TRAFFIC IMPACT ASSESSMENT

&

CAR PARKING CERTIFICATION

61-65 LUCAS AVE, 36 MCKAY AVE & 31 HARVEY AVE, MOOREBANK

Prepared for:	A&K Engineering Group
Date Prepared:	July 2018
Revision:	C

Liverpool City Council

INDEX

1. Introduction

Safeway has been commissioned by A & K Engineering Group to undertake a Traffic Impact Assessment of the proposed development comprising of a 5 storey residential flat building with 2 levels of basement at 61-65 Lucas Avenue, 36 McKay Avenue and 31 Harvey Avenue, Moorebank. The development is located within the Liverpool Council LGA and has been assessed under the SEPP (Affordable Rental Housing) 2009 and Liverpool Development Control Plan 2008 (DCP).

The proposed development will provide 76 dwellings:

- 15 x studio apartments
- 8 x 1 bedroom apartments
- 50 x 2 bedroom apartment
- 3 x 3 bedroom apartments

This report entails our investigations and assesses the impacts of this proposed development on the surrounding environment and assesses compliance with the SEPP (Affordable Rental Housing) 2009, DCP and the relevant Australian Standards. In the course of preparing this assessment, the subject site and its surrounds have been inspected and relevant data collected and analysed. Of the 76 dwellings 28 are affordable housing and will be assessed accordingly.

This development would not require referral to the Roads and Maritime Services (RMS) under the provisions of SEPP (infrastructure) 2007.

2. Site Location

The site is bounded by 3 site frontages and is situated on the western side of Lucas Avenue, northern side of McKay Avenue and southern side of Harvey Avenue. It is also situated directly opposite Nuwarra Public School, approximately 200 metres from Moorebank Shopping Centre, and 130m to public transport.

The site currently comprises of 5 separate lots totalling approximately 3636sqm. The configuration of the consolidated lots is rectangular in shape. There are currently 6 separate driveways providing access to the existing properties.

The site is zoned R4 high density under the Liverpool Local Environmental Plan 2010. Council is also in receipt of a development application for a residential flat building to the west along McKay Avenue, namely 32-34 McKay Avenue. There is also a residential apartment block currently being constructed

directly opposite the site, along the eastern side of Lucas Avenue. The site location is depicted in Figure 1 and an aerial photograph is depicted in Figure 2.

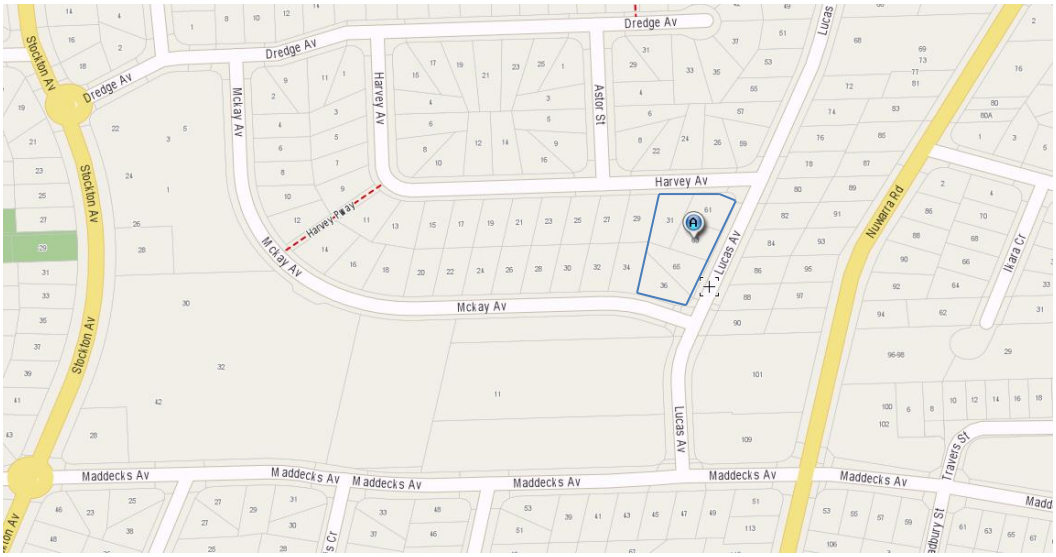


Figure 1: Street Map

Figure 2: Site Plan

3.0 Existing Traffic Conditions

3.1 Road Network

The road hierarchy of the network surrounding the site are described below and shown in Figure 3.

Lucas Avenue: A local street which runs in an north-south direction between Lusty Place and Maddecks Avenue and runs in a predominantly east-west direction between Lusty Place and Dredge Avenue. Lucas Avenue is approximately 970m long. The street has a default 50km/h speed limit and a 40km/h school zone between Harvey Avenue and Maddecks Avenue. The street has restricted parking on the western side between Maddecks Ave and McKay Avenue and the remainder of the street remains unrestricted. The restrictions are "1P 8am-3:30pm Mon-Fri". There is an existing Give Way treatment along Lucas Avenue at the intersection with Maddecks Avenue.

Harvey Avenue: A local road which runs in an east-west direction (along the site boundary) between Lucas Avenue and Dredge Avenue. It is approximately 350m long and has a default 50km/h speed limit. Unrestricted parking is permitted along both sides of the road.

McKay Avenue: A local road which runs in an east-west direction (along the site boundary) between Lucas Avenue and Dredge Avenue. It is approximately 430m long and has a default 50km/h speed limit. There is also a school zone within the street extending along the school frontage. Parking is generally restricted along the street where double barrier lines exist. However, along the school frontage parking is unrestricted on the southern side of the street and the northern side has "No Stopping 8:30am-9:30am and 2:30pm-3:30pm School Days".

Maddecks Avenue: A collector road which runs in an east-west direction between Jack O'Sullivan Road and Brickmakers Drive. It is approximately 1.7km long and has a 50km/h speed limit. The road has a school zone and limiting speed to 40km/h between 8am-9:30am and 2:30pm-4pm school days. Parking is also restricted to 1 hour during the school zone periods.

Nuwarra Road: A sub-arterial road which runs in a north-south direction between Alfred Road and Heathcote Road. It is approximately 2.5km long and has a 60km/h speed limit. Parking is generally not permitted along both sides as the road rules require a 3m distance to be available adjacent to a parked vehicle and a double line.

Stockton Avenue: A collector Road which runs in a north-south direction between Newbridge Road and Junction Road. Stockton Avenue is approximately 1km long. The street has a 50km/h speed limit. Unrestricted parking is generally permitted on both sides of the road.

Newbridge Road: An arterial road with 3 lanes in each direction and signposted 70km/h in the vicinity of the site. Parking is generally restricted.

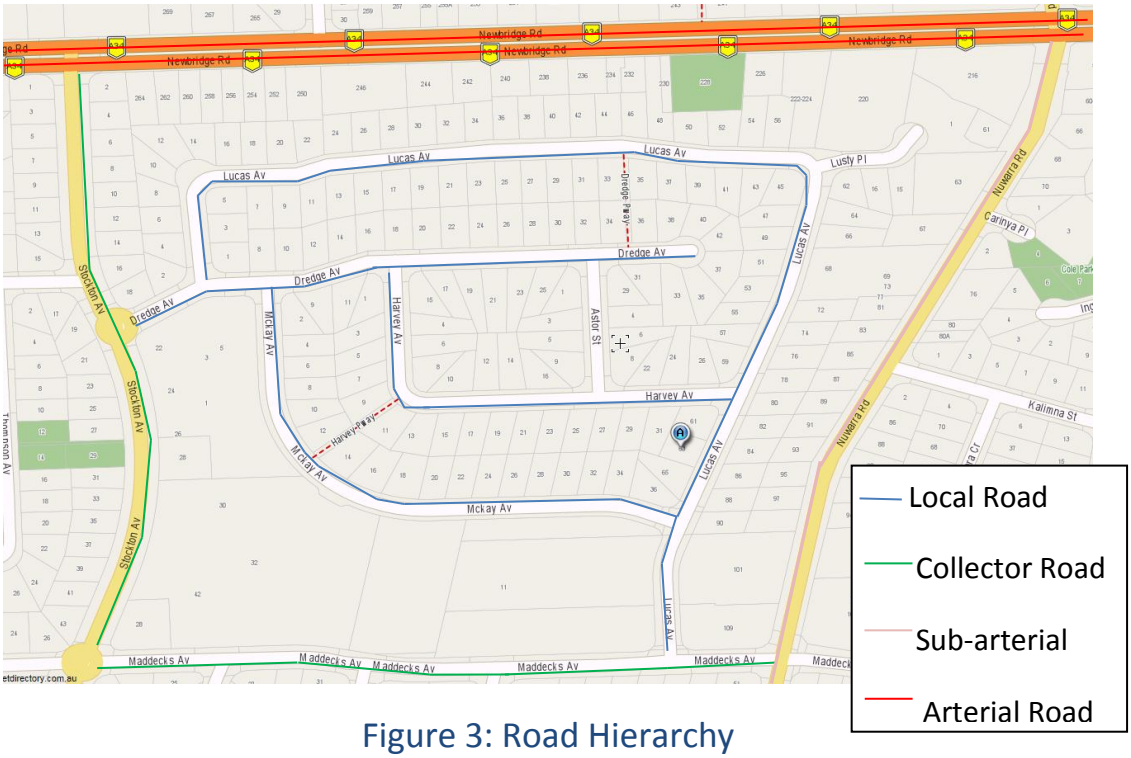


Figure 3: Road Hierarchy

3.2 Public Transport

The existing bus services that operate in the locality are depicted in Figure 4. The site is located approximately 150m from bus stops on Maddecks Avenue.

The following bus services operate on the roads in relatively close proximity to the subject site:

- 902 – Liverpool to Holsworthy via Moorebank and Hammondville. This service typically operates with 30 minute frequencies.
- 902X – Sandy Point to Holsworthy. This service provides four AM and four PM services.
- 903 – Liverpool Station. This service typically operates at 30 minute intervals during the AM and PM peaks and at 1 hour intervals outside of the peak periods.
- M90 – Liverpool to Burwood via Moorebank, Milperra, Bankstown, Greenacre, Chullora and Strathfield. This service typically operates at 15 minute intervals.

As such, the subject site is considered to be relatively well served by public transport.

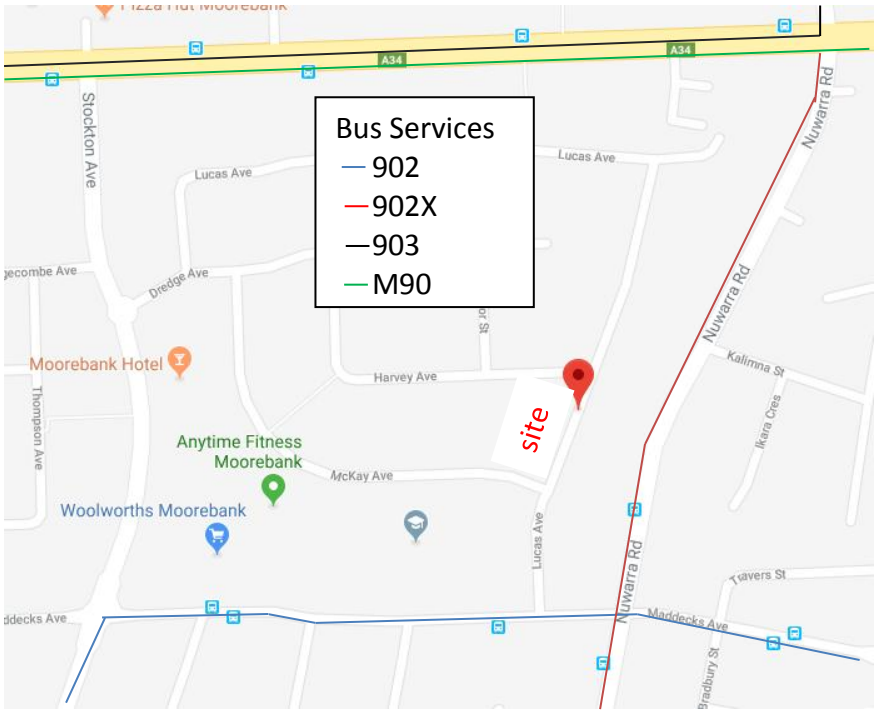


Figure 4: Public Transport Map

3.3 Active Transport

The southern side of McKay Avenue, east of the intersection with Lucas Avenue has a footpath which provides a connection to the footpath along Maddecks Avenue to the south of the site and Stockton Avenue to the north-west. Surrounding streets generally have footpaths on at least one side of the road catering for encouraging people to walk to the shops, schools and public transport. People may also cycle to and from their destinations as cycling is increasing in popularity particularly as council implements its cycling strategy.

A pedestrian crossing is provided on McKay Avenue at the frontage to the public school.

3.4 Existing Site Traffic Generation

The existing site is comprised of 5 lots each containing a single residential dwelling which will generate approximately 5 vehicle trip per hour during the peak period and 53.5 daily vehicle trips – as per the RMS Guideline to Traffic Generating Developments – TDT2013/04a.

4 Description of Proposed Development

The proposed development entails construction of a 5 storey residential flat building. The proposed development will include:

- 76 x residential units
- 2 level basement
- 103 x car parking spaces (including 6 disabled parking spaces and 11 visitor spaces);
- 25 x bicycle parking spaces
- 4 x motorcycle parking spaces

5 Traffic Generation and Impact of the Proposed Development

Although the additional traffic movements as result of rezoning would have been accounted for within the precinct study undertaken prior to rezoning the precinct, this report assesses the existing traffic generation and analyses whether the proposed development would have any impact on the performance of the primary surrounding intersections.

As part of the traffic assessment, two intersections are assessed:

- Priority intersection of Lucas Avenue and Maddecks Avenue
- Priority intersection of McKay Avenue and Lucas Avenue

Both intersections are 3-leg intersections. Figure 5 and figure 6 show the layout of the intersections using SIDRA 7.

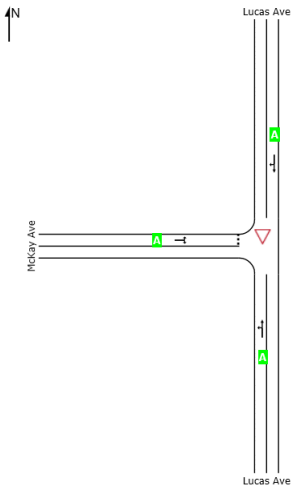


Figure 5: Priority intersection of Lucas Avenue with McKay Avenue

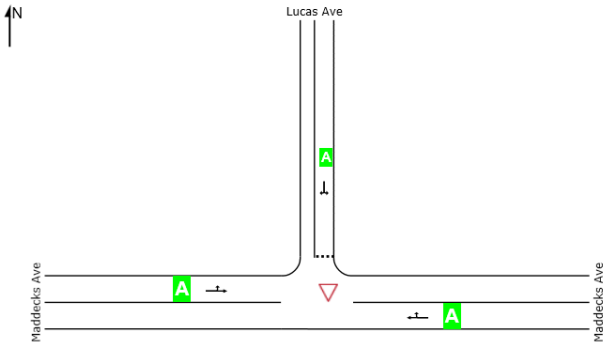


Figure 6: Priority intersection of Lucas Avenue with Maddecks Avenue

Table 1 explains the SIDRA outputs and how intersection performance is analysed and measured. SIDRA undertakes calculations to measure how an intersection will operate given the specified inputs, road layout, traffic treatment and traffic flows.

Level of Service	Average Delay per Vehicle (sec/veh)	Traffic Signals, Roundabout	Giveway & Stop Signs
A	< 14	Good Operation	Good Operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near Capacity & accident study required
E	57 to 70	At Capacity, at signals incidents will cause excessive delays Roundabouts require other control mode	At capacity, requires other control mode
F	> 70	Unsatisfactory and requires additional capacity.	Unsatisfactory and requires additional capacity.

Table 1

5.1 Existing Traffic Volumes

Traffic counts were undertaken at the above-listed intersections for the weekday AM and PM peak periods. The AM and PM peak periods were determined to be 7:45am to 8:45am and 5:30pm-6:30pm respectively.

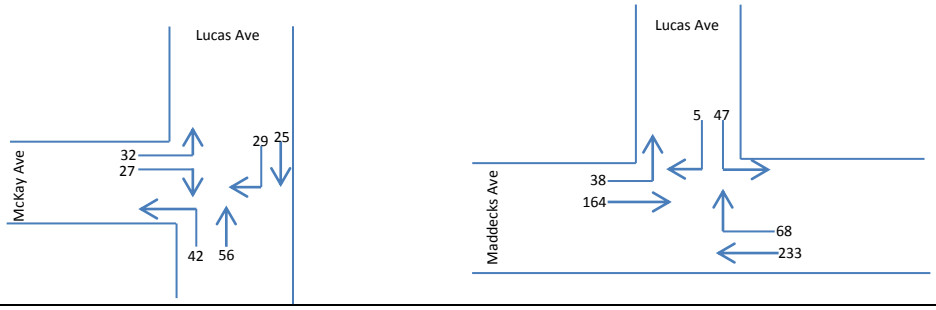
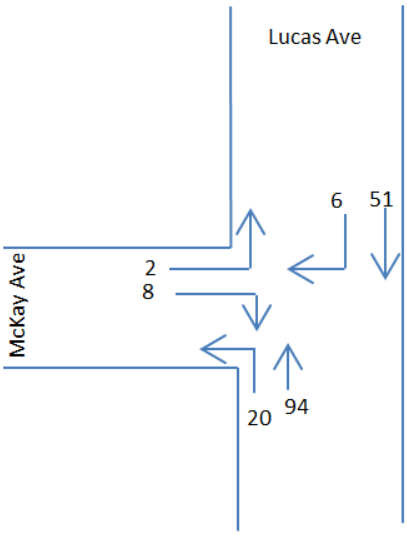


Figure 7: Existing Weekday AM Peak Volumes



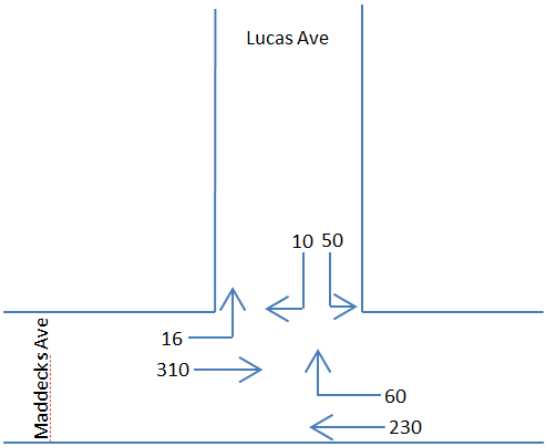


Figure 8: Existing Weekday PM Peak Volumes

The existing intersections were assessed using SIDRA Intersection Analysis Software (version 7) in order to determine the Level of Service and Degree of Saturation. The intersections were found to be operating at a level of service A and degree of saturation to be <0.6 showing that the intersections are operating an excellent level. The SIDRA output data has been reproduced in Appendix C.

5.2 Traffic Volumes Post Development

As discussed earlier in this report the proposed development contains 76 residential units. The RMS Guide to Traffic Generating Development stipulates that high density residential flat buildings within a metropolitan sub-regional area generate 0.29 vehicle trips, per unit, in the peak hour.

Application of the trip generation rate enables us to determine that the proposed development would generate 22.04 (assume 23) vehicle movements during the peak hour. Deducting the existing traffic generation discussed in section 3.4 of this report, the proposed site would generate an additional 18 vehicle movements during the peak hour. This would result in one additional vehicle movement every 200 seconds (3-4 minutes). The number of additional vehicle movements is negligible and is not expected to have a notable impact to the surrounding road network. To have a more realistic intersection analysis the generation rate of the neighbouring residential flat building site at 32-34 McKay Avenue, Moorebank has also been included in the assessment. Although the site is yet to be determined, it's potential generation has been incorporated in the input data in order to attain a realistic intersection performance analysis.

Tables 2, 3 and 4 depict the origin and destination trips during the peak hour which have been adopted when assessing the impact that the subject development coupled with the neighbouring development at 32-34 McKay Avenue would have at the surrounding intersections.

	Origin	Destination	Total
AM Peak Hour	18	5	23
PM Peak Hour	5	18	23

Table 2: Trip distribution for subject site

	Origin	Destination	Total
AM Peak Hour	12	3	15
PM Peak Hour	3	12	15

Table 3: Trip distribution for 32-34 McKay Ave

	Origin	Destination	Total
AM Peak Hour	30	8	38
PM Peak Hour	8	30	38

Table 4: Combined trip generation

SIDRA analysis output, as reproduced in appendix C shows that the level of service (LOS) of each intersection will remain excellent and operate at level of service A.

Intersection	Period	Level of Service	Degree of Saturation
McKay Ave/Lucas Ave	Existing AM Peak	A	<0.6
	Existing PM Peak	A	<0.6
	Post development AM Peak	A	<0.6
	Post development PM Peak	A	<0.6
Lucas Ave / Maddecks Ave	Existing AM Peak	A	<0.6
	Existing PM Peak	A	<0.6
	Post development AM Peak	A	<0.6
	Post development PM Peak	A	<0.6

Table 5: SIDRA Results

6 Parking Requirements and Car Park Compliance

6.1 Liverpool Development Control Plan 2008

The relevant development guideline, being Liverpool Council DCP 2008, table 12 provides specific parking requirements for residential flat buildings. Figure 5 provides a copy of the parking rates from the DCP.

Multi dwelling housing and residential flat buildings		
Residential & Business zones	1 space per small dwelling (< 65sqm) or 1 bedroom 1.5 spaces per medium dwelling (65 - 110sqm) or 2 bedrooms 2 spaces per large dwelling (> 110sqm) or 3 or more bedrooms 1 visitor car space for every 4 dwellings or part thereof	Service access for removalists and garbage servicing

Figure 5: DCP parking requirement

Sepp Infill affordable housing	0.5 spaces per dwelling containing 1 bedroom 1 space per dwelling containing 2 bedrooms 1.5 spaces per dwelling contain	

Figure 6: SEPP (Affordable Rental Housing) 2009

The proposed apartment mix is as follows:

- 15 x studio
- 8 x 1 bedroom units
- 50 x 2 bedroom units
- 3 x 3 bedroom units

Calculations stipulate the following minimum parking requirements:

Specification	SEPP Parking Rate	Number of units	Parking Requirement	Parking Provided
studio	Not specified	4	Assumed in 1 bed calc.	Assumed in 1 bed
1 Bedroom	0.5 spaces	7 + 4 = 11	5.5	5
2 Bedroom	1 space	17	17	17
3 Bedroom	1.5 spaces	0	0	0
Total			**22.5**	**22**

Table 6: SEPP Parking Calculations

Specification	DCP Parking Rate	Number of units	Parking Requirement	Parking Provided
studio	1 space	12	12	12
1 Bedroom	1 space	1	1	1
2 Bedroom	1.5 spaces	33	49.5	50

3 Bedroom	2 spaces	3	6	6
Visitors	1 space per 4 units	48	12	12
Total			**80.5**	**81**

Table 7: Liverpool DCP Parking Calculations

The proposed development provides 103 car parking spaces for residents and visitors including 6 disabled spaces. Loading within the site may be undertaken by small rigid vehicles, swept paths are attached in appendix D. Loading will be undertaken through agreement with the building manager. Once booked the building manager would reserve 3 visitor parking bays. The time slots would be off-peak and during work hours when visitors are less likely to be attending the site.

Based on the above, the proposed development satisfies the requirements of the DCP and SEPP (affordable housing) with regards to car parking provision. It should be noted that no parking requirement is specified in the SEPP for studio apartments, however we assumed the studios as one-bedroom apartments.

6.2 Parking Bay Dimensions

According to Australian Standard AS2890.1-2004 the proposed development's residential parking bays would be categorised as a User Class 1A, namely:

Residential, domestic and employee parking.

The requirements for User Class 1A car parks as specified in the Australian Standards are as follows:

- Bay width 2.4m or 2.3m for small cars;
- Bay length 5.4m or 5.0m for small cars; and
- Aisle width 5.8m.

The proposed development provides parking bays with minimum dimensions of 2.4m by 5.4m and circulation aisles with a minimum width of 5.8m. These dimensions are compliant with Australian Standards (AS/NZS 2890.1-2004) and it is expected that they will operate in a safe and efficient manner.

6.3 Blind Aisles

According to AS2890.1-2004 (Clause 2.4.2(c)), blind aisles must be extended by a minimum of 1m beyond the last parking space. Where a parking space is bound by a wall, it is required to be widened by at least 0.3m.

The proposed development basement parking level complies with these specifications as a minimum of 1m beyond the last parking space and additional 0.3m clearance adjacent to parking spaces bound by walls are provided.

6.4 Access to the Car Park

Access to the car park is provided from McKay Avenue. The driveway location also complies with Figure 3.1 of AS2890.1-2004 and is not situated in an area identified as prohibited. The car park access has 7m width and is suitable for small rigid vehicles to access the site for suitable loading and removalist vehicles – discussed further in section 6.5 of this report.

The proposed driveway access is situated opposite Nuwarra Public School. McKay Avenue serves as a rear access road for the school and therefore some traffic is expected at school drop-off and pick-up times. Although it would be ideal to have access to the site located on Harvey Avenue it was not possible due to stormwater issues. Addressing the stormwater issues resulted in impacts on compliance of the ramp.

A detailed SIDRA analysis was undertaken as part of the study and results discussed in section 5 of this report and output reproduced and presented in Appendix D. This study assessed whether there would be an impact on the performance of the intersection of McKay Avenue and Lucas Avenue and found that that the level of service A would be maintained post-occupation.

It should be noted that the peak volumes of vehicles exiting the residential flat building are between 6am-8am whilst the peak drop off period occurs at 8:15am. Similarly, the PM peak for residential building occurs between 5pm-7pm whilst the school pick-up period occurs between 3pm-3:15pm. This proposed development will not impact on the road network and will not impact on safety. Rather it would be better than the existing conditions as the existing driveways on McKay Avenue require motorists to reverse onto the street rather than forward –out as per the proposed.

In this regard the proposed location of the driveway is considered reasonable and achieves compliance with the requirements of AS2890.1-2004.

Australian Standards indicate that two-way roadways or ramps should provide a minimum width of 5.5m between kerbs. The proposed development's access ramps provide a minimum width of 5.5m between 0.3m kerbs and therefore comply with Australian Standard requirements.

6.5 Loading Area

As discussed in section 6.1, the loading area will be facilitated by scheduling a time slot with the building manager. The building manager will then ensure 3 visitor spaces within basement 1 are vacated prior to deliveries attending the site. Swept paths have been undertaken depicting the location of this loading area. This is considered a reasonable measure as there are 20 available visitor parking spaces and demand for these spaces will be low during the periods 10am-3pm Monday to Saturday. The architect has advised that a height clearance of 2.7m is provided along the ramps and within the basements. The height clearance can accommodate common loading and removalist vehicles. dimensions of truck heights for such commonly used vehicles can be obtained from the Hertz hire website.

https://www.hertztrucks.com.au/trucks

6.6 Ramp Gradients

AS 2890.1-2004 states the grade requirements for straight ramps at private or residential car parks as follows:

> *(i) The maximum gradient for a domestic driveway shall be 1 in 4 (25%).*
>
> *(ii) Up to 20 m long straight ramps—1 in 4 (25%) maximum. The allowable 20 m maximum length shall include any parts of grade change transitions at each end that exceed 1 in 5 (20%).*
>
> *(iii) To prevent bottoming or scraping changes in grade in excess of 12.5% require transition ramps.*
>
> *(iv) A maximum grade of 1 in 20 (5%) should be provided for the first 6m from the property boundary.*

The entry ramp provides a gradient of 1 in 15.4 with a 2-metre transition gradient of 1 in 10. the ramp between Basement 1 and Basement 2 is to provide a maximum gradient of 1 in 4 (25%) with 2m transition ramps of 1 in 8 (12.5%) and thus comply with Australian Standards.

6.7 Disabled Parking

The proposed development's design includes 6 parking spaces for the mobility impaired – four of these spaces are situated within basement 1 and two are situated on basement 2. Australian Standard AS2890.6:2009, stipulates the following requirements for these spaces:

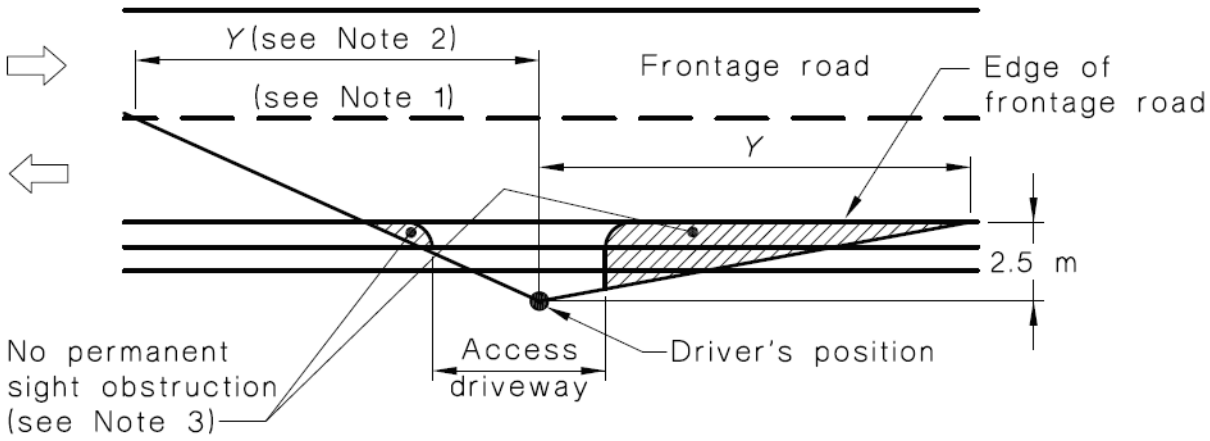
- A parking space of minimum dimensions 2.4m x 5.4m; plus
- An adjacent shared space of equal dimensions; and
- Indication of appropriate markings and bollard instalment along the shared space.

For parallel spaces, AS2890.6-2009 requires a dedicated space to be 3200mm wide by 7800mm long and a shared area adjacent to the non-trafficked side of the dedicated space being 1600mm wide by 7800mm long.

Bollards will be provided where required as per AS2890.6-2009 specifications. In regard to the parallel spaces, the shared area is provided within the aisle. We have been advised that a letter from a qualified accessibility specialist will also be submitted addressing compliance of the accessible parking spaces.

6.8 Sight Distance for Vehicles

McKay Avenue is a local road that with a default urban speed limit of 50km/h and 40km/h during school zone periods. For the purpose of this assessment we have adopted the 50km/h speed limit to determine the sightlines. Referring to Figure 3.3 of AS 2890.1:2004, it is recommended to leave the shaded area in the figure below (excerpt from AS 2890.1:2004) free of permanent obstacles for a length 'Y' of 69 [m].



Frontage road speed (Note 4) km/h	Distance (Y) along frontage road m		
	Access driveways other than domestic (Note 5)		Domestic property access (Note 6)
	Desirable 5 s gap	Minimum SSD	
40	55	35	30
50	69	45	40
60	83	65	55
70	97	85	70
80	111	105	95
90	125	130	Use values from 2nd and 3rd columns
100	139	160	
110	153	190	

Figure 6: AS2890.1:2004 Sight Line Specification

In the vicinity of the subject site McKay Avenue is relatively straight and flat, sight lines are deemed satisfactory as there are no permanent obstructions there are also parking restrictions adjacent to the driveway during the peak periods and will ensure vehicles sightlines are further enhanced and unobstructed.

6.9 On-Street Parking

Unrestricted on-street parking is available along the Lucas Avenue and Harvey Avenue frontages. Also, as discussed earlier in this report on-street parking is also generally permitted along the McKay Avenue frontage as the southern side has unrestricted parking available within indented bays. However, the northern side of the road has "No Stopping 8:30am-9:30am and 2:30pm-3:30pm School Days" restrictions.

6.10 Swept Paths

Swept path assessments have been undertaken for the critical car spaces and access analysing relevant Australian Standard Vehicles. Swept paths have also been undertaken assessing the ability of vehicles passing on the ramps and also vehicles entering and exiting key car parking spaces within each basement level. These swept paths are presented in Appendix D of this document. Based on these swept paths, it can be seen that the anticipated manoeuvres by these vehicles can be sufficiently accommodated within the proposed design.

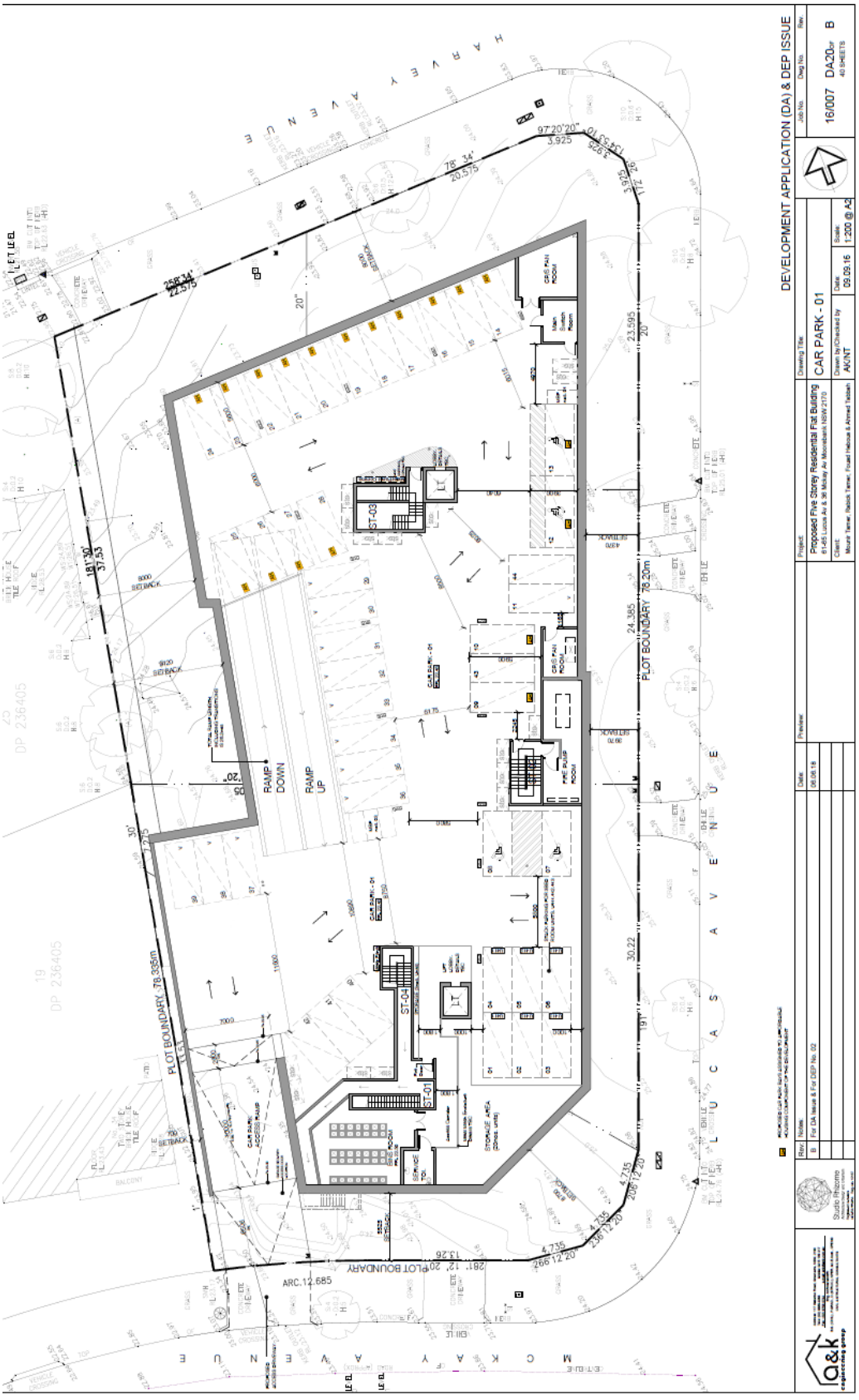
7 Conclusions

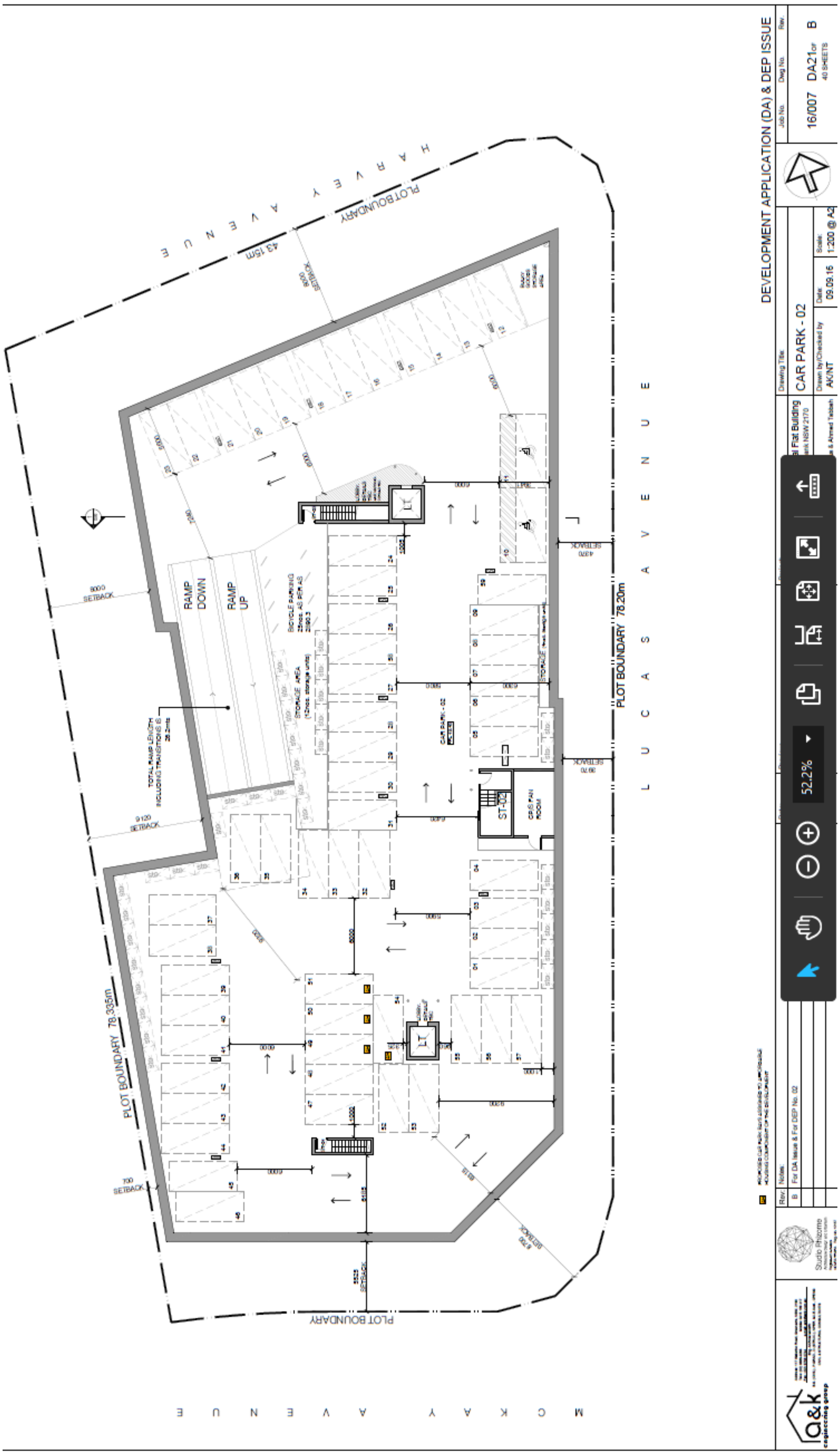
- The car parking provision satisfies the requirements of SEPP (Affordable Rental Housing) 2009 and Liverpool DCP 2008 through the provision of 103 car parking spaces;
- The traffic generation from the proposed residential flat building will result in a net increase of 23 vehicle movements during the peak hour. These movements will be split in both directions and can be readily accommodated with minimal impact on the surrounding road network. Although the projected traffic movements from proposed developments would have been accounted for within the precinct study prior to rezoning, we modelled surrounding intersections using SIDRA 7 and it was confirmed that the proposed development will have negligible impact on their performance;
- The site is located in proximity to a number of bus services and within walking distance to Moorebank Shopping Centre, Nuwarra Public School, Library and Childcare centres;
- The car park assessment indicates that the proposed development's car park complies with the requirements specified within AS2890.1-2004;
- The proposed development embraces the policies within Liverpool Council's DCP and will create minimal traffic impact which would be readily accommodated.

Overall, the proposed development is supportable on traffic planning grounds and will operate satisfactorily.

Appendix

Appendix A: Reduced Plans




DEVELOPMENT APPLICATION (DA) & DEP ISSUE
CAR PARK - 02
16/007
DA21
B
09.09.16
1:200 @ A2
HARVEY AVENUE
LUCAS AVENUE
MCKAY AVENUE
PLOT BOUNDARY
PLOT BOUNDARY 78.20m
PLOT BOUNDARY 78.335m
43.15m
RAMP DOWN
RAMP UP
STORAGE AREA
CAR PARK - 02
For DA Issue & For DEP No. 02

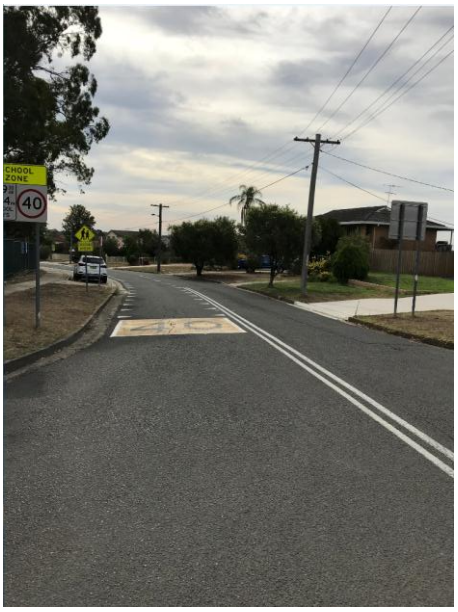
Appendix B: Photographs

Existing property at #36 McKay Avenue

Existing property at #61 Lucas Avenue

Existing property at #63 Lucas Avenue

Existing construction site at 80-82 Lucas Avenue



McKay Avenue (west view)

Lucas Avenue (North view)

Harvey Avenue (west view)

Existing parking restrictions within McKay Avenue

Appendix C: SIDRA

McKay Ave / Lucas Ave (Existing AM)

LANE SUMMARY

▽ **Site: 101 [Site1]**

Existing AM peak
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Lucas Ave													
Lane 1	103	0.0	1909	0.054	100	2.0	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	103	0.0		0.054		2.0	NA	0.0	0.0				
North: Lucas Ave													
Lane 1	57	0.0	1899	0.030	100	2.5	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	57	0.0		0.030		2.5	NA	0.0	0.0				
West: McKay Ave													
Lane 1	62	0.0	1338	0.046	100	4.9	LOS A	0.2	1.2	Full	500	0.0	0.0
Approach	62	0.0		0.046		4.9	LOS A	0.2	1.2				
Intersection	222	0.0		0.054		2.9	NA	0.2	1.2				

LANE LEVEL OF SERVICE

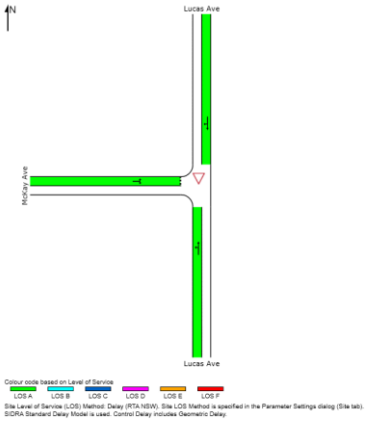
Lane Level of Service

▽ **Site: 101 [Site1]**

Existing AM peak
Giveway / Yield (Two-Way)

All Movement Classes

	South	North	West	Intersection
LOS	NA	NA	A	NA



DEGREE OF SATURATION

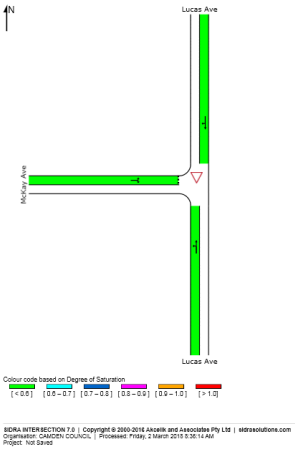
Ratio of Demand Volume to Capacity (v/c ratio)

▽ **Site: 101 [Site1]**

Existing AM peak
Giveway / Yield (Two-Way)

All Movement Classes

	South	North	West	Intersection
Degree of Saturation	0.05	0.03	0.05	0.05



McKay Ave / Lucas Ave (Existing PM)

LANE SUMMARY

▽ **Site: 101 [PM Existing McKay Ave]**

Existing PM peak
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Lucas Ave													
Lane 1	120	0.0	1933	0.062	100	0.8	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	120	0.0		0.062		0.8	NA	0.0	0.0				
North: Lucas Ave													
Lane 1	60	0.0	1940	0.031	100	0.5	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	60	0.0		0.031		0.5	NA	0.0	0.0				
West: McKay Ave													
Lane 1	11	0.0	1175	0.009	100	5.0	LOS A	0.0	0.2	Full	500	0.0	0.0
Approach	11	0.0		0.009		5.0	LOS A	0.0	0.2				
Intersection	191	0.0		0.062		0.9	NA	0.0	0.2				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

LANE LEVEL OF SERVICE

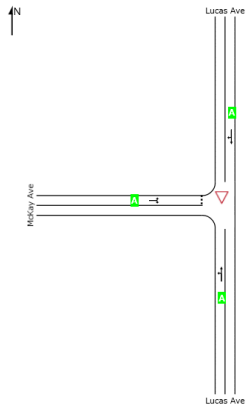
Lane Level of Service

Site: 101 [PM Existing McKay Ave]

Existing PM peak
Giveway / Yield (Two-Way)

All Movement Classes

	South	North	West	Intersection
LOS	NA	NA	A	NA



Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.

DEGREE OF SATURATION

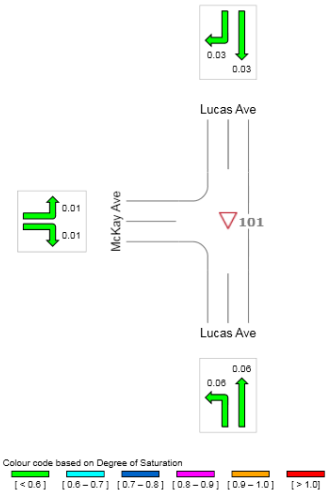
Ratio of Demand Volume to Capacity (v/c ratio)

Site: 101 [PM Existing McKay Ave]

Existing PM peak
Giveway / Yield (Two-Way)

All Movement Classes

	South	North	West	Intersection
Degree of Saturation	0.06	0.03	0.01	0.06



Lucas Ave / Maddecks Ave (Existing AM)

LANE SUMMARY

Site: 101 [AM Peak]

Existing AM Peak
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Maddecks Ave													
Lane 1	317	0.0	2099	0.151	100	1.0	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	317	0.0		0.151		1.0	NA	0.0	0.0				
North: Lucas Ave													
Lane 1	55	0.0	1313	0.042	100	5.2	LOS A	0.2	1.1	Full	500	0.0	0.0
Approach	55	0.0		0.042		5.2	LOS A	0.2	1.1				
West: Maddecks Ave													
Lane 1	213	0.0	2103	0.101	100	0.9	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	213	0.0		0.101		0.9	NA	0.0	0.0				
Intersection	584	0.0		0.151		1.4	NA	0.2	1.1				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

LANE LEVEL OF SERVICE

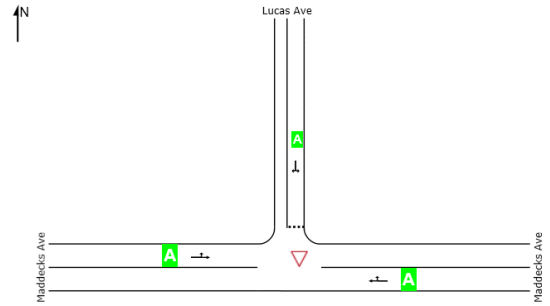
Lane Level of Service

Site: 101 [AM Peak]

Existing AM Peak
Giveway / Yield (Two-Way)

All Movement Classes

	East	North	West	Intersection
LOS	NA	A	NA	NA



DEGREE OF SATURATION

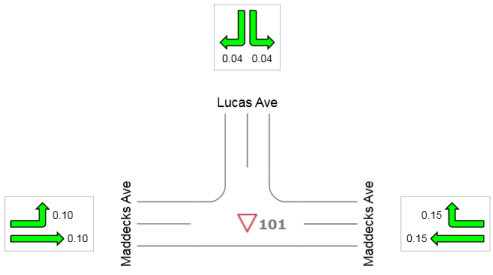
Ratio of Demand Volume to Capacity (v/c ratio)

Site: 101 [AM Peak]

Existing AM Peak
Giveway / Yield (Two-Way)

All Movement Classes

	East	North	West	Intersection
Degree of Saturation	0.15	0.04	0.10	0.15



Lucas Ave/ Maddecks Ave (Existing PM)

MOVEMENT SUMMARY

Site: 101 [PM existing Peak]

Existing AM Peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Maddecks Ave											
5	T1	242	0.0	0.145	0.0	LOS A	0.0	0.0	0.00	0.11	49.3
6	R2	63	0.0	0.145	4.6	LOS A	0.0	0.0	0.00	0.11	48.9
Approach		305	0.0	0.145	1.0	NA	0.0	0.0	0.00	0.11	49.3
North: Lucas Ave											
7	L2	53	0.0	0.059	5.7	LOS A	0.2	1.5	0.39	0.60	45.7
9	R2	11	0.0	0.059	7.6	LOS A	0.2	1.5	0.39	0.60	45.7
Approach		63	0.0	0.059	6.0	LOS A	0.2	1.5	0.39	0.60	45.7
West: Maddecks Ave											
10	L2	17	0.0	0.162	4.6	LOS A	0.0	0.0	0.00	0.03	49.3
11	T1	326	0.0	0.162	0.0	LOS A	0.0	0.0	0.00	0.03	49.8
Approach		343	0.0	0.162	0.2	NA	0.0	0.0	0.00	0.03	49.8
All Vehicles		712	0.0	0.162	1.1	NA	0.2	1.5	0.03	0.11	49.2

LANE LEVEL OF SERVICE

Lane Level of Service

Site: 101 [PM existing Peak]

Existing AM Peak
Giveway / Yield (Two-Way)

All Movement Classes

	East	North	West	Intersection
LOS	NA	A	NA	NA

DEGREE OF SATURATION

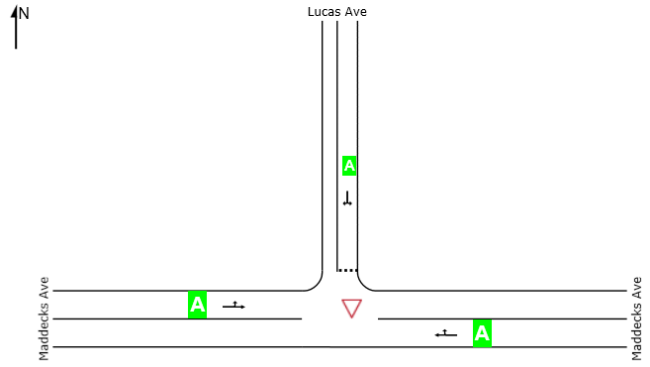
Ratio of Demand Volume to Capacity (v/c ratio)

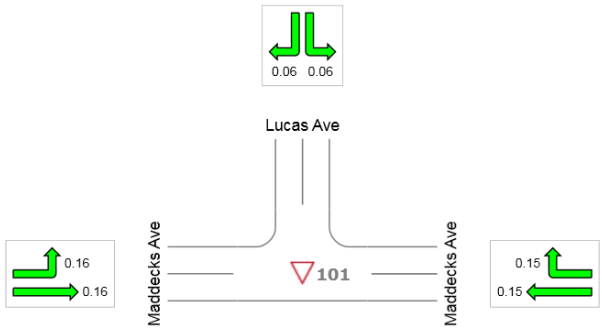
Site: 101 [PM existing Peak]

Existing AM Peak
Giveway / Yield (Two-Way)

All Movement Classes

	East	North	West	Intersection
Degree of Saturation	0.15	0.06	0.16	0.16





McKay Ave / Lucas Ave (Post-development AM)

MOVEMENT SUMMARY

Site: 101 [AM peak post development]

Existing AM peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Lucas Ave											
1	L2	45	0.0	0.055	4.6	LOS A	0.0	0.0	0.00	0.24	48.2
2	T1	59	0.0	0.055	0.0	LOS A	0.0	0.0	0.00	0.24	48.7
Approach		104	0.0	0.055	2.0	NA	0.0	0.0	0.00	0.24	48.5
North: Lucas Ave											
8	T1	32	0.0	0.030	0.0	LOS A	0.0	0.0	0.00	0.26	48.6
9	R2	26	0.0	0.030	4.6	LOS A	0.0	0.0	0.00	0.26	47.7
Approach		58	0.0	0.030	2.1	NA	0.0	0.0	0.00	0.26	48.2
West: McKay Ave											
10	L2	35	0.0	0.082	4.7	LOS A	0.3	2.0	0.17	0.53	46.2
12	R2	68	0.0	0.082	5.1	LOS A	0.3	2.0	0.17	0.53	45.8
Approach		103	0.0	0.082	4.9	LOS A	0.3	2.0	0.17	0.53	46.0
All Vehicles		265	0.0	0.082	3.2	NA	0.3	2.0	0.07	0.36	47.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

LANE LEVEL OF SERVICE

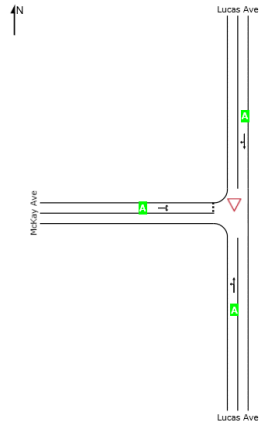
Lane Level of Service

Site: 101 [AM peak post development]

Existing AM peak
Giveway / Yield (Two-Way)

All Movement Classes

	South	North	West	Intersection
LOS	NA	NA	A	NA



DEGREE OF SATURATION

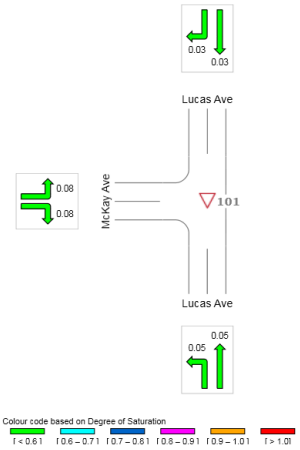
Ratio of Demand Volume to Capacity (v/c ratio)

Site: 101 [AM peak post development]

Existing AM peak
Giveway / Yield (Two-Way)

All Movement Classes

	South	North	West	Intersection
Degree of Saturation	0.05	0.03	0.08	0.08



McKay Ave / Lucas Ave (Post-Development PM)

MOVEMENT SUMMARY

Site: 101 [PM peak post development]

Existing AM peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Total veh/h	Demand Flows HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Lucas Ave											
1	L2	49	0.0	0.077	4.6	LOS A	0.0	0.0	0.00	0.18	48.5
2	T1	99	0.0	0.077	0.0	LOS A	0.0	0.0	0.00	0.18	49.0
Approach		148	0.0	0.077	1.5	NA	0.0	0.0	0.00	0.18	48.8
North: Lucas Ave											
8	T1	54	0.0	0.033	0.0	LOS A	0.0	0.0	0.00	0.09	49.5
9	R2	9	0.0	0.033	4.6	LOS A	0.0	0.0	0.00	0.09	48.6
Approach		63	0.0	0.033	0.7	NA	0.0	0.0	0.00	0.09	49.4
West: McKay Ave											
10	L2	3	0.0	0.011	4.8	LOS A	0.0	0.2	0.22	0.53	46.1
12	R2	9	0.0	0.011	5.2	LOS A	0.0	0.2	0.22	0.53	45.7
Approach		13	0.0	0.011	5.1	LOS A	0.0	0.2	0.22	0.53	45.8
All Vehicles		224	0.0	0.077	1.5	NA	0.0	0.2	0.01	0.17	48.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

LANE LEVEL OF SERVICE

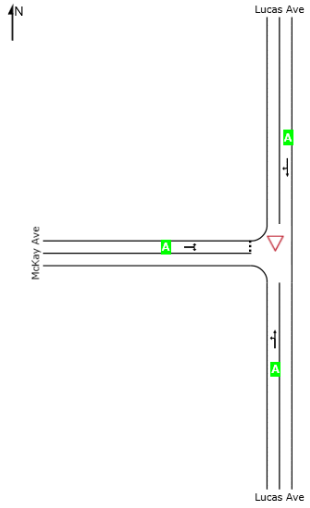
Lane Level of Service

Site: 101 [PM peak post development]

Existing AM peak
Giveway / Yield (Two-Way)

All Movement Classes

	South	North	West	Intersection
LOS	NA	NA	A	NA



DEGREE OF SATURATION

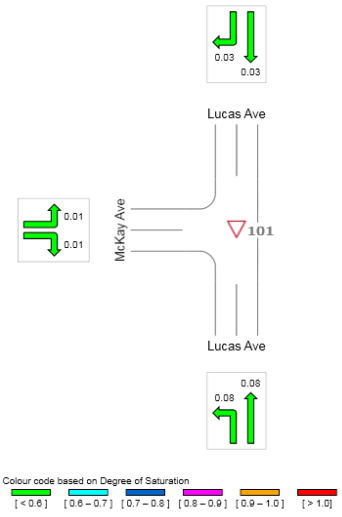
Ratio of Demand Volume to Capacity (v/c ratio)

Site: 101 [PM peak post development]

Existing AM peak
Giveway / Yield (Two-Way)

All Movement Classes

	South	North	West	Intersection
Degree of Saturation	0.08	0.03	0.01	0.08



Lucas Ave / Maddecks Ave (Post-Development AM)

MOVEMENT SUMMARY

Site: 101 [AM Peak - post development]

Existing AM Peak
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Maddecks Ave											
5	T1	245	0.0	0.151	0.0	LOS A	0.0	0.0	0.00	0.12	49.3
6	R2	73	0.0	0.151	4.6	LOS A	0.0	0.0	0.00	0.12	48.9
Approach		318	0.0	0.151	1.1	NA	0.0	0.0	0.00	0.12	49.2
North: Lucas Ave											
7	L2	85	0.0	0.072	5.1	LOS A	0.3	2.0	0.27	0.53	46.0
9	R2	9	0.0	0.072	6.9	LOS A	0.3	2.0	0.27	0.53	46.0
Approach		95	0.0	0.072	5.3	LOS A	0.3	2.0	0.27	0.53	46.0
West: Maddecks Ave											
10	L2	41	0.0	0.102	4.6	LOS A	0.0	0.0	0.00	0.10	48.9
11	T1	173	0.0	0.102	0.0	LOS A	0.0	0.0	0.00	0.10	49.4
Approach		214	0.0	0.102	0.9	NA	0.0	0.0	0.00	0.10	49.3
All Vehicles		626	0.0	0.151	1.6	NA	0.3	2.0	0.04	0.18	48.7

LANE LEVEL OF SERVICE

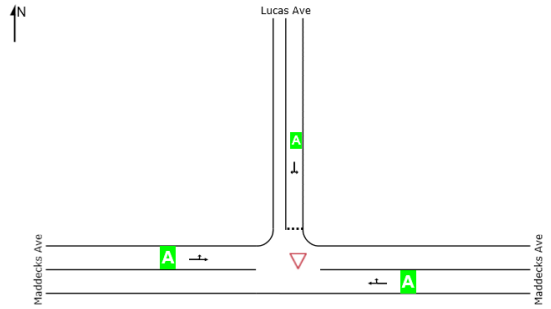
Lane Level of Service

Site: 101 [AM Peak - post development]

Existing AM Peak
Giveway / Yield (Two-Way)

All Movement Classes

	East	North	West	Intersection
LOS	NA	A	NA	NA



DEGREE OF SATURATION

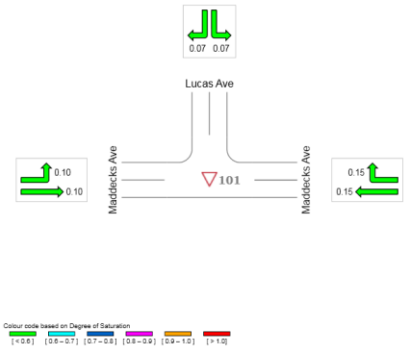
Ratio of Demand Volume to Capacity (v/c ratio)

Site: 101 [AM Peak - post development]

Existing AM Peak
Giveway / Yield (Two-Way)

All Movement Classes

	East	North	West	Intersection
Degree of Saturation	0.15	0.07	0.10	0.15



Lucas Ave / Maddecks Ave (Post-Development AM)

LANE SUMMARY

Site: 101 [PM Peak - post development]

Existing AM Peak
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Veh	Dist m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
East: Maddecks Ave													
Lane 1	341	0.0	2092	0.163	100	1.3	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	341	0.0		0.163		1.3	NA	0.0	0.0				
North: Lucas Ave													
Lane 1	66	0.0	1060	0.063	100	6.1	LOS A	0.2	1.6	Full	500	0.0	0.0
Approach	66	0.0		0.063		6.1	LOS A	0.2	1.6				
West: Maddecks Ave													
Lane 1	347	0.0	2116	0.164	100	0.3	LOS A	0.0	0.0	Full	500	0.0	0.0
Approach	347	0.0		0.164		0.3	NA	0.0	0.0				
Intersection	755	0.0		0.164		1.3	NA	0.2	1.6				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

DEGREE OF SATURATION

Ratio of Demand Volume to Capacity (v/c ratio)

Site: 101 [PM Peak - post development]

Existing AM Peak
Giveway / Yield (Two-Way)

All Movement Classes

	East	North	West	Intersection
Degree of Saturation	0.16	0.06	0.16	0.16

LANE LEVEL OF SERVICE

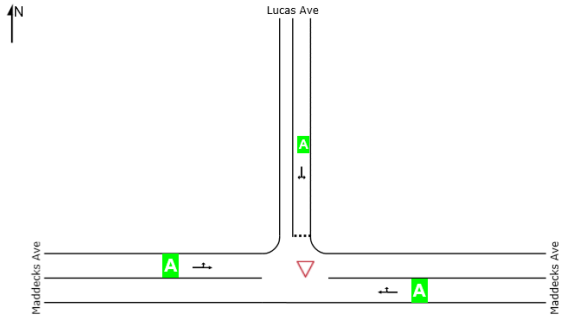
Lane Level of Service

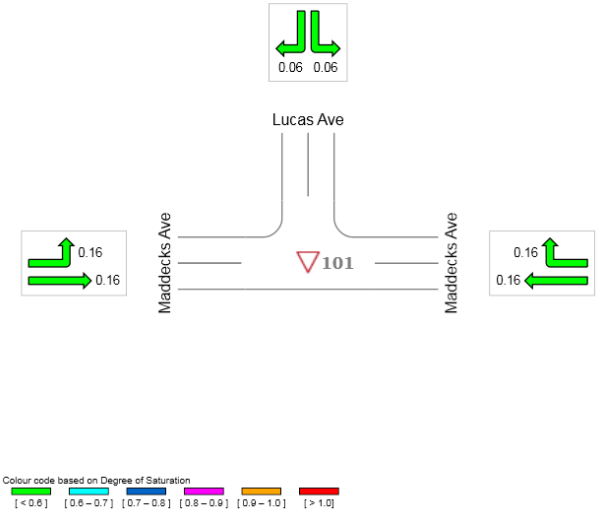
Site: 101 [PM Peak - post development]

Existing AM Peak
Giveway / Yield (Two-Way)

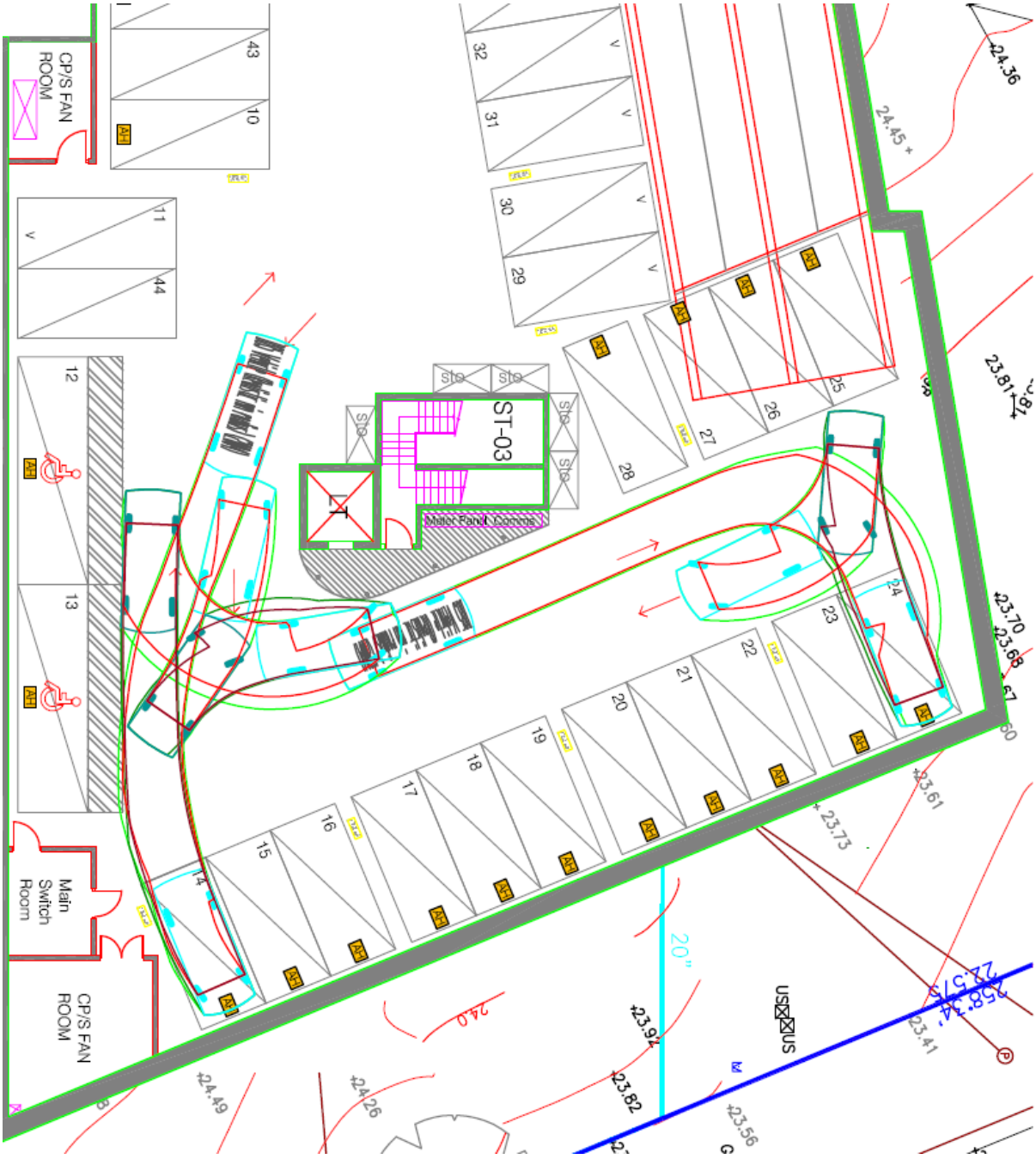
All Movement Classes

	East	North	West	Intersection
LOS	NA	A	NA	NA

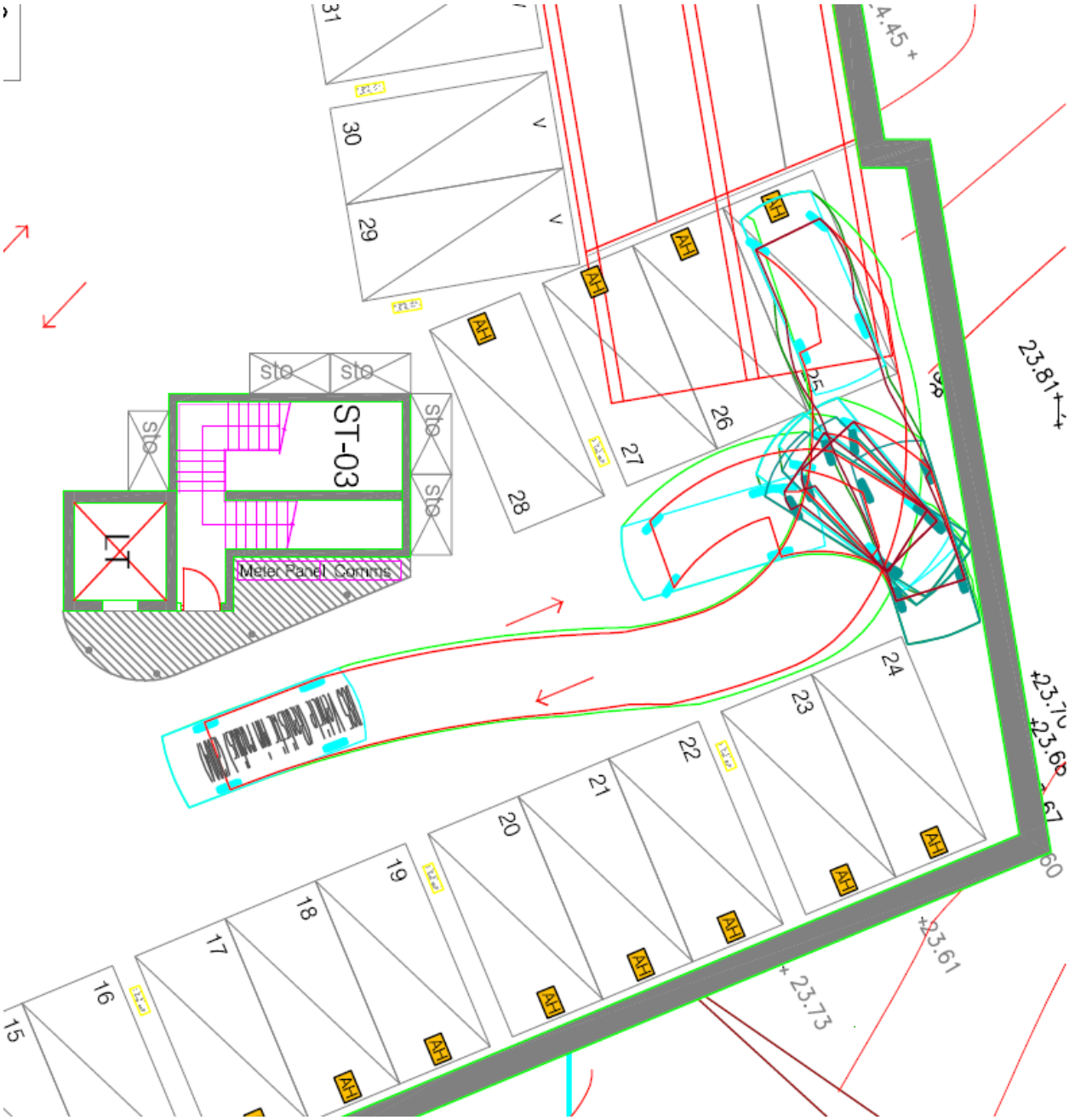




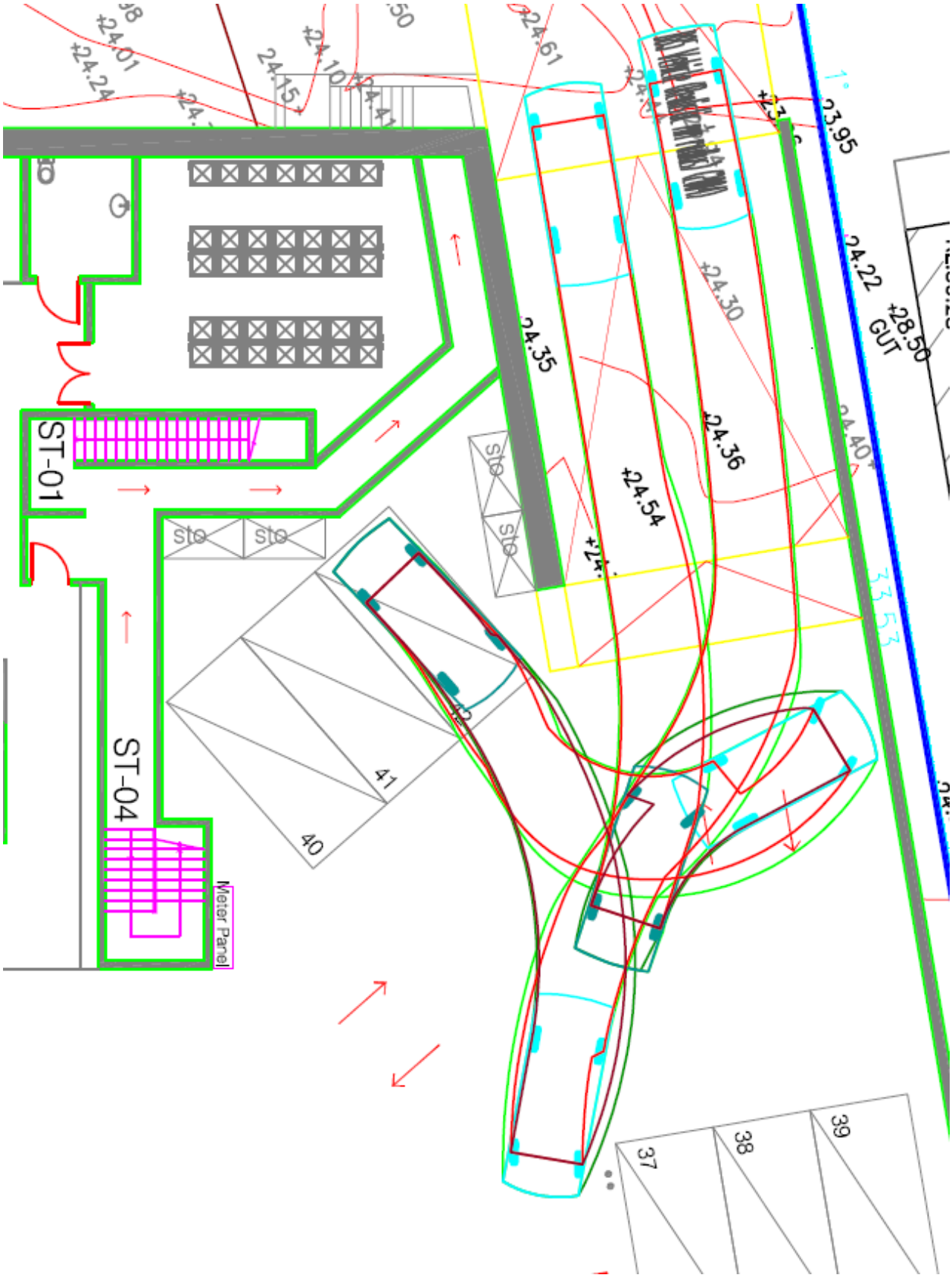
Appendix D: Swept Paths



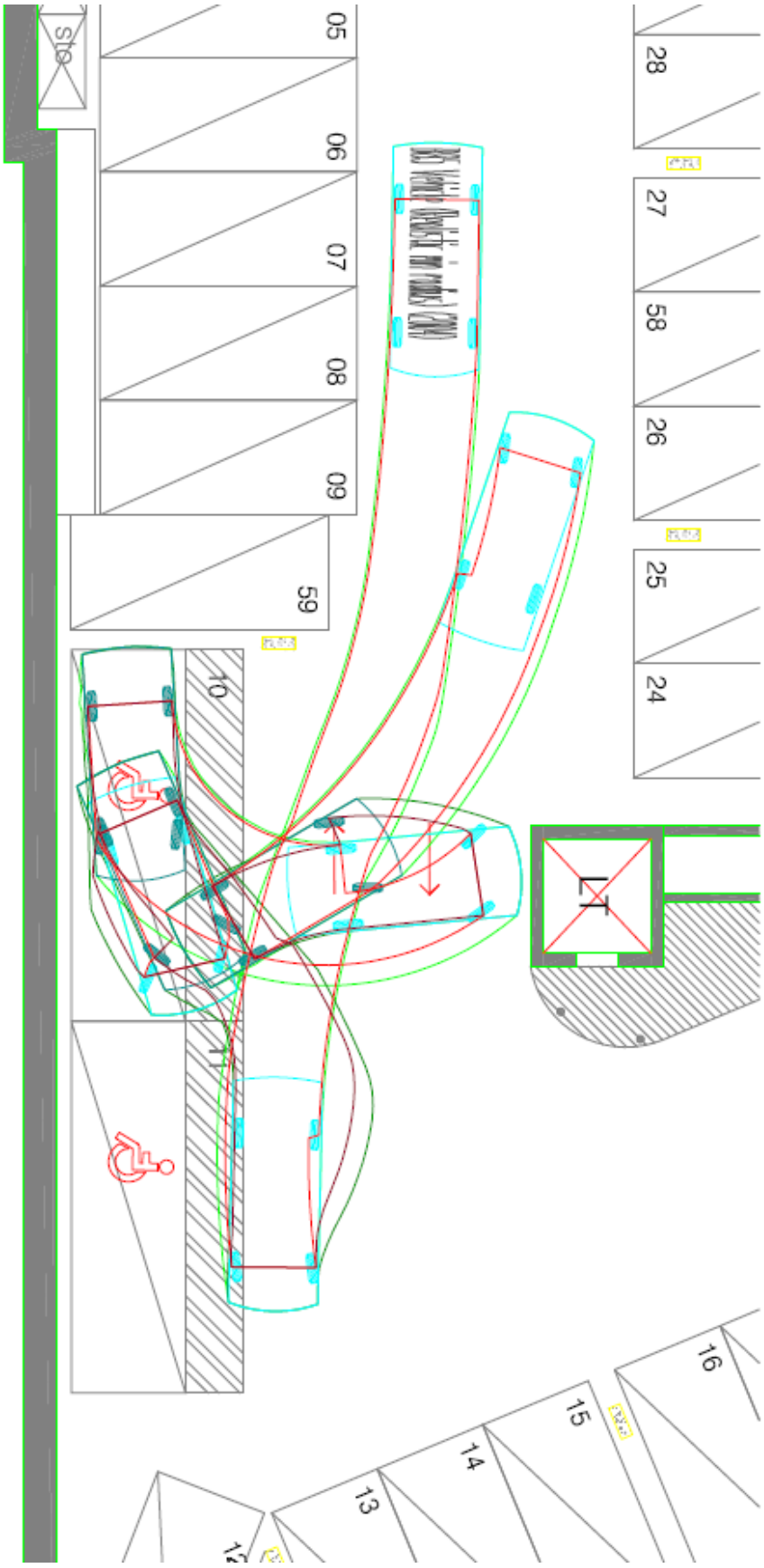
Vehicles parking in spaces 14 and 24 (basement 1)



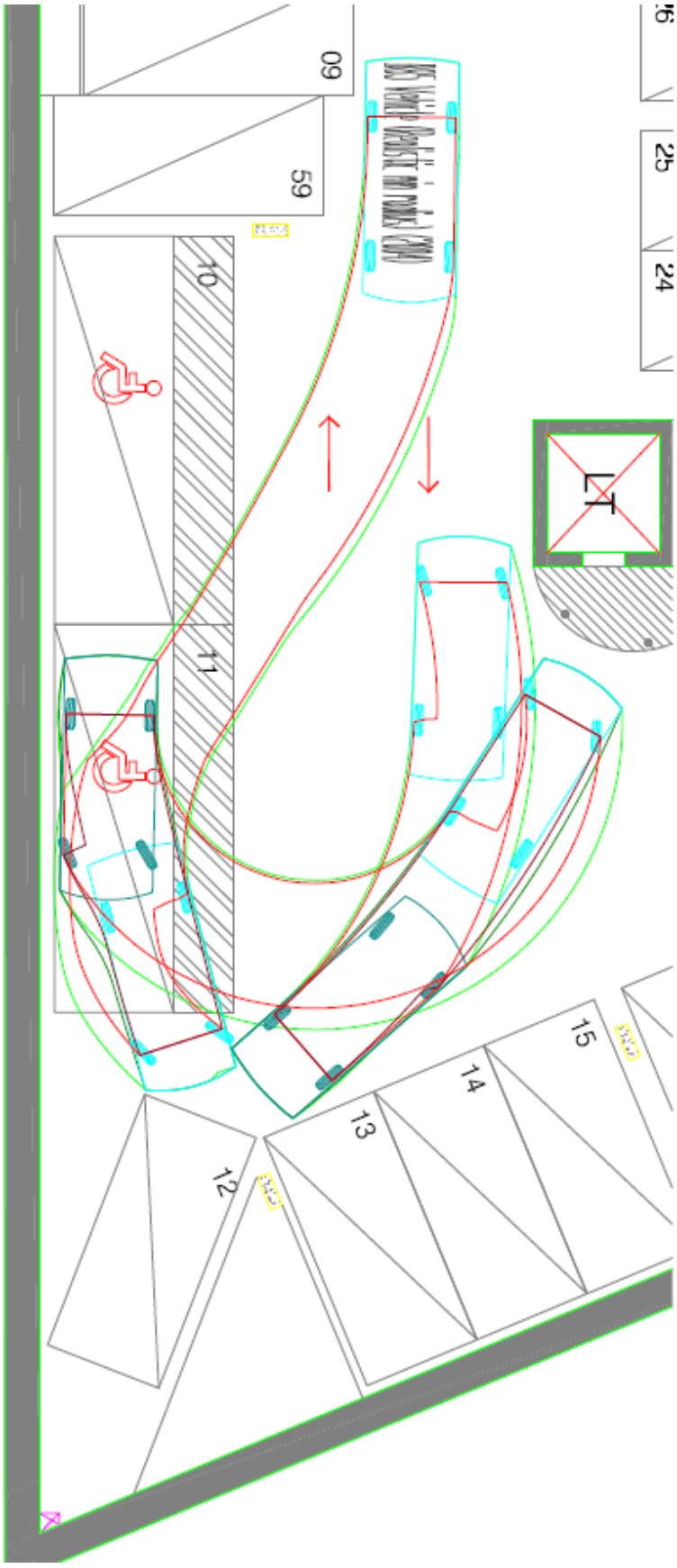
Vehicles parking in space 25 (basement 1)



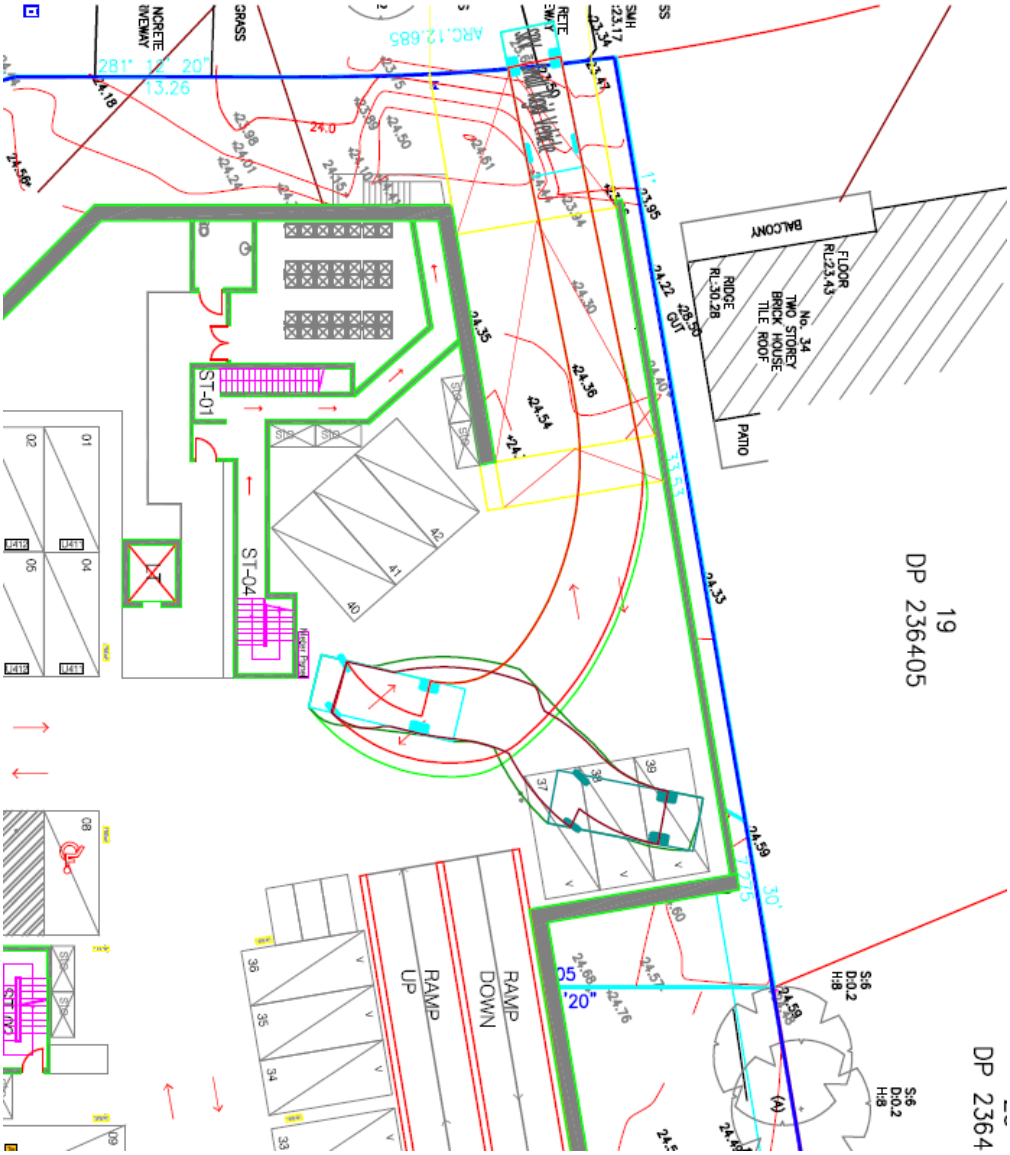
Vehicle parking in space 42 (basement 1)



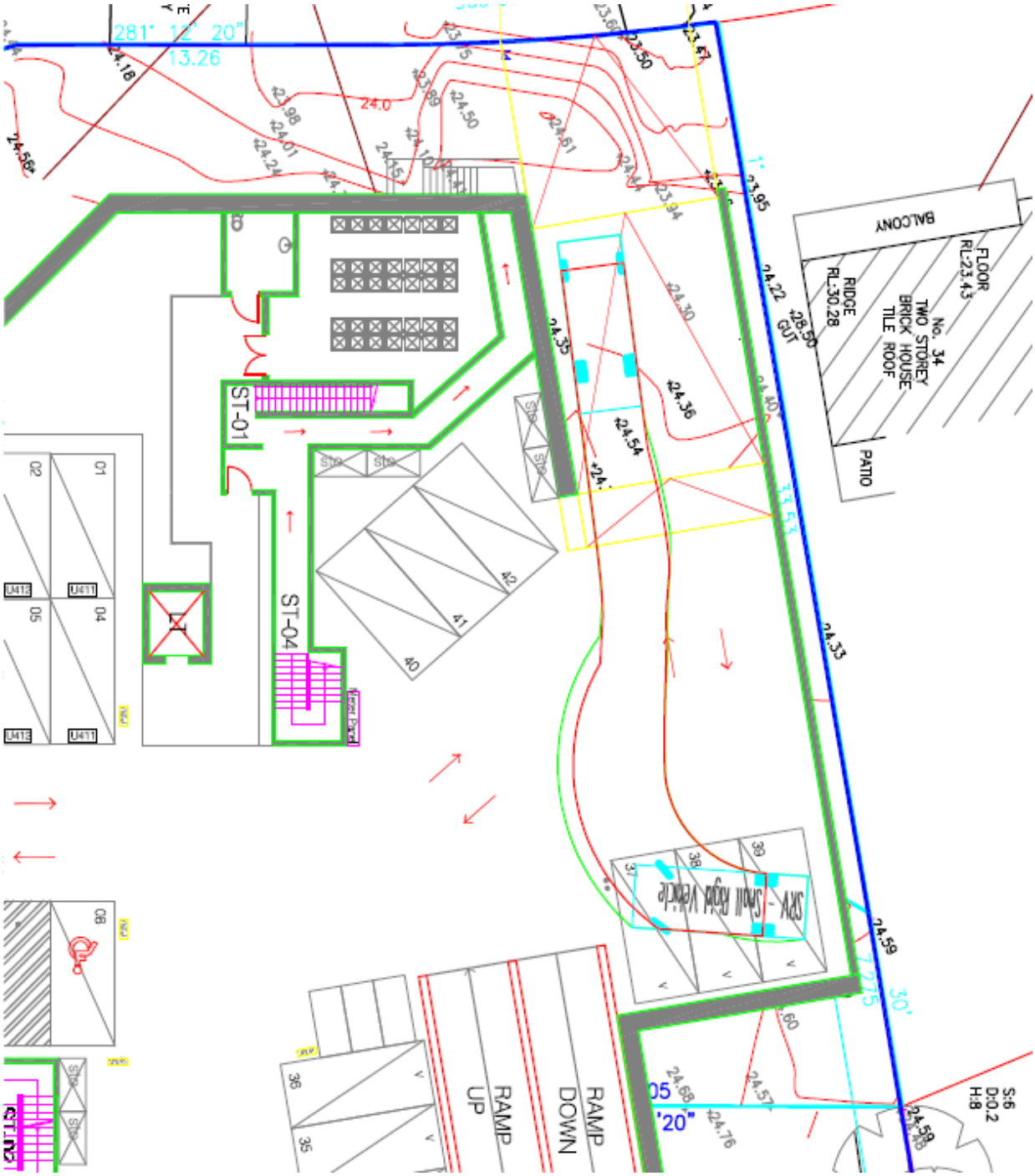
Entering and exiting (north) disabled space Basement 1



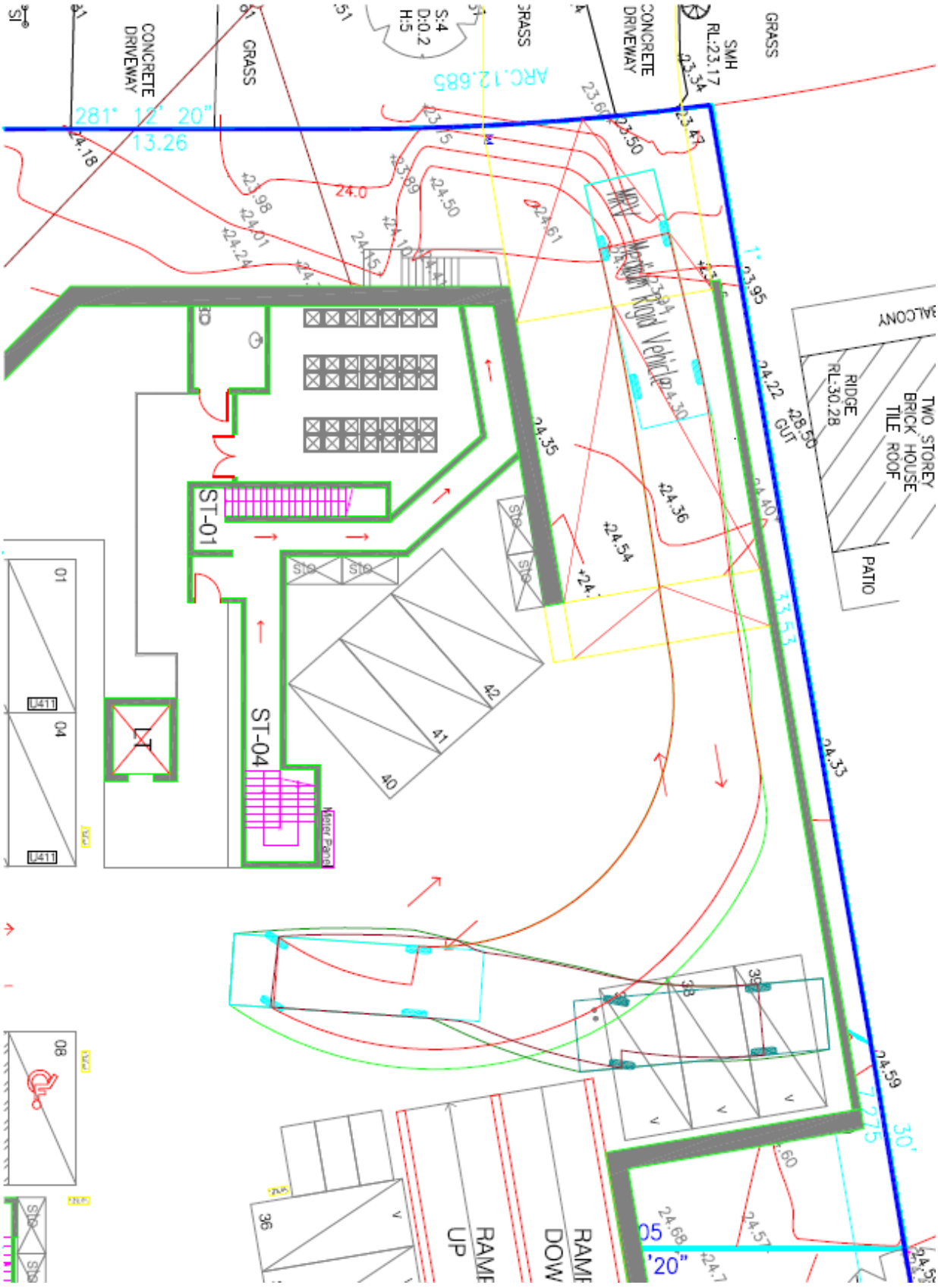
Entering and exiting (north) disabled space Basement 1



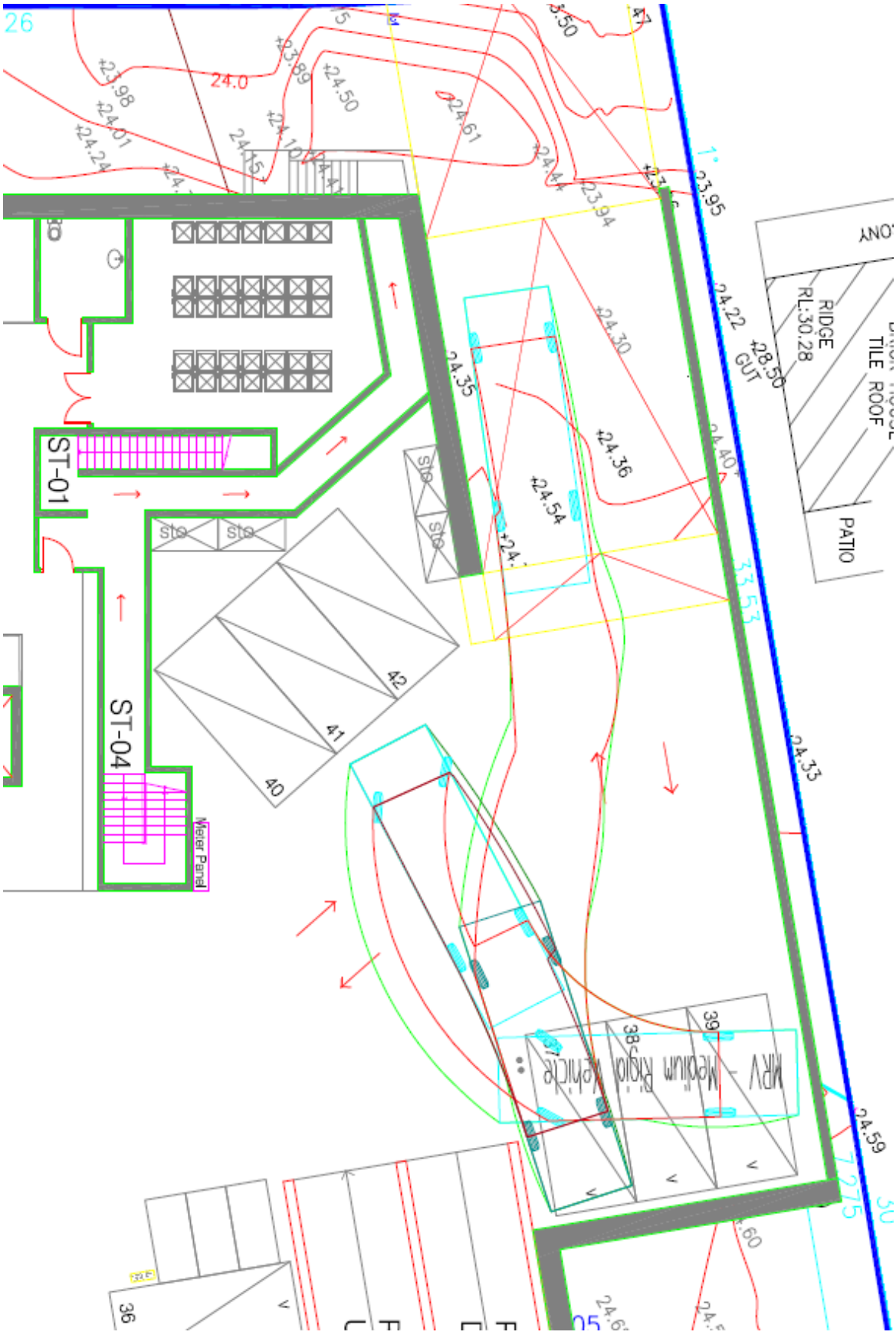
SRV Entering spaces 37, 38, 39 - Basement 1



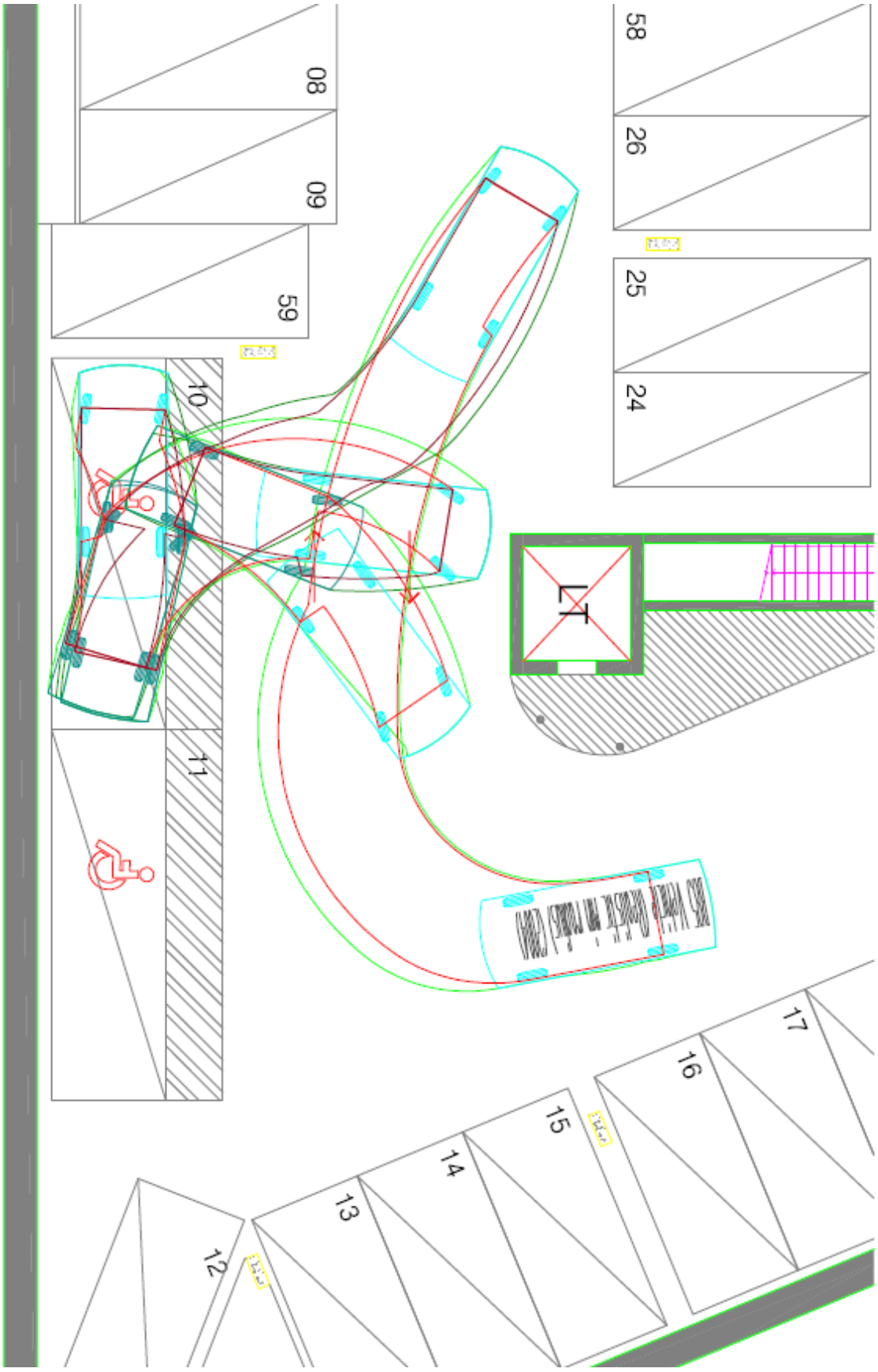
SRV Exiting spaces 37, 38, 39 - Basement 1



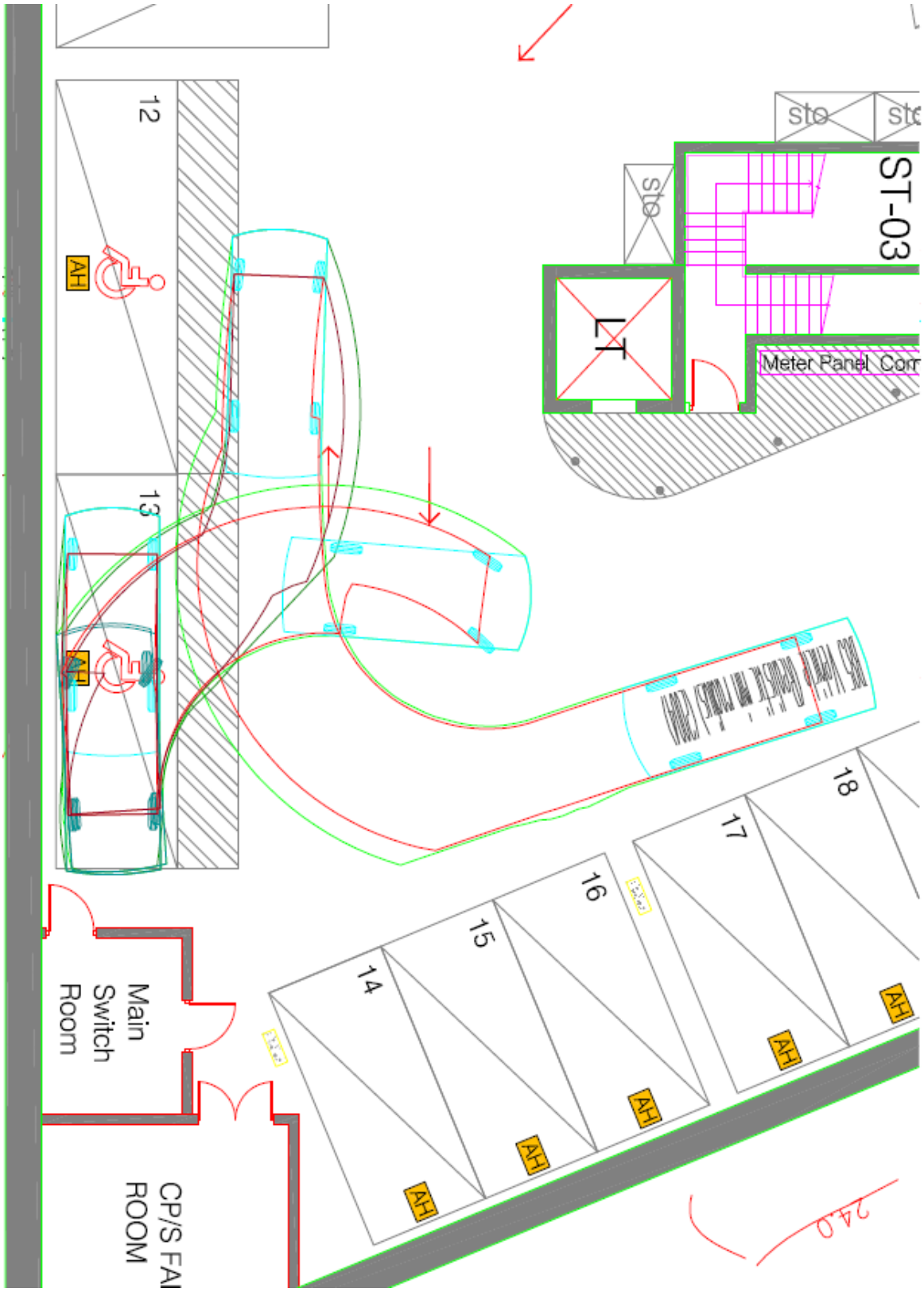
MRV Entering spaces 37, 38, 39 - Basement 1



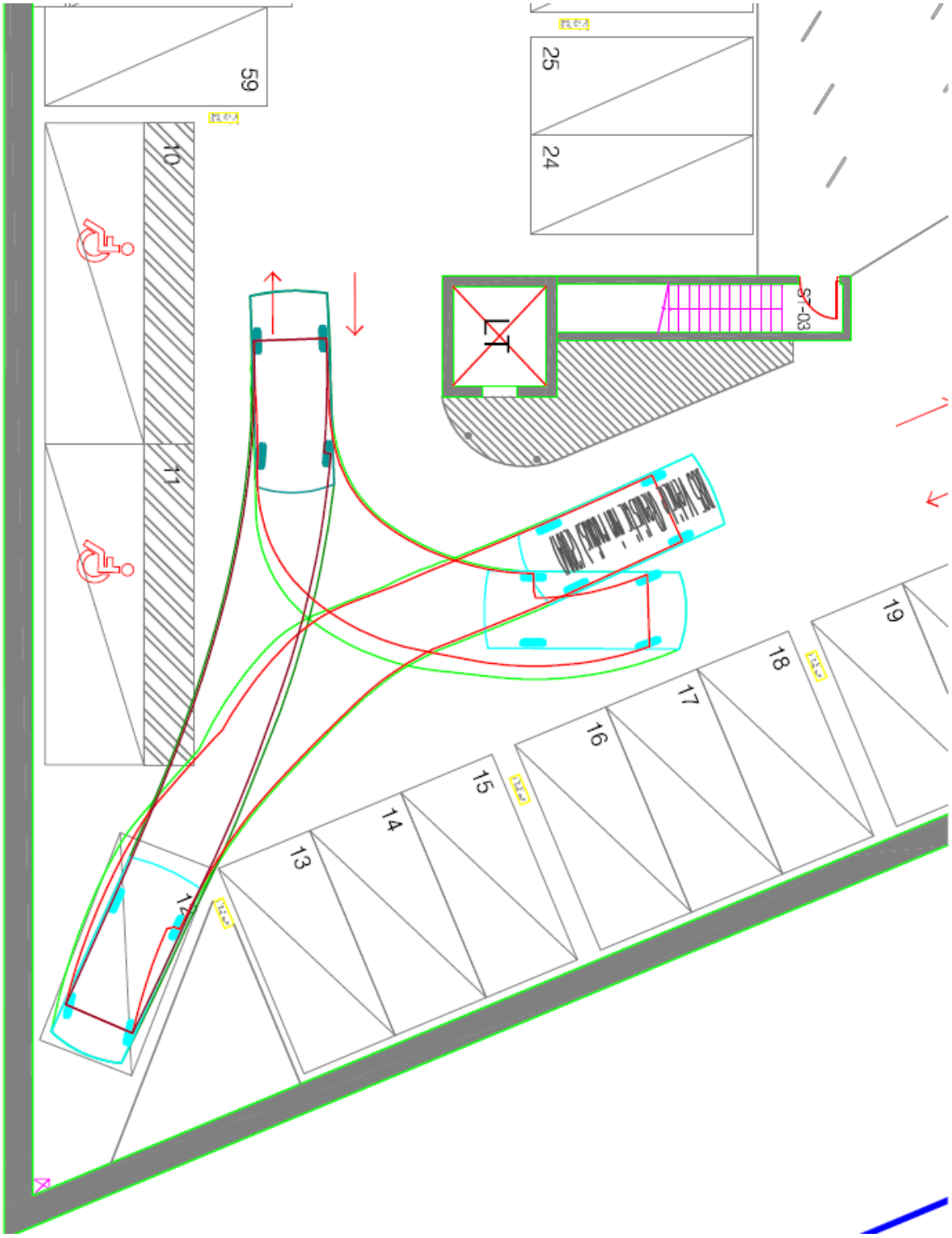
MRV Exiting spaces 37, 38, 39 - Basement 1



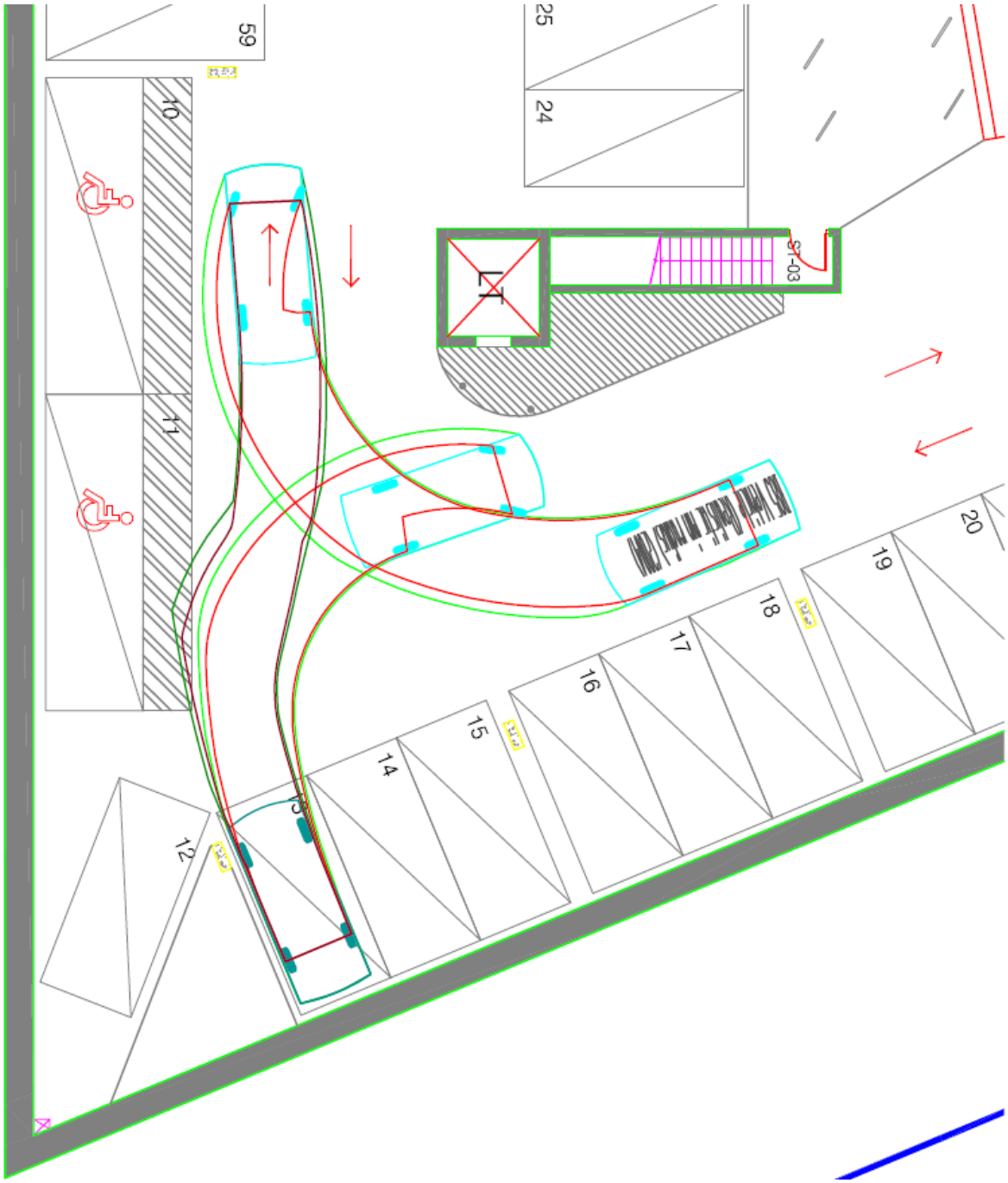
Entering and exiting disabled space (south) Basement 2



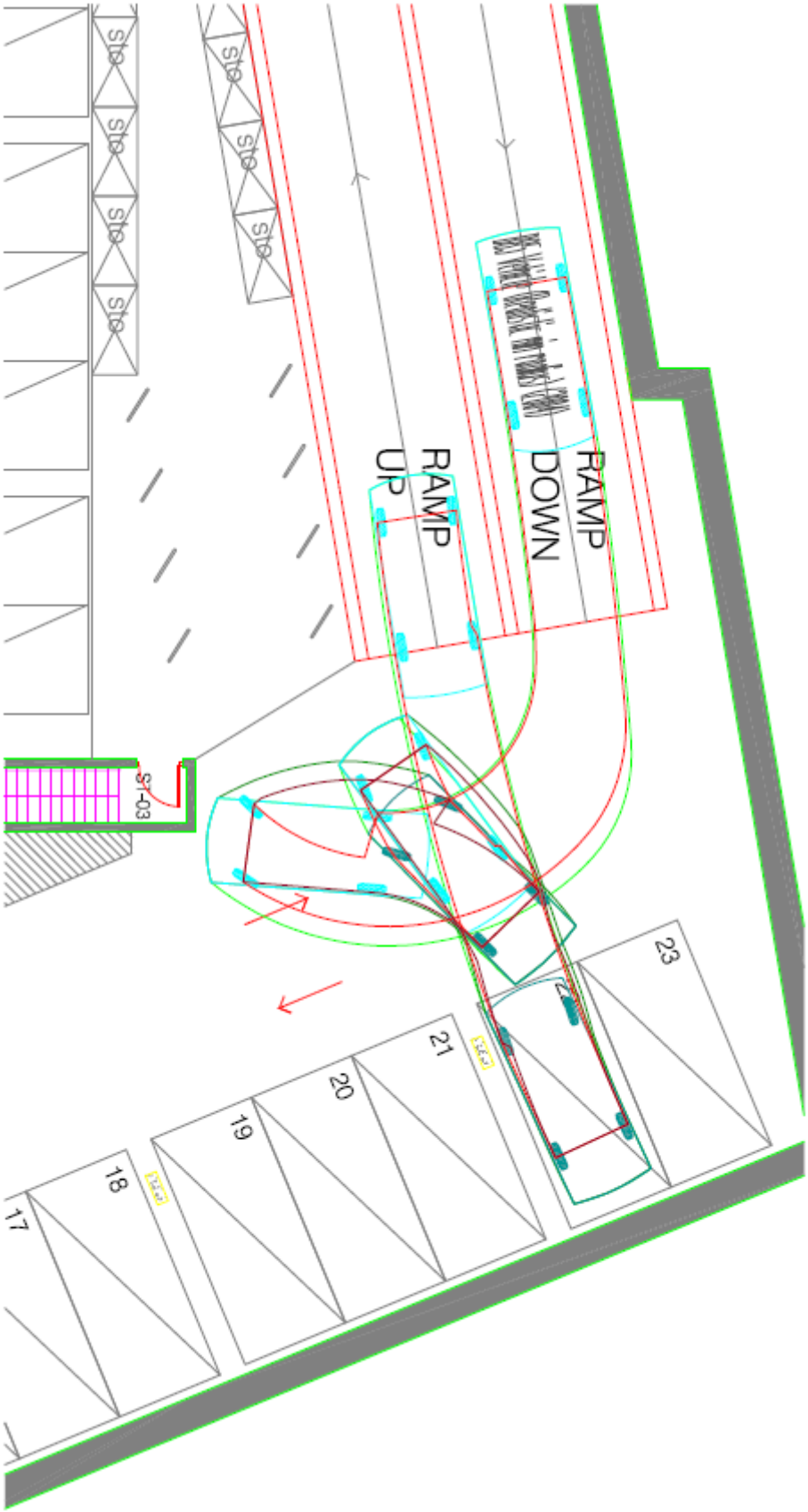
Entering and exiting disabled space (south) Basement 2



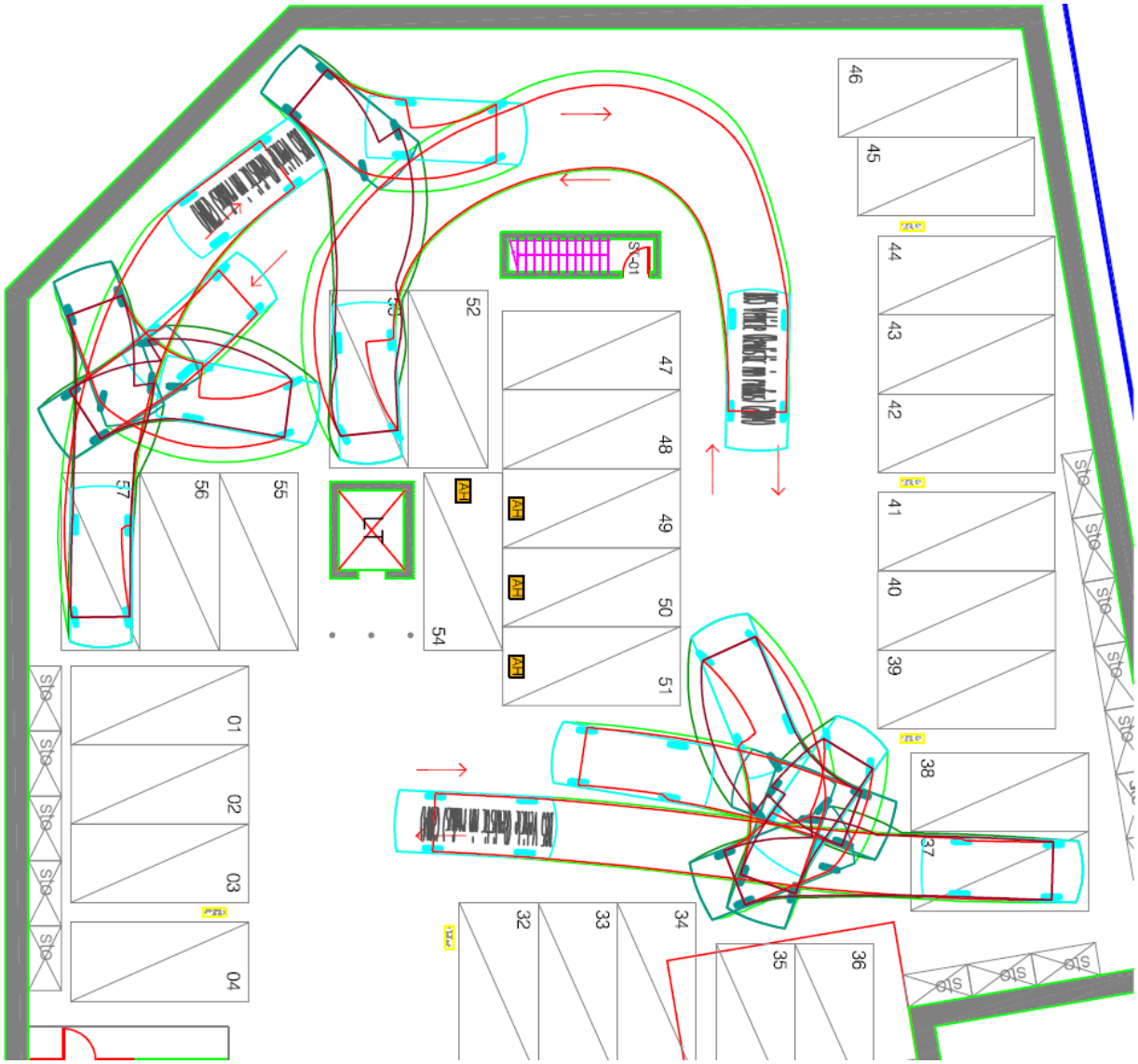
Entering and exiting space 12 - Basement 2



Entering and exiting space 13 - Basement 2

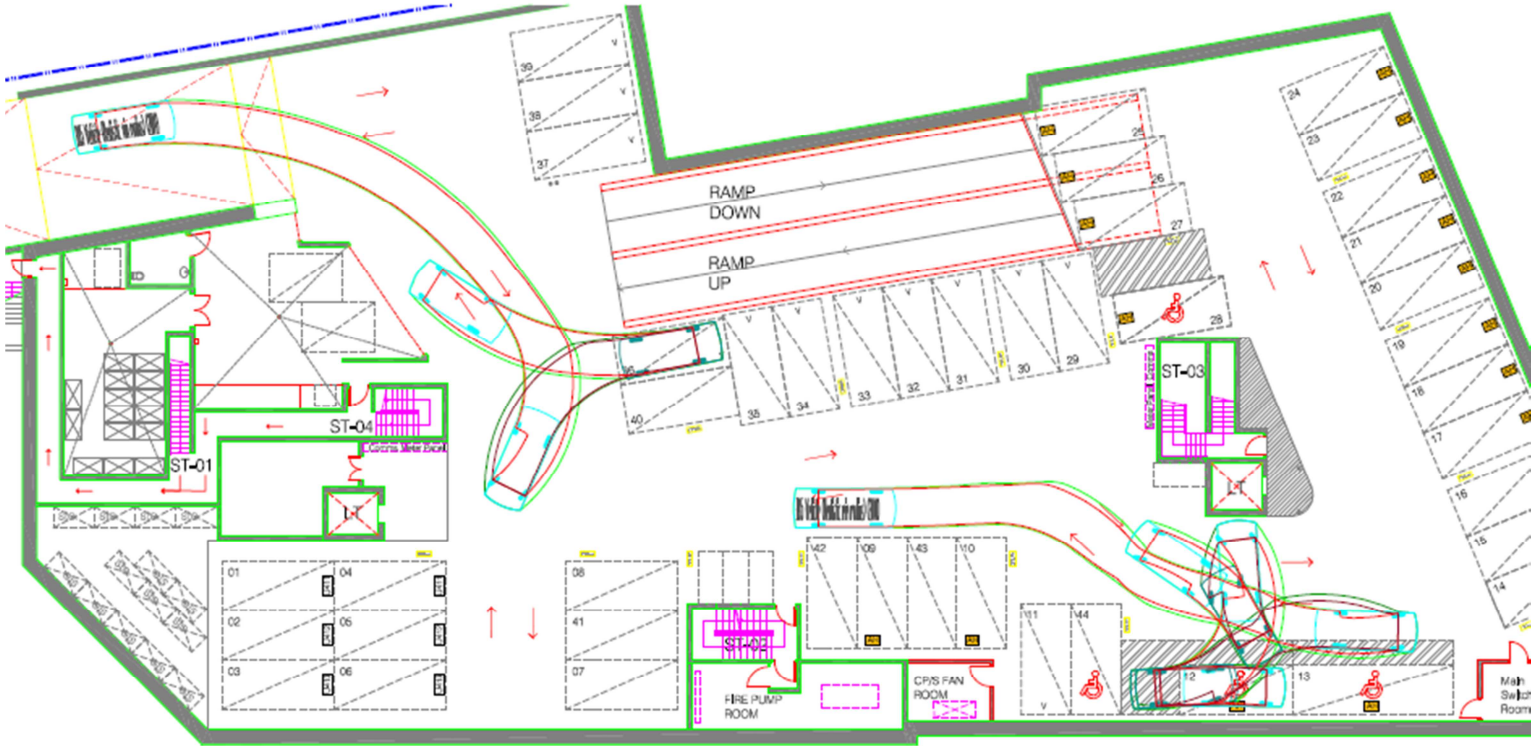


Entering and exiting space 22 - Basement 2



Entering and exiting spaces 37, 53, 57 - Basement 2

B1 - Parking spaces 36 and 12



Rev	Description	Date	Project
A	Spaces 36 and 12	6/08/2019	61-65 Lucas Avenue, Moorebank

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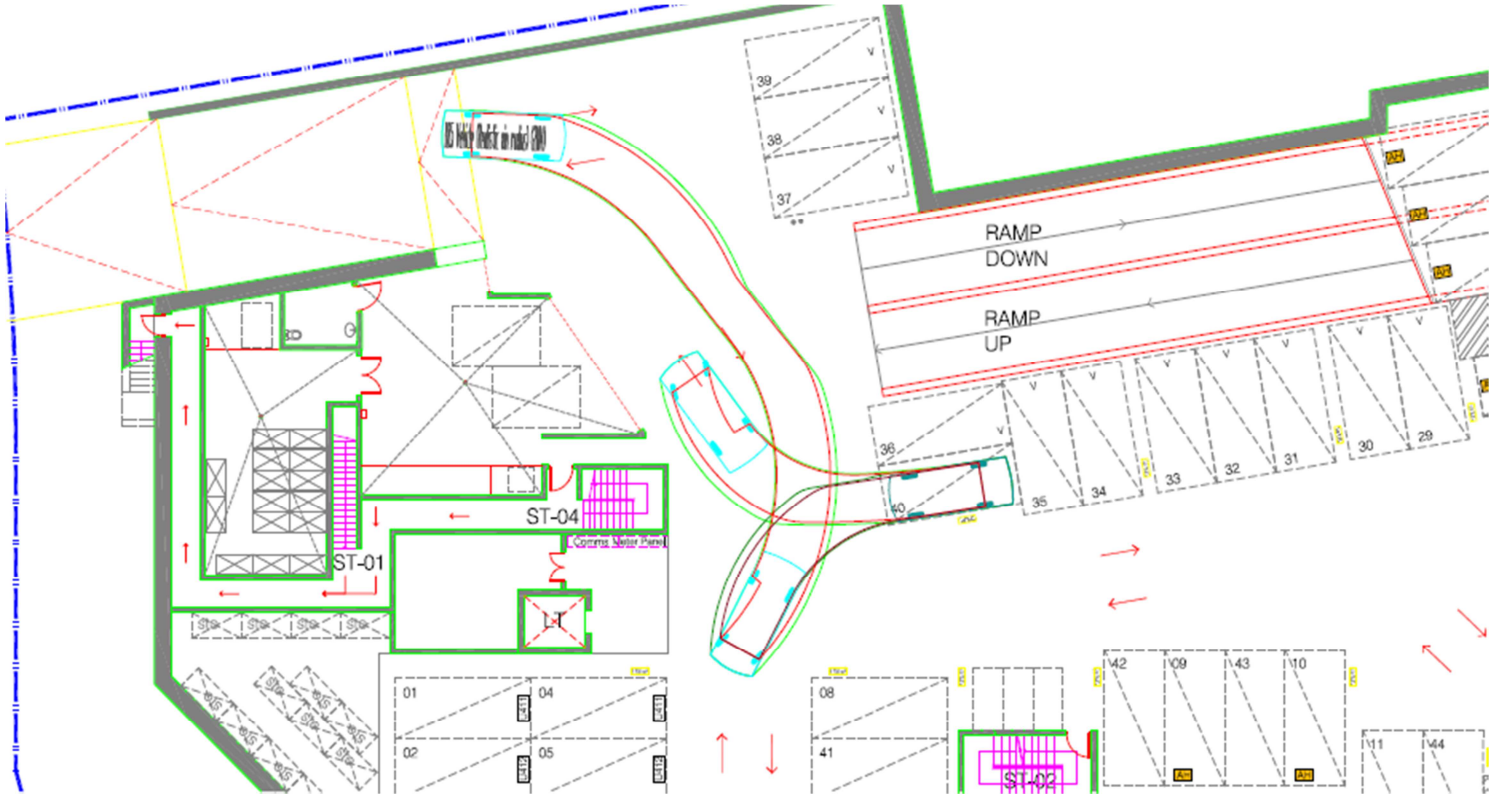
B1 - Parking space 40



Rev	Description	Date	Project
A	Space 40	6/08/2019	61-65 Lucas Avenue, Moorebank

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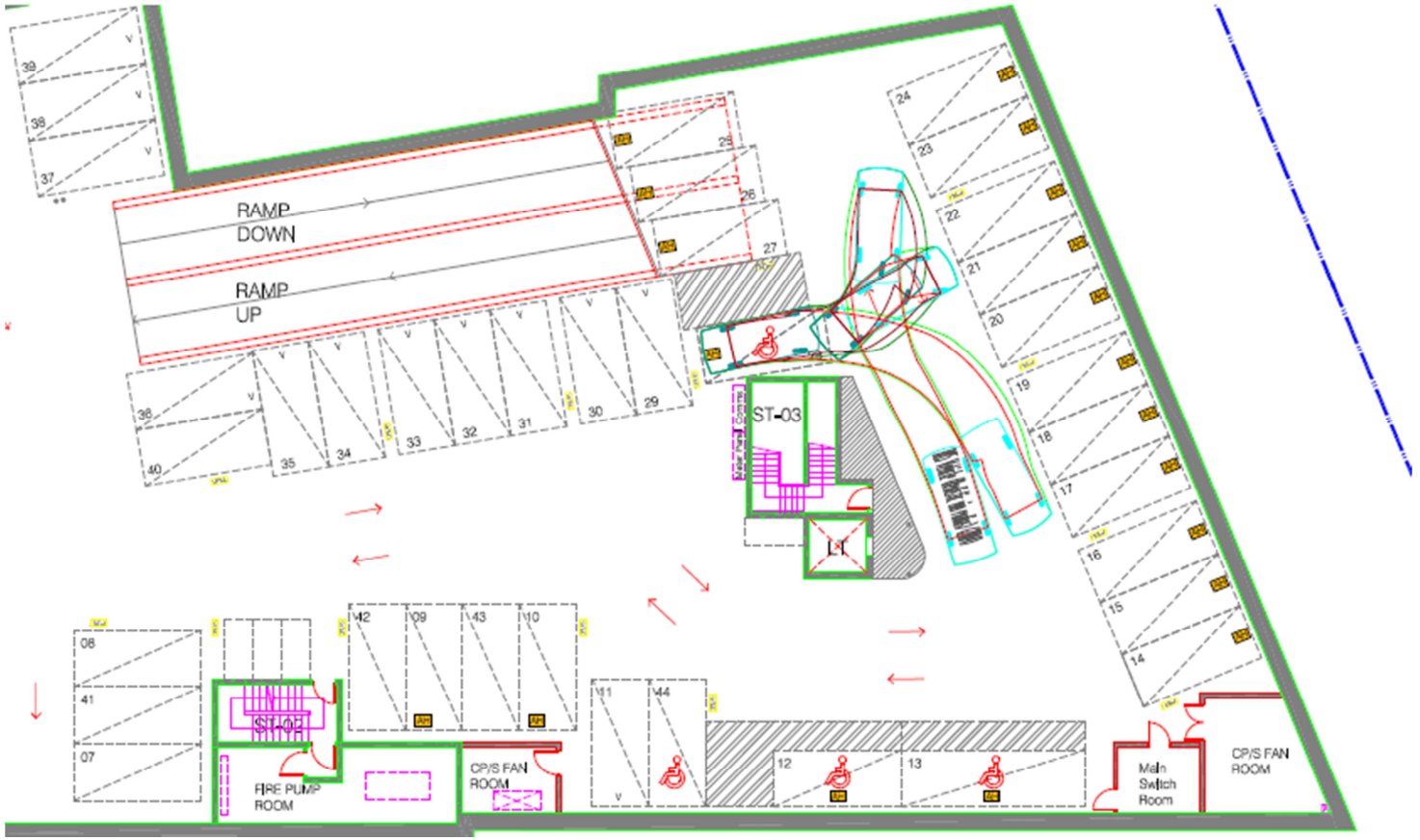
B1 - Parking space 28



Rev	Description	Date	Project
A	Space 28	6/08/2019	61-65 Lucas Avenue, Moorebank

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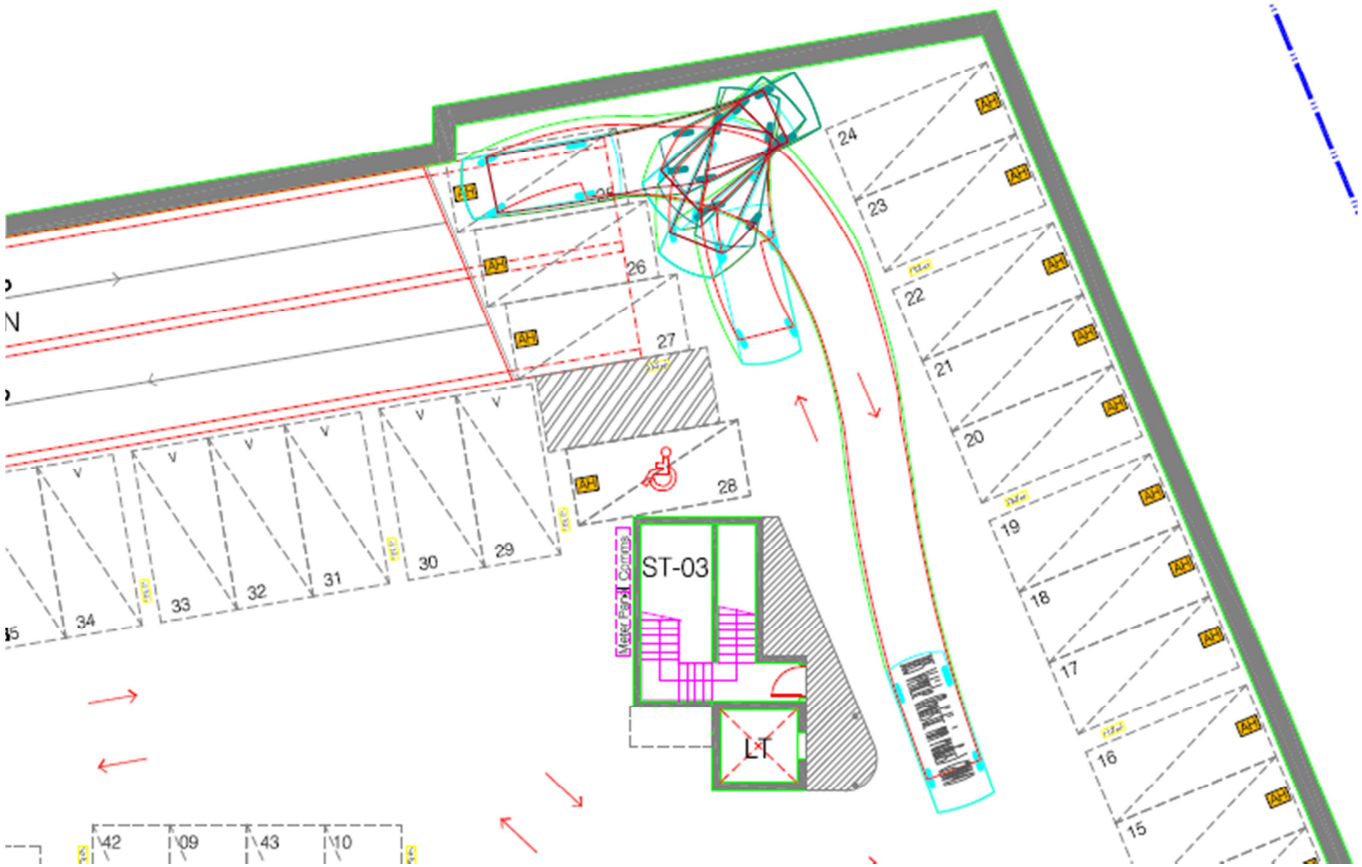
B1 - Parking space 25



Rev	Description	Date	Project
A	Space 25	6/08/2019	61-65 Lucas Avenue, Moorebank

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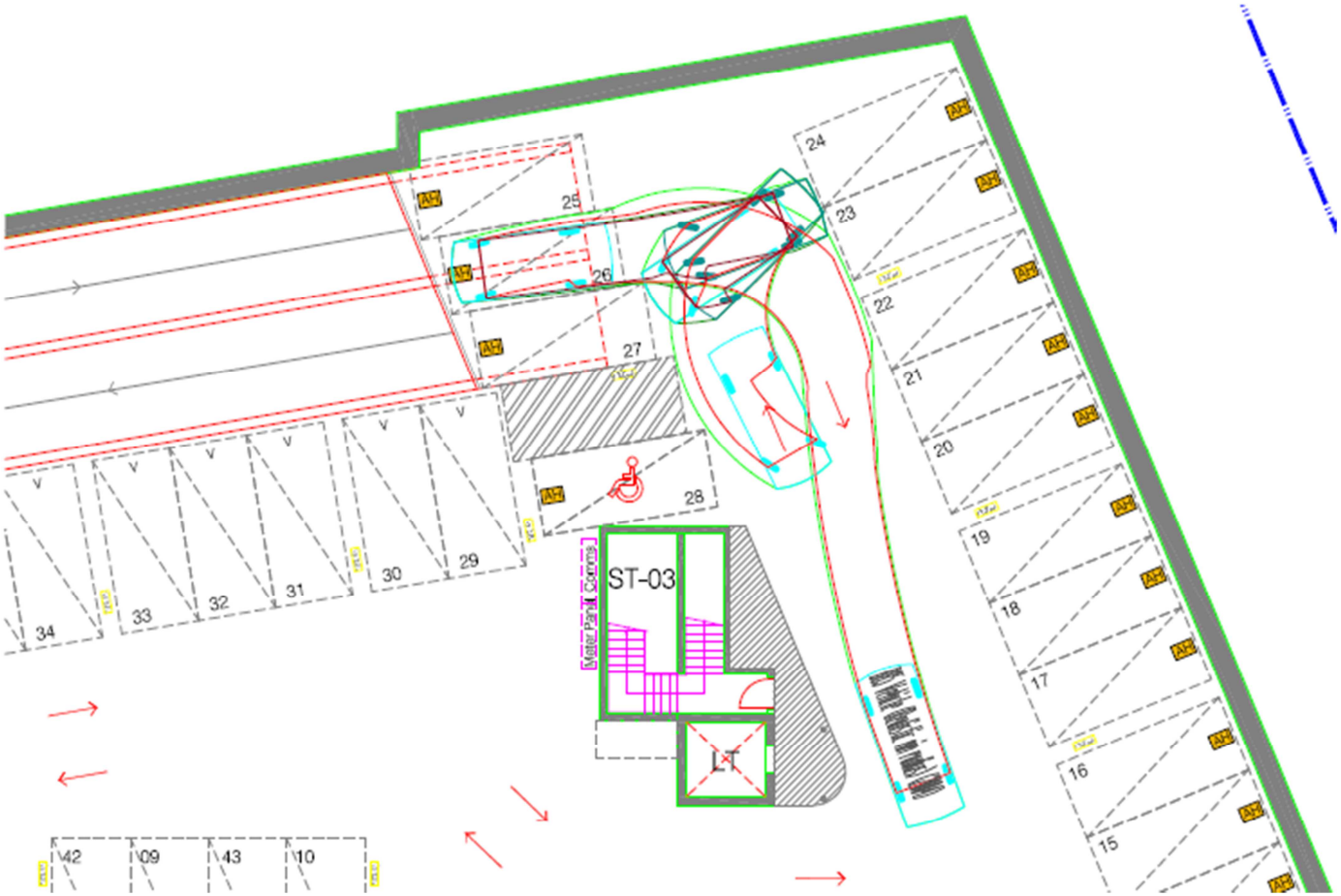
B1 - Parking space 26



Rev	Description	Date	Project
A	Space 26	6/08/2019	61-65 Lucas Avenue, Moorebank

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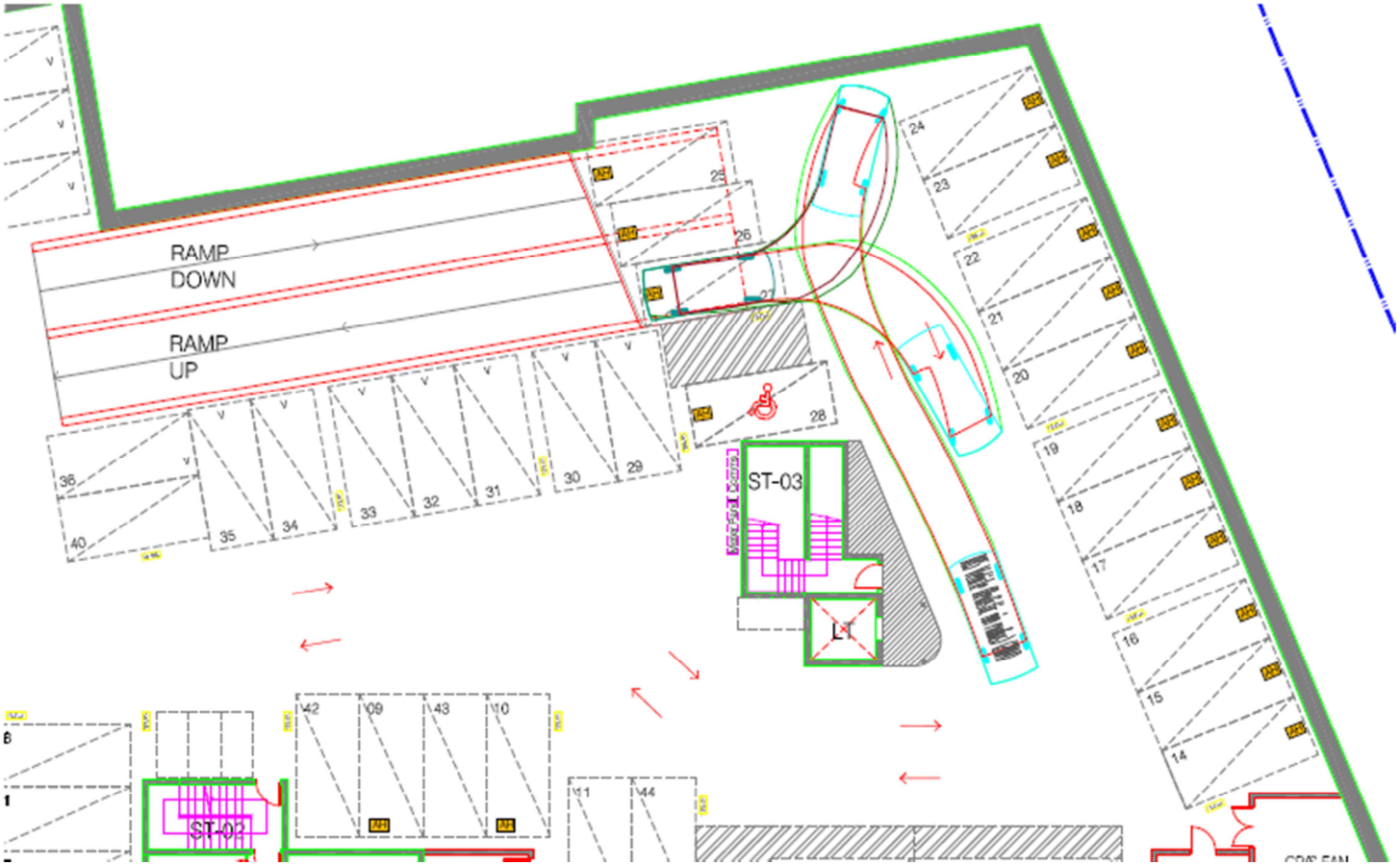
B1 - Parking space 27



Rev	Description	Date	Project
A	Space 27	6/08/2019	61-65 Lucas Avenue, Moorebank

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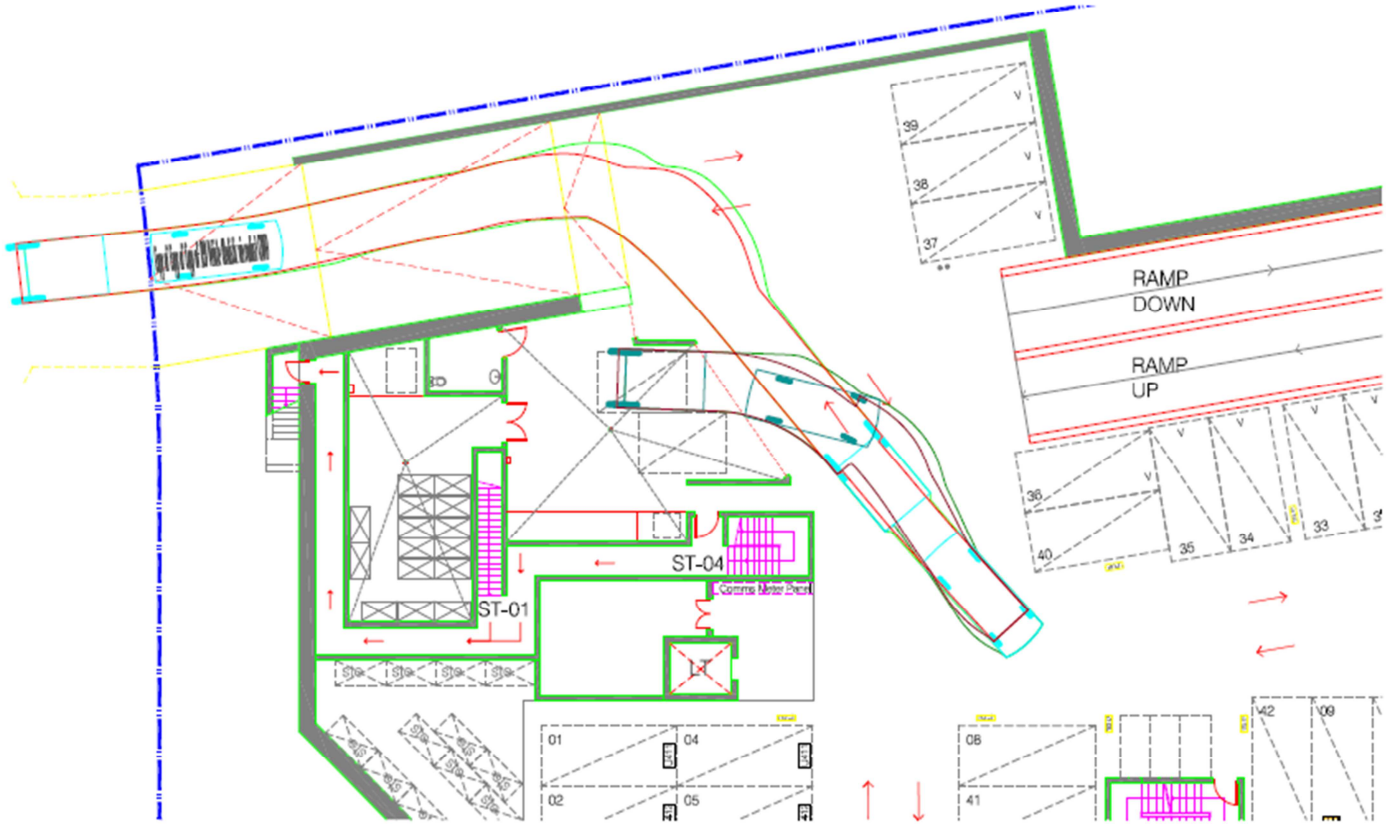
B1 - B99 Towing Skip bin 1 Entering



Rev	Description	Date	Project
B	B99 towing skip	10/08/2019	61-65 Lucas Avenue, Moorebank

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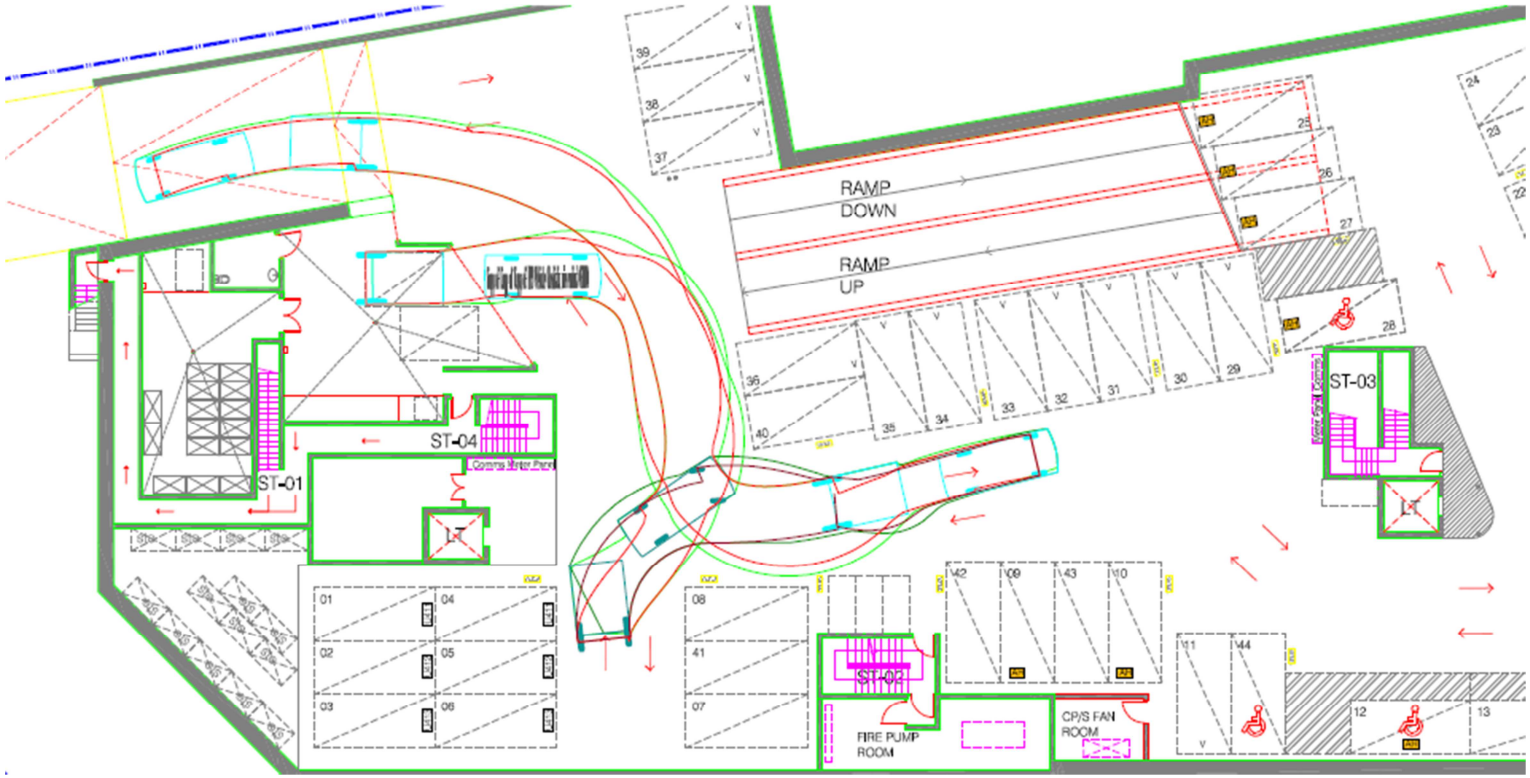
B1 - B99 Towing Skip bin 1 Exiting



Rev	Description	Date	Project
B	B99 towing skip	10/08/2019	61-65 Lucas Avenue, Moorebank

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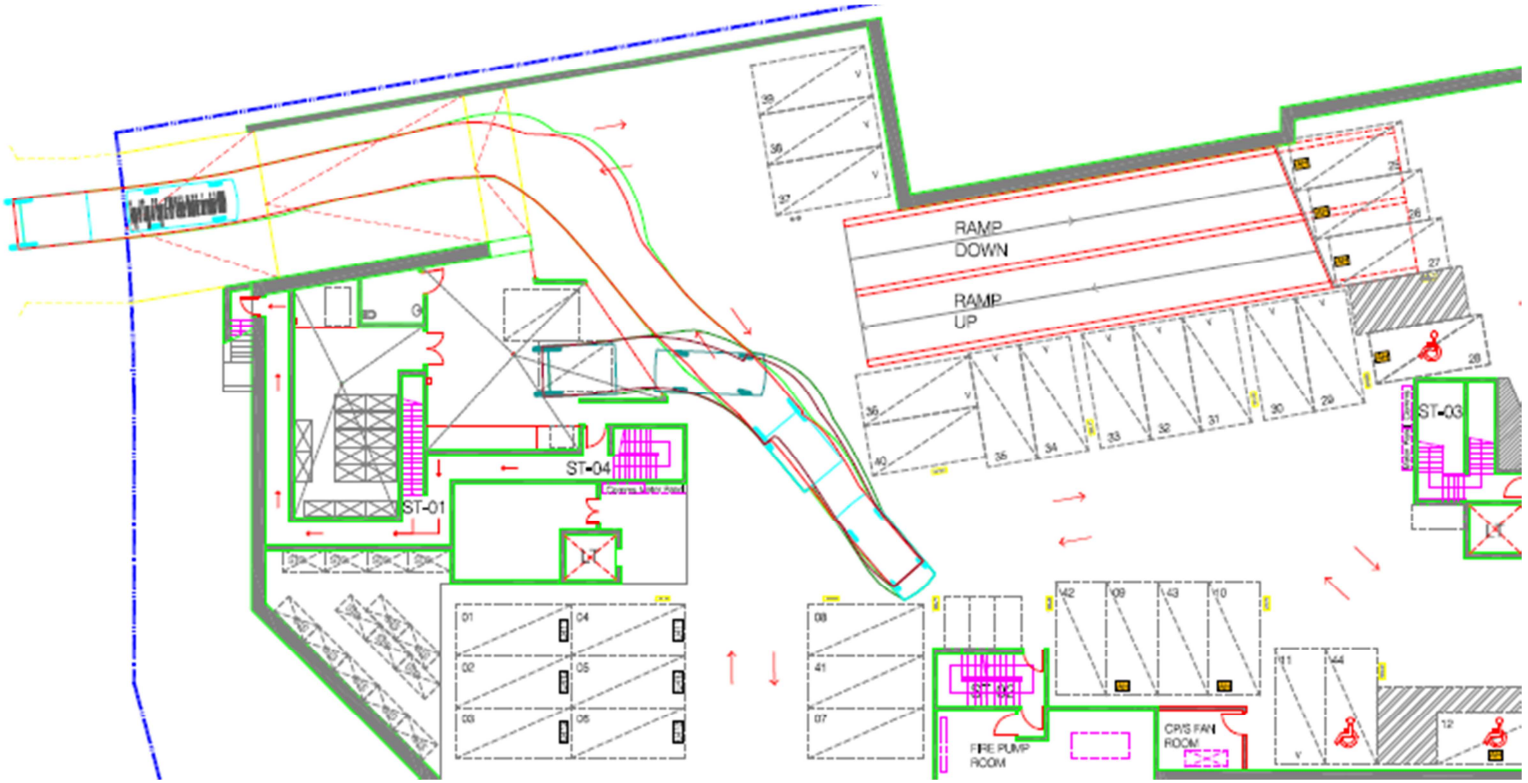
B1 - B99 Towing Skip bin 2 Entering



Rev	Description	Date	Project
B	B99 towing skip	10/08/2019	61-65 Lucas Avenue, Moorebank

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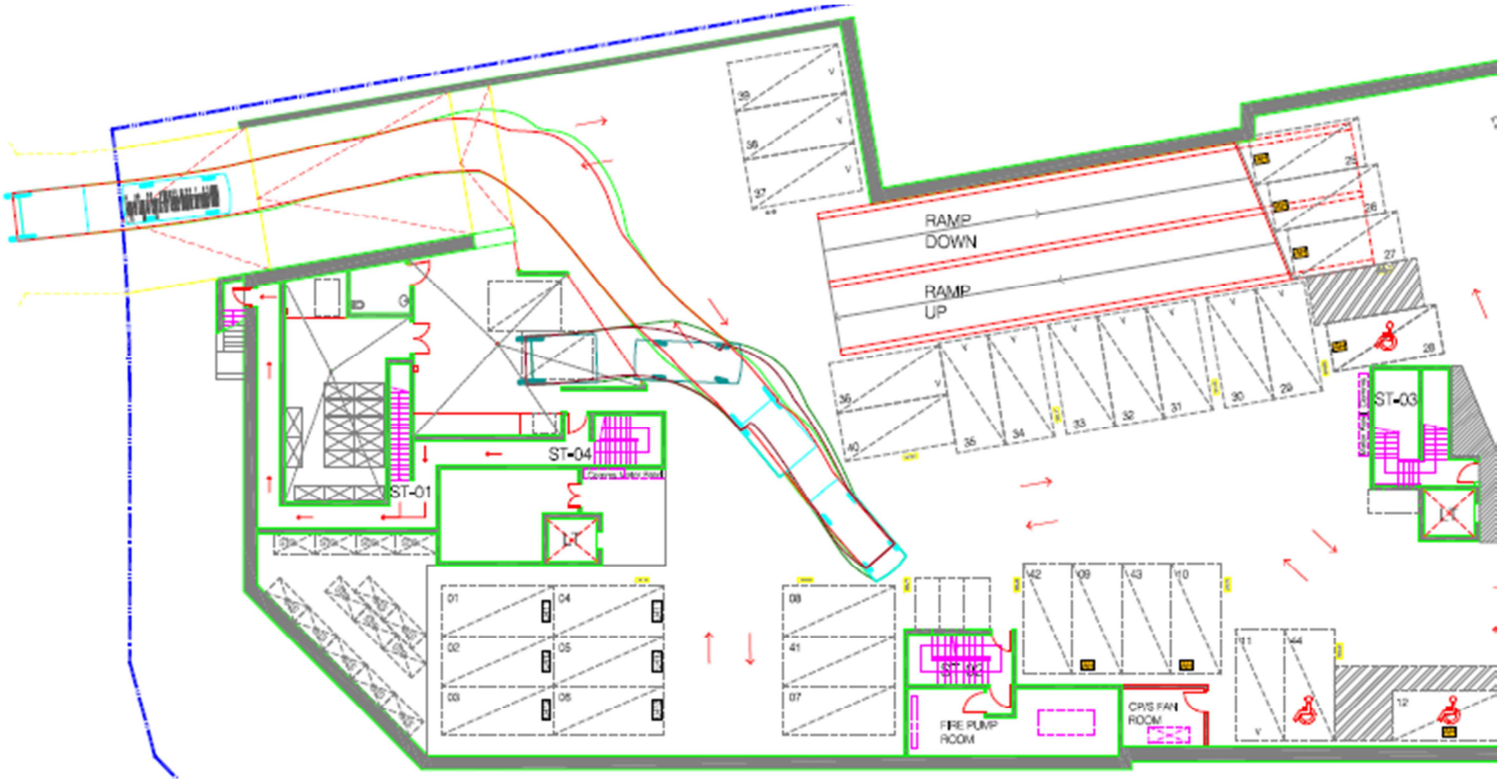
B1 - B99 Towing Skip bin 2 Exiting



Rev	Description	Date	Project
B	B99 towing skip	10/08/2019	61-65 Lucas Avenue, Moorebank

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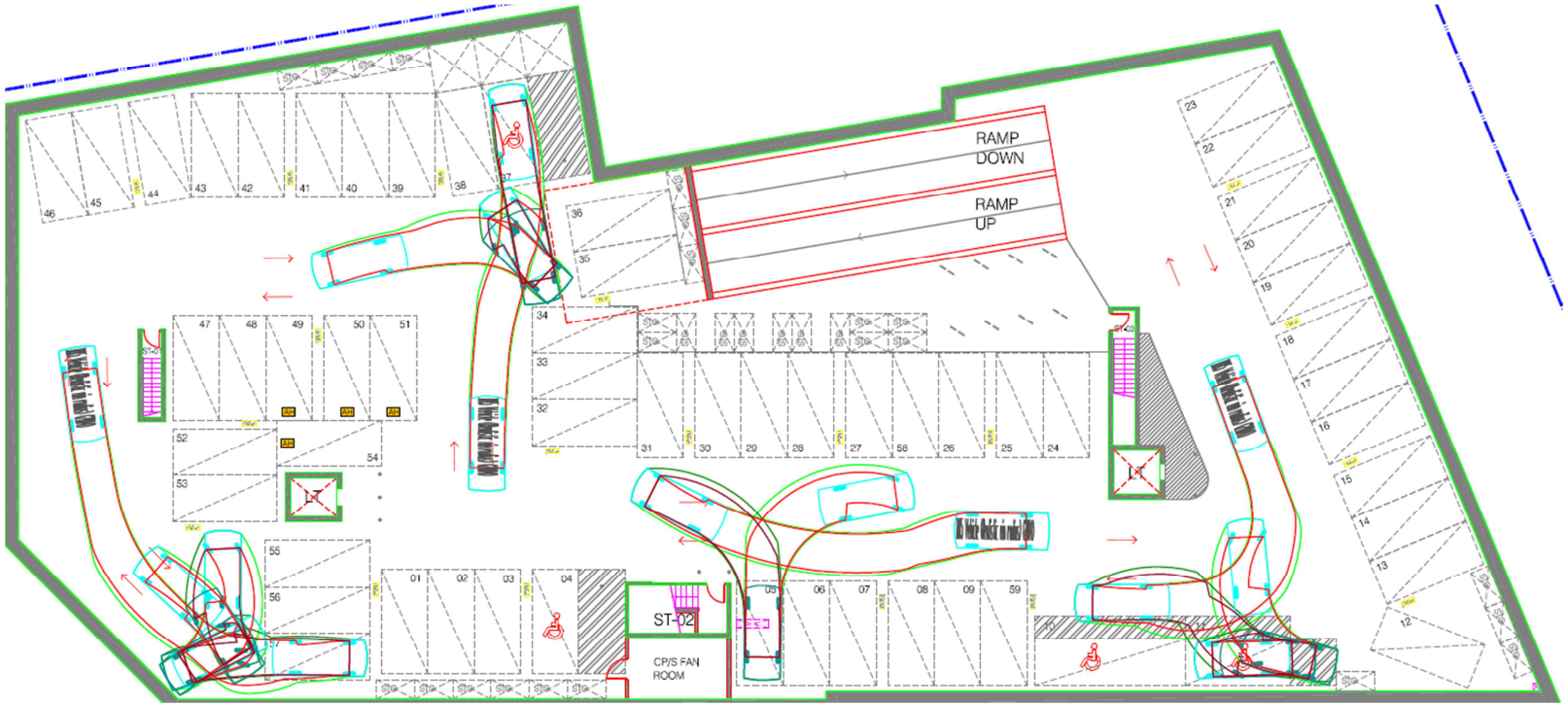
B2 - Parking spaces 5, 11, 37, 57



Rev	Description	Date	Project
A	Spaces 5, 11, 37, 57	12/08/2019	61-65 Lucas Avenue, Moorebank

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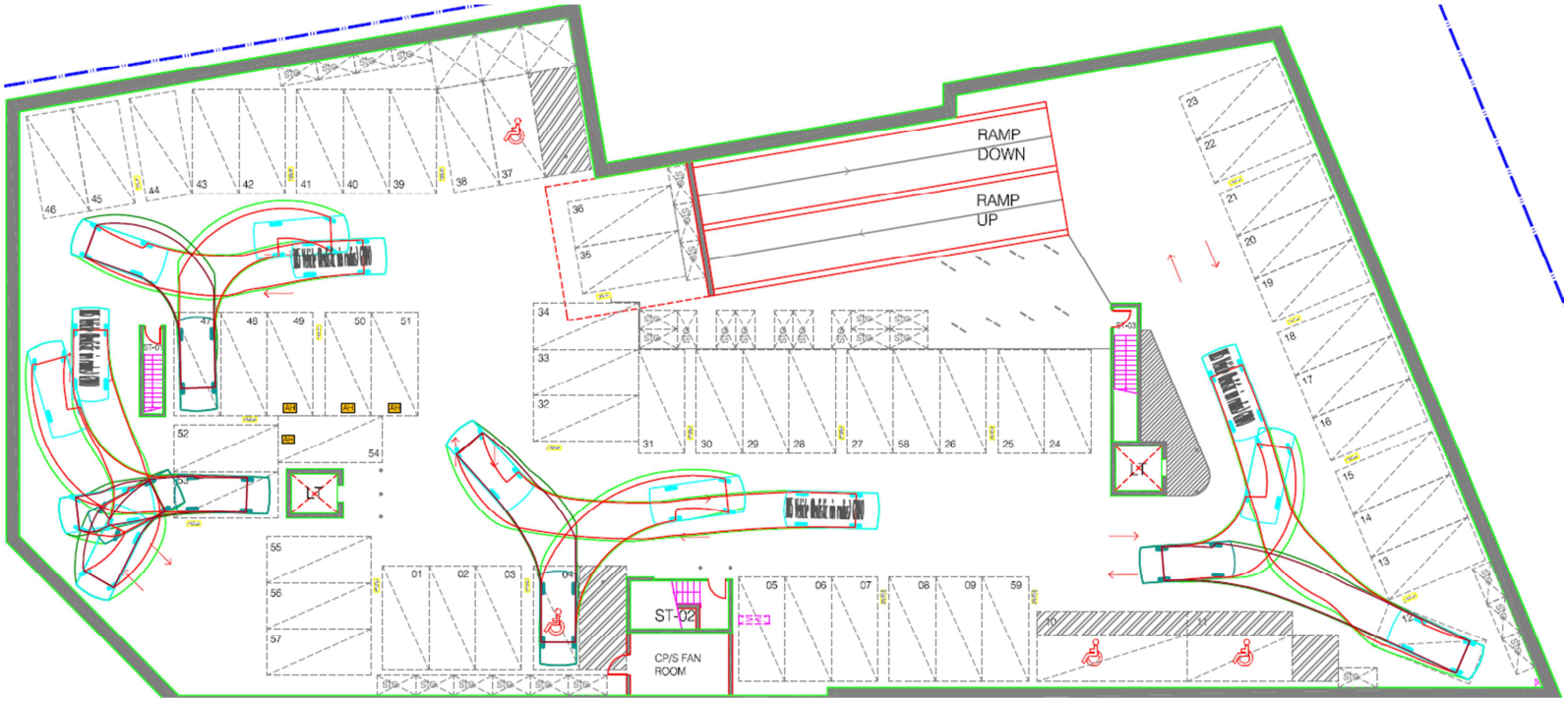
B2 - Parking spaces 4, 12, 47, 53



Rev	Description	Date	Project
A	Spaces 4, 12, 47, 53	12/08/2019	61-65 Lucas Avenue, Moorebank

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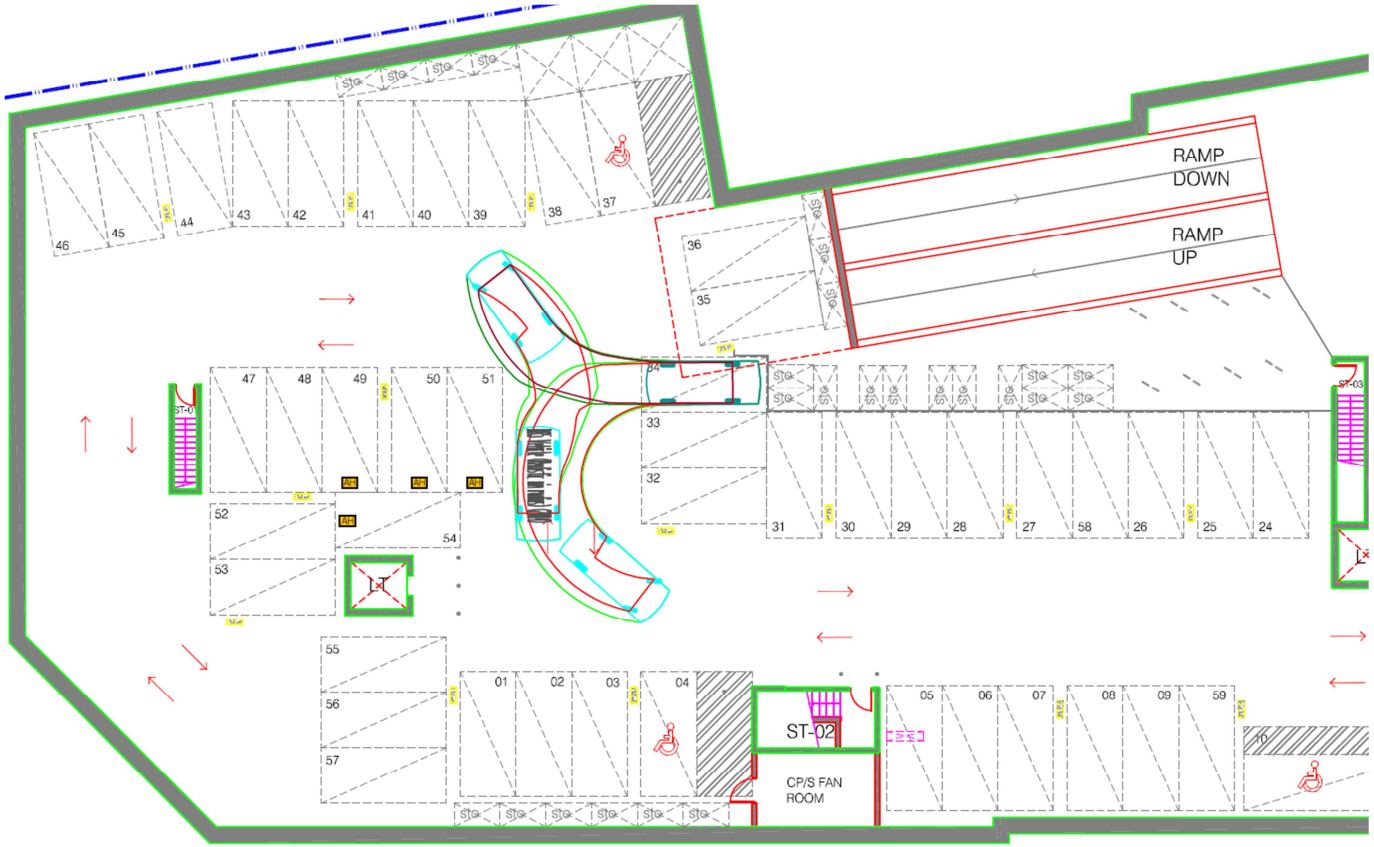
B2 - Parking space 34



Rev	Description	Date	Project
A	Space 34	12/08/2019	61-65 Lucas Avenue, Moorebank

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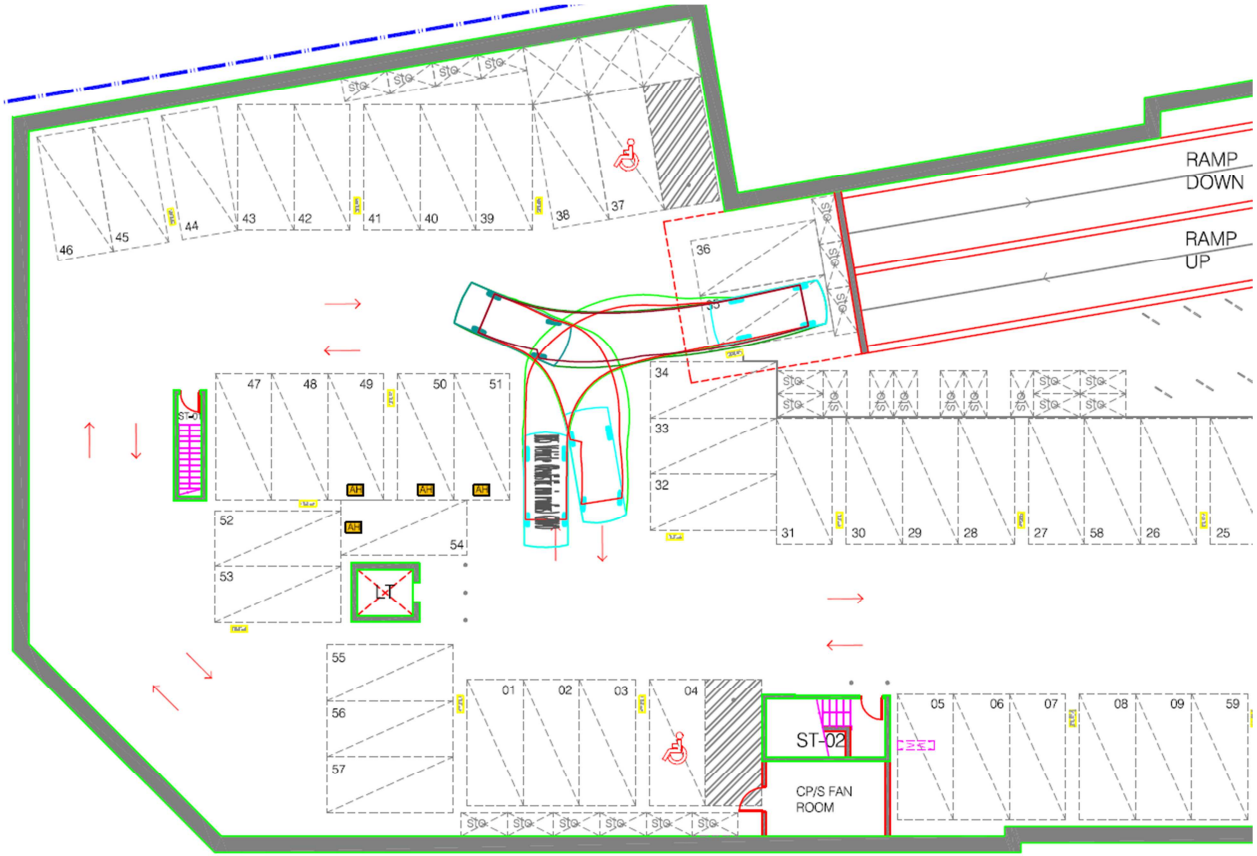
B2 - Parking space 35



Rev	Description	Date	Project
A	Space 35	12/08/2019	61-65 Lucas Avenue, Moorebank

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