The Dove Way: Landfill Redevelopment and Soil Reclamation Scheme

Ground Engineering

amey consulting

Phase I: Site Characterisation

The Scheme

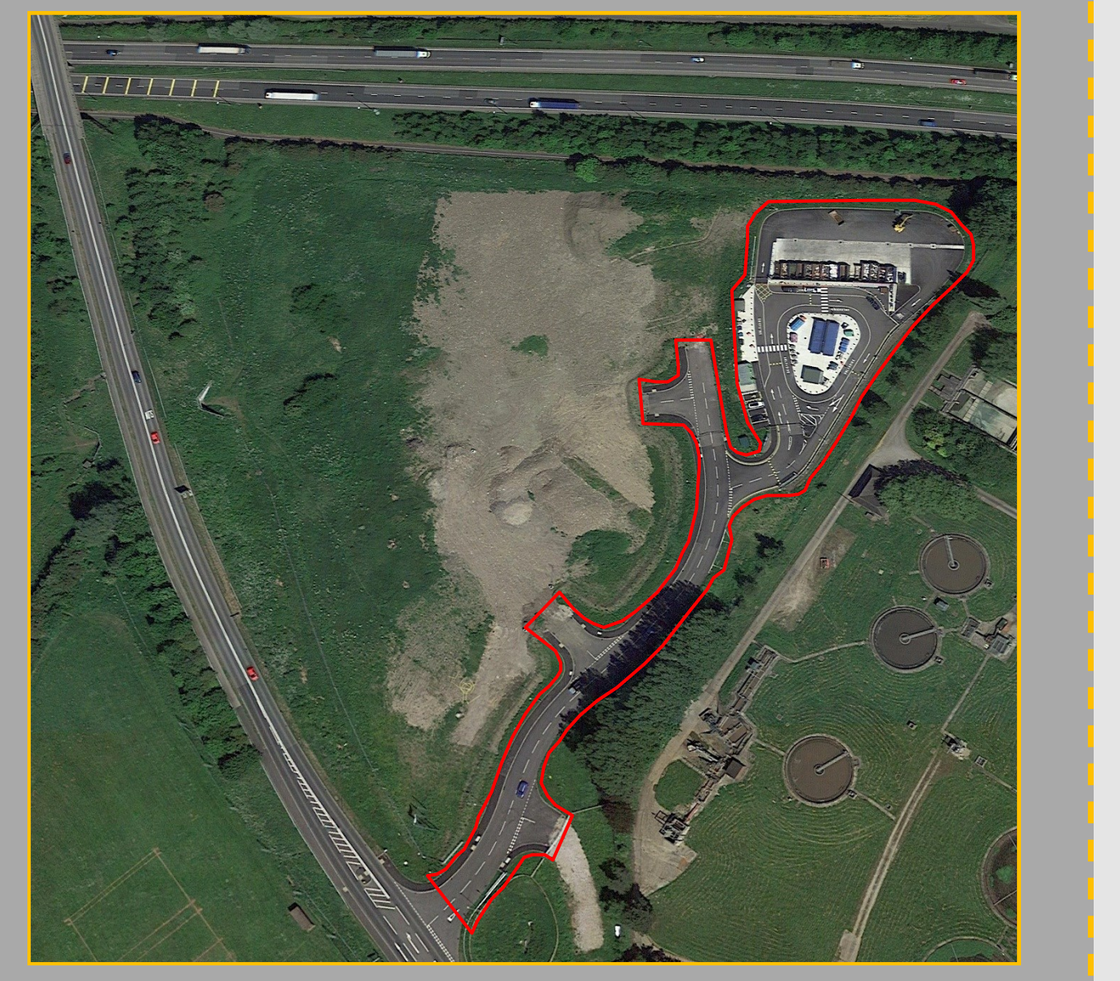
The Dove Way Soil reclamation scheme comprises of a household waste recycling centre (HWRC) and access road on a historic municipal co-disposal landfill which is recorded to have operated between 1964 and 1978.

A phased investigative approach was used with a detailed ground investigation (GI) under BS10175 (1) into the landfill consisting of four cable percussive boreholes, eleven window samples and twenty two trial pits. A subsequent investigation included the installation of standpipe monitoring wells to facilitate long term groundwater and ground gas monitoring.

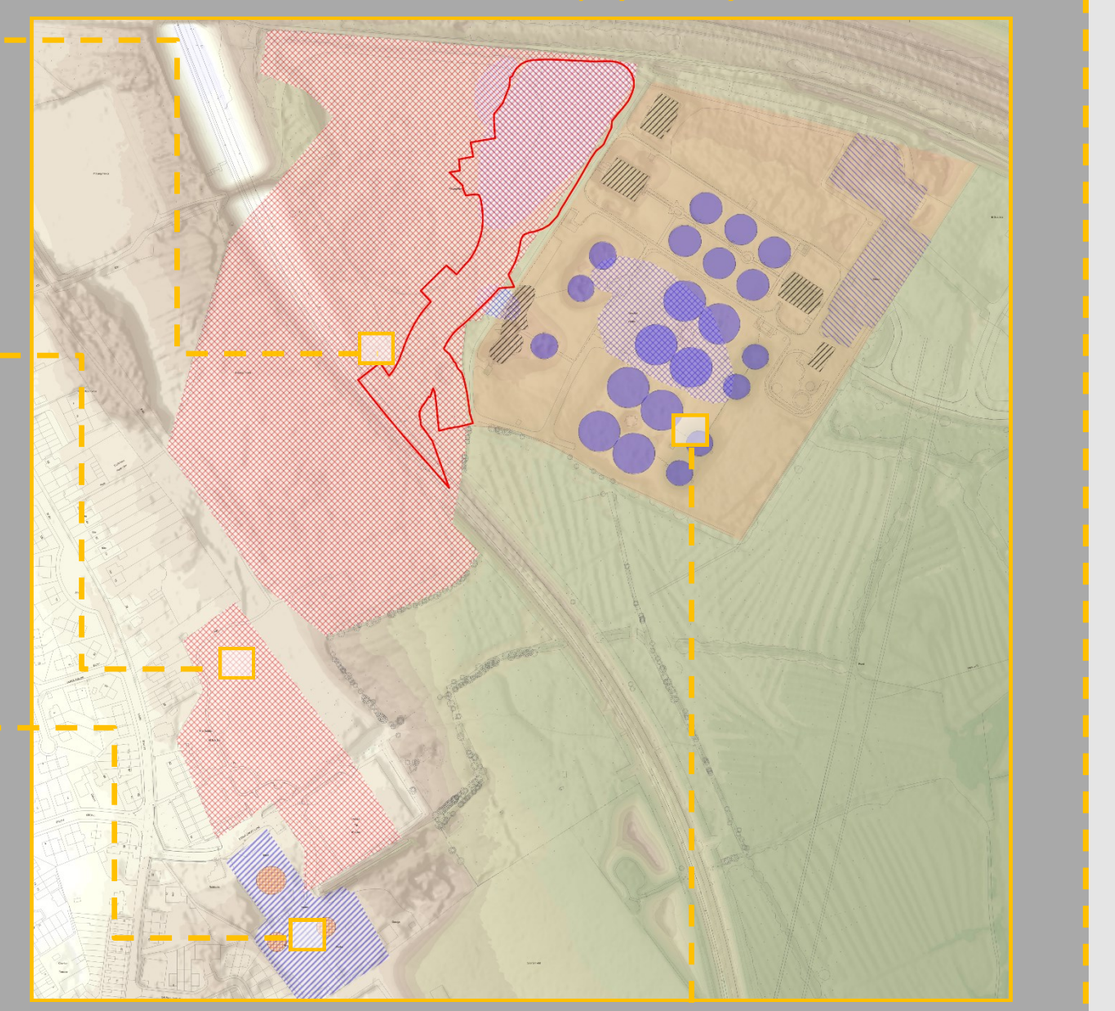
Investigation identified a significant fraction of soil intermixed with household waste, assumed to have been daily cover used in the operation of the landfill. This is the material placed at the end of each day after waste is deposited

Contamination risk assessments were undertaken in accordance to CLR11 (2) in order to ascertain the contaminative nature of the landfill and to discharge planning conditions relating to construction of the HWRC. Assessments were also undertaken to evaluate the re-usability of the soil fractions and supported the re-use of soils defined by a materials management plan (MMP) under CLAiRE's Definition of Waste Code of Practice (DOWCOP) (3).

Aerial view of the site pre-development



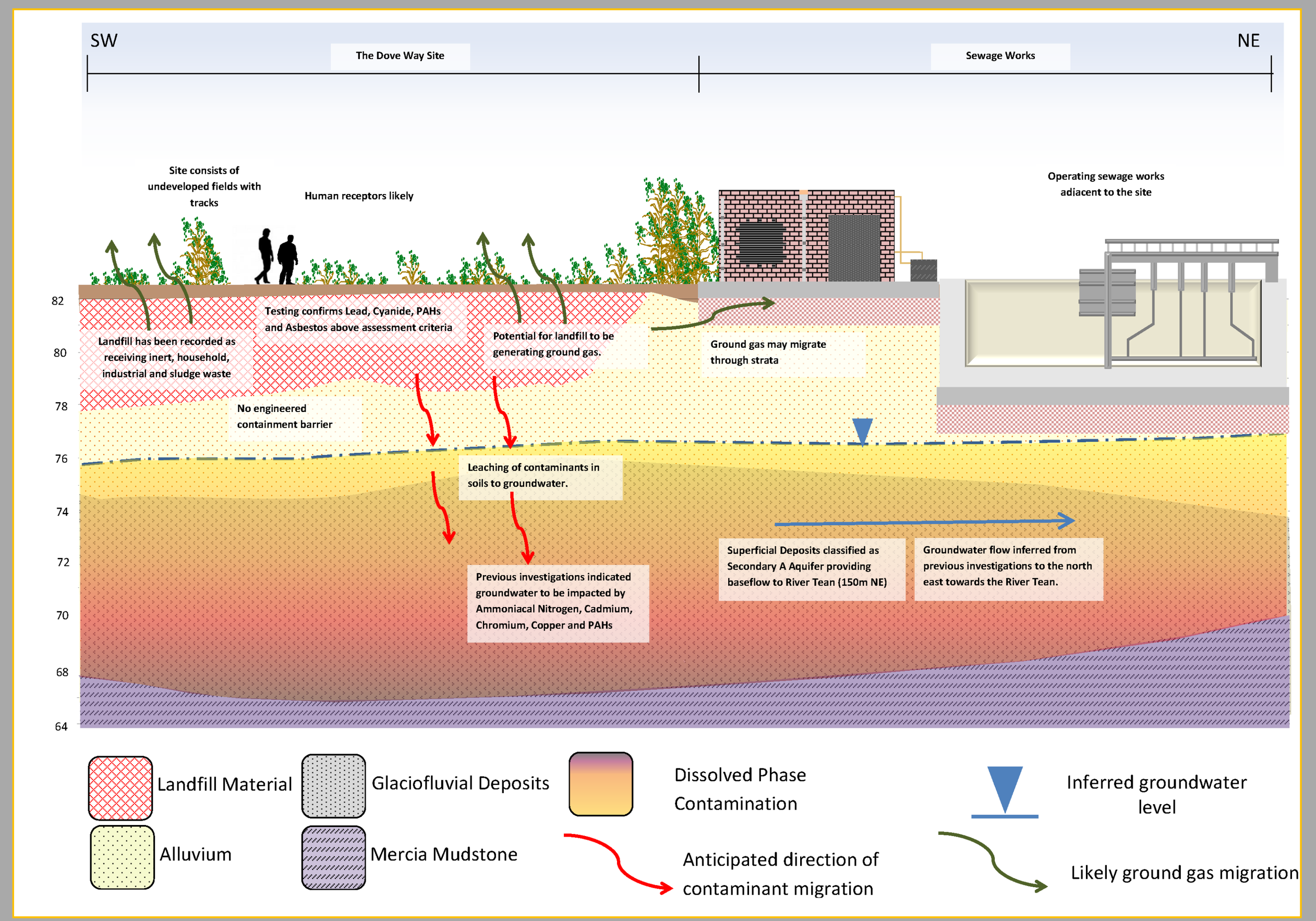
Aerial view of the site post-development (above)
Geo-Environmental Hazards Map (below)



Site Characterisation

Geology and Hydrogeology		
Artificial Ground	Made Ground / Landfill Material	• Likely to be contaminative in nature • Pose a risk to human health, controlled waters • Potential ground gas generation
Superficial Geology	Alluvium Glaciofluvial Deposits	• "Secondary A Aquifer" providing baseflow to primary river 150m to the north
Bedrock Geology	Mercia Mudstone	• Naturally halite bearing strata, typically fractured, weak and friable
Landfill and Waste Sites		
Landfill adjoining Pennycroft Sewage Works (0m onsite)		• Located on site • Operated between 1964 and 1978. • Waste deposited was a mixture of inert, industrial waste, commercial, household waste, and liquids/sludge
Old Site The Wharf Historic Landfill (80m South)		• Up hydraulic gradient of the site. • Operational dates unknown but likely between 1981 and 1997 • Within an area of a Gasworks shown to be present circa 1922 to 1937
Surrounding Land Use		
Uttoxeter Gasworks (135m South)		• Present circa 1922 • operative up until 1937 • Infrastructure present up until 1997
Uttoxeter Sewage Works (0m East)		• Present since 1922 • Expansion of filter/sludge beds • Remained operational to present day.

Preliminary Conceptual Site Model



SW
The Dove Way Site
Sewage Works
NE
Landfill Material
Glaciofluvial Deposits
Dissolved Phase Contamination
Inferred groundwater level
Alluvium
Mercia Mudstone
Anticipated direction of contaminant migration
Likely ground gas migration

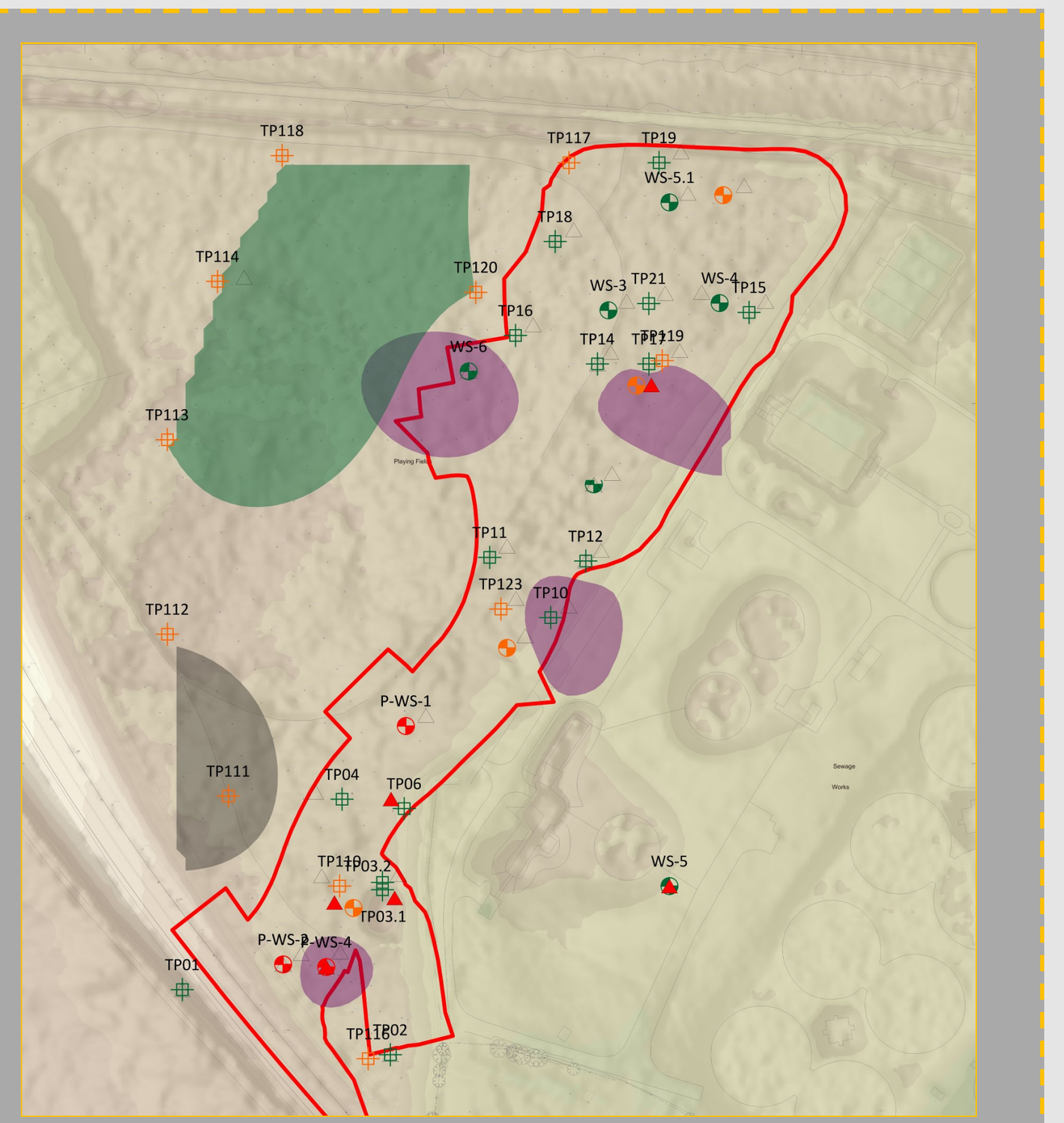
Phase II: Contamination Assessment

Human Health Risk Management

Measured soil concentrations were to appropriate generic assessment criteria. Isolated exceedances of Lead (purple), Cyanide (green) and Benzo(a)pyrene (grey) were identified. Asbestos (red) was detected at six locations accounting for 15% of soils tested.

The most at risk receptors are considered construction workers due to the nature of construction works and probable contact with contaminated soils. Risks were mitigated through suitable PPE and procedure. An asbestos specialist was present throughout works under CAR-SOIL 2012 (4) and CIRIA C733 (5) Asbestos guidance.

To mitigate exposure to site end users, a clean cover with anti-dig geotextile membrane was placed in all areas of soft landscaping to provide a cover to asbestos impacted soils. The hardstanding of the access road and HWRC also breaks any viable pathways to end users.

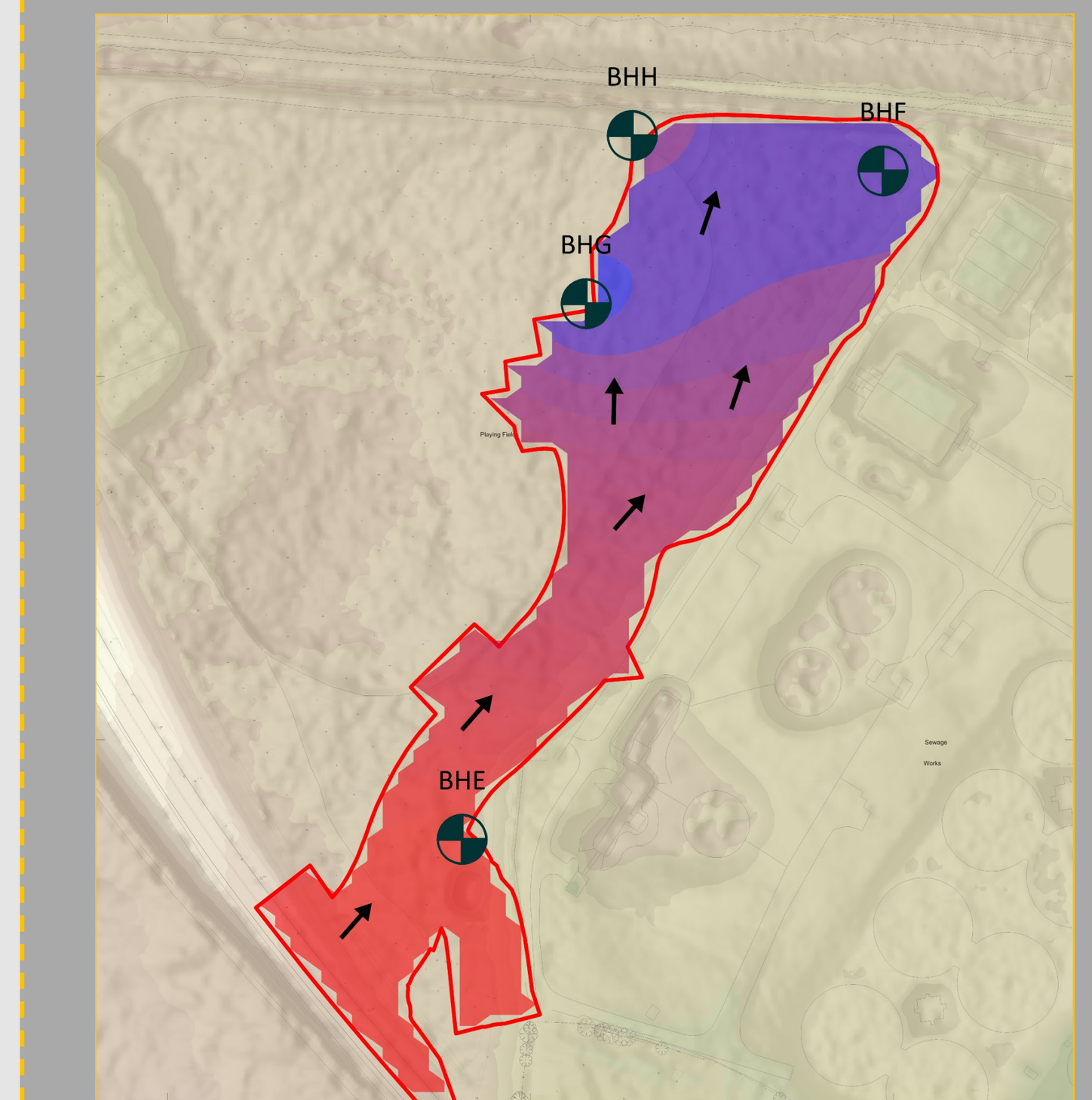


Distribution of contaminated soils where measured concentrations exceed generic assessment criteria

Ground Gas Risk Management

Monitoring indicated completion of CH_4 generation. A residual CO_2 production phase has been recorded likely to be a function of well effects introducing oxygen into the underlying alluvium.

The majority of the site is of a low sensitivity, the sole building, a mini cabin, was designed on raised supports to allow free flow of air beneath the structure to reduce the potential of gases to accumulate in hazardous concentrations.



Simplified plume model showing general conditions of groundwater

Controlled Waters Risk Management

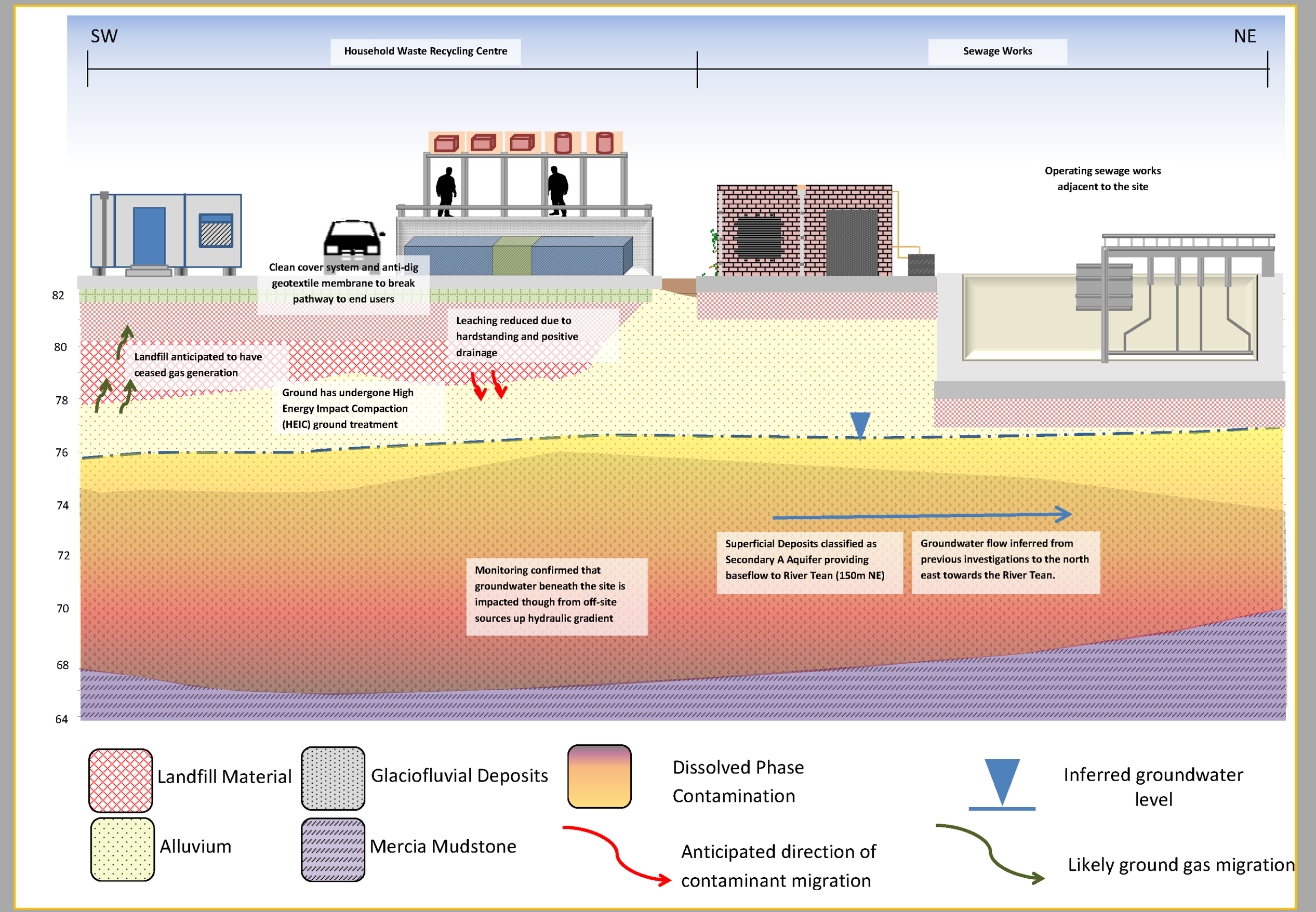
Concentrations were compared to Environmental Quality Standards (EQS) (6) for the protection of surface waters. Monitoring recorded included exceedances of cadmium, mercury and zinc, boron, arsenic, copper and molybdenum. The majority of the metal exceedances measured were only slightly above the assessment criteria. Significantly elevated levels of ammoniacal nitrogen were measured in each location on several occasions, with concentrations measuring over an order of magnitude above the assessment criteria. Typically the concentrations decreased downgradient.

The groundwater up hydraulic gradient of the site has been shown to have similarly elevated levels of contaminants as those measured onsite. Therefore groundwater entering the site was determined as already impacted, and the current site is not the sole source of the contaminants measured in the groundwater. Detailed Quantitative Risk Assessment ascertained that surface waters would not be impacted upon based on the concentrations measured through the site.

Drainage waters from the proposed access road and HWRC will be connected to oil interceptors and no soakaways or sustainable urban drainage have been designed to drain directly to the ground at the site.

Infiltration will be significantly reduced across the site as all of the site surface area will consist of positively drained hard standing resulting in significant reduction of leaching of residual mobile contamination resulting in a beneficial impact on groundwater quality.

Revised Conceptual Site Model



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Site Remediation

Waste Hazard Assessment

Soil quality data from the investigation was entered into a hazard assessment tool, HazWaste Online (7) to determine whether the substances contained in the soils tested exceed any risk phrases that would render the materials as 'hazardous' waste under the Environment Agency: WM3 guidance (8). On the provision that asbestos containing material would be removed, 12 samples of 49 assessed were determined as hazardous waste. A number of samples had one or more of the following hazardous properties: HP7 Carcinogenic, HP 10: Toxic for reproduction, HP 11: Mutagenic and HP14 Ecotoxic.

The remaining 37 samples as non-hazardous waste. This was to be expected given the site is a former landfill that has previously been used for the co-disposal of different waste streams. Waste Acceptance Criteria (WAC) testing confirmed that several samples exceeded Hazard Waste Landfill criteria and would require treatment prior to disposal.

Whilst not used to support the re-use of soils under the DOWCOP, the waste hazard assessment was utilised to justify the design approach and to satisfy the client that material re-use would be a more sustainable and cost effective solution.

Soil Stripping and Excavation

During construction works it was necessary to undertake excavations into the former landfill site, resulting in the generation of a significant quantity of mixed landfill wastes.

These comprised domestic refuse including tyres, glass, wood, paper and plastics as well as construction wastes, such as concrete and brick, mixed with soils that would have been used as daily cover during the landfill lifecycle.

Approximately 9700m^3 of material was excavated. Of that, 2500m^3 was site won topsoil ,and 7200m^3 site won landfill wastes including daily cover soil.

Non-sorted, excavated landfill material (left) and excavation activities (right)

Non-sorted, excavated landfill material (left) and excavation activities (right)

Soil Screening and Recovery

Screening was undertaken to separate three types of material grade; <25mm soil, 25mm-75mm aggregate and >100mm waste.

Asbestos specialists were present throughout the process of screening and aggregate crushing. Asbestos containing materials were identified, hand picked and removed for suitable disposal. Air quality monitoring was deployed to monitor for potential release of airborne fibres exceeding the occupational limit of 0.01f/ml.

The screened materials were processed at a minimum of two times to ensure maximum efficacy and recoverability in volumes of waste. Oversized aggregate was processed onsite by rock crushing.

Screened and graded soil (above)

Stockpiling of Materials

Approximately 7200m^3 of site won landfill waste has been processed of which approximately 4529m^3 is recovered soil (less than 25mm), and 2058m^3 (25mm to 100mm) and 471m^3 (over 100mm) is aggregate comprising crushed concrete brick and other fragments.

Samples of the site won recovered soil material were stockpiled and chemically tested weekly at a rate of one sample per 250m^3 to verify the suitability of the material to be used as fill material beneath the geotextile across the access road and HWRC footprint.

Materials, accounting for 2750m^3, which did not pass through the screening process were disposed of separately as waste and have not been re-used. As such they were stockpiled and disposed of offsite with the List of Waste codes (right).

Material description	LoW code
Asbestos 70.1% concentration within cement	17 06 05* – Construction materials containing asbestos
Asbestos 70.1% concentration within lagging	17 06 01* – Insulation materials containing asbestos
Mixed Non-hazardous metals, rubber (not from tyres), plastic	19 12 04 - Plastic and Rubber

Non-reusable waste consisting of plastics and rubber in the screener

Stockpiling of non-reusable wastes for disposal

Site Verification

Ground Treatment

In order to provide stable ground and decrease voiding within the underlying material, high energy impact compaction (HEIC) was undertaken across key areas of the site.

A layer of cohesive material was placed to prevent dust generation and potential release of asbestos fibres. Open trenches were used to deflect vibrations from existing service lines from the sewage treatment works.

Compaction resulted in an overall lowered elevation. Site won material was used to raise the levels as part of the clean cover system beneath the geotextile with imported virgin limestone gravel used to achieve site levels. An excess of recovered material was stockpiled for use on the adjacent site which had been tendered for a proposed commercial park. The excess material was agreed to be used beneath the hardstanding of the car parks and access roads, and not within the footprints of the buildings or soft-landscaped areas in conformance with the Remediation Report and Materials Management Plan and as agreed with the Local Planning Authority.

Aerial view of the site during construction. Of the HWRC

Clean Cover Design and Site Verification

BRE 465 Cover Systems by Land Regeneration (9) sets out the required thickness of clean cover to be placed above the layer of made ground. However, due the presence of asbestos and uncertainties surrounding 'acceptable' concentrations, the use of this tool is not considered appropriate in this instance.

A proposed minimum 500mm of cover was agreed with the Local Planning Authority (LPA) to be sufficient to be protective of the measured concentrations, breaking any viable pathway to future users and avoid accidental disturbance of underlying wastes, particularly asbestos. In addition, the hardstanding further breaks pathways and the anti-dig geotextile membrane should discourage digging into the wastes in addition to greatly reducing natural soil mixing.

Placement of imported clean material above site won fill and anti-dig geotextile

Verification consisted of nine trial pits in areas of soft landscaping to test samples of the topsoil and underlying imported material, to verify its suitability as clean cover material in-situ and verify that sufficient thickness of clean cover material is present across the site. Chemical testing confirmed suitability and each trial pit was excavated to a minimum of 0.65mbgl demonstrating that the thickness of clean cover exceeded the minimum thickness agreed with the LPA.

Therefore it was considered that the contaminant linkages at the site were broken and the remediation undertaken was sufficient to establish the site suitable for its intended use as an access road and HWRC.

View of the completed Household Waste Recycling Centre

Cost Saving Elements	
Initial design to excavate all landfill material to natural strata. An estimated 15,000m^3 tonnes of material to be disposed as hazardous waste.	
Reduction in Disposal Costs	
Geo-Environmental Design to reduce volumes through risk management, HEIC techniques and efficient geotechnical design.	*£3,696,000*
Recommendation to implement MMP to recover soil fractions in excavated material	*£3,234,000*
Reduced volume of imported clean material	*£675,000*
Total Cost Reduction:	**£7,605,000**

References:

1. *BSI. 2011. Investigation of potentially contaminated sites. Code of Practice. London.*
2. Environment Agency. 2004. *Model Procedures for the Management of Contaminated Land. (CLR11). Bristol.*
3. CL:AIRE. 2011. *The Definition of Waste: Development Industry Code of Practice.* V2. London.
4. HSE. 2012. *Control of Asbestos Regulations 2012.* Directive 2009/148/EC
5. CIRIA. 2014. *Asbestos in Soil and Made Ground: A Guide to Understanding and Managing Risks. London.*
6. The Water Framework Directive (Standards and Classification) Directions. 2015.
7. *HazWaste (Online) Assessment Tool.*
8. *Environment Agency. 2015. Waste Classification. Guidance on the Classification and Assessment of Waste. Bristol.*
9. Building Research Establishment. 2004. *Cover Systems for Land Regeneration—Thickness of Cover Systems for Contaminated Land.* BR465