

**Report to North Trent Cancer  
Network:**

**North Trent Cancer Review  
Mapping Patient Travel Times**

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# Contents

Introduction .....	2
Aim .....	2
Methods .....	2
Data .....	2
Method .....	4
Results .....	10
Summary .....	10
Contact Details & Further Information .....	11

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# PUBLIC HEALTH GIS UNIT

## North Trent Cancer Review - Mapping Patient Travel Times

### **Introduction**

This report describes the methods and the results of the GIS project undertaken to identify travel times of patients attending North Trent Cancer Network NHS Hospital Trusts.

This mapping project is part of an overall review of Chemotherapy services in North Trent. The full report: Joseph, V (2001) *Report on Cancer Therapy Services Review – North Trent Cancer Network* Doncaster Health Authority, Is available from:

[http://www.doncasterhealth.co.uk/documents/chemotherapy/chemotherapy\\_report.pdf](http://www.doncasterhealth.co.uk/documents/chemotherapy/chemotherapy_report.pdf)

### **Aim**

To estimate the travel times of cancer patients (Breast, Lung and Colorectal) attending North Trent Cancer Network NHS Hospital Trusts using three 15-minute travel isochrones (0-15 minutes, 15-30 minutes, 30-45 minutes) around the hospital trusts.

### **Methods**

#### **Data**

##### **Spatial**

Two types of spatial data have been used:

- Large scale OSCAR (1:10,000 scale) road network data (© Crown Copyright Ordnance Survey) incorporating all Motorways, 'A', 'B' and minor roads, covering NHS Executive Trent Health Region - used in the calculation of the travel isochrones. The OSCAR dataset was constructed specifically for highly accurate GIS travel time/distance operations.
- Individual unit postcode data, PostPoint ® (© MapInfo Corporation), used to georeference the locations of the cancer patients. A postcode on average contains 14 to 15 individual domestic delivery points (individual addresses), and is therefore an accurate method of georeferencing individual patient data, and is ideally suited to GIS tasks of the sort undertaken here. The PostPoint file used here (dated 1999) is an aggregated postcode file in which the coordinates are accurate to 1m of the nearest property to the centre of the postcode. PostPoint represents one of the most accurate postcode georeferencing datasets currently available.

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## Attribute

Four sets of attribute data have been used:

- Approximate road speeds for peak\* urban and non urban roads obtained from Department of Transport and Local Government Regions (DTLR) published sources (At the time of publication the DTLR was known as the Department for Transport, Environment and the Regions – DETR. DETR is the reference name used here):
  - ▶ Office for National Statistics (1999) *Transport Statistics Bulletin, Road Traffic Statistics: Traffic Speeds on English Trunk Roads 1999*. Available from <http://www.transtat.detr.gov.uk/roadtraf/index.htm> – Used for obtaining peak time road speeds for Motorways and Trunks roads.
  - ▶ DETR (1998) *Traffic Speeds in Inner London: 1998*. Available from <http://www.transtat.detr.gov.uk/roadtraf/index.htm> – Used for obtaining peak time road speeds for non trunk roads (class ‘B’ and minor roads).  
\*The DETR (and the replacement body DLTR) provide traffic speed estimates for both morning and evening peak periods – the morning peak time speeds have been used in this analysis as they are the slower mean speeds.
  
- Postcodes for the eight North Trent Cancer Network NHS Trusts:
  - ▶ Northern General Hospital – Sheffield - S57 AU
  - ▶ Weston Park Hospital – Sheffield - S10 2SJ
  - ▶ Bassetlaw Hospital - S81 0JN
  - ▶ Barnsley District General Hospital - S75 2EP
  - ▶ Chesterfield Royal Infirmary - S44 5BL
  - ▶ Doncaster Royal Infirmary - DN2 5LT
  - ▶ Mexborough Montagu Hospital - S64 0AZ
  - ▶ Rotherham District General Hospital - S60 2UD
  
- Postcoded patient data.
  - ▶ Definition of cases: Patients with Lung (ICD-10: C34); breast (ICD-10: C50); and colorectal (ICD-10: C18, C19, C20) who received chemotherapy in the North Trent Cancer Network (Doncaster, Barnsley, Rotherham, Sheffield, and North Derbyshire Health Authorities). The chemotherapy prescriptions were made by an Oncologist at Weston Park Hospital between January 2001 and March 2001.
  - ▶ Data collection. The Project Reviewer (Victor Joseph) identified selected cancer cases from prescription records held at Weston Park Hospital. Cases identified were those who received chemotherapy during the period from January 2001 to March 2001. This period was judged to be adequate enough to identify current users of chemotherapy services. Secondly, due to time limitations a 3-month period was considered to be a reasonable duration to get an adequate sample size of data required.
  - ▶ Patient identifiable information (name, date of birth, and hospital number), including diagnosis and chemotherapy regimens were collected from prescription records. As the prescription sheets did not contain information on patients' postcode, the postcodes were obtained separately from the

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medical record. A list of chemotherapy regimens for breast, lung, colorectal cancers was used to identify cases that received chemotherapy. This information was entered into an excel spreadsheet.

- ▶ A total of 1275 records were identified from the selected cancers over the three-month period. To ensure confidentiality a list was made containing only the patient identifiers and passed onto the medical record for the postcode to be added manually onto the paper record. After obtaining the postcodes of patients from the medical record, the reviewer added the postcodes to the original data.
- ▶ Data were sorted in excel to identify multiple entries of the same patients. This was to determine the number of cases that received chemotherapy during the 3-month period from January 2001 to March 2001. Multiple entries were removed and the data supplied to the GIS Unit. A total of 691 records with selected cancers were sent to the GIS Unit for mapping.
- ▶ Data provided for mapping contained three fields, a unique identification code, cancer site, and full postcode. No patient identifiable information was supplied to the GIS Unit.

## Method

The work was carried out in five stages,

1. Geocode by postcode the locations of the eight hospital sites (for which isochrones would be generated).
2. Geocode by postcode the locations of the patient data.
3. Assign estimated speeds to the link and node road network.
4. Create travel isochrones for each of the eight locations for the 3 time intervals (15 minutes, 30 minutes, and 45 minutes).
5. Identify for each of the three cancer sites the number of cancer records located within each 15-minute isochrone.

### 1. Geocoding Hospital and Patient Postcodes

Doncaster Health Authority provided the postcodes for the cancer patients and the eight hospital sites; each postcode represents the main hospital mailing address, and patient home address. The geocoding process involves matching the postcodes of the hospital and patient data with a file of spatial postcodes. The spatial postcode file contains the coordinates for each postcode and allows any attribute data that has a valid and correctly matched postcode to be mapped. All eight hospital postcodes were valid and correctly geocoded, and all but nine of the 691 patient postcodes were correctly matched. The reasons for non-matching can include an incorrect postcode, an incorrectly formatted postcode, or the postcode is older than the spatial postcode file used as a georeference. Postcodes are updated by the Royal Mail on a six-monthly basis to reflect changes in postal geography (new housing developments and so on). Therefore, it is important to ensure that where possible the temporal period of the two postcode files is the same. The PostPoint postcode data used here is dated 1999. If the unmatched patient postcodes are correct and valid in every respect then the mismatch may result from changes made by The Royal Mail between 1999 (date of the spatial postcodes used here), and 2001 (data of the cancer patient data).

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## 2. Geocoding Patient Data

In total 691 individual cancer patient data were supplied. These data are broken as follows:

### *Supplied Data*

Total data supplied	= 691
Total data georeferenced	= 682
Total data not georeferenced	= 9

### *Data Used*

Total data georeferenced	= 682
Total georeferenced data in Trent	= 679*

Total georeferenced data in Trent distributed by cancer site:	
Breast cancer	= 382
Lung cancer	= 111
Colorectal cancer	= 186

\*Only data georeferenced in Trent Health Region (to March 2002) were used as link and node road network data were only available for this region.

## 3. Assigning speeds to the road network

To perform accurate travel time analysis road speeds are required for each of the four road types in two classes (urban and rural) during peak periods (see notes below):

Table 1. Road Types and Peak Time Travel Speeds

Road Type	Location	Speed (mph)	Peak time	95% Confidence limits
Motorway	Urban	38	07:00-10:00	± 1.0 mph
	Non-Urban	54	07:00-10:00	± 1.0 mph
'A' Roads	Urban	20*	07:00-10:00	± 1.0 mph
	Non-Urban	40*	07:00-10:00	± 1.0 mph
'B' Roads	Urban	12	07:45-09:15	± 0.6 mph
	Non-Urban	14	07:45-09:15	± 0.6 mph
Minor Roads	Same	10	07:45-09:15	± 0.6 mph

\*Single Carriageway Roads

Road speeds were taken from two DTLR sources. One gave peak-time road speeds for both urban and non-urban areas for English trunk roads (Motorways and primary 'A' roads). The second provided road speeds for an urban area only (inner London) covering all road categories, see table 1 above.

There are a number of points to consider with these data.

- For the trunk roads peak-time is defined as the period: 07:00 to 10:00. As the trunk road network covers the entire country the 95 per cent confidence interval for the estimated speeds is given for the Government regions. For the Yorkshire and Humberside region the 95 per cent confidence interval is quoted as 1.0 mph either side of the quoted estimate for peak times (Trunk roads are defined as roads falling under the responsibility of the Secretary of State for Transport and Local Government Regions (DLTR) – all other roads are the responsibility of local government.)

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- For all other roads peak time is defined as the period: 07:45 to 09:15. The 95 per cent confidence interval is given as 0.6 mph either side of the quoted estimate for peak times.
  - Inner London road speeds were used for this analysis for two reasons:
    - ▶ Firstly no other road speed data are freely available from the DLTR covering minor roads. Sheffield City Council has advised that these data are suitable for the Sheffield area.
    - ▶ Sheffield City Council has advised that central Sheffield has the lowest mean peak-time road speed in England – lower than inner London. Therefore – while the analysis extends beyond central Sheffield, the speeds quoted for inner London would serve as a suitable proxy for this area (London is the second slowest to Sheffield City). However it is important to bear in mind that the speeds used are estimates only (based on sampled data of actual travel times over certain road sections collected over a number of occasions). Nonetheless in absence of more local and specific data these are considered as the best alternative.
  - The area covered for the analysis does include urban areas, however there are also non-urban and rural areas. As a consequence inner London road speed data has not been used throughout – even though it offers the slowest speeds for all roads (hence providing a ‘worst case’ scenario). The Trunk road speed data provides slightly higher mean road speeds compared to the inner London speeds, however because of the mixed urban/rural nature of the area of analysis it is felt this provides a more balanced perspective on travel times. This is illustrated in the attached map that illustrates the spatial distribution of roads in the study area. The motorways in blue, and Primary ‘A’ roads in green are the trunk roads. It is apparent that there are a good number of trunk and non-trunk ‘A’ roads (in Red) providing justification for choosing roads speeds from both sources. Furthermore any undue bias or potential inflation of mean travel times by using the slighter higher mean speeds for trunk roads will be offset by the slower inner London road speeds used for the ‘B’ and minor roads.

#### **4. Creating Travel Time Isochrones.**

The travel time isochrones were created using RouteView Pro™ routing and catchment analysis software (© Copyright Infotech Enterprises) working within MapInfo Professional Desktop Mapping Software (© Copyright MapInfo Corporation).

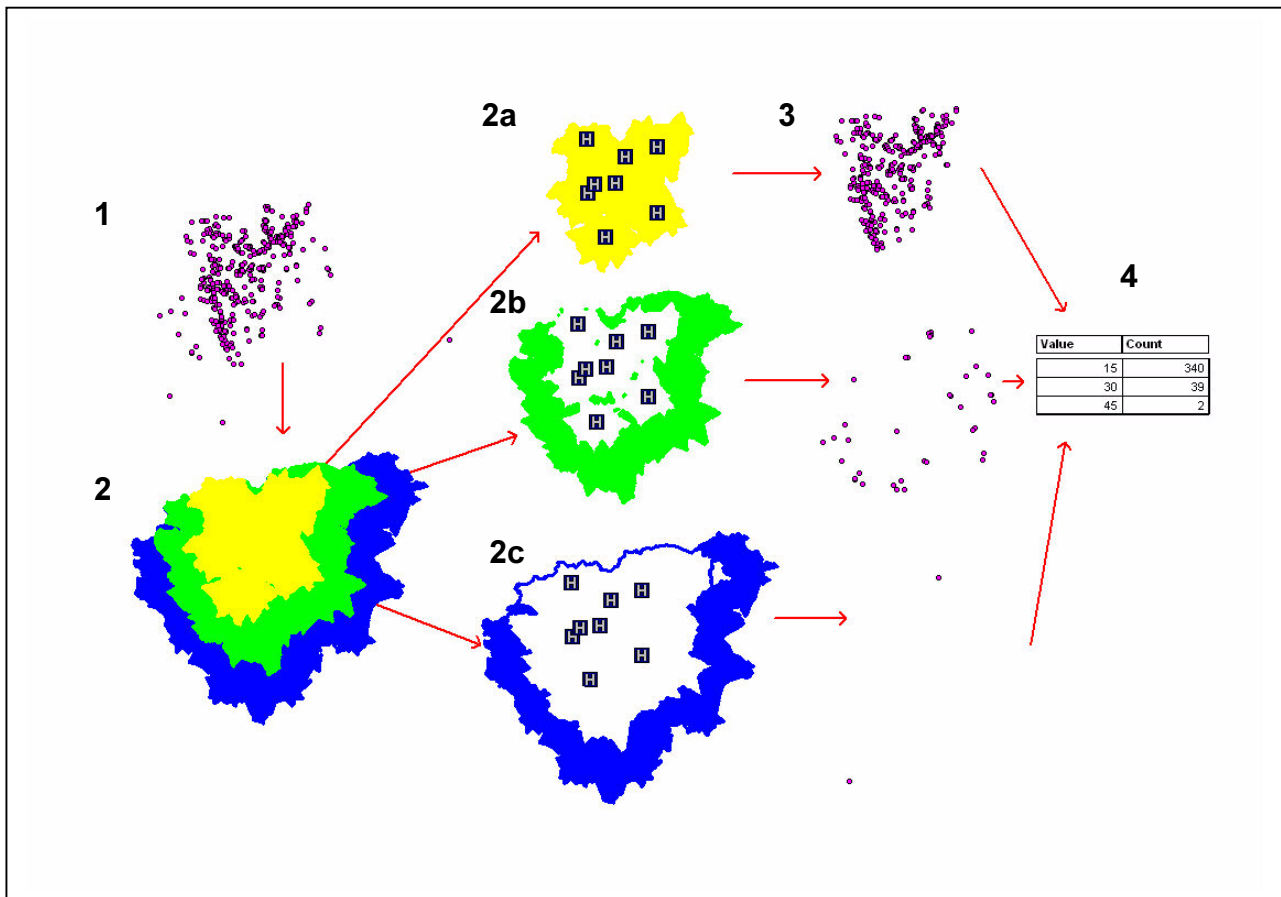
Fifteen-minute time increments were used and the routes calculated were done so for the fastest times using all road types. No data relating to public transport routing is currently available, and therefore all routes calculated are done so based on car journeys travelling along the optimum routes for the fastest journey.

#### **5. Identifying Patients within each Isochrone.**

Individual fifteen-minute isochrones were created for each hospital location. Once created all the separate isochrones for each time increment were merged. This process

resulted in three separate enclosed polygons, one each for the 15, 30 and 45 minute travel times, located around all eight hospitals combined (see figure 1.). The patient postcodes were identified by each cancer site, mapped and then overlaid on top of the isochrones. A GIS query identified the distribution of cancer patient by site in each of the three isochrones. The results are depicted as both a map and table. The bottom of the map contains a pie chart depicting the percentage distribution of each cancer site in each of the 15 minute travel isochrones, and a bar chart illustrating the number of cancer cases in each time band.

**Figure 1. GIS processes for identifying cancer data in 15 minute incremental isochrones**



1. All cancer data are georeferenced by postcode and mapped (only those located within Trent are used)
2. 15 minute isochrones are generated around the hospital locations
  - a. 0-15 minutes
  - b. 15-30 minutes
  - c. 30-45 minutes
3. The cancer data are mapped, and the cases located within each set of isochrones identified
4. The total number of cases found in each isochrone are summed

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## Results

The distribution of patients by cancer site in each 15-minute isochrone is summarised in the table 2 below:

Table 2. Distribution of Cancer Data by Site by 15 Minute Travel Isochrone

	<b>Total</b>	<b>In 0-15 mins (%)</b>	<b>In 15-30 mins (%)</b>	<b>In 30-45 mins (%)</b>
Breast	382	340 (89%)	39 (10.2%)	2 (0.5%)
Lung	111	98 (88.2%)	11 (9.9%)	2 (1.8%)
Colorectal	186	174 (93.5%)	11 (5.9%)	1 (0.5%)

Please see attached map.

The times provided are for cancer patients travelling to the nearest cancer treatment hospital, rather the specific treatment centre they used. In general the majority of patients for all three cancer sites were within 15 minutes travel to one of the North Trent Cancer Hospitals. All patients for both Lung and Colorectal cancer were within 45 minutes travel, and only 1 Breast cancer patient lived further than 45 minutes travel time to the nearest treatment centre.

## Summary

The aim of this project was to identify estimated travel times for patients attending one of the eight North Trent Cancer Network NHS Trusts as part of an overall review of cancer services.

Three sets of 15 minute travel time isochrones were constructed based on the postal address postcode of the hospital locations. The majority of patients are within 15 minutes travel (88 to 93 percent). All patients except for one Breast Cancer patient are within the 45 minute travel isochrone.

The isochrones were created based on the entire road network – i.e Motorways to minor roads using GIS routing and analysis software. The resulting isochrone map illustrating the distribution of patients in each 15 minute time band are all based on traffic speeds for morning peak periods. As no public transport information was available, the isochrones represent the fastest possible route by any of the roads within the network (rather than specific routes taken by either buses or private cars).

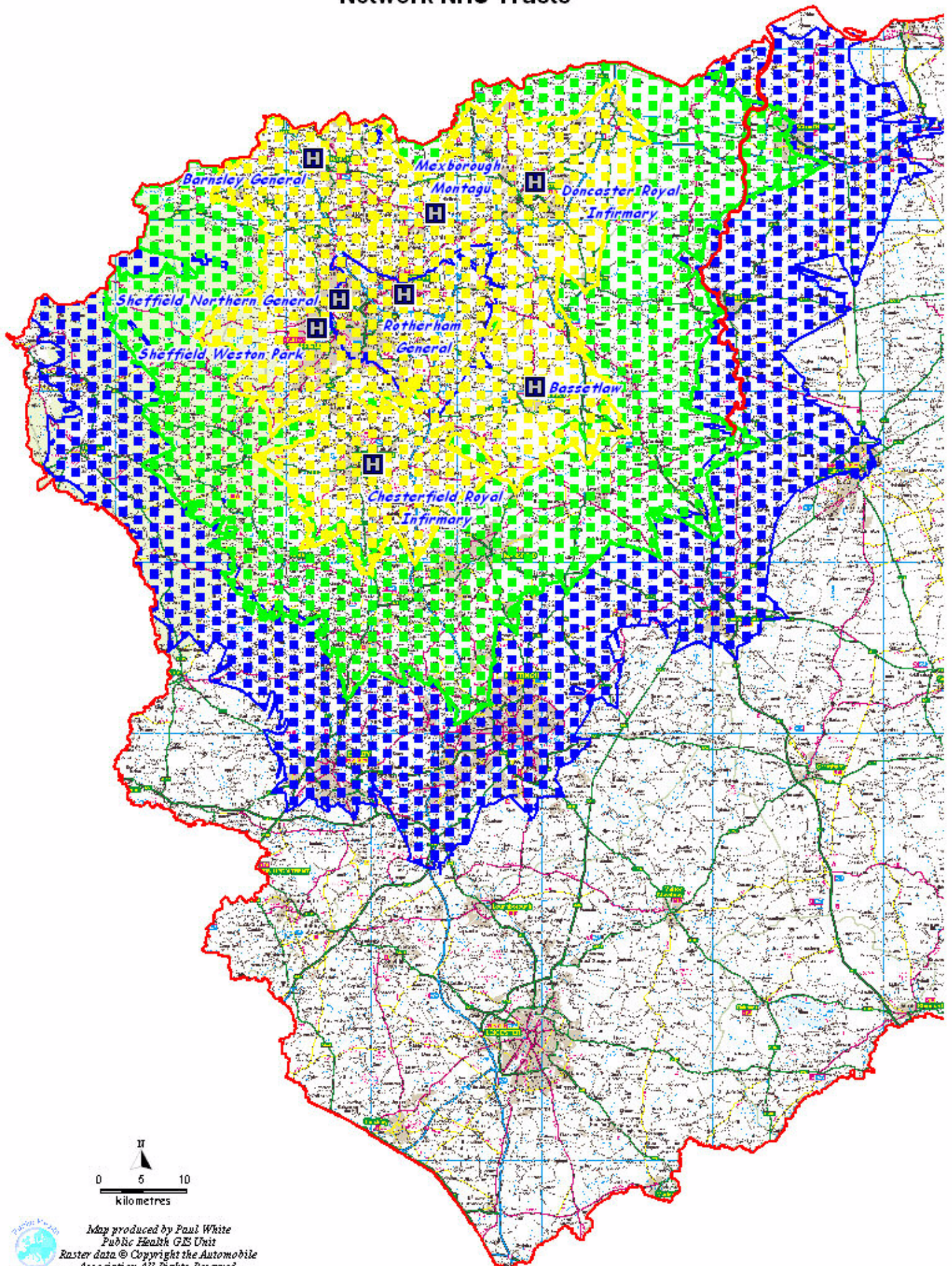
The road speed data were obtained from government sources, and it is this point that should be borne in mind when interpreting the results. Proxy road speeds were used in absence of actual surveyed road speed data for the particular area covered by this project. Therefore the appropriateness of these proxy speeds must be considered when viewing the results. Nonetheless the speeds used, based on data from both inner-London and the national Trunk road network were done so to provide a balanced estimate of mixed urban and non-urban travelling speeds for morning peak periods. Consequently, in absence of specific data, the speeds used represent the best estimates currently available.

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## **Contact Details & Further Information**

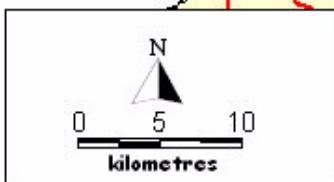
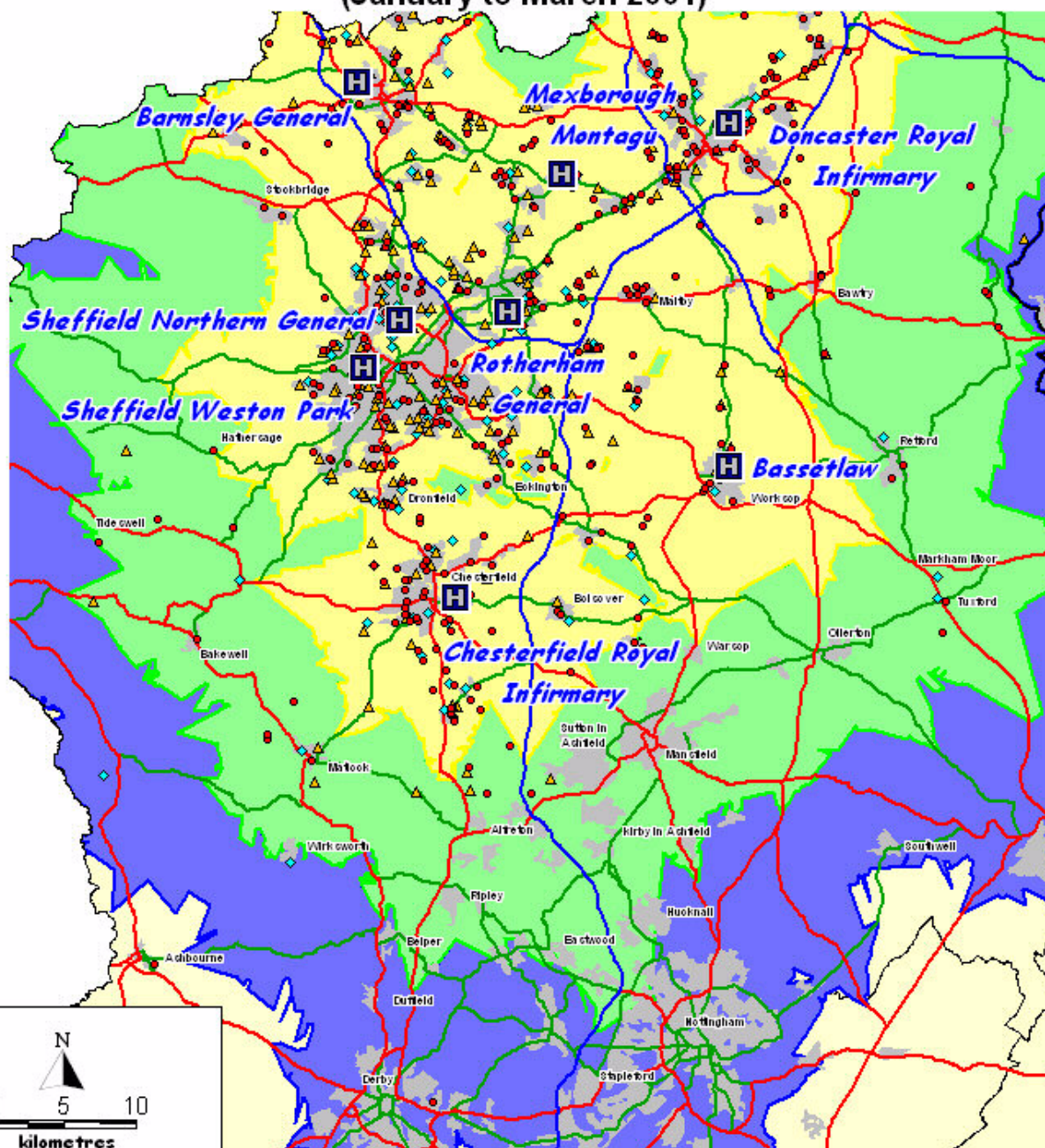
To obtain further copies of this report, or information regarding the work described here please contact Paul White 0114 2220831, email [p.s.white@sheffield.ac.uk](mailto:p.s.white@sheffield.ac.uk), or Jane Shields 0114 2220727, email [j.shields@sheffield.ac.uk](mailto:j.shields@sheffield.ac.uk). Postal address the Public Health GIS Unit, ScHARR, University of Sheffield, Regent Court, 30 Regent Street, Sheffield, S1 4DA.

# 15-Minute Peak Travel Time Isochrones From North Trent Cancer Network NHS Trusts



Map produced by Paul White  
Public Health GIS Unit  
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# Distribution of Breast, Lung and Colorectal Cancer Patients (n=679) by 15 Minute Travel Isochrones from North Trent Cancer Network Hospitals (January to March 2001)



**Legend**

- North Trent Cancer Network NHS Trusts
- Breast Cancer
- Colorectal Cancer
- Lung Cancer
- Motorways
- Primary Roads
- 'A' Roads
- Urban Areas
- 15 Minute Isochrone
- 30 Minute Isochrone
- 45 Minute Isochrone

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