ALIGN Working on behalf of HS2

Colne Valley Viaduct And Incidental Earthworks & Fencing

Colne Valley Viaduct Schedule 17: Design and Access Statement

Align JV Consent Ref: ALJ-TP-083

Document no: 1MC05-ALJ-TP-REP-CS01_CL01-000005

Revision	Author	Reviewed by	Approved by	Date approved	Reason for revision
C01	John Woodhouse / Chris Patience	Andy Heap	Jon Neale	10-August-2019	Initial Issue
C02	John Woodhouse / Chris Patience	Andy Heap	Jon Neale	20-September-2019	Initial Issue

Security classification: OFFICIAL

Handling Instructions: None

Code 1 – Accepted

Colne Valley Viaduct
Design & Access Statement

Code 1 - Accepted

HS2

HS2 Ltd 1MC05-ALJ-TP-REP-CS01_CL01-000005 September 2019

Title: Colne Valley Viaduct And Incidental Earthworks & Fencing Colne Valley Viaduct Schedule 17: Design and Access Statement
Document Number: 1MC05-ALJ-TP-REP-CS01_CL01-000005
Revision: C02

Code 1 – Accepted

Contents

Code 1 – Accepted

Code 1 – Accepted

1.0 Introduction

This section summarises the purpose and scope of the project and this Design and Access Statement, together with Schedule 17 requirements.

Code 1 – Accepted

Executive Summary

1.1

1.1.1 Purpose

This Design and Access Statement has been prepared to support the submission of Schedule 17 requests for approval of plans and specifications of the Colne Valley Viaduct (CVV), its approach embankments, and associated floodplain compensation areas, to the London Borough of Hillingdon and South Bucks District Council.

The CVV is one of the most significant structures along the line of the route of High Speed Two (HS2) Phase One. This Design and Access Statement explains the context of the Colne Valley and justifies the rationale for the design of the scheme, it supports the Written Statement and provides key visualisations of the viaduct and its embankments.

This Design and Access Statement expands upon the design decisions made, the key opportunities and constraints affecting design and the contextual elements within the Colne Valley that the design has responded to.

1.1.2 Team

ALIGN JV are working on behalf of HS2 Ltd to design and construct the CVV. They are a consortium of three companies which comprise:

- Bouygues Travaux Publics
- Sir Robert McAlpine
- VolkerFitzpatrick

Their combined experience, both in the UK and worldwide, in delivering high-profile infrastructure projects safely, on time and on budget, has established their reputation. Therefore, their alliance was formed to deliver the CVV to the highest standards of excellence.

1.1.3 Document structure

This report has been subdivided into the following sections:

- **Context:** An appraisal of the physical, environmental, recreational, social and cultural features of the local context.
- **Brief:** Summary of briefing material, from HS2 design requirements and guidelines, hybrid Bill requirements, technical requirements and stakeholder aspirations.
- **Design vision:** Encapsulates the overall design vision through a series of key design objectives and visualisations.
- **Viaduct design:** Summary and justification of the viaduct design proposals relating to the overall design strategies, deck cross section, pier design, abutments, approach embankments, noise barriers and materiality.
- **Landscape design:** A summary of the indicative landscape design proposals with reference to the overarching landscape vision and design considerations, covering habitat creation and management, access and recreation, water management, and the visitor experience.
- **Sustainability:** Summary of how environmental, social and economic considerations have influenced the design proposals.
- **Construction and operational access:** Documenting the external access requirements during both the construction and operation of the viaduct.
- **Engagement:** Summary of the various methods and results of engagement with local authorities, stakeholders, the local community and the HS2 Independent Design Panel undertaken to date.
- **Summary:** Summary of the CVV and landscape design proposals alongside the feedback from the HS2 Independent Design Panel.

Code 1 – Accepted

HS2 Project

1.2

1.2.1 Project overview

HS2 is a new high speed railway network that will connect major cities in Britain. It will bring significant benefits for inter-urban rail travellers through increased capacity and improved connectivity between London, the Midlands and the North. It will release capacity on the existing rail network and so provide opportunities to improve existing commuter, regional passenger and freight services, particularly on the West Coast Main Line (WCML).

1.2.2 Phase One

Phase One of HS2 will provide a dedicated high speed rail service between London, Birmingham and the West Midlands. Phase Two of HS2 will extend the railway to the north-west and north-east: to Manchester with connections to the WCML at Crewe and Golborne; and to Leeds with a connection to the East Coast Main Line approaching York.

1.2.3 Central Section C1

Central Section C1 comprises 22km of the high-speed rail line, running between the Colne Valley and the Chilterns. It includes the 3.4km long Colne Valley Viaduct and its approach embankments, the Chiltern twin-tunnels and five vent shafts and headhouses.

Key

- Proposed HS2 route
- Phase One Central Section C1
- Colne Valley Viaduct and its approach embankments
- Chilterns Area of Outstanding Natural Beauty
- Colne Valley Regional Park
- Proposed HS2 stations

N

Fig.1.1_ Aerial map - Central Section C1

Code Accepted

HS2 Project

1.2.4 Colne Valley Viaduct Location

The Colne Valley Viaduct will run through the Colne Valley Regional Park and is located in both South Bucks District and the London Borough of Hillingdon. Three Rivers District Council is located to the north of the viaduct. The Schedule 17 application boundary defines the consentable area for the Colne Valley Viaduct, its approach embankments, flood plain storage, and ecological scrapes and ponds. Please refer to Section 2 of this report for further information relating to the existing context of the Colne Valley.

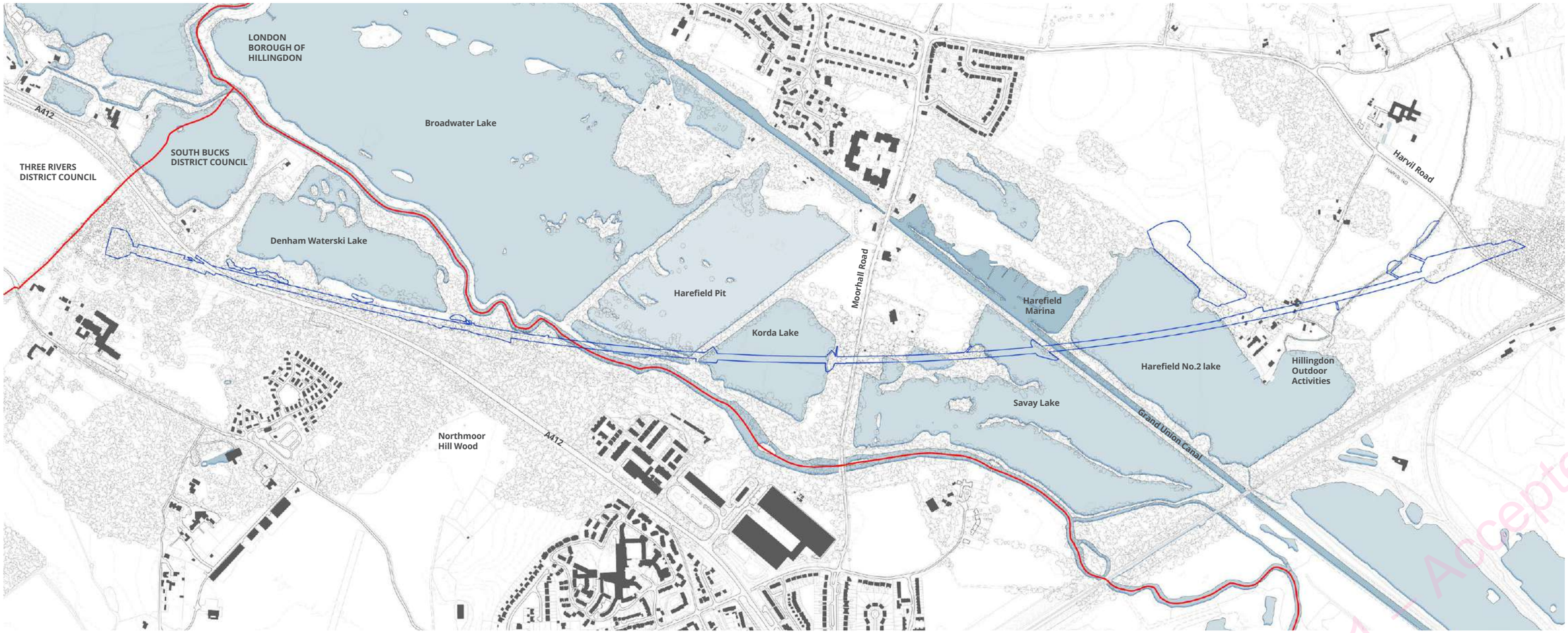


Fig.1.2_ Existing site plan - Schedule 17 application and local authority boundaries

Code 1 - Accepted

1.2

1.2.5 Colne Valley Viaduct

The Colne Valley Viaduct (CVV) is a significant feature within the new high-speed rail line. ALIGN JV's approach has been to create a viaduct of exceptional quality, with a distinctive and readily recognisable design, which responds positively to its sensitive landscape setting.

The design is informed by a thorough understanding of the landscape and environmental context, as well as onerous technical criteria. The design proposals have also been developed alongside the key HS2 Design Principles of:

- Contextual approach
- Structural honesty
- Functionality, maintainability and flexibility
- Safety and security
- Value for money
- Buildability
- Sustainability

In developing our proposals, the landscape design seeks to respond positively to the character of the Colne Valley which is highly valued by the local community. The design has followed the general approaches (as applicable) in the HS2 Landscape Design Vision which are to:

- Conserve
- Enhance
- Restore
- Transform

Extensive engagement with the Colne Valley Regional Park Panel and the HS2 Independent Design Panel has been a crucial part of the design process. As the design has developed, proposals were shared with local planning authorities, statutory consultees, environmental groups and local communities at public engagement events. Feedback from this engagement process has influenced and steered the design submitted as part of these Schedule 17 requests for approval.

Fig.1.3_ Visualisation (15 - Refer to Section 1.5.2 for viewpoint location) - View from the Old Orchard Pub

Fig.1.4_ Visualisation (14 - Refer to Section 1.5.2 for viewpoint location) - Extended spans over Harefield No.2 Lake

Code 1 — Accepted

HS2 Project

1.2.6 Project development

The Colne Valley Viaduct (CVV) was granted deemed planning permission upon Royal Assent of the High Speed Rail (London - West Midlands) Act 2017 (referred to in this report as the HS2 Act) in February 2017. An initial preliminary design for the CVV was prepared as part of the HS2 Act in order to define the location and alignment of the viaduct, together with broad design principles relating to the scale, massing and appearance.

Since that time, enabling works contractors and utility companies have been undertaking early works to prepare the line of the route for the main civil works required to construct the railway. Since the summer of 2017 Main Works Civil Contractors, including ALIGN JV, have developed the hybrid Bill design into a scheme design for Schedule 17 submission. The CVV has now reached a level of design maturity whereby approvals can be sought.

Schedule 17 requests for approval for the viaduct is being sought during the summer of 2019 and construction activity for it is expected to start in early 2020. Subject to obtaining Schedule 17 plans and specifications approval, preliminary construction of the viaduct will take approximately 3-4 years. Following construction, rail and systems installation will take place prior to testing, commissioning and ultimately, operation from 2026.

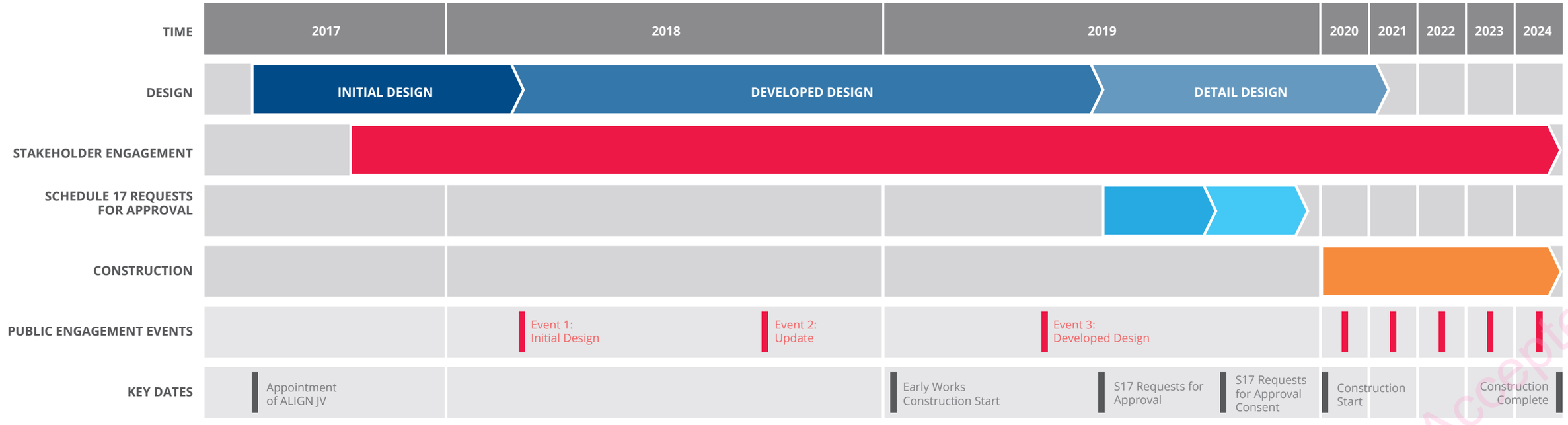


Fig.1.5_ Indicative project timeline - Colne Valley Viaduct

Code 1 – Accepted

Schedule 17

1.3

1.3.1 Overview

The key documents, including Planning Forum Notes, that are relevant to this Design and Access Statement and Schedule 17 requests for approval are:

- High Speed Rail (London-West Midlands) Environmental Minimum Requirements Annex 2: Planning Memorandum, HS2 Ltd
- High Speed Rail (London - West Midlands) Act 2017: Schedule 17 statutory guidance, Department for Transport
- HS2 Phase One Planning Forum Note 1: Content of Submissions and Standard Templates, HS2 Ltd
- HS2 Phase One Planning Forum Note 2: Drawings for Plans and Specifications Approvals, HS2 Ltd
- HS2 Phase One Planning Forum Note 3: Written Statements and Design and Access Statements, HS2 Ltd
- HS2 Phase One Planning Forum Note 10: Indicative Mitigation, HS2 Ltd
- Planning Forum Note 16 (PFN14): Operational Noise from the Railway & Altered Roads

1.3.2 Schedule 17 documentation

The Schedule 17 requests for approval of plans and specifications for the design and external appearance of the Colne Valley Viaduct (CVV), its approach embankments and other matters is supported by other documentation that sit alongside this Design and Access Statement, including:

- Written Statement (1MC05-ALJ-TP-REP-CS01_CL01-000006): This document sets out the rationale and detail of the complete Schedule 17 submission, including indicative landscaping proposals. The document cross refers to this Design and Access Statement in several places.
- Specifications Schedule (1MC05-ALJ-TP-SCH-CS01_CL01-000001): This document lists out the matters for approval contained within this Schedule 17 requests for approval.
- Indicative Mitigation Details (1MC05-ALJ-TP-REP-CS01_CL01-000007): This document is subject to other Schedule 17 approvals, athough the indicative mitigation does form part of the integrated design for the Colne Valley and viaduct as a whole. This document is a consultation on the proposed landscape mitigation and treatment. It also contains details on proposed watercourse realignments.
- Noise Modelling Report (1MC05-ALJ-TP-REP-CS01_CL01-000015): This report documents the indicative operational noise modelling that has been undertaken to inform the design.
- Drawings: A series of plans, elevations, sections and visualisations showing the proposed viaduct, indicative landscape proposals. floodplain storage areas, ecological ponds and scrapes, watercourse realignments, indicative tree loss and highway visibility splays.

Code 1 – Accepted

References

1.4

1.4.1 Document list

This Design and Access Statement should be read in conjunction with the documents listed opposite, submitted as part of this Schedule 17 requests for approval. These documents also form a part of the concurrent consultation on Indicative Mitigation Details, as set out in the document 1MC05-ALJ-TP-REP-CS01_CL01-000007.

For Approval

- 1MC05-ALJ-TP-SCH-CS01_CL01-000001 - Specifications Schedule
- 1MC05-ALJ-TP-DGA-CS01_CL01-100222 - Proposed Block Plan - Large Scale
- 1MC05-ALJ-TP-DGA-CS01_CL01-100223 - Proposed Block Plan Sheet 1 of 5
- 1MC05-ALJ-TP-DGA-CS01_CL01-100224 - Proposed Block Plan Sheet 2 of 5
- 1MC05-ALJ-TP-DGA-CS01_CL01-100225 - Proposed Block Plan Sheet 3 of 5
- 1MC05-ALJ-TP-DGA-CS01_CL01-100226 - Proposed Block Plan Sheet 4 of 5
- 1MC05-ALJ-TP-DGA-CS01_CL01-100227 - Proposed Block Plan Sheet 5 of 5
- 1MC05-ALJ-TP-DGA-CS01_CL01-100236 - General details - Typical Spans
- 1MC05-ALJ-TP-DGA-CS01_CL01-100237 - General Details - Extended Spans
- 1MC05-ALJ-TP-DGA-CS01_CL01-100239 - General Details - Fixed Buttress
- 1MC05-ALJ-TP-DGA-CS01_CL01-100238 - General Details - Expansion Portal
- 1MC05-ALJ-TP-DGA-CS01_CL01-100240 - General details - Noise Barriers
- 1MC05-ALJ-TP-DGA-CS01_CL01-100261 - General Details - North Abutment
- 1MC05-ALJ-TP-DGA-CS01_CL01-100262 - General Details - South Abutment
- 1MC05-ALJ-TP-DGA-CS01_CL01-100242 - Proposed Landscaping - Key Plan
- 1MC05-ALJ-TP-DGA-CS01_CL01-100243 - Proposed Landscaping Sheet 1 of 5
- 1MC05-ALJ-TP-DGA-CS01_CL01-100244 - Proposed Landscaping Sheet 2 of 5
- 1MC05-ALJ-TP-DGA-CS01_CL01-100245 - Proposed Landscaping Sheet 3 of 5
- 1MC05-ALJ-TP-DGA-CS01_CL01-100246 - Proposed Landscaping Sheet 4 of 5
- 1MC05-ALJ-TP-DGA-CS01_CL01-100247 - Proposed Landscaping Sheet 5 of 5
- 1MC05-ALJ-TP-DGA-CS01_CL01-100327 - River Colne Floodplain Storage - Proposed Sections
- 1MC05-ALJ-TP-DGN-CS01_CL01-100361 - Newyears Green Bourne Floodplain Storage - Proposed Sections
- 1MC05-ALJ-TP-DGA-CS01_CL01-100333 - Proposed drainage Typical Sections

For Information

- 1MC05-ALJ-TP-REP-CS01_CL01-000005 - Design and Access Statement
- 1MC05-ALJ-TP-REP-CS01_CL01-000006 - Written Statement
- 1MC05-ALJ-TP-REP-CS01_CL01-000007 - Indicative Mitigation Details
- 1MC05-ALJ-EV-REP-CS01_CL01-000015 - Noise Modelling Report
- 1MC05-ALJ-SE-REP-CS01_CL01-000001 - Engagement Report
- 1MC05-ALJ-TP-DGA-CS01_CL01-100215 - Location Plan
- 1MC05-ALJ-TP-DGA-CS01_CL01-100216 - Existing GA - Key Plan
- 1MC05-ALJ-TP-DGA-CS01_CL01-100217 - Existing GA - Sheet 1 of 5
- 1MC05-ALJ-TP-DGA-CS01_CL01-100218 - Existing GA - Sheet 2 of 5
- 1MC05-ALJ-TP-DGA-CS01_CL01-100219 - Existing GA - Sheet 3 of 5
- 1MC05-ALJ-TP-DGA-CS01_CL01-100220 - Existing GA - Sheet 4 of 5
- 1MC05-ALJ-TP-DGA-CS01_CL01-100221 - Existing GA - Sheet 5 of 5
- 1MC05-ALJ-TP-DGA-CS01_CL01-100328 - Watercourse Realignments - General Location Plan
- 1MC05-ALJ-TP-DGA-CS01_CL01-100329 - River Colne Realignment - Proposed Layout
- 1MC05-ALJ-TP-DGA-CS01_CL01-100330 - River Colne Realignment - Proposed Sections
- 1MC05-ALJ-TP-DGA-CS01_CL01-100331 - Newyears Green Bourne Realignment - Proposed Layout
- 1MC05-ALJ-TP-DGA-CS01_CL01-100332 - Newyears Green Bourne Realignment - Proposed Sections
- 1MC05-ALJ-GI-MAP-CS01_CL01-000006 - Indicative Tree Loss Maps (Pages 1-6)
- 1MC05-ALJ-TP-DGA-CS01_CL01-100335 - Visibility Splays Layout - Sheet 1
- 1MC05-ALJ-TP-DGA-CS01_CL01-100336 - Visibility Splays Layout - Sheet 2
- 1MC05-ALJ-TP-DGA-CS01_CL01-100337 - Visibility Splays Layout - Sheet 3
- 1MC05-ALJ-TP-DGA-CS01_CL01-100338 - Visibility Splays and Vehicle Restraint Barrier Spec

Code 1 – Accepted

Illustrative Visualisations

1.5

1.5.1 Overview

Within this Design and Access Statement, a selection of computer generated visualisations of the Colne Valley Viaduct (CVV) have been included for illustrative purposes. Viewpoints have been selected to present key design features and the relationship of the CVV with important site locations within the Colne Valley. Photography and imagery depict a range of different seasons, weather conditions and times of day to ensure the CVV is presented as realistically as possible. The visuals are set in the year 2040, approximately 15 years after completion, to portray the viaduct within a relatively mature landscape setting.

1.5.2 Viewpoint schedule

The viewpoint locations, weather conditions, time of year and time of day are listed and numbered below:

1. North abutment looking north - Jul / 7am / Rain
2. A412 crossing looking south - Mar / 6pm / Clear sky
3. A412 looking north from layby - Nov / 10am / Sun
4. A412 looking north - Mar / 11am / Overcast
5. Denham Waterski Lake looking west - Nov / 12pm / Sun with clouds
6. New recreational routes alongside viaduct - Jul / 12pm / Clouds
7. River Colne Crossing looking north - Jun / 10am / Overcast
8. Korda Lake crossing looking north - Jan / 1pm / Sun with clouds
9. Moorhall Road looking north - Mar / 1pm / Overcast
10. Moorhall Road looking south - Nov / 12pm / Sun with clouds
11. Grand Union Canal crossing - Dec / 2pm / Sun with clouds
12. Harefield No. 2 Lake looking south - Dec / 3pm / Sun and clouds
13. South abutment looking south-east - Sep / 5pm / Sun
14. Harefield No. 2 Lake looking north - Nov / 2pm / Sun
15. Old Orchard Pub looking south-west - May / 12pm / Sun
16. View above rail level looking north-west - Sep / 11am / Sun

Fig.1.6_ Site plan - Viewpoint locations

Code 1 – Accepted

Acronyms

1.6

1.6.1 Acronyms

- CVV - Colne Valley Viaduct
- CVRP - Colne Valley Regional Park
- DAS - Design and Access Statement
- EA - Environment Agency
- EMR - Environmental Minimum Requirements
- ES - Environmental Statement
- HOAC - Hillingdon Outdoor Activities Centre
- HS2 - High Speed Two (the project)
- HS2 Ltd - High Speed Two Ltd (the nominated undertaker)
- HS2 IDP - HS2 Independent Design Panel
- LLAU - Limits of Land to be Acquired or Used
- LOD - Limits of Deviation
- LPA - Local Planning Authority
- MWCC - Main Works Civils Contract
- NYGB - Newyears Green Bourne
- OCS - Overhead Catenary system
- OHLE - Overhead Line Equipment
- SSSI - Site of Special Scientific Interest
- WFD - Water Framework Directives
- WCML - West Coast Main Line
- PRoW - Public Right of Way

Code 1 – Accepted

Blank Page

Code 1 – Accepted

Code 1 – Accepted

2.0 Context

An appraisal of the physical, environmental, recreational, social and cultural features of the Colne Valley.

Code 1 – Accepted

Planning Context

2.1

2.1.1 Local Authority boundaries

The extent of the Schedule 17 requests for approval incorporates the boundaries of two Local Authorities, London Borough of Hillingdon and South Bucks District Council. This Design and Access Statement supports both of these Schedule 17 requests for approval.

Extensive engagement has taken place both informally and formally with each of the planning authorities through pre-application meetings and conversations at other regular forums. Feedback received has helped to inform the final design of the proposed Colne Valley Viaduct and its indicative landscape scheme.

Key

- Proposed Viaduct
- Proposed railway alignment
- Local Authority boundary line
- London Borough of Hillingdon
- South Bucks District Council
- Three Rivers District Council

0 200 500 M

N

Fig.2.1_ Site Plan - Defined Local Authority boundaries

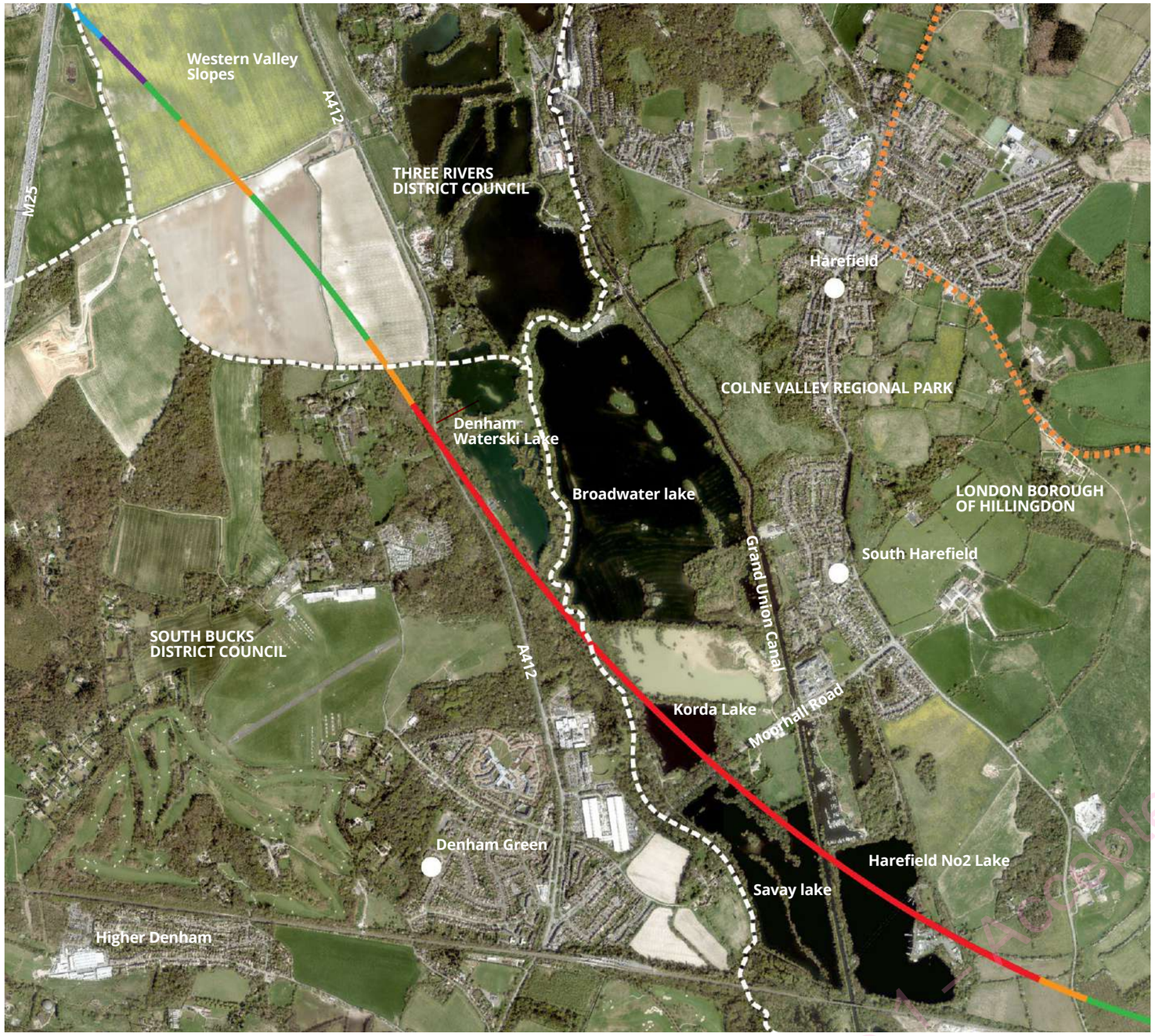
Code 1 Accepted

Regional Context

2.2

2.2.1 Location

The Colne Valley Viaduct will run through the Colne Valley Regional Park and is located in both South Bucks District and the London Borough of Hillingdon. It crosses the Valley to the north west of London, north of the M40 and south of South Harefield. The abutments are located at either end of the viaduct. To the north, the railway enters a tunnel within the Western Valley Slopes, located in Three Rivers District, prior to passing underneath the M25 and continuing through the Chilterns Area of Outstanding Natural Beauty. To the south, the railway enters the Copthall cutting and continues east, towards Ruislip before entering a tunnel and continuing underground in West London towards the new station at Old Oak Common.



Key

- Proposed viaduct
- Proposed embankment
- Proposed cutting
- Proposed tunnel portal
- Proposed tunnel
- Colne Valley Regional Park boundary line
- Local Authority boundary line

0 200 1000 M

N

Fig.2.2_ Aerial Photograph - Section C1 alignment in the Colne Valley

Code 1 - Accepted

Regional Context

2.2.2 Landscape context

The Colne Valley is attractive, highly valued by local communities and, although not designated in its own right for its landscape quality, has significant environmental sensitivities.

The area is defined by the River Colne that winds its way through a pronounced valley, marked by slopes that rise from the floodplain to an elevated plateau to the west and undulating farmland and the edge of London to the east.

The contrasting terrain gives rise to a landscape of varied character, from the contained, low lying lakes of the valley floor to large scale, open farmland of the dry valley slopes.

The proposed works subject to the Schedule 17 requests are within the Colne Valley Regional Park which sits between the suburban fringe of London and the Chilterns and is characterised by agricultural land and extensive lakes interspersed with urban development linked to commuter towns and villages. The urban areas include Ickenham, Denham, Denham Green, Harefield and South Harefield, West Hyde and Maple Cross. Chalfont St Peter lies to the west of the M25. As illustrated in the Landscape Character Area Plan opposite, the valley and its immediate hinterland can be broadly grouped into the following four character areas;

- Western Valley slopes
- The River Colne Valley
- Eastern Valley slopes
- Undulating farmland

These areas are substantially aligned with local level Landscape Character Assessments prepared by local planning authorities for areas within the Regional Park, and comprise;

- Colne Valley Floodplain
- Mid Colne Floodplain – Broadwater Lake to Shire Ditch
- South Harefield Undulating Farmland
- Newyears Green Undulating Farmland
- Maple Cross Slopes

2.2.3 Western Valley slopes

The Western Valley Slopes include several dry valleys that form a varied landscape of vast and rolling farmland dotted with mature and ancient woodland. This creates a landscape that combines openness and enclosure.

On the steeper valley slopes, winding lanes are a distinctive feature, in particular Tilehouse Lane; and several walking and cycling routes cross the area tracing along historic boundaries, such as Old Shire Lane.

2.2.4 River Colne Valley

The River Colne and its tributaries run from north to south through the valley. The wetland environment is accentuated by a number of former gravel pits that have been restored into a number of lakes, providing a wildlife and recreational resource.

A well-established network of public rights of way cross the area, including the Colne Valley Trail and Grand Union Canal Walk. The valley supports a mosaic of habitats of national and local significance; this includes the designated Mid Colne Valley Site of Special Scientific Interest (SSSI), Local and National Nature Reserves and Local Wildlife Sites.

Areas of dense woodland creates a strong sense of enclosure within certain areas of the landscape. However, there are long-distance views across the water features, from higher ground to the north, east and west, and long, but more narrow views along the Grand Union Canal, Moorhall Road and parts of the A412.

2.2.5 Eastern Valley slopes

To the east of the River Colne, the landscape is broadly defined by open valley slopes that transition to elevated, undulating farmland plateau further to the east.

The open valley slopes are characterised by the rolling terrain that rises up from the valley floor to the top of the valley sides, typically of grassland with a few small areas of woodland, some of which are designated areas for nature conservation. Settlement density is low, comprising scattered farmsteads and individual buildings, with the eastern edge of the slopes being contained by denser areas of settlement at the top of the valley sides, namely Harefield, South Harefield, Ickenham and Uxbridge.

A number of footpaths and long distance recreational routes cross the valley slopes, one of which passes through an area of open access land to the south of Mount Pleasant and another through Uxbridge Golf Course. Long views across the Colne Valley from higher slopes are available, particularly to the west of Harefield. Small streams traverse the valley slopes and the rolling landform allows for the collection of water in small depressions, in contrast to the drier areas of the western valley slopes, adding to the diversity of landscapes with the Park.

2.2.6 Undulating farmland

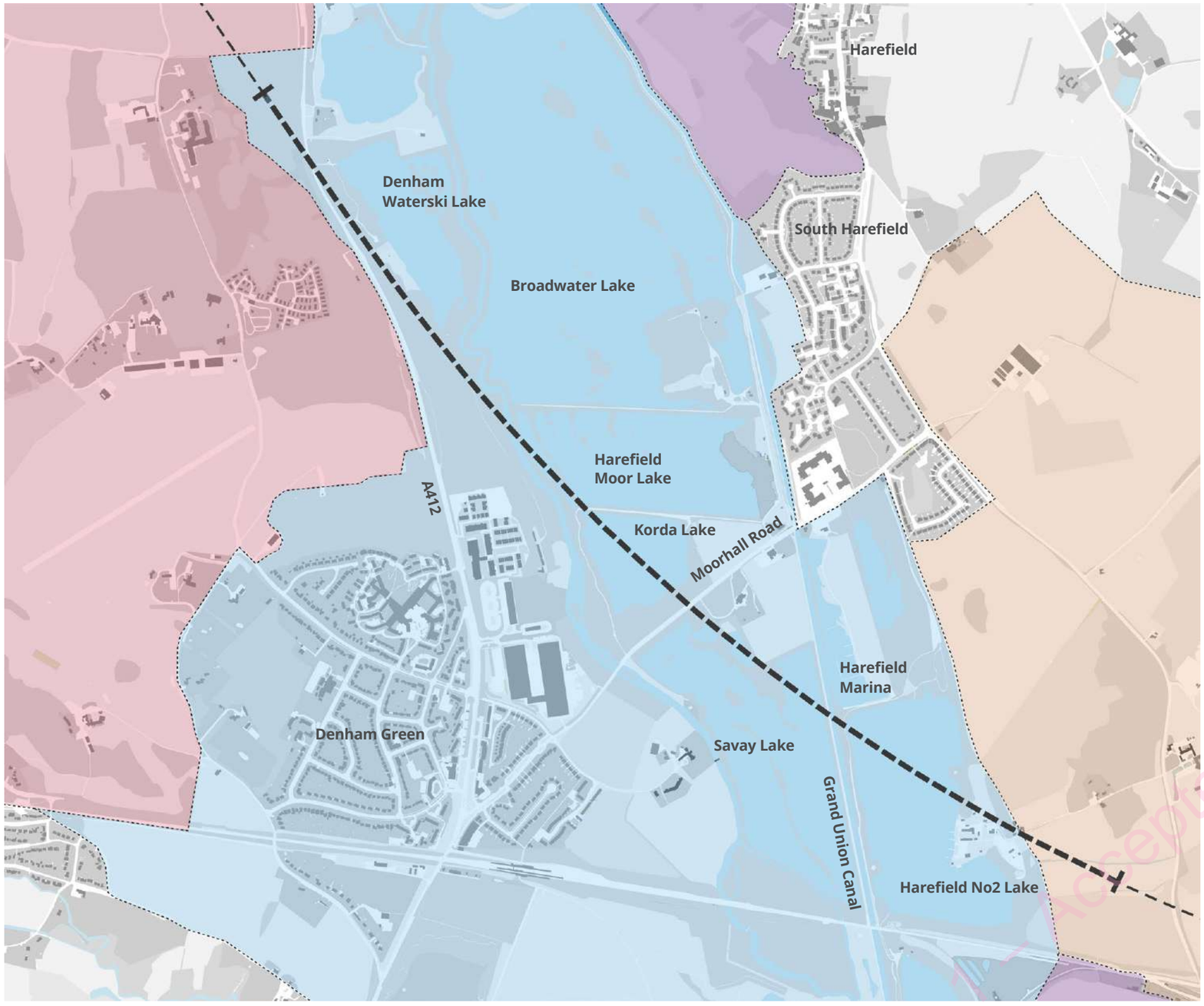
East of the Colne Valley, the area is characterised by elevated, gently undulating and in parts sloping farmland, where tree cover is sparse, bar occasional areas of woodland.

The character of the landscape contrasts with the steeper valley sides to the west and the wooded farmland to the north, which includes Bayhurst Wood that forms a backdrop to views across farmland and a point of reference.

Due to the busy roads, pylon lines and interspersed waste and recycling facilities, the landscape feels fragmented, contributing to an urban fringe

Code 1 – Accepted

2.2



Key

- Proposed viaduct
- Proposed railway alignment
- Western Valley slopes
- River Colne Valley
- Eastern Valley slopes
- Undulating farmland

0 200 500 M

N

Fig.2.3_ Site plan - Landscape character areas

Code 1 Accepted

Regional Context

2.2.7 Ecology

The Colne Valley contains a diversity of habitats and species. Historic mineral extraction has created a series of large lakes, several of which are crossed by the scheme. These lakes, as well as areas of wetland, wet woodland, and ancient woodland support nationally important populations of breeding birds and wintering waterfowl.

The Limits of Land to be Acquired or Used (LLAU) for the viaduct extends into the following designated sites:

- Mid Colne Valley Site of Special Scientific Interest (SSSI)
- Mid Colne Valley Site of Metropolitan Importance (SMI) (within and extending beyond Mid Colne Valley SSSI)
- Tilehouse Gravel Pits Biological Notification Site (BNS) (within Mid Colne Valley SSSI)

These designations have played a key consideration in the overall approach to the proposed landscaping presented in later chapters, and set out in the Further Mitigation Information (1MC05-ALJ-TP-REP-CS01_CL02-000007).

2.2.8 Geology

The underlying geology is varied. On the western valley side is Upper Cretaceous chalk around Maple Cross, reaching as far south as Denham, reflecting the rolling hills of the nearby Chilterns. Further south, the underlying geology comprises clay, silt and sand of the London Clay and Lambeth Group, surrounding the chalk ridges and extending to the eastern valley side.

In much of the area, the underlying geology comprises sands and gravels from the alluvium along the River Colne. It is this composition that has primarily been sought after by the aggregates industry, lending the Colne Valley well to mineral extraction and subsequent restoration as a landscape of lakes. However, some areas of geology remain on the surface, in particular around Harefield and Maple Cross, further contributing to the diverse character of the Park's landscape.

2.2.9 Connectivity

There is a varied transport network and multiple pedestrian routes within the Colne Valley, including the following;

- The northern reaches of the Colne Valley are crossed by a number of major arterial transport routes, in particular the M25, the M40/A40 and the A412 (Denham Way/North Orbital Road); and the Chiltern Main Line
- Numerous local roads serve the Park, many of which follow historic routes through the valley including Moorhall Road, Coppermill Lane, and Dews Lane
- Denham Station on the Chiltern Main Line is centrally located within the Park
- The Grand Union Canal crosses the Valley north-south
- There are numerous long distance paths, circular walks and public rights of way within the Colne Valley, including the Colne Valley Trail and National Cycle Route No. 6

Code 1 – Accepted

2.2

Key

- Proposed viaduct
- Proposed railway alignment
- Building
- Grass
- Garden
- Woodland
- Ancient woodland
- Lake / canal / river
- Mineral processing
- Site of Special Scientific Interest
- Chilterns Main Line
- National railway station

0 200 500 M

N

Fig.2.4_ Site plan - Environmental and landscape context

Code Accepted

Regional Context

2.2.10 Landscape setting photography

A Fig.2.7_ Photograph - Western valley slopes

B Fig.2.8_ Photograph - View of western valley slopes from eastern valley slopes

Fig.2.5_ Key plan

F Fig.2.6_ Photograph - View from the eastern valley slopes

Code 1 – Accepted

2.2

C Fig.2.9_ Photograph - Western valley slopes

D Fig.2.10_ Photograph - Undulating farmland

E Fig.2.11_ Photograph - View of Broadwater Lake from western valley slopes

Code 1 – Accepted

Local Context

2.3.1 Colne Valley sub areas

This section of the report has been sub-divided into a series of sub-areas running north to south;

1 A412 corridor to River Colne

From the north abutment and approach embankments just to the west of the A412 North Orbital Road alongside Denham Waterski Lake and towards the River Colne.

2 River Colne to South East Korda Lake

From the River Colne through dense woodland, crossing Long Lake and towards the south eastern edge of Korda lake.

3 Moorhall Road Crossing

From the eastern edge of Korda Lake to the western edge of Savay Lake, including the crossing of Moorhall Road. An intersection of routes through the valley within existing dense tree cover and scrubland.

4 North West Savay Lake to North East Harefield No. 2 Lake

From the north western edge of Savay Lake to the eastern edge of Harefield No.2 Lake, including the Grand Union Canal Crossing. The sub area is typified by waterscape transitioning from recreational lakes to canal and the associated Harefield Marina.

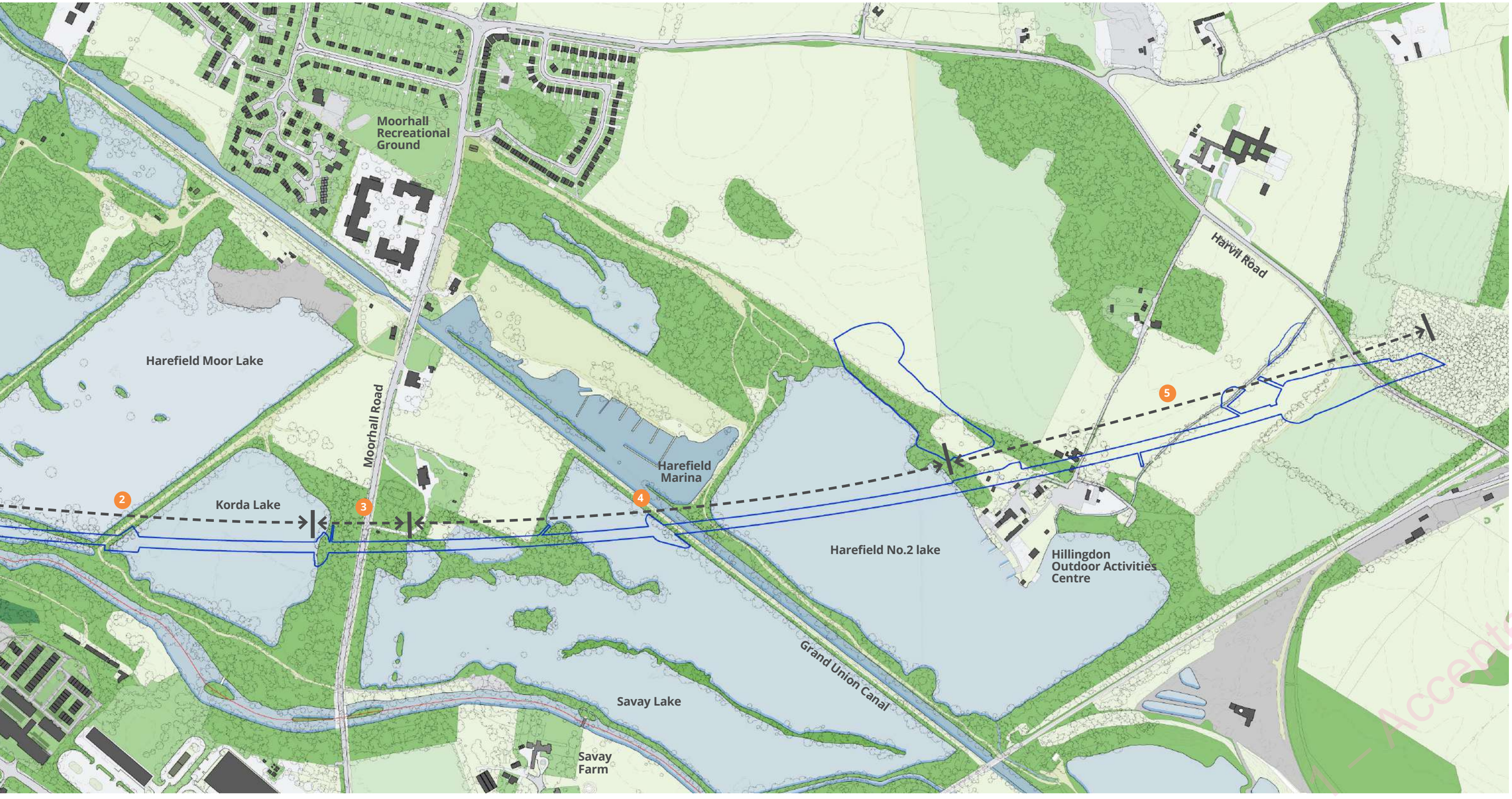
5 North East Harefield No.2 Lake to Harvil Road

From Harefield No.2 Lake, including the area of land currently occupied by Hillingdon Outdoor Activities Centre (HOAC) towards Harvil Road, the south abutment and approach embankments. The area is characterised by recreational lake frontage and undulating farmland to the south.

Fig.2.12_ Site plan - Colne Valley sub areas

Code 1 - Accepted

2.3



Code 1 — Accepted

Local Context

2.3.2 Sub-area 1

A Fig.2.13_ Photograph - A412 looking south (sub-area 1)

B Fig.2.14_ Photograph - A412 layby (sub-area 1)

C Fig.2.15_ Photograph - Denham Waterski Lake looking north (sub-area 1)

Fig.2.16_ Site plan - Sub-areas 1 and 2

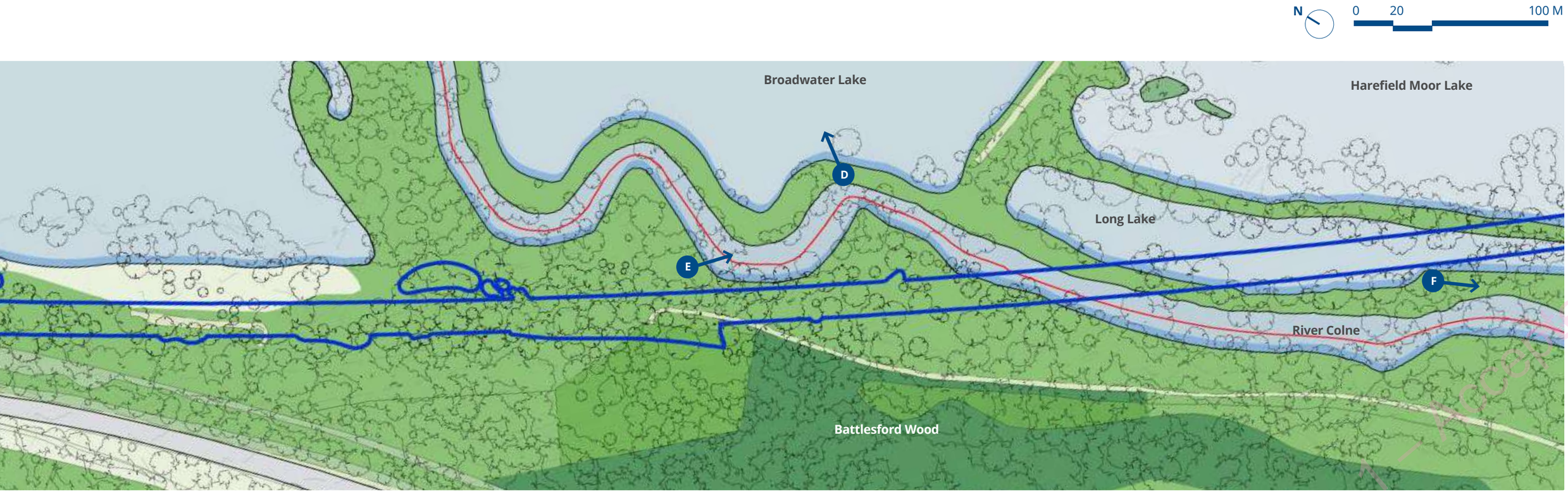
2.3

2.3.3 Sub-area 1 and 2

D Fig.2.17_ Photograph - Broadwater Lake looking north (sub-area 1)

E Fig.2.18_ Photograph - River Colne (sub-area 1)

F Fig.2.19_ Photograph - Recreational route along Long Lake (sub-area 2)



Code 1 – Accepted

Local Context

2.3.4 Sub-area 2 - 4

G Fig.2.20_ Photograph - South-east edge of Long Lake (sub-area 2)

H Fig.2.21_ Photograph - Korda Lake looking north-east (sub-area 2)

I Fig.2.22_ Photograph - Moorhall Road looking north-east (sub-area 3)

Fig.2.23_ Site plan - Sub-areas 3, 4 and 5

Code 1 - Accepted

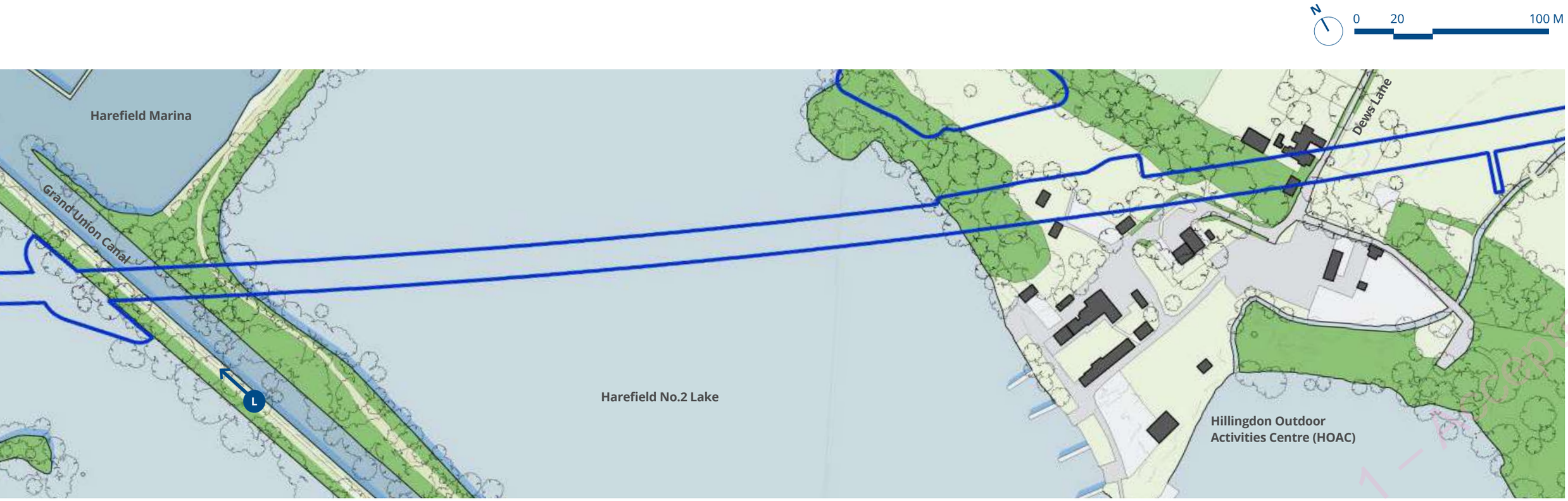
2.3

2.3.5 Sub-area 4-5

J Fig.2.24_ Photograph - Savay Lake from Grand Union Canal (sub-area 4)

K Fig.2.25_ Photograph - Grand Union Canal and Harefield Marina (sub-area 4)

L Fig.2.26_ Photograph - Grand Union Canal looking north (sub-area 4)



Code 1 – accepted

Local Context

2.3

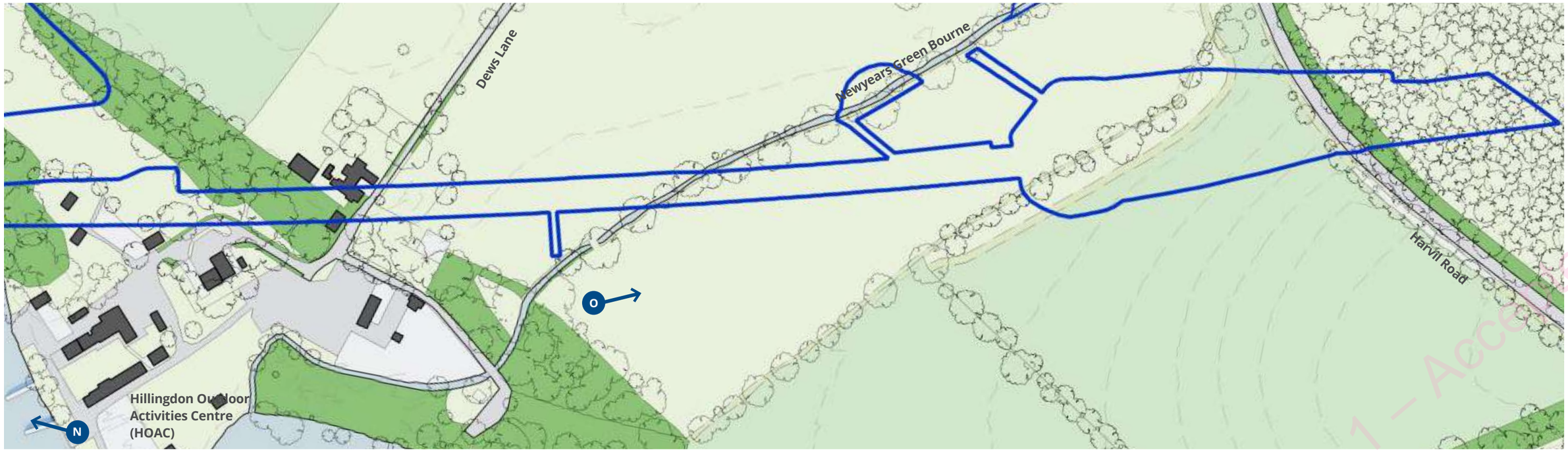
2.3.6 Sub-area 5

M Fig.2.27_ Photograph - Harefield No.2 Lake looking north (sub-area 5) (Not shown on key plan)

N Fig.2.28_ Photograph - View from HOAC (sub-area 5)

O Fig.2.29_ Photograph - Grassland south of HOAC (sub-area 5)

Fig.2.30_ Site plan - Sub-area 5



Code 1 – Accepted

Water Resources

2.4

2.4.1 Overview

The Colne Valley Viaduct needs to respond to the extensive and varied water environment that it crosses.

Large areas of the Colne Valley have been identified by the Environment Agency (EA) flood risk mapping as lying within Flood Zones 2 and 3 for either the River Colne or Newyears Green Bourne watercourses. Additionally, the viaduct crosses these watercourses. The design response must respect the watercourses, provide a railway that is resilient to flooding and not increase the risk of flooding to others.

The Environmental Statement identifies the following water resources and flood risk zones in the Colne Valley;

- Flood zones 2 and 3 and groundwater source protection zones 1 and 2
- Mid Colne Site of Special Scientific Interest (SSSI), Local Wildlife Sites, Broadwater Lake Nature Reserve, River Colne, Long Lake, Korda Lake, Savay Lake, the Grand Union Canal, Harefield No. 2 Lake and a Local Nature Reserve and ancient woodland to the north
- Three Water Framework Directives (WFD) water bodies (two surface water and one groundwater)

The water environment is also important for wildlife, with the Mid-Colne Valley SSSI and Local Wildlife designations reflecting the diverse wetland habitat and wildfowl species that are present within the valley, particularly on Broadwater Lake.

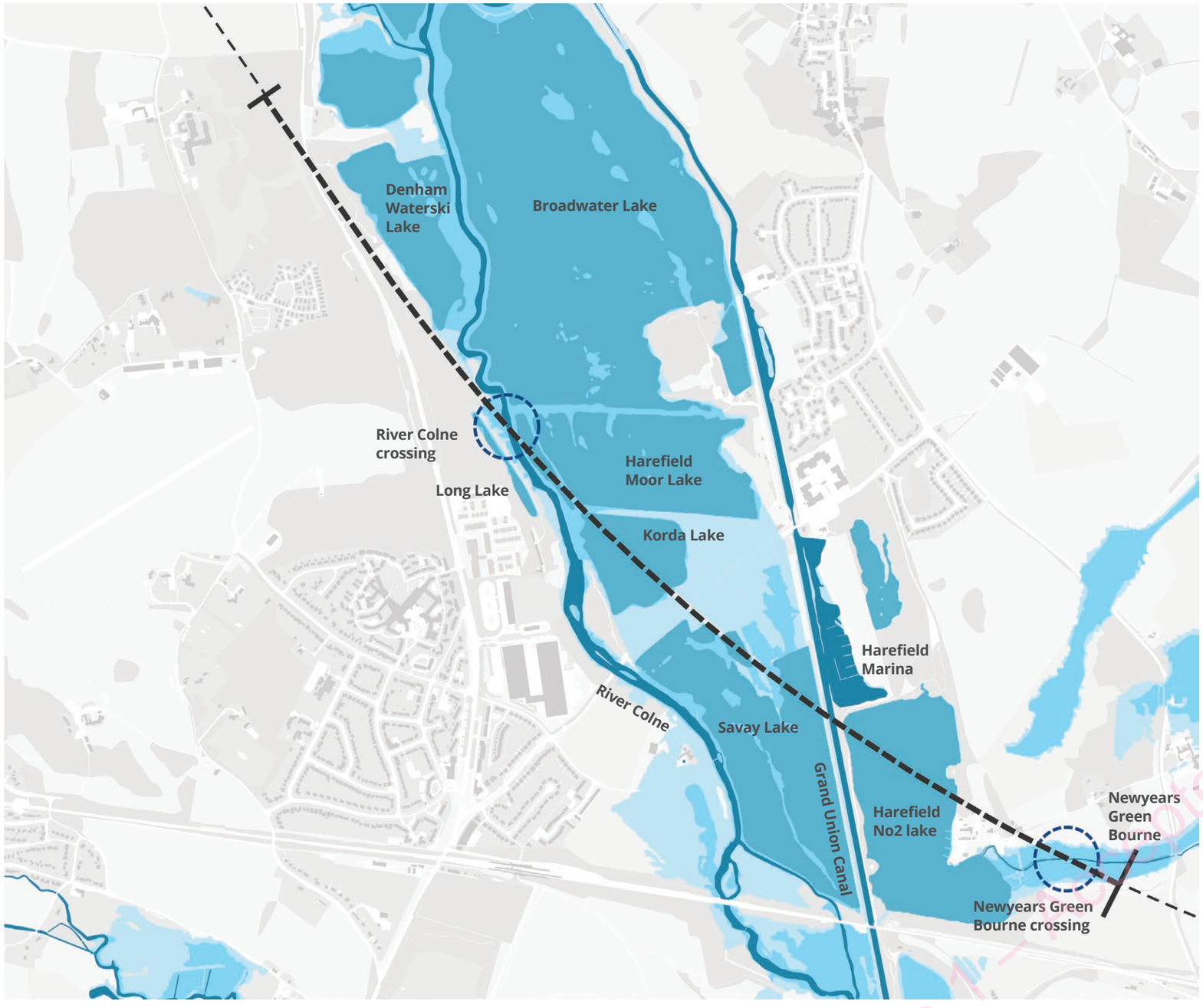


Fig.2.31_ Site plan - EA flood water levels

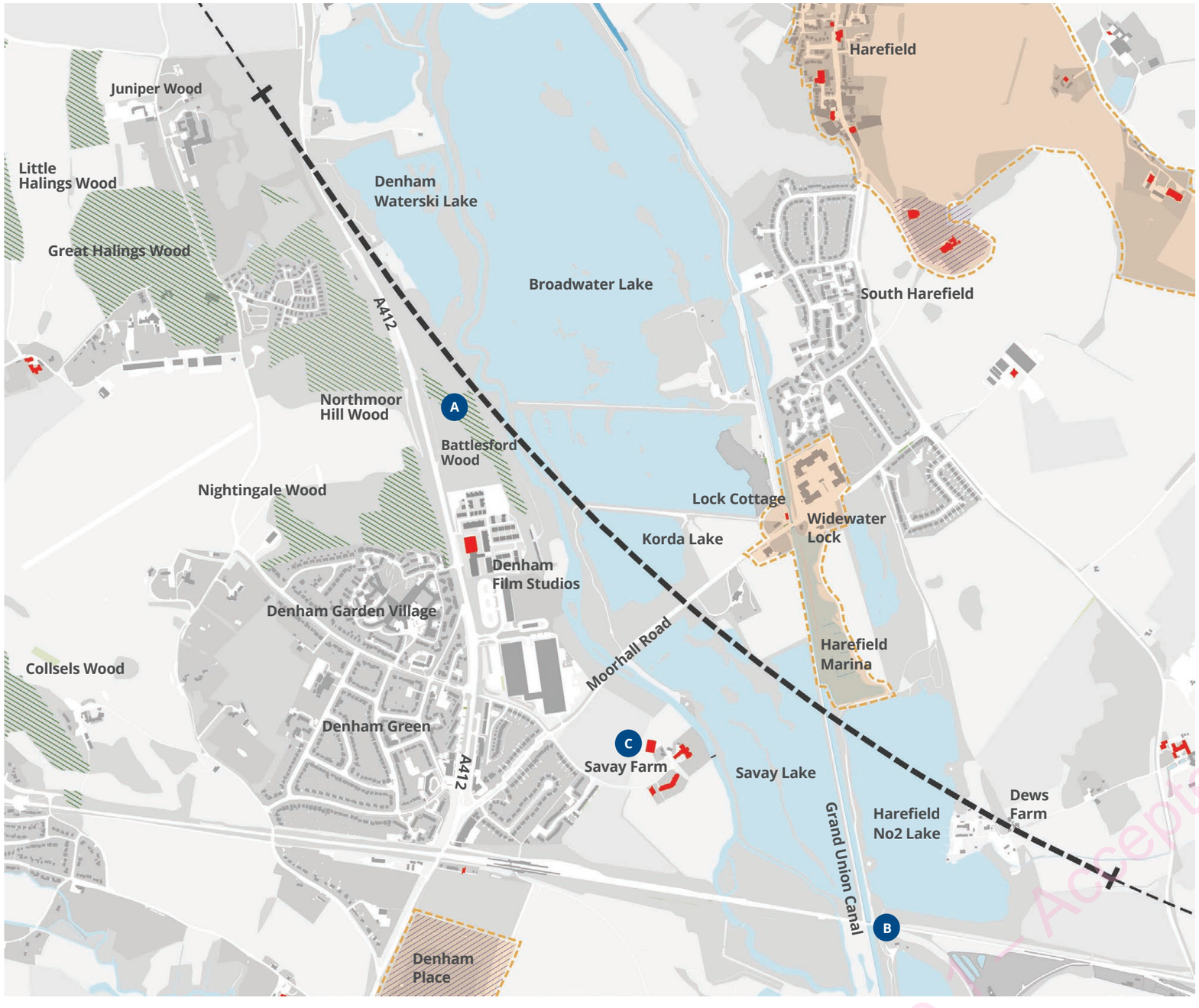
Code 1 – Submitted

Social and Cultural Context

2.5.1 Community

There are a number of built up areas and recreational facilities located within the Colne Valley, including:

- Several properties located in the vicinity of the viaduct at Tilehouse Lane, Wyatts Covert; Denham Grove (De Vere Hotel), Dew's Farm and Dew's Farm Cottages
- Denham Green and Denham Garden Village, located on the western side of the valley within South Bucks District
- Denham Waterski Club, located on the A412
- Hillingdon Outdoor Activities Centre, located on the eastern bank of Harefield No.2 Lake
- The Colne Valley Regional Park has a comprehensive pedestrian and cycle network that serves movement locally within the Park boundary and beyond
- South Harefield located on the eastern valley slopes
- Harefield Marina and business park located on Moorhall Road
- Savay Farm - Grade I, C14 building next to a Scheduled Monument



Key

- Proposed viaduct
- Proposed railway alignment
- Photograph location (see opposite page)
- Listed building or scheduled monument
- Conservation area
- Ancient woodland
- Registered park / garden

0 200 500 M

N

Fig.2.32_ Site Plan - Social and cultural context plan

Code 1 Accepted

2.5

2.5.2 Cultural heritage

There are several designated heritage assets located in the vicinity of the Colne Valley Viaduct including Grade I and II listed structures. Key heritage assets include a grade I listed building and scheduled monument at Savay Farm, with elements that date back to the late 14th century. Battlesford Wood is designated ancient woodland of high historic value, and there are several other areas of ancient woodland, registered parks and gardens and conservation areas that are part of the Colne Valley Regional Park. Local designated assets include:

Listed buildings (in proximity to the CVV:

- Savay Farm - Grade I, C14 building next to a Scheduled Monument thought to date from the Medieval Age.
- Denham Film Studios - Grade II, built in 1936 by Walter Gropius and Maxwell Fry.
- Widewater Lock Cottage - Grade II, built C18 by the Grand Junction Canal Company
- Highway farmhouse- Grade II, early C17 situated on Harvil Road

Locally listed buildings:

- Dews Farm

Conservation areas:

- Harefield
- Widewater Lock
- Denham

Nature reserves:

- Northmoor Hill Wood LNR
- Denham Quarry Park
- Broadwater Lake
- Bayhurst Wood

Ancient woodlands:

- Juniper Wood
- Little Halings Wood
- Great Halings Wood
- Northmoor Hill Wood
- Battlesford Wood
- Nightingale Wood
- Holly Hill Wood
- Newstead Wood
- Collsels Wood
- Bayhurst Wood

The site is partly located within the London Borough of Hillingdon designated Colne Valley Archaeological Priority Zone. Particular significance of this area relates to non-designated archaeological remains from the prehistoric to post-medieval period.

A Fig.2.33_ Photograph - Battlesford Wood ancient woodland

B Fig.2.34_ Photograph - Existing railway crossing Grand Union Canal

C Fig.2.35_ Photograph - Savay Farm

Fig.2.36_ Aerial photograph - 1946 Northmoor Hill Wood

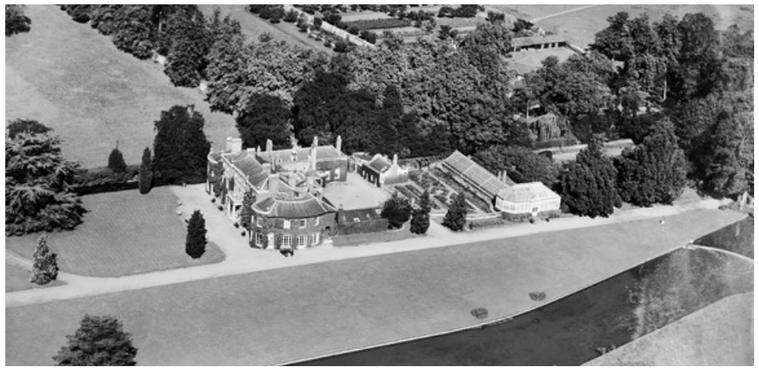


Fig.2.37_ Aerial photograph - 1938 Denham Court

Fig.2.38_ Photograph - Former road bridge in proximity to Savay Farm

Code 1 - Accepted

Social and Cultural Context

2.5.3 Historical

Over the years the landscape of the Colne Valley has shifted several times in form and use. Currently it is characterised by a mixture of lakes and woodland, and is largely agricultural and rural. Before the addition of the lakes, the flat valley floor and surrounding slopes once consisted of irrigated farm land, evidence of which can still be found today. The Industrial Revolution however had a huge impact on what can be seen today, transforming the valley fields and lakes of the current Colne Valley Regional Park, whilst creating the beginnings of a transport network that continues to grow.

There exists some evidence of human settlements as early as 400,000BC, however much was destroyed during interglacial periods. This resulted in the deposit of sand, gravel and silt, the later extraction of which would define the current landscape of the Valley.

With the retreat of the ice sheets, forests developed and the valley was largely used as arable land up until the Industrial Revolution. There are several listed buildings that date back to this period, including the fourteenth century Savay Farm and a near-by Scheduled Monument thought to date from the Bronze or Medieval Age.

The 18th and 19th century saw rapid industrial growth in the region, with the construction of the Grand Union Canal from around 1794 and the Great Western Railway in 1838. This changing context has dramatically altered the setting of many of the heritage assets within the Colne Valley.

There are some assets where their designation as a conservation area or listed building has been as a result of the industrial activities of the past. For example, Widewater conservation area and the Grade II listed Widewater Lock Cottage are designated due to the unique architecture associated with Canal Locks constructed at the time and the special heritage value that it now contributes to the local area.

Since the industrial period, infrastructure in the Valley has continued to grow, including the construction of the M25, A412, Harvil Road, Moorhall Road, M40, the Chilterns Railway and Denham Aerodrome. Several footpaths also allow users easy movement through the valley. Gravel was extracted from the valley floor in order to create this network of connections and the extraction pits have now become lakes, including Broadwater, Korda, Harefield No.2, Savay and Denham Waterski Lakes

Please refer to the heritage setting assessment for Savay Farm within the Written Statement (1MC05-ALJ-TP-REP-CS01_CL01-000006) for further information.

Code 1 – Accepted

2.5

Fig.2.39_ Aerial photograph - 1921 River Colne and Grand Union Canal

Fig.2.40_ Aerial photograph - A412 in 1933

Fig.2.41_ Aerial photograph - Colne Valley in 1952

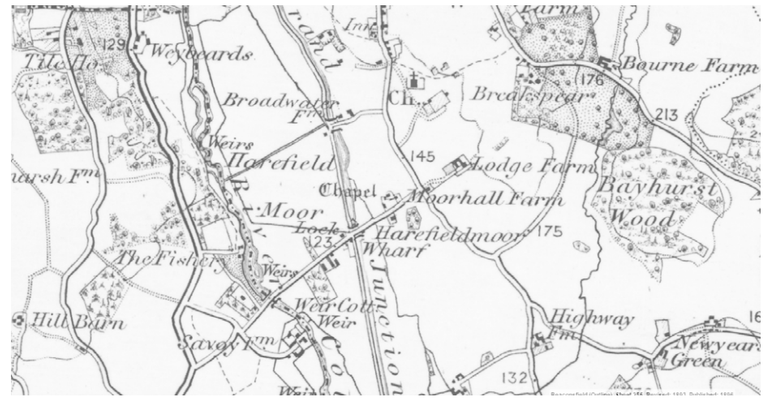


Fig.2.42_ Map - Colne Valley in 1896

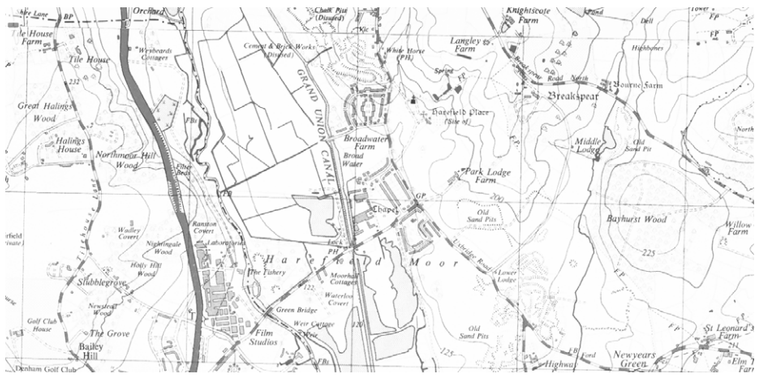


Fig.2.43_ Map - Colne Valley in 1956

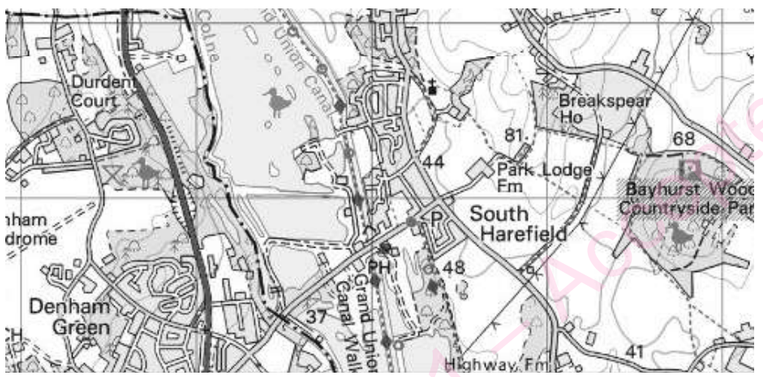


Fig.2.44_ Map - Colne Valley in 2019

Code 1 – Accepted

Recreational Amenities

2.6.1 Overview

The Colne valley is served by a range of recreational amenities, centred around the lakes, rivers and canal. Key amenities include the following;

- Boradwater Lake
- Denham Waterski Lake
- River Colne
- Newyears Green Bourne
- Hillingdon Outdoor Activities Centre (HOAC)
- Grand Union Canal
- Harefield Marina
- Korda Lake

These amenities have been described on this page in terms of their key features, existing use, and potential opportunities.

1 Broadwater Lake

Key features

- Mid Colne Valley Special Site of Scientific Interest (SSSI) and Wildlife Trust Nature Reserve

Use

- Significant ornithological interest; breeding woodland and wetland birds, e.g. tufted duck & wintering wildfowl
- Important habitat for Daubenton's bats

Opportunities

- Enhancement of wetland habitats
- New pedestrian routes along eastern edge

2 Denham Waterski Lake

Key features

- Lake enclosed by mature vegetation, providing tranquil and secluded environment despite proximity of the A412

Use

- Activities include water skiing, wakeboarding and open water activities

Opportunities

- Possible connection to new river trails and creation of external seating or picnic areas to the lake edge

3 River Colne

Key features

- It is primary watercourse through the Colne Valley and provides a variety of wetland habitats

Use

- The river is largely inaccessible with some riverside trails to the South

Opportunities

- Diversion of the river will be avoided to minimise the impact on ecology and wildlife habitats
- New pedestrian link bridge over the river

4 Harefield No.2 Lake

Key features

- Located adjacent to Hillingdon Outdoor Activities Centre and the Grand Union Canal

Use

- Activities include climbing, sailing, windsurfing, canoeing, angling and fishing

Opportunities

- Enhancement of existing site as a recreational gateway to the south of the park

5 Grand Union Canal

Key features

- Historic route, enclosed by canal-side vegetation

Use

- Barge mooring.
- Towpath used as a recreational pedestrian route

Opportunities

- Enhancing recreational routes either side of the canal with new amenity space and lake views

6 Harefield Marina

Key features

- Marina adjacent to the Grand Union Canal

Use

- Moorings for cruisers and narrowboats

Opportunities

- Enhancing recreational routes either side of the canal with new amenity space and lake views

7 Korda Lake

Key features

- Lake enclosed by mature vegetation, providing a variety of wetland habitats

Use

- The lake is used as a fishery, predominantly for carp angling

Opportunities

- Possible new pedestrian routes

Code 1 – Accepted

2.6

Key

Built

- Proposed viaduct
- Proposed railway alignment
- Building

Connectivity

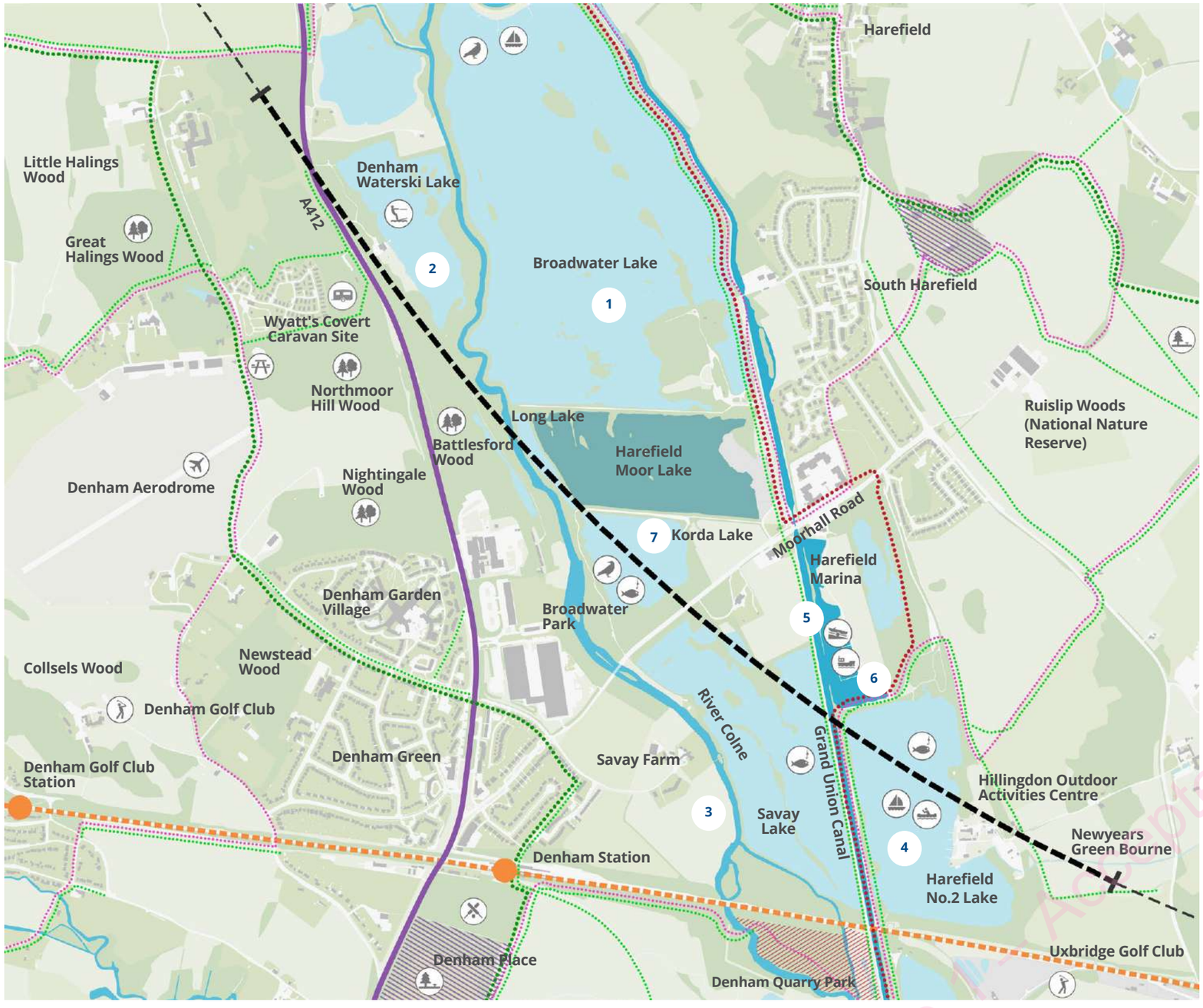
- Colne Valley trail / National cycle route No. 6
- Long distance path
- Circular walk
- Public right of way
- A Road
- Chilterns Main Line

Environment

- Grass
- Garden
- Woodland
- Lake / canal / river
- Mineral Processing
- Registered park / garden
- Country park

Recreation

- Golf Club
- Fishing
- Sailing
- Canoeing
- Wildlife
- Aerodrome
- Boat landing
- Barges
- Water-skiing
- Swimming
- Sports ground
- Picnic area
- Public park



0 200 500 M

N

Fig.2.45_ Site plan - Recreation and users

Code Accepted

Code 1 – Accepted

3.0 Brief

A summary of briefing material, from HS2 design vision and guidelines, hybrid bill requirements, technical requirements and stakeholder aspirations.

Code 1 – Accepted

HS2 Design Drivers

3.1.1 HS2 core design principles

The Design Vision sets out the role that design can play in making High Speed Two a catalyst for growth across Britain. HS2 is based on three core design principles of people, place and time. These have informed the design process for the Colne Valley Viaduct at every stage and provide a basis against which design solutions have been tested.

People

Design for everyone to benefit and enjoy

1. Design for the needs of our diverse audiences
2. Engage with communities over the life of the project
3. Inspire excellence through creative talent

Place

Design for a sense of place

4. Design places and spaces that support quality of life
5. Celebrate the local within a coherent national narrative
6. Demonstrate commitment to the natural world

Time

Design to stand the test of time

7. Design to adapt for future generations
8. Place a premium on the personal time of customers
9. Make the most of the time to design

Fig.3.1_ HS2 core design principles - People, place and time

3.1.2 Other key design principles

Other key aspects of the HS2 Design Vision that have influenced the design of the Colne Valley Viaduct are;

Identity

The HS2 Arts Strategy is an opportunity to foster HS2's vision to enhance national and civic pride through one-off expression and local design stories.

Environment

The HS2 Sustainability Strategy promotes an environmental rationale to deliver imaginative, appropriate and environmentally sensitive solutions.

Innovation

HS2 Ltd has brokered partnerships with industry bodies and centres of excellence, to create an ecosystem of resources to encourage and support innovation across the programme of work.

Code 1 – Accepted

3.1.3 HS2 strategic goals

From an early stage of the project, core strategic goals were established as key outcomes for the new high speed line. These goals have guided the design approach to the Colne Valley Viaduct (CVV), with the following acting as key drivers for the design;

HS2 will create an environmentally sustainable solution and be a good neighbour to local communities:

- To design every part of HS2 and its service to be sympathetic to the people and places we affect and to stand the test of time
- To actively communicate with neighbours and interest groups to minimise the impact of HS2 construction and operation on people and the environment

HS2 will set new standards in passenger experience

- To deliver passenger experience and customer service that is recognised worldwide
- To place people at the heart of our design, setting new standards for travel

3.1.4 HS2 sustainability goals

Sustainability is an important component to making HS2 an exemplar project. Therefore designing out and reducing waste, minimising our carbon footprint and protecting Britain's heritage shall be key drivers for the CVV. The HS2 sustainability goals are set out in Fig. 3.3.

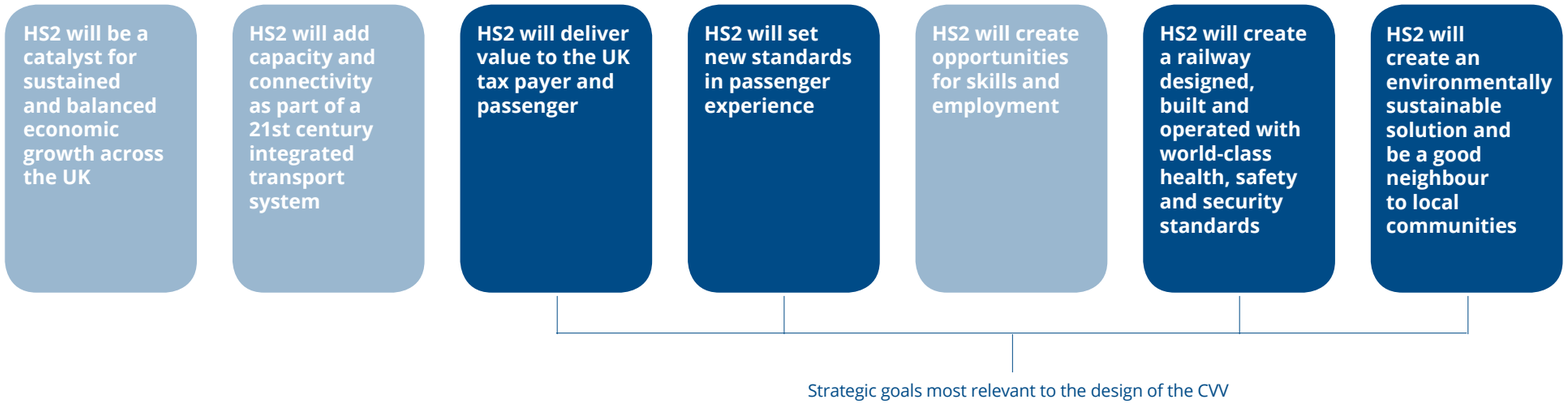


Fig.3.2_ HS2 strategic goals

Spreading the benefits

Economic growth and community regeneration

Being a catalyst for regeneration and economic growth across the UK, maximising the benefits to communities and individuals and minimising the negative impacts

Opportunities for all

Skills, employment and education

Providing rewarding jobs and careers that are open to all in society, setting new standards for equality, diversity and inclusion and providing a legacy of skills, learning, expertise and experience

Safe at heart

Health, safety and well-being

Creating a world-class 'safe at heart' culture where no one gets hurt, and which prioritises the health and well-being of those who build, operate, use and host HS2 services and infrastructure

Respecting our surroundings

Environmental protection and management

Being a catalyst for breaking new ground wherever possible on environmental standards including resource use, waste, carbon minimisation, the protection of the natural and historic environment and safeguarding communities.

Standing the test of time

Design that is future-proof

Designing a network that is resilient to climate change, adaptable to future trends and demands, and built around the needs of the people who will use it.

Fig.3.3_ HS2 sustainability goals

Code 1 – Accepted

HS2 Act

3.2.1 Location

The purpose of the hybrid Bill is to secure the necessary powers to acquire land and construct the railway and other associated works.

The parliamentary plans and sections accompanying the HS2 Act show the centerline of works, the Limits of Deviation (LOD) and the Limits of Land Acquired or Used (LLAU). It is a requirement of hybrid Bills that some flexibility is provided to account for the fact that at the Parliamentary stage, the design is at an early level of maturity.

The LOD control the horizontal and vertical extents that the Scheduled Works contained in Schedule 1 of the HS2 Act can be constructed within. The Colne Valley Viaduct and its associated embankments and abutments form a part of Schedule Work number 2/1 as described in Schedule 1 to the HS2 Act. The centerline of the railway may also deviate vertically upwards by up to 3 metres and downward by any extent.

Within the LLAU, ancillary works and other works incidental to the construction or operation of the railway, such as environmental mitigation, access creation, temporary construction compounds, may also take place.

Fig.3.4_ Site plan - LOD and LLAU

Code 1 - Accepted

3.2

3.2.2 Design

The Colne Valley Viaduct (CVV) has been identified as a key design feature of HS2 Phase One:

"Stations aside, the Colne Valley viaduct will be the most significant visible engineering feature of the HS2 Phase One route... It will have international significance and its design should reflect that... Sympathetically and imaginatively designed, the viaduct can become a suitable symbol for the country's future high speed railway network."

House of Commons Select Committee, Second Special Report, February 2016, para 181.

A parliamentary design for the CVV was prepared in order to define the location and alignment of the viaduct, together with broad design principles relating to the scale, massing and appearance. This design comprised a 3.4km long viaduct with a typical span length of 60m, straight piers and a concrete box girder deck. This design was subject to the environmental assessment reported in the Environmental Statement, that accompanied the hybrid Bill.

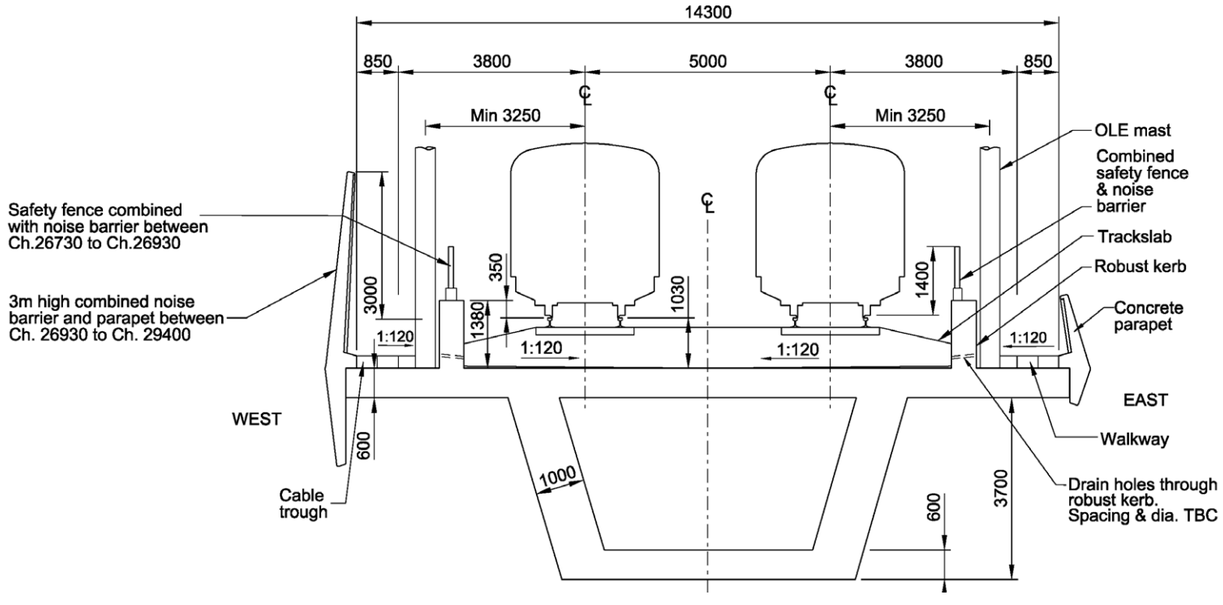


Fig.3.5_ HS2 Ltd design to support Hybrid Bill - Typical section (straight section)

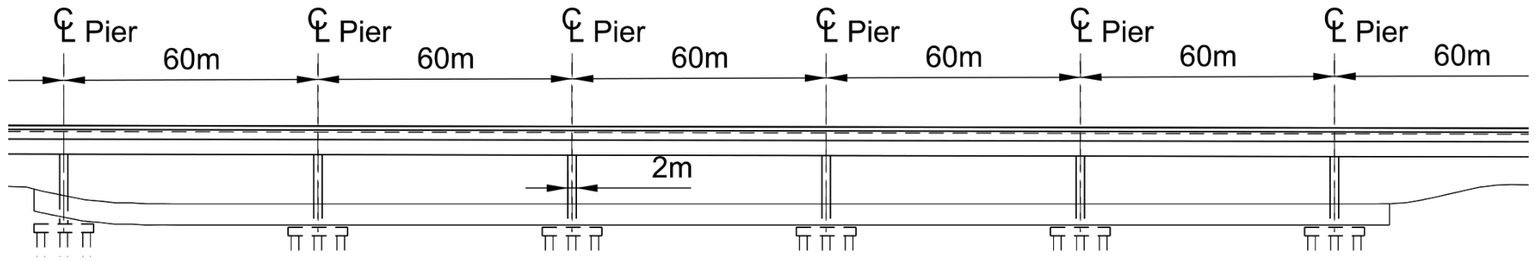


Fig.3.6_ HS2 Ltd design to support Hybrid Bill - Proposed elevations over water

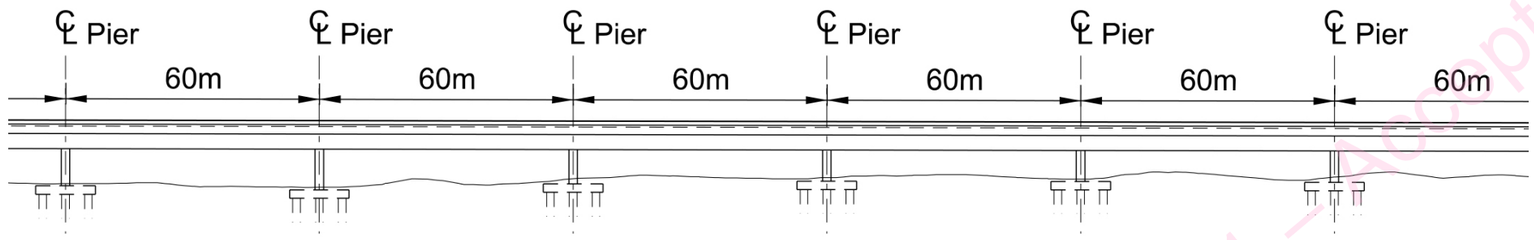


Fig.3.7_ HS2 Ltd design to support Hybrid Bill - Proposed elevations over land

Code 1 – Accepted

Reference Documents

3.3

3.3.1 Overview

Reference Documents have been provided to ALIGN JV as key approaches to follow when developing the design. Some of these reference documents were developed with input from statutory bodies, either through consultation or engagement at relevant forums, such as the HS2 Phase One Planning Forum.

In some cases, such as the Colne Valley Regional Park Additional Mitigation Plan, the documentation has been developed by third parties directly as a result of assurances given by HS2 Ltd during the hybrid Bill stage.

3.3.2 HS2 design approach documents

These documents provide design guidance and cover all key areas of programme work. The Design Approach documents do not prescribe what is required but are intended as a resource to help the team deliver the design of the railway to the standard that HS2 expects. The following approach documents have informed the developing design proposals for the Colne Valley Viaduct (CVV);

- HS2-HS2-AR-GDE-000-000005: HS2 Open Route Structures Design Approach
- HS2-HS2-EV-STR-000-000010: HS2 Landscape Design Approach
- HS2-HS2-AR-GDE-000-000015: HS2 Art Approach

3.3.3 Other HS2 design documents

Other HS2 design documents that have formed part of the design brief and for the Colne Valley Viaduct include:

- HS2-HS2-BR-STD-000-000004: Bridge Design Requirements
- HS2-HS2-EN-REP-000-000019: Common Design Elements
- HS2-HS2-SU-STR-000-000006: Sustainability Approach Document

These documents were also issued as part of the baseline technical standards.

3.3.4 HS2 technical standards

Technical standards provide the technical requirements and associated guidance for the design basis of the structural elements. Adoption of technical standards will help ensure a consistent approach to design across the whole project, minimising the assumptions that designers need to make to achieve the level of design quality demanded by a high speed railway.

3.3.5 Common Design Elements

Common Design Elements (CDEs) have been developed to address local context, deliver value for money and reinforce the identity of the HS2 along the line of the route. These elements include noise barriers, viaduct piers and viaduct/ bridge parapets. Whilst the guiding principles have been considered, it is recognised that the Colne Valley Viaduct is a special and unique structure, highly specific to its local context.

3.3.6 Additional design documentation

Other documents that have informed the design include:

- C227-ATK-ST-REP-000-000011: CVV Specimen Design
- Canal and River Trust: HS2 Design Principles for Waterway Crossings

3.3.7 Additional Mitigation Plan

The Colne Valley Regional Park Panel commissioned an Colne Valley Regional Park Additional Mitigation Plan (AMP) to identify additional landscape and ecological mitigation and enhancements within the Colne Valley Regional Park. This plan encompasses proposals both within and outside the present HS2 Act limits.

Fig.3.8_ Reference documents - HS2 design approach documents

Code 1 - Accepted

Environmental Statement

3.4

3.4.1 Overview

The HS2 Phase One Environmental Statement (ES) was produced to accompany the High Speed Rail (London - West Midlands) Bill. The ES includes the likely significant environmental impacts along the route and measures to manage and reduce those impacts.

The effects set out in the ES are key to the design of the viaduct as the Environmental Minimum Requirements (EMR) require that the environmental effects set out in the original ES are not exceeded by the design and external appearance of the viaduct. The design of the Colne Valley Viaduct should respond to particular environmental factors, such as noise, ecology, surface water and landscape.

The main Environmental Statement, published in November 2013, was set out in five volumes:

Volume 1: Introduction and background information

This provides an introduction to the ES and includes an overview of the impact assessment process and the consultation itself, and the main strategic, routewide and local alternatives considered.

Volume 2: Area reports and map books

Reports of the main environmental effects of HS2 in different geographical areas (known as 'community forum areas') along the HS2 Phase One route. This volume also contains books of maps relevant to each report. The relevant area for the Colne Valley Viaduct is 'CFA07 Colne Valley'.

Volume 3: Routewide effects

This document sets out the likely routewide environmental effects of the construction and operation of HS2 Phase One.

Volume 4: Off-route effects

This document sets out the likely significant environmental effects of Phase One of HS2 expected at locations beyond the route corridor, such as rail stations, rail depots and rail lines. This volume covers areas not included in the community forum area reports in Volume 2.

Volume 5: Environmental topic reports and map books

Reports by topic for the environmental effects of the building and operation of Phase One of HS2. This volume also contains books of maps relevant to each report. The topic areas most relevant to the architectural design of the Viaduct are as follows;

- Volume 5 Cultural Heritage: CFA07 Colne Valley
- Volume 5 Landscape and Visual Assessment: CFA07 Colne Valley
- Volume 5 Sound, Noise and Vibration: CFA07 Colne Valley
- Volume 5 Traffic and Transport: CFA07 Colne Valley
- Volume 5 Water Resources: CFA07 Colne Valley

Further environmental information relevant to the Colne Valley was included in Supplementary and Additional Provisions Environmental Statements.

Code 1 – Accepted

Undertakings and Assurances

3.5.1 Overview

The HS2 Act included a number of commitments made in relation to the development and delivery of the new high speed line. Recorded in a register accompanying the Environmental Statement, a number of these Undertakings and Assurances (U&As) relate to the Colne Valley Viaduct (CVV), ranging from noise attenuation to mitigating effects on ancient woodland located within the proximity of the railway. These U&As must be complied with. The full register of U&As can be found online:

https://www.gov.uk/government/publications/high-speed-rail-london-west-midlands-bill-register-of-undertakings-and-assurances

A full set of U&As relevant to the CVV can be found in the Written Statement (1MC05-ALJ-TP-REP-CS01_CL01-000006). Those most relevant to the permanent design of the CVV include:

- **704 & 705:** Assurance to establish Colne Valley Regional Park Panel [Provided for context in relation to below assurances].
- **706:** The engagement will include, where reasonably practicable, the presentation of draft designs of relevant HS2 mitigation and restoration proposals and draft design of the Colne Valley viaduct to the members of the Panel by the nominated undertaker in a timely manner, so as to give a reasonable opportunity for the members to comment on the draft designs.
- **712:** 1. The Secretary of State will require the nominated undertaker to engage in pre-submission discussions with the relevant local planning authorities [South Bucks District Council and London Borough of Hillingdon] on the design of the Colne Valley viaduct. 2. The Secretary of State will require the nominated undertaker to take part in such discussions in such time so as to provide the relevant local planning authorities reasonable opportunity to comment on the detailed design proposals for the Colne Valley viaduct.
- **713:** When formulating the final plans and specifications of the Colne Valley viaduct supplied to the relevant local planning authorities under Schedule 17 to the Bill, the Secretary of State will require the nominated undertaker to have regard to all reasonable suggestions made by the relevant local planning authority/authorities on the draft plans and specifications, so far as is reasonably practicable and within the limits and powers set out in the HS2 Act, and so far as they do not impact the timely economic and safe delivery and operation of the railway and are relevant to the grounds on which the relevant planning authority would be entitled to refuse approval under Schedule 17 to the Bill.
- **714:** The Environmental Statement (ES) reported 48 minor impacts at residential properties at South Harefield. The Secretary of State will require the nominated undertaker to implement a 3m noise barrier on the upside line of Work No. 2/1 from chainage 26+350 to 28+450, or implement noise mitigation measures which deliver equivalent performance in removing 44 of the 48 minor noise effects as reported in the ES.
- **715:** The ES reported seven moderate impacts and six minor impacts at residential properties close to Savay Farm. The Secretary of State will require the nominated undertaker to implement a 3m noise barrier on the downside line of Work No. 2/1 from chainage 26+730 to 26+960, or implement noise mitigation measures which deliver equivalent performance in removing all 6 of the minor noise effects as reported in the ES.
- **716:** The ES reported 18 moderate impacts and 69 minor impacts at residential properties at Wyatt's Covert and Tilehouse Lane. The Secretary of State will require the nominated undertaker to implement a 4m [noise barrier] on the downside line of Work No. 2/1 from chainage 28+500 to 29+850, or implement noise mitigation measures which deliver equivalent performance in removing 16 out of 18 moderate noise effects and 53 out of 69 minor noise effects as reported in the ES.
- **2097**: The Promoter will consider an area within the Hillingdon, Denham, Ickenham, Harefield and Ruislip environs within which a no net biodiversity loss target will be applied.
- **2115:** The Promoter will develop further measures that provide additional protection for at risk bat and bird populations during detailed design, wherever reasonably practicable'
- **2704:** The Promoter recognises the potential of Phase One of HS2 to have impacts on populations of bats and in particular, some bird species. With regards to geese and cormorants in the Colne Valley, the Environmental Statement did not identify any important flight lines for such species, however it acknowledges that a small risk of infrequent collision will remain. The Colne Valley Viaduct, as a key design element, will complement local aspirations and contribute to the natural and built environment where possible. Regarding Barn Owls, the Promoter will reconvene the Barn Owl action group in January 2017 to discuss how to take forward results from an independent report into the dispersal of this species. This will inform mitigation measures both near the line to prevent collisions and in the wider landscape to enhance existing populations.

Code 1 – Accepted

3.5

3.5.2 Sound, noise and vibration

The ES provided for noise barriers on the viaduct which varied between 1.4 metres and 4 metres high as shown on the figure to the right. Assurances relating to specific noise impact levels were provided to South Bucks District Council in the following locations;

- South Harefield
- Savay Lane to the west of Denham
- Wyatt's Covert to the north of Denham

The relevant assurances are set out in Section 3.4.2. The design proposals for the Colne Valley Viaduct must meet these requirements.

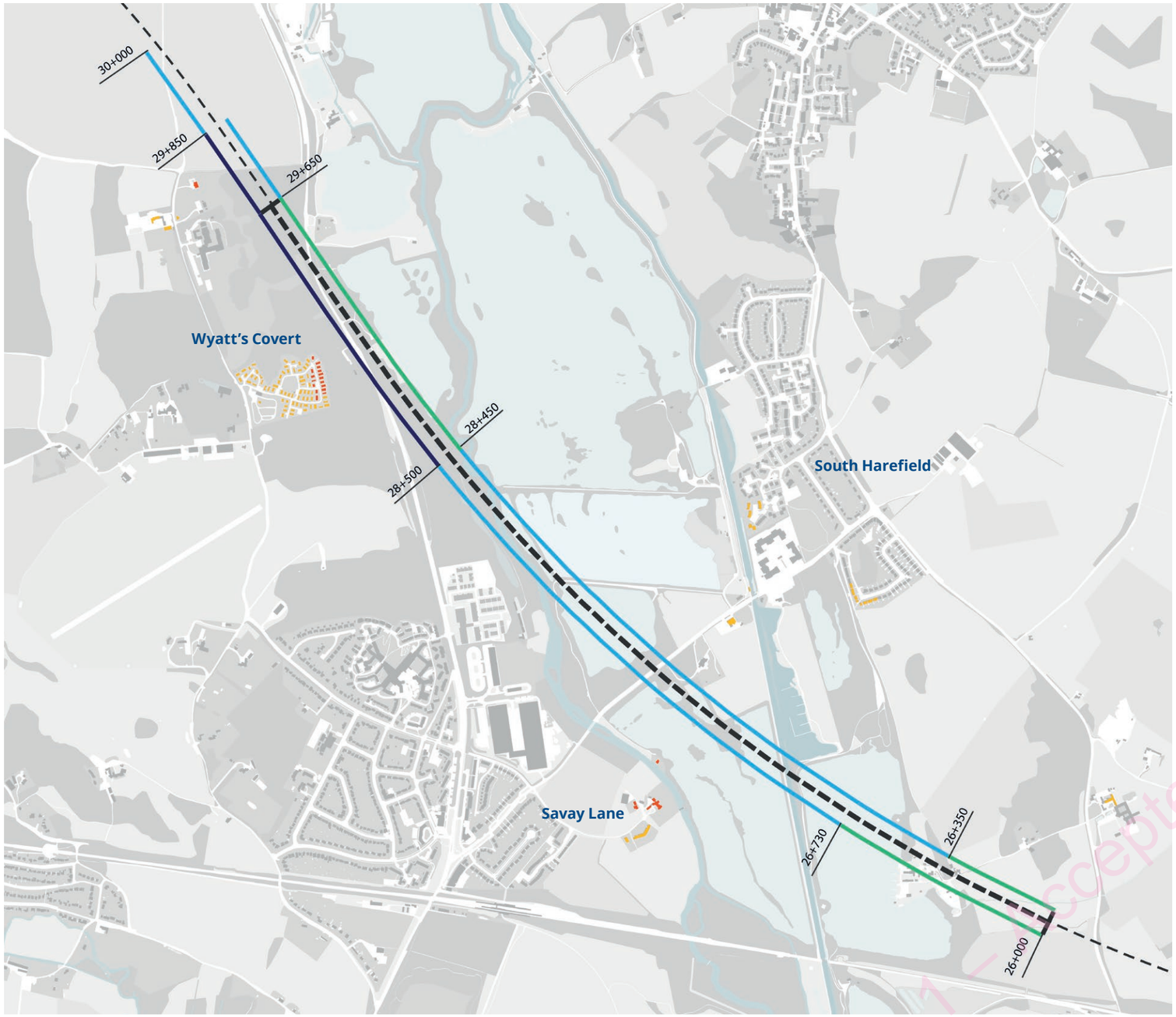


Fig.3.9_ Site plan - Noise barrier heights specified in the ES and U&As

Code 1 - Accepted

Specimen Design

3.6

3.6.1 Overview

HS2 Ltd commissioned the 'Colne Valley Viaduct Specimen Design' study, completed in April 2017, to provide guidance for the detailed design of the Colne Valley Viaduct by ALIGN JV. The concept design was developed through engagement with the Colne Valley Regional Park Panel and the HS2 Independent Design Panel, and has helped to inform the initial scheme design work and technical development.

The document examined a range of options and ideas for how the viaduct can be sensitively and aesthetically sited within the Colne Valley. The concept was developed and appraised against the following key criteria;

- Extraordinary
- Fits the landscape
- Appropriate scale
- Elegance
- Responds to the landscape character areas
- Responds to landscape constraints
- Positively utilises reflection
- Well proportioned
- Uncluttered
- Addresses varied views of the viaduct
- Positive passenger views
- Maintains views and landscape flow through
- Legible
- Structurally achievable
- Buidability

Further details on the aspects of the specimen concept carried forward in the design proposals are described in Section 5 Viaduct Design.

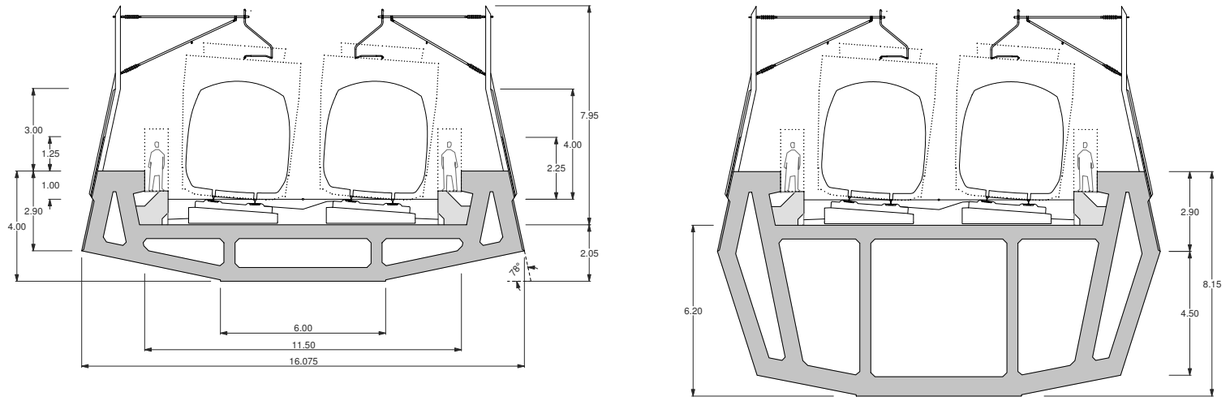


Fig.3.10_ Specimen Design - Typical cross sections (A) and (B)

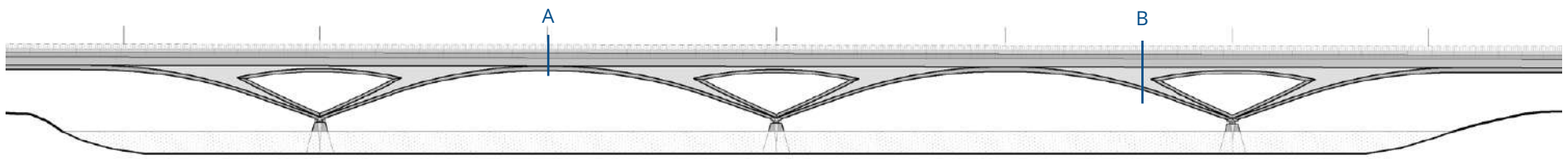


Fig.3.11_ Specimen Design - Typical water span elevation

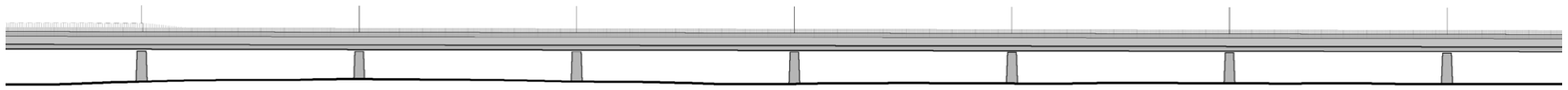


Fig.3.12_ Specimen Design - Typical land span elevation

Fig.3.13_ Visualisation - Specimen Design over Korda Lake

Code 1 – Accepted

Operational Requirements

3.7

3.7.1 Operational design brief

The viaduct will be required to carry the HS2 dual track, with high speed trains operating of up to 320km/h in each direction, and will be designed with safety as the highest priority. The design needs to factor in the following:

- Track spacing and train gauge
- Significant train speeds and the associated forces
- Frequency of trains and associated fatigue of materials
- Maintenance and repair, including limited hours for inspection
- Comfort level of the passengers
- Ease and speed of construction

The viaduct also need to accommodate the necessary installation of infrastructure to operate high speed rail, including overhead catenary system, signalling and telecommunication, cabling, drainage and maintenance walkway.

There are specific HS2 technical standards and key dimensions that guide all of these requirements.

3.7.2 Other key requirements

Other key operational requirements that have been considered include:

- Performance – Design a viaduct to perform to its stated level for a stated time or stated demand. It is influenced by the combined factors of reliability, availability and maintainability.
- Reliability – Design a viaduct that is able to perform a required function under stated conditions or for a stated demand.
- Availability – Design a viaduct to perform its required function over a stated period of time. It is influenced by the combined factors of reliability and maintainability.
- Maintainability – Provision to safely and efficiently maintain the viaduct and associated rail infrastructure from both land and over water. Design a viaduct that can be restored to operational condition within a specified period of time.
- Safety – Design a viaduct that can perform safely, be maintained safely and not import or export any unacceptable risks under its stated function and operating conditions. In particular, the desgin considers train derailment and safe evacuation of passengers in the event of an emergency.
- Monitoring – Ability for inspections of the viaduct to be undertaken safely when required.
- Durability – To meet the design life of the structure, i.e. the period during which the item is expected by its designers to work within its specified parameters.
- Drainage – Design an adequate drainage system for the viaduct.
- Noise – Requirement to meet commitments made through the hybrid Bill process that required noise mitigation measures to meet specific levels. As well as an objective to reduce environmental noise and vibration impact where reasonably practicable.
- Constructability – Design a viaduct that can be effciently and safely constructed, whilst limiting impact on the local community and environment where possible.
- Affordability – Design a viaduct that is affordable.

Code 1 – Accepted

Code 1 – Accepted

4.0 Design Vision

Encapsulates the overall design vision for the Colne Valley Viaduct and associated landscape through a series of key design objectives and visualisations.

Code 1 – Accepted

Fig.4.1_ Visualisation (15) - View from the Old Orchard pub

Issue - Accepted

4.1

Extraordinary

The Colne Valley Viaduct is a structure of international significance and it's design reflects that. A symbol for the UK's high-speed railway network and responsive to its unique landscape setting. The 3.4km long structure will be one of the largest viaducts in Europe and few infrastructure projects have been designed to meet such demanding technical and operational requirements.

Code 1 – Accepted

Fig.4.2_ Visualisation (12) - Extended spans over Harefield No2 Lake looking south

Code 1 – Accepted

4.2

Enduring

The Colne Valley Viaduct has been designed to last at least 120 years – a landmark for a new era in British infrastructure. The significance of this legacy is reflected in the design quality of the viaduct and the landscape proposals that integrate the new structure into its surroundings. Responding to a host of complex challenges, the viaduct's design achieves a distinctive, timeless aesthetic.

Code 1 – Accepted

Fig.4.3_ Visualisation (14) - Extended spans over Harefield No2 Lake looking north

Code 1 – Accepted

4.3

Responsive

The viaduct is highly responsive to the character of the Colne Valley: structural spans and pier forms vary as the viaduct passes through a mosaic of lakes and woodland. Over water, extended structural spans open up the space below the structure, enabling panoramic long-distance views to the landscape beyond. In woodland areas, where more restricted views of the viaduct are experienced at closer quarters, shorter spans provide greater headroom beneath the viaduct. The landscape and ecology proposals conserve as much of the most sensitive habitats as possible, including ancient woodland. The design will also establish new landscape and wetland features, introducing habitats which have been lost or are scarce in the Colne Valley.

Code 1 – Accepted

Fig.4.4_ Visualisation (11) - Grand Union Canal crossing

Code 1 – Accepted

4.4

Crafted

The Colne Valley Viaduct's supporting piers are faceted and sculpted to reduce their bulk. This strategy been refined by a crafted play of opposites: dark and light, rough and smooth, flush and recessed, further reducing the visual impact of the piers' mass.

Code 1 – Accepted

Fig.4.5_ Visualisation (10) - Moorhall Road crossing

Colne 1 – Accepted

4.5

Expressive

The design celebrates the architecture of engineering: it's structural form is a combined expression of power, speed, function and technology. Despite the substantial structural demands of high speed trains, the design achieves a refined and elegant structure. The viaduct requires fixed buttresses to transfer train braking loads into the ground and portals to allow thermal expansion at regular intervals. These are deliberately located where the viaduct intersects key sites and routes within the Colne Valley. Great care has been taken to express these essential buttresses and portals as visibly special structures, unique to their function and location.

Code 1 – Accepted

Fig.4.6_ Visualisation (13) - South abutment looking south

Code 1 – Accepted

4.6

Cohesive

While the Colne Valley Viaduct is highly responsive to its context, it is conceived and appears as a single, coherent structure. A common design language used to sculpt the viaduct's components ensures that the structure is recognisable wherever it is encountered within the Colne Valley Regional Park.

Code 1 – Accepted

Fig.4.7_ Visualisation (6)- New recreational routes alongside the viaduct

4.7

Interactive

The landscape design proposals promote interaction with the viaduct where possible by creating new pedestrian routes and amenity spaces alongside the structure. Where parts of the viaduct meet the ground, people can touch the structure – here, cast textures create a sense of connection with the natural landscape while providing interest at a human scale.

Code 1 – Accepted

Fig.4.8_ Visualisation (7) - River Colne crossing looking north

Colne_V_Accepted

4.8

Connected

While the railway is about connectivity at a national and regional scale, the proposals also connect at a local level. The indicative landscape design incorporates new pedestrian routes within the Colne Valley to enhance recreational access and amenity. In some locations these routes open previously inaccessible areas within the park.

Code 1 – Accepted

Code 1 – Accepted

5.0 Viaduct Design

Summary and justification of the viaduct design proposals relating to the overall design strategies, deck cross section, pier design, abutments, approach embankments, noise barriers and materiality.

Code 1 – Accepted

Key Considerations

5.1.1 Specimen Design response

At the beginning of the design process, a detailed appraisal of the Specimen Design was undertaken by ALIGN JV. It was tested against technical requirements and site survey information to evaluate which key design principles were to inform the design proposals. It was also appraised against the HS2 design drivers and functional requirements identified in Section 3 of this report.

The key design principles identified to be carried forward include:

- **Elegance over prominence:** Considering the viaduct as a 'beacon' structure through design quality and elegance across the landscape, rather than as a 'shout-out' structure.
- **Special spans over water:** The Colne Valley Viaduct will largely be experienced as small snapshots crossing through trees. Wider views will therefore mostly be across the lakes and water-bodies that the line traverses. Responding to this, the design uses extended spans over water.
- **Maximising passenger view:** Provided that acoustic requirements can be achieved, partially transparent noise barriers could allow for passenger views out while reducing the apparent visual bulk of the viaduct in the landscape.
- **Pattern and texture at low level**: Introducing texture at low level enhances the viaduct's connection to the ground. Tactile surfaces provide interest at points where people come into contact with the structure, while removing large blank faces vulnerable to graffiti.

This section of the Design and Access Statement explains in more detail the benefits of adopting the above principles within the viaduct design.

The following considerations were discounted:

- **In-situ construction:** The deck design within the Specimen Design would need to be constructed using significant amounts of cast in-situ concrete, with a large amount of associated formwork. This would increase construction cost, programme, labour requirements and disruption to the Colne Valley.
- **Concrete volume:** The size and weight of the specimen deck cross-section would be such that, even at the shallow mid-span sections, the structure would be highly inefficient and construction would be complex. A structure of this volume would also require larger bearings than illustrated, with additional space required on the bearing shelf to accommodate displacement and provide access for replacement.
- **Cellular deck cross section:** Post-tensioned cables within the viaduct deck require adequate space for installation, maintenance and inspection. The small voids within the Specimen Design cross section would not allow safe access for construction and maintenance workers.
- **Bearings over water:** The appearance of the structure treading lightly over the surface of the lakes is a key feature of the Specimen Design. The level of the bearings, however, is such that in a 1 in 100-year plus climate change flood event, the bearings would be under the water and require replacement after every flood event. This therefore represents a major hindrance to durability, maintenance and safety for the structure. Lifting the bearings above this level reduces the structural span and fundamentally changes the geometry of the structure.

Code 1 – Accepted

5.1.2 Beacon structure

The Specimen Design considered several options in relation to achieving an 'internationally recognisable beacon structure' (HS2 Specimen Design C227-ATK-ST-REP-000-000011_P01). It discounted pursuing a large, tall structure as a 'beacon', discarding this approach as being unsuitable for the sensitive landscape context of the Colne Valley (see Fig. 5.1).

ALIGN JV's interpretation of the beacon requirement is for a viaduct that is of exceptional quality, with a distinctive and readily recognisable appearance, befitting to its sensitive landscape context. The proposed design continues to follow a contextual approach, using a series of discrete 'vignettes' at prominent locations (see Fig. 5.2).

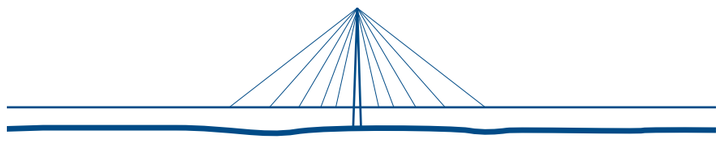


Fig.5.1_ Diagram - Beacon as a landmark structure

Fig.5.2_ Diagram - Beacon as targeted, discrete 'vignettes'

5.1.3 Scale and visual mass

An unusual characteristic of the Colne Valley Viaduct is the low level of the tracks above the surrounding landscape. The proportions and scale generated by this geometry are a significant design challenge. The low track level made it important to maximise headroom and opportunities for views of the sky and landscape underneath the viaduct, to reduce the risk of it being perceived as a barrier.

A significant benefit is gained by raising structural elements as high as possible above the ground, maximising views of the landscape beneath. The design achieves a balance between the more frequent supports of shorter spans and the increased structural depth necessary for longer spans. The width of the structure has also been minimised, which is of importance when passing beneath the viaduct.

5.1.4 Viaduct articulation

Alternating fixed buttresses and expansion portals are required along the viaduct to allow the structure to expand and contract with changes in temperature, with corresponding expansion joints in the track required at roughly 900m intervals. Each module therefore has a fixed and braced stability 'buttress' in the centre plus independent piers supporting rail expansion at each end. The design expresses these special structural conditions as unique pier forms and structural spans. These components are illustrated in the Fig. 5.3.

Fig.5.3_ Diagram - Viaduct articulation

5.1.5 Noise protection

There are a number of noise sources associated with high speed trains operating on a viaduct, including;

- Wheel and rail noise from interaction of rolling wheels on rails
- Pantograph, both aerodynamic and frictional noise with catenary wires
- Traction motors and other train systems
- Aerodynamic noise from the train body
- Radiated noise from the viaduct structure

In order to protect against airborne noise sources, the viaduct requires noise barriers along its entire length. In order to balance noise control with visual and aesthetic design requirements, the barriers comprise both opaque acoustically absorptive and transparent acoustically reflective elements.

A key challenge for the noise barrier design is to achieve a balance between a range of technical requirements and design aspirations. Primary design requirements are described below;

- Protection against operational noise must at least meet minimum standards specified in the Environmental Statement (ES) and Undertakings and Assurances (U&As)
- Reduction of visual impact where possible
- Integration of the barrier within the overall design of the viaduct
- Transitions between barrier heights should be carefully considered to ensure visual continuity along the length of the viaduct
- The noise barrier should consider the structural and fatigue effects from the pressure waves generated by high speed trains
- Passenger views from the train should be provided where possible
- Consideration of protection against bird strike, particularly given its natural setting and proximity to SSSIs and natural wildlife reserves
- Ensure the barriers can be easily inspected, maintained and replaced where necessary

Code 1 – Accepted

Structural Principles

5.2.1 Early structural options appraisal

In order to select the most appropriate structure for the Colne Valley Viaduct, numerous structural options were developed to a level that would enable them to be properly appraised. These structures were judged against broad criteria that included sustainability, contextual approach, visual mass, safety, security, value for money, build-ability, and maintainability.

5.2.2 Variable depth box girder

Mapped against the above criteria, the variable-depth box girder was selected as the preferred structural approach, taking into consideration the following benefits;

- Segmental construction, allowing the structure to be launched from the north embankment
- Reduced in-situ construction, moving ancillary works and substantial form-work away from the site
- Lightweight and structurally efficient, reducing the volume of concrete where possible
- Longer spans that can respond more intelligently to their context
- Fewer supporting piers
- Maintenance access provided within the deck

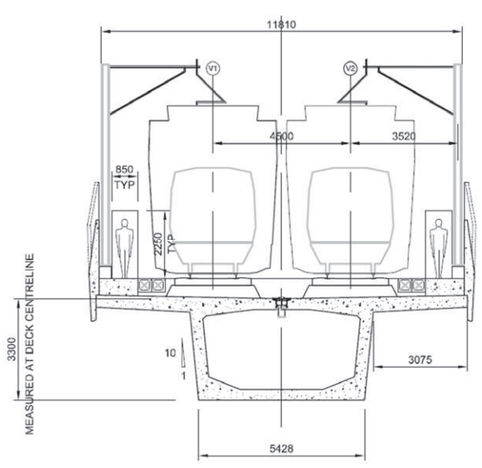


Fig.5.4_ Section - Continuous depth box girder

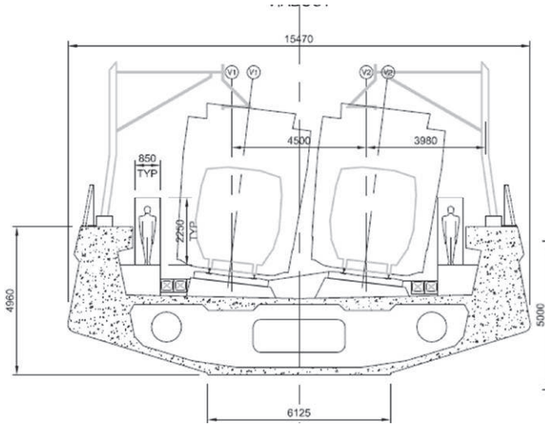


Fig.5.6_ Section - Through concrete box girder

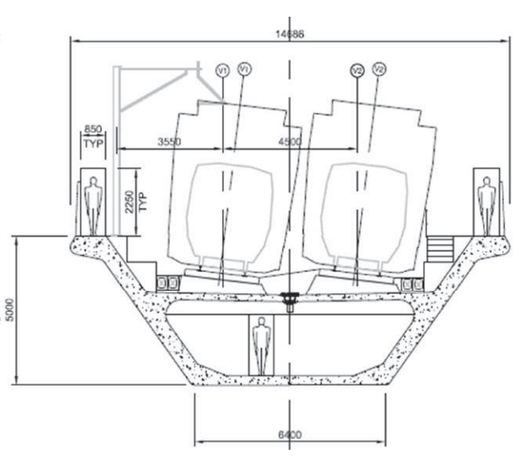


Fig.5.8_ Section - Through concrete box girder

Preferred option

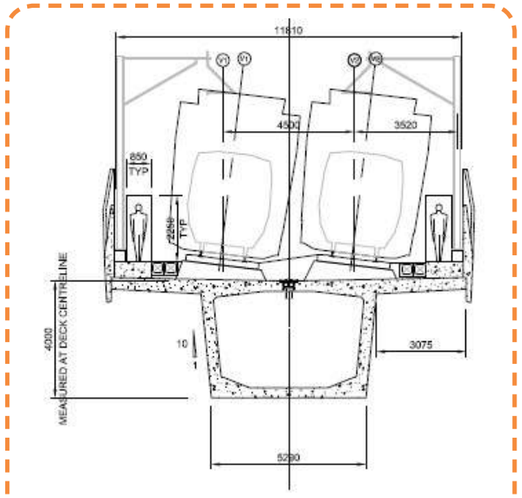


Fig.5.5_ Section - Variable-depth box girder

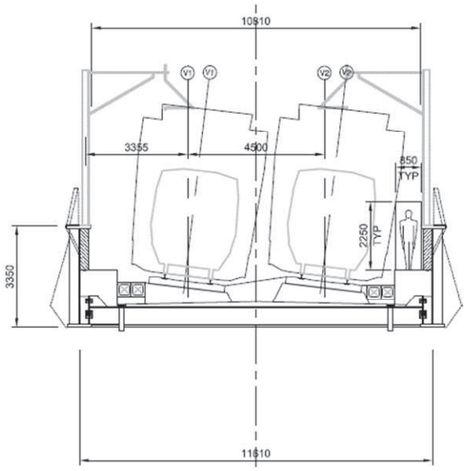


Fig.5.7_ Section - Steel half-through deck

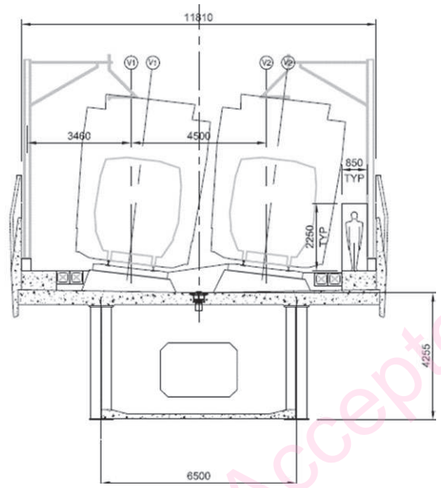


Fig.5.9_ Section - Twin girder composite deck

Code 1 – Accepted

5.2

5.2.3 Structural spans

Typically structural spans are proposed to range between 40m and 80m. Over longer spans the deck is haunched to provide additional depth over the piers, reflecting the forces acting upon the structure. This allows for a greater degree of flexibility in span, meaning that the location of supporting piers can be adjusted to suit their context.

The haunching of the deck forms simple, continuous profiles modelled to minimise bulk and visual mass. The deck soffit provides a clean, smooth and continuous curved profile between piers.

Due to the low lying nature of the viaduct, the height of the soffit above ground level is important when determining appropriate spans. Where possible, spans maximise the views and clearance beneath them.

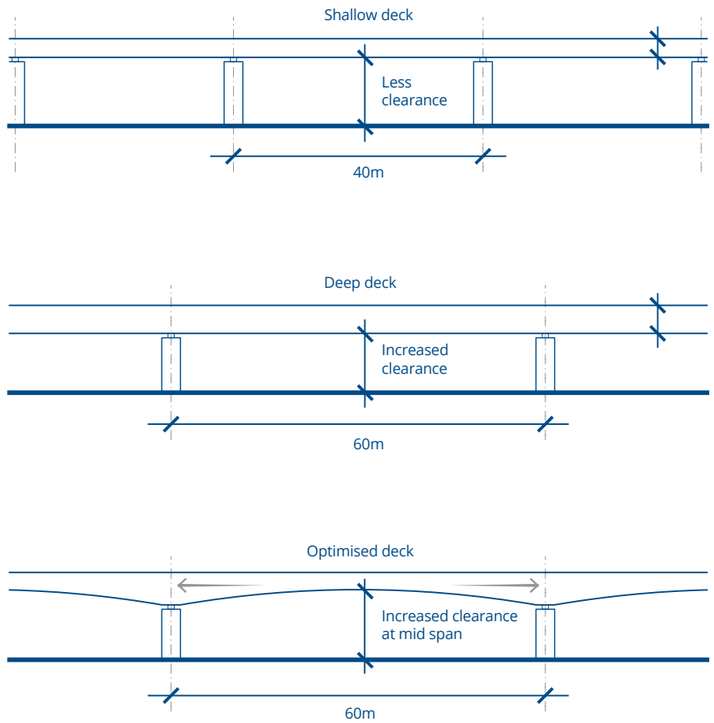


Fig.5.10_ Diagram - Haunched deck principles

5.2.4 Piers

The viaduct deck is supported on, and spans between, vertical piers that transfer loads to the ground. Their setting out has been carefully considered to respond to existing site features, character areas, and varied topography, while achieving both elegant and structurally efficient spans. Piers sizes have been minimised where possible, and are set back from the outer edge of deck structures. The aesthetic of the piers have been designed to achieve a unified language across the full length of the viaduct. Pile caps and foundations sit approximately 1m below existing ground level, ensuring piers meet seamlessly with the ground. Over water bodies the pier footings will be located under the water to ensure they are not visible.

5.2.5 Bearings

On a low viaduct the piers cannot flex enough to allow for expansion and movement within the deck (see Fig. 5.11). Movement bearings are therefore required at each pier to allow the deck to slide back and forth approximately 300mm. These bearings need to be accessible for inspection, maintenance and replacement, with a large enough surface area to allow for jacking the deck above to permit maintenance procedures. For continuity, a constant bearing zone has been used across all piers.

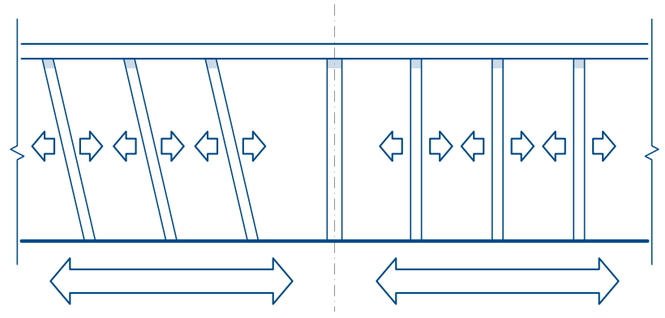
5.2.6 Abutments and approach embankments

Abutments and approach embankments are located at each end of the viaduct where the structure meets the land. At these locations, maintenance stairs are required to provide access into the viaduct deck and to track level. Sloped and planted embankments will be used to reduce the visible extent of the concrete abutment walls and stairs.

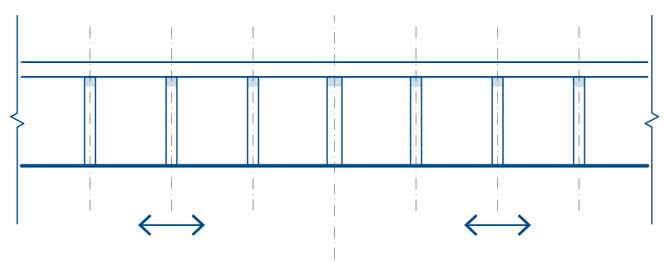
5.2.7 Construction strategy

The construction strategy is tailored to the complex and variable site conditions of the Colne Valley, minimising impact on local communities and the environment. Pre-cast concrete construction will be used for the viaduct deck, with segments transported along the deck from the north of the site as it is built. This reduces construction time, minimises environmental impact and takes a considerable amount of construction traffic off local roads. Design refinement has reduced the volume of concrete needed to construct the viaduct.

1. On a tall viaduct, piers allow for expansion and movement



2. On a lower viaduct, piers cannot flex enough for the required expansion



3. Movement bearings at the connection between deck and piers allow for expansion and movement in the deck

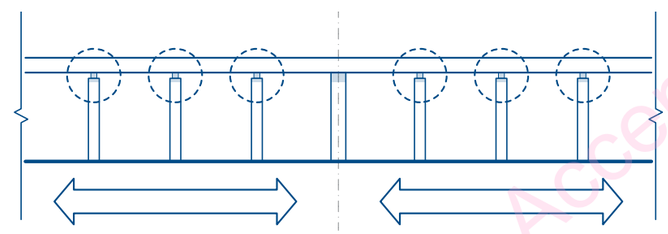


Fig.5.11_ Diagram - Bearing requirements

Code 1 – Accepted

Viaduct Deck

5.3.1 Structure

A fundamental design principle for the viaduct has been to reduce the volume of concrete required wherever possible by maximising structural efficiency. The variable depth box girder deck locates the majority of structure directly below the track, resulting in a more direct transfer of load to structure below. By optimising structural efficiency, less concrete is required within the viaduct deck, resulting in a structure with less visual mass at deck level and a reduced deck width. The benefits of a lighter structure above continue into the supporting structure, resulting in smaller piers and reduced foundations. By reducing the concrete required structurally, views of the landscape and up to the sky have been maximised.

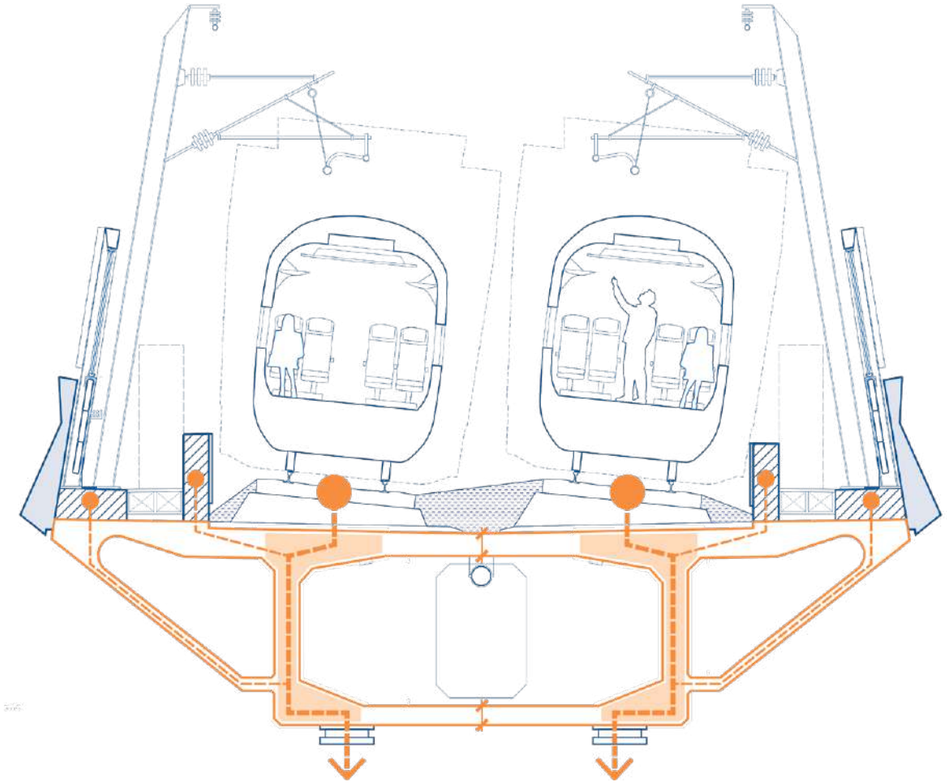


Fig.5.12_ Typical cross section - Structural principles

5.3.2 Access

The box section provides the minimum height and circulation space to allow for safe inspection, maintenance and emergency escape for a two-person stretcher (1). Openings within the side walls of the box section provide access into the voids behind the inclined deck soffits. Clear height for inspection and maintenance within this void is also provided.

At deck level, robust kerbs have been introduced close to either side of the track to improve safety in the event of a train derailment (2). Behind these, a maintenance walkway is provided for those working on the viaduct (3).

Escape from the trains will be provided either by an adjacent train pulling alongside, or directly onto the opposite track. Maintenance workers are also able to use the maintenance routes for escape.

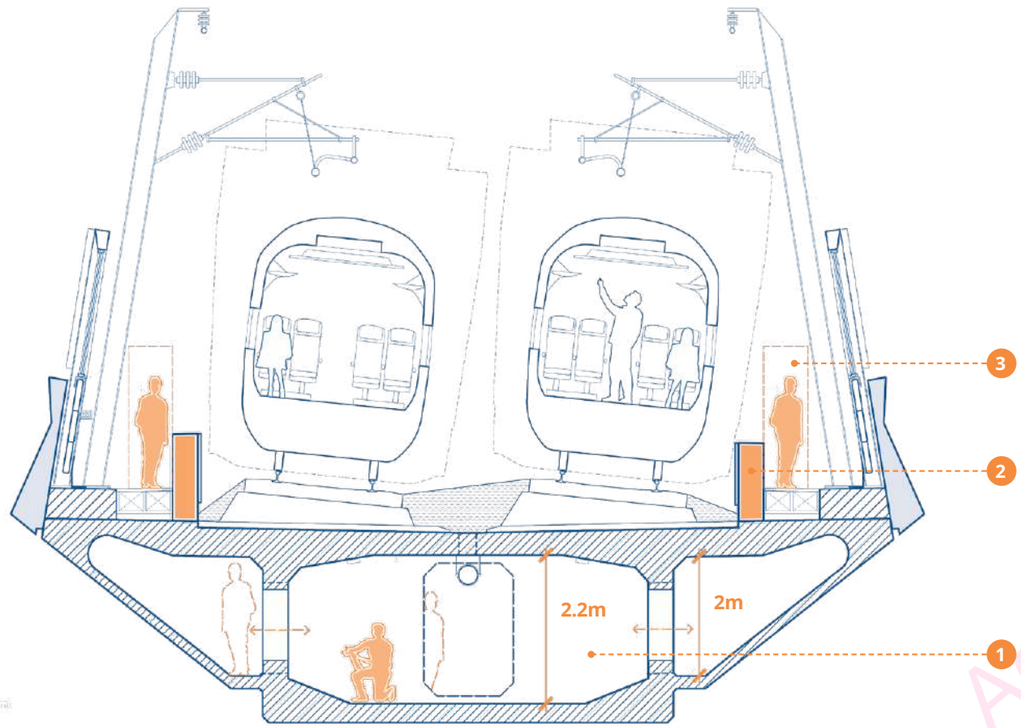


Fig.5.13_ Typical cross section - Access principles

Code 1 – Accepted

5.3

5.3.3 Appearance

A key design principle is to minimise visual impact as far as possible. As well as reducing the physical mass, the shaping of the external faces of the viaduct will have a significant effect on visual appearance. The play of light and shadow has been used to break up the structure visually. External faces are angled to pick up more daylight where possible. The inclined deck soffits reduce the visible face of the box girder, particularly where haunches are deep at wider spans (1).

A continuous concrete parapet provides a clean, simple and uninterrupted horizontal band along the entire deck (2). This 'datum' line helps to mark the break between the structure below and the lightweight deck systems above, while achieving visual continuity across the viaduct.

The noise barriers are inclined inwards to lower their apparent height from ground level, while partially transparent barriers help to reduce visual impact (3).

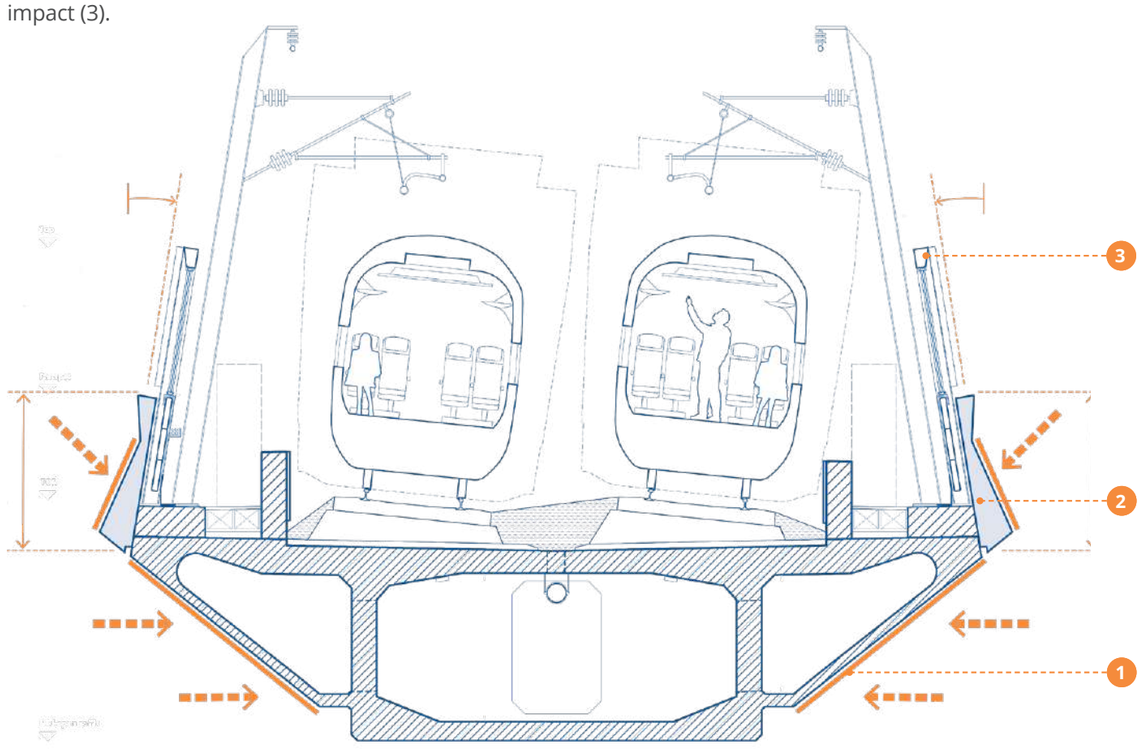


Fig.5.14_ Typical cross section - Appearance principles

5.3.4 Noise

Noise barriers extend the full length of the viaduct, on both sides of the deck, but have been designed to vary according to the acoustic requirements. The barriers are inclined and have been located as close to the tracks as possible to optimise noise protection performance (1). Where possible, transparent panels have been incorporated to provide passenger views over the landscape and reduce visual impact (2). A flexible noise barrier configuration allows the extent of opaque absorptive (3) and reflective transparent sections (2) to vary according to the different noise mitigation requirements along the viaduct. The majority of the barriers are 4m (above top of rail) in height, while a short section at the north side of the viaduct reduces to 1.65m in height. The robust kerbs also provide the opportunity to locate absorptive surface close to low level noise sources (4).

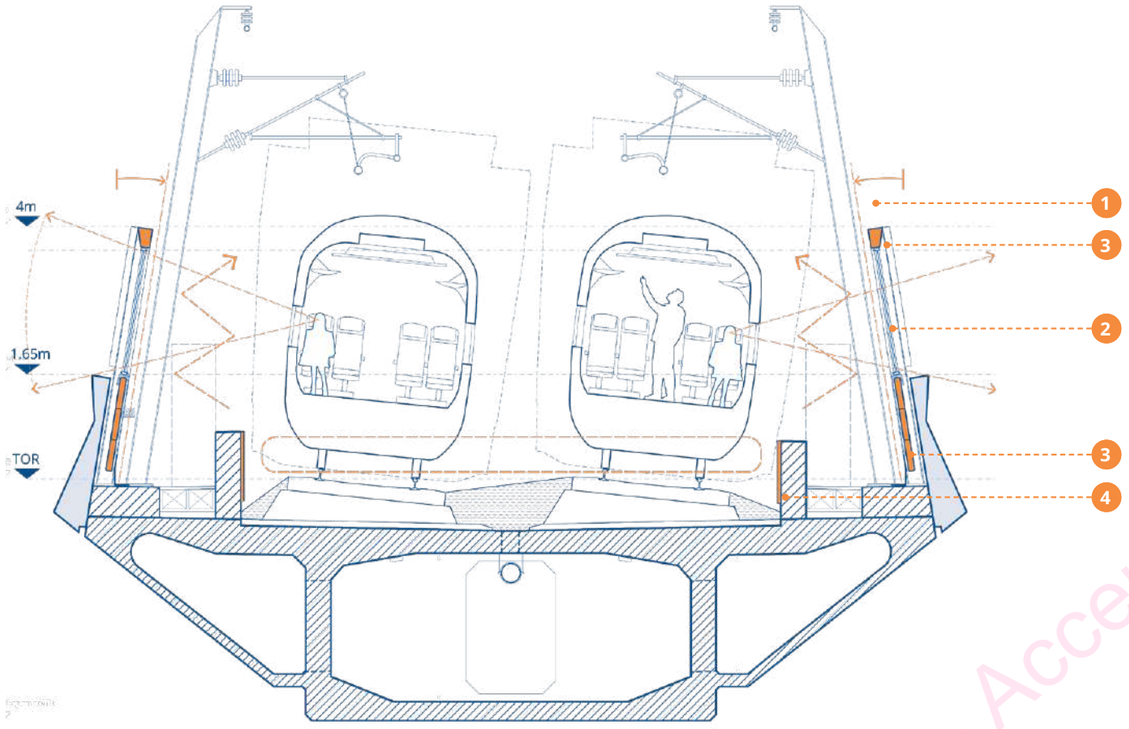


Fig.5.15_ Typical cross section - Noise principles

Code 1 – Accepted

Viaduct Deck

5.3.5 Proposed deck cross section

1. Feeder cable
2. Overhead catenary system
3. Galvanised steel OCS mast
4. Opaque absorptive noise barrier top edge
5. Transparent acrylic panel with etched black lines
6. Galvanised steel noise barrier posts
7. Galvanised steel opaque absorptive cassettes
8. Maintenance access walkway
9. Robust kerb with absorptive inner face
10. Precast concrete parapet with inward sloping sill
11. 100mm recessed drip detail
12. Cable troughs
13. Track bed
14. Viaduct drainage concealed within deck void
15. Variable-depth deck segment with inclined soffits
16. Maintenance access within inclined soffit void
17. Access through deck segments
18. Train envelope

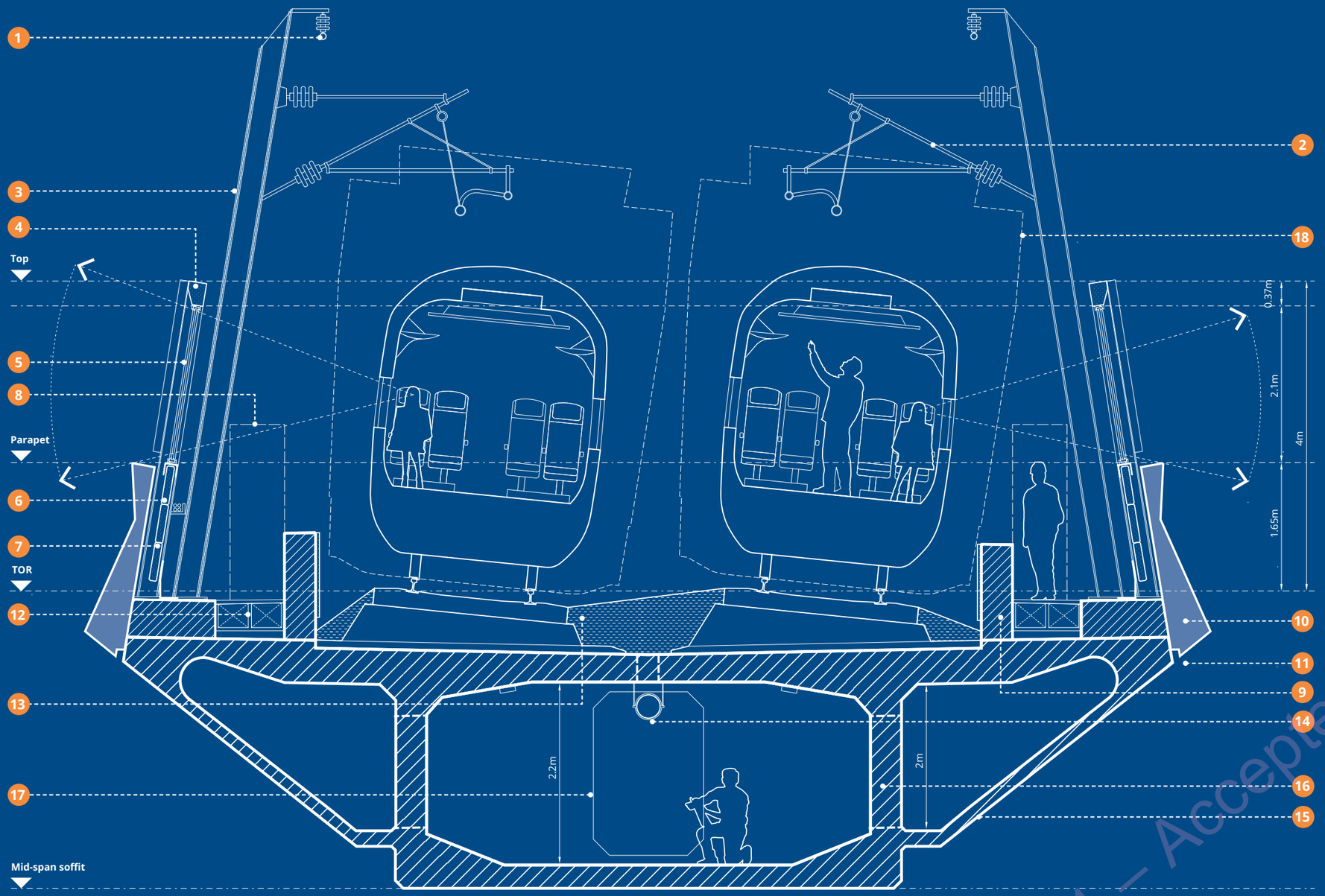


Fig.5.16_ Proposed cross section - Typical viaduct deck at mid-span

Code 1 – Accepted

5.3

5.3.6 Parapet and noise barrier

Standardised precast concrete units form a continuous parapet, providing a clean, simple and uninterrupted horizontal band along the entire viaduct deck. This helps to achieve visual continuity across the viaduct and emphasise the slight curvature of the alignment. The sill is sloped back towards the deck to prevent staining on the outer face. A top fold helps to break up the scale of the external face by adding a line of shadow along to the sill edge. The lower edge is aligned with the soffit panel to ensure a streamlined and integrated appearance with the substructure below. At the joint between the parapet and inclined soffit, a continuous 100mm drip groove controls water discharge and potential staining of the structure below.

The noise barrier design is described further in Section 5.8.

5.3.7 Inclined soffit

The inclined soffit panels minimise the apparent deck depth by reducing the shadow cast onto the box section. The soffit design is also important to ensure that the experience of viewing or passing under the structure will be as appealing as possible. The soffit panel will be cast integrally with the viaduct deck segment, providing a consistent finish, colour and joint alignment. The soffit is plain and continuous, providing visual continuity with no protrusions, gaps, or material inconsistencies.

5.3.8 Services

Rail system components such as handrails, ladders, pipes, cables, earthing straps etc., are concealed behind the parapet to ensure a clean, simple and uncluttered appearance where possible. While passengers travelling at high speed are unlikely to notice rail system components, they have been located discreetly at low level to ensure minimal visual impact when viewed from the ground.

5.3.9 Drainage

All surface drainage is dealt with by a closed system that discharges remotely from the structure. Below deck drainage pipework is concealed within the box section and the piers to minimise external clutter on the viaduct.

Fig.5.17_ Visualisation (16) - Perspective deck cross section over Harefield No.2 Lake

Code 1 – Accepted

Woodland Spans

5.4.1 Overview

The surroundings of the Colne Valley Viaduct can be broadly defined by two key character areas; woodland and water. In order to integrate with the landscape of the Colne Valley, the viaduct responds to these characteristics through its structural articulation.

The woodland areas are characterised by their sense of enclosure. Dense woodland and varied topography restricts far reaching views across the valley. Structural spans in these areas are typically shorter, providing increased clearance beneath the viaduct and greater flexibility in the position of piers by varying span lengths.

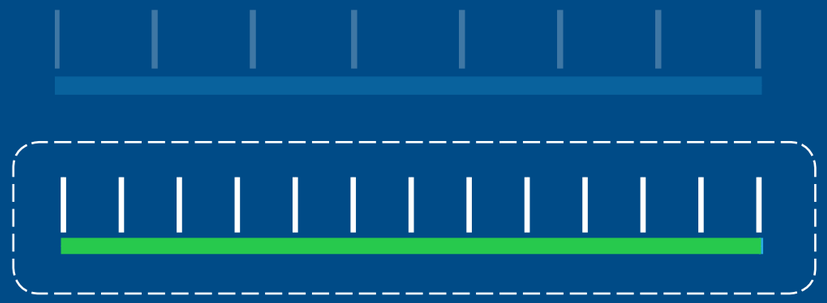


Fig.5.18_ Structural span diagram - Woodland

Fig.5.19_ Site plan - Woodland character areas

Code 1 Accepted

5.4

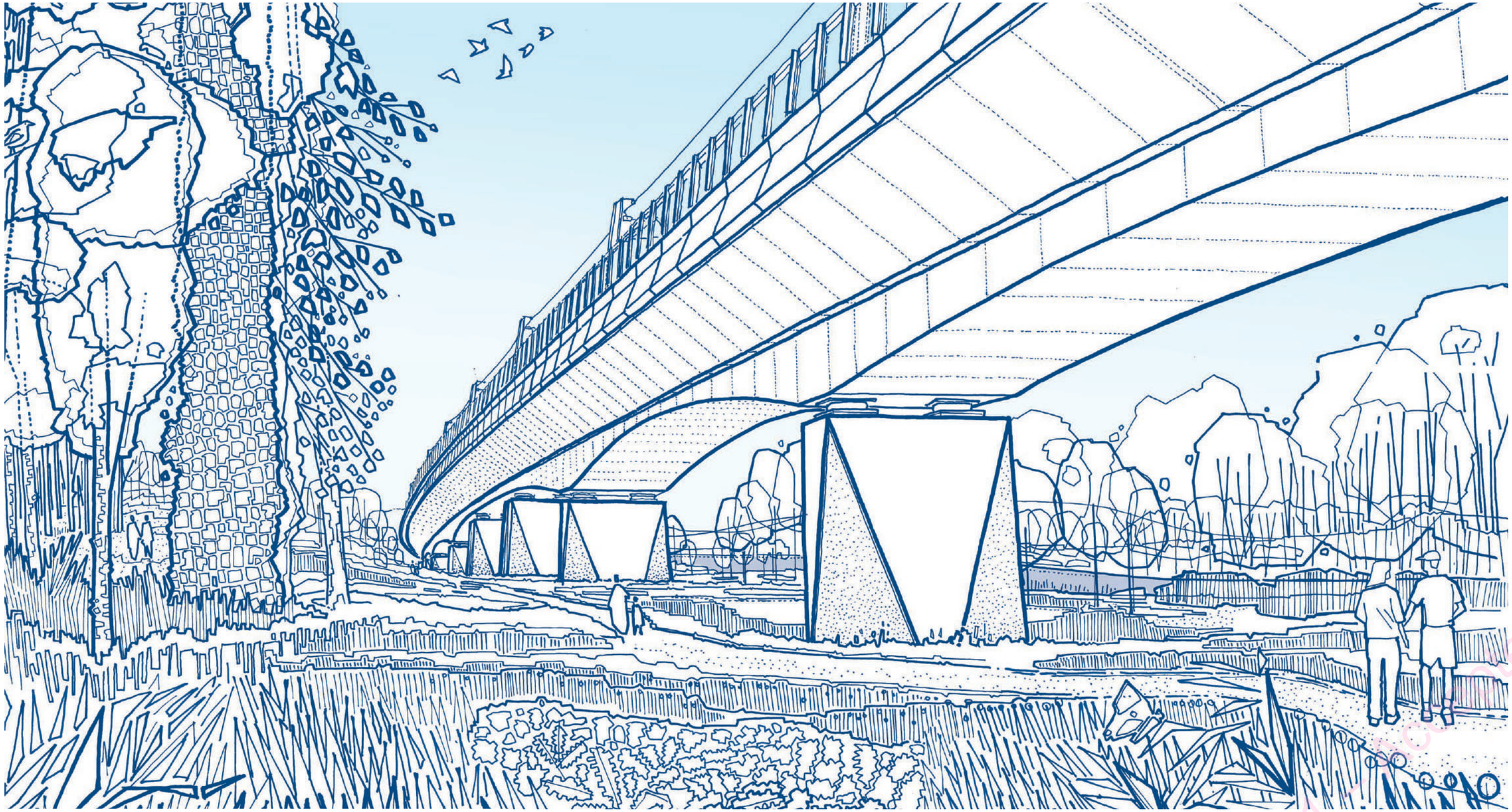


Fig.5.20_ Sketch - Woodland spans looking north near the River Colne crossing

Code 1 Not Scanned

Woodland Spans

5.4.2 Typical spans

Straight piers support the deck within woodland areas, creating typical spans between 45m and 60m. The use of a haunched deck enables a relatively shallow structural zone at mid-span, providing increased clearances underneath the structure.

Fig.5.22_ Sketch diagram - Piers part of the ground

Fig.5.23_ Sketch diagram - Span profile and rhythm

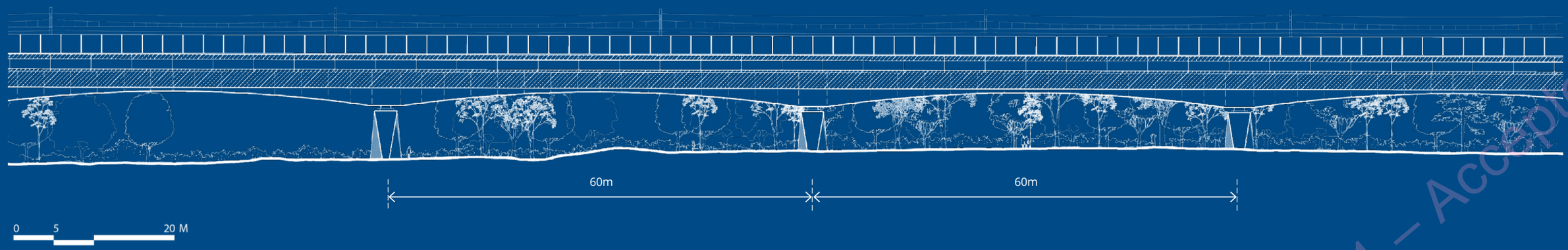


Fig.5.21_ Proposed elevation - Typical 60m spans between straight piers

Code 1 – Accepted

5.4

Fig.5.24_ Illustrative view - Typical 60m span with straight piers

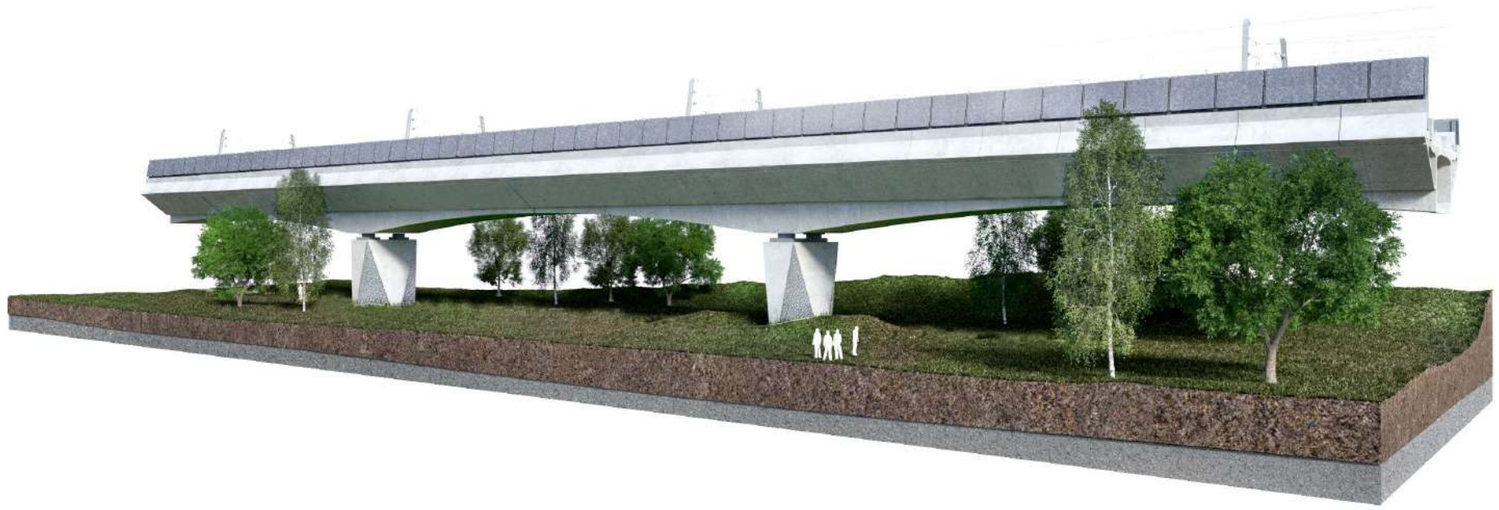


Fig.5.25_ Visualisation (5) - Woodland spans along Denham Waterski Lake

Code 1 – Accepted

Woodland Spans

5.4

5.4.3 Straight pier form

Due to the topographical variation across the site, the pier heights range from approximately 2.4m to 8.6m. Simple faceted forms with vertically orientated planes maintain a consistent appearance across all straight piers despite the varied topography. The piers taper out slightly in each direction, expressing the forces acting on them and grounding them in the landscape. In plan view the straight pier twists from a rectangular footprint at the head into a diamond-shaped footprint at the base. By tapering in the corners, the visual mass of the pier is reduced.

5.4.4 Texture

A textured concrete finish is proposed at low level where piers can be experienced close-up. Selective use of texture provides a finer grain of interest and can deter graffiti. The use of textured concrete at low level reinforces this connection with the surrounding landscape, while the smooth finish at the viaduct soffit is continued onto the pier at high level. Textured concrete finish is proposed at low level where the piers will be more susceptible to weathering and vegetation growth over time. These surfaces will weather more evenly than a smoother finish over time.

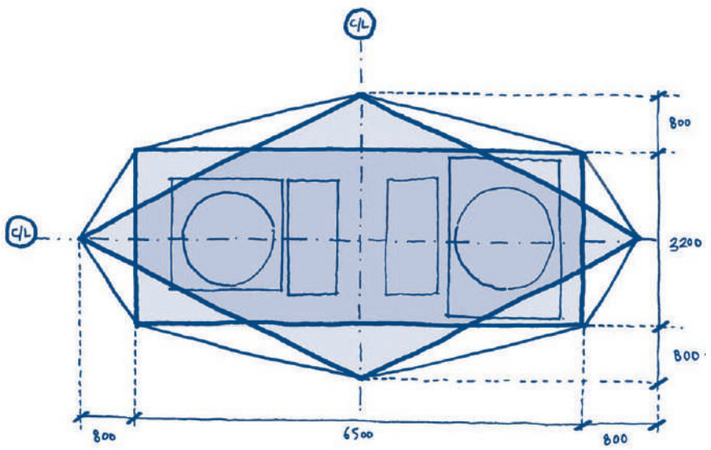
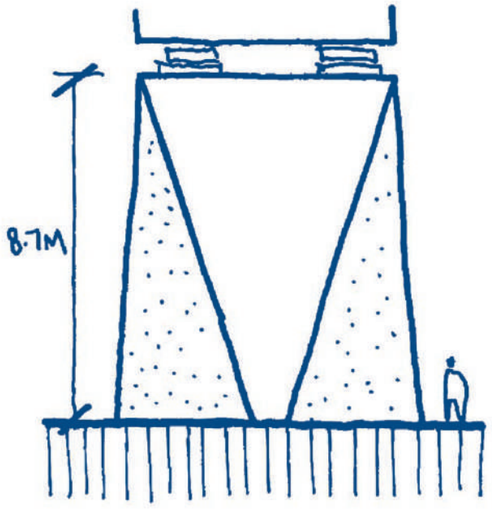


Fig.5.26_ Sketch plan - Head and base footprint



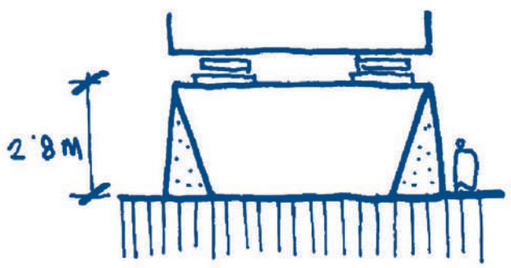


Fig.5.27_ Sketch elevations - Pier height variation

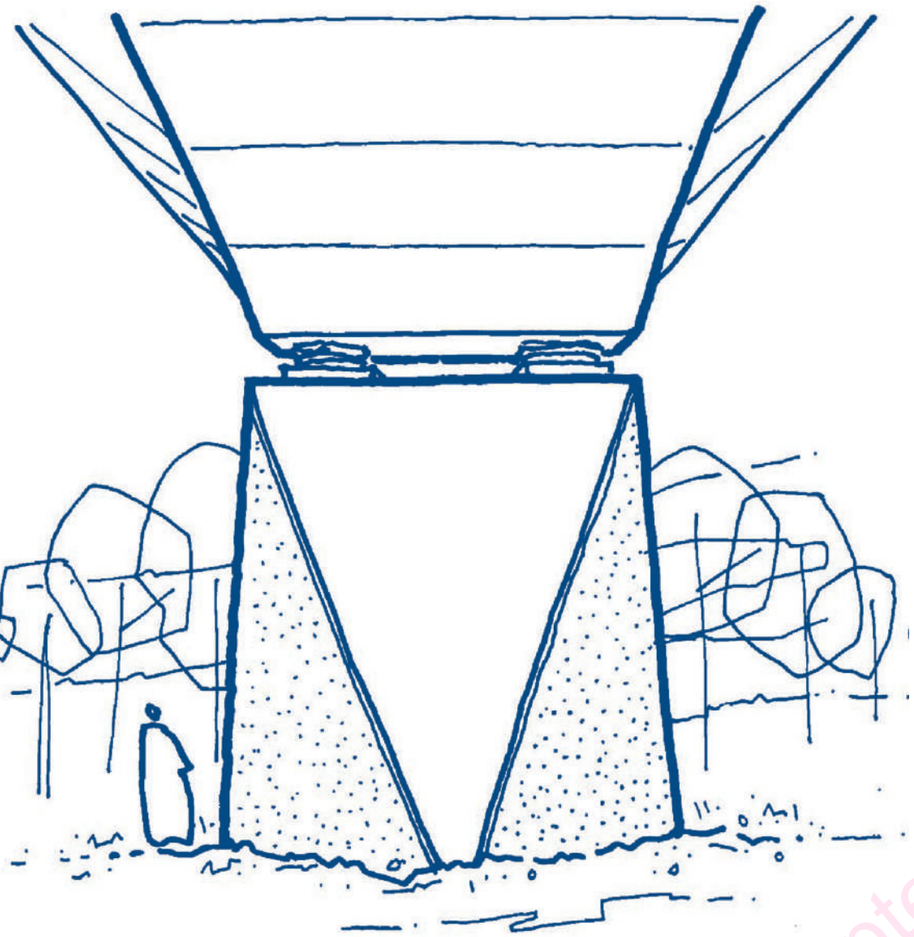


Fig.5.28_ Sketch view - Straight pier inside face

Code 1 – Accepted

Fig.5.29_ Visualisation (6) - New recreational route alongside woodland spans

Colne Valley – Accepted

Woodland Spans

5.4

5.4.5 Special Crossings - A412 North Orbital

The A412 North Orbital is a busy two-lane road with a 50mph speed limit. The road has no pavement and so is not used by pedestrians. It is largely enclosed by surrounding woodland on either side.

The viaduct approaches the road at a skewed alignment, running almost parallel with the highway to the south. A long stretch of the viaduct is therefore highly visible along the A412, particularly as tree clearance in proximity to the viaduct results in reduced screening of the structure.

An 80m span is required to cross over the A412. Cantilevered construction methods are used to build the viaduct deck, allowing segments to be assembled from each pier, minimising construction impact on the road. Refer to section 8.1.3 for more detail on the proposed construction method.

In order to accommodate visibility splays from the highway for passing vehicles, the inside face of the woodland piers either side of the road have been reshaped accordingly. This creates a unique pair of piers which distinguish the A412 crossing as a key site intersection. The faceted form and use of triangular faces retain a consistent language with other piers.

A vehicle restraint barrier either side of the road is required to protect each of the piers from vehicle collisions.

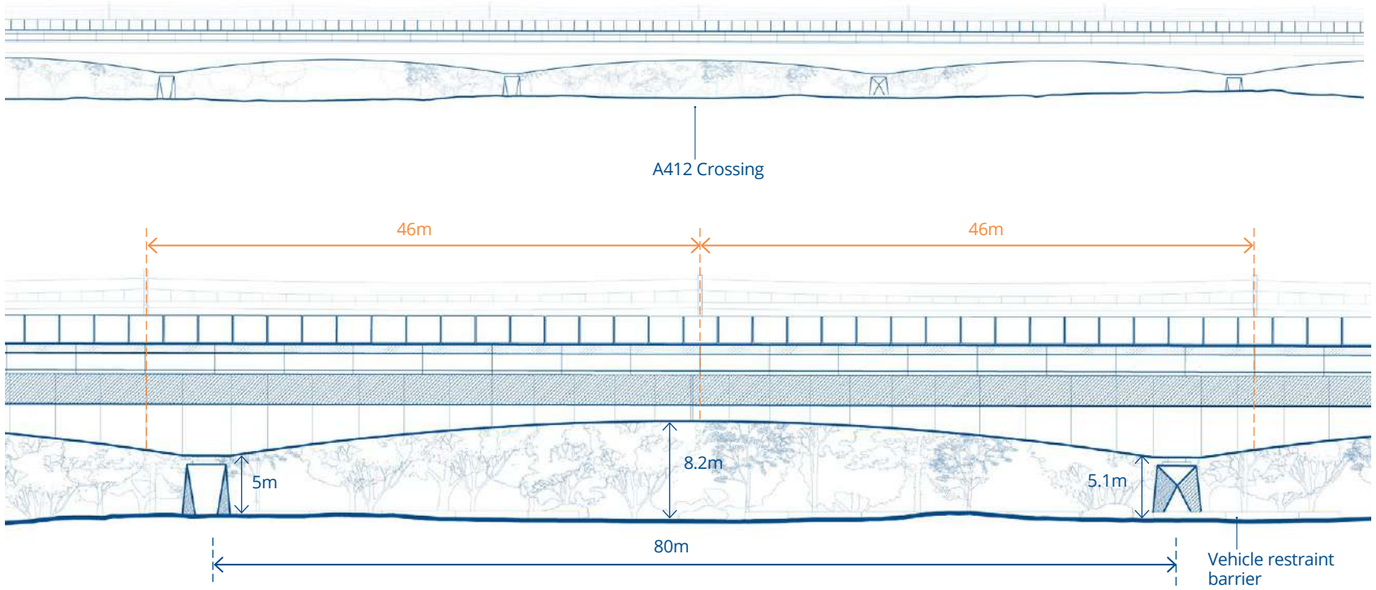


Fig.5.30_ Proposed south elevations - A412 crossing

Fig.5.31_ Visualisation (4) - Looking north from the A412

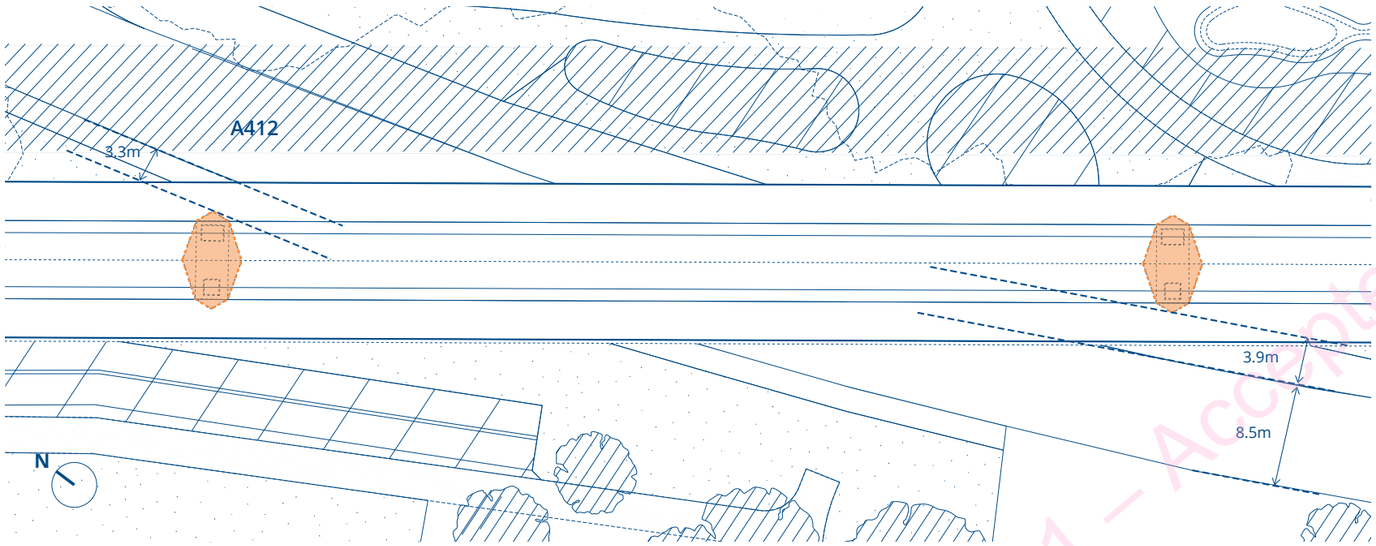


Fig.5.32_ Proposed plan - A412 crossing

Code 1 – Accepted

Fig.5.33_ Visualisation (2) - A412 crossing looking south

Code 1 – Accepted

Woodland Spans

5.4

5.4.6 Special Crossings - River Colne

The viaduct crosses the River Colne west of Korda Lake within an enclosed woodland area. In order to minimise impact on the river and its immediate wetland environment, an 80m structural span is proposed to ensure piers are located on land either side of the river. This will minimise the realignment of the watercourse and will allow the continuation of wetland planting on each of the river banks, preserving its enclosed, intimate character.

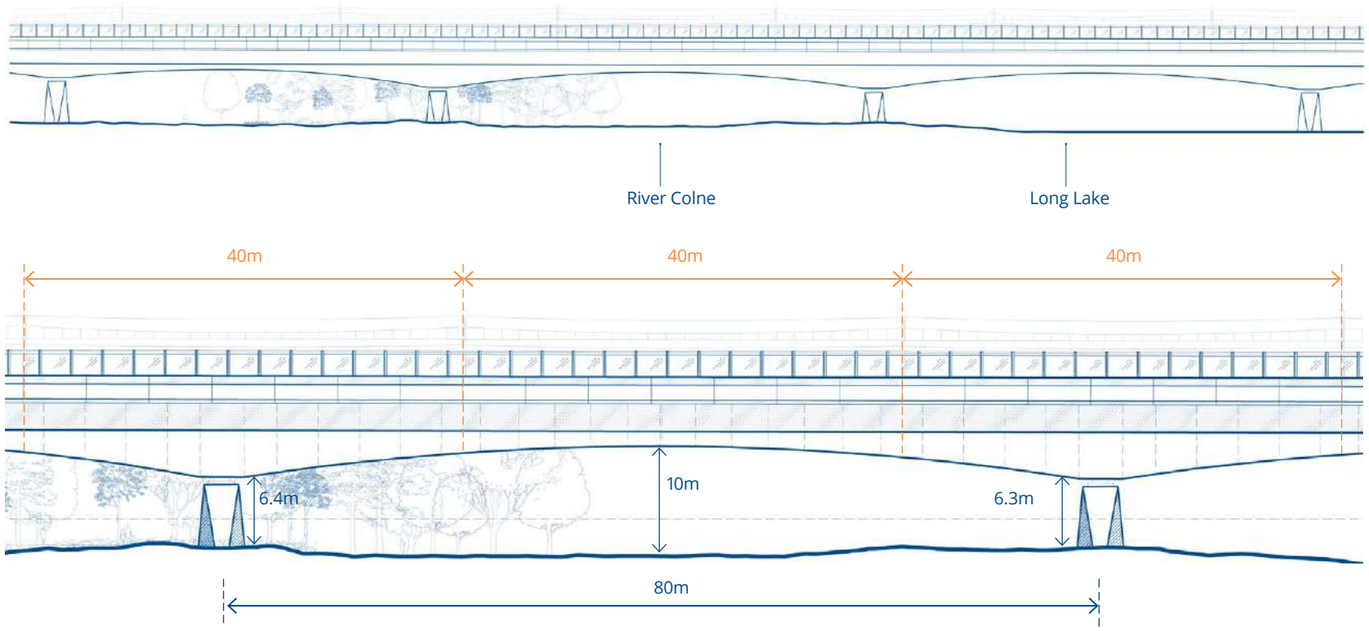


Fig.5.34_ Proposed south elevations - River Colne crossing

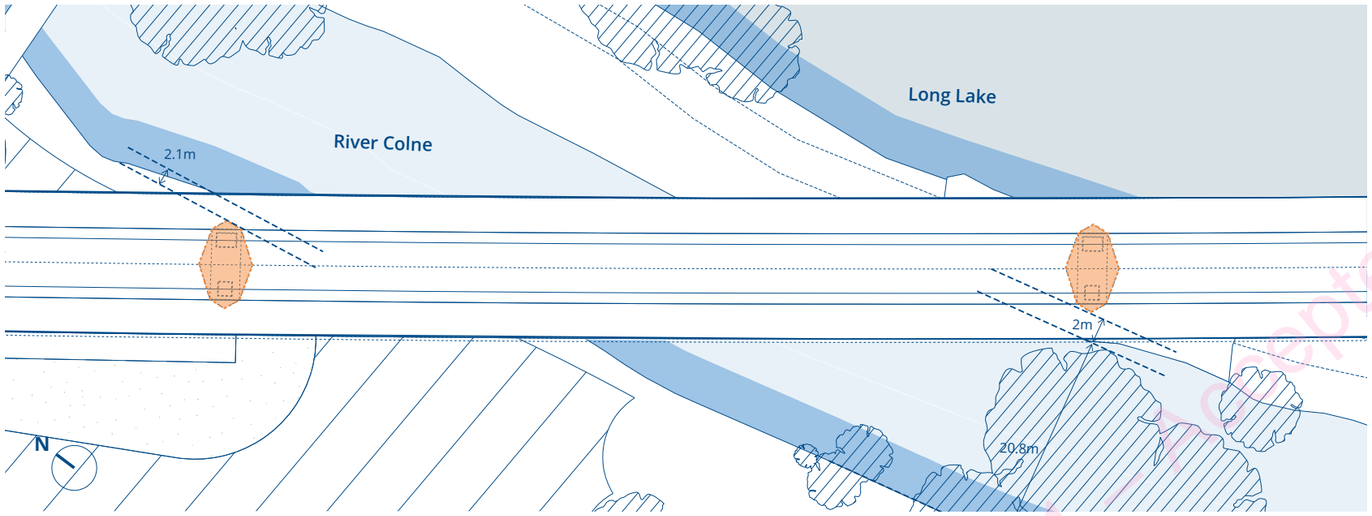


Fig.5.35_ Proposed plan - River Colne crossing

Code 1 Incorporated

Fig.5.36_ Visualisation(7) - River Colne crossing looking north

Code 1 – Accepte

Water Spans

5.5.1 Overview

The water spans are located over lakes which are intersected by roads, the Grand Union Canal and the River Colne. In contrast to the enclosed woodland areas, lakes provide expansive open views towards the surrounding landscape from various vantage points. The structural spans over water are extended in length to preserve these open landscape views.

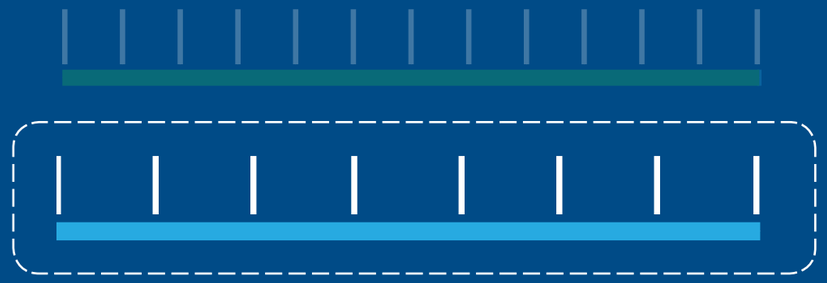


Fig.5.37_ Structural span diagram - Water

Fig.5.38_ Site plan - Water character areas

Code 1 – Accepted

5.5

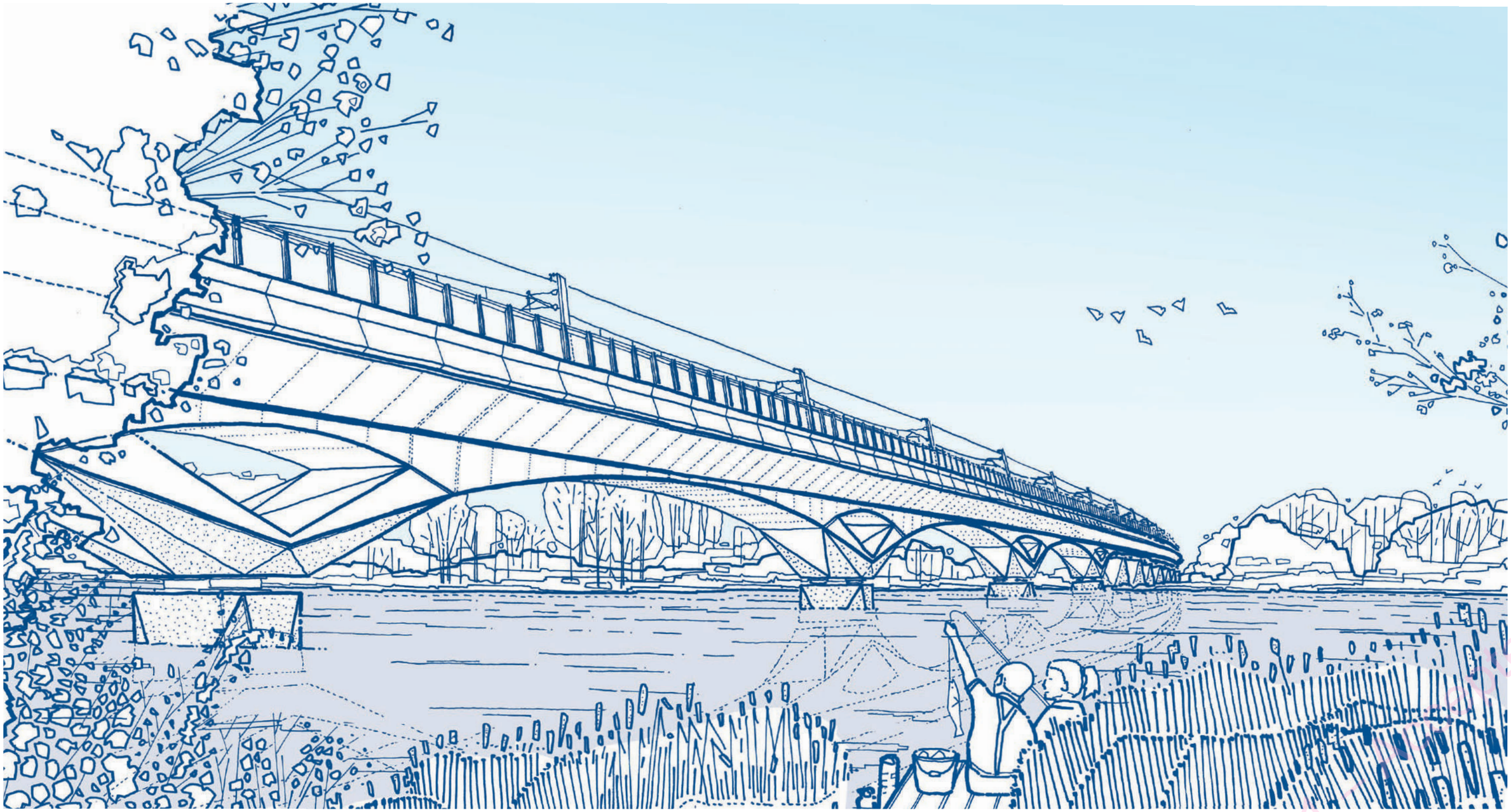


Fig.5.39_ Sketch - Korda Lake crossing looking east

Code Not Approved

Water Spans

5.5.2 Extended spans

A major challenge has been achieving a structure that skims lightly across the lakes. The technical requirement for movement bearings to be above flood risk levels has a fundamental impact on the length that can be achieved in the longer spans over the water and the geometry of the special supports. Considerable design effort has been spent on achieving an elegant and refined structure, with special focus on the rhythm of the spans and reducing visible mass of the structure.

Fig.5.40_ Sketch diagram - Extended span

Fig.5.41_ Sketch diagram - Silhouette

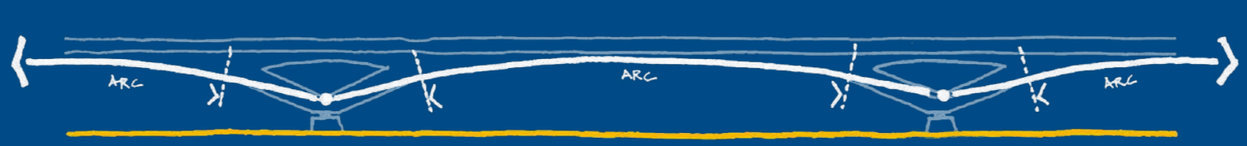


Fig.5.42_ Sketch diagram - Span profile and rhythm

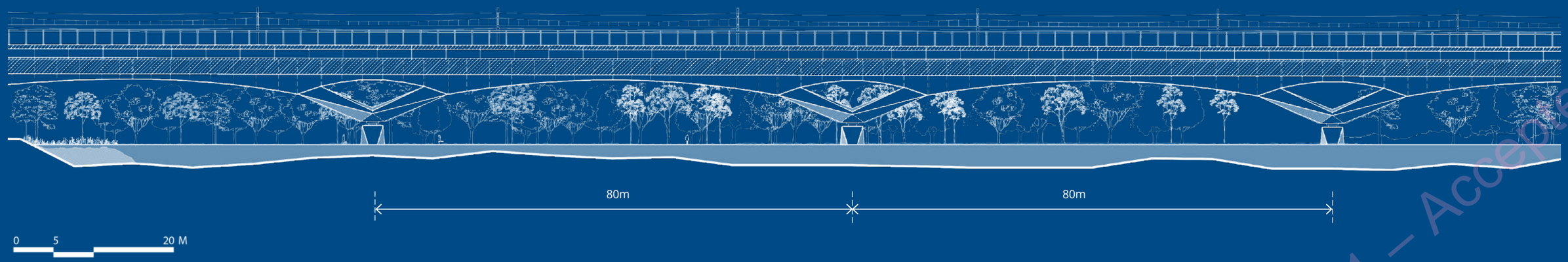


Fig.5.43_ Proposed elevation - Extended spans over Korda Lake

Code 1 – Accepted

5.5

Fig.5.44_ Illustrative view - Typical arch form deck span

Fig.5.45_ Visualisation (14) - Looking north across Harefield No.2 Lake

Code 1 – Accepted

Water Spans

5.5

5.5.3 Arch form deck

Arch form deck structures enable extended 80m spans over water, preserving openness and expansive landscape views. A shallow arc profile helps to stretch the perceived span distance and create a sense that the structure is 'bouncing' at speed over the water. The arch form deck creates a distinctive and dynamic structure spanning across the lakes.

An important design driver has been to achieve visual continuity between the gentle arc profile of the deck and the v-shaped legs. Continuity has been achieved by introducing a straight tangent line from the arc to the centre of the v-profile. Faceted planes are used to manipulate light and shadow, defining a slender silhouette profile. Shadow and texture make the lower parts of the structure appear darker and visually recessive when viewed against the water and woodland beyond. The underside and top faces are broken up by triangulated folds, with alternating smooth and textured finishes to the underside.

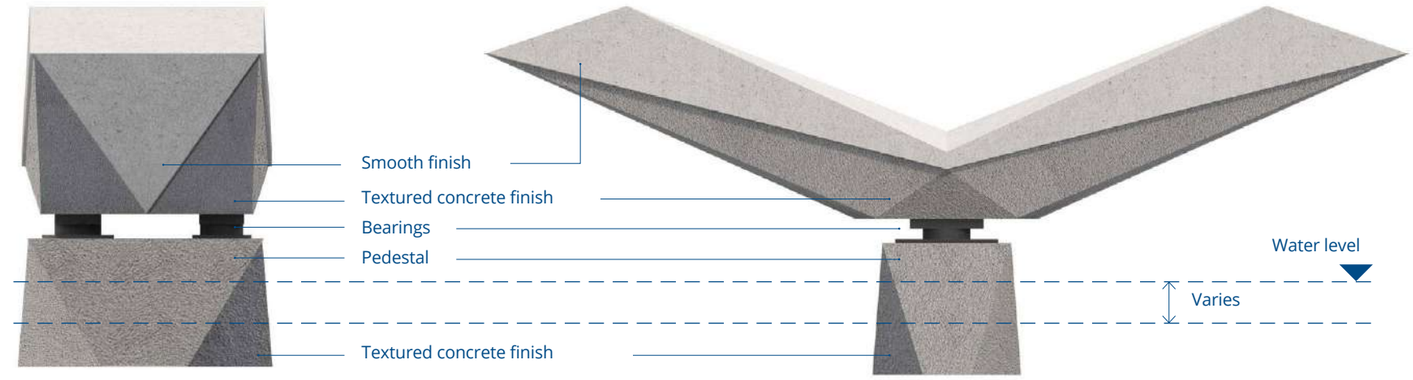


Fig.5.46_ Proposed elevations - Arch form deck and pedestal

5.5.4 Bearings

As explained in Section 5.2.5, movement bearings are required at each intermediate pier to allow the deck to slide back and forth approximately 300mm. These bearings need to be accessible for inspection, maintenance and replacement. In order to maximise the longevity of the bearings, the bearing plate should not be subject to any wear from friction created by movement. If any sediment and/or debris carried within flood water finds their way onto the bearing surface, they can become embedded and act as abrasives as the bearing moves, causing the bearing plate will degrade over time and require replacement. In order to protect the bearings from flood water, the proposed height of the bearing plate is typically located a minimum of 100mm above the 1 in 100 year flood levels, including an allowance for climate change.

5.5.5 Pedestal design

Despite water level variance across the lakes, the form of the pedestal has been kept consistent to ensure visual continuity of the arch form deck and span profile. The form of the pedestal is simple and compact and its shaping creates a visual relationship with other piers. To disguise the variance in pedestal heights as far as possible, the textured concrete surfaces create a darker appearance, allowing it to become less visually prominent when viewed against the water. Textured concrete is also used to better disguise staining from water level variation and weathering.

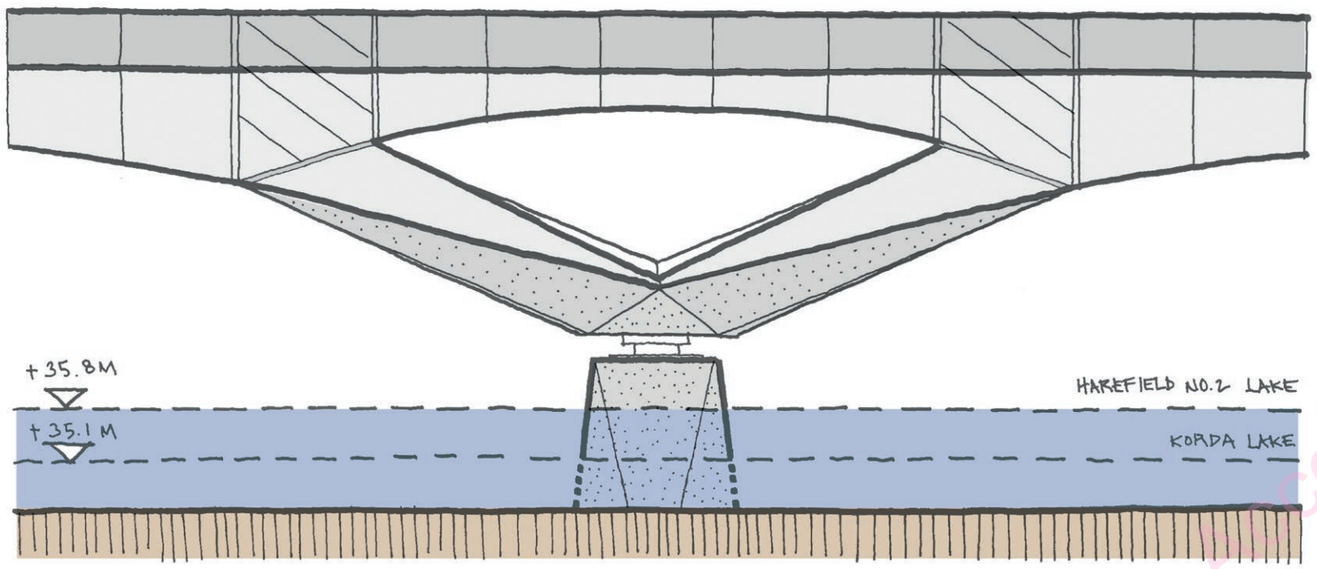


Fig.5.47_ Sketch view - Arch form deck and water level variance

Code 1 – Accepted

Fig.5.48_ Visualisation (8) - Looking north across Korda Lake

Colne Valley Viaduct

Fig.5.49_ Visualisation (12) - Looking south across Harefield No.2 Lake

Code 1 – Accepted

Special Structures

5.6.1 Overview

A sequence of special engineering structures are required along the viaduct. Fixed buttresses transfer braking loads to the ground while expansion portals allow for thermal expansion and are aligned with rail expansion joints at approximately 900m intervals. The structural span and pier forms at these locations are unique to intermediate sections of the viaduct in both their function and form, visually expressing these locations as key site features in the landscape.

Fig.5.50_ Diagram - Alternating fixed buttresses and expansion portals

Fig.5.51_ Diagram - Special structures marked as key features in the landscape

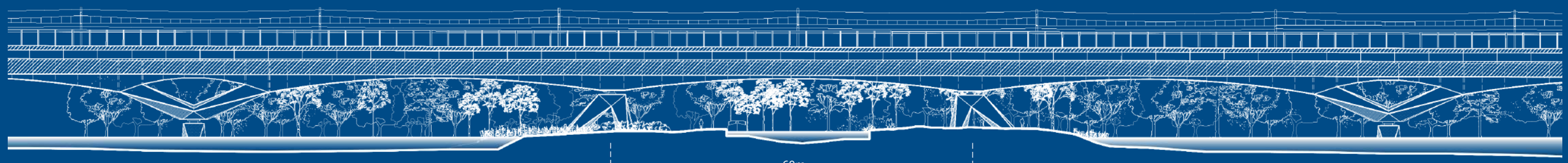


Fig.5.52_ Proposed elevation - Fixed buttress span at Grand Union Canal

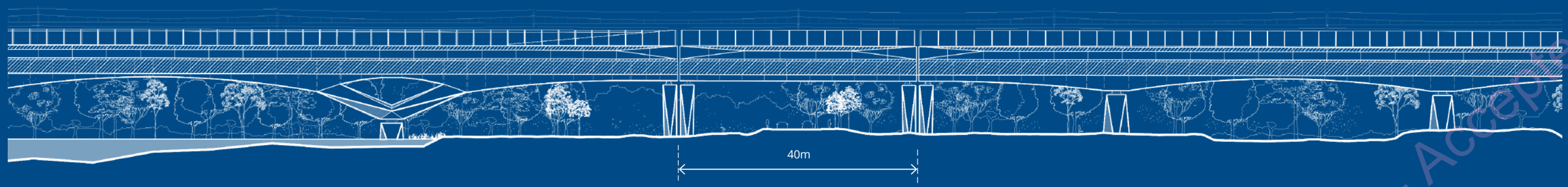


Fig.5.53_ Proposed elevation - Expansion portal at Moorhall Road

0 5 20 M

Code 1 – Accepted

5.6

5.6.2 Response to site features

These special structures have been strategically located at key intersections with the landscape;

1. Denham Waterski Lake - Fixed buttress
2. Woodland crossing adjacent to the River Colne - Expansion portal
3. Korda Lake perimeter track - Fixed buttress
4. Moorhall Road - Expansion portal
5. Grand Union Canal - Fixed buttress
6. Harefield No.2 Lake perimeter footpath - Expansion portal

By expressing these locations as special structures, the proposals establish a combined structural and contextual logic which responds to specific site features. These conditions will also define focal points for new and enhanced landscape features such as amenity areas and routes within the Colne Valley Regional Park.

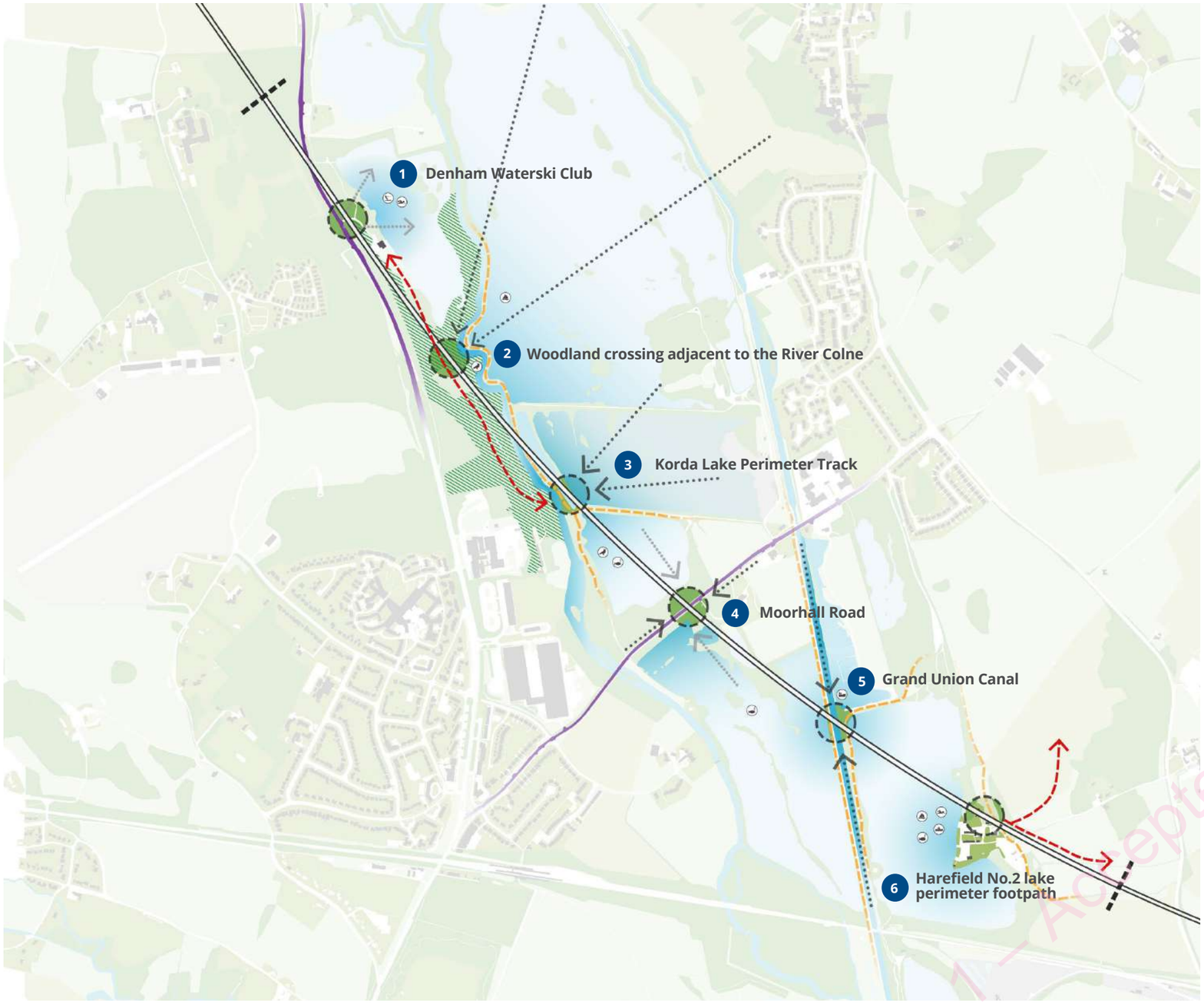


Fig.5.54_ Site plan - Location of fixed buttresses and expansion portals

Code 1 — Accepted

Special Structures

5.6.3 Fixed buttress piers

The fixed buttress is a single span portal, fully integrated to the viaduct module. Each fixed buttress support is composed of an internal concrete support and an external inclined concrete support. The fixed buttresses are generally located at the centre of the viaduct deck modules.

The pair of fixed buttress piers appear as trestle legs supporting the deck above, expressive of the horizontal forces that are acting upon them.

Careful crafting of the pier form helps to reduce visual bulk and emphasise slenderness. A textured concrete finish is applied to the inner faces at low level, emphasising the notion that the pier is part of the ground.

Fig.5.57_ Illustrative view - Fixed buttress span over the Grand Union Canal

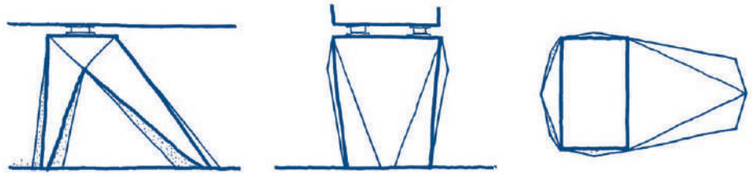


Fig.5.55_ Sketch - Fixed buttress pier elevations and plan view

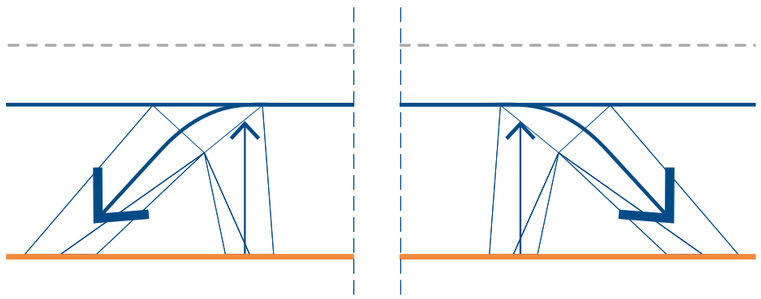


Fig.5.56_ Structural diagram - Fixed buttress span

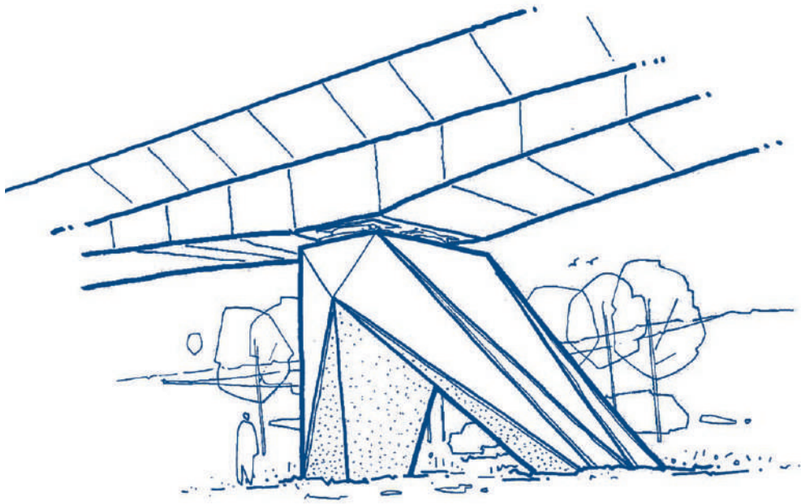


Fig.5.58_ Sketch - Illustrative view of fixed buttress pier

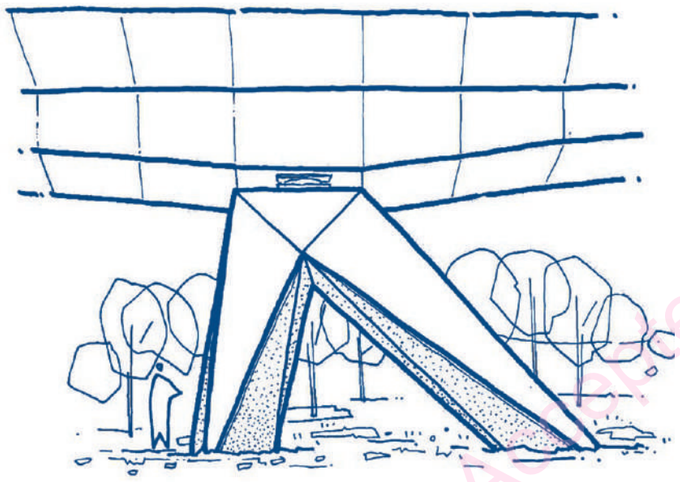


Fig.5.59_ Sketch - Illustrative view of fixed buttress pier

Code 1 – Accepted

5.6

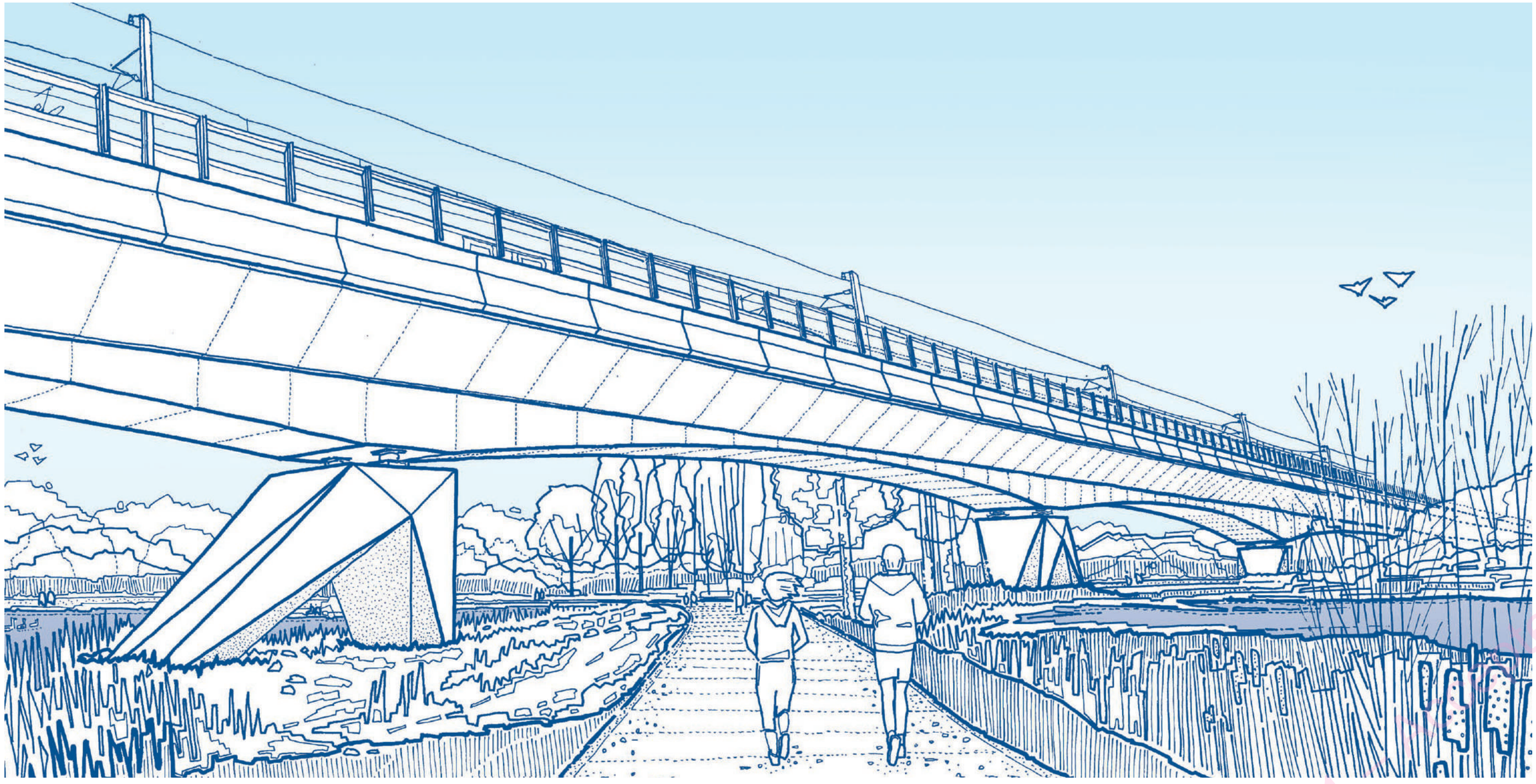


Fig.5.60_ Sketch view - Looking north from Korda Lake perimeter track

Code 1 Unrestricted

Special Structures

5.6

5.6.4 Grand Union Canal crossing

The viaduct crossing over the Grand Union Canal is an important location that demands special attention due to its recreational value. The current condition is characterised by a predominantly enclosed visual corridor lined by trees, hedges and low level wetland planting.

To preserve this sense of enclosure as much as possible, the fixed buttress piers are set back behind the existing tree line to form a single clear span over the canal. This reduces the visual impact when approaching the crossing from either the tow path or canal itself. The offset of the piers from the canal edge allows the continuation of a 'soft edge' to the eastern edge of the canal, ensuring continuity of the low level wetland planting indigenous to the canal.

The span achieves a balance between setting back the piers from the canal while also minimising the structural depth of the deck and increasing views and clearance beneath. The profile of the underside of the deck forms a gentle curve which springs from each of the fixed buttress piers.

The location of fixed buttress structures help to distinguish the crossing as a key feature within the Colne Valley. Closer-up, the pair of fixed buttresses appear as trestle legs supporting the deck above, expressive of the horizontal forces acting upon them. Their faceted form emphasises slenderness by manipulating light and shadow cast on the structure. The textured concrete finish helps to emphasise this contrast, while also providing texture at low level that can be experienced up close by passers-by.

The Overhead Line Equipment (OHLE) masts are located at the mid-point of the span. The 40m mast spacing is continued across each of the spans over water either side of the canal, reinforcing a sense of symmetry and rhythm to this part of the viaduct.

Please refer to Section 6 Landscape Design for more information regarding the landscape design in proximity to the canal crossing.

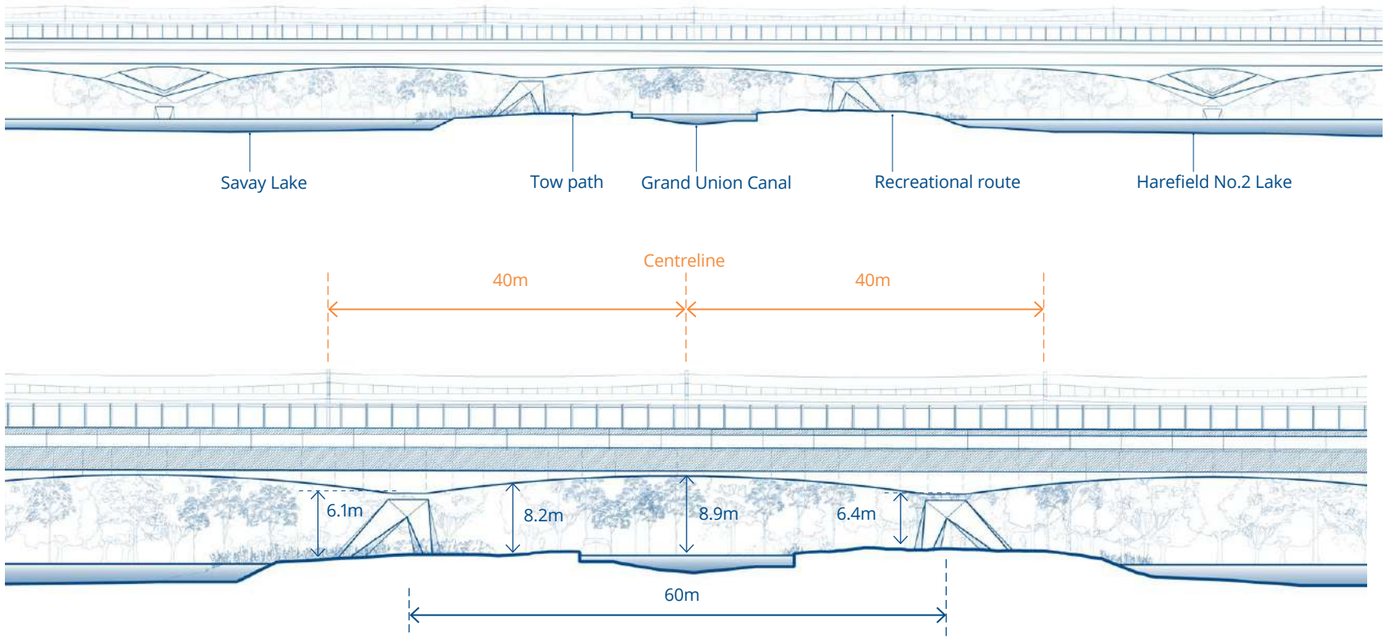


Fig.5.61_ Proposed south elevations - Grand Union Canal crossing

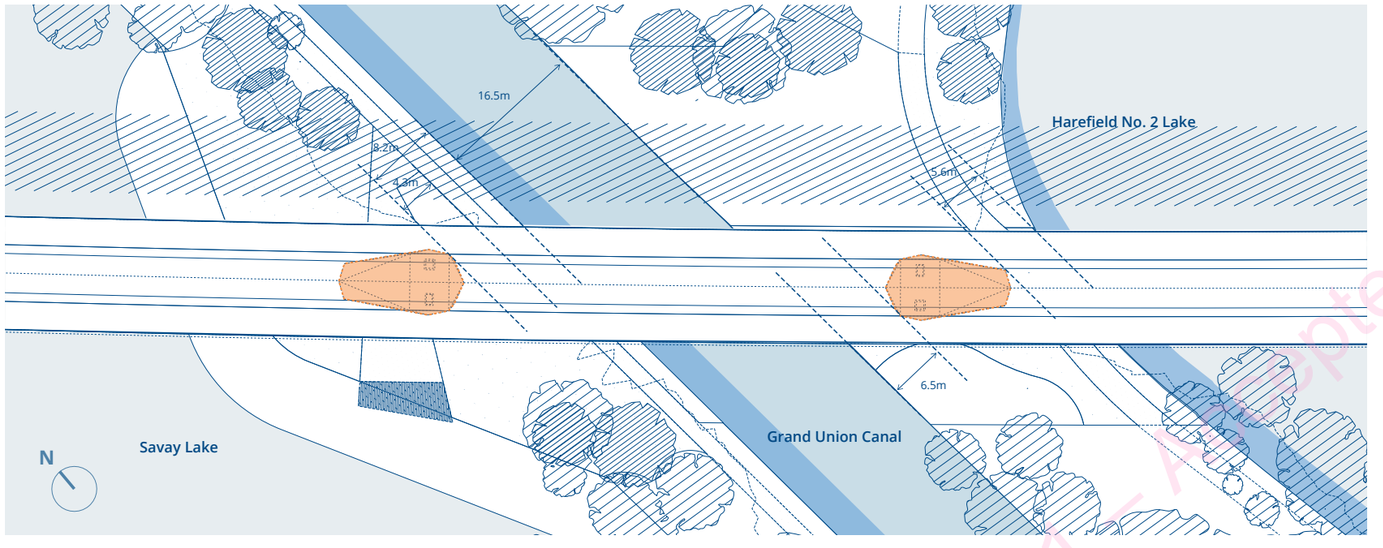


Fig.5.62_ Proposed plan - Grand Union Canal crossing

Code 1 - Accepted

Fig.5.63_ Visualisation (11) - Grand Union Canal crossing looking north

Code 1 – Accepted

Special Structures

5.6.5 Expansion portal piers

The expansion portal is an independent single span portal with expansion joints at both ends. Each expansion pier is composed of two slim and parallel concrete supports. The internal piers support the independent single span, while the external wall supports the adjacent viaduct module end span.

A 350mm gap between the deck modules and the two walls of the expansion pier is maintained to allow the end of the viaduct module to expand and contract to reduce rail / structure interaction issues.

While the form of the pier is highly dependent on structural requirements, its form achieves symmetry and reduces visual bulk where possible. Similarly to other piers, a textured concrete finish at low level is used to help ground the piers in the landscape and express a more slender silhouette.

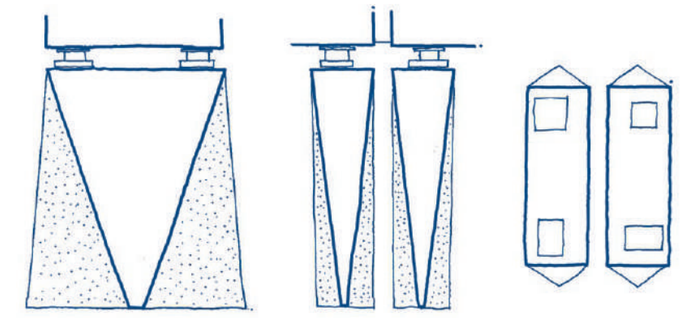


Fig.5.64_ Sketch - Expansion portal pier elevations and plan view

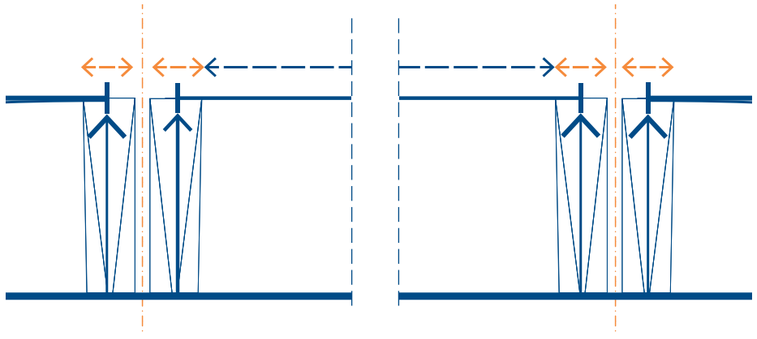


Fig.5.65_ Structural diagram - Expansion portal span

Fig.5.66_ Illustrative view - Expansion portal over Moorhall Road

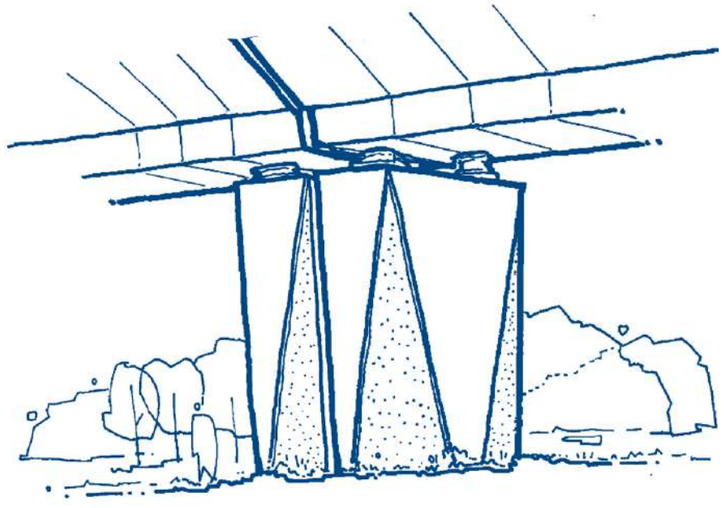


Fig.5.67_ Sketch view - Expansion portal pier

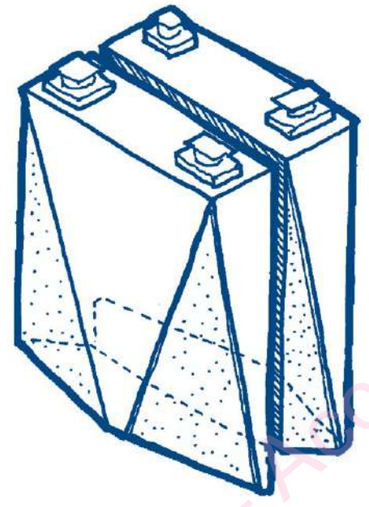


Fig.5.68_ Sketch diagram - Expansion portal pier

Code 1 – Accepted

5.6

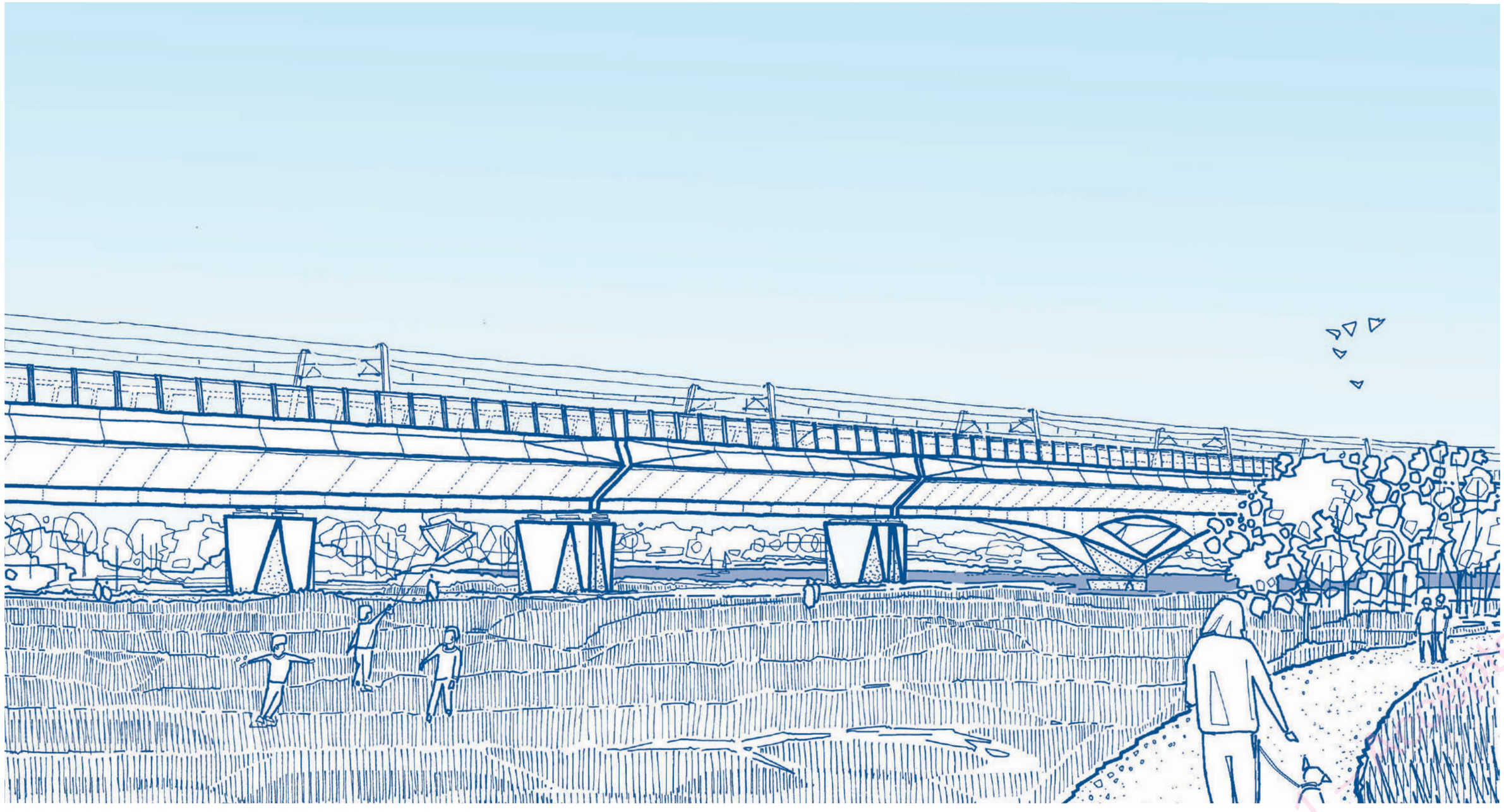


Fig.5.69_ Sketch view - Looking south from Harefield Lake No2 perimeter footpath

Code 1 Limited

Special Structures

5.6

5.6.6 Moorhall Road Crossing

The viaduct crossing over Moorhall Road is a highly visible intersection within the Colne Valley, The expansion joint span provides the opportunity to locate special pier structures either side of the road, distinguishing the crossing as a key site feature. Currently the road is largely enclosed by woodland and hedges, creating an enclosed visual corridor with long axial views. The perpendicular crossing of the road limits the footprint of the viaduct and the extent of the viaduct visible from Moorhall Road. The footpath to the east of the road is infrequently used by pedestrians so the viaduct is predominantly experienced at speed from passing vehicles.

Here the special span is distinguished from others by its continuous depth to the underside of the deck; the reduced span length of 40m negates the requirement for a haunched deck. The span is centred on the road to achieve symmetry and frame distant axial views. This symmetry is reinforced by the Overhead Line Equipment (OHLE) mast set out, which is centred on the structural span. The 40m span minimises structural deck depth, maximising clearance below the soffit and permitting more daylight and views beneath. The piers are set back from the kerb to reduce visual impact when approaching along the road or footpath. The pier locations allow for the continuation of low level planting in front, softening the appearance of the piers as they meet the ground.

While the viewing corridor along Moorhall Road will remain largely enclosed by existing trees and low level hedges, new views over Korda and Savay Lake will open up around the viaduct.

Please refer to Section 6.10.2 Landscape Design for more information regarding the landscape design in proximity to the road crossing.

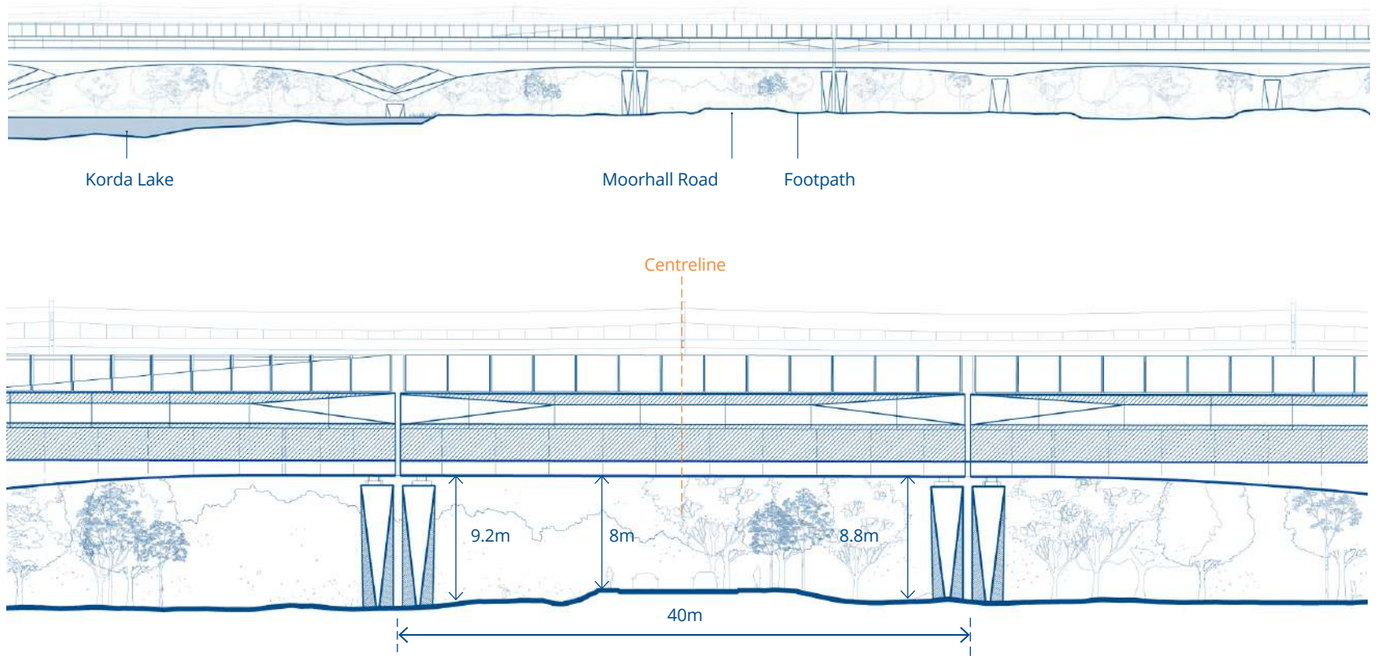


Fig.5.70_ Proposed south elevations - Moorhall Road crossing

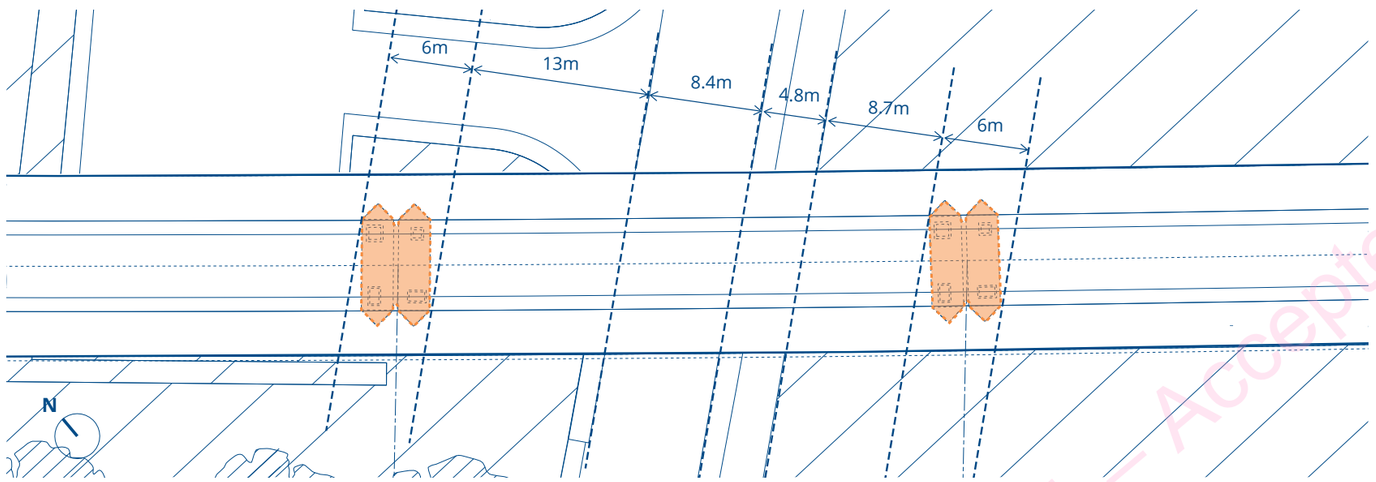


Fig.5.71_ Proposed plan - Moorhall Road crossing

Code 1 – Accepted

Fig.5.72_ Visualisation (9) - Moorhall Road crossing looking south

Code 1 – Accepted

Abutments & Approach Embankments

5.7.1 Overview

A key design principle for the abutments and approach embankments is to clearly express the viaduct emerging from the surrounding landscape. The parapet line is continued above the abutment walls, reducing the visual dominance of the abutment and making the viaduct appear longer and more elegant.

The extent of visible vertical abutment walls is minimised by the planted sloped embankments and concrete flank walls. The raised embankments also conceal visual clutter associated with the maintenance stairs either side of the viaduct, allowing guarding to be fixed to the inside face of retaining walls.

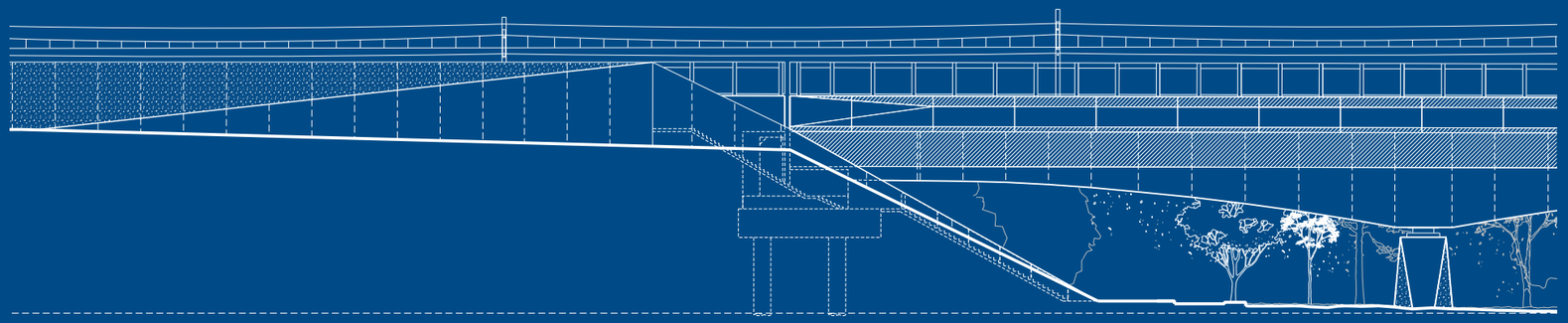


Fig.5.73_ Proposed south elevation - North abutments and approach embankments

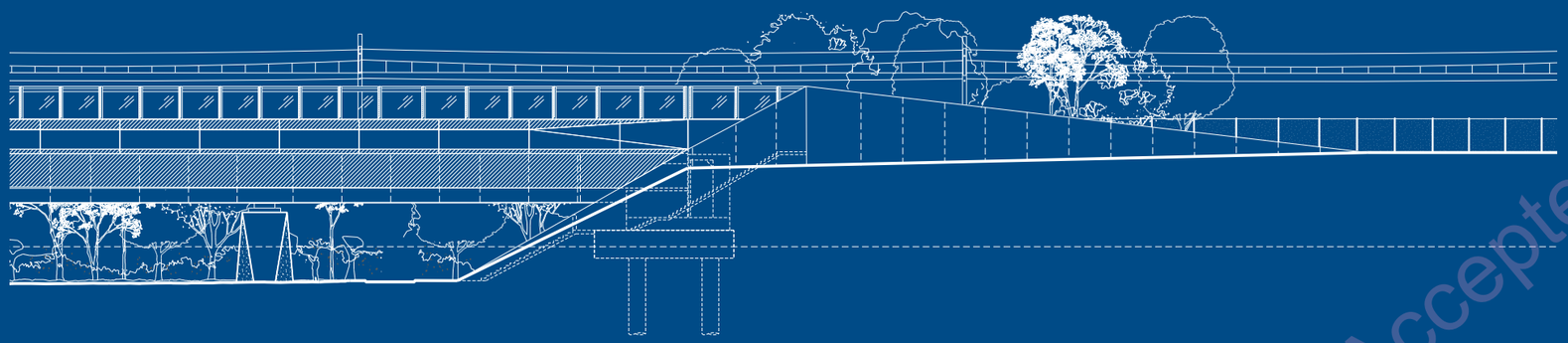


Fig.5.74_ Proposed south elevation - South abutments and approach embankments

0 5 20 M

Code 1 – Accepted

5.7

Fig.5.75_ Illustrative view - South abutment and embankments

Fig.5.76_ Visualisation (13) - South abutment and embankments

Code 1 – Accepted

Abutments & Approach Embankments

5.7

5.7.2 Abutment design

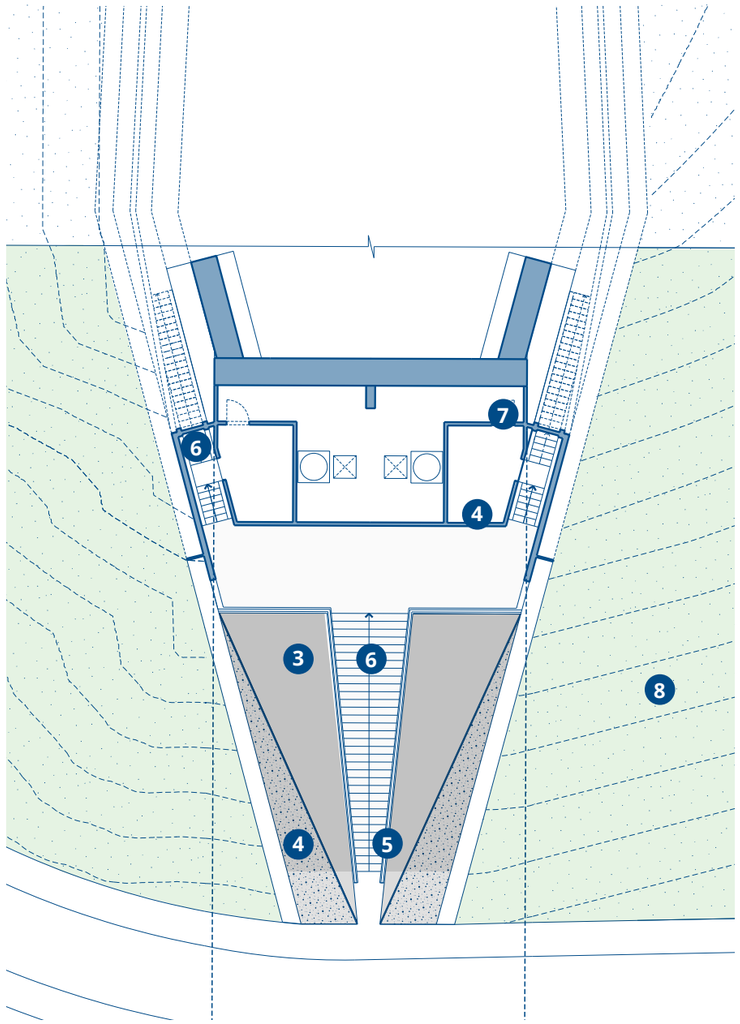
There will be a lack of daylight and rainfall underneath the viaduct at the abutments. Hard landscaping has therefore been proposed in the form of a splayed maintenance stair with sloped concrete faces either side. These faceted faces increase contrast between light and shadow, helping to break up the visual scale of the slope, and create a common language with pier forms. The sloped faces align with two flank walls at high level, which emerge from the embankment slope to form a concrete 'sleeve' to the viaduct deck. At the top of the embankment level the profile of the flank walls gently slope away over a 40m distance. The flank walls provide a consistent start and end condition to the viaduct, irrespective of differing noise barrier types. A security fence and 4m solid concrete noise barrier sit behind the flank walls at the south and north embankments respectively. A textured concrete finish is applied to the vertical abutment walls to ensure they appear recessive to the external sloped faces and flank walls. Texture is also used on the sloped concrete faces to help break up scale.

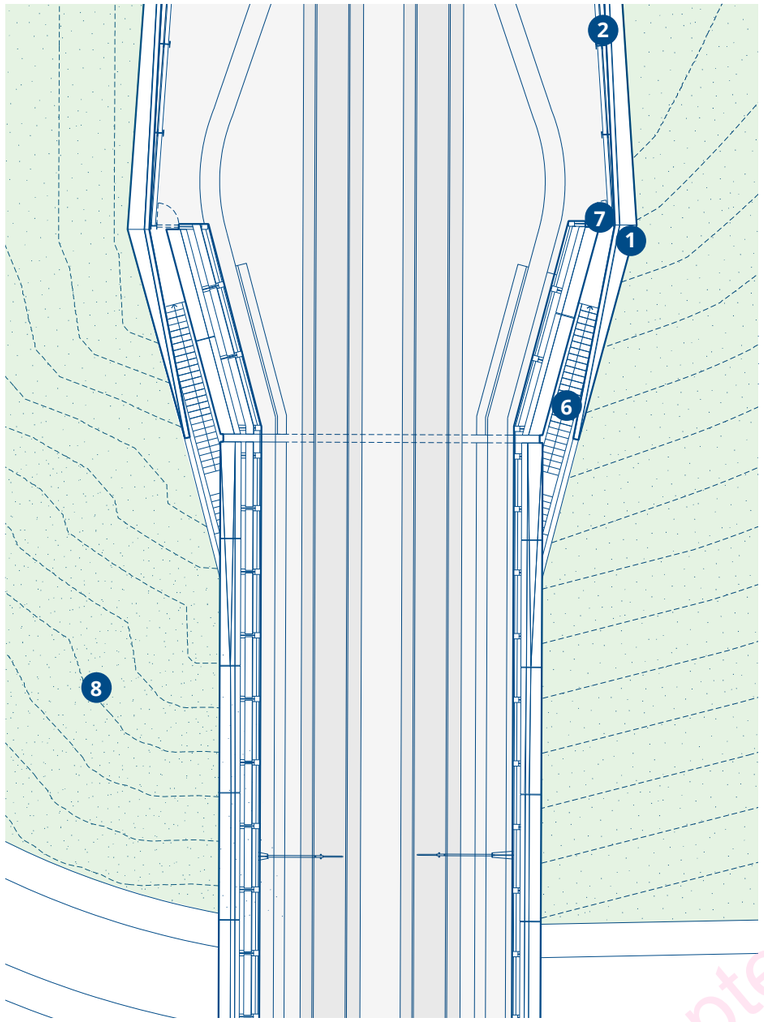
5.7.3 Embankment design

The embankments are fully integrated with the abutment design. The planted slopes provide visual screening to the concrete walls of the abutment and clutter associated with the maintenance stairs. The embankment slopes follow a uniform gradient, closely matching the angle of the lower stair and concrete flank walls. The profile of the slope ensures adequate protection against falling from the embankment into the stairs either side of the abutment.

5.7.4 Access

Stairs are required to provide maintenance access from the base of the embankment up to the bearings and to railway level. Two stairs flank the viaduct at high level and combine into a single flight at ground level. Security doors are located at the top of the stairs and concealed between the flank walls and noise barriers. Access into the viaduct deck segments is provided from behind the abutment walls via secure door access. Security fencing close to the abutment and viaduct has been minimised where possible. At the north, the 4m opaque noise barriers prevent access onto the railway, while at the south a 1.8m post and wire fence is discretely located behind the concrete sleeve walls. Refer to Section 6 for more detail on the security strategy.





1. Embankment noise barrier - Inclined precast panel (smooth texture)
2. Embankment noise barrier - Inclined precast panel (textured concrete)
3. Abutment walls - Precast concrete (smooth finish)
4. Abutment walls - In-situ concrete (textured concrete finish)
5. Lower handrail - Galvanised steel flat section
6. Stair - In-situ concrete
7. Access door - Galvanised steel
8. Embankment - Planted slope

Fig.5.77_ Proposed ground level plan - North abutment

Fig.5.78_ Proposed rail level plan - North abutment

N

Code 1 – Accepted

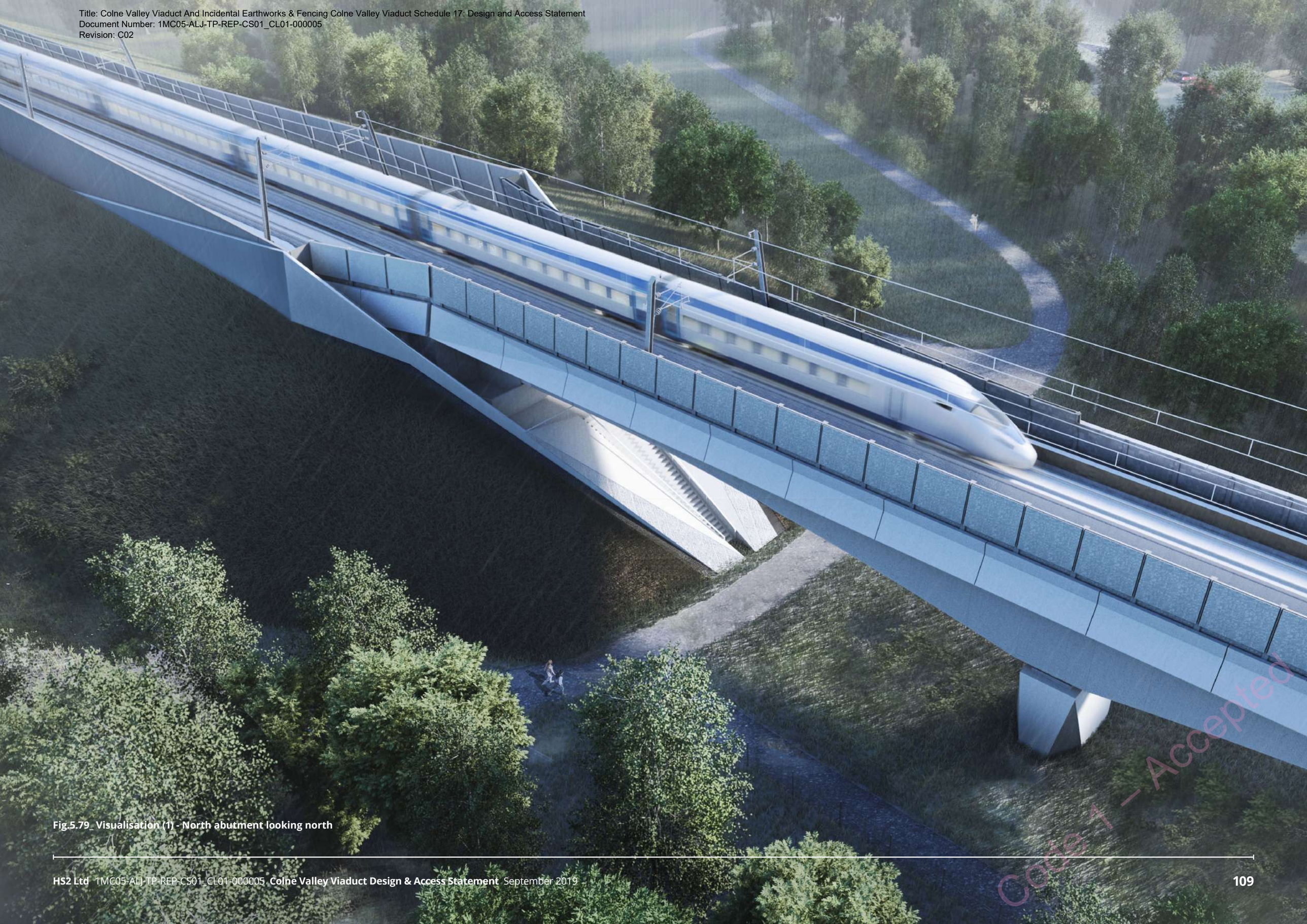


Fig.5.79_ Visualisation (1) - North abutment looking north

Code 1 – Accepted

Noise Barriers

5.8.1 Noise barrier strategy

This section of the Design and Access Statement should be read alongside the Noise Modelling Report (1MC05-ALJ-EV-REP-CS01_CL01-000015) provided for information as part of this Schedule 17 requests for approval. The Noise Modelling Report demonstrates how the noise mitigation meets the relevant requirements.

Acoustic modelling has been undertaken based on rolling stock and track specifications agreed with HS2. Following iterative modelling of noise barrier options, the following configurations and heights (measured from top of rail) have been proposed for the Colne Valley Viaduct and approach embankments:

- Type 1: 1.65m opaque absorptive barrier
- Type 2: 4m hybrid - 1.65m high opaque absorptive barrier with a 2m high transparent panel (acoustically reflective) above and an opaque absorptive top edge (2A). In locations where noise performance requires optimising, an acoustically absorptive inner face is incorporated on the top edge of the barrier (2B).
- Type 3: 4m opaque absorptive barrier (3A). A resonator is incorporated to the inner face of the top edge in some locations to optimise noise performance (3B).
- Type 4: 4m concrete opaque absorptive barrier on the embankment. Refer to Section 5.7 for more detail.

Fig.5.80_ Site Plan - Noise barrier type locations

Code 1 – Accepted

5.8

5.8.2 Type 1: 1.65m opaque barrier

- Provides unobstructed views of the Colne Valley for train passengers
- Low level acoustically absorptive cassettes
- Precast concrete parapet

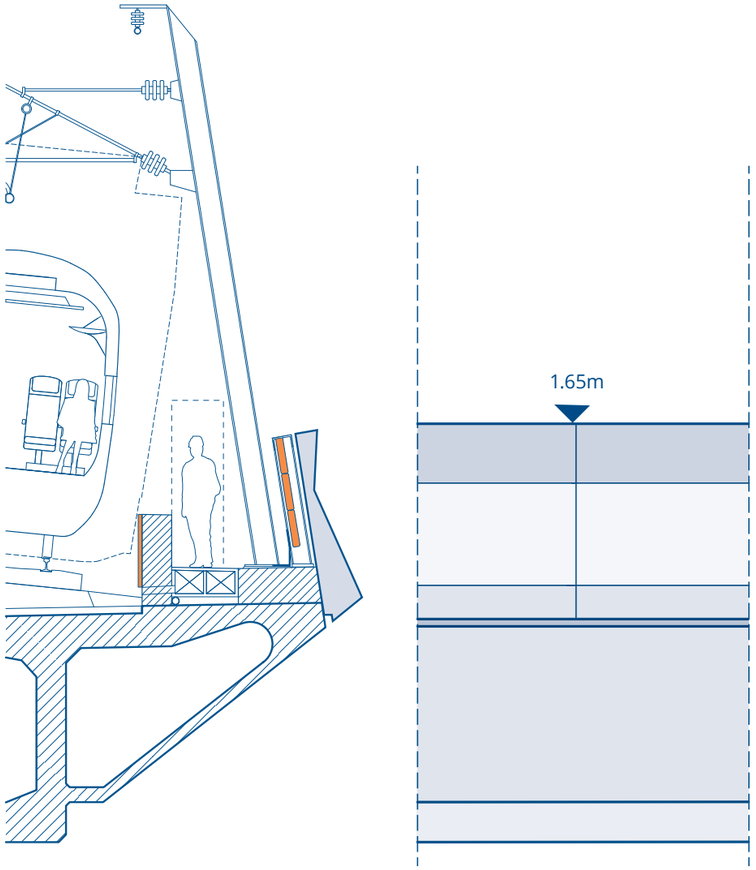


Fig.5.81_ Section and elevation - 1.65m opaque barrier

5.8.3 Type 2: 4m hybrid barrier

- Approximately. 2m x 3m transparent acrylic panel to provide outward views for passengers. Train cant on each side has been taken into consideration when assessing optimum views. Bird collision protection provided by black lines within the acrylic panel
- Low level acoustically absorptive cassettes
- Precast concrete parapet

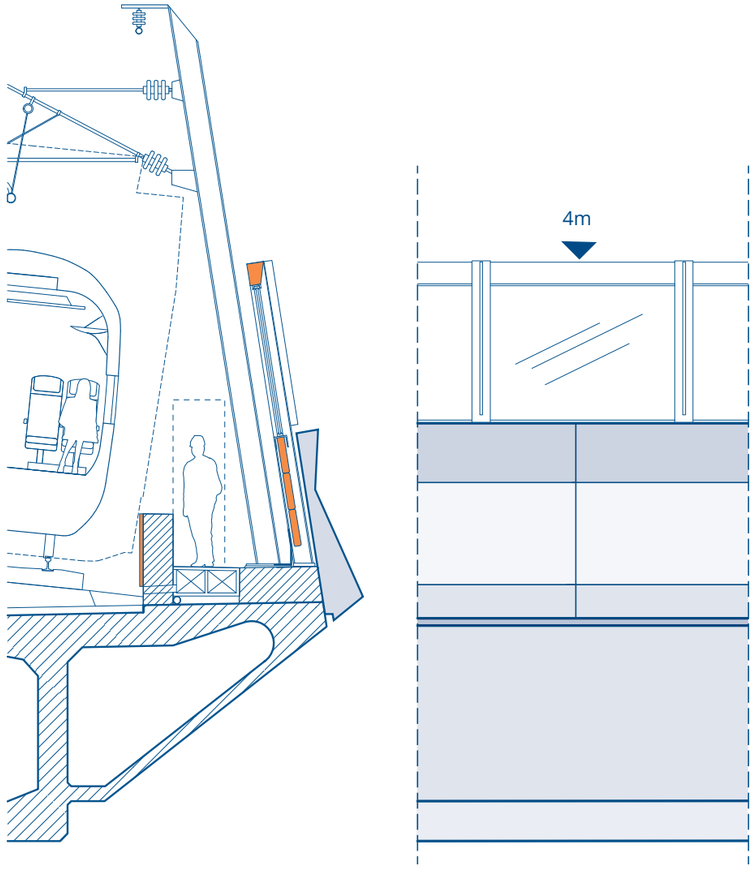


Fig.5.82_ Section and elevation - 4m hybrid barrier

5.8.4 Type 3: 4m opaque barrier

- Full height acoustically absorptive cassettes
- Approx. 2m x 3m galvanised steel sheet fixed to vertical posts
- Precast concrete parapet
- Resonator added to inside of the top edge to optimise acoustic mitigation performance where required

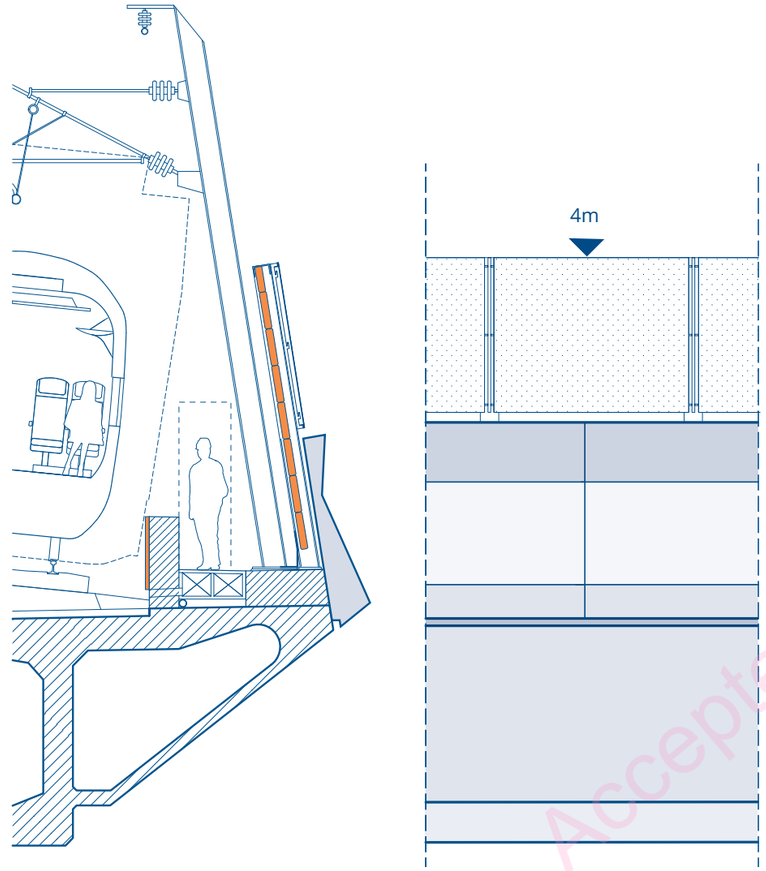


Fig.5.83_ Section and elevation - 4m opaque barrier

Code 1 – Accepted

Noise Barriers

5.8.5 Configuration options

Extensive noise modelling has determined the proportion of acoustically absorptive and acoustically reflective material required within the noise barriers to meet the EMRs and U&As in different locations along the viaduct.

Having established the required acoustic configuration of the noise barriers, a detailed appraisal was undertaken across each of the barrier types to assess scale and composition. The following configurations were considered;

- **Option A: Full height noise barrier -** This resulted in a top heavy appearance, with the noise barrier becoming too dominant and the scale of the noise barrier module becoming too large.
- **Option B: Low parapet with noise barrier above -** While the height and dominance of the noise barrier is reduced by incorporating a slim low level concrete parapet, the extent of visible noise barrier still appears top heavy, particularly on the 4m opaque barrier.
- **Option C: Mid-level parapet with noise barrier above -** The height and dominance of the noise barrier is reduced by incorporating a 1.65m high concrete parapet. The parapet conceals the portion of opaque barrier required on the 1.65m and 4m hybrid, simplifying the appearance. The 4m opaque barrier achieves a more balanced proportion of parapet and noise barrier. The parapet becomes a continuous band running through all barrier types, providing visual continuity across the length of the viaduct.
- **Option D: Full height concrete parapet -** While raising the concrete parapet on the 1.65m opaque barrier and 4m hybrid barrier simplifies the appearance, the extent of visible concrete on the 4m opaque barrier is excessive in scale and creates a heavy appearance.

Option C was selected as the preferred configuration for the above reasons.

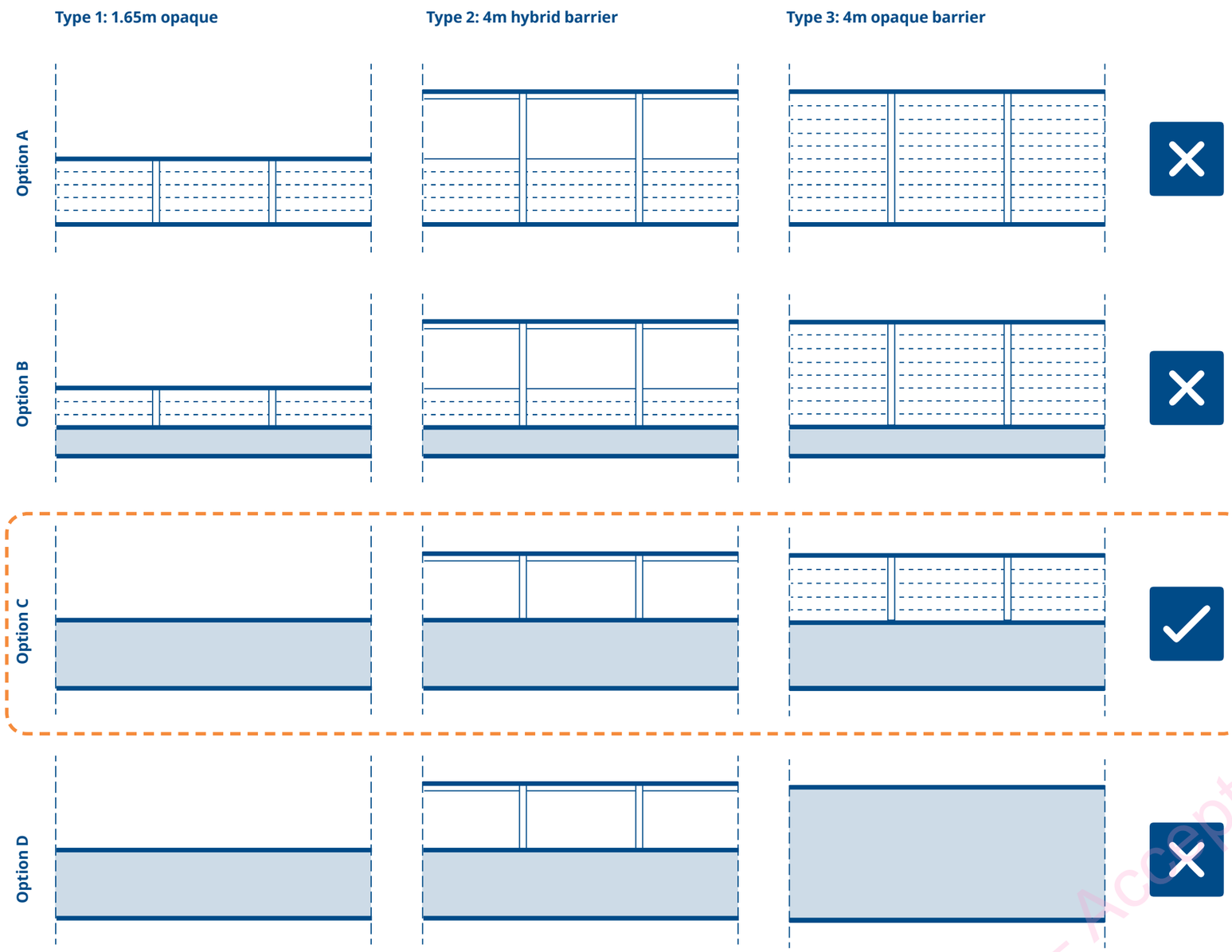


Fig.5.84_ Elevation diagrams - Configuration options

Code 1 – Accepted

5.8.6 Parapet

A precast concrete parapet forms a continuous, horizontal band across the viaduct. Its geometry is aligned with the soffit panel to ensure a streamlined and integrated appearance with the overall structure. The geometry of the parapet is part of a common language of faceted forms used throughout the viaduct.

The majority of the parapet incorporates a fold line to the upper third of the external face. This breaks up the scale of the outer face and provides a slender band of shadow along the top edge, emphasising the horizontal orientation of the deck. The parapet transitions to a triangular fold to mark the ends of the structural deck modules at expansion joints.

A large inward sloping sill will capture the majority of rainwater run-off from above, reducing the risk of staining to the outer face of the parapet. The slope will also deter birds from perching on the parapet. The bottom edge provides a substantial drip groove to ensure water run-off is directed away from the inclined soffit below, reducing the risk of staining.

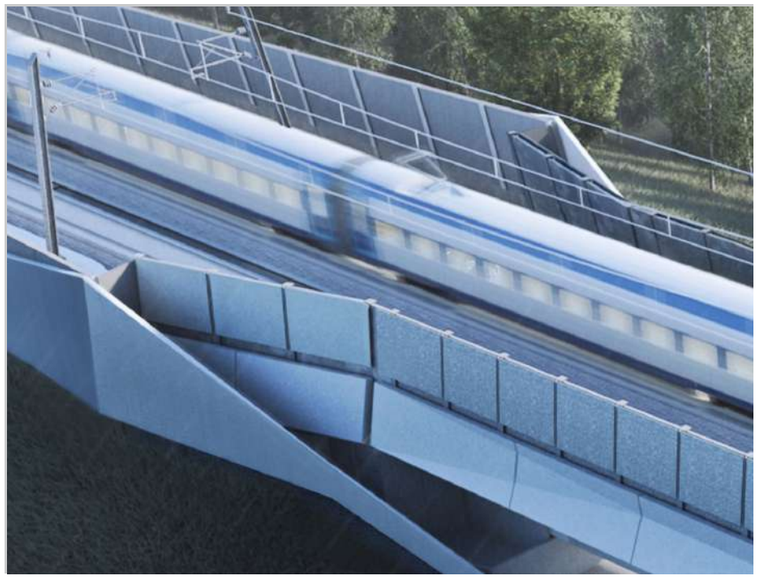


Fig.5.86_ Visualisation - Expansion joint at abutment

Fig.5.87_ Visualisation - Expansion joint at expansion portal

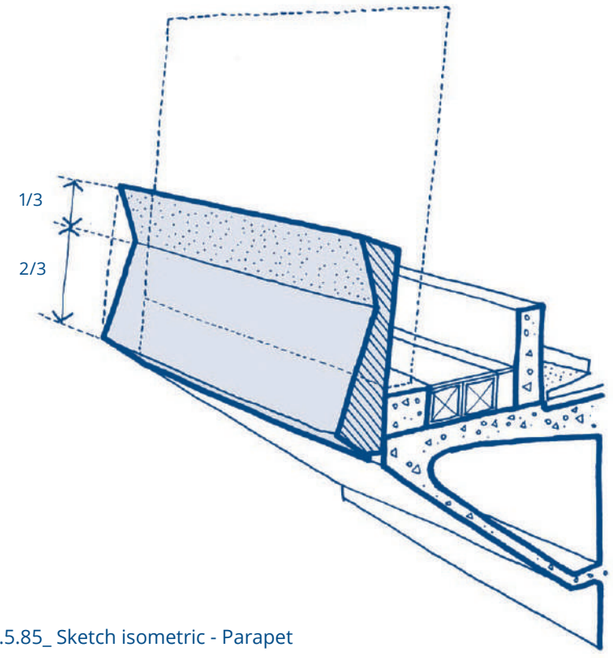


Fig.5.85_ Sketch isometric - Parapet

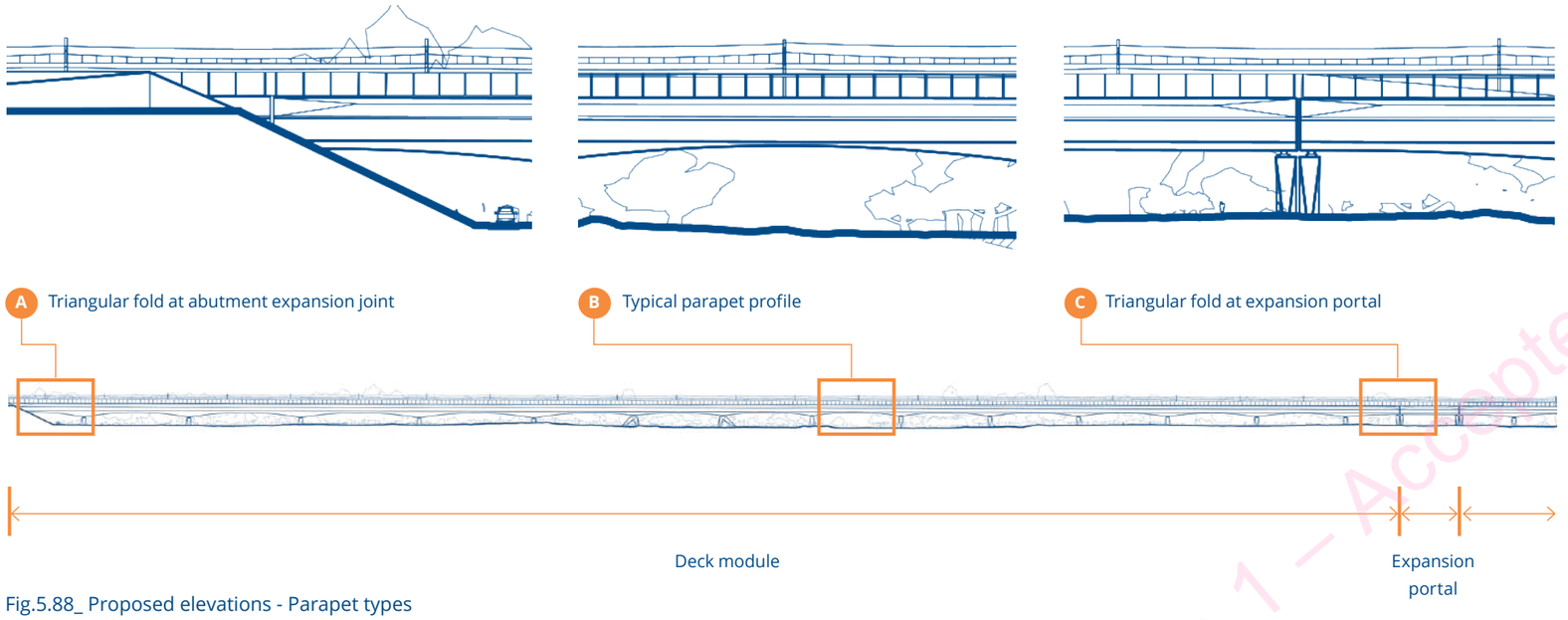


Fig.5.88_ Proposed elevations - Parapet types

Code 1 – Accepted

Noise Barriers

5.8.7 Acoustic performing barrier

The noise barrier comprises acoustic cassettes or transparent acrylic panels supported between steel posts. Barrier systems previously tested and certified on high speed rail have been specified to ensure as far as possible the acoustic performance and longevity of the barrier. The noise barrier is set out on a vertical grid of approximately 3m. This distance is derived by the maximum acrylic panel size viable for HS2 rail conditions. A steel fin to the outer face of the vertical posts, provides consistent detailing across barrier types and a more refined appearance, while emphasising the vertical grid through depth and shadow. Galvanised steel has been specified for the cassettes due to acoustic performance, longevity and visual consistency with above deck components. The barrier has been designed to be easily inspected, maintained and cleaned from the deck. The cassettes and acrylic panels can be removed from each of the maintenance walkways. The cassettes stack on top of one another so have minimal fixings and can be easily removed and replaced if required.

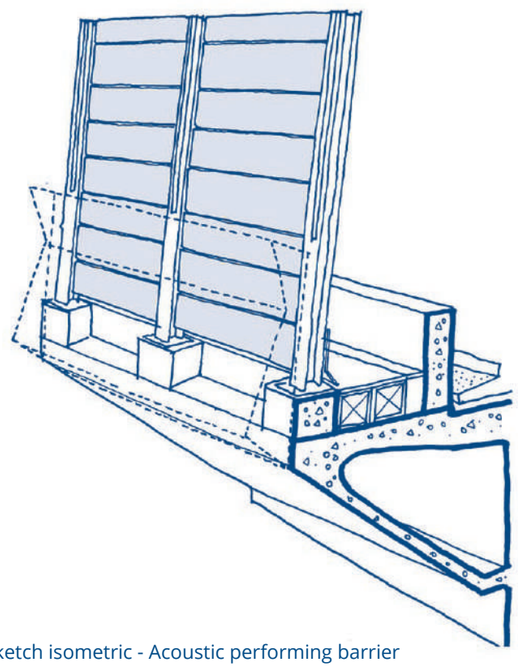


Fig.5.89_ Sketch isometric - Acoustic performing barrier

5.8.8 Opaque barrier design (type 3)

Where a 4m opaque barrier is required, the acoustic cassettes and posts are concealed by a horizontal band of large-format galvanised steel sheets. Sheets are hung along each side via concealed, hook-on fixings, both simplifying the appearance and minimising the number of components requiring future maintenance. The sheets are suspended on the steel fin welded to the outer face of the post. A large shadow gap at the base creates the appearance the upper barrier floating above the parapet. The upper barrier forms a simple, reflective band, visually recessive to the substructure below.

The external cladding panels can be inspected and maintained from the highways and maintenance tracks in proximity to the viaduct.

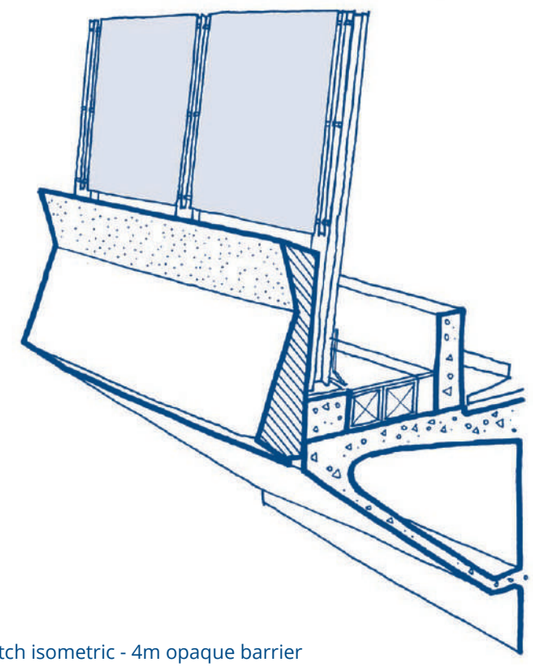


Fig.5.90_ Sketch isometric - 4m opaque barrier

5.8.9 Hybrid barrier design (type 2)

Where a 4m hybrid barrier is proposed, a 2m high by 3m wide transparent panel is supported between the galvanised steel posts. A steel fin on the external face of the post provides a sense of refinement and visual consistency along the barrier. The impact of 'flicker' from the noise barrier posts on passenger experience and medical conditions has been considered. The rate of flicker is determined by the post spacing and the speed on the trains. While the design speed for the trains is 320km/hr, this may vary in some circumstances, such as in poor weather or when there are obstructions on the track. It is therefore not possible for the hybrid barrier design to avoid flicker. It also may occur on other sections of the HS2 route and is a residual matter that, through discussion with HS2 rolling stock and rail operation providers, will be considered in line with wider HS2 inclusivity requirements.

Similarly, the impact of glare from direct sunlight on passenger experience will be mitigated through the rolling stock design in line with HS2 inclusivity requirements. It is anticipated that external glare from the transparent panels will be reduced significantly by the inclination of the barriers.

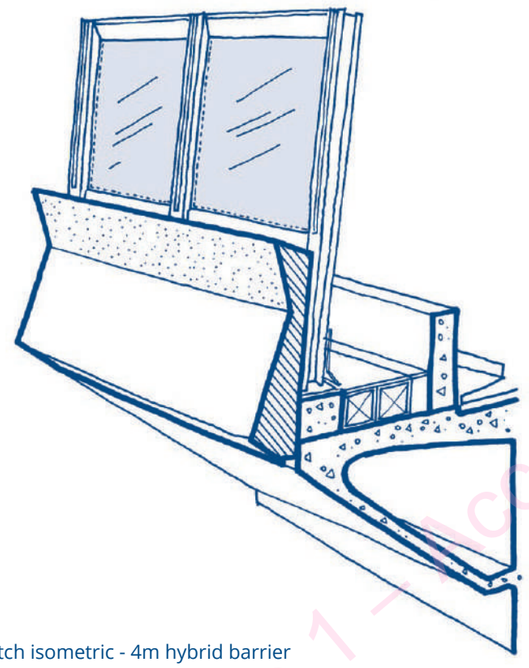


Fig.5.91_ Sketch isometric - 4m hybrid barrier

Code 1 – Accepted

5.8

5.8.10 Type 1: 1.65m opaque barrier

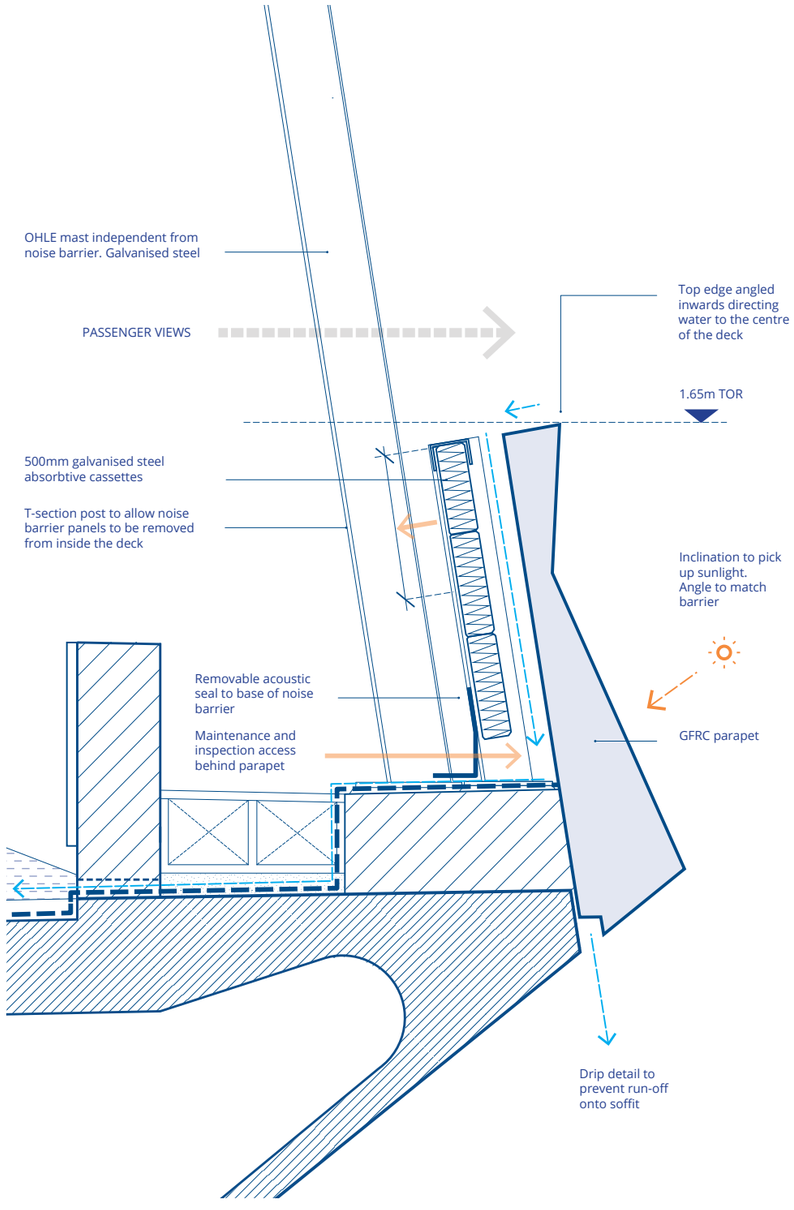


Fig.5.92_ Detail section - 4m hybrid noise barrier

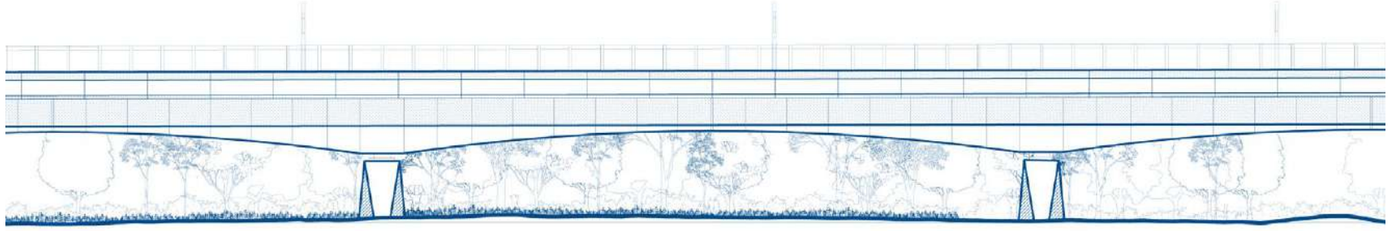


Fig.5.93_ Proposed elevation - Typical 1.65m opaque barrier

Fig.5.94_ Visualisation (5) - 1.65m opaque barrier along Denham Waterski Lake

Code 1 – Accepted

Noise Barriers

5.8.11 Type 2: 4m hybrid barrier

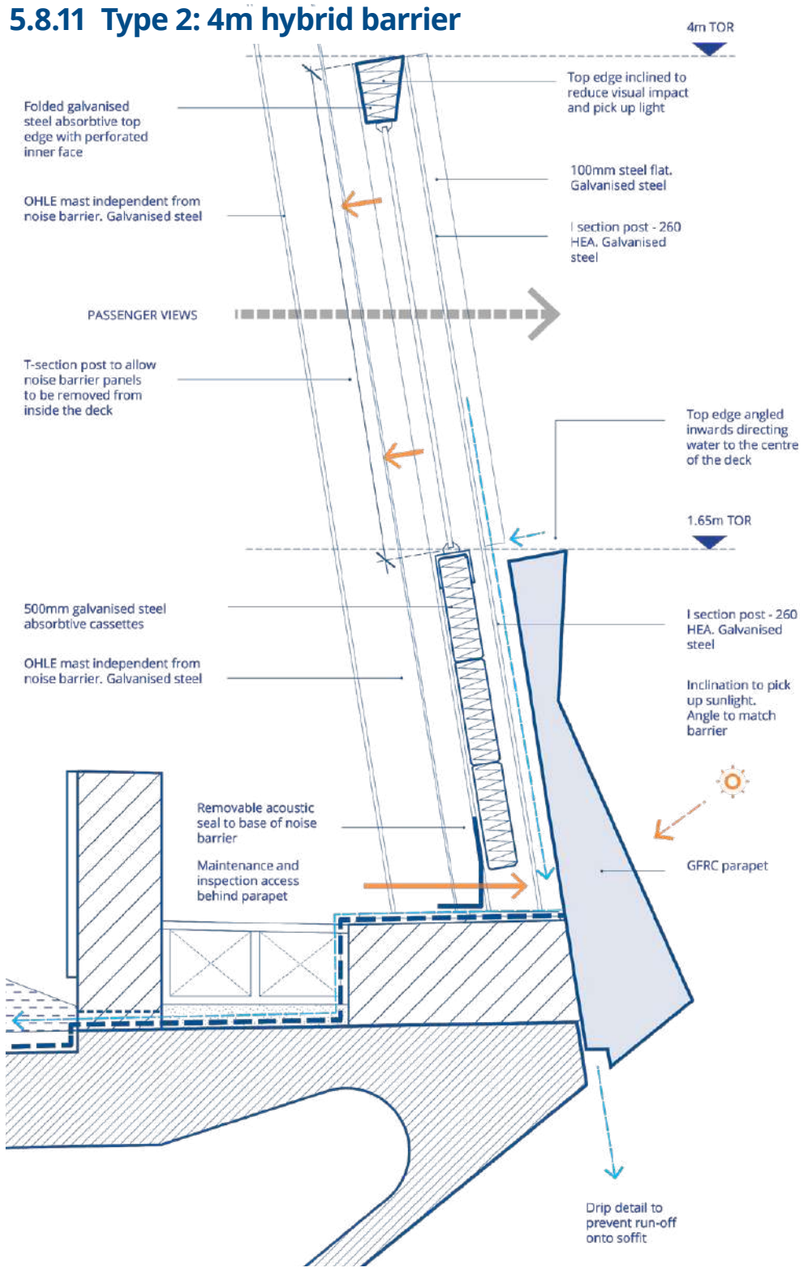


Fig.5.95_ Detail section - 4m hybrid noise barrier

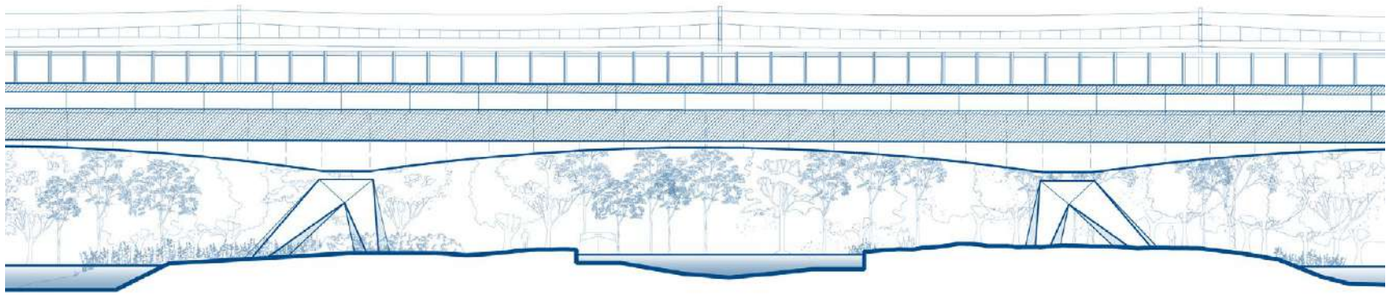


Fig.5.96_ Proposed elevation - Typical 4m hybrid barrier over Grand Union Canal

Fig.5.97_ Visualisation (8) - 4m hybrid barrier over Korda Lake

Code 1 – Accepted

5.8

5.8.12 Type 3: 4m opaque barrier

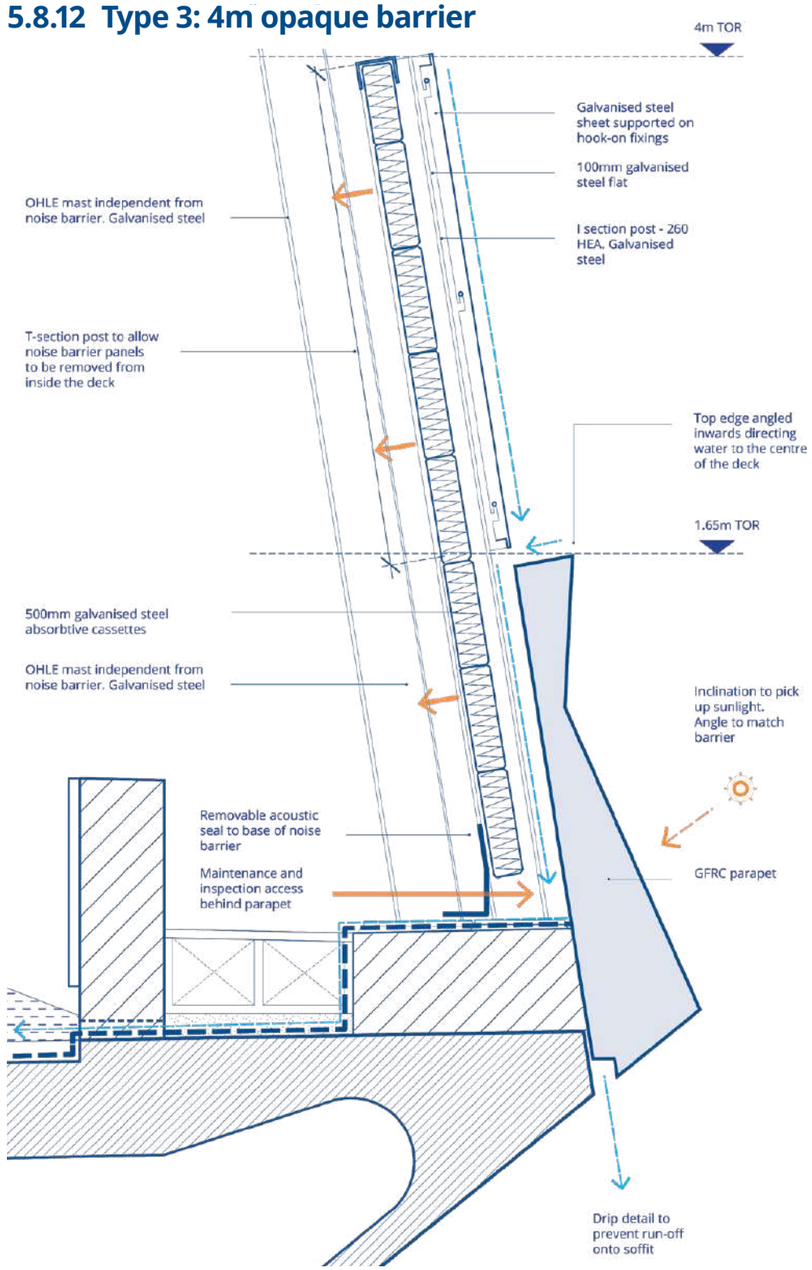


Fig.5.98_ Detail section - 4m opaque noise barrier

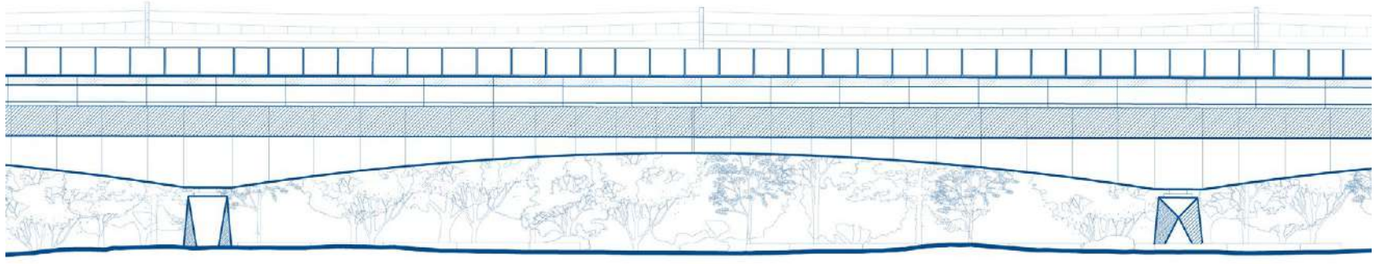


Fig.5.99_ Proposed elevation - Typical 4m opaque barrier over the A412

Fig.5.100_ Visualisation - 4m opaque barrier along the A412

Code 1 – Accepted

Noise Barriers

5.8

5.8.13 Transitions

Locations where the barrier type changes have been carefully considered to achieve a smooth transition and visual continuity across the viaduct. In these locations, the profile of the barrier is gently inclined and stretched over approximately 40m. By emphasising the horizontal, the barrier expresses the movement of the trains. In addition, the continuous parapet helps to unify the barrier appearance over these transition zones.

The following transition conditions occur along the viaduct;

- 4m hybrid to 4m opaque barrier: The steel panel is inclined to provide a gradual transition between the solid and transparent portion of the barrier.
- 4m hybrid to 1.65m opaque barrier: The height of the barrier drops from 4m to 1.65m. A seamless transition is achieved with a gradual tapering down of the transparent panel and the continuation of the mid-level parapet.
- 4m opaque to 1.65m opaque barrier: The height of the barrier drops from 4m to 1.65m. A seamless transition is achieved with a gradual tapering down of the external cladding panel and the continuation of the mid-level parapet.

Fig.5.101_ Visualisation (10) - 4m hybrid to 4m opaque barrier transition at Moorhall Road crossing

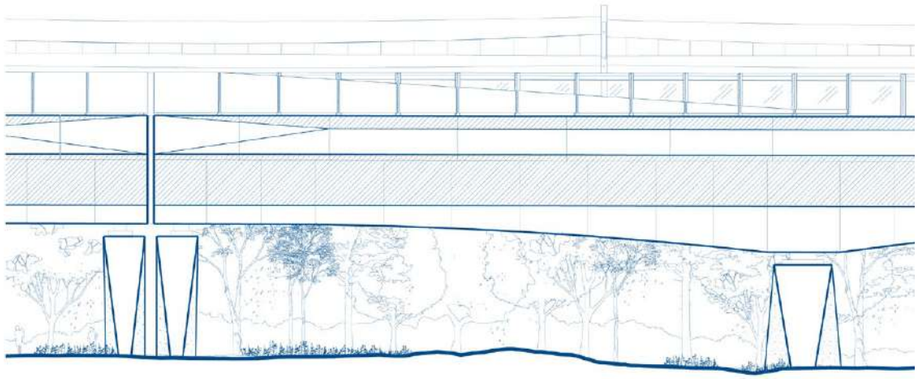


Fig.5.102_ Proposed Elevation - 4m opaque to 4m hybrid transition

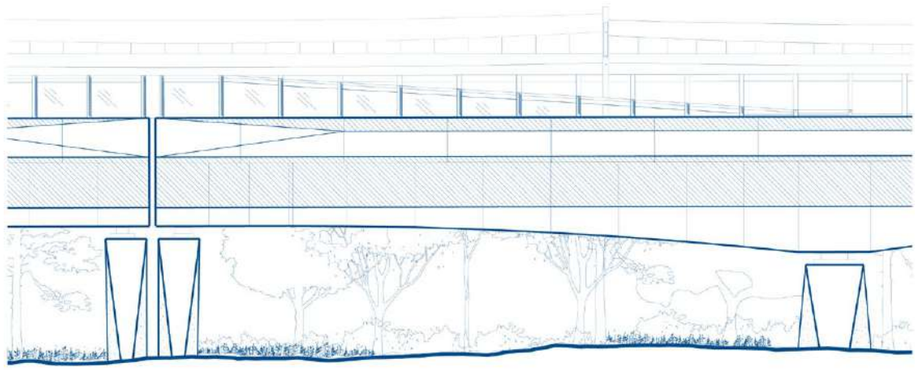


Fig.5.103_ Proposed Elevation - 4m hybrid to 1.65m opaque transition

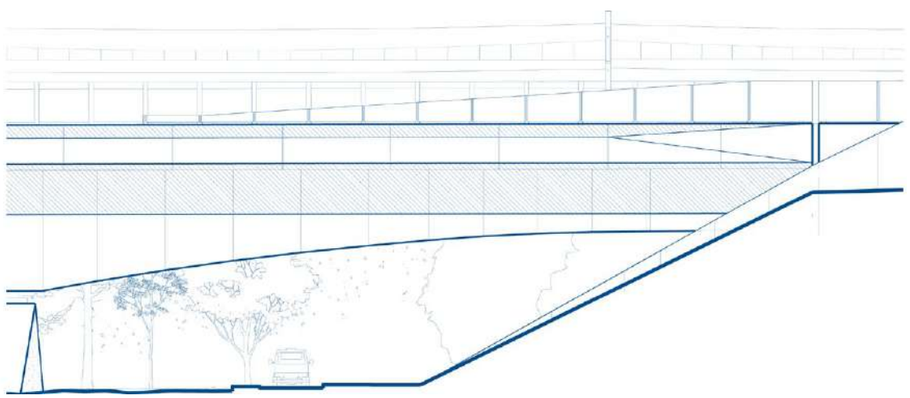


Fig.5.104_ Proposed Elevation - 1.65m opaque to 4m opaque transition

Code 1 – Accepted

Overhead Line Equipment

5.9

5.9.1 Scope

Overhead Line Equipment (OHLE) systems are required to provide electricity to the high speed railway. While the OHLE is not subject to Schedule 17 control and the design of OHLE is procured as a route-wide contract, it remains a highly visible and important part of the viaduct design. The viaduct proposals have therefore been developed in close collaboration with HS2 Rail Systems.

5.9.2 Design intent

Design proposals indicate a design intent for the setting out, form and appearance of the OHLE which should help to inform the final proposals developed by HS2 Rail Systems. In order to achieve a coherent and integrated design approach to the OHLE, the following design principles have been established;

- Location: The OHLE masts are set back and separated from the noise barrier to accommodate different deflection tolerances and ensure acoustic continuity of the barrier i.e. avoidance of noise leakage at interfaces with the OHLE.
- Setting out parameters: OHLE masts are required at approximately 40-60m centres, while span transitions should be limited to a maximum of 4.5m where possible. They are set out on the centre of a noise barrier module.
- Geometry: The OHLE mast are inclined to suit the noise barrier, creating a coherent and integrated appearance. This also reduces the visual impact when viewed from ground level.
- Proposed setting out; Principles have been established to coordinate the masts with pier locations in prominent areas where possible. Over the water spans, 40m spaced masts are approximately centred on 80m spans, while at expansion portals and fixed buttress spans, a mast is centred on the structural span, reinforcing the symmetry of the structure in these locations.
- Pier Access: Clear access directly above pier bearings is required for inspection and maintenance from the railway. Therefore masts cannot be located directly above piers.
- Mast: The sloped head of the I section mast matches the inclination of the parapet to achieve visual consistency.
- Material: The galvanised steel masts will match the material finish of other above deck components.

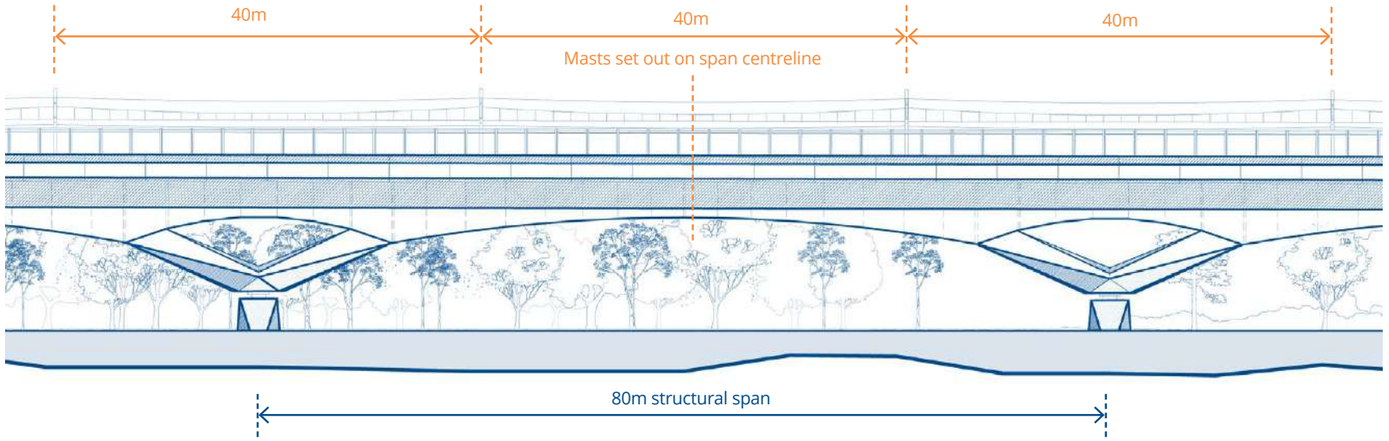


Fig.5.105_ OHLE setting out - Typical extended span

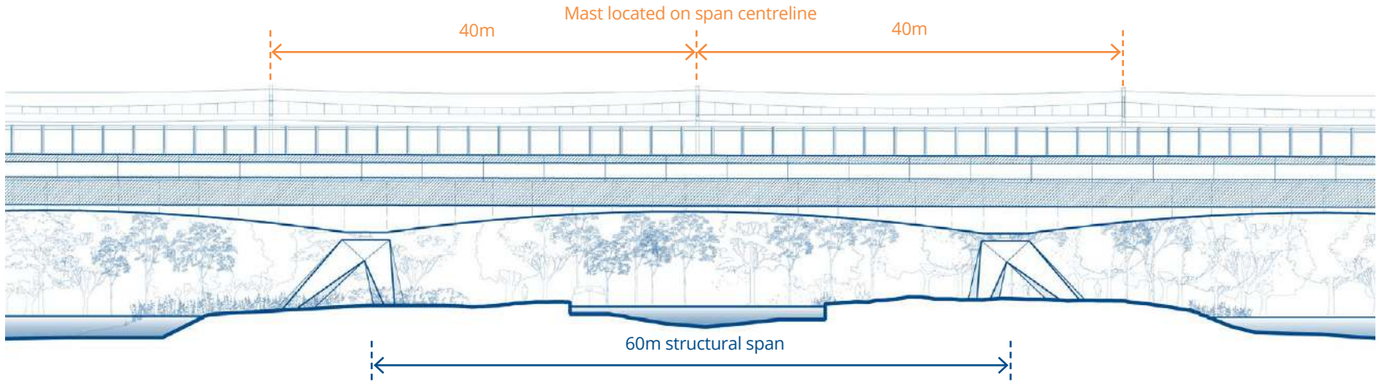


Fig.5.106_ OHLE setting out - Typical fixed buttress span

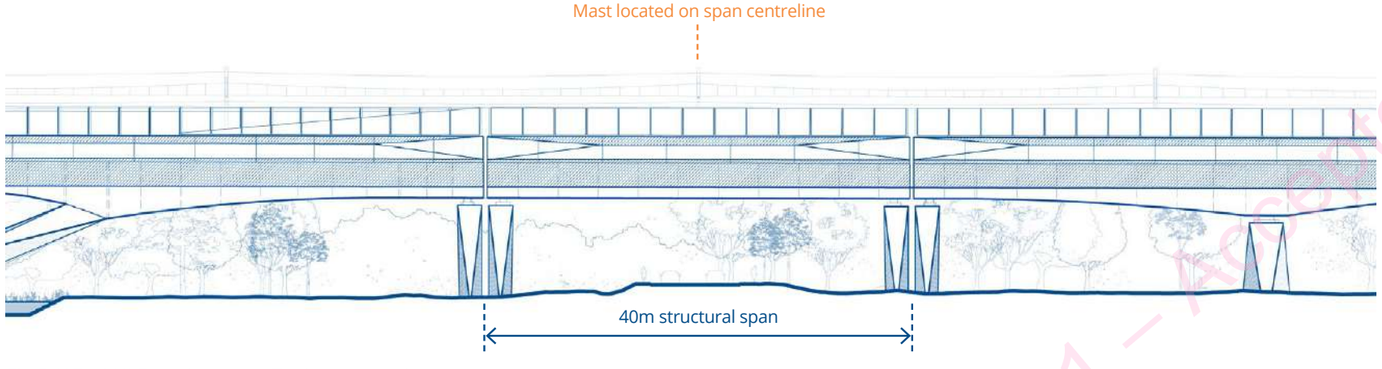


Fig.5.107_ OHLE setting out - Typical expansion portal

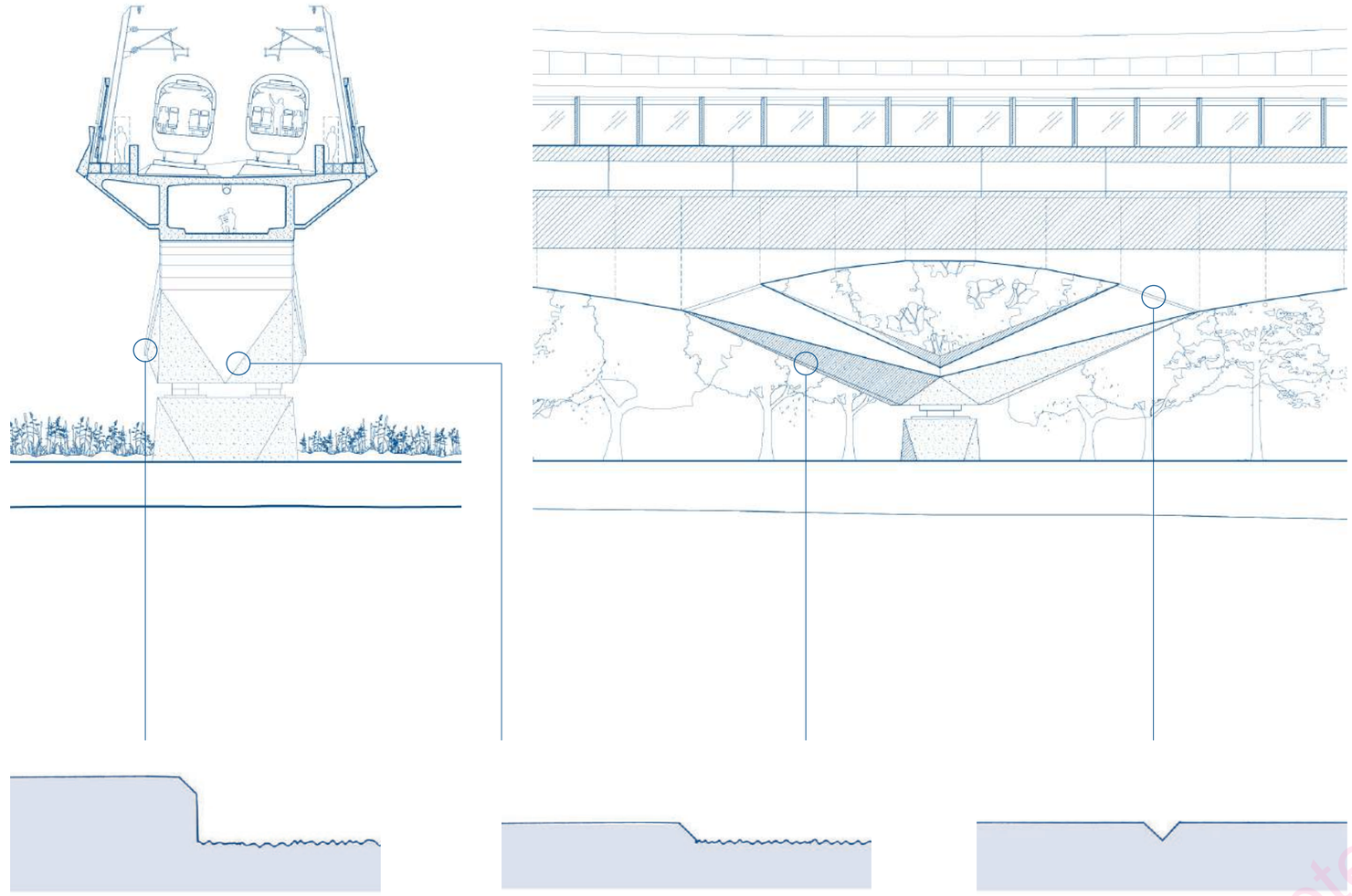
Code 1 – Accepted

Family of Components

5.10.1 Common Design Language

All components have been designed using a common design language to ensure the viaduct is recognisable as a single, coherent structure wherever it is experienced in the Colne Valley. To achieve this, the following design principles have been applied where appropriate;

- Geometry: Folded planes and straight edges characterise the form of structural components.
- Texture: A single textured concrete finish has been selectively applied to locations where the structure meets the ground.
- Edge conditions: Consistent edge detailing to concrete piers (see below sketch details).
- Bearing offset: The bearing offset between pier head and deck soffit remains consistent throughout.
- Straight edges: Curvature is only used in the haunched deck profile and is formed by a continuous, shallow arc spanning between piers. All other structural components are characterised by faceted forms and defined edges.
- Materials: The colour and finish of all concrete components will match as closely as possible. All above deck components will be galvanised steel to ensure visual consistency and a similar change in appearance over time.



Arch form deck - Smooth to textured concrete finish

Typical - Smooth to textured concrete finish

Deck to arch form deck - Smooth to smooth

Fig.5.108_ Sketch details - Concrete edge conditions

Code 1 – Accepted

5.10

Fig.5.109_ Visualisation - Expansion portal pier

Fig.5.110_ Visualisation - Fixed buttress pier

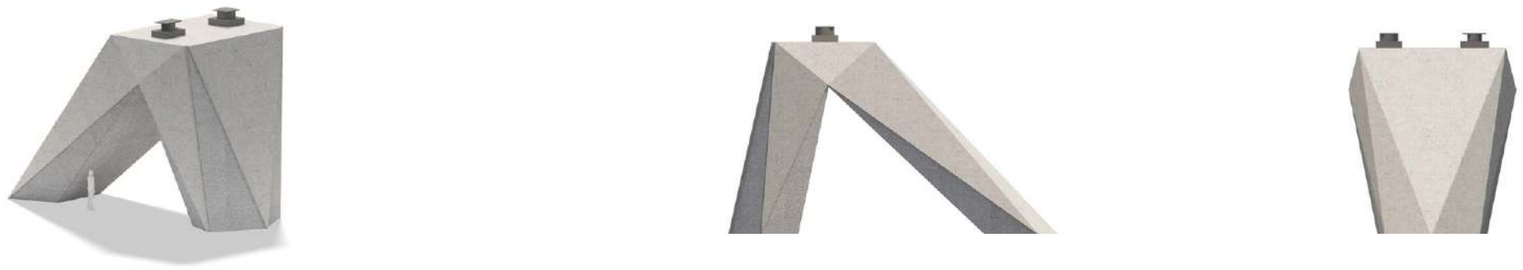


Fig.5.111_ Visualisation - Straight pier

Fig.5.112_ Visualisation - Arch form deck

Code 1 – Accepted

Materials

5.11.1 Overview

Long term visual performance of the viaduct has been considered in the specification and coordination of materials. Highly durable, robust and self-finished materials have been selected throughout to minimise long-term maintenance and ensure that the external appearance responds positively to the effects of weathering over time. Using materials that will change in appearance over the 120 year life of the viaduct, creates a sense of robustness and permanence to the structure.

5.11.2 Concrete

The concrete viaduct structure will provide high levels of durability to achieve a minimum 120 year lifespan.

The deck and parapet will be constructed from pre-cast concrete segments, achieving a high quality finish to highly visible areas such as the deck soffit and inclined panels.

Piers will be constructed in-situ, facilitating more bespoke and complex geometry. In-situ piers will be poured full height to avoid horizontal construction joints

Ground granulated blast-furnace slag cements are specified to achieve a light grey colour. The concrete colour shall be as consistent as possible across all structures, particularly those that can be seen together. The aggregate and concrete batching will be controlled to seek colour consistency as far as reasonably practicable.

A textured concrete finish is proposed at low level where the viaduct is experienced close-up. This will provide a unifying feature to structural components, allowing the viaduct to be instantly recognisable from various locations across the valley. Proposals will use rubber formwork liners to achieve a high level of finish and consistency to textured faces. Liners shall be joined and fixed to prevent visible joints and blemishes.

5.11.3 Galvanised steel

Self-finished materials are specified throughout to ensure longevity and minimise degradation over time. Paint finishes are avoided throughout.

Galvanised steel has been specified for the acoustic cassettes due to enhanced acoustic performance, longevity and visual consistency with all above deck systems, including the barrier posts and Overhead Line Equipment (OHLE) masts. External galvanised steel sheets have also been proposed on the 4m opaque barriers, ensuring a consistent materiality to the above deck components.

5.11.4 Transparent acrylic

Transparent acrylic panels are proposed for the 4m hybrid sections of the noise barrier. The acrylic panels have a hydrophobic (water repellent) coating to provide a self-cleaning effect, improving visibility from the train in wet weather and minimising cleaning requirements. Following preliminary fatigue testing of panel sizes against comparable high speed rail conditions, a maximum allowable size of 2m x 3m has been estimated. The panels will have black etched lines within the panel to mitigate the risk of birds colliding with the panels.

5.11.5 Weathering and maintenance

The use of a simple palette of self-finished materials will ensure that the viaduct weathers uniformly over its design life.

The railway operator will be responsible for maintaining all materials on the viaduct, including keeping the transparent noise barrier panels clean and scratch free.

The risk of staining has been minimised by directing external water run-off above the parapet towards the internal drainage of the viaduct deck. A large drip groove has been added at the base of the viaduct parapet to avoid run-off down the inclined soffit.

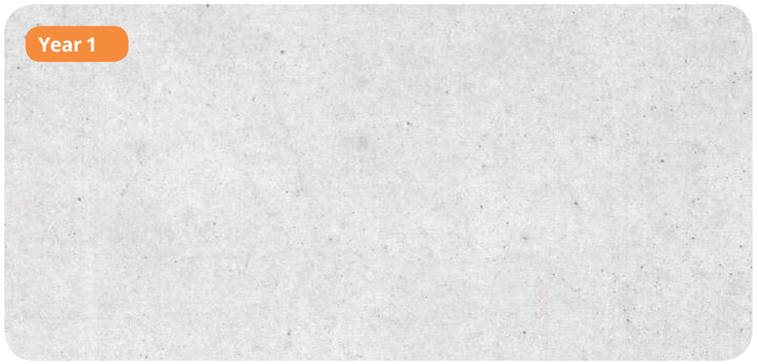
Bird perching is considered unlikely due to the frequency of trains and the proximity of other more suitable perching locations in the Colne Valley, However, measures to further deter bird perching will be considered in further during technical design stage. For example, the inward angle of the top ledge of the parapet may be sloped further back if required.

A final aspect, graffiti, has been carefully considered in the design. The landscape section sets out the design approach at ground level for each of the piers (Section 6.4.4). It is not considered practicable or appropriate to completely secure each pier type with security fencing. Landscape proposals include using defensive planting to limit access to piers deemed vulnerable to possible vandalism. Additionally, measures have been taken in the design of the piers to reduce the likelihood of vandalism on concrete surfaces and mitigate damage if it occurs. The textured concrete finish can deter graffiti artists, while concrete sealant and coatings will be used in locations particularly susceptible to possible vandalism. Where graffiti does occur, it will require removing as a part of the maintenance strategy for the railway.

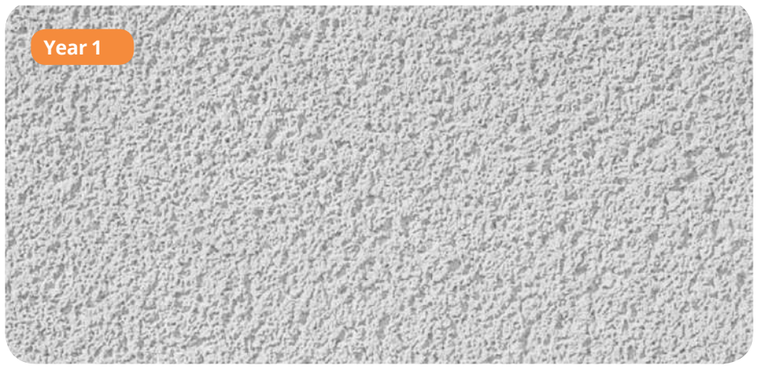
Code 1 – Accepted

5.11

Concrete - Smooth



Concrete - Textured finish



Galvanised steel

Fig.5.113_ Material samples - Long term visual change (illustrative only)

Code 1 – Accepted

Code 1 – Accepted

6.0 Landscape

A summary of the indicative landscape design proposals with reference to the overarching landscape vision and design considerations, covering habitat creation and management, access and recreation, water management, and the visitor experience.

Code 1 – Accepted

Fig.6.1_ Visualisation (15) - View from the Old Orchard pub

Schedule 17 – Accepted

6.1

Narrative

The landscape of the Colne Valley is a complex layering of natural processes and human intervention; it is rich in ecology, natural resources, industrial heritage and recreational opportunity.....it is not pristine, nor is it static... it is however highly valued and in part sensitive to change; this must be respected in how the 'next layer' in this unique landscape is designed.

Code 1 – Accepted

Landscape Design

6.1.1 Purpose

The purpose of this section is to explain the indicative landscape design response immediately adjacent to and underneath the viaduct, and demonstrate how it integrates with the landscape proposals to the north of the Schedule 17 submission boundary (the Western Valley Slopes) and to the south (Eastern Valley Slopes and Undulating Farmland) which sit outside of the boundary this Schedule 17 request for approvals.

Indicative landscape and planting proposals, which are not subject to Schedule 17 paragraph 2 and 3 approval, are provided for information and feedback from the LPAs. Feedback received will be considered for subsequent detailed landscape proposals which will be subject to future Schedule 17 requests for approval under paragraph 9 and 12 of the HS2 Act. Consequently, the purpose of this section of the Design and Access Statement is to show that there is an overall integrated landscape strategy and to describe what that strategy is. It supplements the Indicative Mitigation Details (1MC05-ALJ-TP-REP-CS01_CL01-000007) which outlines the species and management regime to be applied to each landscape area to be created.

The existing landscape can be divided into five main character areas which are set out in 2.4 of this Design and Access Statement and described in detail in the Written Statement (1MC05-ALJ-TP-REP-CS01_CL01-000006). These are as follows:

- A412 corridor to the River Colne
- River Colne to South East Korda Lake
- Moorhall Road crossing
- North West Savay Lake to North East Harefield No. 2 Lake
- North East Harefield No.2 Lake to Harvil Road

0 100 500 M

N

Fig.6.2_ Existing site plan - Landscape context

Code 1 – Accepted

6.1

Code 1 / Accepted

Landscape Design

6.1.2 Landscape design vision

The Landscape Design Approach for the Colne Valley Viaduct embraces the wider HS2 vision, and is based on the three principles of people, place and time. The Landscape Design Approach directly relates to the core principles as set out below;

People

The landscape design shall take into account the needs and aspirations of the relevant stakeholders and the communities in which the alignment runs through, as far as reasonably practicable. It will explore opportunities for social, economic and environmental benefits that the scheme can provide.

Place

The scheme requires sensitive integration into the local landscape, through a conservation, restoration and enhancement design approach. The design should support quality of life and demonstrate environmentally sensitive design.

Time

The landscape design should be adaptable to environmental change, and wherever possible contribute to the existing local landscape character. The ambition of the project is demonstrated by a 120 year design life, and the choice of materials and management measures should reflect this, providing a continual enhancement of the landscape as it ages over time.

6.1.3 Landscape design approach

The landscape design approach is predicated on a thorough understanding of the diverse character, unique patterns and subtleties of the landscape through which the viaduct passes. This draws upon an understanding of landscape in its widest sense including the natural, cultural, social, heritage, perceptual and aesthetic qualities of the landscape. This is summarised in Figure 6.3.

The design has sought to engage with stakeholders and the communities affected by HS2 to understand what is important to them about the existing landscape; and equally what opportunities exist to shape a new 'layer of change' in a sensitive and positive manner.

The design intent is underpinned by some important practical considerations associated with the operation and maintenance of a high-speed railway. Where possible the design has sought to deliver integrated solutions. For example, proposals have looked at how maintenance tracks can function as recreational routes; and how drainage features can provide important habitats. How the landscape is maintained and managed in perpetuity is also of importance.

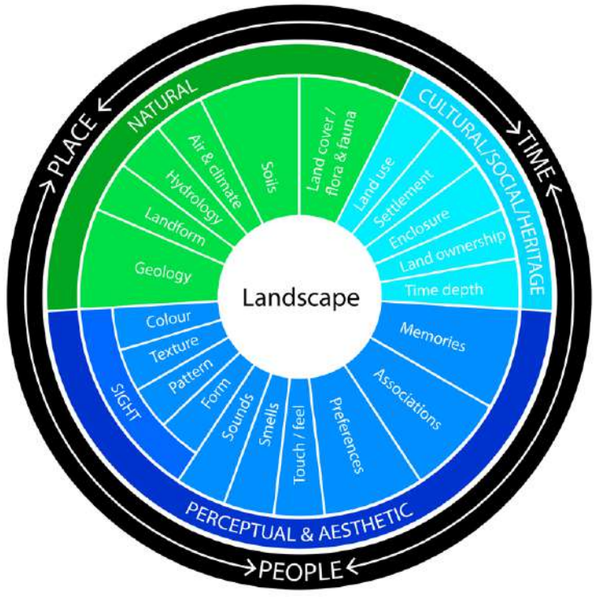


Fig.6.3_ Diagram - Approach to Landscape character assessment (Natural England, 2014)

The proposals touch each of the four generic approaches set out in HS2's landscape design vision:

- **Conserve**: Proposals have sought to protect as much of the most sensitive habitats as possible including retention of ancient woodland;
- **Enhance**: Proposals have created new landscape and wetland features which build in biodiversity and human scale interest;
- **Restore**: Proposals have recreated lost landscape typologies such as wet woodland and wet meadows which have become lost or scarce in the Colne Valley;
- **Transform**: Proposals have sought to deliver new recreational routes for walking and cycling which opens up new areas of Colne Valley Regional Park as part of a strategic rights of way network.

The following sections expand on a set of key design considerations which have shaped the integrated response. These comprise:

- Landscape and biodiversity
- Access and recreation
- Aesthetic and sensory experience
- Drainage and flood management

Fig.6.4_ Photograph - Broadwater Lake

Code 1 – Accepted

6.1

Code 1 – Accepted

Landscape and Habitats

6.2.1 Overview

A set of overarching objectives underpin the design and delivery of integrated landscape and habitat proposals which are described in this Design and Access Statement. These comprise commitments to:

- Minimise loss of vegetation and habitats along the viaduct footprint during both construction and operational phases;
- Reduce environmental impacts; and
- Achieve the target of no net loss in biodiversity for replaceable habitats across the Colne Valley.

The design aspires to re-connect existing habitat corridors that will be severed during construction of the viaduct; and to introduce new habitats that are scarce or absent from the wider landscape but which compliment current habitats and reflect their diverse character. The design will balance the need for habitat creation for wildlife with other key drivers, such as public access and recreation, water management, cultural, and heritage considerations along the River Colne Valley.

6.2.2 Design approach

Landscape and ecological design will be fully integrated, maximising the biodiversity potential of new areas of landscape planting or habitat creation areas. Much of the habitat creation focuses on creation of open wetland habitats that are currently scarce, particularly wet woodland, shallow ponds and scrapes, and wet grassland. Habitat designs are being developed to ensure improved biodiversity compliments that of existing designated sites, including the Mid Colne Valley SSSI, which primarily consists of open deep-water lake habitats, and semi-natural Broadleaf woodland.

6.2.3 Maximising opportunities for habitat creation

Areas of planting or seeding will aim to maximise biodiversity through use of species-rich and locally characteristic seed mixes as well as naturalistic design of planting plots to avoid straight lines and sudden transitions in planting type. Transitionary 'edge' habitats will be introduced where feasible, for example, areas of woodland planting will be merge into grassland areas via scrub and longer grassland. The establishment of new vegetation will include direct planting and seeding at the outset together with allowing areas to naturally colonise from local seed sources.

Habitat creation opportunities focus on:

- Areas where existing lake habitat (open water) is to be reclaimed, to include bank reprofiling and aquatic/ marginal habitat creation
- Creation of additional water-space around specific viaduct piers, to include bank bank reprofiling and aquatic/ marginal habitat creation
- Creating new habitat under the viaduct itself, which is tolerant of variable shade conditions, and along the margins of lakes which currently support Broadleaf woodland, scrub and scattered trees. This will include a mosaic of ponds, scrapes (shallow ponds) and small channels to provide lake-side wetland habitats

Indicative species lists for each of the proposed landscape and habitat typologies are provided in 6.2.4. These lists are not exhaustive and will be developed further during the detailed design phase, informed by a fuller understanding of reinstated soil conditions and profiles, aspect and topography. Continued engagement with Natural England and the Herts and Middlesex Wildlife Trust will also help to inform definitive species schedules.

6.2.4 Landscape & habitat typologies

Amenity Grassland

Typical Species:

- Perennial ryegrass - Lolium perenne
- White Clover - Trifolium repens
- Daisy - Bellis perennis
- Plantain - Plantago major
- Common dandelion - Taraxacum officinale

Broadleaf Woodland

Typical Species:

- Alder - Alnus glutinosa
- Silver birch - Betula pendula
- Pedunculate oak – Quercus robur
- Grey willow - Salix cinerea
- Dogs mercury - Mercurialis perennis

Code 1 – Accepted

6.2

Species Rich Grassland

Typical Species:
- Meadow foxtail - Alopecurus pratensis
- False oat grass - Arrhenatherum elatius
- Crested dogs-tail - Cynosurus cristatus
- Birdsfoot trefoil – Lotus corniculatus
- Yellow rattle - Rhinanthus minor

Wet Grassland

Typical Species:
- Common bent - Agrostis capillaris
- Crested dogs-tail - Cynosurus cristatus
- Meadowsweet - Filipendula ulmaria
- Lady's bedstraw - Galium verum
- Yarrow - Achillea millefolium

Marginal & Aquatic Planting

Typical Species:
- Common reed - Phragmites australis
- Reed canary grass - Phalaris canariensis
- Reed sweetgrass - Glyceria maxima
- Yellow iris - Iris pseudacorus
- Purple loosestrife - Lythrum salicaria

Native Scrub Habitat

Typical Species:
- Hawthorn - Crataegus monogyna
- Alder buckthorn - Frangula alnus
- Dogwood - Cornus sanguinea
- Elder - Sambucus nigra
- Guelder rose - Viburnum opulus

Wet Woodland

Typical Species:
- Alder - Alnus glutinosa
- Grey willow - Salix cinerea
- Silver birch - Betula pendula
- Greater tussock sedge - Carex paniculata
- Common reed - Phragmites australis

Code 1 – Accepted

Landscape and Habitats

6.2.5 Vegetation clearance and reinstatement

Retention of existing vegetation, where practicable, is an overarching project objective. This is linked to achieving biodiversity and no net loss targets; to provide integration of built structures within the existing vegetation framework; and to achieve landscape and visual mitigation as set out in the Environmental Statement.

In order to construct the viaduct, tree felling and vegetation clearance will be required within a defined and controlled corridor which includes a number of satellite construction compounds along the route of the viaduct. The quantum and coverage of tree felling will be determined in due course informed by tree surveys and Arboricultural Impact Assessments.

Figure 6.5 shows a typical section showing the extent of vegetation clearance required to accommodate construction infrastructure.

Outside of this corridor, tree removal or remedial works such as canopy trimming will be very limited, selectively based on tree height and proximity to the viaduct structure. All tree clearance works will be guided by the Arboricultural Impact Assessment.

All land cleared to construct the viaduct will be subject to a landscape reinstatement scheme; this will include tree and scrub planting, understorey planting, grassed areas and wetland planting. A typical reinstatement detail is shown in Figure 6.6.

The anticipated extent of tree clearance within the viaduct corridor is illustrated in the tree loss plans 1MC05-ALJ-GI-MAP-CS01_CL01-000006 (Pages 1-6).

Fig.6.5_ Section diagram - Tree and vegetation clearance

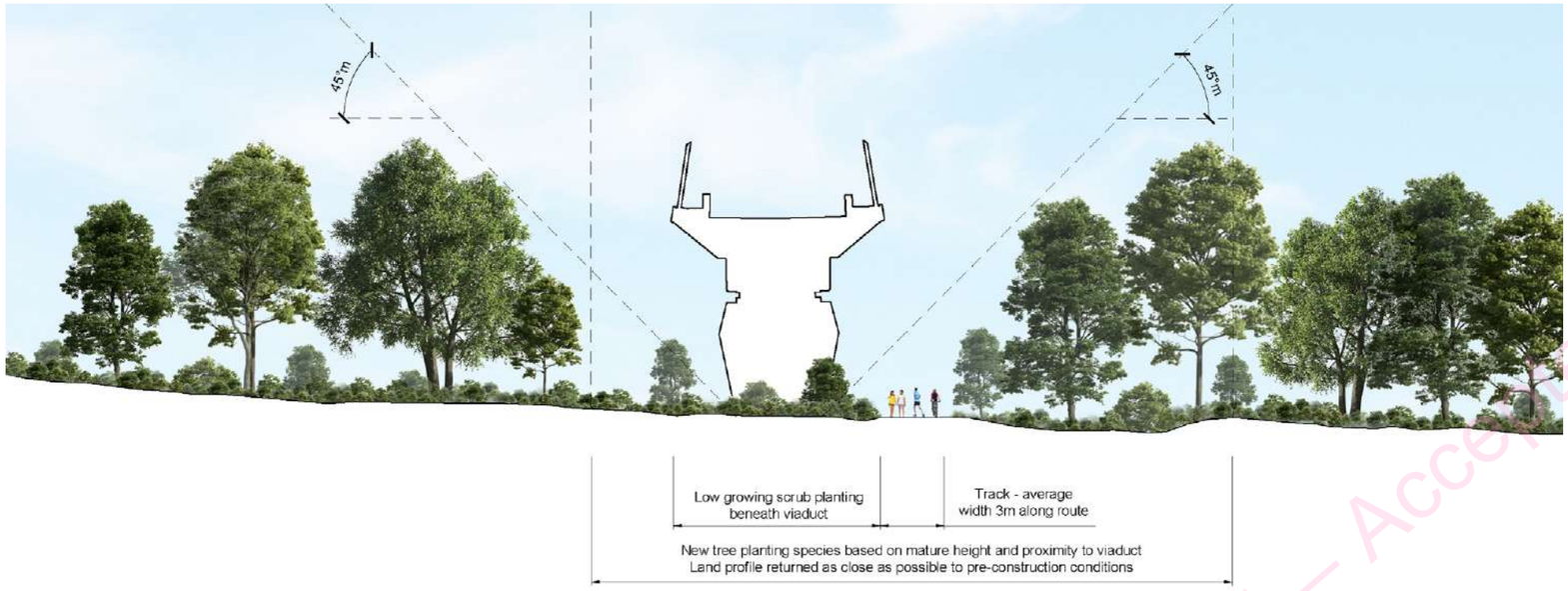


Fig.6.6_ Section diagram - Tree and vegetation reinstatement

Code 1 – Accepted

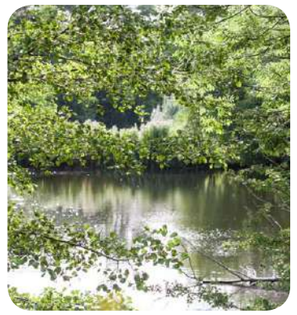
6.2.6 New vegetation

Developing a comprehensive landscape design, fully integrated with ecological design, is only the first step to creating extensive areas of new and restored habitat that merges seamlessly into the existing landscapes. To achieve the desired high-quality habitats, clear principles will be established, to be applied during the construction and future management phases of the scheme. This will be critical to maximising the ecological value of the new and restored habitats. General design principles, to ensure effective implementation and establishment of new habitats, will include:

- Flexibility in design, important to enable the exact profiles of wetland features to be directed on-site (by a suitably qualified and experienced ecologist) once channels and wetlands have been excavated to the proposed design level.
- Designs will minimise future management as far as possible. This will be planned on a rotational basis, so that damage to newly established habitats is minimised.
- Timing of the construction works, and future management will be planned to minimize ecological impacts to new habitats and the species they support. Autumn is often the best time for maintenance work since least disturbance to wildlife will be caused at this time of year.
- Layout of planting (woodland and scrub) will avoid use of geometric grids and uniform spacing, to replicate as far as practicable naturally generating landscapes. Trees and scrub to be typically planted as juvenile stock (whips/ transplants) unless there is justification for more mature plants to provide early screening.
- Where habitat creation is close to the viaduct structure, the effect of shading will be reflected in the design.
- At the detailed design stage, consideration of reinstated soil conditions and profiles, aspect and topography will be used to shape the species schedules and methods of implementation.

6.2.7 Habitat establishment and maintenance

The following section describes the overarching principles of creating the primary habitat typologies including outline management and maintenance activities. Detailed management prescriptions will be set out in the Landscape and Ecological Management Plans which are being developed during detailed design stages.



Wetland / Lake Edge

Incorporate multi-stage profiles to create shallow bays and backwaters, marginal shelves with muddy margins, reed/swamp vegetation and transitions to wet grassland. Gradients of banks and bed will vary, to create micro-habitats.	New channels and wetland features should, as far as possible, be allowed to naturally move and change size, shape and location (dynamic wetlands). Within the limits of the Scheme, new channels should not be trained and should be allowed to find their own course during operation.

Mosaics of Wet Woodland

Mosaics of small flowing channels, ponds/ scrapes, willow/alder scrub and wet grassland glades within wet woodlands will provide important features for a range of species. Construction should ensure profiles are varied, creating a wide 'drawdown zone', so that as water levels fluctuate muddy margins develop across the hydrological profile.	Ponds will undergo natural succession to marsh and scrub over-time and occasional desilting may be required. However, the retention of a wide range of successional stages is important in maintaining the overall species diversity of the habitat. For ditches to function effectively and to avoid them becoming redundant, sensitive management (desilting) is likely to be required. A 'little and often' approach is preferred to minimise disturbance to the habitat.

Mosaics of Species Rich Grassland

Construction will focus on flat profiles, but with some variety of landform slope and aspect built-in to allow the incorporation of other habitat types, e.g. wader scrapes in open locations and pockets of scrub. For the ditches, natural colonisation is generally preferred, but can be accelerated by selective introductions through plant plugs and cuttings.	Appropriate management of the grassland sward will be through cutting/mowing. Cutting should be timed for suitably dry periods and after any ground-nesting birds have fledged. Cutting at least twice a year is likely to be required and removal of cut material, or aftermath grazing is required to reduce nutrient enrichment. Control of woody plants, rushes, docks, thistles and other undesirable species is essential to maintain a predominantly open grassland sward.

Broadleaf Woodland

Planting of new broadleaf woodland will include extensive areas of woodland-edge planting along existing retained woodland habitats. Supervision during construction is important to ensure planting spacing and patterns replicate a natural woodland landscape.	For the first three years following initial planting, dead, dying or damaged stock should be replaced with the same species as soon as practical in the first planting season following failure. As the woodland establishes, natural colonisation should be considered and the site is in proximity to existing areas of woodland . Retention of fallen trees and standing deadwood will be written into management plans to maximise biodiversity of new woodlands.

Code 1 - Accepted

Access and Recreation

6.3.1 Overview

The landscape of the Colne Valley is well served by an existing rights of way network centred around the lakes and canals with connections to neighbouring settlements. These provide both local and regional designated walking and cycle routes. In addition, there are other permissive routes, many of which are ill-defined on the ground and in poor condition.

Maintaining and enhancing access to the Colne Valley was one of the key feedback themes from the public engagement events on the viaduct held in March 2018.

6.3.2 Opportunities

The linear nature of the HS2 viaduct works provides an opportunity to enhance parts of the existing rights of way network on land within the Act Limits; this includes provision of new routes and addresses issues of severance particularly along the River Colne.

Proposals have been developed in alignment with strategic access and recreational initiatives within the valley including those promoted through the Colne Valley Regional Park Additional Mitigation Plan; and by local and county-wide planning authorities. The design process has been shaped by regular engagement with relevant bodies to secure coherent and integrated route planning which will deliver community benefits beyond the narrow corridor impacted by HS2.

6.3.3 Proposals

Subject to obtaining any necessary consents and agreements with landowners, the alignment of potential new recreational routes to be delivered by HS2 is illustrated in Figure 6.8. This includes connecting routes within the Western Valley Slopes and south of Harvil Road (which will be included in future Schedule 17 requests for approval). Existing routes and proposed routes promoted by the CVRP AMP and by Buckinghamshire County are also shown for context. Existing routes and proposed routes promoted by the CVRP AMP and by Buckinghamshire County are also shown for context. Where proposed routes have the potential to connect across public roads, discussions with Highways Authorities to secure safe crossing facilities will be required – the location of potential crossing points is shown on Figure 6.8

A brief description of routes delivered by HS2 in the vicinity of the viaduct is provided below and should be read in conjunction with Figure 6.8.

A412 to Moorhall Road

This route, which is entirely within Act Limits, will deliver north-south connectivity alongside the River Colne and address severance created by the Colne through the potential provision of a new footbridge. Much of this route will also serve as a vehicle maintenance track for land piers between the A412 and Moorhall Road reusing, where practicable, materials from the decommissioned haul road. Maintenance use will be infrequent and typically planned. In its middle section the path will cross the River Colne via a new pedestrian bridge. This will be subject to detailed design and continuing discussion with the Environment Agency, landowners and relevant statutory bodies. The bridge will be submitted for consent in due course. The route will typically be formed by a 2.5m track comprising granular, self-binding material (or equivalent) which is both durable and easily maintained – surfacing materials will reflect hues and colours in the landscape and the viaduct itself. The finished surface will be suitable for pedestrian and cycle use. Gated access will be provided at each end to ensure unauthorised vehicle access is controlled; a suitable chicane or other device will be installed requiring cyclists to dismount.

Moorhall Road to HOAC

This potential route will initially follow the existing Moorhall Road carriageway footpath which is outside of HS2 control. From here it will follow a viaduct maintenance route connecting through to the Grand Union Canal towpath, albeit permission to construct this will be required from the current landowner. The existing towpath will then provide options for heading north or south and connections to the wider existing rights of way network including the Colne Valley trail.

HOAC to Harvil Road

There are extensive HS2 related works in this area which include the upgrade of Dews Lane, the provision of a new National Grid station at Harefield Moor, new flood compensation areas adjacent to Harefield Lake, together with the viaduct itself. The only footpath works which form part of the HS2 contract are those which require diversion of the U34 footpath alongside the Newyears Green Bourne and the downgrading of Dews Lane (existing alignment) to a recreational path. The former will be a worn grass track to replicate the current finish, whilst the latter will become a surfaced route (c. 2.5m wide) providing access to properties on Dews Lane and wider connections to proposed routes within Harefield Moor which form part of the Colne Valley Additional Mitigation Plan proposals in this area.

Routes on the south of Harvil Road (delivered by the adjoining works contract) are aligned with the terminus of routes to the north to provide a connected and coherent network.

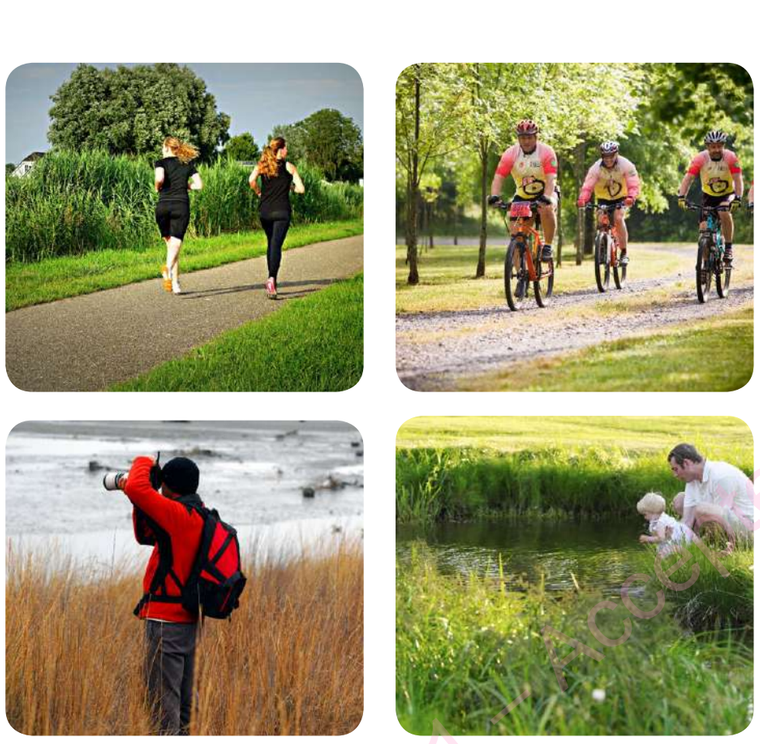


Fig.6.7_ Photographs - Access and recreational amenity precedents

Code 1 - Accepted

6.3

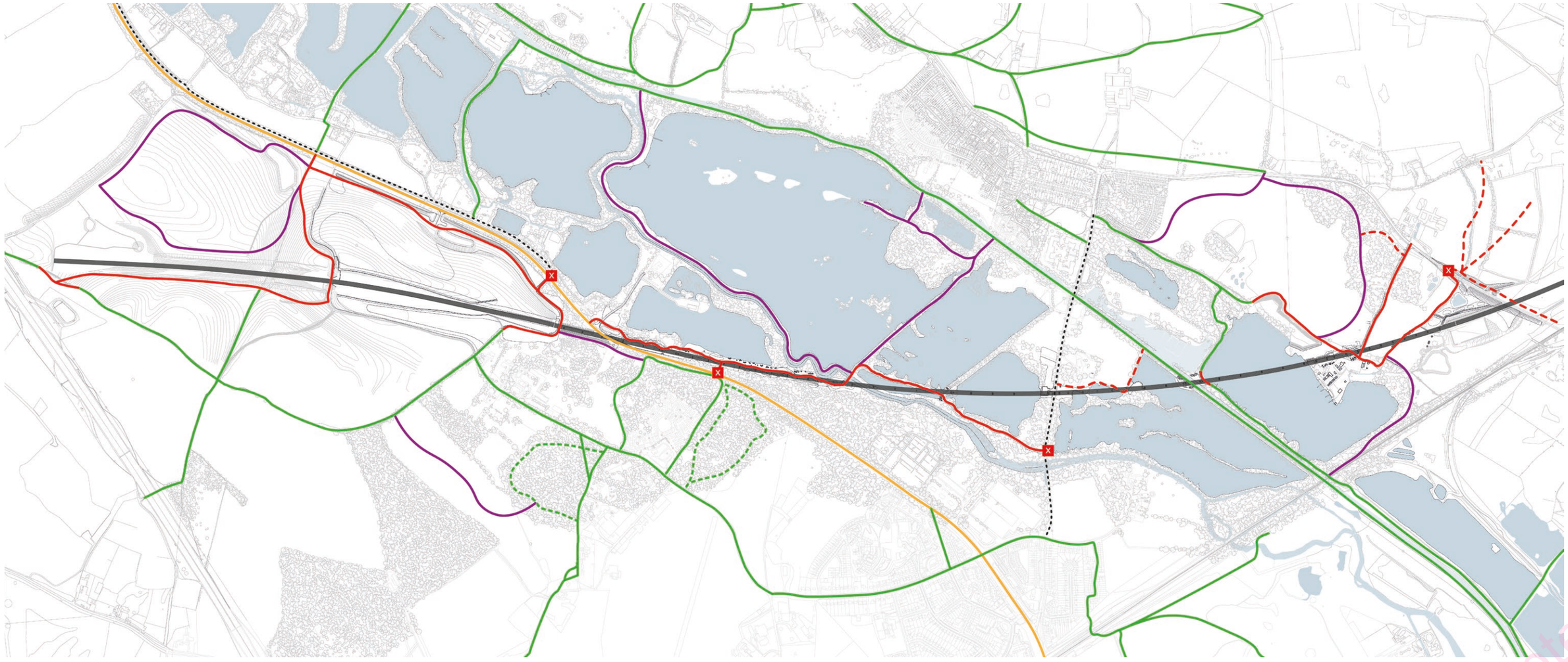


Fig.6.8_ Site plan - Access and recreation

Code 1 - Accepted

Aesthetic and Sensory Experience

6.4.1 Overview

This section describes the aesthetic and sensory experience which is embedded in the landscape strategy. This relates to how landscape design can create connection between people and place, shaping distinctive spaces and providing different visitor experiences inspired by the local context.

Proposals must equally be resilient and have a time-depth quality to ensure that the place-making aspirations embedded in the design are enduring.

The following topics and design considerations are explored as a means of articulating the overall approach to place making – and, by extension, the aesthetic and sensory experience:

- Creation of interconnected and distinctive spaces
- Interactions with the viaduct
- Opportunities for art in the landscape

6.4.2 Connected and distinctive spaces

The landscape design seeks to create different visitor experiences along the linear development corridor, providing opportunity to interact and engage with the natural environment as well as the viaduct. The mapping of the visual experience is illustrated in Figure 6.9 which indicatively shows how views of the viaduct and wider landscape start to create a structure for defining distinctive spaces.

Several 'character areas' are created which provide a framework for design development (including opportunities for art, planting etc):

1. Woodland and wetland corridors within the shadow of the viaduct
2. Open glades with views of lakes and wildlife
3. Riverscape
4. Enclosed woodland corridor with limited visual connection to viaduct
5. Framed views of the viaduct
6. Lakeside areas with panoramic views of the viaduct
7. Canal corridor
8. Pasture and open views

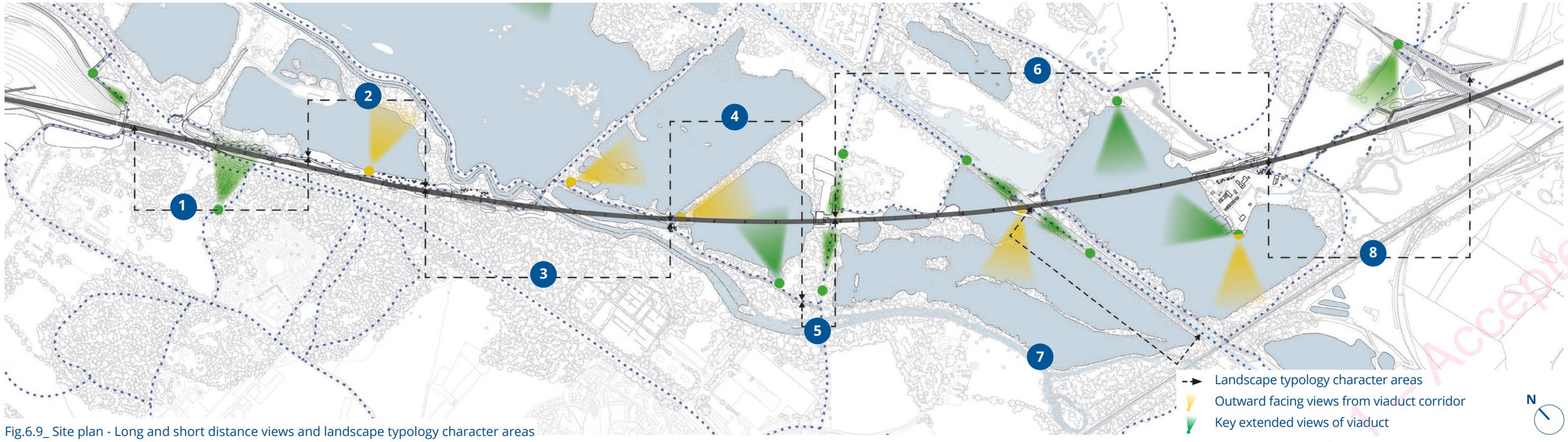


Fig.6.9_ Site plan - Long and short distance views and landscape typology character areas

Code 1 – Accepted

6.4.3 Public art strategy

It is HS2's ambition to develop a local public art programme in collaboration with relevant partners and stakeholders; this may be a discreet programme associated with the viaduct works but could equally form part of a broader strategy to deliver art within the Colne Valley area.

This section summarises a high-level approach for the Colne Valley Viaduct main works contract. Future art installations developed as part of a coordinated strategy with stakeholders will focus on permanent installations during the operation phase; and on the construction period (utilising elements such as art on hoardings). Art may take many forms including digital, multi-media and performance art.

The presence of a linear feature (the viaduct), traversed by rights of way connecting recreation spaces and places to live and work, suggests that an arts 'trail' would be an obvious approach in this location. This trail may be HS2 focussed or equally a subset of a wider Colne Valley Trail which could by example celebrates themes such as nature, engineering excellence and innovation, industrial legacy etc.

Figure 6.10 illustrates how the network of existing and proposed footpaths beneath the viaduct, creates a series of nodes where arts interventions could be located – this includes by example entrances/ gateways, crossing points, openings in the landscape, spaces adjacent to 'special' pier designs. With reference to the locations denoted on Figure 6.10 the following art opportunities have been considered:

1. Defines entrance to Shire Lane bridleway from the A412
2. Defines entrance to the CVV recreational route
3. Special pier (fixed buttress)
4. Open glade and extended views to the lake
5. Special pier (expansion pier)
6. Crossing of the River Colne
7. Special pier (fixed buttress) and extended views over Korda Lake
8. Defines entrance to the CVV recreational route
9. Defines entrance to the CVV recreational route
10. Towpath intersection with the CVV recreational route
11. Special pier (fixed buttress) and Savay Lake viewing area
12. Extended views of CVV and Harefield No.2 Lake
13. HOAC (or future development) and extended views of the CVV and Harefield No.2 Lake; potential interpretation boards for archaeological finds in the area
14. Defines entrance to the CVV recreational route and footpath U34 from Harvil Road

It should be noted that the architectural and landscape designs are not dependent on any public art being delivered.

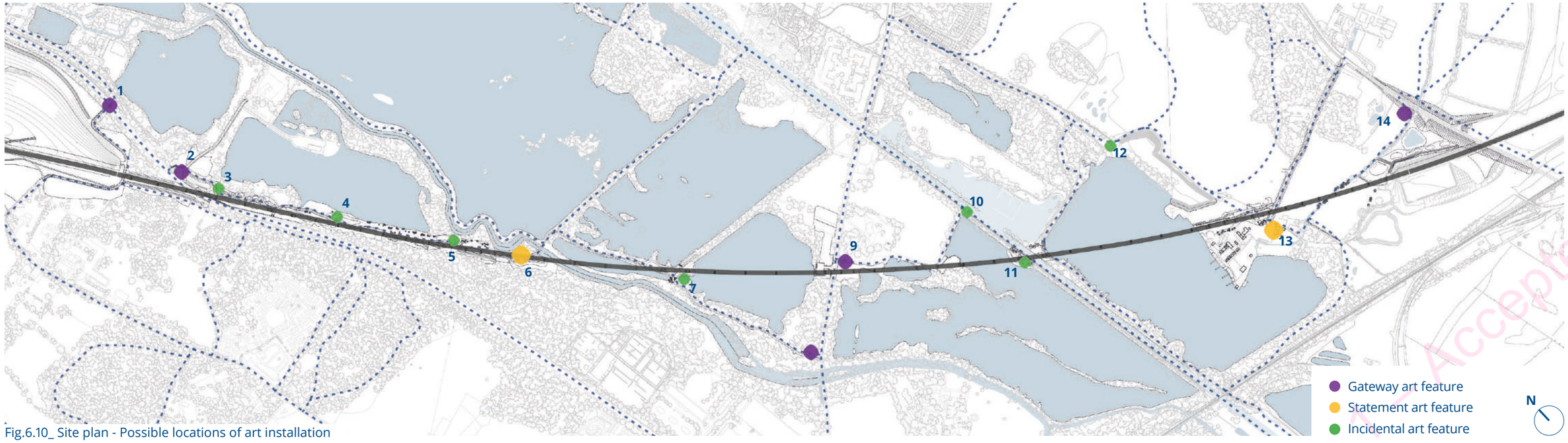


Fig.6.10_ Site plan - Possible locations of art installation

Code 1 – Accepted

Aesthetic and Sensory Experience

6.4.4 Viaduct interaction

The viaduct represents a unique opportunity to attract and engage visitors - this may take many forms including curating how people are able to interact with the structure in both a visual and physical sense.

The landscape strategy seeks to draw visitors close the structure where the architectural detailing and the structural components is most evident; and to establish panoramic viewing opportunities which reveal the scale and form against the backdrop of lakes and woodland.

The extent of public access to piers will be shaped by a number of factors, including:

- Security considerations - Accessible piers are typically in places with potential for greatest use where passive surveillance may help to minimise anti-social behaviour. There is a presumption against secure fencing around piers with use of defensive planting preferred where there is an identified risk of damage to/ climbing of structures to access bearings and deck;
- Wildlife sensitivities - Public access to piers which are located in the most sensitive habitat areas have been avoided;
- Nodal / gateway locations - Close quarters access is focussed around some of the more interesting pier forms where the potential to establish 'feature' spaces with seating or artwork may be greatest

The table on the following page demonstrates how access provision has been considered at each of the pier locations.

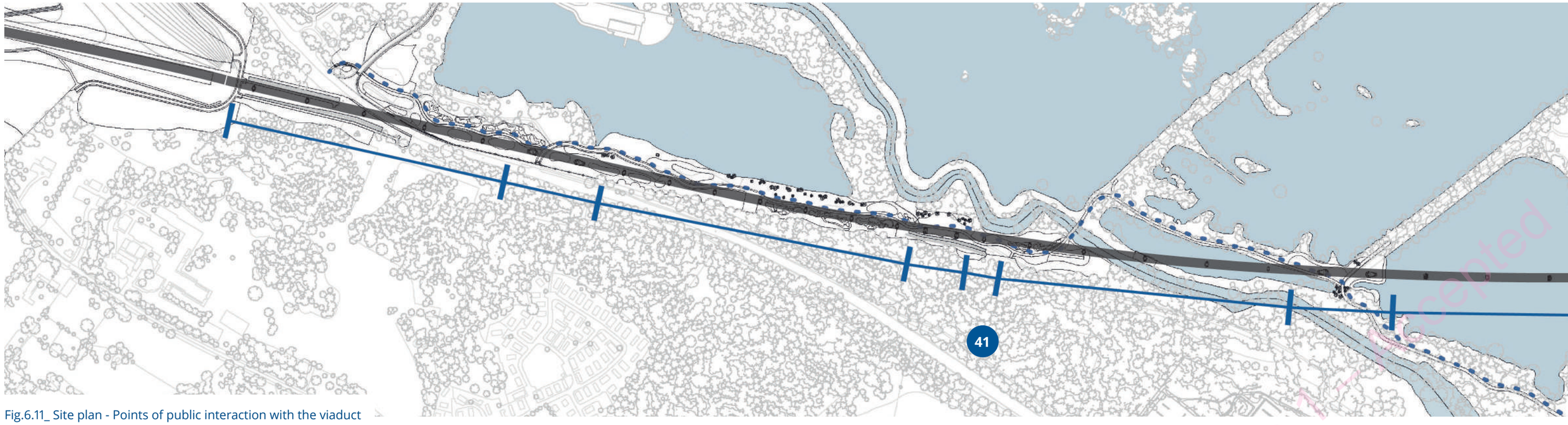


Fig.6.11_ Site plan - Points of public interaction with the viaduct

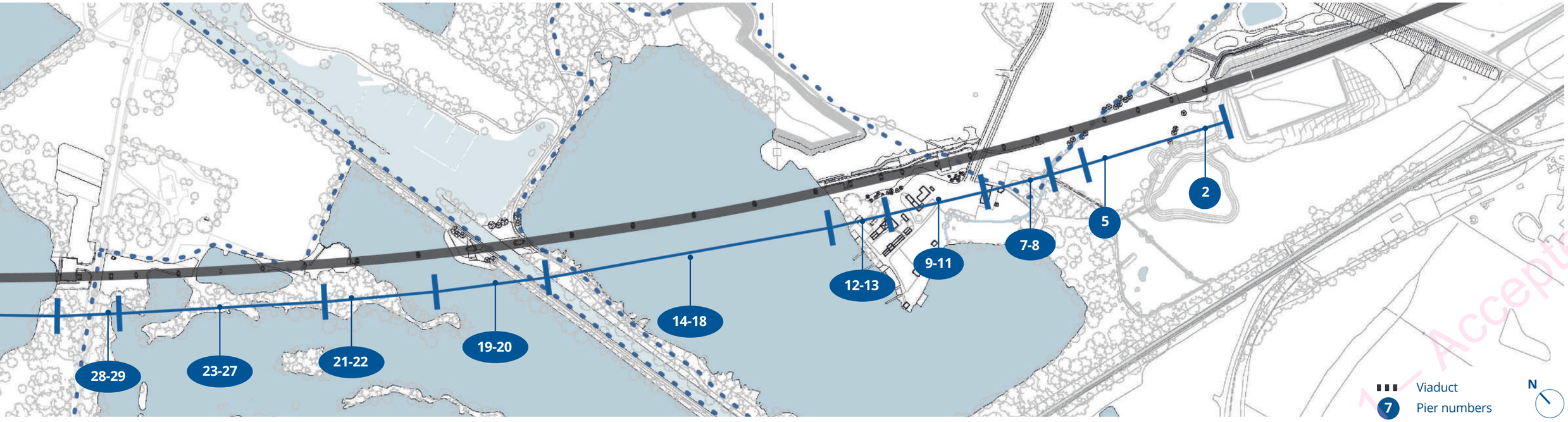
Code 1 - Accepted

6.4

Pier no.	Design	Description
2 -5 7-8		No public access to piers - land substantially returned to agricultural uses and/ or restricted access due to other sensitive infrastructure
6		Access to pier from public right of way
9-11		No public access to piers - land substantially returned to agricultural uses and/ or restricted access due to other sensitive infrastructure
12-13 28-29		Set within vegetation framework; limited or no public access in proximity to piers

Pier no.	Design	Description
14-18 21-22 30-33		Viewed from lake edges and rights of way
19-20		Piers accessible from the canal towpath and from the public right of way
23-27		Set within vegetation framework; limited or no public access
34-35 41		Piers accessible from the proposed new recreational route

Pier no.	Design	Description
36-40		Piers over water or set within more sensitive habitat areas where public access typically discouraged
42-43		Piers accessible from the proposed new recreational route
44-50 53-57		Piers set within more sensitive habitat areas and in areas where denser vegetation is required for screening purposes from A412 - public access offset from pier bases
51-52		Piers set within more sensitive habitat areas and in areas where denser vegetation is required for screening purposes from A412 - public access offset from pier bases



Code 1 – Accepted

Drainage and Flood Management

6.5.1 Overview

The viaduct works will require replacement flood storage areas; wetland habitats; and means to control drainage from the viaduct track bed and overground flows. The landscape strategy is the means by which an integrated approach to water management can be achieved – this takes into consideration important principles of sustainable and multi-functional drainage and water management systems; HS2 design standards and guidance; and stringent legislation and regulatory regimes covering aspects such as water quality, control of pollution and flood risk.

Technical details relating to drainage systems and flood compensation can be found in relevant sections of the Written Statement (1MC05-ALJ-TP-REP-CS01_CL02-000006) and Indicative Mitigation Proposal (1MC05-ALJ-TP-REP-CS01_CL02-000007).

6.5.2 Track drainage

This comprises rainwater discharge from the viaduct track bed. The viaduct track drainage approach is predicated on discharge of water from the track bed via pipework set within piers either as direct discharge into water bodies (piers over water) or via piped or open swales systems (land piers) with a final connection to watercourse or lakes. The approach to dealing with track drainage has evolved from early concepts which looked to attenuate land piers by means of open swales and attenuation basins to a predominantly underground piped based solution with direct discharge to watercourses and lakes. This preferred approach has been driven primarily by space constraints to ensure features such as recreational routes, maintenance access and habitat can be accommodated within the typically narrow corridor. Exceptions to this include areas around the north and south abutments where there is sufficient space to create open cut swales.

6.5.3 Overground flows

This comprises surface water discharge from adjacent catchments and includes local modification to ground level arising from the viaduct works. By substantially decoupling the track drainage from an open swales and attenuation system, a greater area of land has been made available to create multi-functional waterbodies which serve both a land drainage and a habitat function. This applies primarily to land at the northern end of the viaduct (refer to Figure 6.12). In this section a series of scrapes and ponds are proposed which act both as a capture point for over ground water flow but which also serve as habitat in their own right. This approach is cognisant of the surrounding wetland context and has advantages in that it provides shallow water body habitats which are largely absent in the valley floor. The scrapes will be designed to varying sizes and depths and will be fed from over ground flow and rainfall – given the variety in depths and profile they can exist as dry, semi wet and permanently wet habitat. Reference should be made to Section 6.2 which provides details on the ecological objectives including contribution of these features to no net loss calculations.

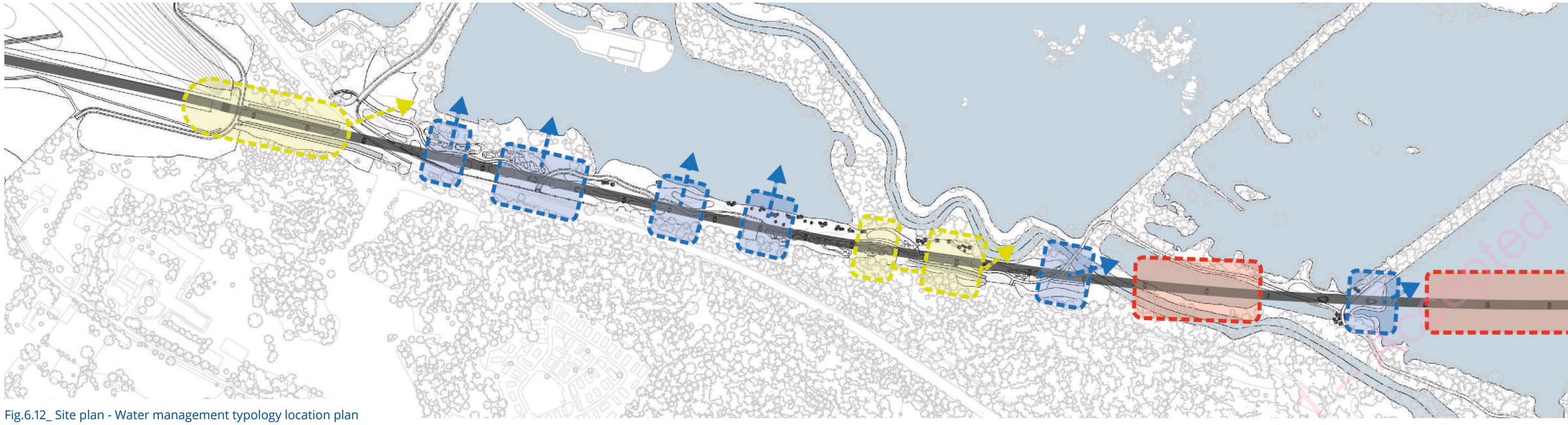


Fig.6.12_ Site plan - Water management typology location plan

Code 1 - Accepted

6.5.4 Flood compensation

This comprises land required to mitigate the loss of flood storage arising from the viaduct.

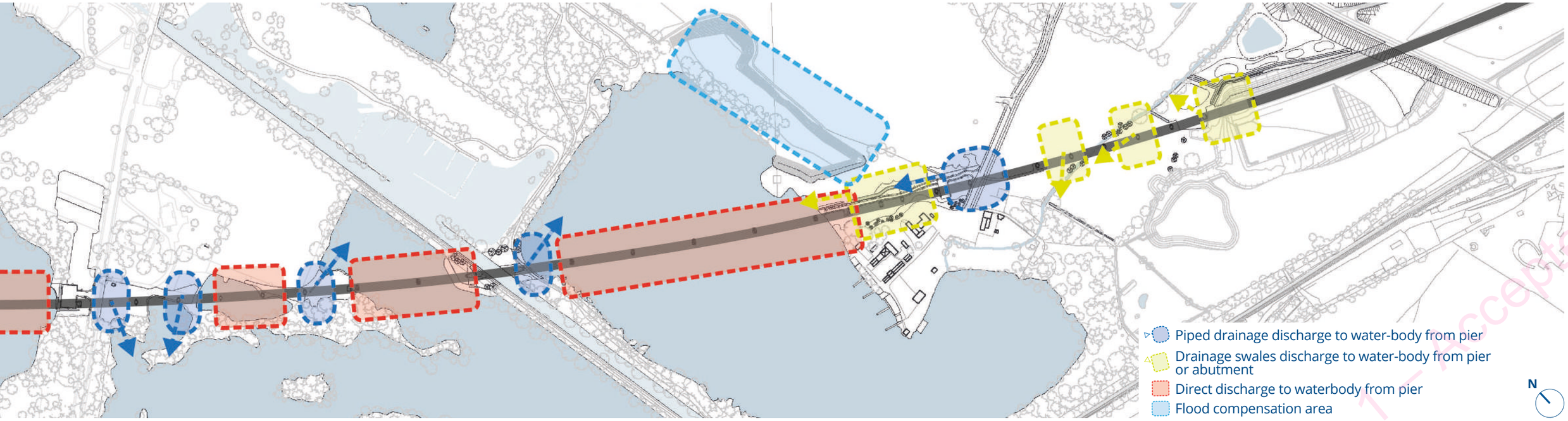
There are two principal areas identified for flood compensation:

- Land on Harefield Moor on the north-eastern edge of Harefield Lake No.2
- Land to the east of Newyears Green Bourne

For the majority of the time the flood compensation areas will be dry, vegetated features. Only in periods of flood will they hold water. The preliminary designs will be refined and submitted in due course as part of future Schedule 17 requests for approval.

There are some important design principles which govern the progression of these features namely:

- Retain areas of mature trees and hedgerows as far as practicable. By example, the majority of trees on the locally elevated western shoreline of Harefield Lake No.2 will be retained with water ingress/ egress via channels to the north and south of the retained tree belt;
- Maximise the habitat value of the flood area though introduction of varied bank profiles and vegetation types; and
- Limit where practicable overly engineered or steep slopes; where this is not achievable then planting is typically used to soften the appearance.



Code 1 – Accepted

Integrated Design

6.6.1 People, Place, Time

The aspects described on previous pages are brought together into integrated design solutions which reflect the three core principles of the Landscape Design Approach described in Section 6.1.3

People

Multi-functional routes carved through the corridor; places to dwell and interact with the viaduct; opportunity to engage with the wider valley landscape

Place

A place where wildlife can flourish in harmony with other uses; new habitats are created and existing retained; and areas required for construction are restored and repaired

Time

Management regimes adopted to preserve character; habitats designed to be robust and capable of withstanding climate change; provision of sustainable and multi-functional drainage solutions

Code 1 – Accepted

6.6

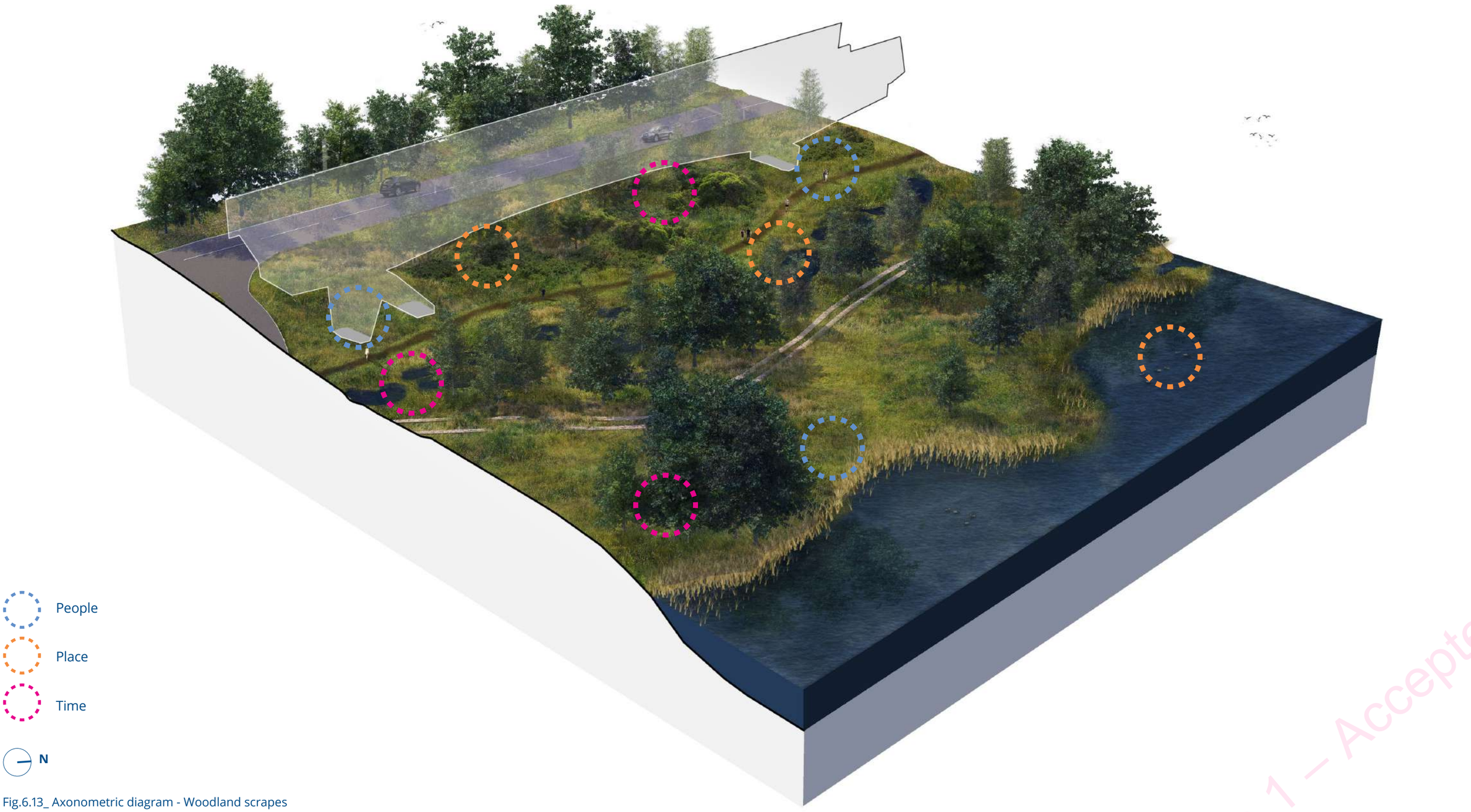


Fig.6.13_ Axonometric diagram - Woodland scrapes

Code 1 – Accepted

Landscape Design Response

6.7.1 Colne Valley sub-areas

Figure 6.14 opposite shows the landscape design response to the Colne Valley Viaduct across the extents of the Schedule 17 Application area.

The landscape design has been divided into a series of sub-areas running north to south, and are described in more detail on the following pages.

1. A412 corridor to the River Colne
2. River Colne to South East Korda Lake
3. Moorhall Road crossing
4. North West Savay Lake to North East Harefield No. 2 Lake
5. North East Harefield No.2 Lake to Harvil Road A412 Corridor

0 100 500 M

N

Fig.6.14_ Site plan - Landscape design response

Code 1 – Accepted

6.7

Code 1 - Accepted

Sub-Area 1 - A412 Corridor to the River Colne

6.8.1 Northern embankment transition

At the northern end of the viaduct the landscape proposals represent a transition from the more open grassland character of the Western Valley Slopes to the enclosed wooded character which prevails through much of the lower valley landscape.

The wooded slopes of the north embankment are a continuation of the tree belts which follow the trace up to the Tilehouse Lane bridge crossing; this provides visual screening of the railway infrastructure and represents a replacement for tree and habitat loss within the footprint of the viaduct itself.

The landscape treatment provides integration of open swales which serve to drain the viaduct piers at this location; these swales will be seeded with a grass mix which can tolerate wet and dry conditions.

This is also the point where the Shire Lane bridleway is diverted around the viaduct abutment, returning to its original alignment adjacent to the A412. The bridleway doubles as the maintenance track which serves the northern abutment.

Where required, boundary fencing, comprising post and wire agricultural style fencing will be used to delineate ownership boundaries. The extent or alignment of this fencing has not been agreed with landowners at this stage.

Security fencing around the abutment is not required. 4m noise barriers (which extend north along both sides of the track) and security doors at the top of the upper flights of stairs provide sufficient protection against trespass on the railway without need for additional standalone fencing.

Fig.6.15_ Site section - North embankment

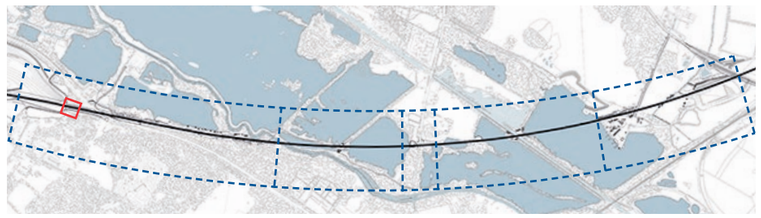
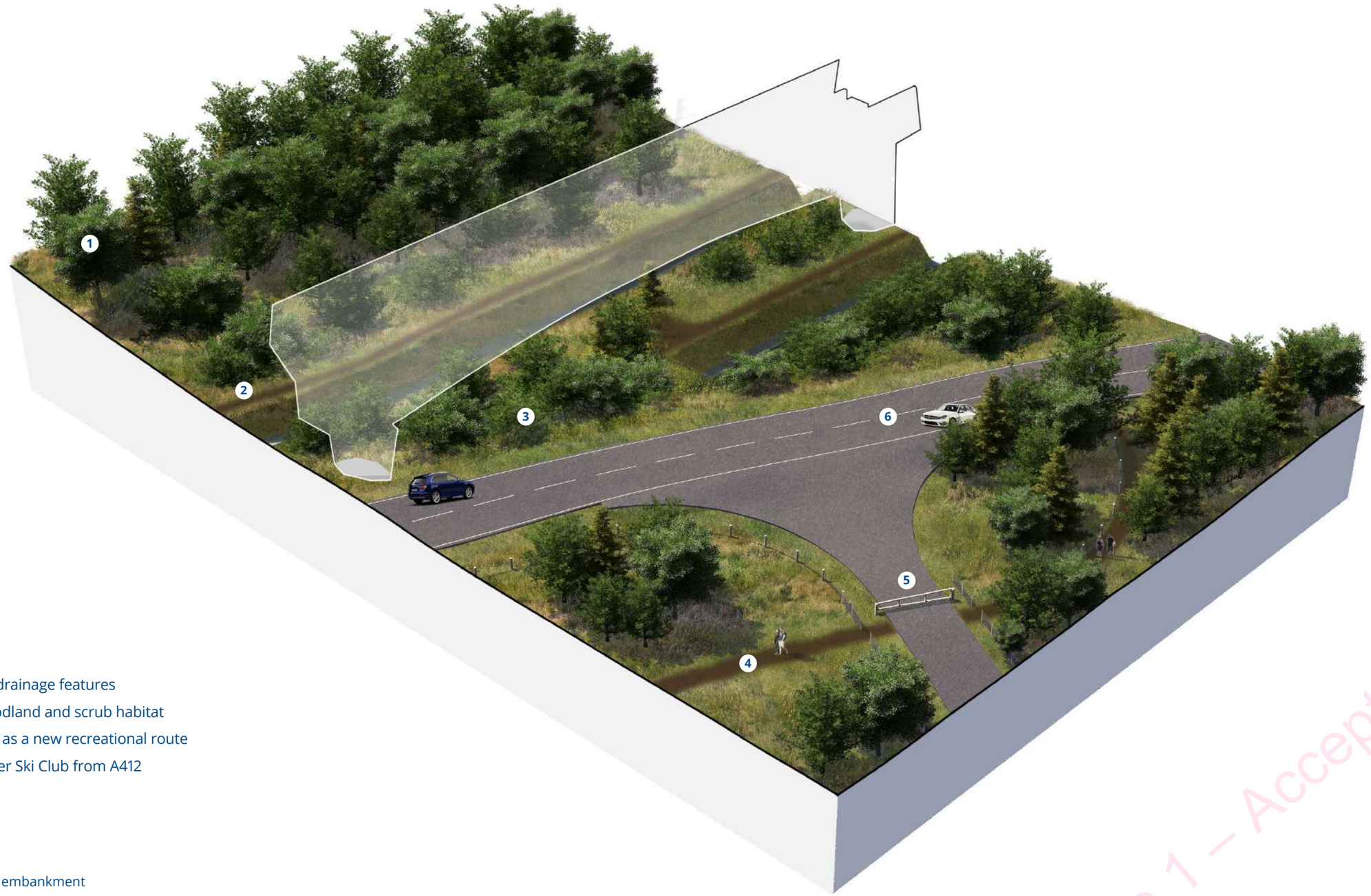


Fig.6.16_ Plan - Key plan

Fig.6.17_ Plan - North embankment

Code 1 — Accepted

6.8



1. Existing trees retained
2. Maintenance route accessing drainage features
3. New areas of low growing woodland and scrub habitat
4. Maintenance route to be used as a new recreational route
5. Entrance to new Denham Water Ski Club from A412
6. A412

N

Fig.6.18_ Axonometric diagram - North embankment

Code 1 – Accepted

Sub-Area 1 - A412 Corridor to the River Colne

6.8.2 Woodland scrapes

The landscape treatment aims to retain as much as possible the wooded enclosure and intimate feel to the A412 corridor, whilst creating a richer habitat mosaic at ground level. Tree and groundcover loss within the footprint of the viaduct is replaced with a series of scrapes and small ephemeral waterbodies (fed by over ground flows and rainfall) interspersed with scrub and low tree cover where mature tree height limits are constrained by technical design standards.

The wetland scrapes will create a more diverse range of habitat typologies – introducing ones which are largely absent in an area which is dominated by broadleaf woodland and deep water bodies. These features also provide some attenuation of surface water flows albeit they do not form part of the viaduct drainage system.

Clear and multi stem tree planting together with denser patches of scrub will filter views beneath the viaduct from the A412 whilst strategic placement of new scrub and tree planting around the scrapes will allow filtered views of the lake from the proposed maintenance track. Planting between the existing track and the lake edge will be largely retained. All planting is designed to be relatively low maintenance and the emphasis is on developing a naturally regenerating landscape to replicate much of the existing character.

The landscape proposals include recreational routes provision in this sub-area, with footpaths forming part of the proposed north-south route linking the Western Valley Slopes to Harefield Moor. Part of the proposed footpath in this sub area utilises the viaduct maintenance track which is required to service the piers during the operational phase.

Fig.6.19_ Site section - Woodland scrapes

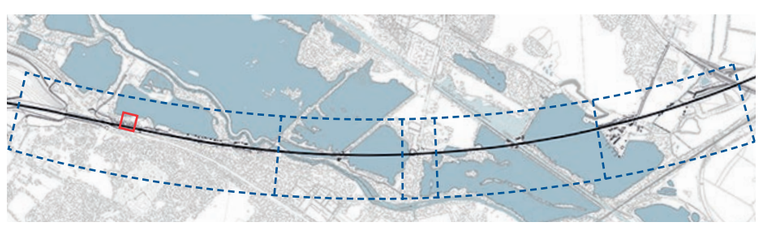
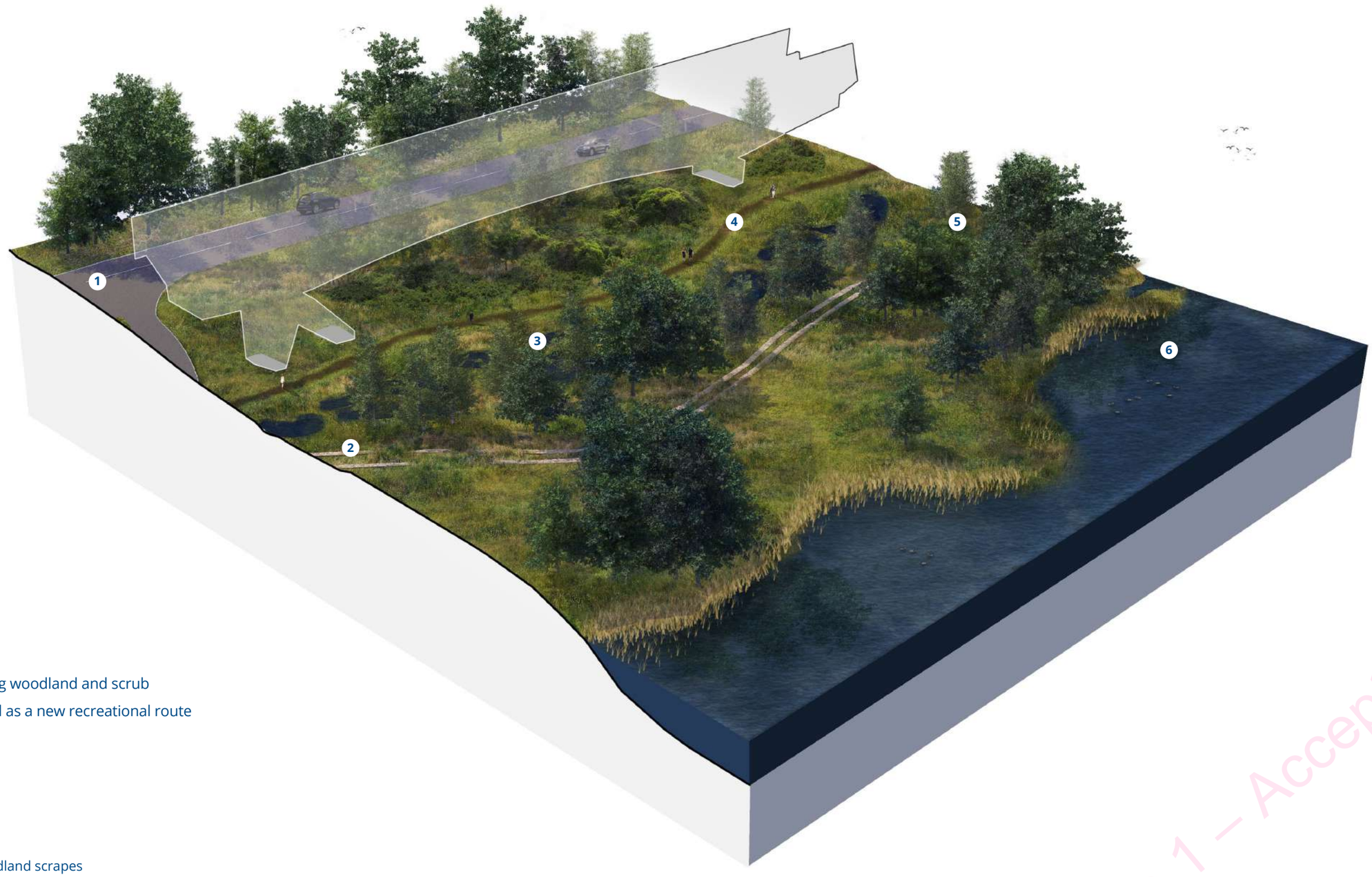


Fig.6.20_ Plan - Key plan

Fig.6.21_ Plan - Woodland scrapes

Code 1 – Accepted

6.8



1. A412
2. Existing footpath retained
3. Scrapes set within low growing woodland and scrub
4. Maintenance route to be used as a new recreational route
5. Existing planting retained
6. Denham Water Ski Lake

N

Fig.6.22_ Axonometric diagram - Woodland scrapes

Code 1 – Accepted

Sub-Area 1 - A412 Corridor to the River Colne

6.8.3 Open glade

The open glade area is an extension, in part, of the character of the woodland scrapes with areas of scrub, ground flora and low tree cover providing a mosaic beneath the viaduct; here the tree cover ties into the retained woodland edge on the west of the viaduct which incrementally forms a more substantial buffer between the viaduct and the A412 as one moves south. Public access also continues through this section.

In contrast with the predominantly enclosed character of the woodland scrapes, this section includes an open glade along the western shore of the Denham Waterski Club Lake providing views of the lake from the footpath and opening up the area to more sunlight. This in turn creates potential for distinct habitat typologies including larger ponds and wetland meadow which thrive in more open and sunlit conditions.

The reprofiling of the Denham Waterski Club Lake (undertaken as part of a separate planning application to relocate the waterski club facilities) presents an opportunity to establish reed margins on the shore line; this is not only beneficial from a landscape and habitat perspective but also helps to maintain the integrity of the bank which is vulnerable to washout from wave action emanating from water skiing activity.

Fig.6.23_ Section - Open glade

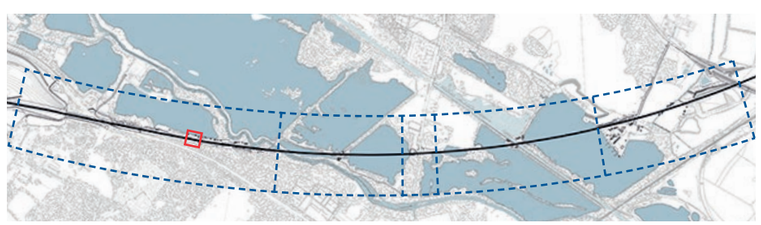
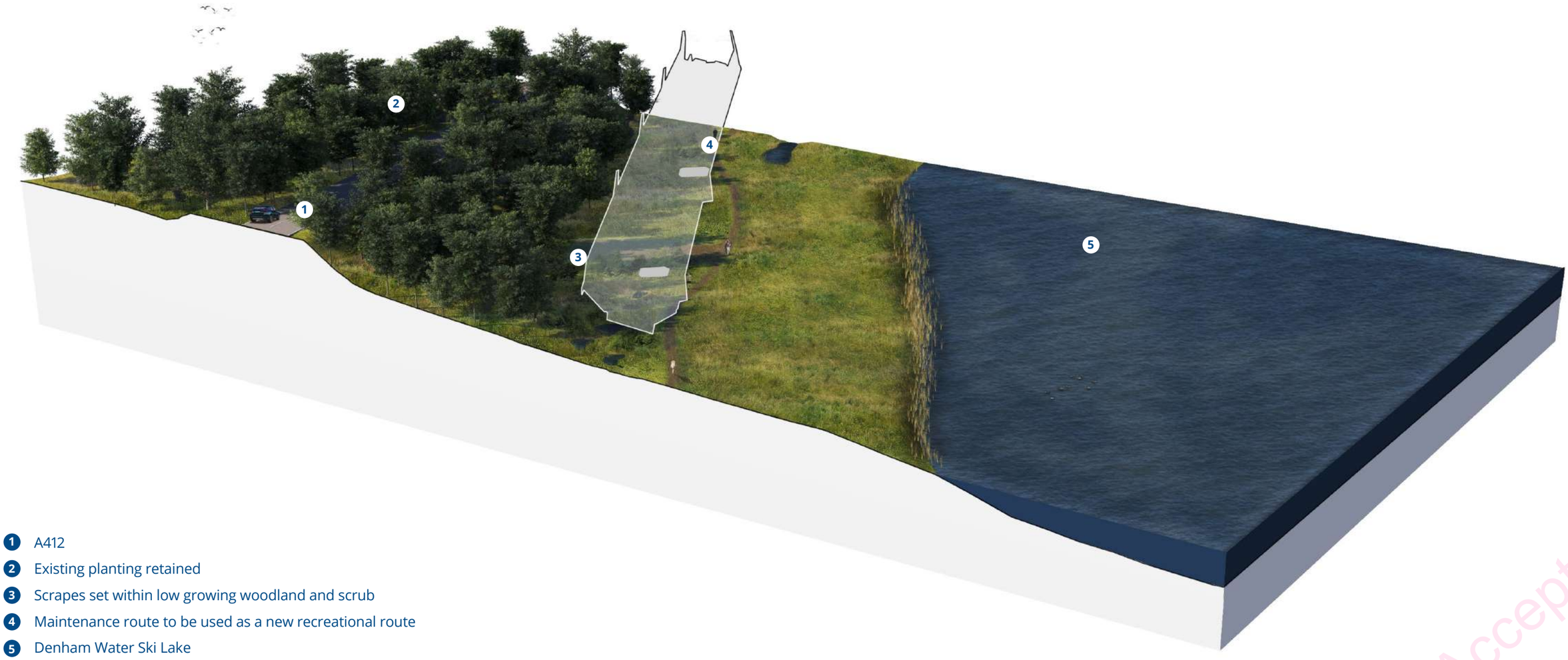


Fig.6.24_ Key plan

Fig.6.25_ Plan - Open glade

Code 1 – Accepted

6.8



1. A412
2. Existing planting retained
3. Scrapes set within low growing woodland and scrub
4. Maintenance route to be used as a new recreational route
5. Denham Water Ski Lake

N

Fig.6.26_ Axonometric diagram - Open glade

Code 1 – Accepted

Sub-Area 1 - A412 Corridor to the River Colne

6.8.4 Wet woodland

Localised low points along the margins between the viaduct and river edge provide opportunity to create additional pockets of wet woodland, extending the areas that will remain after the viaduct has been constructed. These areas will contrast with the retained broadleaf woodland which extends up the slope to the west of the viaduct to create a dense planted buffer between the A412 and the viaduct within the valley floor.

The combined maintenance track and recreational footpath alignment passes through a narrow open glade between the expansion piers 42 and 43 bringing visitors close to the pier bases. Creating different access experiences at specific piers is an important component of a broader strategy to allow visitors to engage with the viaduct in different ways including touch. Opportunity also exists for public art installations as part of the overall visitor experience objectives (also within other sub areas).

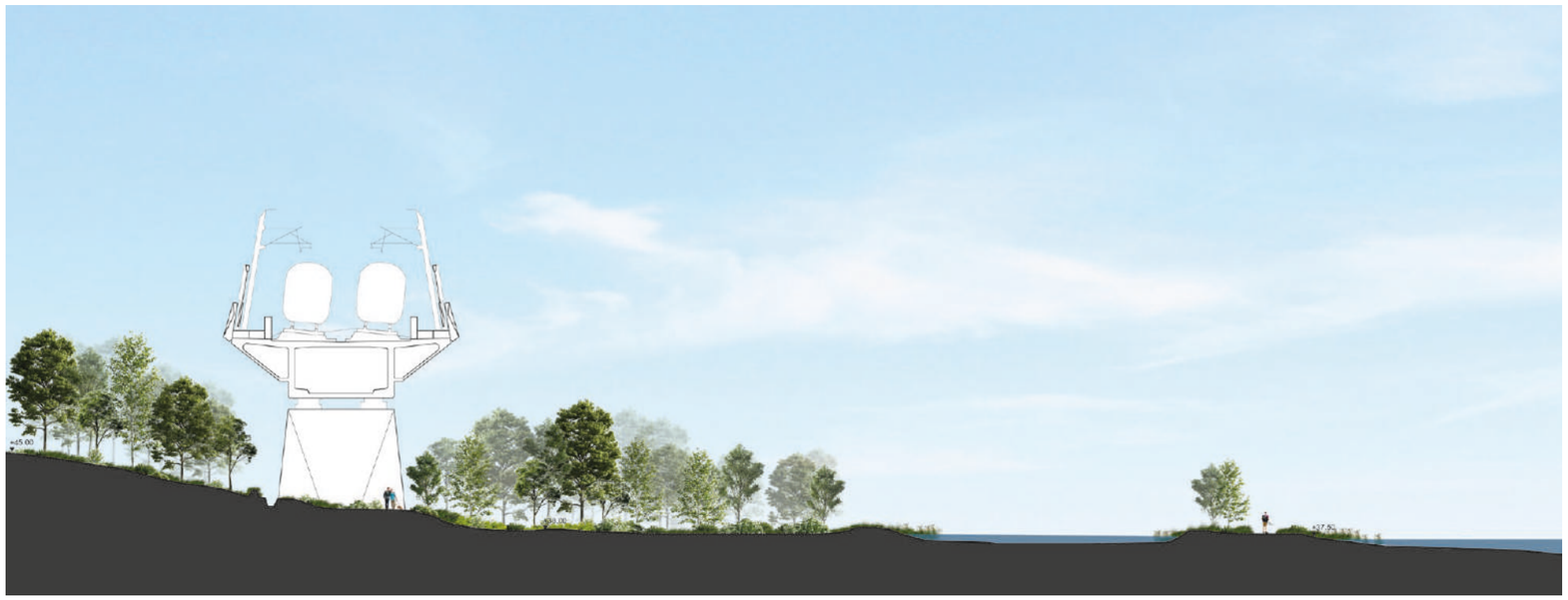


Fig.6.27_ Section - Wet woodland

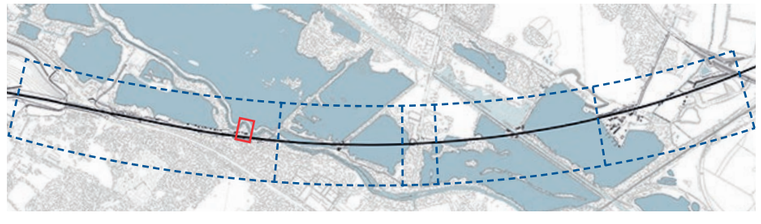
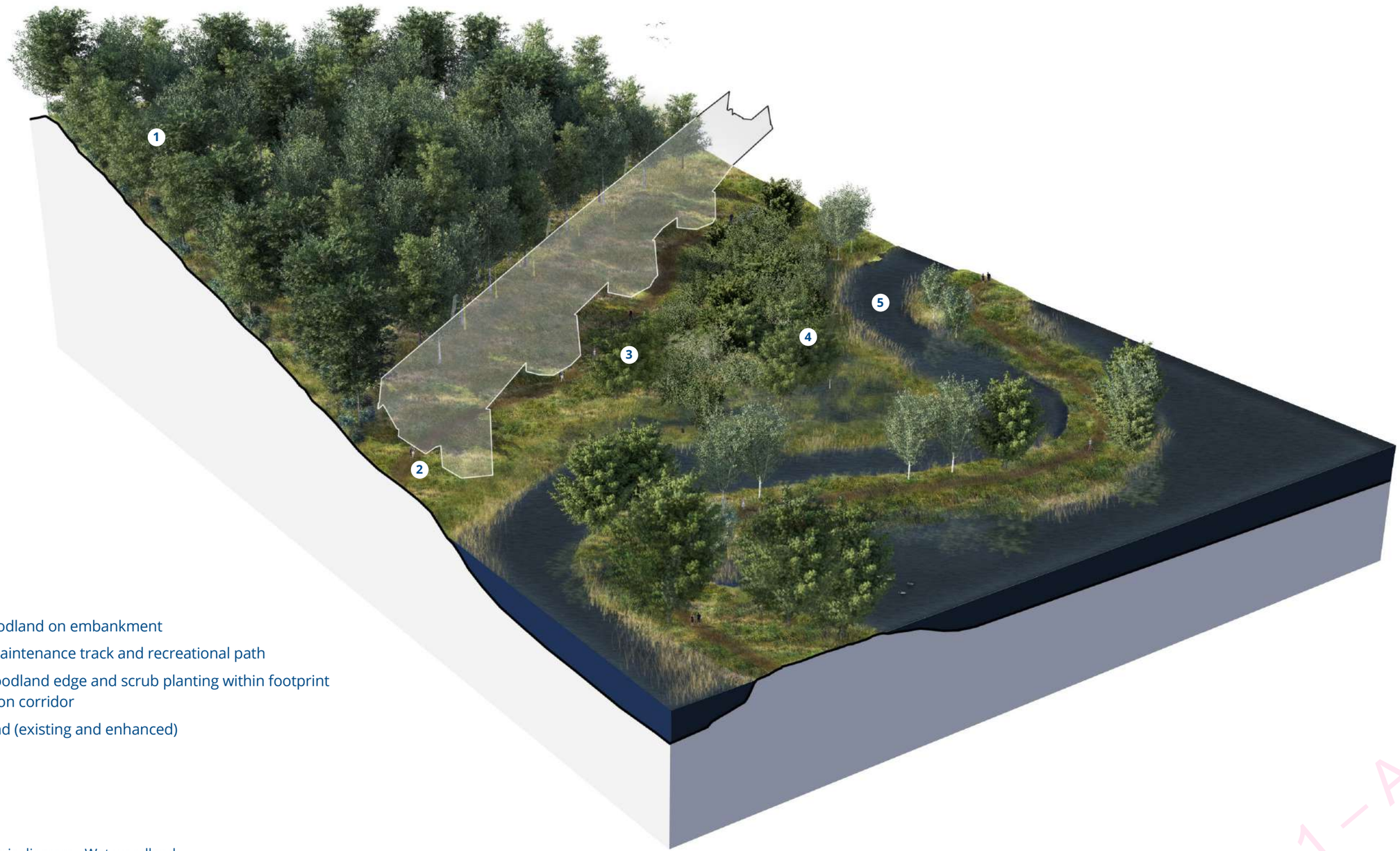


Fig.6.28_ Key plan

Fig.6.29_ Plan - Wet woodland

Code 1 – Accepted

6.8



1. Retained woodland on embankment
2. Combined maintenance track and recreational path
3. Proposed woodland edge and scrub planting within footprint of construction corridor
4. Wet woodland (existing and enhanced)
5. River Colne

Fig.6.30_ Axonometric diagram - Wet woodland

Code 1 – Accepted

Sub-Area 2 - River Colne to South East Korda lake

6.9.1 River Colne crossing

An important component of the recreational access strategy in this area is the proposed pedestrian bridge crossing of the River Colne. This is designed to provide east-west footfall which is absent at present due to severance caused by the river itself. The bridge is seen by stakeholders as an important component of the strategic network proposals in the area. The general design intent in relation to the bridge is shown in the visualisations opposite.

The area also replicates the proposed ephemeral waterbodies and scrapes character which prevails further north – here the concentration of the lakes and river corridor provide a context for wetland habitat creation. Careful detailing of planting and screening on the southern shoreline of Broadwater Lake will be required to ensure that disturbance to wildfowl on the lake is prevented.

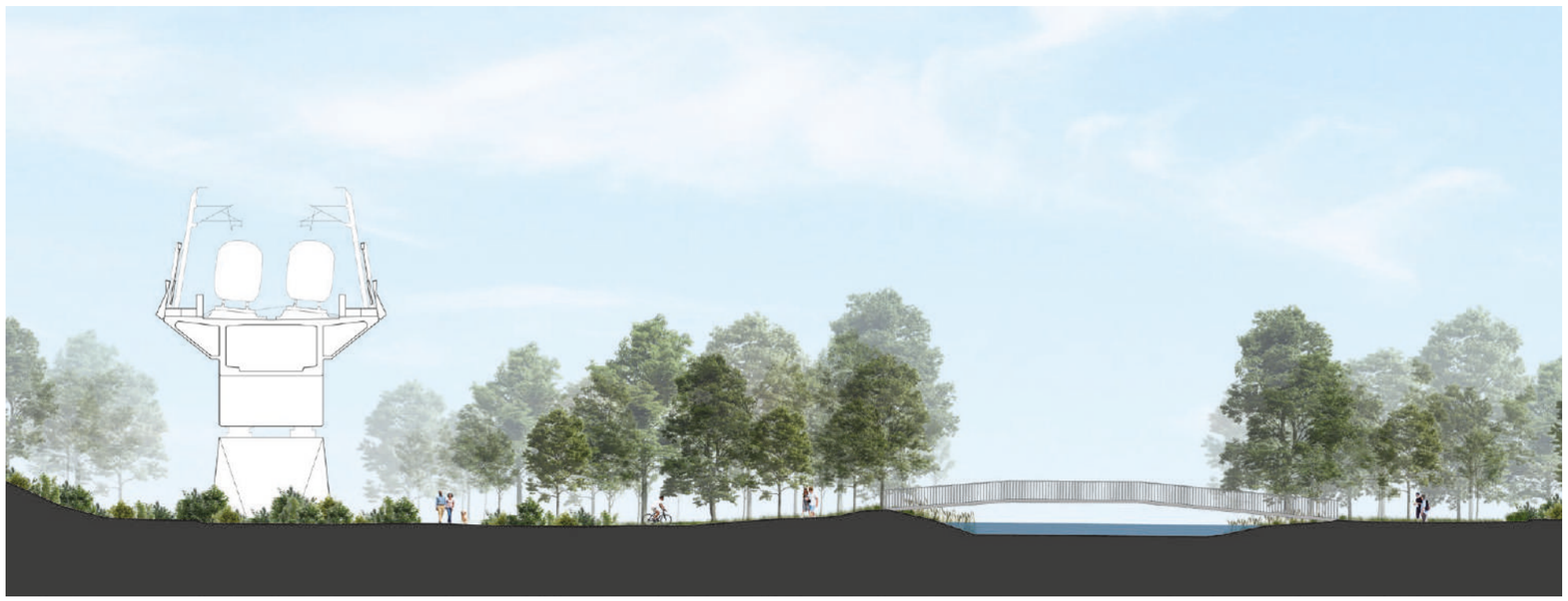


Fig.6.31_ Section - River Colne crossing

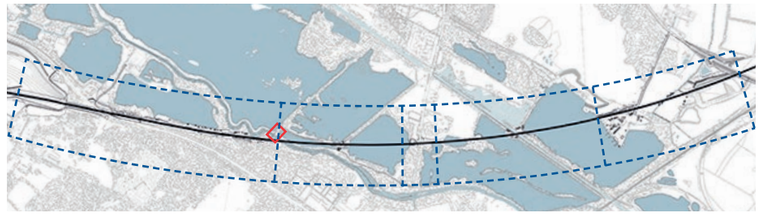
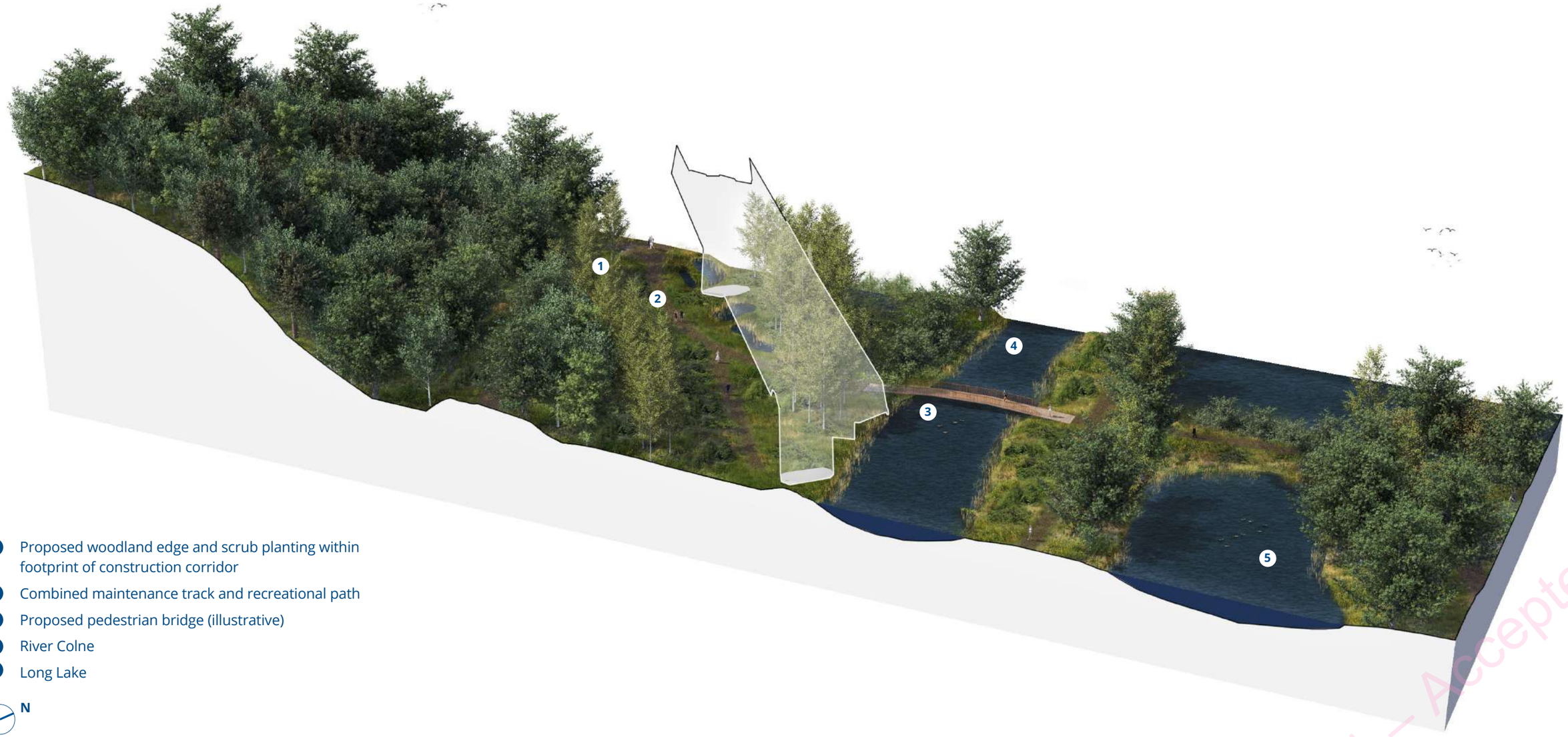


Fig.6.32_ Key plan

Fig.6.33_ Plan - River Colne crossing

Code 1 – Accepted

6.9



1. Proposed woodland edge and scrub planting within footprint of construction corridor
2. Combined maintenance track and recreational path
3. Proposed pedestrian bridge (illustrative)
4. River Colne
5. Long Lake

N

Fig.6.34_ Axonometric diagram - River Colne crossing

Code 1 – Accepted

Sub-Area 2 - River Colne to South East Korda lake

6.9.2 Korda Lake edge habitat

At the northern end of Korda Lake the landscape treatment responds to the design language of the fixed buttress piers which are land based pier types; here the regimented spacing of the piers has resulted in the buttress pier 'landing' within the water. To address this the shoreline has been extended to wrap around the pier base and profiled to allow establishment of reed beds and marginal planting. The profile of this lake shore extension is shown opposite.

Once vegetation is mature this will read as a land pier, albeit delivering broader biodiversity value derived from an ostensibly marginal habitat.

The proposed maintenance track extends through this area providing a continuation of the north-south recreational routes. This is an important junction, connecting the path delivered by the HS2 works with a planned east-west route along the northern shoreline of Korda Lake which is identified through the Colne Valley Regional Park Additional Mitigation Plan. Where these tracks meet users will experience filtered views through retained trees across Harefield Moor Lake and across Korda Lake.

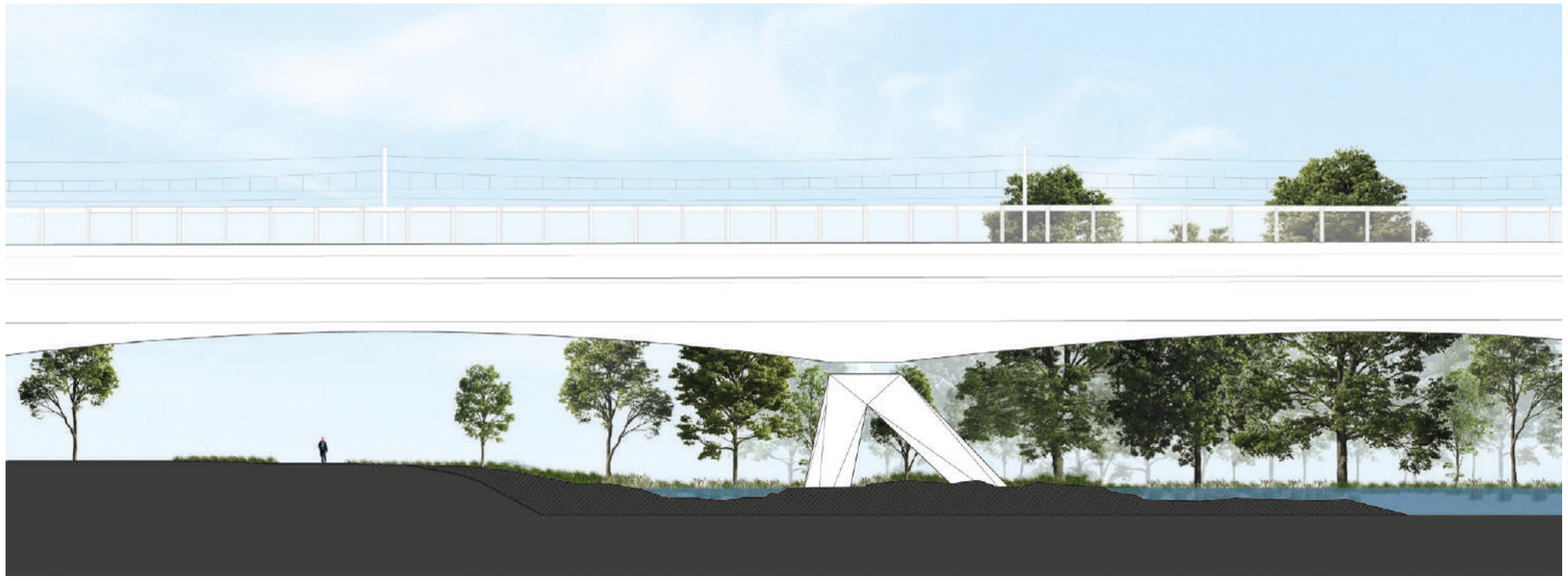


Fig.6.35_ Section - Korda Lake

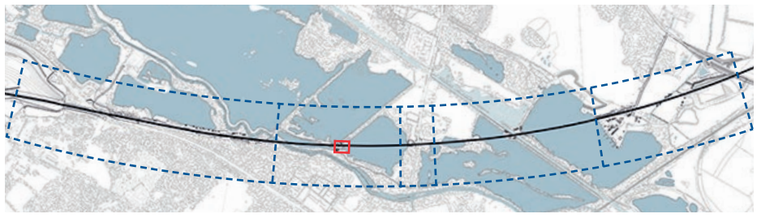
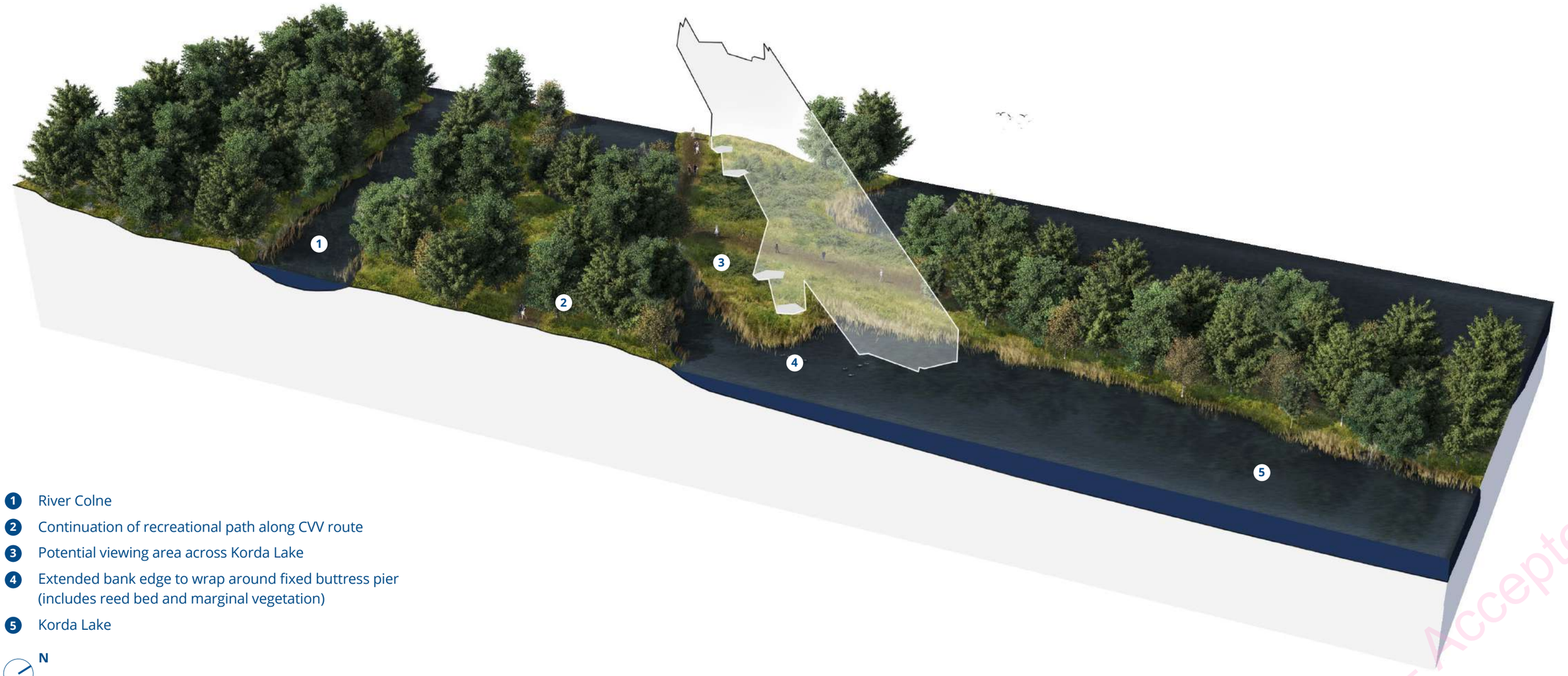


Fig.6.36_ Key plan

Fig.6.37_ Plan - Korda lake

Code 1 – Accepted

6.9



1. River Colne
2. Continuation of recreational path along CVV route
3. Potential viewing area across Korda Lake
4. Extended bank edge to wrap around fixed buttress pier (includes reed bed and marginal vegetation)
5. Korda Lake

N

Fig.6.38_ Axonometric diagram - Korda Lake

Code 1 – Accepted

Sub-Area 3 - Moorhall Road Crossing

6.10.1 Moorhall Road

North of Moorhall Road a section of Korda Lake will be re-profiled to allow pier 30 to sit entirely in water. Where the lake edge is re-profiled, the new landform will be planted with wetland marginal planting.

To the south of Korda lake the landscape treatment is designed to integrate the viaduct within framed views along Moorhall Road and to integrate the emergency evacuation area which sits beneath pier 29. The proposals respond to the loss of vegetation in this area to create satellite construction compounds on both sides of Moorhall Road. Planting will typically comprise native tree and scrub species to replicate the current and prevailing mixes.

Fig.6.39_ Section - Moorhall Road

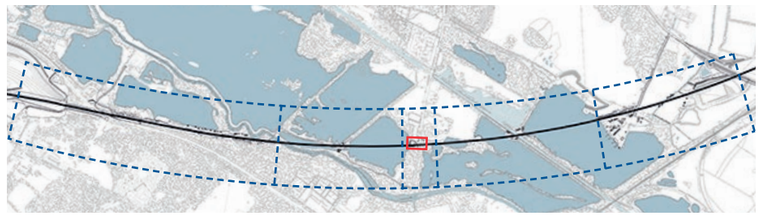


Fig.6.40_ Key plan

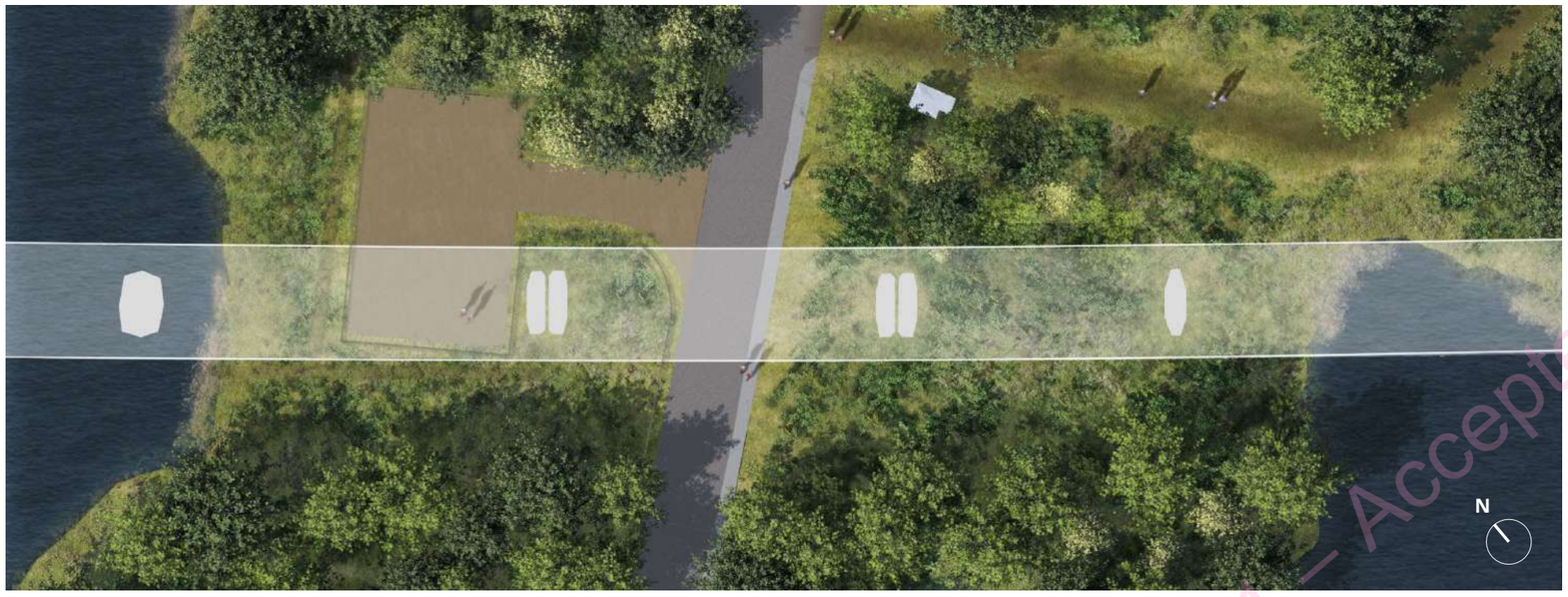
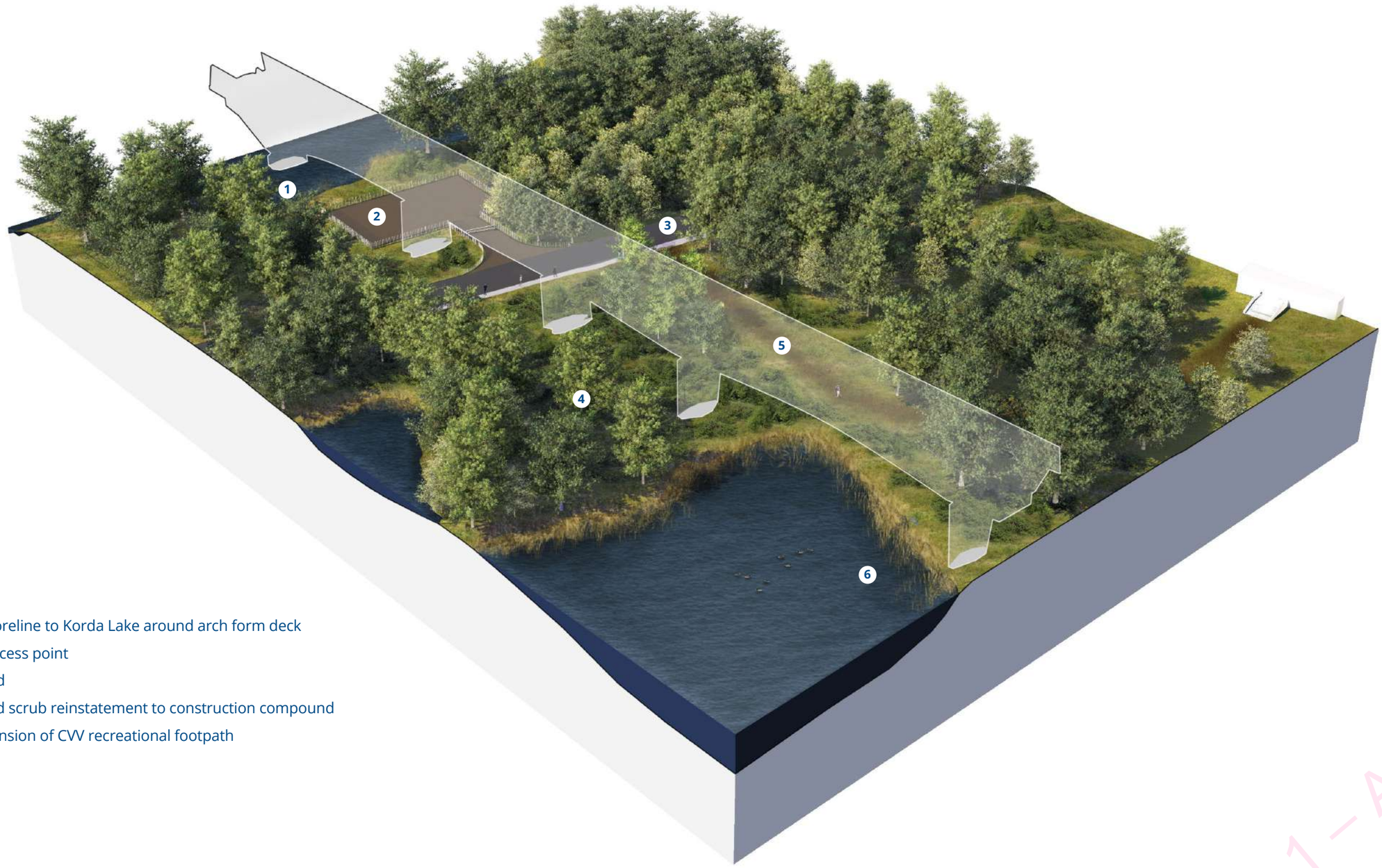


Fig.6.41_ Plan - Moorhall Road

Code 1 – Accepted

6.10



1. Excavated shoreline to Korda Lake around arch form deck
2. Emergency access point
3. Moorhall Road
4. Woodland and scrub reinstatement to construction compound
5. Potential extension of CVV recreational footpath
6. Savay Lake

Fig.6.42_ Axonometric diagram - Moorhall Road

Code 1 – Accepted

Sub-Area 4 - North West Savay Lake to North East Harefield No.2 Lake

6.11.1 Grand Union Canal and lake edge habitat

The crossing of the Grand Union Canal is an important gateway along the route and careful consideration has been given to the experience of towpath and boat users in developing both the landscape and architectural design. The landscape solution in this area has two key elements. Firstly, the area around the piers (on the towpath side) is to be opened up (locally) to allow access to the 'special' piers and to open out views of Savay Lake. Secondly, to build out a portion of the lake edge in Savay Lake to create the landing for the pier at this location, incorporating a shelving profile to allow establishment of marginal vegetation and habitat, including reed beds.

Retention of mature tree cover to the north and south of the crossing point is an important consideration to ensure the 'approach' views of the viaduct are framed by tree lined corridors. Only at the pier locations do views out of the corridor begin to briefly open.

A similar treatment is proposed to the pier on the offside where the Colne Valley Trail follows the narrow land strip between the canal and Harefield Lake no.2.

Fig.6.43_ Section - Grand Union Canal

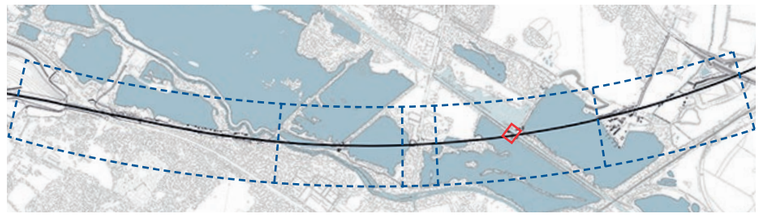


Fig.6.44_ Key plan

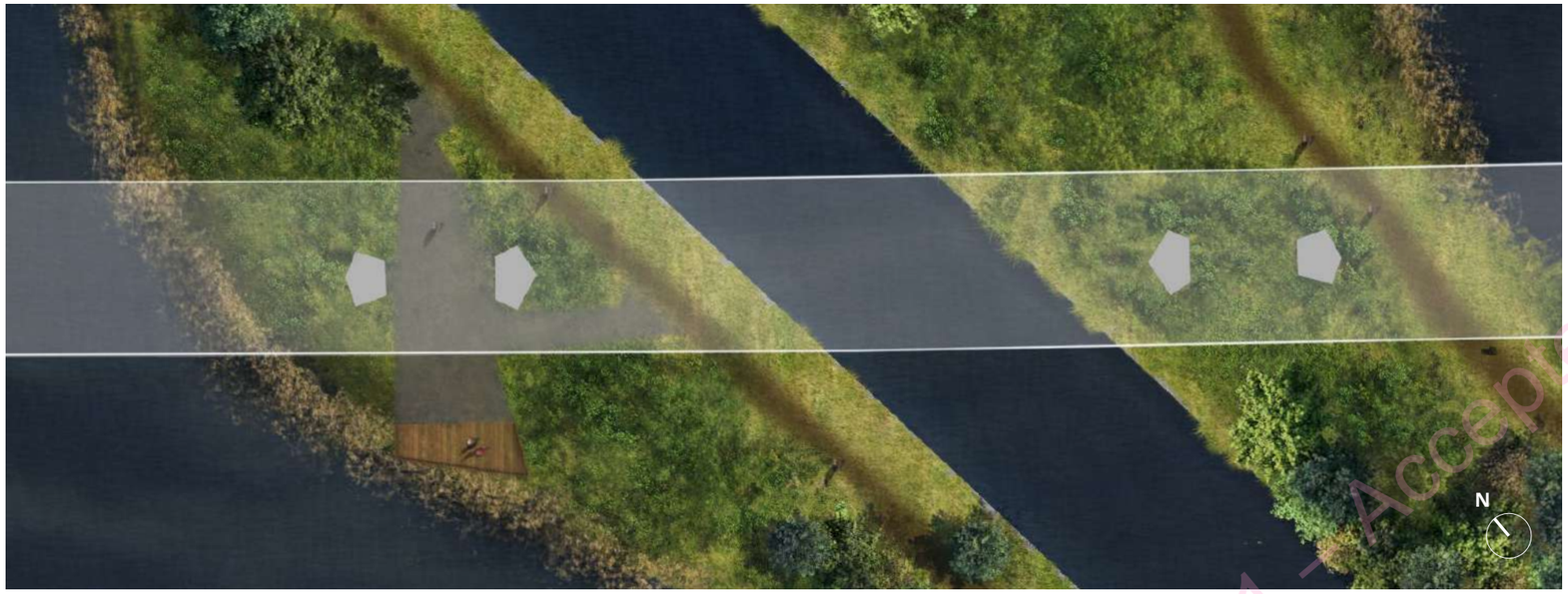
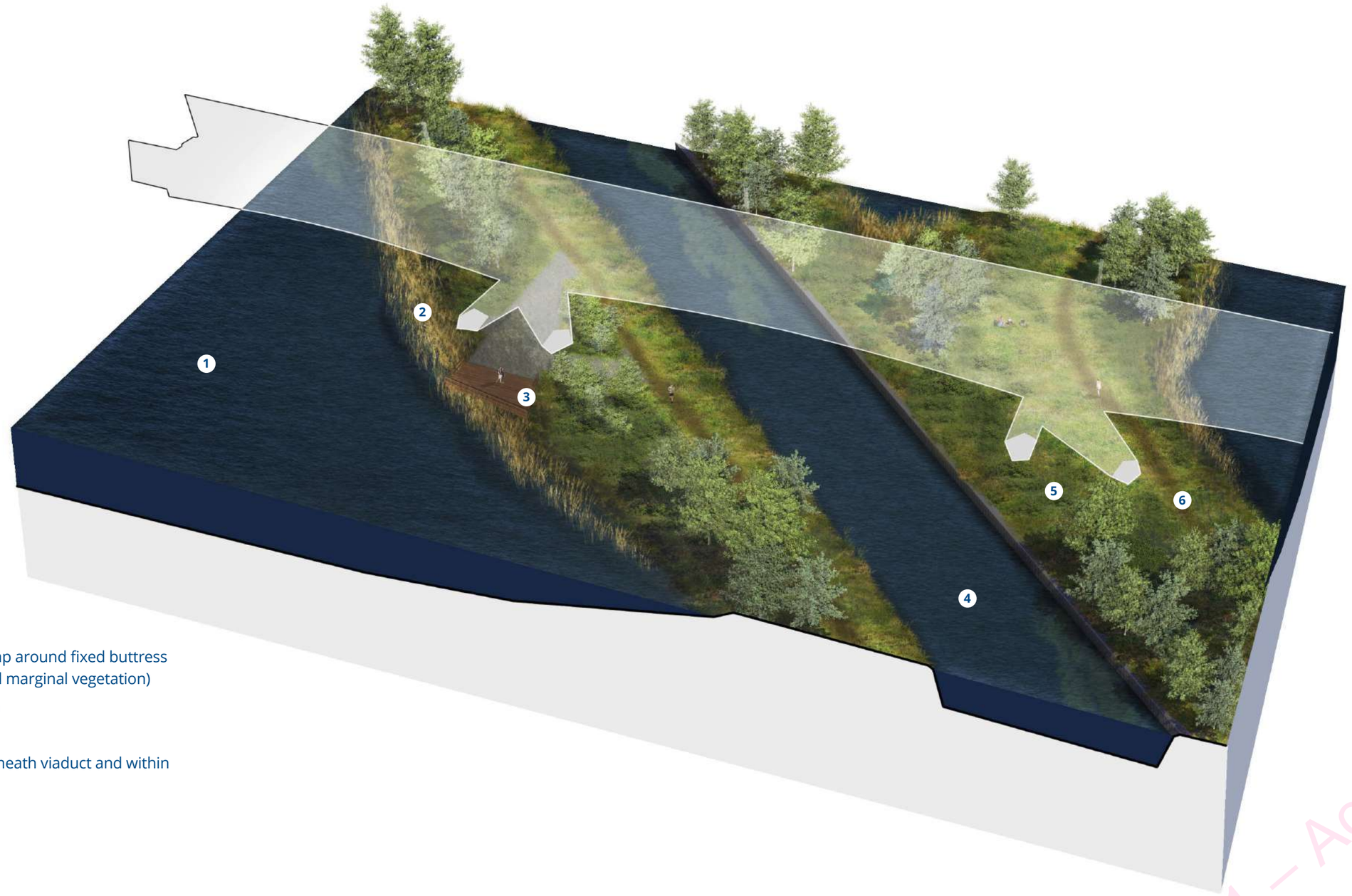


Fig.6.45_ Plan - Grand Union Canal

Code 1 – Accepted

6.11



1. Savay Lake
2. Extended bank edge to wrap around fixed buttress pier (includes reed bed and marginal vegetation)
3. Proposed viewing platform
4. Grand Union Canal
5. Scrub and tree planting beneath viaduct and within construction area footprint
6. Colne Valley Trail

N

Fig.6.46_ Axonometric diagram - Grand Union Canal

Code 1 – Accepted

Sub-Area 4 - North West Savay Lake to North East Harefield No.2 Lake

6.11.2 Harefield Moor and open pasture

This area incorporates the narrow corridor occupied by the viaduct; and peripheral land take within HS2 Act Limits which has a direct and indirect use associated with the HS2 works.

Landscape fabric beneath the viaduct and within the boundary area for approval will largely be returned to a similar or identical use as per the pre-construction character. For areas associated with the HOAC buildings this will comprise tree/ scrub planting and grassed areas as ground cover; whilst further to the south a return to open pasture is proposed. This includes the integration of HS2 drainage ditches which outfall to the Newyears Green Bourne (NYGB).

There will be localised and very minor alterations to the alignment of the NYGB and landscape restoration will be delivered as part of these works to reflect the river edge character. There will be no permanent pedestrian or vehicular crossing of the NYGB as part of HS2 works.

Footpath U34 is proposed to be diverted along the alignment of the NYGB and terminate at Harvil Road where a new recreational routes provided by the adjacent HS2 contract will continue to link up to other footpaths to the north east. The footpath will not be surfaced or lit and will be defined by waymarking signage found elsewhere on the rural rights of way network.

A permanent floodplain storage area on the northern shoreline of Harefield Lake No.2 has been designed to accommodate flood events and will for the most part remain as a dry basin. Reference should be made to the water and flood risk section of this Written Statement (1MC05-ALJ-TP-REP-CS01_CL02-000006) for technical details. The landscape design is to be developed further but in principle it will include: retention of tree cover on lake shore line (with localised tree loss to create ingress/ egress channels at the northern and southern end); grassed slopes with mosaics developed to maximise habitat and biodiversity value; mitigation planting on the upper slopes to act as screening for the proposed Ickenham Grid Supply Point; and realignment of footpath U34 to take account of the new earthworks.

Fig.6.47_ Section - Permanent floodplain storage area

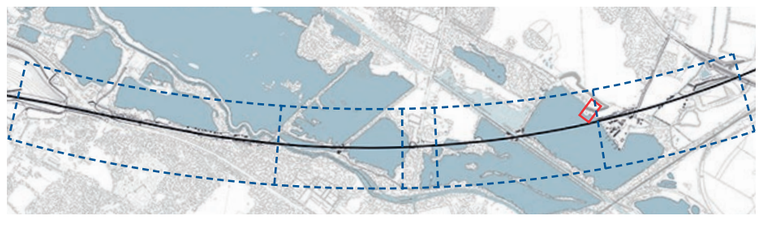
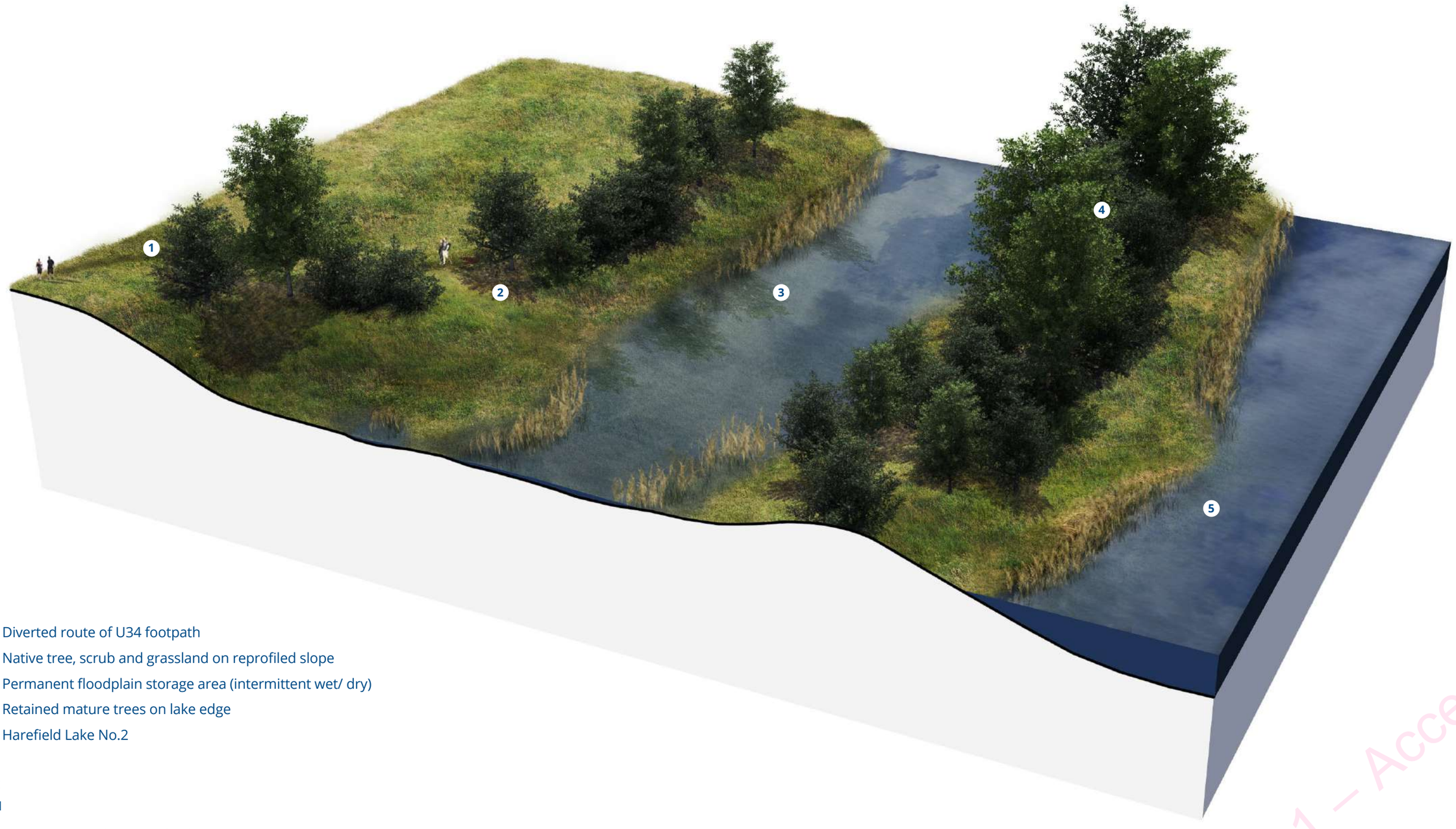


Fig.6.48_ Key plan

Fig.6.49_ Plan - Permanent floodplain storage area

Code 1 – Accepted

6.11



1. Diverted route of U34 footpath
2. Native tree, scrub and grassland on reprofiled slope
3. Permanent floodplain storage area (intermittent wet/ dry)
4. Retained mature trees on lake edge
5. Harefield Lake No.2

N

Fig.6.50_ Axonometric diagram - Flood compensation

Code 1 – Accepted

Sub-Area 5 - North East Harefield Lake No.2 to Harvil Road

6.12.1 South embankment and Harvil Road

At the south eastern end adjacent to the realigned Harvil Road and on the viaduct embankment slopes, native species tree belts with a differentiated edge treatment are proposed. This will help to integrate the railway and future Ickenham Auto-Transformer Feeder Station within the retained landscape framework; proposals are also cognisant of the woodland planting proposed to the north of the Copthall Cutting and delivered as part of the adjacent contract and the already approved and implemented Harvil Road woodland habitat creation.

Security fencing proposals around the south embankment are set out on the accompanying landscape proposal drawings. The design of security fencing is informed by HS2 technical standards. On-going land negotiations will in due course inform where boundary fencing is required. Such fencing will typically comprise a post and wire agricultural style fence.

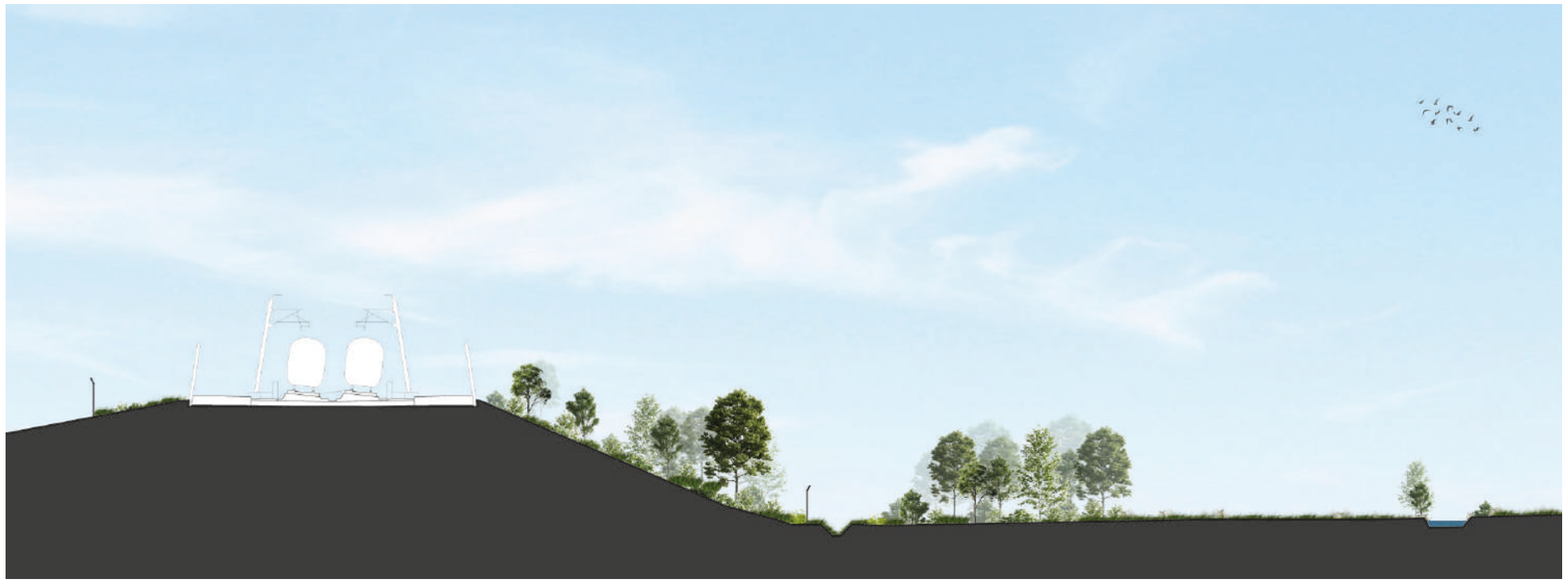


Fig.6.51_ Section - South embankment

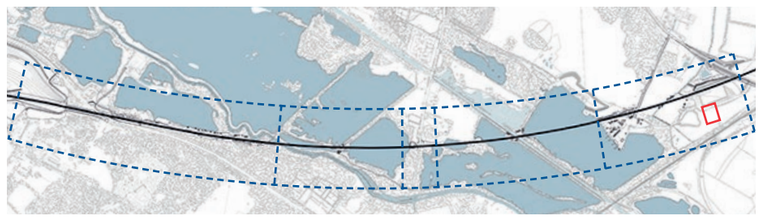
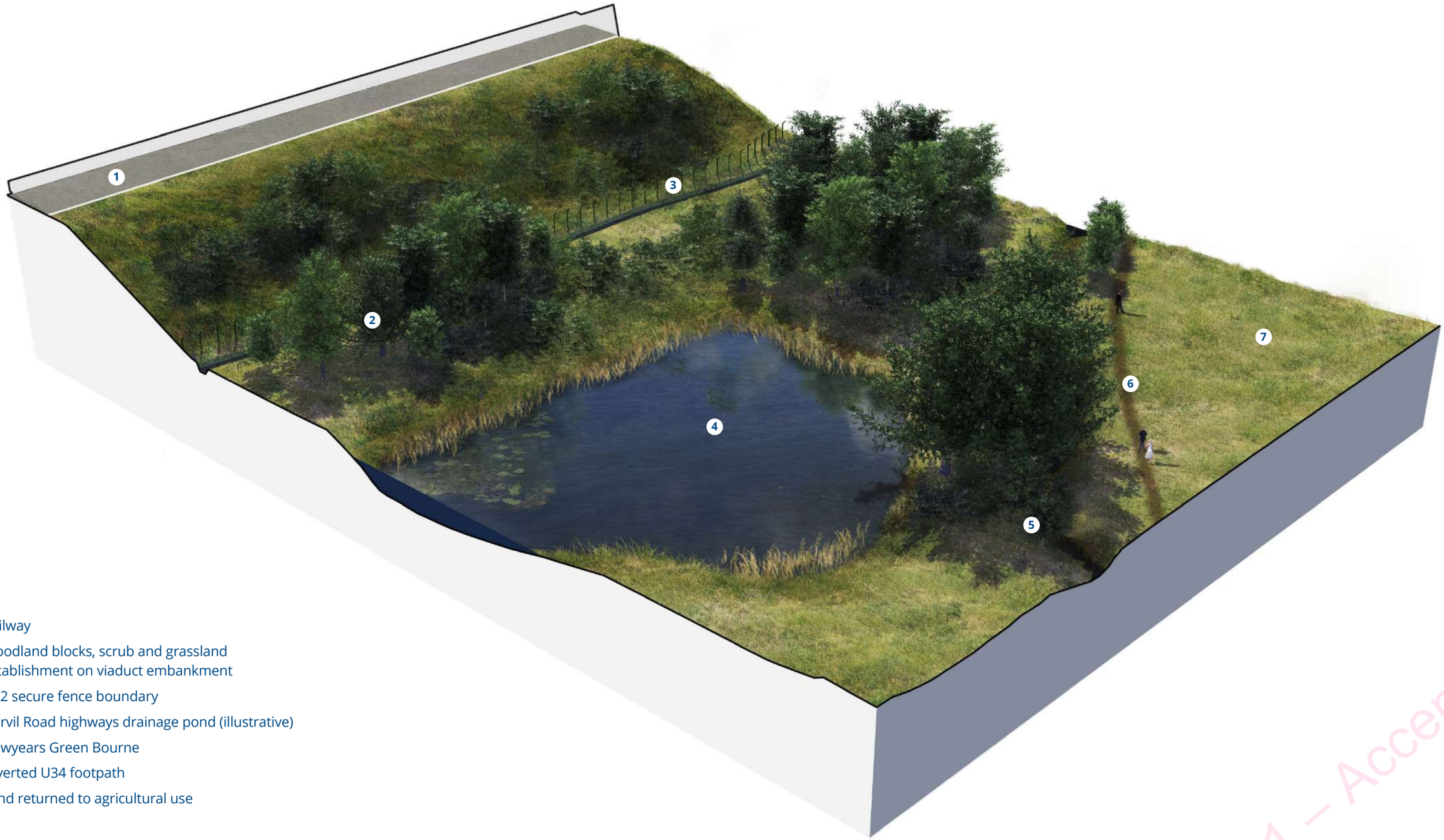


Fig.6.52_ Key plan

Fig.6.53_ Plan - South embankment

Code 1 – Accepted

6.12



1. Railway
2. Woodland blocks, scrub and grassland establishment on viaduct embankment
3. HS2 secure fence boundary
4. Harvil Road highways drainage pond (illustrative)
5. Newyears Green Bourne
6. Diverted U34 footpath
7. Land returned to agricultural use

Fig.6.54_ Axonometric diagram - South Embankment

Code 1 – Accepted

Code 1 – Accepted

7.0 Sustainability

Summary of how environmental, social and economic considerations have influenced the design proposals.

Code 1 – Accepted

Overview

7.1.1 Overview

HS2's ambition is to build the most sustainable high speed railway of its kind in the world. The HS2 sustainability policy identifies five themes reflecting the economic, environmental and social aspects of sustainability. These are:

- Spreading the benefits: Economic growth and community regeneration
- Opportunities for all: Skills, employment and education
- Safe at heart: Health, safety and well-being
- Respecting our surroundings: Environmental protection and management
- Standing the test of time: Design that is future proof

7.1.2 Sustainability commitments

The Main Works Civil Contract (MWCC) has made sustainability related commitments as a part of their Undertakings and Assurances and meeting HS2 Technical Standards. These commitments include:

- The Infrastructure works will be designed and constructed to meet an aspirational rating of 'Excellent' under BREEAM Infrastructure (Pilot) scheme.
- Develop a carbon management strategy with a carbon reduction target of 50%. The sustainability criteria are applied to all stages of the project, through design, construction and operation.

7.1.3 BREEAM assessment

The HS2 Phase One development is being assessed against the BREEAM New Construction Infrastructure (Pilot) scheme. ALIGN JV is required by HS2 to ensure that all works under the MWCC C1 contract are fully compliant with the HS2 BREEAM requirements and that the C1 project aspires towards achieving a BREEAM rating of Excellent and a minimum target score of 70%.

The Colne Valley Viaduct (CVV) will be assessed as a part of the C1 assessment and its design and construction will aim to meet the target Excellent rating with a score in excess of 70%.

A BREEAM Infrastructure assessment is broken down into a Strategic Assessment and Project Detail Assessment, which includes the design/ interim stage and final/post construction stage.

A single Strategic Assessment has been undertaken by HS2 for the whole of the HS2 Phase One development. The Strategic credits awarded in this assessment total a score of 20.78%. This will be carried over to the Project Detail Assessment.

The assessment involves meeting best practice sustainability criteria (set out as a series of individual 'credits') across the following categories:

- Integrated Design
- Resilience
- Stakeholders
- Local Well-being
- Transport
- Land use and Ecology
- Landscape and Heritage
- Pollution
- Materials
- Carbon and Energy
- Waste
- Water
- Innovation

The development of this assessment is ongoing and is not required to be complete at the scheme design stage. However, where the scheme design has benefited the overall sustainability of the C1 section of HS2, some of these are referred to in the following sub-sections.

7.1.4 Resilience

A Climate Change Adaptation & Resilience report has been prepared identifying measures to mitigate and adapt for potential climate impacts.

Key to maximising resilience of the viaduct has been to locate movement bearings over water above flood risk levels to withstand the future effects of increased and more extreme flooding events expected as a result of climate change. In addition, floodplain storage areas, initially required to be larger for the construction period, will be maintained in perpetuity.

Sustainable drainage systems (SuDS) will be provided with allowance for climate change, in accordance with current best practice planning guidance. Surface water discharge will be directed to scrapes and capture ponds which would not only act as land drainage but also a habitat function. The scrapes will be designed with varying depths and can exist as dry, semi wet and permanently wet habitat.

The choice of planting species and procurement of planting stock will take into consideration climate change resilience; this is guided by HS2 Technical Standard HS2-HS2-SU-STD-000-000003 (Climate Change Adaptation and Resilience)

All materials specified for the viaduct are highly durable and robust, maximising the design life of the viaduct and ensuring it will age gracefully over time. Highly robust concrete piers and abutments are specified at low level where the structure is most susceptible to damage. More lightweight components required for the noise barrier are located at high level, away from public access and adjacent to access walkways for ease of inspection and maintenance. All noise barrier components are galvanised steel to maximise durability. Please refer to section 7.1.11 for more information on galvanised steel.

7.1.5 Stakeholder

There has been extensive stakeholder consultation and engagement, which has influenced the design of the structure and landscape. The design has been shared with the Local Authorities, statutory consultees, key environmental groups, businesses and the local community. Three public engagement events have been held through 2018 and 2019 where the designs were exhibited, and feedback received. Although the design of the proposed CVV is the focus of this Design and Access Statement and the Schedule 17 requests for approval, the feedback has also influenced the construction methodology and as a result, a proposed haul road under the viaduct is now proposed to reduce further the impacts on the local road network. In addition to the above, regular engagement with the community throughout the construction programme, in accordance with the Code of Construction Practice, will be undertaken.

7.1.6 Local well-being

Alongside the wider HS2 local well-being benefits being provided outside the design process, the specific CVV landscape design has considered opportunities for local well-being. The landscape design proposes new pedestrian routes and amenity spaces alongside the viaduct. The enhanced connectivity is proposed to link up to other public rights of way both at the western and eastern end of the proposed CVV and some of the Additional Mitigation Projects being proposed by the Colne Valley Regional Park Panel.

Code 1 - Accepted

7.1.7 Transport

To reduce impact on local roads during construction, a haul road will be constructed running directly from the main compound at Maple Cross through the Colne Valley, alongside the viaduct. The design also allows the construction of the viaduct deck from an overhead gantry system, minimising vehicle trips, abnormal loads and associated in-situ concrete pouring and lifting. This has had both traffic and construction land-take benefits. Please refer to section 8.1 for more information on construction routes and methodology.

The landscape proposals include new footpaths to better connect to the existing public right of way network. This will encourage more frequent use of the Colne Valley Regional Park by pedestrians and cyclists. Please refer to section 6.3 for more information on access and recreation.

7.1.8 Land Use and ecology

A biodiversity action plan (BAP) will be produced for the CVV site and will cover construction and in-use phases of the project. Provisions will be made to protect the local habitat and species of principal importance. Measures have been taken in the landscape design to ensure no net loss in biodiversity. These have included conserving as much of the most sensitive habitats as possible and introducing new wetland features and habitats. For example, ancient woodland loss has been avoided adjacent to Ranstons Covert/Battlesford Wood. Lost landscape typologies such as wet woodland and wet meadows, which have been lost in the area, will be restored. Areas of planting and seeding will aim to maximise biodiversity using species rich seed mixes and native species plant types. Overall, the present calculations for no net loss is showing a positive benefit which will be carried forward into the technical design stage. Watercourse realignments have also been reduced in both their length and their extent of transposition, this will result in less geomorphological disruption to the watercourse, whilst the realignments present an opportunity to improve these corridors of the watercourse in the areas affected by construction. Please refer to section 6.2 for more information on landscape and ecology.

7.1.9 Landscape and heritage

The landscape design will be fully integrated and maximises the biodiversity potential of new areas of landscape planning and habitat creation. Extensive stakeholder engagement has helped to understand what is important to the local community. The landscape section of this Design and Access Statement includes full details of the proposed landscape design and the Indicative Mitigation Details (1MC05-ALJ-TP-REP-CS01_CL01-000007) sets out the proposed species mix and management regime associated with this.

7.1.10 Pollution

Air quality mitigation measures for construction and operation will be identified and implemented.

All non-road mobile machinery engines will be required to comply with current versions of EU Directive Staged Emission Standards (97/68/EC).

A plan to minimise watercourse pollution will be developed for the construction of the viaduct and will include the creation of a water treatment pond for reusing water on site.

The CVV will aim for the operational noise and vibration to be less than the significant observed adverse effect level (SOAEL) through the use of best practicable means (BPM).

The temporary lighting on the CVV will make sure that it will be directed onto the site, away from the sky, dwellings and areas containing wildlife.

7.1.11 Materials

A life cycle assessment has been calculated to determine materials with lower embedded carbon to be included in the design. Products will be specified which have Environmental Product Declarations (EPD).

A Sustainable Procurement Plan has been prepared to make sure all major materials including for the temporary works will be responsibly sourced. Discussions have taken place with suppliers to make sure both EPDs and BES 6001 certification can be provided.

The volume of concrete required for the construction of the viaduct has been minimised where possible. The specification of concrete will vary across in-situ and precast components due to different structural, durability and construction requirements. The specification of all concrete components will include a proportion of ground-granulated blast-furnace slag (GGBS), to achieve high levels of durability and strength. GGBS is obtained by quenching molten iron slag from a blast furnace in water or steam, to produce a granular product that is then dried and ground into a fine powder. As a by-product of the steel manufacturing process, the use of GGBS in concrete provides environmental benefits.

All noise barrier components will be galvanised steel to maximise durability, longevity and reduce long-term maintenance requirements. Galvanising is a corrosion protection process for steel, in which steel is coated with zinc to prevent it from rusting. The process involves dipping the steel components into molten zinc, forming a series of zinc-iron alloy layers. This coating self-repairs when damaged, sacrificing itself to protect the base metal. It is environmentally sustainable, has good impact and abrasion-resistance and is low maintenance.

Please refer to section 5.11.1 for more information on materials.

7.1.12 Carbon and energy

The carbon impact of the CVV has been calculated over its expected lifetime. Opportunities have been identified to reduce the carbon by 28% such as using green energy.

7.1.13 Waste

The project will aim to divert up to 95% (tonnage) of construction waste from landfill. All excavated materials generated on site will be reused on the scheme.

7.1.14 Water

Measures to reduce water consumption are being considered such as collecting surface water run off for reuse.

7.1.15 Innovation

Innovation has been key to achieving a design for the CVV that meets design requirements and stakeholder aspirations, whilst also achieving all technical, operational and environmental standards. This design approach can be exemplified by the noise barrier design. Whilst the barriers have been designed to meet acoustic requirements, withstand high levels of fatigue from passing trains and to be easily maintainable, they also provide passenger views for the majority of the viaduct and minimise visual impact. To achieve this, innovative acoustic design measures such as absorptive robust kerbs, top edge absorptive treatments, transparent acrylic panels and absorptive acoustic cassettes have been incorporated. Iterative acoustic modelling has tested which of these measures are required for each location along the alignment, resulting in a barrier design that is highly responsive to its context.

Code 1 - Accepted

HS2 Sustainabilty Goals

7.2.1 Design Response Summary

HS2 sustainability goals have been key drivers throughout the design process. The viaduct and landscape design responses are outlined below:

Safe at heart

Viaduct Design

- Adequate spatial provision for inspection and maintenance access.
- Protection against derailment through robust kerbs.
- Piers designed to minimise anti-social behaviour.
- Safe escape strategy from the trains.

Landscape Design

- Crash barriers along the A412 to prevent vehicle collision with piers.
- New recreational routes to provide safe and level access where possible.
- Vehicle access controlled at the A412 and Harvil Road.
- Defensive planting used where there is a high risk damage or climbing structures.

Respect our surroundings

Viaduct Design

- Design is highly contextual in its response to character areas and the location of special structures at key site features.
- Preservation of expansive landscape views.
- Protection of the community from noise through noise mitigation measures.
- Minimising the volume of concrete required, reducing carbon impact.
- Minimising the width of the deck resulting in less land-take and associated environmental impact.
- Construction strategy minimises impact on local community and environment.
- Minimising use of local roads by locating construction compound next to the M25.
- Launching precast segments along the deck from the north minimises construction traffic and land-take requirements.
- Precast deck segments reduces time on-site and impact on the local community.

Landscape Design

- Landscape strategy responds to local landscape character.
- Minimising tree loss where possible.
- New pedestrian routes to enhance amenity and recreational access.
- Design balances land use and access provision with protection of sensitive habitats.
- Maximising biodiversity value in response to context.
- Addresses flood risk through integrated landscape features.

Standing the test of time

Viaduct Design

- Simple yet distinctive design achieves a timeless aesthetic.
- Risk of staining through weathering reduced.
- Use of robust, durable and low maintenance materials throughout.
- Ease of maintenance to viaduct components.
- Flexible noise barrier system could adapt to changing noise sources.
- Bearings located above flood risk levels to maximise longevity.

Landscape design

- Dual purpose recreational routes provide maintenance access.
- Maximising long-term biodiversity through resilient habitat creation.
- Low maintenance / robust planting to minimise future management.
- Climate change adaptation and resilience informing planting specifications.

Code 1 – Accepted

7.2

Spreading the benefits

Economic growth and community regeneration

Being a catalyst for regeneration and economic growth across the UK, maximising the benefits to communities and individuals and minimising the negative impacts

Opportunities for all

Skills, employment and education

Providing rewarding jobs and careers that are open to all in society, setting new standards for equality, diversity and inclusion and providing a legacy of skills, learning, expertise and experience

Safe at heart

Health, safety and well-being

Creating a world-class 'safe at heart' culture where no one gets hurt, and which prioritises the health and well-being of those who build, operate, use and host HS2 services and infrastructure

Respecting our surroundings

Environmental protection and management

Being a catalyst for breaking new ground wherever possible on environmental standards including resource use, waste, carbon minimisation, the protection of the natural and historic environment and safeguarding communities.

Standing the test of time

Design that is future-proof

Designing a network that is resilient to climate change, adaptable to future trends and demands, and built around the needs of the people who will use it.

Fig.7.1_ HS2 sustainability goals

Code 1 – Accepted

Code 1 – Accepted

8.0 Construction & Operational Access

Documenting the external access requirements during both the construction and operation of the viaduct.

Code 1 – Accepted

Construction

8.1.1 Construction timeline

To minimise our impact on the local community, we will build the viaduct as quickly and safely as possible by overlapping our activities and constructing at different locations at the same time.

The building of the viaduct construction compounds will start later this year. As the construction of the compounds progresses, we will begin to clear a construction corridor and build the haul road and jetties across the lakes. Main construction work for the viaduct will start in 2021 and will take around three years to complete.

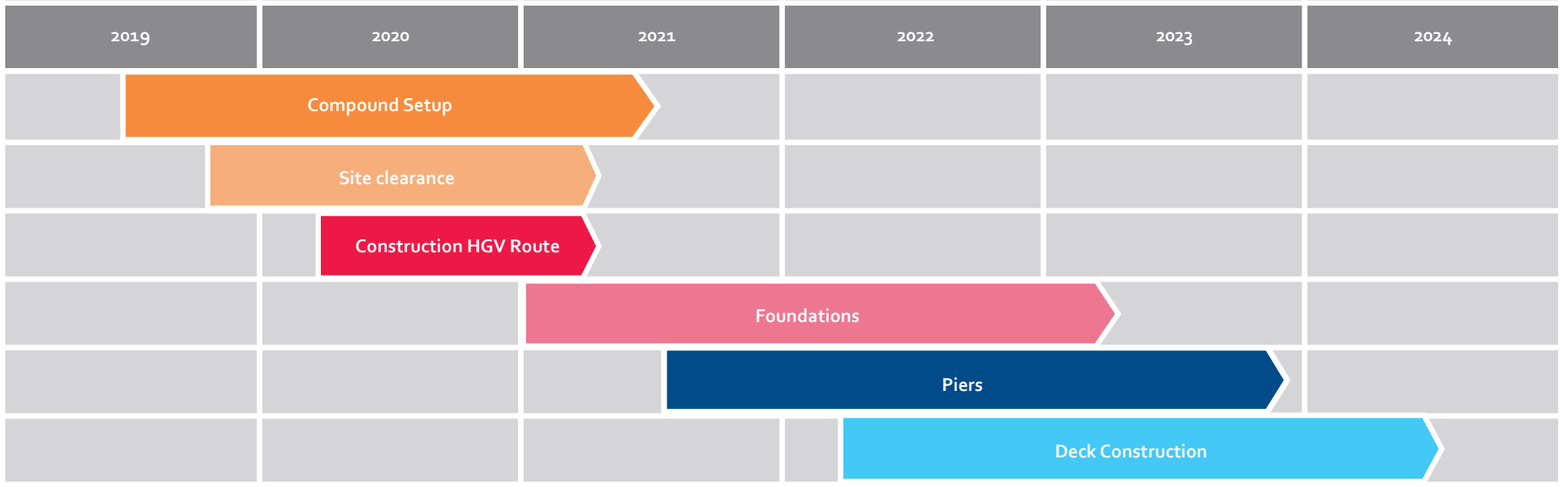


Fig.8.1_ Diagram - Construction timeline

8.1.2 Construction routes

To reduce our impact we will avoid using the local road network where we can. Our priority is to use the new slip roads from the M25 for our lorries and then onto our proposed haul road. The haul road will be used by thousands of lorries over the course of construction.

Key

- Deck launch girder route
- Road routes
- Construction compounds

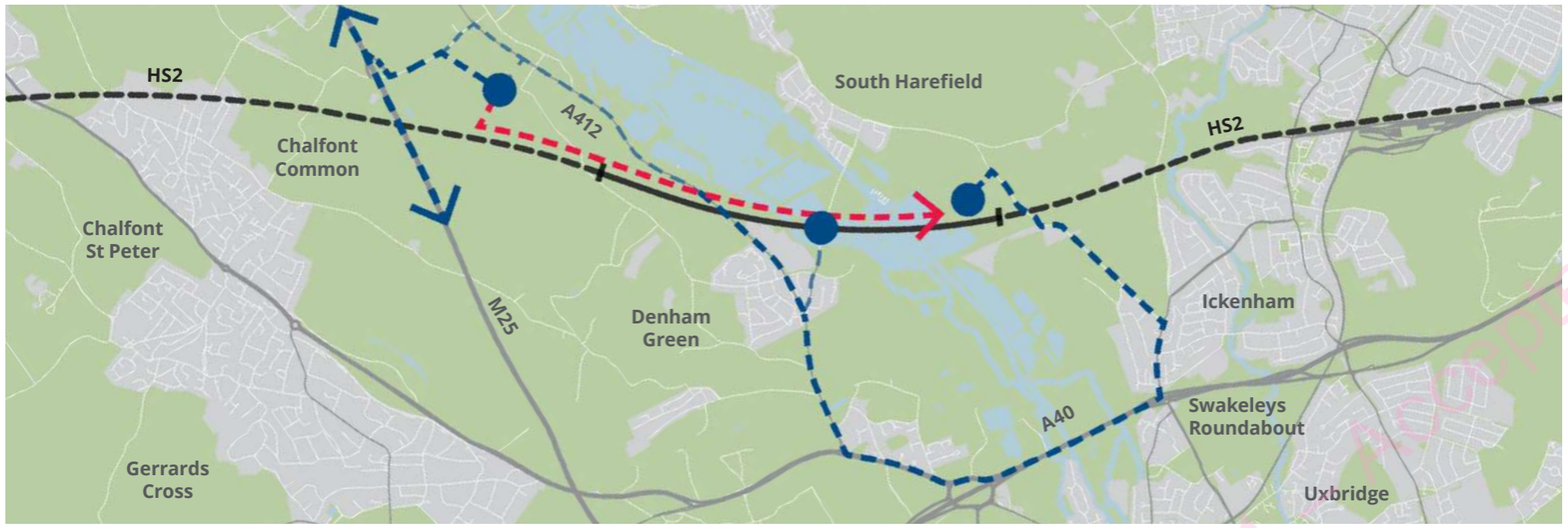


Fig.8.2_ Site map - Construction routes

Code 1 - Accepted

8.1.3 Construction sequence

Our aim is to build the viaduct as quickly as possible whilst reducing the impact to local communities and roads as far as practicable.

To achieve this we intend to manufacture as much of the viaduct as possible within our main site compound at Maple Cross. This means that we can transport the individual pieces of the viaduct deck along its own length using a walking crane laying gantry to lock them together piece by piece over the Colne Valley. This technique will allow the viaduct to 'grow out' from the compound and most importantly, avoids the need to use local roads.

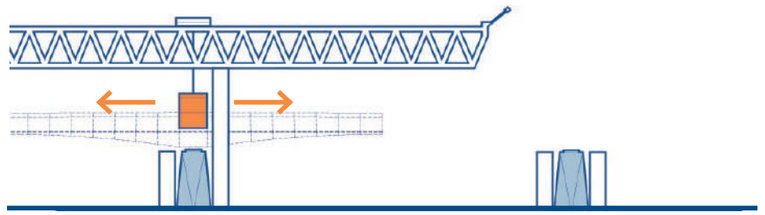
Before we can do this we need to construct the foundations and piers (columns) that hold up the bridge deck. The foundations are constructed using a technique called piling which is essentially the creation of deep holes in the ground filled with reinforced concrete. The piers that hold up the bridge deck and sit on the foundations are constructed by pouring reinforced concrete into moulds which we will build at each location.

In order to reduce the impact on local roads for the construction of the foundations and the piers, we will construct a haul road that runs directly from our main compound at Maple Cross, through the Colne Valley immediately alongside the line of the viaduct. This will include jetties to cross the lakes. All the concrete for most of the foundations and piers will be transported along the haul road. To construct the foundations and piers for the part of the viaduct between Harvil Road and the Grand Union Canal we will bring the concrete along the A412 and Harvil Road via Swakeleys roundabout. This is to make sure we don't close the canal which is an important navigation and leisure corridor in and out of London. The deck construction for this section will still be transported along the viaduct in pieces by the laying gantry, avoiding the roads.

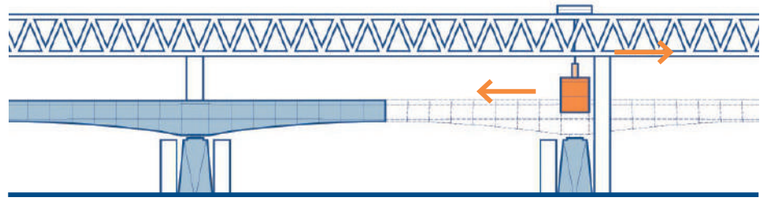
The construction sequence for the viaduct can be summarised in the following stages;

1. Clear a construction corridor
2. Construction jetties and haul road
3. Foundations for the piers
4. Build piers
5. Launch our gantry from the main compound and run it southwards to construct the viaduct deck
6. Attach noise barriers
7. Plant new trees and create the landscape, replacement habitats and recreational features

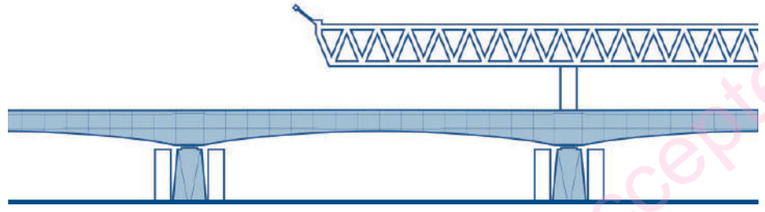
A Piers construction



B Deck segments install (pier 1)



C Deck segments install (pier 2)



D Deck launch girder move forward

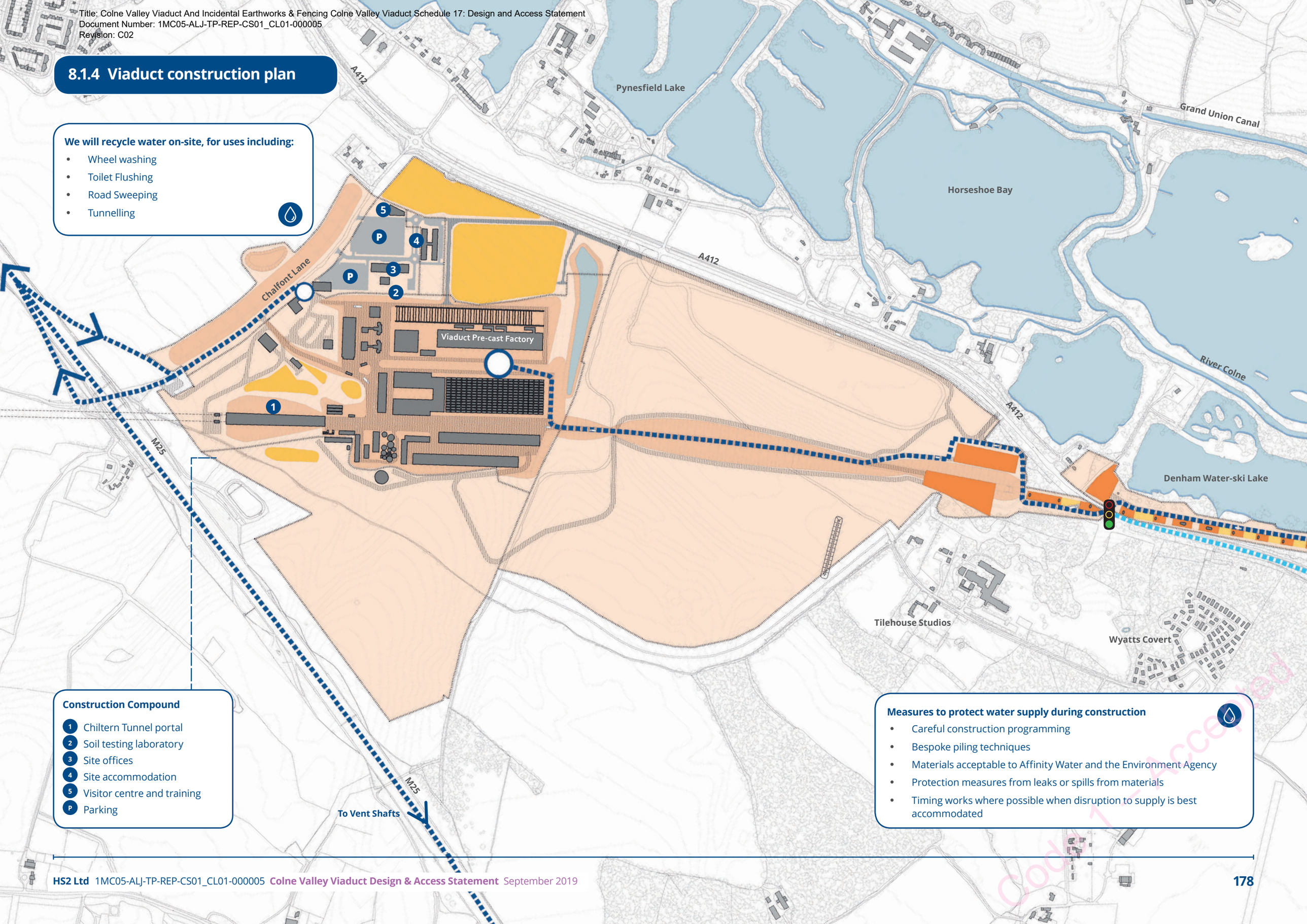
Fig.8.3_ Diagram - Viaduct construction sequence

Code 1 – Accepted

8.1.4 Viaduct construction plan

We will recycle water on-site, for uses including:

- Wheel washing
- Toilet Flushing
- Road Sweeping
- Tunnelling



Construction Compound

1. Chiltern Tunnel portal
2. Soil testing laboratory
3. Site offices
4. Site accommodation
5. Visitor centre and training

P Parking

Measures to protect water supply during construction

- Careful construction programming
- Bespoke piling techniques
- Materials acceptable to Affinity Water and the Environment Agency
- Protection measures from leaks or spills from materials
- Timing works where possible when disruption to supply is best accommodated

Code 1 - Accepted

Our HGVs are designed to minimise their impact:

- All HGVs will be a minimum of FORS bronze and then up to silver after 6 months
- Requesting Euro 6 HGVs from the supply chain
- Dry wheel washes to minimise water usage and keep mud off the roads

Our launching girder

- Our launching girder will transport 4,000 lorries worth of concrete above the Colne Valley

Constructing from South to North:

- Viaduct piles to the east of the Grand Union Canal will be constructed using Dews Lane for access
- Dews Lane will be widened, leaving an improved pedestrian and cycle route for the future

Harefield
South Harefield
South Harefield
Harvil Road
Broadwater Lake
Moorhall Road
Grand Union Canal
Harefield Marina
Dews Lane
Harvil Road
From A412 via Swakeleys Roundabout
Harefield Moor Lake
Korda Lake
Harefield No2 Lake
A412
River Colne
Savay Lake
River Colne
Chiltern Railways
Denham Green
Denham Green
To Dews Lane via A40/Swakeleys Roundabout
To Dews Lane via A40/Swakeleys Roundabout

Key

- Construction area
- Earthworks
- Construction compounds
- Material stockpile
- Primary lorry route
- Secondary lorry route
- Proposed signalised plant crossing with priority to local traffic

Code 1 – Accepted

Operational Access

8.2

8.2.1 Evacuation access

In the event of an emergency, passengers evacuate from the train by escaping directly onto the opposite train or track bed. Egress routes along each side of the track provide a clear escape route for maintenance workers. Escape stairs at each abutment will provide a safe escape route from the track down to a refuge point at ground level. An escape point next to Moorhall Road will also be provided within the noise barrier to allow passengers to escape via an emergency chute. Escape routes will be clearly signposted with emergency lighting provided where necessary.

8.2.2 Maintenance access

Access to the void within the viaduct deck allows maintenance and inspection of the structure, pre-stressed cables, and drainage pipework. Access points are also provided into the void behind the soffit panel. Doors at the abutments provide safe and secure access to these areas.

Planned inspection and maintenance will be predominantly carried out from rail level via maintenance trains operating outside of operational times. In addition, an access track is provided over land where possible along one side of the viaduct. Over water, access to inspect the structure and bearings will be via boat.

8.2.3 Pedestrian access

Some parts of the maintenance tracks along the viaduct are also used as recreational routes for pedestrians and cyclists. Inclusive access is promoted through the provision of DDA compliant gradients where possible and adequate clearance widths and turning spaces for wheelchair users. Please refer to the landscape section of this report for further detail.

8.2.4 Security

Security fencing is required in some areas, but not in proximity to the viaduct. Where security adjacent to piers is a concern, defensive planting is used to deter access. Please refer to the landscape section of this report for further detail.

HS2 Ltd will prepare an evacuation strategy that can be accommodated within the design proposals submitted as part of this Schedule 17 requests for approval.

8.2.6 Vehicle access

Only maintenance vehicles are permitted within the Colne Valley Regional Park via designated maintenance tracks alongside parts of the Viaduct. Controlled access gates at the A412 and from Harvil Road are provided.

8.2.7 Highway crossings

The viaduct crosses existing highways at Moorhall Road and the A412. Necessary clearances, visibility envelopes and crash barrier protection have been provided where necessary. For further detail please refer to Section 6 of the Written Statement (1MC05-ALJ-TP-REP-CS01_CL01-000006).

Code 1 – Accepted

Blank Page

Code 1 – Accepted

Code 1 – Accepted

9.0 Engagement

Summary of the various methods and results of engagement with local authorities, stakeholders, the local community and the HS2 Independent Design Panel undertaken to date.

Code 1 – Accepted

Engagement Process

9.1

9.1.1 Overview

ALIGN JV has undertaken extensive engagement with the Colne Valley Regional Park Panel and HS2 Independent Design Panel. Design proposals have also been shared with the London Borough of Hillingdon, South Bucks District Council, statutory consultees, environmental groups and local communities through public engagement events. Engagement with these parties has informed the design proposals subject to these Schedule 17 requests.

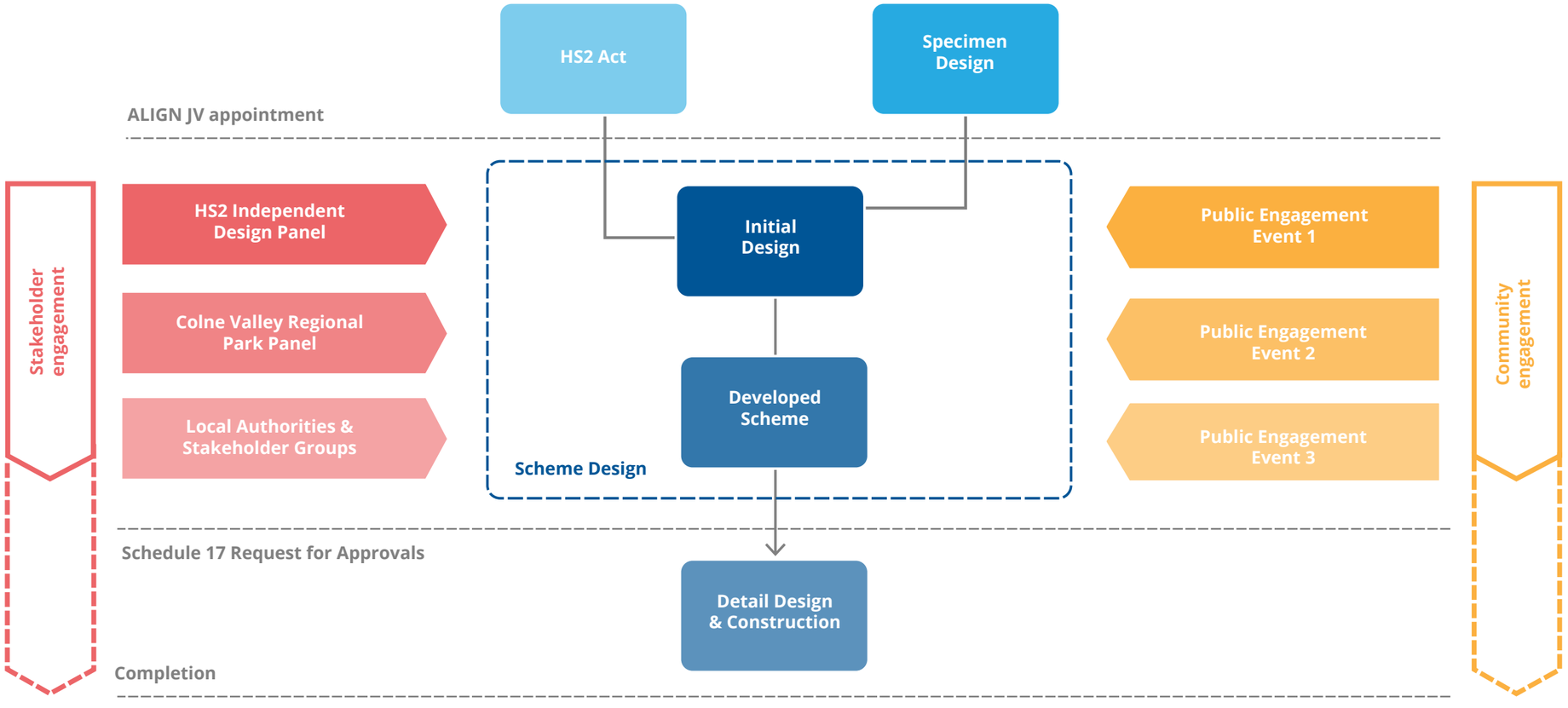


Fig.9.1_ Diagram - Engagement process

Code 1 – Accepted

Stakeholder Engagement

9.2

9.2.1 Stakeholder engagement overview

ALIGN JV has worked closely with key stakeholders to seek views and ideas to help develop the design of the viaduct and associated landscaping, as well as the construction methodology.

The key stakeholders engaged during the design process to date include:

- Colne Valley Regional Park Panel
- Local Authorities including the London Borough of Hillingdon, Hertfordshire County Council, Chiltern District Council, South Bucks District Council, Buckinghamshire County Council and Three Rivers District Council
- Local community
- Canal & River Trust
- Natural England and Environment Agency
- Harrow Angling Society
- Herts and Middlesex Wildlife Trust
- Denham Water Ski Club
- Denham Grove Hotel
- HS2 Independent Design Panel

For further information on stakeholder engagement please refer to the Written Statement (1MC05-ALJ-TP-REP-CS01_CL02-000006) and the HS2 Independent Design Panel Report submitted as part of these Schedule 17 requests.

Code 1 – Accepted

Public Engagement

9.3.1 Overview

The documents supporting the High Speed Rail Act assert the importance of involving local people in the design process. Information Paper D1, alongside HS2's Community Engagement Strategy, outlines the clear requirement to not just inform the local community but to actively involve them during the design process by seeking their views and ideas. As such, ALIGN JV developed a programme of public events, which engaged with the local community early in the design process up until the Schedule 17 requests for approval were submitted. Three periods of engagement were planned and undertaken for the Colne Valley Viaduct during 2018 and 2019.

9.3.2 Event 1: Initial design

ALIGN JV together with HS2 Ltd presented initial design proposals for the Colne Valley Viaduct, together with the Chiltern South Portal and Western Valley Slopes. Four events were held in March 2018 at Maple Cross, Denham, Ickenham and Harefield. At the events the public were presented with twelve exhibition panels describing the following themes;

- Project Introduction
- Landscape and Context
- Users and Recreation
- Landscape and Recreational Opportunities
- Western Valley Slopes
- Tunnel Portal Design
- Engagement and Initial Design Development
- Viaduct Design
- On-Going Viaduct Design Development
- Construction
- Next Steps

The panels included sketches and early design options to reflect the initial stages of design. Residents were provided leaflets summarising the initial design proposals together with a questionnaire asking them to provide feedback on seven areas of design. Within theme the public were asked to prioritise a series of design objectives by rating them from 1 (high) to 6 (low), as well as providing additional comments.

Fig.9.2_ Selected engagement panels - Event 1

Code 1 - Accepted

9.3

9.3.3 Event 2: Update

In September and November 2018, engagement events were held at Maple Cross, Ickenham, Ruislip, Harefield and Denham. These events were held to provide communities with updated information on progress. For the Maple Cross/West Hyde community, this took the form of a public presentation, whilst for the remaining communities public walk-in events were held.

For the Maple Cross/West Hyde community, the presentation highlighted the feedback received from the Event 1 questionnaire, covered updates to topics most relevant to the area, and included a question and answer session.

For the walk-in events, six exhibition panels were presented, featuring charts displaying the quantitative data received from the Event 1 questionnaire and updates on some of the public's key concerns – noise, traffic and recreational opportunities. ALIGN JV staff attended events to answer any questions from the public.

9.3.4 Event 3: Developed design

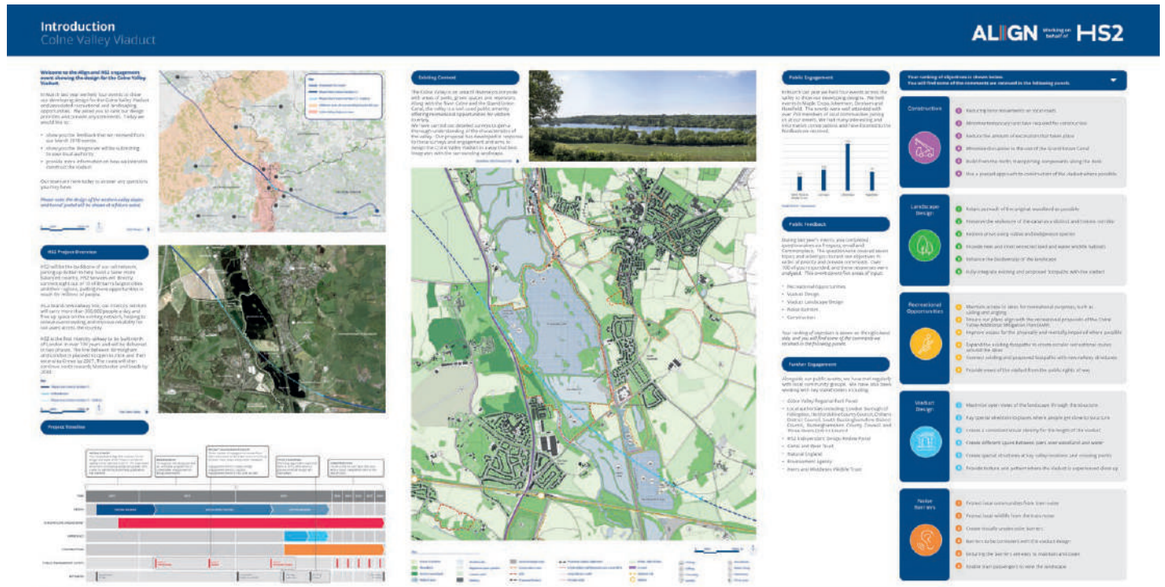
In May 2019, a third public engagement event was held at Maple Cross, Denham, Harefield, West Ruislip and Ickenham to present developed design proposals for the Colne Valley Viaduct. It was an opportunity to present the feedback received from the previous events and how this influenced the proposals submitted for Schedule 17 requests for approval. A 'You said, We did' panel specifically highlighted how this feedback influenced the design. The content of the boards provided more information on areas of primary concern, such as construction impact and noise mitigation. The exhibition content provided a more holistic representation of viaduct and landscape proposals to reflect the higher levels of design resolution. Material presented included plans and elevations of the whole viaduct and a wide selection of photomontages. The panels are shown in Figures 9.4-9.5 on the following pages.

For further information on public engagement please refer to the Written Statement (1MC05-ALJ-TP-REP-CS01_CL02-000006).

Fig.9.3_ Engagement event photographs - Event 3

Code 1 – Accepted

Public Engagement



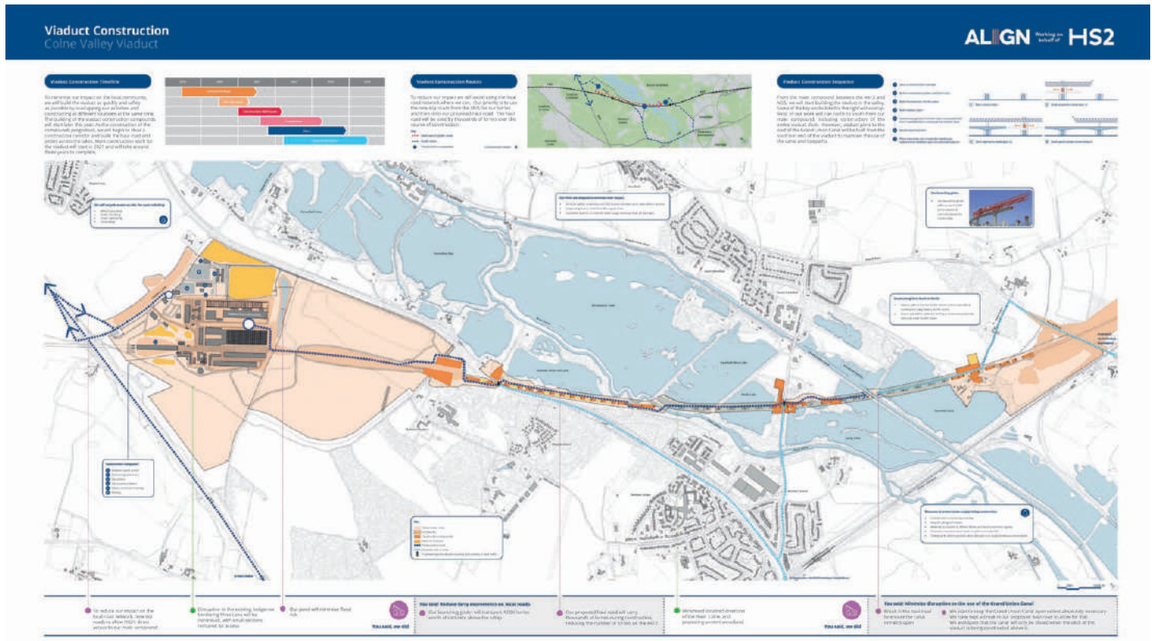


Fig.9.4_ Selected engagement panels 1-4 - Event 3

Code 1 – Accepted

9.3

Fig.9.5_ Selected engagement panel 5 - Event 3

Code 1 – Accepted

Code 1 – Accepted

10.0 Summary

Code 1 – Accepted

Overview

10.1.1 Design Summary

The Colne Valley Viaduct (CVV) is a key landmark structure and a vital component of High Speed Two, befitting its unique landscape setting. The design celebrates the architecture of engineering, with a structure that is expressive of power, speed and function. High speed trains create substantial structural loads and the viaduct proposal balances onerous engineering demands with a refined and elegant design using crafted and faceted concrete forms.

Structural spans and pier forms respond to the varied landscape of the viaduct's route. Over the lakes, 80m structural spans form a rhythmic sequence of low, slender arcs that skim lightly over the surface, preserving views across the water through to the landscape beyond. In woodland areas, where more restricted views of the viaduct are experienced from nearby footpaths, shorter spans maximise headroom beneath the structure whilst patterns and texture on the piers provide interest at a human scale.

The piers are faceted and sculpted to reduce their bulk. This strategy been refined by a crafted play of opposites: dark and light, rough and smooth, flush and recessed, further reducing the visual impact of the piers' mass.

A common design language unifies varying site and acoustic requirements along the structure's 3.4km length, ensuring that it reads as a coherent design, readily recognisable throughout the Colne Valley's landscape of lakes and woodland.

Acoustic barriers help to mitigate the impact of train noise where required. Where possible, innovative transparent barriers reduce the apparent scale of the viaduct experienced at ground level, whilst providing daylight and views for passengers between the two long tunnels at each end of the valley.

Cross-disciplinary design team work has ensured that the 4m high barriers appear as light as possible, clearly subsidiary to the main structure and fully integrated with the overall design concept. Robust, durable and self-finished materials have been specified throughout to ensure the viaduct is low maintenance and ages gracefully throughout its 120-year design life.

10.1.2 Conclusion

The proposed design for the CVV achieves the briefing criteria set out in Section 3 of this DAS; including the HS2 core design principles and goals, a host of demanding technical and operational requirements, the environmental requirements, particularly for noise and flooding, and the extensive commitments set out in the HS2 Act. In particular, the HS2 Act stated that the design should reflect the international significance of the CVV and provide a suitable symbol for the country's high speed network. The CVV design achieves this requirement through delivering an exemplary, distinctive and readily recognisable structure befitting to its sensitive landscape context.

The challenging requirements of the brief have been balanced with the aspirations of stakeholders, the Local Planning Authorities (LPAs) and the local community. The proposed design is the result of extensive engagement with the Colne Valley Regional Park Panel (CVRPP), the HS2 Independent Design Panel (HS2 IDP), London Borough of Hillingdon, South Bucks District Council, statutory consultees, environmental groups and local communities. The recommendations and feedback provided during this engagement process have been key to informing the design now presented for approvals.

The proposed CVV design, in a form ready for Schedule 17 submission, was presented to the HS2 IDP on 8 July 2019 and their subsequent report is included in Appendices Section 11.1. The report states that the HS2 IDP finds much to admire in the proposed CVV design and that the efforts made to minimise the scale and visual impact of the viaduct, in this sensitive landscape context, are to be applauded. In particular it notes that the design meets the aspirations of the HS2 Design Vision, outlined in Section 3.1 of this DAS.

The HS2 IDP report also congratulates the design team on achieving an elegant design through close attention to detail. ALIGN JV will continue this approach during detail design, particularly where the public can experience the structure close-up. In particular, the HS2 IDP recommends that the refinement of the abutments at detailed design stage will be critical to ensure the aspirations of the design submitted for approval can be fully realised.

The HS2 IDP report requests that the design story is presented clearly in the Schedule 17 requests for approval. Considerable attention has been paid to explaining the key factors and events that have influenced the proposed CVV design in this DAS and the Written Statement (1MC05-ALJ-TP-REP-CS01_CL01-000006).

With regards to landscaping, ALIGN JV recognises that the detailed design will need to deliver upon the landscape approach presented in Section 6 of this DAS, the landscape plans and the Indicative Mitigation Details (1MC05-ALJ-TP-REP-CS01_CL01-000007) (IMD). At detailed design stage, the landscape design will be developed further and approvals will be sought for the final restoration schemes under Paragraph 9 to the HS2 Act, or as part of schemes submitted for approval required to support the Bringing In to Use approval under Paragraph 12 to the HS2 Act. Any feedback received from the Local Planning Authorities and consultees on the landscape design approach set out in the DAS and IMD will be considered as detailed design progresses.

In particular, further consideration will be given to the landscape treatment at Moorhall Road. Whilst the HS2 IDP recommended exposing more of the structure in this location, the preferred approach expressed by the London Borough of Hillingdon is to retain as much vegetation as possible. ALIGN JV will therefore continue the current approach to retain trees and vegetation where possible at Moorhall Road, unless removal is necessary for the construction or permanent alignment of the viaduct.

Clarity has been requested by the HS2 IDP regarding how the proposed recreational routes will be delivered. ALIGN JV and HS2 Ltd will continue to proactively engage with the LPAs, CVRPP and landowners, to agree appropriate recreational routes that are required for the CVV and support local use of the Colne Valley area.

ALIGN JV wishes to thank all stakeholders, the LPAs, members of the community, the wider general public and the HS2 IDP for their views, ideas and feedback, and look forward to continuing to work closely with them on the future stages of the project.

Code 1 – Accepted

10.1


Fig.10.1_ Visualisation (15)


Fig.10.2_ Visualisation (7)


Fig.10.3_ Visualisation (1)


Fig.10.4_ Visualisation (6)


Fig.10.5_ Visualisation (12)


Fig.10.6_ Visualisation (5)


Fig.10.7_ Visualisation (11)


Fig.10.8_ Visualisation (8)


Fig.10.9_ Visualisation (10)

Code 1 – Accepted

Code 1 – Accepted

11.0 Appendices

Code 1 – Accepted

HS2 Independant Design Panel Report

HS2 INDEPENDENT DESIGN PANEL

HS2 Independent Design Panel Meeting to discuss the Schedule 17 Stage Design for Colne Valley Viaduct

15.30 – 16.30 Monday 8 July 2019

Attendees

Prof. Sadie Morgan	Chair of the HS2 Independent Design Panel
Tony Burton	Vice chair of the HS2 Independent Design Panel
Annie Coombs	Deputy chair of the HS2 Independent Design Panel
Martin Stockley	Deputy chair of the HS2 Independent Design Panel
Billy Ahluwalia	Senior Project Manager, HS2 Ltd
Martin Short	Lead Architect for Phase One MWCC, HS2 Ltd
Robert Howard	Landscape Design Manager Central, HS2 Ltd
Kevin Roberts	Senior Project Engineer, HS2 Ltd
Matt Dormer	Town Planning Lead Phase One Technical, HS2 Ltd
James Glynn	Town Planning Area Central, HS2 Ltd
Clive Green	Senior Communications Manager, HS2 Ltd
David Smith	Lead Civil Structures Engineer, HS2 Ltd
Saeed Mahmood	South Bucks District Council
Declan Gandee	South Bucks District Council
Steve Braund	South Bucks District Council
Alan Price	Design Director, ALIGN
Erwan Vicat	Viaduct Engineer, ALIGN
Ewan Jones	Lead Architect, ALIGN
Chris Patience	Lead Architect Viaduct, ALIGN
John Woodhouse	Lead Planner, ALIGN
Simon Railton	Lead Landscape, ALIGN
Edward Bailey	HS2 Panel Manager, Frame Projects

Apologies / copied to

Ian Thynne	London Borough of Hillingdon
Ifath Nawaz	South Bucks District Council
Robert Davis	Landscape Design Team, ALIGN
Steve Austin	Town Planning Manager, HS2 Ltd
James Dearing	Design Manager, HS2 Ltd
Ella Davies	Senior Interface Manager, HS2 Ltd
David Emms	Project Director, C1, HS2 Ltd
Alasdair Hassan	Head of Project Engineering Central, HS2 Ltd
Christoph Brintrup	Design Director, HS2 Ltd
Laura Kidd	Head of Architecture, HS2 Ltd
Tom Venner	Commercial Development Director, HS2 Ltd
Giles Thomas	Phase One Engineering Director, HS2 Ltd
Zoe Stewart	Lead Design Manager, HS2 Ltd
Mariyam Ijaz	Assistant Project Manager, HS2 Ltd
Bridget Jackson	Head of Benefits, HS2 Ltd
Alice Williams	PA to Interim Design Director, HS2 Ltd
Paul Gilfedder	Head of Town Planning, HS2 Ltd

Delivered by Frame Projects

Note on Design Panel process

The HS2 Independent Design Panel was established in 2015 at the request of the Department for Transport, to help ensure that, through great design, HS2 delivers real economic, social and environmental benefits for the whole country.

The HS2 Design Vision sets out nine principles grouped around three themes: People; Place; and Time. The design uses this framework to help the HS2 Ltd leadership, project teams and other partners to make the right design choices – and this also informs its advice on designs that are to be submitted under Schedule 17 of the Phase One HS2 Act.

The panel plays an advisory role, providing impartial and objective advice, to support the design process. At a pre-application stage it is for HS2 Ltd to decide what weight to place on the panel's comments balanced with other considerations. Once a Schedule 17 application is submitted, the panel's advice may inform the local planning authority's decision making process.

The HS2 Independent Design Panel comments below follow on from five previous reviews of Colne Valley Viaduct. Further details of panel membership and process are available at:

https://www.gov.uk/government/publications/hs2-design-panel

Timing of Schedule 17 meeting

This meeting took place in advance of Schedule 17 submission for Colne Valley Viaduct.

HS2 Ltd confirmed that there will be no significant design changes prior to the application being submitted.

Views of the Local Planning Authority

South Bucks District Council has had a number of meetings with the design team and noted that, overall, it does not object to the proposals subject to a Schedule 17 submission. The council is in the process of developing a formal response to the latest revisions as part of the pre-application process. Important issues to be resolved are the visual impact of the noise barriers, and the response of the design to the landscape. The council maintain the view that the landscape proposals should be part of this Schedule 17 submission. Noise is also a concern, but the council is happy with the open engagement it has held with the design team and is confident this technical issue will be resolved during the detailed design stage.

The London Borough of Hillingdon was invited to attend, but sent their apologies.

HS2 Independent Design Panel's views

Summary

The panel recognises the huge challenges faced in designing the Colne Valley Viaduct including: its necessary scale; the requirements for noise barriers; the technical demands of high speed rail; the sensitivity of the landscape; and its significance within the route as a whole. The panel is supportive of the overall approach and feels the Schedule 17 stage designs meet the aspirations of the HS2 Design Vision - subject to the continuation of design work through to delivery. It welcomes the intention to include the indicative landscape proposals within the Design and Access Statement and the Indicative Mitigation Details document, which will help give confidence on what will be delivered. As detailed design work progresses following the Schedule 17 (plans and specifications) approval process, a key area of focus will be the refinement of the landscape approach and the detailing of the viaduct – particularly in those parts of the structure which will be in close proximity to the public. There is also scope for further refinement of the abutment design through detailed design. The panel highlights the importance of a holistic design approach to manage the relationship between elements delivered by other contractors, such as overhead line equipment, and the viaduct. The panel strongly supports the decision not to use fencing around the viaduct piers, and the efforts to conceal fencing behind the staircase walls of the abutments. It urges HS2 Ltd to consider what wider design lessons can be learnt from the Colne Valley Viaduct, and how the quality of the proposals can influence the rest of the route.

Viaduct

- The panel finds much to admire in the Schedule 17 stage design for Colne Valley Viaduct. It thinks the proposals, including the landscape vision which is to be subject to subsequent Schedule 17 requests (Bringing into Use and Site Restoration Agreements), meet the aspirations of the HS2 Design vision – subject to continuing further design work through to delivery. It offers comments for consideration as detailed design work progresses towards construction.

- In general, the efforts made to minimise the scale and visual impact of the viaduct, in this sensitive landscape context, are to be applauded. It urges HS2 Ltd to explore how this standard of design, can be championed across the route.

- The panel understands the challenges presented by changing water levels, and welcomes the attention given to minimising the visual impact of the pedestals supporting viaduct piers located in the lakes.

HS2 Independent Design Panel – Schedule 17 report
8 July 2019
HS2-IDP-71Y-Colne Valley Viaduct

Code 1 – Accepted

11.1

- It welcomes the focus on expressing and celebrating the structure, particularly through the design of the piers, as well as efforts made to refine the proposals through, for example, subtle shaping of the haunches. It encourages the team to ensure this design story is clearly expressed within the Schedule 17 submission material, for example, within the Design and Access Statement.

- The panel supports the consideration being given to the design of abutments and the focus on expressing them. Further refinement is needed during the detailed design stage to ensure this complex element can be delivered to the high level of quality promised by the Schedule 17 submission.

- The attention to detail gives the scheme elegance and the panel congratulates the design team on its achievement. The panel highlights the importance of ensuring detailed design continues to be refined through to construction. The panel asks for clarity from HS2 Ltd about which design assurance mechanisms are in place beyond Schedule 17 stage to protect design quality. These mechanisms should also address the interface with elements to be delivered under different contracts, such as overhead line equipment.

- The panel strongly favours the alignment of catenary masts with the centre point between viaduct piers. It urges HS2 Ltd to give careful consideration to how it can control the location of catenary, so that it positively contributes to the design as a whole.

Landscape

- Overall the panel welcomes and commends the thoughtful indicative landscape designs presented and offers its support as this critical area of the scheme is developed.

- The quality of the landscape design around the viaduct will be fundamental to its success – the panel's support is intrinsically linked to the delivery of the indicative landscape presented. Therefore, it welcomes the intention to provide the local planning authorities with a level of assurance on the landscape through the Design and Access Statement and the Indicative Mitigation Details document.

- The panel recognises the efforts made to 'highlight' the point where the viaduct crosses over Moorhall Road. It suggests the team further considers how the landscaping could develop to celebrate this crossing, for example through more tree removal to open up views of the piers.

- Links with the wider landscape, such as cycle paths, will help make this scheme 'more than a railway'. The panel would welcome further clarity on how these aspirations will be progressed.

- As part of any submission, it is essential that all information gives an accurate, consistent and clear representation of the scheme to be delivered. This includes aspects such as the 'naturalistic' ground modelling and landforms proposed.

Fencing

- The panel warmly welcomes the confirmation that there will be no fencing around the piers across the viaduct, and that where fencing is required at the abutments, they will be concealed behind the walls which frame each staircase.

Next steps

Overall, given the enormous technical constraints, the panel feels the Schedule 17 scheme for Colne Valley Viaduct meets the aspirations of the Design Vision. It trusts that this level of design quality will be followed through as detailed design work continues towards construction, and that the comments outlined above can help inform this process.

The panel suggests the Design and Access Statement included within the Schedule 17 submission refers to issues raised in this report and responds to them.

The panel would welcome further discussions on the detailed design of the scheme, including landscape, and other elements of HS2 not yet designed e.g. catenary masts, at an appropriate moment – to ensure they support the holistic design response generated to date.

HS2 Independent Design Panel – Schedule 17 report
8 July 2019
HS2-IDP-71Y-Colne Valley Viaduct

Code 1 – Accepted

Physical Model Photography

Fig.11.1_ Physical Model - Expansion portal plan

Fig.11.2_ Physical Model - Expansion portal elevation

Fig.11.3_ Physical Model - Expansion portal axonometric

Code 1 – Accepted

11.2

Fig.11.4_ Physical Model - Fixed pier plan

Fig.11.5_ Physical Model - Fixed pier elevation

Fig.11.6_ Physical Model - Fixed pier axonometric

Code 1 – Accepted

Physical Model Photography

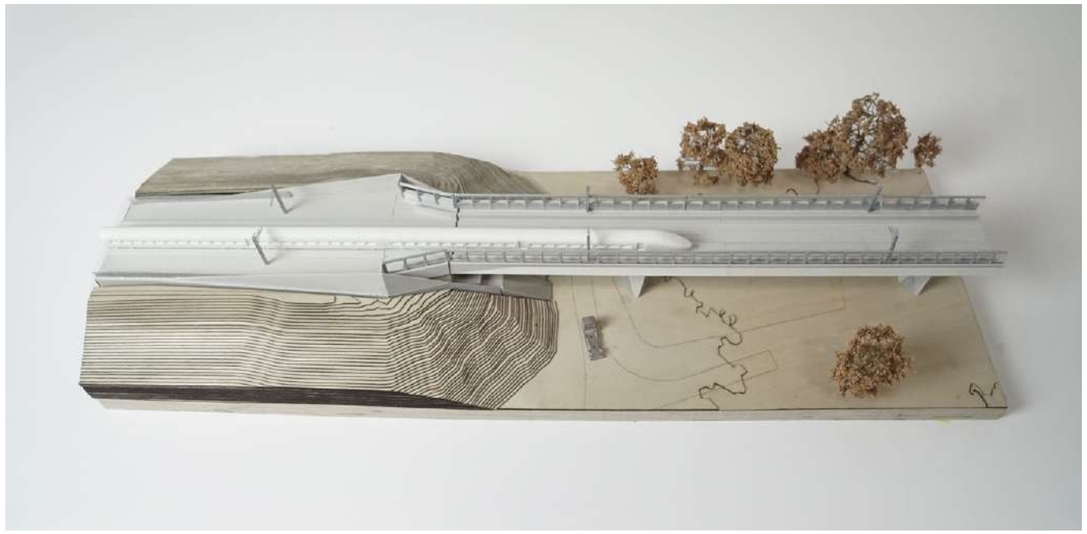


Fig.11.7_ Physical Model - South abutment plan

Fig.11.8_ Physical Model - South abutment elevation

Fig.11.9_ Physical Model - South abutment axonometric

Code 1 – Accepted

11.2

Fig.11.10_ Physical Model - Arched form deck plan

Fig.11.11_ Physical Model - Arched form deck elevation

Fig.11.12_ Physical Model - Arched form deck

Code 1 – Accepted

Figure Contents

11.3.1 Figure List

Code 1 – Accepted

11.3

11.3.1 Figure List (Continued)

Code 1 – Accepted

Figure Contents

11.3.1 Figure List (Continued)

Code 1 – Accepted

11.3

11.3.1 Figure List (Continued)

Code 1 – Accepted

Figure Contents

11.3.1 Figure List (Continued)

Code 1 – Accepted

Blank Page

11.3

Code 1 – Accepted

Title: Colne Valley Viaduct And Incidental Earthworks & Fencing Colne Valley Viaduct Schedule 17: Design and Access Statement
Document Number: 1MC05-ALJ-TP-REP-CS01_CL01-000005
Revision: C02

Code 1 – Accepted