Toitū Te Whenua
Land Information New Zealand

Requesting aerial imagery in an emergency response

Information for Controller, Recovery Manager, and Intelligence Team

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Contents

As of June 2021, this document is in draft and available to our key customers and stakeholders for consultation and feedback.

If you have any feedback on how this document could be improved please contact imagery@linz.govt.nz

Introduction

During an emergency Toitū Te Whenua Land Information New Zealand (LINZ) can provide geospatial support to response agencies.

This includes capturing aerial imagery, LiDAR elevation data and bathymetry seabed data.

Please refer to page 16 of this document for more information about how the LINZ Incident Management Team can support your response and recovery, including a list of key contacts.

1.1 Purpose of this document

The purpose of this document is to:

- demonstrate the value of using aerial imagery for decision making in an emergency.
- promote the national standard for capturing aerial imagery during a response.
- confirm the role of Toitū Te Whenua to provide geospatial support to response agencies.

1.2 Key sections

This document includes:

- information specifically for **Controllers** which explains the different imagery options available.
- a review of the **national aerial imagery specification**, including an explanation of the terminology and highlighting issues which may need to be considered.
- an example **aerial imagery request** for use by GIS staff in the Intelligence Team during an emergency response.

Figure 1 – Reconnaissance flight over Edgecumbe flood in April 2017

Information for Controllers

Imagery plays a vital role in helping inform your decision making during all 4 Rs of emergency management – risk reduction, readiness, response, and recovery.

During a response, in your role as Controller, you may be asked to approve budget to capture, process and deliver imagery. Here is more information to help you make that decision.

2.1 What is imagery?

Imagery includes aerial imagery, also known as orthorectified aerial imagery or aerial photography which has been processed to use in a GIS. You may also be asked to discuss satellite imagery, drone capture and reconnaissance photography. This document is focused on the specification for aerial imagery only.

2.2 Case Study – Pigeon Valley Fire

Nelson Tasman Civil Defence Emergency Management (CDEM) Group captured aerial imagery following the Pigeon Valley Fire.

Figure 2 – RGBI image of Pigeon Valley Fire, with the black area showing the extent of the fire, and the red indicating healthy vegetation.

The Pigeon Valley Fire aerial imagery had many uses in recovery, including

- talking with community groups
- informing online data collection, for example damaged fencing
- planning helicopter flights to re-seed pasture on private property
- forestry company inventory
- private property insurance claims
- in a map prepared for each of 57 property owners within the fire cordon

Nelson Tasman CDEM Group identified a number of lessons following Pigeon Valley Fire:

- Include the Recovery Manager in authorisation of the imagery capture, as they will have key user requirements.
- Engage with the supplier early, and involve them in discussions about what is achievable given the conditions and response time required.
- Imagery formats, resolution, delivery methods and costs should all be part of the formal authorisation process during an event. Ensure all relevant agencies authorise the requirements and costs.
- Think about imagery requirements during peacetime and start having conversations about potential budget allocation. These discussions can take a significant amount of time in the middle of responding to an event.

2.3 Time versus Cost and Quality

It is important to capture the imagery as close as possible to the time of the actual event to generate the most value, which means a decision about budget is likely to be required in the middle of a response.

Careful consideration should be given to time versus cost and quality. Feedback from Councils suggest the long term benefits of using the imagery are significant, and paying a little extra and waiting a little longer to generate a quality product might be the preferred option particularly for recovery. If speed is critical, a well-timed satellite image may be a good option, but availability will be reliant on predetermined satellite flight paths and cloud cover.

Potential timeframes for imagery availability, depending on the ability to capture due to environmental factors, and the size of the area of interest.

First 24 hours	24 – 48 hours	Within 5 days	Within 10 days
Reconnaissance photos	Satellite imagery	Low order orthorectified aerial imagery	Orthorectified aerial imagery

2.4 How will the imagery be used?

Satellite imagery

Figure 3 – Satellite imagery sourced from Planet.com was used to prioritise properties requiring assistance during the Southland flood in February 2020. The imagery happened to be captured within one hour of peak river flow and was relatively cloud free. Unfortunately, these favourable conditions cannot be guaranteed.

Aerial imagery

Figure 4 – Aerial imagery captured for NZ Transport Agency by AAM following the 2016 Kaikoura Earthquake identifies the rail track displacement and land uplift in the tidal area.

2.5 How can Toitū Te Whenua help?

It is likely that your Intel Team will have GIS staff who are well resourced and able to request aerial imagery. Under these circumstances, the following aerial imagery specification may serve as a useful guide.

However, if key staff are not available, you are able to request support from Toitū Te Whenua for aerial imagery. Our Duty Officer will be on stand by, ready to assist you with requesting aerial imagery during a response.

If you need support from LINZ during an emergency contact

027 357 0029
LINZ Duty Officer

Review of aerial imagery specification

In peacetime, Toitū Te Whenua works with Councils and Regional Consortiums to acquire and publish aerial imagery of New Zealand. This specification for requesting aerial imagery during an emergency is based on the original orthophotography acquisition specification.

https://www.linz.govt.nz/data/linz-data/aerial-imagery/national-imagery-coordination

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Emergency

☐ Name of emergency response

State the name of the emergency to make it clear this work is urgent and relates to an emergency response e.g. Pigeon Valley Fire Emergency Response, or Canterbury Flood Emergency Response.

Capture Date

☐ Required timeframe

Confirm the required timeframe for data capture, for example as soon as possible; at the next high tide; or immediately after air traffic control restrictions have been lifted.

Controller

☐ Controller name and contact details

The Controller is the person responsible for coordinating the emergency response, and the person who will authorise the aerial imagery purchase during a response.

Contact

☐ Name, email and mobile number

Provide contact details of the person working in the response who can provide any clarification about the imagery request.

Include both generic contact details, for example the email for the Intelligence Team, (for example intel@cdsouthland.nz), plus specific names, emails and phone numbers of relevant GIS staff.

Products

☐ Orthorectified aerial imagery

☐ Low order orthorectified aerial imagery

☐ Unprocessed aerial imagery

In an emergency response, any combination of the above product options could be requested.

Orthorectified aerial imagery will generate detailed data at the highest resolution, but takes longer to capture, process, and deliver. Use this option when quality of the imagery is more important than how quickly you receive the imagery.

An example is the Pigeon Valley Fire imagery was used as a record of the February 2019 event to inform community meetings and to support insurance claims during recovery.

Low order orthorectified aerial imagery provides lower resolution imagery, but is quicker to capture, process and deliver. Minimum time would be spent on colour balancing, seam line editing or ground control by the supplier. Use this option if receiving the imagery quickly and cheaply is more important than the quality.

An example is the Port Hills fire low order imagery was quickly sourced to inform decision making about the 2017 event.

Unprocessed aerial imagery, or raw images, will not be orthorectified or tiled, and so cannot be immediately added to a GIS. However these photographs may provide valuable intelligence during the first 24 to 48 hours of a response.

An example initial imagery capture was used to identify damage immediately following the 2011 Christchurch earthquake.

Extent

☐ Define area of interest

Define the extent of the emergency response, or the specific area of interest for imagery on a map. An example might be the extent of a fire or the whole water catchment for a flooded river.

Supply the extent as a polygon which can be shared with the imagery supplier. The polygon can be provided as a shapefile, or captured using the Toitū Te Whenua data requirements feature layer. To access this feature layer please contact resilience@linz.govt.nz .

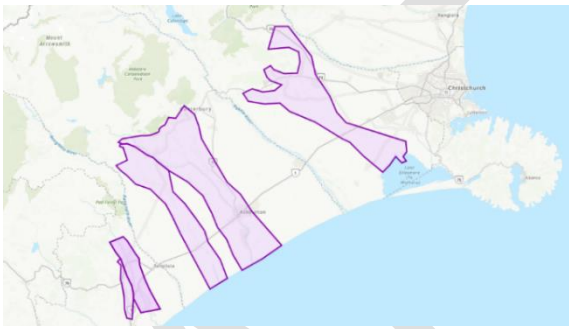

Figure 5 – Example of imagery extent for Canterbury floods May 2021

Spatial Resolution

☐ *Example:* 0.3 metres

The accuracy of imagery, or its spatial resolution, is determined by the Ground Sample Distance (GSD) or pixel size. A higher resolution GSD, e.g. 0.10 metres, will take longer to capture and process.

Based on current technology, 0.3 metres is the suggested compromise between time, cost and quality.

Figure 6 – Comparison of spatial resolution options

Horizontal Accuracy

☐ *Example:* <= +/- 2.0 metres. 90% confidence interval

The spatial accuracy of imagery is a measure of the horizontal accuracy or distance of an image from its true position. Typically, greater horizontal accuracy is required in urban areas.

Improving horizontal accuracy can be achieved by more accurately determining the true location of the camera as the image is captured; by increasing the amount of ground control; or increasing the density and quality of the Digital Terrain Model. This will usually be accompanied by an increase in cost.

Spatial Resolution	Horizontal Accuracy
0.1 metres	<= +/- 0.3 metres
0.2 metres	<= +/- 1.0 metres
0.3 metres	<= +/- 2.0 metres
0.4 metres	<= +/- 3.0 metres

Spatial control

☐ The supplier is responsible for providing any ground control necessary to meet the spatial accuracy specified above.

Image Bands

- ☐ Natural Colour (RGB - red, blue, green)
- ☐ Four Band Colour (RGBI - red, blue, green, near infra-red)

The addition of the infra-red band (the I in RGBI) helps highlight healthy vegetation, and the occurrence of chlorophyll, in red.

The bands required is likely to depend on the type of emergency response.

Figure 7 – RGB image of Christchurch post 2011 earthquake showing the extent of building damage

Figure 8 – RGBI image of Pigeon Valley Fire with the black area showing the extent of the fire, and the red indicating healthy vegetation and the occurrence of chlorophyll

Sun angle	☐ *Example:* The sun angle at the time of the imagery capture must be more than 30° above the horizon. Imagery is usually captured at a time of the day to minimise shadows for example from tall buildings. This requirement may be excluded, if time is the most important factor.
Atmospheric effects	☐ Imagery detail and clarity must not be lost as a result of atmospheric conditions including haze, smoke, dust, and environmental factors. This requirement may be excluded if time is the most important factor.
Cloud cover	☐ *Example:* Imagery must be 100% cloud free. This requirement may be excluded if time is the most important factor.
Projection	☐ All imagery will be provided in New Zealand Transverse Mercator 2000 projection (NZTM2000).
Ortho rectification	☐ Imagery orthorectification process must ensure: a) straight lines on the ground are straight in the image, b) common overall scale and resolution is maintained, c) differences in contrast and brightness between images within a tile are minimised, d) the joins between all tiles are seamless, with no gaps, overlaps, or visible join lines between adjacent images, e) the pixels on adjacent tiles must align, f) features at ground level are continuous across mosaic seam lines e.g. valleys, ridges, buildings, and roads etc, g) no duplication of features occurs along seam lines, and cloned features used to 'touch up' features that are obscured in images must be used with caution and kept to a minimum. Orthorectification is the process of removing the effects of image perspective (tilt) and relief (terrain) effects from imagery.

The process creates a constant scale with features represented in their 'true' positions.

The orthorectification statement is only required if the selected "Product" above is "orthorectified aerial imagery".

Tiling

☐ Orthorectified tiles to align with the appropriate Toitū Te Whenua Topo50 map sheet.

Tile Index	Tile coverage	Tile source data
1:5,000	2,400m x 3,600m	data.linz.govt.nz/layer/104691
1:1,000	480m x 720m	data.linz.govt.nz/layer/104692

Each tile will be supplied complete, i.e. no partial tiles. (A 'complete tile' is the tile dimension, and may not result in a complete tile of imagery).

The choice of tile index relates to spatial resolution above. To ensure the tile files are manageable, a higher resolution image will require a smaller tile size. This requirement may be excluded if time is the most important factor for a response.

Format

☐ uncompressed GeoTIFF or TIFF with TFW file

☐ a single compressed mosaic for the entire extent

☐ unprocessed TIFF (8 bit)

Orthorectified and low order orthorectified aerial imagery to be supplied as GeoTiffs or compressed mosaics.

Unprocessed aerial imagery to be supplied as a TIFF (8 bit).

Index

☐ An index of the tiles will be supplied as a shapefile, including:

Field	Data Type	Example
TILENAME	String(14)	BM13_5000_1006
MAPSHEET	String(4)	BM13
SCALE	String(4)	5000
TILE	String(4)	1006
GSDM	String(10)	0.3
ACCURACY	String(50)	+/- 2.0m at 90% confidence level.
YEAR	String(4)	2020
FLOWN	String	29/01/19,30/01/19
SUPPLIER	String	Photos from the Sky Limited
HCOORDSYS	String	NZTM2000
VDATUM	String	NZVD2016
CAMERA	String	UCE100
HTAGL	String	19000ft
PROJECT	String	Horizons 2020 Aerial Imagery

Licence

☐ All data and products to be provided with a licence that enables the purchaser to release the data to any person, group, or organisation under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence with attribution to the purchaser in line with the New Zealand Government Open Access Licensing framework (NZGOAL).

Aerial imagery specifcation for an emergency response

This one page specification provides a checklist of elements to consider, with example values which can be altered depending on the type of emergency and requirements for using the data. It is recommended that these requirements are discussed with the data supplier to ensure the best outcome. If Toitū Te Whenua is tasked by a CDEM Group to capture aerial imagery for an emergency response, this specification will be used.

To: Aerial Imagery Supplier

From: CDEM Group Intel Team

Cc: CDEM Group Controller; CDEM Group Recovery Manager; Toitū Te Whenua

Re: Emergency request for aerial imagery

☐	**Emergency**	Name of emergency response
☐	**Capture Date**	Required timeframe
☐	**Controller**	Controller name and contact details
☐	**Contact**	Name, email and mobile number
☐	**Products**	Orthorectified / Low order / Unprocessed
☐	**Extent**	Define area of interest on a map
☐	**Spatial Resolution**	0.3 metres
☐	**Horizontal Accuracy**	<= +/- 2.0 metres. 90% confidence interval
☐	**Spatial control**	Supplier to provide any required ground control
☐	**Image Bands**	Natural Colour RGB / 4 Band RGBI
☐	**Sun angle**	More than 30° above the horizon.
☐	**Atmospheric effects**	Minimise atmospheric conditions e.g. haze or smoke
☐	**Cloud cover**	Imagery must be 100% cloud free.
☐	**Projection**	NZTM2000
☐	**Orthorectification**	Maintain scale, resolution, contrast, and alignment
☐	**Tiling**	Align tiles with the appropriate Topo50 map sheet.
☐	**Format**	Uncompressed GeoTIFF / compressed mosaic / TIFF
☐	**Licence**	Creative Commons Attribution 4.0 International (CC BY 4.0)
☐	**Index**	Supply tile index

Toitū Te Whenua
Land Information
New Zealand

Emergency Management Support

If you need support from Toitū Te Whenua during an emergency contact

027 357 0029

LINZ Duty Officer

The LINZ Duty Officer will coordinate support for you during an emergency, whether you need help capturing aerial photography, LiDAR height data or bathymetry data, require access to Crown-owned land, or want to access the latest topo maps or marine charts.

For more information about emergency support available from Toitū Te Whenua, please contact **emergency@linz.govt.nz**

https://data.linz.govt.nz
https://linz.maps.arcgis.com

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Emergency response

Key contacts

Toitū Te Whenua
Land Information
New Zealand

For support with	We can help you	More information	Contact	
Maps	We maintain the authoritive national record of the country's physical features – New Zealand's topography – vital information to brief first responders or plan evacuations. If you are a designated emergency service and require paper maps during an event, please call **0800 555 567** to access the required maps.	Topo maps and data are freely available from our LINZ Data Service (LDS). https://bit.ly/2GsAu2d	**Melissa West** **Manager Topographic Products** **021 683 741**	Ben Jones Group Manager Topography 04 471 6231
Data	New Zealand's most up-to-date property, land and marine data is freely available to download in a variety of formats or access as a service from our LDS.	Key datasets required during a response are freely available from our LDS. https://bit.ly/2xMDg16 Esri REST services https://linz.maps.arcgis.com	**Jonathan Ball** **Manager Data Services** **027 555 7257**	Ian Harrison Senior Spatial Analyst 027 696 1944
Aerial imagery and height data	We will work with response agencies to coordinate the capture and distribution of aerial imagery and LiDAR height data during an emergency, which can help assess the event and inform recovery.	Existing and aerial imagery is available free from LINZ Basemaps. https://basemaps.linz.govt.nz Existing elevation models are freely available from our LDS. https://bit.ly/37EGYH6 Exiting LiDAR data is freely available from OpenTopography. https://opentopography.org	**Andrew Ferrel** **Manager Partnership Programmes** **04 460 0140**	Ben Jones Group Manager Topography 04 471 6231
Tides, charts and navigation	We provide daily tide predictions for 64 sites around the coast of New Zealand.	https://bit.ly/2OmHZw3	**Adam Greenland** **National Hydrographer** **021 243 1577**	Rebecca McAtamney Group Manager Hydrography 027 253 3352
	We maintain charts and navigation information which is fundamental for safety at sea. An emergency may also create new hazards to mariners. We issue Notices to Mariners to advise of important matters affecting navigational safety. https://bit.ly/36zN1vh	Marine charts are freely available to download from our LDS North Island Charts – https://bit.ly/38Kmn4i Sout Island Charts – https://bit.ly/2RzefxE Marine chart viewer – https://bit.ly/37zqX57 If you require official up-to-date charts for navigation purposes phone **0800 555 567**		
Bathymetry	Bathymetry data can be used for tsunami modeling, assessing coastal erosion, and shoreline mapping. We provide access to hydrographic and bathymetric data around the coast of New Zealand, and in selected areas of Antarctica and the South-West Pacific.	Indexes showing the bathymetric data held by Toitū Te Whenua are available on our LINZ Data Service https://bit.ly/36w2lsV Sea level data for sites around New Zealand can be downloaded from Toitū Te Whenua https://bit.ly/2O9cKUV		

For more information about the support available from Toitū Te Whenua, please contact emergency@linz.govt.nz

Emergency recovery

Key contacts

Toitū Te Whenua
Land Information
New Zealand

For support with	We can help you	More information	Contact	
Crown-owned land, waterways and lakes	Our Land & Property Teams in Wellington and Christchurch have technical experience under the Public Works Act and provide centralised property acquisition, management and disposal services for other Crown agencies. The Land & Property Team can confirm availability of Crown land in an emergency and facilitate authorisation of drone footage on Crown-owned land with the Department of Conservation.	Data to show Crown land managed by Toitū Te Whenua is freely available from our LINZ Data Service (LDS) **https://bit.ly/2U6G0iL** More details at **https://bit.ly/30ZlGBA**	**Megan Reid** **Group Manager, Land and Property Wellington** **021 332 096**	Jacob Taulealea Manager, Land and Property Wellington 027 273 5843
Demolition and land remediation	Toitū Te Whenua has an established demolition team with significant operational experience gained responding to Christchurch earthquakes. The team has proven systems and specialist contractors available to provide advice on Crown property, including the: • Safe, effective and cost efficient demolition of damaged or at risk buildings • Land remediation services in high risk, post event environments • Support in securing damaged or at risk buildings.	More details at **https://bit.ly/31clq1b**	**Lydia Bloy** **Group Manager, Land and Property Christchurch** **021 047 9060**	Mathew Bradley Manager, Land and Property Christchurch 029 200 6449
Monitoring earth movements	Horizontal and vertical coordinate and positioning information can provide precise details on the extent and impact of earth movement caused by an event. Our positioning experts were deployed directly after the Kaikoura earthquake to provide updated geodetic control to help support recovery.	Toitū Te Whenua recommends all height data references the New Zealand Vertical Datum 2016 (NZVD 2016), for example for identifying coastal hazard zones or coastal assets at risk from storm tide inundation. For more information about converting your height data to the new datum, please refer to **https://bit.ly/310tRh3** More details at **http://bit.ly/2t57Pgq**	**Graeme Blick** **Group Manager, Positioning & Resilience** **027 249 5901**	Nic Donnelly Manager, Positioning 04 460 0291
Property rights & surveying	When an event such as an earthquake has caused the land to move, this can also impact property boundaries. We can help to determine the impact of earth movement on property boundaries and give guidance for surveyors to help rebuild. We can also help identify and coordinate surveyors to monitor buildings and structures during recovery.	More details at **https://bit.ly/2tXhHcB**	**Anselm Haanen** **Surveyor-General** **027 249 5901**	Lyndon Telfer Assistant Surveyor-General 021 607 954
Property valuation	A disater could affect the value of your property. The rating valuation process in Canterbury was significantly affected by the devasting 2010 and 2011 earthquakes. Toitū Te Whenua do not carry out valuations, however the Office of the Valuer-General sets standards for rating valuations and audits local authorities to ensure consistent values across New Zealand.	More details at **https://bit.ly/313dvEi**	**Neill Sullivan** **Valuer-General** **027 230 5883**	Callum Taylor Deputy Valuer-General 027 230 7317