MEMORANDUM

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TO: Astoria Uniontown Reborn Master Plan Team

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SUBJECT: Astoria Uniontown Reborn Master Plan
Technical Memo 3 – Baseline Transportation Conditions P18061-000

Executive Summary

The Astoria Uniontown Reborn Master Plan team has conducted a transportation conditions analysis for existing and future conditions for the West Marine Drive corridor in Astoria, Oregon. Table 1 summarizes operational results for the existing (2018) and future baseline (2023 and 2035) scenarios.

Table 1: Summary of Existing and Future Intersection Operations

	Location	Mobility Target	Existing 2018 Conditions Volume/ Capacity*	Future 2023 Conditions Volume/ Capacity*	Future 2035 Conditions Volume/ Capacity*
1	West Marine Dr/OR 202/US 101 Business (Smith Point Roundabout)	0.90 v/c	0.72	-	0.77
2	West Marine Dr/Hamburg Ave	Highway movements - 0.90 v/c, Non-highway movements - 0.95 v/c	0.43/0.67	-	0.46/**1.05**
3	West Marine Dr/Portway St	0.90 v/c	0.51	-	0.56
4	West Marine Dr/US 101 Bridge	0.85 v/c	0.71	-	0.81
5	West Marine Dr/Basin St	0.85 v/c	0.49	-	0.53
6	West Marine Dr/Columbia Ave	0.85 v/c	0.51	-	0.61
7	West Marine Dr/Hume Ave	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.44/0.31	0.45/0.32	0.46/0.36
8	West Marine Dr/2nd St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.34/0.11	0.34/0.11	0.35/0.13
9	West Marine Dr/3rd St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.34/0.13	0.34/0.13	0.35/0.15
10	West Marine Dr/4th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.33/0.40	0.34/0.42	0.34/0.36

11	West Marine Dr/5th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.33/0.19	0.33/0.20	0.34/0.20
12	West Marine Dr/6th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.32/0.30	0.32/0.32	0.33/0.32
13	West Marine Dr/Astor St/7th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.31/0.25	0.31/0.26	0.32/0.27
14	West Marine Dr (Westbound)/8th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.41/0.02	0.42/0.01	0.43/0.02
15	West Marine Dr (Eastbound)/8th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.39/0.22	0.39/0.23	0.41/0.24
16	West Marine Dr/9th St	0.85 v/c	0.48	0.48	0.50
17	Commercial St/8th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.54/0.10	0.55/0.10	0.59/0.08

Note: * At signalized locations the V/C ratio reported as intersection average, and at un-signalized locations, the V/C ratio reported as worst major/ minor movement.

The following memorandum summarizes the existing (2018) and baseline (2023 and 2035) transportation conditions for the Astoria Uniontown Reborn Master Plan and West Marine Drive study area in greater detail. Included is an inventory of the existing transportation facilities, a safety evaluation of the roadways and intersections, a qualitative review of the pedestrian and bicycle networks, and a motor vehicle operational analysis of study intersections.

Study Area

The transportation assessment includes two study areas, Uniontown and Downtown. The Uniontown assessment includes intersections in the immediate Astoria Uniontown Reborn Master Plan study area and is generally bounded by the Columbia River to the north, West Marine Drive to the south, Columbia Avenue to the east, and Youngs Bay to the west. The Uniontown analysis will provide a traffic operational analysis for both existing (2018) and baseline (2035) scenarios to determine potential improvement needs triggered with build out of the Astoria Uniontown Reborn Master Plan study area. The following locations have been identified as study intersections for the Uniontown assessment, with their intersection control listed:

1. OR 202/US 101 Business/West Marine Drive (roundabout)
2. Hamburg Avenue/West Marine Drive (unsignalized)
3. Portway Street/West Marine Drive (signalized)
4. US 101 Bridge/West Marine Drive (signalized)
5. Basin Street/West Marine Drive (signalized)
6. Columbia Avenue/West Marine Drive (signalized)

The Downtown assessment includes intersections along Marine Drive and Commercial Street between Columbia Avenue and 9th Street. The Downtown analysis will provide a traffic operational analysis for the potential reconfiguration of Marine Drive along this segment for existing (2018) and baseline (2023 and 2035) scenarios. The following locations have been identified as study intersections for the Downtown assessment, with their intersection control listed:

7. Hume Avenue/West Marine Drive (unsignalized)
8. 2nd Street/West Marine Drive (unsignalized)
9. 3rd Street/West Marine Drive (unsignalized)
10. 4th Street/West Marine Drive (unsignalized)
11. 5th Street/West Marine Drive (unsignalized)
12. 6th Street/West Marine Drive (unsignalized)
13. 7th Street/Astor Street/West Marine Drive (unsignalized)
14. 8th Street/West Marine Drive (Westbound)
15. 8th Street/West Marine Drive (Eastbound) (unsignalized)
16. 9th Street/West Marine Drive (signalized)
17. 8th Street/Commercial Street (unsignalized)

Current Facilities

The existing transportation system includes a range of facilities for people who walk, ride bikes, use transit, or drive.

Pedestrians

Pedestrian and bicycle access is provided throughout the study area, as shown in Table 2. Sidewalk facilities exist on both the north and south sides of West Marine Drive for the entire study corridor, although the quality of these sidewalk facilities varies. Sidewalk widths range between 6 and 14 feet, with the highest being in downtown Astoria. The typical sidewalk width along the project corridor is 8 feet. Despite this width, the sidewalk is frequently blocked due to street light and utility poles, signing, or driveway accesses along the corridor, reducing the effective sidewalk width. Along portions of West Marine Drive, the sidewalk is separated from traffic by either a bike lane or on-street parking, but this separation is limited. While non-decorative lighting is provided along West Marine Drive, increasing pedestrian comfort, few street trees are located near the sidewalk throughout the corridor to provide shade and additional comfort for pedestrians.

Generally, less than 50 pedestrians were observed during the PM peak hour at study intersections. Pedestrian volumes tend to be highest in downtown Astoria or in other areas with more commercial activities, such as the area near the intersection of West Marine Drive/Columbia Avenue. The

intersection of 9th street and West Marine Drive has the highest pedestrian volumes with 88 pedestrians recorded during the PM peak hour.

Signalized intersections at Portway Street, US 101 Bridge, Basin Street, Columbia Avenue, and 9th Street provide the best opportunities for pedestrians to cross West Marine Drive. These intersections have at least one marked crosswalk, in addition to featuring pedestrian signals and intersection lighting. Some unsignalized intersections along this study corridor also have striped pedestrian crossings or lighting to increase pedestrian comfort. Most crosswalks are open along the corridor with curb ramps provided at most intersections. Curb extensions are not utilized at intersections in the study area.

Bicyclists

A westbound bike lane is provided along West Marine Drive from Columbia Avenue to the Smith Point Roundabout and bike lanes in both directions are provided in downtown Astoria east of 6th Street (see Table 2). However, an eastbound bike lane gap exists between Columbia Avenue and the Smith Point Roundabout and in both directions between Columbia Avenue and 6th Street. The bike lanes, if available, range from 5 to 7 feet wide and are painted on-street with no physical separation for traffic. High corridor traffic volumes, frequent driveways and heavy right turning traffic are all potential conflicts with bicyclists along West Marine Drive. Furthermore, challenging intersection geometry, including five-legged intersections and the conversion of West Marine Drive to a one-way couplet, can also make cycling difficult in downtown Astoria.

Bicycle volumes are low throughout the study corridor, with less than 10 bicycles observed at study intersections during the PM peak hour. The 7th Avenue/West Marine Drive/Astor Street intersection has the highest bicycle volume, with 9 observed during the PM peak hour. The Astoria Riverwalk multi-use trail that runs parallel to West Marine Drive, one block to the north, may explain the lower bicycle volumes along the study corridor. This trail is wide enough (8 to 12 feet) to support multiple uses and provides a scenic and calm environment compared to West Marine Drive for both bicyclists and pedestrians. All study intersections along West Marine Drive provide a local street connect to the trail, except for the US 101 Bridge and the 8th Street/Commercial Street intersection. The signalized study intersections and the Smith Point Roundabout provide the best West Marine Drive crossing opportunities for trail users. These intersections also connect the Astoria Riverwalk trail to other destinations and attractions within Astoria.

Table 2: Existing Pedestrian and Bicycle Characteristics

Roadway (limits)	Pedestrian Facilities	Walk Score*	Bike Facilities
West Marine Drive (Smith Point Roundabout to Columbia Avenue)	Sidewalks on both sides	47	Bike lane on north side; none on south side
West Marine Drive (Columbia Avenue to 6th St.)	Sidewalks on both sides	59	None
West Marine Drive (6th St. to 8th St.)	Sidewalks on both sides	87	Bike lanes on both sides
West Marine Drive (8th St. to 9th St.)	Sidewalks on both sides	87	Bike lanes on north side; none on south side
8th St. (West Marine Drive to Commercial St.)	Sidewalks on both sides	87	Bike lane on west side
Commercial St. (8th St. to 9th St)	Sidewalks on both sides	87	Bike lane on south side; none on north side

*Source: Walk Score, July 2018. Score is representative of the corridor

Transit Users

Transit service is provided in Astoria through the Sunset Empire Transportation District. This system provides service through Astoria, in addition to providing daily bus service connecting to Warrenton, Hammond, Seaside, Cannon Beach, and Rainier. Transit stops are located along the study corridor at the Holiday Inn Express (Columbia Avenue and West Marine Drive) and the Astoria Transit Center (9th Street and West Marine Drive). The Astoria Transit Center provides a comfortable waiting experience for users including a waiting area, information, and bathrooms, along with public parking.

Transit service is provided to Warrenton and Hammond daily between 6 AM and 7 PM. Hourly buses run during the week, and six buses run during the weekend. During the week, hourly bus service is also provided south to Seaside between 6 AM and 10 PM. These routes also serve stops throughout Astoria. The Pacific Connector route connects Astoria to Cannon Beach and Tillamook on weekends with five daily trips. Transit service also connects Astoria to Portland and Longview with twice daily bus service.

Drivers

West Marine Drive is a major, commercial corridor in Astoria, serving both local traffic and regional traffic by providing a key connection to the Oregon coast and Washington state. Consequently, West Marine Drive is designed to provide a high-capacity corridor through Astoria. A four-lane cross section (i.e., two through lanes in each direction) is maintained through the study area, although in some sections left turn lanes are provided to further facilitate traffic flow. The posted speed on West

Marine Drive decreases as vehicles travel east along the corridor towards downtown Astoria from 30 miles per hour west of 2nd Street to 25 miles per hour between 2nd Street and 7th Street. Within downtown Astoria (east of 7th Street), the posted speed is 20 miles per hour.

Within the study area, West Marine Drive also connects to major highways, including US 101 and OR 202 and key local streets at traffic signals throughout the study corridor. US 101 connects West Marine Drive and Astoria to Washington state to the north and the Oregon coast to the west, while OR 202 travels southeast from Astoria. Other local streets connect West Marine Drive to the neighborhoods to the south. The remaining roadways in the study corridor serve local traffic needs or business access and primarily connect with West Marine Drive at two-way stop-controlled intersections. Characteristics of the major roadways in the study area are summarized in Table 3.

Table 3: Study Area Roadway Characteristics

Roadway (limits)	Functional Classification*	Cross Section	Posted Speed
West Marine Drive			
OR 202 to Columbia Avenue	Statewide	4 to 5 lanes	30 mph
Columbia Avenue to 2nd Street	Statewide	4 to 5 lanes	30 mph
2nd Street to 9th Street	Statewide	4 lanes	25 mph (2nd St. to 7th St.), 20 mph (7th St. to 9th St.)
OR 202	Statewide	3 lanes	35 mph
US 101	Statewide	2 lanes	55 mph
Portway Street	Commercial/Industrial Collector	2 lanes	25 mph
Basin Street	Mixed-Use Local Street	2 lanes	25 mph
Columbia Avenue	Mixed-Use Local Street (north of West Marine Drive), Residential Local Street (south of West Marine Drive)	2 lanes	25 mph
Bond Street	Residential Collector	2 lanes	25 mph
9th Street	Mixed-Use Local Street	2 lanes	20 mph

*Source: Oregon Highway Plan and Astoria Transportation System Plan, Retrieved July 2018.

Travel Conditions

This section summarizes the existing and future travel conditions for the study area.

Intersection Safety Evaluation

Safety of the intersections in the study area was assessed through historic crash data to identify deficiencies. Intersection crash data was reviewed to identify potential patterns for motor vehicle, pedestrian, and bicyclist crashes. Crash data from the past five years (January 2012 through December 2016) was obtained from ODOT for West Marine Drive and intersecting roadways in the study area.

Over the past five years, 171 crashes occurred at the 17 study intersections. Nearly one-third of the crashes occurred at the Smith Point Roundabout (52 of 171 crashes), while the remaining intersections had less than 20 recorded crashes each. Most of the crashes occurring at the roundabout were either sideswipe, rear end, or turning movement crashes. Many of the crashes at other study locations were rear end crashes. One exception is the intersection of 8th and Commercial which has a high volume of turning movement crashes, likely due to the hard-left turn of US 30 from southbound 8th Street to eastbound Commercial Street.

While many crashes occurred at the study intersections, they were generally not severe; 98 of 171 crashes were property damage only. Most of the remaining crashes did not involve serious injuries. Over the last five years, only one fatality was recorded at the intersection of West Marine Drive and Portway Street. This crash occurred at dusk when a vehicle disregarded the traffic signal while turning left in front of oncoming traffic. Two severe injuries occurred when drivers hit pedestrians at 6th Street and 8th Street, and 19 other crashes resulted in moderate injuries.

Pedestrian Safety

There were 23 reported crashes involving pedestrians over the past five years; a pedestrian was struck by a vehicle in nine of these crashes. Pedestrian crashes were more common in the downtown Astoria study area (19 of 23 crashes) compared to the Astoria Uniontown study area. Within downtown, nine of the crashes involving pedestrians occurred at the intersection of West Marine Drive and 6th Street. The intersections of West Marine Drive with OR-202 (Smith Point Roundabout), 7th Street, 8th Street (westbound), and 8th Street (eastbound) each recorded two pedestrian involved crashes. One pedestrian involved crash was recorded over the past five years at the intersections of Portway Street, Basin Street, Hume Avenue, 3rd Street, 4th Street, and 5th Street.

Pedestrians sustained injuries in all nine reported pedestrian crashes where they were struck by a vehicle. Two of these crashes involved severe injuries for pedestrians, both of which were in downtown Astoria at 6th Street and 8th Street. The remaining crashes all resulted in moderate injuries to pedestrians.

Drivers failed to yield to pedestrians in 35% of crashes involving pedestrians; failure to yield was a factor in 78% of crashes when drivers struck a pedestrian. Inattention also played a role in 33% of crashes involving pedestrians. One crash involved a pedestrian illegally in the roadway, and one crash, where a pedestrian was struck, involved alcohol. Most of the crashes involving pedestrians occurred during the day (78%). Most (87%) of the pedestrian crashes took place during dry conditions, often with clear skies. Two crashes occurred at night without street lighting with wet roadway conditions. Pedestrian crashes were most common in both summer (22%) or fall (43%); 17% of pedestrian crashes occurred in both winter and spring.

Bicycle Safety

Two reported crashes involved bicyclists over the past five years at Hamburg Street and Basin Street, intersections with on-street bike lanes along westbound West Marine Drive. One crash resulted in severe injuries and the other crash led to moderate injuries for each bicyclist. In both accidents, drivers failed to yield to each bicyclist while turning either left or right. One crash occurred during daylight with a dry roadway while the other crash occurred at night without streetlights during rainy conditions.

Motor Vehicle Safety

Crash rates provide an additional perspective on intersection safety and identify locations where people have a higher risk of being involved in a crash. Crash frequencies (the number of crashes in a period of time) tend to increase with higher vehicle traffic. With more exposure to vehicles, there are more opportunities for crashes to occur. Crash rates consider the amount of crashes relative to the traffic volume at the intersection and are expressed in units of crashes per million entering vehicles. Study intersections are divided into groups of similar intersections for this analysis, called "Intersection Populations."

Crash rates for the study intersections were calculated and evaluated using two methods: the critical crash rate method from the Highway Safety Manual and by comparison to statewide 90th percentile crash rates published by ODOT. The critical crash rate method compares an intersection's crash history to that of other similar intersections in Astoria, adjusting for volume at the intersection. The 90th percentile crash rate compares an intersection's crash history to that of other similar intersections across Oregon. Where an intersection's crash rate is greater than either of these two thresholds, it is an indication that a problem might exist, and that further study is warranted.

The Excess Proportion of Specific Crash Types method from the Highway Safety Manual was used as an additional analysis tool at locations with high crash rates. This method identifies the types of crashes that are over-represented at an intersection, when compared to other similar intersections.

Additionally, each study intersection was compared with the 2016 Top 10% Safety Priority Index System (SPIS) list to further identify intersections that have potential safety issues.

The collision rates calculated (based on the past five years of crash data) for the study intersections, excess proportion of crashes, and 2016 SPIS sites can be seen in Table 4. Both the critical crash rate and the 90th percentile crash rates were exceeded at the Basin Street/West Marine Drive intersection, 6th Street/West Marine Drive intersection, 8th Street/West Marine Drive (south) intersection, and 8th Street/Commercial Street intersection. Additionally, both the Smith Point Roundabout and the 8th Street/Commercial Street intersection were flagged as top 10% SPIS sites for 2016.

- **The Smith Point Roundabout** is a two-lane roundabout at the junction of two highways. While this site was not included in the critical crash rate or excess proportion analysis, it has the highest crash rate of al study intersections, and it experiences a high portion of turning movement, side-swipe, and rear end crashes. These crashes could arise from lane changes in the roundabout as vehicles navigate towards their desired exit or aggressive driver behavior since it provides the last passing opportunity for westbound vehicles before entering a long, two-lane bridge. Poor visibility of both lanes for entering vehicles, through either vehicle occlusion or the trees included as part of the center island landscaping, could lead to more crashes at this site. These issues could be compounded by drivers who are less familiar with operations at this location, as this roundabout is located along a major tourist route.
- **The Basin Street intersection** experiences a high volume of rear-end crashes, particularly for westbound traffic, which could be due to its close proximity to the US 101 bridge. There was also one bike and pedestrian crash at this intersection.
- **The West Marine Drive and 6th Street intersection** had several rear-end and nine pedestrian crashes over the last five years, including three crashes where a pedestrian was struck by a motor vehicle. These crashes could arise from queuing spillback or turning movements in downtown Astoria, especially since this area has limited sight distance following a curve. The pedestrian crashes could occur for similar reasons, especially with limited locations for pedestrians to cross West Marine Drive.
- **The 8th Street (Eastbound) intersection** experiences predominantly rear end and angle collisions. These crashes could arise from traffic exiting westbound West Marine Drive to downtown Astoria, which must stop at this intersection, or from vehicles slowing due to the curve for eastbound West Marine Drive at this site.
- **The 8th and Commercial Street intersection** experiences a high proportion of turning movement crashes. This site has a unique intersection configuration where West Marine Drive transitions to a one-way couplet through downtown Astoria. Eastbound traffic along West

Marine Drive must turn left at this intersection to continue along Commercial Street; approximately 40% of these turning movement crashes could actually be sideswipe overtaking crashes because the vehicle movement patterns follow the eastbound West Marine Drive alignment. One-third of crashes at this site involved a truck, including and half of the turning movement crashes that could be sideswipe crashes involved trucks at this location. Existing standard 12-foot lanes and typical urban turn radii make it especially challenging for freight traffic to navigate this turn, leading to a higher number of crashes.

Table 4: Intersection Crash Summary

	Location	Reference Population	Total Collisions (2012 to 2016)	Observed Crash Rate (per MEV)	Critical Crash Rate (per MEV)	Over Critical Crash Rate	90th Percentile Rate (per MEV)	Over 90th Percentile Rate	Excess Proportion Crash Types	Top 10% SPIS
1	OR 202/US 101 Business//West Marine Drive (Smith Point Roundabout)	--	52	1.50	--	--	--	--	--	Yes
2	Hamburg Avenue/West Marine Drive	Urban 4ST	6	0.19	0.43	Under	0.408	Under	None	No
3	Portway Street/ West Marine Drive	Urban 3SG	11	0.36	0.45	Under	0.509	Under	None	No
4	US 101 Bridge/West Marine Drive	Urban 3SG	10	0.30	0.44	Under	0.509	Under	None	No
5	Basin Street/West Marine Drive	Urban 3SG	19	0.65	0.45	Over	0.509	Over	None	No
6	Columbia Avenue/West Marine Drive	Urban 4SG	13	0.46	0.71	Under	0.86	Under	None	No
7	Hume Avenue/ West Marine Drive	Urban 3ST	3	0.11	0.27	Under	0.293	Under	None	No
8	2nd Street/West Marine Drive	Urban 4ST	2	0.08	0.45	Under	0.408	Under	Rear-End	No
9	3rd Street/West Marine Drive	Urban 4ST	4	0.15	0.45	Under	0.408	Under	None	No
10	4th Street/West Marine Drive	Urban 4ST	4	0.15	0.45	Under	0.408	Under	Turning Movements	No
11	5th Street/West Marine Drive	Urban 4ST	1	0.04	0.45	Under	0.408	Under	None	No

12	6th Street/West Marine Drive	Urban 4ST	12	0.46	0.45	**Over**	0.408	**Over**	Pedestrian, Rear-End	No
13	7th Street/West Marine Drive	Urban 4ST	10	0.38	0.45	Under	0.408	Under	None	No
14	8th Street/West Marine Drive (Westbound)	Urban 3ST	3	0.23	0.34	Under	0.293	Under	None	No
15	8th Street/West Marine Drive (Eastbound)	Urban 3ST	6	0.42	0.32	**Over**	0.293	**Over**	None	No
16	9th Street/West Marine Drive	Urban 4SG	0	0.00	0.80	Under	0.86	Under	None	No
17	8th Street/ Commercial Street	Urban 4ST	15	1.04	0.52	**Over**	0.408	**Over**	Turning Movements	**Yes**

Per MEV = Crashes per million entering vehicles

Segment Safety

Safety of the roadway segments in the study area was assessed through historic crash data to identify deficiencies. Crash data from the past five years (January 2012 through December 2016) was obtained from ODOT for West Marine Drive and intersecting roadways in the study area. Crashes that occurred at intersections or were likely intersection-related were analyzed as part of the preceding intersection safety analysis; these crashes are not included in this safety analysis of segments. Segment crash data was reviewed to identify potential patterns for motor vehicle, pedestrian, and bicyclist crashes.

Over the past five years, 59 crashes occurred along the West Marine Drive study corridor on roadway segments between study intersections. Nearly half of these crashes occurred between the Basin Street and Columbia Street intersections (23 of 79 crashes), while the remaining roadway segments had five or fewer crashes each. Over half of the crashes occurring between Basin Street and Columbia Street were identified as intersection crashes at Bay Street and West Marine Drive which was not included in this study. This intersection partially explains the high number of crashes between the Basin Street and Columbia Street study intersections.

Generally, the segment crashes were not severe; 37 of 59 crashes were property damage only. Over the last five years, one fatality was recorded at the intersection. This crash occurred on a wet night when a vehicle struck a power pole between Columbia Street and Hume Street.

Pedestrian Safety

There were 3 reported crashes involving pedestrians over the past five years; these three crashes all occurred at the Bay Street and West Marine Drive intersection where a signalized pedestrian crossing is installed. All pedestrian crashes that occurred on roadway segments led to at least one non-fatal injury.

Drivers failed to yield to pedestrians in all pedestrian crashes at this site. Two of these crashes involved alcohol. Two of the three pedestrian crashes occurred at night with street lights (67%), and two of the pedestrian crashes occurred during dry conditions with clear skies (67%). All of these pedestrian crashes occurred during the spring.

Bicycle Safety

One reported crash involved a bicyclist over the past five years at the Bay Street and West Marine Drive intersection, a location with on-street bike lanes along westbound West Marine Drive, which led to a non-fatal injury. In this incident, a driver failed to yield to a bicyclist. This crash occurred during daylight with a dry roadway.

Motor Vehicle Safety

Crash rates can also be used to identify segments where individuals have a higher risk of being involved in a crash. Crash frequencies (the number of crashes in a period of time) tend to increase with higher vehicle traffic and longer roadway segments. With more exposure to vehicles, there are more opportunities for crashes to occur. Crash rates consider the amount of crashes relative to the traffic volume and length of a segment and are expressed in units of crashes per million entering vehicles. Study segments are divided into groups of similar segments based on roadway functional classification for this analysis, called "Segment Populations."

Crash rates for the study segments were calculated and evaluated using the critical crash rate method from the Highway Safety Manual. The critical crash rate method compares a segment's crash history to that of other similar segments in Astoria, adjusting for volume and segment length. When a segment's crash rate is greater than this threshold, it is an indication that a problem might exist, and that further study is warranted.

The collision rates calculated (based on the past five years of crash data) for the study segments, and 2016 SPIS sites can be seen in Table 5. The critical crash rate was exceeded between the Basin Street and Columbia Street intersections, although this is likely due to the inclusion of the Bay Street intersection on this segment.

Table 5: Segment Crash Summary

	Location	Reference Population	Total Collisions (2012 to 2016)	Observed Crash Rate (per MEV)	Critical Crash Rate (per MEV)	Over Critical Crash Rate
1	Smith Point Roundabout – Hamburg Ave	Urban, Other Principal Arterial (UOPA)	2	0.40	2.42	Under
2	Hamburg Ave – Portway Street	UOPA	4	0.81	2.43	Under
3	Portway Street – US 101 Bridge	UOPA	4	0.79	2.42	Under
4	US 101 Bridge – Basin Street	UOPA	2	1.47	3.50	Under
5	Basin Street – Columbia Avenue	UOPA	23	3.49	2.29	**Over**
6	Columbia Avenue – Hume Avenue	UOPA	4	1.19	2.67	Under
7	Hume Avenue – 2nd Street	UOPA	5	0.87	2.35	Under
8	2nd Street – 3rd Street	UOPA	1	0.77	3.56	Under
9	3rd Street – 4th Street	UOPA	3	2.33	3.57	Under
10	4th Street – 5th Street	UOPA	2	1.95	3.88	Under
11	5th Street – 6th Street	UOPA	2	1.56	3.58	Under
12	6th Street – 7th Street	UOPA	3	2.37	3.59	Under
13	7th Street – West Marine Drive (EB)/8th Street	UOPA	0	0.00	4.48	Under
14	7th Street – West Marine Drive (WB)/8th Street	UOPA	0	0.00	4.70	Under
15	West Marine Drive (WB)/8th Street – 9th Street	UOPA	2	3.13	4.70	Under
16	West Marine Drive (EB)/8th Street – 9th Street	UOPA	0	0.00	11.28	Under
17	8th Street/Bond Street – 8th Street/Commercial Street	UOPA	2	3.17	4.72	Under

Per MEV = Crashes per million entering vehicles

Driving Conditions

Study intersections are compared to mobility targets and standards intended to maintain a minimum level of efficiency for motor vehicle travel. Two methods to gauge intersection operations include volume-to-capacity (v/c) ratios and level of service (LOS).

- **Volume-to-capacity (v/c) ratio:** A decimal representation (between 0.00 and 1.00) of the proportion of occupied capacity (capacity defined as the theoretical maximum vehicle throughput in a given time frame) at a turn movement, approach leg, or intersection. It is the peak hour traffic volume divided by the hourly capacity of a given intersection or movement. A lower ratio indicates smooth operations and minimal delays. A ratio approaching 1.00 indicates increased congestion and reduced performance. A ratio greater than 1.00 indicates the turn movement, approach leg, or intersection is oversaturated, which usually results in excessive queues and long delays.
- **Level of service (LOS):** A "report card" rating (A through F) based on the average delay 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 traffic is highly congested.

Intersection mobility targets vary by jurisdiction of the roadways. All of the study intersections are under state jurisdiction and must comply with the v/c ratios in the Oregon Highway Plan (OHP). The ODOT v/c targets are based on highway classification and posted speeds. The applicable mobility targets at each study intersection are identified in Table 6. Study intersections that do not meet the mobility targets shown will require mitigation strategies to be identified.

Existing Motor Vehicle Volumes

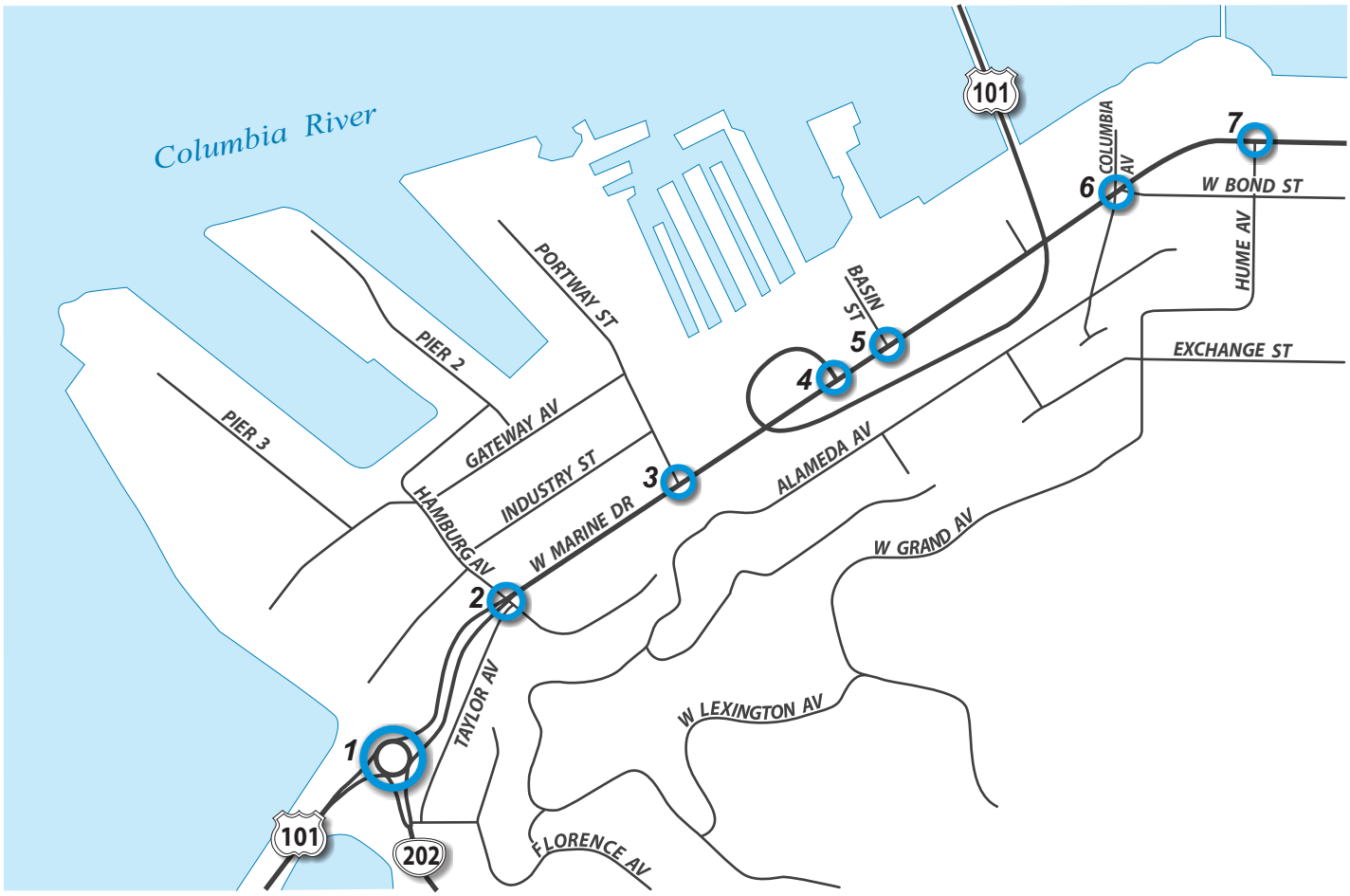
Motor vehicle traffic volumes at study intersections were collected in the summer of 2018.[1] The count data obtained suggests that systemwide peak volumes occur at most of the study intersections between 4:15 p.m. and 5:15 p.m., which therefore will be applied as the peak hour of traffic to compare to ODOT mobility targets for current and future conditions.

The existing peak hour volumes at the study intersections were adjusted to represent the 30th highest annual hour of traffic (30 HV) volumes, based on the methodology summarized in the Traffic

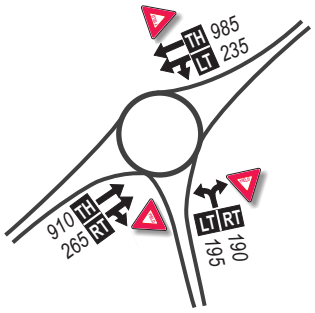
[1] Based on counts conducted July 10th, and July 11th, 2018 by ODOT.

Methodology and Assumptions Memorandum included in the Appendix. The factors resulted in a six percent increase to the counts to adjust for seasonal variations in traffic, replicating 30 HV conditions. The final existing 30 HV peak hour volumes for the study intersections are displayed in Figures 1a and 1b.

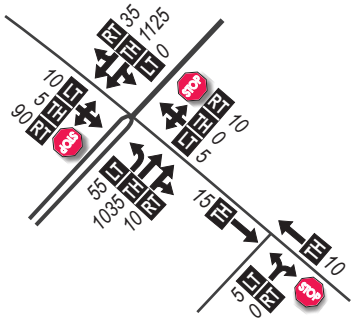
The existing traffic volumes includes freight vehicles. Freight through traffic along the US 30/Marine Drive corridor accounts for 2.5% of all through traffic, on average, during the PM peak, although this value can be higher for turning movements at specific intersections. Freight traffic for most movements at cross-streets along this corridor is less than 5% with most minor street approaches seeing no freight vehicles during the PM peak hour. Movements with a higher proportion of freight traffic include the turning movements to and from the US 101 bridge, which range from 1 to 6%. These heavy vehicle percentages are lower than those recorded by the nearby automated traffic recorder, located on the US 101 bridge, which indicates US 101 has 12% heavy vehicles. However, they are in line with the average heavy vehicle percent on the day the traffic count was collected which ranged from 3-7% heavy vehicles. The slightly lower values during the PM peak could arise from heavier freight traffic during the morning and increased passenger car traffic during the PM. Other turning movements that provide access to the industrial areas north of West Marine Drive between 2nd Avenue and Astoria's downtown also have a higher proportion of heavy vehicles. However, many of these turning movements are on low-volume approaches which could inflate the heavy vehicle percentage.



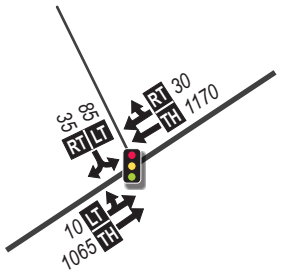
1. ***W. Marine Dr./OR-202 @ US 101***



2. ***W. Marine Dr. @ Hamburg Ave./Taylor Ave.***

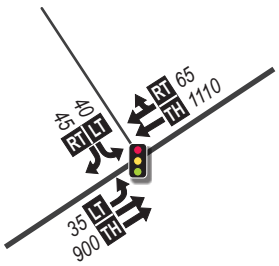


3. ***W. Marine Dr. @ Portway St.***

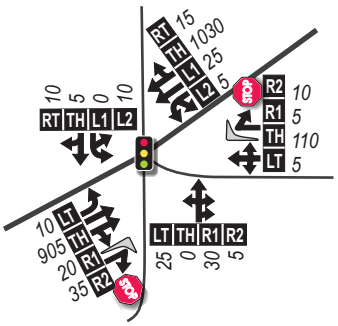


4. ***W. Marine Dr. @ US 101 Bridge***

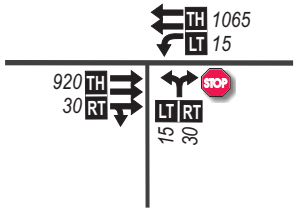
5. ***W. Marine Dr. @ Basin St.***



6. ***W. Marine Dr. @ Columbia Ave./Bond St.***



7. ***W. Marine Dr. @ Hume Ave.***



LEGEND

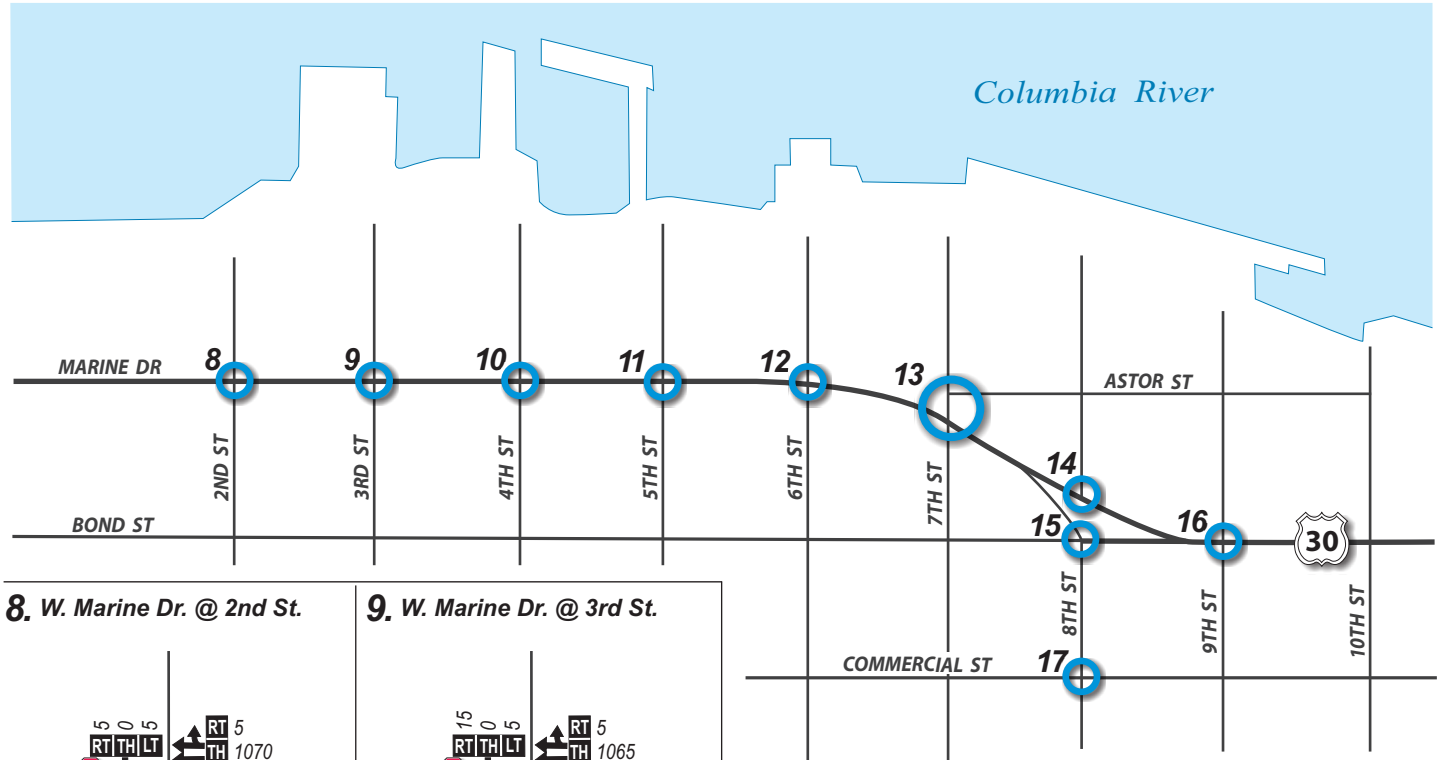
- # - Study Intersection
- Traffic Signal
- STOP - Stop Sign
- ← - Lane Configuration
- *000* - 30th Hour Traffic Volumes
- L2 (2nd Left) L1 (1st Left) TH (Thru) R1 (1st Right) R2 (2nd Right) - Volume Turn Movement

DKS

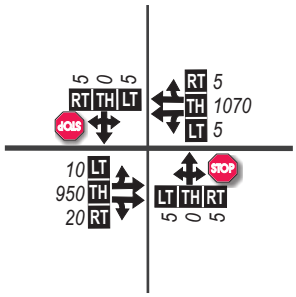
No Scale

Figure **1a**

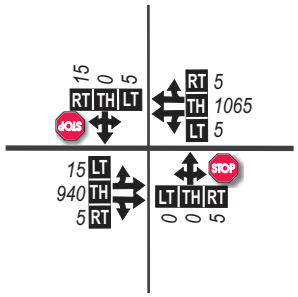
2018 Existing Conditions 30th Hour Traffic Volumes



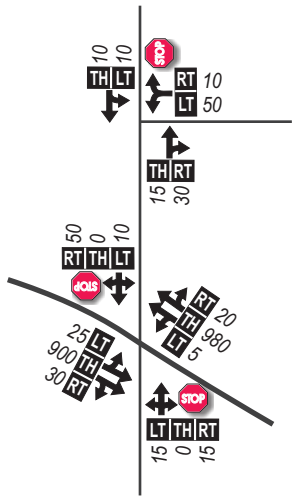
8. W. Marine Dr. @ 2nd St.



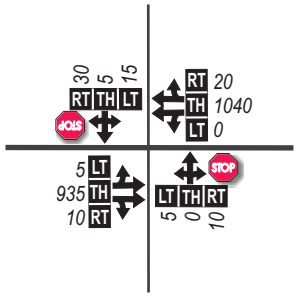
9. W. Marine Dr. @ 3rd St.



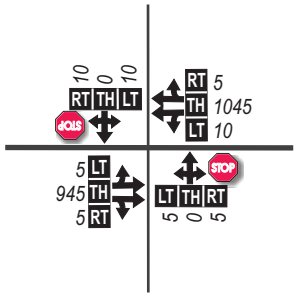
13. W. Marine Dr. @ 7th St./Astor St.



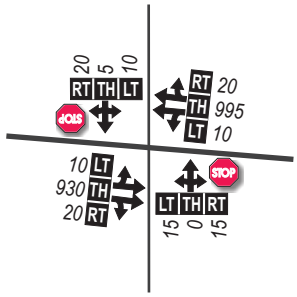
10. W. Marine Dr. @ 4th St.



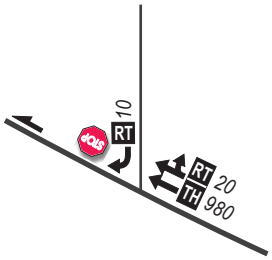
11. W. Marine Dr. @ 5th St.



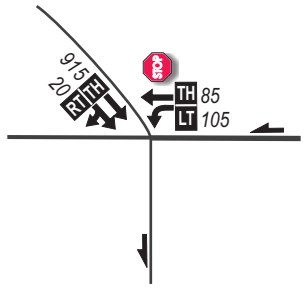
12. W. Marine Dr. @ 6th St.



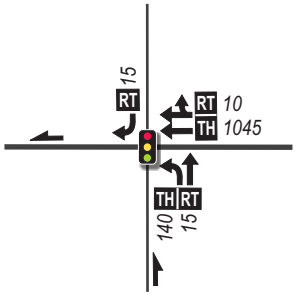
14. W. Marine Dr. (Westbound) @ 8th St.



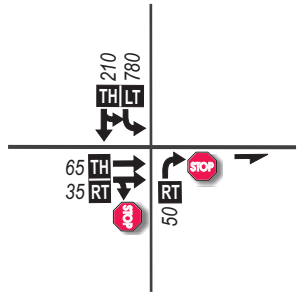
15. W. Marine Dr. (Eastbound) @ 8th St.



16. W. Marine Dr. @ 9th St.



17. Commercial St. @ 8th St.



LEGEND

- # - Study Intersection
- Traffic Signal
- STOP - Stop Sign
- ← - Lane Configuration
- 000 - 30th Hour Traffic Volumes
- LT TH RT - Volume Turn Movement (Left • Thru • Right)

DKS

No Scale

Figure **1b**

2018 Existing Conditions 30th Hour Traffic Volumes

Existing Intersection Operations

The motor vehicle performance evaluation utilized Highway Capacity Manual (HCM) 6th Edition methodology[2] for un-signalized study intersections and HCM 2000 for signalized study intersections. All study intersections operate below their mobility standards in the existing 2018 analysis year (see Table 6).

Table 6: 2018 Study Intersection Traffic Operational Analysis

			Existing 2018 Conditions		
	Location	Mobility Target	Volume/ Capacity*	Delay (seconds)*	Level of Service *
1	West Marine Dr/OR 202/US 101 Business (Smith Point Roundabout)	0.90 v/c	0.72	4.2	A
2	West Marine Dr/Hamburg Ave	Highway movements - 0.90 v/c, Non-highway movements - 0.95 v/c	0.43/0.67	12.2/63.3	B/F
3	West Marine Dr/Portway St	0.90 v/c	0.51	5.7	A
4	West Marine Dr/US 101 Bridge	0.85 v/c	0.71	31.7	C
5	West Marine Dr/Basin St	0.85 v/c	0.49	3.6	A
6	West Marine Dr/Columbia Ave	0.85 v/c	0.51	15.9	B
7	West Marine Dr/Hume Ave	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.44/0.31	10.6/38.3	B/E
8	West Marine Dr/2nd St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.34/0.11	11.9/45.3	B/E
9	West Marine Dr/3rd St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.34/0.13	11.1/30.2	B/D
10	West Marine Dr/4th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.33/0.40	10.8/50.1	B/F
11	West Marine Dr/5th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.33/0.19	10.8/44.9	B/E
12	West Marine Dr/6th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.32/0.30	10.6/48.1	B/E
13	West Marine Dr/Astor St/7th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.31/0.25	10.9/42.9	B/E
14	West Marine Dr (Westbound)/8th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.41/0.02	0.0/12.7	A/B
15	West Marine Dr (Eastbound)/8th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.39/0.22	0.0/14.2	A/B
16	West Marine Dr/9th St	0.85 v/c	0.48	10.9	B

[2] *Highway Capacity Manual, 6th Edition*. Transportation Research Board. Washington, DC. 2016.

17	Commercial St/8th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.54/0.10	9.8/10.0	A/B

Note: * At signalized locations the V/C ratio, LOS and delay reported as intersection average, and at un-signalized locations, the V/C ratio, LOS and delay reported as worst major/ minor movement.

Baseline Transportation System Improvements

The starting point for the 2035 operations analysis relied on a list of street system improvement projects contained in the Astoria Transportation System Plan (2013). These projects represent only those that are expected to be reasonably funded, and therefore can be included in the 2035 Baseline scenario.

Roadway

Several roadway enhancements are identified in Astoria's TSP which directly impact the study corridor or could affect circulation and traffic patterns. Notably, the TSP includes a road reconfiguration project for West Marine Drive between Columbia Avenue and 9th street which is assumed to happen in the short term. This project includes reducing West Marine Drive to three travel lanes and adding bike lanes. While this project has been identified in the TSP, additional analysis is needed, so this project will only be included in future build scenarios for both 2023, the expected opening year, and 2035. The TSP also recommends coordinated signal timing from Portway Street to Columbia/Bond Street on West Marine Drive as a medium-term project. Since this project will likely be implemented by 2035, signal timings in this section of the corridor will be optimized for the 2035 baseline model.

Other projects are expected to occur near the study corridor as part of the TSP, however, these projects are not included in the 2035 baseline model due to their limited impacts to the study corridor. These projects include a proposal to convert Bond Street to two-way traffic with traffic calming measures between Hume and 7th Avenue. As a parallel route to West Marine Drive, converting Bond Street to two-way traffic could re-route some drivers to this facility, reducing volumes along West Marine Drive. However, it is more conservative to assume drivers do not re-route from West Marine Drive to understand possible traffic impacts from the proposed road reconfiguration. Additionally, with appropriate traffic calming measures, Bond Street would be maintained for local traffic rather than as an alternative through route. Local connectivity enhancements are also identified in the TSP for the industrial area north of West Marine Drive off Bay Street.

Pedestrian and Bicycle

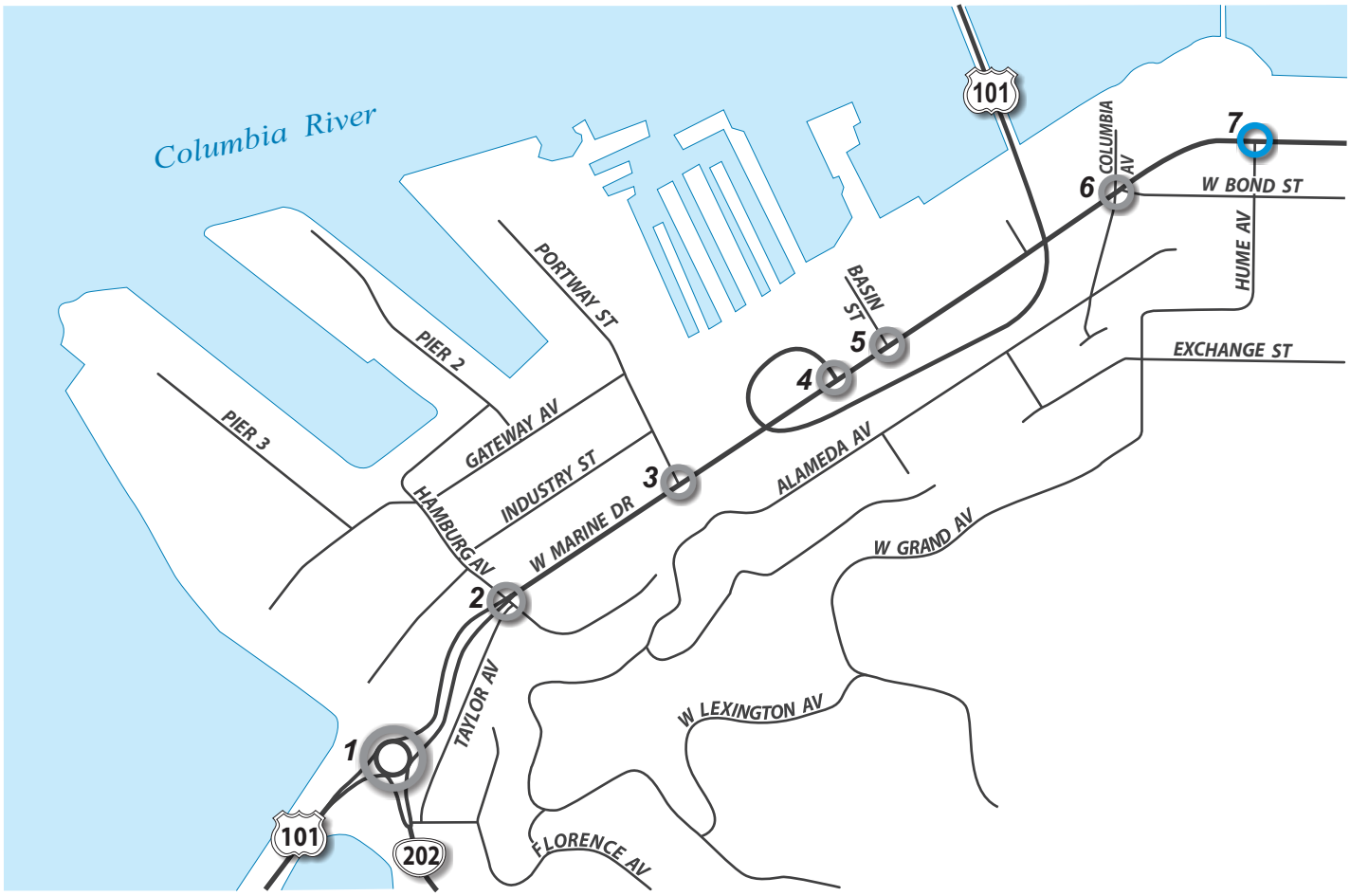
The Astoria TSP identified many pedestrian and bicycle improvements near the project corridor. Pedestrian projects include sidewalk infill along Bond Street between Hume and 2nd Street and additional crossing enhancements at West Marine Drive and Bay Street, 6th Street, 8th Street, and at Commercial Street/8th Street. The bicycle plan includes completing the existing bike lane gaps along West Marine Drive and additional shared roadway and wayfinding improvements on 6th Street and Bond Street. Additional wayfinding guidance will also be provided at the Smith Point Roundabout. These enhancements will improve existing bicycle and pedestrian infrastructure along the corridor.

Transit

The Sunset Empire Transportation District long-range plan identifies several expansions to their existing service. Daily transit service will be provided in Astoria through an east and west route to replace existing transit service provided by regional transit routes. The Astoria routes will operate with hourly headways during the week from 5:45 AM and 10 PM and from 7 AM to 10 PM on weekends. These improvements will be coupled with additional bus stop amenities provided throughout the City of Astoria as part of the TSP. Regional transit connections will still be provided to Seaside and Warrenton between 6 AM and 10 PM daily 7 AM to 10 PM on weekends. Service will be provided every 30 minutes during weekly peak periods on 60 minutes otherwise; headways of up to two hours will be used during the weekend. Service to Portland via regional routes will also be expanded to four daily trips with two additional shorter trips.

Future Motor Vehicle Volumes

Future 2023 and 2035 baseline traffic volumes were forecasted at the study intersections based on the Astoria-Warrenton regional travel demand model. The forecast was based on the 2002 base and 2035 baseline future Astoria-Warrenton Regional travel demand model and the 2002 and 2035 baseline Astoria window-area travel demand model to be consistent with the forecasted volumes for the 2013 TSP (as documented in the Traffic Methodology and Assumptions Memorandum included in the Appendix). The 2035 baseline model assumes the existing roadway network with additional future growth to provide an accurate picture of future baseline transportation conditions. The model volumes were post-processed following the NCHRP 765 methodology which includes estimating link level growth to estimate future turning movement volumes in the future analysis year. Traffic volumes were forecast to 2023 for the downtown Astoria portion of the study area, to understand project impacts during the anticipated opening year, and to 2035 for the entire corridor. These volumes are summarized below in Figures 2a, 2b, 3a and 3b.



1. *W. Marine Dr./OR-202 @ US 101*

NOT INCLUDED IN 2023 ANALYSIS

2. *W. Marine Dr. @ Hamburg Ave./Taylor Ave.*

NOT INCLUDED IN 2023 ANALYSIS

3. *W. Marine Dr. @ Portway St.*

NOT INCLUDED IN 2023 ANALYSIS

4. *W. Marine Dr. @ US 101 Bridge*

NOT INCLUDED IN 2023 ANALYSIS

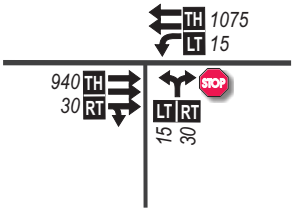
5. *W. Marine Dr. @ Basin St.*

NOT INCLUDED IN 2023 ANALYSIS

6. *W. Marine Dr. @ Columbia Ave./Bond St.*

NOT INCLUDED IN 2023 ANALYSIS

7. ***W. Marine Dr. @ Hume Ave.***



LEGEND

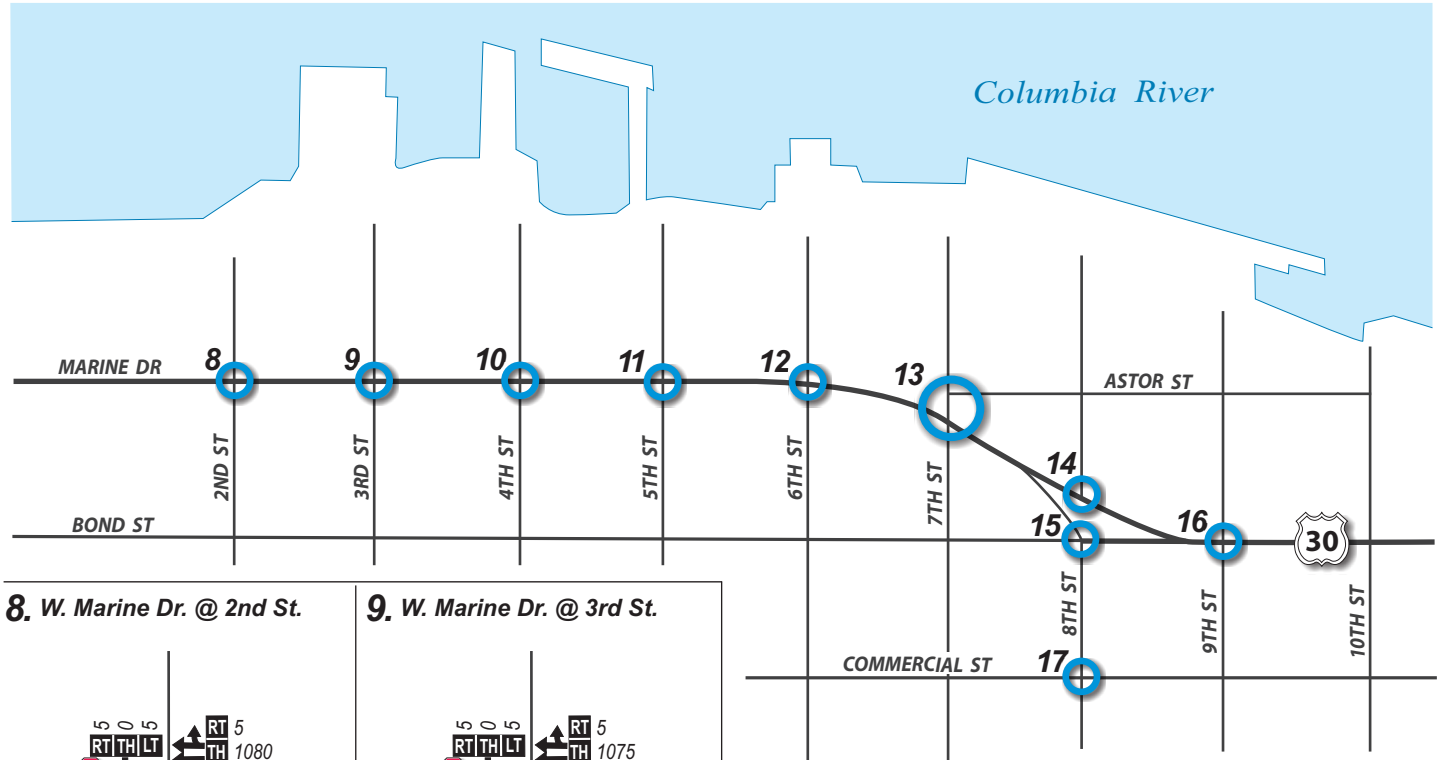
- # - Study Intersection
- Traffic Signal
- STOP - Stop Sign
- ← - Lane Configuration
- *000* - 30th Hour Traffic Volumes
- L2 (2nd Left) L1 (1st Left) • TH (Thru) • R1 (1st Right) R2 (2nd Right) - Volume Turn Movement

DKS

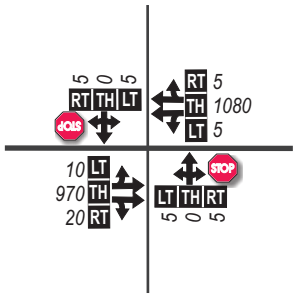
No Scale

Figure **2a**

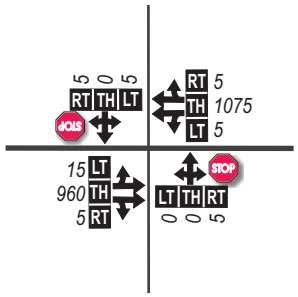
2023 Baseline 30th Hour Traffic Volumes



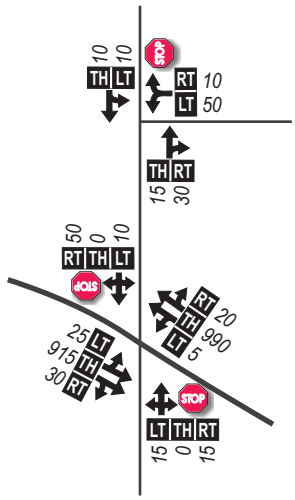
8. W. Marine Dr. @ 2nd St.



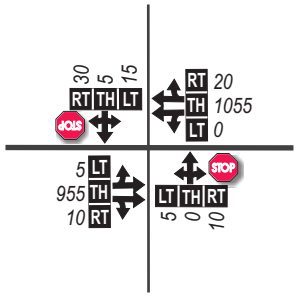
9. W. Marine Dr. @ 3rd St.



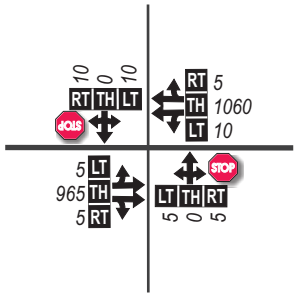
13. W. Marine Dr. @ 7th St./Astor St.



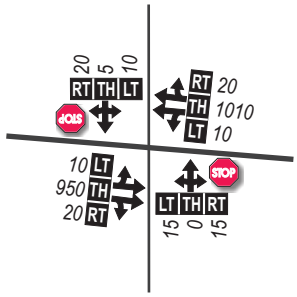
10. W. Marine Dr. @ 4th St.



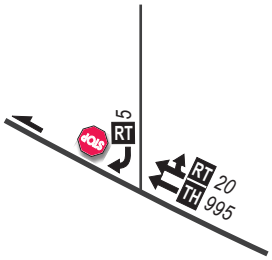
11. W. Marine Dr. @ 5th St.



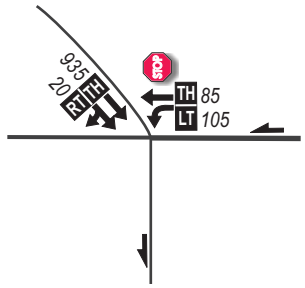
12. W. Marine Dr. @ 6th St.



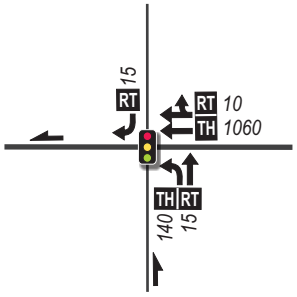
14. W. Marine Dr. (Westbound) @ 8th St.



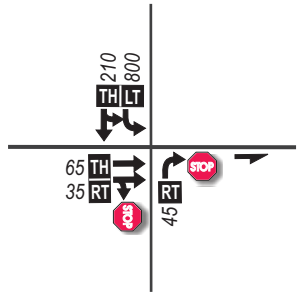
15. W. Marine Dr. (Eastbound) @ 8th St.



16. W. Marine Dr. @ 9th St.



17. Commercial St. @ 8th St.



LEGEND

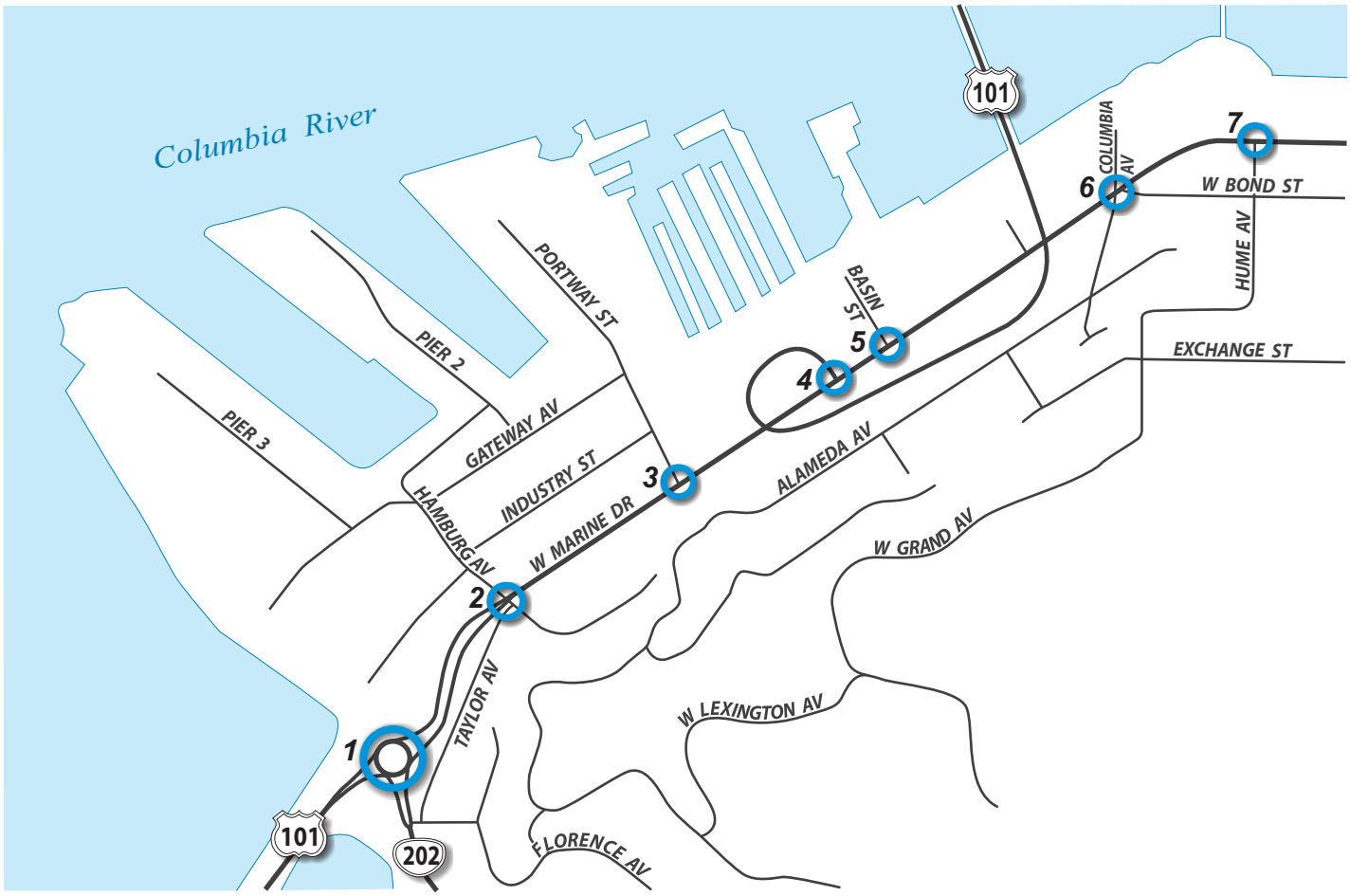
- # - Study Intersection
- Traffic Signal
- STOP - Stop Sign
- ← - Lane Configuration
- 000 - 30th Hour Traffic Volumes
- LT TH RT - Volume Turn Movement (Left • Thru • Right)

DKS

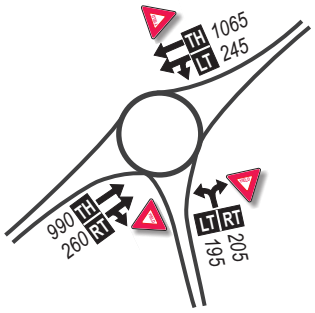
No Scale

Figure **2b**

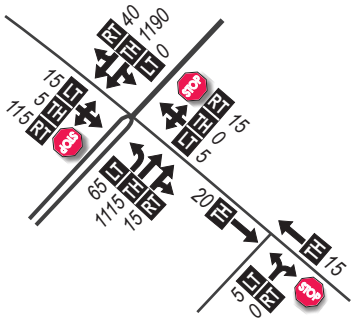
2023 Baseline 30th Hour Traffic Volumes



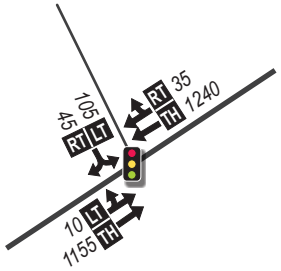
1. ***W. Marine Dr./OR-202 @ US 101***



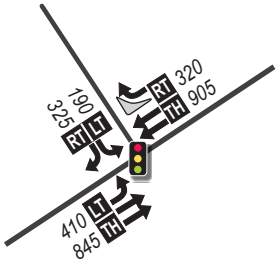
2. ***W. Marine Dr. @ Hamburg Ave./Taylor Ave.***



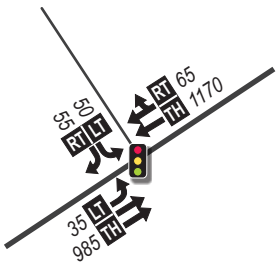
3. ***W. Marine Dr. @ Portway St.***



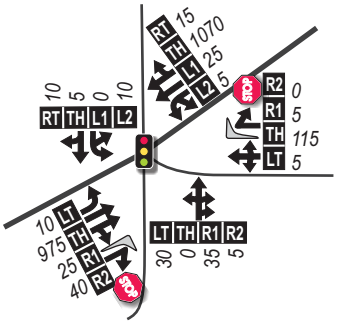
4. ***W. Marine Dr. @ US 101 Bridge***



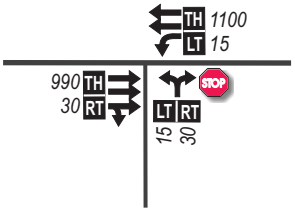
5. ***W. Marine Dr. @ Basin St.***



6. ***W. Marine Dr. @ Columbia Ave./Bond St.***



7. ***W. Marine Dr. @ Hume Ave.***



LEGEND

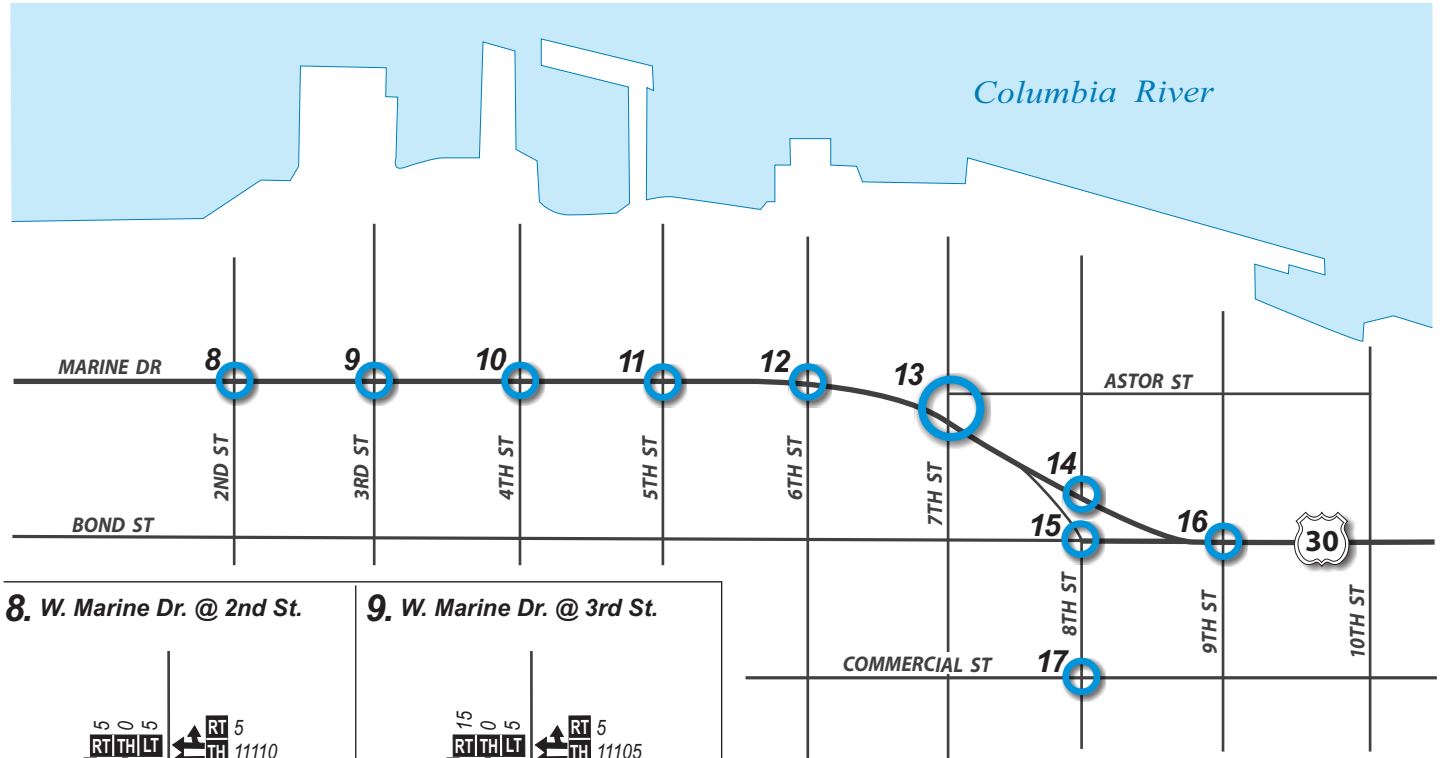
- # - Study Intersection
- Traffic Signal
- STOP - Stop Sign
- ← - Lane Configuration
- *000* - 30th Hour Traffic Volumes
- L2 (2nd Left) L1 (1st Left) TH (Thru) R1 (1st Right) R2 (2nd Right) - Volume Turn Movement

DKS

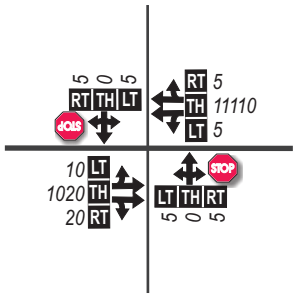
No Scale

Figure **3a**

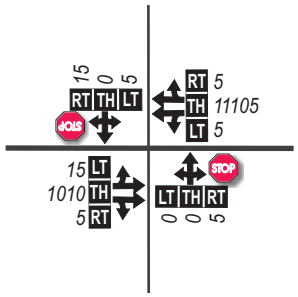
2035 Baseline 30th Hour Traffic Volumes



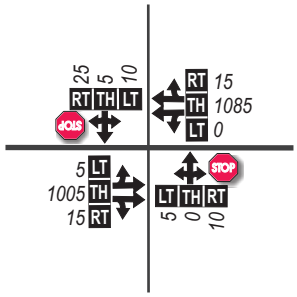
8. W. Marine Dr. @ 2nd St.



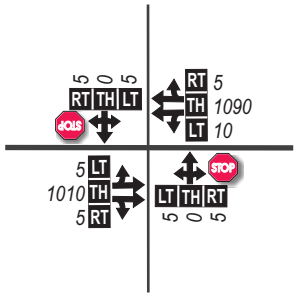
9. W. Marine Dr. @ 3rd St.



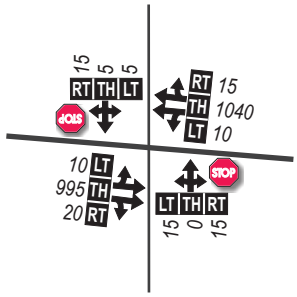
10. W. Marine Dr. @ 4th St.



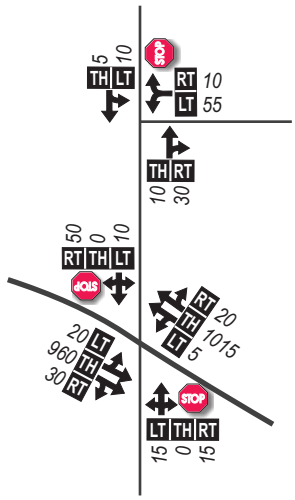
11. W. Marine Dr. @ 5th St.



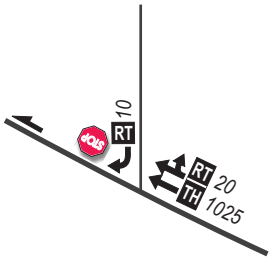
12. W. Marine Dr. @ 6th St.



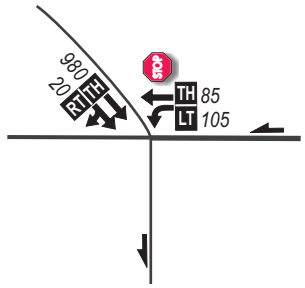
13. W. Marine Dr. @ 7th St./Astor St.



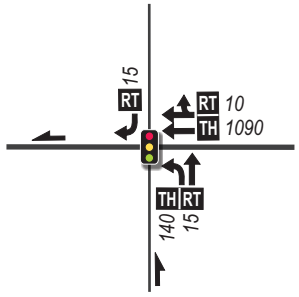
14. W. Marine Dr. (Westbound) @ 8th St.



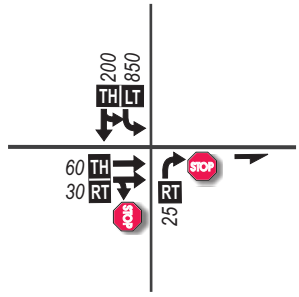
15. W. Marine Dr. (Eastbound) @ 8th St.



16. W. Marine Dr. @ 9th St.



17. Commercial St. @ 8th St.



LEGEND

- # - Study Intersection
- Traffic Signal
- STOP - Stop Sign
- ← - Lane Configuration
- 000 - 30th Hour Traffic Volumes
- LT TH RT - Volume Turn Movement (Left • Thru • Right)

DKS

No Scale

Figure **3b**

2035 Baseline 30th Hour Traffic Volumes

2023 Baseline Motor Vehicle Conditions (Astoria Downtown)

Baseline 2023 operations were analyzed for the portion of West Marine Drive in downtown Astoria to provide a baseline for the possible roadway reconfiguration expected to occur by 2023 along this segment. No geometric changes to West Marine Drive were assumed for the baseline analysis.

2023 Intersection Operations

The 2023 pm peak hour study intersection operations are shown in Table 7. As shown, all study intersections would be expected to operate below the mobility target through 2023. All intersections along West Marine Drive would operate with a v/c ratio of 0.55 or better during the p.m. peak hour.

Table 7: 2023 Study Intersection Traffic Operational Analysis

			Forecasted Baseline 2023 Conditions		
	Location	Mobility Target	Volume/ Capacity*	Delay (seconds)*	Level of Service *
7	West Marine Dr/Hume Ave	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.45/0.32	10.7/40.2	B/E
8	West Marine Dr/2nd St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.34/0.11	12.0/47.2	B/E
9	West Marine Dr/3rd St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.34/0.13	11.1/30.9	B/D
10	West Marine Dr/4th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.34/0.42	10.9/53.6	B/F
11	West Marine Dr/5th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.33/0.20	10.9/47.2	B/E
12	West Marine Dr/6th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.32/0.32	10.7/50.8	B/F
13	West Marine Dr/Astor St/7th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.31/0.26	10.9/45.0	B/E
14	West Marine Dr (Westbound)/8th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.42/0.01	0.0/12.7	A/B
15	West Marine Dr (Eastbound)/8th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.39/0.23	0.0/14.4	A/B
16	West Marine Dr/9th St	0.85 v/c	0.48	11	B
17	Commercial St/8th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.55/0.10	10.0/10.0	A/B

Note: * At signalized locations the V/C ratio, LOS and delay reported as intersection average, and at un-signalized locations, the V/C ratio, LOS and delay reported as worst major/ minor movement.

2023 Intersection Queuing

In addition to the intersection operations, vehicle queuing was assessed at study area intersections. Queuing analysis was conducted using SimTraffic and Sidra (Smith Point roundabout), which estimates the 95th percentile vehicle queue lengths, or the queue length that would not be exceeded in 95 percent of the queues formed during the peak hour. Estimated queues at the intersection of West Marine Drive and the US 101 Bridge could exceed storage at several approaches. This intersection is a major junction connecting Oregon and Washington which contributes to higher traffic volumes for all approaches, leading to longer queues. Southbound left and right turn queues generally had sufficient storage space from the two-lane bridge approach, however, eastbound and westbound through queues spilled through the nearby, closely spaced intersections including Basin Street and Portway street. Eastbound left and westbound right turn queues also exceeded their available storage space.

However, queues along other portions of the study corridor were generally estimated at less than 100 feet for both the eastbound and westbound left turns and minor street approaches. Queues for the traffic signal at 9th Street and West Marine Drive are estimated around 300 feet, but they are not expected to spillback through the downstream signal.

2035 Baseline Motor Vehicle Conditions (Astoria Uniontown and Downtown)

Baseline 2035 operations were analyzed for the entire West Marine Drive corridor. No geometric changes to West Marine Drive were assumed for the baseline analysis.

2035 Intersection Operations

Baseline 2035 intersection operations for all study intersections are summarized below in Table 8. In 2035, the majority of intersections along West Marine Drive are still expected to operate within their mobility targets; however, the southbound movement at Hamburg Avenue and West Marine Drive is expected to exceed the mobility target for non-highway approaches by 2035.

Table 8: 2035 Study Intersection Traffic Operational Analysis

	Location	Mobility Target	Forecasted Baseline 2035 Conditions		
			Volume/ Capacity*	Delay (seconds)*	Level of Service *
1	West Marine Dr/OR 202/US 101 Business (Smith Point Roundabout)	0.90 v/c	0.77	4.5	A
2	West Marine Dr/Hamburg Ave	Highway movements - 0.90 v/c, Non-highway movements - 0.95 v/c	0.46/**1.05**	12.9/153.6	B/F
3	West Marine Dr/Portway St	0.90 v/c	0.56	7.1	A
4	West Marine Dr/US 101 Bridge	0.85 v/c	0.81	25.2	C
5	West Marine Dr/Basin St	0.85 v/c	0.53	4.4	A
6	West Marine Dr/Columbia Ave	0.85 v/c	0.61	18.7	B
7	West Marine Dr/Hume Ave	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.46/0.36	11.0/45.6	B/E
8	West Marine Dr/2nd St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.35/0.13	12.2/52.8	B/F
9	West Marine Dr/3rd St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.35/0.15	11.3/33.8	B/D
10	West Marine Dr/4th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.34/0.36	11.0/53.1	B/F
11	West Marine Dr/5th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.34/0.20	11.0/47.7	B/E
12	West Marine Dr/6th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.33/0.32	10.8/57.3	B/F
13	West Marine Dr/Astor St/7th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.32/0.27	11.0/48.8	B/E
14	West Marine Dr (Westbound)/8th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.43/0.02	0.0/13.0	A/B
15	West Marine Dr (Eastbound)/8th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.41/0.24	0.0/14.8	A/B
16	West Marine Dr/9th St	0.85 v/c	0.50	11.2	B
17	Commercial St/8th St	Highway movements - 0.85 v/c, Non-highway movements - 0.95 v/c	0.59/0.08	10.4/9.9	B/A

Note: * At signalized locations the V/C ratio, LOS and delay reported as intersection average, and at un-signalized locations, the V/C ratio, LOS and delay reported as worst major/ minor movement.

2035 Intersection Queuing

Estimated queues during 2035 along the study corridor will primarily be 100 feet or less for both the eastbound and westbound left turns and minor street approaches. Future vehicle queues at signalized

intersections for mainline traffic on West Marine Drive are still expected to be longer with queues of up to approximately 300 feet. Queuing continues to be an issue, even with optimized signal phase timings, for the 2035 baseline scenario at the US 101 Bridge/West Marine Drive intersection (see Table 9). Southbound left and right turn queues will still have sufficient storage space from the two-lane bridge approach, however, eastbound and westbound through vehicle queues will continue to spill through nearby, closely spaced intersections including Basin Street and Portway Street. Eastbound left and westbound right turn vehicle queues also continue to exceed their available storage space.

Table 9: 2035 Queuing Analysis

	Location	Movement	Storage Space (ft)	95th Percentile Queue Length (ft)
4	US 101 Bridge/West Marine Drive	SBL	>1000	225
		SBR	490	225
		EBL	170*	**375**
		EBT	780	625
		WBT	190	**775**
		WBR	140	**225**

*Additional storage length available in striped two-way left-turn lane