LIGHT FREIGHT

Design Solutions for Thames Freight Infrastructure

BECKETT RANKINE
Marine Consulting Engineers

PORT OF LONDON AUTHORITY

CROSS RIVER PARTNERSHIP
Delivering London's Future Together

Thames Estuary

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P02	08.03.2022	Minor Aesthetic Updates	FB	GG	HP
P03	29.03.2022	Front Cover Update	FB	HP	HP

Contents

Glossary

Bankseat
A bankseat is a support structure to which the landside bearings of the canting brow are fixed.

Canting Brow
A canting brow is a walkway structure connecting the shore to the pontoon. Bearings fixed at either end allow the structure to move, enabling access at all states of the tide.

Dolphin
A dolphin is a man-made, marine, independent structure that extends above the water level. It may or may not be connected to a larger pier, wharf, or bridge structure by pedestrian access walkways.

Dredging
Dredging is the removal of sediments and debris from the bottom of lakes, rivers, harbours, and other water bodies. Generally undertaken to enable/improve vessel navigation.

Pier
A pier is a platform reaching out to a river or sea that can be used as a landing place for vessels.

Pile
Tubular berthing/mooring piles are steel tubes driven deep into the riverbed which become a fully fixed restraint that allows structures to be built on top of or attached to the pile. These often require impact hammer driving and will be embedded between a third and one half of their total length into the bed. This type of pile is difficult to remove from the bed if required.

Pontoon
A pontoon is a floating structure, often made from steel. In this case, the pontoon forms the landing support for the canting brow, a waiting area for users of the pier, and a berthing structure for vessels.

Quay
A quay is a fixed structure which is used to dock vessels and transfer goods or pedestrians from a vessel back to the land.


CANTING BROW


BANKSEAT


PILE


PONTOON

Cross River Partnership

Cross River Partnership (CRP) is a partnership delivering environmental, economic and community-focused projects. We support public, private and voluntary organisations to address creatively challenges around Air Quality, Transport, Placemaking and Wellbeing. CRP's vision is to address sustainability challenges collaboratively in London and beyond. As a testbed for exciting projects in towns and cities, we will share knowledge, evidence, and best practice for the people who live, work and visit these places. All of CRP's partners are represented on its Board. CRP is proud to be working collaboratively with all these public, private and community partners across central London and beyond.

CRP is an alliance of:

- Angel London
- Better Bankside BID
- Brixton BID
- Cadogan
- Camden Town Unlimited BID
- Cheapside Business Alliance
- City of London Corporation
- Eastern City Partnership
- Euston Town BID
- Greater London Authority
- Groundwork London
- Hammersmith BID
- Hatton Garden BID
- London & Partners
- London Borough of Camden
- London Borough of Hammersmith and Fulham
- London Borough of Islington
- London Borough of Lambeth
- London Borough of Southwark
- Midtown BID
- Network Rail
- Port of London Authority
- Royal Borough of Kensington and Chelsea
- South Bank BID
- Team London Bridge
- The Fitzrovia Partnership
- The Northbank BID
- Transport for London
- Vauxhall One
- Victoria BID
- Westminster City Council

About Clean Air Villages 4
CRP's Clean Air Villages 4 (CAV4) project is a Department for Environment, Food and Rural Affairs (Defra) funded project led by Westminster City Council. CRP is working with 26 project partners to improve air quality across different London 'villages', where both air pollution and population density levels are high. These locations reflect the Greater London Authority's Air Quality Focus Areas. The CAV4 freight solutions implemented incorporate Consolidation, Distribution, Mode, Technology and Policy.

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Executive Summary

This study considers the design of the existing piers along the River Thames and how they could be modified to accommodate the requirements of a Light Freight service. To better understand these requirements the study re-visits and expands on the works carried out previously by WSP and Bearing Point. The study confirms the intended focus of the Light Freight service to be smaller, more manoeuvrable cargo, which can be moved using a Roll On - Roll Off methodology, or via manhandling, depending on the location of the pier.

The study considers two models for a successful Light Freight service, which would be actualised based on the magnitude of the Light Freight service:

Partial Service - a service which takes place either before or after existing pier usage without causing disruption to existing users.
Continuous Service - a service which takes place throughout the day.

The location assessment carried out considers a long list of 24 pier locations across London and assesses these against a set of criteria to determine a set of 7 preferred pier locations to which the Light Freight service could deliver.

The 7 preferred locations identified on the shortlist are:

- Wandsworth Riverside Quarter Pier
- Chelsea Harbour Pier
- Battersea Power Station Pier
- Blackfriars Pier
- Bankside Pier
- Tower Bridge Quay
- Masthouse Terrace Pier

A suite of Beckett Rankine design solutions demonstrate how each of the shortlisted pier locations could be modified to allow them to be incorporated into the Light Freight service. These designs allow for integration as either a partial or continuous service and are supported by a costing exercise which demonstrates the potential construction costs involved with each of these designs to give value to the future of the Light Freight scheme. It is more financially viable to begin with a partial service, which is generally more affordable, but would allow for a more limited volume of cargo to be handled. A continuous service is a more significant investment but allows for a greater larger service to operate.

1.0 Introduction

‘The Vision for the Tidal Thames – Thames 2035’ (Thames Vision 2035) is being reviewed, with a refreshed Vision being consulted upon and due to be launched early next year. It will be updated to reflect sustainable growth objectives for the Thames, in line with stakeholder priorities, and wider economic and social trends. It will incorporate a longer-term view to reach net zero carbon and harmful emissions objectives by 2050 and inform actions for the intervening period. There is an increased interest and desire to use the Thames to transport Light Freight in addition to the heavier freight already transported on the river to secure potential environment and logistical benefits. With this in mind, the Port of London Authority, with support from the Cross River Partnership (CRP) DEFRA-funded Clean Air Villages 4 project and the Thames Estuary Growth Board, have commissioned Beckett Rankine to investigate the feasibility of handling Light Freight at London piers and to provide costing and guidelines on pier adaptation that would be required for different pier structures and operational handling approaches to provide robust and agile solutions.

This investigation provides further information of the incorporation of Light Freight on the River Thames, with the overall objective in scaling up Light Freight movement by developing appropriate access infrastructure and integration with either onward logistical movements across London, or in facilitating a “click and collect” service at the piers.

Light Freight services on the Thames could potentially benefit numerous consumers and be a financially viable method of reducing road vehicle movements in central London. The services would contribute towards the Mayor of London’s Plan Transport Strategy and the River Action Plan.

This study contributes toward the PLA and Government objective of achieving net zero carbon emissions by 2050 as set out in PAS 2080.

The project builds on previous work carried out by Bearing Point and WSP. This document considers the initial requirements for a Light Freight service on the Thames in order to develop a brief for how the service might operate. The document then considers the existing piers in London and assesses which would be most suitable for inclusion within a Light Freight scheme. Exemplar designs have been produced to demonstrate how piers could be modified to handle Light Freight. Cost estimates for these modifications are provided.

Bankside Pier - DHL Light Freight service

Existing Freight on the River

Historic Freight

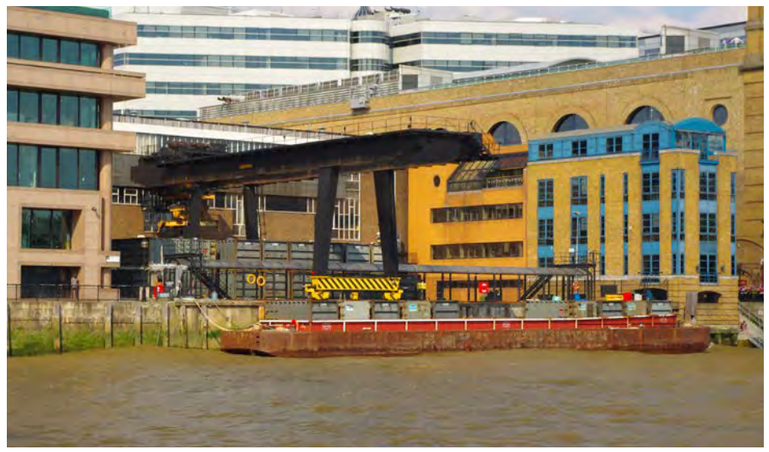
Light Freight is not a new concept on the Thames. From a historic standpoint the Thames has been used for the transport of goods as early as the 16th century as the city’s population flourished alongside the increased requirement for shipbuilding to support the expanding naval power and world trade requirements. The Thames transported timber, wool, foodstuffs and livestock regularly to maintain the city’s people and economy. More recently, the Thames is less well used for Light Freight operations, however there are at least two operations set up in the last few years. As such there is already a precedent for a successful Light Freight service, albeit at a relatively modest scale, on the river. Previous studies carried out by Bearing Point and WSP have, however, identified the potential for significant growth in this sector.

Additionally, Class V passenger boats have, for many years, been provisioned via passenger piers (although dedicated service piers are also used). Freight handling methods include use of sack trucks and roll cages to load food, drinks and other supplies onto vessels. While this is being done regularly it is not without risks; manoeuvring a heavily loaded roll cage, without brakes, down a brow at low tide can be particularly challenging.

In addition to this, waste and recyclates are collected from several of the piers and static ships by specialised vessels such as the Tidy Thames.

Recently a DHL light parcel service was established, bringing packages from London Heathrow to central and east London via a pier in the west.

A service carrying light medical supplies was also inaugurated in 2021. This service brings key non-perishable equipment for operating theatres into London, for use by Guys and St Thomas’ NHS Trust.



Walbrook Wharf

2.0 Initial Considerations

A key challenge for this study is the definition of what constitutes a Light Freight service. To allow the identification of more applicable locations, and therefore design solutions, the first step was to fully establish the study brief. BR split the requirements for the new Light Freight service into three elements.

These are:

- Inputs: What does the service set out to achieve?
- Processes: How will the service achieve this?
- Output: What is required to do this?

In view of the potential breadth of scope which a Light Freight service could cover, and to aid in the identification of the details of the service, it was decided to set out what was understood to be the key elements of the brief. A basic set of assumptions was established within which to consider the practicalities of the service and lend reference to the inputs, processes and outputs required for the pier design solutions.

These assumptions were informed by knowledge of existing operations on the Thames and on other urban waterways together with the outputs from the WSP and Bearing Point studies.

We assumed at an early stage that:

- The Light Freight operation must be able to operate a scheduled service which means operating at all states of tide. If this were not the case then the service would be inefficient logistically as the peak hours would, at times, fall during at times when the vessels were tidally constrained from operating.
- The service should be “last mile ready” or as close to it as reasonably practical. Sorting at the piers should be kept to a minimum and processing should be carried out at the out of London feeder locations as far as possible (albeit the options, certainly where there are extensions, will have space whereby some form of micro-consolidation/storage etc. can be undertaken).
- As a degree of on-site sorting and handling would be required in any circumstance the distribution pier requires a covered area to protect cargo from the elements. A secure room or cabinet is also required for short term storage of freight and also possible as click and collect.
- Freight operations and passengers need to be separated on the piers. This is a safety requirement for both the general public and for workers. Segregation is also necessary to allow existing operations to continue unimpeded by the addition of a Light Freight service.

These assumptions were challenged during the initial assessment and, through discussions with stakeholders, developed into a more detailed understanding of the requirements for a Light Freight service.

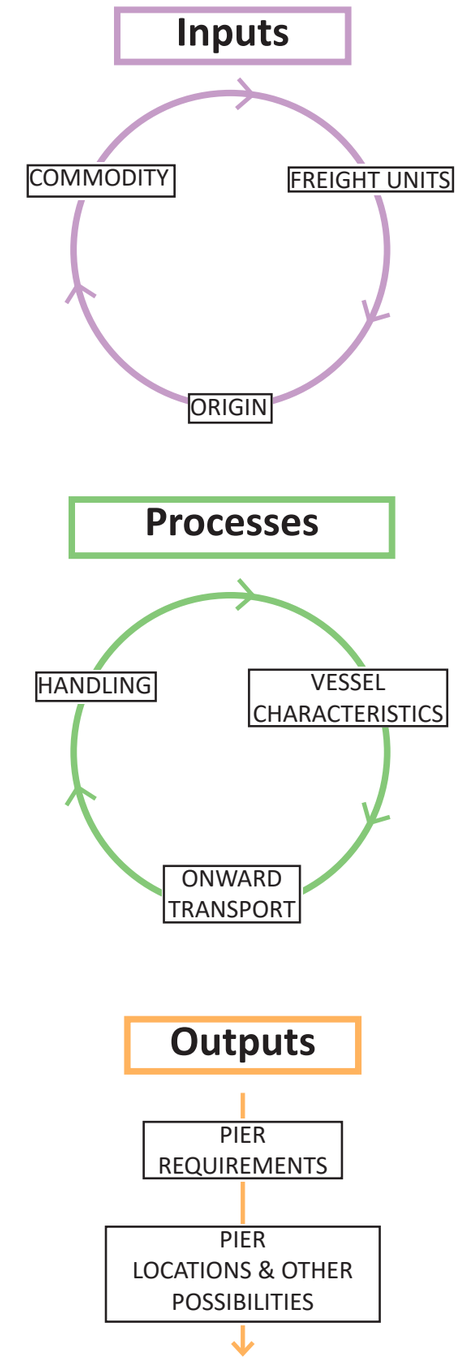


Figure 1: Initial Considerations

2.1 Inputs

2.1.1 Commodities

The first consideration to be developed is the scope of the service itself. The freight type to be transported is directly interconnected with the freight unit which is used. A range of commodities are considered, from letters and parcels through to larger business supplies, as well as the more logistically complicated chilled/insulated goods.

Based on mid-stage discussions with the Project Steering Group and through the PLA's engagement with stakeholders it was decided that the commodities to focus on are letters and parcels, medical supplies, food and drink, and other business supplies. Parcels were the key focus in the WSP report.

Typical Cargo Types

2.1.2 Freight Units

The freight units which the service transports are directly linked to the goods which are being carried. A range of freight units are considered including:

- Handbag
- Tote box
- Trolley
- Platform Trolley
- Roll container
- 1t bags
- Joint Modular Intermodal Container (JMIC)
- 20ft Container
- 40ft Container

The smallest cargo unit, being a hand carried bag, does not influence pier design and is not suitable for more than small volumes so is not considered further. Equally the larger cargo units such as ISO containers and 1-tonne bags are not sufficiently manoeuvrable to allow the Light Freight service to operate effectively on a shared pier.

Wheeled trolley units, such as sack barrows, roll cages, pallet movers or similar can move significant volumes quickly and cheaply and are therefore considered to be the most flexible solution. These unit types are shown in green in the list above.

Typical Freight Units

2.1.3 Origin

The third consideration for the Inputs into a light freight scheme is the origin of the commodities being transported. The origin depends on a number of factors such as the type of commodity and the destination in London. In general, however, the locations from which products will be transported is known. Commodities can be delivered from upstream via Heathrow, where product could be flown in from further afield, transferred across to the river, and delivered downstream. Alternatively, commodities could be brought in via the M25 and transferred onto the river at suitable locations such as DIFT, the Port of Tilbury or Barking, as identified by the WSP report. In any event points of origin are expected to be outside the Ultra Low Emissions Zone and the Congestion Zone so as to avoid their charges.

These locations are shown for clarity on the figure below.

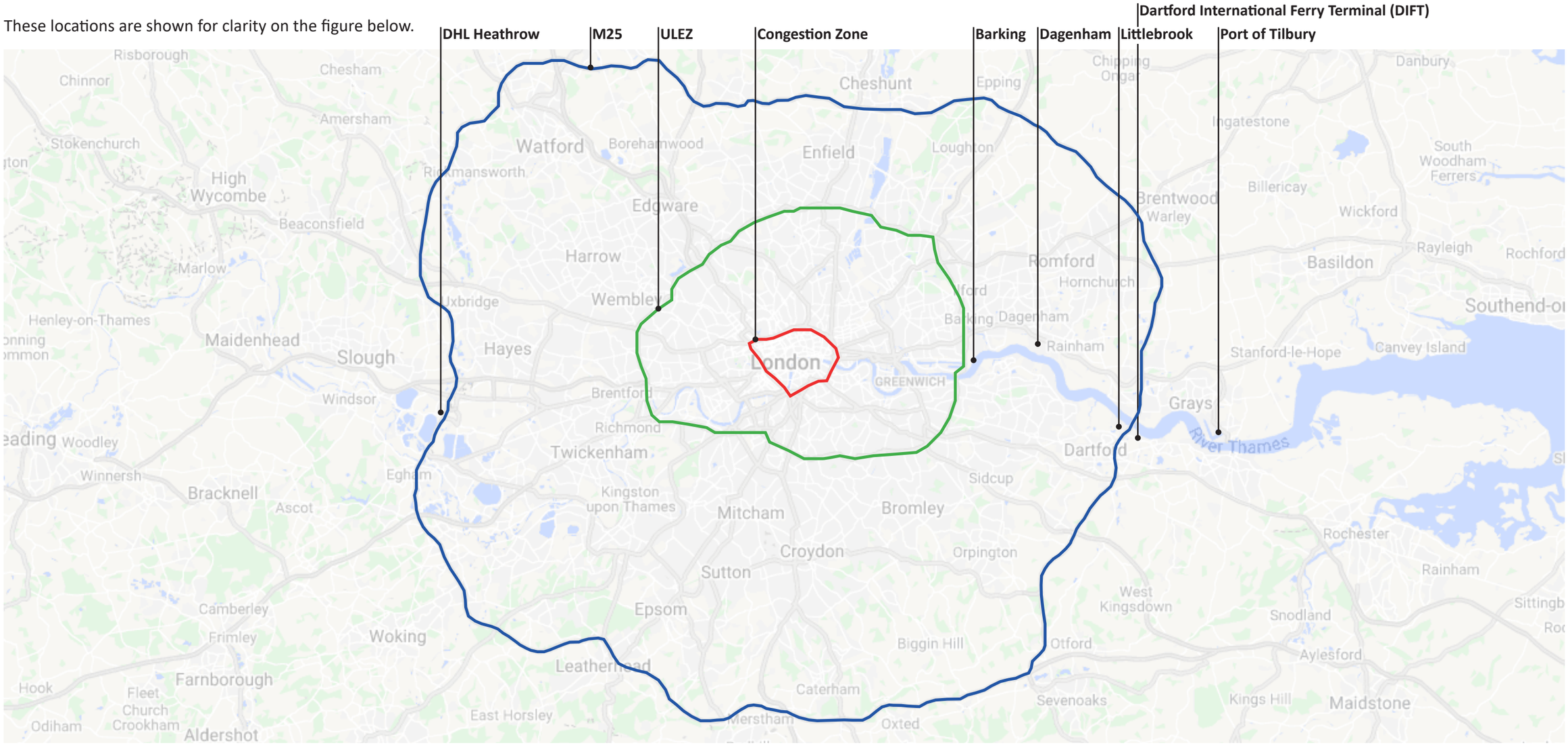


Figure 2: ©Google Maps - Map of London, ULEZ, M25

2.2 Processes

2.2.1 Vessel Characteristics

Having established the Inputs into the Light Freight service, the next element to consider is the identification of likely freight vessel characteristics. The vessel may be different for different freight unit types so a range of vessels have been identified sufficient to inform the pier design requirements.

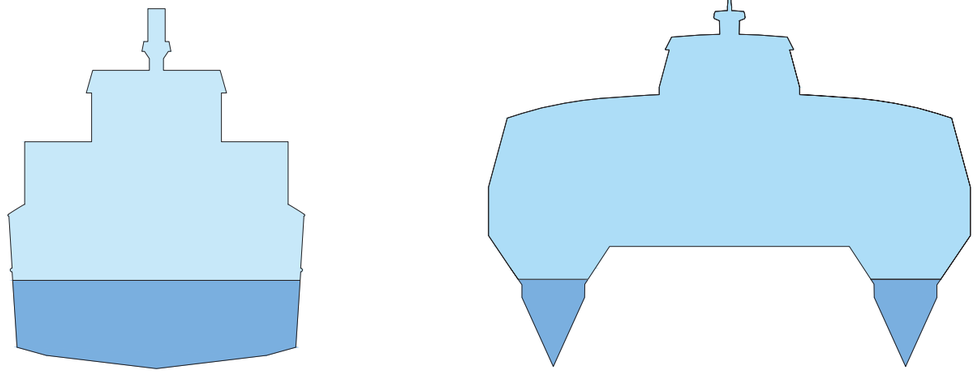
At present, parcel freight is carried by small launches which can readily access a pier. Their size allows them to be loaded and unloaded by hand relatively quickly. The current vessels in use are diesel powered and have been re-purposed from other duties (they are passenger vessels). An issue with these vessels is that they do not allow for scalability as the volume of goods increases into the future. With the potential growth of the sector in mind a larger vessel, similar in size to some of the faster River Bus vessels operating on the river, is expected to be used.

The most critical element of the vessel design is the method of loading, typically vessels use side loading as it allows them to berth alongside mooring points. Side loaded vessels have been assumed for the remainder of this study although end loading remains a possibility if new purpose-built vessels and piers were to be constructed.

Vessel speed dictates how much of the river can be traversed and how long it will take to do so. Higher operational speeds will be required for longer routes from feeder sites further down river. In any event vessel speeds need to be adequate to run a scheduled service irrespective of tidal flow. This in turn means that the vessels will have to be of low-wash design, so a catamaran hull form is the most likely configuration.

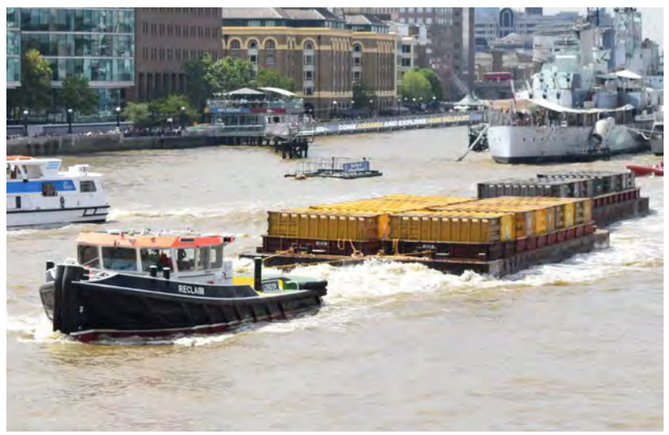
In future, vessels will need to be zero/low emission, at least when operating within London. Electric charging points or facilities to bunker alternative fuels are likely to be required at the piers or close by.

For the purposes of the design work carried out the vessel is assumed to be of similar size to an average Class V river bus on the Thames, however it should be noted that the exact vessel requirements are likely to differ between different service types. The exact draught and air draught requirements have not been fully established. It is noted that there are currently no bespoke Light Freight vessels in operation on the Thames. While an existing vessel could be retrofitted to allow it to serve the Light Freight service, to allow for the variable nature of the service and potential for future growth. The vessels are assumed to be purpose built for the Light Freight service and further consideration should be given to the vessels once details of the route and required capacity are known.



Monohull Vessel (left), Catamaran/twinhull Vessel (right)

Thames Clipper - Fast River Vessel



Cory Barge - Slow River Vessel

©Aqua superPower - Electrical Charging Point

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2.2.2 Handling

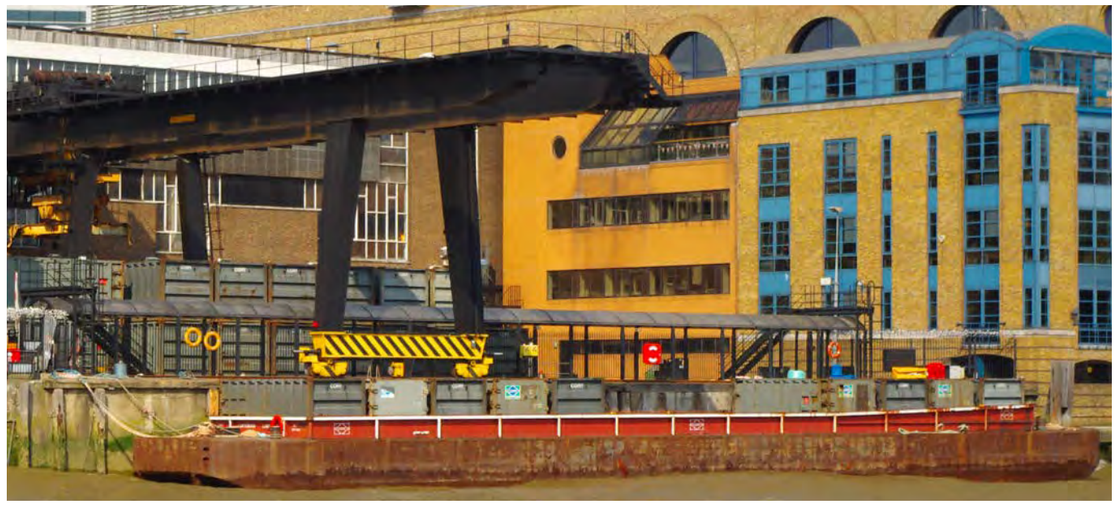
With the vessel arrived at the Light Freight pier destination, the next step is to determine how the goods are likely to be handled.

Smaller, lighter more manoeuvrable goods are able to be loaded and unloaded by hand Carry On – Carry Off (Co-Co) similar to how the existing operations operate. This is not practical when dealing with larger cargo volumes without risk to workers. Whilst all parcel handling will always involve some amount of manual handling, it is assumed for the purpose of this study that making this transfer as easy as possible is the best course. This will allow for greater flexibility for cargo type.

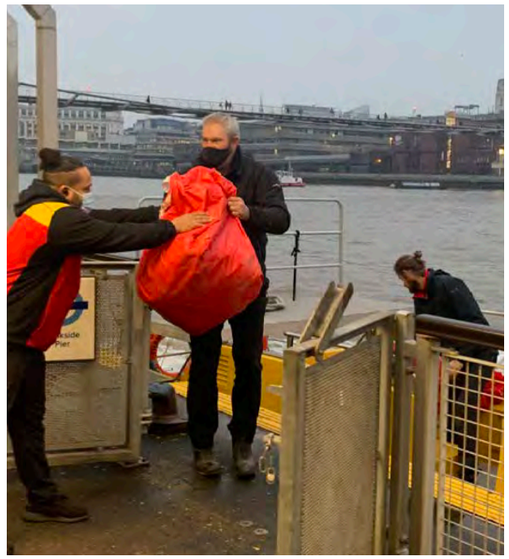
For goods heavier than 20kg, a wheeled transfer system should be used. This could incorporate wheeled trolley, trailer or similar. This does require that the pier deck level is consistent with vessel deck level for easy movement of cargo. If goods are to be moved to the land side, the gradient of the access brow and any on-deck ramps need also be controlled. Dependent on the type and weight of the cargo this Roll On – Roll Off (Ro–Ro) operation could be manual, power assisted or fully powered.

Heavier goods should be transported using a Lift-On Lift-Off (Lo-Lo) methodology. This system would use a crane to lift goods directly from the vessel to a wheeled vehicle or storage area where they can be sorted and distributed. This allows for a large quantity of cargo to be moved at a time, but also requires more room to operate. The use of a crane allows for a differential height between the vessel and landing area making it more suitable for a fixed quay or jetty rather than for a floating pier. As the larger, heavier cargo types and freight units are scoped out of this study, a Lo-Lo method of cargo handing is not considered further.

This study proceeds on the basis than any pier modifications fit for Ro-Ro are also fit for Co-Co. As such the primary method of loading and unloading is assumed to be Ro-Ro for the purposes of this study.



Lift On - Lift Off (Lo-Lo)



Carry On - Carry Off (Co-Co)

Roll On - Roll Off (Ro-Ro)

2.2.3 Onward Transport

The handling of the cargo at the pier allows for the transfer of goods from the vessel to the onward vehicle on which it will complete the last leg of the delivery.

The type of onward vehicle is dependent on the goods being transported and the delivery destinations.

The onward vehicle influences the operational design of a Light Freight pier; whether the vehicle can access the pier determines whether cargo is handled direct from vessel to vehicle, or from vessel to land side to vehicle. As a general rule, vehicles small enough to operate on the pier, are those which are small enough as to not require a numberplate. They should ideally weigh less than one tonne.

The most common types of onward vehicles would be e-bikes and e-vans. These were a focus of the City Market study carried out by Bearing Point. However, additional vehicles such has baggage handlers and Bradshaw Tractors, could be ideal for moving larger amounts of cargo. This type of tractor unit could be suitable for deliveries to larger private developments, such as at Battersea Power Station.

Through discussion with the Project Steering Group, it was agreed to keep a focus on the e-bikes and e-vans as these have the freedom to operate in the majority of locations. There is also the potential for onward journeys to be carried out by e-trucks. These are larger than e-vans and can carry more cargo and therefore offer improvements in the efficiencies of the last mile travel. Due to their larger size, they may not be able to access some pier landing locations however. A benefit of this approach is that e-bikes can, in some instances, operate on a pier. This is explored further below.

At some locations a click and collect parcel service may be required. Click and collect requires a parcel locker unit to be located close by the pier which, in some locations, may be difficult to achieve, as the piers are often located in busy areas where the required riverside space is not immediately available. This is resolvable as a click and collect service could also be installed on the pier itself, but due to size requirements, this would have to be assessed on a location by location basis dependent on the confirmed requirements and cargo throughput of the Light Freight service.

Onward Vehicle Types and Click & Collect Lockers

2.3 Outputs

2.3.1 Pier Requirements

Having defined the nature of the Light Freight service, there are some further requirements to be determined to enable pier design solutions to be realised.

A key consideration is the nature of the service itself. WSP suggested the Light Freight service would need to be a scheduled daily service to be effective. However, depending on the volume of goods predicted this could be a continuous service operating through the full day, or it could be a partial service which would only operate in early morning / late evening. In either of these cases the Light Freight service could have a single destination, or could be multi-drop in nature. This has a significant effect of the requirements of each pier as it may not be required to handle a full vessel's worth of cargo in a single unloading / loading cycle.

The nature of the service would critically impact the design of any potential piers. A continuous service cannot be expected to be integrated with current pier use by passenger vessels and would be expected to require a dedicated berth; this, in most cases, would require a pier extension. If, however, there is a sizeable underused pier then it may be possible to operate a continuous service using the existing pier infrastructure. This is considered further within the site assessment which follows. A partial service, by its nature, is easier to integrate into existing pier usage.

A storage and sorting place is required for the Light Freight service as goods are not always able to be directly loaded to vehicles. Ideally the storage space required should be approximately equal to the carrying capacity of the vessel. This provision allows for a degree of backload (packaging/containers/returns sent back to the distribution centre) but if high backload volumes are expected the storage area would need to be larger. There is also the possibility for the e-bikes use as part of the service to be stored on the pier, this would further increase the required space. While the provision of a larger space for on the pier makes the re-use of an existing pier more difficult and directs the project toward new pier extension, a critical advantage to the provision of a larger space however, is that it offers the service greater flexibility toward the future as the Light Freight service expands.

If future vessels are electric or hybrid powered, or if the piers are to offer e-bike storage, then the piers will need to be fitted with charging facilities.

Bankside Pier - Unrestricted Berth

Western Riverside Waste Authority - Restricted Berth

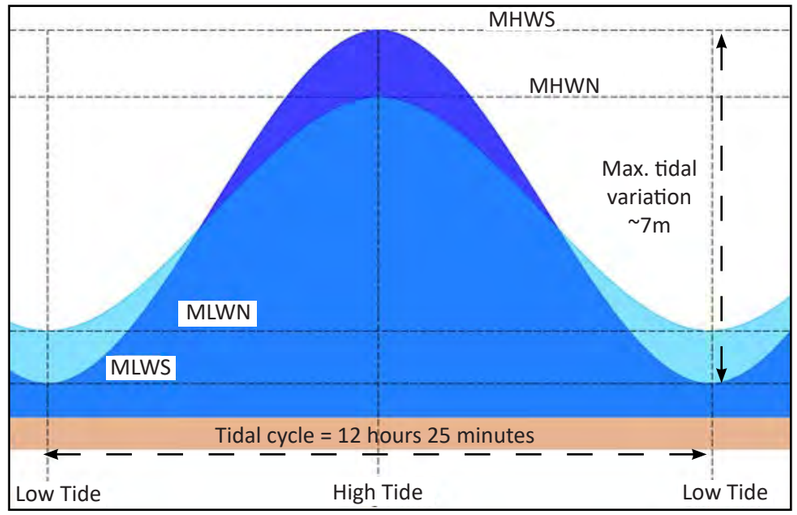


Figure 3: Thames Tidal Cycle

MHWS: Mean High Water Springs
MHWN: Mean High Water Neap
MLWN: Mean Low Water Neap
MLWS: Mean Low Water Springs

3.0 Pier Location Assessment

3.1 Pier Long List

Working with the Project Steering Group, a long list of piers was identified between Hammersmith Bridge and Greenwich. These piers were selected as bounding locations due to the limited water depth above Hammersmith Bridge and the distribution of major consumer destinations. The list includes all the piers shortlisted in the WSP and Bearing Point studies. Also included were some key locations where, although there is no pier at present, there have previously been piers and new ones could be re-established in the future. These are referred to as “sites” within the location list below. Several of these sites have infrastructure remaining (e.g. piles or a bankseat) which may be able to be reused.

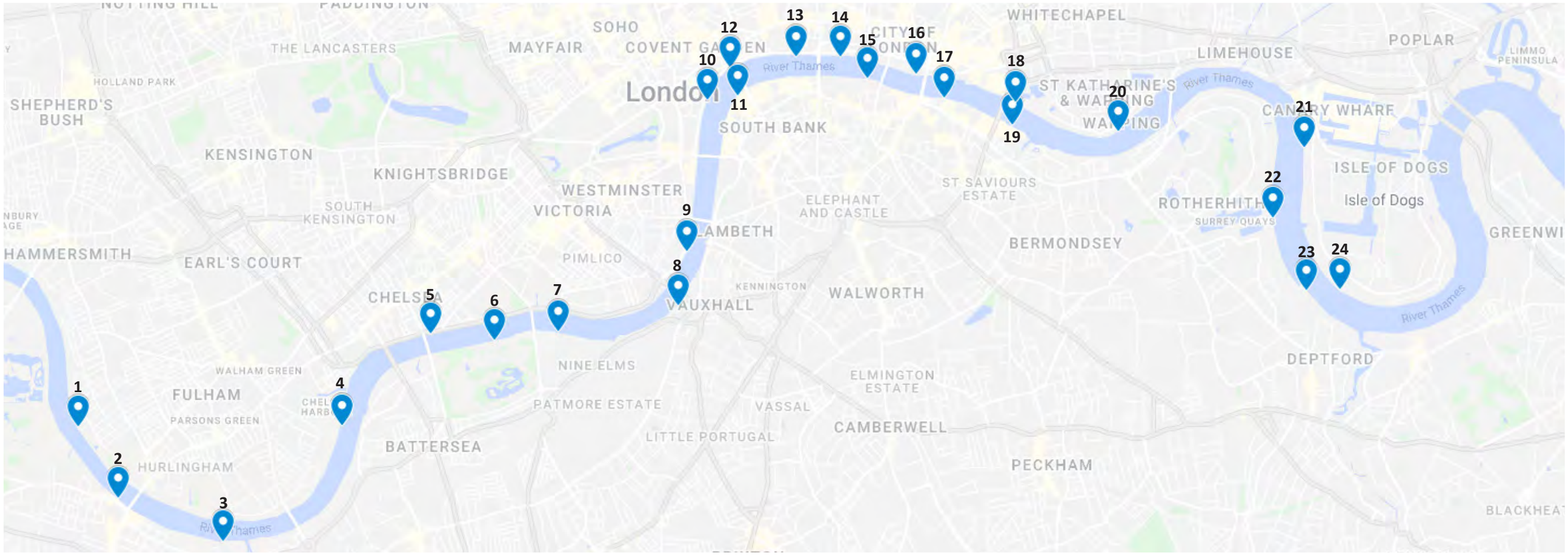


Figure 4: ©Google Maps of River Thames, Central London

1. Fulham Football Club Pier London Borough of Hammersmith & Fulham	**6. Battersea Park Pier (site)** London Borough of Wandsworth	**11. Festival Pier** London Borough of Lambeth	**16. Swan Lane Pier** City of London	**21. West India Dock Pier** London Borough of Tower Hamlets
2. Putney Pier London Borough of Wandsworth	**7. Battersea Power Station Pier** London Borough of Wandsworth	**12. Woods Quay** City of Westminster	**17. London Bridge City Pier** London Borough of Southwark	**22. Greenland Pier** London Borough of Southwark
3. Wandsworth Riverside Quarter Pier London Borough of Wandsworth	**8. St George’s Wharf Pier** London Borough of Lambeth	**13. Blackfriars (site)** City of London	**18. Tower Bridge City Pier** London Borough of Tower Hamlets	**23. Convoy’s Pier** London Borough of Lewisham
4. Chelsea Harbour Pier London Borough of Hammersmith & Fulham	**9. Millbank Millenium Pier** City of Westminster	**14. Blackfriars Pier** City of London	**19. Butler’s Wharf Pier** London Borough of Southwark	**24. Masthouse Terrace Pier** London Borough of Tower Hamlets
5. Cadogan Pier Extension London Borough of Kensington & Chelsea	**10. Hispaniola (site)** City of Westminster	**15. Bankside Pier** London Borough of Southwark	**20. Wapping Pier** London Borough of Tower Hamlets	

Table 1: Long List of Piers from Left to Right on the Map with Boroughs labelled

3.2 Initial Assessment Criteria

Each of the locations on the long list were assessed based on their suitability for integration within a Light Freight service. Each location was assessed independently for a partial service & a continuous service. In the context, the **Partial Service** is a service which takes places either before or after existing pier usage without causing disruption to existing users. A **Continuous Service** is a service which takes place throughout the day. Typically (but not always) a partial service was considered to operate from an existing pier arrangement, while a continuous service was to operate from a pier extension.

The criteria against which the locations were assessed was driven primarily by the Bearing Point City Markets assessment. The adopted criteria are demonstrated in the figure below.

Given the added focus of this study, the scope of the assessment was widened to include additional criteria such as:

- Ability to meet continuous service / partial service
- Pedestrian / Freight Segregation
- Brow access gradient
- Ownership
- Hinterland (potential recipients within range of pier)
- Deliverability (can pier be used as existing, extended or new build)

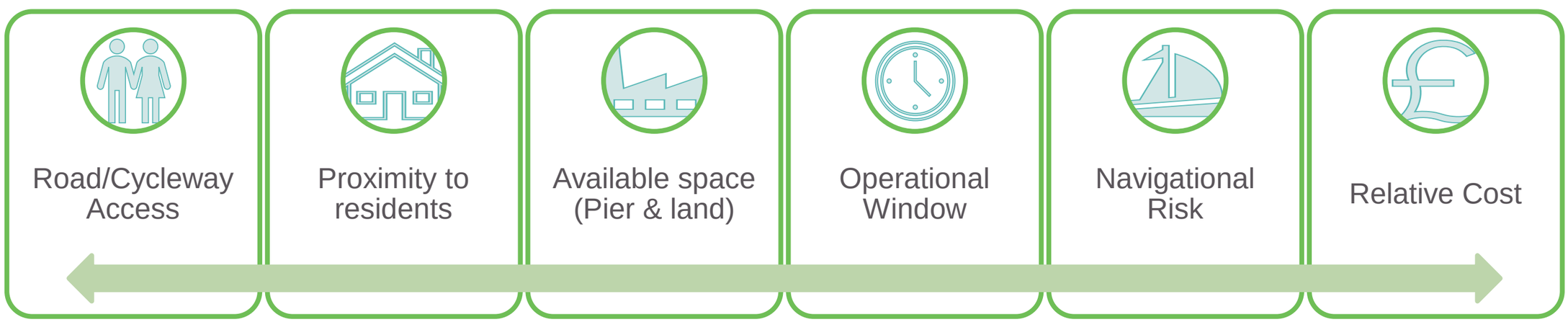


Figure 5: Key Assessment Criteria (Adapted from City Markets Study)

3.3 Initial Assessment Method

The assessment attempted an objective comparison of each of the pier locations with scoring criteria considered as quantitatively as possible. A numerical score between 0 & 5 was awarded for each of the pier suitability judging criteria with a defined meaning for each score to provide consistency. An example of these definitions is provided here on the right, while the full set of criteria and definitions are available upon request.

A score of 0 was used as an exclusion criteria and was assigned only to a location where a feature is missing, and therefore could not be scored.

Inevitably certain factors are of greater importance to the value of a pier for Light Freight than others; the criteria were assigned a weighting to reflect this. These weightings ranged between 1 and 3 and were applied as a straight multiplier such that each pier could theoretically achieve a score of between 0 and 15 for each criteria. Weightings are summarised within the table below.

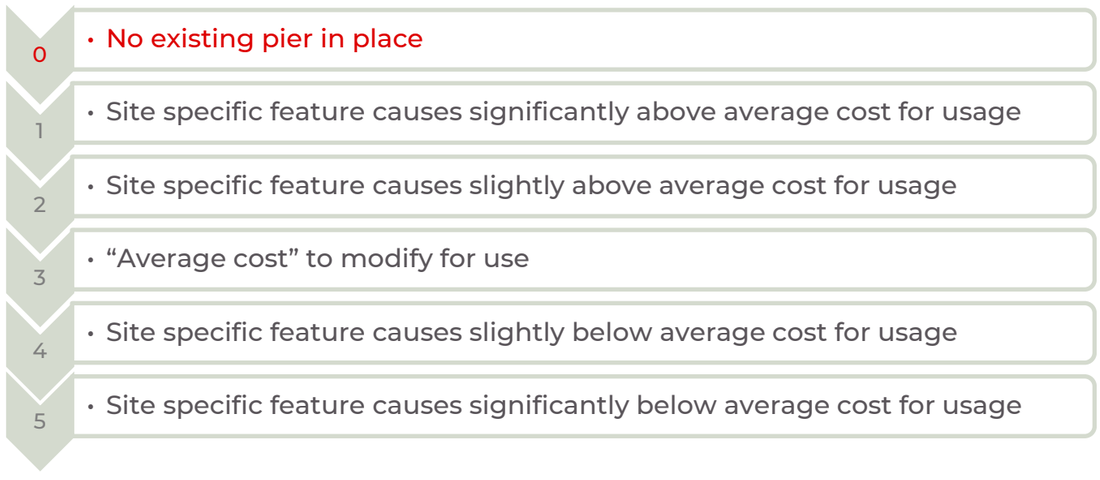


Figure 6: Relative Cost (for Partial Freight Service)

Criteria	Weighting
Road/Cycleway Access	2
Proximity to Residents	1
Available Space (partial/continuous)	2/3
Operational Window	3
Navigational Risk	2/1
Relative Cost (partial/continuous)	1
Brow Gradient	3
Pedestrian / Freight Segregation (partial/continuous)	2/3

Table 2: Criteria Weightings

3.4 Initial Shortlist

The results of the pier location assessment and scoring were compiled and the rankings determined for the partial freight service and continuous freight service independently. The top 10 piers for each service types are provided in the tables below; a full breakdown is available on request.

By producing separate rankings for each freight service type, the most optimal locations overall are established. These optimal locations are those which feature on both lists, shown in green below, as they provide the benefit of flexibility; able to serve both freight service types. Operations at these locations could be introduced initially as a partial service to determine demand and potential for growth. Piers with higher demand could then be developed to suit a continuous freight service.

#	Pier	Score
1	Tower Bridge Quay	58
2	Bankside Pier	57
3	Blackfriars Pier	57
4	Millbank Millennium Pier	53
5	Woods Quay	53
6	Festival Pier	51
7	Greenland Pier	47
8	Battersea Power Station Pier	47
9	Masthouse Terrace Pier	43
10	London Bridge City Pier	43

Table 3: Partial Service - Shortlist

#	Pier	Score
1	Millbank Millennium Pier	65
2	Greenland Pier	64
3	Bankside Pier	63
4	Festival Pier	60
5	Hispaniola (site)	60
6	West India Dock Pier	59
7	Tower Bridge Quay	58
8	Battersea Power Station Pier	58
9	Blackfriars Pier	57
10	Blackfriars (site)	57

Table 4: Continuous Service - Shortlist

3.5 Pier Shortlist

Having obtained a shortlist of the optimal pier locations along the River Thames for consideration as part of the Light Freight scheme, a final step was to incorporate any additional knowledge which may not be fully captured within the assessment method. These additional factors included distribution along the river and known interest from potential operators. For example, Millbank Millennium Pier was removed due to the inherent difficulty in modifying the existing structure.

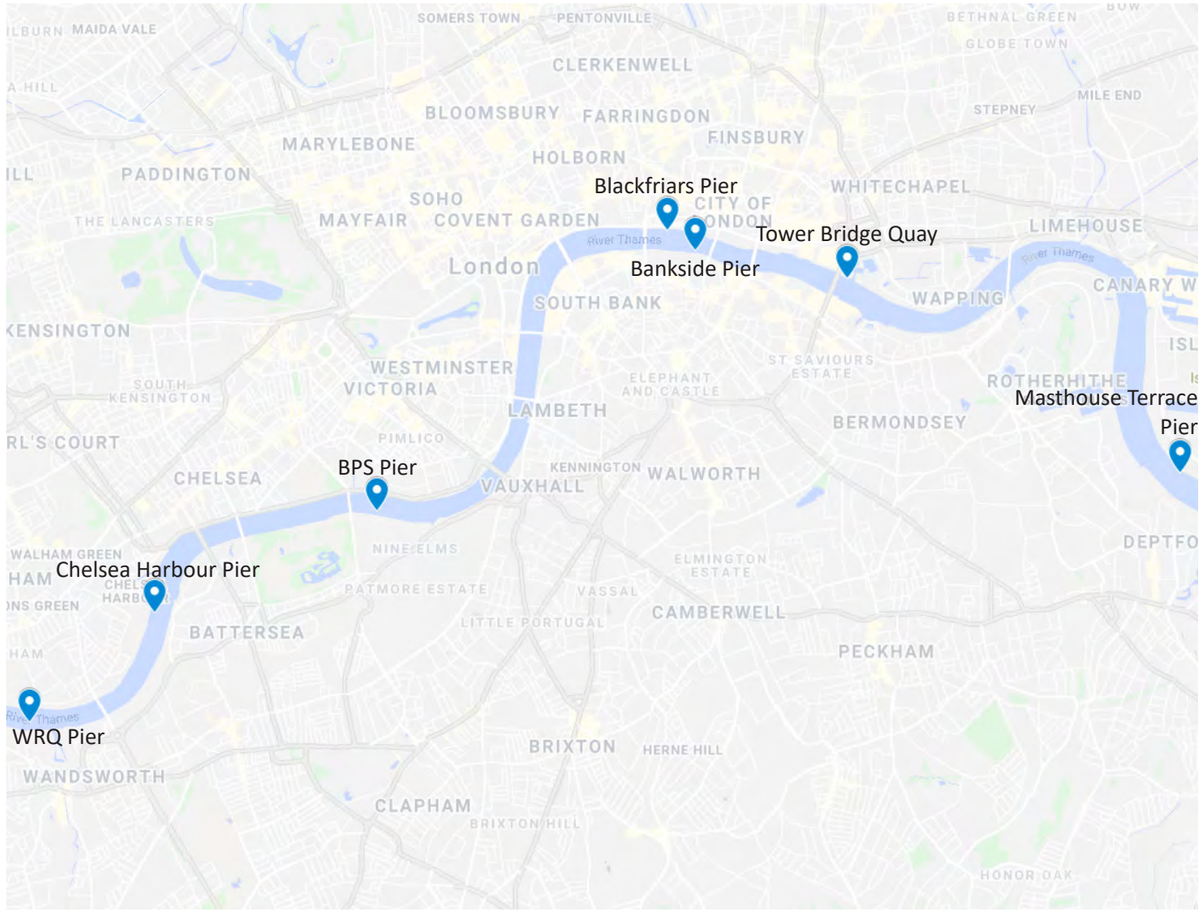


Figure 7: Final Pier Shortlist

4.0 Design Solutions

4.1 Adaptation Design Considerations

The development of pier design solutions considered the critical issues for the use of the piers in their existing condition. Design solutions need to allow the use of the pier for an operational Light Freight service while keeping intrusive works and impacts on existing facilities to a minimum.

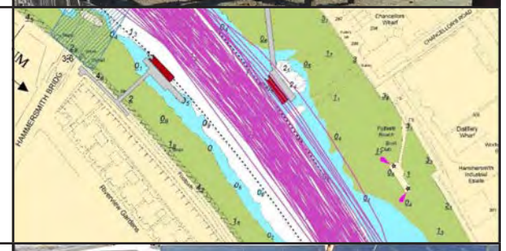
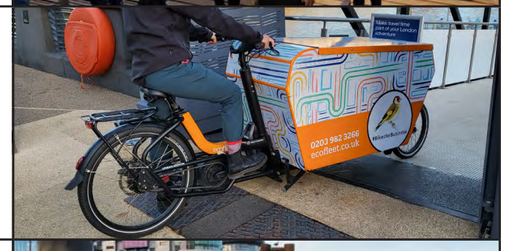
Consideration	Description	Example
Access Gradient	The gradients of access brows to pier pontoons can be extreme at spring low tides. This is particularly severe in locations with limited space, where brows are forced to be shorter. While most piers should provide a suitable gradient for pedestrian access at most states of tide, this does not necessarily mean they will be of suitable gradient to allow the movement of freight at times of low water.	
Navigational Risk	Navigational risk is the risk of the development having a negative impact on the navigation of existing river users. Any pier extension will require a navigational risk assessment and for some piers in locations close to bridges or other obstructions the increased navigational risk associated with an extension and increased traffic may not be acceptable.	
Space for Development	Given the unknowns with respect to the scale of the Light Freight service; flexibility, and the ability to expand the facility in a phased manner is needed. The river is well utilised in some areas, particularly toward central London, and some piers do not lend themselves to easy expansion. The expansion of piers next to listed structures and/or World Heritage Sites may not be a practical proposition.	
Clear Width of Existing Access	To allow for a segregation between freight cargo and pedestrians a suitable width of access is required. A suitable width for a segregated access is circa 4.5m, with 3.5m allowable for short lengths. These minimum widths assume that the cyclist is pedalling so a narrower access could be acceptable should the cargo bike be walked onto the pier. The widths assume two-way traffic; on some piers a one way system is possible.	
Suitability for Cargo Bikes	The piers in the assessment have been designed for pedestrians, not for cargo bikes. Cargo bikes have greater width requirements and have constraints on the turns they are able to accomplish. Several piers have an access that is not only narrow, but also includes hairpin turns which cannot be readily negotiated by a cargo bike. Cargo bikes are a relatively new development and there is limited guidance available on their manoeuvring characteristics. To gain a better understanding of their capability a trial was carried out at Battersea Power Station pier.	

Table 5: Design Considerations

4.2 Cargo Bike: On-Site Testing

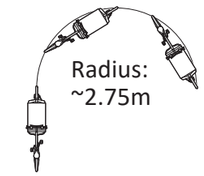
The courier company eco**fleet** provided the study team with an Urban Arrow XL cargo bike to test at a Battersea Power Station Pier (BPS), a shortlisted pier location. The Urban Arrow XL is one of the most popular bikes in the industry. The bike has critical dimensions 2.97x0.70x1.10m and a storage capacity of up to 620litres. The bike has an electric assist feature.

The trial demonstrated that, contrary to expectation, gradient was not a critical concern. The brow gradient at the time of testing was approximately 1 in 8.5 at low tide, and the cargo bike did not have any difficultly starting and stopping on this slope. The electric assist easily coped with the gradient although, in order for the electric assist to be used, the bike has to be ridden up the slope. Pushing a loaded bike would be more challenging. A gradient is also more readily negotiated if it is on a straight run.

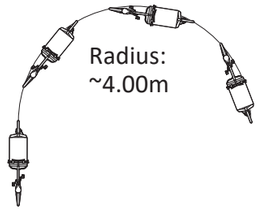
A potential concern, due to the length of the cargo bike combined with its relatively low frame, was a clash with the transition ramps across the pier. The trial established that the transition ramps at BPS pier did not cause any clashes.

The brow width at BPS is 2.4m, which allowed enough space for a cargo biker to pass a pedestrian, or to pause and allow the pedestrian to pass. This was tight, however, and a nervous pedestrian may not be comfortable so close to a cargo bike.

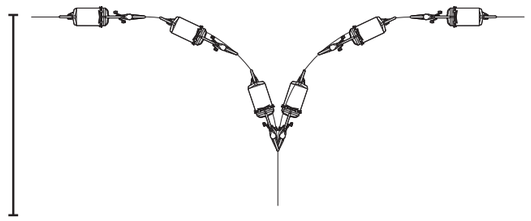
The large turning circle of a cargo bike was found to be the main design challenge. The hairpin turn on the BPS brow was not possible in one movement even with feet down and not pedalling. To successfully navigate this corner 2-3 “bites” were required. Typical turning circles for a “foot down” or walking clean turn and for a “foot up” pedalling clean turn are demonstrated in the figures (right.) Due to the size of the cargo bikes a 3-point turn required a minimum clear width of 4.6m. This represents a significant area of a pier pontoon’s deck.



Turning circle when walking



Turning circle when pedalling



Urban Arrow XL Testing

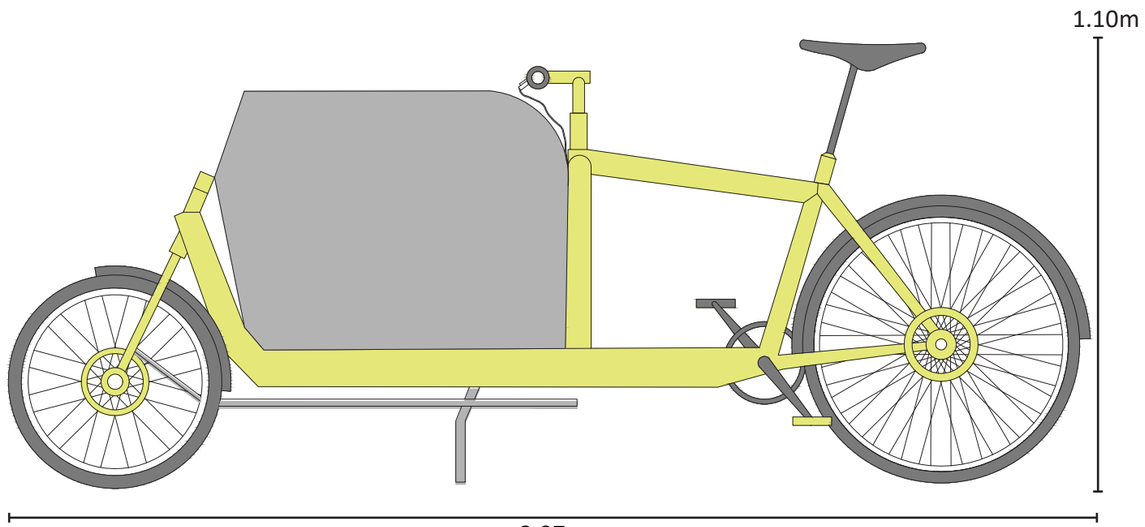


Figure 8: Urban Arrow XL Elevation

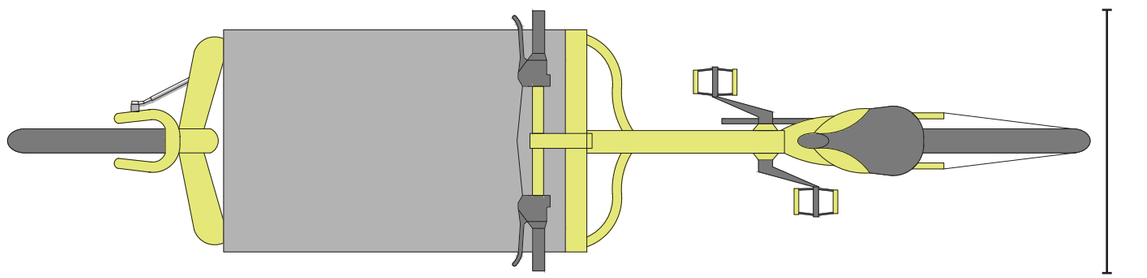


Figure 9: Urban Arrow XL Plan View

5.0 Design Solution Overview

The following slides explore a range of design solutions that could be used for enabling freight services to operate at existing passenger piers and in one case a potential new pier location.

These design solutions are presented as concepts and further design development would be needed for them to be progressed further.

Each of the design solutions is based on the following assumptions:

- The condition of existing infrastructure is sufficient to allow continued use without significant repairs or replacement.
- A form of operational controls will be implemented on all piers to mitigate against congestion from cargo bikes. Whether this is a maximum number allowed at once, or a traffic light system is to be decided at a later date.

These design solutions have been broken down into elements which could be incorporated into further piers and are not limited to only those included in the shortlist. Each solution could be applied to multiple piers on the Thames should an alternative location be progressed. The design solutions can be loosely broken down into:

- Access Widening
- Additional Operational Controls
- Dredging
- New access brows
- Monopile berthing face extension
- New pontoon extension

The following slides discuss each of the shortlisted locations and how these design solutions could be incorporated to allow the piers to facilitate a Light Freight service.

5.1 Bankside Pier - Option 1

LONDON BOROUGH OF SOUTHWARK

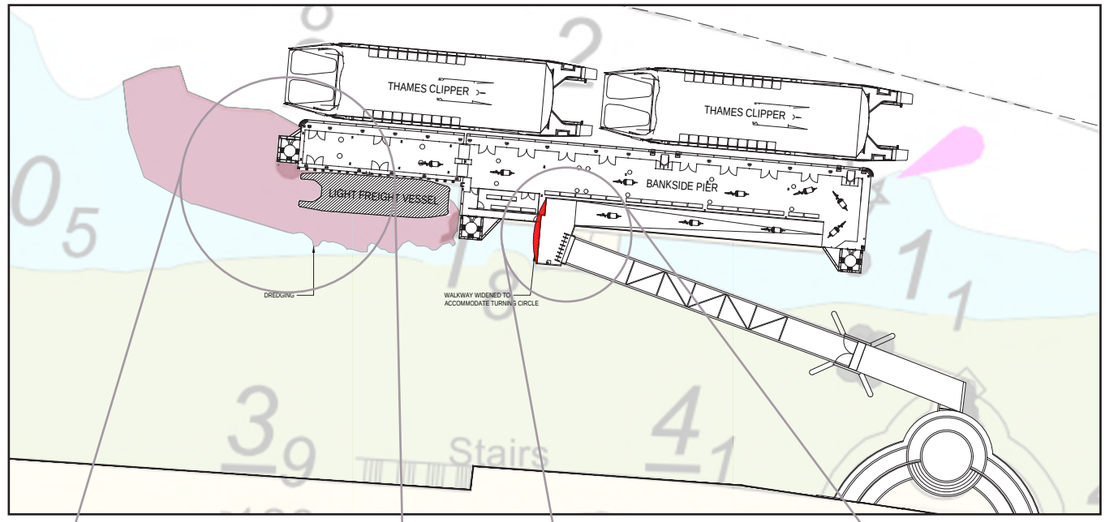
Bankside pier is well located and well connected to its hinterland, and has relatively wide access ways across the brow and the pontoon which facilitate cargo bike movement.

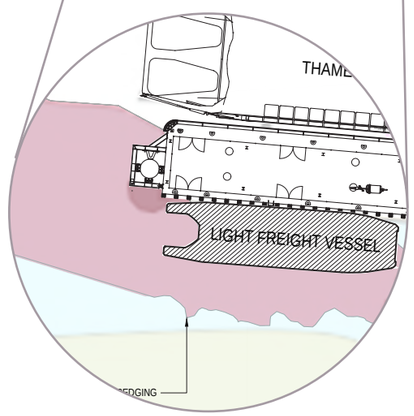
The pier currently operates an early morning DHL service. This operates much in line with a partial freight service as considered by this study. As such, while the scheme is able to operate as is, this design solution considers minimally intrusive methods to better facilitate a Light Freight service. DHL undertake micro-consolidation from a dedicated part of the pier waiting room.

The key changes which can seen in the drawing is inclusion of an additional Light Freight vessel which would operate off the rear face of the existing bankside extension pontoon. Dredging is required to facilitate all tide access here however.

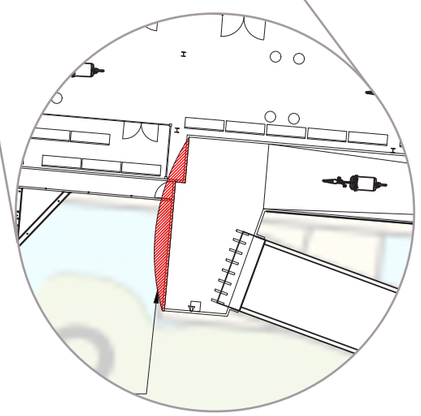
An additional change is the local widening of the landing area at the base of the main access brow. This reduces the pinch point for cargo bikes entering the pier and allows for better segregation between cargo bikes and pedestrians.

A potential drawback of the small Light Freight vessel is that it limits the potential volume of cargo which can be transported. The access to this extension pontoon is also longer than would be desirable as it not only includes 2 hairpin bends, but also crosses the full length of the pedestrian area.





Dredging



Access widening

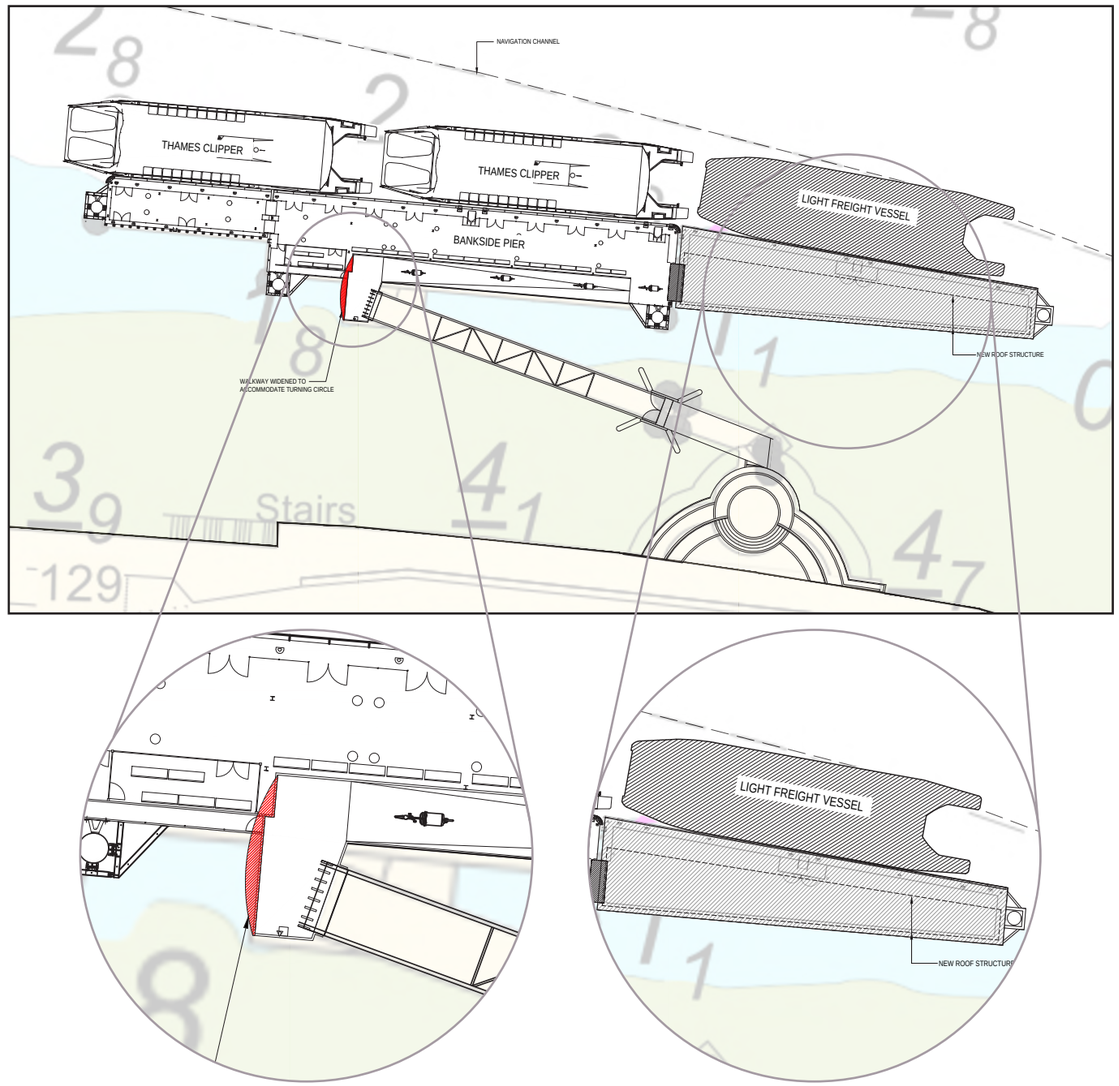
5.2 Bankside Pier - Option 2

LONDON BOROUGH OF SOUTHWARK

A second option which could be implemented at Bankside allows for a full size Light Freight vessel and reduces the interface between pedestrians and cargo bikes as far as practicable.

This is done through the inclusion of a new extension pontoon. This pontoon has been given a staggered front face to minimise intrusion of the navigation channel. The localised widening of the access brow landing remains as per option 1.

The pontoon includes a covered area for any sorting and storage, and would not be accessible to the general public. This pontoon allows for use with a continuous or partial freight service. In the case of a partial freight service, the pontoon could potentially be used for other operations, but this would need to be agreed separately once more is known about the service and its operation.



Access widening

Pontoon extension and new pile

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Marine Consulting Engineers

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Bankside Pier
Light Freight Extension

5.3 Tower Bridge Quay

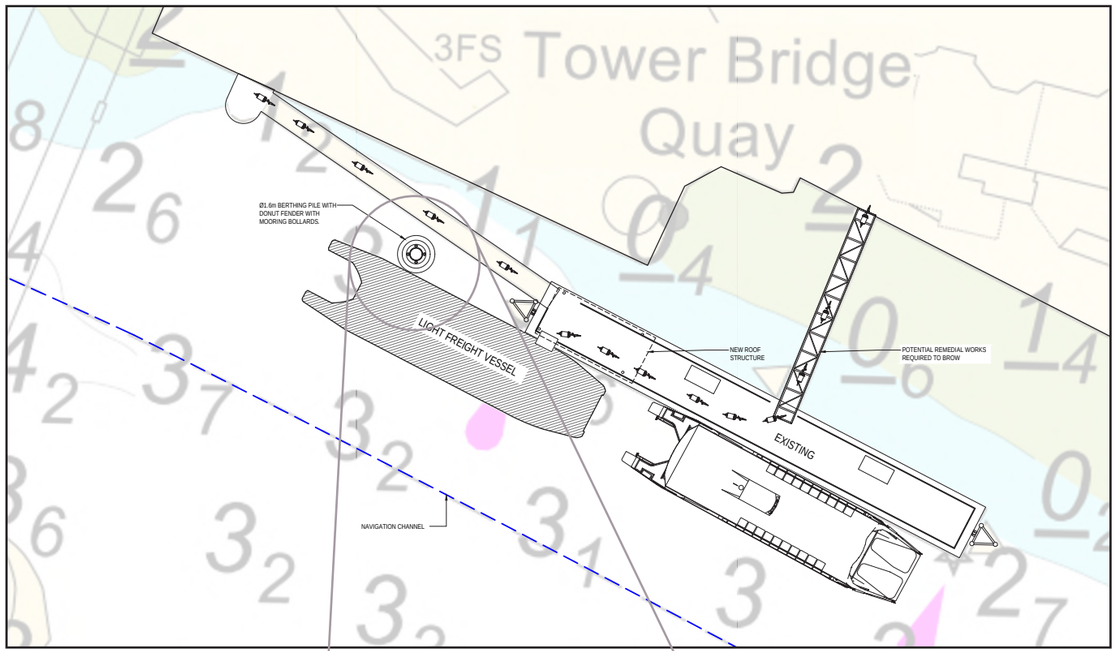
LONDON BOROUGH OF TOWER HAMLETS

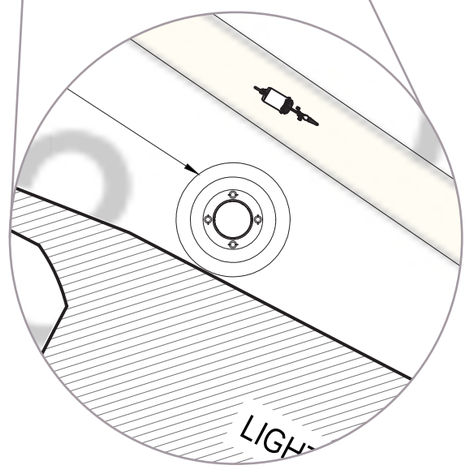
Tower Bridge Quay is well suited for the incorporation of a Light Freight service in addition to existing passenger flows due to having two brows.

The incorporation of a one way system is beneficial to the flow of pedestrians and cyclists, which aids in the operation of the Light Freight service and negates the drawback of the somewhat narrower access brows.

The existing pontoon is not sizeable enough to berth both a Class V passenger vessel and the currently assumed Light Freight vessel. To allow for continued access without negatively impacting existing services, the Light Freight vessel is berthed against both the pontoon and a new tubular monopile such that the full length of pontoon is not required.

A new covered roof is included at the upstream end of the pier for sorting / storage as needed. Due to the size of the pontoon, this area is also limited in size and may be a limiting factor on cargo through this pier.





New berthing pile

5.4 Battersea Power Station Pier

LONDON BOROUGH OF WANDSWORTH

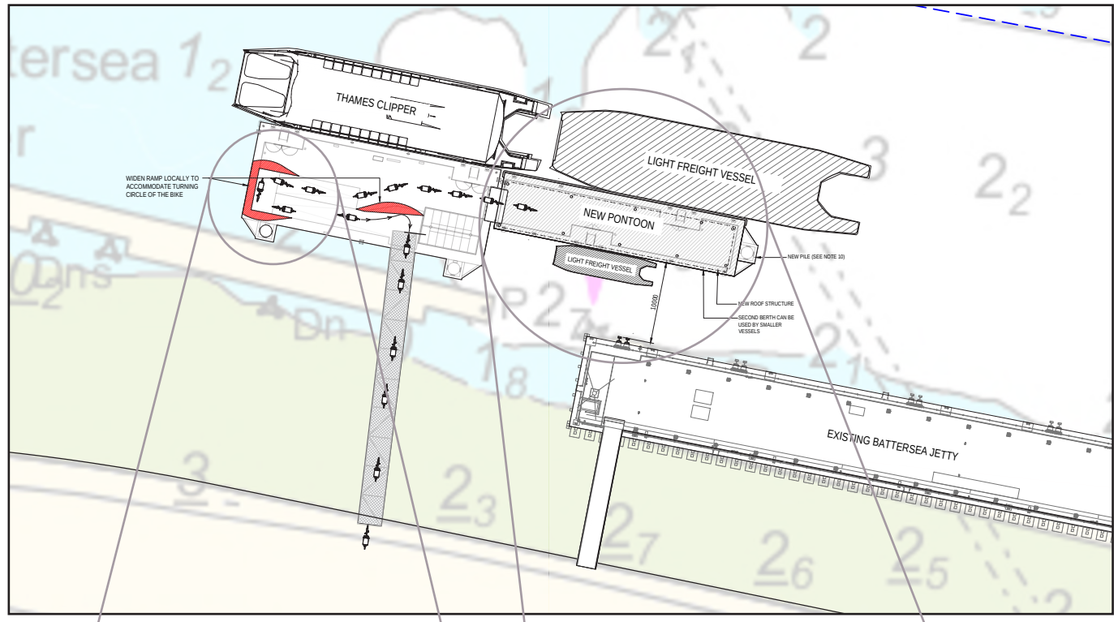
Battersea Power Station Pier is ideally suited for a Light Freight service due to the BPS development immediately landside which offers a dense consumer hinterland.

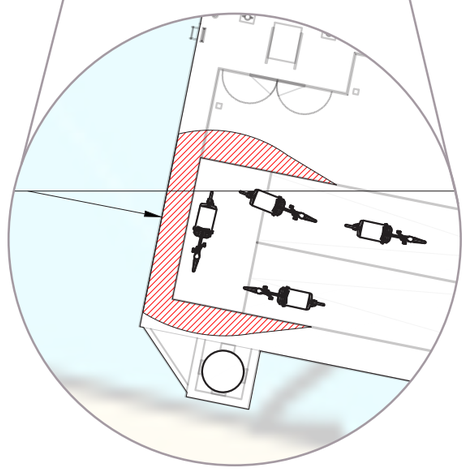
A pontoon extension is required to allow this pier to feasibly receive cargo freight as a continuous service.

The pontoon extension is positioned downstream of the existing pier to avoid the need for dredging.

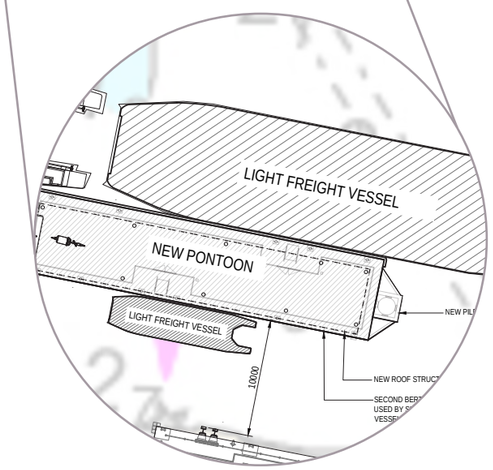
The access ramps on the pontoon itself are widened locally to allow easier transit for cargo bikes.

The new pontoon can be accessed by a larger freight vessel as part of the planning Light Freight service, however, the drawing also demonstrates there is potential for a second berth for a small vessel if a smaller, more direct, service was planned for the BPS development.





Access widening



Pontoon extension and new pile

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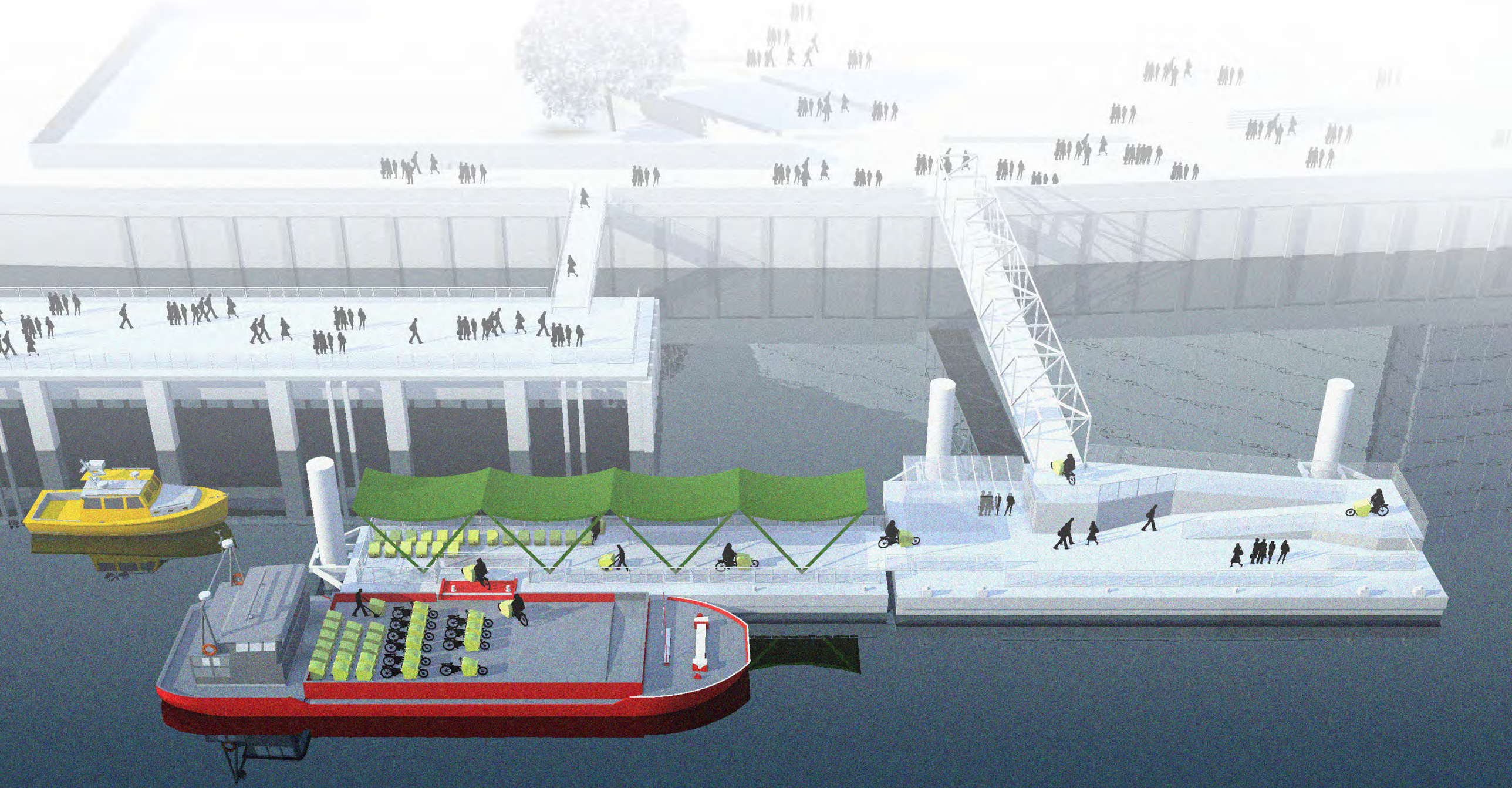


Battersea Power Station Pier
Light Freight Extension

5.5 Wandsworth Riverside Quarter Pier

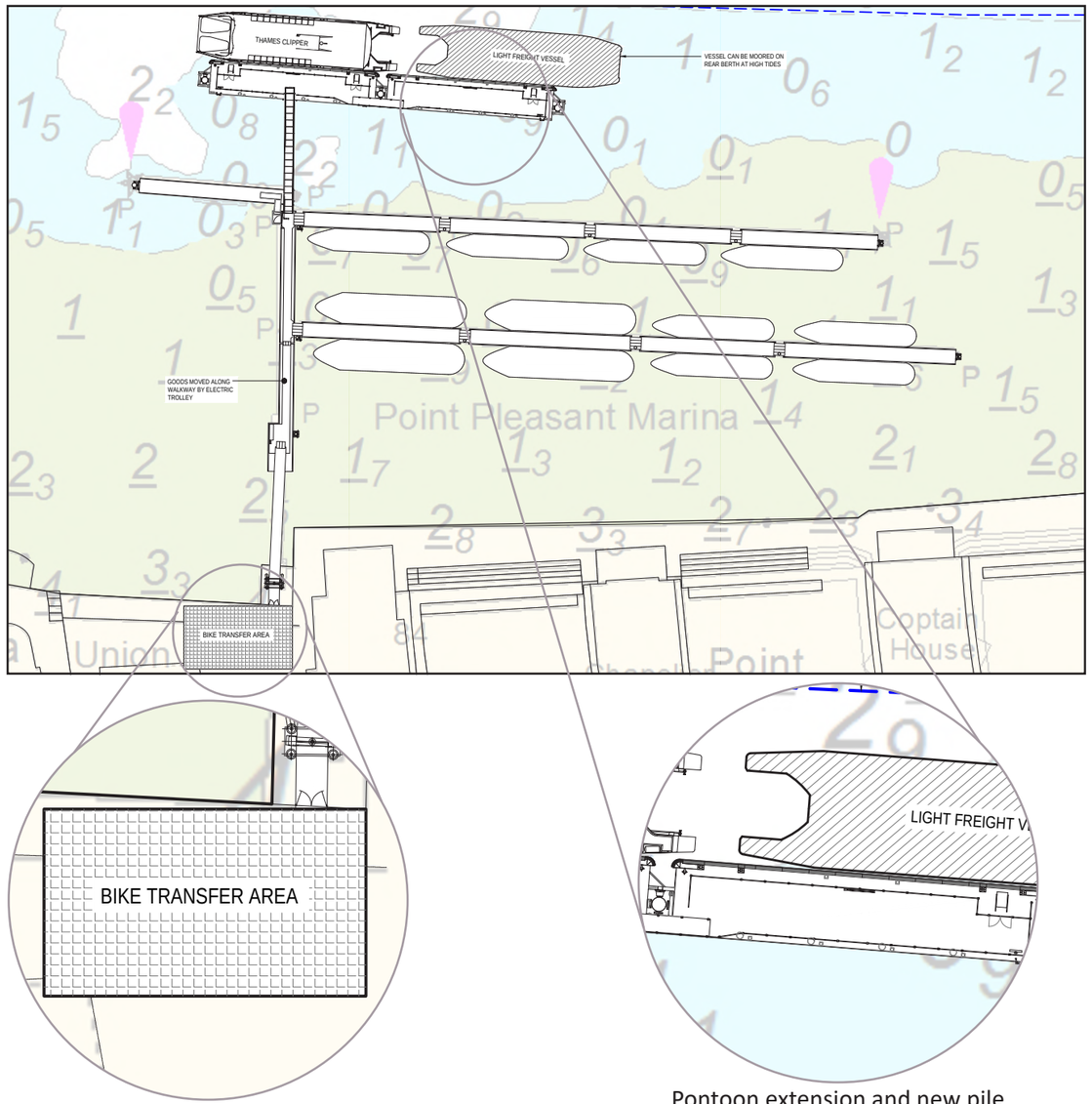
LONDON BOROUGH OF WANDSWORTH

WRQ Pier, unlike the other pier locations considered within this document, is accessed through a set of modular pontoons in addition to the access brow.

The limited size of the existing pontoon means that an extension pontoon is needed to allow for the incorporation of a Light Freight service.

This arrangement means that, operationally, it is inefficient to access the pier arrangement via cargo bikes and therefore utilises an area on the landside for cargo transfer.

Cargo is transferred from the extension pontoon to the landside via an electric trolley. This could be organised such that transfers were regular and kept to timetable to minimise the impact on adjacent house boats and the existing river bus services and its users.



Bike transfer area

Pontoon extension and new pile

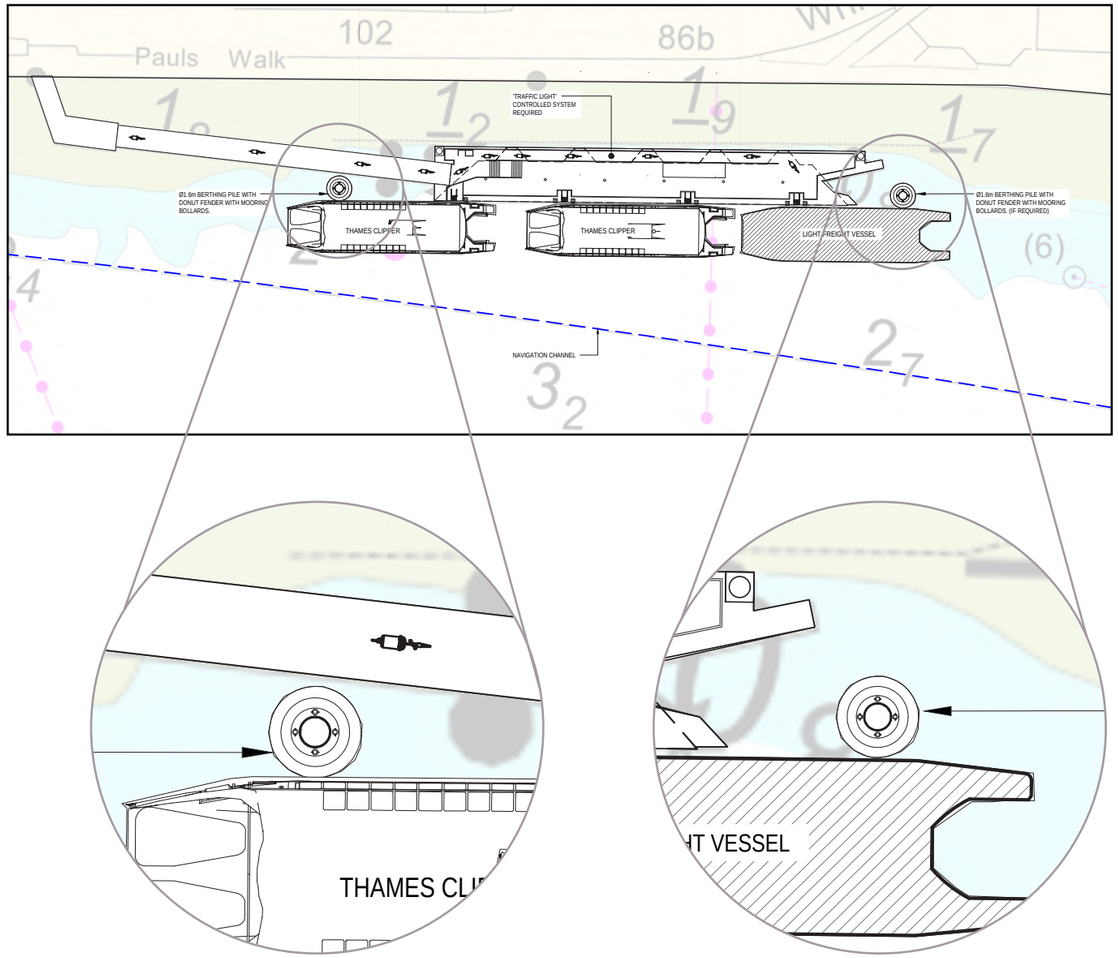
5.6 Blackfriars Pier

CITY OF LONDON

Blackfriars Pier is suitably sized such that a Light Freight service could be adopted in a relatively straightforward manner. The constraints to this are that the current pier is often fully utilised, often with 2 Class V vessels berthed at once. Additionally, the ramped access along the rear of the pontoon is narrow.

Without more intrusive measures such as widening the ramp (and thereby moving the access steps and reducing clear width to the berthing face), an operational control is required here. A traffic light system to prevent cargo bikes from accessing the ramp alongside pedestrians and to prevent two-way cargo bike traffic is considered.

Rather than an extension pontoon, the design features a mooring pile at the upstream end of the arrangement to allow a Class V vessel to berth offset to the main pontoon. There is the potential for an additional mooring pile at the downstream end also, but this would impact the end berth currently used by Thames Rockets.



New upstream berthing pile

Optional downstream berthing pile

5.7 Chelsea Harbour Pier

LONDON BOROUGH OF HAMMERSMITH & FULHAM

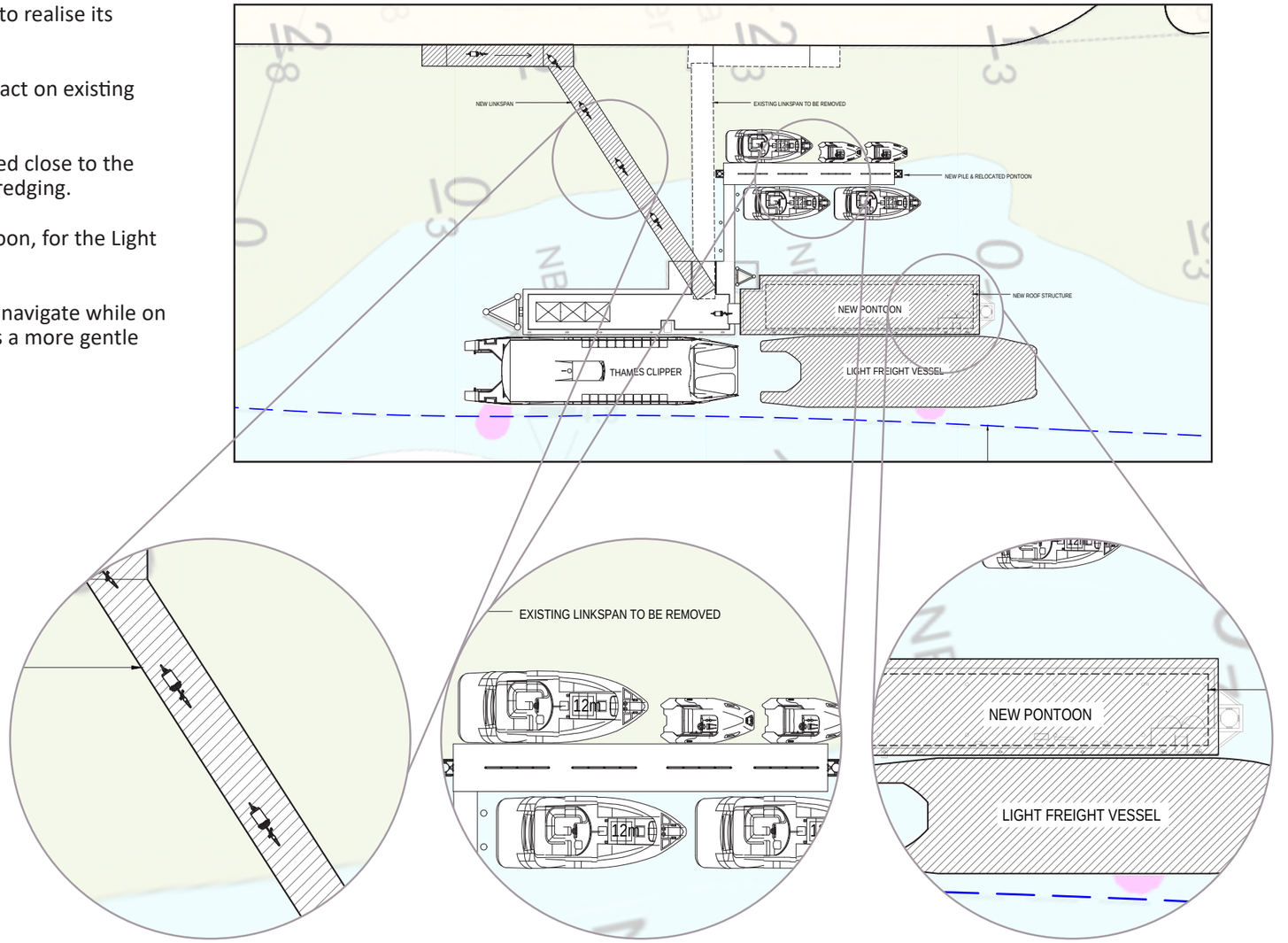
Chelsea Harbour Pier is a pier location which has a lot of potential but requires work to realise its advantages towards the Light Freight scheme.

BR have looked at the possibility to utilise the arrangement while minimising the impact on existing users.

The existing moorings on the downstream end of the arrangement should be relocated close to the landside. This requires a new pile, and depending on the vessels, potentially minor dredging.

This allows a new pontoon of more suitable size to be installed in its place. This pontoon, for the Light Freight service, would be custom built to include the required services and furniture.

The access brow however incorporates 2 hairpin turns which would be impossible to navigate while on a cargo bike. For this reason a new brow is included from a new bankseat. This allows a more gentle gradient and more accessible turns at the top and bottom of the access brow.



New access brow

Relocation of existing moorings

Pontoon extension and new pile

5.8 Masthouse Terrace Pier - Option 1

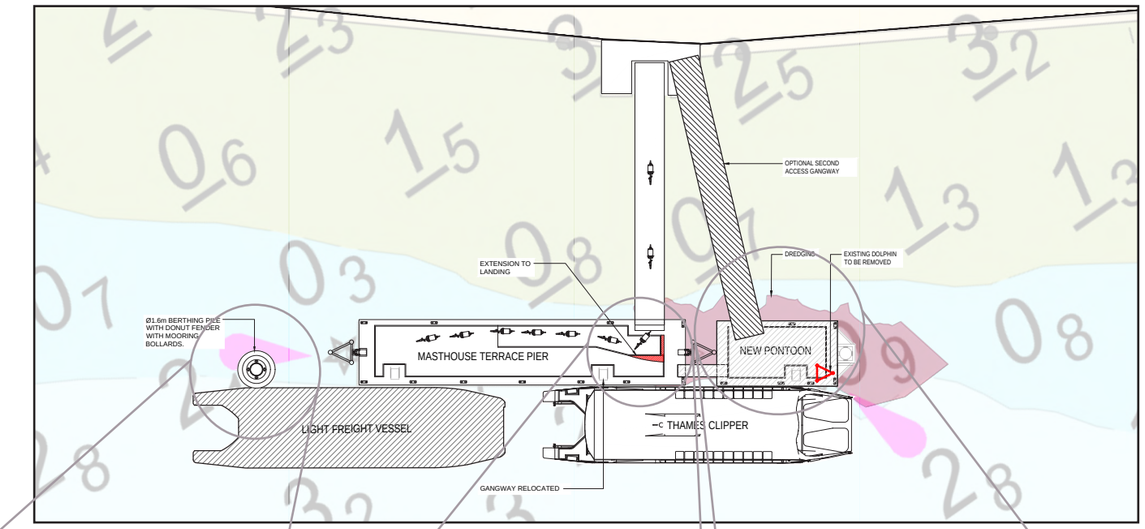
LONDON BOROUGH OF TOWER HAMLETS

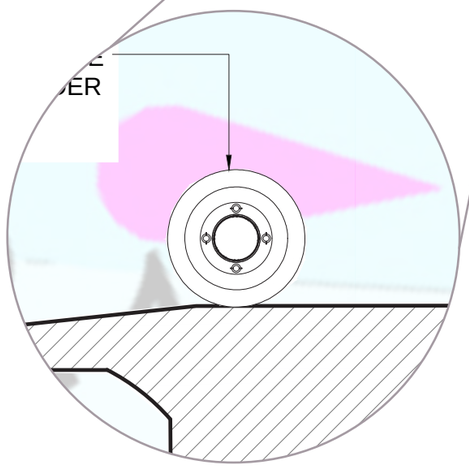
There are two potential options for the adaptation of Masthouse Terrace Pier for Light Freight usage. The first is an extension pontoon as shown in the figure below. This pontoon is relatively small in size but allows for the staggered berthing of the existing river bus service vessel. This new pontoon does however require dredging to avoid grounding at low tide. A existing dolphin at the site also requires removal.

The pontoon is connected to the main pontoon via an access gangway. This gangway is fairly narrow to avoid clashes with either the dolphin or the berthed vessels. To avoid pedestrian congestion, an additional brow could be provided to access the new pontoon directly. This would also reduce the interaction between pedestrians and cargo bikes.

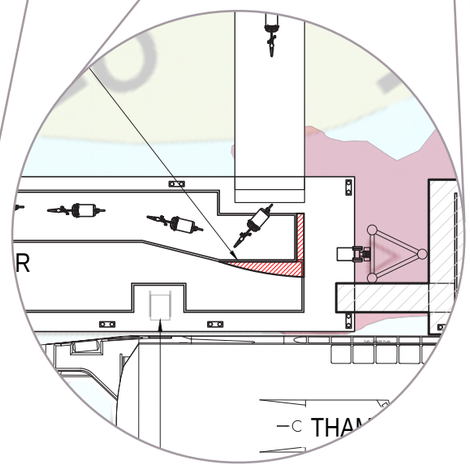
The Light Freight vessel berths offset to the main pontoon in the space made available by the movement of the river bus service vessels with additional security being provided by a mooring pile.

The base of the access brow presents a tight turn and local widening of the raised platform is necessary for suitability for cargo bike use.

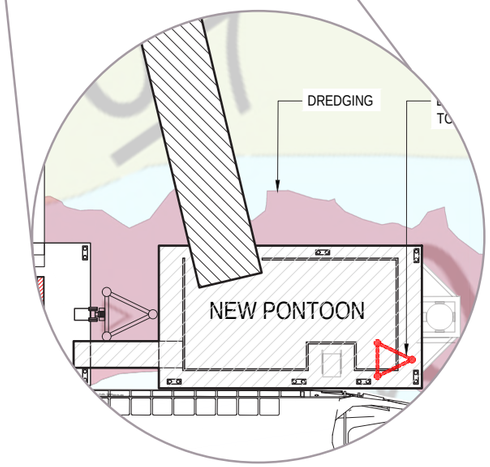




New berthing pile



Access widening



Pontoon extension and new brow (including dolphin demolition)

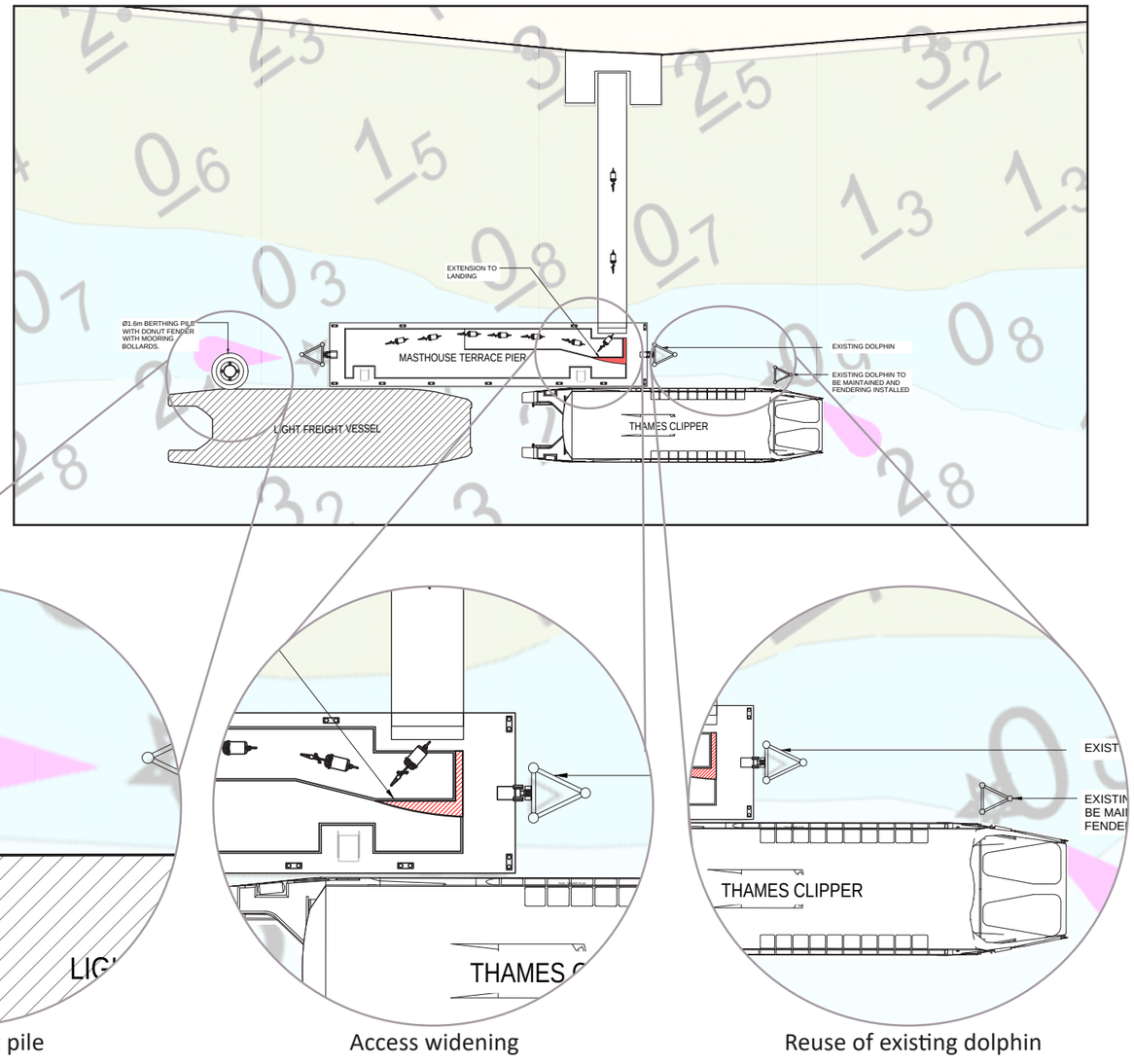
5.9 Masthouse Terrace Pier - Option 2

LONDON BOROUGH OF TOWER HAMLETS

The second option developed, while similar to the former intends to remove the need for the additional pontoon by utilising the existing dolphin to all the existing river bus vessels to berth offset to the pontoon. The viability of this approach depends on the condition of this dolphin which is not currently known.

The Light Freight vessel is then berthed offset to the upstream end of the pier with a mooring pile such that each vessel uses approximately half of the existing pontoon.

To allow cargo bike access, the access brow landing is locally widened as per Option 1.



New berthing pile

Access widening

Reuse of existing dolphin

BECKETT RANKINE Marine Consulting Engineers

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5.10 Sainsbury's Jetty Pier

LONDON BOROUGH OF HAMMERSMITH & FULHAM

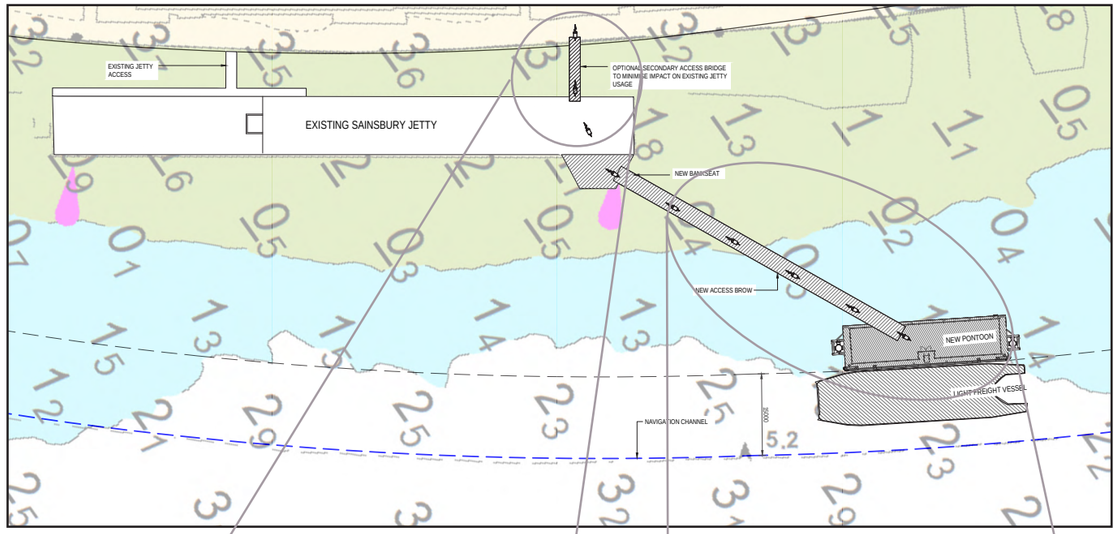
Sainsbury's Jetty is included as an alternative to Chelsea Harbour Pier, noting that the arrangement is quite busy, as it offers access to a similar hinterland and consumer base.

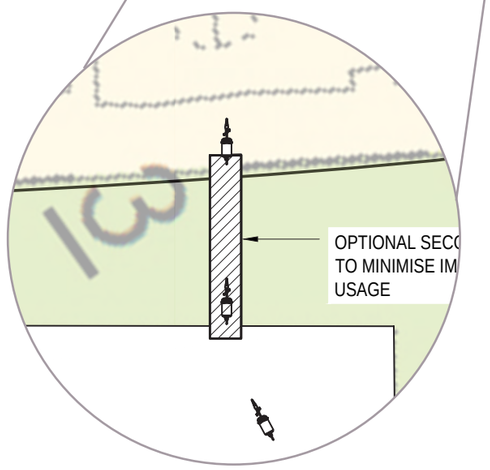
As the location is not, and has never been, a pier location it is not included within the site assessment.

The design solution here requires the installation of a new access brow from the jetty towards a new pontoon which services Light Freight vessel exclusively.

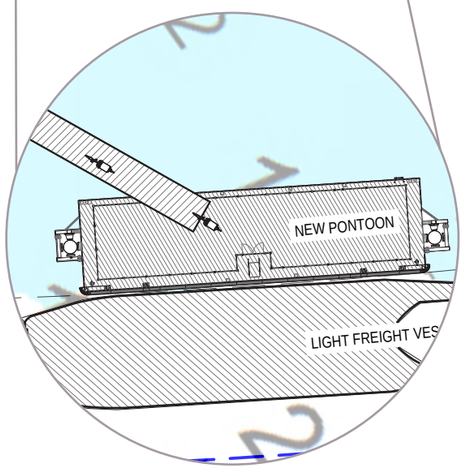
There is the potential for a commercial arrangement to be made with Fulham Riverside (immediately landside) for a shared installation cost for a multi-use pier.

Being a new build, the brow and pontoon could be custom designed to best suit the needs of the Light Freight service.





Optional access brow



New pier arrangement

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6.0 Costing

Beckett Rankine has extensive history with the design and construction of piers along the River Thames. We are currently working on Barking Pier, which is mid construction, and have previously delivered Millbank Millennium Pier, Battersea Power Station Pier and Royal Wharf Pier. We have also worked to provide extensions to several existing piers such as Bankside Pier and Embankment Pier.

Through this, and other works, we have significant knowledge of how new piers are installed, and modifications carried out. We have used this experience to carry out a high level costing for each of the pier options presented, to give an indication as to the respective value for each option.

The costs are based on our experience on previous pier projects and scaled to account for current market values. No additional design work has been carried out to inform these estimates further than than presented within this report. There has been no consultation with contractors during the costing of these pier options.

The costs may vary due to market competition, contractor availability, perceived risks and other factors which cannot be accurately judged at this stage.

Should a new pier be preferred rather than the adaptation of an existing pier such as those locations set out within the shortlist and subsequently costed, its financial cost would be similar to that of Sainsbury's Jetty Pier, which through its very nature, includes the primary elements which a new pier would require (access brow and bankseat, pontoon & piles).

#	Design Option	Cost
1	**Bankside Pier - Option 1** London Borough of Southwark	£ 0.60 to 0.70 million
2	**Bankside Pier - Option 2** London Borough of Southwark	£ 2.95 to 3.55 million
3	**Tower Bridge Quay** London Borough of Tower Hamlets	£ 0.75 to 0.95 million
4	**Battersea Power Station Pier** London Borough of Wandsworth	£ 2.55 to 3.15 million
5	**Wandsworth Riverside Quarter Pier** London Borough of Wandsworth	£ 2.35 to 2.80 million
6	**Blackfriars Pier** City of London	£ 1.15 to 1.40 million
7	**Chelsea Harbour Pier** London Borough of Hammersmith & Fulham	£ 3.55 to 4.30 million
8	**Masthouse Terrace Pier - Option 1** London Borough of Tower Hamlets	£ 2.65 to 3.25 million
9	**Masthouse Terrace Pier - Option 2** London Borough of Tower Hamlets	£ 0.85 to 1.00 million
10	**Sainsbury's Jetty Pier** London Borough of Hammersmith & Fulham	£ 4.25 to 5.20 million

Table 6: Costing of Each Design Option

7.0 Sustainability Considerations

The quantity of carbon embodied in commonly used construction materials varies considerably, and substantial savings are possible with seemingly minor alterations to a structure.

The following choices can be considered during further development of designs to reduce embodied carbon:

- Use steel rather than aluminium for access brows. This does depend on the size and location of the brow as, due to its additional weight, more steel is required compared to aluminium to achieve the same span.
- Use timber cladding and glue-laminated timber portal frames rather than metal elements for the roof structure and any required cladding.
- Using low density mineral wool wall insulation instead of PIR (polyisocyanurate) or PUR (polyurethane) board.

Further information on Embodied Carbon can be found in the Inventory of Carbon & Energy (ICE) Database.

Operational carbon emissions are likely to be a key contributor to the scheme's overall carbon footprint and should be assessed as part of the vessel considerations.

To give an idea of the quantities of embodied carbon for each design solution see Table 7. Steel of different origin and construction method has different embodied carbon. The values presented consider an aggregate tonnage of steel plate and steel sections used across the designs. New steel is assumed. Potential savings are possible through the reuse/ refurbishment of existing members or pontoons.

#	Design Option	Embodied Carbon (tonnes)
1	**Bankside Pier - Option 1** London Borough of Southwark	11
2	**Bankside Pier - Option 2** London Borough of Southwark	262
3	**Tower Bridge Quay** London Borough of Tower Hamlets	65
4	**Battersea Power Station Pier** London Borough of Wandsworth	206
5	**Wandsworth Riverside Quarter Pier** London Borough of Wandsworth	206
6	**Blackfriars Pier** City of London	87
7	**Chelsea Harbour Pier** London Borough of Hammersmith & Fulham	227
8	**Masthouse Terrace Pier - Option 1** London Borough of Tower Hamlets	208
9	**Masthouse Terrace Pier - Option 2** London Borough of Tower Hamlets	53
10	**Sainsbury's Jetty Pier** London Borough of Hammersmith & Fulham	354

Table 7: Embodied Carbon for Each Design Option

Embodied Carbon Definition

Embodied Carbon refers to the Carbon Dioxide (CO_2) emissions associated with materials and construction processes throughout their whole life-cycle.

It is often measured from cradle to (factory) gate, cradle to site (of use), or cradle to grave (end of use). The embodied carbon is the amount of CO_2 to produce a material.

8.0 Summary & Conclusions

Through this study, the work carried out previously by WSP and Bearing Point is expanded on and considered in light of additional certainty of scope.

The study confirms the intended focus of the Light Freight service which is to be smaller, more manoeuvrable cargo such as letters and parcels, medical supplies, food and drink, and other business supplies. This cargo is to be moved primarily with a Roll On-Roll Off approach, although the ability to manhandle goods is to be allowed for where possible.

Two potential service types have been defined, these are a partial service and a continuous service. They represent different visions for how the service could operate and face different challenges in how they could be incorporated on the River Thames. The works to facilitate a partial service are generally less intrusive and more economically feasible than that for a continuous service, but allows for a more limited cargo throughput and potentially limits the service in the future. While a partial service lends itself well to trials, further consideration of demand and likely throughput requirements is needed to determine the direction the main service should follow.

A reassessment of the WSP and Bearing Point pier locations provides further clarity on which piers could be incorporated into the Light Freight service. A finalised shortlist of 7 pier locations is included. Given the partial and continuous service definitions, this location assessment within this study focused on pier locations for each service type independently, such that the identified locations have the greatest potential to be used for each service type as required.

A suite of design solutions demonstrate how each of the shortlisted pier locations could be incorporated into the Light Freight service to service either a partial or a continuous service.

The cost of this design solutions has been provided for each pier to demonstrate the potential costs involved to provide a sense of context and value to the future of the Light Freight scheme.

9.0 Next Steps

The development of a Light Freight service is a significant project and requires extensive consultation with stakeholder. Stakeholder consultation in ongoing. A breakdown of stakeholder which should be considered is indicated below. This list is not exhaustive and provides an high level only of some of those who should be approached at this stage.

- Local Authorities
  - London Councils
  - City of London Corporation
  - Greater London Authority

- Statutory Bodies
  - Port of London Authority
  - Environment Agency
  - Marine Management Organisation
  - Crown Estates

- River Operators
  - Uber Boats by Thames Clippers
  - Livett's Launches
  - Thames Marine Services

- Freight Forwarders / Third Party Logistics

- Port Operators
  - DP World
  - Port of Tilbury

- Potential Customers

- Developers

Additionally, as discussed previously in this study, the vessel type strongly dictates other elements of the service. While existing vessels could be utilised in the short term, the vessel should be custom built for Light Freight usage. A next step is to develop the concept vessel specification.

Design Process

An understanding of the process of how a new pier or pier adaptation would be realised is required to fully appreciate the next steps involved to bring a Thames based Light Freight service to fruition.

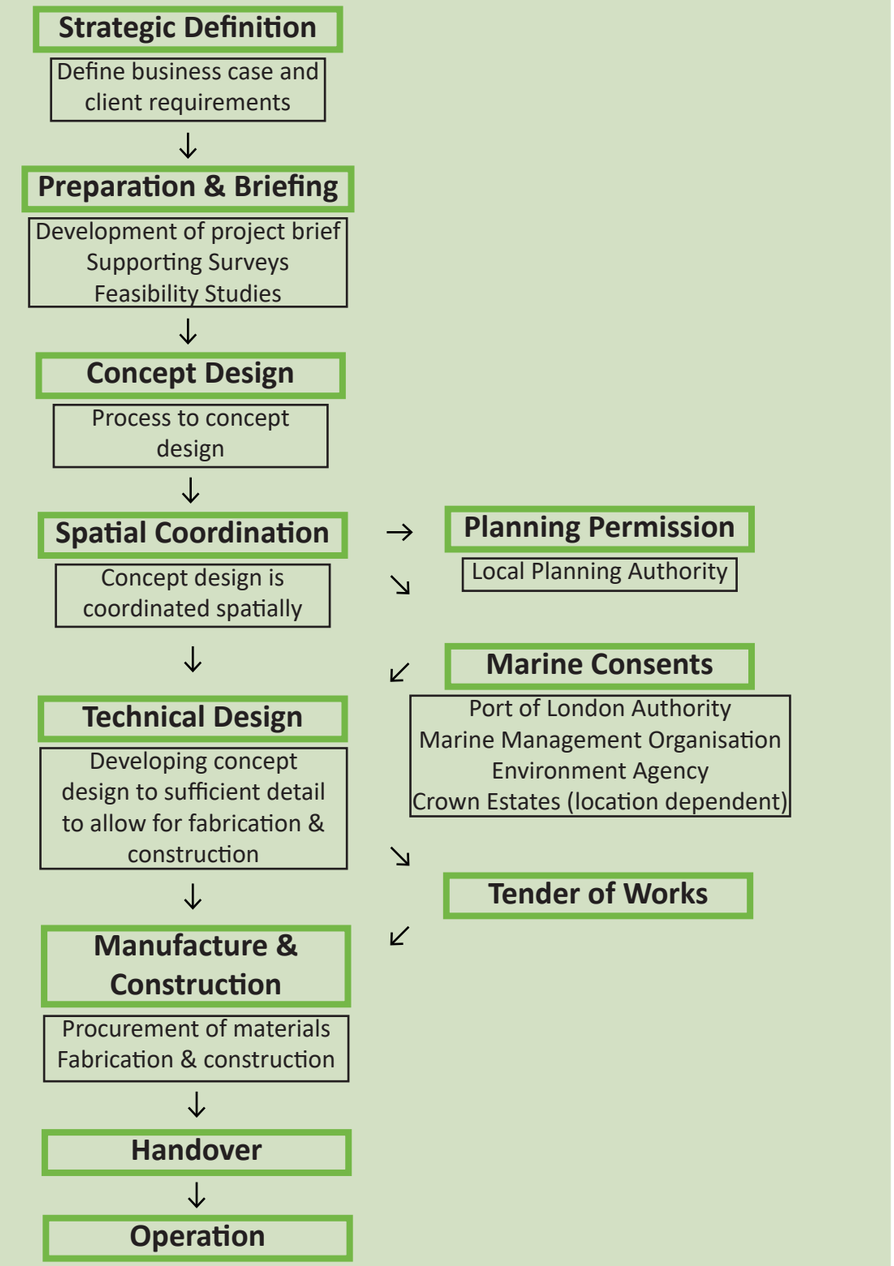

Figure 10: Design Process from Start to Finish

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