



# Automating beforeUdig requests using ArcGIS Pro, Python, and FME

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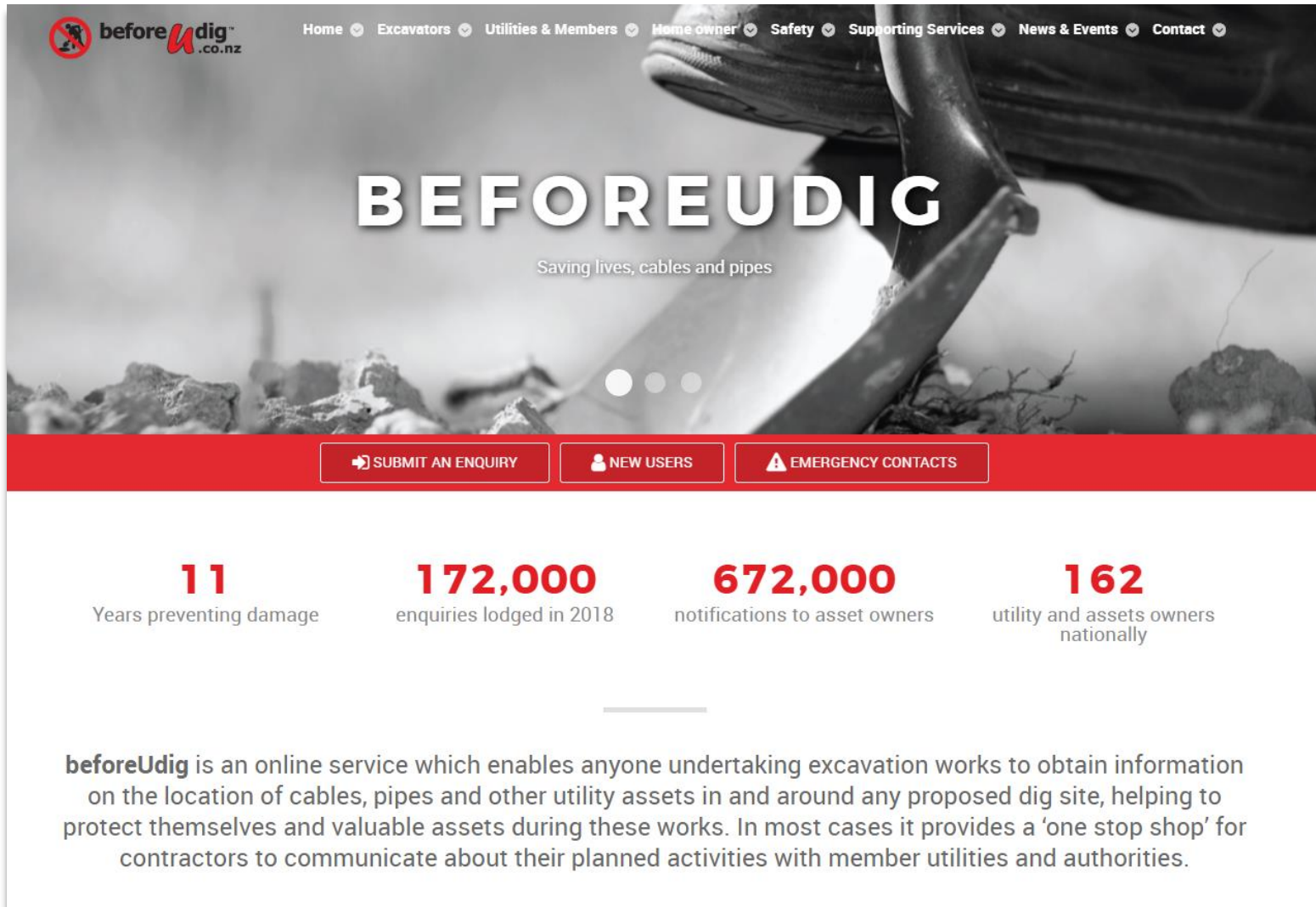
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# Agenda

1. What is beforeUdig?
2. Previous beforeUdig workflow
3. Automation in 1, 2, 3, 4!
4. New automated beforeUdig workflow



A screenshot of the beforeUdig website. The header features the beforeUdig logo on the left and a navigation menu with links: Home, Excavators, Utilities & Members, Home owner, Safety, Supporting Services, News & Events, and Contact. The main banner shows a close-up of a shovel digging into the ground with the text "BEFOREUDIG" and the tagline "Saving lives, cables and pipes". Below the banner is a red bar with three buttons: "SUBMIT AN ENQUIRY", "NEW USERS", and "EMERGENCY CONTACTS". The statistics section displays four key figures: 11 Years preventing damage, 172,000 enquiries lodged in 2018, 672,000 notifications to asset owners, and 162 utility and assets owners nationally. A paragraph at the bottom explains that beforeUdig is an online service for excavation works to obtain information on underground utility assets and provide a 'one stop shop' for contractors to communicate with member utilities and authorities.

**beforeUdig** .co.nz

Home Excavators Utilities & Members Home owner Safety Supporting Services News & Events Contact

# BEFOREUDIG

Saving lives, cables and pipes

[SUBMIT AN ENQUIRY](#) [NEW USERS](#) [EMERGENCY CONTACTS](#)

<b>11</b>	<b>172,000</b>	<b>672,000</b>	<b>162</b>
Years preventing damage	enquiries lodged in 2018	notifications to asset owners	utility and assets owners nationally

**beforeUdig** is an online service which enables anyone undertaking excavation works to obtain information on the location of cables, pipes and other utility assets in and around any proposed dig site, helping to protect themselves and valuable assets during these works. In most cases it provides a 'one stop shop' for contractors to communicate about their planned activities with member utilities and authorities.

## What is beforeUdig?

- An online service for locating underground utility assets
- Typically used for construction or design
- Councils, utilities, or other organisations are notified



## How beforeUdig works...

The screenshot shows the 'beforeUdig' web application for New Zealand. The header includes the logo and a welcome message: 'Welcome to beforeUdig, New Zealand - Protecting Lives, Cables and Pipes'. Below the header, there's a navigation bar with tabs for 'Enquiry Details', 'Location', and 'Summary'. The main interface is divided into three steps:

- Step 1: Search for dig site location**
  - Search Type: Street
  - Street: 25 Victoria Street Petone Lower Hutt Wellington 5012
  - Buttons: Search, Reset
- Step 2: Draw your dig site**
  - Instructions: The cross-hair indicates the centre of your search. You will need to mark out your dig site using the drawing tools provided.
  - Circle diam (min 25m - max 5.05km), Line (max 1km), Area (max 20km<sup>2</sup>)
- Step 3: Confirm your dig site**
  - Notes/Description of Works
  - Confirm your entered details are correct
  - Submit button

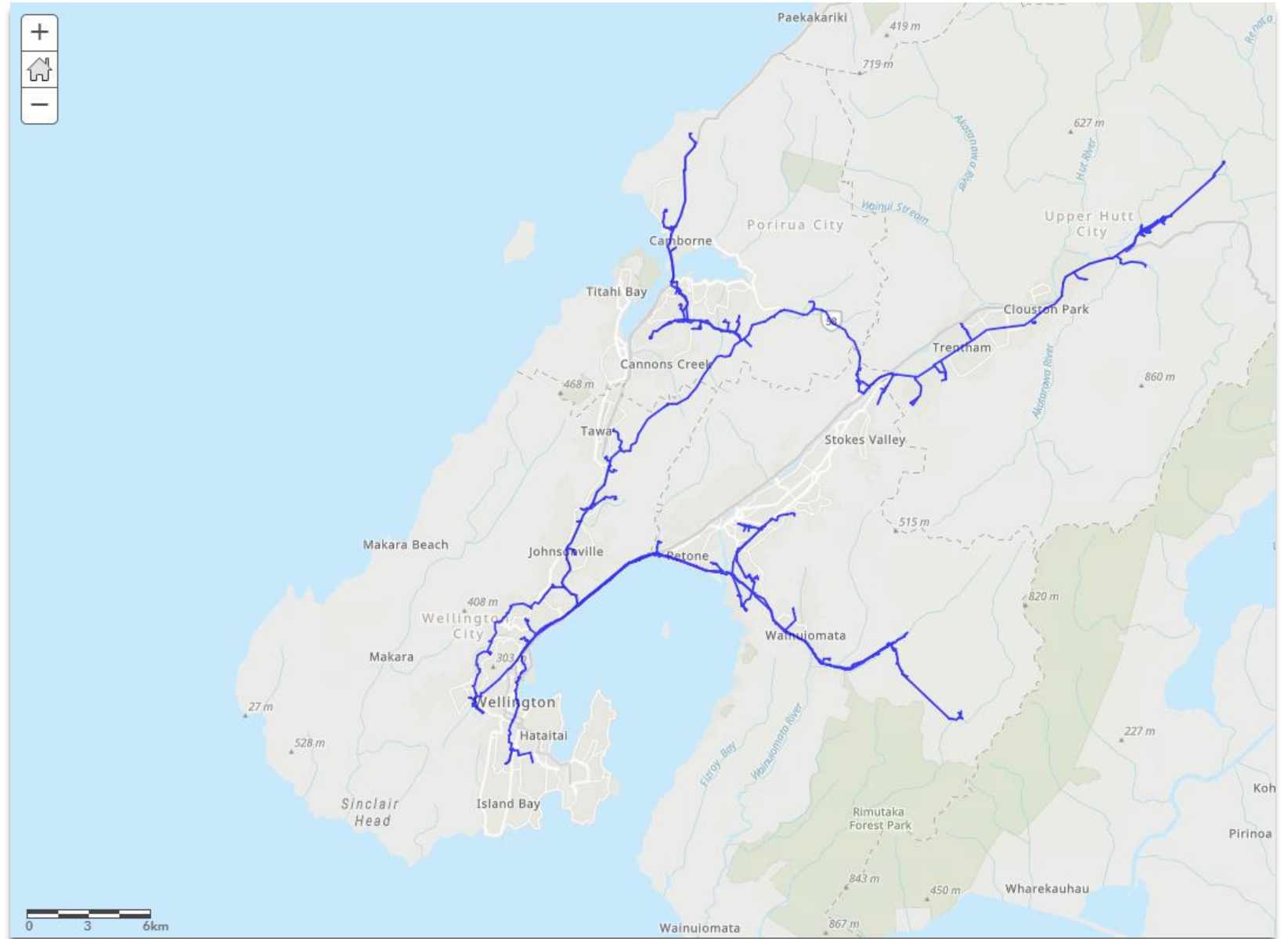
The right side of the interface features a map of the Petone area, showing streets like Hutt Road, Victoria Street, and The Esplanade. A cross-hair is visible on the map, indicating the search location. The bottom of the page contains a footer with links for Privacy Policy, Powered By PelicanCorp OneCall, Copyright, Product By PelicanCorp, Website, Map, Feedback and error reporting, and e-mail.

- Asset owners provide a dataset or WFS of their underground assets
- Users sign in to beforeUdig and...
  1. Create a job
  2. Enter job details
  3. Draw working area on map
  4. Submit
- Assets owners notified



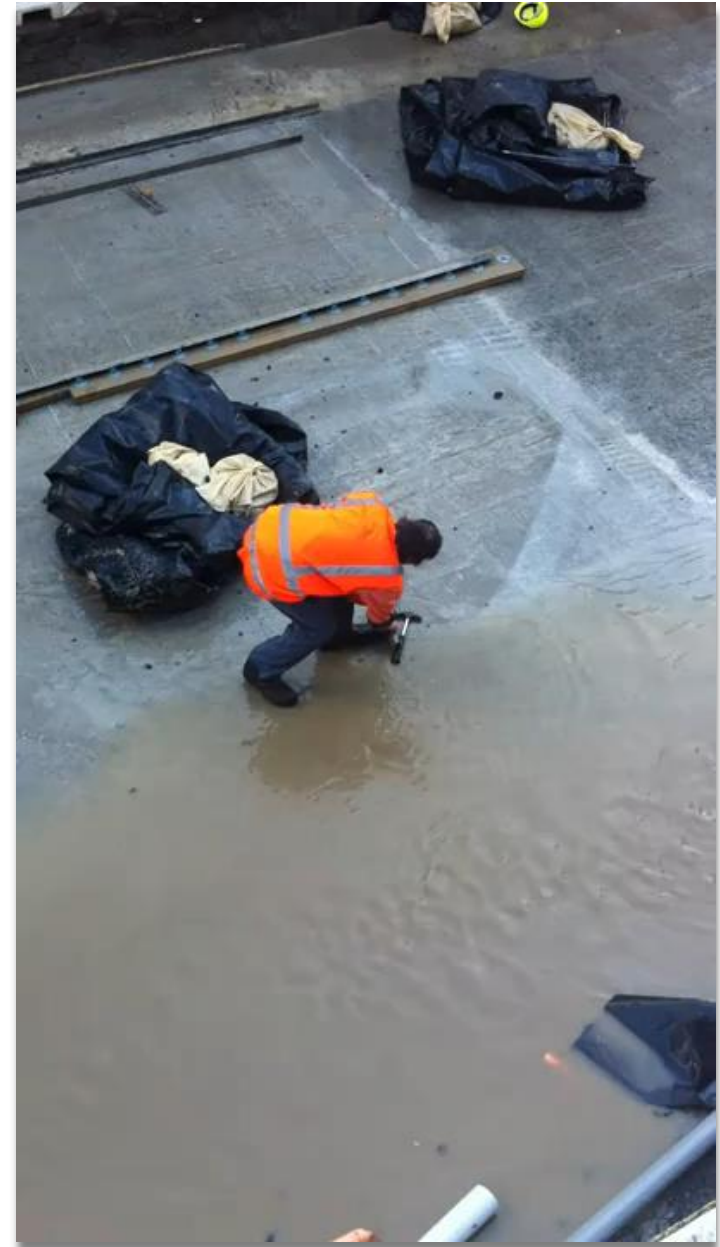
## Bulk water network

- Approx. 185 km of pipes
- Services +400,000 residents across Upper Hutt, Lower Hutt, Porirua, and Wellington



## Why bother?

- One-stop shop
- Protect people working on site
- Protect underground assets



<https://www.youtube.com/watch?v=vA8B4sKI9zA>

# Previous beforeUdig workflow

*According to the documentation...*

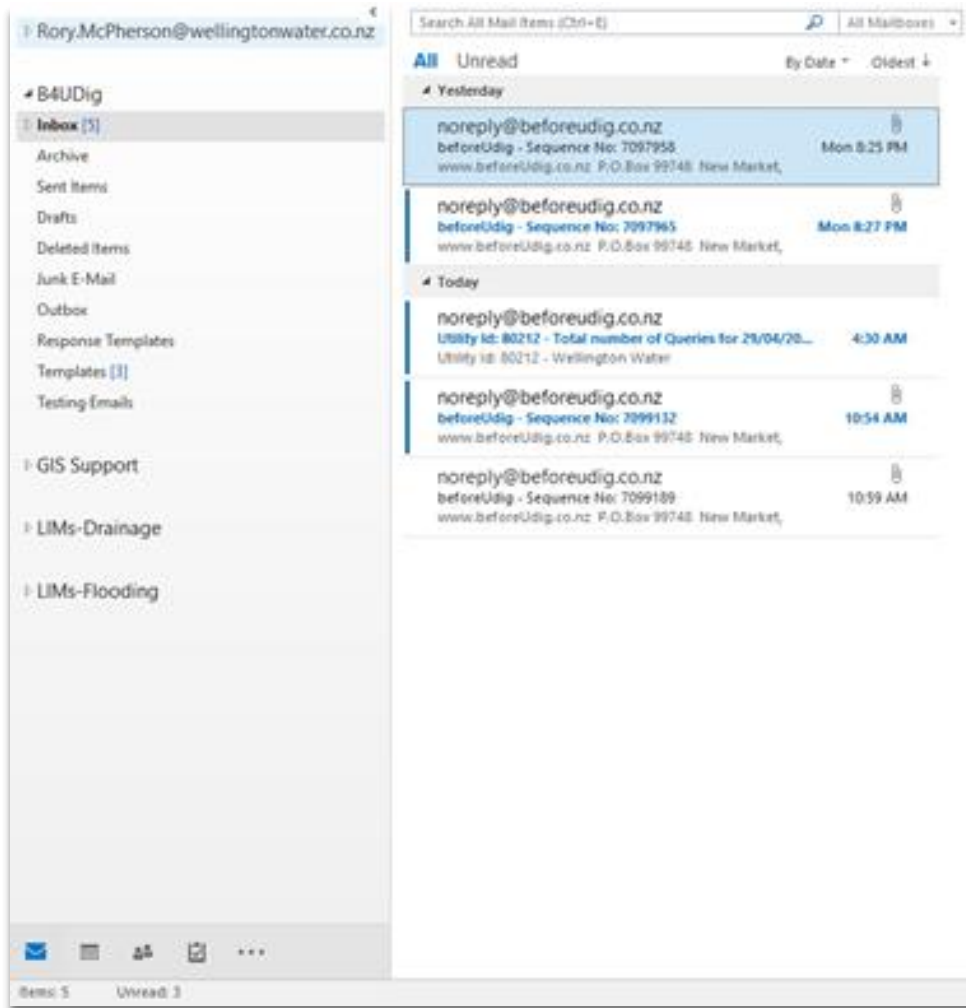


Sequence Notice Response  
Process Documentation

# Previous beforeUdig workflow

*According to the documentation...*

## 1. Monitor incoming emails





beforeUdig™

Sequence No 7258698

Ph: 0800248344  
www.beforeudig.co.nz

#### Utility Details

Please be advised the person below has requested information about underground assets in your jurisdiction. You are required to respond within 2 working days and reference the Job Number, Sequence Number and the User Reference (where supplied).

**To:** Information Development Team  
**Utility ID:** 80212  
**Utility Name:** Wellington Water  
**Email:** b4udig@wellingtonwater.co.nz

**Enquiry Date:**  
**Priority Type:** Normal  
**Enquiry Medium:** Web

#### Customer Details

**Customer ID:**  
**Company:**  
**Address:**  
**Email:**

**Contact:**  
**Phone:**  
**Mobile:**  
**Fax:**

#### Proposed Site Location



**WARNING:** The adjacent map displays the extent of the proposed dig site as specified and confirmed by the beforeUdig customer.

**User Reference:**

Not Supplied

**Working on Behalf of:**

Private

**Start Date:**

10/07/2019

**End Date:**

10/07/2019

**Address:**

50 Takapu Road  
Grenada North Wellington 5028

**For Planning:**

Yes

**Asset Locate:**

No

**Workplace Location:**

Both

**Nature of Works:**

**Plans Requested:**

Yes

**Preferred Locate Date:**

Not Supplied

**Location in Road:**

CarriageWay, Footpath, Berm

Major Earthworks Cutting/Fill

**Additional Work Site Notes:**

Plans only please

## Previous beforeUdig workflow


*According to the documentation...*



1. Monitor incoming emails
2. Review beforeUdig PDF

# Previous beforeUdig workflow

*According to the documentation...*

1. Monitor incoming emails
2. Review beforeUdig PDF
3. Copy coordinates from email...

 noreply@beforeudig.co.nz | B4Udig  
beforeUdig - Sequence No: 7099189

 7099189.PDF 91 KB  
 7099189\_80212\_30\_04\_2019.GML 1 KB

COMPLETION DATE= 31/05/2019  
WORKING FOR AUTHORITY= Wellington City Council


[CALLER DETAILS]  
CUSTOMER ID=  
CONTACT NAME=  
COMPANY=  
ADDRESS=  
SUBURB=  
TOWN/CITY=  
POSTCODE=  
TELEPHONE=  
MOBILE=  
FAX NUMBER=  
EMAIL ADDRESS=

[LOCATION DETAILS]  
ADDRESS=  
SUBURB=  
TOWN/CITY= Wellington  
REGION= Wellington  
POSTCODE= 6011  
ACTIVITY CODE= 105  
ACTIVITY DESCRIPTION= Minor Earthworks/Filling  
**GPS X COORD= 174.771719**  
**GPS Y COORD= -41.276699**  
PRIVATE/ROAD/BOTH= Road Reserve  
JOB NUMBER= 1419880  
MESSAGE= Digout between Tinakori st and Parliament  
NZMESSAGE=

# Previous beforeUdig workflow

*According to the documentation...*

1. Monitor incoming emails
2. Review beforeUdig PDF
3. Copy coordinates from email...
4. Convert coordinates to NZTM



Land Information  
New Zealand  
Toitū te whenua

Back to main site ↗

### Online Conversions - basic

Convert between pre-selected [geodetic datums](#) and [projections](#) using default input and output parameters.

Use the [vertical datum conversion](#) to convert between New Zealand vertical datums - see [instructions](#) for more information.

Use the [detailed online conversion](#) to choose from a wider range of [datums, projections and height systems](#) (including bulk options) that are more suited to users with an understanding of coordinate systems.

#### Input coordinate system

New Zealand Geodetic Datum 1949 ▾

Details

#### Output coordinate system

New Zealand Transverse Mercator Projection ▾

Details

#### Conversion options

Conversion date

Specifies the date at which the conversion applies. Many conversions, for example, are based on a specific date. The date can be entered either as a decimal year (eg 2000, 2013.5) or the word "now" for the current date.

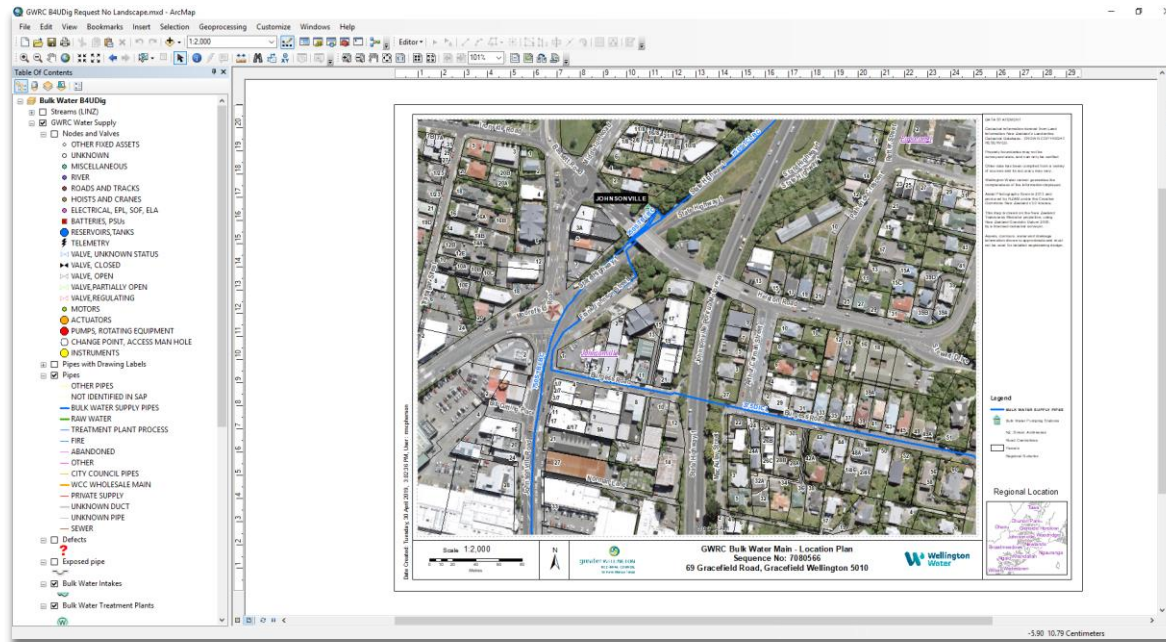
Enter coordinates

Advanced options

# Previous beforeUdig workflow

*According to the documentation...*

1. Monitor incoming emails
2. Review beforeUdig PDF
3. Copy coordinates from email...
4. Convert coordinates to NZTM
5. Open map document



## Examples

### *Bulk Supply within Proposed Site Location*

In this example, the Bulk Supply main passes through the Proposed Site Location along Main St. Additionally, the Location in Road mentions the Carriageway and Footpath which is where this particular main lies.



**WARNING:** The adjacent map displays the extent of the proposed dig site as specified and confirmed by the beforeUdig customer.

**User Reference:**

Not Supplied

**Working on Behalf of:**

Private

**Start Date:**

21/04/2017

**End Date:**

21/04/2017

**Address:**

92-102 Main St, Princes St, 17-19 Geange St, 879-897 F Upper Hutt Central Wellington 5018

**For Planning:**

Yes

**Plans Requested:**

Yes

**Asset Locate:**

No

**Preferred Locate Date:**

Not Supplied

**Workplace Location:**

Both

**Location in Road:**

CarriageWay, Footpath, Berm

**Nature of Works:**

Major Earthworks Cutting/Fill

#### **Additional Work Site Notes:**

Plans only please.



# Previous beforeUdig workflow

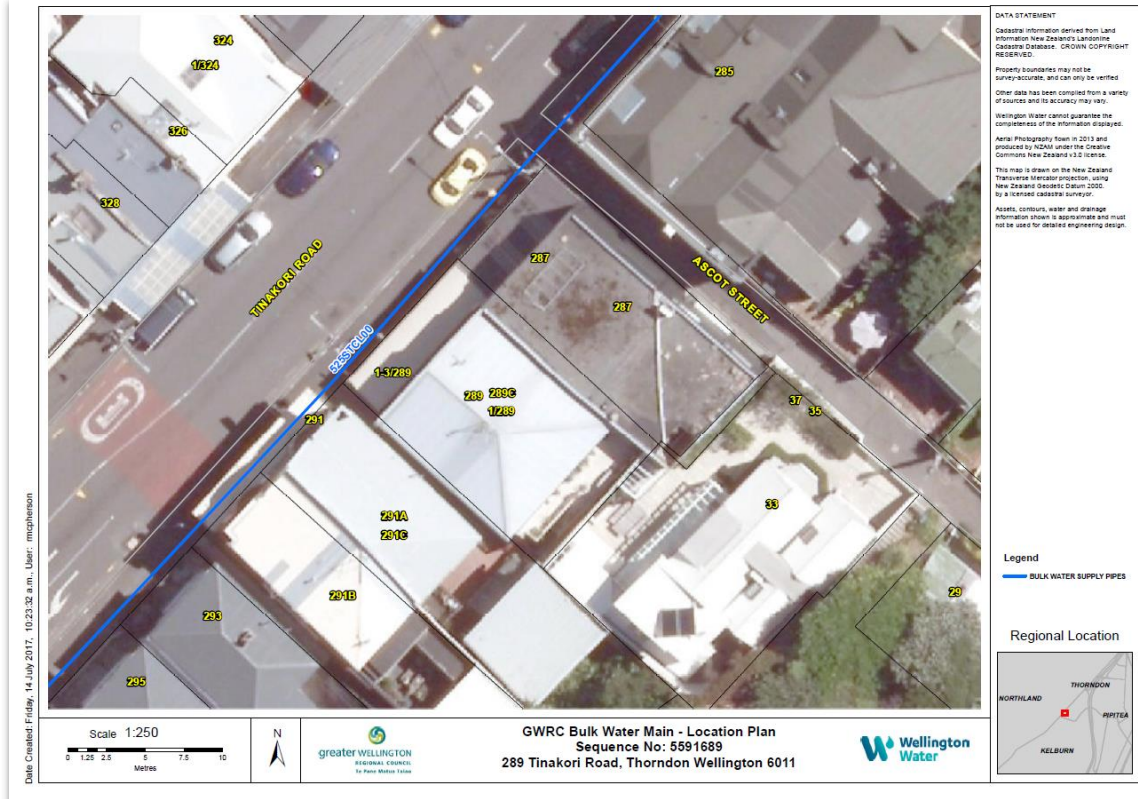
*According to the documentation...*

1. Monitor incoming emails
2. Review beforeUdig PDF
3. Copy coordinates from email...
4. Convert coordinates to NZTM
5. Open map document
6. Assess site location for assets

# Previous beforeUdig workflow

*According to the documentation...*

1. Monitor incoming emails
2. Review beforeUdig PDF
3. Copy coordinates from email...
4. Convert coordinates to NZTM
5. Open map document
6. Assess site location for assets
7. Make a map (or map series)






# Previous beforeUdig workflow

*According to the documentation...*

1. Monitor incoming emails
2. Review beforeUdig PDF
3. Copy coordinates from email...
4. Convert coordinates to NZTM
5. Open map document
6. Assess site location for assets
7. Make a map (or map series)
8. Find and download as build drawings



Name

-  Standard Clearances Letter - Wellington Water.pdf
-  Wellington Water BeforeUDig Sequence No 6120982 - 120 Hutt Park Road - DRAWINGS.zip
-  Wellington Water BeforeUDig Sequence No 6120982 - 120 Hutt Park Road.pdf

# Previous beforeUdig workflow

*According to the documentation...*

1. Monitor incoming emails
2. Review beforeUdig PDF
3. Copy coordinates from email...
4. Convert coordinates to NZTM
5. Open map document
6. Assess site location for assets
7. Make a map (or map series)
8. Find and download as build drawings
9. Package everything up for customer



## Standard clearances to wholesale water supply pipelines

1. If excavations for services are close to a wholesale water pipeline, the pipeline is to be located by our Pipelines team before work commences. Direct contact details are as follows:

- Frank O'Keeffe 021 426 951
- Mark Poehls 021 486 594

2. Minimum clearances are as follows:

- Parallel to the pipeline 1,000mm in plan
- Minimum clearance over or under the pipeline 150mm

All crossings of the pipeline are to be at or near right angles.

3. High voltage electrical cables (greater than 400 volts) to be installed parallel to a water pipeline over a length greater than 100m require a low frequency induction assessment and specific approval from Wellington Water.

4. Our Pipelines team is to be advised when excavation is to begin at least two days prior to work beginning. When the pipeline is exposed in excavations, care shall be taken to ensure that the protective coating is not damaged. Excavation shall be with hand tools when working within 500mm of the pipe.

5. The pipe shall be exposed and monitored when drilling is within 1,000mm of the pipeline.

6. Backfilling material placed around the pipe shall be clean and free from organic material, large stones and soft silts and clays. Crusher run or river run, 10mm down in size or less, are suitable materials.

Hand compaction all around the pipe is necessary, taking care not to cause damage either to the pipe or the protective coating. A minimum cover of 600mm shall be placed before any large mechanical compacting equipment is used.

Staff from the Pipelines team will inspect the pipe before backfilling commences and will be present during backfilling around the pipe.

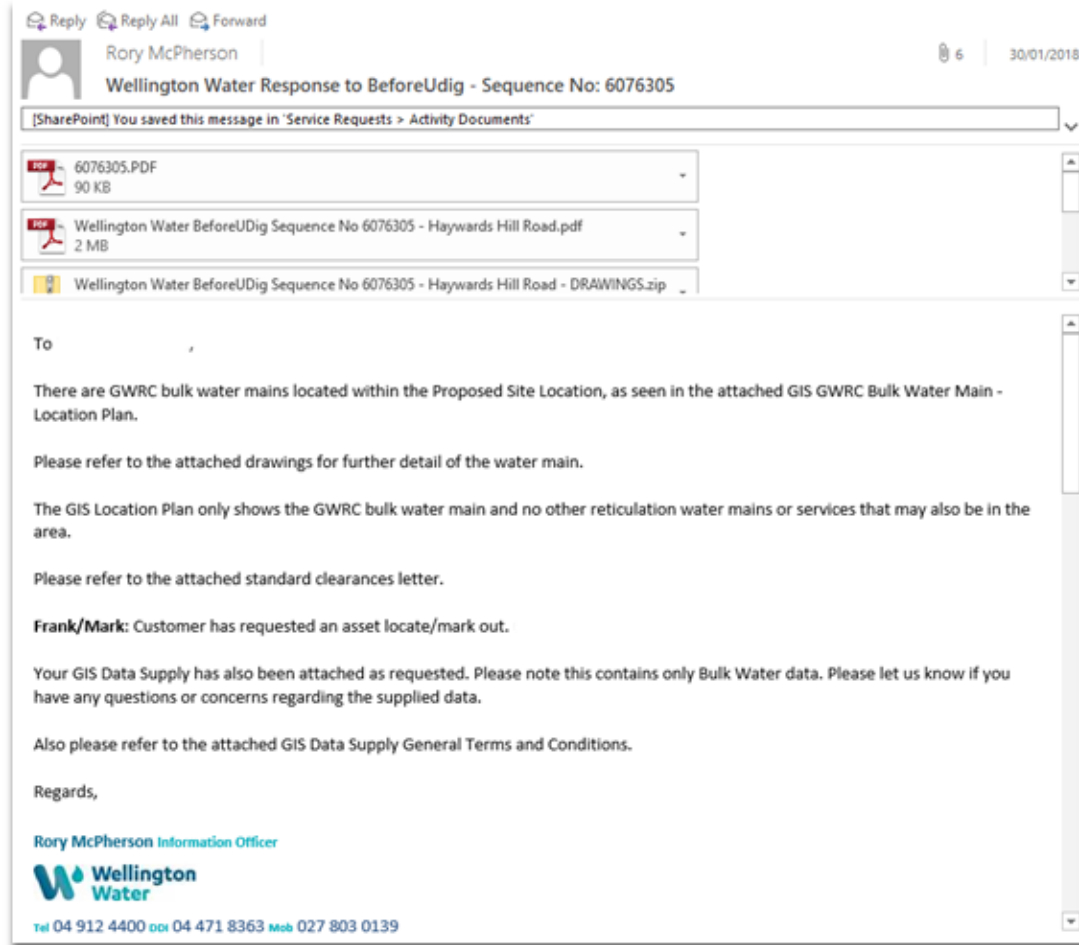
Prepared by:

Information Directorate  
Wellington Water

# Previous beforeUdig workflow

*According to the documentation...*

1. Monitor incoming emails
2. Review beforeUdig PDF
3. Copy coordinates from email...
4. Convert coordinates to NZTM
5. Open map document
6. Assess site location for assets
7. Make a map (or map series)
8. Find and download as build drawings
9. Package everything up for customer
10. Email customer with response, maps, as build drawings, and required letters



## Overall...

- Manual, tedious process
- Very repetitive
- Could take up to 15 min. or longer



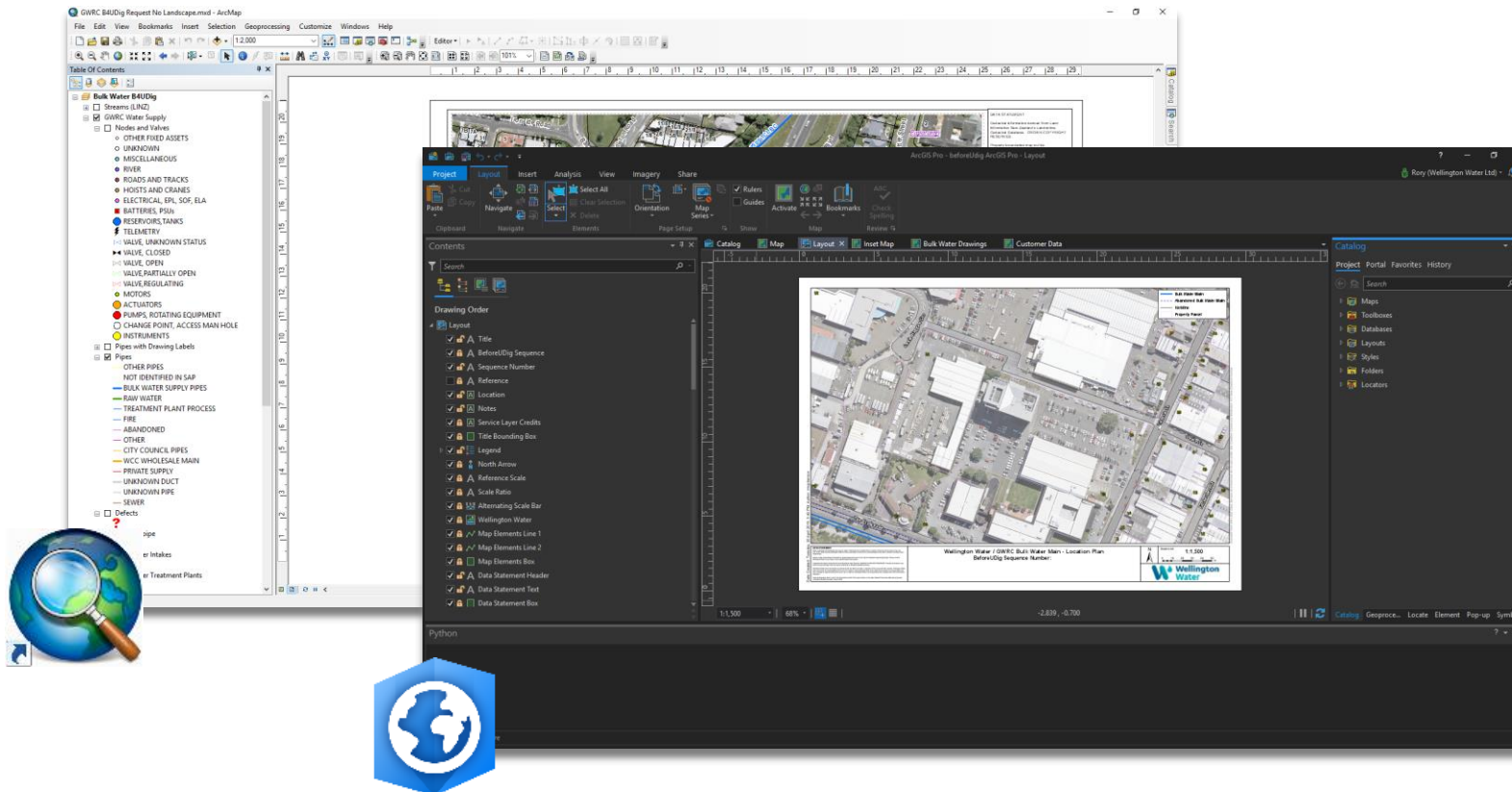
## Choosing the right tools for the job...

⚙️ Task: Improve beforeUdig map document

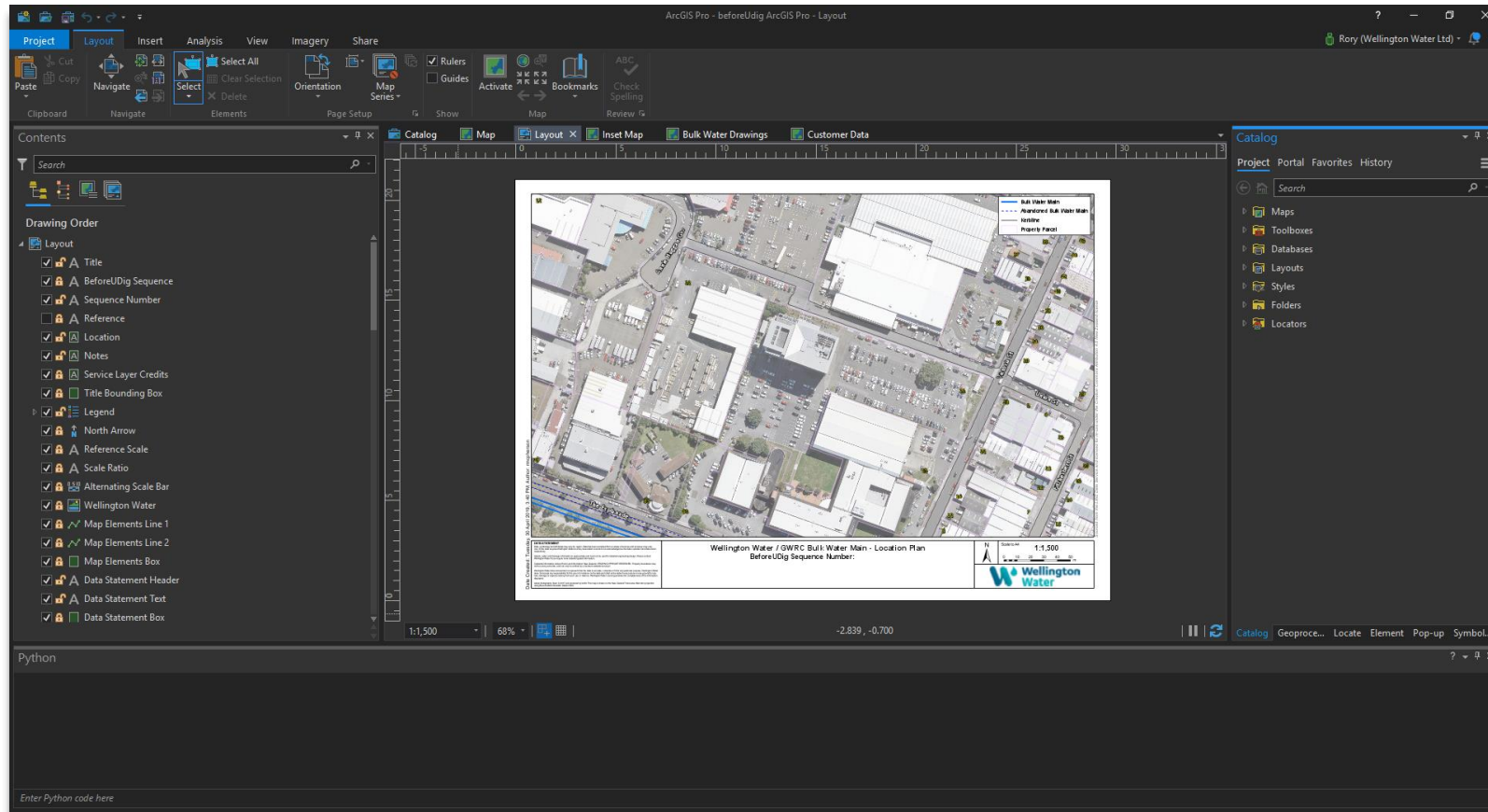
✓ Solution: ArcGIS Pro

## Automation: Step 1

✓ ArcMap to ArcGIS Pro



## Choosing the right tools for the job...



## Automation: Step 1

- ✓ ArcMap to ArcGIS Pro
- Single working project
- Supports Python 3
- Dark theme

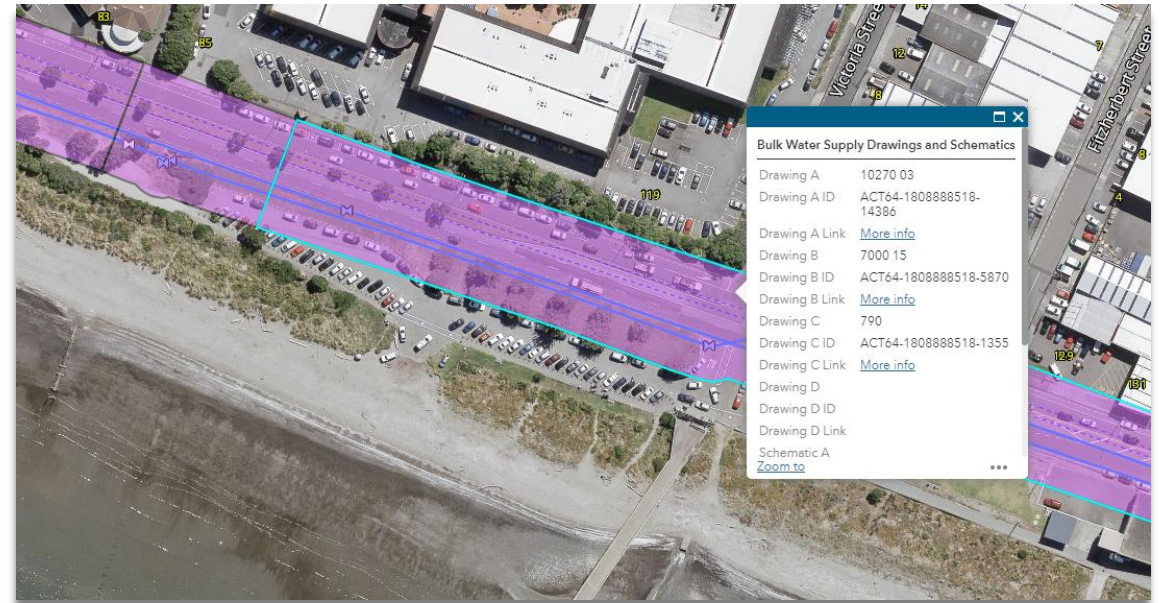
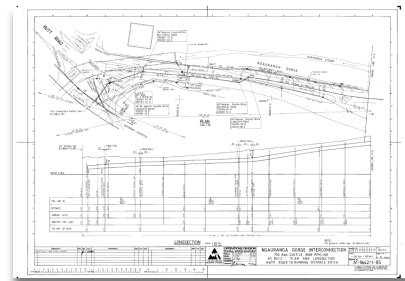
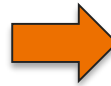
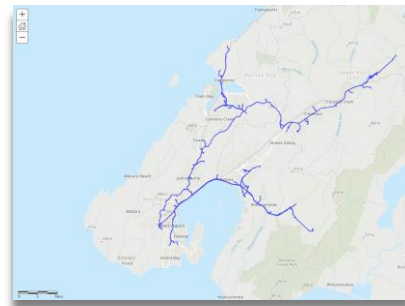


## Automation: Step 2

- Applied buffer to pipes
- Georeferenced as build drawings and schematics
- Ta da! A new 'Bulk Water Supply Drawings and Schematics' layer

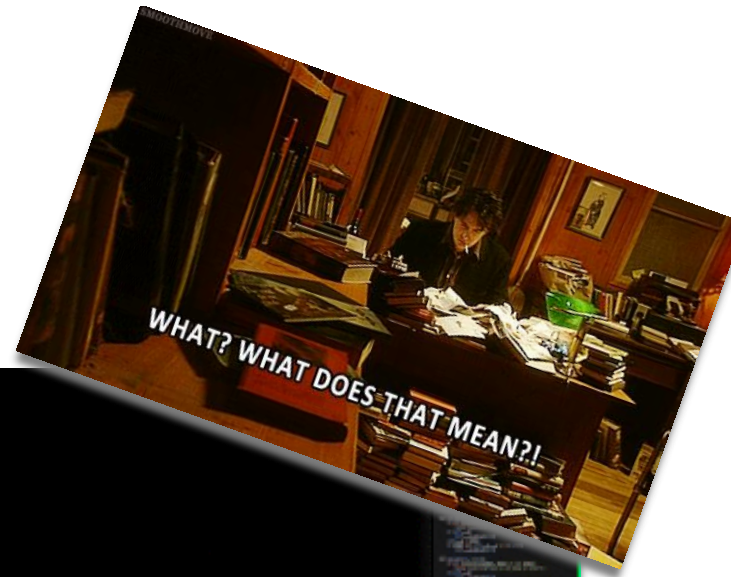
Find drawings by location...

- ⚙ Task: Locate as build drawings and schematics via GIS
- ✓ Solution: New drawings and schematics feature layer

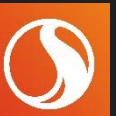




## Automation: Step 3



```
2
3 class Room(object):
4     def __init__(self, inventory, desc, short_desc):
5         self.inventory = inventory
6         self.__n = None
7         self.__s = None
8         self.__e = None
9         self.__w = None
10        self.__desc = desc
11        self.__short_desc = short_desc
12        self.__gate_n = None
13        self.__gate_s = None
14        self.__gate_e = None
15        self.__gate_w = None
16
17        if not isinstance(desc, str):
18            raise TypeError("the input provided is not a string.")
19        elif not isinstance(short_desc, str):
20            raise ValueError("the string provided is empty.")
21
22        # these set the gates
23        # they set the opposite gates, with checks to avoid recursion loops
24        def set_n(self, other):
25            if not isinstance(other, Room) or not other:
26                raise TypeError("room is not None or an instance of Room")
```

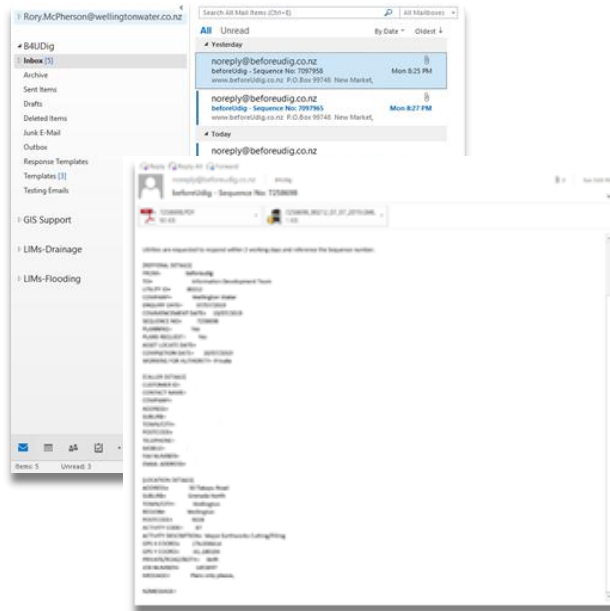


Why read emails? Just a bit of code can do it for you.

⚙ Task: Reading, writing and sending emails

✓ Solution: Exchangelib

- <https://github.com/ecederstrand/exchangelib>



```
for email in beforeUdigAccount.inbox.all().order_by('datetime_received')[:1]:
    if email.subject.startswith('beforeUdig - Sequence No'): # filter beforeUdig
        beforeUdigEmail = str(email.body.replace("\r\nwww.beforeUdig.co.nz\r\n"))
        emailBodyList = email.body.split('\r\n')
        sequenceNum = emailBodyList[18][-9:-2]
        contactName = emailBodyList[27][23:].title()
        company = emailBodyList[28][23:]
        emailAddress = emailBodyList[36][23:]
```



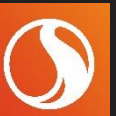
Save credentials as environment variables

```
emailUser = os.environ.get('EMAIL_USER')
password = os.environ.get('PASSWORD')
myCredentials = Credentials(emailUser, password) # set access
beforeUdigAccount = Account('B4UDig@wellingtonwater.co.nz',
```

## Automation: Step 3



✓ Emails



Don't bother creating anymore working folders yourself.

⚙ Task: Create project directory

✓ Solution: Os and Shutil

- <https://docs.python.org/3/library/os.html>
- <https://docs.python.org/3/library/shutil.html>

```
# create beforeUdig directory
folderDir = r'G:\Information Directorate\Data Inquires\B4UDig\Bulk Water BeforeUDig\'
requestFolder = sequenceNum + ' - ' + contactName + ', ' + company # name of folder to be created
drawingsFolder = r'\\Drawings' # name of drawings folder
beforeUdigFolder = folderDir + requestFolder # set directory
os.makedirs(beforeUdigFolder) # create directory folder(s)
os.makedirs(beforeUdigFolder + drawingsFolder) # make drawings folder
shutil.copy(r'G:\Information Directorate\Data Inquires\B4UDig\Bulk Water BeforeUDig\Standard Clearances Letter -
```

## Automation: Step 3



✓ Emails

✓ Files / Folders

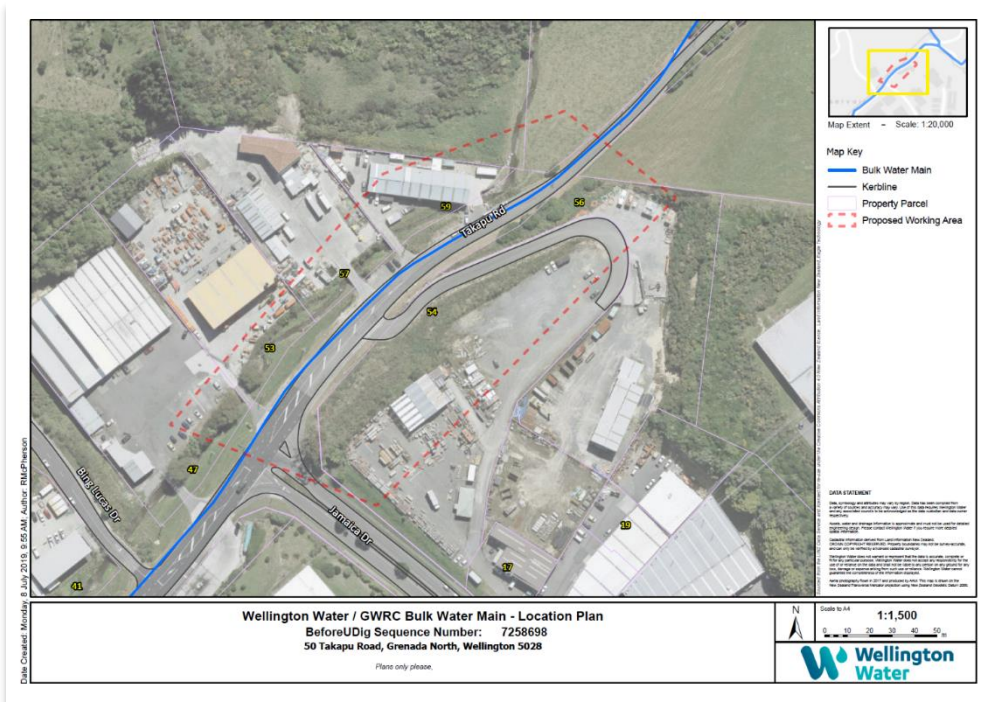


## Automatic map production!

⚙ Task: Make a map

✓ Solution: ArcPy

- <https://pro.arcgis.com/en/pro-app/arcpy/main/arccgis-pro-arcpy-reference.htm>



Read the online documentation



Symbology class

Computers *can* make beautiful maps!



Camera class

Combine with `math.ceil` to get that perfect scale!

## Automation: Step 3



Emails



Files / Folders



Make a map

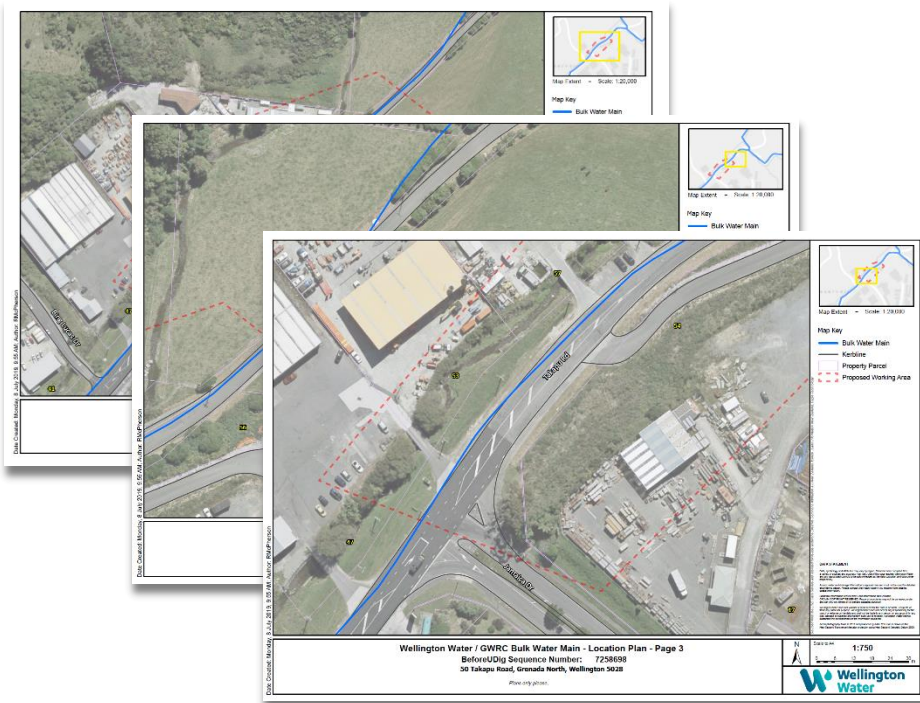


## Automatic map production!

⚙️ Task: Make a map series

✓ Solution: ArcPy

- <https://pro.arcgis.com/en/pro-app/arcpy/main/arcpy-pro-arcpy-reference.htm>



💡 GridIndexFeatures

💡 Memory workspace

Write geoprocessing outputs to memory!

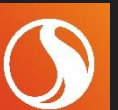
💡 SearchCursor

Works with regular expressions!

## Automation: Step 3



- ✓ Emails
- ✓ Files / Folders
- ✓ Make a map
- ✓ Make a map series



## A bit of geoprocessing...

⚙ Task: Assess site location for assets

✓ Solution: ArcPy

- <https://pro.arcgis.com/en/pro-app/arcpy/main/arcgis-pro-arcpy-reference.htm>



SelectLayerByLocation



Describe function

Returns an object's properties, such as data type, fields, indexes, etc

```
prox = arcpy.Describe(pipeBuffer)
if prox.FIDSet == '':
    proximityResponse = 'OUTSIDE PROXIMITY'
else:
    proximityResponse = 'IN PROXIMITY'
```

## Automation: Step 3



- ✓ Emails
- ✓ Files / Folders
- ✓ Make a map
- ✓ Make a map series
- ✓ Assess site location



# Give me all the drawings!

⚙ Task: Find and download as build drawings

✓ Solution: ArcPy and Requests

- <https://pro.arcgis.com/en/pro-app/arcpy/main/arcgis-pro-arcpy-reference.htm>
- <https://2.python-requests.org/en/master/>
- <https://2.python-requests.org/en/master/user/authentication/>



## Authentication

Find which authentication method works for you.



## SelectLayerByLocation



## SearchCursor

## Automation: Step 3



Emails



Files / Folders



Make a map



Make a map series



Assess site location



As build drawings



## Automation: Step 4

Sorting out your data...

⚙ Task: Convert from GML to shapefile

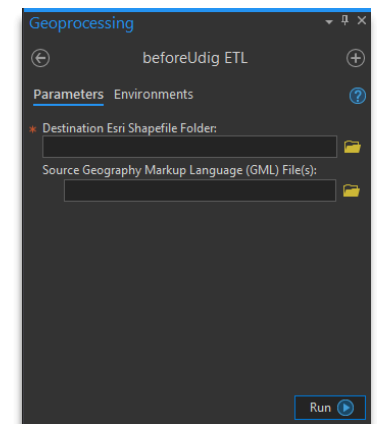
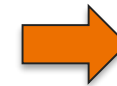
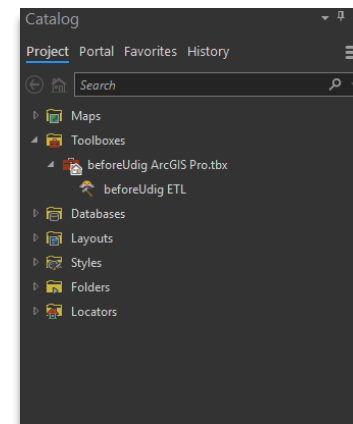
✓ Solution: FME

- <https://pro.arcgis.com/en/pro-app/help/data/data-interoperability/create-an-esri-spatial-etl-tool.htm>

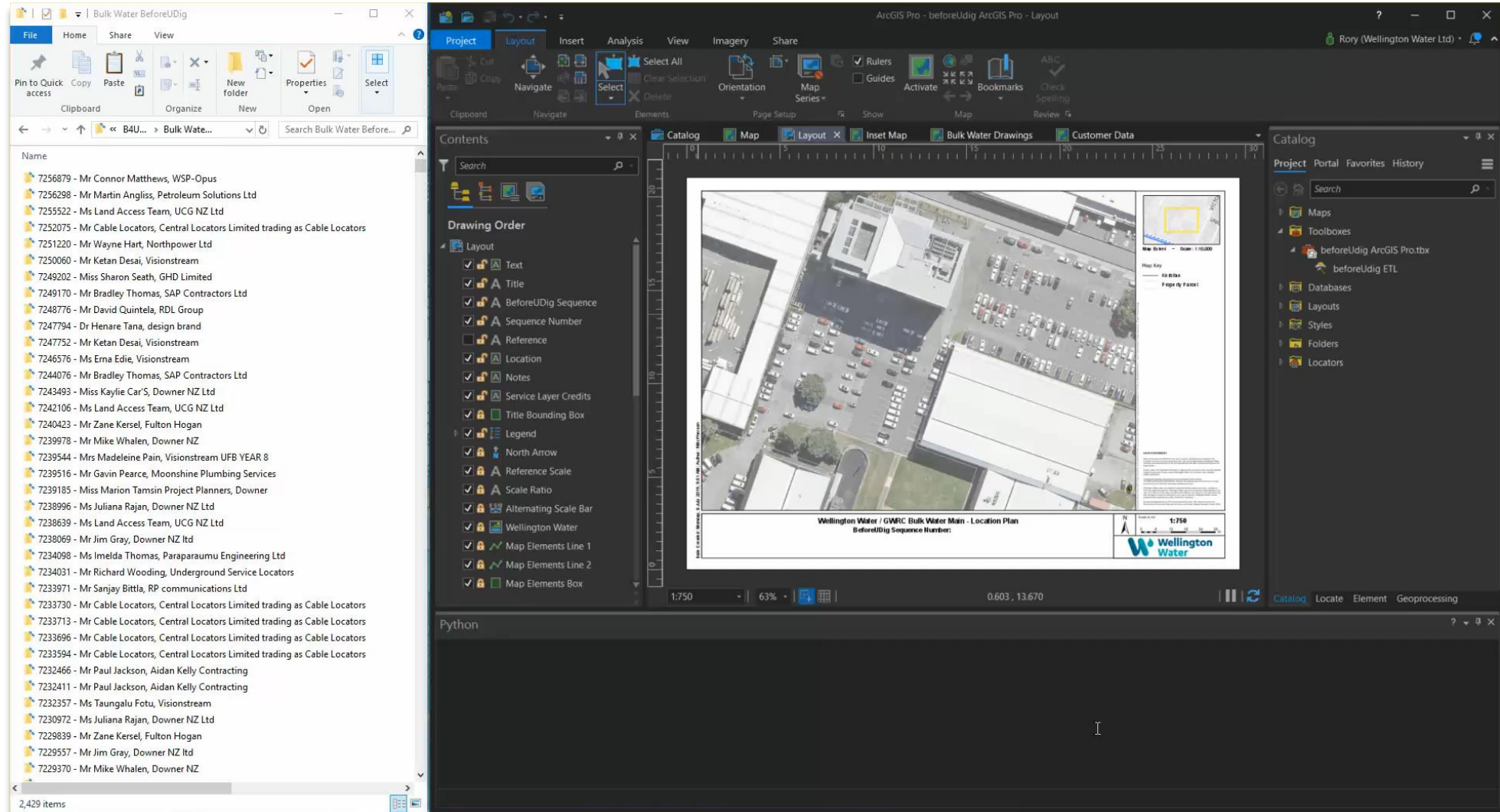


Spatial ETL tool

Add your FME workbench to  
your toolbox in ArcGIS Pro!

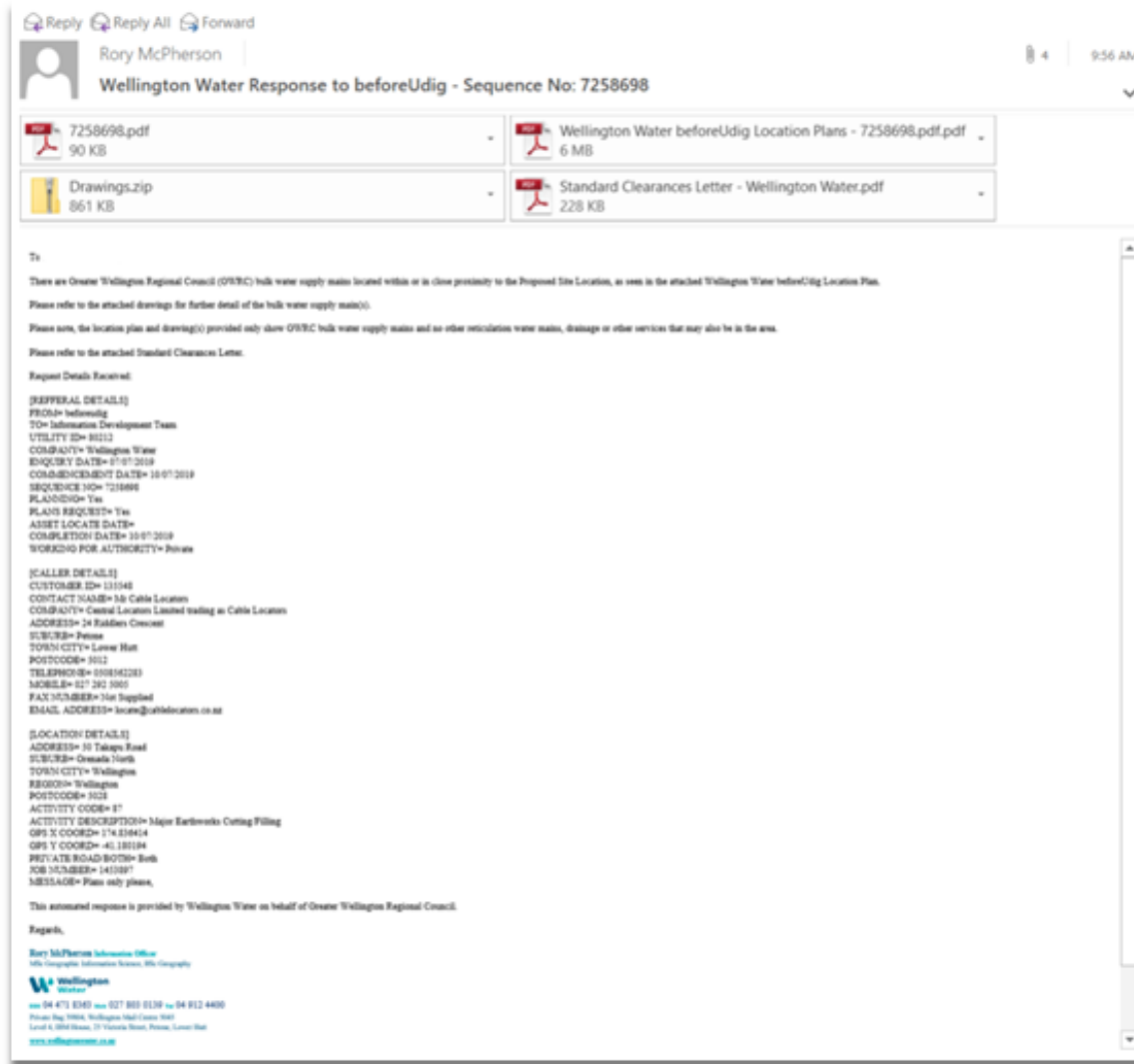


# The new automated beforeUdig workflow



# What does the customer get?

- Nicely formatted email with:
  - Specific customer response
  - Original job request information
  - Locate Services Team (cc'd if requested by customer)
- Original PDF
- Map document (Location Plan PDF)
- Zipped drawings folder
- Standard Clearances Letter



## The end result

- Mostly automated process
- Very fast – can complete in less than a minute
- Huge savings in time and costs



# Automating beforeUdig requests using ArcGIS Pro, Python, and FME

## Questions?

**Rory McPherson**  
GIS Analyst

✉ [rory.mcpherson@Stantec.com](mailto:rory.mcpherson@Stantec.com)

