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**Geological Survey of Ireland Research Programme
- Short Call 2015, Final Report -**

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Organisation name	Tobin Consulting Engineers
Organisation type:	☐ HEI ☐ Public Sector (other) ☒ Private Sector
Department/section	Energy & Environment

Project Title	Production of a handbook of karst for Irish hydrogeologists
Contract No.	2015-sc-046



2. Project information:

Title of project	Production of a handbook of karst for Irish hydrogeologists
Did you make any formal amendment to the project workplan / budget?	☐ yes ☒ no If yes, please specify:

Project Report (max 1500 words, excluding figures and headings):

(i) Objectives and scientific/engineering targets beyond the state of the art

The main outcomes were the writing of a handbook which provides:

- A concise but full guide to the main characteristics of the hydrogeology of karstified limestone.
- A description of the character of the hydrogeology of various karstified limestone areas of Ireland
- A summary of the most effective techniques that may be used to investigate such karst groundwater systems, with special reference to Ireland.

This handbook provides a concise but full guide to the main characteristics of the hydrogeology of karstified limestone. It describes the character of the hydrogeology of various karstified limestone areas of Ireland and summarises the most effective techniques that may be used to investigate such karst groundwater systems, with special reference to Ireland. It will be of use primarily, to practicing

hydrogeologists and allied specialists who lack formal training in karst hydrogeology but who may be required to undertake work in karst.

Despite the importance of karstic groundwater in Ireland little or no training is available to trainee hydrogeologists at undergraduate or graduate level. Textbooks on hydrogeology make only passing reference to the topic and those texts on karst that are available are focussed primarily on geological and geomorphological aspects. Optimal management of groundwater in Ireland requires an informed understanding of the workings of the karst system and of its relations with associated surface waters and ecosystems with particular regard to Irish conditions. The handbook provides this basic information.

Research into karst hydrogeology, karst water quality and ecology has increased with a particular acceleration in output in the past 15-20 years. This includes outputs from University research projects (most recently the modelling of karst systems); the compilation of Groundwater Protection Schemes for counties many of which contain significant karst aquifers; the initiation of hydrometric data collection from karstic springs; the production of Source Protection Reports for karst springs. This new information is largely fragmented and has not been synthesised into a coherent up-to-date summary of our understanding of karst hydrogeology in Ireland. The handbook presents such a synthesis.

(ii) Implementation (including reference to timelines, milestones, management)

The project was managed principally by Dr David Drew, who is the main researcher and author. It began with a comprehensive literature review on karst in Ireland and any recent investigations into Irish karst. The main part of the book was written as outlined in the chapter headings. Fieldwork and photography for the book took place mainly over the summer and autumn.

Bad weather hampered drone activity throughout the summer. The drone contractor also lost all files collected during one field work stint. They repeated the work at their own cost.

Collaboration was explored with Ronan O'Toole in relation to using GSI UAV on selected sites to benefit both projects. Ronan flew selected sites in the autumn.

(iii) Outputs (please use bullet points)

The main output is the book. A poster was also prepared for the Geoscience's conference.

The book comprises the following sections and chapters.

SECTION A
OVERVIEW OF KARST

Chapter 1 Introduction to the book

Chapter 2 What Is Karst?

2.1 Why karsts are distinctive

2.2 Defining karst

2.3 The evolution of karsts

2.4 The significance of karsts

Chapter 3 Karst Landforms

3.1 Introduction

3.2 The development of karst landscapes

- 3.3 Surface landforms of karst regions
- 3.4 Underground landforms Of karst regions (caves)

Chapter 4 Karst Hydrogeology

- 4.1 The karstic groundwater system
- 4.2 Recharge to karstic aquifers
- 4.3 Karst groundwater flow systems
- 4.4 Discharge from karst aquifers
- 4.5 Classifying karst aquifers

SECTION B

KARST IN IRELAND

Chapter 5 An overview of karst in Ireland

Chapter 6 The development of karst in Ireland

Chapter 7 Karst regions of Ireland

- 7.1 The distribution of karst in Ireland
- 7.2 The South of Ireland (South Tipperary, Cork, Waterford)
- 7.3 The Eastern Lowlands (Meath, Westmeath, Offaly, Laois, North Tipperary)
- 7.4 The Western Lowlands (Mayo, Roscommon, Galway, Clare)
- 7.5 The Burren
- 7.6 Plateaux of the north-west (Counties Sligo, Leitrim Cavan and Fermanagh)
- 7.7 Outlying karst areas

Chapter 8 Hydrogeology of karst in Ireland

- 8.1 Introduction
- 8.2 Lithological and structural influences
- 8.3 Recharge
- 8.4 Flow systems
- 8.5 Discharge
- 8.6 Groundwater level changes
- 8.7 Groundwater surface water interactions

Chapter 9 Methods Of Investigation In Karst Hydrogeology

- 9.1 Introduction
- 9.2 The importance of scale in karst aquifers
- 9.3 Methods of investigation
- 9.4 Methods applicable to Ireland
 - Geomorphological mapping
 - Tracing
 - Analysing spring flows

Chapter 10 Case Studies Of Karst Investigations In Ireland

Chapter 11 Bibilography

Impact/value of the project (Max 500 words):

1. The Handbook provides an overview of the nature of groundwater in karstic terrains and how to investigate such groundwater. This information will be particularly valuable to those whose work brings them into interaction with karstic environments but who lack any formal training in karst

hydrogeology.

2. The Handbook summarises the knowledge obtained in recent decades relating to karst in Ireland from a variety of sources into a single accessible source.
3. The Handbook provides a one-stop source of information on Irish karst (text, graphics, and photographs) for educational or promotional purposes for use by second and third level educational establishments, by Governmental and semi-state institutions and by private companies.

The existence of the handbook will facilitate identification of aspects of karst and karst waters in Ireland that require further investigation.