Social, Economic and Environmental Assessment for Sediment Reuse Strategies

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Outline of Presentation

- Overview of SURICATES Work Package WPT1
- Background to the Suite of SURICATES Tools Developed
- Tools Application to Pilot Sites/Case Studies
  - Falkirk, Scotland
  - Port of Fenit, Ireland
  - Port of Rotterdam, The Netherlands
- Conclusions and Recommendations

SURICATES Work Package - WPT1

Title: Secured Social, Economic and Environmental Global Cost Optimisation for New Solution Design and Optimised Business Conditions

Activity 1: GIS Development & Application
Development of a GIS system with Application to Specific Sites (Pilot Sites or Case Studies)

Activity 2: Tools Development & Application
Development of Direct Cost (USAR), Economic and Environmental (BROADSEAT) Tools with Application to Specific Sites (Pilot Sites or Case Studies)

Activity 3: On-Site Monitoring Campaign
Application of Real Time Monitoring Technologies to Specific Sites (Pilot Sites or Case Studies) and Development of a Guidance Document

Overall Approach: Develop and apply a suite of tools for assessment purposes to a number of sites across the SURICATES Partner Countries.

Summary of Tools Outputs

Tool	Summary Output	Output Units
GIS	Geographical Location Acceptability Score on GIS map	Geo - coordinates Numerical Acceptability Score (Colour Coded)
USAR	Suitability of Application Indicative Direct Cost	Y/N €
Economic	Direct, Indirect & Induced Costs/Jobs Created	€, No. of Jobs
BROADSEAT	Energy, Waste, Environmental & Societal Rating	Numerical Score

The GIS Tool – An Overview

- **Developed by the University of Lille**

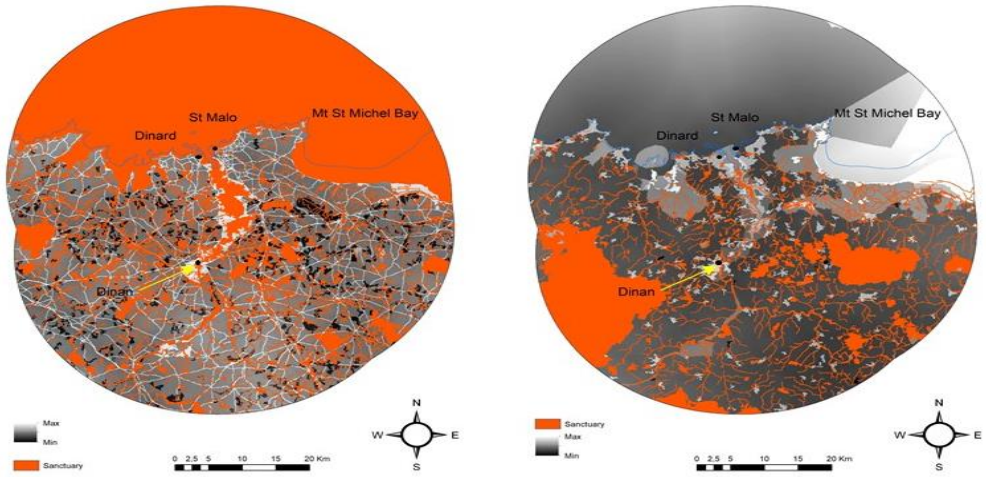
- The **RAIES** (**R**epulsion-**A**ttraction-**I**ncluded-**E**xcluded-**S**anctuarised) **GIS tool** aims to provide different stakeholders with a GIS solution to help them find the best location(s) for sediment reuse projects

- It uses a spatial decision support system, which determines the best location available based on inputs from stakeholders – who may be any relevant type of stakeholder or local citizen

- It uses GIS layers as inputs and provides geographic output

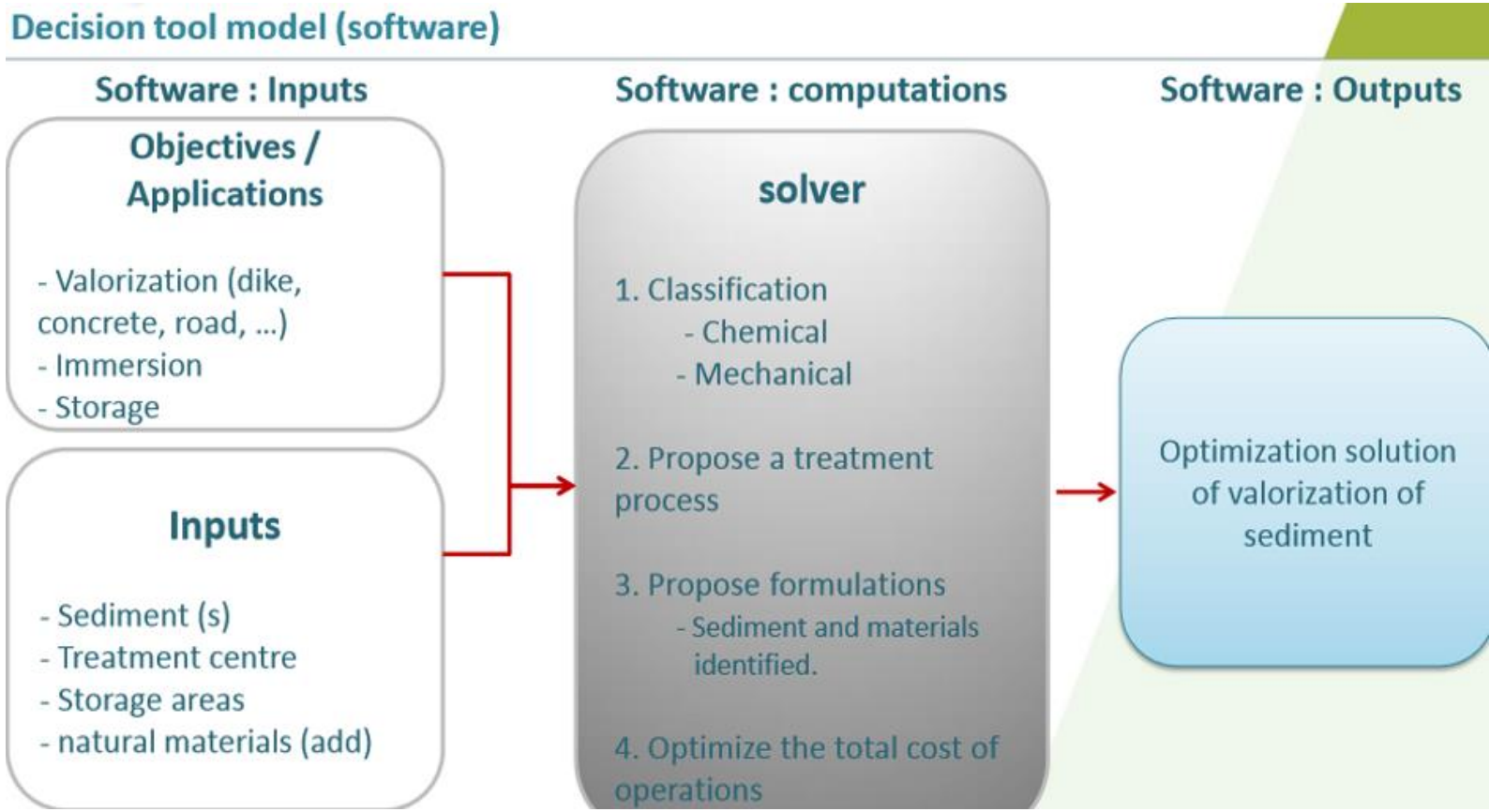
- It provides theoretical relationships between a specific location and an object in a GIS layer (based on stakeholder opinion

- It is a multicriteria tool following Nimby/Yimby principles.

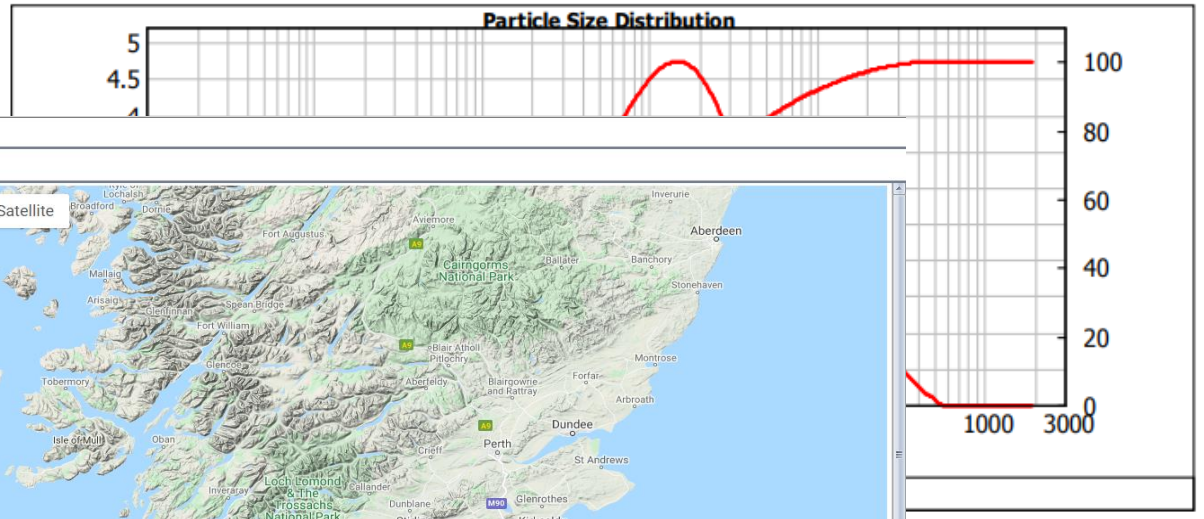


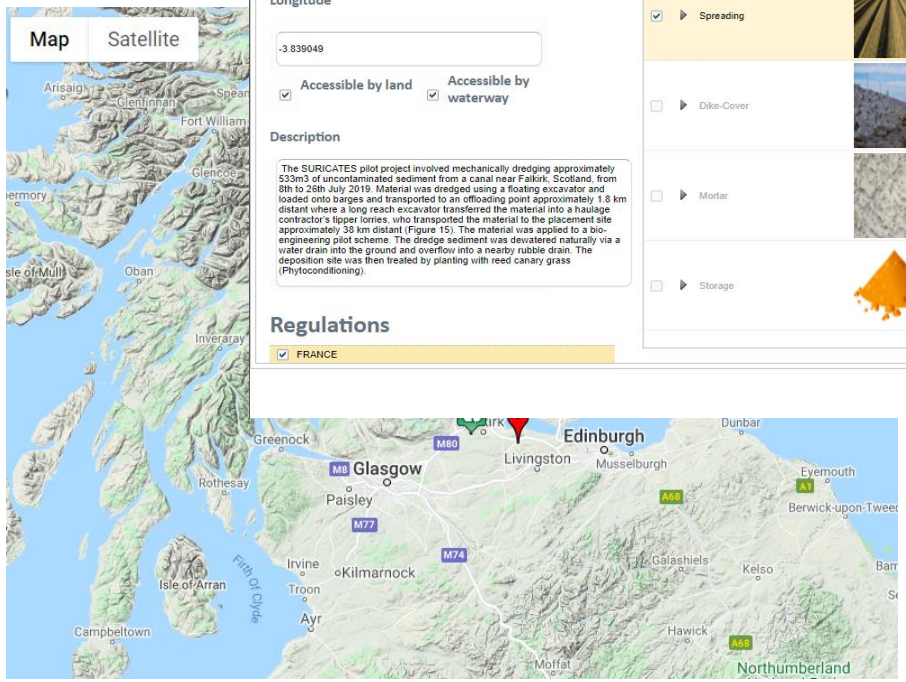
The Direct Cost Tool (USAR) – An Overview

- **Developed by IMT Douai**
- USAR is a tool to help the decision making process for dredged sediment management
- Selection of the most suitable sediment management option is based on criteria including sediment granulometry & chemical characteristics, project costs, environmental criteria, site locations and local & national regulations
- USAR output is an optimised solution for a sediment reuse project with associated direct costs



The Direct Cost Tool (USAR) – An Overview

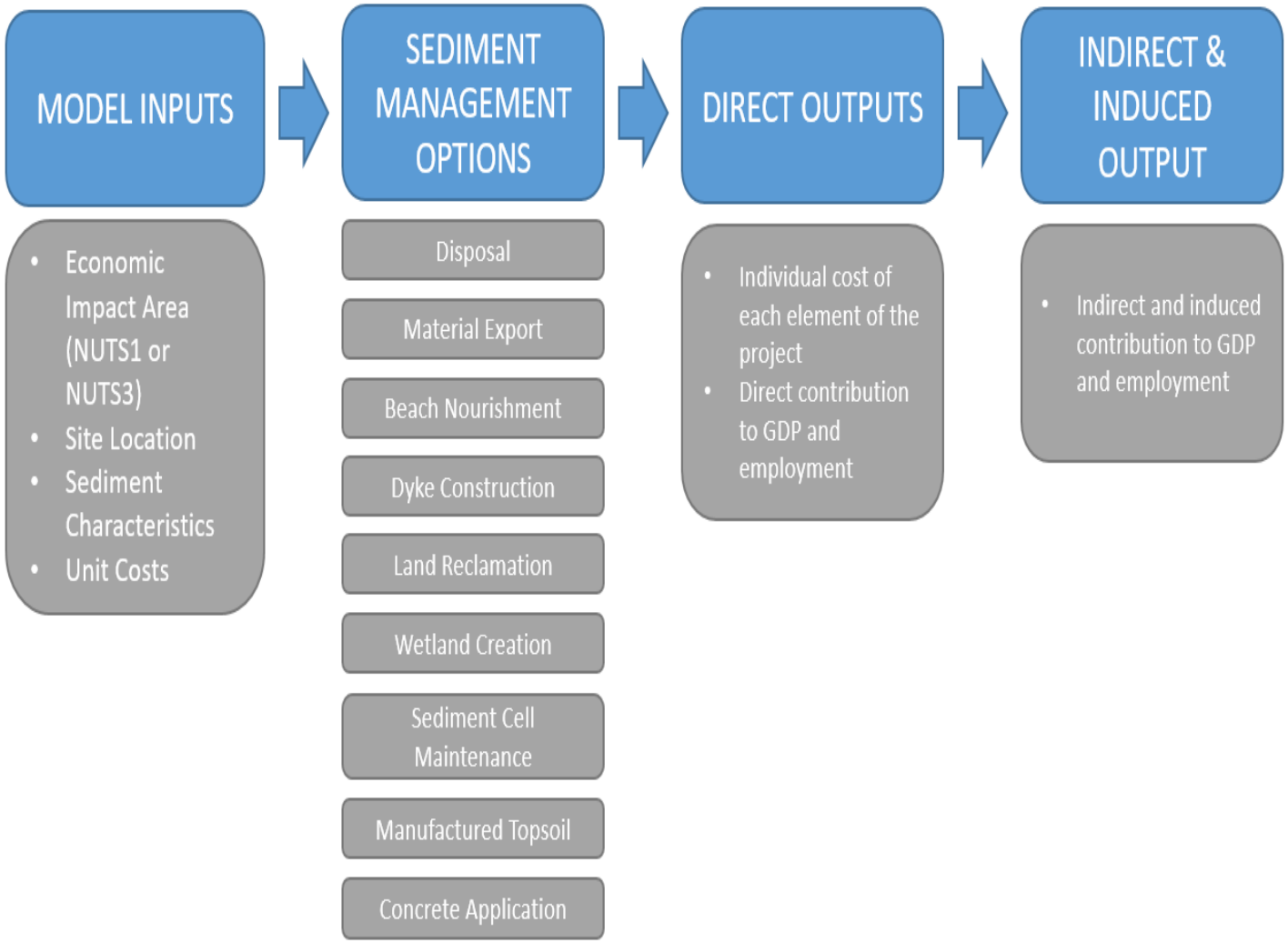




						Average	Unit
						8.75	mg/kg
						145.2	mg/kg
						2.825	mg/kg
						0.9	mg/kg
						51.8	mg/kg
						42	mg/kg
	<1	<1	<1	<1	<1	<1	mg/kg
Chromium	50	47	48	30	35	42	mg/kg
Lead	136	97	94	20	50	79.4	mg/kg
Mercury	1.69	1.03	1	<0.17	0.58	1.075	mg/kg
Nickel	89	76	81	37	55	67.6	mg/kg
Zinc	308	249	237	71	151	203.2	mg/kg
Total PAH-16	5.54	2.89	1.85	0.25	1.71	2.448	mg/kg

The Economic Tool – An Overview

- **Developed by Munster Technological University**
- 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
- The model has been developed for application in the SURICATES Partner Countries of Ireland, Scotland, France and the Netherlands (and the United Kingdom).



Outputs from the Economic Tool

- **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.

Effects on GDP – An Overview

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

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

- **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

Type I Multiplier

Direct Effect on GDP → ***Indirect effect on GDP***

- **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.

Type II Multiplier

Direct Effect on GDP → ***Induced effect on GDP***

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

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

- **Direct Jobs Created**

  Employment Coefficient

  Direct Effect on GDP → ***Direct Jobs Created***

- **Indirect Jobs Created**

  Employment Coefficient

  Indirect Effect on GDP → ***Indirect Jobs Created***

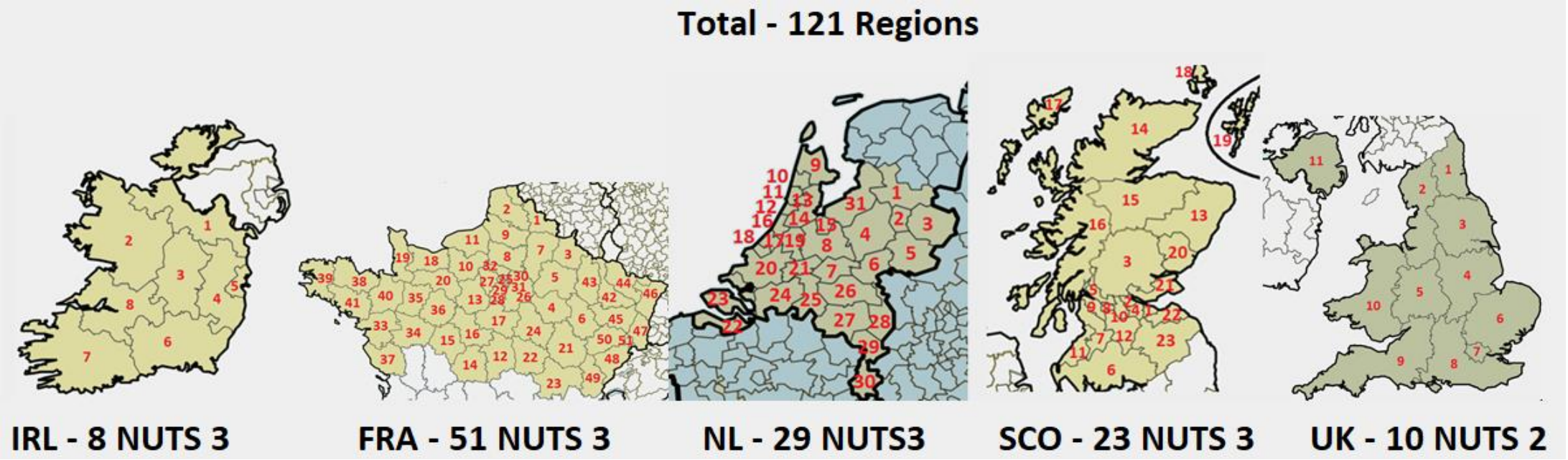
- **Induced Jobs Created**

  Employment Coefficient

  Induced Effect on GDP → ***Induced Jobs Created***

The Economic Tool - 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 at the national scale.



The Environmental Tool (BROADSEAT) – An Overview

- **Developed by the University of Strathclyde**
- BROADSEAT (Beneficial **R**euse **O**f **A**ny Dredged **S**ediment Environmental **A**ssessment **T**ool)[1] is designed to analyse the environmental merits of a beneficial use dredging project
- It compares a real or hypothetical ***Beneficial Reuse Option (BRO)*** **to** ***the Business as Usual (BAU)*** **Case**
- It is a qualitative assessment on a binary scale – 'the better'/'the same'/'worse'
- 54 stakeholder questions are grouped into 4 main categories - Energy, Waste, Environment, Societal
- 10 subcategories - transport, energy, circular economy, waste management, waste regulation, water environment, ecosystem services, biodiversity & conservation, socio-economic impacts and UN Sustainable Development Goals (SDGs)
- The resulting score comparing the *BRO* to *BAU* is coloured coded; radar plots presented as output.

[1] Lord R, Torrance K (2022) BROADSEAT (Beneficial Reuse Of Any Dredged Sediment Environmental Assessment Tool). University of Strathclyde. https://doi.org/10.15129/2e620d12-44bc-42fb-9b14-b0e89a8a7457

The Environmental Tool (BROADSEAT) – An Overview

Default group weighting %	*START HERE: Ask yourself the question "For your Beneficial Reuse Option (BRO) compared to the Business As Usual (BAU) option for the dredged sediment…? (see the list below for the second part of the question).*	Default weighting %	Your own weighting %	Decision	Default score using default weightings	Your score using your weightings
25			22			
	Does the BRO require a **greater** or **lower** distance of transport per tonne dredgings?	5	3	Greater	-5	-3
	Does the transport mode for the BRO involve a **change in mode of transport from water** to road (worse) or **from road to water (better)**?	4	3	Same or not relevant	0	0
	Does the transport mode for the BRO involve a **change to a less fuel efficient** or **more fuel efficient** mode of transport per tonne?	4	4	Same or not relevant	0	0
	Does the transport mode for the BRO involve a **change to a less environmentally impactful fuel**?	4	4	More emission impac	0	0
	Does the BRO require a **greater** or **lower** input of energy per tonne dredgings to process for reuse?	4	4	Lower	4	4
	Does the BRO involve a **change in the form of energy used for processing to grid electricity from liquid fuels**?	4	4	Same or not relevant	0	0
27			35			
	Does the BRO allow continued use of techical material(s) won from the dredged sediment?	3	5	Yes	3	5
	Does the BRO allow substitution of primary resources with material(s) won from the dredged sediment?	3	5	Yes	3	5
	Does the BRO support the use or production of bio-based products, renewable energy vectors or cascading of bioresources?	3	5	Yes	3	5
	Does the BRO change the amount of dredged sediment arisings?	2	2	Same or not relevant	0	0
	Does the BRO involve the direct use of dredged sediment arisings (i.e. without processing, mechanical treatment or additions)?	3	2	Yes	3	2
	Does the BRO involve the subsequent use of some/all of the dredged sediment arisings (i.e. after processing, mechanical treatment or additio	3	2	Yes	3	2
	Does the BRO address legacy contaminated sediments, such by capping, containment or removal?	2	5	Not relevant	0	0
	Does the BRO change the amount of methane likely to be produced by the sediment when dredged compared to ithe BAU option?	2	2	Same or not relevant	0	0
	Does the BRO change the amount of any other emissions to air, land or water likely to be produced by the sediment when dredged compared	2	2	Greater	-2	-2
	Does the BRO eliminate the need for regulatory control compared to the BAU alternative?	2	2	Yes	0	2
	Does the BRO change the amount of work, time or cost involved in obtaining regulatory approval?	2	3	Same or not relevant	0	-2

The Environmental Tool (BROADSEAT) – An Overview

Output Table		
CATEGORY	BAU Rating [-100:100]	BRO Rating [-100:100]
Energy	-4	+5
Waste	+52	+49
Environment	+32	+50
Societal	+68	+60

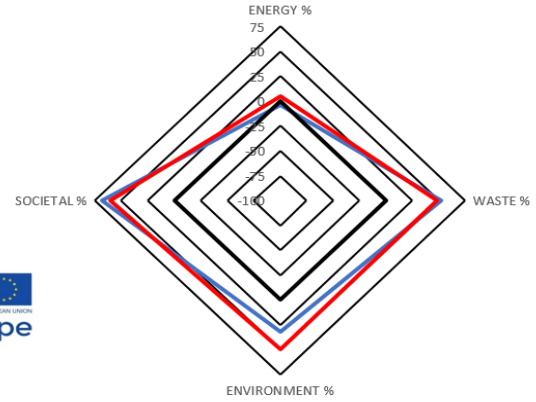
Output for Beneficial Reuse Of Any Dredged Sediment Environmental Assessment Tool (BROADSEAT v 4.0) decision support tool

Score is for Beneficial Reuse Option relative to the Business As Usual case, ranging from -100 (worse) to +100 (better)

Project name Falkirk South Location Union Canal, Country Scotland

CEDA 5 R (select)

Graphic illustration of the energy, waste environmental and societal benefits of your Beneficial Reuse Option (blue=default, red= your weightings)



	Default weightings	Your weightings
Total scores (%)	37	41
Validity check	Valid default weightings BRO score	Your valid BRO score
Component scores		
ENERGY %	-4	5
WASTE %	52	49
ENVIRONMENT %	32	50
SOCIETAL %	68	60

ENERGY

WASTE

Environment

SOCIETAL

Tools Application to Specific Sites (Pilot Sites/Case Studies)

SURICATES Partner Country	Pilot Site/Case Study	Site Owner	SURICATES Partner(s)	Sediment Mgt Application(s)
Scotland	Falkirk	Scottish Canals	Scottish Canals & University of Strathclyde	Bioremediation
Ireland	Port of Fenit	Port of Fenit	Munster Technological University	Disposal at Sea Dyke Construction Wetland Nourishment
The Netherlands	Port of Rotterdam	Port of Rotterdam	Port of Rotterdam & Deltares	Sediment Reallocation

Falkirk, Scotland - General Description of the Project Site and the Sediment Management Project

- The SURICATES pilot project involved mechanically dredging approximately 533m^3 of uncontaminated sediment from a canal near Falkirk, Scotland
- Project duration 8th to 26th July, 2019
- Scottish Canals conducted the dredging work
- Enviro-Clean undertook the haulage work

Falkirk – Project Description

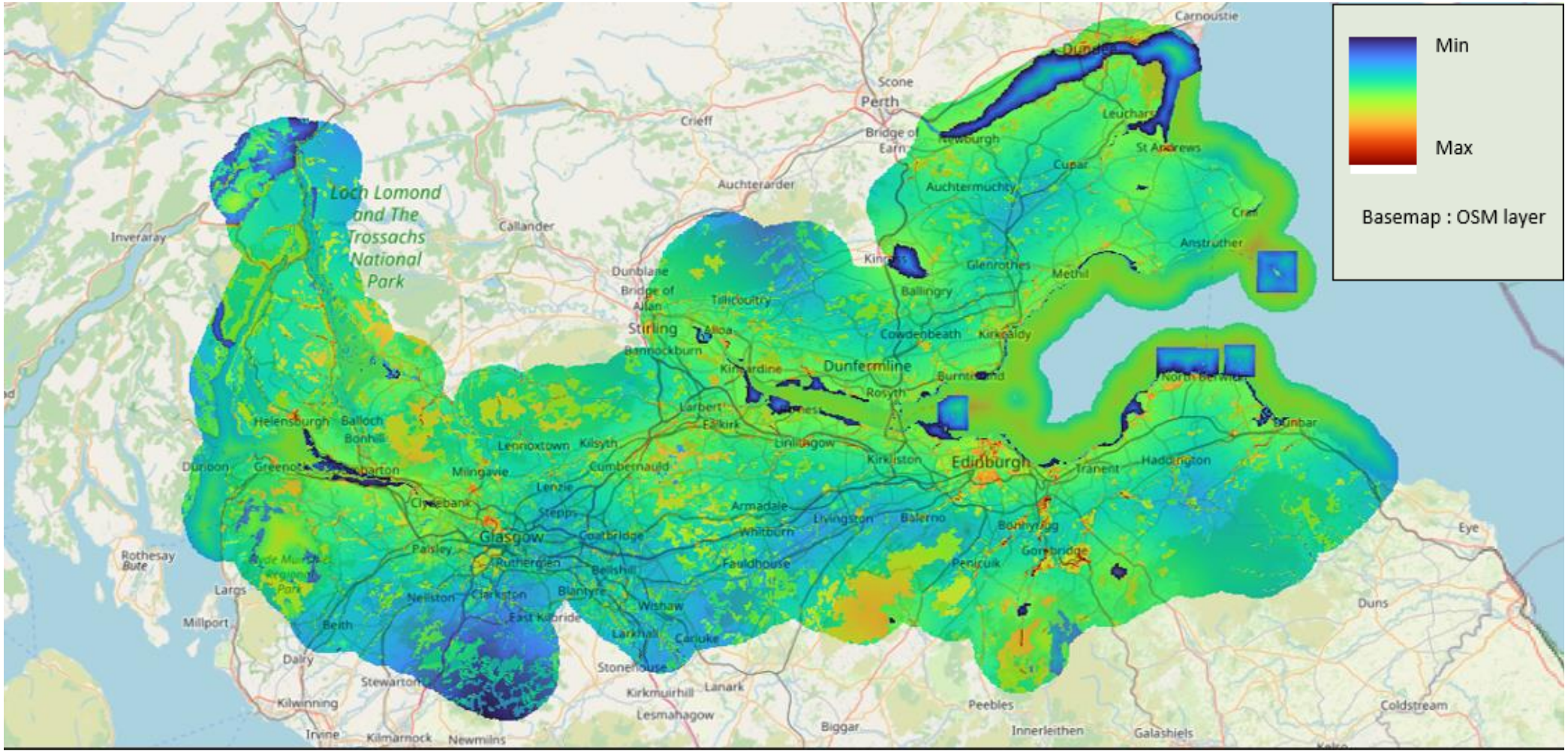
Project Description

- The material was dredged using a floating excavator and loaded onto barges and transported to an offloading point approximately 1.8 km distance where a long reach excavator transferred the material into a haulage contractor's tipper lorries, which then transported the material to the placement site a distance of approximately 38 km.

- The material was applied to a bio-engineering pilot scheme. The dredge sediment was dewatered naturally via a water drain into the ground and overflow into a nearby rubble drain. The deposition site was then treated by planting with reed canary grass (Phytoconditioning).

Item	Description
Dredging site coordinates	55.970176°, -3.611357°
Placement site coordinates	55.995434, -3.839049
Dredger used	Mechanical
Volume of dredged material	533 m^3
Dewatering method	Natural
Treatment method	Phytoconditioning
Transport	Water transport (1.8 km) + Road transport (38km)

GIS Tool Output - Falkirk



Interviewee: Paul Berry, Scottish Canals

Summary Output – Falkirk Project

TOOL	OUTPUT	VALUE		
GIS	Suitability/Acceptability Score	See Graphical Display		
Economic Tool	Direct contribution to GDP	€ 57,343		
	Indirect contribution to GDP	€ 31, 162		
	Induced contribution to GDP	€ 2,697		
	Direct jobs created	0.41 FTE		
	Indirect jobs created	0.21 FTE		
	Induced jobs created	0.02 FTE		
	Overall cost per m^3	€ 108		
	Overall cost per tonne	€ 67.5		
USAR	Sediment chemical properties suitability for chosen application	✓		
	Sediment physical properties suitability for chosen application	✓		
	Overall cost per tonne	€ 59.24		
	Transport cost per tonne	€ 9.24		
BROADSEAT	Energy rating [-100:100]	BAU (Landfill Disposal)	BRO	Difference
		-4	+4	+8
	Waste rating [-100:100]	+52	+68	+16
	Environment rating [-100:100]	+32	+28	-4
	Societal rating [-100:100]	+64	+56	-8

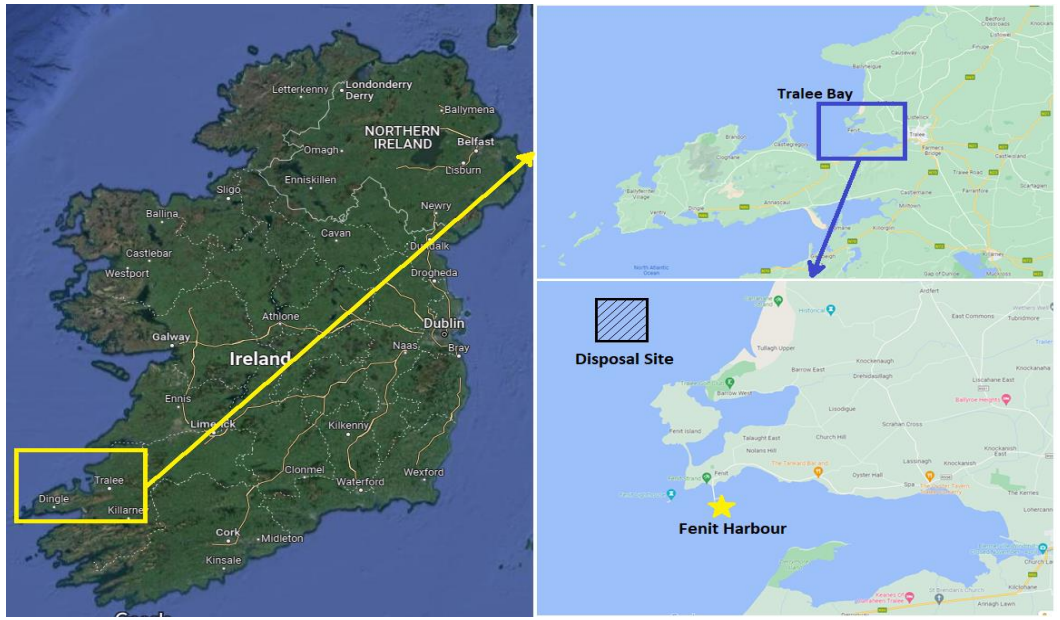
Some Conclusions – Falkirk Project

- The application of the SURICATES tools to the Falkirk site was successful and shows the feasibility of the Tools Application concept
- The application of the models to a small scale project in Falkirk has confirmed that the selected phytoconditioning application is suitable for the sediment dredged from a canal environment.
- The estimated modelled overall direct cost using the economic tool agrees well with the actual project cost (model validation achieved)[1]
- The Falkirk project has positive energy, waste & environment ratings with slightly negative ratings for the societal category.

[1]Harrington, J. et al.:
A downscaled economic model validated and applied to sediment management projects in Ireland and Scotland
Journal of Soils and Sediments. 2022
DOI: 10.1007/s11368-022-03267-z

Port of Fenit, Ireland - General Description of the Project Site and the Sediment Management Project

- The Port of Fenit is a mixed function seaport under the auspices of Kerry County Council, the Local Authority
- Maintenance dredging is an ongoing requirement to provide safe navigable access and berthage for commercial shipping and recreational craft
- Current harbour planning envisages dredging of approximately 1m tonnes of dredged sediment over an 8-year period
- Dredge Sediment Scenarios:
  - Disposal at Sea (Default Scenario)
  - Wetland Nourishment
  - Dyke Construction



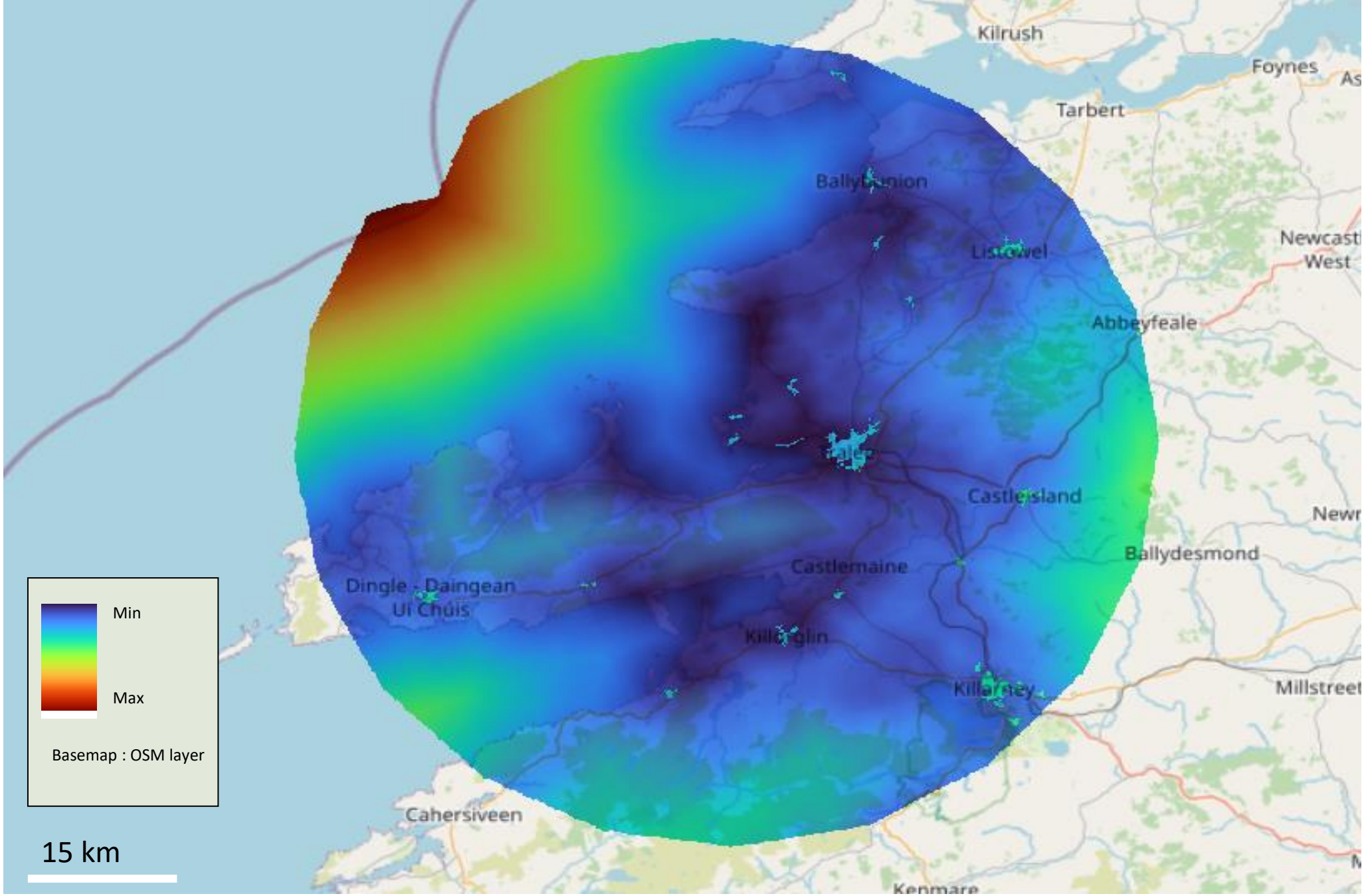
Port of Fenit – Disposal at Sea (Default Scenario)

- The disposal at sea sediment management option has been used for the Port of Fenit in its previous dredging campaigns as the most viable and economic sediment management option

- The tools application is based on 200,000 m^3 of dredged sediment transported by sea to the Irish Environmental Protection Agency licenced disposal site located approximately 7 km sail distance north of the Port of Fenit.

Item	Description
Dredging site coordinates	52.2706301°, -9.862063°
Disposal at sea site coordinates	52.321442°, -9.900344°
Dredger used	Hydraulic Dredger
Volume of dredged material	200,000 m^3
Transport	Water Transport (7 km)

GIS Tool Output – Port of Fenit



Interviewee: Don O' Herlihy, Port of Fenit Harbour Master

Summary Output – Fenit (Disposal at Sea)

MODEL	OUTPUT	VALUE
GIS	Suitability/Acceptability Score	See Graphical Display
Economic Tool	Direct contribution to GDP	€ 1,708,000
	Indirect contribution to GDP	€ 1,002,000
	Induced contribution to GDP	€ 82,100
	Direct jobs created	12.19 FTE
	Indirect jobs created	7.59 FTE
	Induced jobs created	0.60 FTE
	Overall cost per m^3 (including transport)	€ 8.54
	Overall cost per tonne (including transport)	€ 5.34
USAR	Sediment chemical properties suitability for chosen application	✓
	Sediment physical properties suitability for chosen application	✓
	Overall cost per tonne	€ 2.5
	Transport cost per tonne	€ 0.62
BROADSEAT	Energy rating [-100:100]	BAU
		0 (reference)
	Waste rating [-100:100]	0 (reference)
	Environment rating [-100:100]	0 (reference)
	Societal rating [-100:100]	0 (reference)

Port of Fenit – Wetland Nourishment

- The finer dredged sediment from the Port of Fenit is potentially suitable for nourishing and enhancing existing valuable wetlands within Tralee Bay

- The nearby wetland area covers approximately 314 hectares and contains estuarine silts and clays

- The wetland restoration scenario involves 200,000 m^3 of silty dredged sediment being transported via trailer suction dredger approximately 2.5 km sail distance and placed into the designated wetland area via high-pressure discharge of dredged sediment.

Item	Description
Dredging site coordinates	52.2706301°, -9.862063°
Wetland site coordinates	52.251689, -9.829255
Dredger used	Hydraulic Dredger
Volume of dredged material	200,000 m^3
Transport	Water Transport (2.5 km)

Summary Output – Fenit (Wetland Nourishment)

MODEL	OUTPUT	VALUE		
GIS	Suitability/Acceptability Score	See Graphical Display		
Economic Tool	Direct contribution to GDP	€ 2,217,000		
	Indirect contribution to GDP	€ 1,251,000		
	Induced contribution to GDP	€ 108,860		
	Direct jobs created	13.45 FTE		
	Indirect jobs created	7.79 FTE		
	Induced jobs created	0.67 FTE		
	Overall cost per m^3 (including transport)	€ 11.09		
	Overall cost per tonne (including transport)	€ 6.93		
USAR	Sediment chemical properties suitability for chosen application	✓		
	Sediment physical properties suitability for chosen application	✓		
	Overall cost per tonne	€ 2.2		
	Transport cost per tonne	€ 0.30		
BROADSEAT	Energy rating [-100:100]	BAU (Sea Disposal)	BRO	Difference
		0	+4	+4
	Waste rating [-100:100]	0	+12	+12
	Environment rating [-100:100]	0	+16	+16
	Societal rating [-100:100]	0	+52	+52

Port of Fenit – Dyke Construction

- A flood protection dyke is proposed to be located on a coastal stretch approximately 7.6 km east of the Port of Fenit dredging site where there is a high probability of flooding (Ref: Irish Office of Public Works Flood Maps)

- It is assumed that 200,000 m^3 of fine dredge sediment would be reused for the construction of the 3.7 km long dyke with a dyke height of 6.5 m and crest width of 2.5m, plus additional engineering works

- A rock armour outer layer requiring 12,500 m^3 of rock material supplied from the nearby Ardfert Quarry, a trucking distance of approximately 11km.

Item	Description
Dredging site coordinates	52.2706301°, -9.862063°
Dyke site coordinates	52.260798°, -9.744737 °
Dredger used	Hydraulic Dredger
Volume of dredged material	200,000 m^3
Volume of Imported Rock	24,400 m3
Dewatering Method	Natural
Transport	Water Transport (dredged sediment - 7km) + Road Transport (rock import – 11km)

Summary Output – Fenit (Dyke Construction)

MODEL	OUTPUT	VALUE		
GIS	Suitability/Acceptability Score	See Graphical Display		
Economic Tool	Direct contribution to GDP	€ 6,492,000		
	Indirect contribution to GDP	€ 3,722,000		
	Induced contribution to GDP	€ 327,800		
	Direct jobs created	36.96 FTE		
	Indirect jobs created	21.34 FTE		
	Induced jobs created	1.88 FTE		
	Overall cost per m^3 (including transport)	€ 32.46		
	Overall cost per tonne (including transport)	€ 20.29		
USAR	Sediment chemical properties suitability for chosen application	✓		
	Sediment physical properties suitability for chosen application	✓		
	Overall cost per tonne	€ 9.49		
	Transport cost per tonne	€ 0.80 + rock transport		
BROADSEAT	Energy rating [-100:100]	BAU (Sea Disposal)	BRO	Difference
		N/A	-44	-44
	Waste rating [-100:100]	N/A	+12	+12
	Environment rating [-100:100]	N/A	+28	+28
	Societal rating [-100:100]	N/A	+44	+44

Overall Summary Output – Port of Fenit

MODEL	OUTPUT	Disposal at Sea	Wetland Nourishment	Dyke Construction
GIS	Suitability/Acceptability Score	Graphical Display	Graphical Display	Graphical Display
Economic Tool	Direct contribution to GDP	€ 1,708,000	€ 2,217,000	€ 6,492,000
	Indirect contribution to GDP	€ 1,002,000	€ 1,251,000	€ 3,722,000
	Induced contribution to GDP	€ 82,100	€ 108,860	€ 327,800
	Direct jobs created	12.19 FTE	13.45 FTE	36.96 FTE
	Indirect jobs created	7.59 FTE	7.79 FTE	21.34 FTE
	Induced jobs created	0.60 FTE	0.67 FTE	1.88 FTE
	Overall cost per m^3 (including transport)	€ 8.54	€ 11.09	€ 32.46
	Overall cost per tonne (including transport)	€ 5.34	€ 6.93	€ 20.29
USAR	Sediment chemical properties suitability for chosen application	✓	✓	✓
	Sediment physical properties suitability for chosen application	✓	✓	✓
	Overall cost per tonne	€ 2.5	€ 2.2	€ 9.49
	Overall Cost	€ 800,000	€ 704,000	€ 2,254,800
BROADSEAT	Energy rating [-100:100]	0	+4	-44
	Waste rating [-100:100]	0	+12	+12
	Environment rating [-100:100]	0	+16	+28
	Societal rating [-100:100]	0	+52	+44

Some Conclusions – Port of Fenit

- Three scenarios have been analysed; the default Disposal at Sea and also Wetland Nourishment and Dyke Construction
- The USAR tool assessed the physical and the chemical properties of the dredged sediment as being suitable for all three scenarios investigated
- The Disposal at Sea option provides the lowest direct cost
- The wetland nourishment scenario provides the highest positive average rating based on the BROADSEAT tool
- The dyke construction scenario provides the largest economic impact in terms of direct, indirect and induced contribution to GDP and jobs created (but would be the most challenging in many other respects).

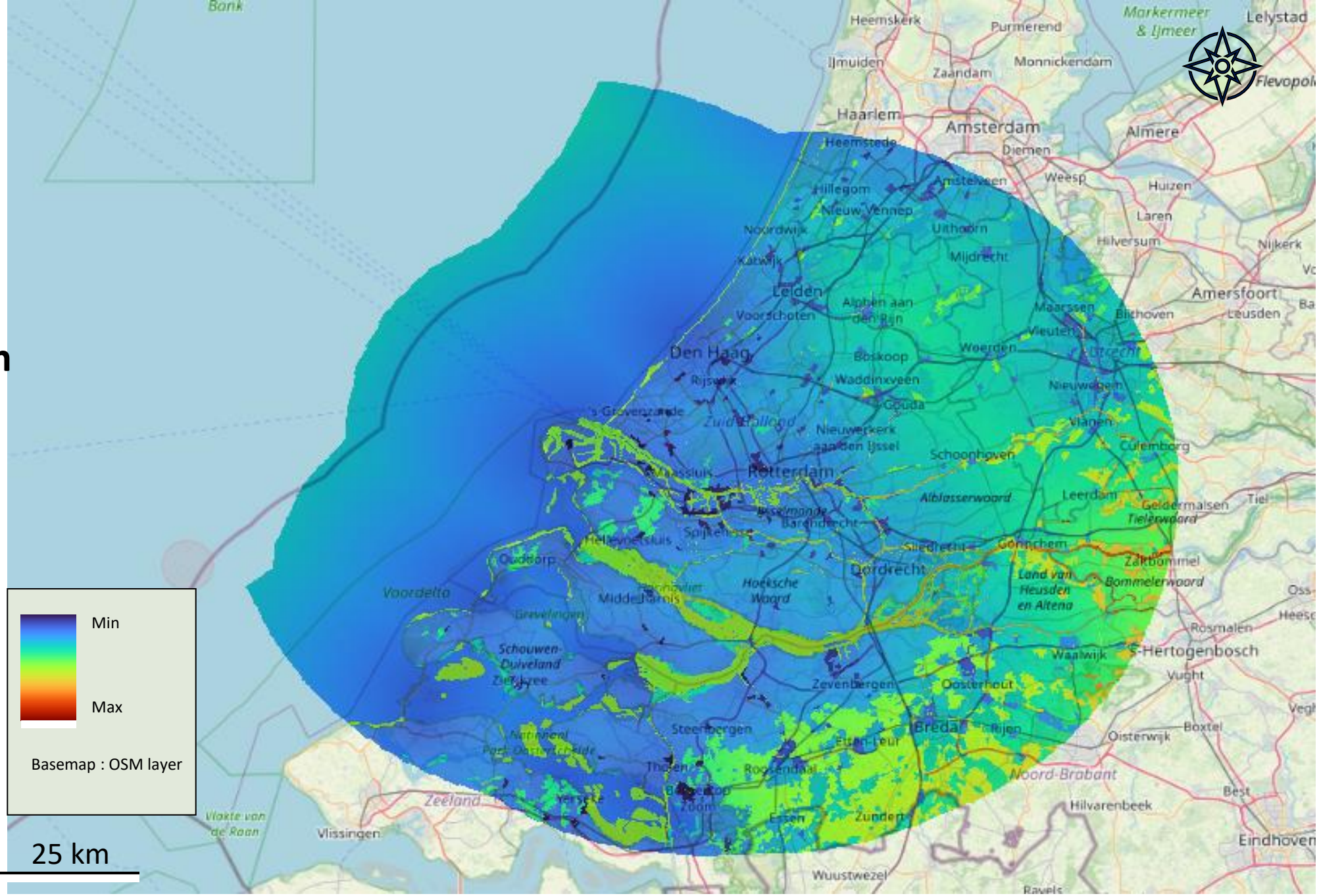
[1] Harrington et al. (2022), *The Application of a Downscaled Economic Model for Sediment Management Projects in Ireland and The Netherlands*, CERI 2022 Conference, Dublin, Ireland.

Port of Rotterdam, The Netherlands - General Description of the Project Site and the Sediment Management Project

- A large-scale pilot project involving the dredging and reallocation of approximately 500,000 m^3 of sediment
- The sediment was dredged by a Port-owned trailing suction dredger *Ecodelta* with an in-built hopper from the inner berthing areas of the Port (freshwater)
- The sediment was then reallocated approximately 10km downstream within a tidally controlled Port waterway area through a 'rainbowing' process

Item	Description
Dredging site coordinates	51.893403°, 4.415365°
Disposal at sea site coordinates	51.923986°, 4.227223°
Dredger used	Hydraulic Dredger
Volume of dredged material	500,000 m^3
Transport	Water Transport (10 km)

GIS Tool Output – Port of Rotterdam



Interviewee: Marco van Wensveen, Port of Rotterdam Manager

Summary Output – PoR (Sediment Reallocation)

MODEL	OUTPUT	VALUE		
GIS	Suitability/Acceptability Score	See Graphical Display		
Economic Tool	Direct contribution to GDP	€ 1,212,000		
	Indirect contribution to GDP	€ 675,300		
	Induced contribution to GDP	€ 61,700		
	Direct jobs created	10.22 FTE		
	Indirect jobs created	6.41 FTE		
	Induced jobs created	1.44 FTE		
	Overall cost per m^3	€ 2.42		
	Overall cost per tonne	€ 1.51		
USAR	Sediment chemical properties suitability for chosen application	✓		
	Sediment physical properties suitability for chosen application	✓		
	Overall cost per tonne	€ 6.33		
	Transport cost per tonne	€ 1.33		
BROADSEAT	Energy rating [-100:100]	BAU (Sea Disposal)	BRO	Difference
		0 (reference)	+86	+86
	Waste rating [-100:100]	0 (reference)	+24	+24
	Environment rating [-100:100]	0 (reference)	+75	+75
	Societal rating [-100:100]	0 (reference)	+44	+44

Some Conclusions – Port of Rotterdam

- The sediment reallocation application implement at the Port has been assessed.
- The USAR tool assessed the sediment from the Port of Rotterdam as suitable for sediment reallocation
- The estimated overall direct cost/contribution to GDP produced by the economic tool is in general agreement with the actual project cost (further validation of the economic tool)[1]
- The BROADSEAT model ranked this sediment management option very positively in the Energy and Environment categories.

[1] Harrington et al. (2022), *The Application of a Downscaled Economic Model for Sediment Management Projects in Ireland and The Netherlands*, CERI 2022 Conference, Dublin, Ireland.

Conclusions and Recommendations

- A suite of tools have been developed to assess the Social, Economic and Environmental Impacts of Sediment Reuse Strategies and Projects. These tools are:
    - GIS (Social Impacts)
    - USAR (Sediment Suitability and Direct Cost)
    - Economic Tool (GDP and Employment Impacts)
    - BROADSEAT (Environmental Impacts)

- This suite of tools has been applied to assess the impacts of a range of different types of sediment reuse projects/strategies
    - Falkirk (Phytoremediation)
    - Port of Fenit (Disposal at Sea, Wetland Nourishment, Dyke Construction)
    - Port of Rotterdam (Sediment Reallocation)

- This suite of tools provides the stakeholder community with the potential capacity to assess sediment management strategies and projects.

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Thank You