Rattlechain Lagoon Findings of Human Health Risk Assessment Project:

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Project Aims and Objectives

- Review quality of existing data and advise on further data requirements to provide a robust dataset
- Assess all plausible pollutant linkages relating to human health
- Establish a Steering Group with key stakeholders to monitor the progress and consider the results of the HHRA
- Produce a human health risk assessment report
- Assess the risk to human health based on the current use of the site in accordance with UK guidance and best practice

Project Aims and Objectives

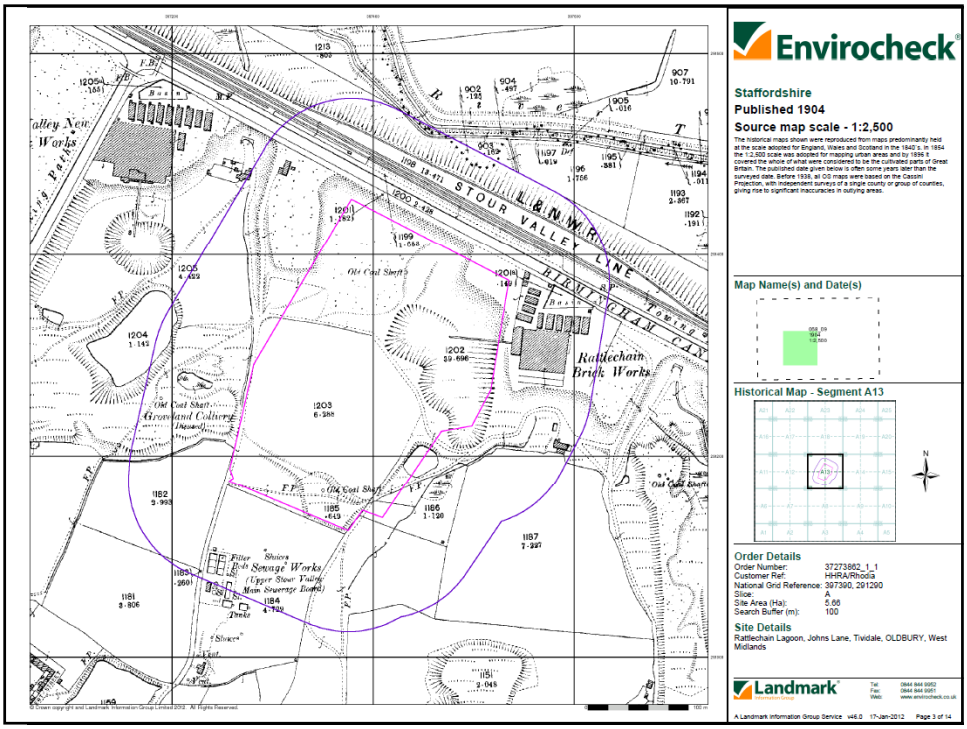
- Work did **not** include:
  - Assessment of risks to wildlife
  - Assessment of risks to controlled waters
  - Assessment of risks from future uses of the site
  - Excludes assessment of risks to workers accessing site:
    - covered by HSE legislation not human health risk assessment

Report Structure

- **Introduction**
  - Includes Background, Objectives of project and Limitations
- **Site History**
- **Site Walkover**
- **Chemistry and Toxicity of Phosphorus Compounds**
- **Review of Existing Data**
  - Including review of similar studies
- **Conceptual Site Model**
- **Human Health Risk Assessment**
- **Recommendations and Conclusions**

Site History

- Site history was obtained through an Envirocheck© report and from publicly available records.
- The site was historically a clay pit and brickworks until circa 1890.
- Albright and Wilson (who were taken over by Rhodia) acquired the site in 1948 for waste disposal.
- Rhodia are one of the largest chemical manufacturing plants in the West Midlands and historically manufactured potassium chlorate and white phosphorus for the match industry.



Site Walkover

- Site walkover was undertaken on 24th May 2011
- Visual inspection of site for condition of boundaries, any obvious signs of contamination e.g. discolouration of soil.
- Used to inform Conceptual Site Model (CSM)

Chemistry and Toxicity of Phosphorus Compounds

- In order to inform the HHRA a literature review of the chemistry, fate and transport and toxicity of phosphorus compounds was undertaken
- Likely reaction products with water and air examined:
  - Hydrophosphorus acid, phosphorus acid, phosphoric acid and phosphine
  - Phosphorus pentoxide highly unlikely to be present as readily reacts with water
- Potential for bioaccumulation reviewed- limited studies
- Toxicological data reviewed to determine appropriate acute and chronic values
- Other relevant publicly available studies examined for information which may be useful to assessment:
  - US studies- Eagle Flats and Eastern Michaud Flats

Review of Existing Data

- Relevant data held by Rhodia Ltd, Environment Agency and Sandwell Council for the Rattlechain Lagoon site and the adjacent housing estate were reviewed.
- Barratt Homes were contacted for records of the soil quality at the adjacent housing estate.
- Aim of review of existing data was to identify whether any further information or data was required in order to enable the HHRA to be undertaken.

Review of Data

Author/s	Date	Rattlechain Lagoon	Adjacent housing estate	Title
Parkman	1989		✓	Rattechain, Tividale, West Midlands- Land reclamation Strategy- Report to Mintworth Limited
Cremer and Warner	1990-1991	✓		Findings of the Site Investigation at the Rattlechain Tip Site, Oldbury, West Midlands
Rendel, Palmer and Tritton	1991		✓	Rattlechain- Revised Site Licence Application Support Statement on behalf of Mintworth Quay Limited
SP Associates	1995		✓	Tividale Sewage Works Reclamation Report
URS	2002	✓		Final Report. Rattlechain Landfill, Oldbury. Quantitative Risk Assessment
Sladen Associates	2003		✓	Geo-Environmental Proposal. Proposed Housing Development Temple Way, Tividale.
URS	2004	✓		Final Report- Additional Investigation and monitoring of the Rattlechain lagoon
Georisk Management Limited	2005		✓	Geo-Environmental Assessment. St Johns Lane, Tividale
Environment Agency	2011	✓		Data on water quality at the discharge point for purposes of discharge consent
Rhodia Ltd	2005-2010	✓		Data on lagoon water samples and groundwater data
Barratt Homes	2007		✓	Information on soil quality at the housing estate.

Gap analysis

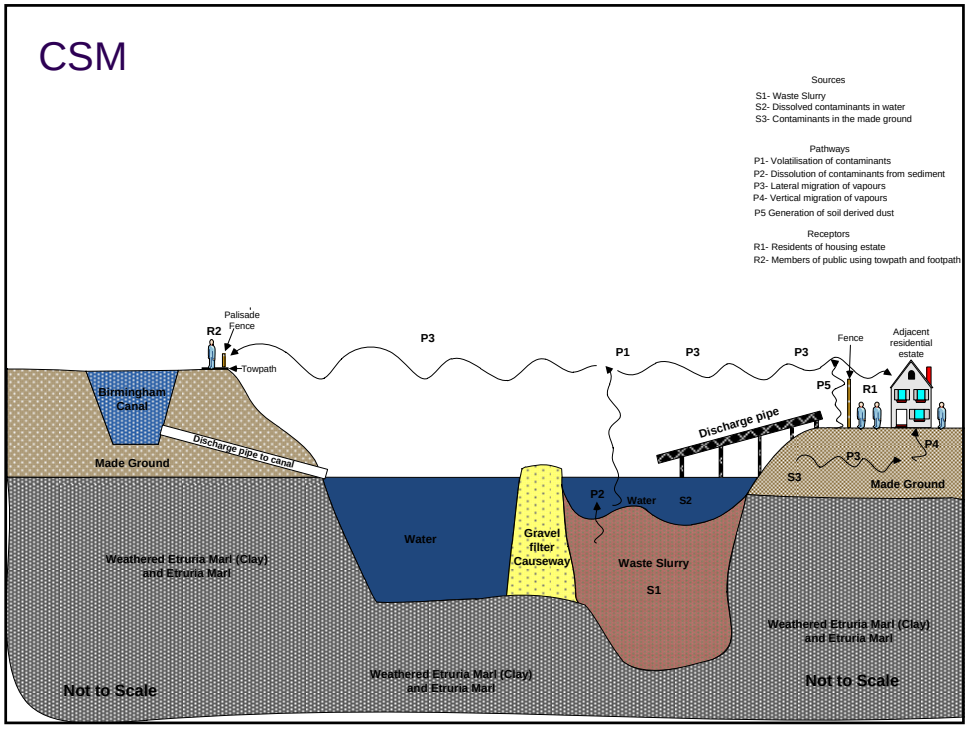
- Review of the existing reports identified a number of data gaps
- Recommendations were made for further samples soil, sediment, soil gas and ambient air to be collected
- Rhodia commissioned further site investigation at the site based on HPA recommendations

Conceptual Site Model (CSM)

- Based on review of existing data and site walkover, a CSM was developed
- In order for harm to be caused to an identified receptor there must be three essential elements present:
  - **contaminant/source**: a substance that is in, on, or under the land and has the potential to cause harm;
  - **receptor**: something which could be adversely affected by the contaminant i.e. people
  - **pathway**: a route or means by which a receptor can be exposed or affected by a contaminant

Source → **Pathway** → **Receptor**

CSM



Excluded pollutant linkages

- **Direct exposure via occupational activities**
  - Not covered under HHRA
- **Exposure via foodchain**
  - No significant foodchain or allotments in immediate area.
- **Exposure via wildlife**
  - Literature review and risk assessment does not consider exposure via animal poisoning to be relevant to human health. Case studies from Australia suggest that secondary animal poisoning is only possible following direct ingestion/contact with gut/gizzard shortly after poisoning. No reported cases of secondary exposure / poisoning in humans found.
- **Exposure via direct contact (water, sediment or soil)**
  - No direct access to the site or lagoon.

Site Investigation Results

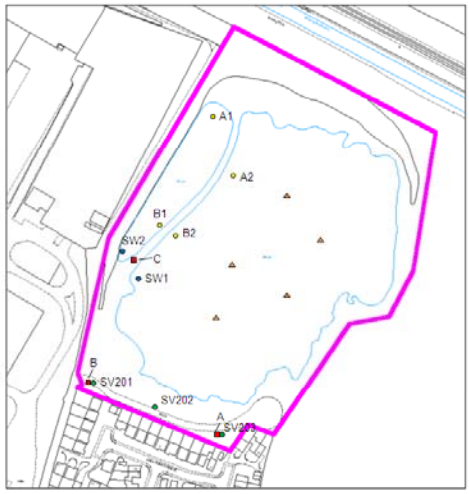
- Investigation was conducted consistent with UK best practice
- Site investigation work was undertaken on the 25th May and ambient air monitoring on 9th June 2011
- The samples collected were sent to UKAS[1] accredited and analysed consistent with UK standards.
- Appropriate limits of detection (LOD) were specified to enable chronic health risks to be assessed.
- Further site works were undertaken on the 27th September- 14th October 2011 (as agreed in previous Steering Group Meeting)
- Additional samples were taken from the lagoon water, ambient air and lagoon sediment.

[1] **The United Kingdom Accreditation Service is the sole national accreditation body recognised by government to assess, against internationally agreed standards, organisations that provide certification, testing, inspection and calibration services. Accreditation by UKAS demonstrates the competence, impartiality and performance capability of these evaluators.**

Site Investigation Results
Phosphine Monitoring

- Undertaken with a PAC Draeger III gas monitor fitted with a phosphine filter (sensitivity 0.01 ppm).
- Sufficient sensitivity to detected chronic and acute effects:
  - chronic effects such as mild headaches can occur at 0.08ppm- identified from toxicological review
- Data logger recording readings every 1 min real-time
- Several monitoring rounds undertaken during a variety of weather conditions
- Monitoring undertaken on 9th June, 27th - 31st July, 3rd- 7th August and 14th October 2011

Investigation locations



Key:
- Surface water sample. ERM Nov 2011
- Sediment sample location. ERM Nov 2011
- Tennax tube location/phosphine monitoring location. ERM June and Nov 2011
- Soil and soil vapour sample location. ERM June and Nov 2011
- Lagoon sediment samples (CD3A-CD6)- Exact locations not reported by ERM but within main lagoon.

Site Investigation Results

- **Soil samples:**
  - no elemental white phosphorus or phosphine above detection limit.
- **Soil vapour samples:**
  - no phosphine above detection limit in soil vapour wells
- **Lagoon sediment samples:**
  - chemicals detected consistent with historical waste (i.e. predominately calcium phosphate). Elemental white phosphorus detected a depth. No phosphine above detection limit.

Site Investigation Results

- **Lagoon water sample:**
  - low levels of elemental white phosphorus detected. No phosphine above detection limit
  - Some volatile organic compounds (VOCs) detected within the water samples
- **Ambient air:**
  - None of the monitoring rounds detected phosphine in air
  - Some VOCs detected in the ambient air
- **Phosphine not detected in any media therefore not assessed further**

Identified contaminants for risk assessment

- Site investigation results were qualitatively assessed to determine the contaminants which could potentially result in a pathway to residents of adjacent housing estate and member of public using footpaths
- No pathways present for direct contact with contaminants. Therefore pathways restricted to inhalation of contaminants which are present in ambient air.
- Main contaminants of concern:
  - **Metals**- soil derived dust generated from site
  - **Persistent organic contaminants** e.g. PAHs- soil derived dust generated from site
  - **Volatile organic contaminants (VOCs)** – present in ambient air
- Data for topsoil imported during development onto adjacent housing estate also reassessed against current criteria.

Risk Assessment:
Soil on Housing Estate

- Data on imported topsoil on housing estate assessed against current assessment criteria e.g. Soil Guideline Values (SGVs) or other published assessment criteria.

METALS

Parameter	Units	Max	Representative concentration*	SGV/Generic Assessment Criteria (mg/kg)	Representative concentration exceeds assessment criteria
Arsenic	mg/kg	6.6	6.8	32[1]	No
Cadmium	mg/kg	0.49	0.32	10[1]	No
Chromium	mg/kg	35	23.7	12900[2]	No
Copper	mg/kg	87	55.7	4020[2]	No
Lead	mg/kg	260	188.7	450[3]	No
Mercury	mg/kg	0.38	0.27	1.0[1]	No
Nickel	mg/kg	23	18.7	130[1]	No
Selenium	mg/kg	0.35	0.27	350[1]	No
Zinc	mg/kg	250	176.1	17200[2]	No

Risk Assessment:
Soil on Housing Estate

ORGANICS

Parameter	Units	Max	Representative concentration*	SGV/Generic Assessment Criteria (mg/kg)	Representative concentration exceeds assessment criteria
Naphthalene	mg/kg	0.5	0.39	8.71[2]	No
Acenapthylene	mg/kg	0.2	0.20	0.998[4]	No
Acenaphthene	mg/kg	0.2	0.12	2130[2]	No
Fluorene	mg/kg	0.2	0.12	1930[2]	No
Phenanthrene	mg/kg	0.8	0.52	0.998[4]	No
Anthracene	mg/kg	0.4	0.26	18300[2]	No
Fluoranthene	mg/kg	1.6	1.19	2160[2]	No
Pyrene	mg/kg	1.6	1.14	1550[2]	No
Benzo(a)anthacene	mg/kg	0.9	0.80	8.54[2]	No
Chrysene	mg/kg	0.9	0.66	927[2]	No
Benzo(b)fluroanthene	mg/kg	1.3	0.89	0.998[4]	No
Benzo(k)fluoranthene	mg/kg	0.6	0.30	100[2]	No
Benzo(a)pyrene	mg/kg	0.9	0.62	0.998[2]	No
Dibenzo(a,h)anthracene	mg/kg	0.2	0.17	1.00[2]	No
Indeno(1,2,3-cd)pyrene	mg/kg	0.8	0.64	9.75[2]	No
Benzo(g,h,i)perylene	mg/kg	1.2	0.85	103[2]	No
Phenols (total)	mg/kg	0.7	0.64	420[2]	No

Risk Assessment:
Soil Derived Dust

- The concentration of metals and persistent organic contaminants in soil derived dust generated from the site was predicted using calculations
- Calculations were taken from Contaminated Land Exposure Assessment (CLEA) guidance
- Predicted concentrations of soil derived dust in air where compared to appropriate air quality standards.

Risk Assessment:
Soil Derived Dust

Parameter	Max concentration in soil mg/kg	Calculated concentration in soil-derived dust in air (ng m^{-3})	Air quality assessment criteria (ng m^{-3})	Exceeds assessment criteria
Arsenic	17.3	0.13	3[1]	No
Cadmium	0.7	0.005	5[3]	No
Chromium	47.6	0.37	2.5[5]	No
Lead	85	0.66	250[2]	No
Mercury	0.2	0.001	1000[3]	No
Nickel	96.4	0.74	20[1]	No
Acenapthylene	0.11	0.0008	0.25[4]	No
Fluorene	0.08	0.0006		No
Phenanthrene	0.66	0.005		No
Anthracene	0.18	0.001		No
Fluoranthene	0.82	0.006		No
Pyrene	0.70	0.005		No
Benz(a)anthacene	0.33	0.002		No
Chrysene	0.47	0.003		No
Benzo(bk)fluroanthene	0.76	0.005		
Benzo(a)pyrene	0.45	0.003		No
Indeno(1,2,3-cd)pyrene	0.39	0.003		No
Dibenzo(a,h)anthracene	0.09	0.0007		No
Benzo(g,h,i)perylene	0.38	0.003		No
Coronene	0.06	0.0004		No
Benzo(b)fluoranthene	0.55	0.004		No
Benzo(k)fluoranthene	0.21	0.001		No

Risk Assessment:
Volatile Organic Compounds in Ambient Air

- Monitoring of ambient air at the site identified a number of VOCs in the air. The VOCs detected included:
  - Decane, methyldecane, butyl cyclohexane, dodecane, hexane, nonane and undecane ***- alkane hydrocarbons***.
- These are ubiquitous in the environment and are commonly associated with petrol emissions. None of these compounds have been detected within the sediment or water - may present a different source than the lagoon.
- VOCs concentrations in air were compared to appropriate air quality standards

Risk Assessment:
VOCs in Ambient Air

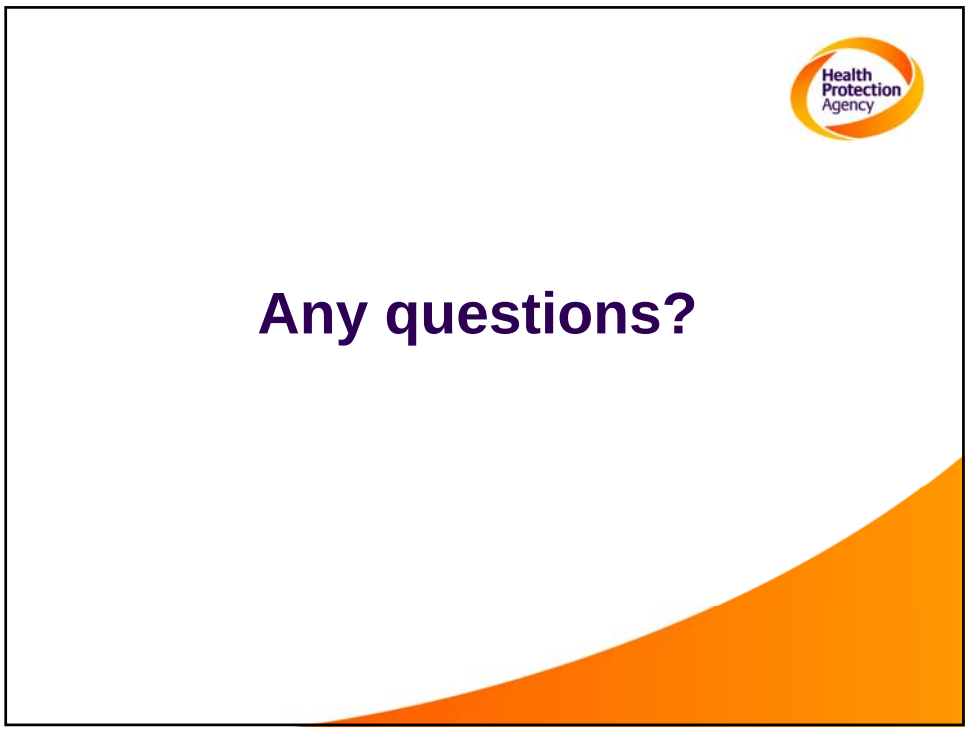
Parameter	Max concentrations (ppb)	Concentration in µg/m³	Air quality assessment criteria µg/m³	Exceeds air quality standard
Methylbenzene (toluene)	1.9	7.2	260[1]	No
Butyl cyclohexane	2	12	10,006[5]	No
Decane	13	77	12,000[4]	No
Methyl decane	2.7	17	12,000[6]	No
Dodecane	1.4	9.4	12,000[4]	No
Tetrachloroethene	15	99	250[1]	No
Hexane	12	42	720[2]	No
Dichloromethane	15	51	3000[1]	No
Naphthalene	1.9	9.8	530[2]	No
Nonane	3.3	17	10,500[3]	No
Undecane	3.9	25	12,000[4]	No

Recommendations/Conclusions

- Based on current conditions at the site there is not considered to be a risk to adjacent residents of the housing estate or members of the public using footpaths.
  - There is no evidence of off-gassing from the site (e.g. phosphine) and inhalation of other gases/particles is not a significant risk.
  - Direct contact with lagoon water or contaminated sediments is not feasible.
  - There is no evidence of any contaminated soil off-site or within easily access of the residents.
- Recommended if further works are undertaken at the site which involve substantial movement of soil or sediment then further monitoring and risk assessment would be advisable.

Next Steps

- **Project Group to comment on draft report?**
- **HPA to formally sign off report**
- **Communications strategy**
- **Communicate and disseminate final report**


Health
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Any questions?