

Economic Modelling and Assessment of the Economic Benefits of Beneficial Use of Dredged Sediment

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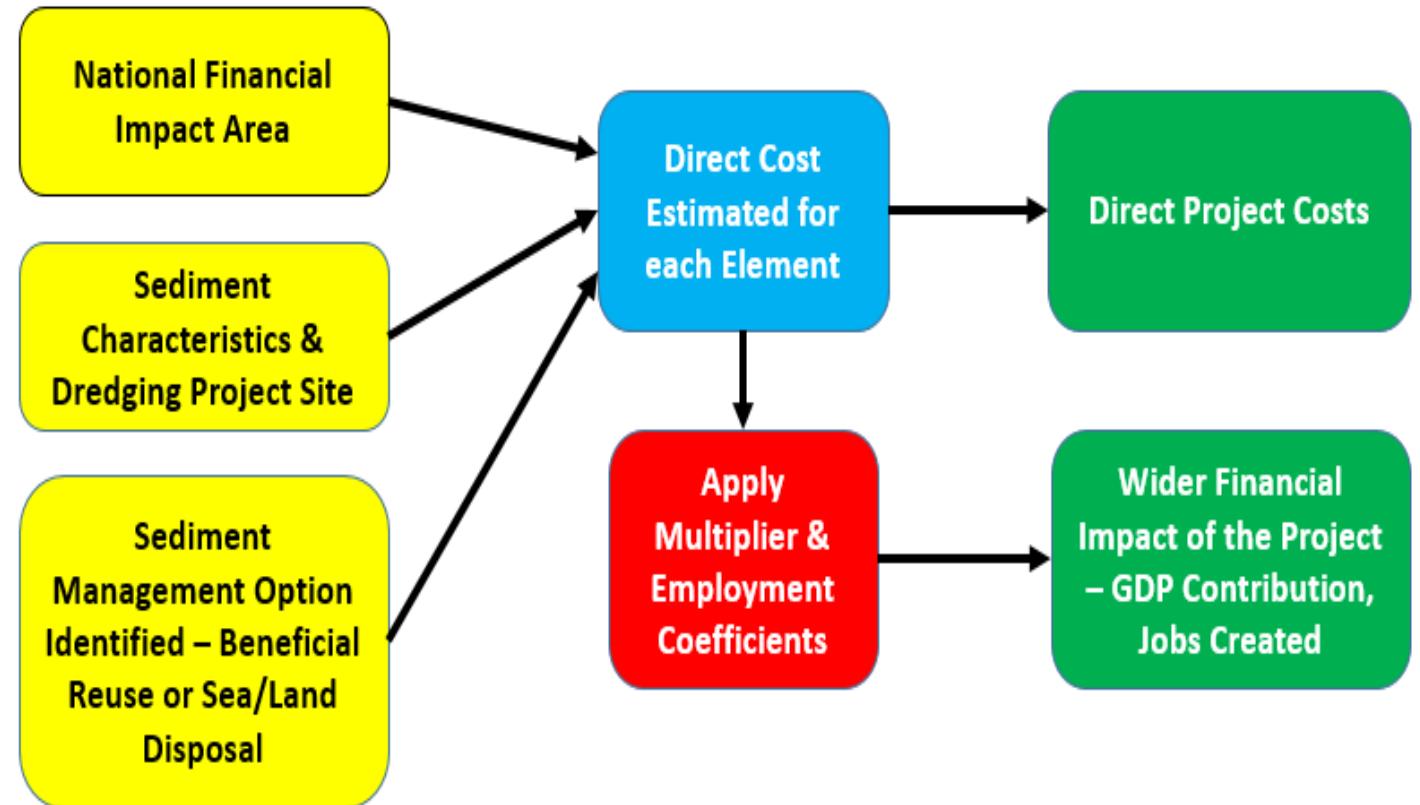
The SURICATES Project – An Introduction

- **SURICATES – Sediment Uses as Resources In Circular And Territorial Economies (2018-2022)**
- Funding Programme: EU Interreg NWE
- Aim to increase sediment reuse for erosion & flood protection
- A range of models & tools being developed, and supported and complemented by Pilot Sites.
- Tools developed include GIS, Direct Cost, Environmental and **Economic Models**
- Integrated decision making tools to inform the sediment management sector.



The Economic Model – An Overview

- The model focuses on the **Economic Analysis and Evaluation** of sediment management projects
- The approach used is based on **Multipliers** derived from input-output analysis of economic activity
- These input-output models generate a **Multiplier Index** that measures the total effect of an increase in investment on employment or income
- A comprehensive unit costs database has been compiled
- The model has been initially developed for application in the SURICATES Partner Countries of Ireland, Scotland, France and the Netherlands (and the United Kingdom).



Outputs from the Economic Model

- **Direct effect on GDP** (direct costs) are the actual costs associated with completion of the dredging project. The total direct cost of a project is the sum of all the individual process unit costs by the associated quantity involved
- **Indirect effect on GDP** is the result of business-to-business transactions caused by direct effects. The businesses benefiting from the direct effect subsequently increase spending at other local businesses
- **Induced effect on GDP** is the result of increased household income caused by the direct and indirect effect. Households increase spending at local businesses. The induced effect is a measure of this increase in household-to-business activity.
- **The direct jobs created** are those jobs directly associated with the project work
- **The indirect jobs created** represent the number of jobs supported by business-to-business transactions due to the economic activity generated by the project
- **The induced jobs created** represent the number of jobs supported by household spending due to the economic activity generated by the project.

- **Direct Effect on GDP (Total Cost)** - Sum of the individual process unit costs multiplied by the associated quantity

$$\text{Direct Effect (Cost)} = \sum_{i=1}^n (\text{Unit Cost} * \text{Quantity})_i$$

- **Indirect Effect on GDP** - Calculated using the **Type I Output Multiplier**. A Type I Output Multiplier can be derived from the Industry by Industry Symmetric Input-Output Tables using the Leontief Inverse Matrix



- **Induced Effect on GDP** – Calculated using the **Type II Output Multiplier**. The steps involved in the derivation are similar to the Type I Approach Output Multiplier derivation but contains additional data on sectoral wages.

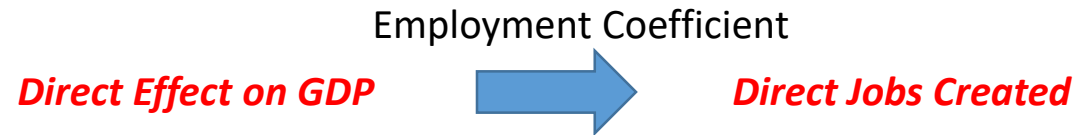


Effects on Jobs Created – An Overview

- **Employment Coefficients** - derived by dividing the *Full Time Equivalent jobs* in a given industry sector by the level of *Total Output* (€) in that industry

$$\text{Employment Coefficient}_i = \text{Full Time Equivalent Jobs}_i / \text{Total Output}_i \text{ [jobs per € invested]}$$

- **Direct Jobs Created**



- **Indirect Jobs Created**

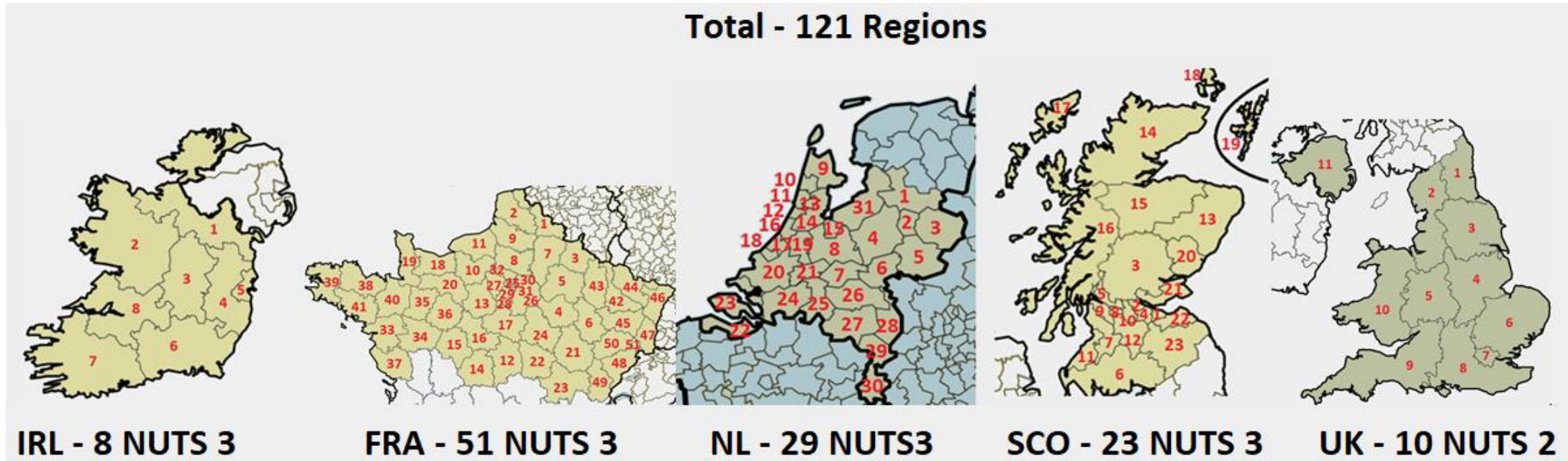


- **Induced Jobs Created**



The Economic Model - Geographic Spread and Downscaling

- The model is downscaled to a regional NUTS 3 level (except with the UK at NUTS 2 level)
- Application of Simple Location Quotients (SLQ) by country
- The Simple Location Quotient approach allows quantification of the concentration of a particular industry or occupation in a region compared to the national scale.



The Economic Model – Some Detail

- Different NUTS levels
- 9 sediment management scenarios:

Land Reclamation

Wetland Creation

Beach Nourishment

Concrete Applications

Sediment Cell Maintenance

Manufactured Topsoil

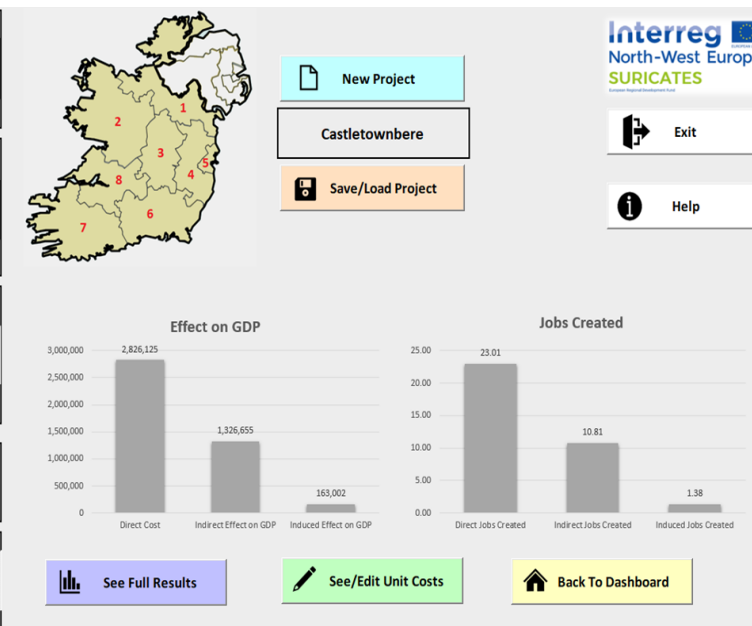
Dike Construction

General Beneficial Use

Disposal (Sea, Land)

- Individual processes for each scenario
- Direct cost database for each country

Regions of Ireland	drop down list	7-South-West	
Type of Dredger Used	drop down list	Mechanical	
Is Barge used?	drop down list	Yes	Capital Dredging
Dredged Material Volume [Sand,Silt,Gravel]	m³	48,383	
Dredged Material Volume [Rock]	m³	17,617	
Dredged Material Volume [Contaminated]	m³	0	
Volume Used	m³	66,000	
Volume Dewatered	m³	66,000	
Dewatering method	drop down list	Natural	Land Reclamation
Treated Material Volume	m³	0	
Treatment Method	drop down list	None	
Distance to Relocation Site	km	0.1	
Transport to Relocation Site	drop down list	Land transport	
Volume Disposed	m³	0	
Volume Dewatered	m³	0	
Dewatering Method	drop down list	None	No Disposal
Treated Material Volume	m³	0	
Treatment Method	drop down list	None	
Distance to Disposal Site	km	0	
Disposal Option	drop down list	None	
Volume of Imported Rock Material	m³	Import 1 18,833	Import 2 11,528
Volume of Imported Quarry Material	m³	None	2,766
Type of Quarry Material	drop down list	None	Aggregate
Distance to Quarry	km	5	80
Volume of Material Exported	m³	0	
Volume Dewatered	m³	0	
Dewatering Method	drop down list	None	No Export
Treated Material Volume	m³	0	
Treatment Method	drop down list	None	



Sediment Management Scenarios

Regions of Ireland	drop down list	7-South-West
Type of Dredger Used	drop down list	Mechanical
Is Barge used?	drop down list	Yes
Dredged Material Volume [Sand,Silt,Gravel]	Beneficial Use Scenario Options	
Dredged Material Volume [Rock]	Available Beneficial Scenarios Explained	
Dredged Material Volume [Contaminated]		

Volume Used

Volume Dewatered

Dewatering method

Treated Material Volume

Treatment Method

Distance to Relocation Site

Transport to Relocation Site

Volume Disposed

Volume Dewatered

Dewatering Method

Treated Material Volume

Treatment Method

Distance to Disposal Site

Disposal Option

Volume of Imported Rock Material

Volume of Imported Quarry Material

Type of Quarry Material

Distance to Quarry

Volume of Material Exported

Volume Dewatered


Dewatering Method

Treated Material Volume


Treatment Method

General Use/No Use

Beneficial Use (General)




Disposal




Engineering Uses


Beach Nourishment



Dyke Construction




Land Reclamation




Environmental Uses

Wetland Creation




Sediment Cell Maintenance




Agricultural/Product Uses

Manufactured Topsoil



Concrete Application



OK

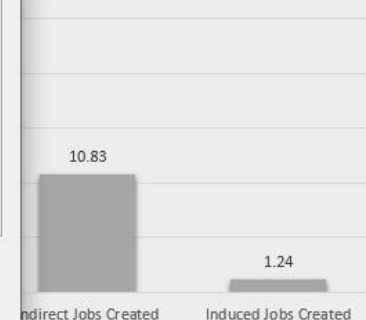


Exit



Help

Jobs Created



Back To Dashboard

Model Application

- The Economic Model has been applied for site specific sediment management projects at:
Castletownbere Fishery Harbour Development, Ireland
SURICATES Pilot Site, Falkirk, Scotland

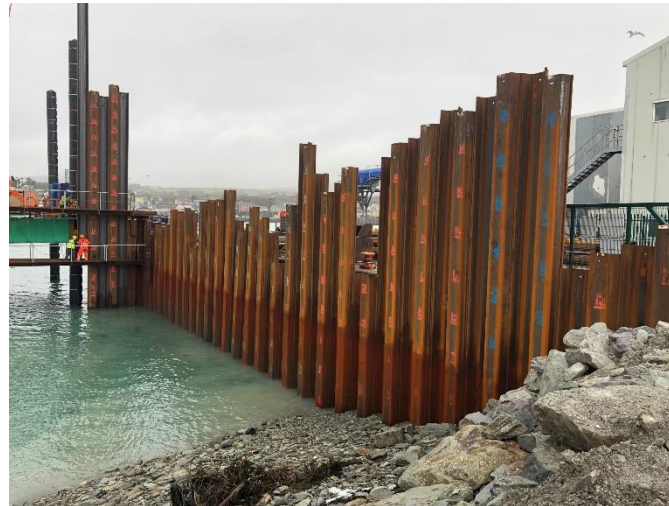
Model Application – Castletownbere Fishery Harbour Development, Ireland



- Owner: National Department of Agriculture, Food & Marine
- Contractor: L&M Keating Ltd.
- Construction of a new quay structure and associated infilling and land reclamation
- Dredging of a berthing pocket and a navigation channel
- Construction of two new breakwater structures
- Dredged sediment used as reclamation material and for the quay wall and breakwaters
- Project commenced in 2018
- Overall Project Cost: €25 million (approx.)
- Sediment Management Project Cost: €3 million

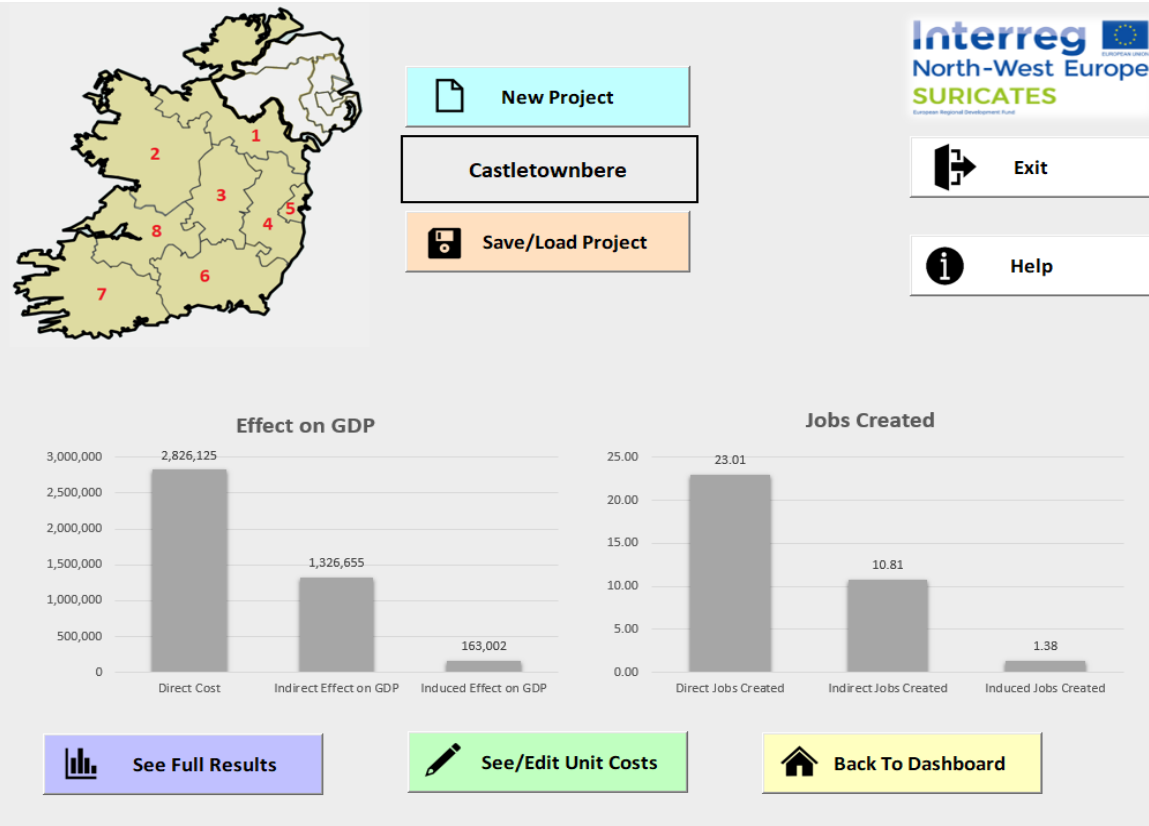
Model Application – Castletownbere Fishery Harbour Development, Ireland

- 66,000 m³ (fine material 48,383m³, rock 17,617m³)
- Rock as quay wall backfill
- Fine material as land reclamation material
- Dredged sediment dewatered naturally; no treatment required
- 33,127 m³ of material imported to site (rock and aggregate)
- Dredged sediment transported by truck over a short land distance - 100 m



Model Output - Results

Regions of Ireland	drop down list	7-South-West	Capital Dredging			
Type of Dredger Used	drop down list	Mechanical				
Is Barge used?	drop down list	Yes				
Dredged Material Volume [Sand,Silt,Gravel]	m³	48,383				
Dredged Material Volume [Rock]	m³	17,617	Land Reclamation			
Dredged Material Volume [Contaminated]	m³	0				
Volume Used	m²	66,000				
Volume Dewatered	m³	66,000				
Dewatering method	drop down list	Natural	Land Reclamation			
Treated Material Volume	m³	0				
Treatment Method	drop down list	None				
Distance to Relocation Site	km	0.1				
Trasport to Relocation Site	drop down list	Land transport	No Disposal			
Volume Disposed	m³	0				
Volume Dewatered	m³	0				
Dewatering Method	drop down list	None				
Treated Material Volume	m³	0	No Disposal			
Treatment Method	drop down list	None				
Distance to Disposal Site	km	0				
Disposal Option	drop down list	None				
Volume of Imported Rock Material	m³	18,833	Import 1	Import 2	Import 3	No Export
Volume of Imported Quarry Material	m³	2,766				
Type of Quarry Material	drop down list	None	Aggregate	None	None	
Distance to Quarry	km	5	80	120		
Volume of Material Exported	m³	0	No Export			
Volume Dewatered	m³	0				
Dewatering Method	drop down list	None				
Treated Material Volume	m³	0				
Treatment Method	drop down list	None	No Export			



	Simulated	Actual
Direct Effect (GDP)	€ 2,826,125	€ 3,000,000
Jobs Created	23.01 FTE	25 FTE

Indirect Effect (GDP)	€ 1,326,655
Induced Effect (GDP)	€ 163,002
Indirect Jobs Created	10.81 FTE
Induced Jobs Created	1.38 FTE

Model Application – Falkirk Site, Scotland



- Owner: Scottish Canals
- Dredged sediment mechanically dredged (approximately 500m³) from the Forth and Clyde Canal near Falkirk, Scotland
- An EU Interreg SURICATES Pilot Project
- Project undertaken in 2020
- Overall Project Cost: €57,000



Model Application – Falkirk Site, Scotland



- A bio-engineering pilot scheme
- Dredged sediment dewatered naturally
- Treatment method involved planting the material with reed canary grass (Phytoconditioning)
- Dredged sediment transported 1.8km via canal and 38km by truck



Model Output - Results

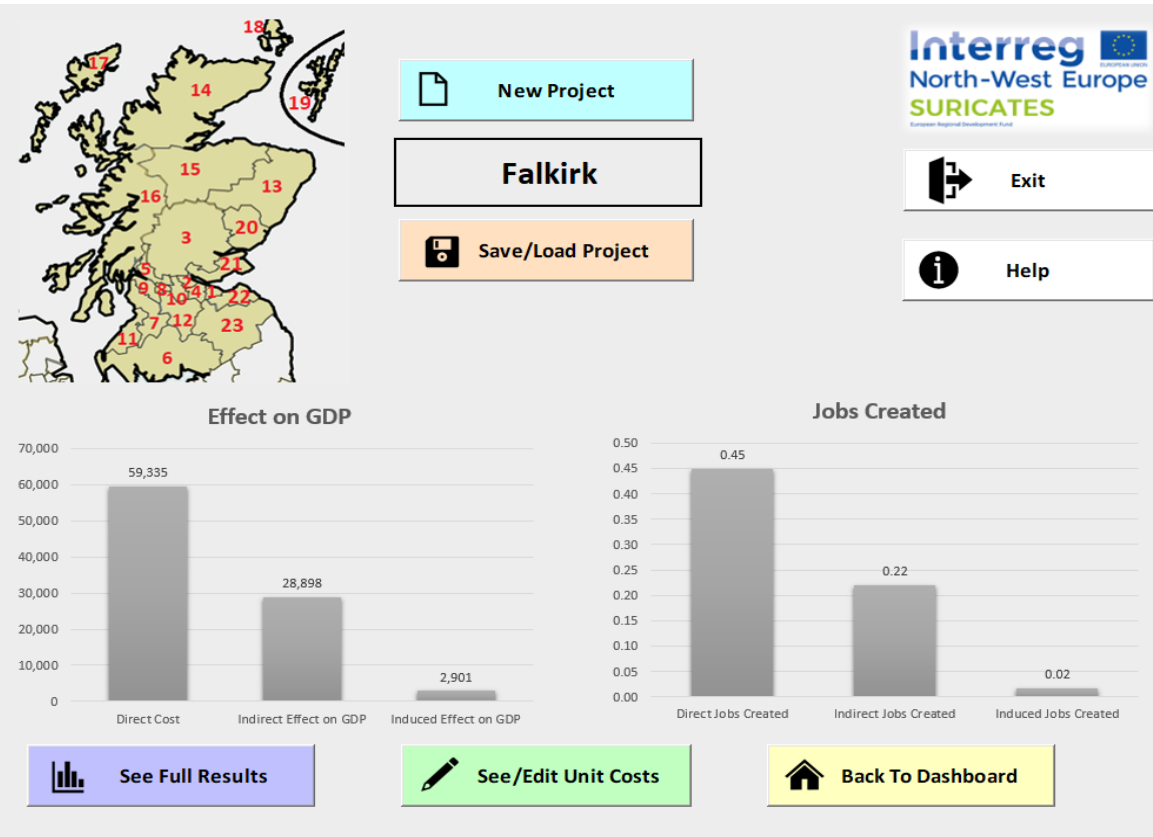
Regions of Scotland	drop down list	2-Falkirk	Capital Dredging
Type of Dredger Used	drop down list	Mechanical	
Is Barge Used?	drop down list	Yes	
Dredged Material Volume [Sand,Silt,Gravel]	m³	500	
Dredged Material Volume [Rock]	m³		
Dredged Material Volume [Contaminated]	m³		

Volume Used	m³	500	Beneficial Use (General)
Volume Dewatered	m³	500	
Dewatering method	drop down list	Natural	
Treated Material Volume	m³	500	
Treatment Method	drop down list	Bioremediation	
Distance to Relocation Site	km	39.9	
Transport to Relocation Site	drop down list	Multiple Transport	

Volume Disposed	m³	0	No Disposal
Volume Dewatered	m³	0	
Dewatering Method	drop down list	None	
Treated Material Volume	m³	0	
Treatment Method	drop down list	None	
Distance to Disposal Site	km	0	
Disposal Option	drop down list	None	

Volume of Imported Rock Material	m³	0	No Import	No Import	No Import
Volume of Imported Quarry Material	m³	0	0	0	0
Type of Quarry Material	drop down list	None	None	None	None
Distance to Quarry	km	0	0	0	0

Volume of Material Exported	m³	0	No Export
Volume Dewatered	m³	0	
Dewatering Method	drop down list	None	
Treated Material Volume	m³	0	
Treatment Method	drop down list	None	



	Simulated	Actual
Direct Effect (GDP)	€ 59,335	€ 57,157
Jobs Created	0.45 FTE	0.65 FTE

Indirect Effect (GDP)	€ 28,898
Induced Effect (GDP)	€ 2,901
Indirect Jobs Created	0.22 FTE
Induced Jobs Created	0.02 FTE

Conclusions

- An Economic Model has been developed for a range of sediment management scenarios
- The Economic Model provides full Economic Effects and is downscaled to a regional NUTS 3 level for the SURICATES Partner Countries
- The model provides a tool to evaluate the wider economic impacts of sediment management projects
- The model has a potential to facilitate and support the stakeholder decision making process (in conjunction with the application of the other SURICATES Tools)
- The Economic Model has been applied to Real Sediment Management Projects in Ireland and Scotland
- On-going work involves application of the Economic Model for a range of Sediment Management Projects across the SURICATES Partner Countries.

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Thank You