

# N52 TULLAMORE TO KILBEGGAN LINK - OPTION SELECTION REPORT - VOLUME F APPENDIX F9B

Option Selection Report

Volume F – Environmental Appendices  
Appendix F9B – Water (Hydrogeology)

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# 1 INTRODUCTION

This report outlines the comparative assessment of options in relation to hydrogeology for the seven options for the N52 Tullamore to Kilbeggan Link Scheme. The options include a management option which consists of maintaining the current N52 route with relatively minor upgrade works. This assessment will form part of a Phase 2 – Option Selection Report which is a deliverable under Phase 2 – Options Selection of the TII PMG 2019. The purpose of the Option Selection Report is to present the project constraints and the assessments that were undertaken in order to identify the Preferred Option for the project.

This report assesses the impact of each option shortlisted for Stage 2 from a hydrogeological perspective. Specifically, the report evaluates the potential impacts on any of the following with the operation of each of the options:

- Water Framework Directive status and risk to that status;
- Nutrient sensitivity;
- Aquifer classification and characteristics;
- Groundwater vulnerability; and
- Proximity to groundwater resources and features.

The impacts for each of the options are identified so that those with unacceptably high levels of impact can be avoided to the extent feasible as part of the overall option assessment process.

A comparative assessment of each route was carried out to assess potential impacts in relation to hydrogeology. This assessment has been undertaken in accordance with “Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes” (NRA, 2008<sup>1</sup>) and has had regard to the TII MCA Guidelines (TII, 2016<sup>2</sup>). A route corridor with an overall width of 500m was applied to each route option, as recommended in the TII Guidelines for Assessment of Hydrogeology for National Road Schemes. The criteria for determining the importance for each hydrogeological attribute are detailed in **Table 1-1**, sourced from the TII Guidelines.

**Table 1-1: Rating Criteria for Hydrogeology Attributes (NRA, 2008)**

Importance	Criteria	Typical Examples
Extremely High	Attribute has a high quality or value on an international scale	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. SAC or SPA status
Very High	Attribute has a high quality or value on a regional scale	Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Inner source protection area for regionally important water source
High	Attribute has a high quality or value on a local scale	Groundwater provides large proportion of baseflow to local rivers Locally important potable water source supplying >1000 homes Outer source protection area for regionally important water source Inner source protection area for locally important water source
Medium	Attribute has a medium quality or value on a local scale	Locally Important Aquifer Potable water source supplying >50 homes Outer source protection area for locally important water source

<sup>1</sup> NRA, 2008. Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Projects. National Roads Association.

<sup>2</sup> TII, 2016. Multi-Criteria Analysis (MCA). Transport Infrastructure Ireland (TII) Publications.

Importance	Criteria	Typical Examples
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer Potable water source supplying <50 homes

The significance of an impact is defined by first considering the importance of the attribute impacted upon and secondly the magnitude of the impact. The importance of hydrogeological attributes (rating criteria) is defined in accordance with the NRA Guidelines.

## 1.1 Guidance

This analysis was undertaken by means of a desktop assessment based on the following guidance and information sources:

- GeoHive – <https://www.map.geohive.ie>;
- Geological Survey of Ireland (GSI) - <https://www.gsi.ie/>;
- Environmental Protection Agency (EPA) - <http://gis.epa.ie/Envision>;
- National Parks and Wildlife Services (NPWS) <http://webgis.npws.ie/npwsviewer/> for designated sites;
- Transport Infrastructure Ireland (TII) “*Project Appraisal Guidelines for National Roads Unit 7.0 - Multi Criteria Analysis*” (2016);
- National Roads Authority (NRA)/TII “*Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Projects*” (2008); and
- UK Highways Agency “*Design Manual for Roads and Bridges, Volume 11, Section 3, Road Drainage and the Water Environment*” (2007) and the updated LA113 (2020<sup>3</sup>).

An assessment of the impact on the hydrogeological constraints was undertaken for the options in accordance with the NRA guidelines (NRA, 2008) and the TII MCA Guidelines (TII, 2016). The documents provide guidance on the assessment procedures utilised for water in the option selection process and provide guidance on the assessment of hydrogeological impacts during the planning and design of national road schemes in Ireland.

## 1.2 Project Appraisal Guidelines Requirements

The TII “*Project Appraisal Guidelines for National Roads Unit 7.0 - Multi Criteria Analysis*” (PAG) states the following for a Stage 2 appraisal of hydrogeology should be considered in the route corridor selection:

*“The TII Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes gives references to soil and water contained in the NRPMG and specifically outlines the approach to be adopted in the consideration and treatment of geology, hydrology and hydrogeology at the Constraints Study, Route Corridor Selection and Preliminary Design / Environmental Impact Assessment phases. Road schemes have the potential to impact groundwater bodies and aquifers. The impact assessment criteria in the MCA are the same as stated in the TII Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.”*

Therefore, the following elements are considered as part of the hydrogeology assessment:

- Water Framework Directive status and risk to that status;
- Nutrient sensitivity;
- Aquifer classification and characteristics;

<sup>3</sup> UK Highway Agency, 2020. Design Manual for Roads and Bridges – A113 Road Drainage and the Water Environment ((formerly HD 45/09)). Department for Infrastructure.

- Groundwater vulnerability; and
- Proximity to groundwater resources and features.

### 1.3 Assessment Criteria

The Stage 2 Appraisal Process was carried out using the full range of sub criteria recommended in PAG unit 7.0, and with regard to the objectives of the scheme, so as to take account of all the predicted impacts of each option or alternative. In many cases there is a strong overlap between the objectives of the scheme and one or more of the PAG sub criteria.

All appraisal criteria use a standard scale. Each impact is scored on a scale of 1 (major or highly negative impact) to 7 (major or highly positive impact). A score of 4 represents a neutral or not significant impact. Each impact is scored as per the system presented in **Table 1-2**.

**Table 1-2: Project Appraisal Guidelines Scoring**

Score	PAG Score
7	Major or highly positive
6	Moderately positive
5	Minor or slightly positive
4	Not significant or neutral
3	Minor or slightly negative
2	Moderately negative
1	Major or highly negative

All scores refer to impacts measured relative to the Do-Minimum. The Do-Minimum consists of doing nothing further to improve the N52 route. The Do- Minimum would therefore by definition be scored as Neutral (relative to itself) under all sub criteria.

PAG 7.0 notes that simply adding up the scores of the different sub-criteria gives an indication of the overall performance of each option under a given criterion, but this is not to be used in a mechanistic way as a decision process. The performance of each option in meeting the scheme objectives was then considered to be one of the criteria presented in **Table 1-3**.

**Table 1-3: Qualitative Scoring**

Score	PAG Score
Preferred	The choice which most fully meets the project objectives.
Good	Where project objectives are met notably better than with the intermediate choices but notably not as well as with the best choice.
Intermediate	Where project objectives are met considerably less well than with the best choice but considerably better than with the worst choice.
Poor	Where project objectives are met notably less well than with the intermediate choices but notably not as well as with the best option.
Least Preferred	The choice which does least to achieve the project objectives.

Having regard to the full range of impacts assessed in each case. This is a high level of ranking of the options or alternatives. The scoring process allows for options or alternatives to be identified as being “Good”, falling between “Intermediate” and “Preferred”, or as “Poor”, falling between “Least Preferred” and “Intermediate”.

For some options there will be very little between their impact scores and some may even have the same impact scores. In such circumstances, the author has applied expert judgement and evaluated each option comparatively against the other options, taking into account the quantitative and qualitative assessments. This has allowed the author to determine a preference for each option. In some instances, similar options may have the same preference.

## 2 EXISTING ENVIRONMENT

### 2.1 Hydrogeology

Each option traverses the Tullamore Groundwater Body (GWB) (IE\_SH\_G\_232) (Good 2013-2018 WFD status, unassigned risk) and to a lesser extent the Kilbeggan Gravels GWB (IE\_SH\_G\_242) (Good 2013-2018 WFD status, unassigned risk) – see **Figure 2-1**. Both are nutrient sensitive GWBs subject to anthropogenic pressures. The Tullamore GWB is a Regionally Important (karstified) bedrock aquifer and the Kilbeggan Gravels GWB is a locally important gravel aquifer in the north of the site. All of the options traverse the Tullamore Ardan Public Water Supply (PWS) Inner protection area.

The GSI groundwater vulnerability map indicates that all routes overlie regions of “Moderate”, “High” and “Extreme” groundwater vulnerability, including regions where rock is exposed at the currently dormant Molloy's Quarry. Cuttings over the GWBs may temporarily impact flow regimes and quality during the construction phase. The permanent impact on GWB recharge is expected to be negligible in the wider regional context.

### 2.2 Study Area and Options

A route corridor with an overall width of 500m was applied to each route option, as recommended in the TII Guidelines for Assessment of Hydrogeology for National Road Schemes, also considering junctions and ring roads.

Each of the seven route options brought forward for Stage 2 assessment are described below:

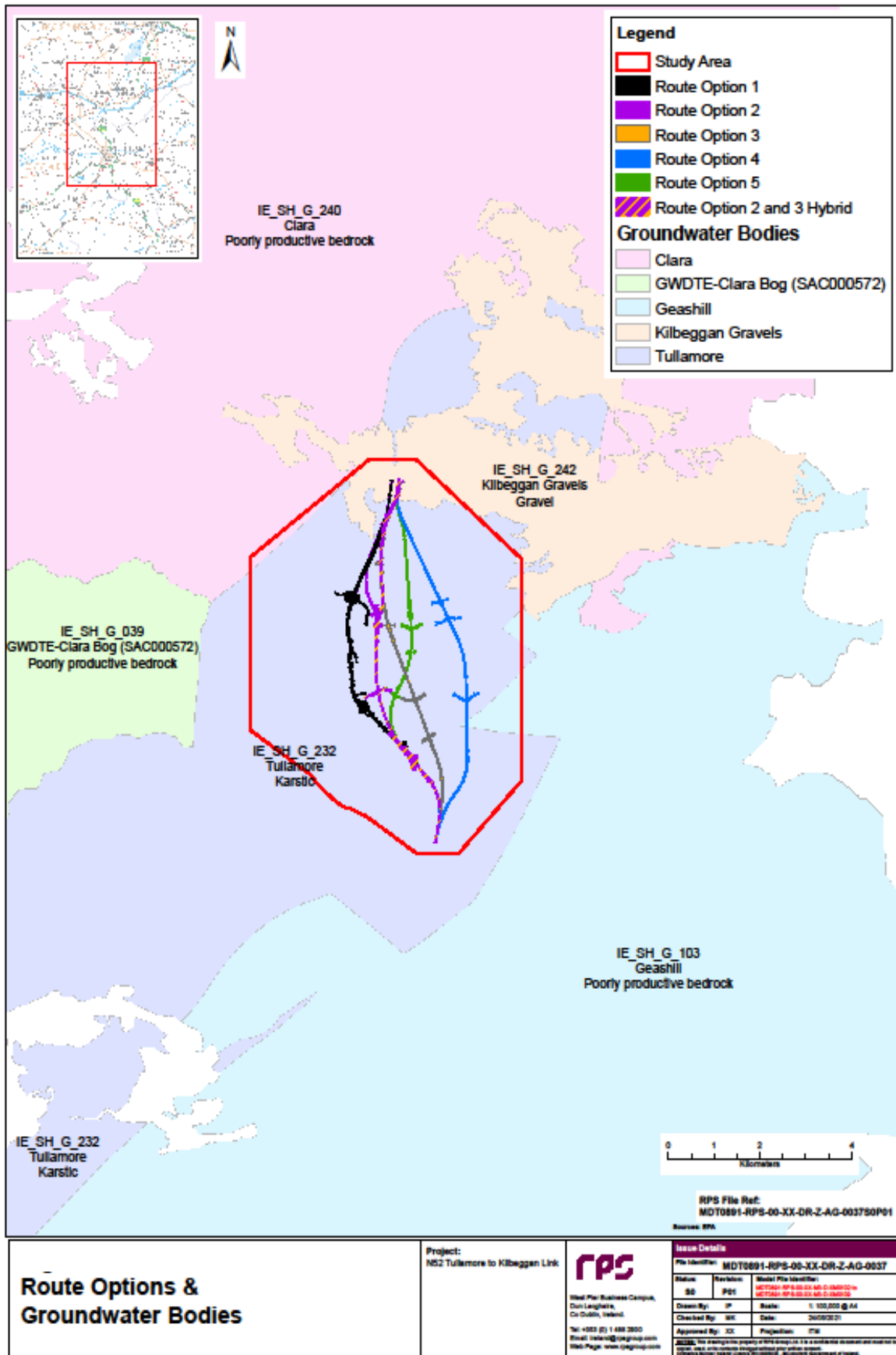
- Proposed Management Option consist of maintaining the existing N52 route in terms of vertical and horizontal alignment. The proposed cross section remains a single carriageway as per the existing N52 route and does not involve significant land take. Access along the N52 is proposed to be facilitated with roundabouts at key junctions.
- Proposed Option 1 (8.54km) follows existing N52 closely in horizontal and vertical alignment. The proposed cross section is wider than the existing carriageway in sections and will involve land take along the edges of the road. Multiple existing field accesses along N52 will be joined by parallel collector roads or diverted to the local roads minimizing field access points to the new carriageway.
- Proposed Option 2 (8.17km) follows the existing N52 closely in horizontal and vertical alignment from the Tullamore Bypass roundabout until chainage 2050. At chainage 2050 it diverges east from the existing N52 and joins back to the existing alignment at chainage 6400. The 4350m new offline road allows for elimination of substandard junctions at Four Roads and Durrow Village. The Option 2 will cross Derrygolán Esker at chainage 5050 to 5200. Option 2 contains the shortest offline section, trying to utilise as much as possible of the existing road. Option 2 skirts to the left of the national monument of MeeneGLISH avoiding direct impact on the monument at chainage 5700. Four crossings of waterbodies will be required on Option 2 at chainages: 2150, 3850, 5900 and 7000.
- Proposed Option 3 (7.90km) diverges east from the existing N52 at chainage 600. It crosses Molloy's Quarry at chainage 1250-1600 and the source protection area at chainage 1000-2100. Three road crossings are proposed along the Option 3: at chainage 2240 with L2003, at chainage 3120 with L2005 and at chainage 4790 with L2006. Three crossing of waterbodies will be required on the Option 3 at chainages: 2150, 5780 and 6800. Option 3 joins the existing N52 alignment at chainage 7000 following to the M6 junction.
- Proposed Option 4 (8.09km) is an eastern option and diverges east from existing N52 at chainage 250. It crosses Molloy's Quarry at chainage 1750-1950 and the source water protection area at chainage 1000-2400. Two road crossings are proposed along Option 4: at chainage 3200 with L2005 and at chainage 4900 with L2006. Option 4 avoids crossing Derrygolán Esker passing it on the east at chainage 4900. It then goes north west passing west of Pallas forest at chainage 6000. Two crossings of waterbodies will be required on Option 4 at chainages: 2730 and 7050. Option 4 joins the existing N52 alignment at chainage 7850 and follows to the M6 interchange.
- Proposed Option 5 (8.05km) diverges east from the existing N52 at chainage 2300 making use of an already upgraded alignment of N52 up to this point. The proposed alignment east of the existing N52 replaces two substandard junctions at Four Roads and Durrow Village and substandard horizontal and

vertical alignment of N52 at the middle section. Two road crossings are proposed at Option 5: at chainage 3480 with L2005 and at chainage 4990 with L2006. Option 5 crosses Derrygolan Esker at chainage 4900-5000. Two crossings of waterbodies will be required on Option 5 at chainages: 2150 and 7050. Option 5 joins the existing N52 alignment at chainage 7850 and follows to the M6 interchange.

- Proposed Option 2-3 (8.10km) was developed during the course of the scheme development and appraisal as a combination of Options 2 and 3 above. This option combines the southern part of Option 2 with the northern part of Option 3 and has been developed as a means of further minimising impact on the Ballybought Castle site identified for Option 2.



Figure 2-1: Groundwater Bodies (Source: GSI, 2021)



## 3 OPTION SELECTION

### 3.1 Methodology

Online sources such as Geological Survey Ireland Spatial Resources and EPA maps have been used to perform geographic information system (GIS) analysis of hydrogeological data. 250 metre buffer zones have been generated around each of the seven no. Stage 2 options' centrelines. The options were assessed with respect to their likely impact on hydrogeological attributes.

The potential hydrogeological impacts on particular attributes falling within the individual route corridors are set out in **Table 3-1**.

**Option 1 and the Management Option** (Brown) route corridor overlies the two production wells for the Tullamore Ardan Public Water Supply (PWS) and another candidate production well. The route corridor traverses a group of three unnamed springs located near the entrance of Durrow Abbey. These discharge to the Durrow Abbey Stream. It traverses four recorded domestic/agricultural supply wells, and a well listed under the "Durrow Water Group Scheme" serving an unknown population.

**Option 2** (Purple) route corridor overlies the two production wells for the Tullamore Ardan PWS and another candidate production well. The route traverses six recorded domestic/agricultural supply wells which supply individual homes.

**Option 3** (Orange) traverses seven recorded domestic/agricultural supply wells. Compared to other options it crosses a relatively larger area of extreme groundwater vulnerability at Molloy's Quarry (0.27km<sup>2</sup>).

**Option 4** (Blue) route traverses the Geashill GWB (IE\_SH\_G\_103) (Good WFD status, not at risk, nutrient sensitive). This is a locally important bedrock aquifer which is moderately productive only in local zones. The route also traverses two recorded domestic/agricultural supply wells. It overlies the majority of the Ballybroder-Ballycallan GWS source protection area and possibly the abstraction wells themselves. The groundwater vulnerability in this area is high. A karst feature known as Molloy's Spring is traversed by the route corridor. The spring connected to a swallow hole 500m to the east outside the route corridor. Compared to other options the route crosses a relatively large area of extreme groundwater vulnerability at Molloy's Quarry (0.32km<sup>2</sup>).

**Option 5** (Green) overlies the two production wells for the Tullamore Ardan PWS and another candidate production well. It traverses five recorded domestic/agricultural supply wells.

**Option 2-3** route corridor overlies the two production wells for the Tullamore Ardan PWS and another candidate production well. The route traverses six recorded domestic/agricultural supply wells which supply individual homes.

**Table 3-1: Hydrogeological Impacts of Options**

Route Option	Attribute	Importance	Impact	Level of Impact
<b>Management Option (Brown)</b>	Potable water source supplying <50 homes	Low	Existing N52 alignment at close proximity an existing well listed under Durrow Water Group Scheme.	Neutral
		Low	Four domestic/agricultural supply wells located within the route corridor.	Neutral
	Springs	Medium	Existing N52 alignment at close proximity to three unnamed springs.	Minor Negative
	Source Protection Area (Inner Zone)	Very High	Existing N52 alignment traverses the Tullamore Ardan PWS Inner Source Protection Area, potential for pollution from road runoff and construction works.	Moderately Negative
	Area of regionally/locally important aquifer	Medium	Tullamore Groundwater Body aquifer (Rkd) characteristics unchanged. However, it may be affected during construction.	Minor Negative
		Low	Kilbeggan Gravels aquifer (Lg) characteristics unchanged. However, it may be affected during construction.	Neutral
	Area of High, Extreme/ X Groundwater Vulnerability	Medium	Existing vulnerability rating unchanged. However, it may be affected during construction.	Minor Negative
Groundwater flooding	Low	The route corridor traverses a site of historical groundwater flooding within a greenfield site in the Acantha area.	Neutral	
<b>Option 1 (Brown)</b>	Potable water source supplying <50 homes	Low	Existing N52 alignment at close proximity an existing well listed under Durrow Water Group Scheme.	Neutral
		Low	Four domestic/agricultural supply wells located within the route corridor.	Neutral
	Springs	Medium	Existing N52 alignment at close proximity to three unnamed springs.	Minor Negative
	Source Protection Area (Inner Zone)	Very High	Existing N52 alignment traverses the Tullamore Ardan PWS Inner Source Protection Area, potential for pollution from road runoff and construction works.	Moderately Negative
	Area of regionally/locally important aquifer	Medium	Tullamore Groundwater Body aquifer (Rkd) characteristics unchanged. However, it may be affected during construction.	Minor Negative
		Low	Kilbeggan Gravels aquifer (Lg) characteristics unchanged. However, it may be affected during construction.	Neutral
	Area of High, Extreme/ X Groundwater Vulnerability	Medium	Existing vulnerability rating unchanged. However, it may be affected during construction.	Minor Negative
Groundwater flooding	Low	The route corridor traverses a site of historical groundwater flooding within a greenfield site in the Acantha area.	Neutral	
<b>Option 2 (Purple)</b>	Potable water source supplying <50 homes	Low	Six domestic/agricultural supply wells located within the route corridor.	Neutral

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Route Option	Attribute	Importance	Impact	Level of Impact
<b>Option 3 (Orange)</b>	Source Protection Area (Inner Zone)	Very High	Two production wells for Tullamore Ardan GWS and one candidate production well located within the route corridor.	Moderately Negative
	Area of regionally/locally important aquifer	Medium	Tullamore Groundwater Body aquifer (Rkd) characteristics unchanged. However, it may be affected during construction.	Minor Negative
		Low	Kilbeggan Gravels aquifer (Lg) characteristics unchanged. However, it may be affected during construction.	Neutral
	Area of High, Extreme/ X Groundwater Vulnerability	Medium	The route corridor transverses predominantly large areas of High vulnerability. A small region of Extreme vulnerability is located within the Zone of Influence in the south of the study area.	Minor Negative
	Groundwater flooding	Low	The route corridor traverses a site of historical groundwater flooding within a greenfield site in the Acantha area.	Neutral
	Potable water source supplying <50 homes	Low	The route corridor is close to seven domestic/agricultural wells.	Neutral
	Source Protection Area (Inner Zone)	Very High	The route corridor transverses the inner protection zones for Tullamore Ardan PWS.	Moderately Negative
	Area of regionally/locally important aquifer	Medium	Tullamore Groundwater Body aquifer (Rkd) characteristics unchanged. However, it may be affected during construction.	Minor Negative
		Low	Kilbeggan Gravels aquifer (Lg) characteristics unchanged. However, it may be affected during construction.	Neutral
	Area of High, Extreme/ X Groundwater Vulnerability	Medium	The route corridor transverse an area of Extreme groundwater vulnerability (0.27km <sup>2</sup> ) and predominantly large areas of High vulnerability.	Moderately Negative
<b>Option 4 (Blue)</b>	Potable water source supplying <50 homes	Low	The route corridor transverses the two recorded domestic/agricultural supply wells.	Neutral
	Springs	Medium	The route corridor is at close proximity to Molloy's Spring.	Minor Negative
	Source Protection Area (Inner Zone)	Very High	The route corridor transverses the inner protection zones for Ballybroder-Ballycallan GWS.	Moderately Negative
		Very High	The route corridor transverses the inner protection zones for Tullamore Ardan PWS.	Moderately Negative
	Area of regionally/locally important aquifer	Medium	Tullamore Groundwater Body aquifer (Rkd) characteristics unchanged. However, it may be affected during construction.	Minor Negative
		Low	Kilbeggan Gravels aquifer (Lg) characteristics unchanged. However, it may be affected during construction.	Neutral
	Area of High, Extreme/ X Groundwater Vulnerability	Medium	The route corridor transverse a relatively larger area of Extreme groundwater vulnerability (0.32km <sup>2</sup> ) and predominantly large areas of High vulnerability.	Moderately Negative

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<b>Route Option</b>	<b>Attribute</b>	<b>Importance</b>	<b>Impact</b>	<b>Level of Impact</b>
<b>Option 5 (Green)</b>	Potable water source supplying <50 homes	Low	Five domestic/agricultural wells also located within the route corridor.	Neutral
	Source Protection Area (Inner Zone)	Very High	The route corridor traverses the inner protection zones for Tullamore Ardan PWS.	Moderately Negative
	Area of regionally/locally important aquifer	Medium	Tullamore Groundwater Body aquifer (Rkd) characteristics unchanged. However, it may be affected during construction.	Minor Negative
		Low	Kilbeggan Gravels aquifer (Lg) characteristics unchanged. However, it may be affected during construction.	Neutral
	Area of High, Extreme/ X Groundwater Vulnerability	Medium	The route corridor transverses predominantly large areas of High vulnerability. A small region of Extreme vulnerability is located within the Zone of Influence in the south of the study area.	Minor Negative
Groundwater flooding	Low	The route corridor traverses a site of historical groundwater flooding within a greenfield site in the Acantha area.	Neutral	
<b>Option 2-3</b>	Potable water source supplying <50 homes	Low	Six domestic/agricultural supply wells located within the route corridor.	Neutral
	Source Protection Area (Inner Zone)	Very High	Two production wells for Tullamore Ardan GWS and one candidate production well located within the route corridor.	Moderately Negative
	Area of regionally/locally important aquifer	Medium	Tullamore Groundwater Body aquifer (Rkd) characteristics unchanged. However, it may be affected during construction.	Minor Negative
		Low	Kilbeggan Gravels aquifer (Lg) characteristics unchanged. However, it may be affected during construction.	Neutral
	Area of High, Extreme/ X Groundwater Vulnerability	Medium	The route corridor transverses predominantly large areas of High vulnerability. A small region of Extreme vulnerability is located within the Zone of Influence in the south of the study area.	Minor Negative
Groundwater flooding	Low	The route corridor traverses a site of historical groundwater flooding within a greenfield site in the Acantha area.	Neutral	

## 4 OPTION SUMMARY

A summary of the preference ranking for each option with respect to hydrogeology is shown in **Table 4-1**. The preference rating is determined based on a comparative assessment of the impacts between options.

Option 1 and the Management Option offers the lowest potential impact on the existing hydrogeological regime and is classed as minor or slightly negative given the ongoing potential impact on the underlying aquifer and associated public water supply. The Management Option in comparison to Option 1 has a reduced land take and is considered to have a lesser negative impact. Therefore the Management Option is classed as the “Preferred Option” and Option 1 is classed as “Good”. Option 4 is classed as moderately negative and given a preference rating of “poor”, given that this route crosses the potential impact zone for both the Ballybroder-Ballycallan GWS and the Tullamore Arden PWS, as well as an area of extreme groundwater vulnerability. Similarly, Option 3 is classed as “poor” and moderate negative given the impact on the Tullamore Arden PWS and a large area of extreme groundwater vulnerability. Options 2, 5 and 2-3 are classed as “intermediate” given the relatively low impact compared to Options 3 and 4.

**Table 4-1: Hydrogeology Preference Rating**

Option	Potential for Impact	Impact Level	Impact Score	Preference
Management Option	<ul style="list-style-type: none"> <li>Neutral impact on potable water sources supplying &lt;50 homes, the Kilbeggan Gravel aquifer and groundwater flooding.</li> <li>Minor negative impact on three unnamed springs, the Tullamore GWB aquifer (Rkd) and areas of High groundwater vulnerability.</li> <li>Moderately negative impact on the Source Protection Area as the route traverses the Tullamore Ardan PWS.</li> </ul>	Minor or slightly negative	3	Preferred
Option 1 (Brown)	<ul style="list-style-type: none"> <li>Neutral impact on potable water sources supplying &lt;50 homes, the Kilbeggan Gravel aquifer and groundwater flooding.</li> <li>Minor negative impact on three unnamed springs, the Tullamore GWB aquifer (Rkd) and areas of High groundwater vulnerability.</li> <li>Moderately negative impact on the Source Protection Area as the route traverses the Tullamore Ardan PWS.</li> </ul>	Minor or slightly negative	3	Good
Option 2 (Purple)	<ul style="list-style-type: none"> <li>Neutral impact on potable water sources supplying &lt;50 homes, the Kilbeggan Gravel aquifer and groundwater flooding.</li> <li>Minor negative impact on the Tullamore GWB aquifer (Rkd) and areas of High groundwater vulnerability.</li> <li>Moderately negative impact on the Source Protection Area as the route traverses the Tullamore Ardan PWS (two production wells and one candidate production well).</li> </ul>	Minor or slightly negative	3	Intermediate
Option 3 (Orange)	<ul style="list-style-type: none"> <li>Neutral impact on potable water sources supplying &lt;50 homes and the Kilbeggan Gravel aquifer.</li> <li>Minor negative impact on the Tullamore GWB aquifer (Rkd).</li> <li>Moderately negative impact on the Source Protection Area as the route traverses the Tullamore Ardan PWS, the route also traverses regions of Extreme groundwater vulnerability.</li> </ul>	Moderately Negative	2	Poor
Option 4 (Blue)	<ul style="list-style-type: none"> <li>Neutral impact on potable water sources supplying &lt;50 homes and the Kilbeggan Gravel aquifer.</li> <li>Minor negative impact on Molloy’s Spring and the Tullamore GWB aquifer (Rkd).</li> <li>Moderately negative impact on the Source Protection Area as the route traverses the Tullamore Ardan PWS and Ballybroder-Ballycallan GWS, the route also traverses regions of Extreme groundwater vulnerability.</li> </ul>	Moderately Negative	2	Poor
Option 5 (Green)	<ul style="list-style-type: none"> <li>Neutral impact on potable water sources supplying &lt;50 homes, the Kilbeggan Gravel aquifer and groundwater flooding.</li> <li>Minor negative impact on the Tullamore GWB aquifer (Rkd) and areas of High groundwater vulnerability.</li> <li>Moderately negative impact on the Source Protection Area as the route traverses the Tullamore Ardan PWS.</li> </ul>	Minor or slightly negative	3	Intermediate

Option	Potential for Impact	Impact Level	Impact Score	Preference
Option 2-3 (Purple-Orange)	<ul style="list-style-type: none"> <li>• Neutral impact on potable water sources supplying &lt;50 homes, the Kilbeggan Gravel aquifer and groundwater flooding.</li> <li>• Minor negative impact on the Tullamore GWB aquifer (Rkd) and areas of High groundwater vulnerability.</li> <li>• Moderately negative impact on the Source Protection Area as the route traverses the Tullamore Ardan PWS (two production wells and one candidate production well).</li> </ul>	Minor or slightly negative	3	Intermediate