

Ground Conditions - Land Contamination Baseline Conceptual Site Model and Preliminary Qualitative Risk Assessment

Pollutant Linkage	Potential Source	Key Contaminants	Pathway	Receptor	Probability	Consequence	Baseline Risk	Rationale
1	On-Site Made Ground associated with historical development and demolition of oil refinery infrastructure and in the operational Contractors Yard.	Metals and other inorganics, asbestos, oils, fuels and grease (Total Petroleum Hydrocarbons), polycyclic aromatic hydrocarbons, polychlorinated biphenyls, chlorinated solvents	Dermal contact with and/or ingestion of contaminants in soil and soil-derived dust	Human – occupants of on-Site residential properties	Receptor not present at baseline			
2	Contaminated natural soils associated with releases to ground from historical oil refinery infrastructure and the operational Contractors Yard.		Inhalation of contaminants in soil-derived dust Inhalation of vapours	Human – workers in and visitors to on-Site commercial properties, members of the public using on-Site public open space	Unlikely	Medium	Low	Residual contamination is present as a result of the historical use of the Site as an oil refinery and contamination associated with historical and current use of the Contractors Yard. Gross contamination has been removed as part of previous phases of remediation. Surface cover at the Site currently comprises mostly vacant land with scrub vegetation, which coincides with areas of the site not currently accessed by the identified receptors. There are currently no earthworks taking place on the vacant land. Locally there are also areas of existing commercial units, external hardstanding and well-vegetated soft landscaping. It is considered unlikely that site users will come into contact with contaminants in soil via the dermal contact, ingestion or inhalation pathways under current use of the Site.
3	Dissolved-phase contamination in groundwater associated with releases to ground from historical oil refinery infrastructure and the operational Contractors Yard. Free-phase petroleum hydrocarbons and chlorinated solvents associated with releases to ground from historical oil refinery infrastructure.		Dermal contact with and/or ingestion of contaminants in windblown soil-derived dust Inhalation of contaminants in windblown soil-derived dust Inhalation of migrating vapours	Human – occupants and visitors to off-Site residential properties, commercial properties, public open space	Unlikely	Medium	Low	Residual contamination is present as a result of the historical use of the Site as an oil refinery. Gross contamination has been removed as part of previous phases of remediation. Surface cover at the Site currently comprises mostly vacant land with scrub vegetation. There are currently no earthworks taking place on the vacant land. Locally there are also areas of existing commercial units, external hardstanding and well-vegetated soft landscaping. Based on the current Site condition and use, it is considered unlikely that windblown, soil-derived dust will be generated and migrate to off-Site human receptors. Under current site conditions it is also considered unlikely that vapours which may be associated with residual on-Site contamination will migrate to off-Site human receptors.
4	Soil-derived and groundwater-derived vapours associated with releases to ground from historical oil refinery infrastructure and the		Leaching and migration of contaminants from soils in the unsaturated zone into groundwater Migration of contaminants via preferential	Controlled Waters – groundwater in Secondary (Undifferentiated) and Secondary A Aquifers	Likely	Medium	Moderate	Residual contamination is present as a result of the historical use of the Site as an oil refinery. Gross contamination has been removed as part of previous phases of remediation. Underlying bedrock is classified as a Secondary A Aquifer and, where present, superficial deposits are classified as a Secondary (Undifferentiated) Aquifer. The site is not located in a groundwater source protection zone. The site is largely unsurfaced at present meaning there is potential for the generation of mobile or leachable contamination from residual contamination in unsaturated soils which may migrate into the underlying aquifers.

Pollutant Linkage	Potential Source	Key Contaminants	Pathway	Receptor	Probability	Consequence	Baseline Risk	Rationale
	operational Contractors Yard.		pathways such as piles to groundwater					
5	Waste materials and free phase hydrocarbons in Crymlyn Tip.		Lateral migration of contaminants in groundwater through soils and bedrock with discharge to surface water receptors as base flow	Controlled Waters – surface water in South Site Reservoir, Tal-y-Fedw, wetland lagoons, North Site Reservoir, Tennant Canal and River Neath	Unlikely	Medium	Low	Residual contamination is present as a result of the historical use of the Site as an oil refinery. RAP works carried out as part of the original Coed Darcy development were designed to recover gross contamination and mitigate risks associated with migration of mobile contamination at the Site boundaries. It is therefore considered unlikely that significant residual contamination is actively migrating to the identified surface water receptors.
6			Migration of contaminants along preferential pathways such as installed services followed by discharge to surface water receptors	Controlled waters and ecological – surface water in Crymlyn Bog SSSI	Low likelihood	Medium	Moderate/low	Residual contamination is present as a result of the historical use of the Site as an oil refinery. Crymlyn Tip which is located directly adjacent to and up-hydraulic gradient of part of Crymlyn Bog SSSI, is a source of free phase hydrocarbons which are currently captured via an active oil recovery system. Additionally, RAP works carried out as part of the original Coed Darcy development were designed to recover gross contamination and mitigate risks associated with migration of mobile contamination at the Site boundaries. There is therefore considered to be a low likelihood of contamination migrating into Crymlyn Bog taking into account the RAP works and whilst the oil recovery system remains operational.
7			Direct contact with contaminants in soils, perched water and/or groundwater	Current and future on-Site buildings, foundations and services	Low likelihood	Mild	Low	Residual contamination is present as a result of the historical use of the Site as an oil refinery. Gross contamination has been removed as part of previous phases of remediation. There is the potential for risks to potable water supply pipework which may require barrier pipe. The site is not directly underlain by key sulphate-bearing strata and it is considered unlikely that there are risks from aggressive ground to concrete.
8			Direct contact with contaminants in migrating perched water and/or groundwater	Off-Site buildings, foundations and services	Low likelihood	Mild	Low	Mobile contamination, if present, may have migrated off-Site but there is considered to be a low likelihood that there is an ongoing impact to off-Site buildings which are generally located at a higher elevation than the Site.
9	<u>On-Site and off-Site</u> Ground/landfill/mine gas	Methane Carbon dioxide Radon	Lateral/vertical migration through soils followed by accumulation in enclosed spaces leading to potentially asphyxiating atmosphere	Human – occupants of on-Site residential properties	Receptor not present at baseline			
10				Human – workers in and visitors to on-Site commercial properties	Low	Medium	Moderate/low	There is considered to be a low likelihood that ground/landfill/mine gas is present in areas of the Site proposed for development in sufficient quantities in enclosed spaces to result in potentially asphyxiating atmospheres. The Site generally lies within a lower probability radon area as 1% of homes are estimated to be at or above the Action Level.

Pollutant Linkage	Potential Source	Key Contaminants	Pathway	Receptor	Probability	Consequence	Baseline Risk	Rationale
								Radon protection measures are unlikely to be necessary in the construction of new dwellings or extensions in lower probability areas, subject to conformation of the level of risk.
11	<u>On-Site and off-Site</u> Ground/landfill/mine gas	Methane Carbon dioxide Radon	Lateral/vertical migration through soils followed by accumulation in enclosed spaces leading to potentially explosive conditions	On-Site and off-Site properties	Low likelihood	Severe	Moderate/Low ^{w*}	There is considered to be a low likelihood that ground gas is present in areas of the Site proposed for development in sufficient quantities in enclosed spaces to result in potentially explosive conditions. * The lowest achievable risk level for a 'severe' 'low likelihood' scenario is 'moderate', however this has been adjusted to 'moderate/low' based on professional judgement of the level of risk.
12	<u>Off-Site</u> Contaminants in windblown, soil-derived dust and entrained in surface water run-off from any areas where soils (and contaminants) are exposed at the surface associated with historical contaminative land uses	Total petroleum hydrocarbons, polycyclic aromatic hydrocarbons, chlorinated solvents, polychlorinated biphenyls and asbestos	Dermal contact with and/or ingestion of contaminants in windblown soil-derived dust	Human – occupants of on-Site residential properties	Receptor not present at baseline			
13	Potentially contaminated perched water and/or groundwater associated with historical contaminative land uses		Inhalation of contaminants in windblown soil-derived dust	Human – workers in and visitors to on-Site commercial properties, members of the public using on-Site public open space	Unlikely	Medium	Low	Historical potentially contaminative land uses have been identified in to the south of the Site. Migration pathways to on-Site human receptors are generally considered unlikely to be realised as the area to the south is at a lower elevation and down-hydraulic gradient from the Site, however migration of contaminants in windblown soil-derived dust is considered plausible.
14	Potential vapours associated with contaminated soil, perched water or groundwater associated with historical potentially contaminative land uses		Inhalation of migrating soil-derived and groundwater-derived vapours	Controlled Waters – groundwater in Secondary (Undifferentiated) and Secondary A Aquifers	Unlikely	Medium	Low	Potential off-Site sources of contamination have been identified, however these are down-hydraulic gradient of the Site to the south and are therefore unlikely to have resulted in contamination of groundwater underlying the Site.
15			Lateral migration through permeable soils	On-Site buildings, foundations and services	Unlikely	Mild	Very low	Potential off-Site sources of contamination have been identified, however these are down-hydraulic gradient of the site to the south and south-west and are therefore unlikely to have resulted in contamination of groundwater underlying the Site. The surrounding area is not directly underlain by key sulphate-bearing strata it is considered unlikely that there are risks from aggressive ground to concrete.

Ground Conditions - Land contamination CSM and risk assessment for the construction phase

Pollutant Linkage	Potential Source	Pathway	Receptor	Receptor Sensitivity	Baseline			Construction Without Mitigation					Construction With Mitigation				
					Probability	Consequence	Risk	Probability	Consequence	Risk	Magnitude of Impact	Significance of Effect	Probability	Consequence	Risk	Magnitude of Impact	Significance of Effect
1	<u>On-Site</u> Made Ground associated with historical development and demolition of oil refinery infrastructure and in the operational Contractors Yard.	Dermal contact with and/or ingestion of contaminants in soil and soil-derived dust	Human – occupants of on-Site residential properties	High	Receptor not present at baseline			Receptor not present during construction phase			n/a	n/a	Receptor not present during construction phase			n/a	n/a
2		Inhalation of contaminants in soil-derived dust Inhalation of vapours	Human – workers in and visitors to on-Site commercial properties, members of the public using on-Site public open space	Medium	Unlikely	Medium	Low	Likely	Medium	Moderate	Medium negative	Moderate adverse	Unlikely	Medium	Low	Negligible	Neutral
3	Contaminated natural soils associated with releases to ground from historical oil refinery infrastructure and the operational Contractors Yard.	Dermal contact with and/or ingestion of contaminants in windblown soil-derived dust Inhalation of contaminants in windblown soil-derived dust Inhalation of migrating vapours	Human – occupants and visitors to off-Site residential properties, commercial properties, public open space	High to medium	Unlikely	Medium	Low	Likely	Medium	Moderate	Medium negative	Moderate adverse	Unlikely	Medium	Low	Negligible	Neutral
4	Dissolved-phase contamination in groundwater associated with releases to ground from historical oil refinery infrastructure and the operational Contractors Yard.	Leaching and migration of contaminants from soils in the unsaturated zone into groundwater Migration of contaminants via preferential pathways such as piles to groundwater	Controlled Waters – groundwater in Secondary (Undifferentiated) and Secondary A Aquifers	Medium	Likely	Medium	Moderate	High likelihood	Medium	High	Low negative	Minor adverse	Likely	Medium	Moderate	Very low negative	Neutral
5	Free-phase petroleum hydrocarbons and chlorinated solvents associated with releases to ground from historical oil refinery infrastructure.	Lateral migration of contaminants in groundwater through soils and bedrock with discharge to surface water as base flow	Controlled Waters – surface water in South Site Reservoir, Tal-y-Fedw, wetland lagoons, North Site Reservoir, Tennant Canal and River Neath	Medium	Unlikely	Medium	Low	Low likelihood	Medium	Moderate/low	Low negative	Minor adverse	Unlikely	Medium	Low	Negligible	Neutral
6		Migration of contaminants along preferential pathways such as installed services followed by discharge to surface water receptors	Controlled waters and ecological – surface water in Crymlyn Bog SSSI	High	Low likelihood	Medium	Moderate/low	High likelihood	Medium	High	Medium negative	Moderate adverse	Low likelihood	Medium	Moderate/low	Very low negative	Neutral
7		Direct contact with contaminants in soils, perched water and/or groundwater	Current and future on-Site buildings, foundations and services	Medium	Low likelihood	Mild	Low	Likely	Mild	Moderate/low	Low negative	Minor adverse	Low likelihood	Mild	Low	Negligible	Neutral
8	Soil-derived and groundwater-derived vapours associated with releases to ground from historical oil	Direct contact with contaminants in migrating perched water and/or groundwater	Off-Site buildings, foundations and services	Medium	Low likelihood	Mild	Low	Low likelihood	Mild	Low	Negligible	Neutral	Low likelihood	Mild	Low	Negligible	Neutral

	refinery infrastructure and the operational Contractors Yard.																
	Waste materials and free phase hydrocarbons in Crymlyn Tip.																
9	<u>On-Site and off-Site</u>	Lateral/vertical migration through soils followed by accumulation in enclosed spaces leading to potentially asphyxiating atmosphere	Human – occupants of on-Site residential properties	High	Receptor not present at baseline			Receptor not present during construction			n/a	n/a	Receptor not present during construction			n/a	n/a
10	Ground gas		Human – workers in and visitors to on-Site commercial properties	Medium	Low	Medium	Moderate/Low	Low likelihood	Medium	Moderate/low	Negligible	Neutral	Low	Medium	Moderate/Low	Negligible	Neutral
11	<u>On-Site and off-Site</u>	Lateral/vertical migration through soils followed by accumulation in enclosed spaces and potentially explosive conditions	On-Site and off-Site properties	Medium	Low	Severe	Moderate/Low*	Low likelihood	Severe	Moderate/low*	Negligible	Neutral	Low	Severe	Moderate/Low*	Negligible	Neutral
12	<u>Off-Site</u>	Dermal contact with and/or ingestion of contaminants in windblown soil-derived dust	Human – occupants of on-Site residential properties	High	Receptor not present at baseline			Receptor not present during construction			n/a	n/a	Receptor not present during construction			n/a	n/a
13	Contaminants in windblown, soil-derived dust and entrained in surface water run-off from any areas where soils (and contaminants) are exposed at the surface associated with historical contaminative land uses	Inhalation of contaminants in windblown soil-derived dust Inhalation of migrating soil-derived and groundwater-derived vapours	Human – workers in and visitors to on-Site commercial properties, members of the public using on-Site public open space	Medium	Unlikely	Medium	Low	Low likelihood	Medium	Moderate/low	Low negative	Minor adverse	Unlikely	Medium	Low	Negligible	Neutral
14	Potentially contaminated perched water and/or groundwater associated with historical contaminative land uses	Lateral migration through permeable soils	Controlled Waters – groundwater in Secondary (Undifferentiated) and Secondary A Aquifers	Medium	Unlikely	Medium	Low	Low likelihood	Medium	Moderate/low	Low negative	Minor adverse	Unlikely	Medium	Low	Negligible	Neutral
15	Potential vapours associated with contaminated soil, perched water or groundwater associated with historical potentially contaminative land uses	Direct contact with contaminants in migrating perched water and/or groundwater	On-Site buildings, foundations and services	Medium	Unlikely	Mild	Very low	Unlikely	Mild	Very low	Negligible	Neutral	Unlikely	Mild	Very low	Negligible	Neutral

* The lowest achievable risk level for a ‘severe’ ‘low likelihood’ scenario is ‘moderate’, however this has been adjusted to ‘moderate/low’ based on professional judgement of the level of risk

Ground Conditions - Land contamination CSM and risk assessment for the operation phase

Pollutant Linkage	Potential Source	Pathway	Receptor	Receptor Sensitivity	Baseline			Operation Without Mitigation					Operation With Mitigation				
					Probability	Consequence	Risk	Probability	Consequence	Risk	Magnitude of Impact	Significance of Effect	Probability	Consequence	Risk	Magnitude of Impact	Significance of Effect
1	On-Site	Dermal contact with and/or ingestion of contaminants in soil and soil-derived dust	Human – occupants of on-Site residential properties	High	Receptor not present at baseline			Likely	Medium	Moderate	n/a	n/a	Unlikely	Mild	Very low	n/a	n/a
2	On-Site Made Ground associated with historical development and demolition of oil refinery infrastructure and in the operational Contractors Yard.	Inhalation of contaminants in soil-derived dust Inhalation of vapours	Human – workers in and visitors to on-Site commercial properties, members of the public using on-Site public open space	Medium	Unlikely	Medium	Low	Likely	Medium	Moderate	Medium negative	Moderate adverse	Unlikely	Mild	Very low	Low positive	Minor beneficial
3	Contaminated natural soils associated with releases to ground from historical oil refinery infrastructure and the operational Contractors Yard. Dissolved-phase contamination in groundwater associated with releases to ground from historical oil refinery infrastructure and the operational Contractors Yard.	Dermal contact with and/or ingestion of contaminants in windblown soil-derived dust Inhalation of contaminants in windblown soil-derived dust Inhalation of migrating vapours	Human – occupants and visitors to off-Site residential properties, commercial properties, public open space	High to medium	Unlikely	Medium	Low	Unlikely	Medium	Low	Negligible	Neutral	Unlikely	Mild	Very low	Low positive	Minor beneficial
4	Free-phase petroleum hydrocarbons and chlorinated solvents associated with releases to ground from historical oil refinery infrastructure.	Leaching and migration of contaminants from soils in the unsaturated zone into groundwater Migration of contaminants via preferential pathways such as piles to groundwater	Controlled Waters – groundwater in Secondary (Undifferentiated) and Secondary A Aquifers	Medium	Likely	Medium	Moderate	Likely	Medium	Moderate	Negligible	Neutral	Unlikely	Medium	Low	Medium positive	Moderate beneficial
5	Soil-derived and groundwater-derived vapours associated with releases to ground from historical oil refinery infrastructure and the operational Contractors Yard.	Lateral migration of contaminants in groundwater through soils and bedrock with discharge to surface water as base flow Migration of contaminants along preferential pathways such as installed services followed by discharge to surface water receptors	Controlled Waters – surface water in South Site Reservoir, Tal-y-Fedw, wetland lagoons, North Site Reservoir, Tennant Canal and River Neath	Medium	Unlikely	Medium	Low	Unlikely	Medium	Low	Negligible	Neutral	Unlikely	Mild	Very low	Low positive	Minor beneficial
6	Waste materials and free phase hydrocarbons in Crymlyn Tip.	Direct contact with contaminants in soils, perched water and/or groundwater	Controlled waters and ecological – surface water in Crymlyn Bog SSSI	High	Low likelihood	Medium	Moderate/low	Low likelihood	Medium	Moderate/low	Negligible	Neutral	Unlikely	Medium	Low	Low positive	Minor beneficial
7			Current and future on-Site buildings, foundations and services	Medium	Low likelihood	Mild	Low	Low likelihood	Mild	Low	Negligible	Neutral	Unlikely	Mild	Very low	Low positive	Minor beneficial

8		Direct contact with contaminants in migrating perched water and/or groundwater	Off-Site buildings, foundations and services	Medium	Low likelihood	Mild	Low	Low likelihood	Mild	Low	Negligible	Neutral	Unlikely	Mild	Very low	Low positive	Minor beneficial
9	On-Site and off-Site Ground gas	Lateral/vertical migration through soils followed by accumulation in enclosed spaces and inhalation	Human – occupants of on-Site residential properties	High	Receptor not present at baseline			Likely	Medium	Moderate	n/a	n/a	Unlikely	Mild	Very low	n/a	n/a
10			Human – workers in and visitors to on-Site commercial properties	Medium	Low	Medium	Moderate/Low	Low likelihood	Medium	Moderate/low	Negligible	Neutral	Unlikely	Medium	Low	Low positive	Minor beneficial
11	On-Site and off-Site Ground gas	Lateral/vertical migration through soils followed by accumulation in enclosed spaces and potentially explosive conditions	On-Site and off-Site properties	Medium	Low	Severe	Moderate/Low*	Low	Severe	Moderate/Low*	Negligible	Neutral	Unlikely	Severe	Low**	Low positive	Minor beneficial
12	Off-Site Contaminants in windblown, soil-derived dust and entrained in surface water run-off from any areas where soils (and contaminants) are exposed at the surface associated with historical contaminative land uses	Dermal contact with and/or ingestion of contaminants in windblown soil-derived dust	Human – occupants of on-Site residential properties	High	Receptor not present at baseline			Low likelihood	Medium	Moderate/low	n/a	n/a	Unlikely	Mild	Very low	n/a	n/a
13		Inhalation of contaminants in windblown soil-derived dust Inhalation of migrating soil-derived and groundwater-derived vapours	Human – workers in and visitors to on-Site commercial properties, members of the public using on-Site public open space	Medium	Unlikely	Medium	Low	Unlikely	Medium	Low	Negligible	Neutral	Unlikely	Medium	Low	Negligible	Neutral
14	Potentially contaminated perched water and/or groundwater associated with historical contaminative land uses	Lateral migration through permeable soils	Controlled Waters – groundwater in Secondary (Undifferentiated) and Secondary A Aquifers	Medium	Unlikely	Medium	Low	Unlikely	Medium	Low	Negligible	Neutral	Unlikely	Medium	Low	Negligible	Neutral
15	Potential vapours associated with contaminated soil, perched water or groundwater associated with historical potentially contaminative land uses	Direct contact with contaminants in migrating perched water and/or groundwater	On-Site buildings, foundations and services	Medium	Unlikely	Mild	Very low	Unlikely	Mild	Very low	Negligible	Neutral	Unlikely	Mild	Very low	Negligible	Neutral

* The lowest achievable risk level for a 'severe' 'low likelihood' scenario is 'moderate', however this has been adjusted to 'moderate/low' based on professional judgement of the level of risk.

** The lowest achievable risk level for a 'severe' 'unlikely' scenario is 'moderate/low', however this has been adjusted to 'low' based on professional judgement of the level of risk.