Value for Money & Policy Review

GSI Tellus Border Project

July 2016

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Glossary

BGS	British Geological Survey
CSU	Central Expenditure Evaluation Unit
DCENR	Department of Communications, Energy and Natural Resources
DECLG	Department of the Environment Community and Local Government
DPER	Department of Public Expenditure and Reform
GSI	Geological Survey of Ireland
GTK	Geological Survey of Finland
K	Potassium
N	Nitrogen
NGU	Norges Geologiske Undersøkelse
NI	Northern Ireland
P	Phosphorous
Rn	Radon
RoI	Republic of Ireland
RPII	Radon Protection Institute of Ireland
SEUPB	Special EU Programmes Body
VfMPR	Value for Money Policy Review

Executive Summary

This document sets out a Value for Money Policy Review (VfMPR) of the Geological Survey of Ireland (GSI) Tellus Border Project. In keeping with the evaluation framework set out in Central Expenditure Evaluation Unit (CEEU)[1] (2007), it begins with an outline of previous studies on the programme followed by a description of a Programme Logic Model populated with the inputs relevant to the Programme.

The Review examines the performances of the Tellus Border Project against a series of nine metrics under headings of: relevance, efficiency, effectiveness, rationale, impact and economy.

Under the Relevance metrics, the review concludes that the Tellus Border objectives, which emphasise the collection of high quality data, measurement of baseline data, land use sustainability, improving human health, mapping contamination and compliance with legislation, are relevant to wider Government policy. It should be noted, however, that the precise scale of these impacts is difficult to measure and the full effect on public policy outcomes may not be fully realised until the surveying is completed on a national basis.

As regards the Efficiency metric, it was found that GSI's expenditure on the Tellus Border activities successfully met budgeted targets despite some minor overspend. In the benchmark comparison of the Project against similar programmes in other jurisdictions, it was found that GSI's policy on not charging for Tellus data is similar to that of other geological survey institutions. Although respondents to the survey were limited, it would appear that data collection on users is far from uniform. No institution was found to collect information on users of free data; nonetheless, the British Geological Survey (BGS) and the Geological Survey of Finland (GTK) do have information on users who pay for data and the Norges Geologiske Undersøkelse (NGU) in Norway do collect descriptive statistics on downloads. The Review concludes that a lack of information on Tellus Border's data usage inhibits a fuller understanding of stakeholders, their needs and the overall impact of the project.

In terms of Effectiveness, it was found that the outputs delivered by GSI in relation to the Project were met successfully and largely on time. This is commendable in light of the technical nature of the programme.

Under the Rationale metric, the Project appears to remedy a market failure whereby, in its absence, there would be an under-provision of high quality geochemical and geophysical data in the market.

Under the Impact metrics, it was found that, while measuring the precise impact of the Tellus Border Project is challenging, it can positively impact on a wide range of areas including: radon mapping, mining, land use planning and academic research.

Under the Economy metric, it was demonstrated the Project is likely to contribute to a net positive benefit to the Irish economy.

[1] http://publicspendingcode.per.gov.ie/about-us/

Balanced Scorecard

Quality of Programme Design

Q. Are the programme objectives clearly specified?

A. The programme is clearly specified. It is a ground and airborne geoscience mapping programme, collecting chemical and geophysical data to inform management of Ireland's environment and natural resources.

Q. Are the objectives consistent with stated Govt priorities? Is there a clear rationale for the policy approach being pursued?

A. Tellus objectives, which emphasise the collection of high quality data, measurement of baseline data, land use sustainability, improving human health, mapping contamination and compliance with legislation, are relevant to wider Government policy. The presence of market failure in the provision of information (which is non-rivalrous) provides a rationale for Government intervention.

Q. Are performance indicators in place from the outset, to allow for an assessment of programme success or failure in meeting its objectives? If not, can such success/failure indicators be constructed *ex post?*

A. The absence of clear KPIs makes the appraisal of outputs challenging. For this reason, it is recommended that GSI gather details of key stakeholders and their application of Tellus data. This would enable improved responsiveness to customer needs.

Q. Have alternative approaches been considered and costed, through cost-benefit analysis or other appropriate methodology?

A. In this specialist area of data collection, it is not clear that there are feasible alternatives. Nevertheless, there may be scope for improved dissemination.

Q. Are resources (financial, staffing) clearly specified?

A. While it was necessary to interrogate budget sub-headings, it was possible to clearly identify financial and staffing resources.

Implementation of Programme / Scheme

Q. To what extent have programme objectives been met? In particular, what do the success/failure indicators show?

A. Programme objectives have clearly been delivered: however greater emphasis on outcomes in terms of stakeholder application, rather than outputs in terms of data availability, would be welcome.

Q. Is the programme efficient in terms of maximising output for a given input and is it administered efficiently?

A. As demonstrated under the 'efficiency' criterion, the programme has been delivered efficiently, broadly within budget.

Q. Have the views of stakeholders been taken into account?

A. While stakeholder consultation has taken place, greater interaction between GSI (data collectors) and data consumers may assist in ensuring customer needs are being met.

Cross-cutting aspects

Q. Is there overlap / duplication with other programmes?

A. There is broad overlap between the collection of Tellus data and work undertaken by other Government agencies e.g. EPA. Given the specialist nature of the data involved, it is not clear that this overlap represents inefficiency, however, following the reorganisation of GSI's parent department[2], synergies may arise.

Q. What scope is there for an integrated cross-departmental approach?

A. Cross Departmental work is in place. Consultations indicate GSI engagement with stakeholders such as the Department of the Environment Community and Local Government (DECLG), Radon Protection Institute of Ireland (RPII) and Teagasc.

Q. Are shared services / e-Govt channels being used to the fullest extent?

A. Data is disseminated electronically: however, it may be possible to enhance efficiency by collecting users' affiliation to better understand their requirements. There may also be scope for charging business users: however this would need to be weighed against any diminution of the promotional benefit arising from Tellus data.

Q. Can services be delivered more cost-effectively by external service providers?

A. Given the remit of GSI and the specialist nature of the work undertaken, it is not clear that services could be delivered more cost-effectively by external service providers.

[2] As of July, 2016, the Department of Communications, Energy & Natural Resources became the Department of Communications, Climate Action and Energy. The new Departmental configuration includes EPA under its aegis.

1. Programme background

Tellus is a ground and airborne geoscience mapping programme. It collects chemical and geophysical data to inform management of Ireland's environment and natural resources. The Tellus programme originates from an initiative developed by Geological Survey of Ireland (GSI) with Geological Survey of Northern Ireland (GSNI) in late 1990s. Originally the Resource and Environmental Survey of Ireland (RESI), the first phase of the programme focussed on mapping Northern Ireland and was undertaken between 2004 and 2007. The RESI strategy was included in the Republic of Ireland's 2007-2013 National Development Plan but funding was not allocated to it due to budgetary constraints at the time.

In 2009, GSI and GSNI submitted a proposal to the Special EU Programme Body (SEUPB) for INTERREG IVA[3] funding to extend the survey to border counties. Some £4.5m was made available from the body which funded the Tellus Border Project from November 2010 to its completion in December 2013. In 2014, Department of Communications, Energy and Natural Resources (DCENR) continued to fund Tellus by means of a capital allocation of €3m to complete a phase of surveying into the north midlands region of Ireland. Throughout 2014 and in early 2015 data acquisition was completed in a further three counties in the midlands of Ireland[4].

In 2014 an evaluation study by PA Consulting (see Previous Studies below) recommended that the Tellus programme be rolled out on a national basis. While it falls outside the remit of this review, it is of interest to note that this recommendation has been incorporated into DCENR's Statement of Strategy 2015-2017[5] whereby an objective is outlined that TELLUS airborne & ground mapping be extended to 50% of country by 2017. It is anticipated that the rest of the country will be covered on a phased basis with 75% completed by 2020 and 100% by the end of 2023.

Currently the project involves a multidisciplinary team of 10 based in GSI and has an annual budget of €3-4m which results in an estimated cost of €9-12m to achieve the 2017 target. The cost of advance mapping to national completion is expected to be c€35m. The scope of the current VfM is 2010-2013. It should be noted that 'a VfM review should not as a general rule, recommend an increased resource allocation for the programme concerned'[6]. Decisions on future funding will be taken in the context of the estimates and budgetary process.

[3] The INTERREG IVA Programme for Northern Ireland, the Border Region of Ireland and Western Scotland is a EU supported Structural Funds Programme which seeks to combat peripherality by addressing economic and social problems arising from the existence of borders.

[4] More details are provided on page 35.

[5] See report located here

[6] http://publicspendingcode.per.gov.ie/wp-content/uploads/2011/11/VFM-Guidance-Manual-2007.pdf

Table 1: Summary of Tellus/RESI programmes

Programme Name	Duration	Region	Completed
Tellus (NI)	2004 -2007	N. Ireland	Y
Tellus Border	2010-2013	Border Counties	Y
Tellus National (Phase 1)	2015-2017	50%	N
Tellus National (Phase 2)	2020	75%	N
Tellus National (Phase 3)	2023	100%	N

Previous studies

Throughout its project life, the RESI/Tellus programme has been subjected to numerous ex-ante and ex-post studies by various public bodies and consultants. These are summarised briefly in Table 2 below:

Table 2: Previous Studies on the Tellus Programme(s)

Year	Details
2001	Cost-Benefit Analysis undertaken by University College Dublin (UCD)
2004	Economic Appraisal of RESNI by Price Waterhouse Coopers (PWC)
2008	Post-project evaluation of the Tellus Programme by PA Consulting
2009	Economic Appraisal of the Tellus 2 Project on by the Department of Enterprise, Trade and Investment
2010	Geo-environmental survey of Northern Ireland GESI North (Tellus Border) Economic Appraisal by BDO Accountants commissioned by Special EU Programmes Body (SEUPB)
2012	Post Project Evaluation of the Tellus 2 Project by the Geological Survey of Northern Ireland
2014	Post Project Evaluation of the Tellus Border project by PA Consulting Group
2016	Unearthed: Impacts of the Tellus surveys in the north of Ireland Royal Irish Academy (RIA) publication featuring peer-reviewed chapters on Tellus and Tellus Border surveys including project impacts

Though the methodology used and research questions differ amongst these studies, the findings relating to the programme have, on the whole, been positive[7]. An analysis of all these studies is beyond the scope of this Review but it may be worth reflecting on the 2014 PA Consulting Group report as it covers the same time period of focus as this VfMPR. PA's report focused, inter alia, on evaluating project management, financial management and delivery of outputs against original objectives. The scope of the study is presented in Table 3 below:

[7] However not all of the studies have been reviewed as they are not available publicly.

Table 3: Terms of Reference for the PA Evaluation (2014)

1	Explain the strategic context of the project	**6**	Define assumptions, identify side effects and distribution effects
2	Outline the rationale, aims and objectives of the project	**7**	Overall assessment for value for money
3	Assess achievement of objectives in relation to timeliness and expenditure as per Letter of Offer	**8**	Make recommendations to assist in planning for future phases of Tellus (in particular how Tellus coverage might be extended to the rest of Ireland) and how the data might be further exploited.
4	Interview key stakeholders	**9**	Provide a full and detailed report on each of the steps
5	Assess risk management	**10**	Present/disseminate results to GSI and GSNI.

The approach adopted by PA[8] involved examining programme data such as licence details, financial returns, Tellus documentation and consultation with a range of stakeholders and interested parties. The results of the evaluation were very positive with findings indicating that the project was delivered on time and on budget, delivered value for money[9] and had generated high quality data for a wide range of stakeholders in the public and private sectors. The report also recommended, based on feedback from stakeholders, that Tellus should complete the mapping for a national dataset, improve stakeholder engagement and to continue to encourage a value-added research programme.

[8] The methodology employed did not specifically adhere to any evaluation guidelines I.e. CEEU Value for Money guidelines.

[9] Value for money is described in PA's evaluation as the demonstration of providing "close management of finances and open competition for technical services".

2. VfMR Context

This Value for Money Policy Review (VfMR) is taking place in the context of the 2015-2017 VfMR round and as part of DCENR's adherence to the Public Spending Code. The Code sets out a framework to ensure that public money is correctly spent and garners the highest value. Adhering to this framework also provides consistency with other Value for Money Reviews. In outlining the VfMR process, the Code mandates that the review should focus on the rationale, relevance, efficiency, effectiveness and impact of the programme in question[10].

As required by the Code, a Steering Group was established comprising members of the Department of Communications, Energy and Natural Resources (DCENR) and the Department of Public Expenditure and Reform (DPER) with an independent chair. The membership of the Group was as follows:

- Ian Keating, Chair, formerly of the Department of the Environment
- Evin McMahon, Senior Economist, Department of Communications, Energy & Natural Resources
- Niall Power, Economist, Department of Communications, Energy & Natural Resources
- Jim Whelan, Assistant Principal, Finance & Corporate Affairs Division
- Ray Scanlon, Principal Geologist, Geological Survey of Ireland
- Laura Watts, Assistant Principal, IGEES Unit, Department of Public Expenditure and Reform
- Adrian Finneran, Assistant Principal, Department of Public Expenditure and Reform

To frame the VfMPR's methodology, it is important to briefly highlight the main elements that have been identified in the Terms of Reference.

[10] From a limited review of other VfMPR it would appear that evaluation criteria can change with the nature of the policy or project in question. For example a scoping document on a VfM on National Road Maintenance does not focus on programme rationale.

Table 4: Summary of Terms of Reference

Programme	GSI Tellus Border Project
Time	The programme will be reviewed over the period 2010 – 2013[11]
Evaluation Criteria	1. Effectiveness – Is the programme meeting its financial and physical objectives? 2. Efficiency – Could more be achieved by the resources invested? Optimising the ratio of inputs to outputs 3. Impact – What socio-economic changes can be attributed to the programme/scheme 4. Rationale - What is the justification or rationale for the policies underpinning the Programme? What is the underlying market failure justification for Government intervention? 5. Relevance - What are the implications for the programme of changes in the wider socio-economic environment and in the context of overall Government policy? 6. Economy (composite metric) – To what extent do monetisable metrics demonstrate the delivery of value for money.

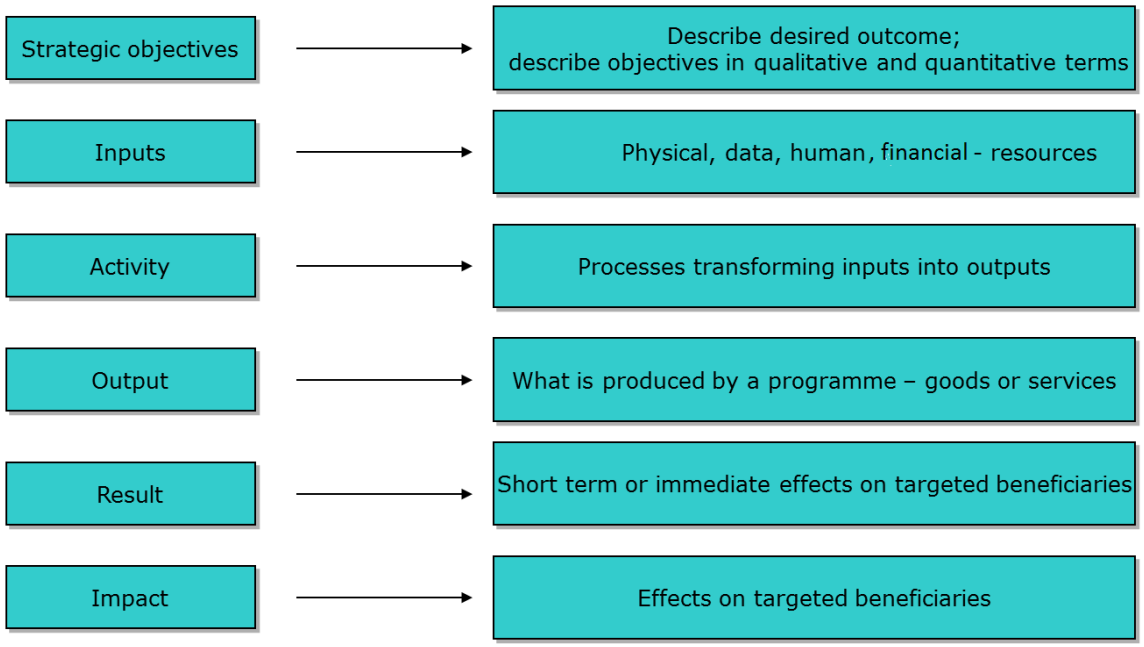
The terms of reference frame the approach taken by the Steering Group. Since the initiation of the programme evaluation, the Evaluation Team has developed an understanding of the programme from meeting various stakeholders at GSI, reviewing data on the programme that they have submitted and examining previous evaluation studies. This information is first used to populate the programme logic model which in turn is used to frame the evaluation questions and key metrics to be analysed.

[11] The period during which data is available for the Republic of Ireland.

3. Programme Logic Model

The Programme Logic Model maps out the shape and logical "cause-effect" linkages of a programme. It should include an outline of the key relationships between the six key areas of objectives, inputs, activities, outputs, results and impacts. With this approach it is possible to measure the achievement at each stage in the chain by reference to agreed performance indicators.

Figure 1: Logic Map inputs



GSI has separately provided valuable input to the Evaluation Team which has been used in this section to populate this model as outlined in Table 5 below.

Table 5: Programme Logic Model for Tellus Programme

Strategic Objectives[12]	• Provide high quality datasets and information to ensure sustainable use of natural resources in the border region • Provide a baseline of information against which future environmental change in the border region can be measured • Contribute to sustainable land-use planning decisions by detecting and mapping geological conditions that may be associated with natural hazards and conditions such as instability (subsidence, landslips) and land drainage • Improve the health of people in the border area by detecting and mapping the conditions that may give rise to health hazards such as naturally occurring radon, anthropogenic radiation (fallout) and contaminated land • Detect and map certain forms of industrial and agricultural contamination and the conditions in which these might develop • Assist Government to comply with requirements of legislation on the assessment and monitoring of natural resources, soils and waters, including European Framework Directives.
Inputs[13]	Staff, funding, overheads in 2010 prices[14] 2010 93,784 2011 944,607 2012 2,589,287 2013 718,337 Total 4,346,015
Activities	**Geochemistry programme:** Tendering for services; management of third party soil; stream water and stream sediment sample collection; management of third party sample preparation and laboratory analysis; quality control of laboratory data; mapping of survey results; merging of survey results with previous surveys; interpretation of survey results; reporting; support research activities. **Geophysical surveying:** Tendering for services; management of third party data acquisition; quality control of contractor data; mapping of survey results; merging of survey results with previous surveys; interpretation of survey results; reporting; support research activities, in particular radon risk mapping

[12] C.f. 'Project Goals' in Tellus Border Project Plan – available on request

[13] Expenditure pertaining to Republic of Ireland

[14] For details see CBA spreadsheet. Unlike the 'efficiency' metric, which applies accounting costs for entire project, north and south, costs and benefits relate to the Republic of Ireland. These 'economic costs' incorporate 'shadow price of public funds' and personnel overheads. They are denominated in constant (2010) prices. Revenue guidelines on GBP/EUR exchange rates applied http://www.revenue.ie/en/practitioner/ebrief/2016/no-172016.html

	Public outreach: Tendering for services ; management of public relations contractors; implementation of communications measures in support of survey operations; implementation of communications measures in support of data uptake amongst stakeholders **Research:** Implementing research mechanisms which include internal collaboration, external collaboration and funding external research.	
Output	**Result**	**Impact**
Mineral Exploration		
(i) Inward investment Accessible geoscience data useful for mineral exploration and development of mineral prospectivity studies.	£32m inward investment in mineral exploration has been cited by GSNI in response to the original Tellus survey of Northern Ireland. However GSI has had some challenges developing defensible equivalent statistics for mineral exploration investment in the border region in relation to Tellus Border. Although many of the prospecting licence applications received by DCENR's Exploration and Mining Division up to end 2013 cited Tellus Border data as part of the rationale for taking out a licence, it is difficult to identify and quantify the inward investment in respect of these. Although licence holders commit to a spend target over the lifetime of the prospecting licence, it takes years to report on actual spend if the licence is not relinquished early.	Increasing understanding of mineral prospectivity and also increasing the quality and range of geological data freely available are both known factors worldwide for attracting foreign direct investment in the mineral exploration sector. Both these factors are cited in the annual Fraser report, and Tellus Border has improved Irelands standing in those rankings.
(ii) Commodities security of supply including critical metals potential Tellus characterises the environment chemically with respect to several critical raw materials.	New primary research	Increasing Ireland's capacity to source its own supply of raw materials when exposed to supply bottlenecks and price volatility in distant/emerging economies.
(iii) Mining impacts Measuring	New primary research	Assisting State to plan and regulate mining activities

environmental impacts of mining		
Agriculture		
(i) Trace element and soil properties assessment Over 50 elements in soil measured as part of Tellus Border including those critical to animal and crop health.	New research which bridges the gap between raw geochemical data and agricultural management decision-support tools.	Focused investment in improved sustainable agricultural productivity is required to meet the ambitious targets of the Food Harvest 2020 initiative. Commercialisation of data and research outputs by feed companies, fertiliser companies and agricultural advisors. Improvements in farm scale economics for individual farmers.
(ii) Soil carbon stocks Soil organic matter maps and radiometric signal maps.	Both provide proxies for soil carbon which is a parameter reported to the EU annually by the EPA in relation to climate change objectives.	Could feed into better understanding of factors affecting changes in Ireland's carbon stocks
(iii) Nutrients assessment Phosphorus, Potassium and Nitrogen geochemistry mapped in soil, stream water and stream sediment and from airborne geophysics	New research which bridges the gap between raw geochemical data and agricultural management decision-support tools.	Understanding P, K and N availability and mobility in the soil, water and sediment could help refine fertiliser use at a time when peak phosphorus is being approached and when the use of fertiliser in excess is causing water quality problems. There is also a significant cost to farmers with excess fertiliser use and P supply is becoming a problem ('peak phosphorus' being approached).
Public Health		
(i) Soil quality. Tellus provides data on the naturally occurring and human-sourced potentially harmful elements in the environment	New primary research on potentially harmful elements occurrence, assessment, health effects	Can inform human health risk assessment for contaminated sites and appropriate land use planning. Potential refined assessment of environmental quality, reduced costs of treating health problems, reduced costs of remediation.

(ii) Radon Airborne geophysics uranium data	New primary research combines uranium data with existing geological factors and in-house radon measurements to model and predict radon risk	Tellus is fulfilling a key aspect of the National Radon Control Strategy by improving radon risk maps. These maps will help focus the Office of Radiological Protection's resources to high radon areas with the view to ameliorating health risks arising from radon.
Environment		
(i) Water quality Multi-element stream water and sediment quality data	Regional baseline for water chemistry forming a background for the assessment and monitoring of water bodies regionally and eventually nationally	The Water Framework Directive is a pivotal directive which drives the assessment, monitoring and remediation and protection of all water bodies in EU member states. Tellus can provide inputs to numerical modelling, water body assessment, river basin management plans. Cross-border seamless water geochemical maps will inform the second River Basin Management Plans and to strengthen cost-effective, science-based decision support systems such as numerical models for WFD implementation. Chemical characterisation of wetlands, waters, soils and sediments will assist with the requirement for integrated catchment management.
(ii) Groundwater flow Airborne geophysical data	Indicates new detail in structural geology and groundwater conductivity for the assessment of groundwater flow pathways, onshore and offshore	Feed into updating groundwater protection schemes, understanding of complex flow aquifers, groundwater quality issues, saltwater incursion, offshore freshwater discharge.
(iii) Strategic environmental assets Multi-element geochemistry; geophysics datasets	Research projects	Supports the development and implementation of scientifically defensible strategies for sustainable use of natural resources. The assessment of the current state of the environment plays a pivotal role in environmental protection. Tellus is providing baseline information on the state of the soil and water environment to be used by local authorities, an Bord Pleanala, the EPA and researchers in managing the environment and its strategic assets. Strategic environmental assets are those natural resources which support investment, industry and job creation. Ireland is uniquely positioned with abundant water assets to support hi-tech water intensive industry, which depends on well-understood water quantity and quality.
Energy		
(i) Geothermal energy Airborne radiometrics data	IRETHERM research on Mourne Mountains and other Irish granites for deep geothermal energy	The government acknowledges the development of renewable energy as a key area relevant to the development of the Green Economy in Ireland. Development of deep geothermal energy targets.

(ii) Unconventional hydrocarbons Multi-element geochemistry; geophysics datasets	Snapshot of current environmental conditions	Unconventional gas could be a key provider in Ireland's future energy mix and investigations are underway by the EPA to determine is safety with regard to environmental impacts. Tellus data can support baseline assessments of environmental quality before, during and after any shale gas extraction operations.
(iii) Updated Geological Maps	Increased accuracy of GSI mapping of Bedrock and Superficial (Quaternary) maps	Improved decision making for planning, groundwater resource management, infrastructure development, aggregate resource location (sand and gravel, and rock quarries), landslide susceptibility and mineral prospectivity mapping. These maps are currently used within the planning process.

4. Evaluation Criteria and Metrics

The VfMPR review involves a study of inputs of the Programme Logic Model to reach conclusions on the evaluation criteria (rationale, efficiency, effectiveness, impact and continued relevance). Before outlining how these are assessed, it is important to detail the broader nature of these terms and how they apply to the Tellus Programme.

4.1 Relevance

To judge relevance, a VfMPR must analyse the rationale for the programme and whether it aligns with national policy.

For the Tellus Border Project this involves examining whether the six objectives of the programme mentioned in the Programme Logic Model[15] are in line with stated Government policy, whether they run counter to any other national policy objective and whether there is still a need for the programme.

To evaluate the relevance of these objectives, the Evaluation Team engaged in desk-based research. Key users of the data were also interviewed via a standardised questionnaire to ascertain the relevance of the project to their policy areas.

Relevance Metric: To what extent are the policies stated in the Programme Logic relevant to other Government policy?

Objective 1: Provide high quality datasets and information to ensure sustainable use of natural resources in the border region

As set out below, the importance of sustainable land use is highlighted across Government policy e.g. *Framework for Sustainable Development*[16]*, Food Harvest 2020*[17]. In order to deliver sustainability, it is necessary to measure changes in soil and water properties to ensure changes are within expected parameters.

Objective 2: Provide a baseline of information against which future environmental change in the border region can be measured

Once again, in order to deliver on a range of environmental objectives, it is necessary to measure baseline data to record deviations from this reference line. Such data also assists in delivering robust Strategic Environmental Assessments.

[15] It is assumed that the objectives in the Programme Logic model reflect the originally stated objectives that motivated the conception of the project.

[16] http://www.environ.ie/sites/default/files/migrated-files/en/Publications/Environment/Miscellaneous/FileDownLoad%2C30452%2Cen.pdf

[17] https://www.agriculture.gov.ie/media/migration/agri-foodindustry/foodharvest2020/2020FoodHarvestEng240810.pdf

Objective 3: Contribute to sustainable land-use planning decisions by detecting and mapping geological conditions that may be associated with natural hazards and conditions such as instability (subsidence, landslips) and land drainage

The Department of the Environment's *Framework for Sustainable Development* highlights the importance of land use planning, advancing 'sustainable development into the future'. The framework 'aims to anticipate and avoid conflict between present and emerging land uses' and highlights 'the mapping of Ireland's natural resources' as making a 'substantial contribution to the evidence base for policy development and decision-making'[18].

The National Radon Control Strategy[19] was launched in 2014. It highlights, inter alia, the need 'establish current baseline values' for radon.

Consultation with the Irish Centre for Research in Applied Geosciences, indicates that Tellus data provides a valuable insight into the potential future land use scenarios:

'Analysis of the Tellus dataset has revealed clear evidence of Cenozoic faulting which could, in principle, have implications for many geological questions of economic importance… the four most economically important issues linked to Cenozoic deformation:

(i) Lough Allen shale gas basin,

(ii) zinc-lead mineralization,

(iii) the lignite deposits of Lough Neagh and

(iv) hydrocarbon leakage in the Irish Sea.'[20]

Objective 4: Improve the health of people in the border area by detecting and mapping the conditions that may give rise to health hazards such as naturally occurring radon, anthropogenic radiation (fallout) and contaminated land.

The National Radon Control Strategy[21] highlights the importance of 'identifying anomalous high risk areas not predicted by the radon map, the need for an improved or higher resolution radon map, future radon mapping requirements the need/ timescale for future revision of the map.'

Consultation with the EPA's Office of Radiological Protection confirmed that Tellus data is a key component in the development of a high quality radon map.

[18] http://www.environ.ie/sites/default/files/migrated-files/en/Publications/Environment/Miscellaneous/FileDownLoad%2C30452%2Cen.pdf
[19] http://www.environ.ie/sites/default/files/migrated-files/en/Publications/Environment/EnvironmentalRadiation/FileDownLoad%2C35484%2Cen.pdf
[20] Faults, intrusions and flood basalts: the Cenozoic structure of the north of Ireland. H. Anderson, J.J. Walsh, M.R. Cooper
[21] http://www.environ.ie/sites/default/files/migrated-files/en/Publications/Environment/EnvironmentalRadiation/FileDownLoad%2C35484%2Cen.pdf

Objective 5: Detect and map certain forms of industrial and agricultural contamination and the conditions in which these might develop.

Teagasc's mission, 'to support science-based innovation in the agri-food sector and wider bioeconomy so as to underpin profitability, competitiveness and sustainability,'[22] is supported by the above objective. Teagasc confirmed that Tellus data is a useful tool in prioritising research areas.

Objective 6: Assist Government to comply with requirements of legislation on the assessment and monitoring of natural resources, soils and waters, including European Framework Directives.

As part of the investigation of the relevance of the Tellus data to meeting these objectives the Evaluation engaged with a number of key environmental policy stakeholders. Stakeholders were asked about the extent to which Tellus data was utilised in assessing compliance with directives listed in Table 5, below.

Table 6: Environmental directives

	Tellus Related Directives *	Relevant Department
1	Water Framework Directive	DECLG/ EPA
2	Nitrates Directive	DECLG/EPA
3	Habitats Directive	DECLG/ EPA
4	Birds Directive	DAHG/NPWS
5	Framework Convention on Climate Change	DECLG/ EPA
6	Seventh Environment Action Programme[23]	DECLG/ EPA
7	Contaminated land policy	DECLG/ EPA
8	Environmental Liability Directive	DECLG/ EPA

*Source: Tellus Border Project Overview Geoscience 2012

Stakeholder feedback indicated that, while Tellus data adds to data quality, it is not currently referenced in detail in relation to the above. It was indicated that Tellus has the potential to provide valuable inputs into Strategic Environmental Assessments[24] which are required under European Law. The SEA Directive applies to a wide range of public plans and programmes (e.g. on land use, transport, energy, waste, agriculture, etc).

Looking to the future, GSI and EPA are jointly sponsoring research into the applicability of the Tellus stream data in their monitoring and reporting requirements under the Water Framework Directive.

Relevance Conclusion

[22] http://www.teagasc.ie/publications/2012/1289/Teagasc-Strategy-Statement.pdf

[23] The Seventh Environment Action Programme, which entered into force on 17 January 2014, recognises that soil degradation is a serious challenge. It requires that by 2020 land is managed sustainably in the EU, soil is adequately protected and the remediation of contaminated sites is well underway, and commits the EU and its Member States to increasing efforts to reduce soil erosion and increase soil organic matter and to remediate contaminated sites.

[24] The SEA procedure can be summarised as follows: an environmental report is prepared in which the likely significant effects on the environment and the reasonable alternatives of the proposed plan or programme are identified. The public and the environmental authorities are informed and consulted on the draft plan or programme and the environmental report prepared.

On the basis of the research outlined above, the review concludes that the Tellus Border objectives, which emphasise the collection of high quality data, measurement of baseline data, land use sustainability, improving human health, mapping contamination and compliance with legislation, are relevant to wider Government policy.

4.2 Efficiency

The efficiency metric judges the extent to which the programme is being delivered in an efficient fashion. It can examine the cost of the programme and its outputs in terms of unit cost, over time, through regional analysis and as benchmarked internationally. In the context of the Tellus Programme, efficiency is gauged by examining expenditure and benchmarking against other similar programmes abroad.

Efficiency metrics

Efficiency Metric 1- To what extent has programme expenditure been managed within budget?

Original Programme Budget

This section examines the extent to which GSI's programme expenditure was in line with the original envisaged expenditure as outlined in the SEPUB's ex-ante economic appraisal budget. It is important to note that costs here relate to accounting costs for the Tellus Border Project. The cost-benefit analysis in Section 4.6 examines the economic costs and benefits related to the Republic of Ireland (RoI).

The original budget outlined in SEPUB's document is outlined in Table 7 below.

Table 7: Original stated budget projections

	2010	2011	2012	2013	Total
GSNI	£19,400	£261,800	£338,200	£228,406	£847,806
GSI	£50,600	£228,600	£222,100	£167,300	£668,600
DKIT	£500	£50,000	£67,000	£15,315	£132,815
QUB	£1,000	£100,000	£134,000	£30,630	£265,630
Contracts	£5,000	£1,535,000	£548,587	£63,268	£2,151,855
Total	**£76,500**	**£2,175,400**	**£1,309,887**	**£504,919**	**£4,066,706**

A breakdown of the GSI's costs are demonstrated in Table 8 below:

Table 8: Original stated budget projections breakdown for GSI

Original project costs for GSI	2010-2013
Project Staff	£ 567,600
Data management Expenses	£ 40,000
PR expenses	£ 55,000
Project management expenses	£ 2,000
Geochemistry expenses	£ 4,000
Total	**£ 668,600**

In addition to the above budget, GSI was also tasked with overseeing the Geochemistry contracts which formed £638,268 of the original £2,151,855 Contracts budget, which is shown in Table 9 below.

Table 9: Original stated budget projections breakdown for Contracts

Original project costs for Contracts	2010-2013
PR contract	£ 110,000
Geochemistry contracts	£ 638,268
Geophysics contracts	£ 1,403,587
Total	**£ 2,151,855**

Funding for the project was formally approved on the 30th September 2010. However, in 2013 there was an agreement for it be increased to £4,555,396 for "further geochemical analysis and research" as an Addendum to the Letter of Offer[25]. The final approved costs described in this letter are therefore as included in Table 10 below:

Table 10: Updated Budget Breakdown

	ERDF	Match	SEUPB Total
Ireland	£922,322	£307,441	£1,229,763
Northern Ireland	£2,494,225	£831,408	£3,325,633
Total	**£3,416,547**	**£1,138,849**	**£4,555,396**

The final budget for GSI-only expenditure is, however, different to the above Table 10. The total amount, taking the extra geochemistry expenditure of 2013 added to the original budget as stated BDO is presented in Table 11. The amounts below were confirmed in correspondence with GSI.

[25] Copy is available on request

Table 11: Budget Amended- GSI

Details	Total
PR contract	£ 110,000
Geochemistry contracts	£ 638,268
Extra budget via 2013	£ 488,690
GSI	£ 668,600
Total	£ 1,905,558

The majority of funding for the Tellus Border project arose from the Special EU Programmes Body (SEUPB). This vehicle was funded with the remaining 25% being paid for by the Irish and Northern Government as demonstrated in Table 10 above[26]. GSNI acted as the project's "Lead Partner" and assumed overall administrative and financial responsibility for the project's implementation; however, the project was also required to follow the SEUPB's reporting requirements.

Project Income and expenditure

This section includes a description of the Financial Management System (Agresso) receipts given to GSI. The total income in euros, detailed in Table 12 is assumed to arise from vouched expenses from the SEPUB which amounted to £1,949,229.

Table 12: Total Receipts recorded under GSI's Tellus Border Project activities

Year received	Amount
2011	€ 8,100.07
2012	€ 608,166.67
2013	€ 912,486.42
2014	€ 727,829.24
2016	€ 81,532.73
Total receipts	**€ 2,338,115.13**

Income was examined against expenditure incurred by GSI in relation to the project as outlined in the in Table 11 below. GSI spent €160k more than they received. This represents a 7% of total income and is closely in line with the target budget detailed in Table 11. As such, the review concludes that programme expenses have been met on target.

[26] See Section 4.1.2 of PA(2012)

Table 11: GSI's Expenditure on Tellus Border Project

Year	Subhead Text	Project Text	Total
2010	Geoscience Initiatives	Tellus Border Project	6,268
2010 Total			**6,268**
2011	Geological Survey of Ireland Services	Tellus Border Project	-526
	Geoscience Initiatives	Tellus Border Project	485,145
	Office Equipment & External IT Services	Tellus Border Project	30
	Postal & Telecom Services	Tellus Border Project	114
2011 Total			**484,763**
2012	Geoscience Initiatives	Tellus Border Project	1,340,142
2012 Total			**1,340,142**
2013	Geological Survey of Ireland Services	Tellus Border Project	851
	Geoscience Initiatives	Tellus Border Project	631,814
	Office Equipment & External IT Services	Tellus Border Project	33,087
	Travel & Subsistence	Tellus Border Project	23
2013 Total			**665,775**
Grand Total			**2,496,948**

Efficiency Metric 2 - Efficiency benchmark with other similar programmes (i.e. other similar initiatives in the UK).

Cross-comparisons of the efficiency of geological surveys can be difficult as there is no uniform approach to their scope and complexity. Indeed, even within countries, there can be variation in the scope of surveys amongst regions. For example, in the United States, surveys can differ from state to state and depend upon the enabling legislation, the specific needs of a state and the conditions under which each survey evolved[27]. Therefore, even if there was accurate and comparable financial data available on the cost of running similar programmes to Tellus, it would not be sufficient to determine if the scheme was run efficiently or not.

Nevertheless, it is possible to compare some aspects of the project in relation to its provision of data. Subsection A of this metric examines the GSI's policy on the Tellus Border data distribution compared to that practiced in other countries. Subsection B looks at the degree to which the Tellus Border data is perceived by external stakeholders.

A. Data-access policy

To address this metric, the Evaluation Team examined similar programmes to the Tellus Border project that have been undertaken in other countries. A survey was sent to several similar geological survey institutes across the world. The questions (which are included in Annex A) queried their approach to distributing data and recording stakeholder engagement.

[27] See American Institute of Professional Geologists, *Importance and Future Roles of State Geological Surveys* (2010) https://www.dep.state.fl.us/geology/news/Role-of-State-Geological-Surveys-is-vital.pdf

Not all those to whom the questionnaire was sent responded to the query; however, a sample of the insights from those who did is set out below:

1. British Geological Survey (BGS)

BGS provides a certain amount of its data free of charge in a "view-only" format whether it is for commercial or non-commercial use. It applies a charge should the user wish to download data; however, academics can download free of charge for research purposes. The rationale for charging relates to the "costs to maintain, deliver and support the data in a variety of formats". Charging revenue also goes towards financing surveys and the provision of non-data services such as answering queries from the public. While BGS is ultimately owned by the UK Government (through the Natural Environment Research Council), it receives just 50% of its funding through Government channels. The remaining 50% is generated through other sources of income including commissioned research and data licensing.

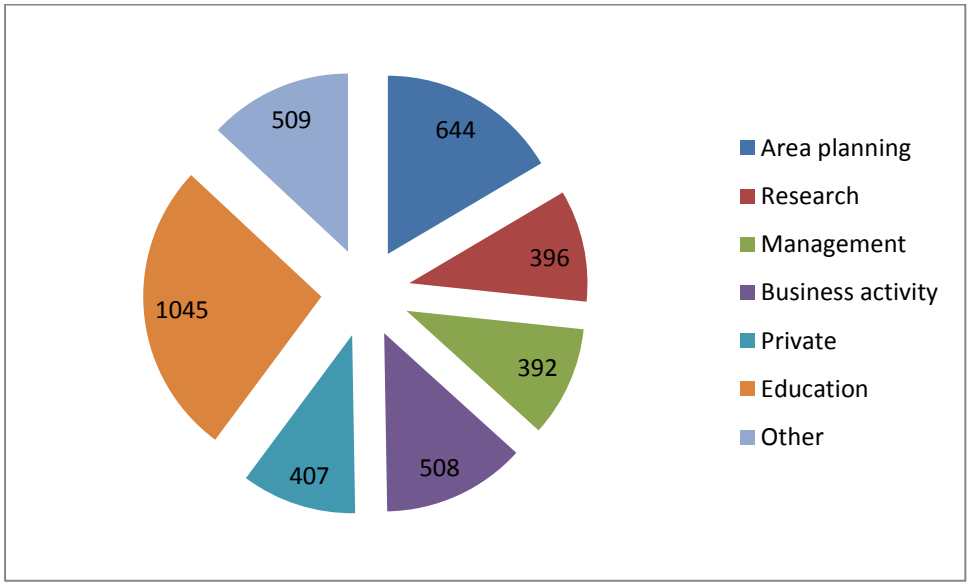
The BGS does not collect data on users who view the data as users are not required to register but it does collect data on those who have "direct licences" and who download and pay for the data. There are 400 direct licences which are said to include local authorities, other government departments (e.g. Department for Environment Food & Rural Affairs, Environment Agency), water companies, transport network operators, power network operators, environmental consultants and academics. They also have a "robust reseller" network of organisations who sell the data with other services. This network is said by the BGS to reach out to "far more customers" than the direct licence users but they also supply royalty returns the BGS. BGS is currently reviewing whether or not it should request users to register to view the data as it would provide a better indicator of the success of initiatives .

2. Norges Geologiske Undersøkelse (NGU) – or Geological Survey of Norway

Most of NGU's data is open and free of charge to download. It does charge a fee where the user requests the data to be transformed and packaged otherwise. It also charges for data pertaining to its onshore and offshore "potential field" aeromagnetic and gravity databases. This data is occasionally co-funded by industry and is for sale for 10 years before being released free of charge. Universities can get access to the data free of charge on special conditions.

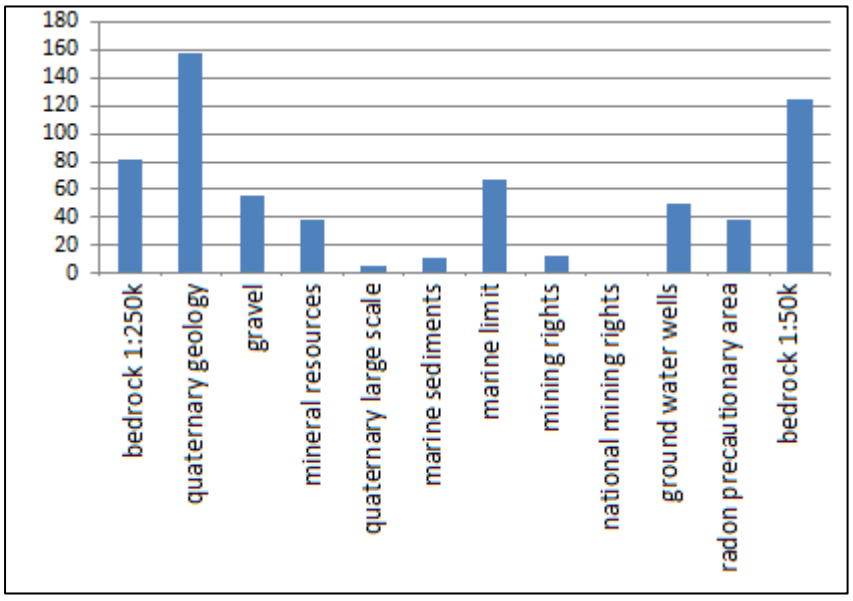
The NGU did not mention if it collects information on the profile of users downloading its data; however, it does collect statistics on which data products are the most popular, which formats are being used, and the purposes for which the data is going to be used.

Figure 2: Reported usage of NGU open and free data



Titles have been translated

Figure 3: Chart of ordered datasets by geological theme



Titles have been translated

3. GTK Finland

The Geological Survey of Finland's (GTK) data products are provided mostly free of charge;[28] however, there are 100 so called "reasonable priced information products" which results in annual turnover from €100,000 to €200,000 for the organisation. These products are directed mostly at prospecting companies.

GTK's impressions from interacting with mining and prospecting companies are that their most important need is that the data is available and is of high quality and that it is "not important" to them that the data is free. They also value the opportunity to discuss data with GTK.

GTK collects limited data on users who pay for their products; however, this does not extend beyond domain addresses of users who download their free data products.

[28] Geological data can be accessed at the following http://hakku.gtk.fi/en/locations/search

4. Summary of Comparable Initiatives

In addition to the responses above, the Evaluation Team also conducted a desk-based data gathering exercise on similar schemes in other countries. The results of these are detailed in Table 12 below:

Table 12: International Table Benchmarking to Tellus

	Geochemistry	Geophysics	Data Costs	Responsible Body	State Funded
Ireland	Arsenic in soils Copper in soils Nitrates in waters Bedrock Geology	Bedrock Geology, Magnetics Radiometrics Electromagnetics	Free	GSI (ROI area)	Yes
Denmark and Greenland	Groundwater resources, aquifer mapping in gravels	Yes Various	Some data behind paywall (deep wells) - rest is free	GEUS	Yes
Finland	Yes-Various, Regional till, stream sediment.	Magnetics, radiometrics, electromagnetics,	Some data behind paywall	GTK	Mix-state and industry
Saskatchewan (Canada)	Yes-Various	Yes Various	Free	Saskatchewan Geological Survey	Unclear run by government
Norway	Yes-Various	Yes-Various	Free (some data	Geological Survey of Norway (NGU)	Yes
United Kingdom	Yes-Various	Yes-Various	Most of the data is free to view (but there is a charge to download).	British Geological Survey (BGS)	Mix-state and revenue from services

Although the approach taken by the various institutions and the nature of the geological surveys conducted differ from country to country, there are some similar attributes. For instance the majority of data is provided free of charge; however, nearly every institution has certain datasets or licences that are for sale. Although the sample size is limited, the BGS does appear to be in a minority in that they apply a charge to download many of their products; however, they have stated that they are satisfied with this approach. Some institutions (BGS and NGU) offer academics all data downloaded free of charge.

Prior to 2007, GSI charged users for data. From an efficiency perspective, there may be scope for GSI to charge data to parties who derive most benefit from it or to those who indicate the highest willingness to pay. The response from BGS indicates that there is a demonstrated willingness to pay for similar data from a variety of different stakeholders within the public and private sectors. Similarly, it was noted in Finland that it was "not important" for the mining and prospecting companies to get data free. For the purposes of this evaluation, it is not possible to conclusively demonstrate that all main stakeholders would have paid for the data and, therefore, it is difficult to judge if a charge for the data would have been a more appropriate policy to follow.

GSI's policy on collecting information on the users of the Tellus Border data is similar with other geological survey institutions. Those who responded to the survey indicated that they generally do not record who has downloaded their freely available data. Some institutions do collect data on users who pay for data or have licences (i.e. BGS, NGU and the GTK). The BGS, in particular has clearly identified who its main stakeholders are from its user-registration records. They are also currently investigating if they should introduce a registration process for users to access their "free data" i.e. their OpenGeoscience portal. Not having a registration facility does mean there is degree of uncertainty as to who the users of the Tellus Border data are. Due to specialist nature of the data it is likely that users would have accepted a small delay to register their details and the use for which the data was intended. Such information is unlikely to have been useful in evaluating what aspects of the project were successful or not.

B. Data Quality

One useful indication of data quality is stakeholder perception relative to international equivalents. While there are no studies specifically comparing the output of the Tellus Border data to other similar schemes, the Fraser Institute Annual Survey of Mining Companies[29] which collects information from the mining industry, does examine feedback on national geological databases. The latest report for 2014 (published in February 2015) records industry's perception of the quality of Irish geological databases as being 6th out of 122 jurisdictions surveyed across the world. This is a significant improvement from an earlier survey conducted in 2012 by the same group which recorded Ireland as 17th out of all jurisdictions. While the reasons underpinning the increase are not disclosed it is possible that the completion of the Tellus Border project may have had a positive effect.

[29] See more at: https://www.fraserinstitute.org/categories/mining#sthash.FRNhYPHm.dpuf

Also included in the Fraser report is the *Policy Perception Index* which is described as a "report card" to governments on the attractiveness of their mining policies. Ireland ranks first on the index out of 122 jurisdictions assessed. The quality of the geological database is a key one of twelve factors making up the composite index and its strong perception across nations undoubtedly contributes to Ireland's high ranking.

As noted, in Section 4.5, the Evaluation Team consulted with a variety of stakeholders. While the stakeholders consulted were not asked about how the Tellus data fares against similar data collected in other countries, some of them deemed it to be high quality[30].

Efficiency Conclusion

In the areas of Efficiency, as outlined above, GSI's expenditure on the Tellus Border activities, successfully met targets despite some minor overspend. In the benchmark comparison of the Project against similar programmes in other jurisdictions, GSI policy on not charging for Tellus data is similar to that of most other geological survey institutions. Although the respondents to the survey were limited, it would appear that data collection on users is far from uniform. No Institution was found to collect information on users of free data; however, the BGS and GTK do have information on users who pay for data and the NGU in Norway do collect descriptive statistics on downloads. The Review considers that a lack of information on Tellus Border's data usage inhibits a fuller understanding of stakeholders, including who they are, their needs and the overall impact of the project. It should be noted that conditions associated with ERDF funding meant that charging was not an option in the pilot phase under review.

4.3 Effectiveness

The effectiveness metric judges the extent to which the project is achieving its objectives as described in the Programme Logic Model. In the case of the Tellus programme, this involves looking at project delivery timelines, the extent to which objectives were realised and the nature of stakeholder feedback.

Effectiveness Metrics

Effectiveness Metric: The extent to which objectives were met according to the envisaged timetable.

The original stated timelines for expectation of the completion of the survey were described on pages 16-19 of SEPUB-BDO's 2010 economic appraisal of the initiative[31].

[30] John Walsh of iCrag was particularly complimentary of the data quality and RPS mentioned it was of high quality

[31] Table 4.3 of the same report gives an abbreviated version of the same tasks and deadlines however some of the expected completion dates in this table contradict those in the more detailed table on pages 16-19. It is presumed that these contradictions arise from typographical errors. The deadlines in page 16-19 are taken here to be the correct, originally stated targets.

The expected deadlines are detailed in Table 13 below. In the adjacent column, 'Actual Delivery', the date of completion of the task described is given. The sources for verification of the completion dates arise from dialogue with GSI and from the Tellus Programme's "Progress Reports" which were sent to the EU funding body SEUPB and also from input from GSI.

Table 13: Original programme objectives and completion dates

	Task	Expected Deadline	Actual Delivery
Year 1	Data Management	Q3 2013	Completed Q4 2013
	Project Management	Q3 2013	Completed Q4 2013
	Outreach[32]	Q3 2013	Completed Q4 2013
Year 2	Geochemical surveys[33]	Q3 2012	Completed Q4 2012
	Geophysical surveys[34]	Q4 2011	Completed Q4 2012
	Chemical analysis[35]	Q4 2012	Completed Q3 2012
	Data production, integration, map production – eochemistry[36]	Q3 2013	Completed Q1 2013
	Soil and stream chemical characterisation of cross-border catchments[37]	Q2 2012	Completed Q4 2013
	Delivery of data required by EU directive[38]	Q3 2013	Completed Q4 2013
	Geochemical surveys[39]	Q1 2013	Completed Q4 2013
	Mapping of groundwater pollution plumes[40]	Q1 2013	Completed Q4 2013
	Soil carbon and peat volume assessment[41]	Q1 2013	Completed Q4 2013
Year 3	Data production, integration, map production – geophysics[42]	Q2 2013	Completed Q2 2014
	Detailed aerial mapping of levels of natural & artificial radioactivity[43]	Q3 2013	Completed Q4 2013

[32] Activities under the Outreach programme were detailed in the Progress Reports. The final project conference was held on 24th October in Hillgrove Hotel Co. Monaghan,

[33] http://www.tellusborder.eu/NR/rdonlyres/3C5C7A18-B342-409B-8588-F89107C1E1D6/0/FinalDrainageRpt_17122012.pdf
http://www.tellusborder.eu/NR/rdonlyres/1AC45E8F-89F3-44F6-95ED-EDE0AE51DF36/0/FINAL_Soils_Rept_13072012.pdf

[34] http://www.tellusborder.eu/NR/rdonlyres/7E6942A1-90BA-4E57-B5D0-1AC27A041ED6/0/TellusBorder_Processing_Report_Version_1_FINAL_Appendix.pdf

[35] http://www.tellusborder.eu/NR/rdonlyres/B48DEACD-2E53-4014-8A3D-B5FA0B462747/0/Tellus_Border_Geochem_Topsoils_QC_EDA_v11.pdf
http://www.tellusborder.eu/NR/rdonlyres/D2A56193-D4BE-47DF-8252-BD618A463733/0/ActLabs_QA_QC_GSI_Description_GSI.pdf http://www.tellusborder.eu/NR/rdonlyres/D2A56193-D4BE-47DF-8252-BD618A463733/0/ActLabs_QA_QC_GSI_Description_GSI.pdf
http://www.tellusborder.eu/NR/rdonlyres/DAF9925E-B0C5-48E0-AE8D-B542B73CC5E1/0/TellusBorderProjectLot2ASGSSummaryReport.pdf

[36] Launched on line by the Minister 3rd Feb 2013

[37] Launched on line by the Minister 3rd Feb 2013

[38] http://www.tellusborder.eu/NR/rdonlyres/5848354B-0AF3-462B-8D33-943DC28F95F1/0/TellusBorder_Geochem_User_Guide_Version_1.pdf

[39] http://www.tellusborder.eu/NR/rdonlyres/3C5C7A18-B342-409B-8588-F89107C1E1D6/0/FinalDrainageRpt_17122012.pdf
http://www.tellusborder.eu/NR/rdonlyres/1AC45E8F-89F3-44F6-95ED-EDE0AE51DF36/0/FINAL_Soils_Rept_13072012.pdf

[40] http://www.tellusborder.eu/NR/rdonlyres/C183A5D1-A5C2-43B4-861F-880C502480FF/0/Wilson_et_al_plumes_postdoc.pdf

[41] http://www.tellus.ie/wp-content/uploads/Keaney_etal_Soil_carbon_postdoc.pdf

[42] http://www.tellusborder.eu/NR/rdonlyres/7E6942A1-90BA-4E57-B5D0-1AC27A041ED6/0/TellusBorder_Processing_Report_Version_1_FINAL_Appendix.pdf

[43] http://www.tellusborder.eu/NR/rdonlyres/A2AF7C6D-6A78-4016-AEB2-D4F613825FB7/0/TBGPH06_Radon_Model_Report_Dec2013.pdf

On average, the difference between the actual and the originally envisaged completion date was two quarters. Some activities experienced significant delays notably the i) geophysical survey and ii) stream chemical characterisation of cross-border catchments. However, both of these activities were conducted by GSNI.

Effectiveness Conclusion

In terms of Effectiveness, it was found that outputs delivered by GSI in relation to the Project were met successfully and largely on time. This is commendable in light of the technical nature of the programme.

4.4 Rationale

The rationale metric asks what is the justification for the policies underpinning the programme and are the programme objectives valid. In the case of the Tellus Programme, this involves investigation of the existence of market failure which necessitates Government intervention.

Rationale Metrics

Rationale Metric - Is there market failure evident (i.e. the private sector would not have produced this data anyway).

As it is non-rivalrous and non-excludable, free information is a public good, whose provision, when left to the private market, may be sub-optimal. This provides a rationale for Government to collect information which can be shared by interested parties.

Due to the varied uses of the Tellus Border data and the range of different stakeholders benefiting from the data, it would not be viable for a single party to invest in mapping the entire area for their own individual benefit. While the private sector does conduct its own geological mapping exercises, these are limited in scope and the data may not be readily sharable with other parties.

In a sense, the Tellus Border project could be seen as acting as a “coordinator role”, which pools resources to deliver a product for all interested parties. The lack of suitable private sector entities to fulfil this role is also evident in other countries where it is common practice amongst other State-owned geological survey institutes to conduct similar programmes to Tellus.

Rationale Conclusion

Given the presence of market failure, the Review concludes that rationale is present for Government intervention.

4.5 Impact

The impact metric examines the socio-economic changes that can be attributed to the Tellus Border programme. It is important to give due consideration to the causality of the impacts of the activities of the programme. Consideration should be given to the counterfactual scenario whereby the impacts would have happened anyway in the absence of the programme.

The Tellus Border project outputs could be thought of as research and data "goods". The intangible nature of measuring the value of such outputs can however make evaluation assessments difficult. Indeed in the European Commission economic appraisal handbook (EC 2014)[44] it is noted that it can be difficult to measure the effect of research initiatives as their "features are unique, and cannot be analysed with the same degree of standardisation of methods for example in railways or in water[45]". The commission recommends establishing first the general target groups for the data followed by mapping their respective benefits. For the Tellus Border Project there is a wide variety of target groups some of which include researchers, mining sector and various public sector bodies.

With such wide variation amongst target groups, it is possible that the benefits arising from the dataset will require different quantification approaches depending on the activities of that particular target group. For example, if mining businesses are a target recipient for the data one could examine the extent to which the data/research has:

i) saved costs,
ii) decreased business mortality with associated job retention
iii) led to the provision of more services (i.e. widened the range of minerals mined).

This is in contrast to researchers who may have the following benefit categories:

i) increased citations (within academia);
ii) increased human capital (within private and public sector organisations);
iii) enabled the attainment of qualification for students; and/or
iv) improved university reputation.

Due to time and resources, it is beyond the scope of this evaluation to accurately quantify all of the Tellus Border benefits that accrue to all target groups; however, this section endeavours to identify the main stakeholders and to map the main benefits that can be attributed to the project.

Under the objective of assessing the *Impact* metric of Tellus Border project, the Evaluation Team engaged with several of the scheme's major stakeholders to gain information on how the project's inputs are affecting their operations. A summary of these stakeholders and their respective use of Tellus' outputs are detailed in Table 14 below:

[44] Cost-Benefit Analysis of Investment Projects; Economic appraisal tool for Cohesion Policy 2014-2020, http://ec.europa.eu/regional_policy/en/information/publications/guides/2014/guide-to-cost-benefit-analysis-of-investment-projects-for-cohesion-policy-2014-2020

[45] The guide refers to ex-ante appraisals of projects however many elements of the conceptual framework does apply to ex-post evaluations.

Table 14: Tellus Stakeholders surveyed

Organisation	Sector	Use of Tellus Data	Programme Logic Output
Environmental Protection Agency	Environment-Government agency	Radon mapping	Radon Water quality Soil quality
Department of the Environment, Community and Local Government	Environment-Government Department	Strategic Environmental Assessments.	Groundwater flow Strategic environmental assets
UCD	Academia	Research	Inward investment Commodities security of supply including critical metals potential Trace element and soil properties assessment Unconventional hydrocarbons
Department of Communications, Energy and Natural Resources Exploration and Mining Division	Natural Resources - Government Department	Mapping Information provision	Inward investment Mining impacts
Teagasc	Agriculture		Soil quality Water quality

Impact Metrics

Impact Metric 1 - To what extent has elements of the Tellus Programme (i.e. Radon mapping & Water quality data) risk mapping affected health policy and/or improved health outcomes?

It is estimated that exposure to radon accounts for approximately 13% of all lung cancers in Ireland, which equates to some 250 lung cancer cases each year[46].

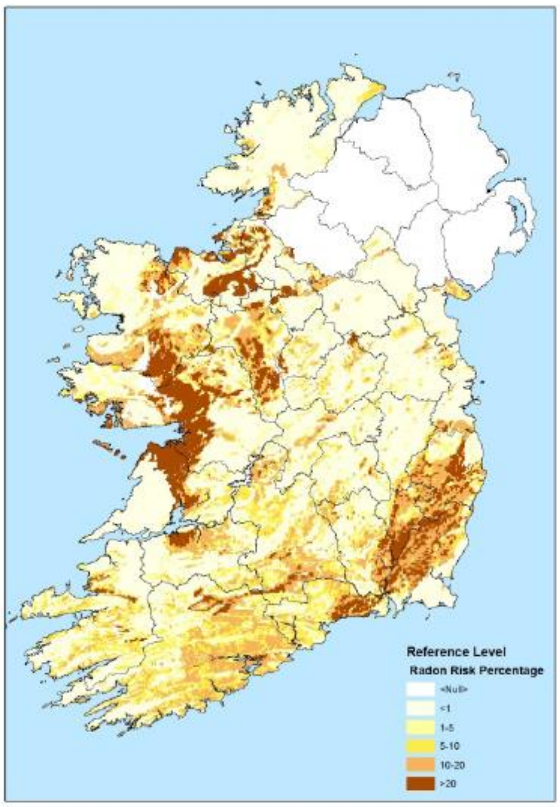
Tellus data can indicate risks associated with lung cancer by monitoring the presence of Radon. Radon (Rn) is a radioactive element which occurs naturally in earth materials. Exposure to high concentrations of radon is known to increase the risk of lung cancer. Accurate mapping of its occurrence can help identify households potentially at risk from exposure to radon and assist with highlighting high radon areas for future development. Currently radon maps are produced from indoor measurements; however in areas were few measurements exist, there may be difficulty in determining radon risks.

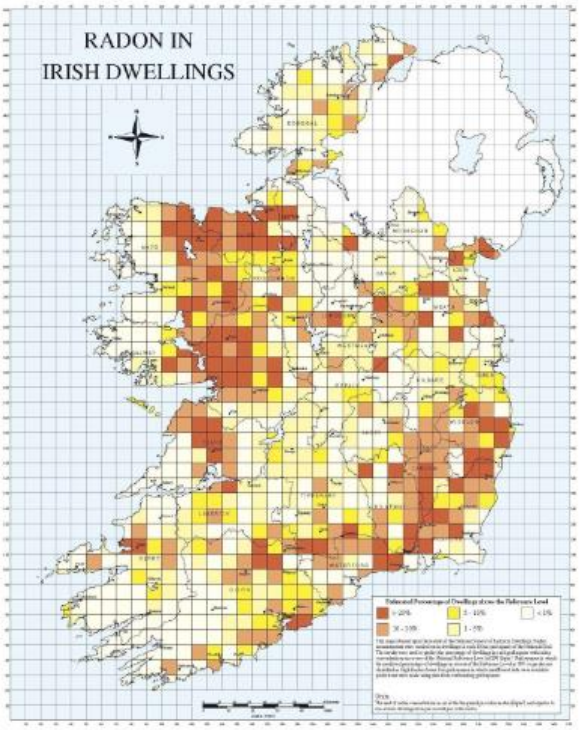
[46] Radiological Protection Institute of Ireland and National Cancer Registry of Ireland, 2005. Health risks due to exposure to radon in homes in Ireland - the implications of recently published data. Dublin: Radiological Protection Institute of Ireland. www.rpii.ie. Also, see Radiological Protection Institute of Ireland and Health Services Executive, 2010. Radon gas in Ireland - Joint Position Statement.

Airborne gamma-ray spectrometry, in particular the mapping of uranium, has been shown to improve the accuracy of radon risk maps. The Tellus data has been used in the Geological Survey of Ireland to model radon risk by combining airborne uranium measurements with other geological factors to provide a modelled value of the risk of exceeding radon reference levels in homes and other buildings. Tellus is working with the Office of Radiological Protection to improve radon mapping in Ireland as part of the National Radon Control Strategy.

As noted above, the National Radon Control Strategy[47] highlighted the need for improved mapping. The EPA's Office of Radiological Protection confirmed that Tellus data is a key component in the development of higher quality radon mapping illustrated in figure 4, below.

Figure 4: Comparison of radon distribution maps produce by new model (left) and previous measurements RPII (right).





http://www.epa.ie/radiation/radonmap/#.VsxN-H2LTcs

Impact Metric 2 - To what extent has the Tellus programme made an impact on mining activity?

To assess the impact on the mining division the Evaluation Team interviewed members of the Exploration and Mining Division (EMD) at DCENR.

All other things being equal, access to high quality data will add to a location's attractiveness as a location for mineral exploration. Minerals Ireland provides a suite of information to prospective investors, of which Tellus is one component. As noted above, DCENR's Exploration and Mining

[47] http://www.environ.ie/sites/default/files/migrated-files/en/Publications/Environment/EnvironmentalRadiation/FileDownLoad%2C35484%2Cen.pdf

Division confirmed that Tellus Border data release has been a direct, contributory factor in three companies applying for and being issued with 34 licence areas.

Furthermore, as noted above, the Irish Centre for Research in Applied Geosciences indicated that Tellus data provides a valuable insight into the potential future land use scenarios.

Impact Metric 3: Impact on spatial land-use planning

It is beyond the scope of this evaluation to quantify the impact of prudential planning; clearly however, benefits would accrue from avoided costs incurred arising from exposure of developments to flood damage. In this sense, the data could be seen as an essential input to insuring homes and businesses against exposure to natural disasters.

Stakeholder feedback[48] indicated that, while Tellus data adds to the richness of the information available and improves its quality, in certain instances it is not utilised directly. For example, in relation to flood prevention, Tellus may inform wider datasets but planning decisions are made primarily with reference to Catchment Flood Risk Assessment and Management (CFRAM) data[49]. It was reported that land-use data will be of greater use when it is available nationwide.

Environmental impact assessment experts[50] also described the potential of the Tellus data to be of benefit to the quality of Strategic Environmental Assessments[51] and Environmental Impact Assessment which are required under European Law for certain projects. The SEA Directive applies to a wide range of public plans and programmes (e.g. on land use, transport, energy, waste, agriculture, etc).

In the agricultural sector, Teagasc confirmed that Tellus data assists in informing future land use planning.

Impact Metric 3: Impact on academia

Part of the Tellus Border outputs involved the commissioning of three post-doctoral research projects. In addition, the data itself has been linked to 25 research papers[52]. Valuing the impact of this research, however, can be difficult. In theory, the benefit of a "unit" of research is the marginal

[48] See table 8, above

[49] http://www.cfram.ie/

[50] Feedback from the RPS group indicated that they "*have not had an opportunity to use the (Tellus) data yet as a lot of (their) work at the minute is at the national plan level and…(the data) is not full coverage yet….(however) the data is very good and will be very useful if there are any EIA/EIS/SEA projects in the Tellus coverage areas*".

[51] The SEA procedure can be summarised as follows: an environmental report is prepared in which the likely significant effects on the environment and the reasonable alternatives of the proposed plan or programme are identified. The public and the environmental authorities are informed and consulted on the draft plan or programme and the environmental report prepared.

[52] See PA (2014)

social value of the scientific publication. This could be estimated by its marginal production cost[53]. Therefore the value of one research paper can be estimated by the ratio of the relevant salary over the number of publications per year[54]. However data limitations (on the annual amount of papers per researcher and their respective salaries) prevent this calculation being achievable in practice. Notwithstanding that, the Review recognises there is a significantly positive benefit associated with the commissioning of the research.

Furthermore, there can also be significant benefits to the university or research institute associated with the production of additional research citations. For instance, research and citations account for a large weight (60%) of the Times Higher Education World University Rankings[55] and such rankings have been demonstrated to have an effect on university choice by students[56]. Improving the reputation of a university can have a multitude of positive effects including but not limited to attracting foreign direct investment, improving labour force productivity, generating non-academic local employment and reducing trade imbalances by contributing to exports[57]. Quantifying these benefits is beyond the scope of this paper; however, qualitatively they contribute additional value.

Impact Conclusion

As noted above, measuring the precise impact of the Tellus Border Project is challenging. Nevertheless, the review concludes that it has positively impacted a wide range of areas including: radon mapping, mining, land use planning and academia.

4.6 Economy

'Economy' in this context relates to an overall composite of the above metrics which seeks to answer the question as to whether the programme represents 'value for money'. In order to quantitatively assess this, a reverse engineered, high level cost benefit analysis is set out below.

As illustrated above, while costs in the Tellus Border project are well defined, benefits are more difficult to monetise. For this reason, calculations below establish the input values required to deliver a positive NPV.

[53] Marginal cost is a proxy of the shadow price of research as market prices are not appropriate

[54] P288 Cost-Benefit Analysis of Investment Projects; Economic appraisal tool for Cohesion Policy 2014-2020, http://ec.europa.eu/regional_policy/en/information/publications/guides/2014/guide-to-cost-benefit-analysis-of-investment-projects-for-cohesion-policy-2014-2020

[55] https://www.timeshighereducation.com/news/ranking-methodology-2016

[56] See *Luca, M. and Smith, J., 2013. Salience in quality disclosure: evidence from the US News college rankings. Journal of Economics & Management Strategy, 22(1), pp.58-77* and *Alter, Molly, and Randall Reback. "True for Your School? How Changing Reputations Alter Demand for Selective US Colleges." Educational Evaluation and Policy Analysis 36.3 (2014): 346-370*

[57] For a narrative in the Scottish context on how university quality can enhance economic output refer to http://www.universities-scotland.ac.uk/uploads/Grow%20Export%20Attract%20Support%20Universities%20Scotland.pdf

As noted above (see table 5), the main sectors which benefit from Tellus data were identified as follows:

- Agriculture
- Environment
- Health
- Mineral exploration

Stakeholder consultation (see Table 14, above) indicated that, in certain of these sectors, Tellus data added to the richness of the information available and improved quality. These benefits were seen as indirect rather than direct, however. For example, in relation to flood prevention, while Tellus might inform wider datasets, it would not directly inform decisions.

Likewise in the agricultural sector, Teagasc confirmed that Tellus geochemical data provides a valuable tool to inform research. It tends not to be used by farmers, however, who employ traditional soil sampling, focussing on properties which can be altered such as ph. level.

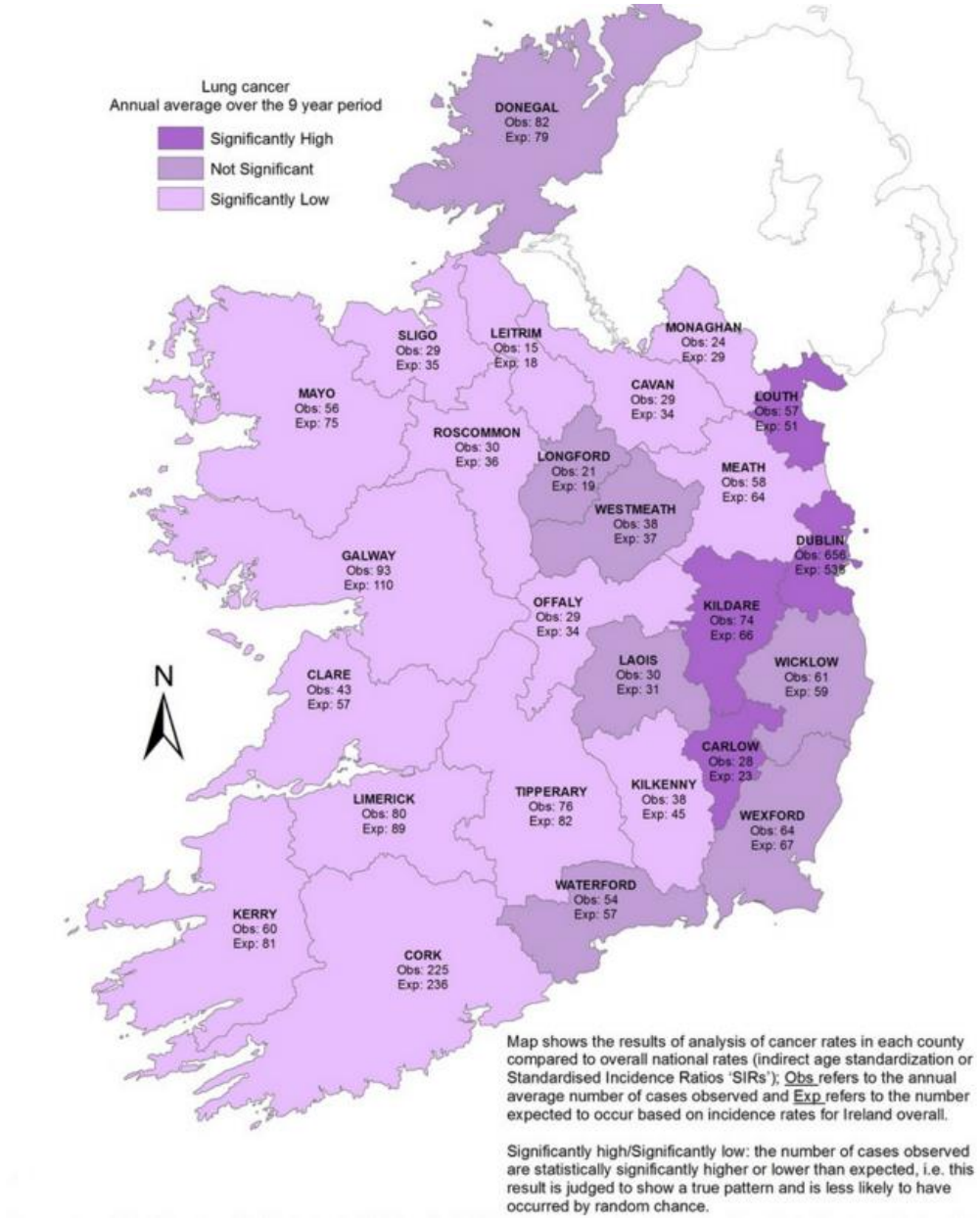
While qualitative benefits are likely to arise in each of the sectors outlined above, the benefits of such basic research are difficult to incorporate into cost benefit analysis. For this reason, monetisable benefits are examined in sectors for which the data is more applied.

Health benefits

As noted above, Tellus data can assist in assessing the radon risk associated with different geographic areas. The National Radon Strategy[58] highlights the importance of mapping in identifying risk areas. Figure 2 (above) illustrates refined radon mapping which is being developed with assistance from Tellus data. Figure 3, below illustates annual average number of lung cancer cases (236) observed in the border region over the years 2004-2012.

[58] http://www.environ.ie/sites/default/files/migrated-files/en/Publications/Environment/EnvironmentalRadiation/FileDownLoad%2C35484%2Cen.pdf

Figure 5: Lung cancer incidence, 2004-2012



Source: http://www.ncri.ie/data/maps?field_cancers_tid_selective=59

Survival rates for this particualrly severe form of cancer are regrettably low, at just 12%[59], indicating approximately 311 annual deaths from lung cancer in the border region.

[59] http://www.ncri.ie/news/article/eurocare-5-results-show-improved-survival-all-cancers-ireland

Mining

Ireland competes for mobile mining investment in the same way it competes for foreign direct investment in already established sectors. As such the State aims to provide a facilitative environment for industry to invest, where appropriate.

Understanding the geology underlying areas of the country can indicate the likelihood of discovering mineral deposits. Companies may find it prohibitively expensive to collect this data individually. Providing it centrally gives Ireland a competitive advantage relative to those countries for which information is not available.

As noted above, the Fraser Institute Annual Survey of Mining Companies[60], which records industry's perception of the quality of Irish geological databases, ranks Ireland 6th out of 122 jurisdictions surveyed across the world. Tellus, among other datasets, is likely to contribute to this perception.

The Department's Exploration and Mining Division has confirmed that Tellus Border data release has been a direct, contributory factor in three companies being issued with 34 licence areas.

In 2013, DCENR commissioned independent research to estimate the value of the Mining sector to the Irish economy. This work estimated an annual gross value added of €274m from the sector[61].

CBA calculations

Applying the shadow price of public funds, the present value of costs associated with the Tellus Border Project in the Republic of Ireland is approximately of €5m.

Taking the two sectors outlined above, with most clearly monetisable benefits, the following outputs would be required to deliver a net positive outcome:

- A reduction of 0.07% in lung cancer deaths in the border region, beginning in 2020[62]. This would equate to annual monetisable benefits in the region of €300k in 2010 prices, applying the value of life prescribed by The Department of Transport, Tourism and Sport[63] (see Appendix).
- An increase of 0.07% GVA in the mining sector. This would equate to annual monetisable benefits in the region of €180k in 2010 prices, applying the value estimated in Indecon's 2013 study[64] (see appendix).

[60] See more at: https://www.fraserinstitute.org/categories/mining#sthash.FRNhYPHm.dpuf
[61] https://www.gsi.ie/NR/rdonlyres/DCFE220F-E5DE-402C-81EB-D9624A732278/0/AssessmentofEconomicContributionofMineralExplorationandMininginIreland.pdf
[62] A lag is assumed as it is deemed unlikely that this benefit would be felt immediately.
[63] Common Appraisal Framework for Transport Projects and Programmes, 2016 http://www.dttas.ie/sites/default/files/publications/corporate/english/common-appraisal-framework-2016/common-appraisal-framework2016_1.pdf
[64] https://www.gsi.ie/NR/rdonlyres/DCFE220F-E5DE-402C-81EB-D9624A732278/0/AssessmentofEconomicContributionofMineralExplorationandMininginIreland.pdf

Comparing these two benefits to the cost of c€5m over a 20 year appraisal period[65] would yield an NPV of €660k and a BCR of 1.1:1. The associated internal rate of return would be 6%. It is important to note that such returns have not been demonstrated with certainty. They are instructive, however, in illustrating the minimum threshold required to deliver a net positive outcome. Greater detail is provided in the Appendix and in the accompanying spreadsheet.

Economy Conclusion

While it has not been demonstrated robustly that monetisable outputs derived from the Tellus Border Project outweigh costs, the review concludes that the Project is likely to contribute to a net positive benefit to the Irish economy which would not exist without the Project.

[65] Applying the prescribed test discount rate of 5%

5. Conclusion/Recommendations

5.1. Conclusions

The Value for Money and Policy Review examined the performance of the Tellus Border Project against a series of nine metrics under the headings of its relevance, efficiency, effectiveness, rationale, impact and economy.

Under the Relevance metrics, it was found that the many of Tellus Border outputs did contribute to the achievement of a number of other Government policies in the areas of agriculture, health and environment. It should be noted, however, that the precise scale of these impacts is difficult to measure and the full effect on public policy outcomes may not be fully realised until the programme is completed on national basis.

In the areas of Efficiency, it was found that GSI's expenditure on the Tellus Border activities complied with budgetary targets despite some minor overspend. In the benchmark comparison of the Project against similar programmes in other jurisdictions it was found that GSI policy of providing Tellus data free of charge is similar to that of most other geological survey institutions. Although the respondents to a survey were limited, it would appear that data collection on users is far from uniform. No institution was found to collect information on users of free data; the BGS and GTK do have information on users who pay for data and the NGU (Norway) do collect descriptive statistics on downloads. The Review concludes that a lack of information on Tellus Border's data usage inhibits a fuller understanding of identity of stakeholders, as well as their needs and the overall impact of the project.

In terms of Effectiveness, it was found that deliverables produced by GSI in relation to the Project were met successfully and largely on time. This is a significant achievement in light of the technical nature of the programme.

Under the Rationale metric, the Project appears to remedy a market failure whereby, in its absence, high quality geochemical and geophysical data in the market would either not exist or be under-provided.

Under the Impact metrics, it was found that the Project appears to impact on several key stakeholder groups. The Tellus data was found to have a positive impact on the development of a National Radon Control Strategy. It is also been cited by stakeholders to have an influence in driving interest from the mining industry. The Tellus Border data's impact on spatial land-use planning was not yet deemed to be significant; however, it was reported by stakeholders that once the data is available on a national scale it will be of greater use. The evaluation noted the positive effect the Project has in relation to research but it beyond the scope of the VfM accurately to quantify these benefits.

Under the Economy metric, it was demonstrated that Tellus is likely to contribute a net positive benefit to the Irish economy.

5.2. Recommendations

The preceding review has demonstrated the difficulty of delivering firm conclusions in the absence of robust evidence. In order to address this issue, it is recommended that information on those seeking to download Tellus data is collected. Currently the GSI does not have reliable information on who is downloading the Tellus Border data and for what purposes it is exploited. In examining other geological survey institutions, the Review noted that the BGS is exploring whether it should request users to register to view their data as they deemed that it "would provide a better indicator if initiatives have been a success". It is recommended that the GSI request users to register in advance of downloading data to indicate, at a minimum, their identity, affiliated organisation and the purpose to which they intend to use the data. It is not expected that that this would deter usage of the databases.

Given the challenges associated with measuring Tellus benefits, the Group recommends that GSI work with stakeholders to develop clear KPIs which can be tracked into the future. These could include collecting details of those accessing Tellus data. In addition to a database of those downloading data electronically, it would also be helpful to build a picture of key stakeholders and their requirements to ensure data is meeting user needs. If this were in place, GSI could record the application of Tellus data across different sectors, such as environment, health, agriculture, planning and mining and refine dissemination and analysis as appropriate.

In terms of the format of the data collected, most stakeholders expressed their satisfaction. Teagasc recommended that geochemical surveying might be augmented to include available phosphorus as distinct from absolute phosphorus. Teagasc is designing a joint research programme on the Tellus samples and data, looking at available phosphorus and other soil properties.

There may be scope for GSI to charge for the Tellus Border data to parties who derive most benefit from it or to those who indicate the highest willingness to pay. The response from BGS and GTK indicates that there is a demonstrated willingness to pay for similar data from certain stakeholders. It is recommended that GSI re-examine their "free-data" policy in this regard.

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Annex A - Geological institutions questionnaire

The following set of questions were sent to a selection of comparable geological survey institutions across the world to inform the findings in the efficiency metric:

i. Does <Institution> provide geological data free of charge or is there a charge for some or all of the data?

ii. if the data is behind a paywall could you please give the reasons why this is the preferred option?

iii. Also do you know what groups (i.e. mining companies, universities) are willing to pay for the data?

iv. does <Institution> collect data on what groups downloads geological data? If so, could you share what are the main groups who interact with this data.

Annex B – Indicative cost benefit analysis calculations

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Costs	93,784	969,167	2,701,771	753,291																	
Costs (2010)	93,784	944,607	2,589,287	718,337																	
SPPF Costs	121,919	1,227,989	3,366,073	933,838																	
Benefits																					
Health											294,378	294,378	294,378	294,378	294,378	294,378	294,378	294,378	294,378	294,378	294,378
Mineral exploration	183,815	191,800	191,800	191,800	191,800	191,800	191,800	191,800	191,800	191,800	191,800	191,800	191,800	191,800	191,800	191,800	191,800	191,800	191,800	191,800	191,800
Energy																					
Agricultural																					
Environmental																					
Total Benefits	183,815	191,800	191,800	191,800	191,800	191,800	191,800	191,800	191,800	191,800	486,178	486,178	486,178	486,178	486,178	486,178	486,178	486,178	486,178	486,178	486,178
Total uplifted (with economic growth) Benefits	183,815	190,213	193,329	202,274	216,236	228,562	237,933	246,737	255,866	263,030	685,401	703,222	717,286	731,632	746,264	761,190	776,414	791,942	807,781	823,936	840,415
Net Benefits	61,896	-1,037,777	-3,172,744	-731,564	216,236	228,562	237,933	246,737	255,866	263,030	685,401	703,222	717,286	731,632	746,264	761,190	776,414	791,942	807,781	823,936	840,415
NPV	61,896	-988,359	-2,877,773	-631,952	177,898	179,084	177,549	175,351	173,180	169,551	420,777	411,159	399,412	388,000	376,914	366,145	355,684	345,522	335,650	326,060	316,744
PVC	121,919	1,169,514	3,053,127	806,684																	
PVB	183,815	181,155	175,355	174,732	177,898	179,084	177,549	175,351	173,180	169,551	420,777	411,159	399,412	388,000	376,914	366,145	355,684	345,522	335,650	326,060	316,744