FUTURE FORECASTING -TECHNICAL MEMORANDUM #5 (DRAFT)

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TO: Project Management Team

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SUBJECT: Sweet Home TSP and NSHA Refinement Plan
TM#5 Future Forecasting

Project #P20020-015

INTRODUCTION

Future traffic forecasting is an important step in the transportation planning process and provides estimates of future travel demand. This memorandum documents the traffic forecasting methodology and results associated with the small community model developed for the Sweet Home Transportation System Plan (TSP) Update. The small community modeling approach, in conjunction with post-processing, provides study intersection turn movement forecasts for the 2045 TSP horizon year. These traffic volumes will be analyzed during future steps in the TSP update to identify future traffic needs.

METHODOLOGY OVERVIEW

The forecasting methodology associated with the small community model (also referred as enhanced zonal cumulative analysis or EZCA) expands upon a cumulative analysis approach, as defined in the Oregon Department of Transportation (ODOT) Transportation Planning Analysis Unit's (TPAU's) *Analysis Procedures Manual Version 2 (APM V2)*. In the context of the traditional 4-step travel demand model approach, the typical cumulative analysis is used for trip generation and trip distribution purposes only. The result is a trip table (for growth increment only) that is used as an input into traffic assignment where analysis is completed by manually assigning the new trips to a street network and then adding them to existing traffic volumes to estimate future volumes.

The enhanced zonal cumulative analysis tool uses the same trip generation and trip distribution methodology as the typical cumulative analysis, but it applies the methodology to all land uses within the city (i.e., both existing uses as well as any future development based on a land use inventory). The enhanced tool then uses Visum modeling software and incorporates intersection node delay to complete the equilibrium trip assignment. The result is an improved traffic volume forecasting tool that dynamically assigns both new and existing trips to the transportation network using an equilibrium assignment procedure that represents routing choice more accurately than manual assignment because it is responsive to varying levels of congestion and delay as traffic

patterns change. This tool enables a more comprehensive analysis of future conditions and potential TSP alternatives.

The following sections of this memorandum detail each component of the travel forecast methodology associated with the small community model including: the roadway network, transportation analysis zones (TAZs), land use, and travel demand. The resulting 2045 future projected volumes are also provided.

FORECAST TOOL COMPONENTS

The following sections summarize the forecast tool components that are used to forecast the future traffic volumes.

ROADWAY NETWORK

The roadway network included in the Sweet Home TSP Visum forecast tool consists of the arterial and collector roadways along with most local public streets within the Sweet Home Urban Growth Boundary (UGB). The roadway network is also extended beyond the UGB to capture potential regional routing decisions that could result from future trips to/from Sweet Home and/or conditions in the local street system. These areas outside the UGB included in the model for routing potential routing purposes include:

- N River Drive (north side of model area)
- Wiley Creek Road (east side of model area)
- Shea Hill Drive (east side of model area)

An existing roadway network was created using centerline data from Open Street Map. Additional roadway attributes were added based on an existing conditions inventory that included posted speeds, traffic control, lane geometries, and number of travel lanes. The purpose of the existing conditions network was to configure the forecast tool and act as a base in the development of the future tool.

The 2045 future year baseline roadway network was then developed to represent the 2045 No-Build conditions. No committed transportation improvements were identified within the model area that are expected to influence traffic routing. Therefore, the 2045 No Build network is identical to the 2021 network. The 2045 future year network will be further refined as it is used to perform analysis of the various transportation alternatives and improvements to be analyzed for the Sweet Home TSP Update.

TRANSPORTATION ANALYSIS ZONES

For transportation forecasting purposes, the Sweet Home UGB was divided into 40 transportation analysis zones (TAZs), which represent the location of various land uses and sources of vehicle trip generation within the city. These TAZ boundaries were determined based on geographical and physical features allowing the best representation of access for an area, along with maintaining homogenous land use types as much as possible (e.g. residential, commercial, etc.). Centroid

connectors were located to best represent access to the street network and major parking facilities. Additionally, there are 4 rural zones that are located to the north of Sweet Home. These rural zones are included to capture land use and trip patterns interactions with areas inside the UGB. The internal TAZs are shown in Figure 1.

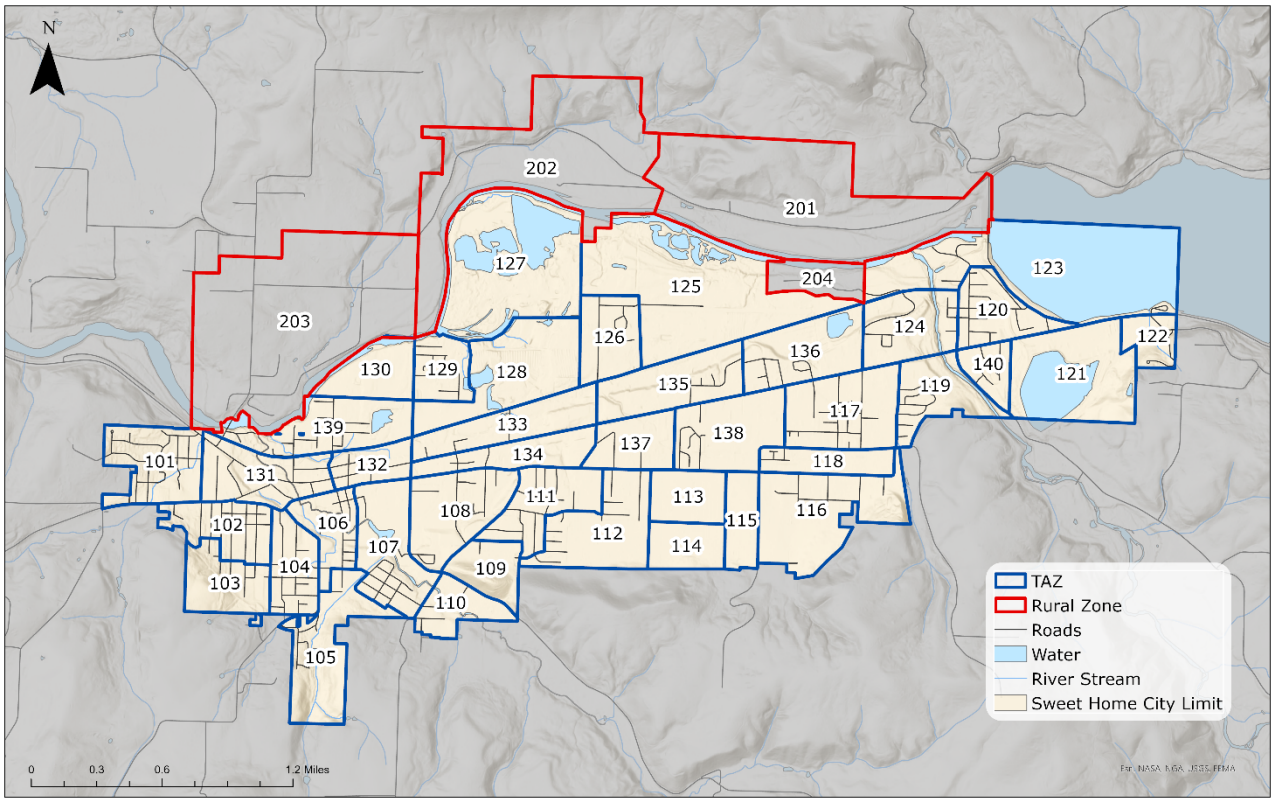

FIGURE 1: SWEET HOME TAZ MAP

LAND USE

Land use is a key factor affecting travel demands placed on Sweet Home's transportation system. The location, density, type, and mix of land uses have a direct impact on traffic levels and patterns. An existing 2021 land use inventory and future 2045 land use projection were performed for each TAZ in the Sweet Home UGB based on existing uses, zoning, and anticipated development patterns.

The housing and employment forecasts used for this TSP analysis relied heavily on three key sources of data:

- The Portland State University Population Research Center prepared the *Coordinated Population Forecast, 2015 through 2065, for Sweet Home County Urban Growth Boundaries (UGB) and Area Outside UGBs,* which provided the population forecast data.

- The *2021 American Community Survey*, which provided average persons per household data.
- Oregon Employment Department inventory of Covered Employers and Employment that summarizes the job type and location of employers

The base 2021 land use inventory approximated the number of households and the amount of retail employment, service employment, educational employment, and other employment that currently exist in each TAZ. Existing employment land uses within Sweet Home were obtained from Oregon Employment Department data and a review of other data sources (tax assessor data, census data, and zoning data and compared with existing aerial photography). The existing land uses correspond to a population of 9,461 residents, which is based on Portland State University Population Research Center estimates. This corresponds to approximately 3,931 households based on an average household size of 2.46 (US Census data).

The future 2045 land use projection is an estimate of the amount of each land use (household and employment) that the TAZ could reasonably accommodate given market conditions and current build-out of vacant or underdeveloped lands assuming Comprehensive Plan zoning. The projected land uses correspond to a year 2045 population projection of approximately 11,246 residents, which corresponds to a 19 percent growth through the planning horizon.

A summary of the existing land use estimates and future projections for the entire Sweet Home UGB is listed in Table 1.

Table 1. Sweet Home UGB Land Use Summary

Land Use / Growth Category	Existing 2020 Quantities	Total Growth 2020 to 2044	Future 2045 Quantities
Population	9,461	1,785 (+19%)	11,246
Households	3,931	641 (+16%)	4,572
Employees			
Retail	x	x	x
Service	x	x	x
Education	x	x	x
Other	x	x	x
Total	x	x	x

TRAVEL DEMANDS

Travel demand on roadways and at intersections in Sweet Home was estimated using the ODOT APM V2 methodology for the EZCA method. This methodology included estimating all vehicle trips (not just growth increment), adjusting the trip distribution to reduce household-to-household trips, and using Visum modeling software to perform the trip assignment. Travel forecasting was performed for the 30th highest hour conditions for both 2021 and 2045. The purpose of the 2021 forecast tool was to calibrate the network in preparation for developing the 2045 network, which would then be used for future analysis.

The travel demand analysis includes the translation of City land use information into motor vehicle trips. This was done for each of the TAZs based on the existing and projected land uses described previously in the Land Use section of this memorandum. Trips traveling to and from the external TAZs were also estimated for both the 2021 and 2045 analysis years. This section of the memorandum describes the methodology used to determine the different trip types and how the trips were distributed and assigned to the roadway network.

TRIP TYPES

Travel forecast projections involve the determination of three distinct types of trips, which are categorized based on whether their origin and/or destination (i.e., the trip ends) are internal or external to the Sweet Home UGB. The three trip types and how they apply to Sweet Home are:

- **External-External (E-E) Trips** do not have an origin or destination in Sweet Home and either do not stop or only make a very minor stop while passing through the Sweet Home UGB. These trips are typically referred to as "through traffic." An example would be a person from Corvallis traveling on US 20 while heading to Bend.
- **Internal-External (I-E) Trips** originate in Sweet Home and are traveling to a location outside of the Sweet Home UGB (e.g., someone working in Sweet Home that returns north to Lebanon in the evening), while **External-Internal (E-I) Trips** originate outside of the Sweet Home UGB and are traveling to a location within Sweet Home (e.g., someone from Lebanon traveling into Sweet Home for shopping).
- **Internal-Internal (I-I) Trips** travel from one location within the Sweet Home UGB to another location within the UGB. An example would be a person traveling between their office and home within Sweet Home.

EXTERNAL TRIP ENDS

External trip ends are the origin and/or destination of E-E, I-E, or E-I trips and were estimated for both 2021 and 2045 and for 30th highest hour conditions at each of the gateways.

The number of 2021 external trip ends was based on existing traffic volumes at key gateways to the city:

- North: US 20 north of Osage St

- East: Oregon 228 (Halsey-Sweet Home Highway) east of Fern Ridge Rd/Rowell Hill Rd
- South: Old Holley Road east of Elkhorn St
- South: 21st Avenue southwest of Cedar St
- South: Ames Creek Road west of Surrey Ln
- South: 43rd Avenue south of Coulter Ln
- South: 50th Ave to the south of Airport Rd
- South: Wiley Creek Road east of Riggs Hill Rd
- East: Shea Hill Drive east Riggs Hill Rd
- East: US 20 east of Riggs Hill Rd/Shea Viewpoint
- North: N River Drive east of Foster Dam Rd
- North: Pleasant Valley Road north of Northside Drive

Replica[1], a web-based data model that includes travel estimation, was used to estimate the portion of through traffic compared to the portion of traffic with either an origin or destination within Sweet Home. The Replica data model is based on "big data" (mobile network) sources and reflects travel trends experienced over a duration of time. The datasets provides an estimate of travel behavior based on sampled conditions. The regional travel patterns and trip types are summarized in Table 2.

Table 2. Regional Travel Patterns Observed at External Gateways

	Percent Entering Traffic		Percent Exiting Traffic	
Gateway	With a Destination in Sweet Home	With an External Destination	With an Origin in Sweet Home	With an External Origin
North: US 20 north of Osage St	72%	28%	87%	13%
East: Oregon 228 east of Fern Ridge Rd/Rowell Hill Rd	78%	22%	72%	28%
South: Old Holley Road east of Elkhorn St	78%	22%	83%	17%
South: 21st Avenue southwest of Cedar St	39%	61%	35%	65%
South: Ames Creek Road west of Surrey Ln	51%	49%	40%	60%
South: 43rd Avenue south of Coulter Ln	57%	43%	50%	50%
South: 50th Ave to the south of Airport Rd	50%	50%	55%	45%

[1] https://www.replicahq.com/

South: Wiley Creek Road east of Riggs Hill Rd	40%	60%	52%	49%
East: Shea Hill Drive east Riggs Hill Rd	50%	50%	25%	75%
East: US 20 east of Riggs Hill Rd/Shea Viewpoint	20%	80%	17%	83%
North: N River Drive east of Foster Dam Rd	45%	55%	35%	65%
North: Pleasant Valley Road north of Northside Drive	67%	33%	65%	35%
Average of All Gateways	**54%**	**46%**	**51%**	**49%**

Source: Replica Trip Count Data taken from 3:00-7:00pm

Table 2 indicates that the majority of external gateways have a trip end (origin or destination) in Sweet Home. Approximately 20 to 60 percent of external trips (varies by location) are also destined to another external location as a "through trip." The east end of US 20 includes the highest portion of external trips – approximately 80 percent of these trips travel through Sweet Home.

The external trip ends that have an internal pair are modeled to pair with the internal trip ends of corresponding land uses within the city (e.g., housing and employment). This modeling process is explained further in the "Trip Distribution" section of this memorandum.

Growth estimates were applied to each gateway to determine 2045 external trip ends for through traffic. The ODOT Future Projected Annual Average Daily Traffic Tables provided data for estimating future growth. The annual growth rates and associated growth factors for each external gateway are shown in Table 3.

Table 3. External Gateway Growth Forecasts for Sweet Home

Gateway	2021 AADT	2041 AADT	Annual Growth Rate	Growth Factor (From 2021 to 2041)
US 20, east of Osage St	10614	11000	0.18%	1.04
OR 228, east of Fern Ridge Rd	4318	4500	0.21%	1.04
US 20, east if Riggs Hill Rd	2262	2400	0.31%	1.06

Source: ODOT Future Projected Annual Average Daily Traffic Tables, Calculated annual growth forecasts

As listed in Table 3, traffic volumes at external gateways are expected to grow by four to six percent total over the 20 year period of 2021 to 2041.

INTERNAL TRIP ENDS

The number of internal trip ends in Sweet Home was determined using a land use-based trip generation methodology, which translates land use quantities (number of dwelling units or number of employees) into vehicle trip ends (number of vehicles entering or leaving a TAZ) based on empirically-derived trip generation rates. Weekday PM peak hour trip generation rates used in the forecast tool are listed in Table 4 for the applicable land uses. These rates were generally developed based on the Institute of Transportation Engineers (ITE) *Trip Generation Manual* and calibrated to observed traffic counts in Sweet Home.

Table 4. Average Weekday PM Peak Hour Trip Generation Rates by Land Use

Land Use	Trips In	Trips Out	Total Trip Ends
Single-family households (per dwelling unit)	0.50	0.30	0.80
Multi-family households (per dwelling unit)	0.40	0.20	0.60
Retail (per employee)	1.88	2.12	4.00
Service (per employee)	0.66	0.84	1.50
Education (per employee)	1.44	1.56	3.00
Other (per employee)	0.05	0.25	0.30

Source: Institute of Transportation Engineers Trip Generation Manual and local traffic counts

By applying these trip generation rates to the TAZ land uses, the number of trips entering and exiting each TAZ in Sweet Home was estimated. Internal trip estimates were obtained for both the existing 2021 land uses and the projected 2045 land uses.

TRIP DISTRIBUTION

Trip distribution was performed to estimate how many trips travel between each of the internal TAZs. Distribution for trips traveling to and from internal zones (i.e., trips having at least one internal trip end) was based on weighting the attractiveness of each zone, as measured by the number of trip ends generated by the zone.

The forecasting model is based on a trip table that describes the internal and external trip ends for each trip within the network. To develop this trip table, External-to-External (E-E) trips are

matched based on the external trip probabilities. Next, all remaining external trips (I-E and E-I) are paired with appropriate internal trip ends. These trips represent the inbound and outbound travel for Sweet Home residents and employees, respectively. Finally, the Internal-Internal (I-I) trip pairs are determined based on the land uses within Sweet Home. Note that the rural zones adjacent to Sweet Home (but outside the UGB) were also considered for I-I trip purposes.

TRIP ASSIGNMENT

Trip assignment involves the determination of the specific travel routes taken by the trips within the transportation network. This step was performed using Visum modeling software. Forecast tool inputs included the transportation network (i.e., road and intersection locations and characteristics, as determined from maps and field inventories) and a trip distribution table (described in prior sections). Iterated equilibrium assignment was then performed using estimated travel times along roadways and delays at intersection movements. The path choice for each trip was based on minimal travel times between locations. Forecast tool outputs include traffic volumes on roadway segments and at intersections.

CALIBRATION

Calibration will be performed on the 2021 base year forecast tools by comparing forecast tool turn volumes at the Sweet Home TSP study intersections with actual counted (measured) 2021 traffic volumes. A plot comparing the measured traffic volumes and the base year forecast tool volumes for all study intersection turn movements will be analyzed to evaluate the accuracy of each forecast tool.

FORECAST TOOL VOLUMES AND POST-PROCESSING

Forecast tool traffic growth plots (2045 minus 2021) for the design hour forecast tool will be included in the appendix. While the travel demand forecast tools were calibrated to local conditions and volumes, raw volumes from the tools are not used for capacity analysis. Rather, motor vehicle turn movement volume forecasts will be developed using post-processing methods consistent with the ODOT APM V2. This approach is derived from methodologies outlined in the National Cooperative Highway Research Program (NCHRP) Report 765, *Analytical Travel Forecasting Approaches for Project-Level Planning and Design*.

The post-processing methodology involves estimating trip growth at the intersection approach level (i.e., volume differences between base and future forecast tools), scaling the growth by the number of forecast years (i.e., forecast years divided by difference in forecast tool years), and adding these volumes to existing traffic counts. Engineering judgment is used as part of the post-processing methodology, with the routing decisions identified by the forecasting tool serving as a reference for making volume adjustments. The results of this process are future year forecasts derived from the Sweet Home enhanced cumulative analysis forecasting tool that are calibrated to observed data. The year 2045 traffic volume forecasts will serve as a future base volume forecast from which future conditions will be evaluated in subsequent memoranda.

Attachments:

- Figure A1 – Household Growth by TAZ

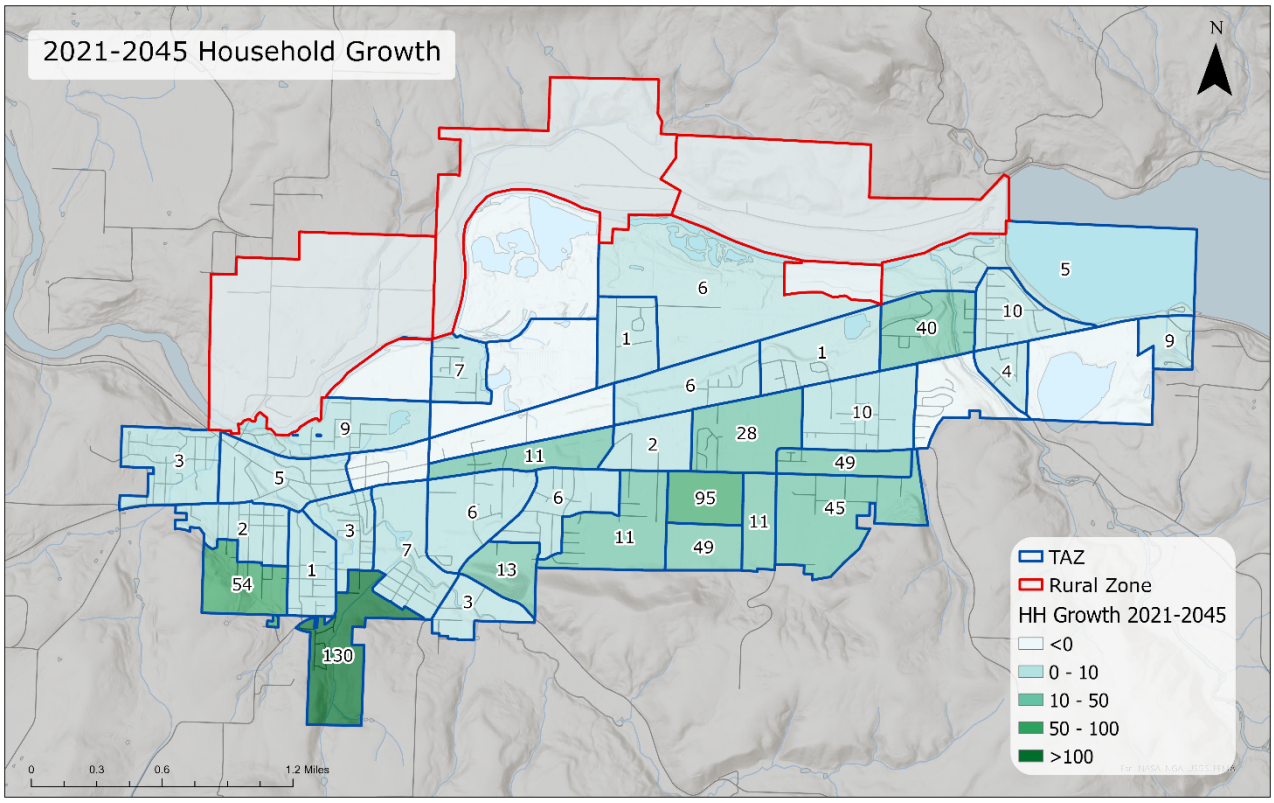

FIGURE A1: SWEET HOME 2021-2045 HOUSEHOLD GROWTH