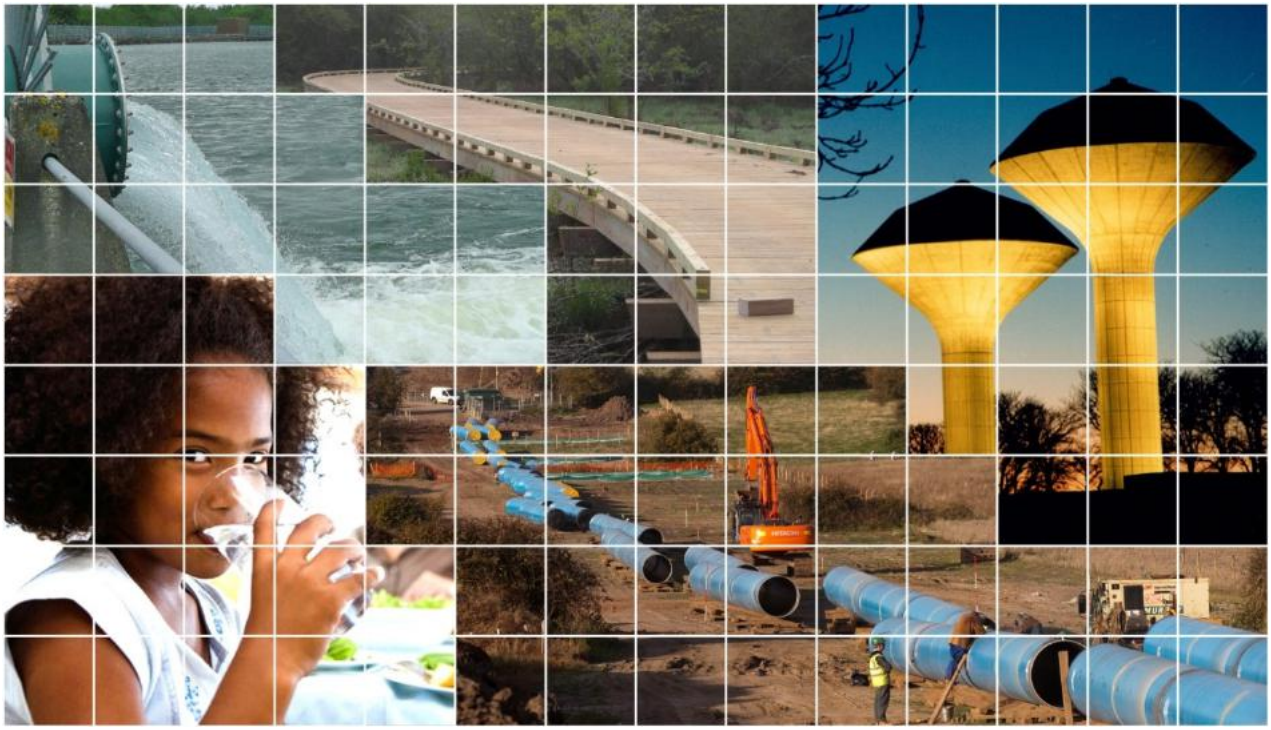
Water Supply Project
Eastern and Midlands Region

Water Supply Options Working Paper

June 2015 **Revision A01**



JACOBS TOBIN Patrick J. Tobin & Co. Ltd

UISCE EIREANN : IRISH WATER

Document Control Sheet

BPP 04 F8
Version 15; March 2013

Project: Water Supply Project – Eastern and Midlands Region
Client: Irish Water **Project No:** 32105801
Document title: Water Supply Options Working Paper
Ref. No: 150525WSP1_Options Working Paper_A01

	Originated by	Checked by	Reviewed by
REVISION	NAME	NAME	NAME
F01	PMG	AK	MFG
Approved by	Michael Garrick	As Project Manager I confirm that the above document(s) have been subjected to Jacobs' Check and Review procedure and that I **approve them for issue**	INITIALS: MG
	Peter Smyth		INITIALS
DATE: 16 Sep 2014	**Document status:** For Client Review		

REVISION	NAME	NAME	NAME
F02	MFG	KOB	PMG
Approved by	Michael Garrick	As Project Manager I confirm that the above document(s) have been subjected to Jacobs' Check and Review procedure and that I **approve them for issue**	INITIALS
	Neil Delaney		INITIALS
DATE: 07 April 2015	**Document status:** For Client Review		

REVISION	NAME	NAME	NAME
F03	MFG	PMG	DGS
Approved by	Michael Garrick	As Project Manager I confirm that the above document(s) have been subjected to Jacobs' Check and Review procedure and that I **approve them for issue**	INITIALS
	Neil Delaney		INITIALS
DATE: 13 May 2015	**Document status:** For Client Review		

REVISION	NAME	NAME	NAME
A01	MFG	PMG	DGS
Approved by	Michael Garrick	As Project Manager I confirm that the above document(s) have been subjected to Jacobs' Check and Review procedure and that I **approve them for issue**	INITIALS: MG
	Neil Delaney		INITIALS
DATE: 25 May 2015	**Document status:** For Client Approval		

Table of Contents

Appendix D Multi Criteria Analysis Review

Appendix E SEA Review

Appendix F SEA Consultation Review

Appendix G Constraints Mapping

List of Acronyms

EIA	Environmental Impact Assessment
GDA	Greater Dublin Area
GDWSSS	Great Dublin Water Supply Strategic Study
IROPI	Imperative Reasons for Overriding Public Interest
IW	Irish Water
MCA	Multi Criteria Analysis
OWP	Water Supply Options Working Paper
PNR	Project Need Report
SEA	Strategic Environmental Assessment
WSP	Water Supply Project Eastern and Midlands Region
WTP	Water Treatment Plant

1 Executive Summary

1.1 Background

On 1st January 2014, Irish Water assumed responsibility for managing Ireland's water and wastewater investment and maintenance programmes. On that date, Irish Water also took over the management of the Water Supply Project Eastern and Midlands Region (WSP) from Dublin City Council / Department of Environment, Community and Local Government. The project is currently in the project planning stage.

When responsibility for the project was with Dublin City Council, the project was known as the 'Water Supply Project – Dublin Region' as the principal focus was planning for future water supply needs of the East / Dublin Region up to 2050 and beyond. However, the transfer of water services functions to Irish Water has opened a unique opportunity to take a strategic view of providing water services at a national level and as a result the project has now been referenced to the (three) regions within which Irish Water operates. Since the bulk of water supplies from the project will be delivered to the East & Midlands, the project is now known as the 'Water Supply Project Eastern and Midlands Region (WSP)'.

1.2 Previous SEA work

During the previous Strategic Environmental Assessment (SEA) process carried out by Dublin City Council (DCC) and their Service Providers over the 2007-2011 period, ten options (one of which had two sub-options) for a new source of water supply, were appraised at a high, desktop-study level, on limited data which was available at that time. The options were appraised under technical, environmental, socio-economic and economic assessment criteria.

The ten Options (and sub-options) assessed in the SEA process (2007-2011) and published by DCC in the SEA Statement of 2011 were:

- Option A – Lough Ree (Direct)
- Option B – Lough Derg (Direct)
- Option C – Parteen Basin (Direct)
- Option D – Lough Ree and Lough Derg
- Option E – Lough Ree and Storage
- Option F – Lough Derg and Storage
  - Option F1 – Lough Derg and Storage (Rochfortbridge)
  - Option F2 – Lough Derg and Storage (Garryhinch)
- Option G –Lough Ree with Impoundment
- Option H – Desalination
- Option I – Groundwater
- Option J – Conjunctive use of the River Barrow and River Liffey

Having assessed these options, the top ranked technically viable options (four in total) that emerged from the 2007-2011 SEA were as follows:

(i) Option F2 (North East Lough Derg with Storage)
(ii) Option B (North East Lough Derg Direct)
(iii) Option C (Parteen Basin Direct)
(iv) Option H (Desalination)

The expressed preference at the time for Option F2 (abstraction from L. Derg with Raw Water Storage) was provisional and was qualified with the requirement for additional investigative works to be undertaken to validate the engineering design, environmental impacts and cost estimates considered through the option appraisal process. These investigative studies were identified as:

(a) Water quality modelling of Lough Derg and Parteen Basin.
(b) A full geophysical survey of the soil and bedrock conditions at Garryhinch.

These investigative studies are now underway on the WSP Project.

1.3 Irish Water Review

Over the 2014-2015 period, Irish Water and their Service Providers have updated and reviewed the 2007-2011 SEA process and Options, and the findings of these updates / reviews are now being reported on by Irish Water in this Options Working Paper, which has been published for public consultation. The Irish Water updating and reviews involved further examinations - these included:

- a desktop review of the SEA ten options appraisal process, taking cognisance of developments in the intervening period (2011-2015).
- re-examining the SEA ten options along with stakeholder feedback previously received during public consultations (2007 – 2011) and subsequently up to the present time (2011 – 2015)
- assessing each of the ten options for their ability to supply the quantity of water needed without impacting negatively on the water source or on the environment
- assessment of each of the proposed water abstractions for compliance with the requirements of the Habitats Directive

Following Irish Water's review of the ten options previously considered, the review validated the four top ranked technically viable options previously identified and confirmed that they still remain appropriate to be brought forward for further consideration (during the EIA & Planning Process). The four options, with their identifying labels in the SEA, listed in no particular order of priority, are as follows:

- DESALINATION - Option H
- LOUGH DERG (DIRECT) – Option B
- LOUGH DERG AND STORAGE – Option F2
- PARTEEN BASIN (DIRECT) – Option C

The Irish Water review also identified the following:

- Option J (Barrow-Liffey Conjunctive use) is unable to sustainably provide the projected water supply requirements of the Water Supply Area

- Option I (Groundwater) is unable to sustainably provide the projected water supply requirements of the Water Supply Area.

- Options A, D, E, and G (all sourcing water from Lough Ree) are unable to sustainably provide the projected water supply requirements of the Water Supply Area whilst remaining in compliance with ESB requirements as set out in 'The Regulations and Guidelines for the Control of the River Shannon'.

- In addition, Options A, D, E, and G cannot be used for water supply as they do not comply with the Habitats Directive Assessment (HDA). This is legislation which applies the precautionary principle (in favour of exclusion) when there is uncertainty in relation to potential environmental impacts on European designated sites (e.g. Special Areas of Conservation).

The identification of Options B, C, F2 and H as reasonable water supply options for consideration during the current EIA & Planning Process validates the Multi Criteria Analysis and the Strategic Environmental Assessment processes applied previously under the SEA and HDA work (2007-2011). It also validates the four top ranked options previously identified in the Adopted Plan / SEA Statement published in 2011.

Given the conditional nature of the SEA 'recommended option' from the previous study it has been decided not to consider any option as an SEA 'recommended option' at this point in the current process.

1.4 Constraints and Assessment Criteria

The Options Working Paper concludes by identifying constraints and assessment criteria that are to be applied in further assessment of the identified reasonable water supply options.

A 'constraint' is any limiting factor on site selection for infrastructure. It can be related to human settlements, or environmental, or technical factors. The selection of the location for infrastructure sites and the routes for pipelines is therefore approached primarily through avoidance of impacts, by avoiding constraints, wherever possible.

Irish Water and their Service Providers have identified a range of constraints considered relevant to site selection for infrastructure. These are presented under the following headings:

- Ecology
- Archaeology, Cultural Heritage and Architectural Heritage
- Soils, Geology and Hydrogeology
- Water Quality
- Landscape and Visual
- Population and Infrastructure

Irish Water is seeking feedback on the range of constraints to ensure all relevant constraints have been identified for further consideration.

Furthermore, as an initiation to the process of constraints mapping, Irish Water and their specialists have identified an initial number of constraints that Irish Water consider should be avoided where options permit. These have been mapped and used to define a "white space" within which infrastructure should be sited.

Feedback is being sought on the constraints used to define this white space.

Further to consideration of siting, the Options Working Paper also sets out the assessment criteria which will be used in further appraisal of Options.

The Options Appraisal methodology will rely on a relative assessment of the 'people related' and 'environment related' impacts to identify a preferred option from the four currently identified technically viable options.

The 'people related' and environmental criteria which will be applicable to the EIA assessments are as follows:

- Biodiversity, Flora and Fauna
- Fisheries
- Air/Climatic Factors
- Material Assets (Energy)
- Sustainability
- Cultural Heritage (including Architecture & Archaeology)
- Landscape & Visual
- Material Assets (Land use)
- Tourism
- Population
- Human Health
- Soils, Geology and Hydrogeology

The technical criteria which will be applicable to the EIA assessments are as follows:

- Safety
- Planning Policy
- Engineering and Design
- Capital and Operating Costs
- Sustainability

Each option will be assessed under each of these assessment criteria outlined above, to identify the emerging preferred option. The Preferred Option will emerge from the four options already identified: B, C, F2 and H.

2 Introduction

2.1 Introduction

On 1st January 2014, Irish Water assumed responsibility for managing Ireland's water and wastewater investment and maintenance programmes. On that date, Irish Water also took over the management of the Water Supply Project Eastern and Midlands Region (WSP) from Dublin City Council / Department of Environment, Community and Local Government. The project is currently in the project planning stage.

Management of the planning stage of the project is currently focused on achieving a planning submission to An Bord Pleanála by mid-2017 with a view to delivering an additional source of water throughout the Eastern and Midlands Region by 2022.

When responsibility for the project was with Dublin City Council, the project was known as the 'Water Supply Project – Dublin Region' as the principal focus was planning for future water supply needs of the East / Dublin Region up to 2050 and beyond. However, the transfer of water services functions to Irish Water has opened a unique opportunity to take a strategic view of providing water services at a national level and as a result the project has now been referenced to the (three) regions within which Irish Water operates. Since the bulk of water supplies from the project will be delivered to the East & Midlands, the project is now known as the 'Water Supply Project Eastern and Midlands Region (WSP)'.

The transfer of responsibility for managing the project from Dublin City Council to Irish Water has also resulted in an increased focus on potential 'Benefiting Corridors' which will be created by the water transfer pipelines between potential new water source options and the terminal delivery point. This is because Irish Water has responsibility for ensuring secure, resilient and high quality water supplies in all locations of Ireland and not just in the East of Ireland. A 'Benefiting Corridor' between a River Shannon-based source and Dublin is greater than, for example, an Irish Sea source in the case of a Desalination option. The increased emphasis on maximising benefits in a 'Benefiting Corridor', when taken into consideration with other assessment criteria, may potentially favour options with water treatment at source since treated water can then be made available to the widest possible areas / communities within the general vicinity of the water pipeline route corridor.

2.2 Project Brief

The core requirement of the WSP Project Brief is to satisfactorily process through the entire planning process a new water supply option; as defined by its source, water transfer system and terminal point.

The Project Brief incorporates a number of key stages as follows:

Stage a) Project Inception

Stage b) Definition of Project Need

Stage c) Options Appraisal

Stage d) Design Report

Stage e) Environmental Impact Statement (EIS)

Stage f) Wayleave / Land Acquisition

Stage g) Additional Reports

Stage h) Planning Stage

Stage i) Any Other Work

2.3 Previous Work and Reference Studies

The requirement for the Water Supply Project has been outlined and detailed via a robust programme of previous historical assessments and studies. The historical assessments/study reports are referred to in Figure 2-1.

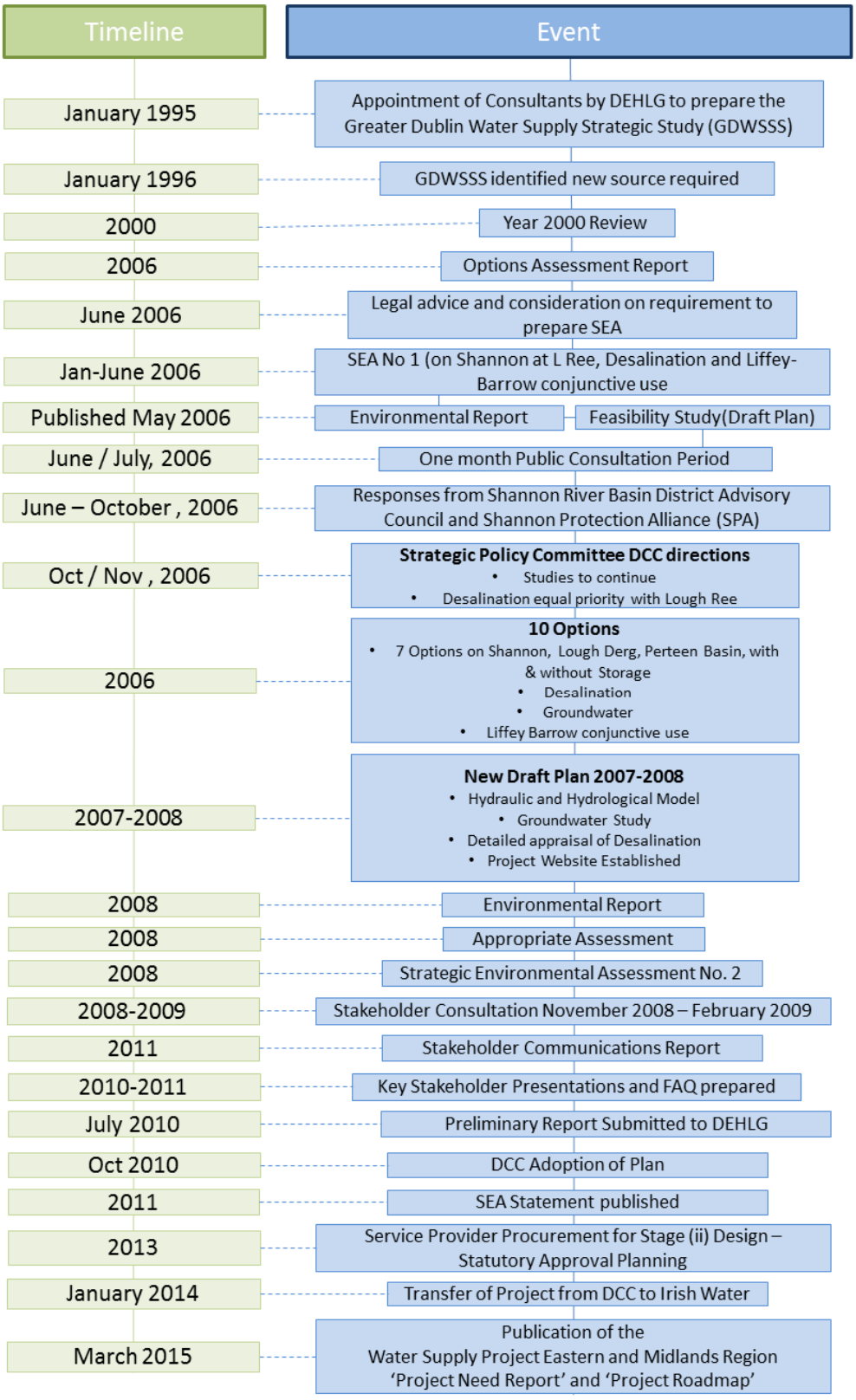


Figure 2-1 Chronological Development of the Project & Historical Datasets/Reporting

The reports detailed in Figure 1-1 form the starting baseline datasets for this current stage.

2.4 Context of the Working Paper

Stage a) and Stage b) of the project brief (Project inception and Definition of Project Need) have now been completed.

Stage c) - Options Appraisal will be implemented as a phased process encompassing 5 distinct phases, with three output Working Papers and/or reports; as indicated on Figure 2-2.

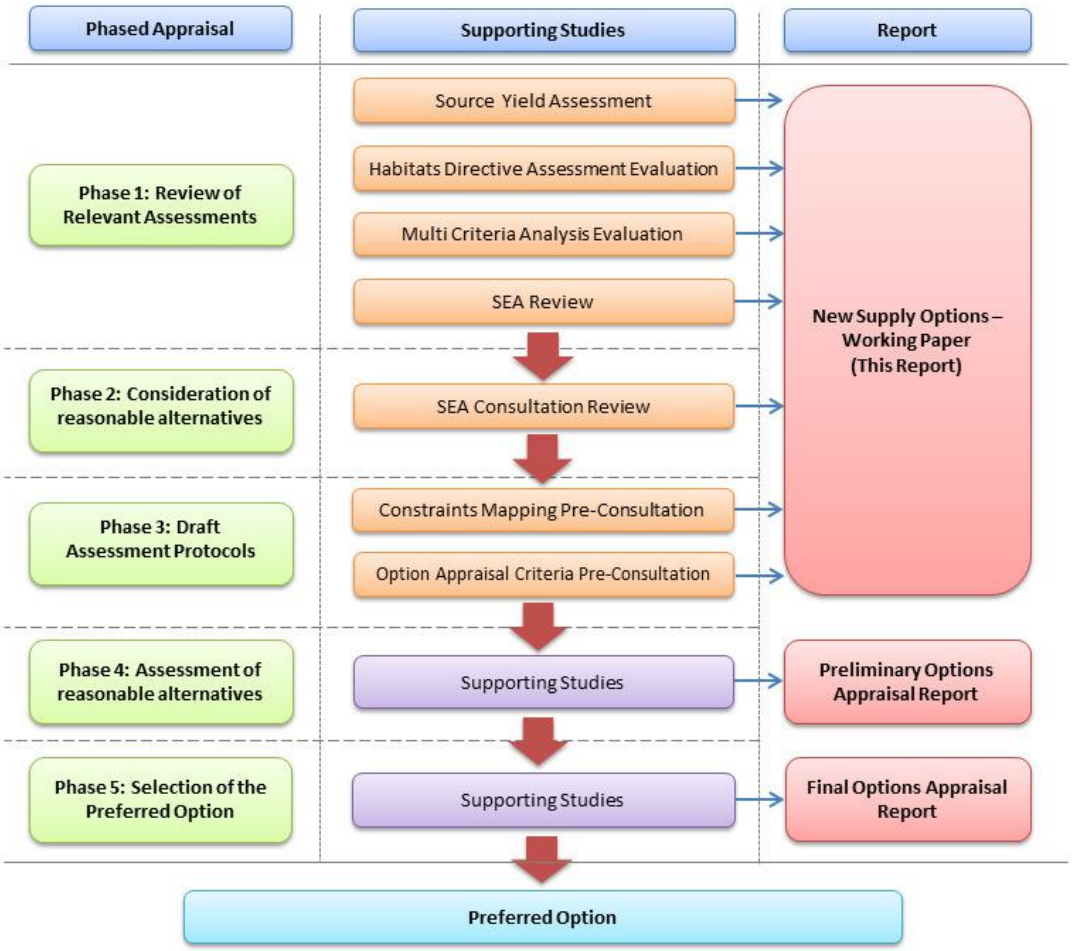


Figure 2-2 Stage c) Options Appraisal Methodology

This Water Supply Options – Working Paper forms the first of these Working Papers/Reports and incorporates work completed under Phases 1, 2 & 3.

The work reported in this Working Paper includes:

- The review of all previous work and recommendations contained within the body of previous work reported in Figure 2-1.
- Identification of all changes to National/European Legislation and European Site Designations that are not captured already within the Figure 2-1 body of work.
- Identification of any other relevant changes or new information that have become available since the completion of the body of previous work reported in Figure 2-1.

- Incorporation of any legacy items that were raised as part of the public consultation process under the previous SEA work.
- Re-visitation, reassessment, and re-evaluation with updated assessment methodologies, of those water supply options identified previously in the body of work from Figure 2-1 to determine:
    - Do those water supply options remain valid?
    - Do those water supply options require further investigation/study?
    - Are there any new water supply options available?
- Identification of the methodology and criteria on which water supply options will be assessed in identification of a Preferred option (Phase 4 & 5).

All of the above tasks, which comprise Phases 1, 2 & 3 of the stage c) Options Appraisal, have been undertaken and are reported within this Working Paper (Figure 2-2).

2.5 Structure of the Working Paper

The Working Paper is structured as follows:

- Section 1 – Executive Summary
- Section 2 – This section (Introduction and Background)
- Section 3 - Summarises the need for a major new water supply source and details the new water supply options inherited from the previous Figure 1-1 body of work
- Section 4 – Outlines the proposed options appraisal strategy to be applied in the identification of a Preferred option
- Section 5 – Introduces and summarises Phase 1 of the options appraisal process
- Section 6 – Introduces and summarises Phase 2 of the options appraisal process; confirming selected water supply options
- Section 7 – Introduces, as Phase 3 of the options appraisal process, proposed criteria intended for use in the assessment of selected water supply options during the following Phase 4 & 5 work, along with initial constraint mapping undertaken to date.
- Attached appendices, A through G, are provided at the back of the report containing the detail of the reviews/assessments which were undertaken in support of the preparation for this Working Paper

3 Water Supply in the Dublin Water Supply Area

3.1 Existing Water Supply

The Dublin Water Supply Area is supplied with potable water from Water Treatment Plants (WTP) located at:

- Ballymore Eustace, treating water from the Upper River Liffey.
- Leixlip, treating water from the Middle River Liffey.
- Vartry (near Roundwood), treating water from the Vartry impoundments.
- Ballyboden, treating water from the River Dodder.
- Srowland (near Athy), a newly commissioned plant treating water from the River Barrow[1].

The main WTPs listed above are supplemented by three smaller water treatment plants located at:

- Bog of the Ring, Fingal, treating groundwater & supplementing the Leixlip supply.
- Rathangan Wellfield, Kildare, treating groundwater & supplementing the Srowland supply.
- Monasterevin Wellfield, Kildare, treating groundwater & supplementing the Srowland supply.

Figure 3-1 shows the location of each of these water treatment plants.

[1] Intended to replace the water currently supplied from the Liffey by Ballymore Eustace to the mid-Kildare area. Full integration of the deployable supply from Srowland and the Kildare wellfields within the Greater Dublin Water Supply Area is discussed in the Project Need Report.

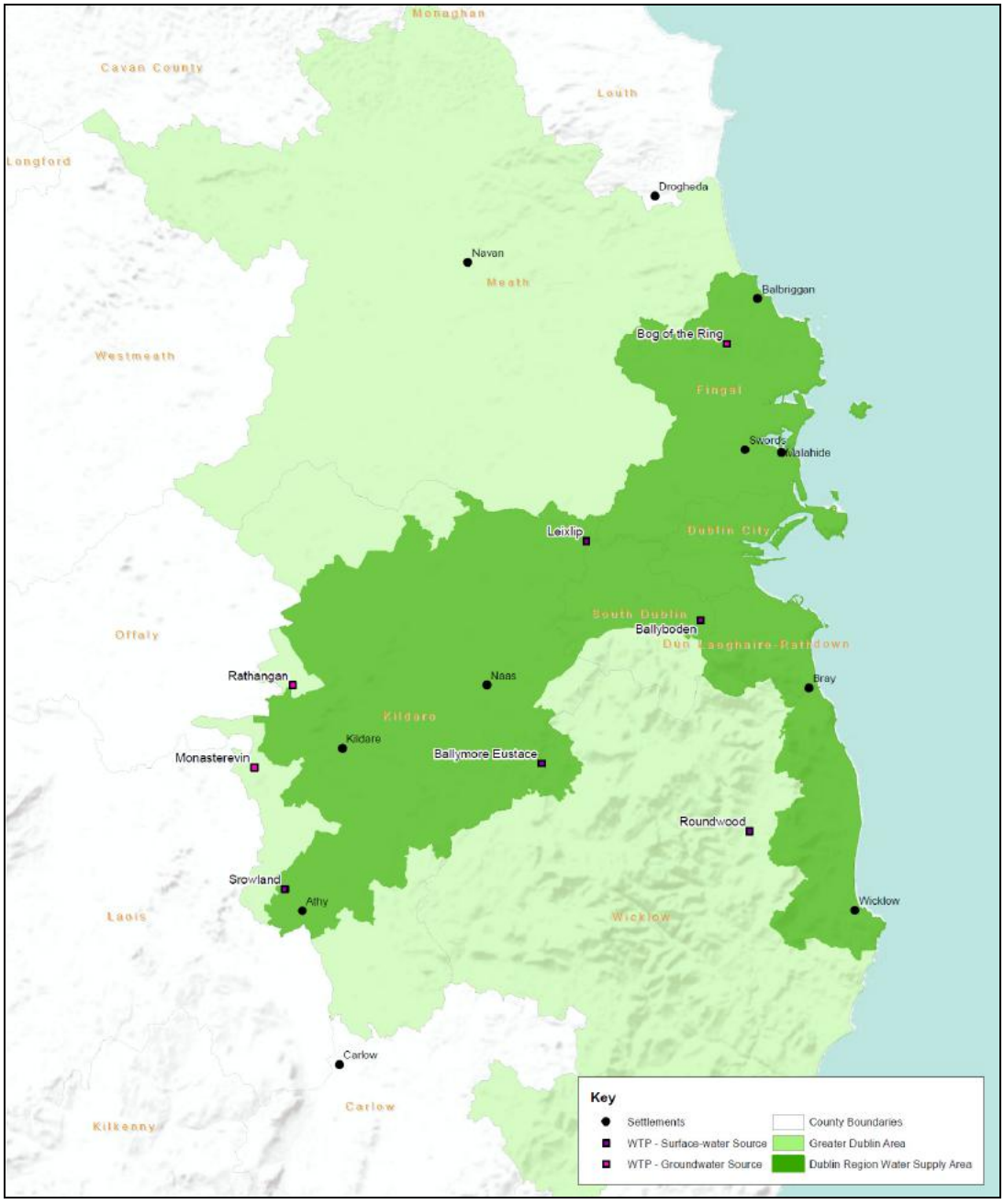


Figure 3-1 Map of the Water Supply Area and Major Water Treatment Plants

In combination, these plants have the capability of supplying 623Ml/d of potable water into the water supply network. In reality, the combined output of these plants can be less than 600Ml/d due to maintenance and operational requirements.

The two largest water treatment plants supplying the Water Supply Area are Ballymore Eustace and Leixlip, currently drawing a combined 525Ml/d of water from the Liffey system. This corresponds to 84% of all potable water supplied into the network.

3.2 Need for additional water supply

The need for a new water supply source for the Dublin Region (Water Supply Area) was first identified in the Greater Dublin Water Supply Strategic Study (GDWSSS) of 1996 and endorsed in a review of the GDWSSS in 2000.

The Preliminary Report of 2010 built upon the findings of these studies, undertaking an assessment of demand growth in the Dublin Region for the 2010 – 2040 period. The demand projection was based on the CSO census of 2006 and included the most recent thinking (at that time) on:

- Projected population growth,
- Economic growth,
- Planning potential,
- Anticipated water savings from water conservation measures.

The Preliminary Report of 2010 concluded that the need for a new water supply option remained, and provided the basis for further project development and appraisal under the SEA Directive. This culminated in the published Plan and SEA Statement of 2011.

3.2.1 Need Review

Given the time lag since the Plan/Preliminary Report of 2010, the need for the new water supply source has been revisited and reviewed under this current Project Brief.

The Project Need Report (Feb 2015) was published for public consultation on March 10th 2015 and was a fundamental review of all elements of water demand to the year 2050.

The review comprised three sections:

- Independent economic assessment of the strategic importance of the project and of the factors which define its scale.
- Assessment of the demographic trends over the planning period to 2050.
- A review of all components of water demand.

Demographic trends were developed from a baseline in the CSO Census for 2011 and projected in the context of a number of planning scenarios.[2]

Water demand growth was developed from commercial and industry metered data[3], available domestic water meter data[4] and latest pilot metering studies; and included a sectoral analysis of industry, and its water usage[5]. Per capita consumption and its

[2]The planning scenarios reflect assumptions on economic development, population growth and migration.

[3] For the years between 2006 and 2014.

[4] Water meter validation data available as part of the Irish Water (IW) Domestic Metering Programme.

[5] International trends in declining intensity of industrial water usage have also been researched and factored into the projections.

responsiveness to water charging and new build construction with more efficient water using appliances were examined and ambitious leakage control targets, on both the customer side and public mains side, were proposed. Savings expected from water conservation and leakage control were factored into projections.

The transfer of water services assets and functions to Irish Water in January 2014 also permitted a more in depth strategic review of the water requirements for potentially benefitting areas, where water may be deployed as required, between a new water source and a terminal reservoir near the Dublin Metropolitan Area, see Figure 3-2.

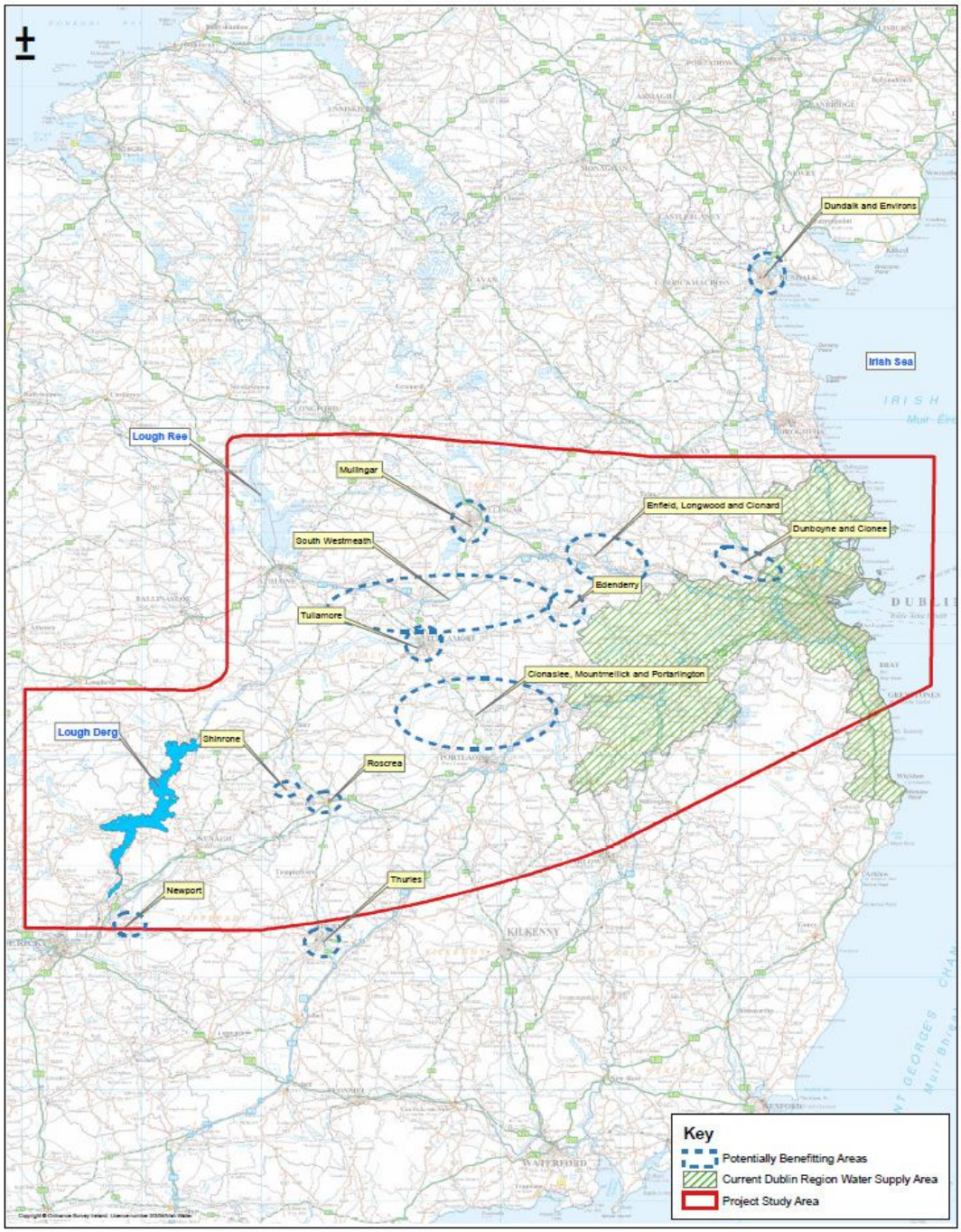


Figure 3-2 Water Supply Area and Potentially Benefiting Areas

The review of the water demand included support for regional development to ensure that national benefits are meaningfully shared and given local effect. The 'Project Need Report' identified a total requirement of 330 million litres per day (Ml/d) by 2050 (215 Ml/d for the Dublin Water Supply Area, 99 Ml/d for a potential 'Benefiting Corridor' and 16 Ml/d used in the treatment process itself).

The Project Need Report identified that availability of a 330 Ml/d new source of supply for the Eastern and Midlands Region will ensure sufficient water to avoid costly interruptions in water supply and also ensure sufficient security of supply, making Ireland an attractive location for expansion of existing enterprises and for inward investment from water intensive industries particularly in the ICT, Bio-Pharma and Agri Food sectors.

3.2.2 Public Consultation on the Project Need Report (PNR)

Consultation on the Project Need Report took place from March 10th to May 5th 2015. An assessment of the submissions received from public consultation on the PNR and the response to those submissions is attached as Appendix A.

This marked the first in a series of public consultations which will take place at different stages in the planning process over the 2015-2017 period (see Planning Process Roadmap http://www.watersupplyproject.ie/project-road-map/).

The current Public Consultation (June – July 2015) on the Options Working Paper (OWP) is the second consultation in the 'series of public consultations'. The prime focus of this consultation is to receive feedback from the public in relation to the proposed constraints and assessment criteria. These constraints apply to location of water abstraction equipment, a water treatment plant and pipelines / pumps for transporting water etc.

Irish Water also wants to receive feedback from the public in relation to the criteria (technical, environmental, economic, socio-economic etc.) which will be used to assess options relative to each other. This current OWP consultation revisits the ten options that were examined during the Strategic Environmental Assessments (SEA) over the 2007 – 2011 period and outlines how the current Environmental Impact Assessment and Planning Phase proposes to progress from the SEA phase through to the submission of a planning application to An Bord Pleanála in mid-2017.

It is important to note that no decisions have been made at this stage in relation to a new supply option for meeting the project need. Decision-making in relation to a new preferred water supply option for meeting the project need requires a combination of

a) feedback from consultation and
b) availability of appropriate support data.

It is intended that an 'Emerging Preferred Option' will be identified circa November 2015 following feedback from public consultations and with the support of appropriate data from investigation surveys.

3.3 Supply Options

3.3.1 The Original SEA Process & SEA Statement

During the Strategic Environmental Assessment (SEA) process carried out by Dublin City Council (DCC) and their Service Providers over the 2007-2011 period, ten options (one of which had two sub-options) for a new source of water supply, were appraised at a high, desktop-study level, on limited data which was available at that time. The options were appraised by Multiple Criteria Analysis (MCA) (an approach which allows all of the criteria to be considered collectively) which included four wide ranging criteria. These were: technical, environmental, socio-economic and economic assessment criteria.

The options assessed had different challenges and degrees of merit, and an SEA recommended option (primarily for meeting Eastern Region Needs) was provisionally identified, involving abstraction from Lough Derg combined with a proposed raw water storage and water treatment facility at Garryhinch in the Midlands.

However, the SEA fully recognised that this 'SEA Recommendation' was indeed only provisional and that data from investigative studies, such as water quality modelling and subsoil surveys, would be required at Environmental Impact Assessment (EIA) and Planning Stage.

This information would be required to assess conditions in Lough Derg / Parteen Basin and at a potential raw water storage site at Garryhinch Bog in sufficient detail before the SEA recommended option could be considered as an emerging preferred option for planning purposes. That investigative work, combined with surveys and data modelling, is now underway during this Environmental Impact Assessment (EIA) and Project Planning Stage.

3.3.2 The SEA Options

The SEA options, shown in Figure 3-3 and outlined below, form the starting point for this current WSP Project Brief.

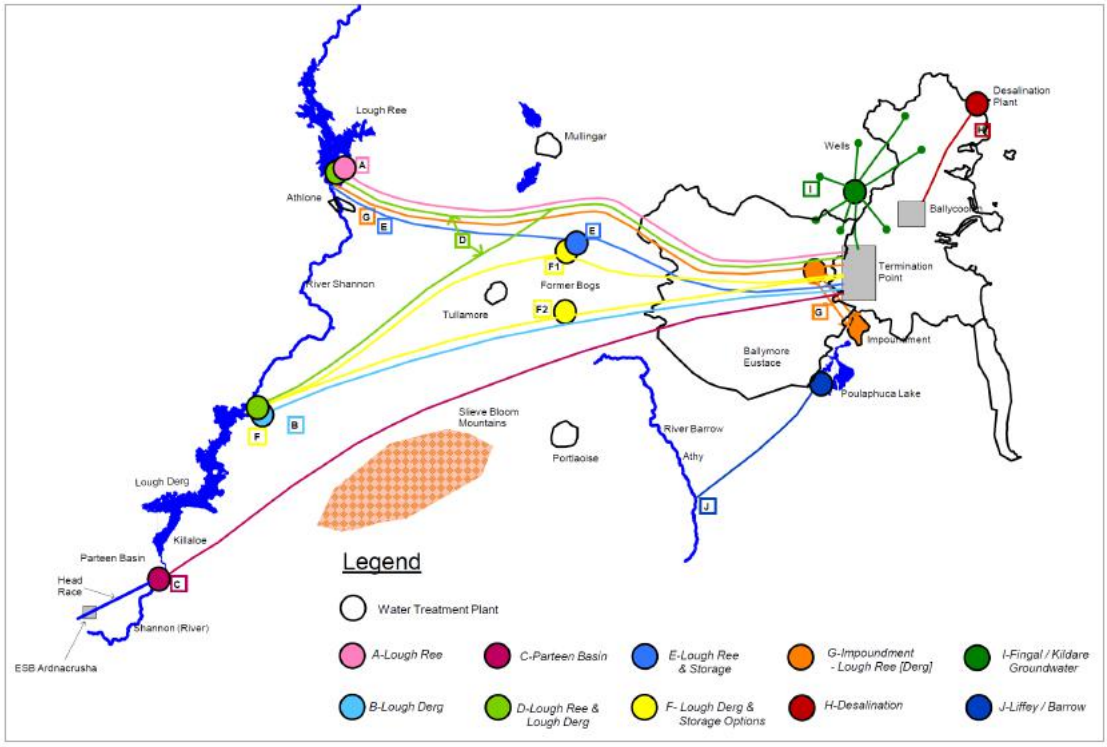


Figure 3-3 Water Supply Options Considered in the SEA

The options are defined as follows[6]:

Option A – Lough Ree (Direct): A constant abstraction design concept. It involves abstraction and treatment on the eastern shore of Lough Ree, followed by a 104km treated water transfer, in a configuration which could supply treated water to other communities on route.

Option B - Lough Derg (Direct): The same design concept to option A, but involving abstraction and treatment on the eastern shore of Lough Derg and a longer distance of 122km for treated water transfer, capable of supplying other communities on route.

Option C – Parteen Basin (Direct): The same design concept to option B, but involving a longer distance of 158km for treated water transfer, capable of supplying other communities on route.

Option D – Lough Ree and Lough Derg: A hybrid design concept, drawing from both lake sources in a phased development, capable of supplying other communities on route, with an anticipated 10 years separation between the phases. The initial transfer pipeline would be 104km in length from Lough Ree; the second would be 67km from Lough Derg, joining the first approximately midway along the Phase 1 route.

Option E – Lough Ree and Storage: A variable abstraction design concept. It involves abstraction on the eastern shore of Lough Ree working in combination with bog storage to allow excess winter water storage, for use in drier summer periods. Storage would be provided at a “cutaway bog” site near Rochfortbridge[7]. The site would include raw water

[6] The alphabetic designations carry through from The Plan and SEA Statement

[7] Owned by Bord na Mona.

storage, water treatment and pumping facilities. Storage facilities would accommodate up to 4 months average supply requirements. Overall raw water and treated water transfer pipelines are approx. 104km in length, in a configuration which could supply treated water to Midlands Local Authorities east of Rochfortbridge.

Option F1 – Lough Derg and Storage (Rochfortbridge): The same design concept to option E, but involving abstraction on the eastern shore of Lough Derg in combination with bog storage at Rochfortbridge. Storage facilities would accommodate up to 2 months average supply requirements. Overall raw water and treated water transfer pipelines are approx. 127km in length, in a configuration which could supply treated water to Midlands Local Authorities east of Rochfortbridge.

Option F2 – Lough Derg and Storage (Garryhinch): The same design concept to option E, but involving abstraction on the eastern shore of Lough Derg in combination with bog storage at Garryhinch[8]. Storage facilities would accommodate up to 2 months average supply requirements. Overall raw water and treated water transfer pipelines are approx. 122km in length, in a configuration which could supply treated water to Midlands Local Authorities east of Portarlington.

Option G – Lough Ree with Impoundment: A similar design concept to option E, but using a new impoundment in a suitable valley in the Dublin / Wicklow mountains to support variable abstraction from Lough Ree. Water treatment is provided beyond impoundment, meaning this option has no capability for supplying treated water to locations on route. This option would involve transfer pipework of approx. 113km in length.

Option H – Desalination: Abstraction of sea water from the Irish Sea in north Fingal, desalination of sea water through a Reverse Osmosis (RO) desalination plant, pumping of treated water to Ballycoolen reservoirs via 25 km pipelines, capable of supplying treated water to locations on route, and discharge of brine (from the treatment process) back into the Irish Sea.

Option I – Groundwater: Abstraction of water from groundwater sources within an 80km radius of Dublin, with piping of groundwater to suitable locations for treatment and introduction into public water supply systems, meaning this option has no capability for supplying treated water to locations between source and treatment.

Option J – Conjunctive use of the River Barrow: A design concept involving the "conjunctive use" of the River Barrow with the Upper Liffey. The option envisages abstractions of water from the Barrow when sustainable quantities may be available (Winter / Spring) and combining these abstractions with variable abstractions from Pollaphuca. This combined abstraction would increase the overall supply to Ballymore Eustace Water Treatment Plant above what is sustainably available from Pollaphuca on its own. This configuration would mean this option has no capability for supplying treated water to locations on route.

[8] Cutaway bog near Portarlington, owned by Bord na Mona.

3.3.3 Irish Water Review (2014-2015) of the Previous (2007-2011) SEA Process and Options

Over the 2014-2015 period, Irish Water and their Service Providers have updated and reviewed the 2007-2011 SEA process and options, and the findings of these updates/ reviews are presented in Sections 4, 5 and 6 of this Options Working Paper.

4 Proposed Options Appraisal Strategy

4.1 Strategy of Appraisal

As stated in Section 2.2, the core requirement of the WSP Project Brief is to satisfactorily process through the entire planning process a new water supply option.

The planning application submitted to An Bord Pleanala will substantially rely on an Environmental Impact Statement (EIS) to define (where unavoidable) the environmental impacts of the project and mitigation strategies that will be employed to minimise these impacts.

The EIS will be developed on the Preferred Option and will rely on a comprehensive options appraisal process to support the identification of this option.

The EIS will be judged firstly in its compliance with current EU Directives.

4.1.1 EIA Directive

The Environmental Impact Assessment (EIA) Directive has been in place since 1985 (85/337/EEC). This Directive, along with three amendments, was amalgamated into Directive 2011/92/EU in December 2011.

Directive 2014/52/EU adopted by the Council of the European Union in May 2014 is now in place and Ireland has a 3 year period to transpose the changes. It is expected that Ireland along with all other member states will adopt the revised Directive by approximately May 2017.

4.1.2 SEA and EIA Interrelationship

Directive 2014/52/EU addresses it's interrelationship with other relevant Directives in a number of locations. Most relevant to this project, is its link to the SEA Directive (2001/42/EC)[9].

On this, the EIA Directive 2014/52/EU notes the following continuity with the SEA Directive:

"…. With a view to avoiding duplication of assessments, the results of other assessments under Union legislation, such as Directive 2001/42/EC of the European Parliament and the Council ….. should, where relevant and available, be taken into account."

In inheriting a relevant and available body of knowledge and evidence previously gathered / compiled under the SEA process, a staged options appraisal methodology has been adopted to take into account this information and avoid duplication of assessment.

[9] Directive 2001/42/EC of the European Parliament and the Council on the assessment of the effects of certain plans and programmes on the environment.

4.2 Appraisal Methodology

The options appraisal methodology forms Stage c) of the overall Project Brief, as referred to previously under Section 1.4.

The Stage c) options appraisal methodology is comprised of five (5) phases as indicated in Figure 4-1.

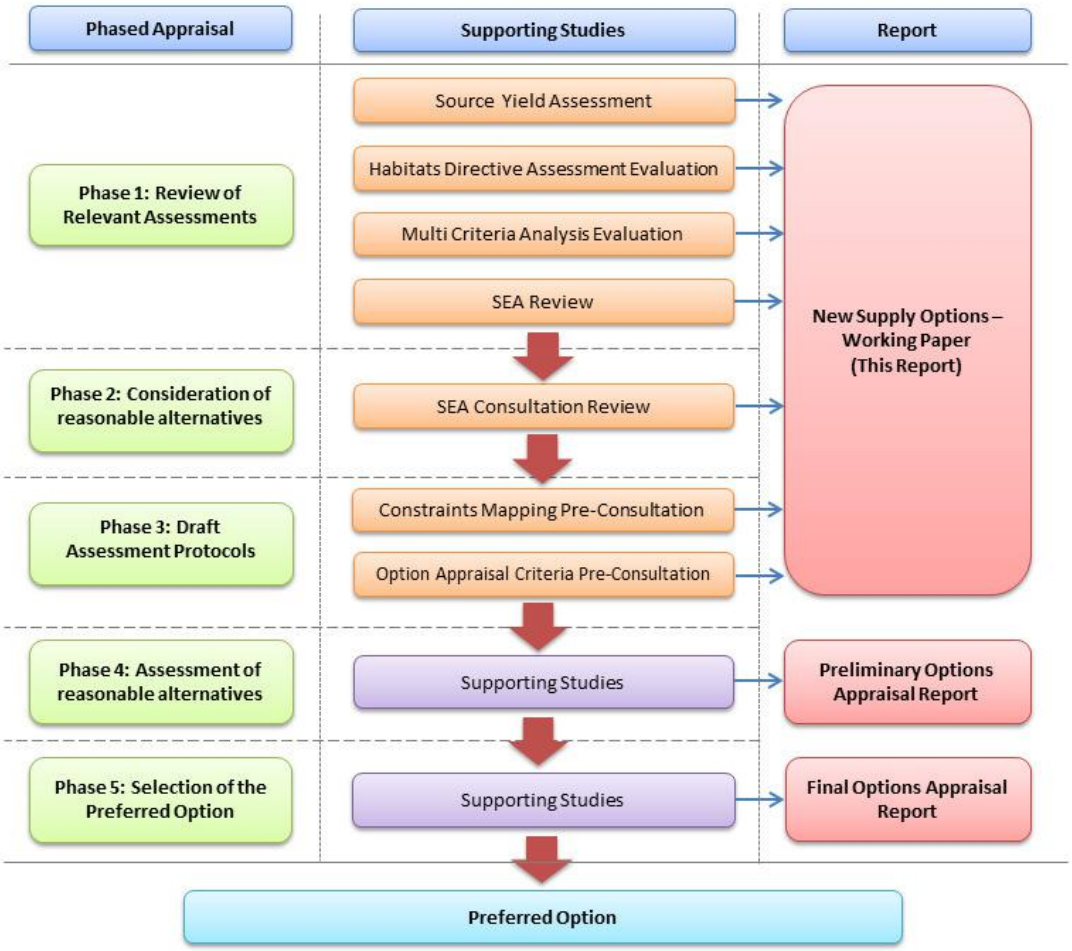


Figure 4-1 Stage c) Options Appraisal Methodology

Phases 1, 2 & 3 have been undertaken and form the basis of this current Working Paper. Subsequent Phases 4 & 5 do not form part of the work reported in this Working Paper.

Phase 1: Review of Relevant Assessments

A significant body of work was undertaken at the SEA stage in support of options appraisal. This culminated in the identification of a provisional 'recommended option'[10], on which the Public were informed.

A desktop review of the SEA options appraisal process has been undertaken to reconfirm those options previously considered as reasonable alternatives. This desktop review has taken cognisance of, and has addressed the intervening period between, the previous SEA work and the current proposed EIS process.

The reasonable alternatives identified under this Phase 1 process have been brought forward into Phase 2.

It is important to appreciate that the provisional recommendation of the SEA stage was based on available data at the time and was subject to specified validating studies to confirm assumptions made at the time.

Those studies, on water quality and modelling of Lough Derg/Parteen and on ground conditions at Garryhinch, are currently ongoing.

Given the conditional nature of the SEA 'recommended option' from the previous study it has been decided not to consider any option as an SEA 'recommended option' at this point in the current process.

Phase 2: Consideration of Reasonable Alternatives

The reasonable alternatives brought forward from Stage c) Phase 1 formed the starting point for consideration of additional options. Phase 2 included:

- Reassessment of feedback (received prior to September 2013) on the options from the SEA consultation stage.
- Consideration of additional sub-options which have emerged from value-engineering and which are considered to have engineering merit worthy of further assessment.

All reasonable alternatives identified through Stage c) Phase 1 & 2 are to be taken forward into Phase 4 - Assessment of Reasonable Alternatives.

Phase 3: Draft Assessment Protocols

Initial constraint mapping and assessment criteria are identified and proposed as the foundation of Phase 4 - Assessment of Reasonable Alternatives.

Phase 4: Assessment of Reasonable Alternatives

Phase 4 - Assessment of Reasonable Alternatives proposes to assess all reasonable alternatives identified in Phase 2 via the Phase 3: Draft Assessment Protocols. It is intended that Phase 4 will involve four steps:

Step 1: Assessment of the findings of particular investigative studies to determine whether anything of such significance has been identified

[10] As based on data available at that time and subject to a recommendation for further validating studies.

which may make the development of any of the reasonable alternatives unfeasible.

Step 2 — Assessment of the individual components of the options (abstraction, pipeline, storage, terminal point). This will involve identification of site constraints for the individual components and the identification of potential mitigation measures where it is not possible to avoid impacts by good siting and routing of infrastructure from the onset.

Step 3 — Preparation of preliminary cost estimates.

Step 4 — Final combination of individual components into one overall emerging preferred option assessment matrix, with 'more' and 'less' favourable classifications assigned to identified constraints. Selection of emerging preferred option will be based on the relative performance of each of the options against the Environmental, Technical and Cost criteria considered.

Phase 5: Selection of the Preferred Option.

Phase 5 – Selection of the Preferred Option will rely on a greater detail of investigation of the Emerging Preferred Option relative performance against Environmental, Technical and Cost criteria, with due to regard to risk. This detailed assessment will be supported and informed by further investigative studies.

4.2.1 Consultation

This phased appraisal methodology will rely upon and be informed by a parallel consultation process, following the consultation Roadmap published with the PNR, (http://www.watersupplyproject.ie/project-road-map/) with views and feedback from the public and interested parties fed into subsequent Phases as option appraisal is refined to identification of the Preferred Option.

As stated previously this Working Paper on water supply options has been prepared following the completion of only Phases 1, 2 & 3 of the overall 5 phase options appraisal process (see Figure 4-1).

5 Phase 1: Review of Relevant Assessments

5.1 Phase 1 Review Methodology

5.1.1 Option Evaluation & Recommendations - Preliminary Report of 2010

Section 1.9 of the Preliminary Report of 2010 outlined the evaluation method applied in assessment of a 'preferred option'. In summary, this evaluation process involved three separate but interrelated processes:

- Multi Criteria Analysis (Sustainability Assessments)
- Strategic Environmental Assessment (Public Consultation)
- Risk Assessments

The multi criteria analysis of options, forming the baseline of the previous options appraisal process, was presented within the Draft Plan and published for public consultation under the SEA process.

Within this Working Paper, the overall process is referred to as Multi Criteria Analysis (MCA) and Strategic Environmental Assessment[11] (SEA) [MCA & SEA].

The "risk assessment of options" process, undertaken in parallel, provided for sensitivity assessment of key project risks to ensure a robust outcome of the options evaluation process. This evaluation process is presented in Figure 5-1.

[11] Multi Criteria Analysis and Strategic Environmental Assessment are closely linked, reflecting the overlap in environmental considerations within the two separate processes.

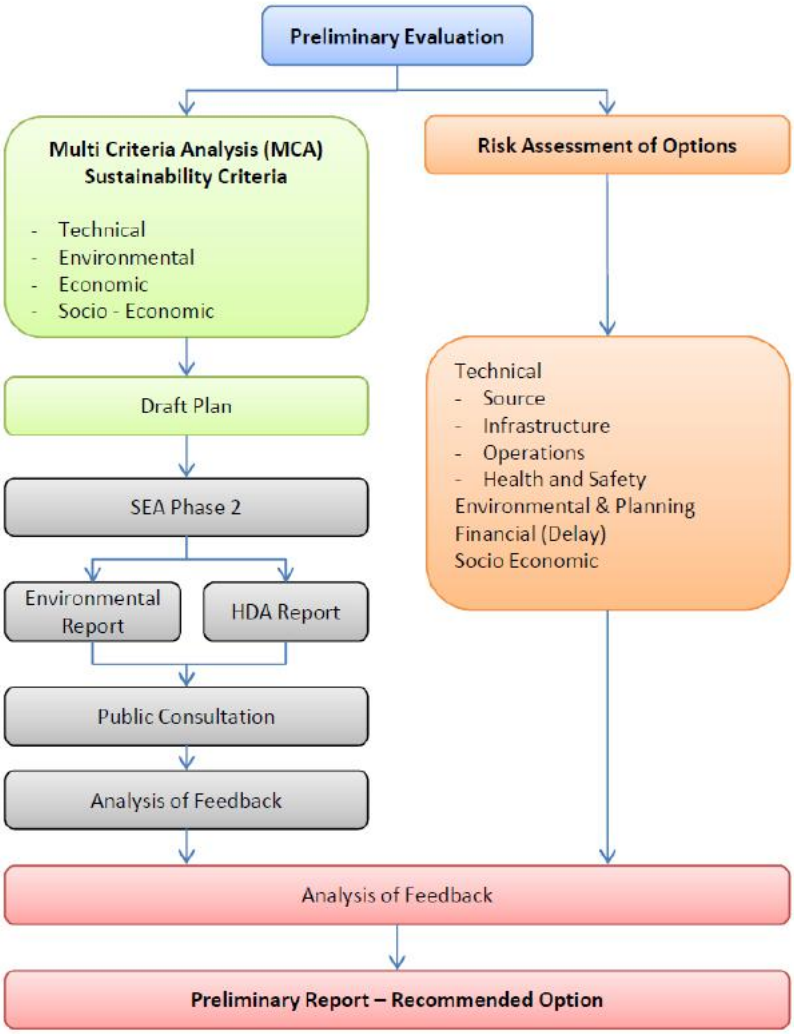


Figure 5-1 MCA and SEA and Risks Assessment Option Evaluation Process

(a) Recommendations from the MCA and SEA Process.

The MCA and SEA processes used a relative rating system to individually evaluate each water supply option under a range of criteria headings; see Table 5-A.

Rating Parameter	Rating Symbol
Major Negative	- -
Minor Negative	-
Neutral	~
Minor Positive	+
Major Positive	+ +

Table 5-A MCA & SEA Rating System

Through this process, the top four options were identified; see Table 5-B:

Option	Description	Technical - Source	Technical - Infrastructure	SEA Env	HDA Env	Economic	Socio Economic
F2	L Derg & Storage	+ +	+	+ +	~	~	+ +
B	Lough Derg (Direct)	+	+	~	~	+	+
C	Parteen Basin (Direct)	+ +	~	+	~	-	+
H	Desalination	-	-		~	- -	-

Table 5-B MCA (Sustainability) & SEA (Public Consultation) Evaluation Summary

(b) Recommendations from the Risk Assessment process

Water supply options were also assessed against a set of identified risk criteria to evaluate the relative risk to successful delivery of a 'fit for purpose' project.

Options were rated from a 'high risk' to 'low risk'; see Table 5-C.

Risk Severity	Risk Rating
High Risk	5
Medium to High Risk	4
Medium Risk	3
Medium to Low Risk	2
Low Risk	1

Table 5-C Risk Assessment Rating

Risk ratings, reflecting the view at the time, were allocated to each option under identified risk criteria on a comparative basis; see table Table 5-D.

Option	Description	Technical - Source	Technical - Infrastructure	Enviro & Planning	Financial	Socio Economic	Total
F2	L Derg & Storage	1	1	1	2	1	**6/25**
C	Parteen Basin (Direct)	1	3	2	3	1	**10/25**
B	Lough Derg (Direct)	2	2	2	3	2	**11/25**
H	Desalination	2	3	3	4	3	**15/25**

Table 5-D Risk Assessment Summary

The 'recommended option' was defined as the *"….water supply option with the lowest numerical score across all risk categories and not containing any specific high or medium risk ratings…"*

It is emphasized that the relative merits of the options, under the MCA and Risk appraisal presented above, were assessed at high level, at SEA stage, with the available data at the time and that these merits and views on risk are open to change with the changes in legislation and new information which has become available since that time.

It was the conclusion of the MCA, SEA & Risk Assessment process that option F2 was the 'recommended option' to provide a new major source to the water supply area.

The expressed preference for option F2 (abstraction from Lough Derg with Raw Water Storage) was further qualified with the requirement for addition investigative works to be undertaken to validate the engineering design, environmental impacts and cost estimates considered through the option appraisal process. These investigative studies were primarily identified as:

- Water quality modelling of Lough Derg and Parteen Basin.
- A full geophysical survey of the soil and bedrock conditions at Garryhinch.

These investigative studies are included within the scope of work now underway on the WSP Project, and they are likely to strongly influence the eventual preferred option.

Given the conditional nature of the SEA 'recommended option' from the previous study it has been decided not to consider any option as an SEA 'recommended option' at this point in the current process.

5.1.2 Review of Options Evaluation Process - Preliminary Report of 2010

In examination of the previously employed option evaluation process, two aspects of the evaluation were noted:

- The potential for 'key' criteria, or high-level screening criteria, within the group of criteria applied in the MCA & SEA process, on which option assessment could commence.
- The direct relevance of a qualitative risk assessment of options to the current Phases 1, 2 & 3 of the Project options appraisal methodology and identification of reasonable alternatives.

In consideration of these aspects, it was considered prudent that:

- A staged methodology be applied whereby 'key criteria', effectively functioning as 'pass-fail' screening criteria, would be identified and applied ahead of the complete MCA and SEA review process.
- The qualitative risk assessment process be considered in Phase four (4) and Five (5) of the Stage c) options appraisal strategy.

Upon examination, it was determined that the **Source yield technical assessment** and the **Habitats Directive Assessment** were the most significant screening criteria that should be considered as part of the current WSP Project review process.

The primary reasons for this determination were that:

- The provision of water from the River Shannon can only be deemed sustainable where abstraction can be clearly shown to comply with the water level operational limits defined in the ESB Regulations and Guidelines for the Control of the River Shannon.

- Since 2008 there have been significant changes in Irish Legislation and developments in the ECJ interpretation of the Habitats Directive, most notably:
    - The replacement of the European Communities (Natural Habitats) Regulations, 1997 (S.I. 94/1997) [12] with the European Communities (Birds and Natural Habitats) Regulations, 2011 (S.I. 477).
    - The Planning and Development (Amendment) Act 2010, in particular Part XAB[13].
    - Clarifications and rulings on the interpretation of the Habitats Directive issued from the European Court of Justice (ECJ) since 2008[14].

5.1.3 Updated Options Evaluation Methodology

Based upon this review, a 2 part options evaluation method was developed and adopted under Stage c) Phase 1 as follows;

- Part 1: Review of water supply options from the Figure 2-1 body of work under;
    - Source Yield Technical Assessment and
    - Habitats Directive Assessment
- Part 2: Review of water supply options under/against remaining MCA & SEA criteria from the Figure 2-1 body of work.

(a) Part 1

Source Yield Technical Assessment

Water supply options are reviewed on their ability to sustainably supply the projected water supply requirement of the water supply area.

For the River Shannon options, a sustainable yield was assessed primarily against the ability to maintain Statutory water levels within the abstraction water body[15].

An unsustainable yield at Phase 1 of the evaluation process was defined under two criteria:

- An inability to meet the whole projected water demand, which was 350 Ml/d in the SEA, currently estimated at 330 Ml/d in the Project Need Report.
- An inability to maintain Statutory water levels (River Shannon options).

[12] In 2008, the Habitats Directive was transposed into Irish legislation mainly by the European Communities (Natural Habitats) Regulations, 1997 (S.I. 94/1997).

[13] Which now also transposes the Habitats Directive into Irish Legislation

[14] These have provided clearer interpretation on key terminology and implementation of the Habitats Directive in member states.

[15] It is recognised that options taken forward must be further appraised on potential impact on residence time within water bodies

Options which, through review, were shown to be unable to meet either of these two criteria were not taken forward as reasonable water supply options for further considerations.

Habitats Directive Assessment

Water supply options capable of meeting the whole projected water demand were also reviewed under the Habitats Directive.

The review included:

- Review of the qualifying features and conservation objectives of the European sites, noting changes in the interim period.
- Review of the sensitivity of the qualifying features.
- Review of the Appropriate Assessment which has considered the characteristics of the draft Plan options and their potential significant adverse effects on the integrity of the European sites.

Where appropriate, the review considered developments in the interim period since the completion of the original assessment work in 2008; considering particularly the changes in Legislation, specifically the European Communities (Birds and Natural Habitats) Regulations, 2011 (S.I. 477), and the Planning and Development (Amendment) Act 2010, Part XAB.

Options which through review were shown to be likely to have significant impacts on European Designated Sites were not taken forward as reasonable water supply options.

(b) Part 2

Those options that passed through Part 1 of the revised evaluation methodology were reviewed against the remaining MCA & SEA criteria to validate the conclusions reached in the SEA process and to identify those outstanding issues requiring further consideration in the current planning process involving preparation of an EIS.

These outstanding issues will be addressed in subsequent Phases 4 and 5 of the options appraisal process.

5.2 Source Yield Assessment

5.2.1 Source yield evaluation - Preliminary Report from 2010

Assessment of source yield within the Preliminary Report from 2010 varied by source water body:

- The yield of the River Shannon & Liffey/Barrow Options was assessed through hydraulic and hydrological modelling of catchment rainfall, and study of gauging station records.
- For groundwater, the sustainable yield of regional aquifers was estimated by a specialist Groundwater Consultant.
- For Desalination, abstracting from the Irish Sea, the sustainable yield issue did not arise.

5.2.2 Source yield evaluation – Review and Update – 2014 - 2015

Reflecting the assessment methodology applied in the Preliminary Report from 2010, the latest WSP review was undertaken in three parts:

- River Shannon Options: The impact of abstraction has been assessed against water levels recorded along the River Shannon in the drought year of 1995.
- Liffey/Barrow conjunctive use options: Review has been carried out of the original modelling work and report prepared on the conjunctive use of the Rivers Barrow and Liffey.
- Groundwater: Review has been carried out of the sustainable yield of regional aquifers[16] previously estimated by a specialist Groundwater Consultant.

The WSP source yield assessment is provided as an attached Appendix B.

5.2.3 Recommendations

Table 5-E below summarises the outcomes from review of the source yield analysis for the various options.

Options B, C, F2 and H have the required Source Yield to progress to more detailed option appraisal. These options cover direct abstraction from both Lough Derg and Parteen Basin, abstraction from Lough Derg assisted by raw water storage, and Desalination.

[16] Having regard to legal changes in the interim period.

Option	Findings
A – Lough Ree (Direct).	Regulatory minimum water levels **cannot** be complied with for the 1995 drought year, and on yield considerations it is not proposed to carry this option forward.
B - Lough Derg (Direct).	Regulatory minimum water levels can be complied with in the 1995 drought year.
C – Parteen Basin (Direct)	Regulatory minimum water levels can be complied with in the 1995 drought year.
D – Lough Ree and Lough Derg	Regulatory minimum water levels **cannot** be complied with in Lough Ree for the 1995 drought year, and on yield considerations it is not proposed to carry this option forward.
E – Lough Ree and Storage	Regulatory minimum water levels **cannot** be complied with for the 1995 drought year, and on yield considerations it is not proposed to carry this option forward.
F – Lough Derg and Storage	Regulatory minimum water levels can be complied with in the 1995 drought year.
G – Lough Ree with Impoundment	Regulatory minimum water levels **cannot** be complied with for the 1995 drought year and on yield considerations it is not proposed to carry this option forward.
H – Desalination	No requirement to review under yield assessment.
I – Groundwater	The regional groundwater resource is limited and **unable** to support the required water demand; accordingly it is not proposed to carry this option forward.
J – Conjunctive use of the River Barrow	The River Barrow could not be expected to sustainably supplement the yield of the Liffey system by more than 20-40Ml/d, and accordingly it **is not** proposed to carry it forward.

Table 5-E Summary of findings from a Source Yield Technical Assessment

5.3 Habitats Directive Assessment

5.3.1 Habitats Directive Assessment - Report from 2008

The Habitats Directive Assessment Report prepared in 2008 contained an Appropriate Assessment (AA), with both a Screening and Stage 2 of an AA undertaken.

The 10 options and sub-options reviewed within the original HDA report are listed below:

- Option A – Lough Ree (Direct)
- Option B – Lough Derg (Direct)
- Option C – Parteen Basin (Direct)
- Option D – Lough Ree and Lough Derg
- Option E – Lough Ree and Storage
- Option F – Lough Derg and Storage
    - Option F1 – Lough Derg and Storage (Rochfortbridge)[17]
    - Option F2 – Lough Derg and Storage (Garryhinch)
- Option G –Lough Ree with Impoundment
- Option H – Desalination
- Option I – Groundwater
- Option J – Conjunctive use of the River Barrow

Options B, C, F1, F2 and H were considered at that time not to represent a risk to the integrity of European Sites, with the inclusion of appropriate mitigation. Option F1 was assessed but ruled out in Appendix G of the Preliminary Report (2010) and was excluded from assessment under the MCA & SEA process subsequently applied.

Options A and D did not meet the criteria of Stage 2 of the Appropriate Assessment process at that time and were not considered as viable options.

Options E and G were not conclusive due to a lack of data and the precautionary principle (in favour of exclusion) was applied.

5.3.2 Habitats Directive Assessment - Review and Update – 2014 - 2015

Review of the Habitats Directive Assessment[18] was undertaken to assess the validity of the 2008 report with regard to Legislative changes, changes to guidelines and changes to European Sites in the interim period. The review assessed how these changes may impact upon the conclusions of the 2008 HDA.

[17] Subsequently assessed out in Appendix G of the Preliminary Report (2010) and excluded from assessment under the MCA & SEA process applied.

[18] This review examined each of nine abstraction locations; Options I & J, which relate to groundwater and surface water abstraction from the Barrow, were not considered technically feasible in the required water quantities in 2008

The Habitats Directive Assessment review is provided as an attached Appendix C.

A summary of this high level review is shown in Table 5-F below:

Option	Is there a risk to site integrity (2008)	Is there a risk to site integrity (2014)	Further Information Required	Potential to mitigate impacts
Option A: Shannon - Lough Ree	Yes	Yes	Yes	Low
Option B: Shannon - Lough Derg	No	Yes	Yes	Medium
Option C: Shannon – Parteen Basin	No	Yes	Yes	High
Option D: Shannon – Lough Ree and Lough Derg	Yes	Yes	Yes	Low
Option E: Shannon Groundwater – Lough Ree & Groundwater & Storage	Yes	Yes	Yes	Low
Option F1: Shannon Groundwater – Lough Derg & Groundwater & Storage	No	Yes	Yes	Medium
Option F2: Shannon – Lough Derg & Storage	No	Yes	Yes	Medium
Option G: Shannon– Lough Ree or Lough Derg & Impoundment	Yes	Yes	Yes	Low
Option H: Irish Sea - Desalination	No	Yes	Yes	High
Option I: Groundwater	Not available	Yes	Yes	Low
Option J: Rivers Liffey & Barrow	Not available	Yes	Yes	Low

Table 5-F Summary of options and review of findings compared with 2008

5.3.3 Recommendations

Based on the overall review of the Habitats Directive Assessment, it is recommended that options A, D, E, G, I and J are not taken forward at this stage based on the precautionary principle (in favour of exclusion). There is a high risk of adverse impacts to specific European Sites from these options. It is also likely that suitable, appropriate mitigation is not possible or implementable.

Based on appropriate mitigation, relevant qualifying interest sensitivity and existing site conditions, options B, C, F1[19], F2, and H were considered much less constrained options. With detailed studies, careful design and appropriate mitigation none of these options presents a significant risk of adverse effects to European Designated Sites.

In this regard all of these options, at the desk study level of appraisal, can likely satisfy Stage Two of the Appropriate Assessment process without triggering Article 6(4) of the Habitats Directive involving compensatory habitat or invoking Imperative Reasons for Overriding Public Interest (IROPI). This, however, is subject to review in detailed option appraisal with supporting environmental and habitat surveys.

[19] As noted above, option F1 was ruled out for technical reasons in the Preliminary Report

5.4 MCA & SEA Review

5.4.1 Introduction

Following completion of the Source Yield Assessment and Habitats Directive Assessment, those options carried through were then reviewed under the remaining criteria applied in the original MCA & SEA process. Specifically, these criteria were:

- Technical
    - Infrastructure (Abstraction / Pumping / Treatment / Storage / transmission etc.)
- Environmental
    - SEA Environmental Report – Aquatic / Terrestrial Ecology / Archaeology
    - Water Framework Directive / Water Quality
- Economic
    - NPV of Capital & Operating Costs
    - Whole Life Costs / Costs of Water Delivered
- Socio Economic
    - Navigation / tourism / Angling / Fisheries / Agriculture / Local Economy etc.
    - Availability of Water for Local Use / Flooding

5.4.2 Summary of Review

Review of the remaining criteria is presented under two headings:

- Technical: Addressed the infrastructural and economic assessment of options.
- Environmental: Addressed the SEA, Water Framework Directive and Socio Economic elements through consideration of the SEA Environment Report (Phase II).

These reviews are presented in Appendices D & E respectively.

5.4.3 Recommendations

Following assessment of the options under the Technical and Environmental criteria outlined above, the following issues were identified:

- A number of infrastructural elements will require further engineering investigation and engineering design, which will in turn impact on construction estimates and the previous economic appraisal.
- There are varying levels of environmental impacts for each of the options assessed.

Although these issues will need to be addressed in Phase 4 & 5 of the options appraisal strategy, they do not affect the consideration of options as reasonable alternatives.

5.5 Phase 1: Summary of findings

5.5.1 Conclusions

A two part review and evaluation process was undertaken to validate (or amend recommendations as necessary) the assessment of options undertaken within the Preliminary Report from 2010 (as informed by both the SEA & HDA).

The key findings from this two part review and evaluation process are summarised below:

- Option J (Barrow-Liffey Conjunctive use) is unable to sustainably provide the projected water supply requirements of the Water Supply Area
- Option I (Groundwater) is unable to sustainably provide the projected water supply requirements of the Water Supply Area.

  Groundwater within a region of 80 km in radius, centred on Dublin, was assessed at the time of preparation of the SEA in (2008) and it was concluded that groundwater on its own would not be able to supply the projected demand, and that the best use of this limited groundwater resource would be in a 'supplementary' capacity. Since that work was completed, the definition of 'available groundwater resource' now included in the Groundwater Regulations (2010) introduces a complex linkage with the Water Framework Directive. The conclusion drawn in 2008, that groundwater has a potential role, as a proven, sustainable supplementary source, capable of augmenting a primary supply from an alternative source, has been identified by the review as correct, and places groundwater in its proper context, in time and scale.
- Options A, D, E, and G (all sourcing water from Lough Ree) are unable to sustainably provide the projected water supply requirements of the Water Supply Area whilst remaining in compliance with ESB requirements as set out in 'The Regulations and Guidelines for the Control of the River Shannon'. Achieving consensus with stakeholders and environmental authorities with respect to water levels & water flows and ensuring minimisation of low flow durations through the Shannon callows downstream of Lough Ree is not achievable with a water abstraction from Lough Ree.
- In addition, Options A, D, E, and G cannot be used for water supply as they do not comply with the Habitats Directive Assessment (HDA). This is legislation which applies the precautionary principle (in favour of exclusion) when there is uncertainty in relation to potential environmental impacts on European designated sites (e.g. Special Areas of Conservation).

The identification of Options B, C, F2 and H as reasonable water supply options for consideration during the current EIA & Planning Process validates the Multi Criteria Analysis and the Strategic Environmental Assessment processes applied previously under the SEA and HDA work (2007-2011). It also validates the four top ranked options previously identified in the Adopted Plan / SEA Statement published in 2011.

5.5.2 Recommendations

Through review and evaluation of the MCA & SEA process it is recommended that these assessments, updated and validated, can be utilised as a basis for identification of reasonable water supply options from those identified in the Preliminary Report from 2010.

It is recommended the following options be considered as reasonable alternatives emerging from this Phase 1 review for the sustainable provision of projected water supply requirement for the Dublin Water Supply Area.

- Option B - Lough Derg (Direct):

  A constant abstraction design concept – this option involves abstraction and treatment on the north eastern shore of Lough Derg, followed by 122km of treated water transfer pipelines, in a configuration which could supply treated water to other communities en route.

- Option C – Parteen Basin (Direct):

  This would have the same design concept as for Lough Derg (Direct) but involves a longer distance of 158km for treated water transfer pipelines. This option could supply treated water to other communities en route to Dublin.

- Option F2 – Lough Derg with storage (Garryhinch):

  This would have the same design concept as the Lough Derg (Direct) option, but involving variable abstraction, in this case, on the north eastern shore of Lough Derg in combination with storage of raw water at Garryhinch in the Midlands. The storage facility would accommodate up to 2 months average water supply requirements (for Dublin). This option could supply treated water to other communities en route to Dublin.

- Option H – Desalination:

  Abstraction of sea water from the Irish Sea in north Fingal – this option involves intake and desalination of sea water through a reverse Osmosis (RO) desalination plant, discharge of brine (from the treatment process) back into the Irish Sea, pumping of treated water through 25km of pipelines, serving communities en route to Dublin.

6 Phase 2: Consideration of Reasonable Alternatives

6.1 Introduction

Further to the work undertaken and reported in Section 5, an assessment was undertaken to identify any additional reasonable alternatives that may not have previously been recognised or considered in the SEA process.

This examination took two forms:

- A review of the consultation reports produced as a result of the previous SEA process.
- A consideration of additional options, or variants within the recommended options, that were considered to have engineering merit worthy of further consideration.

6.2 Review of Consultation

A review of the consultation undertaken through the previous SEA process was conducted to determine if:

- Any reasonable alternatives, other than those already assessed, arose from the public consultation and which ought to be included in those to be taken forward.
- Any submissions received brought into question or challenged the engineering merit of the already identified reasonable alternatives.
- Any issues came to light through consultation post adoption of The Plan, which remain applicable to this planning stage.

The review of the SEA Consultation is attached as Appendix F.

The review concluded that:

- No reasonable alternatives arose through public consultation which were not given consideration worthy of their merit in the Preliminary Report from 2010.
- No submissions received on the new water supply options raised points that brought into question the engineering merit of the identified reasonable alternatives.

Relevant comments received from stakeholders post adoption of The Plan of 2011, and relevant comments received from the March-May 2015 consultation process on the Project Need Report will continue to be considered in the ongoing appraisal of options.

6.3 Consideration of Additional Water Supply Options

The introduction of a new water supply source has the potential to optimise the yield of the existing sources, particularly the River Liffey system, through conjunctive management[20] of new and existing sources together.

[20] The coordinated management of water supplies to increase the total yield from available sources.

Irish Water and their Service Providers have examined the feasibility of enhancing identified reasonable alternatives through conjunctive use analysis and considered that there would be scope to manage Pollaphouca Reservoir, jointly with a new source, to help achieve optimum value from this existing asset.

6.3.1 The Liffey system

The two largest elements of the existing treated water supply system for the Dublin Region are Ballymore Eustace (310Ml/d) and Leixlip (215Ml/d). They both abstract from a single source, the River Liffey.

The safe yield of the River Liffey system, without augmentation from an external source, is capped at its yield in the most severe drought that the system has been designed to withstand. The most severe drought on record for the River Liffey system is the compound drought of 1975-76.

A report on the yield of the River Liffey[21] considered the largest combined abstraction rate that could have been sustained on the River Liffey, without failure, through all available years of record since 1950; and a combined abstraction at Leixlip and Ballymore Eustace of 533Ml/d would have just been sustainable during 1975-76.

(a) Pollaphuca

Pollaphuca is the primary storage reservoir on the River Liffey system. The reservoir is large in comparison to its contributing catchment and so it carries a particular risk that dry winters, such as occurred in 1975-76, may fail to fully replenish water levels in the impoundment.

Figure 6-1 Pollaphuca Reservoir

Pollaphuca reservoir, and the River Liffey system, has been heavily modified since the construction of ESB dams in the 1930's and 1940's. The ESB manage Pollaphuca reservoir for the purpose of water abstraction and power generation, and

[21] TOBIN/Nicholas O'Dwyer, 2005 - determined as part of the planning stages for the new Leixlip WTP, which has recently been commissioned in summer 2014

also for the purpose of flood risk management during flood conditions. Pollaphuca Dam has a maximum crest level of 189.59mOD, and the reservoir is currently operated based on a Maximum Normal Operating Level (MNOL) of 186.30mOD (3.29m below the maximum crest level).

6.3.2 A River Shannon – River Liffey conjunctive approach

Irish Water and their Service Providers considered a conjunctive use option whereby Pollaphuca could be supported by a River Shannon supply to ensure that, even with dry winters, it might be managed to commence the following drought season from a full reservoir position, or a near-full position, based on a management regime which does not raise flooding risk unacceptably.

The ideal strategy would allow the reservoir to fill over the winter, topping out (at the upper level permitted for flood management) late in the spring, and just in time for the commencement of the drought.

Two previously unidentified options were accordingly considered, these are presented as two additional sub options below:

Option B1 – Lough Derg with conjunctive use of the River Liffey: The same design concept as water supply option B, but involving the use of Pollaphuca reservoir to permit a variable abstraction from Lough Derg. Water treatment will be provided on the eastern shore of Lough Derg and linked to a treated water supply from Pollaphuca via linkage around the terminal point reservoir. This option would involve transfer pipework of approx. 122km in length, in a configuration which could supply treated water to other communities en route.

Option C1 – Parteen Basin with conjunctive use of the River Liffey: The same design concept as water supply option C, but involving the use of Pollaphuca reservoir to permit a variable abstraction from Parteen Basin. Water treatment will be provided on the eastern shore of Parteen Basin and linked to a treated water supply from Pollaphuca via linkage around the terminal point reservoir. This option would involve transfer pipework of approx. 158km in length, in a configuration which could supply treated water to other communities en route.

6.3.3 The importance of Flood Management

Submissions made by ESB in relation to the options in the previous SEA process emphasise the importance of their role in flood management. Any conjunctive use strategy which might seek to optimise management of Pollaphuca Reservoir must recognise its multiple roles as a water supply resource, a hydropower resource and as an attenuating storage which protects the communities along the River Liffey in times of flooding.

As part of the Eastern CFRAM Study a report entitled “Liffey Flood Controls & Flood Forecasting System Option”[22], was produced which described the River Liffey flood controls. The report describes that if the threat of flooding exists, the River Liffey reservoirs, including Pollaphuca, are managed on the basis of what is referred to as

[22] “Liffey Flood Controls & Flood Forecasting System Option”, Eastern CFRAM Study, IBE0600Rp0010_Liffey Flood Controls & FFS Option_F01, by RPS Group

the 'Flood Operation Period'. During this period, the primary objective is flood risk management and maintaining dam safety.

In considering a strategy which optimises the existing River Liffey storages and abstractions for water supply, in conjunction with a new supply from the River Shannon, ESB were consulted on the important aspect of flood protection.

While ESB considered the concept carefully, and acknowledged that hydrological modelling might show the proposed conjunctive operation to be feasible, the concept nevertheless assumed that Pollaphuca could be operated, within its normal operating band, but at higher water levels than currently prevail. The flood risk management implications of this were of concern to, and would not be acceptable to ESB.

Seeking to develop increased water supply yield from the River Liffey through storage management in conjunctive use with a new source was, accordingly, considered not feasible and was not explored further.

The flow regime on the River Liffey which may eventuate under the Water Framework Directive obligations for a "Heavily Modified Water Body", into which category the River Liffey falls, also act as a constraint on further development of the River Liffey, which already contributes 84% of Dublins' water supply capacity, with 41% of its Mean Annual Flow taken in water supply.

6.4 Selected Water Supply Options

In completing Phase 1 and Phase 2 of the water supply option appraisal strategy 4 reasonable alternative water supply options have been selected as capable of delivering the projected water supply requirements of the Greater Dublin water supply area.

These are (in no particular order of priority):

- DESALINATION - Option H
- LOUGH DERG (DIRECT) – Option B
- LOUGH DERG AND STORAGE – Option F2
- PARTEEN BASIN (DIRECT) – Option C

7 Phase 3: Draft Assessment Protocols

7.1 Project Constraints Assessment

7.1.1 Introduction

Phases 4 & 5 of the options appraisal methodology will rely on a relative assessment of impacts, both technical and on human beings and the environment, to identify a Preferred Option from the 4 currently identified reasonable alternatives.

With the intention to minimise impact by good design in the physical location of infrastructure, the first step will be to identify constrained areas – i.e. areas within which infrastructure, as far as possible, should not be located[23] and which are to be avoided where alternative siting and routing options permit.

It must be emphasised that the constrained areas identified for this particular project will be used only to aid in selecting less constrained areas for locating infrastructure. They have no legal status preventing future development in these areas.

7.1.2 Study Area

The SEA options previously identified formed the starting point for this current WSP Project Brief, and accordingly were used to define the Project Study Area. The Project Study Area, which bounds the SEA options, is illustrated in Figure 7.1.

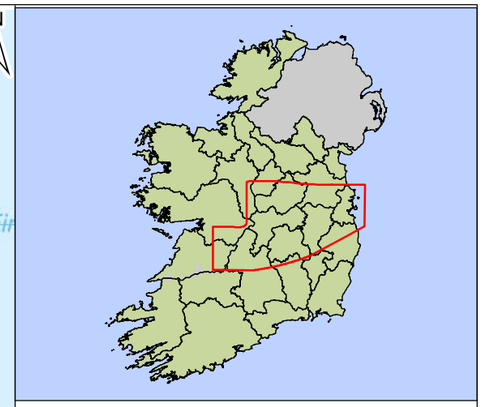
To reflect the identification of 4 technically feasible and reasonable supply options, and with consideration to a number of natural boundaries that exist, revision was made to the Project Study Area and a Refined Study Area was identified. This boundary is illustrated in Figure 7.1.

7.1.3 Constraints Mapping

Mapping of constrained areas within the Refined Study Area initiated with the identification of relevant constraints. The following specialists were engaged in this process:

- Engineering
- Archaeology, Cultural Heritage and Architectural Heritage
- Ecology
- Noise & Vibration
- Air Quality and Odour
- Traffic and Transport
- Landscape and Visual
- Agronomy
- Soils and Geology
- Water Quality - Hydrology

[23] Due to an excessive impact technically, on human beings and/or the environment.



Key

- Refined Study Area
- Project Study Area
- Counties

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
1	22/05/2015	Created to illustrate constraints	PW	PMcG	PMcG	MG

JACOBS

TOBIN
Patrick J. Tobin & Co. Ltd.

Client

UISCE ÉIREANN IRISH WATER

Project

Water Supply Project - Eastern and Midlands Region

Drawing Title

Refined Study Area

Drawing Status

Issued

Scale @A3	1:600,000		DO NOT SCALE
Jacobs No.	32105801	Client No.	WSP1
Filepath	G:\IG\SI\32105801 - WSP DRIGS Tasks\5_Mxds\Report Mxds\Image 1 reports Maps\Figure 7.1 Refined Study Area.mxd		
Drawing No.	Figure 7.1		

- Water Quality - Hydrogeology

The constraints identified are outlined below under the following headings:

- Ecology
- Archaeology, Cultural Heritage and Architectural Heritage
- Soils, Geology and Hydrogeology
- Water Quality
- Landscape and Visual
- Population and Infrastructure

(a) Ecology

The following Ecological constraints were considered relevant to the siting of Infrastructure within the Refined Study Area:

- European Designated Sites:
  - candidate Special Areas of Conservation (cSAC's)
  - Special Protection Areas (SPA's)
- National Designated Sites
  - Natural Heritage Areas and Proposed Natural Heritage Areas
- Protected Freshwater Pearl Water bodies (S.I. No. 296/2009 - The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009)
- RAMSAR Convention Sites (Wetlands)
- Tree Preservation Order Sites (County)
- Nature Reserves
- County Habitat Surveys (where available and relevant to study area)
- European, Irish and Local Protected Habitats and species including:
  - Peatlands
  - Turloughs
  - Fens
  - Ancient Woodlands
  - Native Woodland
  - Irish semi-natural grasslands
  - Limestone pavement
  - Intact Raised Bog
  - Raised Bog (unsurveyed) – vegetated
  - Blanket Bog
  - Wet Heath
  - Coastal Floodplains
  - Forestry
- Bird Data including:
  - Irish Wetland Bird Survey (IWeBS Data)
  - Important Bird Areas (Refuge for fauna)
  - Wintering Bird Sites International/National /Regional

(b) Archaeology, Cultural Heritage and Architectural Heritage

The following Archaeology, Cultural Heritage and Architectural Heritage constraints were considered relevant to the siting of Infrastructure within the study area:

- UNESCO sites
- National Monuments
- Record of Monuments and Place (RMP) sites
- Architectural Conservation Areas
- Records of Protected Structures

(c) Soils, Geology and Hydrogeology

The Soils, Geology and Hydrogeology following constraints were considered relevant to the siting of Infrastructure within the study area:

- Geological Heritage Sites (Natural Heritage Areas (NHA/pNHAs) and County Geological Sites)
- Soil, Subsoil and Bedrock datasets
- Groundwater Aquifer datasets
- Groundwater Vulnerability mapping
- Karst Features
- Existing or retired Landfills
- Mines and Quarries (Operational and Historical)

(d) Water Quality

The following Water Quality constraints were considered relevant to the siting of Infrastructure within the study area:

- Protected Salmonid Waters (S.I. No. 293/1988 - European Communities (Quality of Salmonid Waters) Regulations, 1988)
- Shellfish Waters
- Bathing Waters
- Water Framework Directive Waters - Lakes, Rivers, Coastal water and Transitional water bodies,
- Water Framework Directive Annex IV Protected sites (including recreational waters and waters used for abstraction)
- Areas with potential for flood risk
- Flood Events (OPW)

(e) Landscape and Visual

The following Landscape and Visual constraints were considered relevant to the siting of Infrastructure within the study area:

- Landscape Character Areas, Scenic Areas, and Protected Views
- Walks, Trails, Cycleways

(f) Population and Infrastructure

The following Population and Infrastructure constraints were considered relevant to the siting of Infrastructure within the study area:

- Population Settlements
- Development Plan Zoned Lands
- Areas with elevated Building Densities
- Water and Wastewater Treatment Plants
- High Voltage Power Lines
- Licensed IPPC Facilities

7.1.4 'White Space'

Further to identification of the constraints relevant to the Refined Study Area, the specialists were then challenged and engaged in a workshop environment to collectively agree an initial grouping of key constraints[24] that should be avoided, where alternative siting and routing options permit, to prevent/minimise impact on an area, habitat or species.

As a desk based process, Geographical Information System (GIS) was used to aid in the process of mapping.

At conclusion of this workshop, group agreement was reached on an initial grouping of constraints that were to be applied to the Refined Study area. These constraints are as follows:

- Special Areas of Conservation (SACs)
- Special Protection Areas (SPAs)
- Natural Heritage Area
- Proposed Natural Heritage Area
- RAMSAR Convention Sites (Wetlands)
- UNESCO Sites
- Curragh Aquifer and Pollardstown Fen
- Protected Freshwater Pearl Water bodies (S.I. No. 296/2009 - The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009)

When mapped, the accumulation of these constraints within the Refined Study Area then identified (what was termed) a 'White Space', within which the siting and routing of infrastructure would, where possible, be best positioned with respect to remaining constraints and would help mitigate the impact of this project, both technically and on human beings and the environment.

The constraints and White Space boundary are attached as Appendix G and illustrated in a combined Figure 7.2.

7.2 Assessment Criteria

Further to consideration of siting, it is intended that selected water supply options identified through Phase 1 and Phase 2 be assessed in Phase 4 & 5 under the environmental and technical criteria outlined in Table 7-A below.

[24] from within the identified datasets

Environmental Criteria	Technical Criteria
Biodiversity, Flora and Fauna	Safety
Fisheries	Planning Policy
Water	Engineering and Design
Air/Climatic Factors	Capital and Operational Costs
Material Assets (Energy)	Sustainability
Cultural Heritage (including Architecture & Archaeology)	
Landscape & Visual	
Material Assets (Land use)	
Tourism	
Population	
Human Health	
Soils, Geology and Hydrogeology	

Table 7-A Environmental and Technical Criteria

The proposed assessment criteria have been identified with regard to the provisional criteria listed in the SEA, with additional criteria included as deemed necessary and relevant by Irish Water and its specialists.

Each option will be assessed by relevant technical and environmental specialist under each of these criteria. These assessments will be used to identify the differentiating sub-criteria that will distinguish the emerging preferred options.

With each option individually defined by abstraction location, transmission pipeline route, storage (where applicable) and terminal reservoir infrastructure, option appraisal will rely on assessment of these elements.

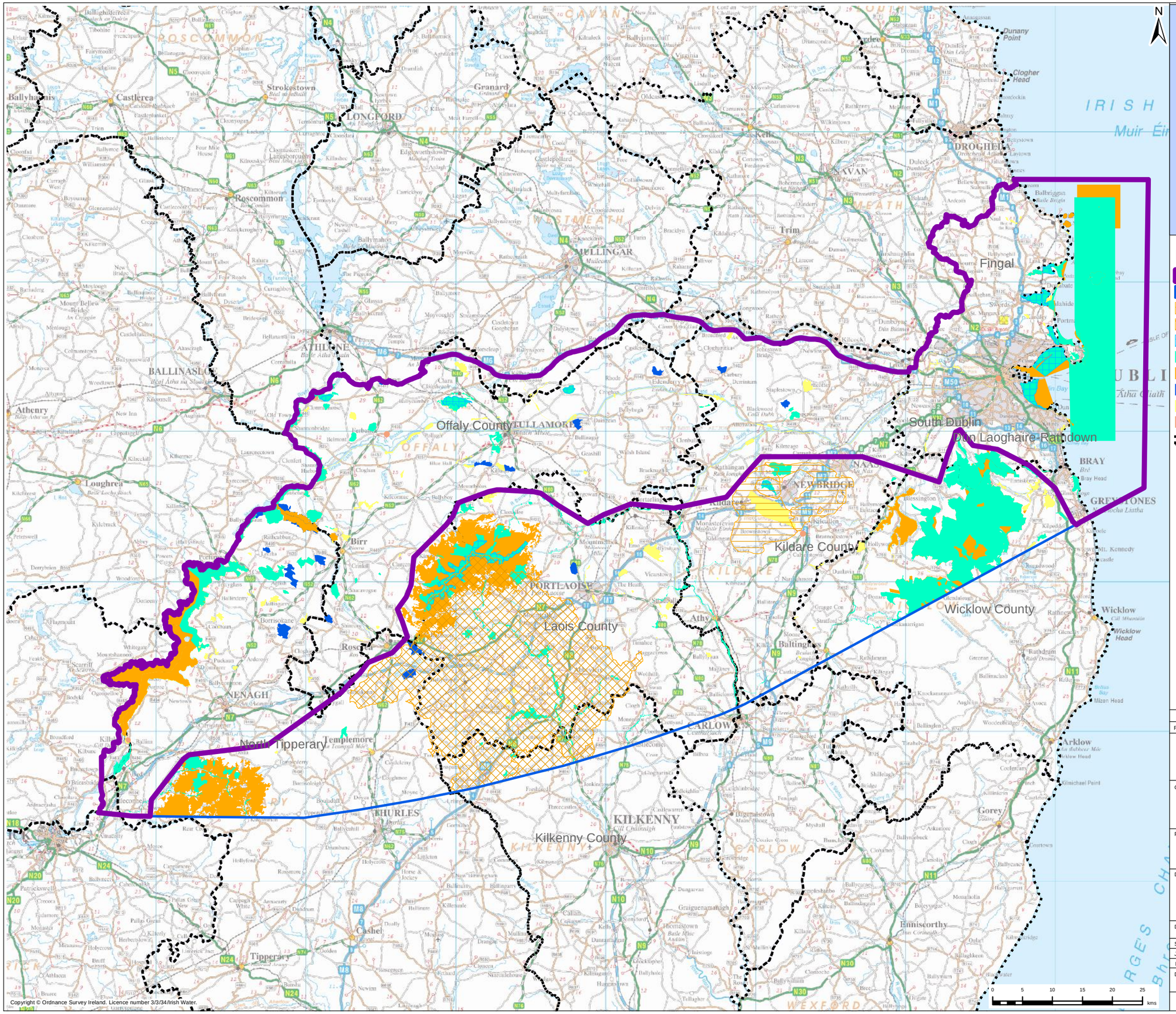
7.3 Risk Appraisal

As noted in Section 5.1, the Preliminary Report included comparison of the risk profile of options in overall appraisal of them. The risk assessment criteria, covered:

- Technical Risk relating to the Source
- Technical Risk relating to Infrastructure and Operations
- Environmental and Planning Risk
- Financial Risk
- Socio-economic risk

The merits of an approach which distinguishes between the different risk attributes of options is recognised as a differentiating feature of the selected new water supply options. In this regard, it is proposed to include the assessment of risk under the criteria identified above.

This assessment is intended to include examination of the changed risk environment arising from Irish Water assuming responsibility for the project; having regard to the legal functions and powers, and planning obligations under statute, of the national water utility.



Key

- White Space Boundary
- Refined Study Area
- Curragh Aquifer and Pollardstown Fen
- Pearl Mussels Catchment
- Ramsar Sites
- Special Area of Conservation
- Special Protection Area
- Natural Heritage Area
- Proposed Natural Heritage Area
- Unesco Sites
- Counties

Rev.	Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
1	22/05/2015	Created to illustrate constraints	PW	PMcG	PMcG	MG

JACOBS TOBIN Patrick J. Tobin & Co. Ltd.

Client: UISCE ÉIREANN IRISH WATER

Project: Water Supply Project - Eastern and Midlands Region

Drawing Title: Cumulative Constraints with White Space Boundary

Drawing Status: **Issued**

Scale @A3	1:600,000		DO NOT SCALE
Jacobs No.	32105801	Client No.	WSP1
Filepath	G:\JNG\432\05001 - WSP-DRGS Tasks\1_Work\Report Mapping\Figure 7.2 Cumulative Constraints with White Space Boundary.mxd		

Drawing No.: Figure 7.2

Appendix A Consultation Submissions Report

Appendix B Source Yield Review

Appendix C Habitats Directive Review

Appendix D Multi Criteria Analysis Review

Appendix E SEA Review

Appendix F SEA Consultation Review

Appendix G Constraints Mapping

Schedule of Drawings

Drawing Number	Drawing Title
32105801-1001	Project Study Area
32105801-1002	Refined Study Area
32105801-1003	Constraint - Special Area of Conservation
32105801-1004	Constraint - Special Protection Area
32105801-1005	Constraint - Natural Heritage Area
32105801-1006	Constraint - Proposed Natural Heritage Area
32105801-1007	Constraint - Ramsar Convention Sites (Wetlands)
32105801-1008	Constraint - UNESCO Sites
32105801-1009	Constraint - Curragh Aquifer and Pollardstown Fen
32105801-1010	Constraint - Protected Freshwater Pearl Mussels Catchment
32105801-1011	Cumulative Constraints with White Space Boundary
32105801-1012	White Space Boundary