3 Proposed Developments and Traffic Growth

3 Proposed Developments and Traffic Growth

3.1 Introduction

This section provides information on the developments in and around the study area covered by the 'East of Plymouth Development Infrastructure Study' and their associated trip generations. These will form a component of the matrices used in the update of the 'Plymouth Eastern Corridor Study' PARAMICS model.

During this study we have specifically considered major developments within or affecting the study area. There will be considerable growth in traffic in the study area in the next 10 years due to background traffic growth and proposed developments. A TEMPRO adjusted NRTF central growth factor has been applied to base year conditions; this includes allowances for numerous smaller scale developments within the study area and Plymouth's regional status as a growth point. A justification for using a TEMPRO adjusted central growth factor is included in section 3.6.

The larger scale developments that may have a significant impact on the study area, and which will be investigated separately, are:

- Plymstock Quarry;
- Sherford New Community; and
- Langage Business Park.

The location of these proposed developments is illustrated in Figure 2. We have also assessed the development proposals at Millbay in the City Centre and the First Bus Garage site to the West of the Laira Bridge. Each is considered in more detail in the proceeding sections.

Figure 2 - Location of Proposed Developments

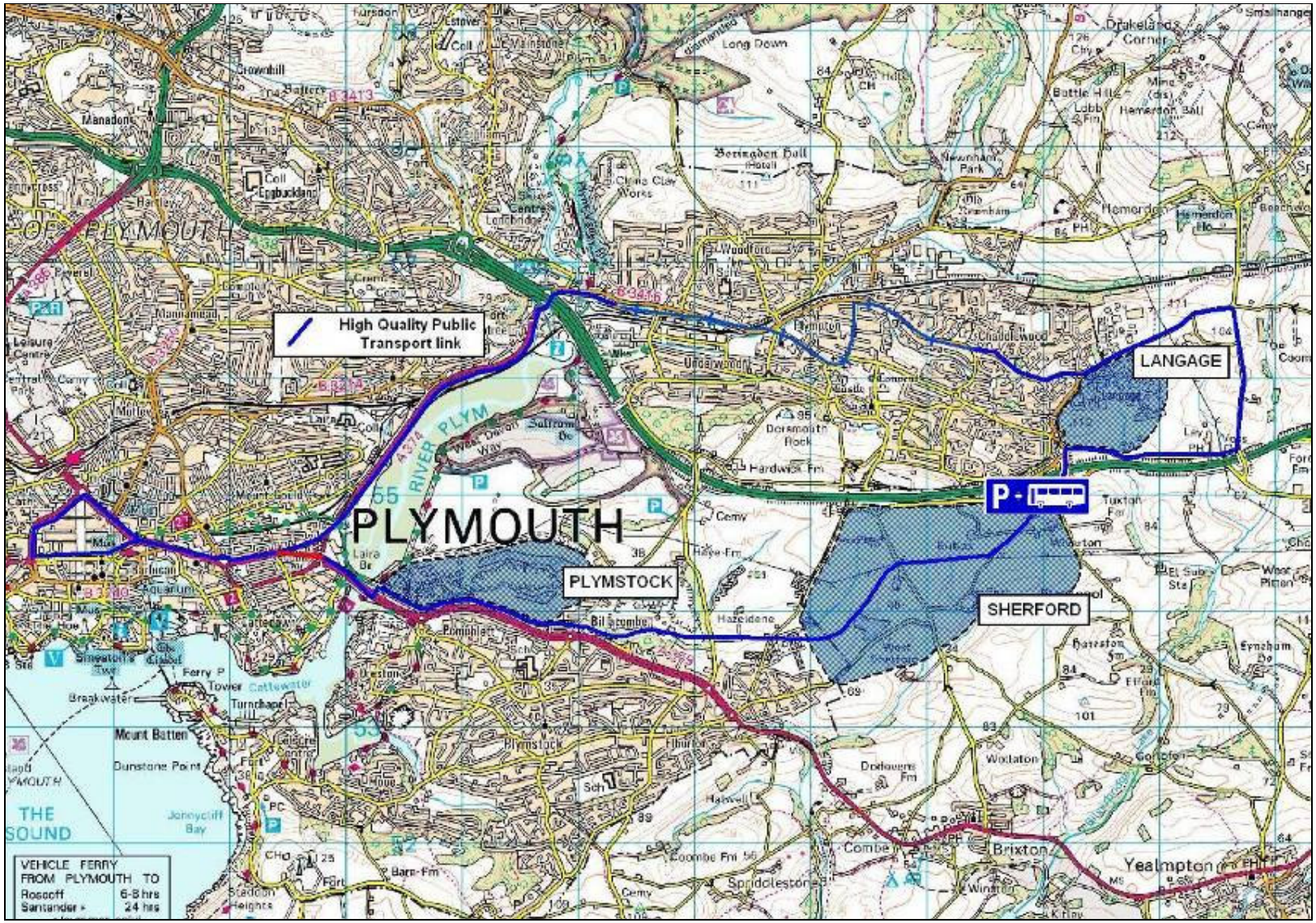
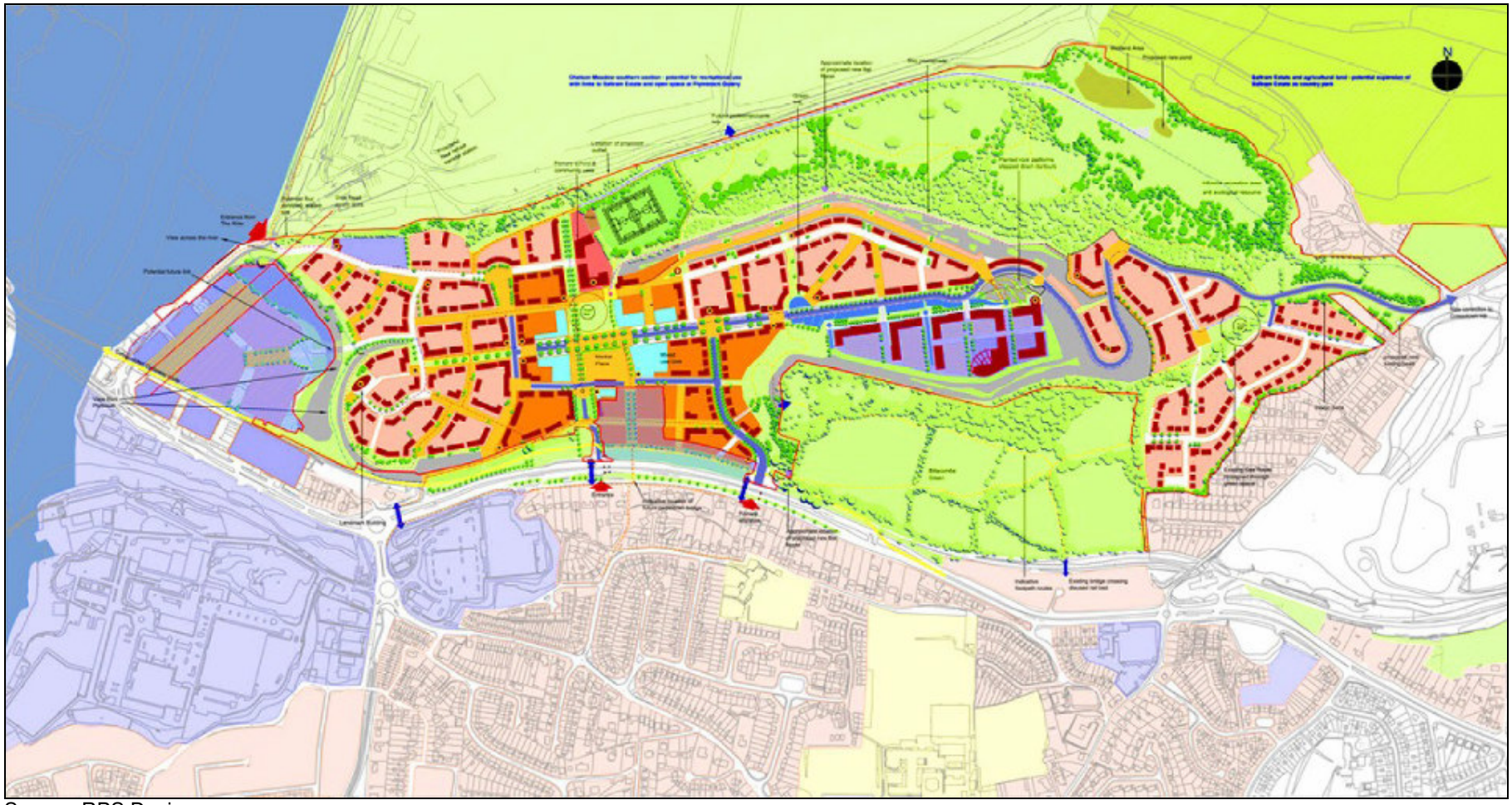


Figure 3 - Plymstock Quarry Master Plan



Source: RPS Design

3.2 Plymstock Quarry

Persimmon Homes are the developers and landowners of the proposed site. At the time of the study being undertaken, JUBB Consulting Engineers Limited were the transport consultants for the development and has produced a Transport Assessment for the scheme (January 2006). The Plymstock Quarry site is a former quarry to the north of the A379 Billacombe Road and East of Laira Bridge. There are proposals for a mixed use development consisting of residential business and leisure facilities. Completion of the development will be phased and will include:

- 1,650 Residential Units;
- 1,805m^2 Local Centre Food Retail;
- 6,700m^2 Local centre Non Food Retail;
- 1,100m^2 GFA Restaurant;
- 300m^2 GFA Pub;
- 100m^2 GFA Takeaway;
- 14000m^2 B1 Office;
- 2000m^2 Pomphlett Industrial estate;
- Primary School 315 pupils; and
- 500m^2 Leisure Facilities.

There will be two primary accesses and two secondary accesses for the development. A main signalised primary access is proposed on the A379 Billacombe road at Broxton Drive, replacing the existing left in left out T-Junction and including pedestrian crossings. A primary access is also proposed on the A379 to the East of Broxton Drive. This new junction will be signalised with pedestrian crossings and bus priority measures.

The site is currently accessed from 'The Ride' on the east side of Laira Bridge. This access will be retained. However, it is envisaged that this will be re-classified as a secondary access. A further secondary access will be provided on the East of the site onto Colesdown hill and Haye Road. A number of on and off site Highway and Public Transport infrastructure improvements have been proposed, including:

- Billacombe Road:
  - Provision of Bus priority measures; and
  - Signalled controlled junctions for access roads

- Multi-modal Interchange:
  - Located in the vicinity of the proposed on-site retail; and
  - Bus priority measures on new access road east of Broxton Drive to A379

The proposed timescale for completion of the development is not stated in the available documentation, although an opening date of 2007 is assumed in the JUBB Transport Assessment. However we feel that this date is highly unlikely. Two construction phases are indicated:

- Phase 1 – 2007:
  - 695 Residential Units (Mixed sizes);
  - 1,805m^2 Local Centre Food Retail;
  - 6,700 Local centre Non Food Retail;
  - 1,100m^2 GFA Restaurant;
  - 300m^2 GFA Pub;
  - 100m^2 GFA Takeaway;
  - 4000m^2 B1 Office;
  - 2000m^2 Pomphlett Industrial estate; and
  - Primary School 315 pupils.

- Phase 2 – 2007:

  - 955 Residential Units (Mixed sizes);
  - 10,000m^2 B1 Office; and
  - 5,000 Leisure Facilities.
  -

JUBB has provided information within their Transport Assessment on the external trip mode split anticipated in a completed development. Tables 3.1 and 3.2 indicate the AM and PM anticipated mode split.

Table 3.1: AM External Modal Split

	Housing	Commercial	School
Car	64%	64%	63%
PT	25%	25%	25%
Walk	3%	3%	6%
Cycle	4%	4%	6%
Motor-cycle	3%	3%	0%
Train	0%	0%	0%
Other	1%	1%	0%

Table 3.2: PM External Modal Split

	Housing	Commercial	School
Car	64%	64%	64%
PT	25%	25%	24%
Walk	3%	3%	4%
Cycle	4%	4%	4%
Motor-cycle	3%	3%	4%
Train	0%	0%	0%
Other	1%	1%	0%

AM and PM two-way person trip rates for the individual land uses contained within the development are indicated in the Tables below.

Table 3.3: AM External Person Trip Rate

	Housing	Commercial	School
	Per Dwelling	**Per 100 m^2**	**Per Pupil**
Car	0.39	0.83	0.06
PT	0.15	0.32	0.03
Walk	0.02	0.04	0.01
Cycle	0.02	0.05	0.01
Motor-cycle	0.02	0.04	0.00
Train	0.00	0.00	0.00
Other	0.00	0.01	0.00
Total	0.62	1.29	0.10

Table 3.4: PM External Person Trip Rate

	Housing	Commercial	School
	Per Dwelling	**Per 100 m^2**	**Per Pupil**
Car	0.45	0.78	0.05
PT	0.18	0.30	0.02
Walk	0.02	0.04	0.00
Cycle	0.03	0.05	0.00
Motor-cycle	0.02	0.04	0.00
Train	0.00	0.00	0.00
Other	0.00	0.01	0.00
Total	0.70	1.21	0.08

Tables 3.5 and 3.6 indicate the two-way person trips produced from 1650 dwellings, a 315 pupil school and 31,005m^2 of commercial floor space.

Table 3.5: AM External Person Trips

	Housing	Commercial	School
Car Driver	650	257	20
PT	254	100	8
Walk	33	13	2
Cycle	41	16	2
Motor-cycle	29	12	0
Train	1	0	0
Other	7	3	0
Total	1015	401	32

Table 3.6: PM External Person Trips

	Housing	Commercial	School
Car Driver	740	241	16
PT	289	94	6
Walk	37	12	1
Cycle	47	15	1
Motor-cycle	33	11	1
Train	1	0	0
Other	8	3	0
Total	1155	376	25

The Eastern Corridor PARAMICS Model requires development trip generations in a vehicular, not person, format. The number of vehicles generated by the Plymstock Quarry development is therefore the number of car drivers in addition to the proportion of public transport users that could potentially be car drivers. 85% of car person trips are car drivers (source: Sherford Travel Demand III, CENSUS 2001) hence a factor of 0.85 has been applied to the public transport component of the development traffic.

Tables 3.7 and 3.8 indicate the generated traffic used within the PARAMICS model, and the distribution used. The distribution of development trips that was applied to the Plymouth Eastern Corridor study has been used. Although discussions were held on the accuracy of the distribution during the ECS, this remains the most robust set of available data.

Table 3.7: PARAMICS Model Input (Vehicle Trips)

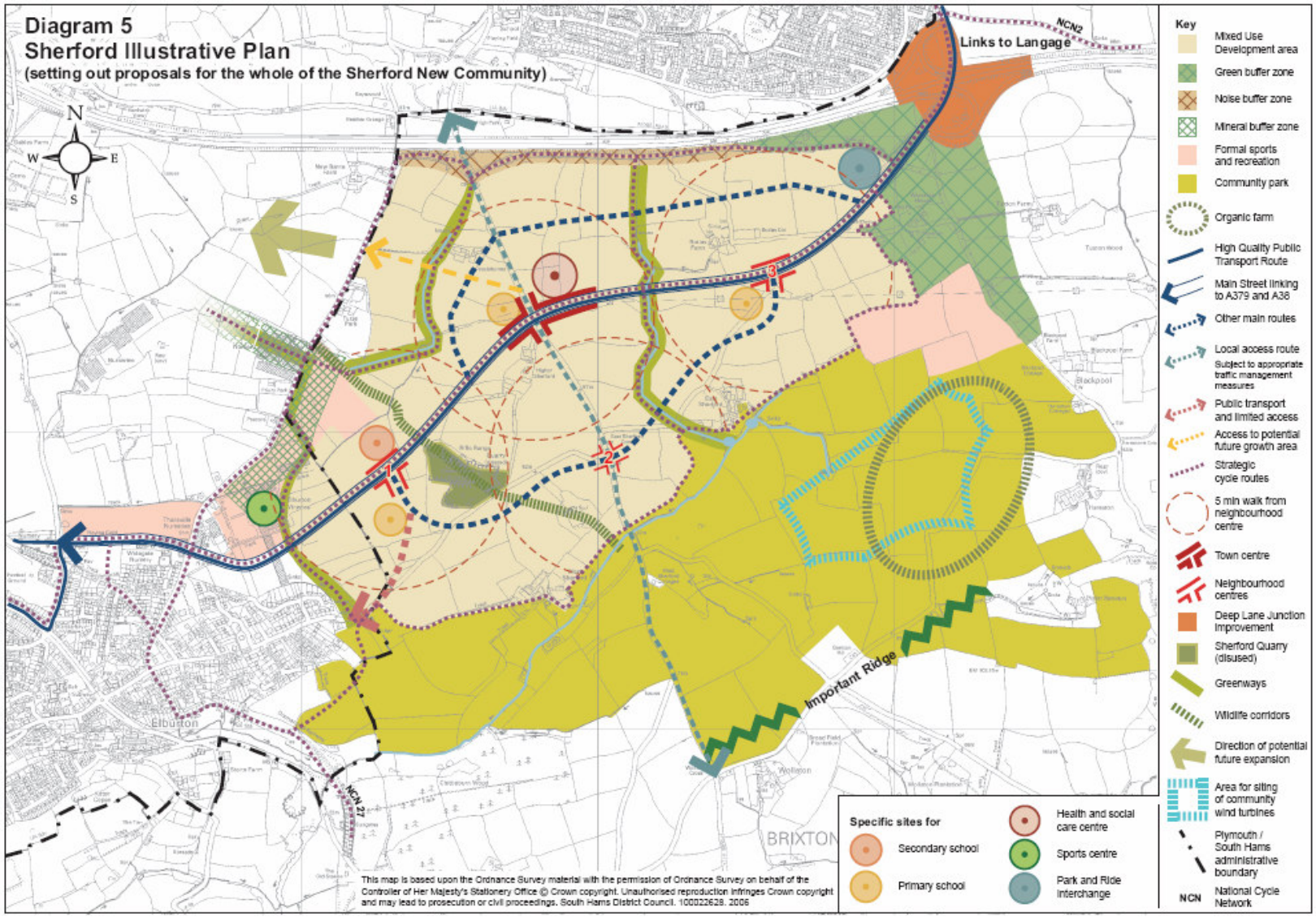
	IN	OUT
Car	260	551
PT	99	210
Total AM	359	761

Detailed spreadsheets have been prepared and circulated to the East of Plymouth Development Infrastructure steering group to explain in the detail the methodology for calculating the 'Paramics Model Input' from the 'External Person Trips'.

Table 3.8: Distribution of Plymstock Quarry Trips

Location	%
City Centre	14%
Plymouth Station	9%
Mount Gould	3%
Millbay/Barbican	8%
Prince Rock/St Judes	5%
Derriford	7%
A38 (W)	5%
A379	5%
A38 (E)	11%
Langage Business Park	8%
Plymstock West	7%
Plymstock East	5%
Plympton East	3%
Plympton West	3%
Plymstock Quarry	-
Sherford	10%

Figure 4 – Sherford New Community MasterPlan



3.3 Sherford New Community

The Sherford proposals are for a mixed use development south of the A38 at Deep Lane. It will consist of 5,500 dwellings by 2016, accommodating an estimated 10,000 people. This will be provided in tandem with community facilities, infrastructure, employment and public open spaces (155,350 m^2). The mixed use is being promoted to encourage internal trips from a community centre and three neighbourhood centres. The Scott Wilson, Sherford New Community Transport Assessment (Travel Demand 3 – June 2006) has been used in this assessment.

Redtree PLC are the developers of Sherford New Community. Scott Wilson are the transport consultants for the development and produced a number of documents indicating trip generations and anticipated mode split forecasts at the completed development.

The Sherford site is approximately 4 miles by road, east from the centre of Plymouth, and is in close proximity to the Langage business development described below. It is proposed that the 5,500 dwellings due for 2016 will be constructed according to the time scale shown in Table 3.9 below.

Table 3.9: Sherford Development Schedule

Year	Progress No. of Units constructed
2007	Start on site
2008	Initial Infrastructure and 400 Dwellings
2010	550
2011	700
2012	750
2013	750
2014	775
2015	775
2016	800

Source: South Hams Local development Framework - Sherford New Community Area Action plan, with numbers increased pro-rata from 4000 to 5500 residential units.

Parsons Brinckerhoff has produced a technical response to the Scott Wilson Limited Transport Assessment of the Sherford development (Sherford New Community Transport Assessment, Travel Demand III). This indicates external and internal trip generations for each of the land uses present in the Sherford New Community proposal.

Residential trip rate calculations are based on 5500 dwellings being constructed, to provide 2016 trip generations that can be directly applied to the PARAMICS model matrices.

Commercial trip rate calculations are based on 150,000sqm of commercial floor space, this is the total commercial development planned for Sherford New Community. The school trip rate calculations are based on the full development of the secondary school. Primary school trips are assumed to be local to the development and have not been shown in the calculations.

Scott Wilson/Parsons Brinckerhoff has provided information within forecasts on the mode split anticipated in the residential component of the completed development. This mode split has also been applied to the school. The mode split for the commercial component of the development has been assumed to be the same as that calculated in the JUBB Plymstock Transport Assessment. Tables 3.10 and 3.11 indicate the AM and PM anticipated *vehicle* mode split.

Table 3.10: AM External Trip Modal Split

	Housing	Commercial	School	Hospital
Car Driver	62%	64%	62%	64%
PT	11%	25%	11%	25%
Walk	7%	3%	7%	3%
Cycle	2%	4%	2%	4%
Motor-cycle	11%	3%	11%	3%
Train	2%	0%	2%	0%
Other	5%	1%	5%	1%

Table 3.11: PM External Trip Modal Split

	Housing	Commercial	School	Hospital
Car Driver	62%	64%	-	64%
PT	11%	25%	-	25%
Walk	7%	3%	-	3%
Cycle	2%	4%	-	4%
Motor-cycle	11%	3%	-	3%
Train	2%	0%	-	0%
Other	5%	1%	-	1%

AM and PM two-way *person* trip rates for the individual land uses contained within the development are indicated in Tables 3.12 and 3.13 below.

Table 3.12: AM External Person Trip Rates

	Housing	Commercial	School	Hospital
	Per Dwelling	Per 100 m^2	Per Pupil	Per 100 m^2
Car	0.52	0.49	0.39	0.30
PT	0.06	0.12	0.04	0.03
Walk	0.04	0.02	0.03	0.02
Cycle	0.01	0.02	0.01	0.01
Motor-cycle	0.06	0.01	0.04	0.03
Train	0.01	0.00	0.01	0.01
Other	0.03	0.00	0.02	0.01
Total	0.72	0.66	0.54	0.42

Table 3.13: PM External Person Trip Rates

	Housing	Commercial	School	Hospital
	Per Dwelling	Per 100 m^2	Per Pupil	Per 100 m^2
Car	0.46	0.80	-	0.20
PT	0.05	0.20	-	0.02
Walk	0.03	0.03	-	0.01
Cycle	0.01	0.03	-	0.00
Motor-cycle	0.05	0.02	-	0.02
Train	0.01	0.00	-	0.00
Other	0.02	0.01	-	0.01
Total	0.64	1.09	-	0.28

Tables 3.14 and 3.15 indicate the two way person trips produced from 5,500 dwellings, a 6,000m^2 hospital, 850 pupil school and 150,000m^2 of commercial floor space.

Table 3.14: AM External Person Trips

	Housing	Commercial	School	Hospital
Car	2859	759	330	18
PT	319	189	37	2
Walk	197	25	23	1
Cycle	69	30	8	0
Motor-cycle	326	23	38	2
Train	48	0	6	0
Other	139	6	16	1
Total	3956	1032	457	25

Table 3.15: PM External Person Trips

	Housing	Commercial	School	Hospital
Car	2552	1248	-	12
PT	285	312	-	1
Walk	176	40	-	1
Cycle	62	50	-	0
Motor-cycle	290	37	-	1
Train	44	0	-	0
Other	121	10	-	1
Total	3530	1696	-	17

Tables 3.16 indicates the generated traffic used within the PARAMICS model.

Table 3.16: AM PARAMICS Model Input (Car Trips)

	IN	OUT
Car	1519	2439
PT	289	252
AM	1808	2691

Detailed spreadsheets have been prepared and circulated to the East of Plymouth Development Infrastructure steering group to explain in the detail the methodology for calculating the 'Paramics Model Input' from the 'External Person Trips'.

Table 3.17: Distribution of Sherford New Community Trips

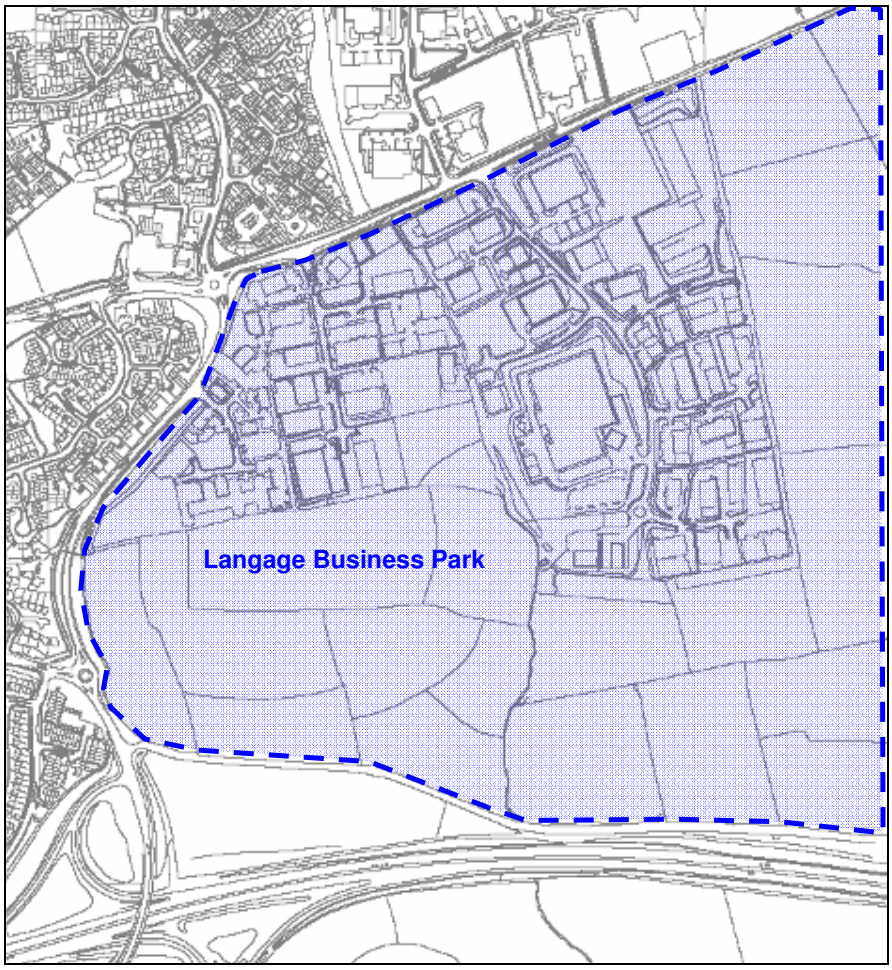
Location	%
City Centre	14%
Plymouth Station	9%
Mount Gould	3%
Millbay/Barbican	8%
Prince Rock/St Judes	5%
Derriford	7%
A38 (W)	5%
A379	5%
A38 (E)	11%
Langage Business Park	8%
Plymstock West	7%
Plymstock East	5%
Plympton East	3%
Plympton West	3%
Plymstock Quarry	10%
Sherford	-

The distribution of development trips that was applied in the Plymouth Eastern Corridor study, has again been used (Table 3.17).

3.4 Langage Business Park

Langage Business Park is located east of Plympton and north of the A38 Deep Lane junction. It has vehicular access onto Holland Road to the north of the site.

Figure 5 - Langage Business Park



The existing business park, housing such companies as Audi, Orange and Carlton, has been granted planning consent for 25HA of B1, B2 and B8 office, light industrial and warehouse accommodation (source: SWRDA). A total area of 20HA has been included in this assessment, and equates to an approximate floor area of 60,000 sq m GFA (Source: Parson Brinckerhoff A38 Corridor study 2006).

The TRICS database has been used to provide weekday trip rates for a business park land use. The AM and PM anticipated modal split present at the development is shown in Tables 3.18 and 3.19.

Table 3.18: AM External Trip Modal Split

	Commercial
Car	74%
PT	5%
Walk	5%
Cycle	2%
Motor-cycle	7%
Train	2%
Other	5%

Table 3.19: PM External Trip Modal Split

	Commercial
Car driver	72%
PT	6%
Walk	7%
Cycle	3%
Motor-cycle	6%
Train	2%
Other	5%

AM and PM two way person trip rates for the development are indicated in Tables 3.20 and 3.21

Table 3.20: AM External Person Trip Rates

	Commercial
	Per 100 m^2
Car driver	1.39
PT	0.10
Walk	0.09
Cycle	0.04
Motor-cycle	0.13
Train	0.04
Other	0.09
Total	1.88

Table 3.21: PM External Person Trip Rates

	Commercial
	Per 100 m^2
Car	1.10
PT	0.09
Walk	0.10
Cycle	0.04
Motor-cycle	0.09
Train	0.03
Other	0.08
Total	1.53

The following tables indicate the AM and PM two way person trips produced from 60,000m^2 of commercial floor space.

Table 3.22: AM External Person Trips

	Commercial
Car	833
PT	60
Walk	54
Cycle	24
Motor-cycle	77
Train	23
Other	56
Total	1128

Table 3.23: PM External Person Trips

	Commercial
Car	660
PT	54
Walk	60
Cycle	24
Motor-cycle	56
Train	18
Other	46
Total	918

The table below indicates the generated traffic used within the AM PARAMICS model.

Table 3.24: AM PARAMICS Model Input (Car Trips)

	IN	OUT
Car	626	208
PT	38	12
AM	664	221

Detailed spreadsheets have been prepared and circulated to the East of Plymouth Development Infrastructure steering group to explain in the detail the methodology for calculating the 'Paramics Model Input' from the 'External Person Trips'.

Table 3.25: Distribution of Langage Trips

Location	%
City Centre	11%
Plymouth Station	9%
Mount Gould	3%
Millbay/Barbican	9%
Prince Rock/St Judes	4%
Derriford	6%
A38 (W)	4%
A379	4%
A38 (E)	10%
Langage Business Park	7%
Plymstock West	6%
Plymstock East	4%
Plympton East	3%
Plympton West	3%
Plymstock Quarry	8%
Sherford	9%

Trip distributions have been calculated from the Plymstock quarry distribution with 9% assigned to a zone within the Sherford development and 8% to Plymstock quarry.

3.5 Other Developments

3.5.1 Millbay Development

Below is a summary of the Millbay development as outlined in the Millbay Scoping Report (2006): The site is 0.6km from Plymouth city centre. There are various access points, with the main ones being Martin St and Millbay Road to the North, and West Hoe Road to the East. The site is approximately 22.3 hectares, of which 7.1 hectares is harbour. Residential properties are located to the north west and south east; and commercial land comprising a large ferry terminal and MOD land is located to the south west. The site is not in a conservation area and there are no listed buildings. The main elements of the scheme include the development of:

- Residential (2,200 units/172,00m2), leisure/retail (28,500m2), business (45,000m2) and hotel space (170 keys/7,500m2);
- Highway works;
- A new boulevard to link Millbay with the City;
- An Arena and conference venue;
- A cruise liner mooring birth and visitor terminal;
- Parking spaces;
- Landscaping; and
- Pedestrian routes.

3.5.2 First Group Bus Garage

The site is located to the west of the Laira Bridge between Gdynia Way and Laira Bridge Road. The extant consent for the site comprises:

- 5,946 sq.metres (64,000sq.ft) of retail warehousing
- 256 sq.metres (2,750sqft) drive-through restaurant; and
- 300 car parking spaces

3.5.3 Miscellaneous Developments

There are a number of other developments at various stages currently in the Plymouth area. Table 3.26 indicates the development and details of the proposals.

Table 3.26: Miscellaneous Developments

Development	Location	Proposal
Derriford	North of Plymouth, East of the A386	240 dwellings and 1,500sqm of B1 office space.
Southway	North of Plymouth, West of the A383	490 Dwellings
Plymouth Airport	North of Derriford	240 Dwellings
Forder Valley	-	350 Dwellings

In addition, there are a number of developments for which accurate details of the proposals are not available at this time. These include:

- Sutton Harbour; Devonport; City Centre/ University; Central Park; East End/Eastern Gateway; Tor Point; Old Newnham Farm

Because of the lack of definitive development proposals, it has been assumed that the traffic generated by all these 'other' developments will be included in a background growth factor that will be applied to base year conditions. This supports the use of the central growth factor.

3.6 Background Traffic Growth

A TEMPRO adjusted NRTF central growth factor has been calculated for the Plymouth area, and applied to the new base year PARAMICS matrices for 2016. This growth has not been applied to the matrix zones where developments are proposed in 2016, to avoid the duplication of growth assumptions[1]. The TEMPRO adjusted NRTF central growth factor has been used because of Plymouth's regional status as a growth point and the significant of level of development proposed for the area in addition to the developments that have been explicitly defined herein. The section below describes the derivation process for the AM and PM growth factors.

Table 3.27: NRTF Factors

Year	Cars		
	Low	[1]Cen	High
2003	1.0554	1.1214	1.1869
2004	1.0693	1.1399	1.2100
2005	1.0833	1.1587	1.2336
2006	1.0975	1.1778	1.2577
2007	1.1096	1.1950	1.2798
2008	1.1220	1.2124	1.3024
2009	1.1344	1.2302	1.3253
2010	1.1470	1.2481	1.3486
2011	1.1597	1.2663	1.3723
2012	1.1714	1.2837	1.3953
2013	1.1833	1.3013	1.4186
2014	1.1952	1.3191	1.4423
2015	1.2073	1.3372	1.4663
2016	1.2195	1.3555	1.4908

$$\frac{1.355}{1.121} = 1.2088$$

The 2003 to 2016 NRTF growth factor is calculated by dividing the 2016 growth value (1.3555) by the 2003 growth value (1.1214). This gives a central NRTF growth factor from 2003 to 2016 of 1.2088. An AM and PM TEMPRO adjustment has been applied to the derived NRTF growth factor to attain Plymouth specific growth. TEMPRO (Version 4.3.2, data set, SW version 14) has been used to provide the AM and PM adjustments included in the following table.

Table 3.28: AM and PM TEMPRO adjustments

	Plymouth			Great Britain			TEMPRO Adjustment
	Origin	Destination	Average	Origin	Destination	Average	
AM	1.128	1.118	1.123	1.131	1.131	1.131	**0.993**
PM	1.114	1.119	1.1165	1.128	1.128	1.128	**0.990**

The TEMPRO adjustments above have been applied to the NRTF factor to produce the final AM and PM TEMPRO adjusted NRTF factors included in the following table. The values shown in the following table are calculated by multiplying the NRTF growth factor by the TEMPRO adjustment (e.g. AM peak : 1.2088 * 0.993 = 1.200)

Table 3.29: TEMPRO Adjusted NRTF factor

	Central
AM	1.200
PM	1.196

[1] The TEMPRO factors were calculated from a data set that contained development within Plymouth, and the application of such factors to zones subject to the proposed three major developments would over estimate the likely travel demand growth in the east of Plymouth.

4 Transport Modelling

4 Transport Modelling

4.1 Introduction

A PARAMICS corridor model covering the study area was developed by SIAS from the Plymouth-wide model, and validated for the AM peak period for use in the ECS. No additional validation work has been undertaken in this infrastructure study, so that resources could be focused on the design processes.

The corridor model was used as part of the Plymouth Eastern Corridor Study to assess the validity of a hierarchy of public transport options linking the new developments in the East of Plymouth with the city centre. This section provides an overview of the work that has been undertaken in this infrastructure study, focusing on the coding of the infrastructure options. The model has therefore been used to assist with the design process and separate modelling activities have been minimised, because of the budget constraints.

A pm peak hour model for the study area was not developed during the Plymouth Eastern Corridor Study, hence no pm peak hour modelling has been undertaken for this study.

4.2 Model Development

A modified version of the SIAS PARAMICS model has been used for the infrastructure study, as it is the best model available for the study area. The main problem with using PARAMICS is the very time-consuming network coding and junction calibration which is required, and the long runtime for assigning the traffic onto the network. However, this is compensated by the interactive nature of the software which clearly shows how vehicles flow through one junction and onto the next. It was therefore considered fit for purpose primarily because of the latter facility.

The SIAS model has been cordoned to cover the area of East Plymouth as defined in the East Plymouth Infrastructure Study Brief and is illustrated in Figure 6. The cordoning involved reducing the size of the modelled area under consideration and amalgamating zones in the west of Plymouth.

The variable demand mode choice spreadsheet model was developed for the Eastern Corridor Study using coefficients derived from previous work on similar corridors in the UK and Plymouth, and has previously been calibrated and validated against available Plymouth data.

The demand model considers the effect of demand suppression and mode choice on the future year matrices. These models have not been adjusted or altered as part of the infrastructure study. Because of the resource constraints of the study budget, and the time consuming nature of the process, two model scenarios were developed. These were a do-min and a do-something models. Each are detailed in the proceeding sections.

4.3 Do Minimum Model

The 2016 Do Minimum model contains only the modifications to the road network and residential, industrial developments etc. that are committed to be built. These consist of:

- A new transport corridor between Deep Lane (just south of the westbound exit from the A38) and the A379; and
- All committed developments in the East Plymouth study area (section 3).

TEMPRO adjusted NRTF central growth rates are used to create the new 2016 matrices, and the trip rates for the new developments are added to give the final Do Minimum model matrices.

The base year is 2004 whilst the forecast year is 2016, as this was identified in the study as being the cut off for developments. This will provide a medium-term indicator of the infrastructure requirements, in a very uncertain and changeable development area. This is therefore considered to be more appropriate than a 2031 assessment, where development patterns remain largely undefined.

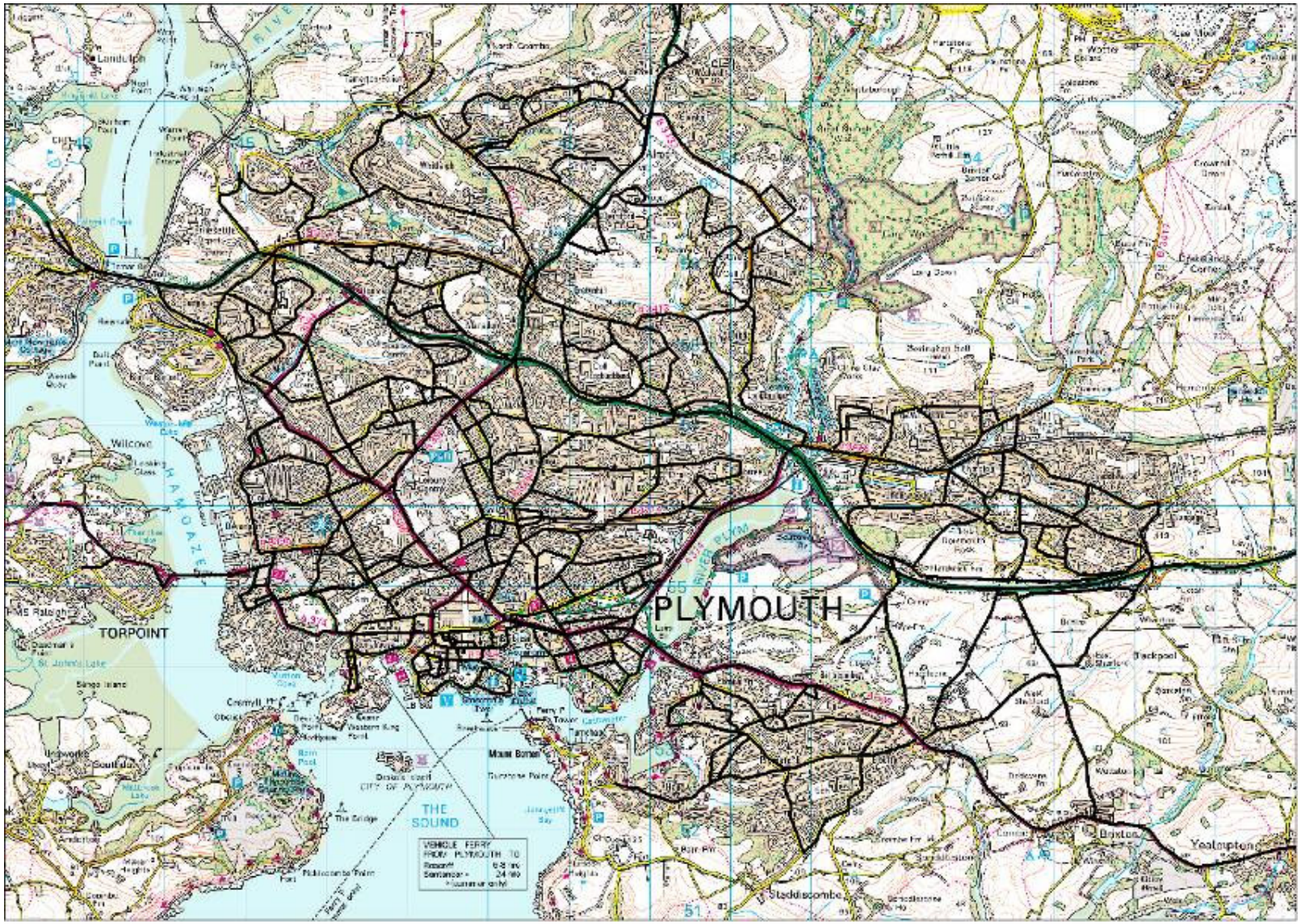
4.4 Do Something Model

The Do-something model contains all the proposed infrastructure as shown in the layout drawings and described in section 5 of this report. This has involved extensive network coding across large areas of the model, including:

- Junctions: Kerb lines; Stop lines; Priorities (give-ways); Signal timings (stages, cycle time and offsets); Lane usage
- Links: Speeds; No. of lanes; Vehicle restrictions (bus lanes)
- Bus Routes: Bus stops; Bus routing through bus priority measures; and
- No additional developments have been included compared to the Do Minimum model.

The two model scenarios provide a suitable framework from which to assess the costs and benefits of the recommended infrastructure investment. Analysis work has also been undertaken to determine the relative impacts of development and background traffic growth, so that more accurate costs can be apportioned. The traffic flows and model running (do-min and do-something) have been used throughout the design process.

Figure 6 - PARAMICS Model Coverage

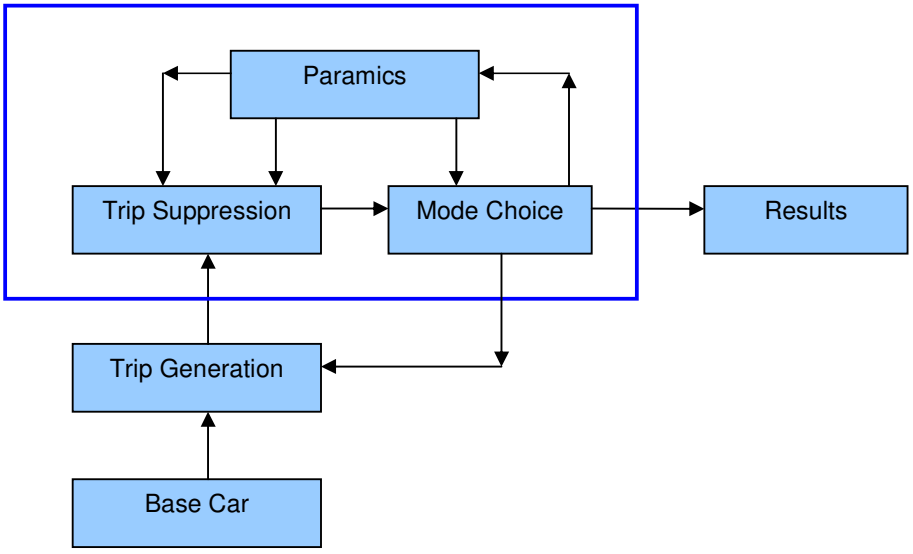


4.5 Modelling methodology

The traffic generation and distribution has been determined from appropriate development related documentation, as outlined in previous sections of this report. The PARAMICS model and variable demand model have been developed to assess the impacts of the future year traffic on the network, and an iterative process has been adopted between the two models, leading to model output convergence.

A key element of the assessment, and therefore modelling process, is the suppression of trips. The combined trip (person movements) generation from Sherford and Plymstock Quarry in 2016 in the AM peak hour has been determined. Clearly, not all of these trips can be accommodated on the already congested highway network, irrespective of capacity improvement and enhanced traffic management. Public transport usage is likely to increase which will accommodate some of the increase in travel demand. However, in a congested network not all trips will, in reality, be made during the AM peak hour, with people re-timing their journeys or not travelling. This is referred to as trip suppression and peak spreading. At present, peak spreading is accounted for in the elasticity used in the trip suppression model; a future enhancement of the modelling would be to isolate the peak spreading element. The general process is outlined in Figure 7.

Figure 7: Schematic of Modelling Methodology



The processes carried out in each sub-model are outlined below.

Trip Generation Analysis

This creates the future year demand matrix from the base PARAMICS highway matrix, National Road Traffic Forecast growth and development trip generation and distributions outlined in Section 3.

Trip Suppression Model

This takes the future year matrix from the trip generation analysis and suppresses it, based on journey times from the future year and the base year PARAMICS models. Two elasticities are used, one that includes an element of mode shift and one that excludes modal shift. These elasticities are applied to sector to sector movements dependent upon whether the bus services for the specific movement have been included in the mode choice model.

Mode Choice Model

This takes the suppressed demand matrix and splits it into three modes, using a nested Logit function and a generalised cost calculation with journey time inputs from the PARAMICS model. The three modes are:

- Park & Ride (P&R);
- Bus; and
- Car.

Bus mode split is assessed for key sector to sector movements only. Bus journey times have been collected from appropriate bus services within the model for these movements.

The mode split for P&R requires a choice between P&R sites. This has been manually specified for sector to sector movements. The A38 and Plympton East to city centre trips have been specified as using the proposed Deep Lane P&R with all remaining sectors to city centre trips using the existing Coypool P&R. The fact that a sector to sector movement is allocated to a Park and Ride does not mean that trips will definitely use the service. If the generalised cost of travelling to the P&R and then catching the bus to the city centre is significantly higher than the cost of travelling direct by either bus or car, the mode share for P&R will be negligible.

The mode choice model creates new highway matrices, with appropriate P&R trips added to the P&R site, and feeds this back into the PARAMICS model to be reassigned.

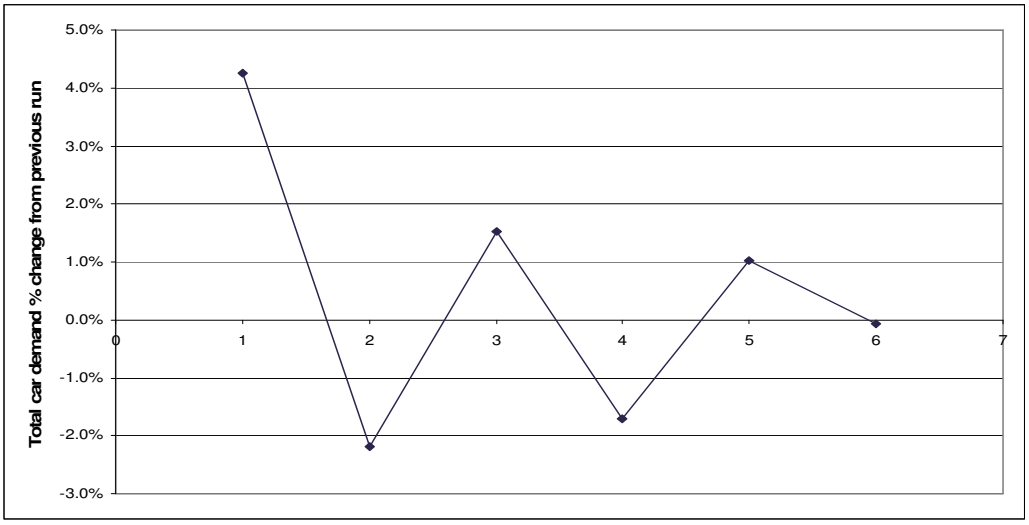
PARAMICS Model

Initially a future year matrix from the trip generation analysis (without suppression or mode choice) was assigned in the PARAMICS model. The public transport and car journey times were then fed into the trip suppression model and Mode choice model to revise the future year matrix from the trip generation analysis. These revised matrices were then reassigned in the PARAMICS model. The public transport and car journey times were then fed back into the trip suppression and mode choice models. This is shown by the red arrows in Figure 7.

Each iteration sees the demand matrices converge closer to an equilibrium value. This process can take some time, or complete convergence may not be achievable, so the convergence is assumed satisfactory when the demand matrices vary between assignments by less than a certain small percentage. After six iterations of the variable demand process, the demand matrices were considered to have converged sufficiently. Figure 8 shows a graphical representation of the convergence.

The PARAMICS model used in this study has modelled the Eastern Corridor as an area-wide strategic model. It provides a simulation of how junctions and the network as a whole will perform once traffic is assigned to the network. However, the model only assigns the traffic to the network that is able to get through junctions in the relevant time period. A significant amount of time should be spent optimising the signal timings to ensure that all the junctions within the model are operating effectively.

Figure 8: Convergence of the Car Demand Matrix Total over Successive Iterations.



The Do Minimum model used for run 6 was therefore be used as a starting point to model the Do Something Scenario.

Table 4.1: Trip Matrix Totals

Model Element	Matrix Totals	Growth from Base Matrix
Base Matrix (car trips)	90806	
Total Base Demand (car + bus trips)	93535	3%
Development Trips + Background Growth	122982	35%
Trips (after Elasticity Suppression)	109302	20%
Trips (after Mode Choice Model)	104828	15%

The number of trips reduce after elasticity suppression due to increased cost of journeys in the future year scenario. The number of trips reduce after mode choice modelling due to car users switching to buses because this mode of travel is cheaper for some journeys.

4.6 Do Minimum PARAMICS Model Results

4.6.1 Do Minimum Modelled Traffic Flows

Tabulated Flows at key locations for the 2016 Do Minimum AM Peak (8.00-9.00) PARAMICS model are included in Table 4.1. These main results are also shown in Figures 8 and 9, for eastbound and westbound flows.

Table 4.2: AM 2016 Do Minimum Flows

Road Name	Description	Flow
A38	Deep Lane to Marsh Mills	2640
	Marsh Mills to Deep Lane	3790
A374	Marsh Mills to Crabtree	3030
	Crabtree to Marsh Mills	2330
A374	Crabtree to Lanhydrock Road	2000
	Lanhydrock Road to Laira Bridge	1790
	Lanhydrock Road to Crabtree	1840
	Laira Bridge to Lanhydrock Road	1460
Billacombe Road	Laira Bridge to Pomphlett Road r/a	690
	Pomphlett Road r/a to Laira Bridge	2250
Billacombe Road	Pomphlett Road r/a to Stentaway Road r/a	320
	Stentaway Road r/a to Pomphlett Road r/a	1010
Elburton Road	Stentaway Road r/a to Haye Road Junction	290
	Haye Road Junction to Stentaway Road r/a	830
Elburton Road	East of Haye Road Junction EB	590
	East of Haye Road Junction WB	550
Sherford Through Route (Cars)	Westbound	560
	Eastbound	700
Sherford Through Route (Buses)	Westbound	10
	Eastbound	10
A38	Marsh Mills to Forder Valley	2270
	Marsh Mills to Forder Valley Slip	1600
	Forder Valley to Marsh Mills	1360
	Forder Valley to Marsh Mills Slip	2250
	Marsh Mills to Manadon	2490
	Manadon to Marsh Mills	2740

Figure 9 - 2016 Do Minimum AM Peak (8.00-9.00) PARAMICS Model Flows (East).

Study Area – Eastern Section

Figure 10 - 2016 Do Minimum AM Peak (8.00-9.00) PARAMICS Model Flows (West).

Study Area – Western Section

4.6.2 Do Minimum Strategic Model Analysis

The purpose of the do-min model is to identify the forecast network performance, within the existing infrastructure constraints. To assist comparison between the do-min and do-something, the following data has been extracted from the model and the results are presented in Table 4.2. All data relates to the:

- Car Journey Times;
- Trip Distances;
- Average Speeds and Trip Suppressions; and
- AM Peak (8.00-9.00).

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Bus journey times are shown in Table 4.3. The routes chosen by cars making the movements shown in table 4.2 will vary throughout the simulation time, due to changing delays in the network. The times shown represent the average journey time of all vehicles making that movement within the peak hour. The vehicles travelling from A38, east of Deep Lane, to the City Centre take a shorter time than those travelling from Sherford due to both the queues exiting the development at the south, and the increased journey time associated with leaving the development from the northern access at Deep Lane and accessing the A38. The short journey time from Sherford to Plymstock Quarry can be attributed to use of the development entrance into Plymstock Quarry from Colesdown Hill. The high journey times from Langage Business Park to Sherford can be attributed to the delays in exiting the development into Plympton and then crossing the Deep Lane junction. The shorter journey time to Plymstock quarry is due to cars rat running through Plympton and accessing the development through the entrance on Colesdown Hill.

The trip suppression figures identify that only 85% of forecast AM peak hour trips will be made, because of high journey time and delays.

Table 4.3: AM Car Times, Distances, Speeds and suppression statistics

Description	Do Minimum				
	Journey Time (min)	Distance (Km)	Average Speed (Km/hr)	% Trips Suppressed	% of Possible Trips
A33 East of Deep Lane					
City Centre via A38/A374	17	14	47	-11%	89%
Sherford Central to					
City Centre (via A379)	24	9	23	-18%	82%
Plymstock Quarry	6	4	41	0%	100%
Plymstock E	8	3	25	-6%	94%
Plymstock W	14	5	23	-15%	85%
Langage Business Park	7	3	24	-17%	83%
Plymstock Quarry to					
City Centre	15	7	25	-25%	75%
Langage Business Park	15	7	29	0%	100%
Plymstock West to					
City Centre	17	6	21	-14%	86%
Langage Business Park	23	8	22	-20%	80%
Plymstock East to					
City Centre	20	6	19	-18%	82%
Langage Business Park	20	7	20	-23%	77%
Langage Business Park					
Sherford (centre)	20	11	33	0%	100%
Plymstock Quarry	10	6	36	0%	100%
Plympton West to					
City Centre	18	7	24	-7%	93%
Langage Business Park	10	4	25	-10%	90%
Global Suppression				**-15%**	**85%**

The trip suppression figures identify that only 85% of the forecast AM peak hour trips will be made, because of the high journey times and delays.

Table 4.4: AM Bus Times

Do Minimum	Bus Journey Time (min)	Car Journey Time for comparison
Deep Lane to		
City Centre via Sherford and A379	26.3	17 (via A38/A379)
City Centre via A38	22.1	
Sherford Central to		
City Centre	24.1	24.0
Plymstock Quarry	11.2	6
Plymstock E	6.9	8
Plymstock W	11.3	14
Langage Business Park	6.9	7
Plymstock Quarry to		
City Centre	12.9	15
Langage Business Park	25.7	15
Plymstock West to		
City Centre	18.4	17
Langage Business Park	29.9	23
Plymstock East to		
City Centre	30.2	20
Langage Business Park	25.5	20
Langage Business Park		
Sherford	6.7	20
Plymstock Quarry	16.2	10
Plympton West to		
City Centre	22.9	18

The longer bus times to Langage from than the corresponding car times can be attributed to congestion within Plymstock accessing the A379, cars can re-route to minimise this delay, whereas buses stay on their allocated route. The relative bus and car journey times, and the similarities between key origin and destination pairs, are a consequence of the on-carriageway operation through Sherford. The designs for Sherford High Street used within this study were more detailed and developed than those used with the Eastern Corridor Study, and this results in the different journey time results.