

2.3 Definition of 'Site-Won Fill'

The general term 'Site-Won Fill' is used to describe material excavated from the site which has been screened to remove elemental phosphorus, calcium silicate slag, phosphate rock fines and oversize material (ie larger than 400mm in any dimension). The term 'Site-Won Fill' is used to distinguish the material from imported fill or crushed site-won demolition hardcore.

Site-won fill typically comprises one or more of the following materials, excavated from the Albright & Wilson site during the SDW works:

- Ashy fill (historically imported ash and clinker).
- Limestone and Sandstone Gravel, variously referred to as 'stone', 'ballast' or 'quarry waste' (historically imported from the power station site).
- Brick and/or concrete rubble.
- Clay previously used as backfill within the site.

2.4 Residual Contaminants

One of the samples of the site-won fill from elsewhere on the site taken by NSC was found to contain a small fragment of asbestos and others to have elevated levels of lead. Despite A&W's reasonable endeavours to decontaminate the site of process related waste and 'other contaminants', it is considered that small amounts of such material will remain within the site-won fill. By confining the site-won fill to below clean cover and imposing restrictions on the development and construction methods on the site it is considered that there is no risk to future users. Correspondence on this issue can be found in Appendix E and chemical analyses in Appendix G.

2.5 Post Remediation Verification Tests

In order to confirm that the decontamination works had been done satisfactorily, a number of trial pits were dug around the site. These were done in several phases and their locations are shown on Figure 5.

Their records and tests on soil samples are included as Appendices H and I. Consequential remedial works are outlined in Appendix J and are discussed in Section 8.

3.0 DECONTAMINATION - ZONE 4A

3.1 General Stratigraphy

Zone 4A had an average starting level of about 8.5m AOD in the furnace house area but the slag bays had been previously excavated to about 5.5m AOD level and held standing water. Substantial concrete substructures to the furnaces and surrounding the slag bays were visible.

The furnace house area was underlain by a variable thickness of previously broken material including slag, ferrophosphorus alloy, brick and concrete rubble. This, in turn, overlay crushed stone, ash and clinker over the in situ alluvium which generally was found at a depth of 2m. The ash and clinker probably predated A&W's occupation of the site and was placed to surface the site when it was used as a timber yard.

▼ Original Ground Level approx 8.5m AOD

Thickness varies	A&W concrete rubble, slag, former furnace foundation remains
0.5 - 1.5	'Overburden' crushed stone, ash, clay
approx 2m	silty clay Alluvium

3.2 Excavation

3.2.1 Overburden

Overburden was visually inspected for phosphorus and excavated to Stockpile A. The locations of the various stockpiles are shown on Figure 4 and the stockpiles are summarised on Table 1. The whole area was excavated to the alluvium and, where necessary, to some depth into it to remove phosphorus.

3.2.2 Calcium Silicate Slag and Phosphate Fines

Calcium Silicate Slag was visually identified and excavated to Stockpile B. No phosphate rock fines were seen.

3.2.3 General Fill

Stony fill and ash was visually inspected and screened to remove oversize material slag and to identify red phosphorus. The screened material was stored in Stockpile A prior to re-use as fill elsewhere.

3.2.4 Phosphorus

Yellow phosphorus was found locally in the shallow fills in the furnace house area, surrounding and impregnating foundation blocks and piles and penetrating the underlying alluvium down the sides of some piles. This was dug out. Fuming material was also encountered in the bases of, and locally around, the slag bays. Fuming and firing material was excavated to skips and processed through the mudstills. Impregnated concrete was broken out and crushed to allow the phosphorus to burn off.

A number of bricks and concrete fragments impregnated with red phosphorus were identified during excavation and screening. All red phosphorus was placed in skips and processed through the mudstills.

3.2.5 Obstructions

The substantial concrete substructures to the furnaces, chimneys and slag bays were broken out and the concrete sent to Stockpile F for subsequent crushing. Remaining piles were broken down and their positions surveyed.

3.2.6 Other Contaminants, including Hydrocarbons

During the excavation works in the south-west corner of the Furnace House area in Grids G6 and H6, a seam of coarse stone rubble coated with thick, viscous black oil was exposed beneath the concrete roadway to the south. The oily material was transferred to Stockpile Q for treatment. Pending removal of the roadway, the excavated edge was sealed with clay to inhibit cross-contamination. When the roadway was excavated, a small area of oily stone rubble was exposed and removed, about 30m³ loose, to Stockpile Q for bioremediation. The stone was similar to that seen in the old oil refinery area of Zone 2 and it is reasonable to suppose that the oily stone had been excavated from there and used as sub-base under the road by A&W to make up a shortfall.

3.2.7 Structures

The substantial concrete surrounds and ramps to the slag bays, pile caps, tops of piles, roadways and other structures were broken out and taken to Stockpile F.

3.3

Backfill

3.3.1 Site-Won Fill

Site-won fill was used as backfill up to about 7.5m AOD. The material was laid in approximately 300mm layers and a minimum of four passes were made with a D6 bulldozer pulling a 5 tonne vibrating roller. Compaction advice was provided to A&W by Pearce Project Management, who were appointed as their earthworks advisor.

3.3.2 Cover and Capping

Imported clean clay was used locally to raise levels to about 7.9m to 8.0m AOD and site-won crushed concrete was used to bring the site up to about 8.2m to 8.3m AOD. This includes the final capping layer of 100mm of clean site-won crushed hardcore/imported granular fill of Class 6F2.

4.0 DECONTAMINATION - ZONE 4B

4.1 General Stratigraphy

At the start of the decontamination this area was covered by concrete floor and road slabs with small mainly brick garage and workshop buildings at the southern end. Most of the buildings and slabs dated from the original construction, although a freestanding 'garage' structure built of precast concrete elements was evidently more recent.

The slabs and concrete had been laid on hardcore over ash and clinker which had probably historically been imported from the adjacent power station to make up levels. It was not apparent how much of the overburden predated A&W's occupation of the site.

▼ Original Ground Level approx 8.3m AOD

Thickness varies	A&W concrete slabs
1.0 - 2.0 bgl ▼	'Overburden' - ash, stone, clay
to depth	silty clay Alluvium

4.2 Excavation

4.2.1 Concrete

The superstructure concrete slabs and substructures were demolished and broken out and the arisings sent to Stockpile F prior to crushing and re-use.

4.2.2 General Fill

The ashy fill and hardcore was excavated, visually inspected for phosphorus and backfilled in Zone 2C and elsewhere in Zone 4.

4.2.3 Calcium Silicate Slag and Phosphate Rock

Only small amounts of Calcium Silicate Slag were visually identified, excavated and stockpiled prior to disposal off-site.

4.2.4 General Rubbish

Metal, wood and other deleterious materials were visually separated for disposal off-site.

4.2.5 Phosphorus

Yellow phosphorus was encountered in Zone 4B where some had impregnated an area of the floor slab to the workshops/storage building after a fire in 1995. Phosphorus was also found in the old drain run crossing Zone 4B along Gridline 13.5 and outfalling into Portbury Ditch.

The concrete slabs and other structures were taken to Stockpile F for crushing. The drain runs were embedded in concrete and were dug out and, when necessary, steamed free of phosphorus prior to placing on the stockpile for crushing.

4.2.6 Structures

As mentioned earlier, the old garages and workshop structures were demolished and floor slabs, roads and substructures broken out and the material stockpiled for crushing. Another drain run crossed the southern end of Zone 4B to an outfall built into a pipe bridge support along GL 6.5. This, and its various inspection chambers, was broken out up to the fence line and proved to be free of phosphorus. The outfall was left in situ after demonstrating that it was clear of phosphorus as it would have been impracticable to remove.

Pile foundations to the previous structures were broken down to about clay level at around 6.5m AOD and surveyed for position

4.3

Backfill

4.3.1 Site-Won Fill

The area was backfilled with site-won fill up to a level of 7.5m AOD. The material was compacted in general accordance with the Specification for Highway Works in that it was laid in nominal 300mm layers compacted by a minimum of four passes of a 5 tonne vibrating roller towed by a D6 bulldozer. Compaction advice was provided to A&W by Pearce Project Management, who were appointed as their earthworks advisor.

4.3.2 Cover and Capping

Clay was imported from off-site to fill to about 8.0m AOD and topped to about 8.2m AOD using concrete and brick crushed to Class 6F2 grading.

4.3.3 Backfill Stratigraphy

	▼ Minimum Ground Level 8.5m AOD
Min 8.2m AOD ▼	Development - road construction and surface finishes
Max 7.5m AOD ▼	Clean crushed concrete over imported fill
7.3m - 6.4m AOD ▼	Site-won fill
to depth	Silty Clay Alluvium

5.0

DECONTAMINATION - ZONE 4C

5.1

General Stratigraphy

Zone 4C was largely covered by a concrete slab and roads with buildings on the west side and the large concrete silo structure to the south. It was traversed by an overhead gantry carrying water and steam pipes. The gantry and main slab were the remains of the former calciner house which formerly stood on the site.

The buildings to the west included the former engine shed and ancillary workshops as well as various transformer bays.

The various concrete slabs had been laid over imported crushed stone and ash and overlay a variable thickness of stone, ash and clayey fill which formed the original timber yard surface. Thin unreinforced concrete slabs were also uncovered. The clay was mainly found towards the western side of the site and appeared to be reworked alluvium, possibly placed to raise site levels when the dock was first dug in the 1870s. The original shoreline probably ran just inside the western boundary fence and was protected by a 'wedge' of stone. The ground to the west had been made up with mainly ashy material probably placed by A&W after installation of the sheet pile wharf further to the west in the early 1950s.

▼ Ground Level 8.6 - 8.2m AOD

Thickness varies	Concrete slabs and substructures	A&W Made Ground
Thickness varies 0.5 - 1.0m bgl ▼	Crushed stone, ash sub-base	
0.5 - 1.5m bgl ▼	Stone, ashy concrete slabs, clay fill	Pre A&W Made Ground
to depth	Firm to stiff silty CLAY	Alluvium

5.2

Demolition and Excavations**5.2.1 Demolition**

The silos were demolished in early 1999 using the same long reach excavator which had removed the Zone 5 dock structure. In order to reach the top of the building, the concrete and brick rubble in Stockpile F was moved over to form a heap beside the silos.

After removal of the asbestos cement sheeting by specialists the former engine shed and, after disconnection of the electricity supply, the other buildings were demolished, the resulting concrete and brick was crushed and used as site capping after separation and oxidising of any phosphorus contaminated materials.

5.2.2 Overburden Excavation

The excavation works included removal of the large areas of concrete slab, ground beams and the marine raft foundation to the silos. The latter proved to be up to 1.5m thick with piles at close centres beneath. The site was excavated to at least 7.5m AOD. Foundation piles were broken down to at least 7.5m AOD and surveyed for position.

5.2.3 Calcium Silicate Slag and Phosphate Fines

Slag rubble was found to have been used locally to infill conduits and trenches in the floor of the former boiler house when it was converted to a store. This was separated out and excavated to Stockpile B prior to removal from site.

No phosphate fines were seen.

5.2.4 Phosphorus

A small amount of yellow phosphorus was found in a drain run beside the former boiler house. This was removed. The concrete surrounded drain was dug out and steamed to clean out the phosphorus into mudstills prior to stilling. The concrete was crushed and any residual phosphorus allowed to oxidise away.

When the concrete surround to the former clay slurry tanks, known as Pit 6, were broken down, the granular fill placed to fill the gap between the concrete structure and the ground was found to be full of yellow phosphorus. Apparently 'Pit 6' had been used as a temporary storage tank for phosphorus during a problem in the plant. When steam lances were used to melt the solidified phosphorus so that it could be pumped out, the highly fluid and penetrative molten material, which has a specific gravity of 2.7, penetrated the joints in the 150mm thick concrete walls to fill the voids in the surrounding gravel and even to penetrate a short distance into fissures in the surrounding clay. Several hundred tonnes of phosphorus contaminated concrete granular material and clay were excavated and processed through the one remaining mudstill.

The excavated clay bottom and sides were carefully inspected by the EC and any small residual pockets and seams of phosphorus removed before the pit was backfilled with clean imported clay.

Whilst there was no evidence of phosphorus migration to the north, this end of the excavation was inhibited by the presence of the overhead gantry supports and a site roadway.

Subsequent post remediation verification trial pitting revealed some slight fuming in TP304 dug just north of the Pit 6 excavations. The area around TP304 was subsequently re-excavated and cleared of any residual phosphorus, see Section 8 and Appendix J.

5.2.5 Other Contaminants (Including Hydrocarbons)

During the course of the post remediation verification pits a number of relatively small areas contaminated with visible hydrocarbons were uncovered and removed as detailed in Section 8 and Appendix J. These mainly comprised pockets of ashy material and coarse stone rubble. Some, if not all, of the latter, are likely to have been oily stone brought from the northern end of the site, where the old oil refinery was, by the contractors building the A&W plant to make up levels or to fill soft spots. In some places the oil had migrated downwards to infiltrate fissures and holes a short distance into the underlying clayey alluvium.

Oily ground was also found underneath the old engine shed and is likely to have originated from spills and leaks from the diesel engines or lubricating oil.

All materials visibly contaminated with hydrocarbons were dug out and removed from site.