Demand Analysis and Tactical Deployment of Ambulance Services in the National Ambulance Service South East Region

A report for the
Pre-Hospital Emergency Care
Council & the National
Ambulance Service

Feidhmeannacht na Seirbhíse Sláinte
Health Service Executive

Pre-Hospital
Emergency Care
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1. Introduction and Background

This project was funded by the Pre-Hospital Emergency Care Council and co-ordinated by Dr Geoff King of the Pre-Hospital Emergency Care Council and Mr Frank McClintock Assistant National Director, National Hospital's Office.

The study builds on earlier work undertaken by the project team of Spatial Planning Solutions and Active Solutions (Europe) for the National Ambulance Service South East region. These studies are the first of their kind in the Republic of Ireland in that it utilises detailed ambulance service records to firstly, assess both demand for and past performance of ambulance emergency care, and secondly, make recommendations on how the spatial configuration of services may be improved to achieve enhanced ambulance services in the region. Current and future trends are also examined.

The project has two parallel functions; firstly to provide recommendations on the spatial configuration of ambulance resources in the National Ambulance Service South East region from results of the demand and performance analysis of the ambulance service in the region; and secondly, to provide input into a template methodology that can be used throughout Ireland to assess ambulance service deployment options.

Project Aims

To achieve the above a set of project aims were developed, these are:

i) To analyse the spatial and temporal patterns of ambulance activity (emergency, urgent & patient transport) and make an assessment of emergency care demand for the South East region.

ii) To explore spatial options required to produce a Tactical Deployment Plan (TDP) that will improve response times for emergency patients.

iii) To communicate the optimum deployment plan and enable query by day or hour in relation to current configuration of services.

iv) To examine the sensitivity of the TDP in respect of current trends – taking into account population trends, development planning and road changes.

v) Consider the implications of ongoing changes in the demographic and development environment of the region and how these may affect future ambulance services.

Team Approach

The project has been undertaken by Spatial Planning Solutions (Cork) and Active Solutions (UK). Both companies have extensive experience in the analysis of ambulance resources and developing plans for enhanced utilisation in Ireland, the United Kingdom and the USA.

In addition to progress meetings with the steering committee, an important aspect of this project was the valuable input and feedback from the ambulance staff of the region. Meetings open to all ambulance staff were held to gain their views on indicative findings and the study aims.

Study Period and Data Collection

Data for the study was supplied by the ambulance service of South East region and covers the period 1st January 2006 to 31st December 2006. This period was considered appropriate to allow a suitable overview of demand for ambulance services to generate the first generation of Tactical Deployment Plan for the region.

Data on emergency (AS1) and urgent (AS2) calls for the study period were generated automatically using the ambulance service's Command & Control system. Patient transport calls that required the use of ambulance resources were included. Other patient transport services that utilise taxi services are not captured digitally.

Report Structure

Detailed findings of temporal and spatial facets of demand for emergency care in the South East Ambulance Service region are set-out in section 2. Section 3 examines response performance with particular attention to AS1 incidents. Section 4 provides an overview of the Tactical Deployment Plan of the region. Demographic trends and future development policy and context is provided in section 5. Section 6 provides the study conclusions and a set of recommendations.

Acknowledgements

We would like to acknowledge the support of Dr Geoff King and the staff in the Pre-Hospital Emergency Care Council for their support in undertaking this project. Mr Frank McClintock, Assistant National Director of the National Hospitals Office who initiated this study. We would also like to thank Mr Nicky Glynn, Chief Ambulance Officer, South East region, Michael Delaney, Communications Officer, and the ambulance service staff for their co-operation, valuable advice and support.

2. Emergency & Urgent Incident Demand Analysis

In this section we examine the demand profile of the emergency calls (AS1) and urgent calls (AS2) for the region during the study period. The demand analysis examines the temporal and spatial variation of demand for ambulance services for these types of incidents and also examines the call sources for the incidents. The results indicate where demand peaks are highest and how demand varies with location. The section provides a baseline for current activity and helps inform how future service delivery may be enhanced.

2.1 AS1 & AS2 Capture & Data Description

The records of AS1 and AS2 incidents were captured digitally within the computer-aided despatch system (CAD) used by the South East Ambulance Service. The ambulance service in this region operates a Medical Priority Despatch System (MPDS). The system operator creates a new record for an incident upon receipt of a call from either one of a variety of sources including the general public on the 999 call system, individual GP's or hospitals in the region. A unique incident identifier is recorded for each call and the name, address and type of incident are recorded by the operator. MPDS codes are given to AS1 incidents. The date and time of the call are automatically captured. For some incidents more than one resource (ambulance) may be assigned, thus generating multiple records for a single incident. For some incidents a resource may be assigned from a station at some distance from the incident, where resources are unavailable at a closer station. If resources become available at the closer station a resource is assigned from that station and the first resource may be stood down from the incident. Time stamps included in the records from the South East CAD record the following:

Table 2.1

Time stamps available in Computer System	
Time Stamp	**Description**
Creation Time	Time incident record created/registered on computer system
Assign Time	Time a resource (Ambulance) is assigned to an incident
Mobile Time	Time the resource leaves its station
On-Scene Time	Time of arrival at the incident location
Off-Scene Time	Time of departure from the incident location
At Hospital Time	Time of arrival at a hospital
Clear Time	Time resource is available to undertake another assignment

Incident Location;

The CAD system includes a mapping component that captures the national grid coordinate of an incident. The system indicates the locality of an incident using the address information provided by the operator. The suggested location is based on a 'look-up' database of localities in CAD which are derived from the OSI/An Post GeoDirectory and other mapping data such as townlands and villages and named road junctions. There are recognised shortfalls with the use of the GeoDirectory particularly in rural areas and under populated areas. The operator can select to assign the incident to the suggested location or establish the location 'by hand' through reading digital map displays. An assessment of the locational accuracy in the data audit of the data indicated minimal errors in data position and none that would materially affect the results of the study.

Incident Numbers;
The total number of AS1 and AS2 calls recorded was **60,125**. A significant number of incidents were 'stood down' either before or after resources were assigned or sometimes after a resource had reached the location of an incident. In general all incidents where the ambulance(s) reached the scene are considered in all aspects of the study and are identified in table 2.2 as 'unique responded incidents with location'; there were 11,186 AS1 and 13,735 AS2 such incidents in the South East region in 2006 (see table 2.2).

A number of incidents were explicitly 'stood down' by Control Room operators where they were either in progress to a scene or, for a small number, where an 'at scene' time is recorded but no location is provided. As these represent a use of ambulance service resources despite being 'stood down', the steering committee considered that such incidents should be included in the temporal and spatial analysis of demand but not in the Tactical Deployment Plan.

A small number of incident records included either no 'at scene' time or had no location information and the database did not specify that these had been stood down. The numbers of such records are small, and upon close examination it is assumed that many of these records were never valid. Given the small number, in particular in respect to AS1 incidents and that most appear to be simply misreported[1] incidents, it is considered appropriate to exclude these records from the analysis, in the knowledge that this exclusion will not affect the overall results.

Table 2.2

Total Incident in South East Region				
Incident Type	**AS1**	**AS2**	**AS3**	**Total**
Unique Responded Incidents with Location	11,186	13,735	16,442	41,363
'Stood Down' before 'At Scene Time'	2,474	1,618	5,009	9,101
'Stood Down' unspecified Location	3,145	1,533	2,195	6,873
No 'At Scene' time	117	250	506	873
Unspecified Location	24	129	1,762	1,915
Number of Incidents	**16,946**	**17,265**	**25,914**	**60,125**

MPDS
A Medical Priority Despatch System (MPDS) is deployed in the South East region. An analysis of the respective categories of calls was carried out to assess the systems efficacy in identifying life threatening calls and the impact on the Tactical Deployment Plan when these are used. This is presented in section 4.6 of the report.

2.2 Temporal Variability

The demand profile for AS1 and AS2 calls received in the South East region is examined by month, day of the week, and by hour of the day.

2.2.1 Monthly Variation

The incident call rate for AS1 and AS2 calls for the study period are listed below in table 2.3, average monthly rates and average daily rates per month are also calculated.

[1] This term is used to refer to records that could be either 'test' records, or errors during a recording that remained stored in the CAD system. They are included here to ensure the number of records stored in the CAD system, and those used in the study, tally.

Table 2.3

Average Monthly Variation (All Incidents)						
Month	AS1	AS2	Total AS1 & AS2	Per Day		
				AS1	AS2	Total
Jan	1,337	1,395	2,732	43	45	88
Feb	1,263	1,491	2,754	45	53	98
Mar	1,375	1,537	2,912	44	50	94
Apr	1,331	1,374	2,705	44	46	90
May	1,312	1,437	2,749	42	46	89
Jun	1,371	1,331	2,702	46	44	90
Jul	1,533	1,408	2,941	49	45	95
Aug	1,523	1,447	2,970	49	47	96
Sep	1,504	1,363	2,867	50	45	96
Oct	1,546	1,457	3,003	50	47	97
Nov	1,268	1,393	2,661	42	46	89
Dec	1,583	1,632	3,215	51	53	104
Total Monthly Average	**16,946**	**17,265**	**34,211**	**46**	**47**	**94**
Average Monthly	***1,412***	***1,439***	***2,851***			

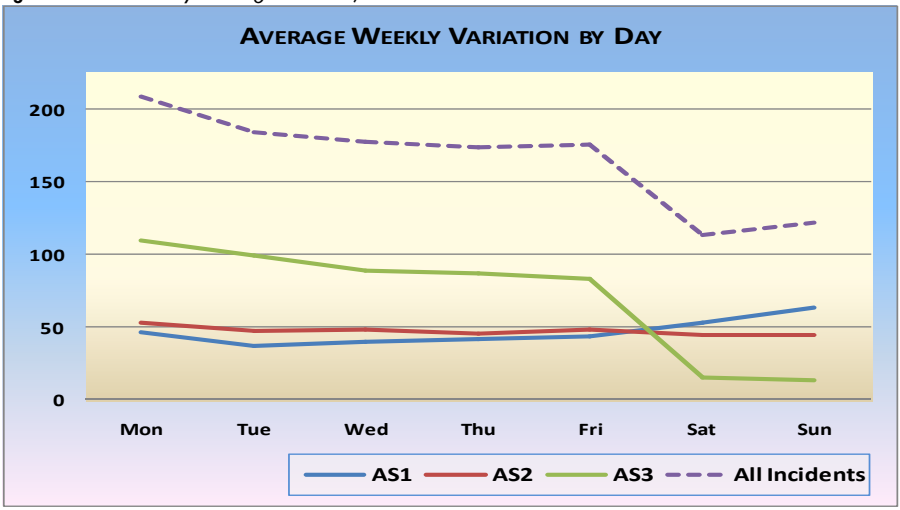
Within the region the average monthly rate for AS1 incidents was 1,412 and 1,439 for AS2 incidents. December had the highest numbers of incidents of any individual month; December also has the highest daily average of any month for AS1 calls with a daily average of 51. This is higher than the annual daily average of 46 AS1 calls per day however it is noteworthy that values of 50 per day were recorded for the months of September and October.

2.2.2 Weekly Variation

Incident rates across the week in the South East are broadly static during week days for AS1 and AS2 activity but show a distinct increase in AS1 activity at the weekends. In contrast a strong reduction in demand for AS3 services and smaller reduction in AS2 activity during the weekends occur (see figure 2.1).

The busiest day is Monday; this is mainly due to high levels of AS3 activity and to a lesser degree from sustained levels of AS1 activity continuing from the weekend. High levels of AS3 activity are likely to arise from a possible backlog from the weekend. In contrast to other regions Fridays are relatively quiet with only a small increase in AS1 and AS2 activity resulting in slightly higher values for all incidents compared to other week days.

Figure 2.1 *Daily Averages of AS1, AS2 & AS3 incidents.*



2.2.3 Daily Variation

When taken together across all days of the week the average hourly rate of AS1 incidents in the South East is generally around 1.93 incidents per hour, the exception to this in the very early morning between 03.00hrs and 07.00hrs when demand reduces to around one incident per hour. In contrast AS3 demand is almost exclusively only required during the day. Call rates for AS3 show a marked drop between 12.00hrs and 14.00hrs (lunch time) and pick up again until 16.00hrs after which rates begin to reduce rapidly. AS2 demand is also concentrated during the day, however there is no apparent demand reduction over lunch times, and the evening reduction is significantly less marked than that of AS3 calls (see figure 2.2 below).

Figure 2.2 *Average number of incidents per hour (all days of week)*

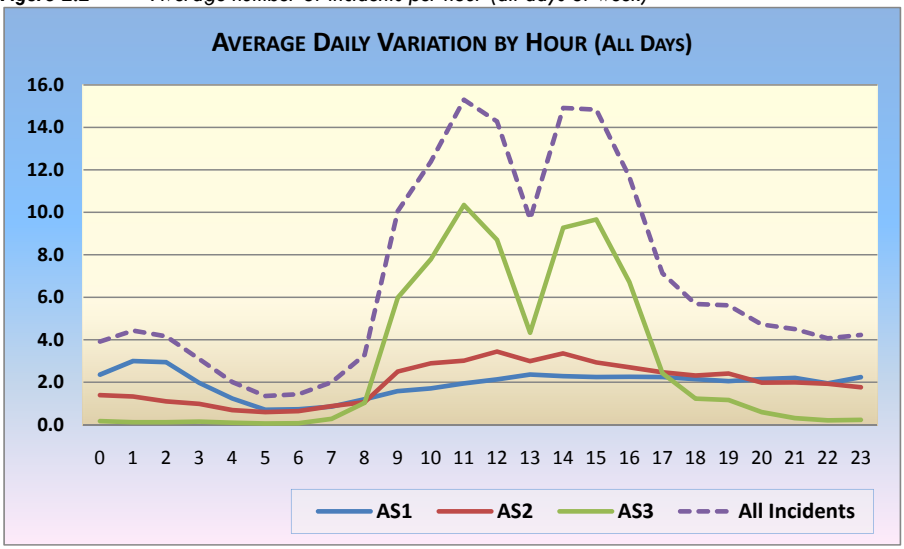


Table 2.4

Average Daily Variation by Hour (All Days)				
Hour	**AS1**	**AS2**	**AS3**	**All Incidents**
Average Hourly	***1.93***	***2.0***	***3.0***	***6.9***
Ave. 08.00 to 18.00	*2.01*	*2.7*	*6.1*	*10.8*
Ave. 19.00 to 07.00	*1.87*	*1.4*	*0.3*	*3.5*

As already noted there are different incident rates during weekend hours compared to weekdays, for this reason figure 2.3, 2.4 examine incident rates for hours during the weekend, during weekdays[2] respectively.

Figure 2.3 *Average number of incidents per hour (weekend only)*

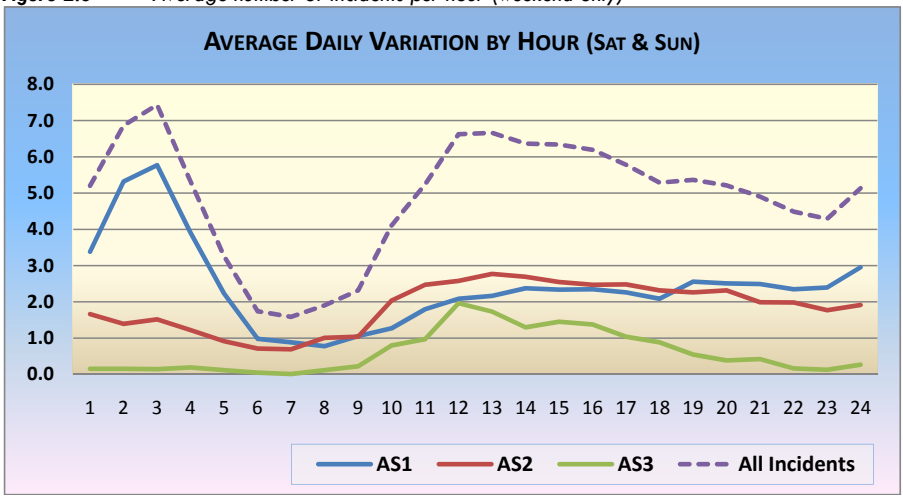


Table 2.5

Average Daily Variation by Hour (Sat & Sun)				
Hour	**AS1**	**AS2**	**AS3**	**All Incidents**
Total Daily Average	**58**	**45**	**15**	**118**
Average Hourly	***2.4***	***1.9***	***0.6***	***4.9***
Ave. 08.00 to 18.00	*2.0*	*2.3*	*1.1*	*5.5*
Ave. 19.00 to 07.00	*2.8*	*1.5*	*0.2*	*4.4*

[2] Excludes Monday incidents which are skewed from remaining AS1 activity in the early hours of Monday morning

Figure 2.4 *Average number of incidents per hour (Weekdays only)*

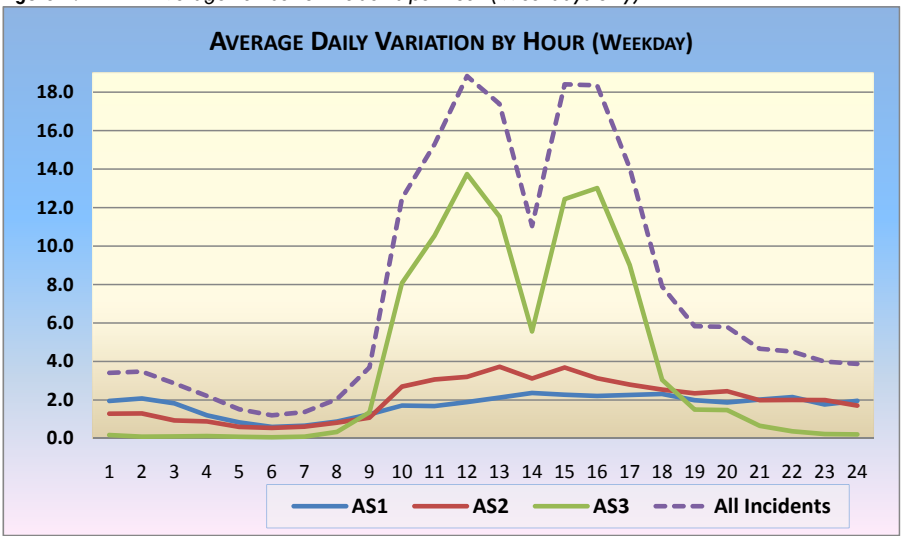


Table 2.6

Average Daily Variation by Hour (Weekday)				
Hour	**AS1**	**AS2**	**AS3**	**All Incidents**
Total Daily Average	**42**	**49**	**94**	**184**
Average Hourly	***1.7***	***2.0***	***3.9***	***7.7***
Ave. 08.00 to 18.00	*2.0*	*2.9*	*8.2*	*13.0*
Ave. 19.00 to 07.00	*1.5*	*1.3*	*0.3*	*3.1*

At weekends demand on ambulance services from AS1 activity increases while there is a corresponding decrease in AS2 and AS3 demand. The average hourly demand at the weekend is 2.4 AS1 incidents per hour compared to the 1.7 per hour for weekdays only. The average hourly rate of AS3 on Saturdays and Sundays is 0.6 compared to 3.9 per hour for weekdays (see tables 2.5 and 2.6).

The period 23.00hrs to 04.00hrs on weekend nights and the early hours of Mondays (see figure 2.3) are the busiest times for AS1 activity with call rates approaching an average of 5.7 per hour at around 03.00hrs. Day time demand for AS1 services is broadly similar to weekday activity.

2.2.4 AS3 Temporal Variability

AS3 calls make up around 43% of the number of incidents recorded in the South East region. Monthly variation of AS3 demand remains stable throughout the year with a monthly average of 2,160 calls. The busiest month was September, however no particularly strong pattern of demand emerges.

Per day an average of 71 incidents occurs (see table 2.7), however figures 2.3 and 2.4 highlight the fact that AS3 activity principally occurs during weekdays and is concentrated into the hours 09:00hrs to 13:00hrs and 14:00hrs to 17:00hrs. For all AS3 incidents 93% of them are required during weekdays (24,398) and of this 83% of those incidents (20,372) occur between the hours listed above. Put simply 79% of all AS3 incidents occur during 30 hours of the week (168 hours).

The records of the South East Ambulance Service indicate that all not all AS3 PTS activity was undertaken by emergency ambulances. The impact of this activity on resource availability is assessed in later sections.

Table 2.7 AS3 Monthly variation

Average Monthly Variation (AS3 Incidents)			
Month	**AS3**	**% of All Incidents**	**Average AS3 Per Day**
Jan	2,362	46%	76
Feb	2,228	45%	80
Mar	2,233	43%	72
Apr	2,107	44%	70
May	2,332	46%	75
Jun	2,162	44%	72
Jul	2,192	43%	71
Aug	2,198	43%	71
Sep	2,110	42%	70
Oct	2,010	40%	65
Nov	2,175	45%	73
Dec	1,805	36%	58
Total	**25,914**	**43%**	**71**
Average Monthly	***2,160***		

2.2.5 Temporal Variation Findings

A number of salient features emerge from the tables and graphs and tables of temporal demand, these are;

- There is only minor variation on the monthly rates of incidents during the study period, while there was little discernable difference between summer and winter rates, December rates for all incidents did increase, especially for AS1 incidents, this was offset by lower rates during January.

- Significant variation of demand activity occurred between weekends and weekdays. The weekly profile of demand demonstrated that AS1 calls increased over weekends, but rates of AS2 and AS3 incidents reduced, especially in the case of AS3 call activity. On weekdays AS3 rates were highest on Mondays and lowest on Fridays.

- During the day two demand peaks are apparent on weekdays, firstly between 11.00hrs to 12.00hrs and particularly between 14.00hrs to 15.00hrs, this is primarily driven by AS3 call activity, which drops to very low levels at 13.00hrs (lunchtime). Call rates for AS1 and AS2 incidents do not display any particular change at this time however.

- At weekends the highest levels of activity occurred between 00.00hrs and 04.00hrs with AS1 calls dominating the demand profile and a peak in activity at 03.00hrs.

- AS3 activity is concentrated into the hours 09:00hrs to 17:00hrs on weekdays.

2.3 Spatial Analysis of Incidents

The spatial analysis sets out to examine patterns of demand across the region. While the impact of demand on resources is examined in later sections of the report, this section provides a framework for how different demands occur between urban and rural locations in the region.

The variability in time and space is assessed initially for AS1 and AS2 incidents. In later sections the AS3 incidents are examined.

2.3.1 Analysis Framework

To assess the spatial distribution of demand for emergency care a spatial typology was developed. This was based on the following criteria:

- Main urban centres (towns greater than 5,000 persons) consisting of:

Carlow	Kilkenny	Carrick on Suir	Clonmel
Tipperary	Dungarvan	Tramore	Waterford City
Enniscorthy	New Ross	Gorey	Wexford

- Towns with population in 2006 of over 1,000 persons *(these towns have full listing of census variables in the CSO Small Area Population Statistics for the region)*
- Rural areas (population density greater than 10 persons per Km^2)
- Sparsely populated areas (population density of less than 10 Persons per Km^2).

Figure 2.5 *Settlements and current distribution of Ambulance Stations*

Figure 2.6 *Spatial Typology*

Source: SABE Eurogeographics, OSI and Spatial Planning Solutions Ltd.

In population terms the most current census in 2006 indicated that the entire region had a population of 460,838 persons. From 2002 to 2006 the population of the region increased by 8.1% (see table 2.8), slightly above the national average of 8%. Population growth was strongest in rural areas with an increase of 8.6% compared to towns and villages with an increase of 7.1%. Wexford had the strongest rural population growth with an increase of 11.6% brining its rural population to 87,188 persons (plus 97 in low density areas). Wexford also had the strongest urban growth, this being heavily influence by the expansion of the Dublin commuter belt in the towns of Gorey and Enniscorthy. Population growth in the towns and villages of Carlow can also be attributed to Dublin's expanding area of influence.

2.3.2 Spatial Distribution of Incidents (AS1 & AS2)

Using the geo-codes of incident location the incidents in the study period were mapped against the rural typology and linked to Census units, Electoral Divisions (EDs), in the region. The results of this exercise are presented below in table 2.8 which provides aggregations of each category of the area typology by county for AS1 and AS2 incidents.

Table 2.8 *Incidents (AS1 & AS2) within spatial typology*

Name	Total Population		% Change	No. Incidents (AS1 & AS2)	All Incidents per 100 persons	AS1 incidents per 100 persons
	2002	2006				
Carlow						
Towns & Villages	23,632	26,507	10.8%	1,786	6.7	3.2
Rural Areas	22,271	23,716	6.1%	1,089	4.6	2.1
Low Density Rural Area	111	126	11.9%	4	3.2	0.8
Total	**46,014**	**50,349**	**8.6%**	**2,879**	**5.7**	**2.7**
Kilkenny						
Towns & Villages	26,577	28,694	7.4%	2,723	9.5	4.8
Rural Areas	53,172	58,219	8.7%	1,977	3.4	1.5
Low Density Rural Area	590	645	8.5%	11	1.7	0.5
Total	**80,339**	**87,558**	**8.2%**	**4,711**	**5.4**	**2.6**
Tipperary South						
Towns & Villages	34,412	35,670	3.5%	4,224	11.8	3.5
Rural Areas	43,526	46,303	6.0%	2,087	4.5	2.0
Low Density Rural Area	1,183	1,248	5.2%	20	1.6	1.0
Total	**79,121**	**83,221**	**4.9%**	**6,331**	**7.6**	**2.6**
Waterford						
Towns & Villages	67,308	71,491	5.9%	5,352	7.5	4.4
Rural Areas	31,480	33,605	6.3%	1,664	5.0	2.3
Low Density Rural Area	2,758	2,865	3.7%	223	7.8	4.2
Total	**101,546**	**107,961**	**5.9%**	**7,239**	**6.7**	**3.7**
Wexford						
Towns & Villages	39,379	44,466	11.4%	4,141	9.3	4.3
Rural Areas	77,117	87,188	11.6%	3,957	4.5	2.3
Low Density Rural Area	100	95	-5.3%	0	0.0	0.0
Total	**116,596**	**131,749**	**11.5%**	**8,098**	**6.1**	**2.9**
SE Region						
Towns & Villages	191,308	206,828	7.5%	18,226	8.8	4.1
Rural Areas	227,566	249,031	8.6%	10,774	4.3	2.0
Low Density Rural Area	4,742	4,979	4.8%	258	5.2	2.8
Total	**423,616**	**460,838**	**8.1%**	**29,258**	**6.3**	**3.0**

Sources*: CSO 2006 & South East Ambulance Service*

The results indicate average rates of incidents per head on population, where for the region as a whole there were 6.3 incidents per 100 persons, this is made up of 3 AS1 incidents per 100 persons with the residual, 3.3, being the number of AS2 incidents per 100 persons.

The key feature from this analysis is that rates of AS1 and AS2 per capita are significantly higher in urban areas compared to rural areas. Thus for example there were 4.8 AS1 incidents per 100 persons in Kilkenny towns compared with 1.5 per 100 persons in rural areas. An additional feature of the results is that in sparsely populated areas rates of incidents are lower than other rural areas, the exception to this being in County Waterford, however this can be attributed to an artefact of the methodology where parts of the fringe around Waterford City have very low

resident population as per the 2006 census but relatively high incident rates from external sources such as road traffic accidents.

In respect to urban/rural difference in incident rates, it is difficult to be definitive about the causes, especially since information on incident type does not indicate levels of severity of a particular incident. Possible reasons for the higher propensity of urban population to avail of ambulance services is likely to be related to a variety of factors such as the location of activities that generate higher demand for emergency services, for example nightclubs or nursing homes, or the perception that emergency care is only used as a last resort in rural areas whereas in urban areas people may be prepared to call the ambulance service earlier.

Although the absence of robust information on incident type limits deeper understanding of this aspect of demand within the context of this study, the fundamental feature of the analysis is that demand for emergency care services is not simply related to per-capita distribution of population in the region but also to its location vis-à-vis urban and rural locations. Thus as urban population increases, demand for emergency care will increase at higher rates than the per-capita increase in population.

Table 2.9 lists the populations and incident rates for all urban areas (towns greater than 1,000 persons in 2006). The table also highlights main settlements where population is greater than 5,000 persons. The towns of Carlow and Wexford show strong population increases. This is considered to be related to the increased commuting area around Dublin City, where road improvement and housing costs in the greater Dublin region have contributed to the enlargement of the employment catchment of the city.

Inevitability there is considerable variability in the levels of incidents that were responded to by the South East Ambulance Service within the towns and villages. In general the larger main settlements have higher numbers of AS1 and AS2 incidents. The highest levels of AS1 incidents occurred in the Waterford City, Wexford and Kilkenny. Towns with hospitals, Wexford, Waterford City, Kilkenny, Clonmel and Cashel have the highest levels of AS2 incidents. Cashel has anomalously high AS2 levels, which appear to be related to the procedures associated with Cashel hospital.

Table 2.9 *Urban Population and AS1 & AS2 incident rates in South East Region*

Name	Pop 2002	Pop 2006	% Change 2002-2006	AS1 & AS2 Incidents		AS1	
				No.	Per 100 Persons	No.	Per 100 Persons
Carlow Towns							
Carlow	18,487	20,724	11%	1,537	7.4	744	3.6
Muinebeag	2,728	2,735	0%	125	4.6	48	1.8
Tullow	2,417	3,048	21%	124	4.1	47	1.5
Total	**23,632**	**26,507**	**11%**	**1,786**	**6.7**	**839**	**3.2**
Kilkenny Towns							
Callan	1,325	1,771	25%	166	9.4	65	3.7
Castlecomer	1,482	1,531	3%	98	6.4	35	2.3
Graiguenamanagh	1,435	1,376	-4%	57	4.1	20	1.5
Kilkenny	20,735	22,179	7%	2,345	10.6	1,232	5.6
Thomastown	1,600	1,837	13%	57	3.1	31	1.7
Total	**26,577**	**28,694**	**7%**	**2,723**	**9.5**	**1,383**	**4.8**

continued over

Name	Pop 2002	Pop 2006	% Change 2002-2006	AS1 & AS2 Incidents		AS 1	
				No.	Per 100 Persons	No.	Per 100 Persons
Tipp South Towns							
Cahir	2,794	3,381	17%	132	3.9	86	2.5
Carrick-on-Suir	5,586	5,906	5%	351	5.9	139	2.4
Cashel	2,770	2,936	6%	1,304	44.4	95	3.2
Clonmel	16,910	17,008	1%	1,752	10.3	695	4.1
Fethard	1,388	1,374	-1%	96	7.0	33	2.4
Tipperary	4,964	5,065	2%	589	11.6	216	4.3
Total	**34,412**	**35,670**	**4%**	**4,224**	**11.8**	**1,264**	**3.5**
Waterford Towns							
Dungarvan	7,452	8,362	11%	805	9.6	271	3.2
Dunmore East	1,750	1,547	-13%	58	3.7	43	2.8
Lismore	1,182	1,240	5%	98	7.9	11	0.9
Portlaw	1,183	1,495	21%	58	3.9	25	1.7
Tramore	9,005	9,634	7%	296	3.1	203	2.1
Waterford City	46,736	49,213	5%	4,037	8.2	2,564	5.2
Total	**67,308**	**71,491**	**6%**	**5,352**	**7.5**	**3,117**	**4.4**
Wexford Towns							
Bunclody	1,361	1,863	27%	88	4.7	56	3.0
Enniscorthy	8,964	9,538	6%	933	9.8	459	4.8
Gorey	5,282	7,193	27%	563	7.8	242	3.4
New Ross	6,537	7,709	15%	490	6.4	238	3.1
Wexford	17,235	18,163	5%	2,067	11.4	915	5.0
Total	**39,379**	**44,466**	**11%**	**4,141**	**9.3**	**1,910**	**4.3**
Urban Total	**191,308**	**206,828**	**8%**	**18,226**	**8.8**	**8,513**	**4.1**

Note: *See table 2.6 for rural population*

2.3.3 Spatial Distribution of Incidents (AS3)

AS3 ambulance activity concerns Patient Transport Services (PTS) and are considered to be non-urgent, routine patient services that use both ambulance resources, mini-bus and local taxi services. Choice of service is based on patient needs and availability of resources. Control Room staff make decisions on appropriate allocation of resources using locally adopted Standard Operating Procedures. Under these circumstances there exists considerable variability in the 'pick-up' location of patients and where they are taken to. The 'pick-up' location may be a patient's home, a nursing home, or a hospital. 'Pick-up' locations often cluster around hospitals where onward transport to another hospital in the region occurs or from a major hospital onward to specialist centres, usually in Dublin.

The South East Ambulance Service records incidents where ambulance resources are used. The system records the 'pick-up' location as a national grid coordinate, it also records the hospital/clinic attended by the patient and the final destination of the patient, which may be their home, a nursing home or a hospital.

The spatial distribution of 'pick-up' points in respect to the study spatial typology reflects the operational and secondary care environment in the South East region. Thus Waterford Regional Hospital attracts a considerable proportion of inward and outward AS3 activity (see table 2.10). In common with AS1 and AS2 incidents there is a strong propensity for AS3 activity to be based in urban centres, however this feature of ambulance service demand is even marked for AS3 activity in the South East.

Table 2.10 *Spatial Typology and AS3 incident rates in the South East Ambulance service Region*

Name	No. Incidents (AS1 & AS2)	All Incidents per 100 persons
Carlow		
Towns & Villages	441	1.7
Rural Areas	76	0.3
Low Density Rural Area	0	0.0
Total	517	1.0
Kilkenny		
Towns & Villages	3,587	12.5
Rural Areas	1,444	2.5
Low Density Rural Area	0	0.0
Total	5,031	5.7
Tipperary South		
Towns & Villages	4,167	11.7
Rural Areas	400	0.9
Low Density Rural Area	0	0.0
Total	4,567	5.5
Waterford		0.0
Towns & Villages	7,561	10.6
Rural Areas	163	0.5
Low Density Rural Area	5	0.2
Total	7,729	7.2
Wexford		0.0
Towns & Villages	2,527	5.7
Rural Areas	434	0.5
Low Density Rural Area	0	0.0
Total	2,961	2.2
SE Region		0.0
Towns & Villages	18,283	8.8
Rural Areas	2,517	1.0
Low Density Rural Area	5	0.1
Total	20,805	4.5

Table 2.11 below provides a matrix of 'pick-up' locations by town against the hospitals where patients were taken. This indicates the highest patient movement occurred from Waterford, with the majority of movement from there to the Waterford Regional Hospital. The next highest number of patient movements occurred from Kilkenny to the Kilcreen Orthopaedic Hospital and represents a high level of inter hospital transfer. Although a significant amount of inter-hospital

transfer occurs between the main hospitals, patient transport in the South East region is characterised by a substantial amount of patient movement between the main hospitals and smaller community hospitals and nursing homes. In total other than the main HSE hospitals and other hospitals out of the region in Dublin and Cork 123 other hospital/nursing homes provide the destination for a significant number of AS3 incidents.

St. James' and Cork's CUH and were the principal 'out-of-region' hospitals attended. In total 2,540 AS3 incidents (16%) went to either Cork or Dublin hospitals.

Table 2.11 *Pick-up Location and Hospital Attended AS3 incidents*

Hospital / Nursing Home Attended (To)	Pick-up Location (From)					
	Carlow	Clonmel	Kilkenny	Waterford	Wexford	Total
Waterford Regional Hospital	45	211	463	864	320	1,903
Kilcreen *(Lourdes Orthopedic Hospital)*	12		1,028	32	1	1,073
St James Hospital	6	5	360	431	70	872
St Patrick's Waterford	1		2	833	1	837
St Luke's Kilkenny	132	13	38	417	51	651
Our Lady's Cashel		463	37	39		539
Cork University Hospital		218	2	234	5	459
St Columba's Thomastown			181	239		420
St Johns Hospital Enniscorthy				89	291	380
Wexford General Hospital		1	80	258	16	355
St Joseph's Clonmel		88	20	191	1	300
St Patrick's Cashel		162		73		235
St Joseph's Dungarvan		2		225		227
Sacred Heart Carlow	81		93	44	5	223
St Vincent's Public	13	7	28	42	127	217
Tallaght Hospital	1		25	20	153	199
St Senan's Enniscorthy				16	182	198
Blackrock Clinic		9	34	62	64	169
St Catherine's (Nursing Home)			43	123		166
St Otteran's Waterford				160		160
Rathkeevin Nursing Home		141		16		157
Mooncoin Residential Care Cent				155		155
District Hospital Carlow	34		79	37		150
Killure Bridge, N/Home Wd				134		134
Mowlam N/H			1	127		128
St Theresa's Clogheen		105		23		128
St Bridget's Carr-On-Suir		51		76		127
Maypark N/Home Waterford				119		119
Beamount	7	1	26	60	24	118
Cluain Aran Tipperary		115				115
Castlecomer District Hospital			59	55	1	115
St Luke's Dublin	12	1	20	67	14	114

Hillview Nursing Home, Carlow	21		74	17		112
Our Lady's Hospital Crumlin		19	33	40	19	111
Carrigtur Nursing Home				22	85	107
St Luke's Clonmel		90	1	15		106
Gorey District Hospital				32	67	99
St Dympna's Carlow	33		61	1		95
Acorn Lodge Cashel		60		34		94
Aut Even	3	24	52	2	11	92
St Vincent's Dungarvan		1		90		91
Bons Secour Cork	1	83		2	2	88
Melview Clonmel		79	1	4		84
Mercy Hospital Cork		74	1	6		81
Cherry Grove, N/Home, Campile				24	54	78
Mater Public Hospital	1	10	15	43	8	77
Greenhill's Nursing Home		30		44		74
Kerlogue Nursing Home				14	59	73
Avondale (Nursing Home)		1	64	6		71
Strathmore Lodge Nursing Home			63	7		70
St Michael's Hospital Clonmel		66	1	1		68
Valencia Nursing Home Camolin				8	59	67
Little Sisters Manor Hill Waterford				59		59
St Canice's Kilkenny	1		48	10		59
St Carthage's Lismore				58		58
Oakfield Nursing Home				6	45	51
New Haughton New Ross				33	17	50
Others	*22*	*307*	*280*	*501*	*239*	*1,349*
Not Specified	*10*	*121*	*125*	*771*	*211*	*1,238*
Total In Selected Main Settlements	**436**	**2,558**	**3,438**	**7,111**	**2,202**	**15,745**

Table 2.11 *Pick-up location and hospital attended AS3 incidents*

A number of key features emerge from the spatial distribution of PTS activity levels across the respective base stations, these are:

- That in contrast to other regions patient transport services are not dominated by inter-hospital transfer except between St. Luke's in Kilkenny and Kilcreen Orthopaedic Hospital.
- Patient transport is highest to Waterford Regional Hospital, transfers to the hospital are well dispersed throughout the region.
- Out of region trips for patients attending Dublin and Cork hospitals represent around 16% of the total volume of AS3 activity.

3. Performance Analysis

3.1 Performance Standards

The Pre-Hospital Emergency Care Council is actively reviewing appropriate performance measurement standards for the Republic of Ireland. Response time has been the traditional performance indicator of ambulance service performance in many jurisdictions. In the past the use of response targets were criticised due to lack of clinical context. Priority dispatch procedures and closer linking of response targets to clinical outcomes have ensured that examination of response time continues to be the most frequently used indicator of performance. In this section we provide an overview of response time results of the ambulance service in the South East region, in later sections we make recommendations on improving these.

Response time is recognised as the time it takes for an ambulance to reach the scene of an emergency incident from receipt of a call. The definition when to start and stop the clock has varied in different jurisdictions. There is a consensus developing that the start time for assessing response time should be based on the time that an emergency call is received (call receipt). In the UK the KA34 data standard for ambulance services defines this start time as the time whereby details of the callers telephone number, the exact location of the incident and nature of chief complaint is ascertained. In this section of the study we assess performance of response time as the elapsed time from this start time to arrival of the first resource to a scene.

A second consideration of the use of response time is what are appropriate response times for particular incidents and to particular locations? In the United Kingdom the Health and Social Care Standards and Planning Framework (2005/06–2007/08), published by the Department of Health redefines the original 1974 ORCON standards by targets based on Category 'A' incidents and Category 'B' incidents. Category 'A' incidents clinically defined as "immediately life threatening" and Category 'B' encompasses incidents that are clinically defined as "not life threatening but still serious". Based on this division the following response targets have been put forward for all ambulance trusts.

- Respond to 75% of 'Cat A' calls within **eight minutes**
- Respond to 95% of 'Cat A' calls within **14 minutes** (urban) and **19 minutes** (rural)
- Respond to 95% of 'Cat B' calls within **14 minutes** (urban) and **19 minutes** (rural)

(From Health and Social Care Standards and Planning Framework (2005/06–2007/08, Appendix 1, page 35)

Urban areas are defined as areas where population is greater than 100 persons per Km^2 (2.5 persons per acre) and rural areas where population density is less than 100 persons per Km^2. In Scotland three spatial definitions are used, high density (more than 120 persons per Km^2), medium density (less than 120 per Km^2 but more than 20 persons per Km^2) and sparse density (less than 20 per Km^2).

Ireland's settlement structure and urban hierarchy is significantly different to the UK and direct translation of these definitions of urban and rural locations may not be appropriate. In the case of the South East despite having a relatively well developed urban structure compared to other regions, nonetheless 54% of the population live in rural areas and the population remains dispersed.

Furthermore the distinction between Category 'A' and Category 'B' calls are not equivalent to the distinction between 'AS1' and 'AS2' incidents in the Irish context. Direct comparison of the results of the performance analysis presented here with other jurisdictions is therefore not yet fully feasible.

In section 2.3.2 we put forward a spatial typology based on census definitions of towns, and population density from the 2006 census. This typology usefully captures the fundamental settlement patterns of the South East region and provides a finer grain of analysis than the UK and one more relevant to an Irish context. The use of response time targets as reflected in the spatial typology is intended therefore to provide an initial overview of performance. It is hoped that this will establish a baseline for interventions aiming to enhance the ambulance service performance and that will move toward achieving a response target of eight minute response time for greater than 50% of 'life threatening' AS1 incidents.

3.2 Response Times in the South East

The average (median) response time for the study period for the entire South East was 21.7 minutes for all AS1 & AS2 incidents combined. For AS1 the median response time for all incidents was 18.5 minutes and 31.4 minutes for AS2 incidents. The percentage incidents responded to within certain time bands provides a better means of examining response targets and these are presented below.

3.2.1 Response Time

For the entire region 15.3% of AS1 incidents are responded to in under eight minutes and 7.7% of AS2 incidents. In the main settlements this rises to 21.8% of all AS1 incidents (15.4% AS2) whereas in rural locations around 5.5% of AS1 calls were responded to in eight minutes (see tables 3.1 & 3.2).

Table 3.1 Response Times by Spatial Typology for AS1incidents

Spatial Type	% of AS1 Incidents Responded by				
	8 Mins	14 Mins	19 Mins	25 Mins	> 25 Mins
Main Towns	21.8%	40.4%	13.2%	7.0%	17.5%
Small Towns	6.7%	8.5%	13.9%	30.6%	40.2%
Rural Area	5.5%	15.1%	16.5%	21.8%	41.1%
Sparse Rural	6.0%	47.2%	18.0%	7.7%	21.0%
Region Total	15.3%	30.7%	14.4%	12.9%	26.3%

Table 3.2 Response Times by Spatial Typology for AS2 incidents

Spatial Type	% of AS2 Incidents Responded by				
	8 Mins	14 Mins	19 Mins	25 Mins	> 25 Mins
Main Towns	11.2%	22.1%	10.9%	7.7%	48.1%
Small Towns	10.9%	11.7%	6.2%	14.0%	57.1%
Rural Area	1.6%	6.5%	8.8%	13.6%	69.5%
Sparse Rural	0.9%	25.7%	11.5%	6.2%	55.8%
Region Total	7.7%	15.4%	9.6%	10.5%	56.8%

The current system of capture of ambulance records do not differentiate AS1 calls that are 'life threatening' and therefore while these figures appear low compared to UK targets the responsiveness to such incidents may in fact be higher than presented here, indeed without being able to isolate life threatening incidents the emergency workload is likely to be overstated for the

region. In section 4.6.2 of the report (see figure 4.6) the impact on responsiveness for calls classed as life threatening is presented which confirms that increased numbers of incidents being responded to within eight minutes, albeit relatively small.

Response times of less than 19 minutes are achieved for 46% of all AS1 incidents (23.1% for AS2) for the region as a whole. Over 56% of AS2 incidents are being responded to in more than 25 minutes, while improvements in response times for AS2 incidents is desirable, additional refinement of the level of 'urgency' associated with particular AS2 incidents is required in advance of initiatives that aim to reduce the response time for this category of incident.

Across the region there are broadly similar response rates for each county at around 24/25% of all AS1 calls achieving a response time of less than eight minutes for three of the counties. County Laois is the exception to this where just 18% of calls were responded to within eight minutes. The presence of just one ambulance station in Portlaoise town is considered to contribute to this relatively poor performance. However, it is important to note the presence of other stations close to the county border in Carlow, Athy and Roscrea which have the potential to attend AS1 incidents in County Laois. It would appear from the low rates of AS1 per capita in Laois, as presented in table 2.7, that indeed some AS1 incidents are already serviced from these stations, thus if these were considered, faster response times for AS1 incidents in the county would be achieved.

In section 4 of this study operational tactics are presented which will improve the response rates for all settlements.

4. Tactical Deployment Planning and Resource Assessment

4.1 Description of goals of Tactical Deployment Planning

4.1.1 Objectives

It is accepted that performance in terms of responsiveness, utilisation and patient outcomes can all be improved by a more dynamic approach to the deployment of available resources relevant to the spatial and temporal patterns of demand. To these ends, Tactical Deployment Planning (TDP) was selected as the process by which recommendations are to be made as to where sufficient resources should be placed in the busiest locations from time to time as demand dictates.

4.1.2 Outline of software systems

ACTIVE's Total Solution Mapping™ (TSM) system has been used to 'bring to life' to all incident data provided by Spatial Planning Solutions (SPS). ACTIVE has not undertaken any independent verification of the data provided, the qualitative aspects of which are discussed elsewhere in this report.

TSM is predicated on connecting data sets using geographic reference, especially where data are otherwise impossible to inter-relate. It provides a fast, accurate and flexible spatial and temporal analysis environment in which to explore the patterns of demand, design the optimum locations from which to respond and determine the work load for each response origin at different times of the day and days of the week. TSM has been configured using Navteq Ireland data purchased by PHECC for the delivery of this project.

TSM contains a module called JourneyMan™, a sophisticated travel time boundary generator. This module allows the creation of a boundary to describe the potential travel time from any given point, using road speeds and congestion rules. These boundaries are used to further analyse incident data, and report on coverage of demand within, for example, an eight minute response time of a proposed or existing response origin (station or standby point). TSM can export data, and create prioritised lists of stations and response origins based on demand.

Most importantly, alternative deployment options can be safely modelled and remodelled in TSM, and potential improvements in performance can be forecast (subject to the constraints inherent in the data being analysed) before any risks are taken in the operational implementation of change.

Deployment plans are displayed in the ACTIVE TDP Viewer™, and run in time with the clock on the computer. As the user moves through the day, the plan changes to reflect the priorities in the particular hour. Dispatchers also have the ability to scroll through the hours to plan for meal breaks, vehicle movements and shift changes.

TDP Viewer™ allows the dispatcher to allocate vehicles to each response origin and visualise the current coverage on a map. The map works with a simple traffic light system to show whether a post is manned, a vehicle is en route to post, or an area is not covered at all.

The dispatcher uses the prioritised lists and visualisation of geographic cover as a guide, along with their professional judgement, to place vehicles in the places most likely to have a call at any particular time of the day. This means that vehicles will be closer to the location of the next call, so that a vehicle can get to the incident quicker and be clear of that incident ready for another in a shorter overall time period.

Provision of the TDP of the South East region to the ambulance service is one of the key deliverables of the project. The fundamental configuration patterns recommended within the TDP of the South East region are contained within this report which provides the best means of examining its components. In the following sections we describe some of the key features of the TDP, its creation, the assumptions within the plan, and distribution of recommended 'response origins'. Readers are pointed to the software systems themselves itself to gain a complete view of the TDP for the South East region.

4.2 TDP - Steps in Creation

4.2.1 Identify best vehicle positions and compare with existing stations

Using ACTIVE TSM loaded with the data provided by SPS, hotspot maps of demand have been created. AS1, AS2 and AS3 calls between 01/01/2006 and 31/12/2006 which utilised an emergency resource are separately analysed and counted firstly into 3km grid squares, from where the 500m concentration of demand within each "hot" 3km grid square can be found. Once the 500m hotspots are identified, a suitable point on the road network on which to "stand by" can be selected within the immediate vicinity, usually a fast road or crossroads to maximise response potential. This methodology identifies **Response Origins** across the operational region.

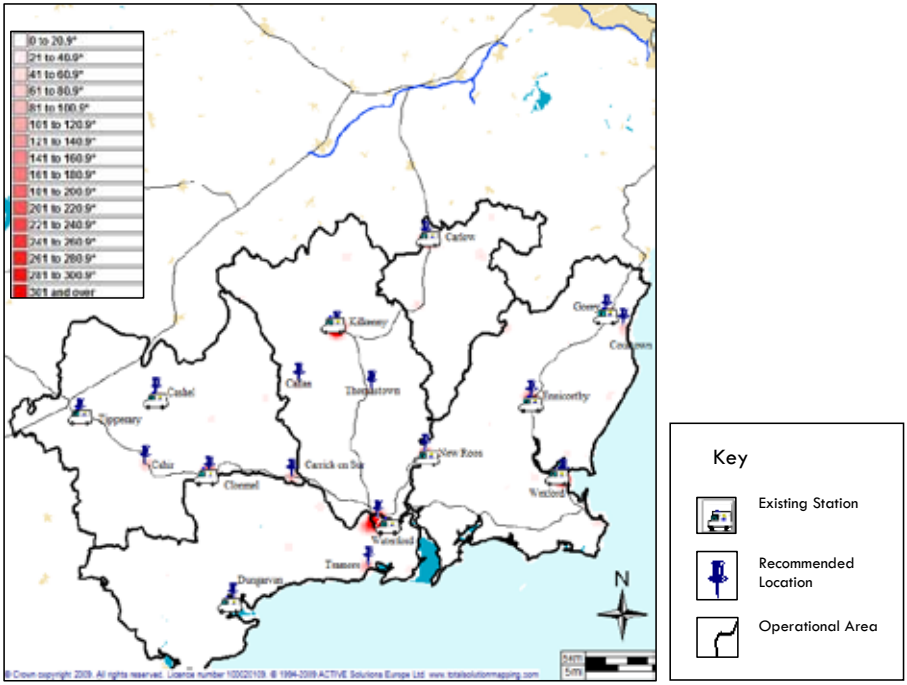


Figure 4.1 *shows the locations of existing stations and recommended demand based response origins. 500m grid squares are coloured from white to red to show the density of incidents.*

4.2.2 Response Footprint Formation

Response Footprints are geographic areas that describe a part of the operational region that a response origin is likely to respond to. These are edge-matched boundaries to ensure complete coverage of the operational region and are drawn based on travel time boundaries but also take into account geographic features such as major roads, railroads, rivers and lakes. It is usual for these footprints to be verified by operational staff as to their reality. This is especially desirable where the road network being used is not complete. The response footprints should be subjected to such a verification process before they are finally relied upon as a logical division of the operational region.

Once verified, the response footprints will ensure that every call gets counted once only in the prioritisation calculation. These boundaries allow each response origin to be prioritised by counting incidents into its response footprint.

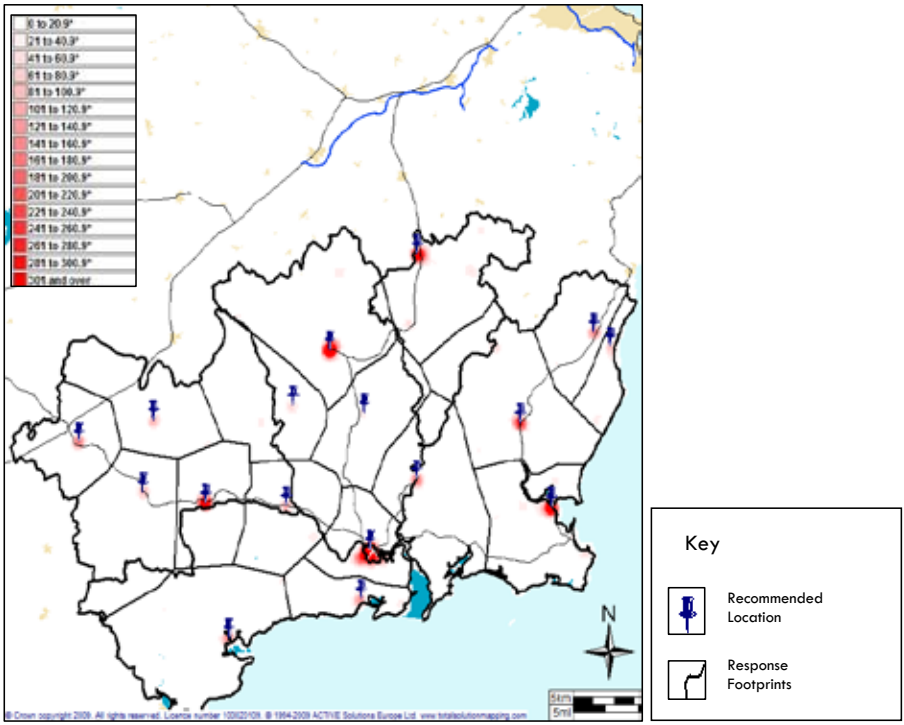


Figure 4.2 *shows the locations of recommended demand based response origins and response footprints around each. 500m grid squares are coloured from white to red to show the density of incidents.*

4.2.3 Tactical Deployment Plan

The TDP Viewer™ contains prioritised lists of response origins based on the amount of demand for each hour of the week. Each vehicle is allocated to a response origin based on the demand in its response footprint. This means some response origins may have two or three resources, if warranted, in some hours, and many response origins will not be allocated vehicles hour after hour until the predicted pattern of demand warrants it. This provides a prioritised list of response origins for dispatchers to use as a guide, to position emergency ambulances where the next call is likely to happen.

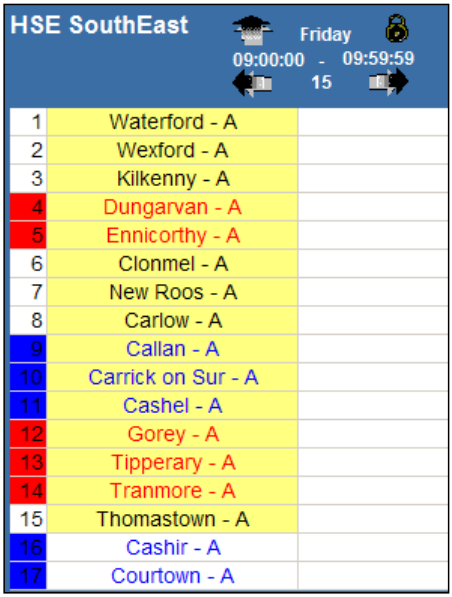


Figure 4.3 *TDP on Friday 09:00am-09:59am*

100% compliance with the plan is not to be expected. This would mean that all resources are in the right place at the right time, all waiting for the next incident. In practice, as the resources are better allocated to the areas of greatest demand, their utilisation rises and they rarely are waiting for a call. The plan needs to be used by dispatchers with some working knowledge of the geography of the operational region to ensure that post to post movements are prudently instructed.

The sample plan at Figure 4.3 is for Friday 09:00am – 09:59am. Each location is listed in priority order based on the demand in this hour, and the letter suffix after the location indicates first (A), second (B) or third (C) vehicles. If the dispatcher can cover the highest priority posts, responsiveness is likely to improve because the vehicles will be close to where the next incident will take place. Yellow cells show how many vehicles should be available in this hour and groups of blue or red location names signify posts of equal priority.

Within the TDP viewer the priorities for each station for each hour of each day are indicated (168 hours in total). The Viewer will thus indicate the ideal configuration of resources for the region. Decisions on deployment are left to the individual dispatcher with guidance for optimum deployment provided by the TDP.

4.3 Current Resource and Performance

In this section we assess the current resource availability in respect to demand profiles. This provides the background to identifying potential benefits to be gained from use of the TDP as it allows us to (a) assess how use of priority response origins indicated in the TDP will draw on the actual available resources (b) assess how current patterns of resource availability impact on performance (eight minute response assumed for AS1 incidents) and (c) suggest possible changes in crewing and resource availability patterns across a week.

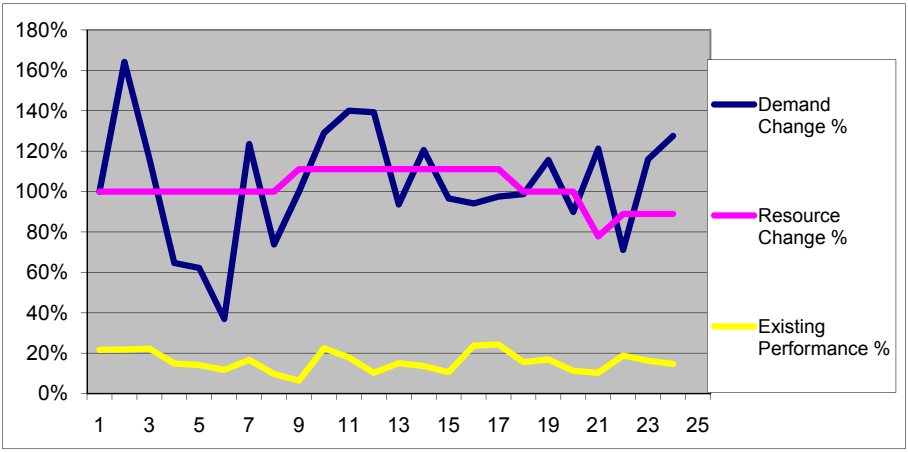
Table 4.1

Day	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Sun	11	11	11	11	10	9	9	14	14	15	16	17	17	17	16	17	16	14	13	14	13	13	13	13
Mon	13	13	13	12	12	11	11	14	14	15	16	17	17	17	16	17	16	14	13	13	13	13	13	13
Tue	11	11	11	10	10	9	9	14	14	15	16	17	17	17	16	17	16	14	13	13	13	13	13	13
Wed	13	13	13	12	12	11	11	14	14	15	16	17	17	17	16	17	16	14	13	14	14	14	14	14
Thur	12	12	12	11	11	10	10	14	14	15	16	17	17	17	16	17	15	14	13	13	13	13	13	13
Fri	12	12	12	12	12	11	11	14	14	15	16	16	16	16	16	16	15	14	13	13	13	13	13	13
Sat	12	12	12	12	12	11	11	14	14	15	16	16	16	16	16	16	16	14	13	13	13	13	13	13

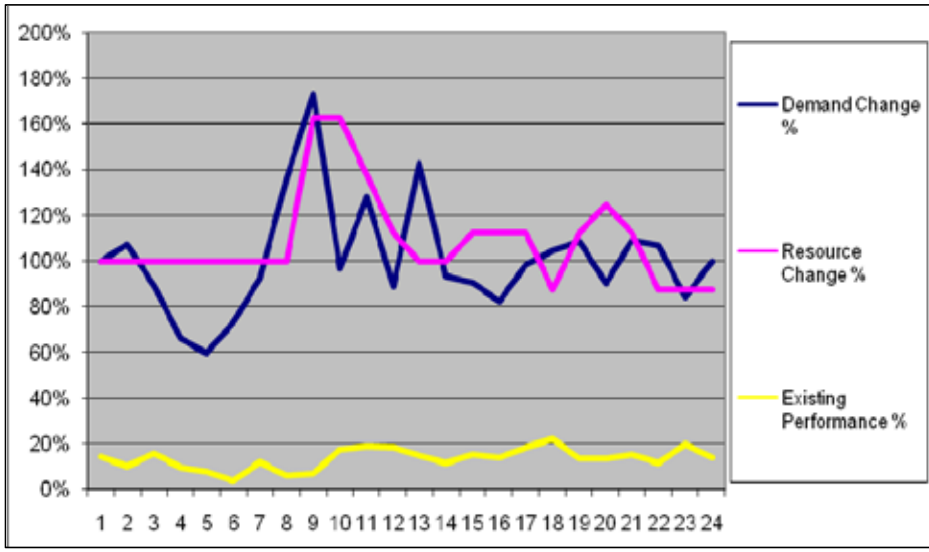
shows the current number of scheduled emergency vehicles available for all workload set out by hour for an average working week. This is derived from resource figures and crewing arrangement provided by the South East Region Ambulance Service.

The series of graphs below show how workload changes throughout the day for each day of the week, and compares this with both the percentage of resource change and the calculated emergency performance. Emergency performance is based on all AS1 classification calls and the number of these that took eight minutes or less from time of call to time at scene.

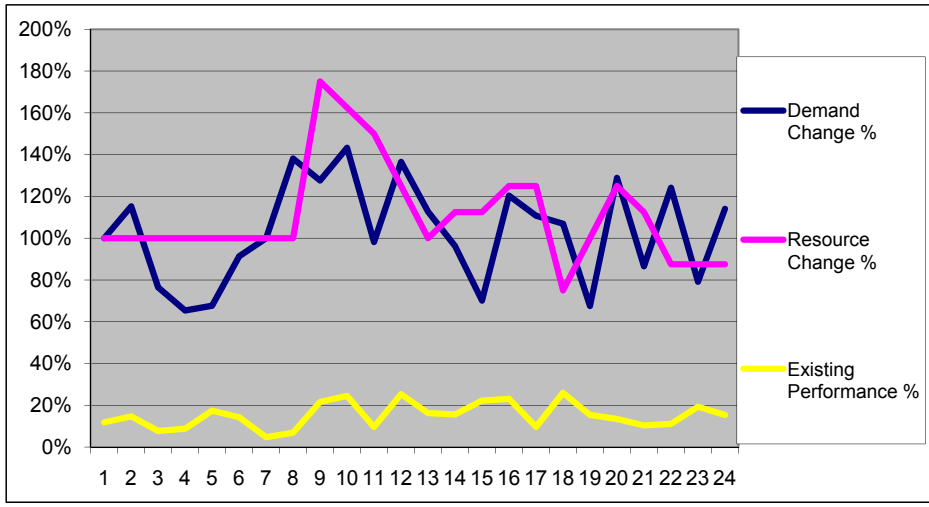
Sunday



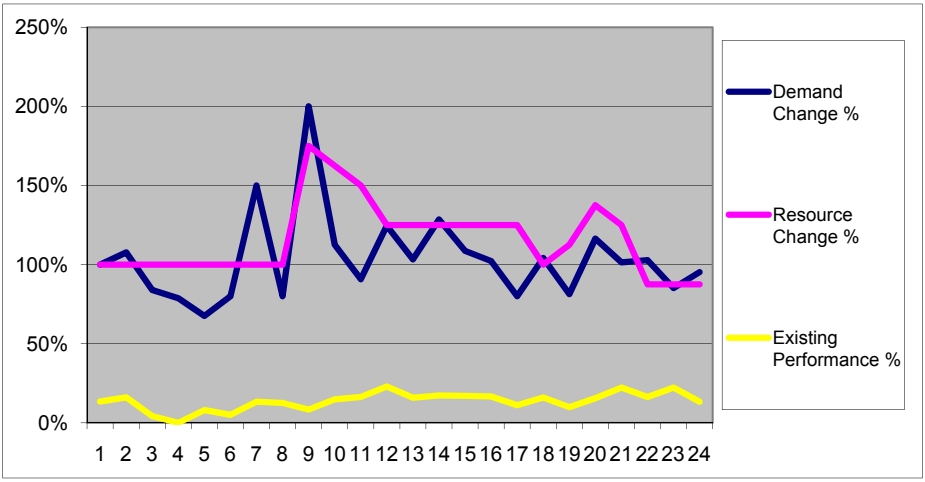
Monday



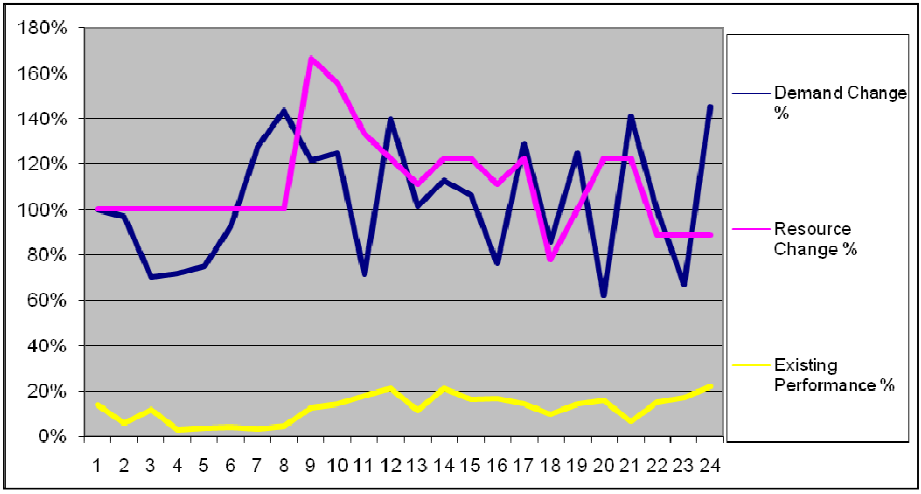
Tuesday



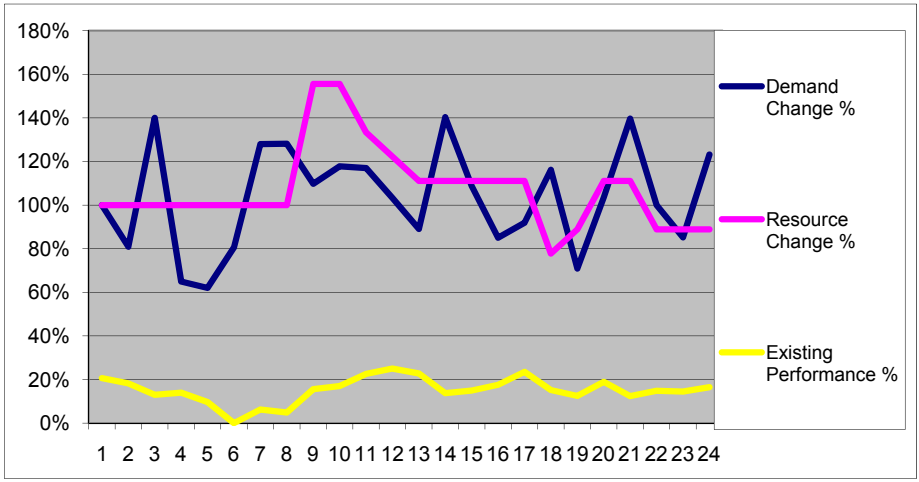
Wednesday



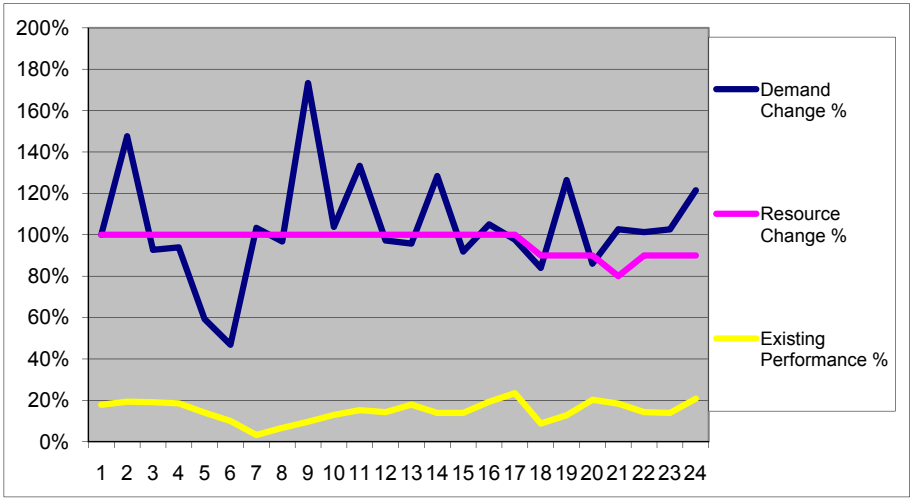
Thursday



Friday



Saturday



Across all of the days of the week the increase in the number of resources comes slightly too late in the morning, and consideration should be given to bringing the steep increase in resources forward by one or two hours.

4.4 Impact of PTS Workload

This section aims to give an insight into the impact of using emergency resources for routine patient transport work. The National Ambulance Service South East region knows that the absence of a fully comprehensive intermediate care or PTS fleet that manages all patient transport needs is draining the emergency resources available to the ambulance service for emergency work. Using the PTS dataset the actual effects can be studied.

Figure 4.4 below shows for each response footprint, how many PTS calls on average occur in each day and hour of the week.

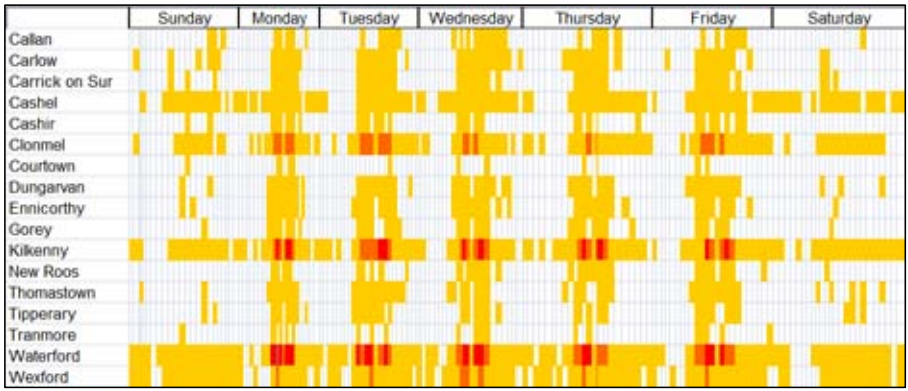
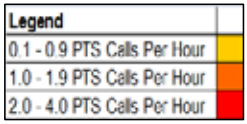


Figure 4.4 *Geographical and temporal spread of PTS workload*

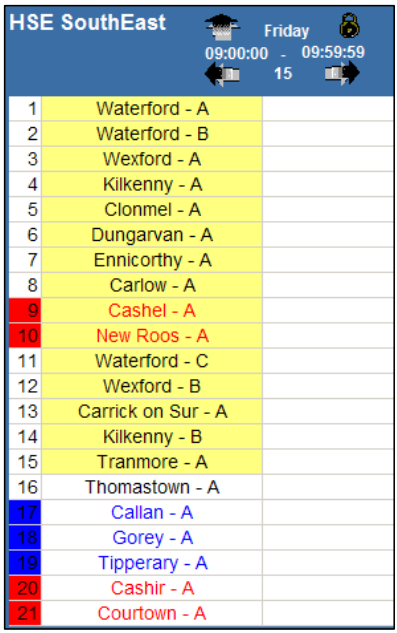


This shows that Kilkenny, Waterford, Wexford and Clonmel have high PTS demand throughout the week. In some hours up to four PTS calls are being carried out, which means four less ambulances available to complete emergency work, for the average duration of the PTS tasks. The matrix gives an indication of where, when and how many vehicles would be needed if an intermediate/PTS fleet was to be assembled in the future.

The TDP is calculated including and excluding the PTS work. As the matrix suggests, all top prioritised vehicles would be needed in Kilkenny, Waterford, Wexford and Clonmel, because the demand is higher than anywhere else.

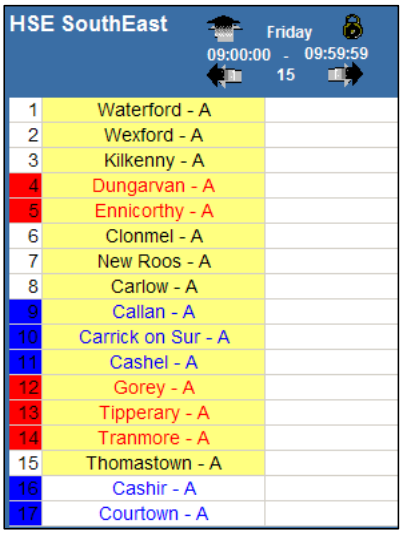
Figure 4.5 is for Friday morning 09:00am – 09:59am. It shows considerable difference between the two plans. When the PTS incidents are excluded from the plan 17 resources will be required to cover all the incidents. When the PTS incidents are included 21 resources are required to cover all the incidents and multiple resources are required at the same location. For example the first two resources are required for Waterford to cope with the demand.

Including PTS



1	Waterford - A
2	Waterford - B
3	Wexford - A
4	Kilkenny - A
5	Clonmel - A
6	Dungarvan - A
7	Ennicorthy - A
8	Carlow - A
9	Cashel - A
10	New Roos - A
11	Waterford - C
12	Wexford - B
13	Carrick on Sur - A
14	Kilkenny - B
15	Tranmore - A
16	Thomastown - A
17	Callan - A
18	Gorey - A
19	Tipperary - A
20	Cashir - A
21	Courtown - A

Excluding PTS



1	Waterford - A
2	Wexford - A
3	Kilkenny - A
4	Dungarvan - A
5	Ennicorthy - A
6	Clonmel - A
7	New Roos - A
8	Carlow - A
9	Callan - A
10	Carrick on Sur - A
11	Cashel - A
12	Gorey - A
13	Tipperary - A
14	Tranmore - A
15	Thomastown - A
16	Cashir - A
17	Courtown - A

Figure 4.5 *Impact of PTS workload on the TDP*

4.5 Tactical Deployment Plan Impact Analysis

TDPs have been created for three different scenarios and a performance forecast has been calculated for each.

Scenario 1 Using the TDP with no alternative fleet for PTS work and an abstraction factor to allow for vehicles off road, sickness etc.

This assumes that the ambulance service continues to work as it is now. Numbers of resources available to cope with emergency incidents is reduced because the average clear to clear time of each call is three and three quarter hours. An abstraction factor of 35% is built in to reduce the number of planned vehicles, to allow for vehicles off road, sickness, meal breaks etc.

Scenario 2 Using the TDP with a PTS fleet to do all PTS work, and an abstraction factor to allow for vehicles off road, sickness etc.

This assumes that PTS work is not carried out by emergency vehicles unless the clinical needs of the patient genuinely dictate an acute care transportation. This means clear to clear times are reduced to an average of 74mins and more vehicles will be available. Again, an abstraction factor of 35% is built in to reduce the number of vehicles further, to allow for vehicles off road, sickness, meal breaks etc.

Scenario 3 Using the TDP with a PTS fleet to do all PTS work, and no abstraction factor.

This assumes that all vehicles are available to be deployed for emergency calls only and the number of vehicles are not reduced due to vehicles off road, sickness, meal breaks etc.

4.5.1 Performance Forecasts

In the absence of any guidance as to current or future performance standards for the South East Regional Ambulance Service, we have used the current UK standards as a parallel. Currently the UK is tasked with getting to 75% or more of all Category 'A' (life threatening) emergency calls within eight minutes. To achieve this standard, ambulance services need to be clear on what is and what is not a life threatening call and the need to be consistent in the calculation of start time. However, in forecasting performance, we have assumed the UK model exists.

For each scenario the predicted performance has been calculated. This is based on the response origins that would be covered in the TDP, and the number of calls covered within eight minutes of each response origin.

A proportion of the incidents do have an MPDS Code but in the absence of all the incidents being coded, emergency incidents are initially assumed to be life threatening. This is quite a broad assumption and some (or perhaps many) AS1 calls may not be life threatening emergencies. In later sections we identify life threatening incidents on the basis of MPDS codes and examine the performance of the ambulance service in relation to these incidents.

The table below shows the current and the forecast performance for the different scenarios as previously described, against a response standard of eight minutes for all Category 'A' incidents. With the current level of resources, the forecast performance in Scenario 3 is 68.6%. All of these forecasts assume an average of two minutes activation time.

Performance Dashboard

Daily Overall Performance		Current Performance	Scenario 1 Performance	Scenario 2 Performance	Scenario 3 Performance
	Sunday	16.9%	63%	64.6%	72.4%
	Monday	14.2%	55%	61.0%	67.2%
	Tuesday	15.9%	59%	64.2%	69.3%
	Wednesday	14.8%	53%	59.5%	64.8%
	Thursday	13.4%	55%	59.1%	64.3%
	Friday	16.0%	59%	65.1%	70.6%
	Saturday	16.1%	63%	66.0%	71.6%
Monthly Overall Performance		15.3%	58.4%	62.8%	68.6%

Figure. 4.6 *Performance 'Dashboard' for AS1 calls*

Summary

- Implementing the TDP should improve responsiveness to emergency demand by 43% points.
- If an intermediate care fleet was introduced to take care of all PTS workload, a further 4% point increase in the number of AS1 calls responded to in eight minutes or less can be expected.
- Reducing the abstraction factor could move the ambulance service on by another 6% points.

4.5.2 Impact of Additional Vehicles

For each scenario we have calculated the predicted impact on performance of additional emergency ambulance resources. This is based on which posts would be covered in the TDP and the number of calls covered within eight minutes from each. We have then assumed the next highest priority post is covered by the new vehicle.

If resources are unlimited, then the best performance is 72% which is constrained not by available resources, but by the limited number of locations available to place the resources.

Thereafter, further performance gains will be available by the addition of resources, and the wider distribution of the response origins to amplify coverage in the wider, rural areas. Estimates in this respect will only be possible on repeat of the TDP exercise for additional vehicles.

Summary

In Scenario 1 the vehicle could be either an ambulance or an intermediate care vehicle which would free up an emergency ambulance for emergency work.

The impact of additional vehicles in Scenarios 2 and 3 varies because the additional posts that can be covered aren't as high a priority compared to those covered in Scenario 1.

In Scenario 2 and 3, additional vehicles would be emergency ambulances because it is assumed a fleet of intermediate care vehicles is available to cover all PTS work.

Table 4.2

Additional Impact of 1 Vehicle (Emergency)			
Current	**Scenario 1**	**Scenario 2**	**Scenario 3**
0.00%	1.6-1.8	1.1-1.3	1.0-1.2

4.6 Analysis of MPDS Data – 'life threatening' incidents

This aspect of the study concerns the MPDS data captured by the South East Ambulance Service and assumes that AS1 incidents can be defined and isolated as 'life threatening' emergencies from that data. The MPDS codes for AS1 are transposed into UK standards for definitions of Category 'A', 'B' and 'C'[3]. The categories comprise of:

Category 'A' Patients who are or may be immediately life threatened and will benefit from a timely clinical intervention

Category 'B' Patients who require urgent face to face clinical attention but are not immediately life threatened

Category 'C' Patients who do not require an immediate or urgent response by blue light and may be suitable for alternative pathways of care.

This sections objectives are thus to:

- To calculate the current performance based on just those incidents that can be classified as Category 'A' based on the MPDS codes in the data using the comparable UK standards.
- To examine whether the response origins allocated in the principal South East study (based on all incidents and equal to the maximum number of resources available) apply to the Category 'A' incidents.
- To consider the impact of creating more response origins than the number of resources, based on the more diverse hotspot map of just Category 'A' incidents.
- To calculate:
    - the best life threatening % performance (against the UK standard of arrival at scene within eight minutes of time of call) using current levels of resources based on just Category 'A' incidents, and
    - any additional performance that additional resources could contribute.

An assumption of the study is that all front line resources will be responding to Category 'A' incidents only.

[3] For a complete listing of the codes associated with the respective categories see Reporting dataset for MPDS Vers. 11.2 users (April 2005) Department of Health, United Kingdom, Ref. 4712 (www.dh.gov.uk).

4.6.1 Data Collection

Data for this study was extracted from the data used in earlier sections in this study. Only AS1 incidents were found to contain MPDS codes.

Table 4.3 shows the breakdown of all incidents by Category. Note that the Category 'A' incidents amount to 42.6% of all MPDS coded incidents or 31.4% of responded incidents with locations.

Table 4.3

AS1 Incidents by MPDS Codes	
Category	**No of Incidents with MPDS Codes**
Category A	3,513
Category B	6,541
Category C	956
Blank Incidents [1]	5,189
Unknown Codes	747
Total	**16,946**

Note *[1] primarily concerns 'stood down' incidents*

4.6.2 Current Performance in relation to findings of principal South East Study (TDP)

For this part of the study, we have assumed the application of equivalent UK performance standards based on reaching 75% of Category 'A' incidents within eight minutes of the time of call, and 95% within 19 minutes.

Initial analysis was performed on the data to help establish our understanding of the response rate to Category 'A' incidents using the South East current deployment plan. Table 4.4 indicates that 16% of Category 'A' incidents were responded to in eight minutes and 61% in 19minutes.[4] (see table 4.4) When all AS1 incidents are considered 15.3% of incidents were responded to within eight minutes and 60.4% in less than 19 minutes (see table 3.1).

Table 4.4

Response to Category 'A' Calls in Minutes			
Minutes	**No of Cat. A Calls**	**Percentage (%)**	**Cumulative Percentage**
0-8	520	16%	16%
8-19	1,444	45%	61%
19+	1,249	39%	100%
Total	**3,213**	**100%**	

Note: *Time divisions set to correspond to UK standards*

Figure 4.7 displays the response origins (shown as pins) designed and agreed in the principal South East study overlaid with demand hotspots from the data for Category 'A' incidents only. This shows strong correlation between the demand concentrations in the principal study (which determined the response origin locations) and the concentrations of Category 'A' demand.

The Category 'A' incident data was processed by our Tactical Deployment Planning software to ascertain the forecast Category 'A' performance if the response origins from the principal study were retained and the current number of resources are assumed.

[4] 9% of Category A responses with a zero time period are omitted in this analysis

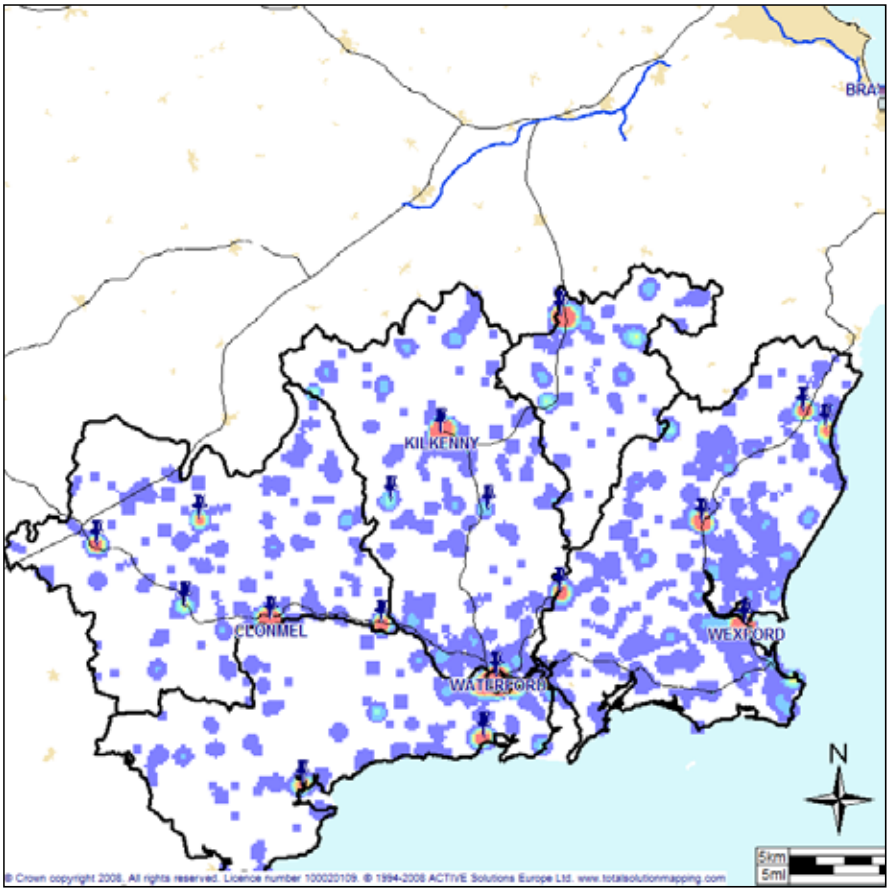
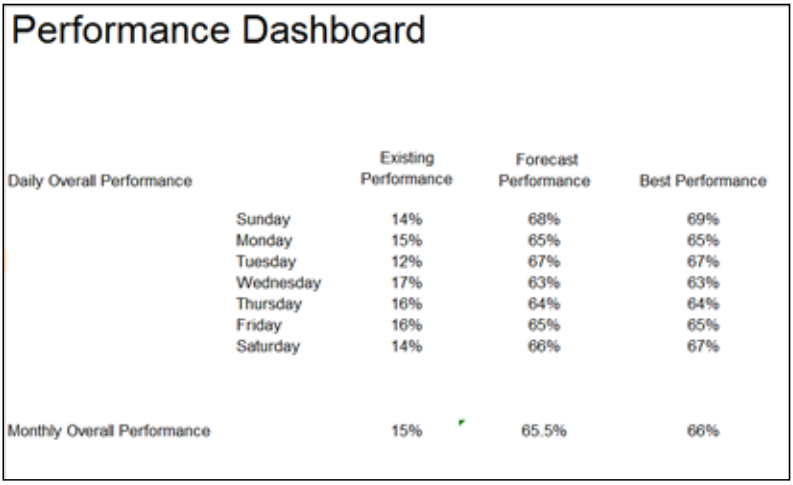


Figure 4.7 *'Response Origins' as defined in section 4.2 and Category 'A' hotspots*

Tactical Deployment Plan contains prioritised lists of response origins based on the amount of demand at each of the 17 locations for each of the 168 hours of the week. Each vehicle is allocated to a response origin based on the demand in its response footprint. This can mean some response origins may have two or more resources, if warranted, in some hours, and many response origins will not be allocated vehicles hour after hour until the predicted pattern of demand warrants it. This provides a prioritised list of response origins for dispatchers to use as a guide, to position ambulances, when they become free, in the location the next incident is most likely to occur.

Figure 4.8 below shows the existing, the best and the forecast performance against a response standard of eight minutes for all Category 'A' incidents, assuming the response origins used in the principal South East study and the existing level of resource. The existing performance matches the calculated Category 'A' response performance of 15%. This is less than the existing performance calculated for all AS1 incidents of 15.3%. The forecast performance that can be achieved using the Tactical Deployment Plan based on just Category 'A' incidents against the level of current resources is 65.5%. If resources are unlimited, then the best performance is 65.7% which is

constrained not by available resources, but by the limited number of locations available to place the resources. All of these forecasts assume an average of two minutes activation time and no abstraction. Therefore in the best case scenario, South East Ambulance Service will not meet equivalent UK standards of Category 'A' performance.



Performance Dashboard

Daily Overall Performance		Existing Performance	Forecast Performance	Best Performance
	Sunday	14%	68%	69%
	Monday	15%	65%	65%
	Tuesday	12%	67%	67%
	Wednesday	17%	63%	63%
	Thursday	16%	64%	64%
	Friday	16%	65%	65%
	Saturday	14%	66%	67%
Monthly Overall Performance		15%	65.5%	66%

Figure 4.8 *Category 'A' incidents performance dashboard*
(see figure 4.6 page 35 for comparison with AS1 calls)

4.6.3 Effect of Category 'A' performance of additional ambulances and additional Response Origins

There follows an investigation into the impact of more ambulances and more response origins to test for increases in the level of performance for Category 'A' calls. Further work was conducted using continuous surface mapping techniques to identify where additional response origins should be located.

Figure 3 shows the response origin locations from the principal South East study as blue pins, and it identifies a further five locations as numbered red rings that come through as potential locations for response origins. Having identified the five new locations, the number of Category 'A' calls that were received at that spot were examined.

The five new locations were chosen as new response origins based on them receiving the highest number of calls. The new five locations were added to the original 17 response origins.

Response footprints were then created to take into account the further five response origins. Response footprints are geographic areas that describe a part of the operational region that a response origin is likely to respond to. These are edge-matched boundaries to ensure complete coverage of the operational region and are drawn based on travel time boundaries but also take into account geographic features such as major roads, railroads, rivers and lakes. It is usual for these footprints to be verified by operational staff as to their reality. This is especially desirable where the road network being used is not complete or the areas of coverage are remote. The response footprints should be subjected to such a verification process before they are finally relied upon as a logical division of the operational region.

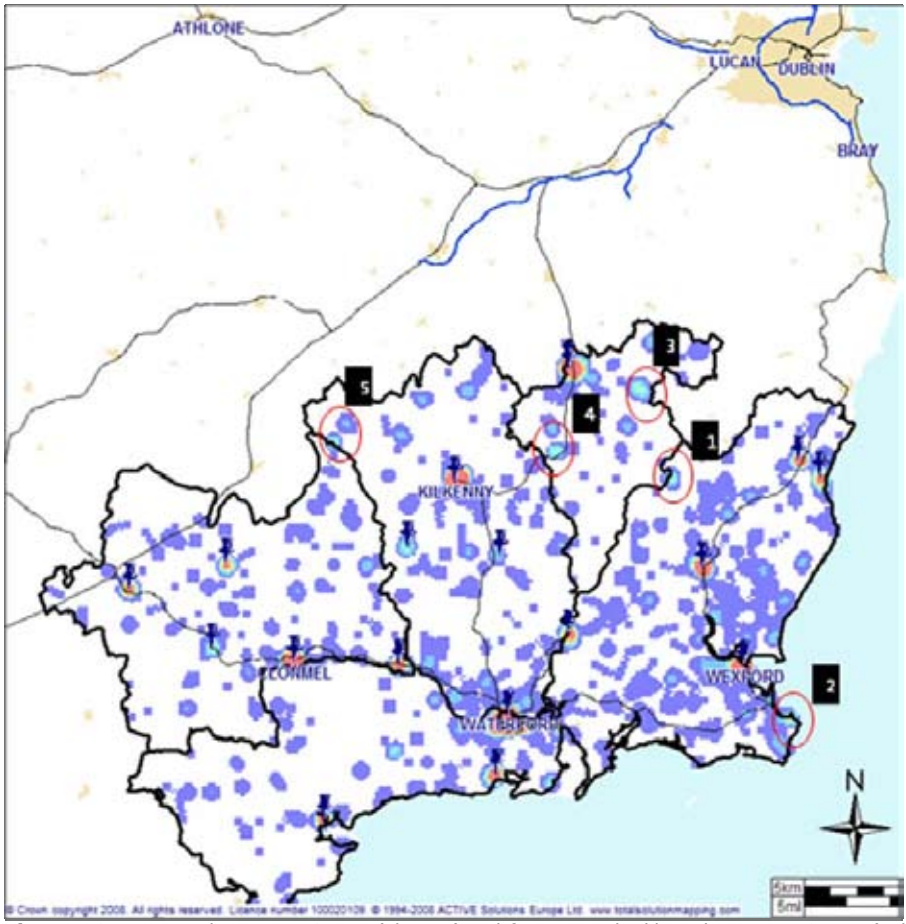


Figure 4.9 *Initial Response Origins (Blue Pin) and five potential additional Response Origins (red circle).*

Once verified, the response footprints will ensure that every call gets counted once only in the prioritisation calculation. These boundaries allow each response origin to be prioritised by counting incidents into its response footprint.

Five response origins and resources (ambulances) were added to the Tactical Deployment Planning software. The results from the Tactical Deployment Plan were evaluated to establish the actual number of ambulances needed on the basis of incident patterns.

Figure 4.10 illustrates the number of ambulances required across the 168 hours of a week using the response origins. It shows that with the present Category 'A' demand in the South East, the full 22 ambulances will not be needed. Apart from the early hours of Sunday morning which is most likely to be the pubs and clubs closing times, the demand does not reach higher than 16 ambulances.

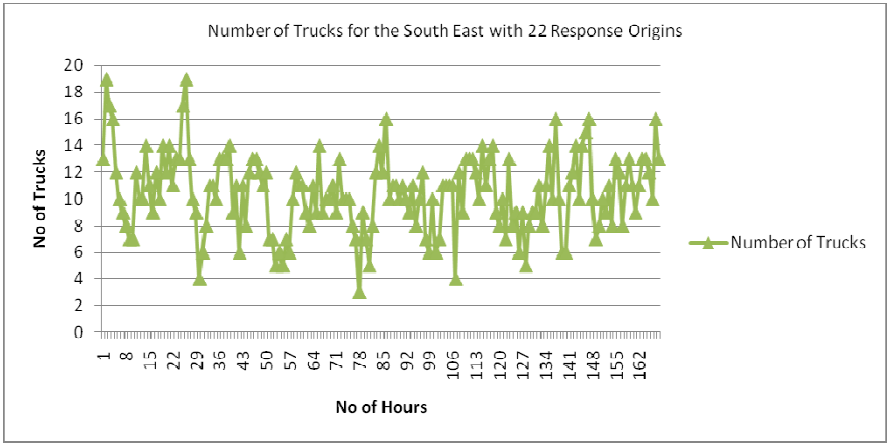


Figure 4.10 *Number of Emergency Ambulances (truck) required over one week (168 hours)*

Therefore, the levels of performance which are reported in Figure 4.11 assume the current levels of resource (17), but with 22 alternative response origins available for deployment. It can be seen, again, that in this scenario, South East Ambulance Service still under perform against the equivalent UK standards.

If we compare differences between the two performance dashboards we can see that the existing performance remains the same at 15%.

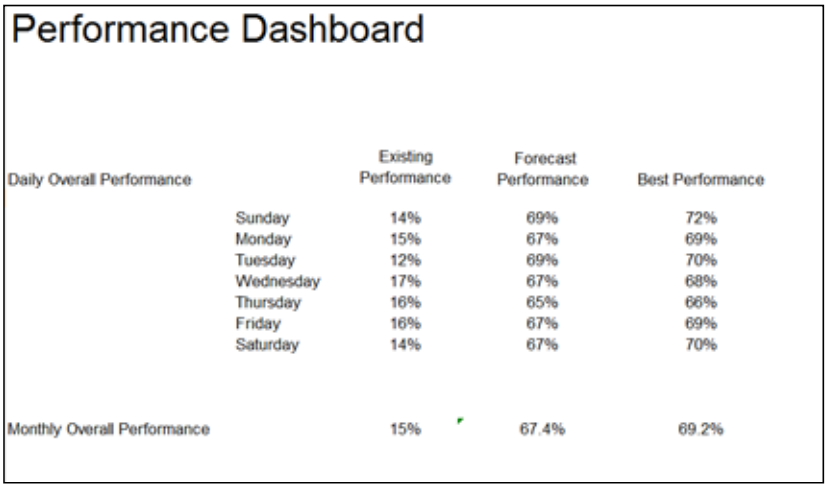


Figure 4.11 *Performance Dashboard Category 'A' with 22 Response Origins and 17 Resources (see figure. 4.6 page 35 for comparison with AS1 calls)*

The forecast performance has increased by 1.9% to 67.4%, whilst the best performance has only increased by 3.2% to 69.2%.

There were two hours where the number of trucks required peaked to 19. The forecast performance was modelled using 19 resources. This increased the performance forecast to 68.9%. It would seem that in this instance an increase in resources will increase the performance. However, the marginal increase in performance achieved by each additional resource is diminishing and will quickly be unrealistic in cost-benefit terms.

The limits of the data must be borne in mind when considering these comments.

4.6.4 Conclusions of MPDS Category 'A' analysis

We cannot verify the accuracy with which MPDS codes are appended to incident data. Assuming that normal ProQA quality standards are applied, then those records in the data that have an MPDS code could be considered accurate, but with only some of South East incidents records not having a useable MPDS code, the proportion that can be shown to be Category 'A' is likely to be under-stated.

Bearing this in mind this study has found that an increase in the number of ambulances beyond the current 17 does have a small material effect on the levels of performance against the Category 'A' data set.

4.6.5 Recommendations of MPDS Category 'A' analysis

- Apply training and consistent standards in the use of ProQA to provide a reliable final determinant for every incident.

- After, say, three months of compliance with recommendation 1, re-run this study on the basis of the Category 'A' (UK standards) incidents to establish a reliable hot spot demand map from which to select, say, 25 response origins that push out into the rural areas more.

Performance forecasts on the basis of this more reliable data will form the basis for a separate cost-benefit analysis of reconfiguring the South East ambulance system.

- Take the learning and recommendations from this study and roll this out to all ambulance services across Ireland to provide a more robust evidence base for Category 'A' performance improvements over time.

It is a reminder to the reader that the general assumption of this study is that front line ambulances will only be responding to Category 'A' incidents. This is a highly hypothetical study as realistically an ambulance service will not have a fleet of ambulances available exclusively to respond to Category 'A' incidents. There will always be workload from Category 'B' or equivalent AS2 incidents that will remove ambulances from the available fleet at any particular time.

5. Demographic Trends and Service Hierarchy Implications

This section sets out the future population projections and infrastructural demands for the National Ambulance Service South East region, comprising the counties Carlow, Kilkenny, Waterford, Tipperary South and Wexford. This analysis will be considered within the context of the National Spatial Strategy, the National Development Plan 2007-2013, the South East Regional Authority Regional Planning Guidelines 2004 and the relevant development plans.

5.1 Demographic and Regional Trends

The South East region of Ireland comprises the five counties of Carlow, Kilkenny, Tipperary South, Waterford and Wexford. The region covers 9,406 square kilometres and comprises 13.5% of the area of the state. The population of the region grew by 8.8% during the inter-censal period 2002 to 2006. This represented an increase from 423,616 persons to 460,838 persons. Between 1996 and 2002 the population of the region grew by 8.2%. This consistent growth rate portrays that successful development that the region has encountered during the last decade, and also represents the significant influence of the Greater Dublin Area (GDA).

The region is predominantly rural with almost 55% of the population living in rural locations. It is strategically located with links to the GDA and Ireland's second city, Cork. Significant change continues in the region and strategic planning is necessary to ensure that such change occurs in a sustainable manner. This section sets out the present and future population statistics and the infrastructural provisions for the South East region. This analysis shall be carried out within the context of the National Development Plan 2007-2013, the National Spatial Strategy, the Regional Planning Guidelines for the South East region and the relevant County Development Plans.

5.1.1 Population

The region as a whole had a population of just below 424,000 persons in 2006. An 8.1% population increase was recorded in the four years from census in 2002 to the census of 2006. This is slightly above the national average growth of the period. Population growth was highest in those areas close to Dublin and with good transport connections to the city. However strong rural population increases were noted for Wexford.

The counties within the ambulance service region cover the same geographic area as the Regional Planning Guidelines' for the South East. The Regional Planning Guidelines accept that there are certain peripheral areas of the region that are not as adequately integrated as they could or indeed should be. The South East Region, especially the northern area of the region is heavily influenced by the Greater Dublin Area (GDA). The presence of the port of Rosslare Co. Wexford makes this region a strategic trans-boundary link to Wales and to Mainland Europe in general. The designation of Waterford City as a gateway in the National Spatial Strategy (NSS) represents a step towards the proper planning of the region. Also the designations of Kilkenny and Wexford as hubs will enhance the potential for growth in the region. Waterford City is to act as a catalyst for development in the area, reducing the requirements to commute for economic opportunity and increasing the attractiveness of the area. This role is to be supported by Kilkenny City and Wexford City. This will require considerable infrastructural investment to allow for economic and demographic growth.

The dependency rate in the state is 31.4%. This average is practically maintained in the South East with Wexford displaying the highest dependency rate at 33.2% of the population. This is

followed closely by South Tipperary with a rate of 32.9% and Waterford which has a dependency rate of 32.2%. Kilkenny has a dependency rate of 32.0% while Carlow county has an average dependency rate of 30.7%. Higher dependency rates indicate a need for additional health services as it is likely that an ageing population is contributing significantly to this.

5.1.2 Population Projections

CSO Regional projections (2006) use a number of different migration and natural increase models. One based on 'recent' trends indicates a population of 563k persons by 2021, whereas the more conservative model the 'medium' model suggests 537k persons.

Table 5.1 *CSO Regional Projections (South East Region)*

Region.	2021 CSO MIF2 (Recent)	2021 CSO M1F2 (Medium)
South East	563,000	537,000

The Regional Planning Guidelines for the South East are predicting a population increase to 500,000 persons by 2020, this being based around a conservative estimate for national migration and reduced levels of overspill from the GDA . In consultation with the Department of the Environment, Heritage and Local Government, the CSO prepared additional regional population projections based on alternative growth assumptions regarding future inter-regional migration to take account of recent trends. Recent trends display movements from Dublin and the Mid-East to the border, Midlands and the South East areas and from Dublin to the Mid-East. The three variants used by the CSO and the Department are;

- An extreme variant got by continuing the over-spill situation (from Dublin) demonstrated by the 2002 pattern of inter-regional migration without change in the future,
- A low variant got by continuing the situation demonstrated by the 1996 pattern of inter-regional migration into the future, and
- A medium variant that utilises the 2002 based trends up until 2006 but for the remainder of the forecast period reverts back to the 1996 based pattern in respect of the flows from Dublin and the Mid-East to the border, Midlands and South East, and from Dublin to the Mid-East region.

The varying population predictions are displayed in the table below.

Table 5.2 *Population projections scenarios (SE Regional Planning Guidelines)*

Region	Continue Overspill 2020 Pop.	Continue Pre-1996 Trends 2020 Pop.	Reduce Overspill 2020 Pop.	SE Guidelines 2020
South East Region	512,761	435,220	463,740	500,000

The Regional Planning Guidelines support the national Spatial Strategy projection of around 500k persons a where overspill population reduces over time, this takes into account national (NSS) and local regional policy. Populations in the principal urban centres in 2020 under this situation are Waterford c. 65k, Wexford c. 25k and Kilkenny c.30k.

The spatial implications population trends will be continued increases for healthcare provision in the principal urban areas. Sustained high population growth in urban areas with good access to Dublin , e.g. Gorey, will continue, and require a certain degree of catch-up in terms of emergency service provision. If recent trends of strong 'urban derived' population growth in rural areas, for

example in County Wexford, continue difficulties in addressing emergency care for a dispersed population will be exacerbated.

5.2 Policy Documents

National Spatial Strategy:

The National Spatial Strategy (NSS) is a twenty-year planning framework with a core aim of achieving balanced social, economic and physical development of the regions. It provides that through the closer matching of where people live and where they work, a better quality of life can be achieved together with economic progression and higher environmental qualities. The NSS recognises that much of Ireland's recent prosperity has been focused in the Greater Dublin Area (GDA). This impacts the other regions of Ireland by reducing their comparative advantages which has meant that some regions are seen as less attractive to economic development when compared to the perceived benefits of the GDA.

The NSS provides that development of the region will be supported by the designation of Waterford as a gateway and the supporting roles of Kilkenny and Wexford as hubs. These agglomerations will drive growth by providing a large and skilled population base, substantial opportunities to increase residential and employment related functions and an improving transport network. Towns suitable for service location are contained in the plan and are listed as Clonmel and Carrick-on-Suir in South Tipperary; Dungarvan and Tramore in Waterford; New Ross and Enniscorthy in Wexford.

National Development Plan 2007-2013:

The NDP specifically prioritises the provision of social infrastructure such as enhancing hospital infrastructure and enhancing primary, community and continuing care facilities, particularly for older persons. The NDP states that challenges in the provision of social infrastructure are likely to arise due to increasing longevity of life and an increasing population of persons with disabilities as a result of reducing mortality from serious illness. Disparities currently exist regarding access to certain services. This problem must be tackled to ensure an acceptable quality of life prevails in all areas of the region.

The plan provides that environmental sustainability and quality of life issues will require continuing investment in areas such as transport, education, health, childcare, sports and cultural facilities and housing. The NDP has set aside funding for various programmes such as;

- The Older People Programme which will receive €9.7 billion during the period of the plan;
- Persons with Disabilities Programme which will receive funding of €19.2 billion; an
- The Health Infrastructure Programme which is set to receive €5.0 billion.

In relation to health care, the NDP provides that in keeping with international trends, services traditionally provided in institutions will continue to be relocated to more appropriate community based settings. The identification of regionally significant towns in the NSS should help with locating such services.

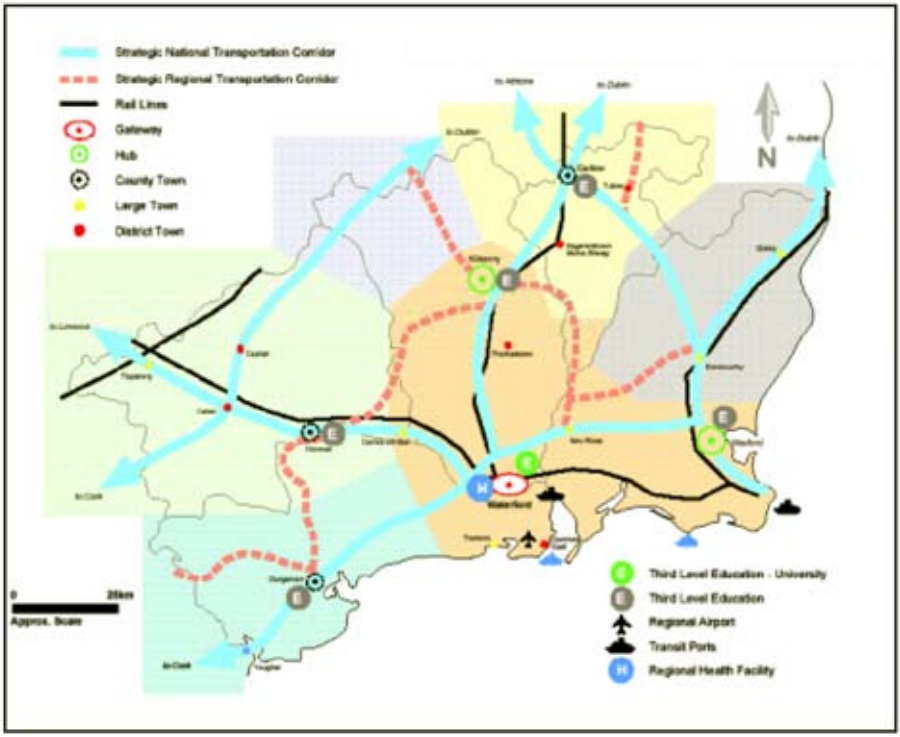
The South East Regional Authority Regional Planning Guidelines:

The Regional Planning Guidelines provide that over the past decade there has been significant growth in the region; however this has been mainly concentrated on the northern fringe of the region. This is down to the close proximity of the region to the GDA, the improvement in the road infrastructure aiding commuting and the relative expense of living in Dublin. Coastal towns have grown also, especially those within commuting range of Waterford City (e.g.) Tramore and

Dunmore East. The guidelines provide that a significant increase in growth rates in Waterford City will be required to achieve critical mass for its gateway designation.

The regional development strategy is set-out in figure 5.1, here the transport infrastructure and settlement strategy indicate the primacy of Waterford as the region's gateway centre with complimentary roles for Wexford and Kilkenny as hubs.

Figure 5.1 *Regional Development Strategy*



The Guidelines provide for different future development roles of urban settlements, these are listed below in table 5.3

Table 5.3 *Types of Development roles for urban settlements in the SE Region*

Gateway	Waterford City	Strategically placed, national scale urban area, which individually and in combination will be key elements for delivering a more spatially balanced Ireland driving development in their own regions
Hubs	Kilkenny Wexford	Strategic urban centres, that suppotr and are supported by the gateway and reach out to wider rural areas of the region that the RPGs are targetnig for significant levels of growth
County Towns	Carlow Clonmel Dungarvan	Critical elements in the structure of realising balanced regional development, acting as a focus for strengthening their own areas.
Large Towns	Enniscorthy Tramore New Ross Carrick-on-Suir Gorey Tipperary Town	Towns with a population in excess of 5,000 pop. (that are not gateways, hubs or county towns) that the RPGs might be; **a)** Targeting for growth or, **b)** that have recently experience high levels of population growth where the objective is that more measured growth is desirable in a manner that allows community, social and retail development to catch up with recent rapid phases of mainly resident development
District Towns	Cahir Cashel Bagenalstown Tullow Dunmore East Thomastown	Towns with population between 1,500 and 5,000 that might perform an important role in driving the development of a particular spatial component of the overall region.

Carlow County Development Plan 2003-2009

The principal towns in County Carlow are Carlow, Tullow, Muinebheag, Hacketstown and Borris. The county has traditionally had a strong rural dimension however, approximately half of the county's population are now located in urban areas. This changing nature of the county will require additional service provision but also the relocation of such services. The plan states that it is anticipated that the population of the county will continue to increase at a rate higher than the national average given the geographic, demographic, economic, infrastructural and educational advantages of the county. However, current economic trends may curb previous trends somewhat. Nevertheless, population growth in some degree is inevitable and it is vital that service provision is located in appropriate, accessible and sustainable areas.

County Kilkenny Draft Development Plan 2008-2014

The Draft Plan for County Kilkenny stated that growth in Kilkenny is not just a result of the expanding GDA, but also an overspill effect from Waterford City's expansion. However, the county has expanded on its own merits also, with the plan making reference to the increase in financial services and health care companies locating in the county. According to the NSS, Kilkenny

as a hub town will require a population of 30,000 by the year 2020. In this regard, the plan states that Kilkenny City will be the main focus of investment for the public and private sector over the period of the plan. The town of New Ross is also specifically noted as having the potential for significant growth in the plan but also in the RPGs. The plan states that with the increasing population, it is expected that there will be more demand for healthcare and medical facilities. At present there are two Acute Hospitals in County Kilkenny, St. Luke's Hospital and Lourdes Orthopaedic Hospital. The County Council is committed to reserving lands for health care facilities in consultation with the HSE.

Waterford County Development Plan 2005-2011

The plan states that Dungarvan is the main county town and as such has a significant role to play. It is a centre for population and economic development. The main economic growth in the town in the recent past has been in Software development and Pharmaceuticals; two attributes that Waterford is noted for. The plan states that increasingly health care services are being provided by the private sector and that the Council will encourage such developments where appropriate. If Waterford is to live up to its gateway status then significant investment and planning is required to ensure that economic progress does not come at a cost to quality of life indicators.

South Tipperary County Development Plan 2003-2009

The County Development Plan identifies Clonmel as the county town with a population catchment of over 50,000 persons. Carrick-on-Suir, Tipperary Town, Cashel and Cahir are then identified a market towns for the surrounding rural hinterland. The area has the fifth lowest level of disposable income in the country, a matter that is of great concern to the Council. Within the county 25.7% of the population live in the most deprived areas of the country. The future provision of social infrastructure and community facilities must directly tackle this problem.

Wexford County Development Plan 2007-2013

Wexford county is one of the fastest growing counties in the country. Of the growth that occurred between 2002 and 2006, 71% was due to inward migration. A significant proportion of this migration is due to the proximity of Wexford to Dublin and the continuing high prices of houses in Dublin. The plan identifies primary and secondary growth centres in the county. Wexford Town has been identified as the primary growth area and is also a designated hub and New Ross, Enniscorthy and Gorey have been identified as secondary growth areas. The objective for Wexford is that it will become a driver for the county and indeed the South East Region, supporting Waterford and Kilkenny in their respective roles. The objectives for secondary growth areas are that they become self-sufficient centres for educational facilities and social facilities and do not become mere dormer towns. District growth areas and local growth areas are also identified in the plan.

National Roads Authority

The National Roads Authority (NRA) was formally established as an independent statutory body under the Roads Act 1993. Its primary function is the provision of safe and efficient road systems throughout the country. For this purpose, it has the overall responsibility for the planning and supervision, construction and maintenance of such roads. The provision of such infrastructure enhances the development potential of regions ensuring that the objective of balanced future development is achieved. The provision of routes in the South East in the immediate future will prove vital to its progression and indeed its overall sustainability. The following road schemes are underway in the various counties of the South East region.

County Carlow

Scheme	Status	Start County	End County
N9/N10 Carlow Bypass	Complete	Carlow	Kildare
N9/N10 Carlow/Knocktopher (Kilcullen/Waterford)	Construction	Kilkenny	Carlow

County Kilkenny

Scheme	Status	Start County	End County
N9/N10 Carlow/Knocktopher (Kilcullen/Waterford)	Construction	Kilkenny	Carlow
N9/N10 Waterford/Knocktopher (Kilcullen/W	Construction	Kilkenny	Kilkenny
N24 Mooncoin Bypass (Western Corridor)	Preliminary Design	Kilkenny	Kilkenny
N25 Waterford City Bypass	Construction	Waterford	Kilkenny
N25 New Ross Bypass	Preliminary Design	Kilkenny	Wexford
N25 Waterford to Glenmore	Route Selection	Kilkenny	Kilkenny
N76 Tennypark Brownstown (Callan realignment)	Preliminary Design	Kilkenny	Kilkenny
N77 Kilkenny Ring Road Extension	Complete	Kilkenny	Kilkenny
N77 Ballynaslee Realignment	Preliminary Design	Kilkenny	Kilkenny

South Tipperary

Scheme	Status	Start County	End County
N7 Nenagh Limerick	Construction	Limerick	Tipperary
N8 Cashel Mitchelstown	Construction	Tipperary	Cork
M8/N8 Cullahill to Cashel	Construction	Tipperary	Laois
N24 Carrick on Suir Bypass	Preliminary Design	Tipperary	Tipperary
N24 Pallasgreen to Bansha (Western Corridor)	Preliminary Design	Limerick	Tipperary
N62 Roscrea Bypass	Constraints Study	Tipperary	Tipperary
N62 Horse and Jockey/ Thurles Bypass	Constraints Study	Tipperary	Tipperary

County Waterford

Scheme	Status	Start County	End County
N25 Waterford City Bypass	Construction	Waterford	Kilkenny
N25 Dungarvan Bypass	Route Selection	Waterford	Waterford
N25 Kinsalebeg Realignment	Complete	Waterford	Waterford
N72 Lismore Cappoquin	Route Selection	Waterford	Waterford

County Wexford

Scheme	Status	Start County	End County
N11 Arklow Gorey Bypass	Complete	Wexford	Wicklow
N11/25 Oilgate to Rosslare Harbour	Constraints Study	Wexford	Wexford
N11 Clogh to Enniscorthy	Route Selection	Wexford	Wexford
N11 Enniscorthy Bypass	Preliminary Design	Wexford	Wexford
N25 New Ross Bypass	Preliminary Design	Kilkenny	Wexford
N30 Enniscorthy Clonroche	Complete	Wexford	Wexford
N30 Clonroche (Templescoby) to New Ross	Route Selection	Wexford	Wexford

5.3 Development Trends Summary

The high rate of migration into the South East region over the last number of years together with predictions that such trends are set to continue present a number of opportunities and challenges for the area. Various locations within the region display differing trends. While 58% of the region's population live in rural areas, certain areas of the region are becoming increasingly urbanised. This will allow for the consolidation of some services but will also require strategic planning to ensure that those remaining in rural locations are not at a disadvantage. Currently, a significant proportion of the population are residing in rural locations meaning that service provision, including health care provision is dispersed and must cover a large geographic location. It is vital that quality of life is consistent throughout the region; otherwise proper planning and sustainable development will undoubtedly be compromised.

6. Conclusions & Recommendations

This type of study is, to the author's knowledge, the first of its kind undertaken on 'real-time' ambulance records from an ambulance service in the Republic of Ireland. Early work by the project team was undertaken for the North-Western region and some similar trends in respect to increasing volumes of ambulance service activity were apparent. A similar Spatial Typology was adopted, as were similar techniques in respect to assessing response times and a similar methodology for the Tactical Deployment Plan.

Through the use of the Tactical Deployment Plan (TDP) the study has extended its scope to embrace not only a research agenda but also the operational context of service delivery in the National Ambulance Service South East region. The TDP demonstrates how the use of additional deployment points used in conjunction with operator knowledge, can make significant improvements on performance in the region. The analysis also demonstrates how the use of emergency ambulance resources in Patient Transport Services impacts on responsiveness to emergency incidents in the region. In the course of the project, preliminary findings were presented to ambulance staff in the South East region; the next steps for implementation and 'roll-out' of the TDP envisages continued consultation with staff to ensure operational relevancy of the 'response-origins' , respective crewing requirements and support for exact locations of deployment points.

Successful implementations of TDP in the UK have demonstrated the need for support from ambulance staff, engagement with other aspects of emergency care provision is also required. Much of these remain outside the scope of the current study; however we do identify where and when demand peaks occur for emergency services, this gives guidance to the types of interventions required.

The following recommendations reflect both the research and operational agendas of the study and therefore are intended to provide a context and framework for analysis of emergency service demand in other Ambulance service regions, but also progress the potential enhancements in the ambulance service for National Ambulance Service South East region.

R1) Transfer methods of analysis to other regions:

The findings in this study and the methods adopted provide a baseline for analysis of emergency service demand for other national ambulance service regions. Extension of the analysis to other regions will allow comparison with demand profile and performance attainment and provide a national audit on ambulance service activity. This information will provide a context to ongoing changes in healthcare provision, in particular in the context of the relationship of ambulance services to changes in management in primary care, pre-hospital emergency care and patient management within hospitals. This will be especially important in the future management of patient transport services.

R2) Future Data Capture and Patient information:

A pressing issue arising from this study is the need to identify 'life threatening' incidents within the AS1 incident type. There are recognised operational difficulties in this requirement, and we are aware of work in this regard being undertaken by the Pre-Hospital Emergency Care Council. In this study the MPDS codes used in the South East Ambulance Service were transposed to UK standards to help identify 'life threatening' incidents. Overall it was demonstrated that there would be a modest improvement in

the response times where only these 'life threatening' incidents are used compared with addressing all AS1 calls. Nonetheless the findings in this study demonstrate an operational imperative of supporting the implementation of MPDS into the ambulance services which should apply ProQA (or equivalent) standards.

This imperative also extends to enhanced information collection on patient needs for Patient Transport Services.

R3) TDP Implementation Support:

The TDP developed in this study has demonstrable significant potential benefits for enhanced responsiveness to emergency incidents in the National Ambulance Service South East region. The analysis demonstrated that without any additional crew or vehicle resources a potential increase in achieving AS1 response times in less than eight minutes in the order of 40% to 50% was achievable. Management and staff support, together with appropriate training and consultation, is required to implement the TDP. In addition to a number of technical issues (principally concerning exact positioning 'response origins') there are changes in operational practice within the ambulance service that require management guidance. Ongoing support from all agencies concerned is required to ensure its successful implementation.

R4) Inter-regional methodology:

Ongoing developments in the HSE and the development of regional control centres present significant opportunities to develop ambulance services better suited to inter-regional service provision. The use of TDP's at regional level will support identification of optimal service configuration and it is recommended that a feasibility study of development of a large scale regional TDP be undertaken bearing in mind considerations concerning recommendations R2 and R3.

In addition to the broader recommendations above there are a number of specific recommendations and actions that are relevant to the South East region, these are:

R5) Revision of TDP:

Given the rapid population growth, ongoing urban growth and changes in infrastructure, updated TDP exercises will be required for the South East within three to four years.

R6) Operational Implementation of TDP:

A programme of implementation of the TDP is required to realise the benefits demonstrated in this study. The programme will involve consultation and training with control staff in the use of the TDP viewer and the best means of integrating its use into normal operations. Identification of the exact positions of 'response origins' is necessary and these will need to be based around 'social' standby locations that can provide facilities required by staff to ensure their acceptance. Examination of existing HSE landholdings, General Practice Co-ops, or other emergency service sites will require consideration. Consultation with operational staff will be necessary for this aspect of the implementation strategy. There may also be Local Authority planning issues to be addressed at certain potential response origin locations.

Implementation on a phased basis in selected localities may be an appropriate strategy to the use of new deployment operations. Development of Community Responder schemes at selected priority areas should be put in place in conjunction to the TDP.

Ongoing monitoring of response-performance audits will be necessary to ensure the effectiveness of the TDP initiative. Control room staff should ideally undertake these audits and additional training may be necessary.

R7) Additional Response Origins based on 'Life Threatening' incidents

Performance analysis of response should focus on 'life threatening' incidents based on applying ProQA to provide reliable incident classification. When established re-run of the study on the basis of Category 'A' (UK Standards) should be used to identify additional hot spot areas and response origins within rural parts of Carlow and North Kilkenny.

R8) Addressing future demands

The analysis has demonstrated that high demand arises in urban centres, continued strong population growth is expected in the principal urban centres and provision of future resources should be aligned to equitably address this growth. The TDP highlighted a requirement for the addition of a response origin in Carlow. In the spatial analysis report for the Midlands region a response origin was indicated in the south Laois area, relatively close to Carlow. The inter-regional analysis may prove that the response origin in Carlow may adequately serve the South Laois area (together with neighbouring regions).

R9) Patient Transport Service & Inter-agency consultation:

Provision of PTS in the National Ambulance Service South East region presents a drain of emergency resources. While information on specific patient needs was not captured in the AS3 records analysed in this study, there may be a case that the extensive use of emergency vehicles for PTS is not necessary. Additional analysis is required to assess how the use of additional intermediate care vehicles will help reduce reliance on emergency vehicles for PTS services. Inter-agency consultations between the ambulance service, GPs and hospitals will provide a starting point to re-directing PTS activity. Examination of patient-management practices at GPs, nursing homes and hospitals will help provide the background to the service demand peaks identified in the study and indicate measures that can be taken to smooth out PTS and AS2 peak workload.

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