History of Puketutu Island

Puketutu Island is located in the Manukau Harbour near the Manukau suburb of Mangere as shown below in Figure 1 below. It was formed about 30,000 years ago from a volcanic eruption and is predominantly made up of basalt with scoria cones.

Figure 1: Location of Puketutu Island.

The island has great significance for Iwi. It was one of the earliest places settled and was home to successive tribal groups including Waiohua, Tainui, Kawerau and Ngatiwhatua. Physical evidence of relatively dense occupation (particularly fortifications, stone building and garden walls) can be clearly seen in early photographs but have mostly been removed by European activities. An important exception is the "Maori gardens area" on the western side of the island and some less-disturbed coastal areas.

Purchased from Iwi by Dr Weeks in 1842 it was soon sold on to others, notably Logan Campbell and John Massey. Sir Henry Kelliher purchased the island about 1940 and established the Sir Henry Kelliher Charitable Trust (SHKCT) in 1963.

Quarry activities began in the 1950's with the building of nearby Auckland Airport and sewage treatment ponds. The quarry lease was purchased by Winstone Aggregates (WA) from Wilkins and Davies in 1988, when many quarries in or close to the Auckland urban area were being closed. At this stage the quarry operator relied on existing use rights, then in 1997 consents were obtained primarily to extend operations below the groundwater level. In 2001 comprehensive consents were obtained to cover all aspects of the quarrying, cleanfilling and sawmill remediation. Cleanfilling commenced about the end of the 1980s and a fill management plan was developed in 1993 to ensure management of incoming fill quality.

Currently Puketutu Island is home to a variety of industries including quarrying, cleanfilling, composting, forestry, pastoral farming, stud farm and a function centre. Sir Henry Kelliher's old homestead, which now acts as function centre is shown below in Figure 2.

Figure 2: The old Kelliher homestead which now hosts functions.

Quarrying and cleanfilling on Puketutu Island is an important resource to the Auckland region as it provides high quality basecourse aggregate and cleanfilling facilities close to the centre of Auckland, minimising cartage.

Another industry that was present on Puketutu Island was a sawmill which also treated timber. The location of the sawmill, which remained in operation until 2005, is shown in Figure 3 below.

Figure 3: Aerial photo of Puketutu Island showing sawmill location.

Cleanfill Background

Cleanfill Beginning

Cleanfilling on Puketutu Island began in the late 1980's as a means of rehabilitating the quarry to a desired land form rather than leaving an exposed pit. Figure 4 below shows the planned final landform for Puketutu that WA proposed and is the subject of ongoing consultation. Incoming cleanfill is used to produce the desired contours with clean clays and soils used for capping.

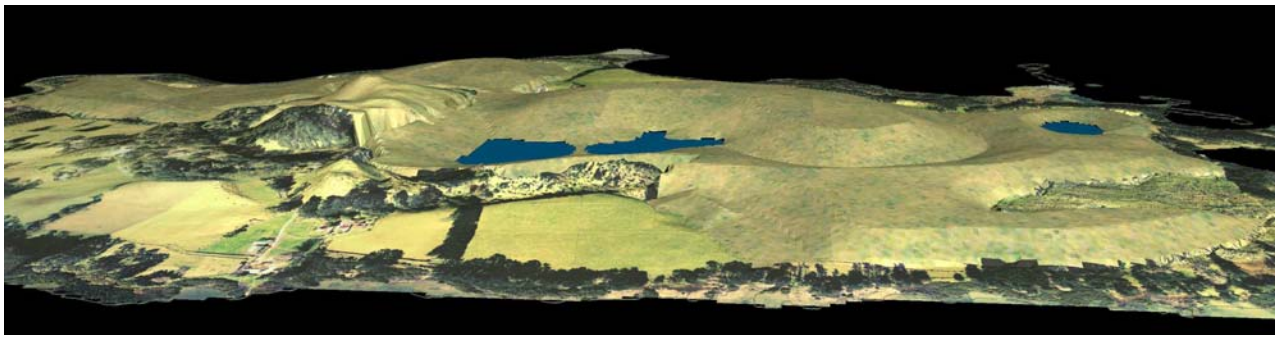

Figure 4: Planned final landform for Puketutu Island

Cleanfilling also allowed for sustained extraction of basalt from Puketutu Island by allowing rock to be extracted below the water level with minimal effect on the islands aquifer system with the extracted rock volume replaced by incoming fill. This greatly extended the life of the basalt resource, enabling more rock to be made available close to Auckland City. Figure 5 below shows the areas of Puketutu Island that have been quarried and filled using the cleanfill process. Some of the area shown below is still being filled and another area (Area F) to the west of the figure has been quarried and will be filled over the next year.

Figure 5: Aerial photo of Puketutu showing clean filled areas post quarrying.

Assessment of Environmental Effects

Puketutu was one of, if not the first, site in the Auckland Region to operate as a Managed Cleanfill. The extensive site specific risk assessments carried out has established levels of contaminants that are acceptable given the receiving environment of this site. The corresponding levels of control in place at Puketutu are, and have been, industry leading. A handful of other fill sites have since adopted similar measures.

Before and during the early stages of filling, studies were carried out to assess the environmental effects of cleanfilling:

- Leaching tests were carried out to assess the risk of contamination and to ensure the islands aquifer areas were not contaminated from incoming fill. One of the leaching tests that was used is shown below in Figure 6.

Figure 6: Field Leaching Tests.

- There has been ongoing monitoring of boreholes:
  - Electrical Conductivity (EC) is currently being monitored in 10 groundwater boreholes.
  - Chloride levels are currently being monitored in four boreholes.
  - A selection of drinking water parameters, arsenic and total hydrocarbons are tested for quarterly with annual testing for DDT and BAP's.
  - In total, a network of up to 32 boreholes have been monitored for ground water levels and EC.
- As a result of an Environmental Risk Assessment carried out by Kingett Mitchell in 2003, it was established that levels of heavy metals in soils deposited on the Island have not had an adverse effect on the environment. As a result of this assessment, and having given consideration to regional wide soil studies, the threshold acceptance levels were established for fill imported to site. This has been developed to accommodate the naturally higher levels of metals in volcanic soils without allowing soils from non volcanic sources to be potentially contaminated from anthropogenic sources to go unrecognised.

One of the aquifers located within Puketutu Island is the central aquifer, shown as the area inside the dashed line in Figure 7 below. This supplies the residents, employees and guests on Puketutu Island with drinking water and therefore the quality of the water in the aquifer must be maintained to a high standard. The following are steps that WA have taken ensure there is no detrimental affect on the central aquifer:

- Depending on contamination levels, Incoming fill is classified as either being suitable for tipping above the central aquifer or not. This creates a two tier acceptance system with different contamination thresholds for each:
    - If the fill contains any asphalt, is untested or test results show contamination higher than the central aquifer limits then it is tipped in an area outside of the central aquifer.
    - If the fill contains any DDT, semi volatile organic compounds, or heavy metal concentrations over those considered to be background for the Auckland volcanic region then these are also tipped in an area outside of the central aquifer.
- Machinery is not fuelled up inside aquifer area to avoid the risk of potential contamination from a diesel spill.
- Ablutions/amenities that were once in the central aquifer area have been moved outside of this area.
- Water was previously taken from the central aquifer for general purpose plant use. It is now only used as a potable supply to prevent waste.

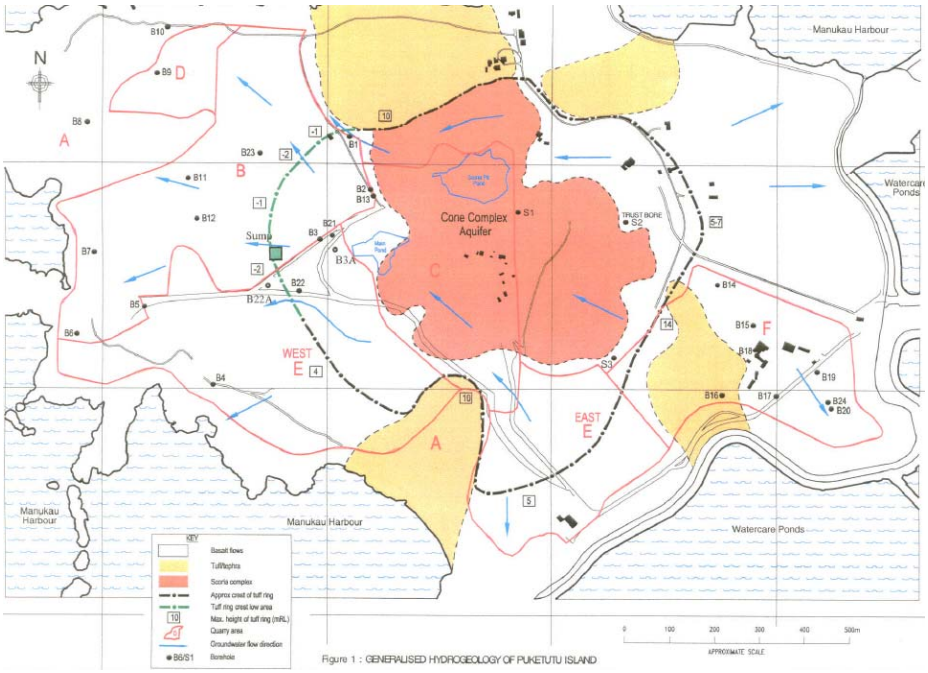

Figure 7: The central aquifer area of Puketutu Island.

As Puketutu is an area of great significance to the local iwi, WA has worked with archaeologists and iwi on a number of occasions at Puketutu. Examples of measures taken to identify and preserve historical areas are:

- In conjunction with the SHKCT, a Department of Conservation archaeologist was engaged to carry out an archaeological study on Puketutu Island to identify areas of historical significance. The study identified Maori gardens, middens, walls and cisterns. To protect these areas:

  - A map has been created marking historical areas and displayed at the quarry to avoid any earth works in these areas.
  - WA has committed to stay out of historical areas, notably the Maori gardens and coastal margins.
  - Furthermore, historical areas have been marked off with visible fencing to demark a boundary for works in order to protect these areas.
- When stripping areas not previously worked, an iwi representative and archaeologist were present during the stripping to identify any areas or items of cultural or heritage significance that may be uncovered.

Consultation with Stakeholders

The two main stakeholders in the island that WA works with are the local iwi and the Puketutu Island owners, SHKCT.

Consultation with the people of Waiohua in relation to Puketutu Island commenced in 1993. As WA began to better understand the complex relationships of various tangata whenua with Puketutu Island, consultation was broadened to include Huakina Development Trust, Makaurau and Pukaaki Maraes, Ngati Te Ata Kawerau a Maki and Ngai Tai ki Tamaki Trust in 1994 and 1995.

Generally iwi did not agree with the quarrying that had occurred in the past (prior to WA taking over the lease) but they accepted the merits of WA continuing to quarry and cleanfill as an integrated activity as a means of rebuilding Puketutu Island to restore it towards its original landform and were pleased with controls WA had in place.

Quarterly meetings are held with representatives from SHKCT as well as regular site visits. During these meetings and site visits, various environmental issues are discussed, including drainage and the final rehabilitation stages of the cleanfill process involving returning filled areas into pastoral farm land and the Fill Management Plan.

On a smaller scale WA also works with the event managers of the Kelliher Homestead which operates as a function centre. Blasting was scheduled so as not to coincide with function timing and consideration is taken to operating areas during functions.

Fill Management Plan

The first Fill Management Plan (FMP) was developed by independent environmental consultants in 1993 in response to concerns about the potential for contaminants to be brought onto site. The fill plan has subsequently been reviewed in order to meet the requirements of the RMA, Manukau City Proposed District Plan, the Auckland Proposed Regional Plan, the land owner and WA's own management policies. The management plan is an operational plan, subject to annual review and improvement.

It became a requirement of resource consents issued by both Auckland Regional and Manukau City Councils to have an agreed FMP. The FMP is prepared by WA and reviewed and signed off by the Puketutu Island Quarry Manager, SHKCT and both the Manukau City and Auckland Regional Councils.

Whilst the filling operation aims to rehabilitate ground levels of previously quarried areas, the purpose of the FMP is to ensure this is carried out in a way that meets the requirements of all interested parties whilst protecting the environment. To establish an acceptable FMP, considerable liaising has occurred between all parties. This consultation process is ongoing with the FMP reviewed each year.

The FMP sets out fill acceptance criteria and procedures to ensure appropriate checks are made on material before and during acceptance onto site. Fill rejection and contingency measures are defined in case inappropriate material is inadvertently brought onto Puketutu (including a quarantine area where unacceptable loads can be put aside and later removed by customer should they fail testing). The FMP also sets out monitoring programs for soils, surface and groundwater to provide confidence that activities on site are not having an adverse effect on the environment.

The current plan is the result of the evolution of the cleanfilling process and changing regulatory requirements over the last 16 years. The current approach has a proactive focus towards accepting fill on to site including:

- WA staff carry out pre-acceptance checks of fill test results before accepting fill.
- WA staff carry out visits to customer sites before accepting fill.
- Presence of an Environmental Coordinator to oversee fill acceptance procedures.
- Every load is subjected to multiple inspection points once fill reaches site with inspection at the fill control point, as shown below in Figure 8, and again at the tip head.
- Use of XRF testing on and off site to give instant chemical results.
- Loads coming onto site are also subjected to random sampling and testing.

Figure 8: The fill inspector inspecting a truck load before it tips off.

Use of XRF Technology

Conventional testing of soil samples require a physical soil sample to be sent to a lab. Sample results are not received until 10-15 days after the sample has been taken. More fill can continue to come from the same site over that period and it is possible that this could be contaminated. To help avoid this WA has purchased a hand held XRF machine shown below in Figure 9. A model was chosen which meets detection limits lower than the Puketutu Island acceptance levels.

Figure 9: A hand held XRF.

XRF stands for X-Ray Fluorescence and provides instant and accurate analysis of soils by identifying the presence of heavy metals and their concentrations. Each element in the periodic table has a unique spectrum when exposed to X-Rays. When a sample is exposed to the X-Rays and the spectrum measured, concentrations of each element in the sample are provided by the XRF machine.

At times the XRF is used at the fill inspection point to test all or every other truck that is coming into site to make sure incoming fill is suitable. The XRF was also used extensively in the sawmill clean up as mentioned in the Sawmill Remediation section of this application.

Staff Environmental and Customer Focus

To manage the cleanfill in an environmentally responsible manner, there is an environmental aspect to the roles of all staff on site. This ensures that the Fill Management Plan as well as other environmental initiatives and requirements are followed.

This is pivotal to the approach that WA takes towards the cleanfill in working towards increased customer responsibility. Every interaction with a customer provides a chance to educate the customers about our requirements and what the customer can do to ensure that they meet them. In this way every employee acts as an ambassador for environmental responsibility.

Once a customer's site has been tested, the results are sent to the Puketutu Environmental Coordinator who then informs the customer that their fill is acceptable for Puketutu. At this point any operational constraints are communicated and worked through to ensure customers know what is expected of them and what they can expect when on site.

Over time a database has been built up by the Environmental Coordinator to match fill test results with their location or address. This is helpful in future assessment of neighbouring or nearby sites. Highly contaminated sites are indicated by a large red spot on a map and nearby sites are treated with caution.

The cleanfill has been divided into approximately 50m square areas which are marked on a map and allocated a grid reference as shown in Figure 10 below. The Fill inspector works with the Environmental Coordinator to ensure that a tally is kept each day so the tip location of incoming fill can be tracked. This is a contingency measure in case it was found that contaminated fill made its way into the cleanfill and remedial action was required.

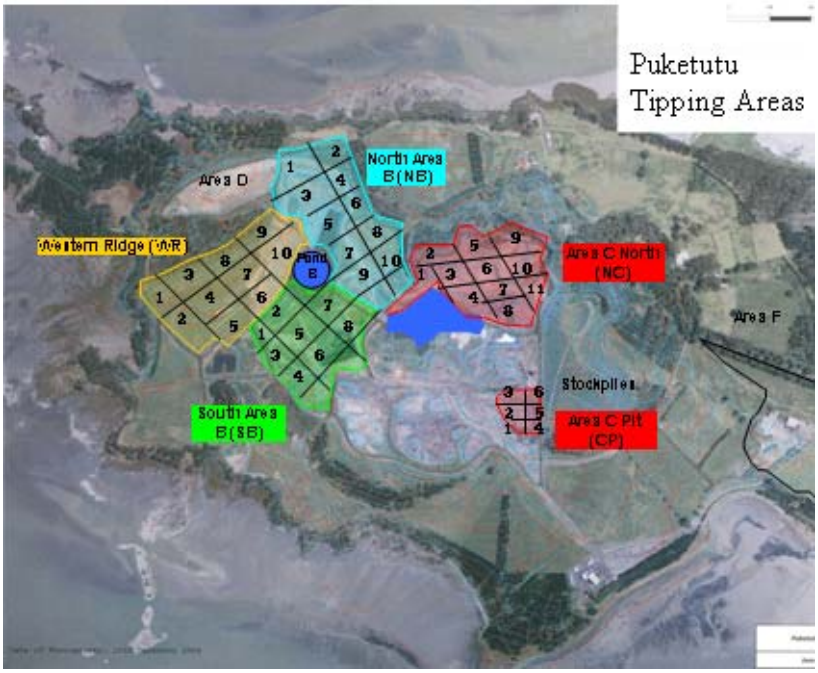

Figure 10: Puketutu tipping area grid references,

Sawmill Remediation

A sawmill complete with CCA (Copper, Chromium, Arsenic) timber treatment plant operated in an area of Puketutu Island for approximately 30 years. After treatment, timber was placed in the sawmill yard to drip dry. There is also anecdotal evidence that excess treatment chemicals were disposed of within the site. These operations contaminated groundwater within the site. As part of WA's lease, WA chose to remediate the sawmill site to allow for efficient extraction of the basalt resource.

In 1998, Pattle Delamore Partners conducted a detailed site investigation to characterise the levels of contamination present in soils, sediments and groundwater on the site. The sampling carried out identified the presence of Arsenic, Chromium and Copper concentrations in soils that exceeded the relevant guideline criteria for unpaved industrial/commercial land use (Health and Environmental Guidelines for Selected Timber Treatment Chemicals, MfE, 1997). Some hotspot areas were significantly in excess of these limits. Groundwater beneath the site was also found to contain timber treatment chemicals at levels 6-25 times the relevant ANZEC criteria for the protection of marine aquatic ecosystems.

A Remediation Action Plan for the cleanup of the sawmill area was agreed with ARC This involved removing highly contaminated material to a controlled Municipal Waste Landfill (MWL) facility. Mildly contaminated material was then excavated and placed in a clay containment cell constructed adjacent to the sawmill area before the sawmill area was validated and stripped for rock extraction.

This strategy provided the most efficient means of ensuring the highly contaminated material was appropriately disposed of, whilst enabling cost efficiencies (reduced transport and landfill charges) for dealing with the mildly contaminated material that did not pose a significant risk to the environment and avoid using valuable space at a MWL. Figure 11 below shows contaminated concrete ready to be carted to landfill and one of the in ground CCA holding tanks uncovered during the works.

Figure 11: Contaminated concrete ready to be carted to landfill and one of the in ground CCA holding tanks uncovered.

Following staff inductions, in accordance with a site specific Health and Safety Plan, excavation works commenced in March 2008 with the concrete drip pad being broken up. The bright green and yellow Cr stained concrete was subsequently removed to landfill (approx 834t). Some of the brightly stained concrete is shown in Figure 12 below.

Figure 12: Some of visible signs of Copper contamination in the concrete from the sawmill drip pad.

Hotspot soils were also excavated and removed to landfill. This included a number of concrete cells, tanks and rubbish material that had not been identified in the initial investigations.

Difficulties were encountered with material that had been deposited/pushed onto the sawmill site covering areas that had been identified in the investigations and required excavation. Some of this required removal to landfill while mildly contaminated material was retained on site.

A clay containment cell was constructed with low permeability compacted clay received from a single source. The constructed base and walls of the clay cell are shown in Figure 13 below. Mildly contaminated material from the sawmill area was excavated and placed in the clay cell and validation sampling of the sawmill area was completed. The use of the hand held XRF was of great assistance in this process as real time analysis could be obtained as excavations progressed. This did not replace the need for lab analysed samples but did help with targeting the remediation approach to hot spot areas and determining the boundary of these areas.

Figure 13: The clay cell which was constructed on site to contain mildly contaminated material.

Once contaminated soils had been removed to landfill and the containment cell finished, sampling was carried out to confirm remaining soils were below the targeted clean up levels. This enabled the underlying rock to be quarried, extending the life of the site. Final validation has been carried out and results show the remediation of the sawmill area has been successful. A Site Validation Report is in preparation and

will be finalised before backfilling of the void to reinstate the area to former ground levels using fill imported onto site from the cleanfill process. Imported soil will be subject to normal quality control processes to ensure the material used is appropriate for the future land use. Figure 14 below shows an operator measuring the depth of the stripping to ensure mildly contaminated material has been removed to the correct depth.

Figure 14: Ensuring mildly contaminated material is excavated to the correct depth.

Levels of contamination discovered in some places during the remediation works were considerably worse than identified in the initial investigation. These required an adaptive approach to managing the contaminated material as it was encountered. The XRF was vital in identifying these areas.

The improvement in groundwater quality shows what that the sawmill remediation was a success. Some of the highlights of the improvements in groundwater contamination are:

- Arsenic levels decreased:
  - 150 times of their previous level in groundwater monitoring bores within the sawmill area.
  - Up to 7 times of their previous level in down gradient boreholes.
- Chromium levels decreased:
  - From 15-45 times of their previous level.
- Copper levels decreased:
  - 15-85 times of their previous level.

Other Environmental Initiatives

The focus of this submission has been on the development of cleanfill management driven WA's proactive approach to cleanfilling and the sawmill remediation.

Some of the other environmental initiatives and controls in place are:

- Sediment and erosion control measures to ensure an appropriate discharge standard into the Manukau Harbour suitable to cope with the all year round operating conditions, and
- Controlled dewatering to maximise recovery of rock with monitoring to avoid saline intrusion of the drinking water supply aquifer for the island.

Other smaller but equally important environmental initiatives that are in place to maintain site environmental awareness and site personnel involvement such as:

- A worm farm for disposal of food scraps,
- Minimisation of rubbish to landfill with increased recycling leading to the reduction in waste, and
- Site environmental toolbox meetings

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