Pleasant Valley North Carver
COMPREHENSIVE PLAN

AGENDA

Technical Advisory Committee - Meeting #8

Thursday, October 17, 2019
3:00 – 5:00 PM
Happy Valley City Hall – Council Chambers
16000 SE Misty Drive, Happy Valley, OR

ITEM	TIME
Welcome and Introductory Items a. Welcome - Michael Walter b. Where we are in the process and today's agenda – Joe Dills, APG	3:00-3:10 PM
Refresher on Plans Created to Date *This is an informational item, as requested by the CAC in September. See attached materials. A summary presentation will be made at the meeting.*	3:10-3:25 PM
Draft Parks Plan *How many and what types of parks will be needed for Pleasant Valley/North Carver as it develops over time? An analysis has been prepared to address this question – see attached memorandum.* a. Presentation – Steve Duh, Conservation Technix b. Discussion c. TAC Direction – The request from the project team is: What comments does the TAC have on the Parks Plan materials to forward to the CAC?	3:25-4:00 PM
Transportation Analysis a. Presentation – Reah Flisakowski, DKS Associates b. Discussion c. TAC Direction – The request from the project team is: What comments does the TAC have on the transportation analysis to forward to the CAC?	4:00-4:50 PM
Next Steps a. Next Steps – Next meeting: December 5, 2019	4:50 – 5:00 PM

The meeting location is accessible to persons with disabilities. To request accommodations, please contact the City Recorder at (503) 783-3836 48 hours before the meeting.

Pleasant Valley North Carver
COMPREHENSIVE PLAN

MEMORANDUM

"Refresher" Plan Set – Progress to Date

Pleasant/Valley North Carver Comprehensive Plan

DATE October 10, 2019

TO Project Committees

FROM Joe Dills, Angelo Planning Group

As requested by the Community Advisory Committee (CAC), attached is a "refresher" set of plan concepts and maps showing progress to date on the Pleasant Valley/North Carver Comprehensive Plan. This is a selective compilation of the key concepts and working recommendations for the plan. Background analyses and progress drafts are available on the project web site (See CAC Agendas and Packets).

Attached are:

- Vision and Guiding Principles
- Plan Area – By The Numbers
- The Plan Area Today – Context and Landscape
- Plan Concepts – Walkable Neighborhoods
- Map – Walkable Neighborhoods Framework
- Refined Land Use Plan (includes CAC Recommendations, June 2019)
- Refined Land Use Plan Metrics (September 12, 2019)
- Plan Concepts – Pleasant Valley Downtown District
- Pleasant Valley Downtown District – Options
- Plan Concepts – North Carver Waterfront District
- North Carver Downtown District – Options
- Refined Street Network Plan (includes CAC Recommendations, June 2019)
- Plan Concepts – Foster Parkway Design Options
- Refined Plan Bikeways and Trail Network (includes CAC Recommendations, June 2019)

Pleasant Valley North Carver
COMPREHENSIVE PLAN

MEMORANDUM

Vision and Guiding Principles

Pleasant Valley/North Carver Comprehensive Plan

DATE December 5, 2018

TO PV/NC Comprehensive Plan TAC and CAC Members

FROM Joe Dills and Jamin Kimmell, Angelo Planning Group

The purpose of this memo is to document a draft vision statement and set of guiding principles for the Pleasant Valley/North Carver (PV/NC) Comprehensive Plan. The vision and principles set forth key ideas that will shape the development and implementation of the plan. They were drafted based on input received from the first meetings of the Technical Advisory Committee (TAC) and Community Advisory Committee (CAC) on October 11, 2018.

VISION STATEMENT

The Pleasant Valley/North Carver area is an integral part of the growing Happy Valley community, and a natural extension of East Happy Valley. The area is comprised of a network of walkable neighborhoods, vibrant mixed-use centers, and thriving employment areas. The natural beauty of the landscape is embraced, the ecological health of the area is preserved and enhanced through environmental stewardship, and nature is made part of every neighborhood. The Carver riverfront has been transformed to include great public access and unique destinations. The area is supported by a resilient and safe network of streets, transit service, infrastructure, high-quality schools, and attractive parks and trails.

GUIDING PRINCIPLES

Promote a Sense of Community. All development is planned and design to create a strong identity and sense of community in Pleasant Valley and North Carver.

Preserve and Celebrate Nature. Nature is protected, celebrated, and integrated into the community. Stream and habitat corridors are preserved and enhanced to ensure they can provide critical ecological functions. People can experience nature up-close through a network of parks and trails. People can appreciate nature from afar, in everyday situations, though views of rolling hills and forested buttes.

Form Walkable, Welcoming Neighborhoods. Neighborhoods are more than a collection of housing. Neighborhoods feel and function like villages: welcoming communities that make room for people of all ages, abilities, and life experiences. Within each neighborhood, housing options include family-sized homes, compact cottages, and livable townhomes and apartments where appropriate. Streets and blocks are designed for walking and local shops and services are within walking distance.

Create Vibrant, Mixed-Use Centers. People gather in town centers to shop, play, and celebrate as a community. Mixed-use buildings allow people to live in these centers, ensuring that streets are alive with activity both during the day and in the evenings. The centers are destinations because they are built around special places, such as the waterfront of the Clackamas River or the confluence of important streets.

Craft Distinctive Places. People perceive the communities in the plan area as distinctive places. Homes and buildings are designed to be varied and interesting. Gateways into the area and individual neighborhoods are marked with distinctive public art or monuments. Unique features are designed into corridors and centers to reinforce a sense of place.

Attract Local Jobs and Businesses. Residents have opportunities to live and work in the same community. Local jobs are available to people with a range of backgrounds and skills, and all pay a living wage. Businesses are attracted by unique advantages of locating in the area and reinforce the development of industry clusters.

Design a Resilient, Connected Transportation System. A robust network of streets and transit routes allow people to move efficiently in, out, and across the area. Streets are designed to both manage traffic flow and encourage walking, biking, and riding transit. Transportation infrastructure is built prior to or concurrent with development.

Ensure Regional Fit. The plan area is integrated with the regional transportation system, land use patterns, and public facilities network. The plan area is viewed both as a distinct, individual place and a part of a larger system of neighboring cities and rural areas.

Plan for Fiscal Health. The plan can be implemented because it addresses fiscal realities. Service providers—including transportation, sewer, water, stormwater, parks, schools, and parks—can build infrastructure to support development because funding mechanisms are aligned with needs and costs.

Plan Area – By the Numbers

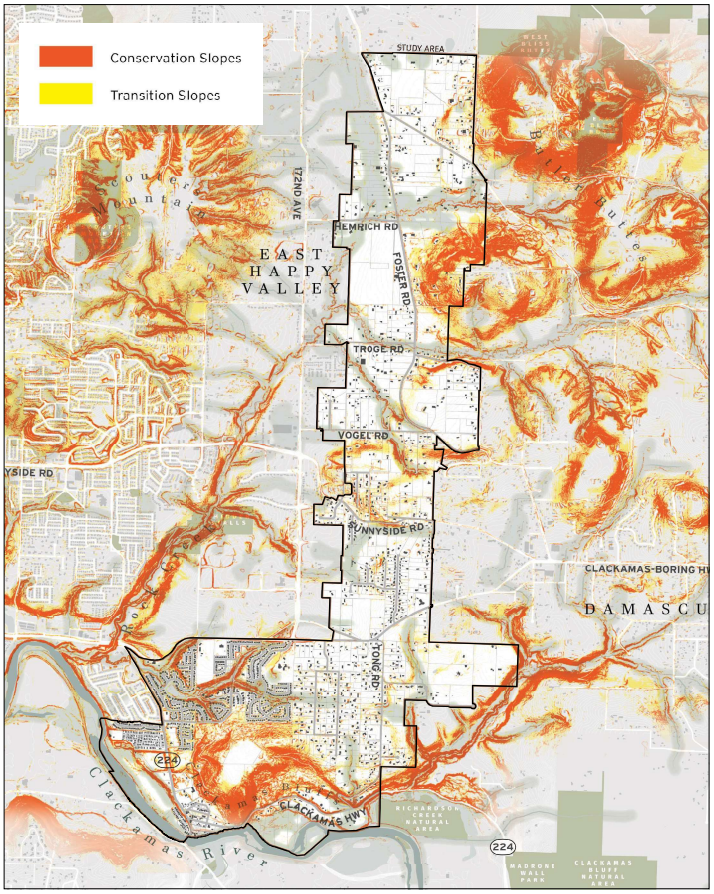
Pleasant Valley North Carver
COMPREHENSIVE PLAN

2,705 acres **1,685 properties** **1.6 acres/parcel (ave.)**

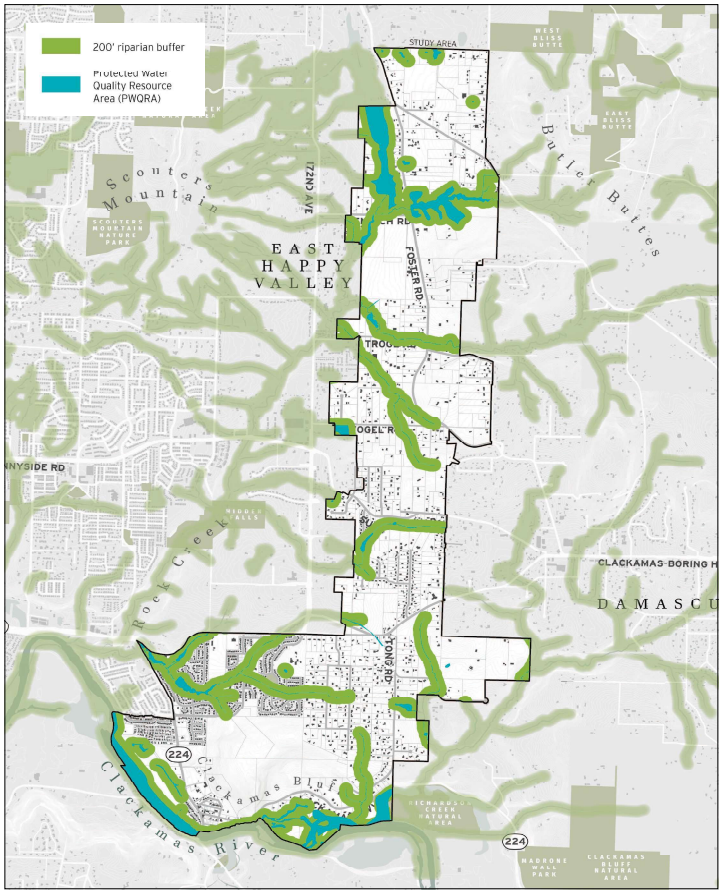
1,735 households **11,400 feet of riverfront**

The Plan Area Today | Context and Landscape

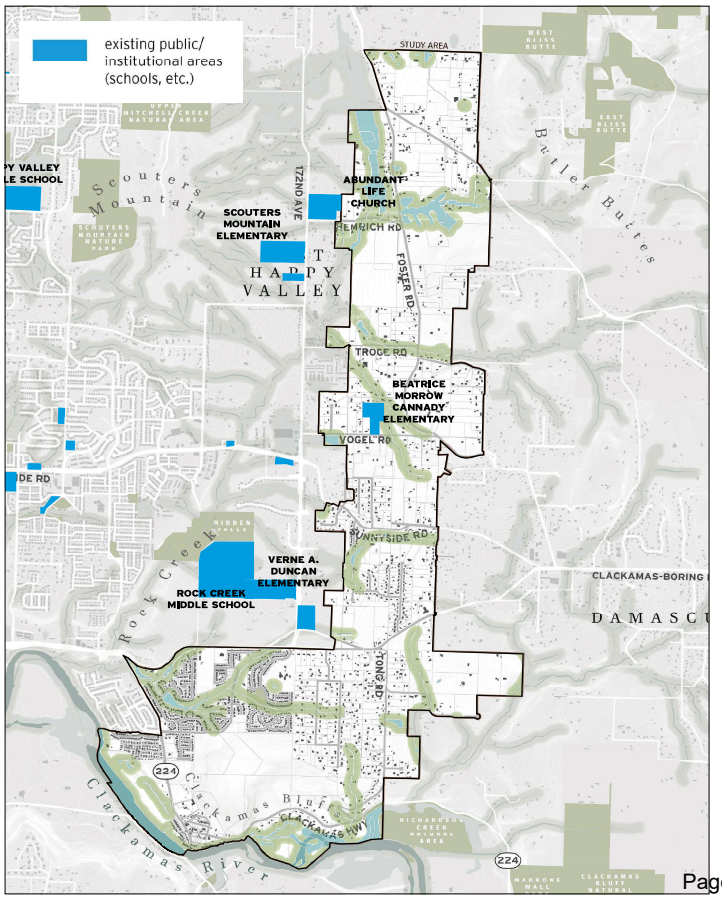
Steep slopes



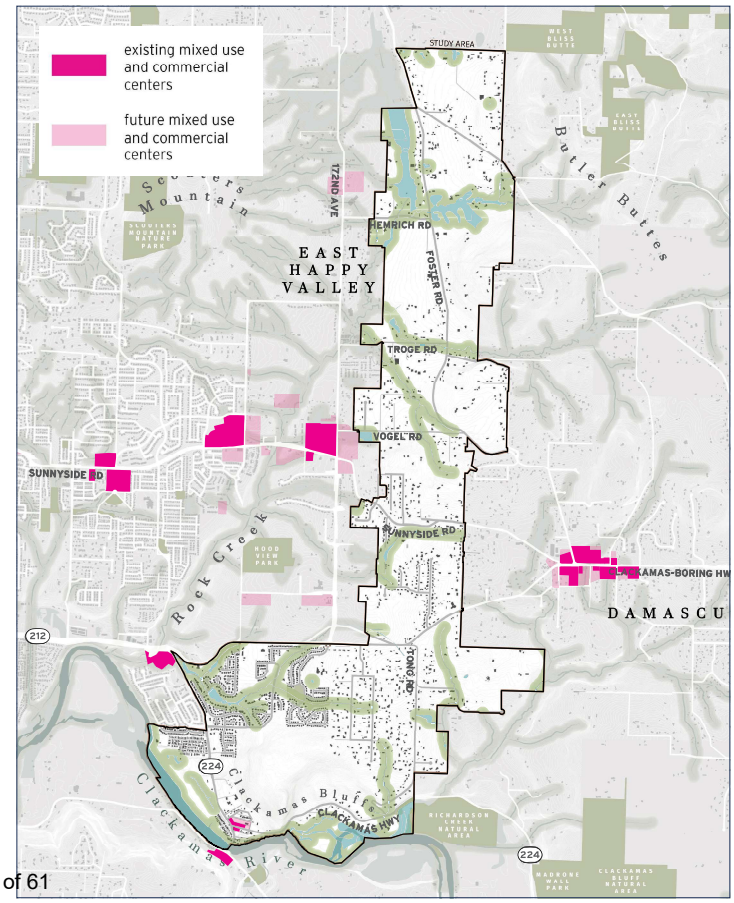
Natural resources



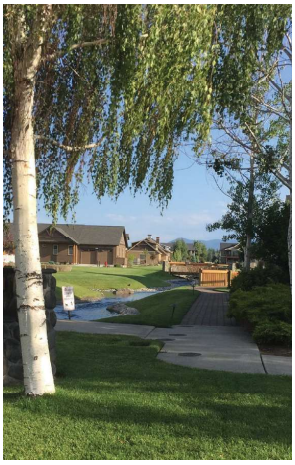
Public and institutional uses



Mixed use and commercial centers



Plan Concepts | Walkable Neighborhoods



Neighborhood Types

The amount and type of existing development today helps determine how neighborhoods will look in the future. There are three conceptual types of neighborhood areas within the Pleasant Valley/North Carver area:

Potential New Neighborhoods
Areas with a mix of pre-existing development and buildable land. These have potential and flexibility to create new walkable neighborhoods over time.

Existing Neighborhoods (large lot)
Existing residential development with rural residential lot sizes, generally less than 3 acres These areas have some limited flexibility for infill, and more potential if redeveloped over time

Existing Neighborhoods (small lot)
Platted and fully-developed residential areas. These are not flexible in the near term, except through individual choices like accessory dwelling units or incremental redevelopment.

Key Principles

- Organize new development to "fit the land" and create recognizable places with distinct identity
- Tailor housing types, mix, and density to each neighborhood
- Create a robust network of connections between neighborhoods (including connections to East Happy Valley)
- Provide easy access to parks and schools for each neighborhood
- Provide walkable access to neighborhood green spaces, commercial centers, the river, and other destinations
- Celebrate and protect the natural areas and habitat within and between neighborhoods

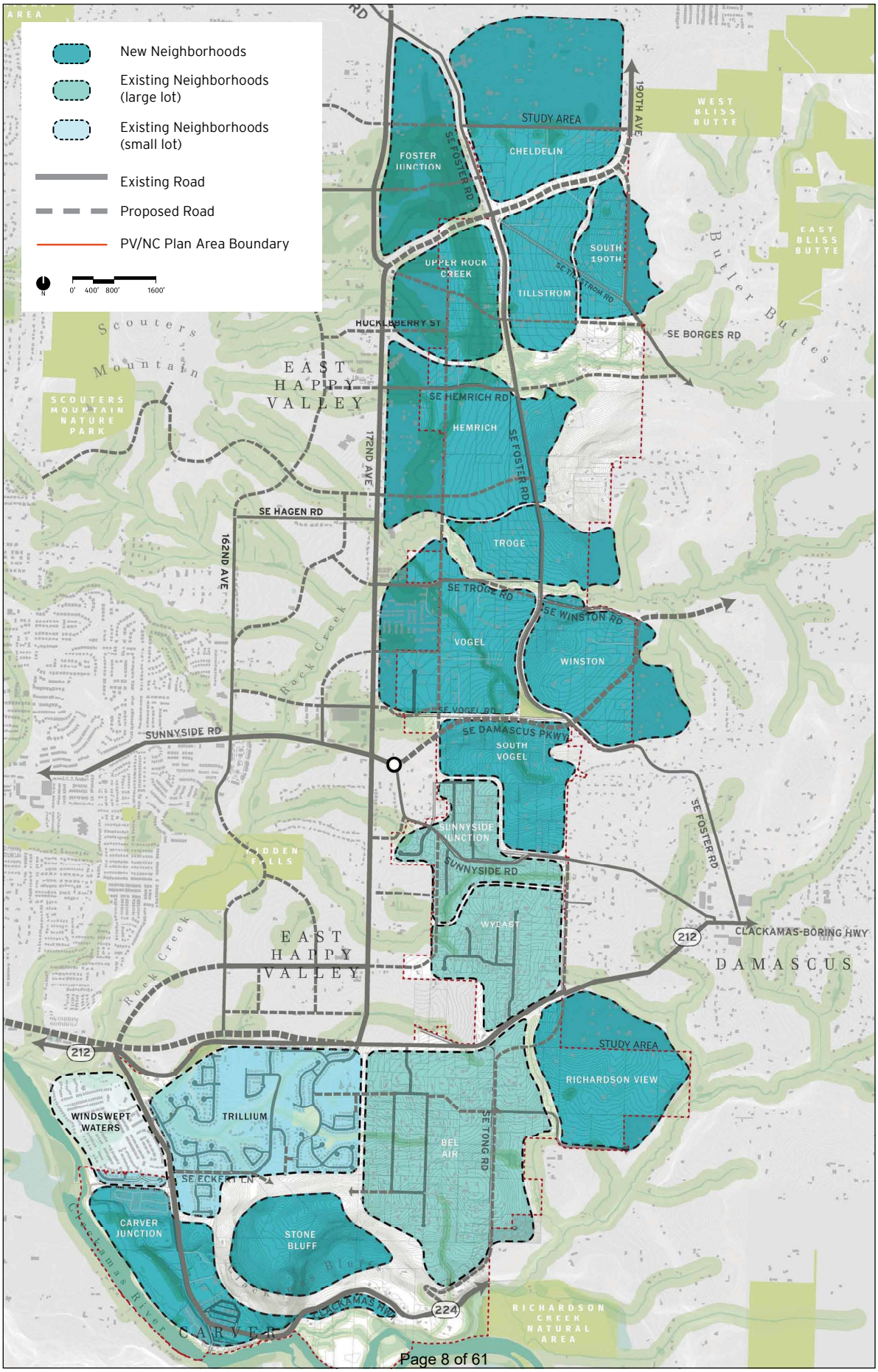
Precedent Example

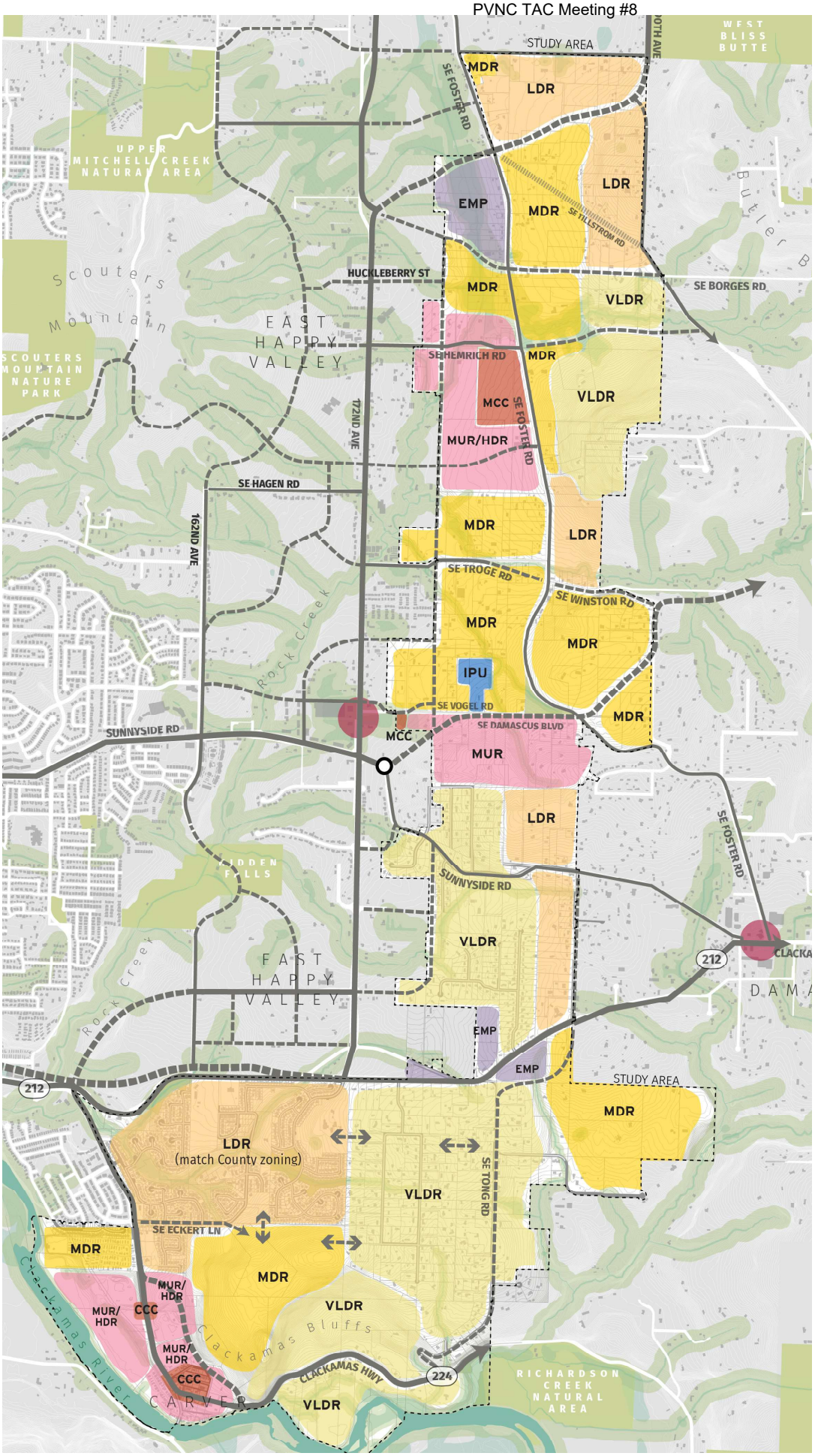
Sunnyside Village (Happy Valley, OR)

Precedent Example

Northwest Crossing (Bend, OR)

Plan Concepts | Walkable Neighborhoods





Pleasant Valley North Carver
COMPREHENSIVE PLAN

REFINED PLAN LAND USE

Includes CAC Recommendations, June 2019

- Streets (Existing)
- Streets (Proposed)
- Town Center

Land Use District

- Very Low Density Residential
- Low Density Residential
- Medium Density Residential
- Mixed Use Residential / High Density Residential
- Mixed Commercial Center/ Community Commercial Center
- Employment
- Institututional and Public Use

N 0' 400' 800' 1600'

9/23/19

PV/NC Land Use - Analysis of Refined Concept (Draft - subject to change)

9/12/2019

Residential - Unconstrained Lands

Land Use	Gross Acres	Unconstrained Acres	Net Buildable Acres	Implementing Zones	Blended Max Density (units/net acre)	Max Units	Minimum Density (80% of max)	Minimum Units
VLDR	742	435	304	R-20 and R-15	2.54	773	2.0	619
LDR	351	285	200	R-10, R-8.5, R-7	5.2	1,044	4.2	836
MDR	731	525	367	R-5, MUR-S	8.7	3,200	7.0	2560
HDR[1]	138	83	58	SFA, MURA	15.0	876	12.0	701
MUR[1]	138	83	58	MUR M1-M2, MURX	25.0	1,461	20.0	1169
Total	**2,099**	**1,411**	**988**	--	--	**7,355**	--	**5,884**

Density Transfer/PUD Clustering for Constrained Lands

	Acres Eligible for Density Transfer/Clustering	Density Transfer/Clustering (units/acre)	Units
Land Eligible for Density Transfer[2]	510	2	1,020

Max Density Summary

Total Max Units	**7,355**
Total Max Units w/ Transfer	**8,375**
Max Density	**7.4**
Max Density w/ Transfer	**8.5**

Minimum Density (80% of Max) Summary

Total Projected Units	**5,884**
Projected Units w/ Transfer	**6,904**
Projected Density	**6.0**
Projected Density w/ Transfer	**7.0**

Housing Type Summary

SFD Units[3]	**4,248**
SFD %	**51%**
MF/SFA Units[3]	**4,127**
MF/SFA %	**49%**

[1] Assumes that the amount of land in areas shown as MUR/HDR is split at 50% MUR and 50% HDR.

[2] Includes undeveloped land within residential zones in Conservation Slopes, Water Quality Resource Areas (75 foot buffer), and Habitat Conservation Areas (High or Moderate Value). No density transfer is assumed for Transition Slope areas.

[3] Assumes that VLDR and LDR are 100% single-family detached; MDR is 60% single-family detached/40% multi-family/single-family attached; and HDR and MUR are 100% multi-family/single-family attached. Assumes all density transfer units are split 50/50 between SFD and MF/SFA

Commercial, Employment, and IPU

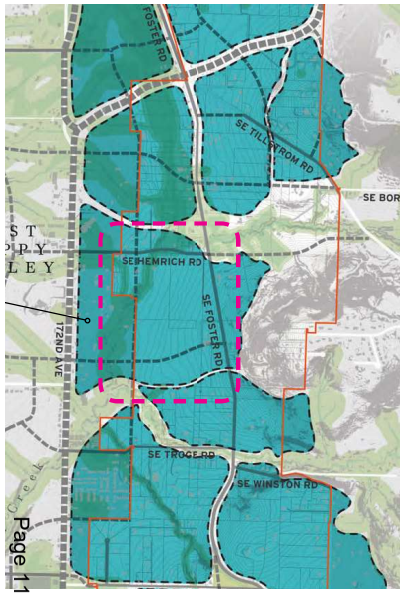
Land Use	Gross Acres	Unconstrained Acres	Net Buildable Acres	Max Density (units/net acre)	Max Units	Projected Density (80% of max)	Projected Units
CCC[4]	4	3	2	30	47	24.0	37
MCC[4]	26	25	18	30	535	24.0	427
EMP	74	42	30	--	--	--	--
IPU	8	7	5	--	--	--	--
Subtotal	**111**	**77**	**54**	**--**	**582**	**--**	**464**

[4] Density and housing unit projections for these zones assume that all zones develop with vertical mixed-use. This is highly unlikely, but it illustrates the maximum residential capacity of the zones. The housing units in these commercial zones should be considered "bonus" units - all the projected housing need must be met in the residenital zones.

Plan Concepts | Pleasant Valley Downtown District

Pleasant Valley North Carver
COMPREHENSIVE PLAN

What is there now?



What makes a great downtown district?

Pleasant Walking Environment

Activated corners + on street parking

Connected to Context

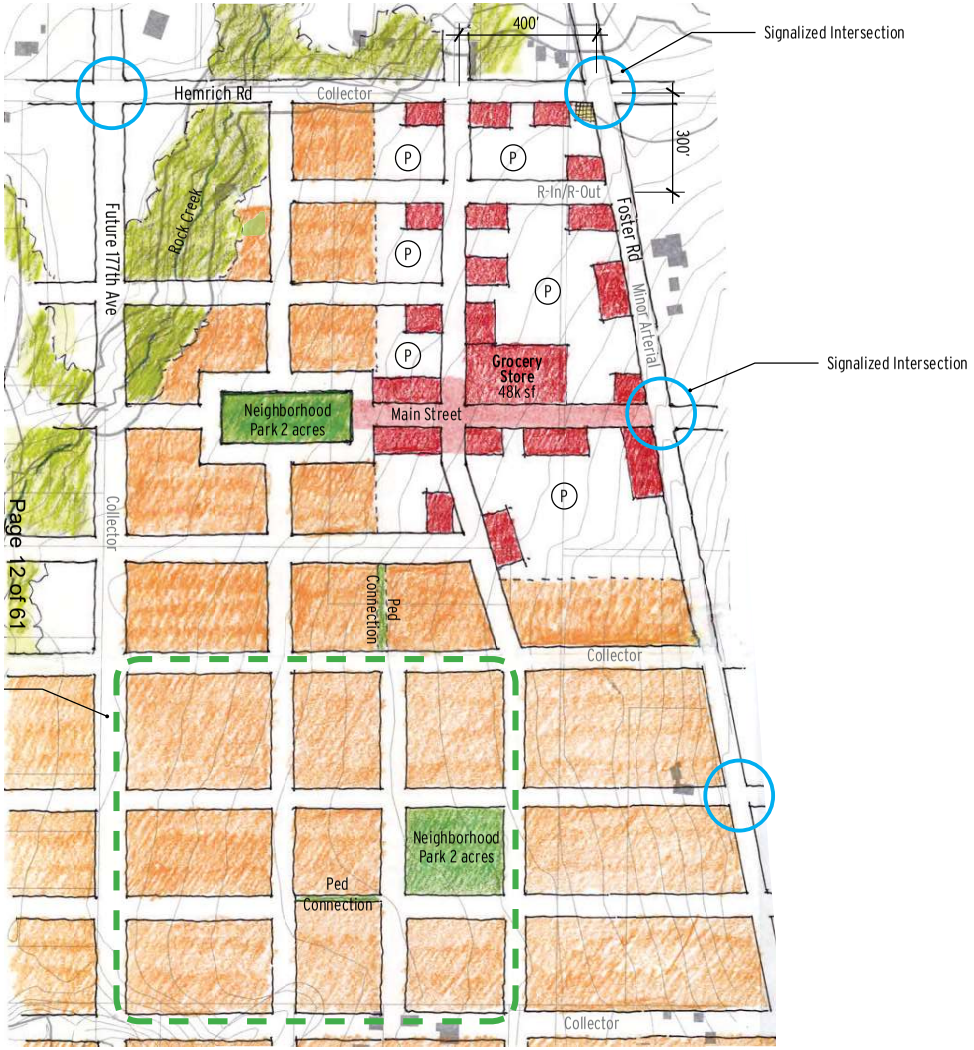
Framed parking lots

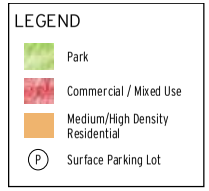
What are some successful examples?

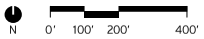
Happy Valley Town Center (New Seasons)

Orenco Town Center (Hillsboro, OR)

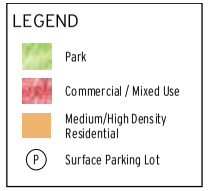
Concept A - Main Street Oriented to Foster







Concept B - Main Street Oriented to Hemrich



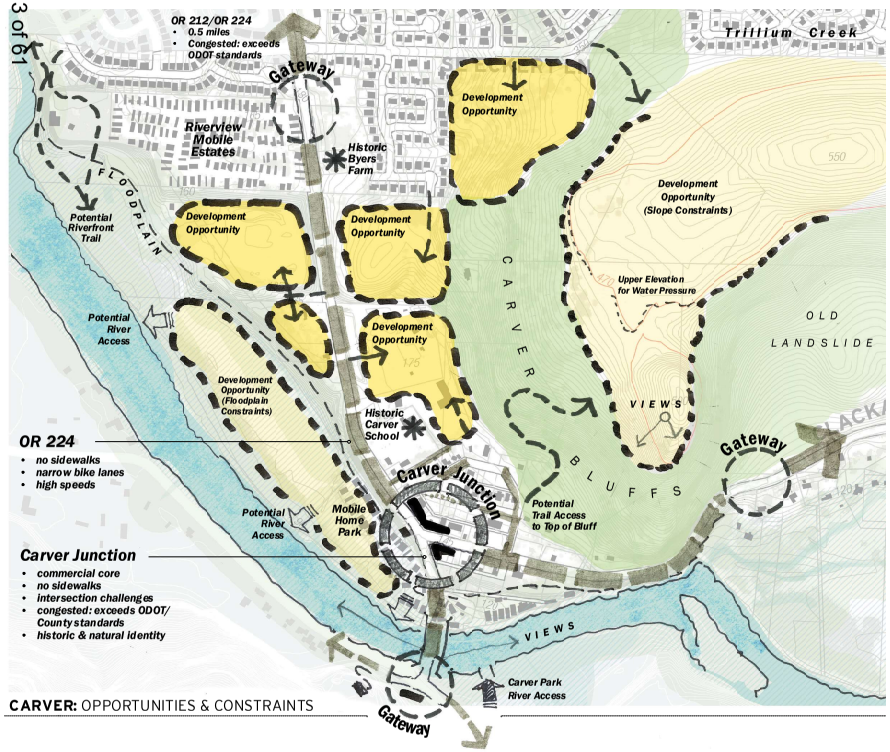
Plan Concepts | North Carver Waterfront District

Pleasant Valley North Carver
COMPREHENSIVE PLAN

What is there now?

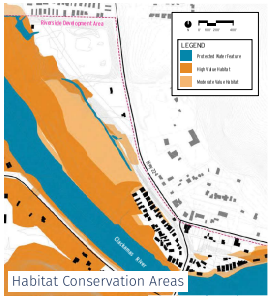
The Carver junction is a special place. The beauty of the Clackamas River and surrounding buttes and the historic significance of this junction combine to create a unique sense of place.

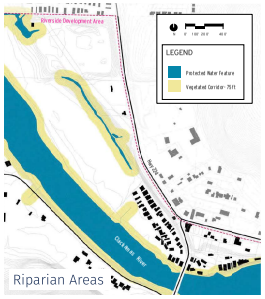
What are the opportunities and constraints?

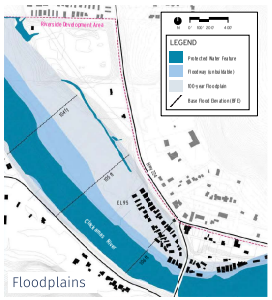


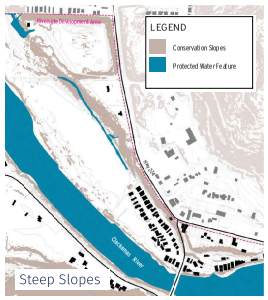
CARVER: OPPORTUNITIES & CONSTRAINTS

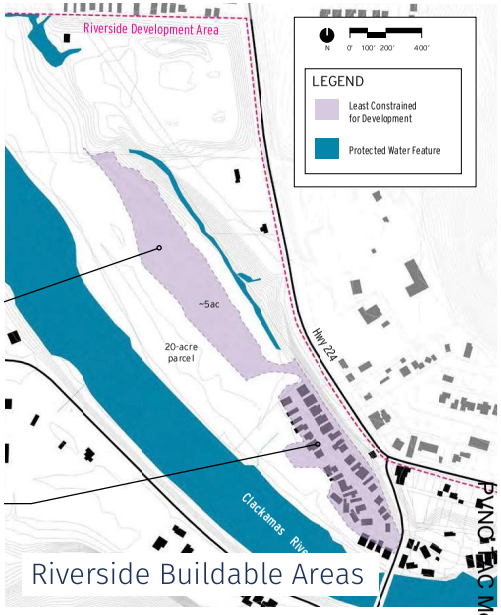
Where is the buildable land on the waterfront?





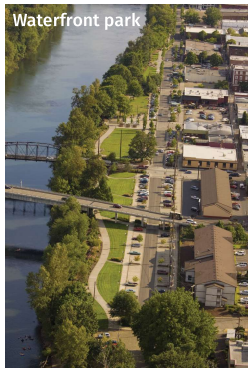


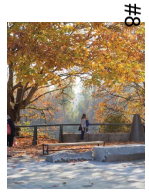




What could the North Carver waterfront look like?

The North Carver waterfront is envisioned to develop into a destination that both encourages new development and preserves the natural and historic features that make it unique. Carver could become a regional amenity, with a large riverfront park, trails, restaurants that face the river, and a historic core with retail shops and a public space. Mixed use buildings, apartments, and townhomes would contribute to lively streets and provide an opportunity many people to live near these amenities.

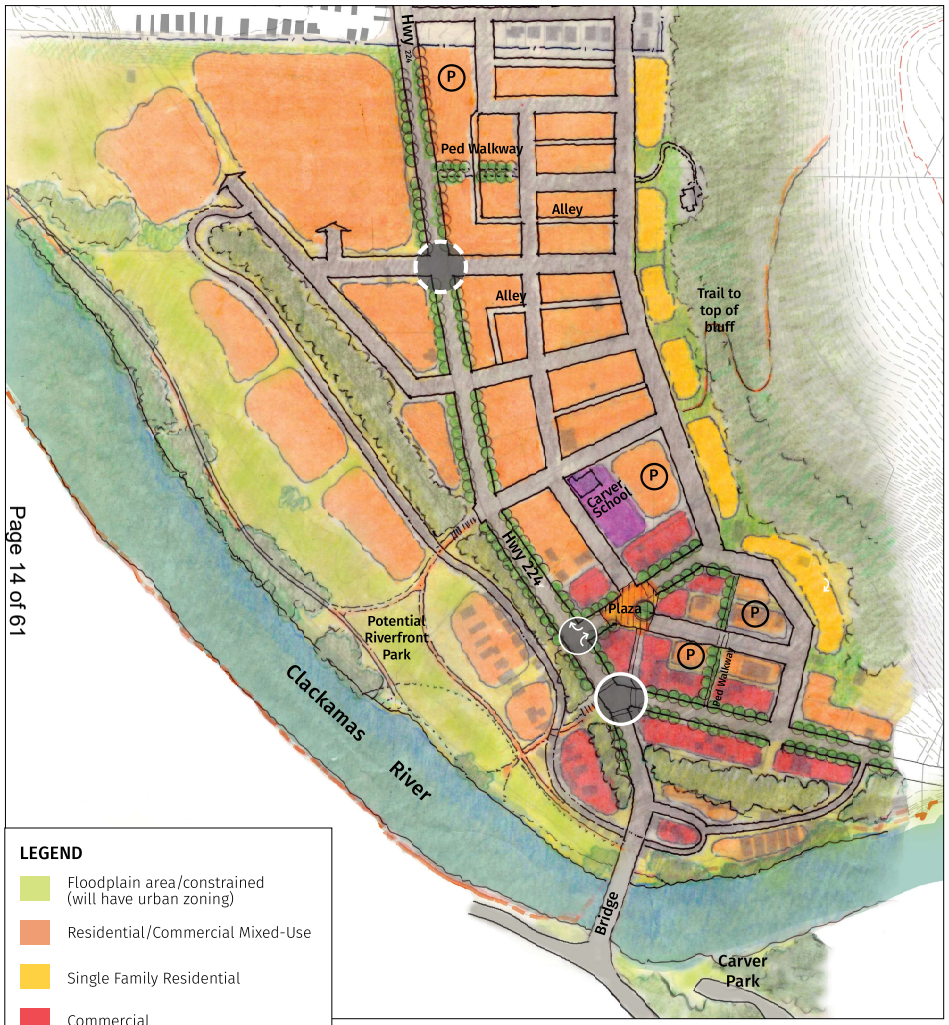




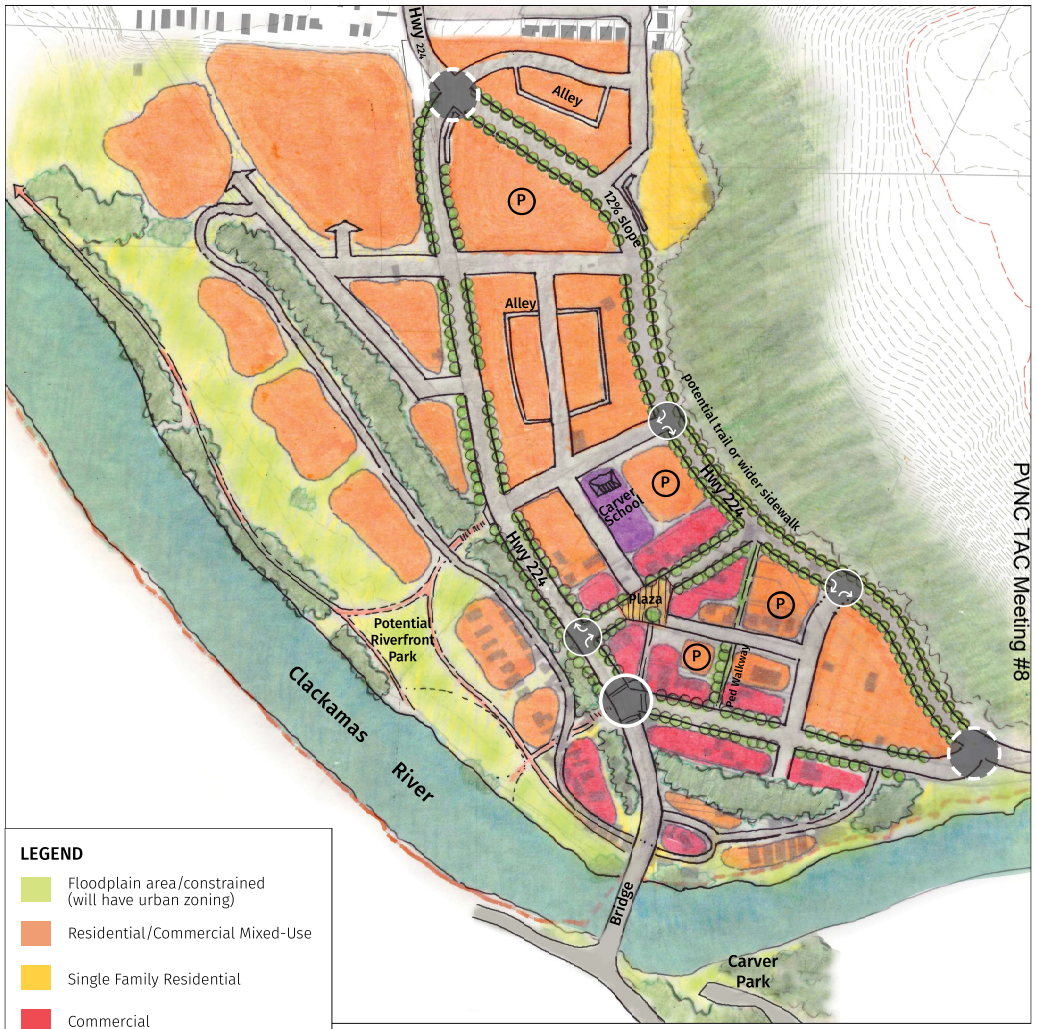
Plan Concepts | North Carver Waterfront District

Pleasant Valley North Carver
COMPREHENSIVE PLAN

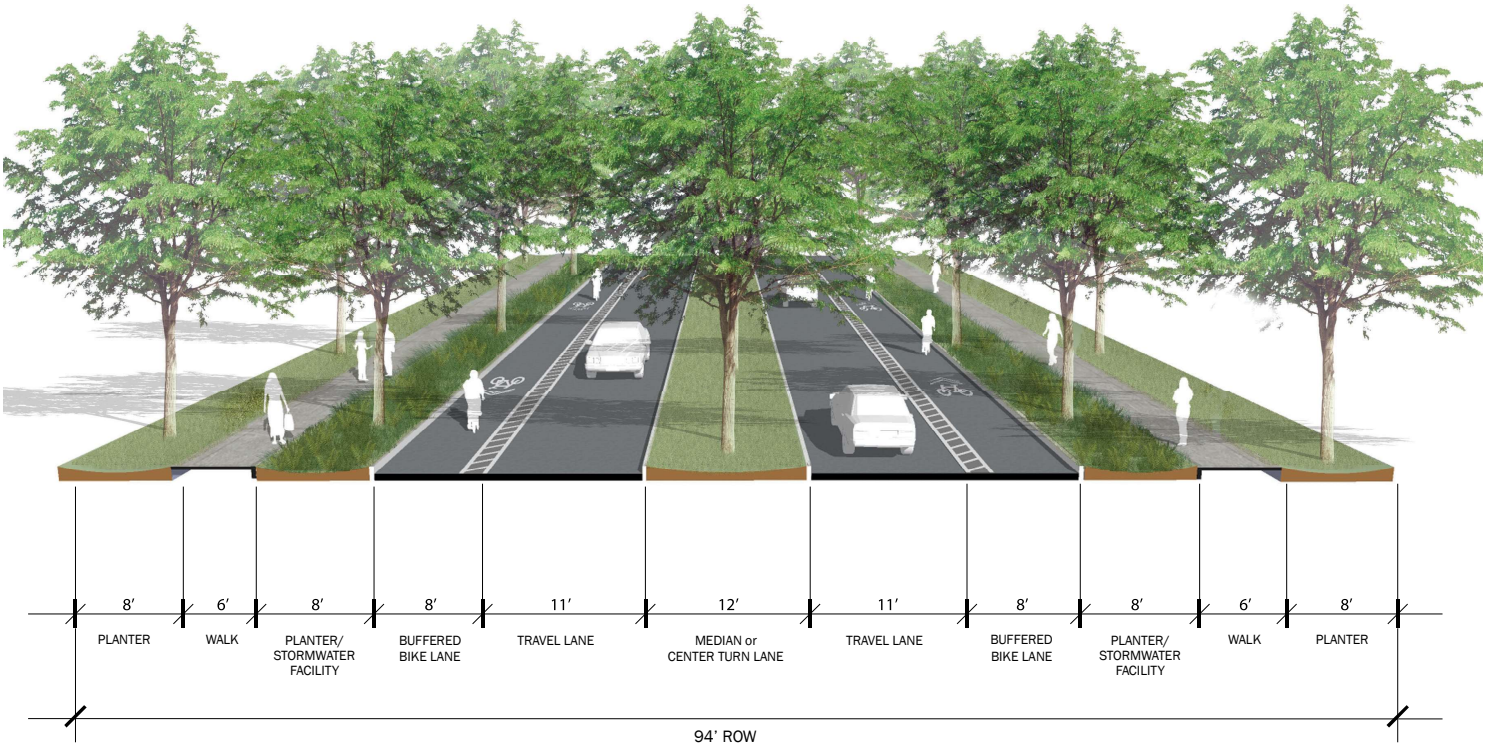
Concept A - Existing Location of Highway 224



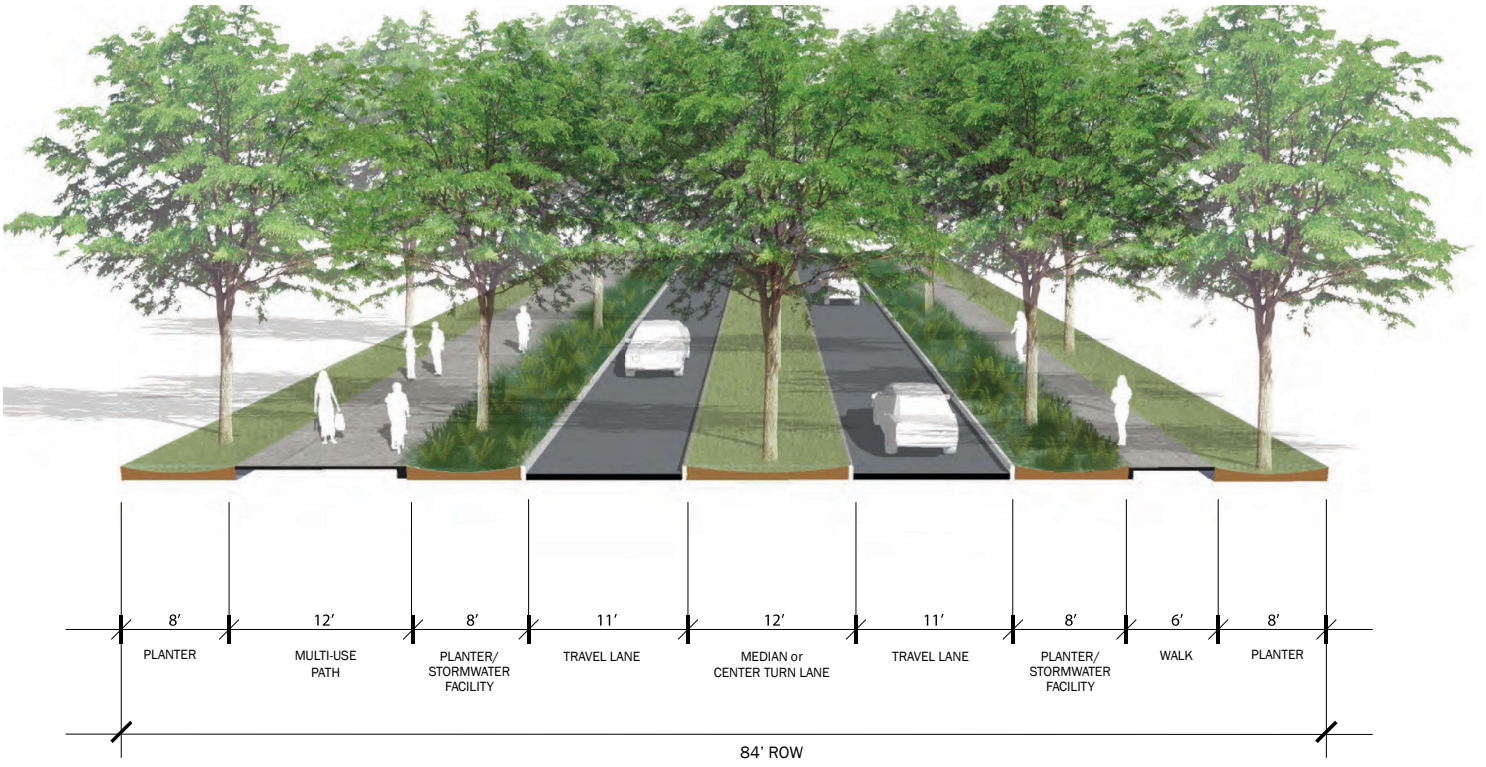
Concept B - Highway 224 Realignment

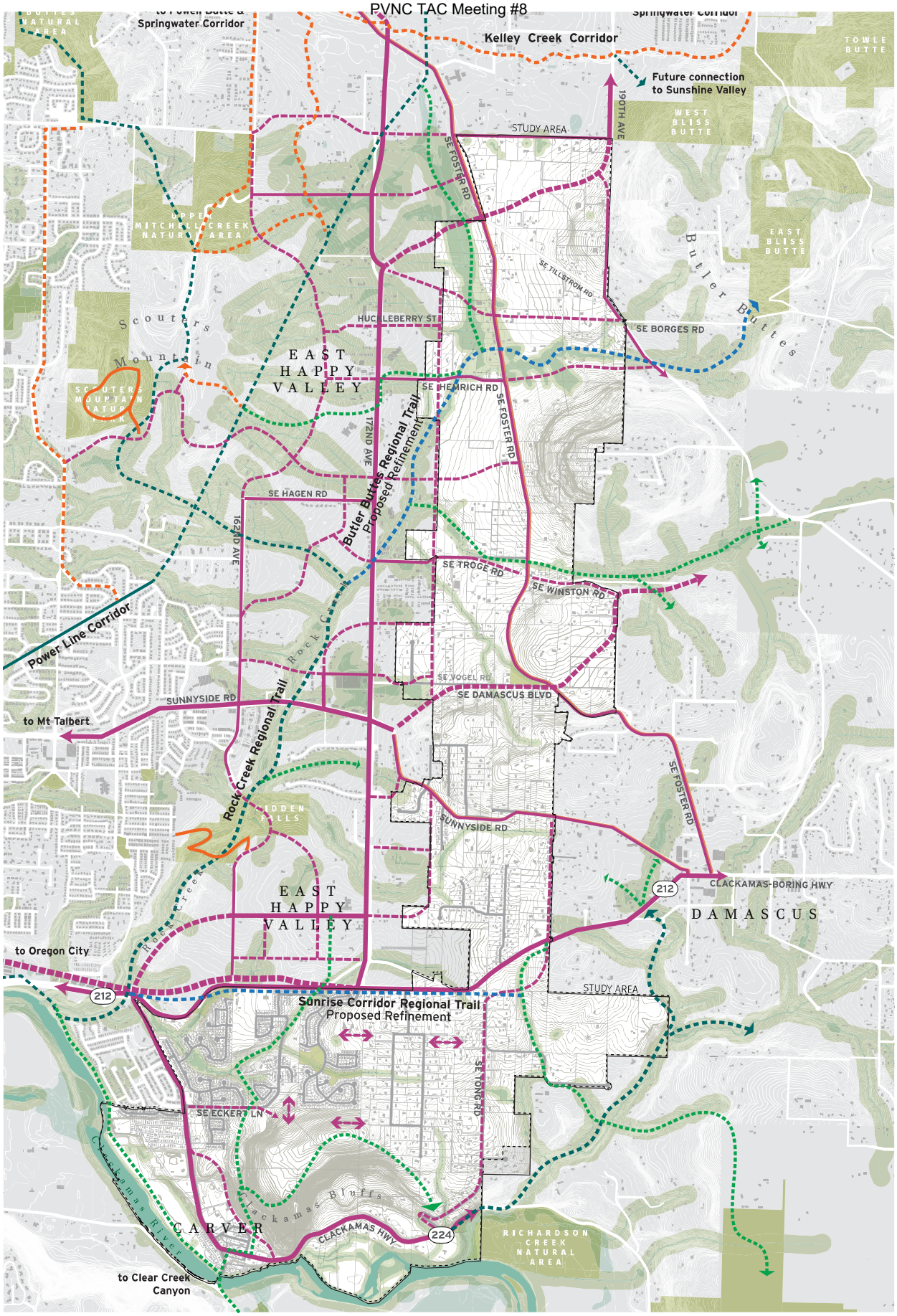


Concept A - Bike Lanes



Concept B - Shared Multi-Use Path





REFINED PLAN BIKEWAYS AND TRAILS NETWORK

Pleasant Valley North Carver
COMPREHENSIVE PLAN

N

- Built Regional Trails
- Planned Regional Trails
- PV/NC Regional Trail - Proposed Refinement
- Major Arterial (existing/proposed) - with bike facilities
- Minor Arterial, Collector, N-hood Street (existing/proposed) - with bike facilities

10/10/2019

Pleasant Valley North Carver
COMPREHENSIVE PLAN

MEMORANDUM

Park System Level of Service Assessment
Pleasant Valley / North Carver Comprehensive Plan

DATE October 8, 2019

TO City Project Team

FROM Steve Duh, Conservation Technix

To measure the provision of parks and recreation opportunities for the Pleasant Valley-North Carver (PV/NC) study area, a level of service (LOS) review was conducted to examine the distribution and acreage needs for parkland. Traditionally, LOS reviews have applied an acreage of parkland per thousand residents as a target measurement for adopted benchmark standards. Service standards are the adopted guidelines or benchmarks the City is trying to attain with their parks system; the level of service is a snapshot in time of how well the City is meeting its adopted standards.

This evaluation will explore how the Pleasant Valley-North Carver planning area relates to performance comparable to the City's standard for the provisions of park acreage and distribution using population and geographic information. This assessment also provides the future direction for ensuring adequate provision of parks for the community based on current and potential future gaps in this community infrastructure.

The adopted parkland standards from the City of Happy Valley Park and Recreation Master Plan (2017) were used to evaluate the LOS in the PV-NC study area and forecast park needs for current and future residents.

PARK & OPEN SPACE CLASSIFICATIONS

As defined in the 2017 Happy Valley Parks and Recreation Master Plan, park and open space lands are classified by function as a means to provide guidance for the intended size and use of each park type. For the assessment of the PV-NC study area, three park classifications were considered:

- Community parks are large park sites developed for organized play that generally contain a wide array of both passive and active recreation facilities and appeal to a diverse group of users. Community parks are generally 15 to 40 acres in size, should meet a minimum size of 20 acres when possible and serve residents within a 2-mile drive, walk or bike ride from the site.
- Neighborhood parks are generally considered the basic unit of traditional park systems. They are small park areas designed for unstructured, non-organized play and limited active and passive recreation. They are generally 2 to 5 acres in size. Neighborhood parks are intended to serve residential areas within close

proximity (up to ½-mile walking or biking distance) of the park and should be geographically distributed throughout the community.

- Natural areas are undeveloped lands primarily left in a natural state and typically places that are geographically or geologically unique, with passive recreation use (e.g., trails) as a secondary objective. Open spaces are individual or isolated tracts of open space that are not connected to a larger natural area network.

LEVELS OF SERVICE & STANDARDS

There is currently very little park land in the study area. North Clackamas Park & Recreation District (NCPRD), Metro and a couple small homeowner associations, have minor holdings, including 1.39 acres of developed parks (NCPRD) and 63.6 acres of open space/natural area. There are 31 acres of public parklands, which include natural areas, wetlands, open spaces owned by both NCPRD and Metro within the study area. Thus, for the assessment of parkland provision discussed below, only the 1.39 acres of neighborhood park are applied.

Figure 1 shows the current inventory of parks and open space in the planning area owned by private HOAs and public, regional park providers. There currently are no parklands provided by the City of Happy Valley in the PV-NC planning area.

Figure 1. Park and Open Space Inventory in Pleasant Valley-North Carver Study Area

Park Site	Classification	Ownership	Acreage	
			Developed	Undeveloped
Trillium Creek Park*	Neighborhood Park	NCPRD	1.39	6.27
Orchard Summit Open Space	Open Space	NCPRD		4.24
SE Vogel Road Site	Open Space	NCPRD		14.31
Richardson Creek Natural Area	Natural Area	Metro		4.8
		Subtotal	**1.39**	**31.01**
HOA open spaces	Open Space	Private		34.03
		Total		**65.04**

*1.39 acres of Trillium Creek Park is developed as a neighborhood park

Map 1 highlights the locations of existing parks and open space lands within the PV-NC study area.

Neighborhood & Community Parks

The City of Happy Valley's existing service standards have been applied to the Pleasant Valley-North Carver study area to assess the current and future demand for parkland. Using the adopted City standard of 2 acres per 1,000 for neighborhood parks and 4 acres per 1,000 for community parks (a combined core park standard of 6 acres per 1,000 residents) determines the amount of acreage required to meet the parkland acquisition standard. When the population of the planning area is compared to the City's acreage standards, the difference between the existing

acreage and "demand" for park acreage to meet the standard is considered the "need" in future acreage. When no parks exist for a classification, these two measures of "demand" and "need" are the same. The LOS was examined for the planning area using both the 2015 population and projected 2040 population.

Figure 2 highlights the current level of service (LOS) for the PV-NC planning area at the City's existing standards for neighborhood and community parks. Using figures consistent with the Housing Needs Analysis for the PV-NC Comprehensive Plan study, the 2015 population (Metro estimate) and the 2040 population forecast (based on maximum land use density projection) were both calculated based on 3.1 persons per household.

Figure 2. Current & Future Level of Service & Performance for PV-NC study area

# Facilities	Classification	Current Acreage	Current LOS (acres/1,000)	Park Standard	2015		2040	
					PV-NC Demand	PV-NC Need	PV-NC Demand	PV-NC Need
0	Community	0.00	0.0	4 ac/1000	21.5	21.5	91.2	91.2
1	Neighborhood	1.39	0.3	2 ac/1000	10.8	9.4	45.6	44.2
	Total Core Park Acreage	**1.39**	**0.3**	6 ac/1000	**32.3**	**30.9**	**136.8**	**135.4**

In reviewing each park classification separately, the PV-NC study area is currently providing 0.0 acres per 1,000 population for community parks (0% of the proposed standard). The resulting deficit of community parkland across the study area is 21.5 acres based on the 2015 population. That deficit may grow to 91.2 acres by 2040 if no additional community parklands are acquired. For neighborhood parks, the PV-NC study area currently provides 0.3 acres per 1,000. The currently acreage deficit for neighborhood parks is 9.4 acres and may grow to 44.9 acres by 2040. The total core park acreage (combined neighborhood and community parks) need is 30.9 acres to meet the standard. The total combined park acreage need may increase to 135.4 acres by 2040.

Considering the potential for annexation of the Pleasant Valley-North Carver study area into the City of Happy Valley, the level of service assessment has been combined to illustrate the demand and need for parks as a unified public park system for the City. Figure 3 combines the City park system and PV-NC study area for both park classifications. The needs for neighborhood parks and community parks are calculated to reveal a total core park deficit of 82.7 acres based on 2015 population estimates. This need for park acreage may grow to 276.6 acres by 2040 without an aggressive land acquisition strategy and coordination with the land development community.

Figure 3. Current & Projected Acreage Needs for Urban Parks for the combined City of Happy Valley and PV-NC Area

# Facilities	Classification	Current Acreage	Park Standard	2015		2040	
				HV/PV-NC Demand	HV/PV-NC Need	HV/PV-NC Demand	HV/PV-NC Need
1	Community	31.2	4 ac/1000	88.2	57.0	217.6	186.4
6	Neighborhood	18.5	2 ac/1000	44.1	25.6	108.8	90.3
	Total Core Park Acreage	**49.7**	**6 ac/1000**	**132.4**	**82.7**	**326.3**	**276.6**

Natural Areas & Private Open Spaces

No numeric standards are proposed for natural areas or open spaces. While numerical planning standards are common for helping to determine a desirable number of neighborhood parks per thousand residents, they do not translate easily to natural areas because of the uniqueness of the land base itself. Natural areas also are highly variable in the degree of environmental sensitivity and possible public access. Hence, they may not directly contribute to the provision of parks and recreation.

Additionally, the City has provided strong leadership in requiring developers to set aside tracts of land through its land use regulations. At the present, approximately 275 acres of sensitive or protected lands have been set aside within Happy Valley city limits as privately held Homeowner Association (HOA) open space tracts via the platting and land development process. The PV-NC study area contains an additional 34.03 acres of open space owned by HOAs. Typically, HOA properties are not open and available for general public uses. They are owned and maintained as private property for use by the residents within the designated HOA. While they provide some value by contributing to an overall system of open space, their restricted access limits any provision of park or recreation needs for the community.

The inclusion of future, protected sensitive areas will strengthen and expand the broader network of public and private natural areas and open spaces. However, the priority for natural area acquisitions or the acceptance of open space dedications from developers should be focused toward those lands that expand ownership of adjacent City-owned properties or to ensure sufficient property is available to accommodate public access and future trail connections.

PARKLAND GAP ANALYSIS

The acreage of parkland per capita provides only a limited measure of the value of recreational access and park amenities in demand for public uses. The Pleasant Valley-North Carver area is mostly devoid of parklands, except for a few properties in the southern section owned by NCPRD and Metro. While the level of service assessment measures the amount of acreage to be acquired to provide for adequate parks and outdoor recreation facilities for the current and future population, a strategic approach to the future equitable distribution of public parks is warranted to ensure access for all residents.

Park access can be defined as the ability to reach a publicly-owned park within a half-mile walk on the road network, unobstructed by freeways, rivers or other barriers. This walking accessibility measure is used by nationally-recognized park agencies and park planning organizations such, as the Trust for Public Lands, and it is the basis for assessing parkland distribution in the Happy Valley Parks and Recreation Master Plan. Walking distance is most commonly defined as a half-mile or a ten-minute walk. Determining the ‘walksheds’ for existing parks can reveal the gaps where residential areas are unserved and lack access to parks within a reasonable walking distance. These gaps may illustrate a need to provide for a more equitable distribution of park facilities. Identified gaps in the park system also can become target areas for future parkland acquisition.

For the Pleasant Valley-North Carver study area, future park facilities should be placed in strategic locations to create equitable access to recreational amenities throughout the planning area. Proposed locations, not associated

with specific parcels, show the approximate distribution feasible to provide for a complete system of parklands and were defined using a ¼-mile primary and ½-mile secondary service area with travel distances calculated 'as the crow flies', since the existing and future road network is inadequate to estimate real-world walksheds. As the Pleasant Valley-North Carver area develops, a re-assessment of parkland walksheds is warranted to confirm and re-evaluate the distribution of potential park areas serving the subarea.

Map 2 shows the mapped walksheds for existing developed parks in the PV-NC study area and the nearby areas within the City of Happy Valley. Map 3 illustrates an equitable distribution for potential, planned neighborhood and community parks. The majority of potential park sites are shown as neighborhood parks, which typically range from 1.5 - 5 acres in size. The level of service assessment for neighborhood parks indicates a need of 9.4 acres for the current population of the PV-NC study area, which grows to a future need for 44.2 acres of neighborhood park acreage for the estimated 2040 population. To meet the existing City standard for neighborhood parks, a minimum of 10-12 neighborhood park sites should be acquired and developed in the PV-NC study area. Neighborhood parks are recommended to be located in residential areas in order to provide walkable recreational amenities.

The level of service assessment for community parks identified a current need for 21.5 acres of developed parkland, which is projected to increase to 91.2 acres by 2040. If each community park ranges in size from 20-30 acres, depending on desired recreational needs, at least one new community park site should be developed and acquired in the near future. By 2040, up to three community parks should be provided to serve the PV-NC study area. Community parks are often located in or adjacent to higher density residential land uses to take advantage of denser populations, more accommodating road systems and public transportation. When community parks are associated with special natural resources, locations are based on those special features and providing adequate public access. The park walkshed map targets future locations for community parks near or adjacent to higher residential land uses and along the riverfront where more public recreation access would be desirable. As Happy Valley explores acquisition targets for parklands, some consideration should be directed to the 14-acre Vogel Road future park site currently owned by NCPRD and the intervening parcel between this site and the school district property to the west.

IMPLEMENTATION PROJECTS

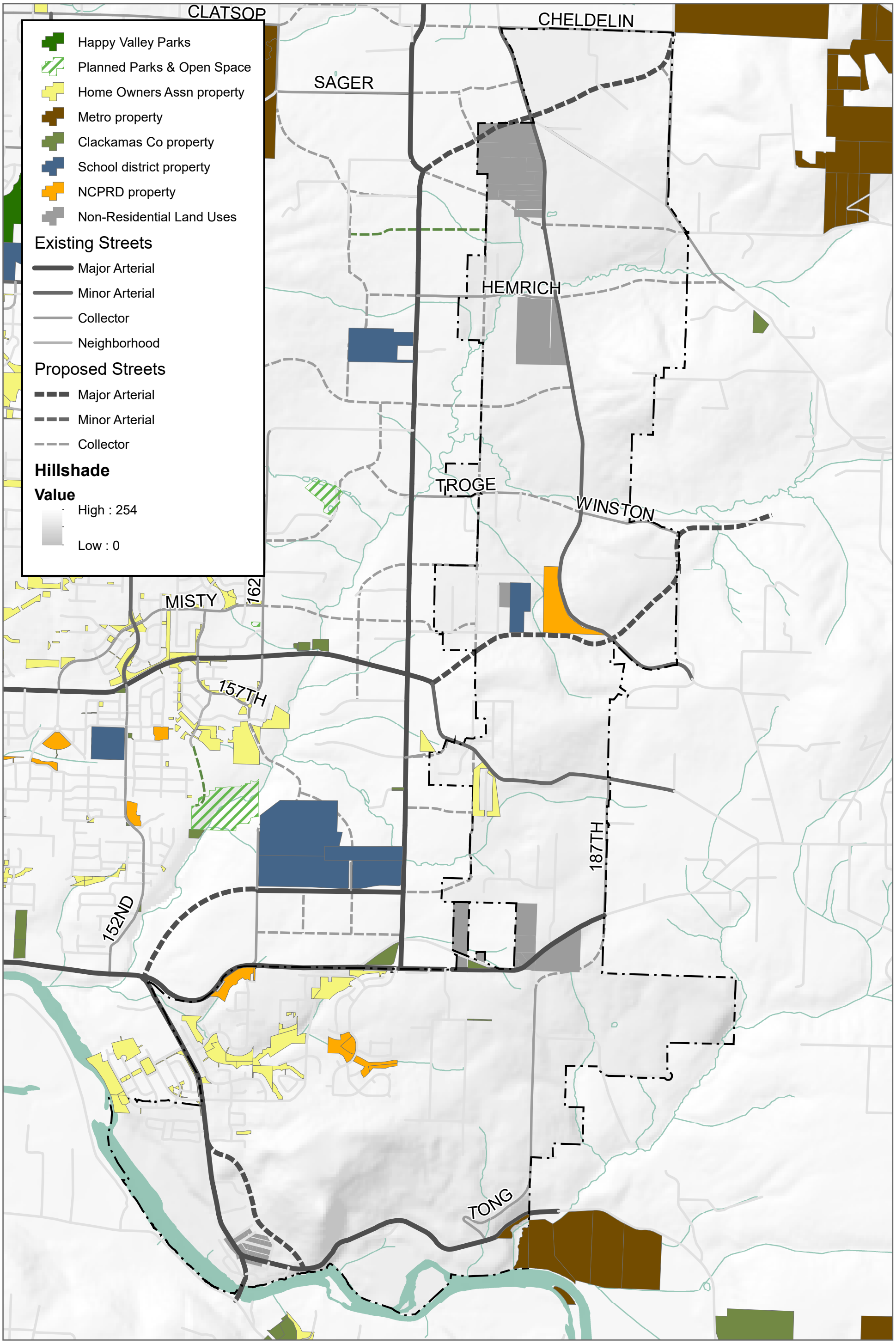
The potential parkland target areas noted on Maps 4 and 5 are intended to guide future acquisition efforts. The provision of ten to eleven new neighborhood and two community parks through acquisition or coordination with developers will improve the overall distribution and equity of parkland and promote recreation within walking distances for Pleasant Valley-North Carver residents. An aggressive acquisition program should be actively pursued in the PV-NC study area to capture opportunities that will be continually diminishing as residential growth continues to consume developable land.

A capital facilities plan (CFP) should be prepared to illustrate the program for acquisition and development to accommodate these identified parkland needs. Staggering neighborhood and community park projects over ten years will allow for significant progress and should be integrated with the existing adopted City CFP for its current park system. As acquisition opportunities arise for both neighborhood and community parks, some adjustments

will be warranted for measuring level of service based on actual, acquired sites, since acreage may vary for any individual project.

Attachments:

- Map 1: Existing Parks & Open Spaces
- Map 2: Existing Parks & Open Spaces within ¼- & ½-mile Walksheds
- Map 3: Potential Park Target Areas with Conceptual Service Areas
- Map 4: Potential Park Target Areas with Walksheds for Existing Parks
- Map 5: Potential Park Target Areas with Proposed Land Uses

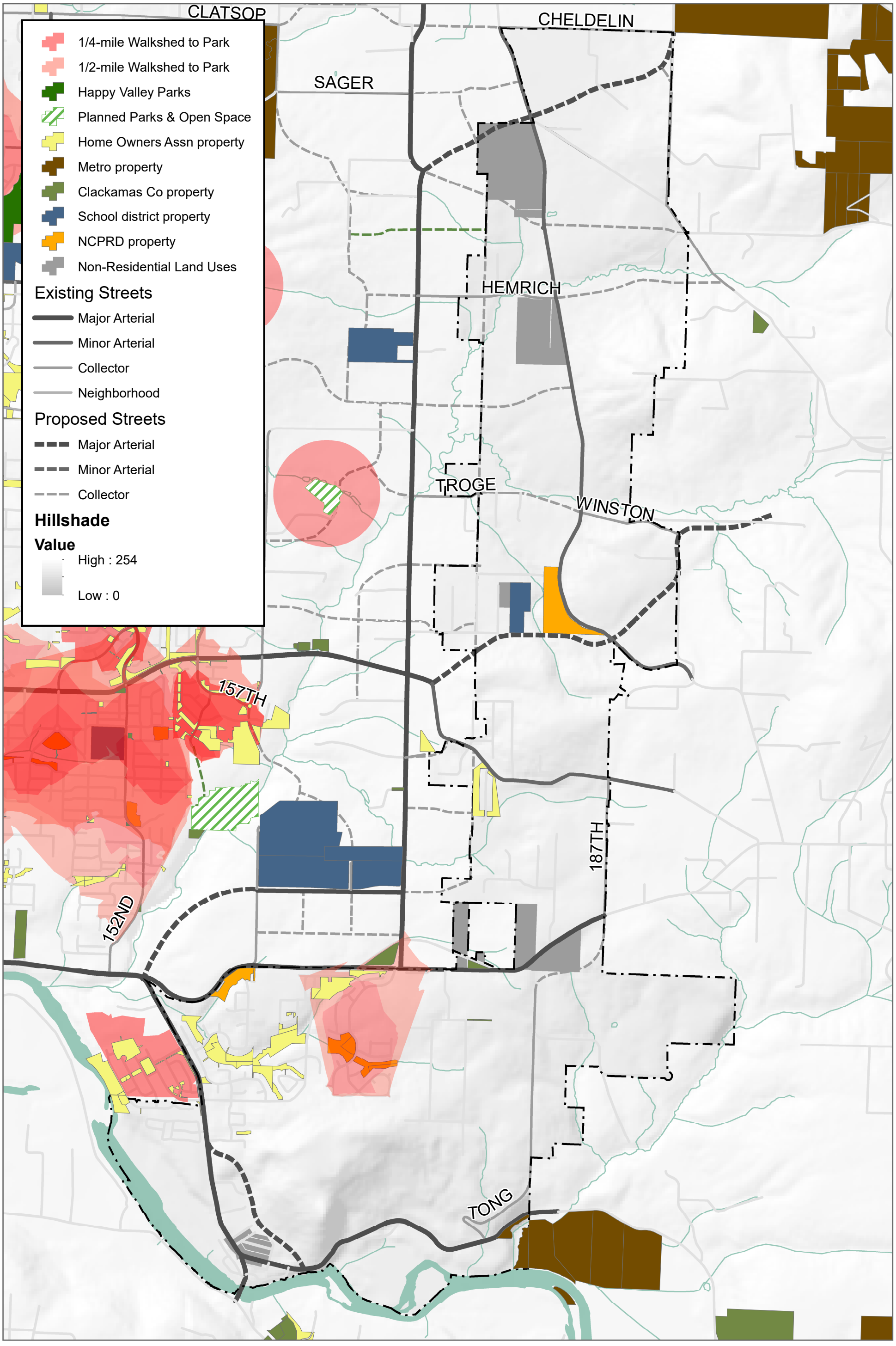


Pleasant Valley North Carver
COMPREHENSIVE PLAN

Map1: Existing Parks & Open Spaces
Preliminary Draft, October 2019

0 1,000 2,000 3,000 Feet

N

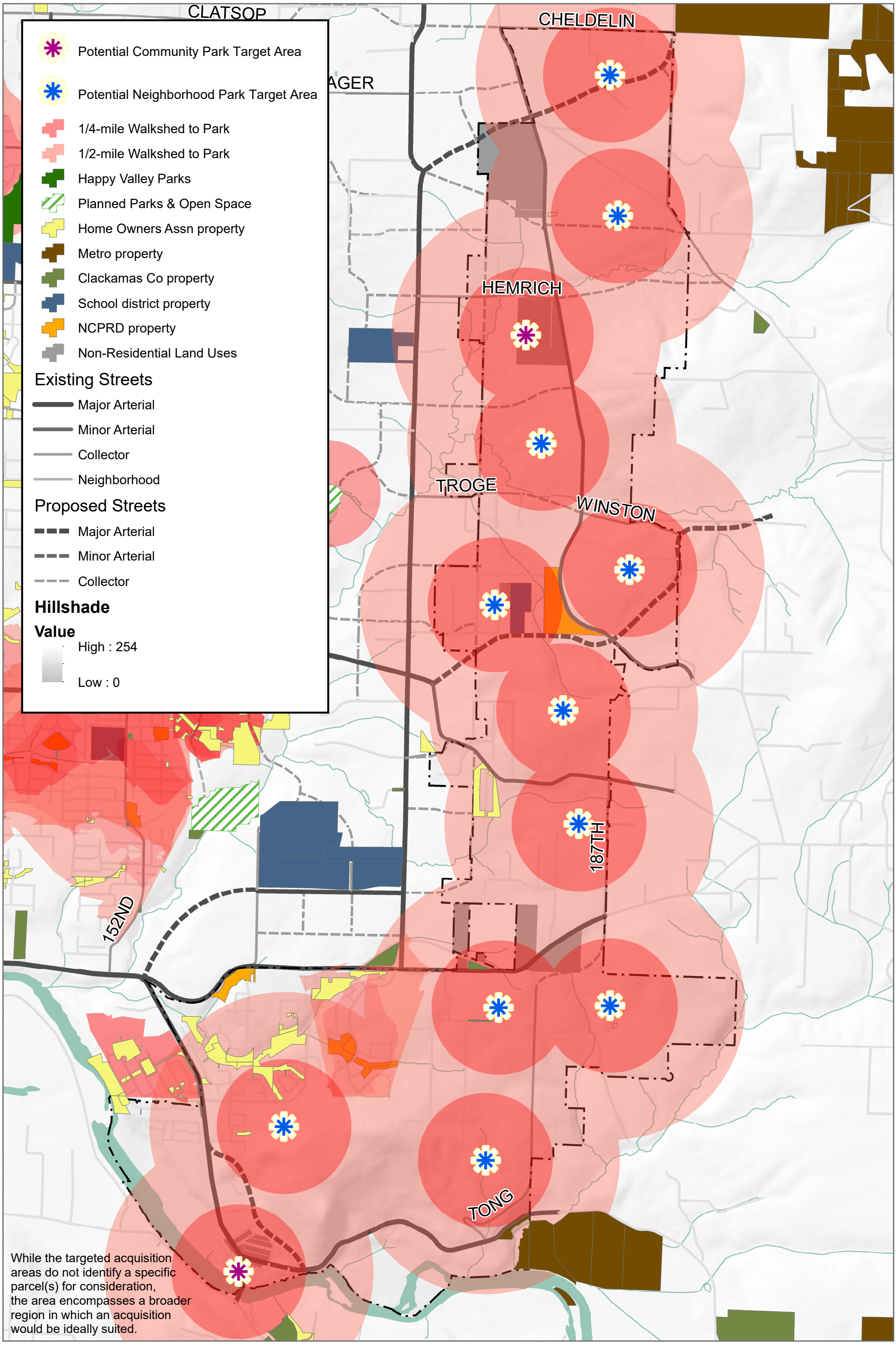


Pleasant Valley North Carver
COMPREHENSIVE PLAN

Map 2: Existing Parks & Open Spaces with 1/4-mile & 1/2-mile Walksheds
Preliminary Draft, October 2019

0 1,000 2,000 3,000 Feet

N

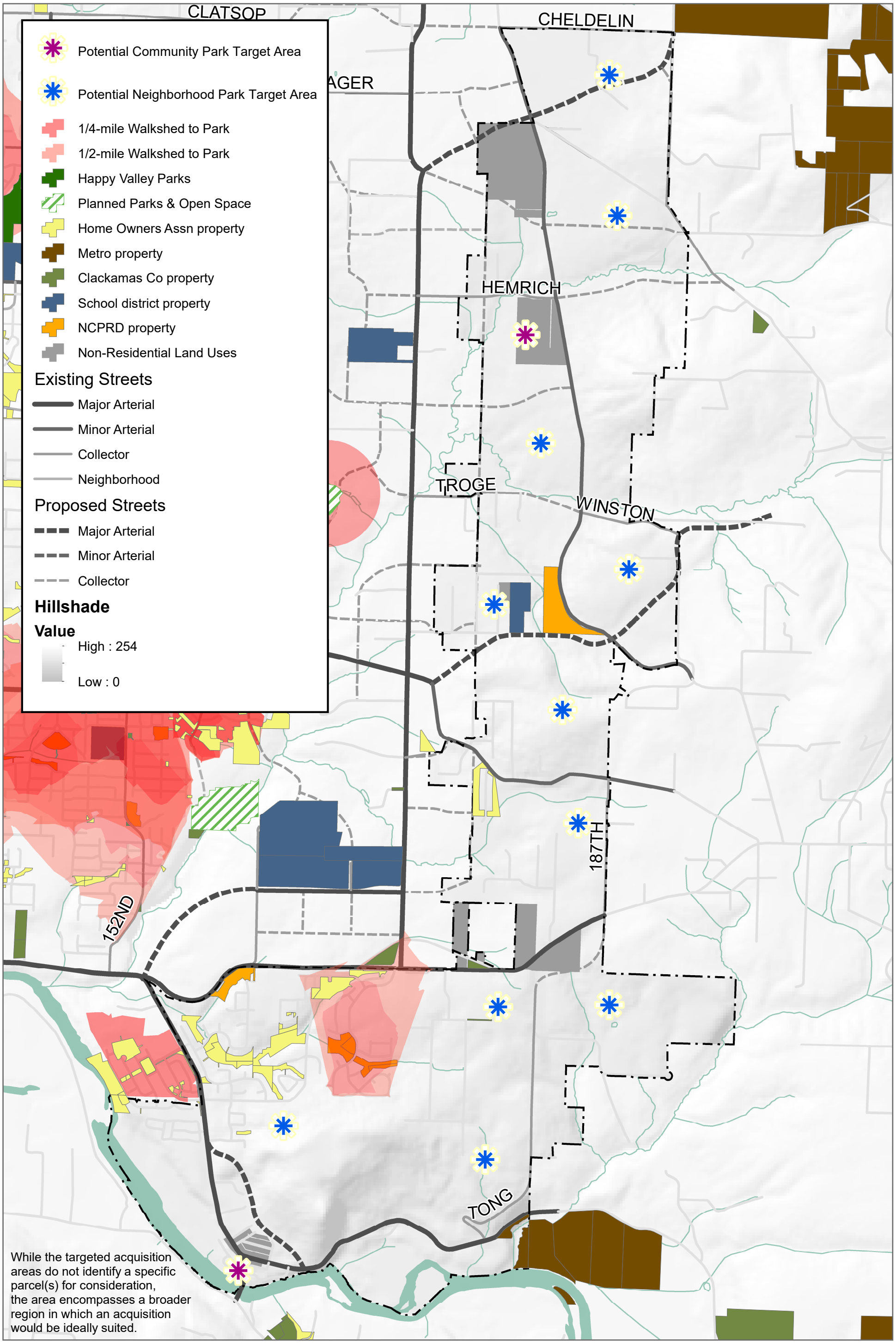


Pleasant Valley North Carver COMPREHENSIVE PLAN

Map 3: Potential Park Target Areas with Conceptual Service Areas
Preliminary Draft, October 2019

0 1,000 2,000 3,000 Feet

N

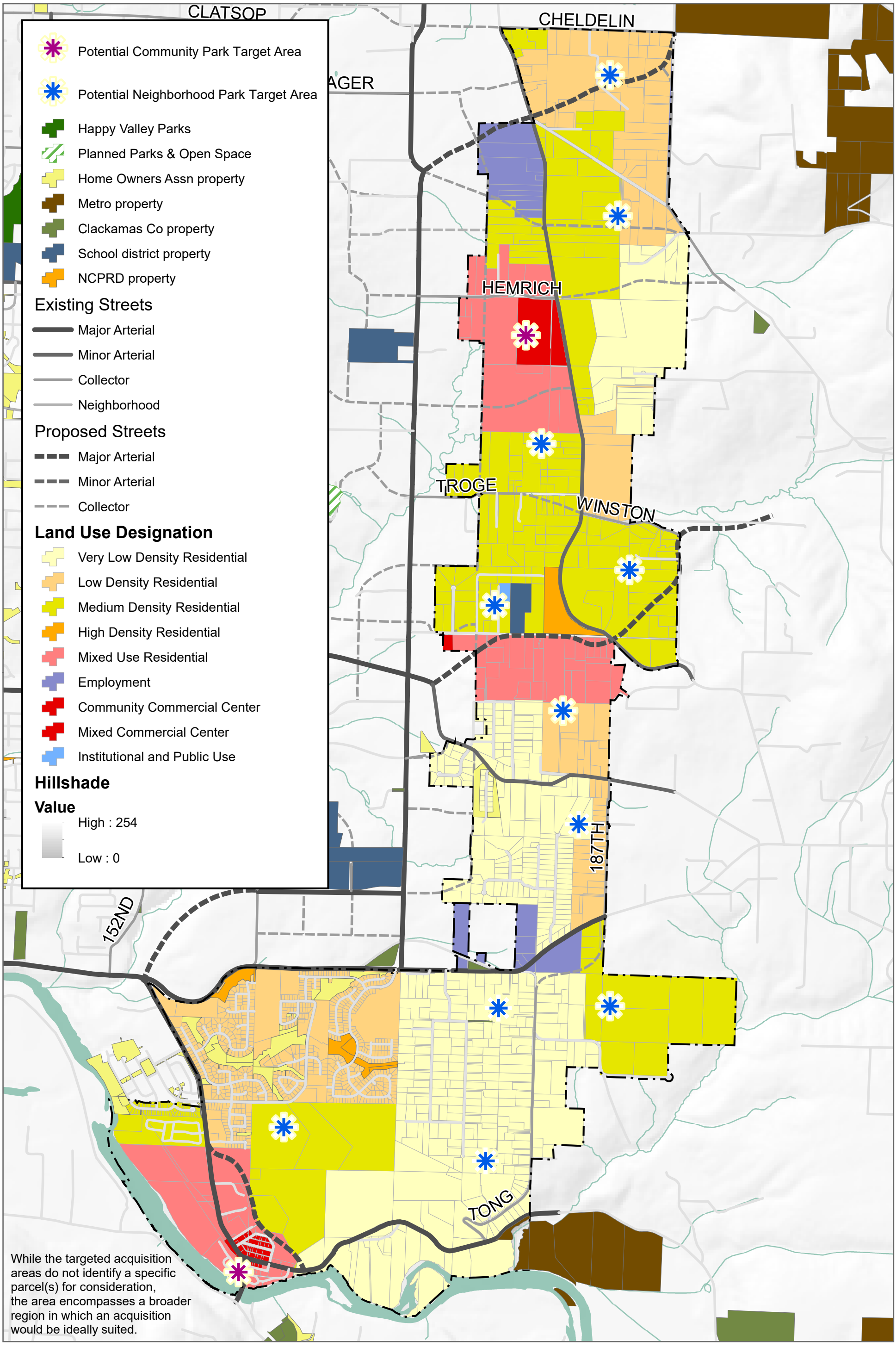


Pleasant Valley North Carver COMPREHENSIVE PLAN

Map 4: Potential Park Target Areas with Walksheds for Existing Parks
Preliminary Draft, October 2019

0 1,000 2,000 3,000 Feet

N



Pleasant Valley North Carver
COMPREHENSIVE PLAN

Map 5: Potential Park Target Areas with Proposed Land Uses
Preliminary Draft, October 2019

0 1,000 2,000 3,000 Feet

N

Pleasant Valley North Carver
COMPREHENSIVE PLAN

MEMORANDUM

Future Transportation Conditions
Pleasant Valley/North Carver Comprehensive Plan

DATE October 8, 2019

TO Michael D. Walter, City of Happy Valley

FROM Reah Flisakowski and Rochelle Starrett, DKS Associates

This memorandum summarizes the future transportation conditions in the Pleasant Valley/North Carver (PV/NC) planning area, which includes approximately 2,700 acres east of the City of Happy Valley. The project study area is generally bordered by 172nd Avenue to the west, the Clackamas River to the south, 190th Avenue to the east, and Cheldelin Road to the north. This memorandum also presents the multimodal improvements needed to support the proposed land use changes in the planning area and a focused evaluation of two network options for the Carver area. The future needs were based on an analysis of future traffic volumes, study intersection operations and off-street trail connections. Existing transportation conditions were documented in a prior technical memorandum.[1]

FUTURE TRAFFIC VOLUMES

Traffic volume forecasts were developed for the year 2040 using the most recent releases of the 2015 Existing and 2040 Financially Constrained Regional Transportation Plan (RTP) travel demand models from Metro. Additional local level network and connectivity refinements were made within the PV/NC subarea to support the development of future volumes in the study area. Future year models were developed for two scenarios: 2040 Baseline and 2040 PV/NC Build.

2040 Baseline Scenario Forecasts

Planned improvements included in the 2040 Baseline scenario are below. These represent projects from the Metro RTP and/or Happy Valley Transportation System Plan (TSP) that are identified as financially constrained (reasonably funded by 2040). The 2040 Baseline scenario also includes a few projects that are not identified as financially constrained in the RTP or TSP but were present in the 2040 Financially Constrained RTP model. These projects are noted in the list below. Based on the model outputs, year 2040 Baseline scenario roadway and study intersection volumes were developed for the analysis.

[1] Existing Transportation Conditions, Pleasant Valley North Carver Comprehensive Plan, DKS Associates, October 19, 2018.

- Widen/construct 162nd Avenue to three lanes, OR 212 to Clatsop Street (RTP 10037, 10040, 10041 and TSP W9, R3, R4)
- Construct Sunnyside Road-Damascus Boulevard east extension as five lane facility, 172nd Avenue to Foster Road, labeled Damascus Boulevard on Figure 1 (RTP 10076 and TSP R23)
- Construct Sunrise Corridor consistent with FEIS, I-205 to 172nd Avenue (RTP 10890, 11301, 12020 and TSP R24)
- Widen 172nd Avenue to five lane facility, Sunnyside Road to 172nd-190th Connection (TSP W2)
- Construct 172nd-190th Connection as five lane facility (RTP 12071 and TSP R7)
- Construct Sager Road extension as three lane facility, 172nd Avenue to Foster Road (TSP R5)
- Construct Hemrich Road extension as three lane facility, 162nd Avenue to 177th Avenue (TSP R9)
- Construct Scouter Mountain Road extension as three lane facility, 147th to 177th Avenue (TSP R10)
- Construct Troge Road extension as three lane facility, 162nd to 177th Avenue (TSP R11)
- Construct Crossroads Avenue as three lane facility, 172nd Avenue to 177th Avenue (R12)
- Widen 172nd Avenue to three lanes, 172nd-190th Connection to Cheldelin Road (TSP W3)
- Construct Rock Creek Boulevard as three lane facility, 172nd Avenue to 177th Avenue (TSP R17)
- Widen Foster Road to three lanes, County line to 172nd-190th Connection Road (RTP 10035, not financially constrained)

2040 PV/NC Build Scenario Forecasts

The 2040 Baseline scenario demand model was modified to develop a 2040 PV/NC Build model which reflects the proposed PV/NC land use changes and Refined Plan Street Network shown in Figure 1. The project team modified the current future land use projections to develop a future land use scenario for the PV/NC plan area as shown in Table 1. Vehicle trip rates per each household and employee were estimated using the 2040 Metro model. These trip rates were applied to the proposed land uses to develop the 2040 PV/NC Build year 2040 roadway and study intersection volumes.

Table 1: Future (2040) Land Use Summary

Scenario	Growth (2015 to 2040)		Total (2040)	
	Households	Employees	Households	Employees
2040 Regional Land Use Projection	6,300	2,200	8,700	2,700
2040 PV/NC Land Use Projection	8,400	1,200	10,800	1,700

Note: Future land use projections for housing and employment based on the proposed PV/NC growth added to the Metro travel demand base model land use data.

The following projects were added to the 2040 Build scenario consistent with the PV/NC Refined Plan Street Network shown in Figure 1.

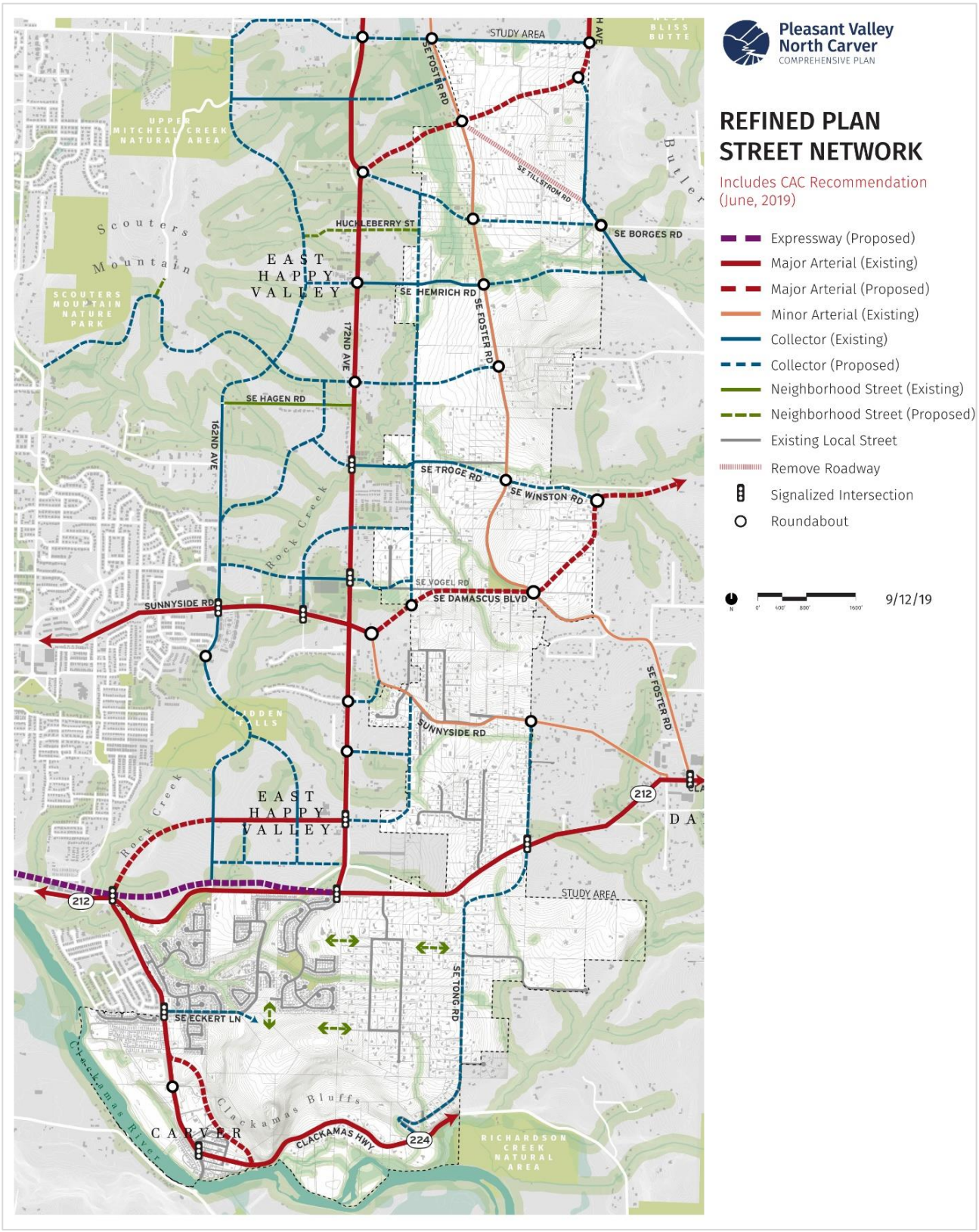
- Construct Sunnyside Road east extension as five lane facility, Foster Road to Winston Road, labeled Damascus Boulevard on Figure 1
- Construct Troge Road extension as three lane facility, 177th Avenue to Sunnyside Road east extension
- Construct Scouter Mountain Road extension as three lane facility, 177th Avenue to Foster Road
- Widen Hemrich Road as three lane facility, 177th Avenue to Foster Road
- Construct Borges Road extension as three lane facility, 172nd-190th Connection to Tillstrom Road
- Close Tillstrom Road between 190th Drive and Foster Road
- Construct Clatsop Road extension from 172nd Avenue to Foster Road (TSP R2, not financially constrained)
- Widen Cheldelin Road as three lane facility, Foster Road to 190th Drive
- Widen 187th Avenue as three lane facility, OR 212 to Sunnyside Road
- Widen Tong Road as a two/three lane facility, OR 212 to OR 224, realign at OR 212 opposite 187th Avenue
- Construct 177th Avenue, Rock Creek Boulevard to Sager Road Extension (TSP R22, not financially constrained)

Future Damascus Boulevard Needs and Implementation

The extension of Sunnyside Road to the east has been a planned regional project for almost a decade. This project would construct a new five-lane Damascus Boulevard facility, between 172nd Avenue and Foster Road. This project is included in both the Metro RTP and Happy Valley TSP as a reasonably funded project for the year 2040 planning horizon.

This project would serve as the first step toward providing a new regional east-west connection between the City of Happy Valley and future urban growth areas to the east, south of the City of Gresham. OR 212 provides the only direct connection between 172nd Avenue and US 26. The 2040 demand model shows OR 212 is expected to operate with significantly congestion in the future and a parallel east-west arterial to the north would improve overall capacity and connectivity in the area. It is important for the PV/NC Plan to identify the need to continue Damascus Boulevard east of Foster Road to serve future 2040 mobility needs and beyond.

Figure 1


Pleasant Valley North Carver
COMPREHENSIVE PLAN
REFINED PLAN STREET NETWORK
Includes CAC Recommendation (June, 2019)
Expressway (Proposed)
Major Arterial (Existing)
Major Arterial (Proposed)
Minor Arterial (Existing)
Collector (Existing)
Collector (Proposed)
Neighborhood Street (Existing)
Neighborhood Street (Proposed)
Existing Local Street
Remove Roadway
Signalized Intersection
Roundabout
9/12/19
STUDY AREA
SE FOSTER RD
SE TILLSTROM RD
SE BORGES RD
HUCKLEBERRY ST
SE HEMRICH RD
172ND AVE
SE HAGEN RD
162ND AVE
SE TROGE RD
SE WINSTON RD
SE VOGEL RD
SE DAMASCUS BLVD
SUNNYSIDE RD
EAST HAPPY VALLEY
Scouters Mountain
SCOUTERS MOUNTAIN NATURE PARK
UPPER MITCHELL CREEK NATURAL AREA
Rock Creek
Butler
BLISS BUTTE
212
SE TONG RD
SE ECKERT LN
Clackamas River
Clackamas Bluffs
CARVER
CLACKAMAS HWY
224
RICHARDSON CREEK NATURAL AREA

FUTURE INTERSECTION OPERATIONS

The 2040 Baseline and Build traffic volumes developed for the PM peak hour were used to evaluate study intersection operations. The analysis was based on 2000 Highway Capacity Manual[2] (HCM) methodology for signalized and 2010 HCM methodology for unsignalized intersections. The 2040 Baseline scenario included financially constrained projects identified in the Happy Valley TSP and the Metro RTP. In addition to the roadway projects listed on page 2, the following intersection improvements were included in the 2040 Baseline scenario:

- traffic signal at OR 224/Market Road
- 172nd Avenue/OR 212 capacity improvements (TSP I8)
- 172nd Avenue/Hemrich Road capacity improvements (TSP I11)
- Foster Road/Tillstrom Road/172nd-190th Connection capacity improvements (TSP I15)

The 2040 Baseline intersection operations are summarized below in Table 2. Many of the study intersections exceed their mobility standards in the future, including OR 212/OR 224, Foster Road/Tillstrom Road/172nd-190th Connection, OR 224/Market Road, and most unsignalized study intersections. Detailed intersection operations are provided in the appendix.

Table 2: Future (2040) Baseline Intersection Performance (PM Peak Hour)

Signalized Intersection	Delay	Level of Service	V/C
172nd Avenue/Sunnyside Road	35.9	D	0.74
172nd Avenue/OR 212	29.5	C	0.81
OR 212/OR 224	160.1	F	1.49
Foster Road/Tillstrom Road/172nd-190th Connection	91.8	F	1.11
172nd Avenue/Hemrich Road	10.5	B	0.71
OR 224/Market Road	>200.0	F	1.66
Unsignalized Intersection	**Delay**	**Level of Service**	**V/C**
Foster Road/Cheldelin Road	21.3	A/C	0.34
190th Drive/Tillstrom Road	44.4	A/E	0.80
Foster Road /Troge Road	54	A/F	0.84
Foster Road/Vogel Road	87.9	A/F	1.08
Signalized Intersection: Delay = Average Intersection Delay (sec.) LOS = Level of Service	Unsignalized Intersection: Delay = Critical Approach Delay (sec.) LOS = Major Street/Minor Street		

[2] 2000 Highway Capacity Manual, Transportation Research Board, Washington DC, 2000. 2010 Highway Capacity Manual, Transportation Research Board, Washington DC, 2010.

V/C = Volume-to-Capacity Ratio Shaded values do not meet standards	V/C = Critical Volume-to-Capacity Ratio Shaded values do not meet standards

Study intersections that are expected to exceed their mobility standards were evaluated further to identify the need for additional improvements. With the roadway widening projects included in the PV/NC Refined Plan Street Network (listed on page 3 and in Figure 1), the intersection of Foster Road/Tillstrom Road/172nd-190th Connection and all unsignalized study intersections would have increased capacity from the addition of left turn lanes. These improvements were used to assess 2040 Build operations, shown below in Table 3. Detailed intersection operations are provided in the appendix.

With these recommended improvements, most study intersections meet the operational standards except for the intersections of OR 224/Market Road and OR 212/OR 224. These intersections significantly exceed their mobility standards under both the 2040 Baseline and Build scenarios. The additional vehicle trips generated by the Pleasant Valley/North Carver proposed land uses **do not degrade operations** at either location.

Additional improvement options were evaluated at these failing intersections. Installing turn lanes at the OR 224/Market Road intersection would significantly improve intersection operations; however, this intersection has constrained right-of-way due to steep topography and close-in development. Constructing additional turn lanes was deemed infeasible. The OR 212/OR 224 intersection is part of the Sunrise Gateway project which is a significant regional corridor project currently in the planning phase. The specific configuration and connection to the OR 212/OR 224 intersection has not been determined. Due to these issues, no improvements were identified for OR 224/Market Road and OR 212/OR 224 as part of the PV/NC plan. See Carver Junction options below, for further information regarding OR 224/Market Road.

Table 3: Future (2040) Build Intersection Performance with Mitigations (PM Peak Hour)

Signalized Intersection	Delay	Level of Service	V/C
172nd Avenue/Sunnyside Road	36.1	D	0.78
172nd Avenue/OR 212	30.2	C	0.81
OR 212/OR 224	168.0	F	1.52
Foster Road/Tillstrom Road/172nd-190th Connection	44.6	D	0.89
172nd Avenue/Hemrich Road	11.2	B	0.71
OR 224/Market Road	>200.0	F	1.66
Foster Road/Vogel Road	25.2	C	0.68
Foster Road/Cheldelin Road	4.4	A	0.60
Foster Road /Troge Road	8.5	A	0.62
Unsignalized Intersection	**Delay**	**Level of Service**	**V/C**
190th Drive/Tillstrom Road	--	--	--

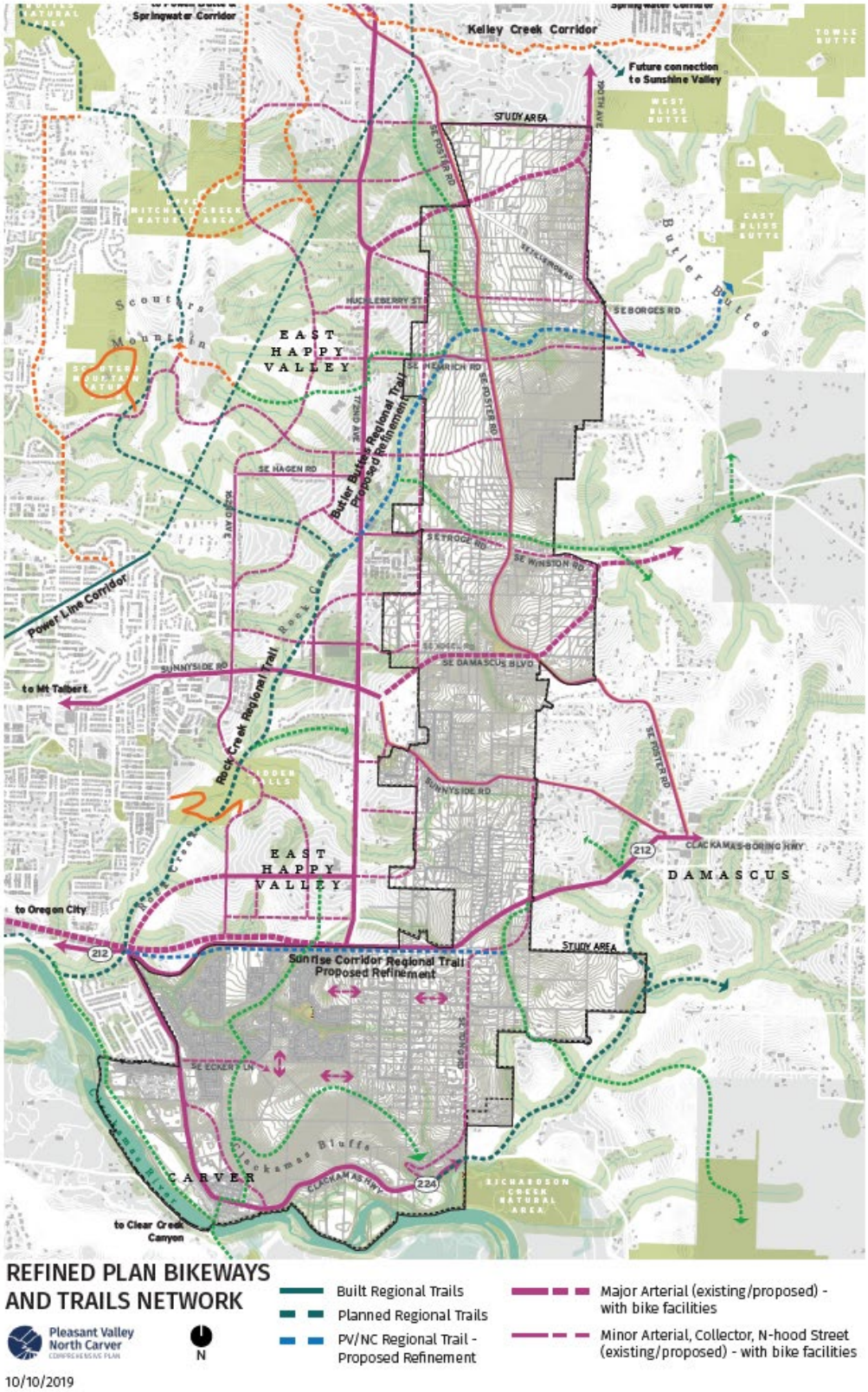
Signalized Intersection: Delay = Average Intersection Delay (sec.) LOS = Level of Service V/C = Volume-to-Capacity Ratio Shaded values do not meet standards	Unsignalized Intersection: Delay = Critical Approach Delay (sec.) LOS = Major Street/Minor Street V/C = Critical Volume-to-Capacity Ratio Shaded values do not meet standards

FUTURE MULTIMODAL SYSTEM

The Pleasant Valley/North Carver area will urbanize the predominantly rural area east of Happy Valley. While many of the existing streets have not been improved to urban standards, as part of the PV/NC plan, arterial and collector roadways will be constructed or re-constructed with bike facilities and sidewalks consistent with Happy Valley urban roadway standards which include a six-foot wide bike lane and a five to seven-foot wide landscape buffered sidewalk on each side of the facility. Providing bicycle and pedestrian facilities will provide a marked improvement for multimodal users over the existing rural environment.

In addition to on-street facilities, local and regional trails are planned in accordance with adopted regional plans and identified local connection needs. The Refined Plan Bikeways and Trail Network is shown in Figure 2. The trail system is aimed at serving both recreational and commuter needs in the planning area by connecting regional trails, parks, neighborhoods and commercial centers.

Figure 2

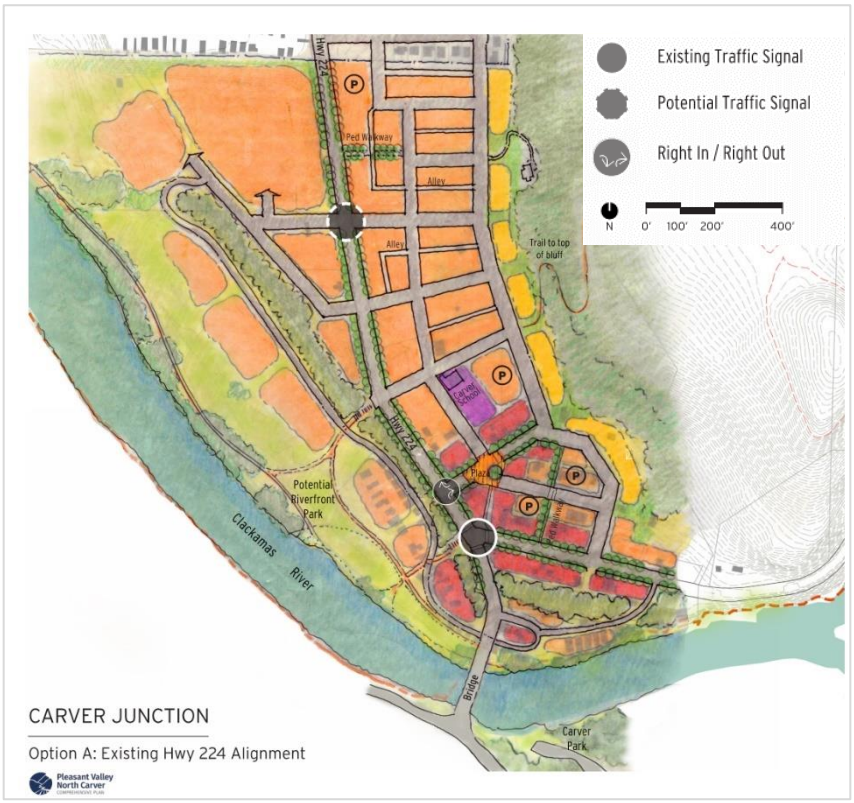

Springwater Corridor
Kelley Creek Corridor
Future connection to Sunshine Valley
STUDY AREA
SE FOSTER RD
SE BORGES RD
Butler Buttes
EAST HAPPY VALLEY
SE HENRICH RD
SE HAGEN RD
Butler Buttes Regional Trail Proposed Refinement
SE ROSE RD
SE WINSTON RD
Power Line Corridor
Rock Creek
SUNNYSIDE RD
to Mt Talbert
SE DAMASCUS BLVD
Rock Creek Regional Trail
CLACKAMAS-BORING HWY
212
DAMASCUS
to Oregon City
Sunrise Corridor Regional Trail Proposed Refinement
SE ECKERT LN
Clackamas Bluffs
CARVER
224
to Clear Creek Canyon
REFINED PLAN BIKEWAYS AND TRAILS NETWORK
Pleasant Valley North Carver
N
10/10/2019
Built Regional Trails
Planned Regional Trails
PV/NC Regional Trail - Proposed Refinement
Major Arterial (existing/proposed) - with bike facilities
Minor Arterial, Collector, N-hood Street (existing/proposed) - with bike facilities

CARVER JUNCTION STREET NETWORK OPTIONS

To help support the proposed PV/NC land use plan, a more detailed street network assessment was conducted for the Carver Junction area. Two distinct network options were developed: Option A – Existing OR 224 Alignment and Option B – OR 224 Realignment. The benefits and concerns for each option are presented below.

Carver Junction Option A

The future street network under Option A, shown to the right, would retain the existing OR 224 alignment and establish a local street grid along the highway between the Clackamas River and the bluff.

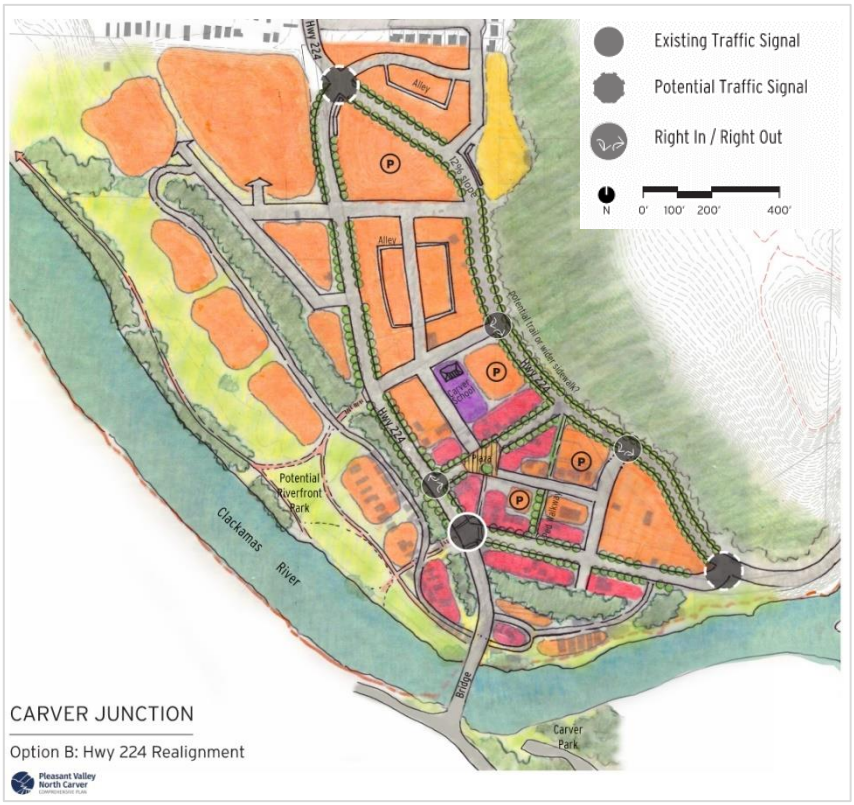


The OR 224/Market Road signalized intersection would serve both vehicle and pedestrian needs in the Carver Junction area. A new traffic signal on OR 224 to the north would likely be warranted to provide additional controlled access to the highway and between future development along each side of the highway. There would be potential to establish a local street grid east of the highway that connects to the existing neighborhood to the north and allows local trips (driving, biking and walking) to be made off the highway. Local street connections to OR 224 may need access restrictions (such as right-in/right-out movements) to preserve capacity and promote safety.

As previously shown in Tables 1 and 2, future 2040 operations at the OR 224/Market Road intersection are expected to significantly exceed mobility standards with no feasible improvements to increase vehicle capacity. The future street network Option A would provide no operational benefit to the OR 224/Market Road intersection.

Carver Junction Option B

The future street network under Option B, shown to the right, would realign OR 224 to the east along the base of the bluff. The existing highway right-of-way would be repurposed as a lower volume-lower speed multimodal corridor through the core of the Carver Junction. This street network would create a new "gateway" intersection on both the north and south end of the area where the old and new highways connect. Each of these intersections would likely warrant a new traffic signal to provide controlled access between the OR 224 realignment, development within the Carver Junction area and the Clackamas River bridge.



There would be potential to establish a local street grid between the old and new highway alignments. A local street connection could also be made between the OR 224 realignment and the existing neighborhood to the north. The street network would require local trips (driving, biking and walking) between the Carver Junction area and the neighborhood to the north to cross OR 224 at the north "gateway" signalized intersection. Local street connections to the OR 224 realignment may need access restrictions (such as right-in/right-out movements) to preserve capacity and promote safety.

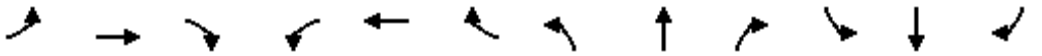
As previously shown in Tables 1 and 2, future 2040 operations at the OR 224/Market Road intersection are expected to significantly exceed mobility standards with no feasible improvements to increase vehicle capacity. Option B would provide an alternative route for regional traffic traveling on OR 224 and reduce the demand at the OR 224/Market Road intersection. Traffic travelling on the Clackamas River bridge would continue to use the existing OR 224/Market Road intersection to connect to the OR 224 realignment. The future 2040 Build scenario operations at the OR 224/Market Road intersection would significantly improve under Option B and meet mobility standards. Detailed intersection operations are provided in the appendix.

Pleasant Valley North Carver
COMPREHENSIVE PLAN

APPENDIX

HCM Signalized Intersection Capacity Analysis
17: SE 172nd Ave & SE Sunnyside Rd/SE Sunnyside Road

09/30/2019



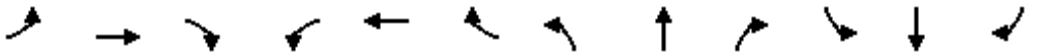
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	250	350	150	5	450	100	250	950	150	100	750	550
Future Volume (vph)	250	350	150	5	450	100	250	950	150	100	750	550
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.8		4.0	5.0		4.0	5.4	4.0	4.0	5.4	4.0
Lane Util. Factor	0.97	0.95		0.97	0.95		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.95		1.00	0.97		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3467	3434		2990	3480		1805	3539	1615	1641	3539	1579
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3467	3434		2990	3480		1805	3539	1615	1641	3539	1579
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	263	368	158	5	474	105	263	1000	158	105	789	579
RTOR Reduction (vph)	0	36	0	0	15	0	0	0	0	0	0	0
Lane Group Flow (vph)	263	490	0	5	564	0	263	1000	158	105	789	579
Confl. Peds. (#/hr)			1	1			1					1
Heavy Vehicles (%)	1%	0%	0%	17%	0%	5%	0%	2%	0%	10%	2%	1%
Turn Type	Prot	NA		Prot	NA		Prot	NA	Free	Prot	NA	Free
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases									Free			Free
Actuated Green, G (s)	10.7	45.4		0.8	35.3		18.4	36.2	110.0	9.4	27.2	110.0
Effective Green, g (s)	10.7	45.4		0.8	35.3		18.4	36.2	110.0	9.4	27.2	110.0
Actuated g/C Ratio	0.10	0.41		0.01	0.32		0.17	0.33	1.00	0.09	0.25	1.00
Clearance Time (s)	4.0	4.8		4.0	5.0		4.0	5.4		4.0	5.4	
Vehicle Extension (s)	0.5	2.9		0.5	2.9		0.5	0.5		0.5	0.5	
Lane Grp Cap (vph)	337	1417		21	1116		301	1164	1615	140	875	1579
v/s Ratio Prot	c0.08	0.14		0.00	c0.16		c0.15	c0.28		0.06	0.22	
v/s Ratio Perm									0.10			0.37
v/c Ratio	0.78	0.35		0.24	0.51		0.87	0.86	0.10	0.75	0.90	0.37
Uniform Delay, d1	48.5	22.1		54.3	30.3		44.7	34.5	0.0	49.2	40.1	0.0
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.3	0.7		2.1	1.6		22.7	6.3	0.1	18.0	12.1	0.7
Delay (s)	58.8	22.8		56.4	31.9		67.3	40.8	0.1	67.1	52.2	0.7
Level of Service	E	C		E	C		E	D	A	E	D	A
Approach Delay (s)		34.8			32.1			41.2			33.0	
Approach LOS		C			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	35.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	18.4
Intersection Capacity Utilization	74.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
21: SE 172nd Ave & Highway 212

09/30/2019



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	800	900	50	20	1100	250	75	100	20	100	50	600
Future Volume (vph)	800	900	50	20	1100	250	75	100	20	100	50	600
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	6.5		4.5	6.5	4.0	4.5	4.5		6.2	6.2	6.2
Lane Util. Factor	0.97	0.95		1.00	0.95	1.00	1.00	1.00		1.00	1.00	0.88
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	3482		1805	3471	1568	1800	1852		1736	1900	2745
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.72	1.00		0.59	1.00	1.00
Satd. Flow (perm)	3433	3482		1805	3471	1568	1369	1852		1071	1900	2745
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	842	947	53	21	1158	263	79	105	21	105	53	632
RTOR Reduction (vph)	0	2	0	0	0	0	0	8	0	0	0	537
Lane Group Flow (vph)	842	998	0	21	1158	263	79	118	0	105	53	95
Confl. Peds. (#/hr)							3					3
Heavy Vehicles (%)	2%	3%	0%	0%	4%	3%	0%	0%	0%	4%	0%	1%
Turn Type	Prot	NA		Prot	NA	Free	Perm	NA		Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases						Free	8			4		4
Actuated Green, G (s)	29.2	70.1		2.1	43.0	105.2	17.5	17.5		15.8	15.8	15.8
Effective Green, g (s)	29.2	70.1		2.1	43.0	105.2	17.5	17.5		15.8	15.8	15.8
Actuated g/C Ratio	0.28	0.67		0.02	0.41	1.00	0.17	0.17		0.15	0.15	0.15
Clearance Time (s)	4.5	6.5		4.5	6.5		4.5	4.5		6.2	6.2	6.2
Vehicle Extension (s)	2.3	5.4		2.3	5.4		2.5	2.5		2.5	2.5	2.5
Lane Grp Cap (vph)	952	2320		36	1418	1568	227	308		160	285	412
v/s Ratio Prot	c0.25	0.29		0.01	c0.33			0.06			0.03	
v/s Ratio Perm						0.17	0.06			c0.10		0.03
v/c Ratio	0.88	0.43		0.58	0.82	0.17	0.35	0.38		0.66	0.19	0.23
Uniform Delay, d1	36.4	8.2		51.1	27.6	0.0	38.8	39.1		42.1	39.1	39.3
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	9.7	0.3		16.9	4.3	0.2	0.7	0.6		8.4	0.2	0.2
Delay (s)	46.1	8.5		68.0	31.9	0.2	39.5	39.6		50.5	39.3	39.6
Level of Service	D	A		E	C	A	D	D		D	D	D
Approach Delay (s)		25.7			26.7			39.6			41.0	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	29.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	105.2	Sum of lost time (s)	17.2
Intersection Capacity Utilization	81.3%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
54: HWY 224 & SE HWY 212

09/30/2019

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	2600	1350	300	1500	600	150
Future Volume (vph)	2600	1350	300	1500	600	150
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	0.95	1.00	1.00	0.95	0.97	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3260	1458	1630	3260	3162	1458
Flt Permitted	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (perm)	3260	1458	1630	3260	3162	1458
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	2737	1421	316	1579	632	158
RTOR Reduction (vph)	0	9	0	0	0	130
Lane Group Flow (vph)	2737	1412	316	1579	632	28
Turn Type	NA	pt+ov	Prot	NA	Prot	Perm
Protected Phases	8	8 6	7	4	6	
Permitted Phases						6
Actuated Green, G (s)	67.0	94.0	16.0	88.0	22.0	22.0
Effective Green, g (s)	66.5	93.5	15.5	87.5	21.5	21.5
Actuated g/C Ratio	0.55	0.78	0.13	0.73	0.18	0.18
Clearance Time (s)	5.0		5.0	5.0	5.0	5.0
Vehicle Extension (s)	2.5		2.5	2.5	2.5	2.5
Lane Grp Cap (vph)	1806	1136	210	2377	566	261
v/s Ratio Prot	c0.84	c0.97	c0.19	0.48	0.20	
v/s Ratio Perm						0.02
v/c Ratio	1.52	1.24	1.50	0.66	1.12	0.11
Uniform Delay, d1	26.8	13.2	52.2	8.5	49.2	41.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	234.9	117.0	250.3	0.6	74.1	0.1
Delay (s)	261.6	130.2	302.6	9.2	123.3	41.4
Level of Service	F	F	F	A	F	D
Approach Delay (s)	216.7			58.1	106.9	
Approach LOS	F			E	F	

Intersection Summary			
HCM 2000 Control Delay	160.1	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.49		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	128.4%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
74: Market Rd 39 & HWY 224

09/30/2019

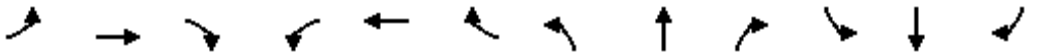
Movement	NBL	NBT	SBT	SBR	NEL	NER
Lane Configurations						
Traffic Volume (vph)	250	300	550	700	250	200
Future Volume (vph)	250	300	550	700	250	200
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0	4.0		4.0	
Lane Util. Factor		1.00	1.00		1.00	
Frt		1.00	0.92		0.94	
Flt Protected		0.98	1.00		0.97	
Satd. Flow (prot)		1678	1586		1569	
Flt Permitted		0.98	1.00		0.97	
Satd. Flow (perm)		1678	1586		1569	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	272	326	598	761	272	217
RTOR Reduction (vph)	0	0	38	0	24	0
Lane Group Flow (vph)	0	598	1321	0	465	0
Turn Type	Split	NA	NA		Prot	
Protected Phases	6	6	2		8	
Permitted Phases						
Actuated Green, G (s)		28.0	56.0		24.0	
Effective Green, g (s)		28.0	56.0		24.0	
Actuated g/C Ratio		0.23	0.47		0.20	
Clearance Time (s)		4.0	4.0		4.0	
Vehicle Extension (s)		2.5	2.5		2.5	
Lane Grp Cap (vph)		391	740		313	
v/s Ratio Prot		c0.36	c0.83		c0.30	
v/s Ratio Perm						
v/c Ratio		1.53	1.78		1.49	
Uniform Delay, d1		46.0	32.0		48.0	
Progression Factor		1.00	1.00		1.00	
Incremental Delay, d2		250.9	358.5		234.9	
Delay (s)		296.9	390.5		282.9	
Level of Service		F	F		F	
Approach Delay (s)		296.9	390.5		282.9	
Approach LOS		F	F		F	

Intersection Summary			
HCM 2000 Control Delay	346.1	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.66		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	148.5%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
78: SE 172nd Ave & SE Hemrich Rd

09/30/2019



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	10	10	100	10	50	30	1150	300	75	1350	30
Future Volume (vph)	10	10	10	100	10	50	30	1150	300	75	1350	30
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.93		1.00	0.88		1.00	0.97		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1630	1587		1630	1503		1630	3159		1630	3249	
Flt Permitted	0.72	1.00		0.74	1.00		0.14	1.00		0.10	1.00	
Satd. Flow (perm)	1227	1587		1275	1503		238	3159		167	3249	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	11	11	11	105	11	53	32	1211	316	79	1421	32
RTOR Reduction (vph)	0	10	0	0	46	0	0	21	0	0	1	0
Lane Group Flow (vph)	11	12	0	105	18	0	32	1506	0	79	1452	0
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)	9.1	9.1		9.1	9.1		44.7	42.9		50.1	45.6	
Effective Green, g (s)	9.1	9.1		9.1	9.1		44.7	42.9		50.1	45.6	
Actuated g/C Ratio	0.13	0.13		0.13	0.13		0.65	0.63		0.73	0.67	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	163	210		169	199		191	1978		218	2162	
v/s Ratio Prot		0.01			0.01		0.00	c0.48		c0.02	0.45	
v/s Ratio Perm	0.01			c0.08			0.10			0.24		
v/c Ratio	0.07	0.06		0.62	0.09		0.17	0.76		0.36	0.67	
Uniform Delay, d1	26.0	26.0		28.1	26.1		5.1	9.1		6.4	6.9	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	0.1		6.0	0.1		0.3	1.7		0.7	0.8	
Delay (s)	26.1	26.0		34.1	26.2		5.4	10.8		7.1	7.7	
Level of Service	C	C		C	C		A	B		A	A	
Approach Delay (s)		26.1			31.1			10.7			7.6	
Approach LOS		C			C			B			A	

Intersection Summary			
HCM 2000 Control Delay	10.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	68.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	72.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
80: SE Foster Rd/Foster & SE Tillstrom Rd & 172nd-190th Connection

09/30/2019

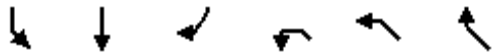
Movement	EBL	EBT	EBR	EBR2	WBL2	WBL	WBT	WBR	NBL	NBT	NBR	SBL2
Lane Configurations												
Traffic Volume (vph)	200	600	50	100	100	200	650	250	40	150	250	150
Future Volume (vph)	200	600	50	100	100	200	650	250	40	150	250	150
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0				4.0	4.0		4.5	4.0		
Lane Util. Factor	1.00	0.95				1.00	0.95		1.00	1.00		
Frt	1.00	0.97				1.00	0.96		1.00	0.91		
Flt Protected	0.95	1.00				0.95	1.00		0.95	1.00		
Satd. Flow (prot)	1630	3162				1630	3124		1630	1555		
Flt Permitted	0.95	1.00				0.95	1.00		0.48	1.00		
Satd. Flow (perm)	1630	3162				1630	3124		827	1555		
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	211	632	53	105	105	211	684	263	42	158	263	158
RTOR Reduction (vph)	0	11	0	0	0	0	37	0	0	0	0	0
Lane Group Flow (vph)	211	779	0	0	0	316	910	0	42	421	0	0
Turn Type	Prot	NA			Prot	Prot	NA		Perm	NA		Perm
Protected Phases	3	8			7	7	4			6		
Permitted Phases									6			2
Actuated Green, G (s)	13.0	24.0				20.0	31.0		41.0	41.0		
Effective Green, g (s)	13.0	24.0				20.0	31.0		40.5	41.0		
Actuated g/C Ratio	0.12	0.22				0.18	0.28		0.37	0.37		
Clearance Time (s)	4.0	4.0				4.0	4.0		4.0	4.0		
Vehicle Extension (s)	2.5	2.5				2.5	2.5		2.5	2.5		
Lane Grp Cap (vph)	192	689				296	880		304	579		
v/s Ratio Prot	0.13	0.25				c0.19	c0.29			0.27		
v/s Ratio Perm									0.05			
v/c Ratio	1.10	1.13				1.07	1.03		0.14	0.73		
Uniform Delay, d1	48.5	43.0				45.0	39.5		23.1	29.7		
Progression Factor	1.00	1.00				1.00	1.00		1.00	1.00		
Incremental Delay, d2	93.9	76.2				71.3	39.6		0.2	4.3		
Delay (s)	142.4	119.2				116.3	79.1		23.3	33.9		
Level of Service	F	F				F	E		C	C		
Approach Delay (s)		124.1					88.4			33.0		
Approach LOS		F					F			C		

Intersection Summary			
HCM 2000 Control Delay	91.8	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.11		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	103.6%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
80: SE Foster Rd/Foster & SE Tillstrom Rd & 172nd-190th Connection

09/30/2019



Movement	SBL	SBT	SBR	NWL2	NWL	NWR
Lane Configurations						
Traffic Volume (vph)	50	150	100	50	0	75
Future Volume (vph)	50	150	100	50	0	75
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.5	4.0			4.0	
Lane Util. Factor	1.00	1.00			1.00	
Frt	1.00	0.94			0.92	
Flt Protected	0.95	1.00			0.98	
Satd. Flow (prot)	1630	1613			1546	
Flt Permitted	0.30	1.00			0.98	
Satd. Flow (perm)	513	1613			1546	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	53	158	105	53	0	79
RTOR Reduction (vph)	0	22	0	0	0	0
Lane Group Flow (vph)	211	241	0	0	132	0
Turn Type	Perm	NA		Prot	Prot	
Protected Phases		2		5	5	
Permitted Phases	2					
Actuated Green, G (s)	41.0	41.0			9.0	
Effective Green, g (s)	40.5	41.0			9.0	
Actuated g/C Ratio	0.37	0.37			0.08	
Clearance Time (s)	4.0	4.0			4.0	
Vehicle Extension (s)	2.5	2.5			2.5	
Lane Grp Cap (vph)	188	601			126	
v/s Ratio Prot		0.15			c0.09	
v/s Ratio Perm	c0.41					
v/c Ratio	1.12	0.40			1.05	
Uniform Delay, d1	34.8	25.4			50.5	
Progression Factor	1.00	1.00			1.00	
Incremental Delay, d2	102.3	0.3			93.5	
Delay (s)	137.1	25.8			144.0	
Level of Service	F	C			F	
Approach Delay (s)		75.3			144.0	
Approach LOS		E			F	

Intersection Summary

HCM 2010 TWSC
84: Foster/SE Foster Rd & SE Cheldelin Rd

09/30/2019

Intersection	
Int Delay, s/veh	2

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Vol, veh/h	75	30	550	150	50	500
Future Vol, veh/h	75	30	550	150	50	500
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	79	32	579	158	53	526

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1290	658	0	0	737	0
Stage 1	658	-	-	-	-	-
Stage 2	632	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	180	464	-	-	869	-
Stage 1	515	-	-	-	-	-
Stage 2	530	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	169	464	-	-	869	-
Mov Cap-2 Maneuver	296	-	-	-	-	-
Stage 1	484	-	-	-	-	-
Stage 2	530	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	21.3	0	0.9
HCM LOS	C		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	330	869	-
HCM Lane V/C Ratio	-	-	0.335	0.061	-
HCM Control Delay (s)	-	-	21.3	9.4	-
HCM Lane LOS	-	-	C	A	-
HCM 95th %tile Q(veh)	-	-	1.4	0.2	-

HCM 2010 TWSC
86: SE Tillstrom Rd & SE 190th Dr

09/30/2019

Intersection	
Int Delay, s/veh	12.1

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Vol, veh/h	75	400	20	300	250	30
Future Vol, veh/h	75	400	20	300	250	30
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	79	421	21	316	263	32

Major/Minor	Major1		Major2		Minor2	
Conflicting Flow All	337	0	-	0	758	179
Stage 1	-	-	-	-	179	-
Stage 2	-	-	-	-	579	-
Critical Hdwy	4.12	-	-	-	6.42	6.22
Critical Hdwy Stg 1	-	-	-	-	5.42	-
Critical Hdwy Stg 2	-	-	-	-	5.42	-
Follow-up Hdwy	2.218	-	-	-	3.518	3.318
Pot Cap-1 Maneuver	1222	-	-	-	375	864
Stage 1	-	-	-	-	852	-
Stage 2	-	-	-	-	560	-
Platoon blocked, %		-	-	-		
Mov Cap-1 Maneuver	1222	-	-	-	344	864
Mov Cap-2 Maneuver	-	-	-	-	344	-
Stage 1	-	-	-	-	780	-
Stage 2	-	-	-	-	560	-

Approach	EB	WB	SB
HCM Control Delay, s	1.3	0	44.4
HCM LOS			E

Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1
Capacity (veh/h)	1222	-	-	-	368
HCM Lane V/C Ratio	0.065	-	-	-	0.801
HCM Control Delay (s)	8.1	0	-	-	44.4
HCM Lane LOS	A	A	-	-	E
HCM 95th %tile Q(veh)	0.2	-	-	-	6.9

HCM 2010 TWSC
88: SE Foster Rd & SE Troge Rd

09/30/2019

Intersection	
Int Delay, s/veh	11.1

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Vol, veh/h	250	5	75	450	450	75
Future Vol, veh/h	250	5	75	450	450	75
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	100	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	263	5	79	474	474	79

Major/Minor	Minor2		Major1		Major2	
Conflicting Flow All	1146	514	553	0	-	0
Stage 1	514	-	-	-	-	-
Stage 2	632	-	-	-	-	-
Critical Hdwy	6.42	6.22	4.12	-	-	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	2.218	-	-	-
Pot Cap-1 Maneuver	~ 220	560	1017	-	-	-
Stage 1	600	-	-	-	-	-
Stage 2	530	-	-	-	-	-
Platoon blocked, %				-	-	-
Mov Cap-1 Maneuver	~ 203	560	1017	-	-	-
Mov Cap-2 Maneuver	318	-	-	-	-	-
Stage 1	553	-	-	-	-	-
Stage 2	530	-	-	-	-	-

Approach	EB	NB	SB
HCM Control Delay, s	54	1.3	0
HCM LOS	F		

Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR
Capacity (veh/h)	1017	-	321	-	-
HCM Lane V/C Ratio	0.078	-	0.836	-	-
HCM Control Delay (s)	8.8	-	54	-	-
HCM Lane LOS	A	-	F	-	-
HCM 95th %tile Q(veh)	0.3	-	7.3	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

HCM 2010 TWSC
93: SE Vogel Rd & SE Foster Rd

09/30/2019

Intersection	
Int Delay, s/veh	44.6

Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Traffic Vol, veh/h	250	350	250	50	100	200
Future Vol, veh/h	250	350	250	50	100	200
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	100	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	95	95	95	95	95	95
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	263	368	263	53	105	211

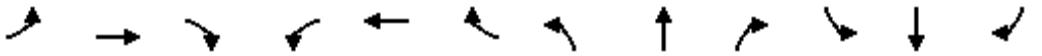
Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	711	290	0	0	316	0
Stage 1	290	-	-	-	-	-
Stage 2	421	-	-	-	-	-
Critical Hdwy	6.42	6.22	-	-	4.12	-
Critical Hdwy Stg 1	5.42	-	-	-	-	-
Critical Hdwy Stg 2	5.42	-	-	-	-	-
Follow-up Hdwy	3.518	3.318	-	-	2.218	-
Pot Cap-1 Maneuver	400	749	-	-	1244	-
Stage 1	759	-	-	-	-	-
Stage 2	662	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	366	749	-	-	1244	-
Mov Cap-2 Maneuver	445	-	-	-	-	-
Stage 1	695	-	-	-	-	-
Stage 2	662	-	-	-	-	-

Approach	EB	SE	NW
HCM Control Delay, s	87.9	0	2.7
HCM LOS	F		

Minor Lane/Major Mvmt	NWL	NWT	EBLn1	SET	SER
Capacity (veh/h)	1244	-	583	-	-
HCM Lane V/C Ratio	0.085	-	1.083	-	-
HCM Control Delay (s)	8.2	-	87.9	-	-
HCM Lane LOS	A	-	F	-	-
HCM 95th %tile Q(veh)	0.3	-	18.7	-	-

HCM Signalized Intersection Capacity Analysis
17: SE 172nd Ave & SE Sunnyside Rd/SE Sunnyside Road

09/30/2019



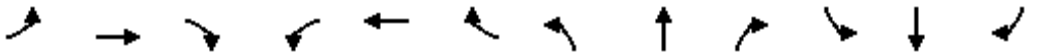
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	250	400	150	5	500	100	300	950	150	100	750	500
Future Volume (vph)	250	400	150	5	500	100	300	950	150	100	750	500
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.8		4.0	5.0		4.0	5.4	4.0	4.0	5.4	4.0
Lane Util. Factor	0.97	0.95		0.97	0.95		1.00	0.95	1.00	1.00	0.95	1.00
Frpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	0.99
Flpb, ped/bikes	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	0.96		1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3467	3450		2990	3491		1805	3539	1615	1641	3539	1579
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3467	3450		2990	3491		1805	3539	1615	1641	3539	1579
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	263	421	158	5	526	105	316	1000	158	105	789	526
RTOR Reduction (vph)	0	29	0	0	13	0	0	0	0	0	0	0
Lane Group Flow (vph)	263	550	0	5	618	0	316	1000	158	105	789	526
Confl. Peds. (#/hr)			1	1			1					1
Heavy Vehicles (%)	1%	0%	0%	17%	0%	5%	0%	2%	0%	10%	2%	1%
Turn Type	Prot	NA		Prot	NA		Prot	NA	Free	Prot	NA	Free
Protected Phases	5	2		1	6		3	8		7	4	
Permitted Phases									Free			Free
Actuated Green, G (s)	10.6	42.2		0.8	32.2		21.7	39.3	110.0	9.5	27.1	110.0
Effective Green, g (s)	10.6	42.2		0.8	32.2		21.7	39.3	110.0	9.5	27.1	110.0
Actuated g/C Ratio	0.10	0.38		0.01	0.29		0.20	0.36	1.00	0.09	0.25	1.00
Clearance Time (s)	4.0	4.8		4.0	5.0		4.0	5.4		4.0	5.4	
Vehicle Extension (s)	0.5	2.9		0.5	2.9		0.5	0.5		0.5	0.5	
Lane Grp Cap (vph)	334	1323		21	1021		356	1264	1615	141	871	1579
v/s Ratio Prot	c0.08	0.16		0.00	c0.18		c0.18	0.28		0.06	c0.22	
v/s Ratio Perm									0.10			0.33
v/c Ratio	0.79	0.42		0.24	0.60		0.89	0.79	0.10	0.74	0.91	0.33
Uniform Delay, d1	48.6	24.9		54.3	33.4		43.0	31.7	0.0	49.1	40.2	0.0
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.8	1.0		2.1	2.7		21.9	3.2	0.1	16.9	12.6	0.6
Delay (s)	59.4	25.8		56.4	36.1		64.8	34.9	0.1	65.9	52.8	0.6
Level of Service	E	C		E	D		E	C	A	E	D	A
Approach Delay (s)		36.3			36.3			37.6			34.4	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM 2000 Control Delay	36.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	18.4
Intersection Capacity Utilization	77.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
21: SE 172nd Ave & Highway 212

09/30/2019



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	850	950	50	20	1100	250	75	75	20	100	50	600
Future Volume (vph)	850	950	50	20	1100	250	75	75	20	100	50	600
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.5	6.5		4.5	6.5	4.0	4.5	4.5		6.2	6.2	6.2
Lane Util. Factor	0.97	0.95		1.00	0.95	1.00	1.00	1.00		1.00	1.00	0.88
Frpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.97		1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	3484		1805	3471	1568	1800	1840		1736	1900	2745
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.72	1.00		0.66	1.00	1.00
Satd. Flow (perm)	3433	3484		1805	3471	1568	1369	1840		1211	1900	2745
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	895	1000	53	21	1158	263	79	79	21	105	53	632
RTOR Reduction (vph)	0	2	0	0	0	0	0	9	0	0	0	539
Lane Group Flow (vph)	895	1051	0	21	1158	263	79	91	0	105	53	93
Confl. Peds. (#/hr)							3					3
Heavy Vehicles (%)	2%	3%	0%	0%	4%	3%	0%	0%	0%	4%	0%	1%
Turn Type	Prot	NA		Prot	NA	Free	Perm	NA		Perm	NA	Perm
Protected Phases	5	2		1	6			8			4	
Permitted Phases						Free	8			4		4
Actuated Green, G (s)	29.7	70.1		2.1	42.5	104.8	17.1	17.1		15.4	15.4	15.4
Effective Green, g (s)	29.7	70.1		2.1	42.5	104.8	17.1	17.1		15.4	15.4	15.4
Actuated g/C Ratio	0.28	0.67		0.02	0.41	1.00	0.16	0.16		0.15	0.15	0.15
Clearance Time (s)	4.5	6.5		4.5	6.5		4.5	4.5		6.2	6.2	6.2
Vehicle Extension (s)	2.3	5.4		2.3	5.4		2.5	2.5		2.5	2.5	2.5
Lane Grp Cap (vph)	972	2330		36	1407	1568	223	300		177	279	403
v/s Ratio Prot	c0.26	0.30		0.01	c0.33			0.05			0.03	
v/s Ratio Perm						0.17	0.06			c0.09		0.03
v/c Ratio	0.92	0.45		0.58	0.82	0.17	0.35	0.30		0.59	0.19	0.23
Uniform Delay, d1	36.4	8.2		50.9	27.8	0.0	38.9	38.6		41.8	39.2	39.5
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	13.5	0.3		16.9	4.6	0.2	0.7	0.4		4.4	0.2	0.2
Delay (s)	49.9	8.6		67.8	32.4	0.2	39.7	39.0		46.2	39.5	39.7
Level of Service	D	A		E	C	A	D	D		D	D	D
Approach Delay (s)		27.6			27.1			39.3			40.5	
Approach LOS		C			C			D			D	

Intersection Summary			
HCM 2000 Control Delay	30.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	104.8	Sum of lost time (s)	17.2
Intersection Capacity Utilization	82.7%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
54: HWY 224 & SE HWY 212

09/30/2019

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Traffic Volume (vph)	2700	1350	300	1500	600	200
Future Volume (vph)	2700	1350	300	1500	600	200
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)	5.5	5.5	5.5	5.5	5.5	5.5
Lane Util. Factor	0.95	1.00	1.00	0.95	0.97	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (prot)	3260	1458	1630	3260	3162	1458
Flt Permitted	1.00	1.00	0.95	1.00	0.95	1.00
Satd. Flow (perm)	3260	1458	1630	3260	3162	1458
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	2842	1421	316	1579	632	211
RTOR Reduction (vph)	0	7	0	0	0	163
Lane Group Flow (vph)	2842	1414	316	1579	632	48
Turn Type	NA	pt+ov	Prot	NA	Prot	Perm
Protected Phases	8	8 6	7	4	6	
Permitted Phases						6
Actuated Green, G (s)	68.0	95.0	15.0	88.0	22.0	22.0
Effective Green, g (s)	67.5	94.5	14.5	87.5	21.5	21.5
Actuated g/C Ratio	0.56	0.79	0.12	0.73	0.18	0.18
Clearance Time (s)	5.0		5.0	5.0	5.0	5.0
Vehicle Extension (s)	2.5		2.5	2.5	2.5	2.5
Lane Grp Cap (vph)	1833	1148	196	2377	566	261
v/s Ratio Prot	c0.87	c0.97	c0.19	0.48	0.20	
v/s Ratio Perm						0.03
v/c Ratio	1.55	1.23	1.61	0.66	1.12	0.19
Uniform Delay, d1	26.2	12.8	52.8	8.5	49.2	41.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	250.4	112.2	297.9	0.6	74.1	0.3
Delay (s)	276.7	124.9	350.6	9.2	123.3	42.1
Level of Service	F	F	F	A	F	D
Approach Delay (s)	226.1			66.1	103.0	
Approach LOS	F			E	F	

Intersection Summary			
HCM 2000 Control Delay	168.0	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.52		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.5
Intersection Capacity Utilization	131.4%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
74: Market Rd 39 & HWY 224

09/30/2019

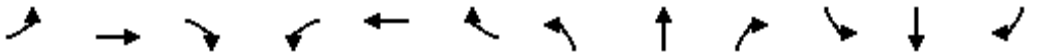
Movement	NBL	NBT	SBT	SBR	NEL	NER
Lane Configurations						
Traffic Volume (vph)	250	300	550	700	250	200
Future Volume (vph)	250	300	550	700	250	200
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0	4.0		4.0	
Lane Util. Factor		1.00	1.00		1.00	
Frt		1.00	0.92		0.94	
Flt Protected		0.98	1.00		0.97	
Satd. Flow (prot)		1678	1586		1569	
Flt Permitted		0.98	1.00		0.97	
Satd. Flow (perm)		1678	1586		1569	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	272	326	598	761	272	217
RTOR Reduction (vph)	0	0	38	0	24	0
Lane Group Flow (vph)	0	598	1321	0	465	0
Turn Type	Split	NA	NA		Prot	
Protected Phases	6	6	2		8	
Permitted Phases						
Actuated Green, G (s)		26.0	60.0		22.0	
Effective Green, g (s)		26.0	60.0		22.0	
Actuated g/C Ratio		0.22	0.50		0.18	
Clearance Time (s)		4.0	4.0		4.0	
Vehicle Extension (s)		2.5	2.5		2.5	
Lane Grp Cap (vph)		363	793		287	
v/s Ratio Prot		c0.36	c0.83		c0.30	
v/s Ratio Perm						
v/c Ratio		1.65	1.67		1.62	
Uniform Delay, d1		47.0	30.0		49.0	
Progression Factor		1.00	1.00		1.00	
Incremental Delay, d2		303.4	305.2		295.1	
Delay (s)		350.4	335.2		344.1	
Level of Service		F	F		F	
Approach Delay (s)		350.4	335.2		344.1	
Approach LOS		F	F		F	

Intersection Summary			
HCM 2000 Control Delay	340.7	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.66		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.5
Intersection Capacity Utilization	148.5%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
78: SE 172nd Ave & SE Hemrich Rd

09/30/2019



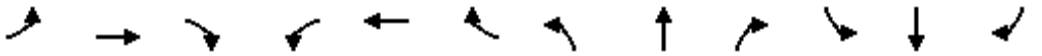
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	10	10	100	10	20	30	1200	250	30	1400	30
Future Volume (vph)	10	10	10	100	10	20	30	1200	250	30	1400	30
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	0.95	0.95		1.00	1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.93		1.00	0.90		1.00	0.97		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1548	1510		1630	1547		1630	3176		1630	3249	
Flt Permitted	0.74	0.99		0.74	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1200	1499		1272	1547		1630	3176		1630	3249	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	11	11	11	105	11	21	32	1263	263	32	1474	32
RTOR Reduction (vph)	0	9	0	0	18	0	0	15	0	0	1	0
Lane Group Flow (vph)	10	14	0	105	14	0	32	1511	0	32	1505	0
Turn Type	Perm	NA		Perm	NA		Prot	NA		Prot	NA	
Protected Phases		8			4		1	6		5	2	
Permitted Phases	8			4								
Actuated Green, G (s)	9.3	9.3		9.3	9.3		1.8	42.4		1.8	42.4	
Effective Green, g (s)	9.3	9.3		9.3	9.3		1.8	42.4		1.8	42.4	
Actuated g/C Ratio	0.14	0.14		0.14	0.14		0.03	0.65		0.03	0.65	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	170	212		180	219		44	2055		44	2103	
v/s Ratio Prot					0.01		c0.02	c0.48		0.02	0.46	
v/s Ratio Perm	0.01	0.01		c0.08								
v/c Ratio	0.06	0.06		0.58	0.06		0.73	0.74		0.73	0.72	
Uniform Delay, d1	24.3	24.3		26.3	24.3		31.6	7.8		31.6	7.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.1	0.1		3.9	0.1		43.0	1.3		43.0	1.1	
Delay (s)	24.4	24.4		30.2	24.4		74.6	9.1		74.6	8.7	
Level of Service	C	C		C	C		E	A		E	A	
Approach Delay (s)		24.4			28.9			10.4			10.1	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	11.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	65.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	64.0%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
80: SE Foster Rd/Foster & 172nd-190th Connection

09/30/2019



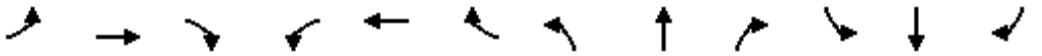
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	150	650	150	200	600	150	50	150	250	200	350	150
Future Volume (vph)	150	650	150	200	600	150	50	150	250	200	350	150
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.97		1.00	0.91		1.00	0.95	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1630	3168		1630	3162		1630	1555		1630	1638	
Flt Permitted	0.95	1.00		0.95	1.00		0.17	1.00		0.29	1.00	
Satd. Flow (perm)	1630	3168		1630	3162		300	1555		499	1638	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	158	684	158	211	632	158	53	158	263	211	368	158
RTOR Reduction (vph)	0	18	0	0	20	0	0	57	0	0	14	0
Lane Group Flow (vph)	158	824	0	211	770	0	53	364	0	211	512	0
Turn Type	Prot	NA		Prot	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	3	8		7	4		1	6		5	2	
Permitted Phases							6			2		
Actuated Green, G (s)	12.8	29.2		16.1	32.5		27.3	27.3		35.0	35.0	
Effective Green, g (s)	12.8	29.2		16.1	32.5		27.3	27.3		35.0	35.0	
Actuated g/C Ratio	0.13	0.29		0.16	0.32		0.27	0.27		0.35	0.35	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	207	918		260	1020		139	421		309	569	
v/s Ratio Prot	0.10	c0.26		c0.13	c0.24		0.02	c0.23		0.08	c0.31	
v/s Ratio Perm							0.09			0.16		
v/c Ratio	0.76	0.90		0.81	0.75		0.38	0.86		0.68	0.90	
Uniform Delay, d1	42.5	34.3		40.8	30.5		29.5	34.9		34.2	31.2	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	14.7	11.3		16.9	3.1		1.3	16.5		5.6	17.3	
Delay (s)	57.2	45.6		57.7	33.6		30.8	51.5		39.8	48.5	
Level of Service	E	D		E	C		C	D		D	D	
Approach Delay (s)		47.4			38.7			49.2			46.0	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM 2000 Control Delay	44.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	100.7	Sum of lost time (s)	16.0
Intersection Capacity Utilization	87.3%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
84: Foster/SE Foster Rd & SE Cheldelin Rd

09/30/2019



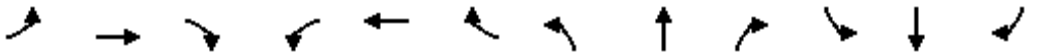
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	10	5	10	50	5	5	10	600	150	20	550	5
Future Volume (vph)	10	5	10	50	5	5	10	600	150	20	550	5
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.90		1.00	0.93		1.00	0.97		1.00	1.00	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1630	1539		1630	1587		1630	1664		1630	1713	
Flt Permitted	0.91	1.00		0.91	1.00		0.42	1.00		0.31	1.00	
Satd. Flow (perm)	1560	1539		1560	1587		721	1664		529	1713	
Peak-hour factor, PHF	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	11	5	11	53	5	5	11	632	158	21	579	5
RTOR Reduction (vph)	0	10	0	0	5	0	0	8	0	0	0	0
Lane Group Flow (vph)	11	6	0	53	5	0	11	782	0	21	584	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		8			4			6			2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)	4.4	4.4		4.4	4.4		35.8	35.8		35.8	35.8	
Effective Green, g (s)	4.4	4.4		4.4	4.4		35.8	35.8		35.8	35.8	
Actuated g/C Ratio	0.09	0.09		0.09	0.09		0.74	0.74		0.74	0.74	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	142	140		142	144		535	1235		392	1272	
v/s Ratio Prot		0.00			0.00			c0.47			0.34	
v/s Ratio Perm	0.01			c0.03			0.02			0.04		
v/c Ratio	0.08	0.04		0.37	0.04		0.02	0.63		0.05	0.46	
Uniform Delay, d1	20.0	20.0		20.6	20.0		1.6	3.0		1.7	2.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	0.1		1.2	0.1		0.0	0.9		0.0	0.2	
Delay (s)	20.2	20.1		21.8	20.0		1.6	3.9		1.7	2.6	
Level of Service	C	C		C	C		A	A		A	A	
Approach Delay (s)		20.1			21.5			3.9			2.6	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	4.4	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	48.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	60.5%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
88: SE Foster Rd & SE Troge Rd

09/30/2019



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	150	20	5	5	30	10	20	600	30	50	400	30
Future Volume (vph)	150	20	5	5	30	10	20	600	30	50	400	30
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Frt	1.00	0.97		1.00	0.96		1.00	0.99		1.00	0.99	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1630	1668		1630	1651		1630	1703		1630	1698	
Flt Permitted	0.73	1.00		0.74	1.00		0.46	1.00		0.30	1.00	
Satd. Flow (perm)	1250	1668		1269	1651		782	1703		523	1698	
Peak-hour factor, PHF	0.95	0.92	0.95	0.92	0.92	0.92	0.95	0.95	0.92	0.92	0.95	0.95
Adj. Flow (vph)	158	22	5	5	33	11	21	632	33	54	421	32
RTOR Reduction (vph)	0	4	0	0	8	0	0	2	0	0	3	0
Lane Group Flow (vph)	158	23	0	5	36	0	21	663	0	54	450	0
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		8			4			6			2	
Permitted Phases	8			4			6			2		
Actuated Green, G (s)	11.9	11.9		11.9	11.9		29.4	29.4		29.4	29.4	
Effective Green, g (s)	11.9	11.9		11.9	11.9		29.4	29.4		29.4	29.4	
Actuated g/C Ratio	0.24	0.24		0.24	0.24		0.60	0.60		0.60	0.60	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	301	402		306	398		466	1015		311	1012	
v/s Ratio Prot		0.01			0.02			c0.39			0.27	
v/s Ratio Perm	c0.13			0.00			0.03			0.10		
v/c Ratio	0.52	0.06		0.02	0.09		0.05	0.65		0.17	0.44	
Uniform Delay, d1	16.2	14.4		14.2	14.5		4.1	6.6		4.5	5.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.3	0.0		0.0	0.1		0.0	1.4		0.2	0.2	
Delay (s)	17.5	14.4		14.3	14.6		4.2	7.9		4.7	5.7	
Level of Service	B	B		B	B		A	A		A	A	
Approach Delay (s)		17.1			14.5			7.8			5.6	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	8.5	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	49.3	Sum of lost time (s)	8.0
Intersection Capacity Utilization	65.3%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
93: SE Vogel Rd & SE Foster Rd

09/30/2019

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Traffic Volume (vph)	450	50	200	20	30	20	40	250	100	100	200	40
Future Volume (vph)	450	50	200	20	30	20	40	250	100	100	200	40
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750	1750
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.95		1.00	0.95		1.00	1.00		1.00	1.00	
Frt	1.00	0.88		1.00	0.94		1.00	0.96		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1630	2870		1630	3064		1630	1642		1630	1672	
Flt Permitted	0.95	1.00		0.95	1.00		0.51	1.00		0.29	1.00	
Satd. Flow (perm)	1630	2870		1630	3064		877	1642		506	1672	
Peak-hour factor, PHF	0.95	0.92	0.95	0.92	0.92	0.92	0.92	0.95	0.95	0.95	0.95	0.92
Adj. Flow (vph)	474	54	211	22	33	22	43	263	105	105	211	43
RTOR Reduction (vph)	0	124	0	0	20	0	0	13	0	0	6	0
Lane Group Flow (vph)	474	141	0	22	35	0	43	355	0	105	248	0
Turn Type	Prot	NA		Prot	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	3	8		7	4		5	2		1	6	
Permitted Phases							2			6		
Actuated Green, G (s)	29.3	33.1		2.4	6.2		27.2	24.2		29.8	25.5	
Effective Green, g (s)	29.3	33.1		2.4	6.2		27.2	24.2		29.8	25.5	
Actuated g/C Ratio	0.37	0.41		0.03	0.08		0.34	0.30		0.37	0.32	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.5	2.5		2.5	2.5		2.5	2.5		2.5	2.5	
Lane Grp Cap (vph)	596	1187		48	237		326	496		248	532	
v/s Ratio Prot	c0.29	c0.05		0.01	0.01		0.00	c0.22		c0.02	0.15	
v/s Ratio Perm							0.04			0.13		
v/c Ratio	0.80	0.12		0.46	0.15		0.13	0.72		0.42	0.47	
Uniform Delay, d1	22.7	14.5		38.2	34.4		18.0	24.8		17.8	21.8	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	7.0	0.0		5.0	0.2		0.1	4.6		0.8	0.5	
Delay (s)	29.7	14.5		43.1	34.6		18.1	29.4		18.6	22.3	
Level of Service	C	B		D	C		B	C		B	C	
Approach Delay (s)		24.2			37.1			28.2			21.2	
Approach LOS		C			D			C			C	

Intersection Summary			
HCM 2000 Control Delay	25.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	70.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
74: Market Rd 39 & HWY 224

10/02/2019

Movement	NBL	NBT	SBT	SBR	NEL	NER
Lane Configurations						
Traffic Volume (vph)	250	40	50	700	250	200
Future Volume (vph)	250	40	50	700	250	200
Ideal Flow (vphpl)	1750	1750	1750	1750	1750	1750
Total Lost time (s)		4.0	4.0		4.0	
Lane Util. Factor		1.00	1.00		1.00	
Frt		1.00	0.87		0.94	
Flt Protected		0.96	1.00		0.97	
Satd. Flow (prot)		1645	1499		1569	
Flt Permitted		0.96	1.00		0.97	
Satd. Flow (perm)		1645	1499		1569	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	272	43	54	761	272	217
RTOR Reduction (vph)	0	0	596	0	19	0
Lane Group Flow (vph)	0	315	219	0	470	0
Turn Type	Split	NA	NA		Prot	
Protected Phases	6	6	2		8	
Permitted Phases						
Actuated Green, G (s)		18.5	15.5		33.9	
Effective Green, g (s)		18.5	15.5		33.9	
Actuated g/C Ratio		0.23	0.19		0.42	
Clearance Time (s)		4.0	4.0		4.0	
Vehicle Extension (s)		2.5	2.5		2.5	
Lane Grp Cap (vph)		380	290		665	
v/s Ratio Prot		c0.19	c0.15		c0.30	
v/s Ratio Perm						
v/c Ratio		0.83	0.75		0.71	
Uniform Delay, d1		29.2	30.4		18.9	
Progression Factor		1.00	1.00		1.00	
Incremental Delay, d2		13.6	10.1		3.2	
Delay (s)		42.8	40.5		22.1	
Level of Service		D	D		C	
Approach Delay (s)		42.8	40.5		22.1	
Approach LOS		D	D		C	

Intersection Summary			
HCM 2000 Control Delay	35.4	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	79.9	Sum of lost time (s)	12.5
Intersection Capacity Utilization	105.5%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group