

BAM Nuttall Ltd

Victoria North: Planning Phase 2

DQRA Addendum

Reference: VNIF-ARP-ZZ-YYY-RP-CG-0021

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Ove Arup & Partners Limited
6th Floor 3 Piccadilly Place
Manchester
M1 3BN
United Kingdom
arup.com

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Contents

Executive Summary	1
1. Introduction	2
1.1 Commission	2
1.2 Planning context	2
1.3 Previous assessments and reports	3
1.4 Limitations	3
2. The Site	4
2.1 Site location and description	4
2.2 Geology	7
2.3 Former meander and mill race	7
2.4 Proposed development	8
2.5 Regulator engagement	8
3. Controlled Waters DQRA	9
3.1 Approach	9
3.2 DQRA assumptions: infiltration rates	9
3.3 DQRA findings	9
3.4 Meanwhile use area 1	9
3.5 DQRA conclusions	9
4. Human Health DQRA	12
4.1 Screening of soil data	12
4.2 Risk assessment outcome	12
4.3 Risks from imported materials and unexpected or residual contamination	14
5. Subsoil and Topsoil Requirements	15
6. Conclusions	16
6.1 Summary	16
6.2 Recommendations for remediation strategy	16
References	17
Appendix A - Rationale behind selection of soil import criteria – Planning Phase 2	ii

Tables

Table 1. Planning phase 2: Criteria for imported fill (for subsoil and topsoil, see Section 5)	10
Table 2. Soil samples exceeding human health GACs for public open space (parks) in planning phase 2	12

Figures

Figure 1: Planning phase 2 (red boundary) within the larger Victoria North development	4
Figure 2: Planning phase 1 (Red Bank plateau) and sub-divisions within the planning phase 2 area	5
Figure 3: Main St. Catherine's Wood area - development proposals	6

Figure 4: The recorded position of the meander bend and mill race in relation to planning phase 2	8
Figure 5: The location of TP120	13
Figure 6: The location of BH323	14

Executive Summary

This Detailed Quantitative Risk Assessment (DQRA) Addendum report has been prepared by Ove Arup & Partners Ltd (Arup) on behalf of BAM Nuttall Ltd (BAM) to present an assessment of the risks to controlled waters and human health associated with the existing ground conditions in the planning phase 2 area of the Victoria North site. This report aims to present sufficient information to discharge the first part of Condition 7a of planning consent 137079/JO/2023, namely the submission of further site investigation and risk assessment to support the development of a Remediation Strategy, for the planning phase 2 area. This report reviews and collates the findings of previous ground investigations and risk assessments, where those findings were pertinent to planning phase 2.

Planning phase 2 is to be developed as an area of formal public open space (POS), with new hard and soft landscaping, together with areas of retained hard and soft landscaping. Earthworks are proposed, which will include areas in which existing slopes are regraded. Where necessary, materials will be imported to supplement the regrading operations. Accessible footpaths are to be provided, and adjacent areas are to be dressed with imported subsoil and topsoil for planting. In limited areas of St. Catherine's Wood, in which regrading is not proposed, existing vegetation is to be preserved.

Concentrations of potential contaminants in soils generated from the planning phase 1 area are likely to be too great for use in planning phase 2, due to risks associated with the adjacent River Irk. Soils from planning phase 1 are therefore, not to be used in planning phase 2.

This DQRA Addendum includes an assessment of risks to controlled waters associated with potential ground contamination within the planning phase 2 area. No demonstrable controlled waters risks have been identified.

Previous ground investigation included samples recovered from within and adjacent to the planning phase 2 area, in which concentrations of potential contaminants exceeded the relevant human health generic assessment criteria (GAC) for public open space (parks). Source-pathway-receptor assessments presented in this DQRA Addendum have concluded that in these cases, the relevant contaminant pathways will be broken and that therefore, there are no demonstrable risks to human health associated with the planning phase 2 proposals.

Soils that are to be locally regraded as part of the planning phase 2 development are not considered to require screening against re-use criteria, as their retention on site will present no new risks to controlled waters or human health. If soils that are grossly contaminated (as assessed on a visual/olfactory basis) are encountered they will not be re-used. No specific soil remediation is therefore, proposed for the protection of human health within planning phase 2. Subsequent development in the areas of meanwhile use in planning phase 2, will require these risk assessments to be revisited as part of subsequent planning applications.

Imported fill will be from off-site (i.e. not imported from elsewhere in the Victoria North site) and will need to meet the imported fill criteria (**Table 1**). These remedial targets have been generated specifically to be protective of the River Irk, using the Environment Agency's Remedial Targets Methodology (RTM) and appropriate infiltration parameters.

For topsoil and subsoil, relevant British Standards have been used to supplement the RTM-derived remedial targets, to address phytotoxic risks associated with zinc, copper and nickel. The thresholds set out in the British Standards are higher than the RTM-calculated criteria for nickel and zinc and therefore, the site-specific criteria previously derived for these metals remain.

The remedial targets presented in **Table 1** are to be applied to all imported general fill, topsoil and subsoil. Testing will be required for every 500m³ of imported fill material.

1. Introduction

1.1 Commission

This report has been prepared by Ove Arup & Partners Ltd (Arup) on behalf of BAM Nuttall Ltd (BAM) to present an assessment of the risks to controlled waters and human health associated with ground contamination within the planning phase 2 area of Victoria North.

Manchester City Council proposes redevelopment of planning phase 2 to include the following elements:

- Regrading of existing slopes;
- The creation of accessible footpaths;
- Planting to supplement existing vegetation;
- Provision of an active transport route onto Red Bank Plateau;
- Two areas for temporary use, referred to as ‘meanwhile use’ areas.

Earthworks will be limited to regrading operations, with only limited filling operations including the import of general fill and topsoil and subsoil for planting.

Ground investigation at Victoria North addressed all of planning phase 2 and adjacent areas. Following ground investigation, Arup completed a geotechnical interpretative report (GIR) [3] and a number of risk assessments, including a Detailed Quantitative Risk Assessment (DQRA) [1] and Updated DQRA [2]. It was assumed in the previous risk assessments that planning phase 2 would remain as an area of public open space and these assumptions, together with the conclusions reached in the DQRA reports, are still valid. The GIR addressed all of planning phase 2, however as a result of subsequent modifications to planning boundaries, the DQRAs excluded meanwhile use area 1 (**Figure 2** and **Section 2.1.5**). The implications of the proposed public open space development in this area are addressed below.

The purpose of this DQRA Addendum report is to review and collate the findings of the previous Arup assessments that are pertinent to planning phase 2, to identify the remediation requirements that are to be implemented as part of the proposed redevelopment.

1.2 Planning context

Planning consent 137079/JO/2023 enables a number of relevant planning conditions for the Victoria North site to be discharged in discrete phases. This DQRA Addendum is relevant to works associated with planning phase 2 only.

Condition 7 relates to ground contamination. The amended Condition 7a of the above planning consent addresses issues associated with ground contamination. The full text of condition 7a is as follows:

“Notwithstanding the Ground Investigation Interpretative Report, Victoria North Infrastructure Works, ARUP, Reference: VNIF-ARP-ZZ-YYY-RP-CG-0009, Dated: 31 January 2022 and Ground Investigation Interpretative Report, Victoria North Infrastructure Works, ARUP, Reference: VNIF-ARP-ZZ-YYY-RP-CG-0009, Dated 23 February 2022., (a) before the development hereby approved commences (excluding vegetation clearance and tree removal), the following information shall be submitted for approval in writing by the City Council, as Local Planning Authority:

- *Submission of the further Site Investigation and Risk Assessment Reports*
- *Submission of a detailed Remediation Strategy*
- *Submission of a Remediation Implementation Plan and verification plan.*

The development shall then be carried out in accordance with the approved details.”

This report aims to present sufficient information to discharge the first part of Condition 7a of planning consent 137079/JO/2023, namely the submission of further site investigation and risk assessment and to support the development of a Remediation Strategy for planning phase 2 of Victoria North.

1.3 Previous assessments and reports

A Ground Investigation Report (GIR) [3] was prepared using the results of the 2019 and 2021 AEG and 2022 BAM ground investigations [4][5][6], which included generic controlled waters risk assessment and human health risk assessment. The GIR included an assessment of data from all areas within planning phase 2, including meanwhile use area 1.

The previous DQRA reports [1][2], which should be read in conjunction with this planning phase 2 DQRA Addendum, provided detailed assessment of the risks to controlled waters for all areas within planning phase 2 except meanwhile use area 1. To supplement the previous DQRA reports, the planning phase 2 DQRA Addendum presented below includes an assessment of risks associated meanwhile use area 1 (Section 2.1.5).

1.4 Limitations

This report was prepared by Arup on behalf of BAM Nuttall Ltd. It takes into account our client's particular instructions and requirements. This report was not intended for, and should not be relied on by, any third party and no responsibility is undertaken to any third party in relation to it.

All reasonable skill, care and diligence have been exercised within the timescale available and in accordance with the technical requirements of the brief. Notwithstanding the efforts made by the professional team in preparing the report, it is possible that other ground contamination or ground conditions as yet undetected, may exist and consequently reliance on this report must be limited accordingly.

2. The Site

2.1 Site location and description

The planning phase 2 infrastructure works that this DQRA Addendum relates to, comprise a programme of landscaping and associated works to enable the creation of areas of formal public open space as part of the Victoria North development, with a number of temporary (or ‘meanwhile’) uses. The planning phase 2 area is defined by the red line boundary presented on **Figure 1**.

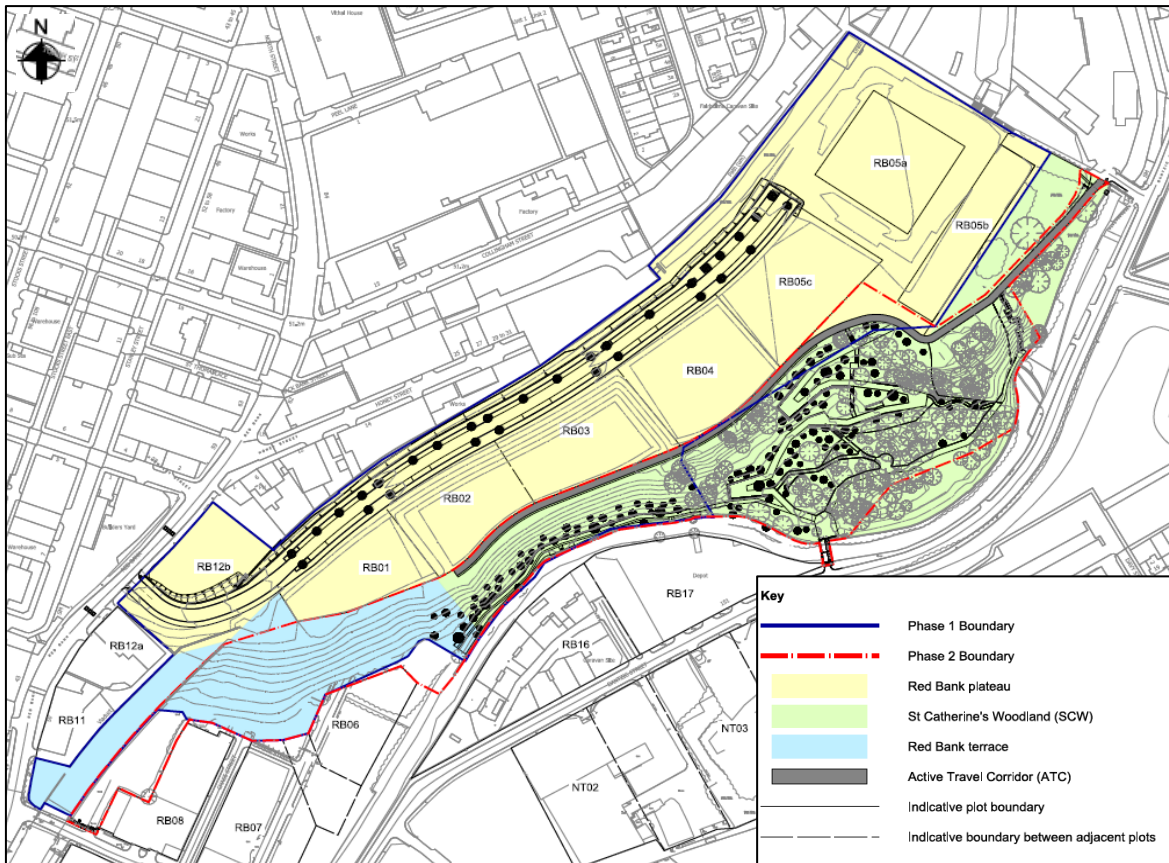


Figure 1: Planning phase 2 (red boundary) within the larger Victoria North development

The planning phase 2 area outlined in red on **Figure 1** includes a number of sub-divisions, as discussed below and shown in **Figure 2**.

2.1.1 Part of Red Bank Plateau

A small area of Red Bank plateau in the north of the site has been included in the planning phase 2 area. This is an area of proposed public open space close to the junction of vehicular- and pedestrian access routes that are to be provided as part of the planning phase 2 development.

2.1.2 The Main St. Catherine's Wood Area

This was an area of existing unmanaged woodland, originally characterised by areas of steep slopes and limited access. Proposed development of the main St. Catherine's Wood area is based on two principal interventions (**Figure 3**):

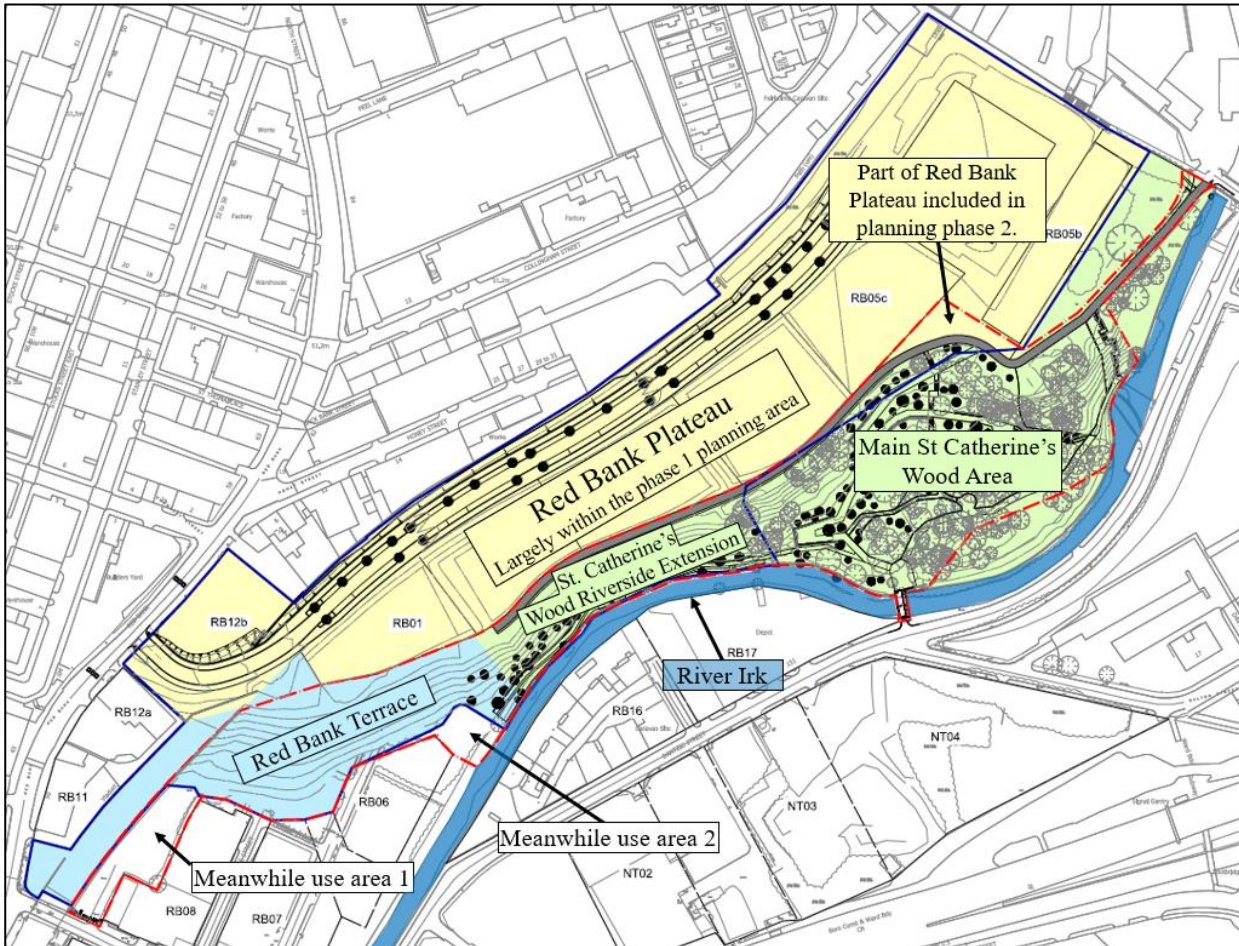


Figure 2: Planning phase 1 (Red Bank plateau) and sub-divisions within the planning phase 2 area

- Zone A: represents the majority of the main St. Catherine's Wood area, which will deliver a programme of landscaping and an area of formal public open space. After proposed localised regrading works to provide the required landform, the area will be planted and serviced by a series of footpaths which will link the planning phase 1 area to adjacent public highways and associated footpaths.
- Zone B: consists of parts of the main St. Catherine's Wood site that are characterised by existing trees and established habitats. Given the ecological value of these areas, disturbance of these areas is to be kept to a minimum throughout the proposed planning phase 2 works.

2.1.3 The St. Catherine's Wood riverside extension

As shown in **Figure 2**, this area of the planning phase 2 site, which runs between the northern bank of the River Irk and the planning phase 1 area on Red Bank plateau, was formerly a steep vegetated slope which descended from the plateau to the riverbank. In order to support the earthworks required for the planning phase 1 works on the Red Bank plateau, these steep slopes were regraded to stable angles, no steeper than 1 in 2.5. In preparation for the regrading works, programmes of invasive species treatment were also undertaken at the foot of the slopes, alongside the river.

The further works required to complete the planning phase 2 development of the St. Catherine's Wood riverside extension are limited to the installation of a new riverside footpath with adjacent landscaping, sections of low retaining wall (not greater than 2m in height) to facilitate the footpath, together with planting of the slope. Any requirements for remediation that were identified by the previous phases of ground investigation and subsequent DQRA, will have been addressed during regrading undertaken as part of the planning phase 1 works. Validation of these areas will be addressed in the planning phase 1 validation report. The remediation and validation of any additional contamination that may be encountered during the construction of the footpath and the proposed retaining wall, will be addressed in the planning phase 2 validation report.

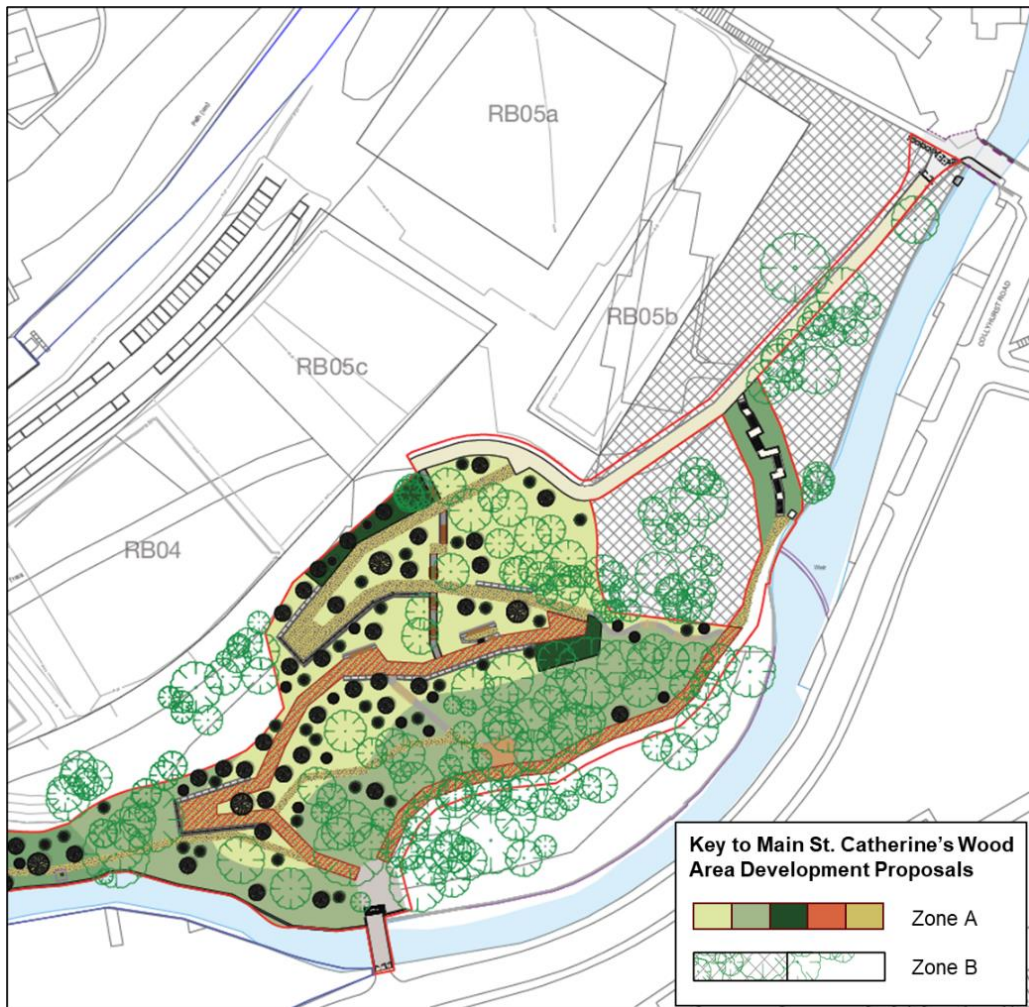


Figure 3: Main St. Catherine's Wood area - development proposals

2.1.4 Red Bank terrace

As shown in **Figure 2**, this area of the planning phase 2 site, which runs down from the Red Bank plateau to low-lying areas to the south, was also formerly a vegetated steep slope. In order to support the earthworks required for the planning phase 1 works on the Red Bank plateau, these steep slopes were re-graded to stable angles, no steeper than 1 in 2.5. Once regraded during the planning phase 1 earthworks, the area was hydroseeded, pending further landscaping works which will follow development within planning phase 1. Planning requirements for this further landscaping will be addressed during subsequent planning phases. Any requirements for remediation that were identified by the previous phases of ground investigation and subsequent DQRA, will have been addressed during regrading undertaken as part of the planning phase 1 works and validation of these areas will be addressed in the planning phase 1 validation report.

A hoarding line is proposed along the upper slopes of Red Bank terrace which will formalise the planning phase 2 extents and prevent unauthorised access to the plateau ahead of plot delivery. A footpath with associated landscaping, lighting and utilities is also proposed along the bottom of the Red Bank terrace, as part of proposed meanwhile uses (see below), which will link the riverside area to Roger Street as a temporary access route to St Catherine's Wood. No further works are required to complete the planning phase 2 development of the Red Bank terrace. The remediation and validation of any additional contamination that may be encountered during the construction of the hoarding or the installation of utilities, will be addressed in the planning phase 2 validation report.

2.1.5 Meanwhile use areas 1 and 2

The two areas of meanwhile use shown on **Figure 2** at the foot of the Red Bank terrace slopes are included in the planning phase 2 area. These meanwhile use areas will be secured by hoarding along the planning phase 2 boundary, with gates to provide secure points of access. Ducting and other utilities provision will be made in these areas to allow lighting and other infrastructure to be provided, to support the provision of

temporary access along the riverbank to St Catherine's Wood. This utility provision is also intended to support any meanwhile uses to which these areas might be put in the short- to medium term.

As discussed above, although the GIR [3] addressed the findings of ground investigation in meanwhile use area 1, as a result of modifications to the planning boundary, this area was not addressed in the DQRA or Updated DQRA. Risks associated with the proposed public open space land use within meanwhile use area 1, are considered below.

2.1.6 Plot RB05b

In the GIR [3], DQRA [1], and Updated DQRA [2], Plot RB05b was included as part of planning phase 2. As shown on **Figure 1** however, Plot RB05b and adjacent areas to the east have since been included in the phase 1 planning application and as such are not considered in planning phase 2.

2.2 Geology

The made ground encountered across much of this area was predominantly granular and is generally described as gravelly sand and sandy gravel. Cohesive made ground is variable but generally described as soft to stiff sandy gravelly clay.

Underlying the made ground in areas of the site adjacent to the river, alluvium is variable in composition and described as medium dense slightly gravelly sand and soft sandy clay or clayey sand. Alluvium is limited in extent, being mostly encountered close to the River Irk and in buried river channels and is recorded as between 0.3m and 4.7m thick.

Underlying made ground and alluvium (where present) glacial till is described as soft to firm, becoming stiff at depth, slightly sandy gravelly clay. Granular bands have been identified within the till, described as medium dense to very dense brown slightly clayey sandy gravel and gravelly sand.

Solid strata were encountered as follows:

- Collyhurst Sandstone - The Collyhurst Sandstone was encountered in the north-eastern part of the main St Catherine's Wood area. It is generally described as extremely weak red brown coarse grained distinctly weathered sandstone.
- Manchester Marls - The Manchester Marl was encountered in the central part of the main St Catherine's Wood area, the part of Red Bank Plateau that is included in Planning Phase 2 and the north-eastern section of the St. Catherine's Wood riverside extension. It is generally described as a reddish brown extremely weak thinly laminated clayey mudstone (weathered).
- Chester Pebble Beds – The Chester Pebble Beds were encountered in the south-western section of the St. Catherine's Wood riverside extension, Red Bank Terrace and the two meanwhile use areas. These strata are generally described as extremely weak to weak dark orange brown slightly clayey coarse grained weathered sandstone.

Rockhead level varies between approximately 25mOD and 32mOD. Generally, the rock head level is at higher elevation at north, gradually decreasing in elevation towards the river.

2.3 Former meander and mill race

Historic mapping shows an old meander bend of the River Irk that is now buried beneath sections of planning phases 1 and 2, together with a buried former mill race that extended from the meander bend for much of the length of the Victorian North site (**Figure 4**). Beginning some time before 1850, made ground has been used to infill these features.

The former meander bend and mill race were considered as possible preferential pathways for groundwater movement. As discussed in the DQRA [1] and Updated DQRA [2], there is no evidence that these features are or have been acting as preferential pathways for contaminant migration.

The proposed planning phase 2 works are not anticipated to uncover or disturb the former meander or mill race features, therefore no new or additional linkages associated with these features will be created as a result.

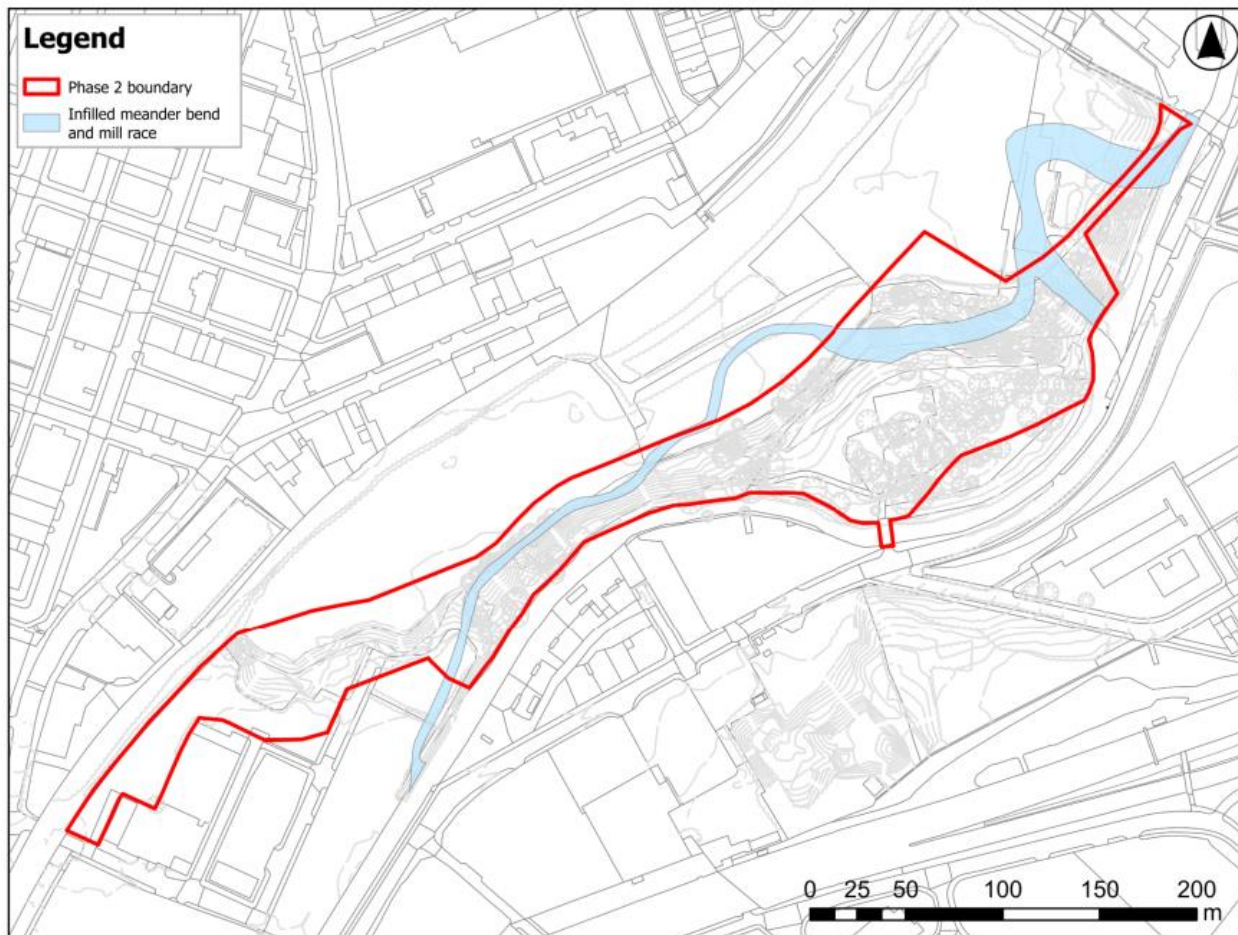


Figure 4: The recorded position of the meander bend and mill race in relation to planning phase 2

2.4 Proposed development

The planning phase 2 area is to be developed as a formal area of public open space (POS), with new hard and soft landscaping proposed. Further to the earthworks undertaken as part of planning phase 1, no additional earthworks or remediation are to be undertaken in the small area of Red Bank plateau within planning phase 2 or within Red Bank terrace.

Within the St. Catherine's Wood riverside extension (**Section 2.1.3**), minor temporary earthworks will be required during the construction of the proposed riverside footpath and associated sections of retaining wall.

Planning phase two includes the preservation of existing trees and established habitats in St. Catherine's Wood Zone B (**Figure 3**), in which no development works are proposed. Interventions in meanwhile use areas 1 and 2 are limited to minor works such as the erection of hoarding and the installation of limited utilities. Existing paved areas are to be largely retained therefore, across these meanwhile use areas.

The only area of earthworks proposed as part of planning phase 2, is in the main St. Catherine's Wood area – Zone A (**Figure 3**).

2.5 Regulator engagement

The Environment Agency and local authority contaminated land team have been engaged from an early stage in the Victoria North scheme. A meeting was held in March 2024 regarding the proposed redevelopment of the planning phase 2 area. The Environment Agency requested confirmation of the input parameters and assumptions made in the DQRA to ensure they are protective of the River Irk. These issues are addressed in **Section 3.2** below.

3. Controlled Waters DQRA

3.1 Approach

There are no Generic Assessment Criteria (GAC) available for the direct assessment of contaminants in soil applicable to controlled waters. Therefore, the DQRA [1] and Updated DQRA [2] included evaluation of groundwater and soil leachate data from both planning phases 1 and 2, to identify contaminants of concern and possible sources of soil contamination that may present a risk of impacts to the underlying Principal Aquifers and River Irk.

The DQRA [1] assumed that a small quantity of material extracted from Red Bank plateau would need to be transferred to proposed earthworks in Zone A of the main area of St. Catherine's Wood (**Figure 3**), however, this is no longer proposed. Except for some localised regrading in Zone A therefore, no re-use of site-won material is proposed within planning phase 2.

3.2 DQRA assumptions: infiltration rates

The input parameters and assumptions used in the RTM models are set out in Appendix D of the previous DQRA assessments [1][2], which should be read in conjunction with this report.

The planning phase 2 area is to remain as open space comprising slopes, paths and planting. In the limited meanwhile use areas, existing concrete paving will remain in situ, pending subsequent planning phases. Some runoff is expected from the slopes and evapotranspiration from planting, but it was considered likely that except for the hardstanding in the meanwhile use areas, a high proportion of rainfall will continue to infiltrate. The assumed infiltration rate across all the planning phase 2 area used in the DQRA was 60%, i.e. 60% of the average annual rainfall will infiltrate into the ground, with 40% being lost as runoff, through evaporation or via evapotranspiration.

3.3 DQRA findings

Except for meanwhile use area 1 (**Section 3.4**), the DQRA [1] and DQRA Updated DQRA [2] presented an assessment of the risks to controlled waters associated with potential ground contamination within both planning phases 1 and 2. No demonstrable contaminant linkages were identified.

3.4 Meanwhile use area 1

To address the controlled waters risks associated with meanwhile use area 1, we have considered the ground and groundwater conditions encountered during ground investigation in that area of the site and have reviewed them against the output of the DQRA and Updated DQRA. This review has identified the presence of contaminants in groundwater which exceed the water quality standards used for assessment. Given the proposals for meanwhile use area 1 however, with retention of existing hardstanding and only minimal ground disturbance from fencing and utilities provision, no new or different risks to groundwater or to the River Irk will be introduced. On this basis, remediation is not required for the proposed meanwhile use area 1. As for human health risks (**Section 4**), this assessment is specific to the proposed meanwhile use and will need to be revisited when permanent development proposals are brought forward as part of subsequent planning phases.

3.5 DQRA conclusions

Re-use criteria have not been derived for materials within planning phase 2 that were to be locally regraded, as there is no evidence to indicate the water quality within the River Irk is being adversely impacted by existing ground conditions, and therefore local redistribution of existing materials will not introduce new contaminant linkages or increase risks to controlled waters. If there is a shortfall in general fill material, this will be imported from outside of the Victoria North scheme.

In order to protect the River Irk, remedial targets have been generated for a number of contaminants of concern for imported fill. This assessment was undertaken using the Environment Agency's Remedial Targets Methodology (RTM). The approach to assessing the risks posed by contamination to controlled

waters is outlined in of the Updated DQRA [2] and accords with the Environment Agency’s land contamination guidance [9] and groundwater protection guidance [10].

Two sets of re-use criteria (Zone 1 and Zone 2) were previously generated for imported fill to be placed within planning phase 2. Zone 1 referred to the area of placement within 50m of the River Irk, whilst Zone 2 was between 50 and 130m from the river. As the targets for Zone 1 and Zone 2 were not significantly different, the Zone 1 targets are proposed for use for imported fill materials within the entire planning phase 2 development.

Suitability for use will be established by screening of imported fill materials against a range of determinands, as set out in **Table 1**. For contaminants of concern, that have been assessed by detailed quantitative risk assessment, the relevant site-specific criteria are included in **Table 1**. For other determinands, generic assessment is proposed, based on residential end-use without private gardens, adjusted on the basis of professional judgment to ensure that unsuitable material is not imported to the site. The rationale used to select the proposed import criteria is set out in Appendix A. All imported fill is to meet the acceptability criteria set out in **Table 1**.

Table 1. Planning phase 2: Criteria for imported fill (for subsoil and topsoil, see Section 5)

Contaminant	Generic acceptability criteria (mg/kg)	RTM-calculated acceptability criteria (mg/kg)	RTM-calculated leachable acceptability criteria (mg/l)
Antimony	500	-	-
Arsenic	40	-	-
Beryllium	1.7	-	-
Cadmium	85	-	-
Total chromium (including trivalent and hexavalent chromium) ⁴	6	-	-
Copper	200	-	-
Lead	310	-	-
Mercury	10	-	-
Nickel	-	26.5 ⁵	0.05
Selenium	430	-	-
Vanadium	500	-	-
Zinc	-	191 ⁵	0.4
Cyanide	24	-	-
Cyanide (free)	24	-	-
Boron	500	-	-
Phenol (Monohydric)	50	-	-
Asbestos	No visible asbestos <0.01%	-	-
TPH C8-C35	-	1000 ^{1,2}	-
TPH – Aromatic C8-C10	-	153 ⁵	1.64
TPH – Aromatic C10-C12	-	76 ⁵	0.53
TPH – Aromatic C12-C16	-	208 ⁵	0.72
TPH – Aromatic C16-C21	-	323 ⁵	0.35
Acenaphthene	50	-	-
Dibenz-a-h-anthracene	0.32	-	-

Contaminant	Generic acceptability criteria (mg/kg)	RTM-calculated acceptability criteria (mg/kg)	RTM-calculated leachable acceptability criteria (mg/l)
Fluoranthene	-	0.04 ⁵	0.00003
Fluorene	50	-	-
Indeno(1,2,3-cd)pyrene	46	-	-
Phenanthrene	50	-	-
Pyrene	50	-	-
Naphthalene	13	-	-
Acenaphthylene	50	-	-
Anthracene	-	0.15 ⁵	0.0005
Benzo(a)anthracene	15	-	-
Benzo (g,h,i) perylene	50	-	-
Benzo(a)pyrene	-	0.4 ⁵	0.00006
Benzo(b)fluoranthene	4.1	-	-
Benzo(k)fluoranthene	50	-	-
Chrysene	32	-	-
Notes 1. RTM-calculated remediation criteria for several of the TPH fractions are far in exceedance of any soil concentrations. Any soils exceeding these criteria would be visibly grossly contaminated. Therefore, it was considered appropriate to set a soil remediation target for TPH C8-C35. 2. If exceedance is noted, the risk-derived criteria for individual carbon bands detailed in this table shall be applied. 3. Not used 4. If total chromium exceeds 6mg/kg, the results will be assessed further to identify the nature and hazard associated with the presence of chromium in the relevant samples. 5. If solid analysis concentrations exceed the RTM calculated acceptability criteria, leachability testing will be required. The results of leachability testing will be compared with the RTM-calculated leachable acceptability criteria specified.			

Testing against the criteria set out in **Table 1** will be required for every 500 m³ of imported fill material used in the planning phase 2 site as per the Victoria North HIF Infrastructure and Enabling Works Specification [11]. A minimum of three samples should be taken per source.

4. Human Health DQRA

4.1 Screening of soil data

A human health soil screening assessment was undertaken as part of the Ground Investigation Report [3], which should be read in conjunction with this report. The approach taken is detailed in Section 6 of the GIR.

Soil data from planning phase 2 (including data from meanwhile use area 1) has been re-screened against generic assessment criteria (GACs) for a public open space (parks) scenario and using a soil organic matter (SOM) value of 6%, which was considered to be appropriate for the area's current and future use.

4.2 Risk assessment outcome

Within planning phase 2, a total of 60 soil samples were screened across the AEG 2019 [4], 2021 [5] and BAM 2022 [6] ground investigations. Exceedances of human health GACs were encountered in 13 soil samples and are summarised in **Table 2**.

Given the proposed public open space end use, exceedances of contaminants at depths below 1m, are considered not to present a risk to users of the site and have not therefore, been considered further. Exceedances at depths less than 1m, are identified in bold on **Table 2**.

Table 2. Soil samples exceeding human health GACs for public open space (parks) in planning phase 2

Contaminant	POS GAC (mg/kg)	No. of samples	Max conc	Exceedances			
				No.	Location	Depth (mbgl)	Concentration (mg/kg unless stated otherwise)
Asbestos	Presence	40	0.011 %	6	BH110	0.3	Amosite fibres
					BH112	0.3	Amosite fibres
					TP120	1.0	Chrysotile cement
					WS103	1.0	Amosite bundles
					TP210	1.0	Chrysotile in debris 0.011%
					BH323	0.5	Chrysotile insulation 0.004%
Arsenic	168	45	180	1	TP219	1.0	180
Lead	1300	45	2250	4	BH110	3.0	1900
					TP120	0.3	2100
					BH306	0.5	1800
					BH314	7.5	2250
Cyanide	24	45	47	1	BH211A	9.0	47
Dibenz(a,h)anthracene	1.36	41	5	2	BH213	1.2	5
					BH323	0.5	3.56
Benzo(a)pyrene	13.2	41	26	2	BH213	1.2	26
					BH323	0.5	22.8
Benzo(b)fluoranthene	16.3	41	37	2	BH213	1.2	37
					BH323	0.5	24.2

For those samples identified in bold on **Table 2**, the relevant source-pathway-receptor linkages have been considered in order to assess potential human health risks for users of the site accessing the relevant areas of public open space in planning phase 2 area. The findings of this further assessment are as follows:

- TP120, 0.3m. TP120 is within Red Bank Terrace, an area that was regraded and hydroseeded during the planning phase 1 works (**Section 2.1.4**). TP120 lies adjacent to the proposed footpath linking meanwhile use areas 1 and 2 (**Figure 5**). At the concentrations recorded during GI (less than 2xGAC), the lead identified in soil samples at this location may present a risk to the workforce undertaking the construction of the proposed footpath however, once the footpath and adjacent landscaping is complete, subsoil and topsoil will break the pathway between soil contaminants and users of the site.

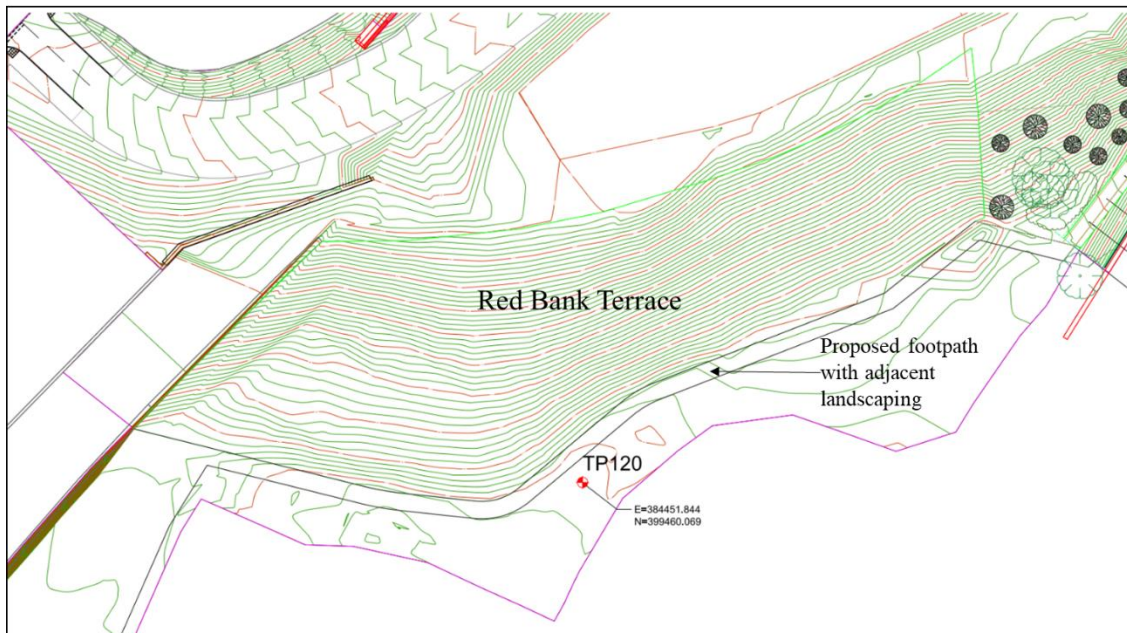
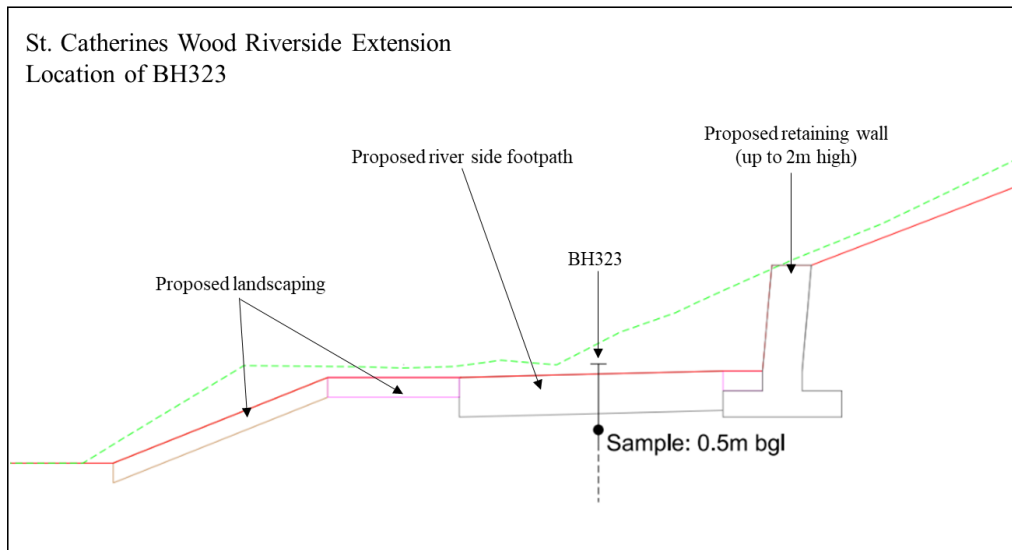


Figure 5: The location of TP120

- BH112, 0.3m. BH112 is also within Red Bank Terrace an area that was regraded and hydroseeded during the planning phase 1 works (**Section 2.1.4**). Hydroseeding was undertaken specifically to limit the potential for dust generation. The asbestos fibres identified at shallow depth in this exploratory hole are not therefore, considered to present a risk to proposed users of the site.
- BH110, 0.3m: Current proposals require that the existing hardstanding remains in situ across meanwhile use area 1. This paving will break the pathway between shallow soil contaminants (asbestos fibres) and users of the site.
- BH306, 0.5m: Current proposals require that the existing hardstanding remains in situ across meanwhile use area 2. This paving will break the pathway between shallow soil contaminants (lead) and users of the site.
- BH323, 0.5m. BH323 lies beneath the proposed riverside footpath (**Section 2.1.3** and **Figure 6**). The potential contaminants identified during GI (asbestos fibres and PAHs) at this location may present a risk to the workforce undertaking the construction of the proposed footpath however, once the footpath is complete, the imported fill provided for the footpath construction, the paving and associated landscaping, will break the pathway between soil contaminants and subsequent users of the site.

It is concluded from this risk assessment that no unacceptable concentrations of contamination have been identified within the planning phase 2 area. No specific remediation is therefore, considered necessary for human health protection.



4.3 Risks from imported materials and unexpected or residual contamination

Depending on the final cut/fill balance, it may be necessary to import general fill for use in planning phase 2. Imported fill will be from off-site and not from other areas of the Victoria North site. Imported general fill materials will be screened against the criteria in **Table 1**, which are significantly lower than human health assessment criteria for parks. Therefore, the imported materials will not pose a risk to human health provided they meet the criteria in **Table 1**.

Topsoil and subsoil will need to be imported for landscaping, with between 100 and 600mm of soil being required, depending on the specific planting requirements set by the landscape architect. The topsoil and subsoil will need to meet the requirements of the British Standards for Topsoil (BS3882:2015) and Subsoil (BS8601:2013). These criteria are discussed in **Section 5**. Imported topsoil and subsoil will not pose a risk to human health provided they meet the criteria in **Table 1** and the British Standard(s).

Where areas of previously unidentified soil contamination are identified during the works, they will be dealt with in accordance with a discovery strategy that will be presented in the planning phase 2 remediation strategy.[12] In Zone B of the main St. Catherine's Wood area (**Figure 3**), existing dense vegetation and steep gradients will limit public access, meaning that frequent human exposure to any previously unidentified contamination will be unlikely.

5. Subsoil and Topsoil Requirements

The British Standards for Topsoil (BS3882:2015) and Subsoil (BS8601:2013) specify the concentrations of certain phytotoxic contaminants: zinc (<300 mg/kg if pH of soil is >7), copper (<200 if pH >7) and nickel (<110 if pH >7). For nickel and zinc, the thresholds identified in these British Standards are higher than the RTM criteria identified in **Table 1** and therefore the RTM-derived values for these determinands have been used.

Topsoil and subsoil is to be imported from off site (i.e. not imported from elsewhere in the Victoria North site). Imported topsoil and subsoil shall meet the acceptability criteria set out in **Table 1**, together with the requirements of the relevant British Standards (BS BS3882:2015, BS8601:2013).

The frequency of testing of topsoil and subsoil for chemical validation will be as per the Victoria North HIF Infrastructure and Enabling Works Specification [11]:

- 1 per 100m³ for brownfield or unknown sources.
- 1 per 500m³ for greenfield sources.

A minimum of 3 samples per source will be tested.

6. Conclusions

6.1 Summary

This DQRA Addendum has adopted and extended the findings of the Updated Controlled Waters DQRA, to address risks to controlled waters and human health risks within the planning phase 2 area of Victoria North. The infiltration assumptions used in the previous DQRA were relevant to planning phase 2 and were different to those used on Red Bank plateau.

The existing material in planning phase 2 is deemed suitable for reuse within planning phase 2, which is to be an area of public open space. No requirement for specific remediation has been identified, as there is no evidence to indicate the water quality within the River Irk is being adversely impacted by existing ground conditions and a human health screening assessment has determined that the soils are suitable for use within the proposed areas of public open space.

Should it be necessary to import fill material, this shall meet the Zone 1 criteria set out in the Updated Controlled Waters DQRA [2] and reproduced in **Table 1** of this report.

6.2 Recommendations for remediation strategy

No specific remediation (such as soil treatment) is required for planning phase 2. To address the requirements of planning condition 7a however, a Remediation Strategy and Remediation Implementation Plan has been prepared for the planning phase 2 works, covering the following:

- Implementation of a discovery strategy during the earthworks, to ensure that previously unidentified areas of contamination are dealt with and are not taken for re-use as fill elsewhere within the site.
- Decommissioning of existing monitoring wells from previous ground investigation. In addition, any historic water wells that are encountered during the works will be decommissioned.
- Imported general fill will need to be tested to ensure it complies with the import criteria set out in **Table 1**. These criteria have been determined to be protective of the River Irk and human health. The forthcoming remediation strategy will include frequency of testing and approach to data interpretation.
- Imported topsoil and subsoil should also be tested to ensure it achieves the criteria in **Table 1**. These criteria have been determined to be protective of the River Irk, human health and plant health. In addition to the criteria in **Table 1**, imported topsoil and subsoil will need to meet BS3882:2015 for topsoil and BS8601:2013 for subsoil.

References

- [1] Arup (2022) Controlled Waters Detailed Quantitative Risk Assessment VNIF-ARP-ZZ-YYY-RP-CG-0011, November 2022.
- [2] Arup (2023) Controlled Waters Detailed Quantitative Risk Assessment VNIF-ARP-ZZ-YYY-RP-CG-1000, 21 August 2023.
- [3] Arup (2022) Ground Investigation Report VNIF-ARP-XX-XXX-RP-CG-0009, August 2022
- [4] AEG (2019) Northern Gateway Final Factual Report (Rev.00) NW1580
- [5] AEG (2021) Northern Gateway Phase 2 Final Factual Report (Rev.00) NW1604
- [6] BAM (2022) Victoria North HIF Infrastructure and Enabling Works – Phase 3 GI, Ground Investigation report – Factual Account BAX.326R, October 2022
- [7] Arup (2023) Victoria North HIF Infrastructure Works – Phase 1 Remediation Implementation and Verification Plan VNIF-ARP-ZZ-YYY-RP-CG-0017, 27 October 2023
- [8] Arup (2024) Victoria North: Gasworks remediation area VOCs DQRA
- [9] Environment Agency, 2019. Land contamination: risk management
<https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks>
- [10] Environment Agency, 2017. Groundwater protection
<https://www.gov.uk/government/collections/groundwater-protection>
- [11] Arup (2023) Victoria North HIF Infrastructure & Enabling Works Specification for Highway Works - Civil Infrastructure VNIF-ARP-ZZ-YYY-SP-C-00, 20 November 2023
- [12] LK Group (2024) St. Catherine's Wood, Phase 2 Victoria North, Remediation Strategy, May 2024.

Appendix A

Rationale behind selection of soil import criteria

Appendix A - Rationale behind selection of soil import criteria – Planning Phase 2

The residential without plant uptake GACs have been used as basic import criteria for soils to be placed within the POS in planning phase 2. This is because the GAC for POS are generally very high values and import of material at those values could allow the import of hazardous waste/contaminated soils. Some of the residential GACs however, are also very high numbers that would potentially permit the import of contaminated materials. In these cases, professional judgement has been applied to moderate the higher GAC numbers to concentrations that would be more typical of uncontaminated made ground. Contaminated soils should not be imported to site.

Some of the contaminants have RTM values, which take precedence over the human health GAC as they are lower. It is important to protect the quality of controlled waters within planning phase 2 areas that are next to the River Irk.

The import criteria for copper is based on the British Standards for topsoil and subsoil.

For TPH, only the aromatic RTM targets are quoted in the table below. Note that the DQRA assessed both aliphatic and aromatic TPH fractions, and came up with criteria for both that are protective of controlled waters. However, the aliphatic fraction criteria were generally very large (>1000mg/kg) so a simplified approach is taken here, where an overall threshold of 1000mg/kg TPH and if this is exceeded, some of the lower aromatic TPH fractions are checked against the RTM targets to ensure there is no risk to controlled waters.

The criteria chosen for imported material to planning phase 2 are as follows:

Contaminant	Generic acceptability criteria (mg/kg)	RTM-calculated acceptability criteria (mg/kg)	RTM-calculated leachable acceptability criteria (mg/l) ⁵	Rationale
Antimony	500	-	-	Residential without plant uptake GAC is 618mg/kg. Rounded to 500mg/kg.
Arsenic	40	-	-	Residential w/o plant uptake GAC
Beryllium	1.7	-	-	Residential w/o plant uptake GAC
Cadmium	85	-	-	Residential w/o plant uptake GAC
Total chromium (including trivalent and hexavalent chromium) ⁴	6	-	-	Residential w/o plant uptake GAC for hexavalent chromium. Used to assess total chromium, with the requirement that if total Cr exceeds 6mg/kg, it will trigger a need for more testing to determine the species of Cr present.
Copper	200	-	-	Residential w/o plant uptake GAC is 7130mg/kg. 200mg/kg is based on the British Standard requirement for topsoil and subsoil, which will be protective of health and planting.

Contaminant	Generic acceptability criteria (mg/kg)	RTM-calculated acceptability criteria (mg/kg)	RTM-calculated leachable acceptability criteria (mg/l) ⁵	Rationale
Lead	310	-	-	Residential w/o plant uptake GAC
Mercury	10	-	-	Residential w/o plant uptake GAC is 56mg/kg. This has been reduced to 10mg/kg, based on professional judgement. Soils containing 50mg/kg mercury are likely to indicate a contaminated source.
Nickel	-	26.5 ⁵	0.05	Residential w/o plant uptake GAC is 181mg/kg. The RTM value is lower, so is used as the import criteria for Ni.
Selenium	430	-	-	Residential w/o plant uptake GAC
Vanadium	500	-	-	Residential w/o plant uptake GAC is 1200mg/kg. Reduced to 500mg/kg soil containing 1200mg/kg Vn likely to indicate a contaminated source.
Zinc	-	191 ⁵	0.4	Resi w/o plant uptake GAC is 40,000mg/kg. RTM is lower, so used as the import criteria for Zn.
Cyanide	24	-	-	Residential w/o plant uptake GAC
Cyanide (free)	24	-	-	Residential w/o plant uptake GAC
Boron	500	-	-	Residential w/o plant uptake GAC for Boron is 10,775mg/kg. Reduced to 500mg/kg as soils with >10,000mg/kg boron likely to indicate a contaminated source.
Phenol (Monohydric)	50	-	-	Residential w/o plant uptake GAC is 1200mg/kg. Reduced to 50mg/kg as import of materials containing >1000mg/kg phenol likely to indicate contaminated source. Phenol is not usually present >50mg/kg in made ground soils.
Asbestos	No visible asbestos <0.01%	-	-	No GAC available. Based on professional judgement.
TPH C8-C35	-	1000 ^{1,2}	-	Agreed with EA as threshold for TPH. If exceeded, triggers the need to check speciated TPH against individual criteria

Contaminant	Generic acceptability criteria (mg/kg)	RTM-calculated acceptability criteria (mg/kg)	RTM-calculated leachable acceptability criteria (mg/l) ⁵	Rationale
TPH – Aromatic C8-C10	-	153 ⁵	1.64	Residential w/o plant uptake GAC is 269mg/kg. RTM value is lower, so adopted for import criteria.
TPH – Aromatic C10-C12	-	76 ⁵	0.53	Residential w/o plant uptake GAC is 1240mg/kg. RTM value is lower, so adopted for import criteria.
TPH – Aromatic C12-C16	-	208 ⁵	0.72	Residential w/o plant uptake GAC is 2480mg/kg. RTM value is lower, so adopted for import criteria.
TPH – Aromatic C16-C21	-	323 ⁵	0.35	Residential w/o plant uptake GAC is 1817mg/kg. RTM value is lower, so adopted for import criteria.
Acenaphthene	50	-	-	Residential w/o plant uptake GAC is 336mg/kg. Reduced based on professional judgement as concentrations of 300mg/kg would indicate contamination of source.
Dibenz-a-h-anthracene	0.32	-	-	Residential w/o plant uptake GAC
Fluoranthene	-	0.04 ⁵	0.00003	Residential w/o plant uptake GAC is 1580mg/kg. RTM value is lower, so adopted for import criteria.
Fluorene	50	-	-	Residential w/o plant uptake GAC is 183mg/kg. Reduced to 50mg/kg as >100mg/kg would indicate contaminated source.
Indeno(1,2,3-cd)pyrene	46	-	-	Residential w/o plant uptake GAC
Phenanthrene	50	-	-	Residential w/o plant uptake GAC is 1520mg/kg. Reduced to 50mg/kg as GAC would indicate contaminated source and likely be hazardous waste.
Pyrene	50	-	-	Residential w/o plant uptake GAC is 3790mg/kg. Reduced to 50mg/kg as GAC would indicate contaminated source and likely be hazardous waste.
Naphthalene	13	-	-	Residential w/o plant uptake GAC
Acenaphthylene	50	-	-	Residential w/o plant uptake GAC is 506mg/kg. Reduced to 50mg/kg as GAC would indicate contaminated source.

Contaminant	Generic acceptability criteria (mg/kg)	RTM-calculated acceptability criteria (mg/kg)	RTM-calculated leachable acceptability criteria (mg/l) ⁵	Rationale
Anthracene	-	0.15 ⁵	0.0005	Residential w/o plant uptake GAC is 36,600mg/kg. RTM value is lower, so used as import criteria.
Benzo(a)anthracene	15	-	-	Residential w/o plant uptake GAC
Benzo (g,h,i) perylene	50	-	-	Residential w/o plant uptake GAC is 359mg/kg. Reduced to 50mg/kg as GAC would indicate contaminated source.
Benzo(a)pyrene	-	0.4 ⁵	0.00006	Residential w/o plant uptake GAC is 3.2mg/kg. RTM value is lower, so used as import criteria
Benzo(b)fluoranthene	4.1	-	-	Residential w/o plant uptake GAC
Benzo(k)fluoranthene	50	-	-	Residential w/o plant uptake GAC is 107mg/kg. Reduced to 50mg/kg as GAC could indicate contaminated source.
Chrysene	32	-	-	Residential w/o plant uptake GAC

Notes

1. RTM-calculated remediation criteria for several of the TPH fractions are far in exceedance of any soil concentrations. Any soils exceeding these criteria would be visibly grossly contaminated. Therefore, it was considered appropriate to set a soil remediation target for TPH C8-C35.
2. If exceedance is noted, the risk-derived criteria for individual carbon bands detailed in this table shall be applied.
3. Not used.
4. If total chromium exceeds 6mg/kg, the results will be assessed further to identify the nature and hazard associated with the presence of chromium in the relevant samples.
5. Routine leachability testing is not required. Leachability testing will be undertaken only if solid analysis concentrations exceed the RTM calculated acceptability criteria. The results of leachability testing will be compared with the RTM-calculated leachable acceptability criteria specified.
6. Visibly contaminated or odorous material must not be imported to site.