Cork Line Level Crossings

Volume 3, Chapter 8: Soils, Geology and Hydrogeology

Iarnród Éireann

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Contents

Table of Acronyms

Acronym	Meaning
ABP	An Bord Pleanála
CA	Competent Authority
CIÉ	Coras Iompair Éireann
CSM	Conceptual Site Model
EC	European Commission
EEC	European Economic Community
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
GI	Ground Investigation
GIS	Geographical Information Systems
GSI	Geological Survey Ireland
GWDTE	Ground Water Dependent Terrestrial Ecosystems
IÉ	Iarnród Éireann
LC	Level Crossing
m	Metres
PPE	Personal Protective Equipment
PWS	Private Water Supplies
SPA	Source Protection Area
ST	Septic Tank

8. Soils, Geology & Hydrogeology

8.1 Introduction

This chapter presents the assessment of the proposed Project in relation to geology, soils, groundwater and contaminated land. This includes impacts to bedrock and superficial geology, mineral extraction, soils, contaminated land, groundwater and associated receptors including private water supplies (PWS).

Geological impacts can occur due to excavating or masking exposures of rocks or superficial geological deposits of scientific interest, particularly if the features of interest are not reproduced elsewhere, nationally or regionally. Impacts can also include restrictions on existing or potential future commercial exploitation of resources, and conversely previous exploitation of resources can impose constraints on the proposed Project; for example, where land has become unstable due to mining or has been contaminated by previous land uses. It is also recognised that rock exposures can deliver environmental benefit, such as improved access to, and exposure of, new areas of geological interest.

During construction, there is an inherent risk of spillage or leakage of fuel or oil from storage tanks or construction plant. Without suitable mitigation measures, these pollutants could enter superficial and bedrock aquifers and cause degradation of water quality. Construction work can also lead to the dewatering of these aquifers which may cause differential settlement effects and impact sensitive receptors such as water supplies or wetlands.

Similarly, during operation of the proposed Project, runoff from the road surface may contain elevated concentrations of pollutants, such as oils, suspended solids, metals, engine coolants (e.g. ethylene glycol) and, in winter, salt which may find their way into the groundwater system. Groundwater flows can also be intercepted or altered by new cuttings and other significant changes to landform.

8.2 Study Area

The assessment covers seven public road level crossing locations over a stretch of roughly 24 km, each more than 2km apart with the exception of XC211 Newtown and XC212 Ballycoskery which are approximately 360m apart.

The study area for geology and contaminated land comprises of 500m around each crossing, although the study area was extended up to a distance of 1km around each crossing for groundwater (this is a standard identification zone relating to public groundwater abstractions).

8.3 Consultation

Consultation responses of relevance to Soils, Geology and Hydrogeology are summarised in Table 8.1.

Table 8.1 Consultation Responses

Consultee	Comment	Response
Geological Survey of Ireland (13th August 2019)	This provided a list of information sources and guidance in regard to Geoheritage, Groundwater, Geohazard, Geothermal Energy and Natural Resources (Minerals/Aggregates).However, it did state that "Though the audits for counties Cork and Limerick have not yet been completed, our records show that there are no current County Geological Sites located within the vicinity of the proposed railway crossing."	The presence or absence of Geological Sites of Interest is documented in the baseline for each area along with potential natural resources, the likelihood of karstification and groundwater conditions.

8.4 Baseline Environment

8.4.1 XC187 Fantstown

Desk Top Study

Soils

Available mapping suggests that there are likely to be several soil associations present at the crossing location and within the study area, as follows:

- The Elton Association, described as a fine loamy drift with limestones;
- The River Association, which is described as river alluvium; and
- The Howardstown Association described as clayey drift with limestones.

Soils in relation to agriculture use are discussed in Volume 3, Chapter 6: Population and Human Health.

Geology

No historical or recent ground investigation (GI) log data is available within the study area. The nearest historical GI borehole log is located 5km towards the southwest.

No geological sites of interest are present within the study area as confirmed by the Geological Survey of Ireland (GSI).

Geological GSI maps show that the bedrock geology at the crossing and within the study area comprises the Visean Limestones (undifferentiated).

Available GSI maps show that the superficial deposits at the crossing are likely to comprise Alluvium, associated with the adjacent surface water course, and Till. There is potential to encounter additional Lacustrine Sediments within the study area.

There are no active quarries or pits within the study area.

The site is located within an area with low to moderate potential for crushed rock aggregate and an area with very low potential for granular aggregate. Within the study area are areas with low potential for granular aggregate, and high to very high potential for crush rock aggregate.

Contaminated land

Historic mapping dated at 1837 to 1842 shows the rail line present, but no other infrastructure is shown at the site except for local road networks. Surrounding land is indicated as vacant and therefore presumed as used for agricultural purposes, with some small dwellings shown within the study area. No industrial land uses are indicated.

Existing rail lines and road infrastructure are the most likely local source of contamination due to potential minor leakage of hydrocarbons and heavy metals over time.

A land owner consultation exercise took place and no septic tanks were identified in the vicinity in the study area.

Hydrogeology

The bedrock at the site is classed as a Locally Important Aquifer, where the bedrock is described as moderately productive only in local zones. This is associated with the limestone bedrock. No other aquifer types are indicated within the study area.

Available recharge maps show that the location is within an area of moderate permeability subsoil with average recharge approximately 126mm/year.

No karst landforms features are mapped as present at the site or within the study area by GSI.

No GI borehole logs are available within the study area; therefore, a worst-case assumption is made that the water table is shallow.

Based on GIS mapping information, one borehole is indicated approximately 420m to the south of the crossing location, indicated as used for agricultural and domestic uses. The notes for this location suggest it ran dry in 1970, and therefore may no longer be in use. A potential dug well may also be located within the study area. It should be noted that the exact location of these assets is not known, as the boreholes and springs are displayed as area zone rather than a location. Additional potential wells and springs are indicated in the surrounding areas, but not within the study area.

The land owner consultation exercise took place and no PWS were identified.

The crossing location is not located within a source protection area (SPA) or zone of contribution. The Water Framework Directive status for groundwater is classified as Good.

Survey Work

Habitat surveys (Volume 3, Chapter 7: Biodiversity) did not record the presence of any likely groundwater dependent terrestrial ecosystems (GWDTEs) in this area.

No ground investigation is proposed at this location, as no earthworks is required.

8.4.2 XC201 Thomastown

Desk Top Study

Soils

Available soils maps suggest that the soils at the crossing location and within the study area are likely to comprise the Howardstown Association, described as clayey drift with limestones.

Soils in relation to agriculture use are discussed in the Volume 3, Chapter 6: Population and Human Health.

Geology

No geological sites of interest are present within the study area as confirmed by the GSI.

GSI geological maps indicate that the bedrock at the crossing location and within the study area is likely to comprise the Visean Limestones (undifferentiated).

Superficial deposits at the crossing location are shown by GSI to likely comprise Till.

A local phase of ground investigation (GI) consisted of six boreholes and four trial pits (OCB Geotechnical, 2020) in the vicinity of the proposed new road-over-rail-bridge and associated works. No bedrock was encountered in boreholes within the study area to a maximum depth of 19.7m. The presence of Till recorded by GSI is consistent with GI data identifying superficial deposits as sandy gravelly silty clay frequently with cobble and boulder content to at least a depth of 19.7m.

There are no active quarries or pits within the study area.

Aggregate potential maps indicate that the crossing location is located within an area with moderate potential for crushed rock aggregate potential. No granular aggregate potential is indicated for this location.

Contaminated land

Historic maps dated from 1837 to 1842 show that the rail line and roads are present, but that the surrounding land is vacant and presumed as used for agricultural purposes. There are a number of small dwellings located in

the surrounding areas, but no industrial use is noted. Based on historic land use, there are unlikely to be any additional sources of potential contamination, other than materials used during the construction of the existing rail line.

No made ground has been identified by the local GI (OCB Geotechnical 2020).

A land owner consultation exercise has been undertaken and recorded the presence of two septic tanks within the study area (ST201/1 and ST2001/2) (see Volume 4, Figure 8.1).

GI groundwater quality analysis revealed the presence of some hydrocarbons, both polyaromatic hydrocarbons (PAH) and total petroleum hydrocarbons (TPH). Existing rail lines and road infrastructure are the most likely local source of contamination due to potential minor leakage of hydrocarbons and heavy metals over time. Any contamination effect associated with the septic tanks is not expected to be significant.

Hydrogeology

Mapping suggests that the bedrock at the crossing location and within the study area is classed as a locally important aquifer, described as moderately productive only in local zones. No superficial aquifers are indicated as present.

However, groundwater monitoring data from the local GI is available at two borehole locations from August and September 2020 and records very shallow groundwater conditions ranging from 0.2 to 1.6m. In addition, groundwater strikes were recorded at various depths at the four trial pits. It should be noted that the depth to standing water level is assumed in this report to be measured from ground level as the GI report does not state which datum was used to generate the depth.

Recharge maps suggest that the area is located within an area with moderate permeability subsoil overlain by poorly drained gley soil. The average recharge at this location is indicated as approximately 137mm/yr.

Available GSI maps do not indicate any karst landforms features.

Historical records suggest there is a potential well located approximately 330m north east of the crossing location, drilled in 1967. The yield from this is noted as poor. It is not known if this is still in use. In addition, there are potentially another seven boreholes, dug wells or springs located within the study area. The exact location of these are not known, as the boreholes and springs are displayed as located anywhere within a 1km area; these 1km areas overlap with the 500m radius surrounding the crossing location.

A consultation exercise with land owners has been carried out and recorded the presence of two PWS (PWS201/1 and PWS201/2) within the study area. PWS201/1 is described as fed by a surface water abstraction (stream) and therefore potential impacts on this PWS are described in Volume 3, Chapter 9: Water. PWS201/2 is described as a 30m deep well for cattle only equipped with a pumping system, with the property connected to mains supply.

The crossing location is not located within a SPA or zone of contribution. The Water Framework Directive status for groundwater is classified as Good.

Survey Work

Habitat surveys did not record the presence of any likely GWDTEs in this area (Volume 3, Chapter 7: Biodiversity).

A local phase of ground investigation (GI) was carried during 2020 and consisted of six boreholes and four trial pits (OCB Geotechnical, 2020) in the vicinity of the proposed new-road-over-rail-bridge and associated works This is provided at Volume 5, Appendix 3A. It provides detailed, site specific information on the local ground conditions, including the depth and thicknesses of the soils and geology, and potential presence of made ground. It also informs on local groundwater conditions.

PWS202/1 was surveyed in January 2020.

8.4.3 XC209 Ballyhay

Desk Top Study

Soils

Available soil mapping suggests that the soil type at the crossing location is likely to comprise Alluvium. Within the study area, additional soil type of the Howardstown association is anticipated. These are described as comprising clayey drift with limestones.

Soils in relation to agriculture use are discussed in Volume 3, Chapter 6: Population and Human Health.

Geology

No historical or recent GI log data is available within the study area. The nearest historical GI borehole log is located 2km towards the north which is considered too distant to be of relevance to this crossing.

No geological sites of interest are present within the study area as confirmed by GSI.

GSI geological maps show that the bedrock at the crossing location is likely to comprise the Copstown Limestone Formation. The bedrock to the north of the crossing location is likely to comprise the Visean Limestone (undifferentiated).

A number of superficial deposits are shown as present in the vicinity of the crossing. Alluvium is expected at the crossing location itself. Additional deposits of Gravels, Till are anticipated to be encountered within the study area.

There is a thrust fault shown trending NE-SW, located approximately 110m north of the crossing location.

There are no active quarries or pits within the study area.

Currently available aggregate potential maps show that the crossing is located within an area with low, moderate and high potential for crushed rock aggregate, located close together. There is a moderate to high potential for granular aggregate at the crossing location, and very high potential areas located within the wider study area.

Contaminated land

Historic maps dated from 1837 to 1842 show that the rail line and surrounding roads are present at this time. No industrial land use is indicated at the site nor within the surrounding areas. Land is shown as vacant and presumed as used for agricultural purposes. There are a number of smaller dwellings shown as located sporadically in the area. Based on historic and current land use, there are no anticipated additional sources of potential contamination, other than materials used during the construction of the existing rail line.

Existing rail lines and road infrastructure are the most likely local source of contamination due to potential minor leakage of hydrocarbons and heavy metals over time.

A land owner consultation exercise has been undertaken and did not record the presence of septic tanks.

Hydrogeology

The bedrock in this area is classed as a Locally Important Aquifer, described as being moderately productive only in local zones. No other bedrock aquifer types are anticipated within the study area.

No GI borehole logs are available within the study area, therefore a worst-case assumption is made that the water table is shallow.

No designated superficial aquifers are shown as present both at the crossing location and within the study area.

Information pertaining to groundwater recharge is varied at the crossing location and in the surrounding areas, with average annual recharge varying between 46 and 200mm/year, with soil ranging from low permeability subsoil, to high permeability subsoil sand and gravels overlain by well drained soils.

No mapped karst features are located within the study area. However, a spring is mapped at a distance of approximately 720m south west of the crossing.

There are no mapped groundwater wells and springs shown within the study area.

A consultation exercise with land owners has been undertaken and has recorded one PWS (PWS209/1) located within or adjacent to the southwestern part of the proposed Project and which feeds two properties (see Volume 4, Figure 8.2). The source is understood to be shallow and the water supply gravity fed.

The crossing site is not located within an SPA or zone of contribution.

Survey Work

Habitat surveys (Volume 3, Chapter 7: Biodiversity and Volume 4 Figure 7.7) have identified the presence of a wet grassland area which could have a groundwater component. This vegetation seems to be located in a naturally low topographical area that would act as a natural water collection basin to both surface water and shallow groundwater if present.

At the time of writing this report, no historical GI borehole logs are available within 1km of the site, therefore a worst-case assumption is made that the water table is shallow.

No local GI has been carried out at this location as no significant construction will take place.

8.4.4 XC211 & XC212 Newtown and Ballycoskery

Desk Top Study

Soils

Soil mapping shows that the soil type likely to be encountered at the crossing location is the Howardstown association, described as comprising clayey drift with limestones. Additional maps classify these as comprising glaciofluvial sands and gravels, and Till.

There is potential to encounter additional soil types within the study area, including Alluvium to the west.

Soils in relation to agriculture use are discussed in the Volume 3, Chapter 6: Population and Human Health.

Geology

No geological sites of interest are present within the study area as confirmed by GSI.

GSI geological maps show that the bedrock at the crossing locations is expected to comprise the Ballysteen Formation of limestone. To the south of the study area, the Ballymartin Formation and the Lower Limestone Shale are expected to be encountered. Additional bedrock types are located immediately beyond 500m, including the Kiltorcan Formation to the south and the Copstown Limestone Formation to the north.

Superficial deposits at crossing XC211 are expected to comprise gravels derived from limestones, whereas at XC212 these are expected to comprise Till. Within the study area additional deposits of Alluvium are likely to be encountered to the west of the crossings.

At XC211, a local phase of GI consisted of two boreholes and three trial pits (OCB Geotechnical, 2020) in the vicinity of the proposed new access road and associated infrastructure for both sites. No bedrock was encountered in boreholes within the study area to a maximum depth of 12m near crossing XC211 and to a maximum of 20m near crossing XC211.

The GI records the presence of top soil of 200 to 250mm thickness and sandy gravelly silty clay with frequently low cobble content. No evidence of bedrock to at least a depth of 12m was recorded.

Unlike the GSI mapping, the local GI suggests the presence of similar superficial deposits across the site, consistent with Till.

At XC212, a local phase GI consisted of one borehole on the south side of the derelict Old Station house; hand dug inspection pits and standard penetration tests. A groundwater monitoring standpipe was installed in the borehole, The GI determined that sandy, gravelly silty clay, frequently with cobble and boulder content was present, underlain by silty sandy gravel, also with cobble content. No bedrock was encountered to a maximum depth of 20m.

Mapping indicates that faulting is prevalent in the surrounding areas, one such fault is likely to fall within the XC211 study area. This fault is un-named.

There are no active quarries or pits within the study area.

Aggregate potential maps show that the crossings are both located within areas where there is moderate potential for crushed rock aggregate. However, within the study area are areas classed as having very low, low, high and very high potential for crushed rock. Crossing XC211 is located in an area with very high potential for granular aggregate; there is no data mapped at crossing XC212. Within both crossing study areas are areas with a high potential for granular aggregate.

Contaminated Land

Historic maps dated from 1837 to 1842 show that the rail line and road network are present at this time. No industrial land use is indicated at the crossing location or within the study area. There are a number of small dwellings shown as located sporadically within the surrounding areas. Surrounding land is indicated as vacant and presumed as used for agricultural purposes. Therefore, based on land use, it is unlikely that there will be additional potential sources of contamination other than the materials used during the construction of the existing rail line.

No made ground was identified at the local phase GI for XC211.

At XC212, made ground was identified at the derelict Old Station, consisting of sandy gravelly silt/clay with angular cobbles and traces of inorganic material such as cloth, glass, stoneware and bricks. Extends to 3.5m.

Soil leachability testing undertaken as part of the GI soil samples have generated hydrocarbons and metals. Existing rail lines and road infrastructure are the most likely local source of contamination due to potential minor leakage of hydrocarbons and heavy metals over time.

A land owner consultation exercise has been undertaken and no septic tanks were identified within the study area.

Hydrogeology

The crossings are located within an area designated as a Locally Important Aquifer, where the bedrock is classed as moderately productive only in local zones. To the north west of the crossing XC211 within the study area is a localised area of locally important aquifer – karstified. A bedrock aquifer fault is also shown trending approximately south west north east, located approximately 350m to 400m to the north of crossing XC211. Approximately 400m south east of crossing XC212 is an area of poor aquifer, where the bedrock is generally unproductive except for local zones.

There are no superficial aquifers indicated at the crossing locations nor within the study area.

However, the local GI provides groundwater level monitoring in superficial deposits for one borehole at each crossing (i.e. XC211 and XC212). Excluding one reading which seems to be an anomaly, which records a groundwater level at 0.01m, groundwater levels ranged from 2.19 to 4.15m at XC211 and from 3.13m to 3.76m at XC212 from August to October 2020. It should be noted that the depth to standing water level is assumed in

this report to be measured from ground level as the GI report does not state which datum was used to generate the depth.

Two out of the three trial pits recorded groundwater strikes at 3m and 1.1m depth in February 2020. Shallow groundwater strikes were also recorded in the borehole associated with XC212 at 2.5 and 3m depth sitting above the thereafter recorded standing water level. This suggests that some perched discontinued shallow groundwater may be present above the main groundwater table in superficial deposits

Groundwater recharge maps show that the average recharge at the crossing locations varies between 155 and 200mm/year. The hydrogeological setting at crossing XC211 is described as high permeability subsoil, sand and gravels overlain by well-drained soil. The setting at crossing XC212 is described as moderate permeability subsoil overlain by poorly drained gley soils.

There are no karst landform features mapped as recorded within the study area.

No groundwater wells or springs are mapped at the crossing locations, nor within the study area.

The land owner consultation exercise has been undertaken and no PWS was recorded within the study area.

The crossings are not located within a SPA or zone of contribution. The Water Framework Directive status for groundwater is classified as Good.

Survey Work

Habitat surveys (Volume 3, Chapter 7: Biodiversity and Volume 4, Figure 7.8) have identified the presence of a wet grassland area and tall herb swamp (corresponding to Annex I habitat 6430 hydrophilous tall heb) around Ballycoskery which could have a groundwater component. This vegetation seems to be located in a naturally low topographical area that would act as a natural water collection basin to both surface water and shallow groundwater if present, and there was evidence of ponding in the field on the day of the visit. The nature of the vegetation suggests the area remains wet a large proportion of the year.

Local phase GIs were completed for the proposed Project at XC211 and XC212 during 2020. This is provided at Volume 5, Appendix 3A. They provide detailed, site specific information on the local ground conditions, including the depth and thicknesses of the soils and geology, and potential presence of made ground. They also inform on local groundwater conditions.

8.4.5 XC215 Shinanagh

Desk Top Study

Soils

Soil maps show that the crossing is located in an area where the Howardstown soil association is likely to be encountered, which is described as clayey drift with limestones. To the west and south, areas of River alluvium are shown. Additional soil maps show this is mapped as Till, derived mainly from sandstones. To the north of the study area, are small areas described as bedrock at the surface, comprising shallow well drained mineral.

Soils in relation to agriculture use are discussed in the Volume 3, Chapter 6: Population and Human Health.

Geology

No geological sites of interest are present within the study area as confirmed by GSI.

Geological maps show that the bedrock at the crossing location is expected to comprise the Kiltorcan Formation. There are additional bedrock deposits located within the study area. To the west and continuing south of the crossing, the following deposits are mapped as present: Lower Limestone Shale, the Ballymartin Formation, and the Ballysteen Formation.

Superficial deposits are expected to comprise Till, at the location of the crossing. Within the study area, to the south and west of the crossing, there is potential to encounter Alluvium. To the north of the crossing are two localised areas described as bedrock outcrop or subcrop.

A local phase of GI consisted of three boreholes and nine trial pits (OCB Geotechnical, 2020) in the vicinity of the proposed new access road and associated infrastructure. Bedrock of predominantly sandstone with some weaker layers of mudstone and siltstone interbedded was encountered at two boreholes at 6.60m and 9.60m.

In terms of superficial deposits, sandy, gravelly, clay/ silt frequently with low cobble content dominates; this is likely to correspond to Till. This is consistent with information provided from geological maps.

Some structural geology features such as faults are mapped in the surrounding region; however, these are beyond the study area. Geological maps show an anticlinal axis approximately 350m north of the crossing.

There are no active quarries or pits within the study area.

Aggregate potential maps show that the crossing is located within an area with very low potential for crushed rock aggregates. The surrounding areas within the study area however are shown to have low, moderate, high and very high potential. No data is available regarding the granular aggregate potential at the crossing location itself, but within the study area are areas with a moderate to high potential for granular aggregates.

Contaminated land

Historic maps dated between 1837 and 1842 indicate that the existing rail line and road networks were present at this time. The surrounding areas of the crossing location are indicated as largely vacant, presumed as used for agricultural purposes. No historic industrial sites are indicated at the crossing location nor within the study area.

No made ground has been identified in GI boreholes (OCB Geotechnical 2020) within the study area.

A consultation exercise with land owners has been undertaken and recorded two septic tanks (ST215/1 and ST215/2) located within 600 m of the proposed Project. The exact location of each septic tank is unknown as shown on Volume 4, Figure 8.1-3, however any contamination effect associated with the septic tanks is not expected to be significant.

Existing rail lines and road infrastructure are the most likely local source of contamination due to potential minor leakage of hydrocarbons and heavy metals over time.

Hydrogeology

Available mapping shows that the bedrock underlying the crossing location itself is classed as a regionally important aquifer – fissured bedrock. Within the study area, the Lower Limestone Shale is classed as a poor aquifer, where the bedrock is generally unproductive except for local zones, and both the Ballymartin Formation and the Ballysteen Formation are classed as locally important aquifers, where bedrock is moderately productive only in local zones.

No superficial aquifers are mapped as present in this area.

However, GI groundwater monitoring data is available from two boreholes and one location records the presence of groundwater in superficial deposits in August and September 2020. One borehole (4.5 m deep) recorded dry conditions despite a groundwater strike at 3.6m. The second borehole (deeper installation) recorded groundwater levels ranging from 4.64m to 9.57m suggesting that the water table is moderately shallow. However, in February 2020, groundwater strike data recorded at various depths at eight trial pits located along the length of the crossing location ranged from 0.6m and 1.8m. This either indicates a large seasonal groundwater level fluctuation or perched discontinued groundwater conditions. It should be noted that for groundwater monitoring data, the depth to standing water level is assumed in this report to be measured from ground level as the GI report does not state which datum was used to generate the depth.

Recharge maps show that average recharge at the crossing location is approximately 400mm/year. Within the study area, this varies to 100mm/year.

There is one karst spring feature, named as St Declas Well, located approximately 110m north of the crossing location. No other features are mapped as present within the study area.

There are no groundwater wells or springs mapped as present at the crossing location itself. However, there is one borehole (named BH3) shown as located approximately 480m west of the crossing, which is indicated as installed to a depth of 76.2m. The exact location of this is not known, as the boreholes and springs are displayed as located anywhere within a defined larger area.

A consultation exercise with land owners has been undertaken and recorded two PWS (PWS215/1 and PWS215/2) are indicated within a 0.5 km radius of the proposed Project. PWS215/1 is located roughly 100 m from the proposed crossing location due west. It is understood to be a 60 m deep well providing the sole domestic supply to the property as well as for animal drinkers. PWS215/2 is understood to be a shallow active abstraction used to supply the property and cattle. The crossing location is not located within an SPA or zone of contribution. The Water Framework Directive status for groundwater is classified as Good.

Survey Work

Habitat surveys did not record the presence of any likely GWDTEs in this area (refer to Volume 3, Chapter 7: Biodiversity).

A GI was completed for the proposed Project during 2020. This is provided at Volume 5, Appendix 3A. It provides detailed, site specific information on the local ground conditions, including the depth and thicknesses of the soils and geology, and potential presence of made ground. It also informs on local groundwater conditions.

A survey was conducted to confirm the location of PWS215/1.

8.4.6 XC219 Buttevant

Desk Top Study

Soils

Available soil maps show that the crossing is located within an area where the soils are expected to comprise Alluvium, with the Howardstown soil association (described as clayey drift with limestone) indicated adjacent to these deposits and continuing into the surrounding areas.

Soils in relation to agriculture use are discussed in the Volume 3, Chapter 6: Population and Human Health.

Geology

No geological sites of interest are present within the study area as confirmed by GSI.

GSI geological maps show that the crossing is located within the Hazelwood Limestone Formation. To the south of the crossing location, within the study area, the Caherduggan Limestone Formation is indicated as present and on-going ground investigations suggest that a cavity filled with soft clay was encountered.

Superficial deposits at the crossing location are shown to comprise Till. Immediately west and north of the crossing, deposits of Alluvium are indicated. There are small, localised areas of bedrock outcrop or sub-crop indicated to the south of the crossing.

A local phase of GI consisted in nine boreholes and four trial pits (OCB Geotechnical, 2020) in the vicinity of the crossing location. Bedrock of limestone was encountered at depths between 2.30m and 8.30m.

In terms of superficial deposits, each of the boreholes indicated the presence of sandy, gravelly, silty clay frequently with cobble content likely to be Till, directly below made ground or topsoil. This is consistent with information provided from geological maps.

There is a thrust fault indicated immediately north of the crossing location, trending roughly east-west, and a series of other un-named faults both within the study area and in the surrounding region.

There are no active quarries or pits within the study area.

Aggregate potential maps show that the crossing is located within an area with very high potential for crushed rock aggregates, with the surrounding area having a high potential. No data is mapped regarding the granular aggregate potential at the crossing location itself, but within the study area are areas with moderate to high potential for granular aggregates.

Contaminated Land

Available historic maps are dated between 1837 and 1842. These show the current roads and rail line are present at this time. More recently a train station and yard was associated with the railway network, but at present the crossing is shown as located in a vacant area, adjacent to a water course, with surrounding land presumed as used for agricultural purposes. There are some small dwellings located in the surrounding area, with a school and Buttevant Castle shown as present, but greater than 500m from the crossing location. No industrial land uses are indicated within the study area. Therefore, based on historic maps, no potential sources of contaminated land, other than the materials used for the rail line and historical station / yard, are anticipated to be encountered at this stage.

Made ground has been identified up to 1.2m in four locations in close proximity to the existing rail line. Made ground is described as granular or reworked fill material depending on locations.

A consultation exercise with land owners has been undertaken and six septic tanks have been identified as shown on Volume 4, Figure 8.3. Any contamination effect associated with the septic tank is not expected to be significant.

Some TPHs were detected in groundwater quality water and soil leachability analysis. Existing rail lines and associated historical station / yard as well as road infrastructure are the most likely local source of contamination due to potential minor leakage of hydrocarbons and heavy metals over time.

Hydrogeology

No historical GI is available therefore a worst-case assumption is made that the water table is shallow.

Hydrogeological maps show that the crossing is located within an area defined as a regionally important aquifer, which is karstified (diffuse). No other bedrock aquifer types are indicated within the study area.

There are no superficial aquifers indicated as present at the crossing location nor within the study area.

However, GI groundwater monitoring data recorded the presence of groundwater in superficial in August and September 2020. The two boreholes screened in superficial deposits recorded groundwater levels ranging from the surface to 2.2m, while the two boreholes screened in bedrock recorded deeper groundwater conditions (5 to 7.2m). This indicates that groundwater levels in superficial deposits are shallow but perched. It should be noted that for groundwater monitoring data, the depth to standing water level is assumed in this report to be measured from ground level as the GI report does not state which datum was used to generate the depth.

No karst landform features have been recorded within the study area.

One potential groundwater well or spring is indicated on current maps within the study area, however the locational accuracy of this borehole is 2km, therefore the exact location and distance from the crossing is uncertain. This borehole is shown to be installed to a depth of 21.3m. The exact location of this is not known, as the boreholes and springs are displayed as located anywhere within a defined larger area.

A consultation exercise with land owners has been undertaken and three PWS have been recorded: PWS219/1, PWS2019/2 and PWS219/3 as shown at Volume 4, Figure 8.3. PWS219/1 is understood to be sourced from a stream flowing from west to east located to the south of the property and provides supply to the property, farmland and cattle. PWS219/2 and PWS219/3 are located within 10m of the proposed Project. Both are also understood to be fed from wells, but the depth of the supplies is not known. The supply from PWS219/3 was found to be equipped with a pumping system that feeds water to a pressurised container located close to the property. Two further surface water abstractions (PWS219/4 and PWS219/5) understood to be animal troughs fed by a small stream are situated adjacent to the proposed crossing location to the south and north respectively as indicated at Volume 4, Figure 8.3.

The crossing location is not located within a SPA or zone of contribution. The Water Framework Directive status for groundwater is classified as Good.

Survey Work

Habitat surveys (Volume 3, Chapter 7: Biodiversity) have identified the presence of a wet grassland area, however this area was observed as generally flooded the day the site visit took place, adjacent to a minor surface water feature. This area also falls within a PFRA, which would suggest that the main mechanism is associated with surface water flooding. For this reason, this area of wet grassland is considered unlikely to be a GWDTE, even though a degree of groundwater contribution cannot be ruled out.

A GI was completed at the crossing location during 2020. This is provided at Volume 5, Appendix 3A. It provides detailed, site specific information on the local ground conditions, including the depth and thicknesses of the soils and geology, and potential presence of made ground. It also informs on local groundwater conditions.

PWS219/1 and PWS2019/2 were surveyed in January 2020.

8.5 Assessment Methodology

8.5.1 Legislation, Policy & Guidance

The overarching policy and legislation applicable to the proposed Project is set out at Volume 2, Chapter 4: EIA Process and Methodology. The EIAR will be delivered in accordance with, but not limited to, the following legislation and guidance:

- Transport (Railway Infrastructure) Act 2001, as amended (See Volume 2, Chapter 4: EIA Process and Methodology);
- S.I. 296 of 2018 European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018;
- Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA 2017); and
- Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy.

Key documents that inform the examination of all environmental areas include:

- Project Ireland 2040: National Planning Framework;
- National Development Plan 2018 – 2027;
- Draft Regional Spatial and Economic Strategy for the Southern Region;
- Regional Planning Guidelines for the South West and Mid-West (2010 – 2022);
- Relevant Metropolitan Area Strategic Plans (MASPs);
- Cork County Development Plan (CCDP) 2014;
- Limerick County Development Plan (LCDP) 2010-2016;

- Relevant Local Area Plans;
- Environmental Liability Risk Assessment, Residuals Management Plans and Financial Provision, EPA (2006); and
- Code of Practice: Environmental Risk Assessment for Unregulated Waste Disposal Sites, EPA (2007).

Relevant Iarnród Éireann and railway infrastructure plans, and strategies include:

- 2030 Rail Network Review;
- Draft Cork Metropolitan Area Transport Strategy (CMATS) 2040;
- Building on Recovery: Infrastructure and Capital Investment 2016 – 2021;
- Rail Review: 2016 Report; and
- Smarter Travel: A Sustainable Transport Future: Anew Transport Strategy for Ireland 2009 -2020.

The WFD has been transposed into Irish law by means of the following main Regulations. These Regulations cover governance, the shape of the WFD characterisation, monitoring and status assessment programmes in terms of assigning responsibilities for the monitoring of different water categories, determining the quality elements and undertaking the characterisation and classification assessments.

- European Communities (Water Policy) Regulations, 2003 (S.I. No. 722 of 2003);
- European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010);
- European Communities (Good Agricultural Practice for Protection of Waters) Regulations, 2010 (S.I. No. 610 of 2010);
- European Communities (Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations, 2011 (S.I. No. 489 of 2011); and
- European Union (Water Policy) Regulations 2014 (S.I. No. 350 of 2014).

8.5.2 Assessment Methodology

Geology

The sensitivity and magnitude criteria provided in Table 8.2 and Table 8.3 were used to assign sensitivity and magnitude for bedrock and superficial geology, features of geological importance and mineral extraction. The impact significance was then determined in line with Table 8.4.

Table 8.2 Sensitivity Criteria for Geology Assessment

Likelihood	Definition
High	Areas containing unique or rare geological or geomorphological features considered to be of national interest (e.g. Geological Heritage Sites)
Medium	Areas containing features of designated regional importance considered worthy of protection for their educational, research, historic or aesthetic importance (e.g. County Geological Sites (CGS)). Geological resources of national/regional importance
Low	Features not currently designated but that may require specific protection in the future. Geological resources of local importance
Negligible	Features not currently protected and unlikely to require specific protection in the future. No exploitable geological resources.

Table 8.3 Magnitude Criteria for Geology Assessment

Magnitude	Definition
High	Total loss or partial loss (greater than 50%) of a site, or where there would be complete severance of a site such as to affect the value of the site
Medium	Loss of part (between approximately 15% and 50%) of a site, major severance, major effects to the setting, or disturbance such that the value of the site would be affected, but not to a significant degree
Low	Small loss (up to 15%) or a medium effect on its setting, or where there would be a minor severance or disturbance such that the value of the site would not be affected
Negligible	Very slight change from baseline condition. Change hardly discernible, approximating to 'no change' conditions

Table 8.4 Matrix for Determination of Impact Significance for Geology Assessment

Sensitivity Magnitude	Negligible	Low	Medium	High
High	Slight	Moderate	Moderate/Substantial	Substantial
Medium	Negligible/Slight	Slight/Moderate	Moderate	Moderate/Substantial
Low	Negligible	Negligible/Slight	Slight/Moderate	Moderate
Negligible	Negligible	Negligible	Negligible/Slight	Slight

Impacts on geology of Slight/ Moderate significance and above are considered to be potentially significant in the context of the EIA Regulations, and the level at which mitigation would be proposed.

Contaminated Land

In line with industry best practice, the assessment focuses on the potential for impacts on receptors as a consequence of encountering contaminated land using a conceptual site model (CSM) developed for the proposed Project. A receptor can be a person (including construction workers), the water environment, flora, fauna or buildings/structures. The CSM represents a network of relationships between potential sources within the study area and exposure of the receptors through different pathways. The principles of risk assessment, including the concept of the source-pathway-receptor linkage, have been adopted by the Environmental Protection Agency (EPA) for the assessment of Environmental Liabilities (EPA, 2006) and Unregulated Waste Disposal Sites (EPA, 2007). However, there remains no formalised approach to the assessment of risks to human health from contaminated soils or groundwater. The contaminated land sources have been identified through a desktop exercise using historical OS maps, consultation information and available GI.

For the purposes of this assessment, the CSM disregards those pathways that are incomplete and therefore cannot pose a risk to any of the identified receptors. Where a source, pathway and receptor combination exist this is referred to as a complete pollutant linkage and a generic qualitative risk assessment has been undertaken.

Potential impacts in relation to contaminated land are discussed in terms of likelihood (Table 8.5) and magnitude/consequence (Table 8.6). The Generic Qualitative Assessment is then undertaken based on the matrix shown in Table 8.7.

Table 8.5 Likelihood Criteria - Contaminated Land

Likelihood	Definition
High likelihood	There is a complete pollution linkage and an event that either appears very likely in the short-term and almost inevitable over the long-term, or there is evidence at the receptor of harm or pollution.

Likelihood	Definition
Likely	There is a complete pollution linkage and all the elements are present and available, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over a long-term.
Low likelihood	There is a complete pollution linkage and the circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such an event would take place and is less likely in the shorter term.
Unlikely	There is a complete pollution linkage, but circumstances are such that it is improbable that an event would occur even in the very long-term.

Table 8.6 Magnitude (Consequence) Criteria - Contaminated Land

Magnitude	Definition
Severe	Short-term (acute) damage to human health (significant harm). Pollution of sensitive water resources as a result of short-term exposure. Damage to a particular ecosystem as a result of acute exposure. Catastrophic damage to buildings/property/Scheduled Monument (SM).
Medium	Long-term (chronic) damage to human health (significant harm). Pollution of sensitive water resources as a result of chronic exposure. A significant change in a particular ecosystem, or organism forming part of such an ecosystem. Substantial damage to buildings/property/SM.
Mild	No appreciable impact on human health based on the potential effects on the critical human health receptor Pollution of non-sensitive water resources. Damage to ecological systems with no significant impairment. Significant damage to sensitive buildings/structures/SM and/or services
Minor	Harm (not necessarily significant), which may result in financial loss or require expenditure to resolve. Non-permanent health effects to human health. No appreciable pollution. Easily repairable effects or damage to ecological systems. Easily reparable damage to buildings/structures/SM/services.

Table 8.7 Matrix for Determination of Impact Significance - Contaminated Land

Likelihood Consequence	Unlikely	Low likelihood	Likely	High likelihood
Severe	Moderate/Low	Moderate	High	Very High
Medium	Low	Moderate/Low	Moderate	High
Mild	Very Low	Low	Moderate/Low	Moderate
Minor	Very Low	Very Low	Low	Moderate/Low

Impacts in terms of contaminated land exposure of Moderate/Low significance and above are considered to be potentially significant in the context of the EIA Regulations, and the level at which mitigation would be proposed.

Hydrogeology

The criteria for the definition of groundwater sensitivity and magnitude are given in

Table 8.8 and Table 8.9. The impact significance was determined similarly to the geology, as defined in Table 8.4

The impact significance for groundwater receptors is the same as for geological receptors and is given in Table 8.10.

Table 8.8 Sensitivity Criteria for Groundwater

Sensitivity	Definition
High	Local aquifer(s) constitutes a valuable resource because of its high quality and yield, or extensive exploitation for public, private domestic and/or agricultural (i.e. feeding 10 or more properties) and/or industrial supply. Important sites of nature conservation dependent on groundwater as per Volume 3, Chapter 7: Biodiversity of this report. Surface water features of International / National importance.
Medium	Local aquifer(s) is of limited value either because of some quality impairment or because exploitation of local groundwater is not extensive (i.e. private domestic and/or agricultural supply feeding fewer than 10 properties). Local areas of nature conservation known to be sensitive to groundwater impacts as per Volume 3, Chapter 7: of this report. Surface water features of Regional importance.
Low	Poor groundwater quality and/or low permeability make exploitation of groundwater unlikely. Minor areas of nature conservation with a degree of groundwater dependency as per Volume 3, Chapter 7: of this report. Surface water features of Authority area importance.
Negligible	Very poor groundwater quality and/or very low permeability make exploitation of groundwater unfeasible. No known past or existing exploitation of this water body. Changes to groundwater are irrelevant to local ecology. Surface water features of less than Authority area importance.

Table 8.9 Magnitude Criteria for Groundwater

Magnitude	Definition
High	Major permanent or long-term change to groundwater quality or available yield. Existing resource use is irreparably impacted upon. Changes to quality or water table level would have an impact upon local ecology. Dewatering effects create significant differential settlement effects on existing infrastructure and buildings.
Medium	Changes to the local groundwater regime are predicted to have a slight impact on resource use. Minor impacts on local ecology may result. Dewatering effects create moderate differential settlement effects on existing infrastructure and buildings.
Low	Changes to groundwater quality, levels or yields do not represent a risk to existing resource use or ecology. Dewatering effects create minor differential settlement effects on existing infrastructure and buildings.
Negligible	Very slight change from groundwater baseline conditions approximating to a 'no change' situation. Dewatering effects create no or no noticeable differential settlement effects on existing infrastructure and buildings.

Table 8.10 Matrix for Determination of Impact Significance for Hydrogeology Assessment

Sensitivity Magnitude	Negligible	Low	Medium	High
High	Slight	Moderate	Moderate/Substantial	Substantial
Medium	Negligible/Slight	Slight/Moderate	Moderate	Moderate/Substantial
Low	Negligible	Negligible/Slight	Slight/Moderate	Moderate
Negligible	Negligible	Negligible	Negligible/Slight	Slight

Impacts on geology of Slight/ Moderate significance and above are considered to be potentially significant in the context of the EIA Regulations, and the level at which mitigation would be proposed.

Impacts on groundwater of Slight/ Moderate significance and above are considered to be potentially significant in the context of the EIA Regulations, and the level at which mitigation would be proposed.

Limitations of the Assessment

- The assessment is reliant on the accuracy of the information provided during consultation.
- The identification of potential contamination sources relies on the accuracy of historical mapping.
- Limited geological and hydrogeological information obtained from the 2006 and 2011 GI have been used for this assessment. In areas where no data were available, the nearest geological and hydrogeological information was extrapolated from the wider available dataset (if within a 1km radius).
- Information relating to PWS and septic tanks is based on information provided by land owners through questionnaires and targeted complementary surveys.

8.6 Potential Effects of the proposed Project

8.6.1 XC187 Fantstown

Do Nothing

This scenario does not interact with any known potentially contaminated land site nor groundwater, and the soils and geology are equally non-affected. As a consequence, no effects are expected for the "do nothing" scenario in relation to soils, geology, contaminated land and hydrogeology.

Construction Phase

The proposed Project for this site is only for closure of the public road level crossing so no construction and no earthwork is expected. Subsequently, no effects are expected in relation to soils, geology, contaminated land or hydrogeology.

Operational Phase

The proposed Project for this site is only for closure of the public road level crossing so no construction and no earthwork is expected. Subsequently, no effects are expected in relation to soils, geology, contaminated land or hydrogeology.

8.6.2 XC201 Thomastown

Do Nothing

This scenario does not interact with any known potentially contaminated land site nor groundwater, and the soils and geology are equally non-affected. As a consequence, no effects are expected for the "do nothing" scenario in relation to soils, geology, contaminated land and hydrogeology.

Construction Phase

The proposed design comprises the following:

- Embankments at each end of the road-over-rail bridge.
- Topsoil will be stripped for embankment construction.
- The construction will take place in layers with a degree of compaction affecting the sub-surface locally.

Additional temporary roads will be required during the construction phase to facilitate the construction of the proposed Project.

Soils and geology

Given the proposed design, removal of soil and superficial deposits as a result of soil stripping is expected to be of negligible magnitude compared to the soils and superficial deposits available. As a result, potential significance of impact on superficial deposits (negligible sensitivity) is assessed as Negligible.

Equally, negligible to no loss is expected from a mineral resource (low sensitivity) perspective. This is expected to result in no to Negligible potential significance of impact.

Contaminated land

The proposed Project is not expected to interact directly with any known potentially contaminated land site however the landowner's questionnaires indicate that two septic tanks are located within 100 m and 400 m of the crossing location (see Volume 4, Figure 8.1). The existing railway and road infrastructure however have the potential to have leaked some heavy metals and hydrocarbons in soils and any shallow groundwater and the local GI confirms the presence of both PAH and TPH. However no direct interaction is expected with potentially contaminated groundwater. Given the proposed design, the likelihood of workers interacting with any contaminated materials is considered to be low and has a mild magnitude of impact. This would result in a Low significance of impact. No other potential contamination pathway is considered to be present.

Temporary storage of oils, fuels and chemicals will be required during the construction phase. Accidental spillage of these contaminants could result in migration through to the superficial deposits of water-bearing Till and glaciofluvial sands and gravels. This could result in a medium magnitude disturbance to groundwater however, it is categorised as a low likelihood resulting in the potential impact significance of Moderate/Low.

Groundwater

GI data suggests the groundwater level is very shallow at the crossing location.

In the absence of cuttings, no dewatering impact is expected.

Given the proposed design activities related to embankments, groundwater disturbances are expected to be very minor and localised. As a result, any groundwater flow disturbance is expected to be negligible for the superficial aquifer (water-bearing Till horizons of low sensitivity), resulting in a potential significance of impact of Negligible. No impact is expected on bedrock groundwater.

No GWDTSs have been identified within the study area. Similarly, the nearest groundwater abstraction is currently recorded 330m away. Consequently, no impact is expected on GWDTEs or groundwater abstractions.

Given that PWS201/2 (medium sensitivity) is located more than 300 m away from the proposed Project and sourced from a 30m deep well, no groundwater flow disturbance is expected at this supply as a result of the proposed Project, and no impact on groundwater quality is expected.

Potential impacts on the surface water fed PWS201/1 are discussed in Volume 3, Chapter 9: Water.

Operational Phase

Geology

Long-term impacts on geology are the same as the ones discussed during the construction phase.

Contaminated land

Based on the information available, no long-term impact is expected on contaminated land.

Groundwater

Based on the information available, no long-term impact is expected on groundwater.

8.6.3 XC209 Ballyhay

Do Nothing

This scenario does not interact with any known potentially contaminated land site nor groundwater, and the soils and geology are equally non-affected. As a consequence, no effects are expected for the "do nothing" scenario in relation to soils, geology, contaminated land and hydrogeology.

Construction Phase

The proposed scheme for this site is for upgrade to CCTV of the public road level crossing which will require open trench excavation for installation of buried cables. The proposed earthworks are assumed to be no greater than 2m depth.

Soils and Geology

Having no historical GI of relevance for this area, the excavation is assumed to penetrate the superficial deposits including the bedrock. Given their placement, the impact to the bedrock is expected to be of negligible magnitude when compared to the surrounding bedrock available. As a result, the potential significance of impact on the bedrock (negligible sensitivity) is assessed as Negligible.

Given the proposed design and area affected, removal of soils and superficial deposits is expected to be of negligible magnitude compared to the soils and superficial deposits available. As a result, the potential significance of impact on superficial deposits (negligible sensitivity) is assessed as Negligible.

Equally, negligible to no loss is expected from a mineral resource (medium sensitivity) perspective. This results in no to potential Negligible / Slight significance of impact.

Contaminated land

The proposed Project is not expected to interact with any known potentially contaminated land area.

The existing railway and road infrastructure however have the potential to have leaked some heavy metals and hydrocarbons in soils and any shallow groundwater, if present. In the absence of localised GI, the presence or absence of potential metals and hydrocarbon background contamination cannot be determined. Given the depth of the excavation of 5 m, there is a risk the excavation could create a vertical pathway for any pre-existing contamination, or any accidental contamination introduced during construction and for workers to interact with potentially contaminated soils and groundwater.

The potential risk of mobilisation of pre-existing contamination is assessed as likely. The effect would be very localised and would not significantly disperse any present contamination within the aquifer. However, the abstracted groundwater could be of poor quality and if discharged without treatment could impact on the surface water quality of where it will be discharged. Potential impacts on surface water quality are discussed in Volume 3, Chapter 9: Water.

The potential risk to workers interacting with potentially contaminated soils and groundwater, without mitigation measures in place, is assessed as likely and could result in in a mild adverse impact on workers. This is therefore assigned a Moderate/Low significance of impact.

Temporary storage of oils, fuels and chemicals will be required during the construction phase. Accidental spillage of these contaminants could result in migration through to the superficial deposits of water-bearing Till, Alluvium and Gravels and bedrock groundwater. The excavation has also the potential to create a vertical pathway for any surface / sub-surface contaminated to migrate into bedrock.

This could result in a medium magnitude disturbance to groundwater however, it is categorised as a low likelihood resulting in the potential impact significance of Moderate/ Low.

Groundwater

Given that no relevant GI is available in this area and groundwater levels are conservatively assumed to be shallow, the dewatering of the open cut trench excavation would be expected to generate a localised minor adverse impact on the superficial aquifer (water-bearing horizons in Till and Alluvium and Gravels of low sensitivity), resulting in a potential significance of impact of Slight.

The excavation could reach the bedrock (Copstown Limestone Formation aquifer of medium sensitivity) and intercept groundwater. The magnitude of impact would be considered minor adverse, given the scale of the bedrock aquifers, resulting in a potential significance of effect of Slight.

Groundwater dewatering can cause differential settlement effects on existing infrastructure and buildings. As pre-existing rail and road infrastructure and buildings exist in close proximity to the proposed open cut trench excavation (medium sensitivity receptors), the risk of settlement cannot be ruled out. Since a soil characterisation has not yet been carried out, the extent of the impact cannot be assessed with a high degree of certainty. Although, due to the dewatering effect expected to be localised for this construction, the magnitude of impact is likely to be minor adverse, resulting in a potential significance of Moderate/Low on existing building and infrastructure.

The exact location of PWS209/1 (medium sensitivity) is unknown but is greater than 50m away from the open trench excavation areas (see Volume 4, Figure 8.2). The dewatering effect is expected to be localised and unlikely to generate a dewatering zone of influence greater than 50m. As a result, a potential impact on yield to the PWS is unlikely but cannot be fully ruled out given that the ground and groundwater conditions have not been confirmed. For this reason, a low magnitude is attributed resulting in a potential significance of impact of Slight on flows. The PWS is expected to be either upgradient or cross-gradient of the proposed Project and therefore no impact is expected on its water quality.

One potential GWDTE (low sensitivity) has been identified at the proposed Project at Ballyhay. The open cut trench excavation has the potential to directly impact this site. Direct impacts on ecology are discussed in Volume 3, Chapter 7: Biodiversity, however the proposed trenches also have the potential to impact on groundwater flows and levels which may contribute to the water balance of this potential GWDTE site. The dewatering effect will however last for only a short duration, the time for the cables to be installed and the trench to be backfilled. For this reason, this is considered to have a low adverse magnitude impact. This results in a potential significance of impact of Slight.

Operational Phase

Geology

Long-term impacts on geology are the same as the ones discussed during the construction phase.

Contaminated land

Based on the information available, no long-term impact is expected on contaminated land.

Groundwater

The open cut trench excavation, if backfilled with granular material more permeable than the natural superficial deposits, has the potential to create a preferential pathway for groundwater in the long-term. This could be of significance to the potential GWDTE identified within the study area (medium magnitude).

Long term potential significance of impact on the potential GWDTE (low sensitivity) as result has been assessed as Slight / Moderate.

8.6.4 XC211 & XC212 Newtown and Ballycoskery

Do Nothing

This scenario does not interact with any known potentially contaminated land site nor groundwater, and the soils and geology area equally non-affected. As a consequence, no effects are expected for the "do nothing" scenario in relation to soils, geology, contaminated land and hydrogeology.

Construction Phase

The proposed design comprises the following:

- Embankments at each end of the road-over-rail bridge.
- Topsoil will be stripped for embankment construction.
- The construction will take place in layers with a degree of compaction affecting the sub-surface locally.
- New alternative access road constructed.
- A maximum of 5m deep cutting at proximity of XC211.

Additional temporary roads will be required during the construction phase to facilitate the construction of the proposed Project.

Soils and Geology

Given the proposed design, removal of soils and superficial deposits as a result of soil stripping is expected to be of negligible magnitude compared to the soils and superficial deposits available. As a result, the potential significance of impact on superficial deposits (negligible sensitivity) is assessed as Negligible.

Equally, negligible to no loss is expected from a mineral resource (medium sensitivity) perspective. This results in no to potential Negligible / Slight significance of impact.

Contaminated land

Made ground has been identified in vicinity of XC212 and leachability test results at XC211 suggest potential contamination on the soils and underlying groundwater. As a results, workers have the potential to directly interact with and disturb this identified contamination. Given the design of the proposed Project at this location, , the likelihood of workers interacting with any contaminated materials is considered to be high and have a mild magnitude of impact. This would result in a Moderate significance of impact.

Temporary storage of oils, fuels and chemicals will be required during the construction phase. Accidental spillage of these contaminants could result in migration through to the superficial deposits of water-bearing Till and glaciofluvial sands and gravels and bedrock groundwater.

This could result in a medium magnitude disturbance to groundwater however, it is categorised as a low likelihood resulting in the potential impact significance of Moderate/Low.

Groundwater

GI data suggests the groundwater level is about 2 to 3m deep at the crossing location, with the potential for localised discontinued perched horizons.

A cutting is proposed along the length (to the east) of the proposed new access road at XC211 up to a maximum depth of 5m, which is expected to result in a localised dewatering effects. Any groundwater flow disturbance is expected to be low however at the scale of the superficial aquifer (water-bearing horizons in Till and glaciofluvial sands and gravels of low sensitivity), resulting in a potential significance of impact of Negligible/Slight. No to negligible impact is expected locally on bedrock groundwater.

For the proposed Project elements related to embankments at both XC211 and XC212, groundwater disturbances are expected to be very minor and localised. As a result, any groundwater flow disturbance is expected to be negligible for the superficial aquifer (water-bearing horizons in Till and glaciofluvial sands and gravels of low sensitivity), resulting in a potential significance of impact of Negligible. No impact is expected on bedrock groundwater.

No PWS have been identified in the study area, consequently, no impact is expected on groundwater abstractions.

One potential GWDTE has been identified immediately to the south of the proposed Project at Ballycoskery and is considered to be of low sensitivity. Activities such as compaction have the potential to impact sub-surface groundwater flows, where shallow groundwater conditions are present. However, because the potential GWDTE is located out with the direct area of works, potential impacts on the sub-surface hydrogeology is considered to be low. This results in a potential significance of impact of Negligible / Slight.

Operational Phase

Geology

Long-term impacts on geology are the same as the ones discussed during the construction phase.

Contaminated land

Based on the information available, no long-term impact is expected on contaminated land.

Groundwater

Based on the information available, no long-term impact is expected on groundwater.

8.6.5 XC215 Shinanagh

Do Nothing

This scenario does not interact with any known potentially contaminated land site nor groundwater, and the soils and geology are equally non-affected. As a consequence, no effects are expected for the "do nothing" scenario in relation to soils, geology, contaminated land and hydrogeology.

Construction Phase

The proposed design comprises the following:

- Topsoil will be stripped for embankment construction.
- The construction will take place in layers with a degree of compaction affecting the sub-surface locally.

Soils and Geology

Given the proposed design, removal of soils and superficial deposits as a result of soil stripping is expected to be of negligible magnitude compared to the soils and superficial deposits available. As a result, the potential significance of impact on superficial deposits (negligible sensitivity) is assessed as Negligible.

Equally, negligible to no loss is expected from a mineral resource (low sensitivity) perspective. This is expected to result in a Negligible potential significance of impact.

Contaminated land

The proposed Project is not expected to interact with any known potentially contaminated land area however the landowner's questionnaires indicate that there are two septic tanks located within 500m of the crossing location (see Volume 4, Figure 8.1-3). Given uncertainties on the exact location of these septic tanks, a worst-case scenario is assumed. In addition, the existing railway and road infrastructure have the potential to have leaked some heavy metals and hydrocarbons in soils and any shallow groundwater, if present. The local GI did not indicate the

presence of any made ground or pre-existing contamination. Given the proposed design and lack of evidence of potential contaminated soils in this area based on the GI, the likelihood of workers interacting with any contaminated materials is considered to be low and have a mild magnitude of impact. This would result in a Low significance of impact. No other potential contamination pathway is considered to be present.

Temporary storage of oils, fuels and chemicals will be required during the construction phase. Accidental spillage of these contaminants could result in migration through to the superficial deposits of water-bearing Till and bedrock groundwater.

This could result in a medium magnitude impact to groundwater however, it is categorised as a low likelihood resulting in the potential impact significance of Moderate/Low.

Groundwater

GI data suggests the groundwater level has the potential to be shallow at the crossing location through either seasonal groundwater level fluctuations or perched discontinued groundwater conditions.

In the absence of cuttings, no dewatering impact is expected.

Given the proposed Project elements related to embankments, groundwater disturbances are expected to be very minor and localised. As a result, any groundwater flow disturbance is expected to be negligible for the superficial aquifer (water-bearing horizons in Till on low sensitivity), resulting in a potential significance of impact of Negligible. No impact is expected on bedrock groundwater.

No GWDTSs have been identified in vicinity of the proposed Project consequently, no impact is expected to GWDTEs.

Given the depth of PWS215/1 and the distance to the proposed Project no groundwater flow disturbance and no groundwater quality impact is expected as a result of the proposed Project.

PWS215/2 is present within close proximity of the proposed new access road (<50m). Topography in this area increases to the east of the proposed new access road therefore an assumption can be made that groundwater flows from east to west. PWS215/2 (medium sensitivity) is therefore likely to be fed by groundwater flowing from the direction of the proposed new access road. Therefore, potential impacts on groundwater flow and quality are possible. Assuming a worst-case scenario of a medium magnitude of impact, this would result in a significance of impact of Moderate.

Operational Phase

Geology

Long-term impacts on geology are the same as the ones discussed during the construction phase.

Contaminated land

Based on the information available, no long-term impact is expected on contaminated land.

Groundwater

Based on the information available, no long-term impact is expected.

8.6.6 XC219 Buttevant

Do Nothing

This scenario does not interact with any known potentially contaminated land site nor groundwater, and the soils and geology are equally non-affected. As a consequence, no effects are expected for the "do nothing" scenario in relation to soils, geology, contaminated land and hydrogeology.

Construction Phase

The proposed design comprises the following:

- Embankments at each end of the road-over-rail bridge.
- Topsoil will be stripped for embankment construction.
- The construction will take place in layers with a degree of compaction affecting the sub-surface locally.

Additional temporary roads will be required during the construction phase to facilitate the construction of the proposed Project.

Soils and Geology

Given the proposed design, removal of soils and superficial deposits as a result of soil stripping is expected to be of negligible magnitude compared to the soils, superficial deposits available. As a result, the potential significance of impact on superficial deposits (negligible sensitivity) is assessed as Negligible.

Equally, negligible to no loss is expected from a mineral resource (medium sensitivity) perspective. This results in no to potential Negligible / Slight significance of impact.

Contaminated land

The proposed Project is likely to interact with potentially contaminated historical buildings and land associated with the railway network at this location. Made ground has been identified and soil leachability / groundwater sample results suggest potential contamination on the soils and underlying groundwater. As a results, workers have the potential to directly interact with and disturb this identified contamination In addition, the land owners' questionnaires indicate that there are four septic tanks located within 100 m of the proposed Project (see Volume 4, Figure 8.3).

Given the design of the proposed Project and evidence of made ground from the GI in this area, the likelihood of workers interacting with any contaminated materials is considered to be high and have a mild magnitude of impact. This would result in a Medium significance of impact. No other potential contamination pathway is considered to be present.

Temporary storage of oils, fuels and chemicals will be required during the construction phase. Accidental spillage of these contaminants could result in migration through to the superficial deposits of water-bearing Till and bedrock groundwater.

This could result in a medium magnitude impact to groundwater however, it is categorised as a low likelihood resulting in the potential impact significance of Moderate/Low.

Groundwater

GI data suggests the groundwater level is shallow at the crossing location.

In the absence of cuttings, no dewatering impact is expected.

Given the proposed Project elements related to embankments, groundwater disturbances are expected to be very minor and localised. As a result, any groundwater flow disturbance is expected to be negligible for the superficial aquifer (water-bearing horizons in Till and Alluvium of low sensitivity), resulting in a potential significance of impact of Negligible. No impact is expected on bedrock groundwater.

The wet grassland identified in proximity of the proposed is unlikely to be a GWDTS and is therefore considered of negligible sensitivity. This area of wet grassland could be directly impacted by the construction of the western embankment, which could result in a medium impact. This would result in a potential significance of impact of Negligible / Slight from a shallow groundwater flow perspective.

PWS219/1, PWS219/4 and PWS219/5 are surface water fed and are assessed in are discussed in Volume 3, Chapter 9: Water.

PWS219/2 and PWS219/3 (both medium sensitivity) are located in the vicinity of the crossing location within the study area (see Volume 4, Figure 8.3). No dewatering effect is expected and therefore potential impacts on yields to these PWS are expected to be none to negligible. No impact is expected on the infrastructure and potential impacts on water quality as a result of accidental spillages are assessed as medium, as a conservative approach to factor in the fact the depth of supply is unknown. This results in a potential significance of impact of Negligible / Slight on flows and Moderate on water quality.

No potential impact is expected on PWS219/1.

Operational Phase

Geology

Long-term impacts on geology are the same as the ones discussed during the construction phase.

Contaminated land

Based on the information available, no long-term impact is expected on contaminated land.

Groundwater

Long term potential significance of impact on the wet grassland identified near Ballycoskery remains Negligible / Slight from a shallow groundwater flow perspective.

8.6.7 Combined Effects of all Sites

Do Nothing

This scenario does not interact with any known potentially contaminated land site nor groundwater, and the geology is equally non-affected. As a consequence, no effects are expected for the "do nothing" scenario in relation to geology, contaminated land and hydrogeology for any of the sites.

Construction Phase

Due to the relatively small-scale construction proposals for each site and the distance between sites, no combined effects are predicted for the proposed Project except for accidental spillages which could potentially impact groundwater quality.

For sites XC201 Thomastown, XC211 Newtown, XC212 Ballycoskery, XC215 Shinanagh and XC219 Buttevant, where a medium magnitude contaminant spillage (oils, fuels and chemicals) is predicted as low likelihood at individual sites, there is the potential to cause a greater adverse impact if multiple sites have a spill where the combined effect means that a greater area is impacted at one time (medium magnitude). However, the likelihood is assigned as unlikely therefore the impact of significance is Low.

Operational Phase

No combined potential impacts are considered significant post-construction.

8.7 Mitigation Measures

This section identifies mitigation measures to avoid/prevent, reduce or offset potential significant impacts, described in Section 8.5 (Potential Effects of proposed Project), taking into account best practice, legislation and guidance, during both construction and operation.

8.7.1 Geology and Soils

Geological impacts are Negligible or Negligible to Slight for deposits, therefore mitigation measures are not considered for the geological deposits.

Loss to a mineral resource is expected to have a potential Negligible / Slight significance of impact.

8.7.2 Contaminated Land

Some localised areas of made ground and evidence of soil /groundwater contamination have been found in various locations across the crossing locations.

Any contaminated groundwater intercepted during construction will be treated prior to being discharged or will be disposed of at an appropriate licensed facility.

Prior to construction activities, appropriate health and safety and waste management procedures for working with contaminated soils will be established. Waste management procedures will take account of inter alia: The principles of risk assessment, including the concept of the source-pathway-receptor linkage, have been adopted by the Environmental Protection Agency (EPA) for the assessment of Environmental Liabilities 11 and Unregulated Waste Disposal Sites 12. However, there remains no formalised approach to the assessment of risks to human health from contaminated soils or groundwater. These procedures will be implemented as appropriate during construction. This will be developed in cognisance of the soil testing, soil leachability tests and groundwater testing results.

Risks to construction and maintenance staff working with/near contaminated land will be mitigated by the implementation of the above in combination with the adoption of appropriate systems of work, including personal protective equipment (PPE) as a last resort. In the event that unrecorded contamination is encountered, works should be stopped, and the working procedures reassessed to confirm the working methods remain appropriate.

Appropriate training of personnel involved in earthworks activities to implement a watching brief to identify potential presence of previously unidentified contamination.

To maximise the reuse of site-won materials on-site (and minimise the need for disposal of waste in line with the principles of the "Waste Hierarchy") whilst ensuring that no risks are posed to human health nor the water environment, a soil reuse assessment will be undertaken prior to construction. The soil reuse assessment will identify any potential risks posed to both human health and the water environment from potentially contaminated soils reused throughout the proposed Project.

If excavated soils are deemed unsuitable for reuse, they will be assessed in line with the 'Guidance on Soil and Stone By-products' (in the context of article 27 of the European Communities (Waste Directive) Regulations 2011 (Environmental Protection Agency, June 2019) prior to disposal to determine whether they are hazardous or non-hazardous. This will establish the most appropriate and cost-effective waste stream for the waste materials.

Where concrete materials are proposed to be used, appropriate guidance such as 'I.S. EN 206-1' should be followed to ensure that ground conditions are appropriate for the use of concrete at each given location.

8.7.3 Hydrogeology

PWS209/1, PWS215/2, PWS219/2 and PWS219/3 will be monitored for yield and quality before and during construction. Should any impact be recorded on any of these supplies, an alternative water supply will be provided to the property affected. A site visit will be undertaken to refine the location of PWS209/1. Following this survey, it will be determined whether the supply should be added to the list of private water supplies being monitored.

Storage of excavated soils and made ground will be minimised on site (spatially and in duration) and all storage areas will be appropriately lined, with adequate drainage management in place. This is to ensure that no polluted water percolates into the ground and minimise run-off and suspended solids.

In addition to the measures identified above in Section 8.6 (Mitigation), mitigation detailed within Volume 3, Chapter 9: Water and the production of Construction Environmental Management Plan (CEMP) will offer additional protection in relation to potential impacts associated with geology, soils, contaminated land and groundwater. For example, mitigation measures designed to protect the surface water environment will also protect groundwater receptors while air quality mitigation measures will avoid the creation of a statutory nuisance associated with dust and air pollution when working with contaminated land.

Following completion of the ground investigation, a settlement analysis will be undertaken for the proposed Project at Ballyhay. Should the settlement analysis raise any concerns additional mitigation measures will be implemented for existing rail and road infrastructure and nearby small buildings.

The backfilling of the trenches in XC209 Ballyhay which fall within the wet grassland area should be backfilled with the material that was dug out to prevent any preferential pathways being created.

8.8 Residual Effects

8.8.1 Geology and Soils

No mitigation measure is required for geology and soil. Residual impacts on geology and soil are therefore expected to stay the same at Negligible to Slight.

8.8.2 Contaminated Land

After implementation of proposed mitigation measures, all residual significance of impact on contaminated land are reduced to Very Low to Low.

8.8.3 Hydrogeology

After implementation of proposed mitigation measures, all residual significance of impact on groundwater and associated receptors are assessed as Negligible to Slight.

8.9 Interactions

No interaction with other topics is anticipated.

8.10 Cumulative Effects

Given the low level of residual impacts associated with this proposed Project in relation to geology, soils, contaminated land and hydrogeology, no cumulative impact of significance is expected with other proposed developments.

8.11 Difficulties Encountered Compiling Information

No difficulties were encountered compiling information.

8.12 References

Directive 2000/60/EC (The Water Framework Directive)

'Guidance on Soil and Stone By-products' (in the context of article 27 of the European Communities (Waste Directive) Regulations 2011 (Environmental Protection Agency, June 2019)

IS EN 206-1:2002 Concrete - Specification, Performance, Production and Conformity, 2002

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