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EXHIBIT **1.2**

SITE AREA AERIAL PHOTO

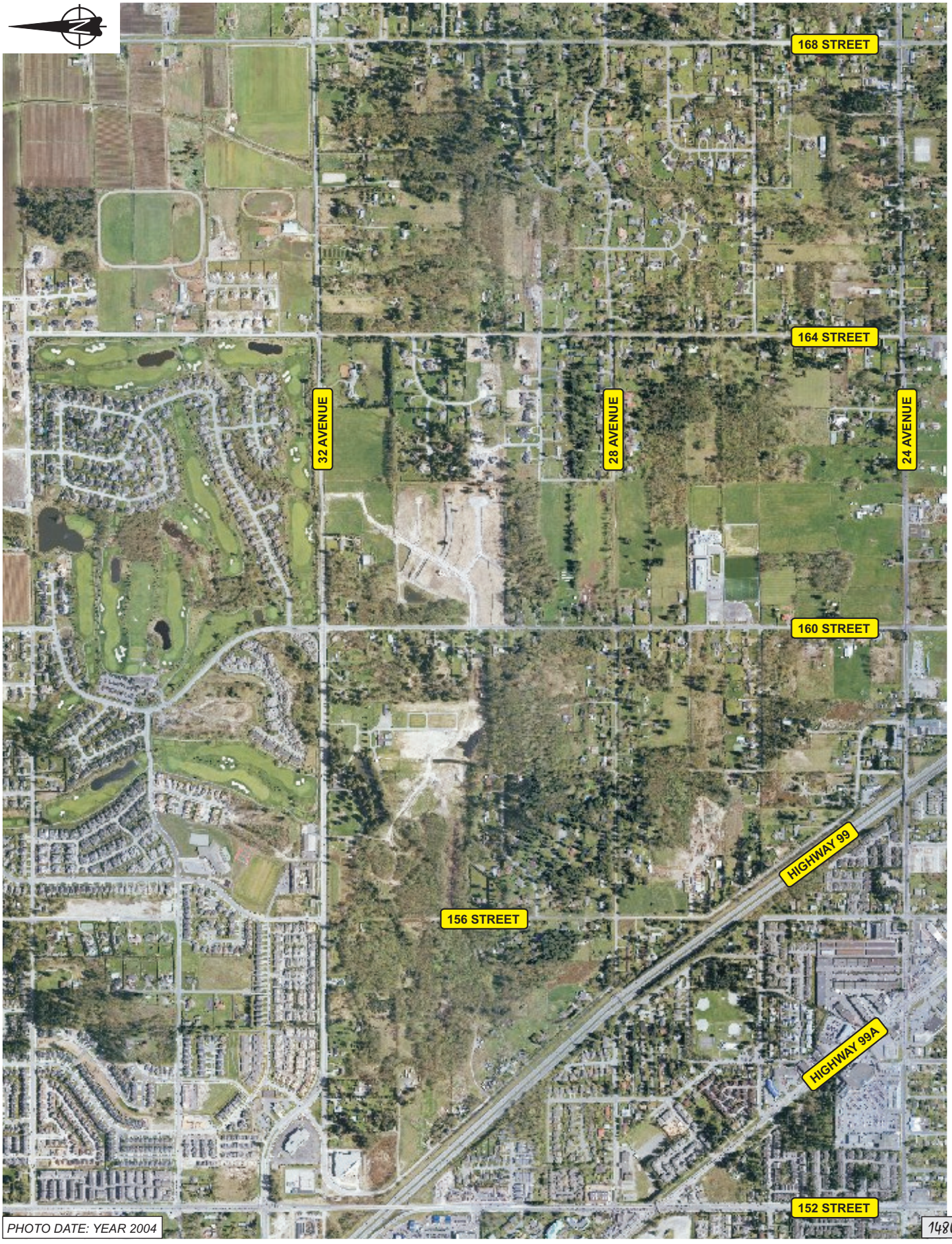

PHOTO DATE: YEAR 2004

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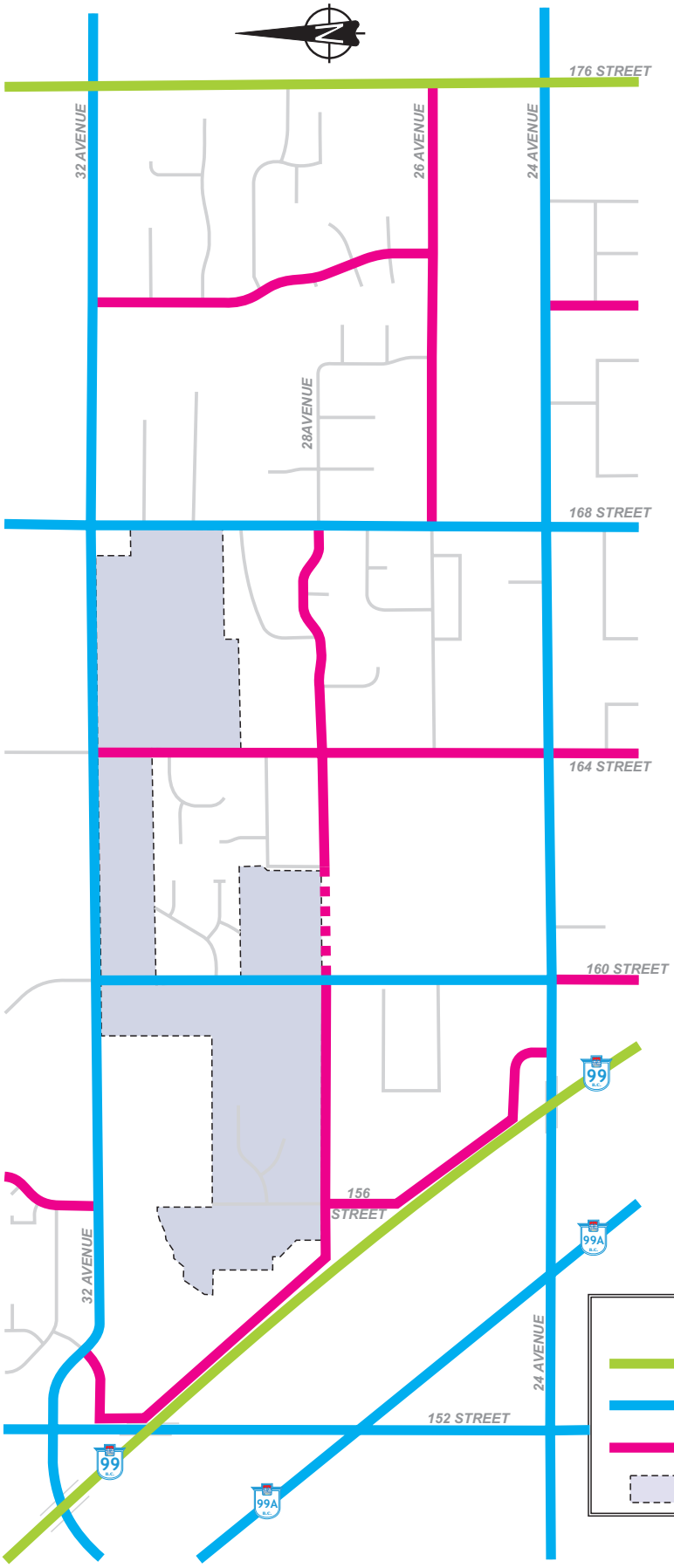
EXHIBIT **2.1**

EXISTING ROAD CLASSIFICATION



small segment of four lanes through the Cloverdale area. Like Highway 99, it has a rural cross-section for almost its full length.

(c) King George Highway: This arterial road runs in a diagonal northwest to southeast orientation from 8 Avenue/Highway 99 in the south to Highway 10 and then directly north to the Patulla Bridge across the Fraser River in the north. It is a mixture of two, four, and six lane cross-section but mostly two lanes in the South Surrey area.

(d) 152 Street: This is also an arterial road, running in a north-south direction from White Rock a short distance south of 16 Avenue through to the Trans Canada Highway at the Port Mann Bridge. In the urbanized area of South Surrey, i.e., north as far as 28 Avenue, it is four lanes but north of here through to almost Highway 10 it is just two lanes. Southbound traffic on Highway 99 can exit to 152 Street, also southbound.

Table 2.1
Study Area Roads By Classification

Road Classification	Road Section
Provincial Hwy	Highway #99
	Hwy #15 (176 St)
Arterial Roads	King George Hwy
	152 Street
	160 Street – 24 Ave to 32 Ave (pending)
	168 Street
	32 Avenue
	24 Avenue
Collector Roads	Croydon Drive – 20 Ave to 32 Ave
	160 Street – 21 Ave to 24 Ave
	164 Street – 16 Ave to 32 Ave
	172 Street – 16 Ave to 32 Ave
	28 Avenue – 168 St to 176 St

Note: Sources – Surrey Drawing R91 (Oct 98) – Arterial, Major Collector & Grid Roads Plan
– Grandview Heights/Highway #99 Corridor – Preferred Land Use Option #1

(e) 168 Street: This is another north-south arterial road connecting 8 Avenue in the south through to Highway 10 in the north. It is a two lane road throughout and has a steep downgrade of 15% in the north direction just north of 28 Avenue.

(f) 32 Avenue: This is an arterial road that runs in an east-west direction connecting South Surrey in the vicinity of King George Highway through to 200 Street in the Township of Langley. It is two lanes for most of its length with the only segment widened to four lanes being from 154 Street west. It has ramps to and from the north at Highway 99. It is a designated truck route.

(g) 24 Avenue: This is another east-west arterial that runs from 128 Street on the west side of South Surrey through to approximately 192 Street in the new Campbell Heights Industrial Park area of Surrey. It has two lanes for most of its length except between King George Highway and 152 Street, and has no direct connections to Highway 99.

(h) 164 Street, 172 Street, 28 Avenue, and Croydon Drive: These are all major collector roads serving the North Grandview Heights area.

(i) 160 Street: Until recently, this has been designated as a major collector road. The City has indicated that 160 Street is in the process of being upgraded to an arterial classification, between 32 Avenue and 24 Avenue.

All of the above roads, with the exception of 152 Street south of 28 Avenue, are of a rural nature with gravel shoulders beyond the paved travel portion of the road and ditches typically on both sides. A summary of the various roads in each classification is provided in Table 2.1.

2.2 Intersection Channelization

The channelization at each of the key intersections within the study area is given in Table 2.2 and illustrated in Exhibit 2.2. This indicates that of the seven intersections considered, the only ones with two through lanes in the east-west direction are on 32 Avenue at 152 Street, whilst the only ones in the north-south direction are on 152 Street at 32 Avenue and on 176 Street/Highway 15 at both 24 Avenue and 32 Avenue. All of these intersections just mentioned have separate left turn lanes – with the northbound left turn movement on 152 Street having double lanes onto 32 Avenue to accommodate traffic destined to Highway 99 north. There are also left turn lanes on all four legs of both the 160 Street and 176 Street intersections on 32 Avenue, and on the west leg of 24 Avenue at 160 Street.

Table 2.2
Existing Intersection Laning Configuration

		Eastbound			Westbound			Northbound			Southbound			Sig-	Prior
E-W Street	N-S Street	L	T	R	L	T	R	L	T	R	L	T	R	nal?	-ity
32 Ave	152 St	1	2	<	1	2	<	2	2	1	1	2	<	Y	--
32 Ave	160 St	1	1	<	1	1	<	1	1	<	1	1	<	Y	--
32 Ave	168 St	>	1	<	>	1	<	>	1	<	>	1	<	N	4-way
32 Ave	176 St	1	1	<	1	1	<	1	2	<	1	2	<	Y	--
24 Ave	160 St	1	1	<	>	1	<	>	1	<	>	1	<	N	E/W
24 Ave	168 St	>	1	<	>	1	<	>	1	<	>	1	<	N	4-way
24 Ave	176 St	>	1	<	>	1	<	1	2	<	1	2	<	Y	--

Note: > or < - means no dedicated left or right turn lane but shared with the adjacent through lane
n/a - means movement not appropriate

2.3 Traffic Controls

Within the immediate neighbourhood area, the only signalized intersections are on 32 Avenue at 160 Street, Croydon Drive, and 152 Street. In the broader area there are also signals on King George Highway at both 152 Street and 24 Avenue as well as on 176 Street/Highway 15 at 24 Avenue and 32 Avenue. All other intersections are stop-controlled. Traffic on arterials typically has the through priority over all other intersecting roads, and traffic on collector roads have the through priority over local intersecting roads. The only exceptions are the four-way stops at the intersections of 168 Street with both 32 Avenue and 24 Avenue. The intersection traffic controls of the intersections in this study are presented in Exhibit 2.3.

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EXHIBIT **2.2**

EXISTING TRAFFIC CONDITIONS

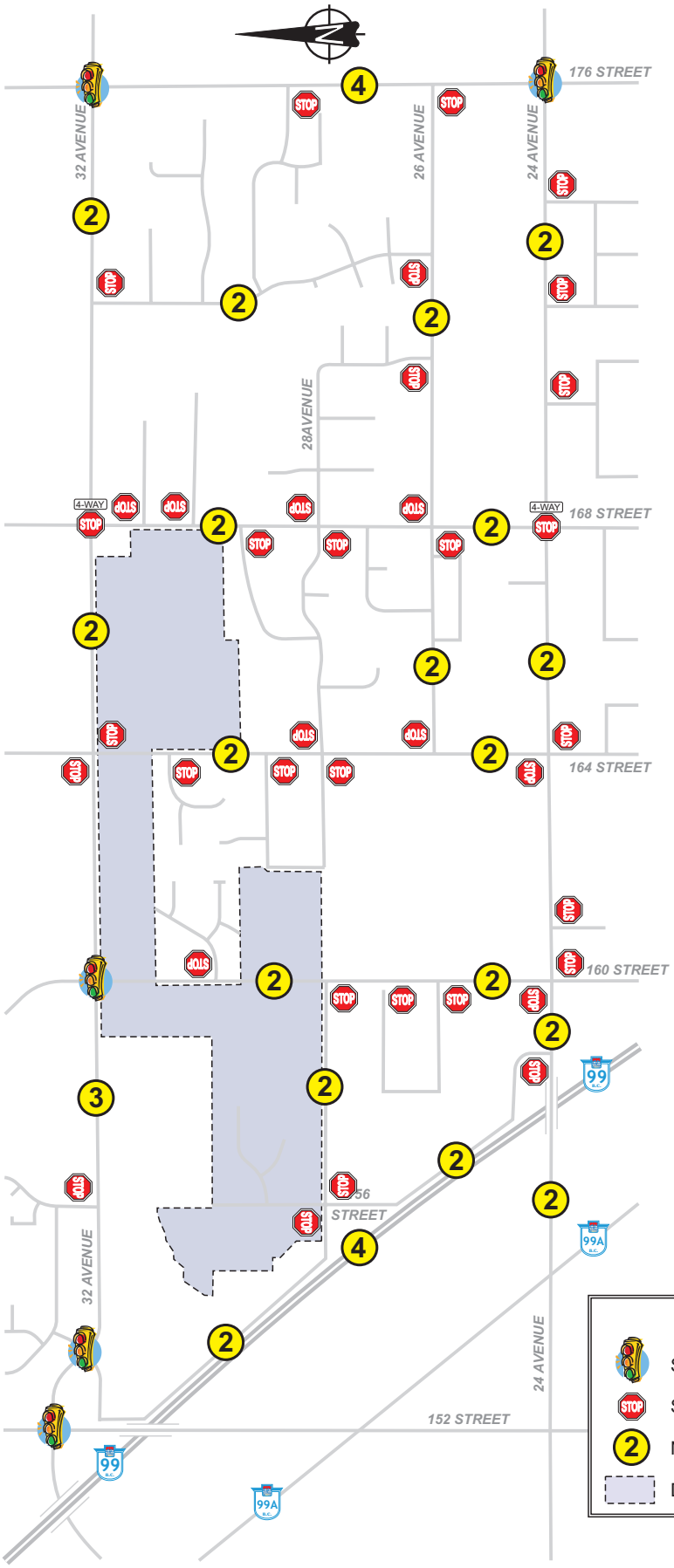

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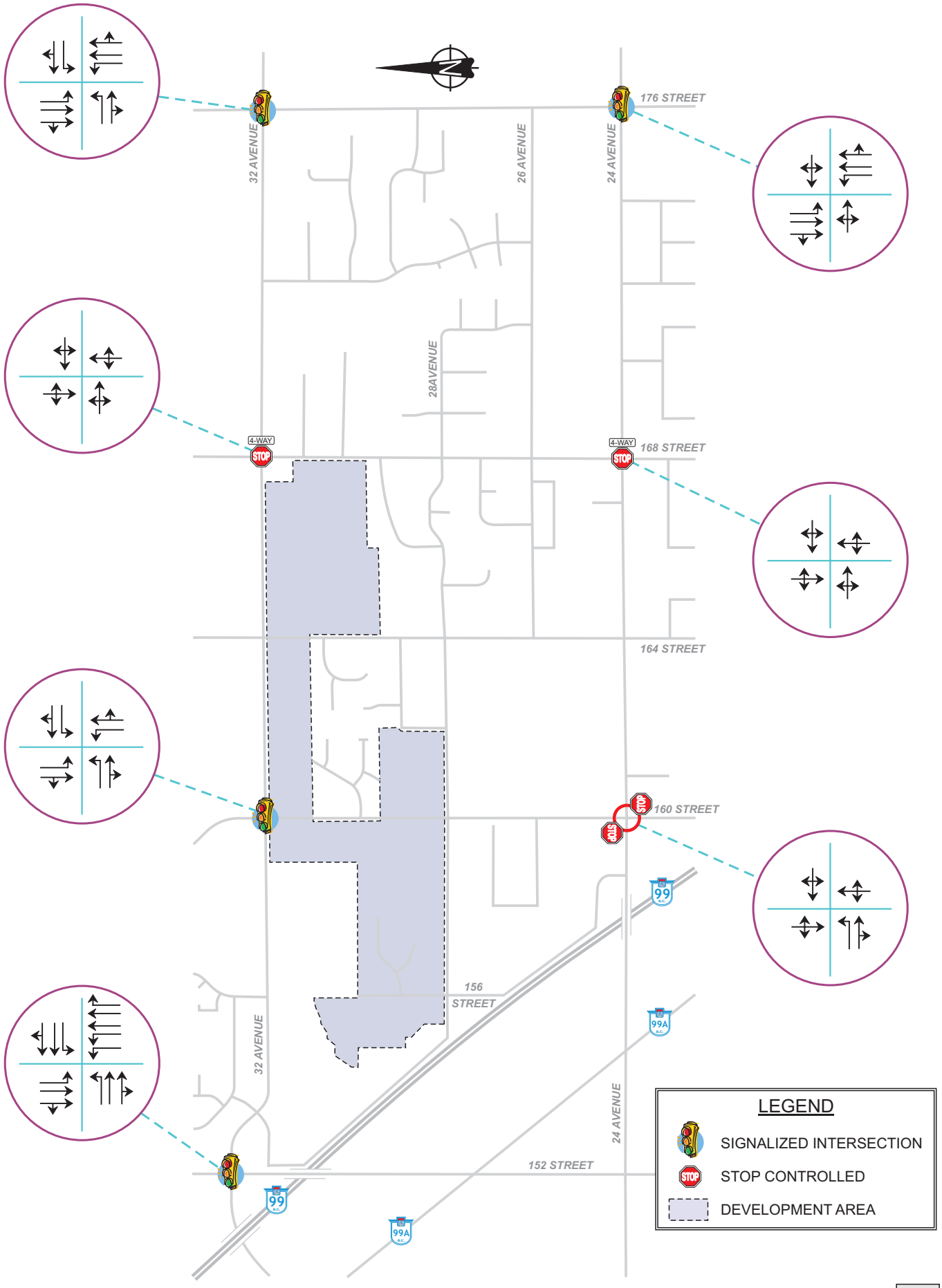
EXHIBIT **2.3**

INTERSECTION CONFIGURATION



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The speed limit on all roads is 50 km/h with the exceptions of 32 Avenue and 168 Street which are 60 km/h, and 176 Street which is 80 km/h.

2.4 Traffic Volumes

Traffic volumes at the study area intersections and on the various road links were obtained from a variety of sources: some directly from the City of Surrey, some from data collected for previous studies in the immediate area, and others through new counts undertaken by Ward Consulting Group as part of this study. Traffic volumes were all factored to 2004 conditions and the resultant intersection turning movements in both the a.m. and p.m. peak hours are illustrated in Exhibit 2.4.

Table 1.3
Current Link Volumes – 2004

		AM		PM	
		EB/NB	WB/SB	EB/NB	NB/SB
32 Ave	e/o 154 St	470	1130	1030	670
	e/o 160 St	390	780	940	580
	e/o 164 St	410	790	700	490
	e/o 168 St	330	670	640	360
	w/o 176 St	370	610	620	460
28 Ave	w/o 156 St	30	30	60	40
	w/o 160 St	10	10	10	20
	e/o 164 St	10	20	30	10
	w/o 168 St	10	10	30	10
	e/o 168 St	10	30	20	10
24 Ave	e/o 156 St	470	610	740	610
	e/o 160 St	400	470	550	450
	e/o 164 St	270	450	540	430
	e/o 168 St	320	370	490	340
	w/o 176 St	320	280	400	290
156 St	n/o 24 Ave	90	110	110	130
160 St	s/o 32 Ave	320	250	210	180
	n/o 24 Ave	290	180	150	210
164 St	s/o 32 Ave	40	30	30	90
	n/o 24 Ave	30	60	60	70
168 St	s/o 32 Ave	160	100	140	180
	n/o 24 Ave	170	200	210	170
176 St	s/o 32 Ave	400	360	420	520
	n/o 24 Ave	430	420	450	400

A summary of the volumes on a select number of links in the study area are provided in Table 2.3 and also shown in Exhibit 2.5. This shows that existing p.m. peak hour volumes on 32 Avenue are a maximum of 770 westbound and 1,100 eastbound just east of 152 Street, and gradually reduce to 400 westbound and 620 eastbound east of 168 Street. Volumes on 24 Avenue to the south are significantly less that this at 600 westbound and 680 eastbound west of 160 Street dropping to 340 westbound and 490 eastbound east of 168 Street. Volumes on the north-south roads, other than 152 Street and 176 Street, are nearly all less than 200 vehicles in the peak direction. A single lane on an arterial road can carry approximately 800 vehicles in an hour and this reduces to 600 on a collector road and 400 on a local road.

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EXHIBIT **2.4**

2004 EXISTING INTERSECTION TRAFFIC VOLUMES

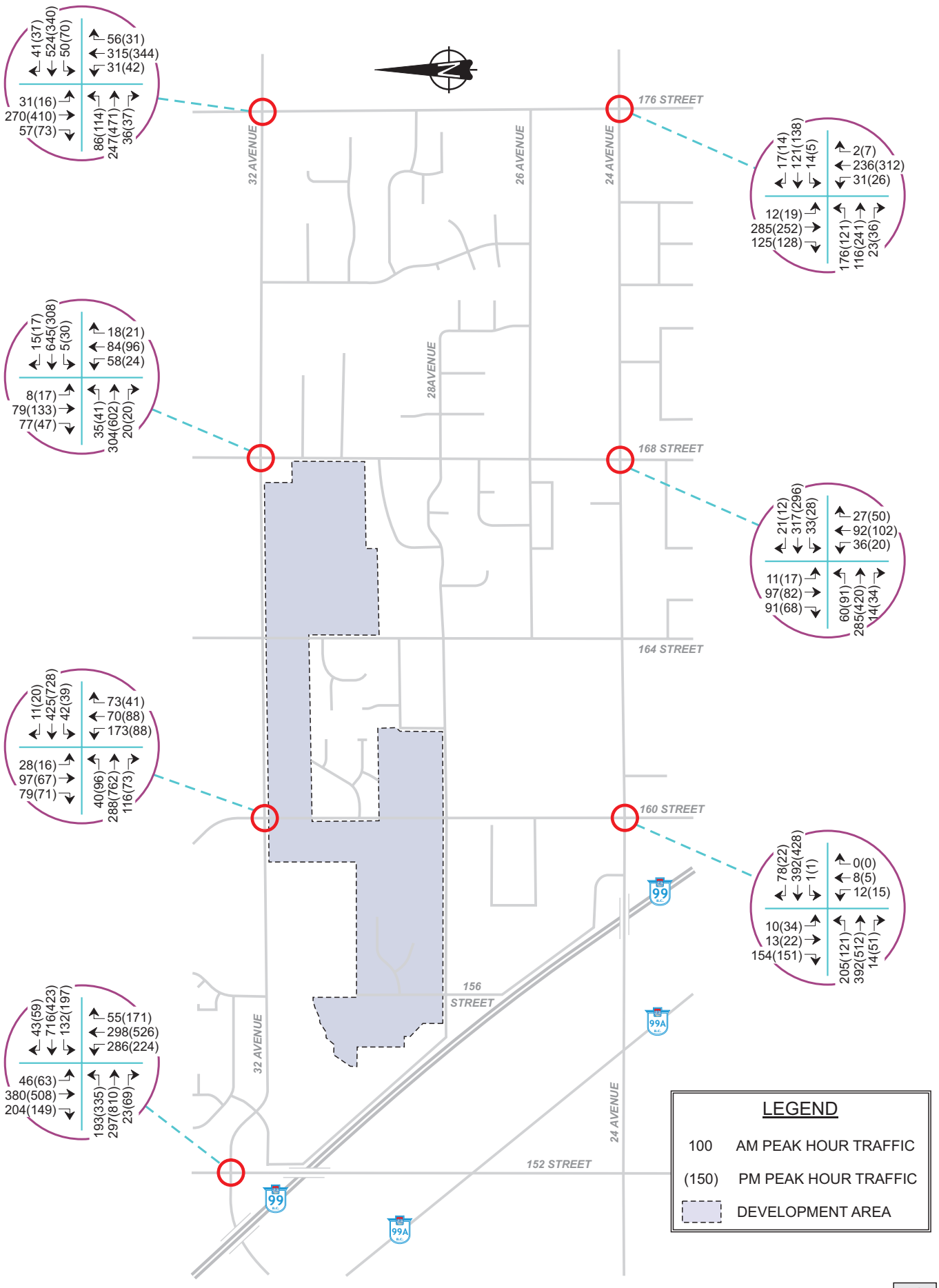

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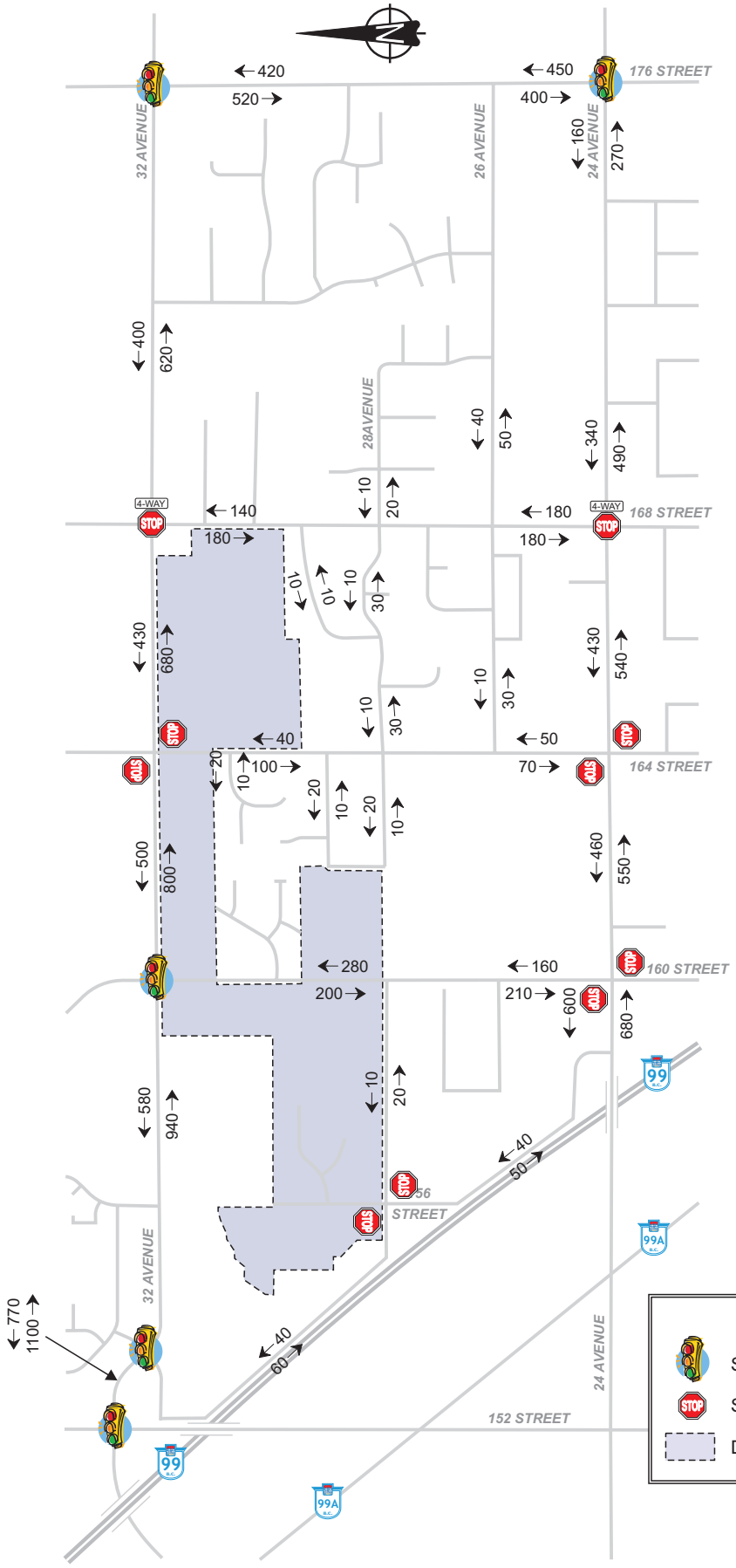
EXHIBIT **2.5**

EXISTING 2004 TRAFFIC VOLUMES ON SELECTED ROADS - PM PEAK HOUR



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2.5 Intersection Performance

The level of service at the key intersections in the area were analyzed using the Highway Capacity Manual methods. For signalized intersections, the operational analysis methodology gives three indicators for the overall performance of an intersection and for the individual turning movements. The first is the volume to capacity ratio (v/c) where the volume is the number of vehicles wishing to make a certain movement, and capacity is the maximum number of vehicles that can be accommodated in an hour. This takes into account the number of lanes available for the movement, whether the movement is protected or permitted, conflicting traffic, the cycle length, and the amount of green time the movement receives. The higher the v/c ratio, the more congested the intersection becomes. When the v/c ratio is greater than 1.00, this indicates that more vehicles wish to make a given movement than are able to, due to the limited capacity. The second measure, the average delay per vehicle, is based on the cycle length, the green time for each movement and the v/c ratios. The third measure is the level of service which is established from the average delay. The larger the average delay - and the higher the v/c ratio - the worse is the level of service. Table 2.4 shows the relationship between level of service, delay and v/c ratio.

Table 2.4
Volume/Capacity, Reserve Capacity vs. Level of Service

LoS	Signalized Intersection Stopped Delay/Vehicle (s/veh)	Delays	Unsignalized Intersection Avg. Ttl Delay
A	≤ 10.0	Little or no delay	≤ 10
B	> 10.0 and ≤ 20.0	Short traffic delays	> 10 and ≤ 15
C	> 20.0 and ≤ 35.0	Average traffic delays	> 15 and≤ 25
D	> 35.0 and ≤ 55.0	Long traffic delays	> 25 and ≤ 35
E	> 55.0 and ≤ 80.0	Very long traffic delays	> 35 and ≤ 50
F	> 80.0	Failure	> 50

The generally accepted guidelines for determining whether or not a signalized intersection needs to be upgraded is that all individual movements should operate with a v/c ratio of 0.90 or less. If this threshold is not achieved, any signal changes required to achieve these levels should be identified. These cover changes to signal timings and phasing, for example adding advanced phases for left turn movements and possible elimination of certain turning movements, but not the provision of additional capacity with extra through or turn lanes. When traffic generated by a development is added to an intersection and the v/c ratio of a specific movement that was less than 0.90 under background conditions is now greater than 0.90, then improvements must be identified to allow the intersection to operate at the 0.90 value. If the intersection was above 0.90 under background conditions, then the original v/c ratios must not be exceeded, i.e., the operation of the intersection must be no worse as a result of the development.

The performance of unsignalized intersections was also reviewed using the methodology for such intersections in the *Highway Capacity Manual*. The methodology estimates the capacity of each movement based on the conflicting pedestrian and traffic volumes. From the capacity, the actual volume is subtracted to arrive at the reserve capacity, which is the additional traffic

volume increase which can be accommodated by each movement before the capacity is reached. An operational level of service is assigned to the movement based on the reserve capacity and the relationship between the two is included in Table 2.4.

While the overall level of service and delay for an unsignalized intersection provide a measure of overall performance, it is commonly turning movements at such intersections which are the primary focus of interest. With only low turning volumes to or from the minor road and high through volumes on the main road, delays to turning vehicles can become excessive. As delays increase, turning vehicles will attempt to turn across unacceptable gaps which can present safety concerns.

Each of the seven intersections identified in Table 1.2 were analyzed under background conditions using the above methodology for the 2004 a.m. and p.m. peak hours and the results of this are presented in summary form in Table 2.5, whilst the detailed results are presented in Tables A1 to A7 in the appendix.

Table 2.5
Summary of Intersection Performance – 2004

Intersection	LoS	v/c	Crit. Mvmt.
AM Peak Hour			
32 Ave/152 St	C	0.87	--
32 Ave/160 St	B	0.84	--
32 Ave/168 St #	F	1.22	WB
32 Ave/176 St	B	0.75	--
24 Ave/160 St #	F	0.51	NB
24 Ave/168 St #	C	0.68	--
24 Ave/176 St	B	0.68	--
PM Peak Hour			
32 Ave/152 St	C	0.84	--
32 Ave/160 St	B	0.86	--
32 Ave/168 St #	F	1.23	EB
32 Ave/176 St	B	0.72	--
24 Ave/160 St #	F	0.77	NB,SB
24 Ave/168 St #	F	1.01	EB
24 Ave/176 St	B	0.71	--

Note: # - unsignalized intersection; LoS = Overall Level of Service; v/c = maximum v/c ratio for individual movement or the highest v/c ratio of the minor legs of unsignalized intersection; Crit. Appr.= LoS of the approach is E or F

This indicates that the four signalized intersections analyzed, viz., 32 Avenue at 152 Street, 160 Street and 176 Street, as well as 24 Avenue at 176 Street, all operate at an acceptable level of service in both the a.m. and p.m. peak hours with the maximum v/c ratio being 0.87 for the 32 Avenue/152 Street intersection but this is still Level of Service C.

Of the three unsignalized intersections, the 32 Avenue/168 Street intersection is most in need of an improvement as the v/c ratio is 1.22 and 1.23 in the two peak hours. Traffic signals coupled with left turn lanes on each leg are the only real solution at this intersection. This very aptly confirms the observations in the field as there are extensive queues especially on the two legs of 32 Avenue in both the a.m. and p.m. peak hours because of the four-way stop controls and the lack of turn lanes on any of the four legs. The other four-way stop controlled intersection of 24

Avenue/168 Street also fails in the p.m. peak hour although not nearly as severely. Again traffic signals would solve this problem.

2.6 Transit

Currently there are no transit services within the North Grandview Heights area. The closest is Route 354 which travels north on 152 Street from the south and then turns west on 32 Avenue destined for the South Surrey Park-and-Ride lot on the west side of Highway 99 south of the 32 Avenue diversion. Consequently, there are bus stops at this 152 Street/32 Avenue intersection and this is the closest stop to the subject neighbourhood. From this same park-and-ride facility, this route and two other bus routes run express service to Downtown Vancouver, these being *Routes 351* and *352*. Another runs to the King George Station of the SkyTrain line, this being *Route 345*.

TransLink uses 400 metres as the maximum walking distance to define the area served by transit routes within residential neighbourhoods. The minimum walking distance to the intersection of 152 Street/32 Avenue from the most westerly point of the neighbourhood at 32 Avenue/156 Street is 800 metres which far exceeds this acceptable distance.

2.7 Pedestrian Facilities

Currently the only roads in the North Grandview Heights area which have sidewalks are the four or five lane segments of 32 Avenue west of 154 Street, 152 Street from 32 Avenue to 34 Avenue and from 28 Avenue south to 16 Avenue, and 24 Avenue west of King George Highway. There are a few other isolated short segments of sidewalk specifically in front of new developments.

3.0 FUTURE CONDITIONS

3.1 Model Development

Ward Consulting Group (WCG) have previously developed a South Surrey Sub-Area model on behalf of the City of Surrey using the EMME/2 software and this model was used for projecting future traffic volumes on the road network resulting from the development of the Grandview Heights lands. This model has been prepared for both the 2010 a.m. peak hour and 2021 p.m. peak hour and uses population and employment projections at selected horizon years. Because of the continuous growth and new plans put forward for developments in the general South Surrey area, it was considered necessary to ensure that the most up-to-date land use data was available for this model. These developments include the Highway 99 Corridor Land Use Plan including the Grandview Corners shopping centre, North Grandview Heights, Morgan Heights, and Campbell Heights developments.

Once the 2021 land use data for the model was established and confirmed, the network itself was reviewed to ensure that all proposed improvements to the network expected to be in place by

2021, based on current plans or commitments, were included. This covered all of the improvements committed to by both the City and developer for the Grandview Corners development as well as other improvements already scheduled by the City.

3.2 Population and Employment

As noted above, the City's current projections within the study area were updated to reflect the uses and densities proposed in the current plan for the North Grandview Heights neighbourhood. This updating was also extended south to 24 Avenue to include the proposed changes in the Morgan Heights area and the proposed new commercial centre surrounding the intersection of 24 Avenue and 160 Street. The data provided by the developers for the North Grandview Heights and Morgan Heights developments, in terms of proposed uses and densities, was considered to be more appropriate than the City's current data. As a result, this land use was converted into population and employment numbers as required for the EMME/2 model using the same ratios as used elsewhere in the region for similar land uses.

The model uses an employment base to calculate trips in commercial and industrial zones. Consequently, the floor area of retail, particularly in the Grandview Corners development, was refined to ensure that the model produced a similar number of trips to what was estimated in the traffic impact study undertaken for this commercial development.

The boundaries of the zones in the model covering the North Grandview Heights area are provided in Exhibit 3.1 and the population and employment data for these five zones comparing the 2001 and 2021 projections as in the most recent model are given in Table 3.1. The land uses proposed as part of the NCP update plan were then taken into consideration for each of these five zones and the calculations of population and employment for these zones are given in Table 3.2. The proposed North Grandview Heights NCP update plan is shown in Exhibit 3.2. This indicates that the population, which was previously projected at 2,436 persons will now increase to 8,190, whilst the employment, which was previously projected at 1,605, will now drop to 770.

Table 3.1
North Grandview Heights City's Projected Land Use (original)

Traffic	Year 2001				Year 2021			
Zone	Pop-Tot	Emp-Tot	Emp-ret	Emp-oth	Pop-Tot	Emp-Tot	Emp-ret	Emp-oth
8121	39	13	1	12	39	1190	238	952
8122	210	13	1	12	297	54	4	50
8123	168	26	2	24	500	18	1	17
8124	155	13	1	12	400	18	1	17
8141	923	165	13	152	1200	325	26	299
Total	***1495***	***230***	***18***	***212***	***2436***	***1605***	***270***	***1335***

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EXHIBIT **3.1**

EMME/2 TRAFFIC ZONES

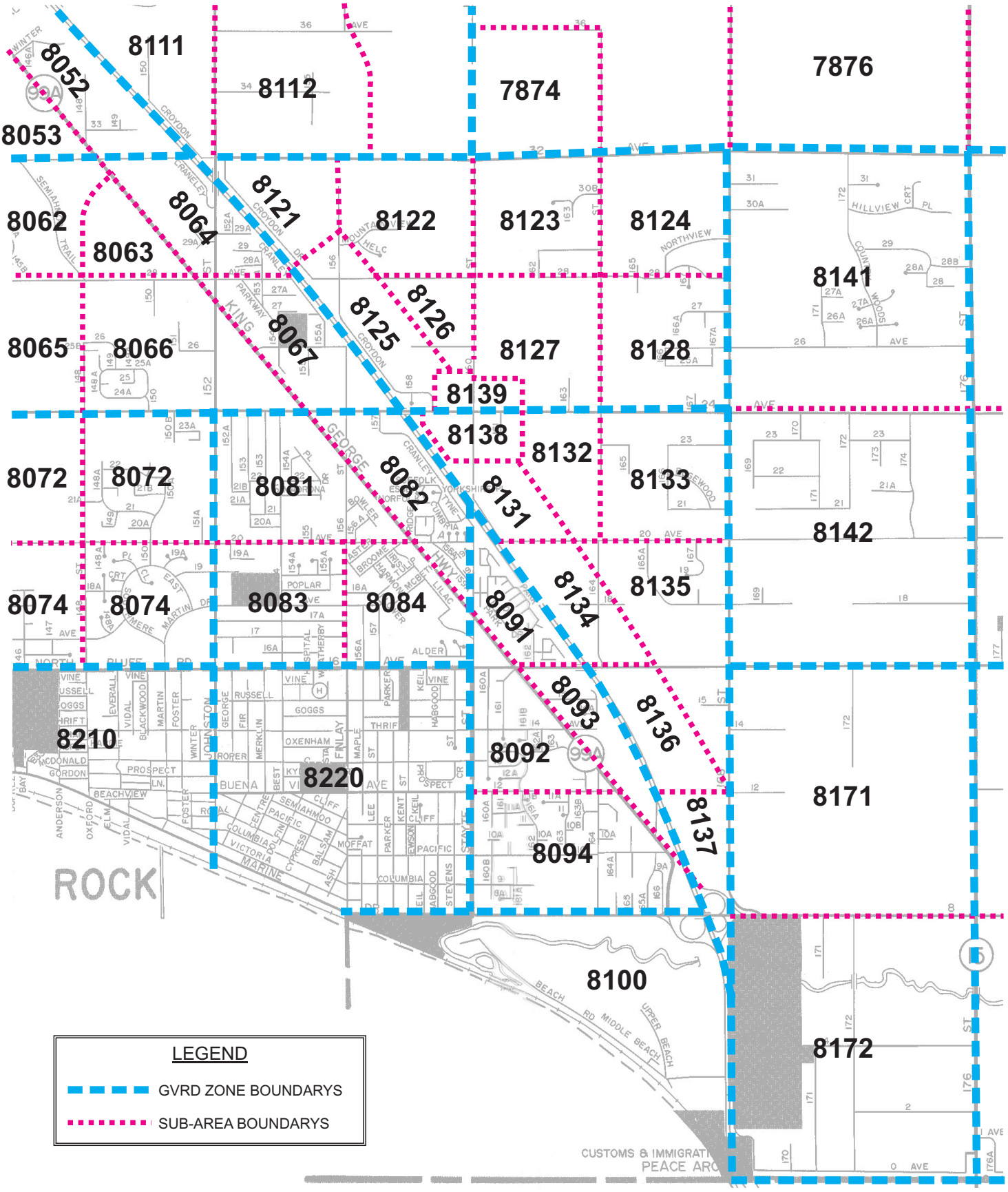
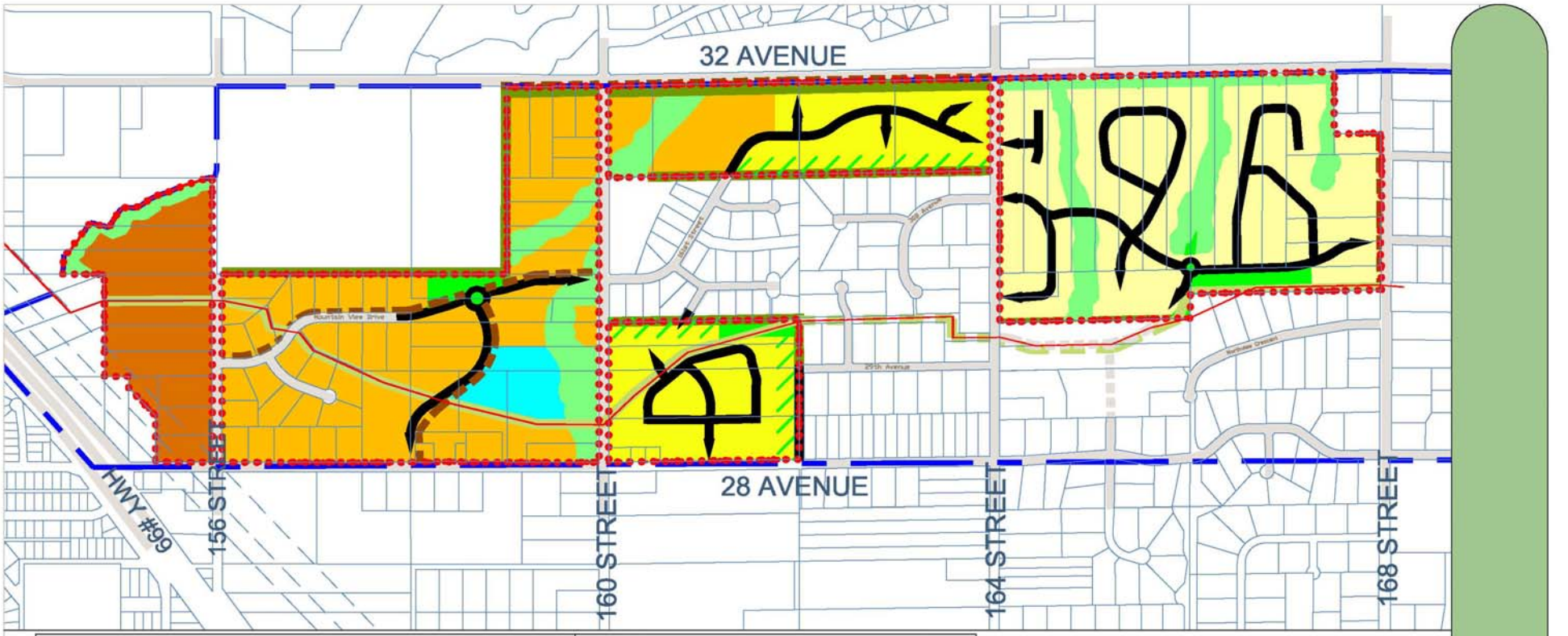


EXHIBIT 3.2

PROPOSED SITE CONCEPT PLAN



NORTH GRANDVIEW HEIGHTS
NEIGHBOURHOOD CONCEPT PLAN

2005 NCP amendment area land use concept plan

2

Table 3.2
Assumption for Land Use Updates

Traffic Zone	Land Use	Area	Coverage/ UPA	GFA/ DU	Factor*	Emp	Pop
8121	Business Park	17 acres	25%	185,130 sf	300	619	
	Commercial	3 acres	25%	33,670 sf	500	65	
	Total					***684***	***0***
8122	Cemetery	39.5 acres	25%	430,155 sf	5000	86	
	Single Family			2 DU	2.9		6
	Multi-family			798 DU	2.3		1836
	Cluster Housing			457 DU	2.6		1188
	Total					***86***	***3030***
8123	Single Family			268 DU	2.9		777
	Multi-family			54 DU	2.3		124
	Cluster Housing			59 DU	2.6		154
	Total					***0***	***1055***
8124	Single Family			227 DU	2.9		658
	Total					***0***	***658***
8141	Single Family			1188 DU	2.9		3444
	Total					***0***	***3444***
	Grand Total					***770***	***8187***

3.3 Proposed Area Road Network Changes

One of the key components of the existing road network is the partial interchange on Highway 99 at 32 Avenue/152 Street. This allows for northbound traffic to enter the highway from 32 Avenue and southbound traffic to exit the highway at 32 Avenue in both directions and 152 Street southbound. Additional ramps are currently proposed at this interchange to allow northbound traffic on 152 Street to enter the highway northbound directly as well as for northbound traffic on Highway 99 to exit to 152 Street northbound.

The City is also currently investigating the possibility of providing a new interchange on Highway 99 on 24 Avenue. If constructed, this will have ramps to and from the north on Highway 99 from both directions on 24 Avenue. It is likely to also have a northbound off ramp from the highway. The City directed that, for the purpose of this study, this new interchange was assumed to be in place.

The City is currently planning to extend the five laning of 32 Avenue east from Croydon Drive to 160 Street and upgrade the section from this point to 168 Street to a three lane facility by 2010. Beyond 168 Street it will be upgraded to a three lane section by 2015. The City are also proposing to upgrade 24 Avenue to a five lane cross-section between 152 Street and 162 Street partly in conjunction with the development with the Grandview Corners commercial development and to upgrade the King George Highway also to a five lane cross-section between the 32 Avenue Diversion and 16 Avenue. Furthermore, in conjunction with the proposed commercial development new signals will be installed on 24 Avenue at 168 Street, 160 Street, and 156 Street. These were all included in the model as were all of the additional turn lanes recommended in the Grandview Corners traffic impact study particularly those at the 160 Street, 164 Street, and 168 Street intersections on 24 Avenue.

All of these changes to the network were input into the model to reflect the assumed network conditions in 2021.

3.4 Development Trip Generation

The transportation planning model was used to establish the amount of traffic expected to be generated by the proposed development as reflected in the population and employment estimates established for each of the relevant zones.

The model uses standard trip generation rates developed over the years for the entire Greater Vancouver Region. The amount of traffic estimated by the model is given in Table 3.3. This indicates that in the three zones of relevance to this study, there will be 1,230 trips generated in the morning peak hour, with 390 of those inbound and 840 outbound. In the P.M. peak hours there will be 1,188 trips in total with 890 inbound and 298 outbound.

Table 3.3
Traffic Generated from EMME/2 Zones

	AM			PM		
	Total	**In**	**Out**	**Total**	**In**	**Out**
Zone 8122	781	246	535	754	565	189
Zone 8123	271	86	185	262	197	65
Zone 8124	178	58	120	172	128	44
Total	***1230***	***390***	***840***	***1188***	***890***	***298***

In studies where the model is not used for estimating the amount of traffic, the rates published by the Institute of Transportation Engineers in their manual *Trip Generation Rates* are used. These rates were applied to the various uses and sizes in the North Grandview Heights area in order to substantiate the estimates prepared by the model. The results of these calculations are given in Table 3.4.

Table 3.4
Estimated Trip Generation Based on ITE Rates

			AM			PM	
	Size	**Total**	**In**	**Out**	**Total**	**In**	**Out**
Block 1 (zone 8122)							
Condo/Townhouse	471 D.U.	207	35	172	245	164	81
Total Trips for Block 1		*207*	*35*	*172*	*245*	*164*	*81*
Block 2 (zone 8122)							
Single Family	459 D.U.	344	86	258	463	292	171
Condo/Townhouse	327 D.U.	143	24	119	170	114	56
Total Trips for Block 2		*487*	*110*	*377*	*633*	*406*	*227*
Block 3 (zone 8123)							
Single Family	241 D.U.	180	45	135	243	153	90
Condo/Townhouse	54 D.U.	24	4	20	28	19	9
Total Trips for Block 3		*204*	*49*	*155*	*271*	*172*	*99*
Block 4 (zone 8124)							
Single Family	182 D.U.	137	34	103	184	116	68
Total Trips for Block 4		*137*	*34*	*103*	*184*	*116*	*68*
Grand Total		***1035***	***228***	***807***	***1333***	***858***	***475***

The trip generation rates prepared by the two different methodologies were then compared and the results of this are given in Table 3.5. This indicates that the model has a tendency to overestimate in the morning peak hour, and underestimate in the afternoon peak hour. It should be noted that only the outbound non-peak direction in the afternoon peak hour traffic (i.e. outbound) is underestimated in the model. Given that the model is normally considered to be within the accuracy of +/- 20%, this comparison of the model estimates and ITE rates is acceptable.

Table 3.5
Comparison of Trips: ITE Rates vs. EMME/2

	AM			PM		
	Total	**In**	**Out**	**Total**	**In**	**Out**
Blocks 1&2 vs zone 8122	-85	-101	14	124	5	119
Block 3 vs zone 8123	-67	-37	-30	9	-25	34
Block 4 vs zone 8124	-41	-24	-17	12	-12	24
Total	***-193***	***-162***	***-33***	***145***	***-32***	***177***

3.5 Trip Distribution

By doing a select link analysis, the model was able to provide information on the distribution of the trips generated by the three zones. A summary of this information is given in Table 3.6. This indicates that there is a different distribution to the inbound and outbound trips in both the morning and afternoon peak hours; and this is to be expected. The highest orientation is to the South Surrey area, west of Highway 99, with approximately 25%-32%.

Table 3.6
Distribution of North Grandview Trips

	AM		PM	
	In	**Out**	**In**	**Out**
Hwy99 (N)	10%	16%	16%	6%
Hwy99 (S)	0%	0%	0%	0%
North (north of 32 Ave)	19%	8%	10%	14%
East (east of 168 St)	17%	22%	18%	13%
South (south of 24 Ave)	9%	9%	15%	15%
West (west of Hwy 99)	25%	33%	27%	32%
Local*	20%	12%	14%	21%

Note: Local – area bounded by 32 Ave, 168 St, 24 Ave and Hwy 99

3.6 Projected Traffic Volumes

Traffic volumes on the road network both with and without the Grandview Heights developments in place were established using the model. As noted above, these projections assumed that the 24 Avenue interchange would be in place. The new residents living in the area bounded by 24 Avenue and 32 Avenue now have a choice of routes of accessing Highway 99 and as a result, a significant amount of traffic that would have been oriented to the 32 Avenue interchange had there been no 24 Avenue interchange is now oriented to 24 Avenue. The projected 2021 traffic volumes, without the subject lands being developed - these are sometimes

referred to as the 'background volumes'- are illustrated in Exhibit 3.3 whilst the increase in volumes on these same roads resulting directly from the development of these proposed lands is provided in Exhibit 3.4. The total volumes including those developed by these lands – these are sometimes referred to as the "combined volumes" - are presented in Exhibit 3.5. A summary of the increases in traffic generated by the development of the subject lands is presented in Table 3.7. This indicates that the most significant increase in traffic resulting from the development of the proposed lands is on 32 Avenue where there are 70 vehicles westbound and 330 vehicles eastbound in the p.m. peak hour. The total traffic on the key road links, including the traffic resulting from the development of North Grandview Heights, is given in Table 3.8

Table 3.7
Development Traffic Volumes

		PM	
		EB/NB	WB/SB
32 Ave	e/o 152 St	330	70
	w/o 160 St	100	30
	e/o 160 St	60	80
	e/o 168 St	20	100
28 Ave	w/o 160 St	80	210
24 Ave	e/o 164 St	10	70
	e/o 168 St	20	60
160 St	s/o 32 Ave	60	160
	s/o 28 Ave	200	80
164 St	n/o 28 Ave	20	70
	s/o 28 Ave	120	30
168 St	n/o 32 Ave	10	20
	n/o 24 Ave	20	10

3.7 Intersection Analysis – Future Traffic

The same seven intersections were again analyzed, this time under 2021conditions for both the a.m. and p.m. peak hours with all of the traffic generated by the proposed developments included. A summary of these results are presented in Table 3.9 while the detailed results are included in Tables A1 to A7 in the Appendix. The key findings for each intersection are as follows.

(a) 32 Avenue/152 Street: This arterial intersection will operate at an acceptable level of service with a v/c ratio of 0.90 in the a.m. peak hour but this increases to 0.96 in the p.m. peak hour. It will be necessary to provide a third northbound through lane at this intersection if the desirable target of 0.90 is to be achieved. As was noted earlier, the additional ramps included in Phase 2 of the 32 Avenue/152 Street Interchange, as well as the 24 Avenue Interchange are included in the model's network and these will result in a significant amount of traffic that would normally be considered to use this intersection being diverted elsewhere.

(b) 32 Avenue/160 Street: This signalized intersection will continue to operate at an acceptable level of service through to well beyond 2021. It is noted that this intersection, in fact, performs better than under 2004 conditions and this is no

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EXHIBIT **3.3**

FUTURE 2021 BACKGROUND TRAFFIC VOLUMES - PM PEAK HOUR

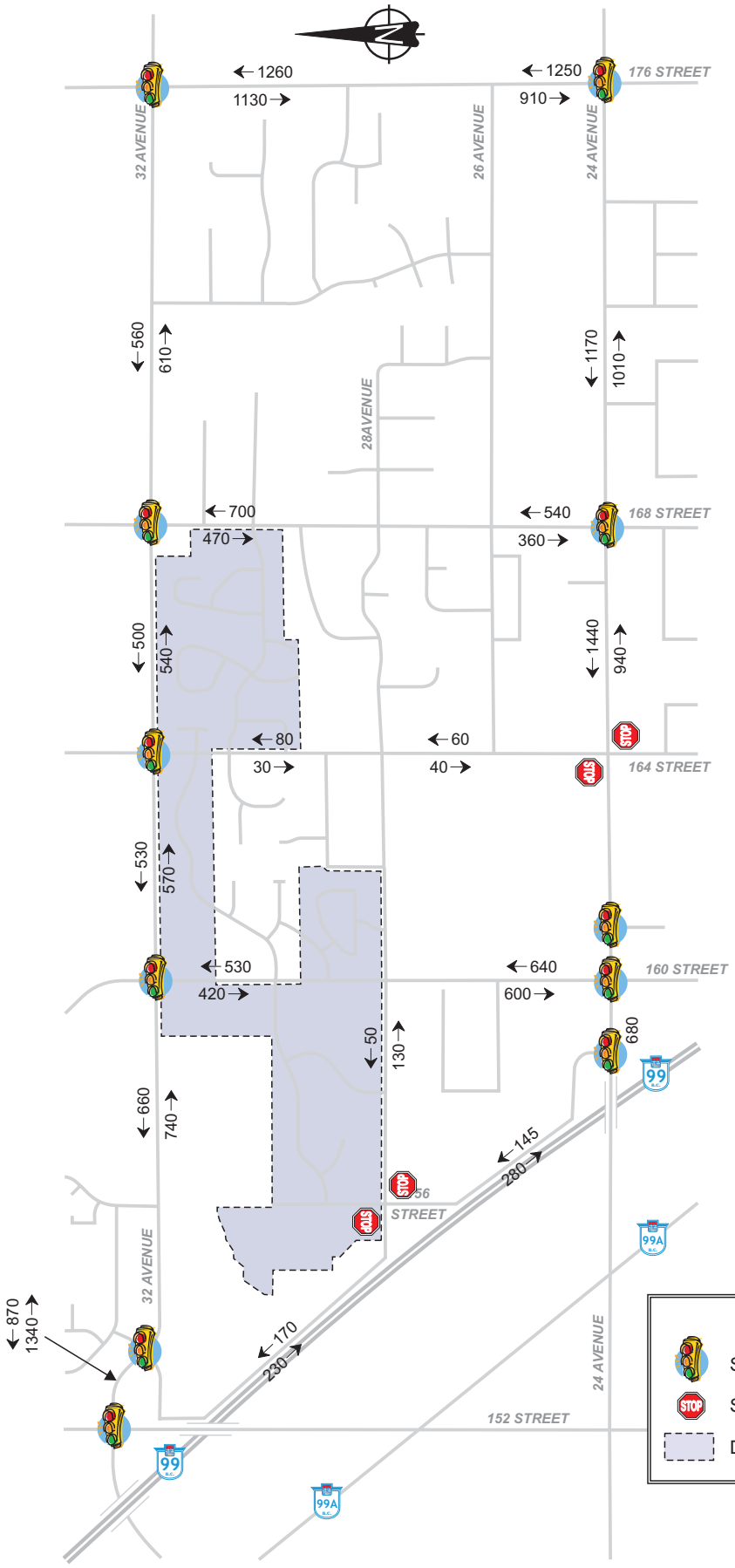

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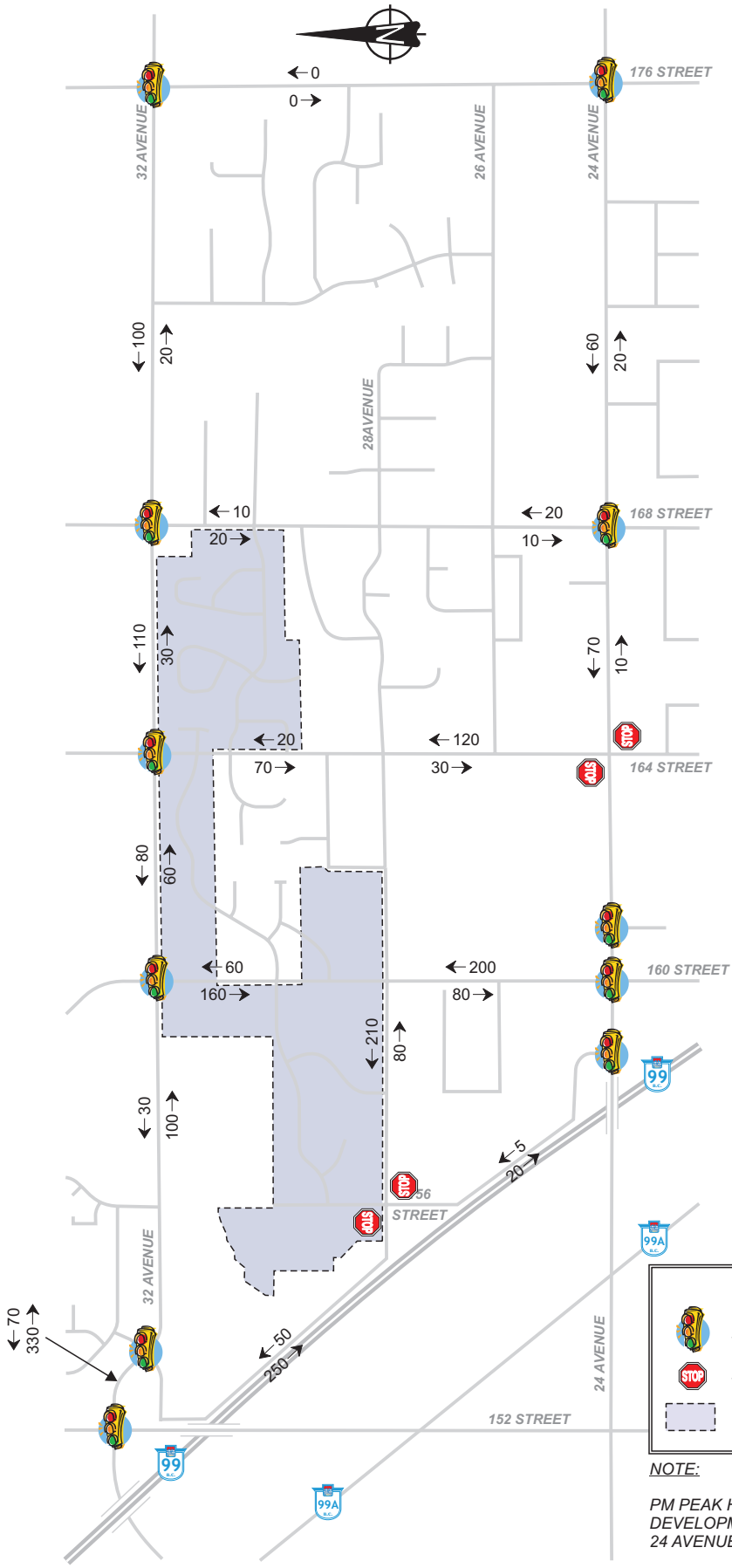
EXHIBIT **3.4**

PROPOSED DEVELOPMENT TRAFFIC VOLUMES



NOTE:

PM PEAK HOUR TRAFFIC GENERATED BY DEVELOPMENTS BOUND BY 32 AVENUE, 24 AVENUE, 168 STREET, AND 154 STREET

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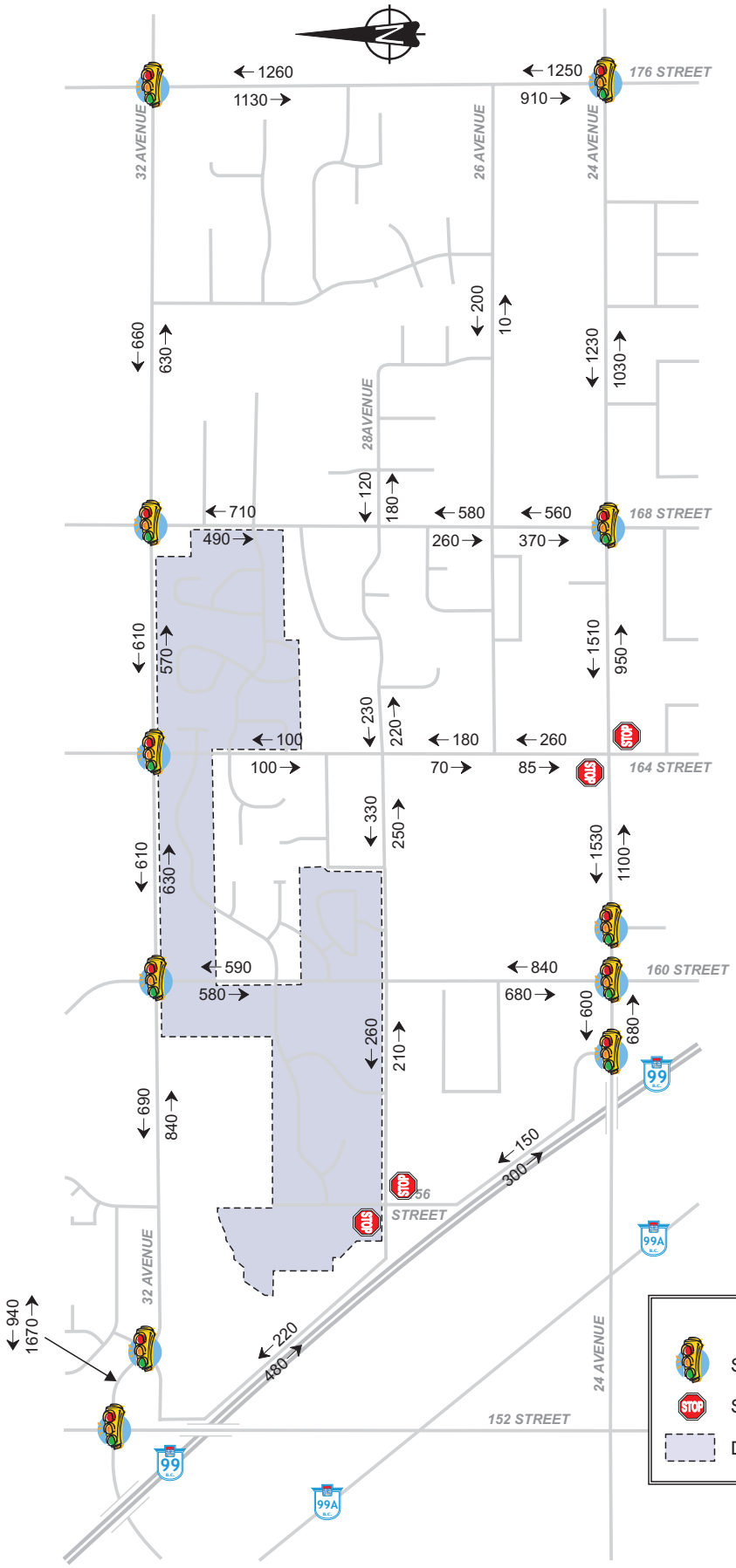
EXHIBIT **3.5**

FUTURE 2021 COMBINED TRAFFIC VOLUMES - PM PEAK HOUR



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doubt because of the opening of the 24 Avenue interchange which as already noted, draws some of the 32 Avenue traffic away to 24 Avenue, as well as the assumed five lanes of 32 Avenue.

Table 3.8
Projected Volumes
2021 A.M. & P.M. Peak Hours

		AM		PM		
		EB/NB	**WB/SB**	**EB/NB**	**WB/SB**	**# of lane**
Hwy 99	n/o KGH	3500	2010	2000	3940	4 lanes
	s/o KGH	3300	2010	2730	3530	4 lanes
	s/o 152 St	2710	2350	2750	2660	4 lanes
	s/o 24 Ave	1990	1560	1870	1810	4 lanes
32 Ave	e/o 152 St	940	1210	1670	940	5 lanes
	e/o 154 St	510	670	960	480	5 lanes
	w/o 160 St	650	670	840	690	5 lanes
	e/o 160 St	650	590	630	610	3 lane
	e/o 168 St	770	580	650	670	3 lane
	w/o 176 St	670	580	610	640	3 lane
	e/o 176 St	650	470	360	700	3 lane
28 Ave	w/o 160 St	30	80	210	260	2 lane
	e/o 160 St	100	190	250	280	2 lane
	e/o 164 St	150	170	210	230	2 lane
	e/o 168 St	110	160	180	120	2 lane
24 Ave	w/o Hwy 99	1270	1590	1600	2240	5 lanes
	e/o Hwy 99	1750	2010	2130	2800	5 lanes
	e/o 160 St	1100	1280	1140	1530	5 lanes
	e/o 164 St	1060	1110	950	1510	5 lanes
	e/o 168 St	1090	970	1040	1230	5 lanes
	e/o 176 St	1210	880	1000	1230	5 lanes
152 St	n/o 32 Ave	960	1200	1510	1060	5 lanes
	n/o Hwy 99	830	1250	1610	970	5 lanes
	s/o Hwy 99	970	1290	1670	1300	5 lanes
	n/o KGH	910	1030	1190	1200	5 lanes
	s/o KGH	850	1000	1440	1490	5 lanes
	n/o 24 Ave	720	810	1160	1210	5 lanes
160 St	s/o 32 Ave	240	320	590	580	3 lane
	n/o 28 Ave	90	300	580	440	3 lane
	s/o 28 Ave	140	390	840	680	5 lanes
	n/o 24 Ave	550	1010	1220	1550	5 lanes
	s/o 24 Ave	340	730	1140	1180	5 lanes
164 St	s/o 32 Ave	70	70	80	100	3 lane
	n/o 28 Ave	20	90	100	50	3 lane
	s/o 28 Ave	70	40	180	70	3 lane
	n/o 24 Ave	90	110	260	90	3 lane
	s/o 24 Ave	130	70	380	30	3 lane
168 St	s/o 32 Ave	300	460	700	490	3 lane
	s/o 28 Ave	210	430	580	260	3 lane
	n/o 24 Ave	200	490	560	370	3 lane
	s/o 24 Ave	240	360	830	260	3 lanes
176 St	s/o 32 Ave	1060	1180	1250	1130	5 lanes
	n/o 24 Ave	900	1150	1250	910	5 lanes
	s/o 24 Ave	830	900	1030	770	5 lanes

Note: assumed capacity/lane = 800 vph for City Streets, and 1600 vph for Highway
Underlined for 2 lanes and Underlined + Shaded for 3 lanes

Table 3.9
Summary of Intersection Performance – 2021

Intersection	LoS	V/c	Crit. Mvmt.	Rem
AM Peak Hour				
32 Ave/152 St	C	0.90	--	
32 Ave/160 St	B	0.62	--	
32 Ave/168 St #	B	0.76	--	Signalized
32 Ave/176 St	B	0.81	--	
24 Ave/160 St #	C	0.88	--	Signalized
24 Ave/168 St #	B	0.69	--	Signalized
24 Ave/176 St	C	0.90	--	
PM Peak Hour				
32 Ave/152 St	D	0.96	EBT,WBL	
	D	0.90	--	W/ 3rd NBT
32 Ave/160 St	B	0.64	--	
32 Ave/168 St #	C	0.86	--	Signalized
32 Ave/176 St	E	1.00	EBL,NBT,SBL	
	C	0.88	WBT,SBL	W/ 2 WBT
24 Ave/160 St #	E	1.15	EBL,WB,NBL,SBL	Signalized
	D	0.98	EBL,WBL,NBL	W/ 3rd WBT
24 Ave/168 St #	C	0.95	--	Signalized
	C	0.83	--	W/ sep NBR
24 Ave/176 St	D	1.01	EBL,WBT,SBL	
	D	0.93	EBL,SBL	W/ sep WBR

Note: # - unsignalized intersection; LoS = Overall Level of Service; v/c = maximum v/c ratio for individual movement or the highest v/c ratio of the minor legs of unsignalized intersection; Crit. Appr.= LoS of the approach is E or F
Assumptions for year 2021 network with 24 Avenue interchange at Hwy 99

(c) 32 Avenue/164 Street: This presently unsignalized intersection will serve as the exit point for most of the traffic generated by the lands on either side of 164 Street. The traffic volumes on 32 Avenue will continue to increase from their present levels and it is recommended traffic signals be installed at this intersection in conjunction with development of these lands.

(d) 32 Avenue/168 Street: This presently unsignalized intersection is recommended to be signalized under 2005 conditions and with such signals this operates at an acceptable level in both peak hours through to this 2021 horizon year.

(e) 32 Avenue/176 Street: This intersection on Highway 15 will operate acceptably in the morning peak hour but in the afternoon peak hour will fail with a v/c ratio of 1.00. If this is to be improved, it will need a second westbound through lane on 32 Avenue. It is noted however, that the development of the subject lands adds only 57 vehicles to this westbound movement. This improvement will therefore be required regardless of whether or not the subject lands are developed as proposed or developed as previously approved.

(f) 24 Avenue/160 Street: With signals in place as is required for the Grandview Corners development, this intersection operates at an acceptable level of service in the morning peak hour albeit at 0.88 when the commercial development is not open. It increases to 1.15 in the p.m. peak hour and reduce to 0.98 once a third

westbound through lane is provided. This third lane improvement scenario has also been identified by the City as desirable. Whilst a value of 0.98 indicates congestion, some of the traffic assigned to this route will undoubtedly reroute to 32 Avenue which, as is noted above, will not have any congestion issues.

(g) 24 Avenue/168 Street: This intersection is also to be signalized in conjunction with the Grandview Corners development and with these in place the intersection operates acceptably providing there is a right turn lane added on the south leg.

(h) 24 Avenue/176 Street: This intersection operates at an acceptable level of service in the morning peak hour albeit just at 0.90. In the afternoon peak hour it requires a separate right turn lane on the east leg.

3.8 Future Laning

Based on the interchange assumptions and the laning configuration, 32 Avenue needs to be upgraded to a five lane cross-section east as far as 160 Street as is currently proposed and then continue east to 164 Street. From 164 Street to 176 Street it should be widened to three lanes. A three lane cross-section means one travel lane in each direction plus a centre left turn lane at the intersections and other accesses. To the south, 24 Avenue is required to be five lanes from 152 Street to 162 Street initially, but ultimately all the way east to 176 Street.

Of the three north-south roads, viz., 160 Street needs to be five lanes between 24 Avenue and 26 Avenue and three lanes north of here while the other two, viz., 164 Street and 168 Street, both need to be three lanes, i.e., one travel lane in each direction plus left turn lanes at all intersections. This three laning also applies to Croydon Drive from 32 Avenue through to 24 Avenue. For all other roads, a two lane cross-section with allowance for on-street parking is adequate.

The Future Laning requirements are presented in Exhibit 3.6

3.9 Sensitivity to 24 Avenue Interchange

The city has also requested that an additional model run without the 24 Avenue Interchange in place should also be tested, and the results presented in Table 3.10. In general, the traffic volumes on the network are not appreciably different. One particular phenomenon noted is that the volumes on 24 Avenue to the east of Highway 99 are lower whereas the volumes to the west were higher. This was investigated and determined to be a result of eliminating the heavy turning movements at the new 24 Avenue Interchange at Highway 99. With the Interchange in place, some of the through traffic travelling between the east and west sides of Highway 99 avoid 24 Avenue. Whereas, without the interchange in place, there was significantly less congestion in this vicinity and the through movements increased. The laning requirements on all the roads remained the same as was previously identified.

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EXHIBIT **3.6**

FUTURE TRAFFIC CONDITIONS

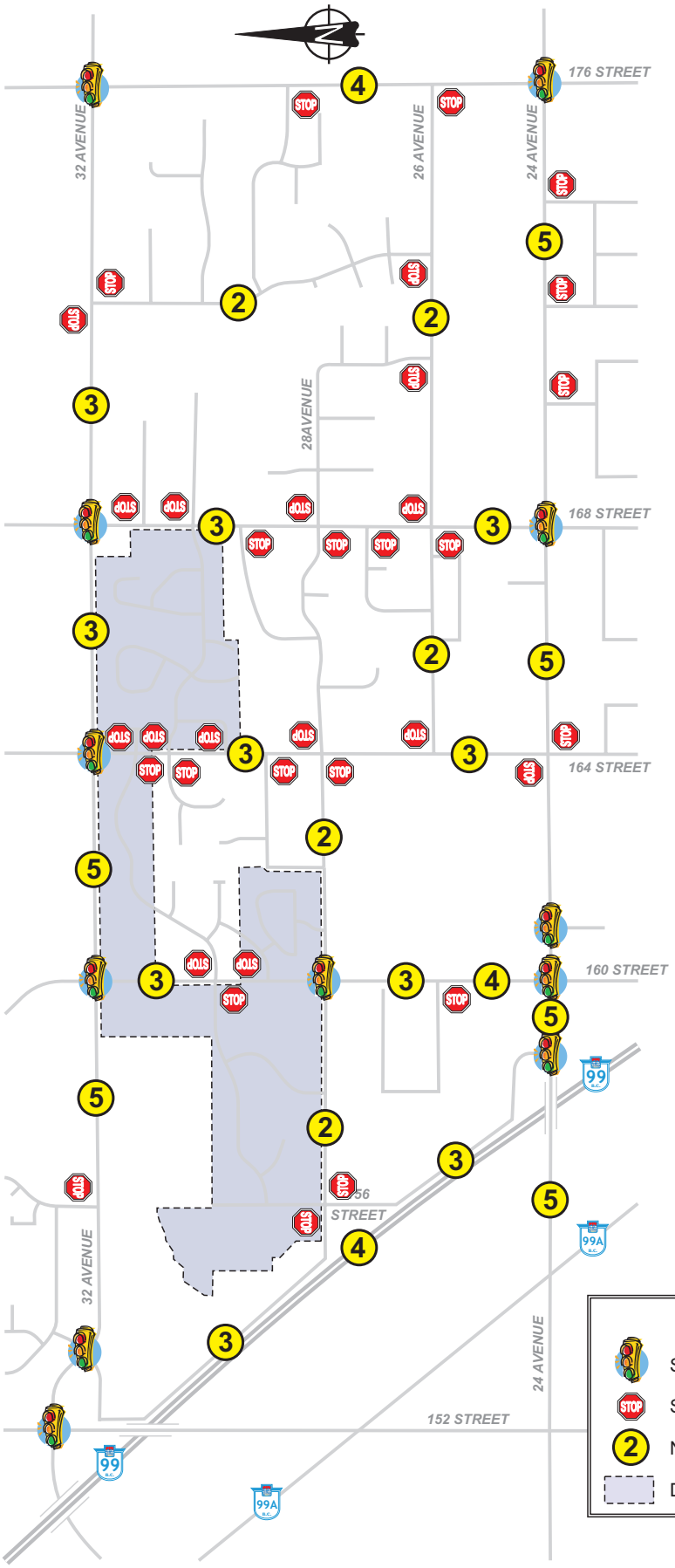

Table 3.10
Model Results for year 2021 AM & PM (up-dated model)
With NO 24 Ave Interchange

		AM		PM	
		EB/NB	WB/SB	EB/NB	WB/SB
Hwy 99	n/o KGH	3590	2000	1980	3930
	s/o KGH	3080	2410	2530	3300
	s/o 152 St	1910	1540	1840	1740
	s/o 24 Ave	1910	1540	1840	1740
32 Ave	e/o 152 St	1020	1360	1680	1230
	e/o 154 St	610	800	1020	780
	w/o 160 St	760	810	950	970
	e/o 160 St	630	580	640	640
	e/o 168 St	780	580	700	670
	w/o 176 St	650	570	580	610
	e/o 176 St	650	470	370	700
28 Ave	w/o 160 St	30	80	220	280
	e/o 160 St	100	210	280	280
	e/o 164 St	150	170	250	220
	e/o 168 St	110	160	180	120
24 Ave	w/o Hwy 99	1630	1730	1990	2310
	e/o Hwy 99	1630	1730	1990	2310
	e/o 160 St	1100	1220	1100	1420
	e/o 164 St	1080	1080	940	1460
	e/o 168 St	1100	930	960	1170
	e/o 176 St	1210	880	940	1250
152 St	n/o 32 Ave	910	1170	1460	1000
	n/o Hwy 99	690	1120	1420	860
	s/o Hwy 99	1140	1370	1700	1380
	n/o KGH	1180	1220	1390	1430
	s/o KGH	820	980	1410	1450
	n/o 24 Ave	760	860	1240	1270
160 St	s/o 32 Ave	390	500	930	750
	n/o 28 Ave	240	480	940	620
	s/o 28 Ave	270	570	1250	860
	n/o 24 Ave	510	970	1420	1500
	s/o 24 Ave	280	750	1130	1200
164 St	s/o 32 Ave	70	70	130	110
	n/o 28 Ave	30	100	150	70
	s/o 28 Ave	90	50	240	90
	n/o 24 Ave	90	90	310	90
	s/o 24 Ave	120	50	410	30
168 St	s/o 32 Ave	330	470	780	520
	s/o 28 Ave	230	430	630	300
	n/o 24 Ave	220	510	600	440
	s/o 24 Ave	240	350	750	270
176 St	s/o 32 Ave	1100	1170	1290	1150
	n/o 24 Ave	950	1150	1320	990
	s/o 24 Ave	820	910	1010	740

Note: assumed capacity/lane = 800 vph for City Streets, and 1600 vph for Highway
Underlined for 2 lanes and Underlined + Shaded for 3 lanes

3.10 Neighbourhood Road Network

A preliminary Road Network Plan has been prepared for the North Grandview Heights area as shown in Exhibit 3.2. It is noted that the 28 Avenue is shown as a continuous collector road from east of 168 Street, through to Croydon Avenue. The city has an extensive grid road

network pattern in the north-south direction, 152 St., 156 St., 160 St., 164 St. and 168 St. In the east-west direction, in the general vicinity of the study area, it is 32 Ave., 28 Ave., 24 Ave., 20 Ave. and 16 Ave., where 28 Ave. is designated as a collector road. It is not intended to be a through road as was noted earlier, a collector road simply gathers up traffic from the local roads and carries them to the arterial roads. In this case, 28 Ave. could be designated as a minor collector road, since it is recommended that the north-south collector roads are 160 St. and 164 St. and will continue to have the through priority at the intersections with 28 Ave. The segment between 164 St. and 168 St. have already existed as a continuous route and it is primarily used by local traffic. The same is intended for the segment from 164 St. through to 156 St. Without such a link traffic travelling between the different components of this neighbourhood, i.e. from a point west of 160 St. through to east of 164 St. or even more importantly, traffic travelling from this neighbourhood to the proposed school to the east of 160 St. would be forced to use 32 Ave. or 24 Ave. This not only means increased traffic on these busy arterial roads but exposes these vehicles to unnecessary safety issues with the higher traffic volumes and furthermore takes more time and uses more fuel in order to make a simple trip within the overall neighbourhood. Often traffic calming is not normally applied to collector roads, however, 28 Avenue could be a candidate for such features. This could include curb extensions at intersections with or without raised intersections, center medians, etc. in order to slow down any faster moving vehicles. Looking at the overall road network in the North Grandview Heights area, it is apparent there would be no desire to use 28 Avenue for a through route since it does not continue west beyond Croydon Dr. and the fastest route to points outside of the NCP is by using 32 Ave. and 24 Ave. Providing there is good access to these arterial roads through signalized intersections traffic will tend to stay on the arterials.

It is desirable to have intersections aligned opposite each other. This has been achieved on 160 St. with the new leg of 30 Ave. on the west side, aligning with the existing leg on the east side. It would be desirable to achieve the same goal on 164 St. with the new leg of 30B St. opposite the existing leg of the same name. This alignment of new to existing legs is shown on 168 St.

It is desirable to keep reasonable spacing between intersections on collector roads these should be a minimum of 40m apart.

It is noted that the school site is to be located on a local road this is considered very desirable, i.e. it is preferred over having such a school on a collector or arterial road. Since the school is now forced to provide adequate capacity for pick-up/drop-off facilities on-site. This activity should not be a problem on the proposed new north-south road linking 28 Ave. to 30 Ave.

3.11 Traffic Calming

Traffic calming is normally introduced to reduce the likelihood of cut-through traffic or unwanted traffic who should not be using the roads through a neighbourhood. As already noted, although these features are not normally introduced on a collector road, a limited amount of such features could be introduced on 28 Ave. These features could also be introduced on some of the other routes. It is noted in the plan that traffic circles are shown in at least two locations providing these are relatively small they would serve as an effective traffic calming measure. As

noted, above measures include curb extensions and center medians. Three or Four-way stops could also be introduced rather than one street having the through priority at every street.

Also a number of techniques - such as speed bumps, traffic circles and other physical devices - can be used for traffic calming. The most effective of which is to reduce the pavement width. As noted this can be achieved through curb extensions or through the design standards for local roads. However, the narrower these local roads are the less provision for on-street parking. These traffic calming techniques should not be included as part of the original road designs. Only in the unlikely event that short-cutting or speeding traffic occurs should these techniques be considered.

3.12 Transit

Translink has indicated that neither 1 acre nor ½ acre developments are sufficiently dense to support conventional transit services. However, the cluster housing and the multi-family housing as is proposed primarily in the area west of 160 St., transit service should be considered. Whether this is a fixed route transit service along 32 Ave., 160 St. then passing through the Grandview Corner shopping center and continuing back west on 24 Ave., Or, whether it is a community service circulating through 28 Ave. and 30 Ave. this decision will have to be left to Translink. Based on the road network plan proposed either of these services are feasible without any further changes to the road network.

3.13 Pedestrian and Bicycle Facilities

The city of Surrey requires sidewalks on both sides of arterial and collector roads wherever adjacent to developments and this is assumed that this will continue in the North Grandview Heights area. The primary exception will be on the north side of 32 Ave. between 164 St and 176 St. where the adjacent land is agricultural and as a result no sidewalk is required. Sidewalks also need to be provided on at least one side of all local roads. The plan also shows a number of continuous multi-use trails throughout the network. This encourages the movement of pedestrians throughout. The main east-west pathway should be a 4m asphalt pathway with connecting pathways being 3m in width. Benches and other amenities for pathway users should be provided at view locations and key intersections along the pathway. The city standards also require wide curb lanes on arterial and major collector roads to enable cyclists and motorists to safely share the road. The city's core bicycle network includes 168 St. and 176 St. in the north-south direction. Some are due for network improvements.

4.0 SUMMARY OF THE RECOMMENDED REAL IMPROVEMENTS

Based on the study undertaken for the revisions to the North Grandview Heights neighbourhood concept plan the following is a summary of the recommended road improvements:

- Widen 32 Ave. to a 5-lane cross section between 156 St. and 164 St. and to a 3-lane cross section beyond as far as 176 St.

- Construct 28 Ave. as a continuous collector road between 168 St. and Croydon Dr., albeit with stop controls on 28 Ave. and uninterrupted through movements on 160 St., 164 St. and 168 St., as at present.

- Upgrade 160 St. through the neighbourhood to a 3-lane standard. Upgrade 160 St and 164 St to a 3-lane standard in order to accommodate one lane of travel plus left turn lanes at intersections and key exit points.

- Eliminate all direct access to 32 Ave., limiting such access to the main intersections of 156 St., 160 St., 164 St. and 168 St.

- Signalize the intersection of 32 Ave/164 St- it is assumed that 32 Ave/168 will be signalized regardless of the proposed development.

- Ideally, align intersecting streets on either side of the collector roads rather than have them offset.

- Actively pursue the development of the pedestrian trail through the neighbourhood as shown on the current plans.

Table A1
32 Avenue / 152 Street Intersection Performance
- Signalized Intersection

		Eastbound			Westbound			Northbound			Southbound			Over
		L	T	R	L	T	R	L	T	R	L	T	R	-all
2004 AM														
Existing	LoS	C	C	C	B	D	D	D	B	A	D	B	B	C
	v/c	0.71	0.41	0.41	0.40	0.87	0.87	0.75	0.24	0.09	0.31	0.58	0.58	0.87*
	Delay	30.4	22.4	22.4	17.4	37.6	37.6	44.4	17.8	5.9	38.0	20.0	20.0	28.1
2004 PM														
Existing	LoS	C	C	C	C	C	C	D	C	A	D	C	C	C
	v/c	0.78	0.84	0.84	0.70	0.57	0.57	0.70	0.52	0.30	0.42	0.73	0.73	0.84*
	Delay	24.9	34.7	34.7	27.7	30.7	30.7	49.3	28.5	5.6	45.0	32.6	32.6	31.2
2021 AM[(1)]														
W/ 24 Ave	LoS	C	C	C	C	C	C	B	B	A	C	C	C	C
Interchange	v/c	0.81	0.70	0.70	0.86	0.85	0.85	0.01	0.50	0.32	0.53	0.90	0.90	0.90*
	Delay	32.8	29.2	29.2	33.3	33.0	33.0	15.0	19.5	3.7	29.6	32.0	32.0	28.6
W/O 24 Ave	LoS	D	C	C	C	D	D	D	C	A	E	D	D	D
Interchange	v/c	0.83	0.61	0.61	0.82	0.90	0.90	0.26	0.43	0.27	0.79	0.88	0.88	0.90*
	Delay	41.0	34.3	34.3	31.3	44.1	44.1	41.2	30.6	5.0	61.7	44.3	44.3	38.8
2021 PM[(1)]														
W/ 24 Ave	LoS	D	E	E	E	D	D	C	D	C	D	C	C	D
Interchange	v/c	0.89	0.96	0.96	0.91	0.77	0.77	0.02	0.92	0.78	0.61	0.69	0.69	0.96*
	Delay	47.1	58.2	58.2	59.7	46.5	46.5	27.0	50.5	20.7	36.3	28.4	28.4	43.8
(w/ 3rd NBT)	LoS	D	D	D	D	D	D	C	D	C	D	C	C	D
	v/c	0.87	0.90	0.90	0.86	0.64	0.64	0.03	0.72	0.82	0.59	0.75	0.75	0.90*
	Delay	35.6	45.5	45.5	46.1	35.8	35.8	31.5	40.0	23.7	38.5	33.2	33.2	37.3
W/O 24 Ave	LoS	E	D	D	E	E	E	D	D	C	D	C	C	D
Interchange	v/c	0.95	0.88	0.88	0.92	0.97	0.97	0.24	0.92	0.72	0.73	0.69	0.69	0.97*
	Delay	66.1	43.4	43.4	68.7	60.4	60.4	38.1	54.5	21.9	49.6	30	30.6	47.4
(w/ 3rd NBT)	LoS	D	D	D	D	D	D	E	D	C	D	D	D	D
	v/c	0.88	0.83	0.83	0.83	0.90	0.90	0.39	0.78	0.77	0.66	0.77	0.77	0.90*
	Delay	46.2	35.9	35.9	45.4	45.1	45.1	57.7	46.0	24.2	44.7	36.8	36.8	40.1

Note: (1) removed dual NBLT on 152 St by 2021 when 152 St Interchange been built

Table A2
32 Avenue / 160 Street Intersection Performance
- Signalized Intersection

		Eastbound			Westbound			Northbound			Southbound			Over
		L	T	R	L	T	R	L	T	R	L	T	R	-all
2004 AM														
Existing	LoS	B	B	B	A	B	B	C	B	B	B	B	B	B
	v/c	0.25	0.47	0.47	0.10	0.84	0.84	0.47	0.23	0.23	0.07	0.28	0.28	0.84*
	Delay	11.7	10.1	10.1	8.1	18.4	18.4	23.7	11.2	11.2	17.7	13.8	13.8	15.5
2004 PM														
Existing	LoS	A	B	B	B	A	A	C	B	B	C	B	B	B
	v/c	0.23	0.86	0.86	0.27	0.46	0.46	0.25	0.24	0.24	0.04	0.26	0.26	0.86*
	Delay	7.7	16.9	16.9	10.5	9.0	9.0	22.8	17.5	17.5	20.6	13.4	13.4	14.4
2021 AM[(1)]														
W/ 24 Ave	LoS	B	B	B	B	B	B	A	A	A	A	A	A	B
Interchange	v/c	0.04	0.62	0.62	0.25	0.51	0.51	0.19	0.15	0.15	0.06	0.20	0.20	0.62*
	Delay	13.3	15.9	15.9	16.3	16.6	16.6	9.3	4.2	4.2	8.3	8.0	8.0	13.8
W/O 24 Ave	LoS	B	B	B	C	B	B	B	A	A	A	A	A	B
Interchange	v/c	0.05	0.68	0.68	0.32	0.51	0.51	0.46	0.15	0.15	0.06	0.25	0.25	0.68*
	Delay	14.9	17.6	17.6	21.0	18.7	18.7	13.6	4.5	4.5	9.0	9.2	9.2	15.4

		Eastbound			Westbound			Northbound			Southbound			Over
		L	T	R	L	T	R	L	T	R	L	T	R	-all
2021 PM[(1)]														
W/ 24 Ave	LoS	B	B	B	C	B	B	B	B	B	B	B	B	B
Interchange	v/c	0.39	0.64	0.64	0.53	0.48	0.48	0.40	0.44	0.44	0.08	0.26	0.26	0.64*
	Delay	17.2	13.2	13.2	21.4	15.3	15.3	13.8	11.6	11.6	10.7	10.4	10.4	13.6
W/O 24 Ave	LoS	C	C	C	D	C	C	C	A	A	A	A	A	C
Interchange	v/c	0.29	0.86	0.86	0.61	0.62	0.62	0.78	0.48	0.48	0.06	0.28	0.28	0.86*
	Delay	27.0	26.8	26.8	51.0	25.3	25.3	22.8	9.6	9.6	6.8	7.9	7.9	21.2

Note: (1) assumed 3 lanes on 32 Ave @ 160 St by 2021

Table A3
32 Avenue / 168 Street Intersection Performance
- Signalized Intersection

		Eastbound			Westbound			Northbound			Southbound			Over
		L	T	R	L	T	R	L	T	R	L	T	R	-all
2004 AM														
Existing	LoS	C	C	C	F	F	F	B	B	B	B	B	B	
(unsignalized)	v/c	0.69	0.69	0.69	1.22	1.22	1.22	0.36	0.36	0.36	0.35	0.35	0.35	
	Delay	22.4	22.4	22.4	134	134	134	14.5	14.5	14.5	14.0	14.0	14.0	
2004 PM														
Existing	LoS	F	F	F	C	C	C	B	B	B	C	C	C	
(unsignalized)	v/c	1.23	1.23	1.23	0.69	0.69	0.69	0.32	0.32	0.32	0.43	0.43	0.43	
	Delay	140	140	140	22.7	22.7	22.7	14.0	14.0	14.0	15.5	15.5	15.5	
2021 AM[(1)]														
W/ 24 Ave	LoS	A	B	B	B	B	B	B	B	B	B	B	B	B
Interchange	v/c	0.06	0.76	0.76	0.57	0.56	0.56	0.22	0.43	0.43	0.21	0.69	0.69	0.76*
(signalized)	Delay	8.9	15.1	15.1	19.3	12.1	12.1	18.1	15.1	15.1	16.4	19.5	19.5	15.6
W/O 24 Ave	LoS	A	B	B	B	B	B	B	B	B	B	B	B	B
Interchange	v/c	0.06	0.75	0.75	0.57	0.56	0.56	0.31	0.45	0.45	0.27	0.67	0.67	0.75*
(signalized)	Delay	8.9	14.8	14.8	18.8	12.0	12.0	19.2	15.3	15.3	17.1	19.1	19.1	15.4
2021 PM[(1)]														
W/ 24 Ave	LoS	B	C	C	D	C	C	B	C	C	B	B	B	C
Interchange	v/c	0.28	0.75	0.75	0.76	0.77	0.77	0.09	0.86	0.86	0.01	0.43	0.43	0.86*
(signalized)	Delay	17.5	20.4	20.4	35.6	21.2	21.2	12.2	24.5	24.5	12.0	14.0	14.0	21.5
W/O 24 Ave	LoS	B	C	C	D	C	C	B	C	C	B	B	B	C
Interchange	v/c	0.23	0.78	0.78	0.78	0.78	0.78	0.10	0.89	0.89	0.05	0.40	0.40	0.89*
(signalized)	Delay	18.3	24.1	24.1	28.9	24.4	24.4	14.1	30.6	30.6	15.4	15.5	15.5	25.5

Note: (1) assumed 3 lanes on 32 Ave @ 168 St by 2021

Table A4
32 Avenue / 176 Street Intersection Performance
- Signalized Intersection

		Eastbound			Westbound			Northbound			Southbound			Over
		L	T	R	L	T	R	L	T	R	L	T	R	-all
2004 AM														
Existing	LoS	B	B	B	A	B	B	B	B	B	B	B	B	B
	v/c	0.38	0.37	0.37	0.12	0.75	0.75	0.08	0.27	0.27	0.09	0.24	0.24	0.75*
	Delay	13.4	10.8	10.8	9.4	15.8	15.8	14.6	12.8	12.8	14.8	12.2	12.2	13.3
2004 PM														
Existing	LoS	B	B	B	B	B	B	B	B	B	B	B	B	B
	v/c	0.36	0.72	0.72	0.29	0.53	0.53	0.15	0.25	0.25	0.04	0.33	0.33	0.72*
	Delay	12.9	15.9	15.9	12.6	13.4	13.4	14.1	11.8	11.8	12.9	12.1	12.1	13.3
2021 AM														
W/ 24 Ave	LoS	C	C	C	C	C	C	B	B	B	C	B	B	B

		Eastbound			Westbound			Northbound			Southbound			Over
		L	T	R	L	T	R	L	T	R	L	T	R	-all
Interchange	v/c	0.69	0.81	0.81	0.59	0.62	0.62	0.23	0.61	0.61	051	0.76	0.76	0.81*
	Delay	32.6	27.4	27.4	34.0	21.5	21.5	17.9	14.4	14.4	28.9	17.5	17.5	19.7
W/O 24 Ave	LoS	C	D	D	D	D	D	C	C	C	D	C	C	C
Interchange	v/c	0.56	0.76	0.76	0.41	0.84	0.84	0.23	0.62	0.62	0.54	0.74	0.74	0.84*
	Delay	31.2	35.4	35.4	40.4	47.1	47.1	25.6	21.0	21.0	37.9	24.0	24.0	28.2
2021 PM														
W/ 24 Ave	LoS	E	B	B	C	E	E	C	E	E	F	D	D	E
Interchange	v/c	0.98	0.30	0.30	0.31	0.99	0.99	0.02	1.00	1.00	0.67	0.94	0.94	1.00*
	Delay	77.6	15.6	15.6	31.3	71.6	71.6	24.0	60.8	60.8	81.3	49.8	49.8	56.4
(w/ 2 WBT)	LoS	D	C	C	D	E	E	B	C	C	E	C	C	C
	v/c	0.84	0.38	0.38	0.53	0.88	0.88	0.01	0.78	0.78	0.63	0.74	0.74	0.88*
	Delay	45.8	23.6	23.6	51.4	56.8	56.8	17.0	29.0	29.0	67.6	27.2	27.2	34.8
W/O 24 Ave	LoS	F	B	B	C	F	F	C	E	E	F	D	D	E
Interchange	v/c	1.00	0.28	0.28	0.22	1.04	1.04	0.03	1.01	1.01	0.81	0.94	0.94	1.04*
	Delay	83.2	15.7	15.7	29.4	84.6	84.6	24.5	63.1	63.1	107	48.5	48.5	60.3
(w/ 2 WBT)	LoS	D	C	C	D	E	E	B	C	C	F	C	C	D
	v/c	0.85	0.35	0.35	0.37	0.91	0.91	0.02	0.79	0.79	0.78	0.74	0.74	0.91*
	Delay	48.0	23.6	23.6	46.0	60.9	60.9	17.0	29.3	29.3	96.4	26.9	26.9	36.0

Table A5
24 Avenue / 160 Street Intersection Performance
- Signalized Intersection

		Eastbound			Westbound			Northbound			Southbound			Over
		L	T	R	L	T	R	L	T	R	L	T	R	-all
2004 AM														
Existing	LoS	A	A	A	A	A	A	F	F	F	C	C	C	
(unsignalized)	v/c	0.21	--	--	0.00	0.00	0.00	0.32	0.32	0.32	0.51	0.51	0.51	
	Delay	9.3	--	--	0.0	0.0	0.0	82.7	82.7	82.7	24.0	24.0	24.0	
2004 PM														
Existing	LoS	A	A	A	A	A	A	F	F	F	E	E	E	
(unsignalized)	v/c	0.12	--	--	0.00	0.00	0.00	0.33	0.33	0.33	0.77	0.77	0.77	
	Delay	8.8	--	--	0.0	0.0	0.0	84.6	84.6	84.6	48.4	48.4	48.4	
2021 AM[(1)]														
W/ 24 Ave	LoS	D	C	C	B	C	C	C	D	B	C	D	C	C
Interchange	v/c	0.78	0.77	0.77	0.33	0.88	0.88	0.30	0.12	0.10	0.24	0.27	0.71	0.88*
(signalized)	Delay	39.5	22.6	22.6	15.8	33.4	33.4	33.8	39.3	12.8	32.9	39.8	28.7	29.3
W/O 24 Ave	LoS	C	C	C	B	C	C	C	D	B	C	D	C	C
Interchange	v/c	0.65	0.75	0.75	0.34	0.83	0.83	0.22	0.16	0.11	0.28	0.37	0.56	0.83*
(signalized)	Delay	29.5	21.1	21.1	13.5	27.3	27.3	31.3	38.2	13.1	32.3	38.7	21.4	25.5
2021 PM[(1)]														
W/ 24 Ave	LoS	F	D	D	E	F	F	F	D	B	E	D	D	E
Interchange	v/c	1.09	0.92	0.92	0.91	1.15	1.15	1.10	0.43	0.14	0.86	0.38	0.88	1.15*
(signalized)	Delay	110	38.1	38.1	72.0	108	108	114	44.2	11.8	61.3	45.0	51.0	73.0
(w/ 3rd WBT)	LoS	E	D	D	E	D	D	E	D	B	D	D	D	D
	v/c	0.96	0.98	0.98	0.91	0.93	0.93	0.95	0.43	0.14	0.74	0.39	0.82	0.98*
	Delay	70.4	50.3	50.3	72.3	46.8	46.8	67.9	44.5	12.0	43.4	45.5	42.1	50.6
W/O 24 Ave	LoS	F	D	D	E	E	E	D	E	B	F	D	C	E
Interchange	v/c	1.04	0.88	0.88	0.90	1.06	1.06	0.57	0.81	0.18	1.04	0.36	0.59	1.06*
(signalized)	Delay	97.3	35.9	35.9	69.6	76.4	76.4	40.2	57.0	11.6	97.7	38.9	27.6	57.8
(w/ 3rd WBT)	LoS	E	D	D	D	D	D	C	E	B	E	D	C	D
	v/c	0.91	0.95	0.95	0.83	0.84	0.84	0.47	0.80	0.18	0.91	0.37	0.55	0.95*
	Delay	57.0	46.2	46.2	53.4	39.5	39.5	31.9	55.4	11.6	61.8	39.6	22.0	43.8

Note: (1) assumed 5 lanes on 24 Ave @ 160 St by 2021

Table A6
24 Avenue / 168 Street Intersection Performance
- Signalized Intersection

		Eastbound			Westbound			Northbound			Southbound			Over
		L	T	R	L	T	R	L	T	R	L	T	R	-all
2004 AM														
Existing	LoS	C	C	C	C	C	C	B	B	B	B	B	B	
(unsignalized)	v/c	0.66	0.66	0.66	0.68	0.68	0.68	0.32	0.32	0.32	0.39	0.39	0.39	
	Delay	20.1	20.1	20.1	20.7	20.7	20.7	13.1	13.1	13.1	13.7	13.7	13.7	
2004 PM														
Existing	LoS	F	F	F	C	C	C	B	B	B	B	B	B	
(unsignalized)	v/c	1.01	1.01	1.01	0.66	0.66	0.66	0.38	0.38	0.38	0.36	0.36	0.36	
	Delay	63.7	63.7	63.7	21.0	21.0	21.0	14.5	14.5	14.5	14.2	14.2	14.2	
2021 AM[(1)]														
W/ 24 Ave	LoS	B	B	B	C	B	B	B	B	B	B	B	B	B
Interchange	v/c	0.26	0.65	0.65	0.53	0.57	0.57	0.36	0.29	0.29	0.19	0.69	0.69	0.69*
(signalized)	Delay	12.5	12.0	12.0	20.6	11.2	11.2	19.1	13.0	13.0	14.9	17.1	17.1	13.0
W/O 24 Ave	LoS	B	B	B	C	B	B	C	B	B	B	C	C	B
Interchange	v/c	0.20	0.63	0.63	0.44	0.64	0.64	0.36	0.29	0.29	0.19	0.73	0.73	0.73*
(signalized)	Delay	11.7	13.3	13.3	25.8	18.8	18.8	22.2	15.9	15.9	17.8	20.4	20.4	16.9
2021 PM[(1)]														
W/ 24 Ave	LoS	C	B	B	C	D	D	C	D	D	C	B	B	C
Interchange	v/c	0.53	0.53	0.53	0.16	0.94	0.94	0.55	0.95	0.95	0.32	0.49	0.49	0.95*
(signalized)	Delay	21.3	16.1	16.1	21.8	41.8	41.8	27.5	43.4	43.4	29.9	15.8	15.8	31.4
(w/ sep NBR)	LoS	B	B	B	B	C	C	D	C	B	C	B	B	C
	v/c	0.48	0.47	0.47	0.14	0.83	0.83	0.77	0.70	0.44	0.15	0.59	0.59	0.83*
	Delay	17.5	11.6	11.6	17.4	24.7	24.7	39.5	27.3	11.8	21.7	19.6	19.6	20.6
W/O 24 Ave	LoS	C	B	B	C	D	D	C	D	D	D	B	B	C
Interchange	v/c	0.70	0.47	0.47	0.15	0.93	0.93	0.63	0.90	0.90	0.52	0.58	0.58	0.93*
(signalized)	Delay	31.0	14.8	14.8	21.4	38.6	38.6	32.4	36.8	36.8	42.2	18.3	18.3	29.4
(w/ sep NBR)	LoS	C	B	B	B	C	C	D	C	A	C	C	C	C
	v/c	0.63	0.45	0.45	0.14	0.83	0.83	0.77	0.65	0.35	0.22	0.65	0.65	0.83*
	Delay	23.9	11.9	11.9	19.2	26.7	26.7	40.2	25.4	7.8	21.8	20.2	20.2	21.4

Note: (1) assumed 5 lanes on 24 Ave @ 168 St by 2021

Table A7
24 Avenue / 176 Street Intersection Performance
- Signalized Intersection

		Eastbound			Westbound			Northbound			Southbound			Over
		L	T	R	L	T	R	L	T	R	L	T	R	-all
2004 AM														
Existing	LoS	B	B	B	B	B	B	B	A	A	B	A	A	B
	v/c	0.68	0.68	0.68	0.26	0.26	0.26	0.08	0.14	0.14	0.02	0.25	0.25	0.68*
	Delay	16.9	16.9	16.9	11.7	11.7	11.7	10.6	9.3	9.3	10.1	7.7	7.7	11.1
2004 PM														
Existing	LoS	B	B	B	B	B	B	B	B	B	B	A	A	B
	v/c	0.71	0.71	0.71	0.24	0.24	0.24	0.07	0.20	0.20	0.05	0.24	0.24	0.71*
	Delay	16.5	16.5	16.5	10.9	10.9	10.9	11.8	10.7	10.7	11.7	7.7	7.7	11.7
2021 AM														
W/ 24 Ave	LoS	E	D	D	D	B	B	B	B	B	E	B	B	C
Interchange	v/c	0.87	0.90	0.90	0.85	0.50	0.50	0.08	0.53	0.53	0.88	0.63	0.63	0.91*
	Delay	66.9	41.9	41.9	51.4	19.5	19.5	14.6	17.0	17.0	64.1	18.0	18.0	29.1
W/O 24 Ave	LoS	D	D	D	D	D	D	C	D	D	D	C	C	D
Interchange	v/c	0.79	0.87	0.87	0.77	0.74	0.74	0.07	0.76	0.76	0.78	0.62	0.62	0.87*
	Delay	37.6	46.7	46.7	40.9	41.7	41.7	31.9	40.1	40.1	38.9	23.4	23.4	37.6

		Eastbound			Westbound			Northbound			Southbound			Over
		L	T	R	L	T	R	L	T	R	L	T	R	-all
2021 PM														
W/ 24 Ave	LoS	E	B	B	B	E	E	C	C	C	F	C	C	D
Interchange	v/c	0.93	0.51	0.51	0.24	1.01	1.01	0.23	0.82	0.82	0.98	0.68	0.68	1.01*
	Delay	57.3	19.8	19.8	12.9	58.3	58.3	25.5	30.3	30.3	127	25.0	25.0	38.5
(w/ sep WBR)	LoS	E	C	C	B	D	B	C	C	C	F	C	C	D
	v/c	0.90	0.51	0.51	0.26	0.92	0.31	0.19	0.74	0.74	0.93	0.62	0.62	0.93*
	Delay	61.4	26.3	26.3	18.0	51.3	18.0	26.6	32.3	32.3	116	28.2	28.2	37.6
W/O 24 Ave	LoS	F	C	C	B	F	F	D	E	E	F	C	C	E
Interchange	v/c	1.03	0.43	0.43	0.21	1.06	1.06	0.32	1.00	1.00	0.99	0.67	0.67	1.06*
	Delay	91.2	24.3	24.3	17.3	82.0	82.0	41.4	69.9	69.9	89.5	28.1	28.1	59.1
(w/ sep WBR)	LoS	E	C	C	C	E	A	D	D	D	E	C	C	D
	v/c	0.94	0.47	0.47	0.24	0.97	0.42	0.26	0.93	0.93	0.92	0.62	0.62	0.97*
	Delay	67.4	27.4	27.4	20.0	64.4	8.6	36.0	53.5	53.5	70.4	24.5	24.5	44.5

Note: (1) assumed 5 lanes on 24 Ave @ 176 St by 2021

APPENDIX III

GENERAL RESIDENTIAL DESIGN GUIDELINES

GENERAL RESIDENTIAL DESIGN GUIDELINES FOR NORTH GRANDVIEW HEIGHTS (NCP AMENDMENT AREA)

1. Overview

The NGH NCP Amendment (NCPA) area complements and preserves the existing residential character of North Grandview Heights and establishes a high quality residential environment. This will be achieved through the Design Guidelines outlined below and through Building Design Guidelines (a Building Scheme) established through the subdivision and / or rezoning process as required by City policy. The Building Design Guidelines will be based on a residential character study conducted by a qualified Design Consultant. Any development or improvement in the area will be designed to meet the objectives and main design elements incorporated in the construction scheme to the approval of a qualified Design Consultant. All Multiple Residential and Cluster Housing development proposals will also be reviewed in accordance with the Development Permit Guidelines of Surrey's Official Community Plan.

2. Principles of Residential Design in North Grandview Heights NCPA Area

Ten principles to guide the design and development of residential projects in the amended North Grandview Heights NCPA were established by City Council through its approval of the Stage 1 NCPA report. Most of these principles are addressed through the applicable policies and development guidelines contained in the residential, buffering and transitional policies in the preceding sections of this report. To supplement the land use and development policies, a series of general Design Guidelines below will help guide the review of residential proposals in the area.

The ten principles approved by City Council are:

1. Retain a maximum number of existing trees;
2. Retain the existing suburban standard for streets, vehicles, pedestrians and cycling circulation;
3. Encourage the development of a wide range of housing types;
4. Encourage the enhancement of the existing features of the overall area pertaining to water-courses, drainage, topography, existing vegetation, regional heritage structures, views and access to light;
5. Ensure that "edge" conditions will provide effective interfaces between the proposed development and the existing neighbourhood conditions, taking into consideration density and massing;
6. Incorporate a Crime Prevention Through Environmental Design program (CPTED) based on the siting of dwellings and their relationship to open areas and streets in the neighbourhood and immediate vicinity;

7. Incorporate yard setbacks to clearly indicate definition between public, semi-public and private spaces;

8. Identify measures to ensure Single Detached dwellings address all street frontages appropriately;

9. Use building design solutions that will minimize the reflection of noise to other nearby residential developments; and

10. Retain the suburban characteristics of the area by encouraging the use of appropriate materials, architectural components and details to maintain and enhance the existing residential fabric in an overall cohesive character;

3. General Design Guidelines

3.1 Objectives

The main objective of these guidelines is to facilitate the coordinated development of an identifiable, pedestrian friendly residential neighbourhood with a 'rural' feel in which the natural beauty of the area is integrated with buildings reflecting natural materials and unique, high-quality design.

The Design Guidelines are intended to provide overall direction to achieve the intended neighbourhood character, preserve and enhance the natural environment and trees, encourage pedestrian access to destination areas, facilitate social interaction and achieve the overall development objectives defined in the amended NCP.

The overall identity and character of the neighbourhood will be largely determined by the appearance of the main streets and form / design of houses, pedestrian / cycling routes and public spaces used by the local residents. These guidelines focus on design principles that will be applicable throughout the neighbourhood. They will facilitate the development of individual sites in a manner that is consistent with the overall image of North Grandview Heights.

To achieve the principles and objectives, the Design Guidelines have been formulated to focus on:

- Yards abutting public streets and linear parks;
- Pedestrian / bike corridors, linkages and buffers;
- Tree preservation;
- Streets; and
- Residential buildings.

3.2 Design Guidelines for Yards Abutting Public Streets and Public Spaces

3.2.1 Gates

a. The character / design study of the area will determine if fences and entryways are to be allowed in the front yards.

b. Yards abutting the street have a strong impact in determining the character and livability of the street. The rear of Multiple Residential and Cluster Housing sites and Single Detached lots should help to unify the streetscape. The landscaping, definition of yard edges, and design of open areas along public streets should achieve continuity and be complementary to the existing housing in the area.

c. To maintain the continuity and quality of the streetscape, yards of townhouses and Cluster Housing along streets should be treated and landscaped as front yards of Single Detached lots.

d. Deeper setbacks from the public streets should be considered to reinforce the rural 'feel' of the neighbourhood in Cluster Housing and Multiple Residential developments.

e. Gates are not permitted at entrances in Cluster Housing or Multiple Residential developments.

f. Instead of gates, entrances to Cluster Housing and Multiple Residential sites should consider the use of architectural or landscaping elements which identify the threshold between public and private property. Any minor structure used for this purpose must also be located at the dominant front yard setback line.

g. A combination of walls, pavement change, landscaped medians, treed boulevards, arbours, trellises, pedestrian gatehouses, feature lighting posts, etc. are recommended for identification of the entrance to Cluster Housing and Multiple Residential developments.

3.2.2 Fences

a. No chain link fences will be permitted except as required at edges of environmental areas.

b. No fences will be permitted in front yard areas of Single Detached lots. Consistency of treatment of yards toward the street should be ensured by the use of shrubs and hedges as a standard boundary definition. This is also applicable to Cluster Housing sites.

c. All fences along side property lines abutting a flanking street should start at mid-point of the depth of the house. To maintain adequate sight angles at the intersection, only low landscaping

should be planted at the corner of the site or standardized deciduous trees that do not interfere with vehicle sight lines.

d. Any portion of private property between the fence and the property line should be landscaped (shrubs and climbers are suggested).

e. To maintain the overall Single Detached residential character of the neighbourhood, no fences will be allowed on Cluster Housing or Multiple Residential sites along public roads. If fences elsewhere are unavoidable, transparent fences could be recommended in combination with landscaping on both sides of the fence.

f. Continuous straight fences should provide a 0.60 m. wide space in front of the fence for landscaping on private property. Articulation, with landscaping on both sides of the fences, is recommended as an alternative in Cluster Housing developments.

g. No fence along side and / or rear property lines should be higher than 1.80 m. The upper 0.30 m. of the fence should be latticed.

h. Fences between lots should not start less than 3.60 m. from the front yard setback.

i. Rear yard fences (preferably wrought iron, picket fences, three board fences, low stone wall / wrought iron fence combinations, etc.) on lots along the major greenways and public open spaces, where required, should be no higher than 1.20 m., and used in combination with landscaping. The intent is to increase the overall width of the linear greenway by visually incorporating the landscaping on private lots to form part of the linear greenway or park and to provide natural surveillance for CPTED.

3.2.3 Driveways and Sidewalks

a. The construction materials for the driveways and sidewalks will be defined in the Building Design Guidelines for each project.

b. To reinforce the pedestrian dominance on the street, achieve the integration / continuity of landscaping on front yards, and allow for boulevards with regularly spaced trees, the following conditions will apply to all residential developments:

- On corner lots, the garage driveway should be provided from the secondary street as best as possible.
- Visual separation between individual parallel driveways should be achieved by way of landscaping.
- Continuity of public sidewalks should not be interrupted by the pavement of driveways (sidewalk pavement should be continued across the driveway pavement).

– The use of paving materials other than asphalt and a strong definition of edges is recommended. The driveway should be treated as part of the front yard landscaping.

3.2.4 Garages

a. A window should be provided on the side of the garage that is visible from the street.

b. Wherever possible, habitable rooms should be encouraged above the garage.

c. Reduce visual impact of garage doors by blending garage door with house building materials and design.

3.2.5 Service and Parking Areas in Multi Residential / Cluster Housing Sites

a. Recreational vehicle, visitor / common parking areas, garbage container enclosures, satellite dishes and other service elements should not be visible from a public street. If these structures are to be located toward the street, a 7.50 m. wide landscaped area (or equivalent to the front yard setback) should be provided toward the street. Shrubs and hedges should be considered to screen direct views to these service areas.

3.2.6 Gateway / Entrances to the Neighbourhood

a. An entry feature / neighbourhood identification sign will be constructed on the southeast corner of 32 Avenue and 160 Street. The entry feature will consist of an identification sign integrated into the architecture of the area, be lit and designed / constructed in consultation with the developer of the site, the City and the neighbourhood residents' association.

b. Other key entry points to the neighbourhood from both 28 Avenue and the north-south collector roads should also be considered for gateway and / or median treatment.

3.3 General Design Guidelines for Lineal Parks, Multi-Use Trails, Linkages and Buffers

3.3.1 General

a. These guidelines apply to the various components of the pedestrian / bike network that extends throughout the neighbourhood as identified on the open space and pedestrian / bicycle circulation plan. The network provides pedestrian and bicycle access to the neighbourhood parks, east-west through the community along the Grandview Heights Interceptor connecting to the Pioneer Greenway along Highway 99, and from the neighbourhood to the

City's main streets, while also offering additional opportunities for passive recreation.

b. The design of all linear parks and multi-use trails should consider the guidelines contained in the document entitled "Review of the Standards for Multi-Use Pathways" and the recommendations on gradients and physical design contained in Section B. 1 of the "City of Surrey Bicycle Blue Print."

c. Lighting of bicycle paths should consider the recommendations contained in the "Bikeway Design Supplement to the Urban Geometric Design Guide for Canadian Roads."

3.3.2 Multi-Use Pedestrian / Bicycle Trails Along Major Streets

a. Bike routes may be located off-street and consist of a 4.00 m wide pathway incorporated into the landscaped buffer.

b. Bike routes may be located on streets.

3.3.3 The Grandview Interceptor Linear Park / Multi-Use Trail

a. This main pedestrian / bicycle trail extends east-west through the amended NCPA area connecting the Highway 99 Corridor through to 176 Street. It connects with the three neighbourhood parks and will be accessed via secondary connections from the residential precincts within the plan area.

b. The width of the pathway within the Interceptor right-of-way should be a minimum of 4.0 metres to allow walkers, joggers and bikers to conveniently utilize the pathway. The pathway may meander within the right-of-way depending on its width and location.

c. Where secondary accesses to the Interceptor pathway occur, they should flare out toward the intersection with the Interceptor.

d. In some cases, access to the Interceptor may take place through Multiple Residential development or Cluster Housing sites. The recommended width for these connections is 8.00 m.

e. Generally, to improve the perception of safety and avoid the tunnel narrow passage effect, the recommended widths of off-street sidewalks are 3.00 m. The pathway will be widened as necessary to accommodate utility services if applicable.

f. A firm surface is recommended for all pathways and trails and the edges of the pathways should be clearly identifiable (the pathway may be gravel through planted areas).

g. Bollards and / or bike baffles should be used at the approaches to an intersection with a street.

h. To accommodate street crossings, changes in texture and / or colours should be introduced to the pathway surface, starting at 5.00 m. before reaching the bollards.

i. Direct connections from Multiple Residential or Cluster Housing sites to the pedestrian / bicycle trails should be located central to the trails length (if direct access is not provided from the individual dwelling units along the trail).

j. Lighting of the Interceptor trail is to be implemented as required by the City's Parks, Recreation and Culture Department.

3.3.4 Crime Prevention Through Environmental Design (CPTED)

a. Compliance with the City's Official Community Plan, CPTED recommendations and required in the design of the open space and pedestrian / bicycle circulation components of the NCPA.

b. Clear visual continuity of the pathway must be ensured by careful direct continuity and alignment of the various portions of the multi-use network, including the routes along local streets that connect with off-street pathways.

c. Sudden changes in alignment or interruptions of the trails should be avoided. Their alignment and dimensions should provide wide views and avoid a service alley character.

d. Dwelling units located along the multi-use trail are strongly encouraged to provide second floor windows and balconies toward the trail to increase opportunities for casual surveillance.

e. To help develop a sense of ownership over these public spaces, the provision of arbours, low gates and sidewalks from individual units to the trail is recommended. Where the trail is through a natural area, one to two shared access points per development are permitted to limit impacts on a sensitive area.

f. Lighting should increase the sense of security for both users and residents of the units fronting on the trail and / or open spaces.

g. Where necessary, pedestrian scale, low level lighting that does not interfere with the privacy of adjacent residential units is recommended.

h. Landscaping within multi-use trails that are 6.00 m. wide or less should consider low shrubs and plants only. In theses cases, trees should be planted at various setbacks from the path, on private yards abutting the trail, to avoid a tunnel effect.

i. Surrey Parks are closed from dusk until dawn.

3.4 Design Guidelines for Site Assessment and Tree Preservation

3.4.1 General

a. The purpose of Cluster Housing is to preserve significant natural environmental features, in particular trees, by providing flexibility in land use and the siting of buildings.

b. Efforts will be made to preserve as many quality trees as reasonably possible in Cluster Housing and Multiple Residential development sites in order to best maintain the natural characteristics of the area.

c. Property owners will be encouraged to develop in cooperation with neighbouring property owners as one larger site in order to preserve as many trees as possible and construct units on the areas on the site with the least numbers of existing quality trees.

3.4.2 Site Assessment

a. As part of the site planning and development application process a tree survey and arborist review (and environmental review where required) will be completed by qualified professionals for each property to identify and confirm the location, size, and quality of trees and other sensitive landscape features.

b. This information, as well as site topography, soil drainage conditions, and watercourses, will be used to identify areas on the site which should be preserved as much as possible from development and suitably reflected in the planning and design of the site.

3.4.3 Development Process

a. A conceptual development plan will be prepared for each site based on the natural terrain of the land, watercourses, and the quality trees identified on the site. The plan will complement the existing terrain and preserve as many quality trees as reasonably possible.

b. Cluster Housing and Multiple Residential units and driveways will be designed and located around identified existing quality trees.

c. The site design will minimize the amount of cut and fill required on the land to minimize the impact on trees and the environment. Utilities and driveways will be located where best to accommodate the preservation of existing trees.

d. Consideration of cut and fill slopes for roads and buildings, as well as work space requirements to install infrastructure and facilities should be considered in the tree retention design process.

e. All Cluster Housing developments will be Development Permits areas in order to best ensure high quality design and development and preservation of quality trees.

f. Construction methods and protection measures should be implemented in order to prevent tree damage and unnecessary tree loss.

g. Areas that contain significant trees may be considered for parkland and / or environmental open space dedication.

3.5 Design Guidelines for Private Buffers

3.5.1 General

a. As identified on the land use concept plan, where private buffers are required between differing land use densities, existing quality trees will be preserved and new trees planted as required to provide a substantial vegetated buffer to create a visual barrier.

b. Private buffers will be designed to separate existing and proposed land uses.

3.5.2 Design Guidelines

a. For lands in buffers, a tree survey and arborist review (and environmental review where required) will be completed by qualified professionals to identify the location, size, and quality of trees.

b. Existing quality trees will be preserved and additional trees planted as required to provide for an adequate buffer.

c. Additional planting in the form of shrubs and hedges will be included in the landscaped buffer.

d. The buffer will include an earth berm. The design and specifications of this berm will be determined at the time of development application.

e. Planting within the buffer will be with low-maintenance trees and plants.

f. Within the buffer a fence may be located. The design and specifications of this fence will be determined at the time of development application.

g. Private buffers will be designed to accommodate the principles of CPTED in order to minimize the potential for criminal activity.

h. No structures of any sort (example: sheds and play structures) will be located within the identified buffer areas.

i. The buffers will be secured by a Restrictive Covenant or Easement at the time of lot creation in order to ensure that landscaping and trees are preserved and no structures are constructed.

3.6 Design Guidelines for the Streets

3.6.1 General

a. The overall character in the North Grandview Heights Amendment area will be defined by the width, pavement textures and design of the streets. These guidelines indicate the intent of achieving a special character for the neighbourhood streets and acknowledge the need to use some special road standards to achieve the desired character.

b. Specific cross-sections for the streets are identified in the roads section of the NCPA document. Ongoing cooperation between the development proponents and the City will take place to confirm an appropriate cross-section to achieve the desired character, sustainability and operations objectives.

c. Intersections should consider curb extensions (narrowing) to reduce the crossing distance for pedestrians and lower vehicle speed. Curb narrowing (chokers) and landscaping (with trees) should be considered for every 6 – 8 on-street parking spaces.

d. Different textures or decorative pavers should be used at the major street intersections and at the crossings of the Interceptor trail.

e. The number of traffic signs at the interior of the neighbourhood should be minimized. Other traffic control devices are preferred. Wherever possible, if traffic signs are unavoidable, they should be grouped and mounted on light posts; single traffic signs on a single pole should be avoided.

3.6.2 Street Lighting

a. The type of lamp post and single luminaire similar to those used in Morgan Creek or equivalent, except instead of Stress-Crete concrete poles standard metal poles should be used, throughout the amended NCPA area. This type of lighting should be primarily oriented to serve pedestrian (i.e., lower, with a gentler glow and placed at shorter intervals).

b. Lamp posts and double luminaries should be considered on the median or boulevards along 160 Street at the entry to 32 Avenue.

c. For consistency from project to project, the type of lamp, its height, intensity, intervals, etc., will be coordinated by Engineering through the servicing agreement process.

3.7 Design Guidelines for Buildings

3.7.1 General

a. This set of guidelines focuses on achieving a harmonious architectural relationship and coordination among buildings, and the relationship between buildings and the street. It is expected that the presence of some architectural details throughout the neighbourhood and the establishment of several landmark / reference points will achieve a unity of character and provide a strong identity to the North Grandview Heights area.

b. It is recommended that focal points such as clusters of existing trees, benches, arbours, gateways, landmarks, etc. be developed in the linear open space system at intersections, viewpoints and streets.

c. Site layouts and designs should be based upon the principles of defensible space and provide ample opportunities for casual surveillance of public spaces (CPTED).

d. Site planning and building designs should be responsive to the contours and natural features of the site, and the specific conditions of the site (i.e., views, noise, slopes, etc.).

3.7.2 Design Guidelines for Residential Areas

a. The building materials and colours will be determined through the Building Design Guidelines prepared for each project.

b. The design of Cluster Housing projects along a public street and entry points should have a strong Single Detached character to recognize the Single Detached character of the North Grandview Heights area. The layout of the units should focus on the street and pedestrian access from the street should be considered for all units along a public road, although vehicular access will generally be from interior roads.

c. Garages should not be the dominant element on the streetscape or dominate the façade of Single Detached units. To achieve this objective, the following is recommended:

- It should be encouraged that garages be located behind or on the side of the house where possible.
- No carports or port-cocheres should be permitted;
- Garage doors should not occupy more than 40% of the house frontage and the garages should be is recessed at least 1.00 m. from the front of the house;

- Panel glazing, if used in the garage doors must complement the top of the garage opening and should not be the sunburst style; and

d. To retain some of the existing character of the area, the design of Single Detached and Cluster Housing units fronting on the street should incorporate, as a dominant façade component, one or more of the following architectural features / elements:

- Gable roof components with a 8/12 to 12/12 slope; gabled dormers; pitched roofs;
- Strong roof overhangs / eaves projections, the size of which is to be determined through the Building Design Guidelines;
- Louvered ventilation on gables;
- Porches; verandahs; horizontal siding and wide trim;
- Stucco should only be used in combination with other natural finishing material;
- The maximum height of a roof overhang over the main entrance to a house should not exceed more than 1½ storeys.

e. No vinyl siding will be permitted as an exterior cladding material.

f. No flat roofs will be permitted, except for small areas at rear of buildings – the recommended range of roof slopes is between 8/12 to 12/12.

g. No metal or red roof tiles, other tiles or duroid will be permitted. In keeping with the style established in Morgan Creek, cedar shakes are preferred. Other materials may be permitted subject to approval by the City of Surrey.

h. The maximum height for Single Detached and Cluster Housing units along 32 Avenue is 2 stories (9.5 m), and the maximum height for Single Detached and Cluster Housing units in other areas is 3 stories with the third floor within the roof (11.0 m) to reflect the Single Detached character of the area.

i. Cluster Housing along the local streets should provide a variety of forms, details and grouping that relate to a Single Detached street character, and should comply with the following:

- The design of grouped units along the street should not be repetitive, and duplex groups should avoid the mirror image effect;
- Where Cluster Housing front only Single Detached residential units, the quality of materials and overall design of the units should be compatible with the Single Detached units across the street; and

- To achieve visual diversity within the various projects, variations in building heights, separations, roof lines and setbacks may be considered between unit groupings.

j. Residential units exposed to side and rear views from public roads, parks, or linear walkways, should provide similar architectural detailing to the side and rear and street fronting elevations.

k. In order to achieve privacy on porches, verandahs, patios / decks of units located toward a public street or toward public open spaces / linear parks, the finished grade of the dwelling units should be above the level of the sidewalk or open space. No retaining wall will be allowed along property lines unless required as a result of strong natural site conditions.

l. Retaining walls, where absolutely necessary, shall not exceed 0.6 metres in height. If higher retaining walls are required, they must be terraced, with a rise of 0.6 metres per wall and a run of 0.9 metres per terrace to allow for landscaping between walls to soften the impact of the wall. Where a retaining wall faces the street, they must be screened by appropriate landscaping. The distance to a retaining wall from the front property line should be at least equal to the height of the retaining wall. A smooth finished grade or ground level transition from lot to lot is preferred. Where a fence is located on top of a retaining wall, the maximum total retaining wall and fence height is not to exceed Surrey Zoning Bylaw #12000.

3.7.3 Building Design Guidelines

In addition to the general Design Guidelines above, development proponents will be required to undertake Building Design Guidelines for each individual residential project. These Design Guidelines should reflect the existing character of the area. The Building Design Guidelines will set the parameters for dwelling design and lot restrictions with respect, but not limited, to the following.

a. General
- Topography
- Water Courses
- Trees, Vegetation & Parks
- Road Networks
- View Potential
- Low-impact stormwater management practices
- Solar orientation
- Alternative energy systems (i.e., geothermal)
- Green building practice such as LEEDS or equivalent
- Linear Park

- Proximity to Highway / 32nd Avenue (Noise Control)
- Mitigate traffic noise
- Pedestrian & Bicycles Networks
- Double frontage lots

b. Architectural Features
- Rural / Suburban Character
- Density and Massing
- Housing Types
- Landscaping (Hard and Soft)
- Existing Trees and Vegetation
- Architectural Detailing

c. Specifics, Standards and Objectives
- Main Design Objectives and Architectural Components
- Definition of Architectural Character
- Siting, Setbacks and Usable Outdoor Space
- Relation of Building to Street
- Lot Grading
- Building Coverage
- Building Area
- Retaining Walls
- Units Orientation
- Tree Preservation
- Landscaping
- Driveways and Sidewalks
- Fencing (Privacy and Decorative)
- Accessory Buildings / Structures
- Dwelling Sizes and Types
- Building Height and Massing
- Corner Lots Treatment
- Roof Design
- Roof Pitch
- Roof Overhangs and Rainwater Leaders
- On-Site Parking
- Balconies, Decks and Patios
- Foundation Exposure
- Siding Finishes
- Roofing Form / Materials
- Skylights
- Fascias, Bargeboards
- Colours
- Accent Materials & Trims
- Windows / Fenestration

- Entry Treatment
- Chimneys and Flues

d. Restrictions
- Materials
- Secondary Suites
- Appearance During Construction
- Design Repetition
- Drainage Easements
- Rights of Way
- Location of Meters
- Front Yard Finishes

APPENDIX IV

WATER ANALYSIS

Technical Memorandum

DATE: August 25, 2005

TO: James Kay, P.Eng., Aplin & Martin Consultants Ltd.

FROM: Eric Morris, P.Eng.

RE: **WATER SYSTEM PLANNING FOR NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD COMMUNITY PLAN (NCP) AMENDMENT**
Water Servicing Analysis
Our File 2191.003

1. INTRODUCTION

1.1 SCOPE

The existing "North Grandview Heights" Neighbourhood Community Plan (NCP) area is located between 28 Avenue and 32 Avenue, from Highway 99 to Highway 15 (176 St.) in South Surrey. An NCP amendment is proposed for portions of the NCP area west of 168 Street. This memorandum addresses the interim and ultimate water servicing strategy for the developments associated with the NCP amendments.

The scope of this report includes the following items:

- Derivation of interim and ultimate demand loading according to the site plan (attached), Kerr Wood Leidal Associates Ltd. (KWL) demand database, and City of Surrey Design Criteria Manual. The following demand loadings are developed:

  1. Interim and ultimate fireflow demands.
  2. Interim and ultimate maximum day and peak hour demands.

- Perform a hydraulic analysis using the City of Surrey's water model to develop interim and ultimate servicing strategies.

1.2 BACKGROUND

LAND USE

The area included in the North Grandview Heights NCP Amendment is shown on Figure 1. It has an area of approximately 114 hectares (282 acres), and is bounded by the Grandview/Highway 99 Corridor Plan area to the west, 32nd Avenue to the north, 28th Avenue to the south and 168th Street to the east. The amendment area includes approximately 33% of the total North Grandview Heights NCP area of 339 hectares (838 acres).

The Land Use Plan for the North Grandview Heights NCP Amendment includes the following land uses:

- an Elementary School off of 160 Street (west-side);
- several neighbourhood and linear parks;
- single detached housing (2 to 6 UPA);
- cluster housing (6 to 8 UPA); and
- multi-family housing (15 to 25 UPA).

Of note, the proposed land use outlined in the NCP amendment is higher density than the previous NCP land use designations for the area, namely:

- one acre residential (RA);
- one acre residential gross density (RA-G); and
- existing one acre/half acre lots.

To the south of the North Grandview Heights development is the "Morgan Heights" development which is currently in the NCP review stage (Grandview Heights #1). For analysis it has been assumed that both the Morgan Heights and North Grandview Heights developments proceed simultaneously.

PREVIOUS WATER SERVICING STUDIES

Water servicing for the entire Grandview area including the proposed development is described in the 2005 Grandview Pump Station Pre-Design Report[1].

[1] Kerr Wood Leidal Associates for the City of Surrey, ***Grandview Pump Station Pre-Design***, Final Report, January 2005.

2. DESIGN CRITERIA

The City of Surrey's Design Criteria Manual (DCM), May 2004 was used to set the design criteria for assessing system requirements. The applicable criteria are summarized below.

2.1 SITE DESIGN WATER DEMANDS

Land use and unit densities for the Grandview Heights area were obtained from the "North Grandview Heights Neighbourhood Concept Plan, Beech Developments Inc. and Southtrac Holding Inc." (attached).

Demands for the site were estimated using two methods:

1. Design Criteria Manual: Maximum day demand (MDD) of 1,000 L/ca/day (for fireflow calculations), and peak hour demand (PHD) of 2,000 L/ca/day (for minimum pressure constraint). This method gives a total MDD and PHD for the development of 71 L/s and 142 L/s respectively. This method was used to develop demands for the ultimate scenario.

2. Water Model Method: As used in the City's water model and the Grandview Pump Station Pre-Design. Maximum day demand made up of 320 L/ca/day base demand plus an additional seasonal demand of 26,300 L/ha/day[2]. Peak hour demand constituted by 410 L/ca/day plus 55,000 L/ha/day. In addition a 20% "safety factor" was applied to the above demand rates. This method gives a total MDD and PHD for the development of 66 L/s and 118 L/s respectively. This method was used to develop demands for the interim scenario.

Population loading rates were developed using rates given in the Design Criteria Manual for South Surrey namely:

- detached units: 2.9 ca/lot; and
- townhouse units: 2.3 ca/lot.

A detailed breakdown of the demands for the proposed NCP sub-areas is attached as Table 2-1.

As stated in Section 1.2, the land use in the North Grandview Heights NCP amendment area was originally specified as "One Acre Residential". This land use was used to develop water servicing for the Grandview area in the 2005 Grandview Pump Station

[2] Based on lot area only, excludes proposed public road right-of-ways.

Pre-Design Report. The factored MDD and PHD loadings (Water Model Method) for the NCP amendment land use are 21 L/s and 27 L/s higher than the loadings developed based on the original NCP land use.

2.2 DEMANDS TO ENTIRE GRANDVIEW AREA

Demands for the remainder of the Grandview Area are as developed in the Grandview Pump Station Pre-design Report.

2.3 PRESSURE

The required system water pressures from the Design Criteria Manual are summarized in the following table.

Table 2-2: Pressure Design Criteria

Description	Pressure m H_2O (psi)
Minimum pressure at Peak Hour Demand	28 (40)
Minimum pressure coinciding with Fire Flow and Maximum Day Demand	14 (20)

2.4 FIREFLOWS

Applicable fire flow requirements from the DCM are summarized below.

Table 2-3: Fireflow Criteria

Land Use	Interim Fire Flow (L/s)	Design Fire Flow (L/s)
Single-Family Residential (RF, RF-SS, RF-G, RF-12, RF-9)	45	60
Multiple Residential (RM-10, -15, -19, -30, -45)	90	120
Institutional (School)	90	120

Of note, the interim fireflow requirement is only to be used if the existing water system can be used to provide an interim fire flow, which will be eventually supplemented by future system expansion/looping (as part of a phased development or a City improvement in the 10-year capital plan).

2.5 MINIMUM MAIN SIZE

The DCM requires 200 mm diameter watermains as a minimum main size except for the last 100 m of dead-end watermains which may be smaller diameter.

2.6 VELOCITIES / HGL GRADIENTS

The DCM requires:

- a maximum HGL gradient of 0.5% (5 m/km) for mains larger than 250 mm diameter; and
- maximum velocity of 2 m/s for ultimate design flows, and 3.25 m/s where an interim fire flow is required.

2.7 SEISMIC DESIGN STANDARDS

The North Grandview Heights Area is not in a seismically vulnerable zone as defined in the City's DCM.

3. WATER SERVICING IN GRANDVIEW AREA

3.1 EXISTING PRESSURE ZONES

The North Grandview Heights development currently lies partly in the westernmost sub-zone of the Kensington 110 m Zone, partly in one of the Eastern sub-zones of the Kensington 110 m Zone and partly in the Morgan Creek 80 m Zone. The neighbouring Grandview Heights NCP #1 area lies partly within the westernmost sub-zone of the Kensington 110 m Zone and partly within the 142 m Grandview Zone.

Pressure zone boundaries are shown in Figure 1; the zones are described in the following sections.

142 M GRANDVIEW ZONE

The 142 m Grandview Zone includes all of the high ground east of Highway 99 in South Surrey. Ground elevations in the current zone range from 15 m to 112 m. The high point is located just south of the reservoir at the intersection of 23 Avenue and 166 Street. The zone elevations are predominantly above 70 m elevation with the exception of Agricultural Land Reserve (ALR) land located east of 176 Street on 16th Avenue.

The 142 m Grandview Zone is supplied by the Grandview Pump Station. No balancing or fire storage is available at the zone HGL, hence the pump station must provide

maximum day demand flows concurrently with fireflows, and peak hour flows. The existing Grandview Pump Station is presently operating at capacity and cannot service additional demands. A replacement pump station with greater capacity is targeted for completion in 2006.

110 M KENSINGTON ZONE

The 110 m Kensington Zone lies north of the 142 m Grandview Zone. Elevations in the zone currently range from 25 m to 95 m in elevation. The zone is currently sub-divided into several unconnected 'sub-zones.'

The westernmost sub-zone is supplied via a connection at King George Highway and 24 Avenue from either:

- the 15500 - 24 Avenue PRV from the GVRD (current normal operation); or
- the City's 24 Avenue low-pressure main to the Semiahmoo Zone supplymain (used in hydraulic analysis).

This sub-zone also serves as the supply to the 80 m Morgan Creek Zone.

The eastern sub-zones (3) currently are supplied via PRV stations fed from the Grandview Zone at:

1. 29 Avenue and 164 Street;
2. 28 Avenue and 168 Street; and
3. 26 Avenue and 172 Street.

80 M MORGAN CREEK ZONE

The 80 m Morgan Creek Zone is wholly fed from the 110 m Kensington Zone (from the westernmost sub-zone) via five PRV stations (located on or north of 32 Avenue).

Elevations in this zone range from 5 m to 45 m. The zone is separated from the 80 m Elgin Zone to the west by Highway 99.

Based on a review of aerial photographs taken in April 2004, it was determined that the Morgan Creek Zone will be in an essentially built-out condition during interim servicing; therefore OCP demands are included in this zone in both the interim and ultimate condition.

4. SERVICING FOR NORTH GRANDVIEW HEIGHTS NCP AREA

Interim and ultimate water servicing strategies have been developed for the North Grandview Heights NCP Amendment Area. As previously mentioned, the Grandview Heights NCP #1 area lies directly south of the North Grandview Heights NCP area, and is expected to develop simultaneously. As a result, the Grandview Heights NCP #1 area has been included in the water modelling, and the water servicing strategies have been developed in conjunction.

The system upgrades for the interim and ultimate servicing strategies are based on the recommendations of the KWL Grandview Pump Station Pre-design Report (Option B-2). This ensures that the proposed pressure zone boundary changes and infrastructure upgrades are in accordance with the City's water system upgrade plans.

4.1 DESCRIPTION OF INTERIM SERVICING STRATEGY

The requirement for an interim servicing strategy is driven by the fact that the existing Grandview Pump Station cannot support additional demands. A portion of the Grandview Heights NCP #1 area lies within the 142 m Grandview Zone, and any development that occurs in this zone cannot place additional demands on the Grandview Pump Station. Therefore, an interim servicing strategy that removes area from the 142 m Grandview Zone and provides an alternate source of supply to the 110 m Kensington zone (which is partly fed by PRV from the Grandview Zone) has been developed. The reduction in demand on the Grandview Pump Station that results from these changes allows for interim development to proceed in the 142 m Grandview Zone.

The pressure zone boundaries have been revised for interim servicing as shown in Figure 2. The zone boundary changes are summarized as follows:

- the Kensington West Sub-Zone is extended eastward to 166 St. by constructing a new watermain on 28 Ave. between 160 St. and 162 St.
- the 110/142 m zone boundary between 160 St. and 164 St. is shifted southward.
- the area between 29/32 Avenue and 164/168 Street is placed in a 90 m pressure zone.

In order to evaluate the interim servicing condition, the North Grandview Heights NCP Amendment and the neighbouring Grandview Heights NCP #1 development infrastructure and demands were added to the City of Surrey's calibrated water model and simulations were conducted for maximum day plus fireflow and peak hour demands. A servicing strategy that satisfies the City of Surrey design criteria for peak hour pressure, fireflows and maximum pipe velocity and headloss was then developed.

The recommended changes to existing infrastructure and upgrades required for interim servicing are summarized in Table 4-1 below (also refer to Figure 2). Included in this

table are minimum pipe sizes required to service only the NCP areas. Refer to Section 4.3 for an overview of supply and demand in each pressure zone and feedermain discharges.

When reviewing Table 4-1, please note the following:

- Some tasks are required for servicing both the North Grandview Heights NCP Amendment and Grandview Heights NCP #1; others are required for only one of the NCP areas. This information is provided in the "NCP" column.
- New on-site watermains, which are typically 200 mm diameter have not been included in Table 4-1.
- It is assumed that appropriate valves and settings to handle interim/ultimate zone boundary changes are incorporated into new watermain construction, and therefore these items are not listed as separate tasks.

Table 4-1: Tasks Required for Interim Water Servicing of NCP Areas

Task	NCP[1]	Description	Length (m)	Diameter (mm) Existing/Proposed/ Minimum for NCP Servicing
1	Both	Construct low-pressure (110 m HGL) watermain on 24 Avenue from the existing Grandview reservoir westward to 164 Street.	460	0/750/500[2]
2	Both	Construct low-pressure (110 m HGL) watermain on 24 Avenue between 164 Street and 160 Street.	850	0/750/500[2]
3	Both	Construct low-pressure (110 m HGL) watermain on 160 Street from 24 Avenue to 28 Ave.	820	0/600/400[2]
4	NGDVW	Construct 160 Street watermain between 28 Avenue and 32 Avenue to the Morgan Creek Zone.	805	0/500/200
5	Both	Construct 28 Avenue watermain linking 160 Street to 162 Street (links 110 m Kensington sub-zones).	400	0/300/300
6	Both	Construct 162 Street watermain linking 28 Avenue to 29 Avenue.	200	0/200/200
7	Both	Upgrade 164 Street watermain linking 29 Avenue and 30 Avenue (+/-).	205	152/250/250
8	NGDVW	Upgrade 164 Street watermain south of 164 St. and 30 Ave. PRV Station.	10	152/200/200
9	NGDVW	Upgrade watermain on Helc Place	180	152/250/250
10	NGDVW	Construct 160 St. and 30 Ave. PRV Station	N/A	N/A
11	Both	Decommission 164 St. and 29 Ave. PRV Station	N/A	N/A

Task	NCP[1]	Description	Length (m)	Diameter (mm) Existing/Proposed/ Minimum for NCP Servicing
12	Both	Modify piping/valves at the intersection of 28 Ave. and 164 St. to accommodate zone boundary change.	N/A	N/A

Notes:
1. NGDVW = North Grandview Heights NCP Amendment; GDVW#1 = North Grandview Heights NCP #1.
2. Minimum pipe size is based on the ultimate zone boundaries; a minimum 600 mm diameter pipe is required for interim servicing of the NCP areas.

Revised PRV Station settings for interim servicing are as follows:

- New 160 St. and 30 Ave. PRV Station: HGL = 78 m;
- 164 St. and 30 Ave. PRV Station: HGL = 90 m; and
- 168 St. and 30 Ave. PRV Station: HGL = 80 m (Fireflow Only).

In addition to the PRV setting changes listed above, a valve will be closed on 164 St. north of the new watermain tie-in (south of 32 Ave.) to separate the 80 m Morgan Creek and the new 90 m pressure zone as shown in Figure 2.

4.2 DESCRIPTION OF ULTIMATE SERVICING STRATEGY

For the ultimate water servicing strategy it is assumed that the new Grandview Pump Station is completed and OCP demands are present in all locations of the city. The following changes are made to the pressure zone supply and boundaries:

- The 110/142 m pressure zone boundary between 160 St. and 164 St. is shifted northward to the location recommended in the KWL Grandview Pump Station Pre-design Report as shown in Figure 3.

- Supply to the Morgan Creek Zone via the 24 Avenue low-pressure main to the Semiahmoo Zone supplymain is assumed to be terminated and supply is switched to the 160 St. low-pressure main (i.e. the Grandview Reservoir); in addition, the zone HGL is raised to 90 m nominal HGL. These changes in supply are in accordance with the recommendations of the KWL Grandview Pump Station Pre-design Report.

The recommended changes to existing infrastructure and upgrades required for ultimate servicing are summarized in Table 4-2 below (also refer to Figure 3). Included in this table are minimum pipe sizes required to service only the NCP areas. Refer to Section 4.3 for an overview of supply and demand in each pressure zone and feedermain discharges.

Table 4-2: Tasks Required for Ultimate Water Servicing of NCP Areas

Task	NCP[1]	Description	Length (m)	Diameter (mm) Existing/Proposed /Minimum for NCP Servicing
13	Both	Upgrade watermain on 28 Ave. between 160 St. and 158 St.	400	321/400/400
14	NGDVW	Upgrade watermains on 156 St. north of 28 Ave. and Mountain View Drive	960	160/200/200
15	N/A	Obsolete	N/A	N/A
16	GDVW#1	Construct high pressure (142 m HGL) watermain on 24 Avenue from the existing Grandview reservoir westward to 164 Street	460	321/500/500

Notes:
1. NGDVW = North Grandview Heights NCP Amendment; GDVW#1 = North Grandview Heights NCP #1.

Revised PRV Station and valve settings for ultimate servicing are as follows:

- new 160 St. and 30 Ave. PRV Station: HGL = 90 m; and
- valve opened on 164 St north of new watermain tie-in (south 0f 32 Ave) to join 90 m pressure zones.

4.3 SUMMARY OF DISCHARGE RESULTS AND PRESSURE ZONE DEMANDS

Supply sources for the 142 m Grandview Zone, 110 m Kensington Zone and 80/90 m Morgan Creek Zone for the interim and ultimate servicing strategies are summarized Table 4-3 below along with peak hour demands from the NCP areas within these zones.

Table 4-3: Summary of Pressure Zone Supply Sources and NCP Area Peak Hour Demands

Zone	Supply Sources and NCP Area Demands	
	Interim	**Ultimate**
Morgan Creek 80/90 m Note: Interim zone area includes a portion of 110 m West Sub-Zone north of 32 Ave. to allow for comparison with ultimate zone area values.	▪ PRV feeds from Kensington 110 m West Sub-Zone (HGL = 78 m, PHD = 233 L/s) ▪ Low-Pressure Main from Grandview Reservoir on 160 St. via PRV Station at 30 Ave. (HGL = 78 m, PHD = 133 L/s) ▪ PRV Feed from 110 m Kensington Zone at 164 St. and 30 Ave. (HGL = 90 m, PHD = 33 L/s) ▪ Fireflow Feed from PRV Station at 168 St. and 30 Ave. (HGL= 80 m, PHD = 0 L/s) ▪ *NCP Demand (80 m Zone) = 32 L/s* ▪ *NCP Demand (90 m Zone) = 28 L/s* ▪ *Rest of Zone = 339 L/s*	▪ Low-Pressure Main from Grandview Reservoir on 160 St. via PRV Station at 30 Ave. (HGL = 90 m, PHD = 366 L/s) ▪ PRV Feed from 110 m Kensington Zone at 164 St. and 30 Ave. (HGL = 90 m, PHD = 32 L/s) ▪ Fireflow PRV Feed from 110 m Kensington Zone at 168 St. and 30 Ave. (HGL = 80 m, PHD = 0 L/s) ▪ *NCP Demand (b/w 164/168 St.) = 12 L/s* ▪ *NCP Demand (east of 164 St.) = 32 L/s* ▪ *Rest of Zone = 354 L/s*
Kensington 110 m	▪ Low-Pressure Main from Grandview Reservoir on 160 St. (PHD = 235 L/s) ▪ Supply from Kensington 110 m West Sub-Zone via a 155 mm diameter crossing of Highway 99. (PHD = 10 L/s) ▪ *NCP Demand (North Grandview NCP) = 59 L/s* ▪ *NCP Demand (Grandview NCP #1) = 23 L/s*	▪ Low-Pressure Main from Grandview Reservoir on 160 St. (PHD = 541 L/s) ▪ *NCP Demand (North Grandview NCP) = 98 L/s* ▪ *NCP Demand (Grandview NCP #1) = 17 L/s*

5. SUMMARY AND RECOMMENDATIONS

The North Grandview Heights NCP amendment area is located between 28 Avenue and 32 Avenue, and from Highway 99 to 168 Street in South Surrey. It is situated within the 110 m Kensington and 80 m Morgan Creek pressure zones. Interim and ultimate water servicing strategies have been developed for the area and are summarized below.

INTERIM SERVICING STRATEGY

For the interim condition, the pressure zones are modified by extending the Kensington West Sub-Zone eastward to 166 St. and shifting the 110/142 m zone boundary southward between 160 St. and 164 St. The area between 29/32 Avenue and 164/168 Street is placed in a 90 m pressure zone.

It is proposed that the North Grandview Heights NCP Amendment area be supplied by a new low-pressure feedermain to be constructed from the Grandview Reservoir to the 110 m Kensington Zone via 24 Avenue and 160 Street. Several watermain upgrades are also proposed to improve conveyance within the 80 m Morgan Creek and 110 m Kensington Zones.

In addition to these watermain upgrades, it is recommended that a new PRV Station be constructed on the low-pressure watermain at the Morgan Creek/Kensington zone boundary; this station will reduce the HGL to 78 m. The following existing PRV stations will also have operational changes:

- The 164 St. and 30 Ave. PRV Station will have a revised HGL setting of 90 m.
- The 168 St. and 30 Ave. PRV Station will have a revised HGL setting of 80 m and will provide fireflows only.
- The 164 St. and 29 Ave. PRV Station will be decommissioned.

Once the infrastructure described above is in place, the entire North Grandview Heights NCP amendment area can be developed while maintaining acceptable peak hour pressures and fireflows.

ULTIMATE SERVICING STRATEGY

For the ultimate condition, the 110/142 m pressure zone boundary between 160 St. and 164 St. is shifted northward to the location recommended in the KWL Grandview Pump Station Pre-design Report and the Morgan Creek Zone is assumed to be supplied by the 160 St. low-pressure main alone.

Several local watermain upgrades are required to achieve acceptable fireflows and pressures. It is recommended that the new 160 St. and 30 Ave. PRV Station setting be changed to 90 m HGL to supply a 90 m Morgan Creek pressure zone.

KERR WOOD LEIDAL ASSOCIATES LTD.

Prepared by: Reviewed by:

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Technical Review

EM/am
Encls.

STATEMENT OF LIMITATIONS

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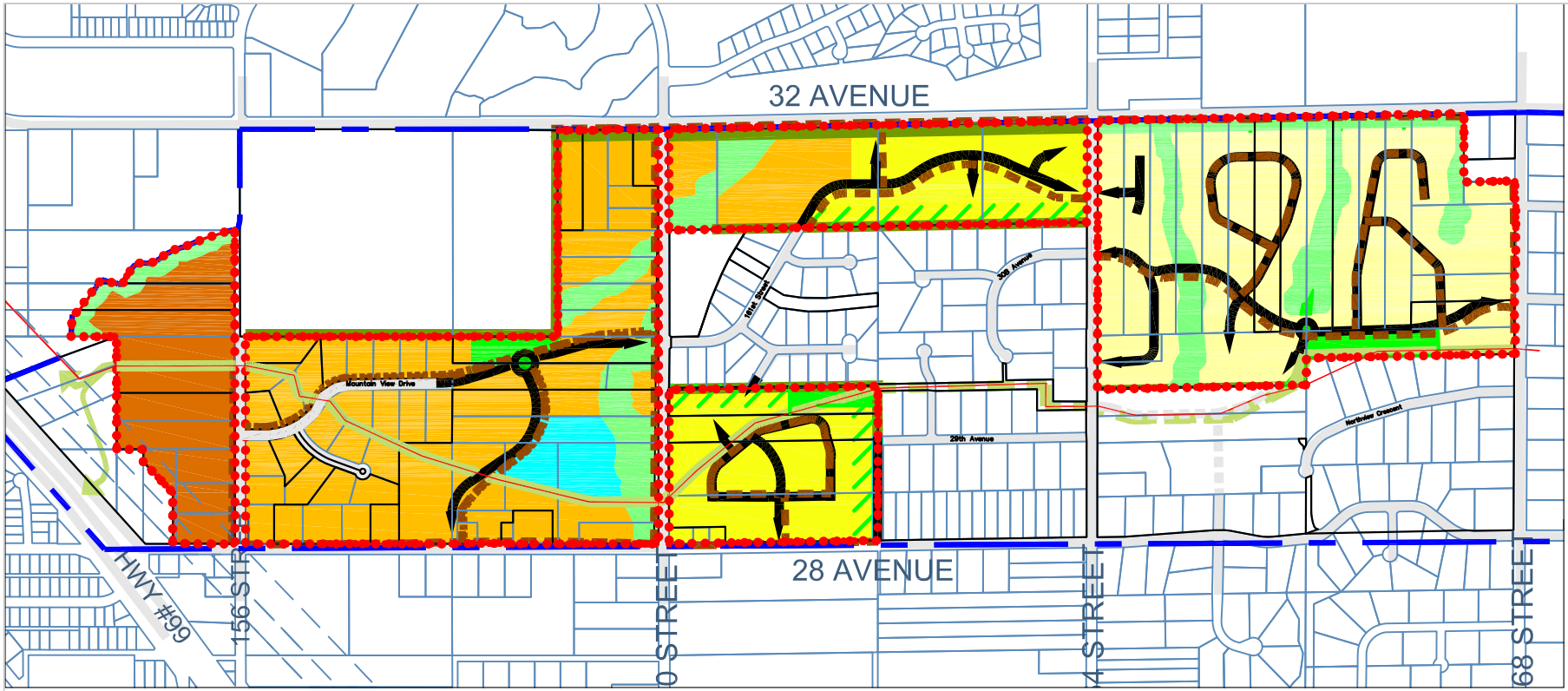
Table 2-1: Water Demands

Section	Land Use	Area (acres)	Units per Acre	Units	Population per Unit	Population	CITY OF SURREY DCM				WATER MODEL				
							Fire Flows (L/s)		D (L/s)	H (L/s)	Bdres (L/s)	BD-ICI (L/s)	SD (L/s)	MDD (L/s)	PHD (L/s)
							Ultimate	Interim							
2	MF	14.7	25	366.6	2.3	843	120	90	9.8	19.5	3.1	0.0	1.8	5.9	9.3
1	MF	13.6	25	339.2	2.3	780	120	90	9.0	18.1	2.9	0.0	1.7	5.5	8.6
3	CH	11.6	8	92.9	2.9	269	120	90	3.1	6.2	1.0	0.0	1.4	2.9	5.1
4	CH	35.3	8	282.3	2.9	819	120	90	9.5	19.0	3.0	0.0	4.3	8.9	15.6
12	Park	2.0	0	0.0	0	0	0	0	0.0	0.0	0.0	0.0	0.2	0.3	0.6
9	SF	29.2	6	175.0	2.9	507	60	45	5.9	11.7	1.9	0.0	3.6	6.6	11.9
7	CH	14.6	8	116.5	2.9	338	120	90	3.9	7.8	1.3	0.0	1.8	3.7	6.4
8	SF	21.7	6	129.9	2.9	377	60	45	4.4	8.7	1.4	0.0	2.7	4.9	8.8
10	SF	52.4	2	104.7	2.9	304	60	45	3.5	7.0	1.1	0.0	6.4	9.1	17.9
11	SF	39.5	2	79.1	2.9	229	60	45	2.7	5.3	0.8	0.0	4.9	6.9	13.5
6_1	CH	8.2	8	65.8	2.9	191	120	90	2.2	4.4	0.7	0.0	1.0	2.1	3.6
6_3	CH	10.7	8	85.5	2.9	248	120	90	2.9	5.7	0.9	0.0	1.3	2.7	4.7
6_2	School	8.4	0	0.0	0	750	120	90	8.7	17.4	0.0	0.5	1.0	1.9	3.4
5	CH	20.2	8	161.9	2.9	469	120	90	5.4	10.9	1.7	0.0	2.5	5.1	8.9
TOTALS		282.0		1999.4		6125			70.9	141.8	19.9	0.5	34.7	66.2	118.5

Q:\2100-2199\2191-003\400-Work\[WaterDemands_revised2.xls]Gdvw Hts Table 2-1



LEGEND

- Single Detached (2 upa)
- Larger Transition Lots (2-3 upa)
- Single Detached (4-6 upa)
- Cluster Housing (6-8 upa)
- Multifamily (15-25 upa)
- Environmental Area
- Neighbourhood Park
- Linear Park / Multi-use Trail
- Enhanced Sidewalk / Walkway
- Landscaped Buffer
- Elementary School
- Existing Public Road
- Proposed Public Road (local road location subject to detailed design)
- Approximate Intersection Location (Subject to detailed design)
- Round-about
- Amendment Area
- North Grandview Heights Area Boundary
- North Grandview Gravity Sewer Interceptor

Notes:
(1) This plan is conceptual in nature and is intended to reflect a general pattern of land uses. Land use boundaries will be confirmed within the context of detailed rezoning and subdivision applications.
(2) Density refers to units per-gross acre of land.
(3) All development should obtain an Arborist report to determine the number of trees that can be preserved.

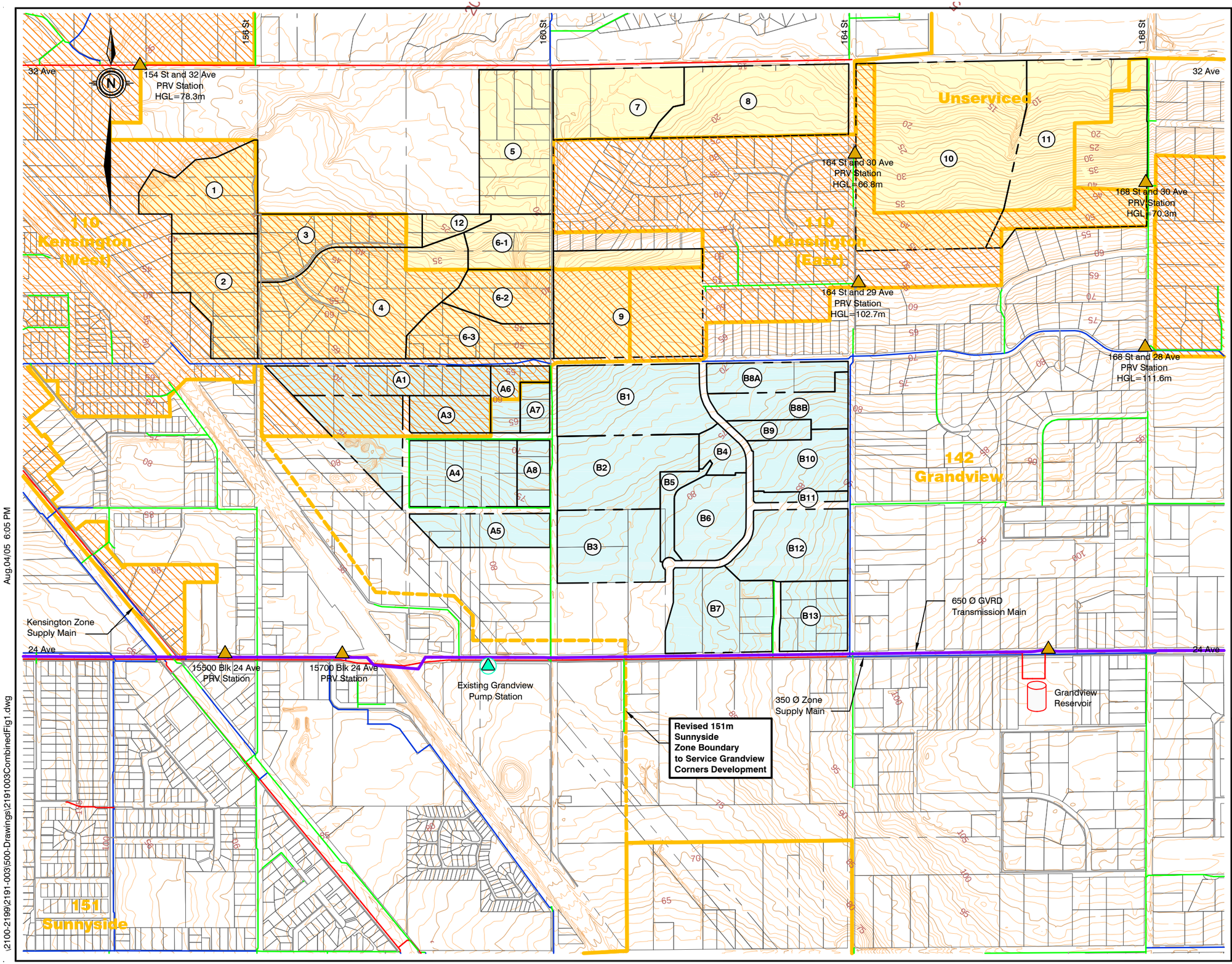
N

APLIN MARTIN CONSULTANTS LTD

NORTH GRANDVIEW HEIGHTS
NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

2005 NCP amendment area land use plan plan



Aplin and Martin
Grandview NCPs
Water System Planning

Legend

- Section Boundary
- GVRD Transmission Main
- Pump Station
- Reservoir
- PRV
- Pressure Zone Boundary
- 1m Contour
- 5m Contour
- North Grandview Heights NCP Ammendment Area
- Grandview Heights NCP #1 Area
- Section Number (Refer to Table 2-1)

Water Main Diameter (mm)

- ≤ 150
- 150 - 250
- 300
- > 300

Notes:

1. Topographic elevations are in metres to geodetic datum.

KERR WOOD LEIDAL associates limited
CONSULTING ENGINEERS

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Scale in Metres

Project No.	Date
2191-003	August 2005

Existing Infrastructure and Pressure Zones

Figure 1

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Aplin and Martin
Grandview NCPs
Water System Planning

Legend

- Section Boundary
- GVRD Transmission Main
- Pump Station
- Reservoir
- PRV
- Pressure Zone Boundary
- 1m Contour
- 5m Contour
- North Granview Heights NCP Amendment Area
- Grandview Heights NCP No. 1 Area
- Revised Pressure Zone Boundary
- N/C — Normally Closed Valve
- New Watermain
- 152/250/250 Ø — New Watermain Diameter Existing/Proposed/Minimum Required to Service NCP Area

Notes:

1. Topographic elevations are in metres to geodetic datum.
2. On-site watermains shown are included in hydraulic model and are schematic. Additional watermains will be required for on-site servicing.
3. Minimum based on ultimate pressure zone boundaries; a minimum 600 Ø pipe is required for interim servicing.
4. WaterCAD scenario = Revised Interim 2

KERR WOOD LEIDAL associates limited
CONSULTING ENGINEERS

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Scale in Metres

Project No.	Date
2191-003	August 2005

Interim Servicing Infrastructure

Figure 2

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APPENDIX V

SANITARY SERVICING STRATEGY

NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

SANITARY SERVICING STRATEGY

BY
APLIN & MARTIN CONSULTANTS LTD.

August 26, 2005

Project No. 24206

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NORTH GRANDVIEW HEIGHTS NCP AMENDMENT

SANITARY ANALYSIS

1.0 INTRODUCTION

This report presents the sanitary sewer infrastructure analysis for the Morgan Creek system considering the addition of flows from North Grandview Heights Neighbourhood Concept Plan Amendment. It also provides preliminary servicing designs for each development area. The basis of the changes in population used in this report is from the proposed land use strategy presented in Section 2 of the NCP document.

2.0 SERVICING STRATEGY

The North Grandview Heights Neighbourhood Concept Plan (NGH NCP) area is generally serviced by septic tanks and drain fields. As identified in the 1999 North Grandview Heights NCP the ultimate concept for servicing this area relies, in part, upon gravity and pumped connections to the existing Morgan Creek system.

Sewage from the North Grandview Heights area bound by 32 Avenue in the north, the Grandview North Gravity Interceptor in the south, 170 Street in the east and 156 Street in the west will feed into the Morgan Creek sanitary sewer system, with the exception of an area in the northeast corner. Sewage will flow by gravity to Morgan Creek Sewage Pump Station #1. Sewage from Morgan Creek Pump Station #1 is pumped to Morgan Creek Pump Station #2 from which it is in turn pumped to the GVS&DD Crescent Road pressure sewer leading to the siphon sewer crossing the Nicomekl River at approximately 135A Street and Crescent Road.

The area bound by the Grandview North Gravity Interceptor in the south and west, 156 Street in the east and Morgan Creek (Titman Creek) in the north was originally included in the design catchment area for Morgan Creek Pump Station #2. Due to environmental and topographical constraints in constructing a gravity sewer to connect to the Morgan Creek Pump Station #2 sewer system, this area has been designed with a pump station to pump sewage into the Grandview North Gravity Interceptor. Subsequently it has been removed from the Pump Station #2 catchment area. There is still a small component of this area, north of the creek and south of 32 Avenue that continues to drain to the Morgan Creek System.

There is an area of approximately 9.5 hectares immediately south of 32 Avenue and west of 168 Street that would require pumping to the Morgan Creek sanitary sewer system based upon the site topography. With the few number of lots affected they could individually pump into low pressure sewer systems and connect to the gravity mains where required.

Figure 1 identifies the existing sanitary catchment zones and the existing Morgan Creek pump stations.

3.0 CAPACITY ANALYSIS

The detailed calculations for the existing sanitary sewer infrastructure that will be affected by this NGHNCP Amendment are included as **Tables 1 - 5** and illustrated in **Figures 2 - 4**. The Sewer Analysis charts utilize a conservative estimation of flows, (based on maximum population densities), and follow the City's design methodology of capacity based upon a maximum of 70% depth of flow relative to the capacity of the pipe.

Analysis of the existing pressure sewers suggest that there is adequate capacity in the existing force mains pumping from both pump stations to accommodate these flows. However, there are five segments of gravity sewer, two tributary to PS#1 and three to PS#2, totaling 392 metres, that would exceed the City's design target of 70% depth of flow. As shown in **Table 1**, the segments from S60 to S68 and S8 to S7 may exceed the capacity of the existing pipes, with surcharges of 55 and 33mm respectively. As shown in **Table 5**, segments from S15 to S16, S16 to S17, S3A to S2 would operate up to 79% depth, though would still be capable of conveying the theoretical peak flows.

Since these segments and are generally located within existing subdivisions and installed at substantial depths, monitoring is recommended to confirm the adequacy of these sections under actual flow conditions. As such, because the computed flows are marginally over Surrey design criteria capacity, should replacement or upgrading be required, alternative technologies such as pipe bursting should be considered.

4.0 REQUIRED UPGRADES

Within the Morgan Creek system, Pump Station #1 has a duplex submersible pumping station configuration, (two pumps installed, one duty, and one standby) with an existing capacity of 46.7 Litres/sec. The existing theoretical design flows from the Morgan Creek catchment are 46.7 Litres/sec; however, with the increased density associated with the proposed Amendment, the theoretical total design flows increase to 73.5 Litres/sec. The capacity of Pump Station #1 can be increased to 73.5 Litres/sec by replacing the existing pumps, installing new starters, and replacing the control kiosk. Installation of a standby generator and creation of additional emergency storage capacity is required at this station.

Pump Station #2 has a triplex submersible pumping station configuration, (two pumps installed with provision for a third identical pumping unit in future). The existing capacity with one duty pump, one standby, is 130 Litres/sec. With the third pump installed the capacity will increase to 215 Litres/sec. The existing theoretical design flows from the Morgan Creek catchment are 176 Litres/sec; however while the increased density will result in a design flow of 208.3 Litres/sec. Assuming the third pump is installed under the City of Surrey 10-year Servicing Plan Project ID #7733, Pump Station #2 will have the required capacity to service the projected design flows for the current NGH NCP as well as this Amendment.

5.0 SERVICING DESIGN

The preliminary layout of the sewers throughout the Amendment area as shown on **Figures 5 - 17** is based upon existing ground elevations. As such, it is demonstrated that this servicing concept is feasible; however, the actual depths and grades of the proposed services will be established at the detailed design stage. Designers are to ensure that minimum pipe grades of 0.5% and maximum pipe depths of 3.5m, as per City of Surrey design criteria, are maintained wherever possible. All layouts are preliminary and flexible, and services will be adjusted accordingly. Basement homes are to be accommodated throughout the NCP lands.

Figures 5 and 6 illustrate a conceptual servicing concept of the cluster development located west of 160 Street. Currently the westerly section of sewer is identified as having four servicing alternatives: extra-depth sewer; dual sewers, rear-yard sewer through the park; or private lift station. If the design road grades can be lowered to accommodate standard depth (3.5m) and still service the lands to the northwest, this is the preferred alternative. Otherwise, a gravity feed from the northeast through the park at standard depth is a viable alternative.

This gravity system will drain east to 160 Street and south in a new sanitary sewer. The cluster developments along 160 Street will connect to this new sewer, and ultimately drain to the existing manhole at the intersection of 32 Avenue and 160 Street.

Figures 7 and 8 illustrate a conceptual servicing concept of the single-family development located east of 160 Street and north of 28 Avenue. This system is designed as an interim solution until the Interceptor phase east of 160 Avenue moves forward. As such, this system must provide a gravity connection for the lots to the east along 28 Avenue.

The profile of this alignment currently shows two manholes that exceed standard depth. This situation is expected to be avoided by either cutting the high ground with the road profile or raising the sewer alignment and filling near SANMH411A. Otherwise, permission for City of Surrey Operations will be required to allow the additional depth.

Figures 9 and 10 illustrate a conceptual servicing concept of the westerly portion of single-family development located on 30A Avenue immediately north of Wills Brook Road and south of 32 Avenue. These lands can be serviced with gravity sewers at standard depths. The existing walkway containing sanitary sewers will provide the outlet for this development.

Figures 11 and 12 illustrate a conceptual servicing concept of the easterly portion of single-family development located on 30A Avenue south of 32 Avenue and west of 164 Street. These lands can be serviced with gravity sewers at standard depths. A connection to an existing manhole and 200mm main on 164 Street will be required and the side-yard servicing will require a walkway.

Figures 13 to 17 illustrate a conceptual servicing concept of the single-family development located south of 32 Avenue between 164 and 168 Streets. These lands have three creek crossings, and as a result, the avoidance of extra-depth manholes is important. A pipe-bridge is proposed for the middle creek crossing. Several side-yard walkways are proposed. Further, due

to the existing topography, there are lots along 32 Avenue and 168 Street that will likely require pumped connections and forcemains in the street to connect to a nearby gravity sewer. The entire system will drain northwest to the existing manhole at the north part of the intersection of 32 Avenue and 164 Street.

Table 6 provides preliminary sewer design calculations based on the preceding profiles. Although the slopes of several sections of sewer have been assumed to be either 1 or 2%, the critical sections have all been verified in the profiles. Consequently, the majority of the minor sanitary sewer systems will be 200mm, with manholes 1-4 in the lands east of 164 Street to be 250mm if the grades remain at 0.25%.

6.0 SUMMARY

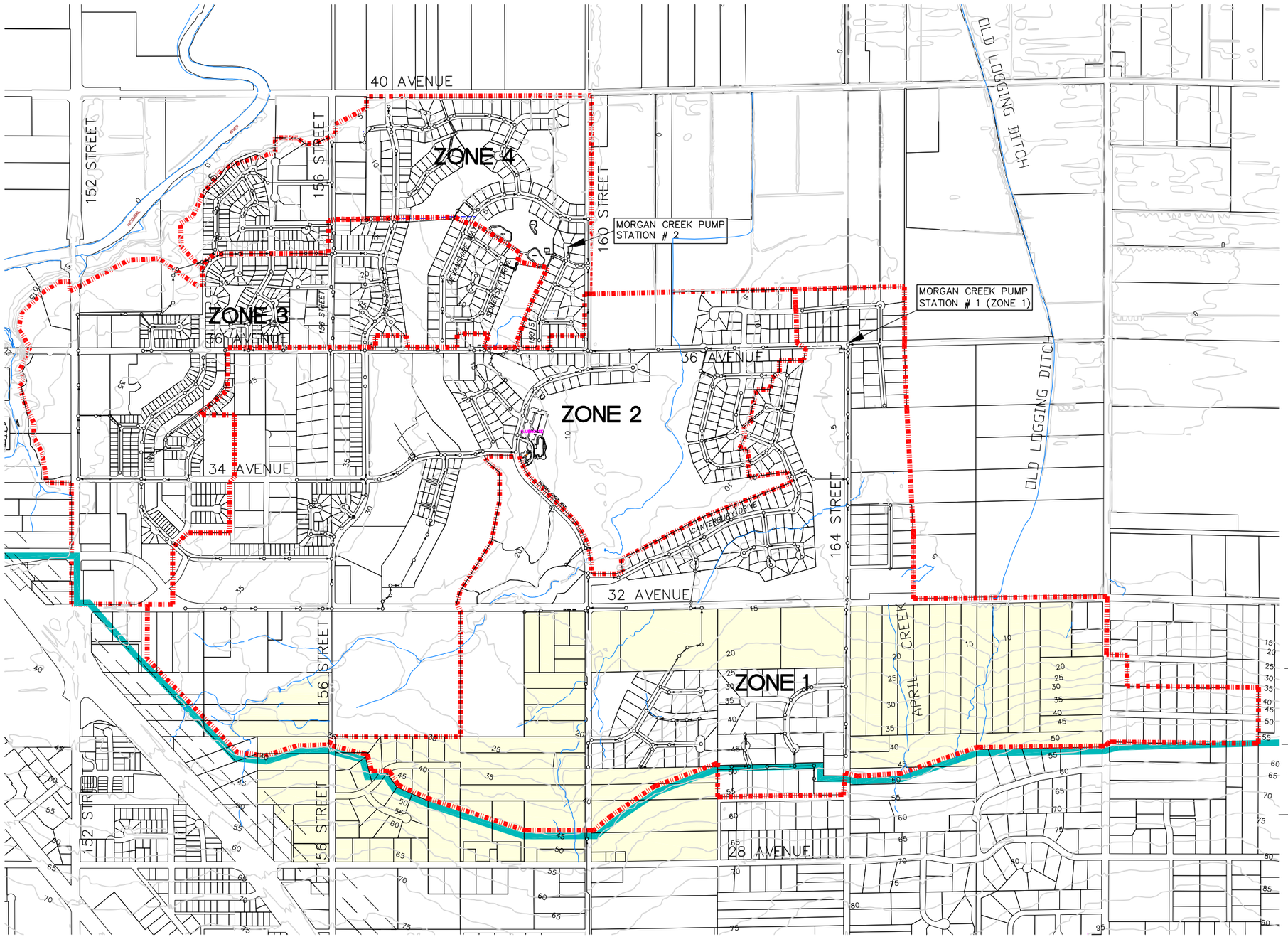
The City's long-term sanitary servicing plans for the North Grandview Heights NCP Amendment area involves sewer infrastructure in both the Morgan Creek and Grandview Interceptor systems. To accommodate the sewage flows from the increased population associated with the proposed North Grandview Heights NCP Amendments the following upgrades and additions to the sanitary sewer system are required:

1. Increase the capacity of Morgan Creek Pump Station #1 to 73.5 Litres/sec by replacing the existing pumps, providing a standby generator, and additional emergency storage. This will service the area bound by 32 Avenue in the north, the Grandview North Gravity Interceptor in the south, 170 Street in the east and 156 Street in the west. This upgrade would be a requirement of the approval for applications within the North Grandview Heights NCP Amendment area.

2. Install the third pump and standby generator at Morgan Creek Pump Station #2 to increase the capacity to 215 Litres/sec. The timing for this upgrade will be driven by measured inflow to this pump stations from within the entire catchment area. Funding will be from the City current DCC 10-year Servicing Plan Project #7733.

3. Construct Phase 1 of the Grandview North Gravity Interceptor. (Proponent driven, either as part of the Grandview Heights #1 or North Grandview NCP's) This will service the area bound by the Grandview North Gravity Interceptor in the north, 28 Avenue in the south, 162 Street in the east and Croyden Drive in the west within the North Grandview Heights NCP area, as well areas to the south of 28 Avenue. Until the Interceptor is built there is no capacity in the existing sanitary sewer system to support development to the south of the Grandview North Gravity Interceptor alignment. Development of the area west of 156 Street and east of the BC Hydro right-of-way which will likely have a pumped sewage system is also dependent on the construction of the Interceptor.

4. Construct the network of 200 and 250mm internal sanitary mains to direct flows to the Morgan Creek catchment or the future Interceptor stub at 160 Street. These mains will be designed to accommodate basement homes throughout the Amendment area.



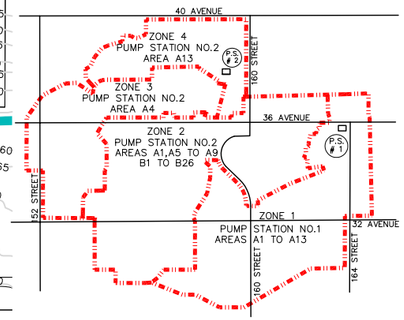
LEGEND

- EXISTING SANITARY
- PROPOSED SANITARY
- NORTH GRANDVIEW INTERCEPTOR
- MAJOR CATCHMENT BOUNDARY
- SUB-CATCHMENT BOUNDARY
- EXISTING WATERCOURSE
- EXISTING CONTOUR
- FUTURE ROAD
- (B1) SUB-CATCHMENT AREA NAME
- RM-10 ZONING
- PROPOSED MH NUMBER
- (98A) EXISTING MH NUMBER

G	GOLF COURSE
RA	SUBURBAN ACRES 5 UNITS PER HECTARE
RH	SUBURBAN HALF-ACRE RESIDENTIAL 5 UNITS PER HECTARE
RF	SINGLE FAMILY RESIDENTIAL 15 UNITS PER HECTARE
RF-G	COMPACT SINGLE FAMILY RESIDENTIAL 18.5 UNITS PER HECTARE
CD	CLUSTER HOUSING (AT SINGLE FAMILY DENSITY) 15 UNITS PER HECTARE
RM-10	MULTI FAMILY
RM-15	TOWNHOUSE 37.1 UNITS PER HECTARE
RM-30	GARDEN APARTMENTS 50 UNITS PER HECTARE
PA-1	INSTITUTIONAL RESIDENTIAL
C-5	NEIGBOURHOOD COMMERCIAL 75 PEOPLE PER HECTARE
RMS-1	INSTITUTIONAL RELIGIOUS 50 PEOPLE PER HECTARE
IB	BUSINESS PARK 90 PEOPLE PER HECTARE

NOTE: POPULATION DENSITY = 2.9 PEOPLE PER LOT
2.3 PEOPLE PER TH UNIT

NOTE: MANHOLE DESIGNATION D301, D302, ... ETC IN SANITARY CATCHMENT PLAN IS EQUIVALENT TO D1, D2, ... ETC. IN DESIGN DRAWINGS.



INSET

N

APLIN MARTIN CONSULTANTS LTD

NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

overall catchment plan

1

MORGAN CREEK PUMP STATION # 1 (ZONE 1)

ZONE 2

ZONE 1

36 AVENUE

32 AVENUE

28 AVENUE

164 STREET

156 STREET

OLD LOGGING DITCH

APRIL CREEK

GOLF COURSE CPG

CANTERBURY DRIVE

CEMETERY (NOT INCLUDED IN CATCHMENT AREA) PC

SCHOOL

CLUSTER HOUSING (CD)

SOUTHRAC SUBURBAN HOUSING (CD)

LEGEND

- EXISTING SANITARY
- PROPOSED SANITARY
- FUTURE SANITARY
- MAJOR CATCHMENT BOUNDARY
- SUB-CATCHMENT BOUNDARY
- EXISTING WATERCOURSE
- EXISTING CONTOUR
- FUTURE ROAD
- (B1) SUB-CATCHMENT AREA NAME
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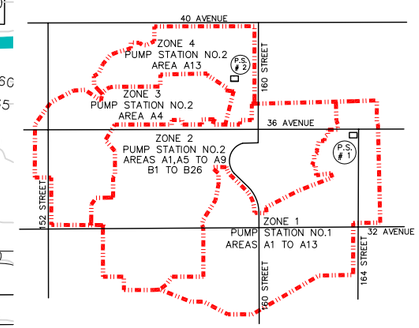

INSET

N

APLIN & MARTIN CONSULTANTS LTD

NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

sanitary catchment zone 1

2

ZONE 3

ZONE 2

ZONE 1

36 AVENUE

34 AVENUE

32 AVENUE

156 STREET

159 STREET

164 STREET

SOMERSET DR

ELEMENTARY SCHOOL (P1)

PARK

GOLF COURSE

GOLF COURSE CPG

RM-10

RM-15

RM 30

RMS-1

IB

PC

CEMETERY
(NOT INCLUDED IN CATCHMENT AREA)

CD

RA

RH

RF

PLUMP HOUSE

MORGAN CREEK WAY

CANTERBURY DRIVE

EXISTING 200ø SAN

B1 B2 B3 B4 B5 B6 B7 B9 B10 B11 B12 B13 B14 B15 B16 B17 B18 B19 B20 B22 B23 B24 B26 B27

S1B S2 S4 S6A S9 S11 S12 S13 S14 S15 S16 S17 S18 S27 S30 S32 S50 S51 S52 S53 S54 S55 S56 S57 S58 S59 S60 S61 S68

LEGEND

- EXISTING SANITARY
- PROPOSED SANITARY
- FUTURE SANITARY
- MAJOR CATCHMENT BOUNDARY
- SUB-CATCHMENT BOUNDARY
- EXISTING WATERCOURSE
- EXISTING CONTOUR
- FUTURE ROAD
- (B1) SUB-CATCHMENT AREA NAME
- RM-10 ZONING
- PROPOSED MH NUMBER
- (S99A) EXISTING MH NUMBER

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INSET

40 AVENUE
ZONE 4 PUMP STATION NO.2 AREA A13
ZONE 3 PUMP STATION NO.2 AREA A4
ZONE 2 PUMP STATION NO.2 AREAS A1,A5 TO A9 B1 TO B26
ZONE 1 PUMP STATION NO.1 AREAS A1 TO A13
36 AVENUE
32 AVENUE
152 STREET
160 STREET
164 STREET
P.S. #2
P.S. #1

N

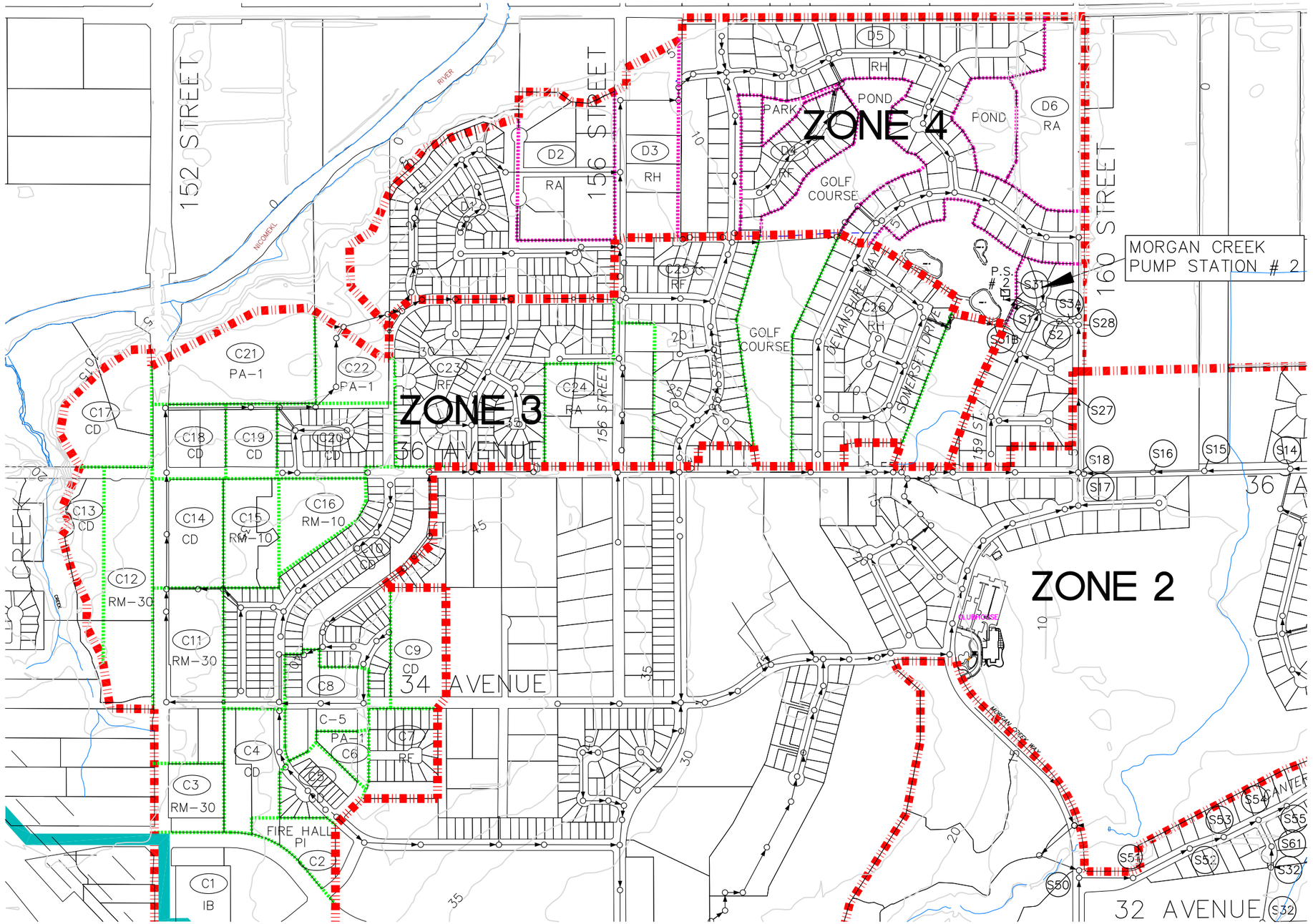
APLIN MARTIN CONSULTANTS LTD

NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

sanitary catchment zone 2

3



LEGEND

- EXISTING SANITARY
- PROPOSED SANITARY
- FUTURE SANITARY
- MAJOR CATCHMENT BOUNDARY
- SUB-CATCHMENT BOUNDARY
- EXISTING WATERCOURSE
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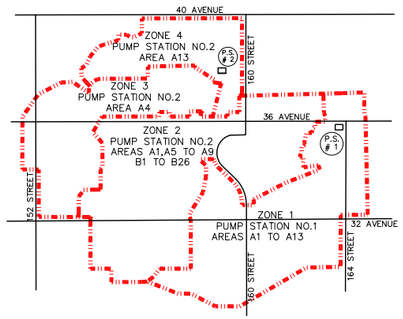


INSET

N

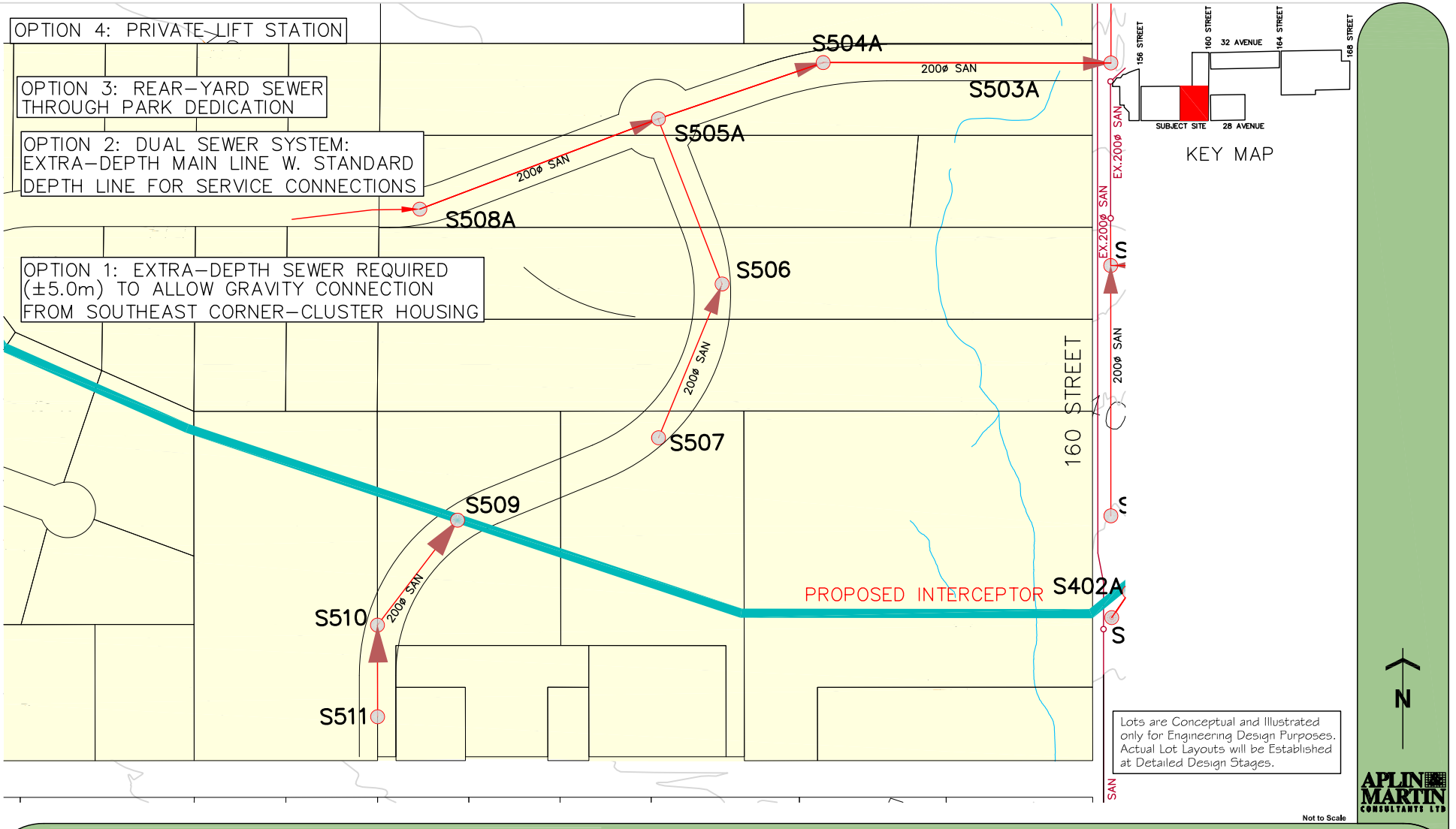
APLIN MARTIN CONSULTANTS LTD

NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

sanitary catchment zone 3 & 4

4



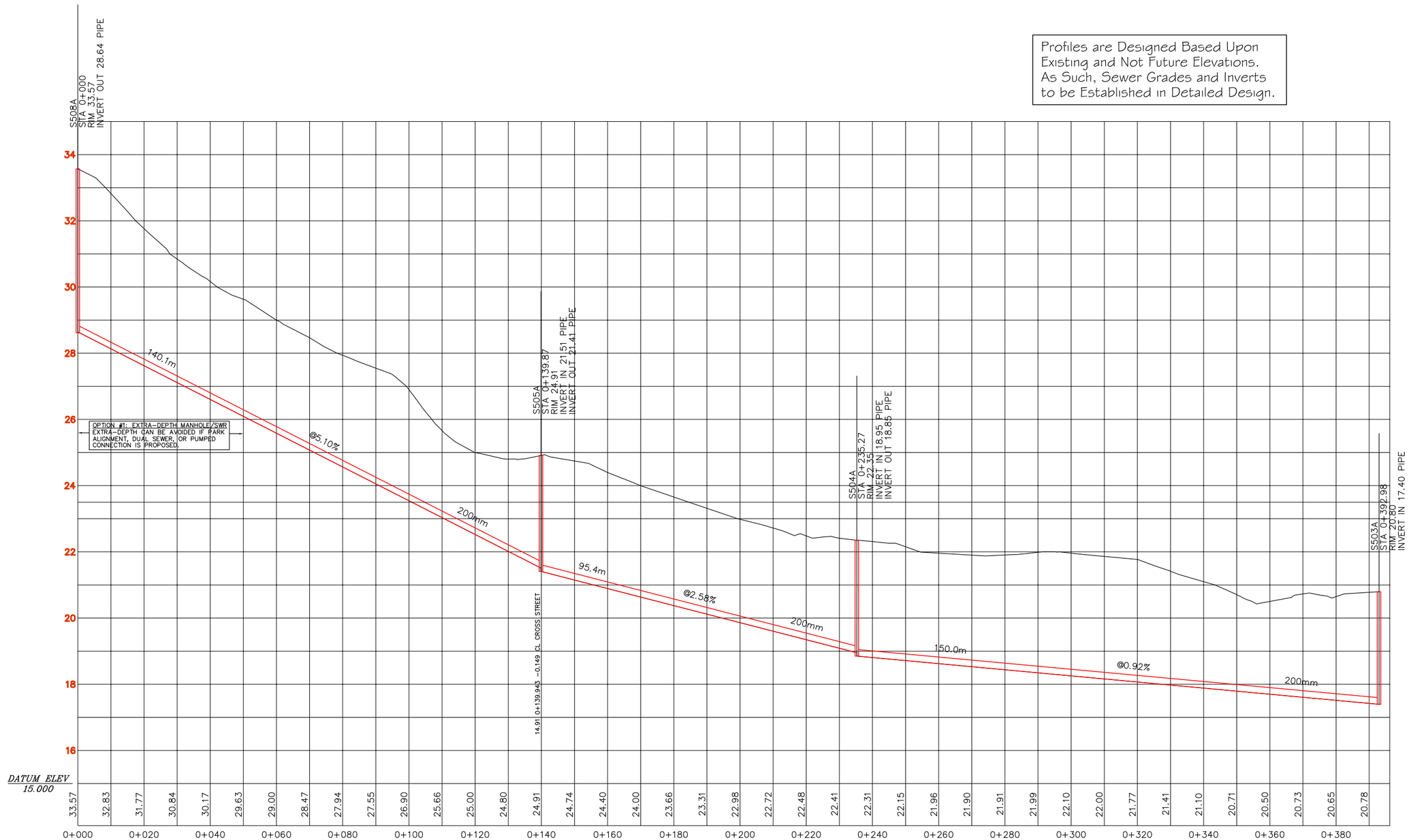
NORTH GRANDVIEW HEIGHTS
NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

proposed minor sanitary system west of 160 Street

5

Profiles are Designed Based Upon Existing and Not Future Elevations. As Such, Sewer Grades and Inverts to be Established in Detailed Design.



Not to Scale

N

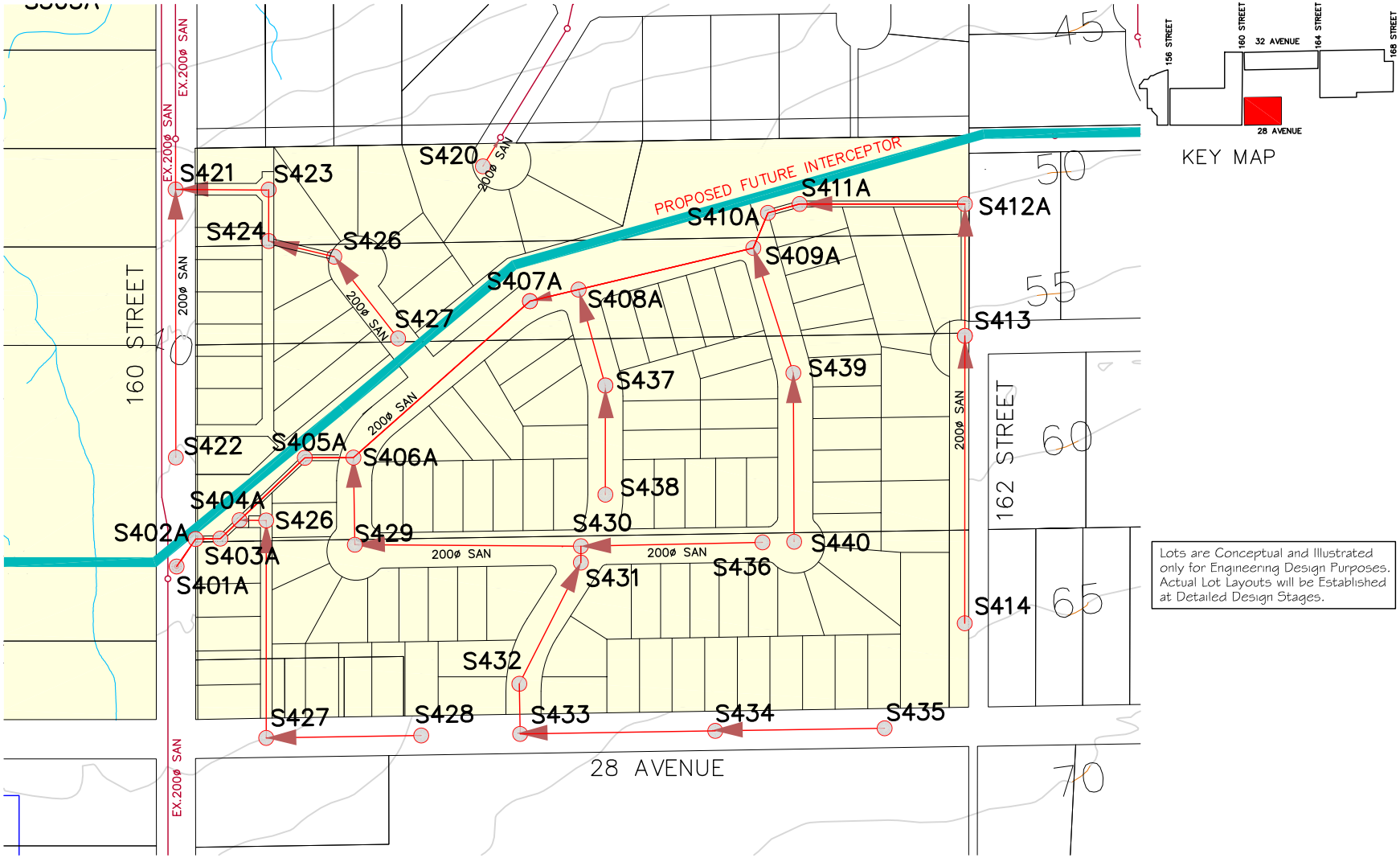
APLIN MARTIN CONSULTANTS LTD

NORTH GRANDVIEW HEIGHTS
NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

proposed minor sanitary profile west of 160 street

6



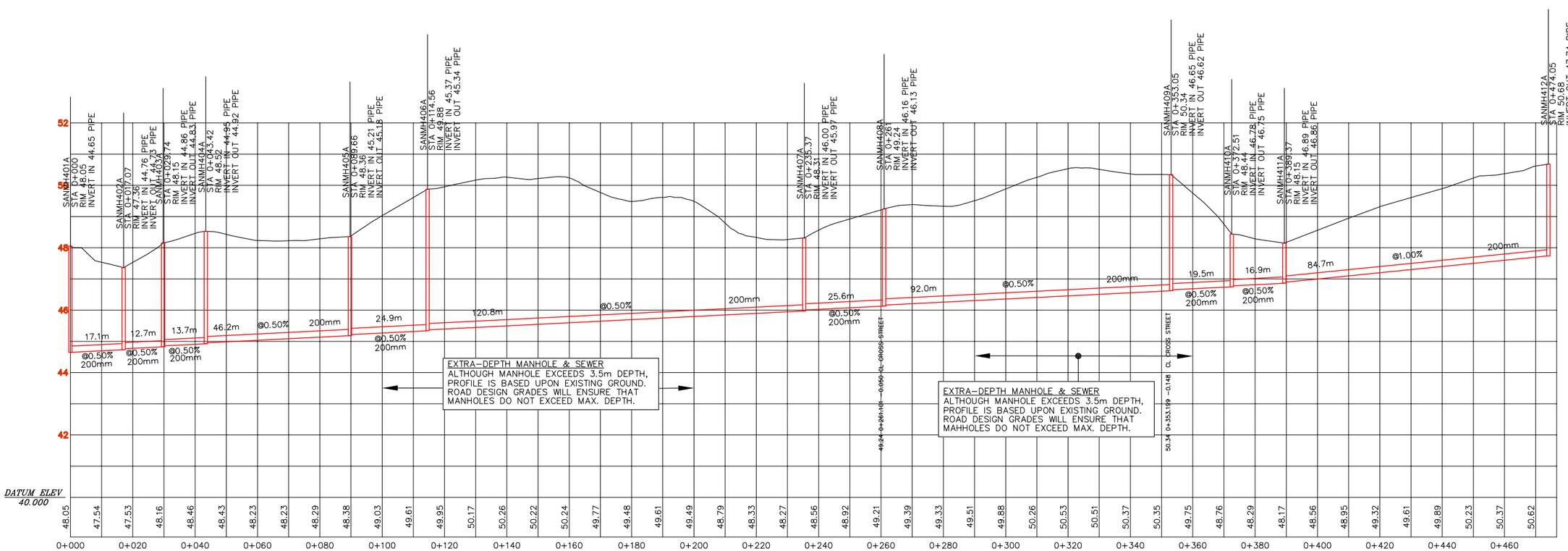
APLIN MARTIN CONSULTANTS LTD

NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

proposed minor sanitary system east of 160 Street, north of 28 Avenue

7



Profiles are Designed Based Upon Existing and Not Future Elevations. As Such, Sewer Grades and Inverts to be Established in Detailed Design.

Not to Scale

N

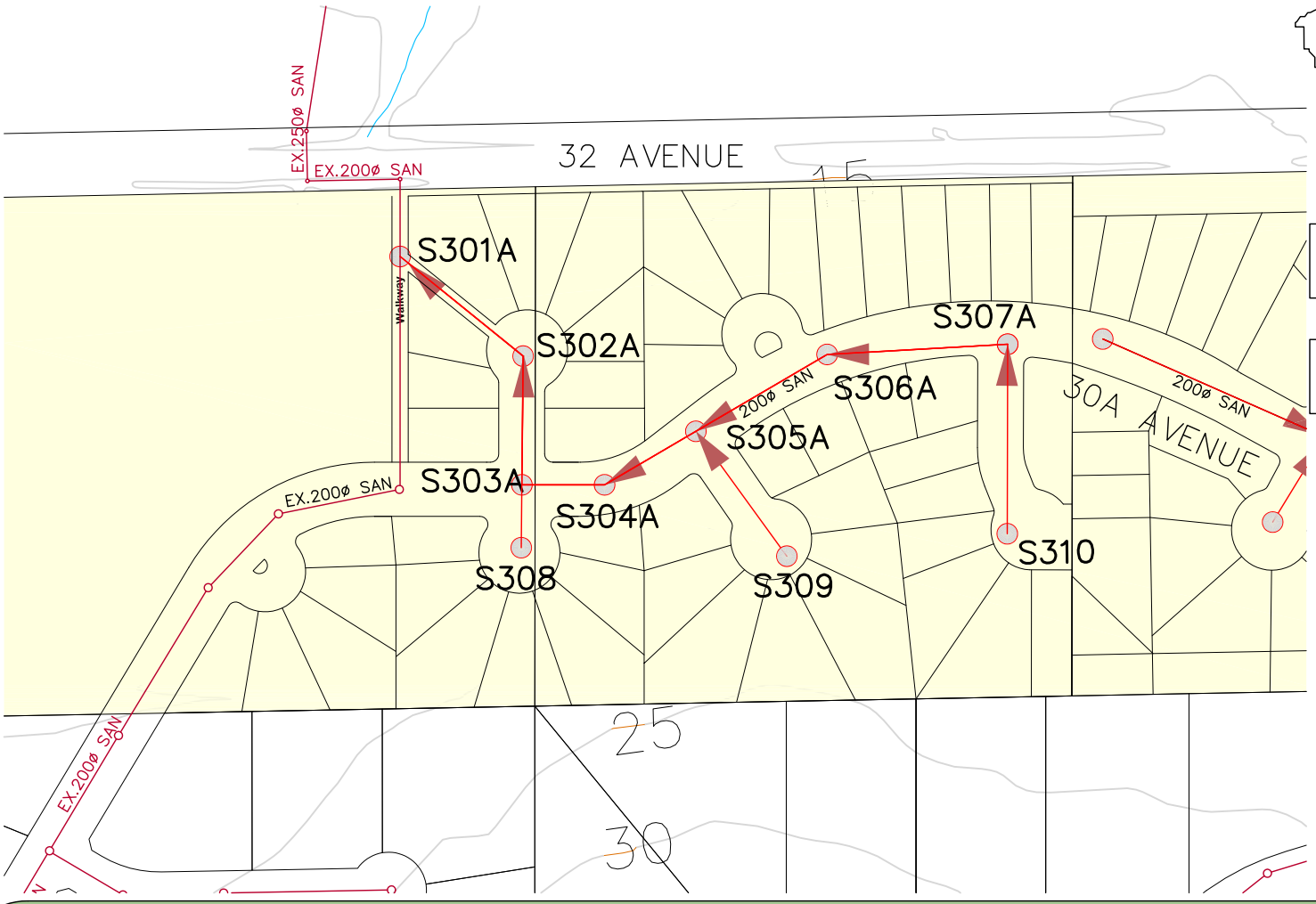
APLIN MARTIN CONSULTANTS LTD

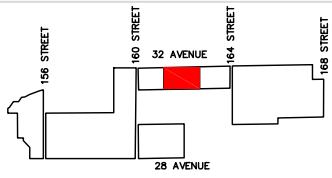
NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

proposed minor sanitary profile east of 160 Street, south of Interceptor, north of 28 Avenue

8





KEY MAP

Lots are Conceptual and Illustrated only for Engineering Design Purposes. Actual Lot Layouts will be Established at Detailed Design Stages.

Sewers are Depicted in Non-Standard Locations for Profile Purposes Only. Sewers tol be Located in Standard Locations as per Typical Sections.

N

Not to Scale

APLIN MARTIN CONSULTANTS LTD

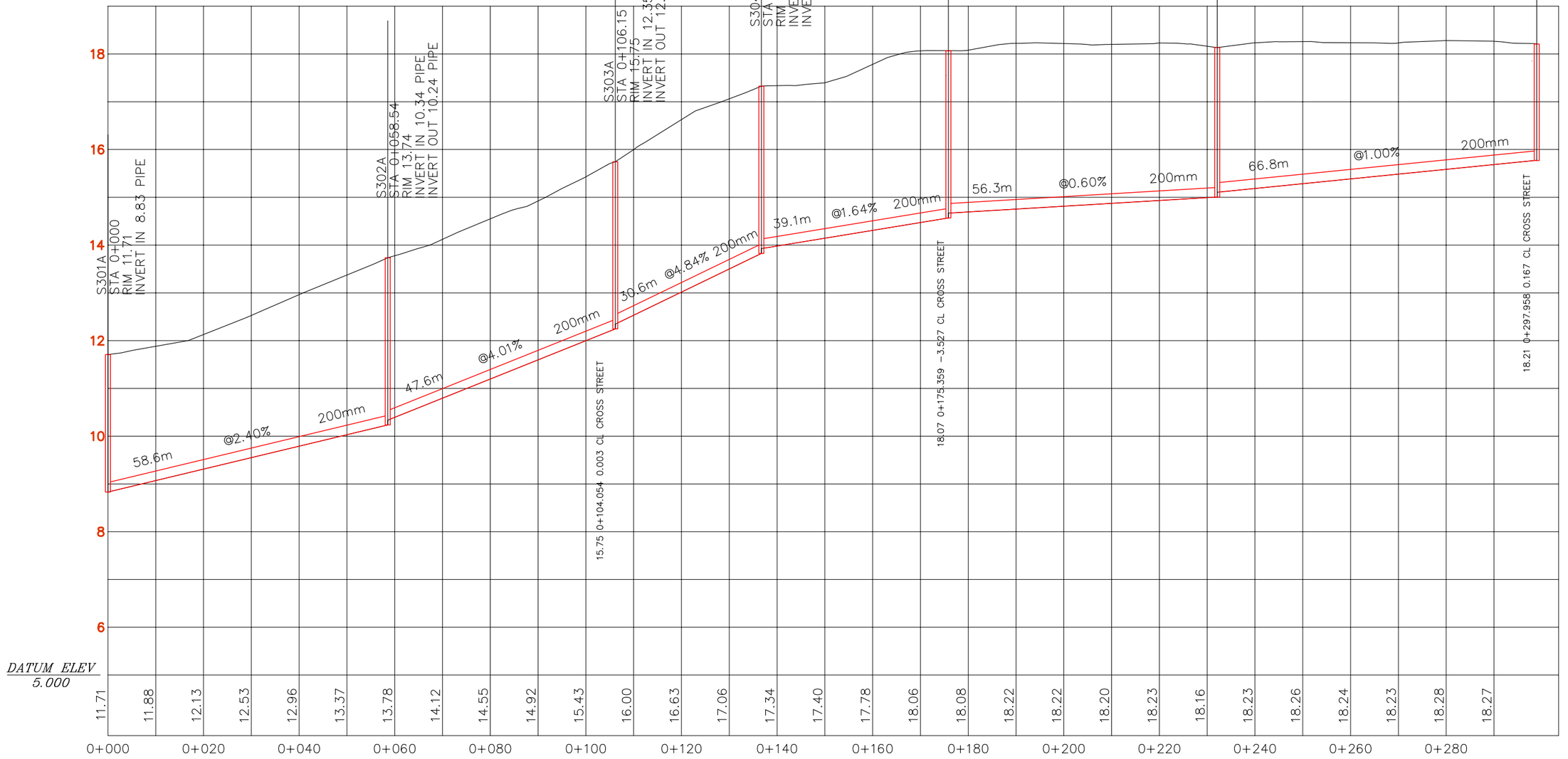
NORTH GRANDVIEW HEIGHTS
NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

proposed minor sanitary system - 30a Ave west

9

Profiles are Designed Based Upon
Existing and Not Future Elevations.
As Such, Sewer Grades and Inverts
to be Established in Detailed Design.



Not to Scale

N

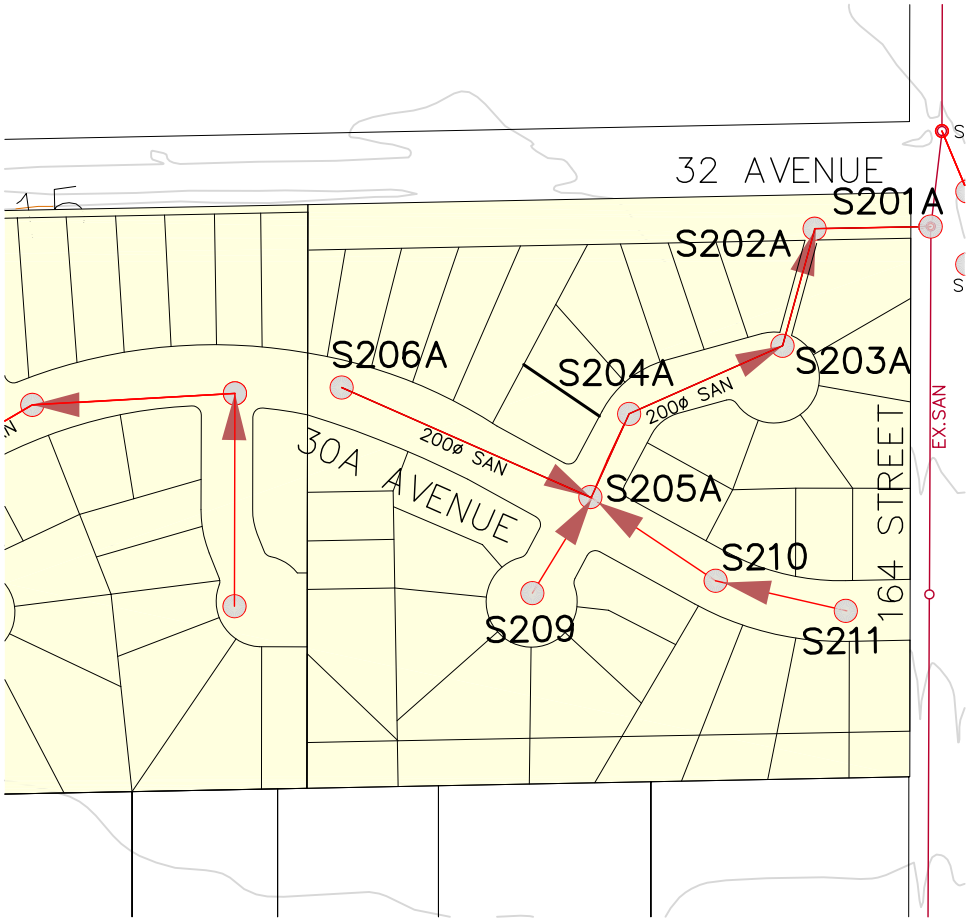
APLIN & MARTIN CONSULTANTS LTD

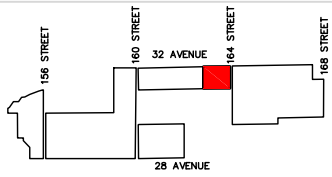
NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

proposed minor sanitary profile - 30a Ave west

10





KEY MAP

N

Lots are Conceptual and Illustrated only for Engineering Design Purposes. Actual Lot Layouts will be Established at Detailed Design Stages.

Not to Scale

APLIN MARTIN CONSULTANTS LTD

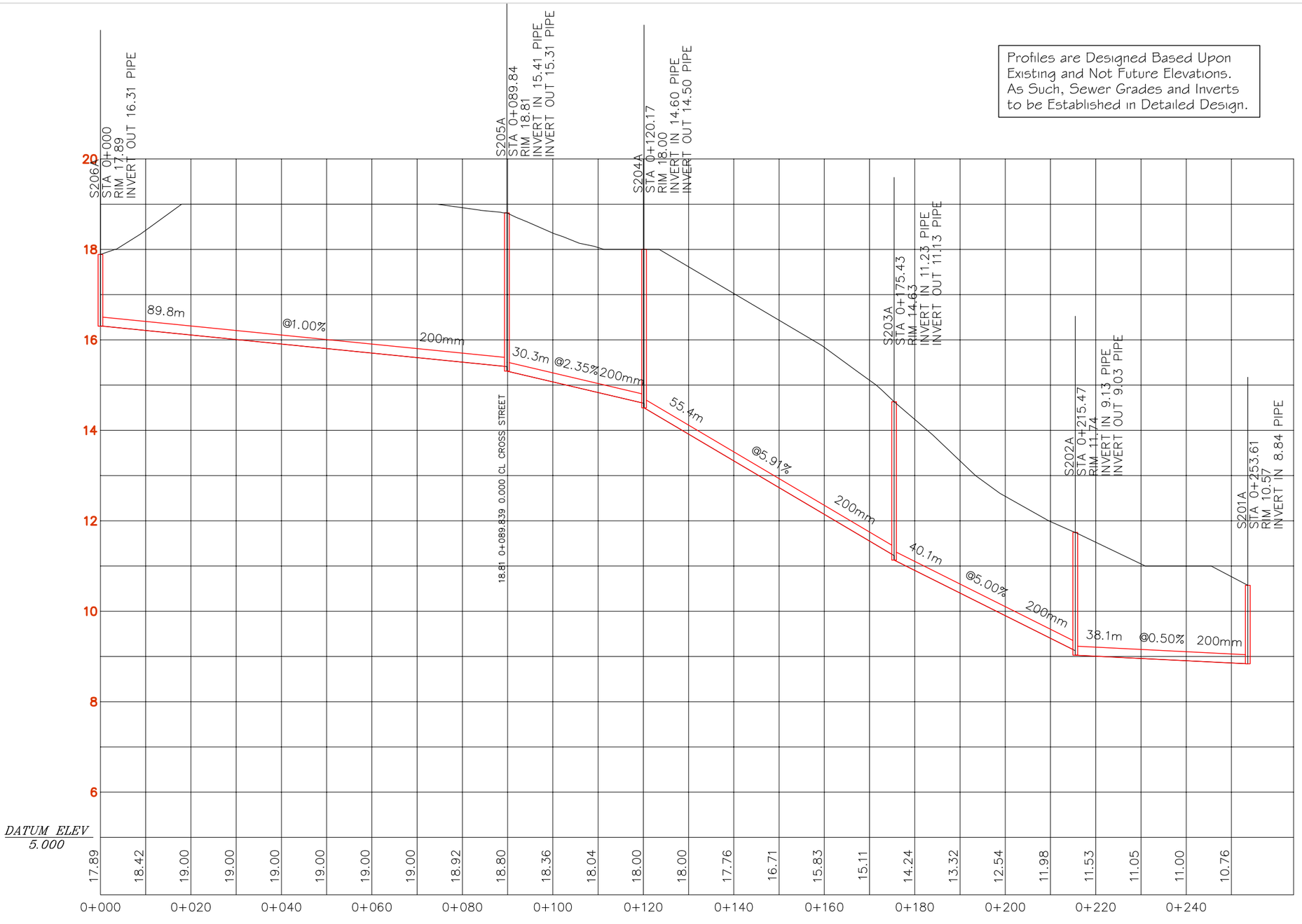
NORTH GRANDVIEW HEIGHTS
NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

proposed minor sanitary system - 30a ave east

11

Profiles are Designed Based Upon Existing and Not Future Elevations. As Such, Sewer Grades and Inverts to be Established in Detailed Design.



Not to Scale

N

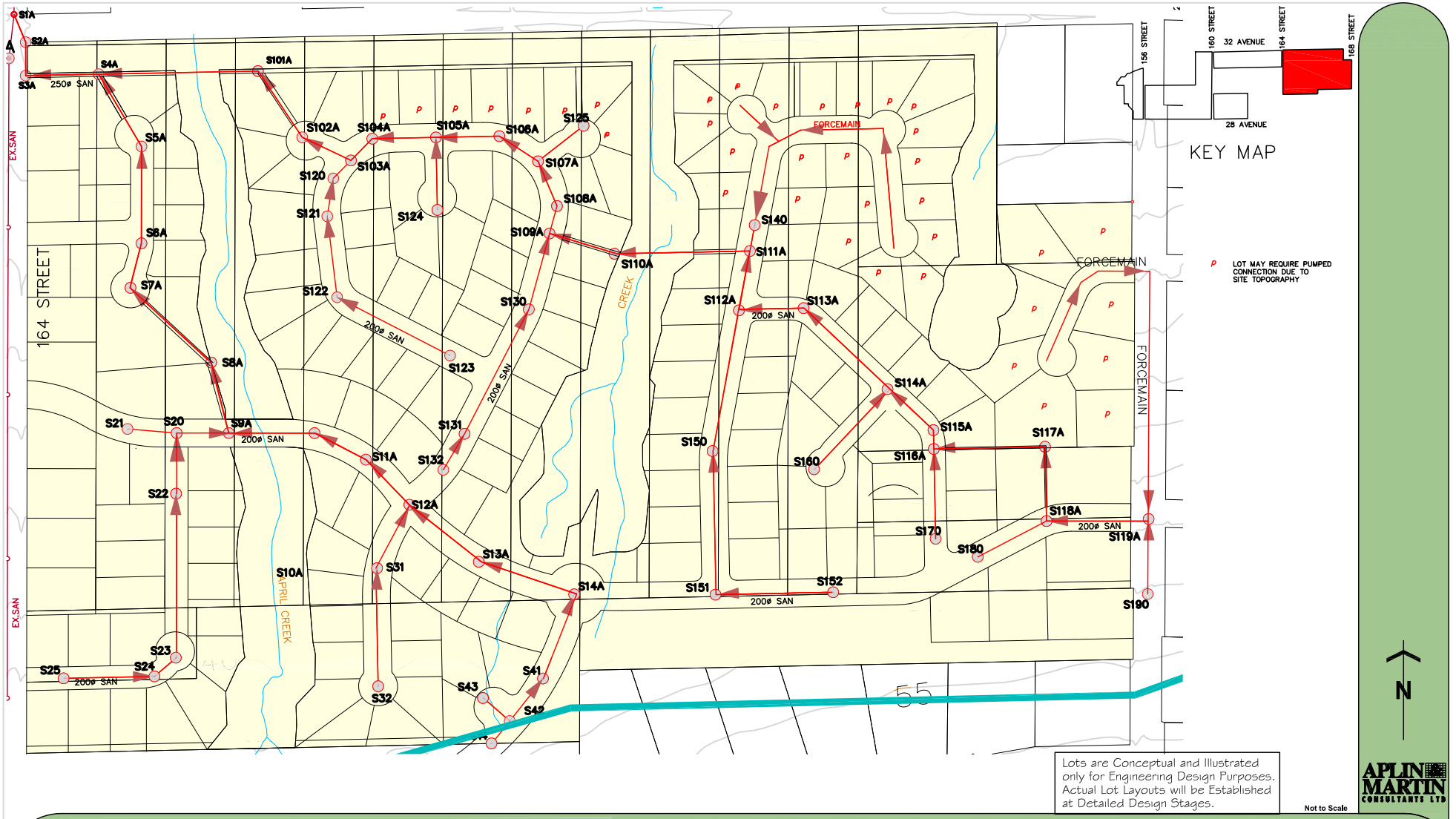
APLIN & MARTIN CONSULTANTS LTD

NORTH GRANDVIEW HEIGHTS
NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

proposed minor sanitary profile - 30a Ave east

12



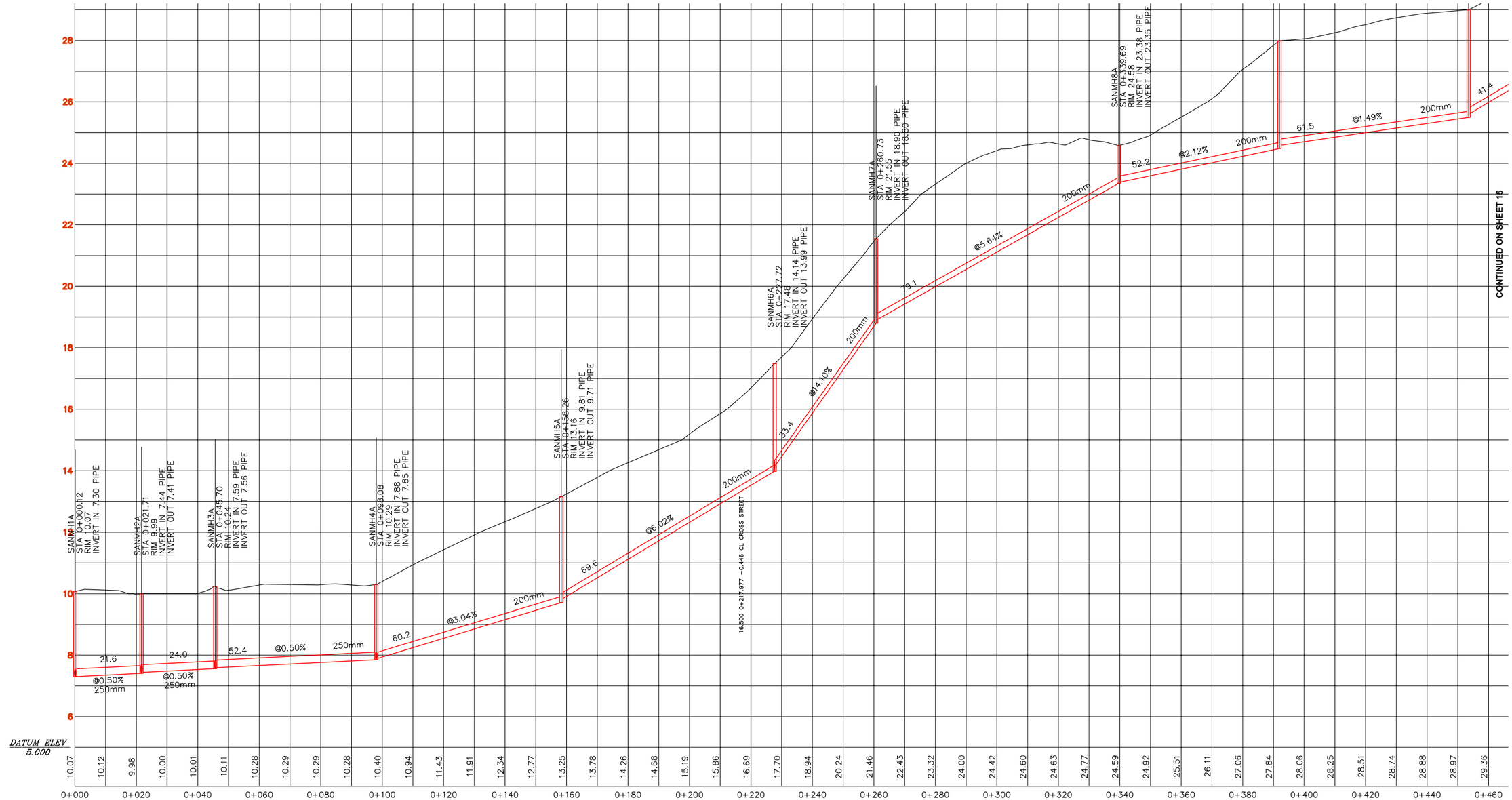
NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

proposed minor sanitary system east of 164 street

13

Profiles are Designed Based Upon Existing and Not Future Elevations. As Such, Sewer Grades and Inverts to be Established in Detailed Design.



CONTINUED ON SHEET 15

Not to Scale

N

APLIN & MARTIN CONSULTANTS LTD

NORTH GRANDVIEW HEIGHTS
NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

proposed minor sanitary profile east of 164 street

14

Profiles are Designed Based Upon
Existing and Not Future Elevations.
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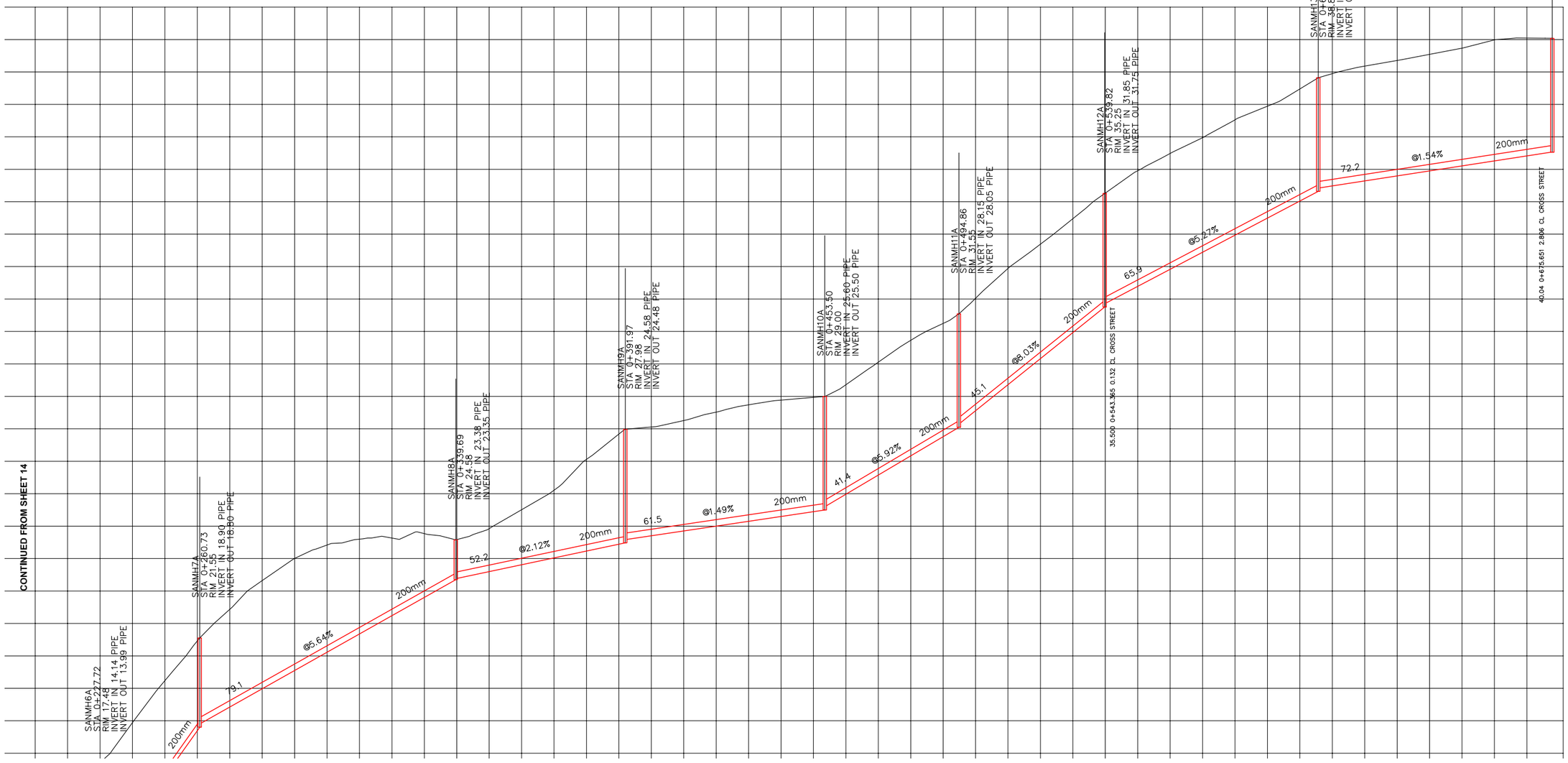
to be Established in Detailed Design.



Not to Scale

N

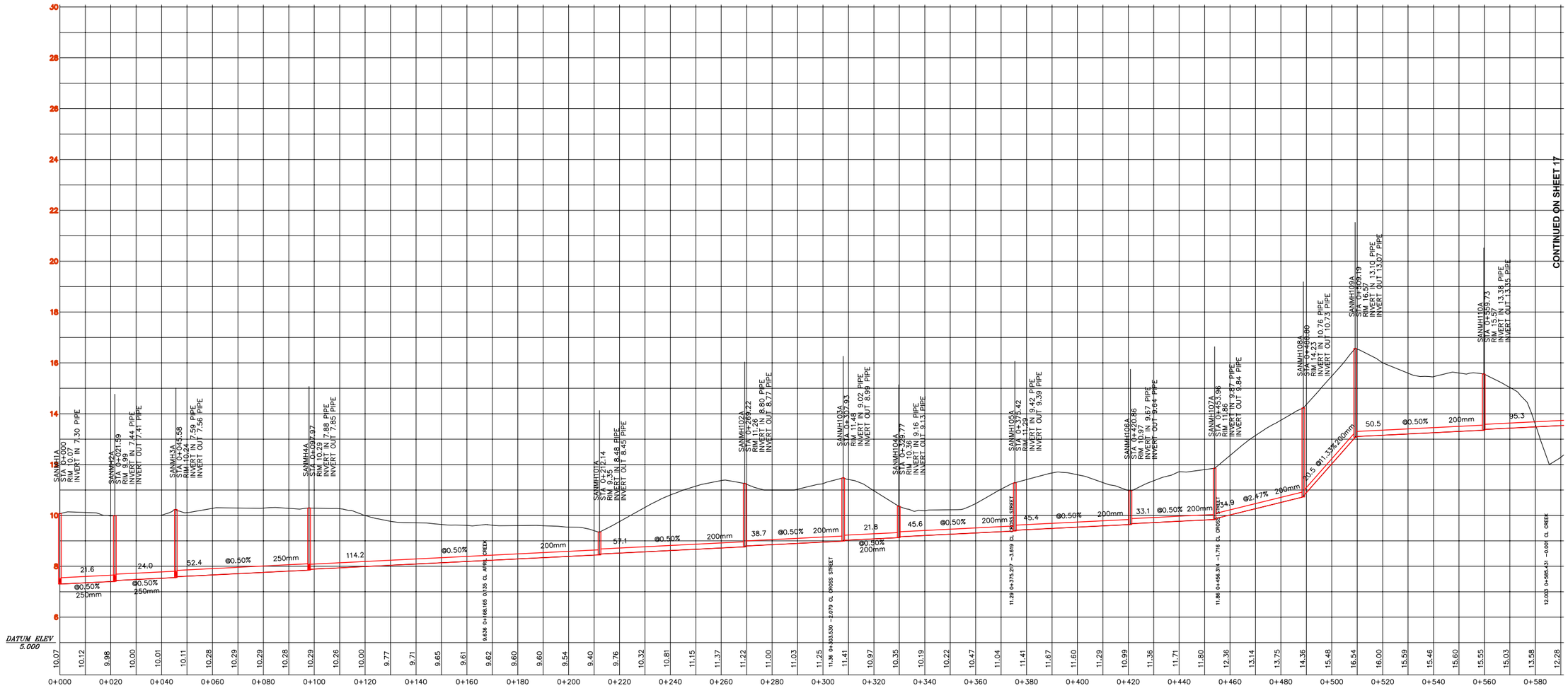
APLIN MARTIN CONSULTANTS LTD

NORTH GRANDVIEW HEIGHTS
NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

proposed minor sanitary profile east of 164 street (2)

15



Profiles are Designed Based Upon Existing and Not Future Elevations. As Such, Sewer Grades and Inverts to be Established in Detailed Design.

N

Not to Scale

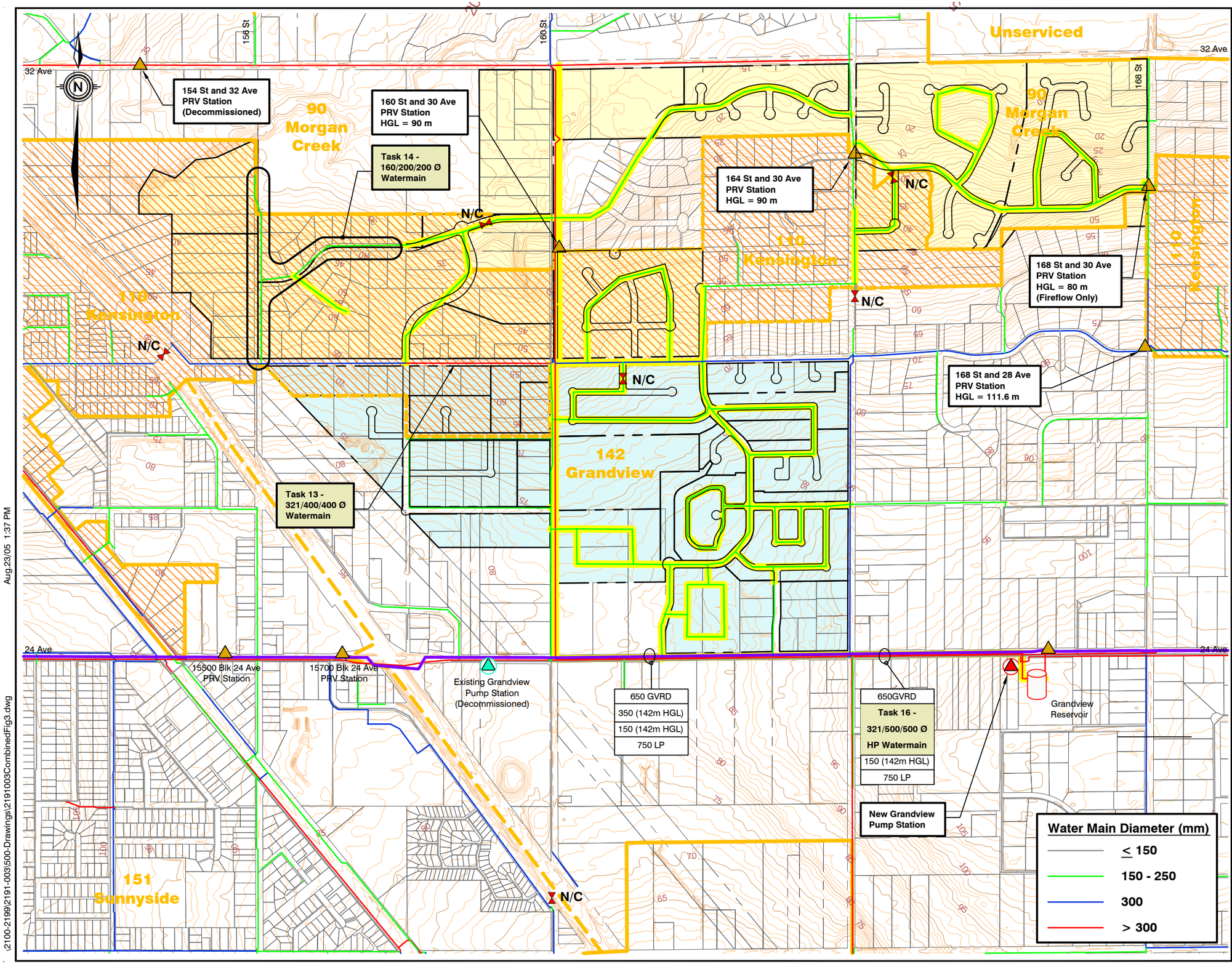
APLIN & MARTIN CONSULTANTS LTD

NORTH GRANDVIEW HEIGHTS
NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

proposed minor sanitary profile east of 164 street (3)

16



Aplin and Martin
Grandview NCPs
Water System Planning

Legend

- GVRD Transmission Main
- Pump Station
- Reservoir
- PRV
- Pressure Zone Boundary
- 1m Contour
- 5m Contour
- North Granview Heights NCP Amendment Area
- Grandview Heights NCP No. 1 Area
- Revised Pressure Zone Boundary
- N/C — Normally Closed Valve
- New Watermain
- 152/250/250 Ø — New Watermain Diameter Existing/Proposed/Minimum Required to Service NCP Area

Notes:

1. Topographic elevations are in metres to geodetic datum.
2. On-site watermains shown are included in hydraulic model and are schematic. Additional watermains will be required for on-site servicing.
3. WaterCAD scenario = FINAL

KERR WOOD LEIDAL associates limited
CONSULTING ENGINEERS

400 0 400
Scale in Metres

Project No.	Date
2191-003	August 2005

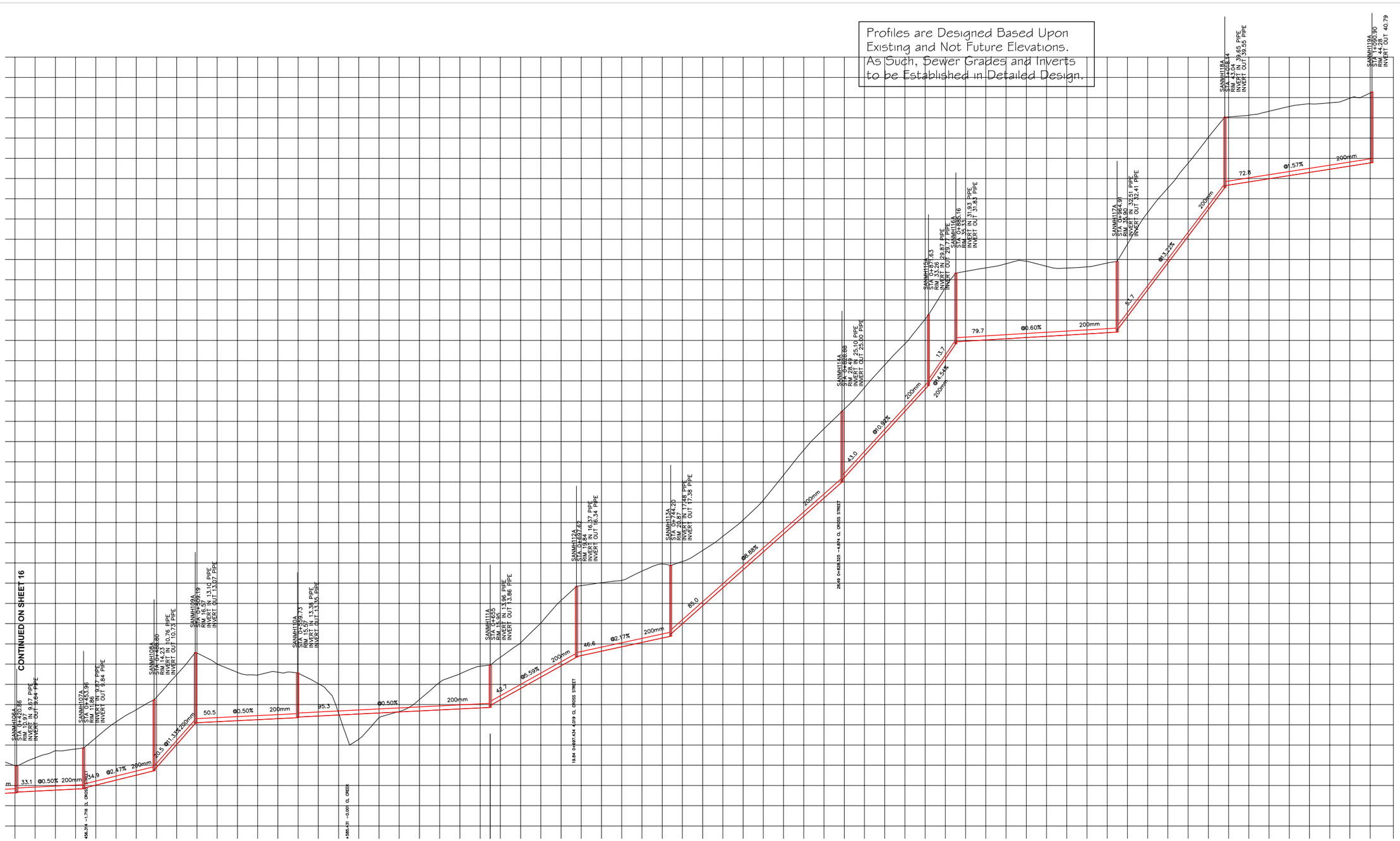
Ultimate Servicing Infrastructure

Figure 3

Aug.23/05 1:37 PM

\2100-2199\2191-003\500-Drawings\2191003CombinedFig3.dwg

Profiles are Designed Based Upon
Existing and Not Future Elevations.
As Such, Sewer Grades and Inverts
to be Established in Detailed Design.



Not to Scale

N

APLIN & MARTIN CONSULTANTS LTD

NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

proposed minor sanitary profile east of 164 street (4)

17

Table 1 SANITARY FLOW TO MORGAN CREEK PUMP STATION 1

ZONE 1

Area Name	Manhole (From)	Manhole (To)	Net Area Ha	Area Ha	Total Number of Lots or Units	Land Use G,SL,SA, U,MF,IB	Pop Density per/lot or unit	Pop	Cum. Pop	Usage Level	Daily Flow (L/day)	Peak Factor	Peak Flow (L/s)	Infiltration (L/s)	Q (L/s)	V_{Design} (m/s)	D_{Cap} (mm)	Pipe Length (m)	Slope (m/m)	Q_{Cap} (L/s)	V_{Cap} (m/s)	Q/Q_{Cap} %	D_d/D_{Cap} %	V_{Actual} (m/s)	Roads
A7	S108	S109		9.08	160	RM-10	2.9	464	464	350	162,400	3.99	7.50	1.18	8.68	0.68	200	74.50	0.0050	23.19	0.74	37%	42%	0.68	Morgan Creek Way
	S109	S50							464	350	162,400	3.99	7.50	1.18	8.68	0.80	200	9.10	0.0077	28.78	0.92	30%	38%	0.80	Morgan Creek Way
A1			**5.36**	**5.36**	**99**	**Cluster H**	**2.9**	**288**	**288**	**350**	**100,783**	**4.09**	**4.77**	**0.69**	**5.46**										
A2a			**14.66**	**17.83**	**272**	**Cluster H**	**2.9**	**788**	**1076**	**350**	**376,434**	**3.78**	**16.47**	**3.01**	**19.47**										
A2b				**2.50**		**School**	**50**	**125**	**1201**	**350**	**420,184**	**3.75**	**18.22**	**3.33**	**21.55**										
A2c			**1.70**	**1.70**	**31**	**Cluster H**	**2.9**	**91**	**1292**	**350**	**452,148**	**3.73**	**19.50**	**3.55**	**23.05**										
A2d	**S50A**	**S50**	**3.06**	**3.39**	**57**	**Cluster H**	**2.9**	**164**	**1456**	**350**	**509,685**	**3.69**	**21.76**	**3.99**	**25.75**	1.20	250	98.95	0.0118	64.60	1.32	40%	44%	1.24	Morgan Creek Way
	S50	S51							1920	350	672,085	3.60	28.00	5.17	33.17	0.91	300	98.60	0.0047	66.29	0.94	50%	50%	0.94	Canterbury Drive
A8	S51	S52		0.92	5	RH	2.9	15	1935	350	677,160	3.60	28.19	5.29	33.48	0.88	300	107.55	0.0042	62.67	0.89	53%	52%	0.90	Canterbury Drive
A8	S52	S53		0.88	6	RH	2.9	17	1952	350	683,250	3.59	28.42	5.40	33.82	0.82	300	62.55	0.0035	57.21	0.81	59%	55%	0.84	Canterbury Drive
A8	S53	S54		0.54	4	RH	2.9	12	1964	350	687,310	3.59	28.57	5.47	34.04	0.92	300	69.80	0.0047	66.29	0.94	51%	51%	0.94	Canterbury Drive
A3				11.99	30	RA	2.9	87	87	350	30,450	4.26	1.50	1.55	3.06										
A5a			**4.35**	**4.72**	**81**	**Cluster H**	**2.9**	**234**	**321**	**350**	**112,243**	**4.07**	**5.28**	2.17	**7.45**										
A5b	**S33**	**S32**	**5.39**	**5.92**	**73**	**RF**	**2.9**	**212**	**533**	**350**	**186,564**	**3.96**	**8.55**	**2.93**	**11.48**	0.98	250	95.60	0.0113	63.21	1.29	18%	29%	0.98	Golf Course
A8	S32	S61		0.60	3	RH	2.9	9	542	350	189,609	3.96	8.68	3.01	11.69	0.92	250	40.00	0.0093	57.35	1.17	20%	31%	0.92	Golf Course
	S61	S54						0	542	350	189,609	3.96	8.68	3.01	11.69	0.93	250	49.85	0.0098	58.87	1.20	20%	30%	0.93	Golf Course
A8	S54	S55		0.49	3	RH	2.9	9	2514	350	879,964	3.51	35.71	8.53	44.25	0.97	300	53.45	0.0045	64.87	0.92	68%	61%	0.99	Canterbury Drive
A8	S55	S56		1.10	8	RH	2.9	23	2537	350	888,084	3.50	36.01	8.63	44.64	0.98	300	102.00	0.0046	65.59	0.93	68%	61%	1.00	Canterbury Drive
A8	S56	S57		0.94	7	RH	2.9	20	2558	350	895,189	3.50	36.27	8.74	45.00	0.96	300	102.45	0.0043	63.41	0.90	71%	62%	0.97	Canterbury Drive
A8	S57	S58		5.11	34	RH	2.9	99	2656	350	929,699	3.49	37.52	8.83	46.35	1.00	300	95.60	0.0047	66.29	0.94	70%	62%	1.01	Canterbury Drive
A8	S58	S59		0.67	4	RH	2.9	12	2668	350	933,759	3.49	37.67	8.88	46.55	1.02	300	54.10	0.0050	68.38	0.97	68%	61%	1.04	Canterbury Drive
A8	S59	S60		0.24	2	RH	2.9	6	2674	350	935,789	3.48	37.74	8.94	46.68	0.99	300	57.00	0.0046	65.59	0.93	71%	62%	1.01	Canterbury Drive
A8*	S60	S68		4.98	35	RH	2.9	102	2775	350	971,314	3.47	39.02	9.58	48.60	0.64	**300**	**46.20**	**0.0013**	**34.87**	**0.49**	**139%**	**>100%**	**0.49**	**Golf Course**
	S68	S6A						0	2775	350	971,314	3.47	39.02	9.58	48.60	1.09	300	35.00	0.0057	73.01	1.03	67%	60%	1.11	Golf Course
	S6A	S6						0	2775	350	971,314	3.47	39.02	9.58	48.60	1.11	300	106.90	0.0060	74.90	1.06	65%	59%	1.13	Golf Course
A4				20.03	40	RA	2.9	116	116	350	40,600	4.23	1.99	2.60	4.58										SE 32 Ave/160 St
A6			**3.82**	**4.25**	**52**	**RF**	**2.9**	**150**	**266**	**350**	**93,273**	**4.10**	**4.43**	**3.15**	**7.57**										
AEX				9.20	19	RH	2.9	55	322	350	112,558	4.07	5.30	9.69	14.99										
A14 Southrac				**41.27**	**184**	**CD**	**2.9**	**534**	**855**	**350**	**299,318**	**3.84**	**13.31**	**8.50**	**21.81**										SE 164 St/32 Ave
A9	CO	S9		2.05	7	RH	2.9	20	875	350	306,423	3.84	13.61	8.76	22.37	1.26	200	69.75	0.0139	38.67	1.23	58%	55%	1.28	164 Street
A10	S9	S8		0.59	2	RH	2.9	6	881	350	308,453	3.83	13.69	8.84	22.53	1.32	200	109.55	0.0156	40.97	1.30	55%	53%	1.33	164 Street
A10	S8	S7		0.99	4	RH	2.9	12	893	350	312,513	3.83	13.86	8.97	22.83	1.37	200	90.30	0.0170	42.76	1.36	53%	52%	1.38	164 Street
A10/11*	S7	S6		3.27	13	RA-G	2.9	38	931	350	325,708	3.82	14.40	9.39	23.79	0.84	**200**	**109.80**	**0.0050**	**23.19**	**0.74**	**103%**	**>100%**	**0.76**	**164 Street**
A11	S6	S5		0.82	6	RH	2.9	17	3723	350	1,303,112	3.36	50.69	19.08	69.77	0.95	375	140.40	0.0031	97.62	0.88	71%	63%	0.96	164 Street
A11/12	S5	S4		1.04	1	RA-G	2.9	3	3726	350	1,304,127	3.36	50.73	19.22	69.94	0.89	375	140.00	0.0026	89.40	0.81	78%	67%	0.90	164 Street
A13	S4	S3		0.85	3	RA-G	2.9	9	3735	350	1,307,172	3.36	50.83	19.33	70.16	1.12	375	113.60	0.0048	121.47	1.10	58%	55%	1.14	164 Street
A13,A12	S3	PS1		13.03	48	RH	2.9	139	3874	350	1,355,892	3.35	52.51	21.02	73.52	1.10	375	11.45	0.0044	116.30	1.05	63%	58%	1.11	164 Street

*PIPE SECTION TO BE MONITORED FOR UPGRADES WHERE DESIGN FLOW EXCEEDS 88% DESIGN CAPACITY

DENSITIES = CLUSTER - 7.5UPA, RF - 5.5UPA

Total Population = 3874

Pump Station #1 Existing Capacity = 46.7L/s

LAND USAGE DESCRIPTION:

RA	= ONE-ACRE RESIDENTIAL	RM-15	= TOWNHOUSE
RH	= HALF-ACRE RESIDENTIAL	RM-30	= GARDEN APARTMENTS
RH-G	= HALF-ACRE RESIDENTIAL GROSS DENSITY	RMS-1	= INSTITUTIONAL RESIDENTIAL
RF	= SINGLE FAMILY RESIDENTIAL	C-5	= NEIGHBORHOOD COMMERCIAL
RF-G	= COMPACT SINGLE FAMILY RES.	PA-1	= INSTITUTIONAL RELIGIOUS
G	= GOLF COURSE	IB	= BUSINESS PARK
CD	= CLUSTER HOUSING (AT SINGLE FAMILY RESIDENTIAL)	P1	= SCHOOL

Table 2 SANITARY FLOW TO MORGAN CREEK PUMP STATION 2
ZONE 2

Area No:	Area (Ha)	Total No	Units	Land Use	Pop Density (per/lot)	Pop	Cum. Pop (persons)	Usage Level (L/per/day)	Cumulative Daily Flow (L/day)	Peak Factor	Peak Flow (L/s)	Infiltration (L/s)	Total Flow (L/s)
B1	3.20	-	Ha	IB	90.0	288	288	350	100,800	4.09	4.77	2.28	7.04
B3	7.84	145	Units	RM-15	2.3	334	622	350	217,525	3.92	9.88	3.82	13.70
B4	0.71	36	Units	RM-30	2.3	82	703	350	246,103	3.89	11.09	3.91	15.00
B5	1.42	144	Beds	RMS-1	1.0	144	847	450	310,903	3.85	13.84	4.10	17.93
B6	0.72	-	Ha	CD (IL)	90.0	65	912	350	333,583	3.83	14.77	4.19	18.96
B7	1.40	52	Units	RM-15	2.3	119	1031	350	375,282	3.79	16.47	4.37	20.84
B8	1.82	20	Lots	RF	2.9	58	1089	350	395,582	3.78	17.29	4.61	21.89
B9	4.72	60	Lots	CD	2.9	174	1263	350	456,482	3.73	19.72	5.22	24.94
B10	4.06	8	Lots	RA	2.9	23	1286	350	464,602	3.73	20.04	5.74	25.78
B11	3.76	49	Lots	RF	2.9	142	1428	350	514,337	3.69	22.00	6.23	28.23
B12	2.64	-	Ha	PI	50.0	132	1560	350	560,537	3.67	23.79	6.57	30.36
B13	6.22	13	Lots	RA	2.9	38	1598	350	573,732	3.66	24.30	7.38	31.68
B14	2.98	10	Lots	RH	2.9	29	1627	350	583,882	3.65	24.69	7.77	32.46
B15	2.54	25	Lots	RF	2.9	72.5	1700	350	609,257	3.64	25.67	8.10	33.76
B16	7.39	96	Lots	RM-10	2.9	278.4	1978	350	706,697	3.59	29.36	9.05	38.41
B17	3.29	26	Lots	RH	2.9	75.4	2053	350	733,087	3.58	30.35	9.48	39.83
B18	1.08	2	Lots	RA	2.9	5.8	2059	350	735,117	3.58	30.42	9.62	40.04
B19	2.03	13	Lots	CD	2.9	37.7	2097	350	748,312	3.57	30.92	9.88	40.80
B20	2.96	-	Ha	PI	50.0	148	2245	350	800,112	3.55	32.84	10.27	43.11
B21	6.64	-	Ha	CPG	50.0	332	2577	350	916,312	3.50	37.09	11.13	48.22
B22	6.29	32	Lots	RH	2.9	92.8	2670	350	948,792	3.48	38.27	11.94	50.21
B23	0.36	5	Lots	RH	2.9	14.5	2684	350	953,867	3.48	38.45	11.99	50.44
B24	0.39	3	Lots	RH	2.9	8.7	2693	350	956,912	3.48	38.56	12.04	50.60

Table 3 SANITARY FLOW TO MORGAN CREEK PUMP STATION 2
ZONE 3

Area No:	Area (Ha)	Total No	Units	Land Use	Pop Density (per/lot)	Pop	Cum. Pop (persons)	Usage Level (L/per/day)	e Daily Flow (L/day)	Peak Factor	Peak Flow (L/day)	Infiltration (L/day)	Total Flow (L/day)
C1	4.52	-	Ha	IB	90.0	407	407	350	142,380	4.02	6.62	0.59	7.21
C2	1.10	-	Ha	PI	50.0	55	462	350	161,630	3.99	7.47	0.73	8.20
C3	1.50	75	Units	RM-30	2.3	173	634	350	222,005	3.92	10.07	0.92	10.99
C4	2.13	53	Lots	CD	2.9	154	788	350	275,800	3.86	12.34	1.20	13.53
C5	1.41	16	Lots	CD	2.9	46	834	350	292,040	3.85	13.01	1.38	14.39
C6	0.58	-	Ha	PA-1	50.0	29	863	350	302,190	3.84	13.43	1.46	14.89
C7	1.56	24	Lots	RF	2.9	70	933	350	326,550	3.82	14.43	1.66	16.09
C8	2.02	-	Ha	C-5	60.0	121	1054	350	368,970	3.79	16.16	1.92	18.09
C9	2.05	31	Lots	CD	2.9	89	1143	350	400,181	3.76	17.42	2.19	19.61
C10	8.33	114	Lots	CD	2.9	331	1474	350	515,891	3.69	22.00	3.27	25.27
C11	3.79	154	Units	RM-30	2.3	354	1828	350	639,861	3.62	26.78	3.76	30.54
C12	3.62	181	Units	RM-30	2.3	416	2244	350	785,566	3.55	32.24	4.23	36.47
C13	1.59	24	Lots	CD	2.9	69	2314	350	809,774	3.54	33.14	4.43	37.57
C14	3.88	102	Lots	RM-10	2.9	296	2609	350	913,304	3.49	36.92	4.94	41.86
C15	1.88	84	Lots	CD	2.9	244	2853	350	998,564	3.46	40.00	5.18	45.18
C16	1.74	87	Units	RM-30	2.3	200	3053	350	1,068,599	3.44	42.50	5.41	47.90
C17	2.60	39	Lots	CD	2.9	113	3166	350	1,108,184	3.42	43.90	5.74	49.64
C18	1.70	30	Lots	CD	2.9	87	3253	350	1,138,634	3.41	44.97	5.96	50.93
C19	1.18	29	Lots	CD	2.9	84	3337	350	1,168,069	3.40	46.00	6.12	52.12
C20	2.63	37	Lots	CD	2.9	107	3445	350	1,205,624	3.39	47.31	6.46	53.77
C21	3.82	-	Ha	PA-1	50.0	191	3636	350	1,272,474	3.37	49.63	6.95	56.59
C22	1.58	-	Ha	PA-1	50.0	79	3715	350	1,300,124	3.36	50.59	7.16	57.75
C23	9.18	120	Lots	RF	2.9	348	4063	350	1,421,924	3.33	54.76	8.35	63.11
C24	3.95	12	Lots	RA	2.9	35	4097	350	1,434,104	3.32	55.17	8.86	64.03
C25	15.81	63	Lots	RF	2.9	183	4280	350	1,498,049	3.31	57.34	10.91	68.24
C26	8.02	62	Lots	RH	2.9	180	4460	350	1,560,979	3.29	59.45	11.95	71.40

Table 4 SANITARY FLOW TO MORGAN CREEK PUMP STATION 2
ZONE 4

Area No:	Area (Ha)	Total No	Units	Land Use	Pop Density (per/lot)	Pop	Cum. Pop (persons)	Usage Level (L/per/day)	e Daily Flow (L/day)	Peak Factor	Peak Flow (L/s)	Infiltration (L/s)	Total Flow (L/s)
D1	8.91	106	Lots	CD	2.9	307	307	350	107,590	4.07	5.07	1.16	6.23
D2	4.29	8	Lots	RA	2.9	23	331	350	115,710	4.06	5.44	1.71	7.15
D3	3.50	25	Lots	RH	2.9	73	403	350	141,085	4.02	6.57	2.16	8.73
D4	2.95	30	Lots	RF	2.9	87	490	350	171,535	3.98	7.90	2.55	10.45
D5	15.88	104	Lots	RH	2.9	302	792	350	277,095	3.86	12.39	4.61	17.00
D6	3.57	7	Lots	RA	2.9	20	812	350	284,200	3.86	12.69	5.07	17.75

Table 5 SUMMARY OF SANITARY FLOW TO MORGAN CREEK PUMP STATION 2

Area Name	Manhole (From)	Manhole (To)	Area Ha	Total Number Lots or Units	Land Use G,SL,SA, U,MF,IB	Pop Density (per/lot) or (per/unit)	Pop	Cum. Pop	Usage Level	Daily Flow (L/day)	Peak Factor	Peak Flow (L/s)	Infiltration (L/s)	Q (L/s)	V_{Design} (m/s)	D_{Cap} (mm)	Pipe Length (m)	Slope (m/m)	Q_{Cap} (L/s)	V_{Cap} (m/s)	Q/Q_{Cap} %	D_d/D_{Cap} %	V_{actual} (m/s)	Roads
Zone 1	**PS1**	S11						3874		1,355,892		52.51	21.02	73.52										
B25	S11	S12	1.39	7	RH	2.9	20	20	350	7,105	4.38	0.36	0.18	74.06	1.94	250	93.70	0.0206	85.35	1.74	87%	72%	1.96	36 Avenue
B25	S12	S13	3.52	13	RH, RH-G	2.9	38	58	350	20,300	4.30	1.01	0.64	75.17	3.00	250	90.00	0.0623	148.43	3.02	51%	50%	3.03	36 Avenue
B25	S13	S14	0.88	4	RH	2.9	12	70	350	24,360	4.28	1.21	0.75	75.48	1.56	300	86.00	0.0110	101.42	1.43	74%	64%	1.57	36 Avenue
B25, B26	S14	S15	8.28	59	RH	2.9	171	241	350	84,245	4.12	4.01	1.82	79.36	0.95	375	152.90	0.0029	94.42	0.85	84%	70%	0.96	36 Avenue
B25*	S15	S16	0.53	2	RH	2.9	6	247	350	86,275	4.11	4.11	1.89	79.52	0.89	**375**	**89.40**	**0.0025**	**87.67**	**0.79**	**91%**	**75%**	**0.90**	**36 Avenue**
B25*	S16	S17	0.83	3	RH	2.9	9	255	350	89,320	4.11	4.25	2.00	79.77	0.85	**375**	**121.90**	**0.0022**	**82.24**	**0.74**	**97%**	**79%**	**0.85**	**36 Avenue**
	S17	S18						255	350	89,320	4.11	4.25	2.00	79.77	1.65	375	10.30	0.0122	193.66	1.75	41%	45%	1.67	36 Avenue
Zone 2							2693	2693		956,912	3.48	38.56	12.04	50.60										
	S18	S27					2693	2948	350	1,046,232	3.45	38.20	14.04	125.76	1.84	450	129.60	0.0105	292.15	1.84	43%	45%	1.75	160 Street
B25	S27	S28	5.20	19	RH,RH-G	2.9	55	3003	350	1,065,517	3.44	42.45	14.71	130.68	1.61	450	130.25	0.0073	243.59	1.53	54%	51%	1.55	160 Street
	S28	S31A						3003	350	1,065,517	3.44	42.45	14.71	130.68	1.64	450	129.20	0.0076	248.55	1.56	53%	51%	1.57	160 Street
	S31A	S3A						3003	350	1,065,517	3.44	42.45	14.71	130.68	5.13	450	10.39	0.1752	1193.37	7.50	11%	22%	4.89	37A Avenue
Zone 4							812	812		284,200	3.86	12.69	5.07	17.75										
D7	S3A	S2		1	RH	2.9	3	3818	350	1,350,732	3.35	52.39	19.78	145.70	1.03	**450**	**25.00**	**0.0032**	**161.28**	**1.01**	**90%**	**73%**	**1.14**	**37A Avenue**
	S2	S1			RH	2.9	0	3818	350	1,350,732	3.35	52.39	19.78	145.70	1.22	450	38.54	0.0036	171.06	1.08	85%	70%	1.20	37A Avenue
D7	S1	S31	5.40	35	RH	2.9	102	3920	350	1,386,257	3.34	53.61	20.48	147.61	1.10	525	47.69	0.0025	215.03	0.99	69%	60%	1.06	37A Avenue
Zone 3							4460	4460		1,560,979	3.29	57.34	10.91	71.40										
	S31	PS2						8380	350	2,947,236	3.03	103.38	31.39	208.29	1.33	525	7.00	0.0035	254.43	1.18	82%	68%	1.31	37A Avenue

*PIPE SECTION TO BE MONITORED FOR UPGRADES WHERE DESIGN FLOW EXCEEDS 88% DESIGN CAPACITY

Total Population = 12254

Pump Station #2 Existing Capacity = 130 L/s
Pump Station #2 Existing Capacity = 215 L/s

LAND USAGE DESCRIPTION:

RA	= ONE-ACRE RESIDENTIAL	RM-15	= TOWNHOUSE	G	= GOLF COURSE
RH	= HALF-ACRE RESIDENTIAL	RM-30	= GARDEN APARTMENTS	CD	= CLUSTER HOUSING (AT SINGLE FAMILY RESIDENTIAL)
RH-G	= HALF-ACRE RESIDENTIAL GROSS DENSITY	RMS-1	= INSTITUTIONAL RESIDENTIAL	IB	= BUSINESS PARK
RF	= SINGLE FAMILY RESIDENTIAL	C-5	= NEIGHBORHOOD COMMERCIAL	P1	= SCHOOL
RF-G	= COMPACT SINGLE FAMILY RES.	PA-1	= INSTITUTIONAL RELIGIOUS		

TABLE 6 - MINOR SANITARY SYSTEM DESIGN - CALCULATION SHEET

MUN. PROJECT # :

PROJECT TITLE: **North Grandview Heights NCP**
Minor System Flows

PROJECT LOCATION: Preliminary Sewer Design Analysis
South Surrey

AVERAGE DAILY FLOW
RESIDENTIAL = 350 L/day/capita
COMMERCIAL = 40000 L/day/ha
INDUSTRIAL = 30000 L/day/ha

INFILTRATION
0.1 L/s/Ha

Maximum Depth of Flow
50.0%

A&M P 24206
Sheet: 1 of 1
Date: Oct-13-05
By: JBK
Chk: AMB

Area Name	Manhole		Area	Land Usage	Pop Density	Pop	Cum. Pop	Usage Level	Cumulative Daily Flow	Peak Factor	Peak Flow	Infiltration	Total Flow	Pipe Φ	Pipe Length	Slope	Coeff	50% Capacity	Velocity
	(From)	(To)	(Ha)		(per/ha)			L/Pop/day	(L/day)		(L/s)	(L/s)	(L/s)	(mm)	(m)	(m/m)		(L/s)	(m/s)
PG 5	511	510	6.5	CD	2.9	349	349	350	122,219	4.05	5.7	0.7	6.4	200	50.30	0.0100	0.013	16.7	1.065
	510	509	6.5	CD	2.9	349	698	350	244,437	3.90	11.0	1.3	12.3	200	72.40	0.0100	0.013	16.7	1.065
	508	505	5.4	CD	2.9	288	288	350	100,783	4.09	4.8	0.5	5.3	200	140.10	0.0510	0.013	37.8	2.405
	507	506	1.3	SCHOOL	50	125	125	350	43,750	4.22	2.1	0.1	2.3	200	91.30	0.0100	0.013	16.7	1.065
	506	505		CD	2.9		125	350	43,750	4.22	2.1		2.1	200	97.00	0.0100	0.013	16.7	1.065
	505	504		CD	2.9			350	144,533					200	95.40	0.0258	0.013	26.9	1.711
	504	503		CD	2.9			350	144,533					200	150.00	0.0092	0.013	16.0	1.022
	503	502	4.9	CD	2.9	263	263	350	236,667	4.10	11.2	1.2	12.4	200	114.76	0.0100	0.013	16.7	1.065
	502	501	4.9	CD	2.9	263	526	350	328,802	3.96	15.1	1.6	16.7	200	150.00	0.0200	0.013	23.7	1.506
	501	EXMH	4.9	CD	2.9	263	790	350	420,936	3.86	18.8	2.1	21.0	200	150.00	0.0200	0.013	23.7	1.506
PG 7	414	413	0.7	RF	2.9	17	17	350	6,090	4.39	0.3	0.1	0.4	200	147.12	0.0100	0.013	16.7	1.065
	413	412	0.3	RF	2.9		17	350	6,090	4.39	0.3	0.1	0.4	200	67.52	0.0100	0.013	16.7	1.065
	412	411	0.4	RF	2.9		17	350	6,090	4.39	0.3	0.1	0.5	200	84.70	0.0100	0.013	16.7	1.065
	411	410	0.1	RF	2.9		17	350	6,090	4.39	0.3	0.2	0.5	200	16.90	0.0100	0.013	16.7	1.065
	410	409	0.1	RF	2.9		17	350	6,090	4.39	0.3	0.2	0.5	200	19.50	0.0100	0.013	16.7	1.065
	440	439	0.4	RF	2.9	29	29	350	10,150	4.36	0.5	0.0	0.6	200	86.38	0.0100	0.013	16.7	1.065
	439	409	0.3	RF	2.9	23	52	350	18,270	4.31	0.9	0.1	1.0	200	67.23	0.0100	0.013	16.7	1.065
	409	408	0.5	RF	2.9	15	84	350	29,435	4.26	1.5	0.3	1.7	200	92.00	0.0025	0.013	8.4	0.533
	438	437	0.3	RF	2.9	20	20	350	7,105	4.38	0.4	0.0	0.4	200	55.88	0.0100	0.013	16.7	1.065
	437	408	0.2	RF	2.9	6	26	350	9,135	4.36	0.5	0.1	0.5	200	50.99	0.0100	0.013	16.7	1.065
	408	407	0.1	RF	2.9		110	350	38,570	4.23	1.9	0.3	2.2	200	25.60	0.0025	0.013	8.4	0.533
	407	406	0.6	RF	2.9	9	119	350	41,615	4.22	2.0	0.4	2.4	200	120.80	0.0025	0.013	8.4	0.533
	436	430	0.5	RF	2.9	29	29	350	10,150	4.36	0.5	0.0	0.6	200	93.07	0.0100	0.013	16.7	1.065
	435	434	0.4	RF	2.9	15	15	350	5,075	4.40	0.3	0.0	0.3	200	86.78	0.0100	0.013	16.7	1.065
	434	433	0.5	RF	2.9	12	26	350	9,135	4.36	0.5	0.1	0.6	200	99.99	0.0100	0.013	16.7	1.065
	433	432	0.1	RF	2.9	6	32	350	11,165	4.35	0.6	0.1	0.7	200	25.68	0.0100	0.013	16.7	1.065
	432	431	0.3	RF	2.9	6	38	350	13,195	4.34	0.7	0.1	0.8	200	69.62	0.0100	0.013	16.7	1.065
	431	430	0.0	RF	2.9		38	350	13,195	4.34	0.7	0.1	0.8	200	8.40	0.0100	0.013	16.7	1.065
	430	429	0.6	RF	2.9	32	99	350	34,510	4.25	1.7	0.2	1.9	200	115.83	0.0100	0.013	16.7	1.065
	429	406	0.2	RF	2.9	15	113	350	39,585	4.23	1.9	0.1	2.1	200	44.64	0.0100	0.013	16.7	1.065
	406	405	0.1	RF	2.9		232	350	81,200	4.12	3.9	0.5	4.4	200	24.90	0.0025	0.013	8.4	0.533
	405	404	0.2	RF	2.9		232	350	81,200	4.12	3.9	0.6	4.4	200	46.20	0.0025	0.013	8.4	0.533

MUN. PROJECT # :																			
PROJECT TITLE:	North Grandview Heights NCP							**AVERAGE DAILY FLOW**				**INFILTRATION**				A&M Pl	24206		
	Minor System Flows							RESIDENTIAL = 350 L/day/capita				0.1 L/s/Ha				Sheet:	1 of 1		
PROJECT	Preliminary Sewer Design Analysis							COMMERCIAL = 40000 L/day/ha				**Maximum Depth of Flow**				Date:	Oct-13-05		
LOCATION:	South Surrey							INDUSTRIAL = 30000 L/day/ha				**50.0%**				By:	JBK		
																Chk:	AMB		
Area Name	Manhole		Area	Land Usage	Pop Density	Pop	Cum. Pop	Usage Level	Cumulative Daily Flow	Peak Factor	Peak Flow	Infiltration	Total Flow	Pipe Φ	Pipe Length	Slope	Coeff	50% Capacity	Velocity
	(From)	(To)	(Ha)		(per/ha)			L/Pop/day	(L/day)		(L/s)	(L/s)	(L/s)	(mm)	(m)	(m/m)		(L/s)	(m/s)
	428	427	0.4	RF	2.9	15	15	350	5,075	4.40	0.3	0.0	0.3	200	79.44	0.0100	0.013	16.7	1.065
	427	426	0.5	RF	2.9	15	29	350	10,150	4.36	0.5	0.1	0.6	200	111.36	0.0100	0.013	16.7	1.065
	426	404	0.1	RF	2.9		29	350	10,150	4.36	0.5	0.0	0.6	200	13.68	0.0100	0.013	16.7	1.065
	404	403	0.1	RF	2.9		261	350	91,350	4.10	4.3	0.6	5.0	200	13.70	0.0025	0.013	8.4	0.533
	403	402	0.1	RF	2.9		261	350	91,350	4.10	4.3	0.6	5.0	200	12.70	0.0025	0.013	8.4	0.533
	402	401	0.1	RF	2.9		261	350	91,350	4.10	4.3	0.6	5.0	200	17.10	0.0025	0.013	8.4	0.533
	420	EX	0.1	RF	2.9	12	12	350	4,060	4.41	0.2	0.3	0.5	200	13.83	0.0100	0.013	16.7	1.065
	427	426	0.6	RF	2.9	26	26	350	9,135	4.36	0.5	0.6	1.1	200	53.10	0.0100	0.013	16.7	1.065
	426	424	0.4	RF	2.9		26	350	9,135	4.36	0.5	0.6	1.1	200	34.56	0.0100	0.013	16.7	1.065
	424	423	0.3	RF	2.9		26	350	9,135	4.36	0.5	0.1	0.6	200	26.36	0.0100	0.013	16.7	1.065
	423	421	0.5	RF	2.9		26	350	9,135	4.36	0.5	0.1	0.6	200	46.63	0.0100	0.013	16.7	1.065
	422	421	1.5	RF	2.9	23	49	350	17,255	4.32	0.9	0.8	1.6	200	137.24	0.0100	0.013	16.7	1.065
PG 9	310	307	0.9	RF	2.9	17	17	350	6,090	4.39	0.3	0.1	0.4	200	70.12	0.0100	0.013	16.7	1.065
	307	306	0.8	RF	2.9	23	41	350	14,210	4.33	0.7	0.2	0.9	200	66.80	0.0100	0.013	16.7	1.065
	306	305	0.7	RF	2.9	20	61	350	21,315	4.30	1.1	0.2	1.3	200	56.30	0.0060	0.013	13.0	0.825
	309	305	0.7	RF	2.9	20	20	350	7,105	4.38	0.4	0.1	0.4	200	57.12	0.0100	0.013	16.7	1.065
	305	304	0.5	RF	2.9		81	350	28,420	4.27	1.4	0.4	1.8	200	39.10	0.0164	0.013	21.4	1.364
	304	303	0.4	RF	2.9		81	350	28,420	4.27	1.4	0.4	1.8	200	30.60	0.0484	0.013	36.8	2.343
	308	303	0.3	RF	2.9	20	20	350	7,105	4.38	0.4	0.0	0.4	200	23.23	0.0100	0.013	16.7	1.065
	303	302	0.6	RF	2.9	26	128	350	44,660	4.21	2.2	0.5	2.7	200	47.60	0.0401	0.013	33.5	2.133
	302	301	0.7	RF	2.9		128	350	44,660	4.21	2.2	0.6	2.7	200	58.60	0.0240	0.013	25.9	1.650
PG 11	206	205	0.9	RF	2.9	15	15	350	5,075	4.40	0.3	0.1	0.3	200	89.80	0.0100	0.013	16.7	1.065
	209	205	0.4	RF	2.9	20	20	350	7,105	4.38	0.4	0.0	0.4	200	36.96	0.0100	0.013	16.7	1.065
	211	210	0.4	RF	2.9	20	20	350	7,105	4.38	0.4	0.0	0.4	200	44.36	0.0100	0.013	16.7	1.065
	210	205	0.5	RF	2.9		20	350	7,105	4.38	0.4	0.1	0.5	200	49.37	0.0100	0.013	16.7	1.065
	205	204	0.3	RF	2.9	6	61	350	21,315	4.30	1.1	0.2	1.3	200	30.30	0.0235	0.013	25.6	1.633
	204	203	0.5	RF	2.9	29	90	350	31,465	4.26	1.5	0.3	1.8	200	55.40	0.0591	0.013	40.7	2.589
	203	202	0.4	RF	2.9		90	350	31,465	4.26	1.5	0.3	1.9	200	40.10	0.0500	0.013	37.4	2.382
	202	201	0.4	RF	2.9		90	350	31,465	4.26	1.5	0.4	1.9	200	38.10	0.0050	0.013	11.8	0.753
PG 13	190	119	0.6	RF	2.9	6	6	350	2,030	4.43	0.1	0.1	0.2	200	52.36	0.0100	0.013	16.7	1.065
	119	118	0.9	RF	2.9	26	32	350	11,165	4.35	0.6	0.1	0.7	200	72.80	0.0157	0.013	21.0	1.335
	180	118	0.7	RF	2.9	9	9	350	3,045	4.42	0.2	0.1	0.2	200	55.53	0.0100	0.013	16.7	1.065

MUN. PROJECT # :								**AVERAGE DAILY FLOW**			**INFILTRATION**					A&M P	24206		
PROJECT TITLE:	**North Grandview Heights NCP**							RESIDENTIAL = 350 L/day/capita			0.1 L/s/Ha					Sheet:	1 of 1		
	Minor System Flows							COMMERCIAL = 40000 L/day/ha			**Maximum Depth of Flow**					Date:	Oct-13-05		
PROJECT	Preliminary Sewer Design Analysis							INDUSTRIAL = 30000 L/day/ha			**50.0%**					By:	JBK		
LOCATION:	South Surrey															Chk:	AMB		

Area Name	Manhole		Area	Land Usage	Pop Density	Pop	Cum. Pop	Usage Level	Cumulative Daily Flow	Peak Factor	Peak Flow	Infiltration	Total Flow	Pipe Φ	Pipe Length	Slope	Coeff	50% Capacity	Velocity
	(From)	(To)	(Ha)		(per/ha)			L/Pop/day	(L/day)		(L/s)	(L/s)	(L/s)	(mm)	(m)	(m/m)		(L/s)	(m/s)
	118	117	0.6	RF	2.9		41	350	14,210	4.33	0.7	0.3	1.0	200	53.70	0.1322	0.013	60.8	3.873
	117	116	0.9	RF	2.9		41	350	14,210	4.33	0.7	0.4	1.1	200	79.70	0.0060	0.013	13.0	0.825
	170	116	0.9	RF	2.9	15	15	350	5,075	4.40	0.3	0.1	0.4	200	77.95	0.0100	0.013	16.7	1.065
	116	115	0.2	RF	2.9	3	58	350	20,300	4.30	1.0	0.5	1.5	200	13.70	0.1454	0.013	63.8	4.061
	115	114	0.5	RF	2.9	6	64	350	22,330	4.29	1.1	0.5	1.6	200	43.00	0.1092	0.013	55.3	3.520
	160	114	0.9	RF	2.9	9	9	350	3,045	4.42	0.2	0.1	0.2	200	78.91	0.0100	0.013	16.7	1.065
	114	113	1.0	RF	2.9	17	90	350	31,465	4.26	1.5	0.7	2.3	200	85.00	0.0888	0.013	49.9	3.174
	113	112	0.5	RF	2.9		90	350	31,465	4.26	1.5	0.8	2.3	200	46.60	0.0201	0.013	23.7	1.510
	152	151	1.0	RF	2.9	6	6	350	2,030	4.43	0.1	0.1	0.2	200	83.00	0.0100	0.013	16.7	1.065
	151	150	1.2	RF	2.9	17	23	350	8,120	4.37	0.4	0.2	0.6	200	102.95	0.0100	0.013	16.7	1.065
	150	112	1.2	RF	2.9	23	46	350	16,240	4.32	0.8	0.3	1.2	200	103.14	0.0100	0.013	16.7	1.065
	112	111	0.5	RF	2.9	9	145	350	50,750	4.20	2.5	1.2	3.6	200	42.80	0.0889	0.013	49.9	3.176
	140	111	0.2	RF	2.9	67	67	350	23,345	4.29	1.2	0.0	1.2	200	18.89	0.0100	0.013	16.7	1.065
	111	110	1.1	RF	2.9		212	350	74,095	4.14	3.5	1.3	4.9	200	95.30	0.0257	0.013	26.8	1.707
	110	109	0.6	RF	2.9		212	350	74,095	4.14	3.5	1.4	4.9	200	50.50	0.0025	0.013	8.4	0.533
	132	131	0.4	RF	2.9	9	9	350	3,045	4.42	0.2	0.0	0.2	200	29.98	0.0100	0.013	16.7	1.065
	131	130	1.2	RF	2.9	20	29	350	10,150	4.36	0.5	0.2	0.7	200	100.37	0.0100	0.013	16.7	1.065
	130	109	0.7	RF	2.9	12	41	350	14,210	4.33	0.7	0.2	0.9	200	56.05	0.0100	0.013	16.7	1.065
	109	108	0.2	RF	2.9	3	255	350	89,320	4.11	4.2	1.6	5.9	200	20.40	0.0025	0.013	8.4	0.533
	108	107	0.4	RF	2.9	3	258	350	90,335	4.11	4.3	1.6	5.9	200	34.80	0.0025	0.013	8.4	0.533
	125	107	0.5	RF	2.9	15	15	350	5,075	4.40	0.3	0.0	0.3	200	41.43	0.0100	0.013	16.7	1.065
	107	106	0.4	RF	2.9	3	276	350	96,425	4.09	4.6	1.7	6.3	200	33.10	0.0025	0.013	8.4	0.533
	106	105	0.5	RF	2.9	6	281	350	98,455	4.09	4.7	1.8	6.4	200	45.40	0.0025	0.013	8.4	0.533
	124	105	0.6	RF	2.9	12	12	350	4,060	4.41	0.2	0.1	0.3	200	52.00	0.0100	0.013	16.7	1.065
	105	104	0.5	RF	2.9	6	299	350	104,545	4.08	4.9	1.9	6.8	200	45.60	0.0025	0.013	8.4	0.533
	104	103	0.3	RF	2.9		299	350	104,545	4.08	4.9	1.9	6.9	200	21.80	0.0025	0.013	8.4	0.533
	123	122	1.1	RF	2.9	17	17	350	6,090	4.39	0.3	0.1	0.4	200	91.13	0.0100	0.013	16.7	1.065
	122	121	0.7	RF	2.9	15	32	350	11,165	4.35	0.6	0.2	0.7	200	58.43	0.0100	0.013	16.7	1.065
	121	120	0.3	RF	2.9	3	35	350	12,180	4.34	0.6	0.2	0.8	200	27.54	0.0100	0.013	16.7	1.065
	120	103	0.2	RF	2.9		35	350	12,180	4.34	0.6	0.2	0.8	200	18.06	0.0100	0.013	16.7	1.065
	103	102	0.5	RF	2.9	15	348	350	121,800	4.05	5.7	2.2	7.9	200	38.70	0.0025	0.013	8.4	0.533
	102	101	0.7	RF	2.9		348	350	121,800	4.05	5.7	2.3	8.0	200	57.10	0.0025	0.013	8.4	0.533
	101	4	1.3	RF	2.9		348	350	121,800	4.05	5.7	2.4	8.1	200	114.20	0.0025	0.013	8.4	0.533
	44	42	0.2	RF	2.9			350				0.0	0.0	200	20.48	0.0100	0.013	16.7	1.065

MUN. PROJECT # :			**AVERAGE DAILY FLOW**	**INFILTRATION**	A&M P	24206
PROJECT TITLE:	**North Grandview Heights NCP**		RESIDENTIAL = 350 L/day/capita	0.1 L/s/Ha	Sheet:	1 of 1
	Minor System Flows		COMMERCIAL = 40000 L/day/ha	**Maximum Depth of Flow**	Date:	Oct-13-05
PROJECT	Preliminary Sewer Design Analysis		INDUSTRIAL = 30000 L/day/ha	**50.0%**	By:	JBK
LOCATION:	South Surrey				Chk:	AMB

Area Name	Manhole		Area	Land Usage	Pop Density	Pop	Cum. Pop	Usage Level	Cumulative Daily Flow	Peak Factor	Peak Flow	Infiltration	Total Flow	Pipe Φ	Pipe Length	Slope	Coeff	50% Capacity	Velocity
	(From)	(To)	(Ha)		(per/ha)			L/Pop/day	(L/day)		(L/s)	(L/s)	(L/s)	(mm)	(m)	(m/m)		(L/s)	(m/s)
	43	42	0.3	RF	2.9	9	9	350	3,045	4.42	0.2	0.0	0.2	200	25.02	0.0100	0.013	16.7	1.065
	42	41	0.5	RF	2.9		9	350	3,045	4.42	0.2	0.1	0.3	200	38.92	0.0100	0.013	16.7	1.065
	41	14	0.6	RF	2.9		9	350	3,045	4.42	0.2	0.2	0.3	200	49.70	0.0100	0.013	16.7	1.065
	14	13	0.9	RF	2.9	6	15	350	5,075	4.40	0.3	0.2	0.5	200	72.20	0.0154	0.013	20.8	1.322
	13	12	0.8	RF	2.9	6	20	350	7,105	4.38	0.4	0.3	0.7	200	65.90	0.0527	0.013	38.4	2.445
	32	31	1.0	RF	2.9	26	26	350	9,135	4.36	0.5	0.1	0.6	200	84.70	0.0100	0.013	16.7	1.065
	31	12	0.6	RF	2.9	3	29	350	10,150	4.36	0.5	0.2	0.7	200	51.08	0.0100	0.013	16.7	1.065
	12	11	0.5	RF	2.9	3	52	350	18,270	4.31	0.9	0.5	1.4	200	45.10	0.0803	0.013	47.4	3.018
	11	10	0.5	RF	2.9	9	61	350	21,315	4.30	1.1	0.6	1.6	200	41.40	0.0592	0.013	40.7	2.591
	10	9	0.7	RF	2.9		61	350	21,315	4.30	1.1	0.7	1.7	200	61.50	0.0149	0.013	20.4	1.300
	25	24	0.8	RF	2.9	20	20	350	7,105	4.38	0.4	0.1	0.4	200	64.81	0.0100	0.013	16.7	1.065
	24	23	0.2	RF	2.9	3	23	350	8,120	4.37	0.4	0.1	0.5	200	20.63	0.0100	0.013	16.7	1.065
	23	22	1.4	RF	2.9	23	46	350	16,240	4.32	0.8	0.2	1.1	200	117.63	0.0100	0.013	16.7	1.065
	22	20	0.5	RF	2.9		46	350	16,240	4.32	0.8	0.3	1.1	200	43.40	0.0100	0.013	16.7	1.065
	21	20	0.4	RF	2.9	9	9	350	3,045	4.42	0.2	0.0	0.2	200	35.34	0.0100	0.013	16.7	1.065
	20	9	0.4	RF	2.9	3	58	350	20,300	4.30	1.0	0.4	1.4	200	37.72	0.0100	0.013	16.7	1.065
	9	8	0.6	RF	2.9		119	350	41,615	4.22	2.0	1.1	3.1	200	52.30	0.0634	0.013	42.1	2.682
	8	7	0.9	RF	2.9		119	350	41,615	4.22	2.0	1.2	3.2	200	79.00	0.0370	0.013	32.2	2.049
	7	6	0.4	RF	2.9	12	131	350	45,675	4.21	2.2	1.2	3.5	200	33.30	0.1203	0.013	58.0	3.694
	6	5	0.8	RF	2.9	20	151	350	52,780	4.19	2.6	1.3	3.9	200	69.60	0.0600	0.013	41.0	2.609
	5	4	0.7	RF	2.9		151	350	52,780	4.19	2.6	1.4	3.9	200	60.20	0.0310	0.013	29.5	1.875
	4	3	0.6	RF	2.9		499	350	174,580	3.97	8.0	3.8	11.9	250	52.40	0.0025	0.013	15.1	0.617
	3	2	0.3	RF	2.9		499	350	174,580	3.97	8.0	3.9	11.9	250	24.00	0.0025	0.013	15.1	0.617
	2	1	0.3	RF	2.9		499	350	174,580	3.97	8.0	3.9	11.9	250	21.60	0.0025	0.013	15.1	0.617

*Sewer design is preliminary and based on conceptual lot layouts. As such, lengths and slopes are subject to change.
**Areas without preliminary profiles are assumed to be at minimum 1.0% grade, some at 2.0%.
***Tributary areas are averages based on pipe length.

APPENDIX VI

STORM DRAINAGE REPORT

NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

STORM DRAINAGE REPORT

BY
APLIN & MARTIN CONSULTANTS LTD.

September 7, 2005

Project No. 24206

APLIN & MARTIN CONSULTANTS LTD

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NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

STORM DRAINAGE REPORT

1.0 INTRODUCTION

This report presents the drainage and stormwater management servicing strategies for the North Grandview Heights Neighbourhood Concept Plan area. The premise of the report is the proposed land use strategy presented in Section 2 of the NCP.

The North Grandview Heights NCP area is tributary to the Wills Brook and April Creek catchments which are tributary to the Morgan Creek/Old Logging Ditch system within the Nicomekl River basin. There is a drainage pump station at the Old Logging Ditch south of the dyke on the Nicomekl River

Although the North Grandview Heights NCP area is confined between 28 Avenue and 32 Avenue, the boundary used to evaluate the drainage infrastructure requirements extends beyond to include the entire study area used for the 1996 Morgan Creek/Old Logging Ditch Master Drainage Plan (MDP), accounting for all upland drainage that may impact infrastructure sizing. ***Figure 1*** identifies the existing storm drainage catchment areas and key components of the existing drainage system.

The study area of the Morgan Creek/Old Logging Ditch Master Drainage Plan included both the uplands and lowlands between 152 Street and 168 Street, from the watershed at approximately 24 Ave extending to the Nicomekl River in the north.

The 1996 Morgan Creek/Old Logging Ditch Master Drainage Plan (MDP) and the 1999 North Grandview Heights NCP were utilized as key resources in the development of the stormwater management strategy for this NCP, with some modifications made to reflect the specific site and development conditions being proposed for the catchment area.

The stormwater concept presented in the servicing plan are based on providing for the increased runoff resulting from the higher densities associated with the proposed land use from the 2005 concept North Grandview Heights NCP as shown in ***Figure 2.***

The proposed drainage infrastructure is shown in ***Figure 3.***

2.0 METHODOLOGY

The study area is divided into the uplands and the lowlands. Two sets of design criteria are applicable for the study area. A variation of the City of Surrey's design criteria is used for the uplands and the provincial agricultural design guidelines (ARDSA) are used for the lowlands. This required separate computer models to be used for the uplands and lowlands.

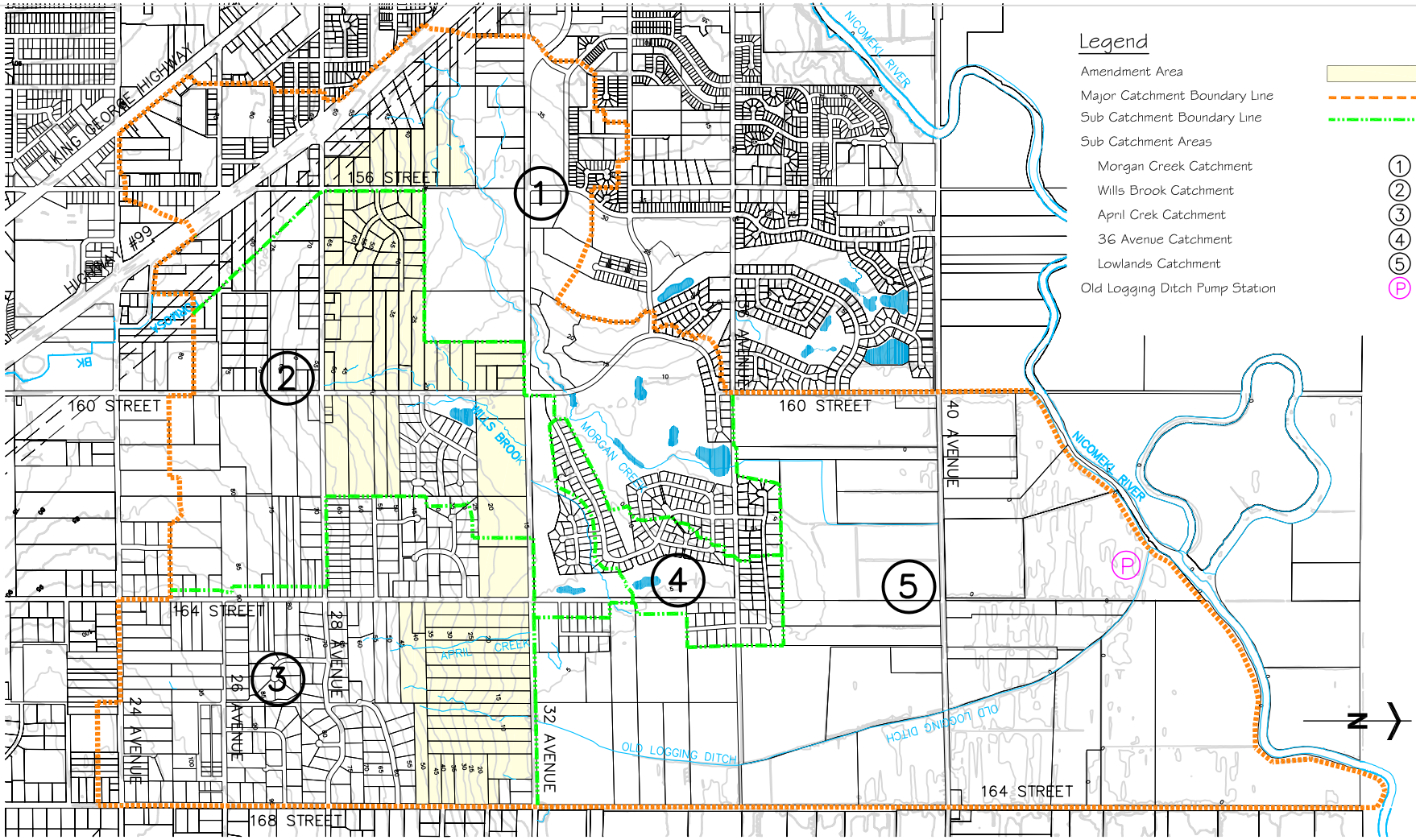

Figure 1

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NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

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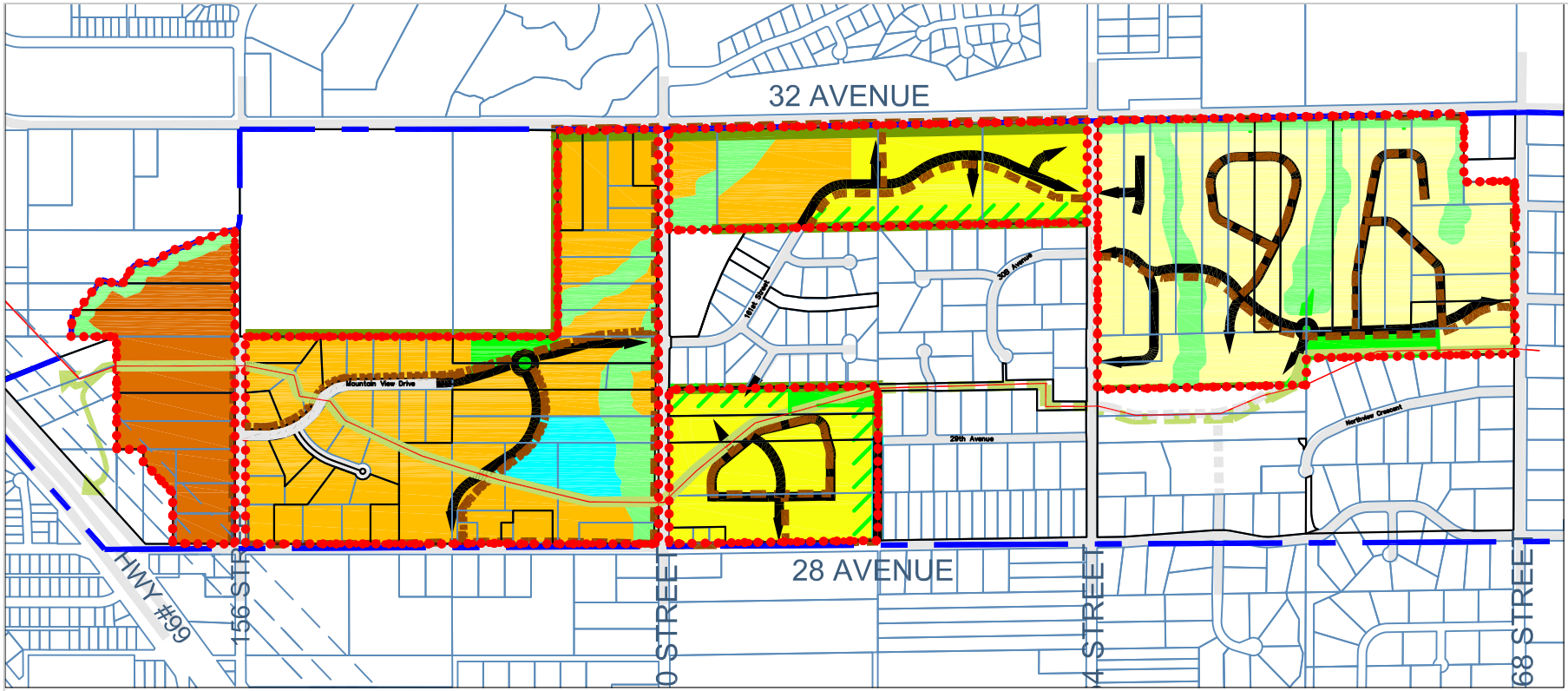
stormwater drainage study area



LEGEND

- Single Detached (2 upa)
- Larger Transition Lots (2-3 upa)
- Single Detached (4-6 upa)
- Cluster Housing (6-8 upa)
- Multifamily (15-25 upa)
- Environmental Area
- Neighbourhood Park
- Linear Park / Multi-use Trail
- Enhanced Sidewalk / Walkway
- Landscaped Buffer
- Elementary School
- Existing Public Road
- Proposed Public Road (local road location subject to detailed design)
- Approximate Intersection Location (Subject to detailed design)
- Round-about
- Amendment Area
- North Grandview Heights Area Boundary
- North Grandview Gravity Sewer Interceptor

Notes:
(1) This plan is conceptual in nature and is intended to reflect a general pattern of land uses. Land use boundaries will be confirmed within the context of detailed rezoning and subdivision applications.
(2) Density refers to units per-gross acre of land.
(3) All development should obtain an Arborist report to determine the number of trees that can be preserved.

N

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Figure 2

NORTH GRANDVIEW HEIGHTS
NEIGHBOURHOOD CONCEPT PLAN

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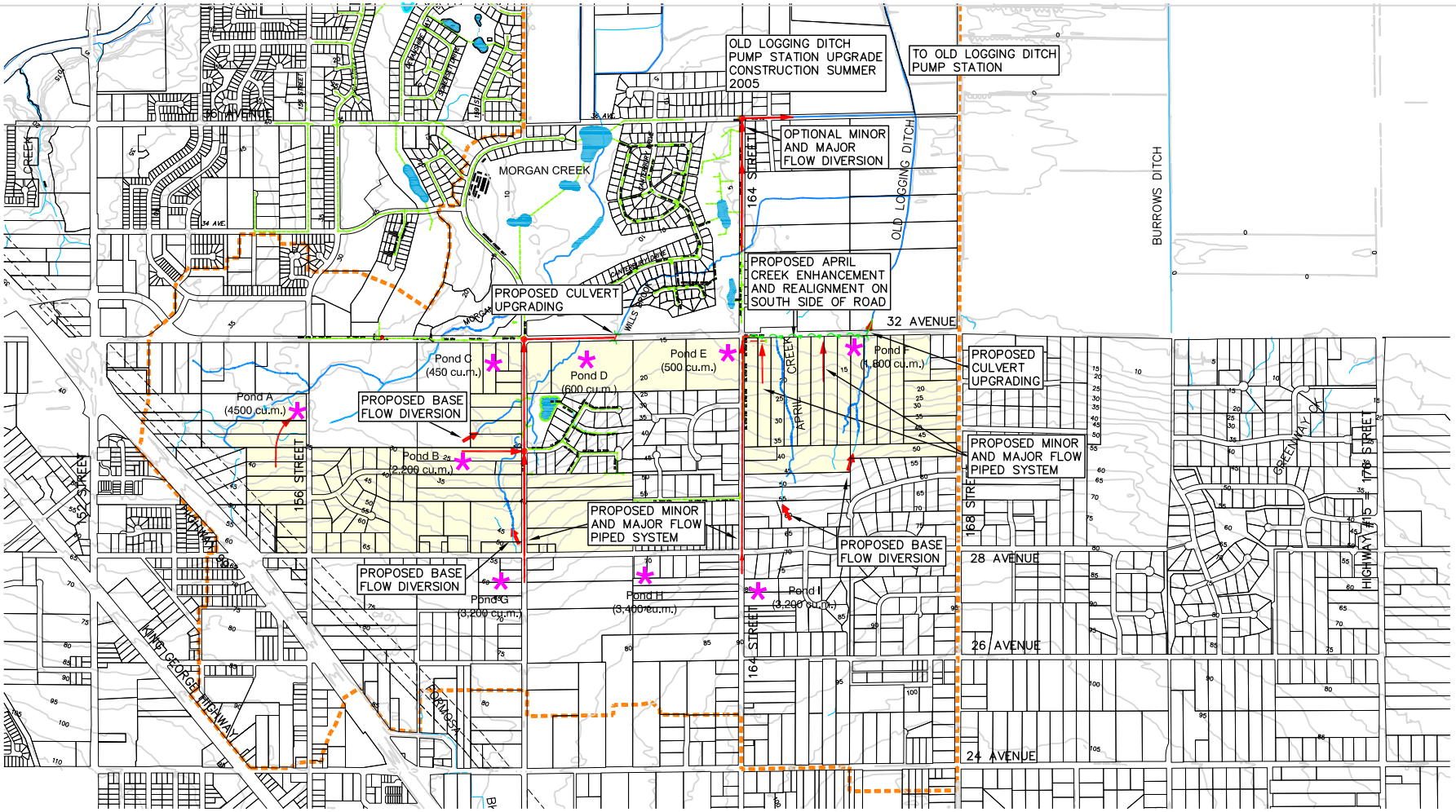
2005 NCP amendment area land use plan plan



Legend

Amendment Area

Major Catchment Boundary Line

Proposed Detention Pond (Volume in cu.m.) * (1,200 cu.m.)

Note: Final location and storage volume of detention ponds will be determined at detailed design.

Figure 3

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NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

proposed storm system

Aplin & Martin Consultants Ltd. prepared a computer model using XPSWMM for the uplands. This model required modelling of 2, 5 and 100 year storm events varying in duration from 1 to 24 hours to meet the City of Surrey's service objectives which are as follows:

The planning for drainage systems which meet the needs of growth must meet four basic criteria which form the fundamental aspects of the City's Drainage Policy:

1. A minor system conveyance capacity up to the 1:5 year return period storm to minimize inconvenience of frequent surface runoff.
2. A major system conveyance capacity up to the 1:100 year return period storm to provide safe conveyance of flows to minimize damage to life and property.
3. Provision of detention to ensure that the increase in impervious area as a result of development does not adversely affect lands downstream.
4. Maintenance of a flood control and drainage system in the lowlands that meets provincial guidelines for agriculture in floodplains (ARDSA).

Dillon Consulting had already prepared a computer model using XPSWMM for the lowlands in preparation of the Old *Logging Ditch / Morgan Creek Functional Feasibility Study for Lowlands Report, August 2002*. Aplin & Martin obtained a copy of the model from Dillon and re-ran the model using the proposed land use from the 2005 concept North Grandview Heights NCP. While flooding in the lowland area is inevitable and unavoidable due to the nature of the floodplain and the dynamic of the lowland area, the agricultural design guidelines (ARDSA) used for the Nicomekl lowlands requires that flooding be limited to 2 days during a 2 day 1:10 year summer storm event, and 5 days during a 5 day 1:10 year winter storm event. Future development must ensure that these criteria, or a better level of service if it currently exists, are upheld.

Modelling Parameters

The Surrey Municipal Hall: Rainfall IDF Data shown in ***Table 1*** were used to develop rainfall hyetographs with the AES distribution for the 1, 2 and 6 hour events and the SCS Type 1A distribution for the 12 and 24 hour events in accordance with the City of Surrey Storm Drainage Criteria.

TABLE 1

Rainfall IDF Data - Surrey Municipal Hall				
		Rainfall Amounts (mm)		
Type of Storm	**Duration**	**2 YR**	**5YR**	**100 YR**
AES	1 H	10.0	12.9	20.7
AES	2 H	14.6	17.7	26.2
AES	6 H	26.9	32.5	47.8
SCS-TYPE 1A	12 H	39.2	47.3	69.4
SCS-TYPE 1A	24 H	56.2	67.7	99.1

The parameters used for each of the sub-catchments in the study area for the uplands modelling are as follows:

- Morgan Creek Sub-Catchment is shown in the ***Figure 4*** indicating the location of the nodes associated with the modelling parameters presented in ***Table 2***.
- Wills Brook Sub-Catchment is shown in the ***Figure 5*** indicating the location of the nodes associated with the modelling parameters presented in ***Table 3***.
- April Creek Sub-Catchment is shown in the ***Figure 6*** indicating the location of the nodes associated with the modelling parameters presented in ***Table 4***.
- 36 Avenue and Lowlands Sub-Catchments are shown in the ***Figure 7*** indicating the location of the nodes associated with the modelling parameters presented in ***Table 5***.
- The parameters used for the Dillon lowlands model were revised for the various sub-catchments as shown in ***Table 6***.

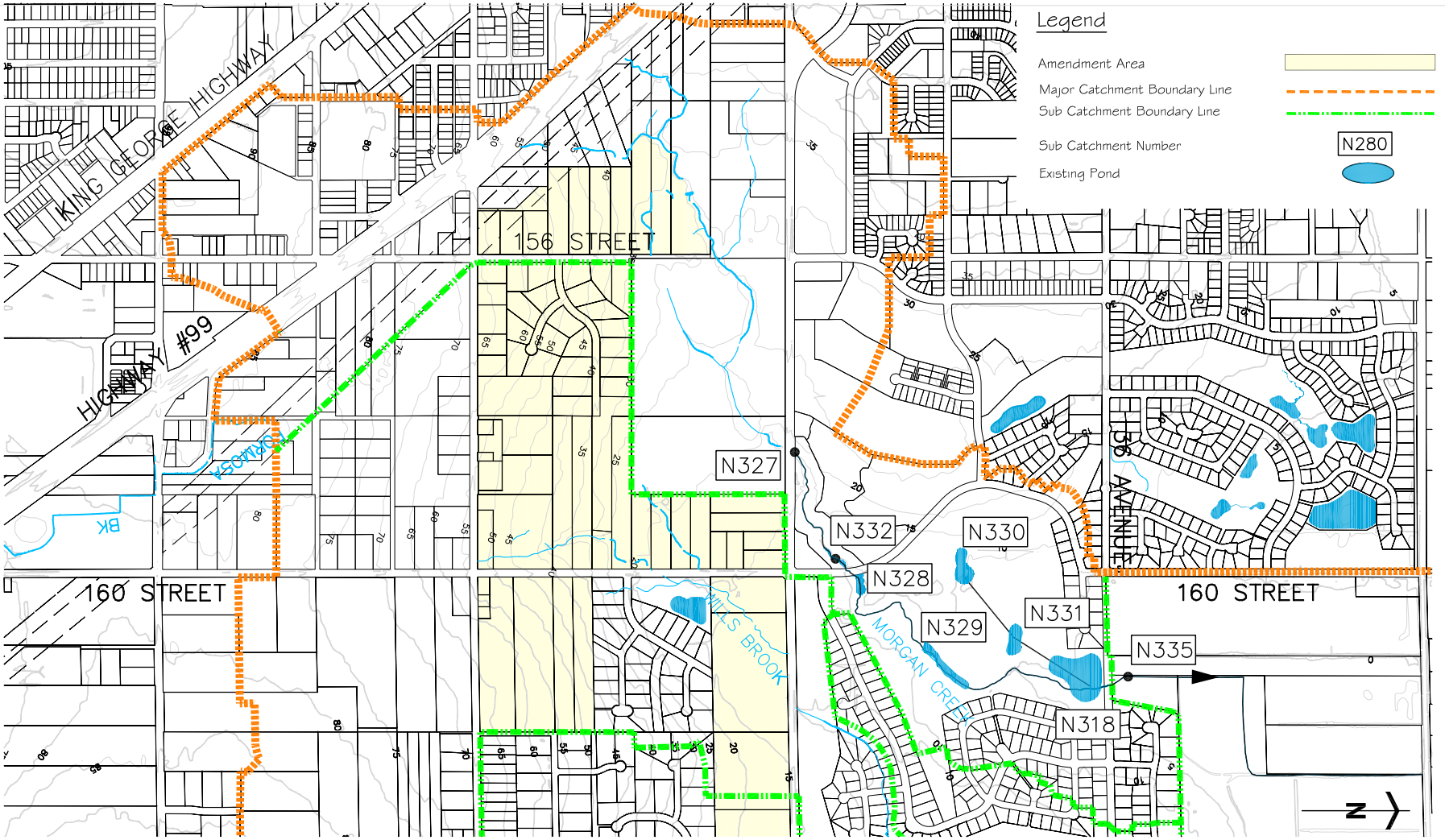

Figure 4

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NORTH GRANDVIEW HEIGHTS
NEIGHBOURHOOD CONCEPT PLAN

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morgan creek catchment

Table 2

Summary of Morgan Creek Sub Catchment Parameters

Node	Existing		Proposed		Infiltration
	Area (ha)	% Impervious	Area (ha)	% Impervious	Parameters
N327	34.35	10	-	-	Uplands
	37.52	65	-	-	Uplands
	25.96	90	-	-	Uplands
N332	4.35	10	-	-	Uplands
	20.17	65	-	-	Uplands
	11.31	90	-	-	Uplands
N328	2.41	10	-	-	Uplands
	1.24	65	-	-	Uplands
N329	26.77	10	-	-	Uplands
N330	8.18	65	-	-	Uplands
N318	13.38	65	-	-	Uplands
	1.66	90			Uplands
N335	5.09	55	-	-	Uplands

Uplands Infiltration Parameters	
Impervious Depression Storage (mm)	0.5
Pervious Depression Storage (mm)	10
Impervious Manning's n	0.015
Pervious Manning's n	0.25
Impervious Zero Detention (mm)	0
Horton's Maximum Infiltration (mm)	25
Horton's Minimum Infiltration (mm)	1
Infiltration Decay Rate	0.00115

Baseflow Summary	**Upland**	**Lowland**
Event (L/s/ha)	1.32	0.69

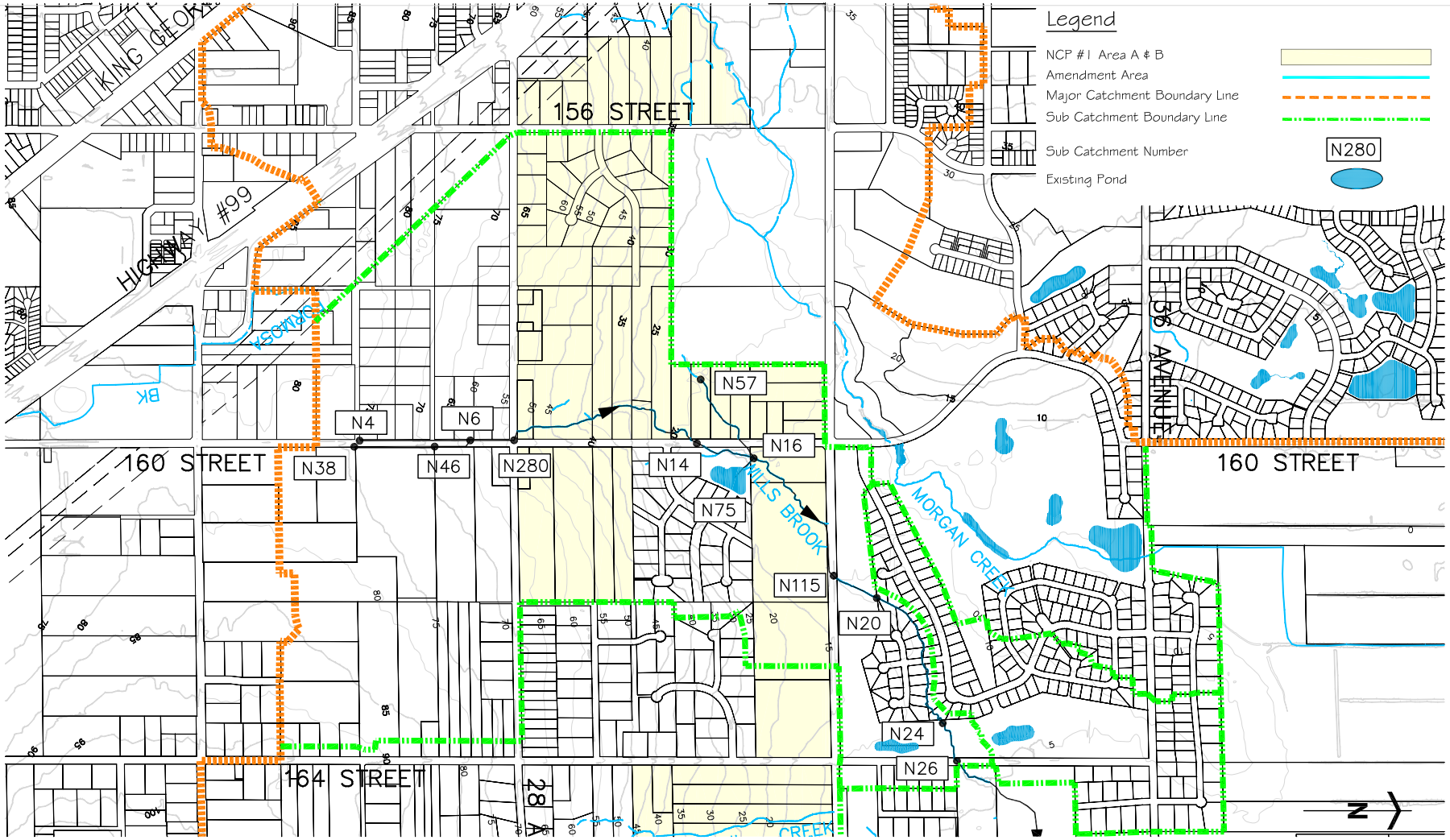

Figure 5

NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

wills brook catchment

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Table 3

Summary of Wills Brook Sub Catchment Parameters

Node	Existing		Proposed		Infiltration
	Area (ha)	% Impervious	Area (ha)	% Impervious	Parameters
N4	14.14	10	4.92	65	Uplands
N6	14.05	10	7.17	65	Uplands
N38	10.34	10	5.41	65	Uplands
			1.07	20	Uplands
N42	16.00	25	2.88	80	Uplands
			1.13	65	Uplands
N46	4.07	80	4.07	80	Uplands
N280	31.95	10	43.96	65	Uplands
			2.43	50	Uplands
			7.04	80	Uplands
N14	5.78	10	3.37	10	Uplands
N57	8.64	50	26.95	65	Uplands
N60	15.58	10	0.66	10	Uplands
N75	10.91	50	5.99	65	Uplands
	13.46	10	16.88	50	Uplands
N115	21.38	10	3.57	10	Uplands
			8.46	65	Uplands
			1.29	40	Uplands
N20	5.96	10	5.96	10	Uplands
N24	2.88	50	2.88	50	Uplands
	1.85	10	1.85	10	Uplands
N26	3.64	10	3.64	10	Uplands
	2.55	50	2.55	50	Uplands

Uplands Infiltration Parameters	
Impervious Depression Storage (mm)	0.5
Pervious Depression Storage (mm)	10
Impervious Manning's n	0.015
Pervious Manning's n	0.25
Impervious Zero Detention (mm)	0
Horton's Maximum Infiltration (mm)	25
Horton's Minimum Infiltration (mm)	1
Infiltration Decay Rate	0.00115

Baseflow Summary	**Upland**	**Lowland**
Event (L/s/ha)	1.32	0.69

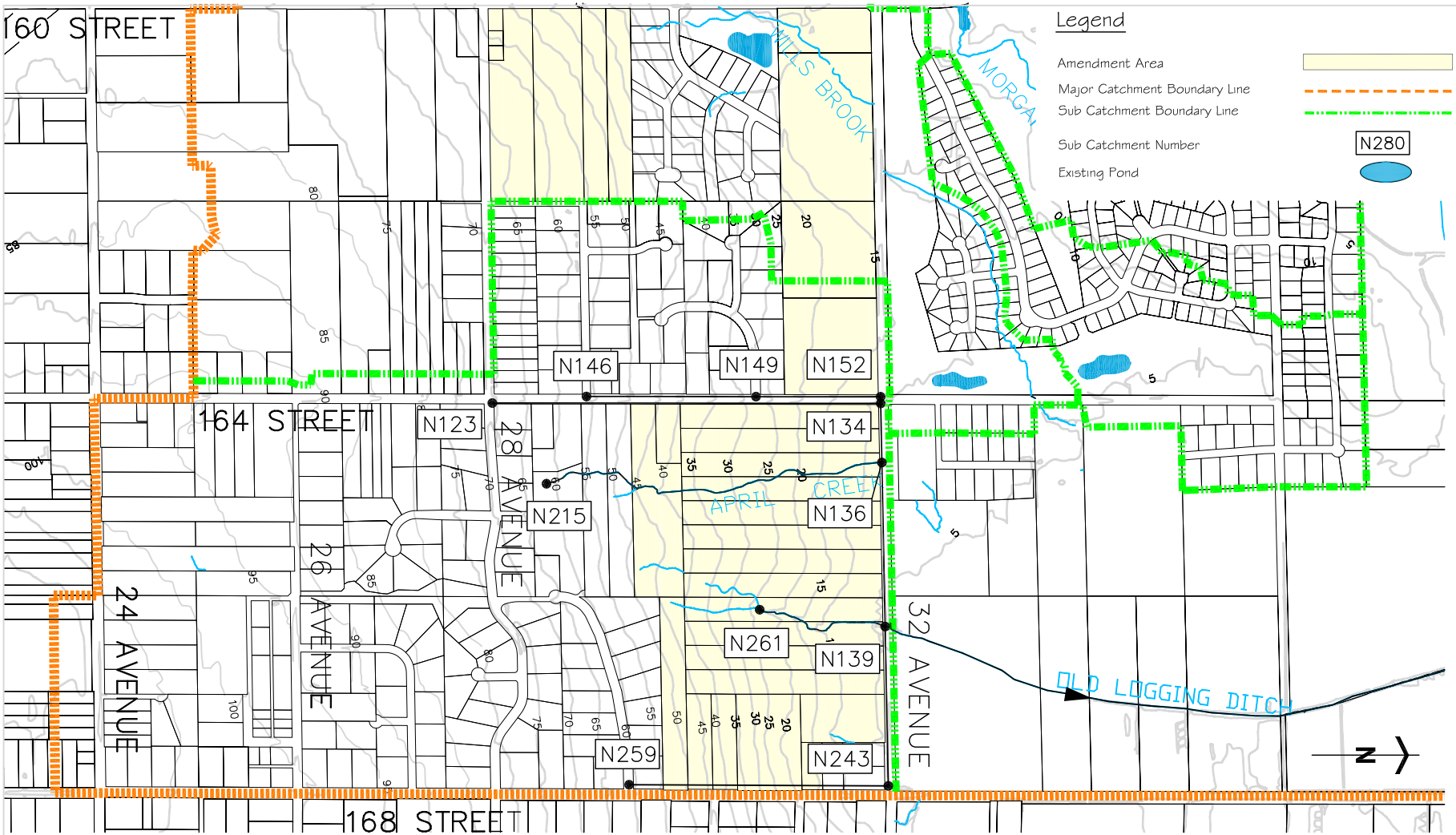

Figure 6

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NORTH GRANDVIEW HEIGHTS
NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

April Creek Catchment

Table 4

Summary of April Creek Sub Catchment Parameters

Node	Existing		Proposed		Infiltration
	Area (ha)	% Impervious	Area (ha)	% Impervious	Parameters
N123	30.95	10	8.27	50	Uplands
	10.63	50	32.40	65	Uplands
N134	2.79	50	5.33	50	Uplands
N136	9.92	10	2.46	10	Uplands
			5.02	65	Uplands
N139	29.46	10	23.41	50	Uplands
	1.06	50	12.31	65	Uplands
N146	3.12	10	7.86	50	Uplands
	8.95	50	1.72	65	Uplands
			0.56	80	Uplands
N149	13.44	50	13.49	50	Uplands
N152	2.78	50	3.30	50	Uplands
	5.07	10	4.49	65	Uplands
N215	24.63	50	1.18	10	Uplands
N261	6.66	10	3.94	10	Uplands
			6.67	50	Uplands
N259	9.06	50	13.71	50	Uplands
N243	4.18	50	9.00	65	Uplands
			4.08	50	Uplands

Uplands Infiltration Parameters	
Impervious Depression Storage (mm)	0.5
Pervious Depression Storage (mm)	10
Impervious Manning's n	0.015
Pervious Manning's n	0.25
Impervious Zero Detention (mm)	0
Horton's Maximum Infiltration (mm)	25
Horton's Minimum Infiltration (mm)	1
Infiltration Decay Rate	0.00115

Baseflow Summary	**Upland**	**Lowland**
Event (L/s/ha)	1.32	0.69

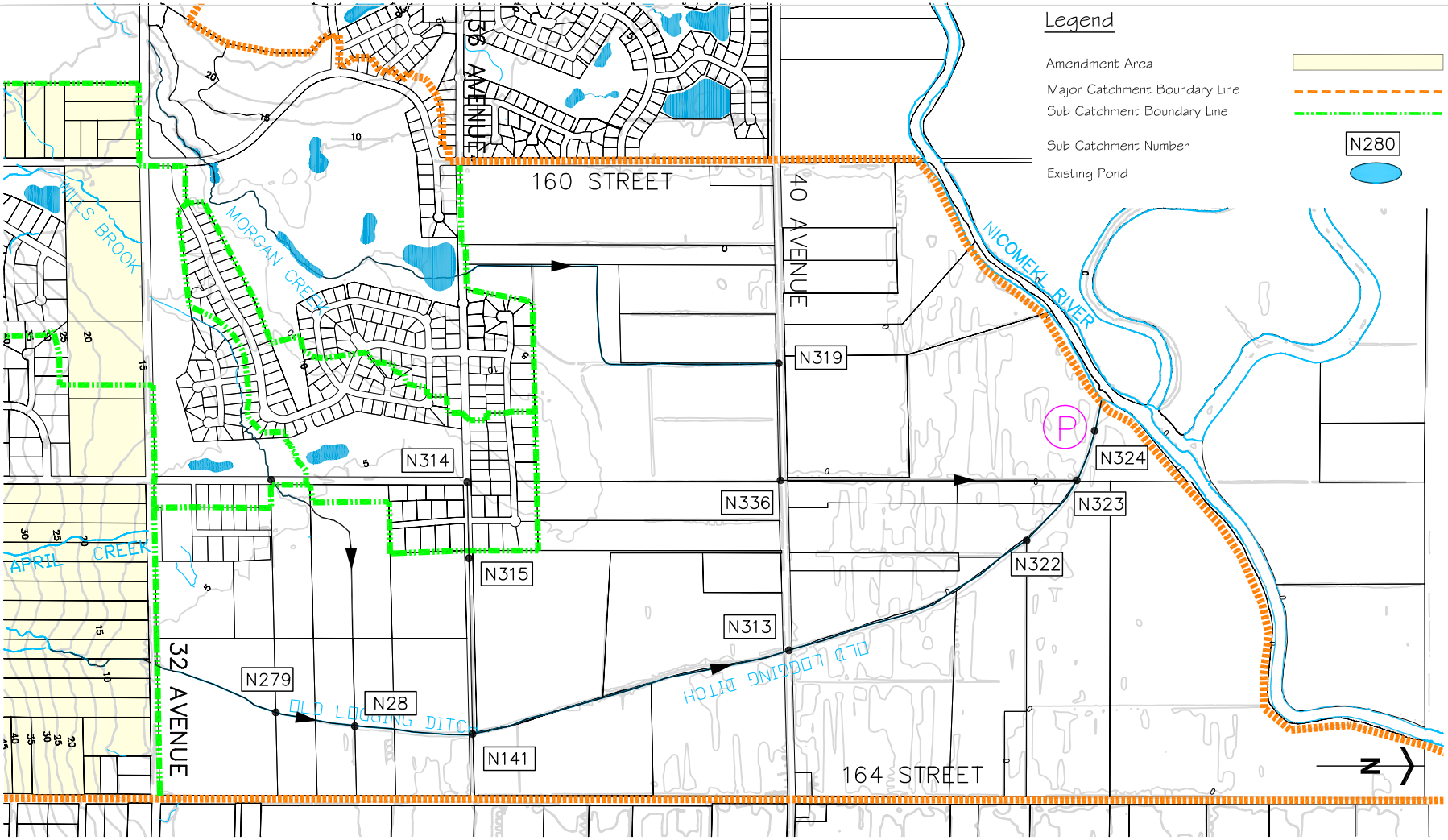

Figure 7

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NORTH GRANDVIEW HEIGHTS
NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

36 avenue and lowlands catchment

Table 5

Summary of 36 Avenue Subcatchment Parameters

Node	Existing		Proposed		Infiltration
	Area (ha)	% Impervious	Area (ha)	% Impervious	Parameters
N315	22.86	55	-	-	Uplands
	7.25	10	-	-	Uplands

Summary of Lowlands Subcatchment Parameters

Node	Existing		Proposed		Infiltration
	Area (ha)	% Impervious	Area (ha)	% Impervious	Parameters
N279	18.34	10	-	-	Lowlands
	4.10	50	-	-	Uplands
N28	23.88	10	-	-	Lowlands
N313	94.50	10	-	-	Lowlands
N319	39.00	10	-	-	Lowlands
N322	106.23	10	-	-	Lowlands
N323	55.18	10	-	-	Lowlands

Infiltration Parameters	Uplands	Lowlands
Impervious Depression Storage (mm)	0.5	0.5
Pervious Depression Storage (mm)	10	7
Impervious Manning's n	0.015	0.015
Pervious Manning's n	0.25	0.25
Impervious Zero Detention (mm)	0	0
Horton's Maximum Infiltration (mm)	25	3
Horton's Minimum Infiltration (mm)	1	0.3
Infiltration Decay Rate	0.00115	0.00115

Baseflow Summary	**Upland**	**Lowland**
Event (L/s/ha)	1.32	0.69

Table 6

Subcatchment Parameters of the Amended Area

Node Number		Original (Dillon) Model		Amended Area		Width	Slope
		Area (ha)	Impervious (%)	Area (ha)	Impervious (%)	(m)	m/m
SC1	# 1	37.74	55	27.95	55	1406	0.045
	# 2			9.79	65	750	0.037
SC2	# 1	32.25	55	8.30	55	826	0.040
	# 2			23.15	65	951	0.043
	# 3			0.80	80	121	0.027
SC3	# 1	43.97	45	7.04	80	680	0.049
	# 2			25.34	65	710	0.042
	# 3			11.59	80	485	0.024
SC4	# 1	45.25	50	45.25	65	1078	0.042
SC5	# 1	37.56	65	37.56	65	1441	0.044
SC6	# 1	40.09	50	17.59	50	854	0.085
	# 2			22.50	65	1102	0.085
SC7	# 1	47.88	45	17.65	50	1147	0.082
	# 2			30.23	65	1872	0.079
SC8	# 1	40.71	50	19.80	50	1055	0.078
	# 3			2.32	55	100	0.078
	# 4			18.51	65	675	0.078
SC9	#1	40.73	40	40.73	40	1685	0.053
SC10	# 1	68.1	40	45.73	40	1494	0.054
	# 2			20.37	65	1046	0.077

Infiltration Summary

Parameter	Upland	Lowland
Impervious Depression Storage (mm)	10.0	0.5
Pervious Depression Storage (mm)	15.0	1.0
Impervious Manning's n	0.035	0.015
Pervious Manning's n	0.5	0.2
Impervious Zero Detention (mm)	3.0	1.0
Horton Maximum Infiltration (mm)	10.0	3.0
Horton Minimum Infiltration (mm)	0.5	0.3
Infiltration Decay rate (/s)	0.00115	0.00115

Baseflow Summary

	Upland	Lowland
Event (L/s/ha)	1.32	0.69

3.0 HYDROLOGIC MODELLING RESULTS

XPSWMM models were created for the uplands and the lowlands and used to model both existing and future development conditions. Modelling was done both with and without detention in the uplands to determine the effectiveness thereof.

Uplands Model

The pre development conditions were modelled with the three existing pumps at the Old Logging Ditch Pump Station. The City is planning to upgrade the Old Logging Ditch and drainage pump station in 2005/2006 and this was included in the modelling for the post development conditions.

For the pre development conditions ***Figure 8*** indicates the nodes associated with the modelling results which are summarized in ***Table 7.***

For the post development conditions without detention ***Figure 9*** indicates the nodes associated with the modelling results which are summarized in ***Table 8.***

For the post development conditions with detention ***Figure 10*** indicates the nodes associated with the modelling results which are summarized in ***Table 9.***

The modelling included base flows in the creeks to ensure adequate sizing of the infrastructure to accommodate peak flows. ***Table 10*** summarizes the estimated base flow rates at the various creeks and the peak flows together with base flows at the major culvert crossings of 32 Avenue.

In the lowlands there is overtopping of the ditches and flooding into the lowlands for both pre and post development conditions. The lowland watercourse nodes are identified in ***Figure 11*** and ***Table 11*** summarizes the total flow out of the system into the lowlands for the various storm events. There is a significant increase frequency and intensity of flooding into the lowlands if no upland detention provided. By providing detention in the uplands there is a slight increase in frequency but a decrease in the intensity of flooding into the lowlands. Detention in the uplands is effective and should therefore be provided. The volumes of the detention required are shown as part of the proposed drainage infrastructure in ***Figure 3.*** The detention is shown in the approximate area where it is to be provided. The exact location and form of detention would be determined at the design stage.

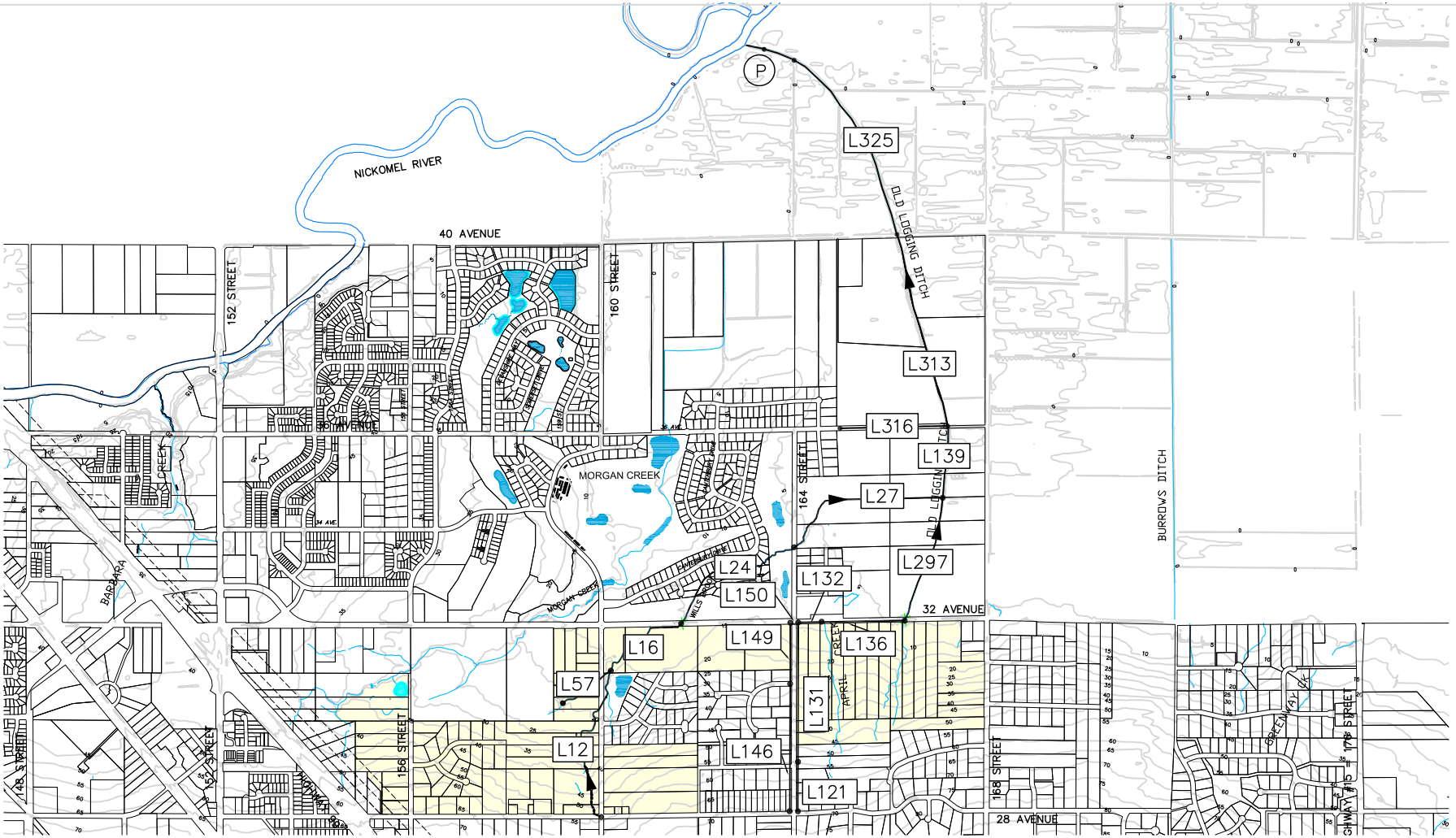

Figure 8

NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

pre development conditions

N

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Table 7

Drainage Modeling Summary of Old Logging Ditch Catchment
Summary of Peak Flows With Base Flow
Outfall - Nicomekl River Boundary Conditions

PRE DEVELOPMENT FLOWS (cms)[1]

Storm Duration	L278	L281	L114	L115	L314	L315	L12	L57	L16	L24	L27	L121	L131	L146	L149	L150	L132	L136	L297	L316	L139	L313	L325
2Y1H	-	-	-	-	-	-	0.761	0.244	0.967	1.085	1.066	0.410	0.450	-	0.563	0.440	0.798	1.303	1.472	0.561	2.478	2.173	1.681
2Y2H	-	-	-	-	-	-	0.627	0.197	0.804	0.949	1.038	0.333	0.396	-	0.453	0.421	0.453	1.194	1.533	0.457	2.544	2.471	2.276
2Y6H	-	-	-	-	-	-	0.650	0.140	1.023	1.176	1.210	0.332	2.097	-	0.338	0.348	0.687	1.098	1.568	0.302	2.820	2.632	3.643
2Y12H	-	-	-	-	-	-	0.691	0.145	1.074	1.260	1.241	0.344	0.385	-	0.327	0.343	0.693	1.115	1.566	0.307	2.872	2.691	4.050
2Y24H	-	-	-	-	-	-	0.713	0.148	1.109	1.470	1.321	0.353	0.391	-	0.321	0.342	0.696	1.112	1.560	0.272	3.020	2.588	3.799
5Y1H	-	-	-	-	-	-	0.960	0.305	1.206	1.264	1.127	0.516	0.553	-	0.745	0.532	0.924	1.509	1.694	0.742	2.811	2.595	1.825
5Y2H	-	-	-	-	-	-	0.735	0.235	0.942	1.104	1.089	0.393	0.415	-	0.615	0.454	0.826	1.363	1.732	0.558	2.917	2.785	2.558
5Y6H	-	-	-	-	-	-	1.042	0.220	1.633	1.854	1.404	0.530	0.731	-	0.580	0.449	1.109	1.660	2.159	0.437	3.716	3.285	4.605
5Y12H	-	-	-	-	-	-	1.052	0.212	1.637	1.848	1.404	0.520	0.733	-	0.546	0.434	1.112	1.554	2.150	0.392	3.799	3.262	4.810
5Y24H	-	-	-	-	-	-	1.063	0.213	1.646	1.866	1.405	0.514	0.727	-	0.545	0.430	1.109	1.540	2.177	0.412	3.831	3.055	4.361
100Y1H	-	-	-	-	-	-	1.473	0.483	1.873	1.845	1.353	0.789	0.885	-	1.171	0.741	1.294	2.111	2.274	1.234	3.686	3.377	3.531
100Y2H	-	-	-	-	-	-	1.475	0.349	2.281	2.040	1.406	0.790	0.839	-	0.907	0.709	1.326	2.099	2.507	0.848	4.014	3.631	4.272
100Y6H	-	-	-	-	-	-	2.240	0.268	3.263	2.897	1.410	1.097	1.166	-	1.012	0.901	1.554	2.441	2.992	0.913	4.824	3.739	5.615
100Y12H	-	-	-	-	-	-	2.080	0.413	3.112	2.889	1.409	1.031	1.090	-	0.991	0.747	1.531	2.414	2.989	0.852	4.823	3.672	5.652
100Y24H	-	-	-	-	-	-	2.068	0.415	2.969	2.881	1.408	0.995	1.055	-	0.769	0.681	1.479	2.336	2.989	0.770	4.824	3.316	5.221

[1]Old Logging Ditch Pump Station with existing 3 pumps.

[2]Old Logging Ditch Pump Station with existing 3 pumps plus 3 new screw pumps and ditch improvements.

[3]With proposed storm system improvements and no detention uplands.

[4]With proposed storm system improvements and detention uplands.

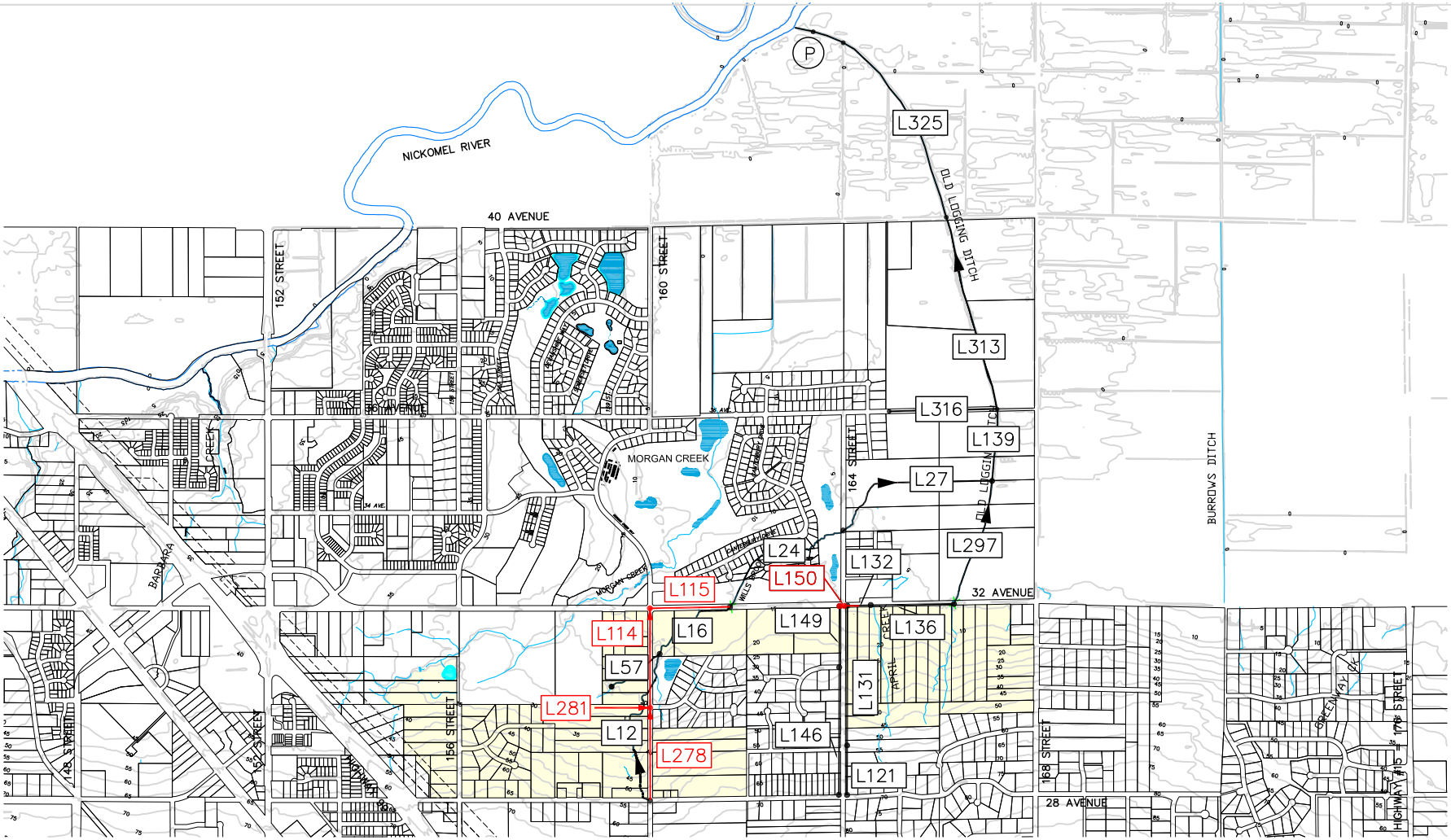


Figure 9

APLIN MARTIN CONSULTANTS LTD

NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

post development conditions option 1 without detention

Table 8

Drainage Modeling Summary of Old Logging Ditch Catchment
Summary of Peak Flows With Base Flow
Outfall - Nicomekl River Boundary Conditions

POST DEVELOPMENT FLOWS OPTION 1 WITHOUT DETENTION (cms)[2,3]

Storm Duration	L278	L281	L114	L115	L314	L315	L12	L57	L16	L24	L27	L121	L131	L146	L149	L150	L132	L136	L297	L316	L139	L313	L325
2Y1H	1.793	0.565	2.513	2.540	-	-	0.692	0.284	0.901	2.727	1.387	1.142	1.244	0.445	0.802	0.933	2.167	3.079	3.433	0.555	4.414	3.542	2.467
2Y2H	1.409	0.446	2.011	2.025	-	-	0.560	0.213	0.855	3.063	1.402	0.930	1.011	0.350	0.634	0.743	1.748	2.527	2.961	0.450	4.213	3.815	3.130
2Y6H	0.907	0.299	1.323	1.342	-	-	0.376	0.125	0.765	2.299	1.397	0.621	0.680	0.235	0.433	0.504	1.178	1.772	2.209	0.294	3.662	3.246	4.252
2Y12H	0.922	0.303	1.345	1.364	-	-	0.382	0.127	0.733	2.344	1.398	0.632	0.692	0.239	0.428	0.506	1.198	1.782	2.210	0.300	3.584	3.218	4.371
2Y24H	0.807	0.272	1.171	1.184	-	-	0.335	0.116	0.712	2.050	1.397	0.541	0.605	0.221	0.410	0.477	1.082	1.633	2.071	0.257	3.503	3.025	3.900
5Y1H	2.380	0.732	3.204	3.241	-	-	0.866	0.365	1.016	3.696	1.407	1.453	1.584	0.543	1.016	1.191	2.731	3.951	3.692	0.736	4.794	4.178	2.638
5Y2H	1.712	0.538	2.437	2.466	-	-	0.668	0.257	1.095	3.727	1.404	1.125	1.222	0.424	0.767	0.899	2.112	3.064	3.502	0.550	4.822	4.356	3.385
5Y6H	1.325	0.443	1.914	1.934	-	-	0.534	0.191	1.113	3.261	1.403	0.874	0.981	0.357	0.668	0.775	1.753	2.643	3.241	0.419	4.700	3.882	4.808
5Y12H	1.206	0.396	1.739	1.757	-	-	0.490	0.170	1.039	3.011	1.403	0.803	0.894	0.318	0.589	0.684	1.570	2.377	2.999	0.392	4.490	3.754	4.986
5Y24H	1.087	0.368	1.586	1.607	-	-	0.444	0.157	1.022	2.935	1.402	0.772	0.862	0.304	0.581	0.675	1.536	2.371	2.985	0.391	4.479	3.527	4.547
100Y1H	4.005	1.166	4.233	4.185	-	-	1.189	0.630	1.977	6.555	1.411	1.677	1.887	0.700	1.454	1.750	3.634	5.575	3.813	1.225	4.922	4.715	3.588
100Y2H	2.708	0.798	3.524	3.570	-	-	0.904	0.400	1.890	5.956	1.406	1.654	1.843	0.597	1.132	1.336	3.150	4.783	3.607	0.837	4.921	4.688	4.561
100Y6H	2.305	0.719	3.267	3.311	-	-	0.811	0.345	1.989	5.845	1.407	1.581	1.759	0.551	1.122	1.314	3.068	4.762	3.329	0.908	4.774	3.980	5.731
100Y12H	2.303	0.748	3.272	3.313	-	-	0.812	0.322	1.918	5.739	1.407	1.524	1.704	0.553	1.119	1.308	3.008	4.665	3.363	0.863	4.794	3.980	5.755
100Y24H	1.654	0.544	2.413	2.448	-	-	0.651	0.234	1.615	4.660	1.407	1.209	1.346	0.468	0.893	1.038	2.383	3.703	3.196	0.765	4.769	3.672	5.331

[1]Old Logging Ditch Pump Station with existing 3 pumps.

[2]Old Logging Ditch Pump Station with existing 3 pumps plus 3 new screw pumps and ditch improvements.

[3]With proposed storm system improvements and no detention uplands.

[4]With proposed storm system improvements and detention uplands.

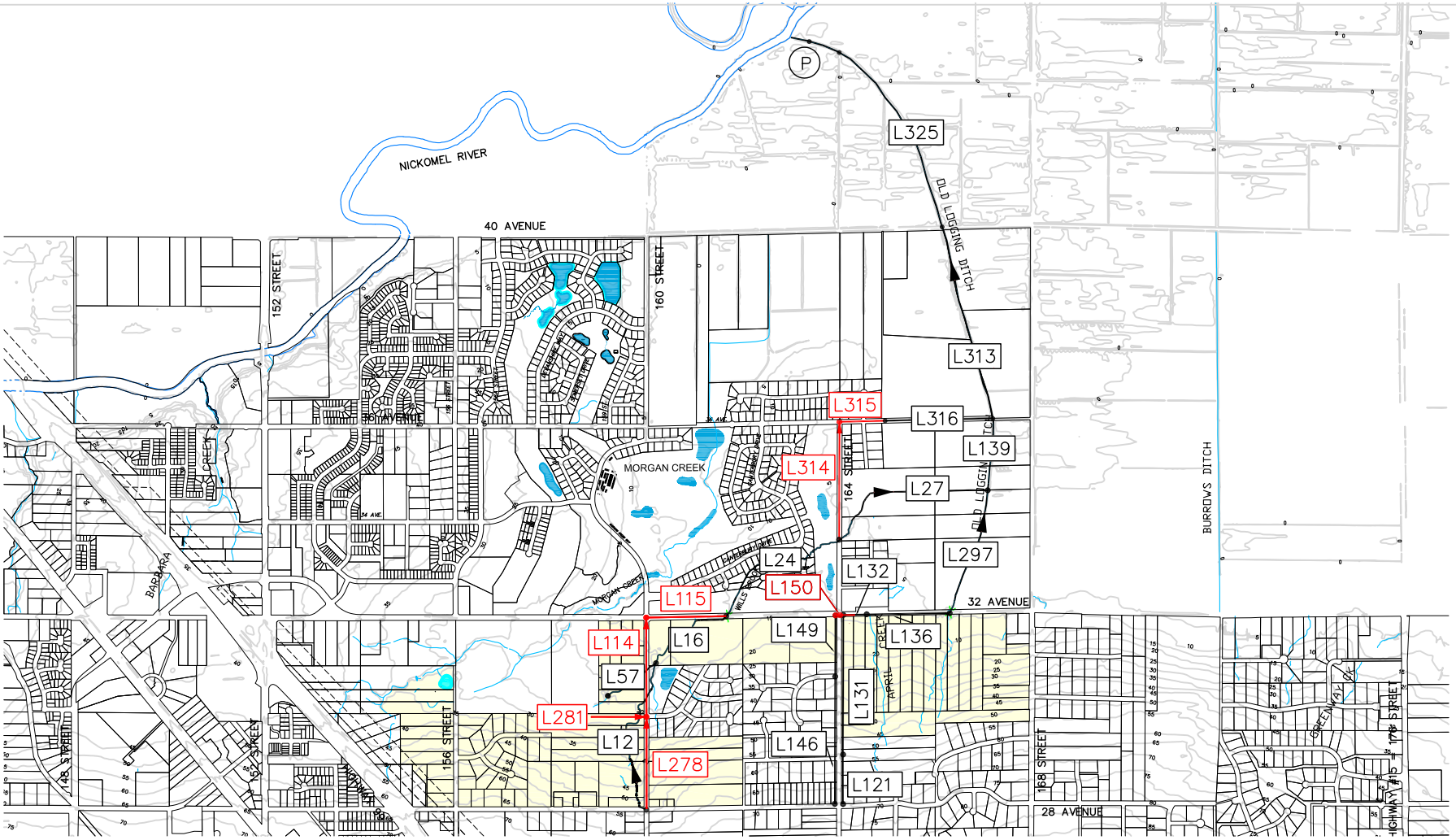


Figure 10

NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

post development conditions option 2 with detention

APLIN MARTIN CONSULTANTS LTD

Table 9

Drainage Modeling Summary of Old Logging Ditch Catchment
Summary of Peak Flows With Base Flow
Outfall - Nicomekl River Boundary Conditions

POST DEVELOPMENT FLOWS OPTION 2 WITH DETENTION UPLANDS (cms)[2,4]

Storm Duration	L278	L281	L114	L115	L314	L315	L12	L57	L16	L24	L27	L121	L131	L146	L149	L150	L132	L136	L297	L316	L139	L313	L325
2Y1H	0.954	0.080	1.020	0.820	0.753	0.735	0.625	0.034	0.734	1.462	0.718	0.880	0.994	0.270	0.637	0.648	1.620	2.607	2.408	0.953	2.824	2.632	1.827
2Y2H	0.763	0.116	0.842	0.745	0.867	0.863	0.614	0.050	0.895	1.716	0.877	0.880	0.974	0.230	0.516	0.524	1.493	2.300	2.606	1.086	3.137	3.543	2.537
2Y6H	0.520	0.186	0.868	0.746	0.962	0.960	0.597	0.093	0.976	1.935	1.008	0.633	0.692	0.160	0.360	0.393	1.059	1.648	2.071	1.211	3.145	3.501	4.317
2Y12H	0.481	0.203	0.643	0.681	0.955	0.953	0.597	0.090	0.973	1.910	0.992	0.644	0.704	0.159	0.348	0.384	1.063	1.668	2.036	1.197	3.047	3.452	4.371
2Y24H	0.414	0.195	0.588	0.637	0.935	0.932	0.594	0.086	0.964	1.853	0.957	0.557	0.624	0.151	0.341	0.392	1.016	1.562	1.950	1.168	2.989	3.216	3.897
5Y1H	1.438	0.108	1.526	1.267	0.991	0.978	0.647	0.046	0.846	1.951	1.011	0.903	1.052	0.373	0.846	0.858	1.905	3.165	3.113	1.313	3.757	3.699	2.462
5Y2H	1.055	0.135	1.195	1.173	1.206	1.200	0.627	0.059	0.997	2.316	1.080	0.887	0.979	0.267	0.611	0.620	1.591	2.589	3.018	1.473	3.860	4.374	3.354
5Y6H	0.939	0.298	1.222	1.322	1.416	1.416	0.616	0.151	0.691	1.991	1.234	0.885	0.999	0.240	0.550	0.607	1.587	2.474	3.038	1.792	4.299	4.333	4.812
5Y12H	0.826	0.287	1.097	1.196	1.382	1.382	0.612	0.145	1.167	1.966	1.189	0.826	0.919	0.221	0.492	0.560	1.444	2.267	2.867	1.759	4.198	4.190	4.984
5Y24H	0.778	0.283	1.079	1.162	1.372	1.359	0.607	0.127	1.145	2.611	1.136	0.779	0.869	0.212	0.488	0.577	1.446	2.276	2.844	1.738	4.158	3.896	4.546
100Y1H	2.509	0.277	2.662	2.559	1.476	1.476	0.699	0.141	1.136	4.083	1.367	0.963	1.162	0.484	1.241	1.261	2.418	4.358	3.741	2.157	4.610	5.257	4.063
100Y2H	1.892	0.454	2.128	2.270	1.503	1.503	0.663	0.232	1.608	4.405	1.409	0.946	1.126	0.432	0.973	1.013	2.136	3.750	3.579	2.118	4.587	5.224	6.022
100Y6H	2.034	0.601	2.706	2.790	1.498	1.498	0.654	0.306	1.815	5.307	1.394	0.953	1.102	0.407	0.978	1.160	2.262	3.965	3.222	2.369	4.662	4.496	5.730
100Y12H	1.935	0.563	2.520	2.643	1.498	1.498	0.652	0.287	1.753	5.070	1.395	0.951	1.095	0.406	0.972	1.142	2.692	3.903	3.217	2.293	4.664	4.449	5.755
100Y24H	1.665	0.503	2.241	2.357	1.497	1.497	2.028	0.256	1.620	4.581	1.395	0.909	1.039	0.329	0.754	0.898	1.934	3.253	3.080	2.253	4.666	4.085	5.330

[1]Old Logging Ditch Pump Station with existing 3 pumps.

[2]Old Logging Ditch Pump Station with existing 3 pumps plus 3 new screw pumps and ditch improvements.

[3]With proposed storm system improvements and no detention uplands.

[4]With proposed storm system improvements and detention uplands.

Table 10

Summary of Culvert Peak Flows With Base Flow

	Capacity	Peak Flows		
		2 Year	5 Year	100 Year
	cms	cms	cms	cms
Wills Brook 32 Avenue Crossing	1.880	1.850	2.760	5.732
Old Logging Ditch 32 Avenue Crossing	2.080	1.934	2.957	5.782

Estimated Base Flow Rates at Creeks

Watercourse	Baseflow cms
1. Wills Brook tributary west of 160 Street	0.170
2. Wills Brook at 28 avenue	0.650
3. April Creek at 29 Avenue	0.300
4. Kengsinton Creek At 29 Avenue	0.090

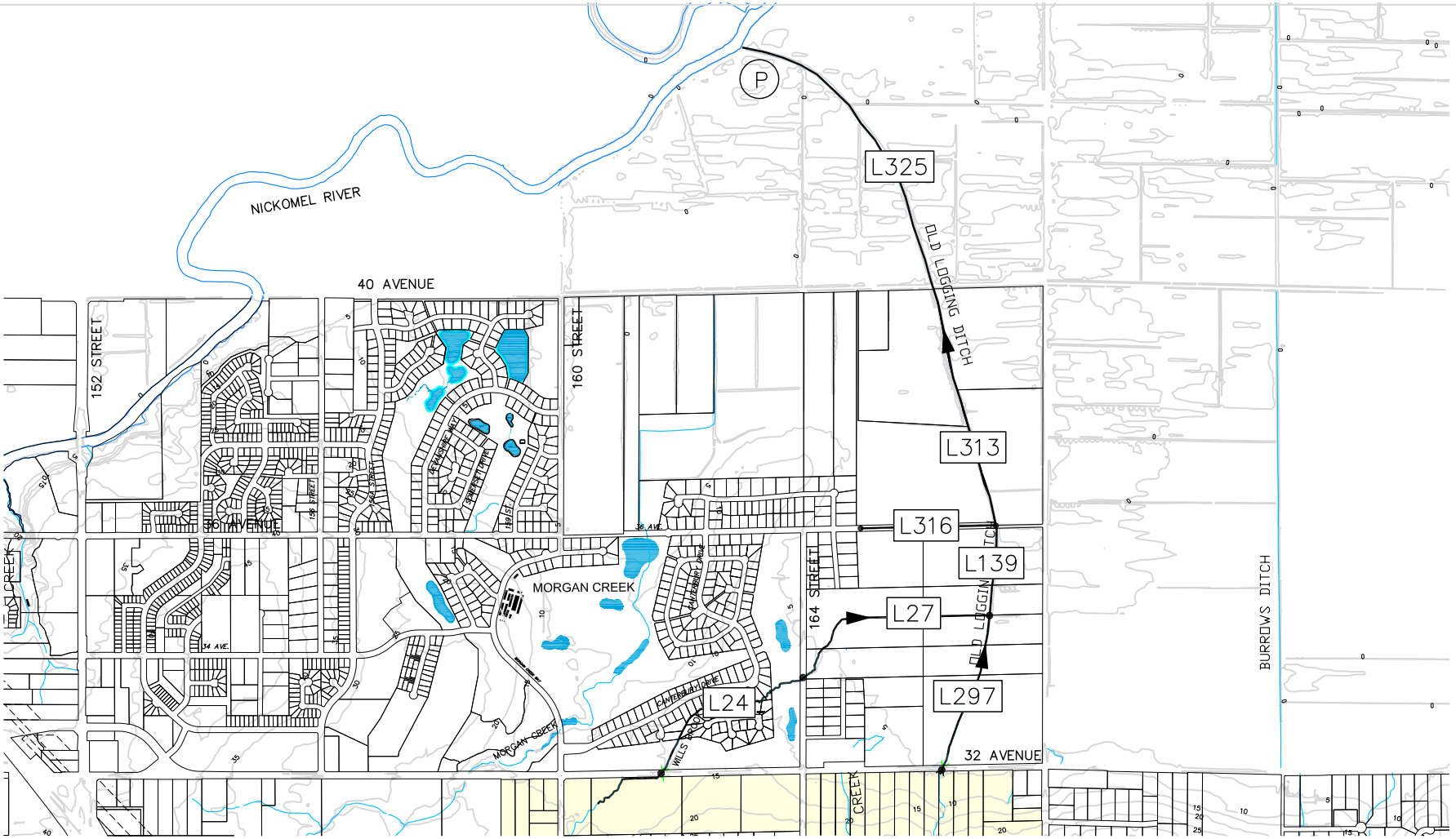


Figure 11

NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

watercourse

APLIN MARTIN CONSULTANTS LTD

Table 11

Drainage Modeling Summary
Old Logging Ditch Catchment With Base Flows
Outfall - Nicomekl River Boundary Conditions
Summary of Total Flow Out of the System in the Lowlands

PRE DEVELOPMENT FLOWS (m^3)[1]

Storm Duration	L24	L27	L297	L139	L313	L325
2Y1H	-	-	-	-	-	-
2Y2H	-	-	-	-	-	-
2Y6H	-	-	-	-	-	-
2Y12H	-	-	-	-	-	-
2Y24H	-	-	-	-	72,724	-
5Y1H	-	-	-	-	-	-
5Y2H	-	-	-	-	-	-
5Y6H	-	1,932	-	-	2,469	29
5Y12H	-	4,004	-	-	21,373	45
5Y24H	-	5,635	-	-	132,558	54

POST DEVELOPMENT FLOWS OPTION 1 WITHOUT DETENTION (m^3)[2]

Storm Duration	L24	L27	L297	L139	L313	L325
2Y1H	-	-	-	-	-	-
2Y2H	-	1,520	-	-	-	87
2Y6H	-	4,825	-	-	-	252
2Y12H	-	5,260	-	-	5,097	221
2Y24H	-	4,037	-	-	55,783	118
5Y1H	-	2,074	760	-	-	137
5Y2H	-	4,167	32	-	-	192
5Y6H	-	12,957	274	-	8,555	85
5Y12H	-	15,081	-	-	28,164	60
5Y24H	-	13,888	-	-	109,379	34

POST DEVELOPMENT FLOWS OPTION 2 WITH DETENTION UPLANDS (m^3)[2,4]

59 49 65 68

Storm Duration	L24	L27	L297	L139	L313	L325
2Y1H	-	-	-	-	-	-
2Y2H	-	-	-	-	-	-
2Y6H	-	-	-	-	962	-
2Y12H	-	-	-	-	6,709	-
2Y24H	-	-	-	-	60,425	-
5Y1H	-	-	-	-	-	-
5Y2H	-	-	-	-	-	-
5Y6H	-	-	-	-	17,523	-
5Y12H	-	-	-	-	37,989	-
5Y24H	-	-	-	-	123,537	-

[1]Old Logging Ditch Pump Station with existing 3 pumps.

[2]Old Logging Ditch Pump Station with existing 3 pumps plus 3 new screw pumps and ditch improvements.

[3]With proposed storm system improvements and no detention uplands.

Lowlands Model

As with the Uplands model, the ditch and drainage pump station upgrades were excluded for the pre development modelling and included for the post development modelling. The results of the post development modelling with the revised zoning were also compared with Dillon's previous results.

The results of the modelling are presented in ***Figure 12*** and ***Table 12.***

With the proposed revised zoning there is some increase in maximum elevation and duration of flooding for the post development condition when compared to the results of the previous zoning (Dillon model). However, with the proposed drainage pump station and ditch improvements the requirements of the ARDSA criteria are still adequately met, and there is a significant improvement over the level of service that currently exists.

The impacts on the existing drainage systems and the requirement for infrastructure servicing is presented in the following section

4.0 PROPOSED DRAINAGE AND STORMWATER MANAGEMENT

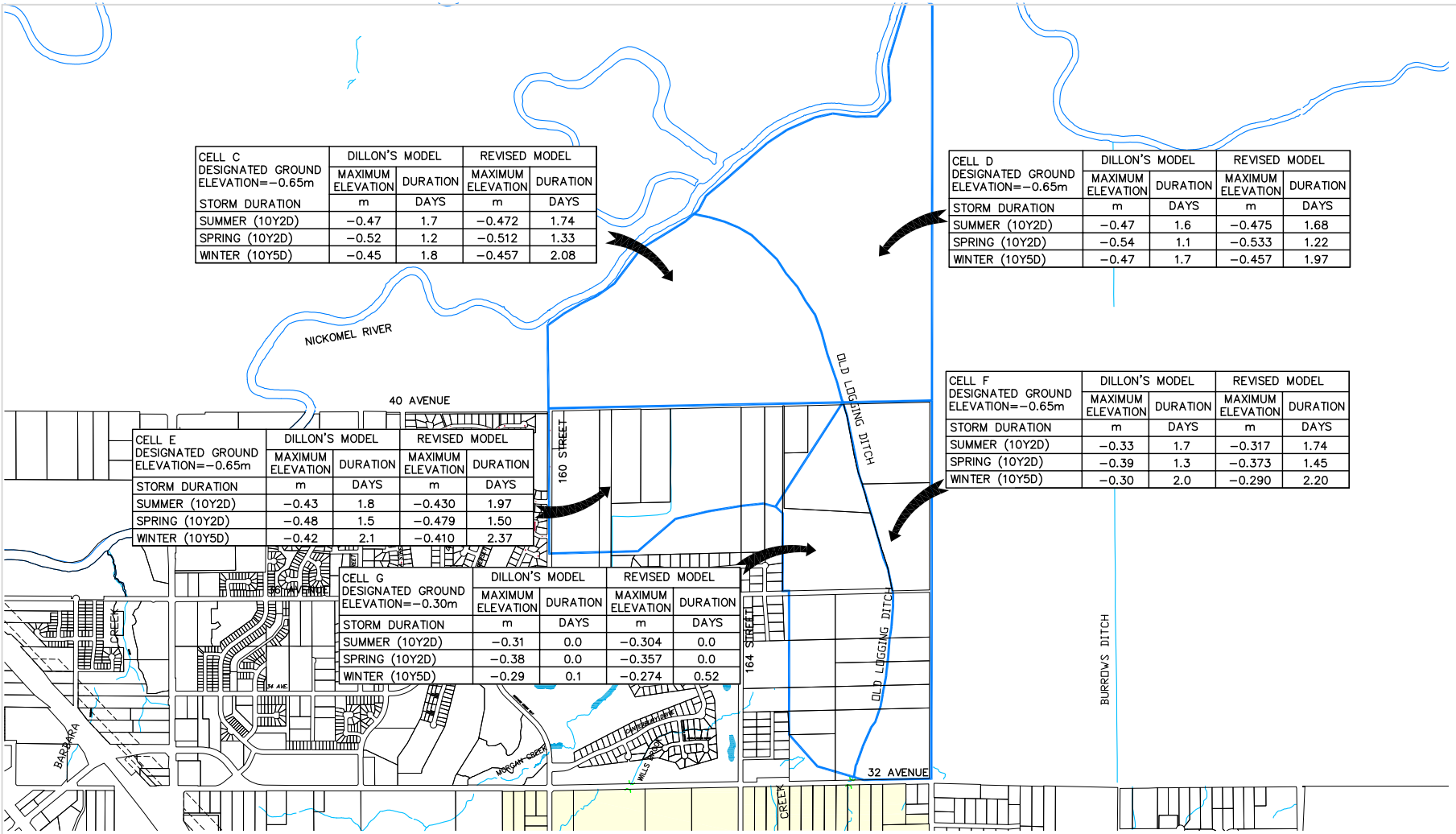
The proposed servicing concepts that will accommodate the NCP amendments are summarized in the following sections.

Minor and Major Servicing

Minor servicing will be designed to support runoff from the 1:5 year storm event. The major servicing will be for runoff exceeding the 1:5 year level and to provide safe conveyance of runoff up to the 1:100 year storm event to minimize damage to life and property.

Due to steep gradients along the north-south trunk drainage routes within the NCP area, these would comprise closed conduit systems designed for the 1:100 year event. To facilitate the construction of basements the concept of accommodating the 1:100 year event in closed conduits will be extended to the east-west trunk drainage routes and the minor drainage system as well. This becomes a requirement for servicing houses with basements. Where this is not feasible major events will generally be conveyed overland, either within roadways or other specified drainage routes, providing that flooding of adjacent lands can be prevented. For those trunk storm sewers with steep slopes, high capacity inlets will be required as well as on laterals to ensure major storm runoff enters the trunk storm sewers.

Existing storm sewers will be utilized where possible, and twinned or replaced as required to provide additional capacity. The main trunk drainage sewers north-south on 168 Street and 160 Street and east-west on 32 Avenue from 160 Street will need to be constructed in order for development to proceed in the NCP area.



CELL C DESIGNATED GROUND ELEVATION=−0.65m	DILLON'S MODEL		REVISED MODEL	
	MAXIMUM ELEVATION	DURATION	MAXIMUM ELEVATION	DURATION
STORM DURATION	m	DAYS	m	DAYS
SUMMER (10Y2D)	−0.47	1.7	−0.472	1.74
SPRING (10Y2D)	−0.52	1.2	−0.512	1.33
WINTER (10Y5D)	−0.45	1.8	−0.457	2.08

CELL D DESIGNATED GROUND ELEVATION=−0.65m	DILLON'S MODEL		REVISED MODEL	
	MAXIMUM ELEVATION	DURATION	MAXIMUM ELEVATION	DURATION
STORM DURATION	m	DAYS	m	DAYS
SUMMER (10Y2D)	−0.47	1.6	−0.475	1.68
SPRING (10Y2D)	−0.54	1.1	−0.533	1.22
WINTER (10Y5D)	−0.47	1.7	−0.457	1.97

CELL E DESIGNATED GROUND ELEVATION=−0.65m	DILLON'S MODEL		REVISED MODEL	
	MAXIMUM ELEVATION	DURATION	MAXIMUM ELEVATION	DURATION
STORM DURATION	m	DAYS	m	DAYS
SUMMER (10Y2D)	−0.43	1.8	−0.430	1.97
SPRING (10Y2D)	−0.48	1.5	−0.479	1.50
WINTER (10Y5D)	−0.42	2.1	−0.410	2.37

CELL F DESIGNATED GROUND ELEVATION=−0.65m	DILLON'S MODEL		REVISED MODEL	
	MAXIMUM ELEVATION	DURATION	MAXIMUM ELEVATION	DURATION
STORM DURATION	m	DAYS	m	DAYS
SUMMER (10Y2D)	−0.33	1.7	−0.317	1.74
SPRING (10Y2D)	−0.39	1.3	−0.373	1.45
WINTER (10Y5D)	−0.30	2.0	−0.290	2.20

CELL G DESIGNATED GROUND ELEVATION=−0.30m	DILLON'S MODEL		REVISED MODEL	
	MAXIMUM ELEVATION	DURATION	MAXIMUM ELEVATION	DURATION
STORM DURATION	m	DAYS	m	DAYS
SUMMER (10Y2D)	−0.31	0.0	−0.304	0.0
SPRING (10Y2D)	−0.38	0.0	−0.357	0.0
WINTER (10Y5D)	−0.29	0.1	−0.274	0.52

Figure 12

APLIN MARTIN CONSULTANTS LTD

NORTH GRANDVIEW HEIGHTS
NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

lowlands water level

Table 12
Flooding Duration Summary for Summer Design Event (2 day 10 Year Storm Event)
Comparison of Existing (2001), Future Conditions (Dillon's Model) and Future Conditions (Amended Area)

Cell	Designated Ground Elevation[3] (m Geodetic)	Existing Condition [1]		Future Condition as per Original Model [2]		Proposed Amended Area[2] (Revized Zoning)	
		Maximum elevation (m Geodetic)	Duration (days)	Maximum elevation (m Geodetic)	Duration (days)	Maximum elevation (m Geodetic)	Duration (days)
C	-0.65	-0.49	2.5	-0.47	1.7	-0.472	1.74
D	-0.65	-0.48	2.1	-0.47	1.6	-0.475	1.68
E	-0.65	-0.44	3.0	-0.43	1.8	-0.430	1.97
F	-0.65	-0.33	2.3	-0.33	1.7	-0.317	1.74
G	-0.30	-0.33	0.0	-0.31	0.0	-0.304	0.00

Flooding Duration Summary for Spring Design Event (2 day 10 Year Storm Event)
Comparison of Existing (2001), Future Conditions (Dillon's Model) and Future Conditions (Amended Area)

Cell	Designated Ground Elevation[3] (m Geodetic)	Existing Condition [1]		Future Condition as per Original Model [2]		Proposed Amended Area[2] (Revized Zoning)	
		Maximum elevation (m Geodetic)	Duration (days)	Maximum elevation (m Geodetic)	Duration (days)	Maximum elevation (m Geodetic)	Duration (days)
C	-0.65	-0.59	0.9	-0.52	1.2	-0.512	1.33
D	-0.65	-0.59	0.7	-0.54	1.1	-0.533	1.22
E	-0.65	-0.55	1.5	-0.48	1.5	-0.479	1.50
F	-0.65	-0.43	1.5	-0.39	1.3	-0.373	1.45
G	-0.30	-0.42	0.0	-0.38	0.0	-0.357	0.00

Flooding Duration Summary for Winter Design Event (5 day 10 Year Storm Event)
Comparison of Existing (2001), Future Conditions (Dillon's Model) and Future Conditions (Amended Area)

Cell	Designated Ground Elevation Designated Ground Elevation[3] (m Geodetic)	Existing Condition [1]		Future Condition as per Original Model [2]		Proposed Amended Area[2] (Revized Zoning)	
		Maximum elevation (m Geodetic)	Duration (days)	Maximum elevation (m Geodetic)	Duration (days)	Maximum elevation (m Geodetic)	Duration (days)
C	-0.65	-0.52	2.2	-0.45	1.8	-0.457	2.08
D	-0.65	-0.52	1.8	-0.47	1.7	-0.457	1.97
E	-0.65	-0.48	3.0	-0.42	2.1	-0.410	2.37
F	-0.65	-0.35	2.5	-0.30	2.0	-0.290	2.20
G	-0.30	-0.35	0.0	-0.29	0.1	-0.274	0.52

Note: Shaded cells do not meet City (ie. Modified ARDSA) flooding duration requirements

[1]Existing development and existing infrastructure

[2]Future development with infrastructure improvements (including 0.9 m^3/s new screw pumping plus other improvements)

[3]Selected designated ground elevation does not include consideration of fill placement for future conditions

Watercourse Diversion

April Creek, Wills Brook and their tributaries currently exhibit ongoing erosion due to the steep gradients. It is proposed that diversion structures (within the storm sewer) be constructed at the heads of these water sources to provide necessary base flows, while diverting higher flows to the trunk storm drain system. These diversion structures will be designed to allow a controlled amount of higher flows into the watercourse to replicate the natural pre-development flows. Bio-filtration will be provided at the outlets of proposed development to assist in capturing pollutants prior to discharge to the natural watercourse.

The 32 Avenue widening plan in the original North Grandview NCP Report proposed that a portion of April Creek adjacent to 32 Avenue, between 164 Street and Old Logging Ditch be relocated to the north side of the road. The proposed North Grandview NCP Amendment makes provision for a green belt that is wide enough to accommodate an enhanced April Creek on the south side of the road, between the road and the proposed residential housing. April Creek is to be enhanced but remain on the south side of 32 Avenue.

Lowland Drainage

The further development of the uplands will not increase erosion to low gradient water courses in the lowlands. However the increased runoff volumes would otherwise increase flooding potential. While flooding in the lowland area is inevitable and unavoidable due to the nature of the floodplain and the dynamic of the lowland area, the agricultural design criteria (ARDSA) used for the Nicomekl lowlands requires that flooding be limited to 2 days during a 2 day 1:10 year summer storm event, and 5 days during a 5 day 1:10 year winter storm event. Future development must ensure that these criteria, or a better level of service if it currently exists, are upheld.

The City is planning to upgrade the Old Logging Ditch and drainage pump station in 2005/2006. The storm drainage model for the lowland drainage system was rerun to take into account the increased flows resulting from the proposed increased densities as shown in the 2005 NCP Amendment. With the proposed upgrades to the Old Logging Ditch and drainage pump station there was little impact in the depth and duration of flooding. In all instances the results were well within the limitations of the ARDSA criteria and a significant improvement on the current levels of service. The upgrades to the Old Logging Ditch and drainage pump station can proceed without change as planned in 2005/2006.

The underground storm sewer system containing the major flows will continue along 32 Avenue to discharge base flows into Wills Brook at the 32 Avenue crossing. This will require the upgrading of the Wills Brook crossing of 32 Avenue and the upgrading of the Wills Brook channel from 164 Street to the Old Logging Ditch as previously identified in the Old Logging Ditch Master Drainage Plan. Located on private property, it may not be possible to upgrade the section of channel east of 164 Street. An alternative is to divert any flows in excess of the existing channel capacity north along 164 Street to 36 Ave and then east into the existing ditch within the 36 Avenue corridor that flows east to the Old Logging Ditch. The proposed detention and infiltration systems recommended for this NCP will further reduce the peak flows.

Erosion remediation and outfall reconstruction is required at the 32 Avenue crossing of Old Logging Ditch

The Old Logging Ditch Pump Station upgrades and proposed improvements for the lowland drainage should be implemented prior to development proceeding in the uplands area, wherever possible.

Stormwater Detention

As discussed earlier in the report, the system was modelled both with and without detention. The results conclusively showed that detention in the uplands is effective in reducing peak flows and should therefore be provided. The volumes of the detention required are shown as part of the proposed drainage infrastructure in ***Figure 3.*** The detention is shown in the approximate area where it is to be provided. The exact location and form of detention would be determined at the design stage.

Stormwater Quality Control

As the NCPA area is primarily residential, with no commercial or industrial lands, the potential for negative storm water quality impacts is therefore minimized. The use of BMPs as outlined below will significantly increase the quality of storm water runoff. In addition, the proposed watercourse diversions will eliminate high runoff rates with the associated reduction in stream bank erosion and maintain stream hydrology and water quality.

As each component of the Amendment area will need to provide stormwater detention, it is recommended that consideration be given to creating facilities with extended detention that provide additional levels of quality treatment. The land for these facilities must be allocated and the facilities constructed at the outset of the first application within each catchment.

Green Infrastructure Performance Standards and Guidelines

The green infrastructure performance standards and guidelines suggest the minimum levels of performance for maintaining and potentially enhancing natural drainage systems in the North Grandview Heights NCP area. The principle is to preserve the natural environment and promote natural drainage systems (in which storm water is detained and permitted to seep naturally into the ground). Infiltration systems are required as a component of the sustainable development concept and as a means of reducing total run-off volumes resulting from new development. The infiltration systems and devices do not replace the need for conventional drainage service systems.

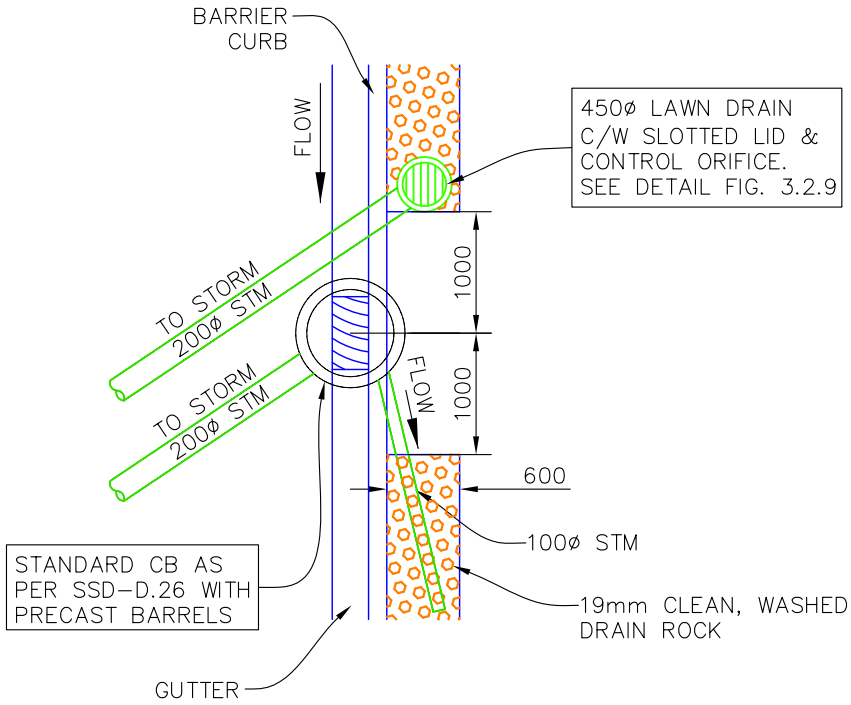
A consideration in the development of infiltration systems is soil type. While this sustainable development approach will promote infiltration and reduce runoff, the effect thereof has not been accounted for in the drainage analysis in order to determine the viability of the proposed conventional drainage system. As a result the analysis makes provision for soil types that might not be conducive to promoting infiltration. However, stormwater modelling has confirmed that

peak flows are extremely sensitive to pervious depression storage. Where appropriate, these features will be effective in reducing peak flows.

On street rights-of-ways the sustainable development approach provides an opportunity to direct street runoff into drain rock trenches on one side, as illustrated on **Figure 13 to Figure 16.** For small rainfall events these trenches can be used to treat and infiltrate the runoff by making the soil base pervious. The infiltration capacity can be supplemented by installing perforated catch basins, which will capture, infiltrate and ultimately ensure safe conveyance of all runoff to the storm system. Additional infiltration Best Management Practices (BMP's) that can be applied include installing infiltration devices, providing suitable shade trees and preservation of topsoil on street rights-of-way.

On building sites, infiltration and reduced runoff can be achieved by reducing the total paved surface and routing the drainage from impervious areas through grassed and other pervious areas or infiltration facilities. The infiltration BMP's outlined for street rights-of-way are equally beneficial for building sites.

The public and natural areas, such as parks, pedestrian and bicycle routes, dedicated greenways water courses and preservation areas throughout the NCP area are all naturally conducive to promoting infiltration and reducing runoff.



DRAIN ROCK TRENCH – PLAN VIEW

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N

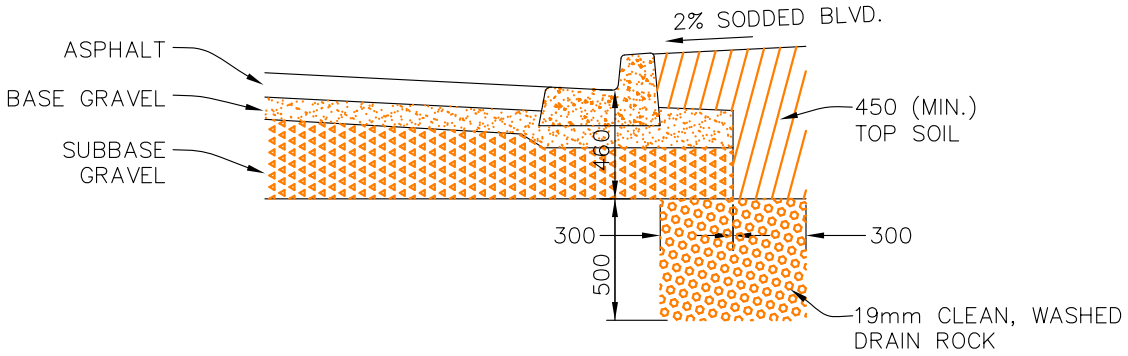
Figure 13

APLIN MARTIN CONSULTANTS LTD

NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

drain rock trench - plan view



DRAIN ROCK TRENCH – SECTION VIEW

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Figure 14

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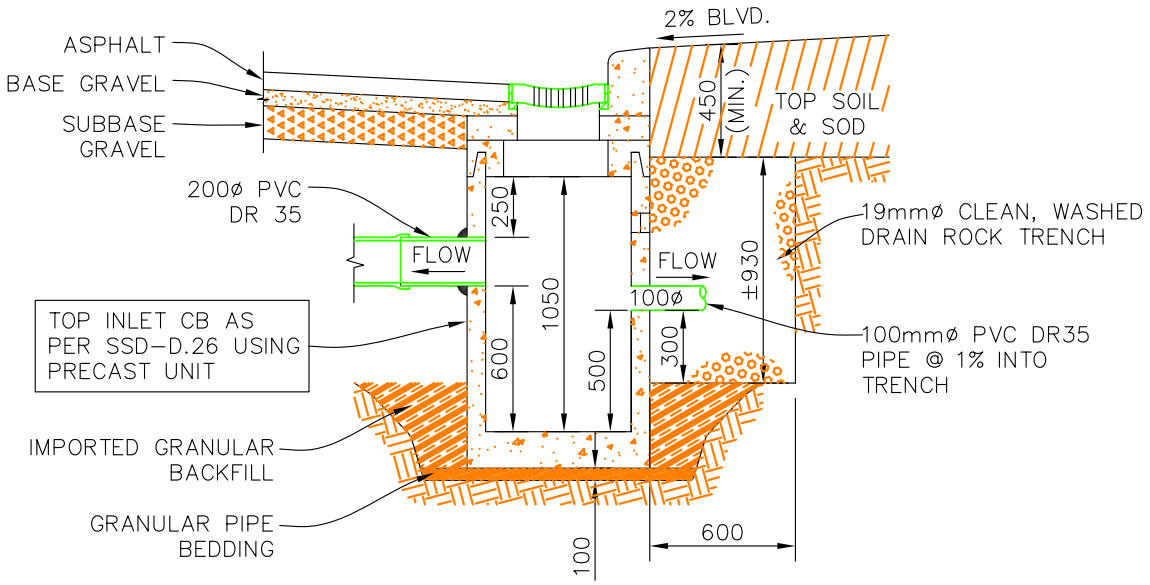
APLIN MARTIN CONSULTANTS LTD

NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

drain rock trench - section



DRAIN ROCK TRENCH – SECTION AT CATCH BASIN

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Figure 15

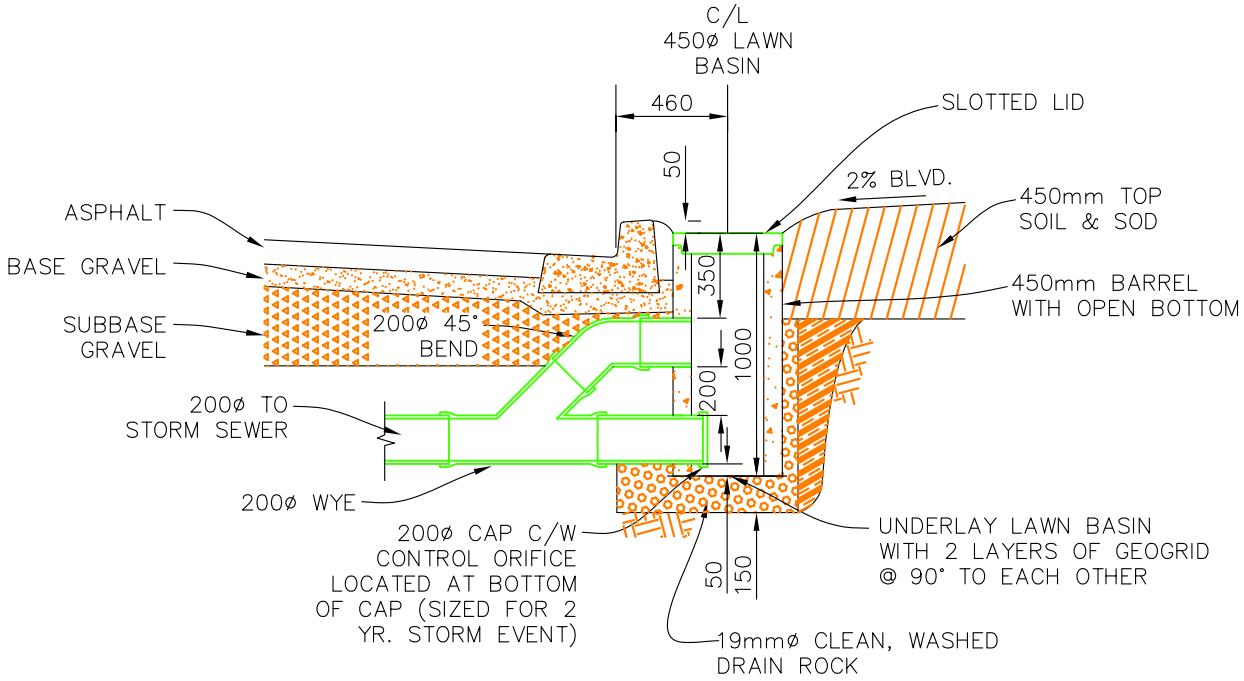
N

APLIN MARTIN CONSULTANTS LTD

NORTH GRANDVIEW HEIGHTS NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

drain rock trench - catch basin section



DRAIN ROCK TRENCH – SECTION AT LAWN BASIN

NTS

Figure 16

N

APLIN MARTIN CONSULTANTS LTD

NORTH GRANDVIEW HEIGHTS
NEIGHBOURHOOD CONCEPT PLAN

Beech Developments Inc. & Southrac Holdings Ltd.

drain rock trench - lawn basin section

Summary

To accommodate the storm runoff from the increased density associated with the proposed North Grandview Heights NCP the upgrades and additions to the sewer system as shown on ***Figure 3*** are required. Timing of implementation would be dependent on development phasing.

- Upgrade the Old Logging Ditch and drainage pump station. The City is planning on implementing this in 2005/2006. This needs to be completed concurrently with development in the upland areas.
- Upgrade the crossings of Wills Brook and Old Logging Ditch at 32 Avenue or the alternative high-flow alternative if necessary.
- Construct the main trunk drainage sewers north-south on 164 Street and 160 Street and east-west on 32 Avenue from 160 Street.
- Within each phase of development construct the east-west trunk drainage routes and the minor drainage systems as required to accommodate the phased development.
- Construct diversion structures at the heads of April Creek and Wills Brook to provide necessary base flows, while diverting higher flows to the trunk storm drain system.
- Provide detention storage for each phase of development within the NGHNCP area.

APPENDIX VII

DEFINITIONS OF CURRENT FUNDING METHODS

DEFINITIONS OF CURRENT FUNDING METHODS

1.0 DCC REBATES

Where a Developer constructs specific works and services which may be outside the boundaries of the land being serviced or developed that are included in Surrey's "10 Year Servicing Plan" as a "growth" item. The cost of the specific works and services shall be reimbursed from only the applicable development cost charges (DCC) element only after being initially paid by the Developer.

2.0 DEVELOPMENT COORDINATED WORKS (DCW)

Where the City asks the Developer to construct and agrees to pay for additional works typically outside of the boundaries of the land being serviced or developed. Funds are usually directed to:

- Safety related items;
- Works that will mitigate the impact of development;
- Works which will provide continuity of existing standards;
- Works which will facilitate the future upgrading of City services; and
- Works that will logically complete a road or service or condition where redevelopment will not occur and local improvements will not be planned for small works.

This method can be initiated by the Developer or the City at the time of development and is subject to approval by Surrey at the time of development, and subject to available funds.

3.0 UPSIZING (WATER, SANITARY)

This method is used when the City requests oversizing and agrees to pay for the difference in cost to upsize and construct a new sanitary sewer or water main from the developments needs to the City's needs. Upsizing is dependent upon available funds at the time of development, and is initiated by Surrey. The City will only pay upsizing from the confirmed level of supply under the design criteria for the subject zone; not just from the minimum pipe size.

4.0 FRONTAGE LATECOMER

Where the City has required a Developer to provide a highway or water, sewer, or drainage facilities that serve land other than the land being serviced or developed, the Developer may submit a Latecomers Application to the City; where a specific unit charge will be levied against the benefiting lands for a 10 year term. The City shall collect a unit charge on applicants who obtain physical access to, connect to or benefit from the extension. Such a unit charge shall be paid to the City who will, in turn, pay the front-ender on an annual basis.

This method may be initiated by the Developer only if front-ending a utility that will benefit his development, and benefit others as per the Latecomers Procedure Manual. The Developer can than present a Latecomer Application to the City along with the required fees. The latecomer will require those deemed to be benefiting from the utility to pay a unit charge as per the Latecomers Procedure Manual prior to obtaining physical access. The use of this method is dependent on the development scenario and on the financial benefit to the Developer at the time of development.

5.0 AREA (SANITARY PUMP STATION AND FORCE MAIN) LATECOMER

Where a sanitary pump station and/or gravity lines and/or force main that can serve lands other than those being serviced or developed, the Developer may submit an area Latecomers Application to the City, where a specific unit charge will be levied against the benefiting lands for a 10 year term. The City shall collect a unit charge from applicants who obtain physical access to, connect to or benefit from the works. Such a unit charge shall be paid to the City, who will in turn, pay the front-ender on an annual basis (as per the Latecomer Procedure Manual).

This method may be initiated by the Developer only if front-ending a utility that will benefit his developmen will benefit a larger catchment as well. The Developer can then present a Latecomer Application to the City along with the required fees. The latecomer will require those deemed to be benefiting from the utility to pay a unit charge as per the Latecomer Procedure Manual prior to obtaining physical access. The use of this method is dependent on the development scenario and on the financial benefit to the Developer at the time development.

6.0 DCC FRONTENDER AGREEMENTS AND DEVELOPMENT WORKS AGREEMENT

The City has endorsed the use of Frontender Agreements or Development Works Agreements as a method for reimbursing Developers for front-ending major infrastructure elements that are not covered by DCC rebates. This mechanism for DCC Frontender Agreements and Development Works Agreements are outlined in the attached City of Surrey Inter-office Memo, dated September 27, 2002.

Note: Consultants must refer to and follow the current Latecomer Procedure Manual.

SURREY
CITY OF PARKS

INTER-OFFICE MEMO

TO: Manager, Land Development

FROM: Land Development Manager

DATE: September 27, 2002 FILE: 5250-00

RE: DCC Frontender Agreements and Development Works Agreements

Introduction

In late 1997, Council endorsed the use of DCC Frontender Agreements (Corporate Report S980) as a method of reimbursing Frontending developers for major items of engineering infrastructure. This was followed in early 1998 by a Council endorsement of the use of Development Works Agreements (Corporate Report C387) as an additional method for reimbursing developers for Frontending the cost of major engineering infrastructure that are not covered by DCC rebates.

In endorsing these reimbursement methods, Council also set parameters for their use. These included the following:

- A suggested minimum cost of the infrastructure should be $500,000.
- The cost of preparation and administration of the agreements must be funded by the developer.
- Within the benefiting area, there must be no other infrastructure items requiring DCC rebates for that category of work unless the DCCs collected in the area can support the additional items.
- The City's ability to commit future DCC funds to deal with higher priority items in that category must not be significantly limited.

Difference Between DCC Frontender Agreements and Development Works Agreements

DCC Frontender Agreements can only be used on items of infrastructure that are in the 10 Year Capital Servicing Plan and the cost of the works can only include items that are included in the calculation of the DCCs. This does not cover such items as legal fees, City fees, Letter of Credit fees, etc. The DCC Frontender Agreement is easier to prepare, does not require a by-law and can be adjusted by mutual agreement at a future stage. DCC Frontender Agreements can be extended beyond ten years, but the developer should cover any costs for the increased administration.

A Development Works Agreement can be used to cover cost of major infrastructure items that are not covered by DCCs. These include:

- infrastructure costs that cannot be fully recovered from the DCCs collected in the benefiting area,
- infrastructure costs that are not in the 10 Year Capital Servicing Plan, and
- costs not normally covered under infrastructure costs (e.g. operation and maintenance costs, financing costs).

As a Development Works Agreement imposes a cost on the future developer that is over and above the normal charges, it requires a successful petition from the benefiting area, a by-law to be passed that imposes the charge on the benefiting area and it must also adhere to the stipulations detailed in the Local Government Act. As such, the Development Works Agreement process is less flexible and must be more strictly administered. However, this agreement does allow the developer, and the benefiting area land owners, more flexibility to recover costs that may not covered by other types of latecomer agreements. The Development Works Agreements cannot be extended beyond 10 years. As an additional charge (the Specified Charge) has to be collected from all future developers in the benefiting area, an additional project management step has to be introduced to ensure that this charge is collected when the Servicing Agreement is finalised.

The DCC Frontender Agreement Process

The following provides a step-by-step process to prepare and execute a DCC Frontender Agreement. This process may be adjusted to suit individual situations.

A flow chart illustrating the DCC Frontender Agreement process is provided below.

1. The developer outlines the scope of work they wish to include in the DCC Frontender Agreement. This should be done with some knowledge of what items are included in the 10 Year Servicing Plan and approximately what the total cost of the works will be. Initial discussions should be held between the City and the developer to define the scope of the work, the benefiting area, confirm that the works are in the 10 Year Plan, the expected DCCs to be generated in the benefiting area, the applicability of the DCC Frontender Agreement as a method of reimbursement for frontending these engineering works and the anticipated agreement fee.

2. The City reviews the 10 Year Servicing Plan to confirm that the subject work is included, that there are no other works contemplated in the benefiting area that will compete for DCC funds, and the work is eligible for reimbursements from DCCs collected from future developers.

3. The developer completes a preliminary cost estimate and calculates the expected DCC revenues for that component of work from the benefiting area. This will determine if the full frontending costs can be recovered from future development in the benefiting area and approximately how much build-out will have to occur before the developer recovers their costs. If the applicable component of the DCCs generated in the benefiting area does not cover the frontending developer's costs, the developer can consider recovering the remaining costs through a Development Works Agreement.

4. The Engineering Project Manager reviews the costs and available DCCs to be collected in the benefiting area to confirm that the presented costs are realistic and complete. The City project manager must also decide at this stage who will do the design, tendering and construction administration of the project. In most cases the frontending developer's consultant will undertake these functions. However, as these works essentially do fall under the City's Purchasing Policy, the City can elect to have these works done by a City selected consultant and an open tender process. The key objective is to ensure that the works get designed and constructed in a cost-effective manner for the taxpayers.

5. Determine the process under which the works are to be constructed. These works can be done under a separate Servicing Agreement or as part of the Servicing Agreement for the associated development. The requirement for, and amount of, any Letter of Credit for the works must also be decided. This can be based on an assessment of the City's risk if the work is not completed.

6. Draft the DCC Frontender Agreement based on the previously established format. Key items to consider when drafting the agreement include:

   - a description of the works to be completed,
   - the estimated capital cost,
   - when the works are to be completed by,
   - what happens if the works are not completed on schedule,
   - the start and end date of the agreement,
   - if a 5 year extension to the 10 year agreement is warranted, and
   - the amount of the fee to prepare and administrate the agreement (typically ranges from $3,000 to $5,500 depending on the complexity of the works and the agreement).

7. The developer reviews the document and discusses any issues with the Engineering Project Manager. Once general consensus has been reached on the agreement, the developer's consultant should supply the information required in the schedules. These include a listing of the owners and properties in the benefiting area, a description of the works, a map showing the benefiting area and any other relevant information. Copies of these schedules are forwarded to the Engineering Project Manager to include in the final agreement.

8. The Engineering Project Manager drafts a corporate report to Council to advise them of the developers proposal to front-end the work providing they can recover the costs from future developers, the estimated capital cost of the work, and the estimated component DCCs to be collected in the benefiting area. Request Council's approval for the use of the DCC Frontender Agreement as a mechanism to allow the developer to recover their frontending costs.

9. Following Council's approval for the use of the DCC Frontender Agreement, finalise the agreement and forward it to the developer for execution.

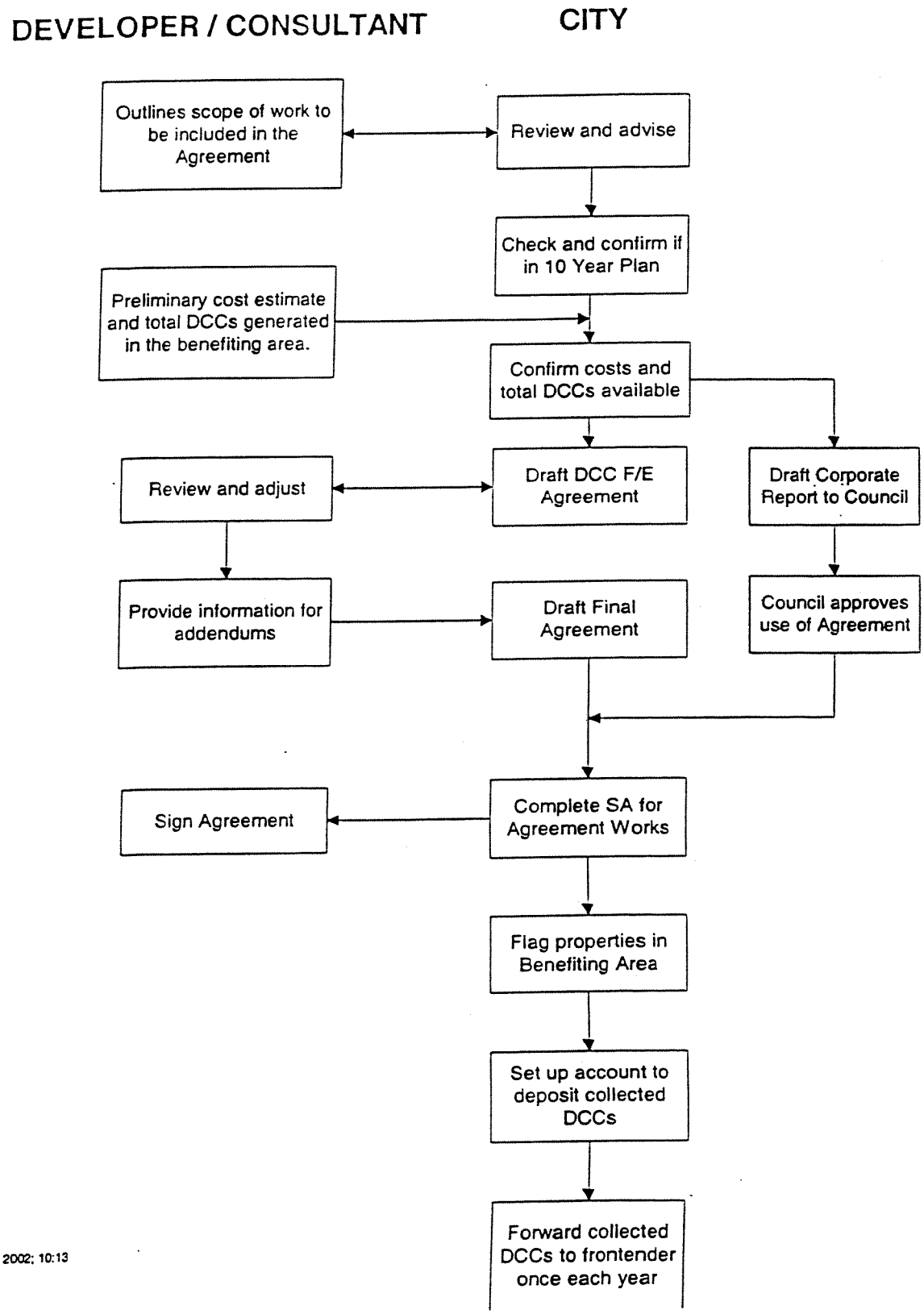
10. Flag all properties in the benefiting area on the WANG system as well as on COSMOS.

11. Financial Services Division to set up the account for collecting and distributing the collected DCCs.

12. Prior to subdivision approval or building permit approval of all future developments in the benefiting area, the Engineering Project Manager must collect 100% of the DCCs for that component of work.

13. The Frontending developer can be given a DCC rebate for the front-ended work, but this amount must be recorded by the Financial Services Division as having been paid, and must be deducted from the total capital cost.

DCC FRONTENDING AGREEMENT PROCESS



The Development Works Agreement Process

1. The developer outlines the scope of work, the approximate costs, benefiting area and number of units they propose to include in the Development Works Agreement.

2. The Engineering Project Manager reviews with the developer and assists in deciding if the Development Works Agreement is an applicable mechanism for recovering the frontending costs of the proposed infrastructure.

   At this early stage the Engineering Project Manager should review the proposal and assess if the costs and cost recovery mechanism are fair and reasonable for both the developer and the benefiting area land owners, assist the developer by providing input on alternative cost recovery mechanisms, the required petitioning process, expected implementation schedule and possible approaches with respect to Servicing Agreement and construction requirements. Also review if a portion of the costs can be recovered through a DCC Frontender Agreement.

3. The developer provides details of the scope of work, preliminary cost estimate, benefiting area boundaries, approximate cost per unit and construction schedule.

4. At this stage the Engineering Project Manager must also decide if the work would be done under a separate Servicing Agreement or as part of the Servicing Agreement for the associated development. The City can also determine the amount of financial security required for the Development Works Agreement works. The amount of financial security required can be linked to the developer's need for the infrastructure in order to get approval for their rezoning or subdivision.

5. The Engineering Project Manager assists developer in drafting the petition. The Engineering Project Manager must ensure that the petition is in accordance with Sections 631 and 937.1 of the Local Government Act. Key items that the petition **must** contain include:

   - a description of the work and who (City/developer) will be doing the work,
   - when the work will be completed by,
   - the **maximum** unit charge to be imposed,
   - how the charge is calculated,
   - the number of years the charge will be imposed, and
   - the area the charge is imposed on (the "benefiting area").

   The Engineering Project Manager's role here to assist in making sure the petition is complete and clear to the petitioners and also to assess if the charges to be applied are fair, reasonable and applicable to land owners and future developers in the benefiting area. Some discussion may be required with the Legal Services Division or the City Clerk to confirm particular elements of the work or the petitioning process.

6. The Engineering Project Manager drafts a corporate report to Council to advise them of the developer's proposal to front-end the work, providing they can recover the costs from future developers. Provide information on the estimated capital cost of the work, the estimated per unit Specified charge, the boundaries of the benefiting area and the estimated schedule of the works and the time span of the agreement. Request Council's approval for the use of the Development Works Agreement as a mechanism to allow the developer to recover their frontending costs and that Council authorise the introduction of a Development Works Agreement By-law.

7. Once Council has given approval of the use of the Development Works Agreement, the developer petitions the benefiting area, with the petitions meeting the requirements as detailed in Sections 629 to 632 of the Local Government Act. For a valid petition, the developer must have **majority** of the registered owners of each property signing each petition (e.g., if a property is registered under 3 property owners, at least 2 of the property owners must sign the petition). For the developers to present a valid petition process, positive petitions must be received from 2/3 of the property owners in the benefiting area representing at least 50% of the value of the land in the benefiting area. In most cases, the value of the land can be treated as uniform throughout the benefiting area, particularly where the same, or similar, land use is planned.

8. Concurrently with the petitioning process, the Engineering Project Manager will draft up the Development Works Agreement and include all the appendices. Section 937.1 of the Local Government Act specifies the items that must be included in the agreement. To assist in administering the agreement, items that must be clearly identified include:

   - the actual Specified Charge,
   - if there is an annual escalation rate on the Specified Charge and the date the Specified Charge changes,
   - the annual payout date and completion date of the agreement, and
   - a clear description of which properties are included in the benefiting area.

   A copy of the agreement must be reviewed by the Legal Services Division.

9. The developer provides the Engineering Project Manager with the **original** copies of the petitions and a recent title search of properties in the benefiting area (this will usually be Schedule A of the agreement).

10. The Engineering Project Manager reviews and checks the petition for conformity with the Local Government Act requirements. Each petition must be checked for the correct owner, address or legal description, that a majority of the registered owners have signed and that there have been no changes or qualifications made to any of the petitions. A covering memo and the original copies of the petition are sent to the City Clerk requesting that they be checked and it be confirmed that they meet the City's requirement.

11. Following confirmation from the City Clerk, draft a second memo to the City Clerk requesting that the Development Works Agreement By-law be submitted to Council for Introduction, 1st and 2nd Readings. Note that the initial Readings of the By-law can be given prior to the executed agreement and securities being received from the developer. However, the Engineering Project Manager must assess the risk of the developer not executing the agreement and/or Servicing Agreement and, if advisable, delay the Introduction and initial Readings until the executed documents has been received from the developer.

12. If a Servicing Agreement is required for the works, this should be completed prior to the Development Works Agreement By-law receiving Final Approval. Once Final Approval is given on the By-law, the City is obligated to collect the Specified Charge from all properties developing in the benefiting area. If the works are not completed or secured for, then the City may be under some obligation to complete the works at the City's cost.

13. The developer signs the Development Works Agreement, and returns it to the City along with the required financial security and any required rights-of-way or other legal documents.

14. The developer undertakes the construction work unless the City has agreed to manage this phase of the work.

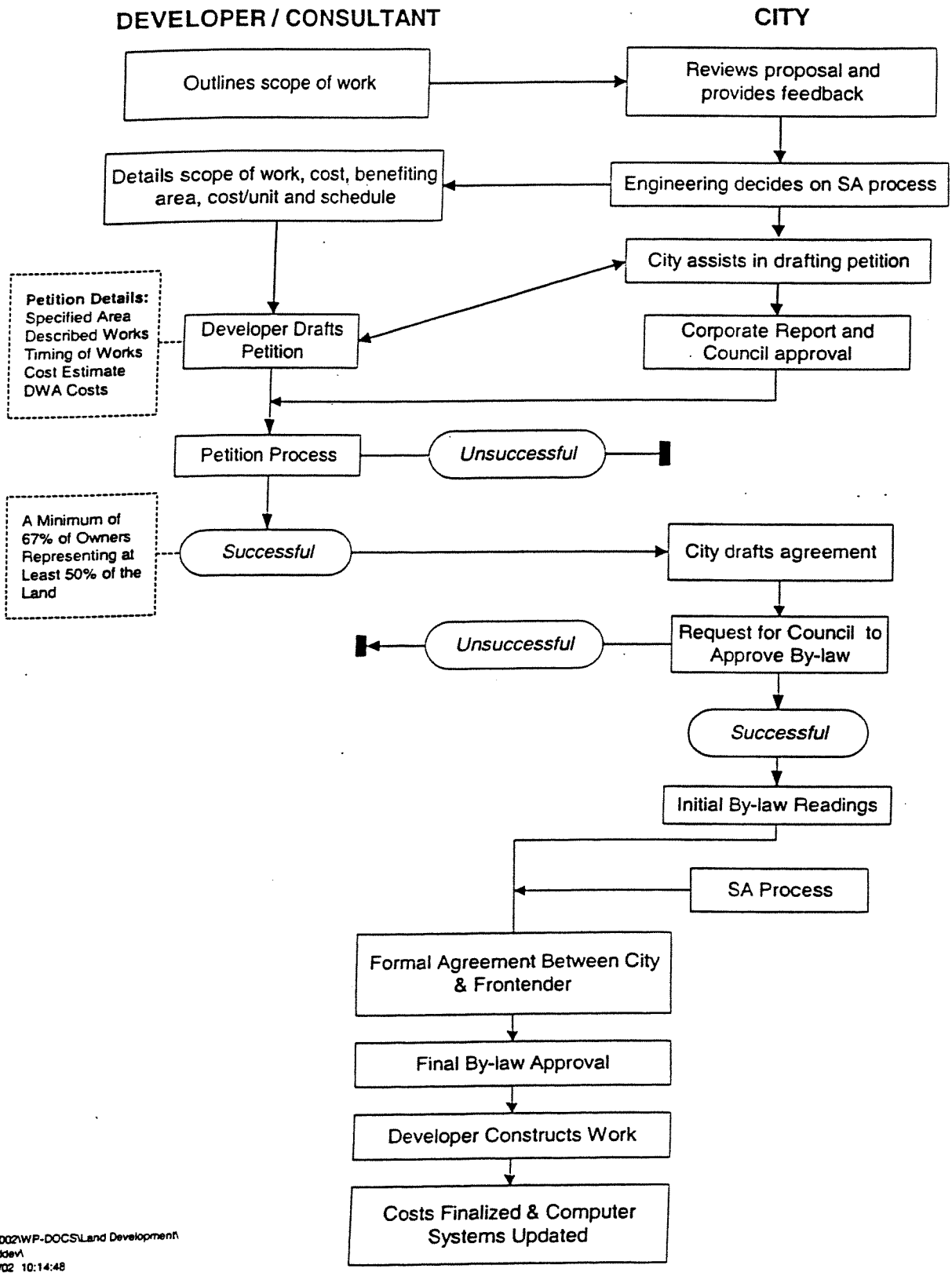
15. The Engineering Project Manager requests the City Clerk to send the By-law to Council for Final Approval.

16. Once the work is complete, the developer's consultant checks and certifies the final cost of the work and calculates the new, final Specified Charge. This information is forwarded to the City for checking. This final Specified Charge cannot exceed the amount specified in the petition. An agreement amendment letter acknowledging the final cost must be sent to the developer for signing and returned to the City. The schedules must be adjusted if necessary and copies of the final document forwarded to the developer, City Clerk, Finance and files. Note that an amendment to the By-law or a resigning of the agreement is not required if the costs change.

17. Engineering updates the computer tracking systems with the final cost information.

A flow chart illustrating the Development Works Agreement process is provided below.

DEVELOPMENT WORKS AGREEMENT PROCESS



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Administration and Maintenance

Once a DCC Frontender Agreement or a Development Works Agreement has been finalised and the benefiting area and charge recorded on the computer tracking system, the agreement must be administered and maintained. The process is similar for both types of agreements. The following steps outline this process.

1. A copy of the agreement is forwarded to the Financial Services Division who sets up an account for the funds to be deposited into as they are collected by the Engineering Department and the Building Division.

2. The Engineering Project Manager advises the Building Division of any properties that may be subject to development through a building permit only (commercial, industrial, institutional, multi-family). These properties are flagged on the AMANDA tracking system so that the Building Division is alerted to check with the Engineering Department when an application comes in on one of these properties. When this happens, the Engineering Department checks if a charge is payable and advises both the Building Division and the Accounting Services Division. When a charge is payable, the Building Division collects the charge and forwards it to the Accounting Services Division.

3. When a project comes into the Engineering Department, either for Comments and Requirements or as a Pre-Design package, the Engineering Project Manager must check the computer tracking system for any charges on the property. Where applicable, advise the developer of the charges.

4. Where applicable collect the charges (either 100% of the applicable component of the DCCs or the Specified Charge) when finalising the Servicing Agreement. The Engineering Project Manager should check with the Financial Services Division and either send the funds to them or deposit them in the account advised by Financial Services.

5. Once the charge has been paid, the Engineering Project Manager must remove the charge from the parent property in the computer tracking system. This will avoid the charge being passed on to all the subdivided lots.

6. The Financial Services Division will establish the account for each agreement, record the final Capital Cost and record each amount collected by the City through Servicing Agreements or through Building Permit applications. Financial Services will keep a running total of the funds collected, the amount of funds to be reimbursed that year and the remaining amount available for reimbursement.

7. Once each year the Financial Services Division will reconcile the amount collected that year and forward these funds to the frontending developer.

8. The Financial Services Division has agreed to release one interim payment each year to the frontending developer, on application, provided it is a substantial amount (more than $30,000).

9. The Financial Services Division will keep a record of all payments to and from each agreement account and will advise the developer, when requested, of the status of the account.

10. When the agreement expires, or has been fully paid out, the charge must be removed from any remaining parent parcels on the computer tracking system.

FREQUENTLY ASKED QUESTIONS

1. **Can the DCC Frontender Agreement or a Development Works Agreement be completed after the Servicing Agreement for the works has been executed?**

   Yes. Essentially both agreements are a mechanism to allow the developer to recover their frontending costs. However, in keeping with the City's general approach on latecomer type agreements, the developer must advise the City in advance of finalising the Servicing Agreement that they intend to request a DCC Frontenders Agreement or a Development Works Agreement. This will allow the Engineering Project Manager to advise the developer on the requirements, timing and process, and to set up for the agreement. The City will only be able to start collecting the charges once the agreement has been executed.

2. **Does financial security up to the full value of the works have to be taken with the agreements?**

   Not necessarily so. The amount of financial security will depend on the works required to support a subdivision, rezoning or building permit application. If a developer chose to proceed with the works in advance of any development application, the City would not require any financial security (other than funds to clean up any possible uncompleted work) as the developer is getting nothing (e.g., rezoning or subdivision) in return for completing the work. In addition the agreement will lapse if the work is not completed by the date specified in the agreement.

3. **Can the City collect the Specified Charge from subsequent developers in the benefiting area while the works are still in progress?**

   Yes. If the work is in substantial progress and the City has funds secured for its completion, then there is little risk that the work cannot be completed. One factor that will need to be assessed is if the subsequent development will be sensitive to the time the works are completed and there is risk that the works may not be completed on time. In this case, the City will have to record a caveat against the completion date, while still collecting the charge.

4. **What fee should be charged for the preparation and administration of the agreement?**

   A calculation of the person-hours required to prepare and administer an agreement resulted in a cost ranging between $4,000 and $7,000, depending on the complexity of the agreement. The fee has been set between $3,000 and $5,000 per agreement. The Engineering Project Manager shall make an assessment of the complexity of the agreement and set a fee accordingly. The fee revenue should be shared between the Land Development Division and the Financial Services Division.

L.J. Bjorseth

Leif J. Bjorseth, P.Eng.
Land Development Manager

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SURREY
CITY OF PARKS

Corporate Report

NO: 5980

COUNCIL DATE: October 6, 19

SPECIAL COUNCIL

TO: Mayor & Council DATE: September 22, 1997

FROM: General Manager, Engineering FILE: 2350-000

SUBJECT: Developer Front Ending of Infrastructure within Neighbourhood Concept Plans

RECOMMENDATION

That Council authorize the use of an agreement, between a group of developers, to finance the construction of major items of infrastructure where expressly approved by Council, and meeting the criteria provided below. Under this agreement, the developers will provide the funds to construct the facility, and the City will agree to pay the developers back over a specified period of time with payments to be equal to the Development Cost Charges collected from benefiting properties.

INTENT

To seek Council's endorsement for the front ending of major items of infrastructure within NCPs where current practices for financing are not workable.

The developers within the NCP would fund the construction of the major infrastructure and would be reimbursed through the rebate of their DCCs payable for the item of infrastructure, and also by a separate payment equal to the DCCs to be paid in the future by other benefiting developers to a maximum of the capital costs (including consulting fees) of the infrastructure. The latter payments will be made annually in amounts equal to the DCCs paid for the specific category from benefiting properties during that year.

The City Solicitor has specifically stated that this approach should only be used in very selective situations and should not be made generally available. Please refer to the complimentary report from the City Solicitor which includes the agreement and his opinion with respect to its use.

BACKGROUND

In a 1995 Corporate Report, the Engineering Department indicated concerns about the City's ability to finance the infrastructure required to support the 14 NCPs in process. A recommendation to sequence the NCPs was proposed. Council decided that the sequencing of NCPs was not an acceptable solution. It was subsequently suggested that each NCP would only be approved if it were self financed. Since that time, the City has adopted 6 NCPs under this system, one with conditions placed upon development due to funding. Previous to this policy change 2 NCPs were adopted.

There are several NCPs that are having difficulty finalizing their Stage 2 Reports due, at least in part, to financing considerations. The most problematic situation is where major items of infrastructure are required before development can commence such as a major sanitary sewer trunk or a major pump station.

Generally the City does not have the funds available at the time of the NCP adoption, therefore the NCP cannot proceed unless a developer, or group of developers, are prepared to advance the funds to finance the needed infrastructure.

CURRENT CITY PRACTICES

1. DCC Rebate

Major items of infrastructure are normally included in the 10 Year Servicing Program and funded by Development Cost Charges. Since the work is required prior to any development, under current practices, the City would require the first developer to finance and construct the facility. The developer would get back his Development Cost Charges to the maximum of his DCCs payable for that category of service and not exceeding the value of the works. The more expensive the infrastructure, the larger the application needed to allow the developer to recover his costs. On larger items of work, it is unlikely a single development will be large enough to allow the developer to recover his costs.

2. Latecomer Agreement

If the rebate of the developers DCCs wasn't adequate to cover the cost of the facility, then the developer has the option of applying for a Latecomer Agreement. Under the Latecomer Agreement provisions, the benefiting properties would pay their share of the cost of the infrastructure upon development of their property. The developers do not like to use this method on large items of infrastructure as there is a 10 year time limit on these agreements and they may not recover their costs if the majority of the benefiting properties do not develop within the 10 year period.

Latecomer Agreements are limited to storm sewers, watermains and sanitary sewers. Benefiting properties under the bylaw can be properties that front the sewer or water mains or the benefiting area.

When the sewer or watermain proposed to be financed by the Latecomer Agreement is in the 10 Year Servicing Plan, the intent is that the works will be funded by DCCs when available and the work has become a City priority. If the item of work is to be funded by a Latecomer Agreement then the item should be deleted from the 10 Year Servicing Plan and the DCC recalculated to avoid double charging the developers. The revised DCC will likely be almost the same after the removal of the item from the program. This becomes inequitable for the developers since they will have to pay the latecomer charge and the DCC whereas before they only had to pay the DCC.

PROPOSAL TO USE DCCs TO REIMBURSE THE FRONTENDER

The Latecomer Agreement and the current DCC rebate policy are considered to be adequate methods of dealing with the majority of infrastructure financing situations. The developers are required to work together to increase the size of the application and therefore the DCCs available to finance the services. The proposed method is not intended to replace or become a replacement for these methods. It is only intended to be used in rare cases where the cost of the infrastructure is very high and where all others methods have been unsuccessful.

If the City wishes to encourage the developers to front end the needed major items of infrastructure, then the City can enter into an agreement with the developers to pay them back over time the capital cost of the design and construction of the infrastructure. The developers would front end the needed infrastructure and, in return, the City agrees to:

1. Rebate to the developers their DCCs for that category of service to help offset the capital costs (as per current practice).

2. Pay to the frontenders the DCCs collected from the benefiting properties as they develop. The maximum amount to be paid under this item would be the cost of the design and construction less the rebate of DCCs already provided under item 1 above.

Under this proposal, the developers will have a greater chance of getting the majority of their money back than with the Latecomer Agreement if the total DCC collected from the benefiting areas for that category of service is significantly greater than the cost of the infrastructure. They also avoid being double charged if the work was in the 10 Year Servicing Plan.

From an engineering perspective, a time limit of 10 years should be placed upon any such agreements. This will allow the City to better assess the implications of this agreement upon the City's priorities and money collected after 10 years will not likely have a significant impact upon the developers front ending the infrastructure.

Advantageous and Disadvantageous of Proposal

It is important to understand that this proposal does have some advantageous to the City and also some disadvantageous. The major advantage is that the developers provides the funds to allow the area, considered a priority to the City, to be opened up for development earlier than would otherwise be possible.

The disadvantage is that any such agreement will commit the City to pay the future DCCs for that category of work payable by the benefiting area to a third party. As such, these funds will not be available for other City priorities. It is therefore critical that this proposal be used very selectively to ensure that the City's priorities are not controlled by the development industry. Also the City is currently finding it difficult to provide its 10% of the cost of the works being funded by DCCs and is currently considering reducing this amount. The use of this method of front ending infrastructure may increase the value of works undertaken with DCCs and therefore increase pressure on the City to provide their share.

The recommended criteria to be used to evaluate the use of this proposal is as follows:

1. The NCP must be priority for the City to open up for development.

2. The City's agreement to commit future DCC funds to this item of work must be consistent with the City's current priorities for this category of service.

3. The City's agreement to commit the future DCC funds must not place a significant limit on the City's flexibility to deal with future demands.

4. The infrastructure to be covered must be a major cost item. As a guideline, we would suggest that the minimum cost of the item of infrastructure should be $500,000.

5. Within the benefiting area, there can be no other item of infrastructure requiring DCC rebates for this category of work. Until the frontending developers have been paid in full, there are no DCCs available to rebate to any other developer (unless other arrangements have been made to deal with this specific issue).

6. All other methods of funding must have been considered and determined to be unworkable for the specific item of infrastructure.

7. The City will have to provide for the administration of these agreements over their duration.

8. All costs of preparation and administration of such agreements must be funded by the developers.

LEGAL IMPLEMENTATION

With respect to the specific agreement and the City Solicitors opinion regarding the agreement and its implementation please refer to the City Solicitor's Report.

Umendra Mital

Umendra Mital, P.Eng.
General Manager, Engineering

JJ/

Attachment

cc: General Manager, Finance & Technology
City Solicitor

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SURREY
CITY OF PARKS

Corporate Report

NO: C 38

COUNCIL DATE: JAN 26

COUNCIL-IN-COMMITTEE

TO:	Mayor & Council	DATE:	January 22, 1998
FROM:	General Manager, Engineering	FILE:	2350-000
SUBJECT:	Development Works Agreement Legislation		

RECOMMENDATION

1. That Council authorize the use of a Development Works Agreement with developer(s) as an additional alternative to finance the construction of major items of infrastructure in NCPs.

2. That all City costs of preparation and administration of the Development Works Agreement be borne by the developer(s) making the application for the Agreement.

INTENT

The purpose of this report is to seek Council's endorsement of an additional approach for the front-ending of major items of infrastructure within NCPs using the new legislation under Section 937.1 of the Municipal Act referred to as the "Development Works Agreement". It is essentially a form of area latecomer agreement which covers works which are included in the City's 10 Year Capital Program. Under this agreement, the developers will provide the funds to construct an engineering service. The benefiting land owners will pay their proportional amount of the cost of such works to the City in conjunction with developing or significantly improving their properties and the City will then reimburse the "front-ending" developers the funds collected.

BACKGROUND

In a 1995 Corporate Report, the Engineering Department indicated concerns about the City's ability to finance the infrastructure required to support the 14 NCPs in process. A recommendation to sequence the NCPs was proposed. Council decided that the sequencing of NCPs was not an acceptable solution. It was subsequently suggested that each NCP would only be approved if it was self financed. Since that time, the City has

adopted 10 NCPs under this system, one with conditions placed upon development due to funding. Previous to this policy change 2 NCPs were adopted.

There were several NCPs that were having difficulty finalizing their Stage 2 Reports due, at least in part, to financing considerations. The most problematic situation was where major items of infrastructure were required before development could commence such as a major sanitary sewer trunk or a major pump station.

Generally the City does not have the funds available at the time of the NCP adoption to construct needed infrastructure, therefore the NCP cannot proceed unless a developer, or group of developers, is prepared to advance the funds to finance (i.e., front end the costs of) the needed infrastructure.

CURRENT CITY PRACTICES

The City has used two different approaches to assist developers in financing the construction of needed infrastructure in conjunction with development in new areas. These are addressed below.

1. DCC Rebate Policy

This policy applies to infrastructure items which are included in the 10 Year Servicing Program and are funded by Development Cost Charges. Frequently, municipal engineering infrastructure which is part of the 10 Year Capital Program (to be funded from DCCs) must be constructed prior to any development in an area. Under current practices, the City may allow the first developer to finance and construct such works in order to allow development in the area to proceed. This "front-ending" developer would get back his Development Cost Charges to the maximum of the DCCs payable on his development for that category of service but not exceeding the value of the works which he constructed. The more expensive the infrastructure, the larger the application needed to allow the developer to recover his costs. For very expensive items of work, a single development will typically not be large enough to allow the developer to recover his costs through the current DCC rebate process.

The current DCC rebate policy is considered to be a satisfactory method for dealing with the majority of development infrastructure financing situations and is currently used on a relatively frequent basis. For more costly construction projects developers often work together to increase the size of the development application such that the DCC rebate available is sufficient to finance the construction of the needed services.

2. DCC Reimbursement Agreements

A second approach which has been used to assist a developer (or group of developers) to front-end the needed major items of infrastructure is the "DCC Reimbursement Agreement". The City can enter into an agreement (as per Corporate Report S980) with the "front-ending" developer (or group of developers)

to pay him/them back over time the capital cost of the design and construction of the works covered by the Agreement. The City makes these payments from DCCs collected during the development of properties in the area which receive benefit from the works constructed under the Agreement.

More specifically, the developers "front end" the costs of the needed infrastructure and, in return, the City agrees to:

1. rebate to the developers their DCCs for that category of service to help offset the capital costs (as per current practice); and
2. pay to the front-ending developers the DCCs collected from other benefiting properties as they develop. The maximum amount to be paid under this item would be the cost of the design and construction of the works less the rebate of DCCs already provided under item 1 above.

This approach was approved by Council for use in constructing sanitary sewer works in the West Cloverdale North NCP and drainage works in the Rosemary Heights Central NCP. Further use of this approach is considered reasonable from an engineering perspective provided that in each such case separate Council authorization is received.

From an engineering perspective, a time limit of 10 years should be placed upon such agreements. This will provide the City a better opportunity to better assess the implications of this agreement upon the City's priorities. Further, money collected after 10 years will not likely have a significant impact upon the developers front ending the infrastructure (the City's Latecomer Policy includes a 10 year time limit on latecomer agreements). The criteria to be used to evaluate the use of "DCC Reimbursement Agreements" has been previously approved by Council. The use of "DCC Reimbursement Agreement" approach is not to become a replacement for the DCC rebate policy. It should only be used in rare cases where the cost of the infrastructure is very high and where all others methods of financing the construction of the necessary infrastructure have been unsuccessful.

DISCUSSION

In addition to the approaches discussed in the previous section, new legislation has been approved which allows the City another option for assisting developers who wish to "front-end" infrastructure in support of opening new development areas. For purposes of this report this will be called the "Development Works Agreement" approach.

The practices discussed under the previous section are suitable for situations where the development on the properties which benefit from the "front-ended" project generate sufficient DCCs to fund the cost of the project. The "Development Works Agreement" approach is applicable in circumstances where the DCCs collected from development on the benefiting properties are not adequate to fund the front-ended works and must be supplemented by additional charges on the benefiting properties. A Development Works Agreement basically requires the benefiting properties at the time of development to pay

DCCs plus an additional amount per unit which is then reimbursed to the developer(s) who "front-ended" the construction of the works.

A Development Works Agreement has a somewhat complicated administrative process which must be followed in accordance with legislation. The process is similar to the Local Improvement By-law process. To enter into a Development Works Agreement, Council must pass a by-law which provides for a developer (or group of developers) to provide, construct, alter or expand sewage, water, drainage and highway facilities using the developer's own funds. Under the Agreement/By-law, the properties that benefit from the constructed works will become indebted to the City and will have to pay to the City their proportionate share of the costs of the works as a condition of any of the following:

- subdivide or stratify their lands;
- obtain a building permit, development permit or development variance permit; or
- rezone their lands.

The City then reimburses the "front-ending" developer the amounts which are collected from the benefiting properties. The Act also makes provision for increasing the charges payable by the benefiting properties by an annual interest rate to be specified in the by-law (this is similar to the annual adjustments provided in latecomer agreements).

A time limit of 10 years should be placed on Development Works Agreements for the same reasons as such a time limit is proposed for DCC Reimbursement Agreements, noted previously in this report.

The process stipulated in the Act for entering into a Development Works Agreement provides the affected property owners (i.e., owners of the benefiting properties) an opportunity to have a voice in what is being proposed. The Act requires that a "sufficient" petition (i.e., 66 2/3 % of the land owners representing 50% of the assessed value of the lands in the benefiting area) for the development works must be presented to Council and that no sufficient petition against the development works agreement has been received. Council will know through the petition process whether or not the community is in favour of the approach being advanced by the "front-ending" developers.

As is evident from the above description, the Development Works Agreement process will involve a significant administrative effort including:

- checking of the petitioning process by the City;
- the preparation and processing of a by-law by City staff and Council; and
- the ongoing administration by the City related to the collection and distribution of funds related to the Agreement.

Should Council approve the use of Development Works Agreements, staff will develop a procedure to administer the implementation of the recommendations of this report and determine the amount and method of payment of fees to cover the City's costs related to Development Works Agreements.

Potential Impact of Development Works Agreements

Council have indicated that they wish to have all NCPs proceed simultaneously provided that they are self financing. The Development Works Agreement is another method of assisting developers in the financing of the infrastructure required by the NCPs without using City funds. The use of the Development Works Agreement may accelerate the development within NCPs and from this perspective may place more pressure on the provision of fire protection police, schools, libraries and park development. It may also increase the amount of under utilized engineering infrastructure that needs to be maintained for some time.

SUMMARY

Where the reimbursement of DCCs from benefiting properties, as described in an earlier Corporate Report and discussed above, is supported by Council but the DCCs are not adequate to cover the costs of the infrastructure required to open up an NCP, the addition of the Development Works Agreement will be a benefit to the development industry. It will assist the developers in getting repaid for front-ending the needed engineering works. It also allows the owners of the benefiting properties to be aware of the proposal and to have some input into the process that affects the development potential of their lands.

Umendra Mital, P. Eng.,
General Manager, Engineering

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c.c. - City Solicitor

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APPENDIX VIII

COUNCIL RESOLUTION

A. ADOPTION OF MINUTES

1. Council-in-Committee - September 12, 2005

(b) The recommendations of these minutes were considered and dealt with as follows:

Item No. C013 North Grandview Heights Neighbourhood Concept Plan Amendment - Stage 2 Report
File: 6520-20 (North Grandview Heights Amendment)

It was Moved by Councillor Hunt
Seconded by Councillor Watts
That Council:

1. Receive this report as information;

2. Approve the final and complete North Grandview Heights Neighbourhood Concept Plan Amendment (the "NCP Amendment"), attached as Appendix I, as a means to manage development in the area of the North Grandview Heights neighbourhood that is subject to this amendment and to provide services, amenities and facilities in support of the development of this neighbourhood;

3. Instruct the City Clerk to introduce amendments, as documented in Appendix II, to Surrey Zoning By-law, 1993, No. 12000 (the "Zoning By-law) to revise the amenity contributions for the NCP Amendment area; and

4. Instruct staff to bring forward Official Community Plan ("OCP") land use designation amendments in the NCP Amendment area, concurrently with the related site-specific rezoning applications.

RES.R05-2239 Carried

APPENDIX VIV

CORPORATE REPORT

CORPORATE REPORT NO.	COUNCIL DATE	SUBJECT
C013	September 12, 2005	North Grandview Heights Neighbourhood Concept Plan Amendment – Stage 2 Report
C009	May 18, 2005	Approval of the Stage 1 Component of the North Grandview Heights Neighbourhood Concept Plan Amendment
R068	April 4, 2005	North Grandview Heights NCP Amendment Application – Status Report
R115	May 10, 2004	Requests to Review and Amend the North Grandview Heights Neighbourhood Concept Plan

The above noted Corporate Reports may be accessed by visiting the following web-site at http://surrey.ihostez.com/ and by clicking "Advanced Search", selecting "Corporate Reports" under "Folder Selections", and entering the Corporate Report number in the "Exact keyword or phrase" box under "Search Criteria".