

Transport Planning Society Bursary Scheme 2022

Hub Network:

A plan to support public bus services through Mobility Hubs



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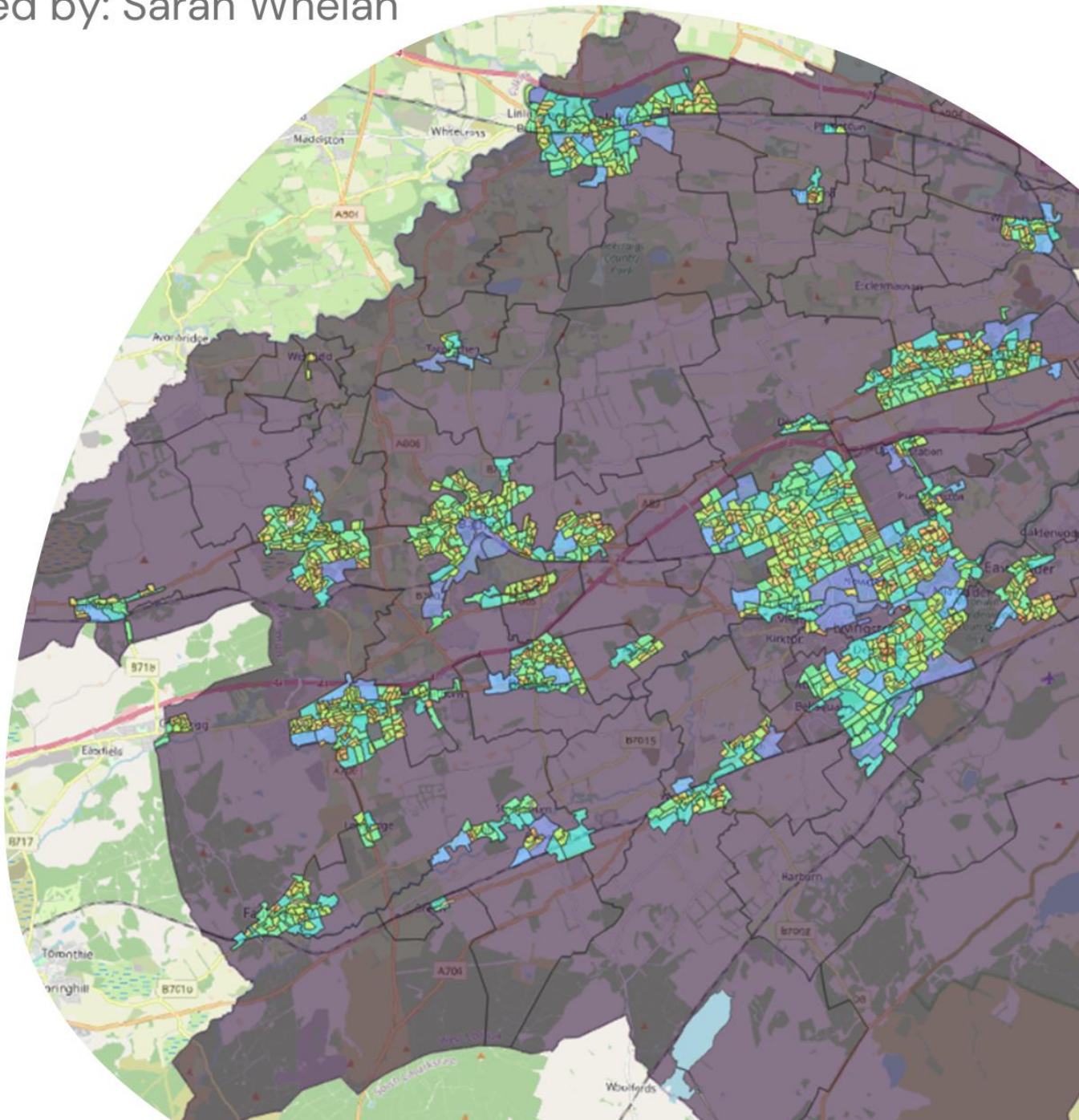


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Acknowledgements

My thanks go to the Transport Planning Society bursary team for volunteering their time to run the scheme, in particular to Jo Ward for managing the scheme and providing me this opportunity. Also, to James Glease for offering advice and encouragement throughout the process as my mentor. Lastly, I would like to thank friends and family who proofread and offered valuable advice and support.

1. Introduction

This study proposes a new methodology to determine the criteria and placement of a successful mobility hub (MH) network, in a way that ensures it is convenient and accessible. MH's are transportation infrastructure which offer connections to a variety of modes of travel, alongside place making measures (Metrolinx, 2008). With the use of a West Lothian case study, the requirements for a MH to successfully shift reliance from private vehicles to public transport are reviewed.

Technology is guaranteed to play an increasing role in our public transport system. It will be demonstrated that technology, such as mapping and modelling, can be used to test scenarios, reducing error and cost for projects. By collecting data on the location of key amenities the mapping highlights the links required between these and residential areas, creating a network of MH's. The proposed mapping technique offers a system of planning that can be replicated in other towns and cities, regardless of scale or provision.

The study shows how existing public transport infrastructure is disconnected and therefore sustains a reliance on private vehicle ownership. Through data-backed placement of MH's, accessible from travel sources and destinations, a network can be created which will secure a place for buses in the future of transport.

2. Requirements of a Successful Hub

The successful uptake of MH's relies on the quality of their provision combined with a shift in behaviour. A review of best practice has been undertaken and key components summarised in **Figure 2.1**.

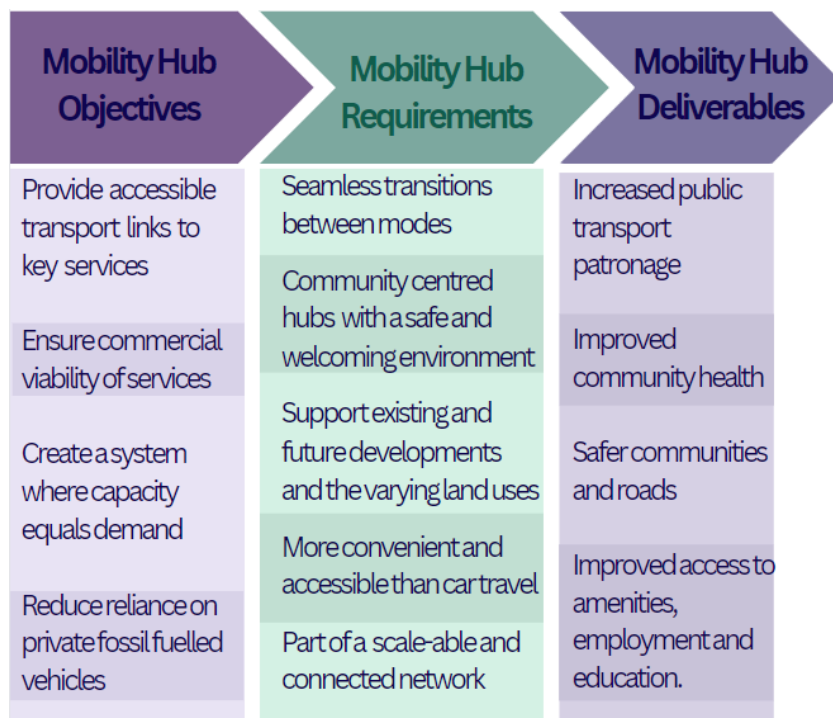


Figure 2-1: Mobility Hub Summary

2.1 Mobility Hubs and Changing Travel Behaviour

CoMoUK (2019) highlight 6 key factors of a successful MH, they are:

- **Choice:** the hub should comprise of shared and public modes of travel, alongside support for pedestrians
- **Visible & Accessible:** the hub should be integrated into the local network and be accessible to all
- **Multimodal:** the hub should make switching modes simple, in terms of physically accessing the service and ticketing.
- **Safe:** the hubs design and facilities should ensure traveller safety
- **Practical:** the hub should integrate non-travel related services
- **Visual, social and community appeal:** the hub should enhance local areas and integrate themselves into community life

Research by [Avenali et al \(2020\)](#) found that bus services can serve demand at a lower social cost (maintenance, infrastructure, pollution, travel time) than rail, except on routes with high daily demand and little fluctuation in peak/off-peak patronage. Creating a hub network that encompasses both modes for different journey types is key.

It is essential that physical infrastructure improvements facilitate behaviour change. The COM-B model demonstrates the criteria required for a specific behaviour to be made ([West & Michie, 2020](#)), summarised in **Figure 2.2**.

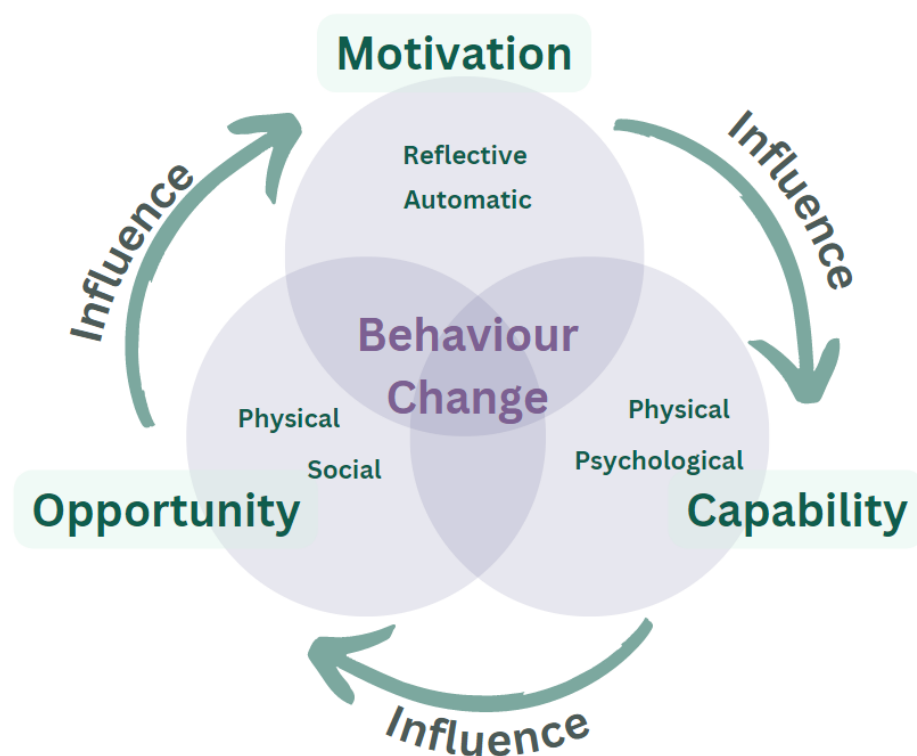


Figure 2-2: COM-B Summary

Our current transport system has made the motivation, capability and opportunity to drive easy to come across.

Capability: Over 70% of adults in Scotland hold a valid driver's license compared to 34% of households having access to a bicycle for adult use ([Transport Scotland, 2019](#)).

Opportunity: Scotland has 34,000miles of road compared to 1,643miles of NCN.

Motivation: Driving a return journey between Glasgow and Livingston at peak time costs £14.02 and takes 70-110 minutes (excluding parking) compared to £20.20 and 106-minutes for a return train ticket.

*Prices correct on 20/11/22

Travel surveys regularly cite the key determinant to mode choice as convenience and cost ([Mobility Lab, 2017](#)). Private vehicles offer door-to-door service, their 'sunk cost' can make car travel appear a cost-effective choice, they provide privacy and personal safety, and they allow route control ([Sustrans, 2019](#)).

An important behaviour to tackle is the aversion to switching modes or services. Changing services brings into play multiple variables; weather, waiting times, safety, delays and increased fares to contend with. Freidrich Lehner highlighted transfers between services or modes were important when managing how people viewed their journey ([Ploeger & Oldenziel, 2022](#)). The door-to-door service of private vehicles had considerable benefit over public transport, as these points of transfer are minimised, and the individual has greater control. Car ownership is also a key consideration to travel choice ([Ding et al, 2017](#)), research has found that once someone has access to a car, there is a perceived financial incentive to use it more often - sunk cost fallacy ([Kahneman, 2012](#)). Ensuring that MH's offer connected ticketing, reliable services, safe waiting areas and accessible information will help reduce the risk associated with multimodal travel or switching services.

Figure 2.3 shows a generalised comparison between journey times and cost while Figure 2.4 shows the balance between capacity and distance.

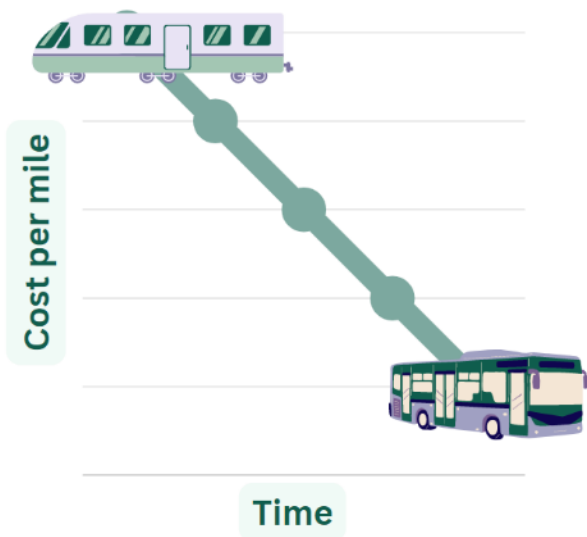


Figure 2-3: Public Transport Cost – Time Comparison

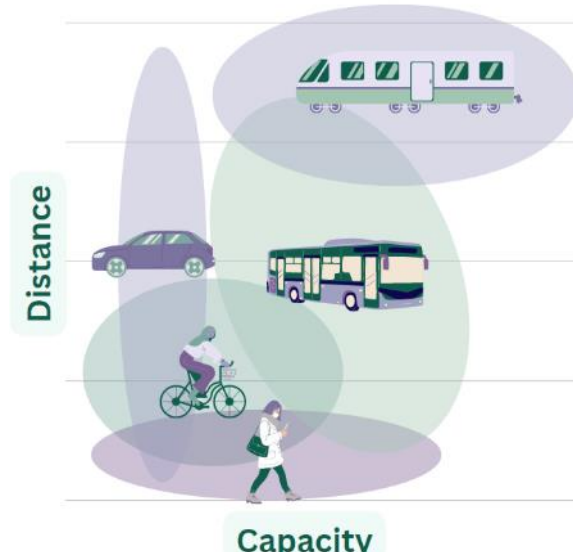


Figure 2-4: Transport modes Distance – Capacity comparison

Those with less disposable income may be forced to pay for a service with their time i.e., take the bus from Livingston to Edinburgh at a cost of £4 and 60-minutes compared to the train at a cost £10 and 16-minutes.

Services need to 'be' and 'appear to be' more convenient and cost effective - in terms of money and time - than a private vehicle. Achieving this requires a two-pronged approach:

- Attract
- Deter

Figure 2.5 displays the attributes of public transport that can be used to attract users to the services (carrot) and the policies and infrastructure which can deter (stick).

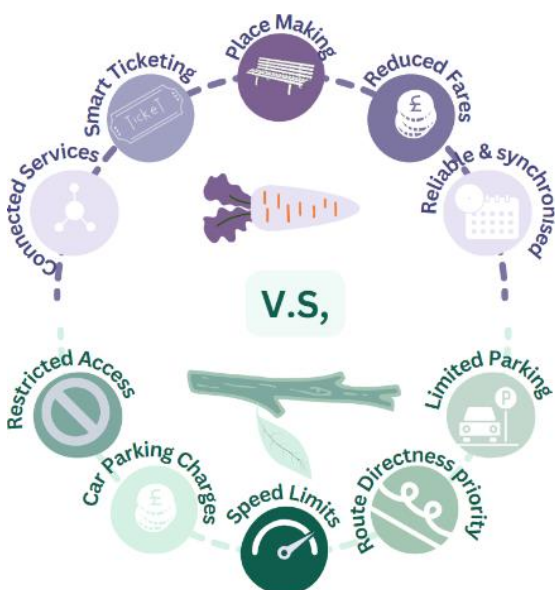


Figure 2-5: Travel behaviour change attractors and deterrents

3. Policy Review

Mobility hubs can do more than increase access to transport, and their implementation will align with the aims of a broad range of local and national policy. A selection are summarised in **Table 3.1**.

Table 3-1: Policy Summary

Area	Policy
Transport	<u>Regional Transport Strategy 2015-2025</u>
	<u>National Transport Strategy</u>
	<u>Young Persons Free Bus Travel Scheme</u>
Air Pollution	<u>Cleaner Air for Scotland 2</u>
	<u>National Low Emissions Framework</u>
Health	<u>National Performance Framework</u>
	<u>Active Scotland Delivery Plan</u>
Social Inclusion	<u>Fairer Scotland Action Plan</u>
	<u>Scotland’s National Strategy for Economic Transformation</u>
Walking/Wheeling/Cycling	<u>Active Travel Policy</u>
Disability Accessibility	<u>Disability Equality Scotland Strategic Plan 2020-2023</u>
	<u>A Fairer Scotland for Disabled People: Delivery Plan</u>
Rural Connectivity	<u>Scottish Government National Planning Framework 4</u>
Climate Change	<u>West Lothian Climate Change Strategy 2021-2028</u>
	<u>Scottish Government Climate Change Plan</u>
Population Distribution	<u>A Scotland for the Future</u>
	<u>Scotland Housing and Planning Delivery Framework</u>

4. West Lothian Background

4.1 Location

West Lothian is within the central belt of Scotland, shown in **Figure 4.1**, with a population of c.182,000. It is a predominantly rural council that had extensive mining operations in the 19th-20th centuries. A [video](#) from 1960's shows the planning behind Livingston, and the key aspirations for the area – place, work, people. The area is now home to 4,500 business, providing c.72,000 jobs. It is a popular commuter area for those working in Edinburgh and Glasgow, with regular train links to both cities within 50-minutes. The M9 and M8 connect Glasgow and Edinburgh, running through West Lothian.

It is West Lothians mix of land use and population density which make it an interesting example to explore in terms of a MH network, as MH's are mainly found in cities with high transport density ([Czarnetzki, F., Siek, F. 2022](#)).



Figure 4-1: West Lothian in a Scottish Context

Table 4.1 compares the West Lothian mode share to the Scottish, Glasgow and Edinburgh averages, using 2019 Scottish Household Survey data.

Table 4-1: West Lothian / Scotland mode share Comparison

Mode	West Lothian	Scottish Average	Edinburgh Average	Glasgow Average
Walk	20%	22%	33%	28%
Cycle	1%	1%	4%	2%
Bus	4%	8%	18%	13%
Train	3%	2%	1%	6%
Taxi	1%	1%	1%	2%
Car	72%	64%	42%	47%
Other	0%	1%	1%	2%

The gap in bus patronage in West Lothian may be explained, in part, by the convoluted bus routes; the recommended Bathgate to Edinburgh bus route is shown in **Figure 4.2**, it takes 92-minutes, the same trip by car would take 35-50minutes.

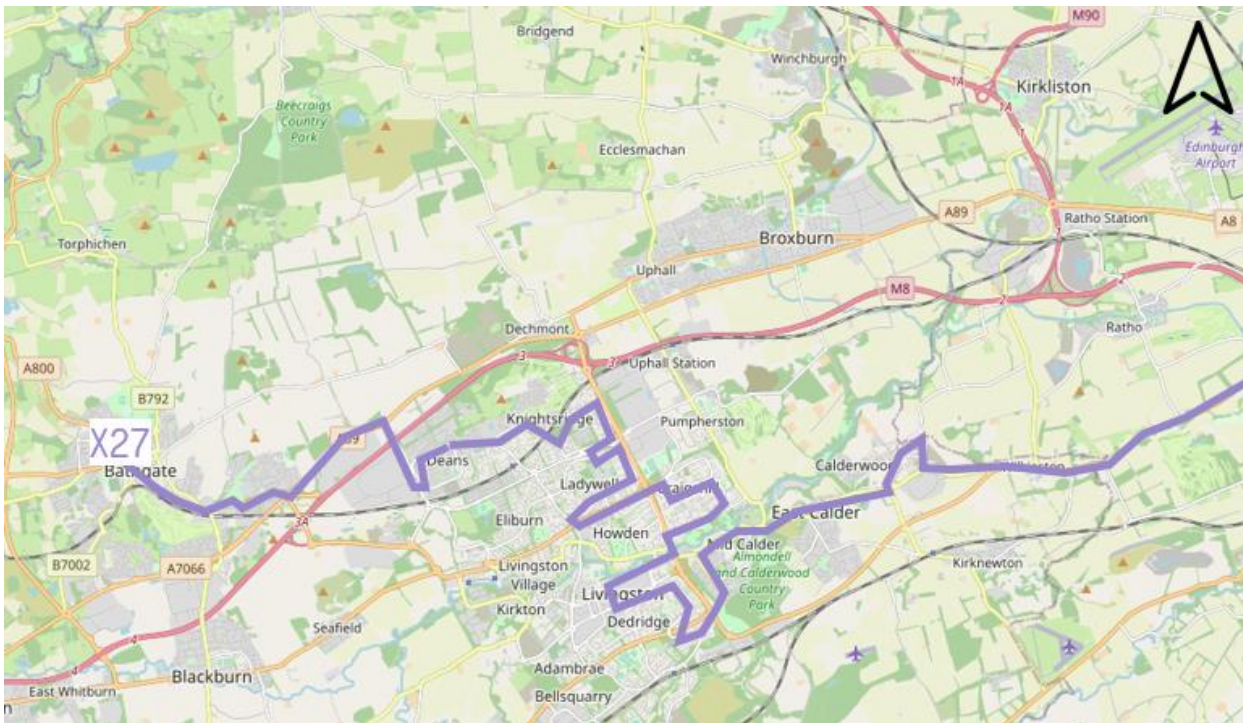


Figure 4-2: X27 Edinburgh to Bathgate Bus Route

4.2 Existing Public Transport Situation

4.2.1 Existing Park & Ride

West Lothian currently operates two P&R's, both situated on the A899 in Livingston, offering 9 bus services an hour, car parking and pedestrian links to local residential areas. **Figure 4.3** shows the 10-minute walking and cycling catchment of the P&R of which 10% of Livingstons population reside within.

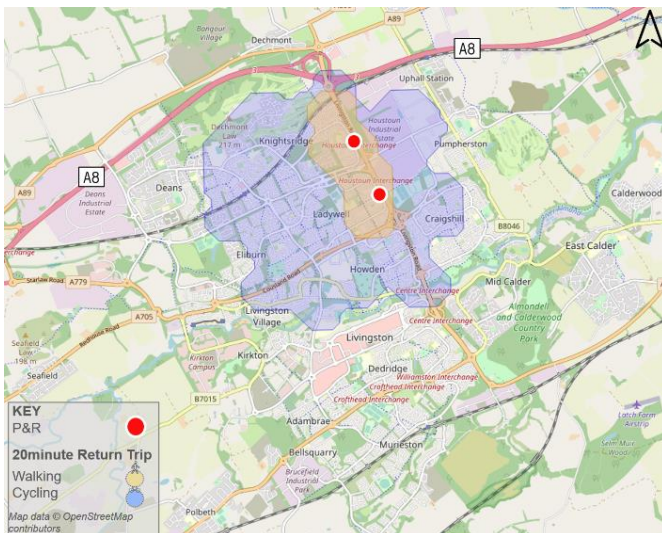


Figure 4-3: Livingston P&R combined 20-minute round trip catchment

Park & Rides (P&R) emerged in the UK in the 1970's as a form of MH and a solution to congestion in city centres (Dijk & Pankhurst, 2014). They situated car parks on city edges, allowing drivers to park at low cost and reduce city centre congestion and emission levels, **Figure 4.4**.



P&R's promised to increase public transport uptake, however, research has found several issues with their results:

- They maintain a reliance on private vehicles for daily journeys;
- Latent demand and apparent cost savings resulted in no overall traffic reduction; and
- A shift from active travel occurred.

Figure 4-4: P&R layout

However, P&R's situated within residential areas, which were able to capture commuters early in the journey were found to be less detrimental (Pankhurst, 1995 & Greater Auckland Inc, 2014).

This is where the future of MH's lie, removing the need for access to a car in the first place. The switch to public transport relies on convenience, however, persuading someone to drive part a journey then switch mode is unlikely to be seen as convenient.

4.2.2 Existing Mobility Hub

Calderwood Mobility Hub in West Lothian was unveiled by the new town's developer as West Lothians first MH in June 2021, shown in **Figure 4.5**. The Calderwood MH hosts a community car club with EV charging connections, e-bike hire and bus stops. A bus connects the community to the Lothian X27 route which runs to Bathgate, Hermiston Gait P&R and Edinburgh city centre.



Figure 4-5: Calderwood Mobility Hub (Image property of Stirling Developments)

The developer has reported success for the MH and points to the community café and shared space streets which see the car as the 'guest'. However, the hub is an individual and the housing design still promotes car ownership through private driveways. Creating a council and regional wide MH network would increase the viability of the hub and have the potential for lasting behaviour change.

4.2.3 Existing Sustainable Travel Services

West Lothian Bike Library is a community-based project connecting individuals with the tools and skill to cycle, while Paths for All health walks groups help individuals grow their confidence and fitness levels. As with the whole of Scotland, individuals under 22 and over 60 can access free bus travel. Linking in with groups and schemes such as these are a key to achieving behaviour change through offering individuals opportunity to travel by more sustainable modes.

4.2.4 Existing Public Transport Connectivity

Figure 4.6 shows a simplified representation of the West Lothian transport network. There is a clear dominance in East-West connectivity, making travel by public transport to employment and services in nearby Falkirk and Stirling inconvenient.

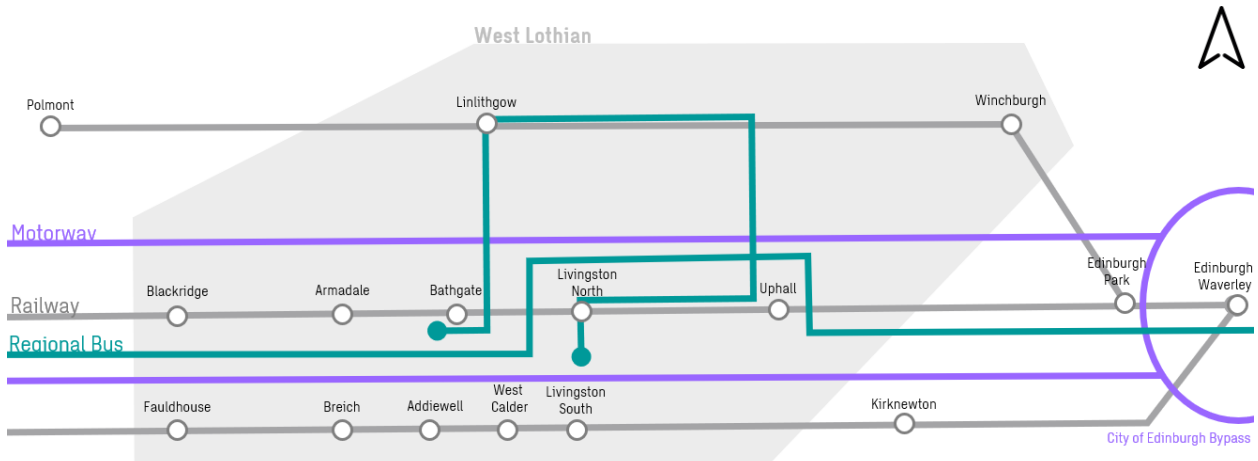


Figure 4-6: West Lothian Regional Transport Map

Figures 4.7 and **4.8** compare the 60-minute catchments from a central point in West Lothian by bus and by train.

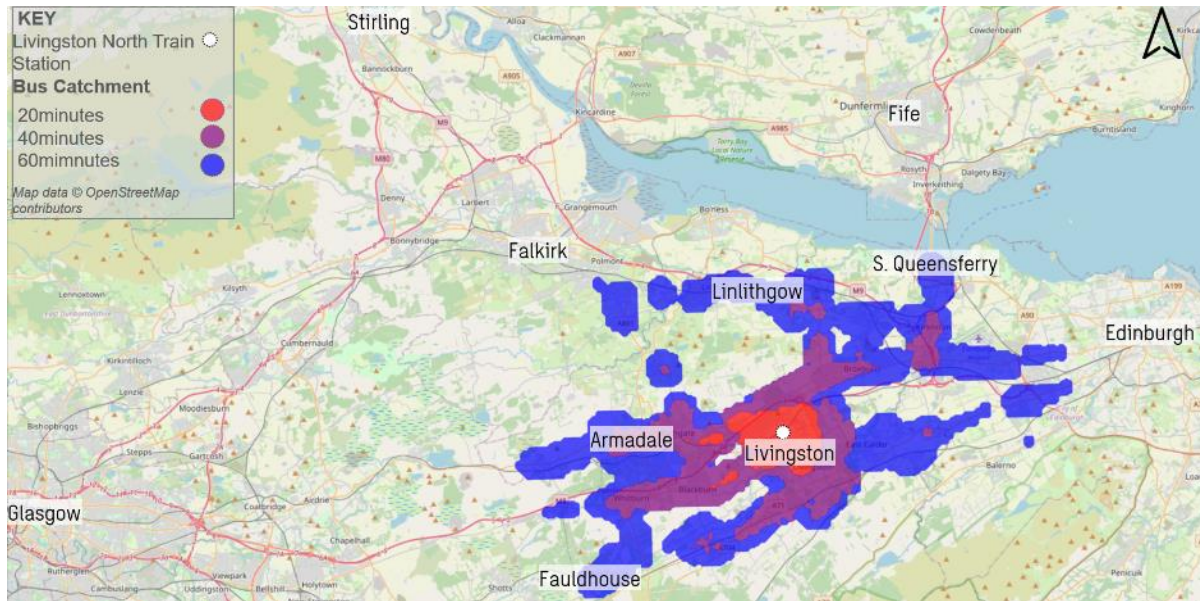


Figure 4-7: Livingston North Bus/Coach 60-minute Catchment

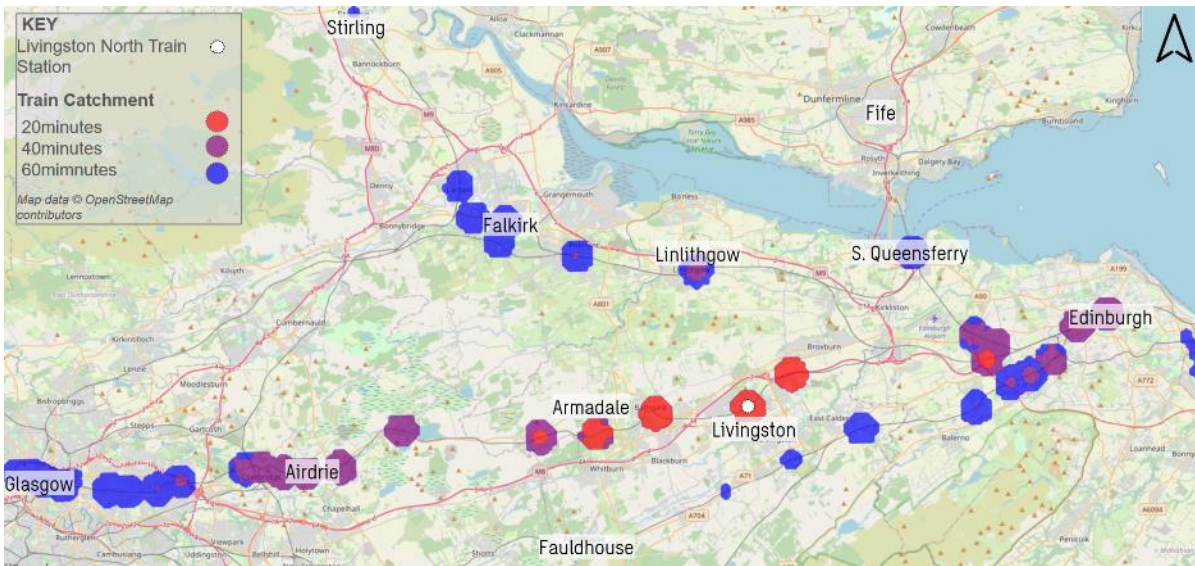


Figure 4-8: Livingston North Train 60-minute Catchment

As the figures show, bus travel in West Lothian provides a denser catchment but only reaches the edge of Edinburgh City Centre to the East and the edge of West Lothian to the west, within a 60minute journey. Train travel offers reduced density but reaches Edinburgh, Glasgow and Stirling city centres. This density/reach comparison is an important aspect of public transport and indicates a positive existing situation for West Lothian.

5. West Lothian Case Study

5.1 Methodology

QGIS and TRACC mapping software have been used to determine the key locations of MH's and their required components to increase accessibility of key services.

Through running two scenarios it was found that focusing on north-south connections brought about the greatest benefit. The proposed MH network was within a 10-minute walk/cycle or 20-minute bus journey of 93% of the West Lothian population and provided links throughout the council area and to Edinburgh and Glasgow.

Table 5.1 highlights the data used in the case study.

Table 5-1: Data Sources

Type	Source	Description
Spatial	Data Cutter	<ul style="list-style-type: none"> Council Boundary
	OS maps	<ul style="list-style-type: none"> Topography
Transport	Data Cutter	<ul style="list-style-type: none"> Public Transport Network Road Network
	Online Mapping	<ul style="list-style-type: none"> Cycle network Core paths
Demographic	Census	<ul style="list-style-type: none"> Age Access to vehicle Health Population Density
	SHS	<ul style="list-style-type: none"> Method of travel
Amenity	Audit	<ul style="list-style-type: none"> GP's Pharmacy Education Supermarkets Parks/Leisure Sport/fitness

5.1.1 Goals and Aims

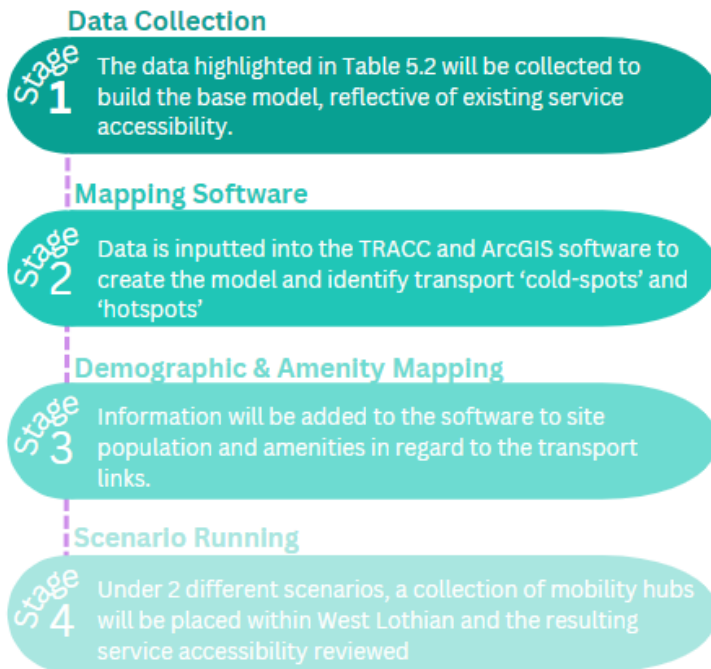
The goal of this case study is to use mapping software to effectively model where MH's could be most effectively situated to promote sustainable bus use in combination with active travel and rail travel.

The case study has 3 aims:

1. To effectively model the existing service accessibility in West Lothian
2. To design mobility hubs fit for purpose in each highlighted area
3. To design a methodology for the placement and facilities of MH networks.

5.2 Methodology

The methodology of the West Lothian case study was created based on consultation with colleagues at Sweco Sweden/Finland as well as review of sector best practice, it can be split into 4 stages:



The methodology was chosen due to its versatility, replicability and visual analysis capabilities. The same project could be replicated across all scales of development and supplementary data could be added at ease, e.g., existing cycle tracks, employer hotspots or collision data.

5.3 Mobility Hub Type

Three MH types were designed, their components are described in **Table 5.2**. They are categorised, by size, as the following:

- **Micro:** Low amenity density despite relative population density and an existing transport network
- **Intermediate:** Moderate amenity density with moderate/high population density and an existing transport network
- **Nucleus:** High amenity density regardless of population density and an existing transport network

Table 5-2: Proposed Mobility Hub Types and Components

Type	Component										
Micro	Drop-off Zone	Bus	Micro-mobility: Bike Hire including adapted, EV and cargo.			Demand Responsive Transport		Place Making		Interactive Information Boards	
Intermediate	Bus (& Train)	Car Club		Active Travel Connections	Micro-mobility: Bike Hire including adapted, EV and cargo.		Place making	Interactive Information Boards		Rest Stop	
Nucleus	Bus (& Train)	Car Club	Active Travel Connections	Micro-mobility: Bike Hire including adapted, EV and cargo.	Place making	Community meeting space / co-working zone	EV Charging	Amenities: Shop, GP, Deliveries, Bike Shop	Interactive Information Boards	Rest Stop	

5.4 Existing Situation

Through the use of TRACC and QGIS software, a public transport 20-minute catchment for West Lothian has been created, **Figure 5.1**. The catchment shows areas in West Lothian which are within 20-minutes by foot, bus or train of all 7 chosen key amenities. The chosen amenities, based on 20-minute neighbourhood guidance, were:

1. Primary School
2. High School
3. Supermarket
4. GP
5. Pharmacy
6. Green Space / National Park
7. Sport & Leisure Centre



Figure 5-1: West Lothian Existing Accessibility Zone

Green accessible zones are the areas where all 7 amenities were within 20-minute travel by existing public transport links of any given spot.

The map shows a series of connected corridors:

- along the A71, stretching from East Calder to Fauldhouse;
- along the A705 between Livingston and Greenrigg; and
- between Broxburn and Armadale.

Under the existing scenario **89%** percent of West Lothian population fall within the catchment.

Table 5.3 shows the percentage of West Lothian within a 10-minute bus journey of the following amenities. It compares accessibility for the entire population and for those that in the 2011 Scottish Census were recorded as having no access to a car/van.

Table 5-3: Population within Accessibility Zone per amenity type

Group	GP	Pharmacy	Primary School	High School	Super-market	Sport Centre	Green Space	Average
Population (182,000)	63%	71%	87%	41%	75%	42%	72%	64%
Without Access to a car	69%	80%	94%	48%	82%	54%	76%	72%

Figure 5.2 shows the Public Transport Accessibility Levels (PTAL) rating for West Lothian. PTAL is an accessibility grading technique which rates transport links, designed by Transport for London. Areas are rated from 1-6, with 1 being 'extremely poor accessibility' and 6 being 'excellent accessibility' and although suited to the density of a city like London, can still provide an indication of overall accessibility (TfL, 2022). As was mirrored in the accessibility mapping above, hot spots of accessibility can be seen in:

- Bathgate;
- Livingston;
- Uphall; and
- Broxburn.

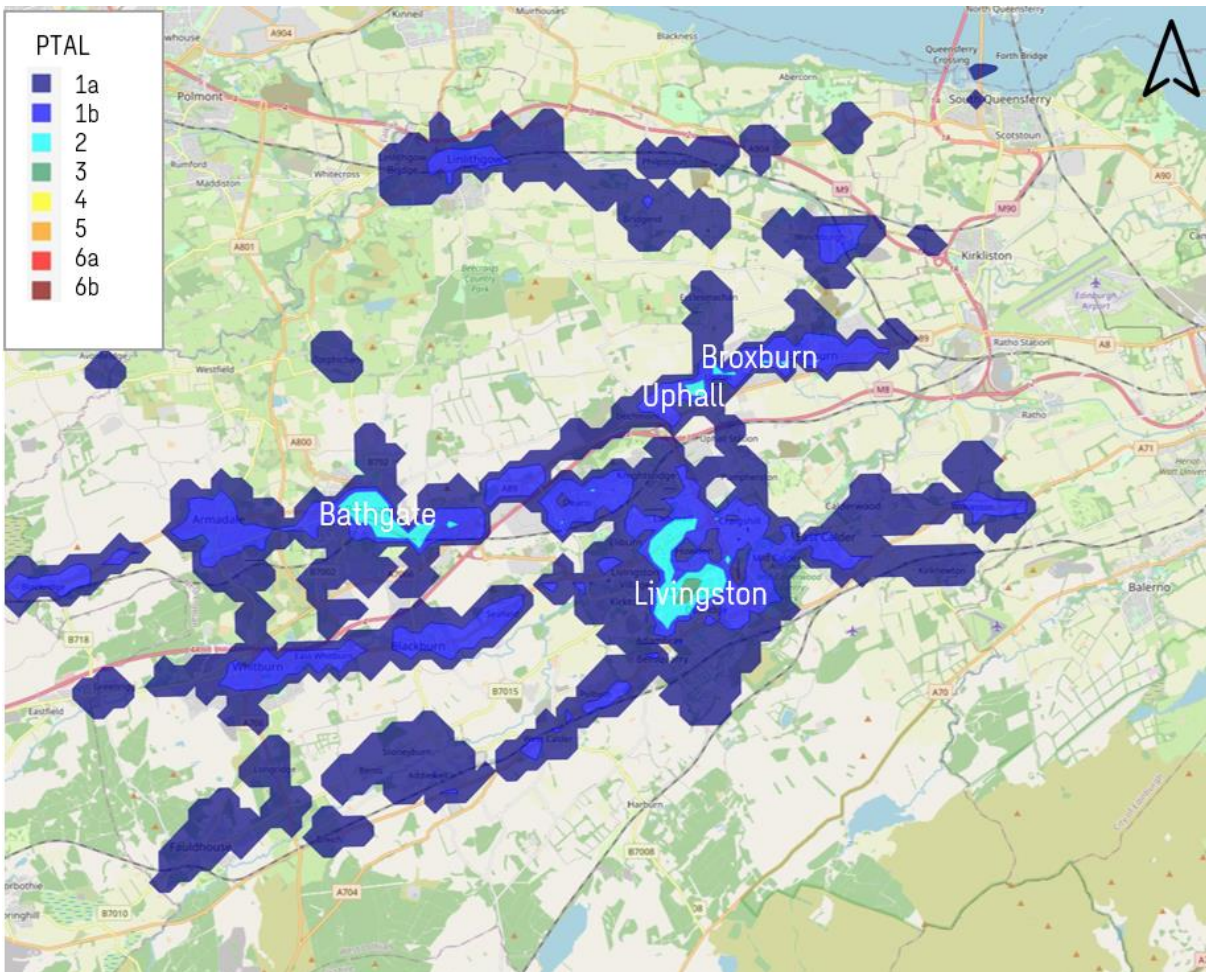


Figure 5-2: West Lothian PTAL

Areas with similar population density to the above, but with lower PTAL scores, as shown in **Figures 5.2** and **5.3**, are:

- Armadale;
- Whitburn; and
- Linlithgow.

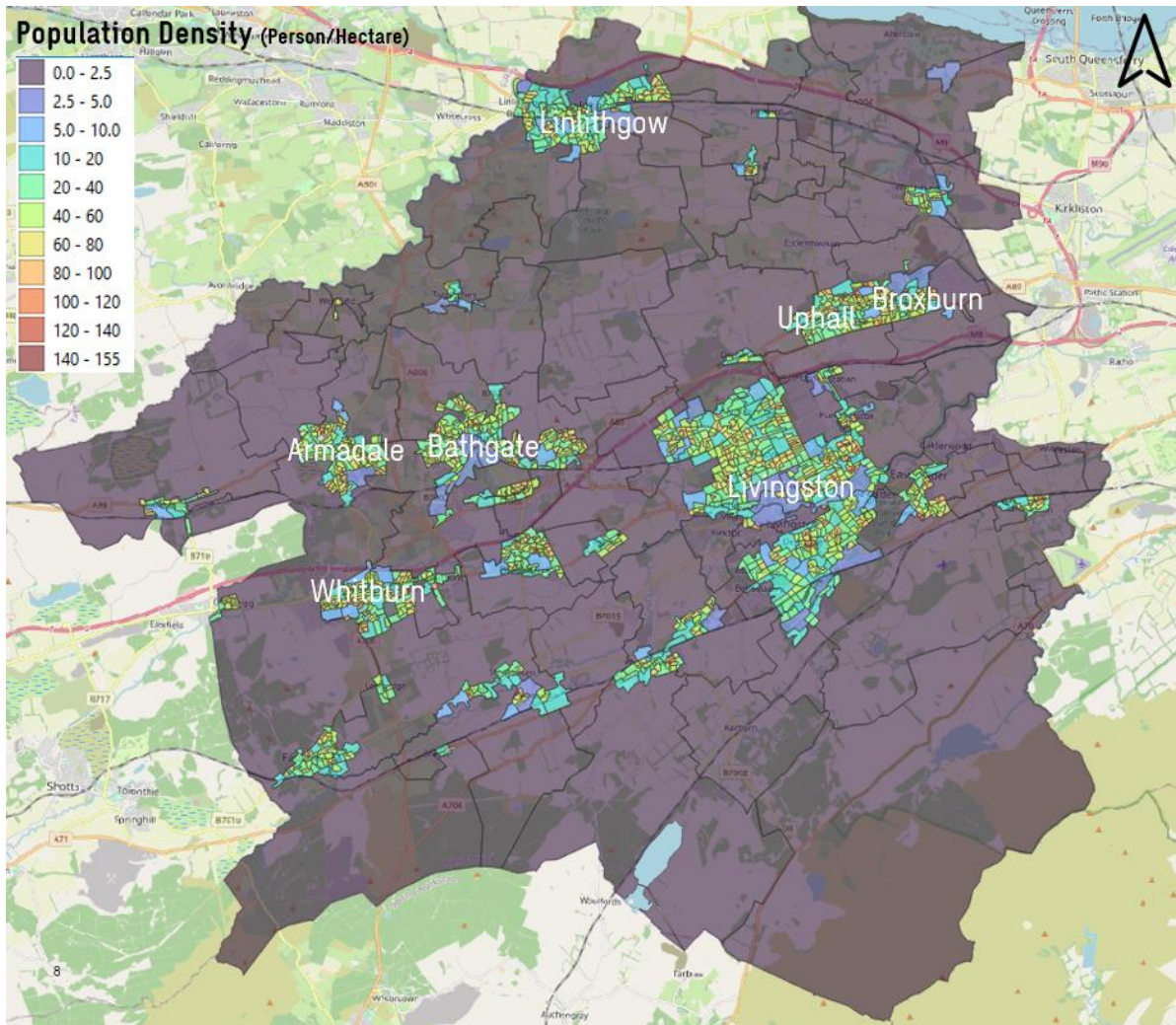


Figure 5-3: West Lothian Population Density (Census, 2011)

5.5 Site Selection

The selecting of the most suitable MH location was based on 9 measures, split across 3 themes. They are as follows:

- **Provision:**
 - Strong existing transport connections
 - Amenity density
- **Need:**
 - Dense population
 - Population have low access to private transport
 - Concentrated areas of poor health
 - Scores high on Scottish Index of Multiple Deprivation (SIMD)
- **Opportunity:**
 - Missing link i.e., Train Station to High Street
 - Under development
 - Lacks a connected centre

Figures 5.4 – 5.6 highlight the demographics of West Lothian.

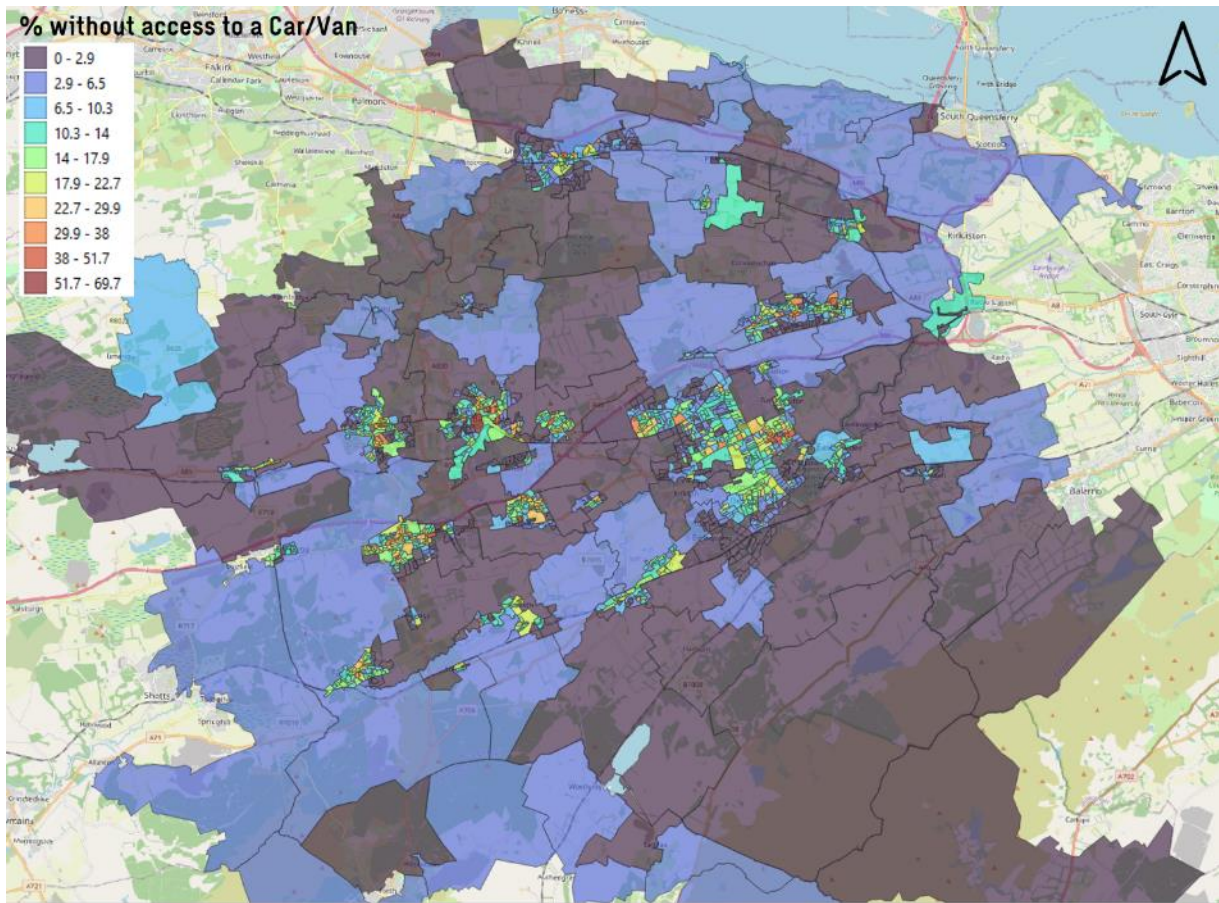


Figure 5-4: West Lothian Percentage of Population without Access to a Car/Van (Census, 2011)

Figure 5.4 shows that the highest proportion of population without access to a car reside in Bathgate, Armadale, and the Craigshill area of Livingston. There is a clear correlation between areas with high population density and low car ownership.

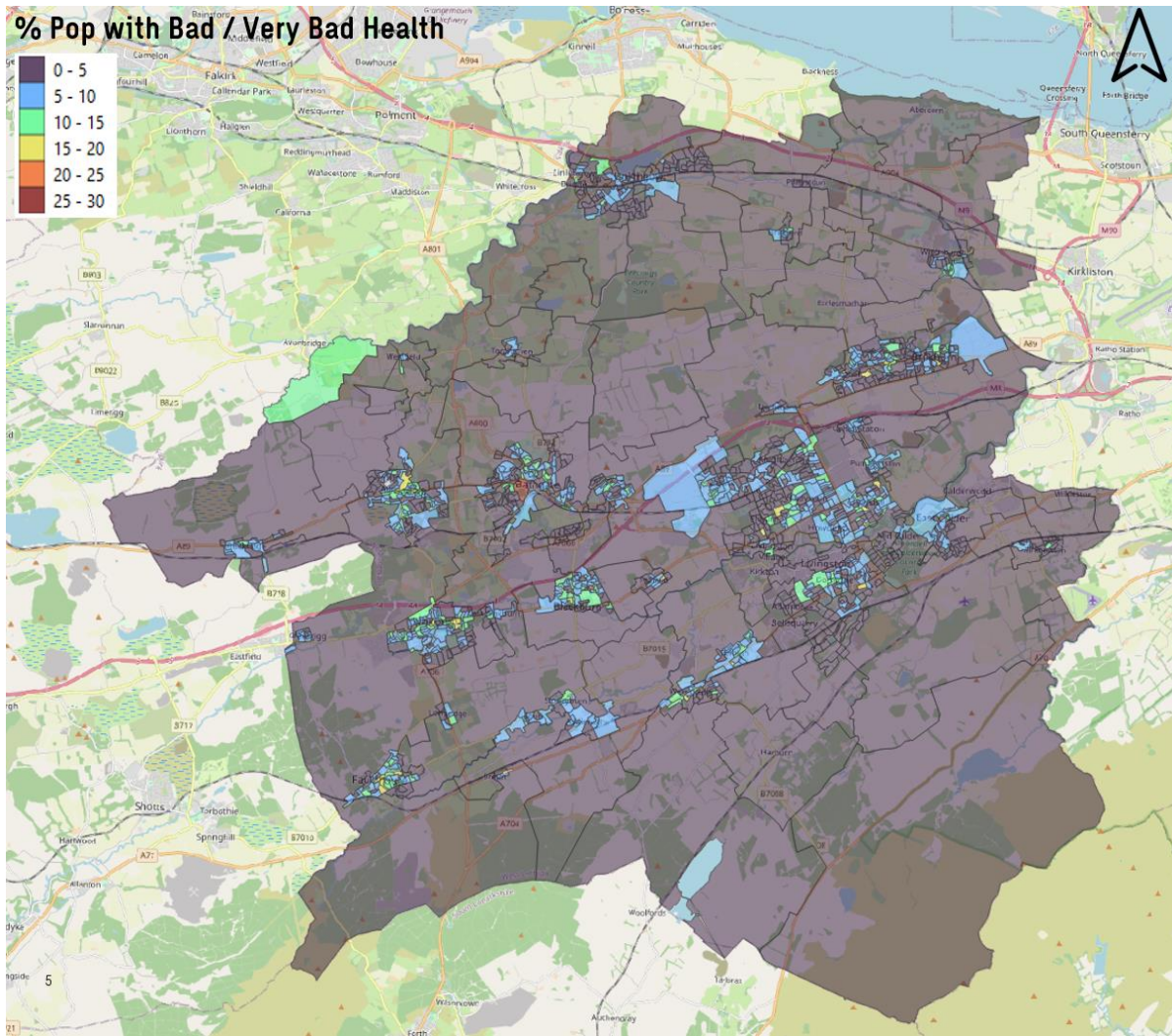


Figure 5-5: West Lothian Percentage Population with Bad /Ver Bad Health (Census, 2022)

Figure 5.5 highlights the zones with the highest percentage of the population with 'Bad' or 'Very Bad' health. Again, there is a concentration in Bathgate, with one output area with 25-30% of residents recording their health as 'Bad' or 'Very Bad'.

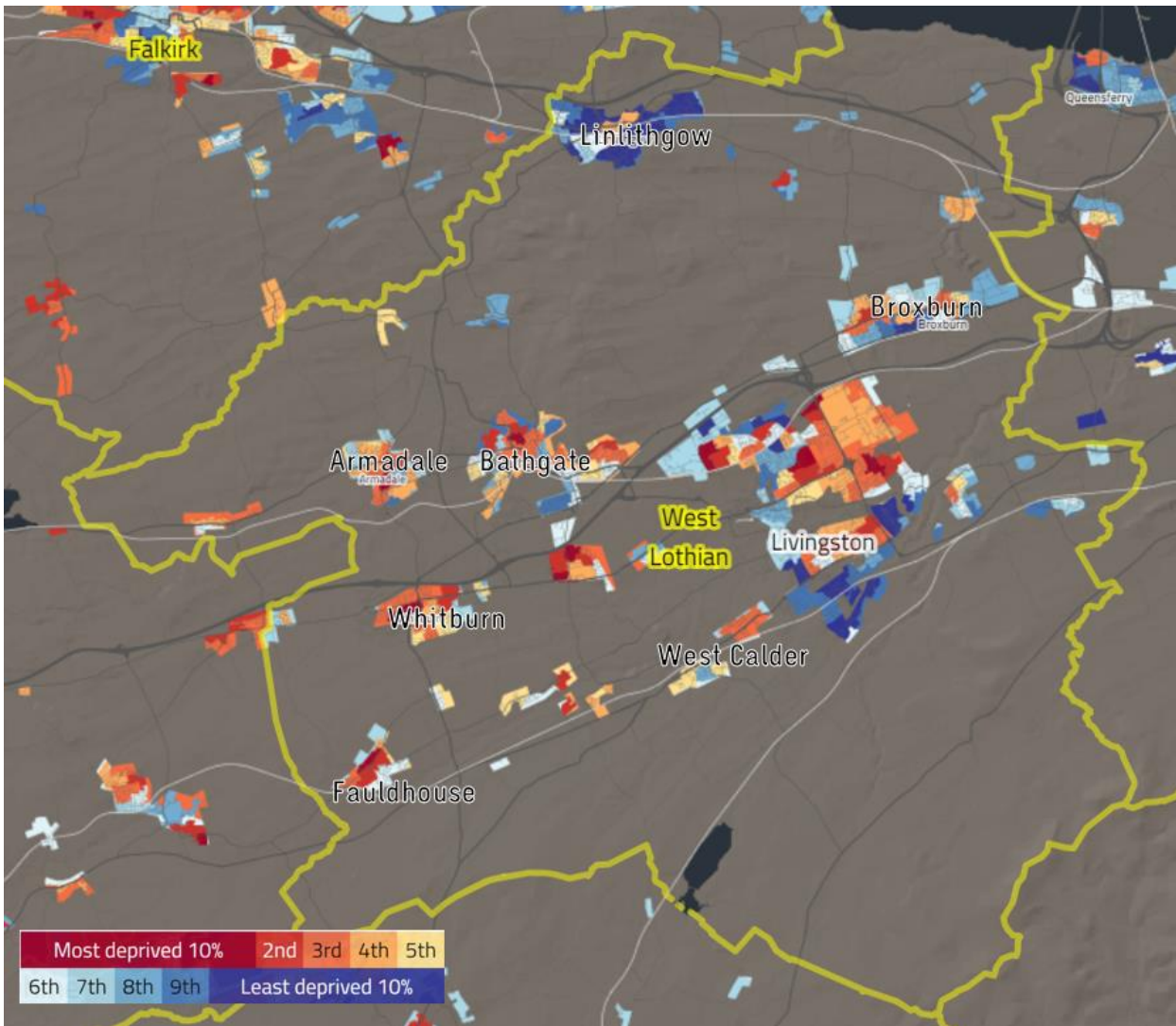


Figure 5-6: West Lothian SIMD Mapping (simd.scot)

Figure 5.6 shows the Scottish Index of Multiple Deprivation. Areas in red are scored as the most deprived and those in blue are the least deprived. Areas within West Lothian scoring within the 10% most deprived can be seen in Livingston, Bathgate, Armadale, Whitburn, Blackburn and Fauldhouse.

Table 5.4 shows areas that meet the criteria to be a potential site for a MH, based on the aforementioned mapping.

Table 5-4: West Lothian Towns/ Villages which meet criteria to be considered for MH (green)

Area	Within Accessible Zone	Amenity Density	Dense Population	Under Development	Low Access to a Car / Van	Population Poor Health	SIMD Rating <small>(1st & 2nd most deprived)</small>	Total
Armadale	Green	Green	Green	Green	Green	Green	Green	7
Abercorn	Red	Red	Red	Red	Red	Red	Red	0
Addiewell	Green	Red	Green	Red	Red	Red	Red	2
Broxburn	Green	Green	Green	Red	Green	Green	Green	6
Blackburn	Green	Red	Green	Red	Green	Green	Green	5
Bathgate	Green	Green	Green	Green	Green	Green	Green	7
Briech	Green	Red	Green	Red	Red	Red	Red	2
Calderwood	Red	Red	Red	Green	Red	Red	Red	1
East Calder	Green	Green	Green	Red	Green	Red	Red	4
Ecclesmachan	Red	Red	Red	Red	Red	Red	Red	0
Fauldhouse	Green	Green	Green	Red	Green	Green	Green	6
Greenrigg	Green	Red	Green	Red	Red	Red	Red	2
Longridge	Green	Red	Red	Red	Red	Red	Red	1
Livingston	Green	Green	Green	Green	Green	Green	Green	7
Linlithgow	Green	Green	Green	Red	Green	Red	Red	4
Polbeth	Green	Red	Green	Red	Green	Red	Red	3
Torphichen	Green	Red	Green	Red	Red	Red	Red	2
Uphall	Green	Green	Green	Red	Green	Green	Green	6
West Calder	Green	Green	Green	Red	Green	Red	Red	4
Whitburn	Green	Green	Green	Red	Green	Green	Green	6
Westfield	Red	Red	Green	Red	Red	Red	Red	1
Wilkieston	Green	Red	Red	Red	Red	Red	Red	1
Winchburgh	Green	Green	Green	Green	Red	Red	Red	4

By reviewing the table, the following towns/villages stand out as potentially viable MH locations:

- Armadale;
- Broxburn;
- Bathgate;
- Fauldhouse;
- Livingston;
- Uphall; and
- Whitburn.

5.5.1 Service Permanence

When running the accessibility review it became clear that not all services and transport connections are fixed - some may change naturally over time, and some could be changed for an improved service – this led to the development of a service scoring system - **service permanence**, shown in **Table 5.5**.

Table 5-5: Service Permanence

Type	Static	Semi-Static	Fluid
Description	Unlikely to change	Possible to change	Can be changed
	Schools	Green Space/parks	Bus Route
	Residential	Cafes/shops	Delivery Services
	Hospital / GP	Cycle Lane	Bike Hire
	Employment	Footway	Market

Understanding the permanence of the location and type of services is crucial to creating a sustainable transport network that will connect people and services as areas change and develop. In the model, static points are treated as fixed while the semi-static and fluid points can be altered under the scenario testing.

5.5.2 Service Promotion

A system was created to determine where a set mode is suitable for a MH. The criteria are shown in **Table 5.6**.

Table 5-6: Mobility Hub Components Scoring

Mode	Discourage	Suitable	Promote
Walk	<ul style="list-style-type: none"> Streetlights and suitable pavement not available OR <ul style="list-style-type: none"> Distance over 2.4km 	<ul style="list-style-type: none"> Streetlights and suitable pavement available AND <ul style="list-style-type: none"> Distance between 2.4km and 1.6km 	<ul style="list-style-type: none"> Streetlights and suitable pavement available AND <ul style="list-style-type: none"> Distance under 1.6km
Cycle	<ul style="list-style-type: none"> No cycle lane on roads above 40mph OR <ul style="list-style-type: none"> Distance over 10km 	<ul style="list-style-type: none"> No Cycle Lane on roads 30mph or below And <ul style="list-style-type: none"> Distance under 10km 	<ul style="list-style-type: none"> Cycle lane or lit cycle track OR <ul style="list-style-type: none"> On quiet route with 20mph limit AND <ul style="list-style-type: none"> Distance under 8km
Public Bus	<ul style="list-style-type: none"> Less than 1 hourly service OR <ul style="list-style-type: none"> Takes more than 60-minutes 	<ul style="list-style-type: none"> At least 1hourly service And <ul style="list-style-type: none"> Takes less than 60-minutes 	<ul style="list-style-type: none"> More than half-hourly service AND <ul style="list-style-type: none"> Takes less than 40-minutes
Train	<ul style="list-style-type: none"> Takes more than 60-minutes OR <ul style="list-style-type: none"> Fare is more than double Bus 	<ul style="list-style-type: none"> Takes less than 60-minutes AND <ul style="list-style-type: none"> Fare is less than double bus 	<ul style="list-style-type: none"> Takes Less than 40-minutes AND <ul style="list-style-type: none"> Fare is less than double bus
Demand Responsive Transport (DRT)	<ul style="list-style-type: none"> Suitable bus or train services available 	<ul style="list-style-type: none"> No suitable bus or train services AND <ul style="list-style-type: none"> Services are out-with walking catchment 	<ul style="list-style-type: none"> No suitable bus or train services AND <ul style="list-style-type: none"> Services are out-with walking and cycling catchment

5.6 Scenario Testing

5.6.1 Scenario 1: North / South Links

Scenario 1 will focus on improving north/south connectivity and links to regional transport links.

Figure 5.7 shows the 5 locations chosen for the MH's; 3 nucleus, 1 intermediate, and 1 micro. It also shows West Lothians existing MH in Calderwood.

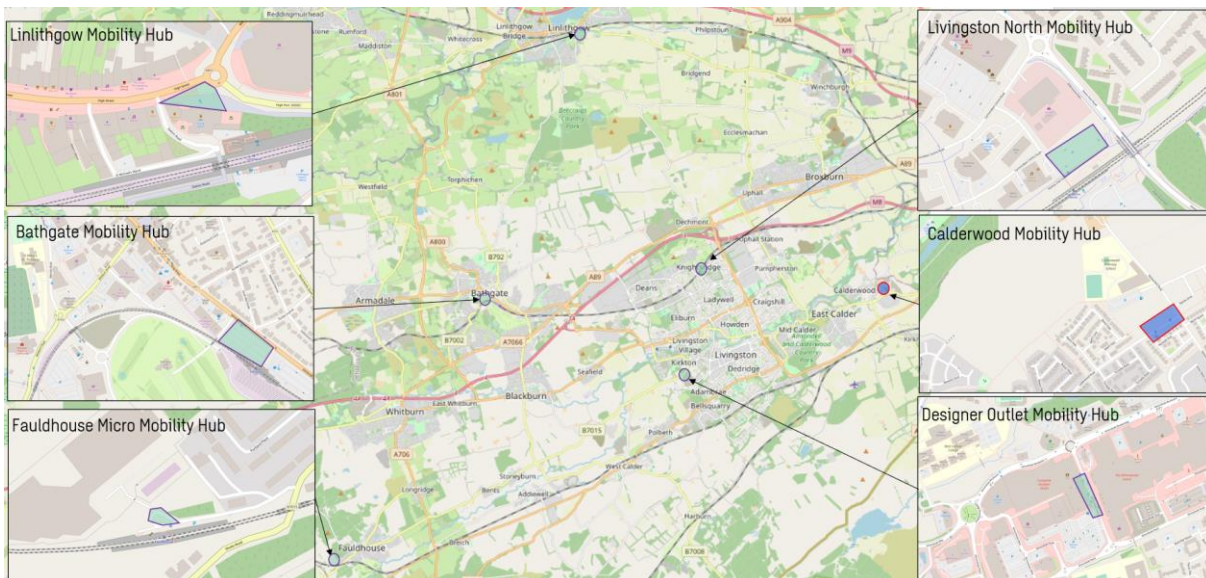


Figure 5-7: Scenario 1: Mobility Hub Locations

Table 5.7 highlights the reasons for choosing each hub

Table 5-7: Scenario 1 Mobility Hub Reasoning

Mobility Hub	Type	Location	Reasoning
Livingston North Rail Hub	Intermediate	Livingston North Train Station	<ul style="list-style-type: none"> Links with Designer Outlet Hub creating a north/south link which can feed to Bathgate MH link via train, bus or active travel. Links to Glasgow-Edinburgh rail line Links with Hospital shuttle bus Links with NCN 75 and core Alderstone Path Nearby GP, supermarket and pharmacy Car Club parking opportunity
Bathgate Rail Hub	Nucleus	Bathgate Train station	<ul style="list-style-type: none"> Links to Glasgow-Edinburgh rail line Links to Livingston North MH via train Bus link to Linlithgow Link to NCN 75 Nearby Highstreet and supermarket Car Club parking opportunity
Fauldhouse Micro Hub	Micro	West Calder Highstreet	<ul style="list-style-type: none"> Links to Glasgow-Edinburgh rail line Cycle links to Longridge & Breich Bus link to highstreet and schools Reduces isolation of train station from town
Linlithgow Rail Hub	Nucleus	Linlithgow Train station	<ul style="list-style-type: none"> Links to Edinburgh-Glasgow/Stirling rail line Links to Bathgate MH via bus Links to NCN 754/Union Canal On highstreet Bus links through town Improved public realm opportunity

Livingston Designer Outlet (DO)	Nucleus	Livingston Designer Outlet	<ul style="list-style-type: none"> • Links to NCN 75 • Links to Livingston South rail station • Links to Livingston North MH via bus/cycle • High amenity density/tourist destination • Links to numerous bus services • Car Club parking opportunity • Improved public realm opportunity
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In all instances land constraints have been considered; two would involve reclaiming land from existing car parks and the other 3 would make modifications to public realm owned by the council or Scotrail.

Figure 5.8 highlights the criteria of a 20-minute neighbourhood (Victoria State Government, 2017). There is growing momentum for 20-minute neighbourhoods (Our Place, 2022) - areas where infrastructure density and diversity can create areas where amenities are within a 20-minute round-trip of residences. **Figures 5.9-5.13** show the 20-minute review of each MH. Icons in black are ones which can be reached within a 20-minute round-trip of each hub by active travel.



Figure 5-8: Components of a 20-minute Neighbourhood

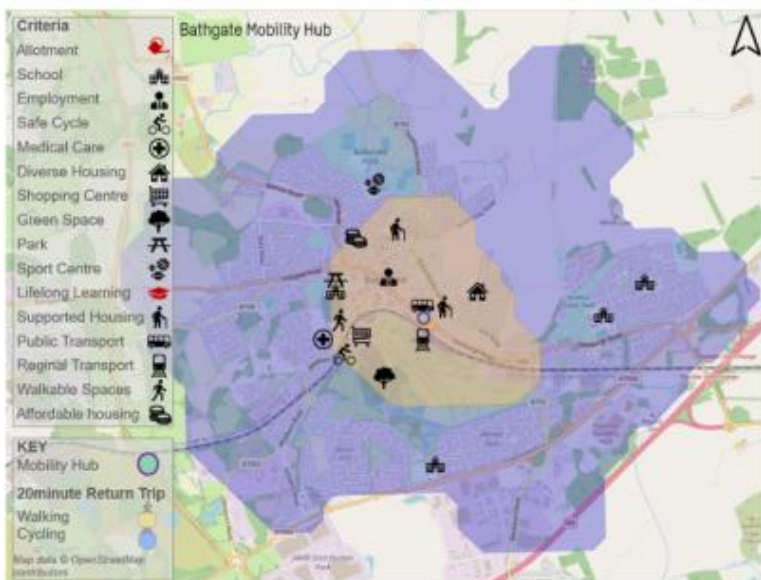


Figure 5-9: Bathgate MH

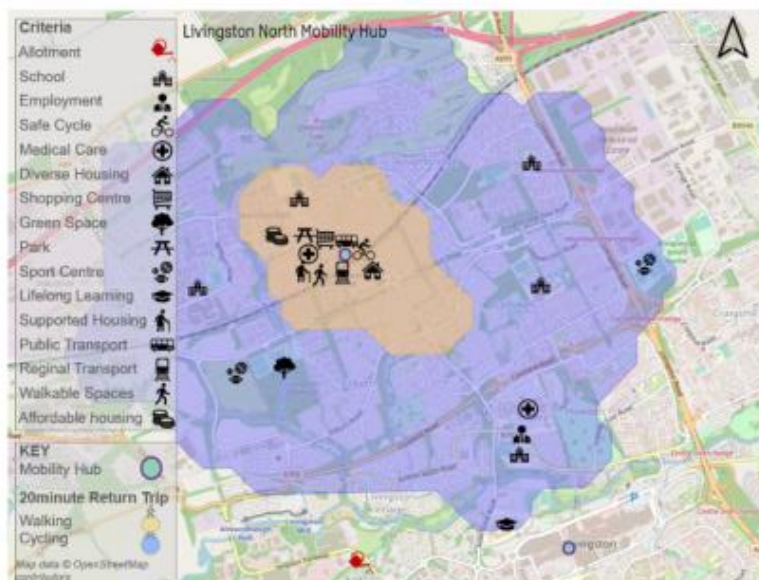


Figure 5-10: Livingston North MH

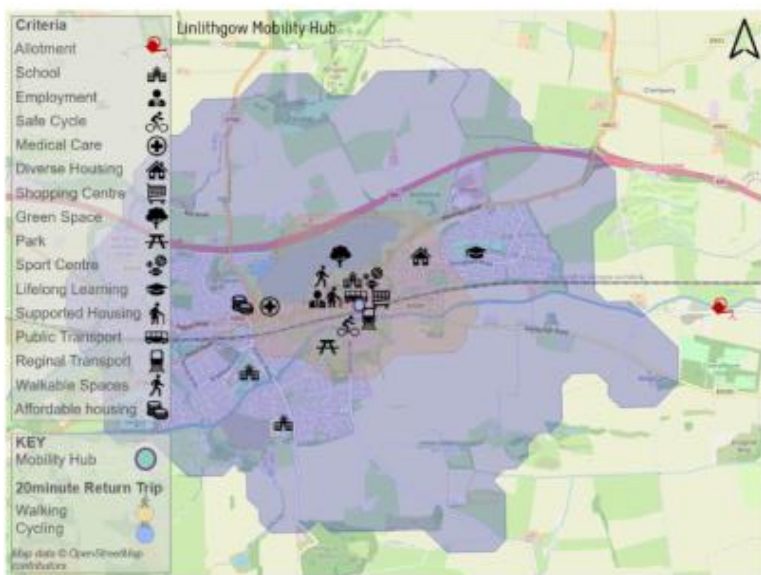


Figure 5-11: Linlithgow MH

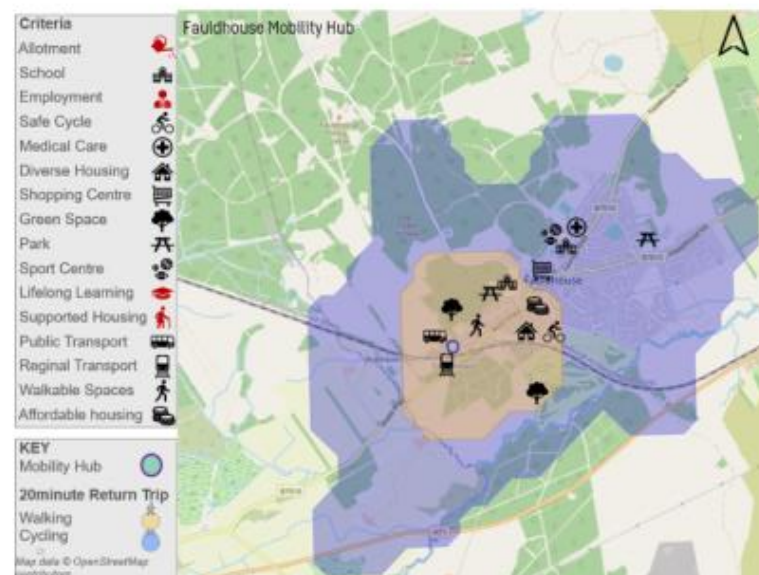


Figure 5-12: Fauldhouse MH

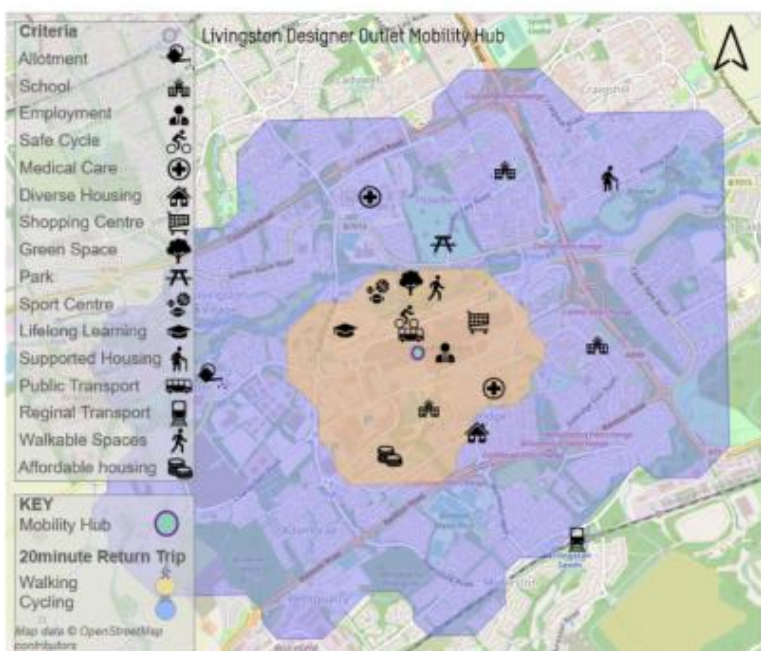


Figure 5-13: Livingston Designer Outlet MH

Figure 5.14 shows the proposed layout and facilities of the Livingston Designer Outlet Mobility Hub.

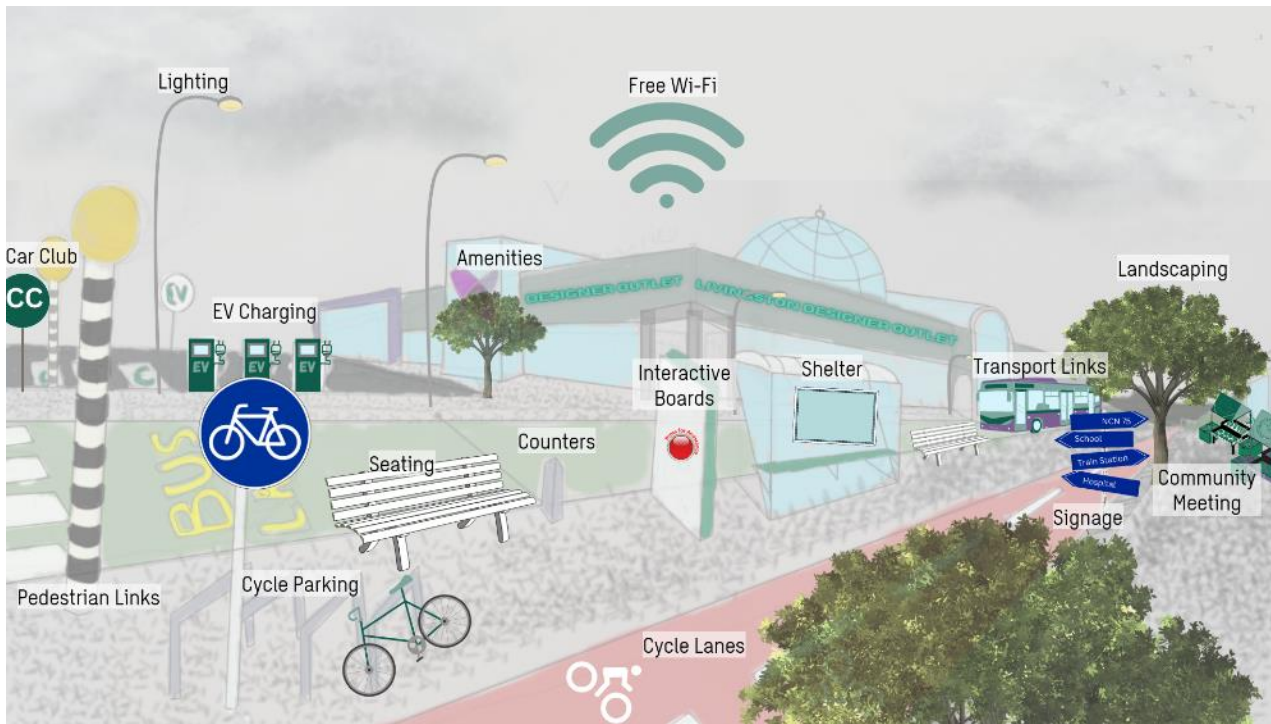


Figure 5-14: Livingston Designer Outlet Proposed Mobility Hub Design

5.6.1.1 Scenario 1 Network Summary

Scenario 1 MH network will:

- Promote north-south links, specifically Bathgate to Linlithgow and Livingston south to Livingston North.
- Promote 20-minute neighbourhoods in Livingston, Bathgate, Linlithgow and Fauldhouse.
- Create a community centre point in communities
- Offer place making opportunities
- Reduce reliance on private vehicle through improved links to amenities and regional transport links

Figure 5.15 shows the accessible zone for the new Hub network. **93%** of the West Lothian population live within the catchment zones. Accessibility and sustainable travel mode share would be further improved by the proposed car club, bike hire, active travel routes and bus stop amalgamation.

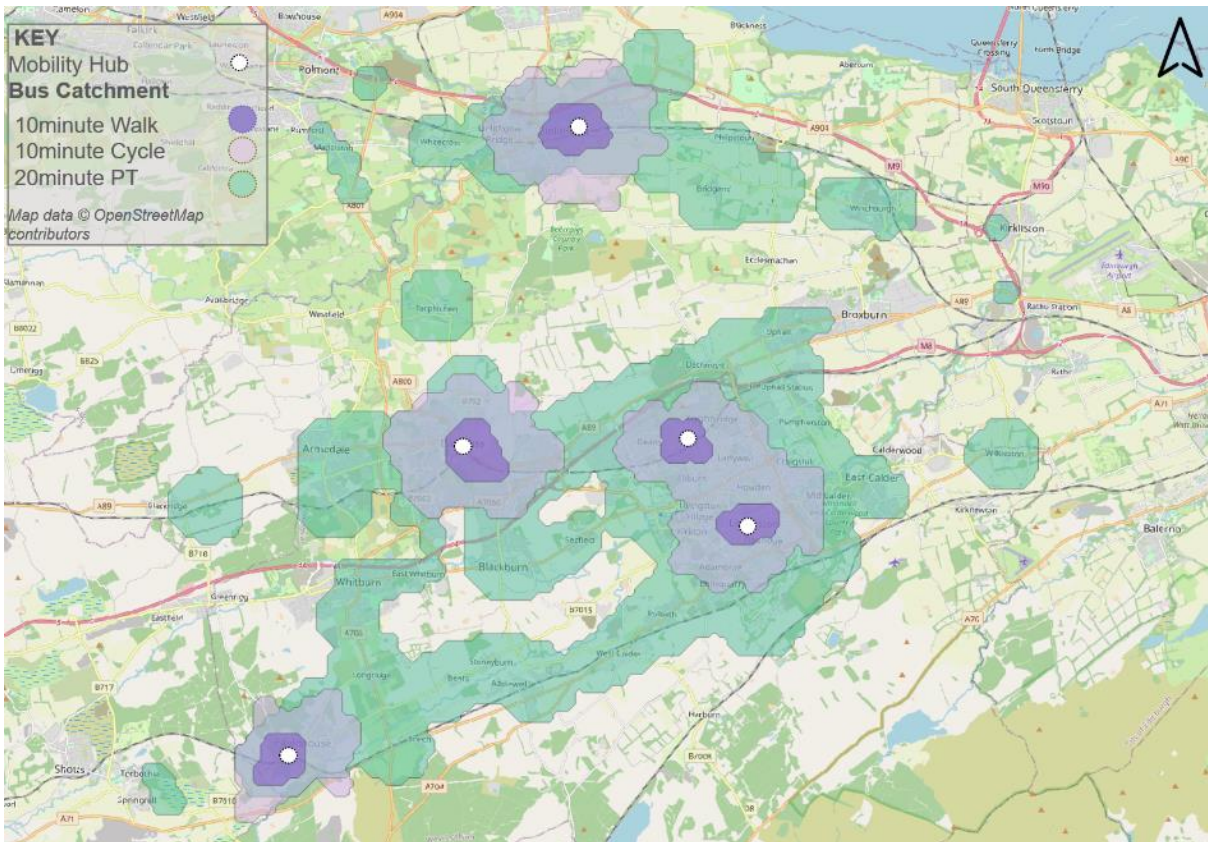


Figure 5-15: Scenario 1 Mobility Hub Catchment Mapping

5.6.2 Scenario 2: Micro-mobility Connections

Scenario 2 will focus on increasing local accessibility in areas well serviced by bus services, primarily through micro-mobility and making use of existing long distance cycle routes.

Figure 5.16 shows the 5 locations chosen for the MH's, 2 nucleus hubs, 2 intermediate, and 1 micro. It also shows West Lothians existing MH in Calderwood.

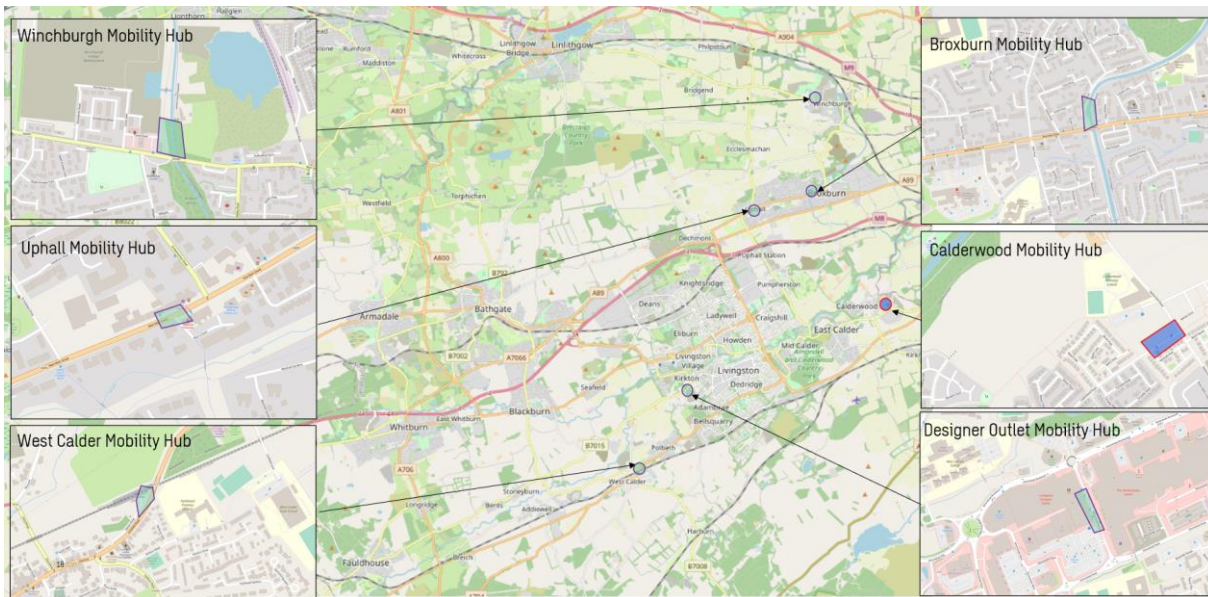


Figure 5-16: Scenario 2 Mobility Hub Locations

Table 5.8 highlights why each MH location was selected.

Table 5-8: Scenario 2 Mobility Hub Reasoning

Mobility Hub	Type	Location	Reasoning
Winchburgh Hub	Intermediate	Union Canal / B9080	<ul style="list-style-type: none"> • Links to union canal and Edinburgh • Links to Uphall and Broxburn MH's using existing cycle path • Area under considerable development • Nearby Winchburgh Village Development • Car Club parking opportunity
Broxburn Hub	Micro	Union Canal / Highstreet	<ul style="list-style-type: none"> • Links to Winchburgh MH via union canal • Links to Union canal for access to Edinburgh • Connects to Uphall MH and train station
Uphall Hub	Nucleus	Uphall Highstreet	<ul style="list-style-type: none"> • Links to Glasgow-Edinburgh Rail line • Centre point between Broxburn, Winchburgh and Livingston • Bus link to highstreet and schools • Makes use of cycle path between train station • Reduces isolation of train station from town
West Calder Rail Hub	Intermediate	West Calder Train station	<ul style="list-style-type: none"> • Links to Edinburgh-Glasgow/Stirling rail line • Links to Designer Outlet MH via existing cycle paths • Links to Schools via existing cycle paths • Creates link between rail and highstreet / residential • Bus links through town • Improved public realm opportunity
Livingston Designer Outlet (DO)	Nucleus	Livingston Designer Outlet	<ul style="list-style-type: none"> • Links to NCN 75 • Links to Livingston South train station • Links to Livingston North train station • High amenity density / tourist destination • Links to numerous bus services • Car Club parking opportunity • Improved public realm opportunity

As in Scenario 1, **Figures 5.17-5.21** show the 20-minute community review of each MH.

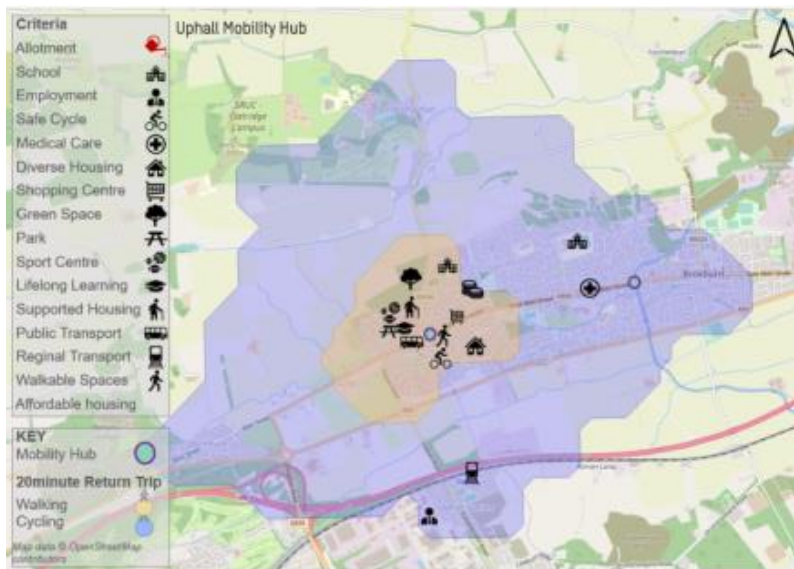


Figure 5-17: Uphall MH

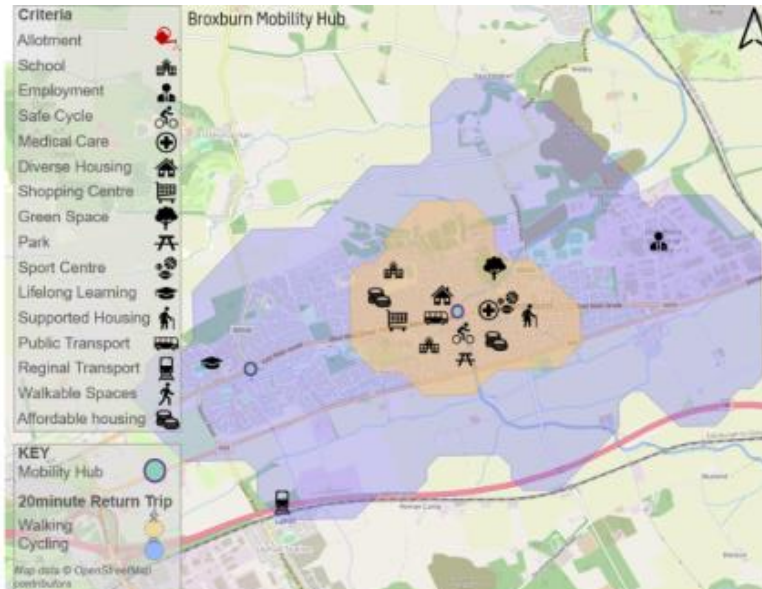


Figure 5-18: Broxburn MH

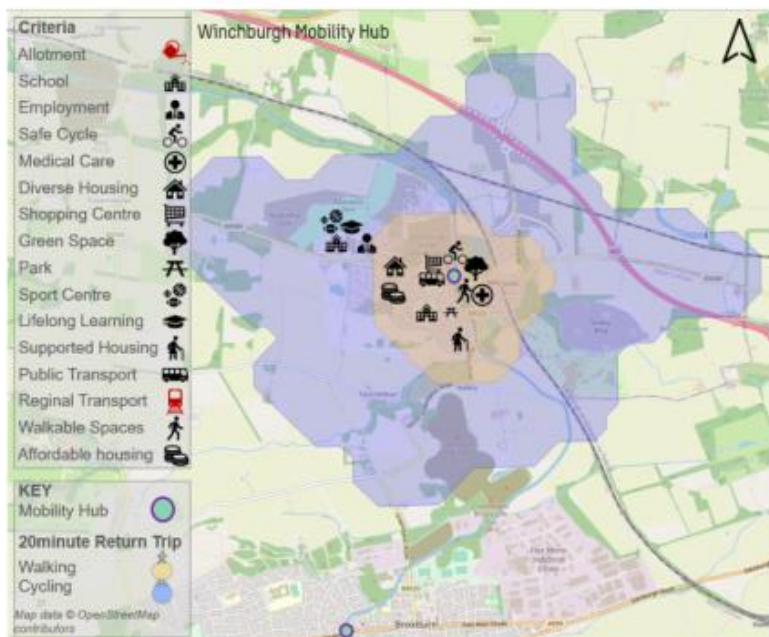


Figure 5-19: Winchburgh MH

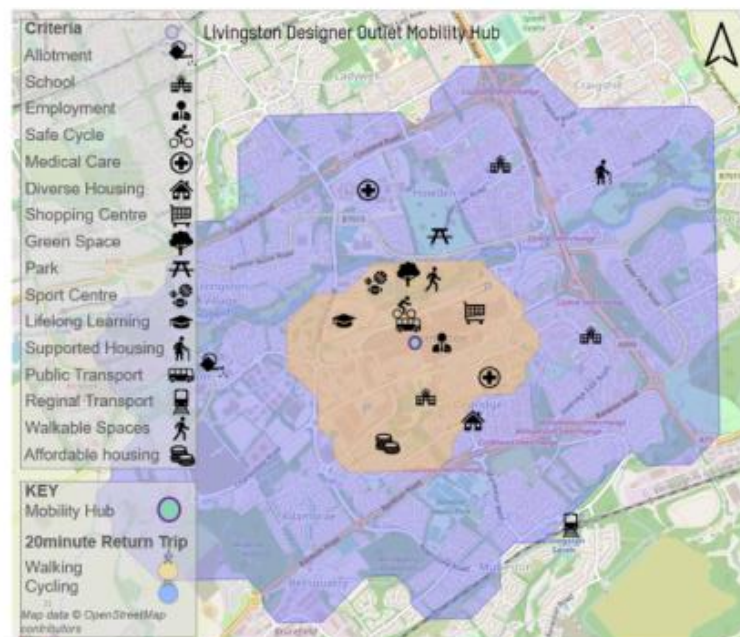


Figure 5-20: Livingston Designer Outlet MH

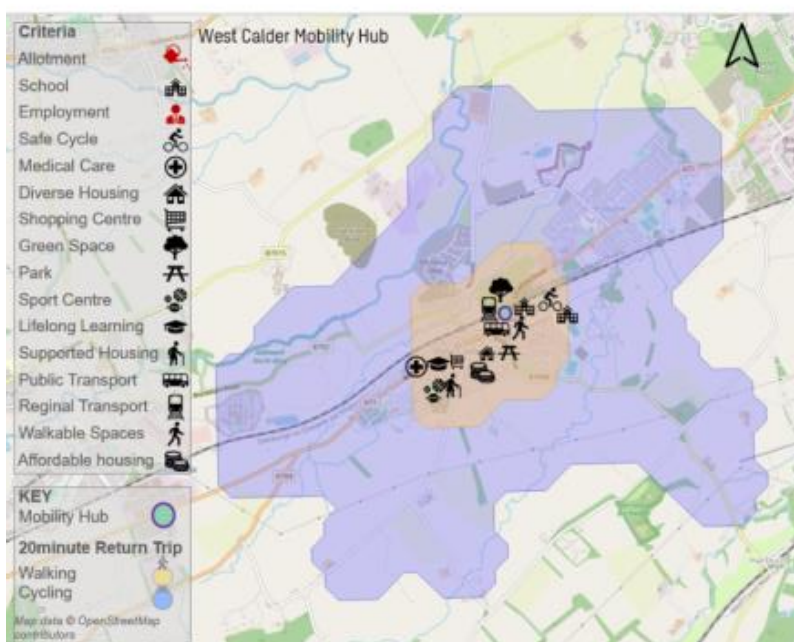


Figure 5-21: West Calder MH

Figure 5.22 shows the proposed layout of the West Calder Rail Mobility Hub and what facilities should be provided.



Figure 5-22: West Calder Rail Mobility Hub Design

5.6.2.1 Scenario 2 Network Summary

Scenario 2 MH network will:

- Promote micro-mobility connections between amenities and existing public transport links.
- Promote 20-minute neighbourhoods in West Calder, Livingston South, Uphall, Broxburn and Winchburgh
- Create connections between out-of-town train stations and highstreets
- Offer place making opportunities
- Reduce reliance on private vehicle through improved links to amenities and regional transport links

Figure 5.23 shows the accessible zone for the new Hub network. **72%** of the West Lothian population live within the catchment zones. Accessibility and sustainable travel mode share would be further improved through improvements to existing cycle tracks and signage.

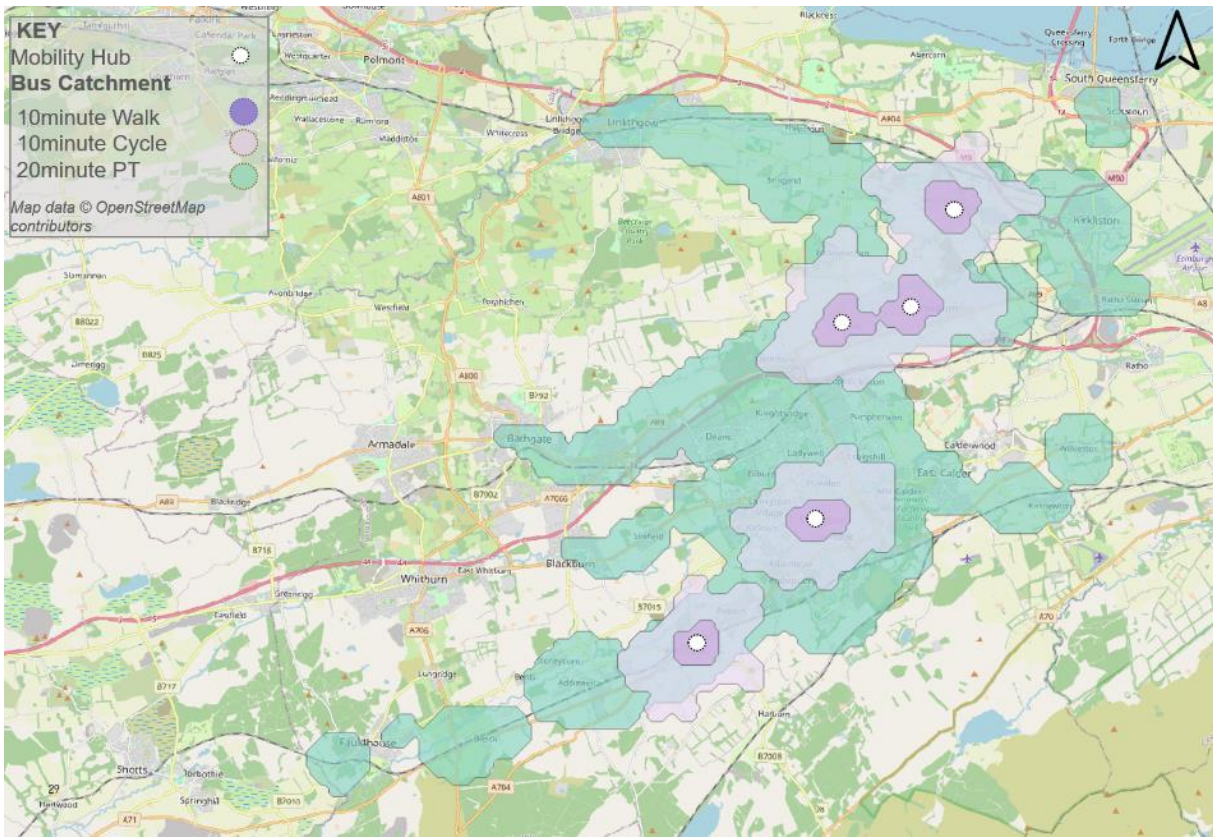


Figure 5-23: Scenario 2 Mobility Hub Catchment Mapping

6. Summary and Recommendations

Analysis shows scenario 1 brings about the greatest accessibility improvement and offers the greatest opportunity for high bus patronage through serving 93% of the population, across areas of high amenity and population density. The mapping methodology demonstrates a repeatable and cost-effective method to trial MH placement through catchment mapping. This same methodology can be scaled depending on the project and data can be tailored to the project aims.

6.1.1 Summary Table

Findings by the following publications have been used to collate the information in **Tables 6.1**:

- Arup & Go-Ahead, 2022
- CoMoUK, 2019
- Arseneault, 2022
- SEStran, 2020



Table 6-1: Summary of Best Practice Mobility Hub Placement & Provision Considerations

Transport	Bus Links	Dense bus network connections
	Train Links	Link to local and regional rail
	DRT	Demand Responsive Transport for rural areas
	Parking	Vehicle and cycle parking facilities. Including accessible cycle parking.
	Car Sharing	Digital platform to connect those making similar journeys.
	Hire	Car Club, bike hire and mobility aid hire (inclusive of standard, adaptable and cargo bikes)
	Charging	EV charging and E-Bike Charging
	Active travel Links	Links to walking and cycling routes
	Autonomous Bus	Autonomous vehicles can be made use of in place of short distance shuttle bus routes. Example: Inverness Campus.
Amenity	Shelter	Sheltered cycle parking and seating
	Cycle Tools	Repair stand for cycles/mobility aid
	Seating	Waiting and meeting seating. Creating community spaces for all.
	Toilets / Changing	Accessible toilets and changing areas.
	Ticketing Services	Access to tickets and membership, usable across all modes.
	Wi-Fi	Free and high speed
	Provision	Access to free water refill and affordable food.
	Postal/Drop-off	Provision of delivery lockers

		Business deliveries could use MH's as a drop-point for HGV's, enabling highstreets to implement pedestrianised zones.
Demographic	Low Income Areas	Support low-income areas to ensure access to employment, education and services
	Engagement	Engage with broad scope of communities to ensure minority groups are included in design and provision
	Transport Deserts	Combine DRT with MH networks to create viable Transport solutions in rural and low population density areas.
Place	Lighting	Appropriate lighting, fitting for the setting of the hub.
	Planting	Landscaping to create a welcoming and naturally sheltered area.
	Meeting space	Creation of communal space, adaptable to events such as Dr Bike, farmers markets, travelling library's, blood donation services and general gatherings.
	Safety	Adaptations reflective of community consultation to improve perceived and actual safety.
	Visibility	Sightlines & visibility considerations – both for promotion of MH and perceived safety of users.
	Art	Investment in art and sculpture along services
	Play	Offering parks and safe spaces for children 0-18.
	Branding	Attractive, informative and connected branding across MH's and services.
Information	Digital Information	Access to digital and interactive information via boards and app. Clear service information e.g., next service countdown.
	Accessible Visual Information	Visual representations of information, accessible to those with learning difficulties, visual impairments or language barriers. Height of information boards – ensure accessible to younger/shorter people and those in wheelchairs.
	Support	Access to support for journey planning via council website, onsite print and digital information boards.
Energy	Solar Photovoltaic Roofing	Reducing reliance on fossil fuels through the use of PV roofing
	Device Charging	Availability of sockets for charging of personal devices e.g. phones or mobility aids.
	Vehicle Fuel	Investment in electrification of rail and buses, offering e-bus charging at stops.
Collaboration	Service Providers	Align design and provision with needs of bus, train, micro mobility providers Set a Hub management plan prior to opening

	Local Community Groups / Residents	Consult and work with local groups – research has shown it increases uptake and positive support of services.
	Developers	Work with council and developers to ensure new residential areas are connected
Policy	Network	Create a long-term MH strategy for council and region, ensuring a future connected network.
	Management	Lay out management plans and responsibilities of different contributors e.g., council, transport provider.
	Funding	Build MH's into transport policy and ring fence funding, diverted from private vehicle infrastructure. Use Developer contributions to support new develops transport connections.

Helping the shift from private vehicle to active travel and public transport will contribute to achieving the [Scottish Governments \(2019\)](#) target of Net Zero emissions by 2045, especially as transport is the leading contributor to Scotland's Greenhouse Gas Emissions. MH's will bring social benefits in terms of transport poverty reduction and increased access to services regardless of health, wealth or location.

6.2 Recommendations

This report has put forward a methodology for the successful placement and design of mobility hub networks which have the potential to increase the convenience and appeal of bus travel in the UK. The following recommendations are made:

- Use GIS mapping and demographic data to determine the optimal placement for hub networks, saving time and money for projects and allowing scenarios to be tested and consulted upon by stakeholders and the public.
- Test future scenarios through adding in potential bus routes, employment centres or active travel links.
- Involve communities and stakeholders throughout the process, ensuring the hubs become a community focal point.
- Ensure collaboration on a local and regional scale to create a cross boundary network of connected hubs.

Through ensuring access to sustainable transport is accessible - in terms of time, cost and placement - the transport hierarchy of convenience, of which the car is currently top, can be amended.

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