right-of-way located adjacent to Tigard Street and extending between Tiedeman Street and Main Street. This area is 3,840' long by 50' wide.

The trail would provide a broad range of community benefits, including:

- providing children and seniors a safe, off-street alternative to the adjacent Tigard Street, which includes no sidewalks along eighty per cent of its length and also includes a narrow, substandard bike lane on one side of the street only;
- providing a safe, traffic-free path for all walkers, joggers, cyclists, and others to exercise and enjoy the outdoors;
- giving the downtown an economic stimulus by providing a new off-street transportation route to downtown businesses of all kinds;

- providing direct, non-motorized access to the bus and commuter rail transit station located opposite to the corridor connects to Main Street.
- improving the unsightly appearance of the unused and unmaintained corridor, which presently detracts from the attractiveness and of both the neighborhood and downtown areas.

Conversion of the property to trail use is in accordance with numerous local plans, including the Downtown Improvement Plan, City Center Urban Renewal Plan, Park System Master Plan, and Transportation System Plans. The trail also enjoys wide community support as evidenced by numerous endorsement letters received by the City. According to these letters, in addition to serving as a gateway to the downtown, the proposed trail will make an important contribution to community livability and pride.

The trail also is part of a broader strategy to get people out of their cars and to promote a healthier and more sustainable community. Installing the rail to trail conversion will result in more choices for moving around Tigard and help create a better place to live. Additionally, this project will improve multi-modal mobility, safety, and borders environmental justice populations.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
6	●	●	●	●	●	●	●	Yes

Project#MUP7: Northern Washington Square Regional Center Crossing

This project was included as a new roadway facility in the 2002 TSP. Instead, it is recommended that this project be developed as a pedestrian and bicycle connection only. The project will provide additional connections to the WSRC and multimodal access across Highway 217. This project would increase the available space for pedestrians and cyclists, while improve safety by providing a facility separated from vehicles.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
7	●	●	●	●	●	●	●	Yes

Railroad Crossings

As noted previously, the existing freight and commuter rail corridor presents a barrier to access for pedestrians and bicyclists in Tigard. Although new multi-use pathways are desirable, current ODOT Rail policy related to at-grade crossings is to reduce the number of at-grade rail crossings. In particular, the 2001 Oregon Rail Plan expresses a desire for a reduction in at-grade railroad crossings within Tigard.

There are nine at-grade railroad crossings in Tigard, and one grade-separated crossing at Highway 99W. Of the ten crossings, six have existing sidewalks and five have bicycle facilities. Several crossings across the railroad tracks are currently "demand" trails and not part of the formal transportation system. These are worn paths across the tracks and could be used as locations for potential future grade-separated crossings for pedestrians and bicyclists. Currently, Grant Avenue ends a Tigard Street near the railroad tracks, directly across from 95th Avenue. There is a worn path across the tracks connecting these two roadways. There is another demand trail where Katherine Street ends at the west side of the railroad tracks.

In addition to crossings with existing demand, additional connections across the railroad tracks to the Tigard Transit Center would benefit pedestrians and bicyclists accessing transit lines. Currently, there are two connections on either side of the TC, at Main Street and Hall Boulevard, but these crossings are nearly 1,500 feet apart.

Due to ODOT Rail policy, other future multi-use pathways, potentially connecting the Fanno Creek Trail with regional destinations such as the Tigard Triangle and the Washington Square Regional Center, should be grade-separated crossings. No new at-grade multi-use pathways are planned in Tigard.

TRANSIT

Transit service is an important part of a balanced transportation system, providing an alternative to private automobile travel for distances too far to walk or bike. As identified in the Needs & Deficiencies report, supporting an environment in which transit is a preferred travel option for the Tigard community requires more than direct investments in transit service. Land use, connectivity, and streetscape features have a major influence on the cost effectiveness of transit service and will help Tigard get more out of its available transit investments. For this reason, the proposed improvements for transit service include planning for land uses that are transit supportive, in addition to providing appropriate facilities and connections to transit.

Table 5-14 shows several strategies and potential improvements for Transit service in Tigard. The table identifies which entities would be in a Primary role (identified with a "P") and which would be in a Support role (identified with an "S"). As the major transit provider in the region, TriMet would be the Primary implementer of most of the service enhancements. In most cases, the City of Tigard is in a Support role for direct transit enhancements and a Primary role for transit supportive infrastructure.

Metro has been developing a 30-year plan to guide investments in light rail, commuter rail, bus rapid transit and rapid streetcar in the Portland metro region to be included in the Regional Transportation Plan. The Regional High Capacity Transit System Plan ranks 16 potential high capacity transit corridors in four regional priority tiers, creates a framework for future system expansion prioritization and proposes amendments that have been incorporated into the draft 2035 Regional Transportation Plan (RTP).

For the 2035 RTP, the highest priority tier of high capacity transit investments focuses on three corridors, two of which would travel through the City of Tigard:

- Powell Boulevard corridor vicinity, connecting Gresham to downtown Portland;
- Barbur Boulevard/Highway 99W corridor vicinity, connecting downtown Portland to Tigard and possibly Sherwood; and,
- WES commuter rail corridor that connects Beaverton to Wilsonville, service upgrades to all day service with trains running at 15-minute intervals.

It should be noted that the City of Tigard supports both the High-Capacity Transit Service on Hwy 99W (T-2) and increased service on WES (T-1) but is in a support role for each of these projects as shown below. Planning for Project T-2, Provide High-Capacity Transit Service on Hwy 99W, is included in the draft RTP financially constrained project list with an estimated cost of $5,000,000.

Table 5-14 Transit Improvements

ID	Improvement	City	TriMet	Beaverton	Washington County	Metro	ODOT
LU-1	Commercial Nodes in Residential Areas	P				S	
T-1	Increase WES frequencies and days of service	S	P	S	S	S	S
T-2	Provide high capacity transit service on Hwy 99W	S	P		S	S	S
T-3	New Tigard Connector service*	P	S	S			
T-4	Transit Stop Amenities	S	P			S	
BT-1	Create a bike hub at the Downtown transit center	P	S				

*Could be funded by the Tigard Triangle LID or pursue through TriMet.

While the City of Tigard does not currently operate transit, there are several potential projects the City could implement to support and improve access to transit. The land use strategy (LU-1) "Commercial Nodes in Residential Areas" creates commercial destinations within residential neighborhoods, and may include small restaurants, coffee shops, or neighborhood retail. These neighborhood commercial nodes will provide residents with the opportunity to take non-work trips by non-auto modes, including transit. This development could be accomplished by allowing neighborhood-commercial as a permitted use in residential zones, or through designating specific nodes in the City's comprehensive plan and/or neighborhood plans.

Within areas targeted for neighborhood-commercial development transit stop improvements, in the form of benches, shelters, or real-time transit information, could be provided for riders. By working with TriMet and other agencies shown in Table 5-14, the City could lead or support the progress of transit projects.

City Transit Projects

Table 5-15 summarize the transit projects for which the City of Tigard would be in a primary role. These projects include accommodating a new bike hub at the Downtown Transit Center and

supporting upgrades to bus stop facilities, both which have an integral role in recreation, commuting, and accessibility for residents.

Table 5-15 Transit Improvement Projects

No.	Consistency with Prior Plans	Project	Description	Total Cost (2009$)	Priority
TP1/ BC1	New	Tigard Transit Center Bicycle Hub	Off-Road Facility Additional Bike Racks Covered Bike Lockers	$23,000	Medium
TP2	New	Transit Stop Amenity Improvements on Highway 99W	Support existing high frequency bus service on the Highway 99W corridor by providing benches, shelters, and real-time information at bus stops	$530,000	High
TP3	New	Additional Transit Stop Amenity Improvements	Support existing high activity bus stops by providing benches, shelters, and real-time information	$397,500	Medium
Total for Transit Improvement Projects				**$950,500**	

New Projects

Project #TP1: Tigard Transit Center Bicycle Hub Improvements

Transit travelers often connect trips with multiple transit lines and other transportation modes, and the Downtown Tigard Transit Center provides several of these connections for residents. Bicyclists using transit benefit immensely from bicycle support facilities at stations, such as secure bicycle parking, either open or covered U-shaped racks, and storage lockers for clothing and gear.

In addition to providing facilities for bicyclists storing their bikes at the station, cyclists may also choose to use bicycle facilities at the Downtown Transit Center, such as water fountains and storage lockers. Since TriMet vehicles are outfitted with bicycle racks that allow cyclists to bring their bikes with them on transit, and thus increase the range of trips possible by both transit and bicycling, there is a wide range of cyclist needs at the station.

The costs for this project assume the installation of 10 new bicycle racks ($150 to $300 each) that allow parking for two bikes, and the installation of 5 new bicycle lockers ($1,000 to $4,000 each).

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
TP1	●	●	●	●	●	○	●	Yes

Project #TP2: Transit Stop Amenity Improvements on Highway 99W

This project focuses on the installation of bus shelters and other user amenities along the Highway 99W corridor in Tigard. The need for bus shelters at bus stops, as well as benches and real-time

transit information, should be evaluated in conjunction with any new commercial or residential development adjacent to the roadway. This project includes the addition of 20 new bus shelters ($10,000 to $15,000), lighting installations ($5,000 to $10,000), and benches ($500 to $1,500).

This project is recommended.

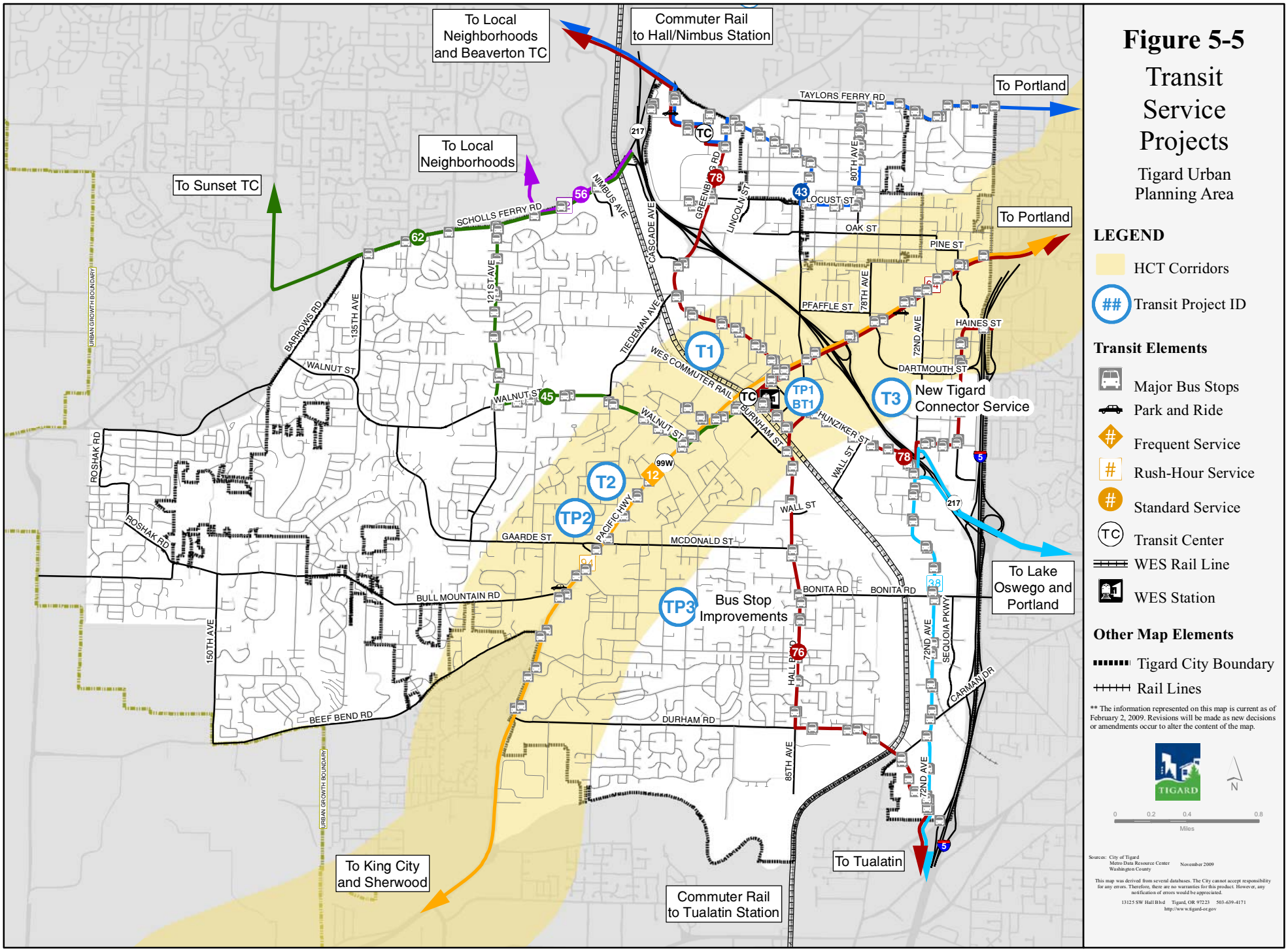
ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
TP2	●	●	●	●	●	●	●	Yes

Projects #TP3: Transit Stop Amenity Improvements at High Activity Stops

This project focuses on installation of bus shelters and other user amenities at high activity bus stops identified by TriMet in Tigard. The need for bus shelters at bus stops, as well as benches and real-time transit information, should be evaluated in conjunction with any new commercial or residential development near these stops. This project includes the addition of new bus shelters ($10,000 to $15,000), lighting installations ($5,000 to $10,000), and benches ($500 to $1,500) at the 15 major bus stops in Tigard.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
3	●	●	●	●	●	●	●	Yes



Note: Transit improvement projects to provide additional amenities at bus stops are not shown.

ROADWAYS FACILITIES PLAN

The roadway facilities plan is presented in this section of the document. Figure 5-6 shows the draft project recommendations and draft project priorities. Figure 5-6 also shows the projects recommended for removal from existing planning documents. Figure 5-7 shows the results of the demand to capacity analysis for the recommended projects.

The following tables (Table 5-16and Table 5-17) summarize the roadway and intersection project recommendations and draft project priorities. Projects that are recommended for removal from existing planning documents are shaded in gray. *Projects from the current City of Tigard CIP and 2035 Draft Metro RTP are presented in Technical Appendix B for reference and context.*

Following the roadway and intersection project tables is an evaluation of two types of projects.

- New projects that have been identified through this planning process
- Projects recommended for removal from the current TSP.

These projects are described in further detail and accompanied by a qualitative evaluation of the potential benefits and drawbacks of implementation.

The roadway and intersection projects involve many of the major arterials and collectors in the City. Several intersection improvements have been identified along the Highway 99W corridor to improve operations, and most are recommended as high priority projects.

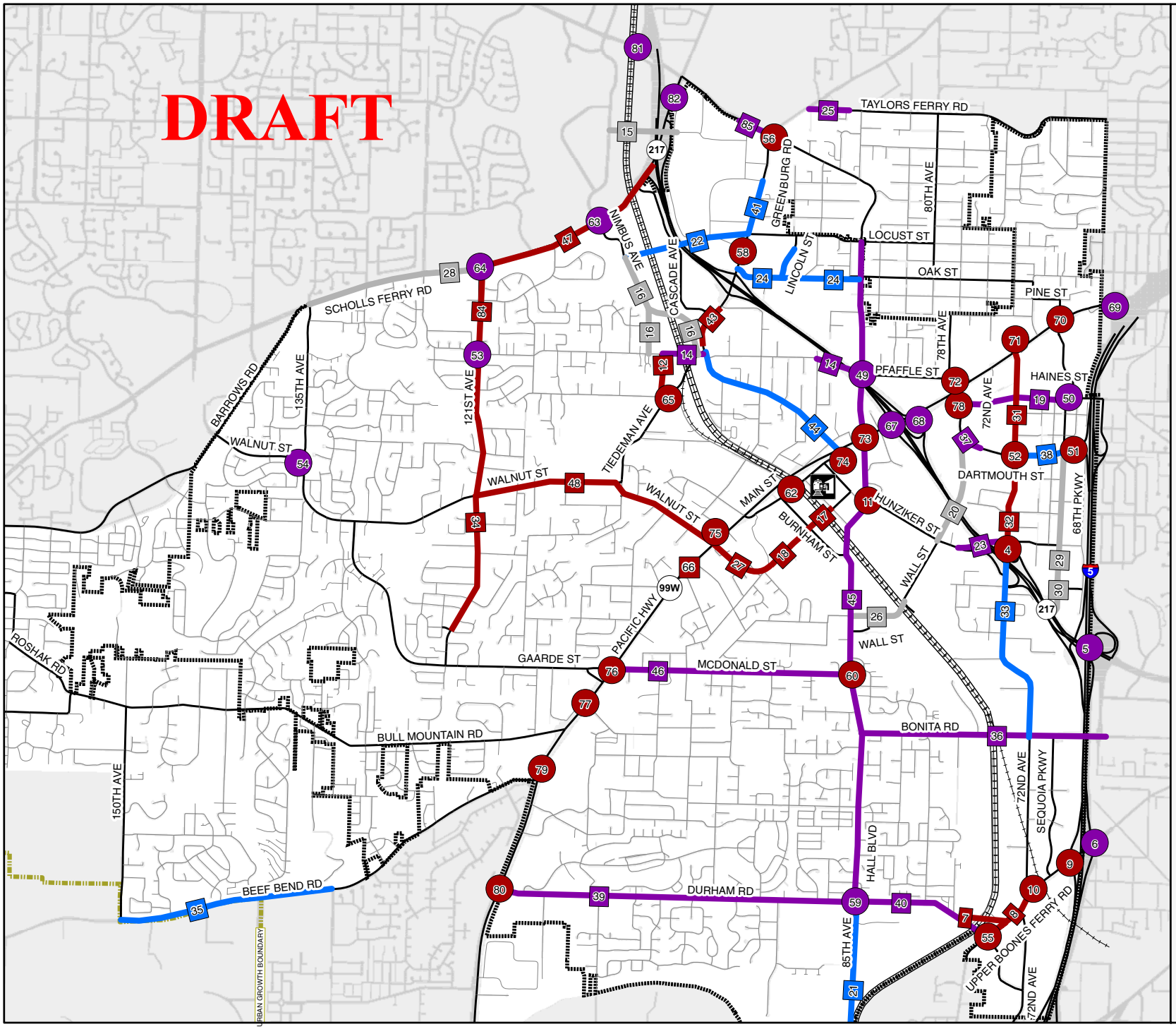
Roadway widening projects are recommended to increase the overall capacity of a roadway based on future traffic demand. These projects include many collectors in the City, including 72nd Avenue, Durham Road, and Greenburg Road. Roadway realignment projects are projects that include realignment of a roadway to reduce the number of approaches at an intersection or to improve safety of existing skewed intersections.

Recommendations for project removals from the current TSP are generally based on either inconsistencies with other plans, the need to reduce the number of high cost projects (such highway or railroad overpasses) in the TSP, or substantial environmental constraints.

Figure 5-6

Roadway Projects

Tigard Urban Planning Area



LEGEND

Intersection Improvements

- High Priority
- Medium Priority
- Low Priority
- Remove from TSP

Roadway Improvements

- High Priority
- Medium Priority
- Low Priority
- Remove from TSP

Note: Roadway improvement numbers refer to tables in body of memorandum.

Other Map Elements

- Tigard City Boundary
- WES Rail Line
- WES Station
- Rail Lines

DRAFT

** The information represented on this map is current as of February 2009. Revisions will be made as new decisions or amendments occur after the creation of the map.

TIGARD

N

0 0.15 0.3 0.6 Miles

Sources: City of Tigard
Metro Data Resource Center
Washington County
November 2009

This map was derived from several databases. The City cannot accept responsibility for any errors. Therefore, there are no warranties for this product. However, any notification of errors would be appreciated.

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http://www.tigard-or.gov

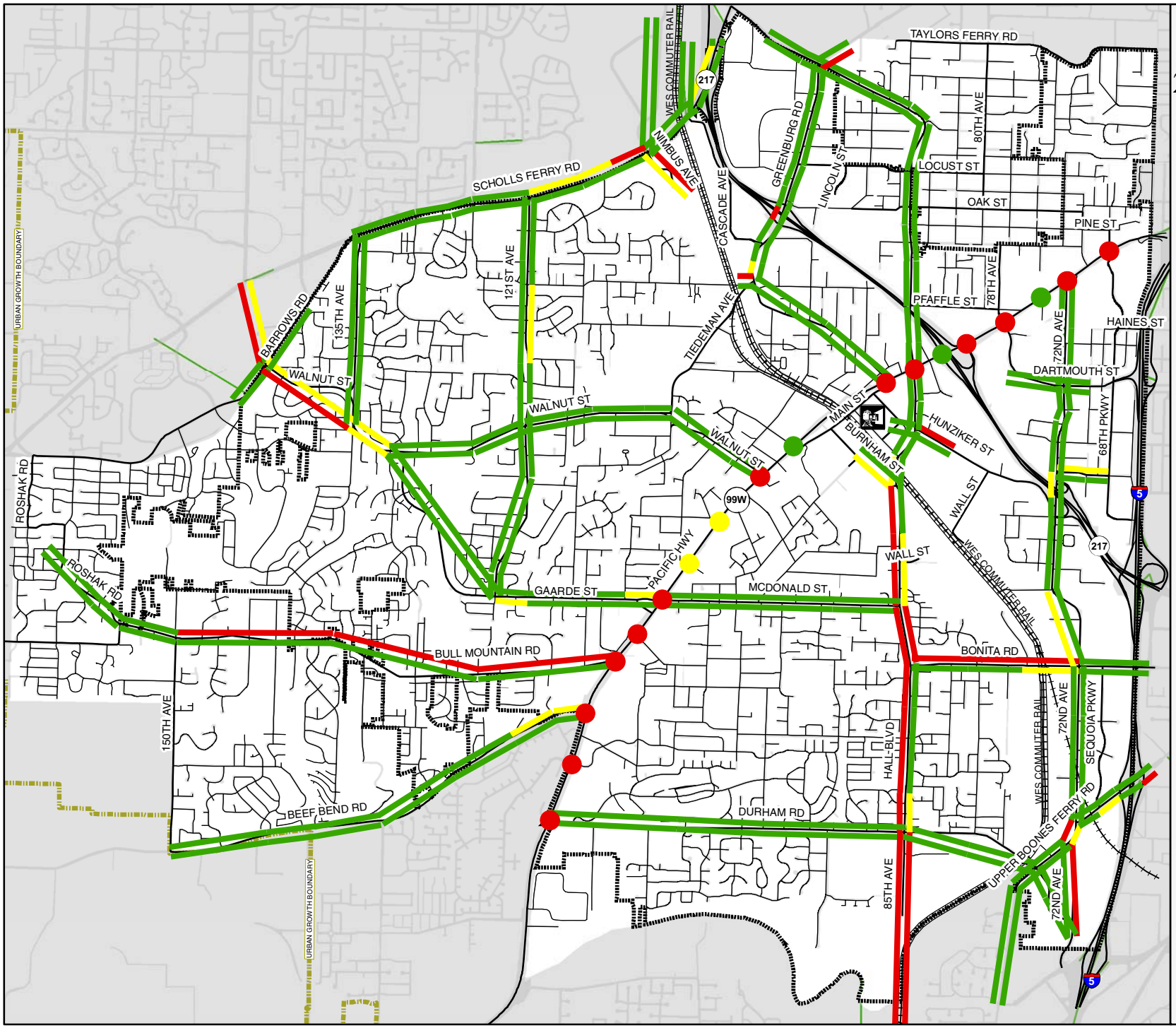

Figure 5-7

2035 Demand-to-Capacity Ratios Preferred Plan

Weekday PM Peak Hour

Tigard Urban Planning Area

LEGEND

D/C Ratio

- less than 0.85
- 0.85 to 1.00
- greater than 1.00

Other Map Elements

- WES Rail Line
- WES Station
- Rail Lines
- Tigard City Boundary

** The information represented on this map is current as of February 2, 2009. Revisions will be made as new decisions or amendments occur to alter the content of the map.

TIGARD

N

0 0.15 0.3 0.6 Miles

Sources: City of Tigard
Metro Data Resource Center November 2009
Washington County

This map was derived from several databases. The City cannot accept responsibility for any errors. Therefore, there are no warranties for this product. However, any notification of errors would be appreciated.

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Table 5-16 Roadway Projects

ID	Project Type	Consistency w/ Prior Plans	Project Name	Description	Cost	Year $	Priority	In Draft Plan Model?	Jurisdiction
Major Regional Projects									
1	Freeway Widening	TSP	I-5 Widening	Increase capacity on I-5 from Hwy 217 to I-205	$302,170,000	2009	High	No	ODOT
2	Freeway Widening	TSP	Hwy 217 Widening	Increase capacity on Hwy 217 from US 26 to 72nd Ave	$362,600,000	2009	High	No	ODOT
3	Road Widening/ New Road	TSP RTP (10598 – ROW only)	99W Connector (Arterials)	Planned series of seven arterials providing connectivity and mobility in the Tualatin/Tigard area. This project is largely outside of the study area but the northern of the three arterials would connect to Upper Boones Ferry Road or 72nd Avenue at the southeastern edge of the City of Tigard. This project also includes capacity improvements on Hwy 99W.	$350,000,000	2009	Medium	Yes	ODOT/ Other
4	Interchange Improvement	TSP RTP (10599)	OR 217/72nd Ave Interchange Improvements	Complete interchange reconstruction with additional ramps and overcrossings.	$19,540,000	2009	High	Yes	ODOT
5	Interchange Improvement	TSP RTP (11302)	I-5/OR 217 Interchange	Interchange Improvements	$81,580,000	2009	High	No	ODOT
28	Road Widening	TSP	Scholls Ferry Rd Widening	Widen to 7 lanes (both dir) b/w 121st and Barrows Rd			Remove from TSP		WACO
47	Road Widening	TSP RTP (10596)	Scholls Ferry Rd Widening	Widen to 7 lanes (both dir) b/w OR 217 and 121st Ave	$19,750,000	2009	High		WACO
Total Major ODOT Project Costs					**$120,870,000**				
Roadway Realignment Projects									
7	Intersection Realignment	TSP RTP (10768)	Durham Road Realignment at Upper Boones Ferry Road intersection	Realign/reconfigure Durham Road, Upper Boones Ferry Road intersections/roadway to accommodate traffic flow between Durham Road and Interstate 5. Refinement study needed to address specific alignment of Durham and Upper Boones Ferry and alignment of southern Durham Road and 72nd Ave.	$9,630,000	2009	High		Tigard
8	Road Widening	TSP RTP (10768)	72nd Ave/Upper Boones Ferry Road	Assumes 5 lanes on 72nd and Boones Ferry (upper?) (roadway project?)	included in project #7		High		Tigard

9	Intersection Improvement	TSP RTP (10768)	Upper Boones FerryRaod/I-5 southbound	Eastbound right turn lane	included in project #7		High		ODOT/ Tigard
10	Intersection Improvement	RTP (10768)	72nd/Upper Boones Ferry	2nd northbound turn lane	$300,000 (included in project #7)	2001	High		Tigard
11	Intersection Realignment	RTP CIP (95006-study only)	Hall/Hunziker/ Scoffins Intersection Realignment	Realign offset intersection to cross intersection to alleviate congestion and safety issues. (CIP includes $75,000 for a study at this location)	$5,000,000	2009	High		ODOT/ Tigard
12	Road Realignment	RTP	Tiedeman Realignment	Realign Tiedeman between Tigard Street and N. Dakota to improve traffic flow in the area and address the existing queiing issue at the North Dakota/Tiedeman intersection.	$1,400,000	2009	High		Tigard
Total Roadway Realignment Project Costs					**$16,330,000**				
New Roadway Projects									
15	New Road	TSP	Northern Washington Square Regional Center Crossing				Remove or convert to ped/bike connectio n		Tigard/ Beaverton
16	New Road	TSP RTP (10762)	Nimbus Road Extension	Extend Nimbus Avenue south to Greenburg Road (or Tiedeman)	$30,000,000	2009	Remove from TSP		Tigard
17	New Road	CIP 95030	Ash Ave Extension (Burnham across railroad to Commercial Street)	Extend Ash Avenue across the railroad tracks at Burnham to Commercial Street.	$3,000,000	2009	High		Tigard/ ODOT Rail
18	New Road	TSP (map only?)	Ash Ave Extension (Maplewood to Burnham)	Extend Ash Avenue from Maplewood, across Fanno Creek, to Burnham.	$3,000,000	2009	High		Tigard
27	New Road	TSP (RTP 10754 for PE)	Walnut to Ash Street Extension	Extend Walnut east of OR 99W to meet Ash/Scoffins and Hunziker Streets.	$19,640,000	2009	High		Tigard
19	New Road	TSP	Atlanta Street Extension	Extend Atlanta Street west to Dartmouth Street	$3,780,000	2001	Medium		Tigard
21	New Road	RTP (10765)	Hall Boulevard Extension	Extend south to Tualatin across the Tualatin River	$58,690,000	2009	Low		ODOT
22	New Road	TSP RTP (10747)	Hwy 217 Over-crossing	Provide a new connection from Nimbus to Washington Square south of Scholls Ferry Road	$5,170,000	2009	Low		Tigard

23	New Road	RTP (10751)	Hunziker to Tigard Triangle Connection	Realign Hunziker Street to meet 72nd Avenue in the Tigard Triangle —requires over-crossing over ORE 217	$9,640,000	2009	Medium		Tigard
24	New Road	WSRC RTP (10746)	Oak-Lincoln-Locust Street Collector System (Washington Square Connectivity Improvements)	Improvements to distribute east/west traffic between Locust and Oak Streets and improve accessibility to Lincoln Center commercial district. Includes Lincoln Street extension to Oak Street. (Lincoln Street portion anticipated to be constructed by development)	$3,000,000	2009	Low		Tigard
25	New Road	TSP	Taylors Ferry Road Extension	Extend to Oleson Road	$2,870,000	2001	Medium		WACO
26	New Road	TSP	Wall Street Connection	New roadway connecting Hunziker St and Hall Boulevard	$15,110,000	2001	Remove from TSP		Tigard
14	New Road/ Intersection Realignment	New Project	North Dakota-Pfaffle Neighborhood Route and North Dakota Realignment at Greenburg Road	Pfaffle-North Dakota east-west connection with Hwy 217 over-crossing to provide a neighborhood route, connecting from 99W at 78th to Scholls Ferry Road, via N. Dakota. Includes realignment of North Dakota at Greenburg Road to provide a continuous east-west connection. Requires purchase existing building.	$15,000,000	2009	Medium		Tigard
Total New Roadway Project Costs					**$108,790,000**				
Roadway Widening Projects									
29	Road Widening	TSP	68th Avenue	Widen to 3 lanes between Dartmouth/I-5 Ramps and Hwy 217			Remove from TSP		Tigard
30	Road Widening	TSP	68th Avenue	Extend 68th Avenue south to Hwy 217 providing right-in/right-out only access to 68th Avenue from Hwy 217, replacing the NB ramps to 72nd at Hwy 217??			Remove from TSP		Tigard
4	Interchange Improvement	TSP RTP (10599)	OR 217/72nd Ave Interchange Improvements	Complete interchange reconstruction with additional ramps and overcrossings. May include Hunziker Realignment	$19,537,000	2009	High		ODOT
31	Road Widening	TSP RTP (10755)	72nd Avenue Widening: Ore 99W to Dartmouth	Widen to 3 lanes (Preliminary Engineering for 3 lanes plus bike lanes and sidewalks included in the CIP from 99W to Dartmouth for $300,000)	$10,000,000	2009	High		Tigard
32	Road Widening	RTP (10755)	72nd Avenue Widening: Dartmouth to Hunziker	Widen to 5 lanes (3 lanes plus bike lanes and sidewalks included in the CIP for $400,000) Includes bridge widening.	$15,000,000	2009	High		Tigard

33	Road Widening	RTP (10756, 10757)	72nd Avenue Widening: Hunziker to Durham	Widen to 5 lanes (widening to 3 lanes in CIP)	$45,000,000	2009	Low		Tigard
34	Road Widening	CIP (95015)	121st Street Widening	Widening 121st Avenue to a 2 or 3-lane roadway with sidewalks and bicycle lanes between Walnut Street and Gaarde Street	$1,580,000	2009	High		Tigard
35	Road Widening	TSP	Beef Bend Road Widening	Complete 3-lane section from 131st to 150th. This is a Washington County facility.	$2,280,000	2009	Low		WACO
36	Road Widening	RTP (10752)	Bonita Road Widening	Widen to 4-lanes from Hall to east of I-5 (Bangy) (ex TSP has 3 lanes w/ ROW for 5)	$28,170,000	2009	Medium		Tigard
37	Road Widening	TSP	Dartmouth Street Widening	Complete 5-lane section from Costco to 72nd Ave (small section missing in eastbound direction only)	$320,000	2009	Medium		Tigard
38	Road Widening	RTP (10759)	Dartmouth Street Widening	Widen to 4 lanes plus turn lanes and sidewalks between 72nd Avenue and I-5 (68th) (3 lanes in CIP for $800,000 + LID funds)	$4,410,000	2009	Low		Tigard
39	Road Widening	RTP (10764)	Durham Road Widening	Widen to 5-lanes from 99W to Hall Blvd including bikeways and sidewalks.	$20,000,000	2009	Medium		Tigard
40	Road Widening	RTP (10753)	Durham Road Widening	Widen to 5 lanes (total, both directions) between Hall Boulevard and Upper Boones Ferry Road	$21,090,000	2009	Medium		Tigard
41	Road Widening	TSP	Greenburg Road Widening	Widen to 4 lanes adjacent to cemetery	$3,780,000	2009	Low		WACO
43	Road Widening	TSP RTP (10748) CIP (95026)	Greenburg Road Widening, South of Hwy 217	Shady Lane to N. Dakota, Widen to 5 lanes with bikeways and sidewalk. Includes bridge replacement.	$6,000,000	2009	High		Tigard
44	Road Widening	TSP RTP (10750)	Greenburg Road Widening to 99W	Tiedeman to OR 99W, Widen to 5 lanes with bikeways and sidewalks	$15,020,000	2009	Low		Tigard
45	Road Widening	TSP RTP	Hall Boulevard Widening, South of Locust	Locust to Durham, Complete widening to 3 lanes; build sidewalks and bike lanes; safety improvements (ex TSP has 5 lanes from Locust to Hunziker)	$8,000,000	2009	Medium		ODOT
46	Road Widening	RTP	McDonald Street Widening from 99W to Hall	Widen to three lanes with sidewalks, bike lanes, and safety improvements	$14,500,000	2009	Medium		Tigard
48	Road Widening	TSP RTP CIP (95023)	Walnut Street Widening	Widen to 2 with turn lanes where necessary from 116th to OR 99W including sidewalks, bicycle lanes, and safety improvements	$14,500,000	2009	High		Tigard
84	Road Widening	CIP (95014)	121st Avenue	Walnut Street to North Dakota Street – two lanes with turn lanes where necessary plus bike lanes and sidewalks	$380,000	2009	High		Tigard

85	Road Widening		Hall Boulevard	Add an eastbound through lane on Hall Blvd. from Pamelad Road to Greenburg Road that removes the right-turn lane drop at Pamelad Road and ends as a right-turn lane at Greenburg Road. This completes the five-lane section on Hall Blvd. from Scholls Ferry Road to Greenburg Road	$280,000	2009	Medium		ODOT
58	Road Widening	TSP, RTP (10769)	Greenburg Road/ Washington Square Road	Install Boulevard treatment at Greenburg/Washington Square Road	included in project #56	2009	High		WACO
Total Roadway Widening Project Costs					**$229,567,000**				
Total for Roadway Projects					**$475,557,000**				

The intersection projects shown in Figure 5-6 are summarized in Table 5-17.

Table 5-17 Intersection Projects

ID	Project Type	Consistency w/ Prior Plans	Project Name	Description	Cost	Year $	Priority	Jurisdiction
City/County Projects								
49	Intersection Improvement	New Project	Pfaffle St/Hall Blvd	Traffic signal or other intersection treatment	$300,000	2009	Medium	ODOT/ Tigard
50	Intersection Improvement	TSP	68th Avenue/Atlanta/Hain es	Install a traffic signal	$300,000	2009	Medium	Tigard
51	Intersection Improvement	TSP	68th/Dartmouth	Install traffic signal	$300,000	2009	High	Tigard
52	Intersection Improvement	TSP	72nd/ Dartmouth	Traffic signal; Assumes 72nd Ave and Dartmouth widened to 5 lanes	$300,000	2009	High	Tigard
53	Intersection Improvement	TSP	121st/ North Dakota	Traffic signal	$300,000	2009	Medium	Tigard

54	Intersection Improvement	CIP (95010)	135th Ave/Walnut Street	CIP includes a traffic signal and westbound right-turn lane at this intersection. A roundabout should be considered at this location. Improvements at this intersection are being driven, in part, by the elimination of all left-turns at the Scholls Ferry/Barros Road intersection.	$400,000	2009	High	Tigard
55	Intersection Improvement	New Project	Durham Road at Upper Boones Ferry Road	Construct intersection improvements at Durham Road and Upper Boones Ferry Road to provide dual southbound right-turns, dual eastbound left-turns, eastbound right-turns, and northbound left-turns and improve signal timing.	$770,000	2009	High	Tigard
56	Intersection Improvement	TSP, RTP (10769)	Greenburg/Oleson/ Hall	2nd northbound left turn lane; Assumes Hall widened to 5 lanes	$7,000,000	2009	High	ODOT/ WACO
58	Intersection Improvement	TSP, RTP (10769)	Greenburg/ Washington Square Road (roadway or intersection project?)	Install Boulevard treatment at Greenburg/Washington Square Road	included in project #56	2009	High	ODOT/ WACO
59	Intersection Improvement	TSP	Hall/Durham	2nd southbound left-turn lane; Widen west of intersection to introduce 5-lane section on Durham	$1,810,000	2009	Medium	ODOT/ Tigard
60	Intersection Improvement	CIP (95020)	Hall/McDonald	Add southbound right-turn lane from Hall Street to McDonald Street.	$400,000	2009	High	ODOT/ Tigard
62	Intersection Improvement	CIP (95025)	Main Street/Tigard Street	Install a traffic signal at Main Street/Tigard Street	$180,000	2009	High	Tigard
63	Intersection Improvement	TSP	Nimbus/Scholls Ferry Road	Retain eastbound right-turn lane when 3rd lane added on Scholls Ferry Rd; Retain westbound right-turn lane when 3rd lane added on Scholls Ferry Rd; southbound right-turn lane; Reconfigure northbound and southbound lanes to create exclusive left-turn lanes; Change from split phasing to protected left-turn phasing North South	$1,740,000	2009	Medium	WACO/ Tigard
64	Intersection Improvement	TSP	North Dakota/ 125th/ Scholls Ferry Rd	Southbound right-turn lane, signal timing changes to provide permitted phasing north/south	$680,000	2009	Medium	WACO/ Tigard
65	Intersection Improvement	CIP (95028)	Tiedeman Street/Tigard Street	Install a traffic signal and northbound and southbound left-turn lane	$410,000	2009	High	Tigard
Total City/County Intersection Project Costs					**$188,820,000**			
ODOT Projects								
66	Intersection Improvement	RTP (10770)	Hwy 99W Intersection Improvements and Access Management	Provide increased capacity at priority intersections, including bus queue bypass lanes in some locations, improved sidewalks, priority pedestrian crossings, and an access management plan, while retaining existing	$50,000,000	2009	High	ODOT

				4/5-lane facility from I-5 to Durham Road (replaces 7-lane widening in ex TSP)((Should signal interconnect from I-5 to Durham from ex TSP be added as separate project?).				
67	Intersection Improvement	99W IMP	Highway 217 SB Ramps/Highway 99W	Intersection Capacity Improvements	$500,000	2009	Medium	ODOT
68	Intersection Improvement	99W IMP	Highway 217 NB Ramps/Highway 99W	Intersection Capacity Improvements	$500,000	2009	Medium	ODOT
69	Intersection Improvement	STIP	Highway 99W/ I-5	Northbound through lane	$500,000	2009	Medium	ODOT
70	Intersection Improvement	99W IMP	Highway 99W/68th Ave	Add transit queue bypass lanes in northbound and southbound directions	$400,000 (also included in project #66)	2009	High	ODOT/ Tigard
71	Intersection Improvement	99W IMP	Highway 99W/72nd Ave	Southbound right turn lane; Northbound right turn overlap; Change to protected left turn phasing north/south	$300,000 (also included in project #66)	2009	High	ODOT/ Tigard
72	Intersection Improvement	99W IMP	Highway 99W/Dartmouth St.	Add southbound through lane and transit queue bypass lanes in northbound direction	$600,000 (also included in project #66)	2009	High	ODOT/ Tigard
73	Intersection Improvement	99W IMP CIP (95005, 95031)	Highway 99W/Hall Boulevard	Additional eastbound and westbound through lane on 99W (CIP 95005), exclusive left-, through-, and right-turn lanes on each side street approach (CIP 95031) and transit queue bypass lanes in northbound direction (99W IMP).	$6,000,000 (also included in project #66)	2009	High	ODOT
74	Intersection Improvement	TSP CIP (95005)	Highway 99W/ Greenburg Road	Exclusive side street left-turn lanes on Greenburg Road and Main Street providing exclusive left, through, and right-turn lanes on both approaches, additional eastbound and westbound through lane on 99W.	$5,363,450 (also included in project #66)	2009	High	ODOT/ Tigard
75	Intersection Improvement	99W IMP	Highway 99W/ Walnut Street	Change to protected left turn phasing on Walnut, add westbound left-turn lane, add transit queue bypass lanes in northbound and southbound directions	$600,000 (also included in project #66)	2009	High	ODOT/ Tigard
76	Intersection Improvement	99W IMP	Highway 99W/ Gaarde Street/ McDonald Street	Add third through lane in each direction, westbound right-turn lane, 2nd northbound and southbound left-turn lanes, add transit queue bypass lanes in northbound and southbound directions	$1,500,000 (also included in project #66)	2009	High	ODOT/ Tigard
77	Intersection Improvement	99W IMP	Highway 99W/ Canterbury	Westbound left-turn lane	$250,000 (also included in project #66)	2009	High	ODOT/ Tigard
78	Intersection Improvement	99W IMP	Highway 99W/ Dartmouth Street	Southbound through lane for 500 ft.	$250,000 (also included in project #66)		High	ODOT/ Tigard
79	Intersection Improvement	99W IMP	Highway 99W/Beef Bend Road	Southbound right turn lane (on ORE 99W); Adjust cycle length	$250,000 (also included in project #66)	2009	High	ODOT/ WACO
80	Intersection Improvement	99W IMP	Highway 99W/Durham Road	Northbound left-turn lane	$250,000 (also included in project #66)	2009	High	ODOT/ Tigard

81	Intersection Improvement		Highway 217 SB/Hall Street Interchange Improvements	SB right-turn lane at Hall Blvd/OR 217 ramp (located in City of Beaverton)	$500,000	2009	Medium	ODOT
82	Intersection Improvement		Highway 217 NB On-ramp/ Scholls Ferry Road/ Washington Square Road Interchange Improvement	Add 2nd northbound left-turn Lane and 2nd westbound left-turn lane at OR 217 NB on- ramp	$750,000	2009	Medium	ODOT
Total City/County Intersection Project Costs					**$112,750,000**			
Total for Intersection Projects					**$301,570,000**			

Each of the projects identified in Table 5-16 as recommended "new projects" or "removed projects" from the TSP were originally evaluated according to the seven evaluation criteria and given a qualitative assessment as described in Table 5-5. The following sections describe the roadway and intersection project evaluations.

Major ODOT Projects

Table 5-16 provides a summary of projects under ODOT jurisdiction which are currently included in the City's TSP and are recommended for inclusion in the TSP update. With the exception of Project #3, 99W Connector Arterial(s), none of the identified "Major ODOT Projects" are included in the RTP (the 99W Connector Arterial(s) are on the financially constrained RTP project list).

Project #1: Interstate 5 Widening & Capacity Improvements

The 2002 TSP identified projects to widen I-5 to four lanes in each direction between Highway 217 and I-205, and to otherwise increase through capacity south to Wilsonville. The total project costs were estimated at $200,000,000 (estimate from the 2002 TSP). However, these projects are not included in any state or regional plans, nor were any funding sources identified in the TSP.

The congestion on I-5 through the Tigard TSP planning area has negative impacts on Tigard residents and businesses. For residents, this congestion makes travel to and from activities outside of the city difficult, and for business owners timeliness of critical activities less reliable. City of Tigard Staff will continue to advocate for State and Regional Plans to address these issues.

Project #2: Highway 217 Widening

The 2002 TSP identifies widening of Highway 217 to three lanes plus auxiliary lanes in each direction, with an estimated cost of $240,000,000 (2001$). According to the TSP, the RTP at that time listed a potential widening or HOV or HOT project.

At this time, ODOT is initiating a study to improve operations on the freeway and at interchanges and ramps. The congestion on Highway 217 through the Tigard TSP planning area has negative impacts on Tigard residents and businesses. For residents, this congestion makes travel to and from activities outside of the city difficult, and for business owners timeliness of critical activities less reliable. City of Tigard Staff will continue to advocate for State and Regional Plans to address these issues.

Project #3: I-5 to Highway 99W Connector

This project has been replaced by a series of Southern Arterial Improvements. The purpose of this project is to relieve congestion along Interstate 5, Highway 99W and to some extent Highway 217 by improving arterial connections in and through the Tualatin area. Under current planning, it is anticipated that the arterial connections may improve local mobility, but longer distance regional and statewide trips will remain on Highway 99W. As such, it is critical that the project includes improvements on Highway 99W to ensure that it will function.

These projects are in the RTP Update project list under the federal financially constrained list. Phased construction is anticipated to begin in 2018 and conclude in 2035, with estimated costs of $90,000,000 for right of way acquisition and additional project costs of $260,000,000.

One of the arterial options includes connections in the vicinity of 72nd Avenue near the Interstate 5 interchange, and in the vicinity of the intersection of Durham Road/Upper Boones Ferry Road. City of Tigard Staff will continue to work with the regional partners in the development and refinement of these arterial concepts. This TSP does include realignment of Durham Road.

Project #4: Highway 217 – 72nd Avenue Interchange Improvements

Because this project is recommended and included in the travel demand model, discussion of this project is included in the Roadway Widening section discussion.

This project is recommended..

Project #5: I-5/OR 217 Interchange

Improvements at the I-5/OR 217 interchange are included in the 2002 TSP but are not included in the RTP Update. Congestion on I-5 and Highway 217 makes travel to and from activities outside of the city difficult, and for business owners timeliness of critical activities less reliable. City of Tigard Staff will continue to advocate for State and Regional Plans to address these issues.

Major Roadway Realignments

The recommended major roadway realignments are summarized in Table 5-16. A summary and discussion of the notable projects in the existing TSP is provided after the table.

Notable Projects

Projects #7-10: Durham Road at Upper Boones Ferry Road

The 2002 TSP identifies this realignment of the Durham Road/Upper Boones Ferry Road intersection so that Durham Road is a continuous route to the I-5/Upper Boones Ferry/Carmen Drive interchange. This would potentially involve a new road alignment for Durham Road but also has potential to remain in a similar alignment with major changes at each intersection. This project would involve realignments and/or intersection changes each of the intersections of Durham Road, Upper Boones Ferry Road, and 72nd Avenue and is estimated to cost approximately $9,630,000. A refinement study of this area was recommended in the 2002 TSP and is still warranted as there are multiple options for this area from low impact to high impact and a full realigning of Durham Road would significantly impact developed industrial/commercial areas. Near-term intersection improvements at the Durham Road/Upper Boones Ferry intersection are recommended in the following section (see Project #55 in Table 5-15).

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
7-10	●	●	●	●	●	○	●	Yes

Projects #11: Hall/Hunziker/Scoffins Intersection Realignment

The Hall/Hunziker/Scoffins intersection realignment project is identified in the 2002 TSP and RTP and is currently identified in the CIP for conducting a study. Construction is estimated to cost approximately $5,000,000. This project would provide safety benefit to all modes. This location is also an environmental justice area for the senior population and would enhance their mobility by increasing both pedestrian and vehicle safety.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
11	●	●	●	●	●	●	●	Yes

Projects #12: Tiedeman Realignment

Realignment of Tiedeman to intersect North Dakota west of the existing North Dakota/Greenburg/Tiedeman intersection is identified in the RTP. This project may have environmental impacts as it would be adjacent to Fanno Creek and intersect North Dakota near the Fanno Creek bridge (which needs to be widened to accommodate pedestrians and bicycles). However, it would remove the queuing conflict that currently occurs at the North Dakota/Tiedeman intersection in which eastbound vehicles on North Dakota have a difficult time turning left on to Tiedeman towards Greenburg due to queues on Tiedeman that extend west through the North Dakota/Tiedeman intersection.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
12	●	●	●	●	●	○	●	Yes

New Roadways

The new roadways recommended for inclusion in the TSP are summarized in Table 5-16. All of the proposed projects are included in the current TSP and Draft Metro RTP; however there are several projects in the current TSP that are recommended for removal. A summary and discussion of the proposed project removals, as well as several notable projects in the existing TSP, is provided after the table.

New Project

Project #14: North Dakota-Pfaffle Neighborhood Route and North Dakota Realignment

This project is envisioned to occur in tandem with or subsequent to Project #12 (realignment of Tiedeman to be removed from the North Dakota/Greenburg Road intersection). Project #14 would provide a much needed east-west connection between Pfaffle and North Dakota Street over Highway 217. It would also include realignment of North Dakota to be a continuous east-west route through the North Dakota/Greenburg intersection. The North Dakota realignment is identified in the RTP. This element of the project would require purchase of an existing building at the North Dakota/Greenburg Road intersection which may be costly compared to the system benefit.

This project would provide a continuous route between Highway 99W and Scholls Ferry Road. Modeling indicates there is a demand for this route up to approximately 800 trips per hour, many of which are not neighborhood trips. This route would provide an alternative to 99W and Walnut to get between east and west Tigard. Traffic calming measures could be implemented to keep travel speeds consistent with a Neighborhood Route; however, measures to reduce traffic volumes on this route would reduce the benefit of the crossing which will cost several million dollars.

This project is recommended

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended ?
14	●	●	●	●	●	●	●	Yes

Recommended Project Removals

Project #:15: Northern Washington Square Regional Center Crossing

The Washington Square Regional Center Plan included two new bridges over Highway 217. The northern over-crossing extended from Washington Square Mall Road across Highway 217 connecting to Cascade Avenue (Project #15); the southern crossing conceptually extending Locust Street across Highway 217 to Nimbus Avenue (Project #22). In concept these facilities provide secondary circulation to Highway 217, and improved multi-modal access to the Washington Square Area. The probability of constructing two overpasses of Highway 217 is fairly minimal. Additional evaluation of the northern crossing that has been completed since the WSRC plan indicates that this crossing is not very feasible. As the southern crossing provides more of a system capacity benefit by attracting trips that would otherwise use Scholls Ferry Road, the northern crossing as a auto facility is recommended to be removed from the TSP. The northern crossing; however, would provide a significant enhancement to pedestrian and bicycle circulation and safety. It is recommended that this project be maintained as a pedestrian/bicycle facility (see Project MUP 7).

This project is not recommended as a vehicle bridge.

This project is recommended as a pedestrian and bicycle connection bridge in the same general location (see Project MUP 7).

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended?
15	●	◉	◉	●	◉	◉	◉	No

Project #16: Nimbus Road Extension

This project would extend Nimbus Road from its current terminus south and west to connect with Greenburg Road. This project is not recommended primarily due to the environmental impacts associated with a road extension along the Fanno Creek area and the potential cost impacts of constructing a project in this area.

This project is not recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended?
16	◉	◉	◉	◉	○	○	◉	No

Project #26: Wall Street Connection

The 2002 TSP includes a project to connect Wall Street from Hunziker Street to Hall Boulevard. The extended segment would have a two lane cross section with bike lanes and sidewalks and would be grade separated over the existing railroad tracks. The cost effectiveness of this project is relatively low. Bridge construction over the railroad tracks would require significant structure work. This Transportation Analysis Zone (TAZ) has among the highest senior and disabled population percentages in the city, therefore there would be potential environmental justice impacts to consider and avoid if possible. Costs are also anticipated to be significant due to potential wetlands impacts.

Based on the limited benefits, relatively high costs, and the potential environmental justice impacts, it is recommended that this project be removed from the City of Tigard TSP.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended?
26	◉	◉	◉	◉	○	○	○	Remove from TSP

This project should be removed from the TSP.

Other Project Discussions

Project #21: Hall Boulevard Extension to Tualatin

The 2002 TSP identifies extending Hall Boulevard south to the City of Tualatin. The new connection is also included in the Tualatin TSP. The extended segment of Hall Boulevard is planned as a 3-lane facility.

As a north-south corridor between Tigard and Tualatin, this new extension is forecast to attract approximately 2,500 peak hour trips which will be diverted primarily from 72nd Avenue and Upper Boones Ferry Road. The added traffic will further constrain Hall Boulevard, which serves a high proportion of environmental justice populations and is forecast to be over capacity even without the new bridge. However, it will help alleviate the over-capacity problem forecast on 72nd Avenue and Upper Boones Ferry Road in 2035. The Hall Boulevard Extension would also provide an additional bike/ pedestrian connectivity between Tigard and Tualatin. The bridge crossing over the Tualatin River is a significant environmental consideration.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended?
21	●	●	●	●	●	●	●	Yes

Project #23: Hunziker-Tigard Triangle Connection

The 2002 TSP identifies realigning Hunziker Street to meet Hampton Street at 72nd Avenue. This realignment requires that Hunziker Street crosses over Highway 217. The connection would provide an important link to the Tigard Triangle and would play a significant role in the ability to reconstruct the Hwy 217/72nd Avenue interchange. A variety of alignments for this connection should be considered through project refinement and in connection with plans for the Highway 217/72nd Avenue Interchange. The benefits of this project could also be realized from several different alignments such as Hunziker to Hampton, Hunziker at Wall Street to Beveland, or other similar alternatives.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended?
23	●	●	●	●	●	●	●	Yes

Project #27, 17, 18: Walnut Street Extension – Ash Street (ORE 99W to Hall Boulevard/ Hunziker Street)

The 2002 TSP identifies extending Walnut Street east of ORE 99W as Ash Street to meet Hall Boulevard and Hunziker Street. This project would provide a much needed connection downtown.

A large amount of traffic is anticipated to utilize a Walnut Street extension to Hall Boulevard and Hunziker Street. Walnut Street is a desired route to motorists traveling from Tigard downtown to the west side of ORE 99W. However, there are environmental resources concerns with regard to the Fanno Creek and trail crossing. It would also need to be designed to minimize neighborhood impacts. This project would provide needed additional access to downtown.

This project is recommended

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended?
23	●	●	◉	◉	◉	○	◉	Yes

Road Widening Projects

The road widening projects recommended for inclusion in the TSP are summarized in Table 5-16. Most of the proposed projects are included in the current TSP and Draft Metro RTP; however there are several projects in the current TSP that are recommended for removal. There are also several projects from the existing TSP that are not identified in the RTP that are recommended to stay in the TSP, as well as one project (Project #83: Cascade Avenue) from the WSRC that is recommended to be included in the TSP. A summary and discussion of the proposed project removals, as well as several notable projects in the existing TSP, is provided after the table.

Recommended Project Removals

Project #:28: Scholls Ferry Road Widening (121st to Barrows)

The 2002 TSP identifies widening of Scholls Ferry Road from five lanes to seven lanes between Barrows Road (East) and SW 121st Avenue. This would be a continuation of the planned widening to seven lanes identified in the RTP and Washington County TSP for Scholls Ferry Road from 121st Street to Highway 217 (Project #47).

The 2035 forecast analysis shows this segment of roadway will be over capacity during the weekday p.m. peak hour if it is retained as a five-lane segment. While this project would alleviate the over-capacity condition it would also attract more travel demand, overwhelming the benefits of the widening planned in the RTP (between Highway 217 to 121st Avenue). Further, this segment of Scholls Ferry widening is not consistent with the Washington County Transportation Plan, which shows a future 5-lane section.

This project is not recommended due to inconsistency with Washington County plans for the facility.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended?
28	◉	●	○	○	◉	○	○	No

Project #:29: 68th Avenue Widening (Dartmouth to Hwy 217)

The 2002 TSP identifies widening 68th Avenue to three lanes between Dartmouth Street/ I-5 Interchange and Highway 217. It also identifies extending 68th Avenue South to connect to Highway 217 (see Project #:30, also not recommended), providing right-in/right-out only access to 68th Avenue from Highway 217, which will replace the northbound ramps to 72nd Avenue.

Assuming there is no 68th Avenue Extension project, 68th Avenue is not going to be a heavily-utilized roadway as forecast in the 2035 analysis. The additional capacities associated with the widening will not be needed.

The widening will provide bike lanes on this roadway, which are not existent on 68th Avenue under existing conditions. Although 68th Avenue travels through an area significantly populated by environmental justice populations (low-income, non-English-speaking); the relative impact associated with this project does not appear to be significant.

This project is not recommended without the extension of 68th to Highway 217 with a new northbound on/off-ramp at this location.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended?
29	○	●	●	○	○	●	○	No

Project #:30: 68th Avenue Extension and Hwy 217 NB Ramp

68th Avenue Extension

This project is not recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended?
30	●	●	○	●	●	●	○	No

Other Project Discussions

Project #4: Highway 217 – 72nd Avenue Interchange Improvements

Reconstruction of this interchange is included in the 2002 TSP and is included in the RTP Update non-financially constrained project list. The project includes reconstruction of the existing interchange and would address recurring safety issues. The project cost (in the RTP Update, 2007$) is estimated $19,537,000, with an estimated time of construction from 2018-2025.

This project should be considered in coordination with widening of 72nd Avenue (Projects #: 31-33), see below, as well as Project #23: Hunziker-Tigard Triangle Connection.

This project is recommended.

Project #31-33: 72nd Avenue Widening, Highway 99W to Durham Road

The 2002 TSP identifies widening 72nd Avenue to 5 lanes from ORE 99W to south city limit at Upper Boones Ferry Road/Carman Drive/Durham Road intersection.

Under the 2035 forecast conditions, 72nd will operate acceptably within the Tigard Triangle, but will be over capacity south of Highway 217. If the Hall Boulevard extension to Tualatin is constructed, the diversion of traffic would alleviate the congestion on 72nd Avenue south of Highway 217.

There are no continuous bike lanes on 72nd Avenue and there are frequent gaps in the sidewalks; therefore, the road widening would improve pedestrian/ bike conditions. However, widening 72nd Avenue would impact areas with high environmental justice populations.

72nd Avenue is recommended to be 3 lanes from 99W to Dartmouth and 5 lanes from Dartmouth to Durham Road if the Hall Boulevard extension is NOT constructed. If the Hall Boulevard extension IS constructed, 72nd Avenue should remain a 3 lane road.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended?
31-33	●	●	●	●	●	●	○	Yes*

Projects #39-40: Durham Road Widening from Highway 99W to Hall Boulevard, and from Hall Boulevard to Upper Boones Ferry Road

The 2002 TSP identifies widening Durham Road to five lanes between Hall Boulevard and Upper Boones Ferry Road. Widening Durham Road to 5 lanes will provide more capacity and improve traffic conditions in the 2035 forecast. Durham Road connects I-5/Upper Boones Interchange and the west side of ORE 99W. Durham Road passes an environmental resources area near its intersection with Upper Boones Ferry Road. The widening may impact this area negatively.

This project is recommended due to its improvement to the future traffic conditions.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended?
40	●	●	●	●	●	○	○	Yes*

Project #41-44: Greenburg Road Widening, Hall Boulevard to Highway 99W Avenue

The 2002 TSP identifies a project to widen Greenburg Road to 4 lanes adjacent to the cemetery between Hall Boulevard and Locust Street and to 5 lanes for the segments between Locust and North Dakota, Tiedeman and Highway 99W.

Greenburg Road travels through an area with environmental justice populations. The widening of Greenburg Road may negatively impact this population through right-of-way acquisitions and decreased accessibility and safety for pedestrians and cyclists. There are no impacts to environmental resources associated with this project.

This project is recommended.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended?
41-45	●	●	●	●	●	●	○	Yes*

Project #45: Hall Boulevard Widening (3-lanes Locust to Durham)

The 2002 TSP recommends widening Hall Boulevard from Greenburg to Hunziker to five lanes and three lanes from Hunziker to Durham. Hall Boulevard is currently three lanes from Greenburg to Locust. Widening to three lanes (not five lanes) from Locust Street to Durham Road is recommended as part of the TSP update.

The area west of Hall Boulevard includes a high proportion of environmental justice populations (low income and non-English speaking groups). Pedestrian conditions would be negatively impacted by the wider roadway from a pedestrian level-of-service perspective. Environmental resource impacts are not readily apparent.

The decision to widen this facility to three-lanes versus five-lanes should be considered in coordination with 72nd Avenue widening, the Hall Boulevard Extension (Project #21).

This project is recommended as a three-lane facility.

ID	Multi-Modal Mobility	System Capacity	Consistency w/ Plans	Safety	Cost Effectiveness	Environmental Resources	Environmental Justice	Recommended?
45	●	●	○	●	●	●	○	Yes*

Roadway Projects Summary

The cross-sections for each of the roadway projects presented in the previous sections are shown in Figure 5-8. This material is presented for reference and context for considering each of the roadway projects.

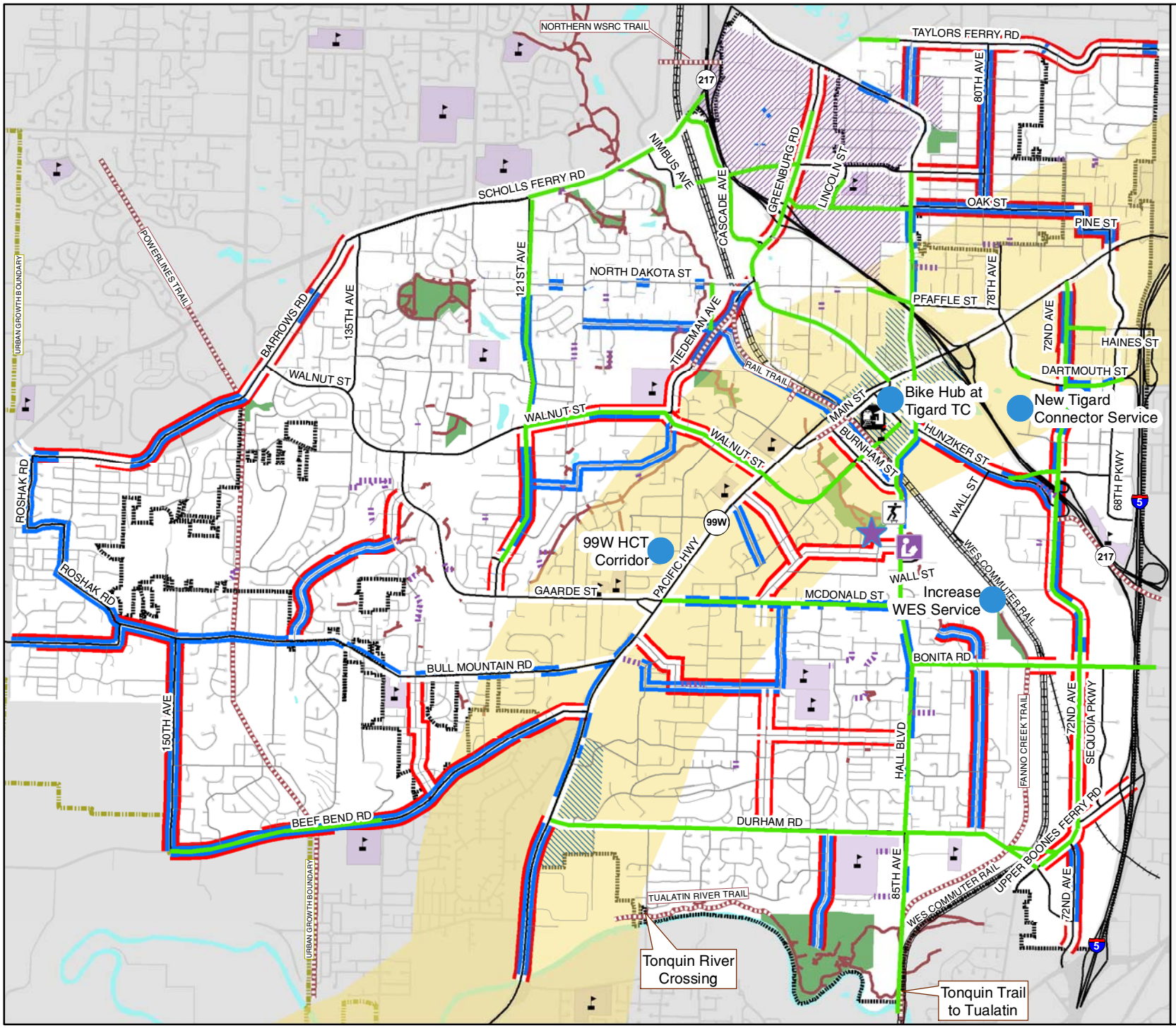

Figure 5-8

Planned Facilities

Tigard Urban Planning Area

LEGEND

Planned Facilities

- Bicycle Facility
- Pedestrian Facility
- Roadway Facility
- HCT Corridor
- Transit Project
- Multi-Use Pathway
- Tigard Trails Project

Existing Facilities

- Multiuse Paths

Generators

- Regional Center
- Town Center
- Schools
- City Library
- Tigard Senior Center
- Tigard Skate Park

** The information represented on this map is current as of February 2, 2009. Revisions will be made as new decisions or amendments occur to alter the content of the map.

TIGARD

N

0 0.15 0.3 0.6
Miles

Sources: City of Tigard
Metro Data Resource Center November 2009
Washington County

This map was derived from several databases. The City cannot accept responsibility for any errors. Therefore, there are no warranties for this product. However, any notification of errors would be appreciated.

13125 SW Hall Blvd Tigard, OR 97223 503-639-4171
http://www.tigard-or.gov

Intersection projects

City/County Projects

The city/county jurisdiction intersection projects recommended for inclusion in the TSP are summarized in Table 5-17. The majority of the intersections in this table are included in the existing TSP. Two additional improvements are suggested, Project #49 (Pfaffle/Hall) and Project #55 (Durham/Upper Boones Ferry). Project #55 is a near-term alternative to the longer-term project described in the roadway project section.

ODOT Projects

The intersection projects recommended for inclusion in the TSP which are under ODOT jurisdiction are also summarized in Table 5-17. The majority of the intersections were included in the existing TSP and/or the 99W Corridor Plan. Many of these projects represent changes to the existing TSP based on a change from a planned 7-lane facility in the TSP to a 5-lane facility after completion of the Highway 99W Corridor Plan.

SUMMARY OF PROJECTS

The projects presented in the previous tables, figures, and discussion were separated by mode in order to develop a complete understanding of issues and opportunities for each mode. However, each of the projects presented in the previous tables and figures may have additional impacts and benefits when compared side-by-side. For this reason, Figure 5-9 is presented to show the locations where projects may overlap. As shown in the figure, there are several locations where pedestrian, bicycle, and roadway projects are planned on the same facility. In these locations, the pedestrian and bicycle facilities will be included with the roadway project, and the associated cost for the roadway project already includes costs for sidewalks and bike lanes.

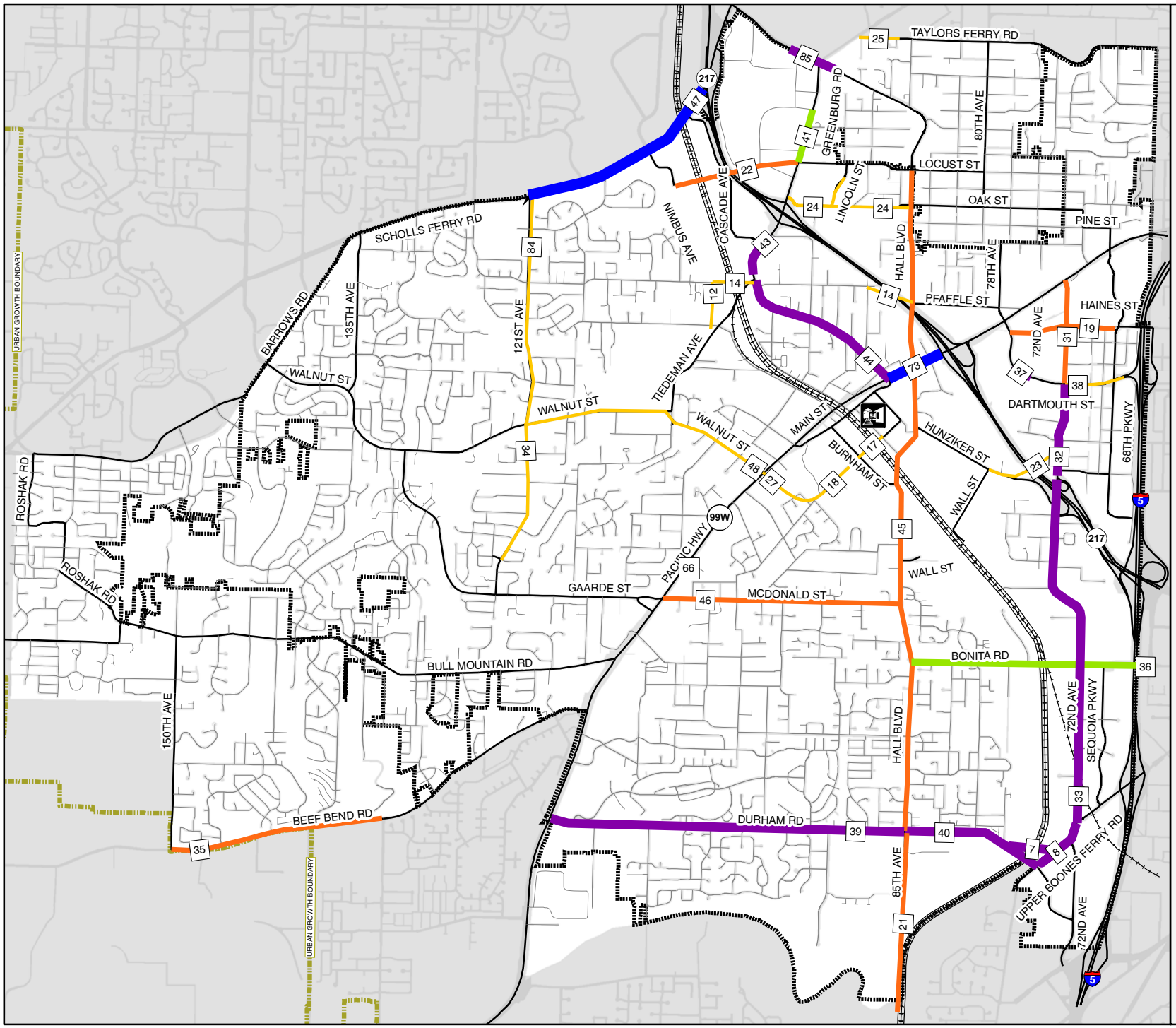

Figure 5-9

Roadway Project Cross-Section

Tigard Urban Planning Area

LEGEND

Roadway Cross-Section (Travel Lanes)

- 2 Lanes
- 3 Lanes
- 4 Lanes
- 5 Lanes
- 7 Lanes

Other Map Elements

- Tigard City Boundary
- WES Rail Line
- WES Station
- Rail Lines

** The information represented on this map is current as of February 2, 2009. Revisions will be made as new decisions or amendments occur to alter the content of the map.

TIGARD

N

0 0.15 0.3 0.6
Miles

Sources: City of Tigard
Metro Data Resource Center
Washington County
November 2009

This map was derived from several databases. The City cannot accept responsibility for any errors. Therefore, there are no warranties for this product. However, any notification of errors would be appreciated.

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http://www.tigard-or.gov

SPEACIAL AREAS

Tigard Triangle

The City of Tigard is focusing their community development goals on downtown Tigard and the Tigard Triangle area. The Tigard Triangle has long been a retail and commercial hub within the City. Today, the Tigard Triangle is zoned for commercial and mixed use development, and is identified as an area of significant growth in housing and jobs.

Although the area is outlined by three major regional roadways, those roadways serve to essentially form an island surrounded by pavement. Travel to and from the Tigard Triangle is funneled through three intersections with Highway 99W: 72nd Avenue, Dartmouth Street and 68th Parkway; the Highway 217/72nd Avenue interchange, the southbound I-5 interchange with Haines Street, and the northbound I-5 interchange with Dartmouth street. Employees and customers traveling to the area on City streets will almost exclusively access the Tigard Triangle area off of Highway 99W. As demonstrated in the existing conditions analysis, today there is congestion on Highway 99W in the vicinity of the Tigard Triangle, and this congestion is forecast to worsen with future development. Today TriMet Route 78 provides transit along 68th Parkway and Hunziker Street. Access to and from the Tigard Triangle area is, and unless action is taken, will remain a critical issue to the success of the Tigard Triangle area.

A second issue with the Tigard Triangle relates to non-auto mobility/circulation to/from and within the area. The Tigard Triangle area as a whole is generally sloping downward from Highway 99W to Highway 217. The topography does make pedestrian and bicycle transportation more difficult. There are no bicycle lanes on the key roadways within the area. There are sidewalks on most streets within the triangle. There are sidewalks and bicycle lanes on Highway 99W adjacent to the Tigard Triangle except between 72nd Avenue and 68th Parkway, where there are no bicycle lanes. However Highway 99W can be characterized as an uncomfortable facility for pedestrians at best and only the most experienced cyclists will feel comfortable and confident riding their bicycles on this facility.

At the broadest level, options for improving access to the Tigard Triangle area fall into the following categories:

- Provide additional intersection and roadway capacity improvements to improve traffic operations at the boundary streets.
- Minimize additional infrastructure investment and focus on travel demand management (TDM) programs.
- Create a mix of critical additional capacity and implementing TDM programs.

The following provides a brief overview of these options.

Infrastructure Investment in Tigard Triangle

Figure 5-6 includes the roadway improvement projects related to the Tigard Triangle. With these improvements congestion within the Tigard Triangle is forecast to be limited to Dartmouth Street, 72nd Avenue and 68th Parkway access points to the area from Highway 99W.

Within the Triangle, this concept includes widening Dartmouth to five-lanes, widening 72nd Avenue to five-lanes, extending Atlanta Street from its existing terminus to connect to 72nd Avenue, and constructing a Highway 217 overcrossing connecting to Hunziker Street. The Atlanta Street extension and Hunziker Street overcrossing would provide needed additional circulation options for auto and non-auto modes of transportation within the Tigard Triangle. In addition, the Hunziker Street overcrossing would provide an additional access to the Tigard Triangle area from the south and west portion of Tigard. The current TSP also includes a connection from Dartmouth Street south across Highway 217 to Hunziker Street. This project is not recommended because it is essentially a duplicate to the Hunziker overcrossing.

Within the Tigard Triangle, 72nd Avenue is classified as an Arterial street, and Dartmouth Street is classified as a Collector street. This concept includes widening both streets to five-lanes. Without, careful design of both facilities, these could both become significant barriers to non-auto travel within the Tigard Triangle.

A roadway design option for consideration in the Tigard Triangle is called a "multiway" boulevard. A *multiway boulevard* has "central travel lanes for relatively fast-moving through-traffic bordered by tree-lined medians with walking paths. It has narrow one-way access roadway on each side for slower traffic and parking, and finally at the edges, tree-lined sidewalks. The medians, narrow access roadways, and sidewalks together create extended pedestrian realms, where movement is at a slow pace"[6]. Below is a concept plan for Octavia Boulevard in San Francisco, California[7]. This multiway boulevard was recently constructed and has been met with favorable support from the city, and neighborhood residents and business owners. More information about this project can be found online at http://www.uctc.net/access/28/Access%2028%20-%2002%20-%20Building%20a%20Boulevard.pdf.

Additional study of the multiway boulevard cross-sectional requirements and consistency with City of Tigard street design standards would be required to determine if this street type could be viable for Dartmouth Street or 72nd Avenue. At preliminary concept level, if 72nd Avenue were converted to a five-lane multiway boulevard, it would provide a centralized spine/center for development and urban design within the triangle.

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[6] "Building a Boulevard", Elizabeth Macdonald, UCTC on-line magazine: Access, Number 28, Spring 2006, page 1 http://www.uctc.net/access/28/Access%2028%20-%2002%20-%20Building%20a%20Boulevard.pdf

[7] IBID, page 6

Plan of Octavia Boulevard

Travel Demand Management in Tigard Triangle

As part of this TSP, Tigard is considering adopting non-auto mode split targets higher than required by the Metro RTP. This would demonstrate the City's commitment to reducing congestion and carbon-footprint. Focusing a TDM program within the Tigard Triangle could serve as a starting point for a successful city-wide TDM program. This could be developed as a Transportation Management Association. (TMA)

For a TMA program to be successful the business owners, employers and residents within the area must own the issues and potential solutions. If the stakeholders believe in the importance of the program and see their own livelihood and neighborhood livability hinging on the success of localized TDM programs, the TMA would have the opportunity to succeed and become part of the social fabric in the area. The Lloyd District TMA is an example of such a program.

The City of Tigard should plan to support the implementation of TDM in their city by committing staff time or a staff position to City-wide TDM management. Initially this role could focus on the development of TDM program for the Tigard Triangle area.

Parking Management would also be a critical component of managing travel options to and from the sub-area. In order for a district or subarea to gain momentum an adequate amount of parking is required; that said too much parking can degrade the environment of a place because of the amount of physical space dedicated to parking. As the Tigard Triangle area continues to grow, and as transit options to/from and within the area increase, the City of Tigard should consider developing a parking monitoring and management program. From a policy perspective, the program would be managed to achieve 85-percent parking utilization on street and off-street. Beyond 85-percent utilization the system can be considered effectively full. The program should also consider parking pricing options. As parking utilization increases to near effective capacity, parking pricing becomes an option to increasing parking supply. Pricing options can be set to benefit retail (i.e. short-term),

or employment (i.e. long-term) parking. This policy choice (short-term or long-term parking) will influence the mode of travel employees and customers use to get to the Tigard Triangle area. To ease the transition to paid parking, employers or the Tigard TMA could consider parking cash out programs and free carpool parking. This could be integrated with transit subsidies provided through the TMA or the City through a local improvement district. Pricing is not necessary at this time; however the City should be prepared to consider this at some point.

As parking becomes more utilized in the triangle, and if parking management programs are implemented, the City should consider developing additional non-auto travel options to provide choices for travelers to gain access to the Tigard Triangle. Options include developing a locally funded city transit circulator connecting the Tigard Triangle to residential areas within the City. Routes could be developed to inter-connect with the downtown Transit Center, the WSRC, the Tigard Triangle and/or other key activity areas in the City. In addition, as high capacity transit is explored on Highway 99W, plans should be made for providing local transit circulation options from the high capacity transit to and within the Tigard Triangle.

From an infrastructure perspective, a travel demand option for the triangle could include maintaining 72nd Avenue as a three-lane road. For circulation within the triangle this may be a viable option because of the pedestrian and bicycle advantages. However, from a city-wide system capacity perspective, this may not be a viable option if Hall Boulevard is also maintained as a three-lane facility. There simply may not be sufficient north/south local circulation options with both of these facilities as three-lane roads.

Access Management on Highway 99W

Access management on Highway 99W is also a critical component of the success of the Tigard Triangle area. As previously described, access to the Tigard Triangle is relatively limited and largely focused to Highway 99W. If congestion on Highway 99W degrades too far, the ease of access to the Tigard Triangle area will decrease, and could ultimately limit growth. Therefore, consistent with other recommendations in this document and the recently adopted Highway 99W plan, access management planning and implementation on Highway 99W is important and recommended.

Transit Oriented Land Use

The eastern portion of the Tigard Triangle is zoned for mixed use development. West of 72nd Avenue the sub-area is zoned for commercial development. Planning is underway to consider the viability of high capacity transit on Highway 99W. Combining high capacity transit with transit oriented land uses in the Tigard Triangle near Highway 99W can be an exciting option to create a renewed vibrancy in the Tigard Triangle. This is consistent with the mixed use zoning in the Tigard Triangle east of 72nd Avenue. In addition, developing 72nd Avenue as a multiway boulevard or another type of street with design to support transit-oriented and mixed-use development also supports the transit oriented land uses.

Recommendations

Focusing exclusively on the Tigard Triangle, the following is recommended:

- **Maintain and improve access to the sub-area** - This includes the intersection improvements on Highway 99W, access management on Highway 99W, the Hunziker Street Overcrossing, and the interchange improvements at Highway 217/72nd Avenue.

- **Develop Travel Demand Management options** – Commit staff time to develop and manage TDM programs for the sub-area. Work with the property owners, residents and business owners to develop ownership of the issues and the programs for reducing SOV travel within the area. This program would include concurrent parking management and development of transit options.

- **Explore the Possibility of Developing 72nd as a Multiway Boulevard –** Multiway Boulevards can move through traffic and provide space for slower speed pedestrian, bicycle travel as well as opportunities for community gathering.

- **Pursue Transit Oriented Land Uses –** Transit oriented land use along 72nd Avenue, and in the vicinity of Highway 99W would provide additional options for non-auto travel and add vibrancy to the Tigard Triangle area.

Washington Square Regional Center

The Washington Square Regional Center (WSRC) Plan completed in 1999 included major infrastructure investments aimed at connecting the Washington Square Mall with the land uses on the west side of Highway 217. Two bridges and roadways were proposed: the northern crossing extended from Washington Square Mall Road across Highway 217 connecting to Cascade Avenue; the southern crossing conceptually extending Locust Street across Highway 217 to Nimbus Avenue. The connectivity benefits of these two roadway extensions would be enhanced by extending Nimbus Avenue south roughly parallel to the WES Commuter Rail tracks to Greenburg Road. In concept these facilities provide secondary circulation to Highway 217, and improved multi-modal access to the Washington Square Area.

The WSRC also included projects identified to improve local circulation. Project #24 in Figure 5-3 represents pedestrian and bicycle improvements to Locust Street, Oak Street and Lincoln Street, as well as an extension of Lincoln Street to Oak Street.

Based on a select zone analysis, travel to and from the Washington Square Mall area is approximately equally distributed (15-20%) on Scholls Ferry Road (from the south and north), Hall Boulevard (to and from the west) and Greenburg road (to and from the south). Approximately 10% of the trips to and from the Mall are made on Oleson Road and Locust Street, and approximately 5% of the trip to and from the Mall travel on Hall Boulevard. The select zone results indicate that there is ample demand for the connections from Washington Square to and from the south west toward Beaverton and Tigard and north east toward Portland.

Project Considerations

Northern Overcrossing from Washington Square Road to Cascade Avenue and Nimbus Avenue on the Westside of Highway 217

Based on input from ODOT and the Cities of Beaverton and Tigard the northern overcrossing from Washington Square Road to Cascade and Nimbus on the west side of Highway 217 was not included in the travel demand modeling for the draft project list primarily due to issues with feasibility of this connection. The analysis results show that although this would be a valuable non-auto connection, from an auto capacity perspective the proposed system can operate without this connection. Therefore this project is recommended for further consideration as a pedestrian and bicycle structure only.

Nimbus Avenue Extension

The Nimbus Avenue extension south to Greenburg/Tiedeman was not included in the travel demand modeling of the draft project list. Again, the analysis results show that the proposed system can operate without this connection. In addition, the potential environmental impacts of this roadway are relatively high. It is possible that the impacts could be avoided and or mitigated; however the associated project costs would likely be relatively high. Therefore this project is not recommended for further consideration.

Southern Overcrossing Extending Locust Street to Nimbus Avenue on the Westside of Highway 217

This overcrossing was included in the modeling conducted for this project. The roadway would provide an east/west connection in the northern part of Tigard where there are few east/west connections. The facility could also provide pedestrian and bicycle access to the Fanno Creek Greenway area. As a continuous route in this part of Tigard, it does mean that there is potential for this route to become a cut-through route; therefore the roadway cross-section should be designed carefully for slow speeds, and to safely and comfortably accommodate pedestrian and bicycle travel. It is recommended that this project remain in the Tigard TSP.

All other recommendations in the Washington Square Area are also recommended to remain in the TSP.

Travel Demand Management

TDM programs were also identified in the WSRC plan. The Mall has a regional draw for employees and customers; thus achieving success in reducing single-occupant vehicle is more difficult because of the spread of locations from which people travel. Therefore it is recommended that the City of Tigard initially focus their TDM program development on the Tigard Triangle area. With success in the Tigard Triangle, the City should subsequently move to Downtown and then the WSRC.

Downtown

The city of Tigard would like to create a downtown which will be active, compact, multi-modal and serve as a catalyst for economic development. The on-going Tigard Downtown Circulation Plan project is reviewing connectivity and access in downtown to develop improved connectivity within Downtown, and establish street standards consistent with vibrant, active, pedestrian-friendly streets. This project is being undertaken by SERA Architects. The findings of this project will be integrated into the draft and final TSP Update.

2035 ESTIMATED TRANSPORTATION REVENUES

. This section documents Tigard's projected transportation revenues based on historic trend information provided by City of Tigard Staff. Available funds are typically split between operating expenditures (i.e maintenance, services, materials) and capital expenditures (i.e. new roadways, or pedestrian/bicycle facilities). The majority of the projects included in this document are considered capital expenditures. Table 5-18 provides a summary of the funding available, the forecast revenues and the potential application of these revenues (operating or capital) As shown, the City of Tigard currently estimates their revenues for transportation from 2009 to 2035 to be approximately $5,150,000 per year (2009 dollars), with approximately 2,750,000 dollars available annually for capital expenditures.

Table 5-18 Forecast Transportation Revenues (2009 Dollars)

	Forecast Annual Revenues	Typical Use of Funds (Operating or Capital)	Forecast Annual Capital Revenues	Percentage of Total Forecast Capital Annual Revenues
State Motor Vehicle Fees	$3,000,000[1]	Operating (75%) Capital (25%)	$750,000[1]	27.3%
County Gas Tax	$200,000	Operating (75%) Capital (25%)	$50,000	1.8%
City Gas Tax	$650,000	Capital (100%)	$650,000	23.6%
TIF & TDT	$300,000	Capital (100%)	$300,000	10.9%
MSTIP	$500,000[2]	Capital (100%)	$500,000[2]	18.2%
State/Federal Fees used in City	$500,000[2]	Capital (100%)	$500,000[2]	18.2%
Annual Total	**$5,150,000**		**$2,750,000**	**100%**
0-5 Year Revenues	$25,750,000		**$13,750,000**	
6-10 Year Revenues	$25,750,000		**$13,750,000**	
11-20 Year Revenues	$51,500,000		**$27,500,000**	
20 Year Revenues	**$103,000,000**		**$55,000,000**	

1 Once State Transportation Bill takes full effect in FY 2012/2013
2 Project specific. Amount listed is an estimate based on historical annual average.

- The **State Motor Vehicle fund** has provided and will likely continue to provide the most significant portion of the funding for Tigard's transportation system. A major component of the State Motor Vehicle fund is a fuel tax (per gallon).

- Together, the **City and County Gas Tax** provides the second largest source of transportation funding to the city. It should be noted that House Bill 2001 passed in the 2009 legislative session prohibits cities from raising fuel taxes between 2009 and 2014. Although the gas tax is recessive as vehicle efficiency increases, this is anticipated to be balanced out by the anticipated overall increase in vehicle miles traveled projected within the city.
- **Transportation Impact Fees (TIFs) and Transportation Development Taxes (TDTs)** are an excellent source of revenues for growth-required needs, but TIFs and TDTs are only collected on development activity, so the revenues stream from TIFs and TDTs are volatile depending on market conditions.
- The **MSTIP** is the Washington County Major Streets Transportation Improvement Program. The majority of county-funded road improvement projects are paid for via MSTIP using local property taxes. It is difficult to project how much MSTIP funds will be spent on county roads within the City of Tigard on any given cycle. The amount provided above represents an anticipated annual average.

Bonds were not considered as a potential revenue source as they do not increase revenue; rather, they allow the city to spend several years' worth of anticipated revenues over a short period of time.

POTENTIAL FUNDING SOURCES

Some additional potential local transportation system funding sources the City may wish to consider include: 1) transportation utility fees, 2) urban renewal districts and/or 3) local improvement districts (LIDs). Each of these alternative funding sources is described below. In addition to these longer term funding sources, there are several grant opportunities that should be evaluated each year. These include:

- Community Development Block Grants (CDBG)
- Special Public Works Funds (SPWF)
- Immediate Opportunity Funds (IOF) — Lottery Program
- State Bicycle-Pedestrian Grants
- ODOT Enhancement Funds
- State Parks Funds
- Federal stimulus grants administered by the state

Transportation Utility Fee

A growing number of cities in Oregon are adopting transportation utility fees. These fees are based on consideration of transportation systems as utilities just like public water, wastewater, or stormwater systems. Fees are typically assessed by usage (e.g., average vehicle trips per development type), with revenues used for the City's transportation system improvements, operations and maintenance.

This fee is used in many Oregon cities through a monthly fee charged to local dwelling units and businesses. The formulas range from a flat rate per dwelling unit and per business ($10/month and $25/month, for example) to rates calculated for each property individually based on the Institute for Transportation Engineers Trip Generation Handbook. Statewide the average revenue generated by local jurisdictions with a Street Utility Free is approximately $26 per year per resident (not per dwelling unit). Typically the revenue generated by these fees are used for operations and maintenance of the street system but these fees can be used for capital projects, including pedestrian and bicycle projects.

Urban Renewal District

An Urban Renewal District is an area that is designated by a community as a "blighted area" to assist in revitalization. Funding for the revitalization is provided by urban renewal taxes, which are generated by the increase in total assessed values in the district from the time it was first established. Urban Renewal Districts have been formed in over 50 cities in Oregon, generally focused on revitalizing downtowns.

Urban Renewal dollars can be used to fund infrastructure projects such as roadway, sidewalk, or transit improvements. Since funding relies on taxes from future increases in property value, the City may seek to create a District where such improvements will likely result in such an increase.

Local Improvement Districts (LIDs)

Under a local improvement district (LID), a street or other transportation improvement is built and the adjacent properties that benefit are assessed a fee to pay for the improvement. LID programs have wide application for funding new or reconstructed streets, sidewalks, water/sewer or other public works projects. The LID method is used primarily for local or collector roads, though arterials have been built using LID funds in certain jurisdictions.

State Grant Programs

Community Development Block Grants (CDBG)

CDBG Program funds are offered through the Federal Department of Housing and Urban Development although administered through the state. To receive CDBG funds, cities must compete for grants based upon a formula that includes factors such as rural/urban status, demographics, local funding match, and potential benefits to low-to-moderate income residents, including new job creation. CDBG funds can also be used for emerging public work needs.

Special Public Works Funds (SPWF) and Immediate Opportunity Funds (IOF) — Lottery Program

The State of Oregon through the Economic and Community Development Department provides grants and loans to local governments to construct, improve, and repair public infrastructure in order to support local economic development and create new jobs.

SPWF and IOF funds have been used in a number of cities for the construction of water, sewer, and limited street improvements. These funds are limited to situations where it can be documented how a project will contribute to economic development and family-wage job creation.

State Bicycle-Pedestrian Grants[8]

ODOT's Bicycle and Pedestrian Program administers two grant programs to assist in the development of walking and bicycling improvements: local grants and Small-Scale Urban Highway Pedestrian Improvement (SUPI) programs. For both these grants, cities that have adopted plans with identified projects will be in the best position to receive grants. Cities and counties can apply for local grants for bicycle and pedestrian projects within the right-of-way of local streets. Local grants up to $100,000 are shared 80% State and 20% local. Projects that consider the needs of children, elderly, disabled, and transit users are given special consideration. . In the SUPI process, cities and counties help ODOT identify sections of urban highways where improvements are needed. Examples of eligible projects include:

- completing short missing sections of sidewalks;
- ADA upgrades;
- crossing improvements (e.g., curb extensions, refuges, crosswalks); and,
- intersection improvements (e.g., islands and realignment)

SUPI projects are located on highways that have no modernization projects scheduled for the foreseeable future. Projects that have a local funding match are typically viewed the most favorably because this indicates strong local support. Projects on highways that cost more than $100,000, require right-of-way, or have environmental impacts need to be submitted to ODOT for inclusion in the STIP. Cities and counties can apply annually for bike path or sidewalk grants of projects they have selected. Grants for projects on local street systems have a match of 20 percent and projects next to state highways have a lower match requirement. Bicycle-pedestrian grants are generally below $125,000 per project. Project evaluation and selection is made annually statewide by the Statewide Bicycle/Pedestrian Committee.

ODOT Enhancement Program

The Transportation Enhancement program provides federal highway funds for projects that strengthen the cultural, aesthetic, or environmental value of the transportation system. The funds are available for twelve "transportation enhancement activities," which are categorized as:

- Pedestrian and Bicycle projects;
- Historic Preservation related to surface transportation;
- Landscaping and Scenic Beautification; and
- Environmental Mitigation.

[8] Source: http://www.oregon.gov/ODOT/HWY/BIKEPED/docs/mainstreethandbook.pdf

The Enhancement Program funds special or additional activities not normally required on a highway or transportation project. So far, Oregon has funded more than 150 projects for a total of $63 million. Enhancement Grants are available through an ODOT process that awards construction funds for three fiscal year periods at a time with applications typically due in spring. The most recent applications were due May 2, 2008 to receive funding for years 2011 to 2013.

State Parks Funds

Recreational Trails Grants are national grants administered by the Oregon Parks and Recreation Department (OPRD) for recreational trail-related projects, such as hiking, running, bicycling, off-road motorcycling and all-terrain vehicle riding. OPRD gives more than $4 million annually to Oregon communities and has awarded more than $40 million in grants across the state since 1999. Grants can be awarded to non-profits, cities, counties, and state and federal agencies.

ESTIMATED TRANSPORTATION COSTS

This section provides a summary of the cost estimates for the projects described in the previous sections of this report. The following tables total cost estimates by jurisdiction, priority, and project type.

Table 5-19 shows the transportation project costs by jurisdiction. Primary and supporting agencies have been identified in order to show costs for projects that span multiple jurisdictions.

Table 5-19 Transportation Project Cost Summary by Jurisdiction

Jurisdiction	Supporting Agency/Jurisdition	Project Cost
Tigard	NA	$289,532,942
	ODOT Rail	$3,600,000
	TriMet	$973,500
	WACO	$6,120,000
	Lake Oswego	$2,010,000
	Tualatin	$740,000
ODOT	NA	$236,746,028
	Tigard	$17,360,000
	WACO	$8,011,152
WACO	NA	$41,565,032
	Beaverton	$3,973,417
Private	NA	$8,683,800
Total		**$619,315,871**

NA = Not Applicable, no supporting agency or jurisdiction

As shown in the table, the City of Tigard has sole jurisdiction over a significant portion of the transportation projects identified for bicycles, pedestrians, and roadways.

Table 5-20 shows the transportation project costs by priority. The draft priorities described in previous sections were used to summarize project costs.

Table 5-20 Transportation Project Cost Summary by Priority

Priority	Project Cost
High	$303,652,258
Medium	$170,035,252
Low	$145,628,361
Total	**$619,315,871**

As shown in the table, high priority projects are associated with the highest total cost out of the three priority rankings.

Table 5-21 summarizes the transportation project costs by project type. The projects shown in the table are summed by each mode presented in the previous sections.

Table 5-21 Transportation Project Cost Summary by Project Type

Project Type	Project Cost
Bicycle Facilities	$13,727,091
Pedestrian Facilities	$35,968,279
Multi-Use Pathways	$11,320,000
Transit Facilities	$950,500
Roadway Facilities	$557,350,000
Total	**$619,315,871**

As shown in the table, the roadway project costs are significantly larger than the project costs for all other modes combined. While several of the roadway projects identified generally have higher costs than other projects, many of the roadway facilities include the addition of sidewalks and bike lanes where none currently exist.

NEXT STEPS

Brief section summarizing the next steps

The Transportation Solutions Analysis Memorandum completes the deliverables that shape the final TSP document. The material contained in this memo and the previous memos for Tasks 1 through 4 will be compiled to create the final document for the future transportation system in Tigard.

APPENDICES

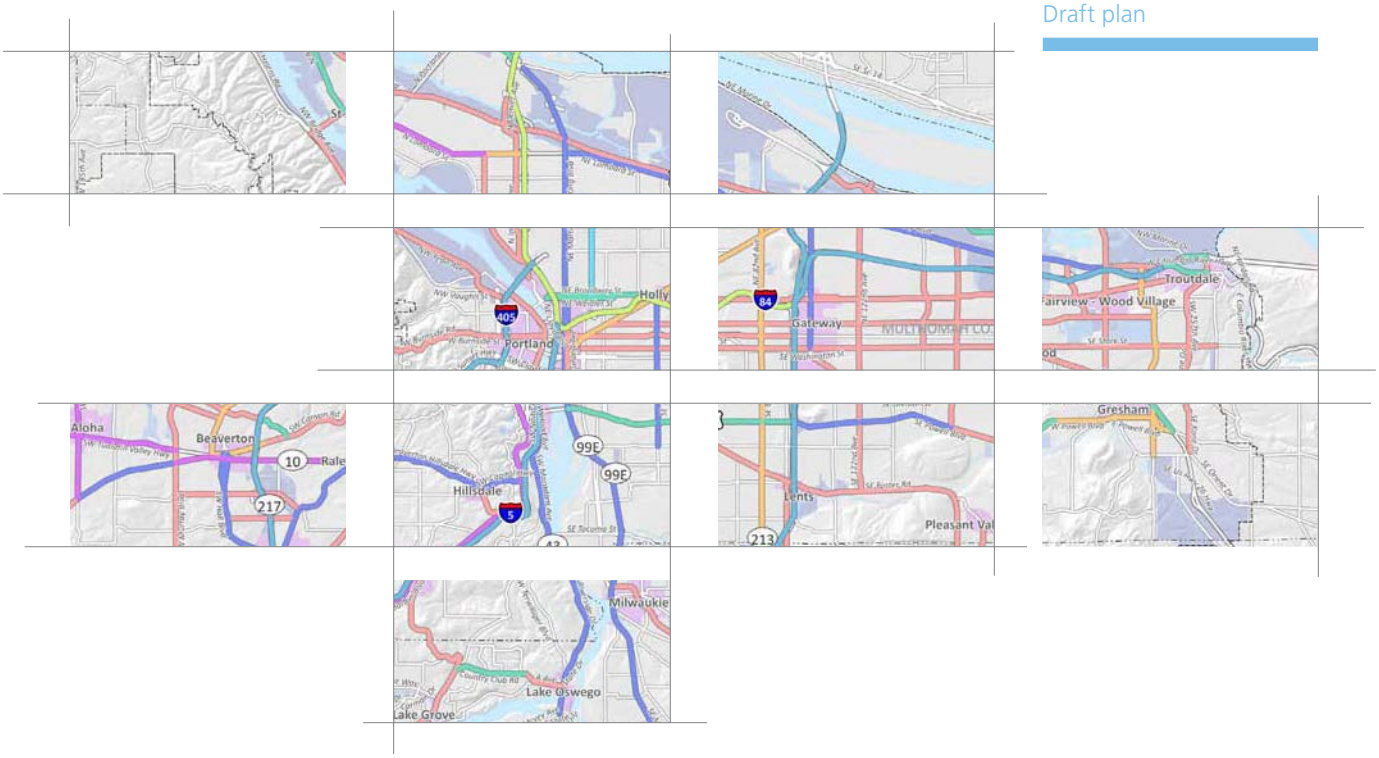
A. TSMO Plan Projects on Tigard's Regional Mobility Corridors

B. Tigard CIP and Metro RTP Project Lists

C. Tigard Neighborhood Trail Project List

Appendix A

TSMO Plan Projects on Tigard's Regional Mobility Corridors



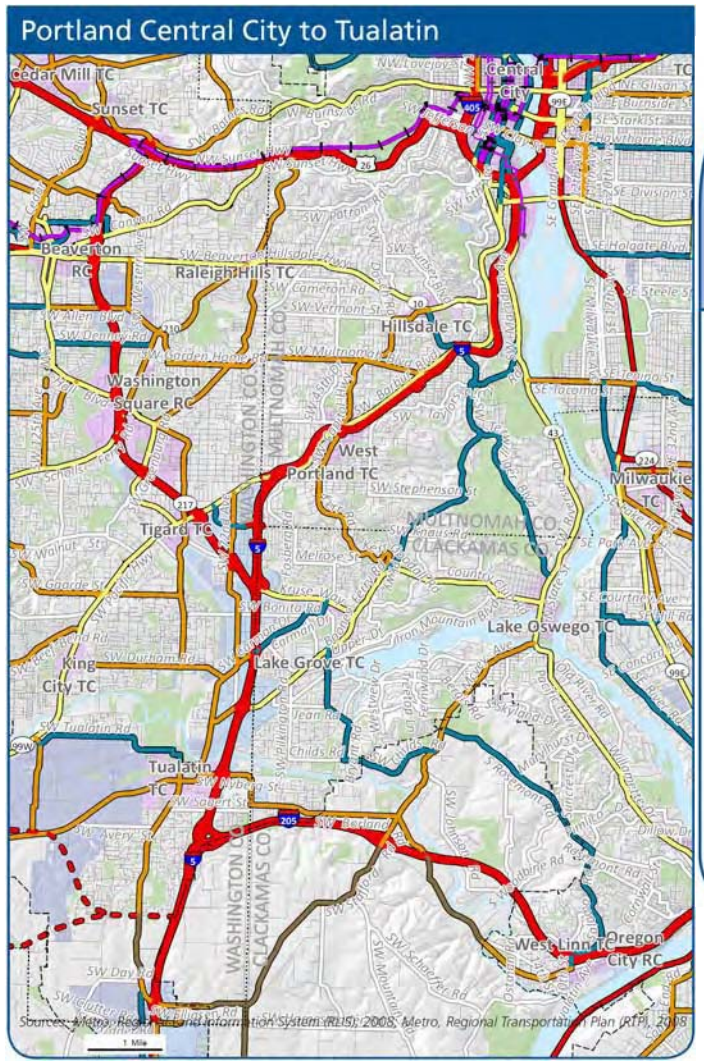
REGIONAL TRANSPORTATION
SYSTEM MANAGEMENT AND OPERATIONS

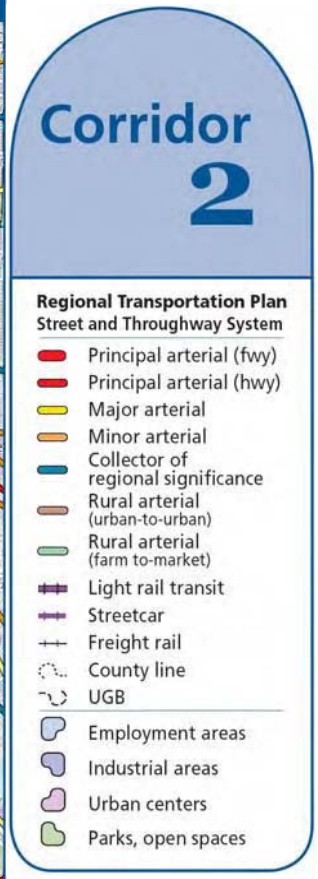
2010 – 2020

Draft plan

September 2009

Metro | *Joint Policy Advisory Committee on Transportation*





Corridor Summary

The Portland Central City to Tualatin mobility encompasses I-5 and parallel arterials, that support auto, truck, transit and bicycle movement in and through the corridor. I-5 is a principal arterial freeway that accommodates interstate and interregional travel. The key parallel arterials include **SW Barbur Blvd (99W), SW Boones Ferry Rd/SW Terwilliger Blvd, SW Taylors Ferry Rd,** and **SW Macadam Ave (Hwy 43)**. This corridor is largely single-family residential uses and neighborhood-serving commercial with a mix of parks and open spaces. The hilly topography in this corridor is hilly contributes to the winding and discontinuous street network.

Where Are We Now?

Currently no regional facilities in this corridor have coordinated signal timings updated within the last five years. Transit signal priority is located at select traffic signals along SW Barbur Blvd. Communications infrastructure exists along SW Barbur; SW Barbur Blvd is also an incident management route equipped with cameras and vehicle detection. The segment of I-5 through this corridor is generally equipped with cameras, ramp meters, detection, and

communication equipment.

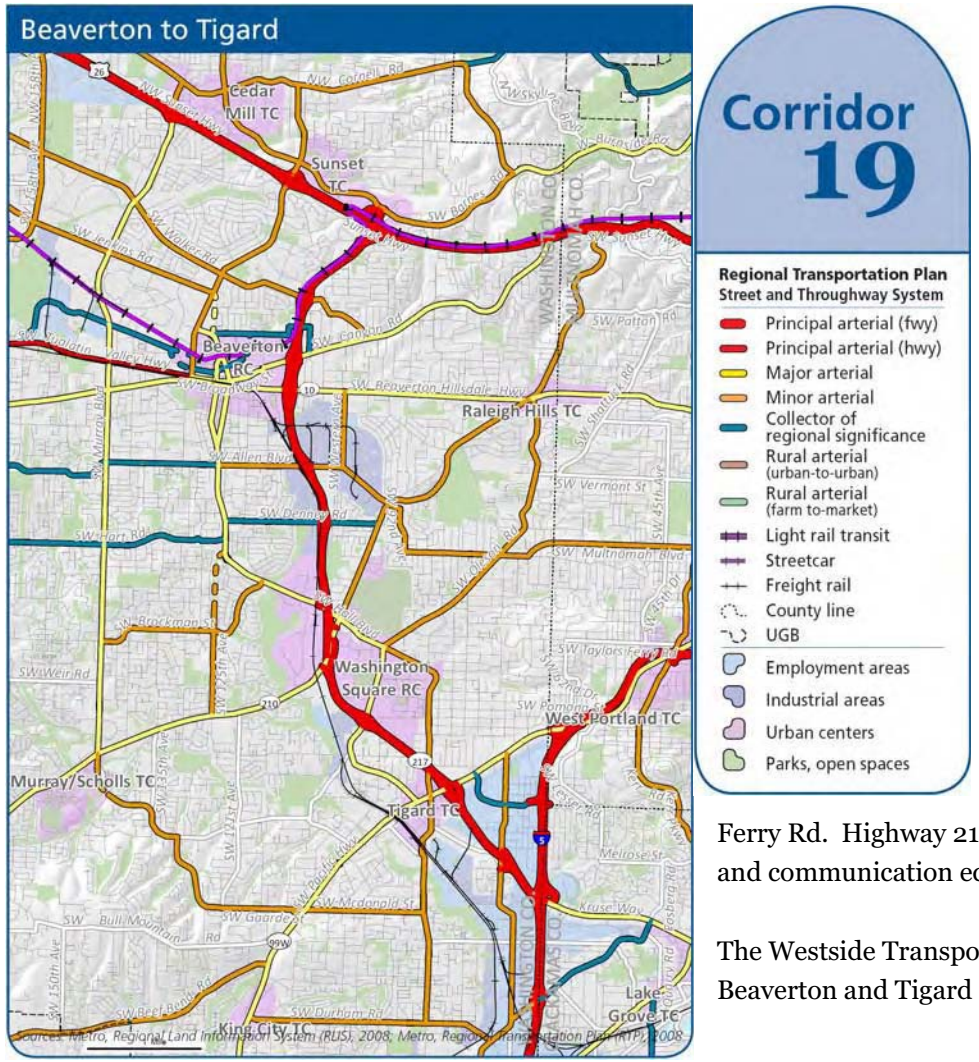
The Westside Transportation Alliance (WTA) works with employers in Tigard and Tualatin (in addition to other Washington County areas) and the Lloyd TMA works with employers in the Lloyd District. Both work to reduce employee drive-alone trips. Additionally, a study has been funded to assess the potential for a new TMA in Portland's South Waterfront. The City of Portland's Smart Trips Downtown program and the Lloyd TMA's Lloyd Links program offer individualized marketing to employees in these areas. There are also several bike-specific projects in the corridor including , a WTA program to install free bike racks for area businesses, and an update of the City of Tigard's 20-year old bike map.

Proj No.	Project Name	Description	Facility	Goal/Obj	Time-frame	Cost	
						Capital	Annual O&M
Regional Multimodal Traffic Management							
	Arterial Corridor Management (ACM)	Improve arterial corridor operations by expanding traveler information and upgrading traffic signal equipment and timings. Install upgraded traffic signal controllers, establish communications to the central traffic signal system, provide arterial detection (including bicycle detection where appropriate) and routinely update signal timings. Provide real-time and forecasted traveler information on arterial roadways including current roadway conditions, congestion information, travel times, incident information, construction work zones, current weather conditions and other events that may affect traffic conditions. Also includes on-going maintenance and parts replacement.	Upper Boones Ferry Rd	Reliability & Traveler Information	1-5 yrs	$1,300,000	$25,000
			Boones Ferry Rd/Capital Hwy		6-10 yrs	$4,600,000	$90,000
			72nd Ave		11+ yrs	$1,600,000	$30,000
			Durham Rd		11+ yrs	$1,400,000	$30,000

Proj No.	Project Name	Description	Facility	Goal/Obj	Time-frame	Cost	
						Capital	Annual O&M
	ACM with Transit Priority Treatment	Includes the ACM project with transit signal priority added to traffic signals along a facility.	Hwy 43 (Macadam Ave)	Reliability, Traveler Information, & Quality of Life	6-10 yrs	$3,700,000	$70,000
	ACM with Adaptive Signal Timing and Transit Priority Treatment	Includes the ACM with both adaptive signal timing and transit priority treatment.	Hwy 99 (Barbur Blvd from Downtown Portland past Hwy 217)	Reliability, Traveler Information, & Quality of Life	1-5 yrs	$3,400,000	$70,000
	Freeway Management	Expand freeway vehicle detection to provide comprehensive freeway traveler information including travel speed, travel times, volumes, forecasted information, incident conditions, and weather conditions.	I-5	Reliability, Traveler Information, & Safety	6-10 yrs	$900,000	$18,000
Traveler Information							
	Traveler Information Only	Provide real-time and forecasted traveler information on arterial roadways including current roadway conditions, congestion information, travel times, incident information, construction work zones, current weather conditions and other events that may affect traffic conditions.	Country Club Rd	Traveler Information	6-10 yrs	$700,000	$14,000
			Hwy 99, south of Tualatin		1-5 yrs	$1,100,000	$20,000
Transportation Demand Management							

Proj No.	Project Name	Description	Facility	Goal/Obj	Time-frame	Cost	
						Capital	Annual O&M
	Individualized Marketing	Implement and/or support intensive outreach to targeted neighborhoods that encourages use of travel options through delivery of local travel options information and services to interested residents. (in support of Portland/Multnomah County Climate Change Action Plan)	Supports new transit/trail facility from Central City Portland to Lake Oswego TC	Quality of life	1-5 years	$0	$500,000
	Individualized Marketing	Implement and/or support intensive outreach to targeted neighborhoods that encourages use of travel options through delivery of local travel options information and services to interested residents. (in support of Portland/Multnomah County Climate Change Action Plan)	Tigard TC and adjacent neighborhoods	Quality of life	6-10 years	$0	$500,000
	Individualized Marketing	(same as above)	Tualatin TC and adjacent neighborhoods	Quality of life	6-10 years	$0	$500,000
	Rideshare incentives	Leverage regional rideshare services to encourage greater levels of carpooling and vanpooling by providing financial incentives to commuters.	I-5	Quality of life	1-5 years	$0	$50,000
	Rideshare incentives	(same as above)	I-5	Quality of life	6-10 years	$0	$50,000
	Rideshare Park&Ride	Negotiate shared parking agreements with public and private parking lots, provide signage and, if needed, coordinate registration.	I-5	Quality of life	1-5 years	$0	$4,800

Proj No.	Project Name	Description	Facility	Goal/Obj	Time-frame	Cost	
						Capital	Annual O&M
	Rideshare Park&Ride	(same as above)	I-5	Quality of life	6-10 years	$0	$4,800
	Employee incentives	Targeted investment to add to employer services to incentivize non-SOV commutes.	to be determined	Quality of life	1-5 years	$0	$50,000
	Employee incentives	(same as above)	to be determined	Quality of life	6-10 years	$0	$50,000
	Transportation Management Associations (TMA)	Support public-private partnerships in regional or town centers that assist employees and/or residents increase use of travel options. Westside Transportation Alliance serves employers.	Tigard, Tualatin and other parts of Washington County	Quality of life	through 10 years	$0	(annual amount recorded in corridor 19)
	Transportation Management Associations (TMA)	Lower Macadam/Johns Landing TMA start-up.	Lower Macadam/Johns Landing	Quality of life	6-10 years	$0	$300,000
	Car-share operations	Support 3 or more carsharing vehicles in developing centers.	Lake Oswego Town Center	Quality of life	1-5 years	$0	$200,000



Corridor Summary

The Beaverton to Tigard corridor encompasses **Hwy 217,** MAX light rail, Westside Express Service (WES) commuter rail, parallel arterials as well as bus service and bicycle routes that support movement in and through the corridor. Hwy 217 supports intraregional travel between Beaverton, Hillsboro, Portland, Tigard, Tualatin, and Wilsonville. The key parallel arterials include **SW Hall Blvd, SW Murray Blvd, SW Oleson Rd** and **SW Scholls Ferry Blvd**. Land use in this corridor is diverse and includes several commercial centers, employment and industrial area. The local street network is a patchwork of well-connected and discontinuous streets.

Where Are We Now?

Currently three regional facilities in this corridor have coordinated signal timings updated within the last five years: SW Murray Blvd, SW Scholls Ferry Rd, and SW Hall Blvd (2 signals). There are no transit signal priority locations in this corridor. Communications infrastructure exists along SW Cedar Hills Blvd, SW Murray Blvd, SW Hall Blvd, and Scholls Ferry Rd. Highway 217 is generally equipped with cameras, ramp meters, detection, and communication equipment.

The Westside Transportation Alliance (WTA) works with employers and employees in Beaverton and Tigard (in addition to other Washington County areas) to reduce drive-

alone trips. There are also several bike-specific projects in the corridor including the WTA program to install free bike racks for area businesses, the City of Tigard's update of their 20-year old bike map, and TriMet installation of E-Access Bike Lockers at several transit facilities in the area.

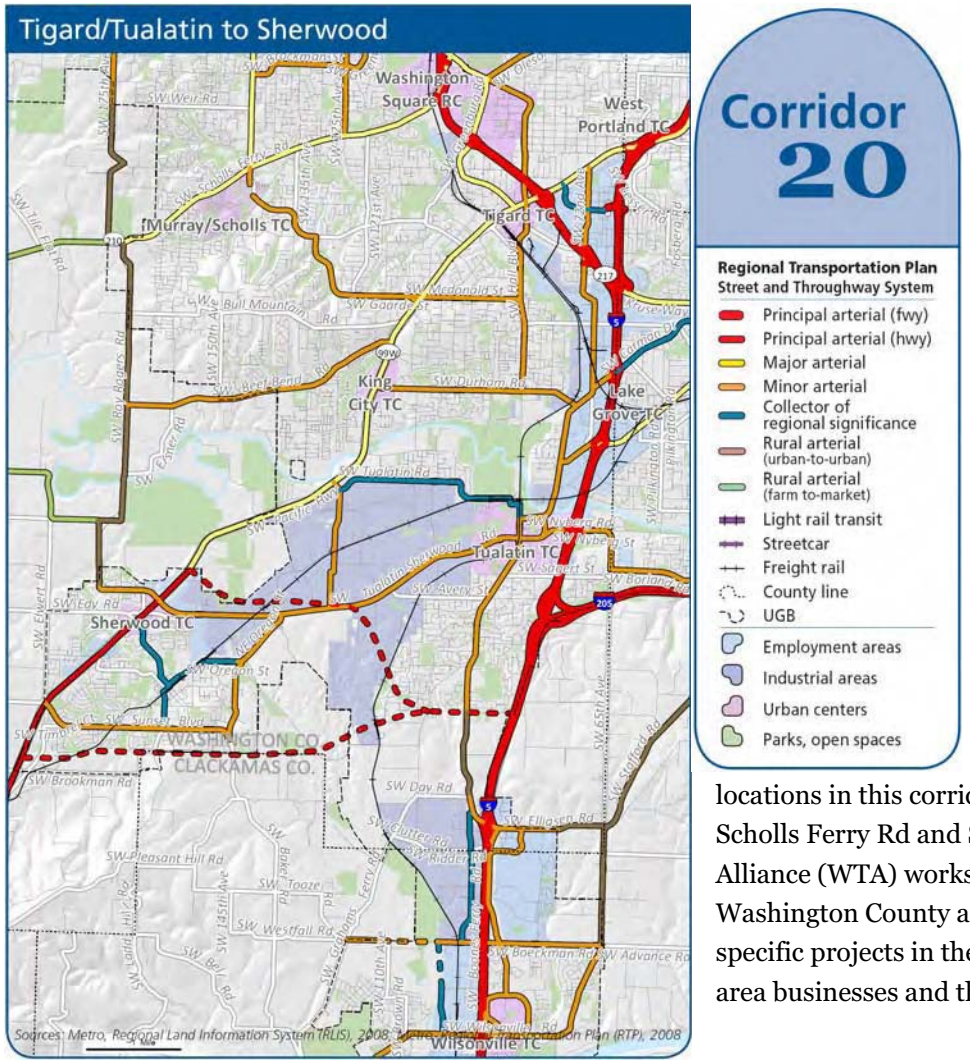
Proj No.	Project Name	Description	Facility	Goal/Obj	Time-frame	Cost	
						Capital	Annual O&M
Regional Multimodal Traffic Management							
	Arterial Corridor Management (ACM)	Improve arterial corridor operations by expanding traveler information and upgrading traffic signal equipment and timings. Install upgraded traffic signal controllers, establish communications to the central traffic signal system, provide arterial detection (including bicycle detection where appropriate) and routinely update signal timings. Provide real-time and forecasted traveler information on arterial roadways including current roadway conditions, congestion information, travel times, incident information, construction work zones, current weather conditions and other events that may affect traffic conditions. Also includes on-going maintenance and parts replacement.	SW Murray Blvd	Reliability & Traveler Information	6-10 yrs	$2,900,000	$60,000
			SW Oleson Rd		11+ yrs	$2,600,000	$50,000
	ACM with Adaptive Signal Timing	Includes the ACM project with signal systems that automatically adapt to current arterial roadway conditions.	Cedar Hills Blvd	Reliability & Traveler Information	6-10 yrs	$2,200,000	$45,000
	ACM with Transit Priority Treatment	Includes the ACM project with transit signal priority added to traffic signals along a facility.	SW Hall Blvd	Reliability, Traveler Information,	6-10 yrs	$3,700,000	$70,000

Proj No.	Project Name	Description	Facility	Goal/Obj	Time-frame	Cost	
						Capital	Annual O&M
			Scholls Ferry Rd (Hall to BH Hwy)	& Quality of Life	1-5 yrs	$1,700,000	$35,000
	Freeway Management	Expand freeway vehicle detection to provide comprehensive freeway traveler information including travel speed, travel times, volumes, forecasted information, incident conditions, and weather conditions.	Hwy 217	Reliability, Traveler Information, & Safety	1-5 yrs	$600,000	$12,000
Traveler Information							
		No projects in this corridor					
Transportation Demand Management							
	Individualized Marketing	Implement and/or support intensive outreach to targeted neighborhoods that encourages use of travel options through delivery of local travel options information and services to interested residents.	Neighborhood served by frequent transit service, other travel options and near commercial zoning.	Quality of life	1-5 years	$0	$500,000
	Individualized Marketing	(same as above)	Neighborhood served by frequent transit service, other travel options and near commercial zoning.	Quality of life	6-10 years	$0	$500,000

Proj No.	Project Name	Description	Facility	Goal/Obj	Time-frame	Cost	
						Capital	Annual O&M
	Rideshare incentives	Leverage regional rideshare services to encourage greater levels of carpooling and vanpooling by providing financial incentives to commuters.	For commuters on 217.	Quality of life	1-5 years	$0	$100,000
	Rideshare incentives	(same as above)	For commuters on 217.	Quality of life	6-10 years	$0	$100,000
	Employer outreach - additional resources	Leverage existing regional investment in employer services and TMAs to work with employers near corridor.	Employment sites near Highway 217		1-5 years		$200,000
	Employer outreach - additional resources	(same as above)	Employment sites near Highway 217		6-10 years		$200,000
	Employee incentives	Targeted investment to add to employer services to incentivize non-SOV commutes.	to be determined	Quality of life	1-5 years	$0	$50,000
	Employee incentives	(same as above)	to be determined	Quality of life	6-10 years	$0	$50,000
	Transportation Management Associations (TMA)	Support public-private partnerships in regional or town centers that assist employees and/or residents increase use of travel options. Westside Transportation Alliance (WTA) provides employer services in Washington County, including this corridor.	Beaverton, Washington Square, Tigard and other parts of Washington County	Quality of life	through 10 years	$0	$300,000

Proj No.	Project Name	Description	Facility	Goal/Obj	Time-frame	Cost	
						Capital	Annual O&M
	Transportation Management Associations (TMA)	Support public-private partnerships in regional or town centers that assist employees and/or residents increase use of travel options. Westside Transportation Alliance (WTA) provides employer services in Washington County, including this corridor.	Beaverton, Washington Square, Tigard and other parts of Washington County	Quality of life	through 10 years	$0	$75,000
	Parking management	Convene stakeholders to plan and implement parking management strategies. Ideally this action raises revenue to expand TDM solutions.	Beaverton Regional Center	Quality of life	1-5 years	$0	$100,000
	Parking management	(same as above)	Beaverton Regional Center	Quality of life	6-10 years	$0	$100,000
	Parking management	Convene stakeholders to plan and implement parking management strategies. Ideally this action raises revenue to expand TDM solutions.	Washington Square Regional Center	Quality of life	1-5 years	$0	$100,000
	Parking management	(same as above)	Washington Square Regional Center	Quality of life	6-10 years	$0	$100,000
	Parking management	Convene stakeholders to plan and implement parking management strategies. Ideally this action raises revenue to expand TDM solutions.	Tigard Town Center	Quality of life	1-5 years	$0	$100,000
	Parking management	(same as above)	Tigard Town Center	Quality of life	6-10 years	$0	$100,000

Proj No.	Project Name	Description	Facility	Goal/Obj	Time-frame	Cost	
						Capital	Annual O&M
	Bike Sharing	Provide funding to implement bikes for loan or rent.	Transit oriented developments, large employers, colleges, hotels and significant transit stops.	Quality of life	6-10 years	$100,000	$50,000



Corridor Summary

The Tualatin to Sherwood corridor encompasses **99W,** parallel arterials, as well as bus service and bicycle routes that support movement in and through the corridor. 99E supports inter- and intraregional travel inside the region and through the Willamette Valley. The key parallel arterials include **SW 72nd Ave/Boones Ferry Rd/Tualatin-Sherwood Rd, SW Hall Blvd,** and **SW Scholls Ferry Rd/Roy Rogers Rd.** These facilities provide access to Washington Square regional center, five town centers, and significant industrial and employment areas. Originally the arterial and collector street network were built as farm-to-market roads. As the area developed the roadway network lacks the continuous grid of more urbanized areas.

Where Are We Now?

Currently no regional facilities in this corridor have coordinated signal timings updated within the last five years; however, a section of Tualatin Sherwood Rd is equipped with adaptive signal timing. There are no transit signal priority locations in this corridor. Communications infrastructure exists along sections of Scholls Ferry Rd and SW Tualatin Sherwood Rd. The Westside Transportation Alliance (WTA) works with employers and employees in Tualatin (in addition to other Washington County areas) to reduce drive-alone trips. There are also several bike-specific projects in the corridor including a WTA program to install free bike racks for area businesses and the City of Tigard's update of their 20-year old bike map.

Proj No.	Project Name	Description	Facility	Goal/Obj	Time-frame	Cost	
						Capital	Annual O&M
Regional Multimodal Traffic Management							
	Arterial Corridor Management (ACM)	Improve arterial corridor operations by expanding traveler information and upgrading traffic signal equipment and timings. Install upgraded traffic signal controllers, establish communications to the central traffic signal system, provide arterial detection (including bicycle detection where appropriate) and routinely update signal timings. Provide real-time and forecasted traveler information on arterial roadways including current roadway conditions, congestion information, travel times, incident information, construction work zones, current weather conditions and other events that may affect traffic conditions. Also includes on-going maintenance and parts replacement.	SW 72nd Ave	Reliability & Traveler Information	11+ yrs	$1,700,000	$35,000
			Upper Boones Ferry Rd		11+ yrs	$1,300,000	$25,000
			Durham Rd		11+ yrs	$1,500,000	$30,000
	ACM with Adaptive Signal Timing	Includes the ACM project with signal systems that automatically adapt to current arterial roadway conditions.	Tualatin Sherwood Rd	Reliability & Traveler Information	1-5 yrs	$1,500,000	$30,000
	ACM with Transit Priority Treatment	Includes the ACM project with transit signal priority added to traffic signals along a facility.	SW Hall Blvd	Reliability, Traveler Information, & Quality of Life	1-5 yrs	$1,900,000	$40,000

Proj No.	Project Name	Description	Facility	Goal/Obj	Time-frame	Cost	
						Capital	Annual O&M
	ACM with Adaptive Signal Timing and Transit Priority Treatment	Includes the ACM with both adaptive signal timing and transity priority treatment.	SW Scholls Ferry Rd (River to Hall)	Reliability, Traveler Information, & Quality of Life	1-5 yrs	$4,200,000	$80,000
			Hwy 99W (from 217 to 124th)		1-5 yrs	$4,200,000	$80,000
Traveler Information							
	Traveler Information Only	Provide real-time and forecasted traveler information on arterial roadways including current roadway conditions, congestion information, travel times, incident information, construction work zones, current weather conditions and other events that may affect traffic conditions.	Hwy 99W (124th to Tualatin Sherwood Rd)	Traveler Information	1-5 yrs	$1,200,000	$25,000
Transportation Demand Management							
	Construction mitigation campaign	Apply additional investment in TDM solutions to mitigate impacts to travelers of all modes during construction projects.	99W construction to Newberg (per HB 2001 legislation)	Quality of life	1-5 years	$0	$100,000
	Employee incentives	Targeted investment to add to employer services to incentivize non-SOV commutes.	to be determined	Quality of life	1-5 years	$0	$50,000
	Employee incentives	(same as above)	to be determined	Quality of life	6-10 years	$0	$50,000

Proj No.	Project Name	Description	Facility	Goal/Obj	Time-frame	Cost	
						Capital	Annual O&M
	Location-efficient living	Support programs and strategies that promote and advance location-efficient living strategies.	Tualatin industrial/employment area west of I-5 and housing west of I-5.	Quality of life	through 10 years	$0	$50,000

Appendix B

Tigard CIP, Metro RTP
Project Lists

Pedestrian/Bicycle Projects in the Tigard CIP (2009-2014)

TSP Update Project #	CIP Project Number	Project/ Program Name	Total Cost	Fully Funded?
B3	97002	Burnham St Reconstruction	$9,746,463	Yes
	97003	Main St Retrofit to Green Street	$700,000	Yes
CP2	95002	Crosswalk – Hall Blvd/Fanno Creek	$100,000	Yes
?, P20	95003	Crosswalk – Hall Blvd/Bonita Road to 600'N	$326,566	Yes
PC7	95006	Crosswalk& Lighting System – Durham Rd at Tigard High School	$68,000	Yes
P22	95007	Barrows Road Sidewalk Installation	$71,814	Yes
P31	95008	Garret Street Sidewalk - Ash St to 99W	$141,790	Yes
P1	95021	North Dakota Street Pedestrian Bridge at Fanno Creek	$275,000	No
	95027	Citywide Pedestrian/Sidewalk Improvements	$250,000	No
P32	95018	92nd Avenue Sidewalk – Durham Rd to Cook Park	$475,000	No
P20, P14	95011	Hall Blvd Half-Street Improvements	$250,000	No
P1	95022	North Dakota St Improvements-Greenburg Road to 95th Ave	$125,000	No
P18	95024	Commercial Street Intersection-Lincoln Ave to Main St	$800,000	No

Pedestrian/Bicycle Projects in the 2035 Draft RTP

TSP Update Project #	RTP Project Number	Project/ Program Name	Project Description	Cost	Federal Financially Constrained?
P10	10606	Washington Square Regional Center Pedestrian Improvements	Complete 7,400 feet of sidewalk improvements	$8,954,000	Yes
B30	10611	Locust Avenue Bike	Completes 1,650 feet of bike lanes in regional center	$3,417,000	Yes
B13	10612	Greenburg Road Bike	Completes 3,400 feet of bike lanes in regional center	$3,610,000	Yes
P10	10749	Washington Square Regional Center Pedestrian Improvements	Improve sidewalks, lighting, crossings, bus shelters, and benches at Washington Square.	$3,900,000	Yes
P14, P18, P16, P9, PC6	10760	Tigard Town Center Pedestrian Improvements	Improve Sidewalks, lighting, crossings, bus shelters and benches throughout the Town Center including: Highway 99W, Hall Blvd, Main Street, Hunziker, Walnut and neighborhood streets.	$4,882,000	Yes
?	10763	Washington Square Regional Center Greenbelt Shared Use Path	Complete shared-use path construction.	$1,821,000	Yes
MUP2, ?	10766	Regional Trail Gap Closure	Infill gaps in regional trail network. Affected trails include Fanno Creek, Washington Square Loop and Westside Trails.	$6,890,000	Yes
B21-B30		Regional Bikeway Improvements	Make spot improvements on key low-volume, low speed through-routes to facilitate bike & pedestrian travel; identify them as bike/pedestrian routes	$4,000,000	Yes
		Pedestrian Improvements	Fill gaps in sidewalk & pedestrian network	$5,000,000	Yes
		Neighborhood Trails & Regional Trail Connections	Construct high priority neighborhood trails to regional trails, sidewalks & transit	$5,000,000	Yes
		Portland & Western Rail Trail	Construct trail along portion of abandoned rail line	$1,000,000	Yes

Roadway Projects in the Tigard CIP (2009-2014)

TSP Update Project #	CIP Project Number	Project/ Program Name	Total Cost	Fully Funded?
17	95030	Ash Ave Extension (Burnham to Railroad)	$890,749	Yes
73	95031	Hall Blvd at Hwy 99W Gateway	$435,000	No
11	97006	Scoffins/Hall/Hunziker Realignment Study	$75,000	No
74	95005	Greenburg Rd/ Hwy 99W/ Main St Intersection Improvements	$5,363,450	Yes
51	95006	Tigard Triangle Local Improvement District (includes some frontage improvements on 68th and Dartmouth and traffic signal at 68th/Dartmouth)	$2,280,303	Yes
54	95010	Walnut St Signal & WB Right-turn Lane at 135th Ave	$400,000	Yes
31	95013	72nd Ave Improvements- Dartmouth St to Hwy 99W	$1,200,000	No
84	95014	121st Ave Improvements- Walnut St to North Dakota St (3 lanes plus bike lanes and sidewalks)	$375,000	No
34	95015	121st Ave Improvements- Whistlers Loop to Tippitt St (3 lanes plus bike lanes and sidewalks)	$2,400,000	No
32	95016	72nd Ave Improvements- Bonita Rd to Hunziker St (3 lanes plus bike lanes and sidewalks)	$300,000	No
31	95017	72nd Ave Improvements- Hunziker St to Dartmouth St (3 lanes plus bike lanes and sidewalks)	$400,000	No
TSP Project 38 for 4 Lanes	95019	Dartmouth St Improvements- 72nd Ave to 68th Ave (3 lanes plus bike lanes and sidewalks)	$800,000 (plus LID funds)	No
60	95020	Hall Blvd Right-Turn Lane (southbound to McDonald Street)	$400,000	No
48	95023	Walnut Street Improvements-116th Ave to Tiedeman Ave (3 lanes plus bike lanes and sidewalks)	$2,500,000	No
62	95025	Main Street Traffic Signal (at Tigard Street)	$175,000	No
43	95026	Greenburg Rd Improvements- North Dakota St to Shady Lane (5 lanes plus bike lanes and sidewalks)	$1,400,000	No
65	95028	Tiedeman Ave Traffic Signal & NB Left-Turn Lane (at Tigard Street)	$410,000	No
	Total		***$19,804,502***	

Roadway Projects in the Draft 2035 RTP Update

TSP Update Project #	RTP Project Number	Project/ Program Name	Project Description	Total Cost	Fully Funded ?
47	10596	Scholls Ferry Road Improvements	Widen to 7 lanes Hwy 217 to 121st	$19,749,000	Yes
4	10599	Hwy 217/72nd Ave. Interchange Improvements	Complete interchange reconstruction with additional ramps and overcrossings	$19,537,000	No
24	10746	Washington Square Connectivity Improvements	Increase local street connections at Washington Square Center based on recommendations in the regional center plan	$3,000,000	Yes
22	10747	Hwy. 217 Overcrossing - Cascade Plaza	Provide a new connection from Nimbus to Washington Square south of Scholls Ferry Road.	$5,166,000	No
43	10748	Greenburg Road Improvements, South	Widen to 5 lanes with bikeways and sidewalks from Shady Lane to North Dakota. Includes bridge replacement.	$4,000,000	Yes
44	10750	Greenburg Road Improvements	Widen to 5 lanes from Tiedeman to 99W	$15,017,000	No
23	10751	Hwy. 217 Overcrossing	Realign Hunziker Street to meet Hampton Street at 72nd Ave. Remove existing 72nd/Hunziker Street intersection.	$9,635,000	Yes
40	10753	Durham Road Improvements	Widen to 5 lanes from Hall to Upper Boones Ferry Road	$21,093,000	Yes
27	10754	Walnut Street Extension	Extend street east of 99W to connect to Downtown Tigard. (PE Phase only)	$3,770,000	Yes
31	10755	72nd Ave. Improvements	Widen to 5 lanes from 99W to Hunziker with bikeways and sidewalks. Includes bridge replacement.	$25,000,000	Yes
38	10759	Dartmouth Street Improvements	Widen to 4 lanes with turn lanes and sidewalks from 72nd to 68th.	$4,412,000	Yes
16	10762	Nimbus Ave. Extension	2 lane extension with sidewalks and bike lanes.	$30,000,000	No
39	10764	Durham Road Improvements	Widen to 5 lanes with bikeways and sidewalks from 99W to Hall.	$20,000,000	Yes
7,8,9,10	10768	Upper Boones Ferry Intersection Improvements	Reconfigure intersection of Durham & Upper Boones Ferry to create a through route between Durham & I-5/Upper Boones Ferry/Carmen Interchange; 2nd Northbound Turn Lane at 72nd/Upper Boones Ferry; 72nd/Boones Ferry assuming Boones Ferry/72nd widened to 5 lanes; eastbound right turn lane at Carman/I-5 southbound.	$9,630,000	Yes
56, 57, 58	10769	Greenburg Intersection Improvements	2nd Northbound turn lane, modify signal timing at Greenburg/Oleson/Hall; install boulevard treatment at Greenburg/Washington Square Road; improve geometry/alignment and extend cycle length at intersection of Greenburg/Tiedeman.	$7,000,000	Yes
66	10770	Hwy. 99W Intersection Improvements	Provide increased capacity at priority intersections, including bus queue bypass lanes in some locations, improved sidewalks, priority pedestrian crossings, and an access management plan, while retaining existing 4/5-lane facility from I-5 to Durham Road.	$50,000,000	Yes
48		Walnut Street Improvements	Widen to 3 lanes from 99W to 116th; build sidewalks & bike lanes; safety	$12,000,000	Yes

TSP Update Project #	RTP Project Number	Project/ Program Name	Project Description	Total Cost	Fully Funded ?
			improvements		
46		McDonald Street Improvements	Construct turn lanes & intersection improvements; add bike lanes & sidewalks in gaps from 99W to Hall	$8,000,000	Yes
45		Hall Blvd. Improvements	Widen to 3 lanes from Locust to Durham; build sidewalks & bike lanes; safety improvements	$13,000,000	Yes
36	10752	Bonita Road Improvements	Widen to 4 lanes from Hall to Bangey.	$36,000,000	No
32	10756	72nd Ave. Improvements	Widen to 5 lanes with bikeways and sidewalks from Hunziker to Bonita	$28,166,850	No
33	10757	72nd Ave. Improvements	Widen to 5 lanes with bikeways and sidewalks from Bonita to Durham	$15,425,000	No
20	10758	Dartmouth Street Extension	3 lane extension; new Highway 217 overcrossing.	$58,690,500	Remove
21	10765	Hall Blvd. Extension	Extend Hall Boulevard across Tualatin River.	$87,220,000	No
66		Highway 99W High Capacity Transit Planning	Identify potential alignments, station locations etc.	$5,000,000	Yes
11	11223	Hall/Hunziker/Scoffins Intersection Realignment	Realign offset intersection to cross intersection to alleviate congestion and safety issues	$5,000,000	Yes
12, 13		Greenburg/Tiedeman/N. Dakota Reconfiguration	Realign one or more streets to improve intersection configurations, railroad crossings & creek crossings	$10,000,000	Yes
		Downtown Circulation Plan Implementation	Acquire ROW, construct streets and streetscape improvements in downtown Tigard	$4,000,000	Yes
	Total			***$529,511,350***	

Appendix C

Tigard Neighborhood
Trails Plan Project List

Tigard Trails Project List

Tigard Trails Project #	Project/ Program Name	Total Cost	Tigard Trails Priority	Fully Funded?
1	106th Avenue to 103rd Avenue, on Murdock Road	$20,000	High	No
2	Gallo Avenue extension to 113th/Gallo Path	$14,000	High	No
3	Pathfinder Way to Pathfinder Genesis Trail	$5,000	High	No
4	116th Place to Howard Drive extension	$5,000	High	No
5	Scholls Ferry Road to Englewood Park Trail/ Apartment Complex to Scholls Ferry Road	$3,000	High	No
6	90th Avenue extension to Inez Street extension	$7,000	High	No
7	Greenfield extension; Ridgefield Drive to Chirp Street	$9,000	High	No
8	100th Avenue extension to Highland Drive	$14,000	High	No
9	Mistletoe Drive to Sunrise Lane	$9,000	High	No
10	Coral Street to Locust Street, 92nd/Lincoln Street extension	$10,000	High	No
11	Gaarde Street to Aerie Drive	$13,000	High	No
12	Fanno Creek Trail/Scholls Ferry to apartment complex	$11,000	High	No
13	Landau Street Extension to 72nd Avenue	$3,000	High	No
14	80th Place to Bonita Road	$6,000	High	No
15	Quail Hollow South Trail to 129th Avenue Trail	$4,000	Medium	No
16	129th Avenue	$3,000	Medium	No
17	Tigard Street to Fanno Creek	$5,000	Medium	No
18	Ventura Drive to 70th Place	$6,000	Medium	No
19	Broadmoor Place to Rockingham Drive	$7,000	Medium	No
20	Spruce Street extension at 80th Avenue	$38,000	Medium	No
21	Steve Street to 84th Avenue extension	$9,000	Medium	No
22	Hunsiker Street/77th Place to 72nd Avenue/ Highway 217 Overpass	$18,000	Medium	No
23	88th Avenue extension to 88th Avenue extension/ Pinebrook Court	$11,000	Medium	No
24	Highlands Trail to Mountain Highland Trail	$7,000	Medium	No
25	Twality Middle School to 92nd Avenue	$1,150	Medium	No
26	89th Avenue extension to 91st Avenue Cul-de-sac	$10,000	Medium	No
27	Waverly Drive extension; 88th Avenue to 85th Avenue	$18,000	Medium	No
28	Gallo Avenue extension; North Dakota Street to Suzanne Court	$4,000	Medium	No
29	132nd Avenue extension; Marion Street to Hollow Lane	$6,000	Medium	No
30	74th Avenue extension; Cherry Drive to Fir Street	$6,000	Medium	No

31	94th Avenue extension; Dakota Street to Greenburg Street	$9,000	Medium	No
32	92nd Avenue extension; Dakota Street to Greenburg Street	$5,000	Medium	No
33	Edgewood Street/Halcyon Terrace extension to Braydon Court	$336,000	Low	No
34	135th Avenue to 132nd Avenue (connects to Trail 12)	$29,000	Low	No
35	Rockingham Drive to Maplecrest Court	$33,000	Low	No
36A	Terrace Trails Drive to Pathfinder Genesis Trail	$6,000	Low	No
36B		$6,000	Low	No
37	116th Avenue extension to Katherine Street	$400,000	Low	No
39	77th Avenue extension to Spruce Street	$28,000	Low	No
40	Burnham Street to Commercial Parking Lot	$5,000	Low	No
41	Hall Boulevard to Matthew Park Street Extension	$16,000	Low	No
42	Murdock Road extension; 109th Avenue to Highway 99W	$12,000	Low	No
43	Schaffer Lane extension; Tigard High School to 85th Avenue	$9,000	Low	No