



New High School Traffic Impact Analysis

Prepared by

DKS

March, 2015





720 SW Washington St.
Suite 500
Portland, OR 97205
503.243.3500
www.dksassociates.com

March 13, 2015

Leslie Imes
Beaverton School District
16550 SW Merlo Road
Beaverton, OR 97003

P#:14168-000

Subject: Beaverton School District New High School Transportation Impact Analysis

Dear Leslie:

DKS Associates is pleased to submit this transportation impact analysis for the proposed new High School located on the northwest corner of SW Scholls Ferry Road/SW 175th Avenue-Roy Rogers Road in Beaverton, Oregon. Please call us if you have any questions or comments regarding this study.

Sincerely,

DKS Associates
A Corporation

Peter L. Coffey
Principal

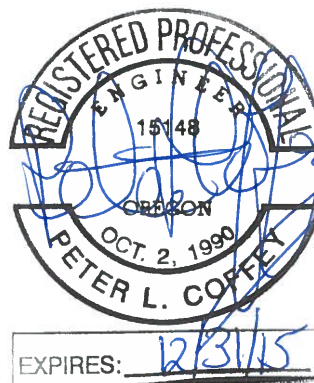


TABLE OF CONTENTS

| | |
|--|------|
| Table of Contents | i |
| List of Figures..... | ii |
| List of Tables..... | ii |
| Executive Summary | iv |
| Existing Intersection Operations | viii |
| 2017 Traffic Conditions | ix |
| 2035 Traffic Conditions | xi |
| Site Plan..... | xiii |
| Project Mitigation Summary | xiv |
| I. Proposed Development..... | 1 |
| II. Existing Conditions | 5 |
| Influence Area | 5 |
| Pedestrian, Bicycle, and Transit Systems..... | 5 |
| Study Area Roadway Network Characteristics..... | 7 |
| Study Peak Period Scenarios..... | 8 |
| Existing Traffic Volumes..... | 8 |
| Intersection Operations..... | 12 |
| Safety Evaluation | 15 |
| III. Background Traffic Forecast | 18 |
| 2017 Year of Opening | 18 |
| IV. Traffic Impacts | 21 |
| Proposed High School..... | 21 |
| Trip Generation..... | 21 |
| Trip Distribution | 23 |
| 2017 Total Traffic Volumes..... | 23 |
| Frontage Improvements..... | 24 |
| Traffic Signal Warrant Analysis..... | 29 |
| 2017 Intersection Operations with Project Trips..... | 31 |
| SW 175 th Avenue/SW Kemmer Road Mitigations and Operations..... | 32 |
| Site Plan Review..... | 35 |

| | | |
|-----|---|----|
| V. | 2035 Long-Range Forecast Year..... | 46 |
| | 2035 Background Intersection Operations | 46 |
| | 2035 Trip Distribution | 47 |
| | 2035 Traffic Operations with Project Trips..... | 47 |
| VI. | Recommended Mitigations | 52 |

LIST OF FIGURES

| | |
|---|----|
| Figure 1: Vicinity Map..... | v |
| Figure 2: Study Intersection Influence Area..... | 2 |
| Figure 3: SCM Concept Plan Street Network..... | 3 |
| Figure 4: River Terrace Community Plan Street Network..... | 4 |
| Figure 5: 2014 Peak Hour Traffic Volumes | 9 |
| Figure 6: Weekday Hourly Traffic Volumes for SW Scholls Ferry Road (north of SW 175 th Avenue) and SW 175 th Avenue (west of SW 175 th Avenue) | 11 |
| Figure 7: Weekday and Weekend Daily Traffic Volumes for SW Scholls Ferry Road (north of SW 175 th Avenue) and SW 175 th Avenue (west of SW 175 th Avenue)..... | 11 |
| Figure 8: SW Scholls Ferry Road/SW 175 th Avenue Breakdown by Collision Type (left) and Severity (right) | 16 |
| Figure 9: 2017 Background Peak Hour Traffic Volumes | 20 |
| Figure 10: Project Trip Distribution..... | 25 |
| Figure 11: 2017 Peak Hour Project Trips | 26 |
| Figure 12: 2017 Total Peak Hour Traffic Volumes..... | 27 |
| Figure 13: Beaverton School District New High School Frontage Improvements..... | 28 |
| Figure 14: SW 175 th Ave/SW Kemmer Rd Interim Improvements..... | 34 |
| Figure 15: Beaverton School District New High School Site Plan..... | 36 |
| Figure 16: 2035 Background PM Peak Hour Traffic Volumes | 49 |
| Figure 17: 2035 Trip Distribution and Project Trips..... | 50 |
| Figure 18: 2035 Total PM Peak Hour Traffic Volumes | 51 |

LIST OF TABLES

| | |
|--|------|
| Table 1: Key Study Area and Proposed Project Characteristics | vii |
| Table 2: 2014 Existing Intersection Operations – Peak Hour | viii |
| Table 3: 2017 Background Intersection Operations – Peak Hour | ix |
| Table 4: New High School Trip Generation – 2017 Peak Hour | x |
| Table 5: 2017 Total Intersection Operations – Peak Hour | xi |
| Table 6: 2035 Background Intersection Operations – Peak Hour | xii |
| Table 7: New High School Trip Generation – 2035 Peak Hour | xii |
| Table 8: 2035 Total Intersection Operations – Peak Hour | xiii |
| Table 9: Existing Roadway Network Characteristics..... | 7 |
| Table 10: Measured 85 th Percentile Speeds | 12 |

| | |
|--|----|
| Table 11: 2014 Existing Intersection Operations – Peak Hour | 14 |
| Table 12: Crash History and Calculated Crash Rates (2011-2013) | 15 |
| Table 13: 2017 Background Intersection Operations – Peak Hour | 19 |
| Table 14: High School Trip Generation Rates Peak – Peak Hour | 22 |
| Table 15: New High School Trip Generation – Peak Hour | 23 |
| Table 16: 2017 Total Intersection Operations – Peak Hour | 31 |
| Table 17: 2017 SW 175 th Avenue/SW Kemmer Road Operations Comparison – Peak Hour | 32 |
| Table 18: SW 175 th Avenue/SW Kemmer Road with Left Turn Lane Operations..... | 32 |
| Table 19: SW 175 th Avenue/SW Kemmer Road with Interim Traffic Signal Operations | 33 |
| Table 20: Recommended Storage Bays under 2017 Total Traffic Conditions - Peak Hour..... | 37 |
| Table 21: Access Spacing from SW Scholls Ferry Road/SW 175 th Avenue Intersection | 38 |
| Table 22: Site Access Intersection Sight Distance | 39 |
| Table 23: Intersection Sight Distance Summary for Proposed Access Points..... | 40 |
| Table 24: Stopping Sight Distance to Proposed Traffic Signal..... | 41 |
| Table 25: High School Parking Requirements – City of Beaverton Development Code..... | 43 |
| Table 26: High School Parking Analysis – Average Peak Demand | 43 |
| Table 27: New High School Parking Demand – Typical School Day | 44 |
| Table 28: Football Event Parking Demand..... | 44 |
| Table 29: New High School Parking Demand – Football Game..... | 45 |
| Table 30: 2035 Background Intersection Operations – Peak Hour | 47 |
| Table 31: 2035 Total Intersection Operations – Peak Hour | 48 |

EXECUTIVE SUMMARY

This study documents the transportation impacts for the proposed Beaverton School District New High School (NHS) located in the northwest quadrant of the SW Scholls Ferry Road/SW 175th Avenue-SW Roy Rogers Road intersection in Beaverton, Oregon. This report documents the evaluation of existing transportation conditions, trip generation and distribution, future year 2035 transportation conditions, and transportation impacts within the study area as a result of the proposed high school. The purpose of this report is to determine the impacts on the surrounding transportation system as a result of the proposed project and identify mitigation measures that would be needed to offset these impacts.

The transportation impact analysis follows transportation impact study guidelines outlined by the City of Beaverton¹ and the scope of services prepared in coordination with City of Beaverton and Washington County staff.

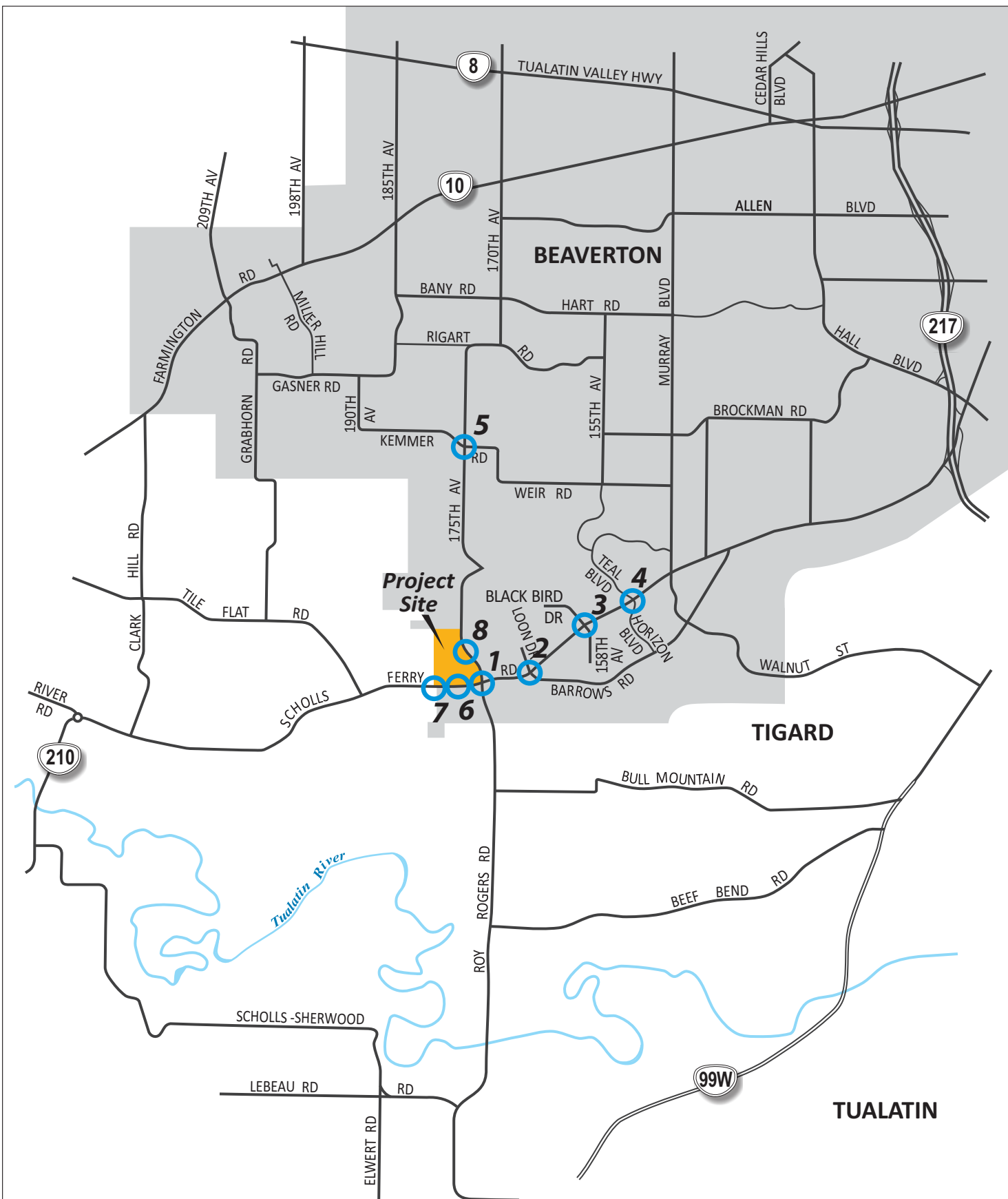
The study area in the vicinity of the high school is shown in Figure 1 along with the Beaverton School District Boundary while the site plan is shown in. Transportation impacts were evaluated at the following eight study intersections, all of which are under the jurisdiction of Washington County:

1. SW Scholls Ferry Road/SW 175th Avenue-Roy Rogers Road
2. SW Scholls Ferry Road/SW Barrow Road-Loon Drive
3. SW Scholls Ferry Road/SW 158th Avenue-Blackbird Drive
4. SW Scholls Ferry Road/SW Teal-Horizon Boulevard
5. SW 175th Avenue/SW Kemmer Road
6. SW Scholls Ferry Road/Restricted Site Access (Right In)
7. SW Scholls Ferry Road/New Collector (West Site Access)
8. SW 175th Avenue/Site Access

As listed, four of the study intersections along SW Scholls Ferry Road feature differing street names to the north and south. For purposes of this report, these intersections will be referred to as the following:

1. SW Scholls Ferry Road/SW 175th Avenue
2. SW Scholls Ferry Road/SW Barrows Road
3. SW Scholls Ferry Road/SW 158th Avenue
4. SW Scholls Ferry Road/SW Teal Boulevard

¹ Traffic Impact Analysis Requirements, City of Beaverton, August 2008.



LEGEND

- Beaverton School District Boundary
- Project Site
- # - Study Intersection

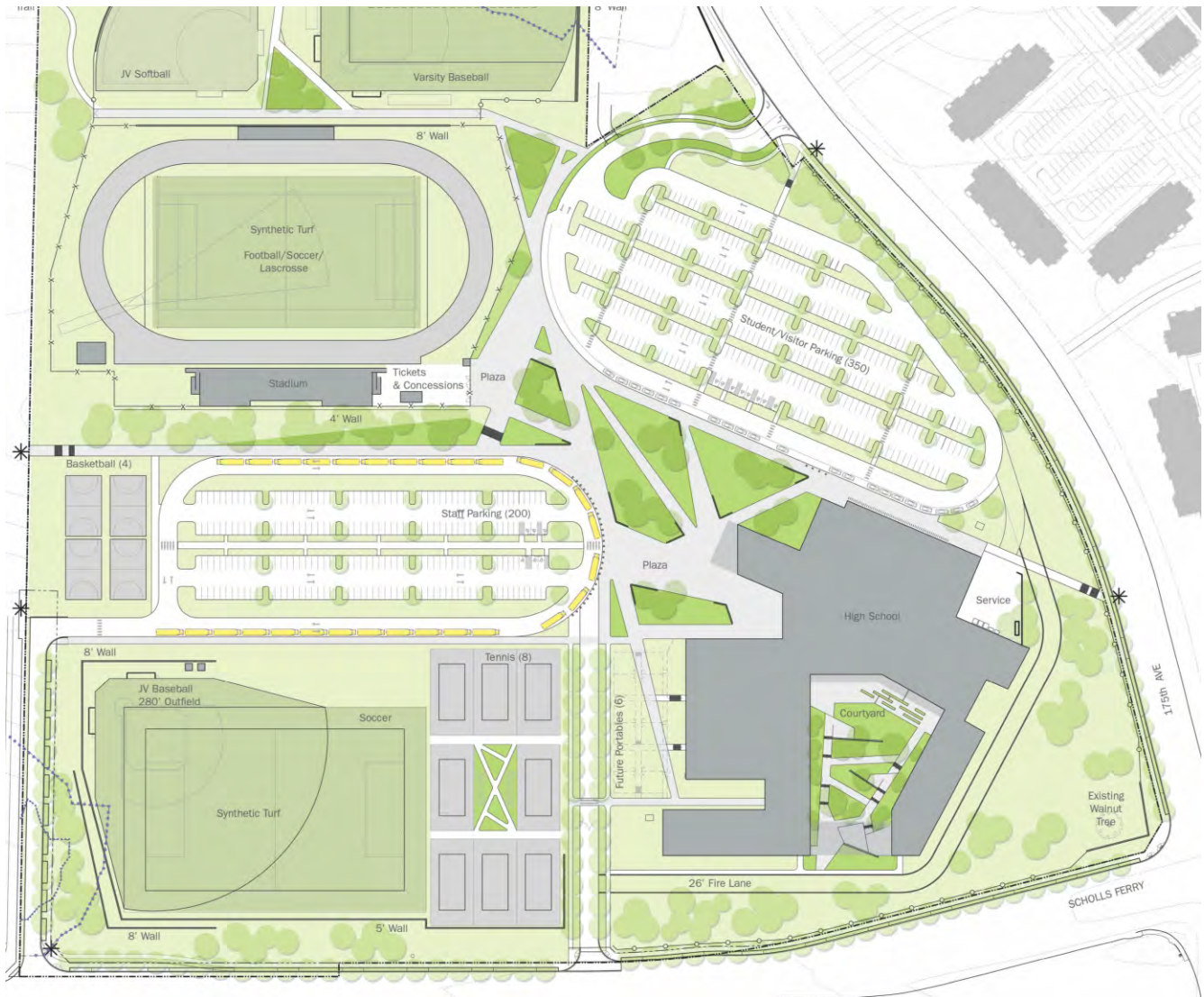
DKS



No Scale

Figure 1

VICINITY MAP



DKS



No Scale

Figure 1a

**BEAVERTON SCHOOL DISTRICT
NEW HIGH SCHOOL
SITE PLAN**

Source: Walker Macy

This chapter provides an introduction to the project and the steps taken to analyze the associated impacts on the transportation network. It highlights important elements of the remaining chapters, including a description of the project site and a summary of the project site evaluation. Table 1 lists important characteristics of the study area and the proposed project.

Table 1: Key Study Area and Proposed Project Characteristics

| Characteristics | Information |
|--|---|
| Study Area | |
| Number of Study Intersections | Eight |
| Analysis Period | Weekday AM peak hour (one hour from 7-9 am) Weekday Afternoon School Peak hour (one hour from 2-4 pm) Weekday PM peak hour (one hour from 4-6 pm) |
| Project Development | |
| Size and Land Use | High school with maximum 2,200 students and 200 staff. Anticipated 1,700 students and 155 staff at day of opening (2017) |
| Proposed Vehicle Trips at maximum 2,200 student enrollment (In Addition to Existing Traffic) | 946 (643 in/303 out) a.m. peak hour trips 638 (211 in/427 out) afternoon school peak hour trips 286 (134 in/ 152 out) p.m. peak hour trips |
| Vehicle Access Points | One full access on SW 175 th Avenue (student/visitor) and one restricted right-in only access on SW Scholls Ferry Road (bus/emergency vehicle). Project proposes to utilize proposed new collector at west end of site for full access on SW Scholls Ferry Road (staff/ bus). |
| Other Transportation Facilities | |
| Pedestrian Facilities | No sidewalks are currently available along SW Scholls Ferry Road or SW 175 th Avenue near the study site. Sidewalks are proposed along project frontages of SW Scholls Ferry Road and SW 175 th Avenue with recommended half street improvements to Washington County five lane arterial cross-section. |
| Bicycle Facilities | Bike lanes are provided along SW Scholls Ferry Road east of SW 175 th Avenue. There are no bike lanes along SW 175 th Avenue-Roy Rogers Road. Bike lanes are proposed along project frontages of SW Scholls Ferry Road and SW 175 th Avenue with recommended half street improvements to Washington County five lane arterial cross-section. |
| Nearest Transit Stop | The nearest TriMet bus stop is located 1.25 miles to the east from the project site (Route 92) at the intersection of SW Scholls Ferry Road/SW Teal-Horizon Boulevard |

Existing Intersection Operations

Existing traffic operations at the study intersections were determined for the a.m., afternoon school, and p.m. peak hours based on the 2000 Highway Capacity Manual methodology for signalized and unsignalized intersections.² The estimated level-of-service (LOS) and volume-to-capacity (V/C) ratio of each study intersection is shown in Table 2 for existing conditions and compared to Washington County and City of Beaverton intersection mobility targets. While SW 175th Avenue and SW Scholls Ferry Road are under the jurisdiction of Washington County, the proposed land use application is through the City of Beaverton. While both agencies utilize V/C ratios for analysis purposes, the County standard refers to the performance of the intersection as a whole, while the City standard applies to the critical lane group.

As shown, all study intersections, except the all-way stop controlled intersection of SW 175th Avenue/SW Kemmer Road currently meet both Washington County and City of Beaverton operating standards during the three peak hours analyzed. While the intersection of SW 175th Avenue/SW Kemmer Road does not meet Washington County mobility targets during the a.m. or p.m. peak hour, it does meet mobility targets during the afternoon school peak hour. The intersection of SW 175th Avenue/SW Kemmer Road currently experiences long delays and queues along the northbound approach during the a.m. and p.m. peak hour.

Table 2: 2014 Existing Intersection Operations – Peak Hour

| Intersection | Mobility Target | | AM Peak | | | Afternoon School Peak | | | PM Peak | | |
|---|----------------------------|----------|---------|-----|-------------|-----------------------|-----|------|-------------|-----|-------------|
| | City | County | Delay | LOS | V/C | Delay | LOS | V/C | Delay | LOS | V/C |
| SW Scholls Ferry Rd/ SW 175 th Ave | 0.98 V/C*, 65 sec delay | 0.99 V/C | 36.9 | D | 0.82 | 27.0 | C | 0.70 | 52.0 | D | 0.91 |
| SW Scholls Ferry Rd/ SW Barrows Rd | | | 15.0 | B | 0.55 | 10.3 | B | 0.44 | 10.9 | B | 0.51 |
| SW Scholls Ferry Rd/ SW 158 th Ave | | | 9.8 | A | 0.49 | 5.2 | A | 0.34 | 5.2 | A | 0.40 |
| SW Scholls Ferry Rd/ SW Teal Blvd | | | 24.9 | C | 0.53 | 21.8 | C | 0.44 | 24.4 | C | 0.56 |
| SW 175 th Ave/ SW Kemmer Rd** | 45 sec delay | | 44.1 | E | 1.03 | 14.6 | B | 0.64 | 63.0 | F | 1.05 |

Delay = average intersection vehicle delay (sec), LOS = intersection level of service, V/C = intersection volume-to-capacity ratio

Bold and Red indicates intersection does not meet mobility target

* Applies to each lane group at intersection

**V/C reported for northbound lane group

² 2000 *Highway Capacity Manual*, Transportation Research Board, Washington DC, 2000.

2017 Traffic Conditions

2017 Background Intersection Operations

The Beaverton School District NHS is anticipated to be open and fully operational by September 2017. To account for background growth and future development in the area, a one percent yearly linear growth rate was used to forecast the future background traffic volumes. The one percent growth was estimated by analyzing historical Washington County daily traffic volumes at locations within the study vicinity. Table 3 lists intersection peak hour operations for the 2017 background scenario. As shown, the signalized intersection of SW Scholls Ferry Road/SW 175th Avenue would operate with a V/C ratio of 0.93 during the p.m. peak hour. Although this intersection would meet the County's mobility target, three movements would not meet the City's mobility target. The northbound left turn, westbound left turn, and southbound through movement would all operate with a V/C ratio of 0.99 during the p.m. peak hour meaning these movements would not have available capacity for future growth. The all-way stop at SW 175th Avenue/SW Kemmer Road would continue to operate at above capacity conditions (V/C > 1.0) during the a.m. and p.m. peak hour, particularly along the northbound approach. The intersection would still operate within acceptable levels during the afternoon school peak hour.

Table 3: 2017 Background Intersection Operations – Peak Hour

| Intersection | Mobility Target | | AM Peak | | | Afternoon School Peak | | | PM Peak | | |
|---|-------------------------|----------|-------------|-----|-------------|-----------------------|-----|------|-------------|-----|-------------|
| | City | County | Delay | LOS | V/C | Delay | LOS | V/C | Delay | LOS | V/C |
| SW Scholls Ferry Rd/ SW 175 th Ave | 0.98 V/C*, 65 sec delay | 0.99 V/C | 38.8 | D | 0.84 | 28.2 | C | 0.72 | 55.8 | E | 0.93 |
| SW Scholls Ferry Rd/ SW Barrows Rd | | | 15.4 | B | 0.56 | 10.2 | B | 0.45 | 11.0 | B | 0.52 |
| SW Scholls Ferry Rd/ SW 158 th Ave | | | 9.9 | A | 0.50 | 5.3 | A | 0.35 | 5.2 | A | 0.41 |
| SW Scholls Ferry Rd/ SW Teal Blvd | | | 25.5 | C | 0.54 | 22.2 | C | 0.45 | 25.1 | C | 0.57 |
| SW 175 th Ave/ SW Kemmer Rd** | 45 sec delay | | 50.8 | F | 1.09 | 15.6 | C | 0.67 | 73.4 | F | 1.11 |

Delay = average intersection vehicle delay (sec), LOS = intersection level of service, V/C = intersection volume-to-capacity ratio

Bold and Red indicates intersection does not meet mobility target

* Applies to each lane group at intersection

**V/C reported for northbound lane group

2017 Trip Generation

The number of new peak hour trips accessing the project site was estimated based on the 1,700 students expected during the 2017 day of opening and a weighted average of national and local high school trip generation data. Table 4 lists the additional a.m., afternoon school, and p.m. peak hour vehicle trip generation estimates for the project site. The resulting weighted average trip rates are identical to the published rates in the *ITE Trip Generation Manual*³.

Table 4: New High School Trip Generation – 2017 Peak Hour

| Study Period | Expected Student Enrollment | Trip Rate (per student) | In % | Out % | 2017 Trip Generation | | |
|-----------------------|-----------------------------|-------------------------|------|-------|----------------------|-----------|-------------|
| | | | | | In Trips | Out Trips | Total Trips |
| AM Peak | 1,700 | 0.43 | 68% | 32% | 497 | 234 | 731 |
| Afternoon School Peak | | 0.29 | 33% | 67% | 163 | 330 | 493 |
| PM Peak | | 0.13 | 47% | 53% | 104 | 117 | 221 |

2017 Intersection Operations with Project Trips

The study intersection operating conditions for the 2017 background with project trips scenario during the a.m., afternoon school, and p.m. peak hours are listed in Table 5. Intersection operations include the frontage improvements proposed to be constructed as part of the project. These improvements include the proposed signalization of the site access along SW 175th Avenue and the new collector street on the west end of the site, which the school proposes to utilize for access. Additional improvements include half street improvements along SW 175th Avenue to add an additional southbound lane and an additional westbound lane from SW 175th Avenue to the new collector intersection. These half street frontage improvements are consistent with the improvements to widen both SW 175th Avenue and SW Scholls Ferry Road to a five-lane arterial cross-section identified in the South Cooper Mountain Concept Plan and Washington County Transportation System Plan. As indicated, the proposed improvements associated with the construction of the NHS would improve peak hour operations at the intersection of SW Scholls Ferry Road/SW 175th Avenue (due to the addition of a second southbound lane on SW 175th Avenue at Scholls Ferry Road). This intersection would meet both agency mobility targets during all three peak hours analyzed. Operations at SW 175th Avenue/SW Kemmer Road would fail to meet City and County standards during the a.m. and p.m. peak hours, while these standards would be met during the afternoon school peak hour.

³ *ITE Trip Generation Manual*, Institute of Transportation Engineers, 9th Edition, 2012.

Table 5: 2017 Total Intersection Operations – Peak Hour

| Intersection | Mobility Target | | AM Peak | | | Afternoon School Peak | | | PM Peak | | |
|---|----------------------------------|----------|---------|-----|-------------|-----------------------|-----|------|---------|-----|-------------|
| | City | County | Delay | LOS | V/C | Delay | LOS | V/C | Delay | LOS | V/C |
| SW Scholls Ferry Rd/ SW 175th Ave**** | 0.98 V/C*, 65 sec delay | 0.99 V/C | 33.5 | C | 0.82 | 31.1 | D | 0.80 | 40.9 | D | 0.81 |
| SW Scholls Ferry Rd/ SW Barrows Rd | | | 17.8 | B | 0.62 | 11.6 | B | 0.49 | 11.3 | B | 0.55 |
| SW Scholls Ferry Rd/ SW 158 th Ave | | | 10.4 | B | 0.50 | 6.0 | A | 0.38 | 5.9 | A | 0.43 |
| SW Scholls Ferry Rd/ SW Teal Blvd | | | 25.8 | C | 0.57 | 22.1 | C | 0.47 | 25.5 | C | 0.59 |
| SW 175th Ave/ SW Kemmer Rd** | 45 sec delay | | 146.8 | F | 1.56 | 27.0 | D | 0.92 | 98.5 | F | 1.23 |
| SW Scholls Ferry Rd/ New Collector (west site access) | 0.98 V/C*, 65 sec delay | | 6.2 | A | 0.69 | 8.3 | A | 0.59 | 4.6 | A | 0.65 |
| SW Scholls Ferry Rd/ Site Access (east)*** | 45 sec delay | | N/A | | | | | | | | |
| SW 175th Ave/ Site Access | 0.98 V/C*, 65 sec delay | | 18.0 | B | 0.68 | 11.4 | B | 0.48 | 5.5 | A | 0.46 |

Delay = average intersection vehicle delay (sec), LOS = intersection level of service, V/C = intersection volume-to-capacity ratio

Bold and Red indicates intersection does not meet mobility target

* Applies to each lane group at intersection

**V/C reported for northbound lane group

***Access proposed to be restricted to right in only.

****Assumes two southbound through lanes on SW 175th Avenue at Scholls Ferry Road

This study found that traffic signal warrants are met at the unsignalized intersection of SW 175th Avenue/SW Kemmer Road under existing 2014 traffic conditions and would continue to be met with the addition of 2017 background and project related traffic. The signalization of this intersection with the addition of northbound and southbound left turn lanes would bring this intersection to within Washington County and City of Beaverton mobility targets during the a.m. and p.m. peak hours, even with the addition of 2017 background and project related traffic. Review of additional turn lanes at this intersection would improve operations; however would not improve operations to within agency mobility targets.

2035 Traffic Conditions

Background Intersection Operations

The Beaverton School District NHS is anticipated to reach a maximum enrollment of 2,200 students by 2035 (the long-range forecast year scenario). To account for background growth and future development

in the area, a travel forecast model developed for the preferred land use scenario and transportation framework associated with the South Cooper Mountain Concept Plan was used. Table 6 lists intersection operations after accounting for the assumed traffic volume growth for the 2035 background scenario. As shown, the all-way stop of SW 175th Avenue/SW Kemmer Road would not meet agency mobility targets during the p.m. peak hour. Additionally, the intersection of SW 175th Avenue/SW Teal Boulevard would meet Washington County mobility targets; however would not meet City of Beaverton mobility targets along the westbound approach. This is consistent with the findings of the South Cooper Mountain Concept Plan which identified both of these intersections to operate with a V/C ratio greater than 1.0 during the p.m. peak hour. While specific improvements were not identified at these locations, the plan identified \$2.5 million for intersection improvements at SW 175th Avenue/Kemmer Road and \$500,000 for improvements at SW Scholls Ferry Road/SW Teal Boulevard.

Table 6: 2035 Background Intersection Operations – Peak Hour

| Intersection | Mobility Target | | PM Peak | | |
|--|----------------------------|----------|--------------|-----|-------------|
| | City | County | Delay | LOS | V/C |
| SW Scholls Ferry Rd/SW 175th Ave*** | 0.98 V/C*, 65 sec delay | 0.99 V/C | 44.6 | D | 0.86 |
| SW Scholls Ferry Rd/SW Barrows Rd | | | 32.4 | C | 0.86 |
| SW Scholls Ferry Rd/SW 158 th Ave | | | 8.1 | A | 0.70 |
| SW Scholls Ferry Rd/SW Teal Blvd | | | 50.5 | D | 0.98 |
| SW 175th Ave/SW Kemmer Rd** | 45 sec delay | | 172.8 | F | 1.37 |

Delay = average intersection vehicle delay (sec), LOS = intersection level of service, V/C = intersection volume-to-capacity ratio

Bold and Red indicates intersection does not meet mobility target

* Applies to each lane group at intersection

**V/C reported for northbound lane group

***Assumes two southbound/northbound through lanes along SW 175th Avenue-SW Roy Rogers Road and two eastbound/westbound through lanes along SW Scholls Ferry Road

2035 Trip Generation

The number of new peak hour trips accessing the project site was estimated based on the 2,200 students expected at maximum enrollment during the 2035 long-range forecast year using the trip generation rates previously mentioned. Table 7 lists the additional a.m., afternoon school, and p.m. peak hour vehicle trip generation estimates for the project site.

Table 7: New High School Trip Generation – 2035 Peak Hour

| Study Period | Expected Student Enrollment | Trip Rate (per student) | In % | Out % | 2017 Trip Generation | | |
|-----------------------|-----------------------------|-------------------------|------|-------|----------------------|-----------|-------------|
| | | | | | In Trips | Out Trips | Total Trips |
| AM Peak | 2,200 | 0.43 | 68% | 32% | 643 | 303 | 946 |
| Afternoon School Peak | | 0.29 | 33% | 67% | 211 | 427 | 638 |
| PM Peak | | 0.13 | 47% | 53% | 134 | 152 | 286 |

2035 Intersection Operations with Project Trips

Future operating conditions were analyzed at the study intersections for the long-range forecast year (2035 total volume scenario which includes project trips). Future 2035 forecasts were developed using a travel forecast model consistent with that used for the South Cooper Mountain Concept Plan. With this, development of future 2035 p.m. peak hour traffic volumes with the proposed high school and maximum enrollment of 2,200 students were estimated at study intersections. Modelling assumptions for the South Cooper Mountain area included p.m. peak hour trips to the existing school site; therefore these trips were subtracted from the development of future 2035 p.m. peak hour traffic volumes with the proposed project⁴.

The study intersection operating conditions for the 2035 total traffic scenario during the p.m. peak hour are listed in Table 8. As shown, the signalized intersections of SW Scholls Ferry Road/SW Teal Boulevard and the unsignalized intersection of SW 175th Avenue/SW Kemmer Road would not meet County or City mobility targets, which is consistent with the 2035 background scenario.

Table 8: 2035 Total Intersection Operations – Peak Hour

| Intersection | Mobility Target | | PM Peak | | |
|--|----------------------------|----------|--------------|-----|-------------|
| | City | County | Delay | LOS | V/C |
| SW Scholls Ferry Rd/SW 175 th Ave**** | 0.98 V/C*, 65 sec delay | 0.99 V/C | 48.9 | D | 0.91 |
| SW Scholls Ferry Rd/SW Barrows Rd | | | 36.8 | D | 0.90 |
| SW Scholls Ferry Rd/SW 158 th Ave | | | 8.4 | A | 0.71 |
| SW Scholls Ferry Rd/SW Teal Blvd | | | 54.7 | D | 1.00 |
| SW 175 th Ave/SW Kemmer Rd** | 45 sec delay | | 202.2 | F | 1.42 |
| SW Scholls Ferry Rd/Site Access (west) | 0.98 V/C*, 65 sec delay | | 10.3 | B | 0.48 |
| SW Scholls Ferry Rd/Site Access (east)*** | 45 sec delay | | N/A | | |
| SW 175 th Ave/Site Access | 0.98 V/C*, 65 sec delay | | 6.8 | A | 0.45 |

Delay = average intersection vehicle delay (sec), LOS = intersection level of service, V/C = intersection volume-to-capacity ratio

Bold and Red indicates intersection does not meet mobility target

* Applies to each lane group at intersection

**V/C reported for northbound lane group

***Access proposed to be restricted to right in only.

****Assumes two southbound/northbound through lanes along SW 175th Avenue-SW Roy Rogers Road and two eastbound/westbound through lanes along SW Scholls Ferry Road

Site Plan

The site plan provided by the Beaverton School District was reviewed to evaluate site access, intersection sight distance, bus loading and access, pedestrian and bicycle access, student pick-up/drop-off areas, site

⁴ A total of 38 p.m. peak hour trips were assumed to the project site as part of the South Cooper Mountain Transportation Analysis.

circulation, and parking needs. The evaluation of these issues includes the identification of associated on-site project modifications or improvements, which are explained in detail in Chapter 4 of this report and summarized in the “Project Mitigation Summary” section below.

Project Mitigation Summary

The following list summarizes the key transportation impact findings associated with the proposed Beaverton School District NHS.

SW 175th Avenue/SW Kemmer Road Mitigations

- The existing all-way stop of SW 175th Avenue/SW Kemmer Road currently does not meet Washington County mobility targets during the 2014 a.m. and p.m. peak hours. With the additional traffic loadings at this intersection associated with 2017 year of opening background growth and traffic associated with the project, it would continue to not meet Washington County mobility targets during the a.m. and p.m. peak hours. This is consistent with findings of the South Cooper Mountain Concept Plan which indicated improvements are needed at this intersection. Although specific improvements were not identified in the South Cooper Mountain Concept Plan, an estimated cost of \$2.5 million was identified for future improvements at this intersection. It was found that while the addition of turn lanes along all approaches would improve operations, the intersection would still not meet mobility targets. Due to the high volume of intersecting traffic, this intersection was found to meet MUTCD traffic signal warrants under existing conditions. It is recommended that a traffic signal be installed at this intersection to provide interim capacity for future growth in the area. Because this deficiency is an existing condition, and because other future development in the SW 175th corridor will impact this intersection as well, it is recommended that the Beaverton School District provide a proportionate share of the costs towards the intersection improvements to mitigate the impacts of the proposed project. This could be done by crediting Transportation Development Taxes paid by the School District or developing a reimbursement or some other cost-sharing mechanism to provide the intersection improvement. With the construction of the project, school related traffic will represent approximately 15-20 percent of the daily traffic at this intersection. As traffic volumes increase in the future, the Beaverton School Districts share of daily traffic volume at the intersection will decrease.

Site Improvements

- It is recommended that guide signage be provided along SW Scholls Ferry Road and SW 175th Avenue to direct students, staff, parents, busses, and visitors to the appropriate access locations during school hours.
- Half street improvements should be provided along the school’s frontage of SW Scholls Ferry Road and SW 175th Avenue. Frontage improvements should conform to Washington County’s arterial roadway standard for a five lane cross-section. This includes 98 feet of right-of-way and a 74 foot paved section. It is recommended that the existing second westbound travel lane along SW Scholls Ferry Road be extended from SW 175th Avenue to the new collector street at the west end of the project site where it would be terminated (drop lane). Furthermore a second southbound travel lane is recommended along SW 175th Avenue from the schools frontage to SW

Scholls Ferry Road. This additional southbound lane would require modification to the existing traffic signal at SW Scholls Ferry Road/SW 175th Avenue.

- It is recommended that a 100 foot long westbound right turn lane be provided at bus/emergency vehicle right-in only access point along SW Scholls Ferry Road to provide buses a deceleration lane outside of the through traffic lane.
- Restripe the eastbound left turn lane at the SW Scholls Ferry Road/SW 175th Avenue intersection to 300 feet in length.
- Restripe the southbound left turn lane at the SW Scholls Ferry Road/SW 175th Avenue intersection to 450 feet in length.

Site Access

- It is recommended that the proposed bus only eastern access on SW Scholls Ferry Road be restricted to right in only to help alleviate operations along the corridor.
- It is recommended that the proposed school access along SW 175th Avenue be signalized. This intersection was found to meet MUTCD traffic signal warrants with the proposed project. This signal would also provide access to the future neighborhood route located on the east side of SW 175th Avenue and could provide the proposed trail connection identified in the South Cooper Mountain Concept Plan. With anticipated development on the east leg of this intersection, it is recommended that the Beaverton School District coordinate with this developer to provide a proportionate share towards the signal improvements. The Beaverton School District requests that the City conditions the development located immediately to the east (opposite this signal) to reimburse the Beaverton School District one-half the cost of the traffic signal.
- It is recommended that the proposed new collector street intersecting SW Scholls Ferry Road at the west end of the project site be signalized. This intersection was found to meet MUTCD traffic signal warrants with the proposed project. This signal would provide full access to the school and would be used by staff and busses exiting the site in addition to future residential and commercial development. With anticipated development on the north leg of this intersection and the City collector roadway classification, it is recommended that the Beaverton School District provide a proportionate share towards the signal improvements by crediting transportation development taxes.
- It is recommended that a path analysis be conducted on site to ensure that buses can make the necessary turn maneuvers.

Site Parking

- A minimum of 550 parking spaces should be provided on the school site. This would satisfy the 480 minimum spaces required by the City's development code. With 550 spaces, approximately 200 spaces should be dedicated to staff, with the remaining approximately 350 spaces for student parking. To accommodate parking needs for events, it is recommended that a minimum of 75 additional spaces be provided on-site by utilizing internal drop-off areas during events for a net total of up to 625 parking spaces.
- It is recommended that no overlapping events be scheduled on-site during high school football games.

Pedestrian and Bicycle Access/School Crosswalks

- A minimum of 122 bicycle parking spaces should be provided near primary school entrances to meet City of Beaverton Code.
- Sidewalks along the project frontage of SW Scholls Ferry Road and SW 175th Avenue should be constructed as community multi-use paths as illustrated in the South Cooper Mountain Concept Plan. These facilities should be paved and planned to accommodate both pedestrians (including those with disabilities) and bicyclists at a width of eight to ten feet.

Transportation Demand Management

- The draft Transportation Demand Management (TDM) Plan is provided in Appendix Y.

I. PROPOSED DEVELOPMENT

The project involves constructing a new high school for the Beaverton School District on the northwest corner of the SW Scholls Ferry Road/SW 175th Avenue-SW Roy Rogers Road intersection in the recently annexed South Cooper Mountain area in Beaverton, Oregon. The site is currently zoned R-1 (Urban High Density Residential) by the City of Beaverton and the high school is considered a conditional use under this land use zoning.

The South Cooper Mountain (SCM) annexation area that surrounds the proposed high school site will be made up primarily of urban neighborhood, compact neighborhood, and single family neighborhood land uses along with a block of main street commercial land use immediately west of the school's proposed site adjacent SW Scholls Ferry Road.⁵ The South Cooper Mountain Concept Plan considers these lands within the annexation area "Near Term Land Uses" (developed within 0-20 years) along with the North Cooper Mountain land uses of low and very low density neighborhoods. The Urban Reserve Area, bordering the South Cooper Mountain Annexation Area to the north, is made up of future neighborhood land use (past 20 years). In total, these three areas as described in the South Cooper Mountain Concept Plan are estimated to have 7,430 housing units.⁶ Figure 3 illustrates the concept plan's land use and street network, with supporting copy provided in Appendix B.

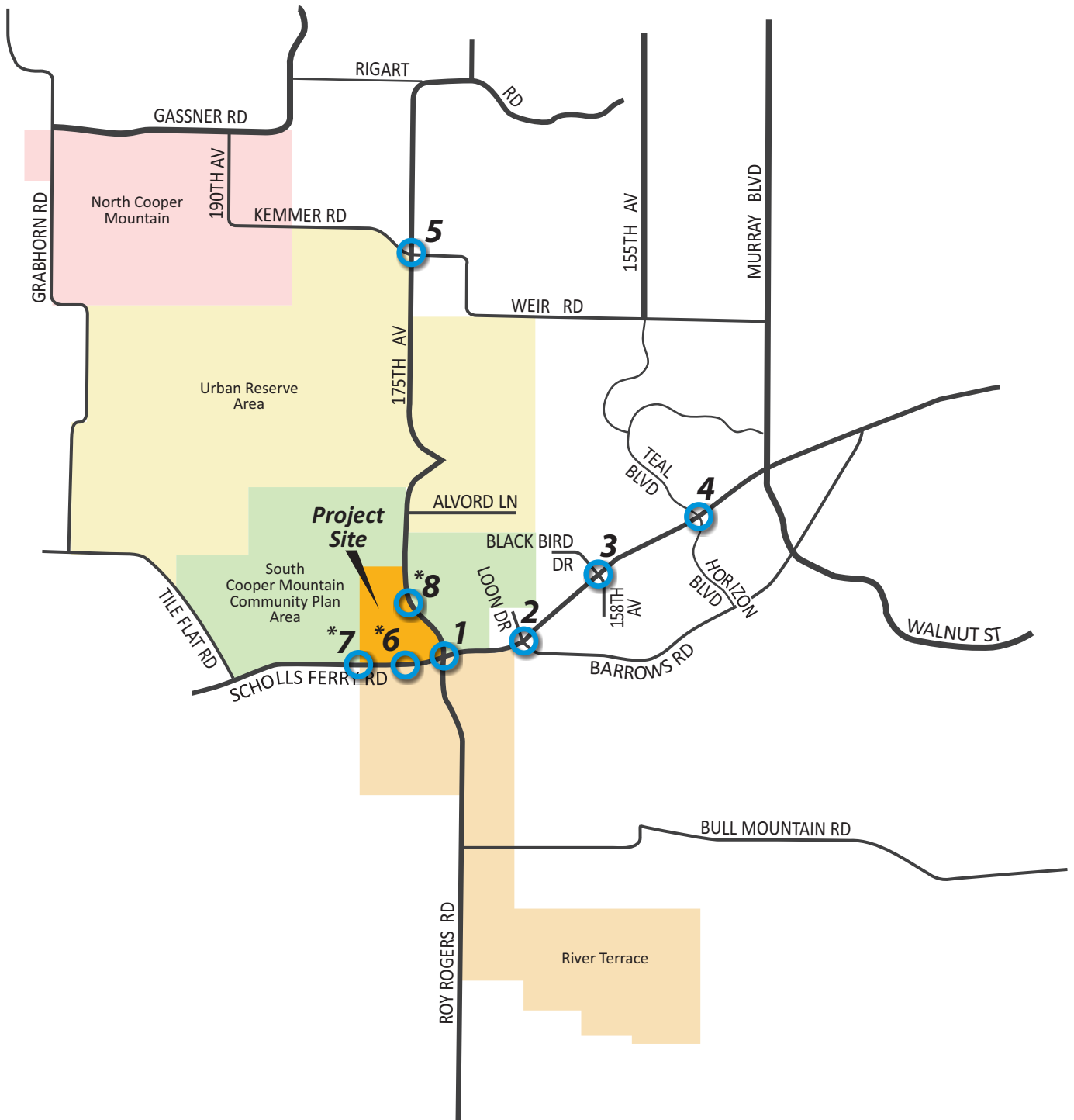
Additionally, the City of Tigard River Terrace Community Plan is located just south of SW Scholls Ferry Road. The River Terrace area is made up of residential, neighborhood commercial, and institutional land uses. The land use assumptions for the River Terrace Community Plan include approximately 2,590 housing units.⁷ A figure of the concept plan's land use and street network is shown in Figure 4 and provided in Appendix C.

Figure 2 shows the location of the land uses that surrounds the proposed project site. The high school is anticipated to open in September 2017. The proposed high school would have a maximum student enrollment of 2,200 students and approximately 200 staff. This student capacity would be similar to other high schools within the Beaverton School District. The site would also house multiple athletic facilities including a football stadium, tennis courts, softball/baseball fields, basketball gymnasium, and practice fields.


⁵ *South Cooper Mountain Concept Plan*, City of Beaverton, September 2014.

⁶ *Transportation Findings for Preferred Scenario*, DKS Associates, June 23, 2014.

⁷ *River Terrace Community Plan: TSP Addendum*, City of Tigard, December 2014.



LEGEND

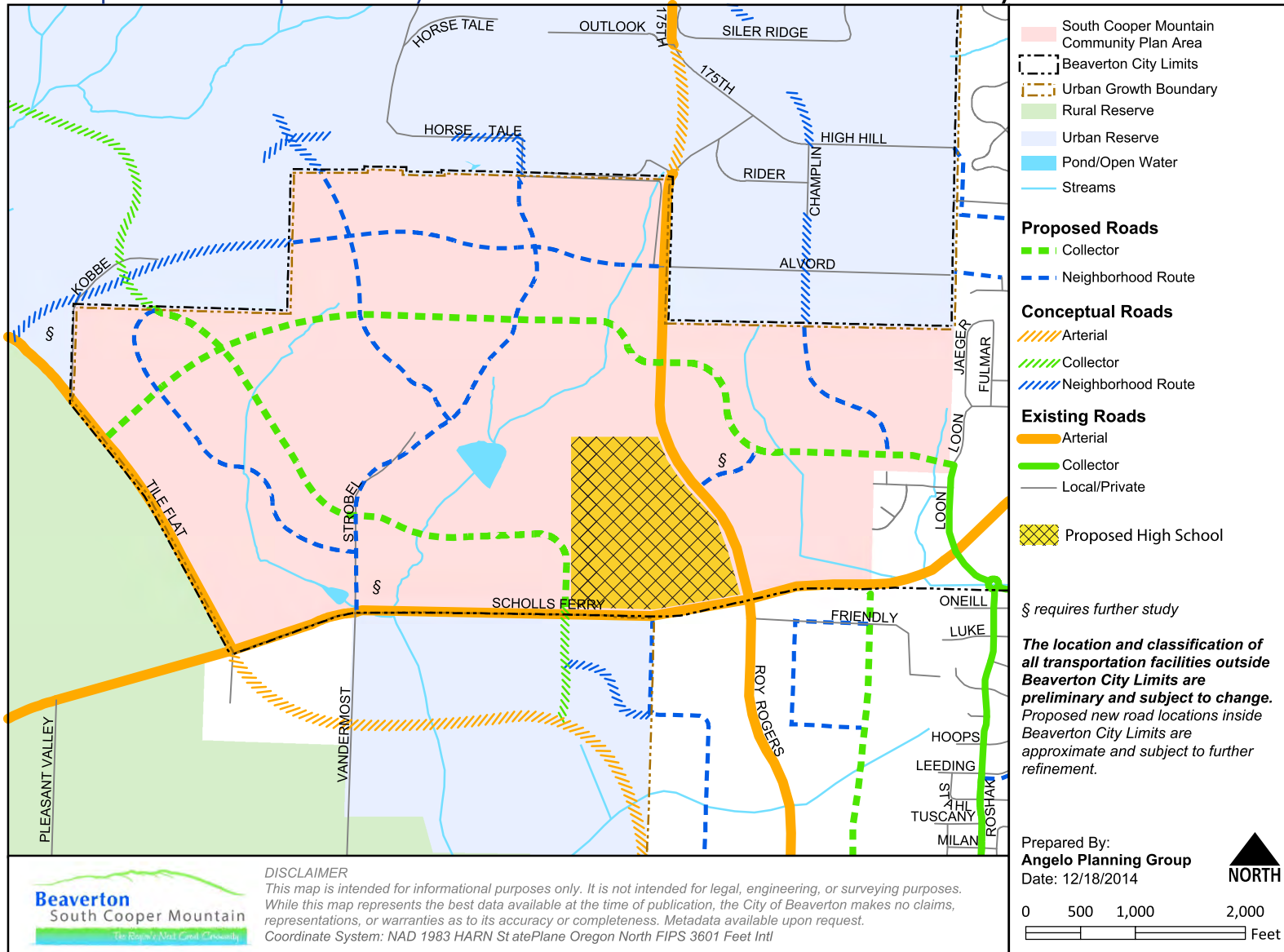
- #  - Study Intersection
- * - Site Access

DKS



Figure 2

STUDY INTERSECTION INFLUENCE AREA



DKS

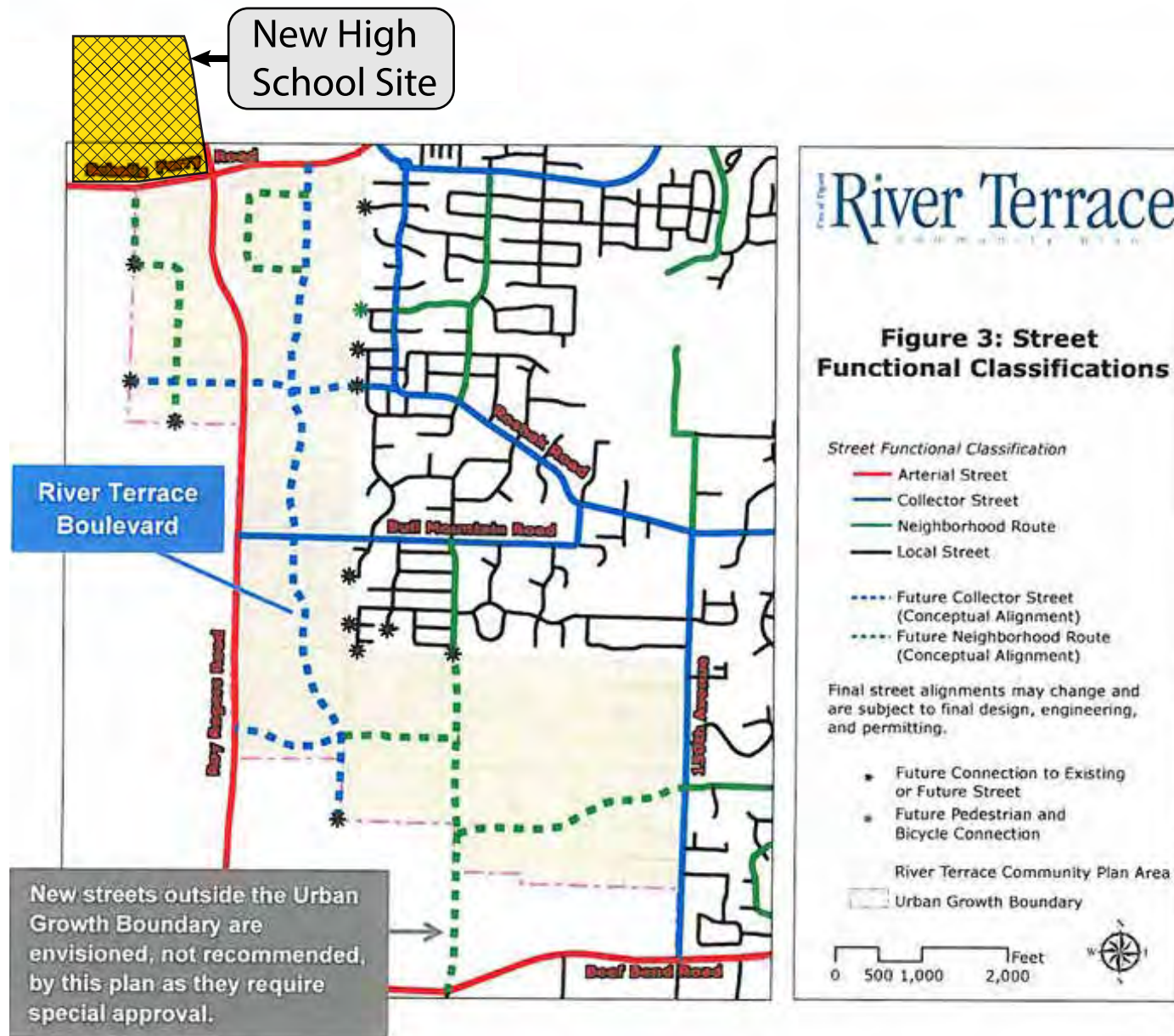


No Scale

Figure 3

**SCM Concept Plan
Street Network**

Source: Angelo Planning Group



DKS



No Scale

II. EXISTING CONDITIONS

This chapter provides documentation of existing study area transportation conditions, including the project site, study area roadway network, pedestrian and bicycle facilities, and existing traffic volumes and intersection operations. Supporting details are provided in Appendices K through M.

Influence Area

The study area was selected per City of Beaverton and Washington County guidelines⁸ and is intended to capture transportation impacts related to the proposed project. The proposed development is a new high school on the northwest corner of the SW Scholls Ferry Road/SW 175th Avenue-Roy Rogers Road intersection within the Beaverton School District. Figure 2 shows the project site and surrounding study area including the following five study intersections:

1. SW Scholls Ferry Road/SW 175th Avenue-Roy Rogers Road
2. SW Scholls Ferry Road/SW Barrows Road-Loon Drive
3. SW Scholls Ferry Road/SW 158th Avenue-Blackbird Drive
4. SW Scholls Ferry Road/SW Teal-Horizon Boulevard
5. SW 175th Avenue/SW Kemmer Road

As listed, four of the study intersections along SW Scholls Ferry Road feature differing street names to the north and south. For purposes of this report, these intersections will be referred to as the following:

1. SW Scholls Ferry Road/SW 175th Avenue
2. SW Scholls Ferry Road/SW Barrows Road
3. SW Scholls Ferry Road/SW 158th Avenue
4. SW Scholls Ferry Road/SW Teal Boulevard

Pedestrian, Bicycle, and Transit Systems

The study area is serviced by TriMet bus route 92 (South Beaverton Express) which has stops located near the study intersection of SW Scholls Ferry Road/SW Teal Boulevard. This route provides weekday rush-hour service only (morning to Portland City Center and evening to Murrayhill). However, at approximately 1.25 miles from the proposed school site and limited service, TriMet route 92 is not expected to service the school until the line is extended. The Beaverton School District provides bus service for students before and after school.

⁸ Washington County guidelines indicate that the impact area include intersections where site generated traffic equals or exceeds 10% of existing average daily traffic. City of Beaverton guidelines indicate that the impact area include intersections where site generated traffic equals or exceeds 5% of peak hour traffic.

Existing peak period (7-9 a.m., 2-6 p.m.) traffic counts at nearby intersections show that up to 14 bicyclists travel along SW Scholls Ferry Road during the afternoon school peak hour (2:55-3:55 p.m.). A small number of bicyclists were counted along SW Scholls Ferry Road during the morning and evening peak hour while no bicyclists were counted along SW 175th Avenue during any of the study time periods⁹. Bike lanes are currently only provided along SW Scholls Ferry Road east of SW 175th Avenue. Pedestrian activity along the two arterial roadways is low. The intersection of SW Scholls Ferry Road/SW Teal Boulevard experienced the most pedestrian activity, likely associated with transit, with a peak of 29 pedestrians during the p.m. peak hour. While SW Scholls Ferry Road/SW 175th Avenue was found to have the greatest number of total entering vehicles, no pedestrians were counted during the three peak time periods.

Sidewalks were recently constructed along both sides of SW Scholls Ferry Road in 2014 west of SW Barrows Road to SW 175th Avenue. The intersection of SW Scholls Ferry Road/SW 175th Avenue is signalized and features new ADA ramps and controlled pedestrian crossings with pushbuttons and pedestrian countdown timers across the north, west, and south legs. The pedestrian crossing along the east leg is closed. Existing pedestrian and bicycle roadway facilities are summarized in Table 9.

⁹ Intersection turn movement counts collected at study intersections on October 28-30, 2014 between 7-9 a.m., 2-4 p.m. and 4-6 p.m.

Study Area Roadway Network Characteristics

Key roadways in the study area are summarized in Table 9 along with their existing characteristics. As shown, all surrounding roadways within the study area network are under the jurisdiction of Washington County and the City of Beaverton.

Table 9: Existing Roadway Network Characteristics

| Roadway | Roadway Jurisdiction | Roadway Classification ¹⁰ | Cross-Section | Posted Speed | Pedestrian Facilities | Bicycle Facilities |
|--|----------------------|--------------------------------------|---------------|--------------|---------------------------|----------------------|
| SW Scholls Ferry Rd (east of SW 175 th Ave) | Washington County | Arterial | 5 Lanes | 40 mph | Sidewalks | Bike Lanes |
| SW Scholls Ferry Rd (west of SW 175 th Ave) | Washington County | Arterial | 2/3 Lanes | 40 mph | None | None |
| SW 175 th Ave (North of SW Kemmer Rd) | Washington County | Arterial | 2 Lanes | 35 mph | Sidewalk, West Side Only | None |
| SW 175 th Ave (South of SW Kemmer Rd) | Washington County | Arterial | 2 Lanes | 45 mph | None | None |
| SW Roy Rogers Rd | Washington County | Arterial | 2/3 Lanes | 45 mph | None | Shoulder |
| SW Barrows Rd | City of Beaverton | Collector | 3 Lanes | 25 mph | Sidewalk, North Side Only | East of SW Roshak Rd |
| SW Loon Dr | City of Beaverton | Local | 2/3 Lanes | 25 mph | Sidewalks | None |
| SW Black Bird Dr | City of Beaverton | Neighborhood Route | 2/3 Lanes | 25 mph | Sidewalks | None |
| SW 158 th Ave | Washington County | Neighborhood Route | 2 Lanes | 25 mph | Sidewalks | None |
| SW Teal Blvd | City of Beaverton | Collector | 2/3 Lanes | 35 mph | Sidewalks | Bike Lanes |
| SW Horizon Blvd | City of Beaverton | Collector | 2/3 Lanes | 25 mph | Sidewalks | Narrow Bike Lanes |
| SW Kemmer Rd (east of SW 175 th Ave) | Washington County | Arterial | 2 Lanes | 25 mph | None | None |
| SW Kemmer Rd (west of SW 175 th Ave) | Washington County | Collector | 2 Lanes | 40 mph | Sidewalk, North Side Only | None |

¹⁰ 2020 Washington County Transportation System Plan, Figure 4E, May 2013.

Study Peak Period Scenarios

Due to travel characteristics of high schools, this traffic study evaluates three peak period scenarios. The a.m. and p.m. peak periods are typical peak periods for a transportation impact analysis since this is when traffic volumes are typically greatest on surrounding roadways. The a.m. peak period is typically the peak travel period for high school traffic (school drop-off activity) and aligns with the a.m. peak of the adjacent transportation system. The p.m. peak period for a high school however does not typically align with the p.m. peak of the adjacent transportation system. The typical high school peak usually falls between 2 p.m. and 4 p.m. during school let out, whereas the p.m. peak of the transportation system usually falls between 4 p.m. and 6 p.m. As a result, this study will evaluate all three periods including both the afternoon school peak to capture the peak end-of-school demand and the surrounding transportation system p.m. peak.

Existing Traffic Volumes

Existing a.m., afternoon school, and p.m. peak period traffic operations were analyzed at the following study intersections:

1. SW Scholls Ferry Road/SW 175th Avenue
2. SW Scholls Ferry Road/SW Barrows Road
3. SW Scholls Ferry Road/SW 158th Avenue
4. SW Scholls Ferry Road/SW Teal
5. SW 175th Avenue/SW Kemmer Road

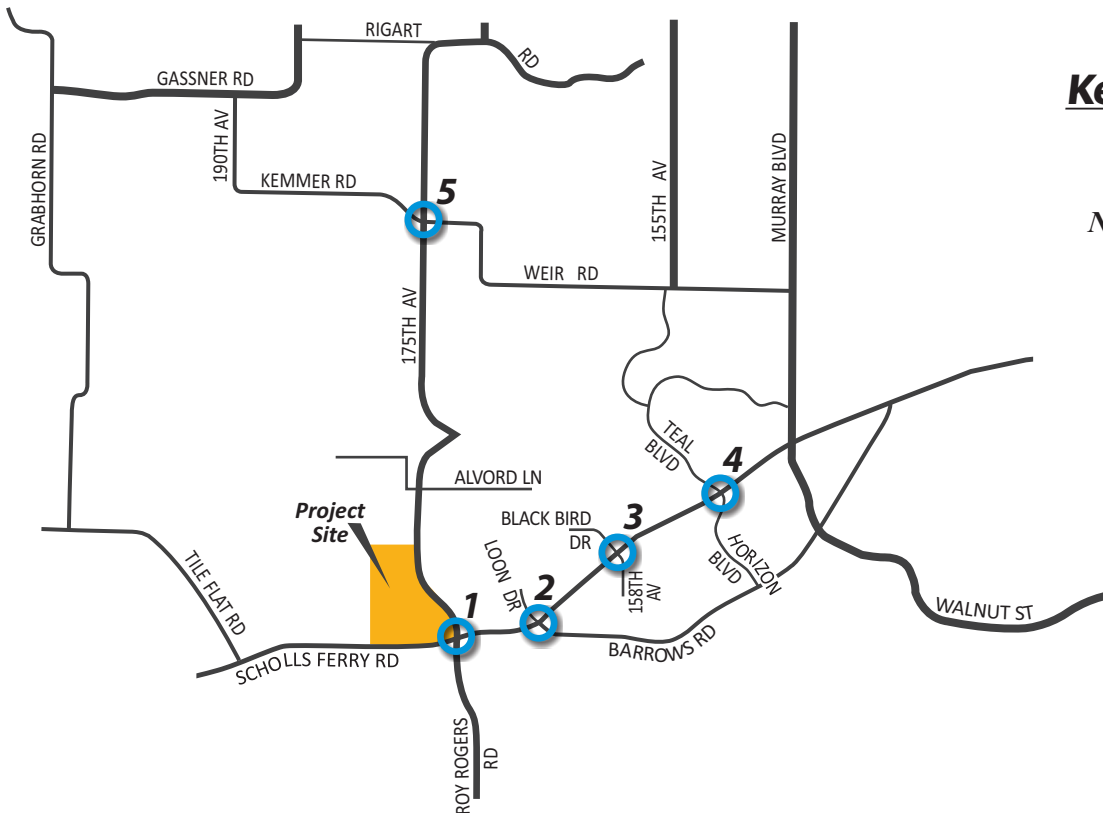
To perform the intersection analysis, traffic counts were collected during the a.m. (7:00 to 9:00 a.m.), afternoon school (2:00 to 4:00 p.m.) and p.m. (4:00 to 6:00 p.m.) peak periods over three weekdays (Tuesday through Thursday) from October 28 to October 30, 2014. Intersection turn movement volumes were found to be consistent over the analysis period; therefore turn movement counts were averaged over the three days of collection and are shown in Figure 5. Existing turn movement counts are included in Appendices D through G.

The purpose of intersection analysis is to determine if the transportation network operates within desired performance levels as required by Washington County and City of Beaverton mobility targets. Intersections are the focus of the analysis because they are the controlling bottlenecks of traffic flow and the ability of a roadway system to carry traffic efficiently is nearly always diminished in their vicinity.

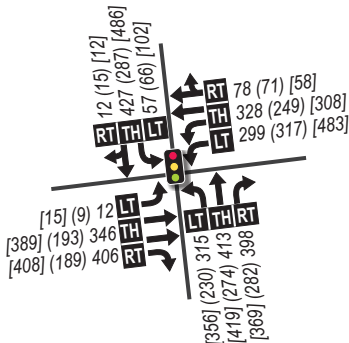
Key Map



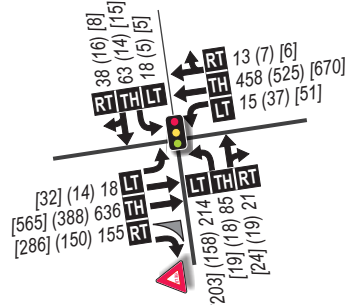
No Scale



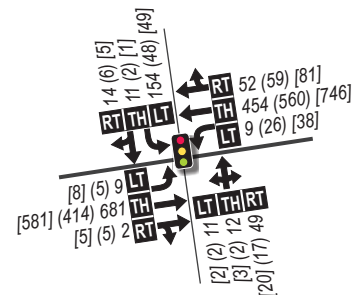
1. Scholls Ferry Rd./175th Ave. - Roy Rogers Rd.



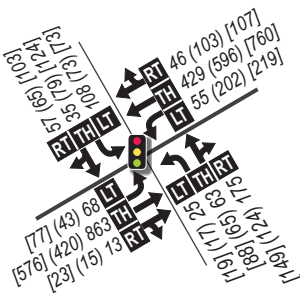
2. Scholls Ferry Rd./Barrows Rd. - Loon Dr.



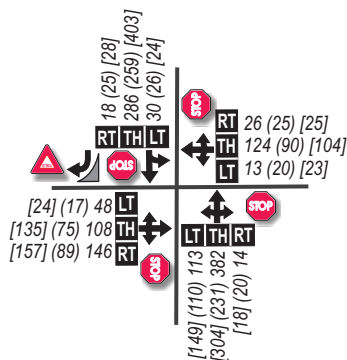
3. Scholls Ferry Rd./158th Ave. - Black Bird Dr.



4. Scholls Ferry Rd./Teal Blvd. - Horizon Blvd.



5. 175th Ave./Kemmer Rd.



- LEGEND**
- # - Study Intersection
 - Traffic Signal
 - Stop Sign
 - Yield Sign

← - Lane Configuration

Peak Hour Traffic Volumes

000 (000) [000] - AM (Afternoon School) [PM]

LT TH RT - Volume Turn Movement
Left • Thru • Right

DKS

Figure 5

**2014 PEAK HOUR
TRAFFIC VOLUMES**

Existing Daily Traffic Volumes

Daily traffic volumes (24-hour) were collected along SW Scholls Ferry Road and SW 175th Avenue to understand travel characteristics in the study area from October 25 to October 31, 2014. Both weekday and weekend counts were collected to help differentiate whether driving trends differ in the study area between weekday and weekend periods and are included in Appendix G.

Two data collection points were collected, one west of SW 175th Avenue on SW Scholls Ferry Road and one north of SW Scholls Ferry Road on SW 175th Avenue. Figure 6 shows a weekday traffic volume plot (a three-day average from Tuesday to Thursday) for SW Scholls Ferry Road and SW 175th Avenue. The time referenced in the figure is the hour beginning. As shown, traffic volumes along SW Scholls Ferry Road are only slightly greater in the p.m. peak than in the a.m. peak. Bi-directional traffic volumes during these peaks reach 1,400 vehicles per hour while weekday daily traffic volumes reach 13,000 vehicles (bi-directional). Along SW 175th Avenue, traffic volumes peak around 900 vehicles per hour in the a.m. peak, and increase to nearly 1,100 vehicles per hour in the p.m. peak (bi-directional). Weekday traffic volumes peak at 9,700 vehicles per day (bi-directional). Along both facilities, traffic volumes drop significantly during the midday period (9:00 a.m. to 2:00 p.m.). Around 2:00 p.m., traffic volumes begin to climb to the p.m. peak hour before dropping off substantially after 6:00 p.m. The a.m. peak hour was found to be between 7:15 to 8:15, the afternoon peak is between 2:55 and 3:55 p.m., and the p.m. peak hour is from 4:40 to 5:40 p.m.

It should be noted that traffic volumes are relatively consistent throughout the weekdays (Monday through Friday), with a significant drop on the weekends. Weekend bi-directional traffic volumes can drop to 8,000 and 6,000 vehicles per day along SW Scholls Ferry Road and SW 175th Avenue respectively as shown in Figure 7.

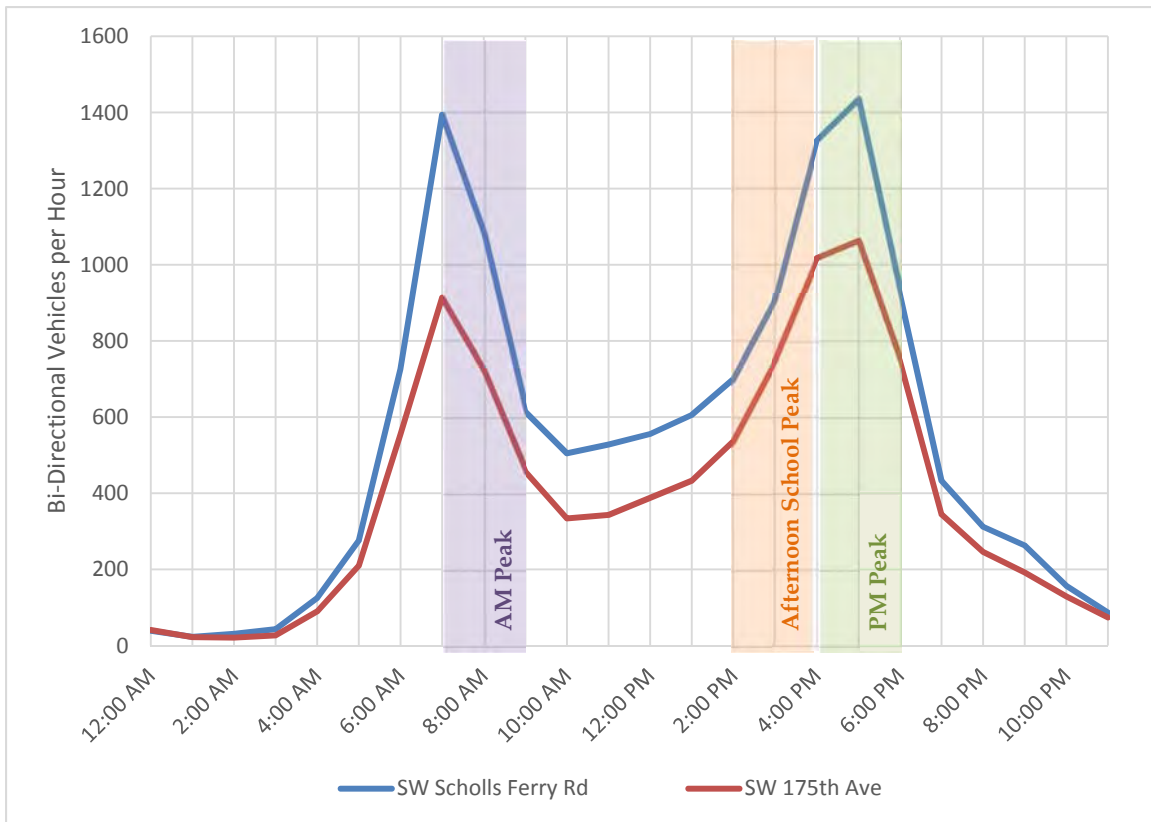


Figure 6: Weekday Hourly Traffic Volumes for SW Scholls Ferry Road (north of SW 175th Avenue) and SW 175th Avenue (west of SW 175th Avenue)

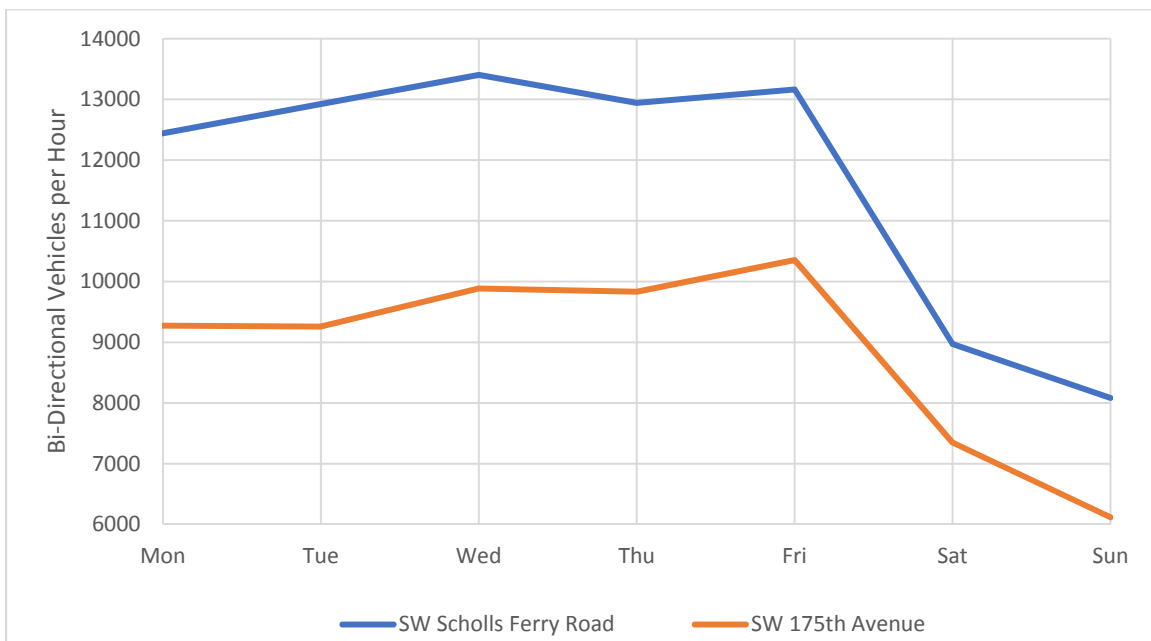


Figure 7: Weekday and Weekend Daily Traffic Volumes for SW Scholls Ferry Road (north of SW 175th Avenue) and SW 175th Avenue (west of SW 175th Avenue)

Existing 85th Percentile Speeds

The posted speed along SW Scholls Ferry Road adjacent to the project site is posted at 40 miles per hour (mph). To the west, this speed zone ends yielding way to the basic rule (55 mph) approximately 900 feet west of SW 175th Avenue. Posted speeds along SW 175th Avenue are 35 mph (north of SW Kemmer Road) and 45 mph (south of SW Kemmer Road). As part of the data collection, 24-hour vehicle speeds were collected along SW Scholls Ferry Road and SW 175th Avenue from October 25 to October 31, 2014. The data collection points were located west of SW 175th Avenue and north of SW Scholls Ferry Road. Table 10 indicates the measured 85th percentile speeds (commonly used to set posted speed limits) along each of these two facilities.

Table 10: Measured 85th Percentile Speeds

| Roadway | Posted Speed | 85 th Percentile Speed | |
|-----------------------------|--------------------------------------|-----------------------------------|--------|
| SW Scholls Ferry Road | 40 mph transitioning to 55 mph | Eastbound | 53 mph |
| | | Westbound | 53 mph |
| SW 175 th Avenue | 45 mph | Northbound | 55 mph |
| | | Southbound | 54 mph |

As shown in the table, speeds on SW 175th Avenue were found to be higher than the posted speeds during the collection period (includes weekend and weekday traffic). Therefore; the percent travelling greater than 5 mph or 10 mph above the posted speed limit was analyzed to determine the level of "excessive" speeding. It was found that approximately 47-percent of drivers travel 5 mph over the posted speed along SW 175th Avenue and approximately 15-percent of drivers travel 10 mph over the posted speed of this facility. On SW Scholls Ferry Road, the speed data indicates that approximately 67-percent of drivers travel 5 mph over the posted speed and approximately 33-percent of drivers travel 10 mph over the posted speed. The higher speeds are likely due to the end of the 40mph speed zone just west of the project site.

Intersection Operations

Before the analysis results of the study intersections are presented, discussion is provided for two important analysis topics: intersection performance measures (definitions of typical measures) and required operating standards (as specified by the agency with roadway jurisdiction).

Intersection Performance Measures

Level of Service (LOS) and volume-to-capacity (V/C) ratios are two commonly used performance measures that provide a gauge of intersection operations. Agencies often incorporate these performance measures into their mobility targets. Descriptions are included in Appendix J and summarized below:

- **Level of Service (LOS):** A "report card" rating (A through F) based on the average delay (seconds per vehicle) experienced by vehicles at the intersection. LOS A, B, and C indicate conditions where traffic moves without significant delays over periods of peak hour travel

demand. LOS D and E are progressively worse operating conditions. LOS F represents conditions where average vehicle delay has become excessive and demand has exceeded capacity; this condition is typically evident in long queues.

- **Volume-to capacity (V/C) ratio:** A decimal representation (between 0.00 and 1.00) of the proportion of capacity that is being used at a turn movement, approach leg, or intersection. A lower ratio indicates smooth operations and minimal delays. As the ratio approaches 1.00, congestion increases and performance is reduced. If the ratio is greater than 1.00, the turn movement, approach leg, or intersection is oversaturated and usually results in excessive queues and long delays.

Agency Mobility Targets

Agencies typically have established targets for intersection operations during peak periods, which are commonly known as mobility targets. The study intersections along SW Scholls Ferry Road and SW 175th Avenue fall under the jurisdiction of Washington County. The Washington County mobility target is a V/C ratio of 0.99 for signalized and unsignalized intersections during the peak hour.¹¹ This measurement is a measure for the entire intersection (all approaches) for signalized and all-way stop controlled intersections, while it is measured for the worst-case stopped approach at unsignalized intersections.

Additionally, the City of Beaverton's Development Code¹² indicates that a signalized intersection should operate with a peak hour average control delay no longer than 65 seconds per vehicle and with a V/C ratio no greater than 0.98 for each lane group. For an unsignalized intersection (two-way or an all-way stop controlled intersection), the peak hour average control delay shall be no greater than 45 seconds per vehicle. The City's mobility targets are included since the land use application is submitted through the City's land use approval process.

Existing Operating Conditions

Existing traffic operations at the study intersections were analyzed for the a.m., afternoon school, and p.m. peak hours based on the 2000 Highway Capacity Manual methodology for signalized and unsignalized intersections.¹³ All intersections, with the exception of SW 175th Avenue/SW Kemmer Road are signalized intersections. The intersection of SW 175th Avenue/SW Kemmer Road is all-way stop controlled. Existing peak hour operating results are compared with Washington County's and City of Beaverton's mobility targets as shown in Table 11.

¹¹ 2020 Washington County Transportation System Plan, November 2011.

¹² Beaverton Development Code, Special Requirements, Section 60.55.10.7, June 2012.

¹³ 2000 Highway Capacity Manual, Transportation Research Board, Washington DC, 2000.

Table 11: 2014 Existing Intersection Operations – Peak Hour

| Intersection | Mobility Target | | AM Peak | | | Afternoon School Peak | | | PM Peak | | |
|------------------------------------|-------------------------|----------|---------|-----|-------------|-----------------------|-----|------|-------------|-----|-------------|
| | City | County | Delay | LOS | V/C | Delay | LOS | V/C | Delay | LOS | V/C |
| SW Scholls Ferry Rd/ SW 175th Ave | 0.98 V/C*, 65 sec delay | 0.99 V/C | 36.9 | D | 0.82 | 27.0 | C | 0.70 | 52.0 | D | 0.91 |
| SW Scholls Ferry Rd/ SW Barrows Rd | | | 15.0 | B | 0.55 | 10.3 | B | 0.44 | 10.9 | B | 0.51 |
| SW Scholls Ferry Rd/ SW 158th Ave | | | 9.8 | A | 0.49 | 5.2 | A | 0.34 | 5.2 | A | 0.40 |
| SW Scholls Ferry Rd/ SW Teal Blvd | | | 24.9 | C | 0.53 | 21.8 | C | 0.44 | 24.4 | C | 0.56 |
| SW 175th Ave/ SW Kemmer Rd** | 45 sec delay | | 44.1 | E | 1.03 | 14.6 | B | 0.64 | 63.0 | F | 1.05 |

Delay = average intersection vehicle delay (sec), LOS = intersection level of service, V/C = intersection volume-to-capacity ratio

Bold and Red indicates intersection does not meet mobility target

* Applies to each lane group at intersection

**V/C reported for northbound lane group

The intersection of SW 175th Avenue/SW Kemmer Road currently exceeds mobility standards during the a.m. and p.m. peak hours. The northbound movement at this intersection currently experiences long delays and queues along the northbound approach during the a.m. and p.m. peak hour. The signalized intersection of SW Scholls Ferry Road/SW 175th Avenue currently operates at a V/C of 0.91 during the p.m. peak hour. This intersection currently meets Washington County mobility targets with an intersection volume-to-capacity ratio less than 0.99. This intersection also meets City of Beaverton mobility targets; however there are several movements that do not currently have capacity for significant future growth. The northbound left turn, westbound left turn, and southbound through movements all operate with volume-to-capacity ratios of 0.95/0.96 during the p.m. peak hour. The remaining study intersections currently meet both agency mobility standards during all three peak periods analyzed.

To validate existing peak hour intersection operations, a site visit was conducted on Tuesday, November 18th, 2014 to observe operations at study intersections during each of the three peak periods analyzed. Field observations noted several movements with extensive vehicle queue lengths during the p.m. peak hour. The southbound queue at SW Scholls Ferry Road/SW 175th Avenue was estimated to reach 15 vehicles, while the northbound left turn queue at this intersection reached up to 20 vehicles. Additionally, large delays and queues were observed along the northbound approach at the intersection of SW 175th Avenue/SW Kemmer Road during the p.m. peak hour. Average delays along the northbound approach during the p.m. peak hour were measured up to 3-minutes per vehicle. Additionally, a queue of approximately eight vehicles was observed along the southbound approach during the p.m. peak hour.

Safety Evaluation

The most recent three years of crash records (2011-2013) for the study area intersections were obtained from the Oregon Department of Transportation (ODOT) crash database and are included in Appendix H.¹⁴ During this three year period, there were a total of 63 reported crashes located at the five existing study intersections. One injury A (incapacitating injury) crash was reported at the intersection of SW Scholls Ferry Road/SW Teal Boulevard. No fatal crashes were reported at any of the study intersections during this time period.

Observed crash rates at the five study intersections were calculated to identify problem areas in need of safety mitigation. The total number of crashes experienced at an intersection is typically proportional to the number of vehicles entering it. Therefore, a crash rate describing the frequency of crashes per million entering vehicles (MEV) is used to evaluate the intersection. This observed crash rate at each site was then compared to a calculated critical crash rate that is unique to each site and based on the critical crash rate procedure in the Highway Safety Manual (HSM) Network Screening chapter.¹⁵ Intersections that exceed their respective critical crash rate are flagged for further review.

Table 12 shows total reported collisions at each study intersection as well as the calculated observed and critical crash rates. As shown, the intersection of SW Scholls Ferry Road/SW 175th Avenue had an observed crash rate that exceeded the respective critical crash rate; therefore it is recommended that further safety analysis be performed at this intersection. It should be noted that capacity improvements were constructed at this intersection in 2014 (additional eastbound and westbound through lanes).

Table 12: Crash History and Calculated Crash Rates (2011-2013)

| Intersection | Reported Crashes | | | | Observed Crash Rate | Critical Crash Rate |
|--|------------------|--------|-----|-------|---------------------|---------------------|
| | Fatal | Injury | PDO | Total | | |
| SW Scholls Ferry Rd/SW 175 th Ave | 0 | 14 | 18 | 32 | 0.94 | 0.85 |
| SW Scholls Ferry Rd/SW Barrows Rd | 0 | 2 | 5 | 7 | 0.37 | 0.94 |
| SW Scholls Ferry Rd/SW 158 th Ave | 0 | 3 | 2 | 5 | 0.33 | 0.97 |
| SW Scholls Ferry Rd/SW Teal Blvd | 0 | 6 | 6 | 12 | 0.52 | 0.90 |
| SW 175 th Ave/SW Kemmer Rd | 0 | 4 | 3 | 7 | 0.51 | 0.55 |

Bold and Red indicate intersection observed crash rate exceeds the calculated critical crash rate based on HSM methodology.

¹⁴ Oregon Department of Transportation, Crash Data System, <https://zigzag.odot.state.or.us>

¹⁵ 2010 Highway Safety Manual (HSM), Chapter 4, Page 4-11: The critical crash rate is a threshold value that allows for relative comparison among site with similar characteristics. The critical crash rate depends on the average crash rate at similar sites, traffic volume, and a statistical constant that represents a desired level of significance.

The study intersection of SW Scholls Ferry Road and SW 175th Avenue had a total of 32 crashes reported over the three year period analyzed. The crashes consisted of rear end (20), fixed object (5), turning movement (5) and angle (2) crashes. All of these crash types are relatively common at signalized intersections, particularly rear end. The majority of the crashes resulted in property damage only (18). Evident injury (injury B) and possible injury (injury C) were also reported. Figure 8 provides a collision breakdown by type and severity for SW Scholls Ferry Road/SW 175th Avenue.

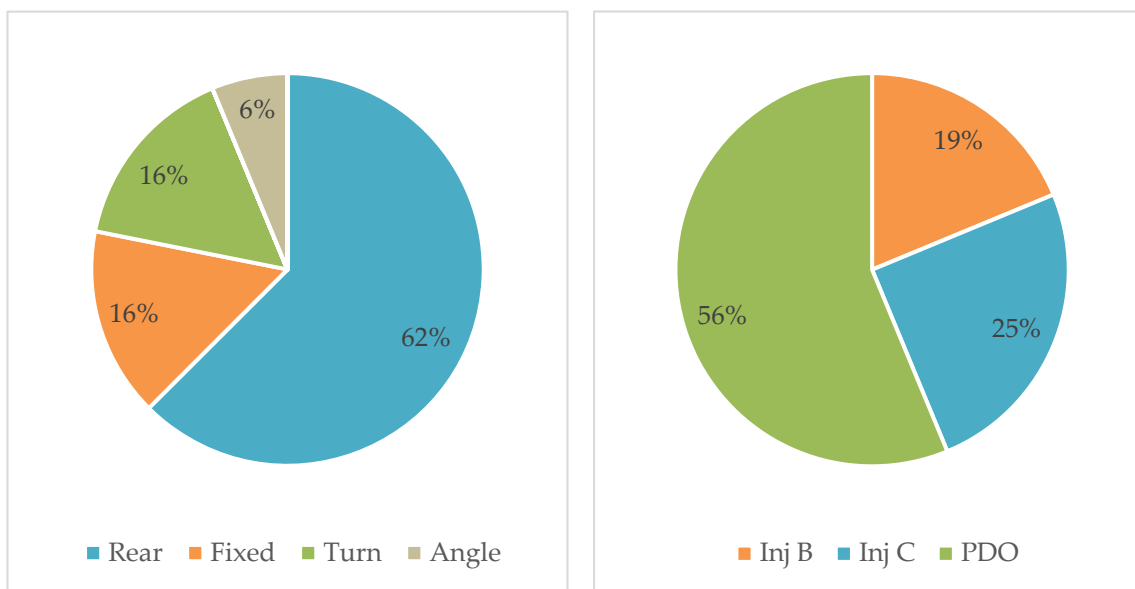


Figure 8: SW Scholls Ferry Road/SW 175th Avenue Breakdown by Collision Type (left) and Severity (right)

Corridor Safety Evaluation

The most recent three years of crash records (2011-2013) for the corridors of SW 175th Avenue and SW Scholls Ferry Road within the study vicinity were also obtained from the Oregon Department of Transportation (ODOT) crash database and are included in Appendix H.¹⁶ During this three year period, there were a total of 41 reported crashes located along SW 175th Avenue from north of SW Kemmer Road to south of SW Scholls Ferry Road. One collision along SW 175th Avenue south of SW Kemmer Road was reported to result in a fatality from a head on collision from an improper overtake. No injury A (incapacitating injuries) crashes were reported. Along SW Scholls Ferry Road, from east of SW Teal Boulevard to west of the proposed site, 39 collisions were reported including no fatalities and two injury A collisions. One of the reported injury A collisions was caused by speeding.

Washington County SPIS

The Safety Priority Index System (SPIS) List is the primary tool that Washington County uses to identify locations where conflicts between motorists have been occurring most frequently. The SPIS is a method originally developed in 1986 by the Oregon Department of Transportation

¹⁶ Oregon Department of Transportation, Crash Data System, <https://zigzag.odot.state.or.us>

(ODOT) for identifying potential safety problems. SPIS has been recognized as an effective problem identification tool for evaluating roadway intersections and segments with higher crash histories. The SPIS score is based on a running three years of crash data where the first year's data is dropped as the current year's data is included. This score is based upon crash frequency, crash rate, and crash severity. A roadway segment becomes a potential SPIS site if a location has three or more crashes or one or more fatal crashes over the three-year period. However, ODOT only reports SPIS locations and data for state governed roadways. For City and County roadways, the Oregon Adjustable Safety Index System (OASIS) can be used by the user for a score similar to the SPIS score.

The OASIS was developed by ODOT as an online analysis tool that is capable of performing SPIS-like safety analysis and allows users to vary the SPIS calculations. The system was designed to be primarily a flagging tool to identify locations for further investigation, similar to the SPIS reports. For the NHS study area, the default settings that were used to export the OASIS report (dated December 2014) include 2010-2012 crash years (most recent in system) with a Segment Qualifier of one fatal or three crashes. The OASIS score is the summation of the four indicators that can be found within the exported report included in Appendix I. Within the study area, a 0.2-mile segment of SW Scholls Ferry Road that includes the SW Teal Boulevard intersection is in the top five percent of segments within Washington County. A 0.15-mile segment of SW 175th Avenue that includes several tight horizontal curves north of SW Alvord Lane was found to be in the top ten percent within Washington County based on the default OASIS weighting system.

III. BACKGROUND TRAFFIC FORECAST

This chapter provides documentation of the expected background traffic volumes (i.e., the “no build” scenario) and intersection operations analysis for the 2017 year of opening.

2017 Year of Opening

The Beaverton School District new high school (NHS) is anticipated to be open and be fully operational by September 2017. Based on conversation with City and County staff¹⁷, there are no approved but not yet built projects within the study area. Therefore; to account for background growth and future development in the area, a one percent yearly linear growth rate was used to forecast the future background traffic volumes. The one percent growth was estimated by analyzing historical Washington County daily traffic volumes at locations within the study vicinity¹⁸. Figure 9 shows the 2017 future background traffic volumes at the study intersections.

2017 Background Intersection Operations

Analysis was performed based on *2000 Highway Capacity Manual*¹⁹ methodology for signalized and unsignalized intersections to determine operations that reflect 2017 peak hour operations. Table 13 lists intersection operations for the 2017 background scenario with calculations provided in Appendices N through P. As expected, all intersections experience a slight increase in delay associated with the additional background traffic loadings. The signalized intersection of SW Scholls Ferry Road/SW 175th Avenue would operate at a V/C ratio of 0.93 during the p.m. peak hour. This intersection would still meet the County’s mobility target; however the northbound left turn, westbound left turn, and southbound through movements would all operate at a volume-to-capacity ratio of 0.99 thus not meeting the City’s mobility target. These three movements would have no capacity for additional traffic loading associated with the proposed high school. The all-way stop at SW 175th Avenue/SW Kemmer Road would continue to operate at above capacity conditions ($V/C > 1.0$), particularly along the northbound approach which would be characterized by long queues and delays.

¹⁷ Meeting with City of Beaverton and Washington County staff, December, 4, 2014

¹⁸ Count locations located on SW 175th Avenue 2,500 feet north of SW Scholls Ferry Road and on SW Scholls Ferry Road 500 feet east of SW 175th Avenue.

¹⁹ *2000 Highway Capacity Manual*, Transportation Research Board, Washington DC, 2000.

Table 13: 2017 Background Intersection Operations – Peak Hour

| Intersection | Mobility Target | | AM Peak | | | Afternoon School Peak | | | PM Peak | | |
|------------------------------------|-------------------------|----------|-------------|-----|-------------|-----------------------|-----|------|-------------|-----|-------------|
| | City | County | Delay | LOS | V/C | Delay | LOS | V/C | Delay | LOS | V/C |
| SW Scholls Ferry Rd/ SW 175th Ave | 0.98 V/C*, 65 sec delay | 0.99 V/C | 38.8 | D | 0.84 | 28.2 | C | 0.72 | 55.8 | E | 0.93 |
| SW Scholls Ferry Rd/ SW Barrows Rd | | | 15.4 | B | 0.56 | 10.2 | B | 0.45 | 11.0 | B | 0.52 |
| SW Scholls Ferry Rd/ SW 158th Ave | | | 9.9 | A | 0.50 | 5.3 | A | 0.35 | 5.2 | A | 0.41 |
| SW Scholls Ferry Rd/ SW Teal Blvd | | | 25.5 | C | 0.54 | 22.2 | C | 0.45 | 25.1 | C | 0.57 |
| SW 175th Ave/ SW Kemmer Rd** | 45 sec delay | | 50.8 | F | 1.09 | 15.6 | C | 0.67 | 73.4 | F | 1.11 |

Delay = average intersection vehicle delay (sec), LOS = intersection level of service, V/C = intersection volume-to-capacity ratio

Bold and Red indicates intersection does not meet mobility target

* Applies to each lane group at intersection

**V/C reported for northbound lane group

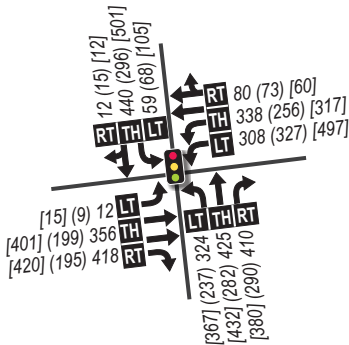
Key Map



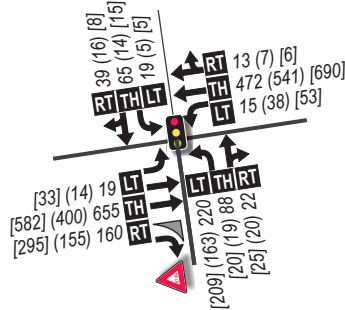
No Scale



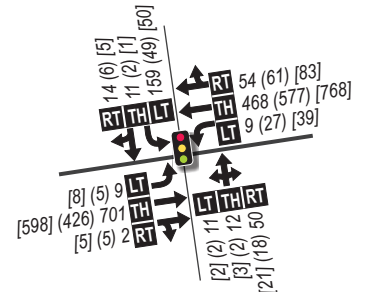
1. Scholls Ferry Rd./175th Ave. - Roy Rogers Rd.



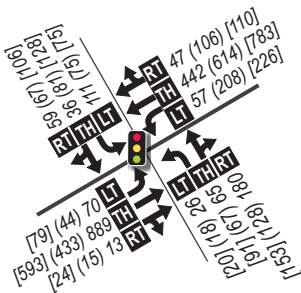
2. Scholls Ferry Rd./Barrows Rd. - Loon Dr.



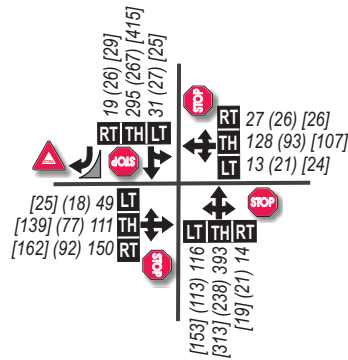
3. Scholls Ferry Rd./158th Ave. - Black Bird Dr.



4. Scholls Ferry Rd./Teal Blvd. - Horizon Blvd.



5. 175th Ave./Kemmer Rd.



- # **LEGEND**
- Study Intersection
 - Traffic Signal
 - Stop Sign
 - Yield Sign

← - Lane Configuration

Peak Hour Traffic Volumes

000 (000) [000] - AM (Afternoon School) [PM]

LT TH RT - Volume Turn Movement
Left • Thru • Right

DKS

Figure 9

**2017 BACKGROUND
PEAK HOUR
TRAFFIC VOLUMES**

IV. TRAFFIC IMPACTS

This chapter documents the impacts that the new high school would have on the surrounding transportation system. This analysis includes project trip generation, distribution, and future operating conditions with the proposed project. The focus of the impact analysis is on the existing study intersections, which have been previously documented and the following three site access points:

6. SW Scholls Ferry Road/Restricted Site Access (Right In)
7. SW Scholls Ferry Road/New Collector (West Site Access)
8. SW 175th Avenue/Full Site Access

The proposed east access along SW Scholls Ferry Road is proposed to be restricted to right in only and serve buses and emergency vehicles. The proposed full access along SW 175th Avenue is proposed to provide access to the student and visitor parking lot, while the access along SW Scholls Ferry Road would provide access to the proposed staff parking lot. Additionally, full access to the site is proposed at the west end of the project along SW Scholls Ferry Road via the proposed City collector street as identified in the South Cooper Mountain Concept Plan. While buses would enter the site from the east access, it is assumed that they would exit the site via the new collector.

Proposed High School

The proposed development is a new high school on the northwest corner of the SW Scholls Ferry Road/SW 175th Avenue intersection within the Beaverton School District. The high school will have an anticipated enrollment of 1,700 students in 2017 (the year of opening), and is expected to reach a maximum enrollment of 2,200 students. The site plan is shown in Figure 15 and provided in Appendix A which includes the addition of the access locations previously documented.

Trip Generation

Trip generation is typically based on rates published in the *ITE Trip Generation Manual*²⁰ unless there is reason to suspect that local data may differ from the published rates or there are minimal studies. Because local data was available for several high schools within the Beaverton School District, they were compared to ITE rates. Trip generation rates were gathered from previous studies of Aloha High School and Wilsonville High School (see Appendix Q for trip generation data for these studies). In addition, trip rates were developed from new traffic counts collected at Westview High School and Southridge High School as part of this study (see Appendix Q for counts). Weighted averages of the local rates are compared to rates from the *ITE Trip Generation Manual* in Table 14.

²⁰ *ITE Trip Generation Manual*, Institute of Transportation Engineers, 9th Edition, 2012.

Table 14: High School Trip Generation Rates Peak – Peak Hour

| Source | Study Period | Trip Rate (per student) | In% | Out % |
|--|-----------------------|----------------------------|-----|-------|
| <i>ITE Trip Generation Manual</i> (Code 530) | AM Peak | 0.43 | 68% | 32% |
| | Afternoon School Peak | 0.29 | 33% | 67% |
| | PM Peak | 0.13 | 47% | 53% |
| Local Data | AM Peak | 0.48 | 64% | 36% |
| | Afternoon School Peak | 0.29 | 33% | 67% |
| | PM Peak | 0.10 | 47% | 53% |

As can be seen the local rates and ITE rates are similar. The *ITE Trip Generation Handbook*²¹ provides a methodology for determining if the ITE rates, local rates, or a combination of the rates should be used for analysis (see Appendix Q for the methodology). If the measured local rates are within 15% of the ITE rates, then the ITE rates are valid for local use. If not, the local rates should be applied solely if warranted or in combination with the ITE rates. The local data used for this study is within 15% of the ITE rates during the a.m. and afternoon school peak hours. Therefore, the *ITE Trip Generation Handbook* suggests that ITE rates should be used for these time periods, and local rates should be used for the p.m. peak.

Because the methodologies for determining the suggested trip rates are inconsistent across the three time periods, it is recommended that this study applies combined trip rates. Combined trip rates are recommended if the local and ITE rates are reasonably close, which is the case. This methodology uses a weighted average based on the number of trips and students for each study.

The resulting weighted average rates are identical to the ITE rates. This shows that the High School land use in the *ITE Trip Generation Manual* is a reasonable data source to use for the NHS. As a result, it is recommended that ITE rates be used to determine the trip generation for the Beaverton School District NHS. The new school expects to enroll approximately 1,700 students when it opens in 2017, and have a maximum enrollment of 2,200 students. Table 15 presents the resulting trip generation for the proposed high school site.

²¹ *ITE Trip Generation Handbook*, Institute of Transportation Engineers, 2nd Edition, 2004.

Table 15: New High School Trip Generation – Peak Hour

| Study Period | Expected Student Enrollment | | Trip Rate (per student) | In % | Out % | 2017 Trip Generation | | | 2035 Trip Generation | | |
|-----------------------|-----------------------------|-------|-------------------------|------|-------|----------------------|-----------|-------------|----------------------|-----------|-------------|
| | 2017 | 2035 | | | | In Trips | Out Trips | Total Trips | In Trips | Out Trips | Total Trips |
| AM Peak | 1,700 | 2,200 | 0.43 | 68% | 32% | 497 | 234 | 731 | 643 | 303 | 946 |
| Afternoon School Peak | | | 0.29 | 33% | 67% | 163 | 330 | 493 | 211 | 427 | 638 |
| PM Peak | | | 0.13 | 47% | 53% | 104 | 117 | 221 | 134 | 152 | 286 |

Trip Distribution

Trip distribution provides an estimation of where the additional project trips would be coming from and going to. It is given as percentages at key gateways to the study area and is used to route project trips through the study area intersections. Trip distribution percentages are shown in Figure 10 and the resulting project traffic volumes for the year of opening (2017 total volume scenario) are shown in Figure 11.

The trip distribution was broken down into three components; students, buses, and staff. Trip distribution for the students was estimated based on existing residential land areas in the area of the proposed high school. Distribution of staff was estimated based on a select zone analysis of the County's regional travel demand model. Bus routing information to and from the school was provided by the Beaverton School District during all peak hours analyzed. It is anticipated that buses would follow the same distribution as students during the a.m. peak hour. During the afternoon school peak hour one-quarter of the buses are assumed to arrive from the north along SW 175th Avenue and the remaining would arrive from the east along SW Scholls Ferry Road (from surrounding bus facilities and option schools). Leaving the site, buses would follow the student distribution.

School related trips would be expected to increase daily traffic volumes by approximately 15 to 20 percent along SW Scholls Ferry Road and SW 175th Avenue. The increase would be greater in the a.m. and afterschool peak hours and less in the p.m. peak hour.

2017 Total Traffic Volumes

Future operating conditions were analyzed at the study intersections for the year of opening (2017 total volume). Future traffic volumes were estimated at the study intersections in order to access traffic conditions with future growth and project traffic. Future year 2017 total traffic volume forecasts were developed using a one percent per year growth and include the trips generated from the expected enrollment of 1,700 students at day of opening. The weekday a.m., afternoon school, and p.m. peak hour traffic volumes used to analyze the 2017 total traffic

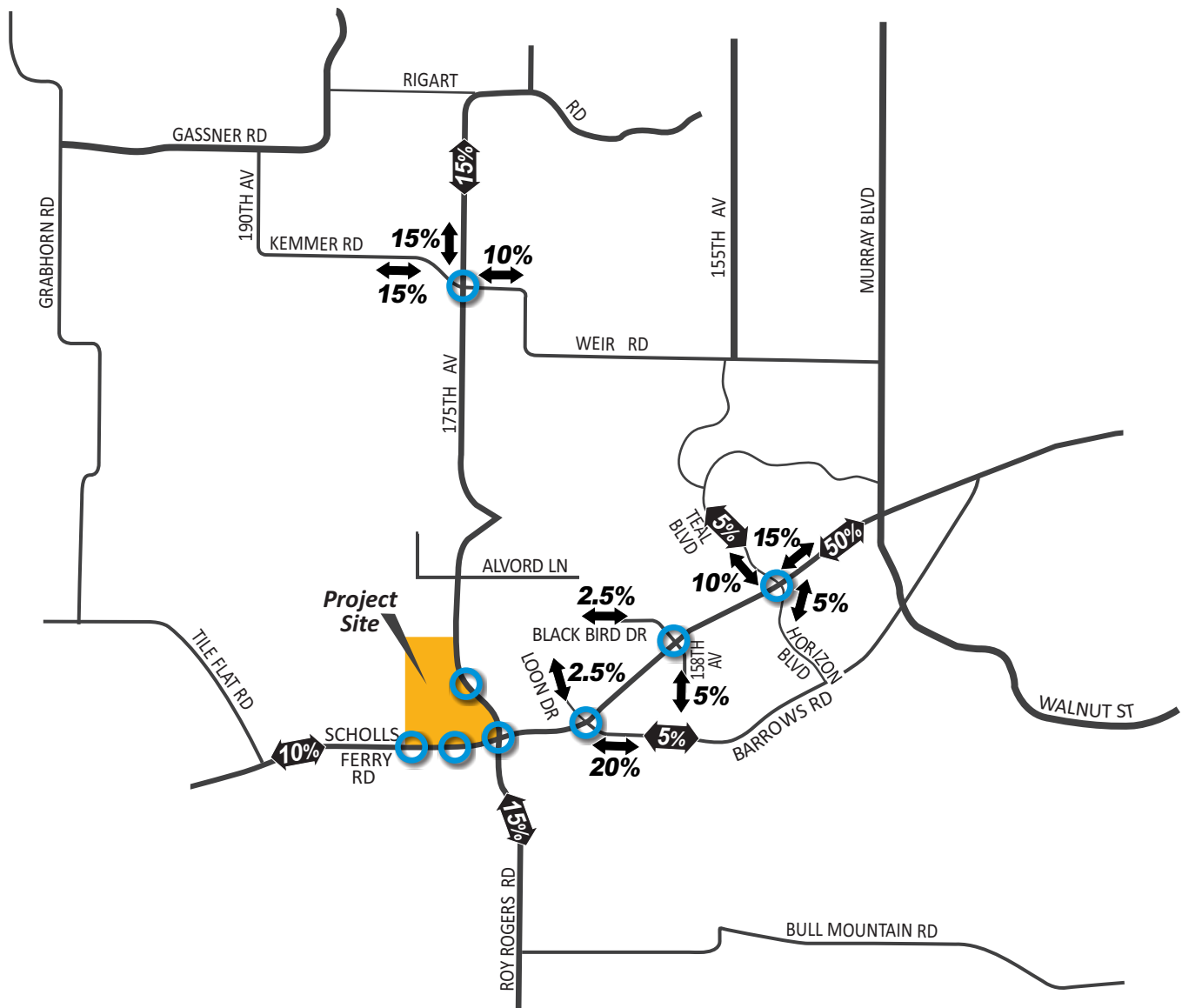
scenario are shown in Figure 12. The heavy vehicle percentage was adjusted for select movements to account for the school buses impact on intersection operations.

Frontage Improvements

The South Cooper Mountain Concept Plan identifies improvements along SW Scholls Ferry Road which consist of widening it to a 5-lane arterial cross-section from SW 175th Avenue west to SW Tile Flat Road in order to meet mobility standards with future development in the area. Additionally, the South Cooper Mountain Plan proposes SW 175th Avenue to be widened to a 5-lane arterial cross-section north of SW Scholls Ferry Road.

Washington County Development Code requires that half street improvements be constructed along the site's frontage of existing arterial roads which abut the site and are not improved in accordance with the Washington County Transportation Plan and Road Design and Construction Standards²². Therefore; it is proposed that this project extend the existing Scholls Ferry Road westbound travel lane, which terminates just west of SW 175th Avenue, along the site frontage and terminate this lane at the proposed new collector roadway at the west side of the project site. Additionally, a second southbound travel lane would be constructed along SW 175th Avenue from the sites frontage, north of the proposed access point, to SW Scholls Ferry Road. This lane would line up with the two existing receiving lanes on the south leg of the intersection. This additional travel lane would require modification to the existing traffic signal at the intersection of SW Scholls Ferry Road/SW 175th Avenue.

²² Washington County Development Code, Article V: Public Facilities and Services, Section 501.-8.2(B) Adequate level of Arterial and Collector Roads.



LEGEND



- Study Intersection

0%

- Student Trip Distribution Percentage

0%

- Staff Trip Distribution Percentage

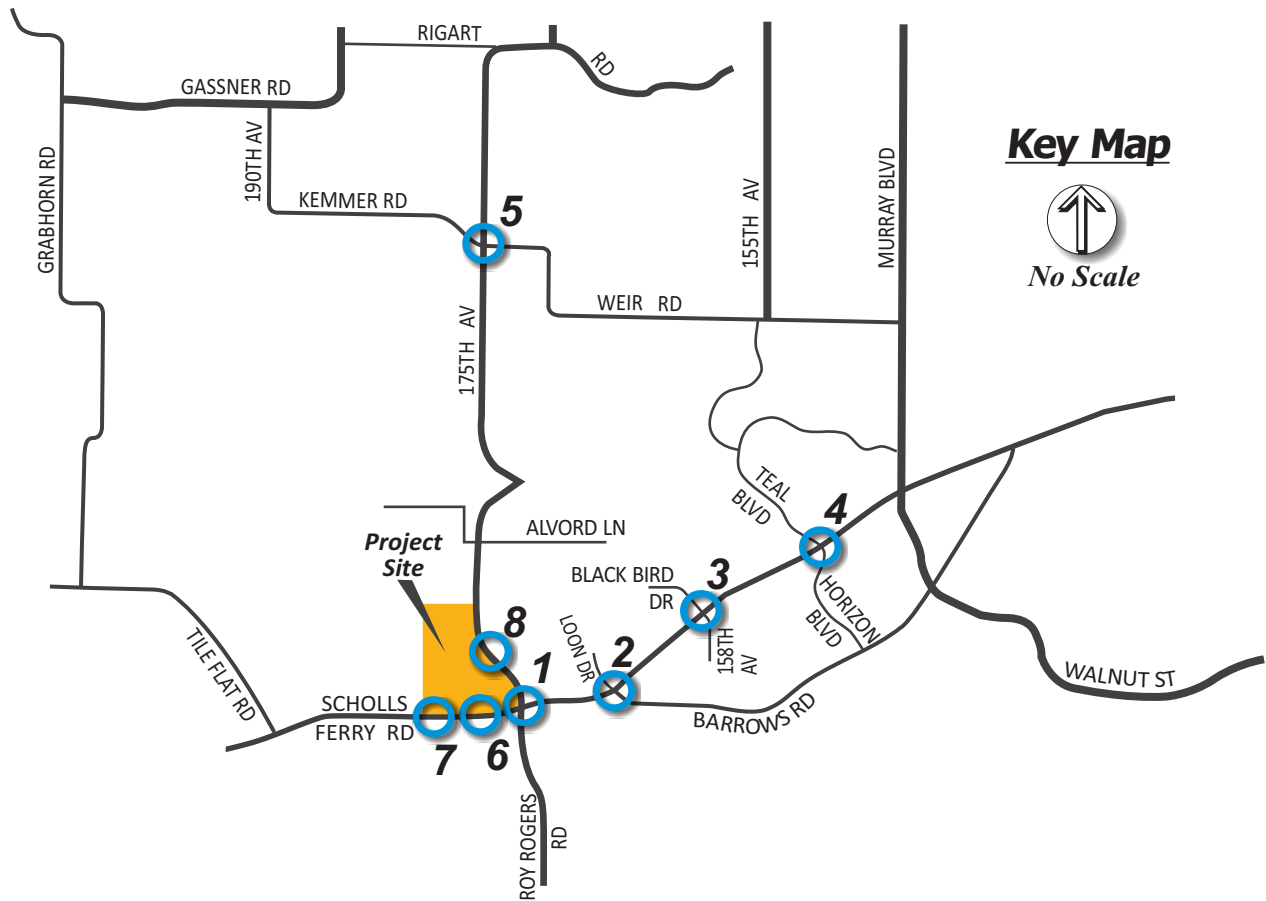
DKS



No Scale

Figure 10

PROJECT TRIP DISTRIBUTION

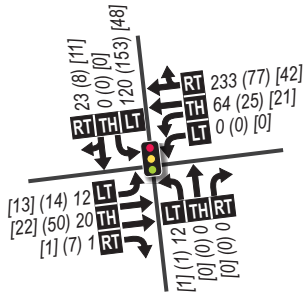


Key Map

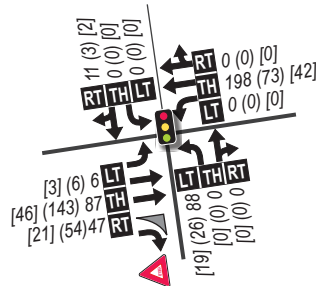


No Scale

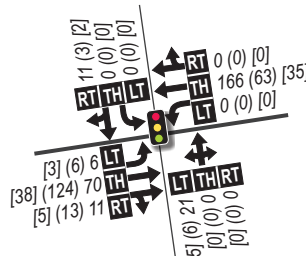
1. Scholls Ferry Rd./175th Ave. - Roy Rogers Rd.



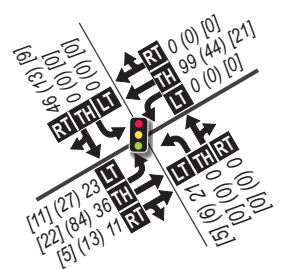
2. Scholls Ferry Rd./Barrows Rd. - Loon Dr.



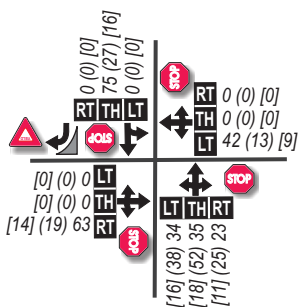
3. Scholls Ferry Rd./158th Ave - Black Bird Dr.



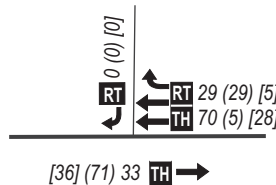
4. Scholls Ferry Rd./Teal Blvd. - Horizon Blvd.



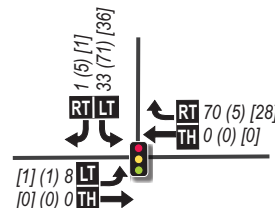
5. 175th Ave./Kemmer Rd.



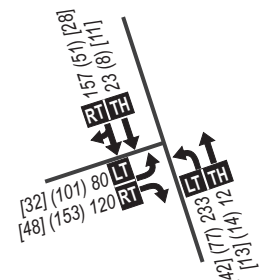
6. Scholls Ferry Rd./Site Access



7. Scholls Ferry Rd./Future Collector (West Site Access)



8. 175th Ave./Site Access



LEGEND

- Study Intersection

Traffic Signal

Stop Sign Yield Sign

← - Lane Configuration

Peak Hour Project Trips

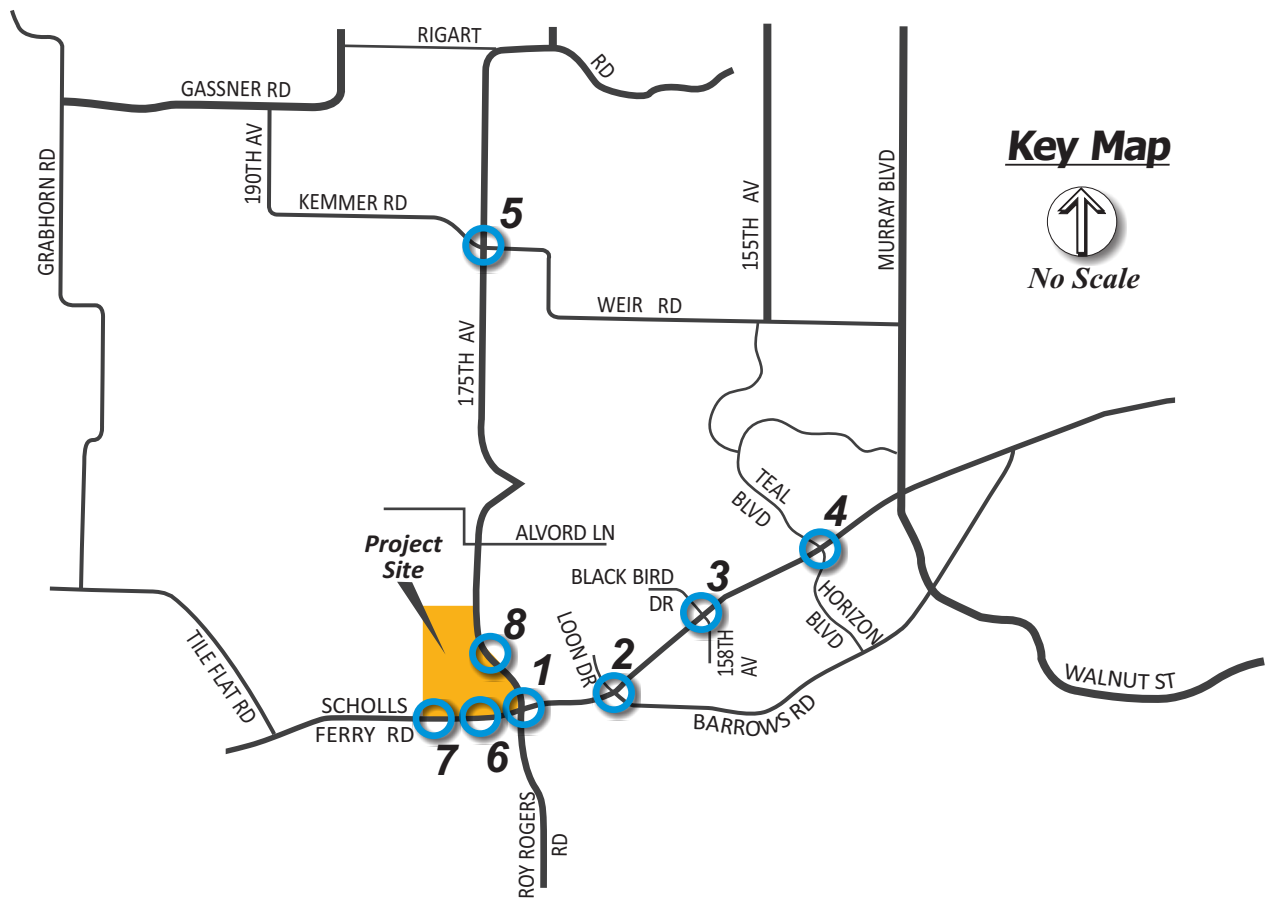
000 (000) [000] - AM (Afternoon School) [PM]

LT TH RT - Volume Turn Movement
Left • Thru • Right

DKS

Figure 11

2017
PEAK HOUR
PROJECT TRIPS

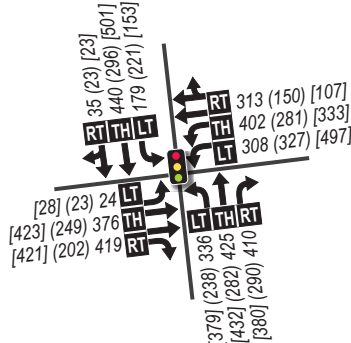


Key Map

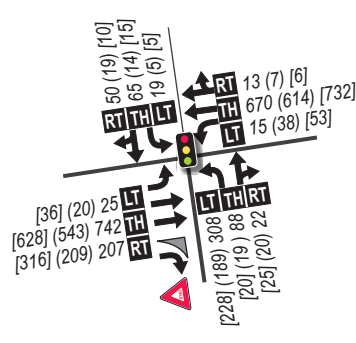


No Scale

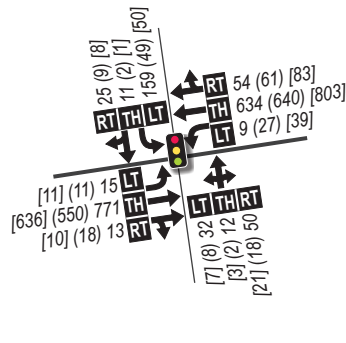
1. Scholls Ferry Rd./175th Ave. - Roy Rogers Rd.



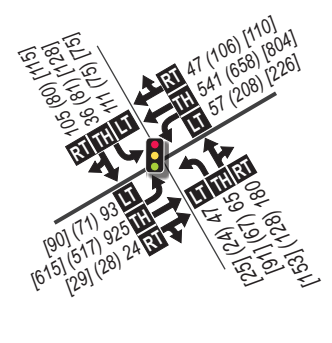
2. Scholls Ferry Rd./Barrows Rd. - Loon Dr.



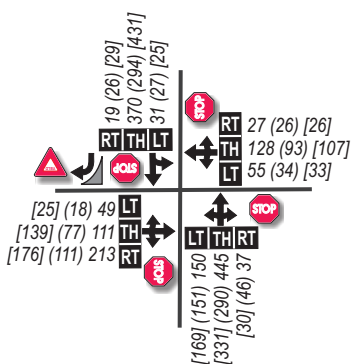
3. Scholls Ferry Rd./158th Ave. - Black Bird Dr.



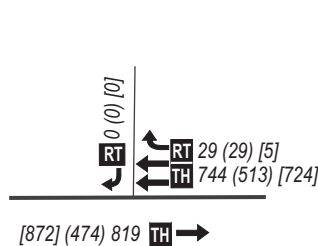
4. Scholls Ferry Rd./Teal Blvd. - Horizon Blvd.



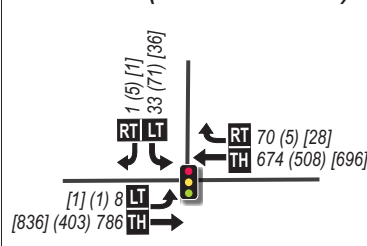
5. 175th Ave./Kemmer Rd.



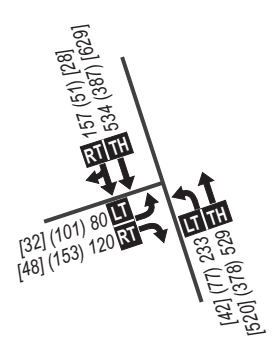
6. Scholls Ferry Rd./Site Access



7. Scholls Ferry Rd./Future Collector (West Site Access)



8. 175th Ave./Site Access



LEGEND

- Study Intersection

Traffic Signal

Stop Sign

← - Lane Configuration

Peak Hour Traffic Volumes

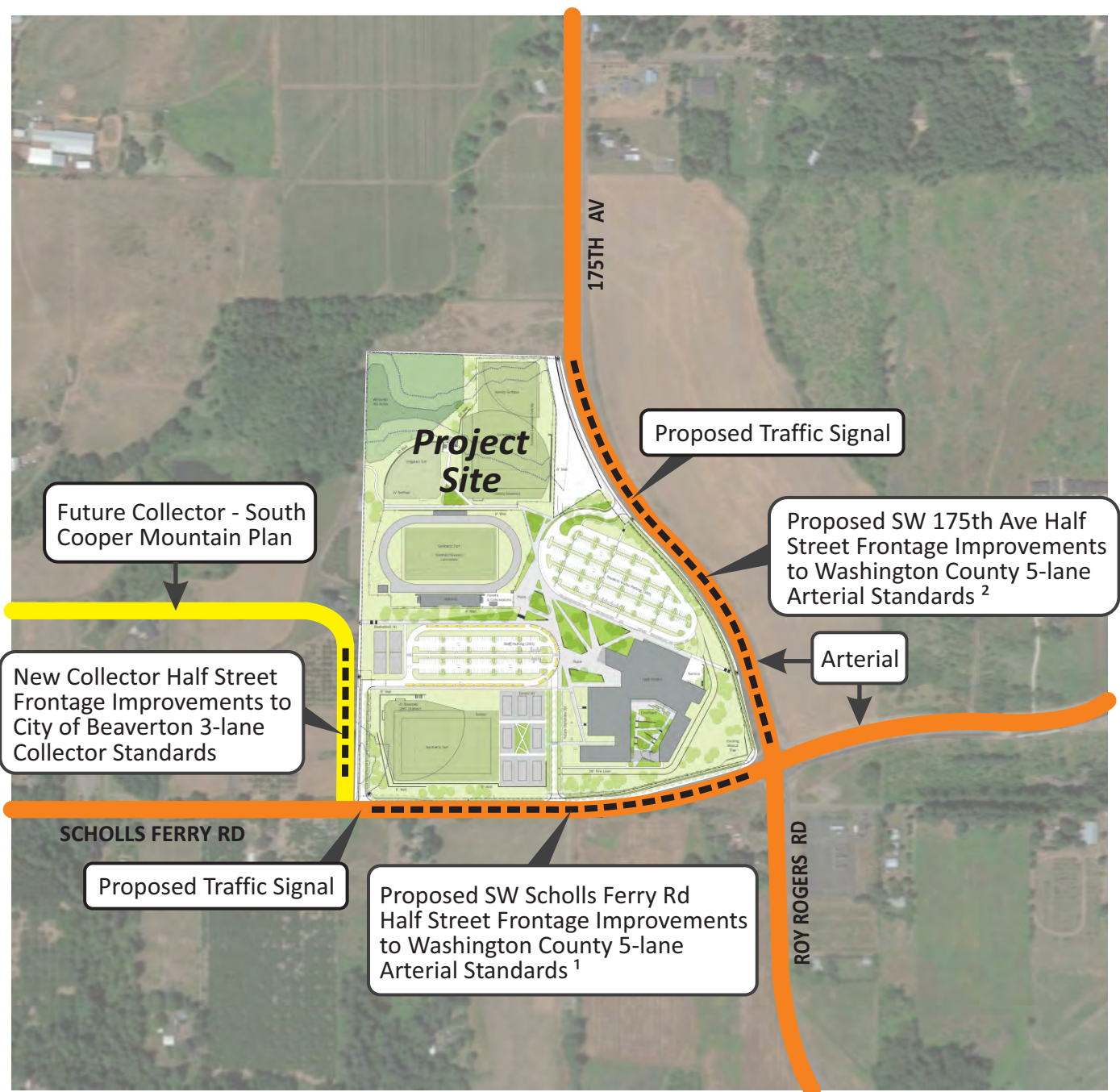
000 (000) [000] - AM (Afternoon School) [PM]

LT TH RT - Volume Turn Movement
Left • Thru • Right

DKS

Figure 12

2017 TOTAL
PEAK HOUR
TRAFFIC VOLUMES



1. Provides additional westbound travel lane from SW 175th Ave/Scholls Ferry Rd to New Collector
2. Provides additional southbound travel lane from site frontage to SW Scholls Ferry Rd

Notes:
 Washington County 5- lane arterial:
 98' ROW, 74' Paved width
 City of Beaverton 3- lane collector:
 74' ROW, 46' Paved width



Figure 13
BEAVERTON SCHOOL DISTRICT
NEW HIGH SCHOOL
SYSTEM FRONTAGE IMPROVEMENTS
 Source: Walker Macy

Traffic Signal Warrant Analysis

Traffic signal warrant analysis was performed at the proposed site access on SW 175th Avenue and at the proposed collector roadway access to SW Scholls Ferry with the forecasted 2017 total traffic volumes to evaluate the potential need for new traffic signals. The west access at SW Scholls Ferry Road is proposed to be a City collector roadway providing access to future residential and commercial areas west of the proposed high school site, therefore signalization of this intersection is likely based on the classification of intersecting roadways.

MUTCD Peak Hour Signal Warrants

The 2009 Manual on Uniform Traffic Control Devices (MUTCD) peak hour signal warrant²³ (Warrant 3) was analyzed for the 2017 total traffic scenario during the a.m., afternoon school, and p.m. peak hours. This warrant is intended to evaluate the need for a traffic signal at locations where there are a large number of vehicles entering the intersection over a short period of time, such as students, parents, staff, and school busses exiting the school site at school let out. With this, the warrant considers the total stopped delay of vehicles along the minor street approach and considers signalization as a means of reducing this delay if proven to be substantial.

For the peak hour warrant, the MUTCD recommends the use of a 70% factor if the speed of the major street is above 40 mph. Since the measured 85th percentile speeds on SW 175th Avenue and SW Scholls Ferry Road are more than 40 mph, the 70% factor was applied to the traffic signal warrant evaluation.

The peak hour signal warrant analysis at the proposed site access along SW 175th Avenue indicates that a signal would be warranted during the a.m. peak hour. The analysis assumes the minor street consisting of one-lane (left turn) and the major street two or more lanes. With this, the right turn volume exiting the site at this access was not used as part of the signal warrant analysis since this movement would have a dedicated right turn lane at day of opening (assumes a T-intersection until the east leg is constructed) and these right turns would not conflict with northbound opposing traffic. As future development occurs along the east side of SW 175th Avenue, this intersection would be expanded to four legs. The South Cooper Mountain Concept Plan identifies the east leg of this intersection as a future neighborhood route. As development occurs, the right turn lane would be modified to a shared through-right lane.

Peak hour signal warrants at the new collector along SW Scholls Ferry Road indicate that a signal would be warranted during the afternoon school peak hour and would be very close to meeting this warrant during the a.m. peak hour. The proposed circulation of busses within the site would direct buses to enter the site via the proposed right in access along SW Scholls Ferry Road and exit the site at the proposed collector. It is estimated that 29 buses would service the high school. With this, it was assumed that buses be considered as approximately two motor vehicles since their size, length, and operating characterizes are different than typical autos (passenger car

²³ *Manual on Traffic Control Devices*, 2009 Edition, Section 4C.04 Warrant 3, Peak Hour.

equivalent). Again it was assumed that the minor street approach consist of one lane (left turn) and the major street two or more lanes. With this, the right turn volume exiting the site at this access was not used as part of the signal warrant analysis since this movement would have a dedicated right turn lane at day of opening assuming a T-intersection until the south leg is constructed. As previously mentioned, the intersecting collector roadway is anticipated to be signalized in the future as surrounding future residential and commercial development occur.

Graphs for both intersections comparing the total of both major street approaches and the minor street higher volume approach during both peak hours and the required MUTCD threshold can be found in Appendix U.

MUTCD Four-Hour Signal Warrants

While only three hours of data from the 2017 total volume scenario are available (a.m., afternoon school, and p.m. peak hours), the 2009 MUTCD four-hour signal warrant (Warrant 2) thresholds were considered. For the four-hour warrant, the MUTCD recommends the use of a 70% factor if the speed of the major street is above 40 mph. The measured 85th percentile speeds on SW 175th Avenue and SW Scholls Ferry Road are more than 40 mph, therefore the 70% factor was applied.

For both the new collector intersecting SW Scholls Ferry Road and proposed access along SW 175th Avenue, two of the three available hours of data (the a.m. and afternoon school peak hours) meet the thresholds provided by the MUTCD for the four-hour signal warrant. This analysis includes the assumption that buses be considered approximately two motor vehicles, discussed within the previous peak hour signal warrant section.

Signal Recommendations for Full Site Accesses at Proposed Site

As previously mentioned, the MUTCD peak hour signal warrant would be met at both proposed access locations, particularly during the afternoon school peak when students are dismissed. Ultimately, safety for the students and buses that will use these accesses to cross the major roadways of SW Scholls Ferry Road and SW 175th Avenue should be considered. The combination of the proposed widening of both SW 175th Avenue and SW Scholls Ferry Road, high weekday peak hour traffic volumes, and high speeds measured on both major roadways (>50 mph) suggest that signalized intersections would help minimize delays and improve safety at both full access locations. Therefore, future intersection operations with the proposed school will include assumed traffic signals at these intersections.

Additionally, the traffic signals would provide a safe crossing for pedestrians to cross SW 175th Avenue and SW Scholls Ferry Road to the future residential neighborhood developments bordering the school site. For example, assuming a walking speed of 3.5 feet per second, 74 feet from curb to curb (with five lane frontage improvements), and a 3 second pedestrian startup time, an adequate vehicular gap of 21 seconds would be needed for a pedestrian to cross the roadway. Based on the forecasted major street daily peak hour volume of 1,500 vehicles, the average headway is calculated to be approximately 2.5 seconds. Therefore it can be assumed that pedestrians would have difficulty finding an appropriate gap in traffic in order to safely cross the

roadway. In fact, the signal at SW 175th Avenue could serve as the proposed trail connection identified in the South Cooper Mountain Concept Plan.

2017 Intersection Operations with Project Trips

The study intersection operating conditions for the 2017 scenario (a.m., afternoon school, and p.m. peak hours) are listed in Table 16 with supporting calculations in Appendices R through T. Intersection operations include the frontage improvements proposed to be constructed as part of the project. As indicated, the proposed improvements associated with the construction of the school would improve peak hour operations at the intersection of SW Scholls Ferry Road/SW 175th Avenue. The project would however impact operations at the intersection of SW 175th Avenue/SW Kemmer Road due the additional traffic loadings associated with the school.

Table 16: 2017 Total Intersection Operations – Peak Hour

| Intersection | Mobility Target | | AM Peak | | | Afternoon School Peak | | | PM Peak | | |
|---|---------------------------------|----------|---------|-----|-------------|-----------------------|-----|------|---------|-----|-------------|
| | City | County | Delay | LOS | V/C | Delay | LOS | V/C | Delay | LOS | V/C |
| SW Scholls Ferry Rd/ SW 175 th Ave**** | 0.98 V/C, 65 sec delay | 0.99 V/C | 33.5 | C | 0.82 | 31.1 | D | 0.80 | 40.9 | D | 0.81 |
| SW Scholls Ferry Rd/ SW Barrows Rd | | | 17.8 | B | 0.62 | 11.6 | B | 0.49 | 11.3 | B | 0.55 |
| SW Scholls Ferry Rd/ SW 158 th Ave | | | 10.4 | B | 0.50 | 6.0 | A | 0.38 | 5.9 | A | 0.43 |
| SW Scholls Ferry Rd/ SW Teal Blvd | | | 25.8 | C | 0.57 | 22.1 | C | 0.47 | 25.5 | C | 0.59 |
| SW 175 th Ave/ SW Kemmer Rd** | 45 sec delay | | 146.8 | F | 1.56 | 27.0 | D | 0.92 | 98.5 | F | 1.23 |
| SW Scholls Ferry Rd/ New Collector (west site access) | 0.98 V/C, 65 sec delay | | 6.2 | A | 0.69 | 8.3 | A | 0.59 | 4.6 | A | 0.65 |
| SW Scholls Ferry Rd/ Site Access (east)*** | 45 sec delay | | N/A | | | | | | | | |
| SW 175 th Ave/ Site Access | 0.98 V/C, 65 sec delay | | 18.0 | B | 0.68 | 11.4 | B | 0.48 | 5.5 | A | 0.46 |

Delay = average intersection vehicle delay (sec), LOS = intersection level of service, V/C = intersection volume-to-capacity ratio

Bold and Red indicates intersection does not meet mobility target

* Applies to each lane group at intersection

**V/C reported for northbound lane group

***Access proposed to be restricted to right in only.

****Assumes two southbound through lanes from SW 175th Avenue to SW Roy Rogers Road

SW 175th Avenue/SW Kemmer Road Mitigations and Operations

The existing intersection of SW 175th Avenue/SW Kemmer Road is an all-way stop controlled intersection that experiences moderate to heavy traffic from all approaches during the three peak hours analyzed, primarily along the northbound and southbound approaches. All approaches currently consist of a single shared travel lane. Table 17 shows the study intersection operating conditions for both 2017 analysis year scenarios (with and without proposed project). As shown, the intersection fails to meet mobility targets during the a.m. and p.m. peak hours under both scenarios. The addition of project trips to the forecasted 2017 background volumes increases the delay in the a.m. and p.m. peak hours. This section will discuss possible mitigations, with resulting operations, to SW 175th Avenue/SW Kemmer Road that may improve operations and safety at the intersection. Afternoon school peak operations will not be considered in the mitigations analysis.

Table 17: 2017 SW 175th Avenue/SW Kemmer Road Operations Comparison – Peak Hour

| Volume Scenarios | Mobility Target | | AM Peak | | | Afternoon School Peak | | | PM Peak | | |
|---|-----------------|----------|--------------|-----|-------------|-----------------------|-----|------|-------------|-----|-------------|
| | City | County | Delay | LOS | V/C | Delay | LOS | V/C | Delay | LOS | V/C |
| SW 175 th Avenue/SW Kemmer Road (all-way stop) | | | | | | | | | | | |
| 2017 Background | 45 sec delay | 0.99 V/C | 50.8 | F | 1.09 | 15.6 | C | 0.67 | 73.4 | F | 1.11 |
| 2017 Total | | | 146.8 | F | 1.56 | 27.0 | D | 0.92 | 98.5 | F | 1.23 |

Delay = average intersection vehicle delay (sec), LOS = level of service for critical lane group, V/C = volume-to-capacity ratio for critical lane group

Bold and Red indicates intersection does not meet mobility target

Northbound Left Turn Lane

Analysis shows that for all scenarios and peak hours, the northbound approach of SW 175th Avenue/SW Kemmer Road is the failing lane group. As shown in Figure 12, the left turn movement consists of almost a third of total northbound entering volumes for each of the three peak hours under the 2017 total traffic volume scenario. Table 18 shows the operating conditions of SW 175th Avenue/SW Kemmer Road with a northbound left turn lane. As shown, the delay is reduced for the a.m. and p.m. peak hour with the inclusion of a left turn lane, but does not reduce to below 2017 background operations during the a.m. peak hour.

Table 18: SW 175th Avenue/SW Kemmer Road with Left Turn Lane Operations

| Volume Scenarios | Mobility Target | | AM Peak | | | PM Peak | | |
|---|-----------------|----------|-------------|-----|-------------|-------------|-----|-------------|
| | City | County | Delay | LOS | V/C | Delay | LOS | V/C |
| SW 175 th Avenue/SW Kemmer Road (all-way stop) | | | | | | | | |
| 2017 Total (with NB left turn lane) | 45 sec delay | 0.99 V/C | 81.9 | F | 1.21 | 57.3 | F | 1.11 |

Delay = average intersection vehicle delay (sec), LOS = level of service for critical lane group, V/C = volume-to-capacity ratio for critical lane group

Bold and Red indicates intersection does not meet mobility target

Analysis reveals that in order to mitigate impacts back to 2017 background conditions, turn lanes would be needed along all approaches of this intersection. With the addition of left turn lanes along the northbound and southbound approaches and right turn lanes along the eastbound and westbound approaches the intersection would operate with an average vehicle delay of 47.2 seconds and a V/C ratio of 1.09 along the northbound approach during the a.m. peak hour. Although these improvements would improve operations at this intersection, it would still fail to meet agency mobility standards along the northbound approach.

MUTCD Signal Warrants

To further explore capacity needs at the intersection of SW 175th Avenue/SW Kemmer Road, the 2009 MUTCD peak hour signal warrant²⁴ (Warrant 3) was analyzed for the 2017 total traffic scenario during the a.m., afternoon school, and p.m. peak hours at this intersection. The analysis shows that a signalized intersection is warranted for all three peak hours. The analysis graph comparing the total of both major street approaches and the minor street high volume approach during all peak hours and the required MUTCD threshold can be found in Appendix U.

Additionally, review of MUTCD four-hour vehicle volume warrant (Warrant 2) was reviewed. This warrant considers the level of intersecting traffic as a basis for considering the installation of a traffic signal. This warrant was found to be met for five of the six hours during the a.m. (7-9) and p.m. (2-6) peak periods under existing traffic volumes.

Table 19 shows the operating conditions of the intersection with the installation of an interim traffic signal. Traffic signal assumptions include operating the northbound and southbound shared lane movements with split phasing due to the vertical profile of SW 175th Avenue which restricts sight distance. Analysis also assumes permissive phasing along the eastbound and westbound shared lane approaches.

Table 19: SW 175th Avenue/SW Kemmer Road with Interim Traffic Signal Operations

| Volume Scenarios | Mobility Target | | AM Peak | | | PM Peak | | |
|--|----------------------------|----------|---------|-----|------|---------|-----|------|
| | City | County | Delay | LOS | V/C | Delay | LOS | V/C |
| SW 175 th Avenue/SW Kemmer Road | | | | | | | | |
| 2017 Total (with traffic signal)** | 0.98 V/C*, 65 sec delay | 0.99 V/C | 66.1 | E | 0.96 | 41.0 | D | 0.90 |

Delay = average intersection vehicle delay (sec), LOS = intersection level of service, V/C = intersection volume-to-capacity ratio

Bold and Red indicates intersection does not meet mobility target

* Applies to each lane group at intersection

**Assumes northbound and southbound left turn lanes along SW 175th Avenue

A sketch of potential interim signal phasing is shown in Figure 14. As indicated, this intersection would operate near capacity with a v/c ratio of 0.96 during the a.m. peak hour and 0.99 during

²⁴ *Manual on Traffic Control Devices*, 2009 Edition, Section 4C.04 Warrant 3, Peak Hour.

the p.m. peak hour. The installation of a traffic signal at this intersection would improve operations with school related traffic and both City and County mobility targets are met. Operations would be better than those under the 2017 background scenario without school related traffic.

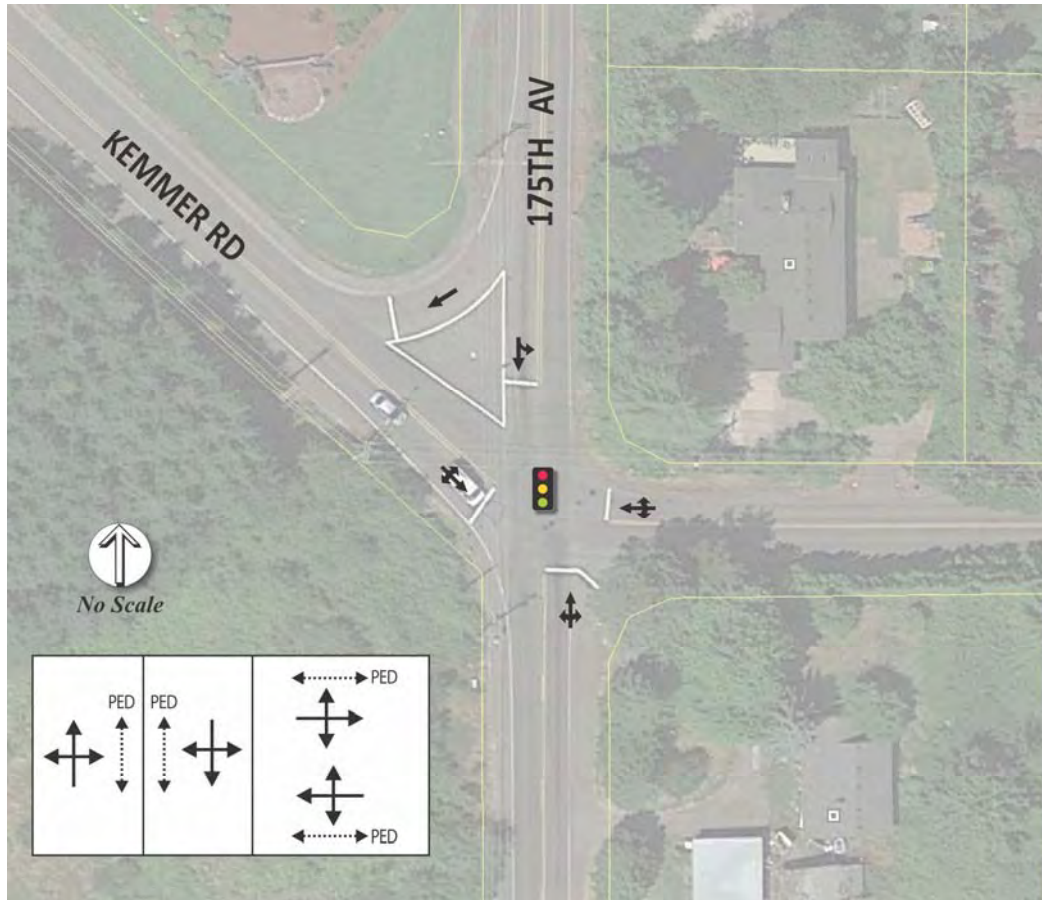


Figure 14: SW 175th Ave/SW Kemmer Rd Interim Improvements

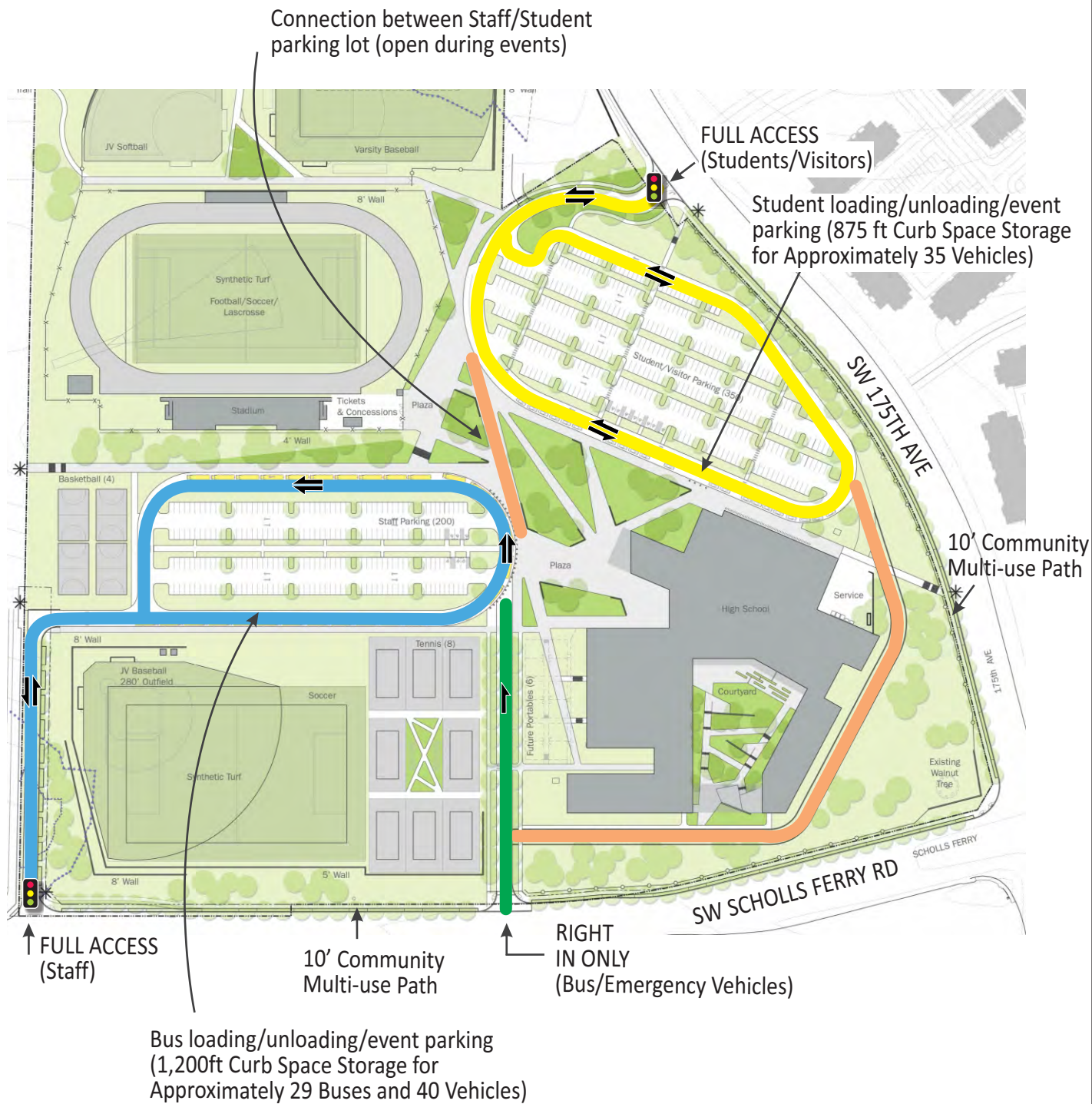
Site Plan Review

The site plan provided by the Beaverton School District and shown in Figure 15 was reviewed to evaluate site access, future queuing and storage needs, access spacing, intersection sight distance, bus loading and access, pedestrian and bicycle access/school crosswalks, bicycle parking, student drop-off area, site circulation and parking needs, and reduced school speed zones. The evaluation of each of these issues includes the identification of associated on-site project modifications or improvements.

Site Access

There are three proposed access locations to the site. The proposed full access located along SW 175th Avenue would provide access to the proposed student and visitor parking spaces. This access is proposed to be located opposite the anticipated future neighborhood route as identified in the South Cooper Mountain Concept Plan. Additionally, access is proposed to the site from the proposed City collector roadway (identified in the South Cooper Mountain Master Plan) that will intersect SW Scholls Ferry Road on the west end of the project site. The new collector would provide full access to the proposed staff parking spaces and also provide an additional bus access to the proposed bus drop off area. The proposed access along SW Scholls Ferry Road west of SW 175th Avenue in the middle of the site is proposed to be restricted to right in only for bus and emergency vehicle access only. Both staff and buses would exit the school site at the proposed collector roadway along SW Scholls Ferry Road. It is recommended that guide signage be provided along SW Scholls Ferry Road and SW 175th Avenue to direct students, staff, parents, busses, and visitors to the appropriate access locations during school hours.

The site plan indicates that a vehicle connection would be provided between the student/visitor and staff parking lots. It is anticipated that this connection would be open during large school events so that visitors exiting the site could do so from both accesses.



LEGEND

- - Bus Only Entrance
- - Faculty/Staff and Bus
- - Student/Visitor
- - Emergency Use Fire Lane

- ⇄ - Traffic Direction Flow
- 🚦 - Traffic Signal

DKS



No Scale

Figure 15

BEAVERTON SCHOOL DISTRICT NEW HIGH SCHOOL SITE PLAN

Source: Walker Macy

Future Queuing and Storage Needs

Queuing analysis was performed for the a.m., afternoon school peak, and p.m. hours under 2017 total traffic conditions to determine the recommended turn lane storage lengths at the full access intersections on SW Scholls Ferry Road/SW 175th Avenue. The queueing analysis was based on the anticipated number of vehicles entering and exiting the site during the peak 15-minutes prior to school beginning and after school lets out. Queuing analysis was also performed at the intersection of SW Scholls Ferry Road/SW 175th Avenue to estimate storage demand associated with the increase in bus and vehicle traffic along the eastbound and southbound approaches. Manual calculations were used to determine vehicle queuing estimates for periods before and after school lets out (see Appendix Z).

The estimated storage lengths required for future turn lanes at the school access points and at the intersection of SW Scholls Ferry Road/SW 175th Avenue are listed in Table 20. The southbound approach at SW Scholls Ferry Road/New Collector would consist of a single approach lane in the interim (year 2017) and would eventually be improved to the City's Collector level roadway when development occurs on the site to the west of the school.

Table 20: Recommended Storage Bays and Queue Lengths under 2017 Total Traffic Conditions - Peak Hour

| Intersection Approach | Movement | Recommended Storage Length |
|---|---------------|---|
| <i>SW Scholls Ferry Rd/New Collector (West Site Access)</i> | | |
| Southbound | Left | 400 ft (no left turn lane provided until collector roadway built-out) |
| Eastbound | Left | 100 ft |
| <i>SW Scholls Ferry Rd/Site Access (bus/emergency vehicle right-in only access)</i> | | |
| Westbound | Right | 100 ft |
| <i>SW 175th Ave/Site Access</i> | | |
| Northbound | Left | 450 ft |
| Eastbound | Left | 250-300 ft |
| Intersection Approach | Movement | Estimated Vehicle Queue Length and (Recommended Storage Lengths) |
| <i>SW Scholls Ferry Rd/SW 175th Ave</i> | | |
| Southbound | Left | 425 ft (450 ft) |
| | Through/Right | 300 ft |
| Eastbound | Left | 200 ft (300 ft) |
| | Through | 300 ft |
| | Right | 300 ft (300 ft) |

As indicated, the storage length at the school access points should be maximized to accommodate the peaking characteristics of the school during school start and end times. The existing storage lengths for the southbound left turn (200 feet) and eastbound left turn (165 feet) at the intersection of SW Scholls Ferry Road/SW 175th Avenue would need to be lengthened to accommodate the anticipated storage needs of vehicles and buses arriving and departing from the site.

Access Spacing

Both SW Scholls Ferry Road and SW 175th Avenue are classified as arterials by Washington County. Washington County controls access to arterial roadways by restricting access to only collector or other arterial roadways. Washington County code requires a minimum access spacing of 600 feet for any direct access to an arterial roadway²⁵. This includes spacing from both intersections and adjacent access points.

The proposed site access along SW 175th Avenue is proposed to be aligned opposite the proposed future neighborhood route identified in the South Cooper Mountain Concept Plan. The east leg of this intersection would provide access to the future neighborhood development in the area and would be constructed as development occurs. Furthermore, the proposed access along SW Scholls Ferry Road is proposed to align with the proposed collector roadway at the west end of the sites property. This new collector is proposed to provide access to the school and will be extended as commercial and residential development occurs.

The distance to the intersection of SW Scholls Ferry Road/SW 175th Avenue from each proposed school access is given in Table 21. As indicated all proposed accesses would meet Washington County access spacing standards for arterial roadways.

Table 21: Access Spacing from SW Scholls Ferry Road/SW 175th Avenue Intersection

| Criteria | Distance to SW Scholls Ferry Rd/SW 175 th Ave Intersection | | |
|----------------------------|---|---|--------------------------------------|
| | SW Scholls Ferry Rd New Collector (West Site Access) | SW Scholls Ferry Rd Restricted Site Access (Right In) | SW 175 th Ave Site Access |
| Measurement | 1,600 ft | 830 ft | 1,100 ft |
| Washington County Standard | 600 ft | 600 ft | 600 ft |
| Standard Met? | Yes | Yes | Yes |

Intersection Sight Distance

To ensure safety at site accesses, intersection sight distance was examined during a field visit on November 18, 2014. Sight lines at the two proposed full access locations are shown in Table 22.

²⁵ Washington County Development Code, Article 501-8.5 Access to County and Public Roads

Table 22: Site Access Intersection Sight Distance

| SW Scholls Ferry Rd/New Collector (West Site Access) | SW 175 th Ave/Site Access |
|--|--|
|  <p>Looking West</p> |  <p>Looking North</p> |
|  <p>Looking East</p> |  <p>Looking South</p> |

Intersection sight distance measurements at the proposed access points are summarized in Table 23. The measured sight distance is compared to the requirements set forth by Washington County and are based on the measured 85th percentile speeds along SW Scholls Ferry Road and SW 175th Avenue near the project site.²⁶ The measured 85th percentile speed for SW Scholls Ferry traffic was 53 mph and for SW 175th Avenue was 55 mph.

²⁶ Washington County Code, Article V: Public Facilities and Services

Table 23: Intersection Sight Distance Summary for Proposed Access Points

| Criteria | Intersection Sight Distance | | |
|---|--|---|--------------------------------------|
| | SW Scholls Ferry Rd/New Collector (West Site Access) | SW Scholls Ferry Rd/Restricted Site Access (Right In) | SW 175 th Ave/Site Access |
| Field measurement (looking east/north) | 800 ft | 610 ft | 740 ft |
| Field measurement (looking west/south) | 700 ft | N/A | 680 ft |
| Washington County Standard (53 mph/55 mph)* | 530 ft | 530 ft | 550 ft |
| Standard Met? | YES | YES | YES |



*Washington County sight distance standards are based on ten times the 85th percentile speeds.

As summarized in Table 23, intersection sight distance would be met at the access locations based on the measured 85th percentile speed of vehicles. Although there are no current sight distance restrictions to due to the horizontal curve along SW 175th Avenue, vegetation growth along the inside of the curve should be monitored to insure sight lines stay clear.

Since the proposed access along SW 175th Avenue is proposed to be signalized, review of stopping sight distance to the traffic signal heads was also reviewed per the American Association of State Highway and Transportation Officials (AASHTO)²⁷. Based on field review, it was determined that adequate stopping sight would be provided and additional supplemental traffic signal heads could be provided in advance to improve the visibility. The sight lines travelling in the northbound and southbound directions are illustrated in Table 24.

²⁷ Geometric Design of Highways and Streets, AASHTO, 2011.

Table 24: Stopping Sight Distance to Proposed Traffic Signal

| SW 175 th Ave/Site Access | |
|--|---|
|  <p>Travelling Northbound</p> |  <p>Travelling Southbound</p> |

To ensure that intersection sight distance will be met with the proposed site plan, parking, significant landscaping, and large signs should be restricted adjacent to the two school driveways. All proposed driveways will be required to meet intersection sight distance requirements; therefore it is recommended that site distance be verified at proposed accesses prior to occupancy.

Bus Loading and Access

It is anticipated that up to 25 full-sized school buses (40 feet in length) and four special needs buses (24 feet in length) will transport students to and from NHS during normal school hours. The majority of buses will enter the school site via the collector roadway on the west end of the project site. Some buses, primarily the shorter special needs buses will use the right in only access along SW Scholls Ferry Road. All buses would exit the site from the proposed collector roadway intersecting SW Scholls Ferry Road on the west end of the site.

As illustrated on the site plan, all bus loading and unloading is to occur on site. The new bus loading area includes approximately 1,200 feet of curb space in the circulating aisle, which is sufficient to easily accommodate all 29 buses at once. Staff parking would be provided in the center of this circulating aisle. With this, sidewalk will be provided between the loading and unloading bus areas and the school entrance in order to ensure safe access.

Pedestrian Access/School Crosswalks

The site plan provided by the Beaverton School District is expected to provide adequate pedestrian and bicycle facilities on the site as long as sufficient bicycle parking is provided and

all sidewalks are constructed to meet ADA requirements.²⁸ The plan also shows sidewalks around the entire school frontage along both SW Scholls Ferry Road and SW 175th Avenue, and provides pedestrian connections to adjacent streets, per the R-1 land use zoning. The South Cooper Mountain Concept Plan shows the sidewalks along the frontage of the school as a proposed community multi-use path that intersects with another multi-use path crossing west to east at the future SW 175th Avenue/site access intersection.

The community multi-use trails are planned to link important land uses and areas of interest with one another. The trails are proposed to be paved and planned to accommodate both pedestrians (including those with disabilities) and bicyclists at a width of eight to ten feet with one to two foot gravel shoulders.

The proposed traffic signals at the two site intersections and the existing traffic signal at SW Scholls Ferry Road/SW 175th Avenue would provide a protected pedestrian crossing across the two arterial roadways. This would allow access to the future residential developments anticipated in the South Cooper Mountain area.

Bicycle Parking

City of Beaverton Code requires that high schools provide one long-term bicycle parking space per 18 students²⁹. With a maximum capacity of 2,200 students for the proposed high school, one space per 18 students equates to a minimum of 122 bicycle parking spaces. Long-term spaces are designed to accommodate persons that can be expected to leave their bicycle parked longer than two hours. School buildings are exempt from the City's requirement to provide cover or shelter for long term parking spaces³⁰.

Student Drop-Off Area

The site plan provides a designated student drop-off area within the site that is separate from school bus and staff loading/parking areas. This area also provides for student parking and access would be provided from SW 175th Avenue. Vehicles would circulate counter-clockwise around the proposed student parking. The student drop-off area includes approximately 875 feet of curb space in the circulating aisle, which is sufficient to accommodate approximately 35 vehicles at once (based on average vehicle length of 25 feet). A walkway is proposed which would provide direct access from the drop off area to the primary school entrance.

Site Circulation and Parking

The City of Beaverton requires 0.2 parking spaces per student and staff.³¹ The Beaverton School District expects to enroll a maximum of 2,200 students and employ 200 staff. Therefore,

²⁸ *ADA Accessibility Guidelines for Buildings and Facilities*, Federal Highway Administration, May 2012.

²⁹ Beaverton Development Code, Special Requirements, Section 60.30.10.5.B, June 2012.

³⁰ Beaverton Development Code, Special Requirements, Section 60.30.10.2.B, June 2012.

³¹ Beaverton Development Code, Special Requirements, Section 60.30.10.5.A, June 2012.

Beaverton's Development Code requires the school to provide a minimum of 480 parking spaces as indicated in Table 25. Because the high school is a conditional use, it could be required that the school provides more than the 480 spaces. As a result, the school district desires to provide the number of parking spaces that satisfy both the requirements in the development code, as well as the estimated parking demand based on characteristics of other Beaverton High Schools.

Table 25: High School Parking Requirements – City of Beaverton Development Code

| Land Use | Student Enrollment | Staff | Parking Rate | Total Parking |
|--|--------------------|-------|--------------|---------------|
| High School | 2,200 | 200 | 0.20 | 480 |
| Parking Rates = Parked Vehicles / (Student Enrollment + Staff) | | | | |

To estimate typical parking demand for NHS, parking was surveyed during the school day at three existing high schools in the Beaverton School District: Aloha High School, Southridge High School, and Westview High School, with summary sheets provided in Appendix W.³² Parking demand rates for each school were calculated using the number of observed parked vehicles, student enrollment, and the number of staff.

As the school year progresses, more students obtain drivers licenses and vehicles. Therefore, there are typically more students driving to school in the spring (May/June) than there are in October and November when the surveys took place. To accommodate this increase in student drivers, the number of parked vehicles was increased by 15% (calculations attached).³³ The resulting parking demand rate is 0.22 parked vehicles per student, as shown in Table 26.

Table 26: High School Parking Analysis – Average Peak Demand

| High School | Student Enrollment | Parked Vehicles (Oct/Nov)* | Adjustment Factor | Estimated Total Parked Vehicles (May/June) | Overall Parking Rate (May/June) |
|--|--------------------|----------------------------|-------------------|--|---------------------------------|
| Westview | 2,418 | 464 | 1.15 | 534 | 0.22 |
| Aloha | 1,962 | 340 | | 391 | 0.20 |
| Southridge | 1,722 | 398 | | 458 | 0.26 |
| Parking Rates = Parked Vehicles / Student Enrollment | | | | Average | 0.23 |
| *Average of October 30 and November 18, 2014 data | | | | | |

³² Parking surveys conducted between 9:30 and 11:00 a.m. on October 30, 2014 and November 18, 2014.

³³ It was assumed that 7/12 of the maximum sophomore enrollment would be added to the number of eligible drivers between October/November and May/June, which is equal to 14.6% of the total enrollment. This is based on historical student enrollment data (freshman through senior) from Beaverton School District which estimates sophomores to be 1/4 student enrollment.

This rate matches published parking rates published by the Institute of Transportation Engineers (ITE).³⁴ Beaverton School District expects NHS to enroll approximately 1,700 students the year of opening (2017), and have a maximum enrollment of 2,200 students with 200 staff. Applying the parking rate from Table 26, this means that NHS should accommodate 391 vehicles in 2017 and 506 vehicles for full enrollment, as shown in Table 27.

Table 27: New High School Parking Demand – Typical School Day

| Scenario | Student Enrollment | Parking Rate | Total Parking Demand |
|-----------------|--------------------|--------------|----------------------|
| Year of Opening | 1,700 | 0.23 | 391 |
| Full Enrollment | 2,200 | | 506 |

The school should also be able to accommodate special events, which can have higher parking demands than the typical school day. To understand peak event demand, parking surveys were conducted during four football games in Beaverton with summary sheets included in the Appendix Q³⁵. The parking surveys were conducted not only for the on-site parking areas for each school, but also in the surrounding neighborhoods and adjacent areas to gain a true understanding of the total parking demand for typical high school football games in the Beaverton School District. These parking surveys demonstrated at Westview, Sunset, and Aloha high schools that patrons to the football game park in adjacent off-site neighborhoods even though there is more than enough available and used parking spaces on the school sites³⁶. The parking layout for the NHS is configured such that all on-site parking areas are conveniently located near the stadium to minimize the desire for vehicles to park in adjacent neighborhoods. The average parking demand rate observed is shown in Table 28.

Table 28: Football Event Parking Demand

| High School | Parked Vehicles | Enrollment | Parking Rate |
|-------------|-----------------|------------|--------------|
| Aloha | 400 | 1,962 | 0.20 |
| Sunset | 535 | 1,722 | 0.28 |
| Westview | 611 | 2,418 | 0.25 |
| Westview | 660 | 2,418 | 0.27 |
| Average | | | 0.25 |

³⁴ Parking Generation, 4th Edition, Institute of Transportation Engineers, ITE Code 530 (High School) indicates a peak period parking demand of 0.23 spaces per student.

³⁵ Parking surveys conducted at Westview High football game on October 10 and November 7, 2014, Sunset High football game on October 24, 2014, and Aloha High football game on May 31, 2014.

³⁶ The on-site parking lots were observed to be approximately 80-percent full during the football game.

Applying the parking rates from Table 28, indicates that the parking demand for a typical school event such as a football game could reach 476 vehicles in 2017 and 616 vehicles for full student enrollment, as shown in Table 29.

Table 29: New High School Parking Demand – Football Game

| Scenario | Student Enrollment | Parking Rate | Total Parking Demand |
|-----------------|--------------------|--------------|----------------------|
| Year of Opening | 1,700 | 0.20-0.28 | 340-476 |
| Full Enrollment | 2,200 | | 440-616 |

Because a football game has the potential to generate a parking demand up to 616 vehicles does not mean that the high school should provide 616 parking stalls. The vast majority of the time, parking would be underutilized if 616 spaces were available. Preliminary site plan layouts indicate that approximately 550 spaces could be provided on the school site. This would accommodate typical school parking demand; small surges associated with most event needs, and would satisfy the 480 minimum spaces required by the City’s development code. With 550 spaces, 200 of the spaces should be dedicated to staff, with the remaining 350 spaces for student parking. To accommodate parking needs for events, it is recommended that a minimum of 75 additional spaces be provided on-site by utilizing internal pick-up/drop-off areas during events for a net total of up to 625 parking spaces. Additionally, it is recommended that no additional events be scheduled on-site during football games.

School Speed Zone

ODOT’s guide to school area safety³⁷ provides guidance on the application of reduced school speed zones along roadways adjacent to school zones. Generally a reduced school speed zone (20 mph) is discouraged where the posted speed of the roadway adjacent to the school is posted 45 mph or above, such as SW 175th Avenue. Additionally, reduced school speed zones are typically not provided at high schools. It is therefore recommended that if the Beaverton School wishes to pursue reduced school speed zones along SW 175th Avenue and/or SW Scholls Ferry Road that they coordinate with Washington County to determine what justification measures would be needed for the reduced speed limit during school hours.

³⁷ A Guide to School Area Safety, Oregon Department of Transportation, July 2006 revised February 2009

V. 2035 LONG-RANGE FORECAST YEAR

The Beaverton School District NHS is anticipated to reach a maximum enrollment of 2,200 students by 2035 (the long-range forecast year scenario). The 2035 background traffic volumes were forecasted for the study area using a travel forecast model developed for the preferred land use scenario and transportation framework associated with the South Cooper Mountain Concept Plan.³⁸ For this model, the long range build-out of the area (both the Urban Growth Boundary areas and Urban Reserve) included 544 acres within the South Cooper Mountain annexation area, 1,232 acres in the adjacent Urban Reserve and 510 acres in North Cooper Mountain resulting in over 7,400 housing units and more than 450 jobs. Roadway improvements included in the analysis as identified in the South Cooper Mountain Concept Plan include:

- Widening of SW Scholls Ferry to five lanes between SW 175th Avenue and SW Tile Flat Road
- Widening of SW 175th Avenue to five lanes north of SW Scholls Ferry Road to the Urban Growth Boundary
- Widening of SW Roy Rogers Road to five lanes south of SW Scholls Ferry Road
- Future roadway network as illustrated in South Cooper Mountain Concept Plan

Table 11 shows the 2035 future background traffic volumes at the six existing study intersections.

2035 Background Intersection Operations

Table 30 lists intersection operations after accounting for the assumed traffic volume growth for the 2035 background scenario which supporting calculations provided in Appendix V. As shown, the all-way stop of SW 175th Avenue/SW Kemmer Road would not meet the mobility targets during the p.m. peak hour under existing traffic control. Additionally, the intersection of SW Scholls Ferry Road/SW Teal Boulevard would operate with a V/C ratio of 0.99 and would not meet the City's mobility target. The westbound approach would operate with a V/C ratio greater than 1.0. While specific improvements were not identified at these locations, the plan identified \$2.5 million for intersection improvements at SW 175th Avenue/Kemmer Road and \$500,000 for improvements at SW Scholls Ferry Road/SW Teal Boulevard.

³⁸ Transportation Findings for Preferred Scenario, DKS Associates, June 23, 2014.

Table 30: 2035 Background Intersection Operations – Peak Hour

| Intersection | Mobility Target | | PM Peak | | |
|--|----------------------------|----------|--------------|-----|-------------|
| | City | County | Delay | LOS | V/C |
| SW Scholls Ferry Rd/SW 175th Ave*** | 0.98 V/C*, 65 sec delay | 0.99 V/C | 44.6 | D | 0.86 |
| SW Scholls Ferry Rd/SW Barrows Rd | | | 32.4 | C | 0.86 |
| SW Scholls Ferry Rd/SW 158 th Ave | | | 8.1 | A | 0.70 |
| SW Scholls Ferry Rd/SW Teal Blvd | | | 50.5 | D | 0.98 |
| SW 175th Ave/SW Kemmer Rd** | 45 sec delay | | 172.8 | F | 1.37 |

Delay = intersection average vehicle delay (sec), LOS = level of service, V/C = volume-to-capacity ratio

Bold and Red indicates intersection does not meet its mobility target

* Applies to each lane group at intersection

**V/C reported for northbound lane group

***Assumes two southbound/northbound through lanes along SW 175th Avenue-SW Roy Rogers Road and two eastbound/westbound through lanes along SW Scholls Ferry Road

2035 Trip Distribution

Trip distribution for the additional traffic generated by the proposed development at maximum enrollment was estimated based on existing and future residential land areas within the school boundary. Trip distribution percentages and resulting project traffic volumes for the long-range forecast year are shown in Figure 17.

2035 Traffic Operations with Project Trips

Future operating conditions were analyzed at the study intersections for the long-range forecast year (2035 total volume scenario). Future traffic volumes were estimated at the study intersections in order to access traffic conditions with future long term growth and project traffic. Future 2035 forecasts were developed using a travel forecast model consistent with that used for the South Cooper Mountain Concept Plan. With this, development of future 2035 p.m. peak hour traffic volumes with the proposed high school and maximum enrollment of 2,200 students were estimated at study intersections. Modelling assumptions for the South Cooper Mountain area included p.m. peak hour trips to the existing school site; therefore these trips were subtracted from the development of future 2035 p.m. peak hour traffic volumes with the proposed project³⁹. The weekday p.m. peak hour traffic volumes used to analyze the 2035 total volume future scenario are shown in Figure 18 while the study intersection operating conditions are listed in Table 31 with supporting information in Appendix X. As shown, the signalized intersections of SW Scholls Ferry Road/SW Teal Boulevard and the unsignalized intersection of SW 175th Avenue/SW Kemmer Road would not meet City or County mobility targets, consistent with the 2035 background scenario.

³⁹ A total of 38 p.m. peak hour trips were assumed to the project site as part of the South Cooper Mountain Transportation Analysis.

BEAVERTON SCHOOL DISTRICT
NEW HIGH SCHOOL TRAFFIC IMPACT ANALYSIS

Table 31: 2035 Total Intersection Operations – Peak Hour

| Intersection | Mobility Target | | PM Peak | | |
|--|----------------------------|----------|--------------|-----|-------------|
| | City | County | Delay | LOS | V/C |
| SW Scholls Ferry Rd/SW 175th Ave**** | 0.98 V/C*, 65 sec delay | 0.99 V/C | 48.9 | D | 0.91 |
| SW Scholls Ferry Rd/SW Barrows Rd | | | 36.8 | D | 0.90 |
| SW Scholls Ferry Rd/SW 158 th Ave | | | 8.4 | A | 0.71 |
| SW Scholls Ferry Rd/SW Teal Blvd | | | 54.7 | D | 1.00 |
| SW 175th Ave/SW Kemmer Rd** | 45 sec delay | | 202.2 | F | 1.42 |
| SW Scholls Ferry Rd/Site Access (west) | 0.98 V/C*, 65 sec delay | | 10.3 | B | 0.48 |
| SW Scholls Ferry Rd/Site Access (east)*** | 45 sec delay | | N/A | | |
| SW 175th Ave/Site Access | 0.98 V/C*, 65 sec delay | | 6.8 | A | 0.45 |

Delay = average intersection vehicle delay (sec), LOS = intersection level of service, V/C = intersection volume-to-capacity ratio

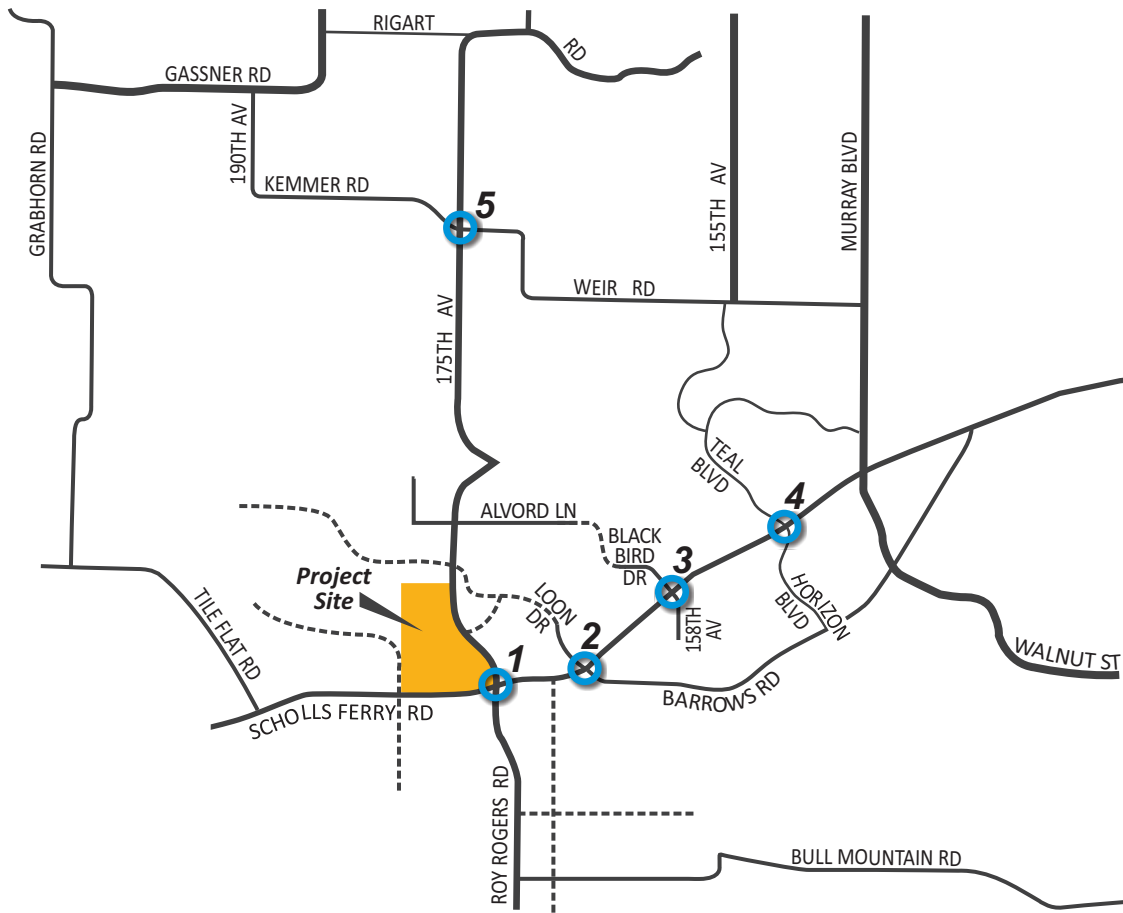
Bold and Red indicates intersection does not meet mobility target

* Applies to each lane group at intersection

**V/C reported for northbound lane group

**Access proposed to be restricted to right in only.

*** Assumes two southbound/northbound through lanes along SW 175th Avenue-SW Roy Rogers Road and two eastbound/westbound through lanes along SW Scholls Ferry Road

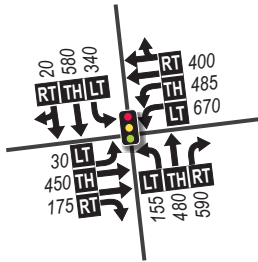


Key Map

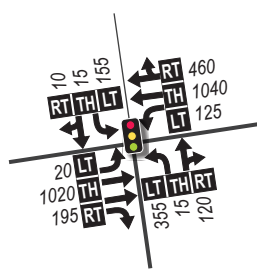


No Scale

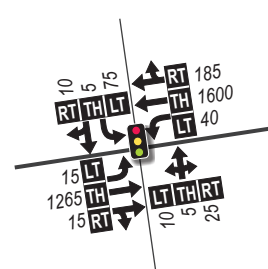
1. Scholls Ferry Rd./175th Ave.



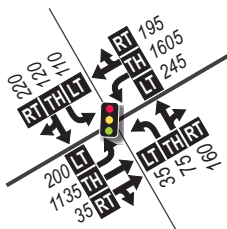
2. Scholls Ferry Rd./Barrows Rd.



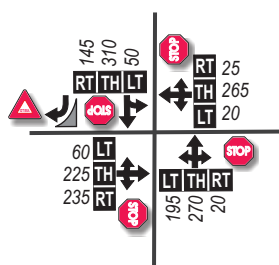
3. Scholls Ferry Rd./158th Ave.-Black Bird Dr.



4. Scholls Ferry Rd./Teal Blvd.



5. 175th Ave./Kemmer Rd.



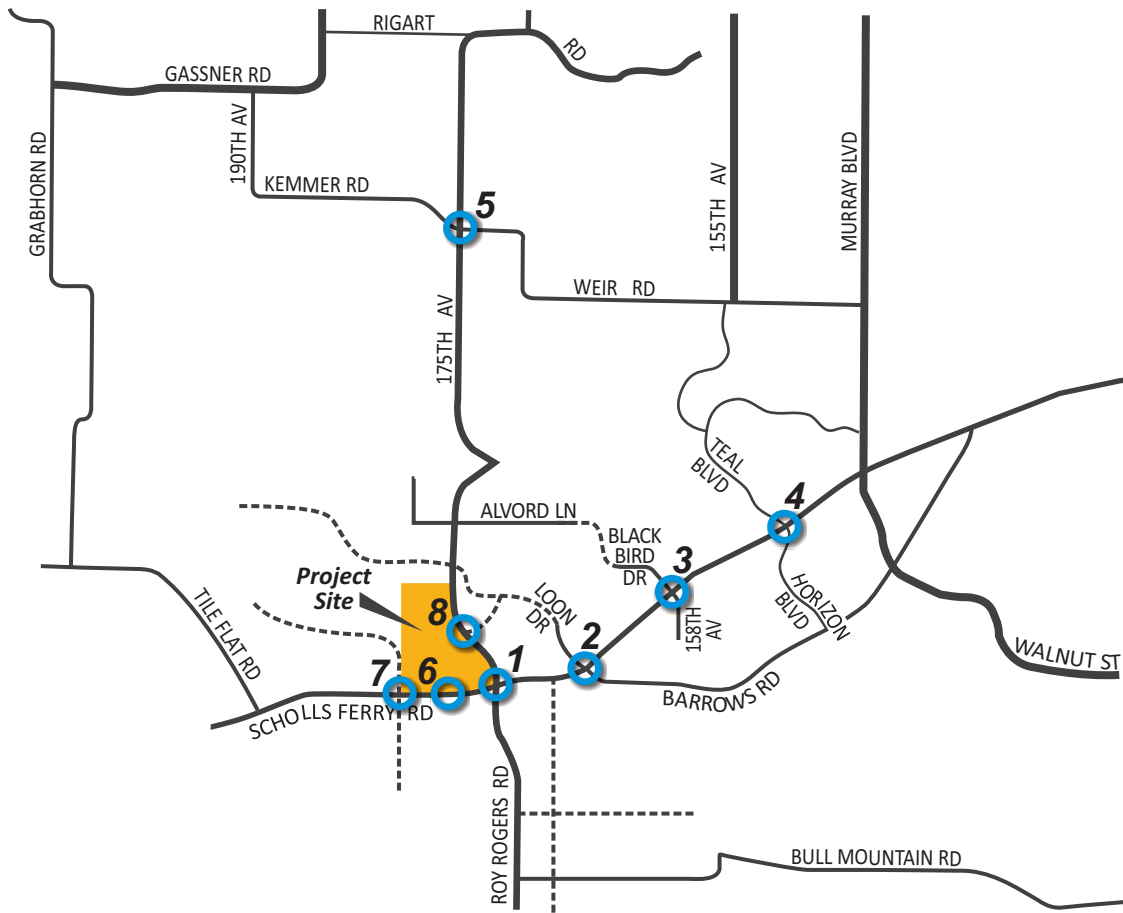
- #** **LEGEND**
- Study Intersection
 - Traffic Signal
 - Stop Sign
 - Yield Sign

- - Proposed Roadways
- Lane Configuration
- 000 - PM Peak Hour Traffic Volumes
- Volume Turn Movement

DKS

Figure 16

**2035 BACKGROUND
PM PEAK HOUR
TRAFFIC VOLUMES**

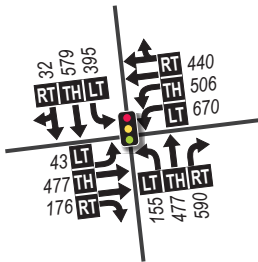


Key Map

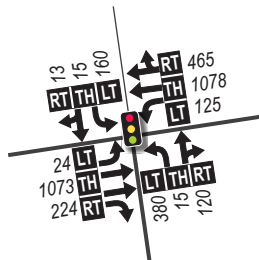


No Scale

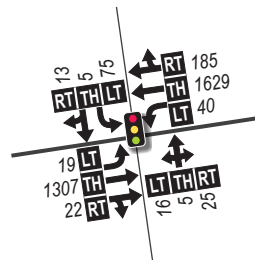
1. Scholls Ferry Rd./175th Ave. - Roy Rogers Rd.



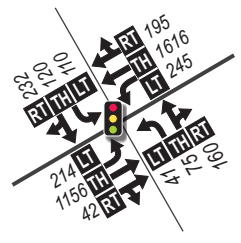
2. Scholls Ferry Rd./Barrows Rd. - Loon Dr.



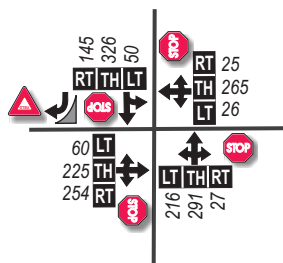
3. Scholls Ferry Rd./158th Ave. - Black Bird Dr.



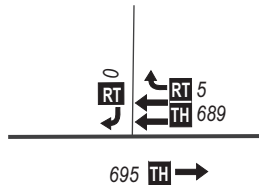
4. Scholls Ferry Rd./Teal Blvd. - Horizon Blvd.



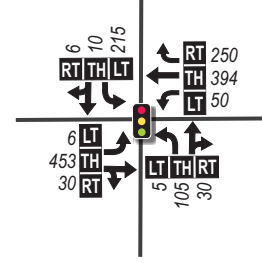
5. 175th Ave./Kemmer Rd.



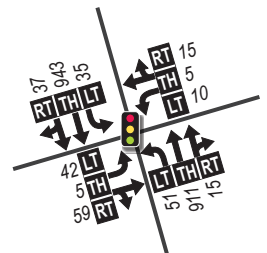
6. Scholls Ferry Rd./Site Access



7. Scholls Ferry Rd./Future Collector (West Site Access)



8. 175th Ave./Site Access



- LEGEND**
- # - Study Intersection
 - Traffic Signal
 - Stop Sign
 - Yield Sign

← - Lane Configuration

----- - Proposed Roadways

Peak Hour Traffic Volumes

000 (000) [000] - AM (Afternoon School) [PM]

LT TH RT - Volume Turn Movement
Left-Thru-Right

DKS

Figure 18

**2035 TOTAL
PEAK HOUR
TRAFFIC VOLUMES**

VI. RECOMMENDED MITIGATIONS

The following list summarizes the key transportation impact findings associated with the proposed Beaverton School District NHS.

SW 175th Avenue/SW Kemmer Road Mitigations

- The existing all-way stop of SW 175th Avenue/SW Kemmer Road currently does not meet Washington County mobility targets during the 2014 a.m. and p.m. peak hours. With the additional traffic loadings at this intersection associated with 2017 year of opening background growth and traffic associated with the project, it would continue to not meet Washington County mobility targets during the a.m. and p.m. peak hours. This is consistent with findings of the South Cooper Mountain Concept Plan which indicated improvements are needed at this intersection. Although specific improvements were not identified in the South Cooper Mountain Concept Plan, an estimated cost of \$2.5 million was identified for future improvements at this intersection. It was found that while the addition of turn lanes along all approaches would improve operations, the intersection would still not meet mobility targets. Due to the high volume of intersecting traffic, this intersection was found to meet MUTCD traffic signal warrants under existing conditions. It is recommended a traffic signal be installed at this intersection to provide interim capacity for future growth in the area. Because this deficiency is an existing condition, and because other future development in the SW 175th corridor will impact this intersection as well, it is recommended that the Beaverton School District provide a proportionate share of the costs towards the intersection improvements to mitigate the impacts of the proposed project. This could be done by crediting Transportation Development Taxes paid by the School District or developing a reimbursement or some other cost-sharing mechanism to provide the intersection improvement. With the construction of the project, school related traffic will represent approximately 15-20 percent of the daily traffic at this intersection. As traffic volumes increase in the future, the Beaverton School Districts share of daily traffic volume at the intersection will decrease.

Site Improvements

- It is recommended that guide signage be provided along SW Scholls Ferry Road and SW 175th Avenue to direct students, staff, parents, busses, and visitors to the appropriate access locations during school hours.
- Half street improvements should be provided along the school's frontage of SW Scholls Ferry Road and SW 175th Avenue. Frontage improvements should conform to Washington County's arterial roadway standard for a five lane cross-section. This includes 98 feet of right-of-way and a 74 foot paved section. It is recommended that the existing second westbound travel lane along SW Scholls Ferry Road be extended from SW 175th Avenue to the new collector street at the west end of the project site where it would be terminated (drop lane). Furthermore a second southbound travel lane is recommended along SW 175th Avenue from the schools frontage to SW Scholls Ferry Road. This additional

southbound lane would require modification to the existing traffic signal at SW Scholls Ferry Road/SW 175th Avenue.

- It is recommended that a 100 foot long westbound right turn lane be provided at bus/emergency vehicle right-in only access point along SW Scholls Ferry Road to provide buses a deceleration lane outside of the through traffic lane.
- Restripe the eastbound left turn lane at the SW Scholls Ferry Road/SW 175th Avenue intersection to 300 feet in length.
- Restripe the southbound left turn lane at the SW Scholls Ferry Road/SW 175th Avenue intersection to 450 feet in length.

Site Access

- It is recommended that the proposed bus only eastern access on SW Scholls Ferry Road be restricted to right in only to help alleviate operations along the corridor.
- It is recommended that the proposed school access along SW 175th Avenue be signalized. This intersection was found to meet MUTCD traffic signal warrants with the proposed project. This signal would also provide access to the future neighborhood route located on the east side of SW 175th Avenue and could provide the proposed trail connection identified in the South Cooper Mountain Concept Plan. With anticipated development on the east leg of this intersection, it is recommended that the Beaverton School District coordinate with this developer to provide a proportionate share towards the signal improvements. The Beaverton School District requests that the City conditions the development located immediately to the east (opposite this signal) to reimburse the Beaverton School District one-half the cost of the traffic signal.
- It is recommended that the proposed new collector street intersecting SW Scholls Ferry Road at the west end of the project site be signalized. This intersection was found to meet MUTCD traffic signal warrants with the proposed project. This signal would provide full access to the school and would be used by staff and busses exiting the site in addition to future residential and commercial development. With anticipated development on the north leg of this intersection and the City collector roadway classification, it is recommended that the Beaverton School District provide a proportionate share towards the signal improvements by crediting transportation development taxes.
- It is recommended that a path analysis be conducted on site to ensure that buses can make the necessary turn maneuvers.

Site Parking

- A minimum of 550 parking spaces should be provided on the school site. This would satisfy the 480 minimum spaces required by the City's development code. With 550 spaces, approximately 200 spaces should be dedicated to staff, with the remaining approximately 350 spaces for student parking. To accommodate parking needs for events, it is recommended that a minimum of 75 additional spaces be provided on-site by utilizing internal drop-off areas during events for a net total of up to 625 parking spaces.
- It is recommended that no overlapping events be scheduled on-site during high school football games.

Pedestrian and Bicycle Access/School Crosswalks

- A minimum of 122 bicycle parking spaces should be provided near primary school entrances to meet City of Beaverton Code.
- Sidewalks along the project frontage of SW Scholls Ferry Road and SW 175th Avenue should be constructed as community multi-use paths as illustrated in the South Cooper Mountain Concept Plan. These facilities should be paved and planned to accommodate both pedestrians (including those with disabilities) and bicyclists at a width of eight to ten feet.

Transportation Demand Management

- The draft Transportation Demand Management (TDM) Plan is provided in Appendix Y.