

10. Completion Assessment

10.1. Post Completion Monitoring

10.1.1. No post-completion monitoring has been undertaken specifically on the NSR although the area remained subject to regular visual inspection following completion to level. The NSR was included within general site groundwater and airborne dust monitoring programmes. A programme of daily, weekly and monthly controlled waters monitoring was implemented by SGP in agreement with the EAW at the onset of the remedial works across the site. This included daily monitoring of the Lodge Stream and monthly monitoring of a series of off-site mine adits deemed to potentially be downstream of the site for groundwater flows, along with monitoring of other locations as

deemed necessary based on site works or visual observations. Sampling and analysis of the remaining boreholes on site has been undertaken on an annual basis since 2003 and was last undertaken during October 2006. Reports were provided to the EAW and WCBC on a monthly basis along with an annual summary.

- 10.1.2. Following the substantial completion of earthworks in October 2005, monitoring of the Lodge Stream has been reduced to a weekly basis. Monitoring of the reed beds constructed in September 2005 to treat alkaline chromium seepages collected from the toe of the slag banks of the Eastern Slopes has also been undertaken on a weekly basis. The reed beds have been successful in reducing the pH and chromium levels and further improvements are anticipated as the beds become established.
- 10.1.3. The monitoring of the mine adits from October 2003 to December 2006 showed little or no evidence of steelworks-derived leachate, other than an isolated occurrence of elevated chromium concentrations at a number of near and distant mine drains in Autumn 2004. Levels subsequently returned to previous concentrations.
- 10.1.4. A comprehensive report has been produced (R175-R27 (final)) and provided to WCBC and EAW summarising all the results and observable trends obtained from October 2003 to December 2006. It is proposed to reduce the monitoring of the Lodge Stream and reed beds to monthly and to cease to off-site mine adit monitoring.
- 10.1.5. Dust monitoring did not show any significant deposition of airborne contaminants during construction of the NSR.
- 10.1.6. Following completion to level of the northern development modules a series of gas monitoring boreholes (21) were installed across the area, a number of which were in proximity to the NSR (see drawing D012). The boreholes were installed to variable depths, with variable response zones depending on ground conditions, using either a window sampler or cable percussion techniques. Eight rounds of monitoring for methane, carbon dioxide, oxygen, carbon monoxide, hydrogen sulphide and VOCs were undertaken over a 4 month period (May – August 2006). A summary of the gas monitoring is

provided in Appendix F. Additional gas monitoring is currently being undertaken to provide further data (June – August 2007).

- 10.1.7. Methane was detected in 3 locations (in the Western Slopes Development Area and NDM2A) and was present up to a maximum of 1.8%. Carbon dioxide was present in a number of locations up to a maximum of 6.6%, along with correspondingly depleted oxygen. Flow rates were negligible resulting in all gas limiting volumes being below 0.07 l/hr.
- 10.1.8. Boreholes CP1 – CP3, installed downgradient of the former coke ovens and by-products area (now remediated and being developed to an ERLIC centre) have been subject to groundwater monitoring since July 2004. The monitoring has confirmed the absence of any on-going contamination of the underlying groundwater from the residual contaminated materials at depth within the NWDM. Monitoring of CP2, the remaining borehole, is to cease in July 2007 subject to EAW agreement.
- 10.1.9. Routine inspection and monitoring has also been undertaken of the No 1 Gate Drain where it enters the site at the base of the NWDM and northern end of the NSR NW Branch which has identified the occasional presence of EPH, benzene and phenols, although no impact on the Lodge Stream has been identified. These results may be due to residual sediments in the drain occasionally releasing contaminants following heavy rain.

10.2. Residual Environmental Risk Assessment

- 10.2.1. The NSR Main and Loop have been provided with compacted mudstone overburden excavated from the main site void, overlying compacted / residual steelworks waste material. At least 5m of clean cover has been provided along the NSR Main where it overlies the steelworks waste and 0.5m of clean cover has been provided along the NSR Loop. Much of the NSR NE and NW Branches have been provided with overburden constructed on natural ground.
- 10.2.2. No contaminants have been identified within the capping layer that pose a hazard to future users of the NSR with respect to the proposed development.
- 10.2.3. Although a number of contaminants are present within the underlying steelworks waste materials (principally lead and chromium) these are

provided with at least 0.5m of clean cover and do not pose a risk to future users of the site.

10.2.4. Fill materials and the underlying ground are free from potential significant sources of gas such as wood and other biodegradable materials. Organic substances potentially posing a risk via vapour transport through the overlying fill material have not been detected in any of the samples. No significant ground gas or vapour risks are likely to arise. However, carbonaceous mudstones can be associated naturally with elevated methane and carbon dioxide concentrations and these have been detected to maxima of 1.8% and 6.6%, respectively during gas monitoring of the completed northern development modules, although with low flow rates. Consequently a risk assessment should be carried out prior to entry to confined spaces e.g. service trenches resulting from development of the NSR.

10.2.5. The replacement steelworks waste materials underlying the NSR do not contain significant leachable amounts of the contaminants previously agreed with the EAW to be of most concern in relation to the site. It is therefore concluded that the replacement materials within the void and elsewhere do not pose a significant risk to controlled waters.

10.3. Development Requirements

10.3.1. The NSR Main has been provided with 5m clean overburden cover and the NSR Loop with 0.5m. EPH have been noted in the cover material at levels above the United Utilities trigger levels for the laying of water pipes in the majority of samples. All apart from two samples are below the action levels. This is consistent with the analysis of the overburden elsewhere on site. Since the fill material is natural reworked mudstone/sandstone it is likely that the EPH identified is due to the presence of low solubility compounds in coal fragments within the material rather than industrial contaminants that would pose a risk. On this basis there will be no physical or chemical constraints to the re-use of excavated soils below topsoil and no chemical constraints to the laying of water mains or other underground services within this material. Nevertheless the statutory undertaker should be passed copies of the test results to determine for themselves any requirements for supply pipe protection measures within this material.

- 10.3.2. The levels of other organic substances within the overburden, such as phenols, did not indicate any requirements to protect water mains installed within the site against the permeation from such chemical species.
- 10.3.3. The majority of the NSR Loop has been provided with 0.5m of overburden over the replaced steelworks waste. The underlying alkaline material contains a number of metal determinands (primarily lead and chromium) in excess of the United Utilities action levels and which may pose a hazard to future service / maintenance workers. It is recommended that any service trenches through this material should be over-excavated by say 200mm and replaced with clean back-fill. The statutory undertakers should be provided with all test results to confirm their requirements.
- 10.3.4. The levels of leachable sulphate within the cover material (to depths of 0.5m in the NSR Loop and 5m along the NSR Main) do not indicate the requirements for the use of sulphate resistant concrete. However, a small number of samples contained total oxidisable sulphide in excess of the 0.3% threshold provided in BRE SD1 indicating the possible presence of unweathered pyritic material within the Carboniferous strata. The characteristic Total Potential Sulphate calculated in accordance with the BRE SD1 methodology is 1.50%. However, ignoring the single high total sulphur result (isolated level is above those detected elsewhere within the NSR or elsewhere on site), the characteristic total potential sulphate is 0.6%. The design sulphate class for the site is therefore DS-3. The soil is natural reworked material, with a characteristic pH greater than 5.5. Assuming that groundwater is potentially mobile within foundation zones, the ACEC class is AC-3 according to Table 2 of BRE SD1. This classification may be revised subject to demonstration of static groundwater conditions and further pH testing of weathered and disturbed fills where structural concrete is to be used during the construction of the road.
- 10.3.5. The levels of leachable sulphate within the underlying slag materials (>5m depth in the NSR Main; >0.5m depth in the NSR Loop) indicate the potential requirement for the use of sulphate resistant concrete for any sub-surface structures. No data is currently available to confirm the concrete classification for building within the slag deposits and further testing may therefore be necessary.

- 10.3.6. Gas monitoring across the northern development modules has detected elevated levels of methane and carbon dioxide in the NDM Phase II (NDM2/2A) area up to maxima of 1.8% and 6.6% respectively. Gas flow rates were negligible with the resulting gas limiting volumes being <0.07 l/hr. Further gas monitoring and risk assessment is currently being undertaken and development requirements will be assessed in the relevant individual module Completion Reports.
- 10.3.7. The upper surface of fill is effectively the formation level for the development and is not topsoil. The developer is responsible for the importation of topsoil for landscaping along the edges of the NSR. It is anticipated that WCBC will require the developers to demonstrate the suitability of the topsoil.
- 10.3.8. Although outside the specific scope of this report it should be noted that the No 1 Gate Drain at the northern end of the NSR NW branch may contain residual sediments that occasionally release contaminants into the drainage network, particularly following heavy rain. It is recommended the drains in this area are comprehensively reviewed, inspected and cleaned of any residual sediment as part of the future works undertaken in this area to the Spine Road / Mount Hill junction and development of the NDM 2A. Meanwhile the drain is to be subject to routine inspections and sampling if deemed necessary.
- 10.3.9. It should also be noted that residual contamination arising from the former coke ovens may be encountered within the soils in the roadway area of the No 1 Gate and Gwalia Road during future construction works within the highways in this area. It will be necessary to incorporate suitable measures to prevent off-site mobilisation of any such contamination, prevent exposure of workers to contamination and excavation of material may be necessary during construction works. Depending on the depth at which any services may be laid at the junction, there may be a requirement to provide protection to water supply pipes, and to use sulphate-resisting cement in any sub-surface concrete works.
- 10.3.10. In addition, although again outside the current area of the NSR it is noted that the area of the former MHWTA (discussed in detail in the Eastern Slopes report, Ref: R754-R09/Final) is likely to be included in future highway proposals for the junction of the NSR NE Branch and Mount Hill. Some residual contaminated materials are present within this area and have been filled and

capped with low permeability clay and mudstones as used at the Wonder Bank and in the North Western Development Module. The capping material will minimise rainwater infiltration into the residual subsurface material and thus reduce the possible migration of any remaining contamination. There has been no subsequent evidence of hydrocarbon contamination migrating to the surface of the cover material.

- 10.3.11. Highway construction works associated with the proposed junction will afford the opportunity to remove the remaining pockets of contaminated material although these do not appear to be causing any environmental harm. Depending on the depth at which any services may be laid at the junction, there may be a requirement to provide protection to water supply pipes, and to use sulphate-resisting cement in any sub-surface concrete works.

10.4. Contingent Environmental Liabilities

- 10.4.1. All filling has been closely supervised and monitored by SGP and SWL for environmental and geotechnical issues respectively. It is confirmed that all reasonable measures have been taken to remedy environmental pollution within site, in accordance with the WCBC planning requirements and as agreed with statutory consultees (EAW etc.). The steelworks waste materials contained within the void underlying the NSR Main and NSR Loop complied with the W1 criteria, are deemed stable and have a low pollution potential as agreed with EAW, primarily on the basis of leachability criteria.
- 10.4.2. No significant residual contaminated soils are present within the clean overburden material used to construct the NSR. This material lies above compacted steelworks waste and is intended to provide a suitable material into which services can be laid. If services are to be laid within the steelworks waste (i.e. >0.5m depth along the NSR Loop), or the materials exposed, measures must be taken to ensure that any arisings are stockpiled so they do not cross-contaminate clean fill on other, neighbouring areas by means of windblown dust, leachate run-off, etc and are disposed of accordingly so as not to contaminate clean fill on other areas of the site.
- 10.4.3. SGP does not anticipate any part of the NSR being registered as Part IIA Contaminated Land by WCBC. No objections to further development of the site from WCBC or EAW are anticipated by SGP on soil quality issues.

- 10.4.4. There is the potential for groundwater migration to occur below the site but this will be at substantial depth and will not be caused or affected by the NSR. Remediation of the NWDM, located immediately upgradient of the NSR NW Branch, has been completed and the area is currently undergoing redevelopment to provide an educational, resources and learning centre. Groundwater monitoring has confirmed the absence of any ongoing groundwater contamination arising from the residual contaminated soils present at depth within the NWDM.
- 10.4.5. Elsewhere on the site the groundwater quality has been monitored via boreholes, local watercourses and mine adits which potentially receive groundwater drainage from the site in accordance with a methodology agreed with the EAW. Monthly reports have been produced and submitted to WCBC and the EAW since the commencement of the reclamation works. No concerns have been raised by WCBC or the EAW to date. Routine monitoring undertaken by SGP on a weekly and monthly basis has demonstrated that any groundwater pollution under the site does not significantly impact on nearby discharges to surface watercourses. Any groundwater pollution below site is likely to be historical in nature and is expected to improve as a result of the reclamation works as rainwater infiltration is expected to be reduced following the laying of tarmac roads and hard standing areas.
- 10.4.6. Due to the poor quality of the groundwater in the general area of the site (arising from the historical mining activity resulting in increased weathering of rocks bearing naturally occurring contaminants) and the absence of any important local abstractions, the EAW accepts that the groundwater beneath and around the site is not considered as a receptor in its own right. It is therefore considered unlikely that any future environmental impairment liability will arise from groundwater quality below the development modules.

10.5. Statutory/Regulatory Approvals

- 10.5.1. The investigations and reclamation strategy across the site have all been agreed in continuing consultation with WCBC Planning and Environmental Protection Department and EAW since 1995.
- 10.5.2. Information has been, and will continue to be, provided to EAW and WCBC throughout the course of the reclamation works and post-reclamation. Copies of principal correspondence between SGP and the Regulatory

Authorities specifically regarding the reclamation works and validation testing in the NSR or considered directly relevant are included in Appendix G.

11. Conclusions and Recommendations

- 11.1. SGP has inspected the remediation works carried out on the NSR and is satisfied that these have complied in all material respects with the strategy recommendations as approved by Wrexham County Borough Council, and that contaminated soils and other deleterious materials underlying the area do not pose a significant risk to public health, the proposed development or the environment subject to the recommendations outlined above and summarised below.
- 11.2. Validation testing of the remediation formation level to the NSR has shown acceptable concentrations of substances with regard to the proposed development. Confirmation of the depth of fill materials used in the cover layer for the NSR is provided in the Scott Wilson Contamination Certification Report Ref: D101082/GEO1706
- 11.3. The formation level is underlain by up to 5m in places of compacted natural mudstone excavated from the void within the main site. The natural and reworked Coal Measures strata may give rise to concrete aggression and hazardous gas concentrations within confined spaces, and appropriate precautionary measures are recommended for development. Ground gas has also been identified within the underlying fills in the NDM Phase II (NDM2/2A). Further gas monitoring and risk assessment is currently being undertaken and will be reviewed in the individual module Completion Reports.
- 11.4. Further testing may be necessary to confirm the concrete classification requirements for any sub-surface structures to be constructed within the steelworks waste deposits in the NSR Loop area (>0.5m depth). Should services be laid within these materials in the NSR Loop area it is recommended oversized trenches are excavated and replaced with clean back-fill. All test results, for both the underlying fills and cover materials, should be provided to the relevant statutory undertakers to determine any other requirements regarding supply pipe protection measures.
- 11.5. Although outside the specific scope of this report it should be noted that residual contamination is anticipated in the areas of the No 1 Drain and NSR NE Branch / Gwalia Road junction and the NSR NW Branch / Mount Hill junction. Future highway construction works in these areas will provide the opportunity to remove residual

contamination as necessary and provide suitable precautionary development protection.

- 11.6. There are no significant off-site pollution risks associated with the residual underlying materials and replacement fill used for the construction of the NSR.
- 11.7. SGP concludes that the appropriate and necessary environmental remediation works have been completed and that the NSR may be constructed in due course. It will be for the developer to place topsoil cover of suitable quality to landscape areas and to satisfy the planning authority with respect to this element of the site remediation. Geotechnical issues covering the site and adjacent land are outside the SGP scope of works and are dealt with by others, although reliance is placed on their information with regards to the depths of covering material.
- 11.8. Smith Grant LLP reserves the right to alter any of the foregoing information recommendations or conclusions in the event of new information being provided and in the light of changes to legislation, guidelines and responses by the statutory and regulatory authorities.
- 11.9. Limitation
This report has been prepared by Smith Grant LLP for the use of Brymbo Developments Ltd and any other person to whom Smith Grant LLP gives a collateral warranty pursuant to its appointment by Brymbo Developments Ltd. Transfer of benefit of this report will be permitted to one further assignee without the written permission of Smith Grant LLP. All reasonable skill, care and diligence has been exercised within the timescale and budget available, and in accordance with the technical requirements of the brief given by and developed with Brymbo Developments Ltd. Notwithstanding the efforts made by Smith Grant LLP in undertaking the assessment and preparing this report, it is possible that other ground conditions and contamination as yet undetected may exist. Reliance on the findings of this report must therefore be limited accordingly. Such reliance must be based on the whole report and not on extracts which may lead to incomplete or incorrect conclusions when taken out of context.