

## 7. Geology and Hydrogeology

### 7.1. Sources of information

The assessment consisted of a site visit, and a desk study of available published information from the sources listed at the end of this chapter together with additional sources of information included as References.

The information outlined here is presented graphically on Figures 9 to 11 (Drawings 00229/022 to 00229/24).

### 7.2. Bedrock

The northern and central sections of the area of study are underlain by sedimentary Carboniferous limestone with Silurian slates and shales at the east (Kilcullen to Castledermot). Granites (igneous rocks) and surrounding metamorphic deposits (Leinster batholith) occurs along the eastern part of the study area. The central Castlecomer plateau area is composed of sedimentary Carboniferous sandstones, siltstones and shales.

#### *Sedimentary rocks*

The main geological formations occurring in the study area are described, starting with the oldest sequence, in Table 7.1.

Some of the Carboniferous limestone formations identified may be associated with Karst features (Ballyadams and Clogrenan Formations, designated Rck-3 on the geotechnical constraints mapping). The dolomitised Limestone rocks may also prove hard to excavate (the boundary of dolomitisation which runs from Carlow to Thomastown can be identified on the geological bedrock maps). The Quartzitic sandstone occurring in the Castlecomer plateau could also prove hard to excavate.

#### *Granite Complex*

A granite complex known as the Tullow granite extends in a broad zone to the east of Gorebridge-Carlow (Rck-5). The granites are igneous rocks and the resulting heat and deformation during their formation has created the surrounding metamorphic rocks. The Tullow granite is the largest granite pluton igneous body in the Leinster Batholith and is mostly of medium-grained texture but some coarse and fine veins cut the mass. Outcrops of granite were observed to the east and south-east of Carlow Town: Kernanstown, Chapelstown and Tinryland (Reference 8), see Rck-5 on the geotechnical constraints maps.

The granites can be very hard and difficult to excavate, although along the joints, the granite is often deeply weathered to sand with solid blocks in-between. This deep weathering can also result in a highly or completely decomposed granite structure. To the east and north-east of Carlow, geophysics surveys (Reference 8) indicated the presence of weathered granite in some locations ranging in thickness from 3.5m to 7.8m.

### 7.3 Glacial Soils

#### *Gravels*

Thick gravel deposits occur within the study area mainly along the major river crossings and also around Kildare (Mid-Kildare gravels). The main gravel areas identified in the study area are as follows:

- Mid-Kildare Gravel: The depth of the gravel layer within the study area is between 5 m to 75 m (Reference 4). The major gravel aquifer is designated G-1 on the geotechnical constraints mapping.
- Gravel deposits along the River Barrow north and south of Carlow. The major gravel aquifer within these deposits is designated G-2. The thickness of the gravel deposits reaches a maximum of 25m in the low-lying land of the Barrow Valley (Reference 8).
- Gravel deposits in the Burren River Valley. The thickness of the gravel deposits ranges between 10m to 15m (Reference 8).
- Gravel deposits along the River Nore north of Kilkenny City. The major gravel aquifer within this area is designated G-3.

These materials do not present problems for road construction, provided the road alignment is kept above the water table. Generally, gravels provide good formation for pavement construction and are generally suitable for reuse. Water bearing sand and silt layers, where encountered, can be problematic.

#### *Clayey Till*

Glacial till dominate much of the study area. These glacial deposits are mainly deposits of the Midlandian ice sheet with the coarse fraction dominated by cobbles and boulders of limestone with lesser proportions of sandstone, slates and shales.

The depth of the till occurring within the study area is not known precisely and is likely to vary considerably.

The geotechnical properties of Irish glacial tills are well-documented (Reference 6). These soils are generally well graded, variable with gravel lenses, with quite an absence of clay minerals. The clay fraction (rock flour) typically amounts to about 15% and the fines fraction (clay and silt) is about 30 to 40%. The glacial tills are generally over-consolidated, and therefore are of a low compressibility. These soils are usually firm to stiff, however due to their low plasticity, they are very susceptible to softening and deterioration in wet weather, especially if heavily trafficked. When the clayey tills are kept dry, they present relatively little difficulty to road construction.

## 7.4 Soft Ground

The main soft soils occurring within the study area are as follows:

### *Peat deposits*

Blanket peat (P-1): occurs to the west and south-west of Carlow Town. The depth of the peat ranges from 0.5 m to 2 m. The peat is considered to be highly humified and uniform throughout this section (Reference 2).

Extensive areas of raised bog between Athy and Kildare (P-2). Kilberry bog near Athy was historically used by Bord na Mona for industrial purposes.

The peat deposits are quite extensive in the north and central sections of the study area.

Peat soils are considered to be problematic for construction work owing to their high organic content, high compressibility and low shear strength. When loaded, these soils usually exhibit large immediate and primary settlement followed by a very pronounced long-term creep settlement. These soils are also known to exhibit a differential settlement due to their high variability within the same location. Peat soils could present problems for embankment stability as a result of the shear failure of the subsoil during construction. Special measures for embankment construction are usually required including piling, excavate-and-replace and preload with vertical drains, etc.

### *Alluvium*

These alluvial materials are deposited by river action or the action of melting glaciers. The following major alluvial tracts cross the study area:

Along the River Barrow from Monasterevin to Carlow Town (AL-1). The alluvium typically consists of dark greyish brown clay layer with clay content up to 60% with a total almost 90 to 100% silt plus clay. The subsoil horizons have a much higher proportion of silt than the top soil. Some thin peat layers can occur between the alluvium and the lake deposits.

Along the basin of the River Barrow from Carlow Town to as far south as Goresbridge (AL-2). These soils are poorly drained and of slightly peaty clay loam texture. The organic content can reach up to 20%. The depth of the alluvium is usually greater than 1m. The depth of the alluvial sands/gravels occurring in river valleys can typically be about 9m to 12m.

Along the River Nore (AL-3), River Greese (AL-4), Len River (AL-5) and Liffey River (AL-6).

These soils are normally consolidated (i.e. they have not been previously compressed by glaciers) and thus are moderately to highly compressible though not as severe as peat soils. Special measures for embankment construction over alluvial materials include preloading, with or without vertical drains, and piling.

Table 7.2 presents a summary of the properties of the soils discussed in above.

## 7.5. Unstable Ground

### *Karst Solution Features*

Some of the Carboniferous limestone formations occurring in the study area are reported to have potential karst solution features. The formations most associated with solution features are known as Ballyadams and Clogrenan and occur in a broad land between Bennettsbridge and Carlow Town. The most exposed areas to Karst are those where the limestone is present near the surface or lies near a catchment area. However, areas of deep Karst collapse structures do occur, for example at Ballyellin, County Carlow and Hollymount, Co. Laois (Reference 7).

The Karst database held by the Geological Survey of Ireland (GSI) was consulted. This database holds records of locations and types of reported Karst features. The location and features of the reported Karst areas are plotted on the geotechnical constraint maps and details are provided in Table 7.5.

The occurrence of sinkholes under a roadway can lead to depressions or collapse in the pavement. Specific areas prone to Karst should be identified at the aerial photograph interpretation and site investigation stages. Depending on the risks, it may be prudent to adopt design measures to control water discharge, which can re-activate solution features, and to incorporate measures which will protect the roadway from potential collapse.

### *Slope Stability*

In order to assess the stability of rock cuttings, it is important to identify the orientation of discontinuities, their condition and also the extent of weathering present, during the detailed site investigation. Steep ground should also be identified. A survey of any previous cases of slope failure in the area of study would prove very useful. Areas of instability may be revealed by examination of local aerial photographs along the proposed routes.

The rocks associated with the Silurian period in particular, may be susceptible to cutting instability because of the complex geological structure characterising these rocks (i.e. folds, faults and variable dip). Cutting stability in Limestone rocks would need careful consideration where Karst weathering is present and also in the granites where deep weathering can occur.

### *Mining Areas (Castlecomer Coal Field)*

The Geological Survey of Ireland (GSI) minerals inventory database records twelve coal mines, fourteen former pits and nine natural outcrops of coal in the area of Castlecomer. Locations identified on the GSI Maps are reproduced on the geotechnical constraints maps. Exploitation of the coalmines has generally ceased and there is only one mining lease issued in the area at present, at Coolbaun three kilometres northeast of Castlecomer.

If routes are proposed in these areas, a through search of mining records should be carried out.

## 7.6. Man-made Features

A list of pits, quarries and landfill areas within and adjacent to the study area is given in Table 7.3. Also shown on the geotechnical constraints mapping is the location of the main quarries, pits and landfill sites within the study area. These locations should not be considered exhaustive as they are based on limited historical data. The GSI are presently updating their records of pits and quarries. It is anticipated that updated records will be available shortly.

### *Pits*

The geotechnical constraints mapping shows many gravel pits, both in-use and disused, within the gravel strata that occur within the study area. They are particularly prevalent following a line of esker deposits west and south of Kilcullen, and following the gravel deposits between Kilcullen and Carlow town. A non exhaustive list of pits occurring within the study area is given in Table 7.3.

### *Quarries*

Quarries identified on the geotechnical constraints maps are relatively few and are mainly in the Castlecomer plateau area. Quarries are also noted in the Carlow area.

The GSI are presently updating their 1994 report on quarry locations and the updated list of quarries is expected to be available soon.

### *Landfills*

A list of landfill sites compiled by the Environmental Protection Agency was consulted for identifying any landfill sites occurring within the study area. A list of these sites is given in Table 7.3 but should not be considered exhaustive. It is important to note the proposed landfill sites that are currently being processed as some site licenses could be granted during the route selection stage of the scheme.

## 7.7. Groundwater

The study area is drained by two main rivers, the River Barrow and the River Nore, and their tributaries. Low-lying areas prone to flooding should be identified in more detail during the evaluation of specific routes.

The GSI were consulted about the locations of public well supplies in the study area, and were able to provide data on wells in Counties Laois and Kilkenny only. These are plotted on the geotechnical constraints maps. Data on County Kildare and County Carlow was not available from the GSI. Further investigation of main

wells will be necessary at route selection stage wherever the routes are likely to impact on the groundwater supply.

## 7.8. Resources - Aquifers

### *Consolidated Sediments (Bedrock)*

The main bedrock aquifers identified are:

- Karstified limestone: Ballyadams and Clogrennan formations. These formations contain an aquifer of regional importance. A large spring located in the south of Paulstown is the source for a regional water supply in a part of Co Kilkenny.
- Dolomitised limestones, Ballysteen, and Milford formations. A substantial part of this aquifer drains in the River Nore. This aquifer has been developed for industrial water supply in Carlow Town and for municipal supply in Muinebheag.
- Ballysteen Formation: can contain aquifers of regional importance (3).
- Ballymartin Formation: only contains aquifers of minor importance (3).
- Maulin Formation: These rocks contain only minor aquifers (3).

The different geological formations listed above can be identified on the Geological bedrock maps (Sheets 16 and 19). The constraints to route selection posed by bedrock aquifers are not likely to be as significant as sand and gravel aquifers, so they have not been plotted on the geotechnical constraints maps.

### *Unconsolidated Sediments (Sand and Gravels)*

There are a number of thick deposits, mainly of sand and gravel, which occur in the study area, as follows:

- Mid-Kildare gravel aquifer, designated G-1. This is a major aquifer, which is widely used as a source of water supply in the area. The thickness of the gravels within the study area is between 5 m to 30 m (Reference 4).
- Along the Burren River in East Carlow (10 m to 15 m).
- Major aquifer along the River Barrow north and south of Carlow Town (10 m to 25 m), designated G-2.
- Major aquifer along the River Nore north of Kilkenny City (10 m to 30 m), designated G-3.

The other gravel aquifers identified stretching along the main rivers occurring in the study area are considered to be minor aquifers (Reference 5).

### *Aquifer Vulnerability and Protection*

A draft aquifer protection plan for County Laois has recently been prepared by the Geological Survey of Ireland. A similar draft aquifer protection plan for County Kilkenny is expected to be available by September 2001. According to the Geological Survey of Ireland, these aquifer protection plans are intended to provide guidance to local authorities for planning permissions but do not have statutory status.

The draft groundwater vulnerability mapping for County Laois and for County Kilkenny were consulted. The data available was examined to identify any major vulnerable aquifers occurring within the study area. Some extremely vulnerable aquifers were reported in areas where the shallow rocks lay within 0 m to 3 m from the surface as follows:

- A large rock and sand/gravel aquifer extending in a broad line from Carlow to Athy. The rock aquifer, associated with the Karstified Clogrenan and Ballyadams Limestone Formations, was reported to be highly vulnerable.

Where the water table would be lowered as a result of excavation, the potential effects on local wells should be assessed. The lowering of the water table could reduce or eliminate the well yield.

Road drainage as well as accidental spillages could potentially have an impact on the quality of the local groundwater. In areas of road crossings through zones of high aquifer vulnerability, specific design measures for road drainage may be required to prevent surface activity from polluting the underlying groundwater.

## **7.9 Mineral Resources**

There are numerous active and disused sand and gravel pits within the study area, many of which are identified on the geotechnical constraints maps. The locations of rock quarries identified on the GSI maps, which are fewer in number are also shown on the geotechnical constraints maps. Some of these pits and quarries may provide a source for road construction materials.

Based on the available information, the only areas that have any significant mineral resources that may constrain route selection are the coal seams around the Castlecomer plateau.

As specific routes could impact on the viability of open cast mining, the potential for mineral resources along specific routes will be considered at route selection stage. It may be possible to identify these potential mineral resource areas in consultation with the Department of the Marine and Natural Resources, the County Councils, as well as the minerals section of the GSI.

A non-exhaustive list of mines in and around the study area is given in Table 7.4.

## 7.10 Sources Of Information:

The following sources of information were used:

- Geological Survey of Ireland, Bedrock Geology Memoirs and 1:100,000 Map sheets 16 and 19, 1994.
- Soil National Survey of Ireland, Soils of Counties Kildare, Laois and Carlow, 1970.
- Geological Survey of Ireland, Select Digital Map output – Quaternary Geology.
- Peatland Map of Ireland, National Soil Survey, 1982.
- Major Aquifers Map of Ireland, Geological Survey of Ireland, 1982.
- Geological Survey of Ireland, Counties Kilkenny and Laois Public Supply Wells, 2001.
- Geological Survey of Ireland, Karst Features Database for Counties Kilkenny and Tipperary, 2001.
- Geological Survey of Ireland, Draft Vulnerability Maps for Counties Laois and Kilkenny, 2001.
- Environmental Protection Agency, Local Authority landfill sites in Ireland, 1995-1997.
- Geological Survey of Ireland, Directory of active quarries, pits and mines in Ireland, 1994.

## 7.11 References

The following references have also been consulted:

1. B J Murphy & Associates, “ N9 Thomastown By-Pass – Geological Report. 1997.
2. Soil National Survey of Ireland, Soils of County Carlow, 1970.
3. Brian P. Connor & Associates Ltd, “Preliminary report on the impact of proposed Thomastown By-Pass on underlying and adjacent aquifers”. 1997.
4. G.R.Wright, “ The Mid-Kildare Gravel Aquifer”, Groundwater Section, Geological Survey of Ireland, 1988.
5. Geological Survey of Ireland, Bedrock Geology memoirs, Geology of Carlow-Wexford.

6. Hanrahan, E.T, “ Irish Glacial Till: Origin and Characteristics”, Oighear-Thalamh Eireann, 1977.
7. Burdon, D.J., “Some Ancient Dolines in the Karst of Ireland”, 2<sup>nd</sup> Multidisciplinary Conference on Sinkholes and the Environmental Impacts of Karst, Orlando, 1987.
8. B.J. Murphy & Associates, “Geotechnical Report (Final), Desk Study, Walkover Survey and Reconnaissance Geophysical Survey, Proposed Carlow Eastern By-Pass”, January 2000.

**Table 7.1 : Geological formations occurring in the study area.**

Period	Formation	Rock Types	Excavatability	Cutting Stability	Map Symbol (where used)
Silurian	Carrighill	Greywackes, siltstones and shales	Generally rippable.	Can be highly faulted and folded leading to stability problems	
	Tipperkevin	Greywackes and shales	Generally rippable	As above	
Carboniferous	Ballymartin	Interbedded muddy limestone and shaly mudstone	Generally rippable	Generally stable	
	Ballysteen	Muddy limestone	Generally rippable	Generally stable	
	Butlersgrove	Argillaceous limestone occasionally	Generally rippable	Generally stable	
	Milford	Calcarenitic Limstone/Dolomitised	Generally rippable	Generally stable	
	Ballyadams	Shelf Limestone, potentially Karstic	Generally rippable, may prove hard to excavate where the rock is massive	Stable except for karstified zones	Rck-3
	Clogrenan	Shelf Limestone, potentially Karstic	Generally rippable	As above	Rck-3
	Quinagh	Lenticular mudstone and coarse siltstone	Generally rippable	Generally stable	

**Note:** The geological formations within the Castlecomer plateau have not been addressed because the plateau area has been excluded from the study area.

**Table 7.2 : Typical Soil Properties**

<b>Soil Type</b>	<b>Strength</b>	<b>Compressibility</b>	<b>Use as Earthworks</b>
Gravel	Good	Low	Good
Glacial Till	Variable	Low-medium	Variable
Peat	Very poor	Very high	Not suitable
Alluvium	Poor	High	Poor

**Table 7.3 : List of Pits, Quarries and Landfill Sites****A : Pits**

<b>Location</b>	<b>Number<sup>1</sup></b>	<b>Nearest Significant Town</b>
Dunmore pit, Dunmore, Co. Kilkenny	/	Kilkenny
Kildavin Pit, Kildavin, Co. Carlow	/	Kildavin
Liam Conway and Sons Ltd., Kildavin, Co. Carlow	/	Kildavin
Farrell's pit	Q87	Naas
Hempstown Commons pit	Q88	Blessington
Kilsaran Concrete LTD	Q89	Kilcullen
Lowtown Quarry	Q90	Lowtown
The Quarry Kilmeague	Q91	Naas/Newbridge
Walshestown pit	Q92	Naas

**B : Quarries**

<b>Location</b>	<b>Number<sup>1</sup></b>	<b>Nearest Significant Town</b>
Ballyellen Limestone Flour Works	Q1	Goresbridge
Clogrennane Quarry	Q2	Carlow
James Walsh Quarry	Q3	Leighlin Bridge

<b>Location</b>	<b>Quarry number</b>	<b>Nearest Significant Town</b>
Dan Morrissey		Milford
Gotham		Castledermot
Allen Quarry	Q86	Naas
Kellymount Quarry	Q96	Kilkenny
Ormonde Brick Shale	Q98	Castlecomer
Threecastles Quarry	Q100	Killaree
Campion's Quarry	Q102	Rathdowney
Carroll Quarry	Q103	Portlaois
Ballyadams Quarry	Q101	Ballintubbert

### **C : Landfill Sites**

<b>Facility Location</b>	<b>Status</b>
Arthurstown, Kill, Co. Kildare	Licensed
Silliot Hill Landfill, Silliot Hill and Brownstown, Co. Kildare	Pre-PD <sup>2</sup>
Powerstown, Carlow	Licensed
Clonsough, Kyleclonhobert, Co. Laois	Licensed
Dunmore, Co. Kilkenny	Licensed
Ballylinan Landfill site, Ballylinan, Co. Laois	Licensed
KTK Pit, Brownstown & Carnalway, Kilcullen, Co. Kildare	Licensed
The Lands, Pollardstown, The Curragh, Co. Kildare	Pre-PD <sup>2</sup>

- Notes 1: Number as shown on the Geotechnical Constraints maps (Drawings 00229/022 to 00229/024)  
 2: Application in process, no decision yet.

**Table 7.4 : Mineral resources**

<b>Location</b>	<b>Minerals</b>	<b>Comments</b>
Galmoy, Co. Kilkenny	Lead and Zinc	Active mine
Rossmore, Co. Laois	Coal	Inactive
Coolbaun, Co. Laois	Coal	Mining lease issued
Harberton Bridge, Co. Kildare	Lead and Zinc	Undeveloped metal deposit
Ardra, Castlecomer, Co. Kilkenny	Brick clay	Brick manufacture

Table 7.5 : Karst Data from GSI

2/26/01

	Feature Type	Feature Name	Easting	Northing	Townland	County	6 inch	1:25,000	Stratigraphy
1	Spring	N/A	26803	15668	DUNINGA	Kilkenny	21	2615SW	BA
2	Spring	N/A	26815	15648	DUNINGA	Kilkenny	21	2615SW	BA
3	Spring	N/A	26841	15632	DUNINGA	Kilkenny	21	2615SW	BA
4	Spring	N/A	26567	15672	MONEFELIM	Kilkenny	21	2615SW	BA
5	Spring	N/A	25669	15669	MONEFELIM	Kilkenny	21	2615SW	BM
6	Spring	N/A	26721	15547	CASTLEKELLY	Kilkenny	21	2615SW	BA
7	Spring	MONEENDUFF	26613	15780	PAULSTOWN	Kilkenny	21	2615SW	BM
8	Spring	TOBERGOORLICK POOL	26601	15726	PAULSTOWN	Kilkenny	21	2615SW	N/A
9	Spring	TOBERKEAGH POOL	26606	15803	PAULSTOWN	Kilkenny	21	2615SW	BM
10	Cave	POULNAGAT	26567	15772	PAULSTOWN	Kilkenny	21	2615SW	BM
11	Spring	N/A	26092	15631	BLANCHVILLES PK.	Kilkenny	21	2615SW	BM
12	Swallow Hole	N/A	26136	15725	FLAGMOUNT NORTH	Kilkenny	21	2615SW	CL
13	Spring	N/A	26048	15394	SHEAFIELD NORTH	Kilkenny	21	2615SW	BM
14	Spring	N/A	26101	15336	KYLEBEG	Kilkenny	20	2615SW	BM
15	Spring	N/A	26125	15335	KYLEBEG	Kilkenny	20	2615SW	BM
16	Spring	N/A	26141	15306	SHEAFIELD SOUTH	Kilkenny	20	2615SW	BM
17	Spring	N/A	26165	15306	SHEAFIELD SOUTH	Kilkenny	20	2615SW	BM
18	Spring	BOSTIONFORT WELL	26269	15324	CASTLEFELLIS	Kilkenny	20	2615SW	N/A
19	Spring	N/A	26042	15229	CLASHWILLIAM	Kilkenny	24	2615SW	N/A
20	Spring	N/A	26041	15191	CLASHWILLIAM	Kilkenny	24	2615SW	BA
21	Spring	N/A	26066	15184	CLASHWILLIAM	Kilkenny	24	2615SW	BA
22	Spring	N/A	26246	15225	WATREE	Kilkenny	24	2615SW	BA
23	Spring	N/A	26275	15208	WATREE	Kilkenny	24	2615SW	N/A
24	Spring	N/A	26317	15209	GOWRAN	Kilkenny	24	2615SW	N/A
25	Spring	N/A	26160	15023	CLOGHALA	Kilkenny	24	2615SW	BA

	Feature Type	Feature Name	Easting	Northing	Townland	County	6 inch	1:25,000	Stratigraphy
26	Spring	N/A	26443	15039	NEIGHAM	Kilkenny	25	2615SW	BA
27	Spring	N/A	26484	15002	GARBYLEESHA	Kilkenny	25	2615SW	BA
28	Spring	N/A	26034	15942	FRENEYSTOWN	Kilkenny	15	2615SW	N/A
29	Spring	N/A	26038	15921	FRENEYSTOWN	Kilkenny	15	2615SW	N/A
30	Spring	TOBERREAGH	26425	15905	JORDANSTOWN	Kilkenny	16	2615SW	BM
31	Spring	N/A	26423	15902	JORDANSTOWN	Kilkenny	16	2615SW	BM
32	Spring	N/A	26455	15895	JORDANSTOWN	Kilkenny	16	2615SW	BM
33	Enclosed Depression	N/A	26923	15338	BALLYELLIN	Carlow	19	2615SW	LP
34	Spring	SPA WELL	25045	15484	PURCELLSINCH	Kilkenny	19	2315SE	BM
35	Spring	N/A	25259	15488	PURCELLSINCH	Kilkenny	19	2315SE	BM
36	Spring	N/A	25365	15464	LAVISTOWN	Kilkenny	19	2315SE	BM
37	Spring	N/A	25405	15444	LAVISTOWN	Kilkenny	19	2315SE	BM
38	Spring	N/A	25184	15479	GALLOWSHILL	Kilkenny	19	2315SE	BM
39	Spring	N/A	25157	15535	DUKESMEADOWS	Kilkenny	19	2315SE	BM
40	Spring	N/A	25286	15610	LEGGETSRATH EAST	Kilkenny	19	2315SE	BM
41	Spring	ST. CANICE WELL	24996	15596	CROKERSHILL	Kilkenny	19	2315SE	BM
42	Spring	N/A	24764	15630	HOLDENSRATH	Kilkenny	19	2315SE	BM
43	Spring	N/A	24766	15862	BISHOPSFURZE	Kilkenny	19	2315SE	N/A
44	Swallow Hole	N/A	24825	15320	SHELLUMSRATH	Kilkenny	19	2315SE	SHL
45	Swallow Hole	N/A	24730	15385	CASTLEBLUNDEN	Kilkenny	19	2315SE	SHL
46	Swallow Hole	N/A	24740	15384	CASTLEBLUNDEN	Kilkenny	19	2315SE	SHL
47	Swallow Hole	N/A	24761	15366	BAUNREAGH	Kilkenny	19	2315SE	SHL
48	Swallow Hole	N/A	24825	15380	CLONMORAN	Kilkenny	19	2315SE	SHL
49	Swallow Hole	N/A	24831	15388	CLONMORAN	Kilkenny	19	2315SE	SHL
50	Swallow Hole	N/A	24731	15315	BAUNREAGH	Kilkenny	19	2315SE	SHL
51	Swallow Hole	N/A	24729	15273	CASTLEINCH	Kilkenny	19	2315SE	SHL
52	Spring	N/A	25990	15490	RATHCASH EAST	Kilkenny	20	2315SE	BM
53	Spring	N/A	25992	15481	RATHCASH EAST	Kilkenny	20	2315SE	SHL

	Feature Type	Feature Name	Easting	Northing	Townland	County	6 inch	1:25,000	Stratigraphy
54	Spring	N/A	25990	15305	BLANCHVILLESTOWN	Kilkenny	20	2315SE	N/A
55	Spring	ST. MARTINS WELL	25505	15614	TEMPLEMARTIN	Kilkenny	20	2315SE	N/A
56	Spring	TOBERNALEABE	25703	15554	CONEYGAR	Kilkenny	20	2315SE	BM
57	Spring	ST. FIACHRAS WELL	25431	15246	KILFERAGH	Kilkenny	20	2315SE	BM
58	Spring	N/A	25245	15915	KYLEMORE	Kilkenny	14	2315SE	BM
59	Swallow Hole	N/A	25242	15925	KYLEMORE	Kilkenny	14	2315SE	BM
60	Spring	N/A	25384	15984	SANDFORDSCOURT	Kilkenny	14	2315SE	BM
61	Spring	N/A	25356	15910	SANDFORDSCOURT	Kilkenny	14	2315SE	BM
62	Spring	N/A	25365	15915	SANDFORDSCOURT	Kilkenny	14	2315SE	BM
63	Spring	N/A	25371	15920	SANDFORDSCOURT	Kilkenny	14	2315SE	BM
64	Spring	N/A	25615	15193	HOLDENSTOWN	Kilkenny	24	2315SE	N/A
65	Spring	N/A	25639	15199	HOLDENSTOWN	Kilkenny	24	2315SE	N/A
66	Spring	WHITE WILLIAMS WELL	25462	15011	KILREE	Kilkenny	24	2315SE	BM
67	Enclosed Depression	WALLSLOUGH	25362	15185	FURZEHOUSE	Kilkenny	23	2315SE	BM
68	Cave	HOLDENSRATH CAVES	24785	15635	HOLDENSRATH	Kilkenny	19	2315SE	SHU
69	Swallow Hole		24656	16822	CONNAHY	Kilkenny	10	2315NE	
70	Spring		24657	16126	SIMONSLAND	Kilkenny	10	2315NE	
71	Swallow Hole		24625	16080	KILLAREE	Kilkenny	14	2315NE	
72	Swallow Hole		24626	16084	KILLAREE	Kilkenny	14	2315NE	
73	Cave	CAVE OF DUNMORE	25094	16495	MOHILL	Kilkenny	14	2315NE	CL

	<b>Feature Type</b>	<b>Feature Name</b>	<b>Easting</b>	<b>Northing</b>	<b>Townland</b>	<b>County</b>	<b>6 inch</b>	<b>1:25,000</b>	<b>Stratigraphy</b>
74	Cave		24520	16073	KILLAREE	Kilkenny	14	2315NE	SAU
75	Borehole	BOREHOLE NO. 6	23100	12650	BALLYPATRICK	Tipperary	78	2311NW	WA
76	Swallow Hole	N/A	23350	12660	KYLANOREASHY	Tipperary	75	2311NW	WA
77	Swallow Hole	N/A	23905	12755	BALLINURRA	Tipperary	76	2311NW	P.G.
78	Swallow Hole	N/A	23975	12775	BALLINURRA	Tipperary	76	2311NW	P.G.
79	Borehole	BOREHOLE NO.7	23100	12650	BALLYPATRICK	Tipperary	75	2311NW	WA
80	Spring	CONWAY'S WELL	24510	12134	PILLTOWN	Kilkenny	39	2311NE	BA
81	Swallow Hole	N/A	24596	12411	BRENAR	Kilkenny	39	2311NE	N/A