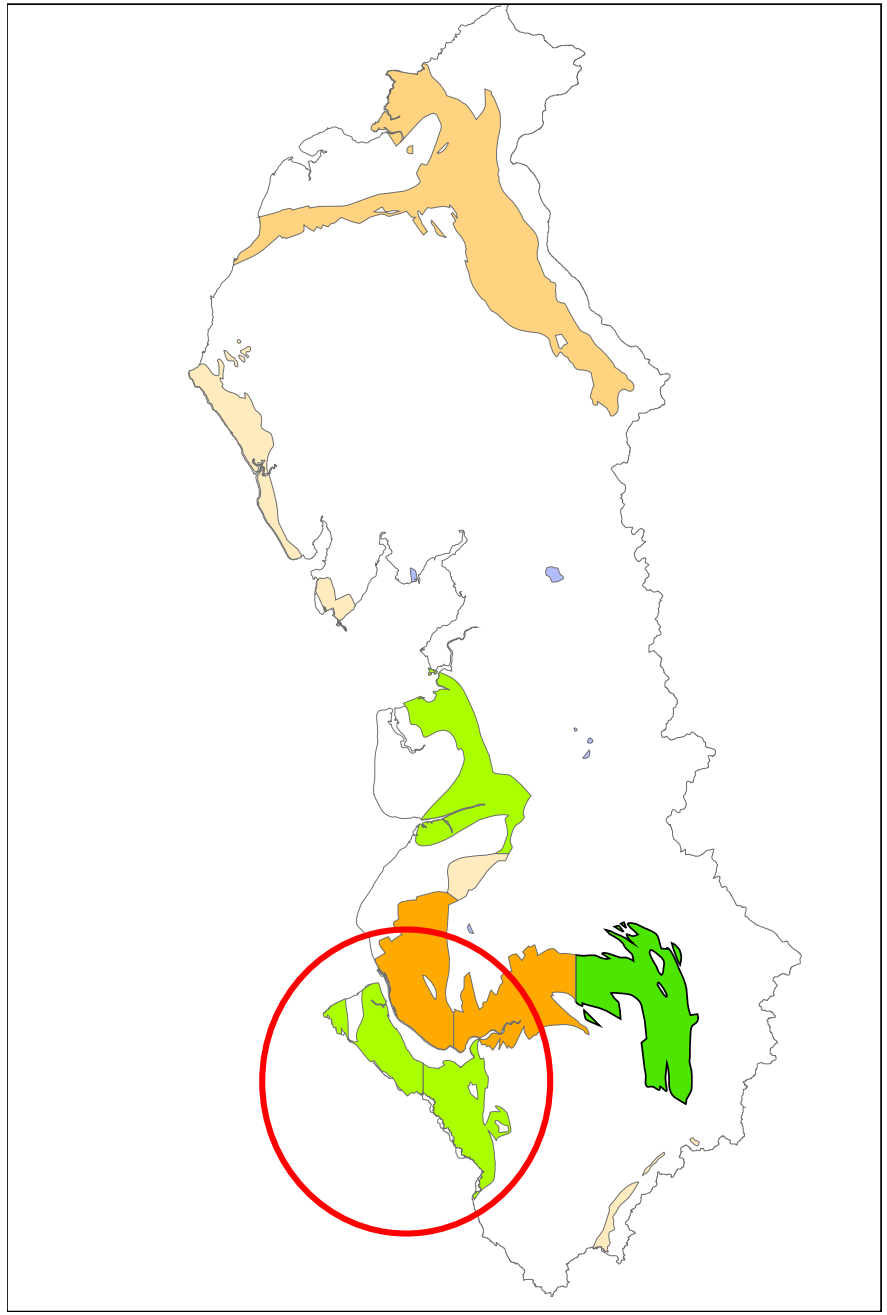
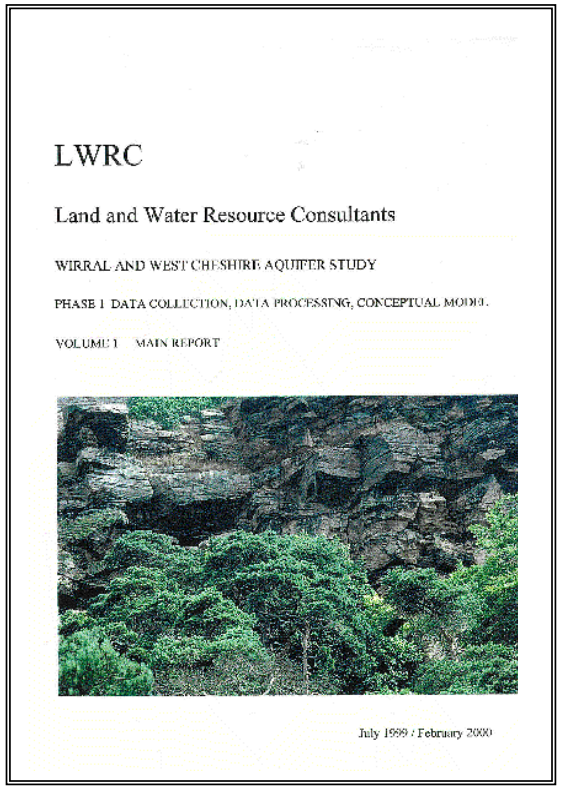
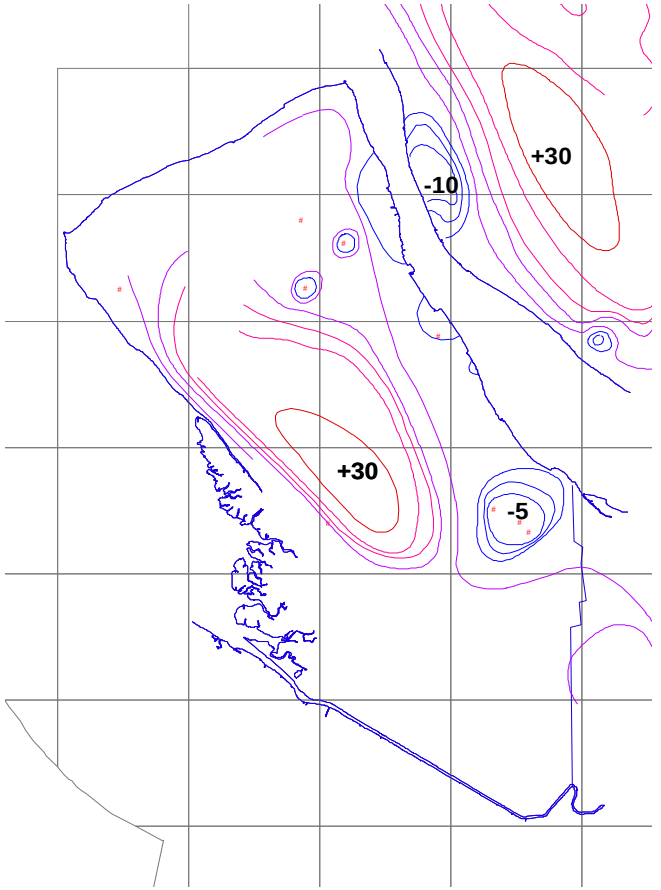
Wirral

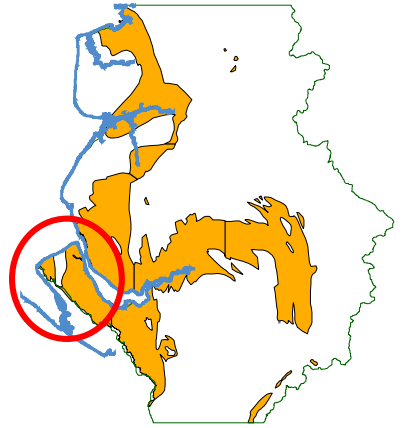



LWRC
Land and Water Resource Consultants
WIRRAL AND WEST CHESHIRE AQUIFER STUDY
PHASE 1 DATA COLLECTION, DATA PROCESSING, CONCEPTUAL MODEL
VOLUME 1 MAIN REPORT
July 1999 / February 2000

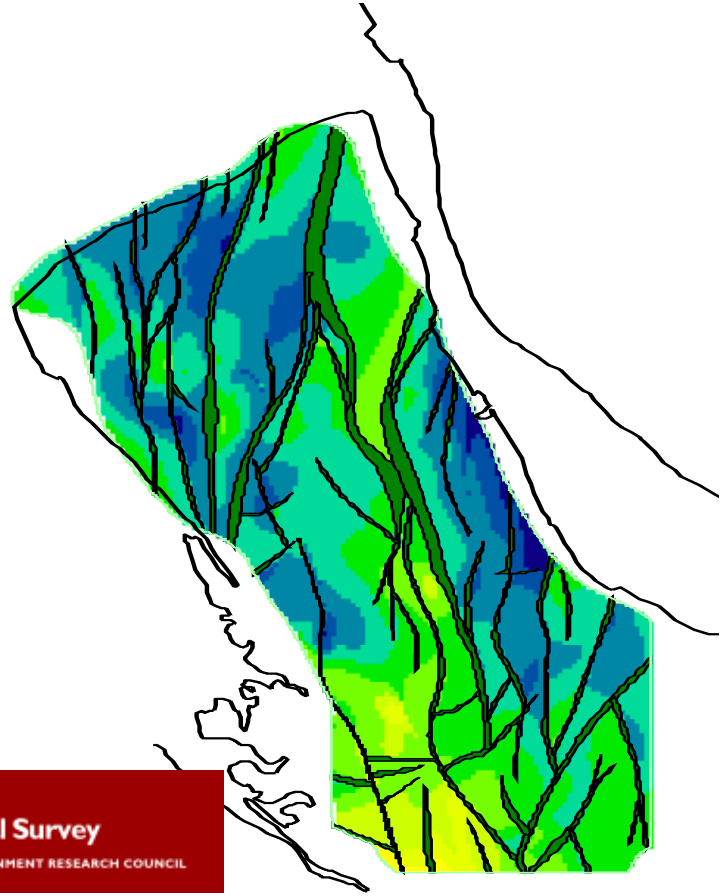
Wirral

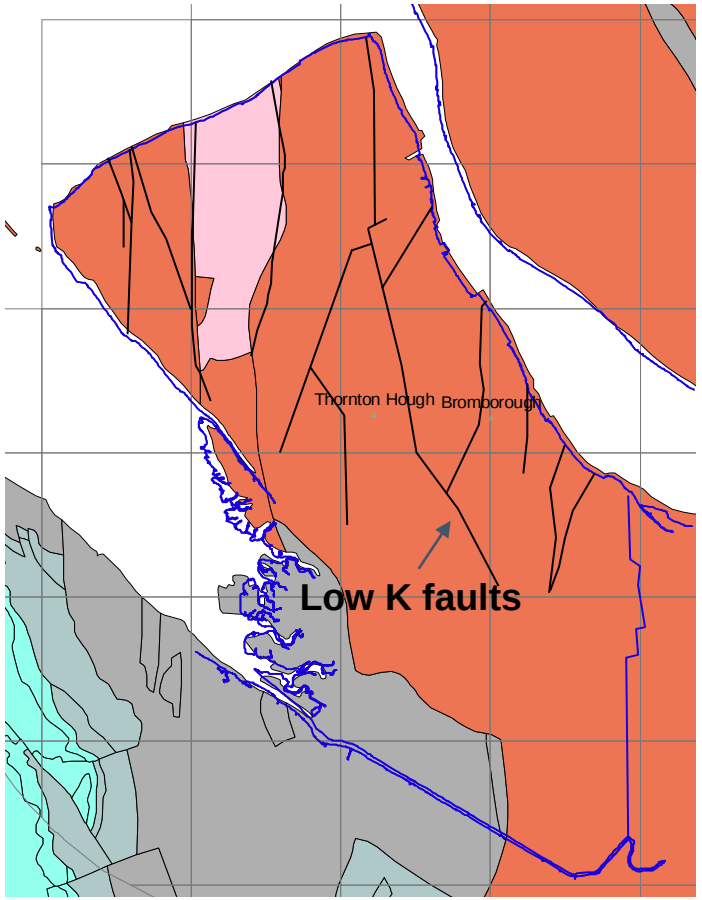
- GW levels 2000
- Historic Abstn
  - 75 years
- Saline intrusion
- Steep GW gradients
- Sustainable Abstraction?



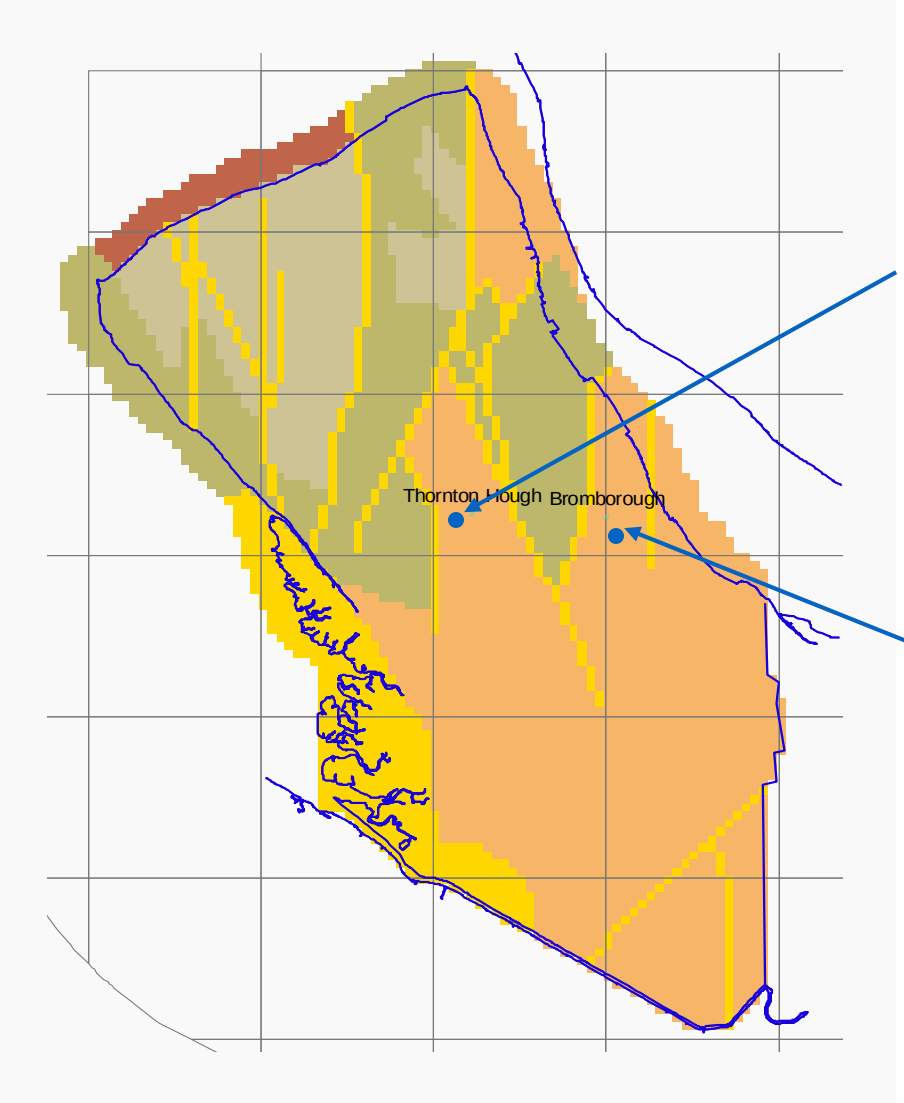


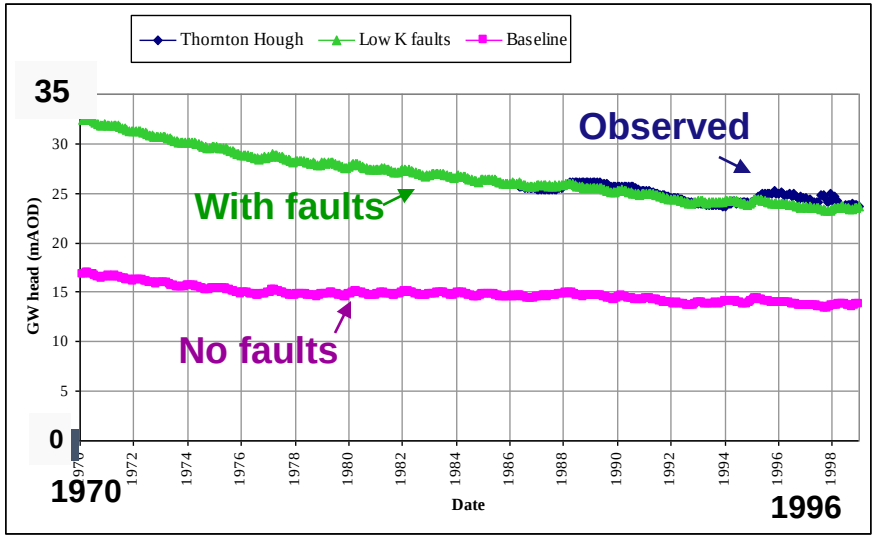
Wirral Model – Fault Representation

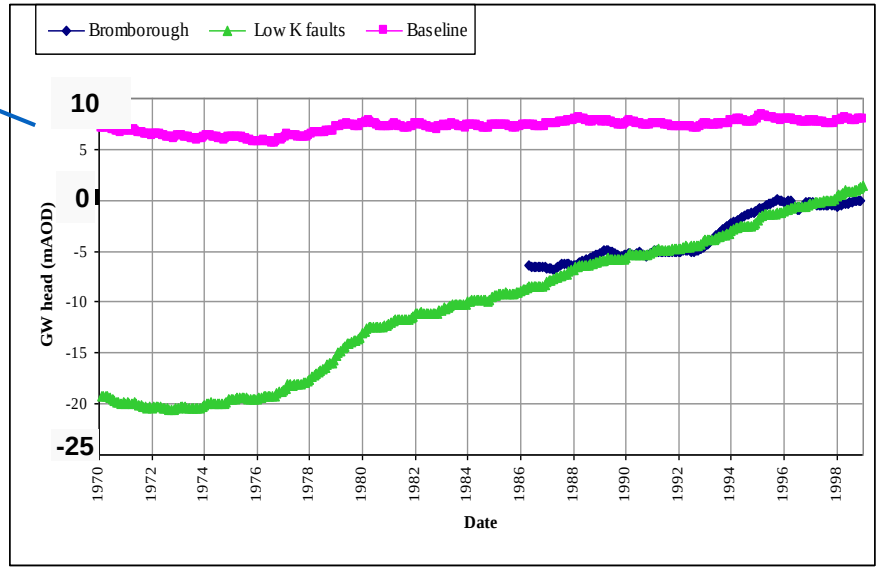




British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

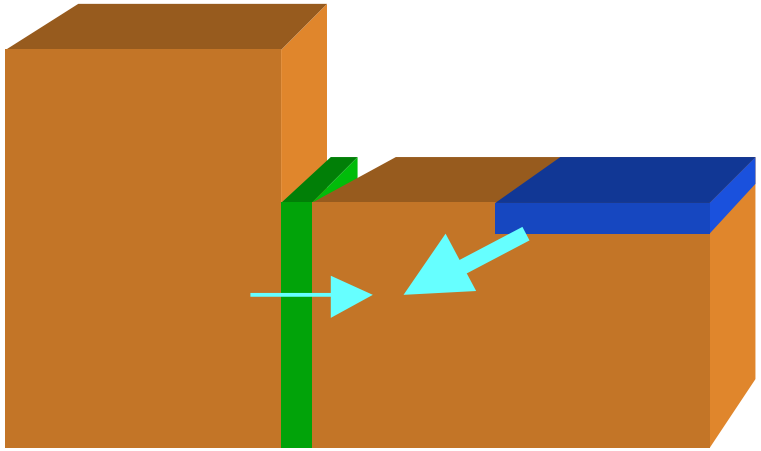




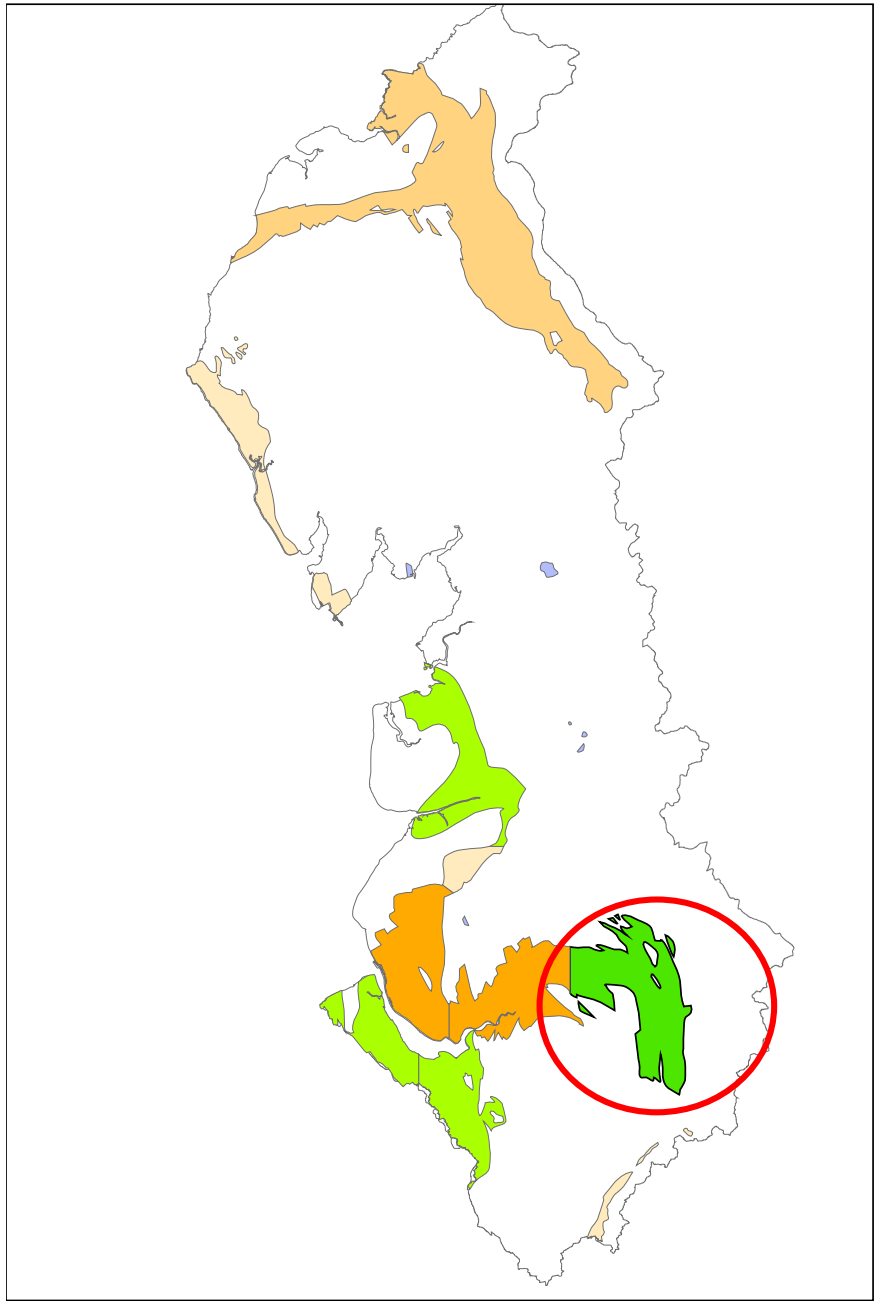


Wirral Model Results

Wirral – Summary:



Manchester & East Cheshire Groundwater Resources Study



ENVIRONMENT AGENCY

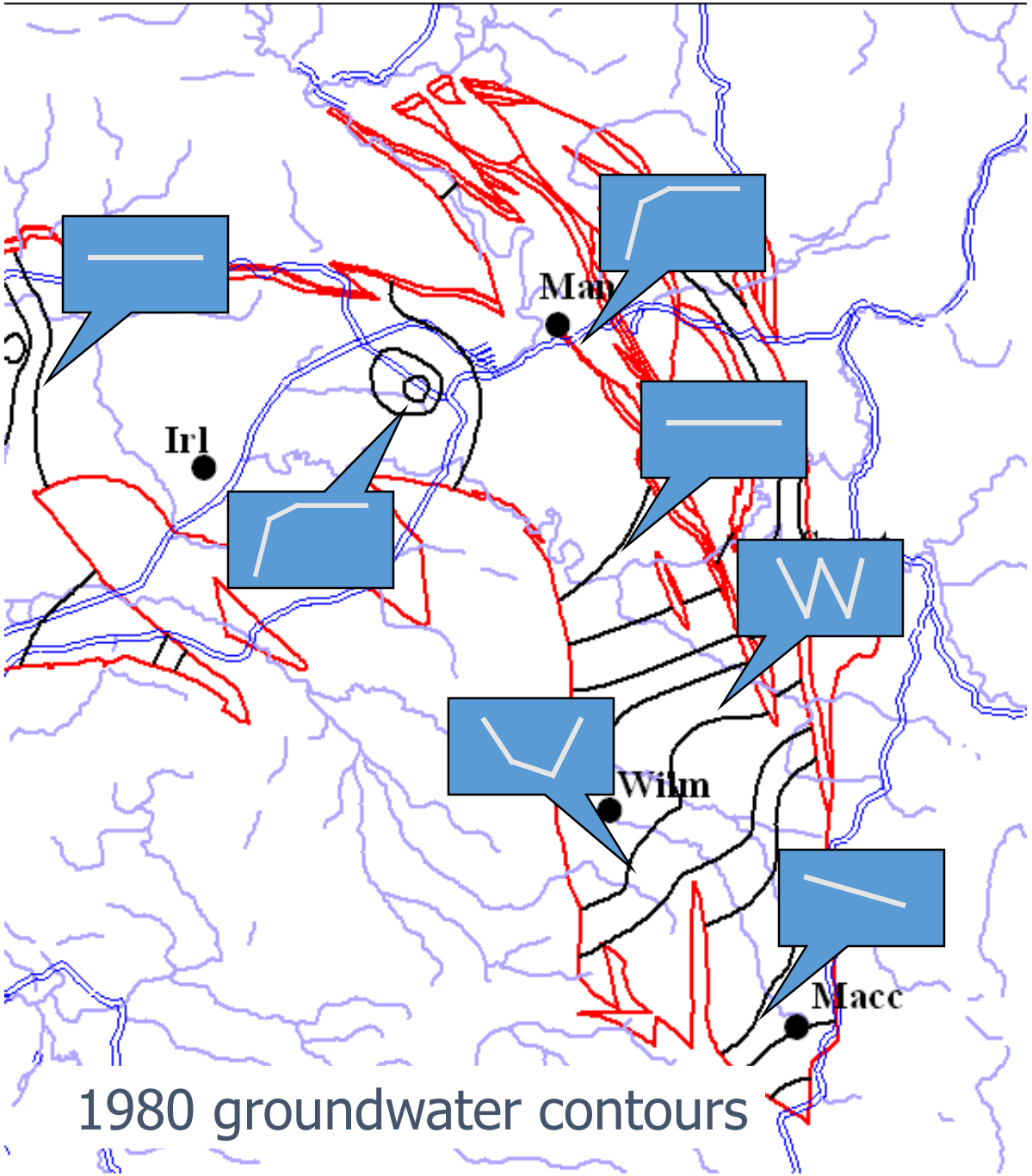
Manchester and East Cheshire
Water Resources Study

Phase 2: Groundwater Model of
the Southern Area (Dean and
Bollin Catchments)

Final Report

June 2004

Groundwater Flows and Levels



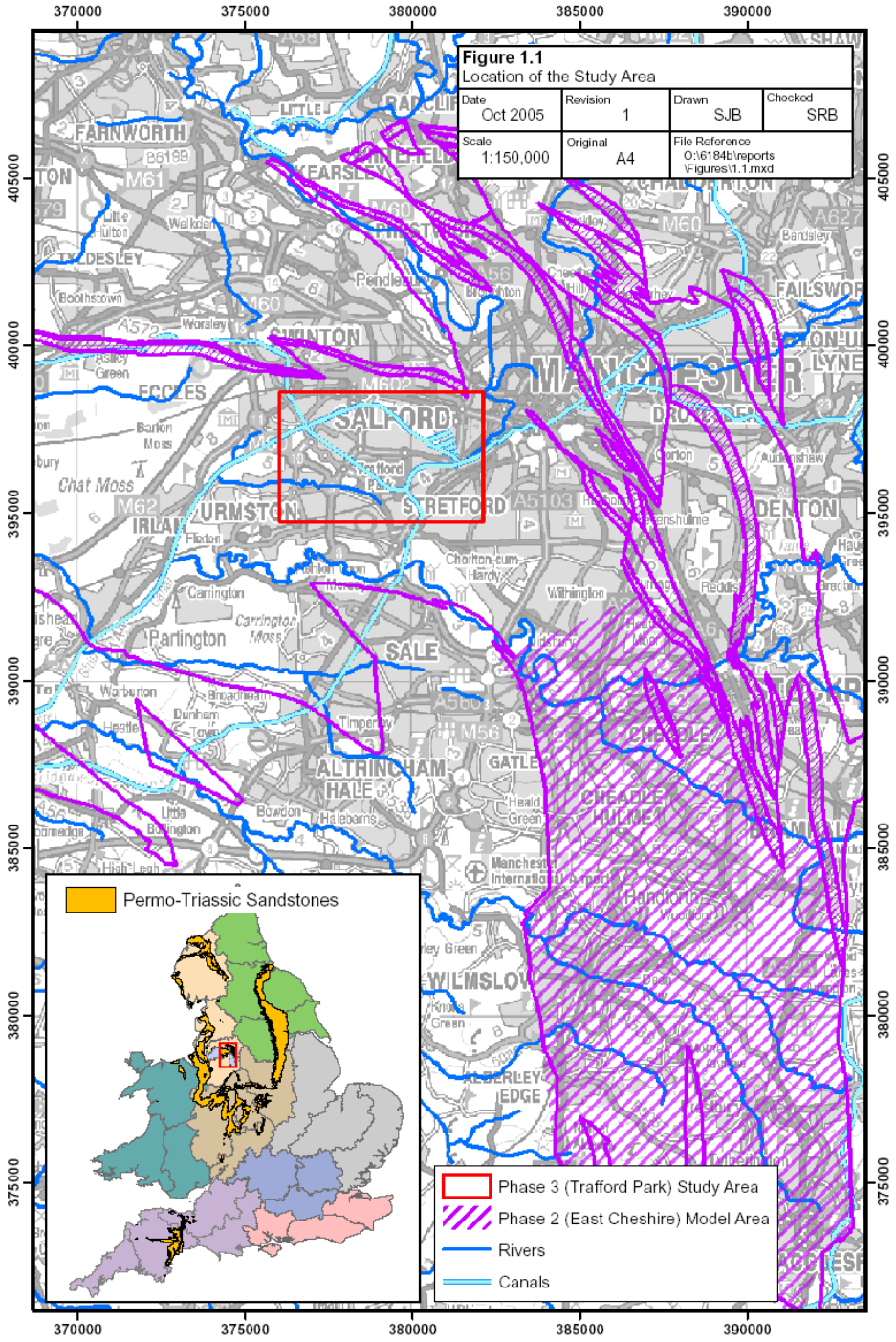
1980 groundwater contours

Manchester & East Cheshire Study Area

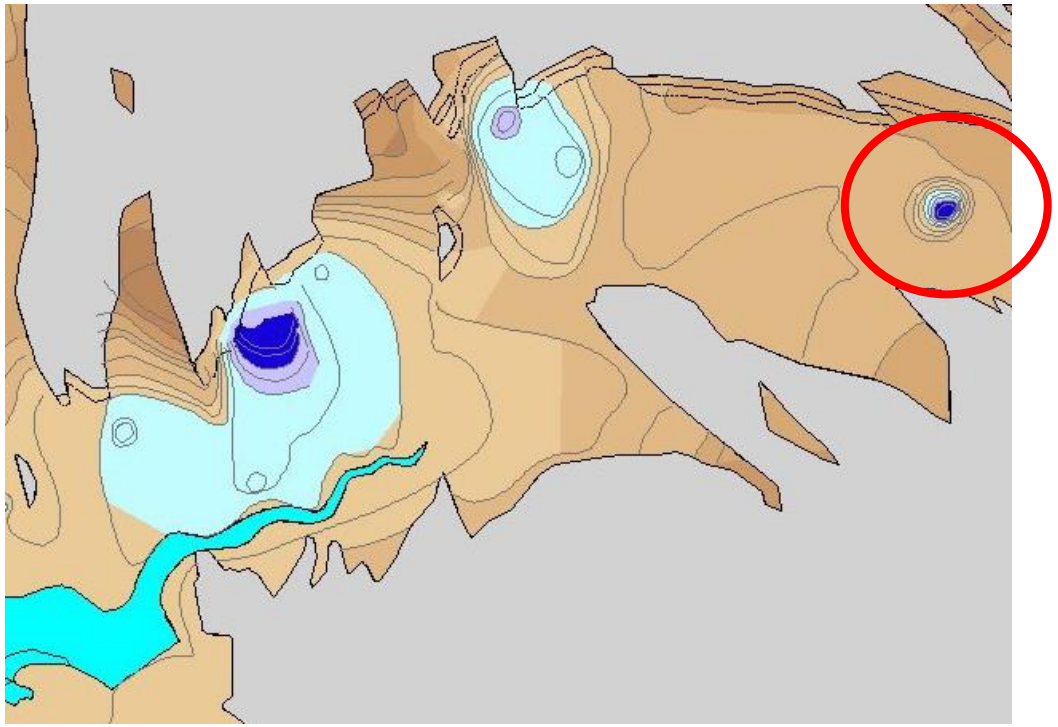
Trafford Park:

- the hardest

- the last!

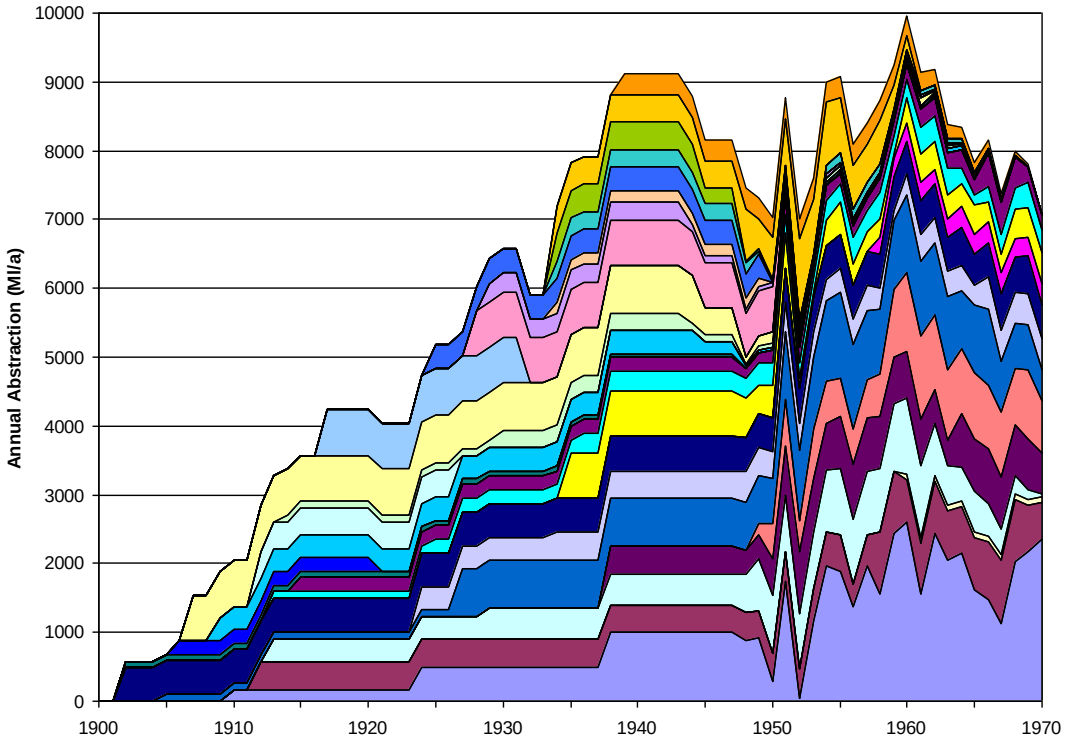


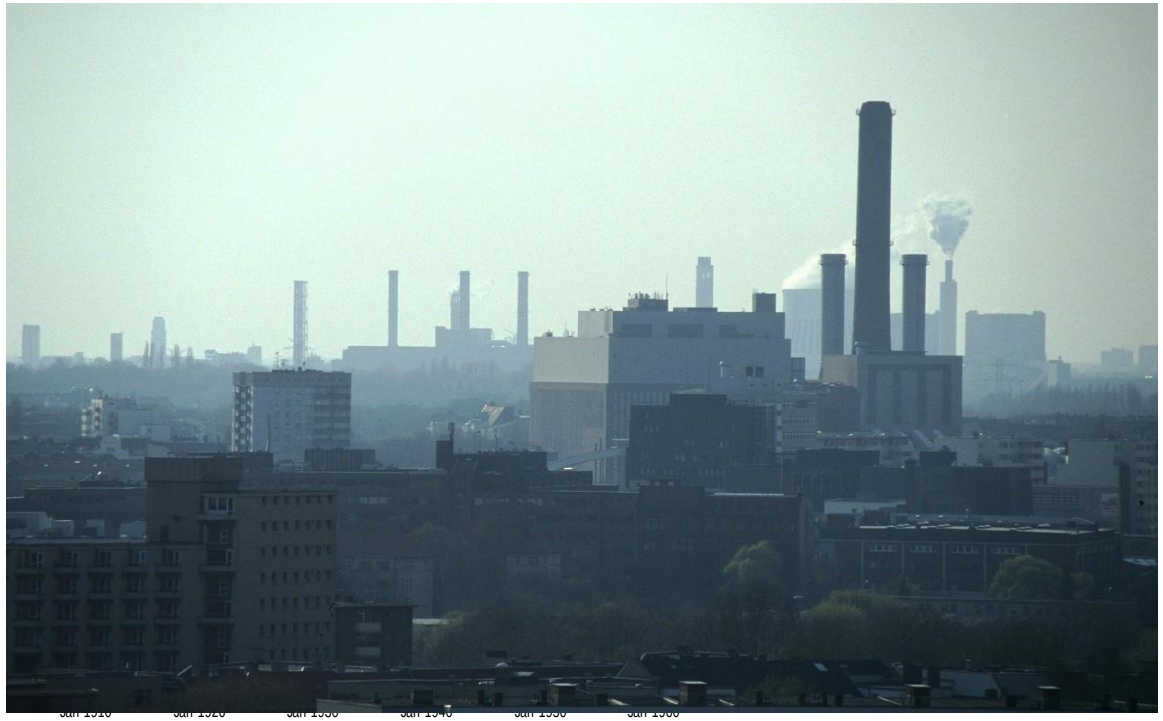
Lower Mersey Basin - Groundwater Levels (2000)



Trafford Park

Historic over abstraction -> falling water levels



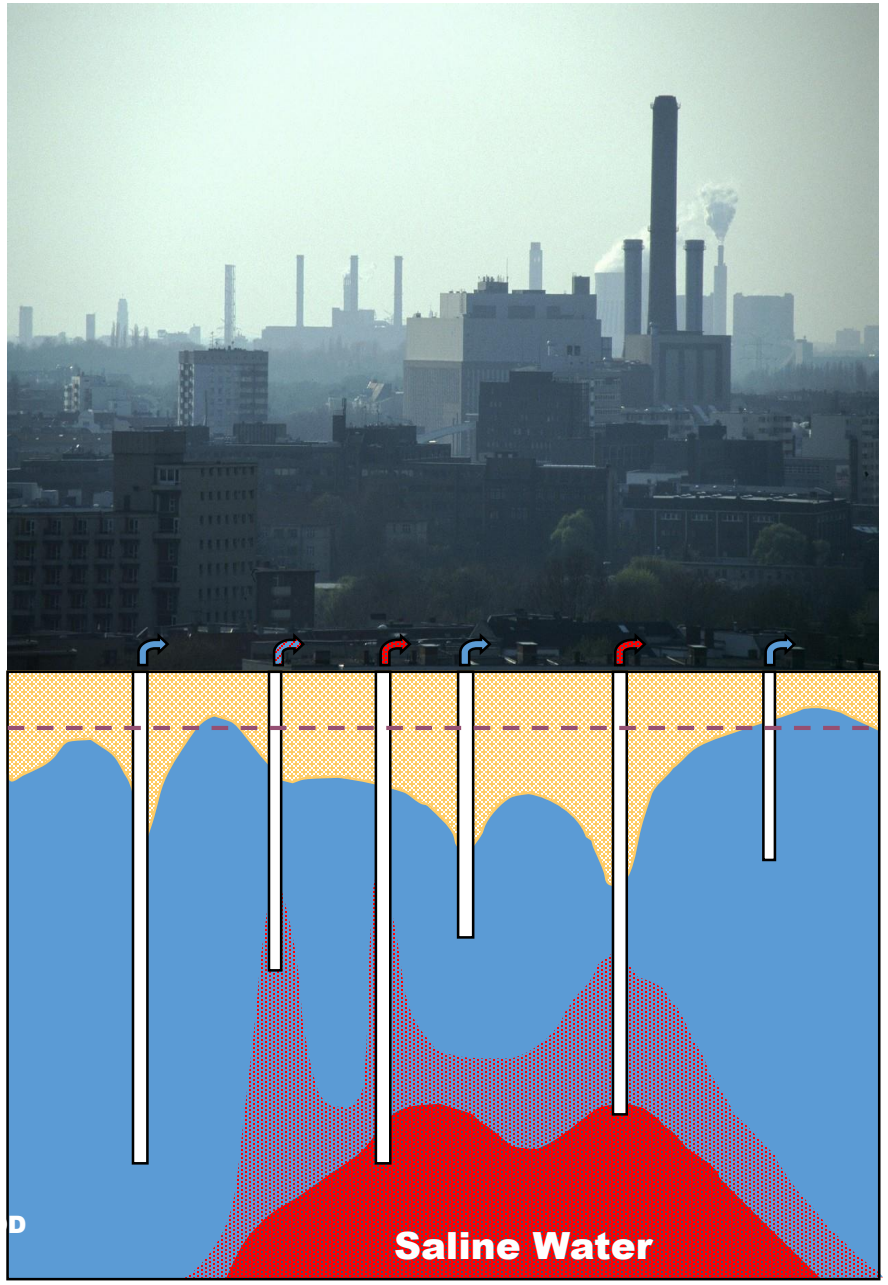


Trafford Park ~ the problem

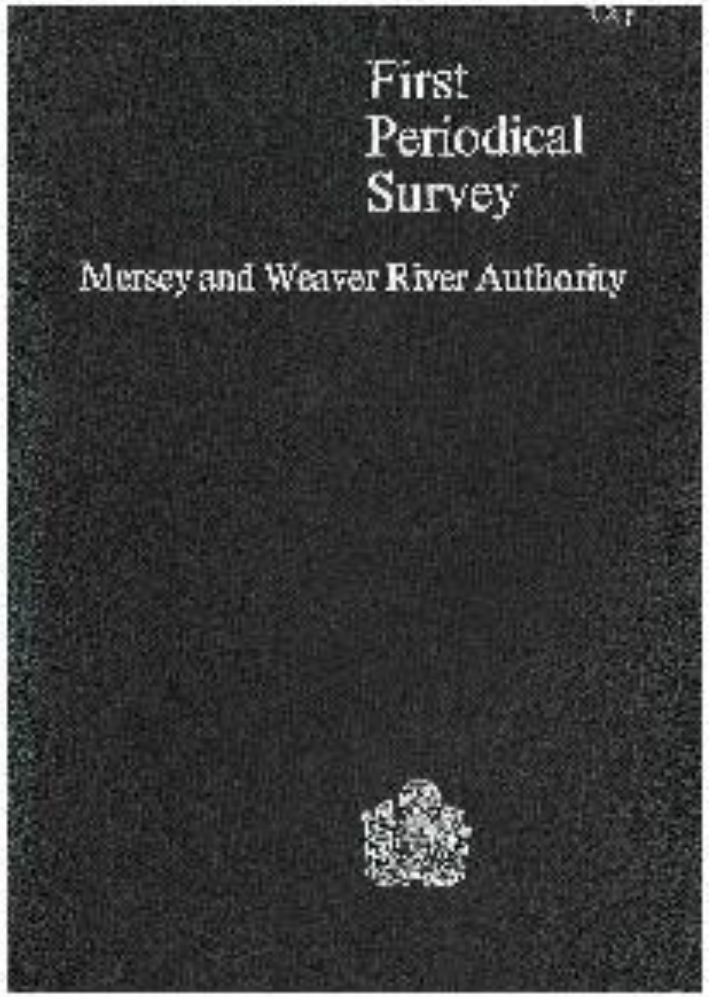
Falling water levels

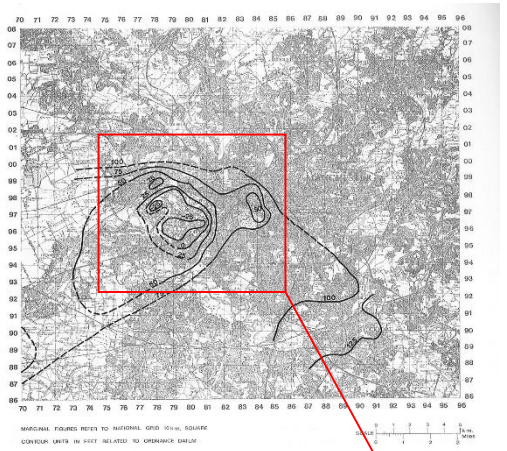
->

Saline upconing

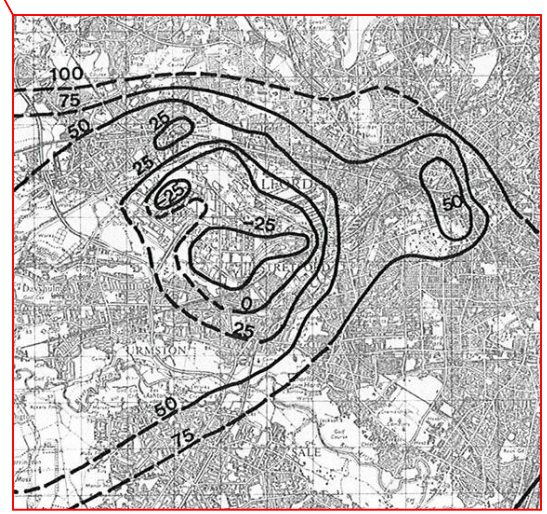


Historic problem recognised





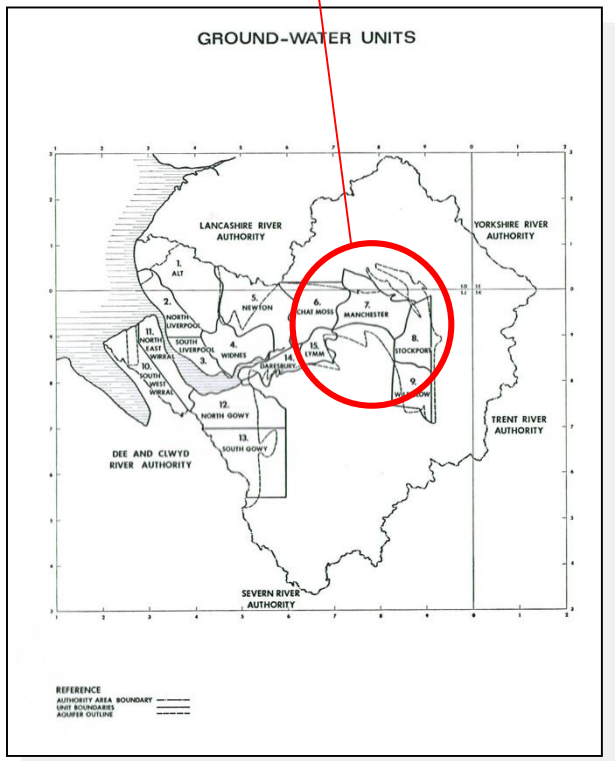
MANCHESTER GROUND WATER DISTRICT
GROUND WATER CONTOURS
1965



Mersey and Weaver River Authority

Statement of Policy for Ground-Water Management 1973

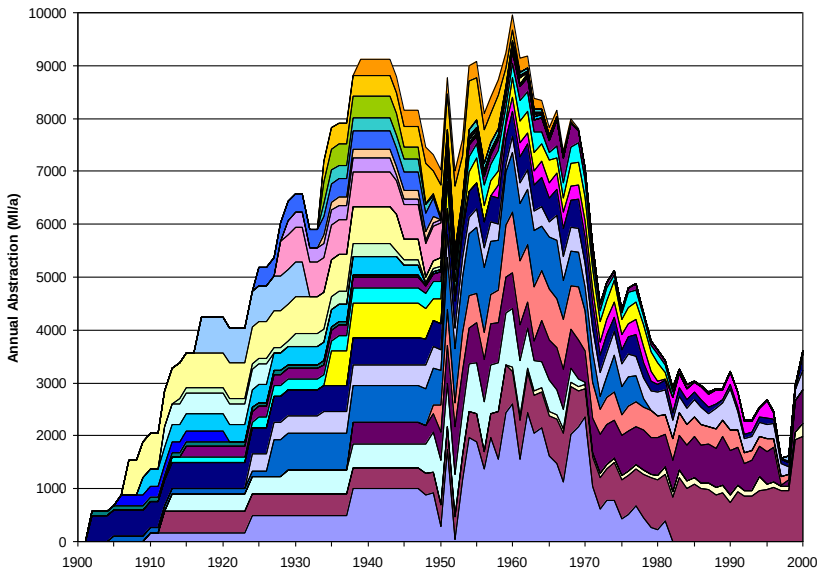
9.9 Within the **Manchester Ground-Water Unit,** there are some signs of slight improvement in ground-water level and the main aim must be not to exceed the present rates of abstractions. Some temporary increases could be considered so long as these were spaced well away from the area within Trafford Park where abstractions are at present concentrated.

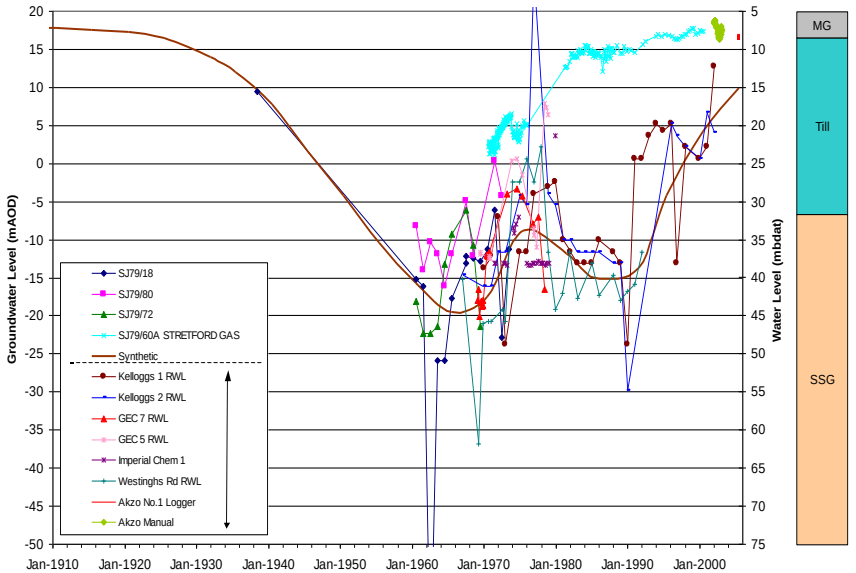


Since 1970

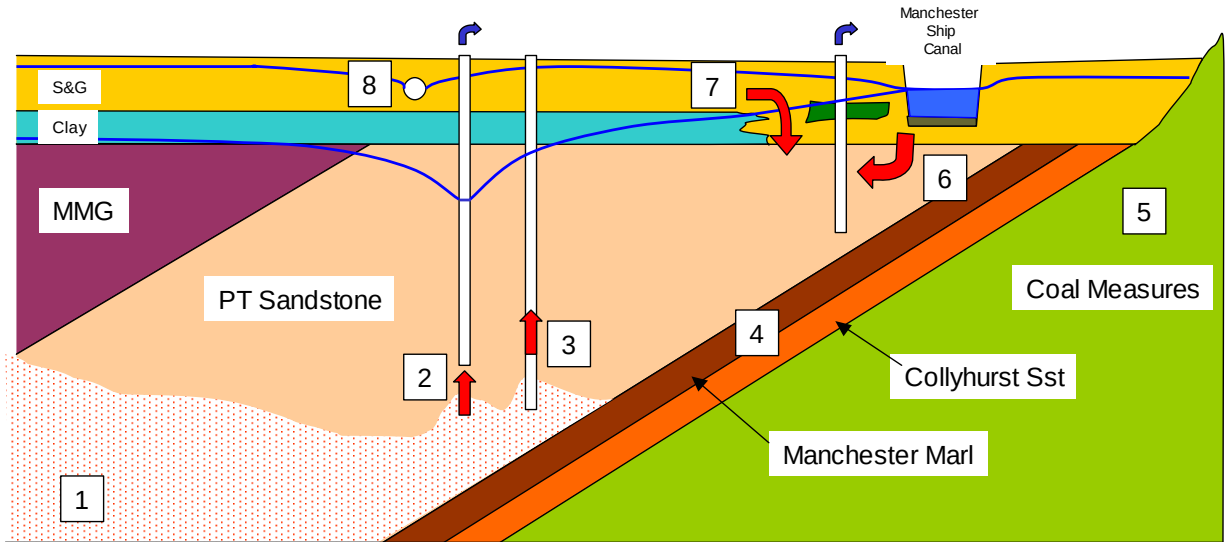
- New concerns
  - Contaminated land
  - Rising groundwater levels
  - Iron rich groundwaters
  - Abandoned coal mines
  - Ground source heat pumps

Since 1970

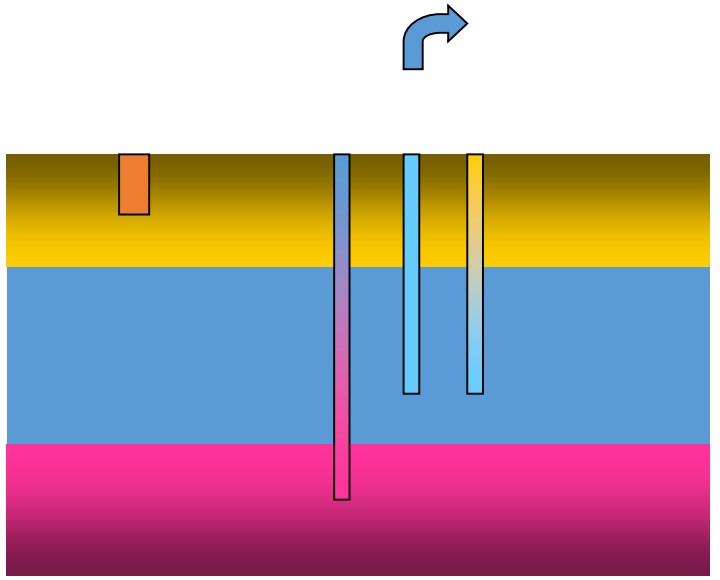

Annual Abstraction (Ml/a)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000


Groundwater Level (mAOD)
Water Level (mbdat)
SJ79/18
SJ79/80
SJ79/72
SJ79/60A STRETFORD GAS
Synthetic
Kelloggs 1 RWL
Kelloggs 2 RWL
GEC 7 RWL
GEC 5 RWL
Imperial Chem 1
Westinghs Rd RWL
Akzo No.1 Logger
Akzo Manual
MG
Till
SSG
Jan-1910
Jan-1920
Jan-1930
Jan-1940
Jan-1950
Jan-1960
Jan-1970
Jan-1980
Jan-1990
Jan-2000

So…Trafford Park:
Conceptual model & issues



So…Trafford Park:
Conceptual Model & the issues

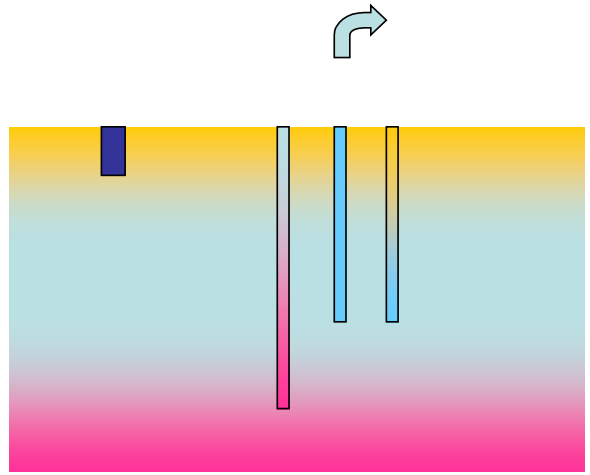


So…what are the issues?

CAMS: (catchment scale) -

How to deal with new licence applications?

- What is the sustainable resource? (sustainable level of abstraction)?
- Where is water (recharge) coming from
  - Below (saline)?
  - Above (contamination, shallow iron)?
  - Surface waters?
  - Laterally (outside of Trafford Park)?

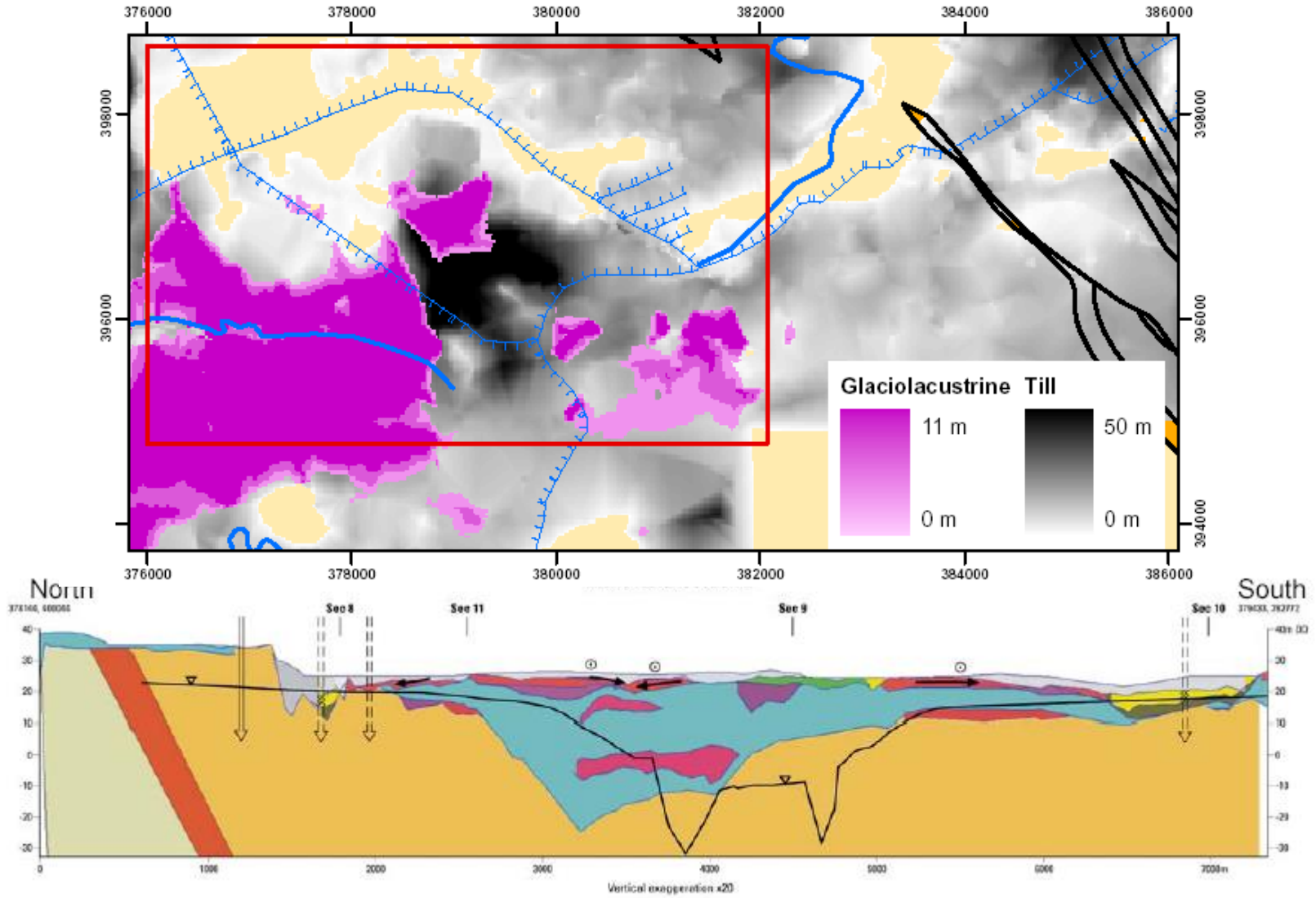


So…what are the issues?

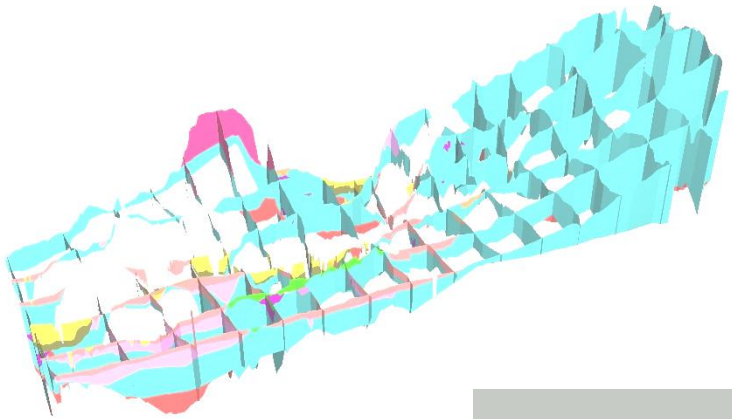
Licensing Decisions: (site specific)

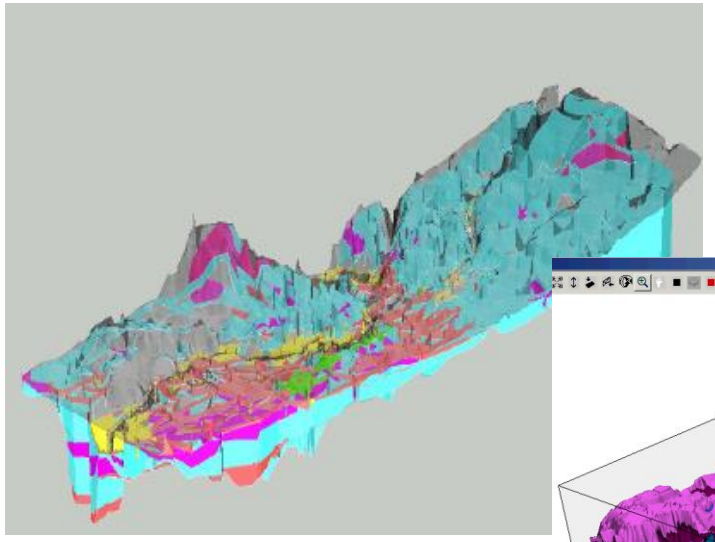
- Can we licence additional abstraction?
- What will the impact be on the quality/groundwater levels
- will groundwater quality deteriorate (timescales?)
- how certain are we? (Risk - consequences)
- What are appropriate conditions

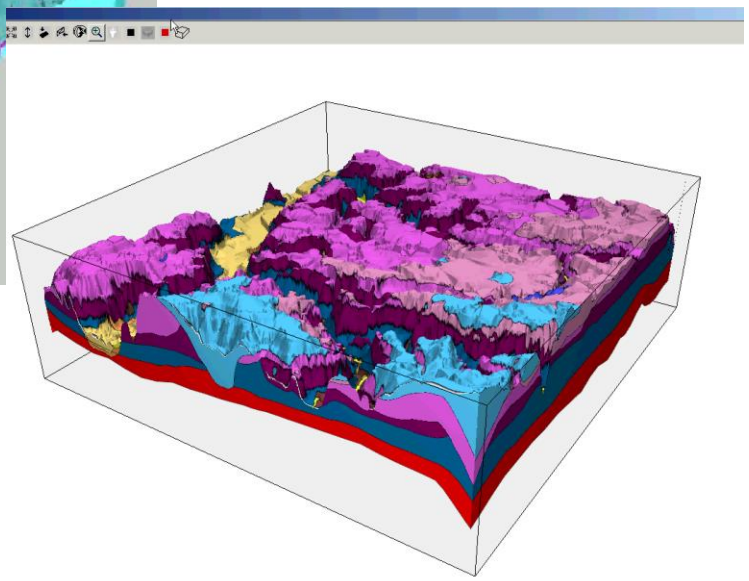
Superficial Deposits
– Importance of BGS mapping



British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL





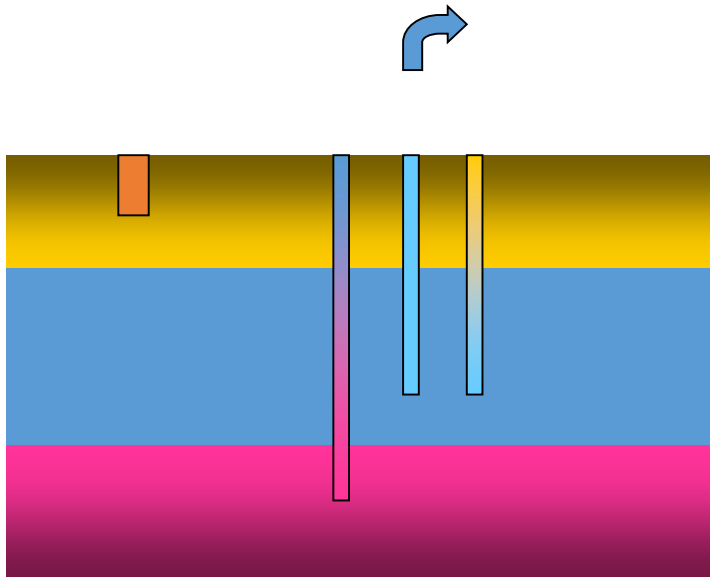


Manchester Urban Model

Iron Rich Groundwater

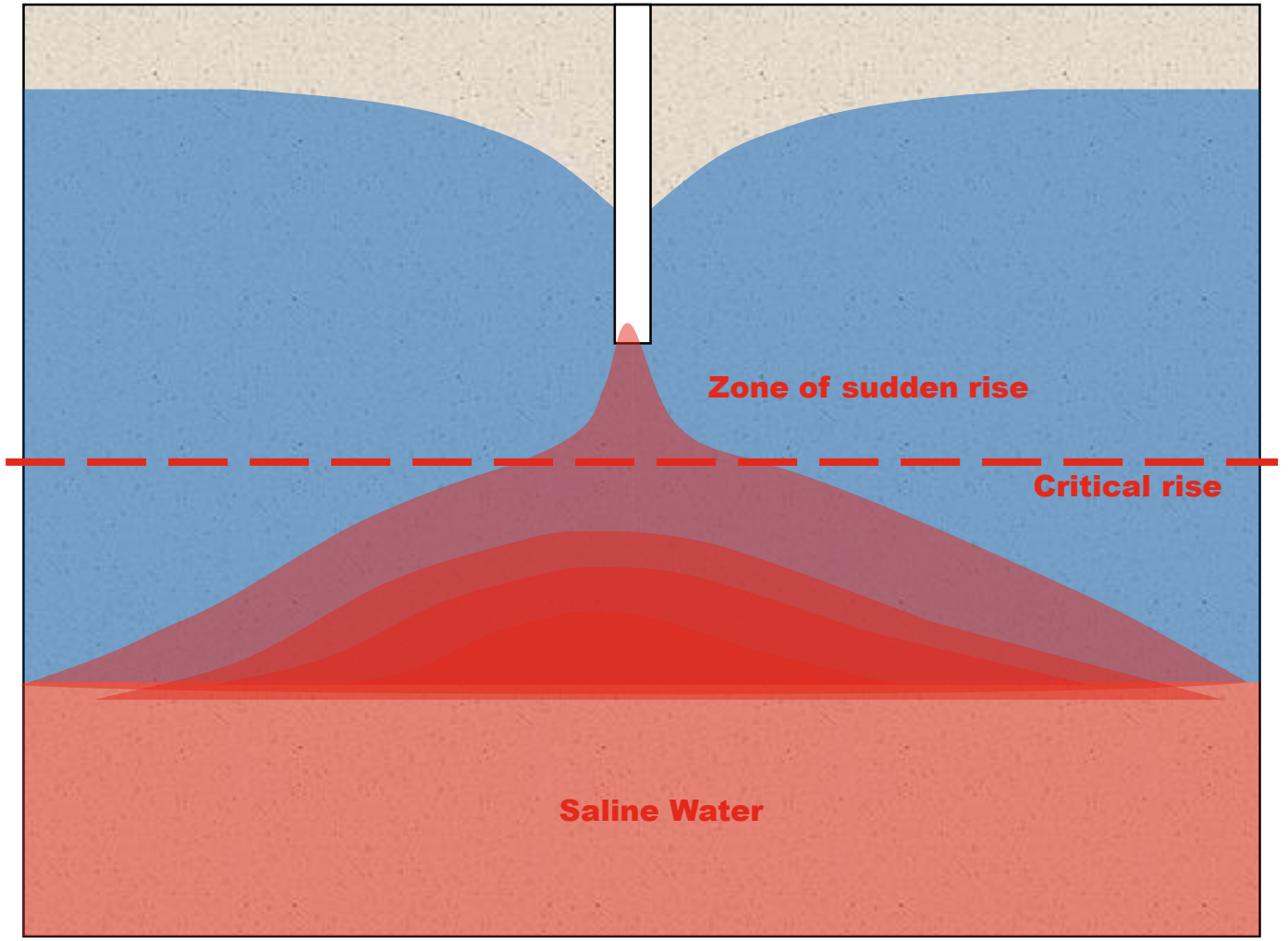
Potential sources:

- Coal Measures
- Bridgewater Canal sediments
- Sherwood Sandstone Group
- Superficial Deposits



<u>Onus on new applicants to investigate</u>

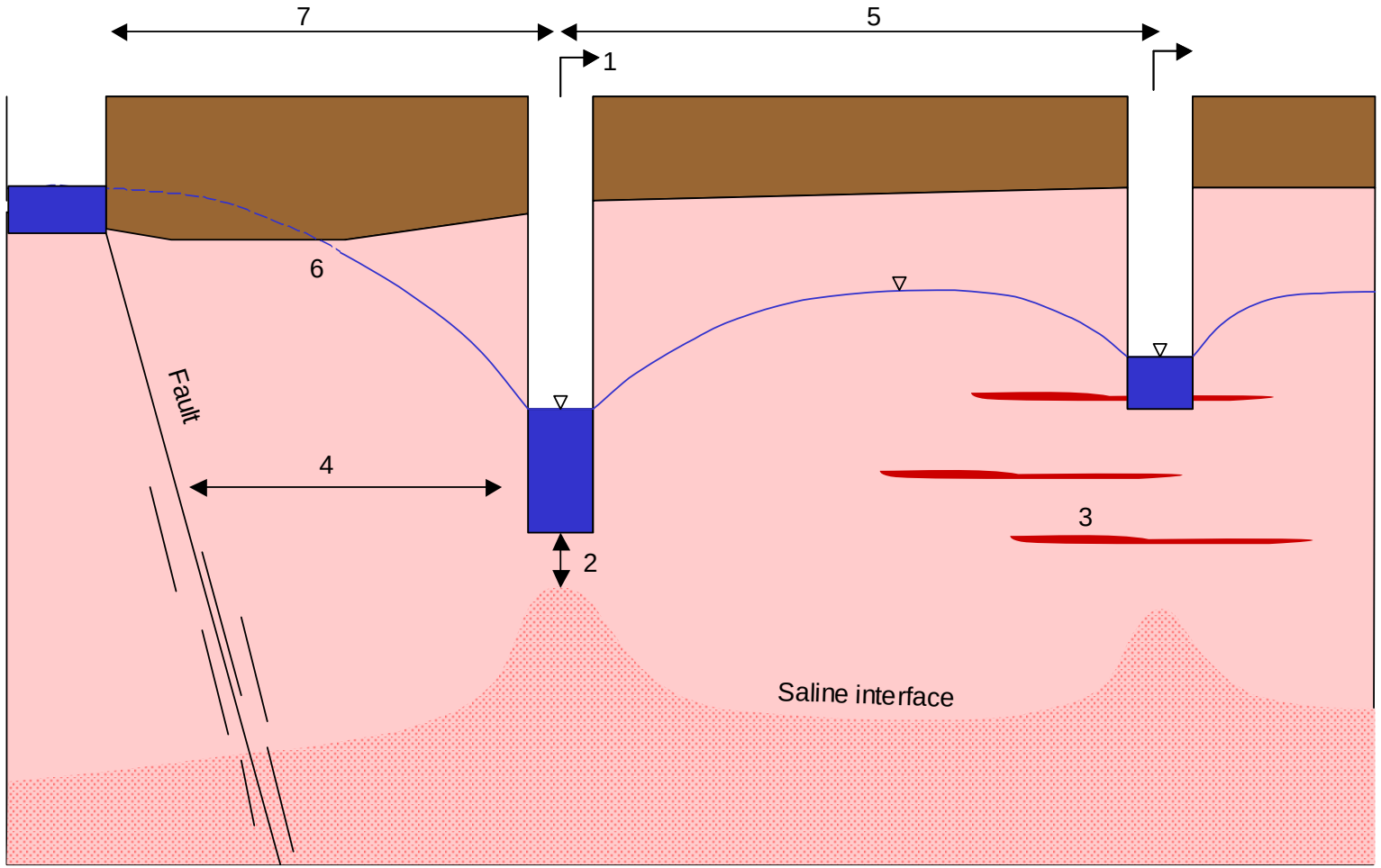
Saline upconing



Factors affecting saline upconing

- Pumping rate
- Depth of borehole (above saline interface)
- Vertical ‘permeability’ (inc. faults and abandoned boreholes)

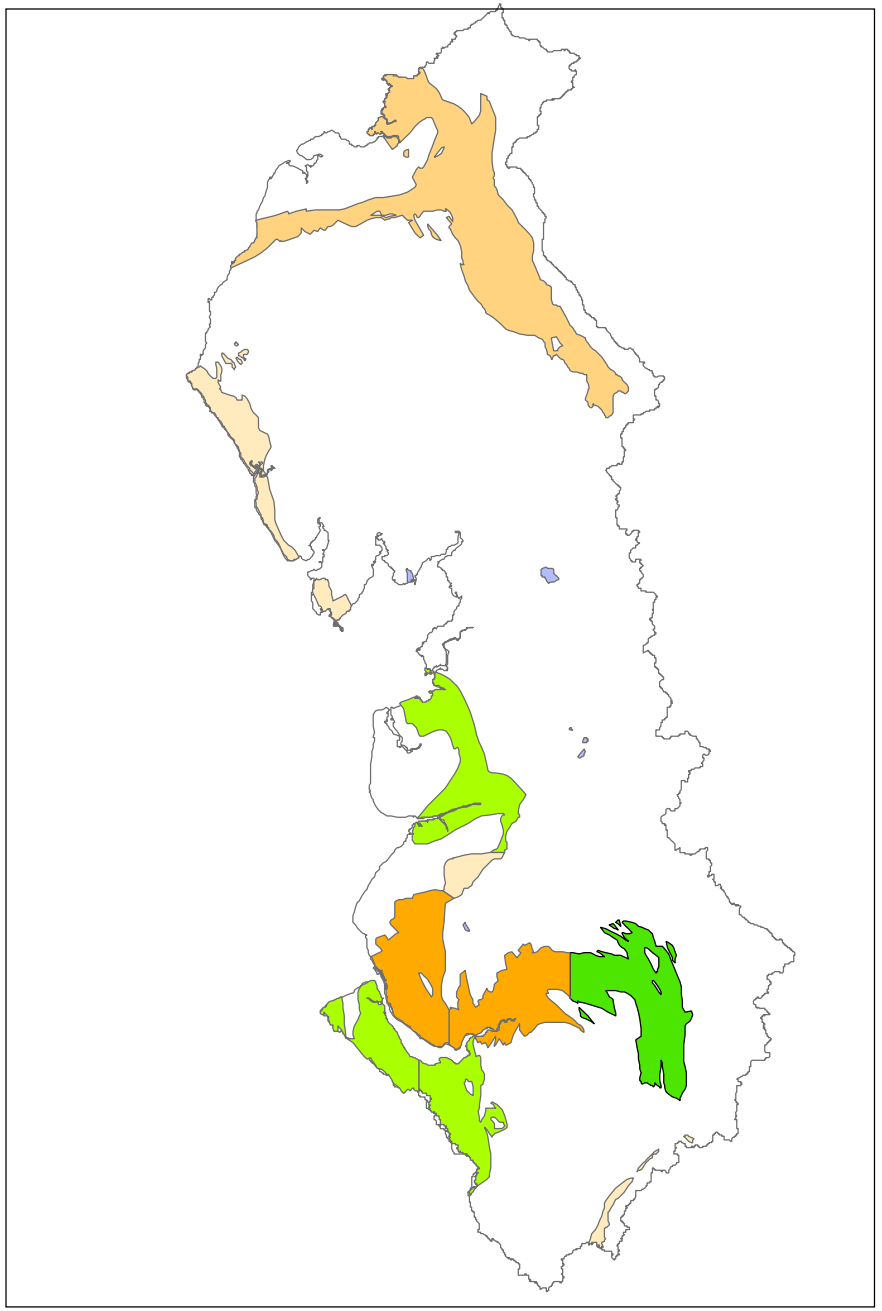
Risk factors for saline upconing



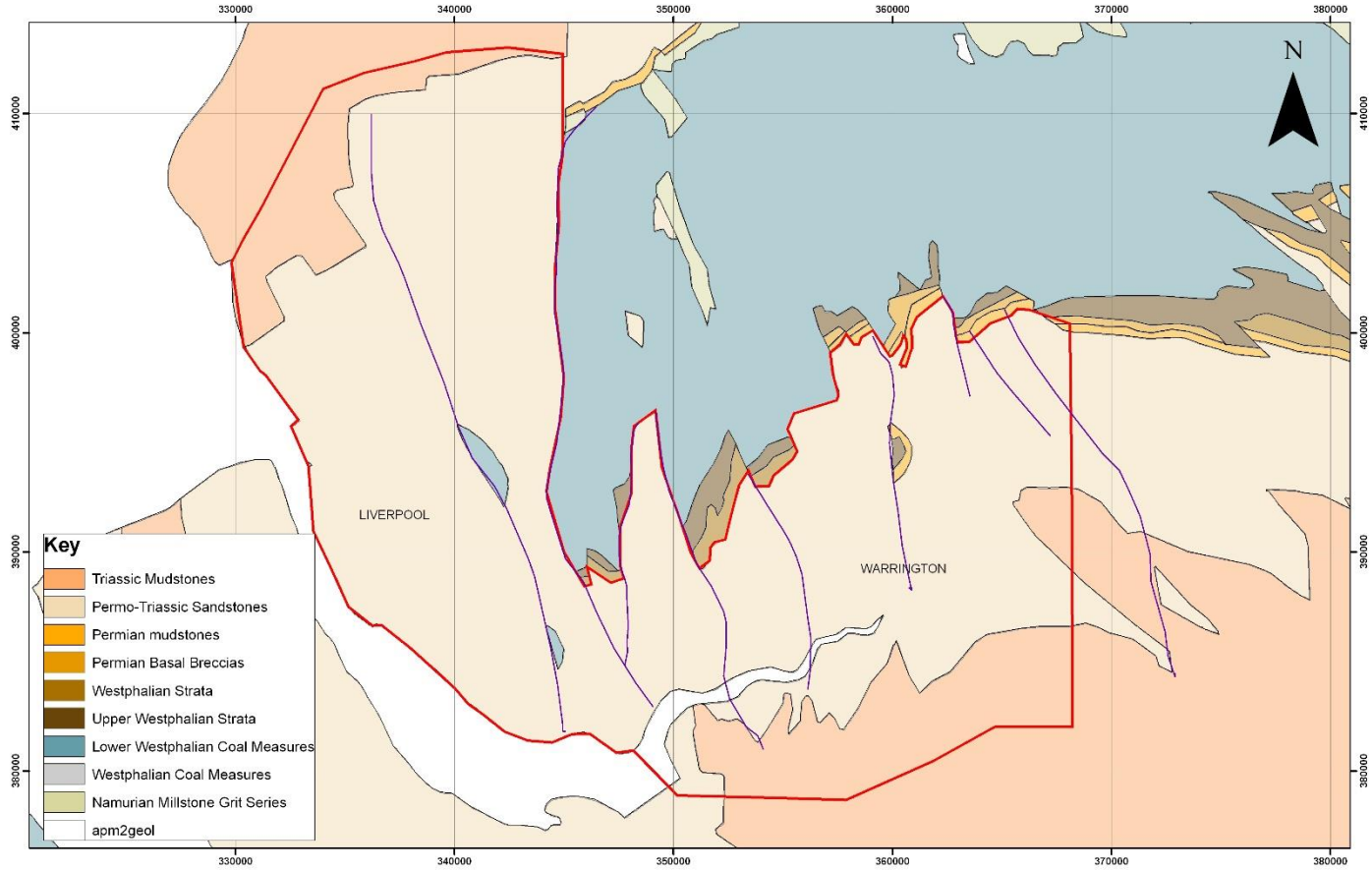
1 Rate of abstraction
2 Elevation of base of borehole above saline interface
3 Presence of marl bands
4 Proximity to faults (or abandoned boreholes)
5 Proximity to other abstractions
6 Confined/unconfined
7 Distance to connected surface water body

Where next
– back to where we started

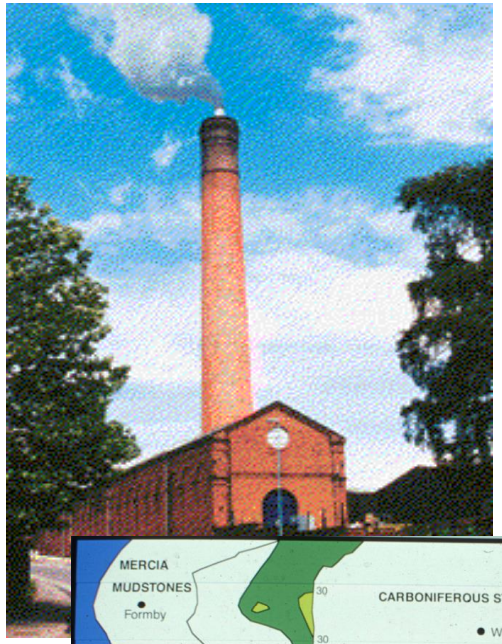
- **Lower Mersey Basin & North Merseyside**

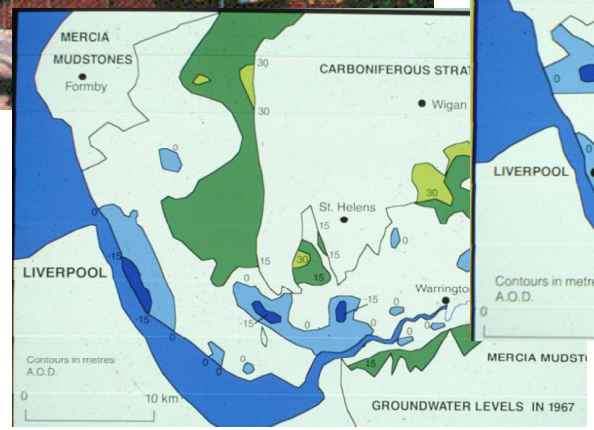


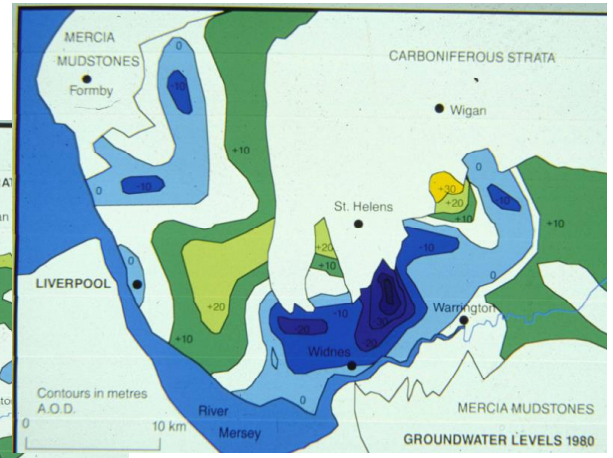
Where Next?

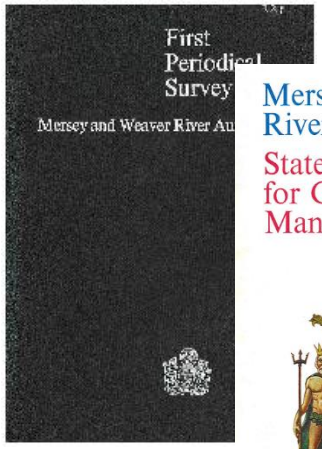

330000
340000
350000
360000
370000
380000
410000
400000
390000
380000
N
LIVERPOOL
WARRINGTON
Key
Triassic Mudstones
Permo-Triassic Sandstones
Permian mudstones
Permian Basal Breccias
Westphalian Strata
Upper Westphalian Strata
Lower Westphalian Coal Measures
Westphalian Coal Measures
Namurian Millstone Grit Series
apm2geol

Groundwater development history & previous studies





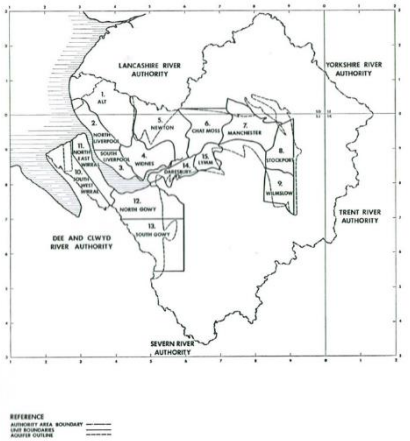




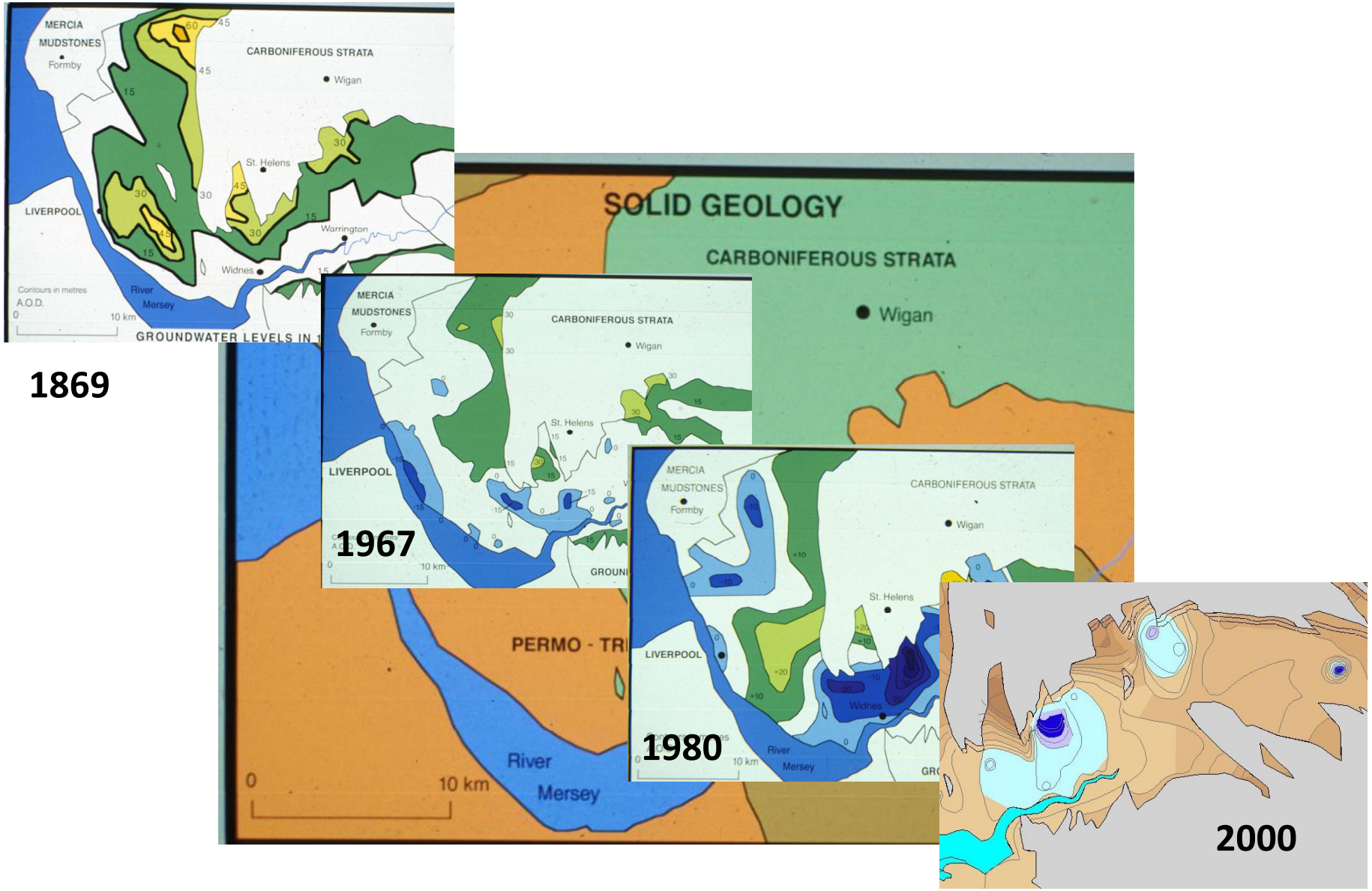
Mersey and Weaver River Authority

Statement of Policy for Ground-Water Management 1973

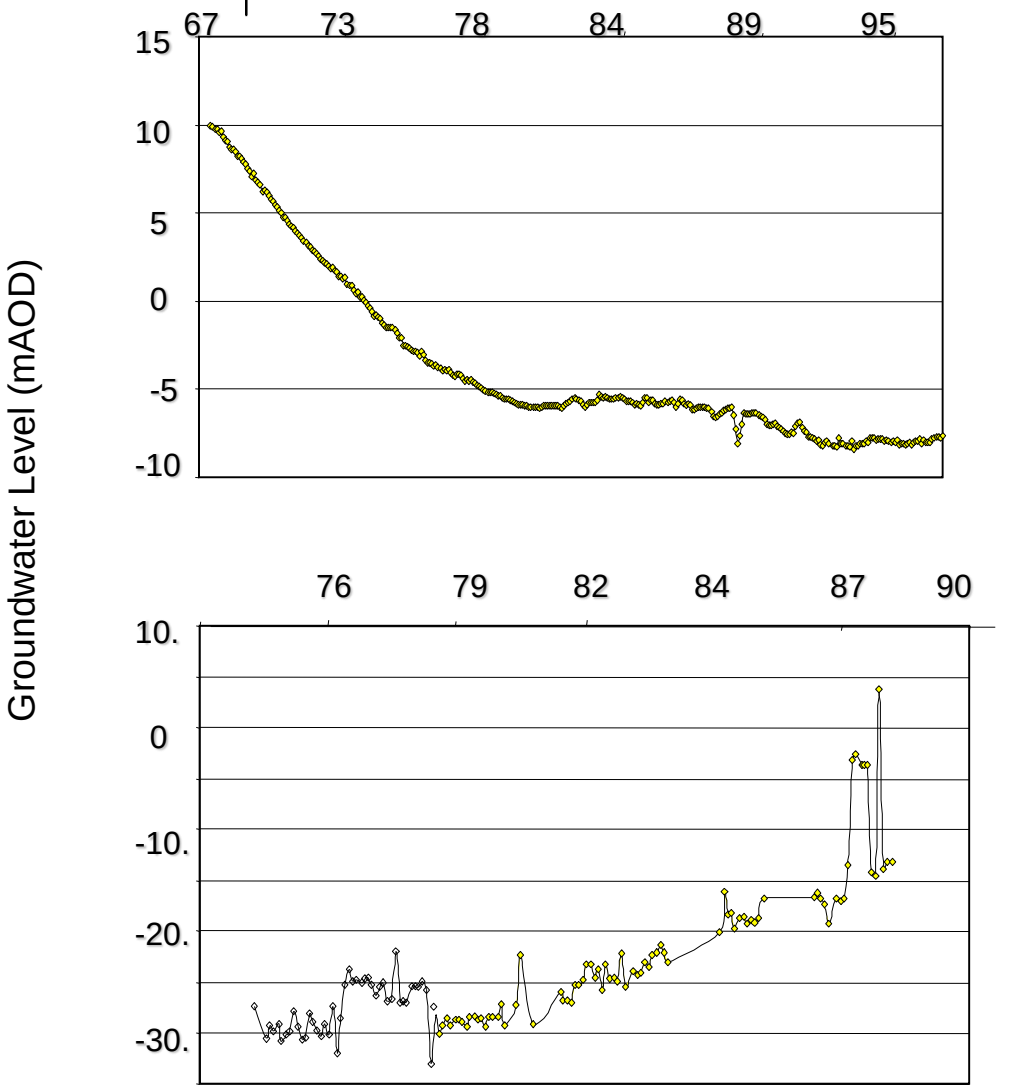
GROUND-WATER UNITS



Mersey Basin - Groundwater Levels



Groundwater Hydrographs
Mersey Basin



Kenyon Lane

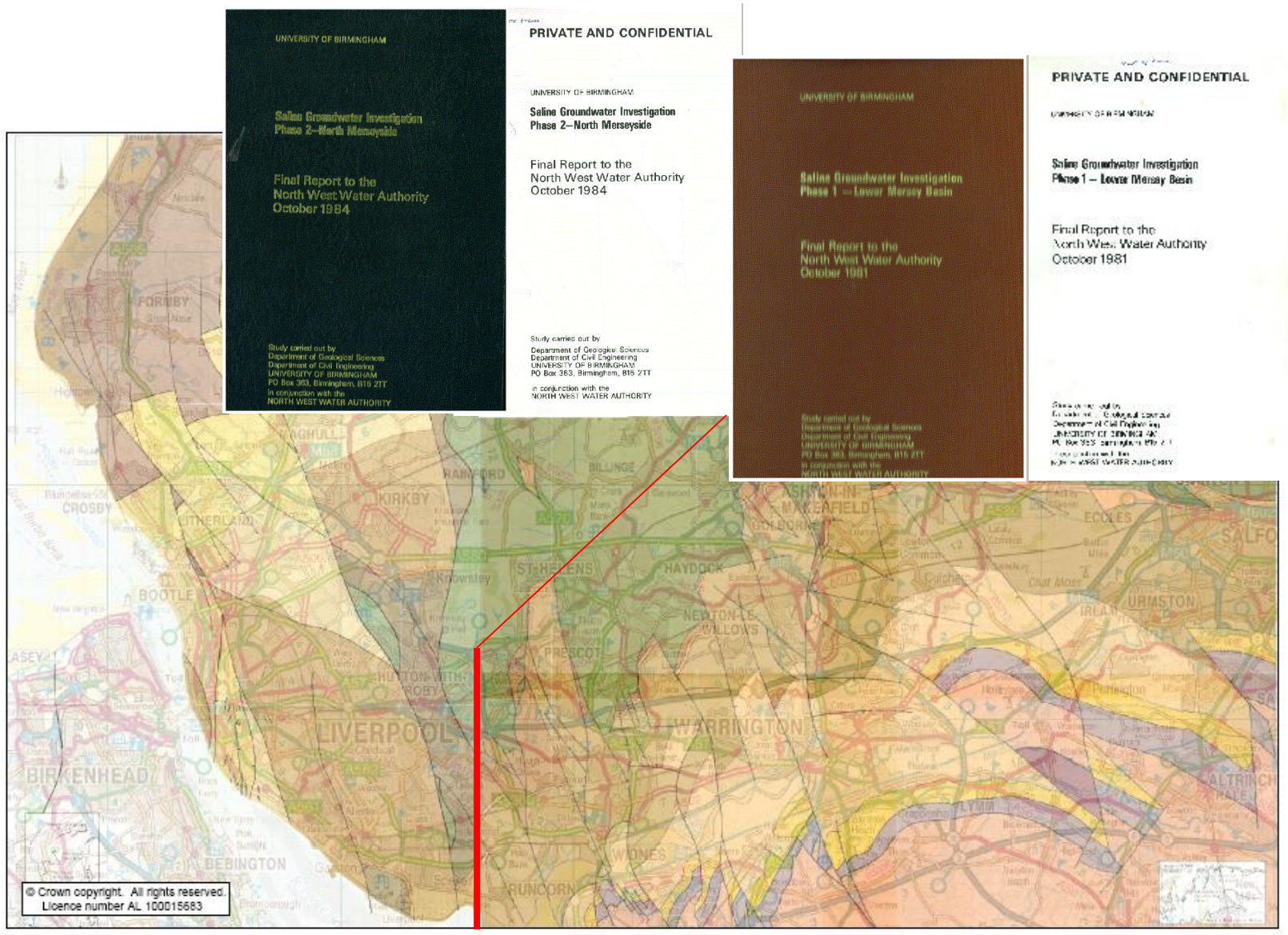
Observation Borehole

Public Water Supply

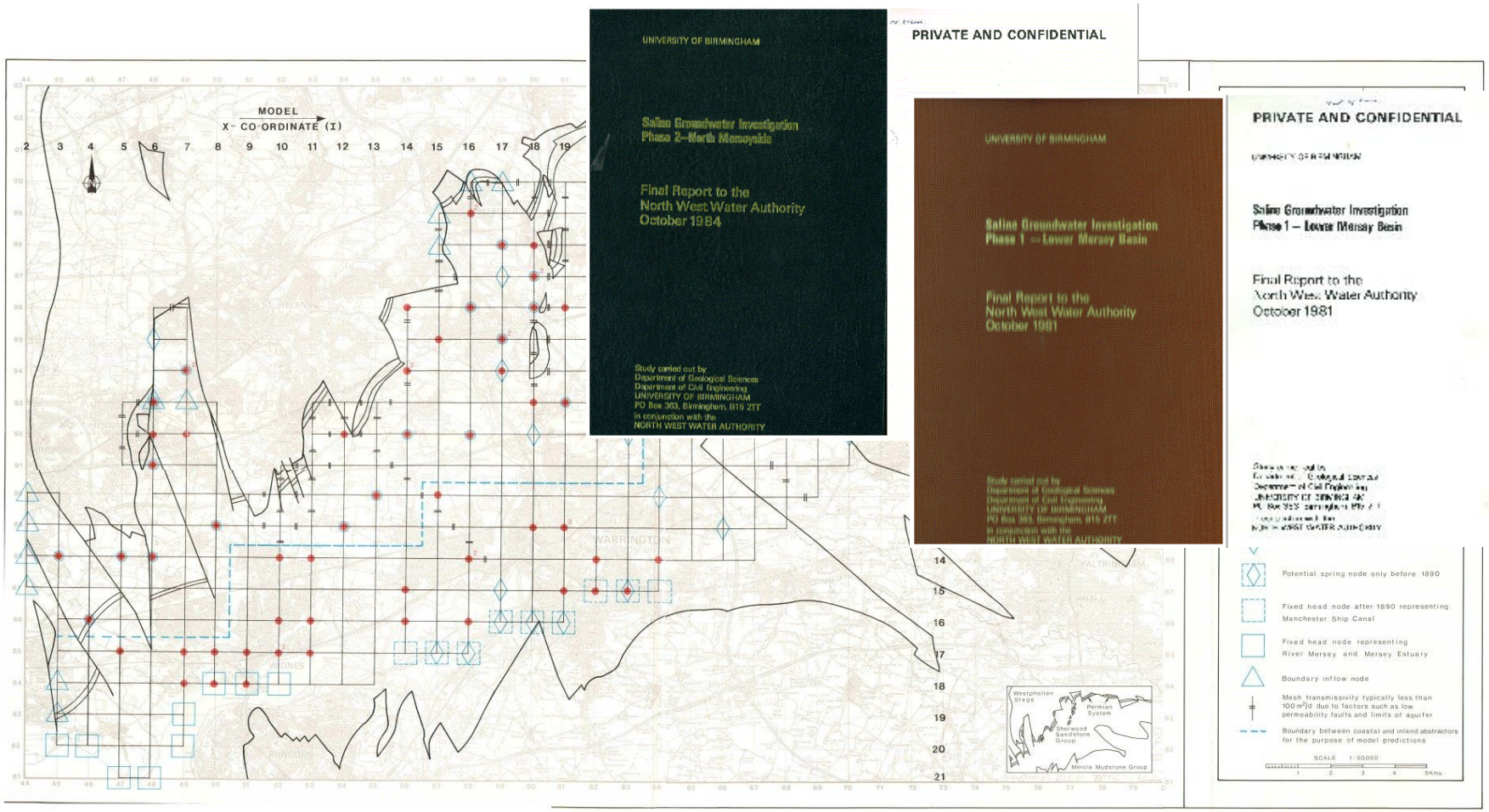
Abstraction Borehole

Groundwater Lake - Winwick

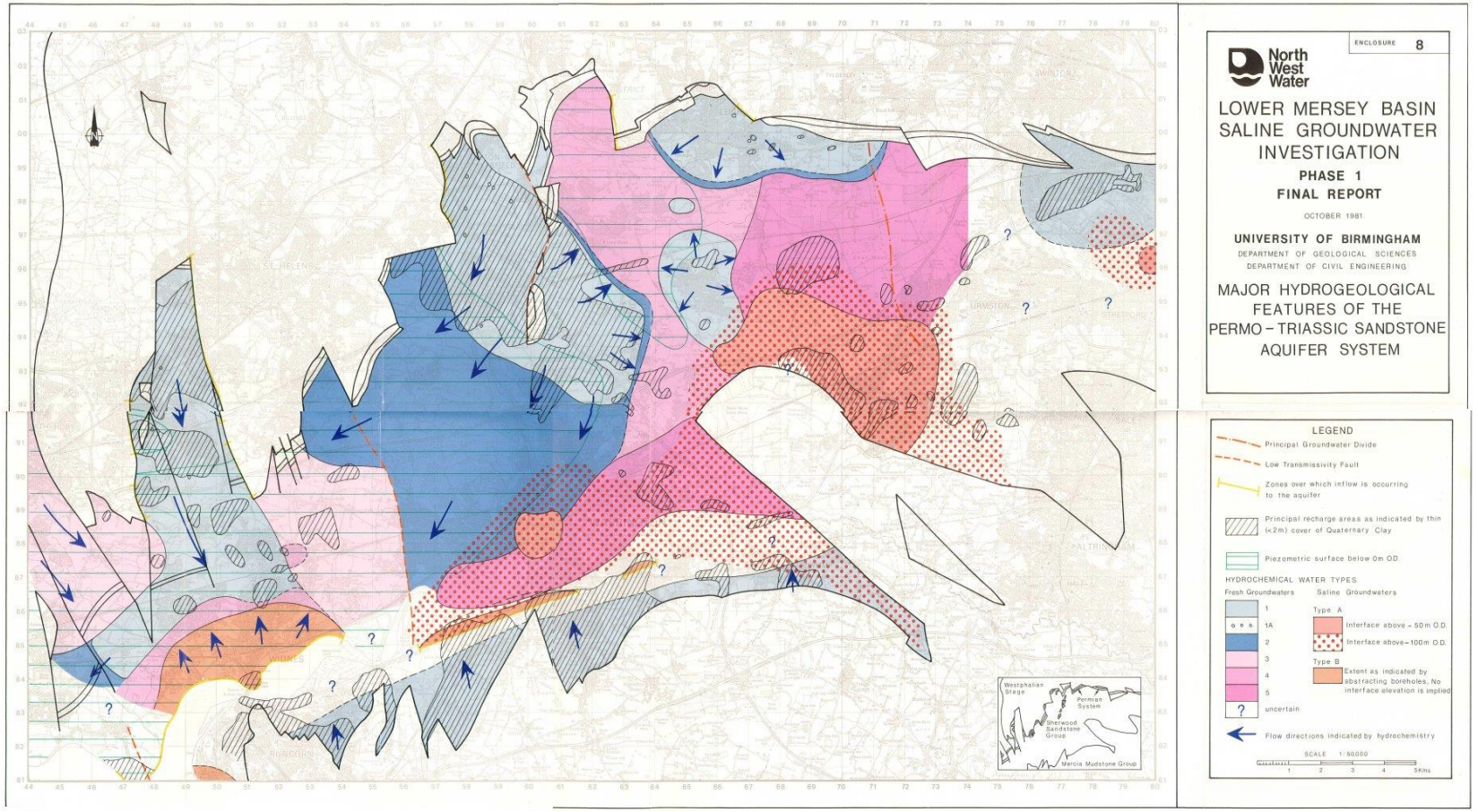
Previous Investigations ~ 1980's Saline GW Study



Groundwater development history & previous studies



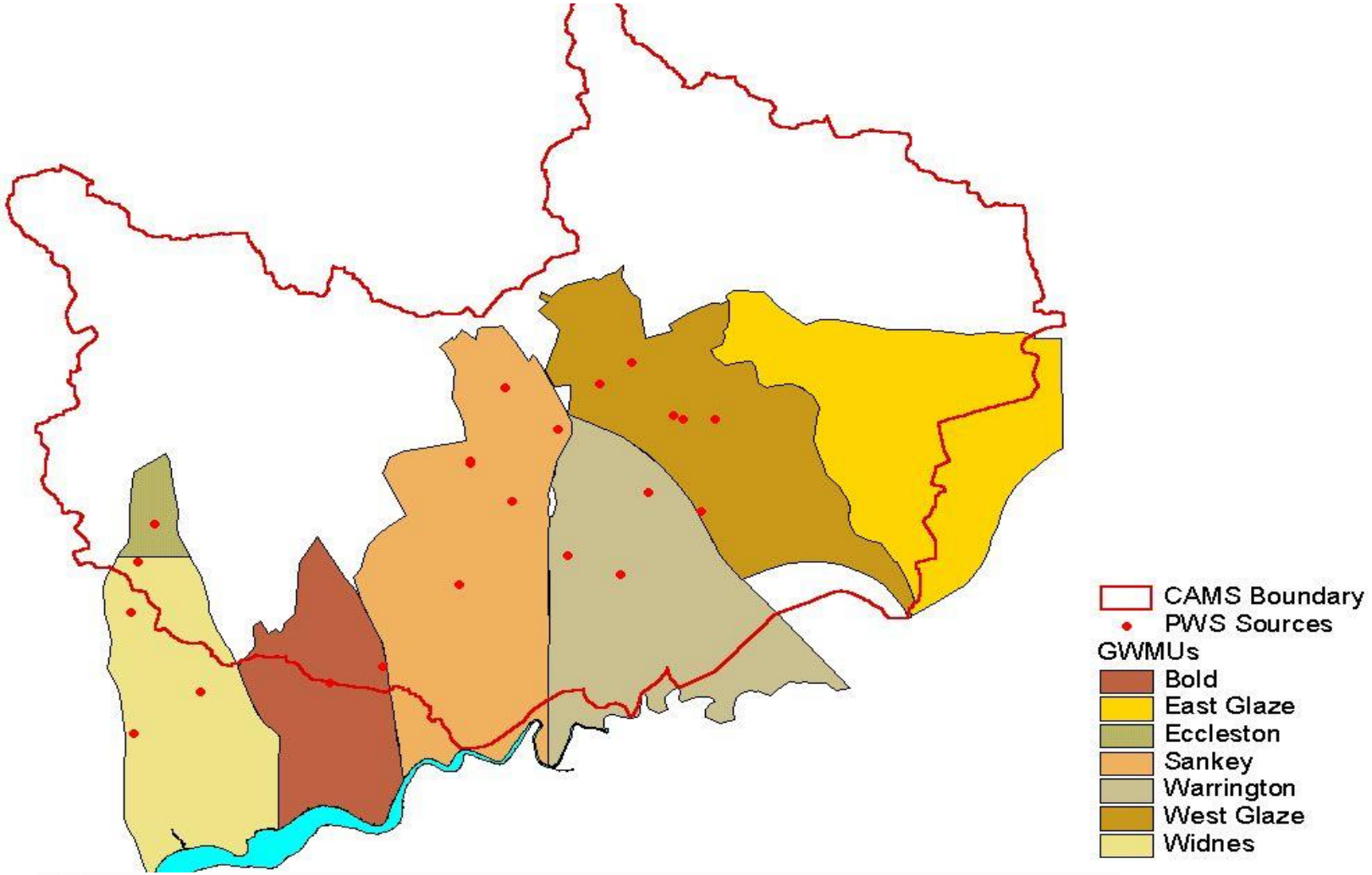
Lower Mersey Basin ~ water types

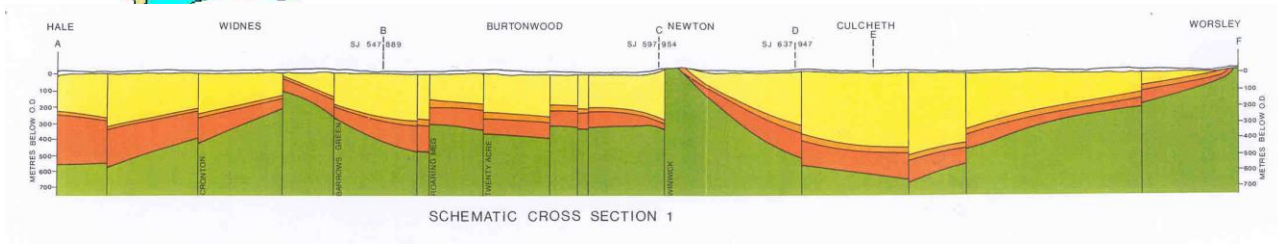


Mersey Basin revisited:

Why ~ what are the issues?

Why?: Refining CAMS input





SCHEMATIC CROSS SECTION 1

Why? - On the rebound?

Groundwater Rebound

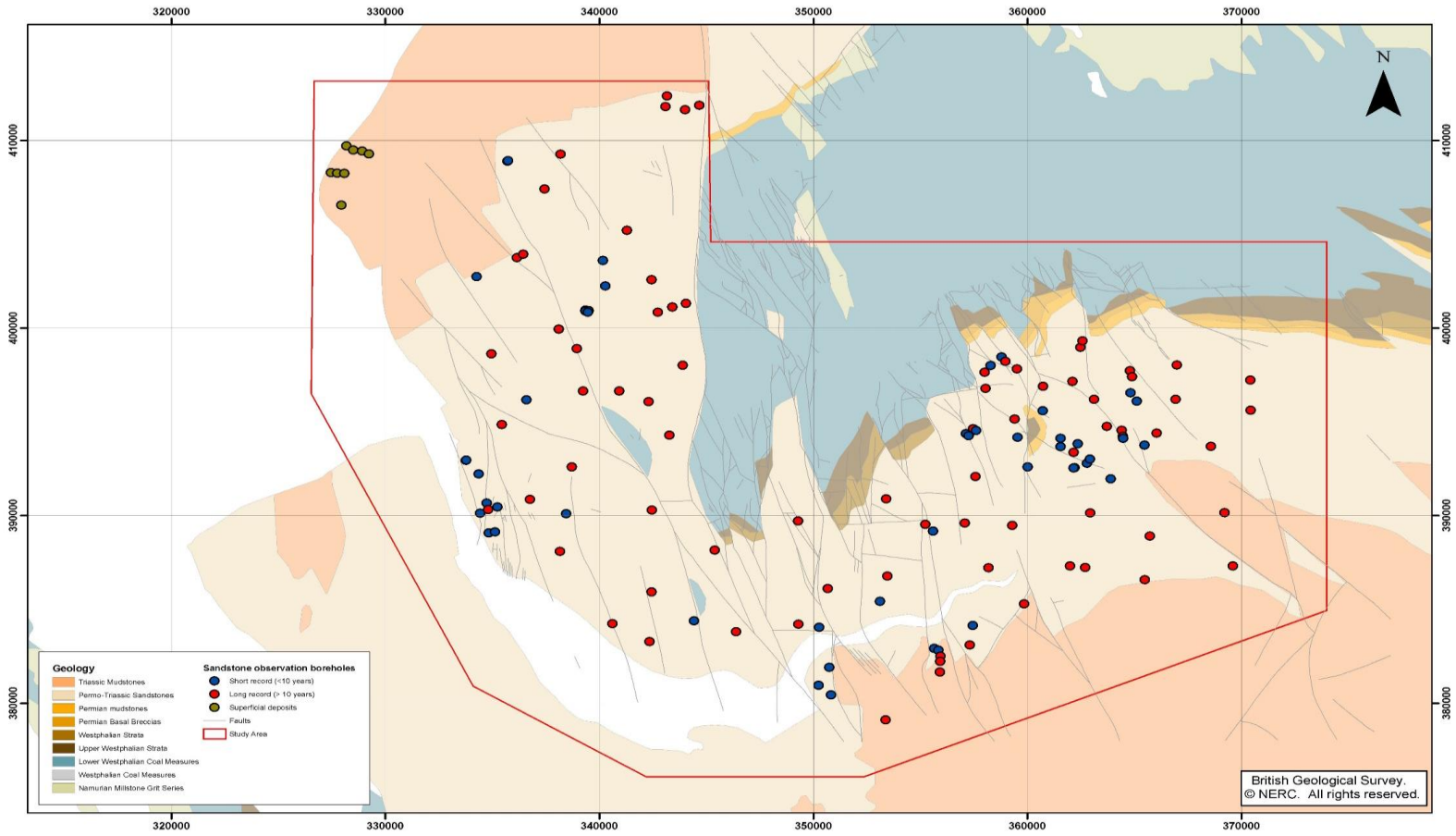
Impact on Infrastructure

e.g. Liverpool Loop Line

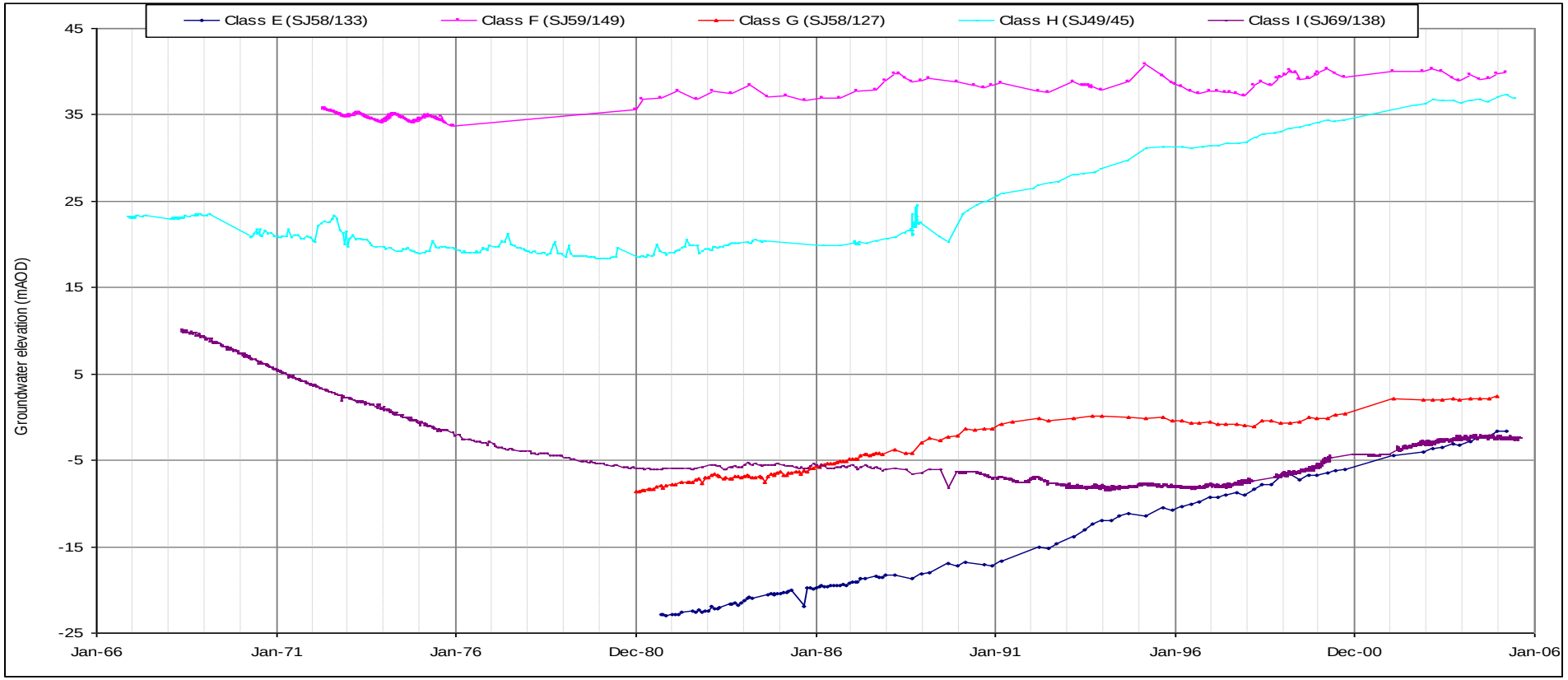
Potential impact on Contaminated Land

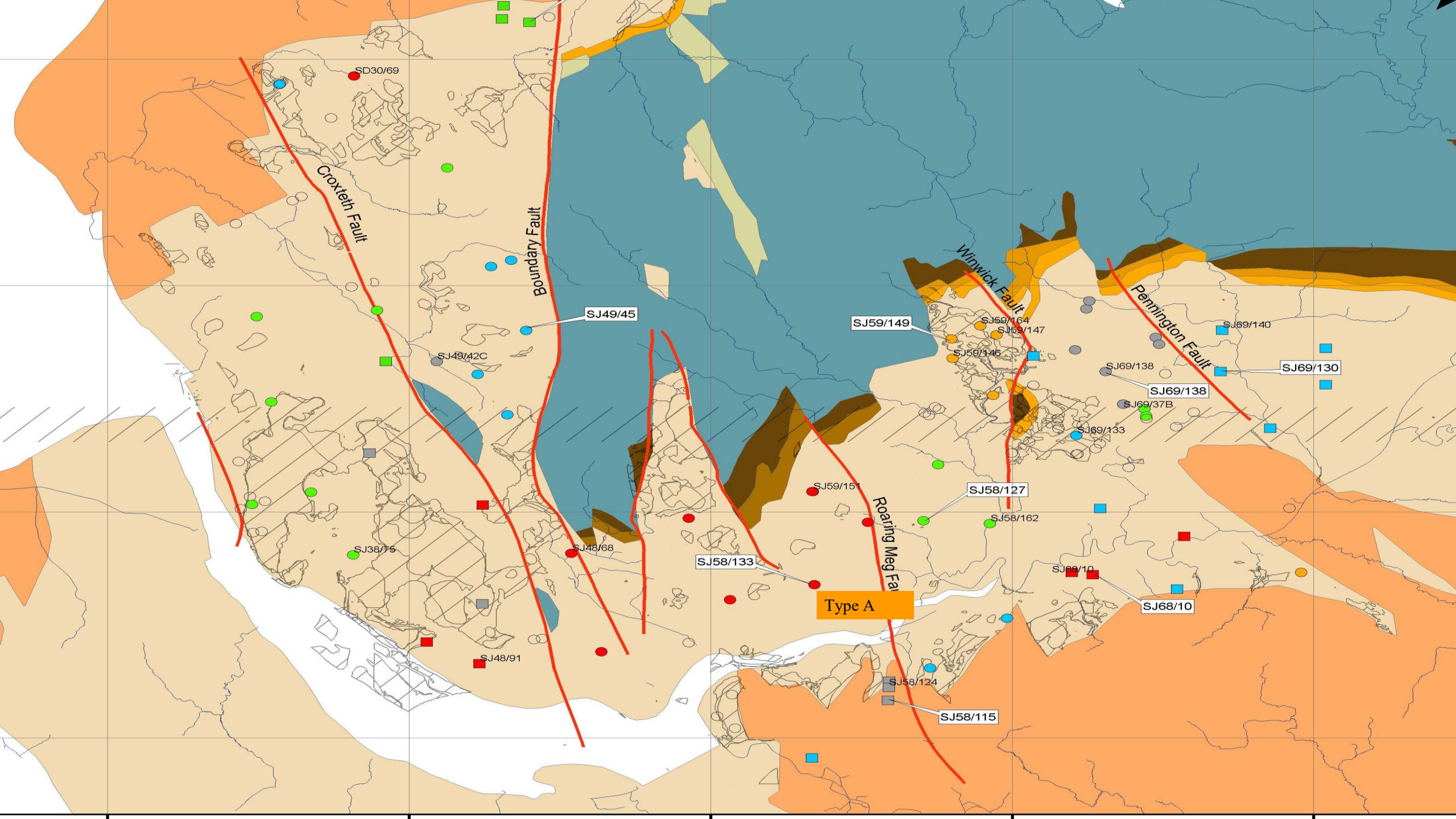
Groundwater levels

– Agency observation network

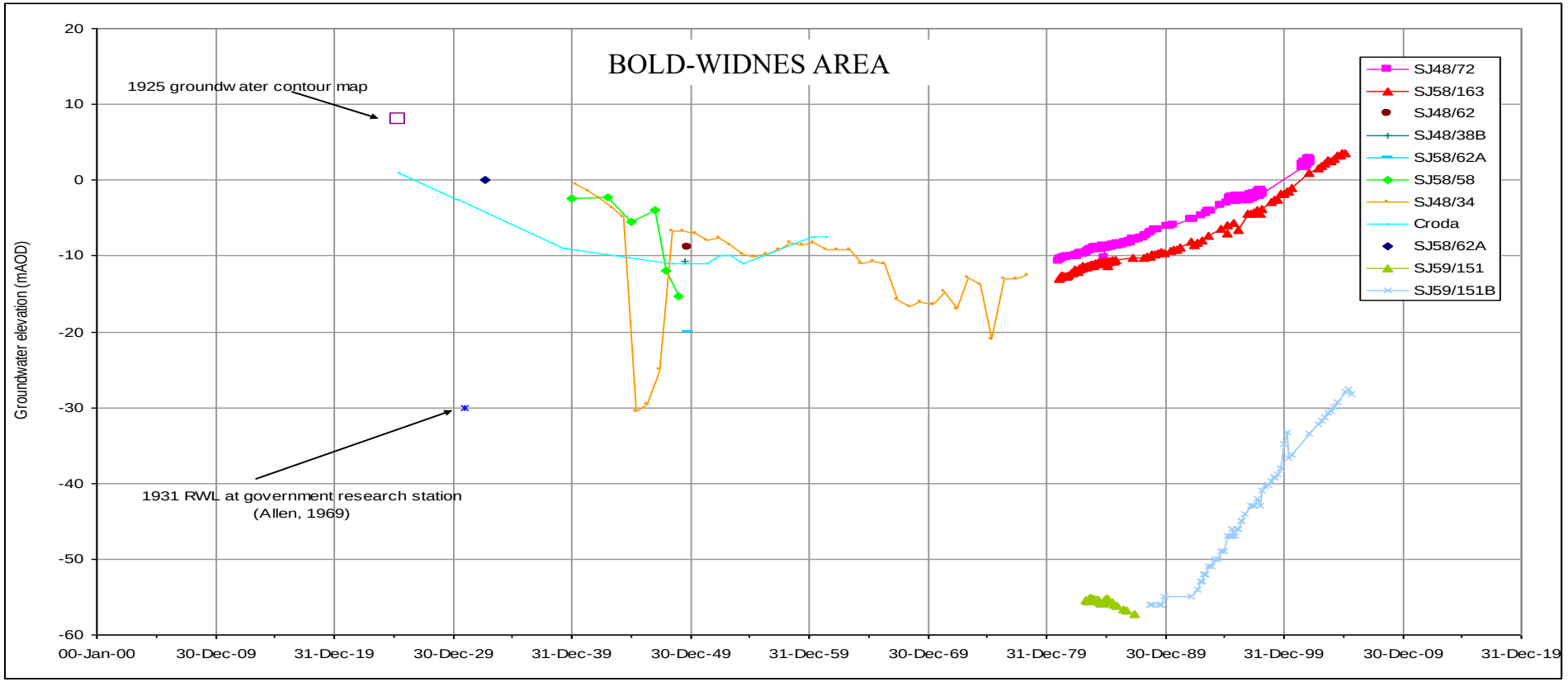


Groundwater levels – Type hydrographs



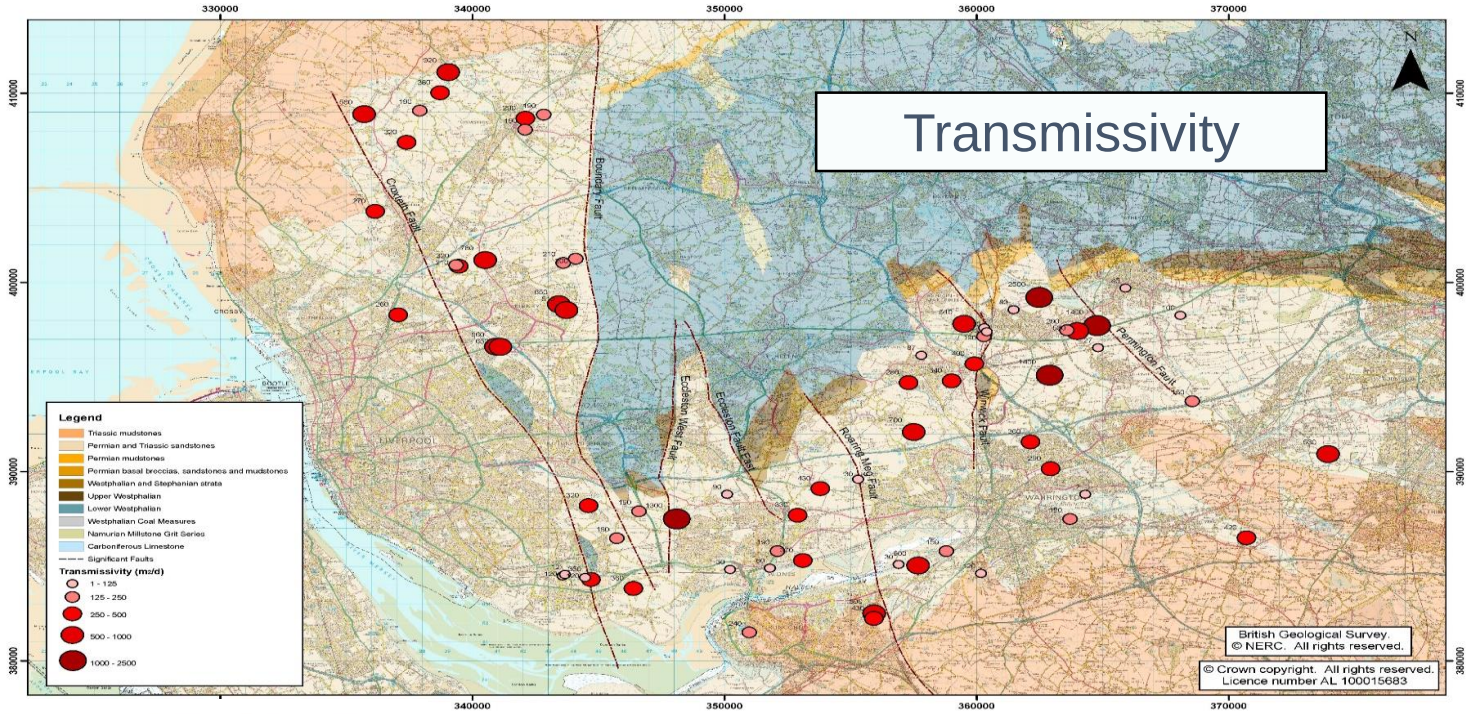

SD30/69
Croxteth Fault
Boundary Fault
SJ49/45
SJ49/42C
SJ38/75
SJ48/68
SJ48/91
SJ59/149
SJ59/164
SJ59/147
SJ59/146
Winwick Fault
Pennington Fault
SJ69/140
SJ69/138
SJ69/130
SJ69/138
SJ69/37B
SJ69/133
SJ59/151
SJ58/127
SJ58/162
SJ58/133
Roaring Meg Fa
Type A
SJ69/10
SJ68/10
SJ58/124
SJ58/115

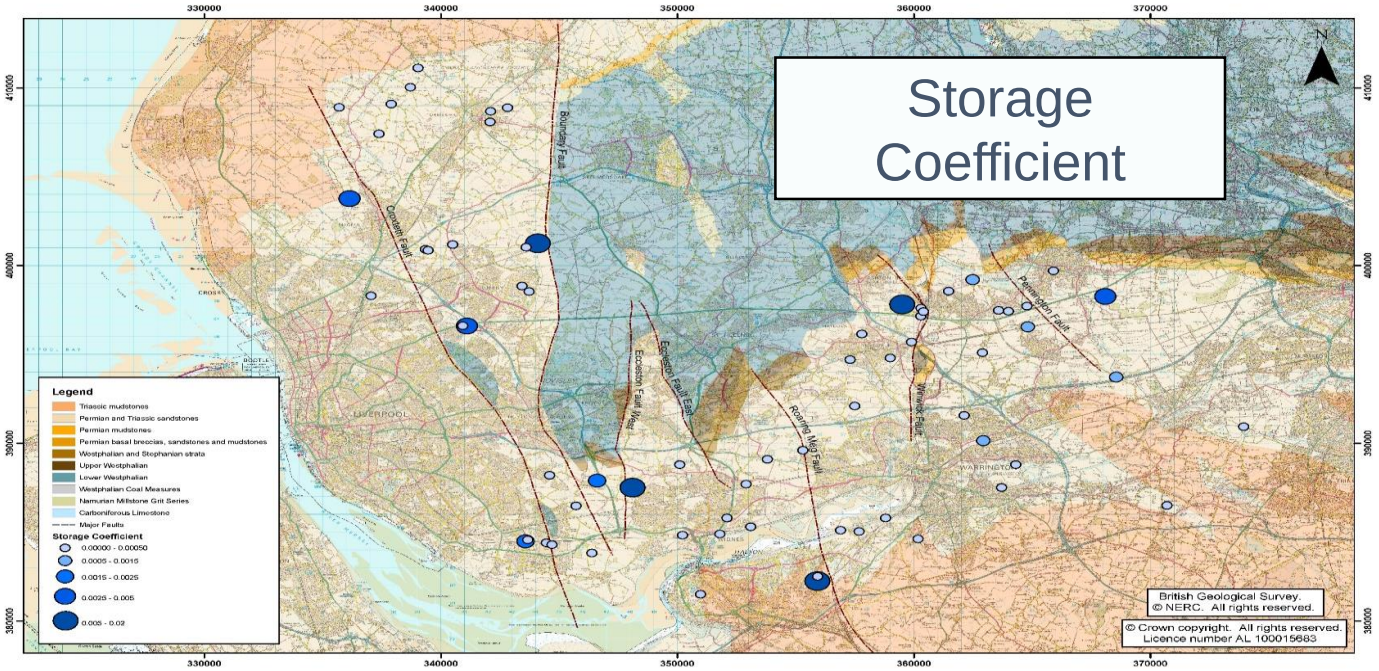
Groundwater levels – long-term variation



How does the aquifer behave?

- rock properties

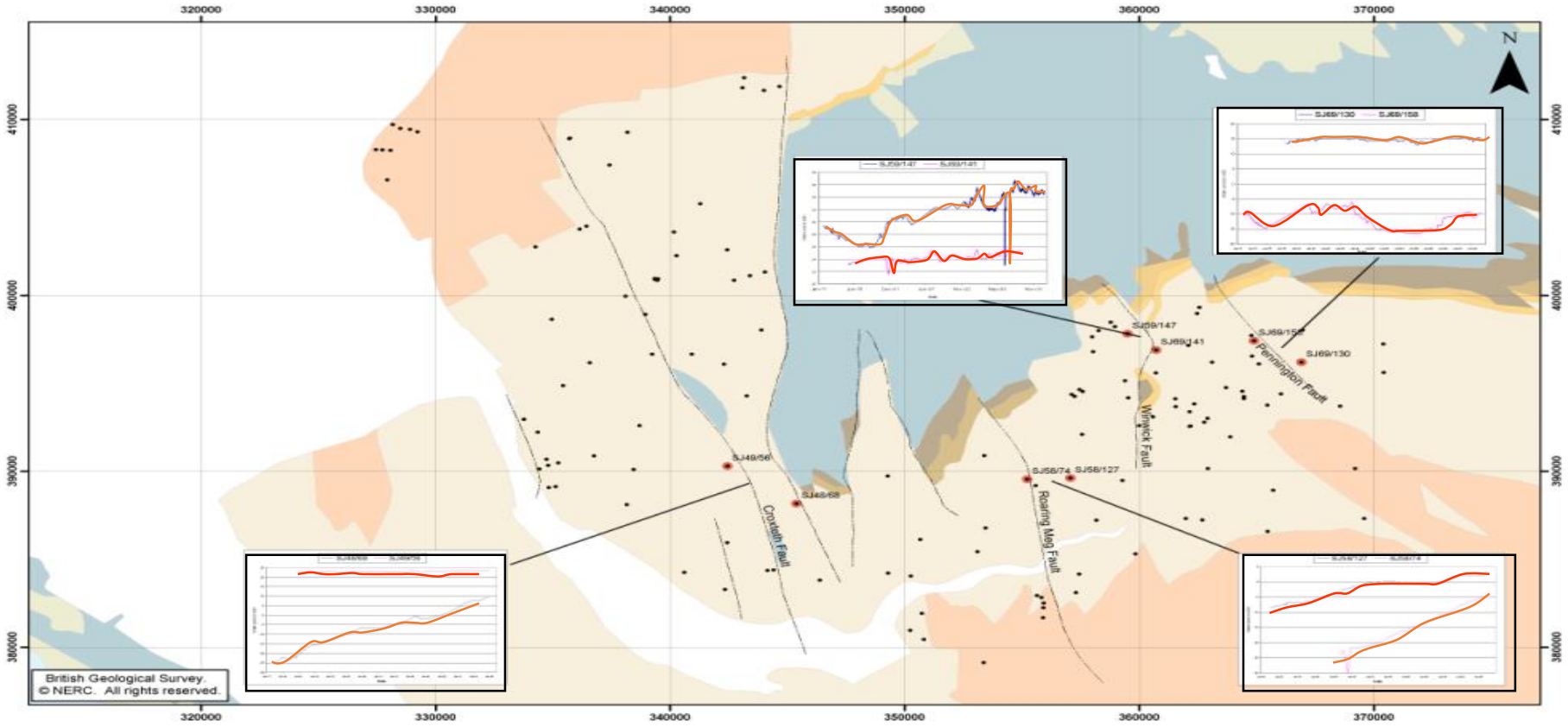




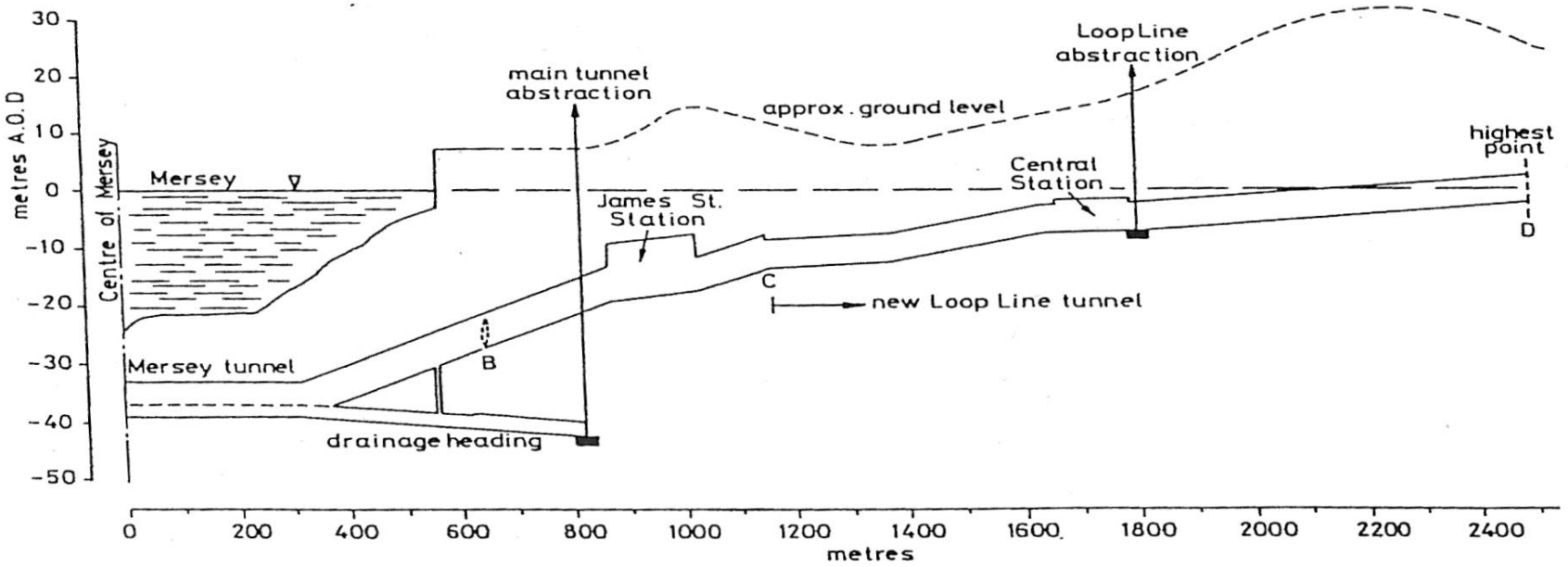
(from ‘Aquifer Properties Manual’)

But is it faulty?

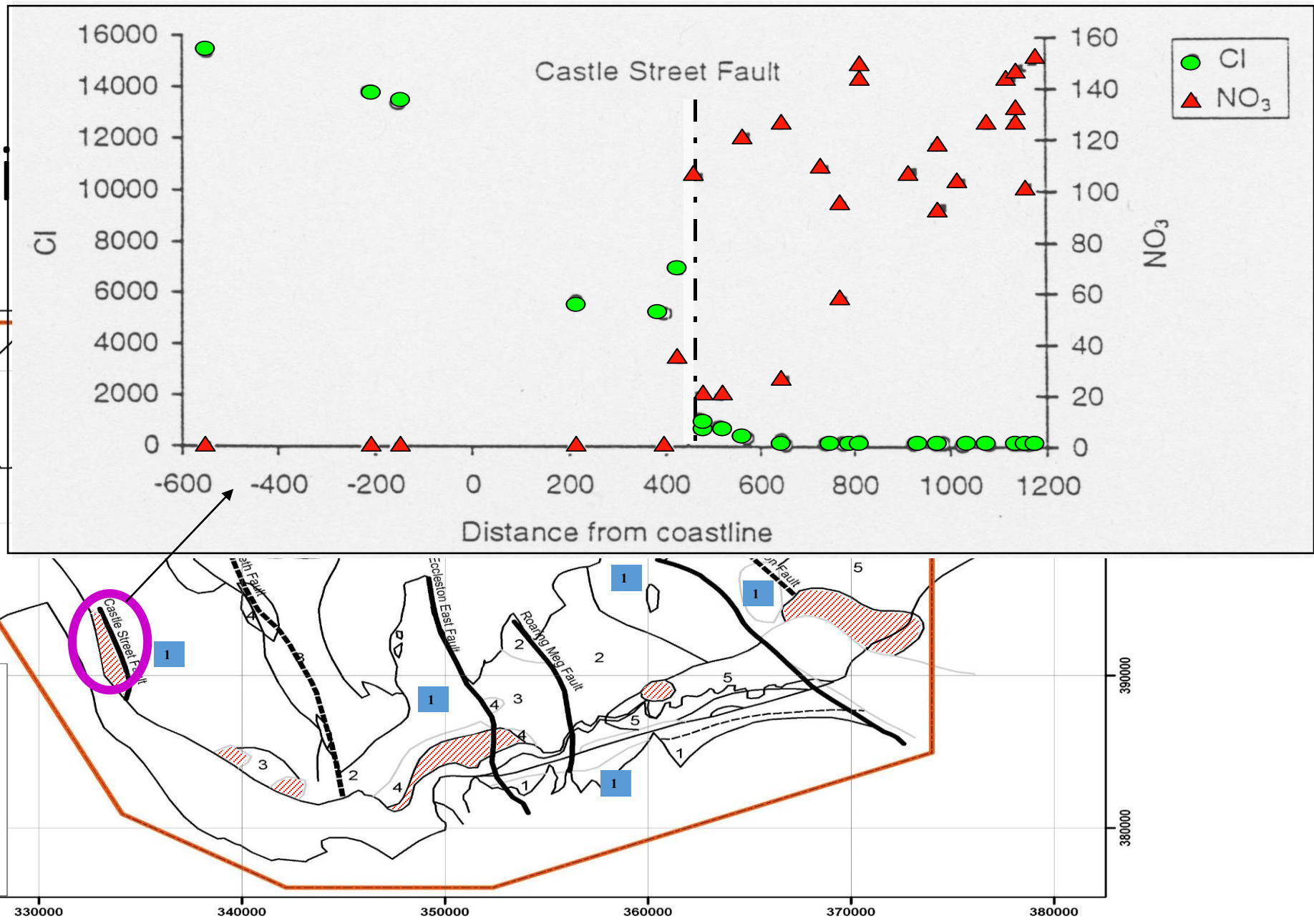
Groundwater responses across faults



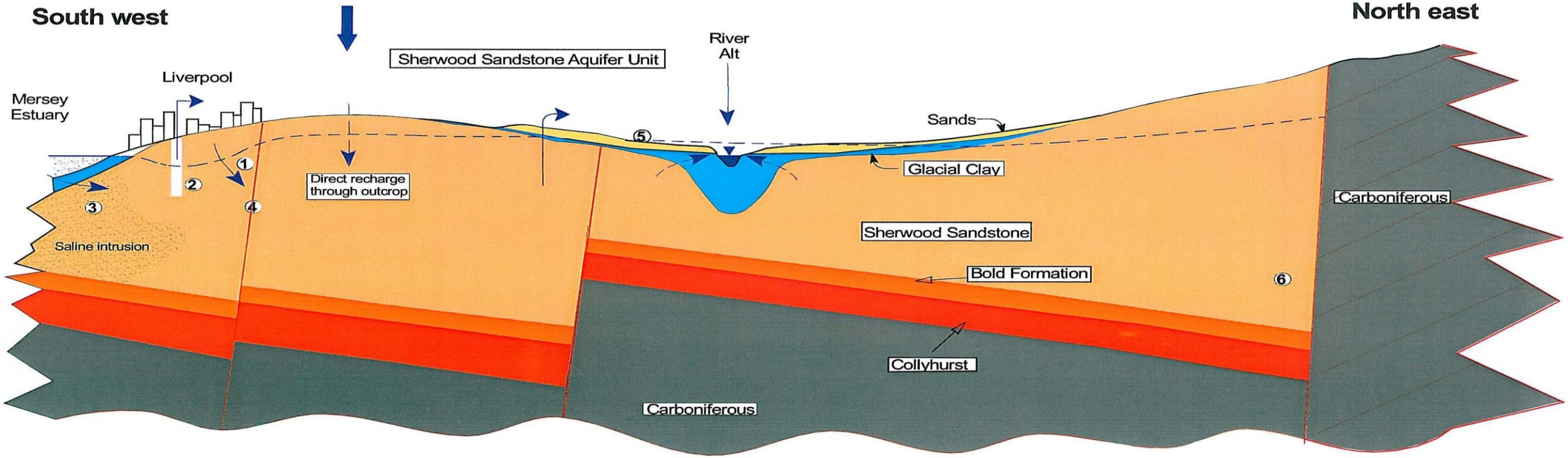
Liverpool Loop Line



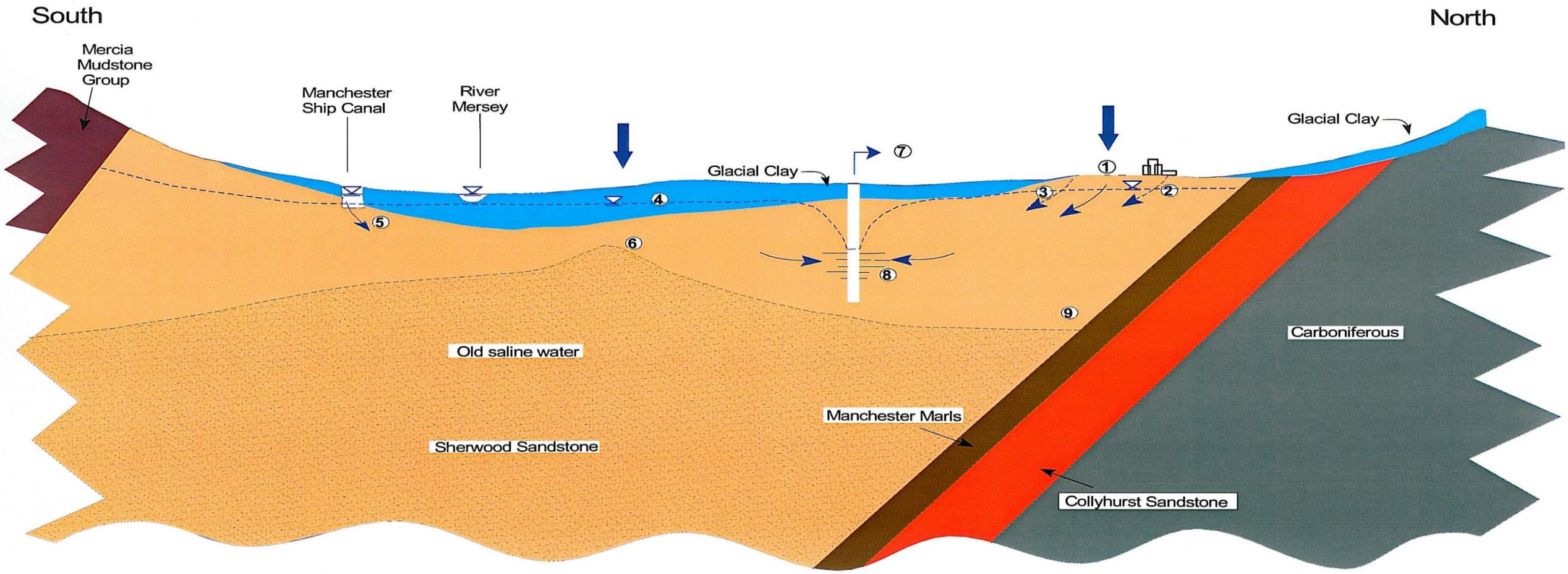
Water Quali


Castle Street Fault
Cl
NO3
Distance from coastline
16000
14000
12000
10000
8000
6000
4000
2000
0
160
140
120
100
80
60
40
20
-600
-400
-200
200
400
600
800
1000
1200
320000
410000
400000
390000
380000
330000
340000
350000
360000
370000
Castle Street Fault
Eccleston East Fault
Roaring Meg Fault
Legend
Water type
Water type boundary
Uncertain boundary
Insufficient recent data
Faults
Major Faults
Potential barriers

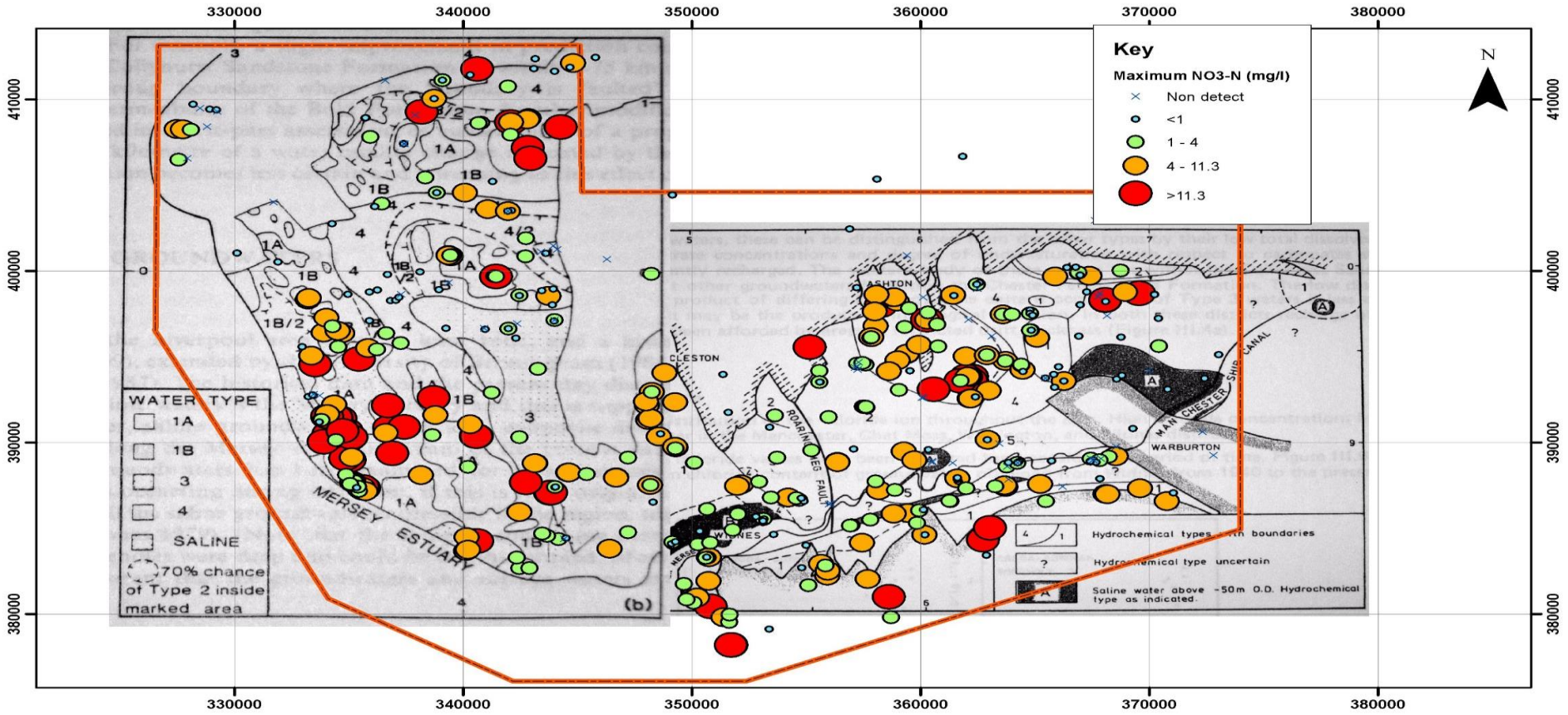
Conceptual model:
Liverpool- Ormskirk ~ SW- NE section



Conceptual model:
Lower Mersey Basin ~ N-S section

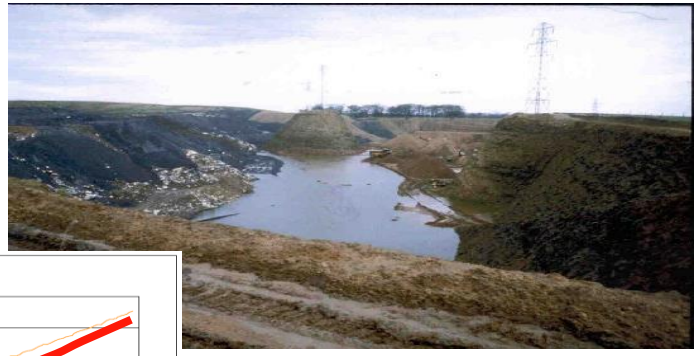


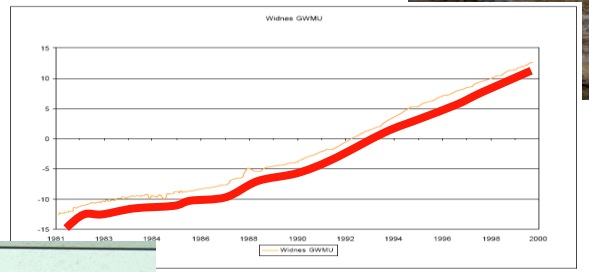
Nitrate distribution

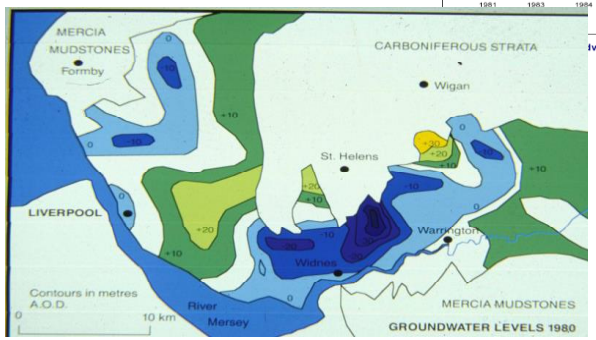


Groundwater Rebound
~ *flood risk mapping?*

- Complicated!!
  - water levels
  - abstraction
  - elevation
  - geology

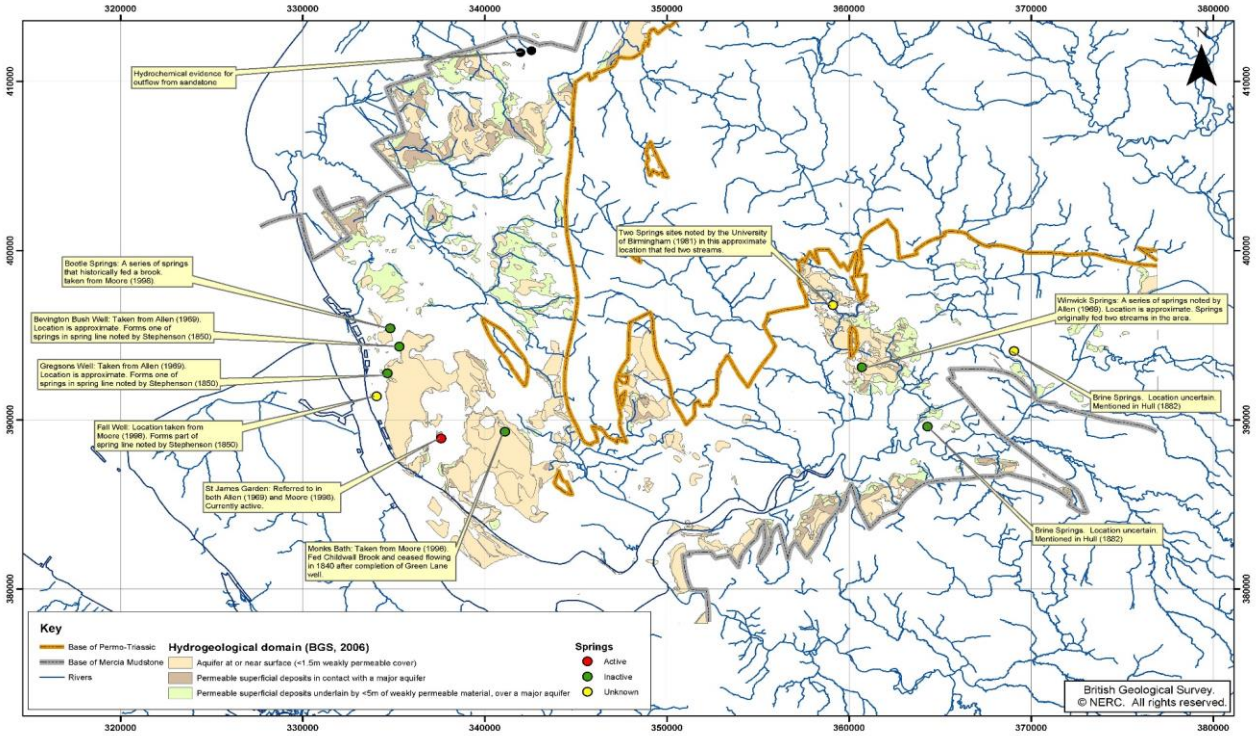


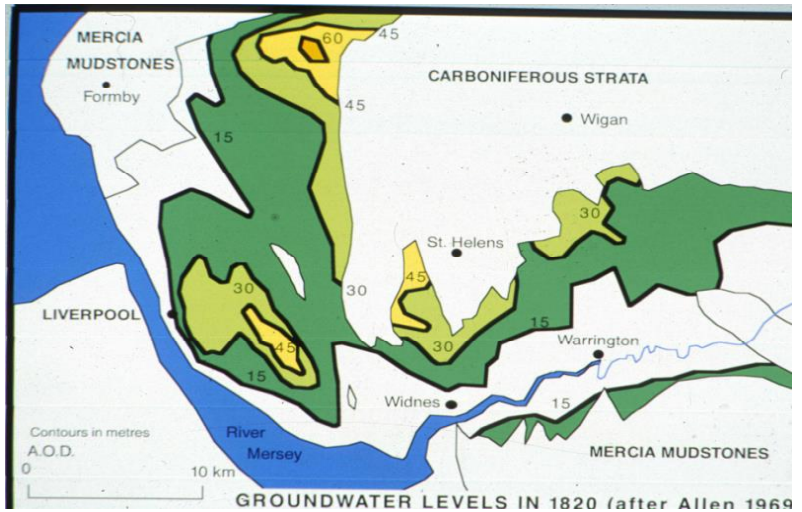




Where could it come out?

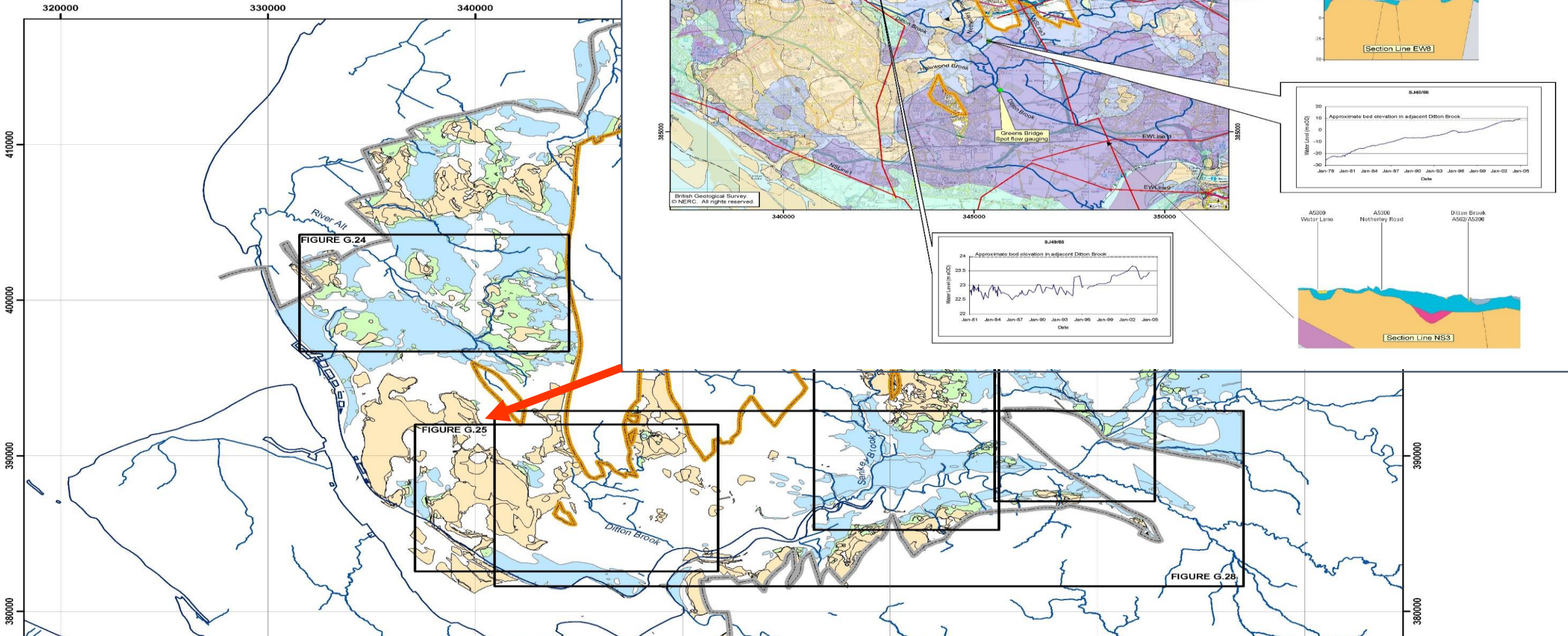
~ *Back to the future? Historic springs*





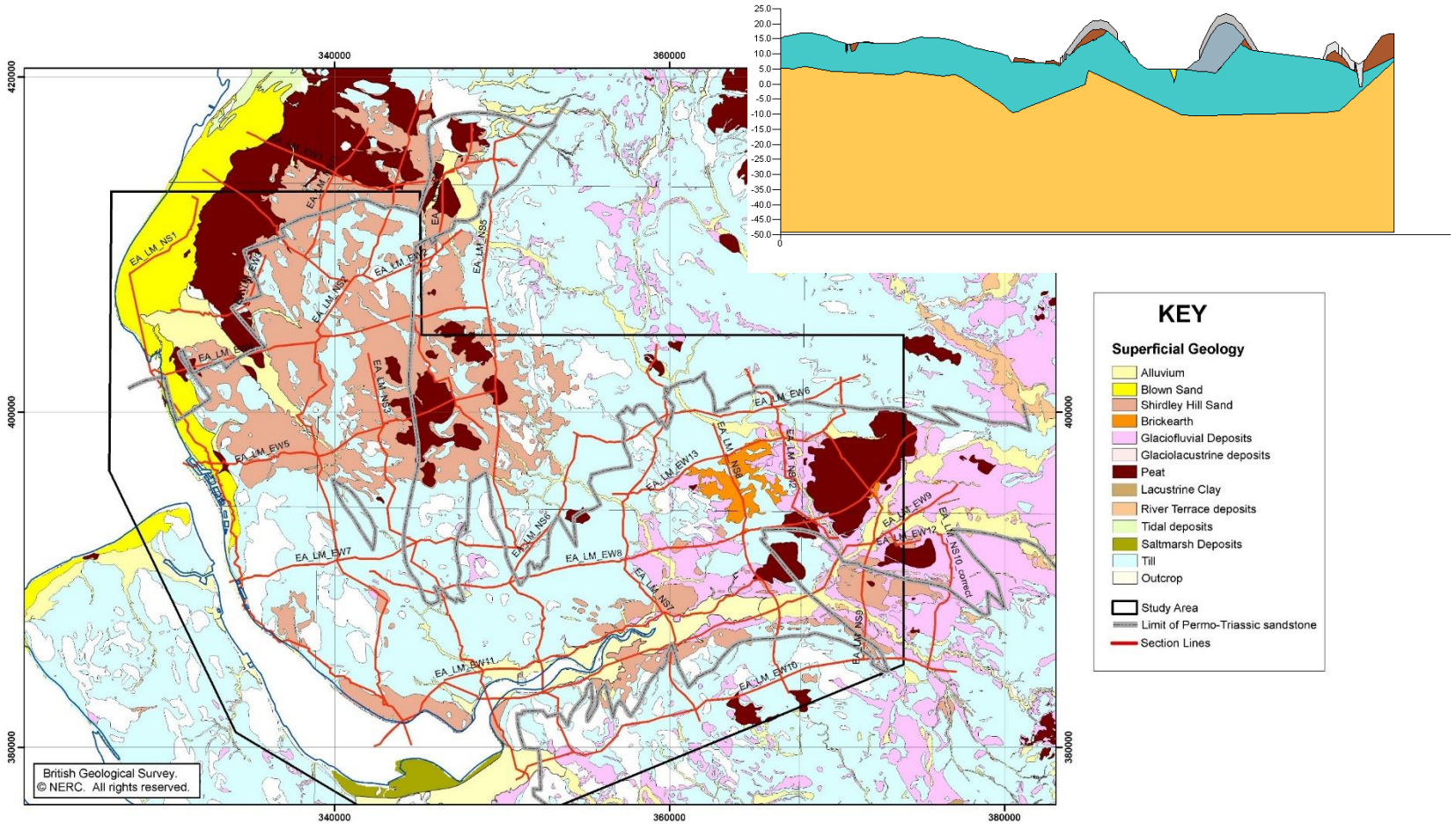
Where can it get out?

~ elevation and drift cover



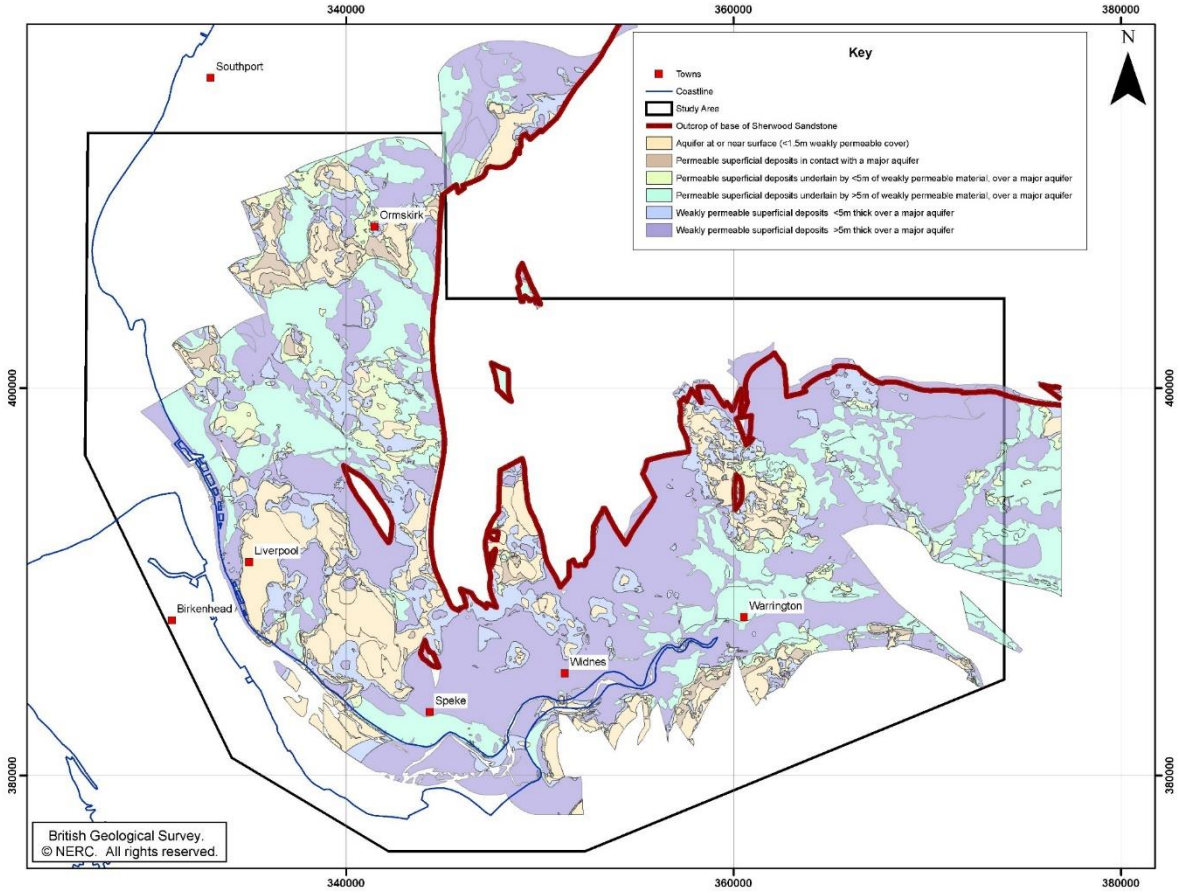
British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Superficial geology sections

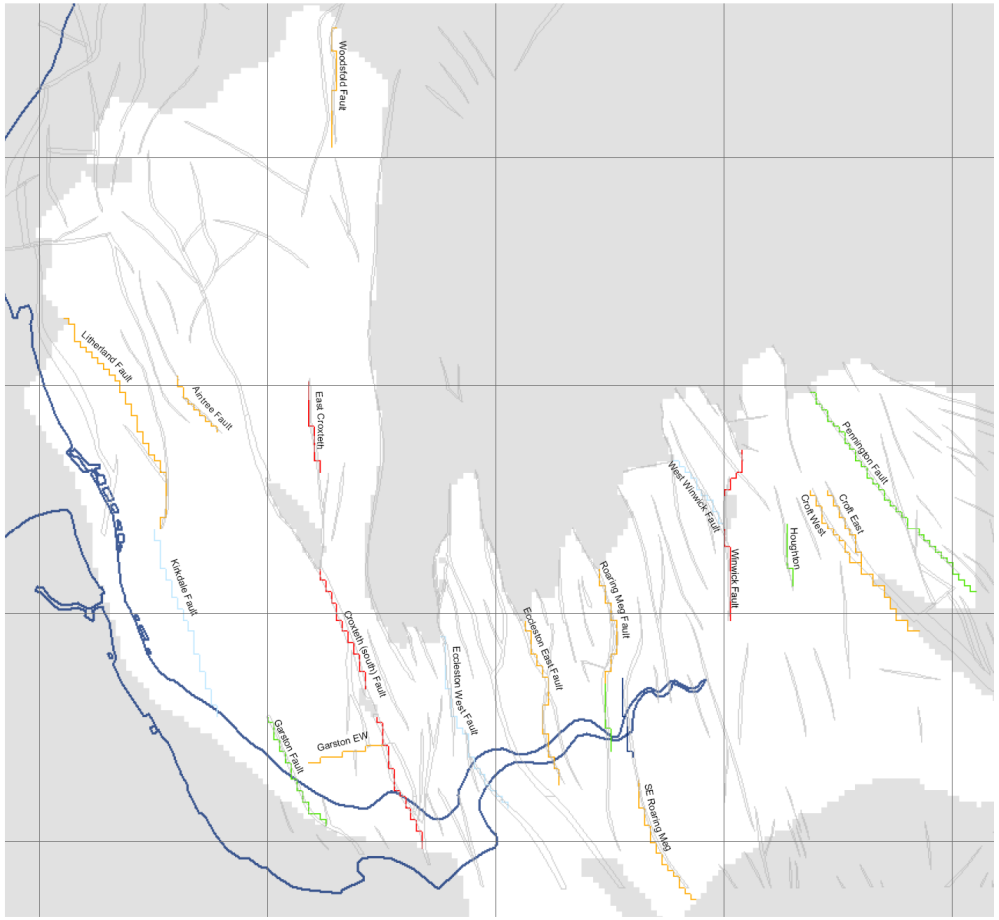


British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Superficial deposits - Hydrodomains

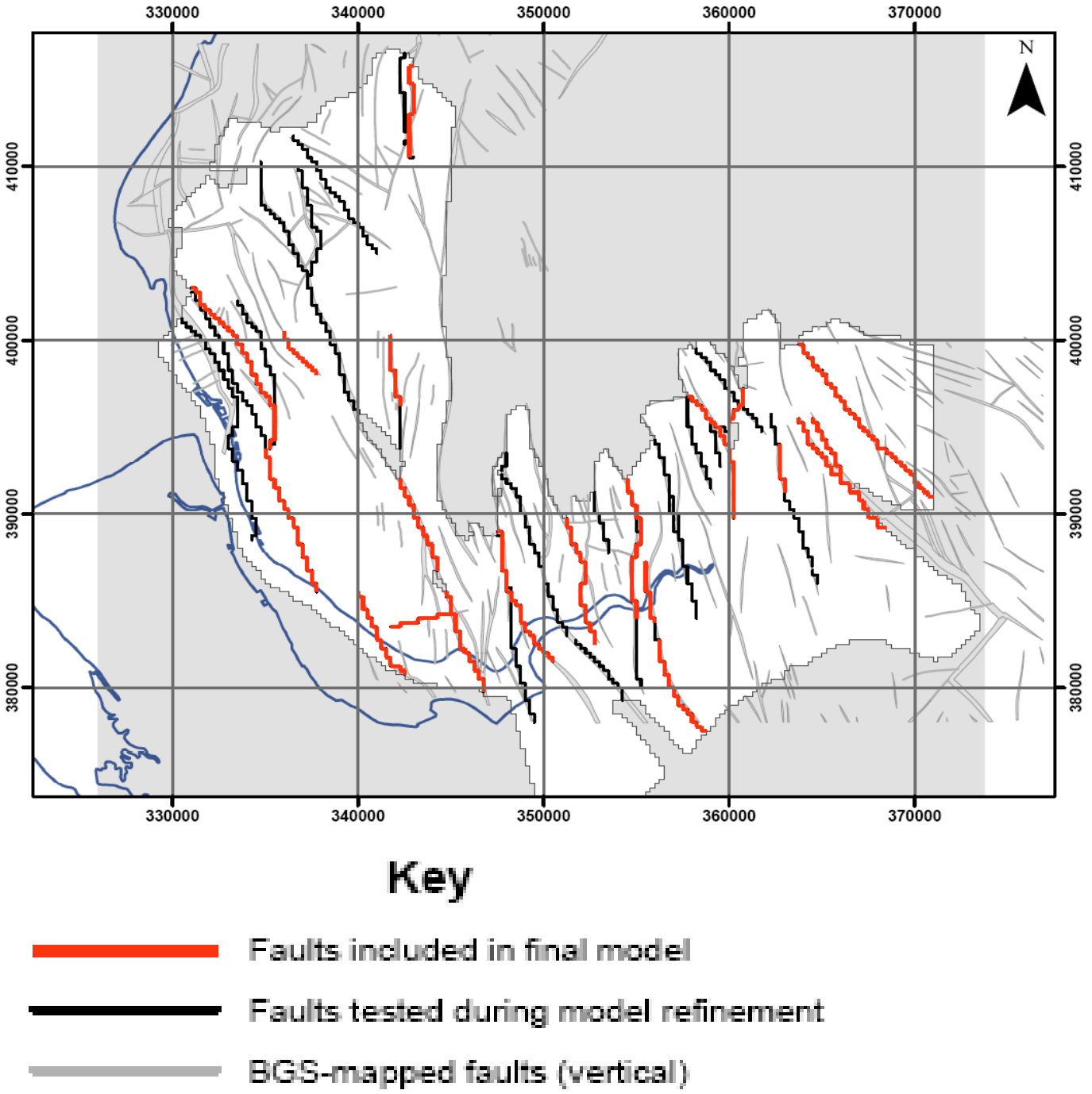


Faults


Woodsfold Fault
Litherland Fault
Alrtree Fault
East Crosteth
Knocdale Fault
Dorsett (south) Fault
Garston Fault
Garston EW
Eccleston West Fault
Eccleston East Fault
Roaring Meg Fault
West Winwick Fault
Winwick Fault
Houghton
Croft West
Croft East
Pennington Fault
SE Roaring Meg

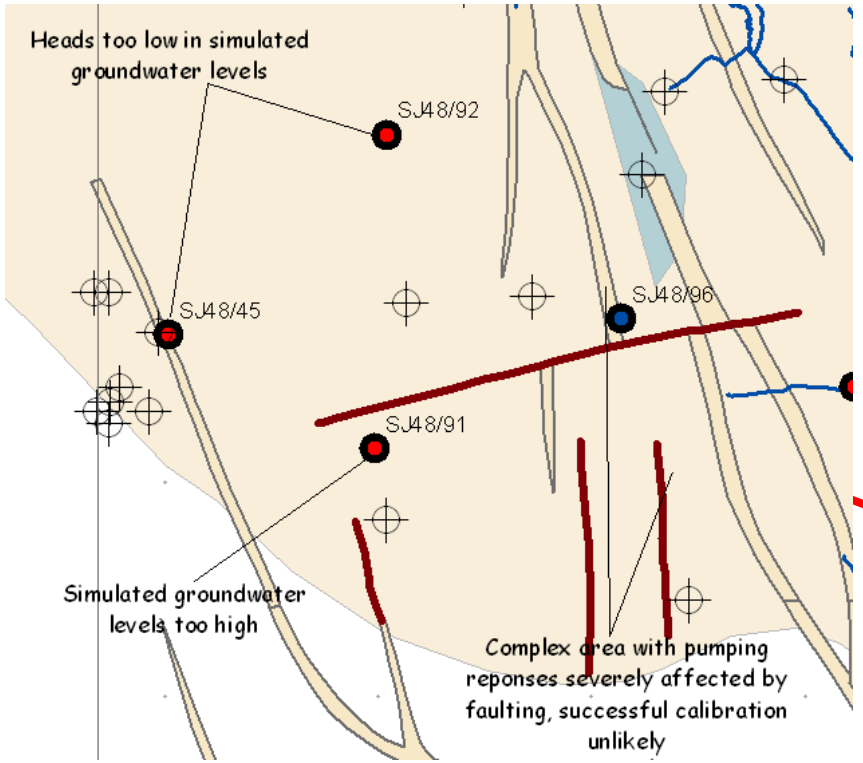
What have we learnt
~ value of BGS data

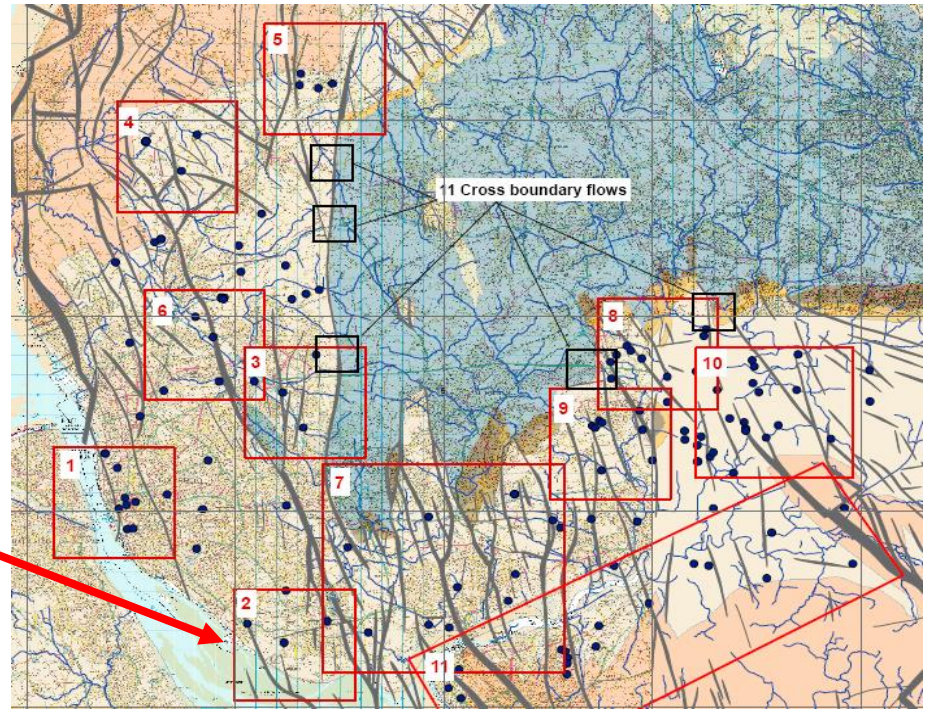
Faults



Models with Faults….
…. and Faults with Models

- Local issues – grid scale e.g. Speke



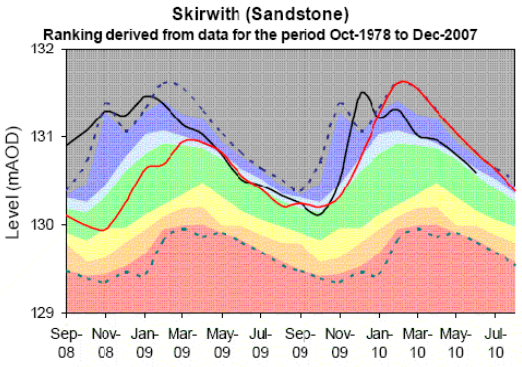


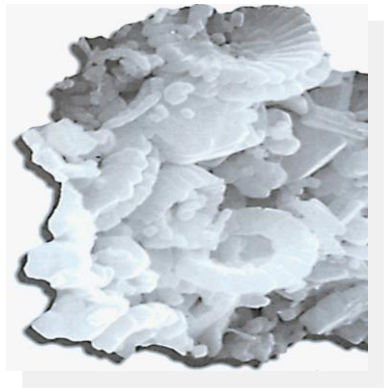
Chalk and cheese:

A bit about drought and flood responses

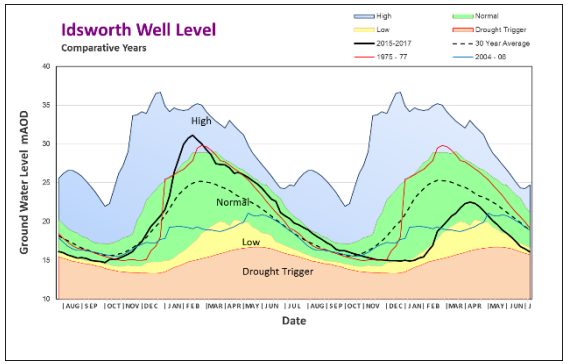
Hydrograph response - Chalk and cheese?

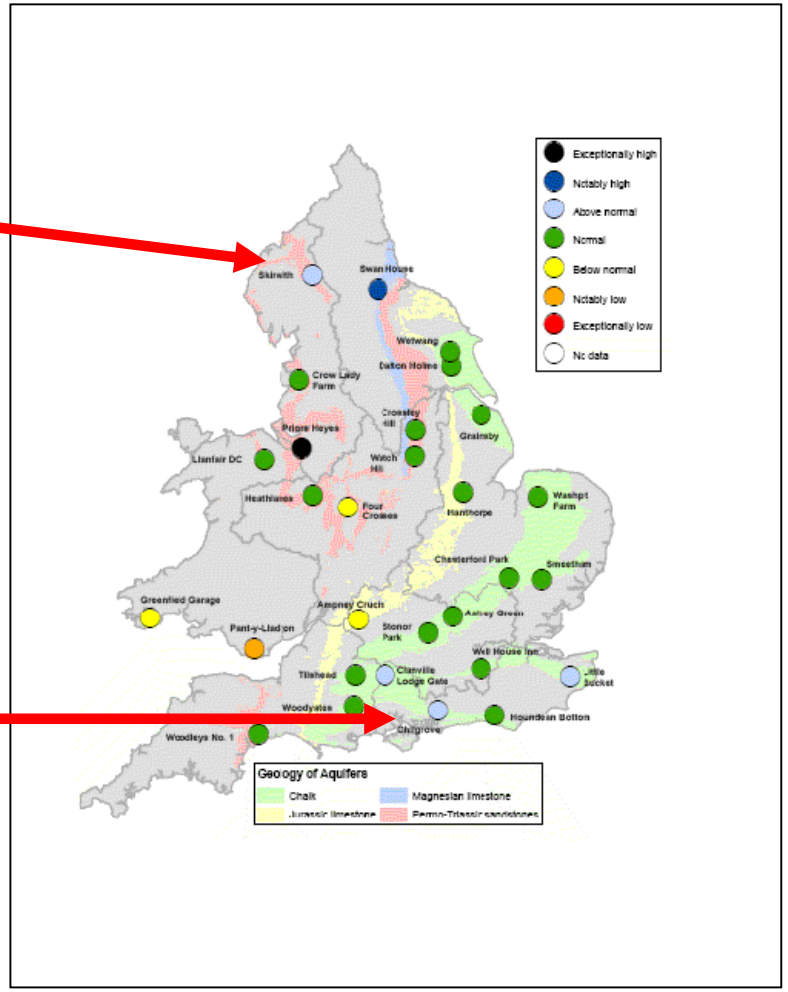
cheese





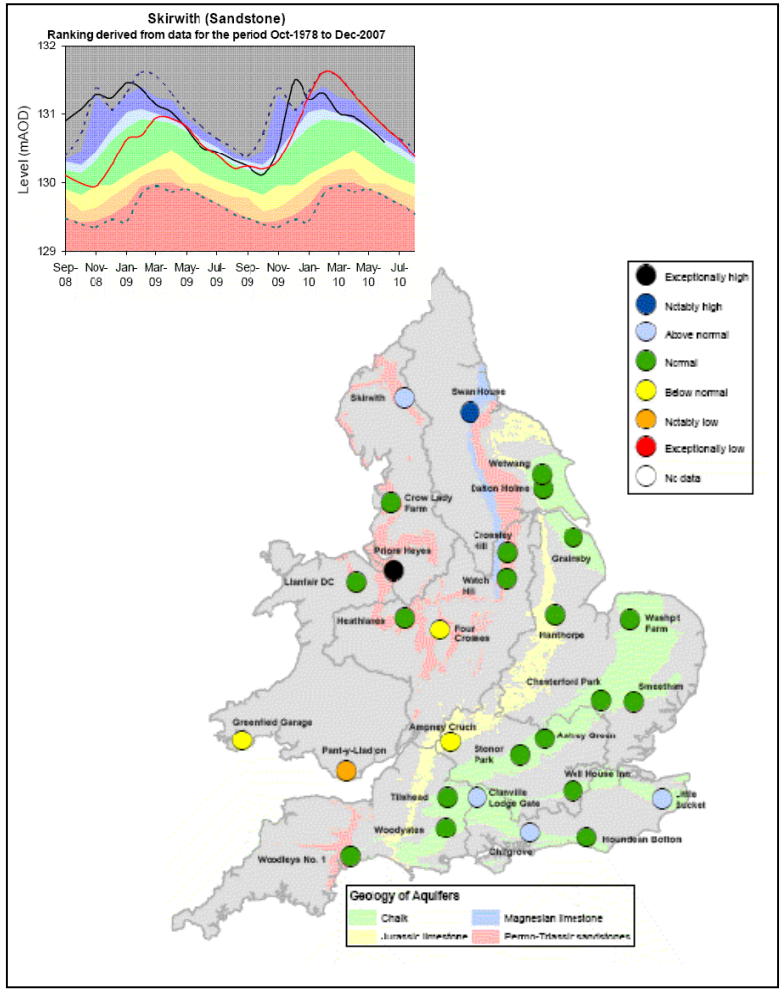
chalk

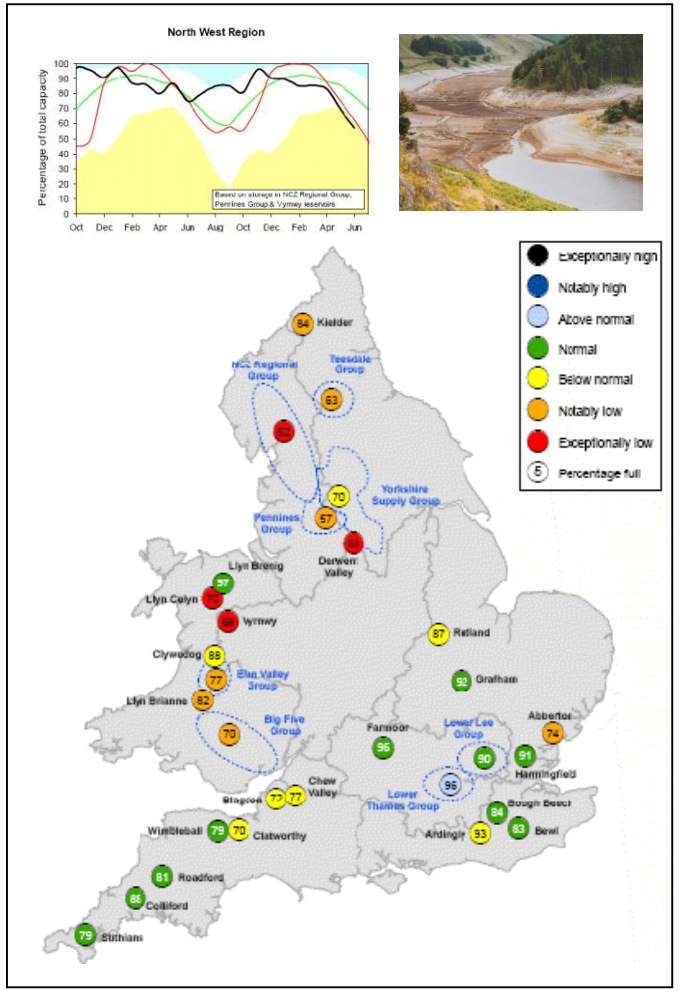




June 2010

Groundwater - of strategic value in Droughts:





June 2010

So, what are my reflections?

On the aquifer: -

- Permo –Triassic Sandstone in NW is faulty
  ….only shows when ‘under stress’
- Recharge is limited – get my drift?
- High storage – strategic resource ….but
- ‘Baseload pumping’ depletes storage
  - Can cause saline upflow/intrusion
  - Or reduce baseflow to rivers
- Droughts and floods – bovvered?...but
- On the rebound in places

~ A supertanker …with a lid!

So, what are my reflections?

On the 'process':

- Importance of conceptual model – understanding
- Numerical models can be useful…but also faulty!
- Value of collaborative working e.g. BGS

So, what are my reflections?

On my career as a hydrogeologist/regulator in NW:

- There are worse jobs!!
  - The people
  - The patch
  - The subject!

Finally - thanks: Team effort

THE UNIVERSITY OF BIRMINGHAM

esi

Mott MacDonald

LWRC

North West Water

NRA

Environment Agency

BGS 1835