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## James Potter

- Specialist in Land Condition ( SiLC) since 2005 one of only 101 worldwide ([www.silc.org.uk](http://www.silc.org.uk))
- Environment Agency
- Hyder Technical manager of team of 12 in UK.
- Now leading due diligence audit in HK.

## Hyder Consulting

- Worldwide engineering and environmental consultancy of over 3800 people. ([www.hyderconsulting.com](http://www.hyderconsulting.com))
- 150 years from Sydney Harbour bridge to the 2012 Olympics and Tallest Building in World
- 2006 very successful year

# Tonights Talk



- UK Contaminated Land Regime – brief overview
- Soil guideline values ( SGV's)
- Thames View estate – Site Specific Assessment Criterion (SSAC)

# Governments's objectives



- Identify and remove unacceptable environmental and human health risks
- Damaged land brought back into use (60% new development to be on brownfield sites)
- Suitable for use – identify unacceptable risk and remediate by breaking linkages

# Part IIA Contaminated Land Regime



- 1995 Environment Act section 57
- Environmental Protection Act 1990
- Contaminated Land Regulations 2000
- Statutory guidance DETR 02/2002 and DEFRA circular 01/2006
- Linked Regulations e.g. Water Resources Act 1991



# Statutory Guidance and the CLAN Note

- The statutory guidance (DETR Circular 2/2000) specifies what is to be regarded as “significant harm”, and a “significant possibility” of such harm, with respect to the definition of contaminated land in Section 78A of the Act.
- For human beings “significant harm” is defined (DETR Circular 2/2000) as: “Death, disease, serious injury, genetic mutation, birth defects or the impairment of reproductive functions”.
- DETR Circular 2/2000 sets the conditions for there being a significant possibility of significant harm:
- “If the amount of the pollutant in the pollutant linkage in question: which a human receptor in that linkage might take in, or to which such a human might otherwise be exposed, as a result of the pathway in that linkage, would represent an unacceptable intake or direct bodily contact, assessed on the basis of relevant information on the toxicological properties of that pollutant.
- Such an assessment should take into account:
  - the likely total intake of, or exposure to, the substance or substances which form the pollutant, from all sources including that from the pollutant linkage in question;
  - the relative contribution of the pollutant linkage in question to the likely aggregate intake of, or exposure to, the relevant substance or substances; and
  - the duration of intake or exposure resulting from the pollutant linkage in question.
- The question of whether an intake or exposure is unacceptable is independent of the number of people who might experience or be affected by that intake or exposure.” DETR Circular 2/2000



## Part IIA Regime

- Defines contaminated land
- Target values for water
- Human health target values
- Damage / harm to ecological systems
- Damage to property / buildings
- Source – pathway – receptor
- Drinking Water Standards – Water Industry Act 1991, Environmental Quality standards Water Resources Act 1990
- Soil Guideline values and CIRIA papers on gas levels
- Biological values being developed
- Linked to Building standards

# Pollutant Linkage



- Source of contamination – landfilled materials or soils contaminated by historical activity
- Pathway how does receptor come into contact
- Receptor as defined in the statutory guidance e.g. human, controlled waters, crops



# Definition of contaminated land

- Any land which appears to be in a condition due to substances in, on or under the land
  - That significant harm is being (or there is a significant possibility of being) caused
  - Pollution of controlled waters is being, or is likely to be caused
- Is the pollutant linkage (or linkages) **SIGNIFICANT**

# Determination of Contaminated Land site



- If pollutant linkage is significant or potentially significant
- Determine the site as a Contaminated Land site or a Special Site
- Appropriate person remediates
- Record of all remedial activity
- Appears straightforward

# Significance ?



- Identify all pollutant linkages and assess if significant by
  - Comparing water data with EQS
  - Using the Soil Guideline Values, maximum and mean value tests and upper 95th percentile (US95%)
  - Other means ( Building standards etc)
- How much data ? One year ? One hot spot ?
- How significant – one result or more?

# HUMAN HEALTH - Soil Guideline values



- ICRCL values withdrawn
- SGV's developed based on toxicological reports describing technical approach taken
- SGV's incomplete and used CLEA model – SNIFFER, RBCA
- 2004 task force set up due to concerns over SGV's – limited number and how to use them
- How much above SGV represents an unacceptable or significant risk



# Statutory Guidance and the CLAN Note



- “A key question, clearly, is then how far above an SGV the relevant soil concentration would have to be to meet the ‘unacceptable intake’ test. At the present time the published DEFRA / Environment Agency technical guidance on risk assessment does not address this issue.” (DEFRA CLAN 02/05)



# UK position

- State of review.
- Improved guidance to support Part IIA and tackle unacceptable risk by means of developing CLEA
- BUT still leave option for site specific assessment because
  - Sites are all different
  - Generic values may not cover complex site specific interactions of contaminants and pathways
  - Use generic models and justify resulting site specific value

# Take a Breather



# The Problem



- Risks identified when work on a gas main revealed high metals in the made ground
- 2500 homes were potentially at risk
- The estate had been built in the 50's when imported power station ash was used to “improve” the site.
- A thin “Clean” topsoil had been imported to form the gardens



# A long story kept short



- Hyder appointed to investigate and assess risks - 2003
- A phased approach was adopted – CLR11
- Phase 1 preliminary investigation. Generic Risk Assessment used. Many substances could be ruled out using available SGV's
- Phase 2 – Further SI improved UCL95 and SSACs developed using SNIFFER exposure model – most CoCs satisfied , not Arsenic
- Phase 3 – investigation to gain bio-accessibility data in order to model and assess arsenic with greater confidence.

# State of Knowledge 2004 after phase 1 and 2



- Max value –268 mg/kg, the SGV for arsenic is 20 mg/kg
- Upper bound value (95%) –51.6 mg/kg (SSAC 28 mg/kg)
- SSAC used some modelling default values
- Bio-accessibility uncertain, crops unknown
- Further sampling in order to gain bio-accessibility data across the site for soil arsenic and provide greater confidence of new SSAC derived for soil arsenic

# Prognosis 2004



- Determination – looming based on SSAC of 28mg/kg currently derived but considered conservative
- Actual Health effects? None known. (Health authority searches revealed no known adverse health issue for the estates population)
- So did the residents want this? – no
- Did Council want to determine the site? – no not convinced a health problem but values above the SSAC!
- Way forward – Spatial distribution data & site specific exposure model parameters needed.



# Phase 3 Investigation 2005 Aims



- Macro (estate) and Micro (garden) distribution characteristics of Arsenic concentrations
- Statistically robust data sets for “topsoil” and underlying ashy fills
- 100 Gardens sampled – nearly 1000 soil samples tested for total Arsenic
- Data sets 0 to 0.2m and 0.3 to 0.6m depth



# Development of Exposure Model

- Bioaccessible fraction of total Arsenic – 100 Physiologically based extraction test (PBET tests (10% of all soils results) – simulates gastrointestinal tract conditions in humans
- Independent BGS CISED tests on 10 duplicates of bioaccessible tests (models easily extracted Arsenic fractions by Chemometric Identification of Substrates and Element Distributions ) to ascertain amounts of arsenic were easily extractable.
- Plant Uptake – CF leafy , CF root – Cropping Trials
- Aim – better site specific model to derive a site specific Arsenic SSAC







# Cropping Trial

- Consumption homegrown vegetables forms a potentially significant exposure pathway for soil arsenic
- Significance increases as bioaccessibility via direct soil ingestion decreases
- Findings – CF Root < CLR10 default  
CF Leafy – lettuce > CLR10

Refinement of CF values was obtained, reducing the As exposure via homegrown vegetables.

- The site specific assessment criterion reflects the actual site conditions not the value derived using default

# Key Outputs



- Probability – Variation in Arsenic concentration just as likely in samples 100m apart, as 100mm apart, thus
- Apparent “hotspot” gardens – not supported
- SSAC between 54 and 70mg/kg, 54mg/kg – likely intakes of soil using maximum soil to plant concentrations 70mg/kg based on soil arsenic bioaccessibility and the max conc factors measured in the cropping trial
- The representative soil arsenic concentration value for private gardens across the estate was calculated to be 58mg/kg
- Lower than the 70 mg/kg and only marginally higher than 54mg/kg



# Cost / Benefit



- Remediation if SGV value of 20mg/kg had been taken as the remedial target value— facing £10M ++ - and to whose benefit if no actual health risks?
- Full Phased Investigations & DQRA £300k over 3 years.

# Lessons in SSCA



- Communication Essential (but risky)
- Phased Investigations – desk study, preliminary investigation, targeted investigation – CLR11
- Bioaccessibility – a key site specific factor
- CISED – supported Bioaccessibility findings by independent techniques – confidence in bio-data raised
- Cropping Study – 1 year – but significant pathway for Arsenic
- Statistical robustness and peer review (LQM) – an essential





Thank You

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