S-map

Indicative benefits

m.e consulting

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SUMMARY

S-map Online is a tool that is administered by Manaaki Whenua – Landcare Research (Landcare) to deliver digital soil information. This information is used to inform a range of activities, supporting activity and delivering a wide range of benefits. Some of the benefits are direct, flowing to users, and others are benefits flowing to non-users and the wider community. Landcare is exploring options to expand S-map coverage and we understand that a business case (for funding) is being prepared. As part of this process, the potential benefits that such a roll-out could deliver is being assessed.

Market Economics Limited (M.E) worked with Landcare to estimate the benefit of S-map and of expanding its coverage. This assessment considers the level of use and estimates the benefits flowing to users. It is a first cut, indicative assessment of the user benefits. It is not a full cost and benefit assessment. It was not the intention to complete a 'final' and detailed estimate of the benefits, but instead to prepare an indicative benefit estimate. During the second and third quarters of 2019, S-map users were invited to complete a survey about their usage patterns, and we draw on the survey to estimate the value of work done using S-map. Where possible the spatial and sectoral patterns were applied to the current S-map user base.

We estimate that there are 6,880 active S-map users and the survey returned 1,014 usable responses. Most users identify as 'private businesses' (46%) and 'landowners' (16%). Not surprising, the top ten applications show a strong connection to agricultural land use and processes, e.g. crop/pasture production management decisions or planning, farm nutrient budget or management models[1], managing nutrient losses and irrigation management. This points to the fact that S-map is used as an input to farm processes, directly and indirectly. S-map is also used in non-farm settings. Most (61%) users indicate that S-map is an important or very important input into their processes.

Base values and wider rollout

Using the survey results about frequency of use, charge-out rates and the sectoral mix of users, we estimate the direct value of S-map related work (direct work) as being **in the order of $19.5m per annum**. Most (76%) of this value is associated with regions that have 'good' S-map coverage. A quarter (24%) of the value is associated with areas with low coverage. Professional, scientific and technical services have the highest level of direct use benefit, valued at $7.7m, followed by agricultural activities, specifically dairying ($4.3m), sheep, beef cattle or grain farming ($2.5m) and horticulture and fruit growing ($1.7m).

The potential use value of expanding S-map assumes that areas that are currently not covered by S-map will see the same use values as the currently covered areas. Using current sectoral usage intensities and values as proxies[2] for sectoral benefits, and applying these to the activities in uncovered areas, we estimate the potential lift in benefits. Assuming that the 'new areas' would see between 80% and 90% of the potential gains, rolling out S-map across a wider area will deliver up to **$11.8m per annum** in additional value or benefit. Around half (48%) of this lift is in area that already have some, but low, S-map coverage.

Importantly, these benefits are not one-offs, but will occur over multiple years. We use a scenario approach to illustrate the magnitude of the multiyear benefits. The present value of rolling out S-map over the uncovered areas is between **$55.5m and $68.1m over 10 years**. This equals 38% of the value associated with the current coverage. It is also very important to bear in mind that in addition to the use benefits, other benefits arise. These wider benefits are discussed in the next section. Quantifying these 'facilitated effects' and benefits are beyond the scope of this project.

[1] OVERSEER®, MitAgator.

[2] We used several different approaches to estimate the proxies, including averages like the benefits per farm, and the $/business.

Wider benefits

As mentioned, the analysis outlines the direct use values but information dataset and tools, like S-map, assist users to complete analysis to a deeper level. This enables higher quality results, more detailed assessments which should lead to better decisions and improved outcomes. This assumes that decision-makers act on the available information – something that is not guaranteed. These facilitate or enable effects which have long-lasting and large effects.

S-map has a direct link to natural capital, an increasingly important consideration. While there is a lack of research and case studies on measuring the value of information products, several authors have examined the value of making better farming decisions, from various perspectives[3], such as increased productivity, reduced inputs (e.g. fertiliser), long-term gains through soil conservation, and the like.

Erosion control is an example where S-map users can influence processes with wide benefits. To put the scale of this potential gain in context, the Ministry for Primary Industries states that erosion and its effects – lost soil, nutrients and production, damage to trees, houses, infrastructure, and waterways – in hill country areas alone are estimated to cost New Zealand's economy **$100 million to $150 million a year[4][5]. Over 10-years, this equals between $963.8m and $1.1bn. If using S-map contributes to a 1% saving, then S-map's value is between $9.6m and $11.4m per year.** Importantly, the savings reflect the outcome of many actions, and not just the availability and use of S-map.

Looking forward, climate change will change the frequency and severity/intensity of storms in some areas and result in drier conditions in other areas. Both trends would increase lost agricultural production from mass movement in hill country and surface erosion, respectively. S-map has a role to play in responding to these pressures, protecting the natural capital and enhancing the response to climate change (i.e. lifting resilience).

The link between land use and freshwater quality is noteworthy. Fresh water contributes to the economy and is valued by New Zealanders. It has cultural, social, economic and recreational values. Maintaining and improving water quality are two key government priorities. There is limited research that values freshwater quality in Dollar terms. Nevertheless, the role of land-use management is important. S-map data has a natural fit with such management and will make an important contribution to land use management. Drawing from the Lake Taupo example, and assuming that soils information is used to (and contributes to) reduce nitrogen use and leaching, then reducing nitrogen discharge to water is put at between $43m and $87m (per year)[6].

Concluding remarks

S-map is a valuable resource enabling users to undertake research and modelling work that would be difficult to undertake in the absence of the information. The survey illustrates the mix of users, with a large portion of private users – either a private business or landowners. This suggests that most of the immediate use benefits will accrue to private users. It is not difficult to foresee a situation where requests for additional funding are responded to by using user-pays arguments. It is worth noting the wider benefits – facilitated benefits as well as avoided costs – of S-map are mostly public benefits, i.e. benefits that will accrue to the wider public and society. Soil information is also required by those who influence or inform farm decision making, such as policymakers and consultants.

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[3] Giasson, Van Wambeke & Bryant, 2000

[4] https://www.mpi.govt.nz/news-and-resources/media-releases/34-million-for-more-erosion-control-work-over-next-4-years/

[5] Another study for the Ministry for the Environment quotes research highlighting the annual cost of soil erosion and sedimentation, suggests that the value is in the order $175m. Furthermore, the highest component of costs is lost agricultural production, estimated at $51m (2019 value).

[6] Based on communication with, and information from, Landcare.

Contents

Appendices

Figures

Tables

1 Introduction

S-map Online is a tool that is administered by Manaaki Whenua – Landcare Research (Landcare). It is used to deliver digital soil information. The information in S-map can be used to inform a range of tasks that are associated with modelling different environmental risks and assessing different soil conditions.

Intuitively, there is value in having the S-map resource. Landcare is exploring options to expand the S-map coverage to include other areas. As part of the process, Landcare is preparing a business case for central government funding to enable S-map to be rolled out across New Zealand and it needs to understand the benefits of increasing the coverage.

Market Economics Limited (M.E) worked with Landcare to estimate the benefit of S-map and of expanding its coverage. This report presents the results. Importantly, the assessment is not a 'full cost and benefit assessment'. The focus is on the benefit side of the equation. Further, it was not the intention to complete a 'final' and detailed estimate of the benefits, but instead to prepare an indicative benefit estimate. The assessment draws on a survey conducted during the second and third quarters of 2019. M.E and Landcare collaborated during the survey design process and Landcare managed the surveying stages. M.E analysed the relevant parts of the collected information and used it in estimating the potential benefits. It is however beyond the scope to explain and quantify all the benefits that current users derive.

1.1 Key tasks

The project was delivered by way of several key tasks, focusing on estimating the potential benefits that rolling out S-map over currently uncovered areas could deliver. The main steps were:

1. Consider available information about current S-map coverage, the existing user profile and user base.
2. Identify and review the benefits that current users are getting from S-map and how these tie in with the spatial patterns of S-map (around the country). During this task, we looked at the spatial patterns revealed during the survey (e.g. where an Auckland based consultant services a Southland farmer)
3. Define the opportunity associated with a wider S-map rollout using a scenario approach[7], and expressing the change in quantitative terms.
4. Estimate the revealed benefits that users are deriving from S-map.
5. Not all benefits of S-map are reflected in the survey and we provide a brief narrative on the other benefits. For example, having access to 'better' information leading to 'better quality' decisions and then enhanced outcomes.

1.2 Limitations and caveats

The estimates presented in the report are subject to limitations and caveats, including

- Several data sources were used, including the survey and the information about S-map users. Regarding the user information, we assumed that it is accurate and current. We did not audit it

[7] We have allowed for 1 scenario but can vary this if needed.

for accuracy, duplicates or any data errors. In terms of the survey, we have assumed that the collected results reflect the spatial and user (by type) distribution of active users

- The assessment reflects the current understanding of S-map, its coverage and the roll-out. The roll-out of S-map is distributed over 5 years. It can be brought forward or delayed, but the timeframe is used to show the potential value over time.
- The report shows indicative estimates only, the results are not forecasting, or projections of the future – they are simply a scenario showing the potential outcomes based on the settings. Similarly, the outcomes are not guaranteed.
- The benefits are based on available information as collected during the survey. We rely on the survey information but in some cases the coverage (return rate) is low, widening the margin of error and lowering the confidence intervals. We note that the information collected on the S-map alternatives is very limited, and this reduced our ability to reflect the potential costs (and benefits) of the status quo approach in the areas without S-map.

As mentioned, a brief narrative about the potential benefits of having better information is included. This narrative is excluded from the analysis, i.e. we did not attempt to quantify these effects.

1.3 Report structure

The report is structured as follows:

Section 2 provides a high-level summary of S-map users and the key ratios identified from the survey.

Section 3 presents the analysis and scenario modelling.

Section 4 concludes the report with a high-level narrative of the potential wider benefits of S-map and soils information.

2 Base information

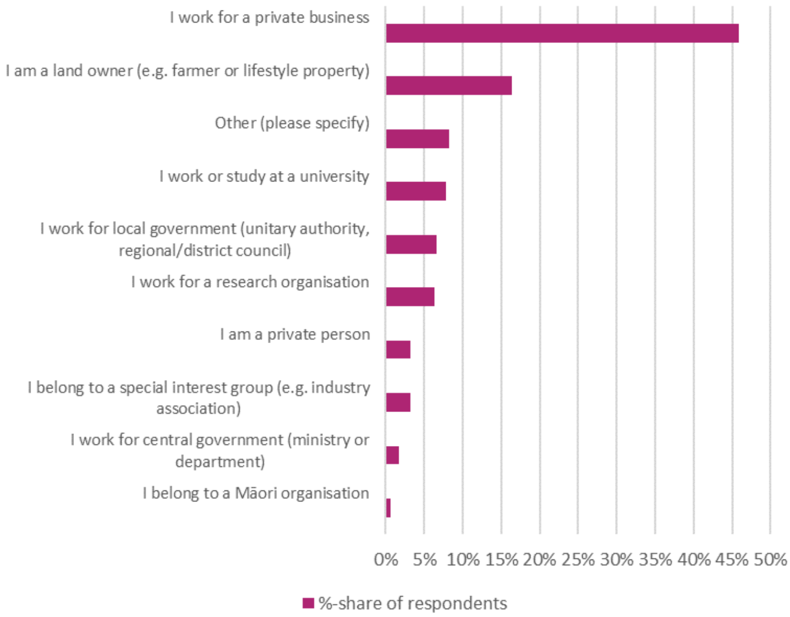
Information about S-map users, and the survey results are used to estimate benefits. Where possible the spatial and sectoral patterns were distilled and applied to the New Zealand-wide landscape. The existing S-map user base was used to scale the survey results.

2.1 User information

The S-map user base information was used as a starting point for estimating the potential benefits of S-map. The user database contains over 13,200 individual records. The records were reviewed, and we adjusted the dataset for non-current users and to remove users that haven't used/accessed S-map in the past two years. One-off users are also identified. After these adjustments, there were 6,880 active users in the dataset. This is seen as the S-map 'user population' and the survey results are scaled to match this estimate.

The survey returned 1,014 usable responses that were used to inform the analysis. The percentage breakdown of users by type was derived from the survey and applied to the active user base. Figure 1 shows the percentage breakdown.

Figure 1: Percentage breakdown of users by type



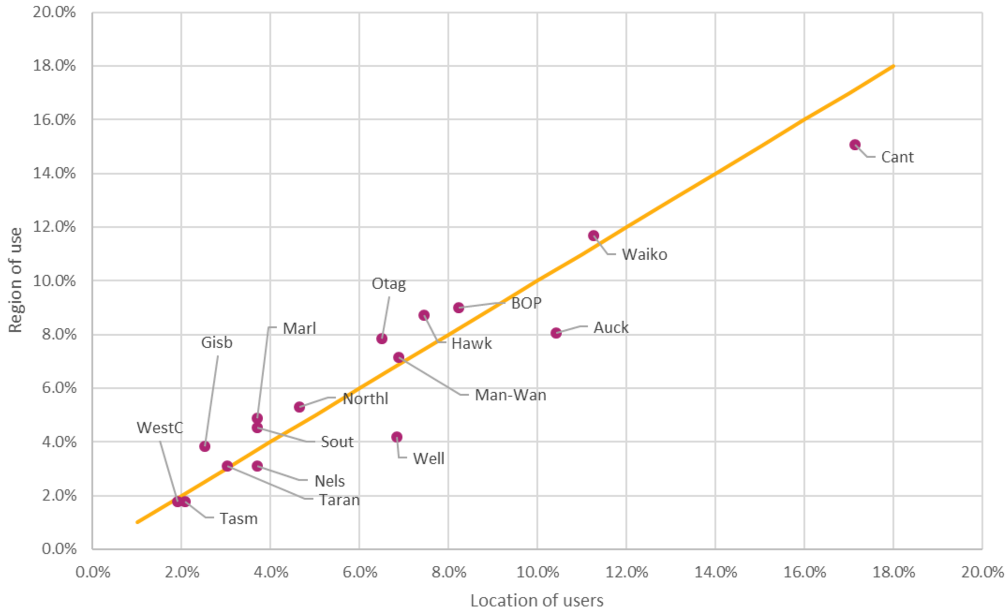
It is evident that the 'private business' segment is the main user group with 46% of the respondents falling in this group. Landowners (16%) are the second largest group. Several smaller groups make up the balance. This includes:

1. University related users (workers or students; 8%),
2. Government – central and local (2% and 7% respectively),
3. Research (6%),
4. Other[8] (15%).

[8] This includes Maori organisations, special interest groups, private individuals and not elsewhere classified groups.

With reference to the spatial distribution of users, we considered both the location of users (where they are based) as well as where they work (in which region did you apply the soil information). Figure 2 shows the relationship between where users are located and the regions where S-map is used. The figure includes a 45°-line. A location below the lines reflects an over representation of location vs regions of use.

Figure 2: Spatial patterns



For example, Auckland hosts over 10% of users but the region represents 8% of use. Wellington and Canterbury have similar patterns. Conversely, the Waikato has a slightly higher 'share of the use' relative to users located in the region. Overall, the spatial pattern suggests that the most users are located in the main regions, and while not directly asked in the survey, it can be assumed that the users are based in the main cities and towns. This is because a large share of users is people working for a business (i.e. contractors or consultants). A share of respondents indicated that they deliver services (or use S-map) across New Zealand but these users are concentrated in government and research organisations and private businesses. When combined with the user profile – that 46% of users are private businesses – this suggests that a sizable share of S-map usage is via contractors or consultants and the service is 'sold' to the regions. Around 6% of users service multiple regions, i.e. are based in one region and use S-map information for another region. Ten percent of the respondents indicated that they service all NZ regions.

Many of the smaller regions, like Gisborne, Marlborough and Bay of Plenty, have a marginally larger share of users relative to the level of use. This suggests that the regions are 'importers' of the services.

Application of S-map

S-map is used for a range of applications. Figure 3 shows the responses for different applications, by user type. Respondents are grouped into four user types, with two (private business and landowners), representing the entire groups as used in the survey. The government group includes both local and central government. The 'other' group includes the balance of respondents, inclusive of researching organisations, special interest groups, university workers/students and so forth.

Overall, the top ten applications that get the most use across all user types are:

- Crop/pasture production management decisions or planning (including modelling),
- Farm nutrient budget or management models – e.g. OVERSEER®, MitAgator,

- Managing nutrient losses,
- Fertiliser applications,
- Land use capability mapping,
- Assessing soil erosion risk,
- Irrigation management,
- Farm operational management and planning decisions,
- Environmental modelling research and reporting, and
- Effluent or wastewater management.

These applications (10) account for 54% of all applications. This points to the fact that S-map is used as an input into many farm processes, directly and indirectly. Users also used S-map to model and consider the wider implications of land use and wastewater modelling.

Figure 3: S-map applications

The relative importance of private sector users across all applications is noteworthy. In fact, it dominates virtually all applications, except 'research (experimental, fundamental or student level)'. The applications with the highest relative (%-terms) use by private users are (note, this is a large %-share of a small number of users):

- Geotechnical surveys,
- Resource consent applications,
- Providing professional advice (excluding the models mentioned earlier),
- Land and property sales (e.g. pre-purchasing assessments), and
- Effluent or wastewater management.

These are relatively specialist areas needing special capability and know-how. These applications tend to form part of technical processes and so the over representation of private users is as expected. Importantly, private users apply S-map for a wide range of applications and the above list is only the top 5 (applications associated with private users, not the entire sample). Private users are over-represented across[9] almost all applications with a median share of 49.7%. The second largest group, landowners, have a different use profile. This group's top applications, in terms of %-share of overall use per category, are:

- Crop/pasture production management decisions or planning (including modelling),
- Farm nutrient budget or management models – e.g. OVERSEER®, MitAgator,
- Fertiliser applications,
- Farm operational management and planning decisions, and
- Preparing, updating or auditing farm environment plans.

When compared against total use, landowners' share is around 13%. This is the average level of use across all the individual use categories.

Government's use (local and central) is at the same level (average of 13% across all the use categories and user-types). The largest use shares are in areas associated with planning, infrastructure and information management. The top five applications for government users are:

- Informing planning processes (e.g. subdivisions),
- Informing regulatory work or policy development (e.g. national policies, regulations, district plans),
- State of environment monitoring,
- Transport or utility infrastructure planning, and
- Official statistics (National Greenhouse Gas Inventory, National System of Environmental & Economic Accounts).

With reference to other users, the applications are varied with the survey suggesting that other users are diverse, but as a group, they are an important segment. This group used S-map for the following applications:

- Research (experimental, fundamental or student level),
- Training, teaching or educational purposes (academic and vocational),
- Data mining or deriving new information,
- Economic modelling and studies (2nd largest),
- Official statistics (National Greenhouse Gas Inventory, National System of Environmental and Economic Accounts).

<u>Importance of S-map to deliver work</u>

A key aspect in estimating the value of S-map to users is to gauge the underlying importance of S-map as an input into project work. If the input is critical and there are limited alternatives, then it can be argued that S-map underpins a wide range of work/projects that have benefits[10]. The survey enquired about how important S-map is as an input into project work. A score of 1 is seen as not important, 3 is neutral and 5 is very important. Figure 4 reports the scoring across the main groups.

As expected, the relative importance of S-map varies across user groups but, overall, most (41%) responses rate S-map as important (score: 4). Scores vary across groups. But almost two-thirds (61%) of respondents indicated that S-map is either 'important' or 'very important' with landowners reporting the lowest score

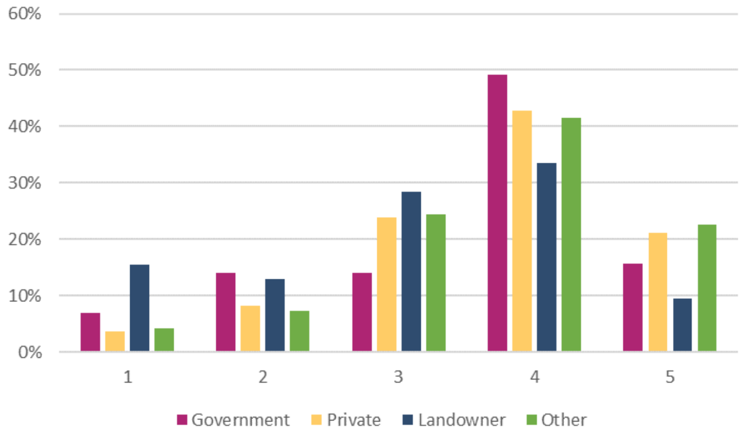
[9] In this section, the measurement is based on the count/number of times a user uses S-map across all the applications and is based on the response rates.

[10] These benefits can be valued using different metrics and a basic one being willingness to pay. This provides an indication of the first layer of benefit, but it excludes other, facilitated benefits that using S-map might unlock.

for relative importance, i.e. 43% of them indicating S-map is ‘important’ or ‘very important’. The other groups put a high value on S-map:

- Government 65%
- Private users 64%
- Other 64%

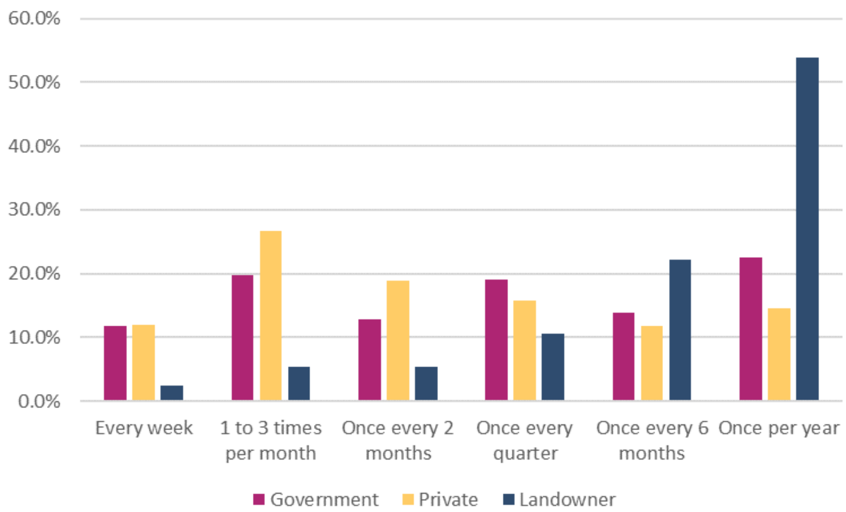
Figure 4: Relative importance of S-map



The relatively low score of landowners is not surprising. We suspect that this reflects landowners’ views that S-map and the associated work is part of managing their entire operations, but not a part of the core business. For the other groups[11], the opposite would hold true since S-map is an input into the core business processes.

With reference to the frequency of use, a low response rate in some groups limited our ability to compare usage rates across the groups. Private and government users have a similar use profile with use distributed evenly across the different time-cohorts. Slightly more than 1-in-10 private and government respondents indicated that they use S-map every week. Beyond this, private users show a slightly more intensive use of S-map with more than half (58%) of users accessing S-map at least once every two months (so 6 times per year). For government users, the equivalent figure is 45%. Landowners do not use the facility as intensively, with most (54%) users accessing it only once per year.

Figure 5: Frequency of Use



[11] Importantly, the government-group relates to those departments and government employees that work with S-map. It is not an All-of-Government measure.

Bringing the frequency of use and the relative importance of S-map together, illustrates that:

- Private users make the most intensive use of S-map and it is an important input into their business processes. It is safe to assume that the private users are professional consulting businesses.
- Users access S-map to inform their processes but the level of use is concentrated into a few bursts of use throughout the year.

Respondents were also asked about

- the number of projects (or tasks) that used S-map as an input,
- the hours S-map was used for, and
- the average charge out rate for staff using S-map.

This information combined with the user profile provide a way to estimate the total (use) value of S-map. That is how much business activity it supports which reflect the direct user benefits derived from S-map.

Appendix 2 provides summary tables of selected datapoints.

2.2 Base Values

As the preceding indicates, S-map is used across New Zealand and by a range of different users. Using these observations enables us to estimate the current baseline value of S-map. This value is not the 'total benefit' of S-map. Instead it reflects the use value and forms a starting point for exploring S-map's total benefit to New Zealand.

The analysis is based on several ratios derived from the survey. In addition to the frequency of use (discussed earlier), the charge out rates reported by users are used. The charge out rates are based on the survey responses and Table 1 shows the range per user type.

Table 1: Charge out rates

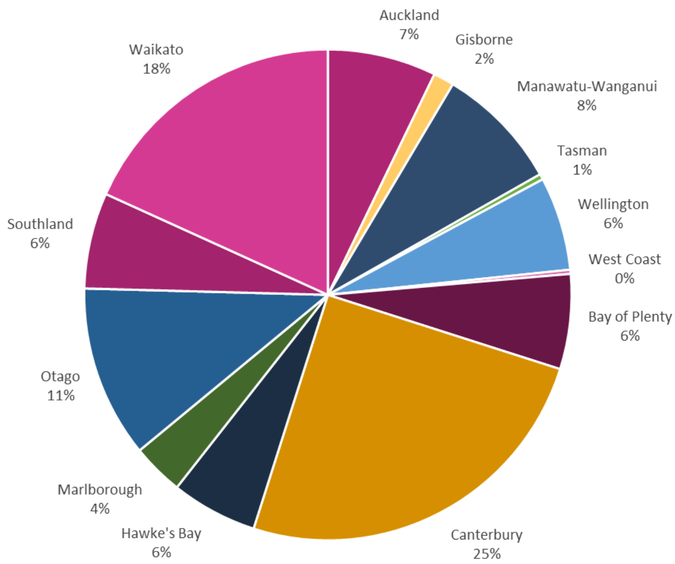
User type	**$/h - Range**		
	Min	**Median**	Max
I work for central government (ministry or department)	140	145	150
I work for local government (unitary authority, regional/district council)	80	150	180
I work for a research organisation	175	210	220
I work for a private business	110	120	150
I am a landowner (e.g. farmer or lifestyle property)	30	88	215
I belong to a special interest group (e.g. industry association)	28	148	200
I work or study at a university	25	70	120
I am a private person	45	45	45
I belong to a Māori organisation	150	150	150
Other (please specify)	47	61	75

The analysis is based on the 'trimmed' medians and 'cleaned' observations. Most responses appear realistic, but some were adjusted for outliers. For example, it is plausible for a student to return a $25/hour rate, but some responses were unrealistic >$1,000/h.

Combining frequency of use (hours spent using S-map), with charge-out rates, provides an 'at least' value for S-map. It assumes that individuals and/or businesses would not undertake the work (using S-map) if they did not get a return on that effort. The return is a function of the direct time-cost (charge out rate multiplied by time).

Using the spatial (regional) and sectoral distribution of users, the frequency of use and charge out rates, we estimate that the value of S-map related work (direct work) is **in the order of $19.5m**. As expected, most (76%) of this value is associated with the regions that have 'good' S-map coverage. A quarter (24%) of the value is associated with areas with low coverage. This highlights the link between the value users derive from S-map and availability. In areas where S-map availability (coverage) is limited, the use values are substantially lower. Figure 6 shows the regional distribution of direct user benefits. Important, the benefits are linked to where users are, not to the areas that are investigated using S-map. It shows that most of the benefits flow to large agriculture-based regions, like the Waikato and Canterbury.

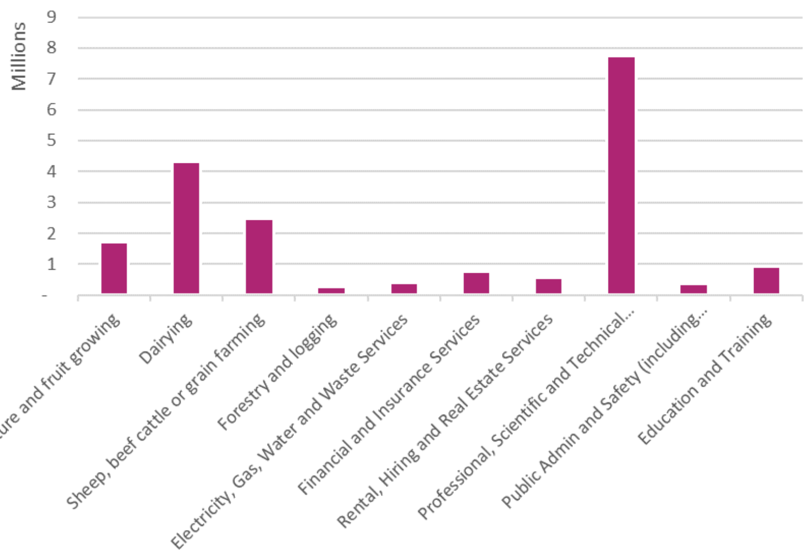
Figure 6: Regional distribution of direct user benefits



Different user groups derive different benefits (value) from S-map. Applying the estimated values across different users on a sectoral basis, provides an ability to estimate the sectoral distribution of values. Figure 7 shows the estimated value per main sector. The sectors are consolidated from the survey.

It is very important to note that the sectoral classification used here shows the 'primary' user and not the 'secondary' user or the client. For example, if a consultancy uses S-map to collect data to run specialist software or models, then that value is recorded under professional, scientific and technical services. Intuitively, a large share of professional services is sold to agriculture. But there are links to non-agricultural activities like construction and planning related activities. These patterns suggest some disconnect between sectors that benefit indirectly from S-map and those using S-map in the first instance.

Figure 7: Value by main sector



Professional, scientific and technical services have the highest level of direct use benefit, valued at $7.7m. This is followed by agricultural activities, specifically dairying ($4.3m), sheep, beef cattle or grain farming ($2.5m) and horticulture and fruit growing ($1.7m). Other sectors with smaller use value are:

- Forestry and logging $0.2m,
- Electricity, Gas, Water and Waste Services $0.4m,
- Financial and Insurance Services $0.8m,
- Rental, Hiring and Real Estate Services $0.6m,
- Public Admin and Safety (including government) $0.4m, and
- Education and Training $0.9m.

Combined, these sectors capture $3.3m of the direct value and this equals 17% of the overall direct use values.

3 Wider roll-out of S-map

Manaaki Whenua Landcare Research are exploring options to expand S-map coverage across a wider area of New Zealand. The specific staging and prioritisation of such a roll-out are unknown. A scenario approach is used to estimate the present value (PV) of the potential use value. The section first provides a summary of the estimated use value of a wider roll-out of S-map, and then the present value of the opportunity is presented.

3.1 Potential value

The potential use value of expanding S-map assumes that the areas that are currently not covered by S-map will see the same use values as the currently covered areas. Appendix 1 reports the spatial distribution of S-map and the percentage of New Zealand's regions that are covered by S-map. The appendix shows the degree to which different farm-types are covered. This is based on a combination of the S-map coverages (GIS-mapping) and Statistics New Zealand's Business Demography Survey that reports the count of businesses, by sector at a meshblock level.

We assumed that if S-map is rolled-out across areas that are currently not covered, then the newly covered areas would see use rates (of S-map) mirroring those of the land-uses (specifically agriculture activities) in other, already covered areas. Using the spatial distribution of S-map across New Zealand as a basis for scaling up the benefits associated with the wider roll-out offers a reasonably firm foundation. Some users are not directly linked to S-map's spatial coverage and it is more difficult to put a definitive estimate on the use values across the non-agriculture sector. Therefore, the survey results are used to inform the scaling. For example, there is a link between professional, scientific and technical services and agriculture and other activities like planning and development (that are associated with public administration and local government) and these relationships were considered. The uplift was based on a weighted approach using both the change in S-map coverage (by region and by sector) and the sectoral relationships revealed in the survey. For sectors with a weak, or no, relationship to agriculture (e.g. electricity and utilities), it was assumed that the change in coverage would result in a shift that equates to a 90% coverage of S-map and the uplift was estimated as the change between the current coverage levels and this new level.

Based on these assumptions, rolling S-map out over the rest of New Zealand will translate into user activity (use values) that is **estimated at $11.8m**. Most of the gains are associated with areas that already have some, but low, S-map coverage. Around 48% of the lift will be in these[12] areas and 29% will be in areas with no coverage (Nelson, Northland and Taranaki). In the areas without any current coverage, the ratios revealed in the other regions were applied to estimate the potential gains. Most of the gains will be in agriculture and professional services. This pattern is a function of land uses and the relationships between other activities (sectors) using S-map.

3.2 Potential value over time

Up to this point, the analysis considered S-map use and the associated values as a single, annual process. But in reality, S-map is an information asset that is used multiple times over consecutive years. Therefore, looking at the values as one-offs will understate the value of rolling out S-map across New Zealand. Using

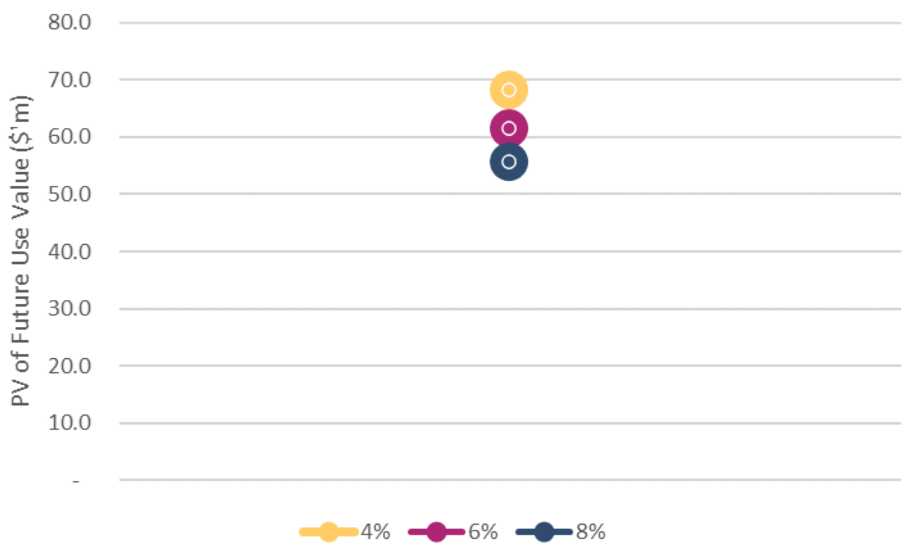
[12] Auckland, Gisborne, Manawatu-Wanganui, Tasman, Wellington, and West Coast.

a scenario, the present value of S-map value over time, is estimated. The scenario is based on several assumptions, including:

- The roll-out and uptake is spread out over five years and is linear,
- The potential value captures up to 80% of the 'new opportunity'. In other words, only 80% of the opportunity associated with the uncovered area is included in the assessment.
- The uptake is homogenous throughout New Zealand, i.e. we do not differentiate between regions and in all regions 80% of new opportunity is captured,
- The assessment considers a 10-year timeframe[13],
- Three discount rates are used. The three rates are 4%, 6% and 8% and they were selected to show the present value under different discounting rates.

The analysis suggests that the direct use value of rolling out S-map over the currently uncovered areas is between $55.5m and $68.1m.

Figure 8: Present Value of Future Use Values (Range); $m



The figure illustrates that rolling out S-map across the rest of New Zealand will unlock new activity, generating value. To put this value in context, the increase is equal to a lift of around 38% of the use values associated with the current coverage.

3.3 Concluding remarks

It is very important to realise that the use values reported in this section are a proxy for the benefit that users derive from S-map. It is the direct benefit, and is based on the value users get from the information in a direct sense. If users do not get 'at least' the stated values, then they would not use S-map. Therefore, these values can be regarded as minimums. It is also very important to bear in mind that in addition to the use benefits, other benefits arise. These wider benefits are discussed in the next section. Quantifying these 'facilitated effects' and benefits are beyond the scope of this project.

[13] This timeframe provides for a total period of 10-years, including an initial 5-year uptake period.

4 Wider benefits

As mentioned, the analysis in this report outlines the direct use values. Information dataset and tools, like S-map assist users to complete analysis to a deeper level. Intuitively, the outcomes of such analysis will deliver higher quality results, be more detailed and provide better contextual information. In turn this should lead to better decisions and improved outcomes. This assumes that decision-makers act on the available information – something that is not a guarantee.

4.1 Links to natural capital

Decision-makers are facing increased scrutiny about the impact of their decisions on the different capitals - natural, social, human and financial (and physical) capital. S-map is a good example of a tool that supports decision-makers. S-map provides information about soil use and management, which farmers and landholders, as well as other users access. S-map has a direct link to natural capital. As illustrated, S-map has very strong links to agriculture and land use. The top ten applications of S-map that get the most use (54%) across all user types, is grouped as follows:

Category	S-map application
Farm management	• Crop/pasture production management decisions or planning (including modelling), • Farm nutrient budget or management models – e.g. OVERSEER®, MitAgator, • Managing nutrient losses, • Fertiliser applications, • Irrigation management, • Farm operational management and planning decisions, • Environmental modelling research and reporting, • Effluent or wastewater management, and • Land use capability mapping.
Natural hazards	• Assessing soil erosion risk.

This points to the fact that S-map is used as an input into many farm processes, directly and indirectly. While there is currently still a lack of research and case studies on measuring the value of information products, several authors have examined the value of making better farming decisions, from various perspectives[14], such as:

- increased productivity,
- reduced inputs (e.g. fertiliser),
- long-term gains through soil conservation, and the like.

Manderson & Palmer (2006) state that if soil information is useful for making better farming decisions, then it should have monetary worth. However, they point out that the value of soil information can be realised only when it is used. Having access to better information does not necessarily lead to better outcomes. For improved outcomes, the decision-maker must act appropriately on the available information. Though technology advances and farm practices have changed over time, the fundamentals of farm management

[14] Giasson, Van Wambeke & Bryant, 2000

remain the same, with decision making at its core. Effective decision-making is crucial for realising the monetary value of information.

A recent study[15] M.E conducted for the Ministry of Transport looked at the benefit of improved pasture management, reduced inputs (e.g. fertiliser) and improved yields. It cited Variable Rate Input Application (VRA) as one example of how costs can be better managed with improved information and applications. In the European context it is suggested VRA could reduce nitrogen application by between 2% and 6% and improve (reduce) nitrogen-leaching by 5% to 20%. In the NZ context, the saving from more efficient/better targeted fertiliser application was estimated to be in the order of \$11m per year (\$3,000-\$3,900 per farm), across all dairy farms in NZ. Assuming S-map can be applied in this context and that it adds to the change in farming practices, to reduce input costs, then it would deliver a series of benefits. Some of these benefits are linked to reducing input costs (less chemicals used). Over 10-years, the present value of such a saving is put between \$84.8m and \$100.2m. In turn, this will have wider ecological benefits that will lift the total monetary (and non-monetary) values. Clearly, S-map's value is not the entire saving because it is not plausible to attribute 100% of this value to S-map; but it can make an important contribution. Hypothetically, **attributing 5% of the gains to S-map suggests that it delivers \$550,000 per year, or between \$4.2m and \$5.0m over 10 years.**

What is clear from the literature is that soil use and management decisions that farmers make every day, ultimately determines the sustainability of agriculture, and soil survey information is a valuable tool in the decision-making process. Soil information is also required by those who influence or inform farm decision making, such as policymakers and consultants. But, simply having access to the information is no guarantee that optimal outcomes/decisions will be achieved – the information must be used and acted upon.

Reliable information and data are important for environmental monitoring, geotechnical modelling (assessing erosion and flood risk) and the like. Erosion control is another example where S-map users can influence processes with wide benefits. To put the scale of this potential gain in context, the Ministry for Primary Industries states that erosion and its effects – lost soil, nutrients and production, damage to trees, houses, infrastructure, and waterways – in hill country areas alone are estimated to cost New Zealand's economy **\$100 million to \$150 million a year[16]. Over 10-years, this equals between \$963.8m and \$1.1bn. The potential of using S-map to better manage these costs is unknown, but if using S-map leads to a 1% saving, then S-map's value is between \$9.6m and \$11.4m per year.**

A separate study for the Ministry for the Environment[17] quotes research highlighting the annual cost of soil erosion and sedimentation. It emphasises the uncertainty associated with the modelling work. But, the authors have attempted to err on the conservative side with their estimates, so the value could be higher than the mean estimate of \$127m. This figure is a 2001 estimate and updating it for inflation to 2019 \$-values, suggests that the value is in the order \$175m. Furthermore, the highest component of costs is lost agricultural production, estimated at \$51m (2019 value). Importantly, the savings reflect the outcome of a range of actions, and not just the availability and use of S-map.

Looking forward, climate change will change the frequency and severity/intensity of storms in some areas and result in drier conditions in other areas. Both trends would increase lost agricultural production from mass movement in hill country and surface erosion, respectively. S-map has a role to play in responding to

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[15] Drones: Benefits study. 2019. A report by Market Economics for NZ Ministry of Transport. Retrieved September 4, 2019, from https://www.transport.govt.nz/air/unmanned-aircraft-systems-or-drones/drone-benefit-study/

[16] https://www.mpi.govt.nz/news-and-resources/media-releases/34-million-for-more-erosion-control-work-over-next-4-years/

[17] Blaschke P, Hicks D, Meister A. 2008. Quantification of the flood and erosion reduction benefits, and costs, of climate change mitigation measures in New Zealand. Report prepared by Blaschke and Rutherford Environmental Consultants for MfE. Wellington: Ministry for the Environment. iv + 76 p.

these pressures, protecting the natural capital and enhancing the response to climate change (i.e. lifting resilience).

Fresh water contributes to the economy and is valued by New Zealanders. But, there is limited research outlining in $-terms (or non-monetary terms) what the value of freshwater quality is. It has cultural, social, economic and recreational values and maintaining and improving water quality are two key government priorities. The link between land use and freshwater quality is well researched.

S-map data has a natural fit with land-use management, and we understand that S-map makes an important contribution to land use management approaches. Unfortunately, there is limited information available about the benefits (in $-terms) that would arise from improved management on water quality values. This makes it difficult to put an illustrative value of S-map's potential role, but it is expected to be material.

Drawing on historic studies, the potential size of the values can be identified. An indicative example is Lake Taupo, where the community (through Central, regional and district public funding) have paid $89m to landowners to reduce nitrogen discharges[18] by 170 tonnes per year, with the aim to improve water quality in the lake[19]. This clearly illustrates the value the Taupo community assigns to water quality.

Work by Carrick, Vesely and Hewsitt (2010)[20] estimated the value of nitrogen removal at $21.80/kgN/yr (in 2010, so $25.10/kgN/yr in 2019 terms). The authors calculate nitrogen discharge from the different soil types[21], and they highlight the link with soil information as a key input that influences nitrogen discharge estimates. The Overseer model also recognises this link[22]. A hypothetical scenario is used to illustrate the value of soil information (from S-map) to nitrogen management. **Drawing from the Lake Taupo example, and assuming that soils information is used to (and contributes to) reduce nitrogen use and leaching, then reducing nitrogen discharge to water could be between $43m and $87m.** This is an avoided cost, so a benefit. That is based on[23] only half of current users (by area coverage) getting a saving of between 0.25kgN/ha/y and 0.5kgN/ha/y. The estimated $-values would increase if the underlying conservative assumptions are adjusted to reflect a less conservative position. **It is very important to note that the avoided cost reflect the nitrogen that is not discharged/leached, it does not reflect the value of better water quality arising from less nitrogen in the environment. There will be other improvements like enhanced eco-system services, improved cultural and societal values arising from better water quality.**

4.2 Concluding remarks

S-map is a valuable resource enabling users to undertake research and modelling work that would be difficult to undertake in the absence of the information. The survey illustrates the mix of users, with a large portion of private users – either a private business or landowners. This suggests that most of the immediate use benefits will accrue to private users. It is not difficult to foresee a situation where requests for additional funding are responded to by using user-pays arguments. But, it is worth noting the wider benefits – facilitated benefits as well as avoided costs – of S-map are mostly public benefits, i.e. benefits

[18] Nitrogen discharge is directly linked to water quality.

[19] Organisation for Economic Cooperation and Development. OECD Environment Policy Paper. The Lake Taupo Nitrogen Market in New Zealand. A review for policy makers. September 2015. No 4.

[20] Carrick, A. Vesely, E. Hewitt, A. 19th World Conference of Soil Science, Soil Solutions for a Changing World. Economic value of improved soil natural capital assessment: A case study on nitrogen leaching. 1-6 August. Brisbane.

[21] We understand that this was based on actual measurements of N-leaching from different soil types in Southland.

[22] OVERSEER Best Practise Data Input Standards. Version 6.2.0 April 2015.

[23] Information received from Landcare.

that will accrue to the wider public and society. For example, reducing erosion and sedimentation has wider eco-system service effects that are not 'gained' by one specific entity. Instead, those benefits accrue to New Zealand. While these public benefits are only covered at a very high level, they are likely to be substantial. But, linking S-map and soil information to these benefits and claiming that S-map is the 'only reason' for the benefits manifesting would be inappropriate and misleading. The true benefits arise from having the good quality information and acting appropriately on that information. The scale of the public benefits is evident and using the two examples[24] shows that the potential wider (non-user) benefits of S-map could be greater than $16m/year. If the potential gains arising from water quality is included, then the value will be even higher. Based on the lower estimate of $43m, suggests that the potential value could be up to $59m/year.

[24] Improved fertiliser management and lower erosion and sedimentation.

Appendix 1: Spatial coverage

Region	% of Region	% of farms				
		Horticulture and fruit growing	Dairy cattle farming	Sheep, beef cattle and grain farming	Forestry and logging	Poultry, deer and other livestock farming
Auckland	**29%**	37%	45%	40%	25%	33%
Bay of Plenty	**59%**	99%	96%	97%	94%	97%
Canterbury	**46%**	93%	94%	88%	77%	93%
Gisborne	**23%**	75%	34%	35%	42%	48%
Hawke's Bay	**98%**	93%	92%	96%	91%	85%
Manawatu-Wanganui	**19%**	11%	25%	20%	17%	15%
Marlborough	**25%**	75%	24%	36%	18%	40%
Nelson	**0%**	0%	0%	0%	0%	0%
Northland	**0%**	7%	1%	1%	0%	1%
Otago	**26%**	58%	83%	62%	58%	65%
Southland	**22%**	59%	82%	74%	53%	70%
Taranaki	**0%**	0%	0%	0%	0%	0%
Tasman	**26%**	18%	28%	38%	30%	32%
Waikato	**72%**	82%	83%	74%	83%	79%
Wellington	**26%**	68%	68%	42%	17%	39%
West Coast	**7%**	38%	20%	21%	32%	15%
Total NZ	**34%**	**68%**	**59%**	**57%**	**45%**	**59%**

Source: M.E calculations based on Manaaki Whenua Landcare Research; Business Demography Survey (Stats NZ)

Appendix 2: Survey Tables

Survey respondents by type and sector

User type	Horticulture and fruit growing	Dairying	Sheep, beef cattle or grain farming	Forestry and logging	Electricity, Gas, Water and Waste Services	Financial and Insurance Services	Rental, Hiring and Real Estate Services	Professional, Scientific and Technical Services	Admin and Supt Services	Public Admin, Safety (incl govt)	Education and Training	Other	Total
I work for central government (ministry or department)	2	1	-	1	-	-	1	4	-	3	-	7	19
I work for local government (unitary authority, regional/district council)	3	2	4	-	4	-	-	23	-	11	1	19	67
I work for a research organisation	8	5	8	5	1	1	-	26	-	-	-	11	65
I work for a private business	59	56	27	17	15	17	17	199	1	-	5	88	501
I am a land owner (e.g. farmer or lifestyle property)	56	37	48	2	-	-	1	6	-	-	2	23	175
I belong to a special interest group (e.g. industry association)	5	10	5	-	-	-	-	4	-	-	-	14	38
I work or study at a university	8	6	6	5	1	-	-	13	1	-	39	26	105
I am a private person	7	3	3	-	-	-	1	8	1	-	1	9	33
I belong to a Māori organisation	3	2	-	-	-	-	-	-	-	1	-	1	7
Other (please specify)	-	-	-	-	-	-	-	1	-	-	-	3	4
Total	151	122	101	30	21	18	20	284	3	15	48	201	1,014
I work for central government (ministry or department)	11%	5%	0%	5%	0%	0%	5%	21%	0%	16%	0%	37%	100%
I work for local government (unitary authority, regional/district council)	4%	3%	6%	0%	6%	0%	0%	34%	0%	16%	1%	28%	100%
I work for a research organisation	12%	8%	12%	8%	2%	2%	0%	40%	0%	0%	0%	17%	100%
I work for a private business	12%	11%	5%	3%	3%	3%	3%	40%	0%	0%	1%	18%	100%
I am a land owner (e.g. farmer or lifestyle property)	32%	21%	27%	1%	0%	0%	1%	3%	0%	0%	1%	13%	100%
I belong to a special interest group (e.g. industry association)	13%	26%	13%	0%	0%	0%	0%	11%	0%	0%	0%	37%	100%
I work or study at a university	8%	6%	6%	5%	1%	0%	0%	12%	1%	0%	37%	25%	100%
I am a private person	21%	9%	9%	0%	0%	0%	3%	24%	3%	0%	3%	27%	100%
I belong to a Māori organisation	43%	29%	0%	0%	0%	0%	0%	0%	0%	14%	0%	14%	100%
Other (please specify)	0%	0%	0%	0%	0%	0%	0%	25%	0%	0%	0%	75%	100%

Importance of S-map as input (by user type)

Importance of S-map as input	Not important		Neutral		Very important	
User type	**1**	**2**	**3**	**4**	**5**	**Total**
I work for central government (ministry or department)	4	1	1	8	1	**15**
I work for local government (unitary authority, regional/district council)	-	7	7	20	8	**42**
I work for a research organisation	1	3	7	23	11	**45**
I work for a private business	14	31	89	159	79	**372**
I am a land owner (e.g. farmer or lifestyle property)	18	15	33	39	11	**116**
I belong to a special interest group (e.g. industry association)	-	1	7	9	13	**30**
I work or study at a university	3	7	18	30	11	**69**
I am a private person	3	-	6	4	1	**14**
I belong to a Māori organisation	-	1	-	2	1	**4**
Other (please specify)	-	-	2	-	-	**2**
Total	**43**	**66**	**170**	**294**	**136**	**709**
	1	**2**	**3**	**4**	**5**	**Weighted ave**
I work for central government (ministry or department)	27%	7%	7%	53%	7%	3.1
I work for local government (unitary authority, regional/district council)	0%	17%	17%	48%	19%	3.7
I work for a research organisation	2%	7%	16%	51%	24%	3.9
I work for a private business	4%	8%	24%	43%	21%	3.7
I am a land owner (e.g. farmer or lifestyle property)	16%	13%	28%	34%	9%	3.1
I belong to a special interest group (e.g. industry association)	0%	3%	23%	30%	43%	4.1
I work or study at a university	4%	10%	26%	43%	16%	3.6
I am a private person	21%	0%	43%	29%	7%	3.0
I belong to a Māori organisation	0%	25%	0%	50%	25%	3.8
Other (please specify)	0%	0%	100%	0%	0%	3.0
Whole sample	6%	9%	24%	41%	19%	3.6

Users' level of soil expertise (by user type)

Soil expertise	Limited knowledge				Very experienced	
User type	**1**	**2**	**3**	**4**	**5**	**Total**
I work for central government (ministry or department)	6	2	5	2	4	**19**
I work for local government (unitary authority, regional/district council)	13	11	21	12	10	**67**
I work for a research organisation	6	8	22	11	18	**65**
I work for a private business	69	90	155	115	72	**501**
I am a land owner (e.g. farmer or lifestyle property)	45	34	46	33	17	**175**
I belong to a special interest group (e.g. industry association)	5	4	9	12	8	**38**
I work or study at a university	23	20	23	23	16	**105**
I am a private person	10	4	10	7	2	**33**
I belong to a Māori organisation	2	4	-	1	-	**7**
Other (please specify)	2	1	-	1	-	**4**
Total	**181**	**178**	**291**	**217**	**147**	**1,014**
	1	**2**	**3**	**4**	**5**	**Weighted ave**
I work for central government (ministry or department)	32%	11%	26%	11%	21%	2.8
I work for local government (unitary authority, regional/district council)	19%	16%	31%	18%	15%	2.9
I work for a research organisation	9%	12%	34%	17%	28%	3.4
I work for a private business	14%	18%	31%	23%	14%	3.1
I am a land owner (e.g. farmer or lifestyle property)	26%	19%	26%	19%	10%	2.7
I belong to a special interest group (e.g. industry association)	13%	11%	24%	32%	21%	3.4
I work or study at a university	22%	19%	22%	22%	15%	2.9
I am a private person	30%	12%	30%	21%	6%	2.6
I belong to a Māori organisation	29%	57%	0%	14%	0%	2.0
Other (please specify)	50%	25%	0%	25%	0%	2.0
Whole sample	18%	18%	29%	21%	14%	3.0

Frequency of use: Private sector users

Users who work for a private business (private sector)	Every week	1 to 3 times per month	Once every 2 months	Once every quarter	Once every 6 months	Once per year	Total	%	Every week	1 to 3 times per month	Once every 2 months	Once every quarter	Once every 6 months	Once per year
Assessing the suitability of land for urban or rural residential devt	9	28	16	11	13	18	95	4%	9%	29%	17%	12%	14%	19%
Assessing soil erosion risk	11	23	30	22	17	23	126	5%	9%	18%	24%	17%	13%	18%
Catchment hydrological modelling	13	18	16	14	9	16	86	3%	15%	21%	19%	16%	10%	19%
Crop/pasture productn managmt decisions or planning (incl modelling)	16	38	32	24	20	22	152	6%	11%	25%	21%	16%	13%	14%
Data mining or deriving new information	1	7	1	10	6	4	29	1%	3%	24%	3%	34%	21%	14%
Economic modelling and studies	1	4	7	6	5	9	32	1%	3%	13%	22%	19%	16%	28%
Effluent or waste water management	15	45	19	19	15	15	128	5%	12%	35%	15%	15%	12%	12%
Environmental modelling research and reporting	15	32	18	11	15	10	101	4%	15%	32%	18%	11%	15%	10%
Fertiliser applications	16	31	23	16	12	21	119	5%	13%	26%	19%	13%	10%	18%
Flood protection or catchment works	3	14	9	9	7	9	51	2%	6%	27%	18%	18%	14%	18%
Training, teaching or educational purposes (academic and vocational)	0	8	6	6	6	2	28	1%	0%	29%	21%	21%	21%	7%
Geotechnical surveys	4	15	9	14	8	10	60	2%	7%	25%	15%	23%	13%	17%
Informing regulatory work/policy devt (e.g. national policies, regulations,	1	9	9	7	5	8	39	2%	3%	23%	23%	18%	13%	21%
Informing land use change processes (e.g. irrigation)	6	28	14	11	8	12	79	3%	8%	35%	18%	14%	10%	15%
Informing planning processes (e.g. subdivisions)	3	16	12	7	10	7	55	2%	5%	29%	22%	13%	18%	13%
Infrastructure planning (e.g. transport, utility)	2	10	14	6	10	3	45	2%	4%	22%	31%	13%	22%	7%
Irrigation management	16	38	22	28	14	22	140	6%	11%	27%	16%	20%	10%	16%
Land and property sales (e.g. pre-purchasing assessments)	22	33	17	9	8	13	102	4%	22%	32%	17%	9%	8%	13%
Land use capability mapping	14	30	22	21	17	22	126	5%	11%	24%	17%	17%	13%	17%
Managing nutrient losses	24	38	28	25	10	20	145	6%	17%	26%	19%	17%	7%	14%
Managing sediment erosion or sediment runoff	11	23	22	17	13	13	99	4%	11%	23%	22%	17%	13%	13%
Official statistics (National Greenhouse Gas Inventory, National System	0	0	0	0	1	0	1	0%	0%	0%	0%	0%	100%	0%
Farm nutrient budget or management models – e.g. OVERSEER®, Mi	35	43	22	20	10	12	142	6%	25%	30%	15%	14%	7%	8%
Farm operational management and planning decisions	15	31	18	15	12	17	108	4%	14%	29%	17%	14%	11%	16%
Preparing, updating or auditing farm environment plans	15	24	16	11	6	26	98	4%	15%	24%	16%	11%	6%	27%
Providing professional advice (excluding the models mentioned earlier)	15	25	16	17	9	4	86	3%	17%	29%	19%	20%	10%	5%
Research (experimental, fundamental or student level)	3	7	5	7	7	5	34	1%	9%	21%	15%	21%	21%	15%
Resource consent applications (preparing, auditing etc)	10	32	34	18	13	13	120	5%	8%	27%	28%	15%	11%	11%
State of environment monitoring	0	4	5	4	2	5	20	1%	0%	20%	25%	20%	10%	25%
Transport or utility infrastructure planning	1	5	4	5	3	0	18	1%	6%	28%	22%	28%	17%	0%
	297	659	466	390	291	361	2464							

Frequency of use: Landowners

Landowners (e.g. farmers or lifestyle property)	Every week	1 to 3 times per month	Once every 2 months	Once every quarter	Once every 6 months	Once per year	Total	%	Every week	1 to 3 times per month	Once every 2 months	Once every quarter	Once every 6 months	Once per year
Assessing the suitability of land for urban or rural residential devt	0	1	1	1	6	7	16	2%	0%	6%	6%	6%	38%	44%
Assessing soil erosion risk	0	2	2	8	7	21	40	5%	0%	5%	5%	20%	18%	53%
Catchment hydrological modelling	1	0	0	1	2	5	9	1%	11%	0%	0%	11%	22%	56%
Crop/pasture productn managmt decisions or planning (incl modelling)	3	4	5	14	23	40	89	11%	3%	4%	6%	16%	26%	45%
Data mining or deriving new information	0	0	0	0	1	3	4	1%	0%	0%	0%	0%	25%	75%
Economic modelling and studies	0	2	0	0	2	1	5	1%	0%	40%	0%	0%	40%	20%
Effluent or waste water management	4	2	3	3	5	19	36	5%	11%	6%	8%	8%	14%	53%
Environmental modelling research and reporting	0	0	0	2	5	14	21	3%	0%	0%	0%	10%	24%	67%
Fertiliser applications	2	3	5	6	20	43	79	10%	3%	4%	6%	8%	25%	54%
Flood protection or catchment works	0	2	0	1	3	10	16	2%	0%	13%	0%	6%	19%	63%
Training, teaching or educational purposes (academic and vocational)	0	1	0	1	2	2	6	1%	0%	17%	0%	17%	33%	33%
Geotechnical surveys	0	0	0	0	3	4	7	1%	0%	0%	0%	0%	43%	57%
Informing regulatory work/policy devt (e.g. national policies, regulations,	0	2	0	0	0	3	5	1%	0%	40%	0%	0%	0%	60%
Informing land use change processes (e.g. irrigation)	1	0	0	1	2	15	19	2%	5%	0%	0%	5%	11%	79%
Informing planning processes (e.g. subdivisions)	0	0	0	1	1	5	7	1%	0%	0%	0%	14%	14%	71%
Infrastructure planning (e.g. transport, utility)	0	0	0	0	2	3	5	1%	0%	0%	0%	0%	40%	60%
Irrigation management	2	3	3	2	6	28	44	6%	5%	7%	7%	5%	14%	64%
Land and property sales (e.g. pre-purchasing assessments)	1	4	2	4	5	21	37	5%	3%	11%	5%	11%	14%	57%
Land use capability mapping	0	5	0	4	6	21	36	5%	0%	14%	0%	11%	17%	58%
Managing nutrient losses	0	2	3	8	12	27	52	7%	0%	4%	6%	15%	23%	52%
Managing sediment erosion or sediment runoff	1	0	1	4	9	16	31	4%	3%	0%	3%	13%	29%	52%
Official statistics (National Greenhouse Gas Inventory, National System	0	0	0	0	0	1	1	0%	0%	0%	0%	0%	0%	100%
Farm nutrient budget or management models – e.g. OVERSEER®, Mi	0	3	4	4	24	31	66	8%	0%	5%	6%	6%	36%	47%
Farm operational management and planning decisions	4	2	8	11	13	35	73	9%	5%	3%	11%	15%	18%	48%
Preparing, updating or auditing farm environment plans	0	0	2	3	9	34	48	6%	0%	0%	4%	6%	19%	71%
Providing professional advice (excluding the models mentioned earlier)	1	1	0	0	2	0	4	1%	25%	25%	0%	0%	50%	0%
Research (experimental, fundamental or student level)	0	2	0	2	4	0	8	1%	0%	25%	0%	25%	50%	0%
Resource consent applications (preparing, auditing etc)	0	0	2	1	0	13	16	2%	0%	0%	13%	6%	0%	81%
State of environment monitoring	0	2	1	1	1	2	7	1%	0%	29%	14%	14%	14%	29%
Transport or utility infrastructure planning	0	0	0	0	0	0	0	0%	0%	0%	0%	0%	0%	0%
	20	43	42	83	175	424	787							

Frequency of use: Government workers (local and central government)

Users who work for local and central government workers	Every week	1 to 3 times per month	Once every 2 months	Once every quarter	Once every 6 months	Once per year	Total	%	Every week	1 to 3 times per month	Once every 2 months	Once every quarter	Once every 6 months	Once per year
Assessing the suitability of land for urban or rural residential devt	4	4	6	5	3	6	28	7%	14%	14%	21%	18%	11%	21%
Assessing soil erosion risk	3	8	5	8	5	6	35	9%	9%	23%	14%	23%	14%	17%
Catchment hydrological modelling	2	2	6	6	4	5	25	6%	8%	8%	24%	24%	16%	20%
Crop/pasture productn managmt decisions or planning (incl modelling)	2	3	2	3	1	5	16	4%	13%	19%	13%	19%	6%	31%
Data mining or deriving new information	1	1	2	2	2	2	10	3%	10%	10%	20%	20%	20%	20%
Economic modelling and studies	0	0	1	1	1	0	3	1%	0%	0%	33%	33%	33%	0%
Effluent or waste water management	3	7	4	4	4	3	25	6%	12%	28%	16%	16%	16%	12%
Environmental modelling research and reporting	1	5	4	3	6	7	26	7%	4%	19%	15%	12%	23%	27%
Fertiliser applications	2	2	0	2	1	1	8	2%	25%	25%	0%	25%	13%	13%
Flood protection or catchment works	1	2	2	3	2	3	13	3%	8%	15%	15%	23%	15%	23%
Training, teaching or educational purposes (academic and vocational)	1	2	1	2	1	1	8	2%	13%	25%	13%	25%	13%	13%
Geotechnical surveys	0	0	0	0	0	3	3	1%	0%	0%	0%	0%	0%	100%
Informing regulatory work/policy devt (e.g. national policies, regulations,	3	4	2	3	6	8	26	7%	12%	15%	8%	12%	23%	31%
Informing land use change processes (e.g. irrigation)	1	6	4	1	5	4	21	5%	5%	29%	19%	5%	24%	19%
Informing planning processes (e.g. subdivisions)	2	8	2	4	1	4	21	5%	10%	38%	10%	19%	5%	19%
Infrastructure planning (e.g. transport, utility)	0	1	2	4	3	7	17	4%	0%	6%	12%	24%	18%	41%
Irrigation management	2	5	0	3	0	4	14	4%	14%	36%	0%	21%	0%	29%
Land and property sales (e.g. pre-purchasing assessments)	0	3	1	5	0	0	9	2%	0%	33%	11%	56%	0%	0%
Land use capability mapping	4	3	3	10	3	7	30	8%	13%	10%	10%	33%	10%	23%
Managing nutrient losses	4	5	3	1	5	5	23	6%	17%	22%	13%	4%	22%	22%
Managing sediment erosion or sediment runoff	8	4	1	6	3	3	25	6%	32%	16%	4%	24%	12%	12%
Official statistics (National Greenhouse Gas Inventory, National System	0	1	0	2	1	1	5	1%	0%	20%	0%	40%	20%	20%
Farm nutrient budget or management models – e.g. OVERSEER®, Mi	5	5	2	2	5	7	26	7%	19%	19%	8%	8%	19%	27%
Farm operational management and planning decisions	1	2	2	4	0	3	12	3%	8%	17%	17%	33%	0%	25%
Preparing, updating or auditing farm environment plans	3	3	6	2	0	1	15	4%	20%	20%	40%	13%	0%	7%
Providing professional advice (excluding the models mentioned earlier)	3	3	3	2	2	2	15	4%	20%	20%	20%	13%	13%	13%
Research (experimental, fundamental or student level)	2	2	1	2	3	2	12	3%	17%	17%	8%	17%	25%	17%
Resource consent applications (preparing, auditing etc)	3	11	1	5	1	6	27	7%	11%	41%	4%	19%	4%	22%
State of environment monitoring	1	2	2	2	4	8	19	5%	5%	11%	11%	11%	21%	42%
Transport or utility infrastructure planning	0	0	0	3	1	5	9	2%	0%	0%	0%	0%	0%	0%
	62	104	68	100	73	119	526							