



MEMORANDUM

DATE: October 14, 2022
 TO: Nicole McDermott, AICP | WSP
 FROM: Reah Flisakowski, PE | DKS Associates
 SUBJECT: Camas North Shore Subarea Plan – Trip Generation and Roadway Connectivity Assessment

This memorandum documents the trip generation estimate and roadway connectivity assessment that was prepared to support the Camas North Shore Subarea Plan. The methodology, evaluation and findings are summarized in the following sections.

TRIP GENERATION

Trip generation is the method used to estimate the number of vehicles that would be added to the surrounding roadway network as a result of development of the concept plan. The trip generation estimate was based on the draft subarea concept plan (dated July 14, 2022) shown below and a summary of developable lands and resulting buildout land use estimates provided by the project team. The preferred concept plan includes a variety of land uses; mixed employment, mixed use, commercial, education, high density residential and low density residential with significant park and open space area.

FIGURE 1: SUBAREA CONCEPT PLAN





The trip generation estimate represents anticipated vehicle trips during the weekday evening (PM) peak hour. The estimate was prepared using data and methodologies provided in the current ITE 11th Edition Trip Generation Manual and ITE Trip Generation Handbook. The trip estimate was based on ITE land use categories that best represent the concept plan designations and the variety of potential future development. The ITE land use category descriptions are included in the appendix. The trip estimates for commercial uses applied a passby trip reduction to account for customers that would already be driving by a development which is not considered a new vehicle trip. The trip generation estimate is shown in Table 1.

TABLE 1: VEHICLE TRIP GENERATION ESTIMATE

CONCEPT PLAN LAND USE	ITE LAND USE	ITE CODE	SIZE*	WEEKDAY PM PEAK HOUR TRIPS		
				IN	OUT	TOTAL
Business Park/ Light Industrial	Industrial Park	130	817 EMP	68	275	343
Commercial	Shopping Plaza with Supermarket	821	116 KSF	502	545	1,047
	<i>Passby Trips (40%)</i>			-201	-218	-419
North Shore Mixed Use	Shopping Plaza	821	264 KSF	671	699	1,370
	<i>Passby Trips (30%)</i>			-201	-210	-411
	Multifamily Housing (Low-Rise)			220	566 DU	182
	Multifamily Housing (Mid-Rise)	221	566 DU	135	86	221
North Shore Residential (Higher Density)	Single-Family Detached Housing	210	114 DU	67	40	107
	Single-Family Attached Housing	215	341 DU	110	84	194
	Multifamily Housing (Low-Rise)	220	341 DU	110	64	174
	Multifamily Housing (Mid-Rise)	221	341 DU	81	52	133
North Shore Residential (Lower Density)	Single-Family Detached Housing	210	700 DU	415	243	658
Parks/Open Space	Public Park	411	77 AC	4	4	8
School	Elementary School	520	330 STU	24	29	53
INITIAL NEW TRIPS				1,967	1,800	3,767
PASSBY TRIP REDUCTION				-402	-428	-830
NET NEW TRIPS				1,565	1,373	2,937

*KSF= 1,000 square feet, EMP = employees, DU = dwelling units, AC = acres, STU = students



The North Shore Mixed Use residential areas were separated evenly into multifamily low-rise and mid-rise development to account for a variety of housing types. Similarly, the North Shore Residential (Higher Density) area was separated into a variety of developments ranging from single-family detached to multifamily mid-rise housing.

The weekday (Monday to Friday) PM peak hour was selected for the trip generation estimate to correspond with the evening commute period which is the time of day that experiences the highest traffic volumes on the surrounding street network. The majority of land uses with the planning area are expected to generate the highest hourly trips during the weekday PM peak hour. Exceptions are the public park and elementary school uses. The public park is planned to include a boat launch and trailhead, with peak trip generation occurring during weekend afternoons. The elementary school peak trip generation would occur during the weekday morning and afternoon peak hours. The PM peak hour captures school staff leaving work and afterschool events.

A portion of the net new trips generated by the plan designations (shown in Table 1) would begin and end within the subarea boundary. For example, residents in the North Shore area could be customers at the local grocery store, have children attend the elementary school and work at the business park. Based on the mix of land uses and level of planned development, approximately 30% of trips would occur within the subarea boundary and 70% would travel outside the boundary. The internal and external trip estimate is shown in Table 2.

TABLE 2: INTERNAL AND EXTERNAL TRIP ESTIMATE

	WEEKDAY PM PEAK HOUR TRIPS		
	IN	OUT	TOTAL
NET NEW TRIPS	1,565	1,373	2,937
TRIPS WITHIN SUBAREA BOUNDARY (30%)	469	412	881
TRIPS OUTSIDE SUBAREA BOUNDARY (70%)	1,095	961	2,056

The buildout of the North Shore subarea was compared to the initial land use growth used to prepare the Camas Transportation Plan (TP) that is in progress. The North Shore subarea land use estimates are higher for residential growth and relatively close for employment growth. The TP land use growth and resulting transportation operations will be updated to ensure the future transportation system can adequately accommodate the new North Shore land use designations.

ROADWAY CONNECTIVITY ASSESSMENT

The subarea concept plan includes multiple connections to the surrounding public street network. These roadway connections are described below and identified in Figure 2 with a red asterisk.

- #1 – NE 232nd Avenue extending to the east as North Shore Blvd was recently constructed along the frontage of Lacamas Lake Elementary School. The existing North Shore Blvd is planned to extend east to provide a Major Road connection through the subarea.
- #2 – The extension of NE 3rd Street (North Shore Blvd) to the west is planned as a Major Road connection between the central portion of the subarea and SR 500.
- #3 – A new Minor Road connection to SR 500 at NE Everett Drive is planned to connect through the subarea.
- #4 – The extension of SE 8th Street east of SR 500 as a Minor Road is planned to connect the east side of the subarea.
- #5 – The existing Leadbetter Road, which connects to SR 500 today, is planned for limited vehicle access to serve the park area and Lacamas Lake boat launch in the subarea.

FIGURE 2: SUBAREA CONCEPT PLAN ROADWAY CONNECTIONS





Approximately 2,056 PM peak hour trips (1,095 entering and 961 exiting) are estimated to travel outside the subarea boundary. This estimate was used to conduct a high-level assessment of the planned roadway connections to the subarea. With buildout of the subarea, the proposed roadway connections are expected to provide adequate roadway capacity to support the land use designations. The subarea will develop over time and the roadway network needed to serve new trips will be determined at the development application level.

APPENDIX

Land Use: 130 Industrial Park

Description

An industrial park contains several individual industrial or related facilities. It is characterized by a mix of manufacturing, service, and warehouse facilities with a wide variation in the proportion of each type of use from one location to another. Many industrial parks contain highly diversified facilities. Some parks in the database have a large number of small businesses and others have one or two dominant industries. General light industrial (Land Use 110) and manufacturing (Land Use 140) are related uses.

Additional Data

The sites were surveyed in the 1980s, the 2000s, 2010s, and the 2020s in California, Georgia, New Jersey, Massachusetts, New York, Ontario (CAN), and Pennsylvania.

Source Numbers

106, 162, 184, 251, 277, 422, 706, 747, 753, 937, 1032, 1070

Land Use: 210

Single-Family Detached Housing

Description

A single-family detached housing site includes any single-family detached home on an individual lot. A typical site surveyed is a suburban subdivision.

Specialized Land Use

Data have been submitted for several single-family detached housing developments with homes that are commonly referred to as patio homes. A patio home is a detached housing unit that is located on a small lot with little (or no) front or back yard. In some subdivisions, communal maintenance of outside grounds is provided for the patio homes. The three patio home sites total 299 dwelling units with overall weighted average trip generation rates of 5.35 vehicle trips per dwelling unit for weekday, 0.26 for the AM adjacent street peak hour, and 0.47 for the PM adjacent street peak hour. These patio home rates based on a small sample of sites are lower than those for single-family detached housing (Land Use 210), lower than those for single-family attached housing (Land Use 251), and higher than those for senior adult housing -- single-family (Land Use 251). Further analysis of this housing type will be conducted in a future edition of *Trip Generation Manual*.

Additional Data

The technical appendices provide supporting information on time-of-day distributions for this land use. The appendices can be accessed through either the ITETripGen web app or the trip generation resource page on the ITE website (<https://www.ite.org/technical-resources/topics/trip-and-parking-generation/>).

For 30 of the study sites, data on the number of residents and number of household vehicles are available. The overall averages for the 30 sites are 3.6 residents per dwelling unit and 1.5 vehicles per dwelling unit.

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in Arizona, California, Connecticut, Delaware, Illinois, Indiana, Kentucky, Maryland, Massachusetts, Minnesota, Montana, New Jersey, North Carolina, Ohio, Ontario (CAN), Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Vermont, Virginia, and West Virginia.

Source Numbers

100, 105, 114, 126, 157, 167, 177, 197, 207, 211, 217, 267, 275, 293, 300, 319, 320, 356, 357, 367, 384, 387, 407, 435, 522, 550, 552, 579, 598, 601, 603, 614, 637, 711, 716, 720, 728, 735, 868, 869, 903, 925, 936, 1005, 1007, 1008, 1010, 1033, 1066, 1077, 1078, 1079

Land Use: 215

Single-Family Attached Housing

Description

Single-family attached housing includes any single-family housing unit that shares a wall with an adjoining dwelling unit, whether the walls are for living space, a vehicle garage, or storage space.

Additional Data

The database for this land use includes duplexes (defined as a single structure with two distinct dwelling units, typically joined side-by-side and each with at least one outside entrance) and townhouses/rowhouses (defined as a single structure with three or more distinct dwelling units, joined side-by-side in a row and each with an outside entrance).

The technical appendices provide supporting information on time-of-day distributions for this land use. The appendices can be accessed through either the ITETripGen web app or the trip generation resource page on the ITE website (<https://www.ite.org/technical-resources/topics/trip-and-parking-generation/>).

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in British Columbia (CAN), California, Georgia, Illinois, Maryland, Massachusetts, Minnesota, New Jersey, Ontario (CAN), Oregon, Pennsylvania, South Dakota, Utah, Virginia, and Wisconsin.

Source Numbers

168, 204, 211, 237, 305, 306, 319, 321, 357, 390, 418, 525, 571, 583, 638, 735, 868, 869, 870, 896, 912, 959, 1009, 1046, 1056, 1058, 1077

Land Use: 220

Multifamily Housing (Low-Rise)

Description

Low-rise multifamily housing includes apartments, townhouses, and condominiums located within the same building with at least three other dwelling units and that have two or three floors (levels). Various configurations fit this description, including walkup apartment, mansion apartment, and stacked townhouse.

- A walkup apartment typically is two or three floors in height with dwelling units that are accessed by a single or multiple entrances with stairways and hallways.
- A mansion apartment is a single structure that contains several apartments within what appears to be a single-family dwelling unit.
- A fourplex is a single two-story structure with two matching dwelling units on the ground and second floors. Access to the individual units is typically internal to the structure and provided through a central entry and stairway.
- A stacked townhouse is designed to match the external appearance of a townhouse. But, unlike a townhouse dwelling unit that only shares walls with an adjoining unit, the stacked townhouse units share both floors and walls. Access to the individual units is typically internal to the structure and provided through a central entry and stairway.

Multifamily housing (mid-rise) (Land Use 221), multifamily housing (high-rise) (Land Use 222), affordable housing (Land Use 223), and off-campus student apartment (low-rise) (Land Use 225) are related land uses.

Land Use Subcategory

Data are presented for two subcategories for this land use: (1) not close to rail transit and (2) close to rail transit. A site is considered close to rail transit if the walking distance between the residential site entrance and the closest rail transit station entrance is ½ mile or less.

Additional Data

For the three sites for which both the number of residents and the number of occupied dwelling units were available, there were an average of 2.72 residents per occupied dwelling unit.

For the two sites for which the numbers of both total dwelling units and occupied dwelling units were available, an average of 96.2 percent of the total dwelling units were occupied.

The technical appendices provide supporting information on time-of-day distributions for this land use. The appendices can be accessed through either the ITETripGen web app or the trip

generation resource page on the ITE website (<https://www.ite.org/technical-resources/topics/trip-and-parking-generation/>).

For the three sites for which data were provided for both occupied dwelling units and residents, there was an average of 2.72 residents per occupied dwelling unit.

It is expected that the number of bedrooms and number of residents are likely correlated to the trips generated by a residential site. To assist in future analysis, trip generation studies of all multifamily housing should attempt to obtain information on occupancy rate and on the mix of residential unit sizes (i.e., number of units by number of bedrooms at the site complex).

The sites were surveyed in the 1980s, the 1990s, the 2000s, the 2010s, and the 2020s in British Columbia (CAN), California, Delaware, Florida, Georgia, Illinois, Indiana, Maine, Maryland, Massachusetts, Minnesota, New Jersey, Ontario (CAN), Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Utah, and Washington.

Source Numbers

188, 204, 237, 300, 305, 306, 320, 321, 357, 390, 412, 525, 530, 579, 583, 638, 864, 866, 896, 901, 903, 904, 936, 939, 944, 946, 947, 948, 963, 964, 966, 967, 1012, 1013, 1014, 1036, 1047, 1056, 1071, 1076

Land Use: 221

Multifamily Housing (Mid-Rise)

Description

Mid-rise multifamily housing includes apartments and condominiums located in a building that has between four and 10 floors of living space. Access to individual dwelling units is through an outside building entrance, a lobby, elevator, and a set of hallways.

Multifamily housing (low-rise) (Land Use 220), multifamily housing (high-rise) (Land Use 222), off-campus student apartment (mid-rise) (Land Use 226), and mid-rise residential with ground-floor commercial (Land Use 231) are related land uses.

Land Use Subcategory

Data are presented for two subcategories for this land use: (1) not close to rail transit and (2) close to rail transit. A site is considered close to rail transit if the walking distance between the residential site entrance and the closest rail transit station entrance is ½ mile or less.

Additional Data

For the six sites for which both the number of residents and the number of occupied dwelling units were available, there were an average of 2.5 residents per occupied dwelling unit.

For the five sites for which the numbers of both total dwelling units and occupied dwelling units were available, an average of 96 percent of the total dwelling units were occupied.

The technical appendices provide supporting information on time-of-day distributions for this land use. The appendices can be accessed through either the ITETripGen web app or the trip generation resource page on the ITE website (<https://www.ite.org/technical-resources/topics/trip-and-parking-generation/>).

It is expected that the number of bedrooms and number of residents are likely correlated to the trips generated by a residential site. To assist in future analysis, trip generation studies of all multifamily housing should attempt to obtain information on occupancy rate and on the mix of residential unit sizes (i.e., number of units by number of bedrooms at the site complex).

The sites were surveyed in the 1990s, the 2000s, the 2010s, and the 2020s in Alberta (CAN), California, District of Columbia, Florida, Georgia, Illinois, Maryland, Massachusetts, Minnesota, Montana, New Jersey, New York, Ontario (CAN), Oregon, Utah, and Virginia.

Source Numbers

168, 188, 204, 305, 306, 321, 818, 857, 862, 866, 901, 904, 910, 949, 951, 959, 963, 964, 966, 967, 969, 970, 1004, 1014, 1022, 1023, 1025, 1031, 1032, 1035, 1047, 1056, 1057, 1058, 1071, 1076

Land Use: 411

Public Park

Description

A public park is owned and operated by a municipal, county, state, or federal agency. The parks surveyed vary widely as to location, type, and number of facilities, including boating or swimming facilities, beaches, hiking trails, ball fields, soccer fields, campsites, and picnic facilities. Seasonal use of the individual sites differs widely as a result of the varying facilities and local conditions, such as weather. For example, some of the sites are used primarily for boating or swimming; others are used for softball games. Soccer complex (Land Use 488) is a related use.

Additional Data

The percentage of the park area that is used most intensively varies considerably within the studies contained in this land use. Therefore, caution should be used when using acres as an independent variable.

The technical appendices provide supporting information on time-of-day distributions for this land use. The appendices can be accessed through either the ITETripGen web app or the trip generation resource page on the ITE website (<https://www.ite.org/technical-resources/topics/trip-and-parking-generation/>).

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in Arizona, California, New Jersey, New York, North Carolina, and Oregon.

Source Numbers

186, 392, 407, 709, 729, 852, 905

Land Use: 520

Elementary School

Description

An elementary school is a public school that typically serves students attending kindergarten through the fifth or sixth grade. An elementary school is usually centrally located in a residential community to facilitate student access. Bus service is commonly provided to students living beyond a specified distance from the school. Middle school/junior high school (Land Use 522), private school (K-8) (Land Use 530), private school (K-12) (Land Use 532), charter elementary school (Land Use 536), and charter school (K-12) (Land Use 538) are related uses.

Additional Data

Elementary school students generally used school buses more than regular transit and were dropped off and picked up more than high school students, who were apt to walk longer distances, ride bicycles, or, in some cases, drive to school. The percentage of students at the sites who were transported to school via bus varied considerably. Some sites experienced higher than average trip rates because many students did not utilize the available school bus service. Due to the varied transit and school bus usage at these sites, it is desirable that future studies report additional detail on the percentage of students who were bused to school and the percentage that were dropped off and picked up.

The technical appendices provide supporting information on time-of-day distributions for this land use. The appendices can be accessed through either the ITETripGen web app or the trip generation resource page on the ITE website (<https://www.ite.org/technical-resources/topics/trip-and-parking-generation/>).

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in Alabama, Arizona, British Columbia (CAN), California, Connecticut, Florida, Hawaii, Minnesota, Montana, Nevada, New York, Oregon, Texas, Utah, Washinton, and West Virginia.

Source Numbers

186, 383, 390, 395, 533, 536, 572, 579, 583, 609, 611, 612, 613, 632, 707, 852, 856, 858, 866, 877, 878, 896, 940, 1039, 1048, 1067, 1083

Land Use: 821

Shopping Plaza (40-150k)

Description

A shopping plaza is an integrated group of commercial establishments that is planned, developed, owned, and managed as a unit. Each study site in this land use has between 40,000 and 150,000 square feet of gross leasable area (GLA). The term “plaza” in the land use name rather than “center” is simply a means of distinction between the different shopping center size ranges. Various other names are commonly used to categorize a shopping plaza within this size range, depending on its specific size and tenants, such as neighborhood center, community center, and fashion center.

Its major tenant is often a supermarket but many sites are anchored by home improvement, discount, or other stores. A shopping plaza typically contains more than retail merchandising facilities. Office space, a movie theater, restaurants, a post office, banks, a health club, and recreational facilities are common tenants. A shopping plaza is almost always open-air and the GLA is the same as the gross floor area of the building.

The 150,000 square feet GLA threshold value between shopping plaza and shopping center (Land Use 820) is based on an examination of trip generation data. For a shopping plaza that is smaller than the threshold value, the presence or absence of a supermarket within the plaza has a measurable effect on site trip generation. For a shopping center that is larger than the threshold value, the trips generated by its other major tenants mask any effects of the presence or absence of an on-site supermarket.

The 40,000 square feet GFA threshold between shopping plaza and strip retail plaza (Land Use 822) was selected based on an examination of the overall shopping center/plaza database. No shopping plaza with a supermarket as its anchor is smaller than 40,000 square feet GLA.

Shopping center (>150k) (Land Use 820), strip retail plaza (<40k) (Land Use 822), and factory outlet center (Land Use 823) are related uses.

Land Use Subcategory

The presence or absence of a supermarket in a shopping plaza has been determined to have a measurable effect on site trip generation. Therefore, data are presented for two subcategories for this land use: sites with a supermarket anchor and sites without a supermarket.

Additional Data

The technical appendices provide supporting information on time-of-day distributions for this land use. The appendices can be accessed through either the ITETripGen web app or the trip generation resource page on the ITE website (<https://www.ite.org/technical-resources/topics/trip-and-parking-generation/>).

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in Alberta (CAN), British Columbia (CAN), California, Connecticut, District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Minnesota, Nevada, New Jersey, New York, Ontario (CAN), Oregon, Pennsylvania, South Dakota, Texas, Vermont, Virginia, Washington, and Wisconsin.

Source Numbers

105, 110, 156, 159, 186, 198, 204, 211, 213, 239, 259, 260, 295, 301, 304, 305, 307, 317, 319, 358, 376, 390, 400, 404, 437, 444, 446, 507, 580, 598, 658, 728, 908, 926, 944, 946, 960, 973, 974, 1004, 1009, 1025, 1069