



The High Speed Rail (London – West Midlands) (Greatmoor Railway Sidings Etc.) Order

Environmental Statement – technical appendices **Volume 4.12:** Water resources assessment



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(Greatmoor Railway Sidings Etc.) Order

Environmental Statement – technical appendices
Volume 4.12:
Water resources assessment



Department for Transport

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1 Introduction

1.1 Structure of the water resources and flood risk assessment appendices

1.1.1 The water resources and flood risk assessment appendices comprise two parts:

- Volume 4.12: Environmental Statement Technical Appendix: Water resources assessment (this appendix); and
- Volume 4.13: Flood Risk Assessment.

1.1.2 Maps referred to throughout the water resources and flood risk assessment appendices are contained in Maps ES-27: Surface Water Baseline, ES-28: Groundwater Baseline and ES-29: Water Framework Directive, in Volume 3: Environmental Statement Maps.

1.2 Study area

1.2.1 The site covers approximately 36.2 hectares of the Proposed Scheme in the Aylesbury Vale District. The site is located near Sheephouse Wood Site of Special Scientific Interest (SSSI) and Finemere Wood SSSI.

1.2.2 The spatial scope of the assessment was based upon the identification of surface water and groundwater features within 1km of the Proposed Scheme, except where there is clearly no hydraulic connectivity between the site and a surface water or groundwater feature. For the purposes of this assessment, the area is referred to as the study area. In addition, all groundwater bodies are considered which are both within 1km horizontally of the site, and also within 10m of the lowest possible construction or dewatering depth. Outside of these distances it is unlikely that impacts on the water environment will be attributable to the Proposed Scheme.

1.2.3 The main environmental features of relevance to water resources and the flood risk assessment include:

- the channel and floodplain of the Muxwell brook;
- three SSSIs: Finemere Wood SSSI, Sheephouse Wood SSSI, and Grendon and Diddershall Woods SSSI;
- Grendon Underwood Meadows Local Wildlife Site (LWS); and
- Superficial deposits comprising Alluvium and Glacial Deposits which may contain groundwater.

1.2.4 Key environmental issues relating to water resources assessment include:

- restriction of groundwater flow by sub-surface structures, affecting superficial deposits and, possibly, features in SSSI or LWS which are dependent on shallow groundwater; and

- potential impacts on groundwater and surface water quality as a result of construction activities associated with excavation, deposition of material and piling for bridge construction.

1.2.5 Maps ES-27 to ES-29, in Volume 3: Environmental Statement Maps, show details of the environmental baseline and design features referred to in this report.

1.2.6 Where a residual impact or mitigation impact to water resources has a consequent effect on ecology, this is discussed further in Volume 2: Main ES, Section 9, Ecology.

2 Stakeholder engagement

2.1.1 Consultation with the following stakeholders has been undertaken to inform the water resources assessment:

- Environment Agency in relation to the crossing of watercourses by elements of the Proposed Scheme, and in relation to the potential impacts of cuttings; and
- FCC Waste Services (UK) Ltd., operators of the Calvert landfill site.

3 Baseline data

3.1 General

- 3.1.1 The following section provides a current description of water resources including surface water and groundwater.

3.2 Surface water

- 3.2.1 All surface water features within 1km of the Proposed Scheme are presented in Table 1.
- 3.2.2 The current surface water baseline is shown in map ES-27 in Volume 3 of this ES. Where a water feature in Table 1 has been given a map reference it appears on one of these maps.
- 3.2.3 All water bodies within the study area fall entirely within the Oxon Ray catchment which itself is within the Thames River Basin District (RBD) and are covered by the associated river basin management plan (RBMP).
- 3.2.4 There are no licensed surface water abstractions within 1km of the Proposed Scheme. Records from Buckinghamshire County Council show no unlicensed abstractions within 1km of the Proposed Scheme. There is the potential for unlicensed abstractions to exist, as a licence is not required for abstraction volumes below 20m³ per day.
- 3.2.5 The Environment Agency reported no current consented surface water discharges within 1km of the Proposed Scheme as of 24th March 2015. However, since this date, FCC has been granted a permit for surface water discharge from the Greatmoor EfW facility. Therefore, this FCC consent has been considered in this assessment.

Table 1: Surface water features within 500m of the Proposed Scheme

Water feature	Location description (Volume 5: Water Resources and Flood Risk Assessment Map Book map reference)	Watercourse classification ¹	WFD water body and current overall status (2015)	WFD predicted outcome (by 2027 as in RBMP)	Receptor value	Q ₉₅ ² (m ³ /s)	Catchment area at this location (km ²)	Notes
River Ray	Located to the south of the Proposed Scheme CFA ₁₂ -SWC ₀₉	Main river	Ray and tributaries North East of Grendon Underwood GB106039030100 Moderate	Good Status	Very High	0.002	4.5	As indicated by the low value for Q ₉₅ , the River Ray is a small watercourse in the study area flowing south west towards Grendon Underwood.
Partly culverted Tributary of River Ray (culverted downstream of Finemere Wood)	Crosses the Proposed Scheme north of Woodlands Farm CFA ₁₂ -SWC ₁₀	Ordinary watercourse	No status class in RBMP – assumed status (from Ray and tributaries, North East of Grendon Underwood) GB106039030100 Moderate	No status class in RBMP – assumed status (from Ray and tributaries North East of Grendon Underwood) Good Status	High	0.0003	0.52	The drain is a tributary of the River Ray which flows to the south west through Finemere Wood and then west towards Hewin's Wood.

¹ Water-feature classifications: Section 113 of the Water Resources Act 1991 defines a main river as a watercourse that is shown as such on a main river map. Section 72 of the Land Drainage Act 1991 defines an ordinary watercourse as 'a watercourse that is not part of a main river'. Section 221 of the Water Resources Act 1991 defines a watercourse as including 'all rivers and streams, ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers) and passages through which water flows'. Main rivers are larger rivers and streams designated by the Department for Environment, Food and Rural Affairs (Defra) on the main river map and are regulated by the Environment Agency

² Derived from National River Flow Archive data and catchment areas calculated using the Flood Estimation Handbook - Centre for Ecology and Hydrology, (2009) Flood Estimation Handbook (FEH) CD-ROM Version 3.0. Q₉₅ is the flow which is exceeded for 95% of the time (i.e. it is a low flow and the river will only have flows less than this for 5% of the time).

Water feature	Location description (Volume 5: Water Resources and Flood Risk Assessment Map Book map reference)	Watercourse classification ¹	WFD water body and current overall status (2015)	WFD predicted outcome (by 2027 as in RBMP)	Receptor value	Q95 ² (m ³ /s)	Catchment area at this location (km ²)	Notes
Unnamed Lake south of Finemere Wood	Unnamed Lake adjacent to the Proposed Scheme, south of Finemere Wood	Not classified	No status class in RBMP – assumed status (from Ray and tributaries North East of Grendon Underwood) GB106039030100 Moderate	No status class in RBMP – assumed status (from Ray and tributaries North East of Grendon Underwood) Good Status	Moderate	Not applicable	Not applicable	The lake is potentially fed by a tributary of the River Ray. There is a 'Jetty' identified on the lake.
Drain known as the Mega Ditch	Crosses the route south of Sheephouse Wood SSSI CFA12-SWC11	Ordinary watercourse	No status class in RBMP – assumed status (from Ray and tributaries (North East of Grendon Underwood) GB106039030100 Moderate	No status class in RBMP – assumed status (from Ray and tributaries (North East of Grendon Underwood) Good Status	Moderate	0.0003	0.62	The drain runs parallel to the existing railway track. A flowing continuous water body was observed during site visits (January 2013 and April 2016).
10 x Unnamed Ponds	10 small isolated field ponds between Finemere Wood and Sheephouse Wood SSSI north of the existing rail line	Not classified	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Low	Not applicable	Not applicable	The ponds are not connected to any other surface water features in the catchment.
2 x Unnamed Ponds	Two small isolated field ponds in the Greatmoor area 400m to 700m south of the Proposed Scheme	Not classified	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Low	Not applicable	Not applicable	The ponds are not connected to any other surface water features in the catchment.

Water feature	Location description (Volume 5: Water Resources and Flood Risk Assessment Map Book map reference)	Watercourse classification ¹	WFD water body and current overall status (2015)	WFD predicted outcome (by 2027 as in RBMP)	Receptor value	Q ₉₅ ² (m ³ /s)	Catchment area at this location (km ²)	Notes
6 x Unnamed Ponds	Six small isolated field ponds between Greatmoor and Woodlands Farm	Not classified	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Low	Not applicable	Not applicable	The ponds are not connected to any other surface water features in the catchment.
Muxwell Brook	Runs along the north western boundary of the Proposed Scheme CFA ₁₂ -SWC ₁₂	Ordinary watercourse	No status class in RBMP – assumed status (from Ray and tributaries (North East of Grendon Underwood) GB106039030100 Moderate	No status class in RBMP – assumed status (from Ray and tributaries (North East of Grendon Underwood) Good Status	High	0.002	4.11	Muxwell Brook flows south-west from north of Balmore Wood, along the southern perimeter of Sheephouse Wood SSSI and eventually into the River Ray south of the route.
2 x Unnamed Lakes	Two unnamed lakes immediately south of the Proposed Scheme, to the south-west of Sheephouse Wood SSSI (part of Calvert clay pits)	Not classified	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Low	Not applicable	Not applicable	The lakes are related to Clay Pits and are not connected to any other surface water features in the catchment.
2 x Unnamed field drains	Two isolated field drains 440m to 850m south of the Proposed Scheme and to the south of the clay pit lakes	Ordinary watercourse	Not assessed by the Environment Agency	Not assessed by the Environment Agency	Moderate	Not applicable	Not applicable	The drains are not connected to any other surface water features in the catchment.

3.3 Groundwater

3.3.1 A summary of the superficial and bedrock geology and hydrogeology is presented in Table 2.

Table 2: Summary of geology and hydrogeology in the study area

Geology	Distribution	Formation description	Aquifer classification	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value
Superficial deposits						
Alluvium	Along the valley of the Muxwell Brook and River Ray	Clay, silt, sand and gravel	Secondary A	Not assessed by Environment Agency	Not assessed by Environment Agency	Moderate
Glacial Deposits	Outcrops to the east and north of the Proposed Scheme	Mainly clay, silt and sand	Secondary Undifferentiated	Not assessed by Environment Agency	Not assessed by Environment Agency	Moderate
Diamicton (mid Pleistocene)	Outcrops to the east and north of the Proposed Scheme overlying the Glacial Deposits (mid Pleistocene)	Till	Secondary Undifferentiated	Not assessed by Environment Agency	Not assessed by Environment Agency	Moderate
Glacial Deposits (mid Pleistocene)	Outcrops to the east and north of the Proposed Scheme overlying the Glacial Deposits	Sand and gravel	Secondary A	Not assessed by Environment Agency	Not assessed by Environment Agency	Moderate
Bedrock						
West Walton Formation	Overlying the Oxford Clay Formation to the southeast of the Proposed Scheme site	Calcareous mudstone, silty mudstone and siltstone	Unproductive	Not assessed by Environment Agency	Not assessed by Environment Agency	Low

Geology	Distribution	Formation description	Aquifer classification	WFD water body and current overall status	WFD status objective (by 2027 as in RBMP)	Receptor value
Oxford Clay Formation (consisting of Weymouth Member, Stewartby Member and Peterborough Member)	Outcrops across most of the Proposed Scheme site	Mudstones	Unproductive	Not assessed by Environment Agency	Not assessed by Environment Agency	Low

3.3.2 There are no licensed groundwater abstractions within 1km of the Proposed Scheme. There are no Source Protection Zones (SPZ) for Public Water Supply (PWS) groundwater sources in the study area. Buckinghamshire County Council (BCC) has no records of unlicensed groundwater abstractions within 1km of the Proposed Scheme. However, there is the potential for unlicensed abstractions to exist, as a licence is not required for abstraction volumes below 20m³ per day.

3.3.3 There are no discharges to groundwater within 1km of the Proposed Scheme.

3.4 Surface water/groundwater interaction

3.4.1 Table 3 summarises the surface water/ groundwater interactions and water dependent habitats within 1km of the route.

Table 3 : Surface water/groundwater interaction and water dependent habitats

Location description	Distance from Proposed Scheme	Formation	Approximate Elevation (mAOD)	Surface water/ groundwater interaction	Comments
Finemere Wood SSSI	150m east	Ancholme Group (West Walton Formation / Weymouth Member).	90 - 130	The site overlies unproductive strata and is unlikely to be in connectivity with groundwater	Poorly drained soils give rise to marshy areas within the wood. A tributary of the River Ray rises at the north-east corner of the wood upstream of the route crossing CFA12-SWC10.
Grendon and Doddershall Woods SSSI	700m south west	Ancholme Group (Stewartby Member) & Alluvium associated with watercourses	75	The site overlies unproductive strata and is unlikely to be in connectivity with groundwater, except in the areas overlying the Alluvium.	A tributary of the River Ray runs through Grendon Wood and supports sawallow and alder. The SSSI is downstream of the route crossing CFA12-SWC09
Sheephouse Woods SSSI	Adjacent to the Proposed Scheme	Ancholme Group (Peterborough Member)	75 - 100	The site overlies unproductive strata and is unlikely to be in connectivity with groundwater	The woodland is traversed by numerous small clay-lined watercourses and channels. These

Location description	Distance from Proposed Scheme	Formation	Approximate Elevation (mAOD)	Surface water/ groundwater interaction	Comments
					tributaries of the Muxwell Brook are upstream of the route crossings CFA12-SWC11 and CFA12-SWC12.
Grendon and Doddershall Meadows LWS	600m southeast of Proposed Scheme	Alluvium	80	Shallow groundwater in the Alluvium is likely to be in connectivity with the LWS	Alluvium underlying this site is hydraulically isolated from the Proposed Scheme.

3.4.2 Further details of the water dependent habitats are provided in Volume 2: the Main ES, Section 9, Ecology.

4 Site specific surface water assessment

4.1 Summary of assessment

- 4.1.1 Table 4 summarises the potential impacts and effects to surface water features from the Proposed Scheme. Only those impacts and effects that are classed as significant are presented in Section 13.4 of the Volume 2: Main ES.
- 4.1.2 Table 4 only includes water features which could potentially be impacted by the Proposed Scheme. Features such as isolated ponds and drains which will lie outside the construction footprint and area of impact of the Proposed Scheme, are not included. However, details of the features are provided in Table 1.

Table 4: Summary of potential impacts to surface water

Surface water feature / receptor	Design element	Receptor value	Discussion of potential impact	Magnitude of impact	Mitigation	Scale of remaining impact	Further mitigation	Residual effect	Duration of effect
Partly culverted Tributary of River Ray (located downstream of Finemere Wood) SWC-CFA12-10	Cutting for sidings	Moderate	Potential sediment mobilisation or spills during construction.	Minor impact Slight effect (Insignificant)	Measures set out in draft CoCP to control sediment mobilisation and risk of spills.	Negligible impact Neutral effect (Insignificant)	None	Negligible impact Neutral effect (Insignificant)	Construction (temporary)
	Sidings access road and footpath overbridge including piling		Deterioration in water quality from routine discharges from the roadway and associated infrastructure or spills.	Minor impact Slight effect (Insignificant)	Balancing pond before outfall to watercourse to restrict runoff rates and mitigate effect on water quality.	Negligible impact Neutral effect (Insignificant)	None	Negligible impact Neutral effect (Insignificant)	Construction (permanent)
	Cutting for sidings Works on existing culvert Balancing pond and associated drainage		During works on the existing culvert, balancing pond and drainage there is potential for temporary impacts to flow. Potential sediment mobilisation or spills during construction.	Moderate impact Large effect (Significant)	Measures set out in draft CoCP to control sediment mobilisation and risk of spills.	Negligible impact Neutral effect (Insignificant)	None	Negligible impact Neutral effect (Insignificant)	Construction (temporary)
Unnamed Lake south of Finemere Wood	Cutting for sidings	Moderate	Potential sediment mobilisation or spills during construction.	Minor impact Slight effect (Insignificant)	Measures set out in draft CoCP to control sediment mobilisation and risk of spills.	Negligible impact Neutral effect (Insignificant)	None	Negligible impact Neutral effect (Insignificant)	Construction (temporary)

Surface water feature / receptor	Design element	Receptor value	Discussion of potential impact	Magnitude of impact	Mitigation	Scale of remaining impact	Further mitigation	Residual effect	Duration of effect
	Surface water drainage		Change to local flow regime due to new surface water drainage system	Minor impact Slight effect (Insignificant)	Balancing pond before outfall to watercourse to restrict runoff rates and limit effect on water quality.	Negligible impact Neutral effect (Insignificant)	None	Negligible impact Neutral effect (Insignificant)	Construction (permanent)
Drain known as the Mega Ditch	Sidings embankment and drainage.	Low	Potential sediment mobilisation or spills during construction. During works for the culverting of the drain, balancing pond and drainage there is a potential for temporary impacts to flow.	Minor impact Slight effect (Insignificant)	Measures set out in draft CoCP to control sediment mobilisation and risk of spills.	Negligible impact Neutral effect (Insignificant)	None	Negligible impact Neutral effect (Insignificant)	Construction (temporary)
			Permanent impact on flow regime in receiving watercourse. Deterioration in water quality from routine discharges from the railway sidings and associated infrastructure or spills.	Minor impact Neutral effect (Insignificant)	Balancing pond before outfall to watercourse to restrict runoff rates and limit effect on water quality.	Negligible impact Neutral effect (Insignificant)	None	Negligible impact Neutral effect (Insignificant)	Construction (permanent)

Surface water feature / receptor	Design element	Receptor value	Discussion of potential impact	Magnitude of impact	Mitigation	Scale of remaining impact	Further mitigation	Residual effect	Duration of effect
Muxwell Brook SWC-CFA12-12	Railway sidings Works on existing culvert, and flood compensation area	Moderate	During works on the existing culvert and flood compensation area at the Muxwell Brook, there is a potential for temporary impacts to flow. Potential sediment mobilisation or spills during construction.	Negligible impact Neutral effect (Insignificant)	Measures set out in draft CoCP to control sediment mobilisation and risk of spills.	Negligible impact Neutral effect (Insignificant)	None	Negligible impact Neutral effect (Insignificant)	Construction (temporary)
6 x Unnamed Ponds	FFC Road Accommodation green overbridge	Low	One pond will potentially be lost during construction activities for the Greatmoor sidings access road overbridge, to the southwest of the existing rail line. The other ponds will not be impacted by the Proposed Scheme.	Major impact Moderate effect (Significant)	Four additional ecological mitigation ponds will be constructed to the north east of the Proposed Scheme	Negligible impact Neutral effect (Insignificant)	None	Negligible impact Neutral effect (Insignificant)	Construction (permanent)

5 Site specific groundwater assessment

5.1 Summary of assessment

5.1.1 Table 5 summarises the potential impacts to hydrogeology (groundwater), surface water/ groundwater interactions and water dependent habitats. Only those impacts and effects that are classed as significant are presented in Volume 2: Main ES, Section 14.4, Water resources and flood risk assessment.

Table 5: Summary of potential impacts to groundwater, abstractions, water dependent habitats and surface water / groundwater interactions

Receptor	Design element	Receptor value	Discussion of potential impact	Magnitude of impact	Mitigation	Scale of remaining impact	Further mitigation	Residual effect	Duration of effect
Hydrogeology (groundwater)									
Superficial deposits comprising Alluvium	Greatmoor Railway Sidings construction including Muxwell Brook replacement flood storage area construction.	Moderate	Superficial deposits, comprising alluvium, may contain shallow groundwater. The deposits are present along Muxwell Brook. The superficial deposits are likely to be in hydraulic connectivity with the watercourse. There is potential for surface water and subsequently shallow groundwater quality to be adversely affected by construction.	Minor impact Slight effect (Insignificant)	Measures set out in draft CoCP to control sediment mobilisation and risk of spills.	Negligible impact Neutral effect (Insignificant)	None	None	Construction (temporary)
Bedrock	Greatmoor Railway Sidings construction	Low	The cutting required for the Greatmoor Railway Sidings penetrate the Weymouth Member and Stewartby Member of the Oxford Clay Formation. Both are classified as unproductive strata with no groundwater present. Therefore, there is no anticipated impact from this cutting on groundwater and no mitigation is required.	Negligible impact Neutral effect (Insignificant)	Not required	Negligible impact Neutral effect (Insignificant)	None	None	Not applicable

Receptor	Design element	Receptor value	Discussion of potential impact	Magnitude of impact	Mitigation	Scale of remaining impact	Further mitigation	Residual effect	Duration of effect
Water dependent habitats									
Finemere Wood SSSI	Greatmoor Railway Sidings	High	This site is underlain by the Ancholme Group, a low permeability, unproductive strata. As such, there will be no connectivity with groundwater. No decrease in flow or quality in surface water courses expected so no potential for impact on surface water dependant habitats.	Negligible impact Neutral effect (Insignificant)	Not required	Negligible impact Neutral effect (Insignificant)	None	None	Not applicable
Grendon and Doddershall Woods SSSI	Greatmoor Railway Sidings	High	This site is underlain by the Ancholme Group, a low permeability, unproductive strata. As such, there will be no connectivity with groundwater. No decrease in flow or quality in surface water courses expected so no potential for impact on surface water dependant habitats.	Negligible impact Neutral effect (Insignificant)	Not required	Negligible impact Neutral effect (Insignificant)	None	None	Not applicable
Sheephouse Woods SSSI	Greatmoor Railway Sidings	High	This site is underlain by the Ancholme Group, a low permeability, unproductive strata. As such, there will be no connectivity with groundwater. No decrease in flow or quality in surface water courses expected so no potential for impact on surface water dependant habitats.	Negligible impact Neutral effect (Insignificant)	Not required	Negligible impact Neutral effect (Insignificant)	None	None	Not applicable

Receptor	Design element	Receptor value	Discussion of potential impact	Magnitude of impact	Mitigation	Scale of remaining impact	Further mitigation	Residual effect	Duration of effect
Grendon and Doddershall Meadows LWS	Greatmoor Railway Sidings	High	<p>This site is underlain by Alluvium over the Ancholme Group. Shallow groundwater in the Alluvium is likely to contribute to the nature of this damp and neutral grassland.</p> <p>The Proposed Scheme will not be constructed over Alluvium which is in continuity with the Alluvium in the LWS. Therefore there is no pathway for impact on the LWS. No decrease in flow or quality in surface water courses expected so no potential for impact on surface water dependant habitats.</p>	<p>Negligible impact</p> <p>Neutral effect (Insignificant)</p>	Not required	<p>Negligible impact</p> <p>Neutral effect (Insignificant)</p>	None	None	Not applicable

6 WFD compliance assessment

6.1 Introduction

6.1.1 The Water Framework Directive 2000/60/EC (WFD) sets out environmental objectives that must be met for all water bodies within Member States. Prior to receiving consent, new developments that have the potential to affect water bodies (or schemes which lead to modifications of water bodies) should be assessed against the Directive's environmental objectives to determine whether they have the potential to prevent these objectives from being met.

6.1.2 The Proposed Scheme has been assessed for compliance with the WFD objectives using the methodology set out in the HS2 WFD compliance assessment³. In addition, the methodology incorporates the clarifications made by the Court of Justice of the European Union (CJEU) ruling for Case C-461/13 (Bund für Umwelt und Naturschutz Deutschland eV v Bundesrepublik Deutschland) as described in the WFD compliance assessment review⁴.

6.1.3 The WFD compliance assessment has been undertaken at the water body scale.

6.1.4 The two key objectives against which the Proposed Scheme has been assessed are:

- No deterioration of status (or potential) for surface and groundwaters; and
- Achievement of good status (or potential) by 2021 or 2027, for water bodies currently failing to achieve this status or potential.

6.2 Potentially impacted water bodies

6.2.1 There is one WFD waterbody which could potentially be impacted by construction, the Ray and tributaries, North East of Grendon Underwood - GB106039030100.

6.2.2 The tributary of the River Ray, the Muxwell Brook and the Mega Ditch all flow into the River Ray and do not have WFD classification. Therefore, for the purposes of this assessment it is considered that these tributaries form part of the River Ray water body (GB106039030100) assessment. Potential impacts on the Muxwell Brook, Mega Ditch and tributary of the River Ray will be evaluated as part of the River Ray and tributaries, North East of Grendon Underwood waterbody assessment.

1.1.1 There are no WFD groundwater bodies within 1km of the Proposed Scheme. Therefore, no groundwater body assessment is required. Superficial deposits containing groundwater are present in some areas and the potential WFD impacts on these deposits will be considered as part of the River Ray and tributaries, North East of Grendon Underwood waterbody assessment.

³ The hybrid Bill scheme: London to West Midlands Environmental Statement, Vol 5 – technical Appendices: Route-wide Appendix (WR-001-000) Water Resources (Nov 2013);

⁴ The hybrid Bill scheme: London to West Midlands Environmental Statement, Water Framework Directive compliance assessment review.

6.3 Surface water body assessment

- 6.3.1 The detailed assessment of the effect of the Proposed Scheme on individual elements of the River Ray and tributaries, North East of Grendon Underwood surface water body are provided in Table 18 at the end of this document. The assessment comprises a risk screening of potential to cause deterioration of current WFD Ecological status (Part A), and a risk screening of potential to prevent future attainment of good Ecological status (Part B).
- 6.3.2 For the risk to future attainment of good Ecological status, actions from the River Basin Management Plan were reviewed for relevance to the construction and operation of the Proposed Scheme. This surface water body does not have any proposed actions (measures) set out in the RBMP.
- 6.3.3 Following mitigation, including implementation of the draft CoCP the Proposed Scheme is not expected to cause deterioration in the status of elements of the WFD for the River Ray and tributaries, North East of Grendon Underwood surface water body, therefore, it is considered compliant.

Table 6: River Ray and tributaries, North East of Grendon Underwood WFD compliance assessment details (Parts A and B)

A. Risk screening of potential to cause deterioration of current WFD Ecological status																
Surface Water body	Current status (2015)	Status objective	Scheme Elements	Proposed Scheme					Impacts from other WFD water bodies (assessed separately)	OVERALL effect on element	Additional Proposed Mitigation Measures		RESIDUAL effect on element (following any additional mitigation measures)			
				Description of scheme element impact							Construction	Operation				
GB106039030100	Poor	Good Ecological Potential by 2027, High Chemical Status by 2027	Identified biological impacts	Development of new railway sidings for FCC goods trains, including cutting holding sidings (crossing a trib of River Ray) , embanked sidings, green accommodation overbridge, footpath overbridge and footpath underbridge					Shading from additional planting	Changes (i.e. either decrease due to de-watering/damming of groundwater flows or increase due to re-charge) in flow velocity and volume	Changes to water body hydromorphology leading to changes in river processes and habitats upstream and downstream	Sediment loading due to construction in shallow aquifer	Change in water quality due to discharge of drainage to a surface water body.			
Ray and tributaries NorthEast of Grendon Underwood																
WFD classification elements	1. Macrophytes and phytobenthos - diatoms	N/A	N/A	Predicted change to status elements (green = none, amber = possibly, red = likely)												
	2. Macrophytes and phytobenthos - combined	Good	Good		No planting or construction in close proximity to the tributary of the River Ray, Muxwell Brook or Mega ditch that could increase shading. No impact.	No impact anticipated	No impact anticipated	Construction close to the Muxwell Brook could intersect with the superficial deposits which are likely to be in hydraulic connection with the brook. Superficial deposits will provide some filtration effect to reduce sediment impacts. The CoCP will employ mitigation to avoid significant impacts to macrophytes from a temporary decrease in water quality resulting from sediment or spills during construction. No likely effect anticipated.	Suitable permanent drainage systems to the Muxwell Brook, Mega ditch and tributary of the River Ray will included sufficient treatment techniques to ensure potential impacts to macrophytes are reduced. No anticipated change in water quality.	Upstream water bodies not impacted by scheme	No material change anticipated.	No additional mitigation required	No additional mitigation required	No material change anticipated.		
	3. Invertebrates	Poor	-		No planting or construction in close proximity to the tributary of the River Ray, Muxwell Brook or Mega ditch that could increase shading. No impact.	No impact anticipated	No impact anticipated	Construction close to the Muxwell Brook could intersect with the superficial deposits which are likely to be in hydraulic connection with the brook. Superficial deposits will provide some filtration effect to reduce sediment impacts. The CoCP will employ mitigation to avoid significant impacts to invertebrates from a temporary decrease in water quality resulting from sediment or spills during construction. No likely effect anticipated.	Suitable permanent drainage systems to the Muxwell Brook, Mega ditch and tributary of the River Ray will included sufficient treatment techniques to ensure potential impacts to invertebrates are reduced. No anticipated change in water quality.	Upstream water bodies not impacted by scheme	No material change anticipated.	No additional mitigation required	No additional mitigation required	No material change anticipated.		
	4. Fish	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

Physico-Chemical status														
Surface Water body	Current status	Status objective	Scheme Elements	Proposed development					Impacts from other WFD water bodies (assessed separately)	OVERALL effect on element	Additional Proposed Mitigation Measures		RESIDUAL effect on element (following any additional mitigation measures)	
				Description of scheme element impact	Development of new railway sidings for FCC goods trains, including cutting holding sidings (crossing a trib of River Ray), embanked sidings, green accommodation overbridge, footpath overbridge and footpath underbridge						Construction	Operation		
GB106039030100	Poor	Good Ecological Potential by 2027, High Chemical Status by 2027	Identified biological impacts	Shading from additional planting	Changes (i.e. either decrease due to de-watering/damming of groundwater flows or increase due to re-charge) in flow velocity and volume	Changes to water body hydromorphology leading to changes in river processes and habitats upstream and downstream	Change in water quality due to discharge of groundwater to a surface water body.	Change in water quality due to discharge of drainage to a surface water body.						
Ray and tributaries NorthEast of Grendon Underwood														
WFD classification elements	5. Dissolved Oxygen	Moderate	Moderate	Predicted change to status elements (green = none, amber = possibly, red = likely)	No planting close to watercourses and no change in culvert length therefore, no change in status is anticipated.	No impact anticipated	N/A	CoCP measures to control risk of spills will ensure potential impacts to water quality are reduced. No anticipated change in water quality.	CoCP measures implemented during construction, and suitable drainage systems (including balancing ponds) will ensure potential impacts to water quality are reduced. No anticipated change in water quality.	Upstream water bodies not impacted by scheme	Implementation of CoCP mitigation during construction should ensure no material changes to water quality	No additional mitigation required	No additional mitigation required	No material change anticipated.
	6. pH	High	Good		Receptor is insensitive to impact	No impact anticipated	N/A	Receptor is insensitive to impact	Receptor is insensitive to impact	Upstream water bodies not impacted by scheme				
	7. Phosphate	Good	Good		Receptor is insensitive to impact	No impact anticipated	N/A	No impact anticipated	CoCP measures implemented during construction, and suitable drainage systems (including balancing ponds) will ensure potential impacts to water quality are reduced. No anticipated change in water quality.	Upstream water bodies not impacted by scheme				
	8. Ammonia	High	Good		Receptor is insensitive to impact	No impact anticipated	N/A	No impact anticipated	Receptor is insensitive to impact	Upstream water bodies not impacted by scheme				
	9. Temperature	High	Good		No planting close to watercourses and no change in culvert length therefore, no change in status is anticipated.	No impact anticipated	N/A	No impact anticipated	Receptor is insensitive to impact	Upstream water bodies not impacted by scheme				
	10. Biological Oxygen Demand (BOD)	High	-		Receptor is insensitive to impact	No impact anticipated	N/A	No impact anticipated	Receptor is insensitive to impact					
	10. Specific Pollutants (Annex VIII)	Good	N/A		Receptor is insensitive to impact	No impact anticipated	N/A	CoCP measures to control sediment mobilisation and risk of spills will ensure potential impacts to water quality are reduced. No anticipated change in water quality.	CoCP measures implemented during construction, and suitable drainage systems (including balancing ponds) will ensure potential impacts to water quality are reduced. No anticipated change in water quality.	Upstream water bodies not impacted by scheme				

Hydromorphological status														
Surface Water body	Current status	Status objective	Scheme Elements	Proposed development					Impacts from other WFD water bodies (assessed separately)	OVERALL effect on element	Additional Proposed Mitigation Measures		RESIDUAL effect on element (following any additional mitigation measures)	
GB106039030100	Poor	Good Ecological Potential by 2027, High Chemical Status by 2027	Description of scheme element impact	Development of new railway sidings for FCC goods trains, including cutting holding sidings (crossing a trib of River Ray), embanked sidings, green accommodation overbridge, footpath overbridge and footpath underbridge							Construction	Operation		
Ray and tributaries NorthEast of Grendon Underwood			Identified biological impacts	Shading from additional planting	Changes (i.e. either decrease due to de-watering/damming of groundwater flows or increase due to re-charge) in flow velocity and volume	Changes to water body hydromorphology leading to changes in river processes and habitats upstream and downstream	Change in water quality due to discharge of groundwater to a surface water body.	Change in water quality due to discharge of drainage to a surface water body.	Upstream water bodies not impacted by scheme	There are no planned changes to the hydromorphology of the tributaries of the River Ray. No material changes anticipated.	No additional mitigation required	No additional mitigation required	No material changes anticipated.	
WFD classification elements	12. Hydrological Regime	-	-	Predicted change to status elements (green = none, amber = possibly, red = likely)	N/A	No impact anticipated	No impact anticipated	N/A	N/A	Upstream water bodies not impacted by scheme	There are no planned changes to the hydromorphology of the tributaries of the River Ray. No material changes anticipated.	No additional mitigation required	No additional mitigation required	No material changes anticipated.
	13. Morphology	-	-	N/A	No impact anticipated	No impact anticipated	N/A	N/A	Upstream water bodies not impacted by scheme	No additional mitigation required		No additional mitigation required	No material changes anticipated.	

B. Risk screening of potential to prevent future attainment of good Ecological status													
Surface Water body	Current status	Status objective	Scheme Elements	Proposed development					Impacts from other WFD water bodies (assessed separately)	OVERALL effect on element	Additional Proposed Mitigation Measures		RESIDUAL effect on element (following any additional mitigation measures)
GB106039030100	Poor	Good Ecological Potential by 2027, High Chemical Status by 2027	Description of scheme element impact	Development of new railway sidings for FCC goods trains, including cutting holding sidings (crossing a trib of River Ray), embanked sidings, green accommodation overbridge, footpath overbridge and footpath underbridge							Construction	Operation	
Ray and tributaries NorthEast of Grendon Underwood			Identified biological impacts	Shading from additional planting	Changes (i.e. either decrease due to de-watering/damming of groundwater flows or increase due to re-charge) in flow velocity and volume	Changes to water body hydromorphology leading to changes in river processes and habitats upstream and downstream	Change in water quality due to discharge of groundwater to a surface water body.	Change in water quality due to discharge of drainage to a surface water body.	Upstream water bodies not impacted by scheme	There are no planned changes to the hydromorphology of the tributaries of the River Ray. No material changes anticipated.	No additional mitigation required	No additional mitigation required	No material changes anticipated.
RBMP measures to achieve objective (yet to be implemented or confirmed as implemented)	Where RBMP measure will happen	When RBMP measure will happen	Predicted change to status elements (green = none, amber = possibly, red = likely)	-	-	-	-	-	-	-	-	-	-
None	-	-	Predicted change to status elements (green = none, amber = possibly, red = likely)	-	-	-	-	-	-	-	-	-	-

7 References

- Environment Agency (2009) River Basin Management Plan, Thames River Basin District.
- European Commission, Water Framework Directive - Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, Strasbourg, European Parliament and European Council.
- Institute of Geological Sciences (1978). South-west Chilterns hydrogeological map. 1:100,000 map, British Geological Survey, ISBN No:0751811823.
- Road Drainage and the water environment (November, 2009), <http://www.dft.gov.uk/ha/standards/dmr/vol11/section3/hd4509.pdf>. Accessed: 01.08.13.