INTRODUCTION

The Thames Gateway area is Europe's largest regeneration project and a national priority. It extends for 40 miles along the River Thames from the London Docklands in the west to Southend in Essex and Sheerness in Kent to the east.

In this paper, having provided a brief overview of the Regeneration Project, we focus upon the South Essex part of the Thames Gateway and describe the development of an integrated land use and transportation model, that was commissioned by Essex County Council, to assist with the development of a transport strategy that would support the regeneration and proposed growth in housing and employment.

The paper continues with a description of various applications of the model. These demonstrate its potential for assessing the impact of different transportation options and their resilience to a range of economic and demographic scenarios.

THAMES GATEWAY

2.1 The Context

The Thames Gateway area covers an extensive area that takes in the London Docklands, parts of Kent to the south of the Thames Estuary and parts of Essex to the north of the Estuary. Its regeneration has been identified as a national priority; indeed it has been described as 'the UK Government's top priority for regeneration and growth'. The Government’s vision is to transform
the Gateway into a region which people would actively choose to locate in; an area in which people genuinely want to live and work. As described by the Department for Communities and Local Government:

‘Existing and new residents will be part of, and help to create, economically prosperous communities, rich in social and environmental diversity, making a fuller contribution to London, the South East and the whole of the UK’

The Gateway has an advantageous location. It is close to central London which is a nationally-important economic driver and, by virtue of its ports, airports and access to the Channel Tunnel Rail Link, it is a potential gateway to the markets of Europe.

2.2 Thames Gateway South Essex

Thames Gateway South Essex (TGSE) is a subregion of the wider gateway, consisting of the Essex districts of Basildon, Castle Point and Rochford, along with the two unitary authorities, Basildon and Thurrock. In 2001, the Census recorded a usually-resident population of 634,150 and a resident workforce of 296,311. Many of these people worked outside of South Essex; there are significant journey to work flows to both central London and to employment centres within East London.

Port facilities, distribution, tourism, transportation, fuel and automobile research and development are some of the existing key roles fulfilled by the area. The Thurrock area is also host to the Lakeside retail development. This is of regional significance with a catchment area that extends beyond the South Essex area.

However the level of skills and qualifications in the Thames Gateway South Essex area is historically below the regional average. Improving the skill base within the subregion is likely to be a high priority and will doubtless be an important factor if TGSE is to grow as envisaged.

2.3 The scale of proposed development within TGSE

Substantial growth is planned for the TGSE in the period to 2021. The Draft East of England Plan (DEEP) makes provision for an additional 55,000 jobs and 43,000 new dwellings. This later figure represents a 16% increase in dwellings.

One aim of the plan is to reduce the levels of out-commuting. To this end it is seeking to provide for a rate of growth in the number of jobs that is higher than that for the new dwellings.

Such large increases in the numbers of both dwellings and jobs will obviously have repercussions for the local transportation systems. We estimate that in 2021 as many as one in seven trips will be attributable to these new developments. The sheer scale of growth offers the opportunity to make a step change away from the current transport pattern to something that better serves the objectives of the sub-region.

The area faces a real challenge in accommodating these increases considering the existing level of infrastructure. These needs must be understood at both at both a strategic and local level in order to develop
strategies to keep TGSE moving and ensure that key routes have the capacity to cope with planned growth.

However there are wider issues. In addition to considering the impact upon the transportation systems and networks of the anticipated growth, there is also a need to understand the reverse side of the relationship. That is, that an underperforming transportation network could hinder economic growth. Thought needs to be given to the level of investment that the area requires, how this money could be most effectively spent and even how the expectations contained within the DEEP plan and taken forward in the TGSE strategy documents can perhaps be achieved.

3 THE MODEL DEVELOPMENT

3.1 Overall Modelling Framework

Previous discussions amongst Thames Gateway South Essex partners had identified the need for a transport modelling capability that covered the whole of the TGSE’s geographical area and that would support both the Transportation Board’s Business Plan and also inform large infrastructure projects such as the construction of the London Gateway port development. Having put together a package of funding comprising contributions from central government, the Highways Agency, the Government Office for the East of England, the Regional Development Agency along with contributions from the two TGSE unitary authorities and the County Council itself, Essex County Council commissioned consultants Mouchel Parkman to develop a transport modelling framework that would address the various issues that were emerging, associated with the TGSE’s high levels of growth.

The preferred option comprised three tiers of modelling:

- an upper tier Strategic Modelling tool to inform expected sub-regional outcomes including the total numbers and distribution of population and jobs resulting from different land use options and transport infrastructure provision;

- a middle-tier multimodal Network Assignment Model specifically describing transport network supply and demand. This model was seen as being important for forecasting points of network congestion and levels of traffic on highways, buses and railways for different network options and schemes; and

- a lower-tier level of modelling that would be based on Operational Assessment Models. This level was seen as being more dependent on local circumstances, such as a need to assess the effects of specific bus priority measures at signal controlled locations, define the size and design of new junctions or to test the operation of a set of junctions. The intention was to have a range of model types available and to select the one or ones that were most appropriate each time an application was identified.

The funding secured to date has been channelled into delivery of the Strategic and Network Assignment Models.
The figure below illustrates how the models are anticipated to link together. The models will enable the overall strategy for TGSE to be examined with the choices taken through to the detailed design or management of transport infrastructure within the sub-region.

This paper’s discussion focuses on the Strategic Model.

3.2 The Upper Tier Strategic Model – SETLUM

The upper tier model is called SETLUM (South Essex Transport Land Use Model). It consists of applications of DSC’s DELTA land use modelling package and of TRL’s strategic transport model package (STM), integrated to form a land-use transport interaction (LUTI) model.

DELTA has been developed by David Simmonds Consultancy since 1995. It represents land-use change over periods of time. It consists of six urban and three regional sub-models. The urban sub-models work at a zonal level and estimate:

- the development of buildings on land;
- the demographic change and economic growth (applying growth rates which are either exogenous or predicted in the regional components of DELTA);
• changes in car ownership;
• location and relocation of households and jobs;
• employment and status changes; and
• changes in the quality of urban areas.

The first and last deal with changes in the quantity and quality, respectively, of space that is available for households and firms to occupy. The other three model changes in activities.

The three regional-level sub-models work at a higher spatial level, the units being travel-to-work or functional areas rather than zones. The sub-models represent:

• migration between different labour market areas;
• investment in the regional economy
• production and trade in the regional economy.

DELTA models are usually used in conjunction with an appropriate transport model. DELTA calculates all the information about households, population, employment and floorspace which a transport model requires to generate and distribute travel demands.

![Figure 1 The DELTA Land Use Model](image)

The model developed for SETLUM included some variations in terms of its functionality. It does not include a regional economic model, instead a module was developed to model the interactions between the economic performance of South Essex and that of London. This was intended to reflect the way in
which South Essex falls within the sphere of influence of London; if London’s economy was to grow then it would likely draw in more workers from South Essex. Alternatively if the relative attractiveness of South Essex as a place to do business improved, for example if accessibility between the sub-region and the strategic network was improved, then the local economy might draw in additional employment activities.

STM was designed as a high-speed desktop tool which planners and policy makers could use to assess the potential impacts of policy levers applied either singly or in combination. It models travellers’ responses to the many different components of generalised travel cost, but without using a detailed representation of transport networks and route choice.

To increase robustness, STM is ‘incremental’ i.e. it uses demand models (distribution/modal split) which derive future patterns of modal share and distribution from cost changes and the corresponding patterns in a base year. Highway travel times are calculated in STM using zonally-based speed flow relationships for different road types. Road and rail trips follow routes through the zonal system based on actual networks.

The combined land use and transportation model, SETLUM, provides its forecasts by simulating the future a year at a time, starting from land use and transport infrastructure information for 2001. In each year, the land use model uses output from the modelled transport network to assess the level of accessibility afforded to each zone of land in the model. This then has an impact on the DELTA model’s calculation of land values and utilisation within the zone. The transport model itself is run at two-year forecast intervals.

Given a range of locations in which land has been made available for development the land use model selects those areas that will develop, and
indicates how areas may regenerate in response to improved access. People may re-locate based on changes to the quality of available housing stock, access to jobs and changes to their own housing needs. The transport model uses these changes in land activity to re-define trip matrices and trip distribution for the next two year step, calculates modal choice based on options available and creates a new view of congestion and other key indicators. These are returned to the land use model, which forecasts the consequent responses.

New infrastructure, the release of land for development, land use commitments and policies can be introduced at any time in the future and will impact on both models. The land use model operates a time delay, to reflect the observed lag between transport changes and development activity.

Thus the two models progress through time producing a TGSE outlook based on the outputs created and external changes programmed.

4 THE SETLUM MODEL

4.1 A Brief Description

Although the focus of the model is the South Essex area, the decision was taken to extend the Fully Modelled Area to include adjacent areas within Essex and also parts of the Thames Gateway within Greater London and Kent, to allow for the impacts which TGSE policies may have on these areas (and vice versa). Within this area, a zone system was drawn up. Within the South Essex area this was based upon wards, although in key development area, we chose to sub-divide the wards and created smaller, development zones. Across the rest of the Fully Modelled Area the zones are larger in area comprising either aggregations of several zones or whole local authority districts. There is a total of 128 zones within the Fully Modelled Area.

The population and employment scenarios are defined exogenously. Two alternative scenarios were considered. The first was based upon TEMPROiii and constrained the total population and employment levels to match the TEMPRO forecasts at the Fully Modelled Area. The second was a policy-led scenario and reflected the policies contained within the Regional Spatial Strategies for the South East (for the Kent part of the Fully Modelled Area), Greater London (for the London part) and the east of England (for South Essex and the other parts of Essex contained within the Fully Modelled Area).

Local Planning Authorities were consulted on the likely levels of future development within their area. The information that they provided was used to generate a profile of where and when land was expected to come forward for development. Please note that the model does not necessarily assume that all of the permitted development will actually take place, rather the amount that comes forward will also be dependent upon the modelled market demand which itself is sensitive to other factors including the impact of transport changes.
4.2 A Do-minimum test

The first step to evaluating the impact of different levels or locations of growth was to generate a Do-minimum reference case. This was based upon the ‘most-likely’ land-use scenario (based on the inputs from the local planning authorities) and the committed transport improvements. This reference case provided a baseline against which alternative options could be tested. These would be based upon varying one or more of the following three areas:

- permissive development – namely the availability of residential and/or employment land for development across the Fully Modelled Area;
- transport interventions – to reflect highway or public transport improvements; and
- the levels of economic and demographic growth.

We now proceed to describe the outputs of the do-minimum case.

**Figure 3: Do minimum transportation schemes**

The transportation improvements input to this do minimum run are:

- M25 widening between junctions 27 and 30;
- Sadler’s Farm major scheme; and
- improvements to the A13, M25 junction 30 and the A1014.

Assumptions were made on the impact of the road improvements upon zonal average speeds. The Sadler’s Farm improvements are expected to significantly alleviate congestion in the surrounding area and so are included.

The additional residential and commercial developments have a severe impact upon the road network, despite the do minimum improvements. Modelled average speeds across the TGSE area drop by 12% over the period...
2003 – 2021. The most significant slowdowns occur in the major urban areas, although some of the strategic network is also significantly affected; for example the A13 between Thurrock and Basildon. Despite this slowdown there is still a large growth in car trips, but a more significant increase in train use.

Figure 4: Percentage changes in average speed in the do minimum 2003-2021

Figure 5: Percentage change in trip ends by mode, do minimum 2003-2021

Scenario A: JM for year 2021
Scenario B: JM for year 2003

<table>
<thead>
<tr>
<th>Mode</th>
<th>Percentage Change</th>
</tr>
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<tbody>
<tr>
<td>CAR</td>
<td>21.5</td>
</tr>
<tr>
<td>UG</td>
<td>0.0</td>
</tr>
<tr>
<td>BUS</td>
<td>15.5</td>
</tr>
<tr>
<td>TRAIN</td>
<td>41.1</td>
</tr>
<tr>
<td>CYCLE</td>
<td>9.2</td>
</tr>
<tr>
<td>WALK</td>
<td>-1.2</td>
</tr>
<tr>
<td>Total</td>
<td>16.0</td>
</tr>
</tbody>
</table>
It should be remembered that SETLUM does not explicitly model junctions or local roads, so the appropriate tool to examine the more local effects of (and, where appropriate, necessary solutions to) this growth would be either the middle or lower tier of models.

Perhaps the more significant outputs from SETLUM concern the demographics of the area; where people choose to live, and where employers locate. This can assist in examining some of the wider implications of major transportation changes, and indeed in considering how or whether the regions targets for growth could be met.

We can thus examine the model’s view of outturn job and population changes in TGSE, and compare this with the figures in regional plans.

The population increase envisioned within DEEP totals more than 31,000 for the TGSE area; the bulk of which is concentrated in Thurrock. The figure below summarises the planned growth.

The results of the do minimum run forecast a significantly higher proportion of this growth to occur in TGSE with a subsequent reduction in the predicted level of growth in Kent and Greater London.

The differences between the plans - which amount to some 51,000 additional people predicted in the TGSE area - arise because of the greater attractiveness of the TGSE location, where the cost of living is likely to be comparatively lower than surrounding areas in Kent and East London. Specifically, Thurrock and Southend-on-Sea are expected to experience the greatest increase in population growth. This modelled growth prediction is of...
significant importance when considered alongside modelled predictions of the supply of jobs in the region.

TGSE is ‘allocated’ 55,000 additional jobs in all. Thurrock is again expected to be a key contributor and provide almost half of these jobs. A very significant portion of these could be provided by the proposed new port and business park at the former Shell Haven site, London Gateway.

Figure 7: Do minimum run population growth 2001-2021

Figure 8: Difference between DEEP planned population growth and Do minimum run population growth 2001-2021
Figure 9: Do minimum scenario population growth within TGSE 2001-2021

Total: 82k

Figure 10: DEEP planned extra jobs 2001-2021

Total: 111k
One of the key findings of the do minimum scenario however, is that the TGSE region falls considerably short of achieving the planned 55,000 extra jobs – accruing 41,000 in total. This represents a shortfall of 14,000 jobs in the area.
Consequently, there will likely be increasing movements of journey-to-work trips from population centres in the TGSE region to employment centres outside of TGSE, for example London. This is likely to place further strain on regional transport networks. Below, we have the breakdown of the job changes by district.

Looking at this breakdown, Thurrock and Southend have the greatest shortfalls against their targets. In the case of Thurrock, the results forecast that, without intervention, London Gateway fails to achieve significant growth.

This Do-minimum case provides a starting point for exploring how transport (and improvements to the infrastructure) can assist both in alleviating the added congestion caused by the high levels of growth and in supporting the delivery of high employment targets.

5 THE USE OF SETLUM TO ASSESS IMPACT OF TRANSPORT INTERVENTIONS

5.1 Transport Options

In addition to the transport interventions contained within the Do-minimum reference case several other proposals for improving the flow of vehicles within the South Essex area have been identified. These ‘flagship’ schemes include:
• introduction of a package of telematics, driver information and incident management;
• route management strategies, major maintenance on the A127 and A13;
• a new junction on the A127 near Gardiners Lane;
• M25/A13 junction improvements; and
• Introduction of SERT (South Essex Rapid Transport) system

The schemes were tested both individually and in combination to test their impact upon employment generation.

The range of outputs generated by SITLUM allow the policy maker to look both at the area-wide and zonal impact of a scheme. Figure 16 is an example of the latter whilst the following table. It shows the difference in jobs between the reference case and a test that contains a new junction on the A127 near Gardiners Lane. The movement of jobs reflects the relative attractiveness of zones with and without the junction improvements.

Table 1 shows the change in jobs associated with each of the flagship schemes. The impacts of the five individual schemes are shown in Tests KC through to KG. Their combined impact is shown in Test KB. There are a number of points raised by this table. Firstly the combined impact (as shown in Test KB) is greater than the sum of the individual schemes. Test KB shows an additional 655 jobs across South Essex whilst the sum of the additional
jobs generated by Tests KC through to KG is only 534 jobs. This is an impact
that we see quite often in models of this type. Secondly the overall growth of
jobs, in all the schemes, is quite modest – given the planned growth of 55,000
jobs in the period to 2021.

In the light of these findings, a second round of tests was run. These
assessed the impact on employment of the following more substantial
transport interventions;

• improvements to average speeds on the A127 from the M25 to Southend
  of 20%;
• improvements to average speeds on the A13 (M25 to Sadlers Farm) of
  20%;
• A13 improvements as above plus upgrading the A1014 and adding
  Canvey regeneration link road;
• more substantial improvements to SERT; and
• a Basildon By-pass.

Having described the first set of transport schemes as ‘flagship’ schemes,
these were given the sobriquet of ‘battleship’ schemes.

The results of these interventions are shown in Table 2. Again the sum of the
whole is greater than the individual parts. (Please note the overlap between
schemes). Also with these schemes the model is suggesting a more
substantial increase in employment.
Table 2: Increase in Jobs and resident workers – more substantial schemes compared to Do-minimum case (2001-2021)

<table>
<thead>
<tr>
<th></th>
<th>Extra jobs</th>
<th>7781</th>
<th>399</th>
<th>910</th>
<th>7296</th>
<th>53</th>
<th>540</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extra Resident Workers</td>
<td>4985</td>
<td>639</td>
<td>1768</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

5.2 The London Gateway

London Gateway is the former Shell Haven oil refinery site near Grays in Thurrock. It has been given permission for development as a major deep sea port and business park. The expectation, within the TGSE strategy is that the site will house 16,000 new jobs.

The modelled do minimum scenario generates limited numbers of jobs in the zone. Closer investigation of the model outputs reveals that one possible reason for this is the declining average speeds, both in the locality of the port and on the strategic network. These would make the site relatively unattractive compared to industrial sites in other parts of the sub-region. The zonal trend in speeds is shown in the chart below.
A series of tests have been carried out with a focus on the proposed port development. These tests aimed to identify whether London Gateway could be genuinely successful in attracting development and business. It provides an indication of transportation schemes or policies that could be worth further, more detailed investigation.

A selection of the model outputs have been graphed in the following figures. These figures depict the take up of available land for development, and the corresponding growth in jobs in the zone containing the proposed London Gateway port and business park. We start by looking at the modelled uptake of available land in the do minimum case.
Figure 16: Take up of industrial and warehousing permissions, do minimum

Figure 17: Take up of office permissions, do minimum
Figure 18: Employment growth in the London Gateway zone, do minimum

The Do-minimum test’s output relating to take-up of industrial floorspace and employment growth within the London Gateway zone suggest that there is some limited construction of industrial and warehousing floor space, but very little office development. This leaves a large amount of unused development land representing unmet potential in the London Gateway zone.

To explore the extent to which the site’s growth is constrained by poor accessibility we undertook a series of model runs that introduced alternative transportation changes. These included:

- a greater degree of improvements to the A13 and A1014;
- an LRT system; and
- a direct link between the London Gateway area and Canvey Island.

For simplicity of comparison, all the schemes are assumed to come into effect in 2011.
Table 3: Increase in Jobs in London gateway with different transport interventions – more substantial schemes compared to Do-minimum case (2001-2021)

Figure 19 Location map of possible improvements to transport infrastructure

The effect on the number of jobs is shown in Table 3 and Figure 20. All of the schemes examined improve accessibility to such an extent that additional jobs are generated at the site. The greatest number of jobs would appear to follow the construction of a link to the east of the site, connecting the London gateway to Canvey Island. However even this does not meet the strategy target of 16,000 jobs.

A subsequent refinement was made to the model that attempted to better reflect the attraction of a port development, in terms of its access to wider markets and hence as a location to do business. (Under the basic model the amount of development in the site reflected the attractiveness of the London gateway area solely as a place to do business with other locations within the modelled area and took no account of the new (overseas) transport links that a port would offer. This refinement increased the number of jobs that would be expected to locate to the site in the Do-minimum reference case to around 9000. Further work still needs to be done to gauge the impact that transport improvements of the type described in paragraph 5.2.06 would have on this new do-minimum case.
a) A13 and A1014 improvement

b) LRT improvements
6 CONCLUSIONS

Results of the modelling work shown in this paper reveal that without improvements to the road infrastructure, the potential, for the London Gateway zone in particular, to create centres of employment will struggle to be realised.

Differences between the DEEP planning forecasts and the modelled do-minimum scenario are marked. Modelling outputs suggest a significantly higher than planned growth in the population of the TGSE region combined with a lower than planned level of employment.

Consequently, under the do-minimum scenario, the aspiration of reducing the outflow of journey-to-work trips from the TGSE area will not be realised. Not only will the pressures on an already stretched regional road network increase under this scenario, but continued out-commuting will work against a policy of regeneration in the TGSE area which aims to achieve success through the containment of employment in the local area.

Whilst not an exhaustive list of potential options, the range of transport interventions described in this paper, and tested with the model, suggest ways in which the South Essex area might improve accessibility both in terms of the linkages to the rest of the region and beyond and also within the sub-region, to an extent where the area becomes more attractive to business and the DEEP’s growth plans may be achieved.

Further work still needs to be done both to test some of these improvements at the finer level (using the network assignment model) and also, using SETLUM to test the resilience of schemes to different economic scenarios.
What happens if London continues to grow and draws in more workers from neighbouring sub-regions such as South Essex? What happens if there is a down-turn in London’s economy, how will South Essex be affected?

We would hope to address these issues over the course of the next few months.

References


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1 Thames Gateway South Essex Website www.tgessex.co.uk
2 DCLG website http://www.communities.gov.uk/index.asp?id=1170079
3 The Department for Transport TEMPRO database contains small area forecasts of population, households and employment.