6 Description of the Proposed Development

6.1 Introduction

6.1.1 This Chapter of the ES presents a description of the proposed Energy from Waste Combined Heat and Power (EfW CHP) facility.

6.1.2 The primary purpose of the EfW CHP facility is to treat the waste from the southwest Devon area that cannot be recycled, reused or composted. The facility will therefore primarily deal with Municipal Solid Waste (MSW) provided by the SWDWP Authorities under the SWDWP contract. The remaining processing capacity will be used to process similar Commercial and Industrial (C&I) waste from local businesses in the surrounding area. The EfW CHP facility is designed to treat 245,000 tonnes of waste per annum, although if the incoming waste has a lower than expected calorific value or the plant is available for a greater amount of time, for example if maintenance takes less time than expected, the throughput could be up to 265,000 tonnes per annum (tpa) of waste.

6.1.3 The waste will be combusted and the heat will be used to generate steam. The steam will drive a steam turbine and generate renewable electricity for use at the facility, to supply Devonport Dockyard and Her Majesty's Naval Base (HMNB) and for export to the grid. Steam will also be extracted from the turbine and fed into the Devonport Dockyard and HMNB steam network to be used for heating purposes. The EfW CHP Facility will therefore incorporate Combined Heat and Power (CHP) technology.

6.1.4 The average efficiency of the proposed EfW CHP facility is expected to be 39%, with a maximum efficiency of 49%. This compares to a normal "electricity only net efficiency" of about 27.4% which might occur in the summer months when there is no steam demand from North Yard. A normal modern EfW plant *without* CHP has an efficiency of only approximately 23%.

6.1.5 Solid residues will be produced in the form of incinerator bottom ash (IBA), which will be transported off site and recycled, and residues from the air pollution control (APC) system, which will require disposal off site at a licensed hazardous waste landfill.

6.1.6 A plan of the proposed EfW CHP facility can be seen at Figure 6.1. The facility will comprise the following principal components:

- Tipping hall;
- Waste bunker hall;
- Bale store;
- Turbine / boiler house;
- Air pollution control system, including 95m high chimney;
- Bottom ash collection area;
- Air cooled condensers;
- Water treatment plant building;
- Central control room;

- Administration building;
- Workshop and stores building;
- Transformer compound for the export of electricity from the facility;
- Emergency diesel generator enclosure; and
- Electricity cables and switchgear building, and steam and condensate pipework, for connection to the relevant networks.

6.1.7 In addition to these principal components, there will also be access roads and trafficked areas for operational purposes; replacement of two existing crossings of Weston Mill Stream with a new clear-span bridge; weighbridges and a gatehouse; drainage and connections to infrastructure; hard and soft landscaping and an ecological mitigation area.

6.1.8 The overall design masterplan for the site is to provide a facility which combines high quality architectural design with a form that complements the complex dockyard context of an industrial setting with a backdrop of a woodland area with varying topography and relatively close proximity of residential properties.

6.1.9 The entire planning application site covers an area of 13.07 ha, broken down as follows:

Area for proposed EfW CHP facility building, air-cooled condensers, workshop and stores building, car parking and other associated infrastructure	2.47 ha
"Table Top Mountain" – area for proposed construction compound	1.72 ha
"Blackies Wood" and areas of green space adjacent to Savage Road and Weston Mill Stream	4.15 ha
Area for site access road, weighbridge, new bridge across Weston Mill Stream and sculpture	1.74 ha
Area for Bull Point access road	0.29 ha
Steam pipe and electricity cable connections and switchgear building	2.45 ha
Construction electricity cable connection	0.25 ha
Total	**13.07 ha**

6.1.10 The footprint of the main building itself will cover approximately 6,200m² and together with small auxiliary buildings and equipment approximately 9,000m². The process equipment layout is optimised to give as compact a footprint as possible. This also helps to deliver clean simple lines to the buildings. This optimisation is demonstrated by the following:

- Use of a single combustion and boiler line;
- Positioning of the air cooled condensers to the south of the main building;
- Integration of the turbine generator hall into the main building;
- Internal accommodation of all ancillary plant and plant rooms; and
- Simple road layout delivering easy traffic circulation.

6.1.11 The majority of traffic movements and principal external noise generating equipment (such as the air cooled condensers) are located on the eastern side of the building, away from the closest residential properties on Talbot Gardens and Savage Road.

6.1.12 The plant has been designed to minimise operational noise levels as far as is practicable, including

- Selection of low noise plant items. For example, the ACCs employ large diameter, low speed fans to provide the lowest possible noise emission for this type of equipment
- Selection of wall and roof cladding constructions to minimise noise breakout from the plant buildings. High performance multi-layered cladding systems have been chosen for each part of the facility to provide the necessary reduction in breakout noise resulting from the calculated internal noise levels.
- Selection of acoustic attenuated ventilation openings to minimise noise breakout from the plant buildings. High performance attenuated vents have been chosen for each part of the facility to provide the necessary reduction in breakout noise resulting from the calculated internal noise levels.

6.1.13 The site layout has also been designed to make best use of the site and its topography whilst taking account of the known geotechnical features of the site, to achieve maximum reuse of excavated material. The base ground level has been kept as low as possible and the cut and fill balanced to minimise removal of material from the site during construction.

6.1.14 As well as the operational plant delivering the service requirements of the SWDWP contract, the aim is to provide facilities for the use of the public such as the community area/visitor centre which, as well as its main purpose of providing an educational outlook on waste issues, can be made available as a general community resource for meetings etc.

6.1.15 The site is outside the MoD's dockyard explosive safeguarding zone and so no additional measures are required for building design. A Warships in Harbour Risk Assessment, Nuclear Safety Case Risk Assessment and Helicopter Flight Path Risk Assessment have all been carried out by the MoD (see Appendix 6.1) and no restrictions on the proposed EfW CHP facility have been identified.

6.1.16 Construction is expected to occur between early 2012 and late 2014 and to take approximately 35 months (including the mobilisation, main construction and commissioning phases).

6.1.17 The design life of the EfW CHP facility will be 30 years, and the life expectancy of the facility is approximately 40 years. MVV has experience of operating EfW CHP facilities for periods in excess of the design life, for example MVV's Mannheim facility in Germany has now been operational for more than 45 years.

6.1.18 The site has been fully secured and is deliverable by MVV. The site is located in the northern section of Her Majesty's Naval Base (HMNB), Devonport, Plymouth. It is in the ownership of the Ministry of Defence (MoD) and will be leased by the MoD to MVV for the EfW CHP facility for a period of 45 years if planning permission is granted. The lease term includes a three year construction period, 40 year operational period and a remaining two years for demolition. After this, the site will be returned by MVV to the MoD in essentially the same condition as it was leased to MVV, except that the piled foundations would be left in situ.

6.1.19 The Agreement for Lease also includes an obligation on MoD to enter into a Licence to Occupy for the construction lay down area to be located on land known as Table Top Mountain.

6.2 Principal Components of the Proposed EfW CHP Facility

Main Building

6.2.1 The waste treatment process will take place within the Main Building and no waste will be stored or processed outside the building. The maximum height of this building will be 45m and the minimum height 15m. External 'ribs' will project 3m above the height of the main building enclosure. The total length of the building will be 134m and the width will vary between a minimum of 30m and a maximum of 81m. Drawings showing the four elevations of this building can be seen at Figure 6.2 A-D. A section through this building, showing the internal components, can be seen at Figure 6.3.

6.2.2 The main boiler house building needs to be 45m high in order for the plant to meet the strict requirements of the Waste Incineration Directive (WID) to protect human health and the environment. Specifically, the secondary combustion chamber is sized so that the products of combustion remain at a temperature of at least 850°C for a minimum of two seconds after the last introduction of air to ensure the efficient destruction of organic compounds and carbon monoxide. The products of combustion rise vertically within this chamber. The height of the building is therefore dictated by the need for the secondary combustion chamber to be sufficiently tall to allow a temperature of 850°C to be maintained for two seconds.

6.2.3 The EfW CHP facility is designed to treat 245,000 tonnes of waste per annum at the thermal design point of 82.1 Megawatts thermal (MWth) (hourly throughput of 31.1 tonnes per hour (tph) with a Calorific Value (CV) of 9.5 Megajoules per kilogram (MJ/kg) and an availability of 90% (equal to 7,884 full load operational hours per year). Under low CV and high availability conditions the mechanical throughput could be as high as 265,000 tonnes of waste per annum. It is important to state that this ES assesses the worst-case scenario in terms of tonnage, specifically the vehicle movements in the transport assessment (ES Chapter 12) and the air quality and noise assessments which use these data (ES Chapters 13 and 14 respectively).

6.2.4 The Main Building has been designed to enable the various plant items within it to be maintained and replaced as necessary through the life of the facility.

Tipping Hall

6.2.5 The Tipping Hall will be situated within the Main Building which is fully enclosed. The Tipping Hall provides a reception area for incoming vehicles delivering waste to the facility. Within the Tipping Hall delivery vehicles would transfer waste directly into the Waste Bunker via one of five available tipping bays.

6.2.6 Waste odours are contained within the facility building through the use of a ventilation system to maintain negative pressure. Air from the ventilation system is used as feed air to the combustion plant, which ensures destruction of odorous compounds before they are emitted to atmosphere. During periods of planned maintenance, when the combustion plant is not operating, the air from the ventilation system is passed through the dust and activated carbon filters of the shutdown exhaust system before being emitted to the atmosphere.

Waste Bunker

6.2.7 The Waste Bunker will also be situated within the Main Building. Prior to being loaded into the furnace, waste would be stored and mixed within the Waste Bunker to maximise waste

homogeneity and hence obtain as consistent as possible CV of the waste. The waste bunker will have a storage capacity of ten days (20,000m^3). Since the waste within the bunker would be continuously mixed and agitated the conditions would not be attractive to vermin.

Bale Store

6.2.8 The design of the Main Building includes the infrastructure needed to manage the receiving, storing, transferring and / or diversion of waste when the facility is not available for any reason, for example during planned maintenance, through the provision of a Bale Store.

6.2.9 In the event of the Bale Store being required, waste will be compressed into bales measuring approximately 1.5m^3 to remove air from the waste, wrapped in strong polyethylene film and stored in this area until the plant is back in operation. The polyethylene film provides a full seal against the ingress of air and pests, and is highly resistant to cuts and tears. Under ambient conditions the waste in the bale does not biodegrade as the oxygen and moisture conditions are not at the necessary level to allow biodegradation. Such baling is used in Germany, where bales are even stored outside (see Plate 6.1 below). In the proposed EfW CHP facility the bales will be stored entirely inside the Bale Store. Storing waste in this way avoids the need for waste to be diverted to landfill.

Plate 6.1 Stockpiled bales of waste in Germany (MVV's Leuna EfW Facility)

6.2.10 The bale store will have a storage capacity of 18 days (12,000m^3). Adding this to the ten days' capacity in the waste bunker makes a total storage capacity of 28 days.

Turbine / Boiler House

6.2.11 The Turbine / Boiler House will be the largest part of the Main Building. The Turbine / Boiler House is where the main incineration process will take place and will contain the furnace and boiler. A steam turbine will generate electricity from the superheated steam produced.

Air Pollution Control System

6.2.12 An Air Pollution Control (APC) system will be provided. Flue gases which have passed through the boilers will enter the APC area, where the gases will be cleaned using a dry reagent injection

system before they are released into the atmosphere via the 95m tall chimney. The chimney needs to be this height in order to effectively disperse the gases. The height of this chimney has been determined by the results of the air quality assessment (see ES Chapter 13) which has modelled the relative effectiveness of emission dispersal for a variety of possible stack heights.

6.2.13 Various reagents will be required for the APC system, including sodium bicarbonate, activated lignite carbon and urea (the latter being injected in the furnace).

6.2.14 Continuous emissions monitoring equipment will be installed and the results published on MVV's website.

6.2.15 The system includes an additional economiser unit downstream of the APC system to maximise the recovery of heat from the process.

Air-cooled Condensers

6.2.16 Air-cooled Condensers will be provided to condense the exhaust steam from the steam turbine without producing a visible plume associated with water cooled condensers.

Administration Block and Community Area

6.2.17 An Administration Block will be provided containing the staff welfare facilities, offices and meeting rooms.

6.2.18 A Community Area will be provided within the Administration Block. It will be able to accommodate visiting and community groups, including disabled visitors.

6.2.19 There will be a roof terrace overlooking the site and the adjoining Dockyard and explanation boards to describe the activities and points of interest.

Control Room

6.2.20 A control room will be provided in the waste bunker hall from which the facility will be operated and monitored (see Plate 6.2).

IBA and APC Residue Transfer

6.2.21 Solid residues will be produced in the form of IBA, which will be transported off site and recycled, and residues from the APC system, which will require disposal off site at a licensed hazardous waste landfill. Facilities will be provided within the Main Building for the transfer of IBA and APC residues to enclosed vehicles for subsequent transport off site.

Workshop and Stores Building

6.2.22 A stand-alone workshop and stores building will be provided at the western end of the site, primarily for the storage of equipment, chemicals, etc. The workshop will also contain one office and WC. This building will be 10m high.

Plate 6.2 Typical control room

Generator Transformer Compound and Emergency Diesel Generator Enclosure

6.2.23 A generator transformer compound and emergency diesel generator enclosure will be provided at the facility, outside of the main building to the west of the turbine hall.

6.3 Appearance and Materials

Main Building

6.3.1 The Main Building will comprise a collection of angular shapes, reflecting the technology within the building, generally in neutral materials occasionally 'punched' through by coloured elements. The neutral coloured forms will have a continuous and homogenous roof / wall composite with curved eaves. This will enclose a simple clad box.

6.3.2 The Tipping Hall will be contained between the Water Treatment Hall and the Administration Building. Its form has been broken down into two shapes – one enclosing the entrance and manoeuvring area and the second enclosing the tipping process itself.

6.3.3 The form will be a series of rectangular and angular clad boxes. This cladding will be Kingspan Longspan in Green, Blue and Grey.

6.3.4 The majority of the roof of the Tipping Hall has been designed as fully accessible as a series of roof terraces with a central exhibition space. It is envisaged that this space will be a changeable exhibition space. The remaining terrace is designed to be of educational interest.

6.3.5 The ends of the building will be formed by the Administration Building and Water Treatment Hall. These elements will be completely transparent and within the angular coloured frame of the surround sits a high quality curtain walling system (Kawneer) which will make visible the internal function of the building whilst meeting safety requirements for the Naval Base and Dockyard.

6.3.6 Architectural lighting is proposed to illuminate specific features of the structure between dusk and 23.00. This is utilised only on the façades which are mainly visible from the south east, not from Barne Barton.

6.3.7 The use of this architectural lighting has been discussed with the MoD. The MoD has indicated that whilst the visualisations of the lights indicate that the lighting should not cause an issue to flying operations. If required, a Management Arrangement can be developed and implemented that would allow Flag Officer Sea Training (FOST) Air Control to contact the EfW CHP facility Shift Supervisor and have this lighting temporarily switched off prior to and during any dusk / night flying operations.

6.3.8 Concerns have been noted regarding the roof span and the potential for birds to nest on the roof and cause potential disturbance to surrounding residential areas. MVV will monitor this situation during construction and take appropriate action as necessary to prevent nesting and resting gulls spoiling the building then, and in the operational period.

Waste Bunker and Boiler House

6.3.9 In keeping with the overall concept of shades of grey punctured by elements of colour this part of the building will predominantly have grey cladding – Kingspan Longspan – with grey louvres at high and low level. This cladding will be arranged in horizontal shades of grey to create further interest. The end walls to these elements will be formed by a standing seam aluminium roofing system (Kalzip) which is a continuous roof / wall profile without any visible means of rainwater disposal as this takes place via a secret gutter. The two shapes will intersect and appear to interlock. Both buildings will have exposed curved weathered steel columns which will be

braced horizontally with a light galvanised steel lattice – co ordinate to the positions of the grey cladding bands.

6.3.10 The buildings will be anchored by a precast concrete plinth which will have a pigment addition making it appear as local faced limestone used extensively as a facing material in Plymouth buildings in general and a number of older buildings in the Naval Base and Dockyard.

Air Pollution Control

6.3.11 The majority of the flue gas treatment area's function will be expressed functionally via the exposed air pollution control equipment. Silos, pipework and ductwork will all be visible.

6.3.12 The one area that has to be enclosed is the Bag House Filter which will be expressed as a blue shape with angled roof. This will be formed in Trapezoidal cladding and its angled shape continues the nautical design theme.

Air-cooled Condensers

6.3.13 The Air-cooled Condensers will sit apart from the Main Building and will be connected to it by overhead pipework. The Air-cooled Condensers will be clad in an opaque cladding (Kal Wall) which will be top-lit with coloured feature lighting which will provide a glow in the evening behind curved horizontal columns. These columns will then be silhouetted against the lighting. The comments made in paragraph 6.3.8 above also apply here.

6.3.14 The whole structure will sit on legs to allow the passage of air underneath.

Chimney

6.3.15 The chimney will be a simple cylindrical structure 95m high and 3m in diameter.

6.3.16 The chimney will have a spiral staircase up to a platform for air quality monitoring which will be approximately 23m above the finished ground level.

6.3.17 The chimney surround will be formed in painted steelwork which will be finished in a dark grey at the base and graduated to a light grey at the apex.

6.3.18 The simple treatment is deliberate and in keeping with the transparency of the process in this area. Attempts to produce a more sculptural and expressive form were, and are, considered inappropriate and at odds with the overall concept.

Administration Building

6.3.19 The external treatment of the Administration Building (and Tipping Hall) will be coloured green. Also a roof garden will be created from which can be viewed the Naval Base and Dockyard. As such, visitors to the site will be able to visually make the connection between the building and its surrounding environment.

Workshop

6.3.20 The Workshop will be a simple rectangular building of relatively low profile. It will be clad in Kingspan Longspan flat panel cladding and incorporate a ‘brown roof’.

6.4 EfW CHP Facility Process

6.4.1 A full description of the waste treatment process is provided below. Data on the projected amounts of inputs and outputs can be found in the Waste Flow Model, Appendix 6.2.

Summary of Inputs

6.4.2 **Activated lignite carbon**: This will be used as one of the reagents in the dry APC system and is injected as a powder into the flue gas upstream of the fabric filter. The activated lignite carbon adsorbs mercury, and organic compounds including dioxins and furans.

6.4.3 **Sodium bicarbonate**: This is also a reagent in the APC system. A controlled amount of dry sodium bicarbonate is injected into the flue gas upstream of the fabric filter to absorb acid components (hydrochloric acid (HCl), sulphur dioxide (SO_2) and hydrogen fluoride (HF)).

6.4.4 **Urea solution**: This is used as a nitrogen oxide reducing agent in the furnace.

6.4.5 **Air**: Primary combustion air will be extracted from the waste bunker and secondary combustion air from the IBA bunker area.

6.4.6 **Fuel**: A low sulphur content light fuel oil will be used to supplement furnace temperatures at times of plant shut down and start up or to maintain WID temperature requirements in abnormal conditions such as low CV waste. MVV's operating experience in Germany is that in a typical operating year use of fuel oil represents less than the 1% of the total thermal input to the process. Auxiliary fuel is not required under normal operating conditions. This auxiliary fuel will be stored in three 50m^3 tanks.

6.4.7 **Waste**: This will comprise MSW and C&I waste. See Appendix 6.2 for details.

6.4.8 **Waste water from sample coolers**: This is reused to replace evaporative losses in the bottom ash quench.

6.4.9 **(HCl)**: This is used for the regeneration of the ion exchange columns of the demineralised water plant, in addition, if there is an increased water demand to replace condensate losses from the Dockyard steam network resulting in the waste water amount exceeding the internal water reuse capacity, HCl will be used for the neutralisation of alkaline waste water before discharge into the sewer.

6.4.10 **Towns water**: This is used for miscellaneous purposes, e.g. for water treatment plant.

6.4.11 **Sodium hydroxide (NaOH)**: This is used for the regeneration of the ion exchanger columns of the demineralised water plant. NaOH is also used for pH adjustment of boiler water.

6.4.12 **Condensate from Dockyard steam network**: This will be returned to the water-steam-cycle after cleaning up (polishing) in order to minimise the towns water consumption.

Summary of Outputs

6.4.13 **IBA**: removed from the grate includes ferrous and non ferrous metals and other non-combustible materials such as glass that has not been recycled by householders.

6.4.14 **APC residues**: These are derived from the APC system. These are strongly alkaline and require disposal as a hazardous waste.

6.4.15 **Steam/water vapour**: This can arise from different sources such as boiler house and turbine hall flash coolers or safety relief valves. These are discharged above the roof, and are not harmful to the environment.

6.4.16 **Flue gas**: This is released after cleaning through the chimney which is 95m in height.

6.4.17 **Heat**: Part of the steam production is exported to the Dockyard steam network for heating purposes. In the future this could also be in the form of hot water.

6.4.18 **Electricity**: Some of the electricity produced by the EfW CHP facility will be used by the facility itself, some will be exported to Devonport Dockyard and HMNB, and the remainder will be exported to Western Power Distribution's grid.

6.4.19 In normal operation, the plant will produce **no liquid effluent**.

Detailed Process Description

6.4.20 The following section provides a more detailed technical description of the EfW CHP process. It has been provided by MVV who are the designers of the proposed facility.

Start-up

6.4.21 The facility will use low sulphur light oil (diesel oil) for start up, there is no gas used on site. Auxiliary burners are fitted in the furnace which are used to bring the system up to the required temperature before waste is fed onto the grate. The start up process is carefully controlled to raise the temperature in the furnace and boiler gradually to avoid adverse thermal impact on the system. The start up takes 10 to 12 hours from cold and during this time small quantities only (up to 10% of maximum steam output) of steam will be vented from the boiler house roof vent over a period of around 4 hours during the start up process. As the vent silencer is designed for 110% maximum load there will be no abnormal noise emissions. No waste is introduced until the furnace, boiler and flue gas cleaning systems are at working temperature and there is no bypass to the filter system so there will be no visible emissions from the chimney during start up.

Waste Combustion

6.4.22 Waste will be fed from the waste bunker into the furnace using a grab crane such as that illustrated below in Plates 6.3 and 6.4. The crane operator will mix the waste in the bunker to maximise as far as possible the homogeneity of the waste and its calorific value. This mixing will also serve to identify any items that should not have been disposed of at this facility and which under normal circumstances should not be fed into the furnace – for example used butane gas canisters – and will enable them to be removed from the bunker and stored in a skip within the tipping hall for appropriate disposal off site. However, the EfW CHP facility is designed to safely combust such items should they inadvertently be fed into the furnace.

6.4.23 The combustion technology will incorporate an inclined reciprocating grate. Waste will be fed via a waste feed hopper and a set of feed rams onto an advanced moving grate with a drying zone, a combustion zone and a burn-out zone. The primary combustion air will be supplied under the grate through small holes. Combustion air will be drawn from above the waste bunker.

6.4.24 A photograph of waste burning on a grate, seen from the lower end with IBA in the foreground, can be seen at Plate 6.5 below. Temperatures here range from 850°C to 1,250°C.

6.4.25 The combustion system will be equipped with auxiliary burners fired by low sulphur light fuel oil used for start-up / shutdown and to ensure combustion compliant with WID conditions. The walls of the combustion chamber will be water cooled and refractory lined. Ash generated from combustion will drop off the end of the grate directly into a water bath equipped with a mechanical ash discharge conveyor. This will quench the hot ash and act as an air seal to prevent uncontrolled ingress of air into the primary combustion chamber.

6.4.26 Combustion gases will pass into a secondary combustion chamber lined with a combination of refractory materials and Inconel cladding (a highly corrosion resistant alloy metal), equipped with secondary air injection and distribution nozzles and configured to achieve good mixing of the secondary air with combustion products from the primary chamber. The chamber is sized so that the products of combustion, after the injection of secondary air, remain at a temperature of at least 850°C for a minimum of two seconds. This is to ensure the efficient destruction of organic compounds and carbon monoxide. In the unlikely event that the temperature arising from the combustion of the waste on its own is not sufficient (e.g. when burning very low calorific value waste) the auxiliary burners are used to maintain this temperature. In addition flue gas will be circulated from behind the fabric filter into the firing chamber in order to enhance the incineration process and lower the formation of oxides of nitrogen (NOx).

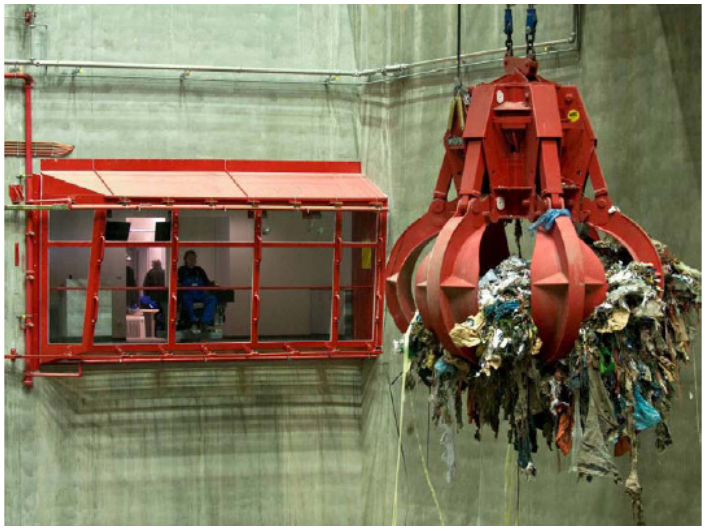

Plate 6.3 Crane operator and hydraulic grab crane in action

Plate 6.4 Typical bunker view with crane control cabin (background), tipping chutes (right), stored waste (centre) and feed hopper (left, flap gate closed)

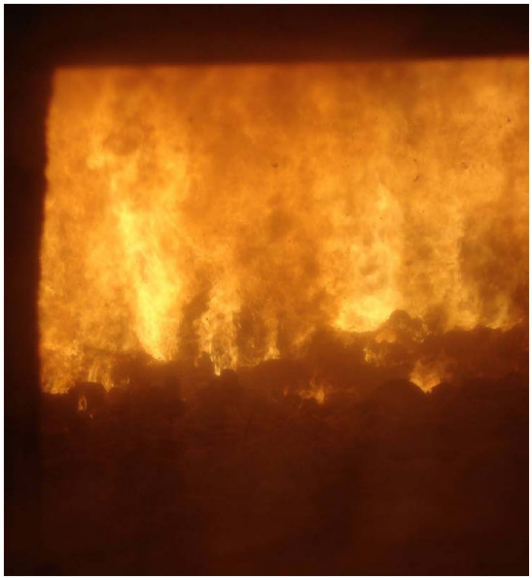

Plate 6.5 Waste burning on a grate

6.4.27 The waste feed rate, the supply of primary and secondary combustion air and the grate speed will be regulated by an advanced combustion control system which measures flow rate, flue gas oxygen and combustion temperature and controls the plant to keep the rate of steam generation constant. This ensures that:

- The boiler and generator operate at their optimal efficiency; and
- Over firing of the boiler with the consequent increase in thermal stress and corrosion as well as the risk of increased CO emissions is avoided.

6.4.28 The amount of heat released by the waste will vary according to its net calorific value (NCV). This is the amount of thermal energy released in the complete combustion of a given quantity of the waste and, due to the inconsistent nature of MSW, constantly varies. The automatic control system will respond to this variation by modifying the waste feed rate and the grate speed to maintain a constant heat release from combustion and hence a constant steam flow rate. The crane operator will mix the waste in the bunker to homogenise the NCV of the waste fed to the boiler.

6.4.29 In addition to conventional combustion control (e.g. with temperature sensors) an infrared camera will be provided to record and control the fire location and the burnout on the grate.

6.4.30 The combustion process generates oxides of nitrogen (NOx). In order not to exceed the emission limit for these substances, the secondary combustion chamber will be equipped with a NOx reduction system. The oxides of nitrogen will be reduced to nitrogen by injecting urea solution into the secondary combustion chamber of the furnace. As the reaction is sensitive to temperature, the injection nozzles will be installed at several levels within the combustion

chamber to enable the injection of urea solution to be precisely adjusted to the temperature conditions within the chamber.

6.4.31 Urea acts as a reducing agent which decomposes during injection in the hot flue gas stream, primarily to ammonia. The hydrogen in the ammonia reacts with the oxygen in the oxides of nitrogen to produce molecules of water vapour and nitrogen. This is a selective non catalytic reduction process (SNCR), which is optimised at temperatures of between 850°C and 1,000°C.

6.4.32 The gases will pass through a combination of water-cooled radiant chambers and an evaporator tube bundle which will reduce the temperature of the gases to around 650°C before coming into contact with the steam super-heaters. This serves to minimise corrosion and also to ensure that the majority of the small ash particles entrained in the combustion gases are below their melting point and are therefore less likely to adhere to the heat transfer surfaces.

6.4.33 The geometry of the furnace and boiler has been designed to minimise areas where excessive corrosion could occur. In certain areas of the combustion chamber and the second pass of the boiler which cannot be protected by refractory lining, the metalwork of the boiler will be protected by layers of Inconel which are applied under carefully controlled conditions to ensure full bonding between the parent metal of the tubes and the alloy.

Steam Generation

6.4.34 High pressure (60 bar) and temperature (420˚C) steam will be created by the evaporation of the water which circulates by natural buoyancy through the evaporator sections and the water tube walls of the combustion chambers. The steam from the evaporators is saturated (that is to say that it is in equilibrium with the water and will condense immediately heat is removed). In order to minimise condensation of steam within the steam turbine and to maximise the efficiency of the turbine, the saturated steam will be further heated in the super-heaters.

6.4.35 The combustion gases will cool rapidly as they pass over the super-heaters. This will maintain heat transfer efficiency, minimise erosion and also minimise the presence of ash deposits on the tubes. The economiser sections will reduce the gas exit temperature to the optimum required for the flue gas treatment process and preheat the boiler water for increased efficiency. The rapid cooling coupled with minimal ash deposits will help minimise the reformation of dioxins and furans.

Air Pollution Control

6.4.36 The process will use a dry APC system using sodium bicarbonate, which will be delivered in sealed bulk powder carriers which are pneumatically loaded and emptied.

6.4.37 Acid pollutants HCl, SO_2 and HF will be removed by a dry scrubbing and filtration system, using sodium bicarbonate as the reagent, to enable more energy to be recovered from the flue gas.

6.4.38 A controlled amount of dry sodium bicarbonate will be injected into the flue gas upstream of economiser 3. Sodium bicarbonate will mix with the flue gases in the economiser and the downstream reaction duct section, which is designed with sufficient residence time to ensure that the necessary chemical reactions are completed. A controlled amount of powdered activated lignite carbon will also be injected into the flue gas upstream of the fabric filter. The purpose of this is described below.

6.4.39 The flue gases will pass through the fabric filter in which the entrained particles are trapped in the filter cake which covers the filter bags. The neutralisation reaction will be completed as the flue gases pass through the filter cake. The filter cake will be removed at regular intervals by reverse air pulses and fall into the filter discharge hoppers. A proportion of this residue will be re-circulated into the flue gas duct upstream of the fabric filter. This increases the neutralisation reaction efficiency, thereby reducing the final quantity of un-reacted sodium bicarbonate in the APC residue. The SO_2 and HCl concentrations at the boiler outlet and at the emission monitoring points in the chimney will be continuously monitored and the quantity of sodium bicarbonate injected will be adjusted in accordance with the difference in the concentrations of the acid gases at the two measurement points to achieve the permitted emission limits.

6.4.40 The primary method of minimising the release of dioxins will be by careful control of the combustion conditions. The gas residence times and the temperatures in the combustion system are such that dioxins / furans are efficiently destroyed.

6.4.41 For additional removal of dioxins and furans an activated lignite coke injection system will be used. The activated lignite coke adsorbs mercury, and organic compounds including dioxins and furans. Other heavy metals such as copper and cadmium are filtered out as particulates by the fabric filter.

The Fabric Filter

6.4.42 The filter bags act as a foundation for the formation of a filter cake which serves as a reaction medium for both the acid gas neutralisation and the adsorption of heavy metals and organic compounds and provides particulate filtration.

6.4.43 The filter cake will be periodically removed from the bags by the automatic cleaning system in order to control the filter cake build up and hence the pressure drop across the bags. The bags are cleaned in rows by reverse jet pulses from compressed air nozzle tubes. The cleaning sequence is triggered automatically when a preset pressure drop across the bags has been reached. The bag filter will be provided with an electrical preheating system. The preheating system is used to preheat the bag filters at start-up and maintain the filter temperature in the event of a short term operational shutdown.

6.4.44 The differential pressure across the filter bag is measured as an indication of the build-up of filter cake on the bags. The material that falls into the ash hoppers during the cleaning process is removed from the system by conveyors. A proportion is re-circulated as described above.

Turbine Generator and Air Cooled Condenser (ACC)

6.4.45 The superheated steam from the boiler will be expanded in a steam turbine. The expansion of the steam will deliver energy in the form of shaft power which, in turn, will be used to drive an electrical generator. Provision will be made in the design of the steam turbine for steam extraction to the existing Dockyard network.

6.4.46 The Facility will use a high efficiency single shaft condensing steam turbine. The turbine will drive a water cooled synchronous generator via a reduction gearbox. The system will be complete with all necessary auxiliary water steam system equipment, valves, pipework and fittings. The turbine will be provided with oil systems for lubricating the turbine, reduction gearbox and generator main and subsidiary bearings and for the high pressure hydraulic operation and servo control of the governing and emergency shut off valves. The oil systems will have main, secondary and emergency pumps and filtration and cooling systems.

6.4.47 The Facility will use a finned-tube air-cooled condenser (ACC) to condense the exhaust steam from the steam turbine. In the ACC the steam will be condensed under vacuum to extract the maximum practical mechanical energy from the expansion in the steam turbine.

6.4.48 The ACC will consist of several sections as follows:

- Tube bundles in carbon steel with aluminium fins;
- A cooling fan system including adjustable blade pitch, frequency regulated electric motors, and direct drive reduction gear;
- Screening of the air intake and exit openings to reduce visual impact; and
- A steel support structure.

Emissions to Water

6.4.49 In normal operation, the plant will produce no liquid effluent. Clean water such as boiler blowdown water or backwash water from the boiler water treatment plant will be returned to the ash quench water seal system on the boiler. Dirty water such as the run-off from the IBA conveying system will be returned to the ash quench system. There are no emissions to water arising from the baling process.

IBA

6.4.50 The IBA remaining after combustion equates to approximately 24% by weight of the input waste, this equates to approximately 58,800 tpa assuming a total waste throughput of 245,000 tpa.

6.4.51 IBA including metals will be discharged from the end of the combustion grate directly into the ash quench bath. From there, the ash will be transferred by means of an ash extraction conveyor (see Plate 6.6 below) into the ash bunker (see Plate 6.7 below) with a storage capacity of eight days (1,540m^3). The bunker will have a sloping floor so that surplus quench water runs back into a collection sump and can be returned to the quench bath from time to time. The ash retains approximately 20% by weight of the water from the quench bath.

6.4.52 The bottom ash will be loaded by means of an automatic travelling overhead grab crane into a collection vehicle. If required, the vehicle will be sheeted before leaving the ash loading station.

6.4.53 The IBA will be processed at an off site facility situated at Whitecleave Quarry at Buckfastleigh, Devon, owned by Sam Gilpin Demolition Ltd. MVV will submit a planning application in spring 2011 and intends to construct the plant, which will be operated by Gilpin, to utilise a significant proportion of IBA as a secondary aggregate. The mechanical processing will include screening and removal of ferrous and non-ferrous metals.

6.4.54 At least 95% of the output IBA (target 99%) will be reprocessed as a secondary aggregate with the remainder sent to an appropriately licensed landfill site – possibly at Heathfield or New England Quarry which are both nearby – as inactive waste attracting the inert waste landfill tax. The treated IBA can be used in highway works, pavement concrete, landfill engineering projects, quarry restoration and brownfield remediation projects.

Plate 6.6 Typical IBA being conveyed to the bunker

Plate 6.7 Typical IBA in bunker

Alternative Locations for IBA Processing

6.4.55 In the event that IBA cannot be taken to Whitecleave Quarry, there are a number of other existing facilities in the UK operated by Ballast Phoenix to which MVV could send the IBA, with planning permission and appropriate permits to operate, including:

- Beeley Woods, Sheffield, S6 1NH (Sheffield City Council – planning permission reference 08/04136/FUL);
- Castle Bromwich, Birmingham, B35 7AG (Birmingham City Council – planning permission reference N/00855/FUL); and
- Edmonton, North London, N18 3AG (has planning permission but details unknown).

6.4.56 MVV will also investigate other sustainable options.

Metals

6.4.57 MVV will recover both ferrous and non-ferrous metals from the IBA. The levels of ferrous and non-ferrous metals remaining in the IBA is a function of the input waste composition which is in turn is largely dependent on the levels of recycling achieved by Waste Collection Authorities and commercial and industrial waste collectors. Metals might typically represent approximately 3.5%, by weight, of the IBA. Gilpin will make arrangements with metal merchants to collect and recycle the ferrous and non-ferrous metals recovered from the IBA thus avoiding landfill and achieving high diversion rates.

APC Residues

6.4.58 The residue from the bag filter, which contains fly ash, the reaction products from the acid gas neutralisation process and activated lignite with the absorbed metals and organic compounds, is considered hazardous waste. The main reason for these residues being classed as 'hazardous' is their alkalinity. The APC residues are not dissimilar to powdered concrete in this respect, which is routinely transported by road in the same type of vehicles as would transport the APC residues.

6.4.59 The typical chemical content of the APC residues is detailed in Table 6.1 overleaf.

6.4.60 The residue will be conveyed from the filter hoppers to an intermediate storage silo. Part of the residue will be returned to the sodium bicarbonate dosing system to improve the utilisation of sodium bicarbonate.

6.4.61 The balance is conveyed to one of two closed residue storage silos. Each silo will have a capacity of 185m^3 which allows a total of ten days' storage. The silos will be insulated and the lower cone will be electrically heated to prevent agglomeration of the residue and to ensure a free flow during the discharge process. The residues have a very low moisture content. The silo is vented through a bag filter to ensure there are no fugitive emissions from the system.

6.4.62 The APC residues amount to approximately 3.5 per cent of the total waste by volume. This equates to approximately 8,575 tonnes annually assuming a total waste throughput of 245,000 tpa. MVV will dispose of APC residues under a contract with Waste Recycling Group (WRG).

Table 6.1: Typical Chemical Content of APC Residues

Component	Percentage
Dust	39.40%
Sodium Chloride (NaCl)	30.17%
Sodium Sulphate (Na_2SO_4)	19.30%
Sodium Sulphite (Na_2SO_3)	0.00%
Sodium Fluoride (NaF)	0.30%
Sodium Carbonate (Na_2CO_3)	8.42%
Mercury II Hydroxide ($Hg(OH)_2$)	0.01%
Cadmium Hydroxide ($Cd(OH)_2$)	0.03%
Activated Lignite	2.37%
Total	**100.00%**

6.4.63 WRG has a facility in Knostrop, Leeds (Environmental Permit number MP3231SD) which already accepts sodium bicarbonate based APC residues from a number of other incinerators or EfW facilities in the UK. The APC residues will be transported there by WRG in sealed bulk powder carriers which are pneumatically loaded and emptied. MVV's intention is to arrange for some of the APC residue loads to be transported away in bulk powder carriers which have delivered sodium bicarbonate to the facility, which would reduce vehicle movements.

6.4.64 At Knostrop, the APC residues are stored in a dedicated silo prior to being conditioned in a simple screw mixer with dilute phosphoric acid which turns soluble lead salts into insoluble salts. At this stage the APC residues are in a semi-dry state and so do not present a dust hazard.

6.4.65 Following conditioning the conditioned APC residues will be transported by WRG in covered bulk haulage lorries and be landfilled at their specialist hazardous waste landfill at Winterton, Lincolnshire (Environmental Permit number BW1785). Here the APC residues will be put into dedicated mono-cells (i.e. cells which take only one type of waste) in the landfill which is licensed to accept hazardous waste.

6.4.66 Both sites are fully operational and already have the requisite consents to be able to cater for the additional volumes of APC residues envisaged.

6.4.67 MVV will also investigate other sustainable options.

Electricity

6.4.68 On average approximately 25 MW of electricity is generated by the steam turbine, of which 2.5 MW is consumed by the plant as the parasitic load, leaving 22.5 MW as the net electrical output for export to Devonport Dockyard, HMNB and Western Power Distribution. The electricity generated will replace electricity from the national grid which is currently mostly derived from fossil fuel sources. A drawing showing the route of the cable connections can be seen at Figure 6.4. Further information can be found below in Section 6.5.

Steam

6.4.69 On average approximately 23.3 MW of steam will be exported to Devonport Dockyard for use within all buildings in the so called North Yard and to the Fleet Accommodation Centre. New pipework will be installed to connect to the existing system; some of the existing pipework will need to be replaced. The pipes comprise a larger diameter pipe to carry the steam to its destination and a smaller diameter pipe to carry the condensate back to the boiler. A drawing showing the route of the pipe connections and replacement pipework can be seen at Figure 6.4. An illustration of the type of pipework required is shown overleaf in Plate 6.8.

Plate 6.8 Typical Steam and Condensate Pipes

6.4.70 The steam provided will displace steam generated by the existing North Yard boilers which run on natural gas and, occasionally in times of gas disruption, distillate oil. They supply steam all year round although in the summer months the steam system is often switched off and drained down because there is no need for heating. Additionally it will also supply to the Fleet Accommodation Centre (FAC) with heat replacing the use of natural gas in this facility. The heat demand of the FAC is throughout the whole year with the peak demand in the winter heating season. When the EfW CHP facility is shut down for maintenance the North yard boilers and the existing infrastructure in the FAC would be used to supply heat, but since most of the EfW CHP facility shutdowns will be in the summer months the use of the existing North yard boilers will be minimal.

Maintenance

6.4.71 There will be periods when the facility needs to be shut down for maintenance purposes; this is expected to last for a maximum period of 21 days each year.

6.4.72 Sufficient storage capacity for Contract Waste is provided to cover the planned maintenance periods and a margin of 33% has been added to cover possible longer term outages of up to 28 days. Third party waste streams will be diverted from the facility during outages.

6.4.73 During periods when the combustion plant is not operating, the air from the ventilation system is passed through the dust and activated carbon filters of the shutdown exhaust system before being emitted to the atmosphere to avoid dust and malodorous compounds being emitted.

6.5 Access, Circulation, Parking and Security

Access

6.5.1 The location of the site means that the predominant highway access to the site will be from the A38 via the A3064, Weston Mill Drive, as shown on Figure 6.5.

6.5.2 After leaving the public highway incoming vehicles would travel along the MoD owned access road towards the Camel's Head Gate of HMNB Devonport. Vehicles will then turn right, across Northern Access Road, into the new access proposed through the MoD car park. This junction would be signalised.

6.5.3 A new road will be formed through the existing car park, resulting in the loss of 151 car parking spaces. The MoD already has a Travel Plan which encourages sustainable transport uses and discourages the use of private cars and has agreed to the proposed loss of car parking spaces.

6.5.4 Sufficient off road queuing areas will be provided to meet the peak delivery periods; queuing on the public highway will not be permitted. A 3-metre high acoustic barrier, expected to be a close-boarded fence, will be installed along the northern side of the road (see ES Chapter 14: Noise and Vibration for further details).

6.5.5 At the western end of the car park, the new road will pass underneath the Weston Mill railway viaduct and join an existing road, prior to the weighbridges / gatehouse. This existing road will be modified to suit the line and level of the weighbridges and the new bridge over the creek (see below).

Weighbridges and Gate House

6.5.6 Weighbridges and a Gate House will be located on this internal access road. The site will be equipped with two weighbridges positioned to allow weighing in and weighing out of all waste delivery vehicles, vehicles delivering consumables and vehicles transporting products and residues.

Crossing Weston Mill Creek

6.5.7 At present there are two existing road crossings of Weston Mill Creek to the west of the proposed location of the weighbridges and gate house, neither of which is wide enough for two way traffic:

- The structure that forms the northern crossing has a weight limit of 1.5 tonnes and is therefore unsuitable for vehicles larger than light cars/vans. It was the first of the two crossings and carried the access road that leads to the MoD storage/works facilities towards Bull Point.
- The southern crossing was installed as part of the MoD's 'D154' project and takes the form of a buried pipe construction. Four large diameter pipes were installed and covered with approximately 2.5m – 3m of fill, possibly using reinforced earth construction. This crossing is robust enough to take heavy goods vehicles, but only in one direction at a time.

6.5.8 It is proposed to demolish both existing crossings and replace them with a new clear-span bridge sufficient to take traffic in both directions at once. The new bridge will take the form of a two-way

access composite steel and concrete bridge spanning approximately 18m. A drawing can be seen at Figure 6.6.

Circulation and Parking

6.5.9 The internal road and pedestrian area layout has been designed to allow the safe movement of vehicles and pedestrians and with regard to relevant health and safety legislation and good industry practice.

6.5.10 The facility has been designed such that vehicles can achieve a turnaround time, from arriving at the entrance weighbridge to leaving the exit weighbridge, of between 15 and 25 minutes (depending on the type of delivery vehicle). This time will include entering the site, being weighed, being monitored, discharging the waste, being re-weighed and leaving the site.

6.5.11 Car parking for staff and visitors, including disabled allocation, will be provided as shown on Figure 6.9. A total of 53 car parking spaces will be provided including two disabled spaces. Five car parking spaces will be provided specifically in proximity to the gatehouse which will be for short term use by visitors who call at the gatehouse / weighbridge to obtain access and instructions to enter the site, including details of where they can park once they are on site.

6.5.12 In addition to the car parking spaces there will be five spaces for motorcycles, ten spaces for bicycles and one bus/coach parking space.

6.5.13 Detailed calculations have been made of the vehicle movements expected to arrive at and depart from the EfW CHP facility. These calculations can be found in ES Chapter 12: Transport Assessment.

Bull Point Access

6.5.14 There will be a need to construct a new access road to Bull Point for the MoD since its existing access road will be outside the new security fence and will be required for the EfW CHP facility. The location of this new access road can be seen at Figure 6.7.

Security

6.5.15 MVV's facility will occupy a site discrete from HMNB Devonport within which it will have full security control, without disruption by or to MoD activities.

6.5.16 A new security fence will be established such that the site and its access route falls outside of the secure area of HMNB Devonport. The fence will be up to 3m in height, Class 3 intermediate security welded mesh fencing to BS 1722 Part 14 with barbed wire topping. This new fence will be one of the first activities of the construction phase and there will be no significant presence on the site until this fence is complete and taken over by the MoD as acceptable for their ongoing security purposes.

6.5.17 Traffic will not be required to pass any MoD security checks, and will have unfettered access to the road approaching the EfW CHP facility weighbridge. It will enable MVV to accept delivery of waste even at times of heightened HMNB Devonport security, with only the publicly accessible MoD land on the approach to the Camel's Head gate being used by EfW CHP facility vehicles. A remotely operated security gate will be positioned on the new access road at the boundary with the existing HMNB Devonport car park and the road will be monitored by CCTV cameras. The weighbridges and gate house will be positioned on the access road immediately east of the new

bridge crossing. The gatehouse will be manned at all times that the EfW CHP facility is open to accept waste deliveries and vehicles on the weighbridge will be monitored by CCTV.

6.6 Utilities, Drainage and Other Infrastructure

Introduction

6.6.1 The proposed EfW CHP facility has a number of utility requirements as outlined below and the works have been designed to include all the necessary connections to these utility services.

6.6.2 In the process of finalising the details of the utilities connections, the relevant organisations have been consulted in order to ensure availability and compatibility of supply and connections.

6.6.3 Clean water, waste water treatment, fire systems and asset management including related maintenance and capital investment are delivered to HMNB Devonport by Kelda Water Services (KWS) under a Private Finance Initiative Contract known as Project Aquatrine. KWS is responsible for Package A of Project Aquatrine which covers all MoD sites in the Midlands, Wales and South West England. KWS has investigated and confirmed the provision of water supply and foul sewer connections as described below.

6.6.4 KWS will carry out all works necessary to provide the water and sewerage connections to the facility and will also be responsible for arranging any necessary easements required for the connections.

6.6.5 The majority of the dockyard electrical network systems with which the EfW CHP facility will interface are owned, operated and maintained by Devonport Royal Dockyard Limited. DRDL is responsible for maintaining power supplies to the operational parts of the dockyard to meet the MoD's requirements. Power supplies to the Dockyard are provided by Western Power Distribution Ltd., the Distribution Network Operator (DNO) for the area. WPD, DRDL and the MoD have all been extensively consulted in the design of the power distribution systems.

Sewerage

6.6.6 The rainwater collection system from building roofs, roads and hard standings will be discharged by means of a separate surface water drainage system whilst sanitary and process wastewater will be discharged to foul sewer.

6.6.7 In normal operation there is no continuous discharge to foul sewer from the process part of the facility, as any waste water generated is reused to make up the water lost in the IBA quenching system. Therefore in normal operation the only discharge to foul sewer is from the sanitary and domestic facilities.

6.6.8 Occasionally there will be the need to discharge process water from the facility (e.g. during shutdowns or when periods of increased steam off-take with high condensate losses by the MoD leads to increased waste water from the water treatment plant) and for this purpose a neutralisation tank and water quality testing are provided with a controlled discharge to the foul sewer to ensure compliance with the requirements of the trade effluent discharge consent for the facility.

6.6.9 The foul sewer connection will be made to a rising main section of the existing internal dockyard network. The route of the foul connection is approximately 275m and will include a new 20,000 litre package pumping station.

Water

6.6.10 A water supply is required to provide water for the process requirements, the fire protection systems and for domestic and potable requirements. This will be supplied from the South West Water supply network via a connection to the mains in the Barne Barton area external to the Dockyard. The route of the water supply connection pipeline is 185m. The connecting pipe will be 150mm diameter cast iron.

6.6.11 Mains cold water will be distributed around the buildings to serve all drinking water connections as close to the rising main as practicable, with connections being provided to the domestic cold water storage tanks.

6.6.12 For the provision of hot water for domestic requirements, consideration has been given to local water heating rather than centralised production and storage and a number of low water use appliances will be installed throughout the facility.

6.6.13 The average water consumption of the process during normal operation including yearly average steam extraction for CHP purposes is 4.46 m^3/h.

Drainage

6.6.14 The proposed drainage strategy provided below has been developed by GHA Livigunn. A drainage layout drawing can be found at Figure 6.8.

Hardstandings

6.6.15 Positive drainage will be provided to all hardstanding areas through the use of a combination of gullies, linear drains or channels and hard pipe. The surface water will pass through a class 1 by-pass petrol interceptor (estimated size at this stage NSB20 - to be confirmed at detailed design stage) prior to being discharged to the tidal estuary of the river Tamar. An outfall structure complete with adequate flow calming measures and scour protection will be provided at the point of discharge. This new outfall structure will be located within the foot print of the site, the invert level of the outfall pipe at the point of discharge will be set such that it is above the maximum tidal water level for a 1 in 200 years return period (i.e. 4.48 m AOD – note that this level already includes an allowance for climate change and a 300 mm freeboard). Consequently the design of the surface water system will be based on free discharge flow conditions.

6.6.16 It is intended to provide an emergency cut-off valve immediately upstream of the outfall such as to prevent any water discharging to the environment in the event of an accidental spill on site.

Roof and Walls

6.6.17 It is proposed to provide a drainage system to drain the run-off roof and wall rain water to an infiltration system. It is intended that the main building roof and wall surfaces will be drained to an infiltration basin whereas the workshop building, due to its size, will be drained to an infiltration trench.

6.6.18 Further information can be found in Section 6.3 of the Flood Risk Assessment, which is Appendix 11.1 of the ES.

Electricity

6.6.19 In order to start up the facility it is necessary to import electrical power from an external network. With the facility in operation electrical power will be generated at 11kV with the plant power requirement (parasitic load) being supplied via the internal power distribution system and transformers at the required auxiliary voltage level of 400V. The plant is able to operate in island mode such that the generator provides the parasitic load requirement only without exporting power, in the event that the connection to the grid is lost. An emergency diesel generator is provided to shut down the plant safely in the event of total power loss (failure of the grid connection coinciding with failure of the turbine generator). For export, the power is transformed to 33kV by the internal feed-in transformer.

6.6.20 Technical meetings and discussions have been held jointly with Western Power Distribution, Babcock and the MoD, and the resulting feasibility studies have determined that the optimum solution is to export the electrical power via a direct connection into the Devonport Dockyard electrical distribution system by means of a connection to the North Intake 33/11 kV substation, located within Goschen Yard. With this arrangement no direct connection to the external grid is necessary. Excess generated power will be exported to the grid via the North Intake substation and the 33 kV connections to the WPD network, whilst power necessary for start up will be imported via the same connection.

6.6.21 A drawing showing the route of the cable connections can be seen at Figure 6.4.

6.6.22 A new switchgear building will be required adjacent to the North Intake substation. New cables will be required to pass beneath Saltash Road, through some existing but redundant pipes which will be re-used as ducts, to access the North Intake substation. New cables will need to be laid within Goschen Yard, which will require some excavation of rock.

6.6.23 WPD has carried out a formal study which confirms that this arrangement will only require minor reinforcement of the network involving the replacement of some switchgear at the Ernesettle substation.

Steam

6.6.24 New pipework will be installed to connect to the existing system; some of the existing pipework will need to be replaced. A drawing showing the route of the pipe connections and replacement pipework can be seen at Figure 6.4.

Gas

6.6.25 There will be no requirement for a gas supply at the facility as no gas fired appliances are to be used.

Telecommunications

6.6.26 The facility will provided with an automatic PABX type telephone exchange and switchboard system with the requisite number of internal extensions to serve the various areas of the facility and the administration building. In addition separate direct lines will be installed to critical

locations in the facility such as the control room and facility managers' office. The telephone line connections will be supplied from the local BT network.

6.6.27 In addition the facility will require high speed broadband internet connections for remote monitoring of process parameters and general communication requirements of the operation and management of the facility. The internet connection provider will be selected at the time of plant construction in order to ensure that the most favourable option can be secured.

6.7 Landscaping and Ecological Mitigation Area

6.7.1 A comprehensive landscaping scheme has been developed, as shown in Figure 6.9.

6.7.2 The proposals for the site incorporate the planting of native species in a landscape strategy that will provide opportunities to improve biodiversity and provide a suitable setting for the development.

6.7.3 The landscape strategy incorporates trees towards the edge of the site, augmenting the existing tree cover where possible and helping to create a degree of connectivity between habitats. The trees would be carefully managed to avoid overhanging branches that would aid accessibility to the site and HMNB Devonport by unauthorised personnel.

6.7.4 Tree planting around the proposed site entrance will help to soften the perimeter fence and create a more interesting gateway to the development. Where possible, native tree species will predominantly be used.

6.7.5 Some other formal shrub planting and avenues are also proposed in the closer vicinity of the building.

6.7.6 The spaces between and round the internal site infrastructure will be planted with a species-rich grassland.

6.7.7 The proposed attenuation pond will be created with a more irregular, organic shape and will be planted with suitable marginal and aquatic plant species.

6.7.8 An ecological mitigation area is proposed in the northern part of the site. This covers the majority of the existing 'Blackies Wood'. The proposed development will include some ecological enhancement of and provision of (controlled) access to this woodland. The Workshop building will incorporate a "brown roof" for the benefit of wildlife.

6.7.9 There is a need to fell two trees (see the Tree Survey at Appendix 8.3) to accommodate the facility, although this is not considered to be significant.

6.8 Sustainable Design and Construction

6.8.1 Sustainable design and construction means using natural resources as efficiently and sustainably as possible; reducing energy and water consumption through building design and location, adopting sustainable urban drainage systems and minimising the consumption and extraction of minerals by making the greatest possible reuse or recycling of materials in new construction. Better use of inert waste materials, particularly construction and demolition waste to substitute primary materials, is identified as key to the reduction of waste nationally.

6.8.2 The EfW CHP facility is designed not just to maximise energy recovery but to maximise the recovery of other useful resources from the residues. IBA will be processed to provide an aggregate for road building and construction. Waste water generated from the process facility will be reused to make up the water lost in the IBA quenching system. Rainwater collected from building roofs and walls will be discharged to a sustainable drainage system (SuDS).

6.8.3 The EfW CHP facility achieves a BREEAM Pre-Assessment rating of Excellent, demonstrating its sustainable design and construction credentials. For example, these include energy saving measures (electricity sub-metering, energy efficient lighting and lifts, electricity load of the development being met by energy derived from waste); water conservation measures (water efficient sanitary fittings, water meter, leak detection system and sanitary supply shut off); and Green Guide specification of materials (e.g. at least 80% of the combined area of external hard landscaping and boundary protection specifications will achieve an A or A+ rating, suppliers will be selected which operate environmental management systems, or are able to demonstrate their environmental credentials, and responsible sourcing).

6.8.4 PPS10 encourages implementation of Site Waste Management Plans during construction, to help in identifying the type of material to be demolished and/or excavated, opportunities for re-use and recovery and to demonstrate how off-site disposal will be minimised and managed. Sustainable waste management methods to be applied when dealing with the construction waste arising are set out in the Outline Site Waste Management Plan prepared by the contractor Kier and found at Appendix 15.1 to this ES. The building layout has been designed to make best use of the site and its topography and cut and fill will be balanced to minimise removal of material. Materials arising from demolition and excavation activities will be re-used on site as far as practicable including for example as backfill and for landscaping. Concrete and tarmac arising from demolition can be treated to produce high quality aggregates and re-used on site. 40,331m^3 of waste are anticipated to be generated as a result of demolition, excavation and construction, of which 32,900 m^3 are proposed to be re-used on site and 5,618 m^3 recycled.

6.9 EfW CHP Facility Operation

Hours of Operation

6.9.1 Waste will be capable of being accepted during the following hours:

Monday to Friday	08:00 – 19:00
Saturdays	08:00 – 18:00
Sundays	08:00 – 16:00
Bank Holidays (except Christmas Day and Boxing Day)	08:00 – 18:00
Christmas Day	Closed
Boxing Day	08:00 – 16:00

6.9.2 The facility will be operational 24 hours a day 7 days a week and staff will therefore be on-site outside of the opening hours indicated above.

6.9.3 MVV recognises that there may be some occasions when the SWDWP may request that the facility accepts Contract Waste deliveries outside the normal opening hours, for example in the case of an emergency or to accommodate the delivery of Contract Waste where Authorised Vehicles have been unavoidably delayed; or in other similar circumstances. It is therefore proposed that the facility be able to accept waste outside the operating hours stated above with agreement with the Local Planning Authority.

6.9.4 The Workshop building has limited doors and openings, none of which face the nearby housing, and it will normally only be used during the day.

Environmental Impact Control

6.9.5 All storage, processing and treatment of waste will take place within the confines of a building with appropriate environmental controls provided.

6.9.6 All waste, residues, products and other materials will be stored in designated on-site storage areas, bunkers or containers.

6.9.7 The site will be kept in a clean and tidy manner both internally and externally. Litter and detritus will be cleared up on a daily basis with particular emphasis on public areas. Any litter escaping the site or deposited by site users will be cleared up to a 10m distance from the site boundaries.

6.9.8 The facility has been designed, and will be maintained, such that vermin, seagulls, flies, etc will not find the facility an attractive environment.

6.9.9 The plant will be equipped with an advanced Continuous Emission Monitoring System (CEMS) which will continuously record the concentrations of oxygen, carbon monoxide, oxides of nitrogen, volatile organic compounds, particles, hydrogen chloride and sulphur dioxide.

6.9.10 Flue gas flow-rate and moisture content will also be measured to enable the mass flow of flue gases to be calculated and all measurements to be corrected to the standard reference

conditions. The CEMS will be controlled by a computer system which will analyse and store the emission data and enable the data to be reproduced and analysed in accordance with the reporting requirements contained in the Environmental Permit.

6.9.11 All waste will be tipped from vehicles in a designated reception and tipping hall which will be maintained under negative pressure to prevent fugitive emissions. Vehicle access openings will be equipped with roller shutter doors or similar. This door will normally remain open during peak delivery times; if there are long intervals expected between deliveries the door may be closed and it will normally be kept closed outside of opening hours. The door is specified as a rapid opening/closing type due to its size in order to minimise waiting time for any vehicles that do arrive when the door is closed. It will not be opened and closed between each delivery vehicle movement.

6.9.12 Waste arriving at the site will be processed in a timely fashion in accordance with the principles of Good Industry Practice. All waste being stored prior to combustion will be stored within a designated storage bunker. If there is the requirement for increased waste storage above the normal storage time, the waste baling facility can be used to bale, wrap and store the waste inside the enclosed bale store.

6.9.13 Waste from the offices on site will be disposed of in accordance with the waste hierarchy and all relevant waste legislation.

6.9.14 Odour will be further controlled by drawing the combustion air required by the combustion plant from the waste bunker, bale store and IBA bunker areas. During plant shut down the air is extracted from the waste bunker and bale store by a separate exhaust system and treated by a combined dust filter and activated carbon filter which is located in the boiler house.

6.9.15 Vehicle access openings will be equipped with roller shutter doors or similar which will be closed when not in use. Odour emissions from the bunker will be prevented by a double lock door system, each tipping bay inside the tipping hall and the tipping hall itself being equipped with roller shutter doors.

6.9.16 MVV will develop and implement an Odour Management Plan to ensure that odours are appropriately controlled. Regular inspections and sniff tests around the perimeter and operational area of the site will be undertaken to establish whether odours are being produced and/or carried off the site. Results of odour assessments will be recorded as soon as they have been completed and by the person who completed them. These records will be available for inspection by the relevant authorities.

6.9.17 Quality and Environmental Management Systems, compliant with ISO 9001 and ISO 14001, will be implemented. As part of the Quality and Environment Management System, an Environmental Impact Control Method Statement will be developed, maintained and updated on a monthly basis. The Method Statement will include the procedures and actions required to:

- Minimise the environmental impacts of transporting, receiving, treating and disposing of Contract and Non-Contract Waste.
- Meet environmental conditions and applicable legislation.
- Minimise amenity impacts on the local population.
- Maintain the grounds and visual integrity of the building, cladding, external boundaries and fencing.

- Operate a web site on which the environmental monitoring results will be published.

6.9.18 A colour capable Closed-Circuit Television (CCTV) monitoring system will be provided to cover and record key areas including the weighbridge, queuing area, access routes, pedestrian routes, un-loading and loading areas. The system will also cover unauthorised access to the site and be operational during hours of darkness or poor lighting. Space will be provided for storing the recorded material and information for 90 days.

6.10 Residual Municipal Solid Waste (MSW) Collection Arrangements

Current Arrangements

Plymouth

6.10.1 Residual MSW collected in Plymouth is taken to the Chelson Meadow Refuse Transfer Station (RTS) where it is bulked up and then transported for disposal at the Lean Quarry landfill site in Cornwall.

6.10.2 Street sweepings, fly-tipped waste, bulky waste and litter are delivered to the Prince Rock Transfer Station at which they are bulked up and transported for disposal at Lean Quarry landfill site in Cornwall.

Devon – South Hams

6.10.3 Residual MSW collected in South Hams is, depending on proximity, either taken to Waste Transfer Stations (WTS) at Paignton or Kingsbridge where it is bulked up and then transported for disposal at the Heathfield landfill site near Newton Abbot, or to the RTS at Chelson Meadow where it is bulked up and then transported for disposal at the Lean Quarry landfill site in Cornwall.

Devon – West Devon

6.10.4 Residual MSW collected in West Devon is taken to the WTS at Crowndale in Tavistock, at which it is bulked up and then transported for disposal at the Lean Quarry landfill site in Cornwall.

Devon – Teignbridge

6.10.5 Residual MSW collected in Teignbridge is taken direct to the Heathfield landfill site near Newton Abbot.

Torbay

6.10.6 Residual MSW collected in Torbay is taken to the Paignton WTS, where it is bulked up and then transported for disposal at the Heathfield landfill site near Newton Abbot.

Changes to Arrangements Arising from use of EfW CHP Facility

Plymouth

6.10.7 Refuse Collection Vehicles (RCV) containing residual MSW will deliver straight to the EfW CHP facility. Residual MSW arising from the Chelson Meadow Materials Recovery Facility and Civic Amenity site and the Weston Mill Civic Amenity site will be bulked up and directly transported for disposal at the EfW CHP facility.

6.10.8 Street sweepings, fly-tipped waste, bulky waste and litter will continue to be delivered to the Prince Rock Transfer Station at which they will be bulked up and transported for disposal at the EfW CHP facility.

6.10.9 The Chelson Meadow RTS will no longer be required for bulking waste when the EfW CHP facility becomes operational because RCVs will deliver directly to the EfW CHP facility. However, two potential alternative uses have been identified for the Chelson Meadow RTS by

Plymouth City Council's Waste and Street Services department. The first use is to construct a new MRF in the RTS to replace the existing MRF which is nearing the end of its operational life. The second use would be to lease the RTS to a private sector company to bulk up commercial and industrial waste.

Devon – South Hams

6.10.10 Some of the residual MSW collected in the South Hams will continue to be taken to the Paignton and Kingsbridge WTSs, from where the bulked up waste will be taken to the EfW CHP facility. For the areas of South Hams in proximity to Plymouth, waste collection vehicles will deliver directly to the EfW CHP facility.

Devon – West Devon

6.10.11 Residual MSW collected in West Devon will continue to be taken to the WTS at Crowndale in Tavistock, at which it will be bulked up and then transported for disposal at the EfW CHP facility.

Devon – Teignbridge

6.10.12 Residual MSW collected in Teignbridge will be taken direct to a new WTS to be constructed – most likely to be at Heathfield near Newton Abbot – where it will be bulked up and then transported to the EfW CHP facility.

Torbay

6.10.13 The residual waste would continue to be bulked up at the Paignton WTS, but instead of being transported to the Heathfield landfill site it would be transported to the EfW CHP facility.

6.11 Construction

Introduction

6.11.1 This section presents information on the construction:

- Team.
- Programme.
- Works.
- Safety and security.
- Traffic.
- Working hours.
- Employment.
- Management of construction environmental effects and waste.

6.11.2 This section of the ES has been developed by MVV and its engineering contractors as well as Scott Wilson.

Team

6.11.3 MVV O&M GmbH will act as the EPC Contractor for the project[1]. MVV O&M GmbH is a wholly-owned subsidiary of MVV Umwelt GmbH. MVV O&M GmbH has built numerous EfW facilities in Germany and currently operates five of these. MVV O&M specialises in the procurement, design, engineering, and construction of EfW facilities and biomass plants.

6.11.4 MVV O&M will employ a variety of international and local subcontractors to deliver the facility.

Programme

6.11.5 Subject to obtaining planning permission, construction is expected to occur between early 2012 and late 2014 and to take approximately 35 months (including the mobilisation, main construction and commissioning phases).

Works

6.11.6 For the purposes of summarising the construction programme and activities in this ES, the construction programme is split in to four general phases:

- Mobilisation and Early Works
- Main Works
- Process Installation

[1] 'O&M' stands for operations and maintenance and 'EPC' stands for engineering, procurement and construction.

- Commissioning

Mobilisation and Early Works

6.11.7 A construction compound will be established on the land known as 'Table Top Mountain', to the south west of the proposed EfW CHP facility.

6.11.8 The scope of the mobilisation and early works will include:

- Discharge of any pre-commencement planning conditions;
- Additional geotechnical site investigation;
- Detailed civil and structural engineering designs;
- Temporary works designs;
- Relocation of the outside perimeter MoD fence;
- Preparation of a fully integrated and coordinated programme;
- Preparatory works for the site mobilisation;
- Connection to temporary electricity supply, most likely to be fed from the existing supply at Bull Point;
- Construction of the MoD access road to Bull Point (see Appendix 6.6 for construction method statement with focus on avoiding / minimising impacts on the water environment); and
- Construction of the access road from the Camel's Head gate to the site.

Main Works

6.11.9 Following completion of these early works, the main site earthworks and piling will be carried out by the civil contractor.

6.11.10 It is proposed to raise the level of the site with inert selected granular material to provide a level platform at 9m AOD. This will minimise the extent of excavation in difficult ground conditions whilst raising the deeper elements of the structure (the waste bunker) thus reducing the level of dewatering required during construction.

6.11.11 Groundwater monitoring has been undertaken across the site. Existing investigations indicate that ground water level varies between approximately -2.6m and 2.1m AOD and are likely to be influenced by tidal fluctuations. Tidal predictions indicate a high tide of approximately 6m AOD in the Devonport area.

6.11.12 The deepest areas of the main building are the waste bunker and the water tanks. The majority of the waste bunker will be founded at a level of approximately 7m AOD and a deeper waste delivery area at a level of approximately 0m AOD. Ground water levels obtained from previous investigations suggest the deeper portion of the bunker will be within the water table therefore dewatering will be required during construction. The optimum solution that has been developed is to use a secant piled wall with grout curtain for the retaining walls of the waste bunker. When

the retaining wall is completed the ground will be excavated within and well points and a temporary water pump will be installed until the base of the bunker has been completed and made watertight. The groundwater has high sulphate levels and as such measures have been included to allow for mitigation regarding disposal to the estuary as follows: Dewatering discharge may require treatment to ensure that it does not have any adverse impacts to receiving water bodies. Treatment may include, but is not limited to, sediment filtration, settlement or neutralisation. Final proposals will be dependent on further sampling during construction.

6.11.13 The excavated material has been identified as suitable for re-use on an industrial site and as such the design has been based on all material being re-used on site. This significantly contributes towards the SWDWP aspiration for significant reduction in waste to landfill.

6.11.14 It is proposed to found all areas of the main structure on piled foundations extending approximately 7m into the Saltash Formation (shale bedrock). Records from current site investigations confirm the presence of buried concrete, steel and timber obstructions within the made ground that limits the options available for pile installation. Underlying the made ground is a layer of alluvium, beneath which is shale bedrock. The risk of obstructions in the ground has resulted in the selection of large diameter rotary bored piles as the most suitable method of piling. Pile arisings will require lime stabilisation to dry out and be suitable as engineering fill in the hardstanding areas.

6.11.15 The external hardstanding areas of the site will take the form of a concrete hardstanding founded on a 150mm thick layer of well compacted Type 1 granular material. This construction make up will overly the existing granular formation at lower levels and a well compacted granular fill material used to raise the main site level to 9m AOD. Transition slabs will be provided at all level access points into the building.

6.11.16 Grading of the site access routes will be required to provide a constant grade to make up approximately 5m from the new site access bridge across the creek. The new bridge will take the form of a two-way access composite steel and concrete bridge spanning approximately 18m with abutment foundations founded on the saltash bedrock formation. See Appendix 6.5 for construction method statement with focus on avoiding / minimising impacts on the water environment.

6.11.17 Foundations for the ACCs will be constructed. See Appendix 6.4 for construction method statement with focus on avoiding / minimising impacts on the water environment.

6.11.18 The erection of concrete structures and steelwork framing, and roof and wall cladding, will then take place.

Process Installation

6.11.19 Process installation will partly overlap with the main works and will include the installation of grate and boiler works, baling plant works, ACC and auxiliary coolers, the turbine, a water treatment plant, balance of plant and APC system.

Commissioning

6.11.20 Following the completion of main works and process installation there would be a period of start-up and testing known as ‘commissioning’. This will end with an acceptance test before the planned service commencement date.

Safety and Security

6.11.21 The necessary infrastructure and personnel to provide a secure and safe construction site will be provided and equipment to control unauthorised access to the site will be installed. This includes:

- Site security fencing around the entire site perimeter;
- Appropriately positioned CCTV system;
- Full time (24 hour, 7 days a week) attendance of security personnel;
- Access control at all entrances to and exits from the site;
- Adequate lighting; and
- Acoustic and visual fire and emergency alarm system.

6.11.22 Before the commencement of the construction works on site, MVV will develop in close cooperation with the local fire, emergency and Police authorities adequate Safety and Security Plans for the construction site in accordance with BS9999. A first step will be the Fire Risk Assessment, followed by a Fire Risk Audit. The identified fire risks in the Fire Risk Assessment and the Fire Risk Audit will be addressed appropriately and fire prevention measures will be developed and made accessible to the site personnel.

6.11.23 The construction site will be lighted adequately to ensure safe working conditions. All lighting will be positioned and adjusted so that it does not cause a nuisance to neighbouring properties. Night time illumination, outside of working hours, will be reduced to a minimum commensurate with the need to maintain the security requirements of the site and the Dockyard, to reduce the environmental impact, and reduce light pollution.

6.11.24 All systems will be regularly inspected and maintained:

- Daily visual inspections of the fence line;
- Daily inspections of the CCTV;
- Regular testing of the audible and visual emergency warning system; and
- Any identified faults or damage will be repaired promptly.

Traffic

6.11.25 To accompany the Transport Assessment, a Framework Construction Travel Plan has been prepared (see Annex E of Appendix 12.1). Within that document an assessment of the associated construction traffic movements has been presented including vehicle movements associated with both HGV deliveries as well as staff movements.

6.11.26 The number of construction staff will fluctuate over the construction period (as shown in Annex E of Appendix 12.1) and in order to minimise traffic congestion, a specific off site parking area has been identified at Goschen Yard. This is located off Saltash Road, approximately 1.4km from the EfW CHP facility. Free buses will be provided to transport staff to the site at the beginning of the day and from the site at the end of the day.

6.11.27 It is intended that parking will be provided on site for supervising staff, who are less likely to be on site everyday and may not stay for the whole day, as they may also visit other sites. All vehicles entering (and exiting) the site will be required to pass through a security control point. Notwithstanding this, parking on site will be provided within a defined area which unauthorised vehicles will not be permitted to use.

6.11.28 In order to avoid fouling of the public highway the following measures will be put into place:

- An automatic wheelwash (or similar) will be provided prior to construction commencing and installed as part of the early works.
- A road sweeper will keep the access roads clean.

Working Hours

6.11.29 Normal working hours during the construction period are anticipated to be:

Monday to Friday	08:00 – 18:00
Saturdays	08:30 – 13:00

Routine maintenance of plant and equipment may be carried out outside of normal working hours.

There may be instances where certain construction activities which have started and cannot be interrupted (e.g. concrete pours) continue beyond normal working hours but such instances will be minimised as far as possible.

Management of Construction Environmental Effects and Waste

6.11.30 A Construction Environmental Management Plan has been prepared by Kier and can be found at Appendix 6.3.