



# C.C. Tatham & Associates Ltd.

## Consulting Engineers

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July 5, 2017

via email: sam@greenwoodconst.ca  
CCTA File 114239

**Sam Greenwood**  
Greenwood Aggregates  
205467 County Road 109  
Amaranth, ON L9W 0V1

**Re: Proposed Violet Hill Gravel Pit, Town of Mono  
Traffic Review**

Dear Mr. Greenwood:

As requested, we have reviewed the proposed Violet Hill pit development plan from a transportation perspective, addressing the site access, site traffic volumes, and the potential impacts to the adjacent road system. Our findings are detailed below.

### **Proposed Pit Development**

#### **Site Location**

The development site is located on the south side of Highway 89 between 3<sup>rd</sup> Line East and 4<sup>th</sup> Line East in the Town of Mono, Dufferin County. As illustrated in Figure 1, the site is bounded by each of the noted roads and is also bisected by 30 Sideroad. The site constitutes part lots 30, 31 and 32 of Concession 4

#### **Site Plan**

The proposal calls for a licensed gravel extraction operation. The area to be licensed is 149.4 hectares, to be extracted in a number of phases. The proposed annual extraction limit is 1,000,000 tonnes, although actual extraction is expected to be less (the 1,000,000 tonne limit is to allow for large construction projects in the immediate area).

#### **Site Access**

Access to the site will be located on 3<sup>rd</sup> Line East, approximately 480 metres south of Highway 89, as illustrated in Figure 2.

## Site Generated Traffic

Estimates of the number of trips to be generated by the site have been based on the following:

- annual extraction limit of 1,000,000 tonnes;
- average truck capacity of 34 tonnes; and
- 250 operating days per year (consistent with year round operations).

The peak operating season is expected to be between the months of May and November, with 80% of the annual tonnage assumed to be extracted during this period. During this time, the pit is assumed to operate 13 hours per day (6:00 to 19:00). The off-peak season (December to April) will see the remaining 20% extracted (reflective of reduced market demands and construction activity during this period). During this period, reduce hours of operation area assumed (8 hours per day).

A summary of the truck trip estimates is provided in Table 1, including daily and hourly truck volumes. To further consider peak hour operations during the day, the average hourly volumes have been increased by a factor of 2 (ie. site activity will not be uniform over the course of the day as some hours will be busier than others). As per Table 1, during the peak season the site is expected to generate on average 12.5 loads per hour, which translates to 12.5 truck trips to the site and 12.5 truck trips from the site. In considering peak hour operations, 25 trucks to the site and 25 trucks from the site are estimated (assuming a peak hour factor of 2). During the off-peak season the volumes are expected to be approximately half. To maintain a conservative approach, the peak hour peak season trip estimates have been assumed in the subsequent assessment.

**Table 1: Site Generated Traffic (loaded trucks)**

Period	Tonnage	Operating Days	Tonnes/ Day	Loads/ Day	Loads/Hour	
					average	peak
Average (Jan – Dec)	1 000 000	250	4000	117	12	24
Peak Season <sup>1</sup>	800 000	145	5517	162	12.5	25
Off-Peak Season <sup>2</sup>	200 000	105	1905	56	7	14

<sup>1</sup> peak season = May to November (during which it is assumed 80% of the annual tonnage will be extracted)

<sup>2</sup> off-peak season = December to April (during which it is assumed that 20% of annual tonnage will be extracted)

The pit will also generate automobile trips at the start and end of each day related to employee use. However, the volume of such will be minor and thus the associated impacts are considered negligible.

In consideration of the market areas, the following trip distribution is expected for aggregate material exported from the site:

- to the west via Highway 89: 25%; and
- to the east via Highway 89: 75%.

The resulting site generated traffic volumes assigned to the road network are illustrated in Figure 3. For purposes of this assessment, the noted peak hour volumes are considered for both the AM and PM peak hours.

## **Haul Routes**

The destination of the aggregate material will dictate the haul route. Given the location of the site in proximity to Highway 89, all truck traffic to/from the site will utilize Highway 89 and 3<sup>rd</sup> Line East. Photographs of the haul route and corresponding intersections are provided in Figure 4 and Figure 5, whereas additional details are provided below.

## **Road Sections**

Highway 89 is a two-lane provincial highway, oriented east-west. The highway has a rural cross-section, including gravel shoulders and roadside ditches. Through the area, the posted speed limit is 80 km/h, hence a design speed of 100 km/h (posted speed limit + 20 km/h) has been assumed. There are a number of horizontal and vertical curves on the highway, reflective of the general topography of the area. As a provincial highway, this road is designated to accommodate significant traffic volumes and all vehicle types (including aggregate trucks). As such, it need not be designated as a haul route - this is inherent in the highway designation.

3<sup>rd</sup> Line East is a Town of Mono road with a typical rural cross-section (gravel surface and open roadside ditches). As a speed limit is not otherwise posted, an 80 km/h speed has been assumed (as typical in rural settings where not otherwise posted).

## **Intersections**

The key intersection is that of Highway 89 with 3<sup>rd</sup> Line East, which is a 4-leg intersection with single lane approaches on all legs. Vehicles on Highway 89 have the right-of-way; those on 3<sup>rd</sup> Line East operate under stop control.

The intersection of 3<sup>rd</sup> Line East with the site access will be a 3-leg intersection, stop control on the site access. Each approach will have a single lane.

## **Traffic Operations Assessment**

### **Existing Traffic Volumes**

Traffic data through the study area was obtained from MTO and reflects the following:

- intersection turning movement count at Highway 89 and Highway 10 (April 23, 2014);
- intersection turning movement count at Highway 89 and Dufferin Road 18/Airport Road (April 16, 2014); and
- mid-block counts at a location 0.9 km west of Dufferin Road 18/Airport Road (April 2012; January 2013 and August 2014).

As the intersection turning movement counts pertain to the major intersections both west and east of the site, and the mid-block counts were completed within the immediate area, the data is considered directly relevant.

Following a review of the count data, the highest peak hour traffic volumes on Highway 89 were established (corresponding to the mid-block count completed in August 2014 which is considered representative of peak summer conditions) and employed in this study. As no data was available at the intersections of 3<sup>rd</sup> Line East and 4<sup>th</sup> Line East, the corresponding turning volumes were estimated in consideration of the level of area development and road system (both of which are somewhat limited and thus minimal volumes are anticipated). The resulting peak hour volumes are illustrated in Figure 6. As the count data was collected in 2014, it has been increased by 1% per year (as detailed below) to reflect current 2017 conditions. To reflect operations of the proposed pit, the associated site generated traffic volumes have also been included in the 2017 volumes.

### **Future Traffic Volumes**

Traffic volumes expected for the 2022 and 2027 horizon years (representing 5 and 10 year planning horizons) for the study area have been estimated based on the 2014 traffic counts and historical growth on Highway 89 as per the *MTO Provincial Highways Traffic Volumes 1988-2013*<sup>1</sup> (which represents the most current published MTO data).

The MTO historical traffic data for the section of Highway 89 from the Mono-Adjala Townline to Highway 10 was reviewed for the period 2003 to 2013. During the 10-year period, the change in volumes ranged from an increase of 1% to a reduction of 18% year to year, with an average decrease of 4 to 5% per year.

In considering future volumes, notwithstanding the recent decrease in traffic levels, an increase of 1% per year has been assumed to ensure a conservative approach. The resulting total volumes for 2022 and 2027 (including consideration for traffic to be generated by the Violet Hill Pit) are illustrated in Figure 7 and Figure 8 respectively. As previously noted, the site is expected to generate 25 truck trips to the site and 25 truck trips from the site during each peak hour.

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<sup>1</sup> *Provincial Highways Traffic Volumes 1988-2013*, Ministry of Transportation of Ontario.

## Intersection Operations

Traffic operations at the intersection of Highway 89 with 3<sup>rd</sup> Line East have been reviewed based on the projected traffic volumes and considering the existing intersection configuration and control (single lane approaches with stop control on 3<sup>rd</sup> Line East). To ensure a conservative approach to the analyses, a peak hour factor of 0.88 has been employed, as has 100% truck traffic for movements to/from 3<sup>rd</sup> Line East and 10% truck traffic for east-west travel on Highway 89.

The results of the analysis are summarized in Table 2 whereas detailed operational worksheets are provided in Appendix A. Average delays (seconds), levels of service and volume to capacity ratios are provided for the critical, stop controlled movement (3<sup>rd</sup> Line movements). Level of service (LOS) A corresponds to the best operating condition with minimal delays whereas LOS F corresponds to poor operations resulting from high intersection delays. A volume to capacity ratio of 1.0 or greater indicates that the intersection is operating at or above capacity.

**Table 2: Site Access Operations**

Intersection & Horizon Year		Movement	AM Peak Hour			PM Peak Hour		
			delay	LOS	v/c	delay	LOS	v/c
3 <sup>rd</sup> Line East & Highway 89	2022	NB	16	C	0.11	27	D	0.20
		SB	14	B	0.03	23	C	0.06
3 <sup>rd</sup> Line East & Highway 89	2027	NB	17	C	0.120	30	D	0.22
		SB	15	B	0.03	25	C	0.05

As noted, acceptable levels of service (LOS D or better) and delays (30 seconds or less) are expected.

While traffic operations were not reviewed at the proposed site access, it can be inferred that acceptable operations will occur given the acceptable operations at Highway 89 (which accommodates a significantly greater volume of traffic).

## Highway 89 Operations

In considering the overall operations along Highway 89, the 2027 traffic projections yield peak hour peak directional volumes in the order of 330 to 580 vehicles (the maximum volumes per direction occur during the PM peak hour). For a provincial highway reflective of Highway 89, the assumed planning capacity is 900 to 1100 vehicles per hour per lane. As such, the future volumes will remain well below the theoretical planning capacity and hence the additional traffic to be generated by the pit can be readily accommodated.

3<sup>rd</sup> Line East is not considered a major road and thus traffic volumes on this road are expected to be minimal. Therefore, an increase in volumes resulting from the proposed pit can be readily accommodated.

## **Road System Improvements**

### **Operational Improvements**

As the operational assessment indicates that the area road system and the corresponding intersections will provide acceptable levels of service and delay under future conditions, no improvements are required from an operational perspective.

### **Turn Lane Improvements**

Notwithstanding the good operating conditions anticipated, the need for exclusive turn lanes on Highway 89 at the 3<sup>rd</sup> Line intersection has been investigated based on MTO turn lane warrants and considering the following:

- 100 km/h design speed (assumed to be speed limit + 20 km/h);
- left and right turning volumes assuming operations at 1,000,000 tonnes per year; and
- approaching and opposing volumes on Highway 89.

At an unsignalized intersection, MTO criteria indicate that a right turn lane should be considered if right turn volumes exceed 60 vehicles per hour during the peak hour and are anticipated to create a hazard or reduce the capacity at the intersection. The eastbound right turn volumes on Highway 89 at 3<sup>rd</sup> Line East are projected to be in the order of 10 vehicles per hour (with 6 trucks assuming an annual extraction limit of 1,000,000 tonnes) and thus well below the design criteria. With regard to the question of whether right turning site traffic would present a hazard at the intersection it is noted that the low volume of turning truck traffic (6 trucks per hour or 1 truck every 10 minutes) suggests that any operational effects on Highway 89 would be infrequent, and considering that trucks inbound to the site would be empty, the operational effects of their deceleration when turning are expected to be minor. It is further noted that the 3<sup>rd</sup> Line East intersection is visible from a distance in excess of 320 metres, thus affording ample opportunity for vehicles following a truck which is slowing to complete a turn to make the necessary adjustments in their travel speeds. In this respect, an eastbound right turn lane on Highway 89 at 3<sup>rd</sup> Line East is not considered necessary. Notwithstanding, in consideration of the turning path of trucks and to minimize off-tracking and maintenance of the gravel shoulder upon approach to 3<sup>rd</sup> Line East, it is recommended that a 60 metre right turn taper be paved within the existing Highway 89 shoulder area which will serve as a partially paved shoulder (ie. the taper not be delineated as an exclusive right turn lane).

MTO left turn lane warrants have been reviewed based on the projected total traffic volumes and a design speed of 100 km/h (based on an 80 km/h speed limit). While the turning volume is not significant (approximately 1 left turn every 3 minutes), the through volumes on Highway 89 are such that they warrant the turn lane in each of the 2017, 2022 and 2027 horizons. As noted in the corresponding warrants provided in Figure 9, a storage length of 15 metres is required for the 2017 and 2022 horizons, and 25 metres for the 2027 horizon. Further to this, MTO guidelines suggest an increase to the storage length of 10 to 15 metres to account for an increased percentage of heavy trucks (eg. tractor trailers). In consideration of the warrant analyses, the anticipated truck volumes (including tractor trailers) and recognizing that the volumes are premised on the site operating at full capacity under peak hour conditions, a storage length of 30 metres is considered appropriate. Further to the noted storage length, the left turn lane is to include a 15 metre offset from the centre of the 3<sup>rd</sup> Line East intersection, a 70 metre parallel lane and a 160 metre taper length for a total length of 275 metres (all of which is based on a 100 km/h design speed).

A functional plan illustrating the above noted improvements is provided in Plan 1 attached. Further to the design standards noted above, the following have been employed:

- a 3.5 metre left turn lane with an alignment as per Figure B9-3 of the *MTO Geometric Design Standards for Ontario Highways*, including a widening of the highway on the north side and a runout lane consisting of a 30 metre parallel lane measured from the centre of the intersection and a 160 metre taper);
- a 3.5 metre westbound through lane where the highway is to be widened;
- a 3.5 metre right turn taper; and
- 3.0 metre gravel shoulders.

Given the existing highway right-of-way, it is expected that the improvements can be accommodated without impact to private properties. It is also noted, that the provision of the westbound left turn lane will result in a road widening on the north side which will further improve visibility to/from the east.

### **Road Condition Improvements**

As previously noted, Highway 89 is a provincial highway, the intent of which is to serve high volumes of traffic and all vehicle types. As such, it has been planned and constructed to accommodate the trips associated with the proposed development. Truck traffic is permitted on Highway 89 365 days per year - there are no load restrictions applied in the spring periods. A visual inspection was conducted of Highway 89 as part of the site reconnaissance. The road is generally in good condition with no significant or major deficiencies that would affect the operations of the proposed pit.

3<sup>rd</sup> Line East is a local Town road with a gravel surface. In this regard, additional review is required of the subject road section to determine the adequacy of such for accommodating the anticipated truck traffic.

## Sight Line Assessment

### Sight Line Requirements

For a posted speed of 80 km/h, the MTO *Highway Access Management Guideline* requires a stopping sight distance of 185 metres and an entering sight distance of 320 metres for a public road or commercial access to a 2-lane road.

Stopping distance refers to the minimum distance required for a vehicle travelling at the design speed to stop before reaching an object in the road. For example, should a vehicle slow or stop on Highway 89 to turn onto 3<sup>rd</sup> Line East, approaching vehicles (either eastbound or westbound) must have sufficient sight lines to ensure they are able to come to a complete stop without colliding with the vehicle. Entering sight distance represents the point of view of a motorist who is waiting to enter or cross Highway 89 from 3<sup>rd</sup> Line East. It is the distance that this motorist should be able to see in order to safely cross or enter the highway and accelerate to the posted speed without being overtaken by an approaching vehicle.

### Highway 89 & 3<sup>rd</sup> Line East

To/from the west, existing sight lines are in excess of 320 metres, as evident in the photos of Figure 10. As such, there are no improvements necessary in this regard.

The available sight lines to/from the east are illustrated in the photos of Figure 11. As evident, the minimum stopping sight distance of 185 metres is provided, thus ensuring motorists can turn to/from 3<sup>rd</sup> Line East in a safe manner (in that approaching motorists would have sufficient time to see a stopped vehicle, or other hazard, in the road and bring their vehicle to a stop as required).

With respect to the entering sight distance of 320 metres, there are limitations resulting from the horizontal alignment of Highway 89; the vertical alignment does not restrict sight lines as illustrated in Figure 12 (which reflects the vertical profile of Highway 89). Plan 2 attached illustrates the 320 metre required lines of sight for a vehicle stopped on 3<sup>rd</sup> Line East, with the driver situated 3 metres and 5 metres in advance of the through edge of pavement on Highway 89. As noted, the line of sight extends beyond the edge of Highway 89 in the order of 8 to 9 metres (all of which is contained within the Highway 89 right-of-way). However, as evident in the photos of Figure 13, the lands adjacent to the highway do not necessarily obstruct the line of sight. In other words, despite the line of sight extending beyond the edge of the highway, visibility of oncoming vehicles is maintained. It must also be acknowledged that the driver eye height for a truck stopped at 3<sup>rd</sup> Line East is higher than that of a passenger car, and that they would be looking towards the roof lines of oncoming vehicles.

It is further noted that the majority of site related traffic will be destined to/from the east via Highway 89. In this regard, the critical sight lines for trucks exiting the site will be to the west. For trucks



entering the site, the critical sight distance corresponds to stopping sight distance for vehicles approaching from behind, which is otherwise satisfied.

In consideration of the above, the existing sight lines to/from the east are also considered appropriate. Relocation of the "Mono Township Line 3 E.H.S." roadway identification sign located approximately 95 metres east of 3<sup>rd</sup> Line is recommended to improve visibility.

### **3<sup>rd</sup> Line East & Site Access**

Excellent visibility is provided along 3<sup>rd</sup> Line East for vehicles destined to, or travelling from, the site. The Highway 89 intersection is visible to the north (480 metres) whereas the 30 Sideroad intersection is visible to the south (530 metres).

### **Summary**

This review has addressed the transportation impacts associated with the proposed Violet Hill gravel pit, to be located on the south side of Highway 89 between 3<sup>rd</sup> Line East and 4<sup>th</sup> Line East. The key points and findings of the review are summarized below.

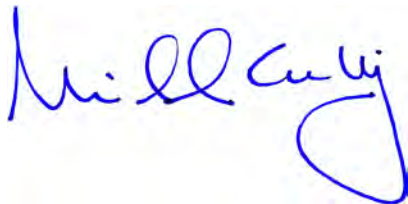
- The site is seeking an annual extraction licence limit of 1,000,000 tonnes, although actual extraction amounts are expected to be less.
- Assuming 1,000,000 tonnes extracted per year, the site is expected to generate approximately 117 loaded truck trips on average, per day (which translates to 117 truck trips to the site and 117 trips from the site).
- In considering that the peak operations are expected to be from May to November during which time 80% of the annual tonnage is assumed to be extracted, corresponding to the peak demands for materials, the daily truck trips will increase to 162 trucks (162 in and 162 out).
- Based on a 13 hour working day and assuming that peak hour volumes for site trips are 200% of the average hourly volumes, a peak hour volume of 25 trucks per hour (25 in and 25 out) is expected during the peak period of May to November.
- Aggregate material will be exported from the site via 3<sup>rd</sup> Line East and Highway 89. Approximately 25% of the material is destined to the west with the remaining 75% destined to the east.
- Under future total traffic conditions (for the years 2022 and 2027), the intersection of Highway 89 with 3<sup>rd</sup> Line East will provide acceptable levels of service. Operations at the proposed site access will also be acceptable given the limited volumes that it will serve.
- Sight distances on Highway 89 at the 3<sup>rd</sup> Line East intersection exceed the Ministry of Transportation guidelines for stopping sight distance for the assumed design speed of 100 kilometres per hour (185 metres). Furthermore, the available sight distances satisfy the MTO requirements for entering sight distance. As such, no improvements to address sight distance issues are recommended, other than the relocation of an existing road sign.

- Good visibility is provided along 3<sup>rd</sup> Line East upon approach to the site access.
- The following improvements are recommended on Highway 89 at the 3<sup>rd</sup> Line East intersection to accommodate site traffic when operating at its extraction limit (1,000,000 tonnes per year):
  - a right turn taper (60 metres in length and to a width of 3.5 metres) should be provided for the eastbound right turn movement to reduce the long-term maintenance needs for this corner (in consideration of right turning trucks); and
  - a left turn lane (30 metre storage + 70 metre parallel lane + 160 metre taper) in addition to a run-out lane (160 metres) is warranted under the 2017, 2022 and 2027 horizons.
- The improvements noted above are based on the site operating at its extraction limit of 1,000,000 tonnes per year and the resulting truck volumes that will be generated. Consideration should be given to a staged approach for the road improvements that reflects the actual amount of material to be extracted and shipped, recognizing that the actual amounts will likely be less, particularly during the opening few years. This will also allow the site to be in operation prior to the road improvements being required such that aggregate material from the site can be used in the construction.
- Highway 89 is a provincial highway and thus is intended to serve truck traffic. 3<sup>rd</sup> Line East is a Town of Mono road and thus has not been constructed with the intent of accommodating increased truck traffic. As such, additional investigations of the subject road section (ie. site access to Highway 89) will be necessary to confirm the suitability (including vibratory impacts) of such as a truck haul route (or alternatively, the identification of road system improvements necessary to adequately accommodate truck traffic).

Should you have any questions or comments on the above, please do not hesitate to contact us.

Yours truly,

C.C. Tatham & Associates Ltd.



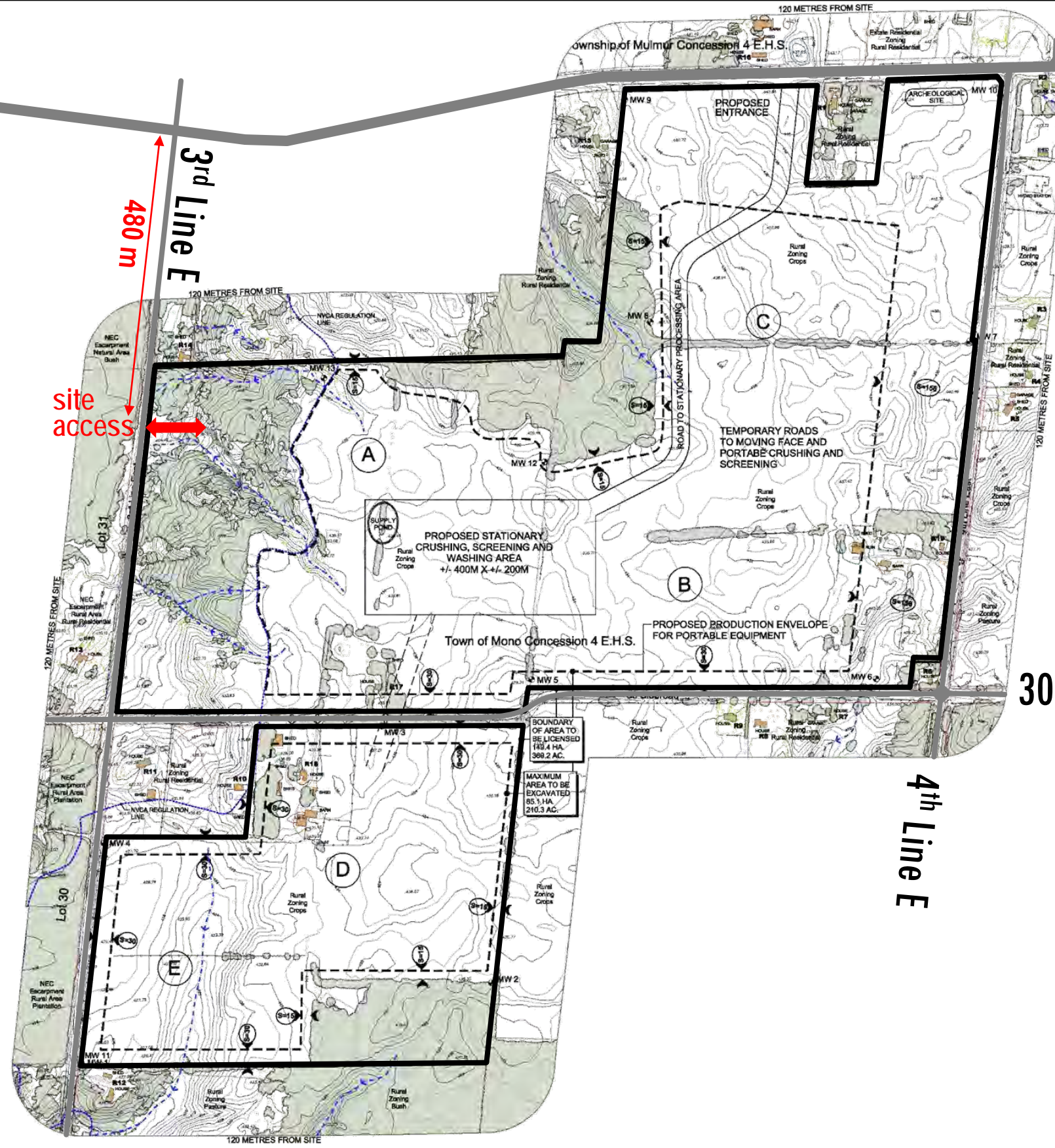
Michael Cullip, P.Eng  
Director, Manager – Transportation & Municipal Engineering  
MJC:mjc

copy: Craig Laing, C.D. Laing Aggregate Management Services (claingams5@gmail.com)

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Highway 89

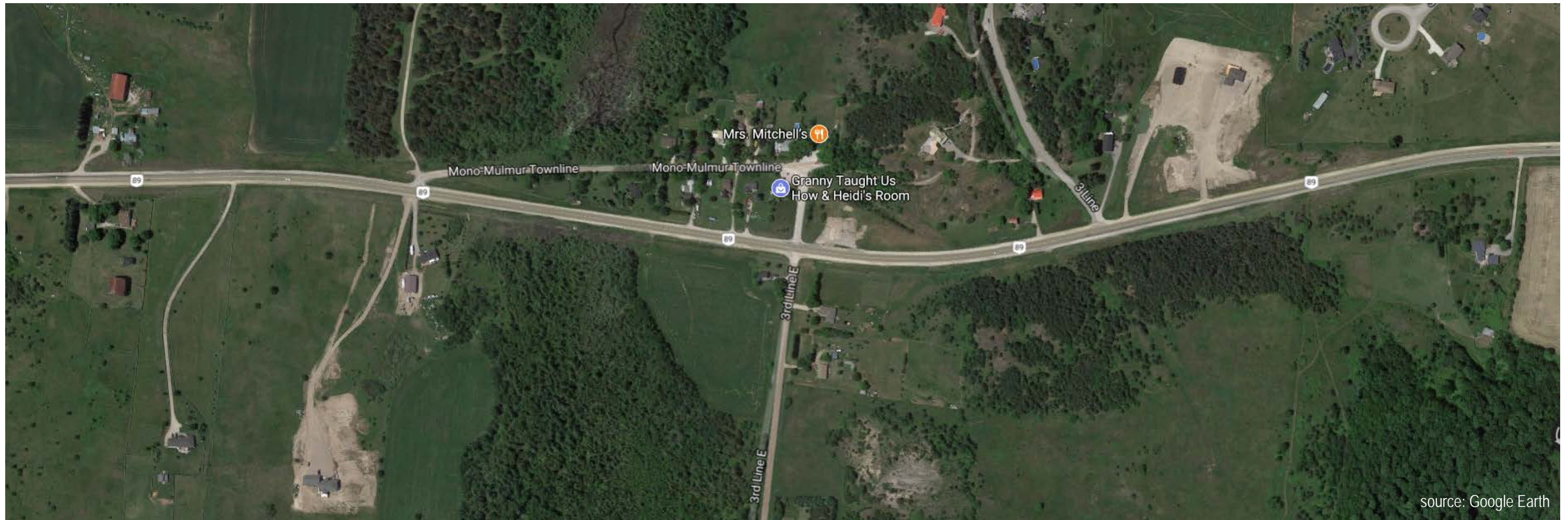


30 Sideroad

Legend

	Boundary of Area to be Licensed		Existing Tree Cover
	Area to be Excavated		Existing Fences
	Elevation, 1M Contour		Building/Structure Use and Receptor Number
	Elevation, Spot		Monitoring Well MW1-MW13 Location and Number
	Parcel Fabric		Existing Entrance/Exit
	Surface Drainage		Cross Sections Location and Identifier
	Setbacks, Metres		



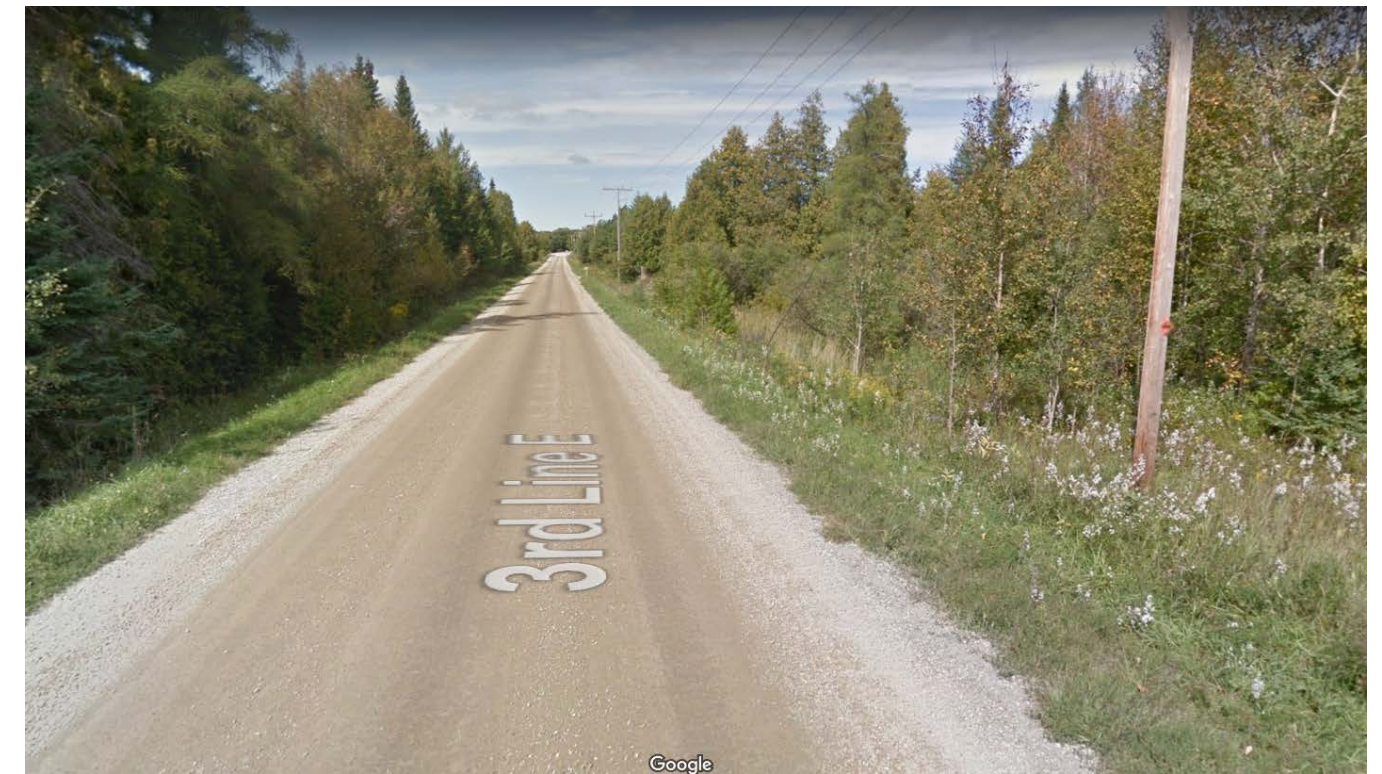


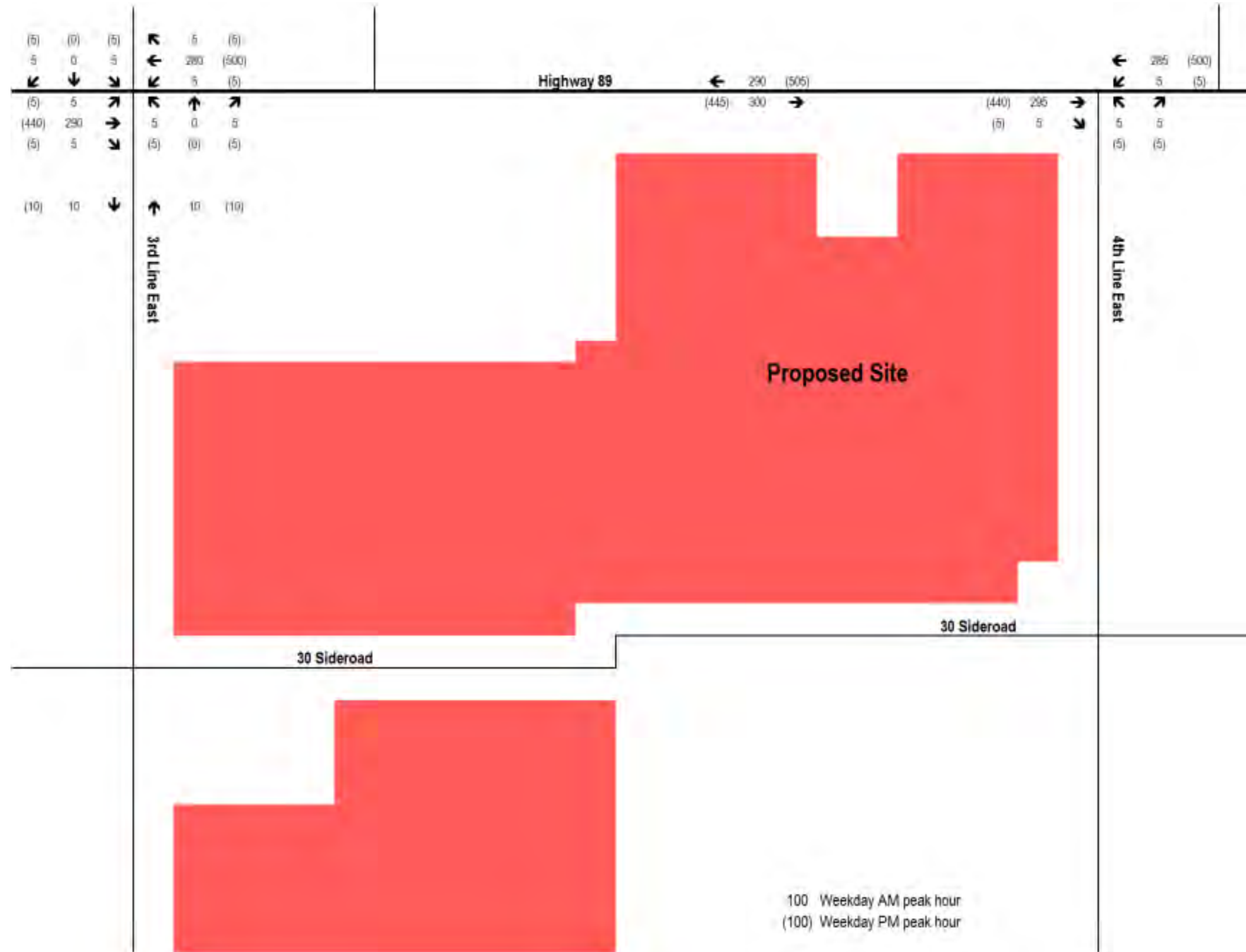


Looking south on 3<sup>rd</sup> Line East from Highway 89  
Looking south on 3<sup>rd</sup> Line East to site access

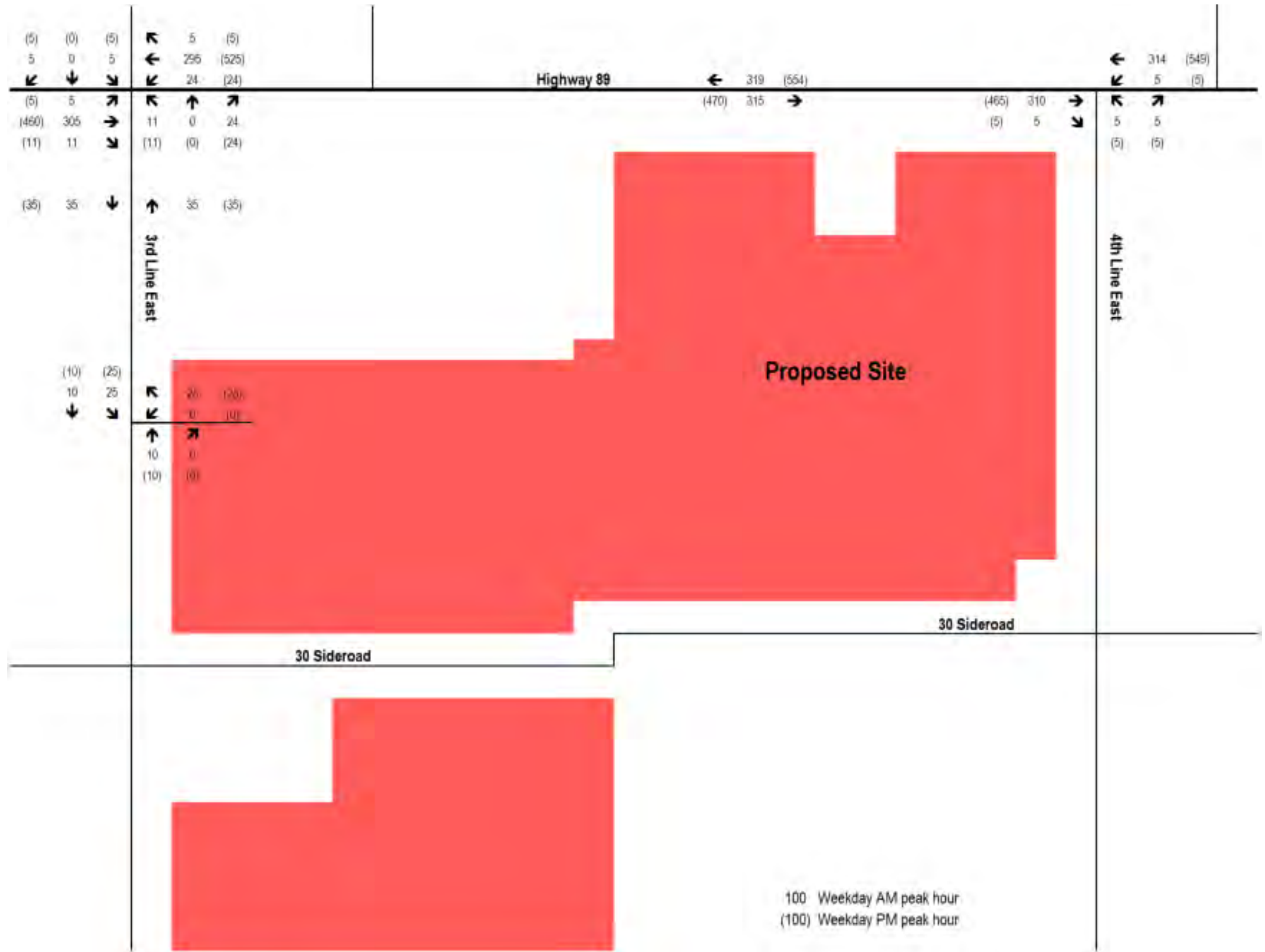


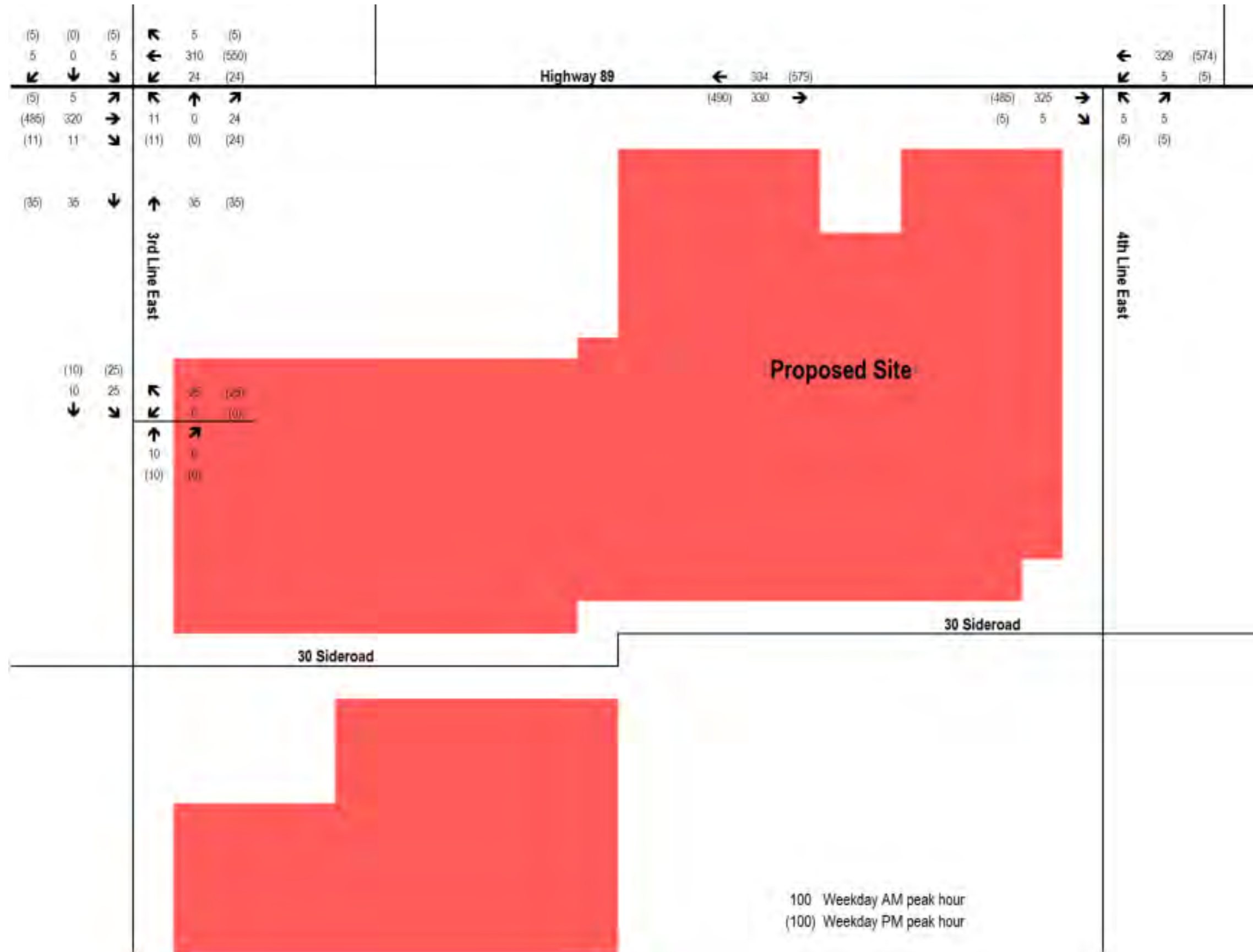
Looking north on 3<sup>rd</sup> Line East to Highway 89  
Looking north on 3<sup>rd</sup> Line East from site access

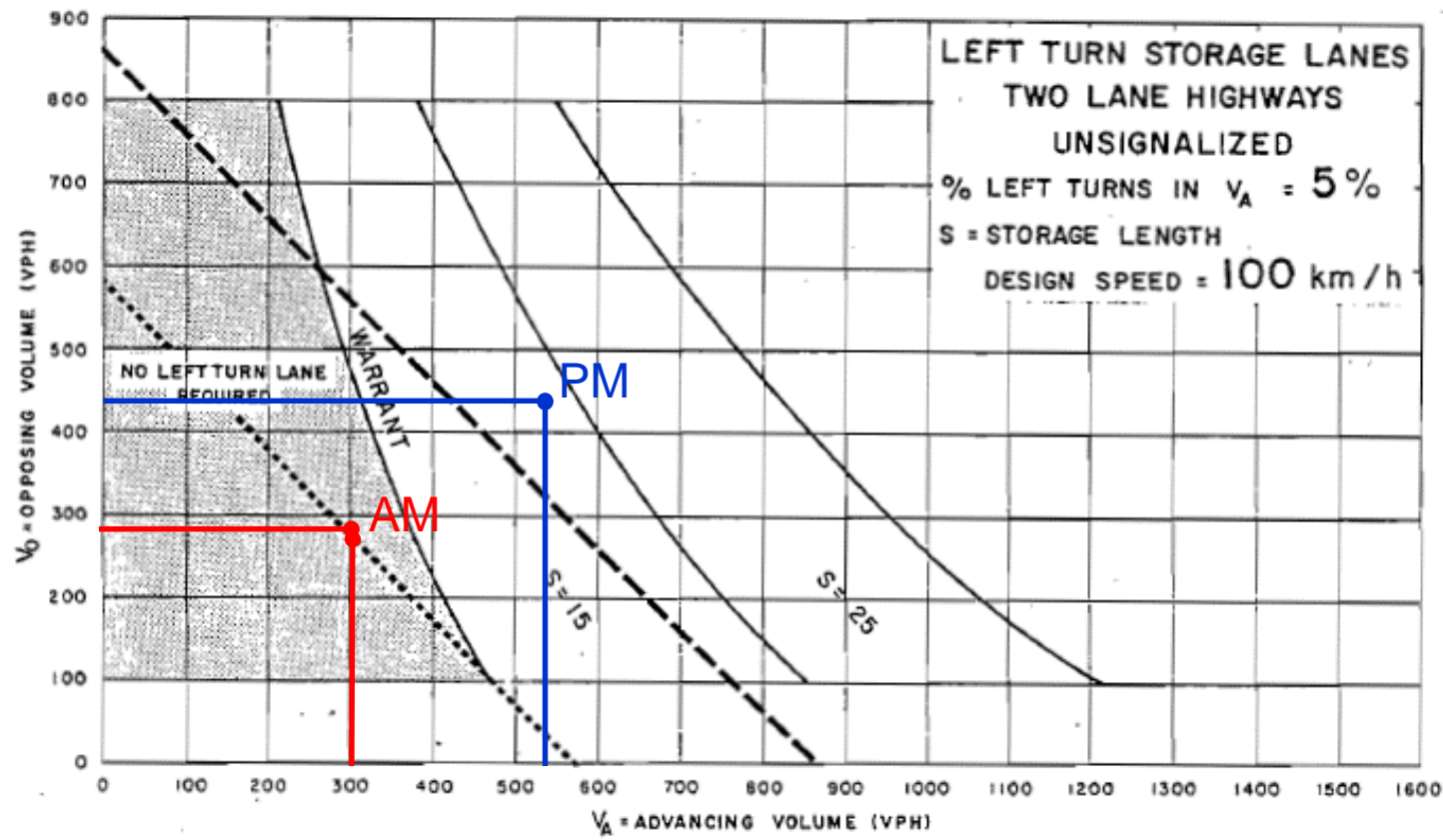








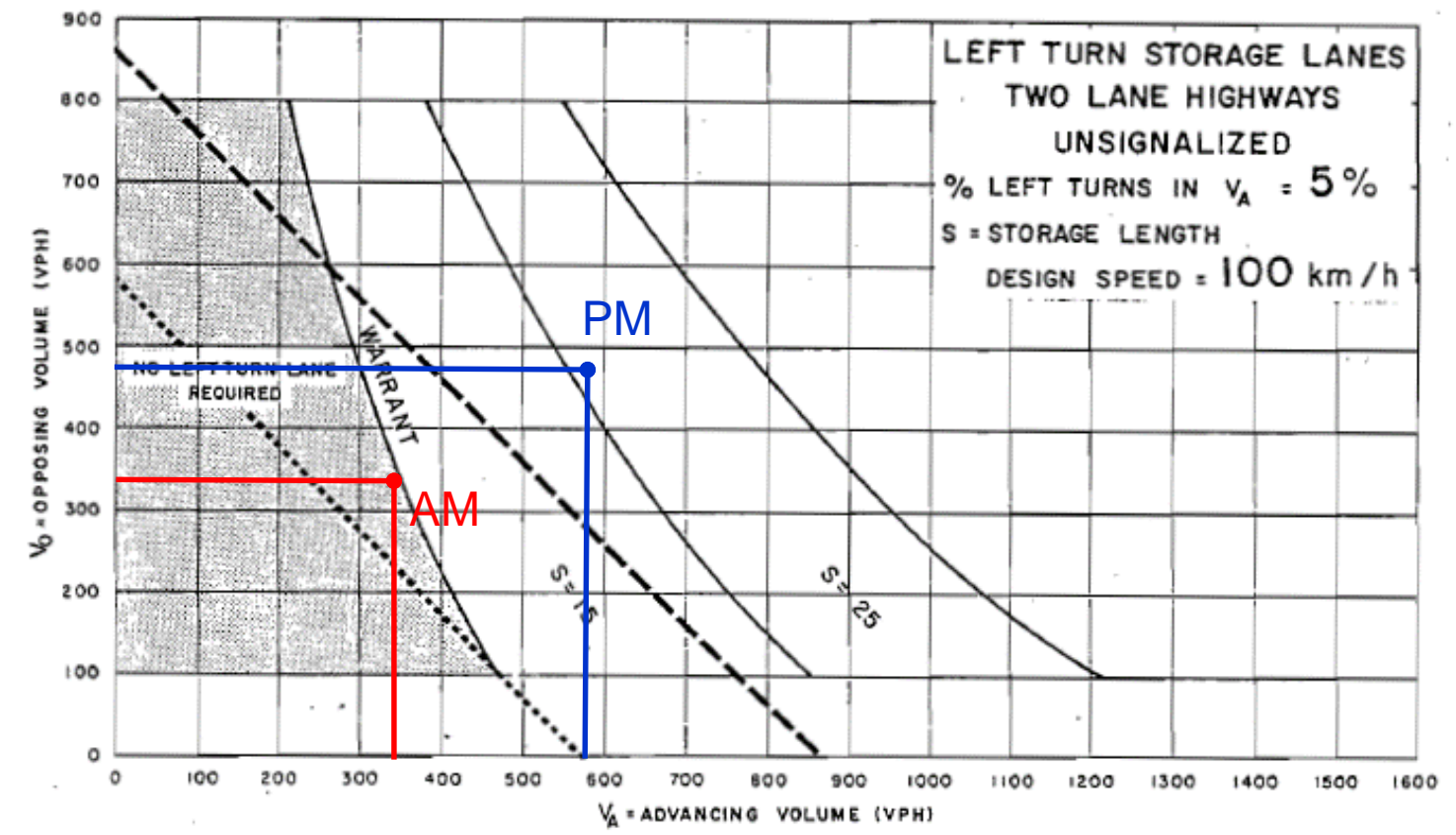




**2017**

WB left turn lane	AM	PM
VA	309	(529)
VO	295	(445)
VL	24	(24)
% left	8%	5%

warranted	N	Y
S	-	15m



**2027**

WB left turn lane	AM	PM
VA	339	(579)
VO	325	(490)
VL	24	(24)
% left	7%	4%

warranted	N	Y
S	-	25m



looking west on Highway 89 from 3<sup>rd</sup> Line East



looking east to 3<sup>rd</sup> Line East from 320 metres to the west



looking east on Highway 89 from 3<sup>rd</sup> Line East



looking west to 3<sup>rd</sup> Line East from 185 metres to the east

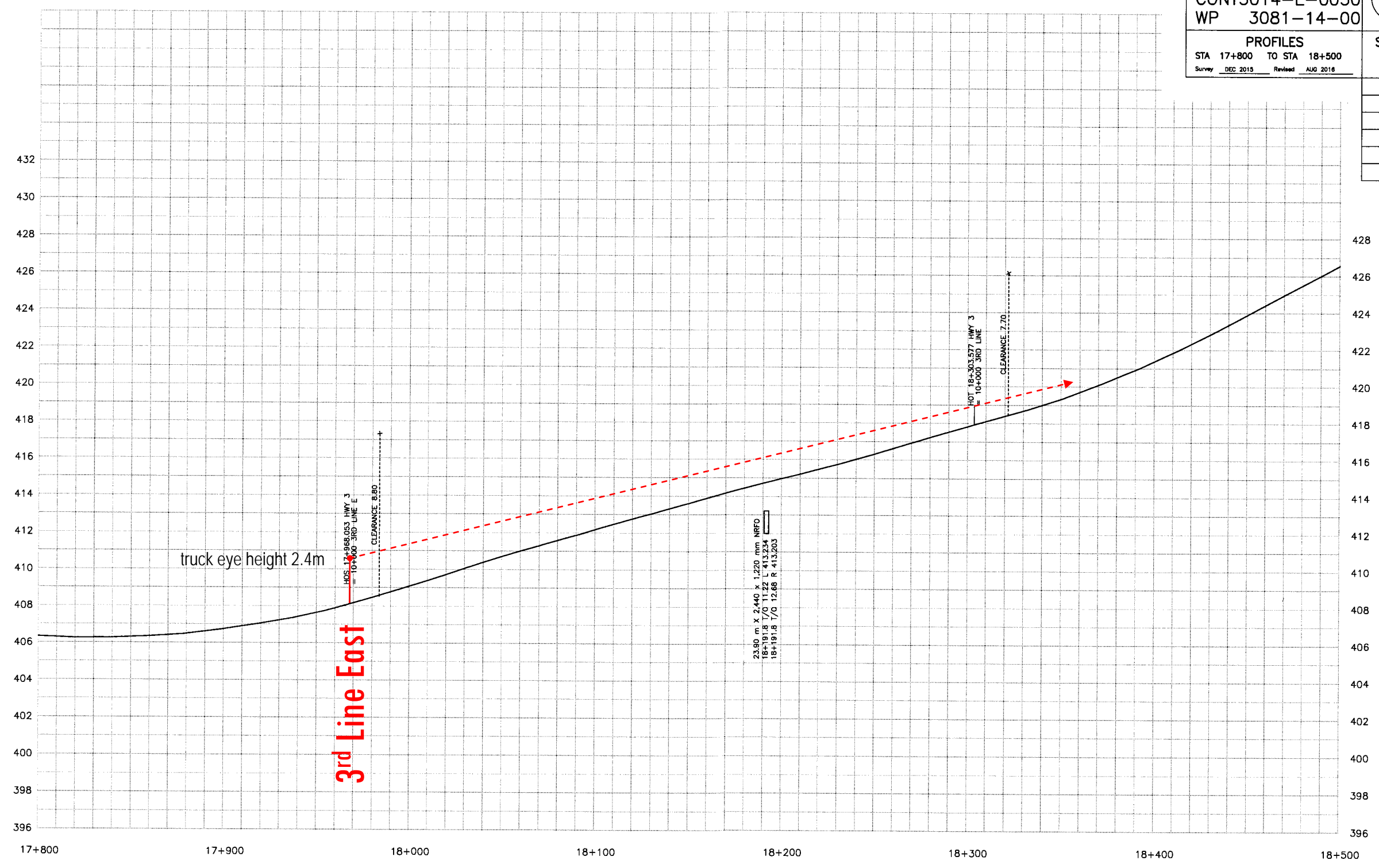


looking west to 3<sup>rd</sup> Line East from 320 metres to the east

METRIC

PLATE No	821-89/28-0
CONT	3014-E-0030
WP	3081-14-00
PROFILES	
STA	17+800 TO STA 18+500
Survey	DEC 2015
Revised	AUG 2016

SHEET



DRAWING MADE BY: [Name] CHECKED BY: [Name] DATE: [Date]  
 DRAWING LAYOUT NAME: [Name] DATE: [Date]  
 PRINTED: Aug 9, 2016 - 15:44

SCALE  
 5.0 : 10 m  
 Horizontal  
 0.5 : 1.0 m  
 Vertical



Violet Hill Pit Traffic Review

Sight Lines on Highway 89 at 3rd Line East – to/from East (profile)

Figure

12

date of photo: February 22, 2017  
photo taken from edge of shoulder on Hwy 89



approximately  
320 metres east  
of 3<sup>rd</sup> Line

consider relocation of roadway  
identification sign to improve  
visibility

date of photo: February 22, 2017

photo taken from edge of shoulder on Hwy 89



vehicles approaching 3<sup>rd</sup> Line from  
GREATER than 320 metres away

truck is approximately 320  
metres east of 3<sup>rd</sup> Line



date of photo: February 22, 2017

photo taken approximately 10 metres in advance of edge of shoulder on Hwy 89



van is turning from 3<sup>rd</sup> Line  
north leg, approximately 335  
metres east of 3<sup>rd</sup> Line East

**Appendix A:  
Traffic Operations**

Intersection												
Int Delay, s/veh	1.5											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	5	305	11	24	295	5	11	1	24	5	1	5
Future Vol, veh/h	5	305	11	24	295	5	11	1	24	5	1	5
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	5	10	100	100	10	5	100	5	100	5	5	5
Mvmt Flow	6	347	13	27	335	6	13	1	27	6	1	6
Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	341	0	0	359	0	0	760	759	353	771	763	338
Stage 1	-	-	-	-	-	-	364	364	-	393	393	-
Stage 2	-	-	-	-	-	-	396	395	-	378	370	-
Critical Hdwy	4.15	-	-	5.1	-	-	8.1	6.55	7.2	7.15	6.55	6.25
Critical Hdwy Stg 1	-	-	-	-	-	-	7.1	5.55	-	6.15	5.55	-
Critical Hdwy Stg 2	-	-	-	-	-	-	7.1	5.55	-	6.15	5.55	-
Follow-up Hdwy	2.245	-	-	3.1	-	-	4.4	4.045	4.2	3.545	4.045	3.345
Pot Cap-1 Maneuver	1202	-	-	812	-	-	227	332	516	313	331	697
Stage 1	-	-	-	-	-	-	494	619	-	626	601	-
Stage 2	-	-	-	-	-	-	473	599	-	638	615	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1202	-	-	812	-	-	217	316	516	285	316	697
Mov Cap-2 Maneuver	-	-	-	-	-	-	217	316	-	285	316	-
Stage 1	-	-	-	-	-	-	491	615	-	622	576	-
Stage 2	-	-	-	-	-	-	449	574	-	600	611	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.1			0.7			16.3			14.4		
HCM LOS							C			B		
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1				
Capacity (veh/h)	359	1202	-	-	812	-	-	395				
HCM Lane V/C Ratio	0.114	0.005	-	-	0.034	-	-	0.032				
HCM Control Delay (s)	16.3	8	0	-	9.6	0	-	14.4				
HCM Lane LOS	C	A	A	-	A	A	-	B				
HCM 95th %tile Q(veh)	0.4	0	-	-	0.1	-	-	0.1				

Intersection												
Int Delay, s/veh	1.4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	5	460	11	24	525	5	11	1	24	5	1	5
Future Vol, veh/h	5	460	11	24	525	5	11	1	24	5	1	5
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	5	10	100	100	10	5	100	5	100	5	5	5
Mvmt Flow	6	523	13	27	597	6	13	1	27	6	1	6
Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	602	0	0	535	0	0	1197	1197	529	1209	1201	599
Stage 1	-	-	-	-	-	-	540	540	-	654	654	-
Stage 2	-	-	-	-	-	-	657	657	-	555	547	-
Critical Hdwy	4.15	-	-	5.1	-	-	8.1	6.55	7.2	7.15	6.55	6.25
Critical Hdwy Stg 1	-	-	-	-	-	-	7.1	5.55	-	6.15	5.55	-
Critical Hdwy Stg 2	-	-	-	-	-	-	7.1	5.55	-	6.15	5.55	-
Follow-up Hdwy	2.245	-	-	3.1	-	-	4.4	4.045	4.2	3.545	4.045	3.345
Pot Cap-1 Maneuver	961	-	-	679	-	-	105	183	399	157	182	496
Stage 1	-	-	-	-	-	-	385	516	-	451	459	-
Stage 2	-	-	-	-	-	-	326	457	-	511	513	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	961	-	-	679	-	-	98	170	399	138	170	496
Mov Cap-2 Maneuver	-	-	-	-	-	-	98	170	-	138	170	-
Stage 1	-	-	-	-	-	-	382	511	-	447	431	-
Stage 2	-	-	-	-	-	-	302	430	-	471	508	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.1			0.5			27.3			23.1		
HCM LOS							D			C		
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1				
Capacity (veh/h)	202	961	-	-	679	-	-	211				
HCM Lane V/C Ratio	0.203	0.006	-	-	0.04	-	-	0.059				
HCM Control Delay (s)	27.3	8.8	0	-	10.5	0	-	23.1				
HCM Lane LOS	D	A	A	-	B	A	-	C				
HCM 95th %tile Q(veh)	0.7	0	-	-	0.1	-	-	0.2				

Intersection												
Int Delay, s/veh	1.4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	5	320	11	24	310	5	11	1	24	5	1	5
Future Vol, veh/h	5	320	11	24	310	5	11	1	24	5	1	5
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	5	10	100	100	10	5	100	5	100	5	5	5
Mvmt Flow	6	364	13	27	352	6	13	1	27	6	1	6
Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	358	0	0	376	0	0	794	794	370	805	798	355
Stage 1	-	-	-	-	-	-	381	381	-	410	410	-
Stage 2	-	-	-	-	-	-	413	413	-	395	388	-
Critical Hdwy	4.15	-	-	5.1	-	-	8.1	6.55	7.2	7.15	6.55	6.25
Critical Hdwy Stg 1	-	-	-	-	-	-	7.1	5.55	-	6.15	5.55	-
Critical Hdwy Stg 2	-	-	-	-	-	-	7.1	5.55	-	6.15	5.55	-
Follow-up Hdwy	2.245	-	-	3.1	-	-	4.4	4.045	4.2	3.545	4.045	3.345
Pot Cap-1 Maneuver	1184	-	-	798	-	-	214	317	504	297	316	682
Stage 1	-	-	-	-	-	-	483	608	-	613	590	-
Stage 2	-	-	-	-	-	-	461	588	-	624	604	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1184	-	-	798	-	-	204	302	504	270	301	682
Mov Cap-2 Maneuver	-	-	-	-	-	-	204	302	-	270	301	-
Stage 1	-	-	-	-	-	-	480	604	-	609	565	-
Stage 2	-	-	-	-	-	-	437	563	-	586	600	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	0.1			0.7			16.9			14.9		
HCM LOS							C			B		
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1				
Capacity (veh/h)	343	1184	-	-	798	-	-	377				
HCM Lane V/C Ratio	0.119	0.005	-	-	0.034	-	-	0.033				
HCM Control Delay (s)	16.9	8.1	0	-	9.7	0	-	14.9				
HCM Lane LOS	C	A	A	-	A	A	-	B				
HCM 95th %tile Q(veh)	0.4	0	-	-	0.1	-	-	0.1				

Intersection												
Int Delay, s/veh	1.4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	5	485	11	24	550	5	11	1	24	5	1	5
Future Vol, veh/h	5	485	11	24	550	5	11	1	24	5	1	5
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	88	88	88	88	88	88	88	88	88	88	88	88
Heavy Vehicles, %	5	10	100	100	10	5	100	5	100	5	5	5
Mvmt Flow	6	551	13	27	625	6	13	1	27	6	1	6

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	631	0	0	564	0	0	1255	1254	557	1265	1257	628
Stage 1	-	-	-	-	-	-	569	569	-	682	682	-
Stage 2	-	-	-	-	-	-	686	685	-	583	575	-
Critical Hdwy	4.15	-	-	5.1	-	-	8.1	6.55	7.2	7.15	6.55	6.25
Critical Hdwy Stg 1	-	-	-	-	-	-	7.1	5.55	-	6.15	5.55	-
Critical Hdwy Stg 2	-	-	-	-	-	-	7.1	5.55	-	6.15	5.55	-
Follow-up Hdwy	2.245	-	-	3.1	-	-	4.4	4.045	4.2	3.545	4.045	3.345
Pot Cap-1 Maneuver	937	-	-	659	-	-	95	169	383	144	169	477
Stage 1	-	-	-	-	-	-	370	501	-	435	445	-
Stage 2	-	-	-	-	-	-	312	444	-	493	498	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	937	-	-	659	-	-	88	157	383	126	157	477
Mov Cap-2 Maneuver	-	-	-	-	-	-	88	157	-	126	157	-
Stage 1	-	-	-	-	-	-	367	496	-	431	417	-
Stage 2	-	-	-	-	-	-	288	416	-	453	494	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0.1	0.4	29.7	24.7
HCM LOS			D	C

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	186	937	-	-	659	-	-	195
HCM Lane V/C Ratio	0.22	0.006	-	-	0.041	-	-	0.064
HCM Control Delay (s)	29.7	8.9	0	-	10.7	0	-	24.7
HCM Lane LOS	D	A	A	-	B	A	-	C
HCM 95th %tile Q(veh)	0.8	0	-	-	0.1	-	-	0.2