

GRESHAM COLLEGE

Oil on Troubled Waters: the Industrial Legacy and Britain's Groundwater

Carolyn Roberts

Frank Jackson Foundation

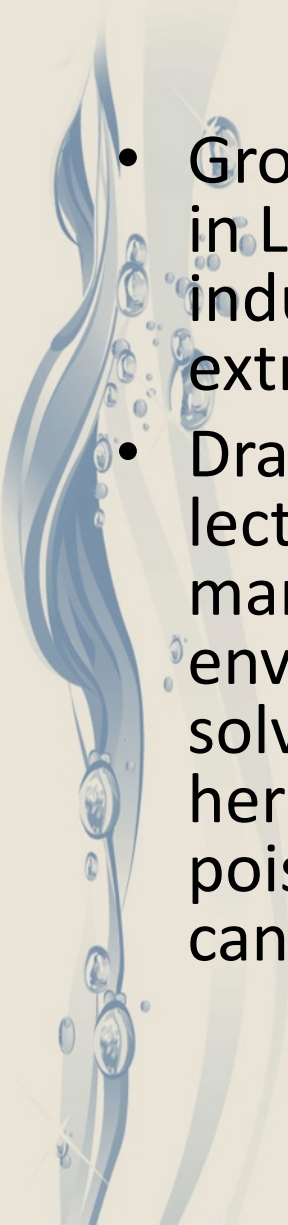
Professor of Environment

And

UK Knowledge Transfer Network



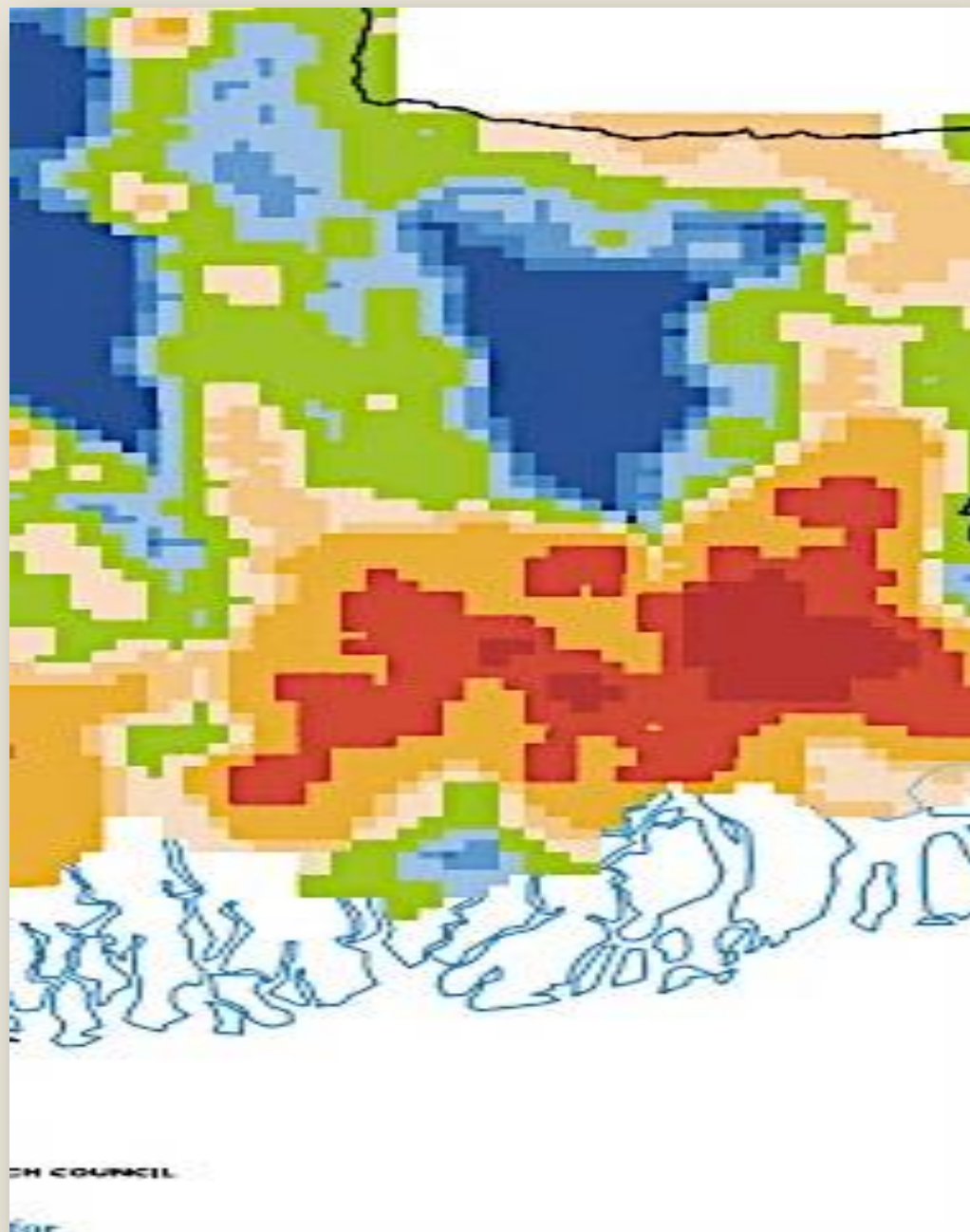
Lord Browne interrupted – insert clip

- 
- Groundwater is an important source of drinking water in London and elsewhere, but the legacy of the UK's industrial revolution includes contamination at an extreme and increasingly widely-realised scale.
 - Drawing on research in the English Midlands, the lecture will explore how mining, metal-based manufacturing, and the oil industry have produced an environmental conundrum that is very complex to solve. How can sites that are part of our industrial heritage be prevented from polluting rivers, and poisoning local residents? Who is responsible, and how can the 'clean-up' be tackled?





Arsenic ore



Medical conditions arising from arsenic poisoning





LADIES

If you desire a transparent, **CLEAR**, **FRESH** complexion, free from blotch, blemish, roughness, coarseness, redness, freckles, or pimples, use

DR. CAMPBELL'S

SAFE ARSENIC COMPLEXION WAFERS

—AND—

Fould's Medicated Arsenic Complexion Soap.

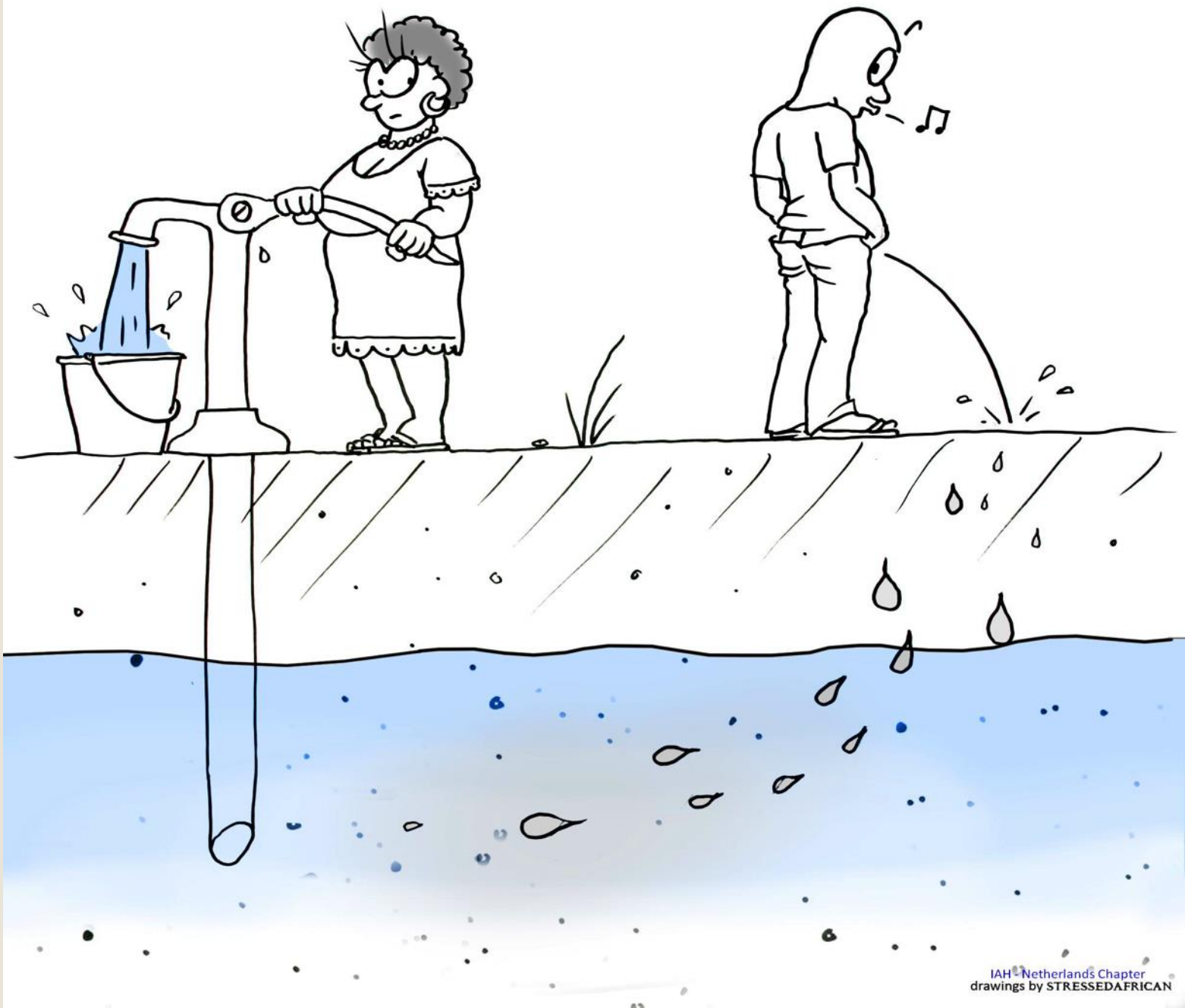
The only real true beautifiers in the world. *Warranted to give satisfaction* in every case or money refunded. Wafers by mail, \$1; six large boxes, \$5. Soap, per cake, 50 cents.

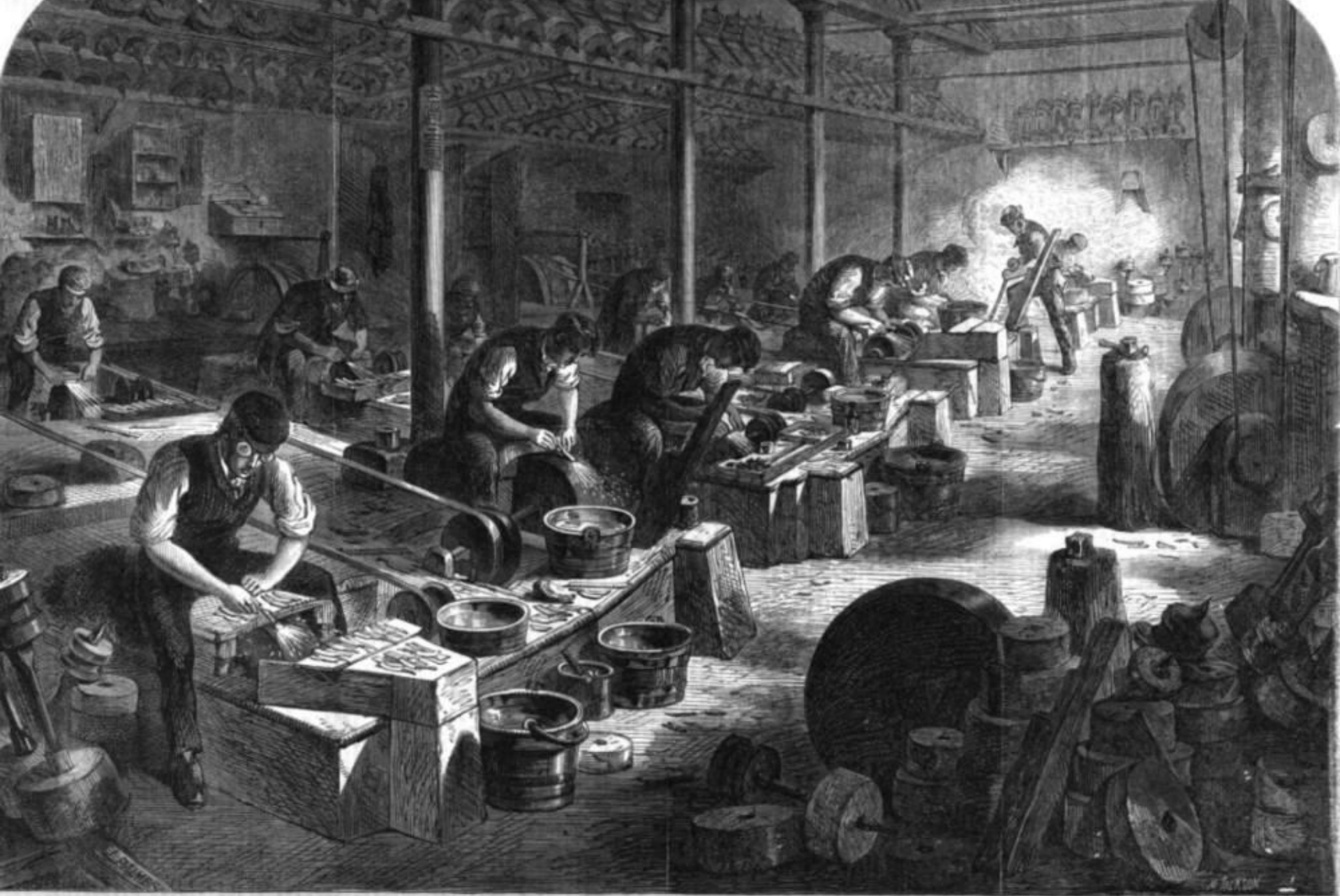
Address, H. B. FOULD, 214 Sixth Avenue, New York.

SOLD BY DRUGGISTS EVERYWHERE.

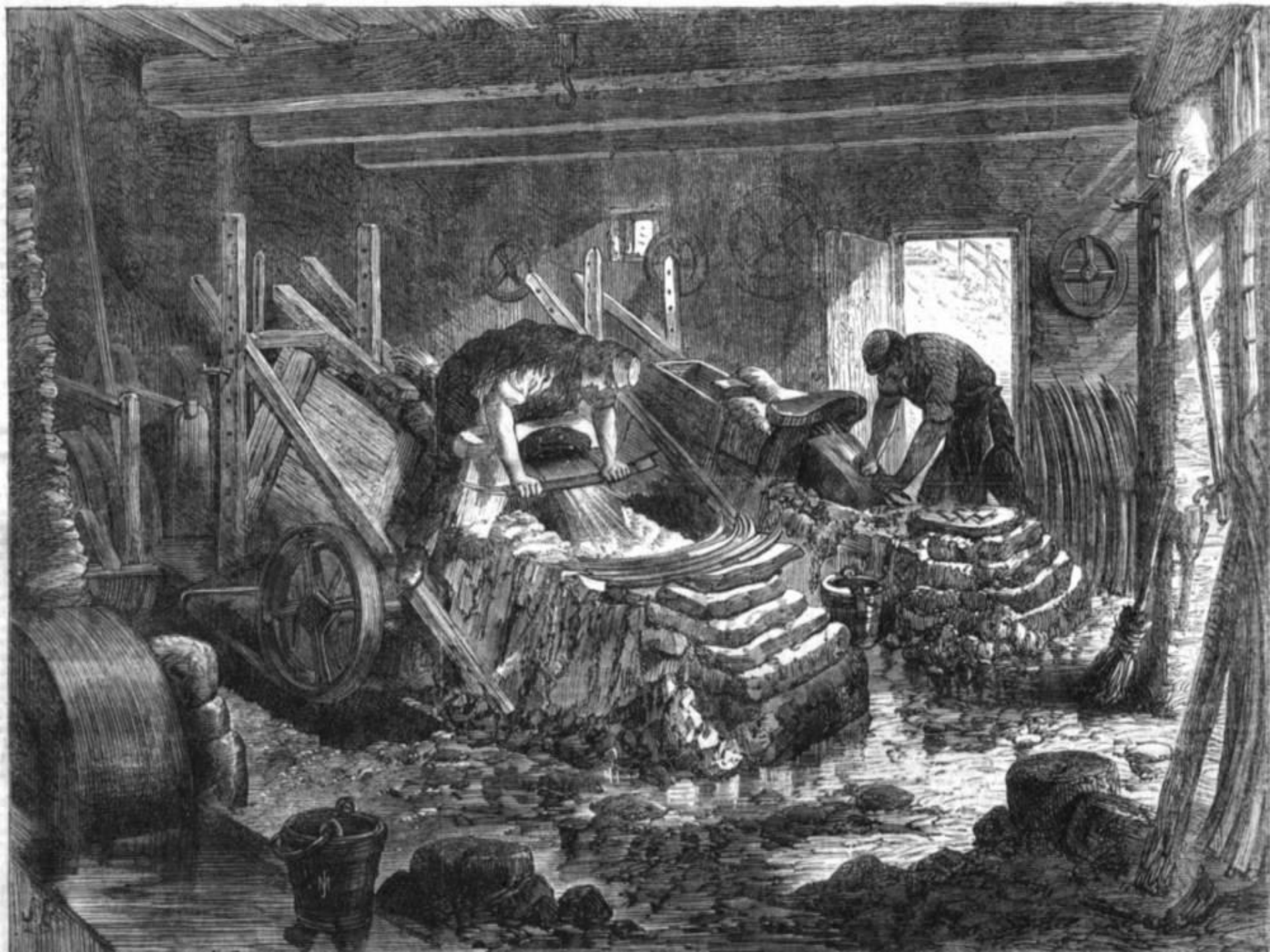


The London 'blacking' factory where Charles Dickens worked as a boy





Steel Manufacturers of Sheffield, about 1866, including wet grinding



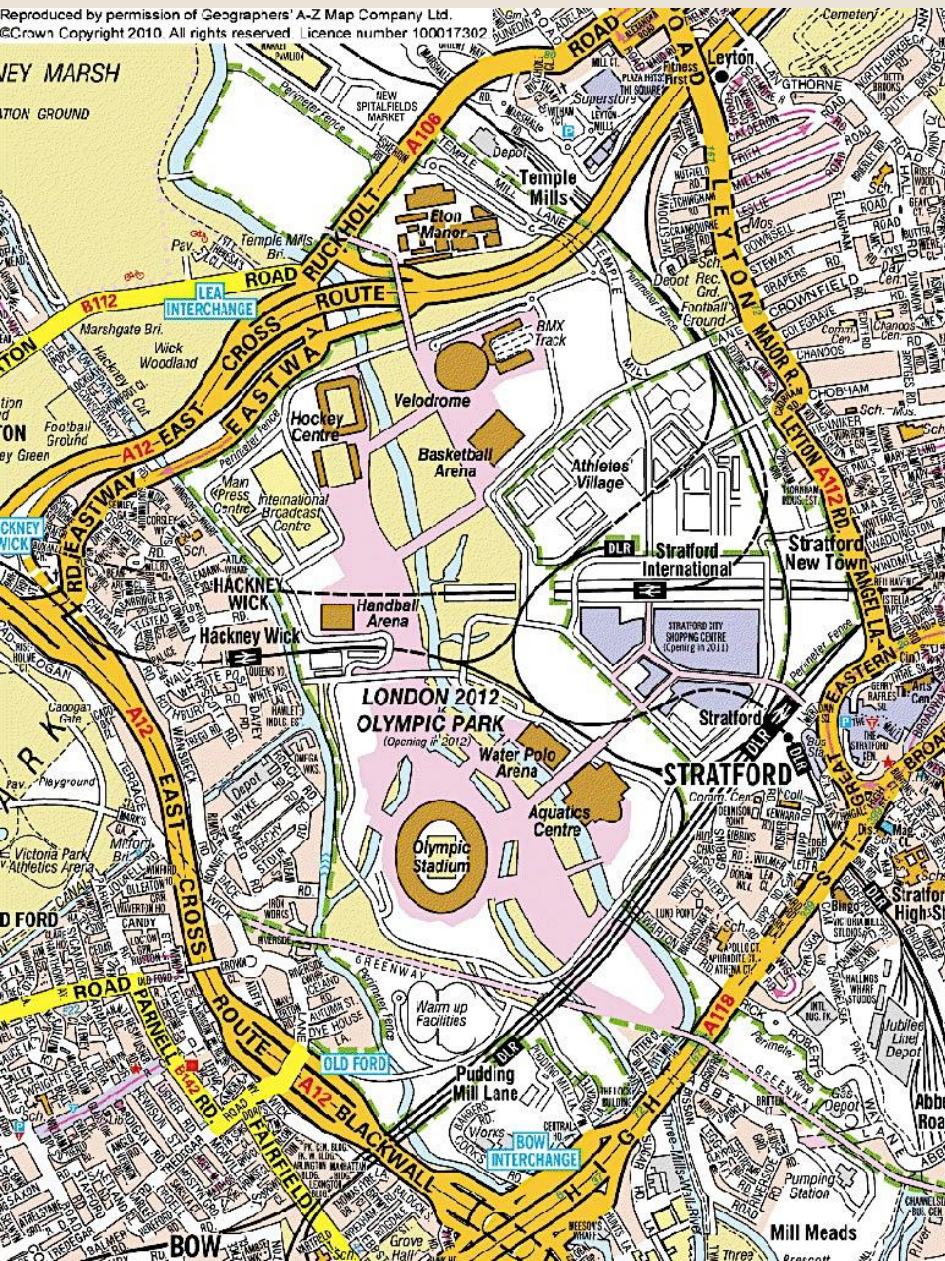
Olympic Park, London



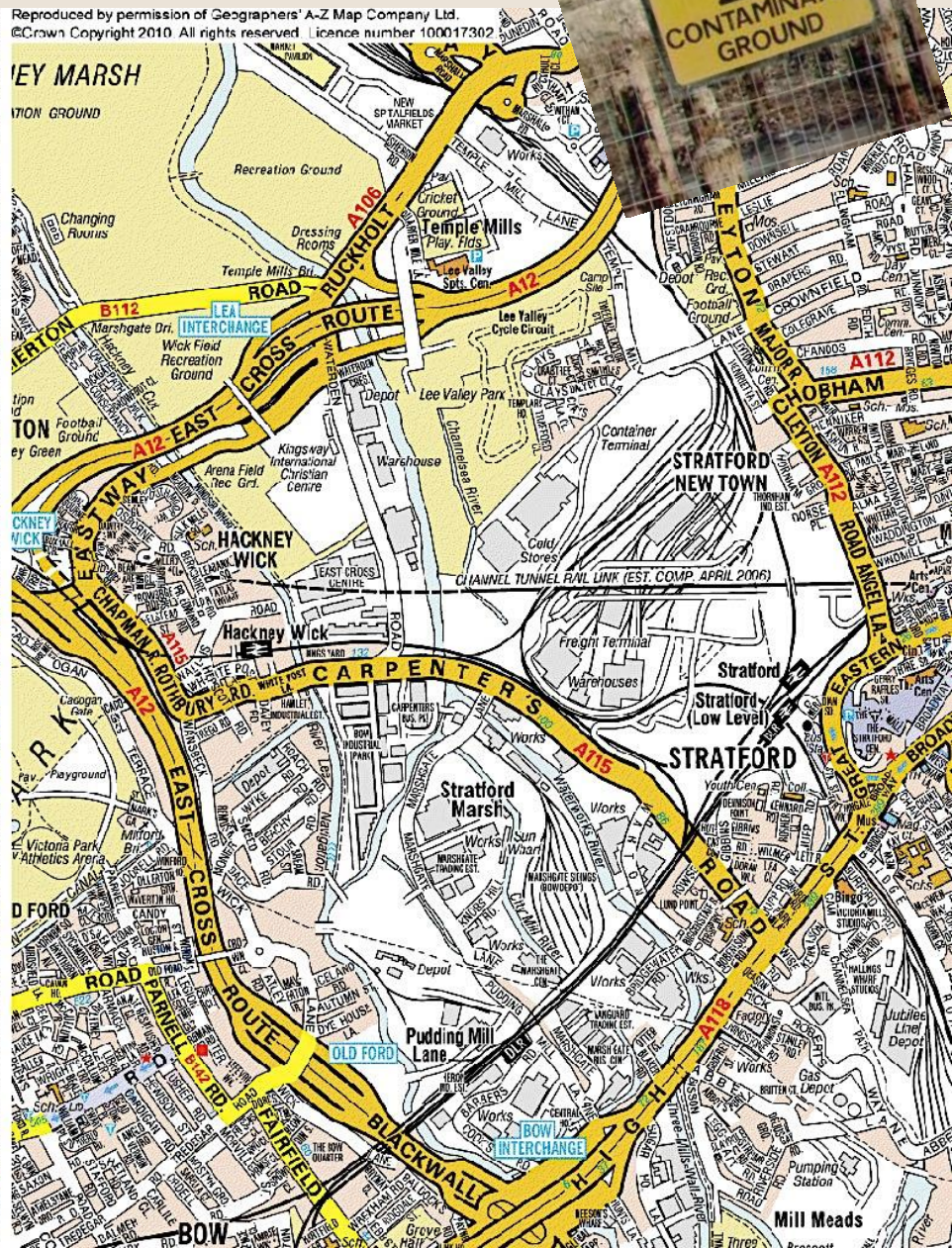


Olympic Park, London

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Olympic Park, London



Over 2 million m³ of soil were excavated, of which around 80 per cent was reused. Over 200,000 m³ of contaminated ground water were treated, enough to fill 80 Olympic-size swimming pools.

Photos from Atkins Global Image database, reproduced in IES Journal





Groundwater moves in mysterious ways

- Film clip of tank experiment



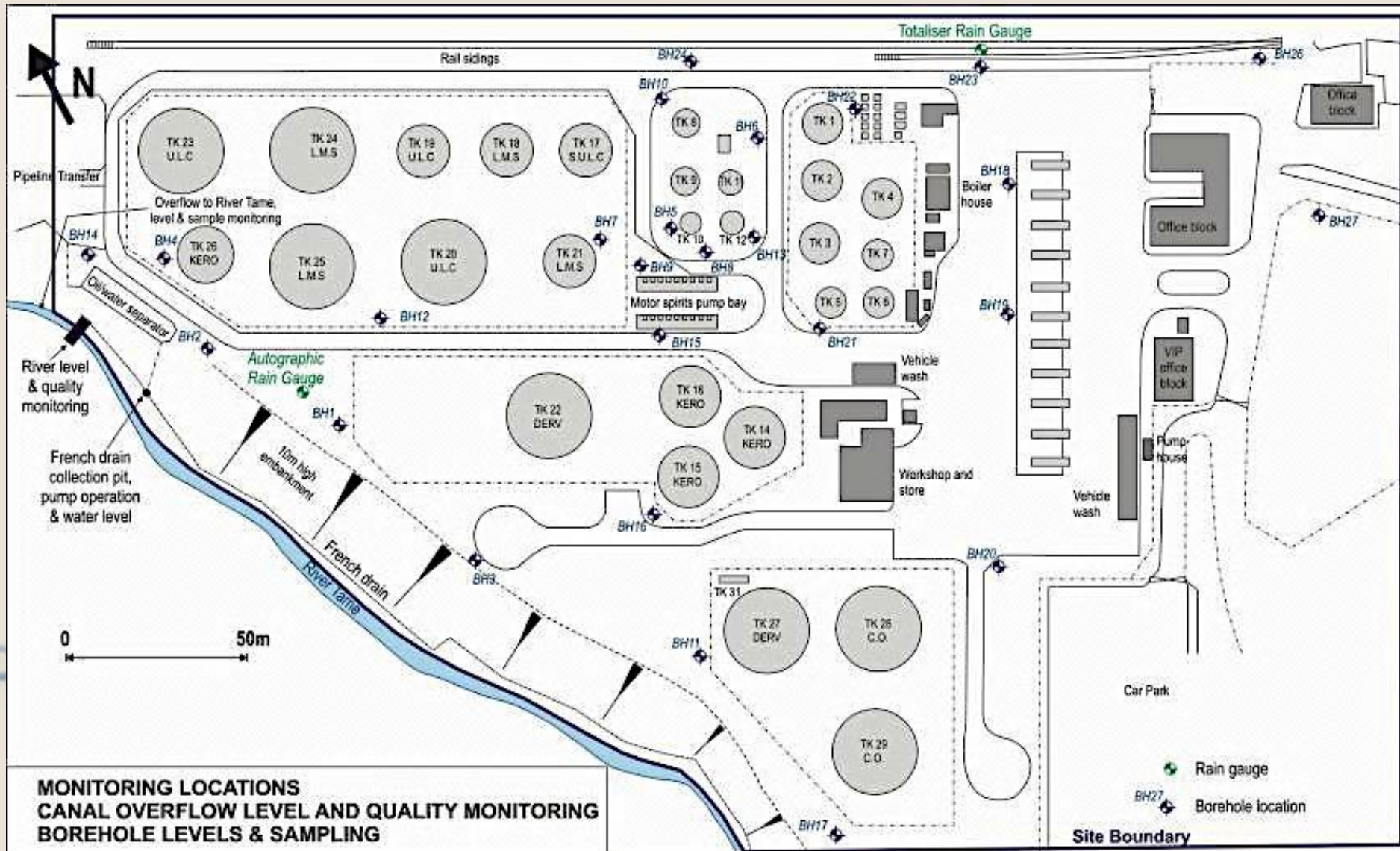
Groundwater moves in mysterious ways

- Film clip of model flows for groundwater

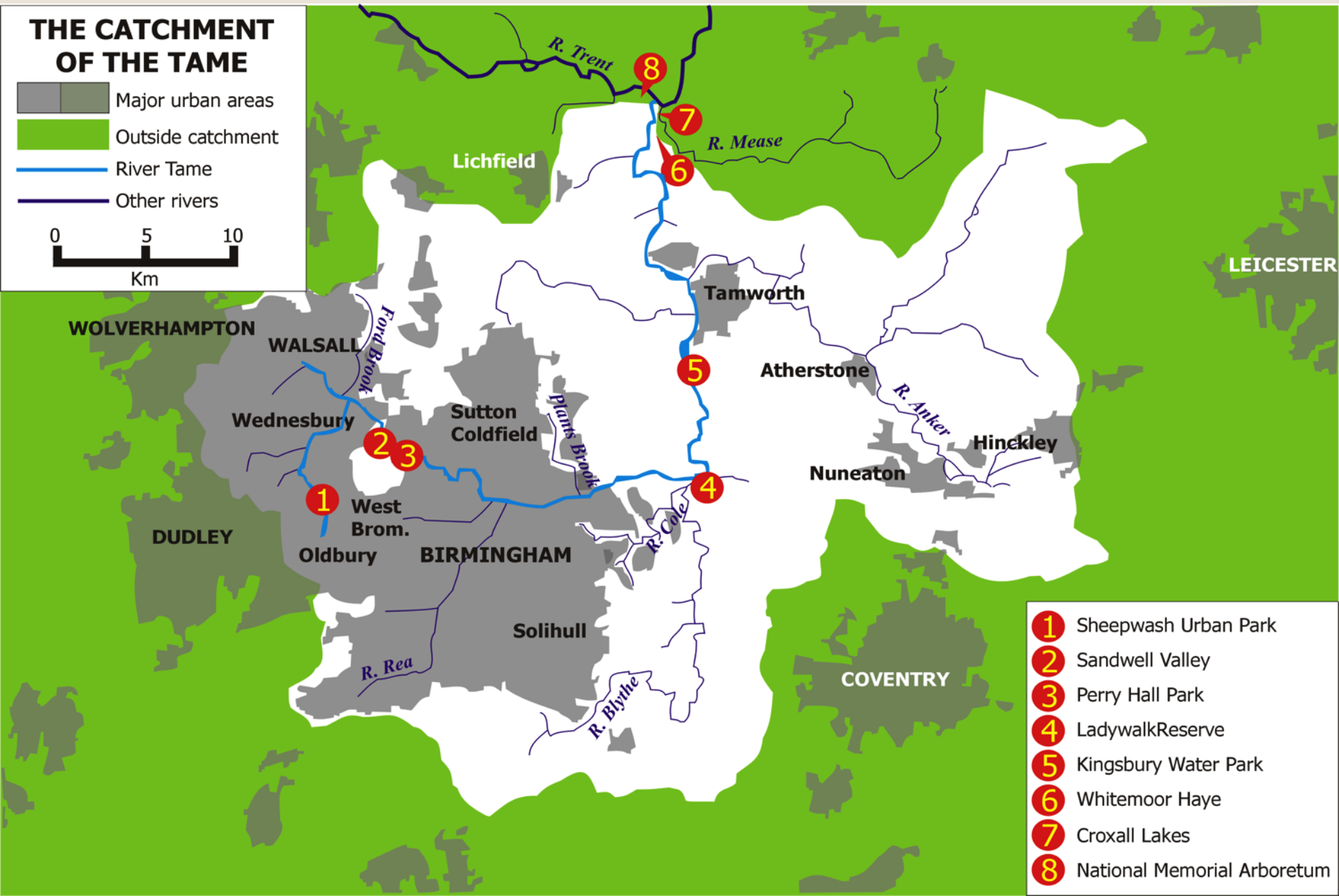




Gulf Oil Terminal, West Bromwich



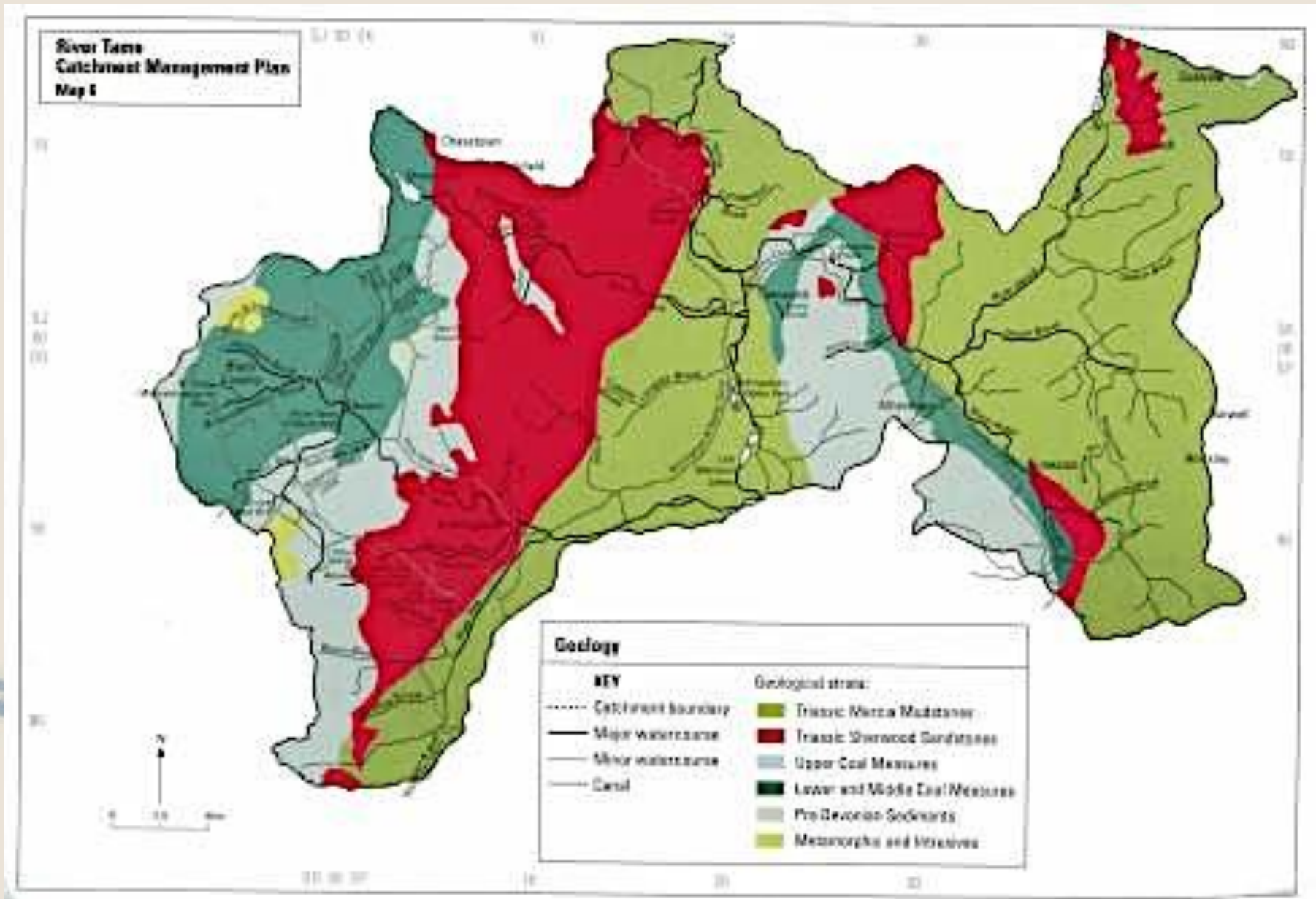
Gulf Oil GB: Catchment Setting



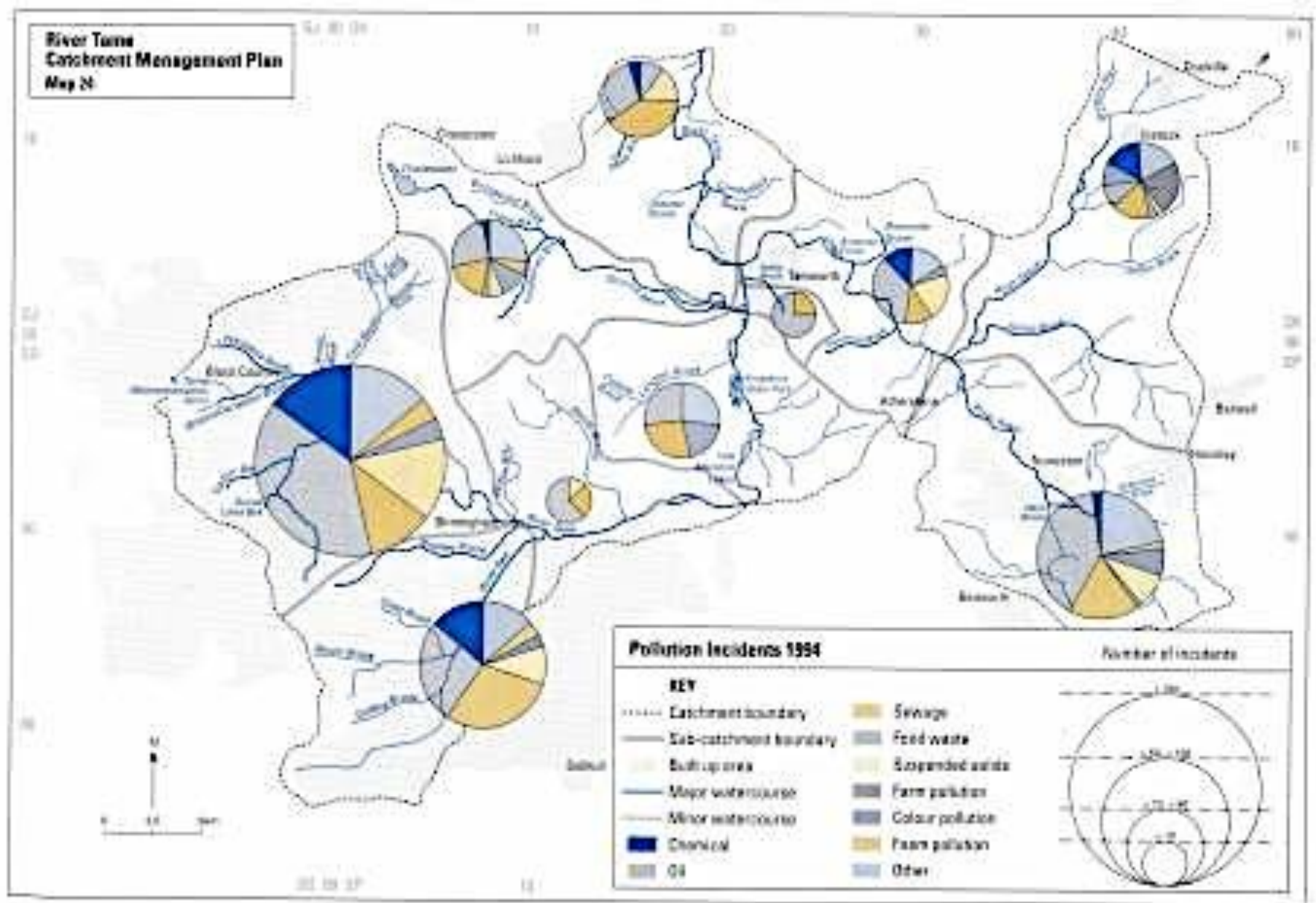
The River Tame before (left) and after (right) remediation works

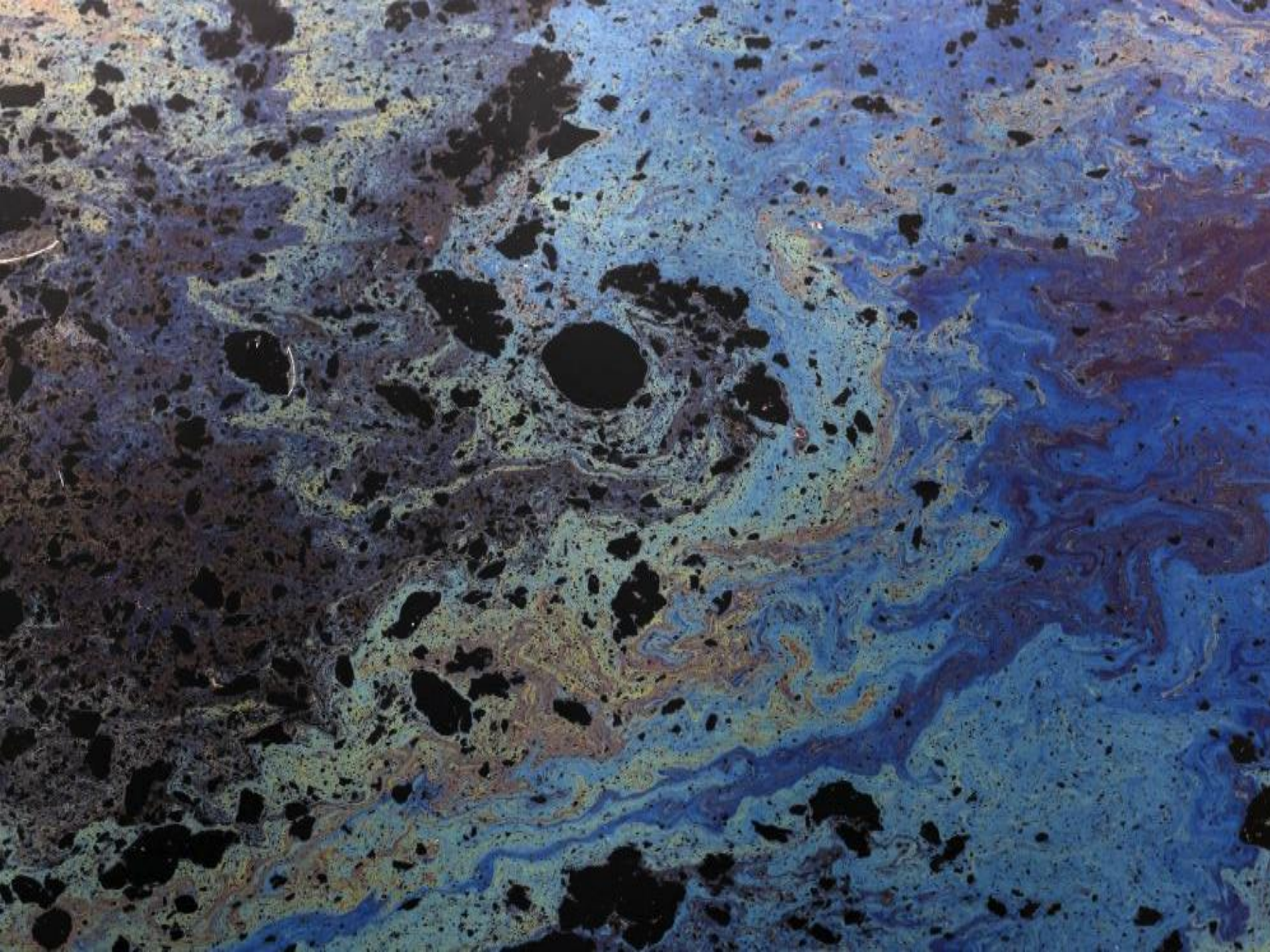


Gulf Oil: Catchment underlain by linked aquifers

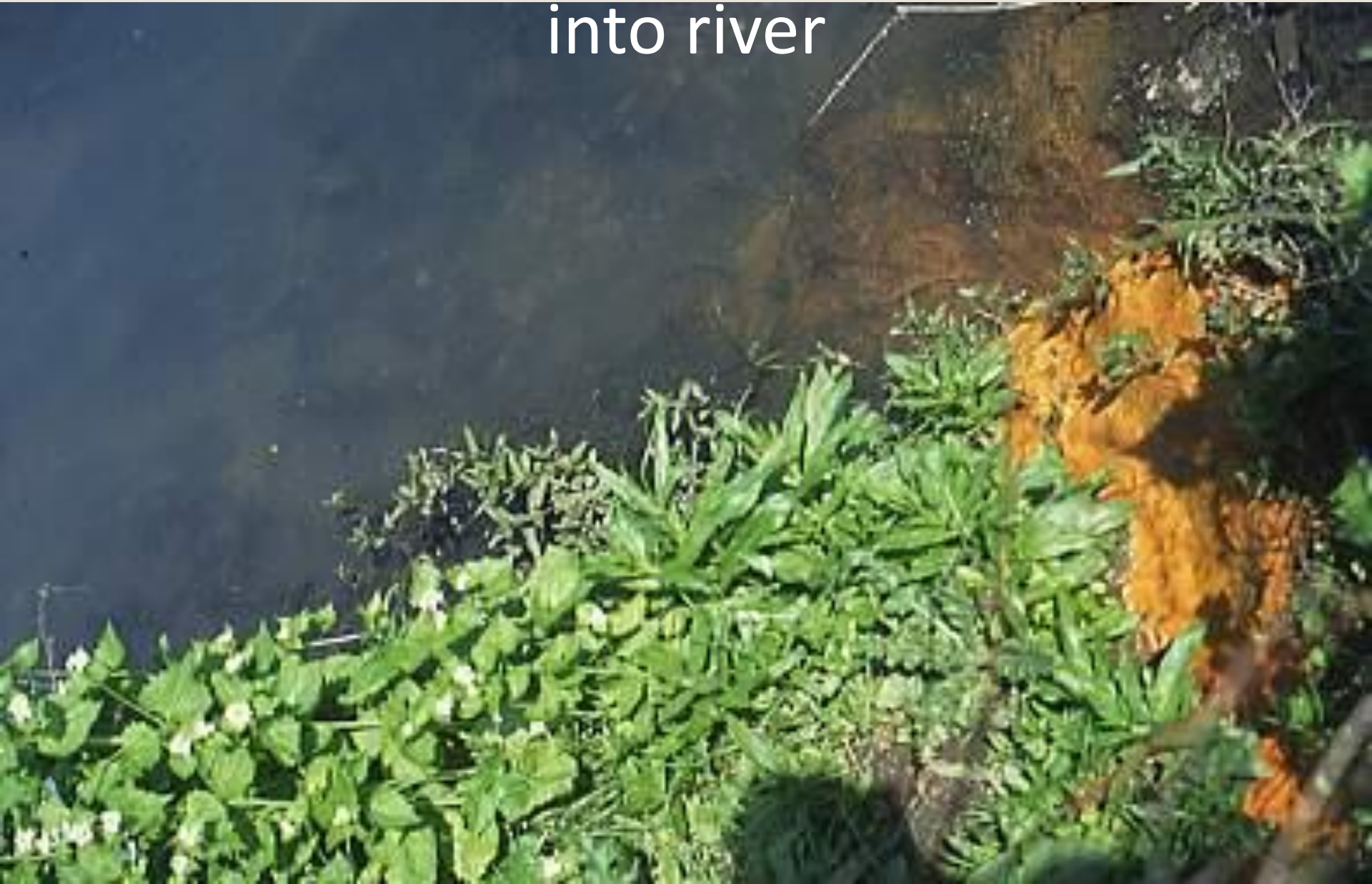


Gulf Oil: Catchment Setting

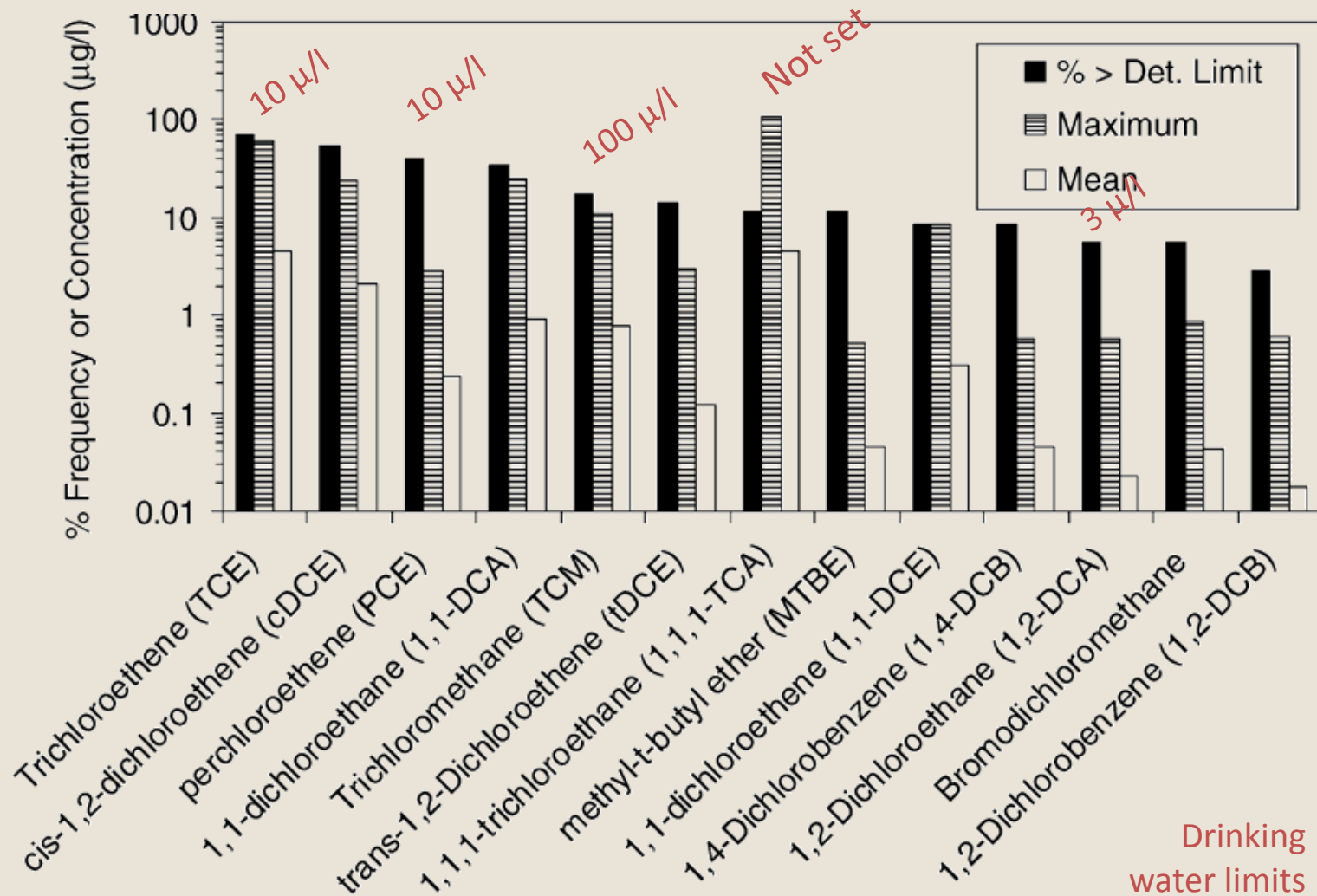




Ochreous seepages from groundwater into river

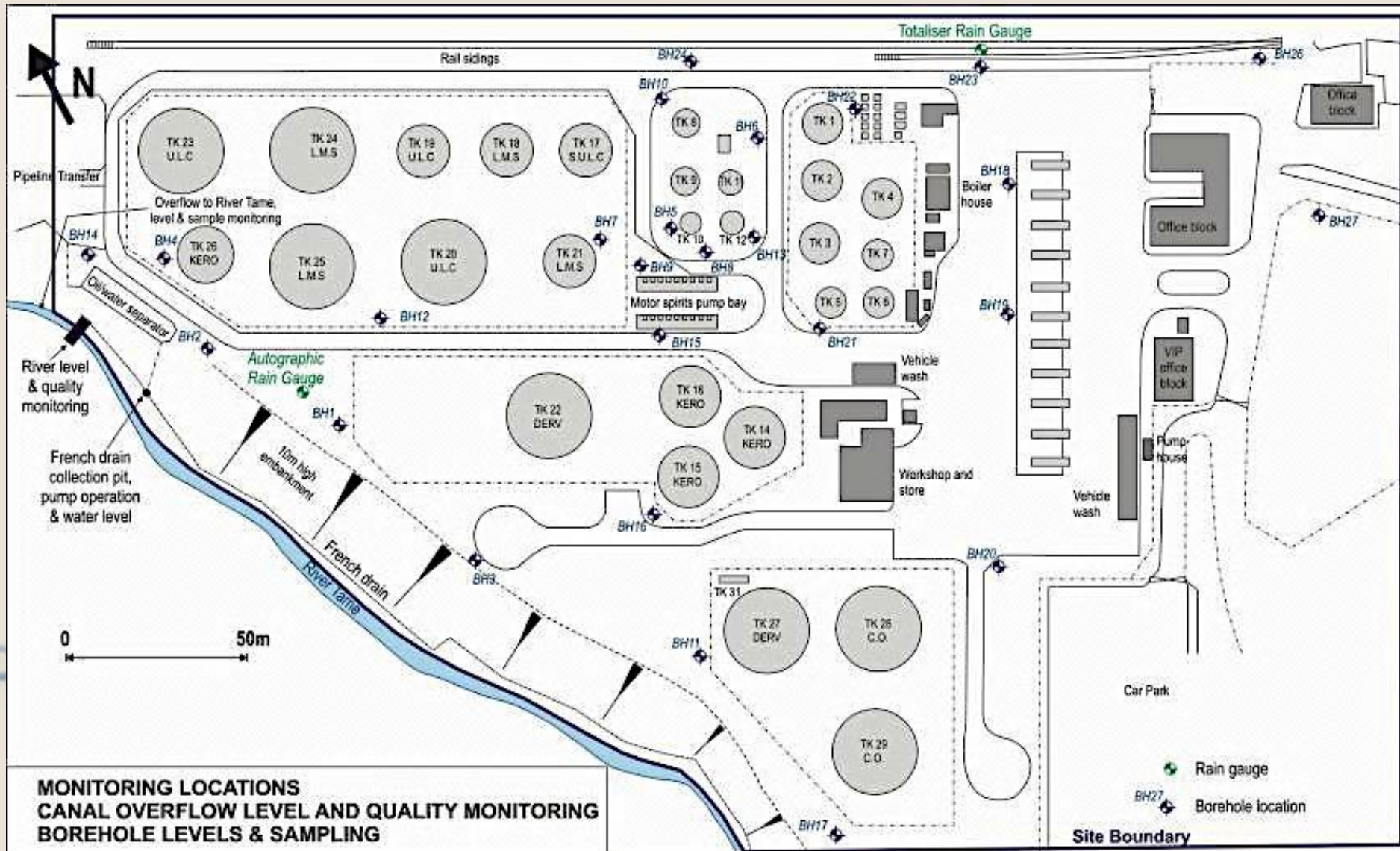


Volatile Organic Compounds in the River Tame, 2001, after Ellis



Drinking
water limits

Gulf Oil Terminal, West Bromwich





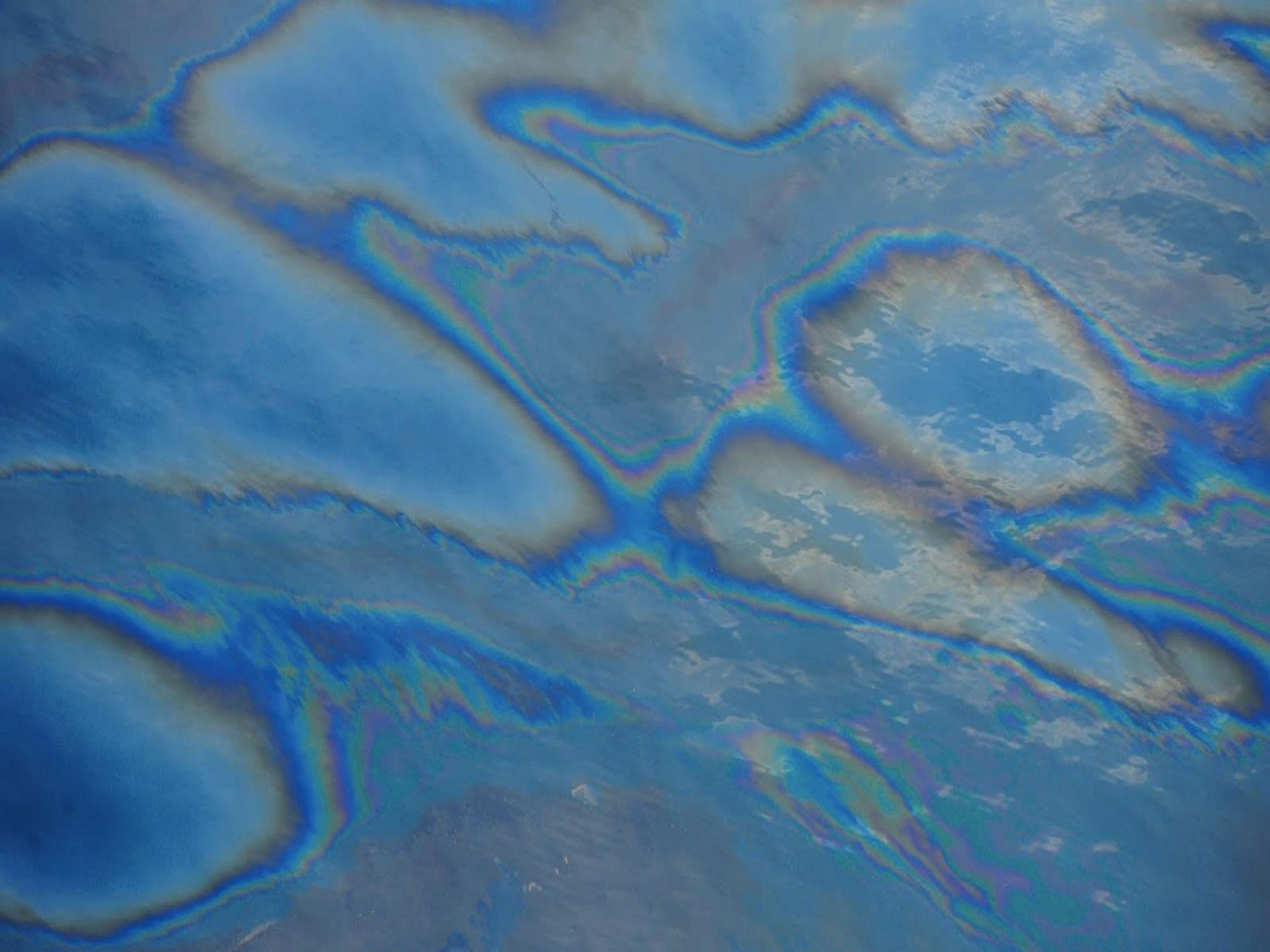


Site of Gulf Oil Terminal, West Bromwich, 1999



Site of Gulf Oil Terminal, West Bromwich, 1945

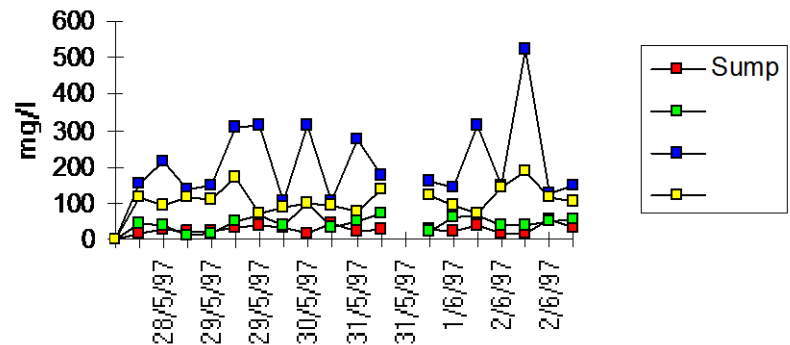




Gulf Oil Terminal

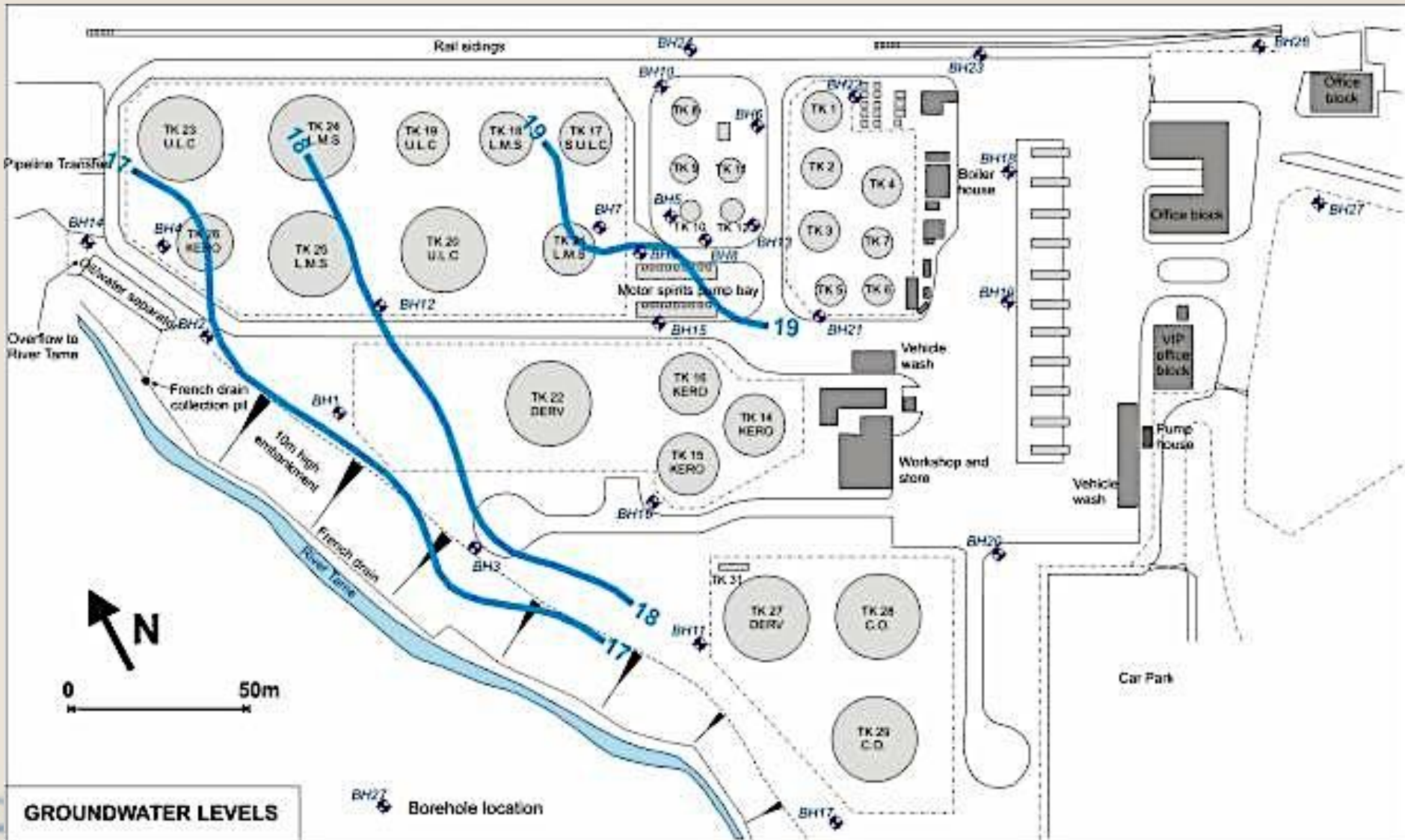


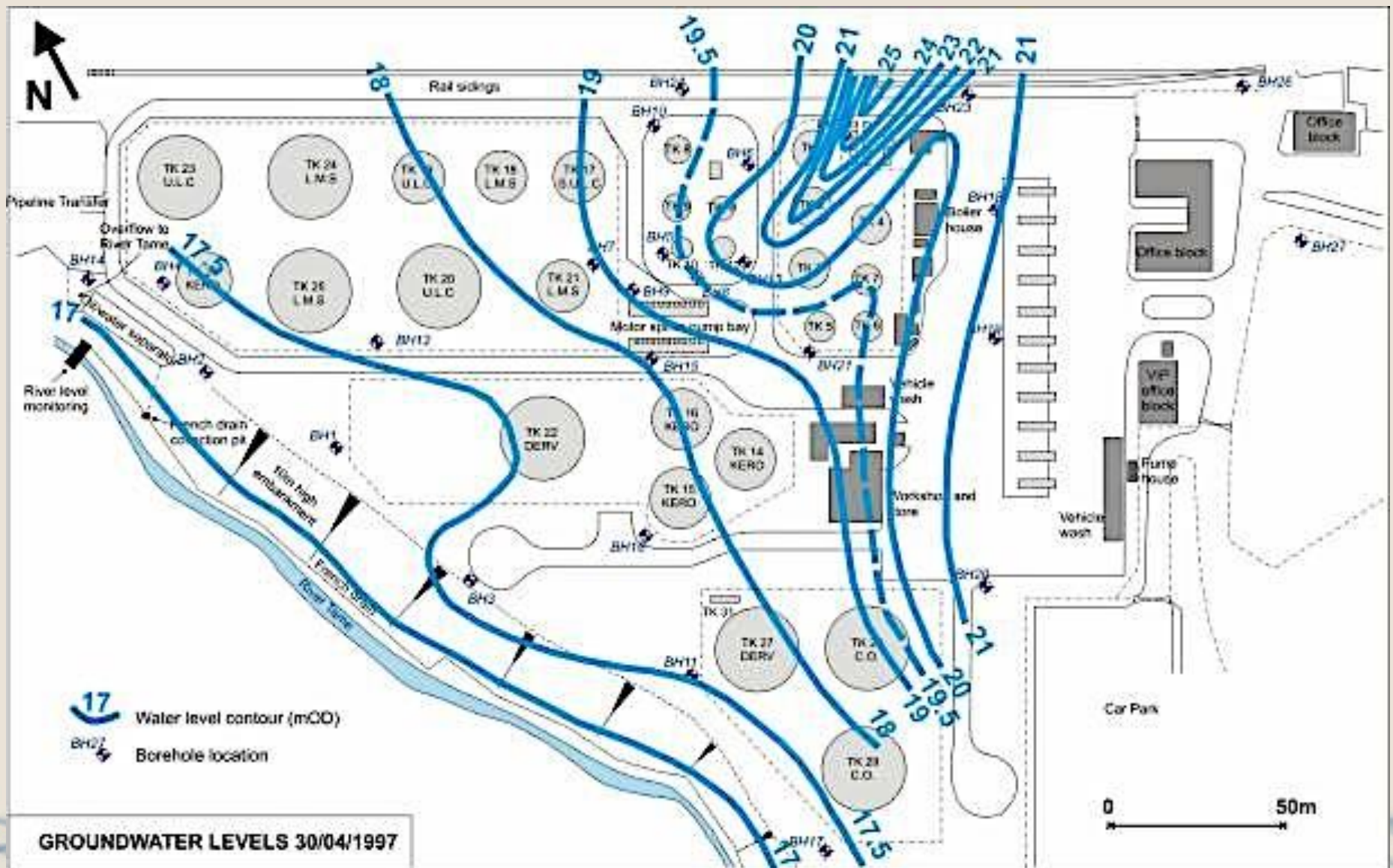
Sump water quality, May/June 1997

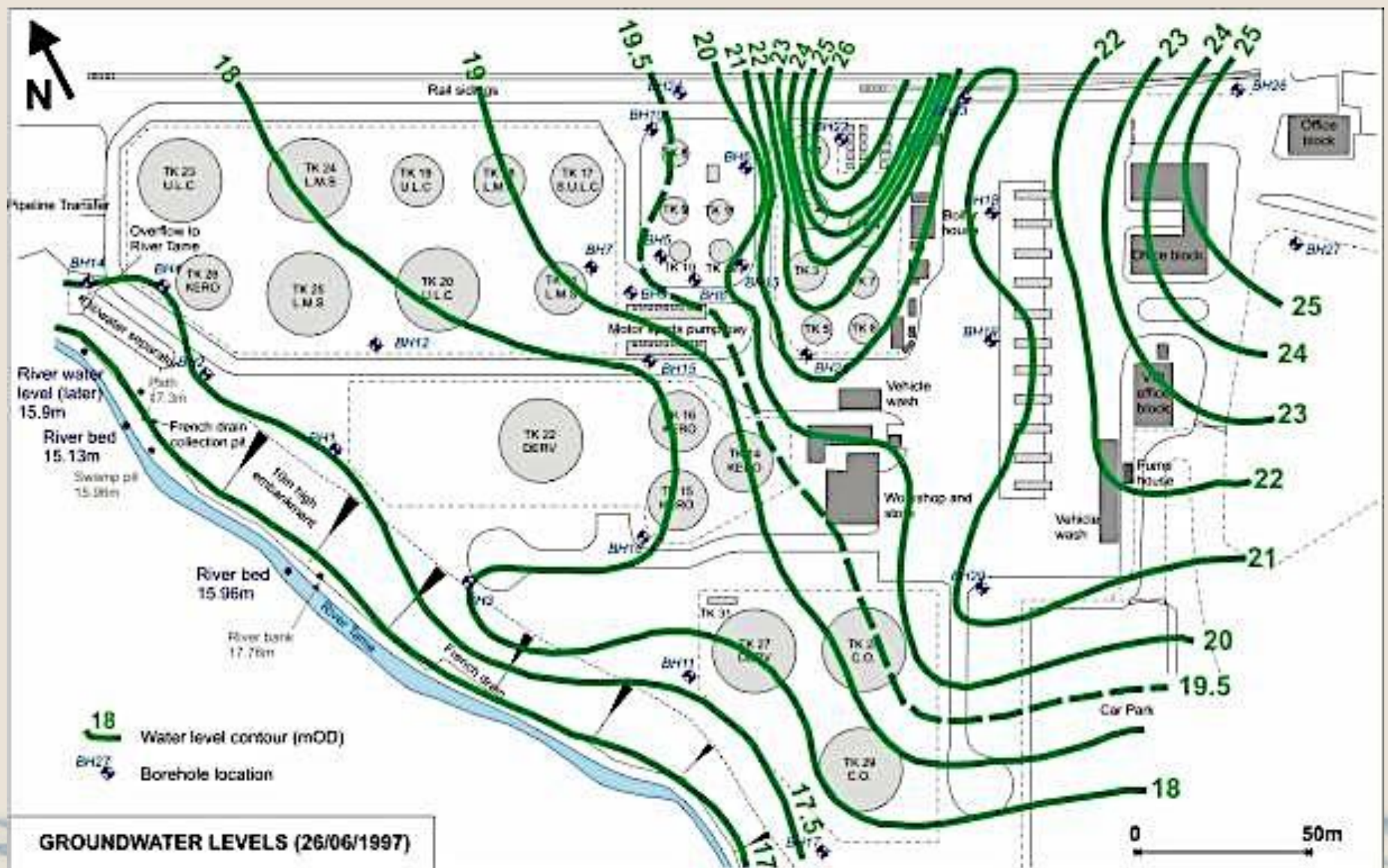


- Site investigation, including borehole installation, monitoring and testing
- Monitoring (quantity, quality), statistical and laboratory analysis
- Historic map and aerial photograph analysis
- Assembling data from other agencies
- Ground and surface water modelling

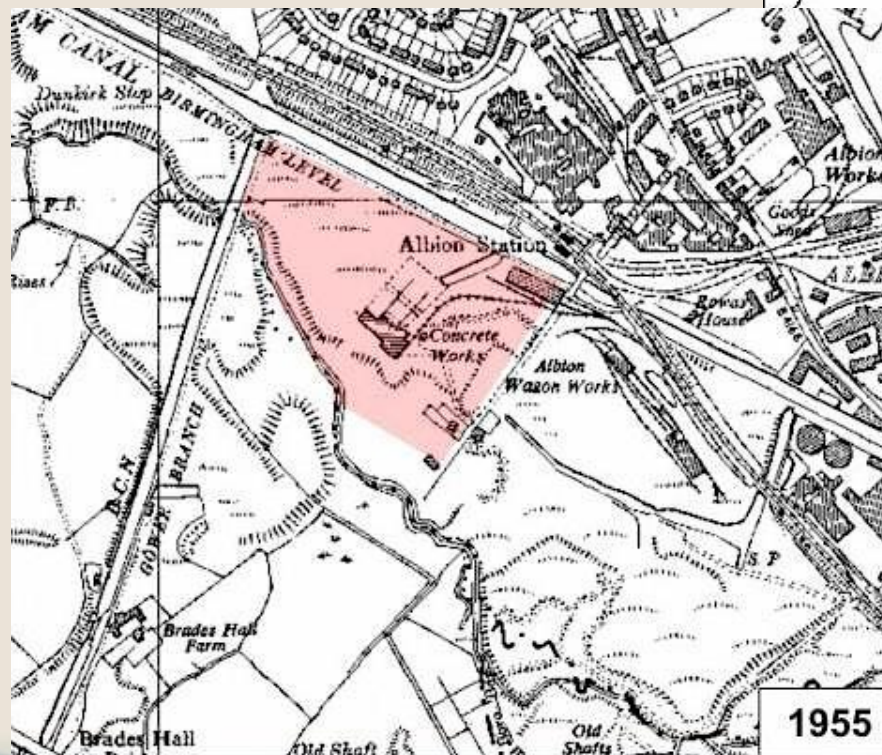
Date	Time	Type	Ch:5 (%)
27/02/97	04:57:35	Interval rea	63.45
27/02/97	04:57:50	Interval rea	57.95
27/02/97	04:58:05	Interval rea	55
27/02/97	04:58:20	Interval rea	49.45
27/02/97	04:58:35	Interval rea	47.95
27/02/97	04:58:50	Interval rea	48.45
27/02/97	04:59:05	Interval rea	49.45
27/02/97	04:59:20	Interval rea	51
27/02/97	04:59:35	Interval rea	52.45
27/02/97	04:59:50	Interval rea	54







Gulf Oil Terminal site, 1887-1955



1955



1887



1921

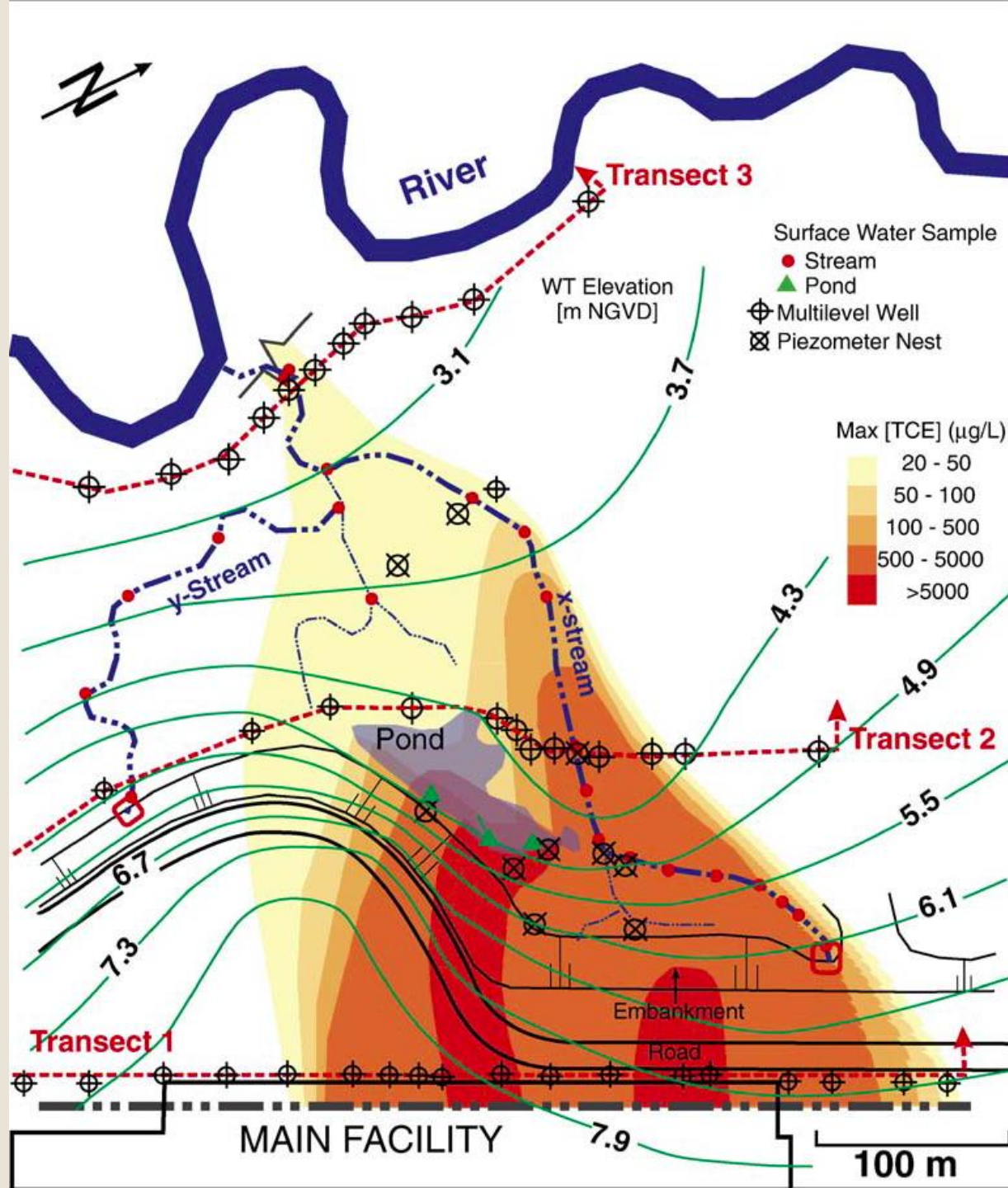
Gulf Oil's UK operation was taken over by Shell in 1997/8, and the hydrological findings were subject to publication restrictions.

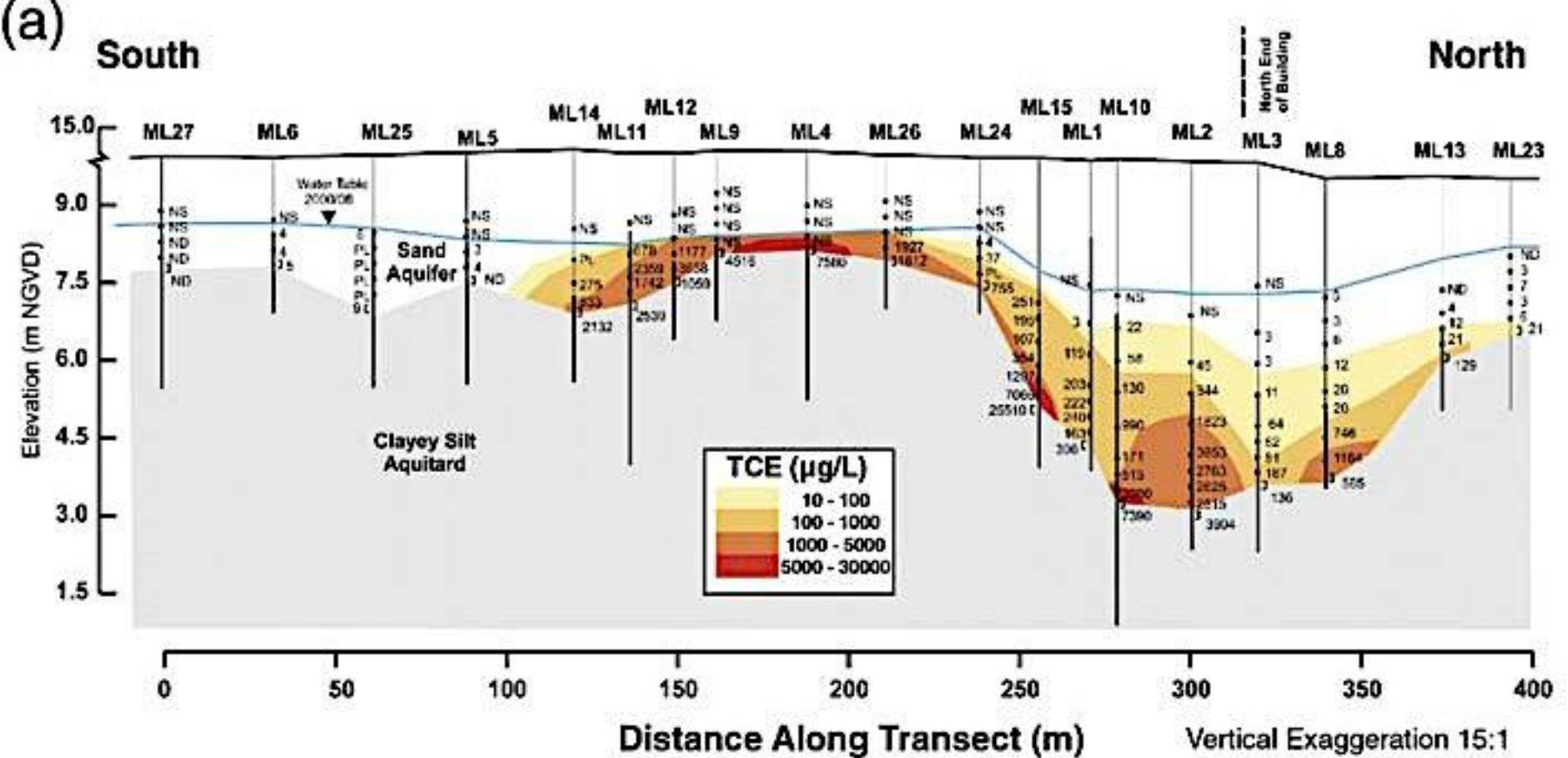




Site of Gulf Oil Terminal, West Bromwich, 2014

TCE in
Connecticut,
USA.
Maximum TCE
concentrations
in
groundwater.
Water table
contours
(September
1999) are also
shown.
Chapman et al,

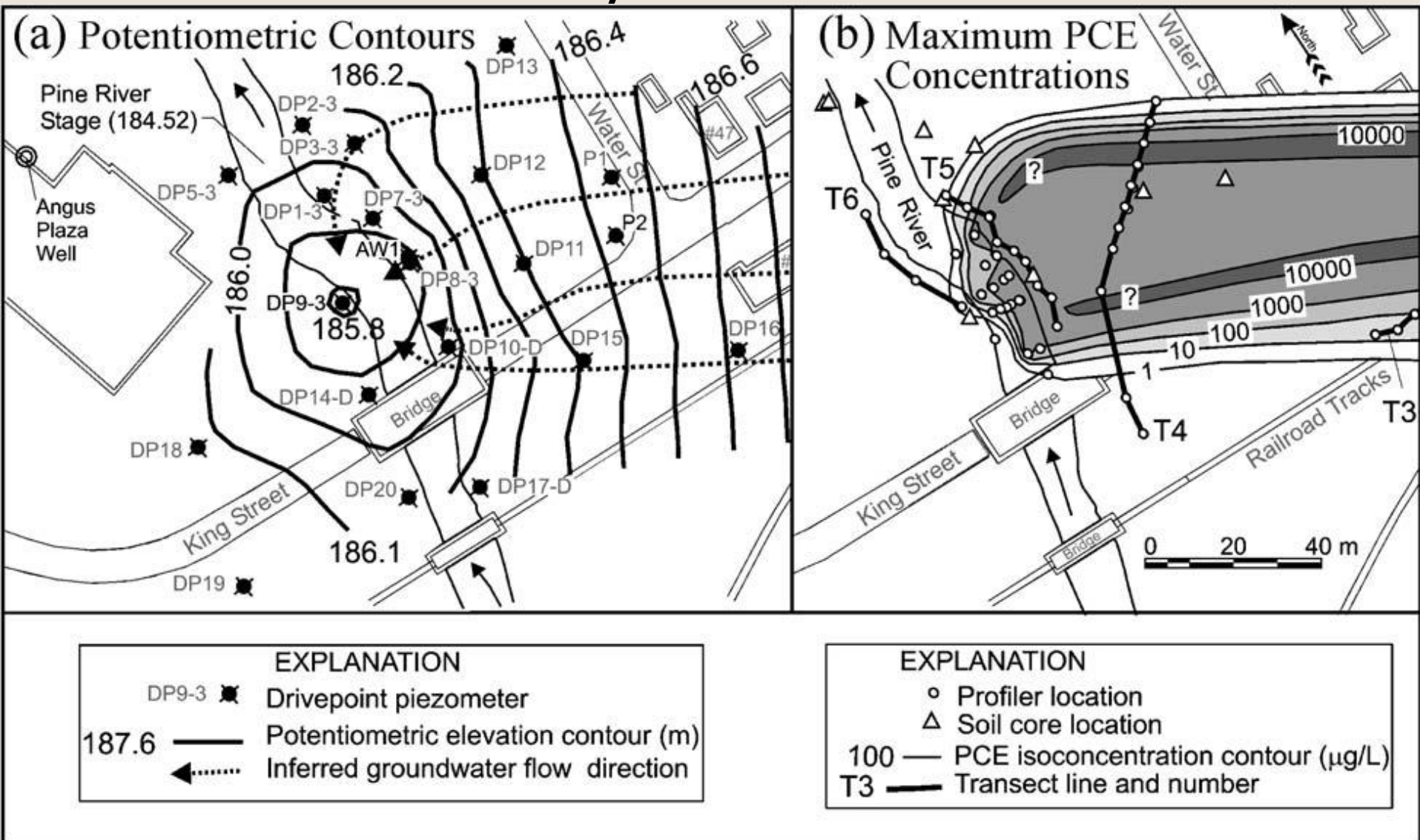




Cross section through the TCE plume, lying below the groundwater

Chapman et al, Connecticut

Tetrachloroethene (PCE – dry cleaning fluid) in Ontario



How do we know what is present?





Approximately
300,000 ha of
land in England
and Wales are
potentially
contaminated

**Chromium from metal
processing in Glasgow**

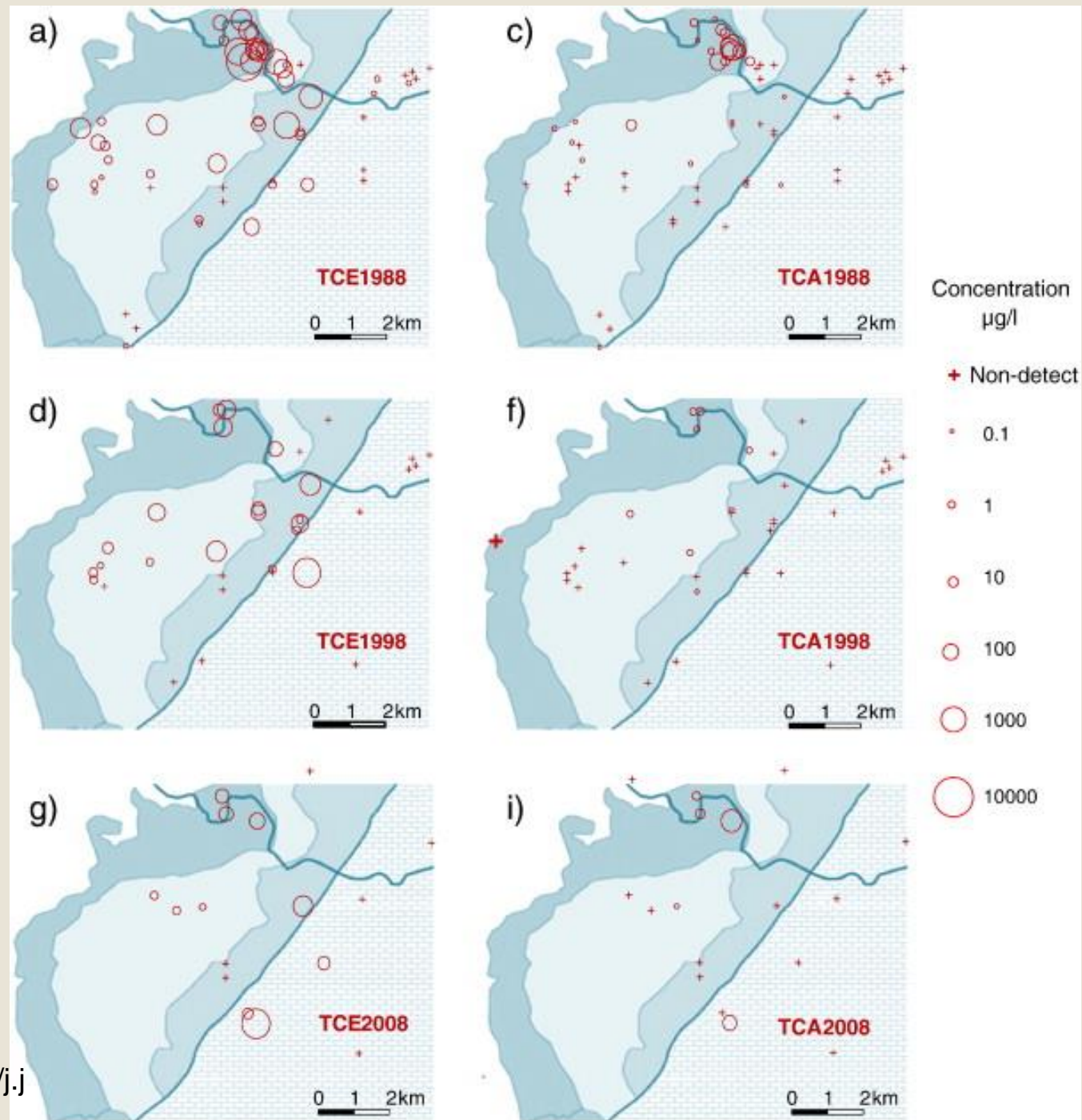
**Dioxin and furans from industry
1890s onwards in Newcastle-
upon-Tyne**

**Hexachlorobutadiene from waste
disposal in Weston, Cheshire**

**Cadmium, lead and zinc from
mining in Shipham, Somerset**

**Tin, copper, lead and arsenic in
spoil heaps in Cornwall**

Birmingham
aquifer
observed
maximum
concentrations
of TCE and
TCA for the
1988, 1998
and 2008
surveys.
Rivett et al,
2012



Potentially toxic elements in city parks

Hursthouse, 2012

mg kg⁻¹ in dry soil

700

600

500

400

300

200

100

0

Mercury

Chromium

Nickel

Lead

Zinc

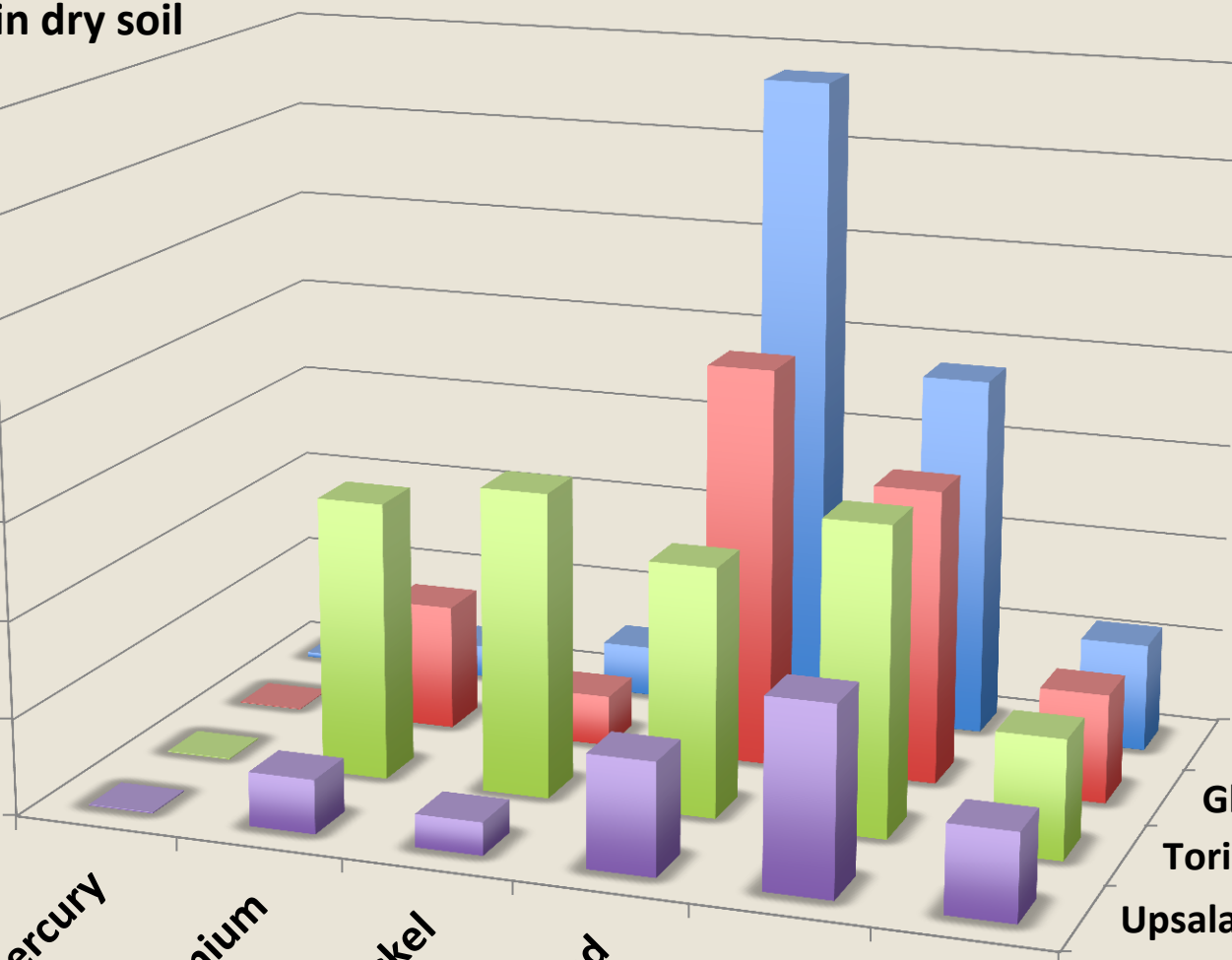
Copper

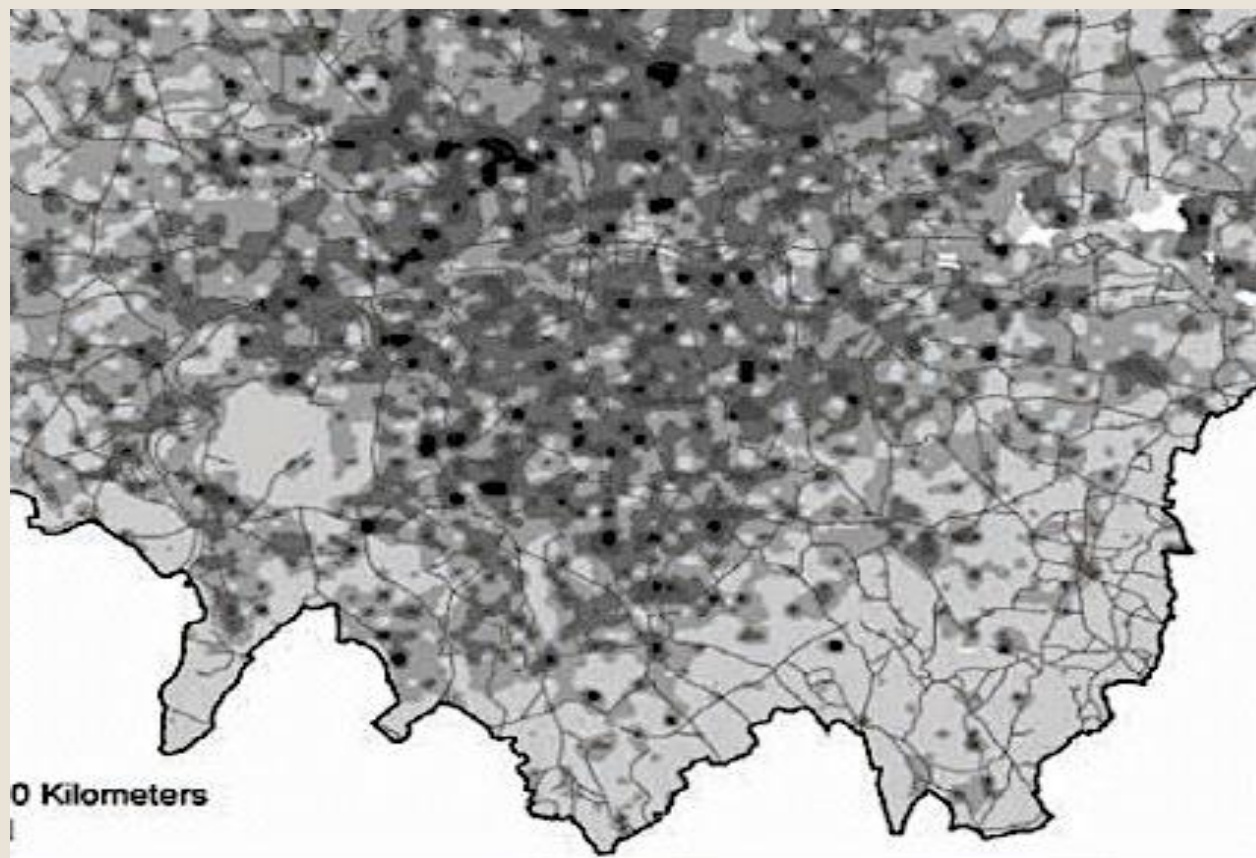
Glasgow a

Glasgow b

Torino

Upsala





10 Kilometers


ed bioaccessible lead in topsoils in the Greater London area; solid lines indicate the Survey Strategic data © Crown copyright 2012)¹⁶



Food and Environmental Research Agency on behalf of Department of Environment, Food and Rural Affairs, 2009

...concluded that overall there is no evidence for widespread impacts of contaminated land on human health but equally, the potential for health impacts has not been dismissed.

Contaminated Land Regime (Part 2A of the Environmental Protection Act, 1990)



‘A **risk based** regime.... Land is contaminated where the enforcing agency (the Environment Agency) believes **that significant harm** is being caused to the environment, where there is a **significant possibility of significant harm**, or where **significant pollution** of controlled waters is being caused or is likely to be caused...the primary regime for dealing with historic contamination no matter when in time the contamination occurred...Remediation must be to a standard such that **the land is suitable for its current use...**’

Reissued, slightly amended in 2012

Royal Commission on Environmental Protection, 1996

“it was not aware of any study that provided firm evidence of adverse effects of contaminated land on health”

