ASK Network Partnership

Hugh Barron & Diarmad Campbell, BGS
What is ASK?

Accessing Subsurface Knowledge

.....a knowledge exchange network
ASK Knowledge Exchange
ASK Network Partnership

launched at The Lighthouse, Glasgow in November 2012

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ASK Network Partnership

launched at The Lighthouse, Glasgow in November 2012

Attended by representatives from:

- 20 private sector organisations
- 12 public sector organisations
- 4 universities
What subsurface knowledge?

Superficial model

Bedrock model

Scottish Water, Shieldhall August 2013,
What subsurface knowledge?

Coal seam model
BGS’s Clyde / Glasgow Project

- Ground conditions
- Contaminated Land
- Flooding
- Sustainable drainage
- Geothermal resources
Glasgow 3D models

- synthesis
- ambitious
- multi-scalar
- multi-attributed
- > 55,000 boreholes

.......full potential is yet to be realised
The Glasgow experience......

SI Data → BGS coded logs → BGS 3D models

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Scottish Water, Shieldhall August 2013,
Future Glasgow – virtuous circle

3D model delivery

Efficient raw data capture

3D models used for decision-making

Free flow of data
3D geological modelling

capture

synthesize

parameterise

deliver
Key 3D modelling requirements

DTM

GI data

NEXTMap DTM (Intermap Technologies Inc)
Information from boreholes

Coded data
3D geological modelling

Gocad - surfaces

Gocad - voxels

GSI3D

Faults in red
Modelling types – central Glasgow

Deterministic model

Stochastic (voxellated) model
Central Glasgow superficial deposits

Median depth 3.6 m

10,342 Boreholes
GSI3D Modelling process

Calculated model
Superficial Deposits model

Catchment model
85 cross sections
1066 boreholes
41,727 control points

Conurbation model
1167 cross sections
11,570 boreholes
326,942 control points
Superficial Deposits model

[Images of maps and models showing different areas and models related to superficial deposits.]
Superficial Deposits model

Clyde Gateway 3D model

16 superficial layers, plus artificial ground

5 km
Engineering property attribution

e.g. Strength or permeability, texture, grain size, SPT

Firm to stiff laminated CLAY and SILT
Medium to very dense silty SAND & GRAVEL with coarser particles
Engineering property attribution

Loose to medium dense silty SAND and SAND

Scottish Water, Shieldhall August 2013,
Engineering property attribution

Very soft to firm laminated CLAY and SILT some local sand beds
Engineering property attribution

Loose to medium dense silty sand and sand
Upper part very soft to very stiff CLAY and SILT occasional peat
Lower part loose to medium dense SAND and GRAVEL
Engineering property attribution

Artificial ground

Highly variable, very loose to very dense sand and gravel or very soft to stiff CLAY and SILT, natural or man-made materials.
Predicting conditions below ground

Ground level  2 m depth  5 m depth

Attributed by strength
3D Engineering geology model

predictive tool

but not a substitute for GI!

Attributed by strength
Engineering data GIS

'UTF' = 'GUF' or 'STMB' = 'GUF'
Bedrock model

- 85 cross sections
- 1066 boreholes
- >106,000 control points
- 1.39km model depth
- 794 faults
- 47 stratigraphic surfaces

Modelled fault network

Mine plans

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Central Glasgow bedrock model

Faults in red
Vertical exaggeration x 3

10 km
500 m

UCMS
GU
GE
KILC
ULGS
KDG

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Scottish Water, Shieldhall August 2013,
ASK data coverage

Bedrock coverage, June 2013

Central Glasgow

Clyde Catchment

Contains Ordnance Survey data © Crown Copyright and database right

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Scottish Water, Shieldhall August 2013,
Model delivery: LithoFrame Viewer

www.bgs.ac.uk/services/3Dgeology/lithoframeSamples.html
Model delivery: GIS layers

shallow mine workings
Model delivery: 3D PDF

www.bgs.ac.uk/services/3Dgeology/lithoframeSamples.html
Model delivery: uncertainty

- High 10s m in XYZ
- Low <10m in XYZ
Model delivery: web (Groundhog)
Groundhog cross section

Cross-Section Viewer

Vertical Exaggeration 3.00

Model base may truncate lowermost unit

Cross-Section based on The Isle of Wight Model

Legend
- Palaeogene Rocks
- Base of Palaeogene Rocks
- Chalk Group
- Base of Chalk Group
- Upper Greensand Group
- Base of Upper Greensand Group
- Gault Clay Formation
- Base of Gault Clay Formation
- Lower Greensand Group
- Base of Lower Greensand Group
- Base of Model
- (Base of Model, this unit is the Wealden Group but the model base is not the base of the Wealden Group)

Vertical Exaggeration is 3.00.
Any white space within a section is due to the section extending beyond the model extent.
This section is based on a prediction of the geological sequence that would be encountered in a section dug along the chosen line and should not be used as a replacement for site investigation. For comprehensive information of the geology at this point, please use our BGS GeoReport Service.

www.bgs.ac.uk/services/3Dgeology/virtualBoreholeViewer.html
Groundhog borehole

Borehole based on The Isle of Wight Model

Legend
- Chalk Group
  - (Base of Chalk Group)
- Upper Greensand Group
  - (Base of Upper Greensand Group)
- Gault Clay Formation
  - (Base of Gault Clay Formation)
- Lower Greensand Group
  - (Base of Lower Greensand Group)
- Base of Model
  - (Base of Model, this unit is the Wealden Group but the model base is not the base of the Wealden Group)

Vertical Exaggeration is 0.59.

This borehole is based on a prediction of the geological sequence that would be encountered in a vertical borehole drilled at this location and should not be used as a replacement for any site investigation. For comprehensive information of the geology at this point, please use our BGS GeoReport Service.

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BGS GROUNDHOG® is a trademark registered in the United Kingdom in the name of the Natural Environment Research Council. NEXTMAP Britain elevation data from Intermap Technologies. Any attempt to decompile or reverse engineer any part of this data is prohibited.
The mobile version of Groundhog offers support for the following platforms:

- iOS 3+
- Android 2.2+
- Blackberry 6+

If you are using a desktop browser, we recommend to access Groundhog from the desktop version.
Wealth of data not accessible
GSPEC

Glasgow SPEcification for data Capture

- raw digital data
- AGS compliant
- Key metadata
improved knowledge exchange

- GCC requirement
- SG e-Planning portal
- Voluntary basis for others
GSPEC – current status

- BGS – Glasgow City Council MoU signed
- BGS upload portal under construction
- Already receiving data manually
Calibrated simulated surface flows to observed records

<table>
<thead>
<tr>
<th>TOTAL WATER BALANCE</th>
<th>% of Total Inflows</th>
<th>Average daily</th>
<th>Average Yearly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Rainfall</td>
<td>17847486 Ml</td>
<td>100 %</td>
<td>5400.637 mm</td>
</tr>
<tr>
<td>Total Evaporation</td>
<td>5884994 Ml</td>
<td>33 %</td>
<td>1780.795 mm</td>
</tr>
<tr>
<td>Total Runoff</td>
<td>7041304 Ml</td>
<td>39 %</td>
<td>2130.694 mm</td>
</tr>
<tr>
<td>Total Recharge</td>
<td>4955857 Ml</td>
<td>28 %</td>
<td>1499.639 mm</td>
</tr>
<tr>
<td>Total Outflows</td>
<td>17882156 Ml</td>
<td>100 %</td>
<td>5411.128 mm</td>
</tr>
<tr>
<td>Net water</td>
<td>-34670 Ml</td>
<td>0 %</td>
<td>-10.4911 mm</td>
</tr>
</tbody>
</table>

estimated recharge distribution which feeds into the groundwater model
Conceptualisation of groundwater system

Extensive area of continuous contact around the River Clyde between Gourock and Bridgeton sand. Bridgeton sand rising to almost outcrop in this region.

Bridgeton Sand and Gourock now in contact to the North and South of the Clyde, although still some areas where they are separated by Paisley Clay deposits.

Bridgeton Sand and Gourock now come into direct contact to North of River Clyde. >5m of Paisley Clay separate the two sand formations at all other locations along transect.

Bridgeton Sand now present, but overlain by thick Paisley Clay deposits, so unlikely any contact between Gourock and Bron formations.

Gourock in contact with River Clyde. Potential for contact between Killearn sand and Gourock through Made ground.

Gourock in contact with River Clyde but isolated from all other conductive deposits by Thick Paisley clay and Till deposits.
Conceptualisation of groundwater system

geological units likely to be important to hydraulic flow selected and their extents mapped in 3 dimensions for inclusion into the flow model
Conceptualisation of groundwater system

elevation data for the top and bottom of the conductive deposits exported into ZOOM
Flow model

Two valleys identified as the significant conductive deposits in the region

Delineated, parameterised and calibrated model

monitoring data to be incorporated
Flow model

Two valleys identified as the significant conductive deposits in the region

Delineated, parameterised and calibrated model

monitoring data to be incorporated
ASK Network Partnership members

Private sector
Arup
Atkins
Grontmij UK
Jacobs
Scottish Coal Co
Scottish Power
URS Scott Wilson

Academic
Glasgow Caledonian University
University of Strathclyde
ASK Network Partnership members

Public sector
Glasgow City Council
Glasgow & Clyde Valley Strategic Planning Authority:
  East Dunbartonshire Council
  East Renfrewshire Council
  Inverclyde Council
  Renfrewshire Council
  South Lanarkshire Council
  West Dunbartonshire Council
North Lanarkshire Council
Scottish Environment Protection Agency
Scottish Water
Transport Scotland
Glasgow wins 'smart city' government cash

Glasgow proposals
ASK Network: the future

- increase membership
- increase data coverage
- develop web delivery
- member workshop, late 2013

Red 250k
Green 50k
Yellow – ASK (10k-50k)