

**Recommended Collection, Presentation and Interpretation
of
Geological and Hydrogeological Information for Quarry Developments**



**Published
By The
Institute of Geologists of Ireland**

General Information		Comment		
Ordnance Survey Maps	Outline of Property Boundary & Limit of Excavation	Ordnance Survey 1:50,000	Map of local and regional drainage catchments and previously ^{Note 2} identified drainage features with particular attention to karst features.	
	Outline of Property Boundary & Limit of Excavation	1:10,560 ^{Note 7}	Map of local and regional drainage catchments and previously identified ^{Note 2} drainage features with particular attention to karst features.	
	Outline of Limit of Excavation	Ordnance Survey 1:2,500	Map of local and regional drainage catchments and previously ^{Note 2} identified drainage features with particular attention to karst features.	
Geological Maps	Geological & Hydrogeological Maps	1:50,000	Map series (where available) to include bedrock geology, subsoil, aquifer and groundwater vulnerability.	
Topographic Survey	Malin Head Ordnance Datum		DTM from Ordnance Survey otherwise ground contours within property boundary to 2m intervals and for 500m outside property boundary to 5m intervals.	
	Topographic Levels ^{Note 4}		Recommended that all surveyed features such as boreholes or water levels be measured to an accuracy of + /- 100mm above Ordnance Datum.	
	Grid References		Recommended that all surveyed features such as boreholes and springs be located to 6 digits on the Irish National Grid.	
	Aerial Photograph	1:10,560 ^{Note 7}	Recommended to extend 2km from limit of excavation.	
Site Information ^{Note 1}				
Geophysical Surveys	Resistivity ^{Note 4}	All Quarries	Sufficient ^{Note 3} line and data point distribution to characterise subsoil nature and depth over extent of excavation.	
		Rock Quarries Only	Sufficient ^{Note 3} line and data point distribution to identify major bedrock structures such as faults, weathered zones or cavities above or below the water table.	
Geological Testing	Trial Pits ^{Note 4}	Subsoil (Rock Quarry Only)	Sufficient ^{Note 3} number to characterise and sample subsoil deposits (>4m depth where possible).	
	Trial Pits ^{Note 4}	Sand & Gravel Deposits	Sufficient ^{Note 3} number to quantify and sample aggregate resource.	
	Boreholes ^{Note 4}	All Quarries	Sufficient ^{Note 3} number to establish geology and geotechnical framework, confidently prove resource, and to present quarry design.	
	Testing ^{Note 5}	Subsoil Sieve Analyses	Sufficient ^{Note 3} number to characterise and prove sand and gravel resource.	
	Testing ^{Note 5}	Rock Analyses	Sufficient ^{Note 3} number to characterise and prove rock resource.	
		Geotechnical Testing ^{Note 4}		Stability studies required to meet Health & Safety Authority requirements.
Hydrogeology	Monitoring Boreholes ^{Note 4}		Sufficient ^{Note 3} number to characterise hydrogeological regimes in both the subsoil deposits and the underlying bedrock.	
		Subsoil	Required if the winter water table is likely to occur within subsoil deposits.	
		Bedrock	Should extend to 3m below the final quarry floor level or to 3m below the summer water table level, which ever is the deepest.	
	Groundwater Monitoring ^{Note 4}		Monthly measurements to include as a minimum, one measurement of the Winter highest level and one measurement of the Summer lowest level.	
			Recommended to provide at least 1 No. continuous groundwater level monitoring device for duration of groundwater monitoring period.	
	Pumping Well(s) ^{Note 4}		Ideally located in area(s) of potentially high permeability from geophysical survey and/or drilling programmes.	
			Pumping well(s) to extend to 5m below final quarry floor level.	
	Pumping Tests ^{Note 4}	Continuous Yield Tests		Required to provide underlying subsoil and bedrock aquifer characteristics, boundary conditions and water samples.
				Test duration of 12 - 72 hours depending on sustainable yield achieved.
			Test duration >72 hours where projected maximum dewatering rate > 3Ml/day ^{Note 8} . Test extraction rate to exceed 1Ml/day from 1 No. or more wells.	
			Groundwater levels to be recorded at regular intervals at pumping & monitoring boreholes, and recommended at available and nearby wells & springs.	
Groundwater Samples ^{Note 4 & Note 5}	Pumping Well(s)		Collect samples 1 hour after the start of and before the end of each pumping test. Analyses for major ions, trace metals, hydrocarbons, pH & conductivity.	
	Monitoring Wells		Collect 1 No. sample from each monitoring borehole & spring on quarry property. Analyses for major ions, trace metals, hydrocarbons, pH & conductivity.	
On Site Potable Water Source ^{Note 4 & Note 5}			Establish sustainable yield and show that the supply can meet Drinking Water Standards (S.I. No.439 of 2000).	
Well Survey ^{Note 4}			Recommended distance of 1km from limit of excavation. A greater distance is recommended where maximum dewatering rate projected to be >3Ml/day.	

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Site Information (Continued)			Comment
Meteorology	Nearest Rainfall Station	30 year Averages	Annual & monthly rainfall averages from nearest meteorological station. Evapotranspiration data from nearest available agri-meteorological station.
		Daily Records	For the period of groundwater monitoring above.
	Nearest Synoptic Meteorological Station	Extreme Rainfall Event Data	Recommended to limit quarry outflow to mean annual flood (QBAR) with storm water storage/retention within property/excavation to accommodate 30 year storm. Where appropriate, proposed storm water retention and settlement measures should be described.
Hydrology	Surface Water Drainage	1:10,560 ^{Note 7}	Drainage map to show location, name (where appropriate) and type of each previously identified drainage feature within 2 km from limit of excavation. Previously identified features to include seasonal & permanent springs, sinks, streams, rivers, lakes, turloughs and wetlands.
	Flow Measurements ^{Note 4}		Use EPA /OPW flow data where available or recommended to take a minimum of 3 low flow measurements between August and October.
	Drainage Capacity Survey ^{Note 4}		Recommended to determine high flow capacity of drainage network from quarry perimeter to receiving water body and for 500m downstream of quarry outflow.
	Surface Water Quality		Use EPA/OPW or Co.Co. data where available and appropriate or take 1 sample at quarry outfall during low flow conditions.
Discharge Licence			A licence is required by Section 16 of the Local Government (Water Pollution Act), 1979 for the discharge of trade effluent to either surface water or groundwater.
Data Interpretation			
Plan Maps		1:10,560 ^{Note 7}	Base Map showing excavation and Phase outlines, boreholes, wells, identified drainage & geological features together with sampling locations.
		1:10,560 ^{Note 7}	Copy of base map showing contours of bedrock surface.
		1:10,560 ^{Note 7}	Copy of base map showing contours of subsoil thickness.
		1:10,560 ^{Note 7}	Copy of base map showing Winter groundwater contours and flow directions.
		1:10,560 ^{Note 7}	Copy of base map showing Summer groundwater contours and flow directions.
		1:10,560 ^{Note 7}	Copy of base map showing groundwater contours, flow directions at appropriate Phase intervals and at end of life.
Cross Sections		Existing Conditions	Sections to have consistent horizontal and vertical scales and to extend a minimum of 500m outside quarry perimeter in each direction on a 1:10,560 ^{Note 7} map.
		Conditions at appropriate Phase intervals	Sufficient number ^{Note 3} of sections showing relevant boreholes, wells, springs, surface water features together with predicted groundwater levels.
		Conditions at End of Life	Sufficient number ^{Note 3} of sections showing relevant boreholes, wells, springs, surface water features together with predicted groundwater levels.
Conceptual Model		Existing Conditions	Conceptual model to describe predevelopment geological and hydrogeological environments at and surrounding planned quarry.
		Conditions at appropriate Phase intervals	Conceptual model to indicate likely significant impacts on geology and hydrogeological environments at and surrounding planned quarry.
		Conditions at End of Life	Conceptual model to indicate likely significant impacts on geology and hydrogeological environments at and surrounding planned quarry.
Appendices			Recommended that all trial pit & borehole logs, pumping rates and water level data collected during the quarry investigation accompany the interpretative report.

Note 1; Recommended integrated and flexible field work programmes, scoped on preliminary conceptual model and capable of changing and evolving as geological and hydrogeological models develop.

Note 2; As shown on published Ordnance Survey maps and /or identified within data bases maintained by the Geological Survey of Ireland and other Government agencies.

Note 3; The actual number will be determined by the nature and complexity of the geological regime and the scale of the likely significant impacts associated with the proposed excavation.

Note 4; Recommended that field work be planned, directed and supervised by appropriately qualified and competent persons.

Note 5; Recommended to use accredited laboratory.

Note 6; Mean Annual Flood as per Institute of Hydrology Report No.124.

Note 7; Or appropriate similar scale.

Note 8; 1MI/day = 1,000M³/day.

Useful References: (i) Code of Practice for Site Investigations B.S. 5930 of 1999;
(ii) Geology in EIS - A Guide - Institute of Geologists of Ireland, 2002.

**Institute of Geologists of Ireland
School of Geological Sciences
University College Dublin
Belfield, Dublin 4**

Tel. 01- 7162085 / email. admin@igi.ie

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