Vertical urbanism and the forgotten plans for heliports

LOOKING AHEAD - A ROTARY AERODROME
(see page 70)

SUGGESTED INTER-CITY
HELICOPTER TRAFFIC ROUTES

Martin Dodge

Department of Geography, University of Manchester

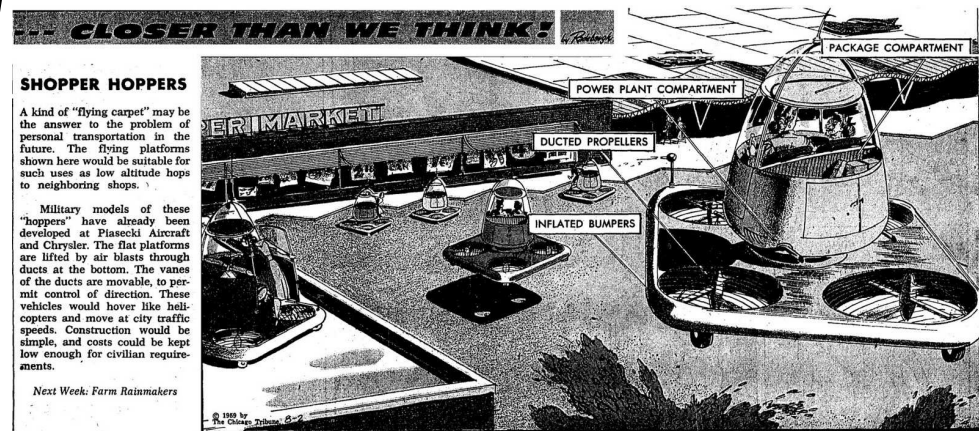*Liverpool Seminar - 14th March 2013*

Start with a question

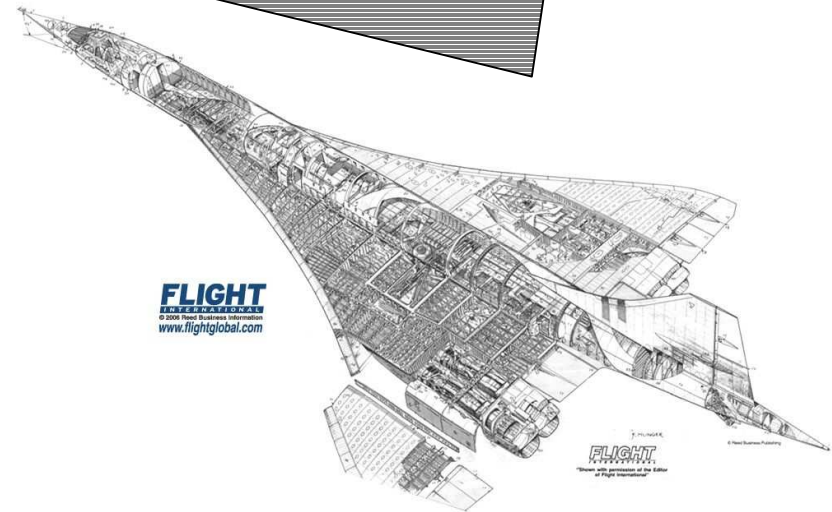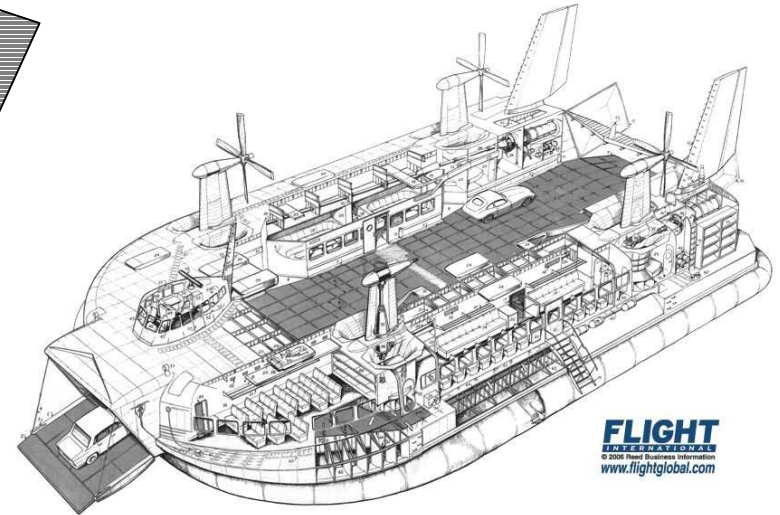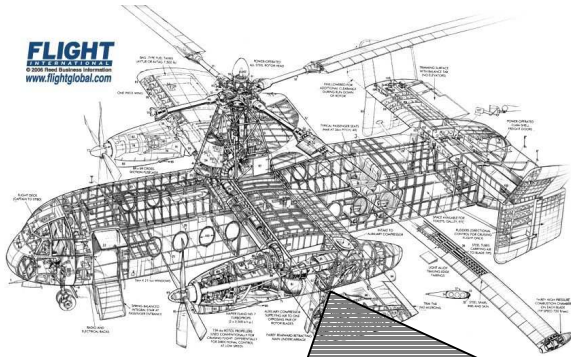# Fantastical machines for personal freedom of the skies

1961 Bell Rocket Belt

Paleo-futurism

Helicopters for Everybody

The Hoppicopter is evolving into a comfortable single helicopter that will supply you with cheap air transport

By Frank Tinsley

BACK in the 30's, a Seattle aeronautical engineer named Horace T. Pentecost became convinced that he could design a set of personal wings. As an engineer and student of aviation history, Pentecost was well aware of the shortcomings of man-made flapping wings, so he gave the problem an entirely different solution. In place of rosy pinions, he substituted the whirling blades of the modern helicopter. His first machine, designed for army paratroopers, was... the clumsy and... chute. Strapped to... was christened "Hoppicopter"... the trooper literally hopped on... landed on his own two feet. It consisted of little more than an engine, rotors and control stick, mounted on a tubular frame that was strapped over the flier's shoulders and back. The Hoppicopter's dependence upon human legs as landing gear proved its...

... CLOSER THAN WE THINK!

SHOPPER HOPPERS

A kind of "flying carpet" may be the answer to the problem of personal transportation in the future. The flying platforms shown here would be suitable for such uses as low altitude hops to neighboring shops.

Military models of these "hoppers" have already been developed at Piasecki Aircraft and Chrysler. The flat platforms are lifted by air blasts through ducts at the bottom. The vanes of the ducts are movable, to permit control of direction. These vehicles would hover like helicopters and move at city traffic speeds. Construction would be simple, and costs could be kept low enough for civilian requirements.

Next Week: Farm Rainmakers

PACKAGE COMPARTMENT
POWER PLANT COMPARTMENT
DUCTED PROPELLERS
INFLATED BUMPERS

Going in reverse? – failures to fly

LOOK FORWARD TO
ROTODYNE
TRAVEL

The first vertical take-off airliner

BBC **NEWS** CORNWALL

News | Sport | Weather | iPlayer | TV | Ra

Home | World | UK | England | N. Ireland | Scotland | Wales | Business | Politics | Health | Education | Sci/Env

30 October 2012 Last updated at 07:21

Scilly helicopter flight link ends

Daily flights by British International Helicopters (BIH) to the Isles of Scilly are ending.

The last flight at 17:30 GMT on Wednesday brings to a close 49 years of a helicopter link from Penzance to the Isles of Scilly.

BIH has cited rising costs and falling passenger numbers.

The final flight will bring to an end almost half a century of helicopter flights

The islands, which have a population of 2,200, will have plane flights si ferry, the Scillonian, whi

Emergencies will be ans and the Cornwall air amb

BIH is moving from its 15 after selling the land to

Theoretical context

- Why? Nerd interest in technical history of city by non-engineer + archive fever for old maps, original plans, 3d renders and models,

- Fascination with the recent past – 1950s as the forgotten decade? Counter-factual histories – what might have been, 'If only infrastructure…'

- But context is really around three themes
  - **Vertical urbanism agenda**
  - **Alertness to aeriality**
  - **Infrastructuralist reading of cities**

Theoretical context

- Vertical urbanism agenda
  - 3d understanding of space rather than the 2d plane viewed on topographic maps and from land use zoning plans
  - Lucy Hewitt "Cities have been explored in terms of distributions, concentrations, networks and sprawl [which] has established an epistemological and empirical bias towards geographies of the surface. Increasingly, however, there are now concerted attempts to interrogate the vertical, sectional and volumetric use of space."
  - Mania for high building. Vertical living as the politics of hierarchical classification and self-segregation
  - Going deep with basement building. Mega tunnelling projects
  - Extracting energy from the layers above and below surface – controversies around wind turbines and fracking
  - Taking to the skies above…

Theoretical context

- **Alertness to aeriality**
  - About looking to the sky as space with economic value, geo-politics, and rich cultural meanings
  - Air above ground matters more – its not a void but active. The fear and threat from terrorism from the sky, the increasing militarisation of aerial terrain beyond the battlefield, autonomous UAV surveillance and coming drone wars
  - Peter Adey recently on the iconic role of helicopters in urban security [police 'copters are most prevalent over M/c]
  - Alison Williams' work on the geopolitical projections into atmospheric space, such delineating air routes and no-fly zones; "Geopolitics has a tradition of adopting a downward looking view-from-above" whereas she argues "it needs to be actively re-orientated to encompass the discourses and practices of looking up." (Williams 2013, p. 225)

Theoretical context

- ## Infrastructural thinking
  - Perennial issue of terrestrial congestion and allure of new by-pass infrastructure, e.g freedom to soar above street, but always colliding with the mundane (battle over runway capacity, motorway widening, etc)
  - Exposing the background'ness and black-boxed nature. Making infrastructure re-appear from its invisible status
  - Challenge to get into the technical space of plans, architects drawings, engineering schematics, jargon, …
  - Securitisation of space of infrastructure, paranoia about information about infrastructure. (Can't take photographs of bridges or publish maps of the power grid)
  - Making social enquiries to what has been asserted as merely 'technical matters' and seeing there is politics in the investments and operations of infrastructures (who gets a HS2 station and who does not – Crewe versus Stoke…)

1950s helicopters, hope.. hype...

Scheduled inter-city service

Trial services for paying passengers:
• Liverpool – Cardiff, 1950-51
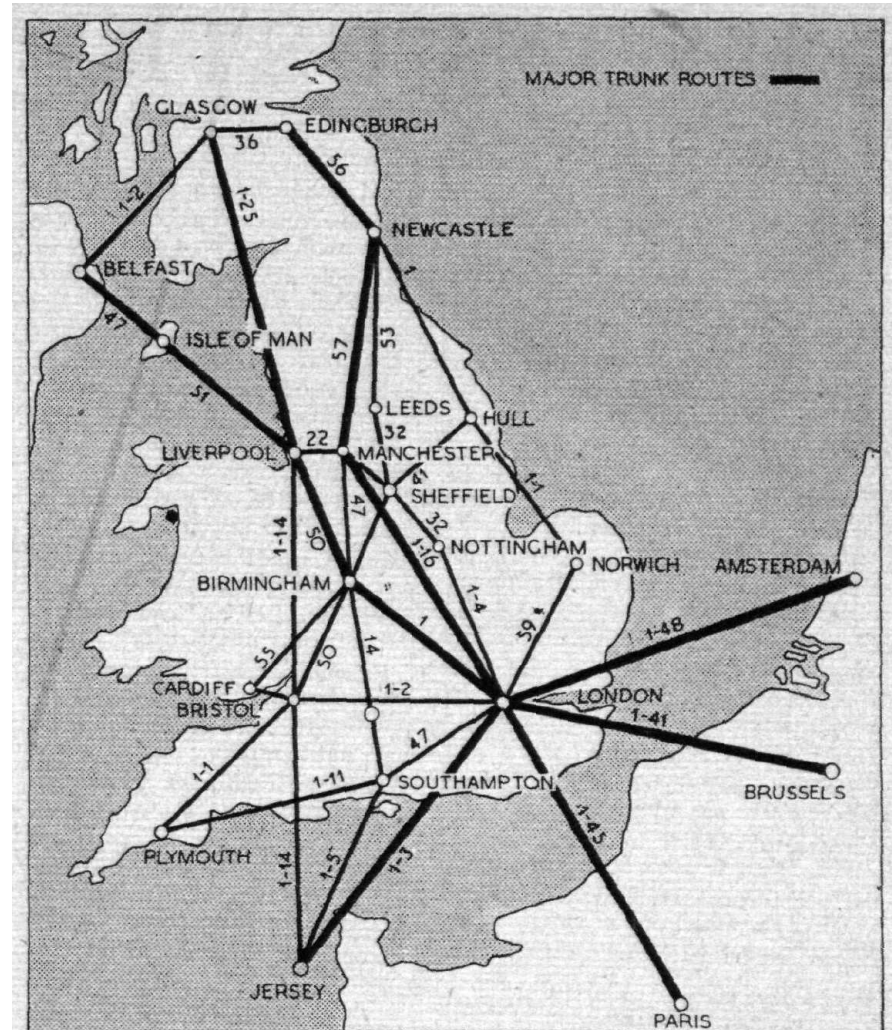• London: Waterloo – Heathrow shuttle in 1955-56

Fig. 7. Hypothetical network of internal and short stage European routes as operated by a 160-m.p.h. B.E.A. helicopter with 48 seats. Figures represent journey time for each route in hours and/or minutes.
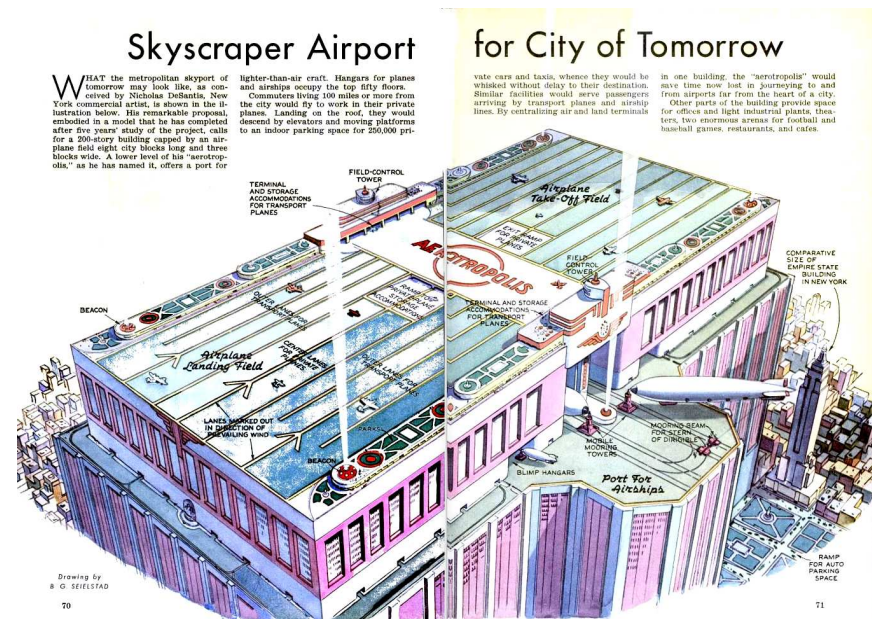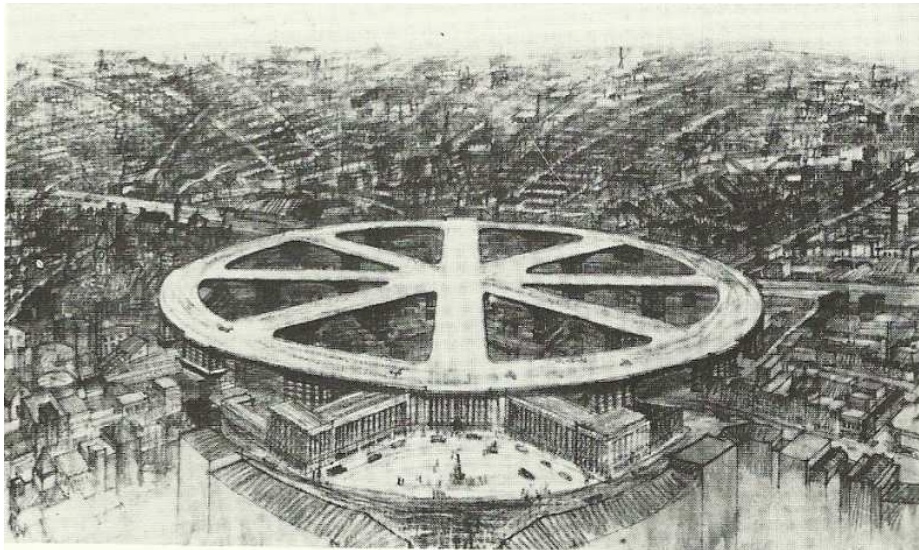
Planning for the helicopter

- Novel and uncertain, but belief in many that helicopter was going to be major transport mode

- Questions raised Parliamentary debates, technical reports, policy documents released

- Underlying logic + pragmatics:

- "There is, for example, no great advantage in flying from London to Manchester in three quarters of an hour if one has to spend an hour at each end travelling from and to the centres of those cities by airport bus. The answer to this problem will probably be found in the helicopter, but not in its present form. It is as yet too costly and too small. We have to look into the future for some form of air bus which will take us from Waterloo to the Place de la Concorde in an hour or less. …. The landing places, or heliports, will have to be well above ground level in order to minimize the noise of operations in the centres of cities."

- (Source: Wade D A L, 1955, "Civil aviation—progress and problems", *Journal of the Royal United Services Institution*, 100(599): 426-33. http://dx.doi.org/10.1080/03071845509422855)

City centre touch-down needed

- Heliport "is a cleared space, an absence of obstacles or structures that could hinder the aircraft"
- Type: ground, special platform, modified rooftop
- Location and accessibility : 5 minutes drive, 15 minutes walk
- Many planning challenges but plenty of scope – lots of bomb sites into 1950s and by mid decade councils beginning to have capacity for redevelopment of city centres after a period of austerity
- How to insert new mode of transport into existing city fabric…. Comparison to c19th railway invasion
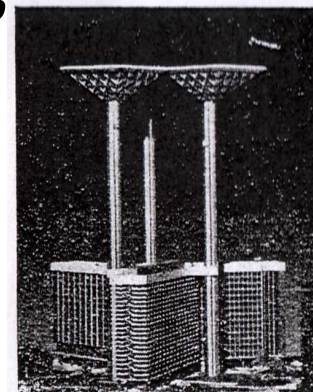- Indeed, notion of exploiting expansive roofs of railway stations was very appealing!

Logic of the rooftop landing!

- Commonsensical at first glance. Get above congestion on streets below

- In our folk memory we <u>imagined</u> helicopters had routinely landed atop many high buildings

- Lineage of (wild) speculations from the 1930s

Skyscraper Airport for City of Tomorrow

WHAT the metropolitan skyport of tomorrow may look like, as conceived by Nicholas DeSantis, New York commercial artist, is shown in the illustration below. His remarkable proposal, embodied in a model that he has completed after five years' study of the project, calls for a 200-story building capped by an airplane field eight city blocks long and three blocks wide. A lower level of his "aerotropolis," as he has named it, offers a port for lighter-than-air craft. Hangars for planes and airships occupy the top fifty floors.

Commuters living 100 miles or more from the city would fly to work in their private planes. Landing on the roof, they would descend by elevators and moving platforms to an indoor parking space for 250,000 private cars and taxis, whence they would be whisked without delay to their destination. Similar facilities would serve passengers arriving by transport planes and airship lines. By centralizing air and land terminals in one building, the "aerotropolis" would save time now lost in journeying to and from airports far from the heart of a city.

Other parts of the building provide space for offices and light industrial plants, theaters, two enormous arenas for football and baseball games, restaurants, and cafes.

London leads the way

- People anticipate demand for helicopter service right in centre of London

- Through the 1950s multiple schemes advanced. We've noted at least 15 different sites put forward with 'serious' schemes

- These included heli-decks on the roofs of all mainline rail stations, landing platforms over bridges and wholesale markets,

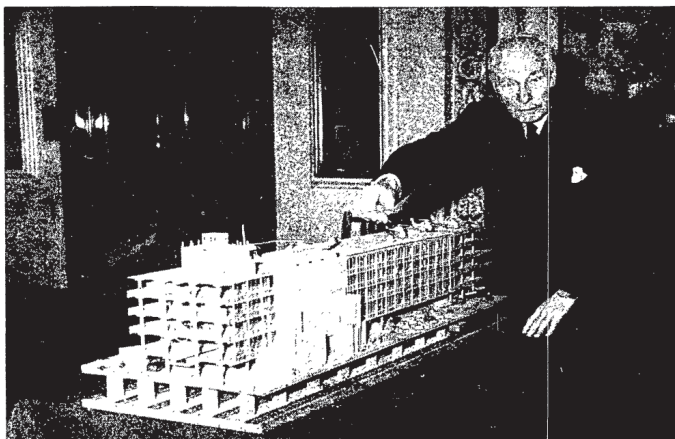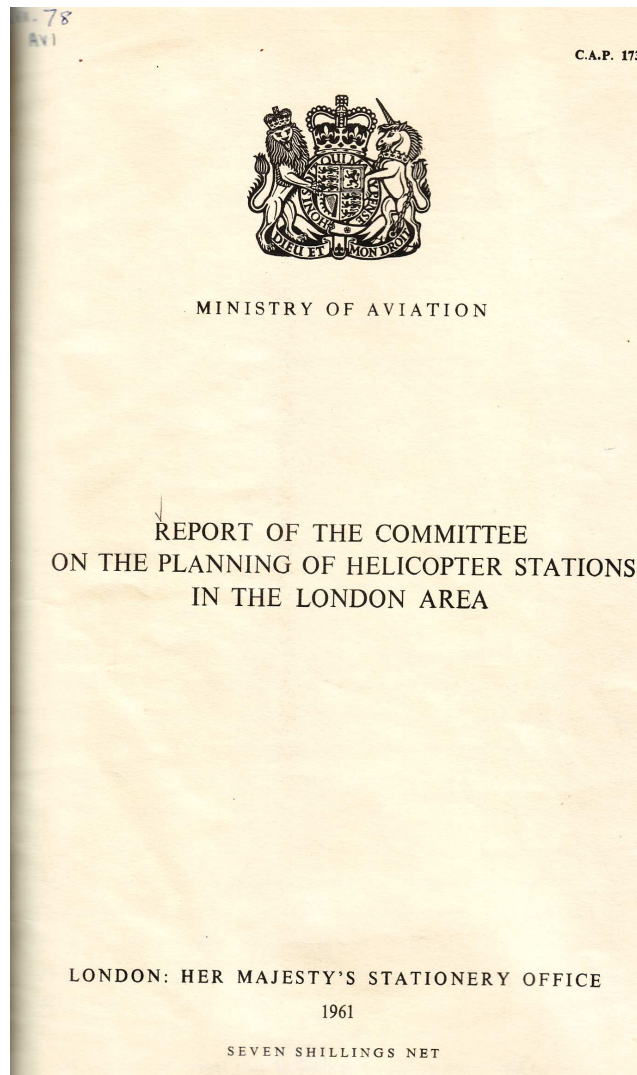- and, heliports in the Thames, mushroom-shaped skyports

PROPOSED HELIDROME FOR CENTRAL LONDON.

TRAFALGAR SQUARE

WESTLAND SIKORSKY S51 HELICOPTER.

HOTEL METROPOLE.

NORTHUMBERLAND AVENUE.

NATIONAL LIBERAL CLUB.

WHITEHALL PLACE.

HELIDROME ENTRANCES AND NEW BUILDING.

LIFTS.

CUSTOMS, POLICE AND POST OFFICES.

HELICOPTER LIFT.

RECEPTION HALL.

ARRIVALS

DEPARTURES

HELICOPTER LIFT.

FLIGHT DECK.

BRISTOL-TYPE 173 13 SEAT HELICOPTER. COMING IN TO LAND.

STORE DECK.

RIVER THAMES

HUNGERFORD BRIDGE.

CHARING CROSS STATION.

RADAR, ETC. CONTROLS. RESTAURANT ETC.

HOTEL.

NEW BUILDING.

CUSTOMS, POLICE AND POST OFFICES.

VILLIERS STREET

EMBANKMENT GARDENS.

CHARING CROSS DISTRICT RAILWAY STATION.

VICTORIA EMBANKMENT.

WHERE AIR, RAILWAY AND ROAD TRAFFIC MAY MEET.

APPROX. 15-20 FT.

FLIGHT DECK

STORE DECK

APPROX. 68 FT.

BRITISH RAILWAYS (SOUTHERN).

VICTORIA EMBANKMENT.

RIVER THAMES

NORTHERN LINE.

APPROX. 68 FT.

APPROX. 15 FT. DISTRICT RAILWAY.

APPROX. 52 FT.

BAKERLOO LINE.

G. H. DAVIS 1952

Model of one-tenth of the proposed replacement for Covent Garden Market, which would be built over King's Cross, London, railway sidings and surmounted by an 800ft × 1,200ft heliport. (Architects, C. W. Glover & Partners)
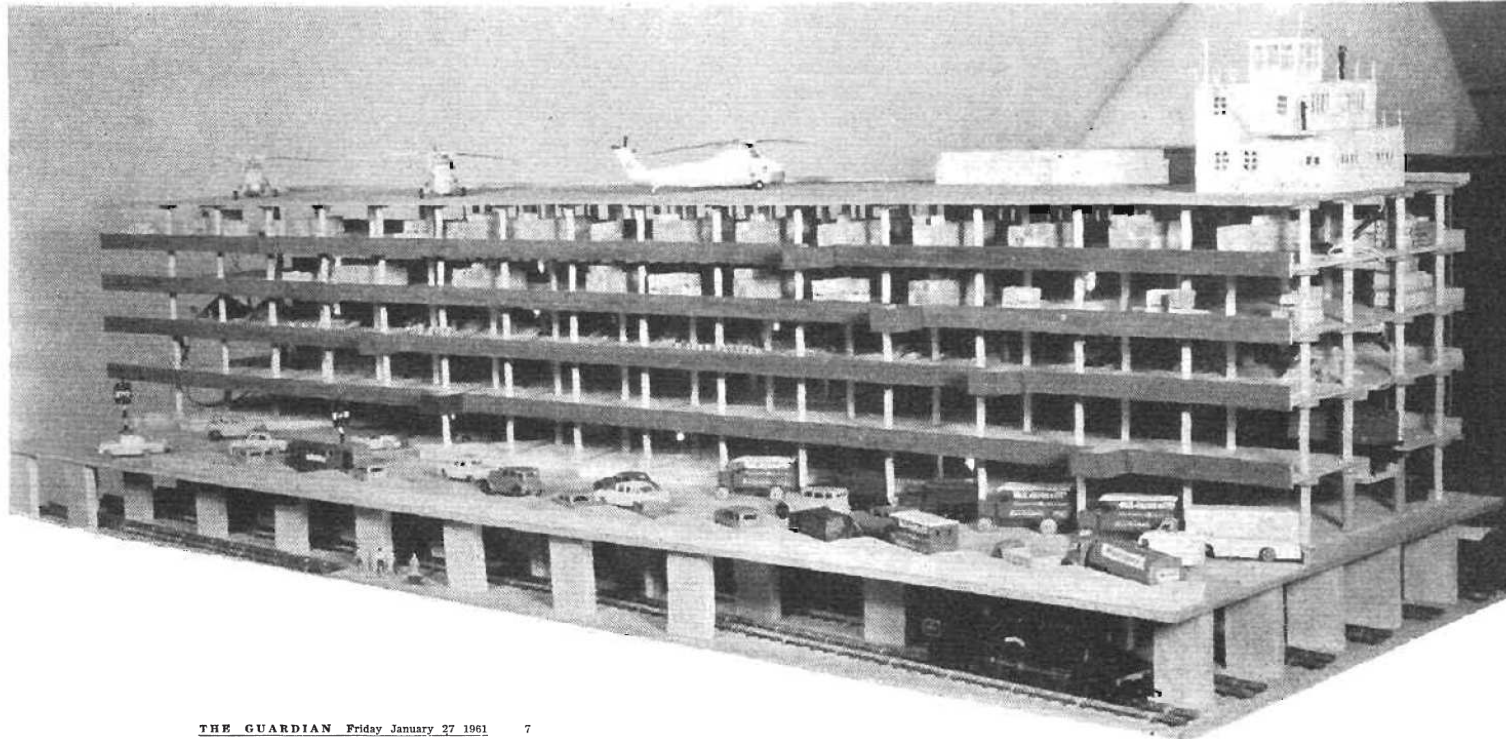
THE GUARDIAN Friday January 27 1961   7

('Market Report', Pathe News, 1961, www.britishpathe.com/video/market-report)

C.A.P. 173

MINISTRY OF AVIATION

REPORT OF THE COMMITTEE
ON THE PLANNING OF HELICOPTER STATIONS
IN THE LONDON AREA

LONDON: HER MAJESTY'S STATIONERY OFFICE
1961

SEVEN SHILLINGS NET

"Since the helicopter's appeal depends on saving time, the heliport should be brought as close as possible to the main source and destination of a substantial proportion of the traffic. …it should not be much more than a quarter of an hour from Grosvenor Sq, and ideally, between the West End and the City" (p.4)
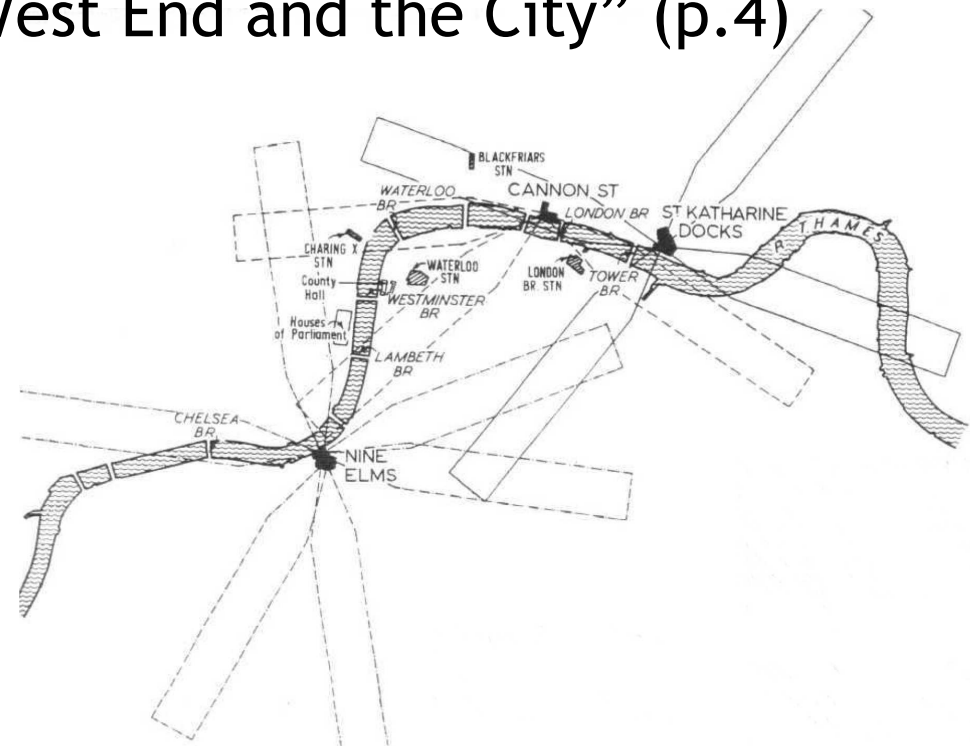
"Three possible sites are suggested: Nine Elms goods yard, Cannon Street Station and St. Katharine Docks"

PLAN X   St KATHARINE DOCKS
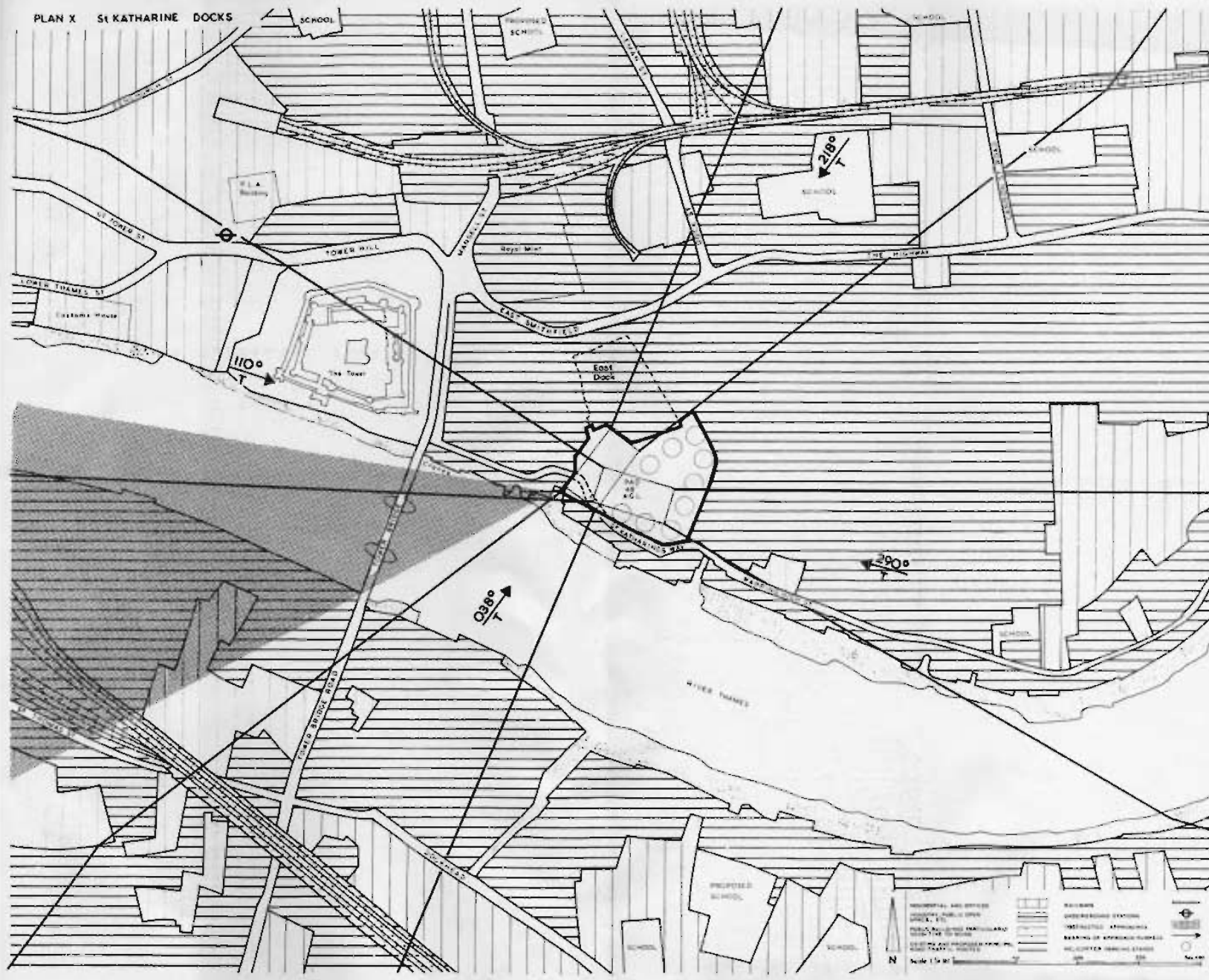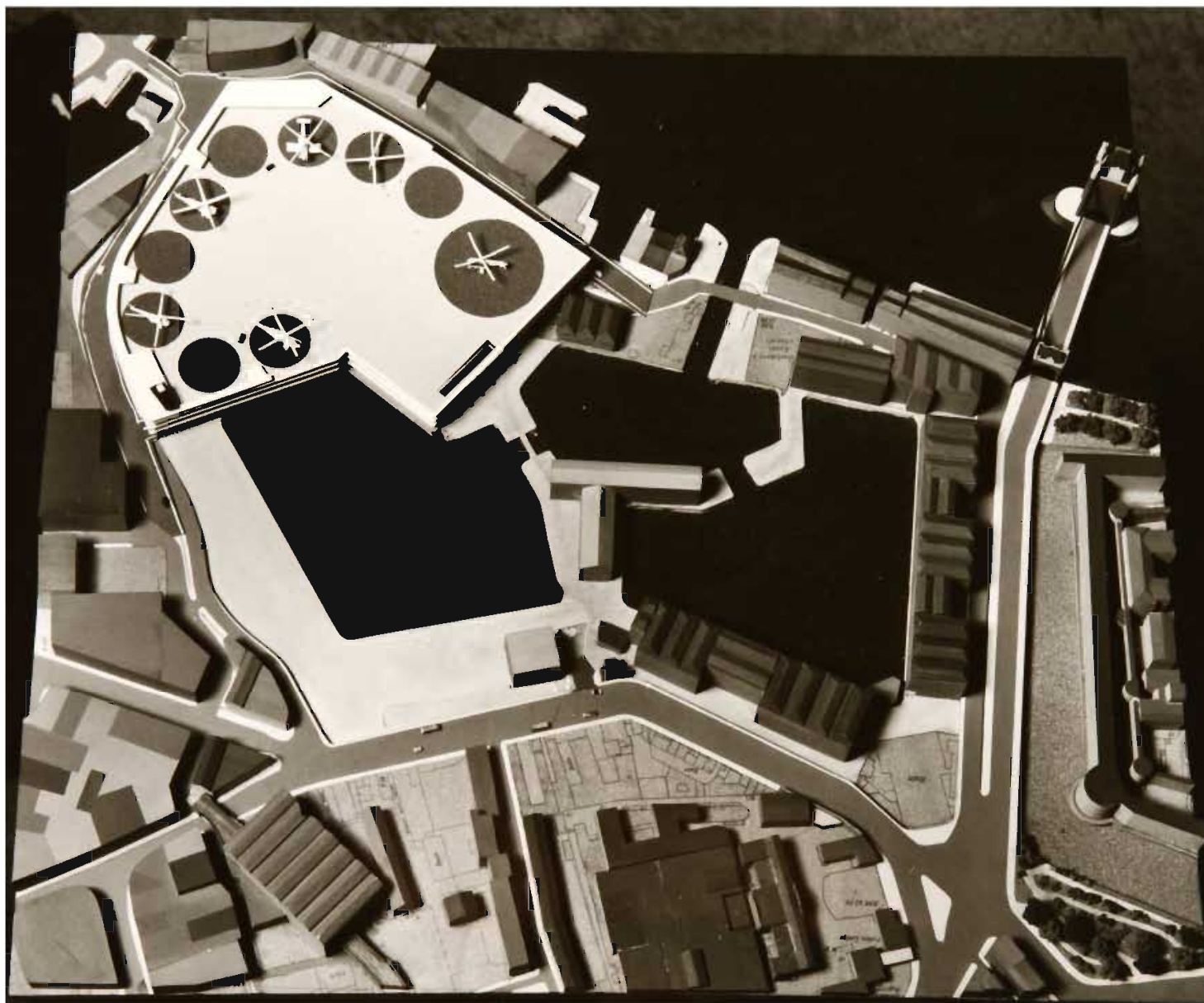
Plate IV   St. Katharine Docks - (A possible heliport viewed from the North)

Battersea pad actually built out in the river, 1959
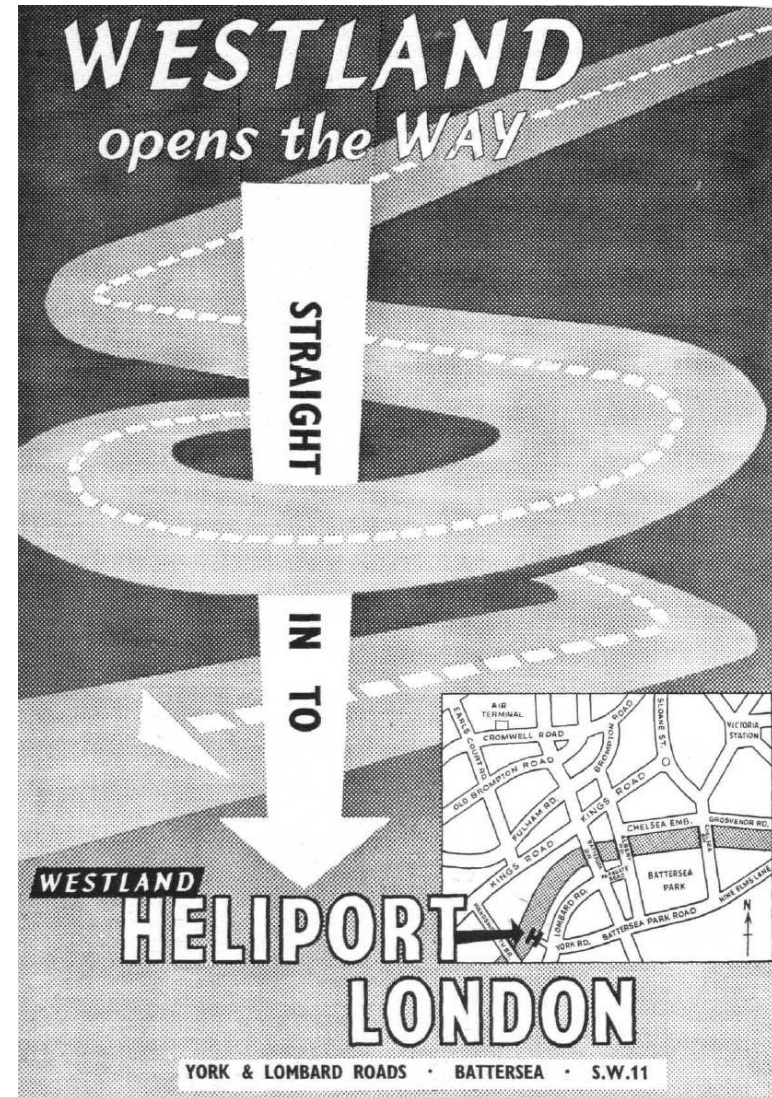
Manchester was making plans for its central heliport

- Multiple sites. Sensible ground level sites, on vacant space, redundant land

M723
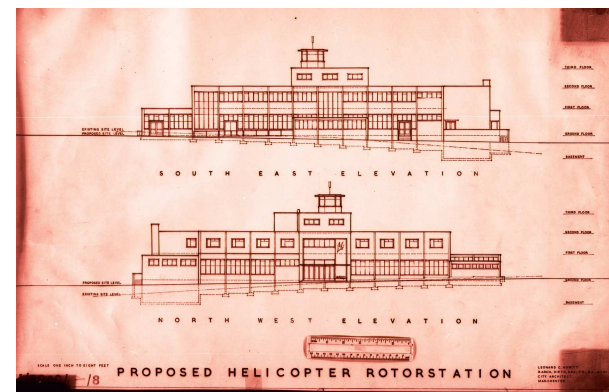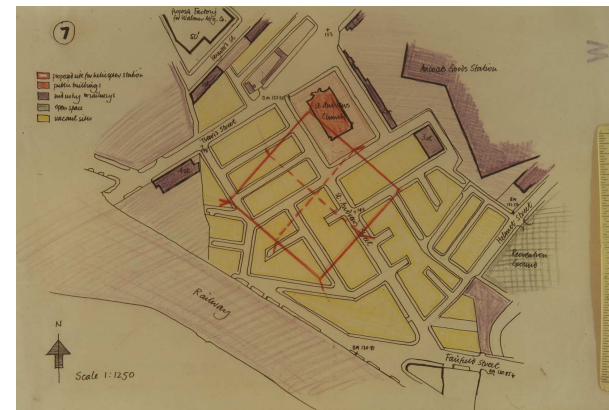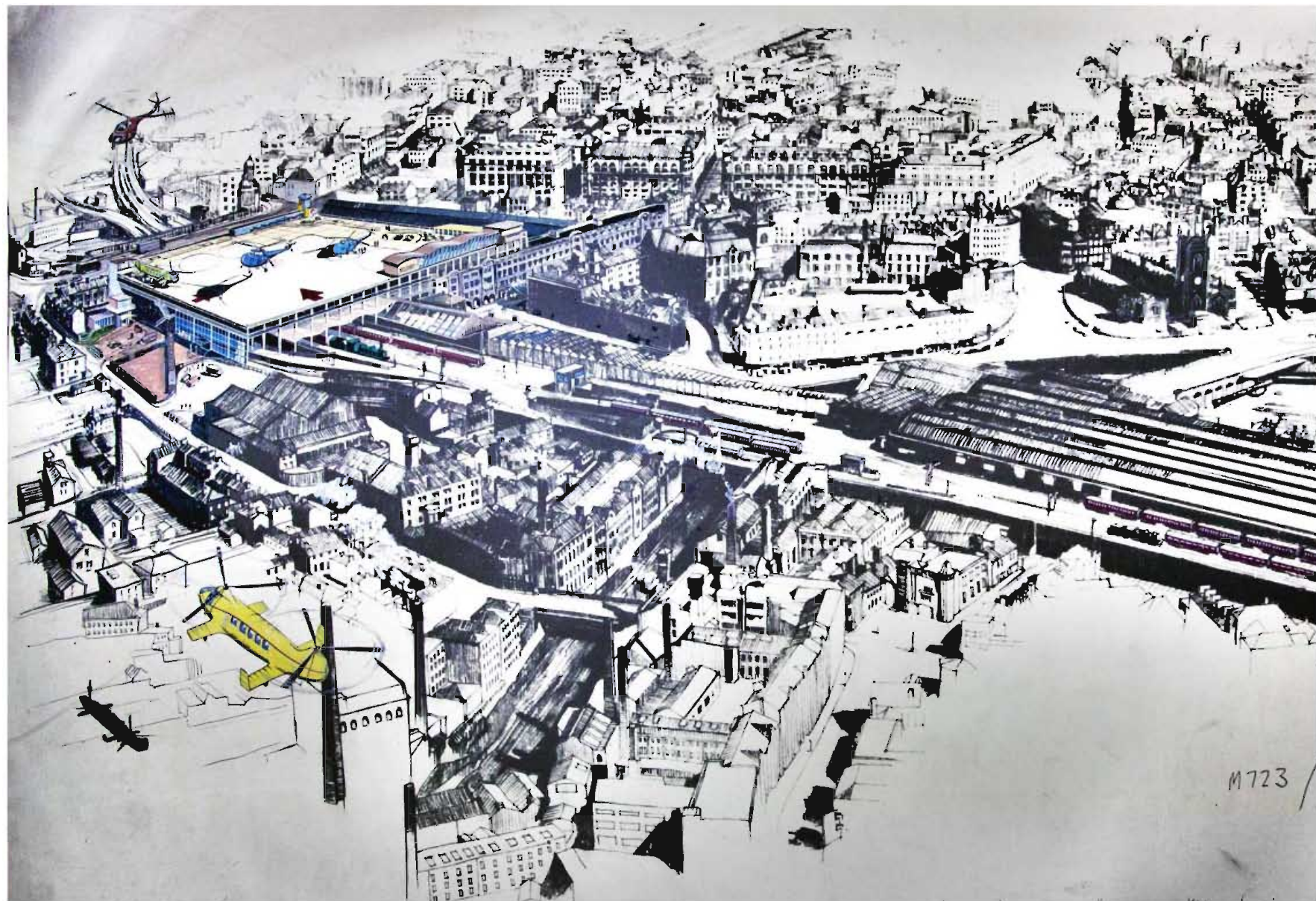
Liverpool too was looking to future of helicopter travel

SUGGESTED INTER-CITY HELICOPTER TRAFFIC ROUTES
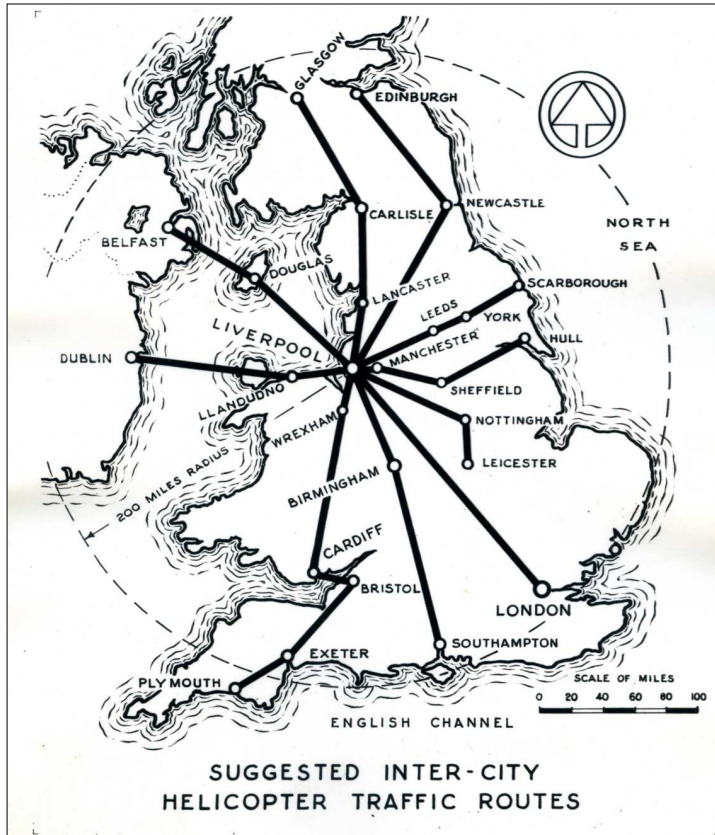
(Source: Liverpool City Archive, ref CE13162)

'copter in Paradise, 1953

Liverpool city engineer, Henry T. Hough

- He advances helicopter agenda in municipal context. Turning guidance coming out from Ministry of Transport and Civil Aviation into planning advice
- Gives high profile public lectures, including in Nov. 1955 on 'The design of helicopter operating sites for passenger services', which is widely report in technical press

"Liverpool has in mind several surface landing sites in its long term plan, and in addition it has approved in principle a roof-top tending site over a bus station and multi-storey car park in the City centre itself where, due to war damage, land is already available for its erection between Paradise Street and South John street."
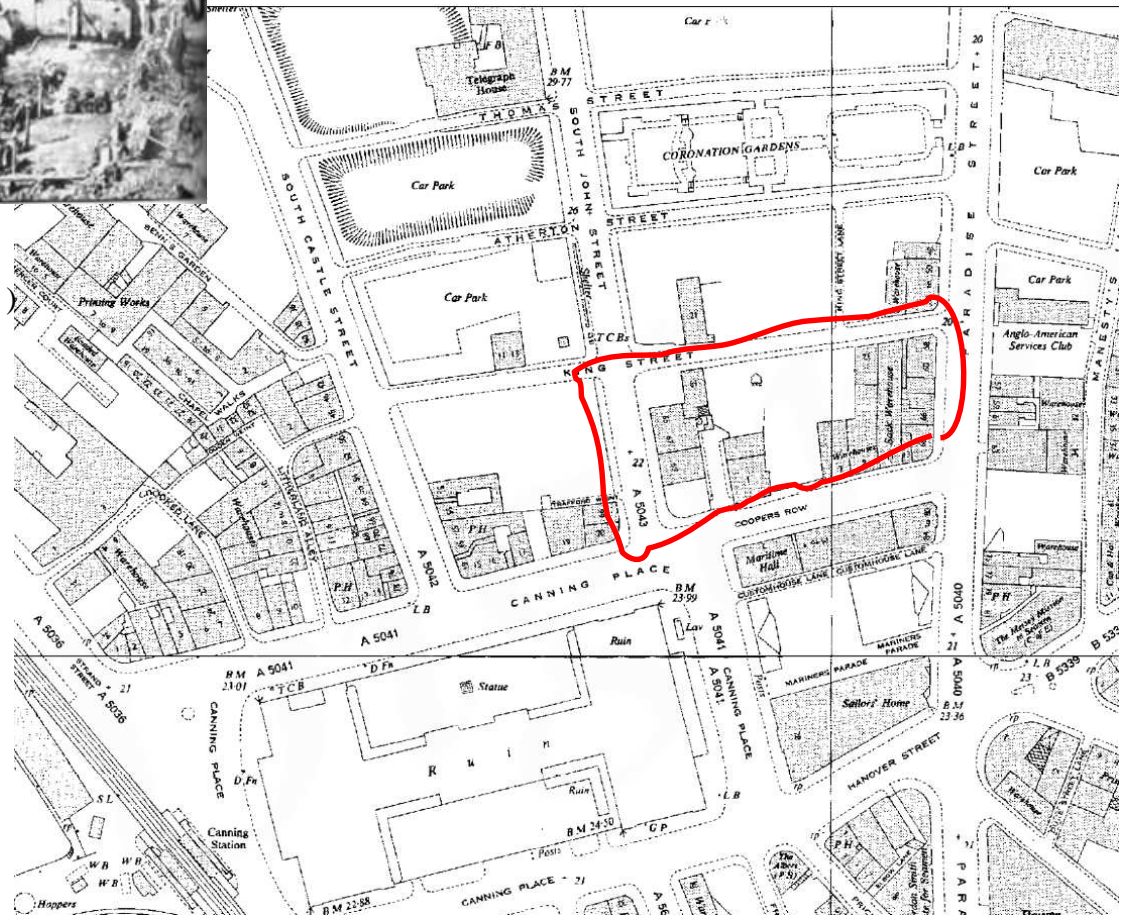
HYPOTHETICAL HELICOPTER ROOF STATION
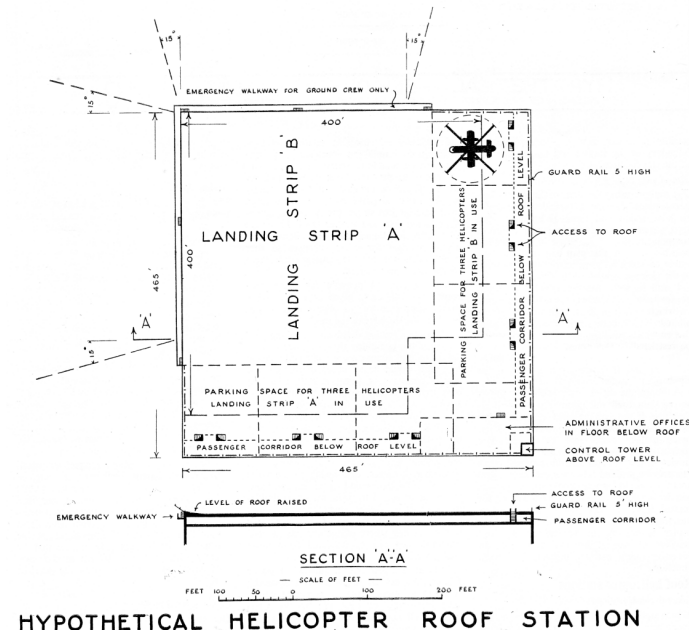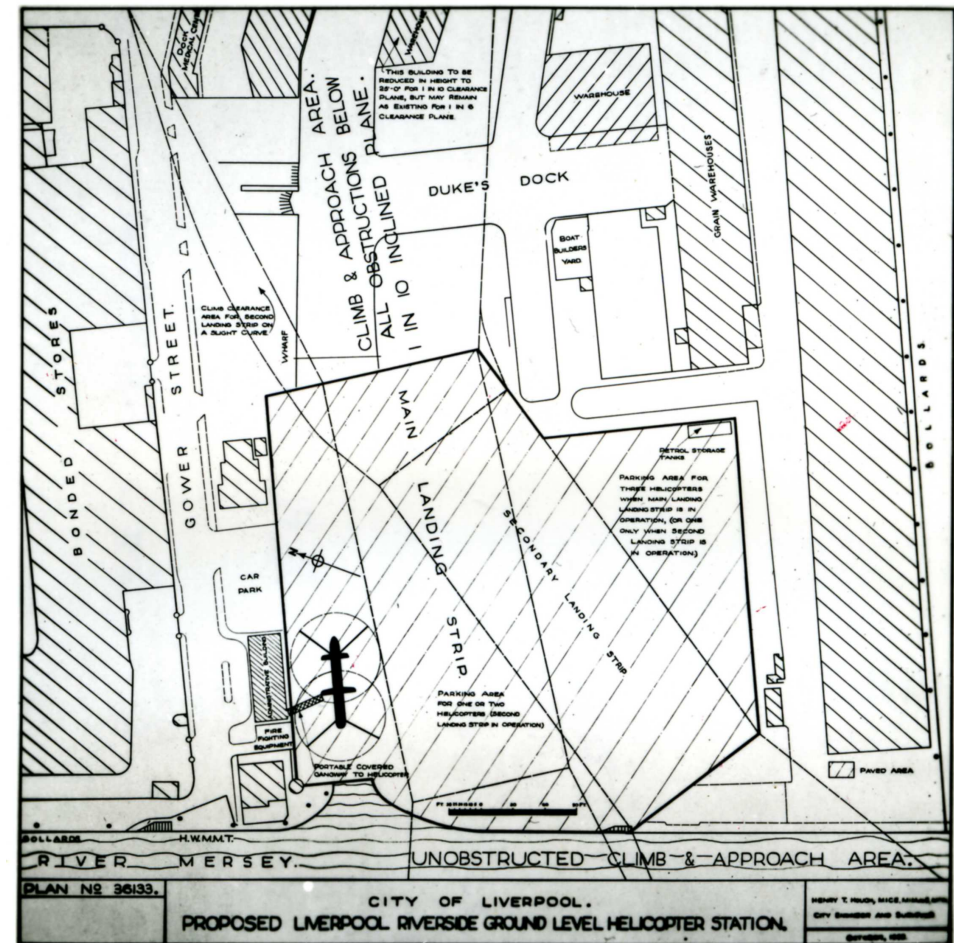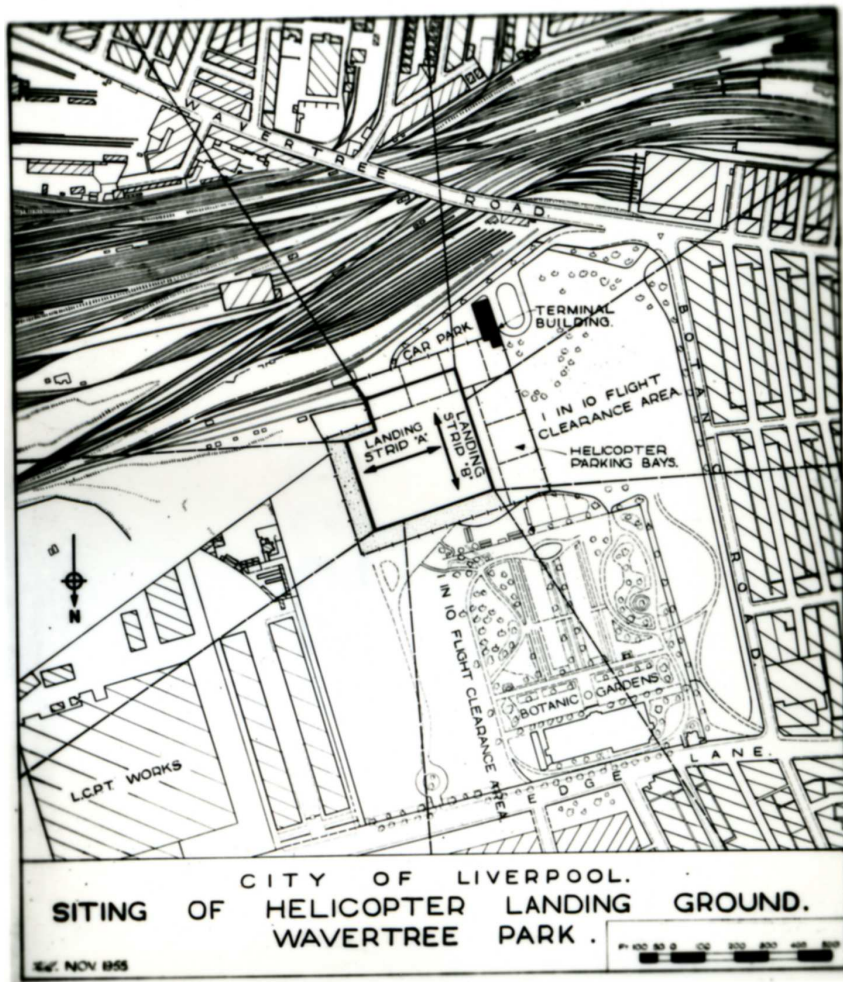
(Source: Liverpool City Archives, refs. 352 ENG/2/15588 and 352 ENG/2/15590)

Bomb damage on Paradise Street, 1941
(Source: www.liverpoolblitz70.co.uk/tag/air-raid/page/2/)

Front runner – Paradise Street – Strand quadrant

CITY · OF · LIVERPOOL · SUGGESTED · REDEVELOPMENT · OF · CENTRAL · RECONSTRUCTION · AREA · No 1 ··
·· SKETCH · PERSPECTIVE · SHOWING · COMPLETED · SCHEME ··

HENRY T. HOUGH.. M.I.C.E.. M.T.P.I.
CITY ENGINEER & SURVEYOR & PLANNING OFFICER

(Source: Liverpool City Archives, ref. 352 ENG/2/12031)

(Source: Liverpool City Archives, ref. 352 ENG/2/15587)

Strand - Paradise Comprehensive Development Area, as conceived by the 1965 *Liverpool City Centre Plan*


4.2 Strand—Paradise Street Comprehensive Development Area

Executive Architects: Kingham Knight Associates and Hall, O'Donohue and Wilson

Consultant Architects: Shankland, Cox and Associates

The largely war-damaged site of this scheme is approximately twenty-five acres in extent. During 1965, a Public Inquiry was held concerning its future and at the time of the preparation of this Plan, the Minister's decision was awaited. The proposals for this area include an enclosed arcade of shops behind the existing ones on the south side of Lord Street. The arcade will be approachable from Church Street by a bridge over Paradise Street, from South John Street, and from Derby Square. The slope of the site is such that the entrance from Derby Square will be level with the arcade, while the other end of the arcade at Paradise Street will be about twenty feet above ground and connected by stairways, ramps and escalators to Church Street and Lord Street. Beneath the shopping floor will be a new bus terminus for sixty buses with escalators to carry people from the central platform up to the shops. Over the arcade, there will be three decks of parking for approximately 2,500 cars, intended primarily for shoppers. The later stages of the scheme will also include an hotel.

Rising above the roof of the car park, which will form a broad terrace, will be five towers of flats and on the north side a long six-storey wall of maisonettes. All the maisonettes will have living rooms overlooking the terrace, and the majority will have small private balconies as well. In all, there will be homes for about 2,000 people. By stacking different buildings on top of one another in this way, it will be possible to create space for a new park of some six acres. It will be planted with trees and shielded from the motorway and the surrounding streets by a narrow band of commercial building surmounted by a footpath in the manner of some city walls.

The scheme will also embrace offices, and a flatted factory, and warehousing that will provide urgently needed space for firms that have been uprooted elsewhere. Design work is well advanced on the buildings on the site of the Old Custom House and they should be in operation by 1968. The first phase of the shopping arcade and parts of the bus-station, the car-park and the flats are scheduled for completion in 1970.
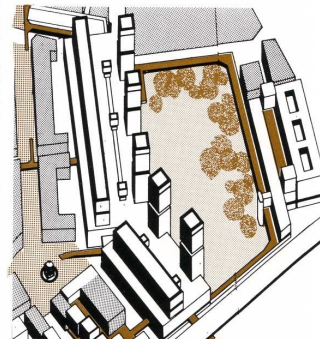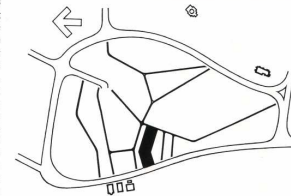
126

BUT, "Among trends in air travel likely to affect the central area, the most important is inter-city helicopter services. These may be introduced, if quieter engines can be evolved but at present, particularly with the airport being so close to the centre, no heliport is proposed." (p.48)

Reality built in late 1960s(?) – the bus station and linked multi-storey concrete car park

No 'copters in the city!

Paradise Street 1978. Panoramic photograph taken by Stan Roberts.
(Source: http://streetsofliverpool.co.uk/how-the-1970s-changed-liverpool-3/paradise-street-1978/)

Last Updated: Friday, 11 November 2005, 20:20 GMT

E-mail this to a friend   Printable version

Buses bid a farewell to paradise

Liverpool's bus passengers bid farewell to Paradise Street bus station, which closed after the last bus on Saturday.

The former station is being demolished by developers Grosvenor, to make way for new leisure and retail development.

Instead passengers will use the new Paradise Street Interchange, which opened on Sunday.

The opening of the interchange marks the first phase of the £920m Grosvenor regeneration project, which will transform a portion of the city centre.

'Step forward'

Each of its 10 bus stops – five each side – are designed to take up to 20 departures an hour.

It will be served by the services that used the old Paradise Street Bus Station, including those going to Garston, Speke, Halewood, Netherley and Runcorn, Bootle, Walton, Fazakerley
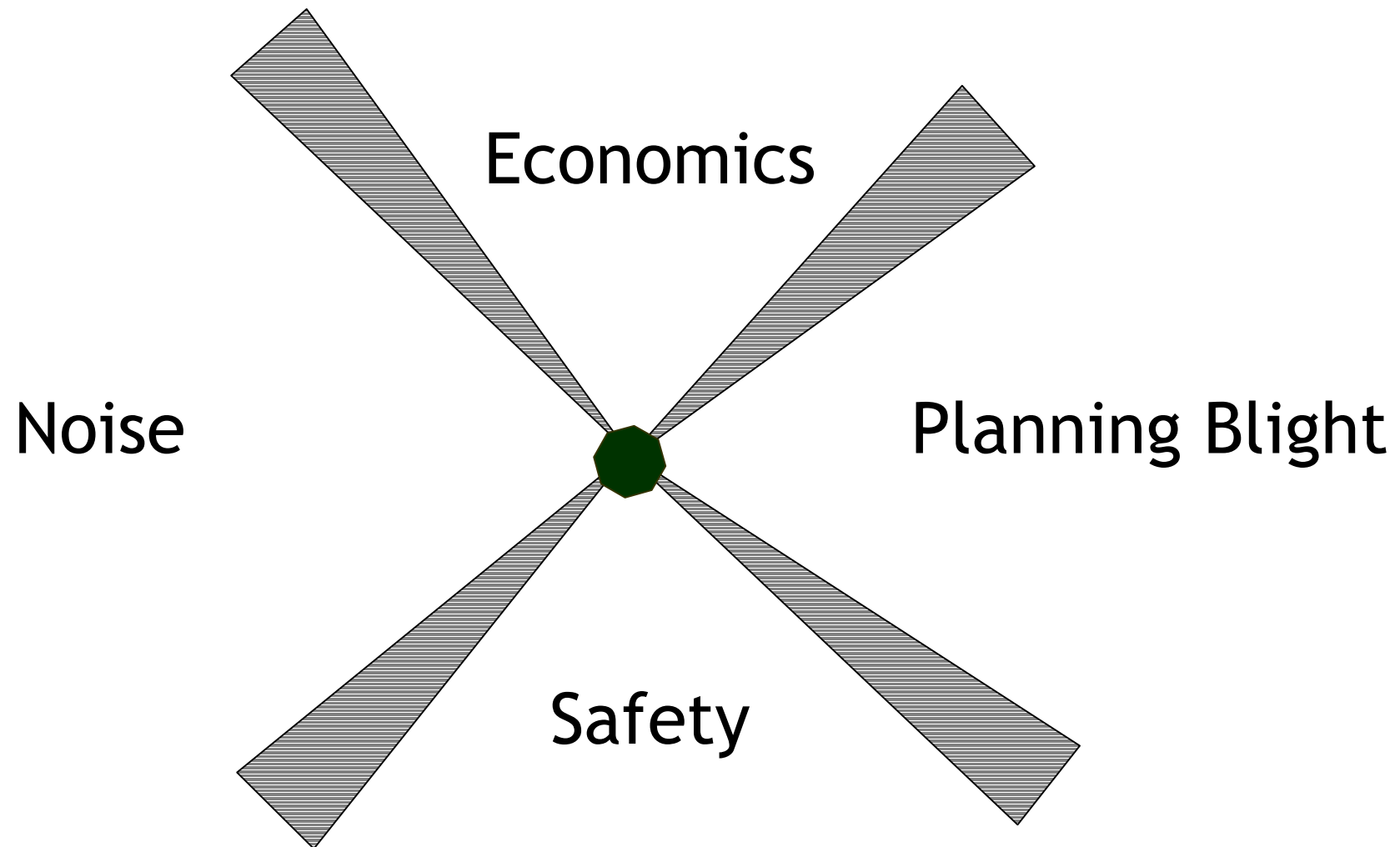
BBC Liverpool
Sport, travel, weather, things to do, features and much more

"Gone but not missed. The monstrosity that was the Paradise Street bus station and car park. Seen here in 2005 just before it was demolished to make way for Liverpool One."

(Source: http://asenseofplaceblog.wordpress.com/2012/05/31/streets-of-liverpool/)

Helicopter hopes in 1950s fades in the face of four issues

Economics

Noise

Planning Blight

Safety

Helicopter hopes in 1950s fades

- ## Economics

- Can't seem to make it pay for regular passenger. Only viable for special circumstances (oil rigs)

Comparison in fuselage capacities of (left) the single-engined Bristol 171 four-seater helicopter and the Bristol 173 13-seater and (right) the "developed" Bristol 173 with stub wings and seats for 18 passengers, and a possible layout for a 48-seat "BEAline bus."
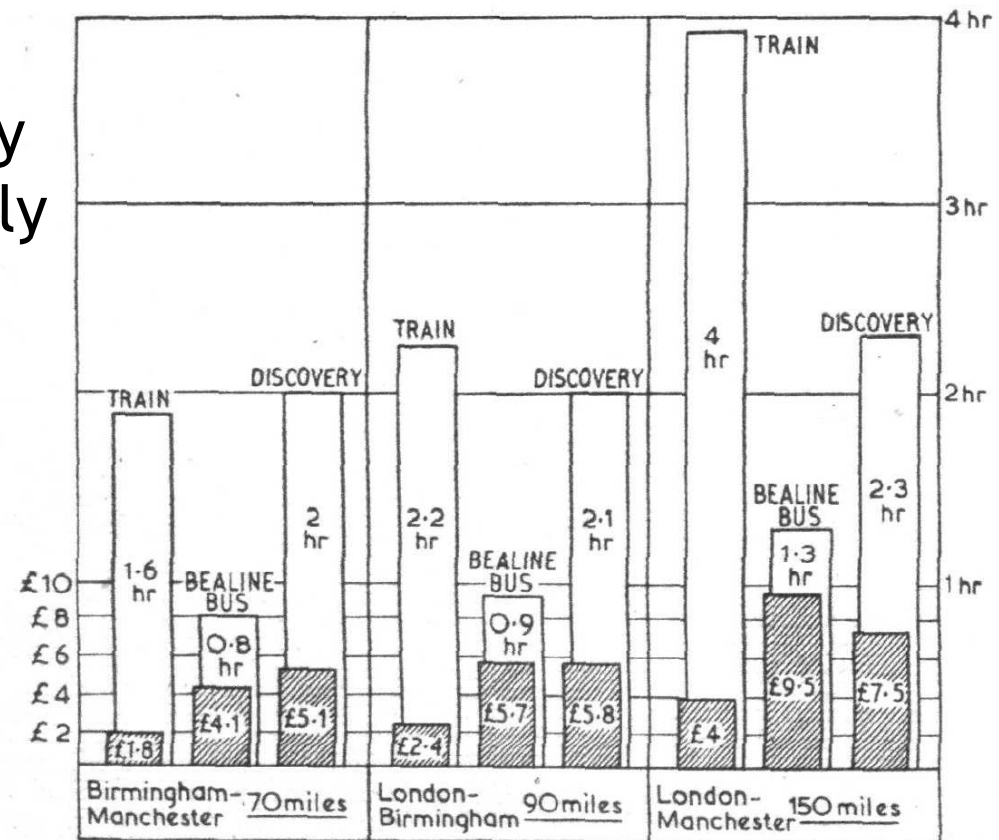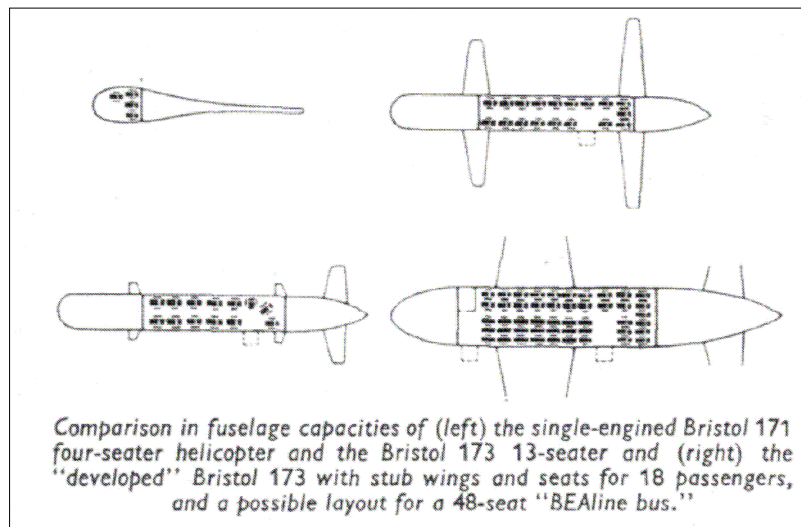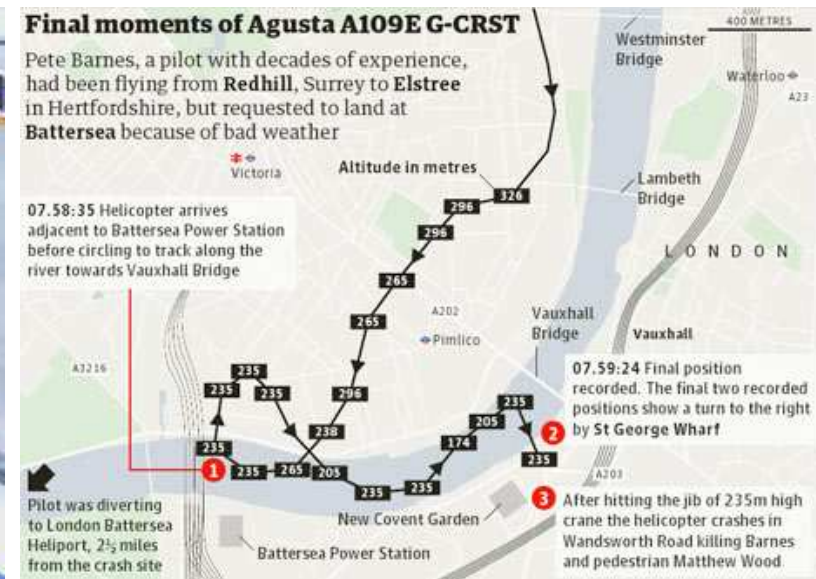

Fig. 5. Comparison, on the basis of times taken and fares charged, between helicopter, aeroplane and train over three important domestic routes. Fares assumed in each case are: train, first-class return (1952); helicopter and aeroplane, estimated break-even return.

Helicopter hopes in 1950s fades

- <u>Safety</u> – perception, reality
- Single-engined, complex aircraft
- Rare and spectacular failures weigh heavily on our risk judgements – aircraft accidents make headlines, car crashes do not

LONDON HELICOPTER CRASH

BREAKING NEWS
HELICOPTER CRASH IN LONDON
CHOPPER STRUCK A CONSTRUCTION CRANE

Final moments of Agusta A109E G-CRST

Pete Barnes, a pilot with decades of experience, had been flying from **Redhill**, Surrey to **Elstree** in Hertfordshire, but requested to land at **Battersea** because of bad weather

07.58:35 Helicopter arrives adjacent to Battersea Power Station before circling to track along the river towards Vauxhall Bridge

07.59:24 Final position recorded. The final two recorded positions show a turn to the right by St George Wharf

Pilot was diverting to London Battersea Heliport, 2½ miles from the crash site

After hitting the jib of 235m high crane the helicopter crashes in Wandsworth Road killing Barnes and pedestrian Matthew Wood

Helicopter hopes in 1950s fades

- <u>Planning blight</u>
- Heliport relatively small. But….
- "In simple terms, the problem is to erect large operating sites without sterilization of ground." (J.S. Shapiro)

HYPOTHETICAL HELICOPTER LANDING GROUND.
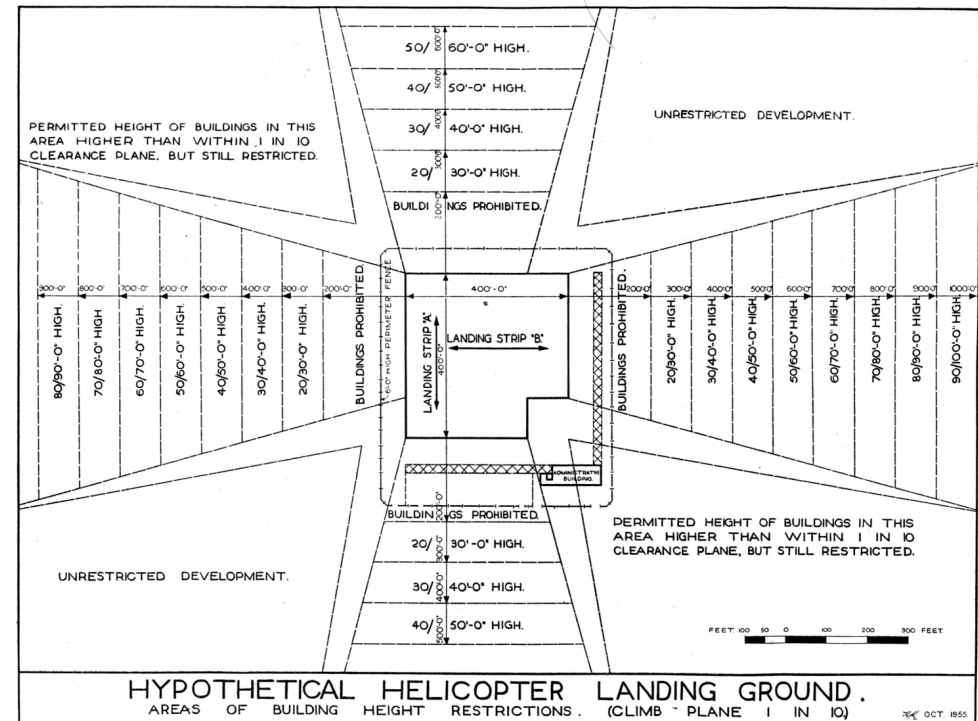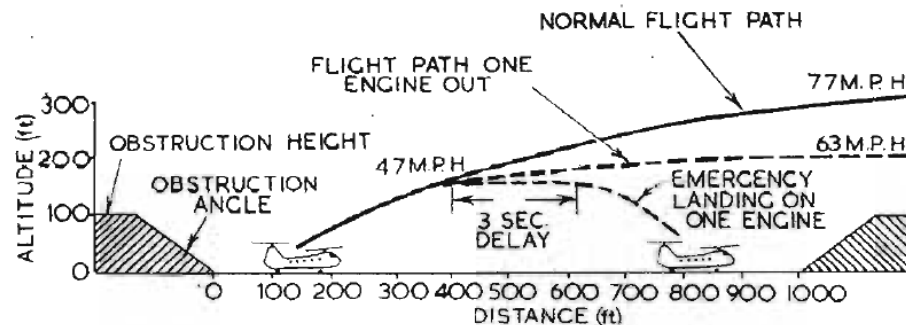AREAS OF BUILDING HEIGHT RESTRICTIONS. (CLIMB PLANE 1 IN 10)

Fig. 3. Safe take-off procedures and effect on heliport dimensions. assuming partial-power performance to meet C.A.A. requirements: (right) forward take-off and (left) backward take-off.

Gliding in, not vertical landing

Helicopter hopes in 1950s fades

- <u>Noise</u>

- ".. it may be a very good thing to get to the Place de la Concorde in an hour and a half, but not if it becomes the Place de la Cacophonie. At present, London is probably the quietest capital in the world, …. Do not let us destroy that admirable quality of London. Unless the problem of noise is solved, a helicopter service would do grave injury to a large number of people who live, work or sleep in central London." (Sir Edward Keeling, House of Commons debate, 2 February 1953)

- From the mid 1950s and thru 1960s control of forms of pollution

- 1956 Clean Air Act; 1963 Noise report

- Helicopters were, and remain, a distinctive and distractingly loud noise in the sky
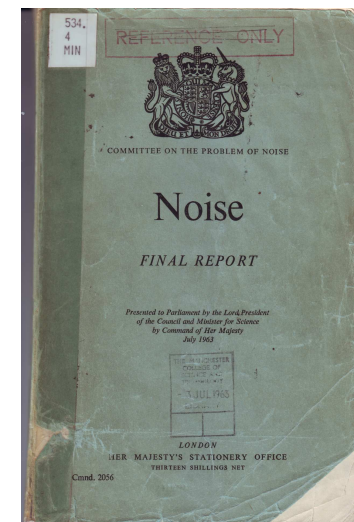
Conclusion

- Part of broadening mobilities turn – cultures of transportation. Resonates with populism of industrial nostalgia and engineering heritage (the Portillo effect)

- Linking past and present through focus on the 1950s and planning of heliports can contribute something to vertical urbanism agenda

- "a fully volumetric urbanism is required which addresses the ways in which horizontal and vertical extensions, imaginaries, materialities and lived practices intersect and mutually construct each other within and between subterranean, surficial and suprasurface domains" (Graham and Hewitt, 2013, p.74-75)

- City as a volume – seen clearly in helicopters and their failed history of development as urban transport

VOL. XXII. Nº 2.   FEBRUARY 1937

MECCANO
MAGAZINE

6ᵈ

LOOKING AHEAD – A ROTARY AERODROME
(see page 70)

Liverpool
Waters

Artist's impression of the proposed development at King Edward Triangle

Image sources and references

- Slide 1
  - Rotary aerodrome in Liverpool, edited image from *Meccano Magazine*, February 1937. http://archive.org/details/meccano-magazine-1937-02
  - "Suggested Inter-City Helicopter Traffic Routes" image, courtesy of Liverpool City Archives, ref. CE13162
- Slide 2
  - *Science et Vie*, Avril 1946 magazine cover image. www.flickr.com/photos/jean-paul-margnac/7044833271/
- Slide 3
  - Bell rocket belt image unsourced
  - Alex Tremulis concept sketch, 1943. Author scan from Corn JJ and Horrigan B, 1994, *Yesterday's Tomorrow's: Past Visions of the American Future* (The Johns Hopkins University Press), p. 100
  - "Closer Than We Think – Shopper Hoppers", *Chicago Tribune* 1959, 2 August. www.paleofuture.com/blog/2008/6/13/shopper-hoppers-1959.html
  - "Helicopters for Everybody", *Mechanix Illustrated*, January 1951 http://blog.modernmechanix.com/helicopters-for-everybody/
- Slide 7
  - Adey P, 2010, "Vertical security in the megacity: Legibility, mobility and aerial politics", *Theory, Culture & Society*, 27(6): 51-67

- Slide 4
  - The Rotodyne, Concorde and Hovercraft cutaway drawings, www.flightglobal.com/cutaways . Rotodyne advert, www.ebay.co.uk/itm/1959-Fairey-Rotodyne-Vertical-Take-Off-Airliner-Ad-/400435141043
  - "Scilly helicopter flight link ends", *BBC News*, 30 October 2012, www.bbc.co.uk/news/uk-england-cornwall-20126003. Penzance Heliport postcard, author image
- Slide 6
  - Hewitt L, 2011, "Sky-high sci-fi: Vertical urbanism in science fiction literature", unpublished paper, available from www.inter-disciplinary.net/wp-content/uploads/2011/08/hewittsppaper.pdf
- Slide 7
  - Adey P, 2010, "Vertical security in the megacity: Legibility, mobility and aerial politics", *Theory, Culture & Society,* 27(6): 51-67
  - Williams A J, 2013, "Re-orientating verical geopolitics", *Geopolitics*,18: 225-246
- Slide 9
  - "The Modern Way". Image courtesy of Richard Brook taken from brochure held The National Archives, ref. HLG51/111
  - "First Airline Helicopter" Sikorsky advert, image available at http://c590298.r98.cf2.rackcdn.com/TM1_708.JPG
- Slide 10
  - Route map, "The commercial future of helicopters", *Flight*, 14 November 1952, p.623
  - Photograph of Bristol type 173, Mk 2 helicopter, www.aviationarchive.org.uk/Gpages/html/G2014.html

- Slide 11
  - Wade D A L, 1955, "Civil aviation—progress and problems", *Journal of the Royal United Services Institution*, 100(599): 426-33. http://dx.doi.org/10.1080/03071845509422855
- Slide 12
  - "Skyscraper airport for city of tomorrow", *Popular Science*, November 1939. http://blog.modernmechanix.com/skyscraper-airport-for-city-of-tomorrow/
  - "An airport in the heart of London", *Meccano Magazine*, May 1933, p.341. http://archive.org/details/meccano-magazine-1933-05
- Slide 13
  - Shapiro J S, 1957, "The glass age skyport", *The Architects Journal*, 7 March, p.366-67
  - *Practical Mechanics*, March 1963, cover image. Author collection
- Slide 14
  - *Illustrated London News*, 2 February 1953, p. 170-71. Image courtesy of John Weedy, www.iln.org.uk
- Slide 16
  - Main image: "Helicopters, all weather", *Flight* 24 February 1961, p. 241. Screenshot from a short archived film clip, "Market Report", *Pathe News*, 1961, www.britishpathe.com/video/market-report. "Alternative to chaos", *The Guardian*, 27 January 1961, p. 7
- Slide 17
  - Map taken from "Any decade now", *Flight*, 3 August 1961, p.168
  - Ministry of Aviation, 1961 *Report of the Committee on the Planning of Helicopter Stations in the London Area*, HMSO London
- Slide 18
  - Ministry of Aviation, 1961 *Report of the Committee on the Planning of Helicopter Stations in the London Area*, HMSO London, p.89. Image courtesy of Richard Brook

- Slide 19
  - Image courtesy of The National Archives, ref. BT247/240
- Slide 20
  - Photograph of Westland heliport, 1959, taken from http://pictures.historicimages.net/pictures/_5/4229/4228143.jpg
  - "Westland opens the WAY" advert image courtesy of Dave Robinson, www.content-delivery.co.uk/aviation/airfields/acads/1959/WestlandHeliport.html
- Slide 21
  - Images are courtesy of Manchester City Archives and GMCRO. Source: City Surveyor and Engineers plan archive, refs. 3260/-/13, 3260/-/8.
- Slide 22
  - Image courtesy of Manchester City Archives, ref. GB127.M723/81
- Slide 23
  - "Suggested inter-city helicopter traffic routes" map image courtesy of Liverpool City Archives, ref. CE13162
  - Two photographs of helicopters in Paradise Street carpark, courtesy of Liverpool City Archives, refs. 352 ENG/2/12834, 352 ENG/2/12837
  - Liverpool – Cardiff map taken from newspaper story: "Passenger helicopter service to begin in June", *Manchester Guardian*, 28 February 1950
- Slide 24
  - "Hypothetical helicopter roof station" image taken Hough H T, 1955, "The design of helicopter operating sites for passenger services", *The Surveyor and Municipal and County Engineer*, 24 December, p. 1252
  - Quotation from "Liverpool prepares for helicopters", *Flight,* 10 December 1954, p. 839

- Slide 25
  - Images courtesy of Liverpool City Archives, refs. 352 ENG/2/15588 and 352 ENG/2/15590
- Slide 26
  - Photograph, www.liverpoolblitz70.co.uk/tag/air-raid/page/2/
  - 1950s 1:1250 Ordnance Survey map
- Slide 27
  - Image courtesy of Liverpool City Archives, ref. 352 ENG/2/12031
- Slide 28
  - Image courtesy of Liverpool City Archives, ref. 352 ENG/2/15587
- Slide 29
  - Quotation and both images taken from *Liverpool City Centre Plan* (City and County Borough of Liverpool, 1965)
- Slide 30
  - Top photograph, www.flickr.com/photos/44435674@N00/2291248394/
  - Bottom photograph, http://streetsofliverpool.co.uk/how-the-1970s-changed-liverpool-3/paradise-street-1978/
- Slide 31
  - Quotation and photograph, http://asenseofplaceblog.wordpress.com/2012/05/31/streets-of-liverpool/
- Slide 33
  - Images from "The commercial future of helicopters", *Flight*, 14 November 1952, p. 622

- Slide 34
  - Left image, www.newsnet5.com/dpp/news/world/2-dead-after-helicopter-crashes-in-london
  - Right image, www.guardian.co.uk/uk/2013/jan/23/london-helicopter-crash-pilot-weather-warning
- Slide 35
  - "Hypothetical helicopter landing ground" image taken from Hough H T, 1955, "The design of helicopter operating sites for passenger services", *The Surveyor and Municipal and County Engineer*, 24 December, p. 1251
  - Bottom image taken from "Can the airlines use the helicopter?", *Flight*, 7 November 1952, p.585
- Slide 36
  - Author scan of the *Noise: Final Report*, 1963
- Slide 37
  - Graham S, Hewitt L, 2013, "Getting off the ground: On the politics of urban verticality", *Progress in Human Geography*, 37(1): 72-92
- Slide 38
  - Rotary aerodrome in Liverpool, cover image from *Meccano Magazine*, February 1937. http://archive.org/details/meccano-magazine-1937-02
  - Miscellaneous images of the Liverpool Waters scheme taken from documents posted on www.liverpoolwaters.co.uk/content/home.php