Holbeach Movement Analysis

February 2018

www.opun.org.uk

Contents

Part 1: Introduction

Part 2: Baseline analysis

Part 3: Changes to the network

Part 4: Methodology

This report was produced in February of 2018 for the Lincolnshire County Council. It was produced by Opun. All graphics were produced in-house by Opun unless otherwise credited.

Opun is a charity, number 1143920.

Opun is a member of the Design Network and the Architecture & Built Environment Network (ABEC Network).

t: +44 7970 363141
e: garry@opun.org.uk
w: opun.org.uk

Part 1: Introduction

Introduction

Background | Purpose

This study was commissioned by Lincolnshire County Council to assess the movement potential of Holbeach, Lincolnshire. The study was undertaken by Opun, the architecture centre of the East Midlands.

Hobeach is a town in decline, with retail outlets closing and a town centre that struggles to attract inward investment. It has many fine historic buildings, and has the potential to be an attractive market town with the right strategy for regeneration.

Key to this are two large areas of housing being proposed within the town. One site sits to the west of the town, the other to the south. If integrated into the strucutre of the town properly, new residents will bring with them much-need spending power, allowing the town to support more and better retail, food and other mixed and social uses.

However, done badly, the new development will likely add traffic to the already congested street network, and new residents will go further afield to spend their money. This would be the worst of all world, with new development damaging the town for existing residents whilst not helping to improve or renew it.

Our study aims to understand the likely effects of the new development on the spaces and places in town and to suggest ways in which accessibility between the new development and town centre can be maximised.

Structure

This report is set out in the following sections:

Part 1 establishes the purpose of the study, defines the study area, and sets out any limitations.

Part 2 is a baseline analysis, examining Holbeach in its current form. This establishes the 'spatial signature' of the current town, revealing the structures within it that provide movement at different scales and for different modes. It also uncovers key accessibility 'hotspots', which are places that have the greatest potential to support mixed-use activities.

Part 3 examines the movement structure of the proposed developments to the south and west of the town, analysing the extent to which they integrate with the existing town and the way in which the internal structure of the sites organise movement.

Part 4 sets out the methodology, explaining the history of the techniques used and outlining how the measurements are undertaken. It also sets out the kinds of information the analysis can generate.

Scope | Limitations

This commission is primarily a desktop study, supported by site visits but not verified through observational field work, extensive measurements or pedestrian gate counts. Nor does it take into account traffic movement study work or vehicle flow counts.

Instead, the modelling here measure the *potential* of routes and spaces to be well-used, based on spatial accessibility. The actual environment within these spaces may limit their potential, with aspects such as the degree of active frontages, the quality of the public realm and landscape, and speed of traffic and the various other 'supports' for the use of space all playing a role in how a space is used in practice.

"The way that places connect is directly related to the way that people move, interact and transact. Space connects or segregates; brings people into social and economic relationships or keeps them apart; helps people save time or consigns them to carbon-intensive lifestyles; enhances real estate value or damages investments; increases safety or encourages criminal behaviour."

(*Space Syntax Laboratory*)

The basics of Space Syntax theory.....

movement

people

place

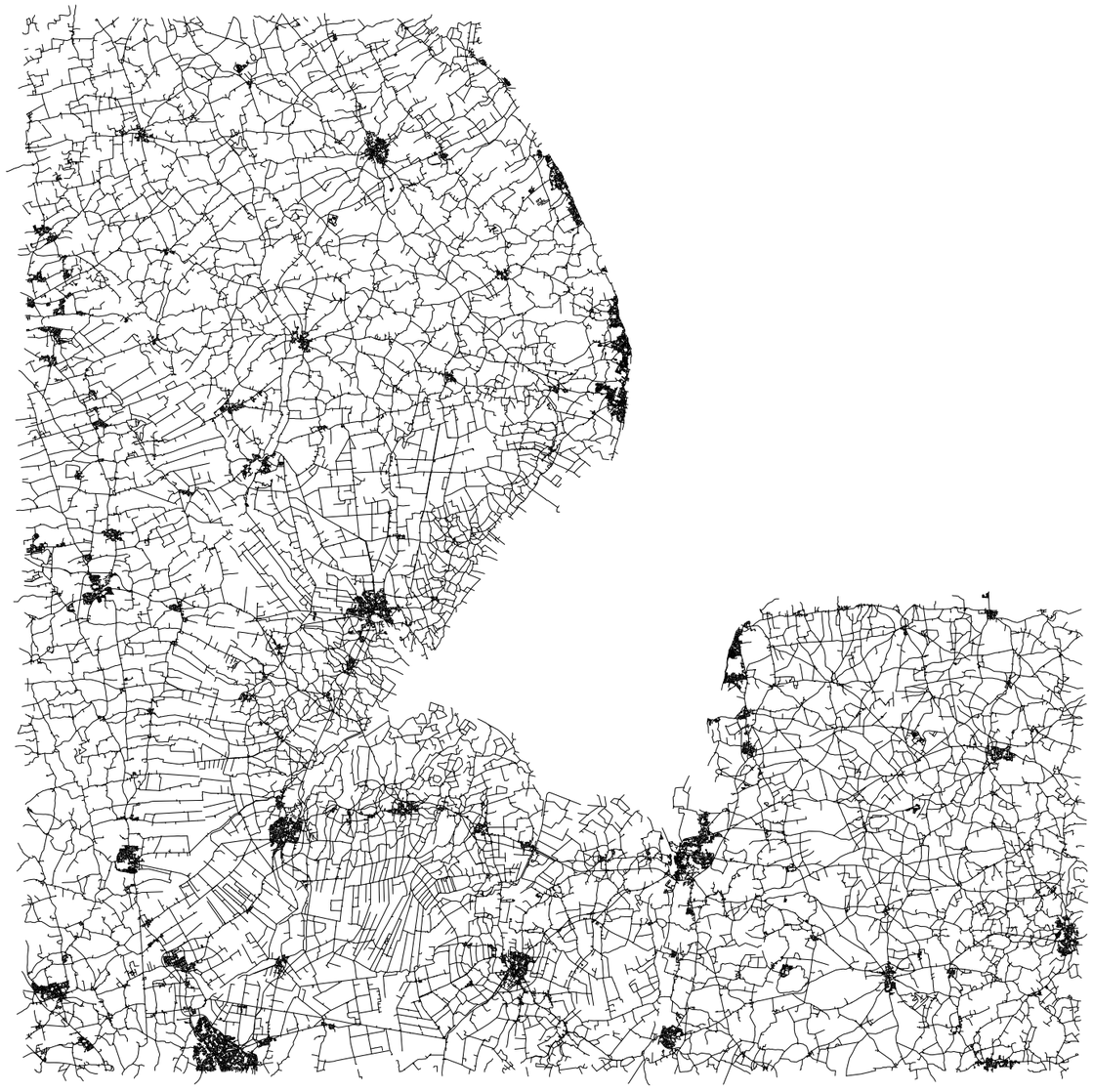
The study area

Although the focus of this report is the urbanised area of Holbeach and its edges, the modelling takes in a much larger extent of the movement network. The area analysed in this study encompasses a large portion of Lincolnshire, roughly equivalent to Ordinance Survey grid square TL.

The performance of a place, both economically and socially, is influenced as much by how it is embedded within the 'supergrid' of regional places as it is by how the place its self is structured.

We use such a large area to ensure that the analysis can accurately account for longer trips, thus revealing which parts of the movement network might be used for through journeys and by people from the town planning a longer journey. This kind of movement is referred to as 'global' movement in this study, i.e. movement beyond the town.

Successful places almost always have a large supporting 'hinterland' of smaller settlements, and are connected to them in such away that make them destinations not just for their residents, but for people far and wide. Understanding the role of Holbeach in the wider distribution of settlements in the area is a key aspect of understanding its potential.



Right: Holbeach town, used for studying local movement.

Left: Full extent of the area modelled.

Image study
Key streets and spaces






Clockwise from top left:
Spalding Road looking to West End
E Elloe Avenue
Northon's Lane
Chestnut Avenue
Church Street
The main junction in town

Image study
Key streets and spaces



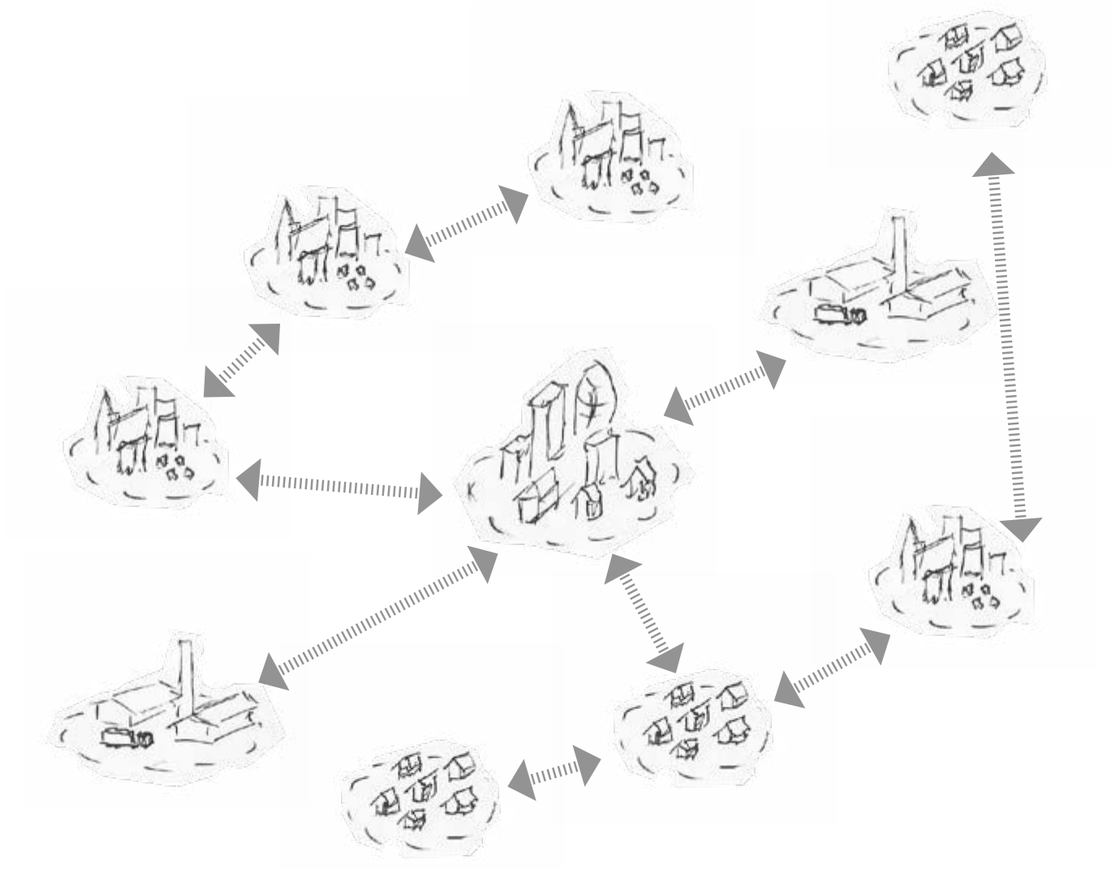



Clockwise from top left:
The footpath linking Northon's Lane with Oakwood Glade
Ash Close
Boston Road looking north
Wide junction corner radii for E Elloe Avenue
Boston Road looking south
Approaching town along Boston Road

Image study
Key streets and spaces

Clockwise from top left:
Market Place on carpark next to park
Seating at the main junction in town
High Street
High Street
High Street
St Johns Street

Part 2: Baseline analysis



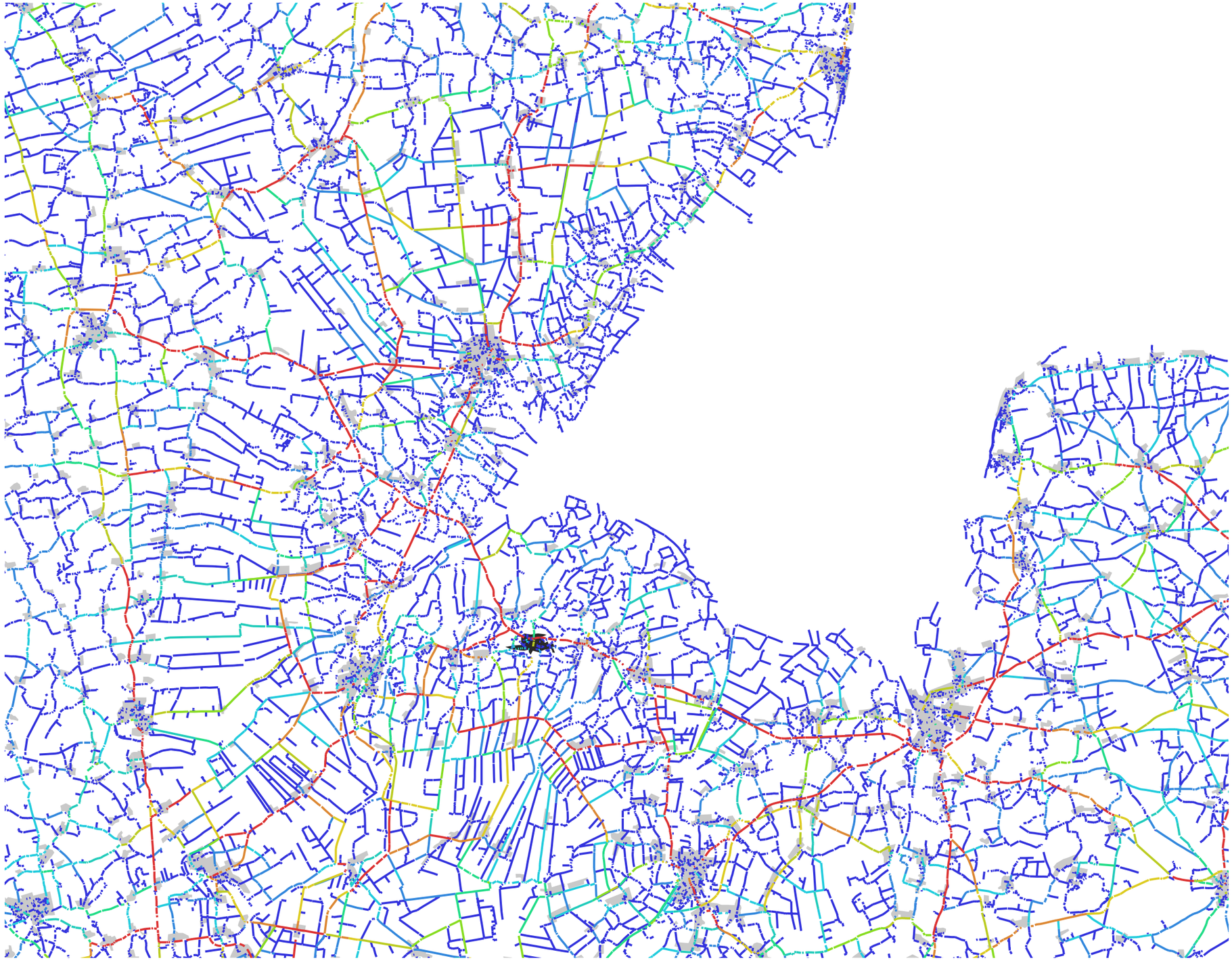
Global movement
25k trips

Looking at very long (25km) trips reveals that Holbeach sits close to by not directly on an important global integrator (a route that links different settlements together).

The A17 passing to the north of the town is predicted by the model to be the route chosen for travelling beyond the settlement east-west. Boston Road and Fen Road show up in this model, albeit at a lower intensity than the A17. This suggests that for north-south movement, the centre of town is a logical route choice in some instances.

Bypassing Holbeach with the A17 has taken much of the through-movement from near-by towns away, which whilst surely the intention at the time, may now be harming Holbeach's ability to generate the activity levels needed to sustain a large retail offer.

Comparing Holbeach to a larger town such as Boston is revealing; many busy routes lead you to the centre of Boston, which has enabled it to grow and expand to exploit its highly integrated location within the wider movement network.



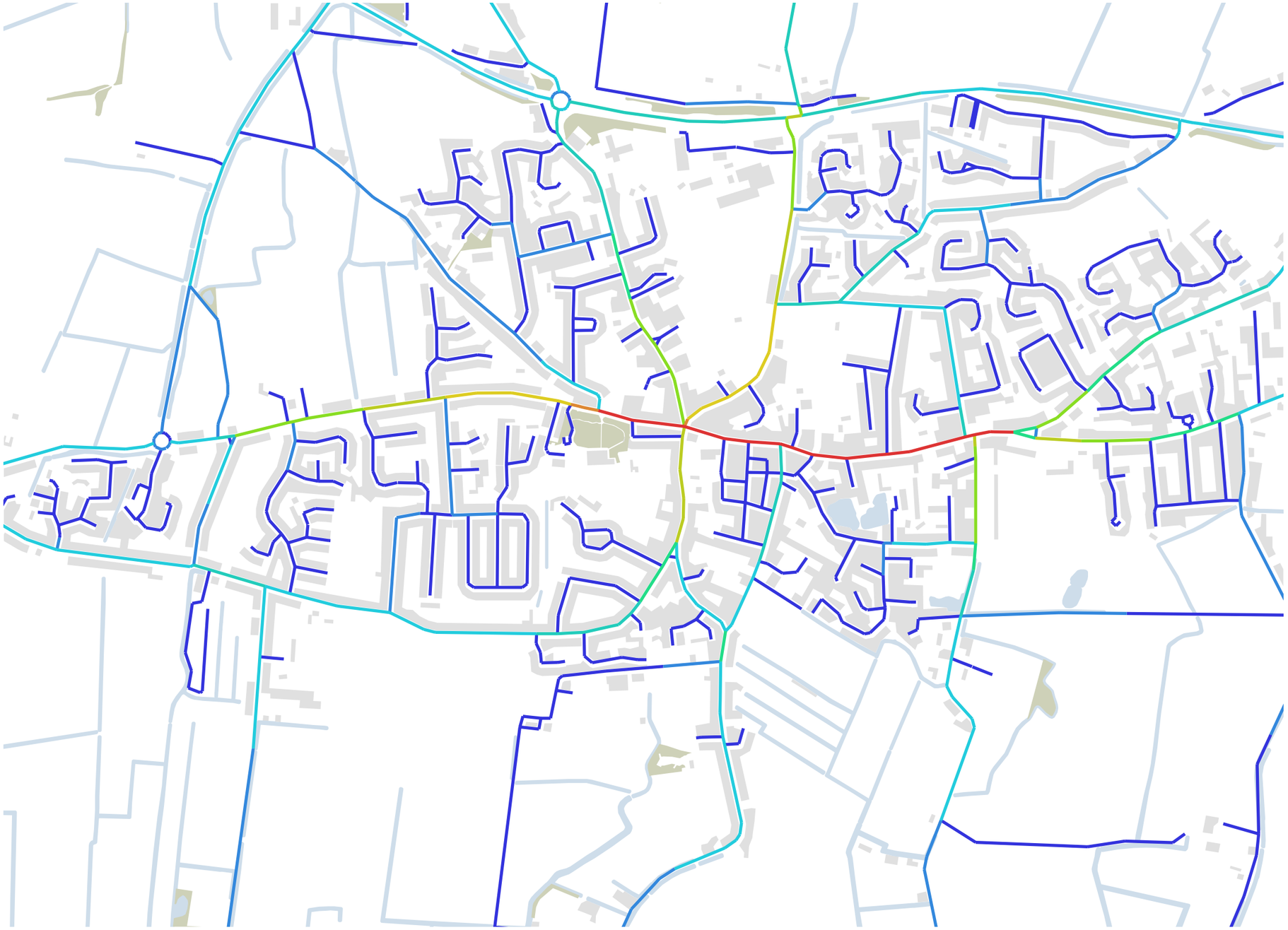
Global movement
2.5k trips

Moving to more local (2.5km) trips sees the town centre become the key route. The A17 is not going to be used for this kind of trip, and instead people are choosing to travel along main radial routes (think of radial routes as spokes on a wheel).

This means that much of the traffic in town is likely to be generated by residents of Holbeach, and not by people passing through from other places. There is, therefore, scope for promoting sustainable modes of transport within town, as this would be of great benefit for traffic levels.

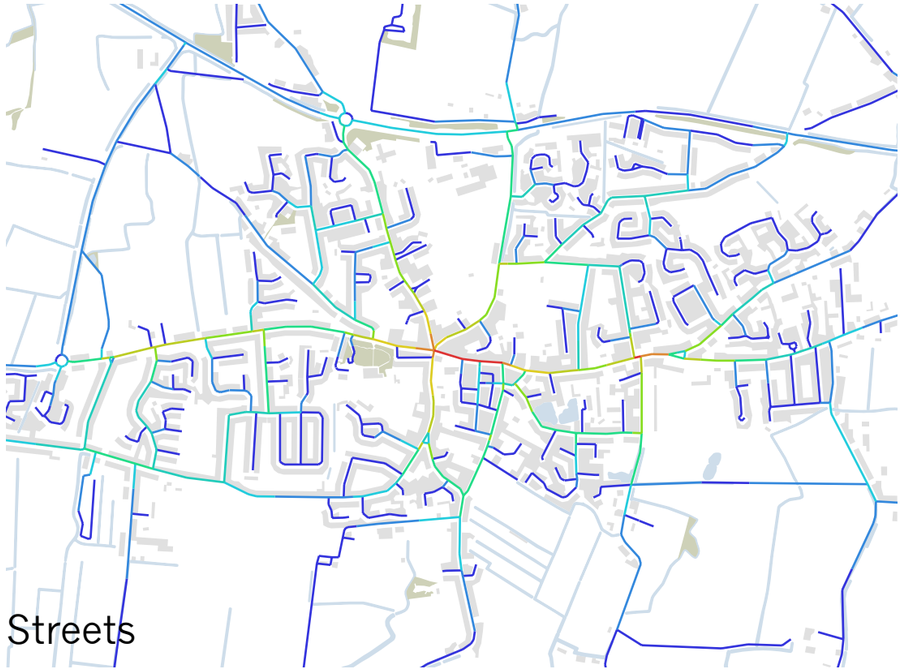
Another thing that becomes apparent when looking at this kind of extended local trip is how little of the town's structure can accommodate these sorts of journeys. Beyond the main radials, there are very few orbitals - routes connecting parts of town to each other without passing through the middle.

This pattern concentrates traffic on the main junction in town, as there are no options to use other streets. The lesson to draw from this is to ensure that street systems include links across town as well as to the centre. That way, more diffusion through the grid is possible, allowing people to avoid overly constrained junctions and help reduce congestion hotspots.



Spatial accessibility
High
Low

Local movement
800m trips



Streets

Moving to 800m trips via the street network, the highly disconnected housing areas of the town become apparent. The issue is that accessible routes do not run to the centre of most of the housing areas. This is likely to mean that many of these areas do not have high instances of sustainable modes being used to access town; they are too spatially isolated from the centre.

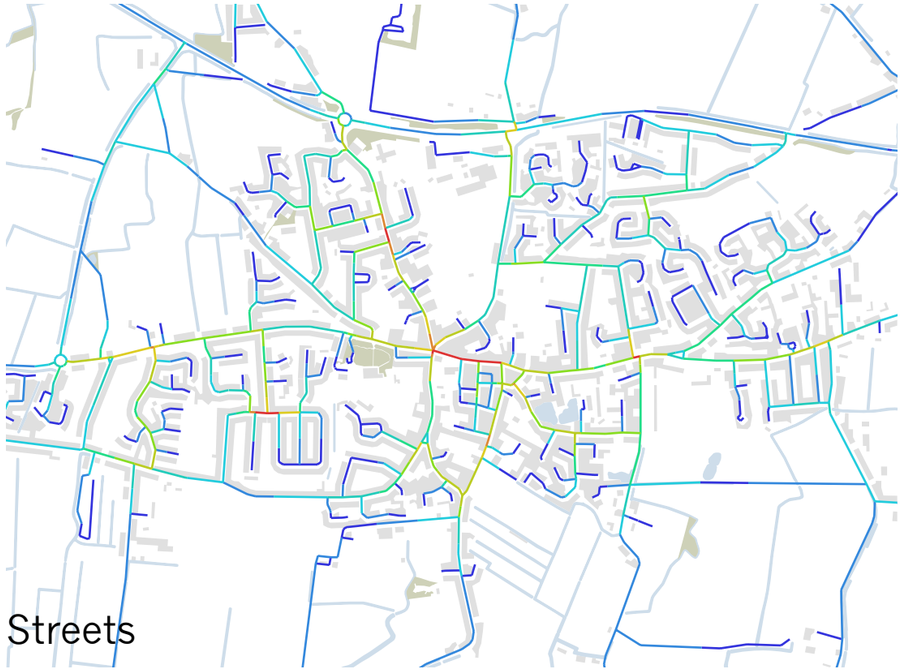
Note the ‘hot spot’ on the junctions around Fleet Street and North Parade. The model suggests that a retail outlet would be supported by the local neighbourhood here. On the ground, The Original Factor Shop can be found in this very spot.

Streets and footpaths

Adding in the footpath network does little to alter the picture. The footpaths around the town centre do not perform a role that the streets cannot, and are therefore only marginally important. What footpath links there are between housing areas do little to make longer trips into town easier.

Spatial accessibility
High
Low

Local movement
400m trips



Streets

Moving to much more local (400m) trips shows the emergence of localised ‘hot spots’, which would be good places to locate play areas etc for very local access. These hotspots, with the exception of the one at the end of Langwith Drive, are at key junctions along the main roads, not within quieter side and back streets.

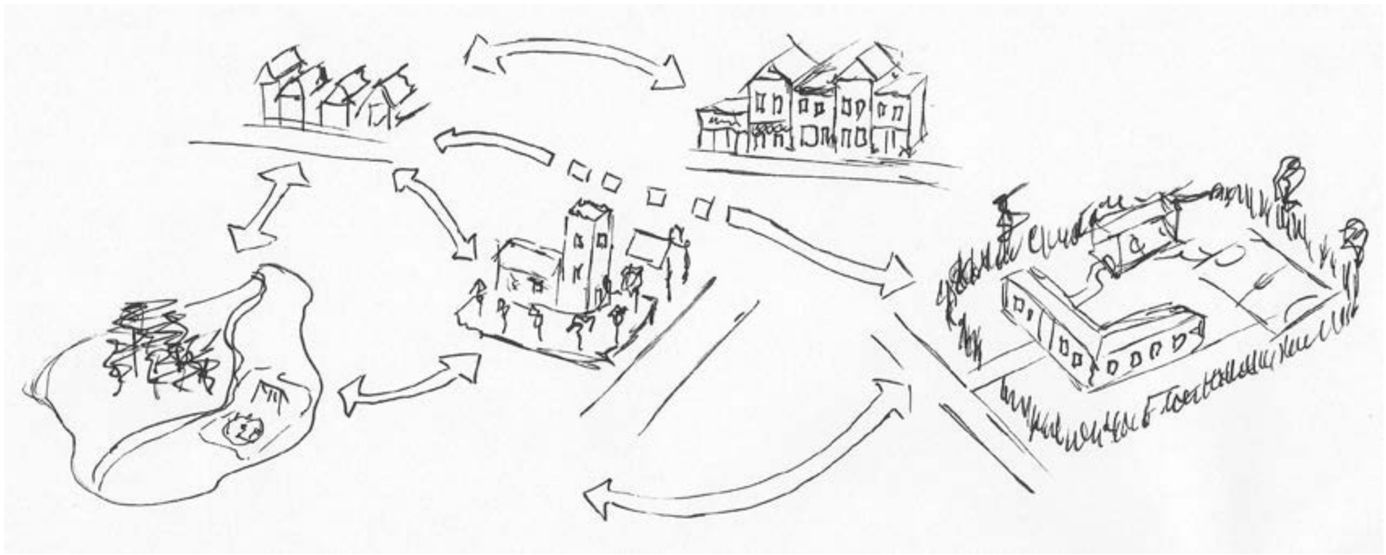
Streets and footpaths

Again, adding in the footpath network does little to alter the picture, although there is now a new ‘hot spot’ at the end of Castle Drive. The overall impression is that much of Holbeach was planned for driving, not walking.

Conclusions
Initial findings and observations

- Holbeach sits close to important global routes, but they do not run through the town centre.
- The bypass has been effective in taking longer trips away from the town centre, but this may have had a negative impact on the towns vitality.
- For shorter trips, the town centre becomes more attractive, mean much of the towns traffic is likely to be self-generated.
- Whilst there are strong routes into town, there are only very weak routes connecting parts of town together without going through the centre.
- The same is true for shorter walking and cycling trips, with little interconnection between residential areas.

Part 3: Changes to the network



Proposed new development

Southern addition

The southern extension to Holbeach sits to the south of Hall Gate, opposite Harwood Avenue. It connects to the rest of the vehicular network in two places; along Hall Gate and to Fen Road to the east. The proposal includes open space, community facilities and a school.

Eastern addition

The development to the west of the town sits between Spalding Road and the A14. It too has two points of connection for vehicles; from Spalding Road and from a new junction along the A151. The masterplan as presented shows open spaces, what appears to be a commercial offer in the core, and an extensive network of greenery.

Common issues
Barriers to movement

There are several common issues that occur when planning new development and relating it back to an existing settlement.

The most common of these is one of separation, whereby for often political reasons direct physical connections between new and existing development is discouraged. Existing residents often lobby hard for buffing to lessen their perception of new development near to them. This often leads to new residents forming a separate community rather than integrating with the existing one.

The physical implications of this approach often mean that direct routes into town centres are either not permissible or are via footpaths only, which have been shown through research to be less appealing for people than a good quality street.

Another common issue is that movement on foot is subject to regular breaks, waits and frustrations. Waiting at lights, at junctions, being forced to walk around roundabouts and having to cross busy roads all reduce the appeal of walking. Routes should therefore be optimised for pedestrian convenience.

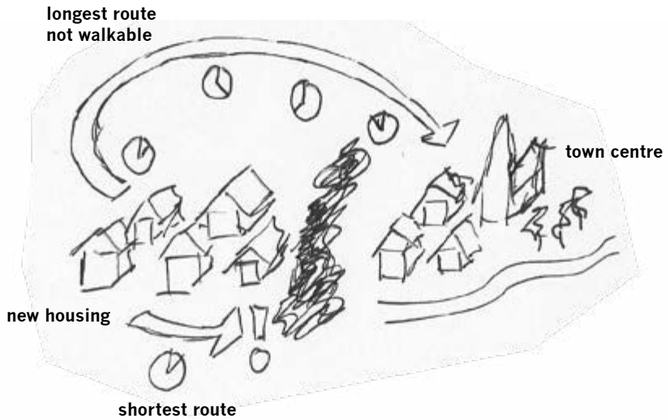
Other issues of consequence to think about when laying out new development is the way the street structure diffuses or concentrates movement. Highly disconnected layouts with lots of culs-de-sac focus traffic on a small number of streets, blocking up junctions and not offering any useful streets beyond simply accessing the houses they serve. A more connected, grid-like structure helps to relieves stress on junctions, allows more of the streets to be useful for a greater number of people, and promotes walking as places are often easier to reach.

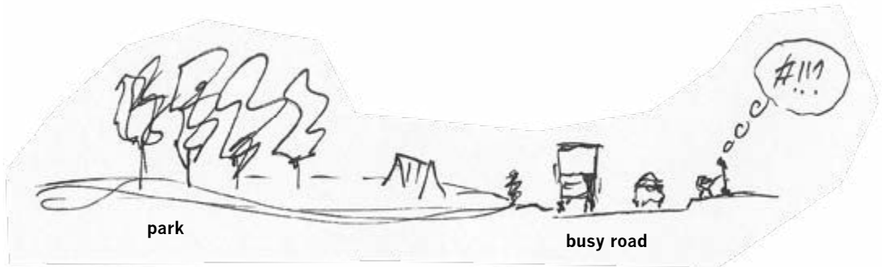
Footway ends abruptly, discouraging use.

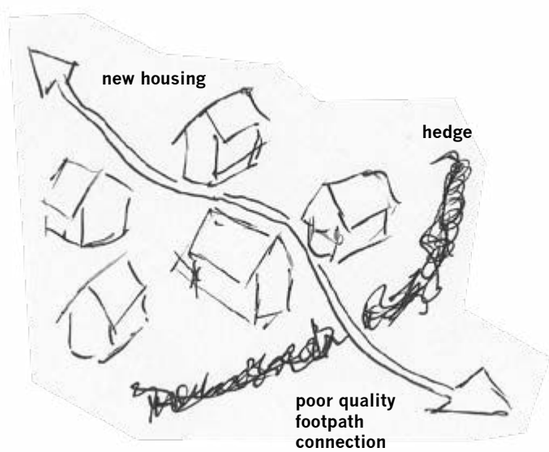
Overly wide junctions are hard to cross.

Footpath links between housing areas are not well used in practice.

Busy streets are hard to cross.







Global movement
2.5k trips

When adding in the proposed new development at the edges of town, very little about the 2.5k trips model changes. The key finding here is that whilst the new street systems proposed link to the development areas, they do not link *between* existing development areas.

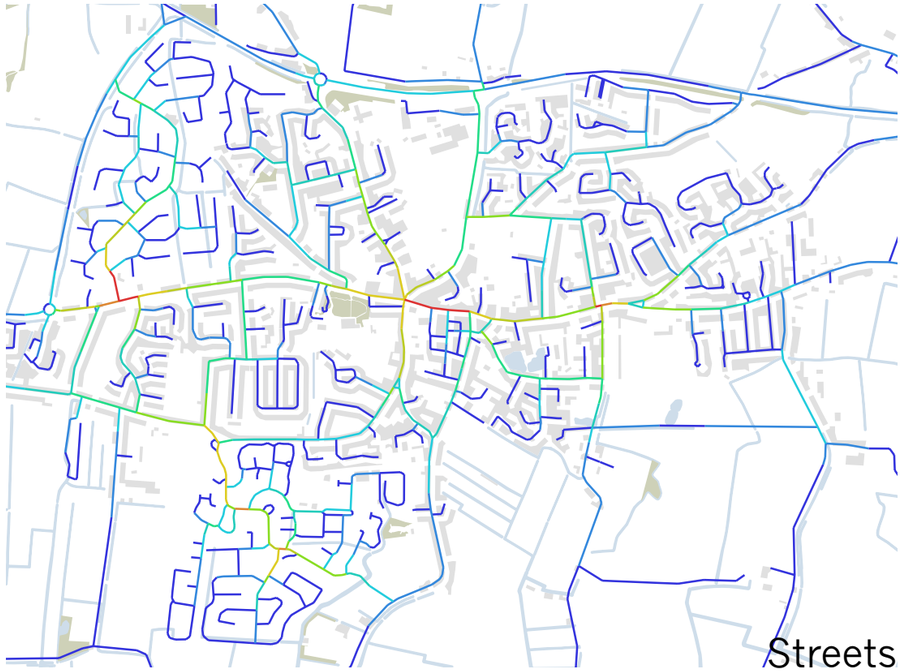
This means they are of very little 'strategic' use to the town as a whole, and will likely only be visited by residents of the new developments. The main spine routes show some through-put, similar to the levels shown to North Parade or Wignal's Gate.

This places a fundamental limit on what kinds of activity these streets can support, with retail only viable if it is sufficiently accessibly by new residents.

Also notable at this scale of trip is how disconnected the street networks of both developments are. They both employ similar patterns to the 1980's and 1990's development in other parts of town, using a 'nested hierarchy' of streets. This is where a main road leads to a series of culs-de-sac rather than the kinds of gridded development typifying earlier eras. This kind of layout has been shown to negatively impact on instances of walking for residents.

Spatial accessibility
High
Low

Local movement
800m trips



Streets

Moving to more local trips on the street network shows that, for the development to the west, the most accessible space created is around the junction with Spalding Road. This could be a good location for mixed use as it would be accessible from the streets to the south of Spalding Road.

For the development to the south, there are two hotspots along the main spine route that are accessible, but these are well away from existing residential areas so will likely only serve new residents.

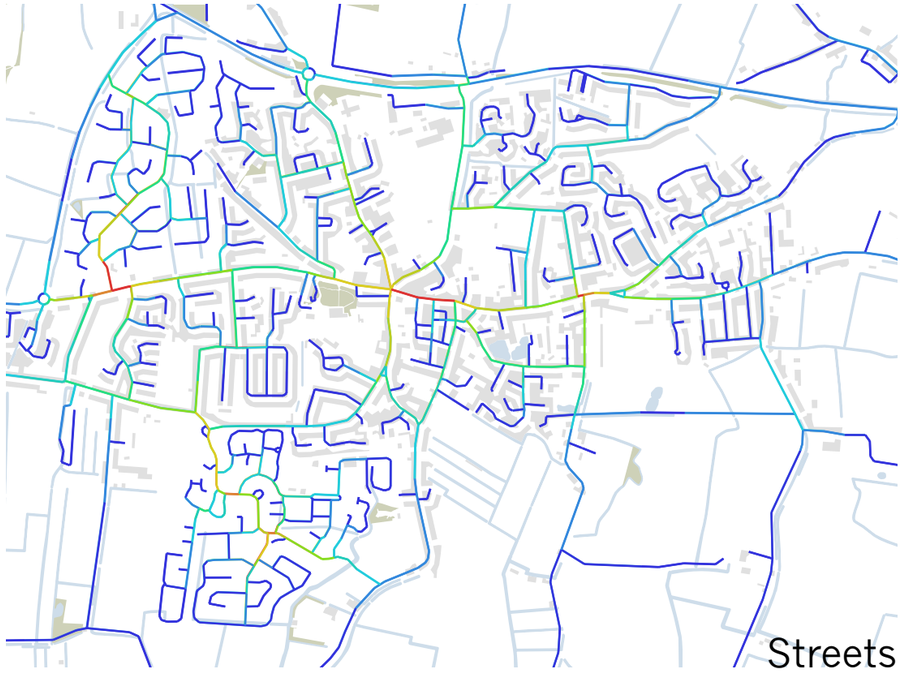
Streets and footpaths

Adding in the footpath network has a significant affect on the model, with both new developments now showing significant ‘accessibility cores’; places where natural movement is expected to be high. These are in the geographical centres of each development, away from existing development and likely to be only accessible for new residents.

Importantly, both developments rely on their footpath networks to generate a significant spatial centre, which requires the footpaths to be of especially high quality to support their use. Should they not be, then mixed uses will struggle to get off the ground for these developments, although especially for the southern proposal.

Spatial accessibility
High
Low

Local movement
400m trips



Streets

Reducing the trip distance down to 400m on the street network shows a similar pattern to before, with the junction on Spalding Road being a key point of accessibility for short walking trips. The hotspots within the southern development remain. This is strong evidence that the western development area has the potential to add mixed uses that serve the wider community, whereas the southern development will be more oriented towards being a separate community. Given that a school is planned on the southern site, this could cause problems for accessing the new facility.

Streets and footpaths

Adding the footpath network back in shift the focus points back how they were for the 800m model. For the southern site, the school entrance is at a walkable point within the development. For the western site, the centre of the site is now showing as the most accessible part of the proposal.

Ideally, the street network would be supported by the footpath network rather than superseded by it; both systems should work together to provide movement to key points. At present, they are organising movement differently across the site, which indicates that these developments may struggle to generate a meaningful core.

Conclusions
Key findings and recommendations

Following the analysis, we find that:

- Neither new development proposal fixes the issues currently faced by Holbeach in terms of how housing areas link together; moving from one side of town to the other has to be done via the town centre crossroad junction.
-
- Both layouts are separate from the town, as many of the existing housing areas are. This could be an issue in terms of traffic and trips by sustainable modes.

- Both of the developments use relatively disconnected internal street networks, with lots of dead ends. This could harm walkability.

- The streets and footpath networks focus movement on different parts of the new sites, which may be an issue if supporting retail uses is a concern.

- The centres for mixed use on both schemes is away from existing residential areas, which may harm their long term viability and make delivering them early in the life of the development more difficult.

Recommendations:

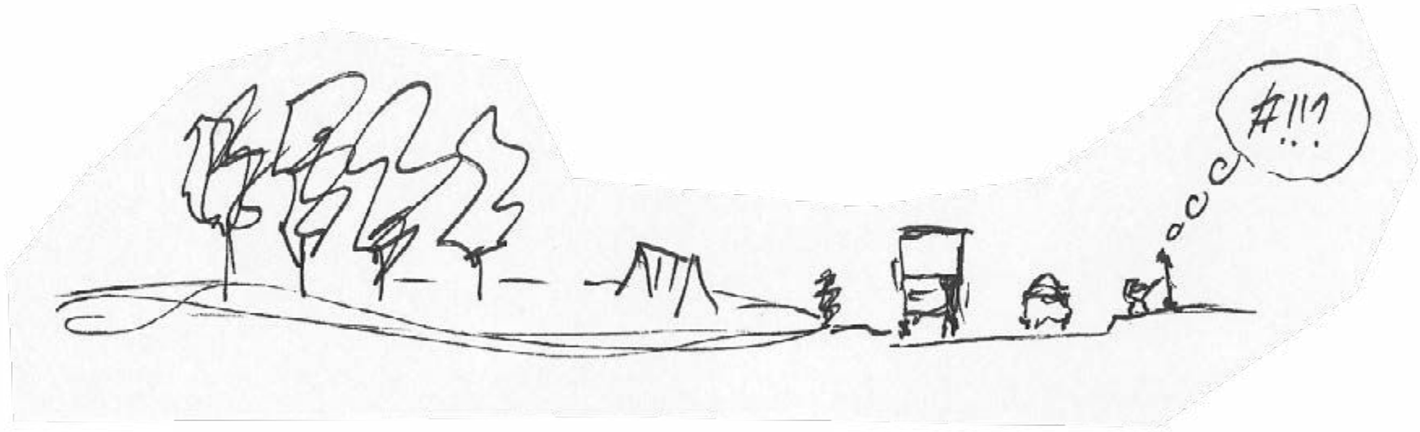
- Both developments would benefit from a better connected internal street network, so that reliance on the footpath network is reduced.

- The streets and footpaths of both development should focus movement on the same places, to maximise activity hot-spots and help support retail uses.

- Any mixed uses should be accessible to people outside of the site. This is especially true of the western development area, where the key junction with Spalding Road presents an opportunity for area wide benefits.

- Iterative testing of layout proposals would help to determine the most valuable movement structure, and therefore could be explored with the design teams involved.

Part 4: Methodology



Our use of Space Syntax

History

The term Space Syntax encompasses a set of theories and techniques for the analysis of spatial configurations. The theory was conceived from the early 1970s onwards by Bill Hillier and colleagues at The Bartlett, University College London, and published in two seminal books, *The Social Logic of Space* and *Space is the Machine*.

Over the years the theory and techniques have been continually developed and refined by the international academic community and by its use in practice. Its unique contribution to the field of urban planning and design is in the identification of fundamental links between spatial layout and the social, economic and environmental performance of places.

The central thesis of Space Syntax is that the spatial layout of buildings and urban places exerts a powerful influence on human behaviour: "The way that places connect is directly related to the way that people move, interact and transact. Space connects or segregates; brings people into social and economic relationships or keeps them apart; helps people save time or consigns them to carbon-intensive lifestyles; enhances real estate value or damages investments; increases safety or encourages criminal behaviour." (*Space Syntax Laboratory*)

Space Syntax has pioneered a space-based modelling approach that is able to explain, compare and predict human behaviour and its consequences within buildings and urban spaces, on foot, on bikes and in vehicles.

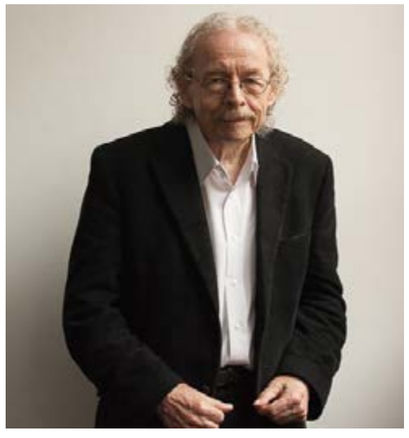
The theory is able to show how the social, economic and environmental performance of places – from the scale of the entire city to the scale of the individual street and building – is measurably affected by the interaction of two key properties of buildings and cities: 'spatial layout attraction' and 'land use attraction'.

This understanding allows us to analyse the performance of places, both existing and proposed, and show how planning and design decisions impact fundamentally on the way that people move, interact and transact in streets and buildings.

Space Syntax therefore provides a tried and tested, evidence-based approach to the analysis and design of spatial layout patterns and this understanding is crucial in the design of new routes and spaces.

The modelling techniques make it possible to quantify and describe how easily navigable any space is, useful for the design of large buildings and masterplan layouts where wayfinding is a significant issue.

Space syntax has also been applied to predict the correlation between spatial layouts and social effects such as crime, traffic flow, as well as between spatial layout and economic effects, such as footfall, land and rental values.



Above: DepthMap X showing movement analysis being undertaken, in this case of Rushden in Northamptonshire.

Left: Professor Bill Hillier, inventor of Space Syntax and developer of the theory into the powerful tool it is today.

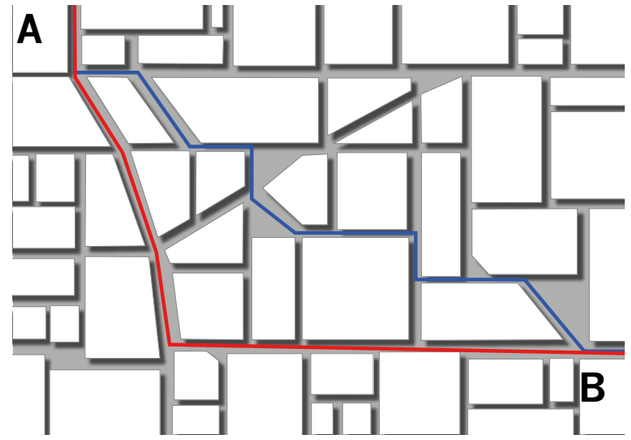
How we move

In developing Space Syntax theory, on-going observations of people using urban systems were undertaken. This painstaking research uncovered some fascinating relationships between the properties of an urban system and how people moved through it. Could 'the architecture of the grid' be exerting a powerful influence on users? And if so, in what way? If a reliable pattern could be found, then, reasoned the researchers, the underlying spatial properties could be measured.

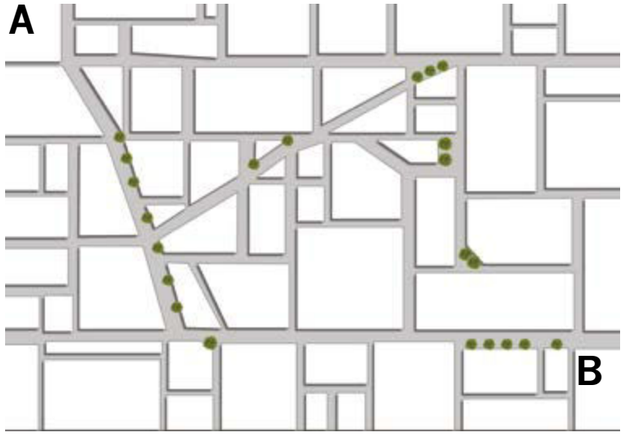
The options for moving through any given system are many-fold but not infinite, and many trip options make little sense for efficient travel. If a person wants to travel from point A to point B in a system, do they take the shortest route (blue) or the most direct (red)?

Contrary to what many people think, route choice has reliably been shown to favour less complex, more direct journeys over shorter but more convoluted options. Although metric distance is a factor, people prefer to use routes that are simple, with as few changes of direction as possible.

Right: A possible movement system with a number of route options.



Right: Shortest (blue) and most direct (red) routes between points A and B.

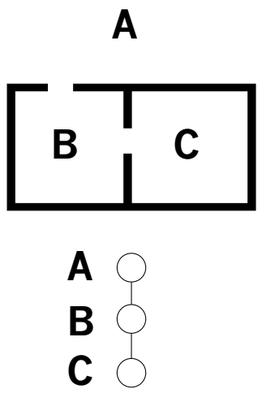


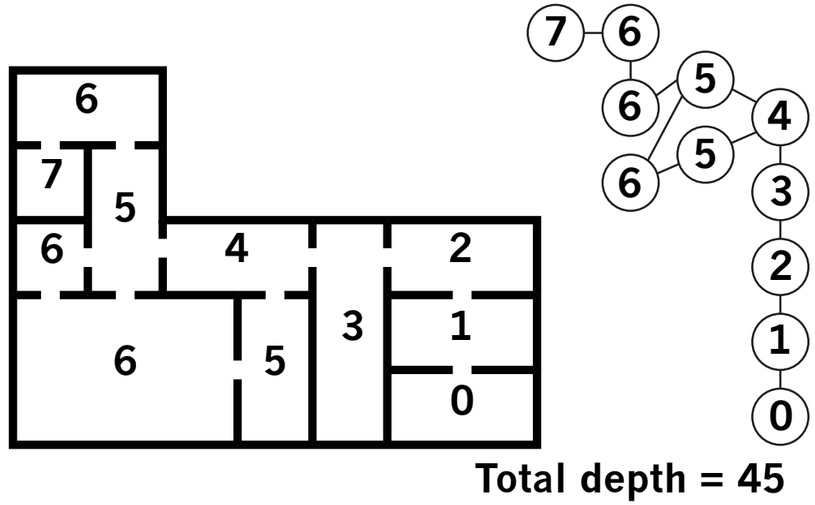
Measuring space

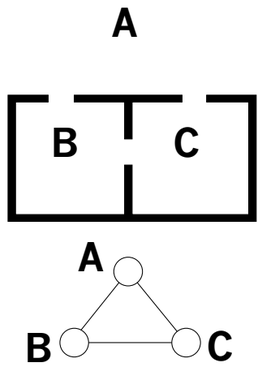
Once it was established that people reliably used space for movement in certain ways, it then became necessary to find a way to measure spatial properties to allow comparisons between parts of a spatial system. A branch of mathematics called graph theory enables precisely the type of measurement needed for our purposes. It uses the concept of spatial 'depth' to build up a picture of how parts of a spatial system interrelate.

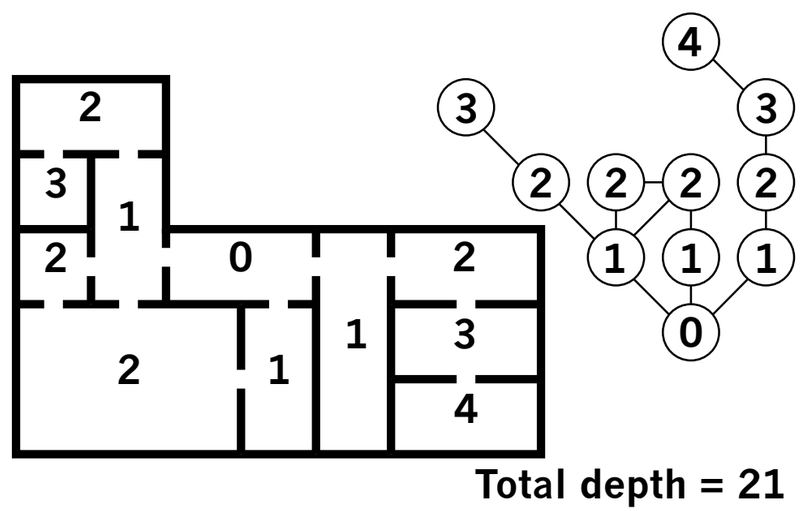
Take the diagram below. On the left of this is a system with spaces A, B and C. To get from A to C you must pass through B. In comparison to the example on the right, A and C are more remote from each other, with a trip between them requiring you to travel further through the system. Here, C can be described as 'deeper' from A than in the diagram on the right. The spaces in the right hand diagram are equal in terms of depth; you can move from one space to all the other spaces in a single 'step', meaning that you travel less 'deep' into the system.

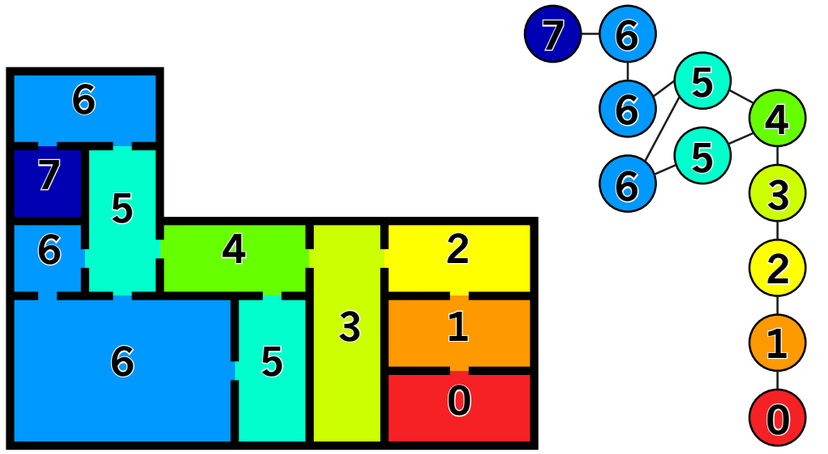
Moving to more complicated systems across the page, we can start to develop graphs that show how large numbers of spatial components relate to one another. As discussed, how spaces within an urban system link together and the complexity of moving from one to another predicts their level of usage. How the system looks depends on your starting point; in the diagram top right, we are starting in a space (0) that is 'deep' to many of the other spaces in the system, requiring users to pass through many other spaces to make progress. By comparison, starting in the more central part of the system means that more spaces are within easy reach. This space can be said to be more 'shallow' than the previous space, as it has more direct neighbours and you can access more of the system in fewer steps. The graph for this starting point shows how the numerical value for this less 'deep' space is calculated. With the support of the observational studies, it is reasonable to assume that this space will attract more movement than the other spaces in this example.





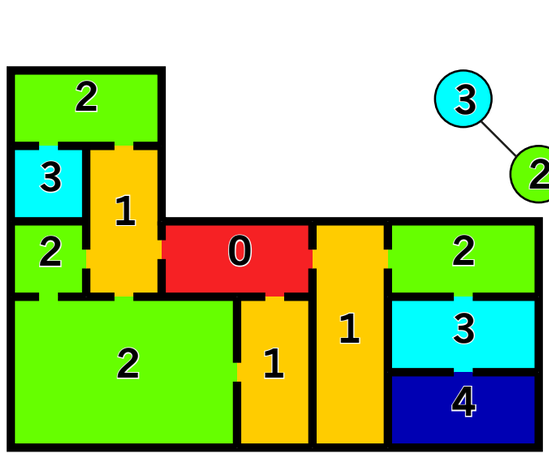


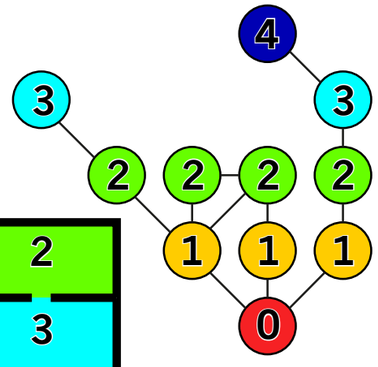




Total depth = 45

To help in visualising the properties of the components of a spatial system, colours can be added to the graph. The software used for undertaking the analysis uses a 'heat' scale to make understanding the outputs of the modelling intuitive for readers.'Hot' spaces are those that are 'shallow' in the system, and thus can be expected to attract more movement. 'Cool' spaces are more spatially isolated, requiring people to travel deeper into the system to find them.





Total depth = 21

The two diagrams are examples of 'step depth' measurement. Starting from a particular space within the system, the total number of steps needed to reach all the other parts of the system can be calculated. Should you want to show how all the spaces in a system related to each other simultaneously, then graph values for every space can be calculated and ranked in order of graph value or 'depth'.

Spatial accessibility

High

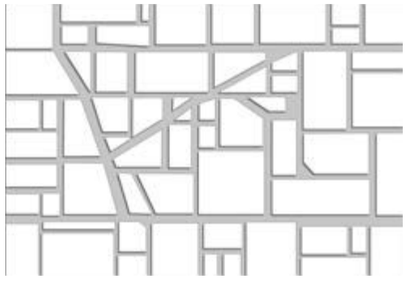
Low

Creating models

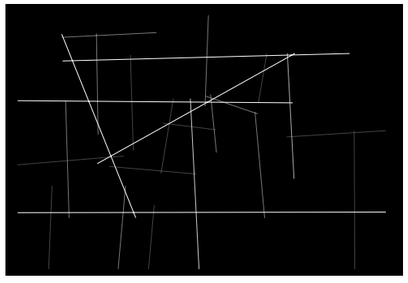
For large urban systems, models are created based on lines of sight through the publicly accessible spaces in the place being analysed. This links the analysis to how users of a system experience its parts to the interrelation between the spaces within it. Lines of sight, or 'axial lines', can either be drawn 'by hand' on computer, overlaid on Ordnance Survey base plans, or can be generated by using road centre lines in GIS models.

The axial line diagrams overleaf show the longest lines that it is possible to draw through the example plan. Different types of analysis require different types of axial line diagrams. For smaller systems such as the one above, an 'all lines' diagram can be produced, which has been shown to produce higher resolution correlations for movement flows. Reducing the amount of lines helps speed up the production of models, but this also lowers the resolution of the output. For small systems this can lead to inaccuracies, but for large urban systems the resolution achieved has been shown to accurately predict movement flows.

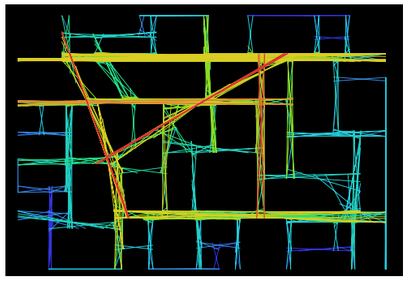
Whilst axial line analysis gives results with strong R-values, another type of analysis has been developed which enables more attributes of a movement system to be analysed; angular segment analysis. In this study, we are using this technique as it enables multiple properties of spaces within a system to be tested co-dependently, making for more accurate models.



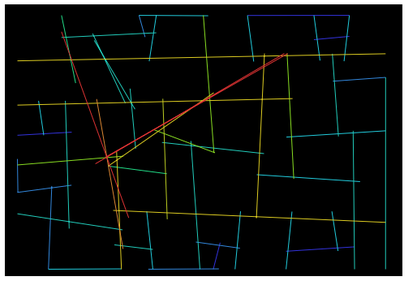
A movement system, ready to be modelled.



Lines of sight through the streets and spaces of that system.



An 'all lines' map, showing the strongest meeting and gathering spaces within the system.



A 'fewest lines' map, showing through movement within the system.

Settlements as movement economies

How settlements are formed has a pronounced effect on their ability to support economic and social activity. In a very real sense, settlements can be seen as 'movement economies', in that the way the uses within any given settlement are distributed is closely related to the way the spaces interconnect and movement flows between them. The map (top) shows the west end of London, with axial line analysis overlaid on its streets. The red lines show the most accessible spaces, the cooler blue and green lines show spaces that are comparatively less accessible. Overlaying land use on the same plan reveals something very important about the relationship between movement and economic activities. Research shows that spatial integration can predict how land uses will be distributed to a great extent; around 80% of retail units are to be found on the streets in the top 20% of integration.

For new development hoping to sustain a mix of uses, generating accessible spaces during the master planning is critical, as without natural movement, economic viability is difficult to achieve. Likewise for 'destination' uses such as hospitals, ensuring they are well integrated into the movement framework helps generate modal choice for users, as locations away from natural movement attractors increases model shift to private cars, increasing traffic and parking demands.

Above: London, analysed for spatial accessibility.

Above: Retail land uses shaded red; note how around 80% of the retail is found on the 20% most spatially accessible streets.

Types of analysis

Space Syntax theory and its techniques of analysis have been used in this study to measure the baseline levels of spatial accessibility in and around Corby.

As mentioned, Hillier *et al's* Space Syntax approach uses a number of geometric measures to represent the relative accessibility of the 'segments' of public space, defined by drawing lines, called 'axial lines', through the system being analysed. The geometry of a layout has a pronounced effect on actual and perceived connectivity and legibility as well as actual and perceived levels of safety, thus making it a powerful predictor of movement.

The software used for this study is the OpenSource version of *DepthmapX*, version 5. The colour range is 'Depthmap classic', and we have normalised the data in order to improve accuracy.

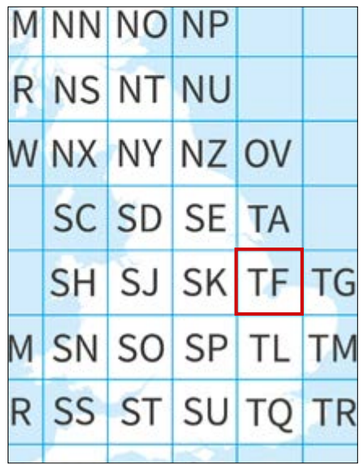
In this study we have used four types of analysis:

Normalised angular choice (NACh_10000 and 2500) indicates the 'through movement' potential of a segment within the model of longer journeys within Kettering, and thus is used to model local car journeys or longer bike rides.

Normalised angular choice (NACh_800 and 400) indicates the 'through movement' potential of a segment within the model for a 10 - 15, or 5 minute walking trip, thus revealing the local pedestrian movement system.

Not all of the analysis is needed for each of the iterations on site; the large radius measures allow the wider movement network to be analysed, and the precise configuration of the routes on site have little impact on this 'global' system. For local walking trips, the routes and spaces on the site become more important so are included.

Right: OS grid references, with the study area highlighted.



Holbeach Movement Analysis

Client: Lincolnshire County Council

Date: February 2018

Reference: Holbeach_SS_REVA

Contact: Garry Hall