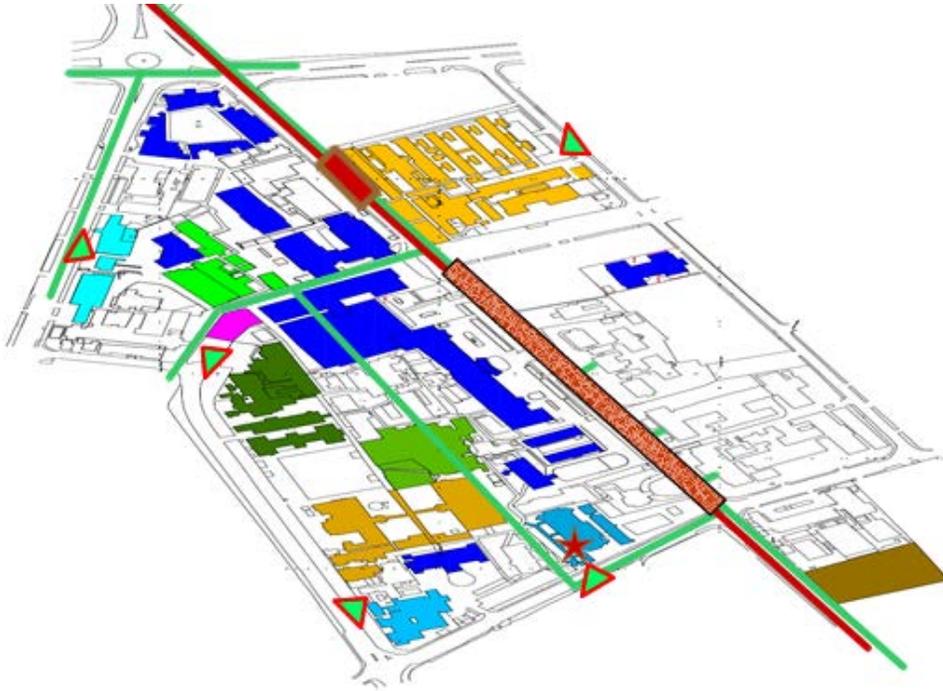


Traffic Impact Study for the Ambulatory Care Centre of the National Hospital of Sri Lanka (NHSL)



Final Report

Department of Transport & Logistics Management

University of Moratuwa

September 2014

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Executive Summary

This report provides the recommendation for improving access and circulation within the proposed NHSL masterplan based on data collected from current observations and analysis of same.

People Access

Around 33,400 persons have been estimated to visit the NHSL complex during a weekday. This is made up around 6,000 staff, 10,400 persons arriving to the OPD, 10,000 visitors for in-patients, and 7,000 other patients and visitors. Of these, around 64%, i.e. around 22,000 persons arrive by bus and train. However over 60% of bus and train users complain of the large distance to walk from the bus stops at Town Hall, Punchi Borella and near Carey College. The arrival pattern of patients to the OPD starts from prior to 7 am and reaches a peak between 8 and 11 am. Staff arrivals begin to peak from 8am with departures beginning from around 1pm. Of the 10,000 persons arriving to visit the patients warded in the 3,300 beds, the peak during the noon visiting hour is the highest attracting around 6,000 persons while the evening visiting hours attracts around 3,000 and the morning around 1,000 persons. There are around 1,000 wheel chair movements recorded at different location within the hospital. Around 500 of these were at the OPD with other clinics also recording high numbers.

Vehicular Access

The location of the NHSL is such that there is little spare road capacity through the day to accommodate any increase in demand. The major road intersections at Borella, Town Hall and Maradana through which any vehicle is required to travel through is already over saturated.

There are an estimated 10,000 motor vehicle trips made to the hospital complex. Of these 85% arrive to drop off the occupants at different gates and hence do not require parking. Only staff or official visitors are allowed parking within hospital premises. There are around 4,000 such vehicle entries a day where the vehicles are parked. Patients and visitors record around 5,000 vehicle arrivals of which 80%, which makes up mostly three wheelers and taxis require little or no parking. Of the others, the daily requirement for parking is around 3,000. These vehicles are parked at the OPD car park, along the Norris Canal Road, Kynsey Place and also at private car parks such as the Central Hospital and even Odel.

Moreover, apart from the approach from Ward Place, all other approaches from these intersections are also congested at most times of the day. These include the Maradana Road at Punch Borella, the Deans Road as well as Town Hall junction, Union Place, Dharmapala Mawatha etc. There are also a number of high traffic generators such as schools, departmental shops and offices in the vicinity that will also expand operations and attract more vehicular traffic in future.

Over 40% of all users identified that traffic congestion was a problem in accessing the hospital.

With increase in per capita income, both vehicle ownership as well as vehicle use in society is expected to increase significantly. The current levels of vehicle use signify that most patients who avail themselves of the facilities at present, do not travel by private vehicle and are thus from lower income groups. An annual growth rate of 6-8% should be used in calculating the growth in vehicle traffic to the NHSL which is based on the expected economic growth rate and past trends. As such

the amount of traffic is likely to double in the next 10-12 years for the current facilities, If the service levels of public transport deteriorates, it could increase further. The growth of hospital activities would increase this more. The migration of the hospital towards serving patients in higher income profiles would increase this further. A doubling of hospital activities even if the social profile of its clients remains unchanged would result in a quadrupling of the traffic accessing the hospital as well as seeking parking spaces.

Traffic Management within NHSL Complex

Currently pedestrian movements are intense both on the roads as well as on the walkways within the hospital premises. This interferes with the movements of patients as well as hospital staff. In order to streamline pedestrian movement in the new development, the following recommendations are made:

No through traffic is allowed on Regent Street (EW Perera Mw) between Kynsey Road and Norris Canal Road. Due to the traffic on Norris Canal Road as well as the section of Regent Street up to Deans Road also has mostly one way traffic.

The hospital square is located between a set of very busy roads all of which carry high frequency bus routes. These are used daily as commuter arteries and busy throughout the day. Hence, it is necessary to ensure that unnecessary traffic does not enter this hospital complex also known as the hospital square. Thus traffic that could attempt to short cut through hospital should be prevented. In this respect the current system is adequate for present. However, it will not suffice when traffic levels double. The primary reason for current traffic through the hospital square is that most traffic entering the hospital enters to EW Perera Mawatha.

Parking

Moreover parking requirements for the proposed new development would increase further if the size of the OPD, number of in-patient beds and staff increase. Approximate doubling of all these would lead to a quadrupling of vehicle use. As such, the demand for parking would increase to 16,000 vehicles and the demand for traffic would be around 48,000 vehicles in and out of the hospital. Moreover, if the facilities to be provided in the new development would attract patients in high income groups, then it is likely that this rate will increase much faster.

Currently there are around 300 spaces both within and outside the hospital. This includes spaces for motor cars as well as equivalent space for motor cycles. The current daily demand for parking is estimated at 2,200 within the hospital with an average space turnover of 1.5 hours per vehicle. The public car parking space requirements appear to be around 1,000 per day mostly accommodated within the two visiting hours. Thus the current space requirement is around 500 spaces, resulting in a current deficit of around 200 spaces.

As per the Traffic Impact Assessment (TIA) Regulations for private hospitals, the requirement for the current hospital activities require around 3,000 parking spaces which is around 6 times what is actually required at present. This is due to the fact that the hospital users essentially subscribe to the lower economic profiles which leads to lower vehicle based access and higher public transport access. For a future development scenario where there is doubling of hospital beds from 3,300 to

6,600 and for providing say 10,000 sq metres of medical activity, the parking space required as per TIA calculations is around 6,000 vehicle parking spaces. Currently this is not applicable to government hospitals since most customers arrive by public transport. However with rising incomes it is likely that the same requirements as for private hospitals would prevail for public hospitals.

This would require to be in multi storey facilities for which 130,000 sq m in total would be required. This would represent a hypothetical 13 floor building of 100m by 100m. This would not be practical.

However if high quality public transport with external park and ride facilities is assured (as what is planned for the monorail) to serve the hospital, it is possible that the hospital could manage with a lesser amount of parking. However, such level of parking may not be sustainable on the road network both outside and inside the hospital complex. As such the hospital should determine a strategic level of parking in consultation with the Colombo Municipal Council and the UDA.

Pedestrian Traffic and Circulation Areas

The staff, patients and visitors are estimated to make 53,000 pedestrian entries to the different buildings within the NHSL complex. There are around 25,000 crossings of the main road junction near the Neuro-Trauma Unit where Regent Street (EW Perera Mw) meets with Norris Canal Road which causes congestion on the road network as most vehicle movements have to pass this junction. There is a high requirement for safe and free flowing pedestrian facilities within the NHSL.

The corridors within the hospital as well as the logistics systems of patient admission, registry and examination followed by issue of medicines at the pharmacy are not integrated to an information data system that would eliminate the time taken for processing a patient. This would reduce the crowding levels as well. The location of conveniences such as toilets, canteen also needs to be considered in order to reduce unnecessary movements and congestion bottlenecks within the building.

Emergency Patient Access and Circulation

In addition it was observed that there are over 1,000 wheel chair movements and around 500 stretcher movements per day mostly to and from the OPD and clinics. There are also around 50 ambulance movements per day.

Currently patients using wheel chairs, stretchers have little or no special designs for movements and as such as inconvenienced when they are wheeled around. Such movements also inconvenience other pedestrians. Ambulances should have speedy access to the required admission areas with minimum delay.

A significant number of trips are made between the OPD and other units of the hospital by patients, in-patients and hospital staff who may take them to the different clinics. They have to pass congested road sections especially the junction at Neuro Trauma unit and along crowded corridors which is often time consuming and difficult especially for the patients.

Public Transport

With a majority of users stating that the distance to public transport was a major barrier to access the hospital, one of the primary design requirements for the new development is to reduce this walk distance. The other would be to ensure suitable quality of public transport. The inability to improve this would result in higher use of three wheelers and taxis by those coming by bus and eventual migration to private vehicles which will also increase parking as discussed earlier.

Proposed Monorail

The Ministry of Transport has proposed the construction of a Monorail line starting from Malabe to Kotahena via, Battaramulla, Rajagiriya, Borella, Punchi Borella, Town Hall, Slave Island, Fort, Pettah, Maradana and Kotahena. A supplementary link line from Kollupitiya to Town Hall is also identified. This if approved by the Treasury, will be ready for operation around 2020. The carriages as well as the station areas would be air conditioned and the system will have closed access so that station activity can be isolated through a set of access gates to the hospital premises. The passenger platform would be around 8-12 metres above the road level and thus have little impact to ground level activities. Its level of noise is considered to be within desired levels for a hospital though some further mitigatory actions may be required in the design.

This would be a suitable modern mode of transport to serve all categories of persons arriving at the hospital. It would also connect the railway lines. The project is currently under feasibility study and design. The National Hospital station is located adjacent to the OPD and would be an ideal location to receive visitors to the complex since it is the OPD that has the highest person traffic. However, the station should be then connected to the other buildings, especially the wards to enable the rush of circulation of visitors especially during visiting hours. The units at the further end of Regent Street such as the Cardiology Unit and the Merchant Ward, Nurses Training Institute should be connected to the Punch Borella Station which would be closer. If both these stations are used, the maximum walk distance to any location within the complex would be reduced to around 300metres.

Recommendations

The recommendations made in this report are that the NHSL development master-plan should take in to account the following:

Access

- 1) Expansion of hospital should necessarily be integrated to the use of a high quality public transport to access the hospital. In this respect, the hospital should actively pursue and support the monorail development proposed by the Ministry of Transport and its trace along EW Perera Mw and station adjacent to the OPD.
- 2) Improve walk access to and from bus stops namely at Punch Borella, Town Hall, Ward Place and next to Carey College and integrate to the new hospital design to minimize walk distances and pedestrian congestion.
- 3) Vehicle access to the different buildings should be spread out to the periphery of the complex with separate entrances from de Saram Road, Norris Canal Road (Ward Place end), Kynsey

Road, thus keeping EW Perera Mawatha and the centre of the hospital square relatively free of traffic.

Public Transport

- 1) To integrate the master-plan design with the proposed monorail system. This system can provide capacity of around 10,000 passengers per hour in each direction at 5 minute frequencies in the peak (which can be reduced to 2 mts). The monorail will be an ideal mode of transport to facilitate the high demand peaks created by hospital visiting hours and OPD hours which is around 6,000 arrivals during the mid day visiting hour with an equal number of departures almost within the hour leading to a passenger handling capacity of around 12,000 passengers per hour.
- 2) Until such a high capacity and high quality public transport is in operation, it is recommended that a shuttle bus service be operated from Borella, Maradana and Town Hall at 5 minute intervals to serve the hospital through the EW Perera Mw. This would require a fleet of around 10 buses which can be outsourced for commercial operation through the provincial bus regulatory authority or the Sri Lanka Transport Board.

Parking

- 1) The amount of parking should be carefully calculated in keeping with the standards required by the Building Regulations (Traffic Impact Assessment) applicable for Sri Lanka (Appendix 5). Currently the standard is given for private hospitals and nursing homes. While it is clear that total dependence on private transport would require around 6,000 parking spaces which is not feasible. If the Monorail access is provided it is possible that parking could be restricted to around 1,500 to 2,000 spaces.
- 2) The staff parking should not be centralized. Each new multi-storey building should have its required parking. This should be included in the future developments of each of the phases 2 to 9. These parks should have access for vehicles from the respective peripheral roads namely Ward Place, de Saram Road, Kynsey Road, Kynsey Lane and Norris Canal Road (Ward Place end).
- 3) The multi storey car park proposed in phase 10 with access from Kynsey Road may not be the most central location for visitors. It would be better to locate it with access from Kynsey Place end which has the least level of congestion. It would then be more centrally located to access all buildings within the complex.
- 4) The public car parks should be connected to an elevated pedestrian walkway system that would not interfere with the vehicular traffic or hospital operations.
- 5) Given that 85% (i.e. around 8500) vehicles at present arrive at the NHSL to drop patients, employees and visitors, care should be taken to include a drop off and pick up location for private vehicles, staff service vehicles as well as taxis and three wheelers.

Traffic Circulation

In order to reduce traffic in the middle of the hospital square the following recommendations are made:

- 1) Ensure that access to all parking lots in the proposed design have both entry and exits from the roads on the periphery of the hospital complex and not from EW Perera Mawatha.

- 2) The section of EW Perera Mw between Norris Canal Road (adjacent to Neuro Trauma Unit) and Kynsey Road (near Cardiology unit) should be restricted for labeled vehicles or vehicles that have special permission. This is the current practice which should be continued.
- 3) This area should be a traffic restrained area in order to provide a calm and tranquil centre to the hospital.
- 4) In order to ensure the free flow of traffic, reduction of vehicle emissions and noise pollution, it is suggested that pedestrian traffic be separated away from the ground level as far as possible.
- 5) The restriction on visiting hours for in-patients may have to be relaxed in order to spread out the traffic congestion that would otherwise happen. This would also ease the requirement for parking and improve utilization of parking spaces. It should be noted that at present in private hospitals this is practiced. The requirement for parking is also reduced accordingly.

Pedestrian Handling Logistics

1. There should be a elevated pedestrian walkway along EW Perera Mw which should ideally be suspended on the supports of the monorail. This would be typically at the 3rd floor level (8-12 meters). This walkway should span between the two stations on either end of EW Perera Mw and extend across Darley Road as well as Maradana Road at Punchi Borella to connect the respective bus stops on those roads. Escalators may be considered to bring them in line with the standard being implemented at Kollupitiya and Bambalapitiya pedestrian over passes.
2. There should be at the same level a set of pedestrian walkways that connect the multi storey car park with all other multi storey buildings within the complex so that the access from the vehicle parking and monorail as well as bus stops to other buildings would also be elevated.
3. The pedestrian walkways should be provided signs and directions in keeping to international standards.
4. In the OPD, there should be a suitable patient management system that would allocate appointments, provide better arrival timing to patients and streamline the process of registering patients and processing them through the medical examinations, consultations and pharmacy with minimum time, circulation and congestion.
5. The out-patients should not be allowed to mix unnecessarily with the in-patient areas. Hence the OPD and any other investigation units patients would frequent together with administrative units should be located in close proximity to each other and separated from in-patient operational areas.
6. The waiting areas, walkway widths, lobbies etc should be designed in keeping with the capacity for which it is designed and international standards for designing spaces.
7. Commonly used conveniences such as refreshments, toilets, should be located adjacent to the walkways without interfering with pedestrian movements. They should also be in different areas in order to reduce access distances and crowding around them.

Patient & Medical Staff Movements: Ambulances, Wheel Chairs, Stretchers and Hospital Staff Movements

1. There should be a second walkway system which is accessible only for hospital staff. This should be used for wheel chairs and stretchers as well as carrying medicines, meals and other trolley related movements throughout the hospital. It could be used for travel of hospital staff as well. But it should be restricted to all others.
2. Ramps of acceptable gradient (max 1 in 12) should be built to ensure that all wheeled equipment can be comfortably moved across the complex.
3. There should be a pathway for ambulances through the hospital complex from any approach to the accident service, cardiology unit and any other unit where emergencies are dealt with. The re-opening of the section of road between the Neuro-Trauma Unit and the Kynsey Place near the Maintenance Unit is recommended. This could also be used for access to parking areas

Planning and Design Audit

1. An audit is recommended to be carried out by an independent institution for traffic and mobility features in the building design before approval stage.
2. A traffic impact assessment as per Building Regulations of the UDA would be required for the masterplan which will require demonstration of the handling of vehicle and person traffic both in accessing the complex and within it..

Transition of OPD

1. It is recommended that a masterplan for the transition arrangement be also developed simultaneously.

1. Introduction

1.1. Objective

Conduct a study and to provide a report on the design requirements for the adequate provision of facilities for the access, storage and circulation of persons and vehicles visiting the National Hospital of Sri Lanka (NHSL).

The two main outcomes of this study would be to ensure that the proposed stage-wise development of the NHSL is provided with suitable (a) access for patients, visitors and employees and that (b) the circulation and waiting/parking spaces for people and vehicles respectively are provided in sufficient quantities as is possible without disruption to the primary functions of the hospital and within the limitations of land and access.

1.2. Items of Work

Towards these objectives the study will include the following items of work to be performed:

1. To collect relevant plans and maps of the developments to be made up to year 2032.
2. To conduct discussion with relevant hospital officials and architects and developers as required road.
3. To gather detailed data on (a) number of persons visiting the hospital including patients, employees and visitors (b) the travel details of such persons by interview of 8% sample rate, (c) number of pedestrian movements in and out of the complex and between different buildings, (d) number of vehicles entering the complex, (e) interview of around 12% of such vehicle drivers, (f) number of vehicles parked and details of such vehicles through an interview of 12% of such vehicle drivers.
4. To analysis all the above to identify the future mobility requirements for the NHSL.
5. To identify the facilities including public transport access, public and private parking, walkways, waiting areas, etc to be incorporated to the development of the OPD and the master-plan development.

1.3. Deliverables

The deliverables of the study shall include, a report setting out the above work as outlined in three stages:

- i. As required for the temporary relocation of the OPD and construction of the OPD
- ii. As required for incorporation into the design of the OPD and its requirements of access, parking and circulation
- iii. As required for the impacts of the OPD for the entire NHSL complex for all developments proposed up to year 2032

2. Description of the Proposed Development Master Plan for NHSL

The description of the proposed development project of the NHSL¹ is summarized as follows:

2.1. Introduction to Project

The National Hospital of Sri Lanka (NHSL) is the country's premier hospital, with 3,300 beds and the final referral point for the whole of Sri Lanka. The NHSL treats about 5,000 to 7,000 out-patients per day and admits about 620 patients daily. However, most units at NHSL function amidst much hardship due to the haphazard construction of buildings over several decades without an effective master plan for the NHSL.

This project seeks to provide high quality tertiary care, training of various categories of staff for the whole country. Therefore the project aims at a coherent, coordinated and well structured development of physical facilities. It envisages the planning and construction of building complexes for medical specialties, surgical specialties, a central Investigation unit, services building, multi story car park and quarters complexes to best utilize the limited land and provide service to patients efficiently.

2.2. Short Coming to be addressed by Project

Over the years the hospital has grown in stature and capacity to handle the ever increasing and constantly changing healthcare needs of the country. The main problem has been identified as the lack of well designed buildings to provide all facilities under one roof. In fact, with the exception of ENT and dermatology units, none of these units have in-ward facilities.

The importance of this project is highlighted as follows:

- It is the ultimate referral point for the whole of Sri Lanka
- Deliver unique high quality specialized tertiary care (most of our services being only available only in the NHSL) with minimum facilities at present
- Main centre for Post Graduate Training (Post Graduate Institute of Medicine) and undergraduate teaching (University of Colombo) and allied health professionals.
- Referral centres for the military forces, police and priests
- Offer services that are essential but are 'expensive' in the private sector

2.3. Functions of the Hospital Complex

The following service units and administrative functions are currently being carried out at the NHSL.

¹obtained from Project Concept Paper submitted by the NHSL to External Resources Department (ERD) on 27th February 2013.

Service Units

Clinics:

- Vascular Surgery Clinic
- Surgical Clinic
- Medical Clinic
- Cardiology Clinic
- Cardio Thoracic Clinic
- Neurology Clinic
- Neuro Physiology Clinic
- Nephrology Clinic
- Genito-Urinary Clinic
- Diabetic & Endocrine Clinic
- Psychiatric Clinic
- E.N.T. Clinic
- Dermatology Clinic
- Leprosy Clinic
- Rheumatology Clinic
- Orthopedic Clinic
- Plastic Surgery Clinic
- Burns Clinic
- Ambulatory Clinic
- Oncology Clinic
- Hematology Clinic
- Rabies Treatment Clinic
- Blood Bank
- National Poison Centre
- Asthma Clinic
- S.T.D. Clinic

Other Units/Services:

- Theatres
- Pathology Department
- X – Ray Department
- CT Scanner
- Endoscopies
- ECG/EEG Room
- Pharmacy and Dispensary
- Public Health Unit
- Injection Rooms
- Physiotherapy Room
- Specimen Taking Rooms
- Shared Accommodation
- Mortuary with Coolers
- Garbage Bin (Dumping Yard)
- Water Tank and Sump
- Transformer Room
- A/C Plant Room
- Fire Protection and Detection system
- Emergency Alarm System

Administrative functions

- Information Room
- Public Addressing/ Network/ Pipe Music/ Digital Numbering
- IT facilities
- Medical Records Room
- Senior Management Conference Room
- Lecture Rooms
- Generator Room
- Drug Store

2.4. Proposed Development

The proposed project seeks to replace most of the older buildings in ten (10) phases as shown in Figure 2.1.

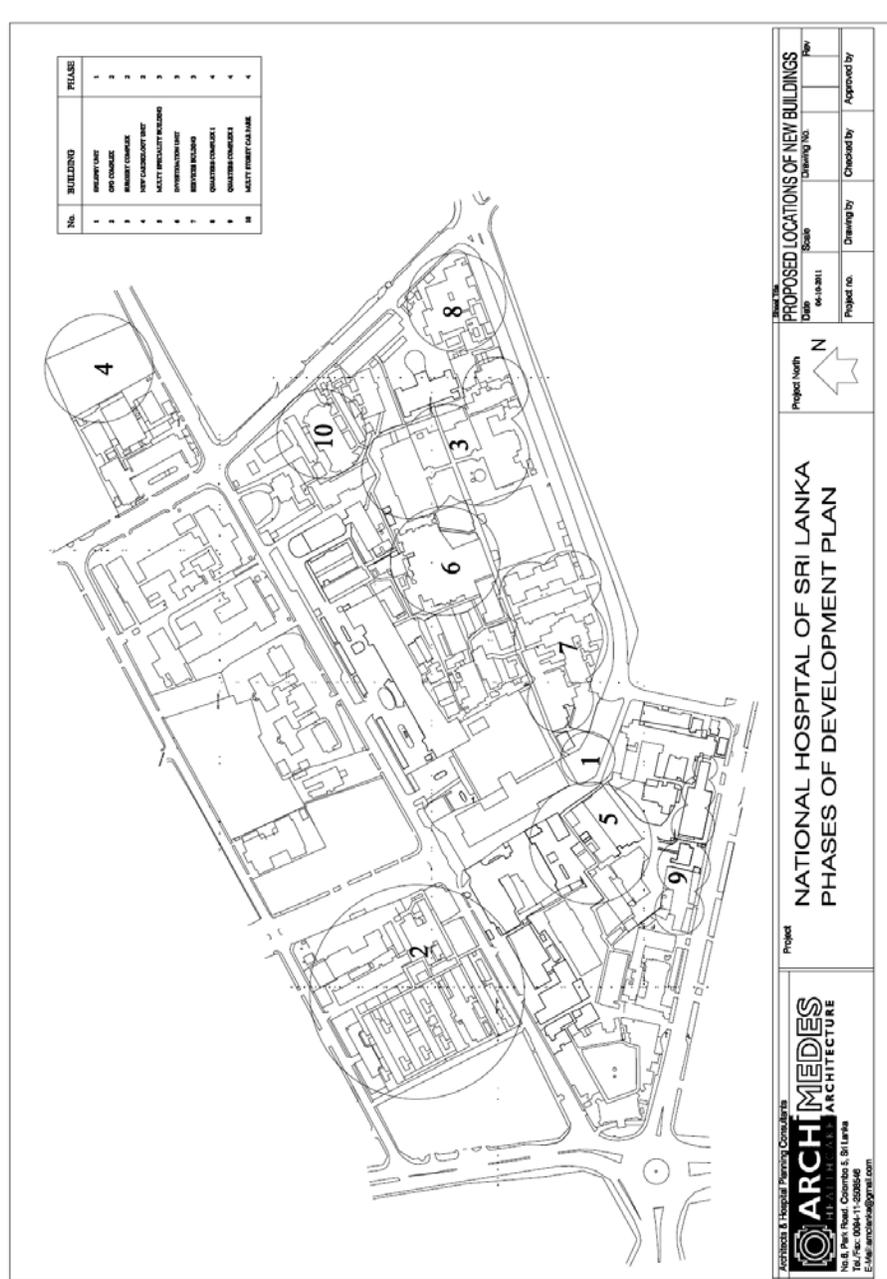


Figure 2-1:Phase Development of NHSL Master plan²

The details of the proposed facility are given in Table 2.1³.

² Drawing submitted by M/s Archimedes to NHSL

Table 2-1: Details of Proposed Facilities under NHSL Master plan

Phase No.	Facility	Unit of Measure
1	Construction of Epilepsy project building	
2	OPD (16 floors)	
	- Furnished outpatient clinics	7 floors
	- Furnished wards	6 floors
	- Administration area	2 floors
	- Emergency units – ETU, PCU, Chest pain unit, Surgical casualty	2 floors
	- Car park	2 floors
3	Surgery complex (16 floors)	
	- surgical wards	525 beds
	- Surgical subspecialties wards	670 beds
	- ICU beds	36 beds
	- HDU beds – surgical	34 beds
	- Operation theatre complex	42 theatres
	- Doctors on call rooms	55 rooms
	- Other (CSSD, Anesthesia, Blood Bank, Surgery Professorial, Radiology etc)	=.
4	Cardiology Cardiothoracic complex (16 floors)	
	- Furnished wards	8 wards
	- Cardiothoracic theatre Suite	9 tables
	- Cardiology intervention suite	1 no.
	- CCU, ICU, HDU, OPD units	65 beds
	- Doctors on call rooms	30 rooms
5	Multispecialty Building (16 floors)	
	- Furnished inpatient wards	535 beds
	- Indoor ECG unit, other facilities	1 no.
	- Doctors on call rooms	50 rooms
6	Investigation unit (16 floors)	

³ as per Project Concept Paper, NHSL Master Plan

Phase No.	Facility	Unit of Measure
	- Equipped facilities for Radiology & Interventional radiology - School of Radiology	
	- Equipped facilities for Pathology, Hematology, Microbiology & Chemical Pathology - On call rooms	100 rooms
7	Services building (16 floors)	
	- Facilities for kitchen, Laundry, Surgical stores, Pharmacy & school of pharmacy, Records, transport, mortuary - Administration area	
8	Multistory car park	
	- No. Vehicles	1000 vehicles
9	Quarters complex 1	
	- Doctors rooms	1000 rooms
10	Quarters complex 2	
	- Nurses rooms	1000 rooms

2.5. Status of Implementation

Phase 1 (Funds already allocated)

Phase 1 Demolition

- Wards 14, 55, 57, 58 and Transport section buildings
- Maintenance building (required to be demolished to construct Epilepsy Unit)
- Dental buildings (already demolished)

Phase 1 – New Construction

1A - OPD (New)-The new OPD facility will be complete with low-end radiology and laboratory facilities. This will come up at the site of the Wards 14, 55, 57 & 58 which will move to the Medical Ward 3 nearing completion.

1B - Epilepsy Unit-Under design for the treatment of epilepsy patients – will consist of OPD, in patient and treatment facilities. (Site behind Neuro Trauma Unit)

1C - New Dental Building (at site of existing building) (Work commenced by CECB)

Phase 2 (To be developed as urgent priority)

- **Phase 2 Demolition** Wards 41, 42, 56
- **Phase 2 – New Construction**

2A - Cardiology / Cardiothoracic Unit Cardiology / Cardiothoracic Unit to be constructed behind existing cardiology complex in a block of land to be given by government after removing of occupants. This unit to be completed with all necessary investigation, radiology & imaging facilities. This unit once completed will relieve the space occupied by wards 32, 33, 34& 35.

2B - Multi - Specialty building (at present site of wards 41, 42 & 56 which will move to new Medical ward 3)

Phase 3 Surgical Complex (after wards 32, 33, 34, & 35 are moved to their new location)

- **Phase 3 Demolition** Wards 32, 33, 34, 35
- **Phase 3 - New Construction Surgery and Surgical Sub- specialties**

The layout and the details of the above are given in Appendix 1.

2.6. Access Points

2.6.1. Bus Halts

There are several access points to the NHSL Complex. These have been identified as (a) the car parking locations used by those who arrive by vehicle then get dropped off or park and enter the hospital buildings and (b) others who get off a vehicle either a bus, hired vehicles or private vehicles on the main roads adjacent to the hospital complex and then enter the premises as pedestrians. Appendix 2 shows the different parking and drop off locations.

The bus stops are listed along with the bus routes servicing these stops and the total frequency of stops.

Table 2-2: Bus Routes Serving NHSL by Bus Stop

Bus Halt No.	Bus Halt Name/Road	Bus Routes Serving Halt	Headway (min/direction)
19	Deans Road/ Ven Baddegama Wimalawansa MW (bus routes for both north & South bound)	167 (Dehiwela - Thotalanga)	20 min.
		140 (Kollupitiya- Wellampitiya)	20 min.
20	Town Hall (In front of Fashion Bug - south bound)	120 (Colombo- Horana/Kesbewa/Piliyandala)	5 min.
		173 (Pita Kotte - Thotalanga)	20 min.
		127 (Pettah - Moragahahena)	30 min.
		128 (Pettah - Kiriwattuduwa)	30 min.
		103-173 (Thotalanga - Narahenpita)	30 min.
21	Town Hall (In front of Mosque - north bound)	120 (Colombo- Horana/Kesbewa/Piliyandala)	5 min.
		173 (Pita Kotte - Thotalanga)	20 min.
		103-173 (Thotalanga - Narahenpita)	30 min.
		122 (Colombo- Avissawella)	15 min.

		125 (Colombo-Padukka/Ingiriya)	15 min.
		155 (Ratmalana-Mattakkuliya)	15 min.
		115 (Pita-Kotte-Town Hall)	30 min.
		167 (Dehiwela - Thotalanga)	20 min.
		175 (Kollupitiya - Kohilawatta)	20 min.
		166 (Angoda - Slave Island)	25 min.
		140 (Kollupitiya- Wellampitiya)	15 min.
		150 (Kelanimulla - Semamalakaya)	20 min.
		155 (Panadura - Town Hall -CTB only)	Infrequent
		115 (Pita-Kotte-Town Hall)	30 min.
		193 (Town hall - Kadawatha)	Infrequent
		145 (Mattakkuliya - Town hall)	Infrequent
		164 (Salmal Uyana - Town hall)	20 min.
		138 (Colombo- Maharagama/Kottawa/Homagama)	5 min.
		127 (Pettah - Moragahahena)	30 min.
		128 (Pettah - Kiriwattuduwa)	30 min.
	Town Hall (In front of Buddhist Ladies College - north bound)	175 (Kollupitiya - Kohilawatta)	20 min.
		166 (Angoda - Slave Island)	25 min.
		140 (Kollupitiya- Wellampitiya)	15 min.
		150 (Kelanimulla - Semamalakaya)	20 min.
		193 (Town Hall - Kadawatha)	Infrequent
		164 (Salmal Uyana - town hall)	20 min.
		138 (Colombo- Maharagama/Kottawa/Homagama)	5 min.
23	Ward Place (In front of Dental Institute -both north & south bound)	190 (Pettah - Meegoda)	15 min.
		170 (Pettah - Aturugiriya)	15 min.
		174 (Thalawatugoda - Pettah)	20 min.
		168 (Nugegoda - Kotahena)	20 min.
		175 (Kollupitiya - Kohilawatta)	20 min.
		150 (Kelanimulla - Semamalakaya)	20 min.
		193 (Town Hall - Kadawatha)	Infrequent
		164 (Salmal Uyana - town hall)	20 min.
		166 (Angoda - Slave Island)	30 min.
24	Carey College(both north & south bound)	175 (Kollupitiya - Kohilawatta)	20 min.
		193 (Town Hall - Kadawatha)	Infrequent
		164 (Salmal Uyana - Town Hall)	20 min.
		166 (Angoda - Slave Island)	30 min.
		150 (Kelanimulla - Semamalakaya)	20 min.
25	Punchi Borella (Maradana)	144 (Pettah - Rajagiriya)	15 min.

	Road- both north & south bound)	176 (Mattakkuliya - Hettiyawatta/Dehiwela)	5 min.
		171 (Fort - Koswatta/Battaramulla)	15 min.
		103 (Fort - Narahenpita/Borella)	5 min.

2.6.2. Car Parks

Similarly, the car parking locations shown in Appendix 2 are listed along with the number of standard passenger cars (salons) that can be parked at each location. A total of nearly 300 equivalent car (salon) parking stalls are available at present.

Table 2-3: Existing Car Parks Serving NHSL and Capacity

Parking Lot No.	Lot Name/Road	Buildings Served by Lot	Capacity (Standard Cars)
1	Ven Baddegama Wimalasena MW	Ministry of Health	
2	Kynsey Road	Nursing Training School	
3	EW Perera Mw	Nursing Training School	12
4		Blood Bank/Wards 16, 62-66	20
5		Wards 23-26	18
6	Norris Canal Road/Kynsey Place		20
7		Operation Theatre/Pharmacy and Kitchen	6
8		Ward 39	
9	EW Perera Mw	Bandaranaike Building	30
10	EW Perera Mw	Bandaranaike Building	40
11		Ward 34/35, Accident Ward	
12	EW Perera Mw	35	12
13	Ward Place	Dental	12
14	EW Perera Mw	Orthopedic clinic	14
15	De Seram Road	OPD	18
16	EW Perera Mw	Doctors Quarters	50
17	Norris Canal Rd	OPD and all wards	40
	TOTAL		292

2.6.3. Gates

Appendix 3 shows the entry points to the hospital wards and buildings. Some entry points are for pedestrians only, while others are for vehicles only, while a third category is for both. There are a total of 35 entry and exit points. Of this there are 23 for pedestrians only while there are 12 from which vehicles are admitted.

3. Data Collection

The following transport surveys at the NHSL were carried out by this study.

- 1) OPD Patient Interviews
- 2) Ward Visitors Interviews
- 3) Hospital Staff Interviews
- 4) Traffic and Pedestrian Count at junctions
- 5) Traffic and Pedestrian Count at Gates
- 6) Parking Location Survey

3.1 OPD Interviews

There are reportedly 7,000 patients arriving to the OPD daily and that each patient is accompanied by 2 persons on average. Therefore, it was estimated that 21,000 people arrive at the OPD everyday and that the target number of arrivals with development of the new OPD (18 story building) for would be between 35,000 to 50,000. Thus the following survey parameters were observed:

- Sample size = 1270 for two days (18%)
- Days of the survey =19, 20 and 21 November 2013
- Duration of the survey = 7.00 am to 11.00 am

3.2 Ward Visitors' Interviews

There are 3,300 beds in the hospital. The number of visitors is restricted to 2 per patient in the Accident Service wards, but for other wards there is no limit. The total number of 20,000 visitors was assumed to visit the patients daily. Thus the following survey parameters were followed:

- Sample size = 1427 (7%)
- Days of the survey =19, 20, 21 and 22 November 2013
- Duration of the survey = 11.00 am to 1.00 pm & 4.30 pm to 6.00 pm

3.3 Hospital Staff Interviews

There are approximately 8,000 staff members in the hospital categorized as (a) doctors, (b) nurses, (c) administrative staff and (d) minor staff. Their working hours are as follows:

- Doctors – 8.00 am to 2.00 pm, 2.00 pm to 8.00 pm, and 8.00pm to next day 8.00 am
- Nurses – 7.00am to 1.00pm, 1.00 pm to 7.00 pm and 7pm to next day 7.00 am
- Administration – 8.45 am to 4.15 pm
- Minor staff – 6.30 am to 2.30 pm, 7.00 am to 5.00 pm, 10.30 am to 6.30 pm to next day 6.30 am

The surveys were carried out in a manner that all categories of workers working all shifts were included. The following survey parameters were followed:

- Sample size = 794 (approximately 10% of 8,000)
- Days of the survey =19, 20, 21 and 22 November 2013
- Duration of the survey = 7.00 am to 7.00 pm

The wards/units from which surveys were collected are:

- OPD
- Neuro Trauma Unit
- Medical Wards – Accident Services
- 3rd Medical Wards
- Psychiatric Clinic
- Bandaranayake Building Wards
- Cardiology Building
- Surgical Unit
- Pharmacy
- Rheumatology Clinic
- Dental
- OPD
- Neuro Trauma Unit
- Clinic
- University Surgical Unit
- Radiology Unit
- Vascular & Transport Theater
- Blood Bank
- Overseer Office
- Matron Office
- ENT Clinic
- PHI Office
- Cardiac Office
- VP OPD War
- Hematology Unit
- Histopathology
- Theater D
- RIA
- OTD
- Ward 16
- Ward 17-22
- Ward 23-26
- Ward 27/29
- Ward 30
- Ward 34/35
- Ward 38
- Ward 39
- Ward 52/56
- Ward 62/66

3.4 Traffic and Pedestrian Counts at Junctions

Four junctions as shown below were selected for the survey:

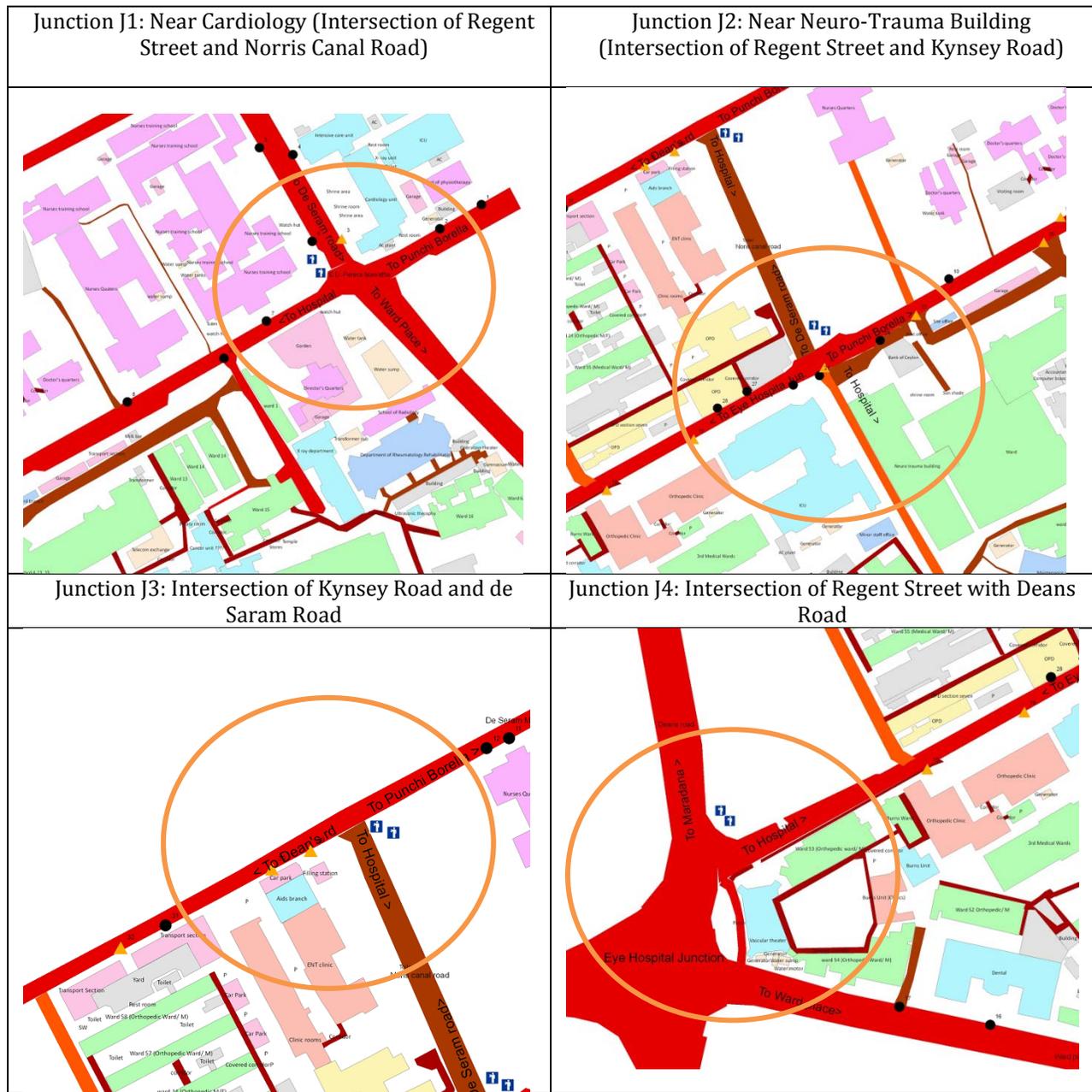
- Junction J1: Near Cardiology (Intersection of Regent Street⁴ and Kynsey Road)
- Junction J2: Near Neuro-Trauma Building (Intersection of Norris Canal Road and Regent Road)
- Junction J3: Intersection of Norris Canal Road and de Seram Road
- Junction J4: Intersection of Regent Street with Deans Road

The parameters of the surveys conducted at these junctions are as follows:

- Days of the survey (Pedestrian and Vehicles) = 21 and 22 November 2013
- Duration of the survey = 7.00 am to 7.00 pm

⁴ The new name for Regent Street is EW Perera Mawatha

Table 3-1 : Locations of Junction counts



3.5 Traffic and pedestrian Count at Gates

There are a total of 35 gates around the hospital, where pedestrians and vehicles can enter. Identified locations were manned for the traffic survey and pedestrian surveys. A manual classified traffic count was taken for both directions. The survey parameters observed were:

- Duration of the survey = 7.00 am to 7.00 pm
- Pedestrian counts = 19, 20, 21 and 22 November 2013
- Vehicle counts = 19 and 20 November 2013

Table 3-2: Locations of Gates where counting was done⁵

Pedestrian Count		Vehicle Count	
Gate	Code	Gate	Code
Cardiology Unit 1	1	Cardiology Unit	3
Cardiology Unit 3	3	Doctor's Quarters	9
Cardiology Unit ICU	4	Blood Bank	13
Nursing Training School	7	Pharmacy and Kitchen	14
Nurse's Quarters (Near NTS)	8	Stores	15
Doctor's Quarters	9	Orthopedic Clinic	18,19
Nursing Quarters Entrance Front	10	ICU and Wards	21
Nursing Quarters Entrance Back	11	Accident ward	23
Blood Bank	13	Bandaranayake Ward	25
Pharmacy & kitchen	14	Filling Station	29
Dental Gate	16	Aids Branch	30
Accident Orthopedic Unit/Ward	17		
54		Transport Sector	32
Orthopedic Clinic 18	18		
Orthopedic Clinic 19	19		
Orthopedic Clinic 20	20		
Accident Ward	23		
Bandaranayake Building	25		
ENT Clinic (Ward 1)	26		
OPD Gate 1	27		
OPD Gate 2	28		
Filling Station	29		
AIDS Unit	30		
Diabetic Clinic	31		

3.6. Parking location Survey

There are about 12 locations in the hospital allocated for parking. Most of these parking are for staff members. The surveys are done parallel to the vehicle counts at gates at same locations on same days.

Location	Gate
Cardiology Unit	3
Doctor's Quarters	9
Blood Bank	13
Pharmacy and Kitchen	14
Stores	15
Orthopedic Clinic	18 & 19
ICU and Wards	21
Accident ward	23
Bandaranayake Ward	25
Filling Station	29
Aids Branch	30
Transport Sector	32

⁵ Details in Appendix 3

4. Data Analysis

4.1. OPD Patient Interviews

A total of 1,270 interviews were conducted on patients to the OPD over a period of two days. This included 32% from within the CMC area while a further 36% were from within the Colombo District while the balance 32% were from outside the Colombo district (Outer CMC).

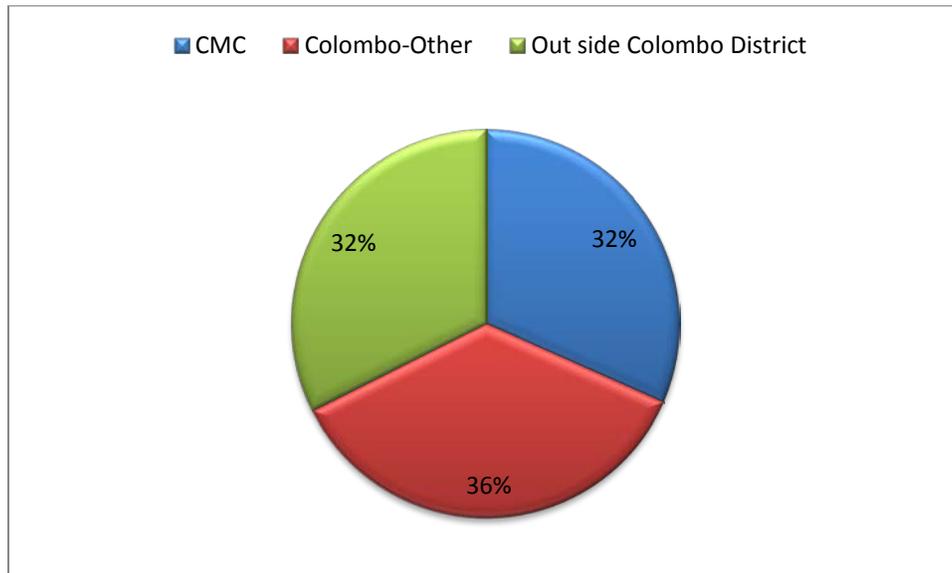


Figure 4-1: Distribution of Origins of OPD patients

The breakdown by district for those from outside Colombo District is given in Table 4.1. This shows that around 10% of patients are from outside the Western Province, and mostly drawn from the districts of Kurunegala, Ratnapura, Galle and Matara. There are also patients who come as far as Ampara, Anuradhapura, Nuwera Eliya, Badulla, Hambantota, Mannar and Moneragala.

Table 4-1: Origins of OPD patients

District	Percentage	District	Percentage
Ampara	0.31%	Kegalle	1.34%
Anuradhapura	0.08%	Kurunegala	1.34%
Badulla	0.31%	Mannar	0.08%
Colombo	67.58%	Matara	0.39%
Galle	0.71%	Matale	0.08%
Gampaha	19.20%	Moneragala	0.16%
Hambantota	0.47%	Nuwera Eliya	0.24%
Kalutara	4.80%	Puttlam	0.39%
Kandy	0.63%	Ratnapura	1.89%

Mode of Transport

As shown in Figure 4.2, 75% of OPD patients arrive by bus, while around 3% use non motorized access of bicycles and by walking. Three wheelers and taxis at 13% provide the largest mode of access by a private mode. Around 9% use other motorized access.

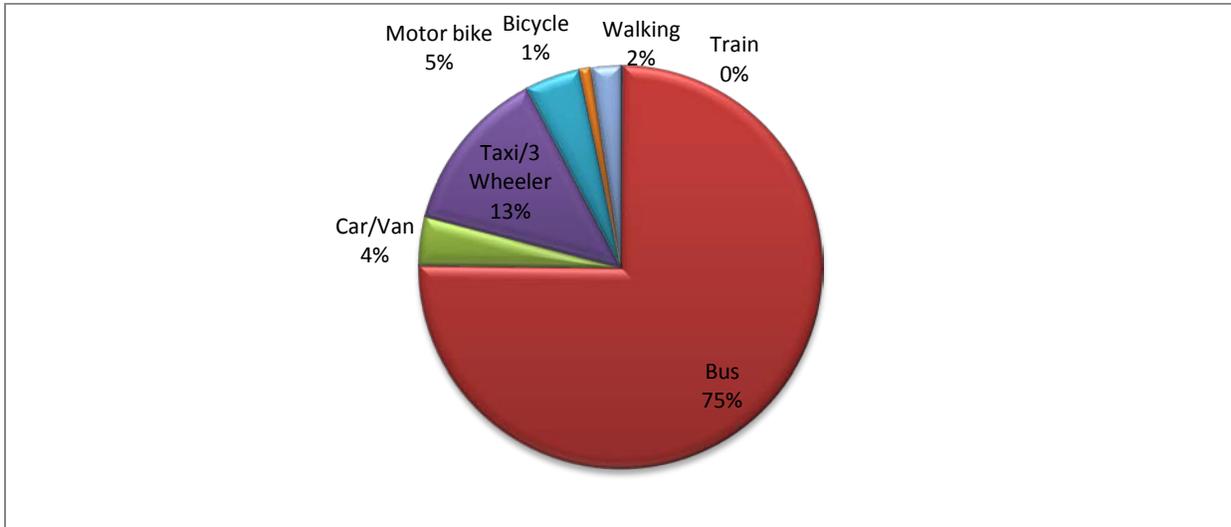


Figure 4-2: Transport Mode Used by OPD patients

Drop Off Locations

It is found that nearly 90% of all patients arriving at the OPD are dropped off by the vehicle they arrive in and do not use parking facilities. This is expected to be made up of all bus passengers, and all three wheeler passengers that make up 88% and those who walk. The drop off locations given below show that bus passengers are dropped off with the most at Town Hall, Punch Borella and Eye Hospital respectively and that three wheelers drop passengers directly at the OPD itself.

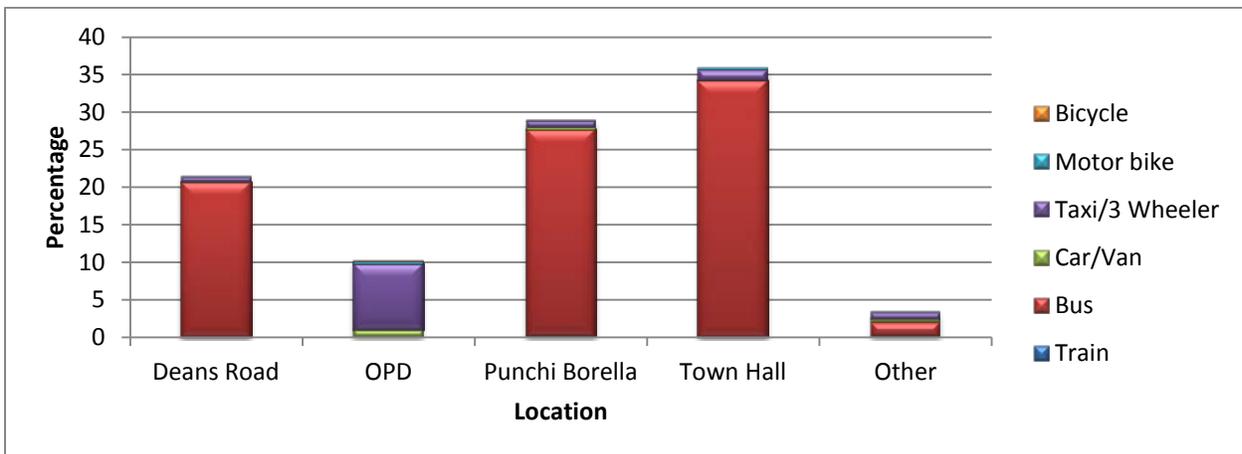


Figure 4-3: Drop Off Locations of OPD Patients

Parking Location

The parking for the OPD is concentrated around the OPD and Norris Canal Road followed by around 30% using the Kynsey Place road side parking.

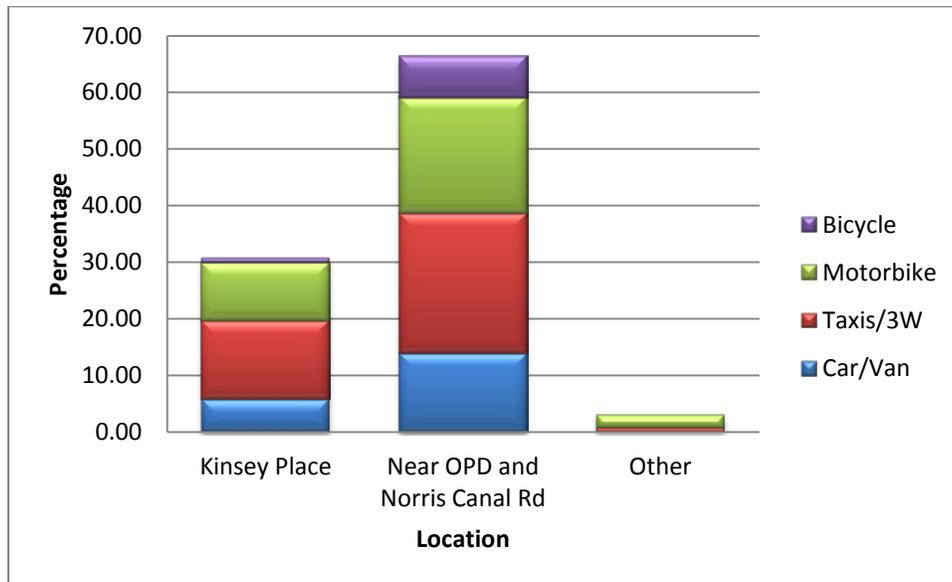


Figure 4-4: Vehicle Parking Locations of OPD Patients

Group Size

The following figure shows the group size which includes the persons accompanying a patient. It shows that around 53% of patients arrive alone while 39% are accompanied by one other person while 8% are accompanied by 2 or more persons. The average number of accompanying persons arriving per patient is 0.6. Thus the average group size is 1.6 persons.

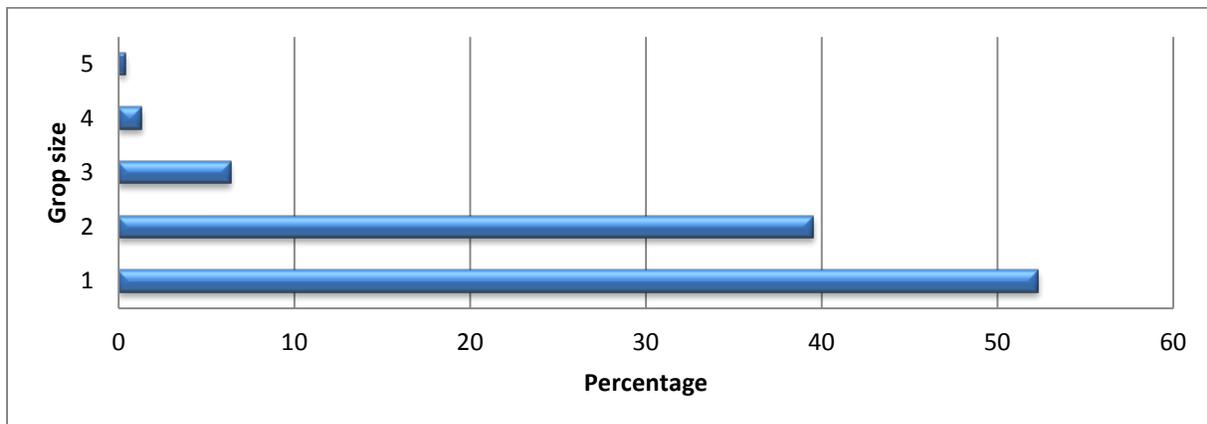


Figure 4-5: Group Size by Percentage of OPD Patients

Patient Visit Details

The average time spent at the OPD as reported by the patients is between 2-3 hours. Around 56% report going to the pharmacy. Even though the pharmacy has a long queue, the additional time spent by those going to the pharmacy was not significantly higher than others. This is possible since

some of them come only to the pharmacy. Around 40% of the patients make regular monthly visits, while around 44% make less frequent visits.

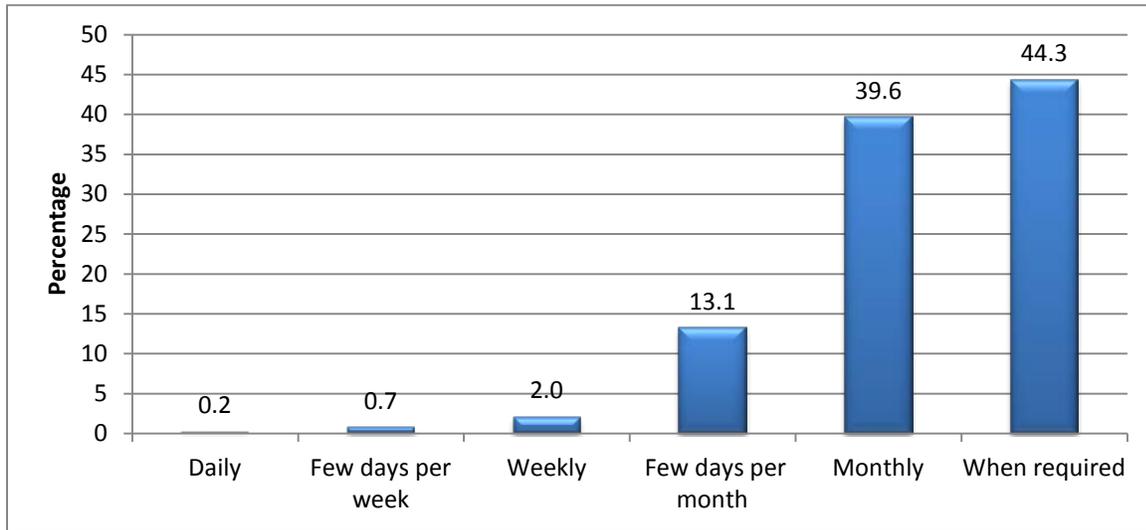


Figure 4-6: Frequency of Visits to OPD by Patients

4.2 Hospital/Ward Visitors Travel Pattern

A total of 1,430 interviews were gathered from visitors to the wards. The analysis shows that 49% of the visitors come from outside the Colombo district while only 14% are from within the city. This shows that there is much higher percentage of people from distant places among the visitors than among the staff or OPD patients.

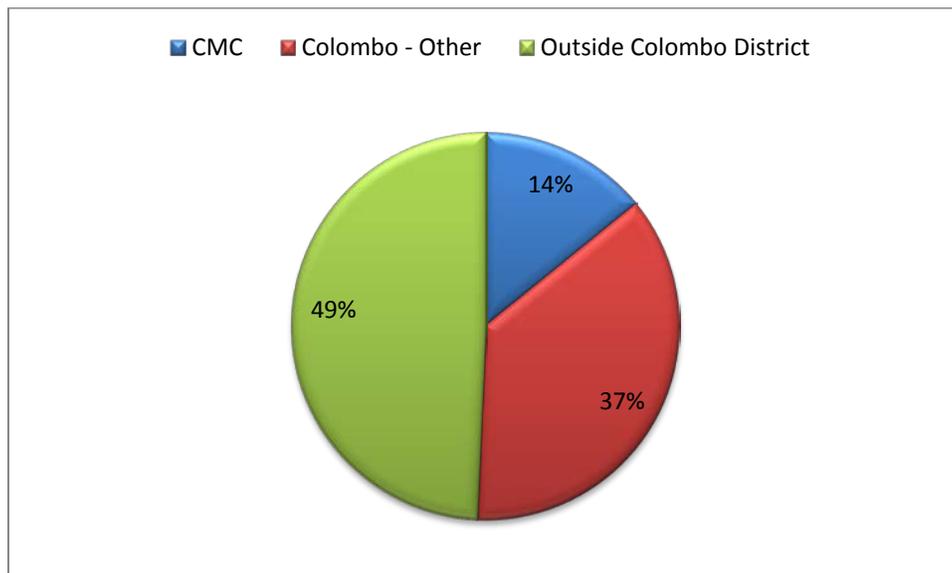


Figure 4-7: Origins of Visitors to In-patients

While a survey was not carried out for the in-patients, it is assumed that the profile of the visitors represents the distribution of the origin places of the in-patients as well. Among the visitors 21% are from Gampaha, while 7% are from Kalutara, while from outside the province, the North Western Province leads with 6.2%, followed by Sabaragamuwa 5.8%, Southern at 3.6%, Central at 2%, with North Central and Eastern at less than 2% and Uva and Northern at less than 1%.

Table 4-2: Origins of Visitors to in-patients

District	%	District	%
Ampara	0.6	Kegalle	2.2
Anuradhapura	0.7	Kurunegala	3.6
Badulla	0.5	Matara	1.6
Batticaloa	0.4	Matale	0.3
Colombo	50.8	Moneragala	0.4
Galle	1.8	Nuwera-Eliya	0.4
Gampaha	20.9	Polonnaruwa	0.4
Hambantota	0.2	Puttlam	2.5
Kalutara	7.4	Ratnapura	3.7
Kandy	1.3	Trincomalee	0.5
		Vavuniya	0.1

Transport Mode Used

In the case of visitors to in-patients in the wards, around 67% use buses, while railway use is negligible. On the other hand non-motorized access is less than 4%, while hired vehicles comprising three wheelers and taxis constitute the largest share of private modes of transport.

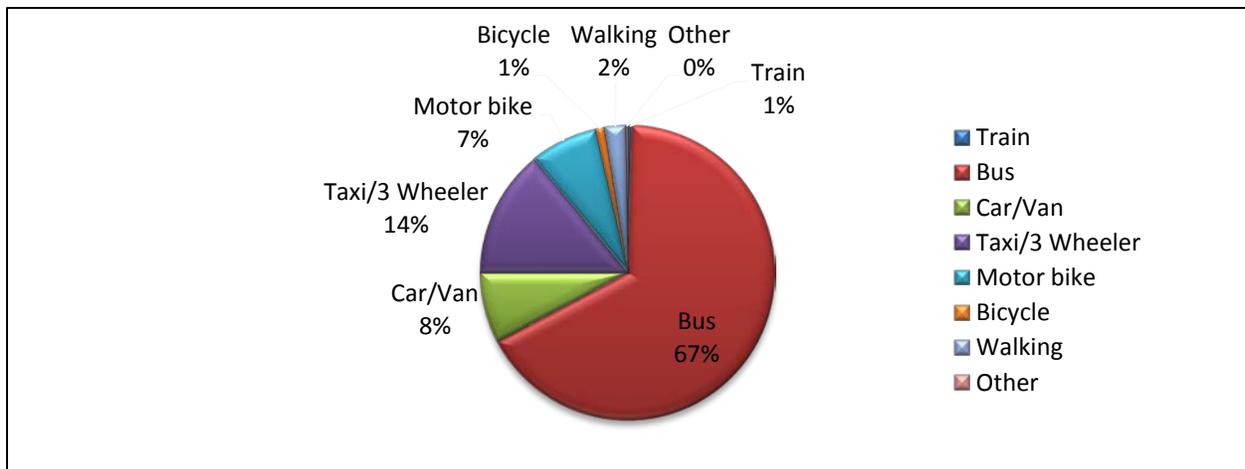


Figure 4-8: Mode of Transport Used by Visitors of In-patients

Group Size

Most visitors seem to travel in groups with only around 47% arriving at the hospital by themselves. Around 35% travel in a group of 2, while a further 12% travel in a group of 3, while the balance 6% travelling in even larger groups. The average group size is 1.81.

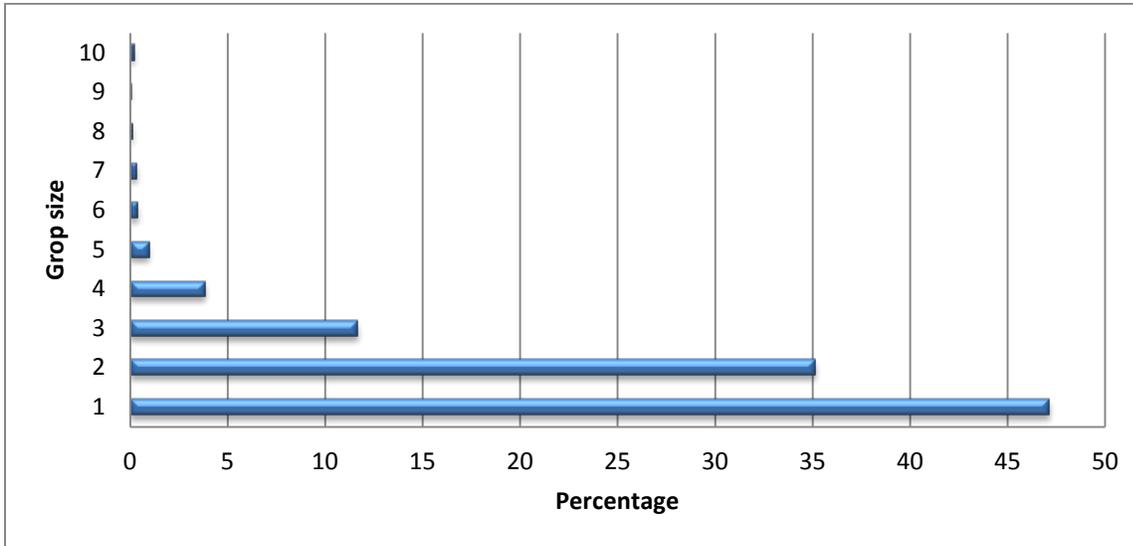


Figure 4-9: Group Size of Visitors to In-patients

Arrival Characteristics

Around 83% of visitors get dropped off near the hospital. This includes all bus and rail passengers. The balance 17% parks their vehicles in the vicinity of the NHSL for the duration of the visit. The average duration of the visit is around 42 minutes which is consistent with the allowed visiting duration of one hour. Around 10% stay less than 15 minutes while around 40% stay the full duration. Around 3% of the visitors appear to stay on inside the hospital either with the patient, attending to other matters or till evening.

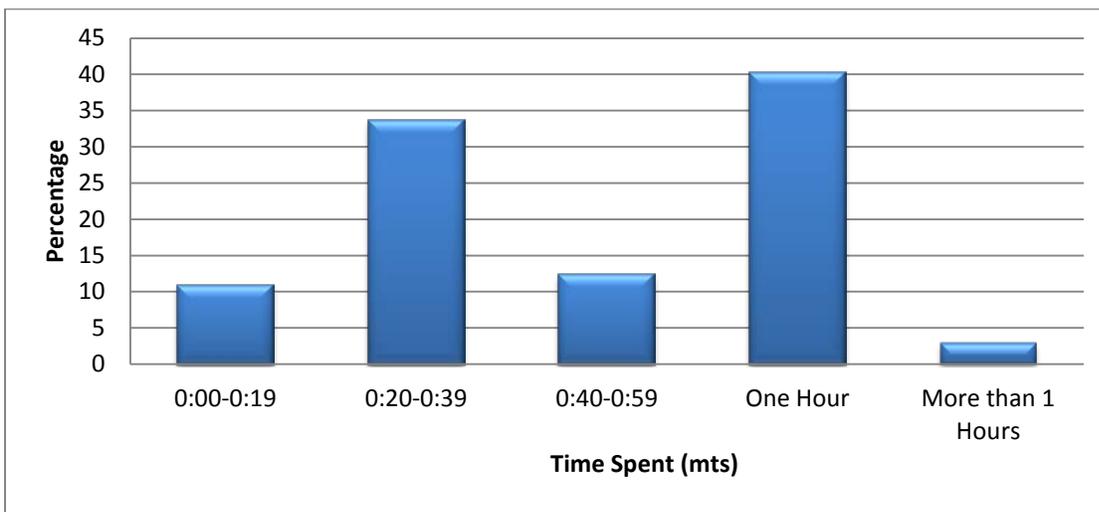


Figure 4-10: Visit Duration of Visitors to In-patients

Drop off Locations

It is shown that the most common drop off location is Town Hall followed by Punchi Borella followed by Ward Place/Eye Hospital. These locations account for 90% of all arrivals.

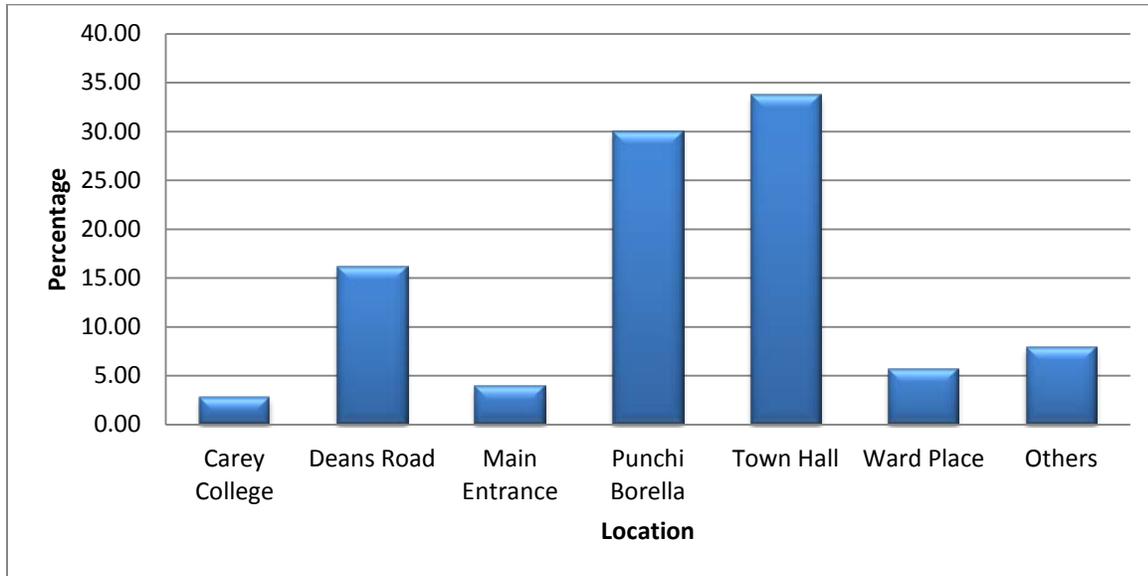


Figure 4-11: Drop-off Locations of Visitors to In-patients

Parking Location

The most common parking locations of visitors are on Norris Canal Road. The different locations along this road accounts for around 55% of all parked vehicles, while the balance is scattered around other parking areas both within and outside the hospital complex.

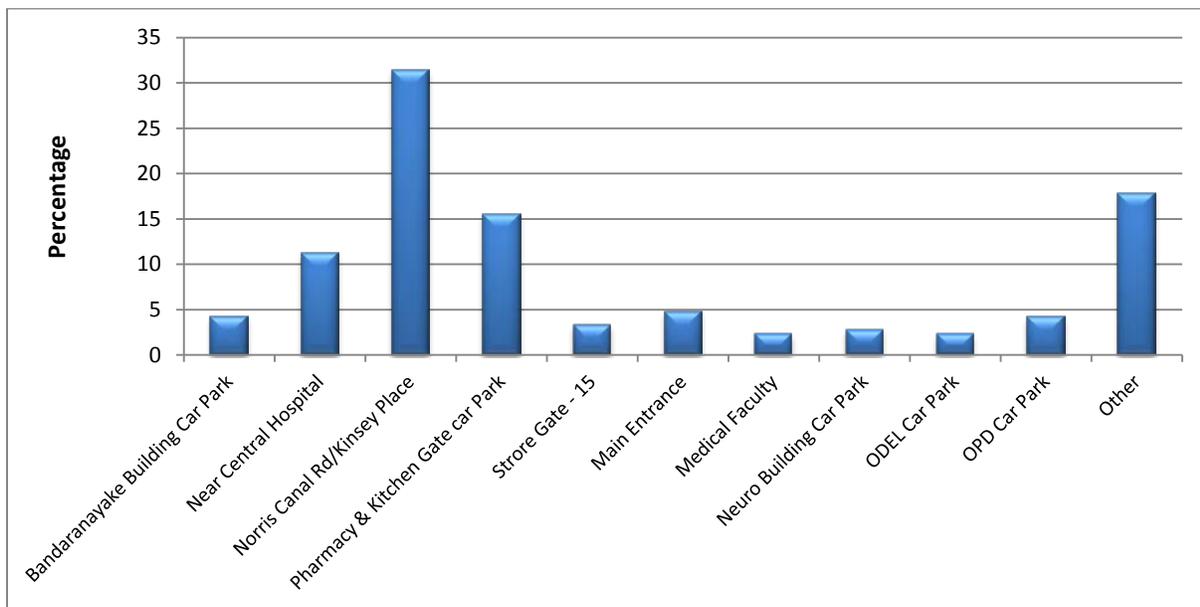


Figure 4-12: Vehicle Parking of Visitors to In-patients

4.3. Hospital Staff Travel Pattern

A total of 794 employees were interviewed, which is approximately 10% of the staff strength. The following details can be observed from the interviews:

Origin of Trip

Around 37% of staff arrives to the hospital from within the CMC area, whereas those who live within Colombo district but outside of the CMC amounts to 39%. It is therefore observed that 24% travel from areas outside the district.

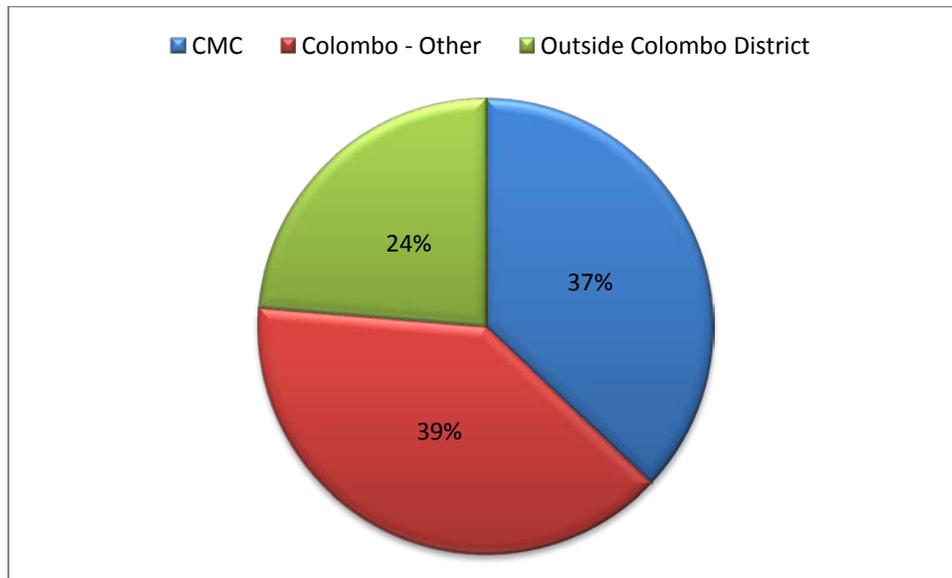


Figure 4-13: Travel to Work Origins of Hospital Staff

It is shown that almost all doctors travel from within Colombo District, while around 20% of other grades of employees travel from outside the district. Work trips originating from outside the province accounts for just 2%, drawn from Galle, Ratnapura and Kurunegala districts.

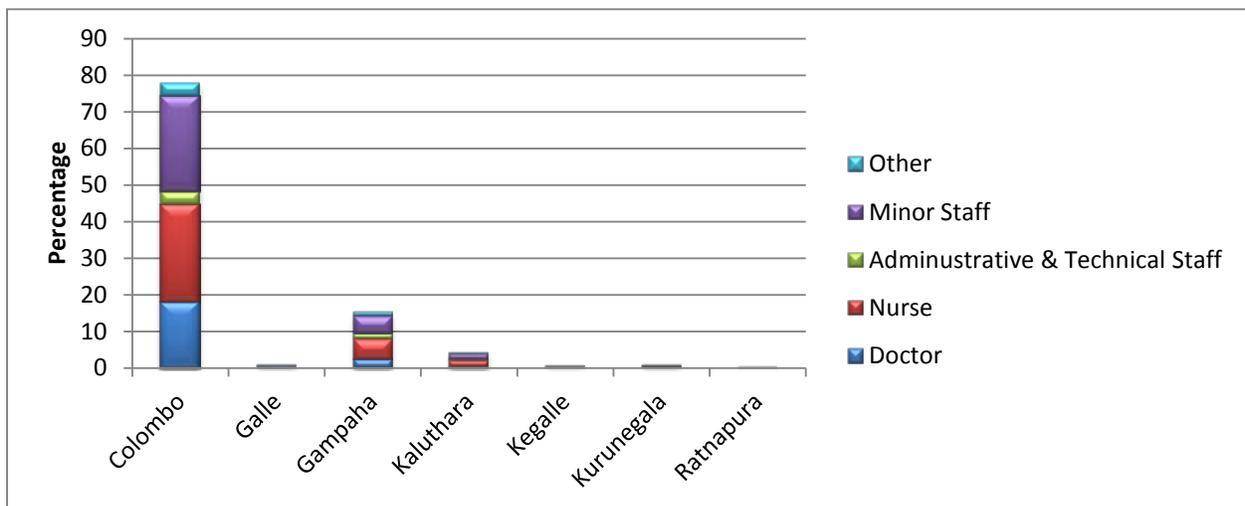


Figure 4-14: Travel to Work Origins of Hospital Staff by District

Transport Mode Used

Around 52% of employees arrive by bus while the train accounts for another 2%. Of the motorized modes, motor cycles make up 13% while 25% walk to the hospital, due to the quarters provided on site.

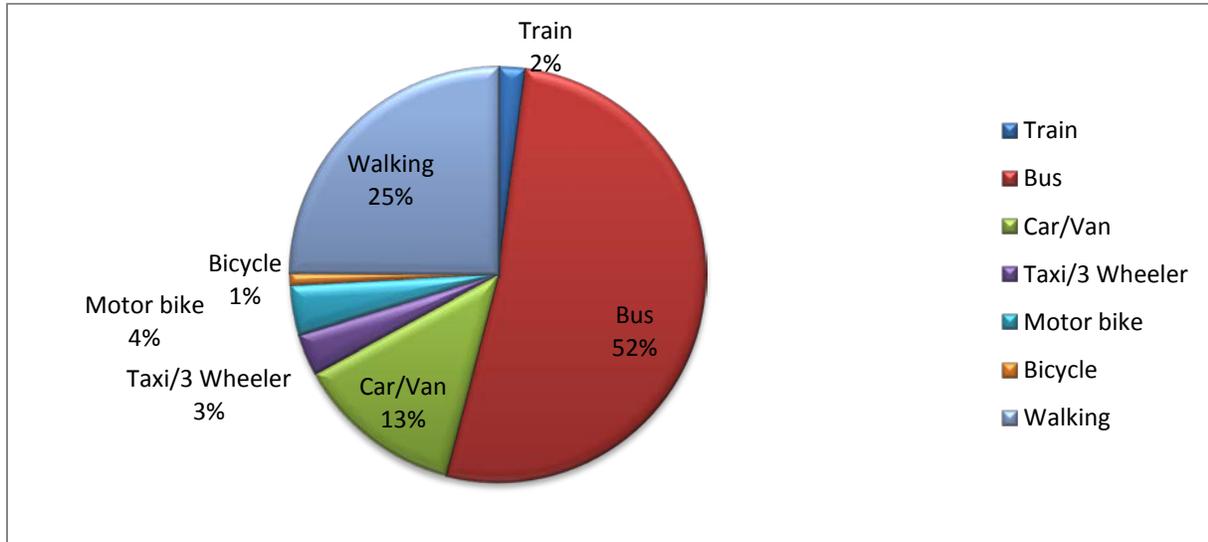


Figure 4-15: Mode of Transport Used by Hospital Staff to Travel to Work

The following figure shows the mode of transport used by employee type. Doctors use mostly private vehicles while around 1/3rd of doctors walk to work, as is the case of nursing staff. Around 1/6th of the minor staff also walk. Thus walking is the second largest access mode ahead of private transport for all employees.

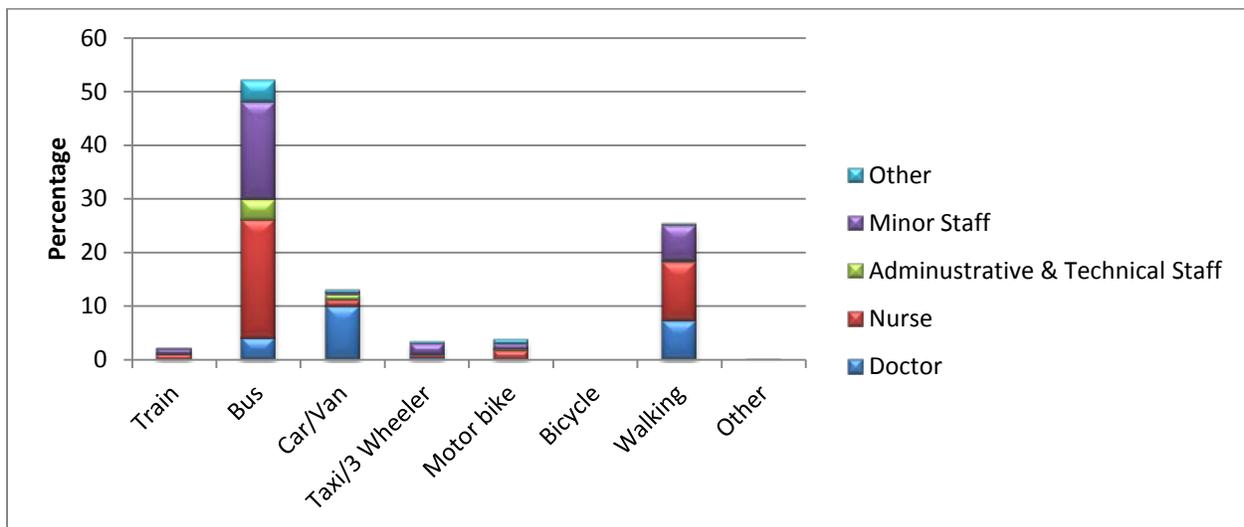


Figure 4-16: Mode of Transport Used by Grades of Hospital Staff to Travel to Work

As shown in the following figure, almost all walking trips are originating from within the CMC, while those coming from outside the district seem to use mostly railways. Most staff using cars and

vans appears to travel from outside the city, while those using other forms of private vehicles seem to all originate outside of the city. Around 1/3 of all bus users appear to come from outside the district.

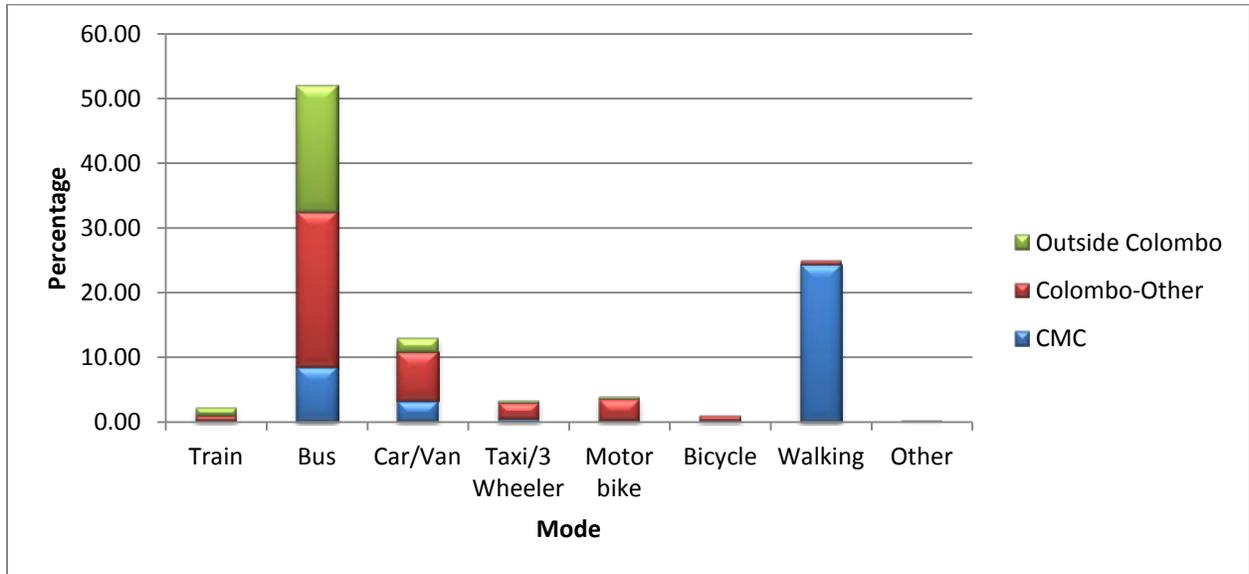


Figure 4-17: Mode of Transport Used by Hospital Staff to Travel to Work by Origin of Trip

Location of Arrival

The information of the location of arrival shows that 82.1% of employees that arrive by a vehicle, get dropped off, while the balance park their vehicles inside the hospital. The major drop off locations and the parking locations are given below. It shows that Town Hall, followed by Punchi Borella accounts for around 2/3rd of all bus passengers, while those using private transport get dropped either near the Bandaranayake ward or at other places within the NHSL complex.

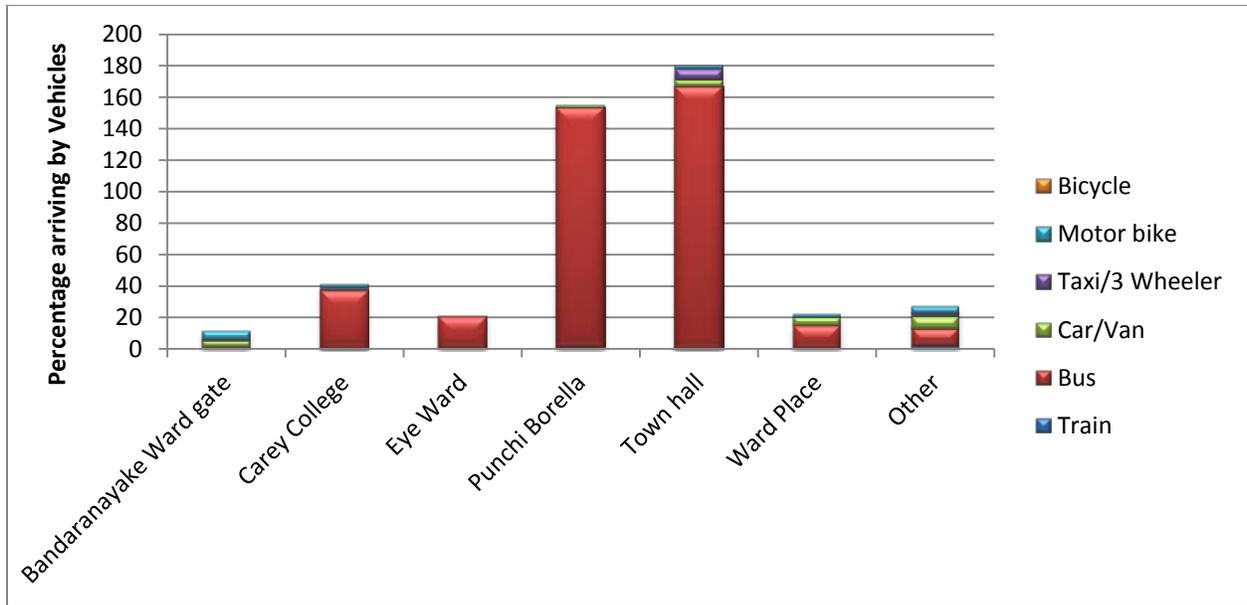


Figure 4-18: Drop off location of Hospital Staff to Travel to Work by Mode Used

For those who arrive by private vehicle and park their vehicles, the following figure shows that most parking happens in and around the Bandaranayake building.

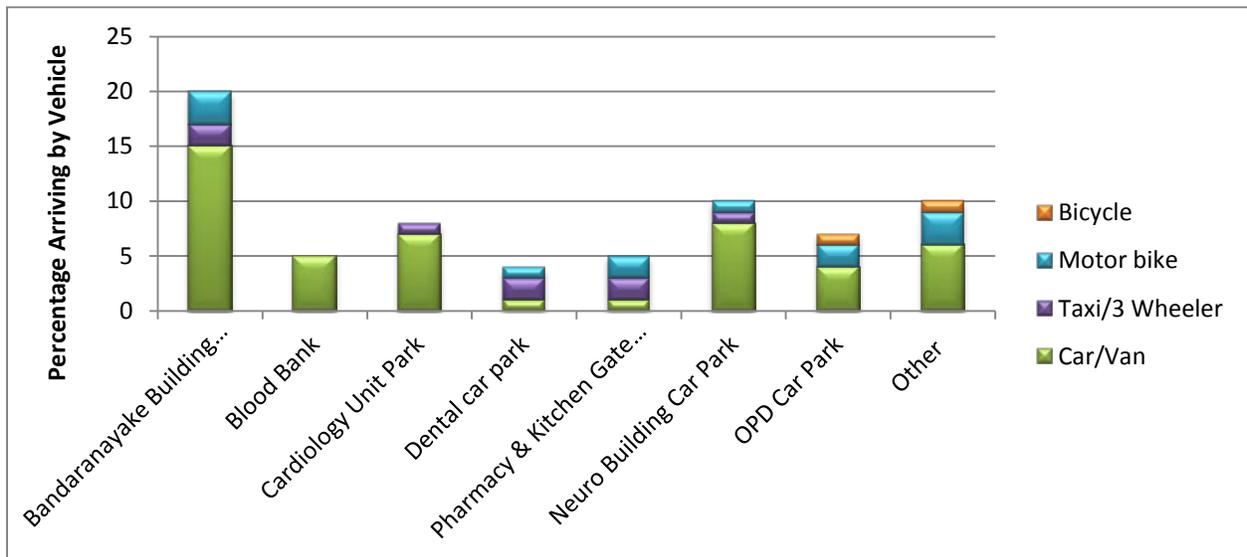


Figure 4-19: Location of Vehicle Park of Hospital Staff to Travel to Work by Mode Used

Travel Issues for Employees

The inquiry on travel issues for hospital employees shows that almost all public transport users complain of high walking distance to and from public transport and the crowded and poor condition of corridors available for walking within the hospital premises. Given that only 25% staff uses private transport, the response on the inadequacy of parking should also be considered as affecting the majority of private vehicle users. It is also clear that traffic congestion in arriving to

the hospital is viewed as a problem by nearly 40% of the employees which includes both private vehicle users as well as others. Hence the problem of poor traffic flow management and unsafe roads is seen as a general problem.

Table 4-3: Transport related Travel Issues for Hospital Staff

Issue	Using Bus and Rail	Using Private Vehicles	Walking and Bicycles
High walking distance to public transport.	42.63%	7.94%	0.70%
High walking distance to car park.	1.63%	5.57%	1.39%
Not enough parking.	1.91%	7.82%	9.24%
Not enough 3W/Taxies.	3.10%	8.85%	6.02%
Crowded Walkways.	40.59%	35.85%	13.70%
Traffic Congestion	20.68%	28.84%	12.59%
Other---	41.94%	63.16%	35.69%

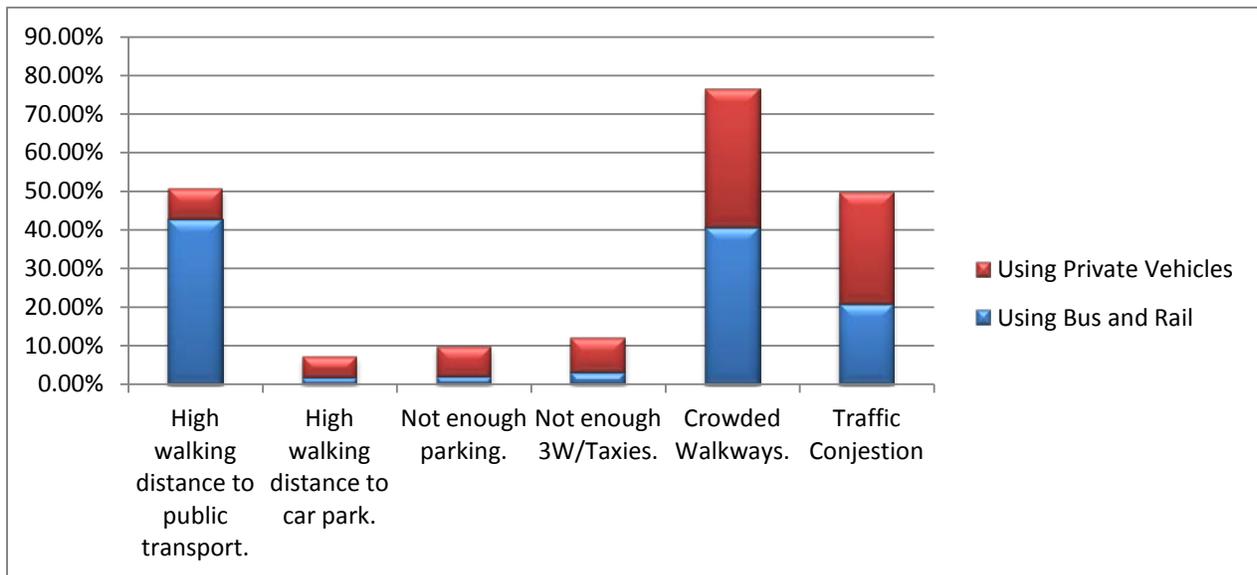


Figure 4-20: Travel Issues Highlighted by Hospital Staff by Mode Used

Use of Railway

The use of the railways as a mode of transport for all the different type of people arriving at the NHSL by trip origin is shown in the following figure. It shows that the railway is used by patients, visitors and staff alike. While trips originating in the Gampaha leads in the use of railway, Colombo and Kalutara districts follow at a much lower level.

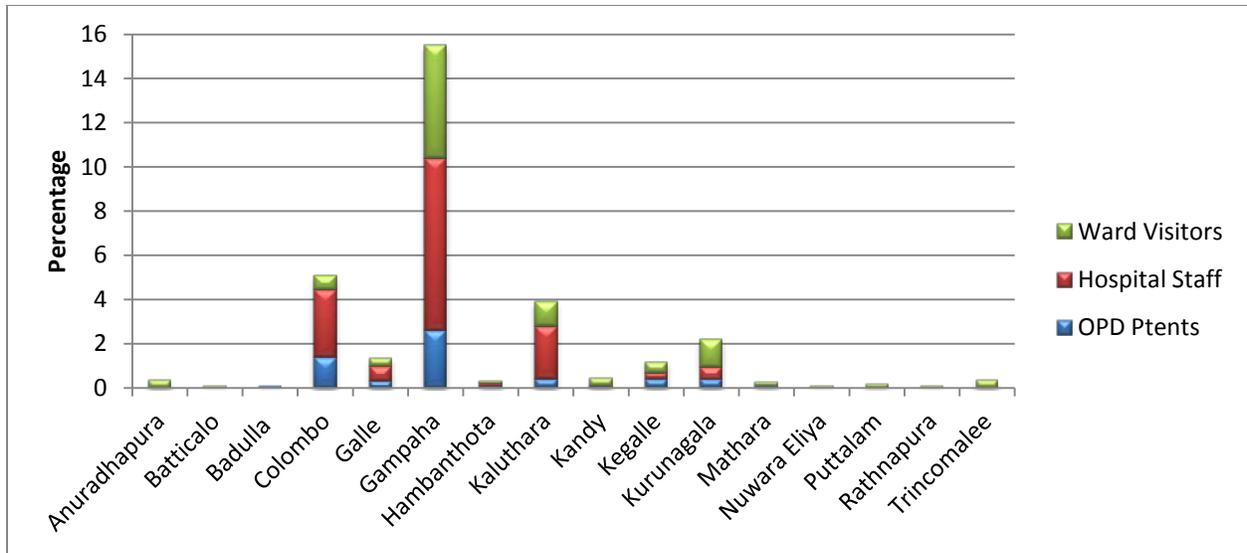


Figure 4-21: Use of Railway by different types of users and trip origin

4.5. Pedestrian Movements at Gates

The pedestrian count for the period 7 am to 7 pm at a total of 25 gates/entrances within the NHSL shows that there are over 100,000 pedestrian movements during this time. In addition, there are over 600 wheel chair movements and over 160 stretcher movements. The highest activity is at the current OPD, where a total of around 26,000 movements in both directions are recorded. This denotes the total number of movements in and out of the OPD made by staff, patients and visitors. There are also around 300 wheel chair movements and 100 stretcher movements to and from the current OPD. The surveys showed that on average the group size per patient was 1.6 and when the movements by hospital staff, patients and accompanying persons are added the total number of entries and exists can be matched.

Table 4-4: Pedestrian Counts (12 hours)

Gate Code	Gate Name	Paedestrian Count (in)	Paedestrian Count (out)	Wheelchair count (in)	Wheelchair count (out)	Stretcher Count (in)	Stretcher Count (out)	Total Pedestrian	Total Wheel Chairs	Total Stretchers
1	Cardiology Unit 1	964	971	0	0	0	0	1935	0	0
3	Cardiology Unit 3	2122	1896	28	17	19	12	4018	45	30
4	Cardiology Unit ICU	2072	1926	0	0	0	0	3998	0	0
7	Nursing Training School	550	513	1	0	0	0	1062	1	0
8	Nurse's Quarters (Near NTS)	227	207	0	0	0	0	434	0	0
9	Doctor's Quarters	1365	1476	0	0	0	0	2841	0	0
10	Nursing Quarters Entrance Front	439	358	0	0	0	0	797	0	0
11	Nursing Quarters Entrance Back	460	357	0	0	0	0	817	0	0
13	Blood Bank	3142	2993	0	0	0	0	6135	0	0
14	Pharmacy & kitchen	1945	1858	0	0	0	0	3803	0	0
16	Dental Gate	1098	1123	9	8	3	3	2221	17	6
17	Accident Orthopedic Unit/Ward 54	2911	2984	1	2	1	0	5895	2	1
18	Orthopedic Clinic 18	1341	1164	5	3	3	1	2505	8	3
19	Orthopedic Clinic 19	2589	2435	21	15	3	4	5024	35	7
20	Orthopedic Clinic 20	4926	3584	111	103	33	30	8509	214	63
21	ICU and Wards	4639	5146	17	10	1	4	9785	26	5
23	Accident Ward	2916	3084	13	13	4	3	6000	26	6
25	Bandaranayake Building	3874	4290	3	4	1	1	8163	7	2
26	ENT Clinic (Ward 1)	4485	5110	13	24	7	12	9595	37	19
27	OPD Gate 1	10648	8931	144	129	41	42	19579	273	82
28	OPD Gate 2	2981	3956	14	17	1	2	6937	31	3
29	Filling Station	317	350	0	0	0	0	667	0	0
30	AIDS Unit	332	368	0	0	0	0	700	0	0
31	Diabetic Clinic	425	503	0	0	0	0	928	0	0
	Total	56765	55577	376	342	114	111	112341	718	225

The ICU, ENT Clinic, Orthopedic Unit are the other high pedestrian zones. Wheel chair and stretcher movement is high at the Cardiology Unit in addition to above. The Bandaranaike Building is also a high pedestrian zone, partly due to the administrative functions located within the building. This is also shown in the following figure.

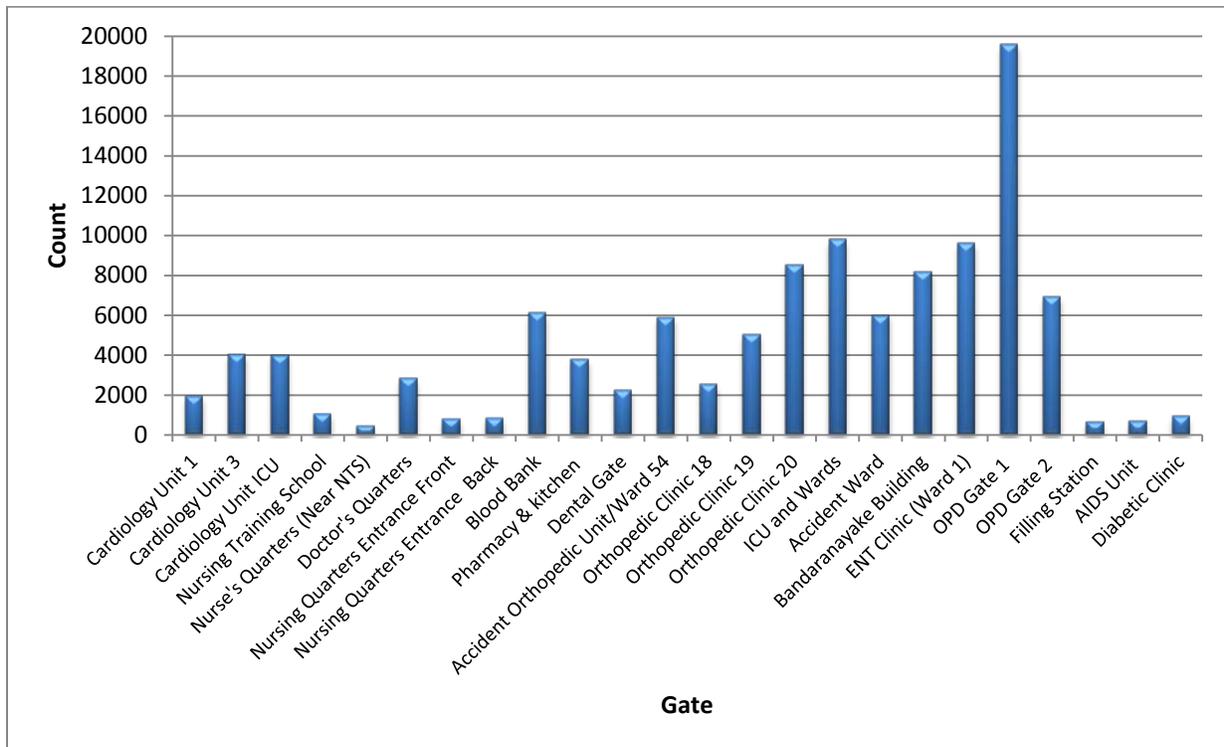


Figure 4-22: Pedestrian movements at Hospital Gates (7 am to 7 pm)

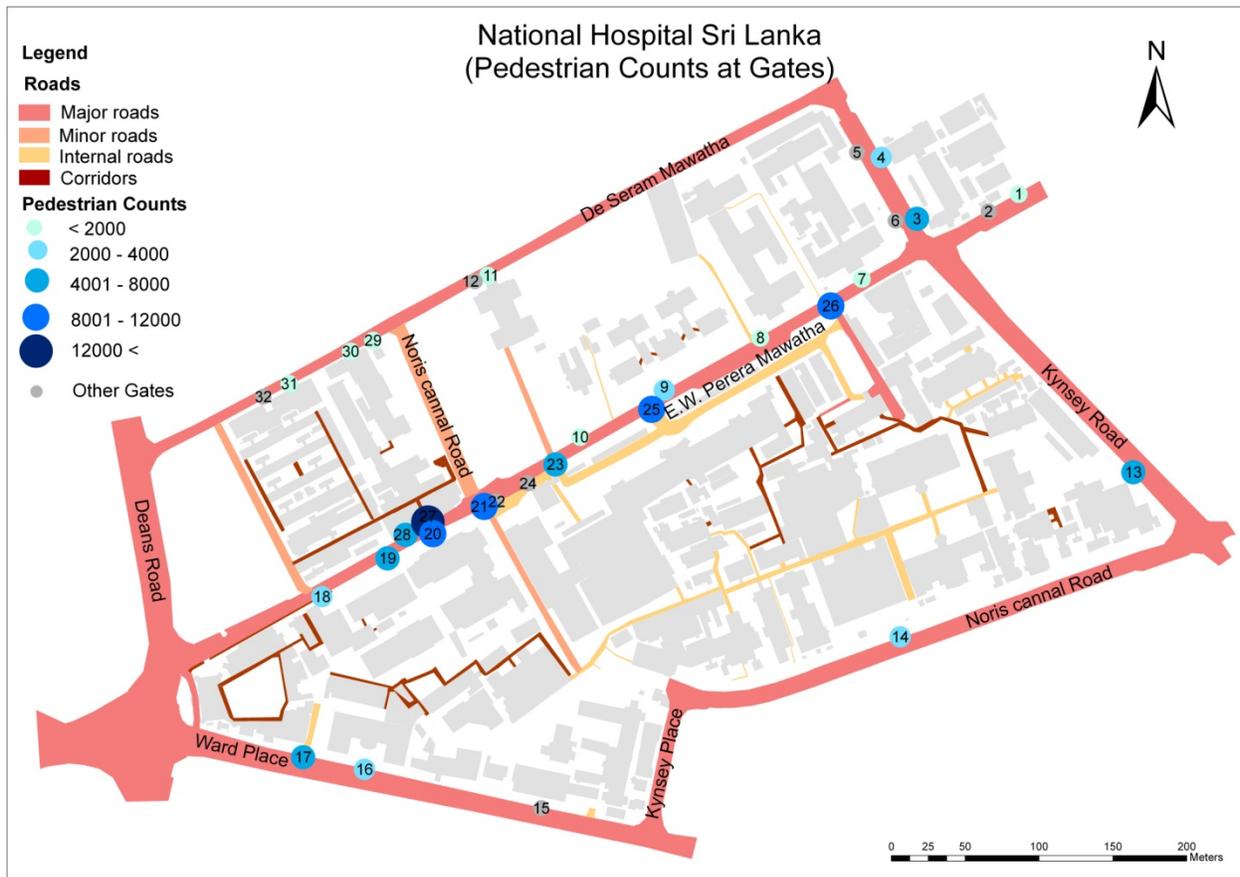


Figure 4-23: Pedestrian Entry Points

Arrival Pattern at current OPD

The arrival pattern at the current OPD shows that arrivals increase from 7am to 10am before dropping gradually to around 2pm, after which it remains moderately active with entries equaling, exists. The highest arrival rate is around 4,000 persons for one hour. The departures increase gradually from 8 am to 11 am and thereafter it drops. The number of persons gathered inside the OPD continues to increase up to around 11 am when it reaches around 2000 to 2500 persons, which is the maximum space requirement within the building.

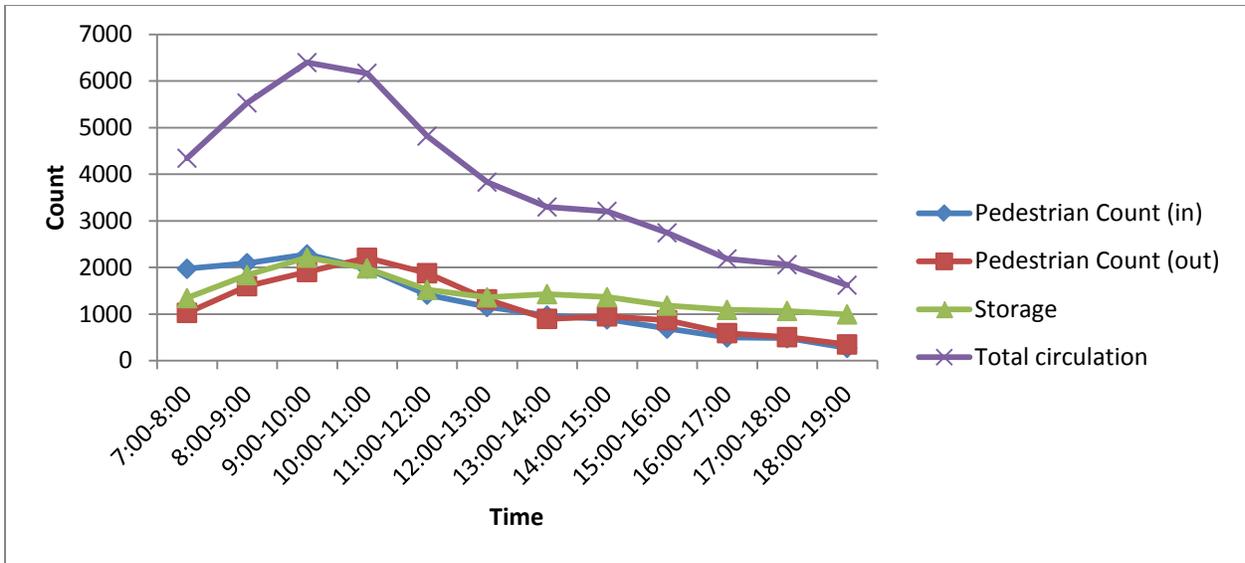


Figure 4-24: Pedestrian movements at OPD (7 am to 7 pm)

Arrival Patterns at Cardiology Unit

The arrival at the Cardiology Unit follows a different curve with early morning peak, but a slower out flow indicating that compared to the OPD patients spend more time there. The inflow peaks again during the mid day visiting hours at which time 900 people are estimated to be in the buildings.

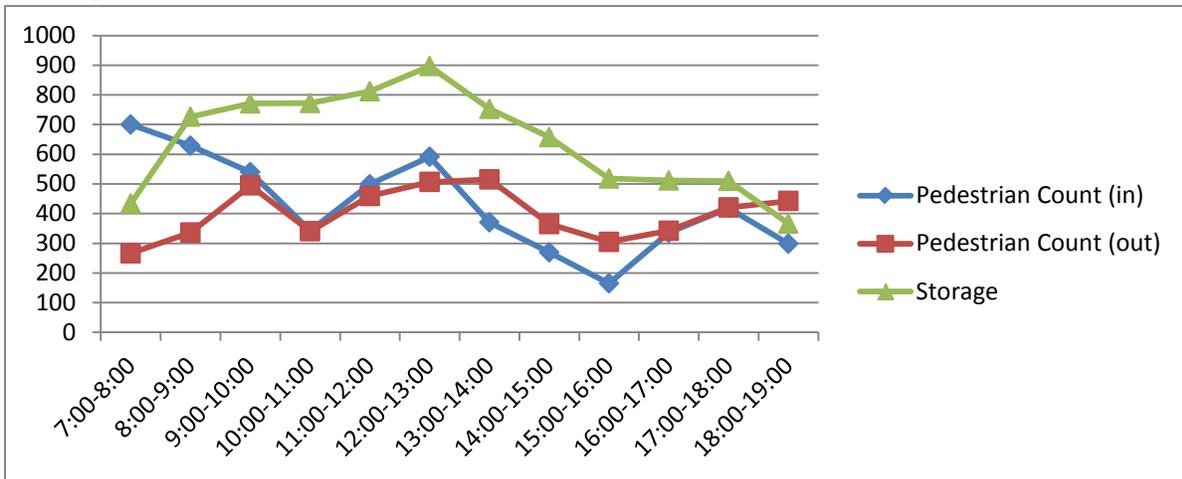


Figure 4-25: Pedestrian Movements at Cardiology Unit (7 am to 7 pm)

Arrival Pattern at Nurses Quarters

As expected the nursing quarters show deficit storage during the day with the peak out flow occurring before 9am. While some level of activity can be observed throughout the day, a peak in and out flow can be observed at mid day due to changes in shifts.

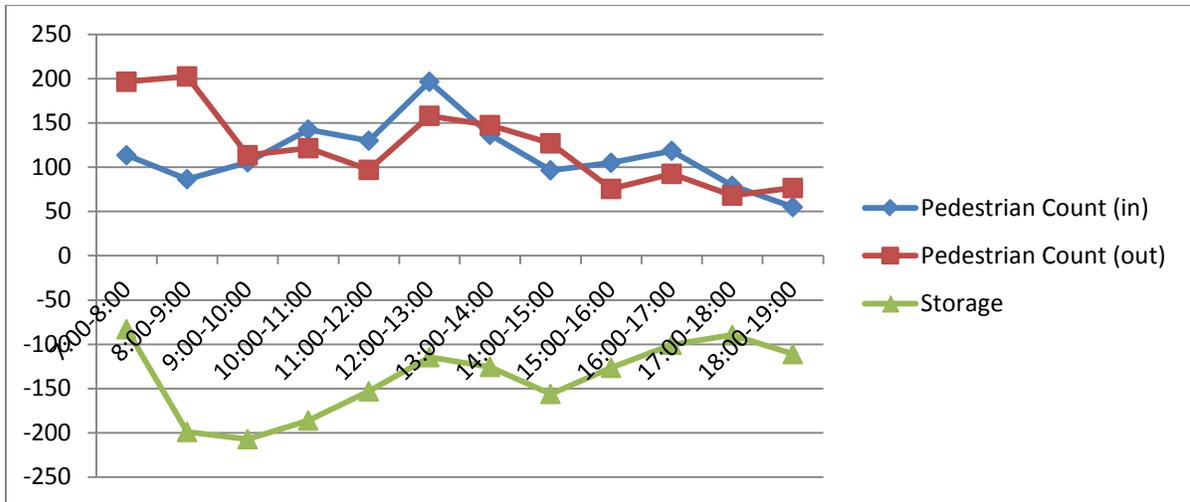


Figure 4-26: Pedestrian movements at Nursing Quarters (7 am to 7 pm)

Arrival Pattern at Doctors Quarters

Even the total movement numbers are very small, doctors’ quarters indicate a high in and out flow between 7 and 8 pm and a repeat between 1pm and 2 pm which could mean that a number of school based trips happen from here. Doctors returning for lunch and getting back is another possibility as well as shift changes at these times.

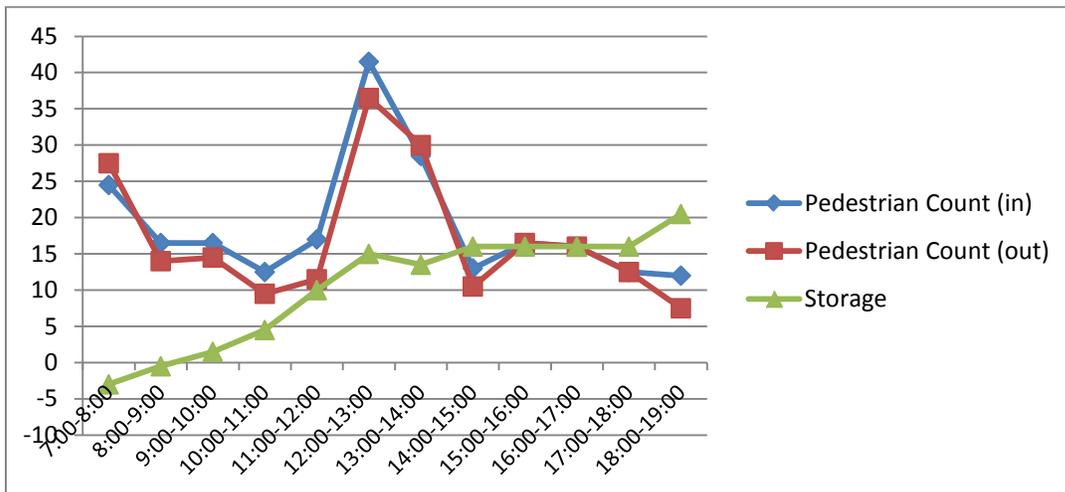


Figure 4-27: Pedestrian movements at Doctors Quarters (7 am to 7 pm)

Arrival Pattern at buildings having In-patient wards and clinics

Since these areas have clinics, wards and administrative offices, the flow pattern is very mixed. There is a generally high level of activity in the morning period. However the storage of persons within the complex remains high indicating that most of these persons are employees. The peak at mid day is from the visitors.

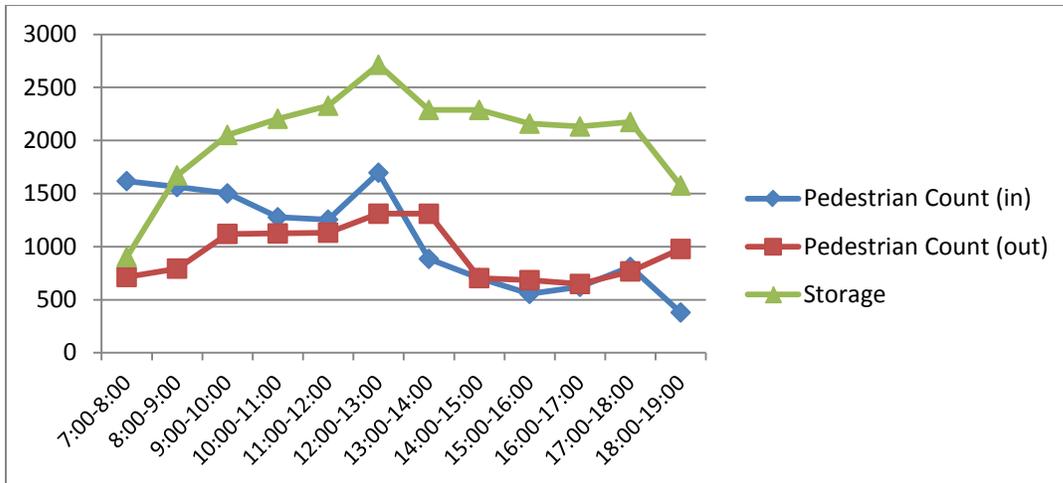


Figure 4-28: Pedestrian Movements at In-Patient Wards and Clinics (7 am to 7 pm)

Arrival Pattern of Accident Service

The inflow and outflow at the accident service shows that most pedestrian activity is confined to the visiting hours where around 300 visitors arrive in the mid day and around 200 arrive in the evening. It is clear that except at visiting hours there are very few people within the complex.

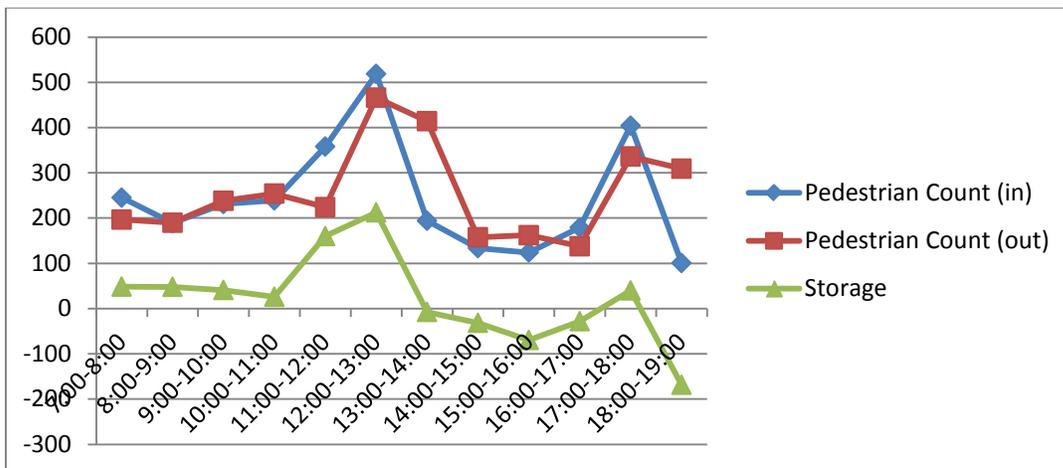


Figure 4-29: Pedestrian Movements at Accident Service (7 am to 7 pm)

Arrival Pattern of all blocks around Bandaranayake Block

This area has a mix of administrative units as well as wards. While the heightened activity at mid day and evening indicated visitors to inpatients, the high presence of hospital employees arriving before 9 and the high level of general activities in the morning indicated general visitors and OPD visitors.

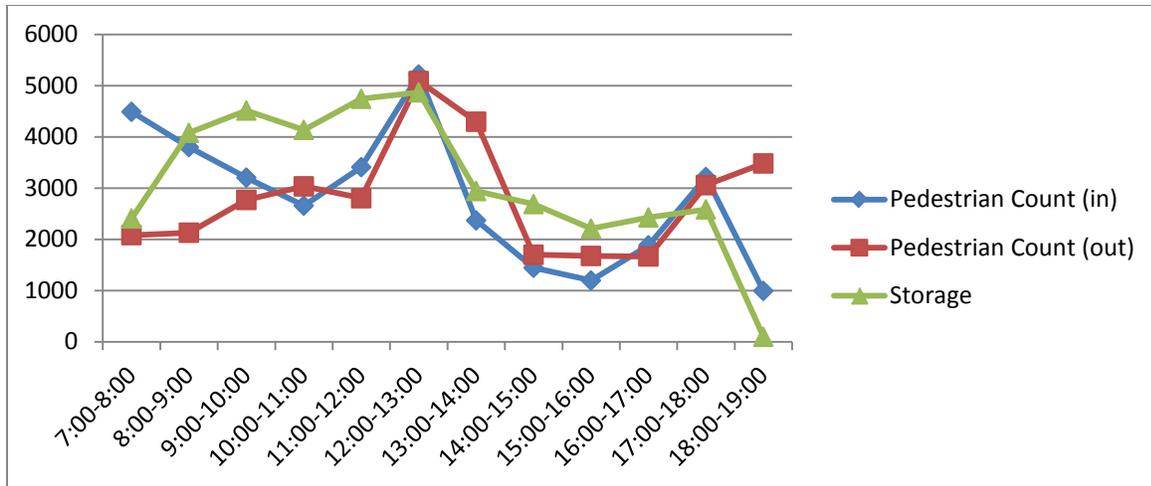


Figure 4-30: Pedestrian Movements around Bandaranayake Block (7 am to 7 pm)

Arrival Pattern of NHSL Hospital complex

The total inflow and outflow shows that the morning peak of 13,000 persons before 9 am indicates the arrival of most of the staff and most of the OPD patients. The mid day peak represents around 5,000 additional entries while the evening peak represents around 4,000 additional entries which can be assumed to be visitors for inpatients.

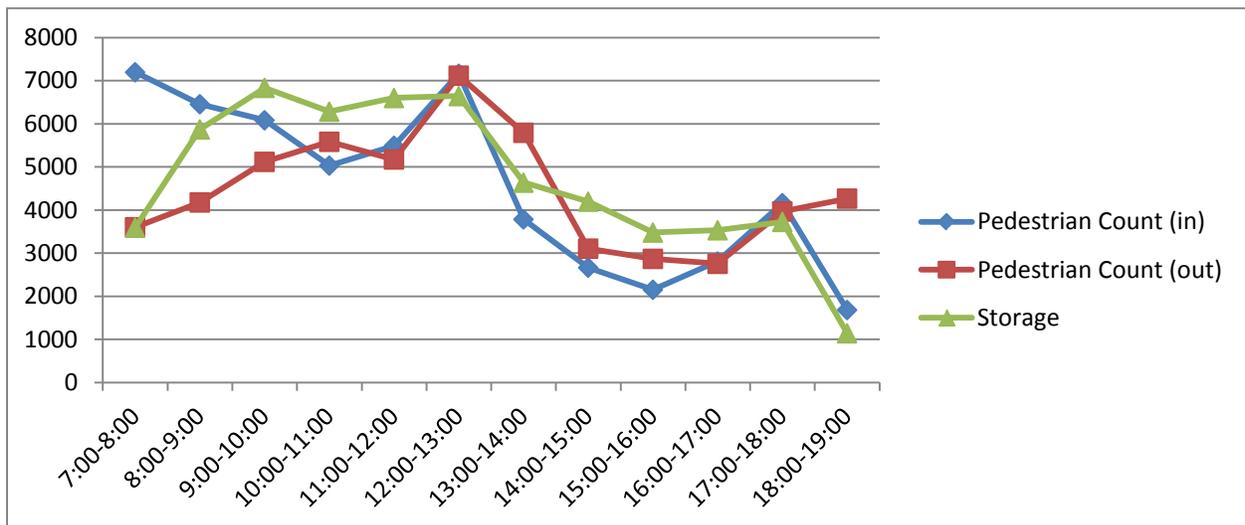


Figure 4-31: Pedestrian Movements at NHSL Complex (7 am to 7 pm)

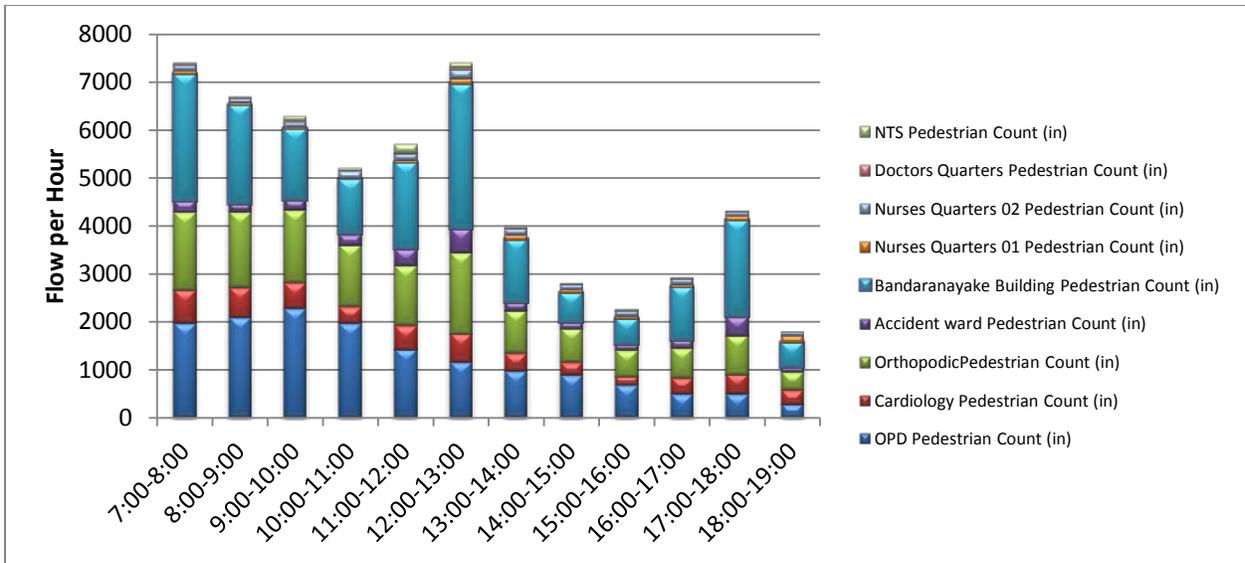


Figure 4-32: Inflow of Pedestrians to NHSL Complex (7am to 7pm)

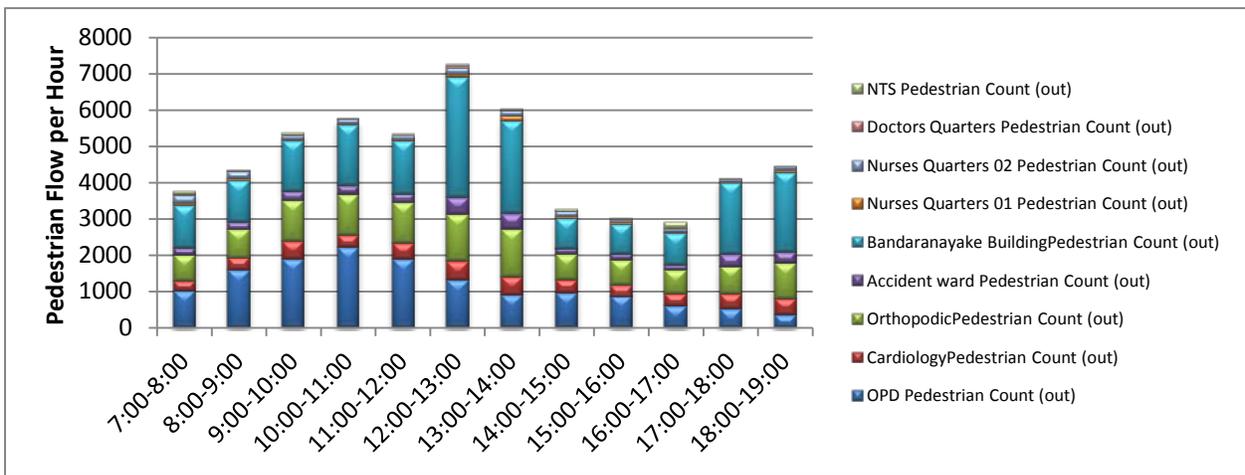


Figure 4-33: Outflow of Pedestrians to NHSL Complex (7am to 7pm)

Hospital Staff Destinations for Internal Walk Trips

The number of buildings that hospital staff enters during the course of a day is given as a percentage of all staff. This shows that more than 60% work within one building while 23% have to go to one other while the balance have to travel to more. There are around 3% who travel to more than 4 buildings. The average number of trips between buildings is 1.6 per staff.

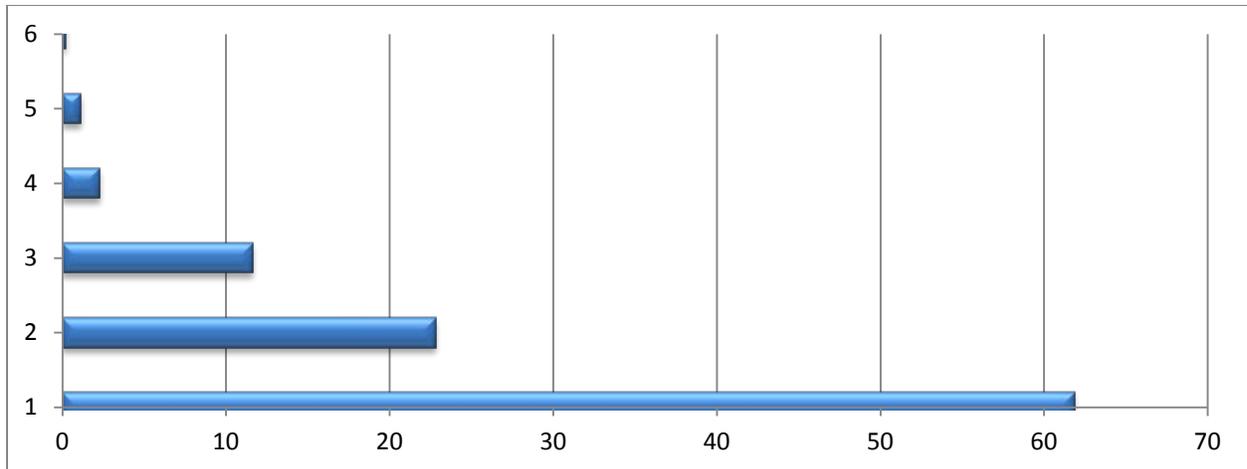


Figure 4-34: Number of Internal Trips between Buildings by Percentage of Hospital Staff

The following table shows the destination of staff in their internal movements within the hospital. The OPD, Bandaranayake building, accident service, matrons office are some of the locations that are mostly visited by the hospital staff.

Table 4-5: Table of Destination for Internal Staff Walk Trips

Location	Total	%	Location	Total	%
3rd Medical Wards (ICU)	15	7	Medical Building	21	10
Accident Service (OPD)	6	3	Medical Faculty	6	3
Accident Ward	47	22	Neuro Trauma Building	10	5
Bandaranayake Building	65	30	OPD	89	41
Cardiology Building	8	4	Overseer office	9	4
Dental	27	12	Pharmacy	21	10
E section	4	2	Pinland Building	5	2
I section	5	2	Plastic Surgery Unit	5	2
Internal Pharmacy	8	4	Surgical Section	7	3
Lab office	4	2	University Surgical Unit	4	2
Matron office	29	13	Other Locations	42	19
			Grand Total	218	100

Pedestrian Flows within NHSL Complex

The pedestrian flow within the hospital i.e., along its corridors and walkways is shown in the following figure. The corridors adjacent to the General Casualty Operating Theatre has the highest flow during the day with over 10,000 movements in both direction with a peak of 1,800 during the mid day peak.. Other than the OPD, most other locations record between 3,000 to 5,000 person movements per day.

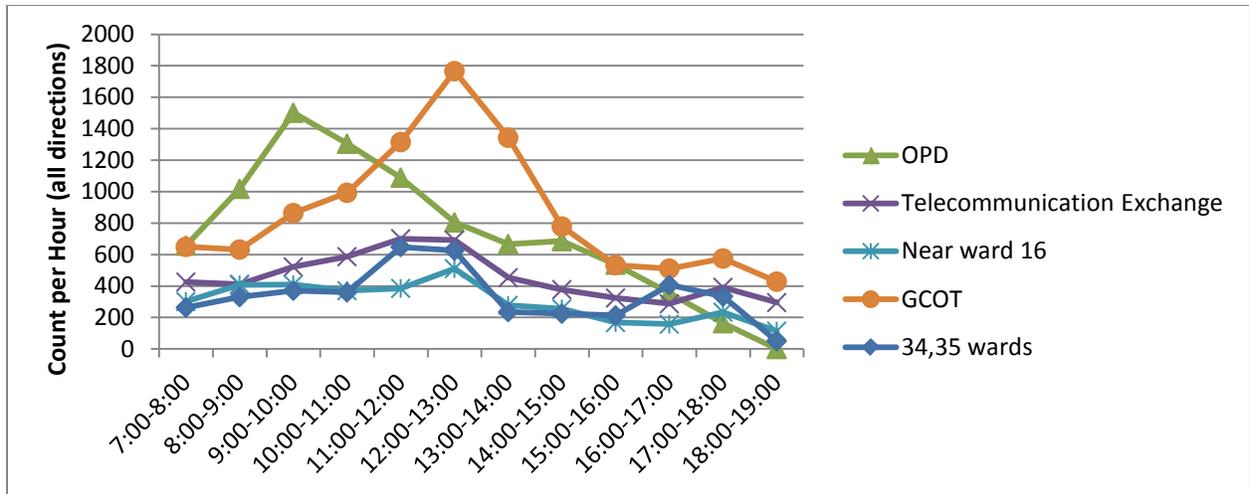


Figure 4-35: Pedestrian Flow at Selected Locations within NHSL (7am to 7pm)

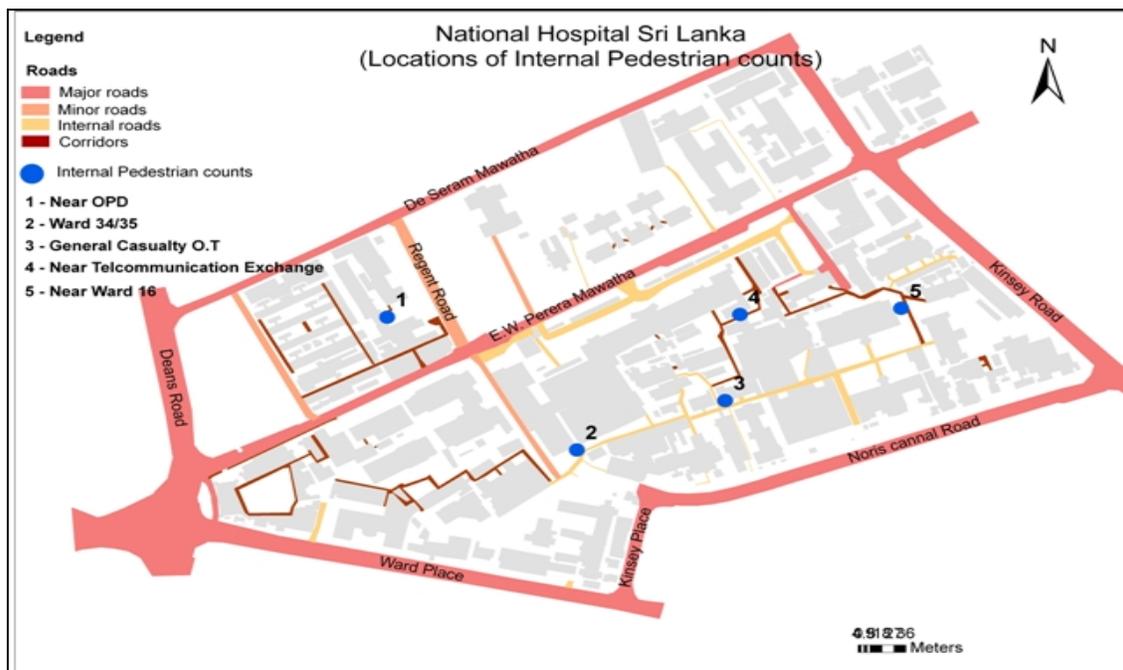


Figure 4-36: Selected Locations for Pedestrian Counts

Pedestrian Movements along Roads and at Junctions

The junction pedestrian movement diagrams shows that the road intersection on Regent Street (EW Perera Mw) adjacent to the Neuro Trauma unit/OPD (J2) has a daily pedestrian movement of 25,000 which is around 25% of the total pedestrian movements of the entire hospital complex leading to the busiest node within the area. The junction on Kynsey Road with Regent Street next to the Cardiology Unit is busier with nearly 40,000 pedestrian movements even though not all are hospital related. However the pedestrian movement from that junction to the hospital complex on Regent Street is around 23,000 movements, while the flow of pedestrians at the OPD end of the

same road is around 21,000 showing a high level of pedestrian activity through the length of the road. The estimated flow of the Eye Hospital junction at the end of Regent Street is around 15,000.

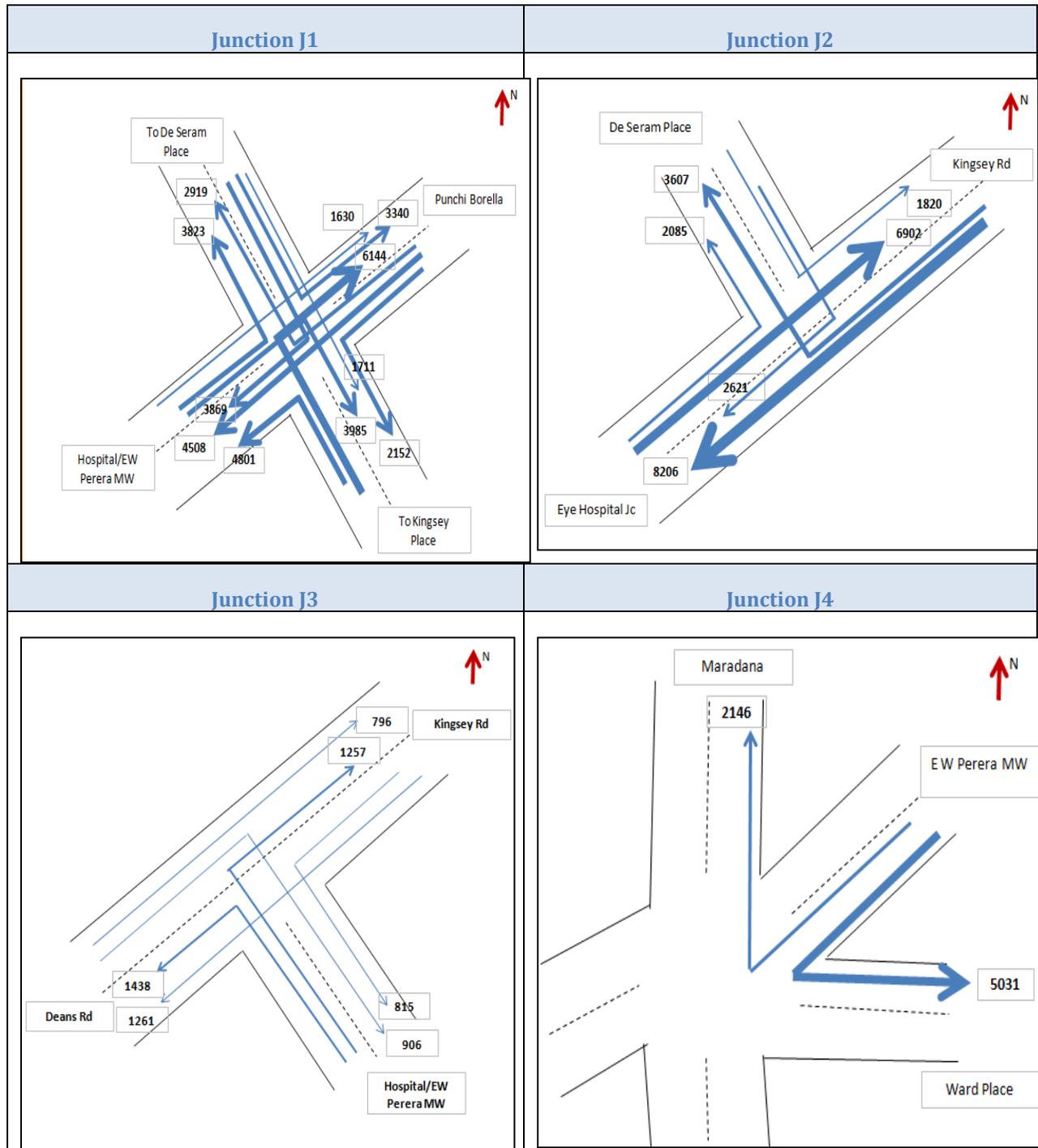


Figure 4-37: Pedestrian Movements at Junctions (7 am to 7 pm)

The following figure shows the total pedestrian flow at all four junctions by 15 minute intervals. This shows a high level of activity through the day with a peaking starting before 12 noon and

continuing for one hour due to the visiting hours. A lesser peak is experienced during the evening visiting hours as well.

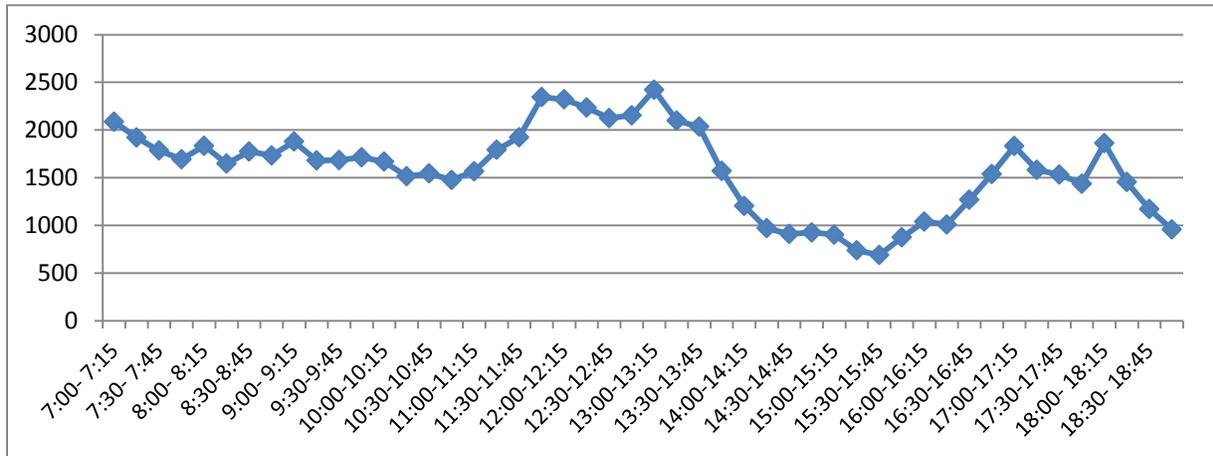


Figure 4-38: Pedestrian Movements at all Junctions (7 am to 7 pm)

4.6. Vehicle Arrivals and Departures

An estimated 4,000 vehicles enter the buildings of the complex between the period 7am to 7pm. The analysis of arrivals between 7am and 7pm given in the following table, which shows that in the doctors quarters there is some activity that fits school drop off and pick up from here. These areas seem to be used for mainly vehicles parking during the day with most vehicles leaving after 2pm.

In other parking areas there appear to be a consistent pattern with around 1/3rd of all the arrivals within the two hour peak arrival period 7-9am and around 1/4th of all departures within the two hour peak departure period from 3 to 5pm.

Table 4-6: Vehicle Arrival Patterns at all Gates (7 am to 7pm)

ArrivalHour	Cardiology Unit	Doctor's Quarters	Blood Bank	Pharmacy and Kitchen	Stores	ICU and Wards	Accident ward	Bandaranayake Ward	Filling Station	Aids Branch	Transport Sector	Orthopedic Clinic	Grand Total
07:00-08:00	20	64	52	10	3	9	14	62	3	3	2	30	272
08:00-09:00	24	58	42	13	4	8	20	70	3	5	9	45	301
09:00-10:00	54	58	74	20	2	28	22	72	3	11	7	28	379
10:00-11:00	24	60	43	13	3	30	16	69	3	6	3	42	312
11:00-12:00	22	74	44	14	9	31	18	57	4	12	4	34	323
12:00-13:00	23	114	46	12	8	29	28	111	7	14	5	14	411
13:00-14:00	25	52	37	14	6	15	41	119	3	10	8	14	344
14:00-15:00	19	45	20	14	3	7	17	78	4	2	3	14	226
15:00-16:00	29	130	29	18	10	52	37	69	9	12	5	12	412
16:00-17:00	25	161	59	34	11	65	18	72	11	4	5	9	474
17:00-18:00	5	38	42	22	17	32	13	60	6	4	6	7	252
18:00-19:00	8	31	22	18	9	50	25	59	4	3	5	5	239
Grand Total	278	885	510	202	85	356	269	898	60	86	62	254	3945

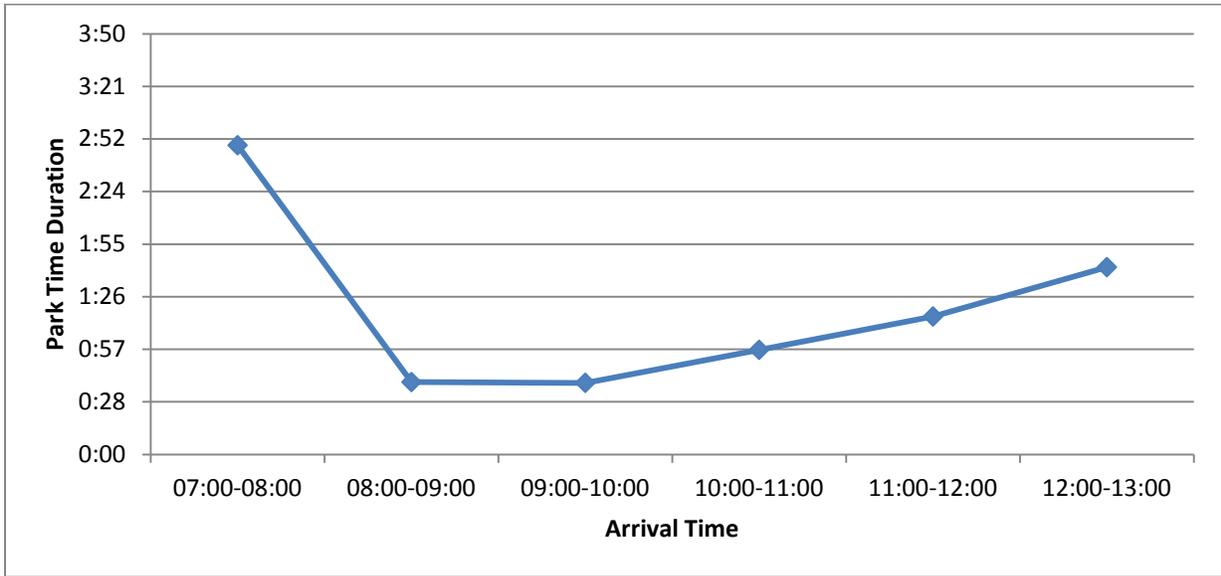


Figure 4-39: Vehicle Arrival Time Vs Park Time Duration at NHSL Complex (7 am to 1 pm)

Parking Duration

It is seen that 60% of all vehicles parking within the hospital premises stay for less than one hour. Only around 25% stay for more than 3 hours. The average parking time is 1 hour and 53 minutes. This means that on average parking spaces are used around 5 times a day.

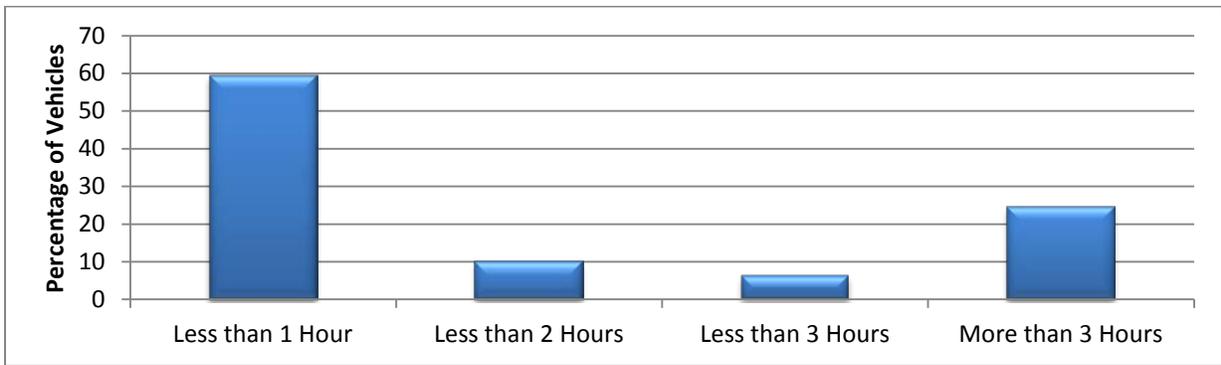


Figure 4-40: Duration of Vehicle Parking within NHSL Complex

Total Vehicle Arrival at NHSL

The arrival of vehicles within the hospital complex has a peak before 9 am which tails off over the day while the departures pick up through the day to peak around mid day and again from 3 to 5 pm. The highest number of vehicles parked at any time during the day was around 300 to 350 vehicles occurring throughout the morning period and also around 5 pm, possible due to vehicles arriving to pick up employees.

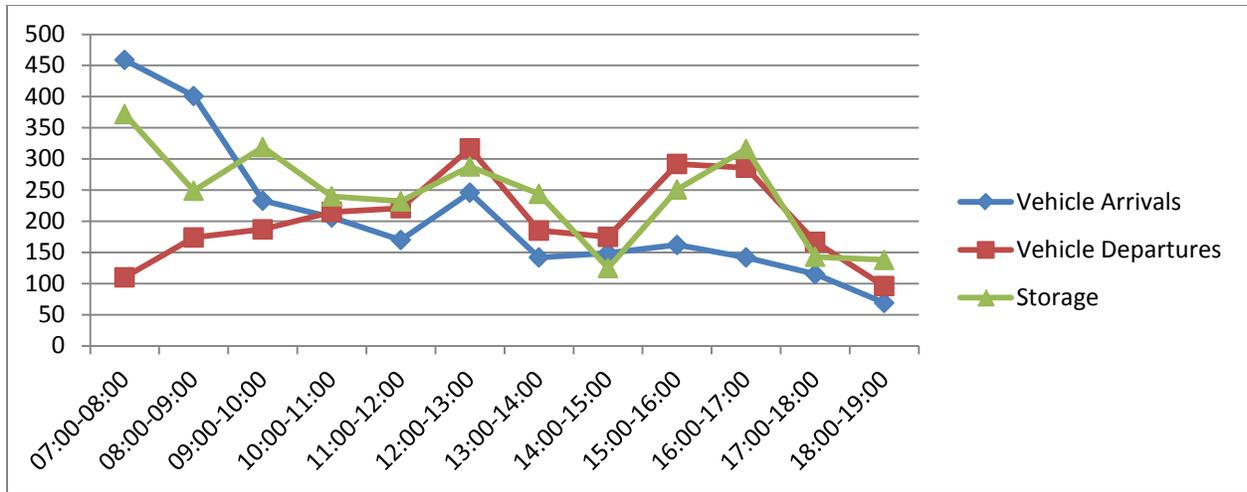


Figure 4-41: Vehicle Storage at NHSL Complex (7 am to 7 pm)

Ambulance Movement in NHSL

Around 50 ambulances have been observed to enter the hospital during a day. The highest number appears to enter during the period 9 to 10am. Most ambulances appear to leave within the hour.

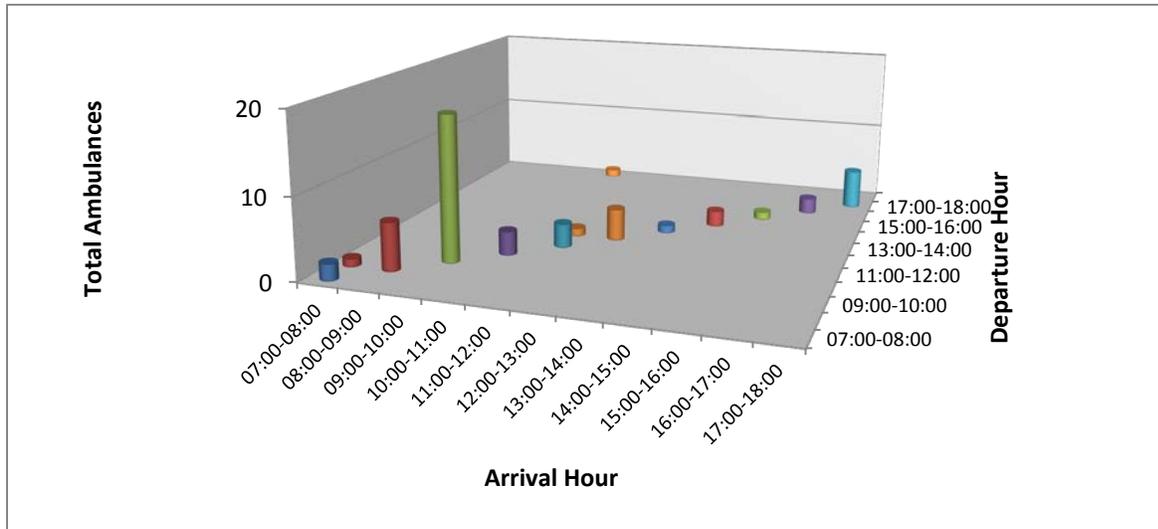


Figure 4-42: Movement of Ambulances (7 am to 7 pm)

Traffic Flow on Roads and Intersections

There are around 9,000 vehicle movements across junction J2 which is where Regent Street (EW Perera Mw) meets Norris Canal Road adjacent to the Neuro Trauma Unit and OPD. Of this the heaviest movement is from Norris Canal side towards Eye Hospital. The section of road between this junction and junction J1 near the Cardiology Unit is restricted with Police presence. Hence the flow is around 4,300 vehicles at the OPD junction but around 8,000 at the Cardiology Unit junction. The flow on Regent Street towards Eye hospital though unrestricted is virtually one way towards the Eye Hospital. This is partially due to turning restrictions on Darley Road. It seems that vehicles parking along the Norris Canal use this to exit the hospital complex, but arrive through de Saram

Road. It is clear that vehicles arriving to park within the hospital, arrive mostly from the Kynsey Road side as opposed to the Eye Hospital side. The partial control is effective in ensuring general traffic from passing through the hospital. This is confirmed by the fact that vehicle numbers entering and leaving the gates (around 8,000) being accounted for in the total flow at both ends of Regent street which is 12,300. This means that around 50% of vehicles do not enter the gates, which would be mostly vehicles that may be entering to drop off passengers as well as a few vehicles that pass through despite the restriction. However it has created traffic flow imbalances and congestion at the junctions at Kynsey Road and Norris Canal along the Regent Street (EW Perera MW).

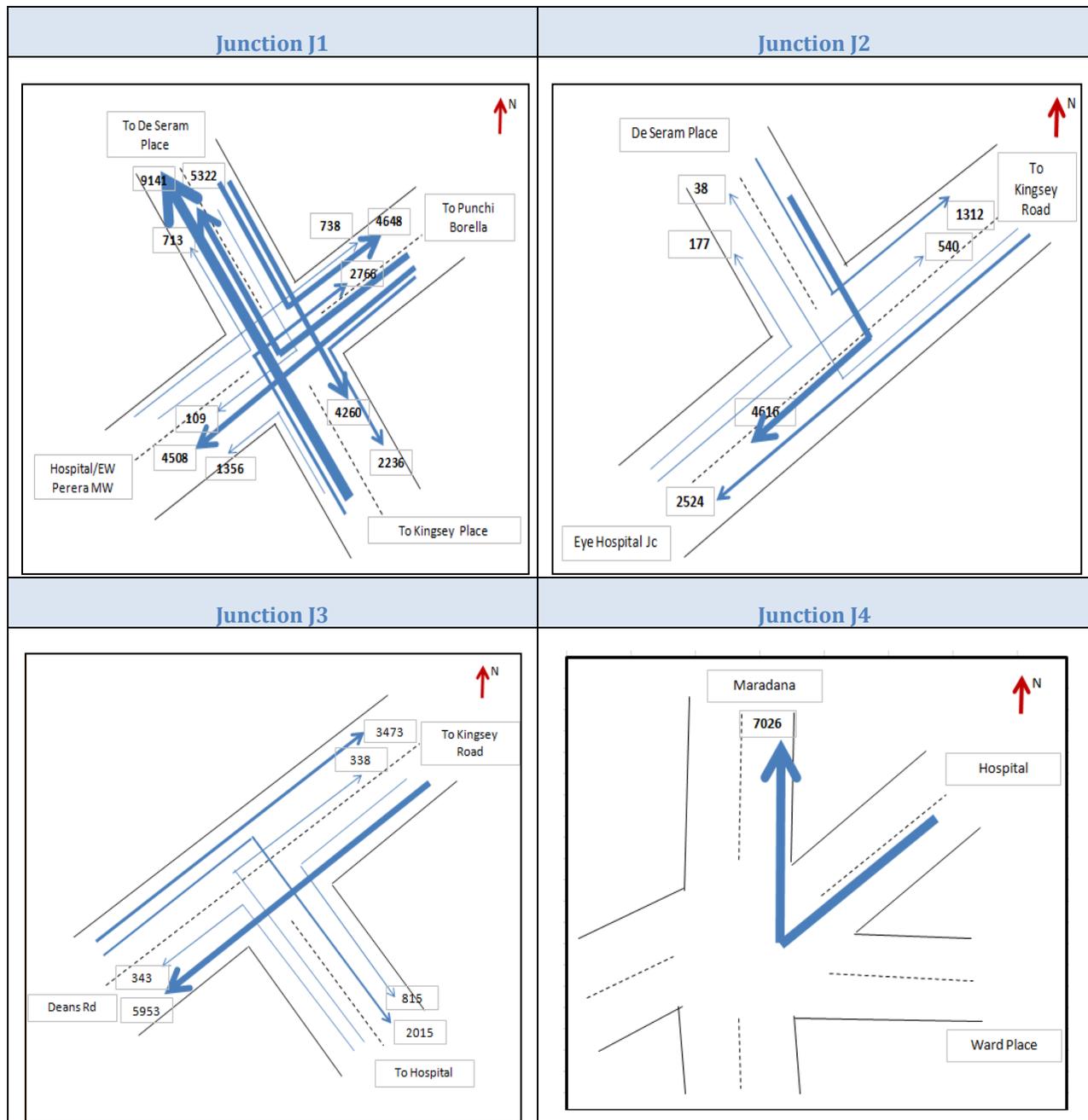


Figure 4-43: Vehicle Movements at Junctions (7 am to 7 pm)

5. Synthesis and Conclusions

The analysis of the different activities discussed in the previous section have been synthesized in order to arrive at conclusions that would assist to understand the current mobility requirements so that the development project could adequately address these in its design for the new buildings and for an improved transport service plan for the NHSL complex.

5.1. Summary of Hospital Mobility Status

The final estimate of the number of persons arriving at the hospital during the day time for the different services and units suitably adjusted for the number of trips they may make between buildings may be estimated as follows:

- Staff - 6,000 (arriving over different shifts with the highest population working from 8 am and 5pm)
- OPD - 10,400 (with average of 6,500 patients plus accompanying persons)
- Ward Visitors - 10,000 (mostly during mid day and evening, few during morning)
- Other Units - 3,000 (spread throughout the day)
- General Visitors/Business purposes - 4,000 (mostly morning time)

These add up to 33,400 persons arriving at the NHSL complex during a weekday.

Of these around 64%, i.e. around 22,000 persons arrive by bus and train. In the case of train they use a bus or three wheelers to get to the hospital. Bus passengers use bus stops at Town Hall, Punchi Borella which are distances of between 500 metres to 1 km depending on which direction they arrive and which building they travel to. Over 60% of bus users complain of the large distance to walk.

There are a further 2,500 persons who arrive walking or by bicycle. These include around 1,800 staff mainly doctors and nurses who are provided hospital quarters and other staff who live within walking distance.

There are an estimated 10,000 vehicle trips made to the hospital complex. Of these 88% arrive to drop off the occupants at different gates. In the case of staff getting dropped off, Bandaranayake Building is a common point while in the case of patients; the OPD is frequented mostly by three wheelers.

Only staff or official visitors are allowed parking within hospital premises. There are around 4,000 such vehicle entries a day where the vehicle has parked. The maximum requirement for parking within the complex which is around 3500 vehicles, occurs around 11 am. There are only around 20% of vehicles that park for over 3 hours and thus average parking duration is around 1.5 hours. Patients and visitors record around 5,000 vehicle arrivals of which 80% , which makes up mostly three wheelers and taxis require little or no parking. Of the others, the daily requirement for parking is around 2,000. These vehicles are parked at the OPD car park, along the Norris Canal Road and also at private car parks such as the Central Hospital and even Odel.

No through traffic is allowed on Regent Street (EW Perera Mw) between Kynsey Road and Norris Canal Road. Due to the traffic on Norris Canal Road as well as the section of Regent Street up to Deans Road also has mostly one way traffic. The staff, patients and visitors are estimated to make 53,000 pedestrian entries to the different buildings within the NHSL complex such that on one person on average enters a building 1.5 times. They also make around 25,000 crossings of the main road junction near the Neuro-Trauma Unit where Regent Street (EW Perera Mw) meets with Norris Canal Road which causes congestion on the road network as most vehicle movements have to pass

this junction. There is also congestion due to trading activities at this location as well as the loading and unloading of patients at the entrance of the OPD all of which are in close proximity to each other. This congestion peaks during visiting hours. The fact that the directional signage for pedestrians is non-standard and not visible or located where required causes much additional travel and congestion at key locations where pedestrians mostly visitors who are unfamiliar with the layout stop to get directions.

The following additional observations on mobility requirements are made:

- There are over 1,000 wheel chair movements and around 500 stretcher movements per day mostly to and from the OPD and clinics.
- There are around 50 ambulance movements per day
- On average each hospital employee visits 0.6 other buildings during a weekday making a total of around 4,000 staff movements within the complex .
- The pedestrian traffic within the complex varies with a high of around 10,000 movements per day to around 3,000 to 5,000 around wards.

5.2. OPD

There are on average 0.6 accompanying persons per patient arriving for treatment at the OPD. The amount of patients varies and the hospital records between 5,000 to 7,000 per day. This leads to around 8,000 to 10,000 persons arriving at the OPD daily. Currently 70% of them arrive by bus, a further 4% use bicycles and walk since 1/3rd of all patients are from within the CMC area. This means that a total of around 1,500 vehicles arrive for the OPD. Among the patients there are 10% who come from outside the province who would have typically travelled for over 3-8 hours by bus. Bus passengers walk from Town Hall, PUNCHI Borella and Eye Hospital bus stops while those arriving by three wheelers get dropped off at the OPD itself.

Currently only 10% of visitors require parking which is provided at the on-street parking along Norris Canal Road as well as Kinsey Place and at the off street Central Hospital car park.

There are currently around 300 wheel chair and 100 stretcher movements per day to and from the current OPD. There are no special facilities such as ramps or dedicated entrances for such movements.

The arrival pattern of patients starts from prior to 7 am and reaches a peak between 8 and 11 am at which point the maximum number of persons inside the building is accommodated which is estimated at around 2,000 to 2,500. However when both arrivals and departures within an hour is considered, the total number of persons circulating within the OPD during the peak period appears to be around 5,000. This includes patients, accompanying persons and hospital staff.

A significant number of trips are made between the OPD and other units of the hospital by patients, in-patients and hospital staff who may take them to the different clinics. They have to pass congested road sections especially the junction at Neuro Trauma unit and along crowded corridors which is often time consuming and difficult especially for the patients.

The corridors within the hospital as well as the logistics systems of patient admission, registry and examination followed by issue of medicines at the pharmacy are not integrated to an information data system that would eliminate the time taken for processing a patient. This would reduce the crowding levels as well. The location of conveniences such as toilets, canteen also needs to be considered in order to reduce unnecessary movements and congestion bottlenecks within the building.

5.3. Visitors for In-Patients

An estimated 10,000 persons arrive daily to visit the patients warded in the 3,300 beds. This is a summation of all trips made during the three visiting hours- morning, noon and evening. Of this the noon peak is the highest attracting around 6,000 persons while the evening attracts around 3,000 and the morning around 1,000 persons. Since the average group size is 1.8, this means that around 5,500 groups visited the wards. On average that would be 1.7 groups of persons visiting each person. The most common entry points to the complex are the Bandaranayake Building and Accident Service.

In the case of visitors to wards, 20% (double that of the OPD) come from outside the province. They come from much further away, most of them travelling up to 3-12 hours to get to the hospital. Like the patients arriving at the OPD, 67% (or 2/3rd) of visitors arrive by bus, with three wheelers and taxis carrying the largest share of private vehicle users. Of this, around 83% get dropped off near the hospital. This includes all bus and rail passengers. The balance 17% park their vehicles for the duration of the visit. The average duration of visits is around 42 minutes which is consistent with the allowed visiting duration of one hour. The bus passengers- like in the case of the OPD patients, get dropped off at Town Hall, Punchi Borella and Ward Place/Eye Hospital bus stops.

The most common parking locations are on the road on Norris Canal Road and Kinsey Place. The different locations along these roads accounts for around 55%, while the balance is scattered around other parking areas both within and outside the hospital complex.

There is some congestion at the entrances to different buildings prior to the visiting hours. The lack of standard signage along the corridors or assistance to unfamiliar visitors leads to much congestion and extra walking.

5.4. Hospital Staff

An estimated number of 6,000 staff report for duty during the day time. Of these 30% have their trip beginning from and within the CMC area. Still 22% travel from outside Colombo district. Unlike patients and visitors, a much lower percentage of staff (54%) arrives by bus and train. This is partly due to the fact that 25% of the employees walk to the hospital, which suggest that around 2,000 employees are provided quarters or live within walking distance. Motor cycles make up the largest mode of private transport. The total number of vehicles that bring staff is estimated at 1,200. It is found that on average, vehicles parked within the complex make around 2.5trips. Thus out of the 4,000 vehicle entries per day, approximately 75% are staff vehicles. The balance is made up of ambulances, vehicles bringing and taking patients, general visitors and some patients and visitors who find parking within the premises.

5.5. Wheel chair and Stretcher Movements

There are around 1,000 wheel chair movements recorded at different location within the hospital. Around 500 of these were at the OPD with other clinics also recording high numbers. This mean that around 1 in 200 movements along the corridors is a wheel chair or stretcher. While most parts of the complex are accessible to these wheeled patients, they are not of standard design in terms of location, gradient or width. There may be a medical necessarily for patients to be as far as possible separated from general visitors. This does not happen as OPD patients, persons accompanying them, visitors to in-patients use the same facilities.

6. Recommendations

The recommendations for the NHSL development master-plan are provided under following sub-headings:

- Access
- Public Transport
- Parking
- Traffic Circulation
- Pedestrian Circulation
- Patient Transport

6.1. Access

Care should be taken in calculating the travel demand for the hospital development. Currently, only 26%, 30% and 21% respectively of OPD patients, visitors for in-patients and hospital staff arrive by motorized transport. This generates approximately 12,000 vehicle movements in and out of the hospital complex. These also leads to around 4,000 vehicles being parked within or adjacent to the complex. With increase in per capita income, both vehicle ownership as well as vehicle use is expected to increase significantly. The current levels of vehicle use signify that most patients who avail themselves of the facilities do not travel by private vehicle and are thus from lower income groups. An annual growth rate of 6-8% should be used in calculating the traffic requirements. As such this percentage is likely to double in the next 10-12 years, even if public transport improves in quality. If public transport deteriorates, it could increase further.

Moreover parking requirements for the proposed new development would increase further if the size of the OPD, number of in-patient beds and staff increase. Approximate doubling of all these would lead to a quadrupling of vehicle use. As such, parking would be required for 16,000 vehicles and the demand for traffic would be around 48,000 vehicles in and out of the hospital. Moreover, if the facilities to be provided in the new development would attract patients in high income groups, then it is likely that this rate will increase much faster. Currently there are around 350 spaces within the hospital. The demand for spaces for patients and visitors accommodated on Norris Canal Road, Kynsey Place and private car parks is around 400 spaces. The current total demand is around 750 spaces. This includes spaces for motor cars as well as motor cycles.

The location of the NHSL is such that there is little spare road capacity through the day to accommodate any increase in demand. The major road intersections at Borella, Town Hall and Maradana through which any vehicle is required to travel through is already over saturated.

Moreover, apart from the approach from Ward Place, all other approaches from these intersections are also congested at most times of the day. These include the Maradana Road at Punch Borella, the Deans Road as well as Town Hall junction, Union Place, Dharmapala Mawatha etc. There are also a number of high traffic generators such as schools, departmental shops and offices in the vicinity that will also expand operations and attract more vehicular traffic in future.

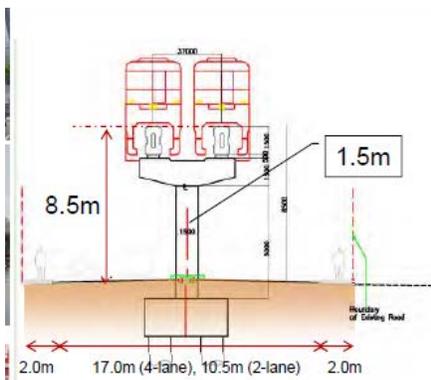
Over 40% of all users identified that traffic congestion was a problem in accessing the hospital.

As such the following recommendations are made for the master-plan development.

- 4) The design for the hospital should take in to account the following:
 - The key highway intersections through which road traffic requires to access the hospital are already congested and the hospital will remain a location difficult to access by road vehicle.
 - The income led growth in traffic for current operation of the hospital is likely to see doubling of vehicle movements approaching the hospital and parking over a period every 10-12 years.
 - Attracting patients from higher income groups will result in a faster growth of access space on highways and at intersections.
- 5) Expansion of hospital should necessarily be integrated to use of high quality public transport to access the hospital. In this respect, the hospital should actively pursue and support the monorail development proposed by the Ministry of Transport and its trace along EW Perera Mw and station adjacent to the OPD.
- 6) Improve walk access to and from bus stops namely at Punch Borella, Town Hall, Ward Place and next to Carey College and integrate to the new hospital design to minimize walk distances and pedestrian congestion.
- 7) Vehicle access to the different buildings should be spread out to the periphery of the complex with separate entrances from de Saram Road, Norris Canal Road (Ward Place end), Kynsey Road, thus keeping EW Perera Mawatha relatively free of traffic.

6.2. Public Transport

With a majority of users stating that the distance to public transport was a major barrier, one of the primary design requirements is to reduce the walk distance. The other would be to ensure suitable quality of public transport. The inability to improve this would result in higher use of three wheelers and taxis by those coming by bus and eventual migration to private vehicles which will increase parking as well.



The Ministry of Transport has proposed the construction of a



Monorail line starting from Malabe to Kotahena via, Battaramulla, Rajagiriya, Borella, Punchi Borella, Town Hall, Slave Island, Fort, Pettah, Maradana and Kotahena. A supplementary link line from Kollupitiya to Town Hall is also identified. This if



approved by the Treasury, will be ready for operation around 2020. The carriages as well as the station areas would be air conditioned and the system will have closed access so that station activity can be isolated through a set of access gates to the hospital premises. It would be around 8-12

metres above the road level and thus form little impact to ground level activities. Its level of noise will be within desired levels for a hospital. This would be an ideal mode of transport to serve all categories of persons arriving at the hospital.

As shown in the following figure⁶, the proposed trace would connect the NHSL from all direction of

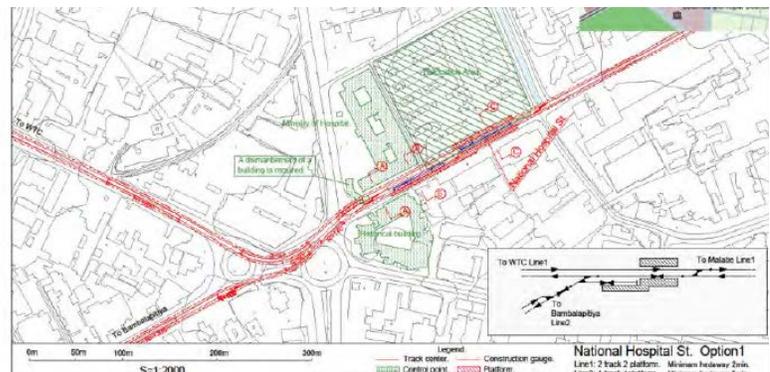


the city and the main arteries to the cities. It would also connect the railway lines. The project is currently under feasibility study and design. The National Hospital station is located adjacent to the OPD and would be an ideal location to receive visitors to the complex since it is the OPD that has the highest traffic. However, the station should be then connected to the other buildings, especially the wards to enable the rush of

circulation of visitors during visiting hours. The units at the further end of Regent Street such as the Cardiology Unit and the Merchant Ward, Nurses Training Institute may be connected to the Punch Borella Station which would be closer. If both these stations are used, the maximum walk distance to any location within the complex would be reduced to around 300metres.

The following recommendations are made:

- 3) To integrate the master-plan design with the proposed monorail system. This system can provide capacity of 10,000 passengers per hour in each direction at 5 minute frequencies in the peak (which can be reduced to 2 mts). There are three directions of travel in and out of the hospital for the proposed system. Thus the monorail will be an ideal mode of transport to facilitate the demand peaks created by hospital visiting hours and OPD hours.
- 4) Until such a high capacity and high quality public transport is in operation, and if such a system is not in place when the master plan is operated, it is recommended that a shuttle bus service be operated from Borella, Maradana and Town Hall at 5 minute intervals to serve the hospital through the EW Perera Mw. This would require a fleet of around 10 buses which can be outsourced for commercial operation through the provincial bus regulatory authority or the Sri Lanka Transport Board.



⁶COMTrans Study Team, Jica. Ministry of Transport Study of Transport Masterplan for Colombo Metropolitan Region, on going

6.3. Parking

The current demand for parking is estimated at 1,800 spaces within the hospital with an average space turnover of 2.5 hours per vehicle. The public car parking space requirements appear to be around 1,400 per day mostly accommodated within the two visiting hours. Thus the current space requirement is around 500 spaces. The new space requirement for doubling of activities would require a minimum of 5,000 spaces. As per the Traffic Impact Assessment (TIA) Regulations for private hospitals, the requirement for doubling of hospital beds from 3,300 to 6,600 and for providing say 10,000 sq metres of medical activity space would require around 5,000 vehicle parking spaces. Currently this is not applicable to government hospitals since most customers arrive by public transport. However with rising incomes it is likely that the same requirements as for private hospitals would prevail for public hospitals.

TYPE OF USAGE	PARKING SPACE REQUIREMENT			MINIMUM NO. OF STALLS BY TYPE
	STANDARD (S)	TWO AXLE COMMERCIAL (LORRY/BUS) (C)	MULTI AXLE COMMERCIAL (TRUCK-SEMI) (T)	
3. HEALTH				
i. Nursing Homes and Private Hospitals	2 or 3 beds	1 for 500 sq.m.	-	3 of S and 1 of C
ii. Consultation Rooms (min Size of rooms to be 8 sq.m.)	6 for 1 consultation	1 for 500 sq.m.	-	3 of S
iii. Medical Laboratories and OPD Areas	1 for 10 sq.m.	1 for 500 sq.m.	-	2 of C

This would require to be in multi storey facilities for which 250,000 sq m in total would be required. This would represent a hypothetical five floor building of 100m by 100m. This would not be practical.

However if high quality public transport with external park and ride facilities is assured (as what is planned for the monorail) to serve the hospital, it is possible that the hospital could manage with a lesser amount of parking. Higher parking would also lead to more traffic outside and within the hospital premises. Hence reducing parking would be one strategy to reduce traffic levels around the hospital.

The following recommendations are made:

- 6) The amount of parking should be carefully calculated in keeping with the standards required by the Building Regulations applicable for Sri Lanka (Appendix 5). Currently the standard is given for private hospitals and nursing homes. Accordingly the requirement for the current scale of operation should be around 3,000 parking spaces. This is not realized since most patients and their visitors do not use private cars. However with income increase an increase is imminent and hence parking requirements should be determined with care in keeping with the type of services to be offered and the scale of operation under the master plan.

- 7) However, such level of parking may not be sustainable on the road network both outside and inside the hospital complex. As such the hospital should determine a strategic level of parking in consultation with the Colombo Municipal Council and the UDA.
- 8) The staff parking should not be centralized. Each new multi-storey building should have the required parking. This should be included in the future developments of each of the phases 2 to 9. These parks should have motorized access from the respective peripheral roads namely Ward Place, de Saram Road, Kynsey Road and Norris Canal Road (Ward Place end).
- 9) The multi storey car park proposed in phase 10 with access from Kynsey Road may not be the most central location for visitors. It would be better to locate it with access from Norris Canal Road (Ward Place) end which has the least level of congestion. It would then be more centrally located to access all buildings within the complex.
- 10) The public car parks should be connected to a pedestrian walkway system that would not interfere with the vehicular traffic or hospital operations.
- 11) Given that 88% (i.e. around 8,800) vehicles at present arrive at the NHSL to drop patients, employees and visitors. As such care should be taken to include a drop off and pick up location for private vehicles, staff service vehicles as well as taxis and three wheelers.

6.4. Traffic Circulation

The hospital square is located between a set of very busy roads all of which carry high frequency bus routes. These are used daily as commuter arteries and busy throughout the day. Hence, it is necessary to ensure that unnecessary traffic does not enter this hospital complex also known as the hospital square. Thus traffic that could attempt to short cut through hospital should be prevented. In this respect the current system is adequate for present. It will not suffice when traffic levels double. The primary reason for current traffic through the hospital square is that most traffic entering the hospital enters to EW Perera Mawatha.

In order to reduce traffic in the middle of the hospital square the following recommendations are made:

- 6) Ensure that access to all parking lots in the proposed design have both entry and exits from the roads on the periphery of the hospital complex and not on EW Perera Mawatha.
- 7) The section of EW Perera Mw between Norris Canal Road (adjacent to Neuro Trauma Unit) and Kynsey Road (near Cardiology unit) should be restricted for labeled vehicles or vehicles that have special permission. This is the current practice which should be continued.
- 8) In order to ensure the free flow of traffic, reduction of vehicle emissions and noise pollution, it is suggested that pedestrian traffic be separated away from the ground level as far as possible.
- 9) The restriction on visiting hours for in-patients may have to be relaxed in order to spread out the traffic congestion that would otherwise happen. This would also ease the requirement for parking and improve utilization of parking spaces. It should be noted that at present in private hospitals this is practiced. The requirement for parking is also reduced accordingly.

6.5. Pedestrian Handling Logistics

Currently pedestrian movements are intense both on the roads as well as on the walkways within the hospital premises. This interferes with the movements of patients as well as hospital staff. In order to streamline pedestrian movement in the new development, the following recommendations are made:

- There should be a elevated pedestrian walkway along EW Perera Mw which should ideally be suspended on the supports of the monorail.



It should be typically at the 3rd floor level (8-12 meters). This walkway should span between the two stations on either end of EW Perera Mw and extend across the Darley Road as well as Maradana Road at Punchi Borella to connect the bus stops. Escalators may be considered to bring them in line with the standard being implemented at Kollupitiya and Bambalapitiya pedestrian over passes.



- There should be at the same level a set of pedestrian walkways that connect the multi storey car park with all other multi storey buildings within the complex so that the access from the vehicle parking to other buildings would also be elevated.

- The pedestrian walkways should be provided signs and directions to international standards.

- In the OPD, there should be a suitable patient management system that would allocate interviews, provide better arrival timing to patients and streamline the process of registering patients and processing them through the medical examinations, consultation and pharmacy with minimum time, circulation and congestion.

- The out-patients should not be allowed to mix unnecessarily with the in-patient areas. Hence the OPD and any other investigation units they would frequent together with administrative units should be located in close proximity and separated from in-patient operational areas.

Wards 3,4	→
Administration	←
Dental Clinic	←
Chiropody	←
Occupational Therapy	←
Physiotherapy	←
Reception / Enquiries	←

13. The waiting areas, walkway widths, lobbies etc should be designed in keeping with the capacity for which it is designed and international standards for design spaces.
14. Commonly used conveniences such as refreshments, toilets, should be located adjacent to the walkways without interfering with pedestrian movements.

6.6. Patient & Medical Staff Movements: Ambulances, Wheel Chairs, Stretchers and Hospital Staff Movements

Currently patients using wheel chairs, stretchers have little or no special designs for movements and as such as inconvenienced when they are wheeled around. Such movements also inconvenience other pedestrians. Ambulances should have speedy access to the required admission areas with minimum delay.

In order to facilitate better movement, it is recommended that:

4. There should be a second walkway system which is accessible only for hospital staff. This should be used for wheel chairs and stretchers as well as carrying medicines, meals and other trolley related movements throughout the hospital. It could be used for travel of hospital staff as well. But it should be restricted to all others.
5. Ramps of acceptable gradient (max 1 in 12) should be built to ensure that all wheeled equipment can be comfortably moved across the complex.
6. There should be a pathway for ambulances through the hospital complex from any approach to the accident service, cardiology unit and any other unit where emergencies are dealt with. The re-opening of the section of road between the Neuro-Trauma Unit and the Kynsey Place near the Maintenance Unit is recommended. This could also be used for access to parking areas

6.7. Planning and Design Audit

In order to ensure that the master-plan design is in keeping with the above, it is recommended that the architects plan for each individual development phase be subject to:

3. A design audit for traffic and mobility
4. A traffic impact assessment as per Building Regulations of the UDA.

6.8. Transition of OPD

The OPD is currently being transferred to different areas in anticipation of the demolition of existing buildings for the new construction. While the transition phase has to be handled smoothly, it is also constrained by the availability of space for housing of such dislocated activities. The relocation is therefore mostly constrained by the space availability and administrative acceptability of such moves. It is therefore recommended that a masterplan for the transition arrangement be also developed simultaneously.

Appendices

Appendix 1: Phasing of NHSL Development Plan



<p>Architects & Hospital Planning Consultants</p> <p>ARCHI MEDES HOSPITAL PLANNING ARCHITECTURE</p> <p>No. 6, Park Road, Colombo 5, Sri Lanka Tel./Fax: 0994-11-2898248 E-Mail: amediane@gmail.com</p>		<p>Project</p> <p>NATIONAL HOSPITAL OF SRI LANKA PHASES OF DEVELOPMENT PLAN</p>		<p>Project North</p> <p>N</p>		<p>Scale</p> <p>06-10-2011</p>		<p>Drawing No.</p> <p>Checked by</p>		<p>Rev</p> <p>Approved by</p>	
<p>Sheet Title</p> <p>DEVELOPMENT PHASES</p>		<p>Date</p> <p>06-10-2011</p>		<p>Project no.</p> <p>Drawing by</p>		<p>Scale</p> <p>06-10-2011</p>		<p>Drawing No.</p> <p>Checked by</p>		<p>Rev</p> <p>Approved by</p>	

Proposals for the development of facilities for buildings to be demolished in the future have to be identified.

Phase 1. (Funds already allocated)

Phase 1 Demolition

- Wards 14, 55, 57, 58 and Transport section buildings
- Maintenance building (required to be demolished to construct Epilepsy Unit)
- Dental buildings (already demolished)

Phase 1 – New Construction

1A - OPD (New)

The new OPD facility will be complete with low-end radiology and laboratory facilities . This will come up at the site of the Wards 14, 55, 57 & 58 which will move to the Medical Ward 3 nearing completion.

1B - Epilepsy Unit

Under design for the treatment of epilepsy patients – will consist of OPD, in patient and treatment facilities. (site behind Neuro Trauma Unit)

1C - New Dental Building (at site of existing building)

(Work commenced by CECB)

Phase 2 (To be developed as urgent priority)

Phase 2 Demolition

- Wards 41, 42, 56

Phase 2 – New Construction

2A - Cardiology / Cardiothoracic Unit

- Cardiology Units
- Cardiac intervention suite
- Cardiothoracic unit
- Cardiothoracic theatre complex

Cardiology / Cardiothoracic Unit to be constructed behind existing cardiology complex in a block of land to be given by government after removing of occupants. This unit to be complete with all necessary investigation, radiology & imaging facilities. This unit once completed will relieve the space occupied by wards 32,33,34& 35.

2B - Multi – Specialty building

(at present site of wards 41,42 & 56 which will move to new Medical ward 3)

Medical sub-specialties :

- In – patient facilities for Chest, Dermatology, Diabetes & Endocrine, Gastroenterology, nephrology, Neurology & Rheumatology
- Orthopedic Unit : In – patient wards + Theatre complex as replacement for wards 52,53,54,57 & 58
- Laboratories – Pathology, Hematology and Biochemistry
- Radiology
- Poison building can move to new OPD complex

Phase 3 Surgical Complex

(after wards 32,33,34, & 35 are moved to their new location)

Phase 3 Demolition

- Wards 32, 33, 34, 35

Phase 3 – New Construction

Surgery and Surgical Sub- specialties

- Operation Theatre Complex
- Surgical Wards
- Burns and Reconstruction unit
- Gastroenterology
- Genitourinary
- Vascular
- ENT
- CSSD

Buildings to be preserved (Shaded blue)

A – Mandatory requirement

- Victoria memorial building (will be converted to museum, library etc)
- Library (3storeyed)

B – Decided to be preserved

- Bandaranayke building
- Accident Service building
- Medical Ward buildings 1, 2 & 3 (under construction)
- Neuro Trauma building
- Merchant's Ward building (ward 15)
- Medium rise quarters buildings
- Breast health centre
- Ward 13
- Building for Medical Faculty
- Surgical stores
- Chapel
- Cardiology Complex (off Kynsey Road)
- Nurses Training School

New facilities required

- Multi – storey car park (1000 vehicles)
- Multi – storey quarters building (proposed site is opposite Accident Service building, Existing 2 storey building to be demolished)
Requirement 1000 rooms (high rise), another site will be required to fulfill requirement. Possible site where laundry is located at present.

Other Buildings to be demolished in future phases.

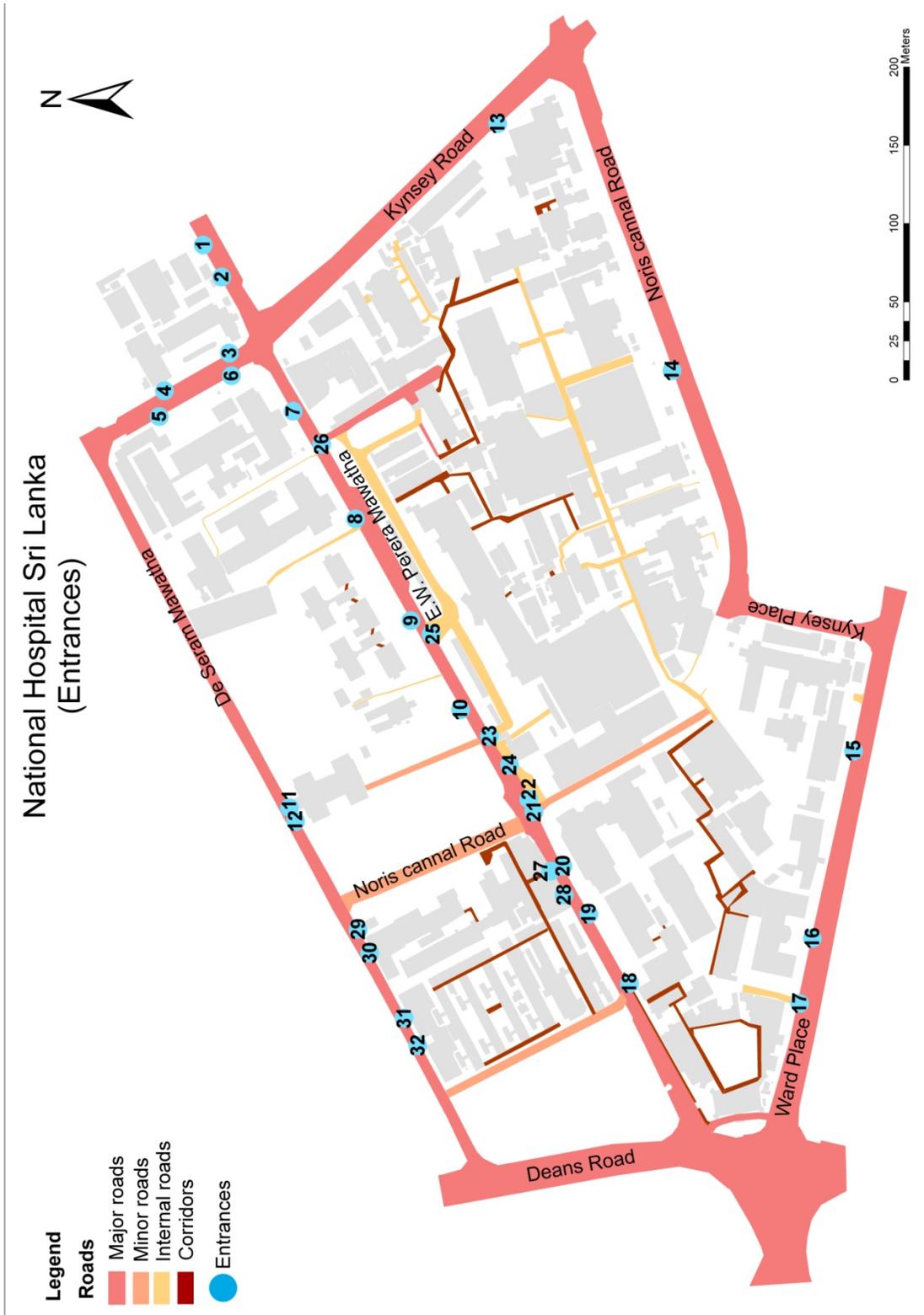
These are shaded green. They have to be demolished in stages after they are relocated in new buildings. The Kitchen, Laundry and Mortuary are also to be relocated in new buildings before existing buildings are demolished.

- Ward 16 Neurology ward (20 male, 20 female)
- Ward 17 Surgical ward (34 male)
- Ward 18 Surgical ward (42 male)
- Ward 19 Surgical ward (37 male)
- Ward 20 Surgical ward (36 male)
- Ward 21 Surgical ward (36 male)
- Ward 22 Urology ward (36 male)
- Ward 23 Surgical ward (45 male-paying)
- Ward 24 Priest ward (30 beds)
- Ward 25 Cardiotheropic ward (25 female + 07 cots)
- Ward 26 Cardiotheropic ward (40 male)
- Ward 29 Surgical ward (29 female)
- Ward 30 Surgical (Vascular/Urology) ward (44 female)
- Ward 35-35 Memorial Ward
- Coudert Memorial Ward
- Ward 38 Surgical ward (34 female)
- Ward 39 Gynecology ward (50 beds)
- Ward 40 Surgical ward (58 female)
- Ward 51 Orthopedic ward (24 children)
- Ward 53 Orthopedic ward (16 male)
- Ward 59 Psychiatric ward (13 male, 11 female)
- Ward 62 Neuro Medical ward (20 female)
- Ward 63 Neuro Medical ward (24 female)
- Ward 64 Vascular ward (35 beds)
- Ward 65 Genito – Urinary ward (27 male, 10 female, 02 HDU)
- OPD Clinics and Canteen
- Orthopedic Clinic (opposite OPD)
- Operation Theatre D
- Department of Surgery
- Blood Bank
- Computer Branch
- Loan Branch
- Account Branch
- Nurses quarters (near laundry)
- Laundry
- Department of Rheumatology and Rehabilitation
- School of Radiology
- Kitchen
- Mortuary

Appendix 2: Access Points: Car Parks and Bus Stops



Appendix 3: Access Points: Gates and Entrances



The description for each gate as shown in Appendix 3.

Gate No.	Gate Name	Access Allowed for		Remarks
		Pedestrians	Vehicles	
1	Cardiology Unit 1		√	
2	Cardiology Unit 2	√		
3	Cardiology Unit 3	√	√	
4	Cardiology Unit ICU	√	√	
5	Nursing Training School			Gate is closed
6	Nursing Training School			Gate is closed
7	Nursing Training School	√	√	
8	Nurse's Quarters (Near NTS)	√	√	
9	Doctor's Quarters	√	√	
10	Nursing Quarters Entrance Front	√	√	
11	Nursing Quarters Entrance Back	√	√	
12	Nursing Quarters Entrance Back			Gate is closed
13	Blood Bank	√	√	
14	Pharmacy & kitchen	√	√	
15	Store		√	
16	Dental Gate	√	√	
17	Accident Orthopedic Unit/Ward 54	√		
18	Orthopedic Clinic 18	√	√	
19	Orthopedic Clinic 19	√	√	
20	Orthopedic Clinic 20	√		
21	ICU and Wards	√	√	
22	Neuro Trauma Building	√		
23	Accident Ward 1	√	√	
24	Accident Ward 2	√		
25	Bandaranayake Building	√	√	
26	ENT Clinic (Ward 1)	√		
27	OPD Gate 1	√		
28	OPD Gate 2	√		
29	Filling Station	√	√	
30	AIDS Unit	√		
31	Diabetic Clinic	√		
32	Bandaranayake Building		√	

Appendix 4: Building Regulation

Extracts from SECTION 31 OF PLANNING & BUILDING REGULATION OF THE UDA

The parking requirements for health care facilities shall be:

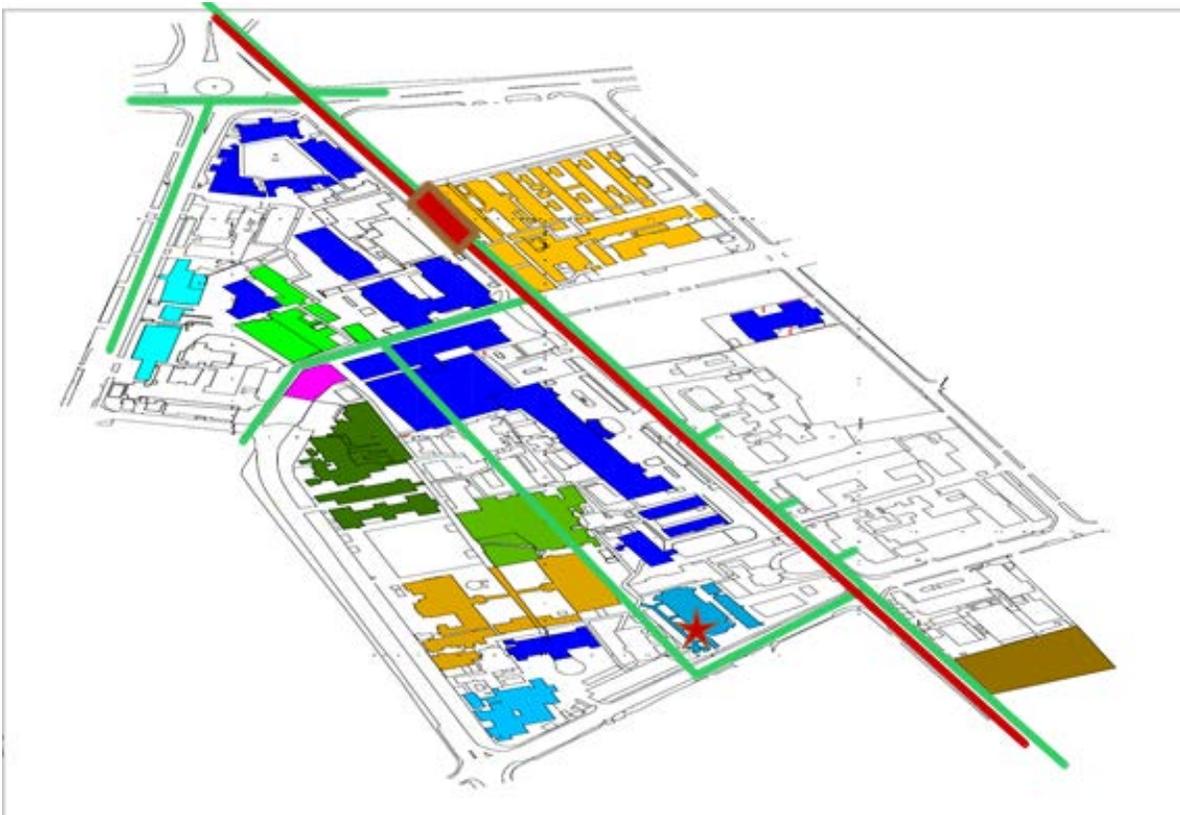
Type of Usage	Parking Space Requirement			Minimum No. of Stalls by type
	Standard (S)	Two Axle Commercial (Lorry/Bus) (C)	Muti Axle Commercial (Truck-Semi) (T)	
HEALTH				
i. Nursing Homes and Private Hospitals	2 for 3 beds	1 for 500 sq.m		3 of S and 1 of C
ii. Consultation Rooms (min.size of rooms to be 8 Sq.m.)	6 for 1 consultation room	1 for 500 sq.m		3 of S
iii. Medical Laboratories and OPD Areas	1 for 10 sq.m.	1 for 500 sq.m		2 of S

Appendix 5- Recommended Transport Facilities 1 of 3 (Monorail and Station)⁷



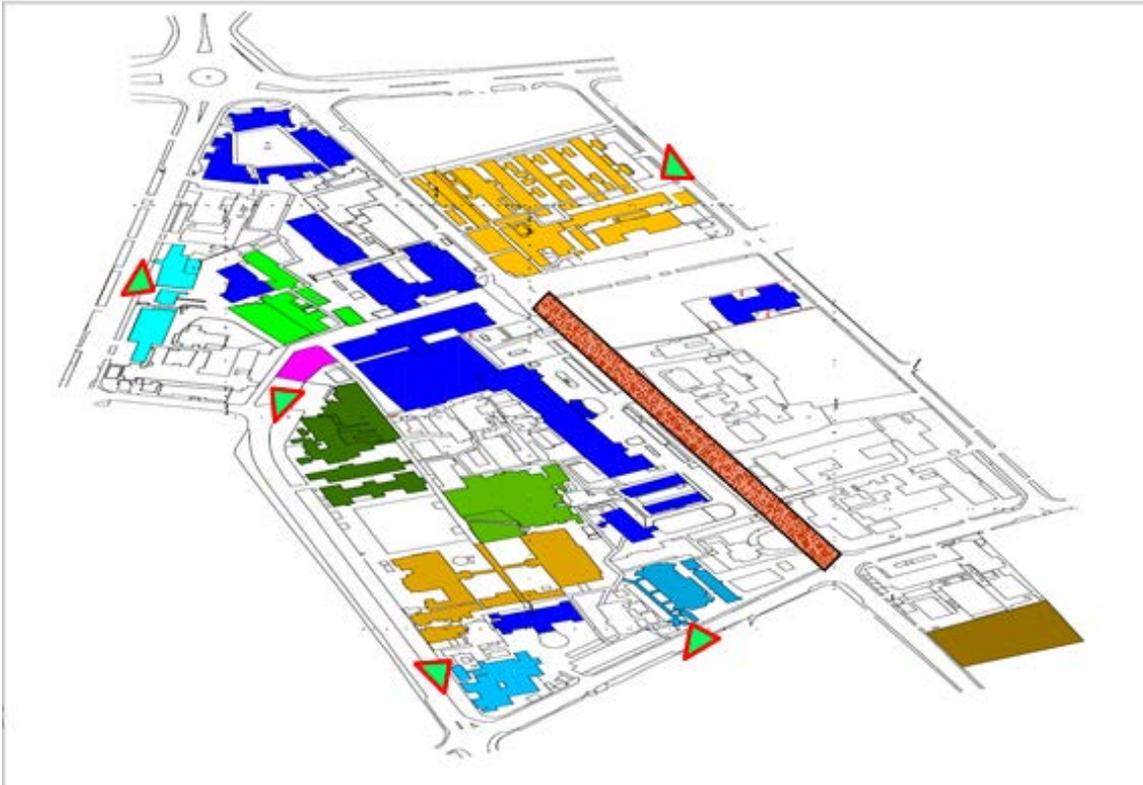
⁷ On base map prepared by M/S Archmedes in NHSL Masterplan Project

Appendix 6- Recommended Transport Facilities 2 of 3 (Monorail, Bus Stops & Walkways)⁸



⁸ On base map prepared by M/S Archmedes in NHSL Masterplan Project

Appendix 7- Recommended Transport Facilities 3 of 3 (Vehicle Entrances and Traffic Restrictions)⁹



⁹ On base map prepared by M/S Archmedes in NHSL Masterplan Project

Appendix 8: Distances to Current Bus Stops

