PORT OF
TILBURY
LONDON

PLANNING ACT 2008

INFRASTRUCTURE PLANNING (EXAMINATION PROCEDURE) RULES 2010

Application by Thurrock Power Limited for an Order

granting Development Consent for the Thurrock Flexible Generation Plant

Planning Inspectorate Reference: EN010092

DEADLINE 4 SUBMISSION

17 May 2021

PoTLL/TFGP/EX/8

1. INTRODUCTION

1.1 This document represents Port of Tilbury London Limited's ("PoTLL") submission for Deadline 4 of the Examination of the proposal by Thurrock Power Limited ("the Applicant") to construct a flexible energy generating plant on land next to PoTLL's recently developed Tilbury2 port terminal, known as the Thurrock Flexible Generation Plant ("the TFGP").

1.2 This submission includes:

- a summary of PoTLL's oral submissions at the Issue Specific Hearing on Traffic on 27 April and on the DCO on 29 April; and at the Compulsory Acquisition Hearing on 28 April (together, "the Hearings");
- PoTLL's comments on the Applicant's Deadline 3 submission made in response to PoTLL's Deadline 2 submissions [REP3-011];
- PoTLL's initial comments on the documents which make up the Applicant's material change request for an alternative access proposal for Abnormal Indivisible Loads ('AILs') (noting that formal submissions will be made on 5 June to the Applicant in respect of the supplementary environmental information provided; and as a Relevant Representation in relation to the additional land proposed as part of the change request); and
- as part of all of the above, an update on discussions with the Applicant in relation to the proposed legal agreement with it and access proposals for the TFGP more generally.

2. SUMMARY OF SUBMISSIONS AT THE HEARINGS

Hearing agenda item	PoTLL submissions
Issue Specific Hearing on Traffic and Transport Issues on 27 April	
Item 3: Abnormal Indivisible Loads	At the Hearing, a plan was shared by PoTLL setting out how the Port of Tilbury has expanded over recent years; and setting out the land forming part of the Freeport proposals that were successful in being chosen by HM Government as one of eight English freeports. This plan is reproduced at **Appendix 1** to this submission.

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	This sets out that RWE's land is within these proposals and thus directly affected by the requirements for the causeway and access to it. In particular, it shows 'Previously Developed Land', which is not part of the Green Belt. It is therefore ripe for redevelopment and is located directly adjacent to the causeway and its land access proposals. Building on this plan, at **Appendix 2** is a drawing focussed on the nexus of the RWE land and the causeway proposals. As can be seen from this drawing, there is a direct physical clash and therefore conflict with the Port's illustrative proposals in the terrestrial and marine environments as well as likely navigational impacts on vessels seeking to access new river berths that would be required for the Port's redevelopment proposals. PoTLL, working with RWE, is confidentially exploring a wide range of potential Port uses in the areas shown as Phase 1 and Phase 2 on this drawing, including expansion of existing uses within the wider Port estate and other new uses attracted by the prospect of Freeport designation and delivery. Whilst PoTLL cannot currently share the full details of what is proposed, through a combination of temporary and permanent planning permissions, permitted development rights and the economic setting/surrounding port baseline, these developments are likely to be fast moving. PoTLL expects, working with RWE, initial Phase 1 uses to be in place by mid 2022 at the latest, with Phase 2 looking to be in construction by late 2023. In light of all of the above, PoTLL continues to maintain an in-principle objection to the causeway proposals and believes that the causeway should not be included within any DCO for the TFGP. However, in the scenario where the ExA and Secretary of State do not agree, PoTLL considers that the scenarios set out in its Deadline 2 submissions should apply. Furthermore, it is considered that the 5 yearly review period currently set out in Requirement 17 of the dDCO for AIL access is not appropriate, given the alternative proposals that are available and given that the AIL access has this seriously detrimental interaction with Port expansion proposals – indeed, apart from Commons and Network Rail issues, it is the biggest

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	external impact of the TFGP project and most likely the greatest potential economic impact by some considerable margin. As such, PoTLL considers the dDCO should reflect that this impact should be sought to be dealt with as soon as possible. As such, it is considered that the review period should be on a yearly basis starting with the commencement of development. On a separate issue, PoTLL understands the points made at the Hearing by the Applicant that given geotechnical issues, it needs to retain the flexibility to use either Work No. 12(c) or (d) for the final part of the journey for construction vehicles to the plant construction site. However, it is considered that the dDCO and any legal agreement with PoTLL and RWE should provide for controls such that the Applicant is only able to use one of those accesses at any given time.
Compulsory Acquisition Hearing on 28 April	
Item 3: Objections to Compulsory Acquisition and Temporary Possession and Item 6: Statutory Undertakers section 127 and section 138 PA2008	As set out at the Hearing, PoTLL's starting point on matters of compulsory acquisition is the requirement at paragraph 8 of the MHCLG guidance on compulsory acquisition that: *'the Applicant should be able to demonstrate to the satisfaction of the Secretary of State that all reasonable alternatives to compulsory acquisition (including modifications to the scheme) have been explored. The applicant will also need to demonstrate that the proposed interference with the rights of those with an interest in the land is for a legitimate purpose, and that it is necessary and proportionate'.* This is particularly relevant to the Applicant's proposals for compulsory acquisition of RWE's land for the purpose of access to and from the causeway. This is because: • there is a clear alternative available, both initially and now through a modification to the scheme;

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	• it is considered that these powers are not proportionate in the context that this causeway is proposed for the use of 60 AILs initially, followed by minimal movements during the TFGP's operational phase. This needs to be set against the economic benefits arising from future Port development that will at best be delayed and at worst significantly negatively impacted, limited or prevented; and • the purpose cannot be considered necessary, legitimate or proportionate in the context of: o its location at one of the last locations available for a deep water berth closest to London and thus an important strategic economic opportunity being lost; o the local plan position referred to in PoTLL's Deadline 2 submissions; o the fact that continued development and growth of river freight facilities and opportunities in the Thames Estuary is supported at a regional level by the Port of London Authority's Investment Plan and the Thames Estuary Growth Board's Action Plan; and o the national picture, where the National Policy Statement for Ports has recognised that port development is an '*engine for economic growth*' (para 3.3.5), that '*capacity must be in the right place if it is to effectively and efficiently serve the needs of import and export markets' (*para 3.4.11 and now further identified through the Freeports proposals); and that there is a '*compelling need for substantial additional port capacity over the next 20-30 years'* (para 3.4.16), when compared to the use proposed as part of the TFGP, which is not required to be location-specific and where an alternative is plainly available. As also set out at the Hearing, PoTLL is working with the Applicant to reach agreement on facilitating normal and AIL access through Tilbury1 with appropriate controls to ensure

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	PoTLL's interests are protected. Once this is agreed PoTLL will expect the draft DCO's land powers that are sought over its interests and in respect of the access road through Tilbury2 more generally, to be removed from the DCO, as it will be clear (even if it is not now, which PoTLL says it is) at that point that the powers are demonstrably not necessary or proportionate. Finally, at the Hearing the Applicant sought to argue that the causeway could not be considered to be a true 'impediment' to Port expansion on the basis that it would be possible to remove the causeway quite easily at the time that any development proposals were brought forward. In response to this, PoTLL notes that: • it is not clear why it should be incumbent on PoTLL to be responsible for removing something that it did not put and did not want to be put into place in the first instance and could reasonably foresee being a significant impediment to Port development and operation – the obligation should not be on PoTLL to prove that it is not possible to remove it, but on the Applicant to prove that it is necessary in the first place; however • in any event it is considered that, particularly given the lack of detail that currently exists as to the construction of the causeway and its related access in what is a complicated geotechnical environment, it cannot be safely assumed that it would be 'easy' to remove the causeway in an expeditious and efficient manner and in the context of PoTLL wanting to bring forward a different economic use. To that end, at **Appendix 3**[1] to this submission there is a geotechnical report prepared by PoTLL's consultants Hydrock, setting out the geotechnical complexities associated with the causeway proposal and the lack of information currently available to show that they could or would be able to be resolved. This demonstrates the difficulties involved in constructing, using and decommissioning the causeway and also the absence of

[1] Appendix 3 also includes a copy of the CV of the principal author of the Hydrock report.

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	adequate information to provide enough confidence that these proposals could be brought forward or removed in an efficient and expeditious manner. As such, it is considered that the Applicant cannot just assert that the causeway could be 'simply removed' and that it would not be an impediment to port development, in light of the various points that are made in the Hydrock report.
Item 5: Funding	As set out at the Hearing, PoTLL notes from the Funding Statement [APP-23] that it is stated at paragraph 3.3.8 that '*Once the DCO is granted, the final investment decision on the Proposed Scheme will be taken, subject to Stratera Energy Ltd board approval. This board approval may be connected to any award of a Capacity Market contract'.* It is noted that Capacity Market auctions have most recently taken place in the January to March time period of each year. With the application for the DCO not due to be determined until 16 February 2022 and taking account of the 6 week Judicial Review period for DCOs, it is unlikely that the Applicant will be able to enter the Capacity Market auction until 2023. It seems unlikely that construction of the TFGP, to the extent that the large capital commitment of the causeway amongst other matters will be required, would take place until success at the auction was confirmed (see, for example, the close to expiring DCOs for Wrexham Energy Centre, Meaford Energy Centre and Abergelli Power Station, where the projects were either unsuccessful or obtained an unsatisfactory price in those auctions). Given the points raised at the Hearing about PoTLL's desire and plans to move quickly with port expansion, this would appear to give rise to a direct clash between construction/use of the causeway and when further Port expansion would likely take place. Further to discussion at the Hearing, PoTLL agrees with the questioning then in respect of the appropriateness of including a DCO article requiring the Applicant to have some form of guarantee or indemnity in place and agreed with Thurrock Council prior to the commencement of the authorised development.

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	PoTLL acknowledges the position expressed by the Applicant that its recent deal with Statkraft and Natwest are an approximate equivalent to the Capacity Market and that the Funding Statement uses the word 'may', but considers that further evidence is needed to show that access to funding would not lead to a delay to construction of the causeway such that it would clash with PoTLL's expansion plans.
Issue Specific Hearing on the draft DCO 29 April	
Item 3: Requirements	Following this hearing, the Applicant has contacted PoTLL to confirm that it is to be added as a consultee under Requirements 4(3), 4(5), 6, 7 and 19. PoTLL had previously asked that it be added as an approver for those parts of the final CTMP that affect the Port under Requirement 6. As discussed at the Hearing, however, PoTLL is willing to agree that the principle of this could, alternatively, be captured by the drafting of the Protective Provisions and will consider this further with the Applicant. <u>In respect of Requirement 17 (NRA)</u> Further to PoTLL's Deadline 2 and Deadline 3 representations on this requirement, PoTLL understands that the Applicant's Deadline 4 DCO will provide for the majority of changes sought by PoTLL. This is likely to be with the exception of ensuring that updates to the NRA are undertaken for any decommissioning phase. PoTLL will therefore continue to press for this to be explicitly mentioned within the Requirement, such as ensuring that any 'change to the operation' referred to in paragraph (4) can be said to be 'including any proposed decommissioning'. <u>In respect of Requirement 18 (Review of abnormal load access)</u> PoTLL set out its suggested amendments to this Requirement in its Deadline 2 and Deadline 3 submissions. Further to the Applicant's on-going position that it is not currently willing to

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	remove the causeway from the draft DCO, PoTLL considers that if this position is maintained until the end of Examination and the ExA and SoS agree to that, the obligation to review the options for AILs should be on a yearly basis and should run from the date of the DCO coming into force rather than from commencement of operation of the power plant, to avoid the economic risks previously discussed arising. PoTLL continues to discuss the detail of the drafting of this requirement with the Applicant with the aim of ensuring that: • PoTLL is consulted at each step of the process set out in the Requirement; and • there is no delay in the Applicant carrying out decommissioning works once all consents for an alternative access are obtained (e.g. by imposing a time obligation of 1 month). <u>Other Requirements</u> PoTLL acknowledges the Applicant's views that Requirements 3 (design) and 14 (landscaping and ecological management plan) should not be amended to explicitly refer to development on the CCR area, as consent is not sought for development in that area by the dDCO. However, PoTLL is concerned that, absent development taking place within the CCR area, there is potential for invasive species or pollution to be caused, which could migrate to PoTLL's adjacent ecological mitigation areas required by the Tilbury2 LEMP. PoTLL would welcome therefore either further content in the Outline Ecological Management Plan [PDC-050] or within the requirements of the full LEMP set out in paragraph (1) of Requirement 14, which provides that the full LEMP includes such measures (e.g. 'measures for the on-going management of invasive species and pollution').

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	Furthermore, as set out in its Deadline 2 submissions, given the location of that area adjacent to PoTLL's ecological management requirements in the Tilbury2 DCO, PoTLL's development aspirations for the wider Tilbury area, and more generally given the wider policy picture supporting carbon capture and the need to demonstrate that projects can deliver it in the future if required, PoTLL considers it important for there to be certainty as to what is to happen on the CCS area in the future. As such, the suggested additional CCR-related Requirements set out in PoTLL's Deadline 2 submissions should be imposed. This would be consistent with the recent Drax Re-power and Eggborough CCGT power station DCO projects.
Item 3: Schedule 9 Protective Provisions	Following this Hearing, the Applicant has provided comments on PoTLL's suggested draft Protective Provisions and these are being considered by PoTLL.
Item 4: Interested Party comments on other aspects of the dDCO	As set out in its Deadline 2 submissions, PoTLL has suggested the following amendments to article 8 of the dDCO: • paragraph 4(a)(iii) should refer to powers in relation to 'streets' rather than 'highways' being able to be transferred without Secretary of State consent – this would enable transfers to PoTLL of the streets within Tilbury2 where the Applicant carries out any works; • PoTLL should be a notified party under paragraph (5); and • PoTLL should be consulted by the Secretary of State prior to any consent for transfer of benefit being granted. These principles in a harbour setting have been provided for in other DCOs to date, such as in article 51(6) of the Port of Tilbury (Expansion) Order 2019 and article 49 of the Lake Lothing (Lowestoft) Third Crossing Order 2020. Many other DCOs have included such provisions in

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	other settings, where statutory undertakers' apparatus, operational land and exercise of statutory functions have been affected by a project. PoTLL is seeking to be included as a consultee because of its position as a statutory undertaker which is affected by the TFGP, both directly in relation to the proposals for normal and AIL access through the Port and the associated CA powers sought; and also indirectly, through the causeway being located directly adjacent to Tilbury2, causing potential impacts to navigation that have required mitigation measures as identified in the pNRA [PDC-052]. As such, as a statutory body needing to ensure there is no detriment caused to its undertaking, it is appropriate that PoTLL is able to give its views to the Secretary of State on the proposed transferee, particularly if PoTLL is concerned that the proposed transferee might not be able to deliver the mitigation measures required to make the development acceptable in terms of its impacts to the Port of Tilbury (including Tilbury2). The Secretary of State would still be the final decision-maker on the request for consent. Furthermore, PoTLL notes the conclusion of the Examining Authority at paragraph 5.8.111 of its Report into the application for the Lake Lothing (Lowestoft) Third Crossing Order that when considering impacts on a harbour authority (in respect of the 'serious detriment' test and planning more generally) that the carrying on of port operations '*encompasses existing and future operations together with the ability of [the harbour authority] to comply with its statutory obligations and duties as SHA [statutory harbour authority] and CHA [competent harbour authority]. We also agree with [the harbour authority] that planning harm is a matter of judgement on the scale of impact on the undertaking and that the decision maker should take a holistic approach'.* This indicates the need for the request for the consent to be considered in the context of the actual and potential impacts on PoTLL as a whole – this needs to apply on an on-going basis, including ensuring that any transferee is able to 'take on the mantle' of not causing impacts to the Port and complying with all of the related provisions of the DCO. It is therefore

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	considered reasonable (as well as being well precedented in DCOs and other legislative instruments) to include PoTLL as a consultee in article 8. As set out in its Deadline 2 submissions, PoTLL is also seeking to be added as a consultee in article 36 of the dDCO. This is because any suspension or extinguishment of navigation within the Order limits would have an effect on the navigation of vessels to and from the Tilbury2 river berths which lie adjacent to those limits. As such, it is appropriate that PoTLL be added as a consultee.

3. COMMENTS ON THE APPLICANT'S DEADLINE 3 SUBMISSION MADE IN RESPONSE TO POTLL'S DEADLINE 2 SUBMISSIONS

Section number	PoTLL response
Section 1: Construction Access through the Port	PoTLL continues to negotiate with the Applicant in respect of a voluntary agreement for access, with appropriate controls in place to ensure that PoTLL's statutory undertaking is protected and that terrestrial movements associated with the Port's operations are able to be made.
Section 2: Use of the Causeway	In respect of previous engagement, PoTLL would simply say that it has engaged with the Applicant over a prolonged period of time, including involving the CEO of PoTLL's parent organisation Forth Ports and multiple members of the PoTLL team. Throughout that time the Applicant's requirements either changed repeatedly or lacked detail to enable a serious proposal to be brought forward but nevertheless PoTLL sought to respond to them, notwithstanding its own large scale development project taking place at the same time. Above and beyond this, however, the key point is that the Applicant has already sought a variety of powers over PoTLL's land through the dDCO to provide for 'normal' construction access, and so there is no reason why this could not have been extended to AILs instead of bringing forward a causeway. Whilst PoTLL acknowledges that it would have sought controls over such powers, again this has been the case for normal construction access powers too, where sufficient controls in PoTLL's Protective Provisions would have assisted.

Section number	PoTLL response
	As such, PoTLL does not consider it reasonable for the Applicant to state that 'lack of engagement' meant that AIL access, such as has been proposed through the Change Request, could not have been brought forward in a way that did not involve use of causeway. In respect of its position on the causeway, PoTLL accepts that this has evolved over time but this does not make the concerns it has expressed any less worthy of careful consideration. Its expansion plans, alongside the recent Freeport initiative, mean that the causeway proposal is not acceptable, as is explained above in section 2. Finally, in response to paragraph 2.9, PoTLL's point is that whilst the effects associated with the causeway are not assessed as significant (setting aside the separate potential impediment on PoTLL's expansion plans and the Freeport generally), they could have been avoided (e.g. as required by the mitigation hierarchy) as there is an alternative (not a 'no development' scenario').
Section 3: PoTLL Suggestion of a Change Request	As set out in its views expressed in the Joint Position Statement submitted prior to the recent round of Hearings [AS-039], PoTLL did not agree with the Applicant that if it were to bring forward removal of the causeway it would be in a 'worse' position than it was with its application as it stood before the Change request has been made. The combination of powers sought in the dDCO, which would exist even if a legal agreement was not able to be reached during Examination, and the statutory duties of PoTLL in respect of operations at Tilbury1, means that with an alternative access in place, as now proposed by the change request, the Applicant would be in the same position as it was with the original application. It cannot therefore be considered 'unreasonable', nor a ransom situation, for the causeway to be removed. PoTLL also disagrees with the position expressed in paragraph 3.7 that '*the Applicant is entitled to have the application as made determined by the Secretary of State, including any changes which the Applicant may choose to make within normal procedural considerations'.* As set out in Bob Neill MP's letter (the then Planning Minister) to the chair of the then Infrastructure Planning Commission *'"[S]ection 114(1) clearly places the responsibility for making a development consent order on the decision-maker, and does not limit the terms in which it can be made. If follows from this that the decision-maker has the power under section 114(1) to make a development consent order which is different from that originally applied for…'*

Section number	PoTLL response
	This has been followed in numerous Orders made since then, most recently for the Wheelabrator project where consent was only granted for 1 out of 2 power stations proposed. Furthermore, as set out in the court challenges in relation to the Preesall gas storage project, the key point is that all parties must have had a chance to submit representations on the change being considered, which has clearly been the case here with the causeway. As such, the various permutations for dealing with the causeway set out in PoTLL's Deadline 2 submissions are perfectly possible and able to be considered during Examination and then by the Secretary of State. As set out in PoTLL's submissions to date and in this submission, the causeway removal from the draft DCO should be taken forward by the Applicant forthwith to enable certainty for all parties at this stage of the Examination. As the change request already provides for what would be new proposals, it is considered that removal of the causeway, which would involve the removal of infrastructure and its effects, would not require any further consultations and thus could be readily dealt with within the Examination timetable.
Section 4: Applicant Change Request	PoTLL notes that despite the Applicant's objections, it has been able to submit a change request which will clearly be able to fit within the Examination programme.
Section 5: DCO Drafting	PoTLL welcomes the revised drafting of Requirement 17 of the DCO at Deadline 2 [REP2-014] but still has outstanding concerns as set out in section 2 above. However, PoTLL has sought to include within its Protective Provisions (as submitted in [REP2-096]) further detailed provision for what must be included in the 'marine operations plan' that forms part of the 'passage plan' to align with the conclusions of the pNRA. It is understood that the Applicant does not disagree with this. In respect of the Protective Provisions more generally, as noted in section 2, the Applicant has provided comments on PoTLL's suggested draft Protective Provisions and these are currently being considered by PoTLL. In respect of PoTLL's concern about works being proposed adjacent to the areas covered by the LEMP, PoTLL's concern is that there are risks that could arise particularly in relation to pollution and invasive species. PoTLL recognises that the Applicant has included standard controls for such matters within its Code of Construction Practice; however, PoTLL is concerned about ensuring that these matters are managed in the long term and on an active

Section number	PoTLL response
	ongoing basis. This is particularly the case in respect of the CCR area which may be left with no development for a long period of time and so will need to be proactively managed. Suggested drafting in this regard is discussed above in section 2.

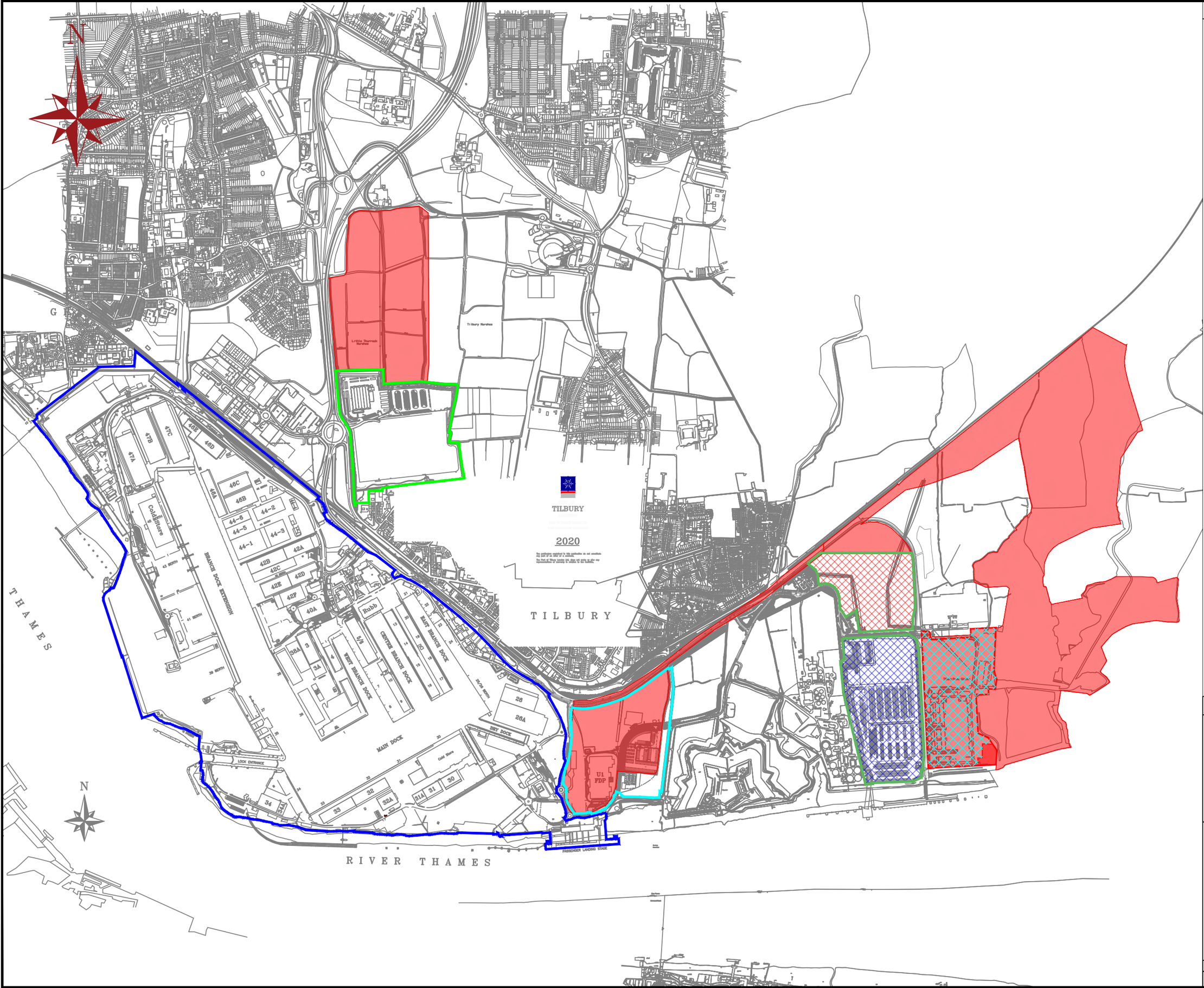
4. INITIAL COMMENTS ON THE APPLICANT'S MATERIAL CHANGE REQUEST

Section/paragraph reference	Applicant's text	PoTLL comments
Draft Development Consent Order (Tracked) [AS-025]		
Article 10(4)	*In so far as any of the works to be carried out as part of Work no. 15 under this this Order would result in conflict or non-compliance with The Port of Tilbury (Expansion) Order 2019(h) landscape and ecological management plan (as defined in that Order), then the requirement to comply with that plan is disapplied by this Order. This disapplication has effect only in so far as The Port of Tilbury (Expansion) Order 2019 landscape and ecological management plan would otherwise apply to area within which Work no. 15 is authorised to be carried out by this Order.*	PoTLL is giving detailed thought to the interaction of the material change with the requirements of its DCO but considers that this wording will need to be changed to provide greater certainty. Furthermore, whilst Work No. 15 may be the main aspect of interaction with the Tilbury2 DCO, the ancillary works and the use of Substation Road may also present a risk to PoTLL's compliance with its own DCO. As such, PoTLL considers that the following wording may be more appropriate, which it will discuss with the Applicant: *As from the date on which the authorised development is commenced, the following requirements in Schedule 2 to the Port of Tilbury (Expansion) Order 2019 cease to have effect to the extent that compliance with them is inconsistent with the construction or use of [Work No. 15 and any ancillary works, the use of Substation Road] or anything done or approved under Schedule 2 (requirements):*

Section/paragraph reference	Applicant's text	PoTLL comments
		(a) [Requirement 3; *(b) Requirement 4;* *(c) Requirement 6;* *(d) Requirement 8;* *(e) Requirements 11(c), (d), (g) and (h); and* *(f) Requirement 12].*
Schedule 1 – Work No. 15	*Work no. 15 - An access road and junction from Fort Road to Work no. 12 comprising engineering works and construction of new road with gates, fencing and alterations to drainage, landscape planting and alteration of services.*	PoTLL notes that the description provided here does not align with the proposed amended Works Plans, as the limits of deviation for Work No. 12 do not begin until some distance south-east of the eastern edge of the limits of deviation for Work No. 15. As such, PoTLL suggests that 'to Work No.12' is replaced by 'to the Port of Tilbury access road'. For clarity and flexibility PoTLL would also suggest amending 'alteration of services' to 'works to apparatus'.
Protective Provisions and Land Powers	n/a	As set out above and in its previous submissions, PoTLL would re-emphasise its requirement that its consent will be required to the use of DCO land and works powers affecting its land and its statutory undertaking.
Code of Construction Practice [AS-031] and Outline Construction Traffic Management Plan [AS-033]		
Code of Construction Practice paragraph 6.5.21	*The main risk is associated with the spread of invasive species in aquatic habitats (including vectors for disease), between watercourses or waterbodies. Measures to control the spread of invasive plants, where these have been identified, will*	PoTLL would query why this only applies when leaving the TFGP construction site. This should apply in all scenarios, particularly if the causeway is consented.

Section/paragraph reference	Applicant's text	PoTLL comments
	include the following: • Ensuring vehicle tyres and wheel arches are cleared of mud, plants and other organic material before moving from one site of the proposed development to another and prior to any use of the Tilbury2 access road (only applicable when leaving the Thurrock Flexible Generation plant construction site);	
Construction Traffic Management Plan	Sections 5, 6 and 8	PoTLL notes that the Applicant has taken into account many of PoTLL's comments on this document made in its Deadline 3 submissions. Where such changes have not been made, those comments still apply. PoTLL would only additionally comment that at paragraphs 6.3.4 and 8.4.2, it should not just be notified of what has been agreed with Thurrock Council, Highways England and the police in respect of arrangements for the timing and measures to be put in place for AIL deliveries; but that PoTLL should be a part of the discussions with all parties as such deliveries will affect the operation of both Tilbury1 and Tilbury2.
ES Addendum [AS-035]		
On-shore Ecology	N/A	PoTLL welcomes the conclusions of this report and the commitments to mitigation measures in areas previously affected by Tilbury2.

Appendix 1: Port of Tilbury existing and proposed port land uses plan



Notes

Legend

- Proposed Thames Freeport areas
- Former Power Station Footprint (part) (45 Acres)
- Tilbury 1 Original Port
- London Distribution Park
- Fortress Distribution Park
- Tilbury 2 CMAT
- Tilbury 2 RoRo

A	AMENDMENT	26/4/21	JNM	Pinsent Masons

PORT OF TILBURY LONDON

DRAWN BY: D Mickelburgh

REQUESTED BY: J Speakman

CHECKED

ENGINEER

Location: Port of Tilbury

Subject: Existing and Proposed Port Land Uses

Scale: NTS

DATE	DRAWING NUMBER	REV	SHEET No.
Apr' 21	TS 5102	A	

Appendix 2: Illustrative drawing showing PoTLL expansion proposals affected by the proposed TFGP causeway

N

Proposed
TFGP

Tilbury 2
CMAT
Terminal

Tilbury 2
RoRo
Terminal

Proposed
TFGP Causeway

Intertidal zone

New Deep Water
River Berths

NGET Tunnel

For illustrative purposes

Notes

K e y

- Phase 1
- Intertidal zone
- Phase 2
- TFGP access

REV	AMENDMENT	DATE	NAME	REV REQ

PORT OF TILBURY LONDON

DRAWN BY: I Wright

REQUESTED BY: .

CHECKED

ENGINEER

Location: Tilbury T3

Subject: Eastward Expansion Masterplan

Initial Phase areas

Scale: NTS

DATE	DRAWING NUMBER	REV	SHEET No.
May '21	TS 5106		

Appendix 3: Report on practical impediments caused by the proposed TFGP causeway

TECHNICAL DESIGN NOTE

Hydrock

Project name	Thurrock Flexible Power Generation Development		
Design note title	Geotechnical Engineering Assessment of the Proposed Statera Causeway, Tilbury		
Document reference	16946-HYD-XX-XX-GE-4001-S2-P1_Statera Causeway Geotechnical Assessment TN		
Author	Martin Cross BSc MA MSc MBA PhD CEng FICE CGeol CSci CEnv SiLC RoGEP Adviser		
Revision	Rev. 2		
Date	17 May 2021	Approved	✓

EXECUTIVE SUMMARY

Hydrock Consultants Limited (Hydrock) has carried out a technical review of existing relevant information and completed a high-level geotechnical assessment of the geotechnical engineering challenges, constraints and risks relating to the construction and subsequent decommissioning of the Statera causeway and marine barge/vessel berthing area associated with the proposed Thurrock Flexible Power Generation Development. The high-level geotechnical engineering assessment considers the practicalities of delivering and then (importantly) subsequently decommissioning the causeway and berthing area. The following table summarises the main findings of the high-level geotechnical assessment.

Executive Summary of main findings of the high-level Geotechnical Assessment

Executive Summary of Key Findings of the High-level Geotechnical Assessment
1. A site investigation comprising a desk study and ground investigation has not been carried out for the proposed causeway and berthing area. A desk study and detailed ground investigation will be required to provide appropriate geotechnical and geoenvironmental parameters for the design of the causeway and berthing area. The present conceptual design provided by AECOM can only be considered as conjectural and lacks specific data to justify feasibility and allow proper engineering scrutiny.
2. There is no detailed bathymetrical survey data for the causeway and berthing area. Without such a survey it may not be feasible to site the causeway and berthing area in the proposed location.
3. The current design has not accounted for flood tides, cross currents and wave loads in relation to the long-term stability of the causeway and berthing area. Without this information it is not considered that a feasible conceptual design can be undertaken for the proposed causeway and berthing area.
4. No unexploded ordnance (UXO) survey has been undertaken for the site area. The site lies within a UXO risk area.
5. No human health or controlled waters risk assessment has been considered for the soils/groundwater and surface water for the causeway and berthing site area. A desk study comprising a preliminary contaminated land and controlled waters risk assessment should have been undertaken prior to completing the conceptual design.
6. No temporary works design has been considered in the conceptual design report for the construction or decommissioning of the causeway and berthing area. It is anticipated that significant temporary works will be required for both the construction and decommissioning of the causeway and berthing area. The design of temporary works will be an important part of the design and construction for this project and consequential impacts.

7. It is clear from the conceptual design report that there is currently no understanding of the ground conditions, geotechnical properties and engineering behaviour of the intertidal and estuarine deposits. The current conceptual design can only be viewed as conjectural and lacks engineering rigour to justify the proposed design concepts.

8. It is clear from the conceptual design report that there is currently no understanding of whether ground improvement techniques will be required as part of the construction process. This reflects the lack of information on ground conditions for the site area. The construction process described in the conceptual design report is vague and no specific methodology or material specification and measures to control the long-term settlement of the causeway have been provided. It is important that the design considers the long-term performance of the causeway to ensure that cranes and vehicles intended to use the causeway can function properly and safely without the need for further remedial works.

9. The current assumption to construct 1:3 side slopes for the causeway is questioned by AECOM, the concept designer. There is currently no ground investigation data to justify whether these slope gradients can be constructed at all. As there is no geotechnical data available no stability analyses can be carried out to support the conceptual design of the causeway side slopes.

10. No geotechnical data or geotechnical analyses are provided in the conceptual design report to support the design of the gabion wall and crane pads to be located at the end of the causeway.

11. The design of the flood gate within the existing flood wall requires further investigation and analysis based on the provision of as-built drawings and will require agreement with the Environment Agency. Whilst the construction of this flood gate can be suitably designed to ensure the integrity of the flood defences are maintained, the introduction of a new gated access will introduce a flood risk in the event of accidental operational mis-management and/or malicious actions.

12. The procedure for decommissioning the causeway and berthing area is vague within the conceptual design report and the report has not considered a number of factors which will have changed since the causeway and berthing area was first constructed. Further consideration must be given to the methodology used for decommissioning the causeway; this methodology should at least consider the factors listed in Section 5.12 of this report. In addition, appropriate working platforms and safe methods of decommissioning working will be required.

13. The conceptual design report does not consider the long-term specification/performance requirements of the causeway and berthing area in sufficient detail. The long-term performance of the causeway structure, mitigation measures required to maintain performance specifications and the requirements for regular monitoring of both the causeway and the berthing area need to be considered in further detail. This is a critical area of design that needs to be addressed in detail; if the long-term performance of the causeway and berthing area cannot be guaranteed, then other options for the transport of abnormal indivisible loads (AILs) will need to be considered.

14. The design risk assessment included within the AECOM conceptual design report has not accounted for many of the hazards/risks in this high-level review and assessment. The Designer's Risk Assessment will therefore need to be significantly updated based on the geotechnical hazards/risks identified in this report before any decision should be made.

The construction of a causeway within the Thames estuary is a significant engineering undertaking and will require the structure to meet long-term performance criteria appropriate for use of special lifting and transportation vehicles to carry the AILs. The Port of Tilbury London Limited ('PoTLL') maintains an in-principle objection to the inclusion of and need for the causeway and considers that the proposed causeway and berthing area should only be used as an absolute last resort given there is already a suitable land access option available for off-loading AILs. The high-level geotechnical assessment has identified a number of significant geotechnical engineering challenges, constraints and risks relating to the construction and subsequent decommissioning of the Statera Causeway and marine barge/vessel berthing area. The AECOM conceptual

design report does not provide sufficient information to support or justify the feasibility of constructing or decommissioning the causeway and marine barge/vessel berthing area at its current proposed location.

1. INTRODUCTION

Statera Energy is planning the development of a new generating station (Thurrock Flexible Power Generation Development (TFGP)) to be located to the north of the existing Tilbury Substation. The construction of the TFGD will require delivery of specified large 'Abnormal Indivisible Loads' (AILs - blocks, transformers and other abnormal loads) that are of a scale that are difficult to transport on the standard highway network, with the largest gas engine blocks likely to weigh approximately 330 tonnes. The existence of obstructions that limit weight, height, and width for the transport of AILs by road, means that transportation of these loads along the highway can require the construction of additional infrastructure. Therefore, Statera has proposed that AILs will be delivered to the development site by a roll-on, roll-off (Ro-Ro) 'Heavy Lift Barge' to a causeway constructed in the River Thames. Wynns Limited has prepared a report for Statera Energy (entitled: Abnormal Indivisible Load to Proposed Thurrock Power Development, Issue No. 0) that considered options for transporting AILs to the Thurrock Power development site. The Wynns Limited (2020) report identified a potential option to transport the AILs by sea and river and to off-load the AILs from a marine barge and across the beach of the River Thames foreshore via a specially constructed causeway. AECOM (2020) completed a high-level review and concept design of the proposal to off-load large AILs destined for the TFGP development from marine barge/vessels via the river "beach" and/or temporary causeway. AECOM (2020) completed a concept design report for the causeway to support an application for a Development Consent Order (DCO).

The construction of a causeway within the Thames estuary is a significant engineering undertaking and will require the structure to meet long-term performance criteria appropriate for use of special lifting and transportation vehicles to carry the AILs. PoTLL maintains an in-principle objection to the inclusion of and need for the causeway and considers that the proposed causeway and berthing area should only be used as an absolute last resort given there is already a suitable land access option available for off-loading AILs. PoTLL also considers that the proposed causeway and berthing area may also impact plans for the future development of the foreshore area and Freeport.

Hydrock Consultants Limited has been appointed by PoTLL to prepare a high-level geotechnical engineering assessment of the proposal to construct and decommission the Statera Causeway and adjacent berthing area for the marine/barge vessel based on the information provided by TFGP's DCO application and the Applicant's submitted material to the Examination at the time of reporting.

2. REPORT OBJECTIVE

This Technical Note (TN) assesses the geotechnical engineering challenges, constraints and risks relating to the construction and subsequent decommissioning of the Statera Causeway and marine barge/vessel berthing area. The TN is based on relevant information contained within a number of sources provided by the Client. The documents are available on the Planning Portal and relate to the application for the DCO for the proposed TFPG Development. Based on the brief provided by the Client, the TN firstly provides a review the relevant information relating to the causeway and the berthing area. This review provides the necessary context to the geotechnical assessment which forms the second part of the TN. The high-level geotechnical engineering assessment considers the practicalities of delivering and then (importantly) subsequently removing the causeway and berthing area. The report focuses on the marine and foreshore aspects of constructing and decommissioning the causeway and berthing area and does not consider the inland roads from the causeway or

other wider implications of the causeway and future wider development along the foreshore area, which are separate matters that the Examination and any decision-maker will also need to test and take into account.

3. INFORMATION SOURCES

PoTLL provided the following sources of information which they considered to be relevant to the construction and decommissioning of the causeway and berthing area:

- AECOM 2020. Thurrock Power: Concept Design of Causeway for Delivery of AILs, Statera Energy. AFP Regulations, Ref. S(2)(q). Project No. 60592577, Rev, D, 11th February 2020.
- Nash Maritime, 2020. Thurrock Flexible Power Generation Plant Causeway, Preliminary Navigation Risk Assessment. Project No. 20-NASH-0100, Issue R03-00, 11.12.20.
- RPS, February 2020. Environmental Statement Volume 6, Appendix 17.1 Phase 1 Intertidal Survey Report and Benthic Ecology Desktop Review. RPS Report No. EOR0750, February 2020.
- RPS, February 2020. Environmental Statement Volume 6 Appendix 17.2: Hydrodynamic Modelling and Sediment Assessment OXF10872.
- RPS, 2021. Habitat Regulations Assessment Report, Document Ref. 5(2)(g), Report No. OXF10872, Rev, March 2021.
- RPS, 2020. Restrictions on Public Access to the Causeway. RPS, Rev. 0, November 2020.
- RPS, 2021. Thurrock Flexible Generation Plant Work Plans 5 of 6, Drawing No. 10872-0136-27, 19.04.21.
- RPS, 2021. Thurrock Flexible Generation Plant Work Plans 6 of 6, Drawing No. 10872-0205-117, 19.04.21.
- Wynns Limited, 2020. Abnormal Indivisible Load to Proposed Thurrock Power Development, Issue No. 0, 2020.

4. REVIEW OF INFORMATION

4.1 Site Location

The location of the proposed TFGP is off Station Road, Thurrock, RM18 8UL, to the north of the existing Tilbury National Grid substation. The location of the proposed causeway on the River Thames is shown in Figure 1. A topographic survey prepared for this project indicates the land forming the shoreline in this area is at approximately +4.3m AOD and a reinforced concrete flood defence wall is provided to a level of +6.48m AOD (based on Environment Agency data). The land immediately behind the flood wall is lower than the shoreline, at a level of around +3.0m AOD.

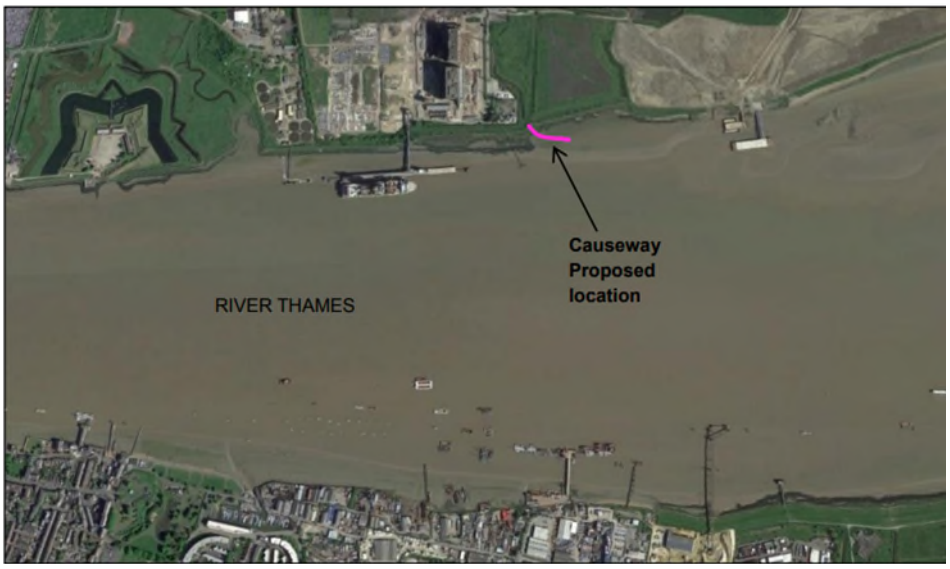


Figure 1 – Location of the proposed causeway

The foreshore at the location of the proposed causeway is initially at a gradient that is suitable for beaching transport vessels. However, beyond a short distance from the shore, the Thames River bed has been dredged for navigation purposes and therefore, becomes significantly steeper and unsuitable for beaching a vessel. The causeway proposed by Wynns Limited for this location is therefore curved in plan in order to accommodate both causeway and beached vessels within the area of potential acceptable foreshore gradient. This results in the beached vessel being located a safe distance from the main navigation channel of the River Thames. The PLA nautical chart indicates that for a causeway constructed in this location, both the causeway and a vessel beached at the causeway head would be outside the main navigation channel.

4.2 Navigational Features and Infrastructure

The main navigational features in the immediate vicinity and surrounding of the Causeway are outlined below:

- The Divers Shoal, the shallowest part of which lies outside the 'Authorised Channel' and is well marked by a light, starboard hand buoy and groynes, is located downstream of Tilbury 2; these groynes on the outer ends are lit by starboard hand light beacons. The shoal extends into the 'Authorised Channel' giving a depth of at least 9.1 metres as reported by the PLA nautical chart on 22 Oct 2020.
- There are 6 groynes immediately to the east of the proposed causeway site, each marked as described above and marking the Divers Shoal.
- Approximately 400m to the east of the proposed causeway is the East Tilbury Jetty, which is currently used by the tugs 'GPS India' and 'GPS Ionia', discharging spoil from various infrastructure projects along the Thames.
- Tilbury 2 terminal is approximately 300m to the west of the proposed causeway. Tilbury 2 currently operates as a ro-ro cargo terminal, facilitating on average two arrivals and departures a day by two vessels.
- PLA mini-plot 150, registered on 23 Sep 2019 shows a shoal with a least depth of 7.4 metres opposite the Tilbury 2 terminal, on the southern side of the 'Authorised Channel'. This depth will not be dredged but it is regularly surveyed and reported by the PLA. The Authorised Channel should not be obstructed by any permanent works, and temporary obstruction or closure of the

Authorised Channel for sporting or cultural events may be permitted only in exceptional circumstances or for significant public events.

- On the southern side of the Authorised Channel, opposite Tilbury 2 and the proposed causeway site, there are several moorings. PLA service vessels operate from Royal Terrace Pier and Denton Wharf, and the Tilbury ferry departs from Town Pier. A regular aggregate service upriver operates from Clubbs Jetty and Gravesend Sailing Club is located on the south bank. It should be noted that all these navigational features on the southern side lie well clear of the 'Authorised Channel', nevertheless a serious marine casualty occurred on 15 Nov 2012 when the bulker MV Amber (10,490 GT) struck the moored barges off Denton Wharf in fog – MAIB Report No 22/2013 dated October 2013 provides further detail.

  (https://assets.publishing.service.gov.uk/media/547c6f48e5274a429000001d/mvAmber.pdf).

4.3 Tides and Tidal Streams

The reported maximum spring tidal range in Gravesend Reach can be as much as 6.5m and surges and cuts in the tidal heights are not uncommon. London vessel traffic services (VTS) mitigates this risk by including relevant information on heights of tide during its routine half-hourly VHF broadcasts

Tidal streams in the main part of the Authorised Channel on the ebb stream may reach 3 knots at reported maximum spring rates; the flood stream is usually a little less; the tide reduces towards the riverbanks but even off the alongside berths it can reach 1 knot.

4.4 Weather

Gale force (>35 knots) winds currently occur on average on two days each month, although as might be expected this could increase to 4 days during the months of November, December, and January. Fog currently occurs, on average on 11 days each year with two days per month being common during December and January (note the MV Amber serious marine casualty referred to above).

4.5 Port of London Authority (PLA)

The PLA is the Statutory Harbour Authority (SHA) for the River Thames responsible for maintaining safe access and managing and supporting the safety of vessels, the general public and all users of the tidal River Thames, together with a duty to improve and conserve the river and its environment. The PLA Harbour Master is responsible for the management of navigation safety in the vicinity of Tilbury 2 on the River Thames and the PLA is identified as the appropriate overarching statutory authority responsible for implementing regulation, guidance and administering risk control measures aimed at managing navigation risk and safety within the TFGD 'DCO Order Limits' and the area of Causeway operation. The PLA publish their regulations, codes of practice and other general guidance on their website (www.pla.co.uk) which includes the following:

- Port of London Act 1968
- Port of London Thames Byelaws 2012
- General Directions for Navigation in the Port of London 2016
- Pilotage Directions 2017
- Code of Practice for Craft Towage Operations on the Thames
- Code of Practice for Rowing & Paddling on the Tidal Thames
- Recreational Users Guide

- Other codes of practice for mooring, berth operators etc.

The PLA also provide other measures to maintain safety of navigation which include:

- Vessel Traffic Services including vessel traffic management and navigational assistance
- Promulgation of information such as Notice to Mariners and Navigation Warnings
- Provision and maintenance of Aids to Navigation
- Hydrographic Services
- Harbour Service Launches and patrols
- Emergency preparedness and response

4.6 Port of Tilbury and Tilbury 2

Adjacent to the Port of London Authority Statutory Harbour Area (SHA), PoTLL has SHA responsibilities for Tilbury 2 within the area marked 'Tilbury Harbour Limits.' PoTLL also has SHA responsibilities for the impounded Tilbury docks. Consultation with the Asset Manager Marine for PoTLL confirmed that the Terra Marique (potential vessel to carry AILs to the causeway) will be subject to an independent passage plan risk assessment in order to confirm any operating restrictions applicable should the Port of Tilbury be chosen as the AIL transhipment terminal instead of the causeway. Should the Port of Tilbury be utilised it is understood that the below restrictions and requirements will apply to the Terra Marique whilst transiting through the Port of Tilbury impounded dock and lock system:

- Draught is unrestricted at all states of tide (minimum draught for operations at all states of the tide being 4.1m).
- Two tugs will be required to assist in transit through the lock; which is a PoTLL requirement for any vessel with a width greater than 16m.
- Tug and tows over 80m have to be assessed on an individual basis, similar to a non-routine passage plan risk assessment required by the PLA and commonly undertaken when details of the vessel, timings and operation are finalised.

4.7 Design Vessels

Wynns Limited (a specialist AIL transport contractor) has provided details of the specialist heavy lift barge that they anticipate they would use to deliver AILs to the proposed causeway (Wyns Limited, 2020). The vessel is specially designed and designated for not always afloat but safely aground (NAABSA) berthing and is therefore, able to beach onto a suitably prepared and maintained river bed. Key features of this vessel are:

- The cargo deck (or "roadway") can be adjusted while the vessel is beached, to lower the deck to a level only approximately 1m above bed level
- The stern of the vessel is fitted with opening doors and an adjustable ramp to allow wheeled loads to roll on and roll off (RoRo).

Vessels to the design of that proposed by Wynns Limited are not common and it is therefore, prudent to also consider alternatives that are more widely available. For this purpose, the use of a dumb pontoon type barge, towed by one or more tugs has also been considered. Such a barge is anticipated to be of broadly similar plan dimensions to the Terra Marique, but would offer less flexibility for unloading the AIL cargo. Such barges would commonly be provided with a ramp to allow wheeled cargo to be rolled off, however the deck level would not be adjustable. The causeway height above the bed level at the berth would therefore need to be greater in

order to accommodate the greater deck height. The deck height is likely to be around 3m, requiring the causeway height above bed to be approximately 2.5m (after allowing for some height to be accommodated by the ramp). The concept design for causeway and berth allows for accommodation of either the specialist vessel or pontoon barge.

4.8 Key Assumptions and Limitations used in the Concept Design of the Causeway and Berthing Area

The proposed concept arrangement of the causeway and modifications to the existing flood defences have been developed based on the following assumptions:

- The location is shown on Figure 1 as defined by the Wynns Limited report (Wynns Limited, 2020), but with the precise location adjusted to accommodate the preferred on-land haul route.
- Conceptual layout of the causeway is shown on Figure 2 and is broadly as indicated in the Wynns Limited report, except that the top width is to be increased to 12.5m to allow greater flexibility to accommodate the swept path required by the AIL transport vehicles (see Figure 3).
- The AIL would be transported to site in a specialist heavy lift barge such as the Terra Marique proposed by Wynns Limited or by a dumb barge and tug, as detailed above.
- Position of the barge when beached to allow for sufficient depth of water at high tide to allow sufficient tidal window for the causeway to be above water at low tide.
- No site-specific geotechnical information is available. AECOM obtained BGS archive borehole data for the general area of the site (British Geological Society (BGS) archive website). However, this borehole data can only be used as a general guide to the geotechnical strata to be encountered as its applicability to this specific site is limited and uncertain.
- The geotechnical data held by the Environment Agency had not been made available for the completion of the Concept Design of the Causeway. AECOM therefore assumed a credible worst-case scenario for geotechnical conditions at the location to conduct stability checks on two cross sections of the causeway, and for sizing a gabion wall at the waterside end.
- No cross currents or waves loads were considered in the stability checks of the causeway or the gabion. These will need to be considered in later stages of design development.
- A 1:3 (vertical: horizontal) slope is assumed for the sides of the causeway.
- Bathymetry at the site is taken from PLA Nautical Chart 337.
- Ground levels and existing flood defence levels are as described in Section 2.1 of the AECOM Concept Design Report (AECOM, 2020).
- AECOM provided a conservative layout of infrastructure required (and hence not necessarily the most economic design or what would actually get built) for the causeway arrangement in the absence of site-specific geotechnical data.
- Should the ground conditions prove to be significantly worse than assumed at this stage, the concept allows for options to improve stability, e.g., ground improvement or soil replacement.
- Minimum width of the causeway provided is 12.5m to allow for the AIL load and swept path of the AIL transport vehicle.
- AECOM completed a high-level structural stability check (only) for the existing river wall opening and potential flood defence gate arrangement and high-level sizing of pre-cast concrete pad running surface.

- Drawings indicate a conservative arrangement so that the environmental assessment can be compliant with the "Rochdale Principle" by recognising that the actual extents are not yet known but demonstrating that the conservative potential impact has been assessed.
- Existing river wall will be demolished between existing movement joints and a new flood defence wall will be constructed to minimise the effects from new flood defences on the stability of the existing structure.
- Nett transport weight of the abnormal indivisible load is taken to be 325 tonnes as specified in the Wynns Limited report.
- AILs will be transported using either SPMTs or flat top trailers, as defined in the Wynns report. A configuration for the flat top trailer option has been received from Wynns Limited.

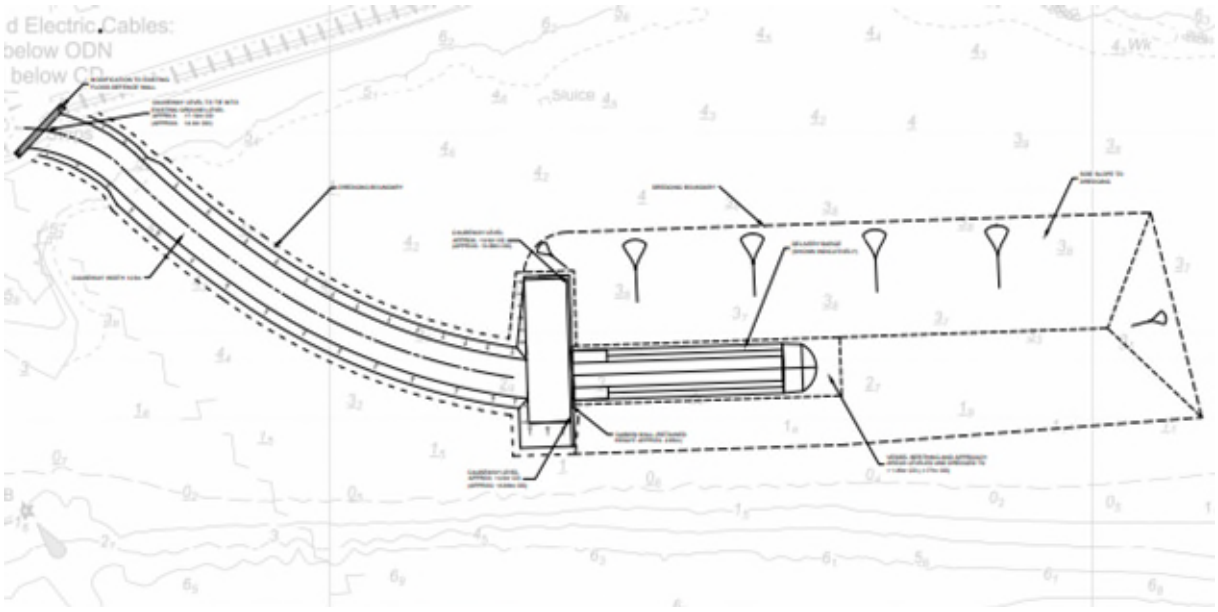


Figure 2 Plan showing causeway and berthing area

4.9 Safety in Causeway Design

AECOM has undertaken a Designer's Hazard Assessment to inform development of the concept design. Key hazards identified include working over water and in tidal water. The concept has been developed to minimise the risks arising from these hazards by facilitating construction from the shore, and avoiding or minimising the need to use major floating plant for causeway construction (other than dredging of berth/beaching pocket) or to place material under water. Output from the AECOM design hazard assessment is included in Appendix D of their report. It is noted that the hazard assessment excludes a number of potential hazards, including: bathymetry, flood tides, wave loads, currents, sediment movement, scour, temporary works design, ground improvement methods etc.

4.10 Environmental Mitigation

In developing the concept design, AECOM sought to minimise the likelihood of the causeway structure causing significant scouring of the existing foreshore, in order to mitigate the risk of damaging the inter-tidal habitat beyond the footprint of the causeway itself. The TFGP project team included environmental specialists that

assessed the potential environmental impact of the works and recommended potential mitigation and/or enhancement features. The AECOM conceptual design report does not provide specific information on how the causeway has been designed to mitigate scouring or changes in sediment deposition associated with the structure.

4.11 Proposed Operation of the Berth Beaching Pocket and Causeway

There will be a maximum of 60 barge deliveries over a planned 6-month period, with potentially only 20-30 deliveries depending on the number of AILs transported on each transit to the causeway. These deliveries will be at intervals of one to three days or more during the construction programme. The Ro-Ro Heavy Lift Barge, most likely to be the Terra Marique, will transit on to the causeway during high tide and will wait in situ. When the tide begins to turn the vessel will ballast down and settle on to the prepared bed of the berthing area adjacent to the causeway. Delivering the AILs to the causeway will involve a multi-staged marine operation composed of a number of phases. As shown on the general arrangement drawings in Appendix A of the AECOM Concept Design Report, abnormal indivisible loads (AILs) (e.g., heavy engines) will be delivered by sea using a heavy lift barge and off-loaded using the causeway. The sequence of operation would be as follows:

- Prior to arrival of the barge, the gate installed within the flood defence wall will be opened to permit vehicles to pass through the opening.
- The barge vessel will arrive at the site during a high tide and will position itself above the required berthing location. As the tidal water level falls, the barge will settle onto the prepared berthing area of river foreshore (the berth beaching pocket). The barge will be made secure. If necessary, two buoys will be provided to assist with the use of winching to achieve final precise positioning of the vessel.
- When the tidal water level has dropped sufficiently to fully expose the causeway a mobile crane will travel down the causeway to one of the crane pads adjacent to the barge. This crane will assist with deployment of the barge ramp to form a transition between the barge and the causeway. (Note: this crane will not lift the AIL loads).
- Unless already on the vessel, a SPMT (Self-Propelled Modular Transporter) or flat top trailer will travel down the causeway and onto the barge deck, and the AIL secured to the SPMT or trailer.
- The SPMT or trailer will travel over the vessel ramp onto the causeway, along the causeway, through the gate in the flood defence wall, and onward via a permanent haul road to the power station construction site.
- The crane will dismantle the barge ramp and re-stow on the vessel, before returning to shore along the causeway.
- The vessel will await the rising tide and, when the water level is sufficiently high, re-float and sail away from the site.
- The gate in the flood defence wall will be closed to keep the flood defence line watertight. This process will be repeated for arrival of the heavy lift barge. The flood defence wall gate will remain closed between barge arrivals, thereby ensuring that the flood defence is maintained at all times except at the times of receiving an AIL delivery. AIL deliveries and barge arrivals will be pre-planned well in advance and will avoid forecast storms and tidal surges and would therefore not be planned for times when it would be necessary for the flood defence gate to remain closed. The operational availability of the causeway, allowing for a one-hour window at high tide to manoeuvre the vessel onto and off the berth area, has been assessed and is estimated to be approximately 90% of the high tides being operable.

4.12 Structure

Key parameters of the causeway design are summarised in Table 1.

Table 1. Key Parameters used for conceptual design

Parameter	Definition
Maximum Barge draught	3.5m
Under Keel-Clearance	0.5m
Upper Causeway level	+4.3m OD
Lower Causeway level	+1m OD
Causeway Length	181m

4.13 Design of the Causeway and Berthing Area

The proposed causeway design is shown in Figure 3 and comprises a minimum crest width of 12.5m, which is considered by AECOM to be sufficient to accommodate the dimensions of the anticipated AIL and its swept path. The causeway crest falls away from the shore at a longitudinal gradient of approximately 1:40 maximum, in order to comply with the maximum gradient requirements of typical SPMTs and heavy lift flat top trailers. At the outer end of the causeway, two crane pad areas are to be constructed to accommodate the crane required to assemble the barge ramp structure. To construct the causeway, the very soft foreshore sediment will be removed at low tide by approximately 0.5m and backfilled with crushed rock fill placed on a geotextile (to prevent the rock sinking into the bed material below). The causeway is then formed from further crushed rock aggregate, reinforced by one or more further layers of geotextile. The longitudinal sides of the causeway will be formed to a stable slope and protected from erosion by tidal currents by rock filled reno-mattresses or suitably sized rock riprap.

At the river end of the causeway, a gabion wall is provided in order to retain the causeway material and to provide a nominally vertical face adjacent to the beached barge. At the outer end of the Causeway, two crane pad areas are provided to accommodate the crane required to assemble the barge ramp structure.

The causeway crest will be protected against erosion by tidal currents by rock-filled gabions or, if necessary, to provide an improved running surface for the SPMT and trailer vehicles, by precast concrete pads. Both options will facilitate some local adjustment of the running surface between AIL deliveries if necessary, to compensate for local differential settlement in the underlying river bed.

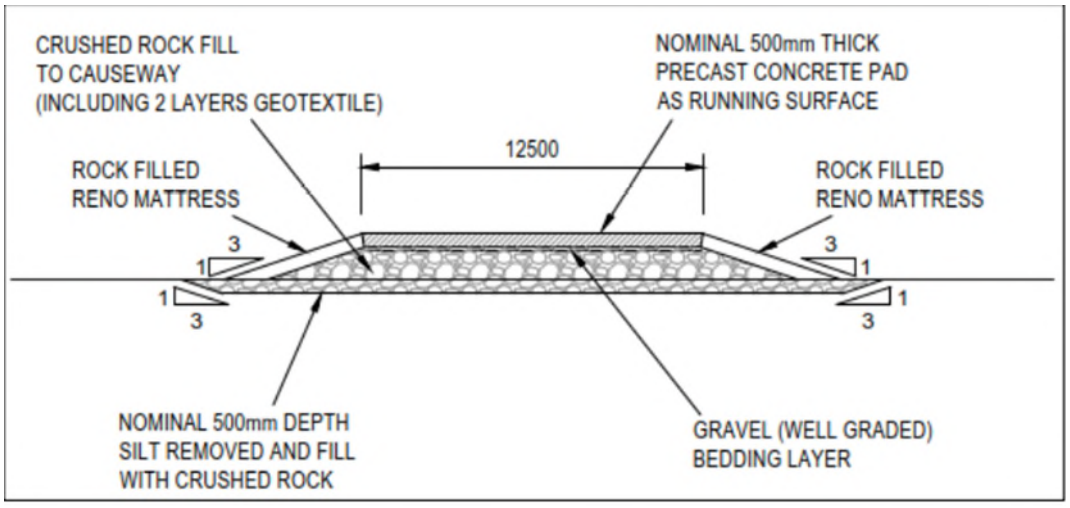


Figure 3 Typical cross section of Causeway structure

4.14 Flood Defence Wall Modification

The landward end of the causeway will tie into the existing ground level immediately in front of the reinforced concrete flood defence wall. A length of this existing flood defence wall will be broken-out and reconstructed to incorporate a gated opening to provide a clear opening of sufficient width to permit the AILs to be driven through the flood wall. A sufficient length of the existing river wall will be demolished (between existing movement joints) and a new flood defence wall will be constructed accommodating a flood gate to a design approved by the Environment Agency (EA). The flood gate will consist of a slot in barrier system with removable posts. This will enable a clear and unobstructed opening for trailer access to deliver abnormal indivisible loading.

At the end of the TFGP and the Lower Thames Crossing's proposed construction period, if the Environment Agency's preference is to keep the slot-in barrier system it will allow them to maintain the gates without the need for heavy lifting operations that would otherwise need with mechanical gate systems. If the Environment Agency would require the gates to be replaced with a reinforced concrete river wall this could be accommodated in the design by providing couplers (base and sides) to fix the reinforcement and to concrete the opening to fill the opening flush with the existing river wall. It is acknowledged that the position of the retained panels either side of the opening will need to be monitored for differential settlement, and stabilised if necessary.

4.15 Preparation of River Bed for Beaching of Barge

The berthing area will be prepared to allow the safe grounding of the Terra Marique. The delivery barge is specially designed to be safely beached onto the river bed; however, the bed must be prepared to be suitable for safe beaching. Preparation will include removal of high spots, infilling of any large low spots and removal of any hard spots or foreign materials found at the surface. Large obstructions will need to be removed to create a safe, flat surface. The berthing area and approaches to the berthing area will be dredged to 1.35m above chart datum allowing for the Causeway to be operational at high water on Spring and Neap tides.

This preparation will be undertaken over an area extending slightly larger than the barge in order to allow for some flexibility and adjustment in the precise position of the barge. In addition, the beaching area must be re-profiled to be sufficiently level, and will be reduced in level (by dredging) to optimise the beaching level relative to the tidal range (approximately -1.77m AOD).

4.16 Retention of Causeway

Although the principal use of the causeway is to facilitate the initial construction of the TFGP, it is proposed to remain in place throughout the life of the TFGP in order to facilitate off-loading of replacement plant (generators etc.), if appropriate.

4.17 Construction Methodology

The anticipated construction method for the causeway and crane platform is by a backhoe working progressively outward from the river bank, replacing the excavated/dredged material with the crushed rock fill, laying the geotextile layers and completing the rock mound to the design level, prior to placing the precast concrete pads. To avoid the existing undrained cohesive soil below the causeway slipping under loading from the excavator, the excavator will form a working platform to support itself, as it advances. Geotextile/geogrid will be placed below the rock fill, and further geotextile/geogrid layers placed within the rock fill layer, to raise the tensile strength and assist with spreading the load.

The anticipated dredging method for the berthing pocket is by a floating marine dredging plant. A decision on the optimum dredging plant will be made at a later stage, as this depends on several environmental and economic factors including the availability of dredgers within the London area at the time the works are to be constructed.

Feasible dredging plants are Backhoe dredger, trailer suction hopper dredger, cutter suction dredger. Use of a water injection dredger may be feasible subject to further engineering studies into the properties of the material to be dredged. Use of a backhoe dredger mounted on a floating barge is currently considered to be the most likely. Dredged material would be disposed of to a licensed disposal area within the Thames estuary or, if the material is contaminated, to licensed landfill facilities. AECOM note that there is a nearby site currently receiving spoil from the Thames Tideway Tunnel development works, but there is no indication of any available capacity or timing in terms of potential availability.

4.18 Estimate of Required Dredging Volume

The volumes are estimated based on the concept design shown in the drawing THPP-ACM-ZZ-XX-DR-MT00001 of the AECOM concept design report. Dredging is required for two purposes:

- To remove (and permit replacement of) soft material from below the causeway footprint, and
- To reduce the bed level at the berthing location (and to form stable side slopes to this area).

The design dredging level is defined as 0.5m below the riverbed level, hence a layer of 0.5m metres of the top layer of the silt shall be removed from the river bed.

Lateral slopes applied for dredging in silt for the temporary works are 1V:5H (1 vertical to 5 horizontal).

Natural riverbed slopes at the riverbank adopt slopes up to 1V:14H which gives an idea of the expected natural slope of the works exposed to the tides and currents action along the design life of the causeway.

1V:3H as stated in the initial approach is considered by AECOM to be unstable, especially in an area subject to strong tidal currents as the Thames estuary.

The volume of the dredged area is reliant on the height of the causeway material required on top of the river bed to ensure a 1V:40H slope. The causeway being sloped on either side at 1V:3V therefore that the height of the material on top of the river bed also affects the width and in turn the width for the dredged amount contributing to the dredged volume.

Spot points along the arced causeway axis, interpolated from the navigational points (in Chart Datum), were used to find the material required on top of the river bed that at that distance from the gabion would result in an appropriate height for the 1V:40H slope.

These measurements were taken up from the gabion's location, river bed level 0m AOD, to the Mean High Water [MHW] mark and then onto the +5m AOD at the flood wall location. Volumes defined as excavations are those landwards from the MHW mark-up to the top of the floodwall line.

4.19 Dredge Volume Estimate

The total dredging and excavation volume, including the grounding pocket, is estimated to be 16,100m3. Included within that estimate is dredging for removal of existing soft material below the causeway structure estimated to be 2,914m3. Excavation volume landward of the MHW mark included in these figures is 220m3.

4.20 Decommissioning of the Causeway and Vessel Berthing Area

Causeway decommissioning will occur either at the end of the design operational lifetime of the project (35 years), or potentially sooner if a suitable alternative option for delivery of gas engines becomes available (ES Addendum: Assessment of Causeway Decommissioning).

Decommissioning of the causeway is expected to involve the following works:

- Deconstruction of the causeway structure, including removal of the security gate/fence, dismantling the concrete slabs and stone gabion foundations, and transporting this material for re-use or disposal.
- Reinstating the permanent sea defence wall where the access gate had been inserted during causeway construction.
- Restoring the mudflat and coastal saltmarsh area from the causeway footprint and barge berthing pocket (if the latter has not already refilled by natural accretion).

The decommissioning plant used and timescale for the work is expected to be similar to that required for construction, and on that basis the impacts associated with decommissioning are expected to be similar to those assessed above (if the environment in the locality remains the same or similar).

4.21 Causeway Habitat Regulations Assessment

The Habitat Regulations Assessment for the causeway and berthing project completed by RPS concluded, beyond reasonable scientific doubt, that there will be no adverse effect on the integrity of the Thames Estuary and Marshes SPA from construction of the causeway. RPS considered that no specific mitigation measures are required to avoid an adverse effect on integrity. Nevertheless, the Applicant would seek to minimise impacts, as follows:

- Construction would avoid the period of peak winter bird activity if possible.
- Low-noise plant including electric plant would be used where practicable to minimise noise generation.
- Works would not be undertaken between dusk to dawn, and no lighting will be used on the causeway.
- Subject to monitoring of bird activity (undertaken during construction of the causeway) confirming that this is necessary, works would cease in the event that 14 consecutive days of freezing temperatures occur (as per guidance on cessation of wildfowl shooting during severe weather). Construction work would recommence once three consecutive days of non-freezing temperatures occurred, after which it would cease again if 14 consecutive days of freezing temperatures occurred.

According to RPS, provided that numbers of birds regularly using habitats in the vicinity of the causeway do not significantly change, the decommissioning of the causeway would not have an adverse effect on the integrity of the Thames Estuary and Marshes SPA.

Given the potentially long length of time before decommissioning would occur, additional wintering bird surveys would be undertaken prior to decommissioning, to inform the Causeway Decommissioning Plan, and if surveys indicate a significant change to the level of bird use of the foreshore in the vicinity of the causeway, an updated HRAR would be produced, and where necessary may involve restrictions on works during some or all of

the winter period. Any necessary mitigation would be confirmed through the Causeway Decommissioning Plan at the time.

Information to enable an Appropriate Habitat Assessment of the TFGP development has been provided by RPS. The screening stage carried out by RPS identified no 'Likely Significant Effects on Natura 2000 sites' in the absence of mitigation with the exception of water quality and hydrological impacts on the Thames Estuary and Marshes SPA / Ramsar, and noise and visual disturbance from construction and use of the causeway on the qualifying features Avocet, Dunlin, Redshank and Ringed Plover of the Thames Estuary and Marshes SPA / Ramsar.

These potential effects were taken forward to an Appropriate Assessment stage where appropriate mitigation was identified to address the risk of significant effects occurring. The proposed mitigation in the form of surface water management features and pollution control safeguards will together ensure that there will be no significant adverse effect on the integrity of the Thames Estuary and Marshes SPA / Ramsar from water quality and hydrological impacts. The assessment of the impacts of causeway construction and use concluded that there would be no adverse significant adverse effect on the integrity of the Thames Estuary and Marshes SPA / Ramsar and no mitigation was therefore required. Measures to minimise impacts from causeway construction and use should this overlap with the passage / wintering bird season, will nevertheless be implemented as best practice.

5. GEOTECHNICAL ASSESSMENT

Based on the review of relevant information about the causeway and berthing area, the following geotechnical design risks have been identified by Hydrock:

5.1 No site-specific geotechnical data is available to support the conceptual design

Although AECOM referred to BGS archival borehole records available for the wider site area, these were not relevant to the causeway site area. AECOM do not provide any information relating to the ground conditions at the proposed causeway location within the conceptual design report.

RPS (2020) completed a Phase 1 Intertidal Survey Report which provides a brief description of the sediments forming the intertidal area at the proposed location of the causeway. From the <2.4m high flood wall is an established saltmarsh vegetated area. This higher intertidal area comprises sand, muddy sand and mud and extends to a <1m soft vertical cliff, which marks the mid-shore intertidal area. The higher intertidal area is periodically covered by spring high tides. The mid shore area comprises a narrow band of artificially placed rock or mixed sediment. The artificially placed rock (Low Energy Littoral Rock) overlies mic sediments of sand and mud. The artificial placed rock appears to have been placed on steeper sections of the mid shore area. Sections of the mid shore area also comprise littoral mussy sand and gravelly sandy mud (Mud Eulittoral Rock). These mid shore areas experience very weak to weak tidal streams. The lower shore comprises a wide area of mudflat comprising littoral sandy mud. The lower shore intertidal mudflat area comprises soft sandy littoral mud.

It is understood that the Environment Agency have geotechnical information relating to the flood defence wall; however, this data was not made available for the completion of the AECOM concept design of the causeway (AECOM, 2020). It should be emphasised that AECOM sought to provide a conservative layout of infrastructure required based on the information they had access to (and hence not necessarily the most economic design or what would actually get built or be needed in the site-specific circumstances) for the causeway arrangement in

the absence of site-specific geotechnical data. It is therefore possible that the configuration of the causeway and berthing area may have to be changed when site-specific ground investigation data becomes available.

AECOM has claimed that a credible worst-case scenario has been assumed for the geotechnical ground conditions at the causeway location to conduct stability checks on two cross-sections of the causeway, and for sizing a gabion wall at the waterside end of the causeway. However, the AECOM conceptual design report does not refer to an assumed ground model used for geotechnical design purposes. There is no information provided on the site characterisation and the selection of geotechnical parameters that have been used in the conceptual geotechnical design. It must be emphasised that the ground conditions typically expected within estuarine environments can be very complex. The ground materials present at the causeway site may demonstrate significant heterogeneity over short distances. Estuarine systems often exhibit complex sediment deposition over short distances in the proximal to distal intertidal environment. For example, the estuarine deposits may comprise braided channels comprising variable clay, silt and sand lithologies, meandering channels, variable floodplain deposits, tidally influenced terminal channels and subtidal to intertidal plains deposits. In Hydrock's opinion, AECOM cannot possibly have any understanding of the ground conditions at the causeway and berthing area. AECOM has not explained what credible worst-case scenario in terms of ground model has been used for the conceptual design of the causeway. AECOM has not provided the geotechnical parameters which have been used for the stability analyses of the causeway and do not include copies of the stability analyses assumptions and calculation sheets undertaken for the two cross-sections used to check the stability of the causeway. In Hydrock's opinion, without site specific ground investigation data it is not appropriate to undertake checks on the causeway slope-stability as part of a conceptual design.

AECOM note in their concept design report that should the ground conditions prove to be significantly worse than assumed, the concept design would allow for options to improve stability, e.g., ground improvement or soil replacement. However, the report does not provide any further information on the specific methodology of ground improvement to be adopted for construction of the causeway. AECOM also do not provide information on the 'soil replacement' methodology suggested as a means of ground improvement. Hydrock consider that until a detailed ground investigation is undertaken at the site of the causeway it will not be possible to understand what type of ground improvement would be suitable for the ground conditions at the site.

At this stage, no desk study or preliminary ground investigation has been undertaken to provide information on the geological, geotechnical and geoenvironmental conditions present at the site. A geotechnical and geoenvironmental desk study should have been completed for the site of the causeway to inform the conceptual design. The desk study report should have been completed before the concept design report completed by AECOM.

A ground investigation will be necessary to provide appropriate geotechnical and geoenvironmental parameters for the design of the causeway and berthing area. The ground investigation should be scoped on the basis of the findings of the desk study and other surveys which are discussed in sections below. Without adequate ground investigation it is questionable whether the causeway and berthing area can be constructed economically and safely at the proposed location.

5.2 No detailed bathymetry survey of causeway and berthing area

There is no detailed bathymetrical survey data for the for the causeway and berthing site area. The concept design refers to relatively small-scale Port of London Authority nautical charts (PLA Nautical Chart 337), which provide insufficient detail of the bathymetry of the site area. It is known that the Thames River bed has been dredged for navigation purposes and therefore, becomes significantly steeper and unsuitable for beaching a vessel. The causeway proposed by Wynns Limited is therefore curved in plan in order to accommodate both

causeway and beached vessels within the area of acceptable foreshore gradient. A detailed bathymetric survey will be required for the site area prior to design of the causeway and berthing area to ensure that the berthing area can be constructed at a suitable berthing gradient and that the berthing side slopes will be stable in relation to the adjacent nearby steeper slopes associated with the deeper dredged navigable channel of the River Thames.

It would be prudent to undertake a bathymetrical survey of a wider area of the Thames Estuary to determine the most appropriate site area for the siting of the causeway and associated berthing area rather than opt to site the causeway at its existing position. This would allow the causeway to be located along an area of acceptable foreshore gradient and away from any natural or dredged channels which may impact both the construction of the causeway and the berthing area. The configuration of the causeway and berthing area can also be optimised to prevent complications of constructing the berthing area near to steeper gradients and natural or dredged channels within the river bed. The location of steeper river bed slope gradients and natural/dredged channels may also cause potential instability issues associated with the design of the berthing area. These issues have not been considered by AECOM in their concept design report and the current site location may not be suitable as a detailed bathymetrical survey has not been undertaken.

5.3 No consideration of floods tides, wave loads and currents to support conceptual design

AECOM confirmed in their concept design report that no cross currents or waves loads were considered in the stability checks of the causeway or the gabion. These factors will need to be considered in later stages of design development. The maximum spring tidal range at the proposed location of the causeway can be as much as 6.5m and surges and cuts in the tidal heights are not uncommon. Tidal streams in the main part of the Authorised Channel on the ebb stream may reach 3 knots at maximum spring rates. Although, the tide reduces towards the riverbanks it can still reach a speed of 1 knot. The desk study for the causeway should include an assessment of, waves, tides, currents, erosion/scour, sediment movement applicable to storm flood protection and the design of the causeway and berthing area. At present only general information has been collected and there is little understanding of the intertidal geomorphology of the site area. A more detailed assessment of these factors is required prior to undertaking detailed design of the causeway and berthing area. This information will be required to model the effect of river water flowing around the causeway and the distribution of pressure along the causeway. Hydraulic modelling will be required to assess the influence of the variation in velocity on the hydrodynamic force and pressure distribution exerted on parts of the causeway. There is currently no understanding of the effects of constructing the causeway and berthing area on the sediment movement and deposition/accumulation of sediments around the causeway, particularly downstream of the causeway. A detailed understanding of both bathymetry, flood tides and currents will be required for the detailed design of temporary works and the main construction of the causeway and berthing area. Without this understanding the current conceptual design of the causeway and berthing area is questionable.

AECOM note that the natural riverbed slopes at the riverbank adopt slopes up to 1V:14H, which gives an idea of the expected natural slope of the works exposed to the tides and currents acting along the causeway. The very shallow natural slopes suggest that it may be difficult to maintain stable side slopes for the berthing area given the very low strength of estuarine materials present at the site. A better understanding of the bathymetry, flood tides, currents and estuarine materials will be required to design stable side slopes for the berthing area. Without this information it might not be feasible to be able to design stable slopes for the berthing area.

5.4 No UXO survey of the site area

The Tilbury Dock area was bombed during the Second World War and therefore falls within a potential UXO risk area. An unexploded WW2 bomb was found within the Docks area as recently as 18th August 2020. A UXO risk

assessment and possible further intrusive investigation may be required at the site of the causeway and berthing area.

5.5 No Human Health and Controlled Waters Risk Assessment for the site

RPS (2020) completed a Phase 1 Intertidal Survey report which included a sediment chemistry analysis across the site area. The sediment chemical analysis was carried out to determine the contamination levels required for dredging and those supportive of the functioning of healthy aquatic ecosystems. The RPS report concluded that the sediment chemistry analysis identified chemical elements at concentrations that are typical of a busy navigational estuary such as the Thames. In the UK, national Action Leves ((ALs) for dredge sediment have been established by Cefas. AL1 is the lower action level. Chemical analysis results that are below this level are considered to have low levels of contamination and the material is chemically acceptable for dredging and disposal at sea. The Canadian Sediment quality guidelines were developed by the Canadian Council of Ministers of the Environment as broadly protective tools to support the functioning of healthy aquatic ecosystems (CCME, 2001). The guidelines consist of threshold effect levels (TELs) and probable effect levels (PELs). Metals and PAH's were above Cefas AL1 and Canadian TEL, but well below Cefas AL2 and Canadian PEL (where relevant). The levels of metals and PAH's were comparable to those reported from surveys in the adjacent Tilbury 2 development (Port of Tilbury London Ltd., 2017).

However, no desk study and geoenvironmental investigation has been undertaken at the site of the causeway and berthing area to assess the potential risk from soil/groundwater and surface water contamination to human health and Controlled Waters. AECOM has identified the design hazard associated with potential contamination and the requirement for contaminated land and controlled water investigation and assessment prior to detailed design. It would have been prudent to have completed a contaminated land and controlled waters preliminary risk assessment as part of the Desk Study for the causeway and berthing area prior to completing the conceptual design report. At present there is no understanding of the potential soil/groundwater and surface waters contamination risk to human health and controlled waters at the site area. The AECOM conceptual report also does not consider any potential soil/groundwater and controlled waters contamination risk associated with the decommissioning of the causeway and berthing area.

5.6 No temporary works design considered as part of the conceptual design

The concept design report has not considered any necessary temporary works design that would be required for the construction of the causeway and the berthing area. AECOM has identified the hazard of site personnel and/or plant becoming in the very soft river foreshore mud/silt. The construction of stable working platforms for plant and personnel and safe working practices during construction and decommissioning of the causeway and berthing area has not been covered within the concept design report completed by AECOM.

AECOM describe the anticipated construction method for the causeway and crane platform is by a backhoe working progressively outward from the river bank, replacing the excavated/dredged material with the crushed rock fill, laying the geotextile layers and completing the rock mound to the design level, prior to placing the precast concrete pads. AECOM state, ‘to avoid the existing undrained cohesive soil below the causeway slipping under loading from the excavator, the excavator will form a working platform to support itself, as it advances. Geotextile/geogrid will be placed below the rock fill, and further geotextile/geogrid layers placed within the rock fill layer, to raise the tensile strength and assist with spreading the load.’ It will be necessary to undertake a detailed ground investigation and to derive suitable geotechnical parameters for the design of working platforms for the use of various construction plant for the construction works.

5.7 No geotechnical properties available for the intertidal estuarine deposits

As discussed in section 5.1, it is anticipated that the spatial distribution intertidal foreshore and estuarine deposits will be complex and variable over short distances. The geotechnical properties of the estuarine deposits are likely to be characterised by very low shear strength and to be highly compressible under load. As discussed, there is no ground investigation data that can be used to substantiate the conceptual design completed by AECOM. AECOM has not explained their assumed ground model and 'credible worst-case' geotechnical soil parameters used in their conceptual design. Without further geotechnical investigation it will not be possible to obtain appropriate geotechnical parameters for the design of a range of specific requirements for the causeway and berthing area. Without an understanding of the ground model and associated geotechnical characterisation of the ground materials that form the ground model it is not possible to be able to complete a conceptual design of the causeway and berthing area.

Please refer to Table 2 which lists the necessary geotechnical parameters and why they are required for the design of the causeway and berthing area.

Table 2. List of Geotechnical Soil Parameters and other survey data required to complete specific design requirements for the causeway and berthing area

Geotechnical Soil Parameters	Specific Design Requirements
Shear strength and consolidation properties of soils with depth.	Settlement analysis of the causeway and design of mitigation measures to control differential settlement along the causeway.
Shear strength properties of soils with depth	Load bearing capacity of the intertidal and estuarine deposits.
Grading, Atterberg Limits, Shear strength and Bulk Density of soils with depth.	Specification of the rock fill to be used for the construction of the causeway including the reno mattresses along the side slopes of the causeway.
Grading, Atterberg Limits, Shear strength and Bulk Density of soils with depth.	Specification of the geosynthetic materials to be used beneath the causeway and for use to strengthen rock fill used in the construction of the causeway.
Grading, Atterberg Limits, Shear strength and Bulk Density of soils with depth.	Analysis of slope stability for the causeway side slopes
Grading, Atterberg Limits, Shear strength and Bulk Density of soils with depth.	Analysis of slope stability of side slopes for the berthing area.
Flood tides, wave loads, cross-currents impacting the causeway. Grading, Atterberg Limits, Shear strength and Bulk Density of soils with depth.	The stability of the causeway cannot be properly assessed without data relating to cross-currents and wave loads.
Flood tides, wave loads, cross-currents impacting the causeway. Grading, Atterberg Limits, Shear strength and Bulk Density of soils with depth.	The stability of the gabion wall at the end of the causeway cannot be properly assessed without data relating to cross-currents and wave loads.
Flood tides, wave loads, cross-currents impacting the causeway. Grading, Atterberg Limits, Shear strength and Bulk Density of soils with depth.	The stability of the crane pads on the causeway cannot be properly assessed without data relating to cross-currents and wave loads.

Without an understanding of the ground model and geotechnical parameters the feasibility of being able to construct the causeway and berthing area in its current location must be questionable.

5.8 Insufficient detail for causeway construction within the conceptual design

AECOM describe the process of constructing the causeway. This involves the removal of the very soft foreshore sediment. This sediment will be removed at low tide by approximately 0.5m. AECOM do not provide any detail of the type of plant that will be used to excavate the soft foreshore sediment and details of how the sides of the excavation will remain stable. It is possible that the sediment if removed by grab dredging will generate a

considerable amount of fluid mud which, being heavier than water, remains within the excavation area. AECOM note that lateral slopes applied for dredging in silt for the temporary works are 1V:5H (1 vertical: 5 horizontal).

AECOM describe that the excavation will be backfilled with crushed rock fill placed on a geotextile (to prevent the rock sinking into the bed material below). AECOM do not provide any information on the type of geotextile to be used below the rockfill or the specification of the rockfill to be used at the base of the causeway. The causeway is then formed from further crushed rock aggregate, reinforced by one or more further layers of geotextile. Again, AECOM does not provide a specification of the 'crushed rock aggregate of geotextile reinforcement to be used for constructing the causeway. AECOM state that the longitudinal sides of the causeway will be formed to a stable slope and protected from erosion by tidal currents by rock filled reno-mattresses or suitably sized rock riprap. However, AECOM has not stated what the stable slope will be and do not provide specifications for the rock filled reno-mattresses rock riprap to be used on the side slopes of the causeway.

AECOM do not mention whether any ground improvement measures will be required prior to construction of the causeway. AECOM do not mention whether staged construction and possible surcharging of the causeway will be required as part of the construction methodology. No mention is provided in relation to requirement for level monitoring and settlement assessment during construction of the causeway. The causeway crest is designed to fall away from the shore at a longitudinal gradient of approximately 1:40 maximum, in order to comply with the maximum gradient requirements of typical SPMTs and heavy lift flat top trailers. It is assumed that the causeway will be required to meet stringent differential settlement tolerances required by the cranes, SPMTs and heavy lift flat top trailers. Therefore, it is critical that long-term differential settlement of the causeway is controlled to maintain longitudinal gradients appropriate for plant using the causeway.

If it is not possible to be able to maintain the causeway gradient to below 1:40 in the long-term, the SPMTs and heavy lift flat top trailers will not be able to use the causeway when these gradients are exceeded.

5.9 Insufficient geotechnical data to design causeway side slopes

A 1:3 (vertical: horizontal) slope has been assumed for the sides of the causeway; however, no geotechnical parameters or stability analyses are provided to rationalise this assumption within the conceptual design report. AECOM consider that side slopes of 1V:3H will be unstable, especially in an area subject to strong tidal currents as in the Thames estuary. Therefore, the current assumption of 1:3 (vertical: horizontal) side slopes for the causeway is already highly questionable. As discussed in section 5.1 and 5.7 a ground investigation is necessary to provide appropriate geotechnical parameters for the design of stable side slopes for the causeway. Hydrock consider that the current conceptual design of the causeway side slopes to be unsubstantiated and that the side slopes are likely to be at lower angles in order to maintain long-term stability.

5.10 Insufficient geotechnical data to allow design of causeway crane pads and gabion wall

At the outer end of the causeway, two crane pad areas are to be constructed to accommodate the crane required to assemble the barge ramp structure. Also, a gabion wall structure is to be constructed at the end of the causeway. AECOM has not provided any specific information relating to the design of the crane pads or gabion wall in relation to load capacity and stability required for the long-term performance of the gabion wall and crane pad.

5.11 Geotechnical constraints relating to the existing flood defence wall

AECOM has recognised that there is insufficient data relating to the existing flood defence wall to be broken out and partially demolished. Although the top of the wall level is known, no other as-built drawings have been

made available. This information will be required for the construction of the new flood defence gate which will provide access to the causeway. All designs for the removal of the existing wall and construction of the new flood gate will need to be agreed in advance with the Environment Agency.

AECOM has recognised the potential hazard associated with the uncontrolled collapse of the existing flood defence wall during demolition which may also compromise the stability and the water tightness of the existing flood wall during demolition/construction operations. AECOM suggest that the existing river wall could be demolished between existing movement joints and a new flood defence wall will be constructed to minimise the effects from new flood defences on the stability of the existing structure. The concept design report does not provide any further information or general arrangement drawings to show this suggested arrangement.

AECOM has also recognised that loading from the SPMT/heavy lift flatbed trailer may induce differential settlement under the remaining parts of the wall either side of the new floodgate. The design of the floodgate and adjacent sections of the floodwall must therefore be designed to mitigate the load imparted by the SPMT/heavy lift flatbed trailers. The design will therefore require detailed information relating to the design of the existing floodwall and ground investigation data for the design of the floodgate.

AECOM has stated that they have completed a high-level structural stability check (only) for the existing river wall opening and potential flood defence gate arrangement and high-level sizing of pre-cast concrete pad running surface. However, no specific information including stability check analyses are provided within the conceptual report.

The installation of a flood defence gate within the existing flood defence wall will be necessary to enable the transfer of plant and AIL to and from the barge causeway. Whilst the construction of this gate can be suitably designed to ensure the integrity of the flood defences are maintained, the introduction of a new gated access point will introduce a flood risk in the event of accidental operational mis-management and malicious actions. Operational plans will be required to minimise the potential for this scenario and appropriate security considerations will also need to be made in any future design.

5.12 Insufficient consideration to requirements for causeway decommissioning

Decommissioning of the causeway and berthing area will occur either at the end of the design operational lifetime of the project (35 years), or potentially sooner, if a suitable alternative option for delivery of gas engines becomes available (ES Addendum: Assessment of Causeway Decommissioning). Decommissioning of the causeway is expected to involve the following works:

- Deconstruction of the causeway structure, including removal of the security gate/fence, dismantling the concrete slabs and stone gabion foundations, and transporting this material for re-use or disposal.
- Reinstating the permanent sea defence wall where the access gate had been inserted during causeway construction.
- Restoring the mudflat and coastal saltmarsh area from the causeway footprint and barge berthing pocket (if the latter has not already refilled by natural accretion).

AECOM suggest that the decommissioning plant used and timescale for the work is expected to be similar to that required for construction, and on that basis the impacts associated with decommissioning are expected to be similar to those for construction. As with the initial construction, decommissioning of such a causeway within the Thames estuary would be a significant engineering undertaking and Hydrock consider that further consideration must be given to the methodology used for decommissioning the causeway; this methodology should consider the following:

- Sediment build-up around the causeway structure.
- Significant settlement and consolidation of causeway materials.
- Careful removal of gabions and reno-mattresses which will not cause splitting of wire mesh and loss of stone content into the Thames estuary.
- Careful removal of riprap or other rock armour used in construction.
- The controlled removal of rockfill and geotextile without losing material in flood tides and strong currents.
- Decommissioning of any ground improvement to enable restoration of former river bed profiles.
- Prevention of finer materials/accumulated sediments being washed into the river.
- Detailed safe methods of working including the design of appropriate working platforms for plant and equipment.
- Final restoration of the riverbed profile.
- Work to be undertaken without detriment to local habitats and public access.

5.13 Insufficient consideration to the long-term structural integrity and performance of the causeway and berthing area

The evaluation of settlements affecting causeway structures constructed in soft soils can be difficult due to the heterogeneity of such deposits over short distances. The determination of the degree of consolidation and the assessment of residual settlement arising from secondary settlement (i.e., creep settlement) in the long-term can be challenging. In addition, it will be important that the causeway is designed to provide adequate protection from flood tides, storm waves, currents and scouring to maintain the stability of the side slopes forming the causeway over the long-term.

It will be necessary to design the causeway in such a manner to maintain the strict tolerances in the form of gradients, differential settlement, longitudinal distortion, mitigation against cracking of slabs etc. to enable the specified plant used for unloading and carrying AILs to perform properly. It will be critical that the causeway is designed to ensure the long-term performance and that continued monitoring is used to ensure that the performance specification and tolerances required for specified plant are maintained at all times.

Likewise, it will also be important to regularly check that the stability of the side slopes of the berthing area and the rate of sediment accumulation within the berthing area are appropriate to ensure the facility can continue to receive barge vessels safely and at the specified levels required for offloading plant etc.

The conceptual design report does not consider the long-term performance requirements of the causeway and berthing area in sufficient detail. The long-term performance of the causeway structure, mitigation measures required to maintain performance specifications and the requirements for regular monitoring of both the causeway and the berthing area need to be considered in further detail. The long-term performance and specified tolerances relating to the plant using the causeway or vessels using the berthing area must be guaranteed over the life-time of the causeway. If the long-term performance and specified tolerances cannot be met an alternative means of transporting AILs must be considered.

The construction of a causeway within the Thames estuary is a significant engineering undertaking and will require the structure to meet long-term performance criteria appropriate for use of special lifting and transportation of AILs.

5.14 Potential constraints to future river frontage use

At this stage in the design process, it is unclear as to the extent and frequency of the causeway and berthing area long-term maintenance requirements. It is likely that access will be necessary for inspections to be carried out, regular dredging of the berthing area, repairing and maintenance works of the causeway and that the plant and associated clearances required to achieve this. This will constrain the potential for any future operational development along the river frontage at the location of the causeway. Safety and navigational implications will also need to be evaluated as a result of the causeway construction and this too has the potential to impact on any future adjacent operational development.

5.15 Insufficient consideration of geotechnical hazards/risks within the Designers Risk Register

The Designer's Risk Assessment included within the AECOM Conceptual Design report has not included many of the geotechnical hazards/risks identified within this high-level geotechnical assessment. The designer's risk assessment will therefore require to be significantly updated based on the geotechnical hazards/risks identified in this report before any proper consideration and determination of the proposals can be informed and undertaken effectively.

6. CONCLUSIONS

A causeway proposal has been brought forward as part of the application which provides inadequate information to demonstrate with any certainty that it could be constructed or decommissioned.

The lack of geotechnical data, ground investigations, bathymetric and flood tide and wave analysis means that there is no detailed or technical information to inform understanding of what will be a substantive undertaking in a changing ground environment, leading to potential stability issues and uncertainty as to how the causeway could be safely constructed, maintained and removed as well as the temporary works that would be required to perform these operations.

With further information required as to the long-term performance of the causeway structure, mitigation measures required to maintain performance specifications and the requirements for regular monitoring of both the causeway and the berthing area, its long term performance is not guaranteed, leading to the potential for further complications after its initial construction.

It is clear that the construction of a causeway within the Thames estuary, and its removal, is a significant engineering undertaking and the information currently available is insufficient to provide adequate information to give clarity as to how this could with any certainty be undertaken appropriately.

DR MARTIN CROSS TECHNICAL DIRECTOR

Dr Martin Cross is an experienced geotechnical engineering specialist with over 35 years' experience of working on major UK civil engineering infrastructure and development projects, encompassing geotechnical, engineering geology and geo-environmental consultancy, specialist geotechnical engineering contracting, site investigation, detailed geotechnical design and expert witness commissions.

Academic Qualifications

BSc (Hons) Geology
MSc Water and Environmental Management
MA Marketing Management
MBA Construction Management Route
PhD Engineering Geology
PGDip Civil Engineering
CIM Diploma Marketing

Professional Qualifications

Chartered Engineer
Chartered Geologist
European Geologist
Chartered Scientist
Charted Environmentalist
Chartered Marketer
Specialist in Land Condition
Geotechnical Adviser – ICE UK Register of Ground Engineering Professionals

Memberships

FICE
MoM^3
FGS
MCIM
RoGEP

Awards

ICE George Stephenson Gold Medal

KEY SKILLS - DEVELOPMENT

Dr Cross is a Project Director and specialist in geotechnical engineering, environmental geology, site waste management, environmental risk assessment and remediation of contaminated land and groundwater. He has managed geotechnical and geo-environmental projects for both public and private clients, co-ordinating all project stages including feasibility reports, desk studies, ground investigations (including design, procurement, supervision and contract management); reporting (Desk Study reports, Factual Site Investigation reports, Mining Risk Assessments, Ground Investigation reports (GIRs), Geotechnical Design Reports (GDRs), Geotechnical Baseline reports). Project Director for contaminated land Phase I and II investigations, contaminated land Tier 1-3 risk assessment, remedial options appraisal, remediation strategy, remediation schemes and remediation verification reporting. Specialist in Land Condition (SiLC) and UK Registered Ground Engineering Adviser and Specialist in Land Condition. He is a certified Project Manager with long track record of managing large geotechnical projects and Frameworks including various decommissioning projects on the DSA Framework at Sellafield, SNS Lot 6 Framework, HA Frameworks, Network Rail Frameworks and Local Authority Frameworks.

RELEVANT PROJECT EXPERIENCE

Raynesway Development, Spondon, Derby

Project Director for the remediation of Accordis Chemical Works (Formerly Courtaulds). Managed the contaminated land Phase I and II investigations of a 360-acre chemical works. Complex contaminated site with both organic and inorganic contaminants affecting soil and groundwater. Completed a series of phased investigations and a programme of monitoring to develop conceptual site models. The remedial options appraisal required remediation pilot trials prior to completing a detailed remediation strategy for the proposed redevelopment of parts of the site for commercial development. Managed the first phase of remediation and engineering enabling works including excavation and removal of hazardous waste including asbestos contaminated soils, engineering earthworks for the creation of new development platforms.

Steetley Regeneration Project, Worksop

Project Director for the reclamation and remediation of former brickworks and colliery sites for the redevelopment of a pre-cast concrete manufacturing plant for Laing O'Rourke. Project involved due diligence reporting, desk study, site investigation, planning application administration, EIA, contaminated land risk assessments. The site overlies a major Magnesian Limestone aquifer and required both DQRA for human health and controlled waters. Completed the remediation strategy, remediation pilot trials and remediation verification reporting. The remediation involved, removal of hazardous waste, ex-situ bio-remediation, in-situ pump and treat of pitch contamination and monitored natural attenuation. Extensive programme of verification testing to demonstrate the re-use of colliery spoil for infilling former limestone quarries. Completed complex earthworks involving reuse of colliery materials to infill former quarry sites and construct development platforms for the new manufacturing plant.

NHS PFI Design and Build Hospital Developments

Geo-environmental lead for the Phase I assessment, Phase II investigations, remediation options appraisal, remediation strategy, verification reporting for various NHS PFI Design and Build hospital developments including: Birmingham, Pontefract, Pinderfields, Hull and Thameside hospitals.

Daventry International Rail Freight Terminal Phase 2 (DIRFT II).
Prologis & Volker Fitzpatrick. Design and Build Contract. Value: £40 Million. Geotechnical Design Fees: £250,000.
Daventry International Rail Freight Terminal (DIRFT) is a rail-road Intermodal freight terminal with an associated warehousing estate in Northamptonshire, UK. In 2005, planning permission was granted to expand the area by about 130 acres, forming DIRFT II DIRFT II involved the design and construction of a rail linked Class B8 unit with associated rail embankment, construction of a bridge over the A428, intermodal transfer area, ancillary offices, car and HGV parking and associated landscape bund. I was the geotechnical lead responsible for the geotechnical design of key structures at the DIRFT II site including: 400m of new railway embankment supporting intermodal transfer slab, existing railway embankment widening to accommodate a second railway track along the existing track, railway overbridge crossing the A428 and approach embankment, warehouse structure housing high bay and low bay slabs.

In-Vessel-Composing facility, Over Hulton, Bolton, Greater Manchester Recycling and Waste PFI: Geotechnical Lead for the development of the In-Vessel-Composting (IVC) Plant, Bolton; the largest of its kind in Europe. Development of IVC plant on land formerly occupied by Exide Batteries. Lead geotechnical design engineer delivering various design packages including: earthworks using lime stabilisation, grouting of shallow coal workings and innovative ground improvement using Controlled Modulus Columns (CMCs. Due to the mining legacy and ground problems of this particular site, we carried out a mining risk assessment and geotechnical interpretation that identified potential risks associated with collapse settlement and differential settlement due to the presence of shallow coal workings and shallow soft cohesive glacial soils respectively. In order to overcome these geotechnical constraints, I developed a series of innovative, cost-effective geotechnical designs, including a ground improvement technique that involved the use of 'Controlled Modulus Columns' rather than a piled solution. This technique involved the use of a specially designed auger which is screwed through the soft compressible soils and into a stronger underlying formation; in this case, a stiff glacial clay. When the auger was extracted a column of improved soil is developed by pressure grouting, at less than 5bar, to improve the surrounding soils. The result is a composite ground improvement solution offering enhanced stiffness characteristics, allowing the CMCs and the surrounding soil to share the imposed loadings of the building. After installation, the CMCs were covered by a specially designed load transfer platform, between 0.4 and 0.8m thick, to efficiently transfer load from the structure to the CMC/soil matrix. As well as being cost-effective, this approach halved the anticipated seven-week construction programme. The project was a finalist and received a highly commended 'innovation' project ward in the 2013 Ground Engineering Awards.

Chemical Manufacturer, Former Waste Tip, West Yorkshire
Geo-Environmental lead for the remediation and reclamation of a waste tip containing asbestos and other hazardous waste. The site was located on a steep and unstable embankment between a river and canal. Services included historical review of operations, comprehensive sampling and chemical testing programme, and liaison with local regulatory officials who viewed the site as a Statutory Nuisance. Subsequent work included completion of human health risk assessment and design of remedial works. Work involved supervision of site restoration works including the off-site removal of tipped material and subsequent earthworks for the re-instatement of the embankment to a stable slope.

Ferrybridge Multi-fuel Power Station Client; Sisk
Geotechnical Lead for the ground investigation, site characterisation/ground modelling studies, geotechnical interpretations and detailed engineering design of the new Multi-fuel Power Station at Ferrybridge, West Yorkshire. The ground investigations included geophysical investigations for the determination of parameters for dynamic analysis of the Turbine Hall. He was responsible for compiling the Ground Investigation Report and Geotechnical Design Report for the new power station.

Berkley, Hinkley Point A and Chapelcross MILWEP Project
Geotechnical lead and technical review for new containment buildings at three Nuclear sites (Berkley, Hinkley Point A and Chapelcross). Deliverable included: Desk study, Gap analysis reporting, Ground investigation procurement and piled and raft foundation designs.

Drigg Low Level Waste Repository, Tranche 1 Project – Preliminary & Detailed Design Packages 1 to 8
Technical Lead and peer review of the preliminary and detailed geotechnical design packages in Tranche 1. Specific detailed design input for the 2km cut-off wall and main system design of the final cap to be placed over newly constructed vaults. Stability analysis of secant piled wall located between Trench 3 and Vault 8.

Reclamation of Former Industrial/Engineering Site, Chesterfield
Project Director for the Phase I and II Contaminated land investigation and remediation of a former engineering works for new commercial and retail development in Chesterfield. Services included the remediation of the site and the design and supervision of earthworks for the creation of containment cells, landscape bunds, capping of slopes for recreation/park land.

Bradford Energy from Waste PFI
Geotechnical and Geo-environmental lead for the development of a new EfW plant at Bolling Back Lane, Bradford. Geotechnical desk study and Phase I Contaminated Land Assessment. Services included the design and specification of ground investigations, mining risk assessment' assessment for re-use of piles assessment, detailed foundation design, asbestos in the ground investigation, shallow mine workings treatment design, mine shaft capping design. Part of the works involved the investigation of former gas works infrastructure, provision of a remediation statement, design of ground gas protection works and development of remediation strategy.

Energy from Waste CHP Plant, Runcorn, INEOS Chlor Vinyls
Geotechnical and geo-environmental lead for the development of a new Energy from Waste plant at Runcorn, Merseyside. Review and planning of ground investigation. Detailed geotechnical design of foundations for process plant, including tanks, filters, bunkers and heavily loaded bases. Earthworks specification and Materials Management Plan

Wirral Waters – West Float, Peel Holdings
Geotechnical lead for the detailed foundation and earthworks design of a former dock area at Birkenhead. Area comprises variable made ground and infilled former dock structures. The remediation strategy was designed to remediate contaminants within the made ground and to provide a development platform through ground improvement suitable for a new International Trade Centre. Detailed ground improvement and foundation design of new International Trade Centre.

Rossfield Park, Ellesmere Port, Residential Development, Peel Investments North: Geotechnical Lead and Client's Agent for the review of previous GI reports covering a proposed housing development on Plots 1 and 2. Review of proposed remediation strategy, foundation design of houses and Earthworks strategy for the development. Providing comments to the developer and subcontractors on behalf of Peel. Inspection of site preparation and enabling works, remediation and earthworks carried out by Encia. Inspection and review of remediation validation reports for hydrocarbon hot-spot removal from residential plots. Review of detailed pile foundation design by housing developer Countryside Properties.

Worsley New Hall Project, Worsley, Greater Manchester, Peel Developments Northern: Geotechnical and Geo-environmental Lead for the development of an 18-hole golf course, club house, hotel, access road from A572 Leigh Road, bridge over the Bidgewater Canal. Deliverables included: Phase 1 Geotechnical and Geo-environmental Desk Study, Mining Risk Assessment Report, Ground Investigation Management and Supervision, Ground Investigation Report, Hotel Ground Investigation and Ground Investigation Report, Earthworks Strategy Report, Access Road Ground Investigation and Ground Investigation Report (including access bridge over the Bridgewater Canal).

Sheerness Port Windfarm, Peel Energy: Geotechnical Lead for the development of a new windfarm along the Lappel Bank, Port of Sheerness. Peel Energy proposed to develop four wind turbines and Generator Building together with associated infrastructure on a strip of land currently used to store cars and vacant areas along the Lappel Bank. Geotechnical deliverables included: Geotechnical and Geo-environmental Desk Study including UXO Risk Assessment, Planning, management and supervision of Ground Investigation, Review of GI factual Report, Ground Investigation Report, Preliminary Turbine Foundation Report (Piled Foundations), Piling Environmental Risk Assessment, Outline Specification for Turbines, Generator Building and Access Road for Planning.

Media City, Plot E2, Salford Quays, Manchester, Peel Media Developments: Geotechnical Lead for the development of an 11-story building, other mixed-use development, offices, hotel and media hub. Geotechnical deliverables: Geotechnical and Geo-environmental Desk Study, Ground Investigation Scope.

Manchester Town Hall Library Extension
Geotechnical lead responsible for the management of the following deliverables, provision of desk study, procurement and management of a ground investigation within the basement of Manchester Town Hall. Completion of geotechnical interpretation and detailed design of foundations for new library extension. Special design for well capping. Inspection and verification of foundations.

Menwith Hill US Base, Harrogate
Geotechnical lead for the management of the ground investigations and foundation designs for various new structures on the Menwith Hill US Base near Harrogate.

Catterick Garrison, North Yorkshire
Geotechnical lead for various MOD building development projects at Catterick Garrison. Services included the completion of desk studies, design and management of ground investigations, detailed foundation design including strip, pads, rafts, vibro-replacement columns, piled structures, design of eccentrically loaded pad foundations detailed earthworks design and specifications for development platforms.

Advanced Manufacturing Park, Yorkshire Forward
Geotechnical lead for the investigation and geotechnical design of a number of structures (AMRC, AMP Technology Centre) located on the manufacturing technology park, Waverley, Sheffield Parkway. Services included: completion of ground investigations to determine ground conditions within former infilled open-cast workings, including compaction of fills, creep and inundation settlement. Design of long-term monitoring of settlement, groundwater, monitoring, ground gas monitoring. Detailed foundation design of piled foundations for the new advance manufacturing park including Rolls Royce.

Sherwood Park Development, Annesley, Mansfield
Project manager for the detailed earthworks design for Sherwood Business Park. Large-scale cut and fill earthworks, detailed earthworks design and specifications for development platforms for new industrial and commercial development. Supervision of earthworks and checking earthworks validation testing and reporting.

St Andrews Quay Development, Hull
Project Manager for the stabilisation works of the existing quay with anchors, removal of dock sediment and treatment prior to disposal.

Next Retail Designer Outlet, York
Project Manager for the geotechnical and geo-environmental deliverables for the Next Retail Designer Outlet in York. Demolition of former hospital sites. Remediation of contamination and asbestos contaminated soils. Detailed earthworks design, Earthworks specification, supervision of earthworks, detailed foundation design of designer outlet structure, design of access roads.

Trafford Park Rail Freight Terminal, Manchester
Geotechnical Project Manager for the design of earthworks package and pavement design of for new rail freight terminal in Trafford Park. Remediation of contaminated land, detailed design of earthworks

for new container storage area together with access by heavy mobile cranes. Design of pavement for heavy mobile cranes.

Millennium Park, Macauley Lane Landfill, Grimsby
Project Manager for the Phase I desk study and Phase II investigations of Macauley Lane Landfill. Completion of ground gas risk assessment and development of landfill remediation strategy for the redevelopment of the site as Millennium Park. The strategy included detailed assessment of waste deposits and development of environmental bunds and clearance of shallow landfill to create areas for the construction of new development platforms.

Sheffield Airport Development, Tinsley Park
Reclamation of former opencast workings. Detailed earthworks for the design of new runway extension over former opencast workings. Design of foundations for airport terminal buildings.

Fields End Business Park, Barnsley
Project Manager for the design of a large cut/fill earthworks for new business park in Barnsley. Design of foundations of structures for specific plots.

National Grid Properties (Formerly SecondSite)
Project Director for Phase I and II investigations of various former gas work sites. Management of Phase 1 and II investigations, Tier 1-3 risk assessment reports, remediation options appraisal, remedial strategies, remediation contracts, validation reports. Sites included: Bury Gas Works, Bradford Valley Road, Bradford Gas Works, Bowling Back Lane, Bradford, Huddersfield Gas Works, Neepsend Gas Works, Sheffield, Woodal Spa Gas Works, Wombwell Gasworks, Barnsley, Weybourne Road Gas Holder Site, Sherringham, Newmarket Road Gas Works, Cambridge, Burberry Gas Works, Birmingham.

Remediation of former British Coal Portfolio Sites
Completion of Phase I desk studies, Phase II ground investigations, contaminated land risk assessment reports, remedial strategies, remediation, validation reports for various former colliery sites and coking plants in West and South Yorkshire. Project Manager for the stage 1 redevelopment and enabling works at Askern, Allerton Bywater, Grimethorpe, Brodsworth and Wath Manvers colliery sites.

Appraisal of Sustainability Report of the revised draft nuclear National Policy (DECC)
One of the main authors of the DECC Appraisal of Sustainability Report of the revised draft nuclear National Policy Statement: Main Report. Assessment of Sustainability for all UK nuclear sites. He was responsible for writing the chapters on Site Geology, Geomorphology, Geotechnical Engineering and Hydrogeology. The AoS report provided an appraisal of the potential impacts of developing new nuclear power stations at each individual site.

Drax Power Station - Barlow Ash Mound
Project Manager responsible for the investigations and controlled waters risk assessment of the long-term leaching behaviour of PFA within the Barlow Ash Mound, Drax Power Station, Selby, UK.

National Power Environmental Framework
Framework Manager for the provision of Environmental Audits, Phase I Desk Studies and Phase II investigations of various National Power Coal Fired Power Station Sites.

Sheffield Development Corporation Site Investigation Framework; Remediation of Don Valley Industrial Sites, Sheffield
Project Manager responsible for the management of Phase I and II assessments and investigations, geotechnical interpretation, mining risk assessments, contaminated land risk assessments for numerous industrial sites in the Don Valley, Sheffield. Sites included Atlas Steelworks (North and South), Broughton Lane Sidings, Brightside Lane Steelworks, Abyssinia Steelworks, Hecla Steelworks, Newall Steelworks, Nunnery Sidings, Carbrook Triangle, Canal basin Redevelopment, Spear and Jackson works.

Landfill Engineering
Project Manager for Due diligence and environmental audits of landfill sites, environmental risk assessment, design of landfill lining, design of landfill capping, design of landfill drainage including SCADA drainage, design of gas flare stacks, design of gas and leachate barriers, landfill licence surrender for various operational landfill sites operated by WRG, Biffa, SITA and Yorewaste.

Former Tannery, West Yorkshire
Project Manager for the design of in situ groundwater treatment system following completion of a detailed sub-surface exploration and chemical testing programme at a former tannery and council depot. Design of an innovative on-site pump and treat system to remediate a confined aquifer containing elevated levels of hydrocarbon contaminants.

Redevelopment of Petrol Service Stations - BP, Shell, Total Fina
Project Management of consultancy frameworks for the Phase I and II assessment and investigations, contamination risk assessments and remediation of petrol service stations in northern England for BP, Shell, Total Fina. Also responsible for designing foundations for shop and canopy and backfilling of tank excavations.

Energy from Waste PFIs, Costain
Project Management of Phase I desk studies, Phase II investigations, contaminated land risk assessment, development constraints, remediation strategies and Materials Management Plans for new energy from waste facilities at various sites including Bradford, Leicester and Runcorn.

Former Dyeworks, Sheffield
Remediation and reclamation of former cleaners/dyeworks for old people's home development. Investigation of organic contamination in soils, developed estimates of volumes and clean-up criteria and supervised excavations and disposal of over 3,000 tonnes of contaminated soil to allow development to proceed.

Former Gasworks and Rail Maintenance Depot Sites, West Yorkshire
Performed a pre-transaction audit for a major UK Plc seeking to dispose of two depot sites which had formerly been used as gasworks facilities. Study included a comprehensive appraisal of

the potential for soil and groundwater contamination at the sites based on a review of former and existing land use in the immediate area, sub-surface exploration programme, detailed soil and groundwater contamination assessment and options appraisal of remedial measures.

Contaminant Containment Barriers
Detailed design and engineering specifications and construction of a range of contaminated groundwater cut-off barriers and ground gas barriers and venting trenches.

Trinity Shopping Development, Leeds
Project Manager for the Phase 1 and Phase II contaminated land investigations and assessment for a large Leeds city centre retail development. Services included mining risk assessment, hydrogeological assessment, geotechnical design of foundations, treatment of sewage contaminated groundwater and also grouting of former shallow mine workings.

Broad Street Redevelopment, Halifax
Project manager for the Phase I and II investigations of the proposed multi-cinema complex and retail development in the centre of Halifax. Human health and controlled waters risk assessment required prior to large-scale excavations for basement car parks. Programme of WAC testing to determine volumes of hazardous waste to be removed off-site. Detailed geotechnical design and earthworks design.

Bus Depots, West Yorkshire
Project Manager for the Phase 1 geo-environmental evaluation of two bus depot facilities to review site operations and to render an opinion as to whether present site activities or historical evidence indicated that hazardous material or oil was likely to be present in superficial deposits. Based on the findings of this study, various warranties were provided by the vendor to account for potential liabilities relating to potential contamination of the underlying aquifer.

Grand Arcade Shopping Centre, Wigan
Project Manager for the Geo-environmental investigation and contaminated land risk assessment of site proposed for 19-storey residential development and car parks in the centre of Wigan. Detailed quantitative risk assessment required in relation to risk to nearby controlled waters. Completion of mining risk assessment, mining investigations, mine workings remediation specification. Large grouting and mine capping programme of works completed. Detailed pile design for new 19-storey structure.

Wirral Waters, Birkenhead
Project manager of Phase I assessment, geotechnical desk study and Phase II ground investigation of residential tower blocks, and shopping centre on former dock areas and landfill site. Extensive groundwater and ground gas monitoring programme of former landfill site.

Port Derwent, Workington
Project Manager for the Phase I investigation and design of Phase II investigations for proposed yacht marina, commercial and residential development on former steel works site. Area extensively affected by steel and iron slag and colliery waste.

Windmill Shopping Centre, Widnes
Project Manager for the Phase 1 and Phase II ground investigation and controlled waters and human health risk assessment. Remedial strategy and remedial works validation for hotspot removal of PAH contamination and remediation of hydrocarbons within a former petrol service station. Detailed geotechnical design of foundations for new extension to the shopping centre. Detailed earthworks design for remediated areas prior to construction of new car parks.

Barons Quay Development, Northwich
Project Manager for Phase II ground investigations at Barons Quay in Northwich. Review and risk assessment relating to salt mine stabilisation works completed by others. Human health contaminated land risk assessment for new shopping centre development. Advised the Client not to proceed with the development as Top Bed salt had not been remediated. This led to legal dispute between English Partnerships, Vale Royal CC and the Developer (Wilson Bowden Developments).

US Airforce / Navy UK Bases
Project manager for the Phase 1 and Phase 2 investigations of hydrocarbon contamination. Remediation options appraisals and remediation strategies. Remediation and clean-up of oil fuel spills/leaking fuel tanks. Design of subsequent earthworks specification for redevelopment of remediated site areas.

Macclesfield Shopping Centre Development
Project manager for the Phase II ground investigation for the contaminated land assessment and geotechnical engineering design of a new shopping centre development.

Derby Road, Chesterfield
Project Manager for the contaminated land remediation for new commercial and retail development in south east Chesterfield. Remediation involved detailed earthworks design including design of stable embankments, development platforms, extensive capping works, parkland landscaping and attenuation ponds.

Agricultural College, Scotland
Project manager for the Phase I desk study of a large site near Ayr for mixed commercial and residential development. Site of former landfill and colliery site investigated as part of the contaminated land assessment. Phase II mining investigation, investigation of quarry infill, detailed design of earthworks for new development.

PFI Building Schools for the Future, Bradford, Leeds and Teesside
Project Manager responsible for the review of contaminated land reports completed by others for numerous school sites; developing remedial strategies and completing new earthworks and geotechnical design required for Planning approval by large UK Tier 1 Contractor.

Stanley Green Industrial Estate, Manchester
Project Manager for the Due Diligence report required for the sale of industrial estate comprising various types of industries.

West Yorkshire Playhouse, Leeds
Project Manager for the remediation of contaminated land, validation reporting and geotechnical design of extension works.

Services included the removal of PAH contamination from shallow soils and replacement with clean inert structural fill prior to extension works and landscaping works at Leeds Playhouse. Mining risk assessment, detailed design of piled foundations.

Housing Development on Former Brickworks, Buckley
Project Manager for the assessment of development constraints for major housing development on former brickworks and quarry site. Responsible for providing the development brief, Phase I and II investigations and remediation strategy. Scheme involved extensive quarry restoration works, earthworks for development platforms, landscaping works and provision of pond network for Great Crested newts.

Millennium Community Village, Milton Keynes
Project manager for the Phase I study and provision of a Development Brief for the development of the Millennium Community Village, Milton Keynes. The project deliverables also included a phase II investigation, ground gas risk assessment, detailed earthworks design, ground gas cut-off.

University of York – New University Campus
Project manager for the Phase 1 investigation and design of Phase II investigations of proposed new University Campus at Fulford, York. Investigation and assessment of groundwater quality and potential leaching of contaminants into an ornamental lake feature from existing landfill. Earthworks design of new car parks.

Garnetts Wharf Housing Development, Otley
Project Director and geotechnical and environmental lead for Phase I and Phase II investigations and assessment of former paper mill and associated landfill sites for the proposed housing development. Preparation of constraints plan and preliminary remedial strategy for remediation and proposed earthworks scheme for site development.

Bold Power Station Reclamation and Redevelopment, St Helens
Project Manager and geotechnical and geo-environmental lead for the demolition, site investigation, remediation and enabling works for the redevelopment of the former Bold Power Station site. Remediation of pfa storage mounds, demolition of structures, demolition waste recycling and reuse and asbestos remediation. Detailed earthworks design and supervision of the construction of new development platforms for housing and commercial development.