

*Bringing ideas
to life*



Blasting Assessment Reports - Python Beyond the Toolbox

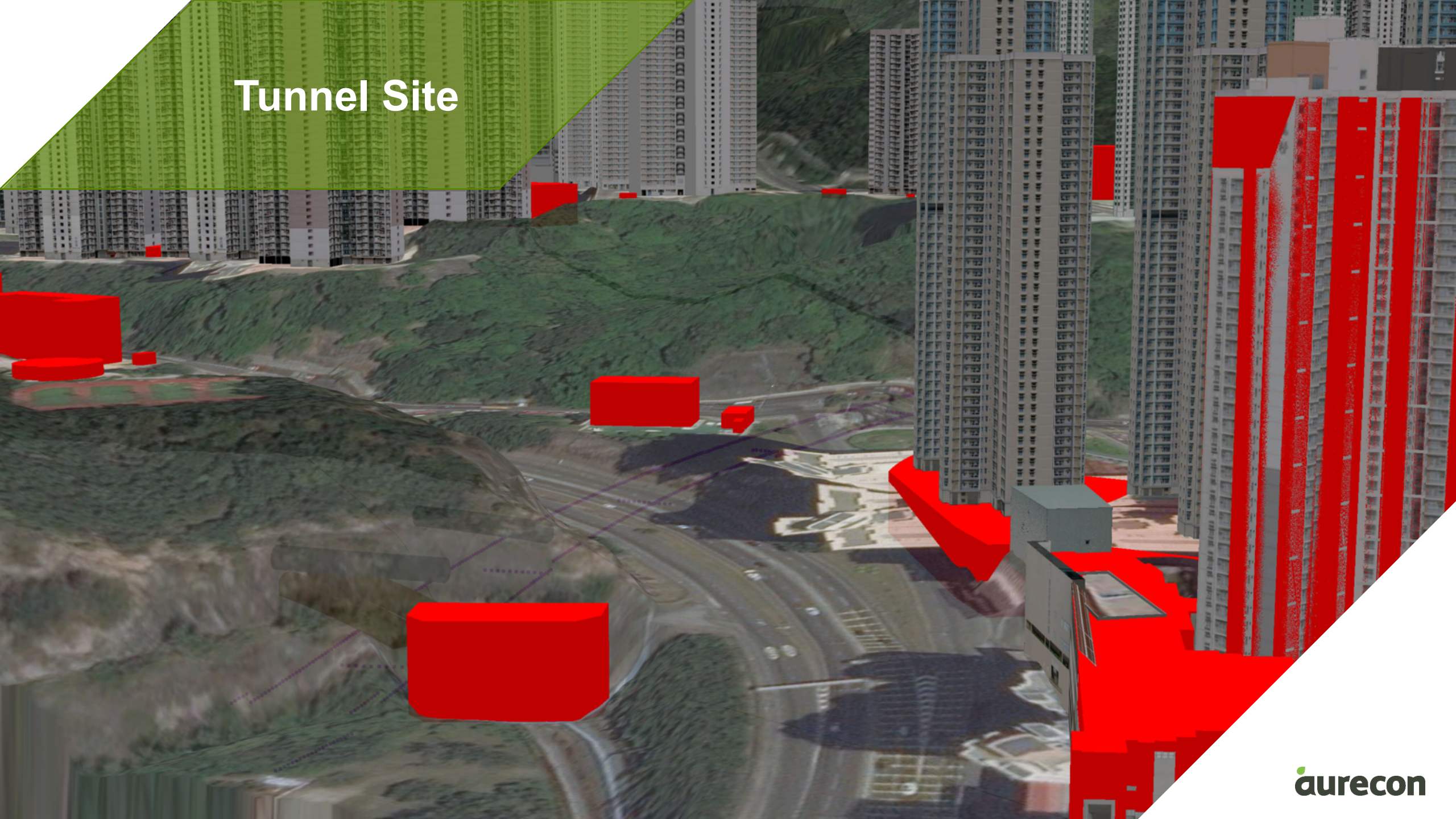
NZEUC 2017
Steven Haslemore 15/08/2017

aurecon

Themes to GIS by:

- GIS as the consultancy within a consultancy/organisation
- Domain vs Technical experts
- Sometimes the GIS thing just needs to get out of the way

Tunnel Site



Bringing ideas to life

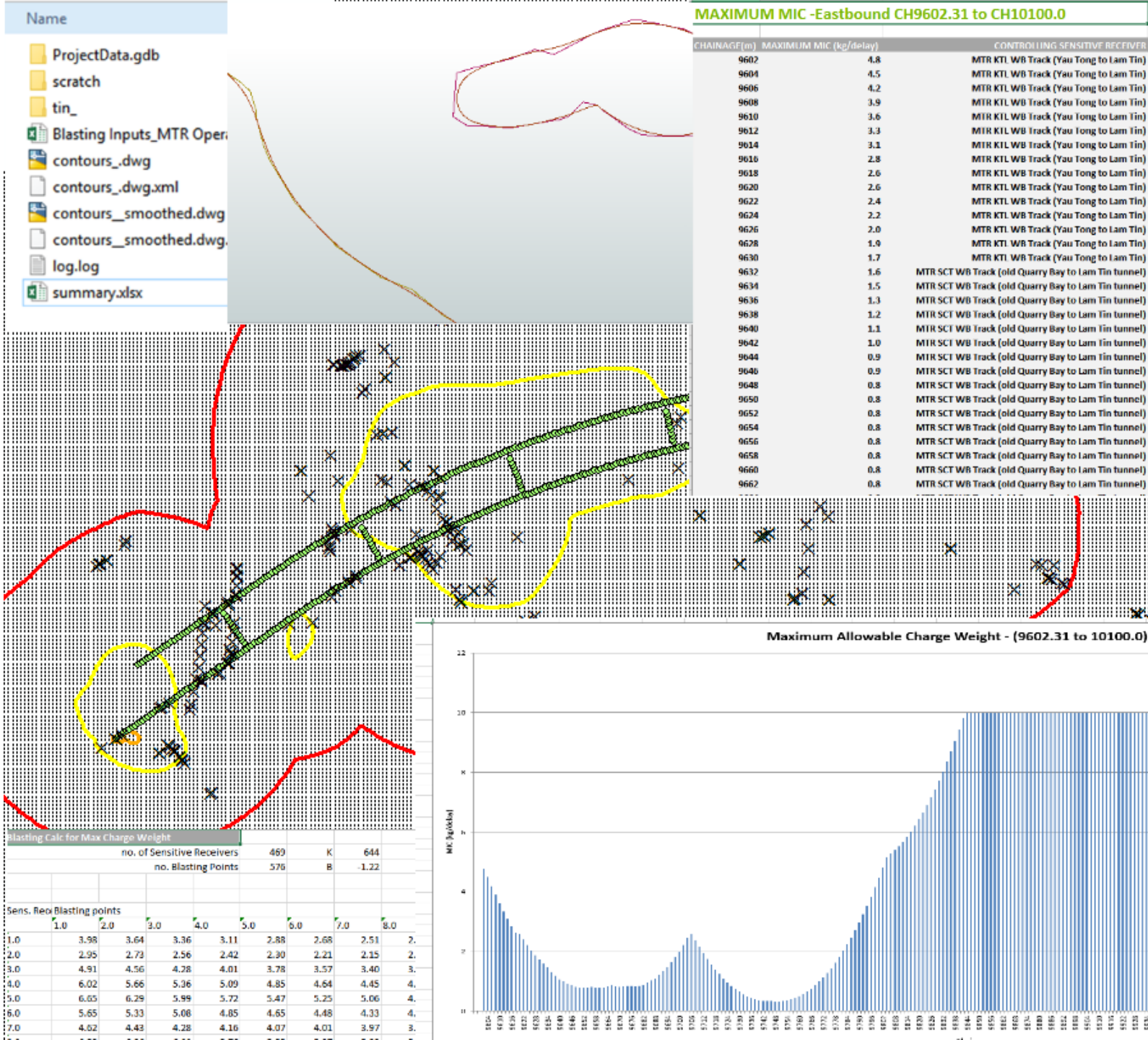
```
# TUNNEL <B> <K> <T> <area name> <input file> <sensitive receiver sheet name> <blast point sheet name> <output folder>
# SURFACE <B> <K> <T> <AR> <area name> <input file> <sr sheet> <bp file> <blast point sheet name> <output folder>
```

Project Data

LIST OF SENSITIVE RECEIVERS						LIST OF BLAST POINTS						
Reference	ID	Easting	Northing	Level	PPV Limit	Reference	Easting	Northing	Blast Level (mPD)	Charge	Tunnel Type	Alignment
1	842198.890	818185.47	5.5	20	4	1	842170.154	818192.078	-3.93	9570.7	Pilot Tunnel	Pilot Tunnel
2	842192.680	818180.20	5.5	20	5	2	842170.978	818192.644	-4.05	9571.7	Pilot Tunnel	Pilot Tunnel
3	842202.250	818181.61	5.5	20	6	3	842177.626	818193.776	-4.50	9573.7	Pilot Tunnel	Pilot Tunnel
4	842205.590	818177.77	5.5	20	7	4	842174.274	818194.907	-4.55	9575.7	Pilot Tunnel	Pilot Tunnel
5	842207.310	818175.79	5.5	20	8	5	842175.022	818196.039	-4.80	9577.7	Pilot Tunnel	Pilot Tunnel
6	842198.890	818185.47	20.6	20	9	6	842177.571	818197.170	-5.05	9579.7	Pilot Tunnel	Pilot Tunnel
7	842192.680	818180.20	20.6	20	10	7	842179.219	818198.302	-5.30	9581.7	Pilot Tunnel	Pilot Tunnel
8	842192.680	818181.61	20.6	20	11	8	842180.867	818199.433	-5.55	9583.7	Pilot Tunnel	Pilot Tunnel
9	842205.590	818177.77	20.6	20	12	9	842182.516	818200.565	-5.80	9585.7	Pilot Tunnel	Pilot Tunnel
10	842207.310	818175.79	20.6	20	13	10	842184.164	818201.697	-6.05	9587.7	Pilot Tunnel	Pilot Tunnel
11	842199.580	818184.68	4.3	70	14	11	842185.812	818202.828	-6.30	9589.7	Pilot Tunnel	Pilot Tunnel
12	842200.940	818183.11	4.3	70	15	12	842187.461	818203.960	-6.55	9591.7	Pilot Tunnel	Pilot Tunnel
13	842202.400	818181.43	4.3	70	16	13	842189.109	818205.091	-6.80	9593.7	Pilot Tunnel	Pilot Tunnel
14	842207.100	818176.04	4.3	70	17	14	842190.757	818206.223	-7.05	9595.7	Pilot Tunnel	Pilot Tunnel
15	842209.130	818173.70	4.3	70	18	15	842192.406	818207.354	-7.30	9597.7	Pilot Tunnel	Pilot Tunnel
16	842356.530	818302.30	37.3	15	19	16	842194.054	818208.486	-7.55	9599.7	Pilot Tunnel	Pilot Tunnel
17	842355.650	818303.89	37.3	15	20	17	842195.702	818209.618	-7.80	9601.7	Pilot Tunnel	Pilot Tunnel
18	842357.760	818300.84	37.3	15	21	18	842197.351	818210.749	-8.05	9603.7	Pilot Tunnel	Pilot Tunnel
19	842355.250	818304.22	37.3	15	22	19	842198.999	818211.881	-8.30	9605.7	Pilot Tunnel	Pilot Tunnel
20	842360.870	818298.85	37.3	15	23	20	842199.270	818212.067	-8.55	9606	2d	Westbound
21	842340.110	818302.32	37.3	15	24	21	842200.918	818213.199	-8.59	9608	2d	Westbound
22	842348.610	818301.78	37.3	15	25	22	842202.567	818214.330	-8.48	9610	2d	Westbound
23	842354.130	818305.75	30.1	15	26	23	842204.216	818215.462	-8.47	9612	2d	Westbound
24	842355.250	818304.22	30.1	15	27	24	842205.864	818216.594	-8.50	9614	2d	Westbound
25	842356.530	818302.30	30.1	15	28	25	842207.513	818217.726	-8.54	9616	2d	Westbound
26	842348.610	818301.78	30.1	15	29	26	842209.161	818218.857	-8.57	9618	2d	Westbound
27	842350.340	818298.71	30.1	15	30	27	842210.810	818219.989	-8.60	9620	2d	Westbound
28	842362.480	818294.48	30.1	15	31	28	842212.459	818221.121	-8.63	9622	2d	Westbound
29	842341.920	818296.05	30.1	15	32	29	842214.107	818222.253	-8.36	9624	2a	Westbound
30	842379.670	818275.42	30.1	15	33	30	842215.756	818223.385	-8.39	9626	2a	Westbound
31	842380.660	818274.10	30.1	15	34	31	842217.405	818224.517	-8.41	9628	2a	Westbound
32	842403.540	818485.08	76.2	25	35	32	842219.054	818225.648	-8.44	9630	2a	Westbound
33	842380.660	818274.10	30.1	15	36	33						
34	842403.540	818485.08	76.2	25	37							
35	842403.540	818485.08	63.2	25	38							
36					39							

```
# -----
# Name: Hong Kong Blasting Tool
# Purpose: Run tunnel and surface blasting analysis
# Outputs:
# Identify max charge weights for given blast point
# Produce ppv and aop contours, surface blasting gr
# Data showing relationships between blast points a
#
# Author: steven.haslemore
#
# Created: 11/08/2016
# Copyright: (c) steven.haslemore 2016
# Licence: <your licence>
# version 1.0: all intil file reading and Logic in place
# 1.1: - apply threshold limit in max weight calculation
# - import Tunnel Type and Alignment
# - break out reporting by Alignment for Summary Short-
# 1.2: - add command line calling
# 1.3: - set the surface blasting grid ranges and colors as
# TUNNEL <B> <K> <T> <area name> <input file> <sensitive receiver
# SURFACE <B> <K> <T> <AR> <area name> <sr file> <sr sheet> <bp fi
# SURFACE -1.22 644 10 5 "LTI-vol5" "Z:\Projects\20160805-ha
# -----
* import xlrd, copy, datetime, math, sys, os, shutil, arcpy, time, re,
* import cadWriter, reportWriter, blastingUtils
* from multiprocessing import Pool
```

Project Results



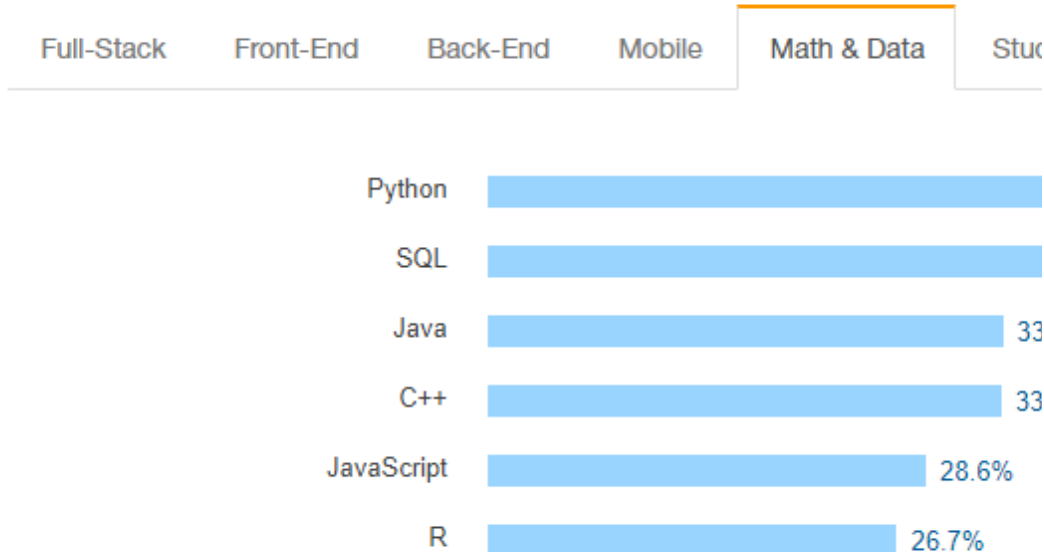
Bringing ideas to life

What does arcpy give me:

- Read an excel file (with funny headers)
- Calculate max charge weight from each BP to every SR
- Fishnet of points over the blast area to model PPV
- Assign them an elevation from a terrain model
- Calculate PPV from each BP to each Fishnet point
- Generate a model of vibration from points
- Derive contours from that model
- Export CAD lines
- Export complex Excel tables/ summaries/ charts

Python 30 second overview:

Most Popular Technologies per Dev Type



PyPI - the Python Package Index

The Python Package Index is a repository of software for the Python programming language, currently **113814** packages here.

To contact the PyPI admins, please use the [Support](#) or [Bug reports](#) links.



Python to glue the gaps:

- Read an excel file
 - xlrd
- PPV & charge weights for BPs, SRs, & Surface Points
 - Classes
 - Sensitive Receiver
 - Blast Point
 - Modules
 - BlastingUtils.py
 - ReportWriter.py
 - cadWriter.py
- Export complex Excel tables/ summaries/ charts
 - xlsxwriter

Executing the vision:

- Modules

- BlastingUtils.py
- ReportWriter.py
- cadWriter.py

- Classes

- Sensitive Receiver
- Blast Point

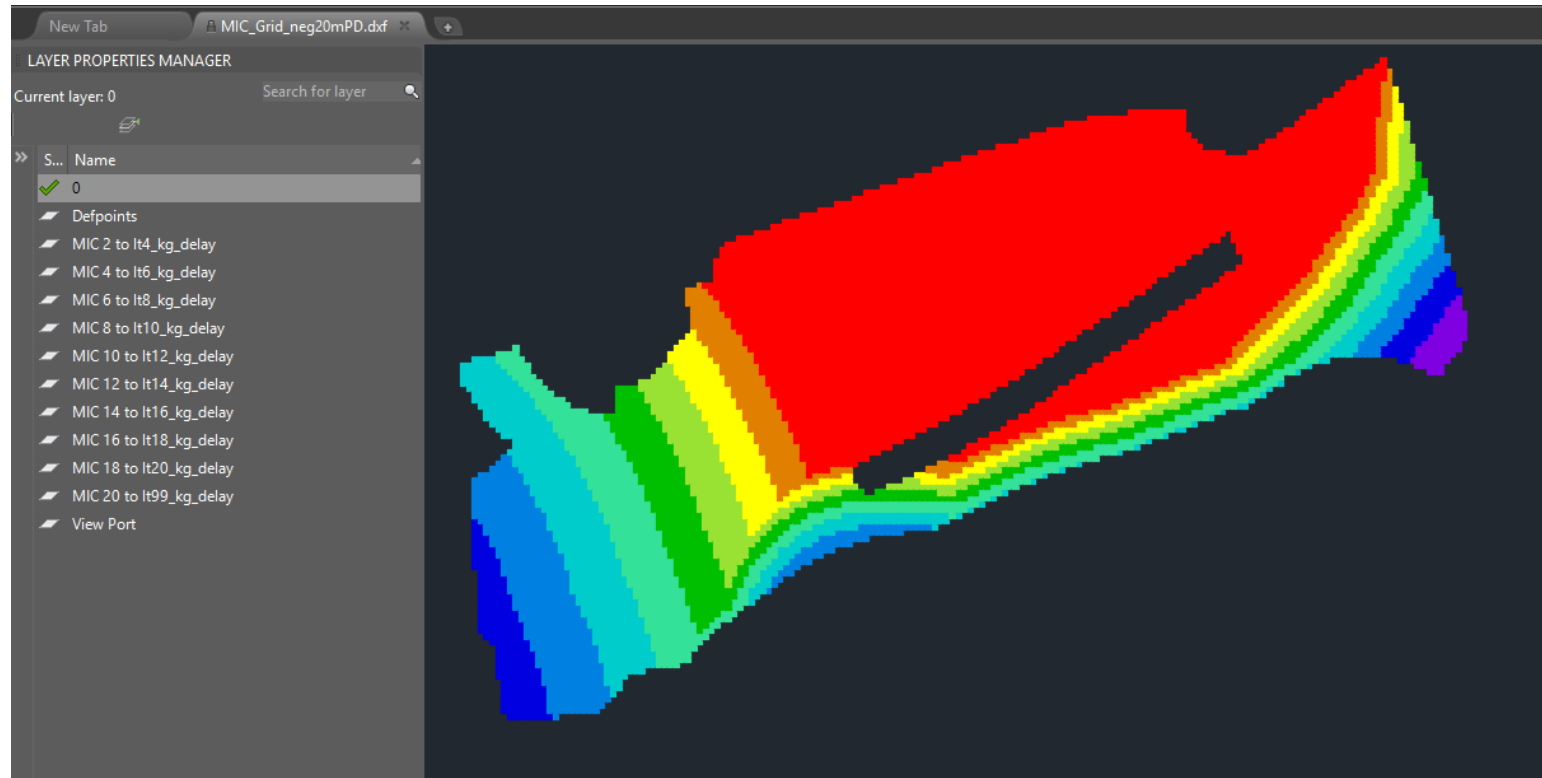
Just 'tweak' that for surface blasting

- Repeat each iteration of the application 13 times ✓
- Keep track of changes in surface elevation ✓
- Calculate some extra values for AOP ✓
- Sensitive receivers will appear at different levels ✓
- Excel summary for each level ✓
- Create filled polygons in CAD coloured by charge weights ✗
- And there'll be ~100 times more input data to process ✗

Pretty Coloured Boxes...

- Create filled polygons in CAD coloured by charge weights

– ezdxfl



Memory and Performance Issues....

- And there'll be ~100 times more input data to process ❌
 - “We should forget about small efficiencies, say about 97% of the time: premature optimization is the root of all evil. Yet we should not pass up our opportunities in that critical 3%” – Donald Knuth, Computer Programming as an Art - 1974
- Memory usage was running high
 - When defining your python class use `__slots__` to name your variables ✅
- Things were too slow! ❌

```
14 class point(object):
15     """Point object of xyz"""
16     __slots__ = ('x', 'y', 'z')
17     def __init__(self, x, y, z):
18         self.x = float(x)
19         self.y = float(y)
20         self.z = float(z)
21
```

There has to be a better way

- Reduce. Reuse. Divide.
- The types of calculations that were needed fall into a category known as *embarrassingly parallel*
 1. **Read** input data (from a file, database, tcp connection, etc.).
 2. **Run** calculations on the input data, where each calculation is *independent of any other calculation*.
 3. **Write** results of calculations (to a file, database, tcp connection, etc.)
- Things were too slow! ☒
 - Python Multiprocessing ☑
 - Divide the contour points into three sets
 - Supply these, along with all the blast points
 - Join them back up

Putting it all together

- Pre the scripted processes
 - Over one days worth of drafters time
- Script pre parallel processing
 - Around 7 hours
- Script post parallel processing
 - Around 2 hours





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