APPENDICES

APPENDIX A: TRAFFIC ANALYSIS

FEHR PEERS

Date: June 5, 2019

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From: Lynn Jacobs, PE, PTOE and Jeff Pierson, Fehr & Peers

Subject: Meridian St Roundabout Feasibility Study: Existing and Future No Build Traffic Operations

SE19-0685

Introduction

The Meridian Street / Birchwood Avenue / Squalicum Way intersections in Bellingham, WA are being evaluated for potential operational improvements. The first step in this evaluation is to develop an existing conditions model that is calibrated and validated to observed field conditions. This model will then be used to evaluate future build and no-build conditions in order to evaluate the anticipated effectiveness of the proposed improvements. For this analysis, the traffic analysis software platform VISSIM was selected due to its ability to evaluate complex and complicated intersection configurations such as the improvements that are being proposed at this location.

This memo presents the results from the model validation and existing conditions analysis. The travel forecasting methodology and results from the future no build analysis are also presented.

Model Description

The Vissim model includes the two signalized study intersections on Meridian St at Birchwood Avenue and Squalicum Way. The simulation model does not include any additional intersections as there are no nearby intersections that influence operations at these locations. The entire PM peak hour is simulated and includes all travel modes: automobiles, freight, transit buses, bicyclists, and pedestrians. Model statistics are reported from six simulations run with different random seeds using Vissim version 11.00-02.

The intersection geometry and existing traffic conditions were observed on April 9, 2019. Traffic counts, including all motorized and non-motorized travel, were collected on May 21, 2019. The

City of Bellingham provided the signal timing information that was incorporated into the model. Transit routes and schedule information was compiled from Whatcom Transportation Agency's (WTA) website.

Observed Conditions

Traffic counts were collected between 7-9 AM and between 4-6 PM. The AM peak hour occurred between 7:45 and 8:45 AM and the PM peak hour occurred between 4:45 and 5:45 PM. The combined demand at both intersections was approximately 1,800 vehicles during the morning and 2,400 vehicles during the evening. The percentage of freight vehicles (defined as FHWA vehicles classes 4, 6 and above) was 3.6% during the morning and 1.4% during the evening. There was limited bicyclist and pedestrian activity during either peak hour with a total volume of approximately 10 users via each mode during each peak hour.

The following existing traffic conditions were observations were during the PM peak hour:

- Tractor-trailers make a wide right turn from southbound Meridian Street onto westbound Squalicum Way, often blocking both southbound lanes on Meridian Street. They also make a wide left turn eastbound from Squalicum Way onto northbound Meridian Street, blocking both northbound lanes.
- Transit buses in the area were typically shorter, approximately 40' in length.
- Pedestrian and bicycle activity in the area was generally low.
- The largest queues observed on Birchwood Avenue and Squalicum Way were around 15-20 vehicles in length. Southbound queues on Meridian Street extended as far north as Orchard Drive (approximately 25 vehicles). Northbound queues on Meridian street extended as far south as Maplewood Avenue (approximately 20 vehicles).
- All queued vehicles typically cleared the intersection during each signal phase.
- Queuing did not extend to the I-5 ramp intersections, and queues were contained within the available left turn storage lengths.

Even though the traffic counts and field observations did not happen on the same day, the model that used the May counts did accurately replicate conditions observed on April 9th as further described below.

Validation Criteria

For this analysis, the following criteria was used to validate the existing model to PM peak hour traffic conditions. The model was not validated to conditions during the AM peak hour.

- Traffic volumes in the model have a GEH statistic less than 5.0. The GEH statistic is a measurement that is commonly used in traffic engineering to compare observed traffic volumes against modeled traffic volumes for the purpose of validation. A lower GEH statistic indicates that the model more closely matched the observed traffic volume.
- Queueing results from the model generally match the observed queuing in the field.
- Congestion in the model generally matches the observed congestion in the field.

Travel time was not used for this model validation due to the limited extents of the study network.

Existing Year Analysis

The existing conditions model was developed using the PM peak hour intersection demand and was input in 15-minute demand increments consistent with the count data. Automobile and freight traffic were coded separately to reflect the freight-specific volumes and travel paths. Given the low volume of pedestrians and bicyclists at these intersections, two pedestrians per hour were assumed at each crosswalk.

Very little calibration was required in order to match existing conditions. Default Vissim parameters for vehicle types, driver behaviors, and conflict areas did were assumed without adjustments. In order accurately model the impact of freight traffic on operations at these intersections, freight-specific turning speeds were assumed that are approximately 5 mph slower than those for regular automobiles. The turnings paths for large trucks coming from and going to Squalicum Way were also adjusted to accurately model how the trucks use both travel lanes and temporarily block other vehicles to complete these movements. Special priority rules and conflict areas were used to achieve this condition.

The detailed analysis results for the PM peak hour are included as an attachment to this memo. The results include volume demand, percent served, GEH, delay, LOS, and queue lengths for each turning movement. **Table 1** summarizes these results for each approach at the study intersections.

Table 1. 2019 Existing: PM Peak Hour Validation Results

Approach	Demand (veh)	Percent Served	GEH	Maximum Queue (veh)	Observed Queue (veh)
Meridian St – Northbound	608	101%	0.4	16	20
Meridian St – Southbound	814	100%	0.1	18	25
Birchwood Ave – Eastbound	264	99%	0.1	10	15-20
Birchwood Ave – Westbound	434	101%	0.2	15	15-20
Squalicum Way – Eastbound	260	100%	0.0	13	15-20
Cornwall Park - Westbound	10	100%	0.0	2	<5
Intersection Total	*2,390*	*100%*	*0.2*	-	-

Source: Fehr & Peers.

The results in Table 1 show that the model is serving 100% of the input demand on each and the GEH values are all less than 1.0. Overall, the maximum queue lengths estimated in the model are comparable with the observed queues with the model showing longer queues Meridian St than on either Birchwood Ave or Squalicum Way. The model is also accurately reflecting how the intersection operates during the peak hour, with each approach generally serving all demand during the signal phase and queues not spilling out of the turn pockets to block vehicles in the through lanes. Since the modeled conditions adequately match observed conditions, the model should be considered valid for use in testing future alternatives.

The estimated average vehicle delay and level of service (LOS) at each approach and the intersection overall is summarized in **Table 2**. LOS grades are determined based on delay thresholds from the latest version of the Highway Capacity Manual (HCM).

Table 2. 2019 Existing: PM Peak Hour Intersection LOS

Approach	Delay (s/veh)	LOS
Meridian St – Northbound	49	D
Meridian St – Southbound	36	D
Birchwood Ave – Eastbound	47	D
Birchwood Ave – Westbound	30	C
Squalicum Way – Eastbound	45	D
Cornwall Park - Westbound	23	C
Intersection Total	*41*	*D*

Source: Fehr & Peers.

Future Year Analysis

Traffic forecasts for future year 2040 conditions were prepared using the latest version of the Whatcom County regional travel demand model maintained by Whatcom Council of Governments (WCOG). The model includes a 2016 base year and a 2036 future year. Before developing the forecasts, the base year model volumes at the study intersections were compared with the collected intersection counts to determine if a post-processing adjustment to the model volumes would be required to account for any differences between 2016 base year and 2019 count year. The model volumes were within 10% of the count volumes during both the AM and PM peak hours so no adjustments were necessary.

The future year intersection forecasts were prepared by adding the 20-year growth from the traffic model to the 2019 demand volumes. Overall, the model forecasts approximately 35% growth in vehicle trips and 50% growth in freight trips at the study intersections. These growth estimates are consistent with the forecasted population and employment growth within the City of Bellingham. The forecasts also account for additional traffic volume on Birchwood Ave from the Orchard Dr extension project.

The future year demand volumes were coded into the microsimulation model and minor signal timing adjustments were included to optimize the intersection operations. The analysis results for the 2040 PM peak hour are summarized in **Table 3**. Overall, all approaches except the park driveway operate with LOS F conditions and the maximum queue lengths are between 25 and 60 vehicles during the peak hour. Detailed results are included as an attachment.

Table 3. 2040 No Build: PM Peak Hour Intersection LOS

Approach	Demand (veh)	Percent Served	Delay (s/veh)	LOS	Maximum Queue (veh)
Meridian St – Northbound	742	102%	76	E	23
Meridian St – Southbound	1,127	99%	107	F	46
Birchwood Ave – Eastbound	444	98%	128	F	34
Birchwood Ave – Westbound	565	100%	>150	F	56
Squalicum Way – Eastbound	361	94%	>150	F	38
Cornwall Park - Westbound	20	98%	53	D	3
Intersection Total	*3,259*	*99%*	*125*	*F*	-

Source: Fehr & Peers.

Meridian St Roundabout Study
Intersection Analysis Results

Existing Traffic

2019 Existing - PM Peak Hour
6/19/2019

		Demand (vph)	Served (vph)	Percent Served	GEH	Delay (s/veh)	LOS (signal)	Avg. Q (ft & veh)	Max Q (ft & veh)
Meridian SB	LT to EB Birchwood	67	68	102%	0.1	46	D	25 (1)	125 (5)
	LT to EB Park	5	5	93%	0.2	44	D	125 (5)	425 (17)
	TH to SB Meridian	426	425	100%	0.1	34	C	125 (5)	425 (17)
	RT to WB Squalicum	175	179	102%	0.3	37	D	125 (5)	425 (17)
	RT to WB Birchwood	141	135	96%	0.5	35	D	150 (6)	450 (18)
	Approach Total	*814*	*811*	*100%*	*0.1*	*36*	*D*	-	-
Birchwood WB	LT to EB Park	0	0	-	-	0	A	75 (3)	375 (15)
	LT to SB Meridian	23	22	94%	0.3	66	E	75 (3)	375 (15)
	LT to WB Squalicum	26	27	103%	0.1	61	E	75 (3)	375 (15)
	TH to WB Birchwood	134	137	102%	0.3	49	D	75 (3)	375 (15)
	RT to NB Meridian	251	252	100%	0.0	10	B	25 (1)	225 (9)
	Approach Total	*434*	*437*	*101%*	*0.2*	*30*	*C*	-	-
Park WB	LT to SB Meridian	1	0	33%	0.8	0	A	0 (0)	50 (2)
	TH to WB Squalicum	8	9	115%	0.4	23	C	0 (0)	50 (2)
	RT to WB Birchwood	0	0	-	-	0	A	0 (0)	50 (2)
	RT to NB Meridian	0	0	-	-	0	A	0 (0)	50 (2)
	RT to EB Birchwood	1	1	50%	0.6	0	A	0 (0)	50 (2)
	Approach Total	*10*	*10*	*100%*	*0.0*	*23*	*C*	-	-
Meridian NB	LT to WB Squalicum	10	8	82%	0.6	34	C	0 (0)	375 (15)
	LT to WB Birchwood	20	21	103%	0.1	105	F	100 (4)	375 (15)
	TH to NB Meridian	564	576	102%	0.5	47	D	100 (4)	375 (15)
	RT to EB Birchwood	10	9	88%	0.4	32	C	100 (4)	375 (15)
	RT to EB Park	4	4	92%	0.2	26	C	100 (4)	400 (16)
	Approach Total	*608*	*617*	*101%*	*0.4*	*49*	*D*	-	-
Squalicum EB	LT to WB Birchwood	13	15	115%	0.5	65	E	75 (3)	325 (13)
	LT to NB Meridian	191	186	97%	0.4	53	D	75 (3)	325 (13)
	LT to EB Birchwood	20	23	114%	0.6	39	D	75 (3)	325 (13)
	TH to EB Park	1	1	83%	0.2	14	B	0 (0)	50 (2)
	RT to SB Meridian	35	36	103%	0.2	8	A	0 (0)	50 (2)
	Approach Total	*260*	*260*	*100%*	*0.0*	*45*	*D*	-	-
Birchwood EB	LT to NB Meridian	171	172	100%	0.1	52	D	50 (2)	250 (10)
	TH to EB Birchwood	52	49	95%	0.4	41	D	25 (1)	150 (6)
	RT to EB Park	4	4	100%	0.0	34	C	25 (1)	150 (6)
	RT to SB Meridian	26	26	101%	0.0	38	D	25 (1)	150 (6)
	RT to WB Squalicum	11	11	100%	0.0	24	C	25 (1)	150 (6)
	Approach Total	*264*	*262*	*99%*	*0.1*	*47*	*D*	-	-
Overall Intersection		***2,390***	***2,398***	***100%***	***0.2***	***41***	***D***	**-**	**-**

		Demand (vph)	Served (vph)	Percent Served	Delay (s/veh)	LOS (signal)	Avg. Q (ft & veh)	Max Q (ft & veh)
Meridian SB	LT to EB Birchwood	146	147	100%	135	F	150 (6)	450 (18)
	LT to EB Park	7	7	105%	108	F	600 (24)	1,100 (44)
	TH to SB Meridian	524	518	99%	98	F	600 (24)	1,100 (44)
	RT to WB Squalicum	268	268	100%	112	F	600 (24)	1,100 (44)
	RT to WB Birchwood	182	174	95%	99	F	650 (26)	1,150 (46)
	Approach Total	*1,127*	*1,114*	*99%*	*107*	*F*	-	-
Birchwood WB	LT to EB Park	0	0	-	0	A	725 (29)	1,400 (56)
	LT to SB Meridian	34	31	91%	219	F	725 (29)	1,400 (56)
	LT to WB Squalicum	48	47	98%	202	F	725 (29)	1,400 (56)
	TH to WB Birchwood	211	215	102%	211	F	725 (29)	1,400 (56)
	RT to NB Meridian	272	270	99%	133	F	400 (16)	1,150 (46)
	Approach Total	*565*	*563*	*100%*	*174*	*F*	-	-
Park WB	LT to SB Meridian	4	3	75%	39	D	0 (0)	50 (2)
	TH to WB Squalicum	14	16	111%	59	E	0 (0)	50 (2)
	RT to WB Birchwood	0	0	-	0	A	25 (1)	75 (3)
	RT to NB Meridian	0	0	-	0	A	25 (1)	75 (3)
	RT to EB Birchwood	2	1	58%	0	A	25 (1)	75 (3)
	Approach Total	*20*	*20*	*98%*	*53*	*D*	-	-
Meridian NB	LT to WB Squalicum	19	17	91%	110	F	25 (1)	575 (23)
	LT to WB Birchwood	31	30	98%	176	F	200 (8)	575 (23)
	TH to NB Meridian	660	680	103%	70	E	200 (8)	575 (23)
	RT to EB Birchwood	26	25	96%	72	E	200 (8)	575 (23)
	RT to EB Park	6	5	86%	53	D	200 (8)	575 (23)
	Approach Total	*742*	*758*	*102%*	*76*	*E*	-	-
Squalicum EB	LT to WB Birchwood	21	21	99%	219	F	700 (28)	950 (38)
	LT to NB Meridian	227	205	90%	226	F	700 (28)	950 (38)
	LT to EB Birchwood	56	56	99%	229	F	700 (28)	950 (38)
	TH to EB Park	1	1	133%	17	B	0 (0)	50 (2)
	RT to SB Meridian	56	58	103%	164	F	0 (0)	75 (3)
	Approach Total	*361*	*340*	*94%*	*217*	*F*	-	-
Birchwood EB	LT to NB Meridian	212	212	100%	127	F	275 (11)	850 (34)
	TH to EB Birchwood	160	149	93%	134	F	300 (12)	825 (33)
	RT to EB Park	7	6	88%	65	E	300 (12)	825 (33)
	RT to SB Meridian	42	43	103%	127	F	300 (12)	825 (33)
	RT to WB Squalicum	23	24	106%	106	F	300 (12)	825 (33)
	Approach Total	*444*	*435*	*98%*	*128*	*F*	-	-
Overall Intersection		***3,259***	***3,229***	***99%***	***125***	***F***	**-**	**-**

Meridian St Roundabout Study
Intersection Analysis Results

Dual Roundabouts

2040 Layout 1 - PM Peak Hour
6/19/2019

		Demand (vph)	Served (vph)	Percent Served	Delay (s/veh)	LOS (rdb)	Avg. Q (ft & veh)	Max Q (ft & veh)
Meridian SB	LT to EB Birchwood	146	146	100%	23	C	75 (3)	350 (14)
	LT to EB Park	7	7	102%	31	D	75 (3)	350 (14)
	TH to SB Meridian	524	521	99%	29	D	75 (3)	350 (14)
	RT to WB Squalicum	268	270	101%	14	B	75 (3)	350 (14)
	RT to WB Birchwood	182	176	97%	9	A	75 (3)	350 (14)
	Approach Total	*1,127*	*1,119*	*99%*	*21*	*C*	-	-
Birchwood WB	LT to EB Park	0	0	-	0	A	925 (37)	1,325 (53)
	LT to SB Meridian	34	30	89%	301	F	925 (37)	1,325 (53)
	LT to WB Squalicum	48	47	98%	276	F	925 (37)	1,325 (53)
	TH to WB Birchwood	211	213	101%	280	F	925 (37)	1,325 (53)
	RT to NB Meridian	272	269	99%	143	F	0 (0)	125 (5)
	Approach Total	*565*	*560*	*99%*	*217*	*F*	-	-
Park WB	LT to SB Meridian	4	3	83%	19	C	0 (0)	50 (2)
	TH to WB Squalicum	14	16	111%	60	F	0 (0)	50 (2)
	RT to WB Birchwood	0	0	-	0	A	0 (0)	50 (2)
	RT to NB Meridian	0	0	-	0	A	0 (0)	50 (2)
	RT to EB Birchwood	2	1	58%	0	A	0 (0)	50 (2)
	Approach Total	*20*	*20*	*100%*	*49*	*E*	-	-
Meridian NB	LT to WB Squalicum	19	18	92%	156	F	1,425 (57)	1,925 (77)
	LT to WB Birchwood	31	30	97%	169	F	1,425 (57)	1,925 (77)
	TH to NB Meridian	660	656	99%	159	F	1,425 (57)	1,925 (77)
	RT to EB Birchwood	26	24	92%	159	F	1,425 (57)	1,925 (77)
	RT to EB Park	6	5	78%	92	F	1,425 (57)	1,925 (77)
	Approach Total	*742*	*733*	*99%*	*159*	*F*	-	-
Squalicum EB	LT to WB Birchwood	21	23	107%	34	D	75 (3)	300 (12)
	LT to NB Meridian	227	219	96%	37	E	75 (3)	300 (12)
	LT to EB Birchwood	56	57	102%	44	E	75 (3)	300 (12)
	TH to EB Park	1	1	133%	2	A	75 (3)	300 (12)
	RT to SB Meridian	56	60	107%	27	D	75 (3)	300 (12)
	Approach Total	*361*	*359*	*100%*	*36*	*E*	-	-
Birchwood EB	LT to NB Meridian	212	210	99%	48	E	300 (12)	675 (27)
	TH to EB Birchwood	160	147	92%	50	E	300 (12)	675 (27)
	RT to EB Park	7	6	83%	22	C	300 (12)	675 (27)
	RT to SB Meridian	42	42	101%	57	F	300 (12)	675 (27)
	RT to WB Squalicum	23	24	105%	51	F	300 (12)	675 (27)
	Approach Total	*444*	*430*	*97%*	*49*	*E*	-	-
Overall Intersection		***3,259***	***3,220***	***99%***	***93***	***F***	**-**	**-**

Meridian St Roundabout Study
Intersection Analysis Results

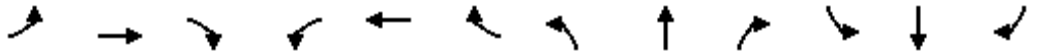
Peanut Roundabout

2040 Layout 2 - PM Peak Hour
6/19/2019

		Demand (vph)	Served (vph)	Percent Served	Delay (s/veh)	LOS (rdb)	Avg. Q (ft & veh)	Max Q (ft & veh)
Meridian SB	LT to EB Birchwood	146	146	100%	9	A	25 (1)	200 (8)
	LT to EB Park	7	7	105%	7	A	25 (1)	200 (8)
	TH to SB Meridian	524	522	100%	7	A	25 (1)	200 (8)
	RT to WB Squalicum	268	269	100%	8	A	25 (1)	200 (8)
	RT to WB Birchwood	182	176	97%	7	A	25 (1)	200 (8)
	Approach Total	*1,127*	*1,121*	*99%*	*8*	*A*	-	-
Birchwood WB	LT to EB Park	0	0	-	0	A	525 (21)	1,175 (47)
	LT to SB Meridian	34	31	90%	184	F	525 (21)	1,175 (47)
	LT to WB Squalicum	48	48	99%	162	F	525 (21)	1,175 (47)
	TH to WB Birchwood	211	217	103%	170	F	525 (21)	1,175 (47)
	RT to NB Meridian	272	270	99%	56	F	0 (0)	0 (0)
	Approach Total	*565*	*565*	*100%*	*120*	*F*	-	-
Park WB	LT to SB Meridian	4	3	83%	10	B	0 (0)	50 (2)
	TH to WB Squalicum	14	16	112%	27	D	0 (0)	50 (2)
	RT to WB Birchwood	0	0	-	0	A	0 (0)	50 (2)
	RT to NB Meridian	0	0	-	0	A	0 (0)	50 (2)
	RT to EB Birchwood	2	1	58%	0	A	0 (0)	50 (2)
	Approach Total	*20*	*20*	*101%*	*22*	*C*	-	-
Meridian NB	LT to WB Squalicum	19	18	94%	69	F	175 (7)	375 (15)
	LT to WB Birchwood	31	31	101%	65	F	175 (7)	375 (15)
	TH to NB Meridian	660	671	102%	60	F	175 (7)	375 (15)
	RT to EB Birchwood	26	25	97%	57	F	175 (7)	375 (15)
	RT to EB Park	6	5	75%	38	E	175 (7)	375 (15)
	Approach Total	*742*	*750*	*101%*	*60*	*F*	-	-
Squalicum EB	LT to WB Birchwood	21	22	102%	179	F	675 (27)	950 (38)
	LT to NB Meridian	227	205	90%	179	F	675 (27)	950 (38)
	LT to EB Birchwood	56	55	98%	191	F	675 (27)	950 (38)
	TH to EB Park	1	1	133%	49	E	675 (27)	950 (38)
	RT to SB Meridian	56	57	101%	170	F	675 (27)	950 (38)
	Approach Total	*361*	*339*	*94%*	*179*	*F*	-	-
Birchwood EB	LT to NB Meridian	212	214	101%	15	B	50 (2)	350 (14)
	TH to EB Birchwood	160	151	94%	16	C	50 (2)	350 (14)
	RT to EB Park	7	6	86%	14	B	50 (2)	350 (14)
	RT to SB Meridian	42	44	106%	12	B	50 (2)	350 (14)
	RT to WB Squalicum	23	25	107%	14	B	50 (2)	350 (14)
	Approach Total	*444*	*440*	*99%*	*15*	*B*	-	-
Overall Intersection		***3,259***	***3,234***	***99%***	***60***	***F***	**-**	**-**

		Demand (vph)	Served (vph)	Percent Served	Delay (s/veh)	LOS (rdb)	Avg. Q (ft & veh)	Max Q (ft & veh)
Meridian SB	LT to EB Birchwood	146	146	100%	9	A	25 (1)	250 (10)
	TH to SB Meridian	531	531	100%	6	A	25 (1)	250 (10)
	RT to WB Birchwood	450	445	99%	5	A	25 (1)	250 (10)
	Approach Total	*1,127*	*1,121*	*99%*	*6*	*A*	-	-
Birchwood WB	LT to SB Meridian	34	31	90%	45	E	50 (2)	250 (10)
	TH to WB Birchwood	259	264	102%	29	D	50 (2)	250 (10)
	RT to NB Meridian	272	271	100%	23	C	50 (2)	250 (10)
	Approach Total	*565*	*566*	*100%*	*27*	*D*	-	-
Meridian NB	LT to WB Birchwood	64	64	100%	11	B	0 (0)	150 (6)
	TH to NB Meridian	660	670	102%	6	A	0 (0)	150 (6)
	RT to EB Birchwood	28	26	93%	5	A	0 (0)	150 (6)
	Approach Total	*752*	*760*	*101%*	*6*	*A*	-	-
Birchwood EB	LT to NB Meridian	439	434	99%	12	B	25 (1)	225 (9)
	TH to EB Birchwood	216	208	96%	10	B	25 (1)	225 (9)
	RT to SB Meridian	106	111	105%	10	A	25 (1)	225 (9)
	Approach Total	*761*	*753*	*99%*	*11*	*B*	-	-
Overall Intersection		***3,205***	***3,201***	***100%***	***12***	***B***	**-**	**-**

Combined Intersection - Interim Signal (Existing Volumes)

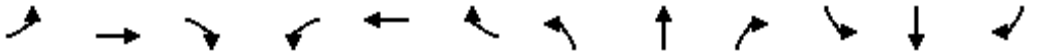


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	362	72	66	23	160	251	38	564	11	67	431	316
Future Volume (veh/h)	362	72	66	23	160	251	38	564	11	67	431	316
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1900	1900	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	393	78	72	25	174	56	41	613	12	73	468	343
Adj No. of Lanes	1	1	0	0	1	1	1	2	0	1	2	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	468	235	217	31	217	212	71	956	19	100	557	407
Arrive On Green	0.26	0.26	0.26	0.13	0.13	0.13	0.04	0.27	0.27	0.06	0.29	0.29
Sat Flow, veh/h	1774	893	824	233	1619	1583	1774	3551	69	1774	1954	1427
Grp Volume(v), veh/h	393	0	150	199	0	56	41	305	320	73	424	387
Grp Sat Flow(s),veh/h/ln	1774	0	1717	1851	0	1583	1774	1770	1850	1774	1770	1611
Q Serve(g_s), s	13.6	0.0	4.6	6.8	0.0	2.1	1.5	9.9	9.9	2.6	14.6	14.7
Cycle Q Clear(g_c), s	13.6	0.0	4.6	6.8	0.0	2.1	1.5	9.9	9.9	2.6	14.6	14.7
Prop In Lane	1.00		0.48	0.13		1.00	1.00		0.04	1.00		0.89
Lane Grp Cap(c), veh/h	468	0	453	248	0	212	71	476	498	100	505	460
V/C Ratio(X)	0.84	0.00	0.33	0.80	0.00	0.26	0.57	0.64	0.64	0.73	0.84	0.84
Avail Cap(c_a), veh/h	655	0	634	251	0	214	137	523	547	137	523	476
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	22.6	0.0	19.3	27.3	0.0	25.3	30.6	21.0	21.0	30.2	21.8	21.8
Incr Delay (d2), s/veh	6.9	0.0	0.4	16.9	0.0	0.7	7.1	2.3	2.2	12.0	11.3	12.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	7.6	0.0	2.2	4.6	0.0	0.9	0.9	5.1	5.4	1.6	8.6	8.1
LnGrp Delay(d),s/veh	29.5	0.0	19.7	44.2	0.0	25.9	37.7	23.3	23.2	42.2	33.1	34.4
LnGrp LOS	C		B	D		C	D	C	C	D	C	C
Approach Vol, veh/h		543			255			666			884	
Approach Delay, s/veh		26.8			40.2			24.1			34.4	
Approach LOS		C			D			C			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	8.2	22.0		21.6	7.1	23.0		13.2
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5
Max Green Setting (Gmax), s	5.0	19.2		24.0	5.0	19.2		8.8
Max Q Clear Time (g_c+I1), s	4.6	11.9		15.6	3.5	16.7		8.8
Green Ext Time (p_c), s	0.0	4.7		1.5	0.0	1.8		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	30.4
HCM 2010 LOS	C

Combined Intersection - Interim Signal (Future Volumes)

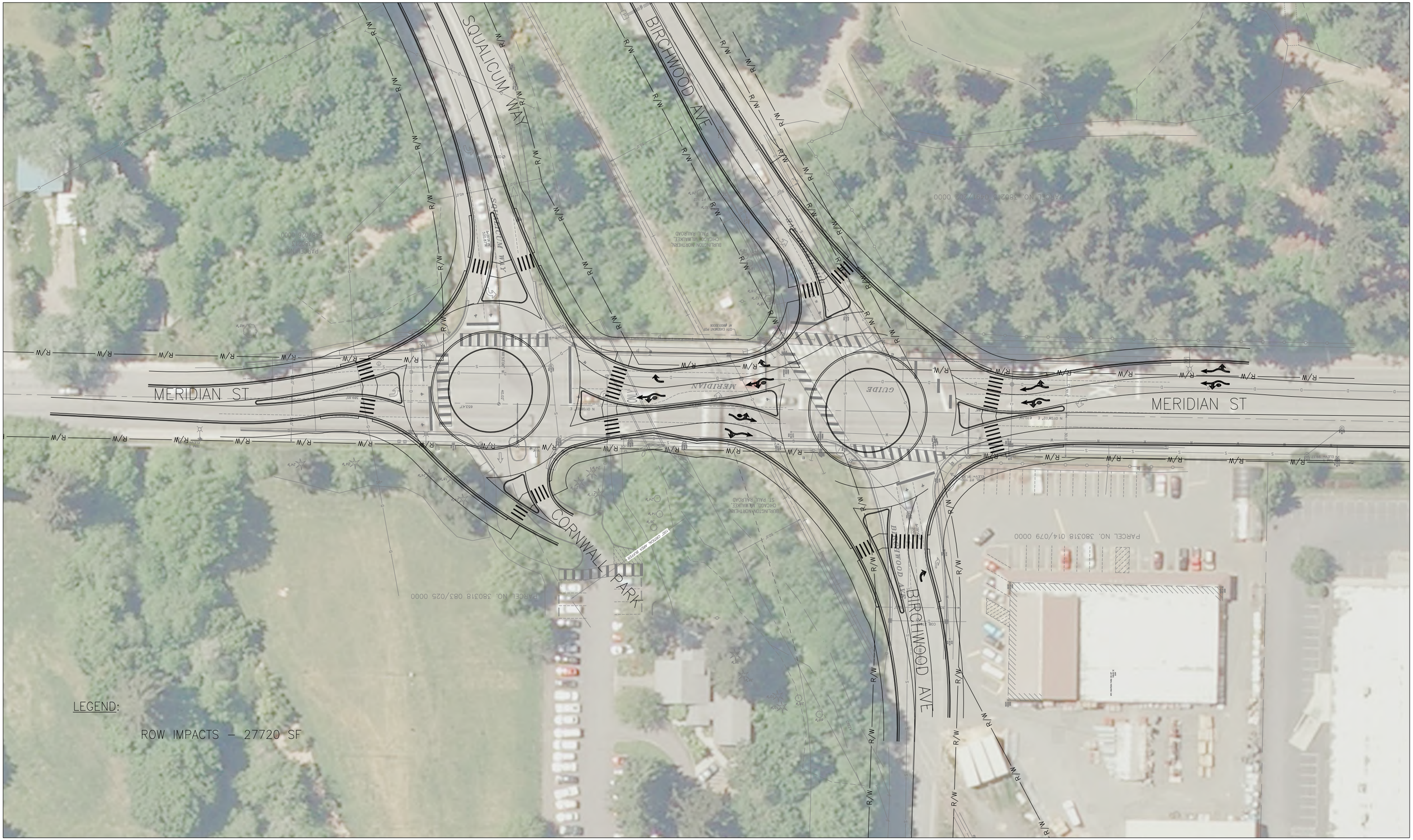


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	439	216	106	34	259	272	64	660	28	146	531	450
Future Volume (veh/h)	439	216	106	34	259	272	64	660	28	146	531	450
Number	7	4	14	3	8	18	5	2	12	1	6	16
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1900	1900	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	477	235	115	37	282	133	70	717	30	159	577	326
Adj No. of Lanes	1	1	0	0	1	1	1	2	0	1	2	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	487	324	159	38	288	278	90	854	36	181	650	367
Arrive On Green	0.27	0.27	0.27	0.18	0.18	0.18	0.05	0.25	0.25	0.10	0.30	0.30
Sat Flow, veh/h	1774	1182	579	215	1637	1583	1774	3462	145	1774	2182	1232
Grp Volume(v), veh/h	477	0	350	319	0	133	70	366	381	159	468	435
Grp Sat Flow(s),veh/h/ln	1774	0	1761	1852	0	1583	1774	1770	1837	1774	1770	1645
Q Serve(g_s), s	23.8	0.0	16.1	15.3	0.0	6.8	3.5	17.6	17.6	7.9	22.5	22.6
Cycle Q Clear(g_c), s	23.8	0.0	16.1	15.3	0.0	6.8	3.5	17.6	17.6	7.9	22.5	22.6
Prop In Lane	1.00		0.33	0.12		1.00	1.00		0.08	1.00		0.75
Lane Grp Cap(c), veh/h	487	0	483	326	0	278	90	436	453	181	527	490
V/C Ratio(X)	0.98	0.00	0.72	0.98	0.00	0.48	0.78	0.84	0.84	0.88	0.89	0.89
Avail Cap(c_a), veh/h	487	0	483	326	0	278	101	450	467	181	529	492
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	1.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	32.2	0.0	29.4	36.7	0.0	33.1	41.9	32.0	32.0	39.6	29.9	29.9
Incr Delay (d2), s/veh	35.6	0.0	5.3	44.3	0.0	1.3	28.5	13.0	12.6	35.6	16.6	17.7
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	16.5	0.0	8.5	11.8	0.0	3.0	2.4	10.1	10.5	5.7	13.5	12.7
LnGrp Delay(d),s/veh	67.8	0.0	34.7	81.0	0.0	34.4	70.4	45.0	44.6	75.2	46.5	47.6
LnGrp LOS	E		C	F		C	E	D	D	E	D	D
Approach Vol, veh/h		827			452			817			1062	
Approach Delay, s/veh		53.8			67.3			47.0			51.3	
Approach LOS		D			E			D			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	13.6	26.5		29.0	9.0	31.1		20.2
Change Period (Y+Rc), s	4.5	4.5		4.5	4.5	4.5		4.5
Max Green Setting (Gmax), s	9.1	22.7		24.5	5.1	26.7		15.7
Max Q Clear Time (g_c+I1), s	9.9	19.6		25.8	5.5	24.6		17.3
Green Ext Time (p_c), s	0.0	2.4		0.0	0.0	1.7		0.0

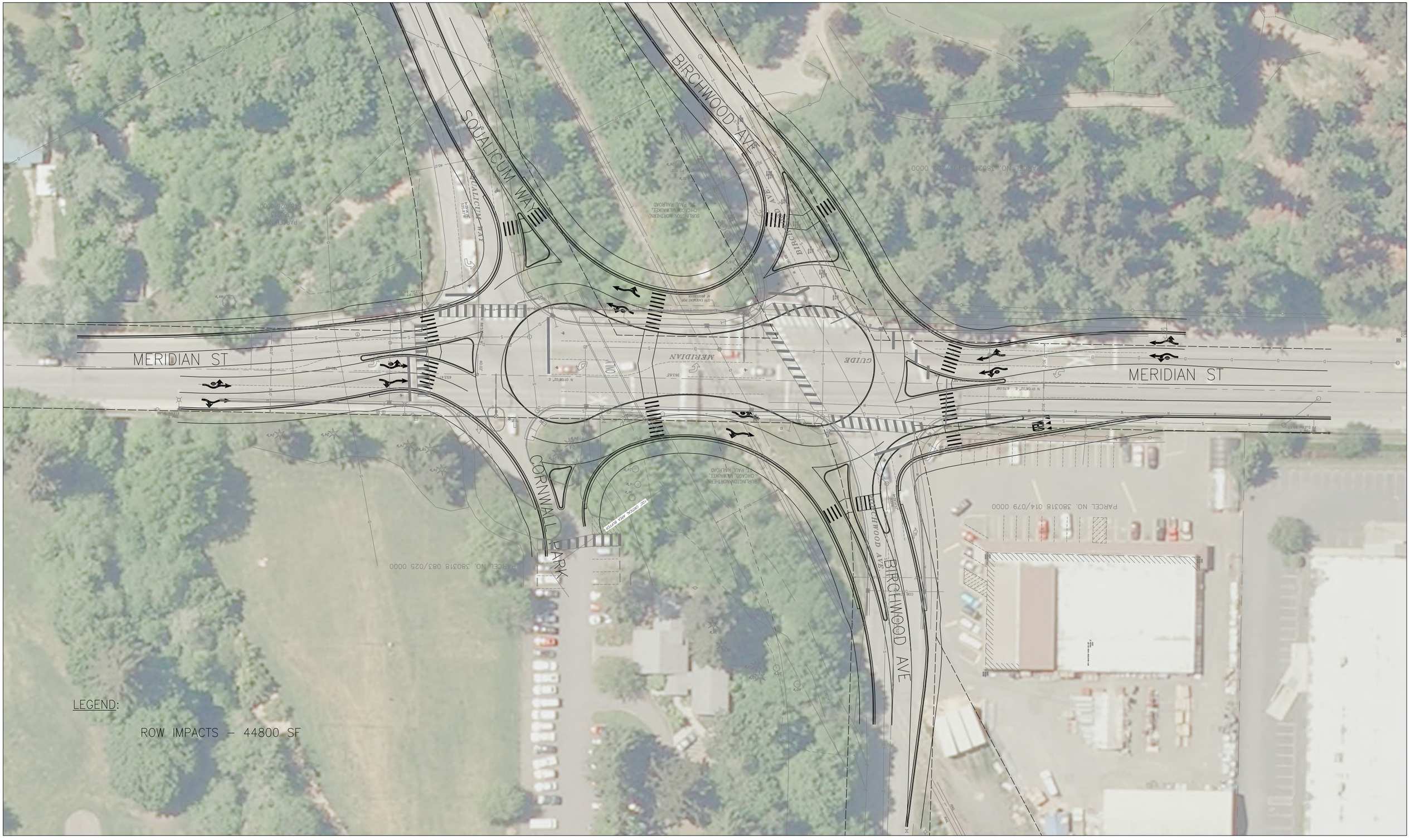
Intersection Summary		
HCM 2010 Ctrl Delay		53.1
HCM 2010 LOS		D

APPENDIX B: CONCEPTUAL ALTERNATIVES



SCALE IN FEET
30 0 30 60

ALTERNATIVE 1 – DUAL ROUNDABOUTS



SCALE IN FEET

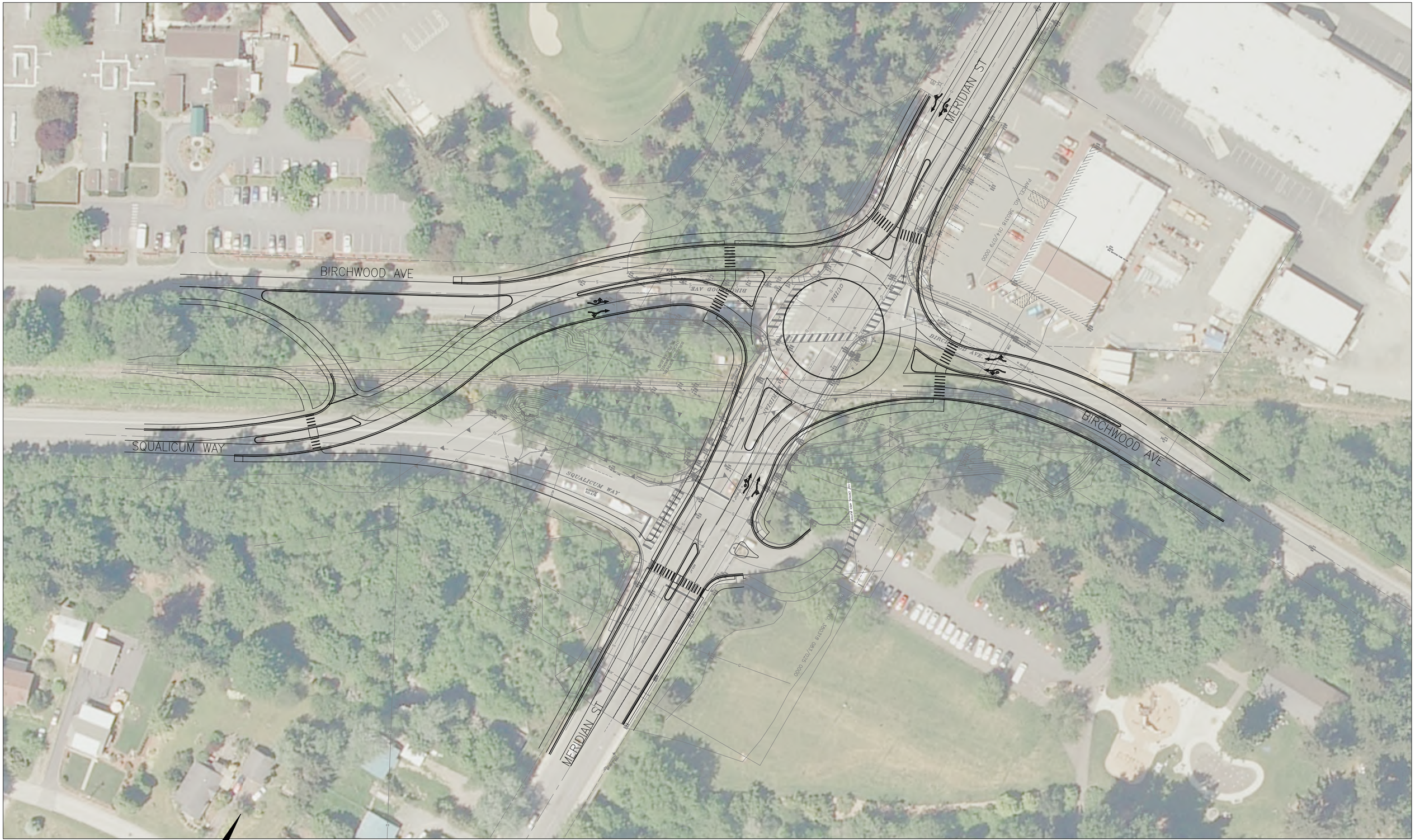
30 0 30 60

ALTERNATIVE 2 – PEANUT

SCALE IN FEET
40 0 40 80

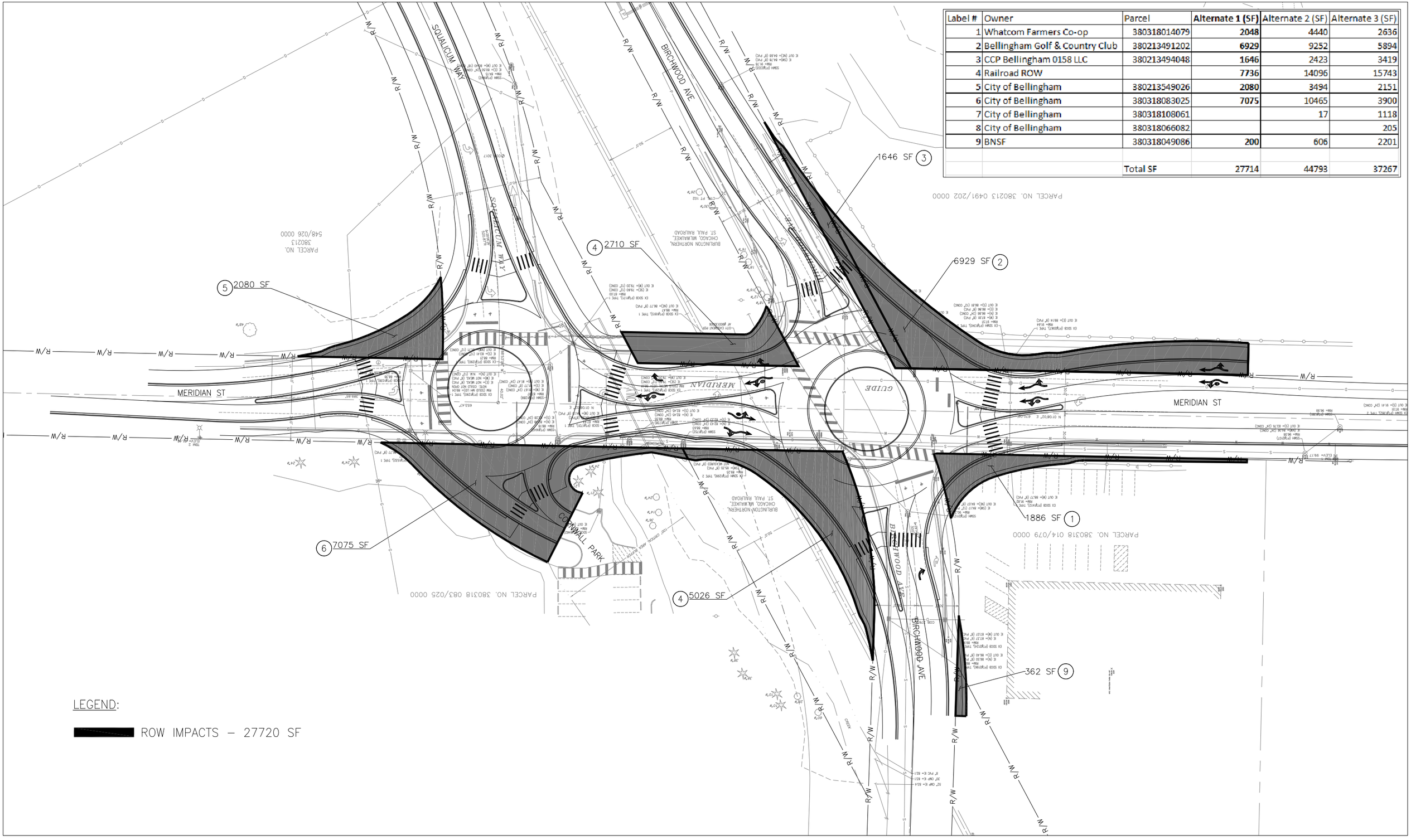
N

ALTERNATIVE 3A – COMBINED SQUALICUM & BIRCHWOOD – SIGNALIZED



ALTERNATIVE 3B – ULTIMATE BUILDOUT

Label #	Owner	Parcel	Alternate 1 (SF)	Alternate 2 (SF)	Alternate 3 (SF)
1	Whatcom Farmers Co-op	380318014079	**2048**	4440	2636
2	Bellingham Golf & Country Club	380213491202	**6929**	9252	5894
3	CCP Bellingham 0158 LLC	380213494048	**1646**	2423	3419
4	Railroad ROW		**7736**	14096	15743
5	City of Bellingham	380213549026	**2080**	3494	2151
6	City of Bellingham	380318083025	**7075**	10465	3900
7	City of Bellingham	380318108061		17	1118
8	City of Bellingham	380318066082			205
9	BNSF	380318049086	**200**	606	2201
		Total SF	**27714**	**44793**	**37267**



LEGEND:

ROW IMPACTS – 27720 SF

SCALE IN FEET

30 0 30 60

ALTERNATIVE 1 – DUAL ROUNDABOUTS (R/W IMPACTS)

City of Bellingham
Meridian Avenue RAB Project
Preliminary Right of Way Cost Estimate

Alternative No. 1

No.	Tax Parcel No.	Owner/Taxpayer	Current Use	Zoning	Parcel Size (SF)	Assessed Land Value	Assessed Imp Value	Assessed Land per S.F.	30% Land per SF Adjustment	Acquisition Area (SF)	Appraisal & Appraisal Review	Cost to Cure	Land Acquisition Costs	Negotiation Fees	Incident *(See Note 1)*	Preliminary Estimated Total
1	380318014079	Whatcom Farmers Co-op	Farm Equip, Feed Sales	Industrial	59,489	$931,722	$454,101	15.66	20.36	2048	**$5,000**	$8,000	**$49,699**	**$6,000**	**$2,500**	**$63,199**
2	380213491202	Bellingham Golf & County Club	Golf Course	Res-Multi	5,816,469	$977,665	$5,314,790	0.17	0.22	6929	**$5,500**	$4,500	**$6,014**	**$5,000**	**$1,750**	**$18,264**
3	380213494048	CCP Bellingham 0158, LLC	Healthcare / Rehab Center	Res-Multi	136,248	$749,232	$1,401,204	5.50	7.15	1646	**$4,000**	$3,000	**$14,767**	**$5,000**	**$1,750**	**$25,517**
4	Unknown	Railway ROW	Vacant - MTCA site	Res-Single	6,068,765	Not Avail	Not Avail	1.69	2.20	7736	**$4,000**	$1,500	**$18,496**	**$4,500**	**$750**	**$27,746**
5	380213548026	City of Bellingham	Vacant / Unimproved	Res-Single	44,278	$75,000	$0	1.69	2.20	2080	**$4,000**	$1,500	**$6,080**	**$750**	**$0**	**$10,830**
6	380318083025	City of Bellingham	Cornwall Memorial Park	Public	2,792,130	$6,500,000	$224,925	2.33	3.03	7075	**$4,000**	$3,500	**$24,912**	**$750**	**$0**	**$29,662**
7	380318049086	BNSF	Vacant / Unimproved	Industrial	90,695	$205,883	$0	2.27	2.95	200	**$4,000**	$1,500	**$2,090**	**$4,500**	**$1,350**	**$11,940**
Preliminary Estimated Totals										27714	**$30,500**	$23,500	**$122,058**	**$26,500**	**$8,100**	**$175,217**

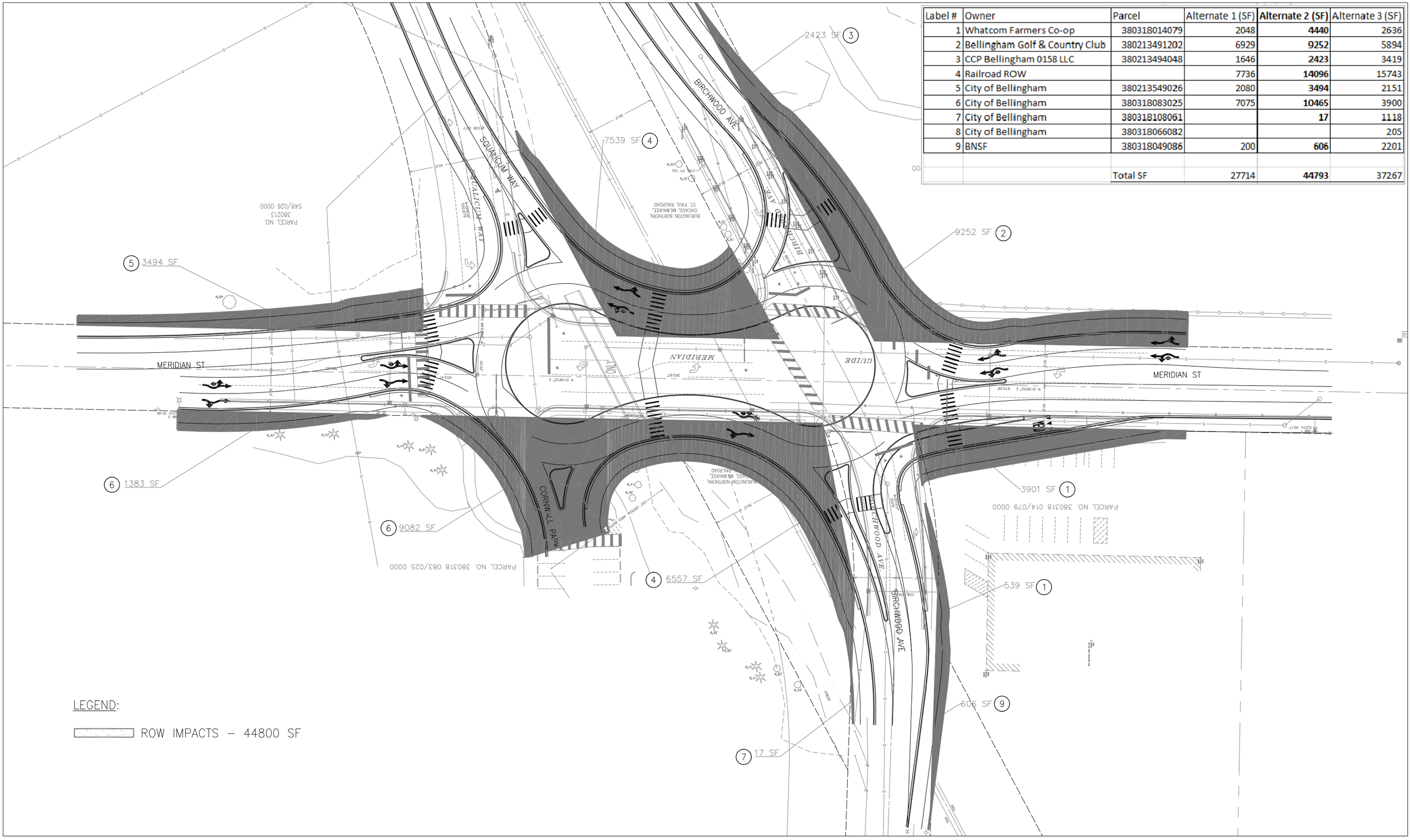
Notes and Assumptions:

1) Incidental costs include Title Reports; Escrow; Statutory Evaluations Allowance, etc.
2) Property Management not required. Costs are excluded.
3) Relocation Assistance Services not required. Costs are excluded.
4) Cost to Cure expenses will eliminate remainder damages.
5) The highest and Best Use in the before condition appears to remain the same in the after condition for all parcels.

Summary

It appears the partial acquisitions do not significanty impact the remaining use of each property. It is resonable to assume the Highest and Best Use remains the same in the after as in the before condition. In regards to the Whatcom Farmer Co-op parcel, it is assumed the loss of parking stalls will be mitigated by relacing lost parking onsite. It is further assumed the existing driveways along Meridian Street and Birchwood Avenue will remain as is or in close proximity to allow sufficient ingress / egress and onsite circulation.

Label #	Owner	Parcel	Alternate 1 (SF)	**Alternate 2 (SF)**	Alternate 3 (SF)
1	Whatcom Farmers Co-op	380318014079	2048	**4440**	2636
2	Bellingham Golf & Country Club	380213491202	6929	**9252**	5894
3	CCP Bellingham 0158 LLC	380213494048	1646	**2423**	3419
4	Railroad ROW		7736	**14096**	15743
5	City of Bellingham	380213549026	2080	**3494**	2151
6	City of Bellingham	380318083025	7075	**10465**	3900
7	City of Bellingham	380318108061		**17**	1118
8	City of Bellingham	380318066082			205
9	BNSF	380318049086	200	**606**	2201
		Total SF	27714	**44793**	37267



LEGEND:

ROW IMPACTS – 44800 SF

SCALE IN FEET
30 0 30 60

ALTERNATIVE 2 – PEANUT (R/W IMPACTS)

City of Bellingham
Meridian Avenue RAB Project
Preliminary Right of Way Cost Estimate

Alternative No. 2

No.	Tax Parcel No.	Owner/Taxpayer	Current Use	Zoning	Parcel Size (SF)	Assessed Land Value	Assessed Imp Value	Assessed Land per S.F.	30% Land per SF Adjustment	Acquisition Area (SF)	Appraisal & Appraisal Review	Cost to Cure	Land Acquisition Costs	Negotiation Fees	Incident *(See Note 1)*	Preliminary Estimated Total
1	380318014079	Whatcom Farmers Co-op	Farm Equip, Feed Sales	Industrial	59,489	$931,722	$454,101	15.66	20.36	4440	**$5,500**	$20,000	**$110,402**	**$7,000**	**$4,000**	**$126,902**
2	380213491202	Bellingham Golf & County Club	Golf Course	Res-Multi	5,816,469	$977,665	$5,314,790	0.17	0.22	9252	**$5,500**	$5,000	**$7,022**	**$5,000**	**$1,750**	**$19,272**
3	380213494048	CCP Bellingham 0158, LLC	Healthcare / Rehab Center	Res-Multi	136,248	$749,232	$1,401,204	5.50	7.15	2423	**$4,000**	$3,000	**$20,321**	**$5,000**	**$1,750**	**$31,071**
4	Unknown	Railway ROW	Vacant - MTCA site	Res-Single	6,068,765	Not Avail	Not Avail	1.69	2.20	14096	**$4,000**	$2,500	**$33,469**	**$4,500**	**$750**	**$42,719**
5	380213548026	City of Bellingham	Vacant / Unimproved	Res-Single	44,278	$75,000	$0	1.69	2.20	3494	**$4,000**	$1,500	**$9,194**	**$750**	**$0**	**$13,944**
6	380318083025	City of Bellingham	Cornwall Memorial Park	Public	2,792,130	$6,500,000	$224,925	2.33	3.03	10465	**$2,500**	$2,000	**$33,671**	**$750**	**$0**	**$36,921**
	380318108061	City of Bellingham	Cornwall Memorial Park	Public	132,815	$208,216	$0	1.57	2.04	17	**$2,500**	$1,500	**$1,535**	**$750**	**$0**	**$4,785**
7	380318049086	BNSF	Vacant / Unimproved	Industrial	90,695	$205,883	$0	2.27	2.95	606	**$4,000**	$1,500	**$3,288**	**$4,500**	**$1,350**	**$13,138**
Preliminary Estimated Totals										44793	**$32,000**	$37,000	**$218,901**	**$28,250**	**$9,600**	**$270,828**

Notes and Assumptions:

1) Incidental costs include Title Reports; Escrow; Statutory Evaluations Allowance, etc.
2) Property Management not required. Costs are excluded.
3) Relocation Assistance Services not required. Costs are excluded.
4) Cost to Cure expenses will eliminate remainder damages.
5) The highest and Best Use in the before condition appears to remain the same in the after condition for all parcels.

Summary

It appears the partial acquisitions do not significanty impact the remaining use of each property. It is resonable to assume the Highest and Best Use remains the same in the after as in the before condition. In regards to the Whatcom Farmer Co-op parcel, it is assumed the loss of parking stalls will be mitigated by relacing lost parking onsite. It is further assumed the existing driveways along Meridian Street and Birchwood Avenue will remain as is or in close proximity to allow sufficient ingress / egress and onsite circulation.

Label #	Owner	Parcel	Alternate 1 (SF)	Alternate 2 (SF)	Alternate 3 (SF)
1	Whatcom Farmers Co-op	380318014079	2048	4440	**2636**
2	Bellingham Golf & Country Club	380213491202	6929	9252	**5894**
3	CCP Bellingham 0158 LLC	380213494048	1646	2423	**3419**
4	Railroad ROW		7736	14096	**15743**
5	City of Bellingham	380213549026	2080	3494	**2151**
6	City of Bellingham	380318083025	7075	10465	**3900**
7	City of Bellingham	380318108061		17	**1118**
8	City of Bellingham	380318066082			**205**
9	BNSF	380318049086	200	606	**2201**
		Total SF	27714	44793	37267

3 3419 SF

2 5894 SF

2636 SF 1

4 1051 SF

4 3779 SF

2201 SF 9

205 SF 8

4 10913 SF

5 2151 SF

1118 SF 7

3900 SF 6

LEGEND:

ROW IMPACTS – 37300 SF

SCALE IN FEET

40 0 40 80

ALTERNATIVE 3 – COMBINED SQUALICUM & BIRCHWOOD (R/W IMPACTS)

City of Bellingham
Meridian Avenue RAB Project
Preliminary Right of Way Cost Estimate

Alternative No. 3

No.	Tax Parcel No.	Owner/Taxpayer	Current Use	Zoning	Parcel Size (SF)	Assessed Land Value	Assessed Imp Value	Assessed Land per S.F.	30% Land per SF Adjustment	Acquisition Area (SF)	Appraisal & Appraisal Review	Cost to Cure	Land Acquisition Costs	Negotiation Fees	Incidental *(See Note 1)*	Preliminary Estimated Total
1	380318014079	Whatcom Farmers Co-op	Farm Equip, Feed Sales	Industrial	59,489	$931,722	$454,101	15.66	20.36	2636	**$5,000**	$12,000	**$65,671**	**$6,000**	**$2,500**	**$79,171**
2	380213491202	Bellingham Golf & County Club	Golf Course	Res-Multi	5,816,469	$977,665	$5,314,790	0.17	0.22	5894	**$5,500**	$4,500	**$5,788**	**$5,000**	**$1,750**	**$18,038**
3	380213494048	CCP Bellingham 0158, LLC	Healthcare / Rehab Center	Res-Multi	136,248	$749,232	$1,401,204	5.50	7.15	3419	**$4,000**	$3,000	**$27,442**	**$5,000**	**$1,750**	**$38,192**
4	Unknown	Railway ROW	Vacant - MTCA site	Res-Single	6,068,765	Not Avail	Not Avail	1.69	2.20	15743	**$5,000**	$1,500	**$36,087**	**$4,500**	**$750**	**$46,337**
5	380213548026	City of Bellingham	Vacant / Unimproved	Res-Single	44,278	$75,000	$0	1.69	2.20	2151	**$4,000**	$1,500	**$6,236**	**$750**	**$0**	**$10,986**
6	380318083025	City of Bellingham	Cornwall Memorial Park	Public	2,792,130	$6,500,000	$224,925	2.33	3.03	3900	**$2,500**	$2,000	**$13,803**	**$750**	**$0**	**$17,053**
7	380318108061	City of Bellingham	Cornwall Memorial Park	Public	132,815	$208,216	$0	1.57	2.04	1118	**$2,500**	$2,000	**$4,279**	**$750**	**$0**	**$7,529**
8	380318066082	City of Bellingham	Vacant / Unimproved	Industrial	78,611	$722,421	$0	9.19	11.95	205	**$4,000**	$1,500	**$3,949**	**$750**	**$0**	**$8,699**
9	380318049086	BNSF	Vacant / Unimproved	Industrial	90,695	$205,883	$0	2.27	2.95	2201	**$5,000**	$1,500	**$7,995**	**$4,500**	**$1,350**	**$18,845**
Preliminary Estimated Totals										37267	**$37,500**	$29,500	**$171,250**	**$28,000**	**$8,100**	**$226,005**

Notes and Assumptions:

1) Incidental costs include Title Reports; Escrow; Statutory Evaluations Allowance, etc.
2) Property Management not required. Costs are excluded.
3) Relocation Assistance Services not required. Costs are excluded.
4) Cost to Cure expenses will eliminate remainder damages.
5) The highest and Best Use in the before condition appears to remain the same in the after condition for all parcels.

Summary

It appears the partial acquisitions do not significanty impact the remaining use of each property. It is resonable to assume the Highest and Best Use remains the same in the after as in the before condition. In regards to the Whatcom Farmer Co-op parcel, it is assumed the loss of parking stalls will be mitigated by relacing lost parking onsite. It is further assumed the existing driveways along Meridian Street and Birchwood Avenue will remain as is or in close proximity to allow sufficient ingress / egress and onsite circulation.

May require culvert extension.

Detention vault

WQ basin discharge to detention vault

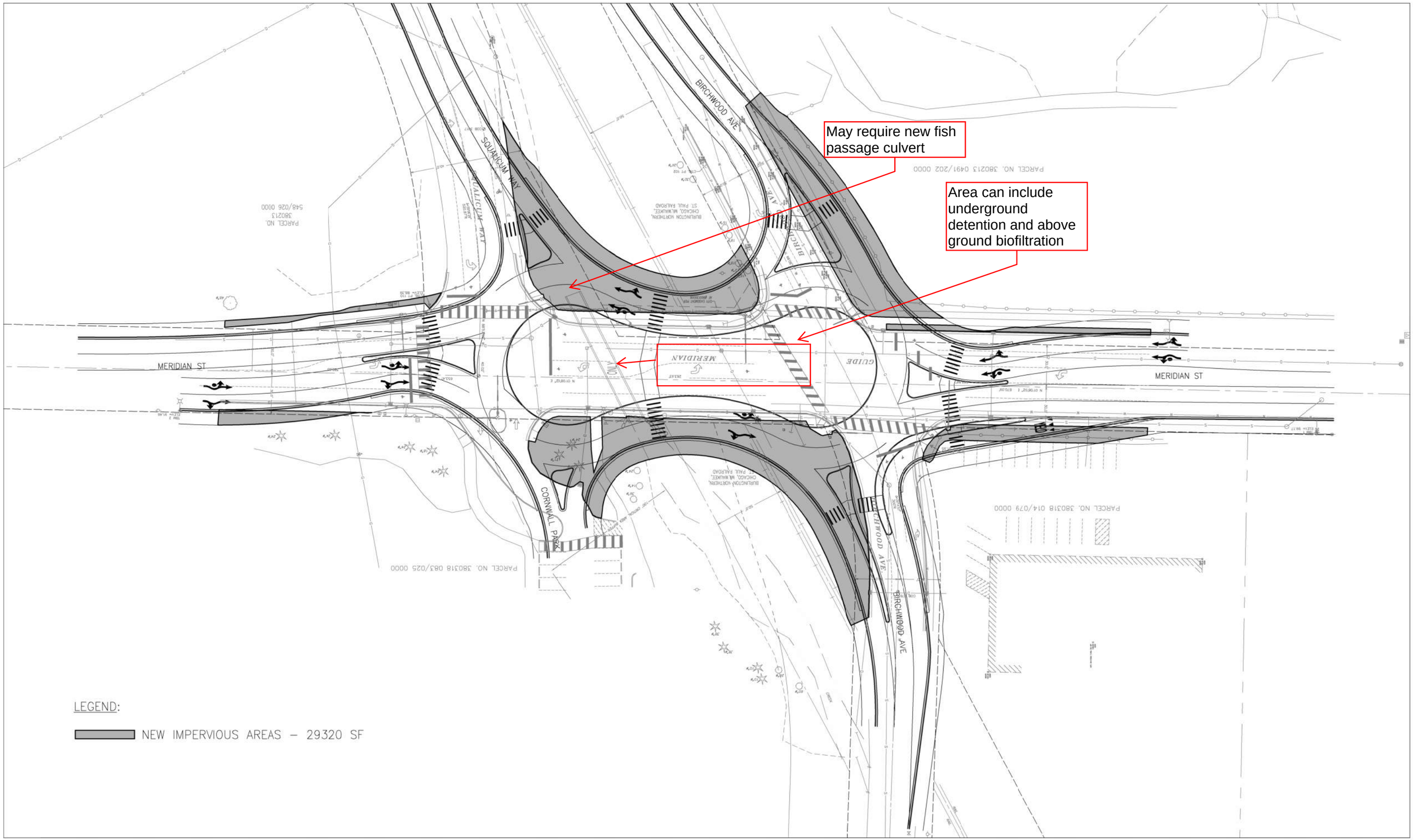
LEGEND:

NEW IMPERVIOUS AREA – 18500 SF

SCALE IN FEET

30 0 30 60

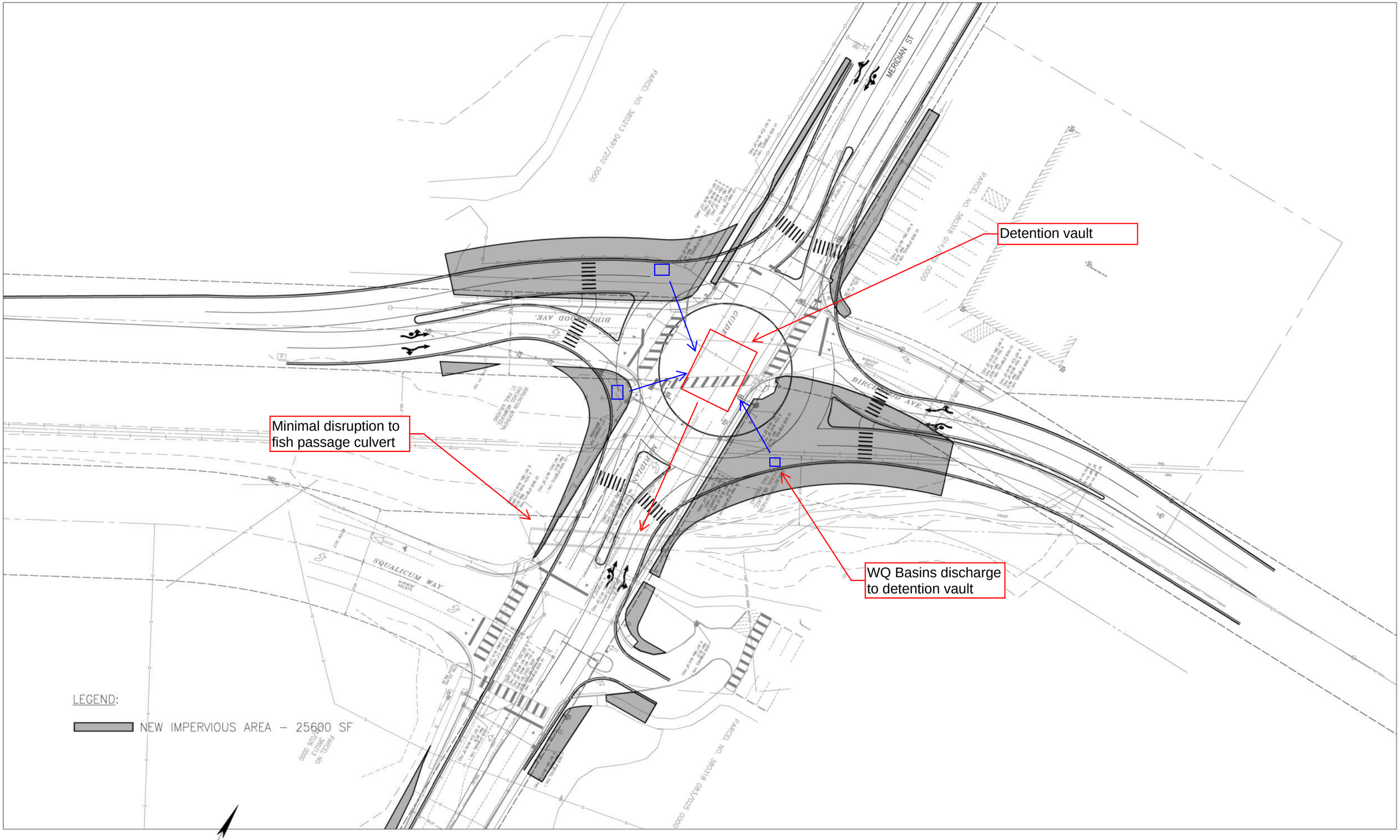
ALTERNATIVE 1 – DUAL ROUNDABOUTS NEW IMPERVIOUS AREAS



SCALE IN FEET
30 0 30 60

N

ALTERNATIVE 2 – PEANUT NEW IMPERVIOUS AREAS



ALTERNATIVE 3 – COMBINED SQUALICUM & BIRCHWOOD NEW IMPERVIOUS AREAS

City of Bellingham

Meridan Street Roundabout - Alternative 1
Dual Roundabouts

Preliminary Opinion of Probable Construction Cost

ITEM	QTY	UNIT	UNIT COST	COST
PREPARATION				
Mobilization	1	LS	$200,000	$200,000
Construction Surveying	1	LS	$50,000	$50,000
Clearing & Grubbing	0.7	AC	$30,000	$21,000
TRAFFIC CONTROL				
Traffic Control	1	LS	$500,000	$500,000
ROADWAY PREPARATION				
Roadway Excavation Incl. Haul	9,600	CY	$30	$288,000
Gravel Borrow	7,200	TN	$25	$180,000
ROADWAY SECTION				
HMA Cl. 1/2 in. PG 58H-22	7,000	TN	$150	$1,050,000
Crushed Surfacing Base Course	7,400	TN	$40	$296,000
STORM DRAINAGE				
Stormwater Improvements	1	LS	$300,000	$300,000
EROSION CONTROL				
TESC	1	LS	$60,000	$60,000
CURBING				
Cement Conc. Curbs	4,845	LF	$40	$193,800
STRIPING & SIGNING				
Channelization and Signing	1	LS	$50,000	$50,000
ILLUMINATION				
Illumination System	1	LS	$400,000	$400,000
SIDEWALK & RAMPS				
Cement Conc. Sidewalk	3,320	SY	$75	$249,000
Cement Concrete Curb Ramps	14	EA	$3,500	$49,000
OTHER ITEMS				
Retaining Walls	1,000	SF	$150	$150,000
Landscaping	1	LS	$150,000	$150,000
Culvert Replacement	1	LS	$500,000	$500,000
Mitigation	0.2	AC	$800,000	$160,000
Miscellaneous/Unknown Costs	1	LS	$800,000	$800,000
			Subtotal	$5,650,000
			Contingency (30%)	$1,700,000
			Total	**$7,350,000**

City of Bellingham

Meridan Street Roundabout - Alternative 2

Peanut Roundabout

Preliminary Opinion of Probable Construction Cost

ITEM	QTY	UNIT	UNIT COST	COST
PREPARATION				
Mobilization	1	LS	$200,000	$200,000
Construction Surveying	1	LS	$50,000	$50,000
Clearing & Grubbing	1.1	AC	$30,000	$33,000
TRAFFIC CONTROL				
Traffic Control	1	LS	$500,000	$500,000
ROADWAY PREPARATION				
Roadway Excavation Incl. Haul	9,600	CY	$30	$288,000
Gravel Borrow	6,500	TN	$25	$162,500
ROADWAY SECTION				
HMA Cl. 1/2 in. PG 58H-22	6,240	TN	$150	$936,000
Crushed Surfacing Base Course	6,600	TN	$40	$264,000
STORM DRAINAGE				
Stormwater Improvements	1	LS	$350,000	$350,000
EROSION CONTROL				
TESC	1	LS	$72,000	$72,000
CURBING				
Cement Conc. Curbs	5,135	LF	$40	$205,400
STRIPING & SIGNING				
Channelization and Signing	1	LS	$50,000	$50,000
ILLUMINATION				
Illumination System	1	LS	$400,000	$400,000
SIDEWALK & RAMPS				
Cement Conc. Sidewalk	3,210	SY	$75	$240,750
Cement Concrete Curb Ramps	14	EA	$3,500	$49,000
OTHER ITEMS				
Retaining Walls	1,500	SF	$50	$75,000
Landscaping	1	LS	$250,000	$250,000
Culvert Replacement	1	LS	$1,000,000	$1,000,000
Mitigation	0.2	AC	$800,000	$160,000
Miscellaneous/Unknown Costs	1	LS	$1,100,000	$1,100,000
			Subtotal	$6,390,000
			Contingency (30%)	$1,920,000
			Total	**$8,310,000**

City of Bellingham

Meridan Street Roundabout - Alternative 3A
Squalicum/Birchwood Signal

Preliminary Opinion of Probable Construction Cost

ITEM	QTY	UNIT	UNIT COST	COST
PREPARATION				
Mobilization	1	LS	$250,000	$250,000
Construction Surveying	1	LS	$75,000	$75,000
Clearing & Grubbing	2.5	AC	$30,000	$75,000
TRAFFIC CONTROL				
Traffic Control	1	LS	$175,000	$175,000
ROADWAY PREPARATION				
Roadway Excavation Incl. Haul	800	CY	$30	$24,000
Gravel Borrow	7,300	TN	$25	$182,500
ROADWAY SECTION				
HMA Cl. 1/2 in. PG 58H-22	3,400	TN	$150	$510,000
Crushed Surfacing Base Course	3,600	TN	$40	$144,000
STORM DRAINAGE				
Stormwater Improvements	1	LS	$200,000	$200,000
EROSION CONTROL				
TESC	1	LS	$40,000	$40,000
CURBING				
Cement Conc. Curbs	1,100	LF	$40	$44,000
STRIPING & SIGNING				
Channelization and Signing	1	LS	$25,000	$25,000
ILLUMINATION				
Illumination System	1	LS	$45,000	$45,000
SIDEWALK & RAMPS				
Cement Conc. Sidewalk	920	SY	$75	$69,000
Cement Concrete Curb Ramps	2	EA	$3,500	$7,000
OTHER ITEMS				
Retaining Walls	2,600	SF	$50	$130,000
Landscaping	1	LS	$250,000	$250,000
Mitigation	0.1	AC	$800,000	$80,000
Miscellaneous/Unknown Costs	1	LS	$500,000	$500,000
			Subtotal	$2,830,000
			Contingency (30%)	$850,000
			Total	**$3,680,000**

City of Bellingham

Meridan Street Roundabout - Alternative 3B

Meridian/Birchwood RAB

Preliminary Opinion of Probable Construction Cost

ITEM	QTY	UNIT	UNIT COST	COST
PREPARATION				
Mobilization	1	LS	$250,000	$250,000
Construction Surveying	1	LS	$75,000	$75,000
Clearing & Grubbing	2.5	AC	$30,000	$75,000
TRAFFIC CONTROL				
Traffic Control	1	LS	$700,000	$700,000
ROADWAY PREPARATION				
Roadway Excavation Incl. Haul	8,000	CY	$30	$240,000
Gravel Borrow	5,800	TN	$25	$145,000
ROADWAY SECTION				
HMA Cl. 1/2 in. PG 58H-22	6,700	TN	$150	$1,005,000
Crushed Surfacing Base Course	7,000	TN	$40	$280,000
STORM DRAINAGE				
Stormwater Improvements	1	LS	$550,000	$550,000
EROSION CONTROL				
TESC	1	LS	$100,000	$100,000
CURBING				
Cement Conc. Curbs	3,815	LF	$40	$152,600
STRIPING & SIGNING				
Channelization and Signing	1	LS	$100,000	$100,000
ILLUMINATION				
Illumination System	1	LS	$400,000	$400,000
SIDEWALK & RAMPS				
Cement Conc. Sidewalk	1,340	SY	$75	$100,500
Cement Concrete Curb Ramps	8	EA	$3,500	$28,000
OTHER ITEMS				
Retaining Walls	900	SF	$50	$45,000
Landscaping	1	LS	$300,000	$300,000
Mitigation	0.4	AC	$800,000	$320,000
Miscellaneous/Unknown Costs	1	LS	$1,400,000	$1,400,000
			Subtotal	$6,270,000
			Contingency (30%)	$1,890,000
			Total	**$8,160,000**

APPENDIX C: OPEN HOUSE AND PUBLIC COMMENTS

Public Works Department
City of Bellingham

Open House and Public Meeting

6:00-8:00 p.m. Monday, June 24, 2019
Abundant Life Church at 3220 Meridian Street

Bellingham is growing and we need to make sure that our streets are safe and comfortable for people walking, biking, and getting to bus stops for school or public transit, as well as driving private vehicles and freight trucks. **What does that mean to you? Come find out, and help influence the outcome.**

Bellingham Public Works has hired Reid Middleton transportation consultants and begun a multi-disciplinary Meridian Street Roundabouts Feasibility Study (ES-0550) focused on the closely spaced intersections of Meridian/Squalicum and Meridian/Birchwood to determine what kind of transportation improvements can be constructed, how much they may cost, and how we can strategically find funding for construction in the future. Completing the engineering and design, acquisition of right-of-way, and securing funding for construction will take many years to complete.

On **Monday, June 24, 2019 at 6:00 p.m.**, Bellingham Public Works will deliver a 15-minute presentation providing background, purpose, and intent of the study, and then ask people to visit displays showing some alternative approaches to providing transportation improvements at and through the intersections of Meridian/Squalicum and Meridian/Birchwood.

This is your chance to interact with professional staff who can answer questions, listen to ideas, and address concerns about existing conditions or any of the alternatives. Public input from this Open House will result in further refinement of the alternatives to be analyzed in further depth. Study conclusions and recommendations for improvements will be developed and presented later in 2019.

More information is available on the Meridian Street Roundabouts Feasibility Study (ES-0550) project web page. Public Works is notifying property owners, residents, and businesses near these intersections of both the feasibility study and the June 24, 2019 Open House.

Please contact me if you have questions and I'll look forward to seeing you there!

Chris Comeau, Transportation Planner
City of Bellingham – Public Works – Engineering
(360) 778-7946 or ccomeau@cob.org

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Bellingham, WA 98225
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Fax: (360) 778-7901
TTY: (360) 778-8382
Email: pw@cob.org

Natural Resources
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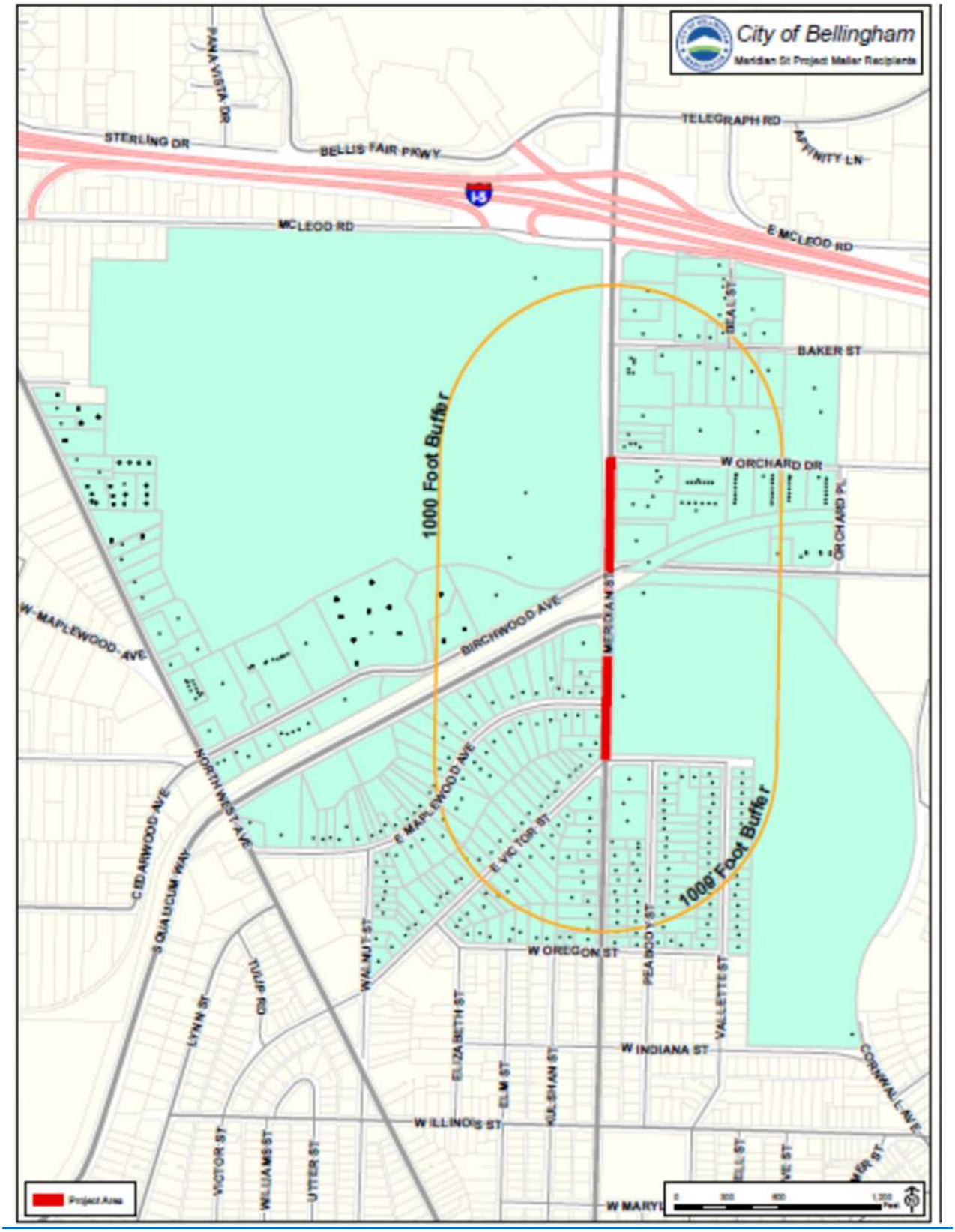
Mailing: 2221 Pacific Street
Bellingham, WA 98229
Phone: (360) 778-7800
Fax: (360) 778-7801
Email: pw@cob.org

Operations
2221 Pacific Street
Bellingham, WA 98229
Phone: (360) 778-7700
Fax: (360) 778-7701
Email: pw@cob.org

Meridian Roundabouts Feasibility Study
June 24, 2019 Open House Abundant Life Church at 3220 Meridian Street from 6:00-8:00pm
James St
Meridian St
Northwest Ave
Northwest Dr
MERIDIAN
PARKVIEW
BIRCHWOOD
Bellingham Golf and Country Club
Bellis Fair
Macy's
Target
The Home Depot
Affinity at Bellingham
Public Storage
Bellingham Cold Storage
Brampton Court Apartments
Big Lots
Shuksan Middle School
Yeager's Sporting Goods
Squalicum Creek Park
Bug Lake
Squalicum Creek
Baker Creek
Spring Creek
Meridian Village
Sunset Square
Applebee's Grill + Bar
Lowe's Home Improvement
Haggen Food & Pharmacy
ALife Church
Google


City of Bellingham
Meridian St Project Mailer Recipients
STERLING DR
BELLIS FAIR PKWY
TELEGRAPH RD
AFFINITY LN
MCLEOD RD
E MCLEOD RD
BEALL ST
BAKER ST
W ORCHARD DR
ORCHARD PL
1000 Foot Buffer
MERIDIAN ST
W MAPLEWOOD AVE
BIRCHWOOD AVE
NORTHWEST AVE
CEDARWOOD AVE
S QUALICUM WAY
E MAPLEWOOD AVE
E VICTOR ST
1000 Foot Buffer
W OREGON ST
PEABODY ST
VALLETTE ST
WALNUT ST
ELIZABETH ST
ELM ST
KULSHAN ST
W INDIANA ST
CORNWALL AVE
W ILLINOIS ST
LYNN ST
VICTOR ST
WILLIAMS ST
UTTER ST
W MARYL
Project Area

Meridian Street Roundabouts Feasibility Study – Public Input

Please mark where you live, work, or own property in relation to the Meridian Street Study Area (below)

Name(s): _____ Street Address: _____

Email (for Meeting Notices) _____

Please record written comments on other side

Meridian Street Roundabouts Feasibility Study

Public Input Written Comments

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Please mail or email all written comments to:

Chris Comeau, Transportation Planner
Bellingham Public Works Engineering
104 W. Magnolia Street
Bellingham, WA 98225

Call (360) 778-7946 or email ccomeau@cob.org

ES-0550 Meridian Street Roundabouts Feasibility Study Public Comment Tracker

#	DATE	NAME	MAIL OR EMAIL ADDRESS	PUBLIC PROCESS; PUBLIC MEETING; AND/OR PUBLIC COMMENT	PROJECT TEAM RESPONSE TO PUBLIC COMMENT/REQUEST
1	2011-2012			**Bellingham Pedestrian Master Plan** adopted by City Council August 2012; folded into Transportation Element of Bellingham Comprehensive Plan, adopted by City Council November 2016	Approved by City Council 2012
2	2013-2014			**Bellingham Bicycle Master Plan** adopted by City Council October 2014; folded into Transportation Element of Bellingham Comprehensive Plan, adopted by City Council November 2016	Approved by City Council 2014
3	2015-2016			**Bellingham Comprehensive Plan Multimodal Transportation Chapter** adopted by City Council November 2016. Specifically lists these two closely spaced intersection in Table B. Arterial & Intersection Improvements Not Yet Funded 2022-2027 (page 33).	Adopted by City Council 2016
4	6/6/2019	Chris Comeau		Open House Notices mailed to 1,089 addresses surrounding intersections	Neighborhood Associations emailed Open House notice for distribution to members
5	6/24/2019	Richard Baila	captain.sawdust@yahoo.com	My name is Richard Baila and I live @ 1303 E. Maplewood Ave. and I have 3 points I would like addressed #1 The creek is a fish creek & the culvert is inadequate for the amount of water in winter #2 I rely on the light *[traffic signal]* @squalicum pkwy to get out onto Meridian #3 the people who can't wait for the light *[traffic signal]* use my street to cut over to Nwest *[Nowthwest]*. The City needs to slow them down. A 15 mph speed limit on our street would make a great revenue source to pay for this project.	This is a complex multi-faceted, multi-disciplinary feasibility study that is taking into account all environmental issues, natural resources, multimodal transportation, recreational, business and residnetia needs in the surrounding area. Project team responses to the comments are as follows: #1: Tributary W and Squalicum Creek are and will contiue to be studied and addressed, as needed; #2: Access to E. Maplewood Avenue will be accounted for addressed by this feasibility study; #3: If significant cut-through vehicle traffic is documented on E. Maplewood, then the project team will consider options to deter cut-thru (diverters or turn-restrictions at Northwest or Meridian). If vehicle speeds are documented above the 25 mph residential street speed limit, then the project team will study the situation and consider education, enforcement, or - if warranted - engineering options to slow vehicles. Revenue from speeding tickets does not pay for capital improvements.
6	6/24/2019	Betty Kellow	bjkellow@yahoo.com	The single roundabout option appears to have a faster traffic pattern in the assimilation and seems potentially to be fully adequate, simple & perhaps less costly. Both the peanut & dual roundabouts have slowdown poiints & restrictions to large truck movement. I would vote for the single roundabout. My concerns are for safer bicycle riding on Meridian and would really like to see bike lanes in this. The current situation does need to be rectified as the waits at lights *[traffic signals]* are extremely long now. I am glad to see this!	

APPENDIX D: ENVIRONMENTAL IMPACT ASSESSMENT

CRITICAL AREAS ASSESSMENT

FOR THE MERIDIAN STREET ROUNDABOUT FEASIBILITY STUDY

BELLINGHAM, WA

JULY 2019

NW ECOLOGICAL SERVICES
2801 Meridian St, Suite 202, Bellingham, WA 98225
nwecological.com | t 360.734.9484

EXECUTIVE SUMMARY

Northwest Ecological Services, LLC (NES) was retained to complete a critical areas assessment for the Meridian Street Roundabout Feasibility Study project in Bellingham, Washington. The assessment performed by NES included identification of wetlands, streams, protected fish and wildlife habitats, and shorelines as observed within the review area. It did not include identification of the following critical areas: geologically hazardous areas or critical aquifer recharge areas.

All information contained in this report is based on available information and site conditions at the time of the site visits. This report is intended for inclusion with future wetland, stream, and wildlife habitat permit applications to the City of Bellingham (COB), Washington State Department of Ecology (WDOE), Washington State Department of Fish and Wildlife (WDFW), and the U.S. Army Corps of Engineers (Corps), as may be required.

The review area included the developed road right-of-way for Meridian Street, Birchwood Avenue, and Squalicum Way and areas within approximately 200 feet.

No wetlands were identified within the review area.

Two streams (Squalicum Creek and Tributary W) were identified within the review area. Both streams are mapped as fish bearing, with a number of species present in each. Squalicum Creek is mapped as shoreline stream with an Urban Conservancy shoreline designation.

A Federal Emergency Management Agency (FEMA) 100-year floodplain is associated with both streams. FEMA mapping also indicates floodway associated with Squalicum Creek.

The township is mapped to contain a big brown bat (*Eptesicus fuscus*) breeding area. This mapping is at a township level and not site specific. No habitat features that would be used as hibernacula or potential day roosts were observed, but foraging habitat is present along the stream corridors.

The on-site streams are expected to be regulated by one or more of the following agencies: COB, WDOE, Corps, and WDFW. The COB regulates Squalicum Creek and Tributary W as Fish and Wildlife Habitat Conservation Areas (HCAs). Squalicum Creek is also under the jurisdiction of the COB Shoreline Management Program (SMP).

COB requires a buffer around regulated critical areas to protect functions. The buffer must remain naturally vegetated except where it can be enhanced to improve functions.

As a shoreline stream, **Squalicum Creek is required to have a buffer of between 100 and 200 feet.** As a fish-bearing stream, **Tributary W is required to have a buffer between 75 and 150 feet**.

NES QUALIFICATIONS

NES is a specialized service-oriented environmental consulting firm based in Bellingham, Washington. We provide a range of biological services to both the public and private sectors. Our services include: wetland assessments, biological assessments, wetland restoration and mitigation plans, natural resource analysis, environmental regulatory compliance, landscape and ecological design, and environmental impact assessment of plants, animals, fish and sensitive habitats. NES professionals have performed wetland and biological assessment over 33,000 acres [1991-2018] in Whatcom, Skagit, Island, Snohomish and King Counties.

NES staff qualifications summary:

- Michele Bodtke is an ecologist with NES and has been providing environmental services within the north Puget Sound area since 2002. Ms. Bodtke also has an extensive understanding of land use laws. Ms. Bodtke has Bachelor of Science in Geology from Michigan State University, and a certificate in wetland science and management from the University of Washington. She is certified through SWS as a PWS, #2790.
- Molly Porter is an ecologist with NES and has provided environmental services within the north Puget Sound area since 2004. Ms. Porter obtained a Bachelor of Science in Environmental Science from Huxley College of the Environment at Western Washington University. She is certified through SWS as a PWS, #2064.
- Katrina Poppe is an ecologist with NES, providing technical support for projects throughout north Puget Sound. Ms. Poppe obtained a Bachelor of Science in Biology from the University of Victoria and a Master of Science in Environmental Science at Western Washington University. Ms. Poppe's graduate research focuses on coastal wetlands and climate change. Her experience also includes botanical surveys and coastal sediment studies. She is certified through SWS as a PWS, #2915.
- Collin Van Slyke is an ecologist with NES, providing technical support for projects throughout north Puget Sound. Mr. Van Slyke obtained a Bachelor of Science in Environmental Science from Huxley College of the Environment at Western Washington University. His experience includes geographic information systems (GIS) management, exhibit creation, and wetland mitigation design and monitoring.
- Erin Donahou is an ecologist with NES, providing technical support for projects throughout north Puget Sound. Ms. Donahou obtained a Bachelor of Science in Environmental Science from Huxley College of the Environment at Western Washington University.

DISCLAIMER

Wetland, stream, and lake delineations and determinations are based upon protocols defined in manuals and publications produced by federal, state and local agencies. The wetland methodology used in this report is consistent with methods described in the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (Corps, 2010) and the Corps of Engineers Wetland Delineation Manual (Environmental Laboratory, 1987), as required by WAC 173-22-035.

The findings were based on observations of conditions at the time of the site visit(s). This report is provided for the use of the named recipient only and is not intended for use by others parties for any other purpose. This report does not guarantee agency concurrence or permit approval.

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1.0 INTRODUCTION

1.1 Scope of Work

Northwest Ecological Services, LLC (NES) was retained to complete a critical areas assessment for the Meridian Street Roundabout Feasibility Study project in Bellingham, Washington. The assessment performed by NES included identification of wetlands, streams, protected fish and wildlife habitats, and shorelines as observed within the review area. It did not include identification of the following critical areas: geologically hazardous areas or critical aquifer recharge areas.

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Project Contact:
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Reid Middleton Inc.
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email: csmith@reidmiddleton.com

Property Owner:
Chris Comeau
City of Bellingham Public Works
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email: ccomeau@cob.org

Report prepared by NES staff:
Molly Porter, PWS
Collin Van Slyke
Northwest Ecological Services, LLC
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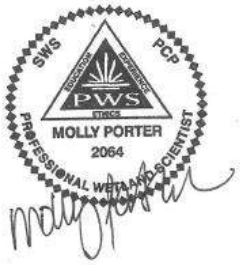
T: 360.743.9484
Email: molly@nwecological.com
collin@nwecological.com



1.2 Review Area

The review area is located on Meridian Street, at the intersection of Squalicum Way and Birchwood Avenue in Bellingham, Washington. The review area included undeveloped

property within approximately 200 feet of the proposed roundabouts (Figure 1, Appendix B). An aerial photograph of the review area and surrounding landscape is included as Figure 2 (Appendix B).

2.0 ASSESSMENT METHODS

The assessment consisted of an office review of existing documentation followed by site visits on June 18th and July 23rd of 2019. The assessment included review and confirmation of features identified in the following previous critical areas assessments for this area, including:

- *Aquatic Critical Areas and Fish and Wildlife Habitat Conservation Areas Assessment Report for the Squalicum Creek Trail from Cornwall Park to the Waterfront, Bellingham, Washington* (GeoEngineers, 2018). This assessment included the reach of Tributary W west of Meridian Street.
- *Cornwall Park Trail Improvements Buffer Mitigation Plan* (GeoEngineers, 2016). This assessment included the reach of Tributary W east of Meridian Street, and was based on 2015 mapping by Welch Ecological Services.
- *Cornwall Park, Squalicum Creek Critical Areas Determination Report* (Welch, 2015).

NES confirmed the presence of the identified features identified in the above reports and assessed the remainder of the review area as defined by Figure 2 (Appendix B). NES conducted the site investigation and assessments in accordance with methodology specific to each resource area (wetlands, fish and wildlife habitats, and shorelines), as described below.

2.1 Field Methods

2.1.1 Wetlands

The wetland delineation was conducted in accordance with the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region* (Corps, 2010) and the *Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory, 1987). This methodology is consistent with the WDOE's requirements established in 2011 (WAC 173-22-035) and the City of Bellingham CAO. To make a positive wetland determination, this methodology requires evidence that at least one positive wetland indicator be found for each of three parameters (vegetation, soils, and hydrology). An area is not considered a regulatory wetland if the area lacks indicators for any one of these three parameters under normal environmental conditions. Upland/wetland boundaries are delineated by locating the transition where soils, vegetation, or hydrology no longer indicate that wetland parameters are met. Methods for each of these parameters are as follows:

- **Vegetation:** The plant community at each sample site is considered to be hydrophytic (wetland) vegetation if the vegetation exhibits indicators of hydrophytic vegetation as defined in the delineation methodology (Corps, 2010). Most often the "Dominance Test" is used as the indicator. The sample plot meets the dominance test for hydrophytic

vegetation if more than 50 percent of the dominant species from all strata have obligate wetland, facultative wetland, and/or facultative indicator status. Indicator status is taken from the Regional National Wetland Plant List (Lichvar, et al., 2014). Dominant species are the most abundant species that individually or collectively account for more than 50 percent of the total coverage of vegetation in the stratum (absolute percent cover), plus any other species that, by itself, accounts for at least 20 percent of the total. The wetland indicator status for each dominant species is then used to determine whether the plant community is dominated by hydrophytic vegetation. Occasionally, the "Prevalence Index" is used as the indicator of hydrophytic vegetation. The Prevalence Index is a weighted-average of all plant species in the sample plot.

- **Soils:** Soil test pits are hand dug to approximately 20 inches and soils are examined for hydric soil indicators. Formal soil test pits are labeled with a sample plot number and located on the delineation map. Soil color, including concentrations, depletions, or gleying, if present, are colored using a Munsell color chart (Gretag-Macbeth, 2000). *Field Indicators of Hydric Soils in the United States* (USDA, NRCS, 2018) is used to determine hydric soil presence or absence.
- **Hydrology:** Wetland hydrology is assessed by an inspection at representative sample plots. Depth to shallow groundwater and/or saturation in each sample plot is recorded, as are observations of other indicators of hydrology including but not limited to water marks, drift lines, sediment deposits, and drainage patterns. These data provide information on timing and duration of ponding and/or saturation in the study area.
- **Growing Season:** Vegetation and hydrology indicators are dependent upon conditions during the "growing season." The growing season, as defined by the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region*, is when non-evergreen plants show biological activity (plant growth) and/or the soil temperature at 12 inches below the surface is a minimum of 41 degrees Fahrenheit (F) (Corps, 2010).

2.1.2 Streams and Lakes

If streams or lakes were identified on the property, NES flagged the ordinary high water mark (OHWM) consistent with state law as defined in RCW 90.58.030. NES used field indicators to determine the OHWM based on the methodology contained in *Determining the Ordinary High Water Mark for Shoreline Management Act Compliance in Washington State (Anderson, 2016),* Ecology Publication #16-06-029. During the site visits, the investigating ecologists also completed a stream characterization of basic stream attributes including depth, vegetation, substrate, and habitat features. If lakes were present, NES documented basic lake attributes including size, surrounding vegetation, and hydrologic connectivity.

2.1.3 Fish and Wildlife

NES documented observations of any state Priority species or federal Threatened, Endangered, or Proposed species protected under the Endangered Species Act (ESA) during the site visits. NES also reviewed the site for general wildlife habitat conditions and habitat connectivity. If streams were present, NES documented any obvious fish passage barriers, characterized general stream attributes (as described above), and documented any observations of fish during the site visits.

2.1.4 Shorelines

NES reviewed the local Shoreline Management Program (SMP) text and maps to determine the potential presence of a regulated shoreline within the review area. During the site visits, NES field verified the presence of any shoreline and determined the extent of SMP jurisdiction based on SMP mapping, OHWM, floodways, wetlands, and floodplains. If shorelines were present, NES determined the OHWM consistent with state law as defined in RCW 90.58.030 and described under Streams and Lakes, below.

2.1.5 Frequently Flooded Areas

NES reviewed Federal Emergency Management Agency (FEMA) and COB mapping to determine of frequently flooded areas are documented on site.

2.1.6 Mapping

NES ecologists marked the boundaries of any new identified critical areas with pink field flagging. The flags were surveyed by Land Development Engineering and Surveying, Inc. (LDES) to produce Figure 3 (Appendix B). The OHWM of Tributary W appeared consistent with 2015 and 2018 mapping so this feature was not re-flagged and survey data from previous mapping efforts were utilized by LDES.

3.0 FINDINGS

Molly Porter (Professional Wetland Scientist [PWS] #2064) and Collin Van Slyke, NES ecologists, conducted site visits on June 18th and July 23rd of 2019. The following description is based on observations from the site visits and information gathered during the document review. Photographs taken at the time of the June site visit are included in Appendix C.

3.1 Landscape Setting and Parcel Overview

3.1.1 Document Review

The following provides a summary of the findings contained within documents reviewed:

- **Aerial Photograph: City IQ (Figure 2) (COB, 2019)**
  The site is located in a relatively urban portion of the City. Two, four-way controlled intersections are located along Meridian Street within the project area. Birchwood

Avenue is located at the northern intersection. Squalicum Way is located at the southern intersection to the west, with the north entrance of Cornwall Park to the east.

Burlington Northern Santa Fe (BNSF) railway owns the property north of Birchwood Avenue on both sides of Meridian Street. Railway tracks in this location have not been used for some time.

Cornwall Park spans the majority of the eastern edge of the review area. A commercial facility (CHS Northwest) is located at the northeast corner. The Bellingham Golf and Country Club (BGCC) is located at the northwest corner. Aside from the aforementioned roadways, the western portion of the review area is undeveloped and primarily forested. Single-family homes are located to the southwest.

- **USDA, NRCS *Soil Survey of Whatcom County Area, Washington* (Figure 4) (USDA, NRCS, 2019)**
  The NRCS soil survey maps one soil unit within the review area: Kickerville-Urban land complex, on zero to three percent slopes (#84).

  Kickerville-Urban land complex is a non-hydric, well-drained soil series. The series is in hydrologic group B and has a moderate infiltration rate when wet. The Kickerville soil component is derived from loess and volcanic ash over glacial outwash. The water table is described as being at an average depth of greater than 200 centimeters.

3.1.2 Field Observations

At the time of the site visits, conditions were generally consistent with the reviewed documents. The review area is located at a transition point within the City. Land use to the south is primarily residential, with the exception of commercial businesses along Meridian Street. Land use to the north is primarily commercial.

The undeveloped portions of the review area are vegetated with a mixed canopy and dense shrubby understory.

Two streams (Squalicum Creek and Tributary W) are situated in ravines approximately 10 to 15 below the adjacent uplands.

The review area contains uplands and streams, as described below.

3.2 Wetlands

No wetlands were identified within the review area.

3.2.1 Document Review

The following provides a summary of the findings contained within documents reviewed:

- **U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) Wetlands Mapper**
  The NWI Wetlands Mapper identifies a palustrine scrub shrub (PSS) wetland

corresponding with Squalicum Creek. A riverine intermittent stream bed, seasonally flooded (R4SBC) wetland is mapped corresponding with Tributary W.

- **Welch Ecological Services (Welch, 2015)**
  Wetlands were identified along both Squalicum Creek and Tributary W, upstream and outside of the review area.
- **COB City IQ**
  No wetlands are identified within the review area. A potential wetland is mapped northeast of Birchwood Avenue and east of CHS Northwest.

3.2.2 Field Observations

No wetlands were identified within the review area.

3.3 Upland Areas

3.3.1 Field Observations

The majority of the review area is developed road right-of-way for Meridian Street, Birchwood Avenue, and Squalicum Way. Curb, gutter, sidewalk is located along both sides of Meridian Street that transitions into forested areas. Sidewalks are generally absent along Birchwood Avenue and Squalicum Way, other than a small stretch south of CHS Northwest and another into Cornwall Park from Meridian Street. In these areas, paved roadway transitions into gravel shoulder, grasses and weedy herbaceous species, then forested areas.

Vegetation and conditions within the undeveloped uplands is mixed.

To the east, Cornwall Park contains forested areas along with maintained lawn. Within the park, the buffer of Tributary W is dominated by red alder (*Alnus rubra*), big leaf maple (*Acer macrophylum*), Pacific ninebark (*Physocarpus capitatus*), Douglas fir (*Pseudotsuga menziesii*), salmonberry (*Rubus spectabilis*), snowberry (*Symphoricarpos albus*), trailing blackberry (*R. ursinus*), ivy (*Hedera helix*), and Himalayan blackberry (*R. armeniacus*). More mature trees including Douglas fir, western red cedar (*Thuja plicata*), and big leaf maple become more common as you move east into the park. The park building shown in aerial photographs (Figure 2, Appendix B) has been removed and this area has been re-planted with a variety of native species. Within the park, the Squalicum Creek buffer is dominated by red alder, tall Oregon Grape (*Mahonia aquifolium*), vine maple (*Acer circinatum*), red-osier dogwood (*Cornus sericea*), young western red cedar, and ivy.

Vegetation in the northwest corner of the review area, adjacent to the BGCC, contains a number of trees or varying ages including western red cedar, Douglas fir, and big leaf maple. The understory is limited, and species are primarily snowberry, salmonberry, and Himalayan blackberry.

The BNSF property is primarily vegetated with red alder and blackberry. The buffer of Tributary W west of Meridian Street also contains red-osier dogwood, big leaf maple, black

cottonwood (*Populus balsamifera*), snowberry, pacific willow (*Salix lucida*), common tansy (*Tanacetum vulgare*), scotch broom (*Cytisus scoparius*), and queen Anne's lace (*Daucus carota*) at a lower percent cover.

The southwest corner of the review area, adjacent to Squalicum Creek, is vegetated with a mix of native conifers, deciduous trees, and shrubs. Red alder, big leaf maple, Pacific ninebark, red-osier dogwood, snowberry, salmonberry, and young fir trees, are common. Some smaller patches of blackberry are present in the understory along with bittersweet nightshade (*Solanum dulcamara*) and a patch of Knotweed (*Reynoutria japonica*) within the stream channel. Some social trails and debris are present in this area.

3.4 Streams and Lakes

Two streams (Squalicum Creek and Tributary W) were identified within the review area (Figure 3, Appendix B).

3.4.1 Document Review

The following provides a summary of the findings contained within documents reviewed:

- **COB City IQ (Figure 2)**
  Squalicum Creek is mapped flowing through Cornwall Park and west under Meridian Street. The stream flows southwest along Squalicum Way for approximately 1.5 miles before emptying into Bellingham Bay.

  In the northeastern portion of the review area, Tributary W is mapped flowing southwest into Cornwall Park, under Meridian Street, south under Squalicum Way, and then west before flowing into Squalicum Creek.

- **WDFW SalmonScape (WDFW, 2019a) (Figure 6)**
  Mapping by WDFW is similar to that of City IQ in this location.

3.4.2 Field Observations

<u>Squalicum Creek</u>

Field observations confirm mapping by background resources. NES marked the OHWM of the reaches of Squalicum Creek within 100 feet east and west of Meridian Street.

At the time of the site visits, the channel was approximately 20 feet wide on average and contained a series of riffles and pools. Water depths ranged from 6 to 12 inches in general. Bed substrate is comprised primarily of cobble or boulders, but smaller patches of gravel and silt were present. The banks were vegetated with overhanging vegetation as previously described.

The stream is located in a fairly confined ravine at the toe of an approximate 15 to 20-foot tall slope. Just east of Meridian Street, the steam flows through a series of notched check dams before flowing through a large box culvert (17 feet wide and 7.5 feet high) under the road. Watermarks were observed two to three feet above the bottom of the culvert at the outlet. The

culvert outfalls into a pool that was at least four feet deep during the June site visit. Some smaller woody debris was present in the channel.

Tributary W

Field observations of Tributary W confirm mapping by background resources (Welch, 2015 and GeoEngineers, 2016 and 2018). Conditions appear to remain consistent with past mapping, therefore the OHWM was not re-flagged or re-surveyed.

The reach of the stream within Cornwall Park was approximately 10 to 15 feet wide and contained approximately six inches of water during the site visit. The substrate is composed of silt and sand. The banks are vegetated.

Tributary W flows west under Meridian Street through a box culvert (10 feet wide and 4 feet high, except a 24-inch pipe at the inlet). West of Meridian Street, the stream is situated in a ravine between Birchwood Avenue and Squalicum Way. The channel in this reach is approximately five feet wide. The stream then flows under Squalicum Way, down a channel along the road for approximately 220 feet and into Squalicum Creek as previously described.

3.5 Fish and Wildlife

The on-site streams are mapped to contain multiple species of salmonids. The township is mapped to contain a big brown bat (*Eptesicus fuscus*) breeding area.

3.5.1 Document Review

The following provided a summary of the findings contained within documents reviewed:

- **WDFW SalmonScape (WDFW, 2019a) (Figure 6)**
  WDFW SalmonScape maps the following species in Squalicum Creek: documented presence of steelhead (*Oncorhynchus mykiss*), chum (*O. keta*), coho (*O. kisutch)*, and Chinook (*O. tshawytscha*) salmon. Bull trout (*Salvelinus confluentus*) are mapped with presumed presence.

  Tributary W is mapped with documented presence of Chinook, coho, and steelhead salmon. Bull trout are mapped with presumed presence.

  Bull trout and Puget Sound Chinook salmon are listed as federally Threatened species and Candidate species by Washington State. Puget Sound steelhead salmon are listed as federally Threatened species and Priority species by Washington State. Chum and coho salmon are not federally listed in this location, but are listed as a Priority species by Washington State.

  WDFW mapping indicates partial fish blockages within both streams under Meridian Street.

- **WDFW Priority Habitat and Species (PHS) Mapping (WDFW, 2019b) (Figure 5)**
  Squalicum Creek is mapped to contain resident coastal cutthroat (*O. clarki clarki*), coho,

Chinook, chum, and steelhead salmon, and bull trout/ Dolly Varden (*Salvelinus malma*). Tributary W is mapped with coho, Chinook, and steelhead salmon, and bull trout/ Dolly Varden.

The township is mapped to contain a big brown bat (*Eptesicus fuscus*) breeding area. This mapping is at a township level and not site specific.

- **Bellingham Habitat Restoration Technical Assessment (COB, 2015)**
  The Tributary W riparian corridor east of Meridian Street is mapped as a forested protection area, as are two other forested polygons south of Squalicum Creek. No designation is given to other areas within the review area.

3.5.2 Field Observations

NES did not observe any federal Threatened or Endangered species or associated habitats within the review area (other than the streams). NES did not observe any other Candidate or state Priority plant or wildlife species or associated habitats within the review area or immediate vicinity.

The township is mapped as potential habitat for big brown bat. In Washington, bat species can be found in lowland conifer-hardwood forest and riparian habitats (WDFW, 2013). No habitat features (mines, caves, lava tubes) that would be used as hibernacula or potential day roosts were observed within the review area. However, foraging habitat is present along the stream corridors.

The site contains suitable foraging habitat for wildlife species that occupy urban habitats including deer, songbirds, and small mammals. However, usage of the site is likely to be limited due to surrounding roads and urban development. Fish are assumed present in both streams.

3.6 Shorelines

Squalicum Creek is under the jurisdiction of the COB SMP, but Tributary W is not.

3.6.1 Document Review

The following provides a summary of the findings contained within documents reviewed:

- **COB SMP and Map**
  In the vicinity of the review area, Squalicum Creek is mapped with a Shoreline designation of Urban Conservancy.

3.6.2 Field Observations

Field observations confirm City mapping.

3.7 Frequently Flooded Areas

Frequently flooded areas are mapped along both Squalicum Creek and Tributary W (Figure 7, Appendix B).

3.7.1 Document Review

The following provides a summary of the findings contained within documents reviewed:

- **COB CityIQ Online Mapper (COB, 2019) (Figure 7)**
  COB mapping indicates 100 year floodplain within the review area associated with both Tributary W and Squalicum Creek. FEMA floodway is also indicated along Squalicum Creek.
- **Federal Emergency Management Agency (FEMA) Flood Hazard Map (FEMA, 2019)**
  FEMA mapping is consistent with COB mapping. The 100-year floodplain associated with Tributary W is mapped with a base flood elevation of 84 feet across Meridian Street. The 100-year floodplain associated with Squalicum Creek is mapped with a base flood elevation of 91 feet across Meridian Street. Floodway is also indicated.

3.7.2 Field Observations

Field observations were consistent with the background documentation. Site specific topography mapping would be required to determine the exact extent of the floodplain within the review area.

4.0 REGULATIONS

Agencies with regulatory authority over site wetlands, streams, fish and wildlife habitats, and/or shorelines are summarized in Table 1.

Table 1. Critical Areas Summary

Feature	Stream Type	Regulatory Authority				Corps Hydrology Classification	Regulated Buffer (ft)
		COB	Corps	WDOE	WDFW		
Squalicum Creek	S	X	X	X	X	RPW	100-200
Tributary W	F	X	X	X	X	RPW	75-150

S= Shoreline; F= Fish Bearing; RPW= Relatively Permeant Water

4.1 City of Bellingham

City of Bellingham CAO & SMP

Both Squalicum Creek and Tributary W are under the jurisdiction of the City of Bellingham CAO. Squalicum Creek is also under SMP jurisdiction.

The COB regulates Squalicum Creek and Tributary W as Fish and Wildlife Habitat Conservation Areas (HCAs). COB requires a buffer around regulated critical areas to protect functions. The buffer must remain naturally vegetated except where it can be enhanced to improve functions.

As a shoreline stream, per BMC 22.11.030(B), **Squalicum Creek is expected to require a buffer of between 100 and 200 feet.**

Per BMC 16.55.500 (D), as a fish-bearing stream, **Tributary W is required to have a buffer between 75 and 150 feet**.

COB requires that buildings and other structures are setback a minimum of 15 feet from the edge of critical area buffers, or from the critical areas where no buffer is required [BMC 16.55.340(G)]. Uses allowed within the 15-foot building setback include: landscaping; uncovered decks; building overhangs; pervious surfaces such as driveways, parking areas, and patios, provided that they are engineered as pervious surfaces as defined by BMC 16.80.050 and conform to applicable water quality standards and that construction equipment does not enter or damage the buffer or critical area.

4.2 Washington State Department of Ecology

Activities altering wetlands and streams may require permit authorization from WDOE per Section 401 of the federal Clean Water Act (CWA) as directed by the U.S. Environmental Protection Agency. **WDOE has authority over discharge into all streams and wetlands** and can impose buffers and compensatory mitigation for impacts (RCW 90.48). The WDOE reviews all CWA Section 404 permit applications received by the Corps for Water Quality Certification. WDOE requires an "individual" review of all wetland disturbances greater than 1/2 acre.

4.3 Washington State Department of Fish and Wildlife

The WDFW requires issuance of a Hydraulic Project Approval (HPA) prior to any activities that may directly or indirectly affect streams or associated wetlands. **WDFW is expected to regulate Squalicum Creek and Tributary W.** Only WDFW has the authority to make this determination.

4.4 US Army Corps of Engineers

The Corps regulates the discharge of dredged or fill material into wetlands, streams, and other drainages that connect to Waters of the United States under Section 404 of the CWA. The Corps regulates structures and/or work in or affecting the course, condition, or capacity of navigable

Waters of the United States under Section 10 of the Rivers and Harbors Act of 1899. The Corps requires notification for **all** disturbances to wetlands, streams, and potentially to other drainages (ditches). It is incumbent upon the landowner to disclose disturbances.

The Corps will automatically assert jurisdiction over some surface waters and will need to complete a "significant nexus" determination for others, depending on the degree of connection to other waters, the hydrologic classification of these associated waters, and their significance in the larger drainage basin. Wetland hydrologic classification and connectivity is described in this report as the "Corps hydrologic classification" (Table 1) using definitions provided in current Corps guidance documents.

The Corps hydrologic classification is based on whether a surface water meets the definition of or is connected to a waterbody that meets the definition of a Traditional Navigable Water (TNW) or a Relatively Permanent Water (RPW). A TNW is a navigable water protected under Section 10 of the Rivers and Harbors Act of 1899 or other waters currently or historically used or susceptible to use in interstate or foreign commerce. An RPW is a surface stream or river that exhibits continuous flow of more than three months out of the year.

Only the Corps has the authority to make jurisdictional determinations; however, the following is a description of the anticipated determinations. Squalicum Creek and Tributary W contain water for more than three months per year and therefore appear to qualify as RPWs. Squalicum Creek and Tributary W flow southwest to Bellingham Bay (a TNW). Therefore, **the Corps is expected to automatically exert jurisdiction over Squalicum Creek and Tributary W**.

Activities in Waters of the United States that require Corps authorization may qualify for authorization under one of the general Nationwide Permits (NWPs) if the activities meet the criteria. In the more commonly used NWPs, discharge (fill) is limited to under 1/2 acre of wetland, 300 linear feet of stream, and 1/3 acre of tidal waters. Discharge exceeding the NWP thresholds requires an Individual Permit from the Corps. Mitigation is required for most activities. The Corps also has discretion to disallow disturbance to high quality wetlands. As part of their permit review, the Corps must verify the project complies with Section 7 of the Endangered Species Act, the Magnuson-Stevens Fishery Conservation and Management Act, and Section 106 of the National Historic Preservation Act, (including archeological sites).

4.5 Mitigation Sequencing

Local, state, and federal agencies require projects impacting wetlands, streams, or wildlife HCAs, and/or shorelines to follow mitigation sequencing. Mitigation sequencing is a process where applicants show they have avoided all impacts to regulated areas and their buffers to the furthest extent possible. In some cases, if alteration to the regulated area is deemed unavoidable, impacts may be allowed if all adverse impacts resulting from a development proposal are mitigated using best available science so as to result in no net loss of critical area functions and values. When alteration or impact to a regulated area is proposed, the applicant

must demonstrate that all reasonable efforts have been taken to mitigate impacts in the following, prioritized, order: 1) Avoid, 2) Minimize, 3) Rectify, 4) Reduce, 5) Compensate.

APPENDIX A: REFERENCES

References

Anderson, P., S. Meyer, P. Olson, and E. Stockdale. 2016. *Determining the Ordinary High Water Mark for Shoreline Management Act Compliance in Washington State.* Washington State Department of Ecology, Shorelands and Environmental Assistance Program. Ecology Publication #16-06-029. Olympia, WA.

Brinson, M. 1993. *A Hydrogeomorphic Classification for Wetlands*. U.S. Army Corps of Engineers, Washington D.C. Tech. Report WRP-DE-4.

City of Bellingham. 2015. *Bellingham Habitat Restoration Technical Assessment*. Bellingham, WA.

City of Bellingham. 2017. The Bellingham Municipal code: Critical Areas Ordinance. Bellingham, WA.

City of Bellingham. 2019. CityIQ Interactive Map. Online at [https://www.iqmap.org/geviewer/Html5Viewer/Index.html?viewer=cityiq]. Accessed June/ July 2019.

Environmental Laboratory. 1987. *Corps of Engineers Wetland Delineation Manual*. Technical Report Y-87-1, U.S. Army Engineers Waterways Experiment Station, Vicksburg, MS.

GeoEngineers. 2016. *Cornwall Park Trail Improvements Buffer Mitigation Plan.* Bellingham, WA. [Cited in text as GeoEngineers, 2016]

GeoEngineers. 2018. *Aquatic Critical Areas and Fish and Wildlife Habitat Conservation Areas Assessment Report: Squalicum Creek Trail from Cornwall Park to Waterfront Bellingham, Washington.* Bellingham, WA. [Cited in text as GeoEngineers, 2018]

Google Earth. 2019. Available online at [https://www.google.com/maps/] accessed June 2019.

Gretag-Macbeth. 2000. Munsell soil color charts. New Windsor, NY.

Hitchcock, C.L. and A Cronquist. 2018. *Flora of the Pacific Northwest*. University of Washington Press. Seattle, WA.

Hruby, T. 2014. Washington *State Wetlands Rating System for Western Washington, 2014 Update*. Washington State Department of Ecology Publication #14-06-029. Olympia, WA.

Lichvar, R.W., D.L. Banks, W.N. Kirchner, and N.C. Melvin. 2016. *The National Wetland Plant List: 2016 wetland ratings.* Phytoneuron 2016-30: 1-17.

Soil Survey Staff, United States Department of Agriculture, Natural Resource Conservation Service. Web Soil Survey. Available online at [www.websoilsurvey.nrcs.usda.gov]/accessed June 2019. [Cited in text as USDA, NRCS, 2019.]

U.S. Army Corps of Engineers. 2010. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region*, ed. J.S. Wakeley, R.W.

Lichvar, and C.V. Noble. ERDC/EL TR-08-13. Vicksburg, MS: U.S. Army Engineer Research and Development Center. [Cited in text as Corps, 2010.]

U.S. Army Corps of Engineers. 2012b. *Western Mountains, Valleys, and Coast Final Draft Ratings.* U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory.

United States Department of Agriculture, Natural Resources Conservation Service. 2018. Field Indicators of Hydric Soils in the United States, Version 8.2. L.M. Vasilas, G.W. Hurt, and J.F. Berkowitz (eds.). USDA, NRCS, in cooperation with the National Technical Committee for Hydric Soils. [Cited in text as USDA, NRCS, 2018.]

U.S. Fish and Wildlife Service. 2019. National Wetlands Inventory Wetlands Mapper. Online at [http://www.fws.gov/wetlands/Data/Mapper.html]. Accessed June 2019.

Washington State Department of Ecology. 2019. Coastal Atlas Map. Online at [https://fortress.wa.gov/ecy/coastalatlas/]. Accessed June 2019. [Cited in text as WDOE, 2019]

Washington State Department of Ecology. 2008. *Using the Wetland Rating System in Compensatory Mitigation*. Washington State Department of Ecology Publication #08-06-009. Olympia, WA.

Washington State Department of Ecology, U.S. Army Corps of Engineers Seattle District, and U.S. Environmental Protection Agency Region 10. March 2006. *Wetland Mitigation in Washington State - Part 2: Developing Mitigation Plans*. Washington State Department of Ecology Publication #06-06-011b. Olympia, WA.

Washington State Department of Fish and Wildlife. 2013. Bat Conservation Plan. Olympia, Washington. 138 pp. Online at [https://wdfw.wa.gov/publications/01504/wdfw01504.pdf]. [Cited in text as WDFW, 2013]

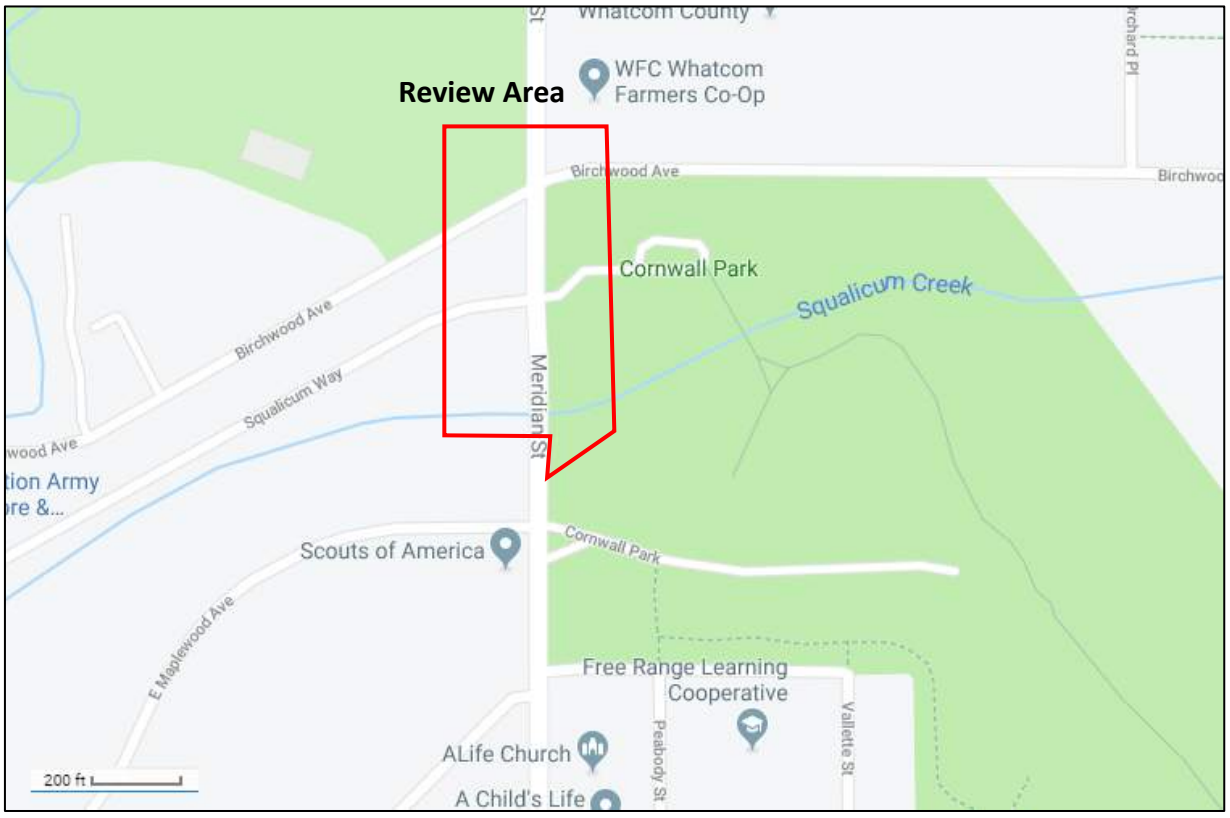
Washington State Department of Fish and Wildlife. 2019. SalmonScape. Online at [www.wdfw.wa.gov]/ Accessed June 2019. [Cited in text as WDFW, 2019a]

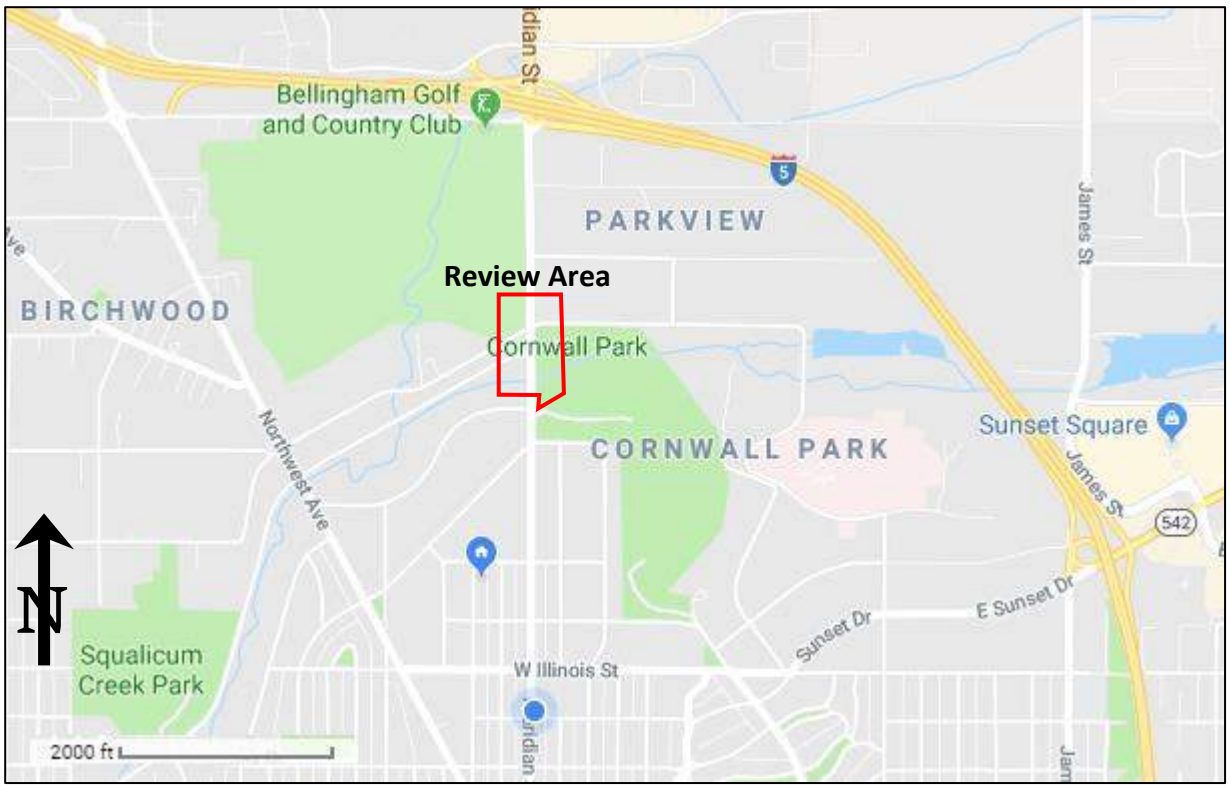
Washington State Department of Fish and Wildlife. 2019. PHS Data on the Web Interactive Map. Online at [http://fortress.wa.gov/dfw/gispublic/prodphsontheweb/viewer.aspx?auth=JwXxUH0ngPvzOg8x0d41qRnwg0WDBo9dbRTgp7769mNhB8lgNJTKeg==]. Accessed June 2019. [Cited in text as WDFW, 2019b]

Washington State Department of Fish and Wildlife. Species of Concern Listing. Online at [www.wdfw.wa.gov/wlm/diversty/soc/soc.htm]/ Accessed June 2019. [Cited in text as WDFW, 2019c]

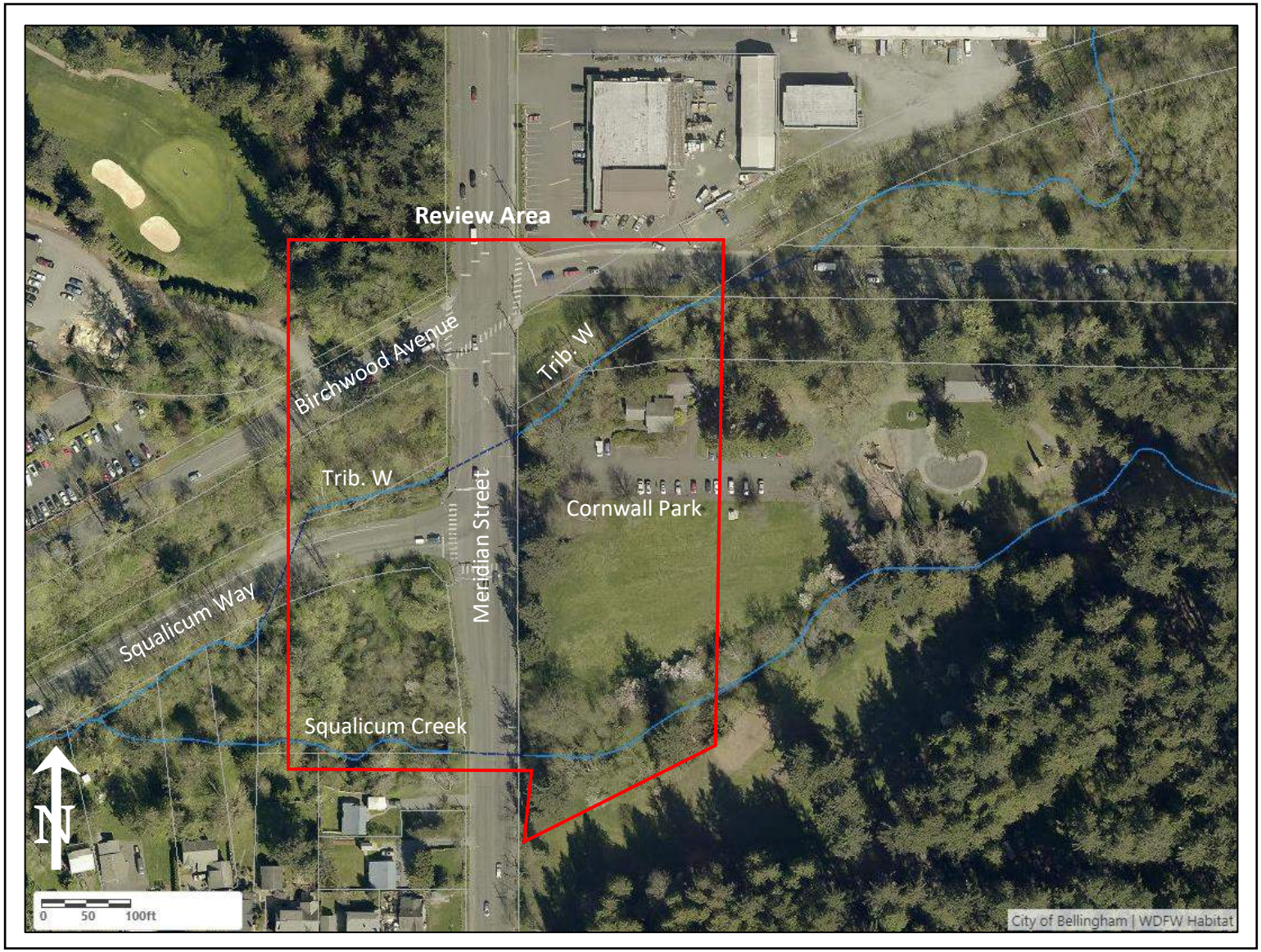
Welch Ecological Services. 2015. *Cornwall Park, Squalicum Creek Critical Areas Determination Report.* Bellingham, WA. [Cited in text as Welch, 2015]

APPENDIX B: FIGURES

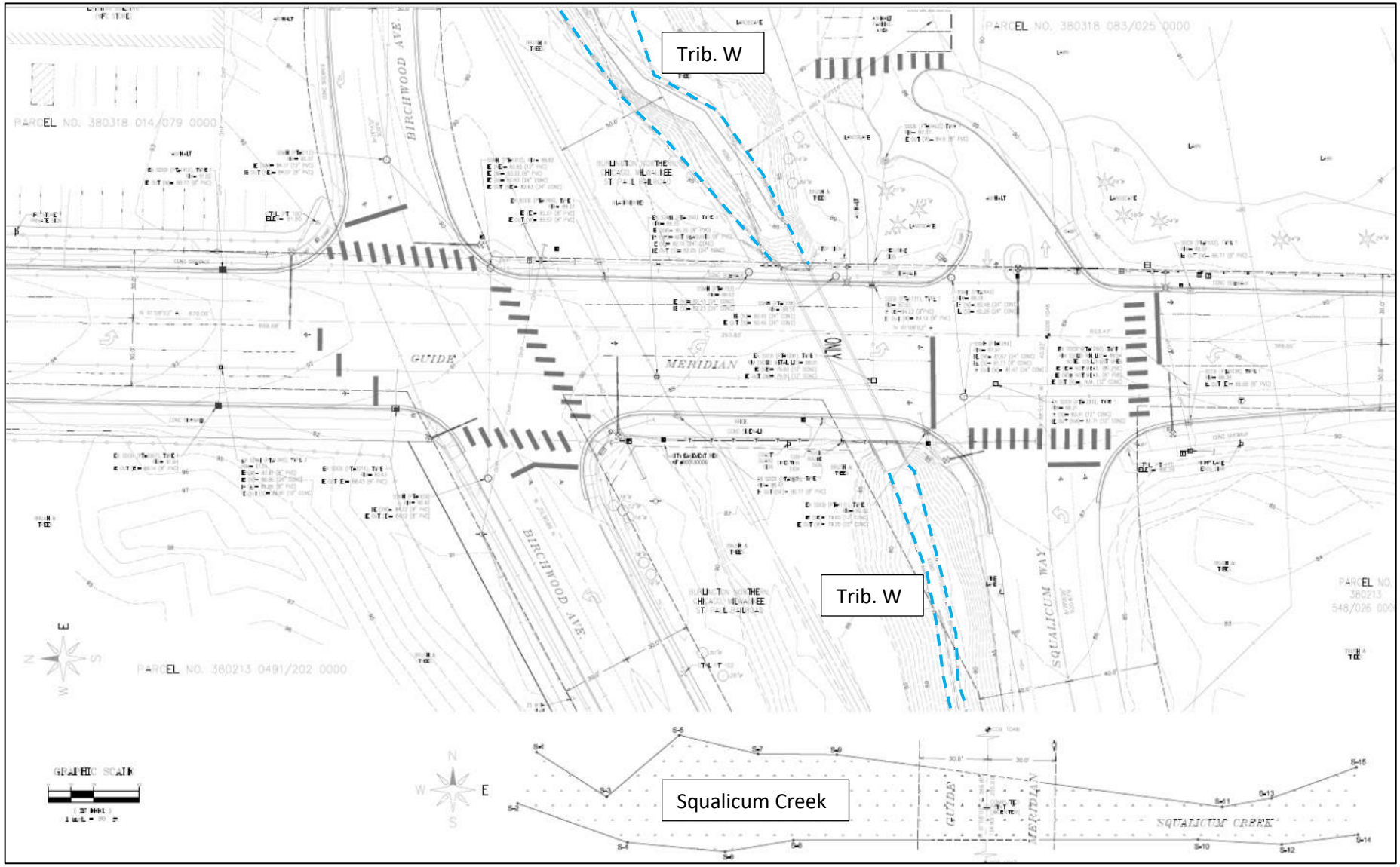




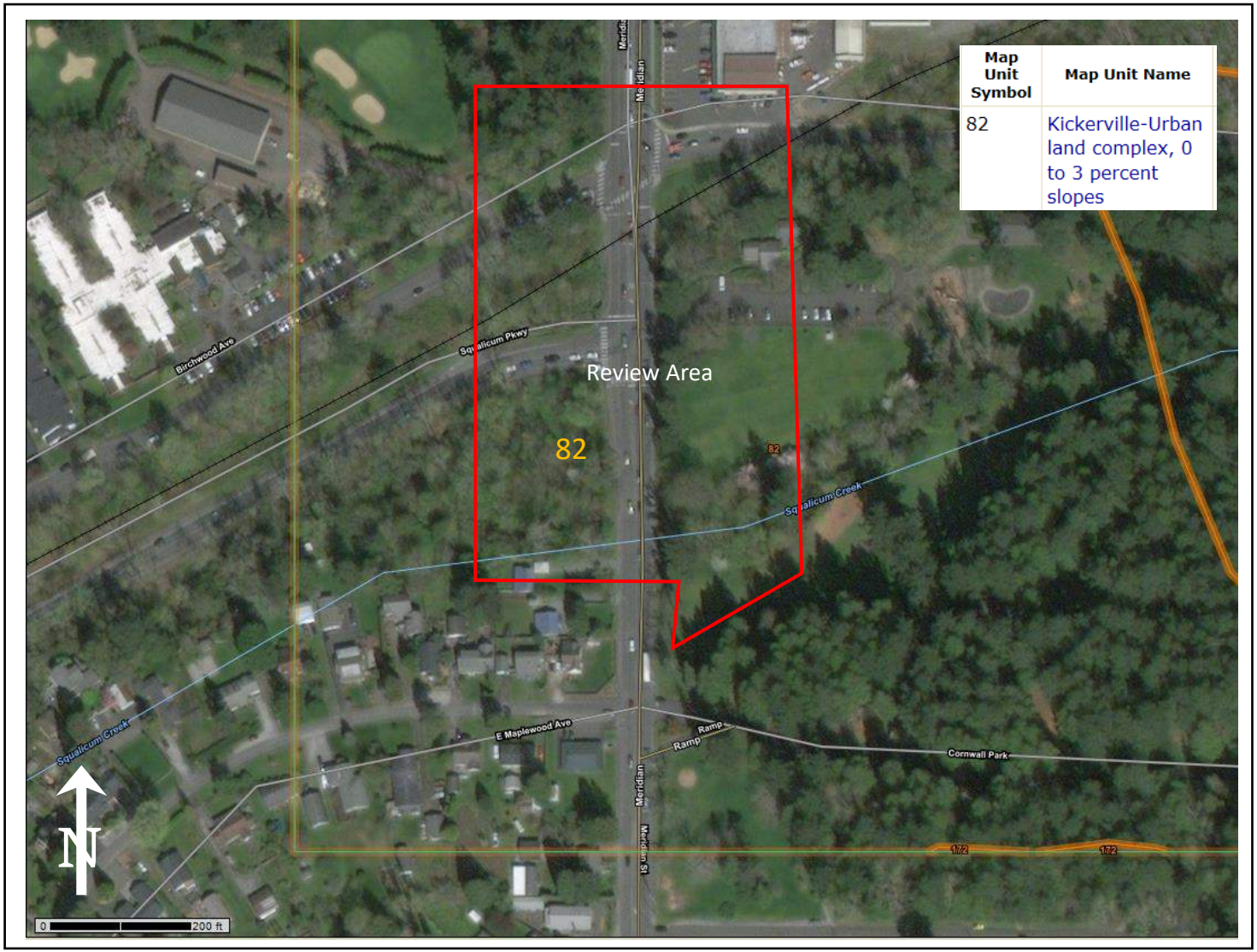
ECOLOGICAL NORTHWEST	**Vicinity Map (Google Maps)** **Meridian Street Roundabout Critical Areas Assessment**	**Figure 1** **JUL 2019**



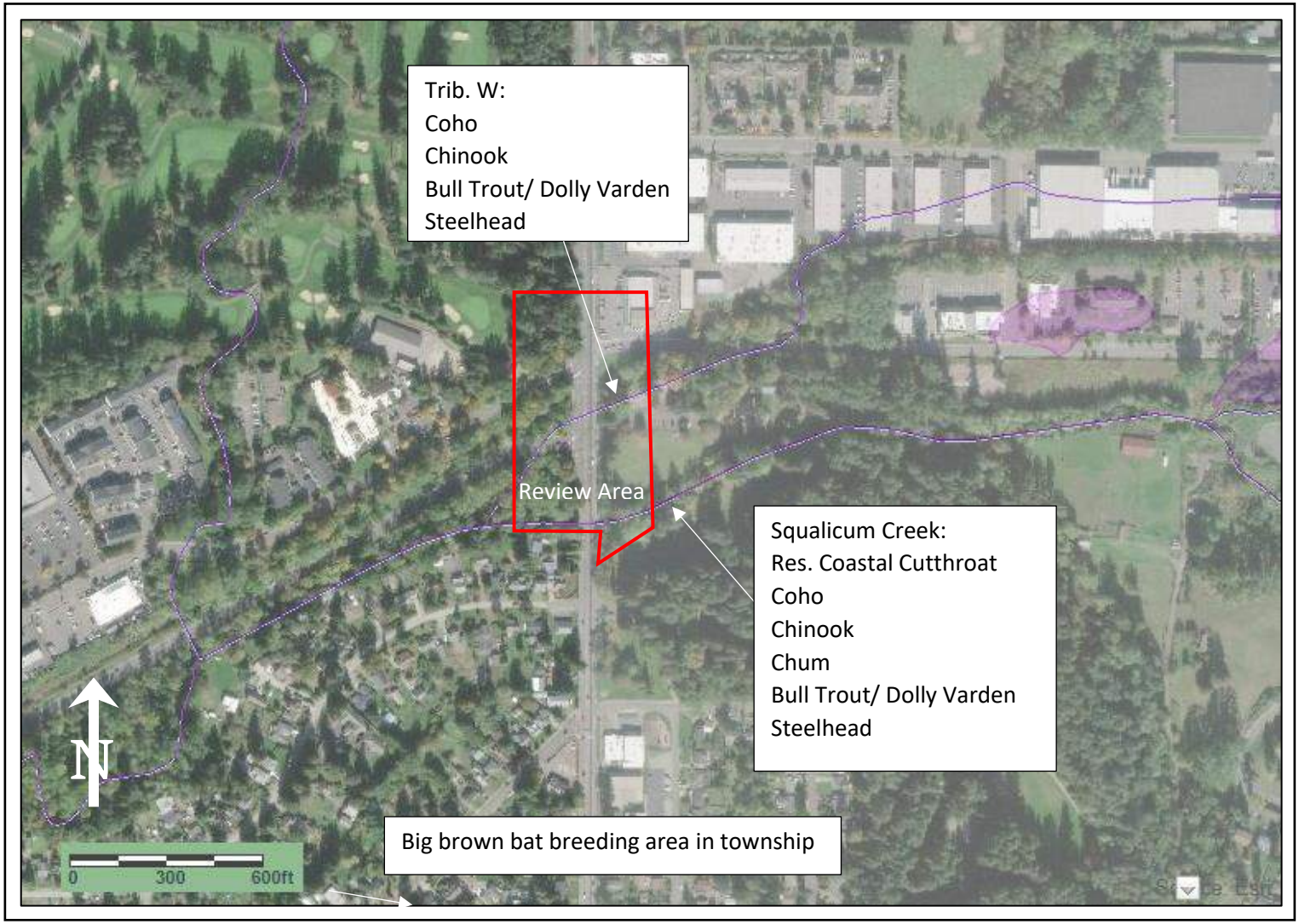
ECOLOGICAL NORTHWEST	**Aerial Photograph** **(COB CityIQ)** **Meridian Street Roundabout** **Critical Areas Assessment**	**Figure 2** **JUL 2019**



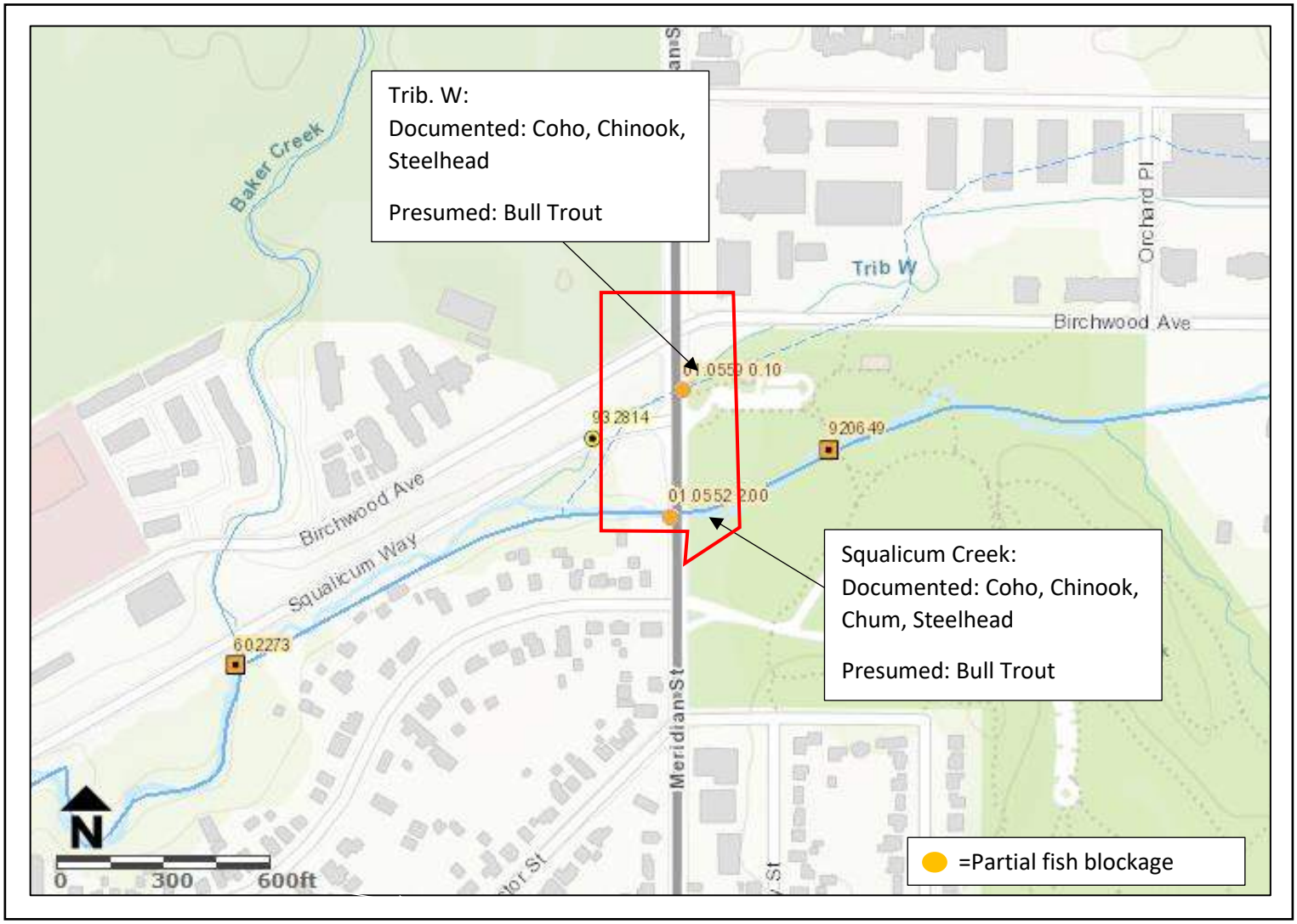
ECOLOGICAL NORTHWEST	**Existing Conditions Survey (LDES)** **Meridian Street Roundabout Critical Areas Assessment**	**Figure 3** **JUL 2019**



ECOLOGICAL NORTHWEST	**Soils Map** **(USDA NRCS)** **Meridian Street Roundabout** **Critical Areas Assessment**	**Figure 4** **JUL 2019**



ECOLOGICAL NORTHWEST	**PHS Map (WDFW)** **Meridian Street Roundabout Critical Areas Assessment**	**Figure 5** **JUL 2019**



ECOLOGICAL NORTHWEST	**SalmonScape Map (WDFW)** **Meridian Street Roundabout Critical Areas Assessment**	**Figure 6** **JUL 2019**

ECOLOGICAL NORTHWEST	**Frequently Flooded Areas** **(City IQ Maps)** **Meridian Street Roundabout** **Critical Areas Assessment**	**Figure 7** **JUL 2019**

APPENDIX C: PHOTOGRAPHS

Meridian Street looking north towards Birchwood Avenue intersection

Meridian Street looking south toward Squalicum Way intersection

Northwest corner of review area near Bellingham Golf and Country Club

Northwest corner of review area near Bellingham Golf and Country Club

Tributary W in Cornwall Park

Tributary W flowing into culvert under Meridian Street

Tributary W and buffer in Cornwall Park

Tributary W looking west from Meridian Street

Squalicum Creek culvert outfall west of Meridian Street

Squalicum Creek west of Meridian Street

Squalicum Creek west of Meridian Street

Squalicum Creek west of Meridian Street

Squalicum Creek culvert inlet east of Meridian Street

Squalicum Creek east of Meridian Street

MEMORANDUM

To:	Charles Smith, Reid Middleton
	Chris Comeau, City of Bellingham Public Works
From:	Molly Porter, Northwest Ecological Services, LLC (NES)
	Collin Van Slyke, NES
Date:	December 20, 2019
RE:	Meridian Street Roundabout Feasibility Study-
	Critical Area Impact Summary for Alternatives Project Designs

BACKGROUND

The City of Bellingham (COB) is considering the feasibility of several design alternatives for a potential roundabout/ traffic improvement project on Meridian Street, at the intersections of Squalicum Way and Birchwood Avenue (Figure 1).

As detailed in the NES July 2019 Critical Areas Assessment, Meridian Street crosses two streams (Squalicum Creek and Tributary W) in the vicinity of the project area. Both streams currently flow west under Meridian Street through concrete box culverts. Both streams are mapped as fish bearing. A Federal Emergency Management Agency (FEMA) 100-year floodplain is associated with both streams. FEMA mapping also indicates floodway associated with Squalicum Creek.

Design alternatives were reviewed by the project team in order to assess their potential to improve vehicular traffic flow, and impacts to other elements, including adjacent critical areas and their buffers. At this time, three different designs were reviewed, including:

- **Alternative Design 1:** a dual roundabout- one each at the Squalicum and Birchwood intersections (Figure 2).
- **Alternative Design 2:** a peanut shaped dual roundabout that mingles both intersections (Figure 3).
- **Alternative Design 3:** merges Squalicum Way into Birchwood Avenue west of Meridian Street. This design removes the existing Squalicum/ Meridian intersection and includes one roundabout at Meridian Street and Birchwood (Figure 4). During further review the combined intersection was moved slightly east due to site topography (Figure 5).

POTENTIAL IMPACTS

The three design alternatives were imported to GIS, and the streams, regulated buffers, and floodplain/floodway were overlaid on each design. At this time designs are conceptual therefore impacts areas should be considered approximate. Stream buffer impacts are based on minimum stream buffers (75 ft for Tributary W and 100 feet for Squalicum Creek). A detailed grading plan has not yet been developed therefore floodplain cut/fill was not able to be calculated. Square footage of floodplain impact was used as a surrogate for cubic yards of fill. The COB Parks master plan includes a trail connection from Cornwall Park west through the project area, located somewhere between the roadways. Exact location and width of this trail has not yet been designed, so this assessment does not include trail impacts. However, an approximate trail alignment is shown on Figure 8 north of Tributary W.

Expansion of the road, sidewalk, or other infrastructure has the potential to result in instream, stream buffer, and/or floodplain impacts. The following provides a summary of anticipated critical areas impacts associated with each of the current design alternatives. All three design alternatives result in some level of encroachment into the Tributary W buffer and some floodplain fill. Approximate totals are provided in Table 1 and areas are depicted in Figures 6 to 8.

Table 1. Estimated impacts associated with each design alternative

Design	Approx. Buffer Impact (acres)	Approx. Floodplain Fill (acres)
Alternative 1- Dual	0.2	0.1
Alternative 2- Peanut	0.4	0.4
Alternative 3- Combined	0.3	0.2

Below is a summary of anticipated impacts for each alternative design.

- **Alternative 1**. Anticipated impacts are shown in Figure 6. This alternative would result in the smallest impacts to the buffer of Tributary W and the least amount of floodplain fill. This design appears to result in a small (< 10 linear foot) culvert extension to the Tributary W culvert. However, this extension is so small it may be able to be avoided with final design, possibly by moving the roundabout slightly to the west.
- **Alternative 2**. Anticipated impacts are shown in Figure 7. This alternative would result in the greatest impact to both the stream buffer and floodplain. This design also includes the greatest in-stream impact and length of culvert extension. The extent of the culvert extension under this alternative increases the potential for total replacement of the culvert and possibly higher project costs.

  As currently shown, this alternative also includes some potential fill in the regulated floodway of Squalicum Creek. The floodway impact is quite small and it may be possible to avoid with final design.

- **Alternative 3**. Anticipated impacts are shown in Figure 8. Impacts to stream buffers and the floodplain resulting from this alternative are between the other two alternatives. It appears this design avoids an extension of the Tributary W culvert.

  During analysis of the three designs, it was discussed that Alternative 3 would likely occur in a phased approach. Phase 1 would include merging the two roadways. Phase 2 would include the roundabout at Meriden Street. Both phases would have some impact to the buffer of Tributary W, but floodplain fill would only occur with Phase 2.

  Alternative 3 also includes the potential to restore approximately 0.3 acres of stream buffer and daylighting a portion of Tributary W, in the abandoned portion of Squalicum Parkway.

MITIGATION

All three alternatives will require permits from local (COB), state (Washington Department of Ecology), and federal (US Corps of Engineers) agencies. Due to anticipated instream work, all three alternatives will likely require coordination and/or a permit from Washington Department of Fish and Wildlife (WDFW). Tributary W is listed as fish bearing and the culvert under Meridian Street is mapped as a partial fish passage barrier. Discussions with WDFW staff (personal communication between Joel Ingram WDFW and Molly Porter NES, October & November 2019) have indicated that WDFW may not automatically require replacement of the culvert if it needs to be manipulated or extended. That determination will be made upon review of final project design. Mr. Ingram noted the tributary has potential for fish presence due to its connection to Squalicum Creek, but there is no natural basin feeding Tributary W except for storm water inputs during most of the year. Final design will need to ensure any culvert modification does not cause backwater or scour holes, which can trap fish on the falling side of high water.

Mitigation will be required for all project impacts. Stream buffer impacts are typically mitigated for at a minimum 1:1 ratio (impact: stream buffer enhancement). Additional mitigation may also be required for impacts to the regulated floodplain. Floodplain mitigation may include additional habitat improvements (riparian vegetation enhancement), balance of the project cut/fill, stormwater improvements, and/or other project design changes (such as avoiding the regulated floodway). Additionally, a no-rise analysis may also be required to ensure the project does not increase flood elevations.

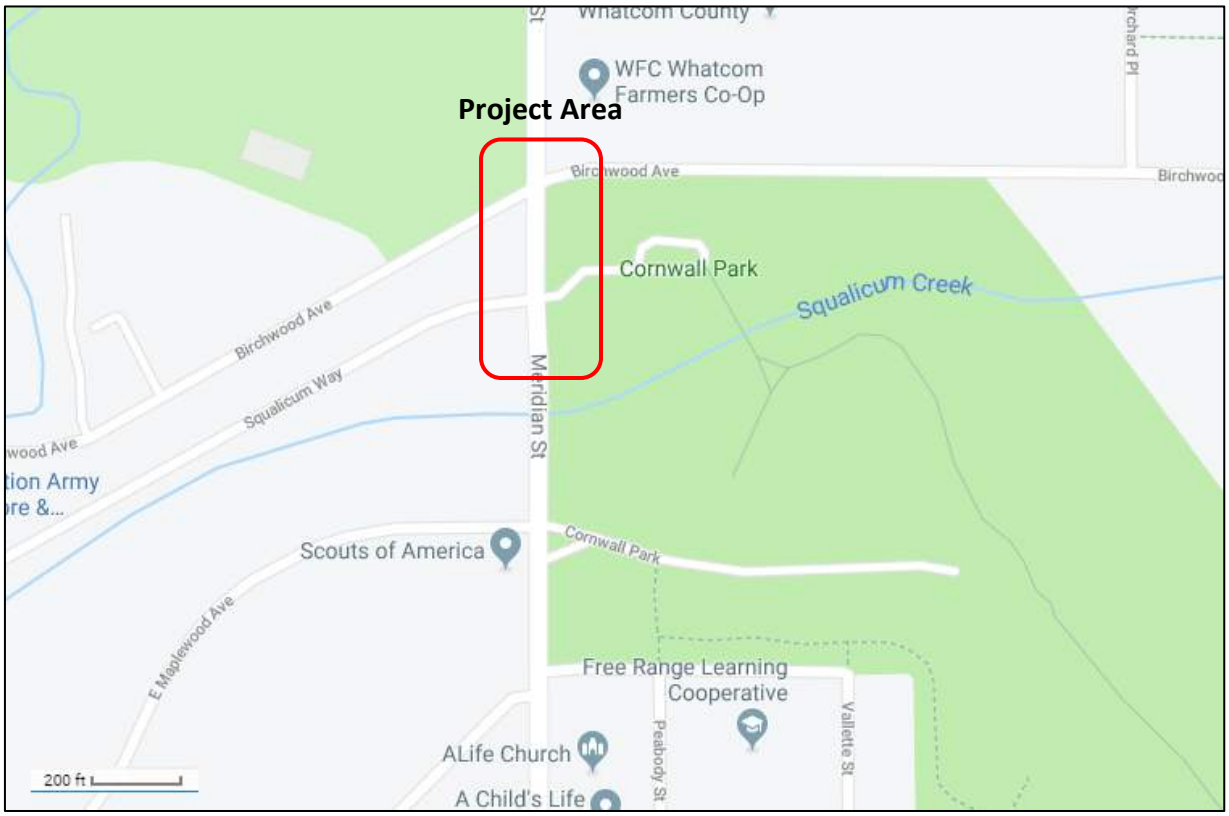
Alternatives 1 and 2 do not have potential for mitigation within the project areas. Buffer enhancement could occur elsewhere within Cornwall Park, or potentially in the buffer of Tributary W, west of Meridian Street. Additional area needed to mitigate for floodplain impacts would depend on final project design and proposed impacts.

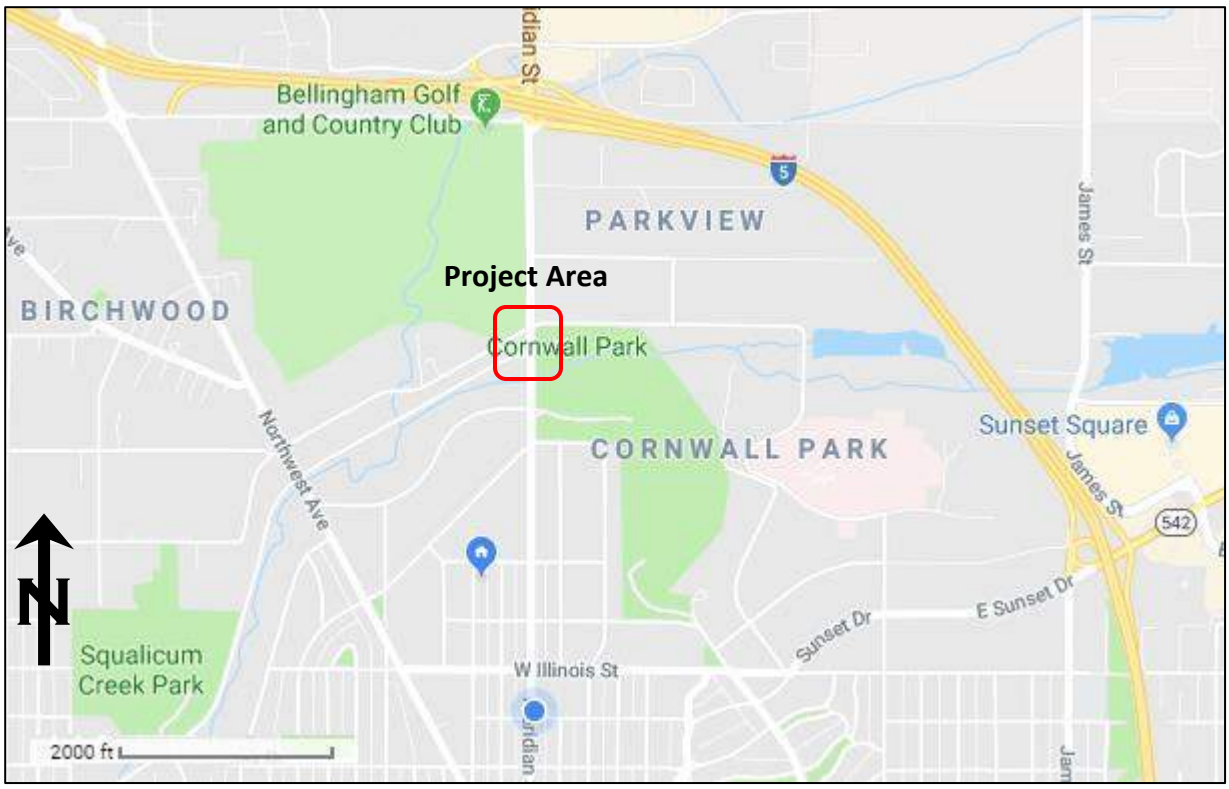
Alternative 3 includes the potential to mitigate for project impacts in the abandoned portion of Squalicum Parkway. This area could be used to mitigate critical areas impacts (both buffer impact and floodplain fill), as well as potentially mitigate impacts associated with the future COB Parks trail. During future project planning there is potential to increase efficiency and

reduce cost associated with mitigation by considering all potential impacts, for both road phases and future City trails. We recommend considering advanced mitigation within the abandoned Squalicum Creek roadway for Alternative 3 project phases and the park trail.

SUMMARY

In summary, all three designs result in some level of impact to regulated stream buffers and floodplain, but they are all similar with none being dramatically less or more impactful. Alternative 3 appears to be the only design that provides long term traffic improvement. Alternative 3 is also the only design that results in the opportunity to perform mitigation within the project area. Mitigation within the abandoned section of Squalicum Way would provide a higher level of habitat improvement over enhancements areas that would likely result from Alternatives 1 and 2. Alternative 3 could include improvements to the stream corridor by removing the section of roadway which is currently fragmenting habitat between the two streams, daylighting a portion of the Tributary W stream channel, and allowing for enhancement to riparian buffers. These potential improvements are also more likely to balance the floodplain cut/fill and compensate for impacts to the regulated floodplain thus avoiding additional floodplain mitigation. Therefore, revised Alternative 3 (Figure 5) is supported as the preferred design.





ECOLOGICAL NORTHWEST	**Vicinity Map (Google Maps)** **Meridian Roundabout Feasibility Study** **Critical Areas Impact Summary**	**Figure 1** **DEC 2019**

CITY OF BELLINGHAM WASHINGTON | ReidMiddleton | FEHR & PEERS

Meridian Street Roundabout Feasibility Study – Alternative 1 – Dual Roundabouts

OPEN HOUSE – *City of Bellingham*

ECOLOGICAL NORTHWEST	**Project Alternative 1** **Dual Roundabouts** **Meridian Roundabout** **Critical Areas Impact Summary**	**Figure 2** **DEC 2019**

ReidMiddleton FEHR PEERS

Meridian Street Roundabout Feasibility Study – Alternative 2 – Peanut

OPEN HOUSE – City of Bellingham

ECOLOGICAL NORTHWEST	**Project Alternative 2** **Peanut** **Meridian Roundabout** **Critical Areas Impact Summary**	**Figure 3** **DEC 2019**

INTERSECTION LEVEL OF SERVICE (Delay Per Vehicle, Sec/veh)

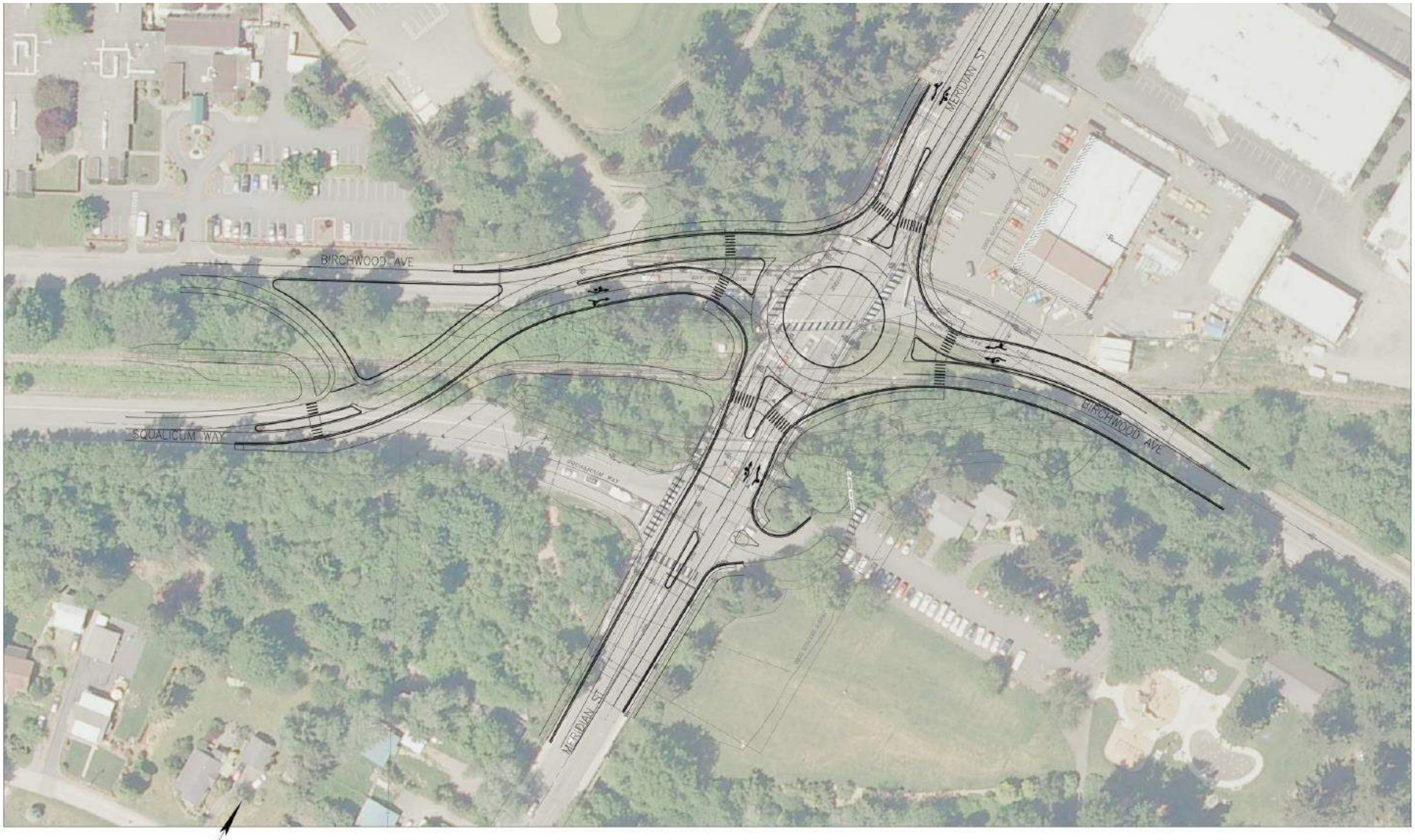
Approach	2019 Existing	2040 No Build	2040 Dual	2040 Peanut	2040 Single
Meridian SB	D 36	F 107	C 21	A 8	A 6
Birchwood WB	C 30	F 174	F 217	F 108	D 27
Park WB	C 23	D 53	E 49	D 29	N/A
Meridian NB	D 49	E 76	F 159	F 66	A 6
Squalicum WB	D 45	F 217	E 36	F 122	N/A
Birchwood EB	D 47	F 128	E 49	C 16	B 11
Intersection Average	D 41	F 125	F 93	F 52	B 12

CITY OF BELLINGHAM WASHINGTON · ReidMiddleton · FEHR PEERS

Meridian Street Roundabout Feasibility Study – Alternative 3 – Combined Squalicum & Birchwood

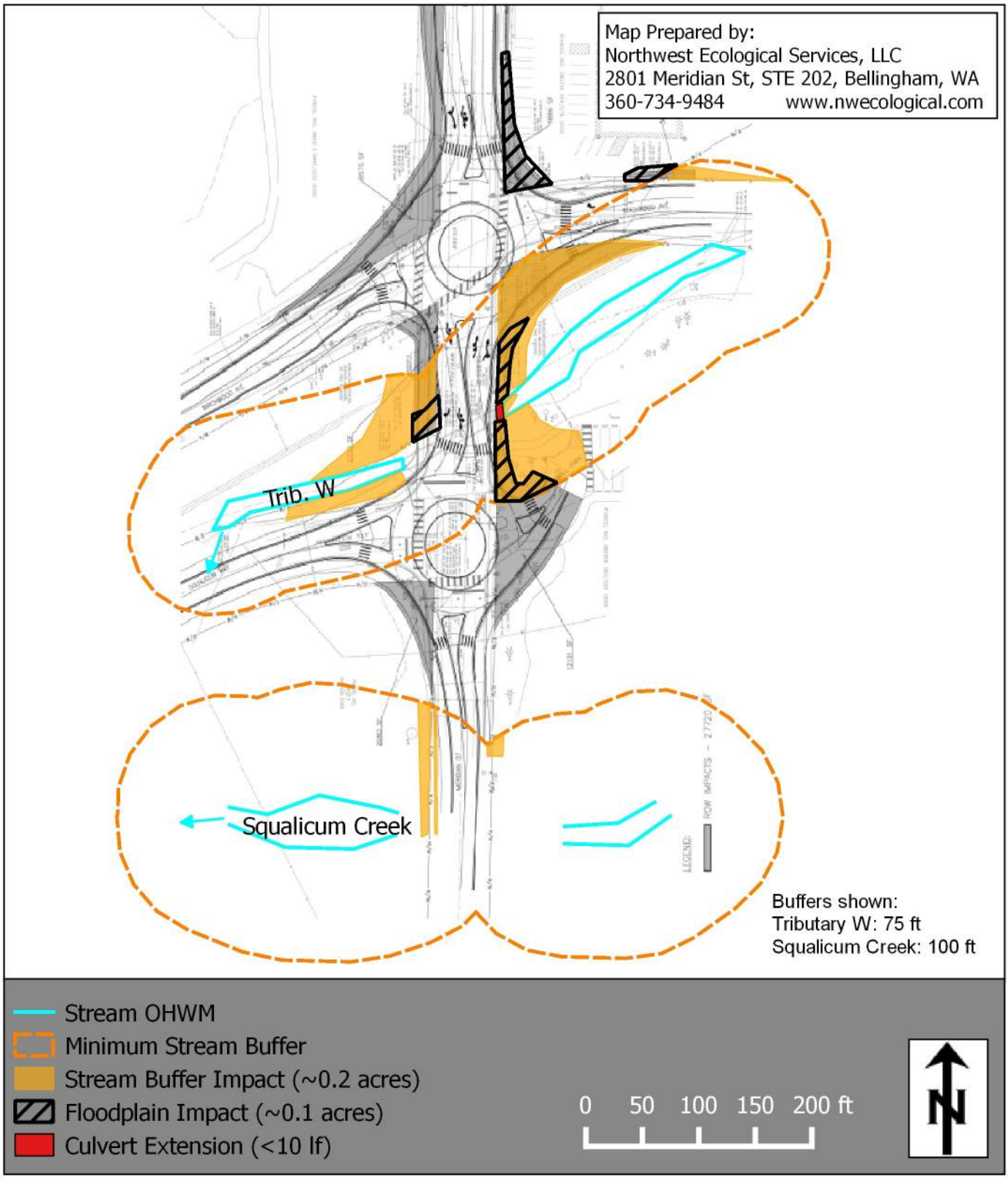
OPEN HOUSE – *City of Bellingham*

ECOLOGICAL NORTHWEST	**Project Alternative 3** **Combined Squalicum & Birchwood** **Meridian Roundabout** **Critical Areas Impact Summary**	**Figure 4** **DEC 2019**

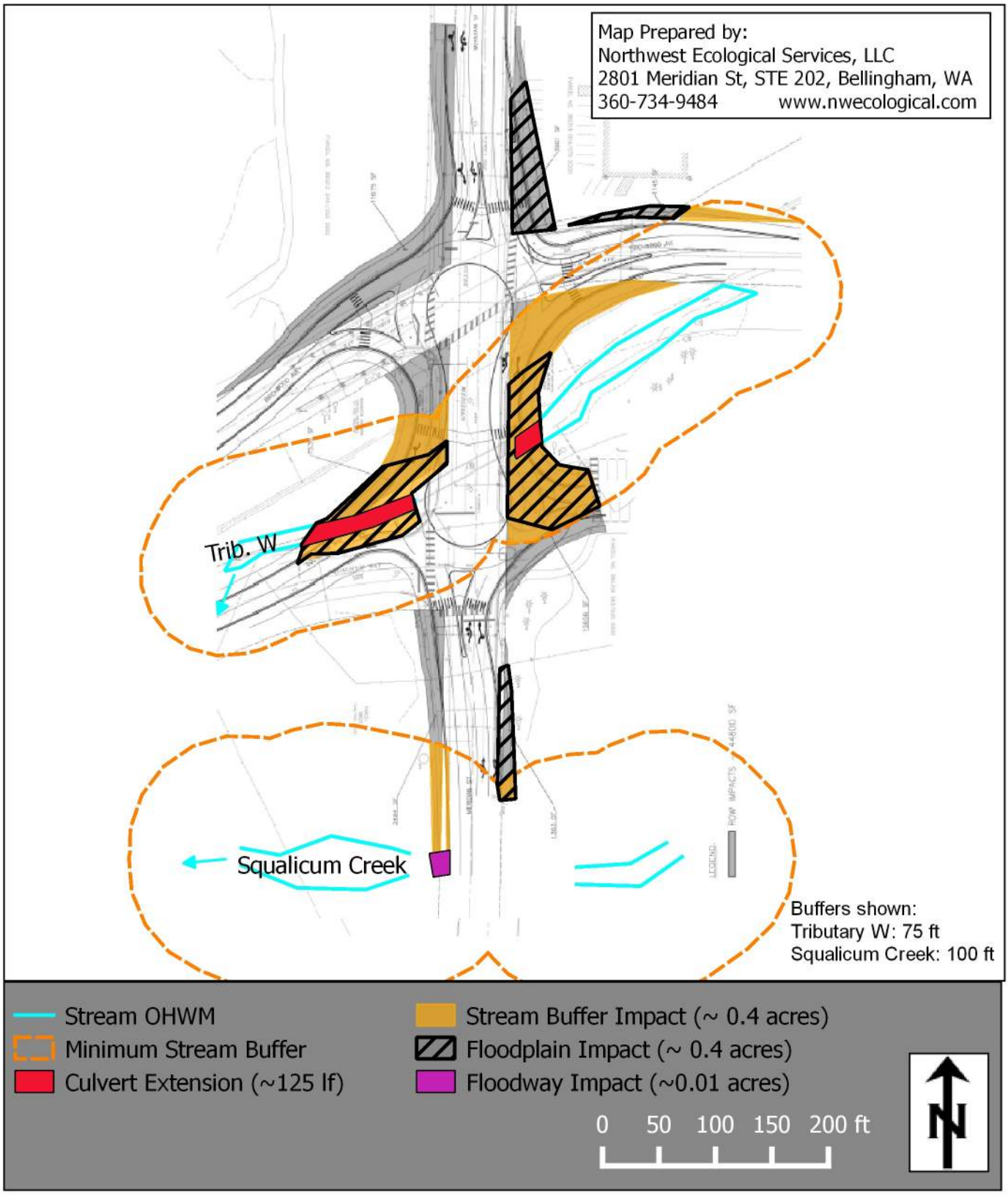


ALTERNATIVE 3B – ULTIMATE BUILDOUT

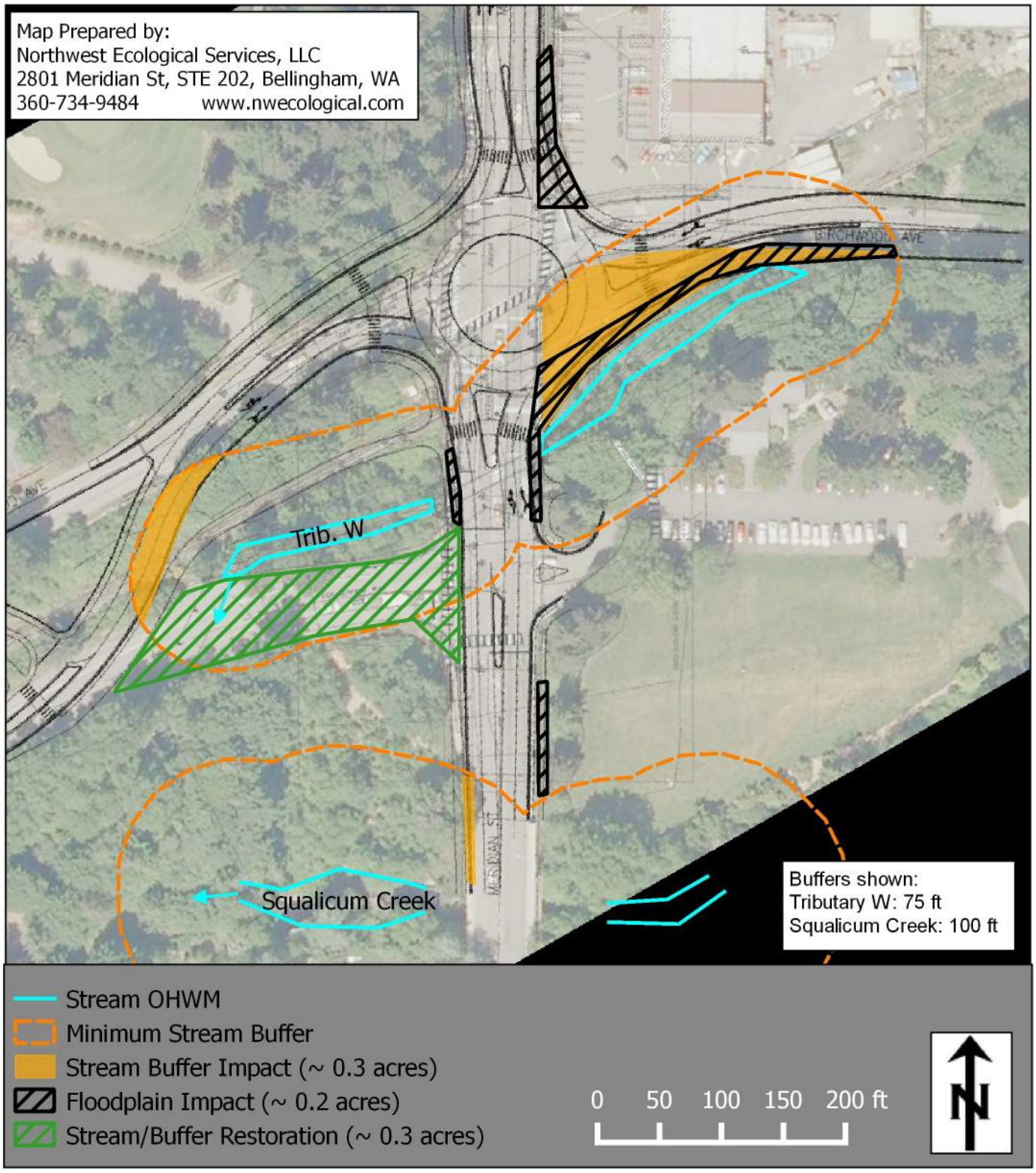
ECOLOGICAL NORTHWEST	**Preferred Alternative** **Alt 3: Combined Revised** **Meridian Roundabout** **Critical Areas Impact Summary**	**Figure 5** **DEC 2019**



Ecological Northwest	**Alternative 1 Impact Map** **Meridian Roundabout Feasibility Study** **Critical Area Impact Summary**	**Figure 6** **DEC 2019**



Northwest Ecological	**Alternative 2 Impact Map** **Meridian Roundabout Feasibility Study** **Critical Areas Impact Summary**	**Figure 7** **DEC 2019**



Ecological Northwest	**Alternative 3 Impact Map** **Meridian Roundabout Feasibility Study** **Critical Areas Impact Summary**	**Figure 8** **DEC 2019**

APPENDIX E: PREFERRED ALTERNATIVE

MERIDIAN ST ROUNDABOUT
INTERSECTION IMPROVEMENTS

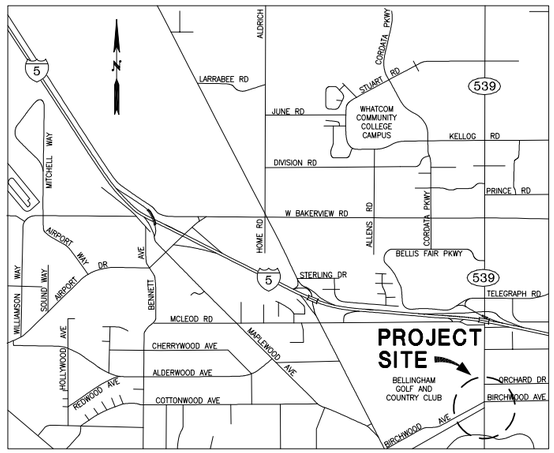
COUNCIL PRESIDENT
DAN HAMMILL

COUNCIL PRESIDENT PRO TEMPORE
MICHAEL LILLIQUIST

MAYOR PRO TEMPORE
GENE KNUTSON

CITY COUNCIL MEMBERS
LISA ANDERSON
PINKY VARGAS
HOLLIE HUTHMAN
HANNAH STONE

PUBLIC WORKS DIRECTOR
ERIC JOHNSTON



VICINITY MAP

SHEET INDEX

NO.	NAME	DESCRIPTION
1	COV	COVER SHEET, VICINITY MAP, AND SHEET INDEX
2	LN1	LEGEND AND ABBREVIATIONS
3	EC1	EXISTING CONDITIONS
4	AP1	ALIGNMENT AND SURVEY CONTROL PLAN
5	RS1	TYPICAL ROADWAY SECTIONS
6–8	CS1–CS3	CHANNELIZATION PLAN

CITY OF BELLINGHAM
PUBLIC WORKS DEPARTMENT

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NO.	DATE	BY	APPR.	REVISION

Reid Middleton

DRN. WRM | DSGN. WRM | CHKD. CRS

CITY OF BELLINGHAM
DEPARTMENT OF
PUBLIC WORKS
CITY PROJ NUMBER: _____

CHARLES R. SCOTT — STATE OF WASHINGTON — 39917 — REGISTERED PROFESSIONAL ENGINEER — PRELIMINARY

CITY OF BELLINGHAM
MERIDIAN ST ROUNDABOUT
INTERSECTION IMPROVEMENTS

DATE: 12/31/2019 | JOB #

SHEET NO:
COV1
1 OF 8

ABBREVIATIONS

AC	ASBESTOS CEMENT
ACP	ASPHALT CONCRETE PAVEMENT
AVE	AVENUE
BP	BEGIN PROJECT
BVCE	BEGIN VERTICAL CURVE ELEVATION
BVCS	BEGIN VERTICAL CURVE STATION
EVCE	END VERTICAL CURVE ELEVATION
EVCS	END VERTICAL CURVE STATION
CB	CATCH BASIN
CI	CONCRETE INLET
CIP	CAST IN PLACE
CKT	CURCUIT
CL	CENTER LINE
CLR	CLEARANCE
COK	CITY OF KIRKLAND
CONT	CONTINOUS
CPP	CORRUGATED PLASTIC PIPE
CSBC	CRUSHED SURFACING BASE COURSE
CSTC	CRUSHED SURFACING TOP COURSE
DI	DUCTILE IRON
DIP	DUCTILE IRON PIPE
E	EAST
ELEV	ELEVATION
EMBED	EMBEDMENT
EOL	EDGE OF LANE
EOP	EDGE OF PAVEMENT
EOS	EDGE OF SHOULDER
EX	EXISTING
FOB	FACE OF BARRIER
FC	FACE OF CURB
FS	FIRE STATION
GE	GRATE ELEVATION
IE	INVERT ELEVATION
IES	ILLUMINATION ENGINEERING SOCIETY
ILLUM	ILLUMINATION
IP	INTERCEPT POINT
JUT	JOINT UTILITY TRENCH
KCM	1000 CIRCULAR MILS
KCRS	KING COUNTY ROAD STANDARDS
LT	LEFT
L	LENGTH
LF	LINEAR FEET
ME	MATCH EXISTING
MFG	MANUFACTURER
MH	MAN HOLE
MIN	MINIMUM
MUTCD	MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES
N	NORTH
NE	NORTHEAST
NO	NUMBER
NOM	NOMINAL
OC	ON CENTER
OHW	ORDINARY HIGH WATER
PC	POINT OF CURVATURE

ABBREVIATIONS (CONT.)

PSE	PUGET SOUND ENERGY
PT	POINT OF TANGENCY
PVC	POINT OF VERTICAL CURVATURE
PVI	POINT OF VERTICAL INTERSECTION
PVT	POINT OF VERTICAL TANGENCY
P, PO	POWER
R	RADIUS, RANGE
RCP	REINFORCED CONCRETE PIPE
REINF	REINFORCED
ROW	RIGHT OF WAY
RPM	RAISED PAVEMENT MARKING
RT	RIGHT
S	SOUTH
SEC	SECTION
SMFO	SINGLE MODE FIBER OPTIC
SPEC	SPECIFICATION
SSMH	SANITARY SEWER MANHOLE
ST	STREET
STA	STATION
T	TOWNSHIP
TESC	TEMPORARY EROSION AND SEDIMENTATION CONTROL
TOC	TOP OF CURB
TOW	TOP OF WALL
TYP	TYPICAL
UPO	UNIFORMED POLICE OFFICER
UTIL	UTILITY
VC	VERTICAL CURVE
W	WEST
WM	WILLAMETTE MERIDIAN

LEGEND

- = EXISTING WATER METER
- = EXISTING WATER VALVE
- = EXISTING FIRE HYDRANT
- = EXISTING POST INDICATOR VALVE
- = EXISTING FIRE DEPARTMENT CONNECTION
- = EXISTING BLOW-OFF
- = EXISTING SPRINKLER
- = EXISTING SANITARY SEWER MANHOLE
- = EXISTING SANITARY SEWER CLEAN OUT
- = EXISTING SD CATCH BASIN (TYPE 1)
- = EXISTING SD CATCH BASIN (TYPE 2)
- = EXISTING SD CLEAN OUT
- = EXISTING POWER JUNCTION BOX
- = EXISTING POWER VAULT
- = EXISTING POWER TRANSFORMER
- = EXISTING COMMUNICATIONS MANHOLE
- = EXISTING COMMUNICATIONS RISER
- = EXISTING STREET LIGHT
- = EXISTING TRAFFIC SIGNAL POLE
- = EXISTING PEDESTAL OR CABINET
- = EXISTING SIGN
- = EXISTING GAS METER
- = EXISTING BOLLARD
- = EXISTING TREE

- = EXISTING WATER LINE
- = EXISTING SANITARY SEWER LINE
- = EXISTING STORM DRAIN LINE
- = EXISTING TELEPHONE LINE (PAINT MARK)
- = EXISTING TV CABLE LINE (PAINT MARK)
- = EXISTING POWER LINE (PAINTMARK)
- = EXISTING OVERHEAD POWER LINE (PAINTMARK)
- = EXISTING FIBER OPTIC LINE (PAINTMARK)
- = EXISTING GAS LINE
- = EXISTING CHANNELIZATION STRIPE
- = EXISTING VEGETATION
- = EXISTING PLANTER
- = EXISTING POND
- = EXISTING SIDEWALK
- = EXISTING CONCRETE
- = EXISTING CURB
- = EXISTING ASPHALT
- = EXISTING EDGE OF GRAVEL
- = EXISTING RIGHT-OF-WAY
- = EXISTING EASEMENT
- = EXISTING PROPERTY LINE
- = EXISTING RAILROAD CENTERLINE
- = EXISTING FENCE LINE
- = EXISTING BUILDING
- = EXISTING WETLAND

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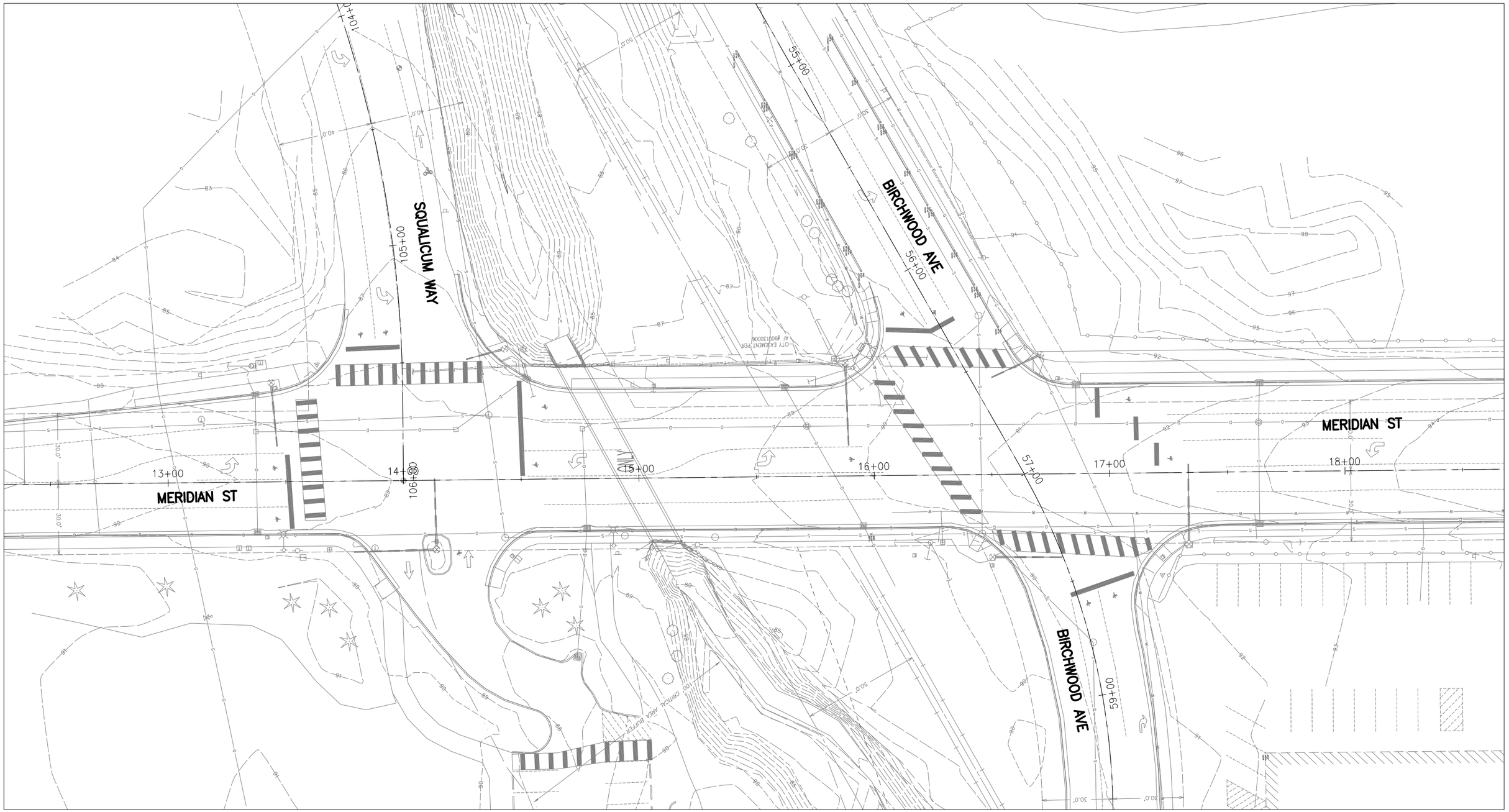
CITY PROJ NUMBER: _____

CHARLES R. SWIFT, STATE OF WASHINGTON, 39917, REGISTERED PROFESSIONAL ENGINEER — PRELIMINARY

CITY OF BELLINGHAM
MERIDIAN ST ROUNDABOUT
LEGEND AND ABBREVIATIONS

DATE: 12/31/2019 | JOB #

SHEET NO:
LN1
2 OF 8



GENERAL NOTES:

1. SEE SHEET LN1 FOR COMPLETE LEGEND.

SCALE IN FEET
20 0 20 40

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NO.	DATE	BY	APPR.	REVISION

Reid Middleton

DRN. WRM | DSGN. WRM | CHKD. CRS

CITY OF BELLINGHAM
DEPARTMENT OF
PUBLIC WORKS
CITY PROJ NUMBER: _____

CHARLES R. SMITH — STATE OF WASHINGTON — 39977 — REGISTERED PROFESSIONAL ENGINEER
PRELIMINARY

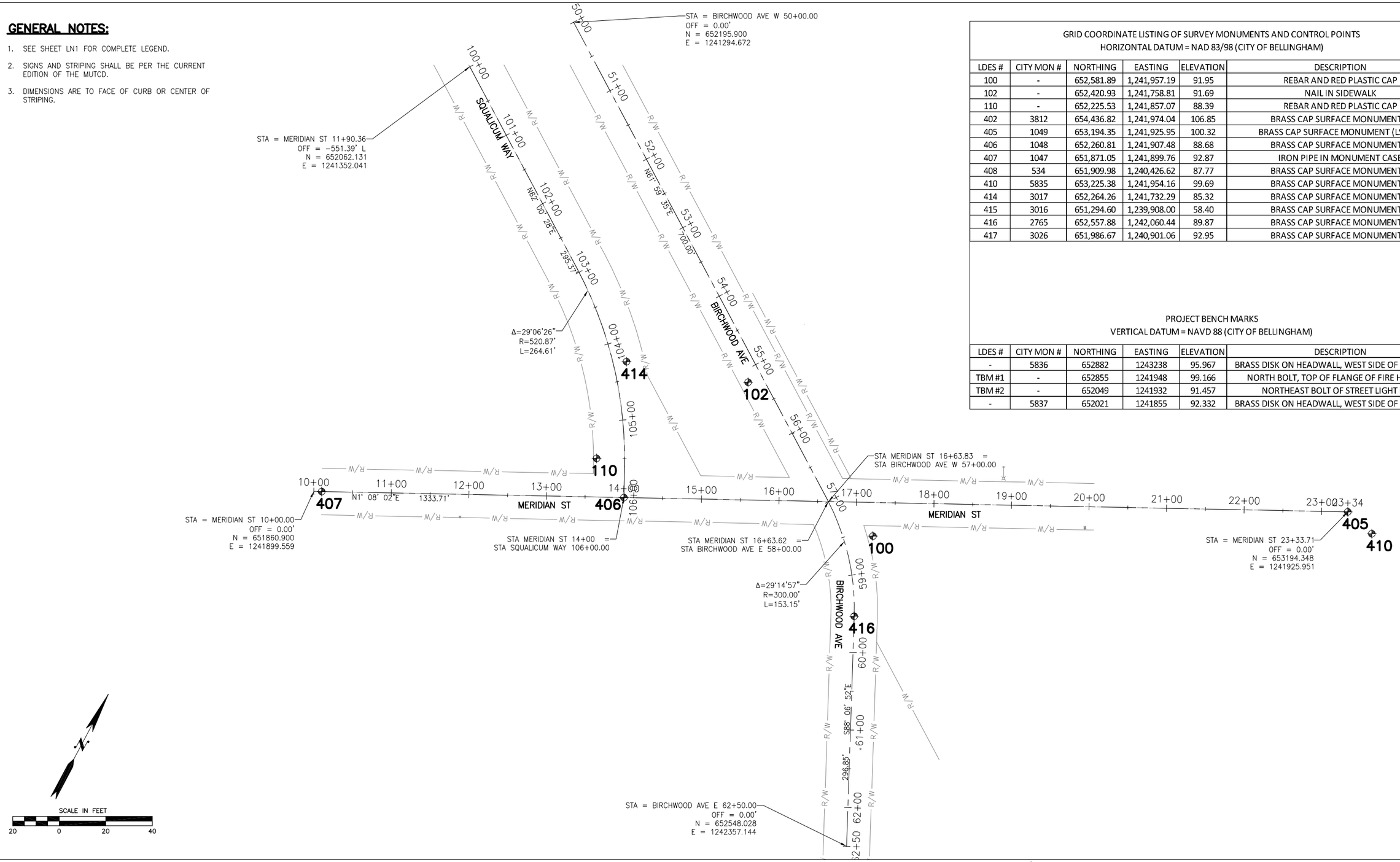
CITY OF BELLINGHAM
MERIDIAN ST ROUNDABOUT
EXISTING CONDITIONS PLAN

DATE: 12/31/2019 | JOB #

SHEET NO:
EC1
3 OF 8

GENERAL NOTES:

1. SEE SHEET LN1 FOR COMPLETE LEGEND.
2. SIGNS AND STRIPING SHALL BE PER THE CURRENT EDITION OF THE MUTCD.
3. DIMENSIONS ARE TO FACE OF CURB OR CENTER OF STRIPING.



GRID COORDINATE LISTING OF SURVEY MONUMENTS AND CONTROL POINTS
HORIZONTAL DATUM = NAD 83/98 (CITY OF BELLINGHAM)

LDES #	CITY MON #	NORTHING	EASTING	ELEVATION	DESCRIPTION
100	-	652,581.89	1,241,957.19	91.95	REBAR AND RED PLASTIC CAP
102	-	652,420.93	1,241,758.81	91.69	NAIL IN SIDEWALK
110	-	652,225.53	1,241,857.07	88.39	REBAR AND RED PLASTIC CAP
402	3812	654,436.82	1,241,974.04	106.85	BRASS CAP SURFACE MONUMENT
405	1049	653,194.35	1,241,925.95	100.32	BRASS CAP SURFACE MONUMENT (LS 424)
406	1048	652,260.81	1,241,907.48	88.68	BRASS CAP SURFACE MONUMENT
407	1047	651,871.05	1,241,899.76	92.87	IRON PIPE IN MONUMENT CASE
408	534	651,909.98	1,240,426.62	87.77	BRASS CAP SURFACE MONUMENT
410	5835	653,225.38	1,241,954.16	99.69	BRASS CAP SURFACE MONUMENT
414	3017	652,264.26	1,241,732.29	85.32	BRASS CAP SURFACE MONUMENT
415	3016	651,294.60	1,239,908.00	58.40	BRASS CAP SURFACE MONUMENT
416	2765	652,557.88	1,242,060.44	89.87	BRASS CAP SURFACE MONUMENT
417	3026	651,986.67	1,240,901.06	92.95	BRASS CAP SURFACE MONUMENT

PROJECT BENCH MARKS
VERTICAL DATUM = NAVD 88 (CITY OF BELLINGHAM)

LDES #	CITY MON #	NORTHING	EASTING	ELEVATION	DESCRIPTION
-	5836	652882	1243238	95.967	BRASS DISK ON HEADWALL, WEST SIDE OF CITY STREET
TBM #1	-	652855	1241948	99.166	NORTH BOLT, TOP OF FLANGE OF FIRE HYDRANT
TBM #2	-	652049	1241932	91.457	NORTHEAST BOLT OF STREET LIGHT BASE
-	5837	652021	1241855	92.332	BRASS DISK ON HEADWALL, WEST SIDE OF CITY STREET

811 Know what's below. Call before you dig.

NO.	DATE	BY	APPR.	REVISION

ReidMiddleton

DRN. WRM | DSGN. WRM | CHKD. CRS

CITY OF BELLINGHAM
DEPARTMENT OF PUBLIC WORKS
CITY PROJ NUMBER: _____

PRELIMINARY

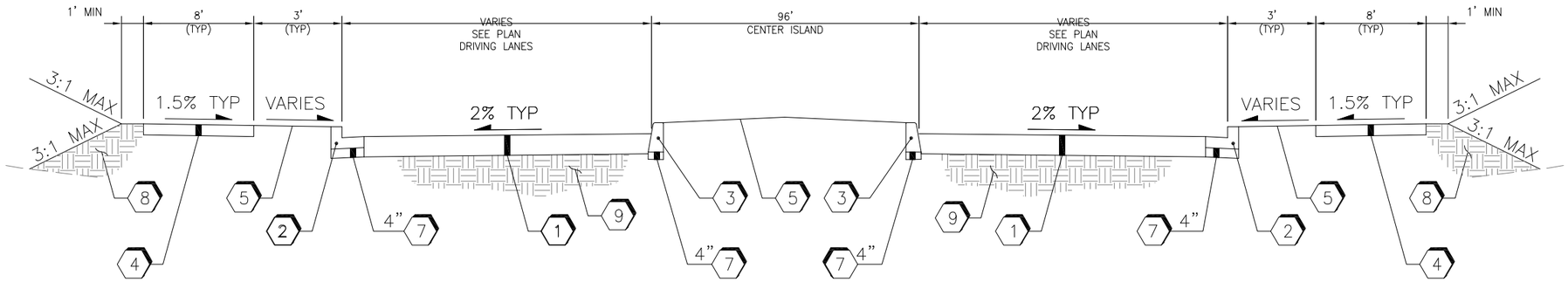
CITY OF BELLINGHAM
MERIDIAN ST ROUNDABOUT
ALIGNMENT AND
SURVEY CONTROL PLAN

DATE: 12/31/2019 | JOB #

SHEET NO: AP1

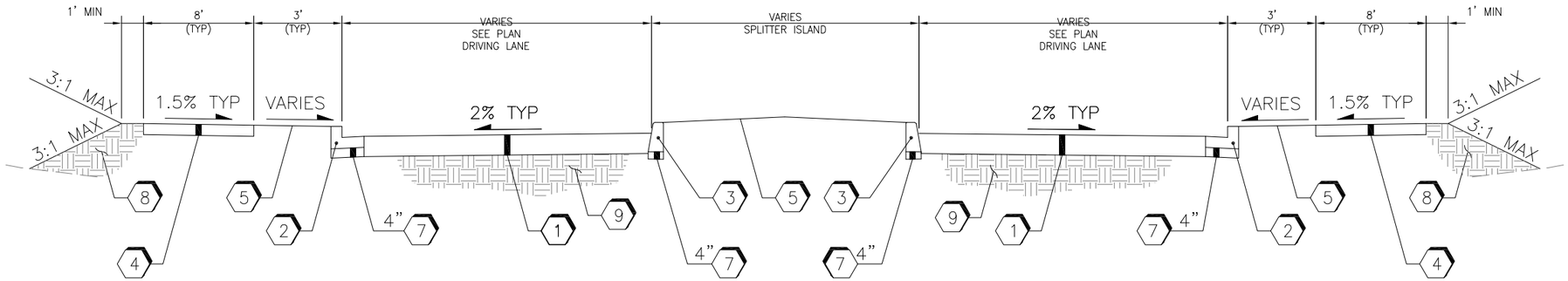
GENERAL NOTES

1. SIDEWALKS SHALL BE SLOPED TOWARDS ROADWAY. CROSS SLOPES SHALL NOT EXCEED 1.5% UNLESS OTHERWISE NOTED.
2. CATCH SLOPES SHALL NOT EXCEED 3H:1V.



CENTER ISLAND – TYPICAL

NOT TO SCALE

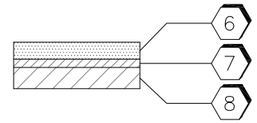


SPLITTER ISLAND – TYPICAL

NOT TO SCALE

CONSTRUCTION NOTES

1. FULL DEPTH PAVEMENT SECTION



2. CEMENT CONCRETE CURB AND GUTTER PER WSDOT STD DRAWING F-10.12-03
3. CEMENT CONCRETE TRAFFIC CURB PER WSDOT STD DRAWING F-10.12-03
4. CEMENT CONCRETE SIDEWALK PER COB STD DRAWING CG-230
5. LANDSCAPING
6. HMA CL. ½ IN, PG 64-22
7. CRUSHED SURFACING BASE COURSE
8. GRAVEL BORROW
9. COMPACTED SUBGRADE

Know what's below. Call before you dig.

NO.	DATE	BY	APPR.	REVISION

Reid Middleton

DRN. WRM | DSGN. WRM | CHKD. CRS

CITY OF BELLINGHAM
DEPARTMENT OF PUBLIC WORKS
CITY PROJ NUMBER: _____

CHARLES R. SMITH — STATE OF WASHINGTON — 35917 — REGISTERED PROFESSIONAL ENGINEER — PRELIMINARY

CITY OF BELLINGHAM
MERIDIAN ST ROUNDABOUT
LEGEND AND ABBREVIATIONS

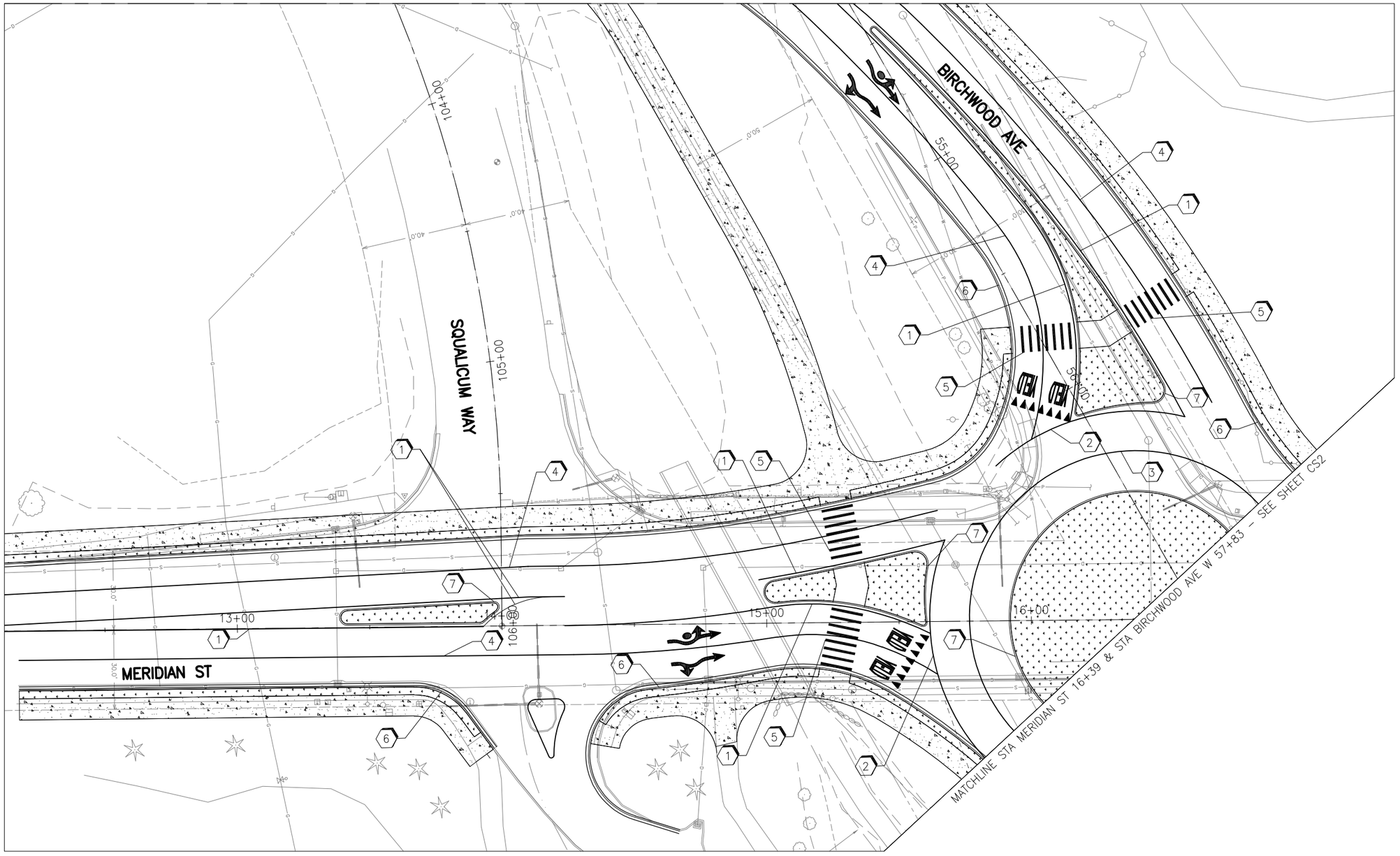
DATE: 12/31/2019 | JOB #

SHEET NO: RS1

5 OF 8

MATCHLINE STA SQUALICUM WAY 103+60 – SEE SHEET CS3

MATCHLINE STA BIRCHWOOD AVE W 55+32 – SEE SHEET CS3



GENERAL NOTES:

1. SEE SHEET LN1 FOR COMPLETE LEGEND.
2. SIGNS AND STRIPING SHALL BE PER THE CURRENT EDITION OF THE MUTCD.

CONSTRUCTION NOTES

1. MMA YELLOW LANE LINE PER WSDOT STD PLAN M–20.10–02
2. MMA WHITE DOTTED EXTENSION LINE PER WSDOT STD PLAN M–20.10–02
3. MMA WHITE EDGE LINE PER WSDOT STD PLAN M–20.10–02
4. MMA WHITE WIDE LANE LINE PER WSDOT STD PLAN M–20.10–02
5. MMA CONTINENTAL CROSSWALK PER COB STD DRAWING TC–310
6. MMA DESIGNATED BICYCLE LANE SYMBOL PER COB DWG TC–315
7. CEMENT CONCRETE CURB AND GUTTER PER WSDOT STD PLAN F–10.12–03
8. CEMENT CONCRETE TRAFFIC CURB PER WSDOT STD PLAN F–10.12–03

LEGEND:

LANDSCAPING

CEMENT CONCRETE SIDEWALK

SCALE IN FEET

20 0 20 40

Know what's below. Call before you dig.

NO.	DATE	BY	APPR.	REVISION

Reid Middleton

DRN. WRM | DSGN. WRM | CHKD. CRS

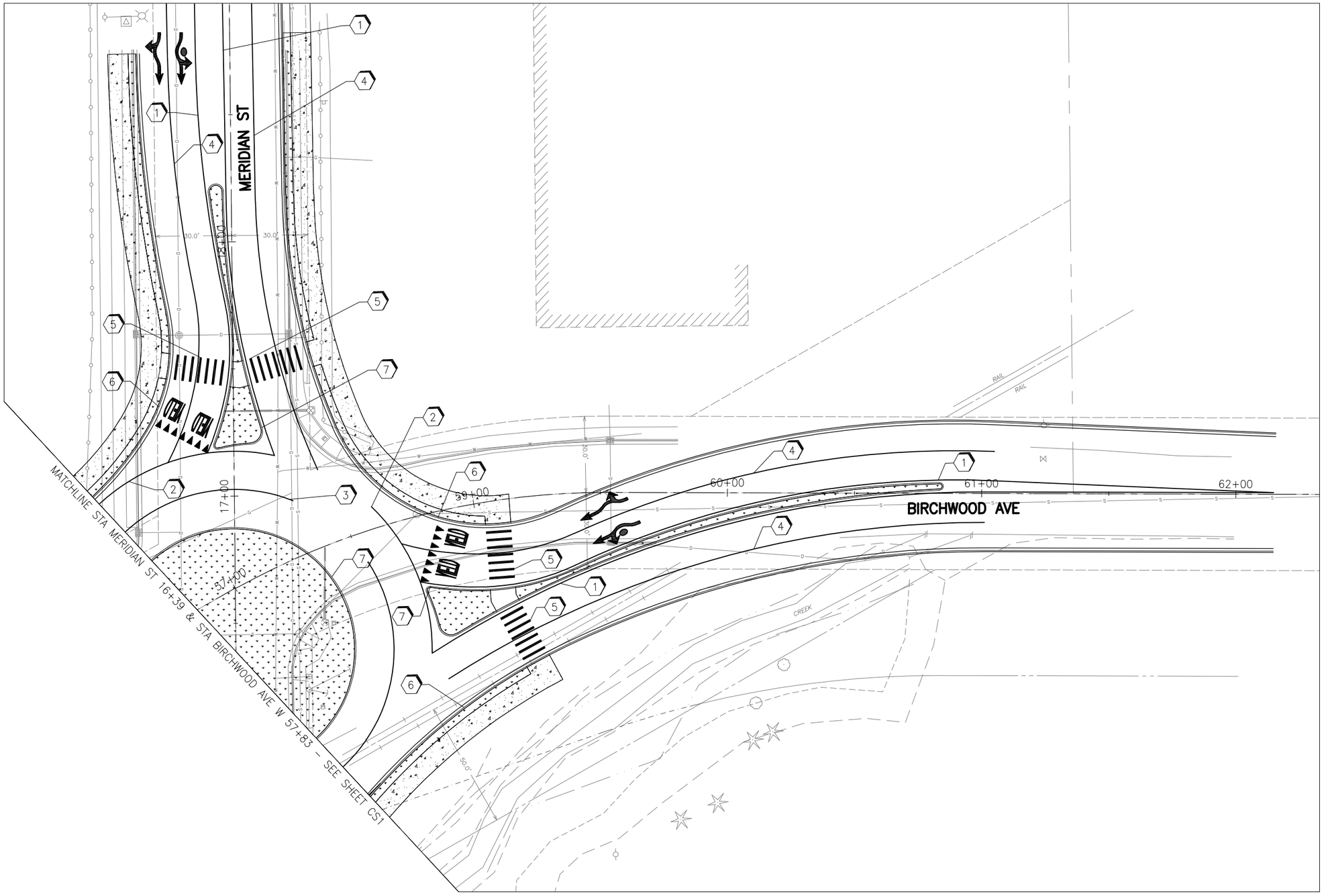
CITY OF BELLINGHAM
DEPARTMENT OF
PUBLIC WORKS
CITY PROJ NUMBER: _____

CHARLES R SCOTT — STATE OF WASHINGTON — 39917 — REGISTERED PROFESSIONAL ENGINEER — PRELIMINARY

CITY OF BELLINGHAM
MERIDIAN ST ROUNDABOUT
CHANNELIZATION PLAN

DATE: 12/31/2019 | JOB #

SHEET NO:
CS1
6 OF 8



GENERAL NOTES:

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2. SIGNS AND STRIPING SHALL BE PER THE CURRENT EDITION OF THE MUTCD.

CONSTRUCTION NOTES

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2. MMA WHITE DOTTED EXTENSION LINE PER WSDOT STD PLAN M-20.10-02
3. MMA WHITE EDGE LINE PER WSDOT STD PLAN M-20.10-02
4. MMA WHITE WIDE LANE LINE PER WSDOT STD PLAN M-20.10-02
5. MMA CONTINENTAL CROSSWALK PER COB STD DRAWING TC-310
6. MMA DESIGNATED BICYCLE LANE SYMBOL PER COB DWG TC-315
7. CEMENT CONCRETE CURB AND GUTTER PER WSDOT STD PLAN F-10.12-03
8. CEMENT CONCRETE TRAFFIC CURB PER WSDOT STD PLAN F-10.12-03

LEGEND:

LANDSCAPING

CEMENT CONCRETE SIDEWALK

N

SCALE IN FEET

20 0 20 40

Know what's below. Call before you dig.

NO.	DATE	BY	APPR.	REVISION

Reid Middleton

DRN. WRM | DSGN. WRM | CHKD. CRS

CITY OF BELLINGHAM
DEPARTMENT OF
PUBLIC WORKS
CITY PROJ NUMBER: _____

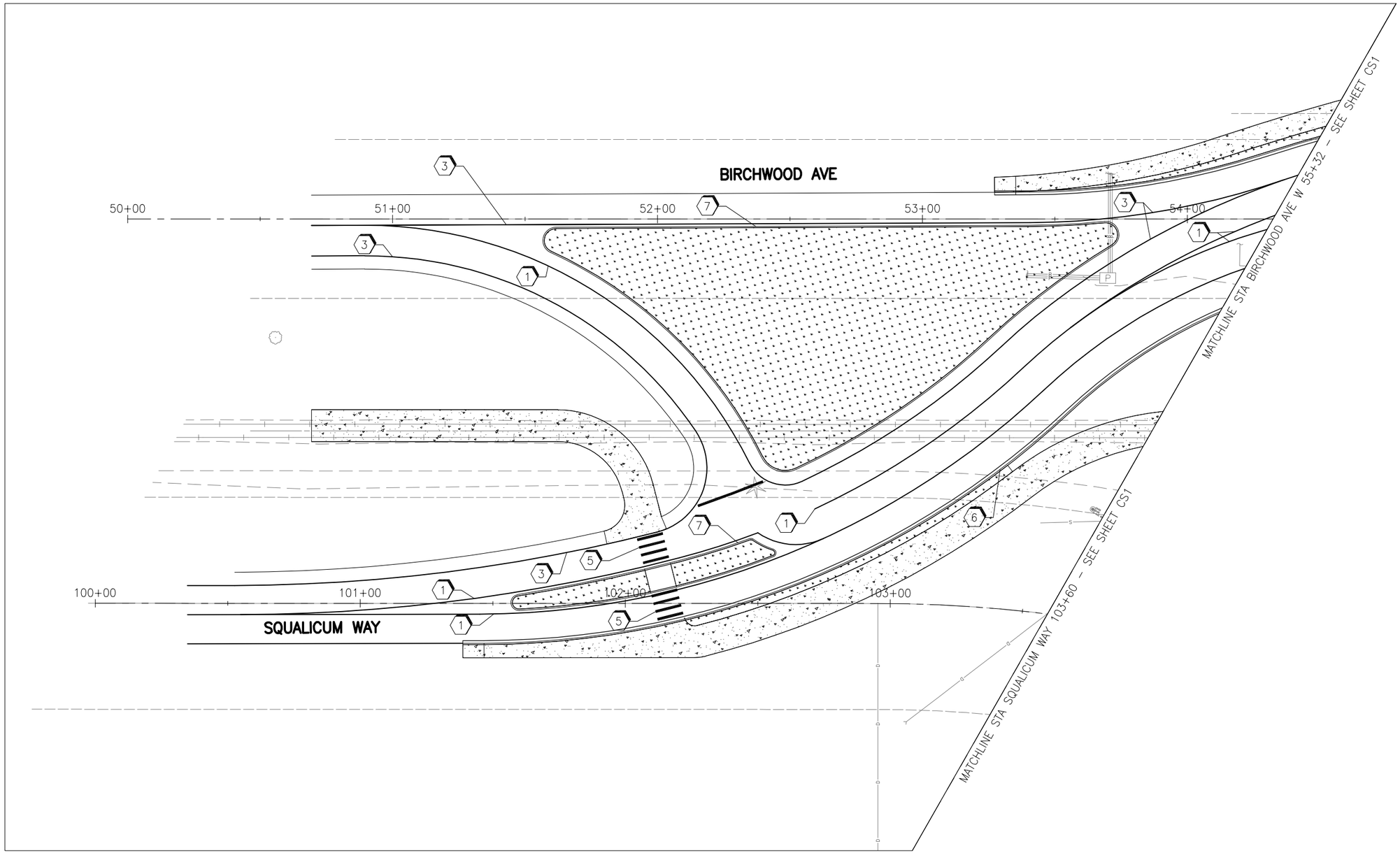
CHARLES R. SHERRY, STATE OF WASHINGTON, 35917, REGISTERED PROFESSIONAL ENGINEER

PRELIMINARY

CITY OF BELLINGHAM
MERIDIAN ST ROUNDABOUT
CHANNELIZATION PLAN

DATE: 12/31/2019 | JOB #

SHEET NO:
CS2
7 OF 8



GENERAL NOTES:

1. SEE SHEET LN1 FOR COMPLETE LEGEND.
2. SIGNS AND STRIPING SHALL BE PER THE CURRENT EDITION OF THE MUTCD.

CONSTRUCTION NOTES

1. MMA YELLOW LANE LINE PER WSDOT STD PLAN M-20.10-02
2. MMA WHITE DOTTED EXTENSION LINE PER WSDOT STD PLAN M-20.10-02
3. MMA WHITE EDGE LINE PER WSDOT STD PLAN M-20.10-02
4. MMA WHITE WIDE LANE LINE PER WSDOT STD PLAN M-20.10-02
5. MMA CONTINENTAL CROSSWALK PER COB STD DRAWING TC-310
6. MMA DESIGNATED BICYCLE LANE SYMBOL PER COB DWG TC-315
7. CEMENT CONCRETE CURB AND GUTTER PER WSDOT STD PLAN F-10.12-03
8. CEMENT CONCRETE TRAFFIC CURB PER WSDOT STD PLAN F-10.12-03

LEGEND:

LANDSCAPING

CEMENT CONCRETE SIDEWALK

N

SCALE IN FEET
20 0 20 40

Know what's below. Call before you dig.

NO.	DATE	BY	APPR.	REVISION

Reid Middleton

DRN. WRM | DSGN. WRM | CHKD. CRS

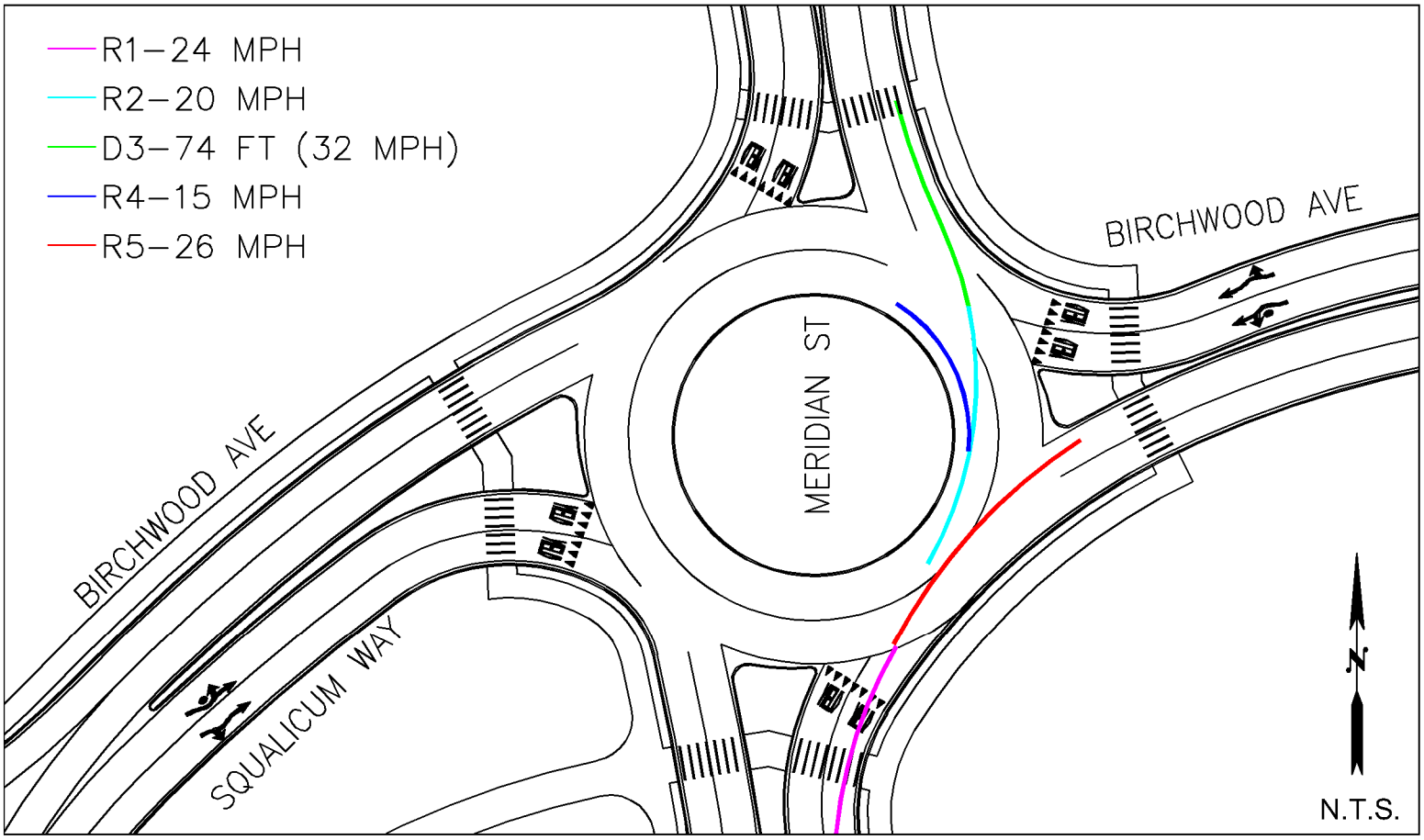
CITY OF BELLINGHAM
DEPARTMENT OF
PUBLIC WORKS
CITY PROJ NUMBER: _____

CHARLES R. SMITH — STATE OF WASHINGTON — 39917 — REGISTERED PROFESSIONAL ENGINEER
PRELIMINARY

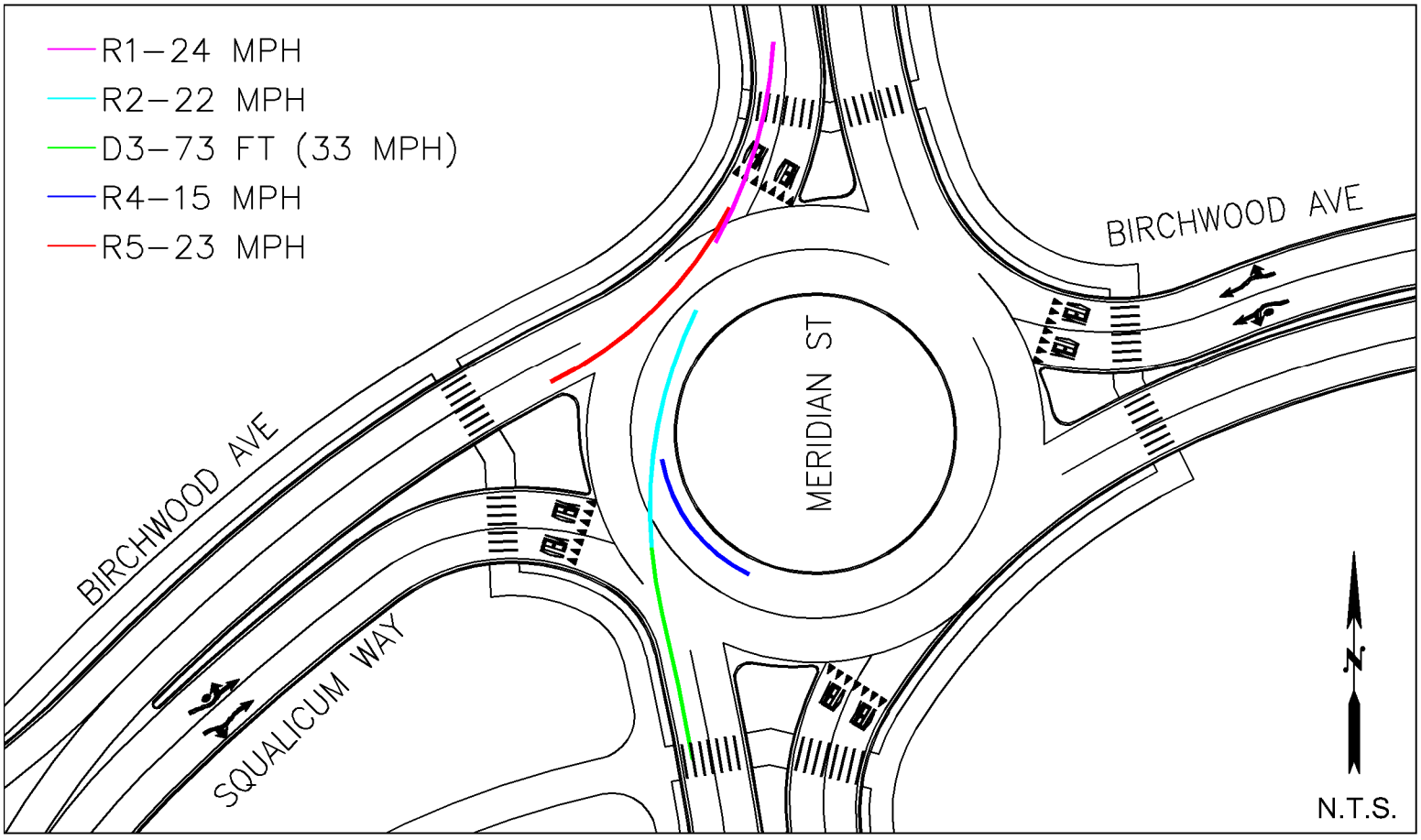
CITY OF BELLINGHAM
MERIDIAN ST ROUNDABOUT
CHANNELIZATION PLAN

DATE: 12/31/2019 | JOB #

SHEET NO:
CS3
8 OF 8



Northbound



Southbound

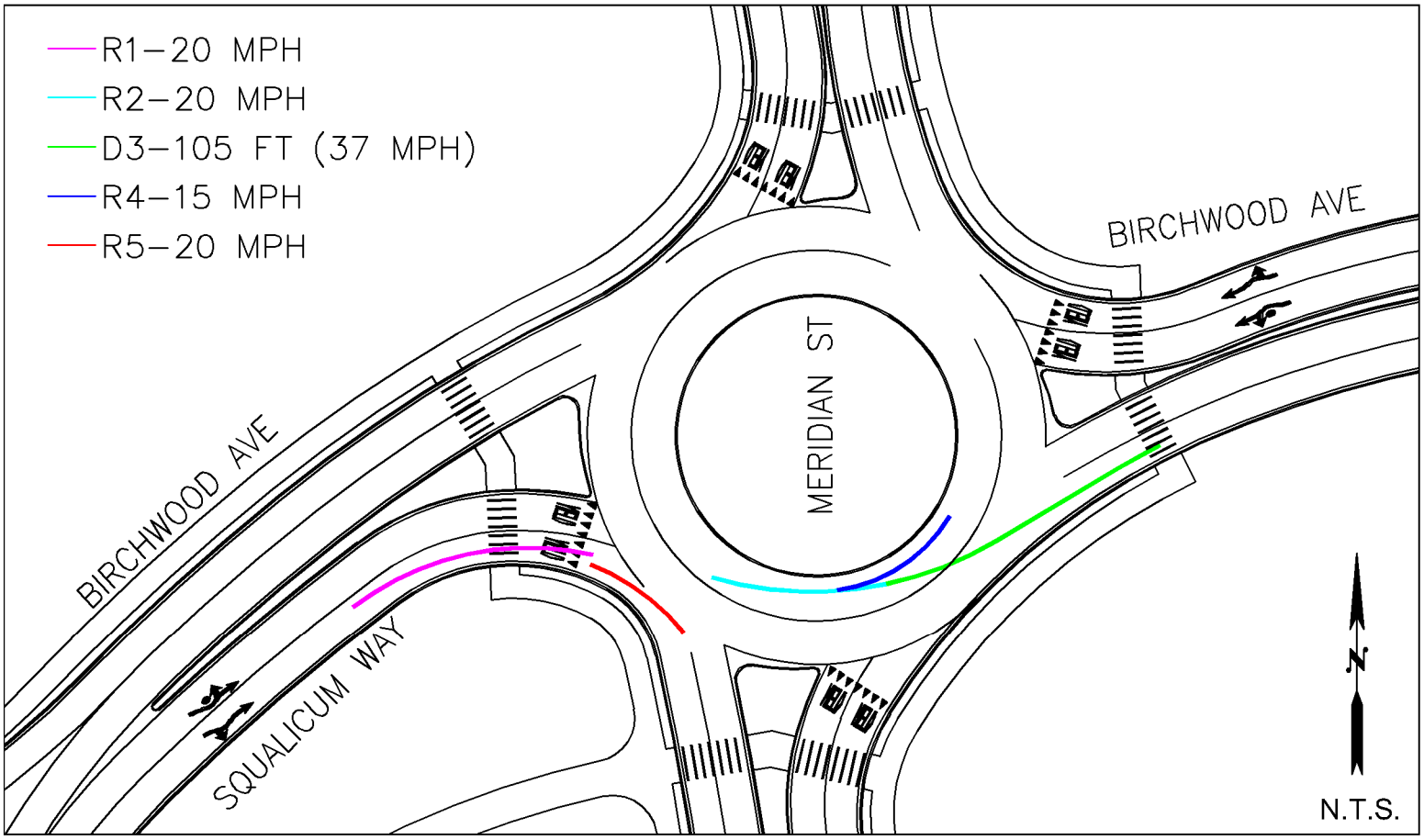
Reid Middleton
728 134th Street SW Suite 200
Everett, Washington 98204
Ph: 425 741-3800

Meridian St & Birchwood Ave Roundabout - SPEED CURVES

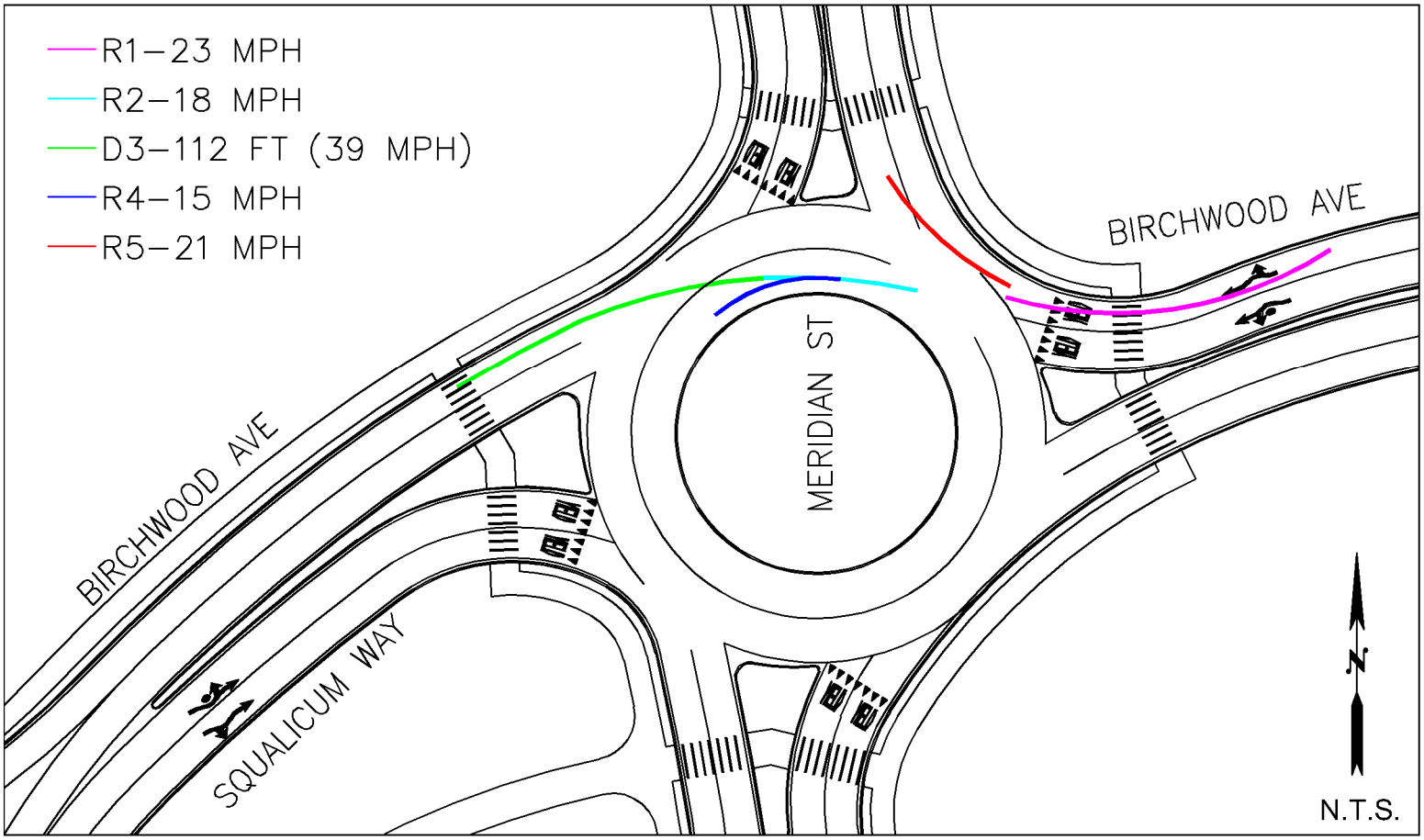
Bellingham, WA

FIGURE S1

December 2019



Eastbound



Westbound

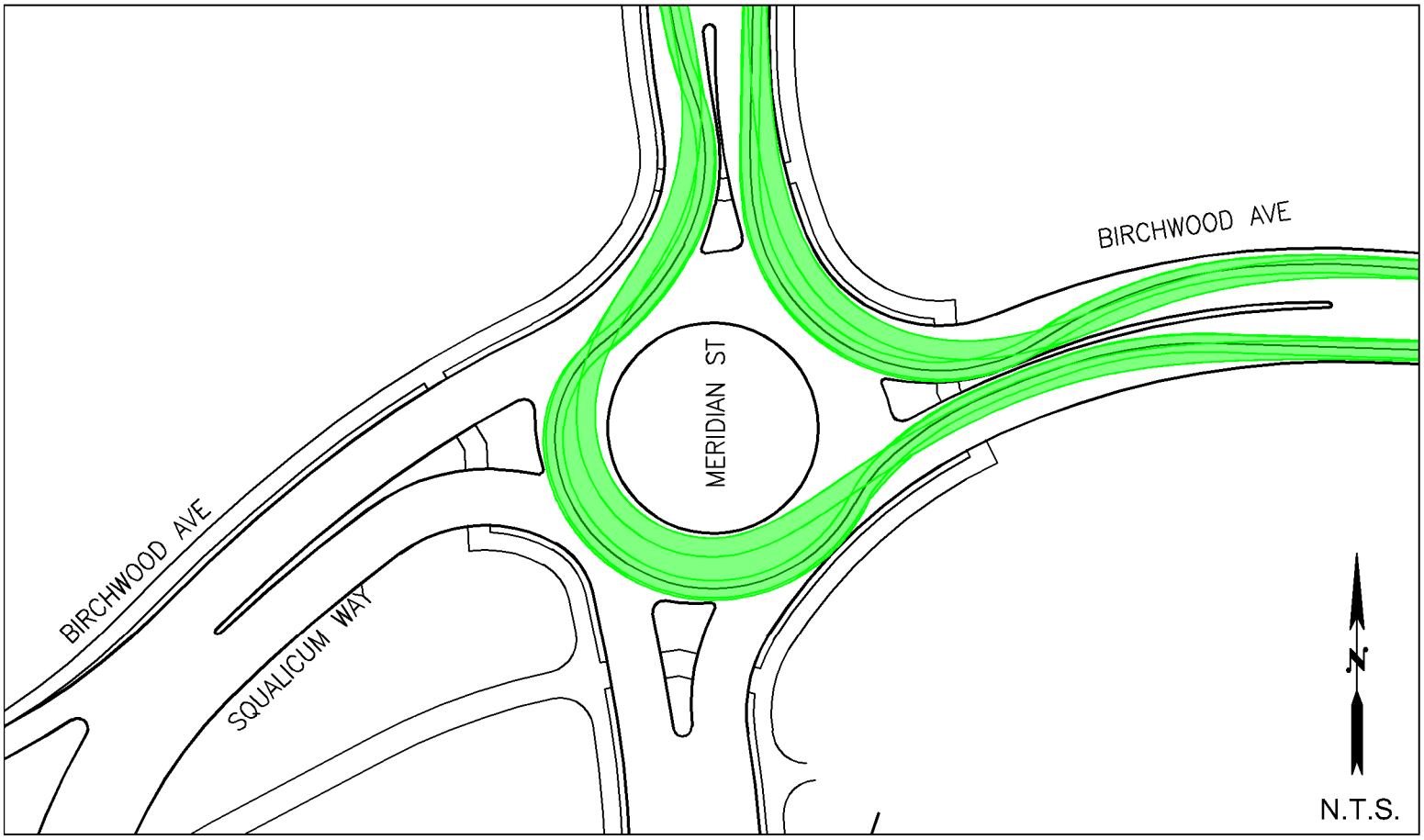
Reid Middleton
728 134th Street SW Suite 200
Everett, Washington 98204
Ph: 425 741-3800

Meridian St & Birchwood Ave Roundabout - SPEED CURVES

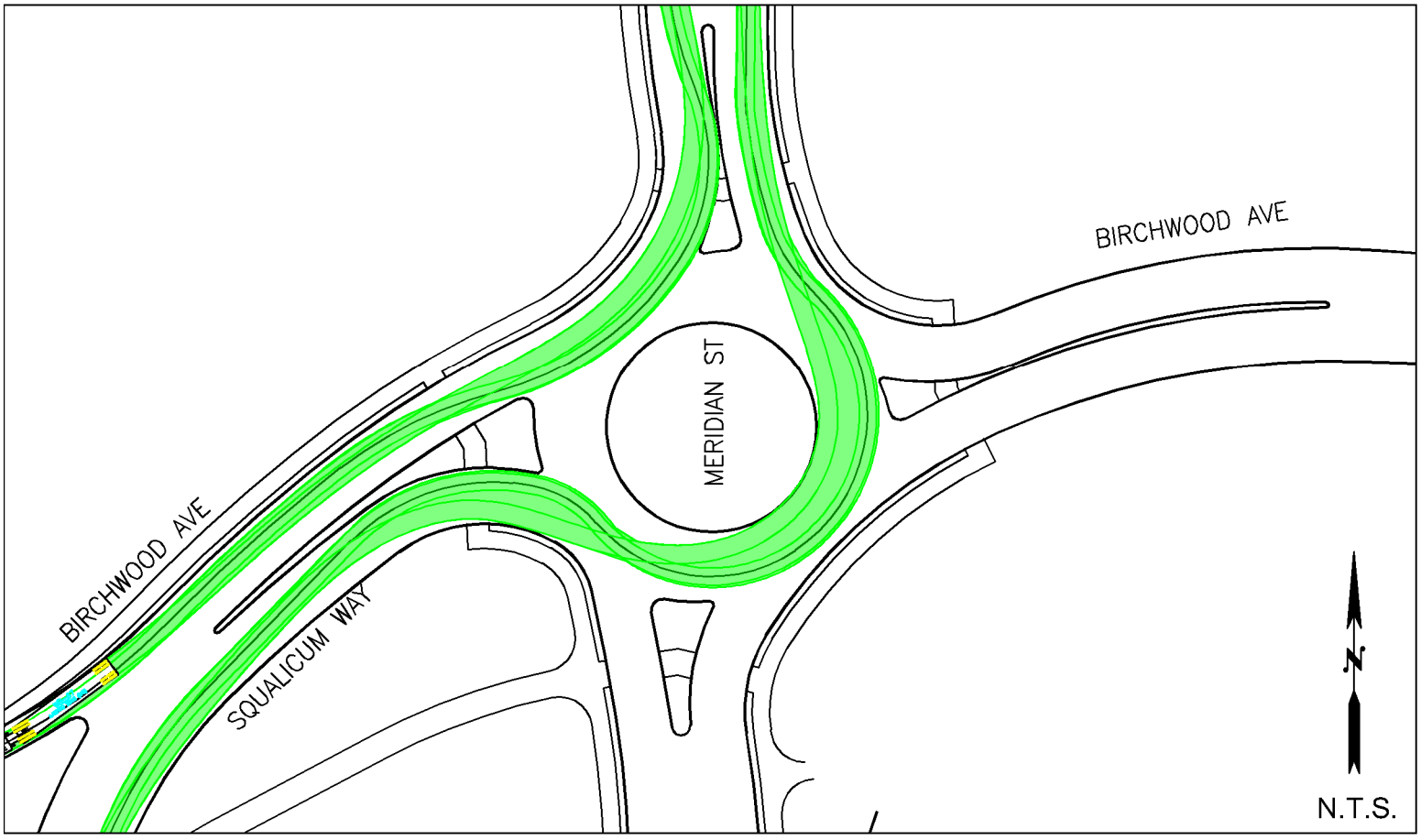
FIGURE S2

Bellingham, WA

December 2019



WB-67 Turning Movements



WB-67 Turning Movements

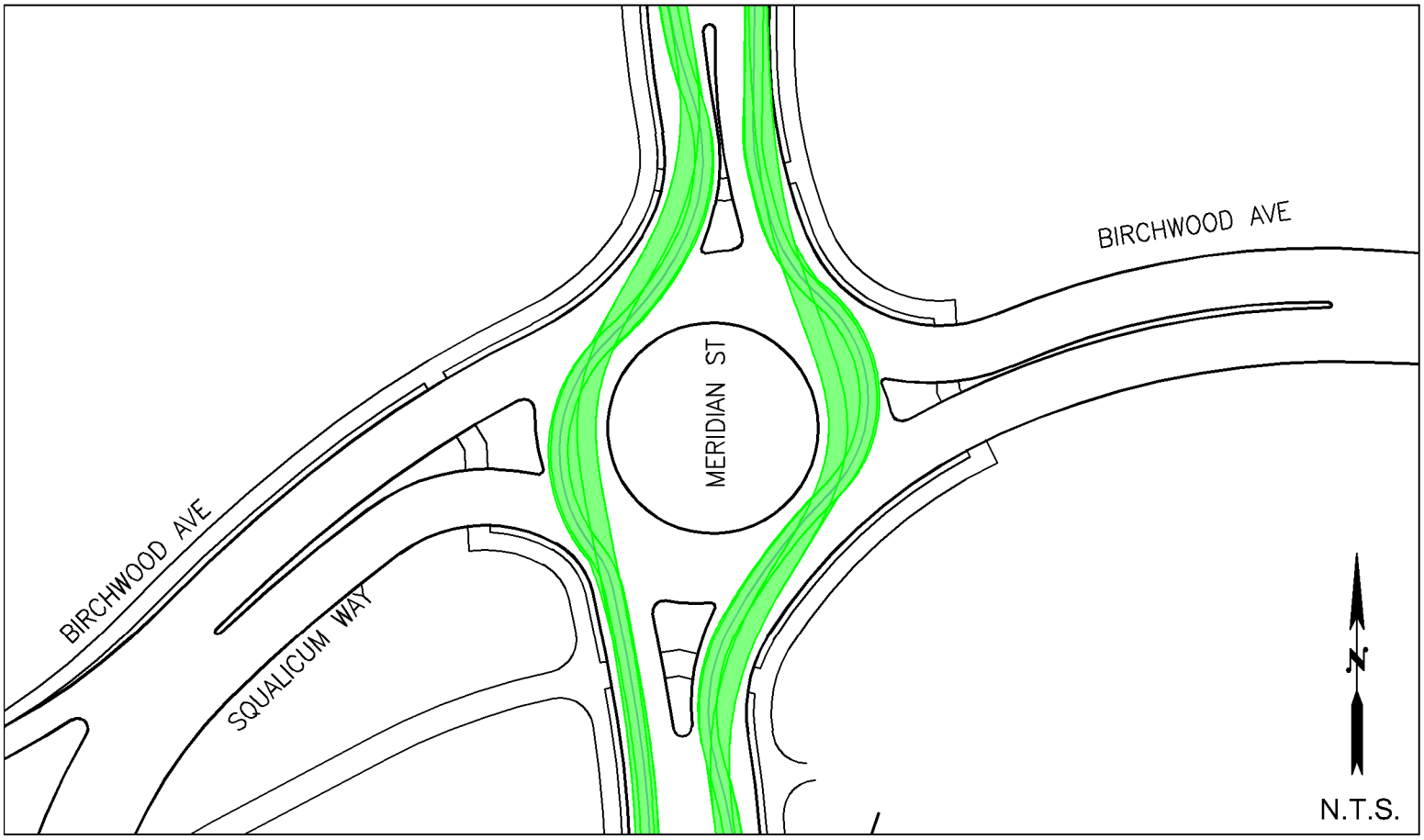
Reid Middleton
728 134th Street SW Suite 200
Everett, Washington 98204
Ph: 425 741-3800

Meridian St & Birchwood Ave Roundabout - TRUCK TURNING

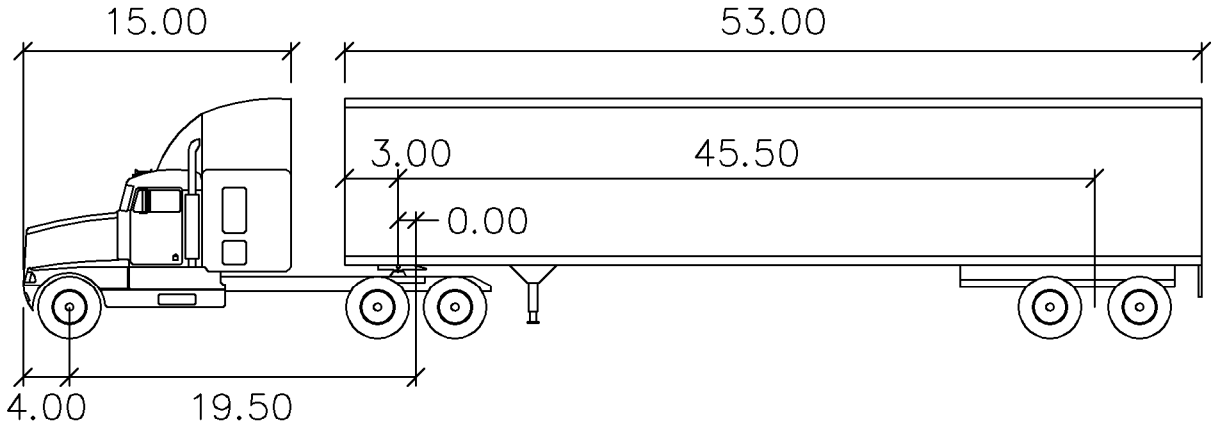
FIGURE T1

Bellingham, WA

December 2019



WB-67 Thru Movements



WB-67	feet		
Tractor Width	: 8.00	Lock to Lock Time	: 6.0
Trailer Width	: 8.50	Steering Angle	: 28.4
Tractor Track	: 8.00	Articulating Angle	: 75.0
Trailer Track	: 8.50		

WB-67 Vehicle Profile

Reid Middleton
728 134th Street SW Suite 200
Everett, Washington 98204
Ph: 425 741-3800

Meridian St & Birchwood Ave Roundabout - TRUCK TURNING

FIGURE T2

Bellingham, WA

December 2019

ReidMiddleton

728 134th Street SW, Suite 200
Everett, WA 98204-5322
(425) 741-3800
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File No. 252019.003