

Breaking Ground

The Role of Geology in the Successful Reclamation of Contaminated Land
by Kevin Cleary and Mary O'Hara

Consulting
Civil
Structural
Mechanical
Electrical
Rail
Transportation
Highways
Environmental
Project Management
Health & Safety
Management Services

www.wyg.com thinking beyond construction

Causes of Contamination

- Our industrial past
 - Town gas works
 - Industrial works
 - Railway land
- Current activities
 - Fuel and chemical storage
 - Power stations and Scrap yards
 - Asbestos Containing Materials
 - Poor Environmental Management
- Land filling
- Radon

Suggested Temporal Changes in Value Caused by Land Contamination

KEY:
1-2 Effect of the discovery of the contamination
2-3 Delay before site investigation works are completed
3-4 Effect of completion of site investigation works
4-5 Delay before remedial works are completed
5-6 Effect of completion of remedial works

(A Brown and Pleasant Land)

Environmental Investigation Procedures

Phased Approach

- Phase I: Define objectives, Desk study, Sampling plan and strategy
- Phase II: On-site sampling, Chemical analysis, Site assessment report
- Phase III: Risk assessment, Remediation system design and implementation
- Phase IV: Monitoring and utilisation

Research – Check Historical Maps


Developing an Environmental Profile of the Site and its Environs

Site Walkover

Phase 2 Site Investigation

White Young Green


- Phase 2 targets high risk areas identified in Phase 1
- Investigation Geophysics, trial pits, boreholes
- Soil, Water and Gas Sampling
- On site sample screening
- Laboratory Analysis
- Site Survey
- Hydraulic tests



Phase 2 Data Objectives

White Young Green

- Refine Conceptual Model
- Delineate contamination extent (lateral & vertical)
- Identify Pollutant Linkages (Source – Pathway – Receptor)
- Risk estimation using Guideline Values
- Sufficient information for additional assessment (I.e modelling, ORA, remedial design)

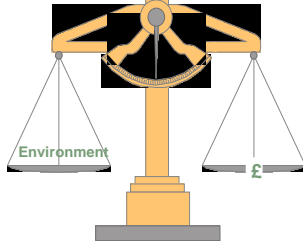


Risk Assessment

White Young Green

- Site specific conceptual model
- Risks to humans
- Risks to the environment
- Source
- Plausible pathway
- Receptor

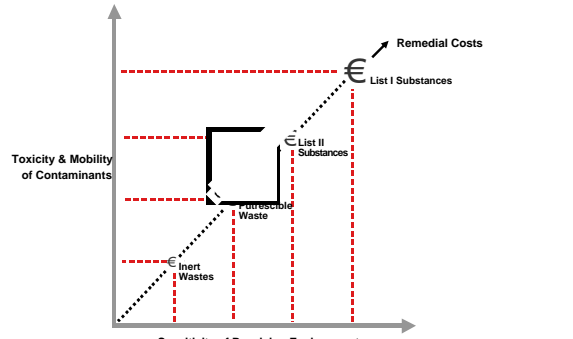
The Risk Assessment & Management



- Risk = exposure x toxicity
- Risk based corrective action

Model

White Young Green



PHASE 1 – DESK STUDY

White Young Green

- Desk top study:
 - Timber Yard
 - Paint Factory
 - Transport Yard
- Preliminary Site Investigations:
 - Drilling
 - Contamination type
 - Geology
 - Hydrogeology
 - Initial Quantitative Risk Assessment

PHASE 2 - SITE INVESTIGATION

White Young Green

- Site Investigations included:
 - 56 boreholes (20m * 20m grid)
 - 21 groundwater monitoring wells
 - DNAPL observed
- Analytical findings:

- Soil:	BTEX, TPH, PAH
- Groundwater:	BTEX, TPH, PAH, Phenol
- DNAPL Identified:	Creosote

Dublin Stratigraphy – Contaminant Pathways

White
Young
Green

STRATIGRAPHY	DISTRIBUTION	MAIN CHARACTERISTICS	SIGNIFICANCE TO CONTAMINATION
FILL	Approx. 40% of Dublin area	General Fill Material (not compacted), varying thickness	Poor Aquifer Often little attenuation capacity Significant Source and Pathway
ALLUVIAL & ESTUARINE DEPOSITS	Floodplains of Main Rivers (Liffey, Dodder, Tolka, Camack)	Soft silts and clays Generally >3-4m thick	Poor Aquifer Varied permeability Potential Pathway
GRAVELS	Floodplains of Main Rivers (Liffey, Dodder, Tolka, Camack)	Fluvial Gravels with interspersed silt layers. 1 – 20m thick. Permeability range: 10^{-2} – 10^{-6} ms	Minor Aquifer Potential Moderate to lower permeability zones. Significant Pathway
BOULDER CLAYS	Widespread	Upper weathered brown Boulder Clay and lower black boulder clay Varying thickness Permeability range: 10^{-8} – 10^{-10} ms	Poor Aquifer Restricts downward migration to bedrock. Can contain water bearing lenses
LIMESTONE BEDROCK	Widespread	Basinal limestone with interbedded shales and mudstones (CALP)	Aquifer Shale and mudstone layers restrict movement. Some movement through fissures/fractures. Pathway

QUANTITATIVE RISK ASSESSMENT

White
Young
Green

- SOURCE: Groundwater and Soil (Hydrocarbon contamination)
- PATHWAY:
 - Air: Indoor & Outdoor Inhalation
 - Soil: Ingestion & Dermal Contact
 - Groundwater: Lateral migration to River Liffey
Vertical migration to bedrock
Ingestion & Dermal Contact
- RECEPTOR: Site users
River Liffey

Excavation and Off-site Disposal and WWT

White
Young
Green



- Top 3m of soil removed across site
- 34 shipments over 11 month period
- 70k tonnes of contaminated soil excavated
- Soil treated in Germany and Holland
- WWTP regulated by EPA to DCC Standards
- >8k m3 of water treated

In-situ Soil Stabilisation

White
Young
Green



CUT OFF WALL BARRIER

- Cement/ bentonite mix
- Keyed into boulder clay
- 1×10^{-9} m/s permeability

SOIL STABILISATION

- Cement/bentonite/binding agent mix
- Leachability testing

MONITORING

White
Young
Green

- Noise
- Dust Deposition
- Air Quality
- Groundwater
- Groundwater levels
- Waste water from the treatment plant
- Meteorological Data
- Odour



THE SITE TODAY

White
Young
Green



- EPA Licence surrender: October 2005
- 02 Head Quarters
- Quality Hotel
- Office Block
- Apartment Block

Conclusion

White
Young
Green



- Think source-pathway-target
- Importance of accurate geological and hydrogeological model
- Geologists have mixture of skills required to manage remediation projects
- Turn a perceived liability into an asset