



**MINISTRY OF HOUSING AND URBAN AFFAIRS
GOVERNMENT OF INDIA**

Planning, Designing and Implementing City Bus Depots

Urban Mobility India Conference and Expo 2019

Objectives

- Need of Depot
- Who are stakeholders and their involvement during various stages
- Criteria for Site Selection

Facilities Planning

- Determining the number and types of buses
- Horizon period
- Estimation of Infrastructure capacity
- In-house vs Outsourced activities

Implementation Structure

- Funding Source

Key Parameters Defining Layout of a Depot

Number of buses to be maintained

Dimensions of buses (*length, floor height*)

Type of fuel (*diesel, CNG, electric*)

Maintenance philosophy

Movement of rolling stock, man and material

Legal framework (*environment, safety, green building etc.*)

Present Indian Scenario

Types of Depots

Tier 1: Parking Bus Depots

- Night Parking
- Physical checking and minor on-site repairs
- Washing

Tier 2: Unitary Bus Depots

- **Parking Bus Depots +**
- Fuelling
- Battery Charging
- Minor and Scheduled Maintenance
- Capacity Building

Tier 3: Central or Regional Bus Depots

- **Unitary Bus Depots +**
- Major Maintenance and Accidental repairs
- Tyre Retreading
- Inventory and Waste Management
- Major planning of civil infrastructure required for parking and unitary bus depots

There can be different combinations of aforementioned activities depending on operational requirement & maintenance philosophy of the operator and size of land parcel available for the depot.

Maintenance Philosophy

Minor repairs

Preventive maintenance – KM based/ Time based

Major maintenance, mid life-refurbishment, accidental repairs

Maintenance Block

- Bench-work and other activities
- Tyre Section
- Fuel Injection Pump
- Brake Testing
- Electrical Section
- Brake Overhauling Section
- Reconditioning of Major Aggregates
- Inventory and Material Handling

Types of Buses

		Impact
Floor Height	<ul style="list-style-type: none">• Low Floor Bus (400mm) – Stepless entry/exit• Semi Low Floor Bus (650mm) - Entry + one step• Standard Bus (900mm) - Entry + two steps	<ul style="list-style-type: none">• Pit Depth• Ramp Gradient• Inspection, Maintenance, Washing
Length	<ul style="list-style-type: none">• Standard Bus (12m)• Midi Bus (9m)• Mini Bus (6m)• Articulated Bus (18m and/or 24m)	<ul style="list-style-type: none">• Turning Radii• Swept Path• Fuelling, Washing, Maintenance, Parking, Circulation, Queuing
Fuel	<ul style="list-style-type: none">• Diesel Bus• CNG/ HCNG Bus• Pure Electric/ Hybrid Bus	Areas – Fuelling, Maintenance, Parking
Deck	<ul style="list-style-type: none">• Single Decker Bus• Double Decker Bus	<ul style="list-style-type: none">• Height• Fuelling, Washing, Maintenance
Rear Axle Configuration	<ul style="list-style-type: none">• Single Rear Axle bus• Multi Rear Axle bus• Rear Axle Loads	<ul style="list-style-type: none">• Swept Path• Fuelling, Washing, Maintenance, Parking, Circulation, Queuing
Comfort	<ul style="list-style-type: none">• Air-Conditioned Bus• Non Air-Conditioned Bus	<ul style="list-style-type: none">• Height• Washing

Bus Depot Perspectives

Planners Perspective

Location

Activities

Workflow

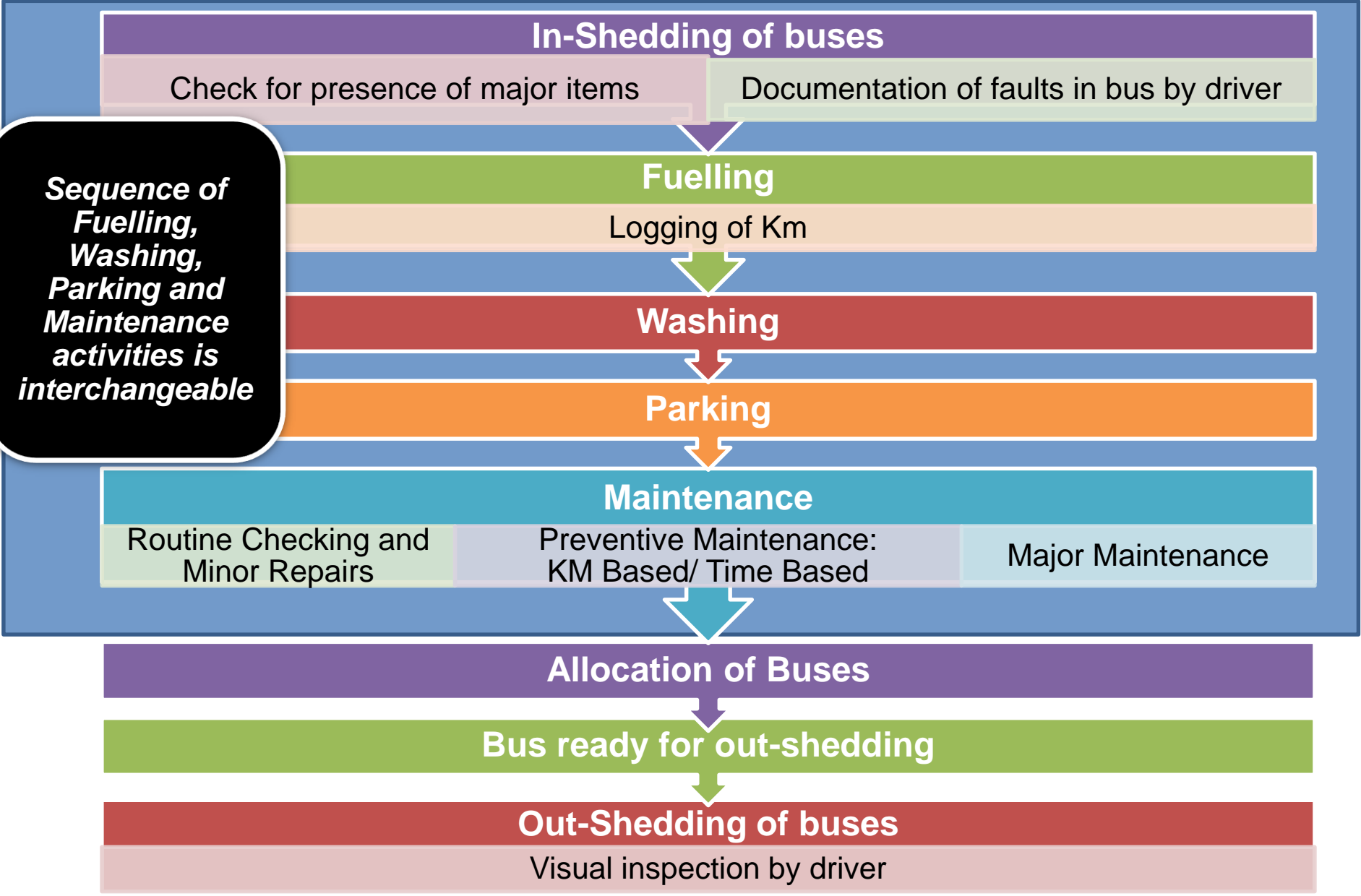
Depot Manager Perspective

Operation

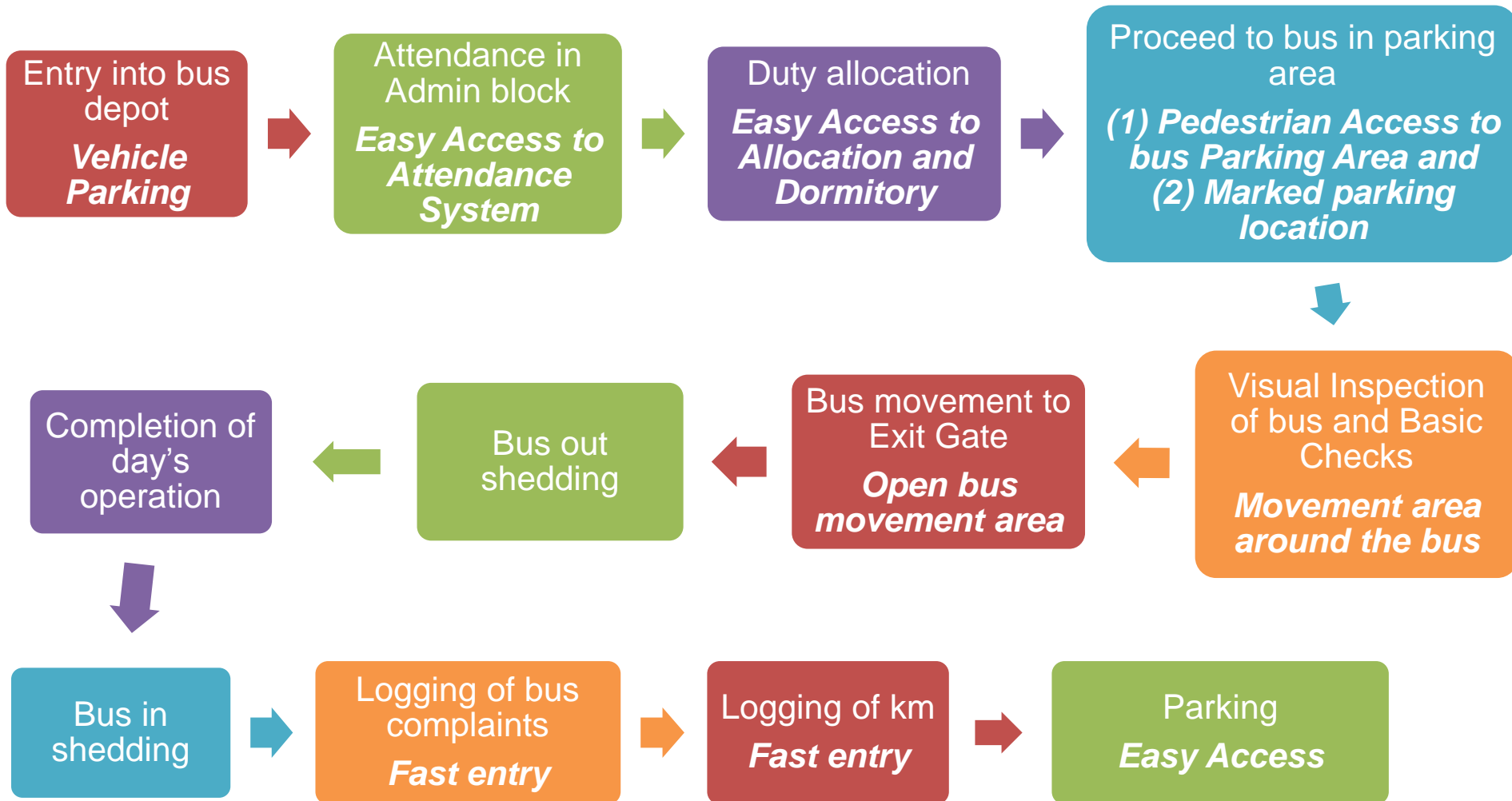
Maintenance

Environment
& Safety

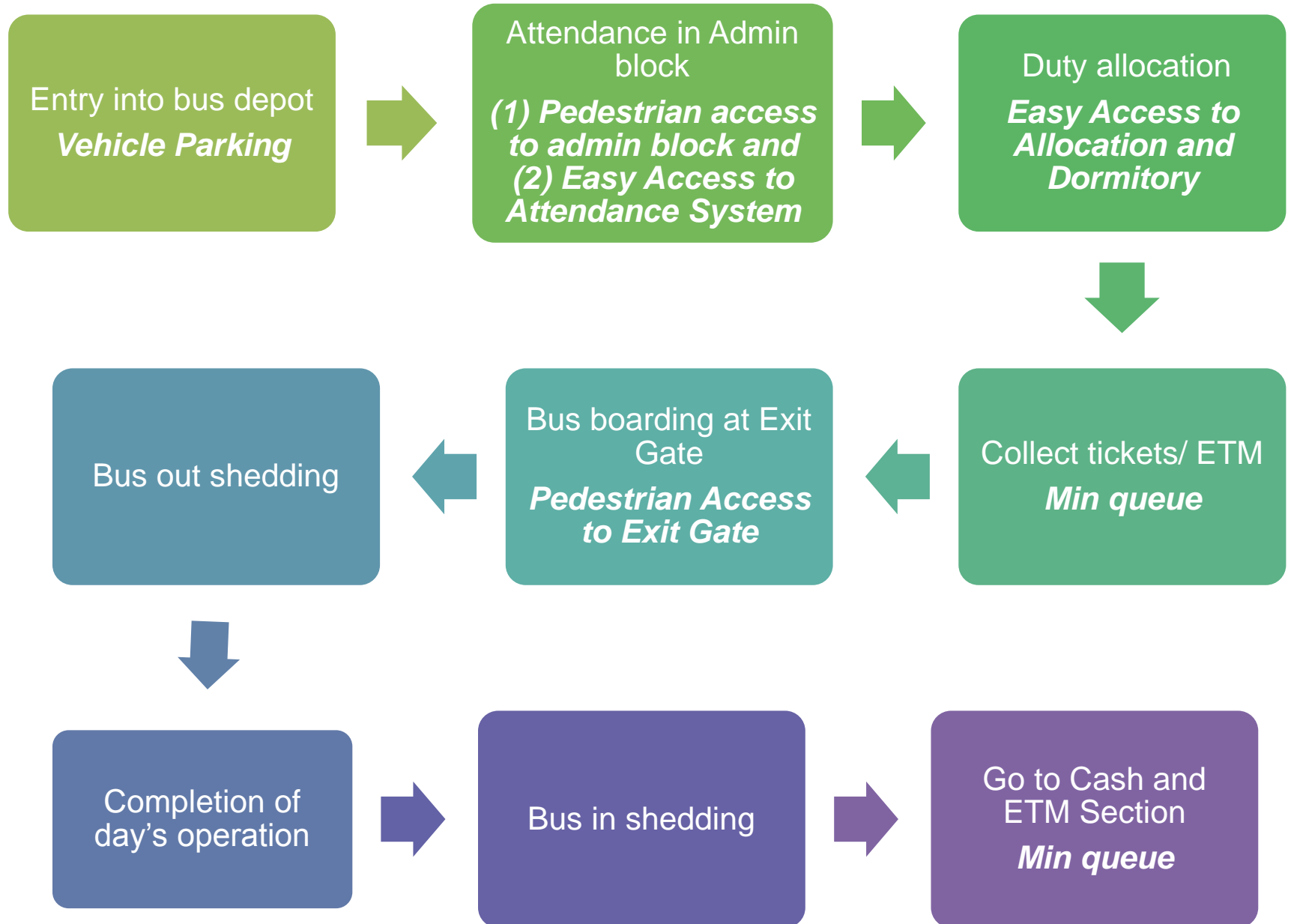
Process Flow



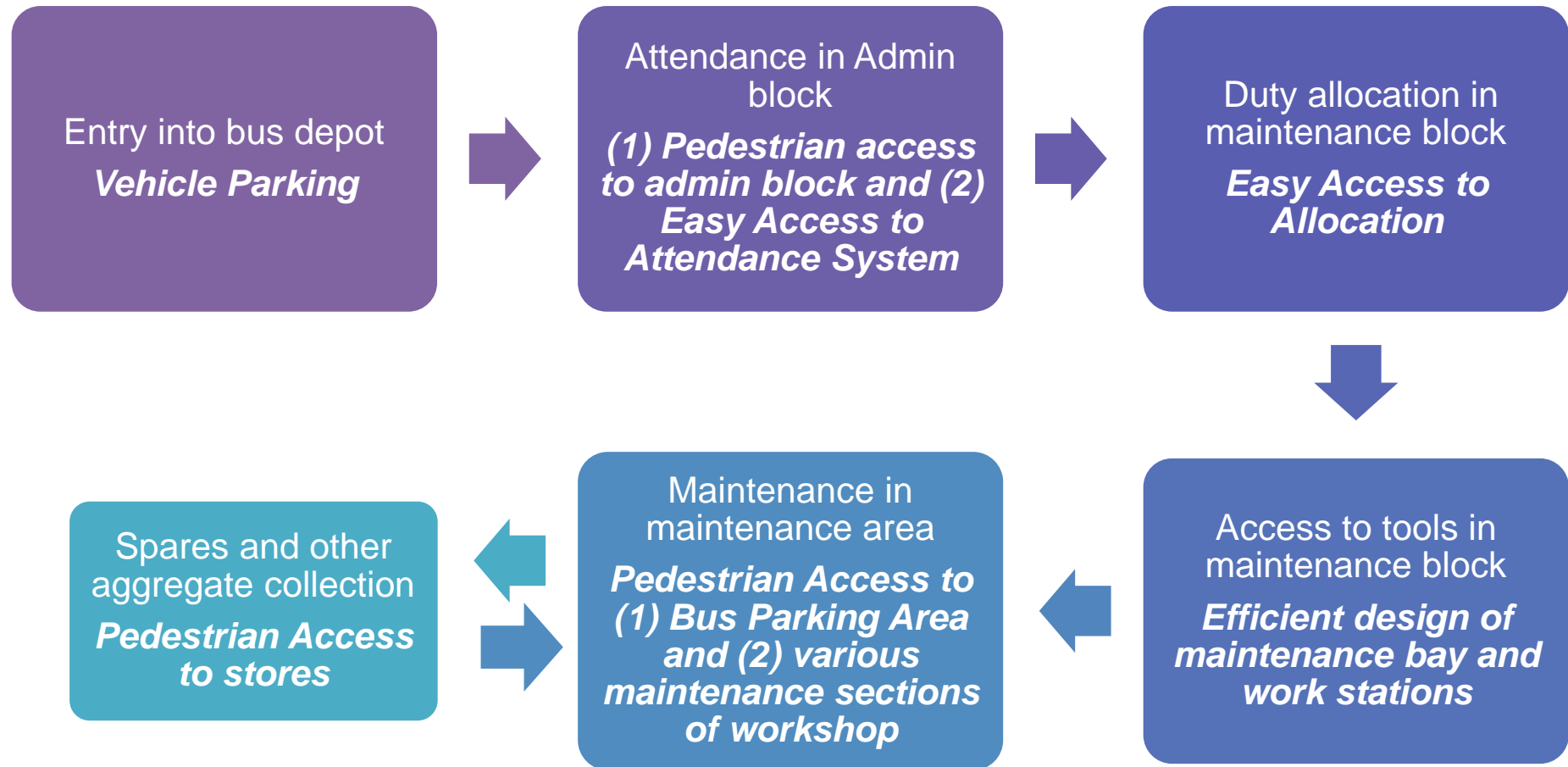
Bus Driver Movement in a Bus Depot



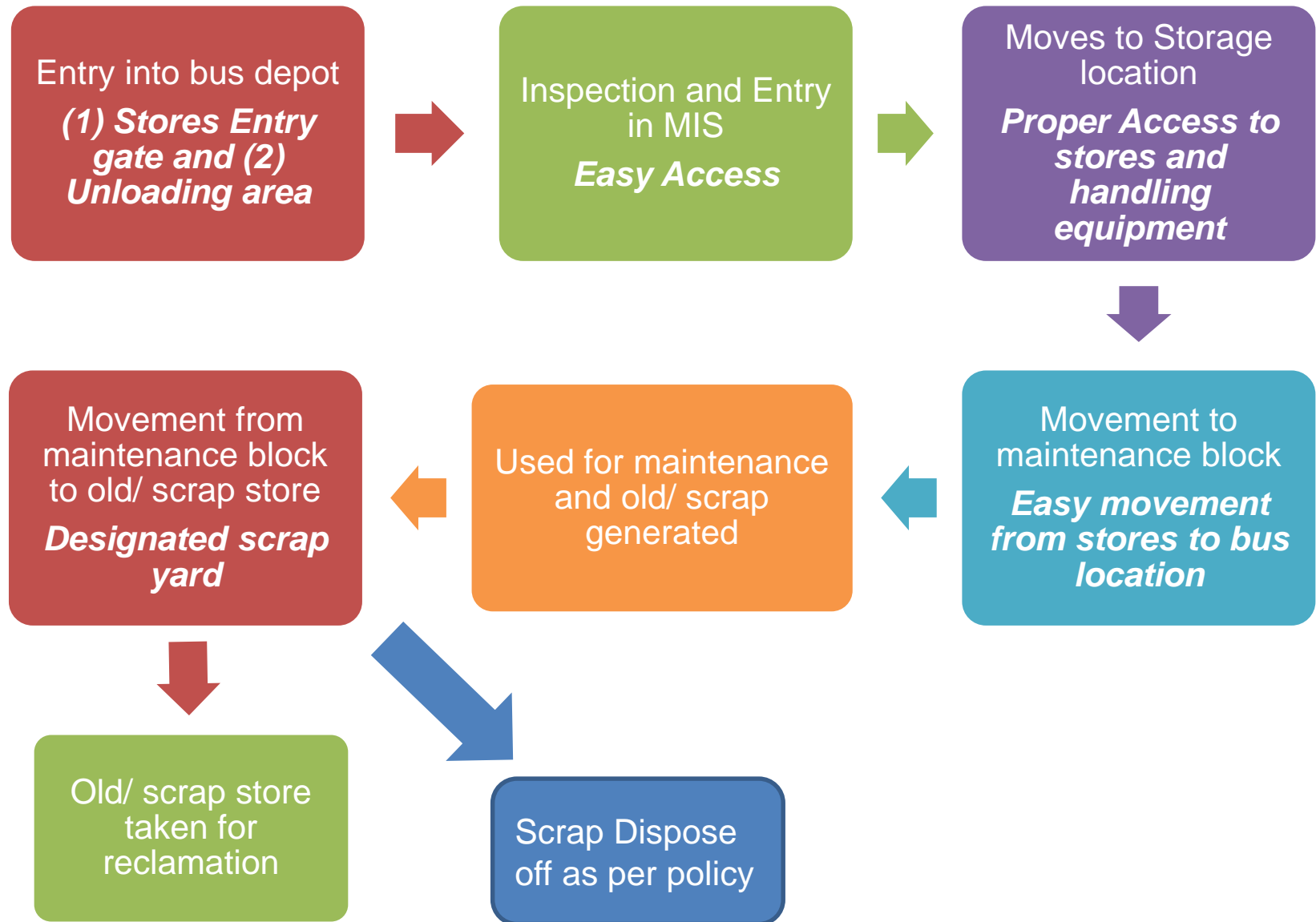
Conductor Movement in a Bus Depot



Maintenance Staff Movement in a Bus Depot



Material Movement in a Bus Depot



Manual Contents

Site Selection

Facilities Planning

Safety &
Security

Utilities
Planning

Environment

Depot Development Process

Site Selection

Evaluation of Multiple Sites

Site Selection – 2 Step Process

Step 1 - Preliminary Screening

- (1) Minimum size
- (2) Minimum width/ frontage
- (3) Ease of procurement
- (4) Land-use restrictions
- (5) Access to Approach roads
- (6) Mitigation measures for environmental issues/ sensitive neighbours
- (7) Low lying areas
- (8) Site preparation costs

Step 2 - Evaluation of Site based on Pre-Determined Parameters

Criteria	Sub-Criteria	Indicative Weightage
Distance from transit centre	Minimize dead mileage cost	20.0%
Access to Public Roads	Full movement access to site with limited traffic disturbance during the peak entry and exit periods	10.0%
Site capacity	Site acreage	10.0%
	Minimum width/ frontage	10.0%
	Shape of site	2.5%
	Expandability	2.5%
Real estate issues	Ease of procurement	5.0%
	Neighbourhood sensitivity issues	10.0%
Environmental issues	Geotechnical and Seismic issues	5.0%
	Forest, wildlife, tree cutting, Wetlands, streams etc. issues	5.0%
Development Cost	Land Cost	10.0%
	Site development cost	4.0%
	Change in land use cost	3.0%
	Mitigation measures for environmental issues	2.0%
	Special design covenants that increase construction cost	1.0%
	Total	100%

Bus depot Site – to be reserved in Master plan of the city

- Comprehensive City Mobility Plan - for identification of suitable land for bus depots
- Identified land should be immediately procured to avoid escalations in price of land.
- Number of Depots - city bus operations plan and CMP

Size of Land Parcel

Size of land parcel is assessed by evaluating the space requirement of individual facilities/ components in the depot.

Area	50 Bus Depot		100 Bus Depot		150 Bus Depot		200 Bus Depot	
	No	Area (sqm)	No	Area (sqm)	No	Area (sqm)	No	Area (sqm)
Fuelling Area	2	200	2	200	3	300	4	400
Washing Area	1	100	2	200	2	200	3	300
Maintenance Bays/ Pits	4		7		11		14	
Inspection Area	2	160	4	320	6	480	8	640
Workshop Area including stores		1100		1600		2000		2400
Bus Parking	50	2500	100	5000	150	7500	200	10000
Admin Area		600		750		1100		1400
Staff Parking		1000		1250		1500		1750
Scrap Yard		250		350		450		600
Sub Station		250		350		450		600
Green Area		600		950		1250		1500
Circulation & Queuing Area		5700		8200		10500		12500
Total Area		12,460		19,170		25,730		32,090
Land Area (acres)		3.08		4.74		6.36		7.93
Area per bus (sqm)		250		192		172		161

Shape of Land Parcel

- Level square or rectangular piece of land is particularly suited.
- Minimum frontage should be ensured for smooth depot operations.

SN	Activity	Approx. Size
1.	Entry/ Exit Gate – 2 (including adjoining structures)	17 m
2.	Staff/ Private Vehicles Entry Gate – 1 (including adjoining structures)	8 m
3.	Other for circulation and segregation of vehicles and operational requirements	50 m
	Total	75 m ~ 90 m of Minimum Frontage/ width is required

Facilities Planning

Entry/ Exit

Fuelling

Washing

Parking

Maintenance

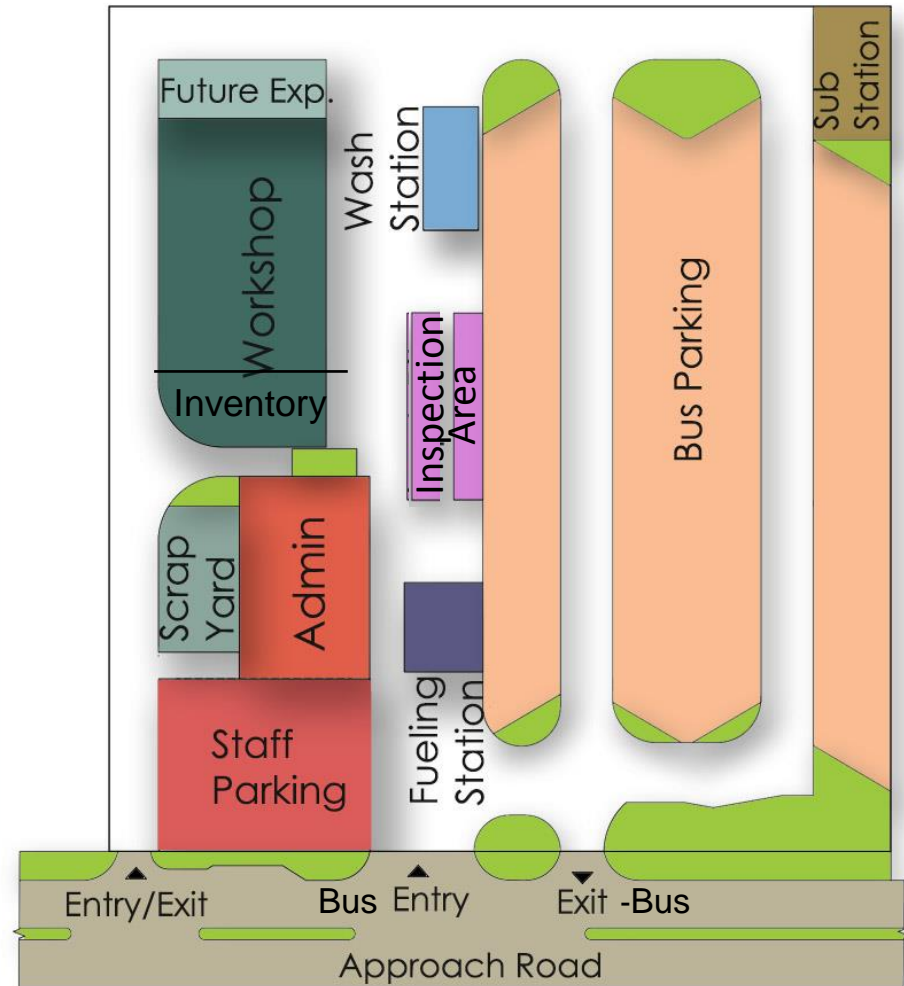
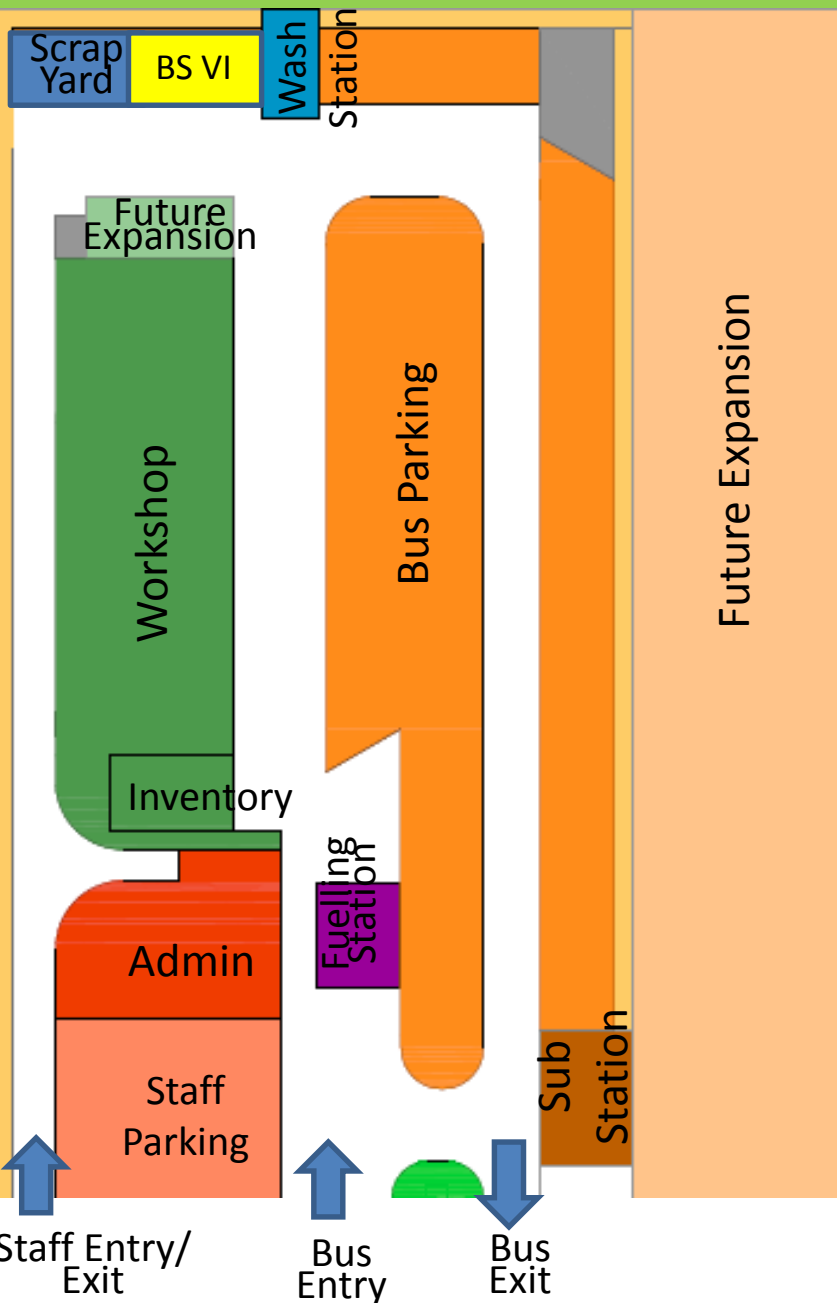
- Routine Maintenance
- Maintenance in bench work areas/ machine shop
- Wheel and tyre activities
- Alignment testing
- Brake testing

Administrative Block

- Attendance of staff/ crew
- Cash handling
- ETM handling and charging
- Staff/ Crew amenities
- Administrative work
- Training & Development

Inventory/ storage work

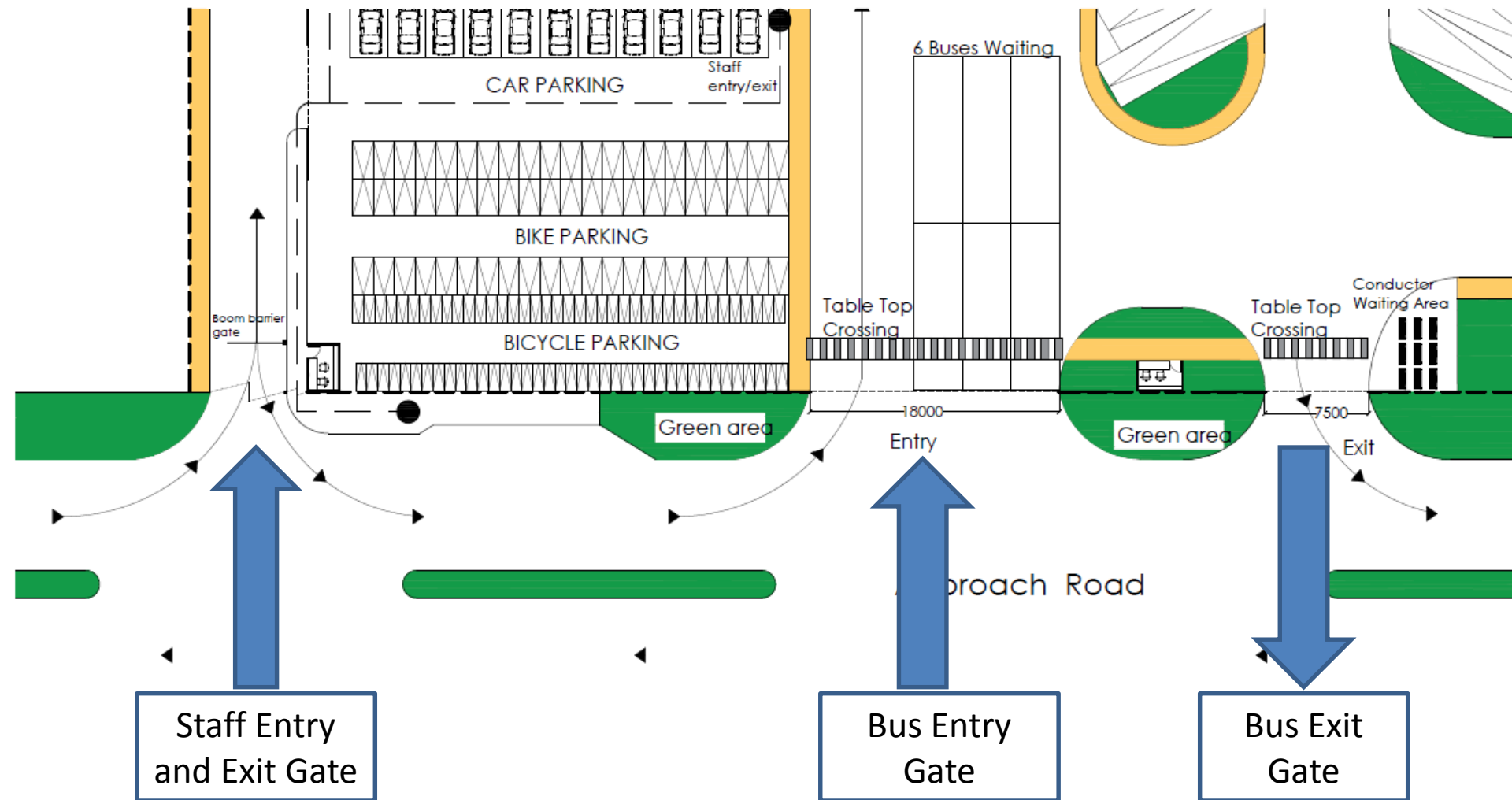
Storage and disposal of scrap



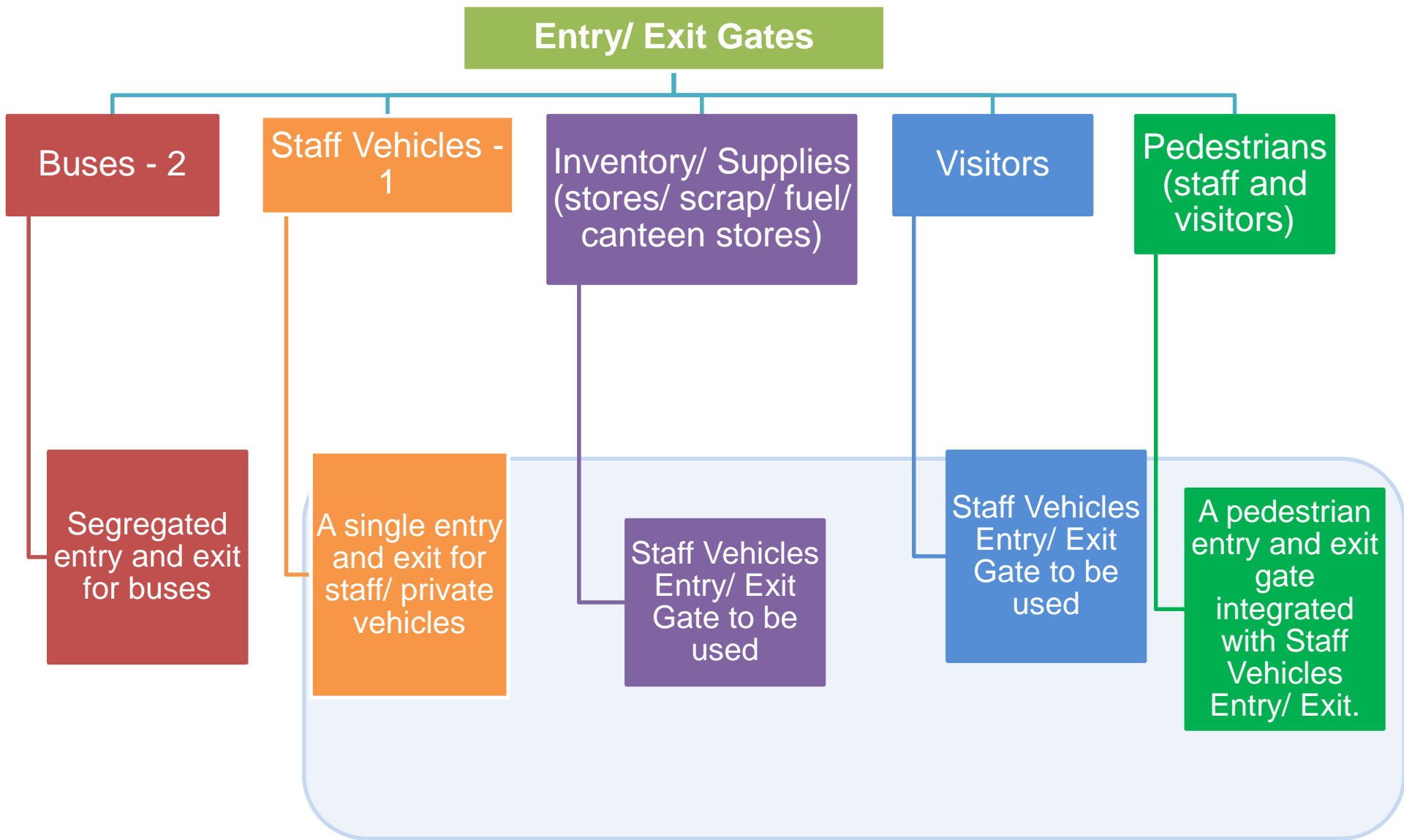
- The layout of facilities is designed based on
- Work flow
 - Minimal and conflict free movement of bus, personnel and material.

Entry and Exit

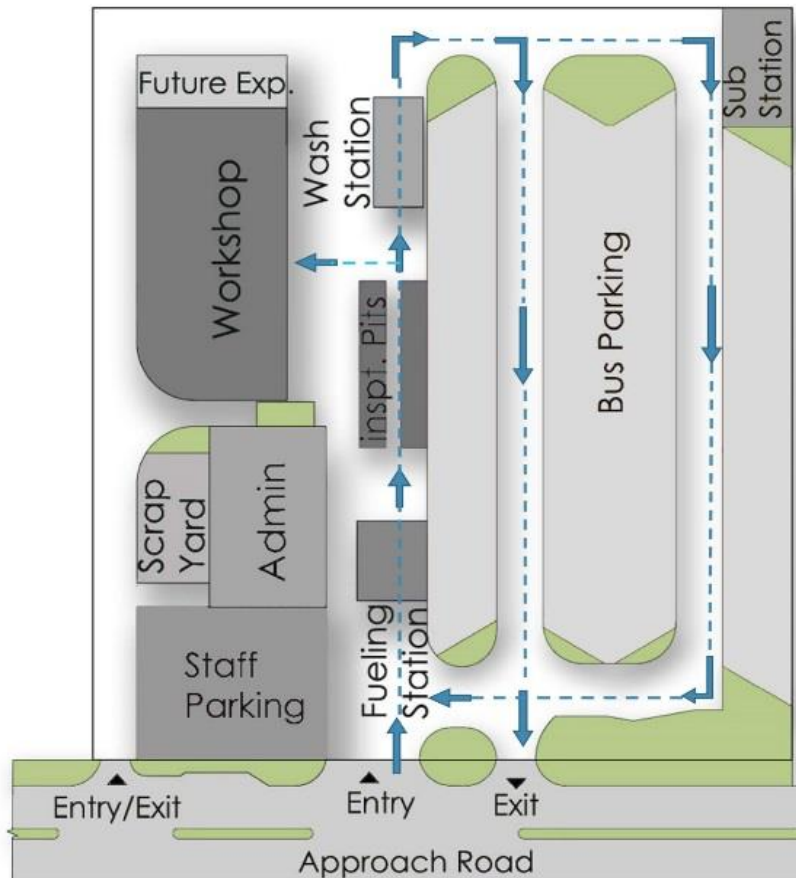
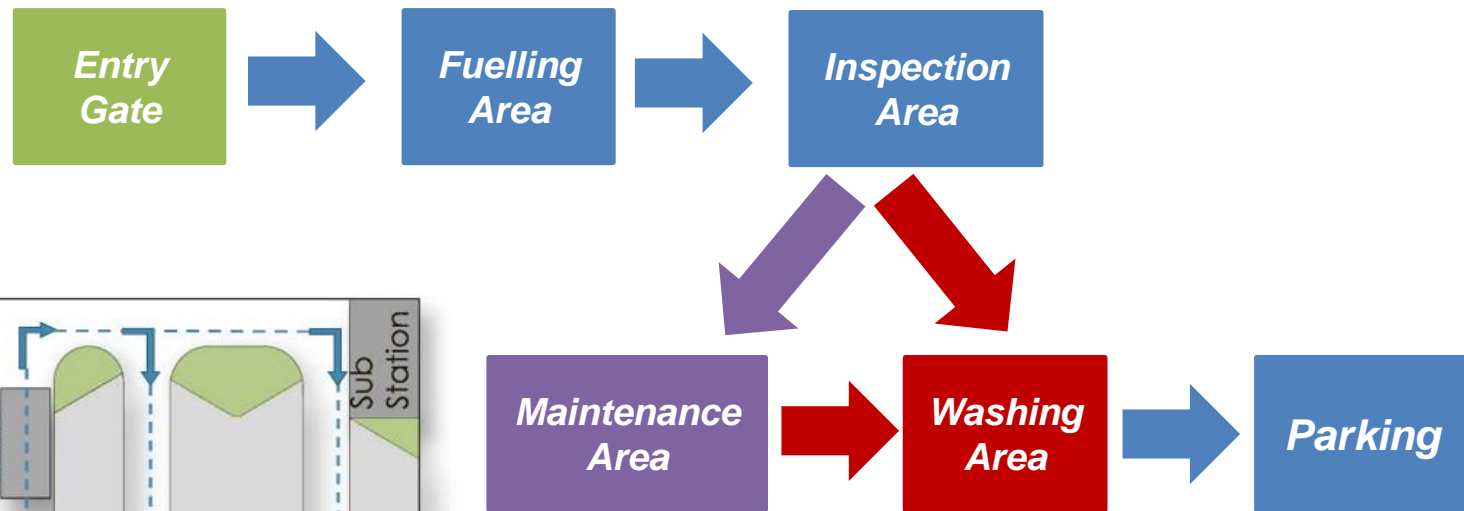
Entry and Exit



Traffic impact analysis needs to be undertaken to assess the impact of bus traffic on the main road and intersections need to be designed accordingly.

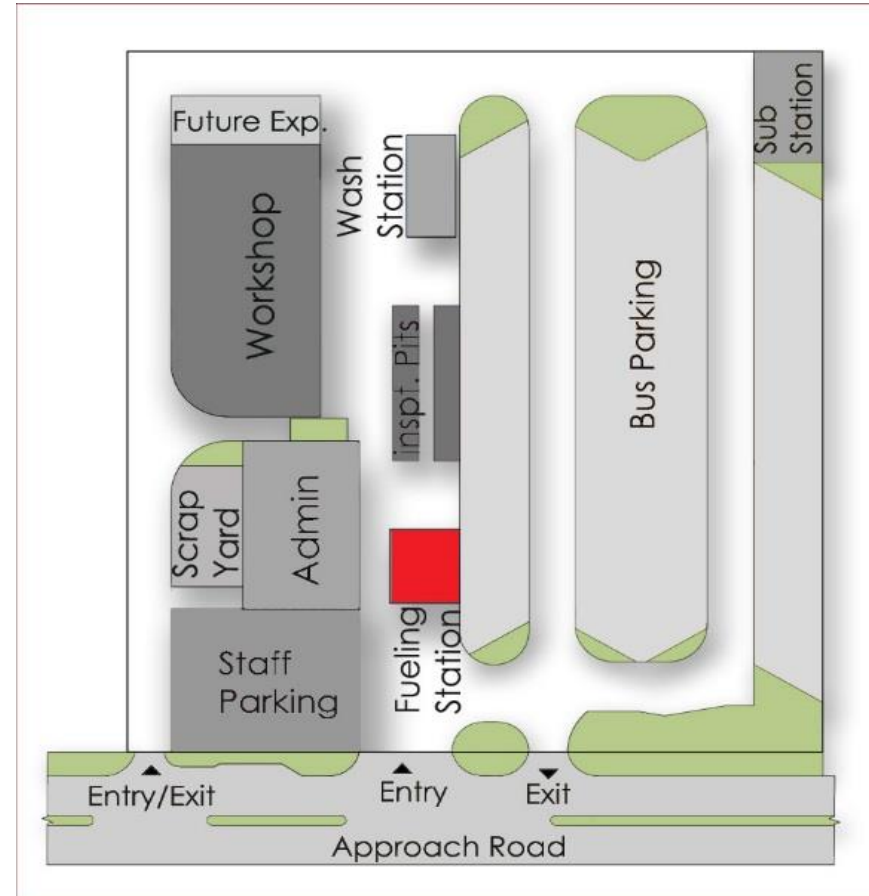
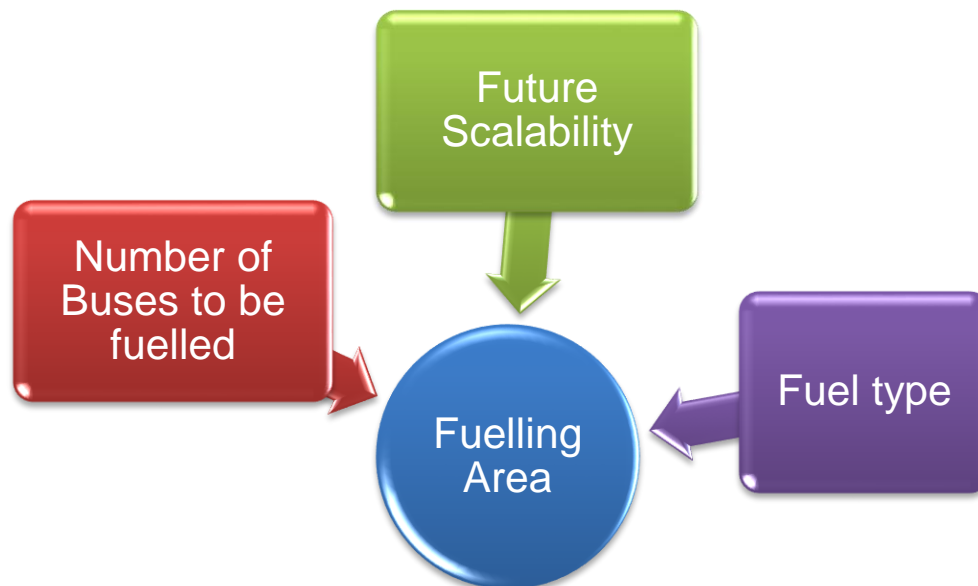


Bus Movement



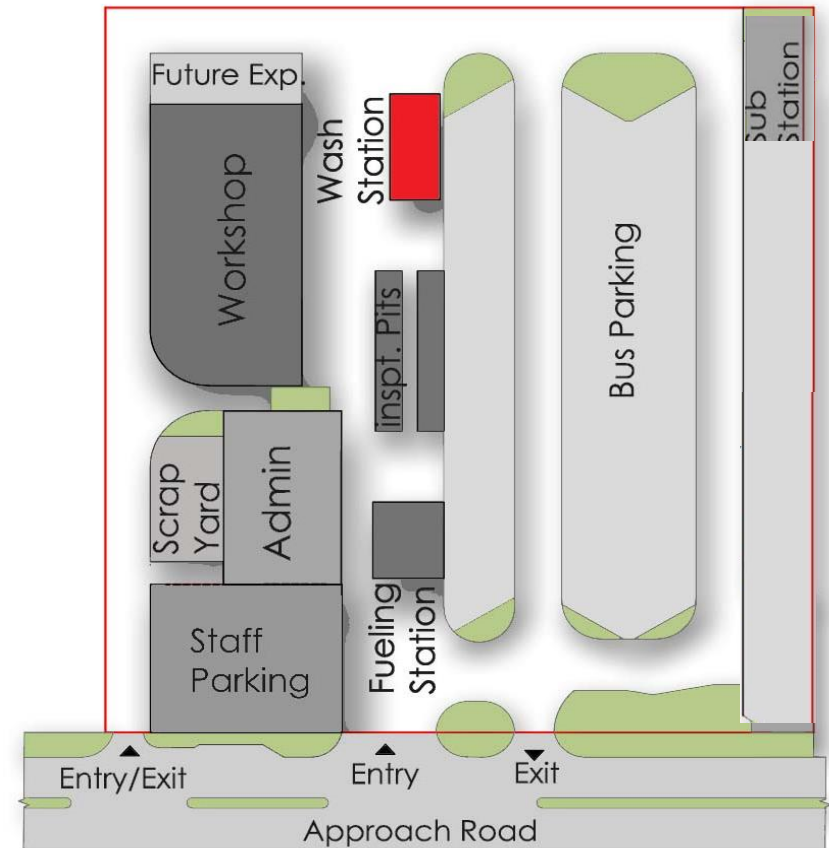
- Movement of the bus within the bus depot should be unidirectional.
- Placement of facilities should facilitate unidirectional movement.

- **Diesel bus depots**, 2 fuelling bays with 4 nozzles for 100 buses.
 - Layout based on OMCs requirements.
- **CNG bus depots**, 2 CNG dispensers for 100 buses.
- **HCNG bus depots**, HCNG reformer plant is required.
- **Electric buses**, charging at the parking
 - Provision of a min 2m space for charging station and cable network.

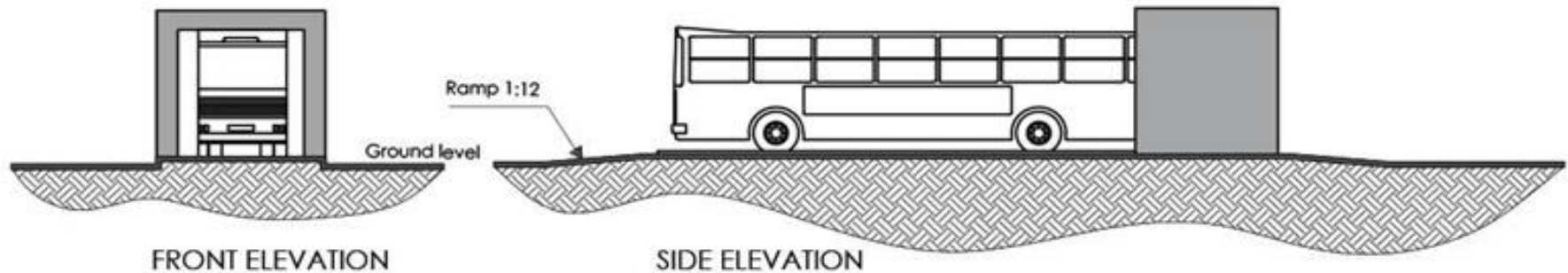
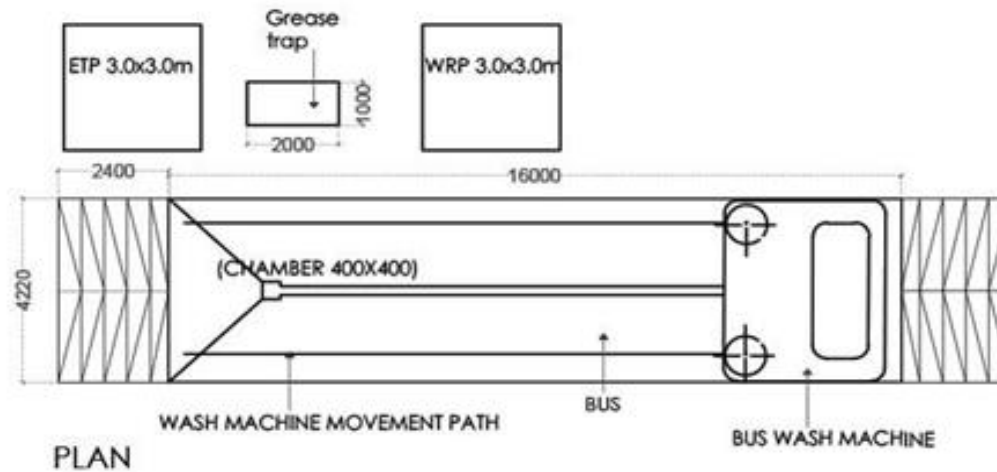


- 2 washing bays for 100 buses.
 - 1 washing bay for additional 50 buses.

An automatic bus washing system based on OEM specifications.



Washing Area – Illustrative Layout



- Space provisioning based on space requirement of equipment to be housed.

Non-individual space	=	informed estimates based on existing good practice or comparable examples + an additional factor for primary circulation
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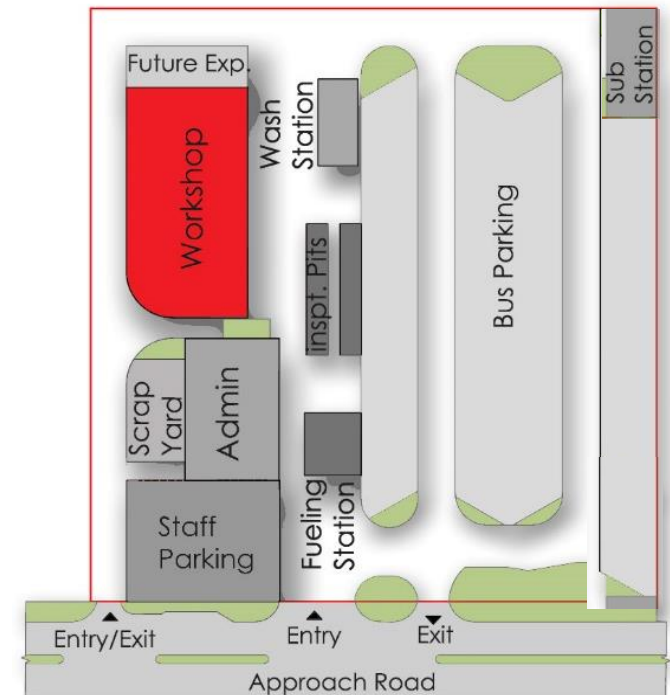
Sections in the maintenance area

- Wheel & Tyre Section
- Battery Section
- Auto Electrical/
Electronic Section
- General (Admin &
Maintenance) Section
- Radiator Section
- Pits/ Bays & General
Maintenance Area

Unitary Bus Depot

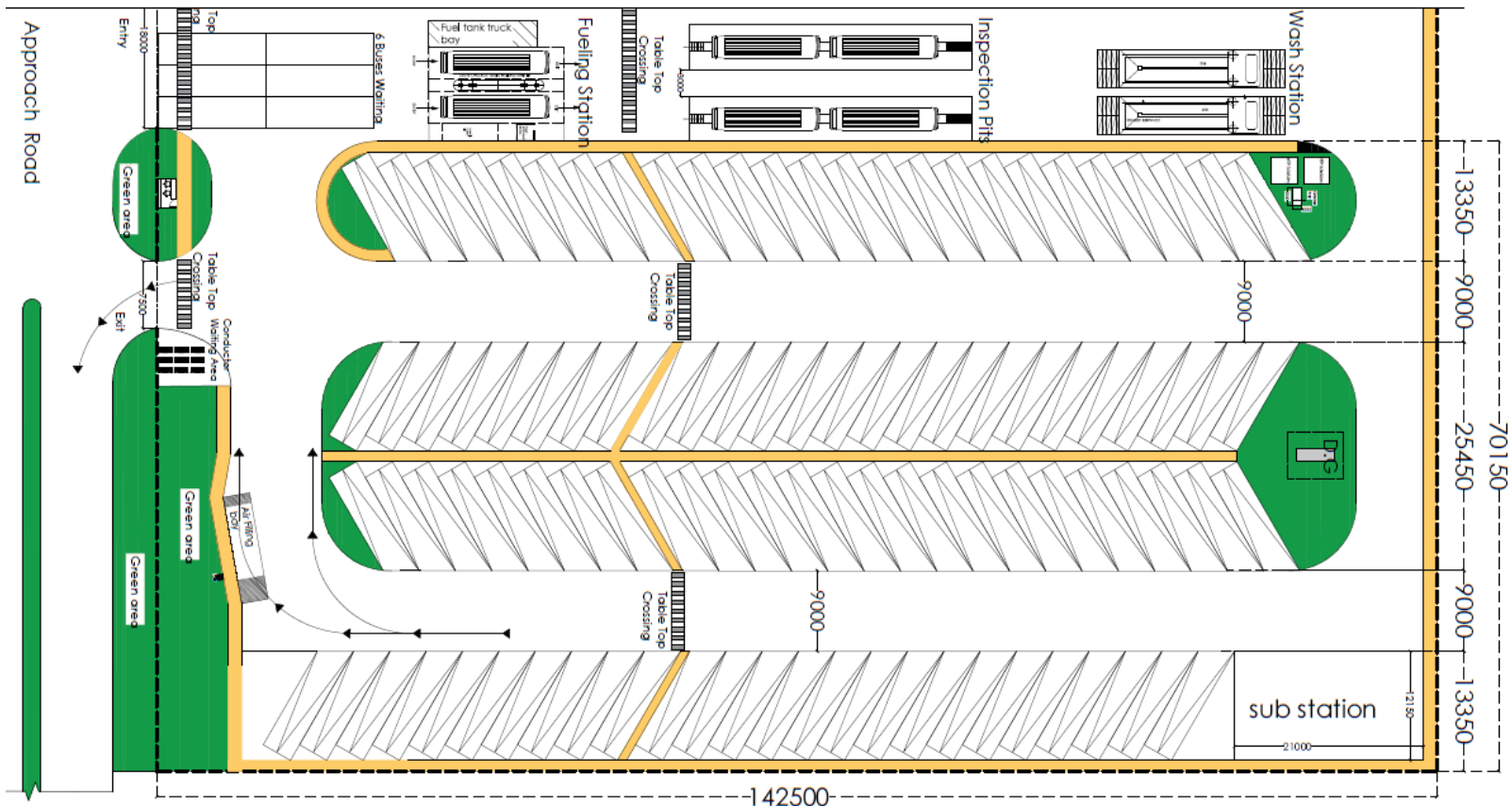
- Machine Shop
- Body Shop
- Fuel Injector
Section
- Reconditioning of
Major Aggregates
Section

Central/ Regional Bus Depot

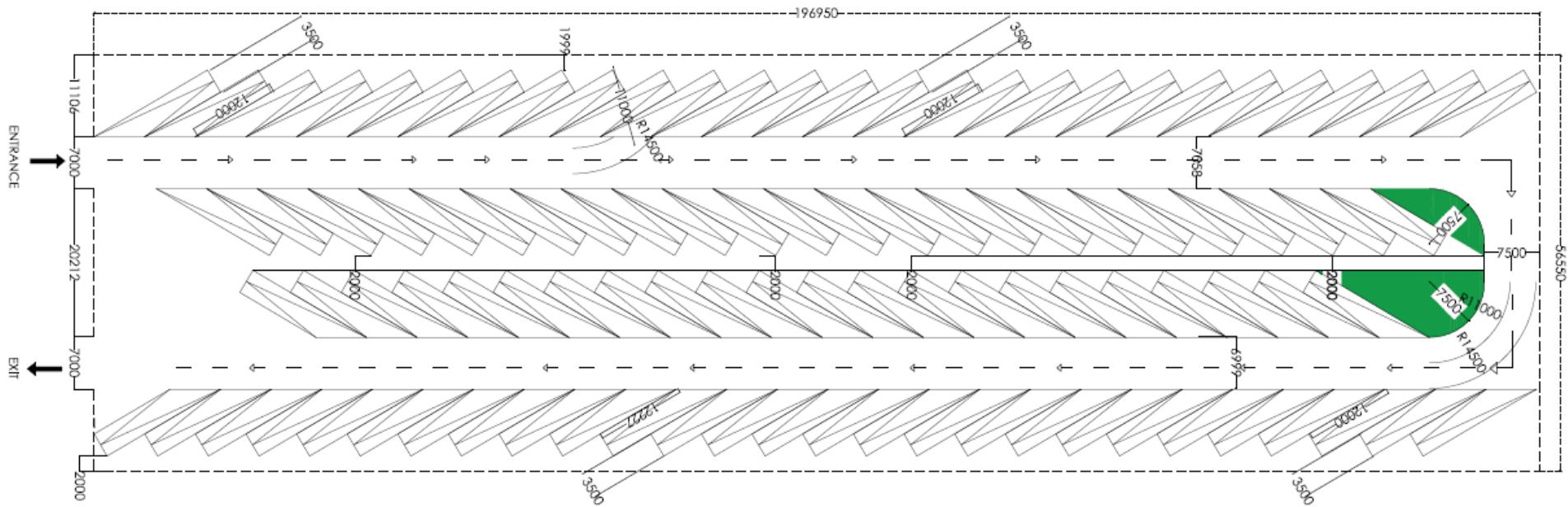


- Integrated bus depots – in smaller cities

- Parking to be designed to ensure minimum maneuvering for bus parking and retrieval and ease of circulation.
- Angular parking 60° is the preferred parking
- Thermosetting resins should be used for marking bus movement corridor.
- In case covered parking is planned than installation of solar plant should be considered.

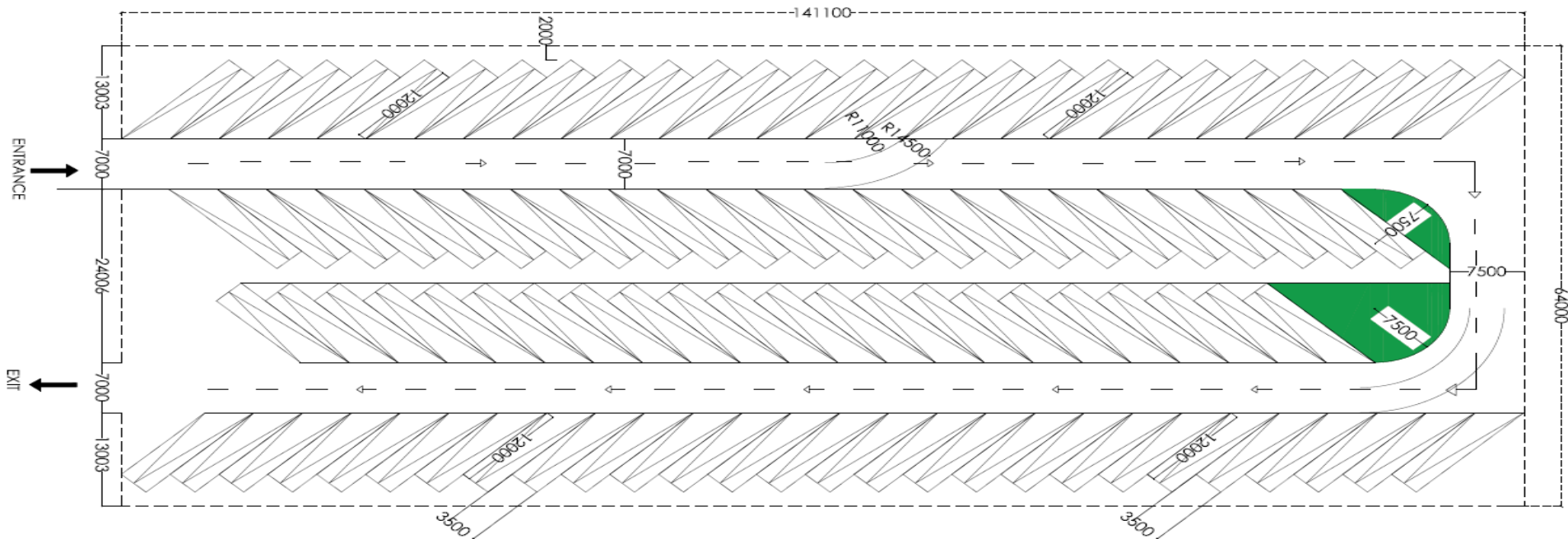


Parking Configuration Options ... 1



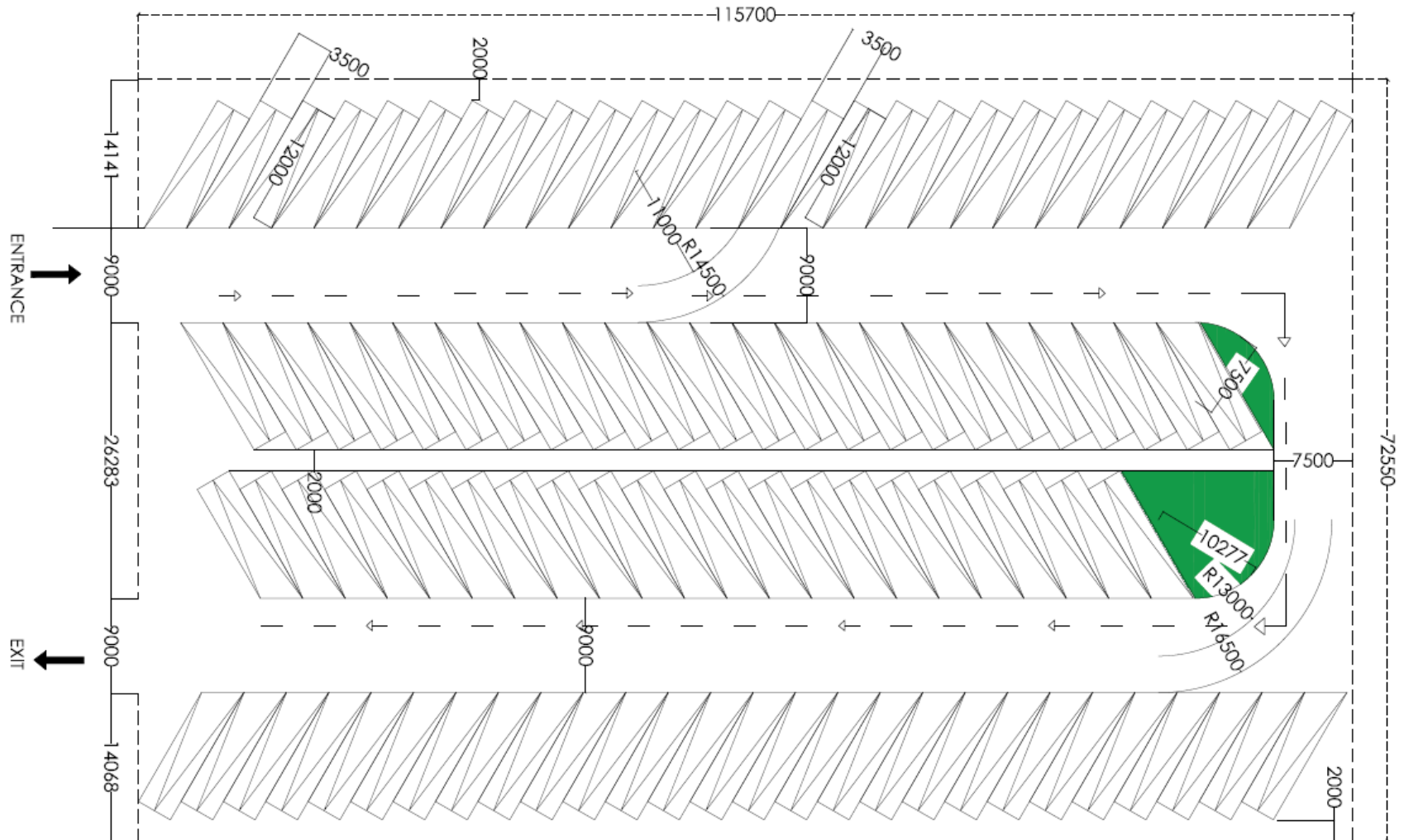
Angular 30° Parking Configuration

Parking Configuration Options ... 2



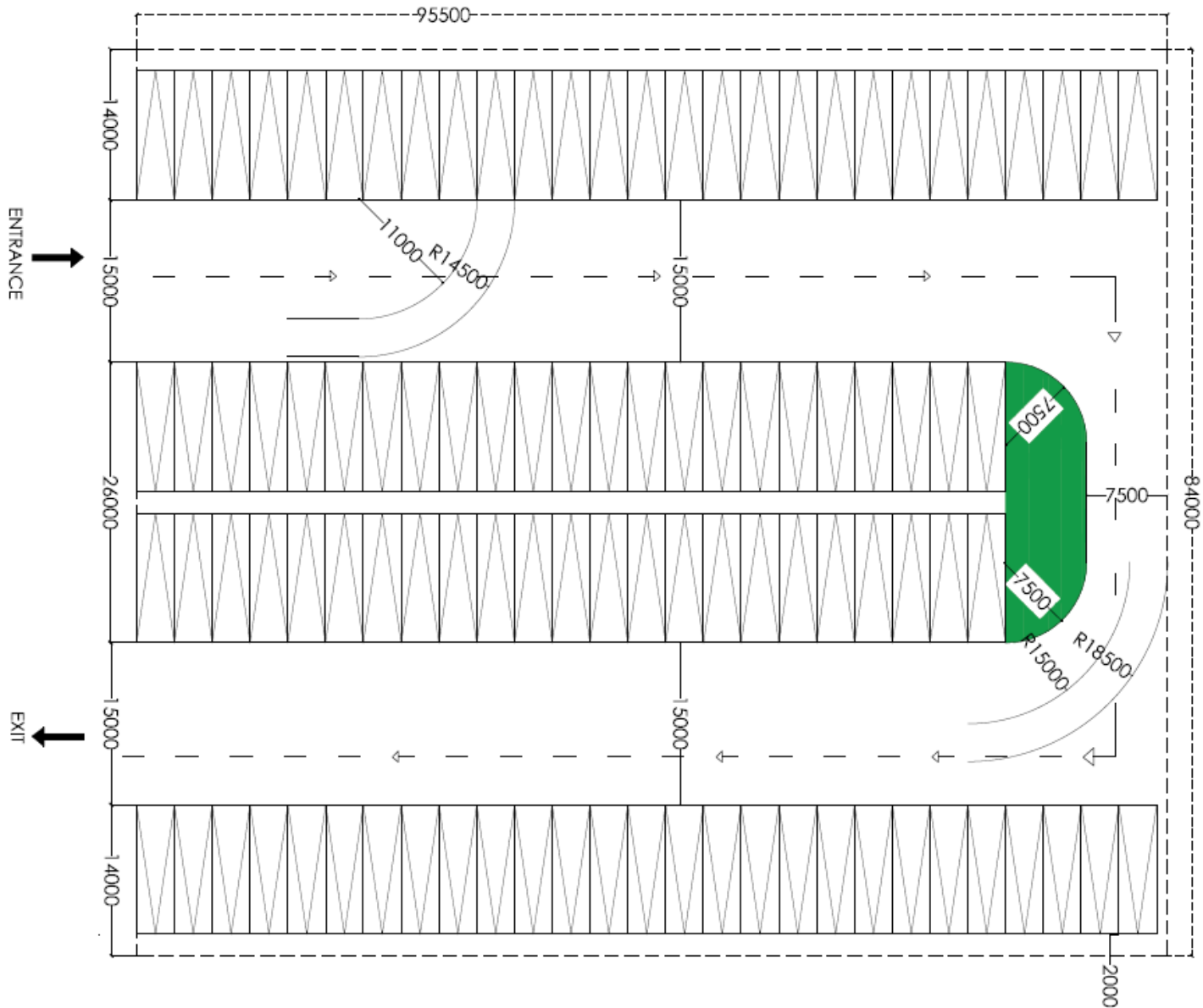
Angular 45° Parking Configuration

Parking Configuration Options ... 3



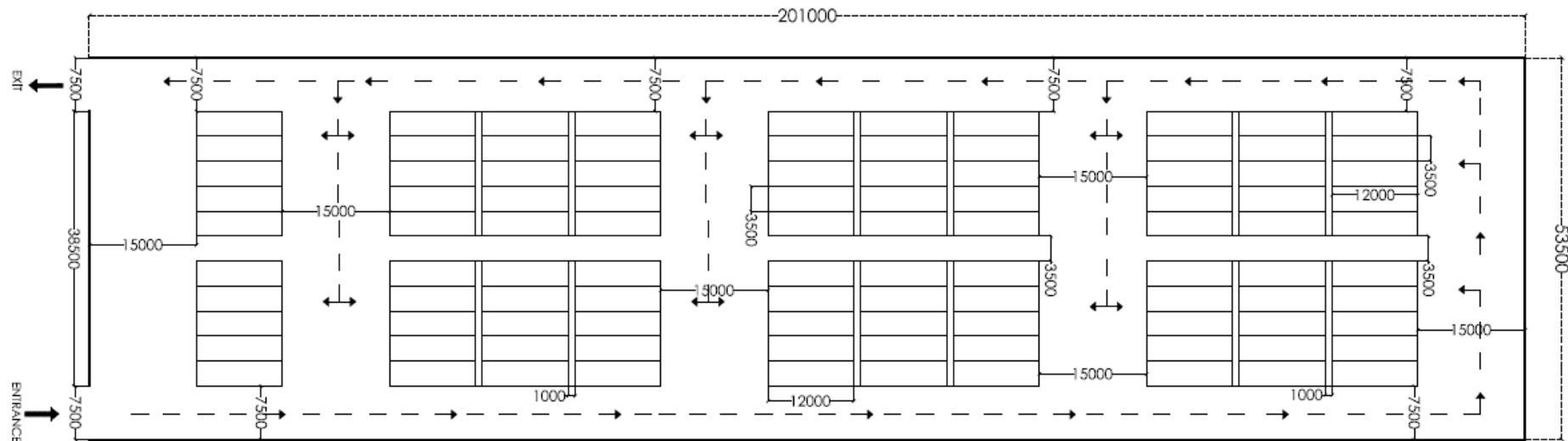
Angular 60° Parking Configuration

Parking Configuration Options ... 4



Row Parking Configuration

Parking Configuration Options ... 5



Inline Parking Configuration

Design Philosophy Tenets

Eliminating potential barriers in planning which might discourage conversion to multilevel depot, in future

Seamless integration of the facility on different floors and corresponding bus circulation

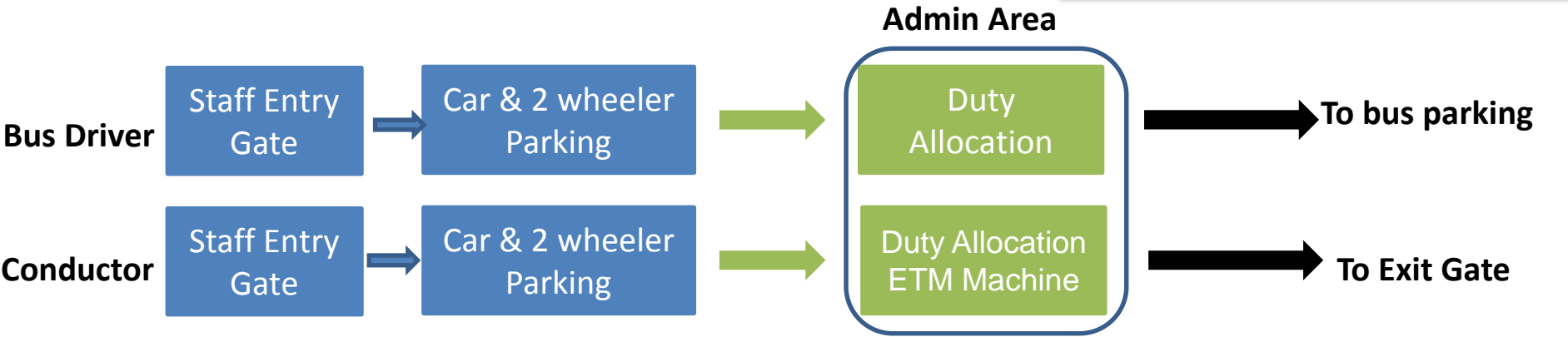
Minimising turnaround time per bus

Development of associated infrastructure for ease of entry/exit

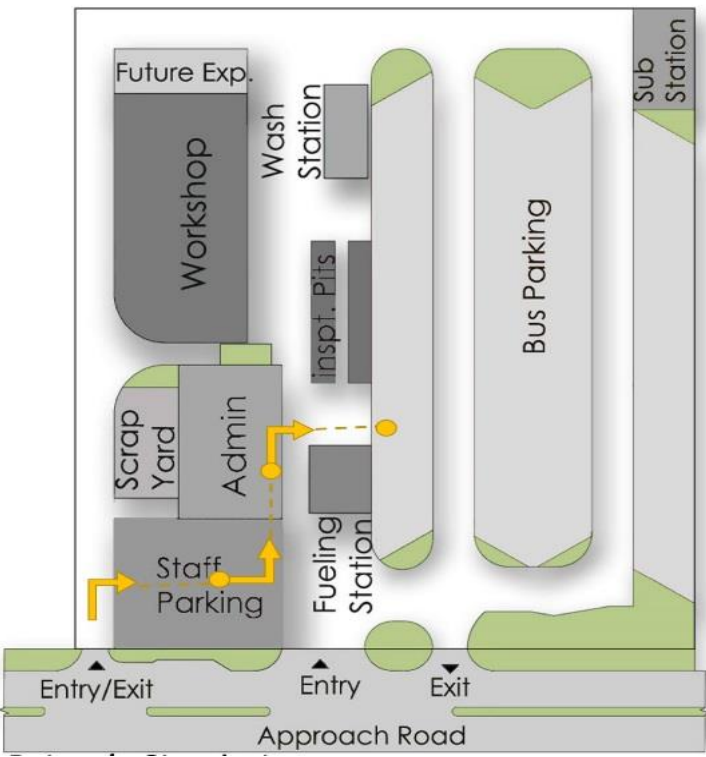
Safety and security aspects

SN	Parameter	Value
1	Cost of procurement of additional land	A
2	Dead mileage for all the buses for the horizon period	B
3	Cost of construction of multilevel depot at the same site	C
Whenever, C is less than $(A + B)$, the multilevel depot should be constructed		

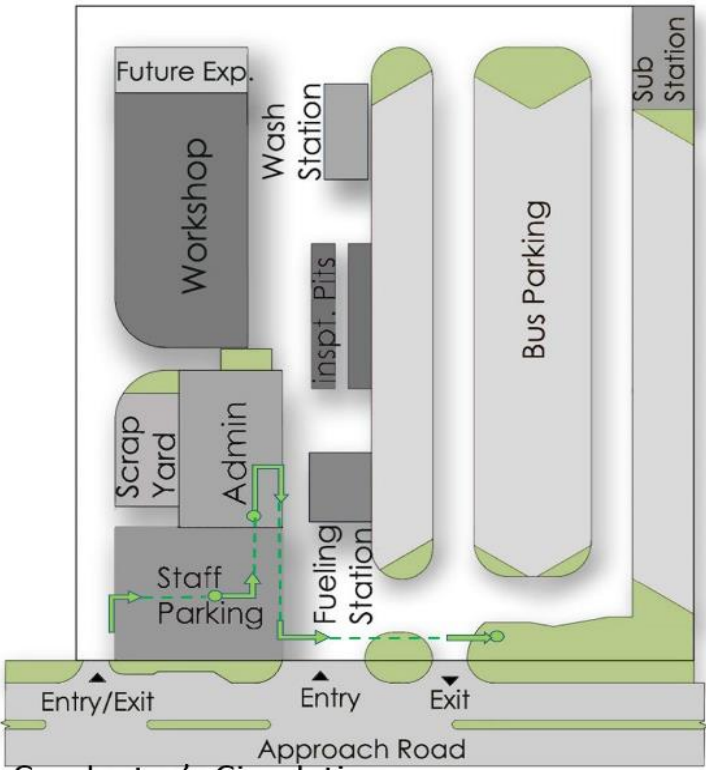
Staff Movement



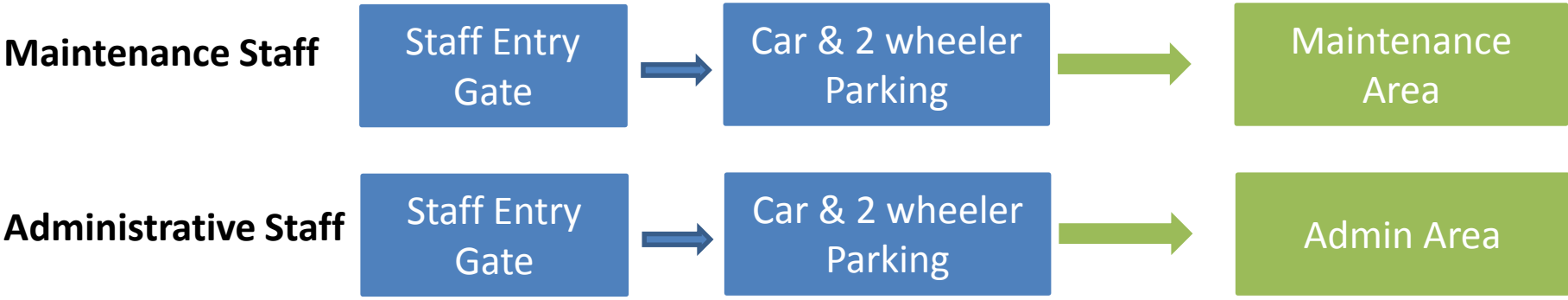
Bus Driver Movement



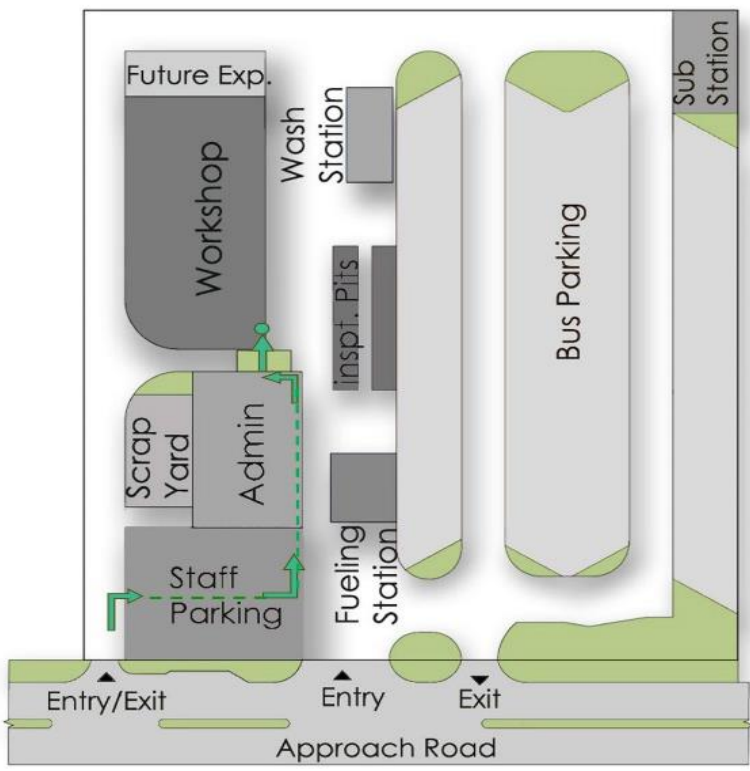
Bus Conductor Movement



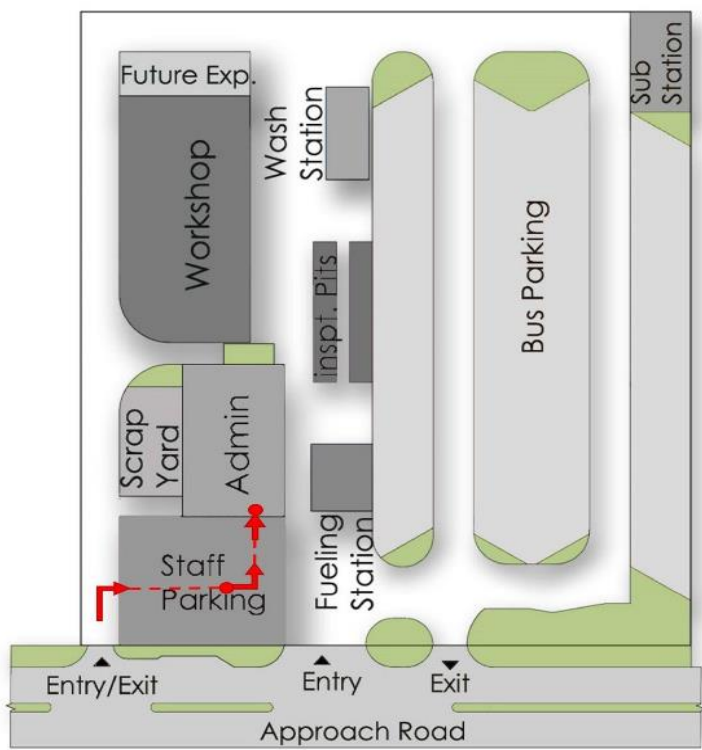
Maintenance and Admin Staff Movement



Maintenance Staff Movement

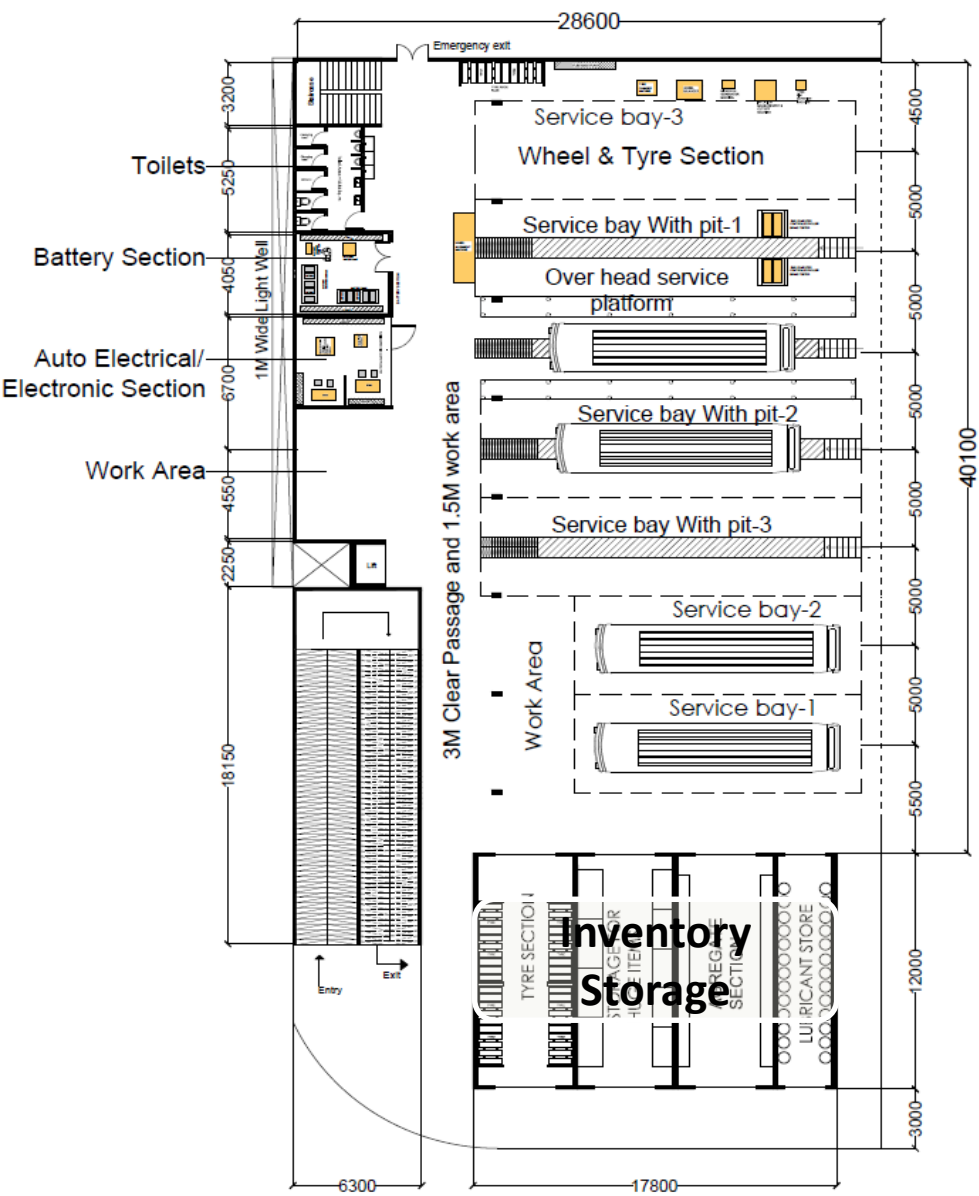


Admin Staff Movement

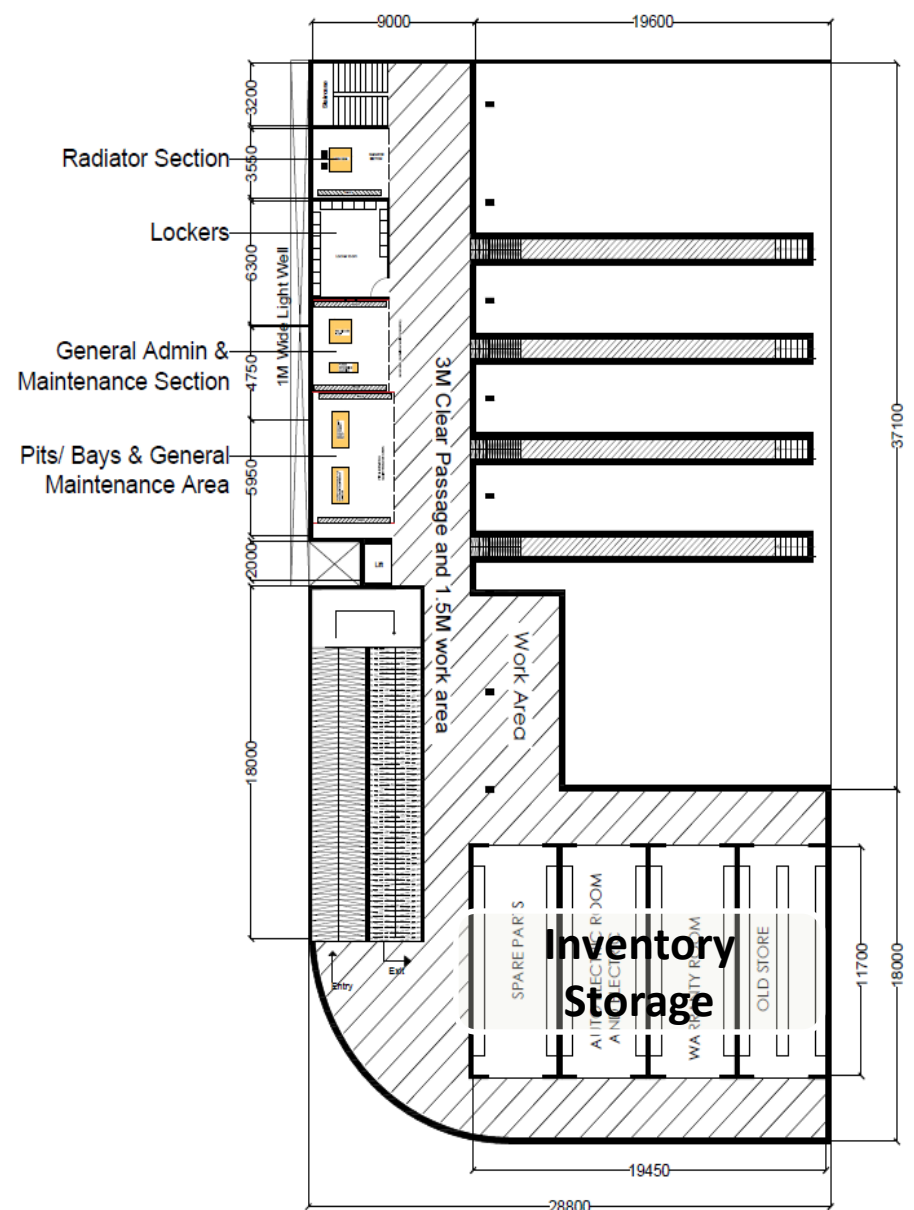


Maintenance Staff Movement

Maintenance Area – Illustrative Layout



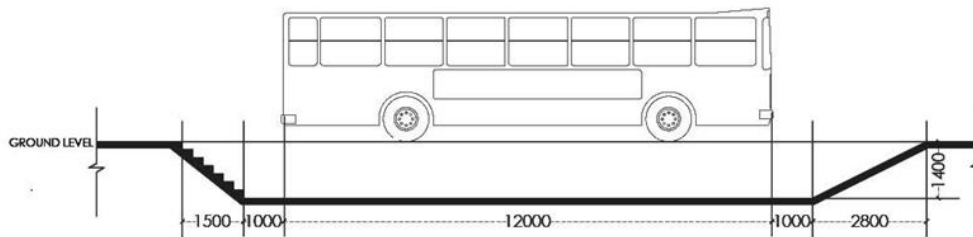
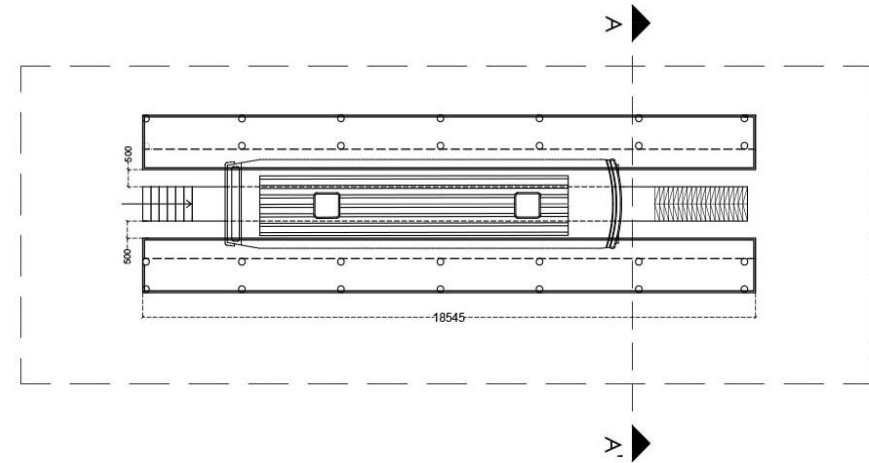
Ground Level



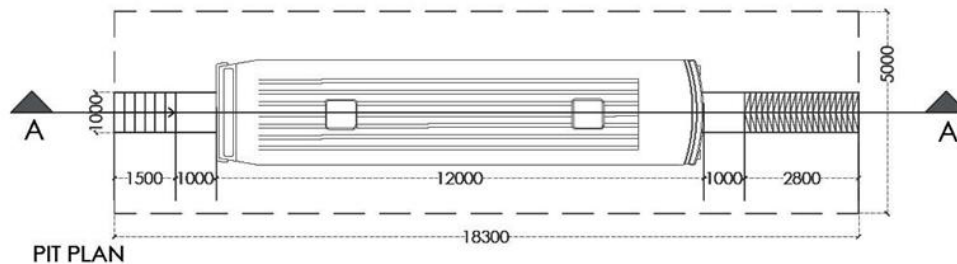
Basement Level

For a 100 bus depot

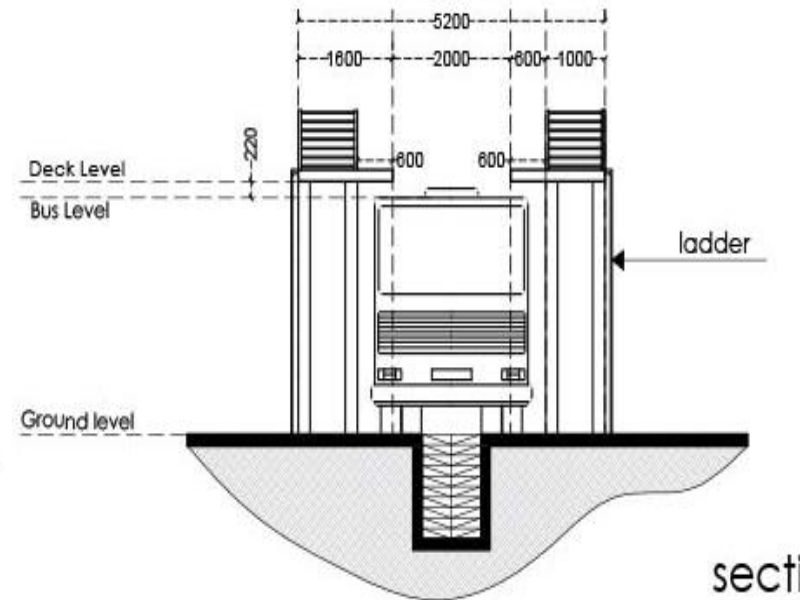
- 8 Maintenance pits
- 3 Maintenance bays
- Wheel section – 1 pit and 2 bays
- One movable column lift



PIT SECTION -AA'



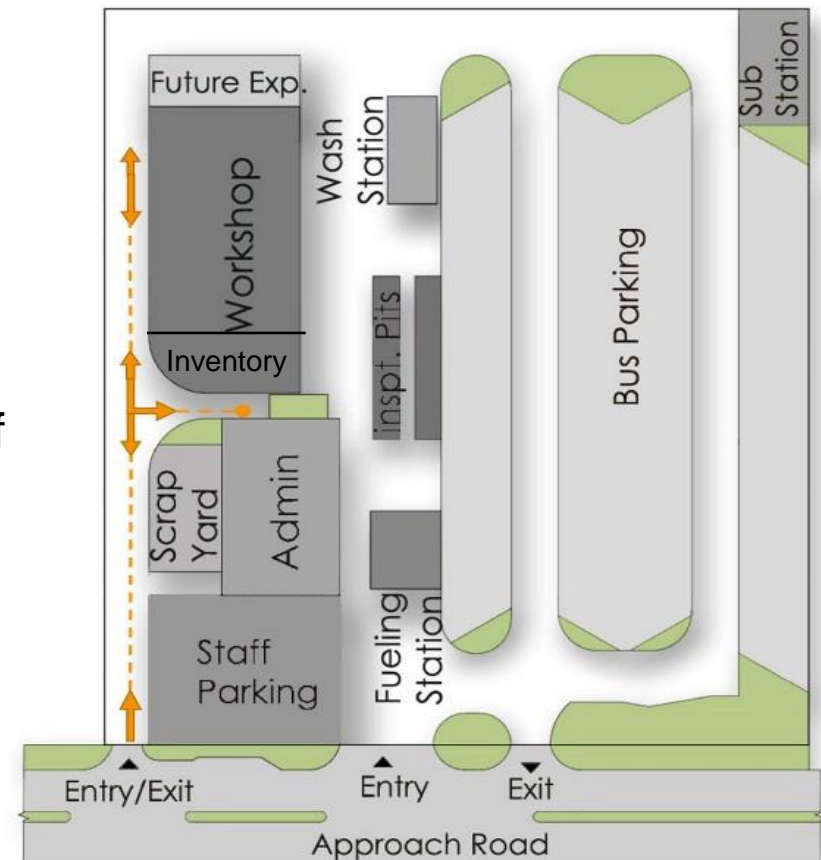
PIT PLAN



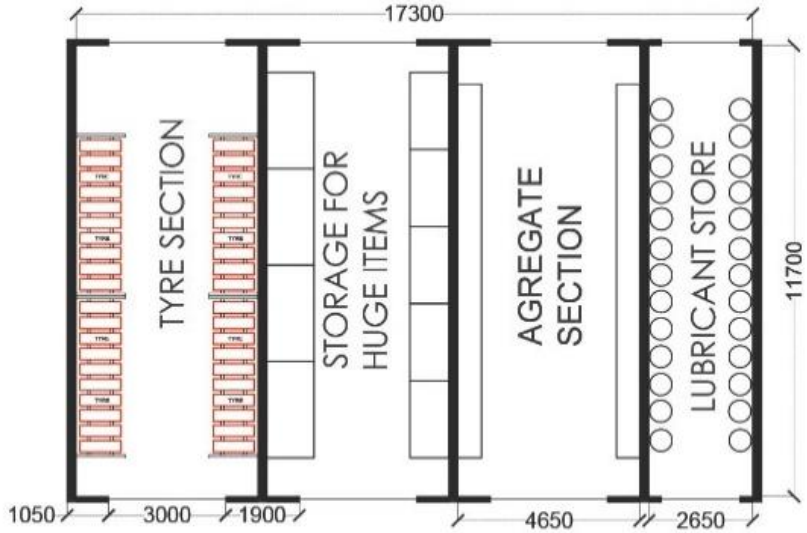
section

Inventory and Material Movement

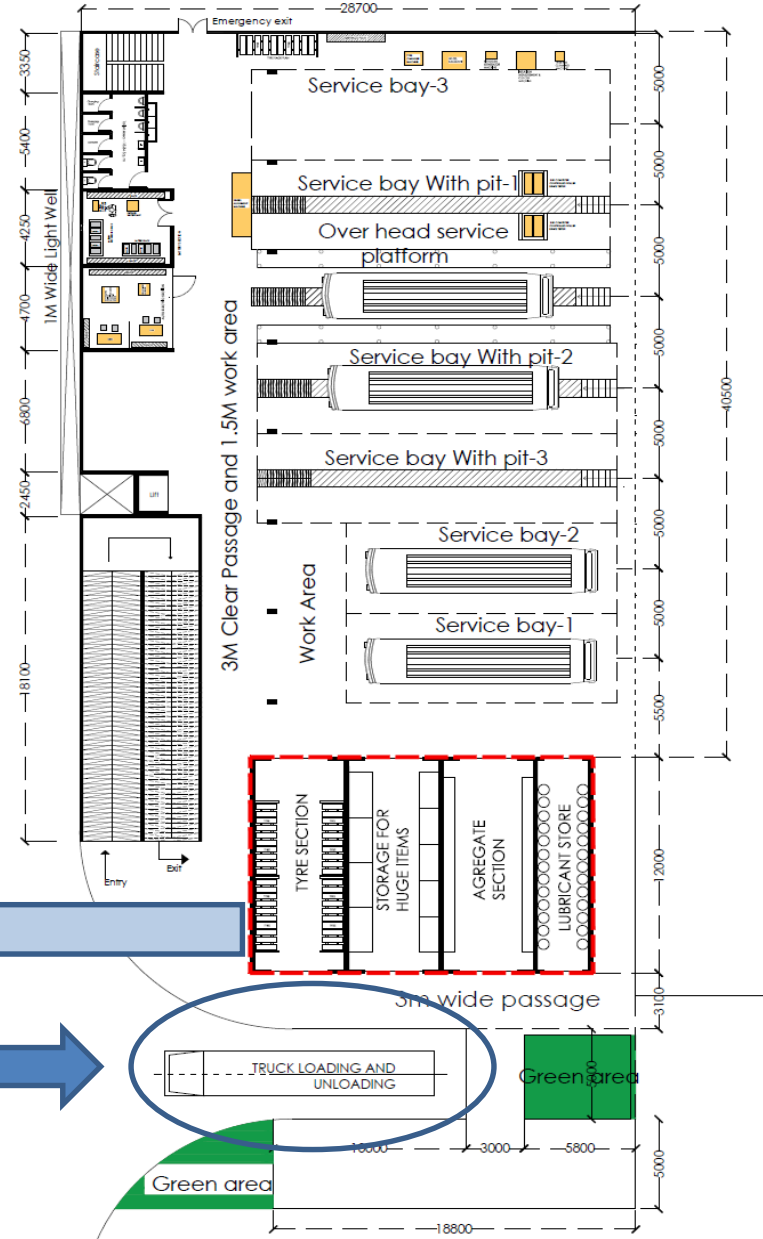
- Space provisioning based on
 - Number of buses in the depot
 - Number of days for which the inventory level is to be maintained as per the operational philosophy of the operator and availability of the spares in the local market
 - Lead time for the inventory
- Entry and exit from Staff Entry Gate.
- Storage gates - minimum width of 3 m
- Aisles – atleast 2 m for smooth movement of forklifts



Inventory Area Illustrative Layout – Ground Floor

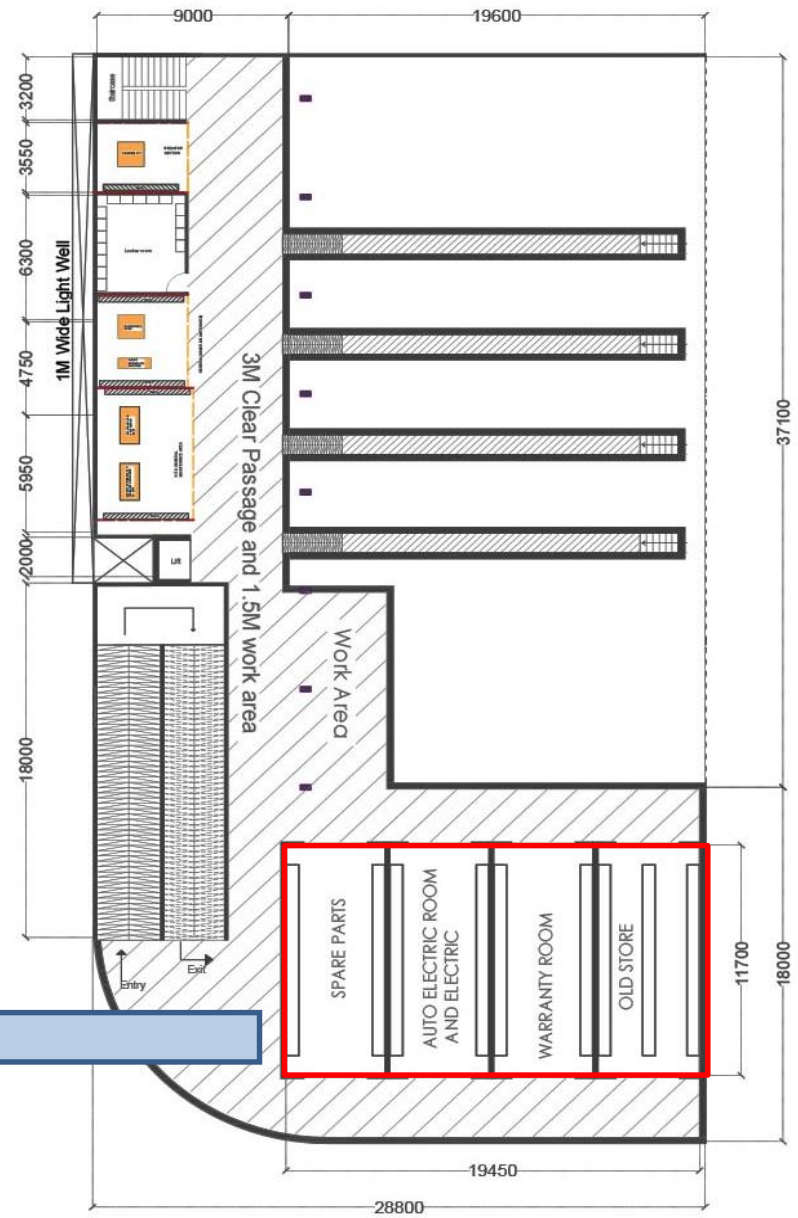
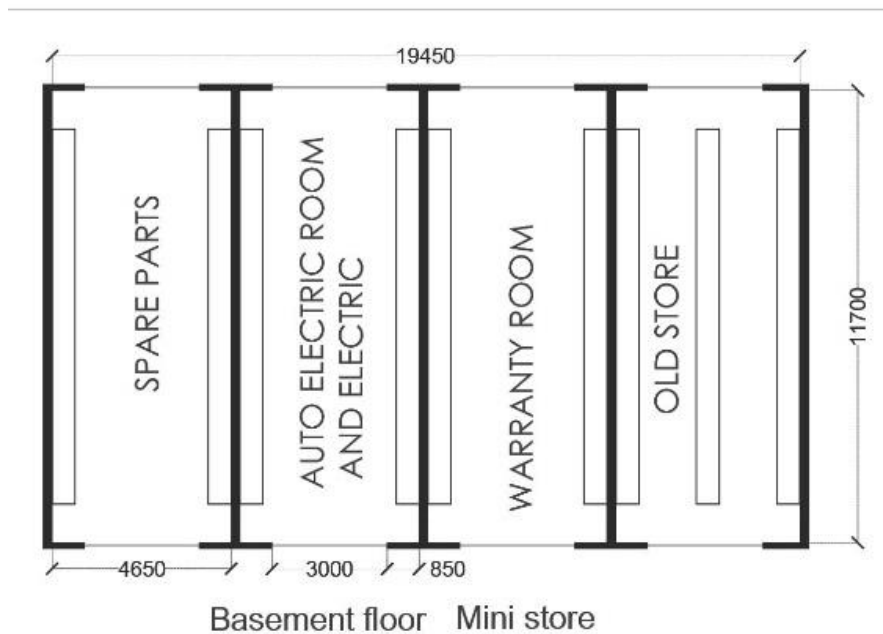


Ground floor Mini store



Loading/ Unloading Bay

Inventory Area Illustrative Layout – Basement



Administrative Staff Movement

Depot
Manager's office

Reporting Office
for Staff

Accounts and
HR section

Duty Allocation
room for drivers

Duty Allocation
room for
conductors with
ETM charging

Ticketing &
Waybill section

Ticket checker's
office

Cash section

Server/ MIS
Room

Control Room

Lost and found

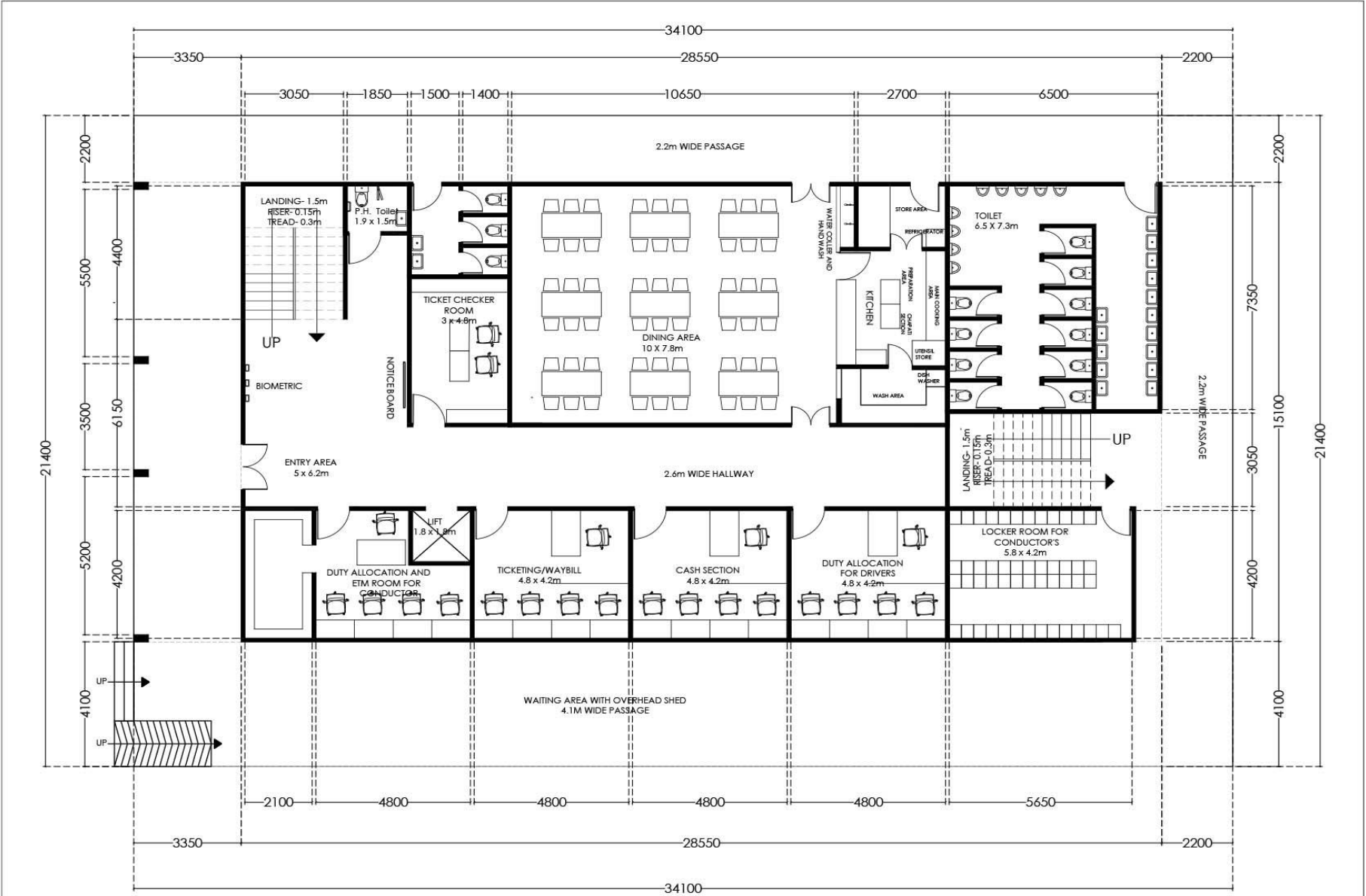
Conference/
Meeting room

Staff Amenities

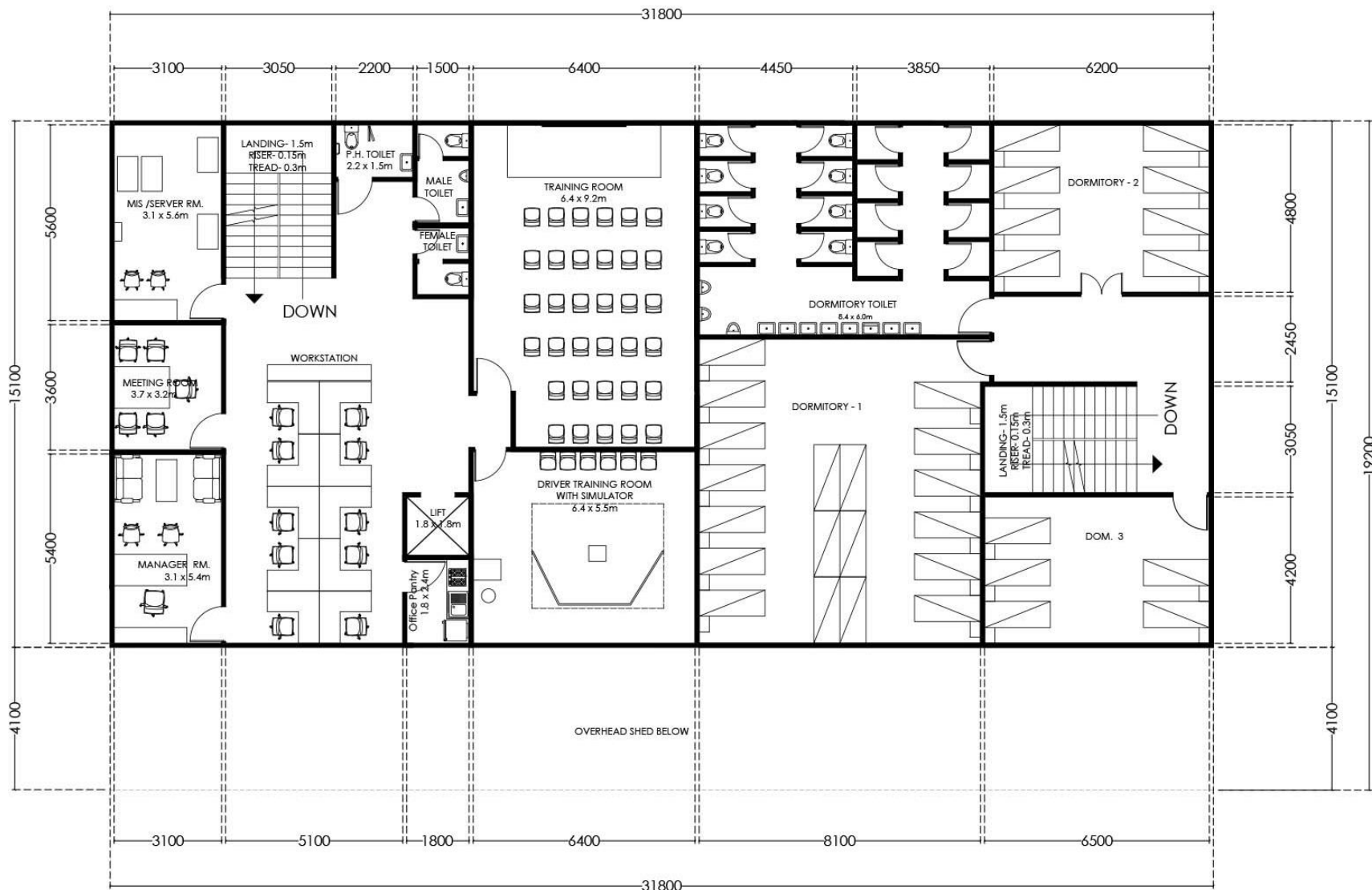
(Toilets,
Dormitories,
Canteen,
Lockers,
Recreation)

Training and
Development
section

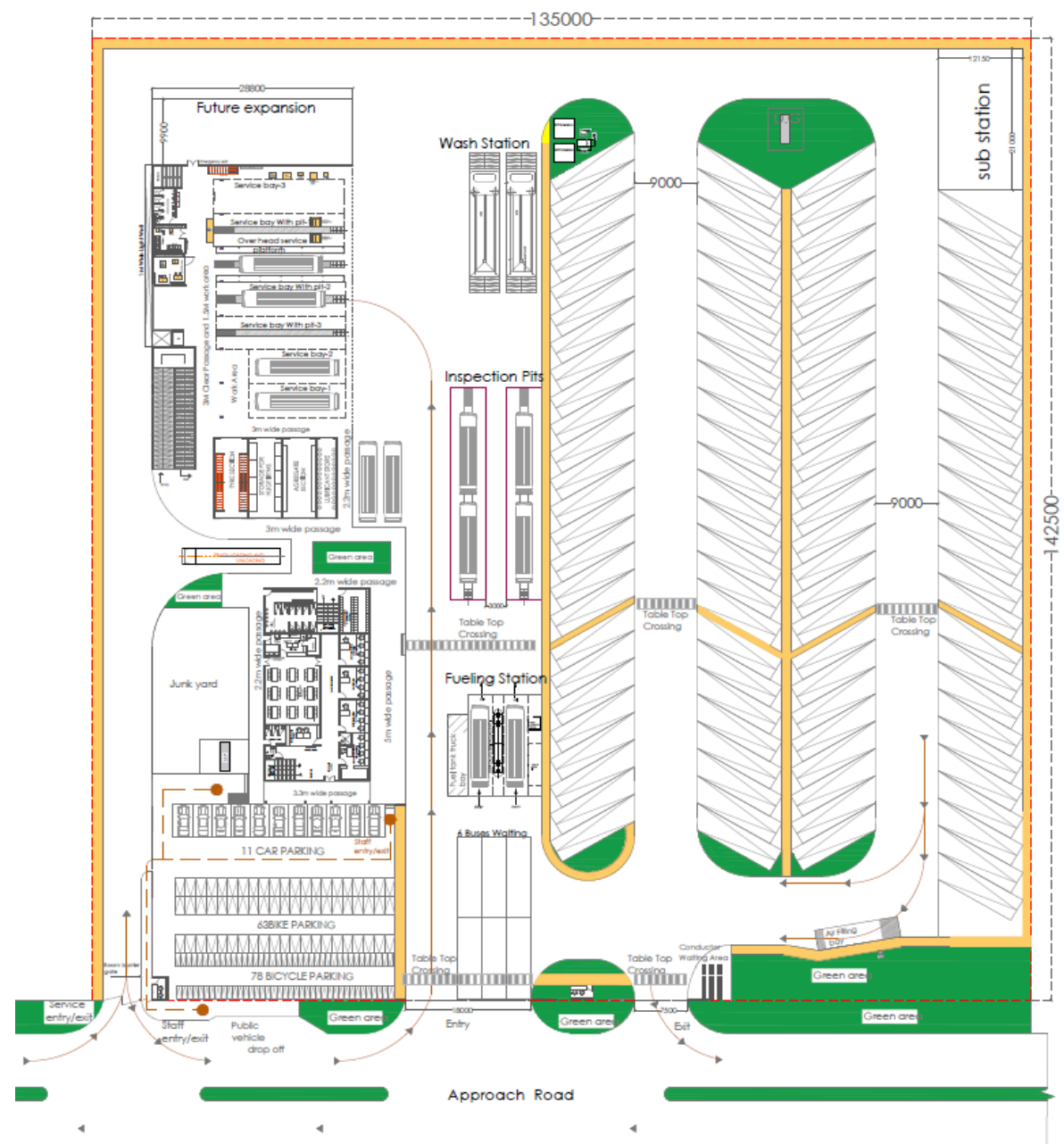
Administrative Block Overall Layout – Ground Floor



Administrative Block Overall Layout – First Floor



Overall 100 Bus Depot Layout



THANK YOU