Land Information New Zealand
Toitū te whenua

positioNZ

Report for the GNSS/GPS Customer Survey 2015

National Geodetic Office

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Contents

1 Introduction 3

1.1 Aim of Survey 3
1.2 Background 3
1.3 Key Findings 3
1.4 Survey Overview: 4
1.5 Acknowledgement 4
1.6 Disclaimer 4

2 Detailed findings and analysis 5

2.1 Demographics of GNSS/GPS users (Questions 1 and 13) 5
2.2 Frequency of use for GNSS/GPS technology (Question 2) 7
2.3 LINZ products and services (Question 7) 8
2.4 Level of agreement of RINEX data statements (Question 8) 9
2.5 Satisfaction of PositioNZ-RT (Question 9) 11
2.5.1.1 Network Coverage 11
2.5.1.2 Uptime and data completeness 12
2.5.1.3 Timeliness for real time data 12
2.6 Use of real time data and services (Question 10) 14
2.7 Multi-GNSS usage and uptake (Question 3, 4 and 5) 15
2.8 Website content and communication (Question 6) 16
2.8.1 Common themes: 16
2.9 PositioNZ-PP enhancements (Question 11) 18
2.10 Webpage with CORS information (Question 12) 19
2.11 General comments and feedback (Question 14) 20

3 Possible Future Actions 22

1 Introduction

1.1 Aim of Survey

To gauge how our customers are using GNSS/GPS technologies as well as their current use and perceptions of the products and services provided by the PositioNZ network. The results of the survey will aid decisions on how the network may be developed to cater for customers needs now and into the future.

1.2 Background

The PositioNZ network was commissioned by LINZ and developed in partnership with GNS Science (GeoNet) from 2002. The network's primary purpose is to monitor NZGD2000's relationship to international reference frames and monitor land deformation at a national level across New Zealand. Static data in the form of RINEX is collected for use by LINZ but is made freely available to the GNSS/GPS community. In 2010, LINZ commissioned the PositioNZ Real Time Service (PositioNZ-RT). This service provides real time GPS and GLONASS data from 35 PositioNZ stations in New Zealand as well as Chatham Island. PositioNZ post processing service (PositioNZ-PP) was also released in late 2014.

GNSS/GPS customer surveys provide insight into how the network is used and what our customer's perceptions are of the products and services available from the network. A baseline GNSS/GPS survey was completed in 2012 with 110 respondents. This follow up survey asked a number of the same questions as well as a few more specific questions related to the development and use of PositioNZ products and services. Since the network was commissioned there has been an uptake in the use of multi-GNSS technologies and LINZ is looking at how it might develop the network to include these new constellations.

LINZ plans to investigate the need for a CORS portal or website for all government and non-government owned CORS stations within New Zealand. The survey was also an opportunity to gauge whether this would be of use to the GNSS/GPS community.

1.3 Key Findings

- Surveyors are still the main users of GNSS/GPS with at least 60% of survey respondents identifying as surveyors.
- The PositioNZ network is used all over the country. Auckland and Christchurch have the highest numbers of users
- Multi-GNSS is increasingly being used, and within 18 months it is anticipated that approximately 60% of GPS/GNSS community will be using multi-GNSS over GPS and GLONASS; with an anticipated increase to 85% over the next 5 years.
- The frequency of the use of GNSS/GPS has increased since 2012. It appears many weekly GNSS/GPS users have increased their usage to daily.
- RINEX3 or multi-GNSS data would be useful to the majority of RINEX users/customers.
- Additional timestamped metadata would be useful to RINEX users.
- Users/customers would like LINZ to provide better network coverage for PositioNZ-RT; providing better access to GeoNet stations would improve PositioNZ coverage.
- There is still a preference for real time users to use their own base station over subscribing to a paid real time network service.
- Many PositioNZ customers/users do not find the Twitter notifications useful and would prefer another method for LINZ to communicate network maintenance or station outages.
- A webpage with all CORS in New Zealand would be useful

1.4 Survey Overview:

The survey was open for 1 month between 1 October – 2 November 2015 and was available online utilising the Survey Monkey tool.

Emails or articles promoting the survey were sent through the following:

- Email to registered PositioNZ-RT users (259 users)
- Notice in Landwrap
- Notice in the NZIS Newslink
- Presentation on PositioNZ at the NZIS Conference
- Posted on the Positioning Stream group on LinkedIn
- Link available on LINZ website through PositioNZ and Geodetic Database pages
- Email to private CORS operators, also requesting they send to their customers

The survey received 118 responses.

1.5 Acknowledgement

Thank you to all those who took the time to respond to this survey. The feedback received has been of value and will assist in future decisions relating to the PositioNZ network.

1.6 Disclaimer

This report compiles responses and general views of our customers. This is informative only and LINZ has not obligated to act upon any of the suggestions. The majority of respondents will be LINZ customers and as a result the conclusions drawn may not be reflective of the entire GNSS/GPS user community in New Zealand.

2 Detailed findings and analysis

This section analyses each question within the survey.

2.1 Demographics of GNSS/GPS users (Questions 1 and 13)

Figure 1 shows that LINZ's major customer base is still surveying with 60% of the respondents identifying as surveyors, this is down from 79% in 2012, however, over the last three years there is an apparent increase in other areas utilising this technology. The next largest area is Education and Research with 10%. The increase in non-survey users could be a result of requiring registration for the PositioNZ-RT in October 2013, making it easier to identity those customers.

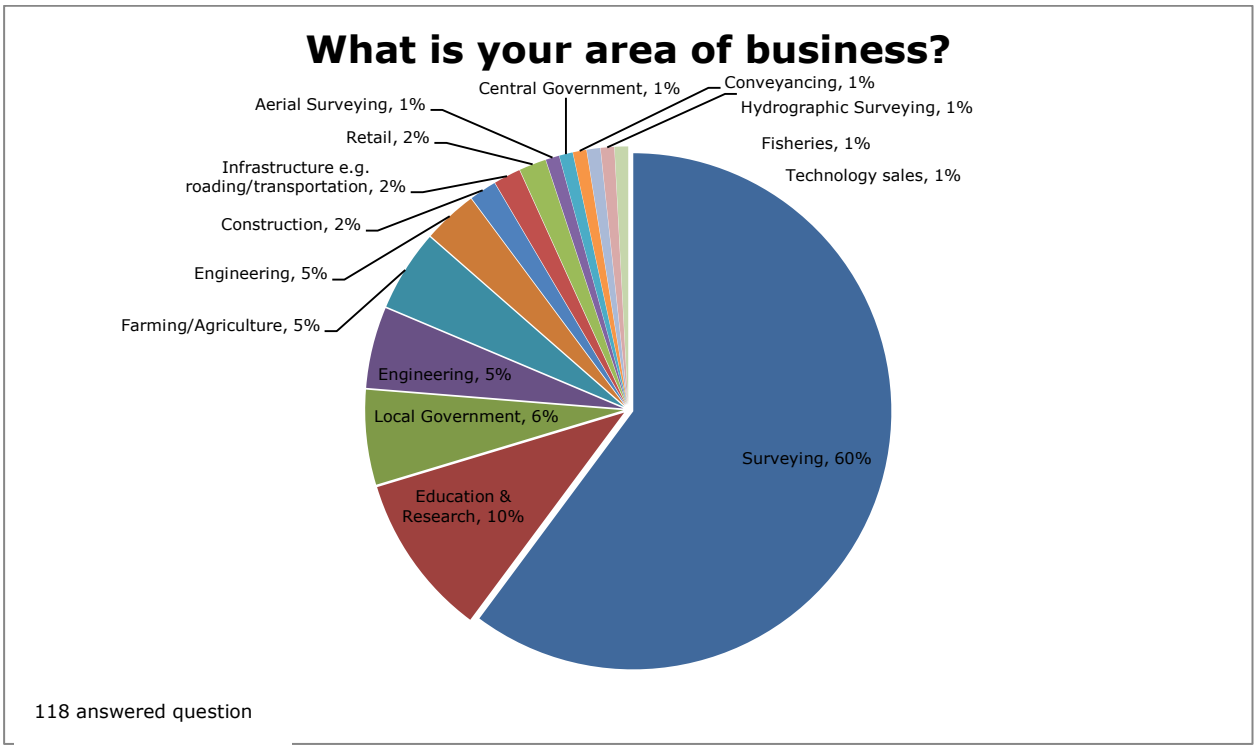


Figure 1: graph for Question 1

The results from Question 13 (Figure 2) shows that LINZ GNSS/GPS customers are located all over the country with the largest customer bases located in Auckland (20%) and Christchurch (17%). It is interesting to note that 11% of respondents work nationwide and no customers from Gisborne and Hawke's Bay regions answered the survey.

This question was not asked in 2012 for comparison.

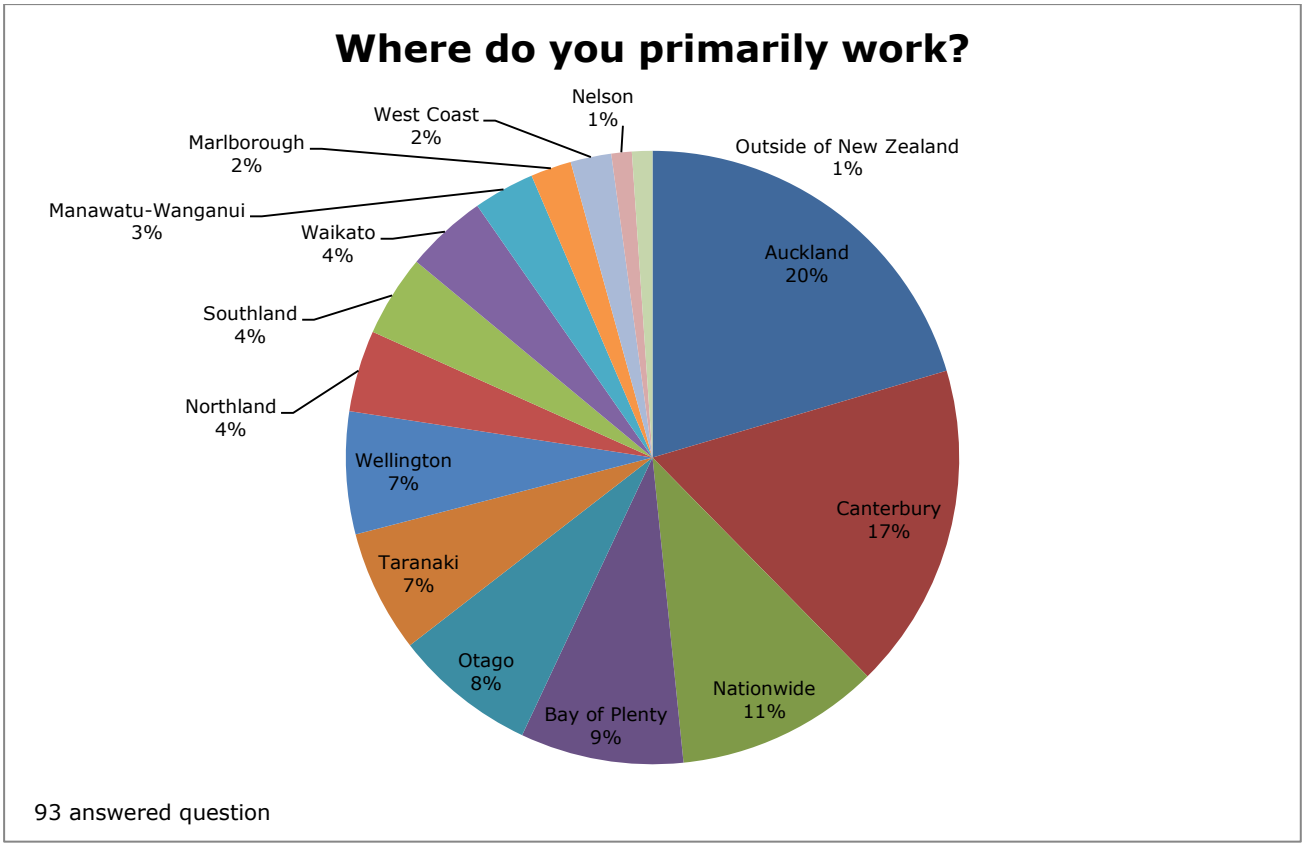


Figure 2: graph for Question 13

2.2 Frequency of use for GNSS/GPS technology (Question 2)

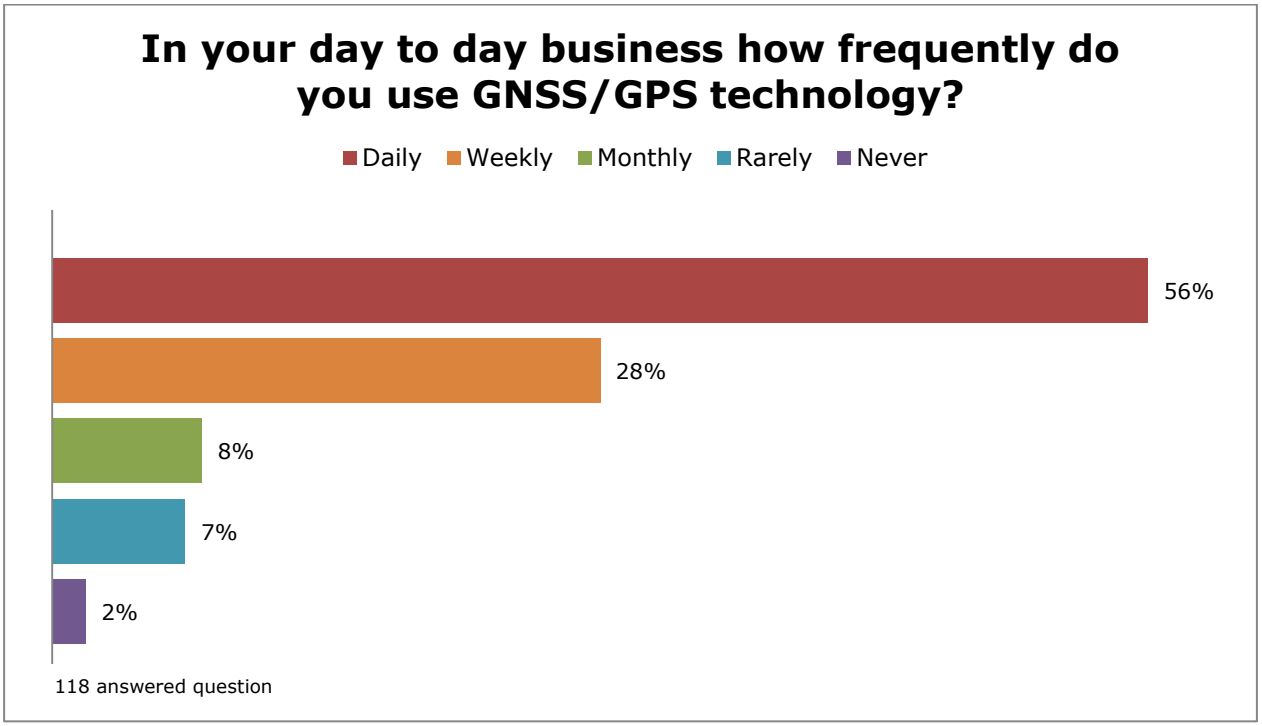


Figure 3: results for Question 2

84% of respondents use GNSS/GPS technologies at least weekly. This is comparable to 2012 where 80% used GNSS/GPS at least weekly (daily + weekly); many of the weekly users have increases their usage to daily. Daily usage has increased from 42% to 56% between 2012 and 2015 while monthly usage has decrease from 43% to 28% during the same period.

This shows that LINZ customers are using GNSS/GPS technology on a more regular basis than they were in 2012.

2.3 LINZ products and services (Question 7)

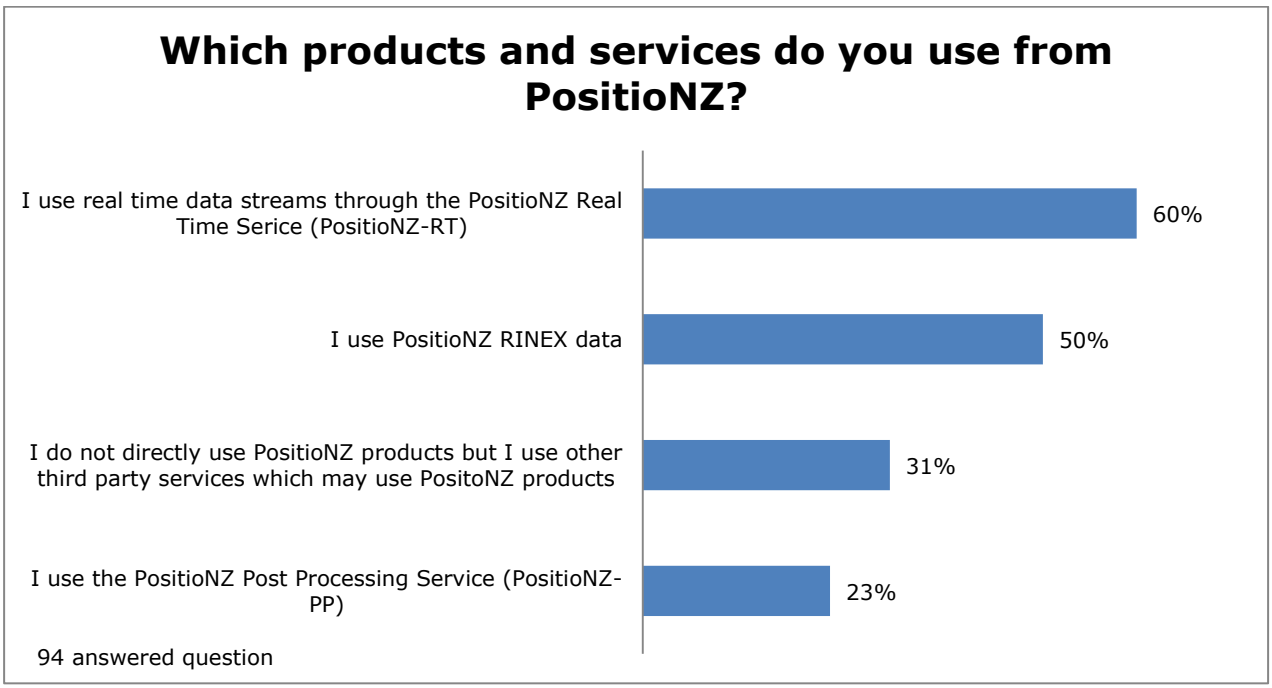


Figure 4: results for Question 7

Figure 4 shows that the most used product or service is PositioNZ-RT where 60% (58 of the respondents) use the service. 50% (47) use RINEX data and 31% (27) use LINZ products through a third party (it is unlikely that this survey will have fully reached this customers base). Only 23% (22) use PositioNZ-PP.

In 2012, 50% (49) used PositioNZ-RT and 42% (41) used RINEX data, both have increased by approximately 10%.

Other points to note not shown by graph:

- 31% (29) of respondents use both the RINEX and PositioNZ-RT, the two main products and services that LINZ provides.
- 28% (26) of respondents only use PositioNZ-RT compared to only 14% (13) using RINEX alone. This suggests that real time methods are used more often than post processing methods.
- 18 % (17) do not directly use LINZ products but use the data through a third party eg: a private CORS operator. 13% (12) access LINZ products and services directly as well as through third party private CORS operators.

We have a record of registered users for PositioNZ-RT and are able to target them directly. This might contribute to why we have a larger number using PositioNZ-RT over other products and services. Customers who use RINEX for example, are able to download the data anonymously.

2.4 Level of agreement of RINEX data statements (Question 8)

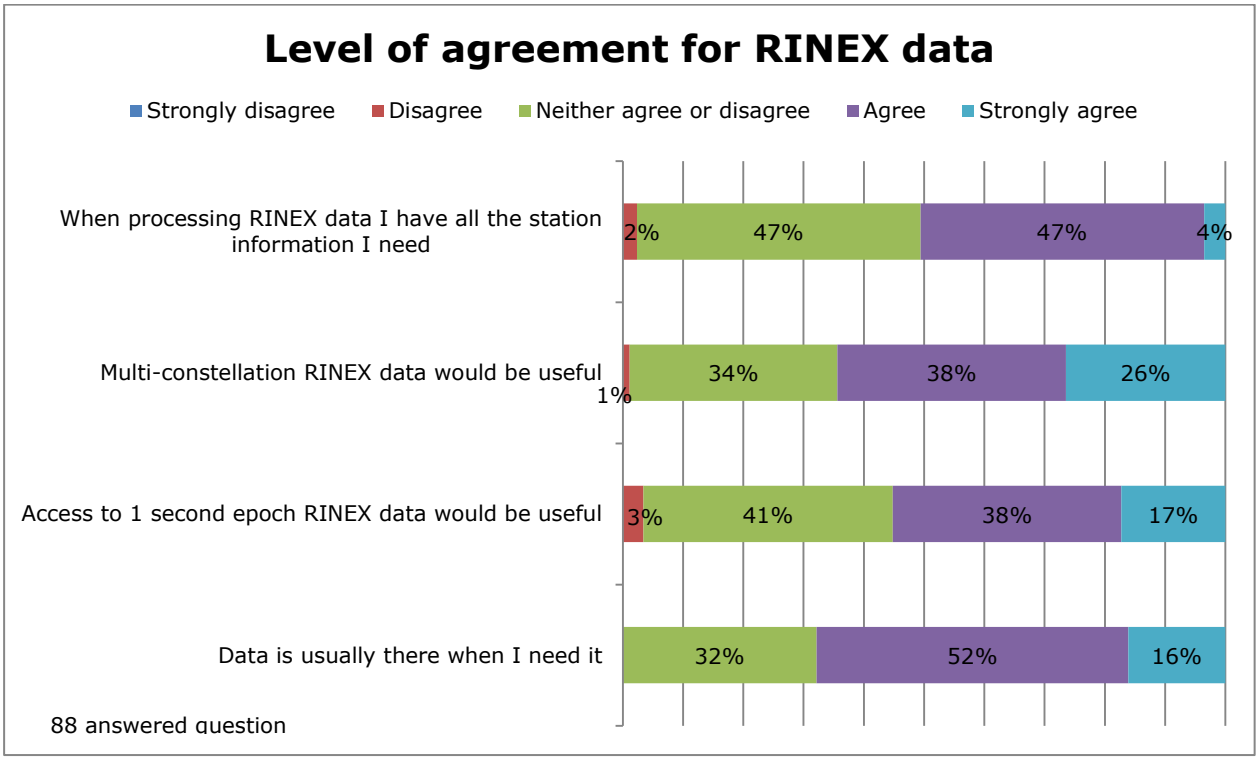


Figure 5: results for Question 8

Overall the respondents are happy with the information that LINZ provides with RINEX files, however there are some improvements that could be made.

51% agree that station information is available when they need it and 2% disagree with this statement.

64% agree that it would be useful to have RINEX3 and 1% stated that it wouldn't be useful. Over a quarter of the respondents strongly agree that multi-constellation RINEX data would be useful.

55% agree that 1 second epoch data would be useful and 3% disagree; they have no need for 1 second data.

68% agree that RINEX data is there when they need it. No respondents indicated that it was not there when they need it.

The balance of the results above are neutral; they neither agree or disagree. This suggests the respondents are happy with the status quo or do not use RINEX data.

A sample of comments from respondents:

"it is difficult to determine the equipment history of a site e.g. antenna changes and antenna height"

"Position NZ not practical to use in Nelson Area. Not enough stations."

"Multi-constellation data would benefit all surveyors of New Zealand"

"In the past it has taken a bit of investigation to confirm antenna height and advanced antenna correction details."

"Multi-constellation would be great but it is still a prohibitively expensive cost premium for the benefits it offers. We expect this will change as Chinese GNSS hardware manufacturers flood the market with lower cost multi-constellation receivers, and it becomes standard. Galileo and QZSS are still only of marginal benefit in NZ. 5 second RINEX files would probably be adequate for most post-processed applications where 30 second data is sub-optimal."

"we have ceased using the LINZ position NZ corrections and now use Leica smartfix network corrections in out GPS units."

2.5 Satisfaction of PositioNZ-RT (Question 9)

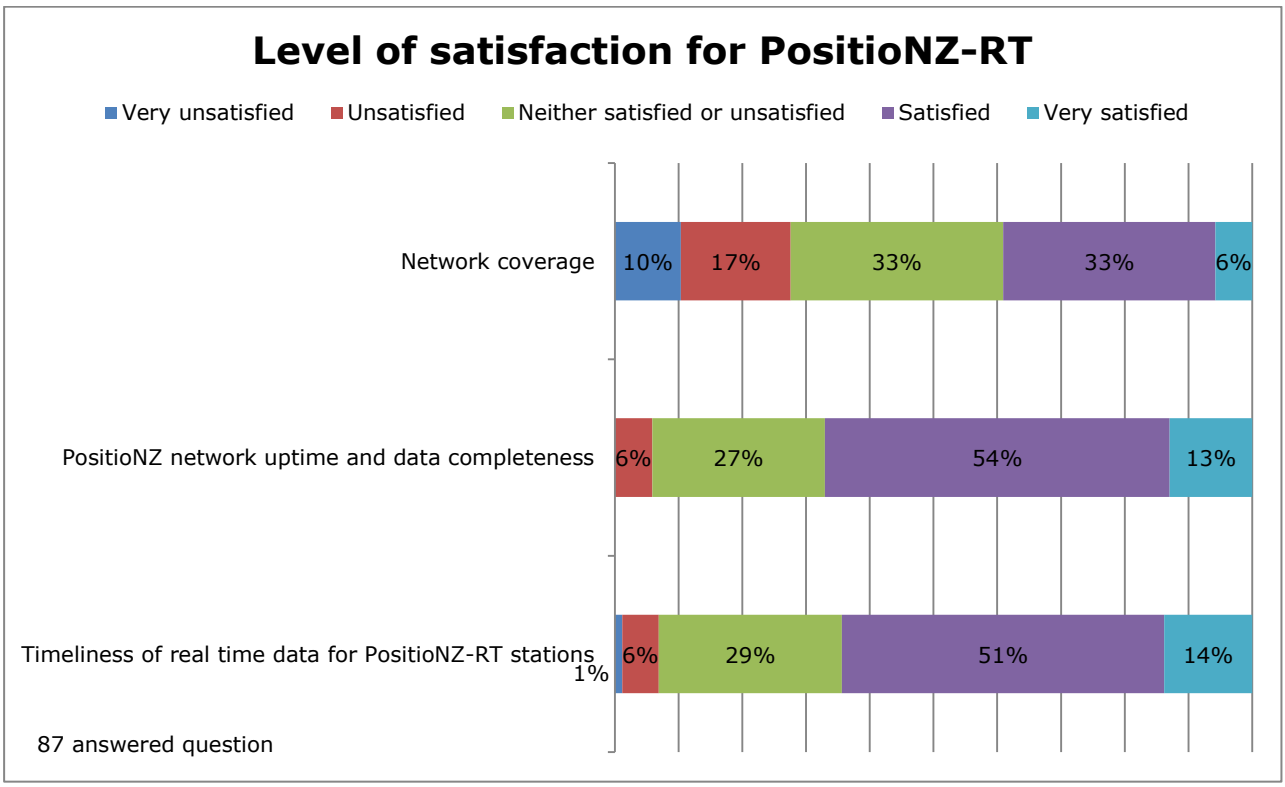


Figure 6: results for Question 9

It is recognised that the LINZ stations are sparse and the network does not provide New Zealand-wide coverage, and this is reflected in the results presented in Figure 6. The network was established to monitor the datum and LINZ provides real time streams where we have stations. LINZ is not currently funded to provide a denser real time network. It is seen as the role of the private sector to infill where there is a demand for additional stations in specific areas and LINZ is able to work with the private sector to ensure those stations are discoverable.

LINZ will continue to work with GNS Science to encourage GeoNet move to a real time network. Many of the GeoNet stations are only tracking GPS and are not set up with communication infrastructure that enables real time streaming. GeoNet intend to upgrade many of their stations over the next 2 years with more coming online when the infrastructure allows it.

2.5.1.1 NETWORK COVERAGE

By providing a real time service LINZ has created a perception that we are supporting national wide real time infrastructure. 10% of PositioNZ-RT users have stated that the network coverage does not meet their needs and further densification of the network would improve the service.

- 27% of PositioNZ-RT users are unsatisfied with the network coverage
- 39% of PositioNZ-RT users are satisfied with the network coverage

A sample of comments from respondents:

"Coverage in the lower south island is poor, therefore I would rarely PositioNZ data."

"We would like a bit more coverage in our region (i.e. West Coast)."

"Greater density would be useful"

"Position NZ not practical to use in Nelson Area. Not enough stations.'

"The main query from a surveyors perspective is why there aren't more GNNS stations more closely located to Auckland (only Whangaparaoa No 3). The system would be used a lot more if there was."

"Require greater Northland coverage"

"Ideally we would like more stations in the north as using the real time service is very beneficial but there is only 3 stations north of auckland and warkworth is not far out - so there is a big gap around mangawhai, dargaville and kaikohe/ kerikeri"

"Coverage in the Taranaki area could always be improved."

"Greater density of stations would be very helpful - especially to support/encourage Network RTK capability, either LINZ or 3rd party"

"Improve network densification by making all GeoNet stations available as real time streams?'

We do a fair bit of Rural work in the South Island there are some major gaps in the Network"

"More basestations would be great. We are in Hamilton the nearest one is some distance from the city, one nearer the CBD would be useful."

"Be good to make better use of GEONET sites where comms upgrades are not prohibitive"

"Main centers like Auckland, Wellington and Christchurch should have better coverage without relying on commercial subscription services. For example many surveyors in Auckland still use their own RTK base because the commercial subscriptions are cost prohibitive and LINZ has poor coverage with the base to far away from main urban Auckland"

"It would be good if PositioNZ was able to tap into more of the Geonet stations"

"Requires additional RT bases in Auckland Region "

"More Stations required to reduce base to rover distance"

2.5.1.2 UPTIME AND DATA COMPLETENESS

67% of respondents are satisfied with the uptime and data completeness of PositioNZ-RT. For the majority of users the network's performance is meeting their needs. There are specific stations that could be improved.

A sample of comments from respondents:

"For real-time applications some critical LINZ stations are unusable."

"It would be useful to have access to RTCM 2.3 (i.e. pseudo range corrections) for use with older equipment."

"AUCK RTCM inconsistent as it drops out for long periods of tie"

"real time data streams have worked well for me."

2.5.1.3 TIMELINESS FOR REAL TIME DATA

65% of respondents are satisfied with the timeliness of real time data. It is assumed that those who are not satisfied (7%) have a high reliance on the network.

2.6 Use of real time data and services (Question 10)

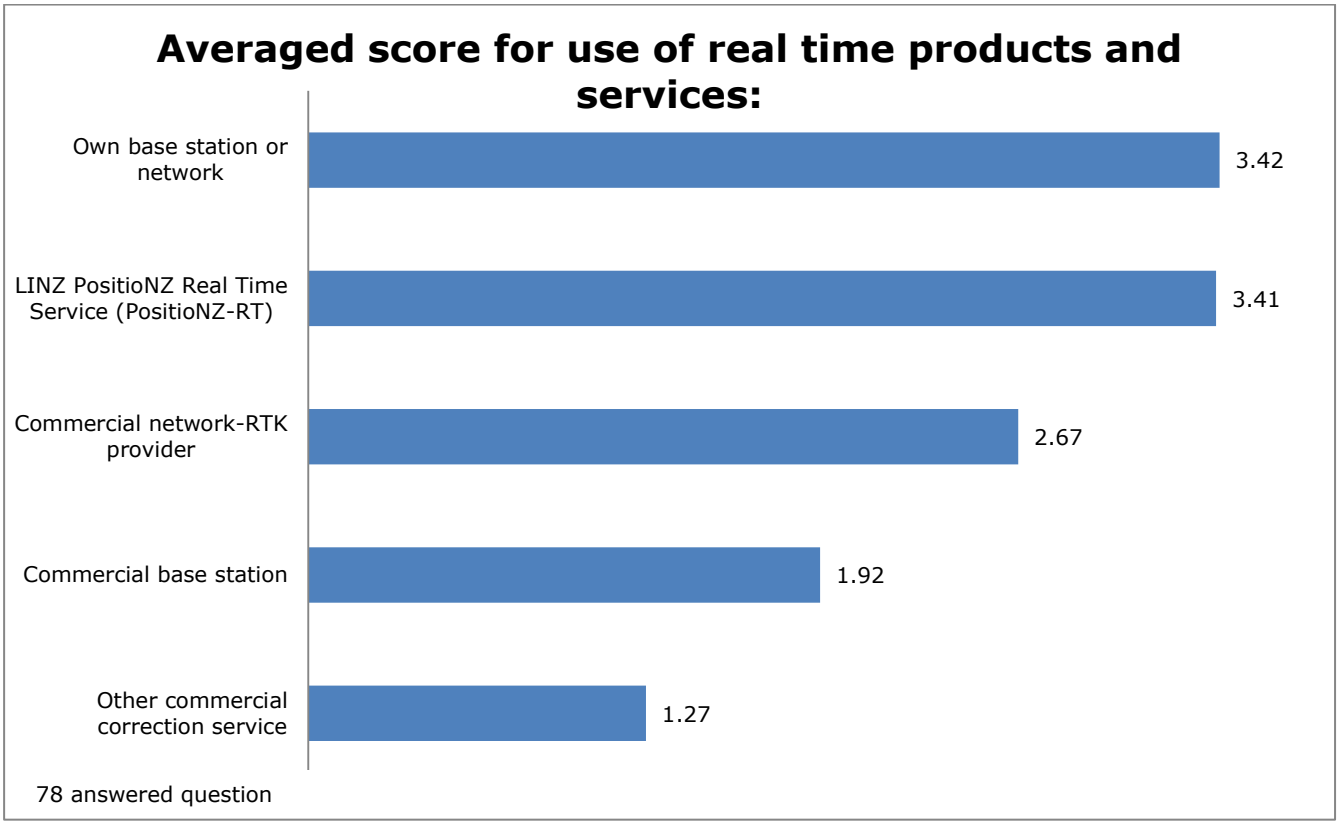
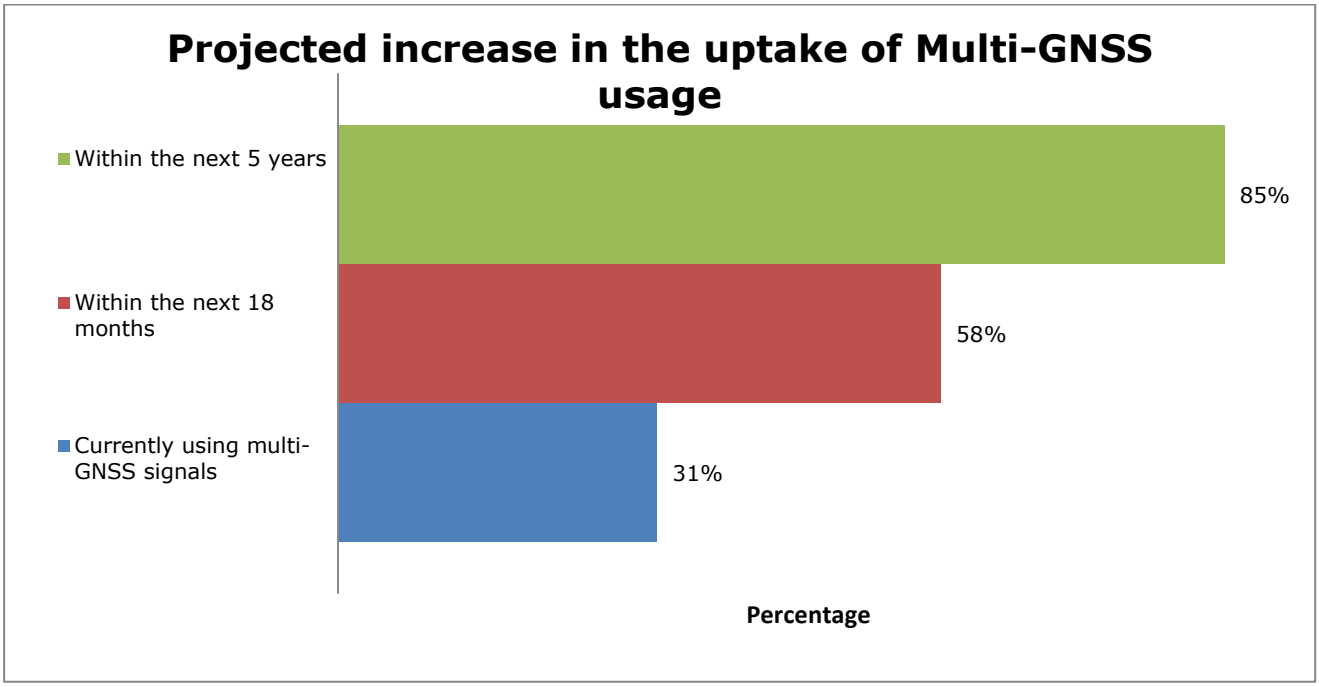


Figure 7: results from Question 10

The responses to Question 10 show that real time users do not a have a preference of using their own base over using PositioNZ-RT. Commercial services are relatively low but commercial networks were separated out from commercial base stations. Overall it is expected that commercial service response would score higher if they were combined. This result suggests that users of a real time service prefer a single base solution over a network solution.

Note: Data was collected by a ranking method; scores ranked 1st were given a value of 5, scores ranked 2nd were given a value of 4 etc. . The sum of values for each item was then divided by the number of responses to give a score out of 5.

2.7 Multi-GNSS usage and uptake (Question 3, 4 and 5)



Use of GNSS signals		
What signals is the GNSS equipment you use capable of tracking?	Do you intend to purchase multi-constellation capable equipment?	Total
GPS only	No, I do not have plans to replace equipment in the next 5 years	6
	Yes, within the next 18 months to 5 years	6
	Yes, within the next 6-18 months	3
GPS only Total		**15**
GPS + GLONASS	No, I do not have plans to replace equipment in the next 5 years	11
	Yes, within the next 18 months to 5 years	26
	Yes, within the next 6-18 months	15
	Not answered	1
GPS + GLONASS Total		**53**
	If you own multi-constellational capable equipment do you have it enabled?	
Multi-constellation (GPS+GLONASS+BeiDou/Galileo/QZSS)	No, but I plan to utilise the multi-GNSS capability within the next 12-18 months	14
	Yes, I use data from all available constellations	35
	Not answered	1
		50
Grand Total		118

31% of respondents are currently using multi-GNSS constellations, this will increase to 58% over the next 18 months and by 2020 85% of our customers are expecting to be using multi-GNSS enable equipment.

It is interesting to note that 14% have no plans to utilise multi-GNSS technologies in the next 5 year. Currently there are only 15 (13%) of the respondents using GPS only equipment. Only 6 of these are surveyors.

2.8 Website content and communication (Question 6)

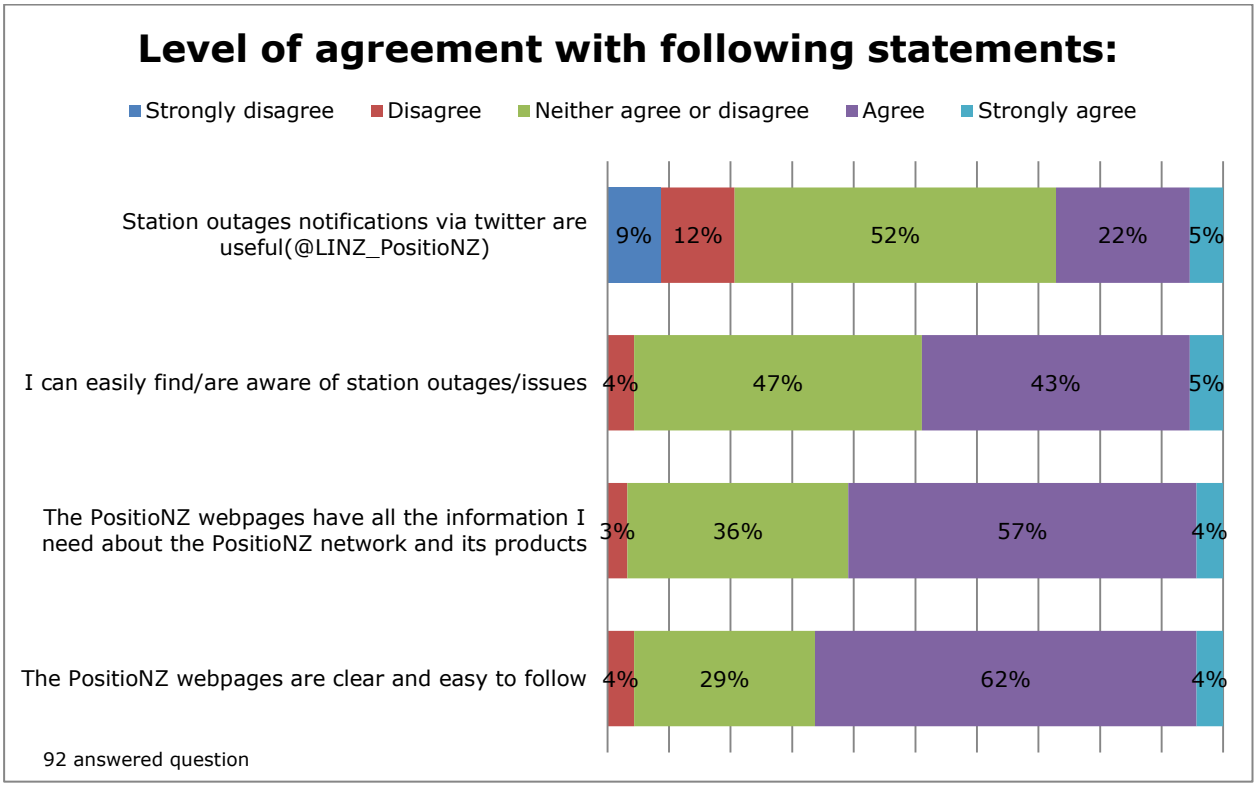


Figure 8: website content and communication

2.8.1 Common themes:

- Twitter is not used by many of our customers.
- Email is more preferred as an option for network notifications. Customers should be able to subscribe to updates relating to a single station.
- PositioNZ webpages are "hidden" and are hard to find on the main LINZ website.
- Many customers do not directly access the LINZ PositioNZ webpages.
- Few respondents are unsatisfied with the communication and information provided about the PositioNZ network.

A sample of comments from respondents:

"I do not regularly use the PositioNZ website. "

"I use the Trimble VRS network, which includes some LINZ bases in its solution. However, I do not get data myself directly off the PositioNZ website"

"Sometimes when we have had issues we have checked the site and the data is not up to date"

"I have a favourites link to the PositioNZ webpage because it is near impossible to quickly get to from the LINZ homepage. Please make it more obvious under the 'Info for surveyors...' as well as wherever it's hidden under geodetic section."

"I Mainly access your Rinex Data via FTP site As I have a tool that logs straight in"

2.9 PositioNZ-PP enhancements (Question 11)

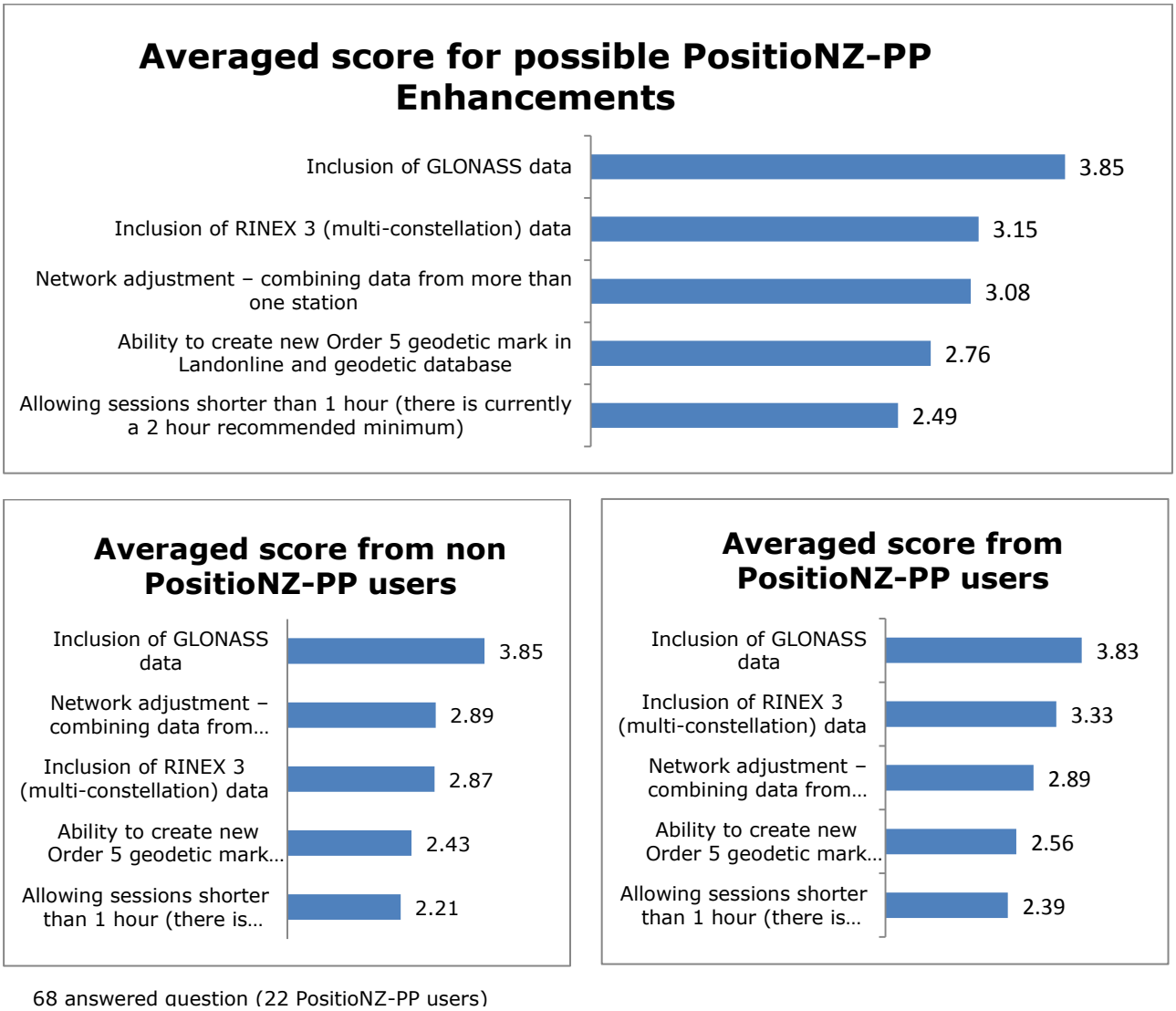


Figure 9: results from Question 11

It was surprising to see that more customers were interested in the inclusion of GLONASS data and multi-GNSS data as an enhancement than getting shorter session times and combining data from more than one user submitted RINEX.

A sample of comments from respondents::

"Enable multi constellation RINEX processing with PP service that allows users to create 5th order coords with two 1-2hr independent sessions (anything longer is not cost effective on typical cadastral jobs)"

Note: Data was collected by a ranking method; scores ranked 1st were given a value of 5, scores ranked 2nd were given a value of 4 etc. . The sum of values for each item was then divided by the number of responses to give a score out of 5.

2.10 Webpage with CORS information (Question 12)

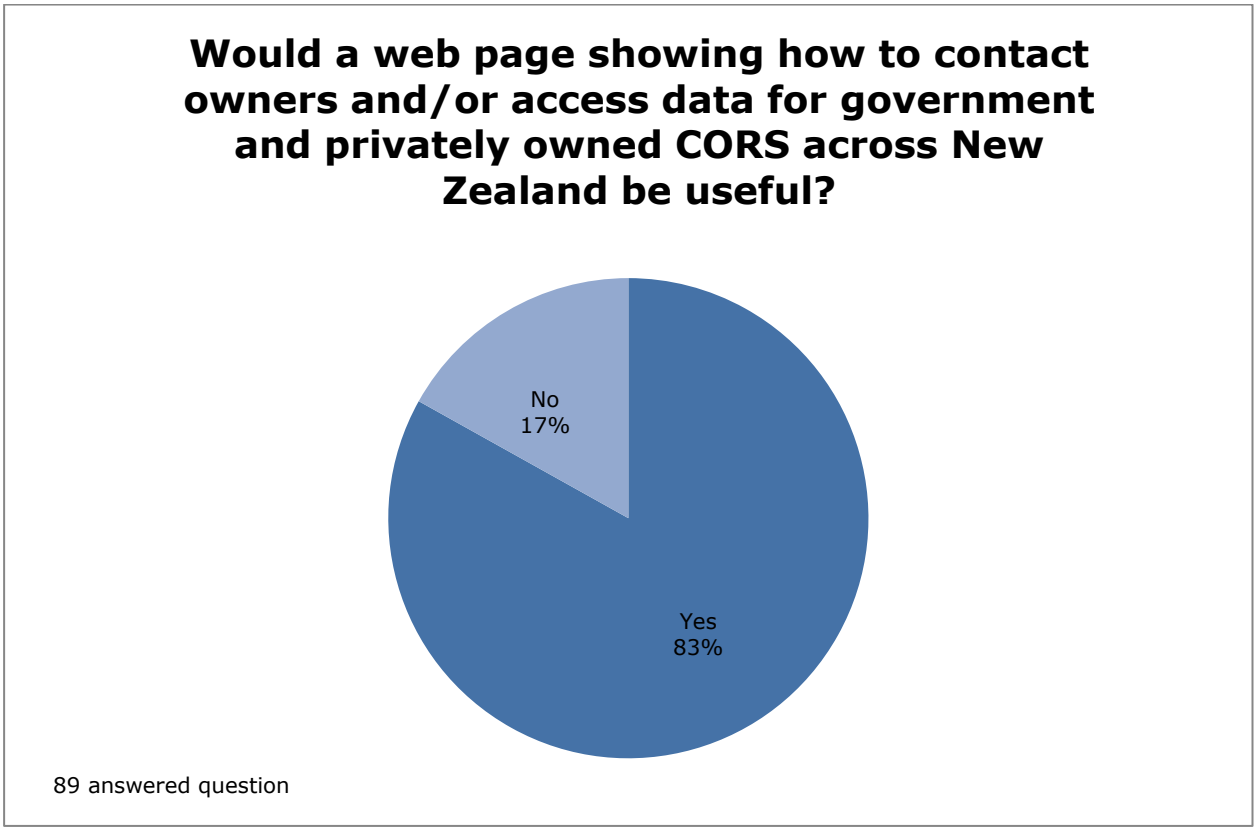


Figure 10 Results from Question 12

There is support for such a webpage with 83% of respondents saying they would find it useful.

What additional information would you find useful on such a web page e.g: equipment changes, contact information:

The following additional information was suggested:

- *"Updated contact information- significantly phone numbers/email address"*
- *"Network coverage, Contact details, services offered"*
- *"Similar to that provided by LINZ."*
- *"Ensure time-tagged meta data!"*
- *"Receiver and Antenna Types/Serial Numbers "*
- *"contact information"*
- *"Location of CORS sites"*
- *"Coverage Area"*

2.11 General comments and feedback (Question 14)

Common themes:

- The addition of Beidou (and other constellations) would be great appreciated to improve performance
- The PositioNZ network would be used more if there was more coverage. Additional PositioNZ stations would be beneficial, with more coverage for the following areas specifically mentioned:
    - Auckland
    - Nelson
    - Taranaki
    - Northland
    - Southland
    - West Coast
- Comms at some sites are causing an issue (specifically MQZG and AUCK) especially when used in the network RTK services.
- Request for better links to GeoNet data
- More GeoNet stations should be brought into the real time network
- LINZ could lead better coordination between CORS operators
- Various opinions about using the LINZ network over a privately operated network
    - there is a preference of a privately operated network over PositioNZ-RT, and;
    - privately operated networks are seen as cost-prohibitive
- Would be useful if LINZ could provide an online planning tool for satellite availability
- Denser network for NRTK/RTK - a CORS site in each city/town in NZ over population of 50,000; would enable single base positioning (10-20km max) for all local authorities/surveyors/other users in reasonable sized centres.

A sample of comments from respondents::

"It would be good to see better coordination between the various organisations which provide CORS services, with the objective being a cohesive nationwide CORS-RT network of sufficient density and with common standards. LINZ should be well placed to take a lead role in this."

"A NZ CORS RT network should be regarded as crucial public infrastructure which will become hugely important with majority public usage within our lifetimes. Vision a long-term strategy is required!"

"Haven't used LINZ PP processing as usually want to process static between local survey marks rather than just as hanging lines relative to the one regoinal permanent base station. RTK stream data (effectively from LINZ) provided through Smartfix. Often a bit variable for many applications, so maybe too much time lag when you get more than 20km away "

"It would be useful to have a web based facility to compute the coordinate of a site for a specific time (epoch) based on the NDM"

"Non-surveying applications requiring accurate RT GNSS corrections are increasing rapidly, and there is the potential for significant inefficiencies if at least basic standards

are not mandated. A parallel would be the shambles that the telcos have allowed to become, with consumers"

"LINZ are doing a great job providing PositioNZ services and continuing to keep upgrading them. Keep up the good work."

"PositioNZ is an awesome service. Keep up the good work!!"

"Really appreciate the free-access and reliability of the real-time data. Well done LINZ."

3 Proposed Future Actions

The following are proposed actions related to specific survey questions

Website Content and Communication (Question 6)	
1	Set up email notifications for stations as a 3 month trial: 1) Change registration form to include station notifications 2) Create a group for each station + for all_users If this is seen to be successful the Twitter account may be used as a more general geodetic notification platform.
2	Add the PositioNZ pages to "Information for Surveys" on main LINZ website
Webpage with National CORS information - including non PositioNZ stations (Question 12)	
3	LINZ will start scoping requirements for the webpage including recommendations collected as part of Question 12
PositioNZ-PP (Post Processing Service) Enhancements (Question 11)	
4	Recommendations from Question 11 to be incorporated into future planning of PositioNZ-PP.
Multi-GNSS Usage (Questions 3, 4 and 5)	
5	Develop a PositioNZ Strategy and business case to investigate the feasibility of moving the network to multi-GNSS.
PositioNZ-RT (Question 9)	
6	Network Coverage: Encourage GeoNet to upgrade their stations so they are capable of streaming real time data through the PositioNZ-RT Service.
RINEX Provision Enhancements (Question 8)	
7	Improve access to sitelogs by making them available through the LINZ website/ftp
8	Improve access to 1 sec RINEX data –make available for 6 months on website. 1" data is current available for streaming stations but not

	accessible through the LINZ website.
9	Investigate when LINZ might be able to start providing RINEX3 for all stations RINEX3 is available for the following stations but not through currently the LINZ website. • WARK • MTJO • LEXA

Appendix A Survey Questions

Land Information New Zealand (LINZ) operates the PositioNZ network, which provides GNSS/GPS products and services.

LINZ is seeking your input as to your current use and perceptions of the products and services provided and how we might cater for your needs in the future.

Your anonymous feedback will be used to drive our work programme.

Thank you for your time and input.

Question 1: What is your area of business?

- Central Government
- Construction
- Education & Research
- Emergency Services
- Engineering
- Farming/Agriculture
- Infrastructure e.g. roading/transportation
- Local Government
- Utilities e.g. electricity
- Surveying
- Other (please specify):

Question 2: In your day to day business, how frequently do you use GNSS/GPS technology?

- Daily
- Weekly
- Monthly
- Rarely
- Never

Question 3: What signals is the GNSS equipment you use capable of tracking?

- GPS only
- GPS + GLONASS
- Multi-constellation (GPS+GLONASS+BeiDou/Galileo/QZSS)

(*If either, GPS only or GPS + GLONASS are selected go to Question 4,*
If Multi-constellation (GPS+GLONASS+BeiDou/Galileo/QZSS) go to Question 5

Question 4: Do you intend to purchase multi-constellation capable equipment?

- Yes, within the next 6-18 months
- Yes, within the next 18 months to 5 years
- No, I do not have plans to replace equipment in the next 5 years

Go to Question 6

Question 5. Do you have the multi-constellation GNSS capability enabled?

- Yes, I use data from all available constellations
- No, but I plan to utilise the multi-GNSS capability within the next 12-18 months
- No, I have no plans to use the new GNSS constellations

Question 6: Please select whether you agree or disagree with the following statements about PositioNZ communication and website content (http://www.linz.govt.nz/positionz-network):

	Strongly disagree	**Disagree**	**Neither agree or disagree**	**Agree**	**Strongly agree**
The PositioNZ webpages are clear and easy to follow					
The PositioNZ webpages have all the information I need about the PositioNZ network and its products					
I can easily find/are aware of station outages/issues					
Station outages notifications via twitter are useful (@LINZ_PositioNZ)					

Any comments?

Question 7: Which products and services do you use from PositioNZ? Please select one or more of the following:

- I use PositioNZ RINEX data
- I use real time data streams through the PositioNZ Real Time Serice (PositioNZ-RT)
- I use the PositioNZ Post Processing Service (PositioNZ-PP)
- I do not directly use PositioNZ products but I use other third party services which may use PositoNZ products

Question 8: Select your level of agreement in regards to the access and availability of PositioNZ RINEX data:

	Strongly disagree	**Disagree**	**Neither agree or disagree**	**Agree**	**Strongly agree**
Data is usually there when I need it					
Access to 1 second epoch RINEX data would be useful					
Multi-constellation RINEX data would be useful When processing RINEX data I have all the station information I need					

Any comments?

Question 9: Select your level of satisfaction with PositioNZ-RT:

	Very satisfied	Satisfied	Neither satisfied or unsatisfied	Unsatisfied	Very unsatisfied
Timeliness of real time data for PositioNZ-RT stations ie, lag times are manageable					
PositioNZ network uptime and data completeness					
Network coverage					

Any comments?

Question 10: If you use real time GNSS data or services please rank the following in order of use:

- ☐ LINZ PositioNZ Real Time Service (PositioNZ-RT)
- ☐ Commercial base station
- ☐ Commercial network-RTK provider
- ☐ Other commercial correction service
- ☐ Own base station or network

Question 11: Please rank the potential enhancements that would make the PositioNZ-PP Service more useful to you:

- ☐ Network adjustment – combining data from more than one station
- ☐ Allowing sessions shorter than 1 hour (there is currently a 2 hour recommended minimum)
- ☐ Ability to create new Order 5 geodetic mark in Landonline and geodetic database
- ☐ Inclusion of RINEX 3 (multi-constellation) data
- ☐ Inclusion of GLONASS data

Question 12: Would a web page showing how to contact owners and/or access data for government and privately owned CORS across New Zealand be useful?

- Yes
- No

What additional information would you find useful on such a web page e.g equipment changes, contact information:

Question 13: Where do * you primarily work?

- Auckland
- Bay of Plenty
- Canterbury
- Gisborne
- Hawke's Bay
- Marlborough
- Manawatu-Wanganui
- Nelson
- Northland
- Otago
- Southland
- Taranaki
- Tasman
- Waikato
- Wellington
- West Coast
- Nationwide
- Outside of New Zealand

Question 14: Do you have any further comments?

Name:
Position:
Organisation:
Email address:

Question 15: If you would like us to include you in future PositioNZ communications, please add your details below.

Thank you for providing us with your feedback.
For more information and PositioNZ contact details please refer to the following:
Email: positionz@linz.govt.nz
Twitter: @LINZ_PositioNZ

Webpages: http://www.linz.govt.nz/positionz-network