Chapter 6

WASTE MANAGEMENT IMPLICATIONS

6. WASTE MANAGEMENT IMPLICATIONS

Introduction

6.1 The proposed project involves the decommissioning, demolition and decontamination of the Cheoy Lee Shipyard (CLS) at Penny's Bay to provide land for the construction of Hong Kong Disneyland Phase 1 and its associated infrastructure. Wastes to be generated during decommissioning and demolition are expected to comprise excavated spoil, construction and demolition (C&D) material, asbestos-containing material (ACM), general refuse, abandoned equipment, and chemical waste.

6.2 Under the Air Pollution Control Ordinance (APCO), asbestos surveys were carried out in March 2001 and April 2001 for visual inspection and sampling of ACM. Such findings have been documented in the Asbestos Investigation Report (AIR) and recommendations to remove ACM have been detailed in the Asbestos Abatement Plan (AAP). To avoid inadvertent disturbance of the ACM by other parties prior to commencement of CLS decommissioning, Project Profile of Asbestos Abatement work in CLS at Penny's Bay were prepared for the application of Environmental Permit (EP) direct in August 2001. An EP has been issued in October 2001. As such, the environmental impacts that may arise during asbestos abatement work are not evaluated further in this report.

6.3 During the operation of the shipyard, various chemicals (i.e. paints, lube oil, etc.) were used and different chemical wastes (i.e. metallic slag wastes, ash) were generated by many processes (i.e. plating, smelting, burning, etc.). Such chemicals might have been spilled or leaked onto concrete floor and then subsequently into the subsurface soil and groundwater. Extent of contamination caused by historical shipyard operation as well as the proposal of remediation measures are discussed in Section 4 of this Report. Therefore, the environmental issues pertaining to contaminated soil and groundwater are not discussed in this section.

6.4 This section focuses on the management of waste arising from this Project, but excluding the remediation of contaminated soil and asbestos abatement work. This section also describes the type and estimated quantities of materials that will remain on site after relocation of the shipyard operation, the waste arising due to the decommissioning of CLS as well as the waste generation from the off-site treatment area at TKW. Recommendations for handling and disposal of the identified wastes will be provided to minimise the waste management implications.

Environmental Legislation, Standards and Evaluation Criteria

6.5 The following legislation relates to the handling, treatment and disposal of wastes in the HKSAR and will be used in assessing potential impacts:

- *Waste Disposal Ordinance (Cap 354)*;
- *Waste Disposal (Chemical Waste) (General) Regulation*;
- *Land (Miscellaneous Provisions) Ordinance (Cap 28)*:
- *Public Health and Municipal Services Ordinance (Cap 132) – Public Cleansing and*

Prevention of Nuisances Regulations

6.6 The following documents, circulars and guidelines which relate to waste management and disposal in HKSAR will also be referred to during the study:

- *Waste Disposal Plan for Hong Kong (December 1989)*, Planning, Environment and Lands Branch, Hong Kong Government Secretariat;
- *Environmental Guidelines for Planning in Hong Kong (1990)*, Hong Kong Planning Standards and Guidelines, Planning Department;
- *New Disposal Arrangements For Construction Waste (1992)*, Environmental Protection Department And Civil Engineering Department;
- *Code Of Practice On The Packaging, Labelling And Storage Of Chemical Wastes*, Environmental Protection Department;
- *Waste Reduction Framework Plan*, 1998-2007 (1998), Planning, Environment and Lands Branch, Hong Kong Government Secretariat;
- *Works Branch Technical Circular (WBTC) No. 2/93, Public Dumps*;
- *WBTC No. 2/93B, Public Filling Facilities*;
- *WBTC No. 16/96, Wet Soil in Public Dumps*;
- *WBTC No. 4/98 & 4/98A, Use of Public Fill in Reclamation and Earth Filling Projects*;
- *WBTC No. 5/98, On Site Sorting Of Construction Waste On Demolition Sites*;
- *WBTC No. 5/99 & 5/99A, Trip-ticket System for Disposal of Construction and Demolition Material*;
- *WBTC No. 19/99, Metallic Site Hoardings and Signboards*;
- *WBTC No. 25/99, 25/99A & 25/99B, Incorporation of Information on Construction and Demolition Material Management in Public Works Subcommittee Papers*;
- *WBTC No. 12/2000, Fill Management*;
- *WBTC No. 29/2000, Waste Management Plan*;
- *Code of Practice on Asbestos Control* (4 sets);
- *Code of Practice – Safety and Health at Work with Asbestos*;
- *Code of Practice on the Handling, Transportation and Disposal of Asbestos Waste*;
- *A Guide to the Chemical Waste Control Scheme* and *A Guide to the Registration of Chemical Waste Producer.*

Chemical Waste

6.7 Under the *Waste Disposal (Chemical Waste) (General) Regulation* all producers of chemical waste must register with EPD and treat their wastes, either utilising on-site plant licensed by EPD, or arranging for a licensed collector to transport the wastes to a licensed facility. The regulation also requires the waste producer to pack, label and store chemical waste properly before collection.

Construction and Demolition (C&D) Materials

6.8 The current policy relating to the dumping of construction and demolition (C&D) material is documented in the *Works Branch Technical Circular No.2/93, "Public Dumps"*. Construction and demolition materials that are wholly inert, namely public fill shall not be disposed of to landfills, but taken to public filling areas (PFAs) which usually form part of reclamation schemes. The *Land (Miscellaneous Provision) Ordinance* requires that dumping licenses be obtained by individuals or companies who deliver public fill to PFAs. The licenses are issued by the Civil Engineering Department (CED) under delegated powers from the Director of Lands.

6.9 In addition to the Works Branch Technical Circular, EPD and CED have produced a leaflet entitled '*New Disposal Arrangements for Construction Waste' (1992)* which states that C&D material with less than 30% by weight (or 20% by volume) of inert material (i.e. public fill) will be accepted at landfill. If the material contains more than 30% inert material by weight, the waste must be sorted and sent to PFA and the non-inert material (i.e. C&D waste) can be sent to landfill for final disposal.

Assessment Methodology

6.10 The criteria for evaluating the potential waste management implications are set out in Annex 7 of the EIAO-TM. The method for assessing potential waste management impacts arising from the project follows those presented in Annex 15 of EIAO-TM and include the following:

- Estimation of the types and quantities of the waste generated;
- Estimation of the timing of generation of each type of waste;
- Assessment of potential impacts from the management of solid waste with respect to potential hazards, air and odour emissions, noise, wastewater discharges and transport; and
- Impacts on the capacity of waste collection, transfer and disposal facilities.

Baseline Condition

6.11 Prior to SI for land contamination assessment, site reconnaissance was undertaken during December 2000 when the shipyard was still operational. A number of surface samples were collected from certain areas of the site suspected as being impacted. Samples were collected at the following locations (refer to Figure 6.1a for the site layout):

- Composite grab sample (Sample 1) of foundry wastes on ground adjacent to Building N.
- Composite grab sample (Sample 2) of foundry sands from foundry floor of Building L.
- Composite grab sample (Sample 3) of dark grey-black ash residue material from aluminium smelter in rear of Building D.
- Grab sample (Sample 4) of bright yellow powder from floor of electroplating shop of Building D.
- Grab surface soil sample (Sample 5) from dark brown surface crust on ground surface in the vicinity of an old solvent still.

6.12 The above samples were all analysed for heavy metals, and chromium VI. VOCs were tested for some samples and the results are summarised below. According to the laboratory results, elevated levels of metals and PAHs were noted.

Table 6. 1 Reconnaissance Soil Sampling Results (Metals)

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Silver	0.9	0.5	34.2	0.3	0.2
Arsenic	2	7	18	11	2
Barium	41	53	740	141	230
Cadmium	0.4	4.2	5.2	0.5	0.4
Chromium	100	2,344	421	9,223	30
Chromium VI	N/A	N/A	N/A	4,909	N/A
Cobalt	20	36	7	11	8
Copper	102	929	209g/kg	432	164
Molybdenum	23	360	70	38	3
Nickel	63	1,857	486	389	15
Lead	29	626	1,031	118	90
Antimony	1	15	30	6	2
Zinc	66	1,491	674	308	382
Mercury	1.3	<0.1	0.2	<0.1	<0.1

Note: Unit in mg/kg or otherwise specified.

Table 6. 2 Reconnaissance Soil Sampling Results (PAHs)

	Sample 2	Sample 3	Sample 5
Naphthalene	<700	1,330	<700
Acenaphthalene	<433	913	<433
Acenaphthene	<167	1,270	<167
Fluorene	<180	4,610	<180
Phenanthrene	<500	30,900	<500
Anthracene	<320	2,320	<320
2-Methylnaphthalene	<223	6,130	<223
Benzo(b,k)fluoranthene	<1,067	471	<1,067
Benzo(a)pyrene	<533	92	<533
Chrysene	<467	1,080	<467

	Sample 2	Sample 3	Sample 5
Fluoranthene	<567	3,050	<567
Pyrene	<867	12,300	<867
Benz(a)anthracene	<433	496	<433
Indeno(1,2,3-cd)pyrene	<200	<200	<200
Dibenz(a,h)anthracene	<77	<77	<77
Benzo(g,h,i)perylene	<223	<223	<223
Low MW PAHs	<2,523	47,500	<2,763
High MW PAHs	<4,434	17,500	<4,434
Total PAHs	<6,957	65,000	<7,197

Note: Unit in μg/kg or otherwise specified.

Identification of Impacts

6.13 As discussed in Section 4, the decommissioning work is scheduled to start in July 2002 and will be completed in December 2005. Major activities to be carried out in relation to waste management to this particular Project include:

- Site clearance;
- Building demolition;
- Slope improvement works behind CLS;
- Land formation of CLS after decommissioning;
- Construction & operation of decontamination systems on- site and off-site; and
- TKW Decommissioning including site reinstatement, removal of chemical wastes and abandoned equipment.

6.14 The nature of each type of waste expected to be generated over the course of this Project is discussed below together with an evaluation of the potential environmental impacts.

Demolition and Decommissioning Phase

6.15 Decommissioning of CLS will consist of asbestos removal, decommissioning and demolition of the twenty-five existing buildings/ workshops, and on-site treatment. As mentioned previously, asbestos removal and details of treatment of contaminated soil (site remediation technologies) will not be addressed in this section.

6.16 During decommissioning and demolition, the following wastes are expected:

- Site clearance waste;
- C&D material;
- General refuse; and
- Chemical waste.

Slope Improvement Phase

6.17 As part of the scope of decommissioning of CLS, slope improvement work will be carried out in hill slopes behind CLS. Such works will comprise cut slope and fill slope. The proposed slope works will generally consist of the following activities:

Earthworks	Slope trimming to improve gradient for landscaping works
Soil Nailing	Formation of holes into slope by drilling, steel bar installation and grouting.
Drainage Improvement	Construction of concrete drainage channels and provisions of subsoil drains
Landscaping Works	Grassing and tree planting.

6.18 Waste arising from slope stabilisation will include:

- Soil and rock from excavation;
- Concrete blocks;
- Vegetation; and
- General refuse.

Land Formation Phase

6.19 The subject shipyard is relative flat and low lying with levels of formation varying between +3.5 mPD and +5.5 mPD. The land formation works will involve the filling of CLS to an average level of +11.0 mPD requiring fill material of around 1.5Mm^3. Works will also include:

- Provision of stormwater drainage system;
- Laying of utilities; and
- Landscaping works.

6.20 C&D material will be generated from the above activities.

Remediation Phase

6.21 As discussed in Section 4, there will be both on-site and off-site soil treatment at CLS and TKW respectively. Pure metal-contaminated soils in CLS will be solidified on-site whereas the other contaminated soil will be excavated, packaged where necessary and transported by trucks to the designated decontamination work site at TKW. Given this arrangement, the types of waste generated at each stage in relation to remediation are identified as follows.

Cheoy Lee Shipyard Site

6.22 Remediation activities carried out at CLS will be primarily soil excavation and solidification of metal-contaminated soil. During the excavation and soil solidification, the following

wastes would be generated.

- Contaminated soils;
- C&D material arising from the construction of the on-site solidification plant;
- Small quantities of chemical wastes including buried drums that hold chemicals and buried asbestos materials, and wastes in connection with the maintenance of backhoes & equipment for excavation; and
- Workforce waste.

Collection and Transportation of Waste from CLS to TKW

6.23 It is proposed in Section 4 that contaminated soils from CLS will be treated at TKW whilst other chemical waste will be collected by licensed collectors for disposal at the appropriate licensed disposal facilities. Dump trucks will be employed to relay the excavated materials from the point of excavation to the unloading point at TKW.

6.24 Dioxin-contaminated soils (as classified as chemical waste) that require extra care of handling will be transported by roll-off trucks. This provides the most effective way to control the handling of such hazardous wastes and minimise the chance of spillage/ leakage during transportation.

Off-Site Treatment Works

6.25 While constructing and operating the treatment work, wastes of the following categories will be generated at TKW.

- C&D material arising from site preparation, setting up & commissioning of the decontamination plants,
- End products/ treatment residues of the decontamination processes,
- Chemical waste arising from the equipment/ plant maintenance, and
- Workforce waste from the plant operatives.

TKW Decommissioning Phase

6.26 After successful completion of remediation at TKW, the subject site will be reinstated/ restored to an environmentally acceptable condition. TKW Decommissioning will consist the following:

- Decommissioning of the thermal desorption plant, the associate equipment and other decontamination system;
- Demolition of storage structures, associated drainage and leachate collection and treatment systems;

6.27 Wastes anticipated from the above works will mainly be C&D material and scrap metal. No

significant waste arising is expected for the decommissioning of the thermal desorption plant as the whole plant will be dismantled and shipped back to the supplier.

Prediction and Evaluation of Environmental Impacts

Demolition and Decommissioning Phase

Site Clearance Waste

6.28 It is expected that the site clearance will involve limited clearance of vegetation with low ecological value as the rare species shall be transplanted as recommended in the *Theme Park EIA* and also Section 8 of this report. No insurmountable impact is expected if such waste is disposed of properly at approved strategic landfills.

C&D Material

6.29 The overriding concerns for building demolition will be safety and minimisation of environmental impacts. To this end, a top-down and non-blasting approach demolition method is selected and it forms the basis of environmental assessment of this Project. C&D material will comprise unwanted material generated during demolition. Based on the size of each building as shown in the following table, it is estimated that around 10,000m^3 C&D material will be generated.

6.30 Contaminated residues remaining on the indoor building surfaces, floors and equipment would cause environmental and health concerns if not handled properly during demolition. Site inspection revealed that three buildings (namely Buildings D, J & L as shown in Figure 6.1a) with half of their indoor surfaces are contaminated due to historical operation. Such material requires proper treatment or removal prior to building demolition

Table 6. 3 Existing Buildings in CLS

Building ID	Usage	Size
A	Company Store	9m x 46m
B	Plating, anodising and lab	19m x 67m
C	Warehouse	9m x 46m
D	Hull moulding and pressing workshop, aluminium smelter	43m x 46m
E & F	Security guards quarters and staff canteen	6m x 32m
G	Worker's canteen	9m x 14m
H	Dangerous Goods Stores	3m x 18m + 9m x 10m
I	Machine Shop	18m x 32m
J	Lost wax store	18m x 32m
K	Fiberglass hull construction workshop	43m x 46m
L	Foundry	18m x 46m
M	Former rolling mill	Removed prior to 1991
N	Metal stamping	9m x 14m
O	Sawmill and moulding shed	24mx 73m

Building ID	Usage	Size
P	Leather dressing, stores, and vehicle maintenance shed	15m x 37m
R	Fibreglass boat finishing	47m x 47m
S	Boat finishing	43m x 70m
T	Boat finishing and painting	33m x 70m
U	Fire suppression pump house	5m x 10m
V	Moulding lofting room, paint booth and mould mock-up building	44m x 70m
W	Welding/ metal workshop	25m x 25m
X	Shot-blasting	11m x 26m
Y	Metal workshop/ hull finishing	19m x 58m
Z	Metal boat/ metal sheet fabrication	19m x 43m

General Refuse

6.31 There are several areas within the subject shipyard which have stockpiled materials. Surveys of the shipyard were conducted in September 2001 to visually identify the waste remaining on site (summarised in Figures 6.1b to 6.1ae). The types of general waste are classified below:

- General debris;
- Workforce waste;
- Wood/ timber and railing of slipways;
- Steel hangars;
- Old furniture and racks;
- Ship wreckage;
- Wooden/ steel piers;
- Disused machines; and
- Scrap metals.

6.32 The storage of general refuse has the potential to give rise to environmental impacts. These include water quality, if waste enters nearby water bodies, odour and visual impacts. The site may also attract pest and vermin if the waste storage areas are not well maintained and cleaned regularly. In addition, disposal of waste at sites other than approved waste transfer stations or disposal facilities can also lead to environmental impacts.

6.33 Provided that the refuse is stored and transported in accordance with good practices and disposed of at approved strategic landfills, the potential impacts will be insignificant. It is expected that the quantity will not exceed 1,000 tonnes steel and 5,000m^3 general debris.

Chemical Waste

6.34 During site surveys in September 2001 (the survey findings are summarised in Figures 6.1b to 6.1ae), the following chemical wastes were identified:

- Asbestos (findings already highlighted in AIR)
- Leftover chemical residues or deposits (i.e. metal slag, PAHs);
- Acid containing battery cells;
- Paint containers with uncured solvent-based paint; and
- Waste oil and solvent.

6.35 Based on visual observations, the quantities are estimated below:

Table 6. 4 Findings of Waste Survey

Chemical Waste	Quantities (No. or otherwise stated)
Paint Cans	46
Oil Drums	10
Battery Cell	35
Chemical Cans	46
Chemical Powder Bags	11
Suspected PCB containing Transformer	1
BCF Sprinkler System in DG Stores	6
Leftover Chemical Deposit	$100m^3$
Buried Chemical Drums	3
Disused Equipment such as transformer	5

6.36 Chemical waste may pose serious environmental, health and safety hazards if it is not properly managed. These hazards may include:

- Fire hazards;
- Adverse environmental effects from spills; and
- Toxic effects to workers.

6.37 To ensure proper handling of such waste, the Demolition Contractor shall register with EPD as chemical waste producer. As shown above, the quantity is relatively small and will be readily accepted at the Chemical Waste Treatment Centre (CWTC) at Tsing Yi or SENT Landfill. In addition, the storage, handling, transport and disposal of chemical waste shall be in accordance with the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes* issued by EPD.

6.38 Wherever possible, opportunities shall be explored to reuse and recycle materials. The Contractor responsible for decommissioning the shipyard shall ensure proper sorting and

segregation of chemical wastes so that the wastes can be appropriately handled and treated. For instance, oily waste containing high percentage of recyclable content can be recovered at a licensed waste oil re-refinery plant. To maximise the opportunity for recycling/ reuse, during the decommissioning stage, recoverable chemical wastes (in particular oil, paint and solvent) shall be separated from the rest and collected by licensed collector for recovery at licensed plant where the waste oil will undergo a series of processes such as pretreatment, phase separation, and multi-distillation. After that, the re-refined oil can be blended with various additives for reuse (i.e. lubricant, motor oil, etc).

6.39 Provided that the mitigation measures and recommendations are strictly implemented, the potential environmental impacts arising from the storage, handling and disposal will be minimal.

Slope Improvement Phase

6.40 The scope of the slope improvement works relevant to this Project is shown on Figure 6.2. It is anticipated that the works will take around 1 year to complete. The activities of the proposed slope works behind CLS are summarised as follows:

Table 6. 5 Scope of Slope Improvement Works for CLS

Activities	Quantity
Soil Excavation	40,000m^3
Rock Excavation	2,100m^3
Soil Nailing	634 nos.
Raking Drains	179 nos.

6.41 Soil and rock generated will be reused within the subject shipyard to the extent possible (i.e. landscape berm formation). The general refuse and vegetation will be transported off-site for ultimate landfill disposal.

Land Formation Phase

6.42 Land formation works will include the removal of seawall blocks and demolition of jetties. Note that the general removal of the upper section of the existing wall is not required as such structure is significantly below the required formation level. However, in some locations the removal of the seawall may be required to allow for construction of piled bridge foundations (associated infrastructure works for the development of Theme Park, Penny's Bay Section of the Chok Ko Wan Link Road). The estimated quantity of C&D material generated is around 5,000m^3.

Remediation Phase

Cheoy Lee Shipyard Site

6.43 According to the findings of land contamination assessment presented in Section 4, some soils contaminated with heavy metals, TPH, SVOCs and dioxins of around 87,000m^3 will need to be excavated and treated either on-site at CLS or off-site at TKW. The potential air and water quality impacts arising from the excavation and mitigation measures have been addressed in the respective Sections of this Report.

6.44 In the trenching investigation conducted from June to November 2001, the burn pit area (Area 3) was found to have a few drums holding chemicals (resembling fibreglass resins) inside and some asbestos corrugated cement sheets buried. Their exact quantities will be confirmed until they are exposed during excavation. They shall be regarded as chemical wastes and their handling and disposal procedures shall be in compliance with the *Waste Disposal (Chemical Wastes) (General) Regulation.*

6.45 As recommended in Section 4 of this Report, on-site solidification of metal-contaminated soil will be carried out after excavation and site preparation. The solidified soil can then be used as public filling materials. The quantity of treated soil would be roughly about 10% (bulking factor) more than that of the contaminated soil, which is about 52,800m^3.

Collection and Transportation of Waste

6.46 Contaminated soil of around 39,000m^3 will need to be moved between CLS and TKW. Contaminated soil shall be carried by trucks via a temporary access road along the south side of the Lantau Airport Railway (LAR). The trucks could carry the contaminated soil in various arrangements depending on the type of contaminants. Contaminated soil earmarked for biopiling and solidification could be trucked in bulk, placed in the rear of dump trucks with capacities typically between 6 to 10 cum with appropriate cover such as impermeable (HDPE) sheeting securely fixed in position over the material in the hold to protect against wind and rain. The material will be moved from the shipyard via the temporary access road to Road P2 then via the proposed temporary access road along the LAR from Yam O to To Kau Wan, refer Figure 6.3.

6.47 Assuming the road shipment of a total of around 9,000m^3 of material for biopile treatment (over a period of around 6 months) the average daily shipment might be 58m^3/day, which equates to between 6 and 10 laden trips per day. However, allowing for the actual programmed rates of excavation over the 6 month period the laden truck trip rate is estimated to vary up to between 27 and 53 laden trips per day. This equates to up to 3 to 5 laden trips per hour over 10 hours. Precautionary measures to minimise environmental impacts include:

- Truck loading shall be monitored to ensure that loss of material does not take place during transportation.
- Transportation would be subject to the Contractors rescue and contingency plans.
- Limitation of the number of laden truck trips to 6 vehicles/hour.
- Speed limitation to 50km/hour.

6.48 At To Kau Wan the dump truck could then deliver the material to the storage area where it would be placed within the biopile stockpile by earth moving equipment. Similar arrangements will be carried out at the CLS storage area for on-site solidification works. This is one of various feasible material handling methodologies for general contaminated material which is shown in Figures 6.4a and 6.4b.

6.49 Other more significant waste material such as the material contaminated with dioxins shall be placed in roll-off trucks and effectively containerised. This provides for the most effective way to control the handling of such waste material.

6.50 The material contaminated with dioxin shall be placed in top loaded roll-off containers, which have hard covers that can be securely shut and back door for tip disposal. Based on an average waste material density of 1.89 tonnes per cubic metre, the nett weight of a typical container with 6 to 12m^3 of waste would be around 11 to 22 tonnes. This is comfortably within the normal range of capacity of the roll off truck.

6.51 Assuming the road shipment of a total of around 30,000 m^3 of dioxin contaminated soil over a period of around 6 months the average daily shipment might be up to 192m^3 per day. This might equate to about 16 to 32 laden trips per day. Allowing for actual programmed rates of excavation over the 6 months, the laden trip rate is estimated to vary up to between 19 to 38 per day. This equates to up to 2 to 4 trips/hour over 10 hours.

6.52 When the trucks approach the TKW Site, they will approach from west well clear of the east side of the site thereby avoiding any disturbance to the area where the group of egrets was sighted.

6.53 At To Kau Wan the containerised dioxin-contaminated material would be unloaded in the normal manner within the enclosed material storage building and redistributed by small front-end loaders to the required area of the building. The storage building would be fully enclosed during operations to prevent losses of contaminated material. The material storage building would have a controlled internal drainage system to collect any leachate from the contaminated material. The above outline is one of various feasible material handling methodologies for dioxin contaminated material which is shown diagrammatically in Figure 6.5. The leachate collected shall be treated on-site at the centralised wastewater treatment unit (a mitigation measures proposed in Section 7 of this Report for the on-site treatment of thermal desorption area runoff, decontamination water and wastewater from wheel washing) and subsequently tested for dioxin prior to discharge into the stormwater drainage system. No detectable dioxin in the effluent shall be allowed.

Risks of Road Accidents during Transportation of Waste

6.54 The road transportation of contaminated material between Penny's Bay and the off site treatment area at TKW is required. The total volume of contaminated material is as follows:

- Material to be treated using Thermal Desorption and other treatments as necessary (Roll Off Trucks : Containerised): 30,000m^3 dioxin-contaminated soil.
- Material to be treated using Biopiles and/or Solidification (Dump Trucks : Bulk): 9,000m^3.

6.55 The number of laden truck movements are estimated based on average payloads as follows:

Method	Total Shipment (m^3)	Payload per Trip (m^3)	Total Laden Trips
Roll Off Truck (Containerised)	30,000	6 - 12	2,500 – 5,000
Dump Truck (Bulk)	9,000	6 - 10	900 – 1,500
Total	39,000	--	3,400 – 6,500

6.56 It should be noted that the environmental implications of losses of contaminated material primarily concern laden trips because of the presence of the contaminated material. An equal

number of additional unladen trips will also be made from TKW back to Penny's Bay.

6.57 The road shipments will be made at the time of excavation of contaminated material from the shipyard in order to avoid the need for temporary stockpiles at Penny's Bay. Therefore the above shipments would be made over the 6 months excavation period. The frequency of laden trips would therefore be between up to 19 to 38 per day for containerised shipments. The average frequency of laden tip truck bulk shipments would be up to around 27 to 53 per day. Overall then the total number of laden shipments, including both containerised and bulk material, would be up to around 46 to 91 per day.

6.58 The proposed truck movements pass along the temporary access road at Penny's Bay then along Road P2 at Yam O, then along the temporary access road along south side of the LAR to the restricted TMCA road at To Kau Wan passing beneath the LAR and onto a road controlled by Lands Dept./ New Airport Section to the TKW Site. The traffic on these roads is almost entirely construction traffic. Only one short section (390m) of road P2 is open to use by the franchised buses for construction workers and a short section of road at To Kau Wan (112m) is used by TMCA.

6.59 An estimate of the number of vehicle accidents associated with the movement of laden vehicles carrying contaminated material to and from To Kau Wan can be drawn from TD statistics. For this purpose the most appropriate class of vehicle for which statistics are available is the heavy goods vehicle. The number of licensed heavy goods vehicles in 2000 was 2,903 and the total number of all accidents involving a heavy goods vehicle was 90. The average mileage of all vehicles in 2000 was 23,000km/vehicle. For heavy vehicles however the annual mileage is estimated to be higher at around 35,000km/vehicle. On this basis the total mileage of heavy goods vehicles in 2000 would be around (2,903 x 35,000 =) 102 million km. The frequency of all accidents for heavy goods vehicles is (90 / 102 million km) = 0.9×10^{-6} accidents per vehicle-km. Since 80% of all vehicle accidents in 2000 were classified as slight, the number of significant accidents would be estimated to be around ($0.2 \times 0.9 \times 10^{-6}$) = 0.18×10^{-6} accidents per vehicle-km.

6.60 For dioxin contaminated material, around 30,000m^3 will be carried in vehicles of between 6m^3 and 12m^3 capacity over a distance of 3.6km. The total laden vehicle distance travelled over the 6 months duration of excavation is therefore up to (30,000 / 6m^3 x 3.6km) = 18,000 vehicle-km. The estimated number of significant vehicle accidents involving laden vehicles carrying dioxin contaminated material to To Kau Wan over the 6 months duration of excavation would be ($18,000 \times 0.18 \times 10^{-6}$) = 3.2×10^{-3} or 0.3% risk of one accident occurring.

6.61 In the same way for contaminated material for biopile and subsequent solidification treatment, a total of 9,000m^3 will be carried in vehicles of between 6m^3 and 10m^3 capacity over a distance of 3.6km. The total vehicle distance travelled over the 6 months duration of excavation is therefore up to (9,000 / 6m^3 x 3.6km) = 5,400 vehicle-km. The estimated number of significant vehicle accidents involving laden vehicles carrying contaminated material for biopile and subsequent solidification treatment at To Kau Wan over the 6 months duration of excavation would be ($5,400 \times 0.18 \times 10^{-6}$) = 0.97×10^{-3} or 0.1% risk of one accident occurring.

6.62 In the unlikely event that a significant incident did occur during the transportation of contaminated material it is important to employ the necessary precautions to avoid loss of any

material with significant contamination. These measures include the use of roll-off trucks (containerised) of material contaminated with dioxin. In addition the trucks shall be accompanied by escort vehicle travelling ahead of the roll-off trucks to reduce the risk of accidents.

6.63 The thermal desorption treatment of dioxin-contaminated material is expected to generate a total of 600m^3 of non-aqueous dioxin condensate equivalent to 960 litres per day. This material will need to be transported from To Kau Wan to the Chemical Waste Treatment Centre (CWTC) at South East Tsing Yi. Such shipments will be made by trucks. Various possible transport scenarios are possible including that the CWTR collects the condensate at a convenient location accessible by public road. One such possibility is that the condensate will be collected at Yam O. In this case the condensate would be taken from TKW by truck along the temporary access road south of the LAR to Yam O and be collected by CWTC at a convenient location along Road P2 at Yam O, refer Figure 6.6. The dioxin condensate will be held in 200 litre drums which will be loaded into a container during transportation. Transportation of 10 to 15 drums of dioxin condensate would be required two to three times per week. On this basis a total of around 152 to 228 laden shipments of dioxin condensate would be required over the 2 years duration of treatment.

6.64 A total of around 600m^3 of dioxin condensate (the rate of condensate generation will be discussed later in this section) will be transported by road between To Kau Wan and Yam O over a distance of 1.7km for collection by CWTC over a 2 year period. Road shipments of 10 to 15 drums (200 litres per drum) of dioxin condensate would be required 2 to 3 times per week. The total laden vehicle distance involved would be up to (594 / 2m^3 x 1.7km) = 505 vehicle-km. The estimated number of significant vehicle accidents involving laden vehicles carrying dioxin condensate per year would therefore be (505 x 0.18 x 10^{-6} / 2years) = 0.05 x 10^{-3} or 0.005% risk of one accident occurring.

Consequences of Road Accidents during Transportation of Waste

6.65 Road transport of waste shall be substantially limited to within the Penny's Bay reclamation area and other temporary access roads away from public roads between the point of excavation and TKW. Strict transportation procedures shall be followed to minimise the chance of road incident including speed control and the use of roll-off trucks (containerisation) of dioxin contaminated soil. No significant environmental and traffic impacts are envisaged as site access between CLS and TKW will be entirely on site access road (other than a short section of Road P2 open to franchised buses for construction workers and a short section of restricted road at TKW under the control of TMCA). Furthermore, no sensitive receivers are located nearby in the vicinity of the site access road. Mitigation measures to minimise the likelihood of road incidents have been proposed at the end of this section. As such, in the unlikely event that a significant incident did occur the possible impact would be spillage of contaminated soil on ground without any significant environmental impacts as the contaminants in soil would not be dispersed easily. Notwithstanding this, the following spill handling measures are proposed to minimise the consequences of spillage:

- Notify FSD immediately in case of major accidents or spillage;
- Fence off the impact area to avoid disturbance of contaminants and then migration of contaminants;

- Excavate the impacted soil immediately for off-site treatment;
- Workers shall put on proper personal protective equipment for workers during excavation as recommended in Section 4 in case of spillage of dioxin-contaminated soil.
- Properly decontaminate the handling and transport equipment in contact with the impacted soil.

Off-Site Decontamination Works

6.66 There will be three major decontamination processes at TKW, viz. biopiling, thermal desorption and solidification that generate wastes.

6.67 **Soil treatment of non-dioxin-contaminated soil:** In biopiling, off-gas from the piles of TPH-contaminated soil will be extracted and the volatile organics will be stripped off by activated carbons before discharge into atmosphere. As TPH is found to contain mainly non-volatile portions and the VOCs emissions are not expected to be significant. The activated carbon would be used in the initial phase (the rate of stripping of volatile contaminants will decrease with decontamination period) and as back-up unit should the emissions exceed the discharge limits. As such, the quantity of carbon used will not be substantial, the activated carbons will not be subject to on-site regeneration but will be reused by contractors who will recharge the spent carbon. If this is not possible, it will be disposed of as chemical waste. It is estimated that some 1-2m^3 of spent activated carbons will be generated each month for the first three months of operation and the total quantity generated during the whole biopiling period should be less than 30m^3.

6.68 After completion of biopiles, solidification is required to reduce the leachability of metals should the resultant soils contain high metals levels exceeding the action levels for soil remediation. The solidified soil can then be used as public filling materials. The quantity of treated soil would be roughly about 10% (bulking factor) more than that of the contaminated soil, which is about 9,900m^3. Whenever the solidified material is to be reused as filling material, they shall be put below at least 1m of clean soil which provides adequate cover to avoid human contact.

6.69 **Soil treatment of dioxin-contaminated soil:** The process of thermal desorption is described in Section 4. Key wastes generated are by-products of the emission control system and condensates resulted from the quenching process. The emission control system will cope with minor gas effluents from the quenching process and fugitive effluents inside the plant. Spent filters and air phase activated carbons of about 1.5 tonnes in total for final emission polishing will be treated and disposed of as chemical wastes. (Note that the thermal desorption plant will employ a catalytic oxidiser for treating the off-gas, activated carbon is only used as back up for final polishing). Deposits that are regularly dislodged from the bag filter will be recharged into the beginning stage of the thermal desorption. Spent water phase activated carbon is estimated to be about 10 tons over the project period. These dioxin-containing wastes will be disposed of at the Tsing Yi CWTC for destruction as recommended in Section 4 of this Report.

6.70 The resultant condensate after thermal desorption would be liquids comprising non-aqueous and aqueous phases. Assuming 20% moisture content of dioxin-contaminated soil, one m^3 soil would turn out 0.2m^3 (or 200L) condensate in which 10% (i.e. 0.02m^3 or 20L) is of non-

aqueous phase whereas the rest of 90% (i.e. 0.18m^3 or 180L) is of aqueous phase. According to the SI results (as presented in Section 4) around 30,000m^3 of dioxin-contaminated soil will need to be treated, therefore the total volume of condensate generated is around 5,400m^3. The volume of non-aqueous condensate (i.e. oil residue) is about 600m^3 (equivalent to 3,000 nos. of 200L-drums).

6.71 While the non-aqueous condensate will be collected and disposed of at CWTC at Tsing Yi, the aqueous condensate will be treated on site through activated carbons where the trace amount of soluble organics will be removed. The treated aqueous phase of the condensate will be used to quench and rehydrate the treated soils, which are dry and powdery after thermal treatment. No monitoring of the quality of the treated condensate is required as confirmation test will be carried out for the treated soil.

6.72 Following thermal desorption, solidification will take place by addition of cement to demobilise the remaining heavy metals (not removed by thermal desorption). About 30,000 m^3 of soil from Area 3 of CLS is contaminated with metals and would be fed to the solidification plant after thermal desorption for the removal of dioxin. Before feeding to the solidification train, the incepted soil will be firstly screened of boulders, rubble and cobbles that would hinder the solidification efficiency. The screened items or rejects which are inert will be crushed on site into proper sizes before treatment. This will increase the volume of the final product by 10%, which is regarded as clean filling materials giving about 33,000m^3.

6.73 In summary, around 42,900m^3 solidified soil from TKW and 52,800m^3 solidified soil from CLS suitable for public filling will be generated after successful remediation. Whenever the dioxin solidified material is to be reused as filling material, they shall be put below at least 3m of clean soil which provides adequate cover to avoid human contact.

TKW Decommissioning Phase

C&D Material

6.74 Based on the size of each storage structure, site drainage and leachate collection and treatment systems, it is estimated that around 5,000m^3 C&D material and 500 tonnes steel will be generated. The C&D material will be disposed at PFAs and the metal will be recycled, as such waste impact will be insignificant.

Summary of Waste Impact

6.75 The timing and quantity of generation of each type of waste is summarised below:

Waste Type	**Prediction of Impact**
Building Demolition Phase (July 2002 – September 2002)	
Site Clearance Waste	As the subject shipyard is located on reclaimed land and the site is not heavily vegetated except along the northern and north-eastern boundaries of CLS, therefore during the demolition phase only limited amount (i.e. approximately 5% of C&D Material) of site clearance waste will be generated.
C&D Material	The demolition of existing buildings at CLS will generate approximately 10,000m^3 C&D material.
Workforce Waste	The maximum daily number of workers on site will be around 100. Based on a waste generation rate of 0.65kg per person, it is estimated that the amount of general refuse will be in the order of 65kg/day.
Steel	Based on visual inspection of CLS, steel waste will be generated due to the demolition of steel hangars and steel piers. It is estimated that the quantity will not exceed 1,000 tonnes.
General Debris	General refuse were noted leftover the CLS after its relocation. It is estimated that the quantity will not exceed 5,000m^3.
Chemical Waste	Various chemical wastes were noted during the site inspection. It is estimated that the quantity will not exceed 1,000m^3 (assumed to be 20% of general debris).
Slope Improvement Phase (July 2002 – December 2003)	
Soil	It is estimated that around 40,000m^3 of uncontaminated soil will be generated during excavation.
Rock	It is estimated that around 2,100m^3 of uncontaminated rock will be generated during excavation.

Waste Type	Prediction of Impact
Land Formation Phase (October 2002 – July 2003)	
C&D Material	The demolition of seawall and jetties will generate around 5,000m^3 C&D Material.
Remediation Phase (November 2002 – February 2006)	
Contaminated Soil	It is estimated that approximately 87,000m^3 contaminated soil (30,000m^3 dioxin-contaminated soil is regarded as chemical waste) will need to be excavated, of which 48,000m^3 (metal-contaminated) will be solidified on-site and the remaining transported for off-site treatment at TKW. After both on- and off-site treatment, around 100,000m^3 clean soil suitable for public filling will be generated.
Chemical Waste	The off-site decontamination works will comprise mainly 3 processes, biopiling, solidification and thermal desorption. It is estimated that less than 20 tons solid chemical waste will be generated, mainly spent filters (air phase and water phase) and around 600m^3 liquid chemical waste will be generated throughout the remediation period.
TKW Decommissioning Phase (February 2006 – July 2006)	
C&D Material	The demolition of storage buildings at TKW will generate about 5,000m^3 C&D material and 500 tonnes steel.

Mitigation Measures

Construction and Demolition Phase

Good Site Practice and Waste Reduction Measures

6.76 It is not expected adverse waste impacts would arise provided that good site practice is strictly followed. Recommendations for good site practice during the decommissioning and demolition activities include:

- Use waste haulier authorised or licensed to collect specific category of waste;
- Obtain the necessary registration and licences under the *Waste Disposal Ordinance* and the *Waste Disposal (Chemical Waste) (General) Regulation* from the Environmental Protection Department;
- Nomination of an approved person, such as a site manager, to be responsible for good site practice, arrangements for collection and effective disposal to an appropriate facility, of all wastes generated at the site;
- training of site personnel in proper waste management and chemical waste handling procedures;
- provision of sufficient waste disposal points and regular collection for disposal;
- appropriate measures to minimise windblown litter and dust during transportation of waste by either covering trucks or by transporting wastes in enclosed containers;
- separation of chemical wastes for special handling and appropriate treatment at a licensed facility;
- regular cleaning and maintenance programme for drainage systems, sumps and oil interceptors;
- a recording system for the amount of wastes generated, recycled and disposed of (including the disposal sites);
- In order to monitor the disposal of C&D material and solid wastes at public filling facilities and landfills, and control fly-tipping, a trip-ticket system shall be included as one of the contractual requirements and implemented by the Environmental Team. One may make reference to WBTC No. 5/99 for details; and
- A Waste Management Plan (WMP) shall be prepared and this WMP shall be submitted to the Engineer for approval. One may make reference to WBTC No. 29/2000 for details.

6.77 Good management and control can prevent the generation of significant amount of waste. Waste reduction is best achieved at the planning and design stage, as well as by ensuring the implementation of good site practice. Recommendations to achieve waste reduction include:

- segregation and storage of different types of waste in different containers, skips or stockpiles to enhance reuse or recycling of materials and their proper disposal;
- to encourage collection of aluminium cans, paper waste and plastic bottles by individual collectors, separate labelled bins shall be provided to segregate this wastes from other general refuse generated by the work force;
- any unused chemicals or those with remaining functional capacity shall be recycled;
- use of reusable non-timber formwork to reduce the amount of C&D material;
- prior to disposal of C&D waste, it is recommended that wood, steel and other metals shall be separated for re-use and / or recycling to minimise the quantity of waste to be disposed of to landfill;
- proper storage and site practices to minimise the potential for damage or contamination of construction materials; and
- plan and stock construction materials carefully to minimise the amount of waste disposal and avoid unnecessary generation of waste.

6.78 In addition to the above good site practice and waste reduction measures, specific mitigation measures are recommended below for the identified waste arising to minimise environmental impacts during handling, transportation and disposal of these wastes.

Waste Recycling

6.79 To minimise the amount of waste disposal to landfills, the general refuse (not contaminated) shall be reused and recycled as much as practical. Waste sorting and segregation shall be carried out in accordance with the following categories for recycling:

- Plastic (i.e. plastic bag, plastic bottle, plastic packaging, etc.)
- Rubber;
- Paper;
- Wood/ timber;
- Glass;
- Textile; and
- Metal (i.e. aluminium can, steel metal, ferrous metal, and non-ferrous metal).

Asbestos

6.80 Although not covered in this Report, the removal shall follow the approved AAP and conditions stipulated in the EP for Asbestos Abatement work in CLS at Penny's Bay and the Code of Practice on the Handling, Transportation and Disposal of Asbestos Waste.

Chemical Waste

6.81 *Removal Sequence*: As asbestos removal will precede building demolition, so the concern will be non-asbestos chemical waste. To avoid disturbance of potential chemical waste during building demolition, all movable objects including sand/ grit/ deposits inside the building under demolition shall be cleared in advance. "Movable objects" shall mean all items inside the building other than those belong parts of the building structure or are anchored firmly on the building structure/ existing ground. All movable objects including sand/ grit/ deposits shall be treated as chemical wastes and placed in drums and delivered to a centralised covered area on site. No mixing or off-site disposal of the waste shall be allowed. The non-removable objects shall be covered with the heavy-duty polythene sheets for later disposal. Transportation and storage of the waste shall be in accordance with the relevant chemical waste regulations. Particularly the requirement of spill prevention measures, worker protection (e.g. PPE) and proper segregation from other wastes shall be observed. Whereas all other chemical wastes outdoors (except dioxin-contaminated soil which shall be transported by roll-off trucks for added safety) shall be handled and stored in accordance with *Waste Disposal Ordinance* and *Waste Disposal (Chemical Waste) (General) Regulation.*

6.82 Workers involved in the handling of chemical waste shall be suitably trained and shall wear appropriate protective masks and clothing when handling such materials. Chemical wastes shall be handled according to the *Code of Practice* on the Packaging, Labelling and Storage of Chemical Wastes. Spent chemicals shall be stored and collected by licensed collectors for disposal at licensed facilities in accordance with the *Waste Disposal (Chemical Waste) (General) Regulation.*

6.83 Containers used for the storage of chemical waste shall:

- Be suitable for the substance they are holding, resistant to corrosion, maintained in good condition, and securely closed;
- Have a capacity of less than 450 litres unless the specifications have been approved by the EPD; and
- Display a label in English and Chinese in accordance with instructions prescribed in Schedule 2 of the Regulations.

6.84 The storage area for chemical waste shall:

- Be clearly labelled and used solely for the storage of chemical waste;
- Be enclosed on at least 3 sides;
- Have an impermeable floor and bunding, of capacity to accommodate 100% of the volume of the largest container or 20% by volume of the chemical waste stored in that area, whichever is the greatest;
- Have adequate ventilation;
- Be covered to prevent rainfall entering (water collected within the bund must be tested and disposal as chemical waste if necessary); and

- Be arranged so that incompatible materials are adequately separated.

6.85 Disposal of chemical waste shall:

- Be via a licensed waste collector; and
- Be at a facility licensed to receive chemical waste, such as CWTC which offers a chemical waste collection service and can supply the necessary storage containers; or
- Be a recycler of the waste, with waste disposal licence from the EPD.

Sorting of C&D Material On-site

6.86 The Contractor shall separate the C&D material including steel, timber and scrap metals from other wastes, as far as practical, and shall arrange for recycling and reuse on site to the extent possible. All C&D materials arising from demolition work shall be sorted on-site and be separated into different groups for disposal at landfills, PFAs, or recycling as appropriate in accordance with *WBTC No. 5/98*. To maximise landfill life, Government policy discourages the disposal of C&D wastes with more than 20% inert material by volume (or 30% inert material by weight) at landfill. Inert C&D material (public fill) is directed to reclamation areas or to an approved public filling area (PFA), where it has the added benefit of offsetting the need for removal of materials from borrow areas for reclamation purposes. Due to limited space at landfills, disposal at reclamation sites or PFAs would be the preferred option. A trip-ticket system for disposal of C&D material as detailed in *WBTC No. 5/99* shall be followed. Finally, a method statement for the sorting, processing and disposal of C&D materials arising from demolition work shall be submitted by the Contractor to the Engineer for his approval.

Building Indoor Surfaces Containing Contaminated Residues

6.87 Building sampling shall be carried out prior to demolition to characterise the contaminants present on the building surfaces, determine whether such residues are classified as chemical waste, and identify suitable reagents for decontamination. After contaminants characterisation, a Decommissioning Plan shall be prepared by the specialist Contractor recommending the indoor remediation protocols as well as the demolition method (preferably a top-down and non-explosive approach) for the Engineer's approval. Those building containing contaminated residues shall be decontaminated first before demolition. In general, the building decontamination may include the following processes:

- Power washing;
- Scabbling;
- Grit blasting; and
- Confirmation testing.

6.88 Power washing and grit blasting will produce secondary wastes, so scabbling is the preferred method of cleaning. To ensure effective and proper cleaning, adequate on-site supervision by competent personnel is required.

6.89 After completion of building decontamination, the material can be discarded as normal C&D

material. The chemical deposits or residues from scabbling will be disposed of to CWTC for ultimate disposal.

General Refuse

6.90 General refuse shall be stored in enclosed bins or compaction units separated from C&D material and chemical wastes. No open stockpile of general refuse is allowed on site to minimise environmental impacts. A reputable waste collector shall be employed by the contractor to remove general refuse from the site, separately from C&D material and chemical wastes, on a daily or every second day basis to minimise odour, pest and litter impacts.

6.91 Aluminium cans, paper waste and plastic bottles are often recovered from the waste stream by individual collectors if they are segregated or easily accessible, so separate labelled bins for their deposit shall be provided if feasible. Site office waste can be reduced through recycling of paper if volumes are large enough to warrant collection. Participation in a local collection scheme shall be considered if one is available.

Slope Improvement Phase

6.92 The excavated soil and rock shall be reused/ recycled within CLS as much as practical (i.e. landscape berm formation). In addition, a Waste Management Plan shall be prepared by the Contractor in order to keep waste arising to a minimum and to ensure that waste is handled, transported and disposed of in a suitable manner.

6.93 The design of slope work shall be planned carefully to maximise the preservation of existing profiles with stabilisation as necessary to minimise cutting and filling.

Land Formation Phase

6.94 The overall total of C&D material to be generated by this Project is estimated around 0.4Mm^3. The C&D material will be reused and recycled as far as practicable in the land formation works within CLS site so as to minimise the amount of C&D material to be disposed of at PFAs.

Remediation Phase

Cheoy Lee Shipyard Site

6.95 On handling contaminated soil, especially of dioxin-contaminated, site workers and the backhoe operators shall be protected from skin contact and inhalation of soil gas. The protection shall be achieved by providing each worker/ operator sufficient personal protective equipment, such as coverall, respirator, etc. and suitable training on handling contaminated waste.

6.96 Chemical wastes shall be handled in compliance with the provisions of *Waste Disposal (Chemical Waste) (General) Regulation.* The site contractors, workers and operatives shall also be required to follow appropriate procedures on handling chemical wastes according to the *Code of Practice on the Packaging, Labelling and Storage of Chemical Wastes.*

6.97 Identified asbestos waste shall be handled in accordance with the Project Profile of Asbestos Abatement Work in CLS, however, the asbestos discovered in soil of Area 3 shall follow the following requirements:

- While the APCO requires registered professionals to undertake the abatement work, the *Waste Disposal Ordinance* and the *Waste Disposal (Chemical Waste) (General) Regulation* provide control on the packaging, labelling, storage, collection and disposal of asbestos waste. Asbestos wastes shall be handled in accordance with the *Code of Practice on the* Handling, *Transportation and Disposal of Asbestos Waste* issued by the Environment and Food Bureau.

- Asbestos waste, by definition under the *Waste Disposal (Chemical Waste) (General) Regulation*, is categorised as chemical waste of which the arrangement of production, collection and disposal will follow the 'trip-ticket' system as with other chemical wastes. The registered asbestos contractor who is the waste producer shall appoint a licensed asbestos waste collector to collect the packaged asbestos waste and deliver to the designated landfill for disposal. Under the *Waste Disposal Ordinance* and *Waste Disposal (Chemical Waste) (General) Regulation,* directions of asbestos disposal shall be obtained from the EPD and prior arrangement with the landfill operator shall be made before disposal.

Collection and Transportation of Wastes

6.98 Dump trucks will be extensively used for the transit of waste, other than material contaminated with dioxin which will be transported by roll-off trucks between the excavation area and TKW. The following precautionary measures shall be taken to avoid spillage, wind erosion and incident in transit.

- Transportation of contaminated soil shall be escorted to improve road safety;

- Strict speed limit shall be imposed on the whole length of the haul road;

- Never overload the trucks to prevent spillage of contaminated soils;

- Dioxin-contaminated material shall be transported in roll-off trucks (containers).

- Always cover the payload on each dump truck with strong and low permeable sheeting or the likes to withstand wind and rain while the truck is travelling; and

- Adequately but not excessively wet the payload to reduce dust generation.

6.99 As dioxin-contaminated soil is classified as chemical waste, the trucks shall be labelled, handled and transported in accordance with the *Waste Disposal Ordinance* and the *Waste Disposal (Chemical Waste) (General) Regulation.* In addition, Chemical Waste Collection Licence under S.21 of the Waste Disposal Ordinance shall be obtained for the collection and transportation of such chemical waste. When the trucks approach the TKW Site, they will approach from west well clear of the east side of the site thereby avoid disturbance to the area where the group of egrets was sighted.

6.100 Dioxin condensate (oily residue) generated from the thermal desorption plant shall be transported in heavy duty and sealable drums made of inert, chemical resistant and robust material, which will then be collected by CWTC's own fleets or licensed contractors which are designed and licensed for the collection of hazardous and chemical wastes.

6.101 Finally, a contingency plan shall be prepared by the Contractor to spell out the necessary procedures to be taken and in case of accident and/ or emergency when transporting the contaminated soil to off-site location(s). All responsible parties and/ or persons and their contact numbers shall be listed in the plan.

Material Handling, Transportation and Storage

6.102 The movement of contaminated material between the shipyard and the off-site treatment area needs to be carried out in a controlled manner taking reasonable precautions to minimize potential losses that might otherwise have significant environmental impacts. The measures recommended need to take into account the degree of contamination of the material involved and the potential impact of losses. This subsection considers the requirements for material handling, transportation and storage in order to arrive at an appropriate scheme to minimise environmental risks in a cost-effective manner.

6.103 **Material Handling and Transportation:** Material contaminated with heavy metals, TPH and SVOCs will be handled in the established manner using bulk earth moving equipment for on-land works including excavation by excavators on site. Dump trucks with sealed rear gates will be used to move the contaminated material between the shipyard and the To Kau Wan works area. The contaminated material in the trucks shall be covered with impermeable sheeting (i.e. HDPE) to prevent ingress of rainwater during transportation.

6.104 Additional precautions relating to the material handling and land transportation for dioxin-contaminated soil are recommended. Roll-off trucks (containerised) are recommended to minimise the risk of material loss during material handling and transportation, particularly in the event of an incident. Direct loading of material into containers at the point of excavation is recommended to minimise double handling and any associated losses. The use of containers will also minimise the risk of material loss during transportation by road. Contingency plans will need to be prepared by the Contractor to specify the accident response action, containment and retrieval procedure.

6.105 Assuming 6 to 10m^3 capacity trucks the total number of laden truck movements of excavated non-dioxin contaminated material from CLS to TKW would be between 900 to 1,500. On the basis that this excavation work was carried out over a period of 6 months this equates to around 6 to 10 truck loads per day.

6.106 The use of roll-off trucks (containerised) have been assumed for dioxin-contaminated material shipments. These containers would be reused after each shipment. The size of containers varies and a rated capacity between 6m^3 and 12m^3 has been assumed. Allowing for a shipment of between 6m^3 and 12m^3 (11.3 tonnes to 22.7 tonnes) of contaminated material and based on the estimated total volume of about 30,000m^3 of dioxin-contaminated material, a total of between 2,500 and 5,000 truck loads would be required. One the basis that excavation work was carried out over a 6 month period this equates to around 16 to 32 truck roads per day.

6.107 **Storage:** A number of factors could affect the method of storage of material contaminated with dioxin. These include the need for and method and extent of transportation to the off-site treatment area, the available storage area and any potential need to move the material to an alternative treatment area.

6.108 The most economic method of storage is to stockpile the contaminated material in earth bunds covered by impermeable membranes to prevent wind erosion and exposure to rain. An impermeable base and drainage system is also required to collect the contaminated leachate. In this case the impermeable base could be formed using a reinforced concrete slab graded to drain leachate through filter membranes to channels and catchpits. The slab would provide a practical hard surface for material handling whilst preventing leakage of any contaminated material. The sides of the stockpiles could either be sloping at angles slightly less than the natural angle of repose of the contaminated material, or be formed using reinforced concrete walls to minimise storage space requirements.

6.109 Containerised storage of dioxin-contaminated material has been considered. This could involve the use of standard 20ft long containers. The contents of contaminated material may vary according to the type of container used. For the purpose of this estimate the volume of contaminated material has been assumed to be 11.7cum (24 tonnes including container self weight). The number of containers required for the total 30,000m^3 quantity of dioxin contaminated material would therefore be 2,564. These could be stacked 3 containers high (2.59 x 3 = 7.8m) in a block formation occupying a total net area of 1.3ha. The stacking of these containers could be carried using a standard reach stacker or a fork lift truck. The stacking area could be formed using a gravel bed foundation or using a sealed pavement.

6.110 The containers would need to be scrapped after proper decontamination at the end of the project because of the health risks from dioxin contamination and the relatively high cost of verifying the effectiveness of any container cleansing works at the end of the project.

6.111 The stockpile method would involve forming a stockpile on a paved area. The side slopes of the stockpile would need to be around 30 degrees to horizontal to maintain adequate stability. Assuming a total height of the stockpile of 3 metres, a total net area of 1.5ha would be required.

6.112 A more land use efficient method of storage would use a stockpile contained within a reinforced concrete storage bin area. Assuming a height of 3 metres for the surrounding wall and a free stockpile height above the top of the wall of an additional 3 metres, the net area required for storage would be 0.66 ha. The storage bin solution preferred where site area is limited because of the more efficient use of available landuse.

6.113 The containerised storage option is not preferred because the containers would require either extensive cleaning and testing to verify they were completely decontaminated and suitable for general reuse or scrapping at the end of the project. The use of storage bins are also not preferred because of the larger volume of C&D material generated from the demolition of the retaining walls around the bin. Given that adequate space exists at To Kau Wan, the controlled stockpile storage method is preferred.

6.114 To further reduce impacts on air quality, the use of a structure over the storage area has been included. The proposed scheme involves a storage height of 5 metres with additional height for headroom and a roof. The roof structure would be in place prior to the deposition, storage or removal of material from the storage building.

6.115 The layout of the storage building is shown in Figure 4.15. Only one-sided operation is provided for within the storage building. The roofing will protect against rain and wind and as such, rainwater will not enter the storage area but will be diverted to the sides of the building and collected in gutters and drain pipes and discharged into the stormwater drainage system.

6.116 For the bulk storage of general contaminated material for solidification only, a stockpile is proposed for storage up to an overall height of 5 metres over a net storage area of 1.0ha. Material stored to the design height shall be covered using impermeable sheeting. To control surface runoff from the metal-contaminated soil stockpiled at CLS, the storage area shall be concrete paved or floor lined prior to stockpiling materials on top. Temporary drainage system shall also be constructed to control any potentially contaminated surface runoff from leaving the treatment/ storage area.

Treatment Area

6.117 As discussed in Sections 3 and 4, the off-site treatment area will be temporarily used for stockpiling of contaminated and treated soil, and soil remediation including biopiling, solidification and thermal desorption. Chemical wastes/ by-products will be generated from such operations and processes. During soil handling and transportation, spillage or leakage may occur resulting the potential contamination of the surfaces of housing unit. The bin structure for stockpiles, containment structure and concrete floor at the treatment site shall be decontaminated after completion of remediation. It is recommended that these structures be decontaminated by scabbling and then be discarded as normal C&D material. The chemical deposits or residues from scabbling will be disposed of at CWTC for ultimate disposal.

Off-Site Decontamination Works

6.118 Most of the soils after treatment will turn to clean inert materials suitable for public filling. The condensate as the end product of the thermal desorption process and other chemical wastes (e.g. spent activated carbons & filters) generated shall be temporarily stored in a secure hut. Such waste will be collected by licensed collectors and disposed of at the CWTC bi-daily to avoid bulk storage at treatment site. Pending collection, the chemical waste shall be packaged and where necessary stored temporarily on-site in accordance with the *Waste Disposal (Chemical Waste) (General) Regulation.*

6.119 It was known that the CWTC is able to handle the chemical wastes generated over the course of this Project. However, prior arrangement shall be made to avoid compromising the daily operation of CWTC.

Treatment of Oily Residue at CWTC

6.120 Though CWTC is designed to handle hazardous organic pollutants including PCB and dioxins, the following measures are proposed to ensure the handling of dioxin condensate arising from this Project will not compromise the performance & operation of CWTC:

- A batch of the oily condensate will be sent to CWTC for a performance test and treatment shall begin only after performance tests have been passed.
- Treatment of condensate shall be in batches with a campaign every week or every two weeks.

Precautionary Measures during Wet and Typhoon Seasons

6.121 The following measures are recommended to minimise the water quality impact at the treatment site during typhoon seasons:

- Surface runoff from the treatment site shall be directed into storm drains via adequately designed sand/ silt removal facilities such as sand traps, silt traps and sediment basins. Channels, earth bunds or sand bag barriers shall be provided on site to properly direct stormwater to such site removal facilities.

- Catch-pits and perimeter channels shall be constructed in advance of site preparation works.

- Open stockpiles on site shall be covered with tarpaulin during rainstorms. Measures shall be taken to prevent the washing away of soil into any drainage system.

- The storage area for metal-contaminated soil pending for on-site solidification at CLS shall be roofed and covered. In addition, run-on/ run-off control elements shall be constructed. Finally, the floor shall be concrete paved.

- A dedicated water treatment unit (standalone from the water treatment unit of the thermal desorption for polishing the aqueous condensate as shown on Figure 4.15) shall be constructed for the treatment of contaminated run-off from the thermal desorber, leachate collected from biopile and storage area and decontamination water from decontamination pad or wheel-wash basin. Direct discharge of such wastewaters shall not be allowed without proper treatment.

Equipment Decontamination Requirement

6.122 For excavation and transport equipment at the CLS or treatment site, if it stays within the contaminated zone, such as excavation and stockpiling areas, it shall be decontaminated (typically steam cleaning) prior to leaving the contaminated zone. The contaminated zone shall need to be clearly defined with fencing. The exit of the contaminated zone shall have a decontamination pad for cleaning of the equipment before it leaves the zone. The decontamination water shall be collected and disposed of at the on-site water treatment unit. Care shall be exercised by the Contractor to prevent contamination of areas outside the contaminated zone.

6.123 In treatment area, particularly for a large-scale ongoing operation, separate equipment shall be employed for transport of treated materials to prevent any potential for recontamination. A "contaminated" loader shall load only the contaminated soils into the decontamination system, and a "clean" loader shall be assigned to remove the treated soils from the stockpile at the outlets of the decontamination systems.

6.124 Lining of trucks with plastic is recommended to prevent spills and leakage during transport. Besides, draping of plastic over the sides of trucks can minimise the amount of soil accumulates on the outside of the body. For transport within the contaminated zone, the cover fabrics/ plastic sheeting can be reused depending on the truck and cover configuration, otherwise they shall be dumped into landfill.

6.125 No water discharge is allowed prior to on-site treatment.

Conclusion and Recommendations

6.126 The quantity and quality of waste arising from this project have been assessed and evaluated. With the implementation of the recommended mitigation measures, minimal impacts are anticipated. This EIA concludes that no unacceptable environmental impact in relation to waste management will result from this Project. All potentially harmful contaminants/ wastes from CLS shall be handled, treated and disposed of in an appropriate manner to avoid and minimise environmental impacts and risks to human health.

6.127 Prior to decommissioning, the Contractor shall submit a Waste Management Plan (WMP) to the Engineer for his approval. Such a management plan shall be site specific, including the collection of contaminated runoff, treated of contaminated runoff from thermal desorption plant, designation of areas for segregation, temporary storage of reusable & recyclable material and chemical waste.

6.128 Prior to demolition of buildings/ workshops, a Decommissioning Plan (detailing the indoor remediation protocols as well as the demolition method) shall be submitted to the Engineer for his approval. The plan shall detail the findings of building sampling at those contaminated buildings, recommend indoor remediation protocols and identify suitable methods for surface decontamination.

6.129 Prior to transport of contaminated materials (general contaminated soil, dioxin-contaminated soil and dioxin condensate) off-site for treatment, a Contingency Plan shall be prepared by the Contractor to the Engineer for his approval. The plan shall spell out the necessary procedures to be taken, provisions for worker health and safety and in case of accident and/ or emergency when transporting the contaminated soil to off-site treatment area. All responsible parties and/ or persons and their contact numbers shall be listed in the plan.

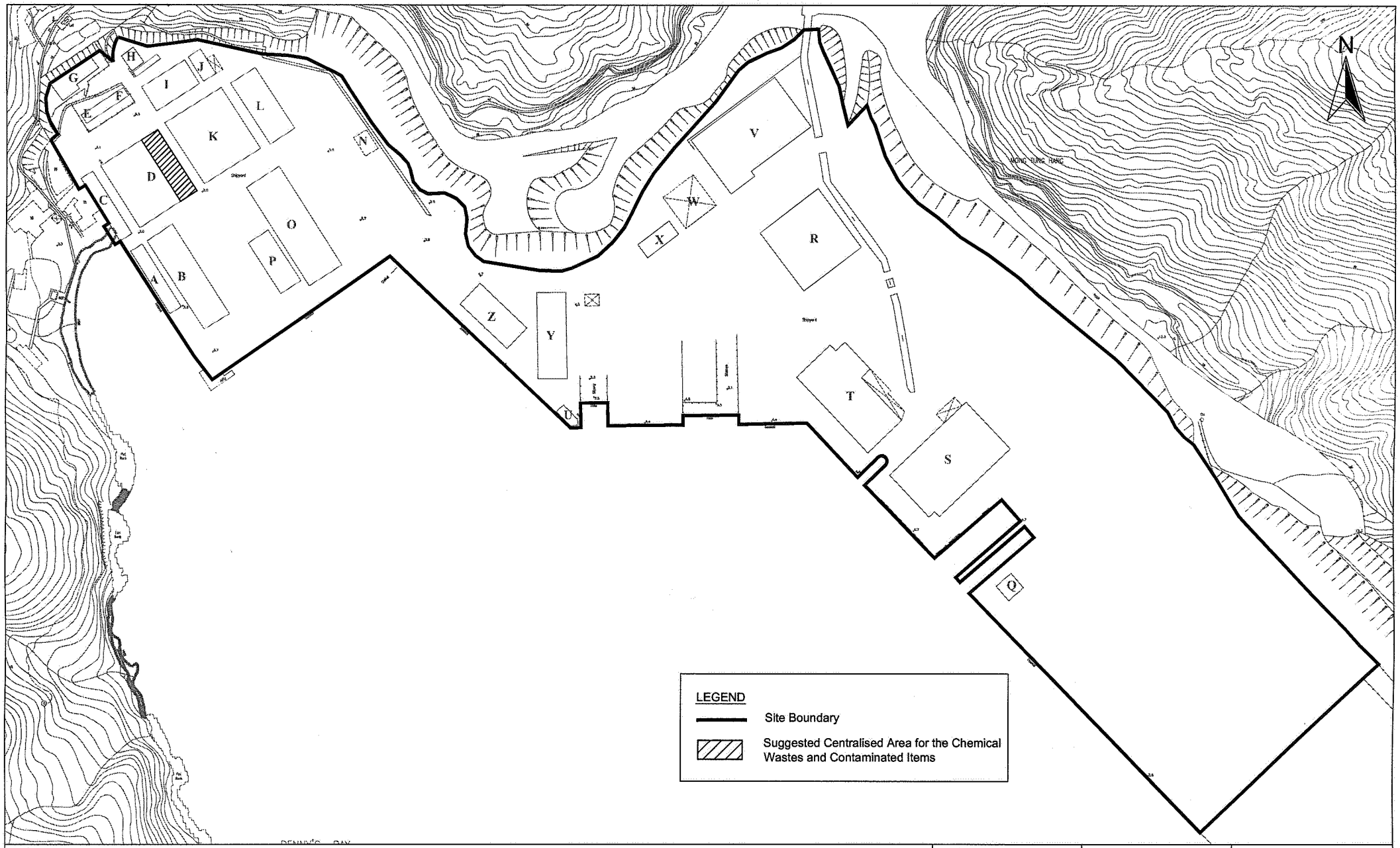
6.130 Prior to the operation of the treatment facilities at TKW, an Operational Plan setting out the details of waste handling and treatment options, the planning and management of the associated environmental and safety issues from waste reception to final disposal shall be prepared by the Contractor to the Engineer for his approval.

6.131 The following registration/ licence/ approval/ permit/ notification are required for the production, storage, collection, and off-site treatment of chemical waste:

- Waste Producer Registration: The Contractor is required to be registered under the *Waste Disposal (Chemical Waste) (General) Regulation*;
- Waste Collection Licence: A Waste Collection Licence under the *Waste Disposal Ordinance* is required for the transport/ delivery of chemical wastes to off-site waste disposal facilities;
- Waste Disposal Licence: A Waste Disposal Licence is required for the operation of the off-site treatment facility a TKW for the treatment for dioxin-contaminated soil.
- Approval for Using Large Container: Approval is required under the *Waste Disposal (Chemical Waste) (General) Regulation* for using chemical waste container with a capacity exceeding 450L.

- Part A Notification: Prior notification to the Environmental Protection Department is required before any collection of Part A chemical waste.

- Noise Permit: A Noise Permit under *Noise Control Ordinance* is required for night-time operation of the decontamination system and transportation of contaminated soil by trucks to TKW at night.



Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Index of Building	Scale: NTS	Project No.: R06100	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD
	Date: Feb 2002	Figure No.: 6.1a	

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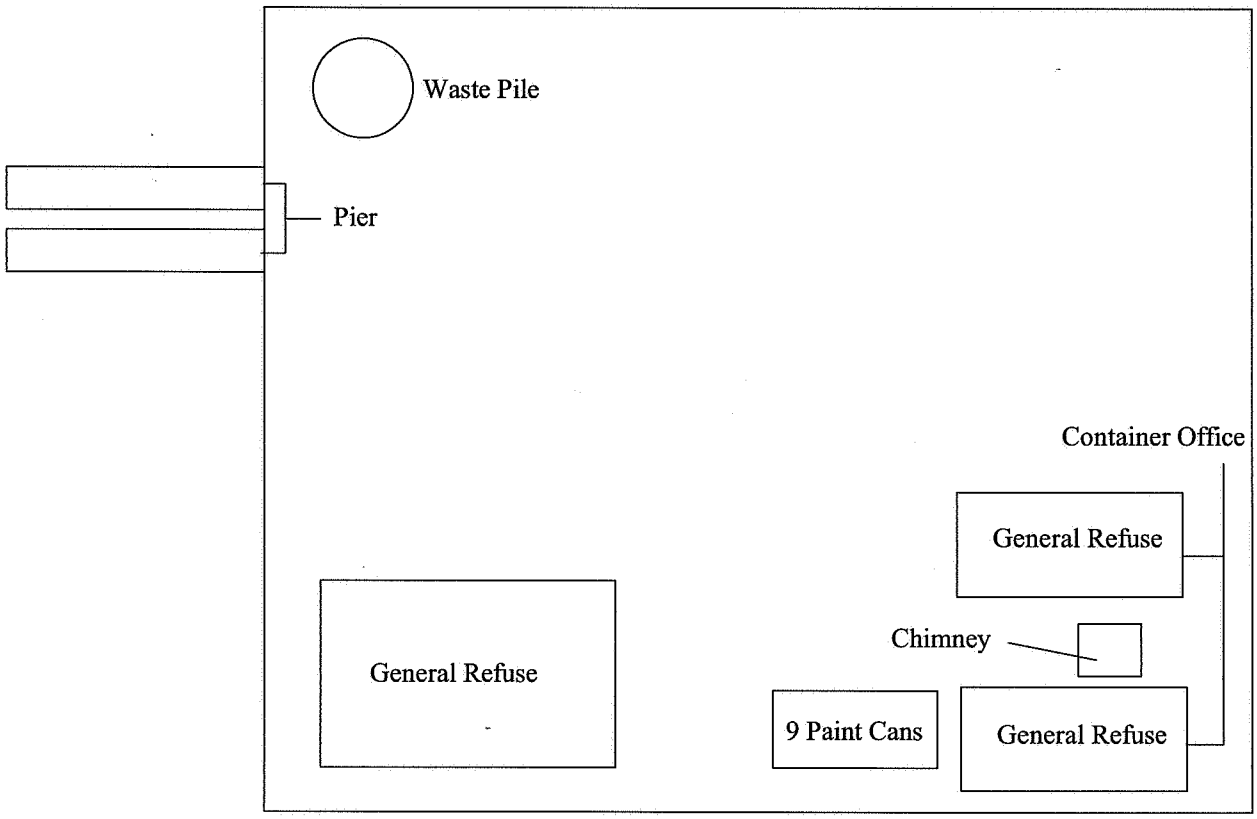

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building Q,G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1b	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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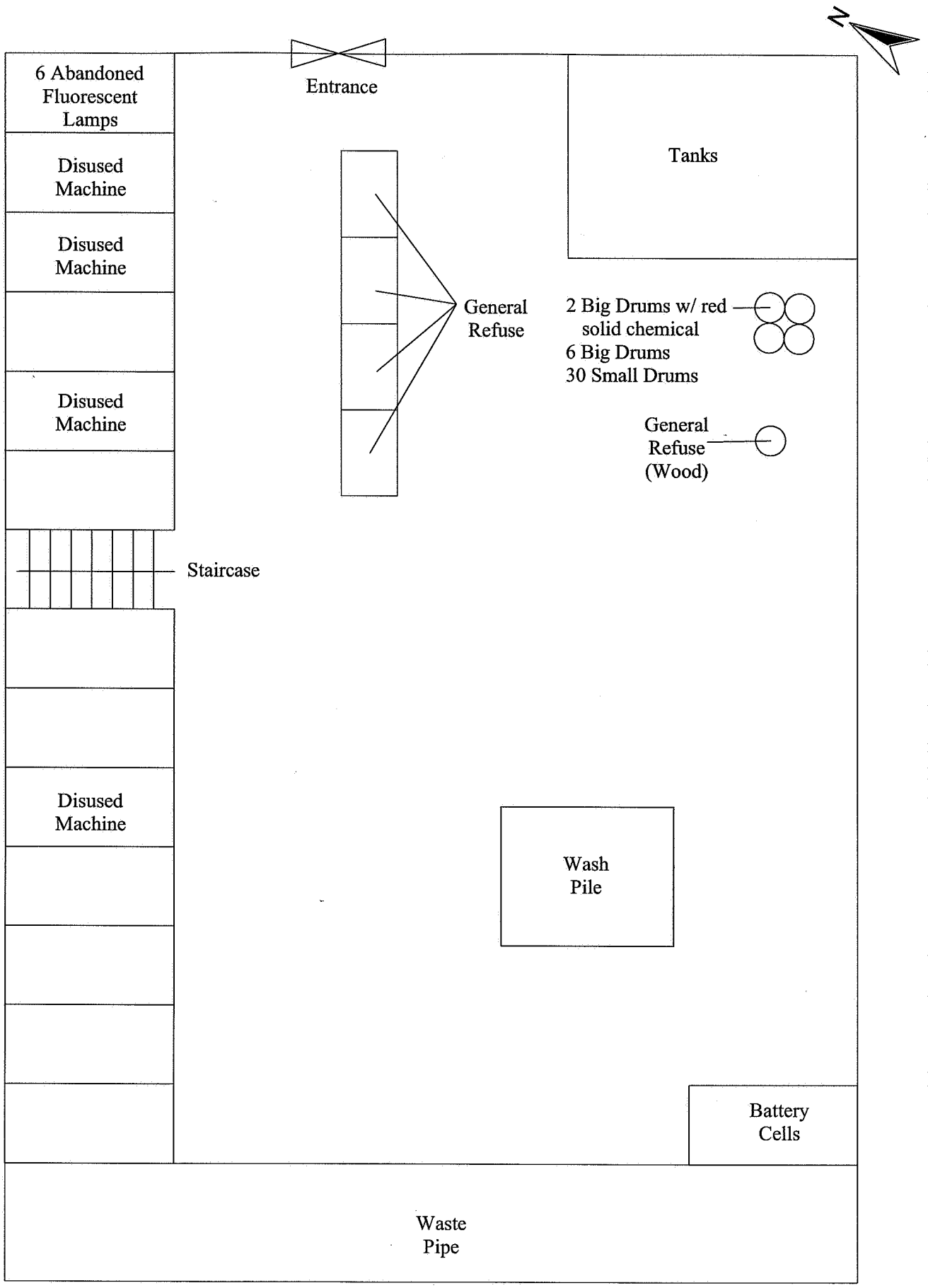

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building S , G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1c	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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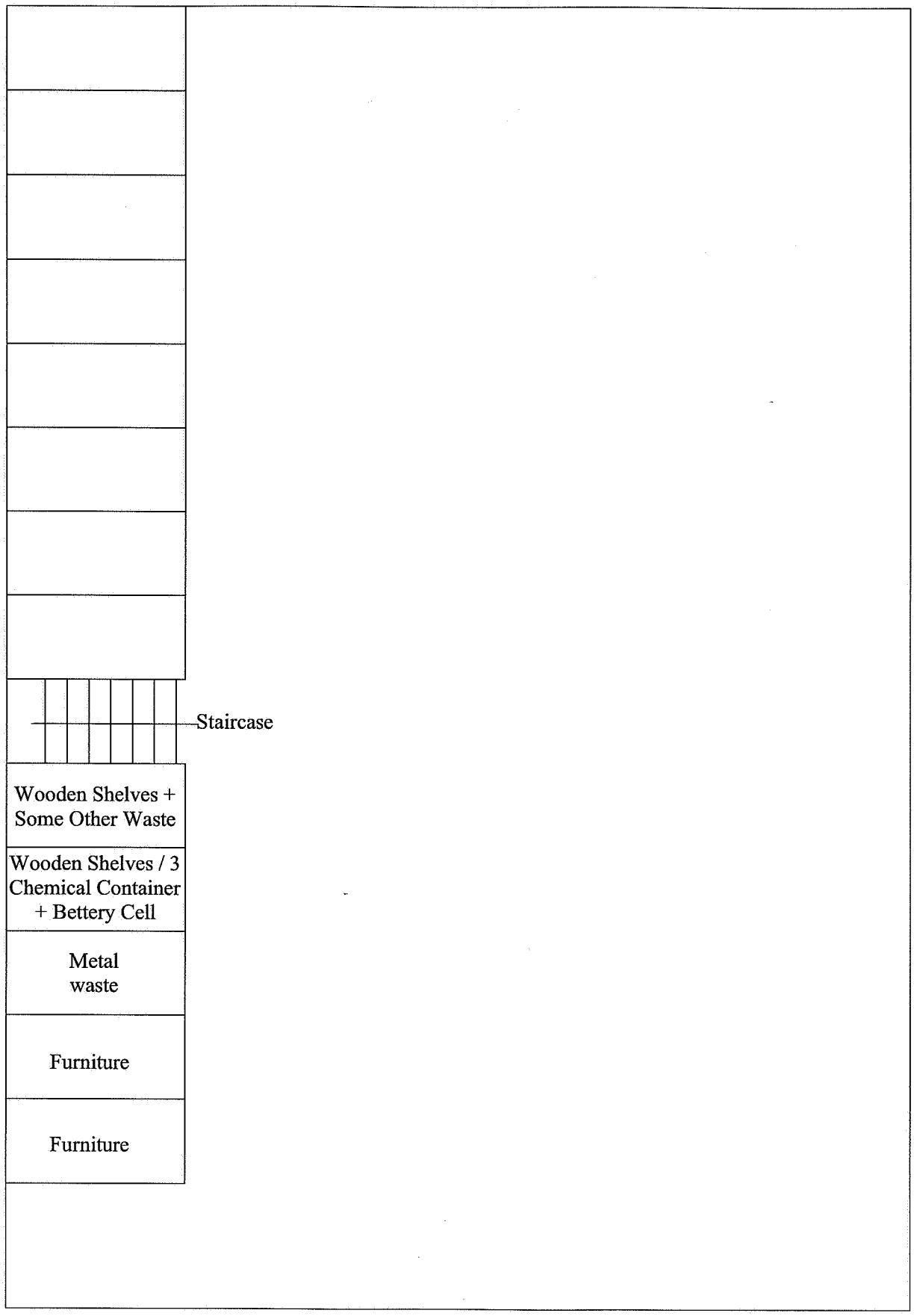

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building S , 1/F	Scale: N.T.S. Date: Feb 2002	Project No. R06100 Figure No. 6.1d	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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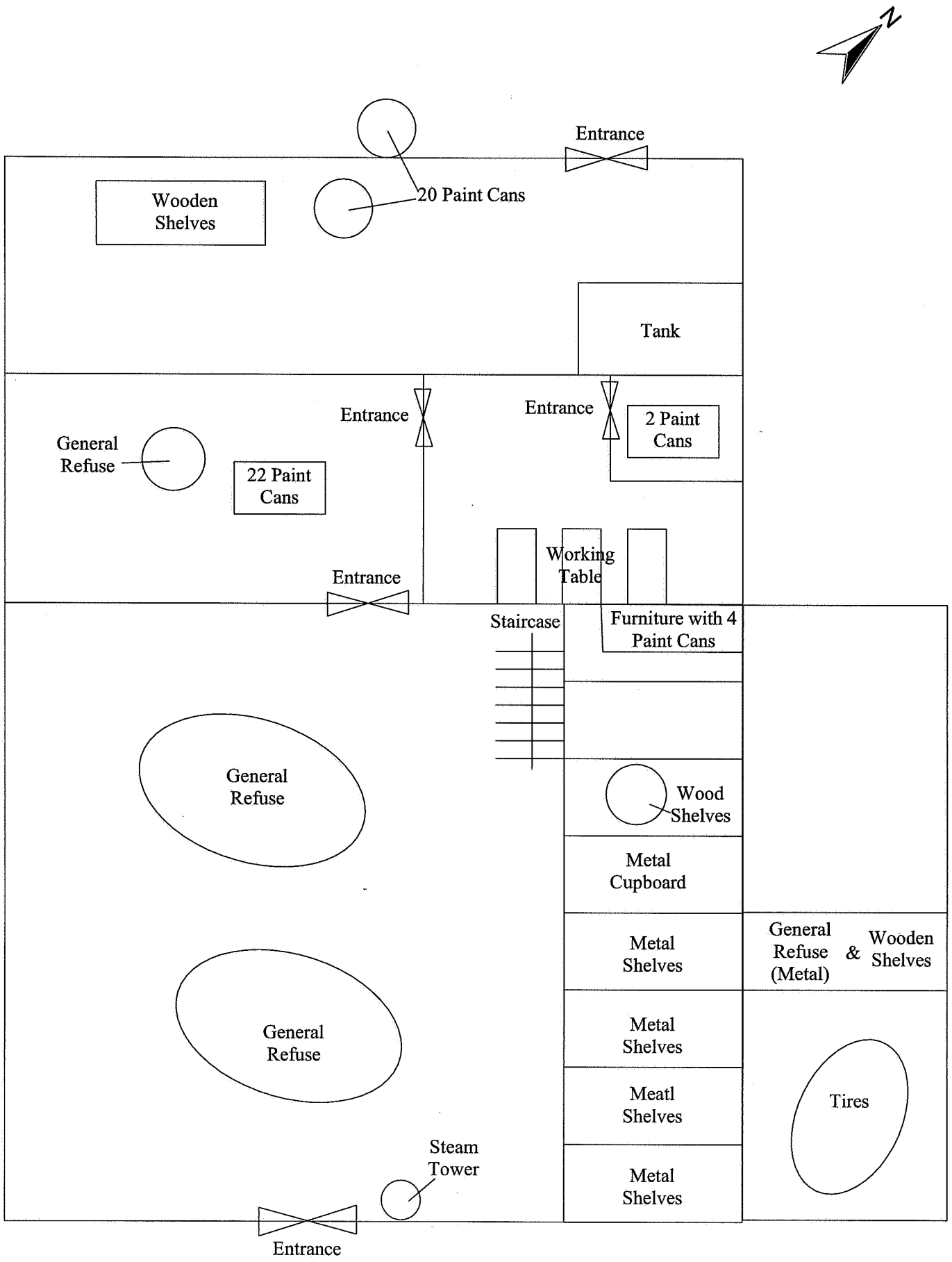

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building T , G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1e	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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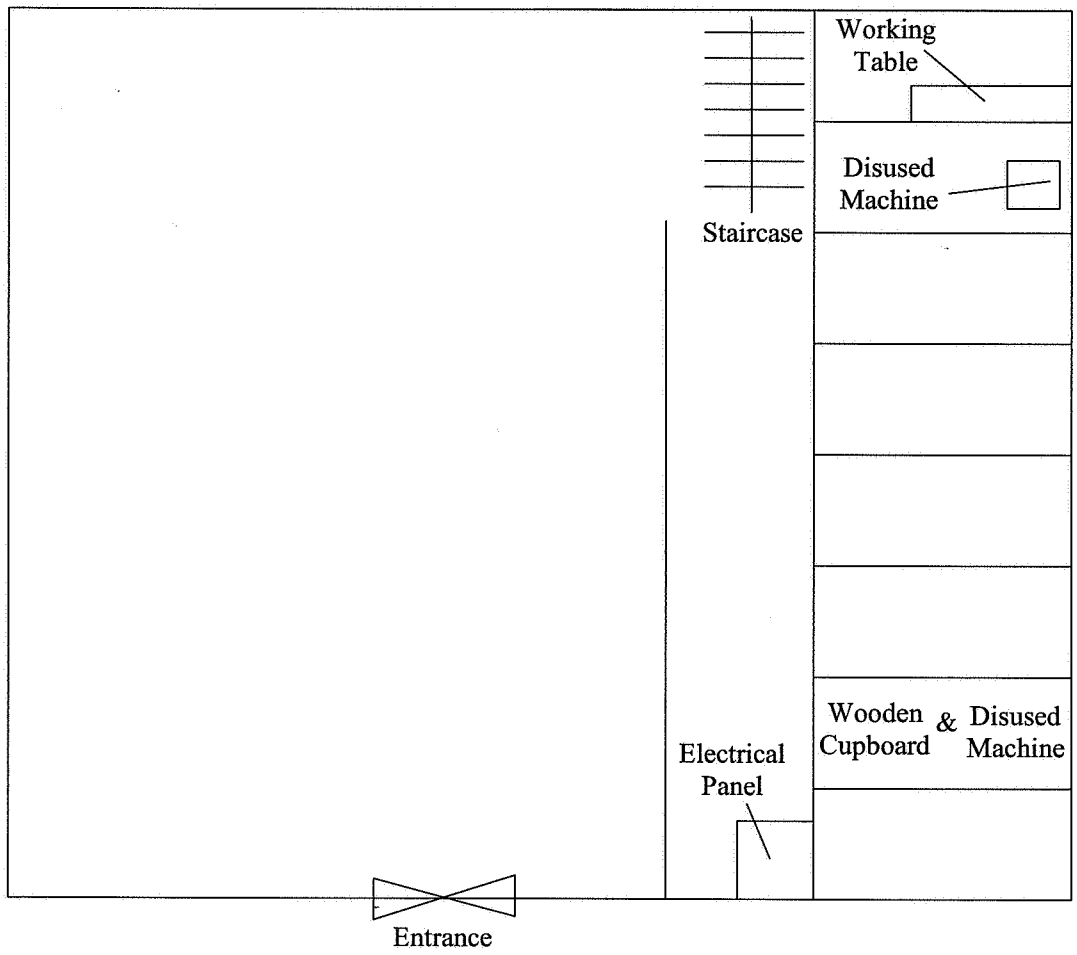

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building T, 1/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1f	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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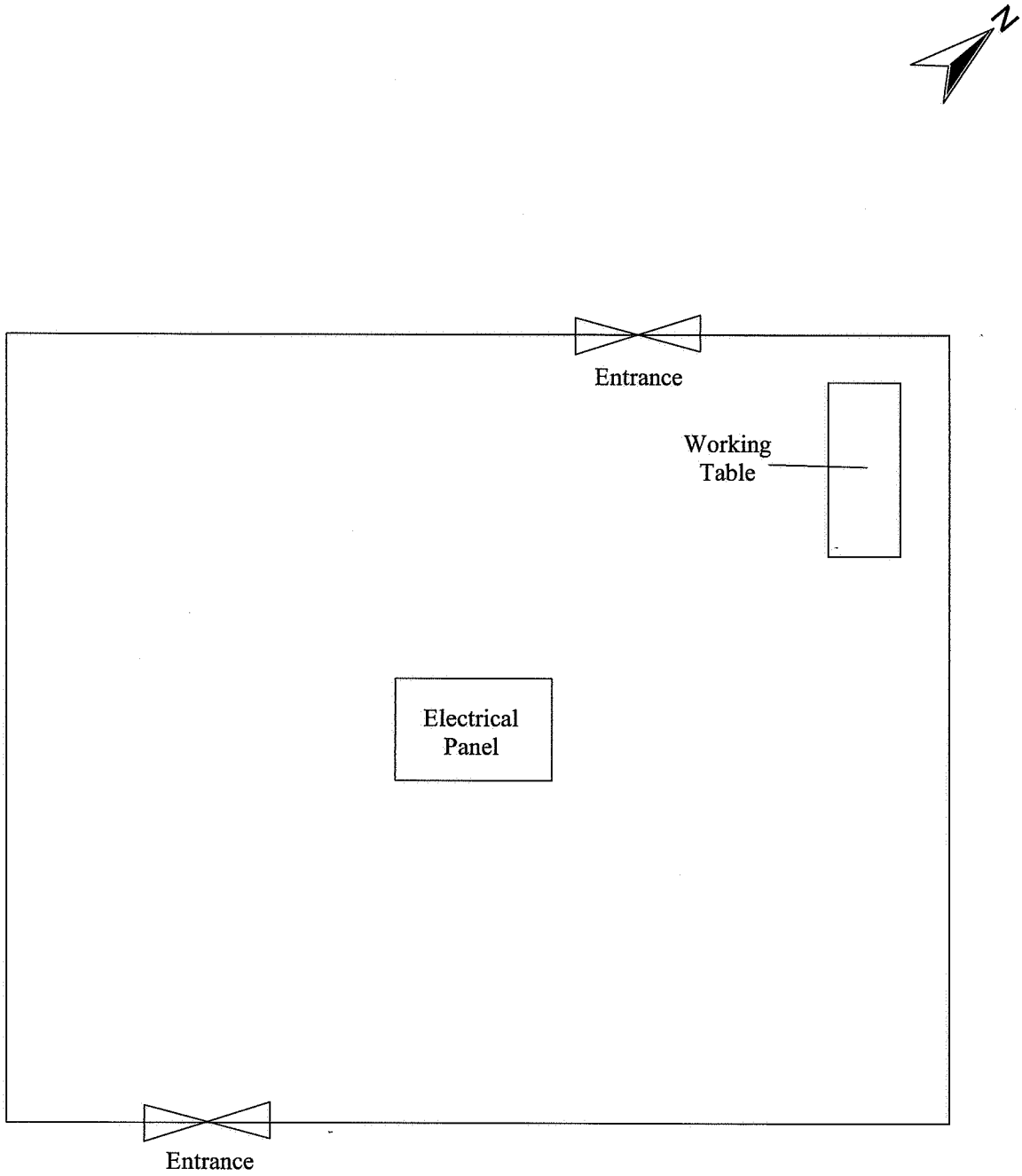

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building R, G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1g	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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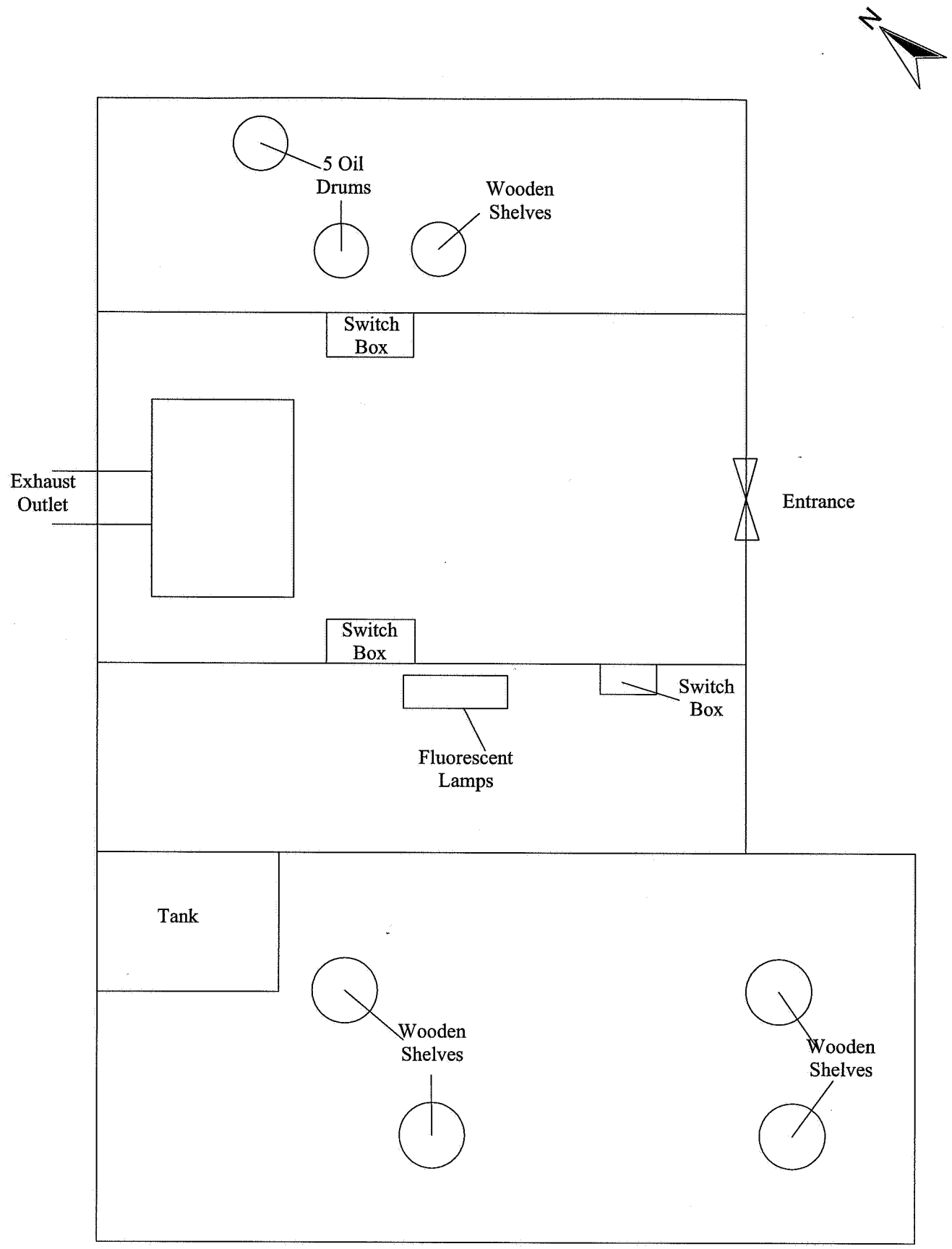

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building V, G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1h	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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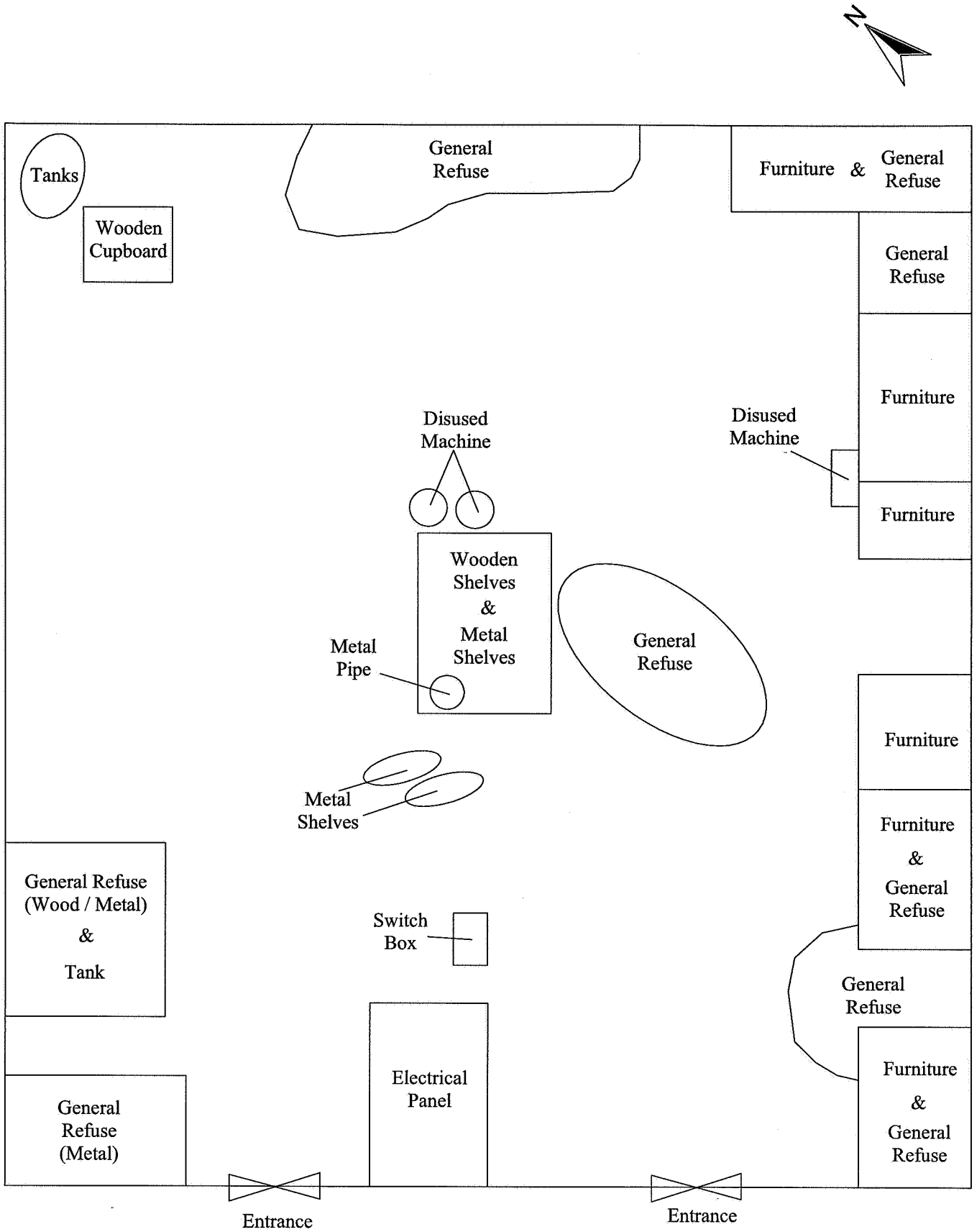

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building W, G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1i	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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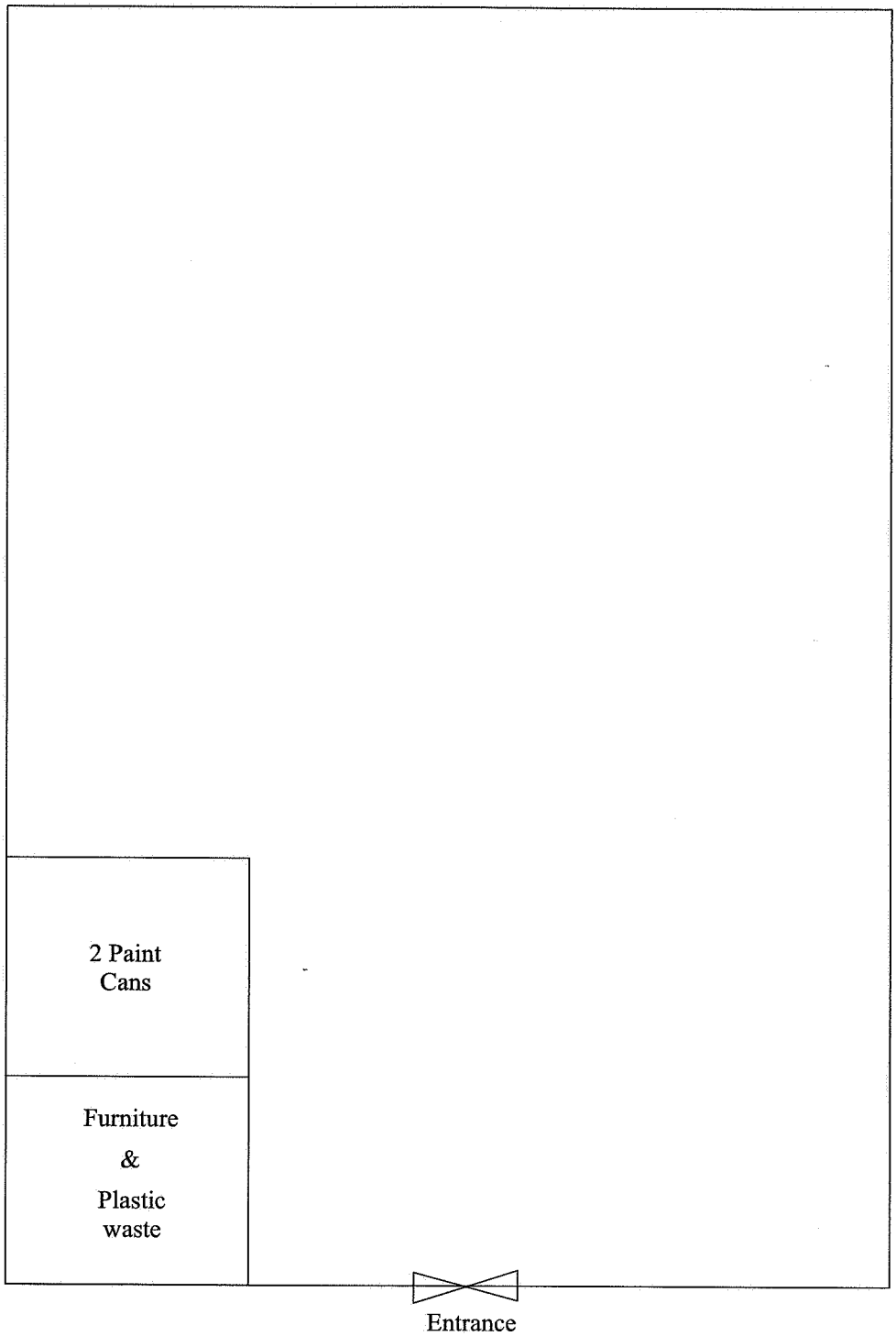

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building X, G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1j	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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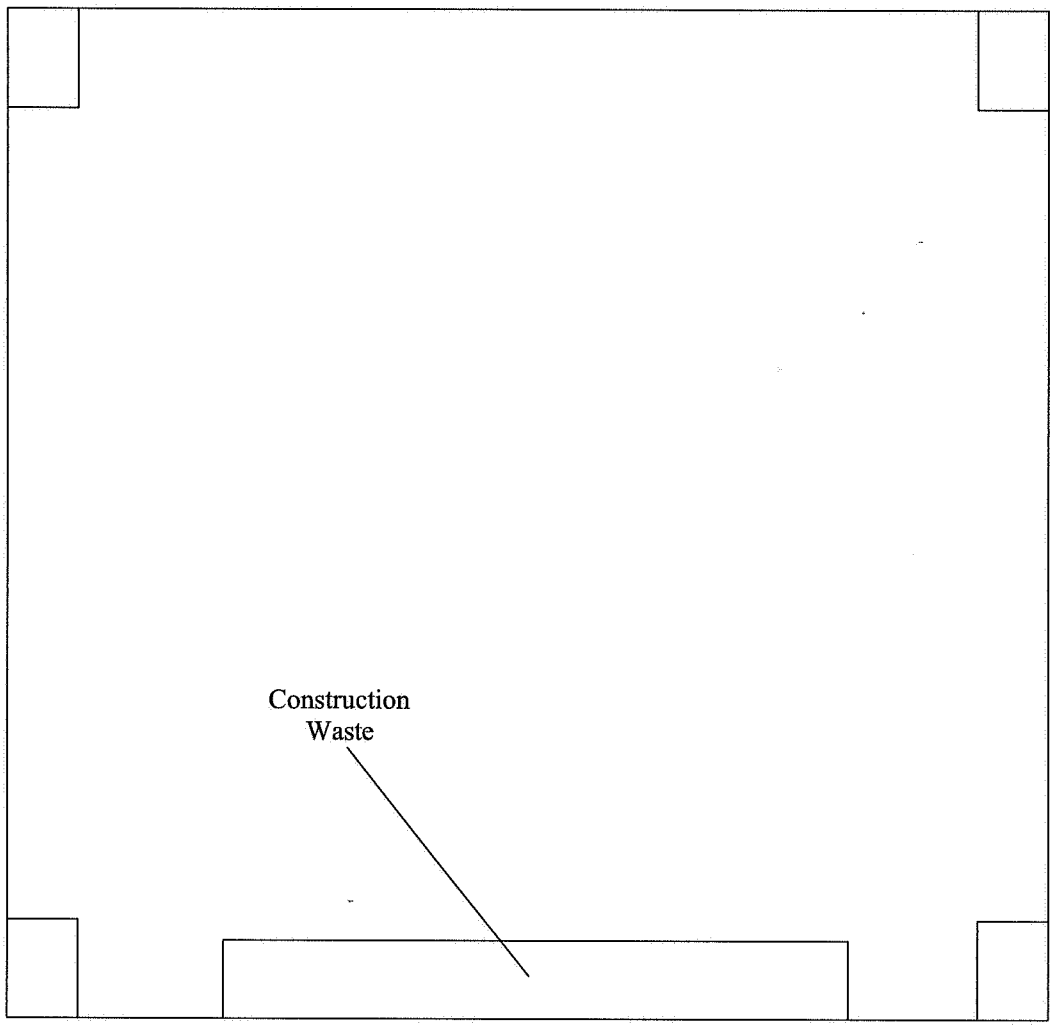

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building 8, G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1k	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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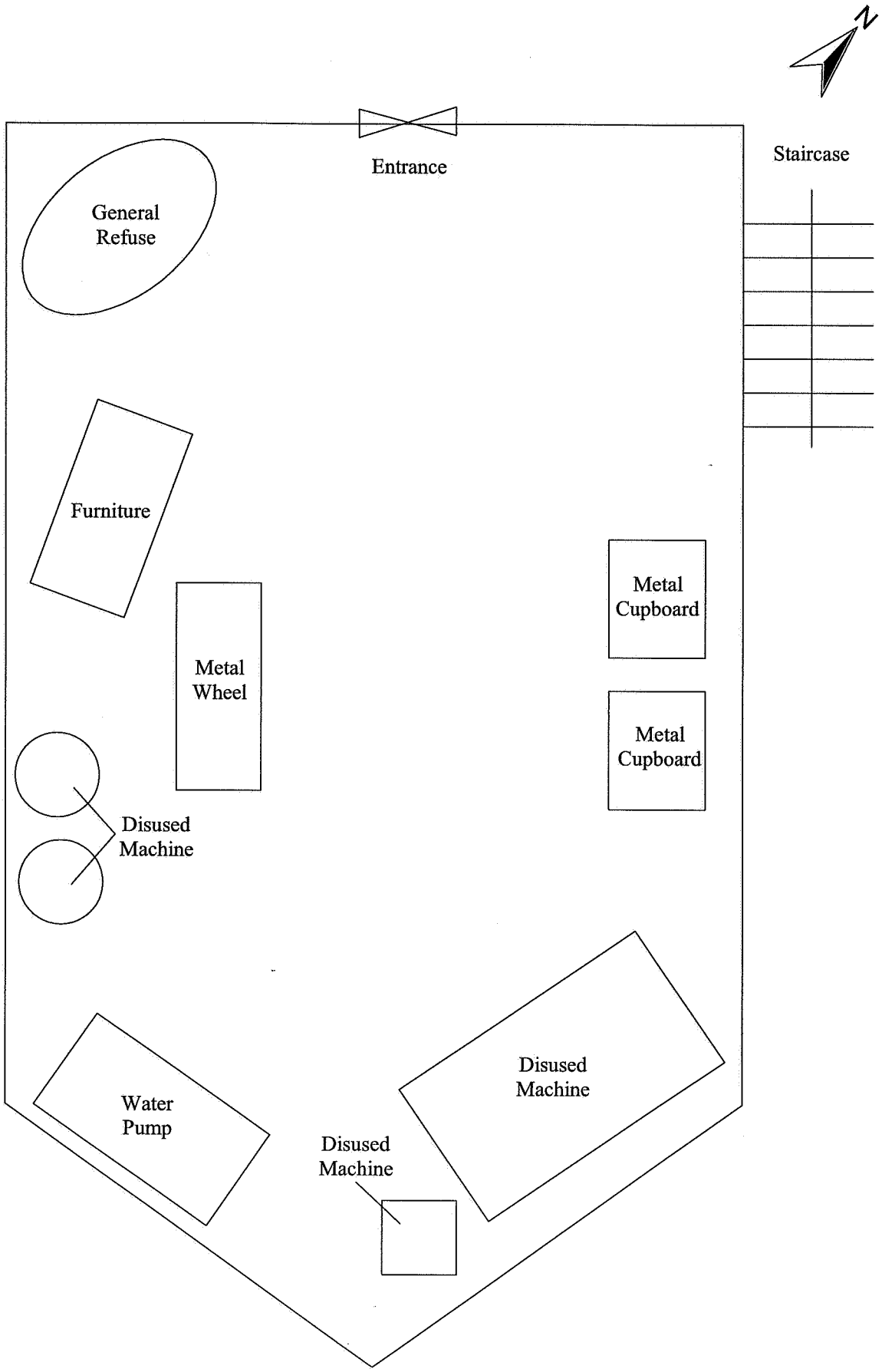

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building U, G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.11	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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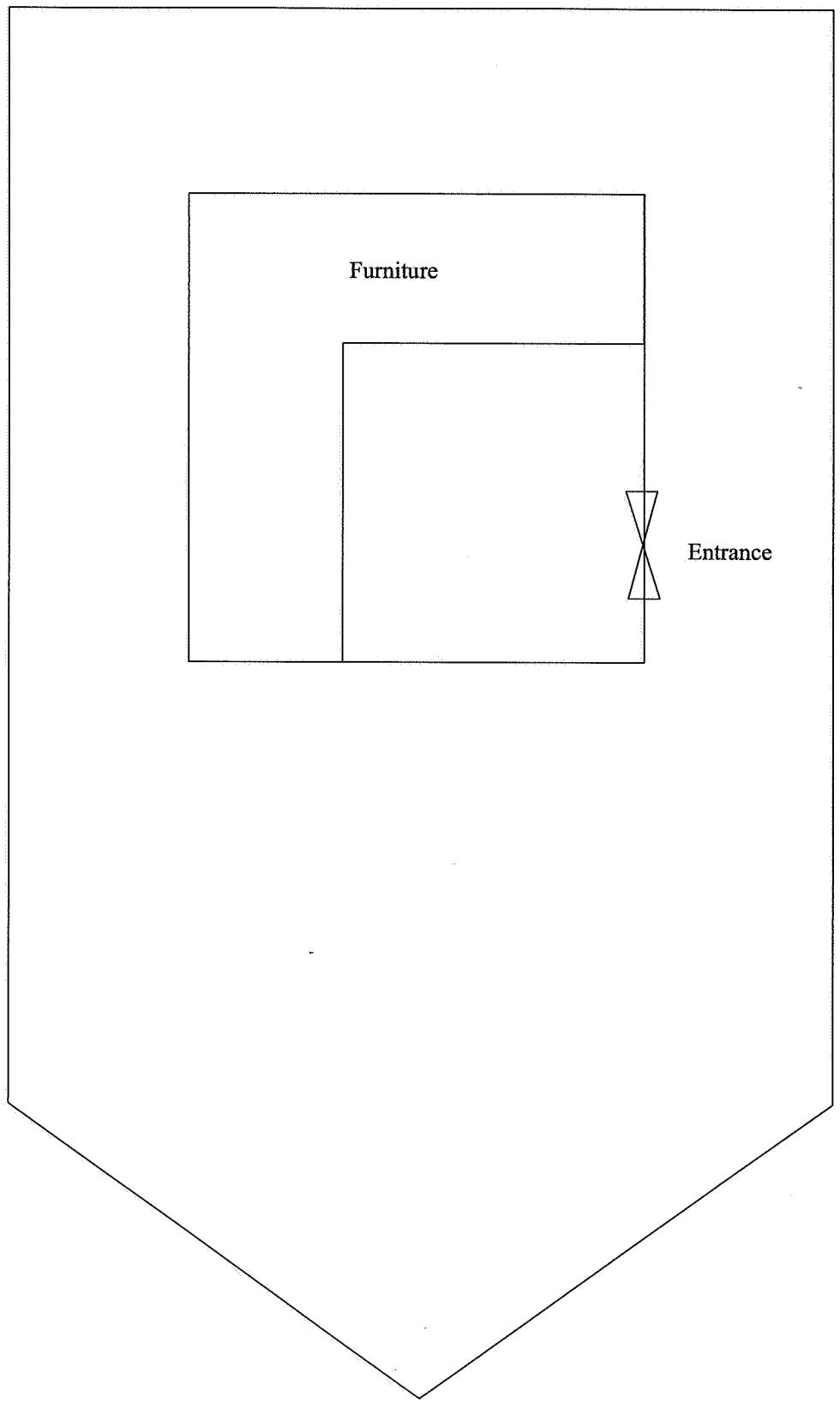

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building U, 1/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1m	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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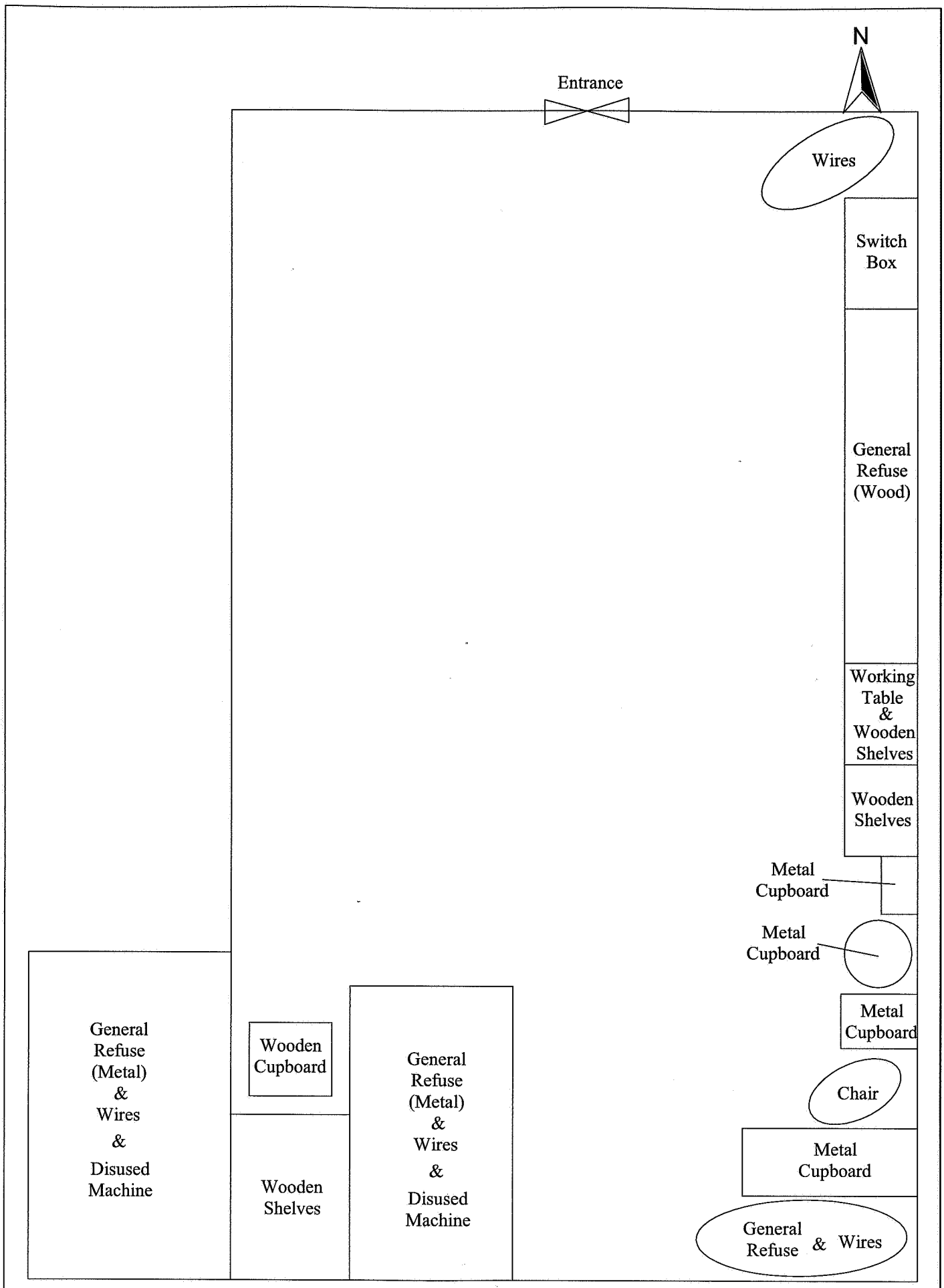

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building Y, G/F	Scale: N.T.S. Date: Feb 2002	Project No. R06100 Figure No. 6.1n	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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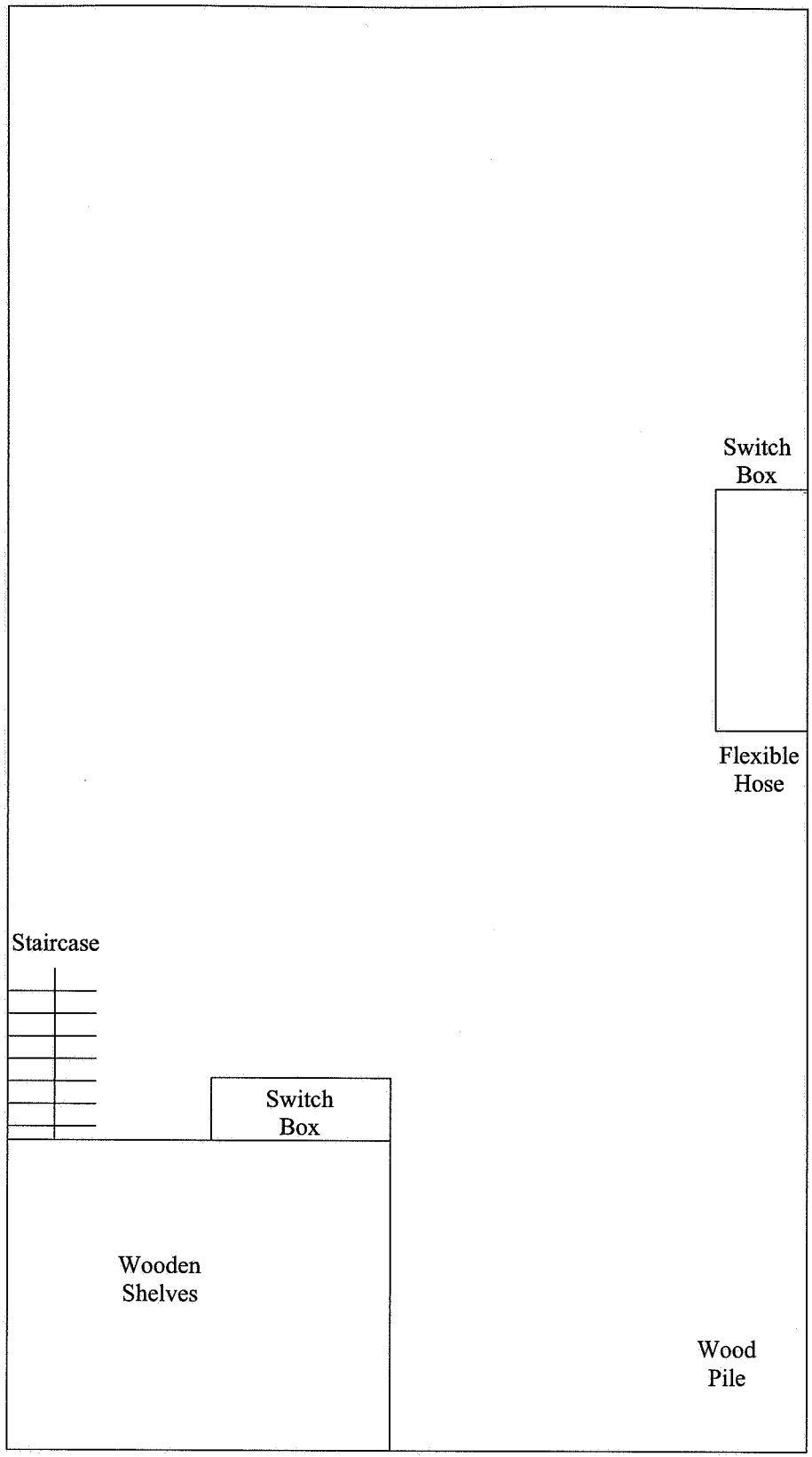

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building Z, G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1o	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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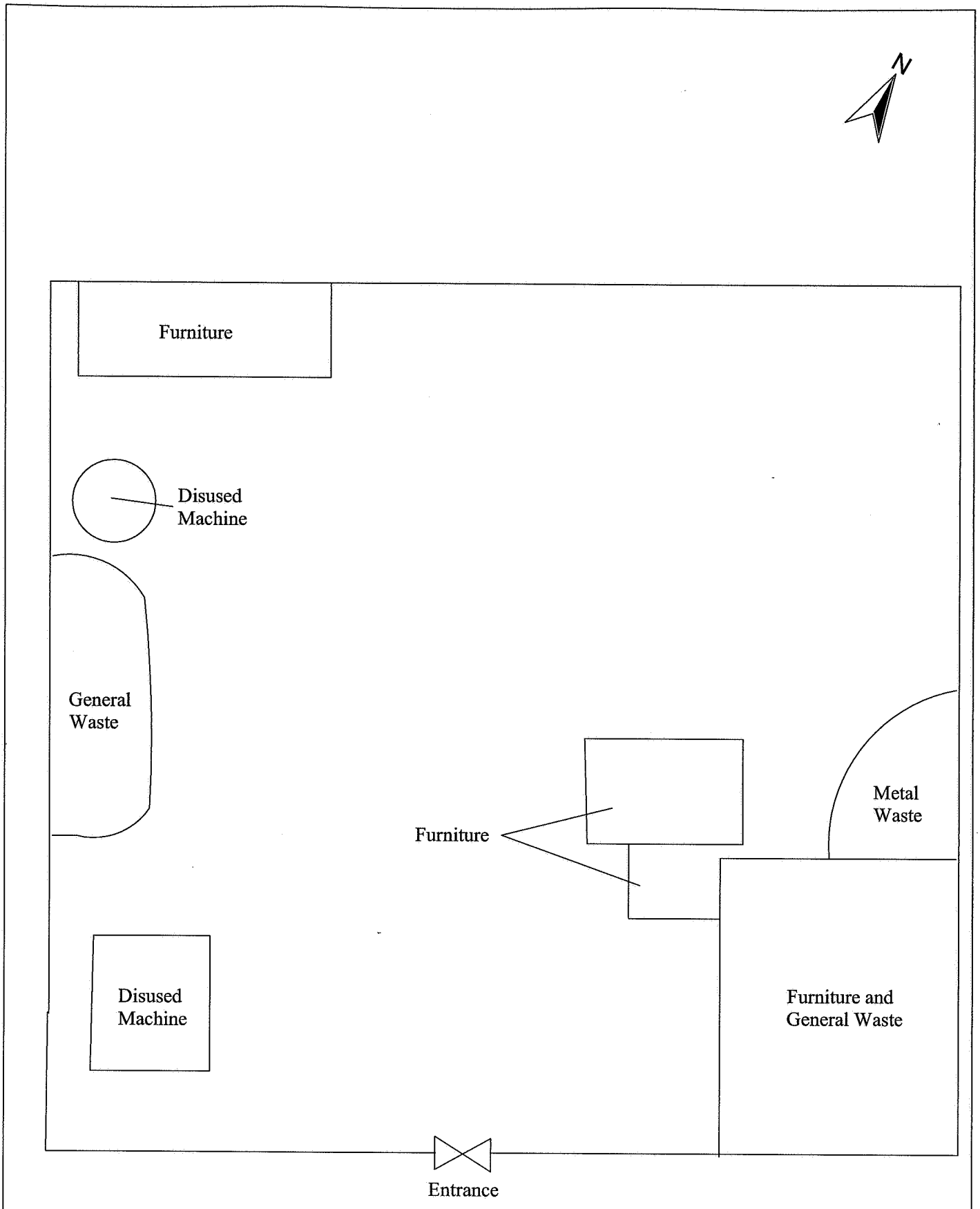

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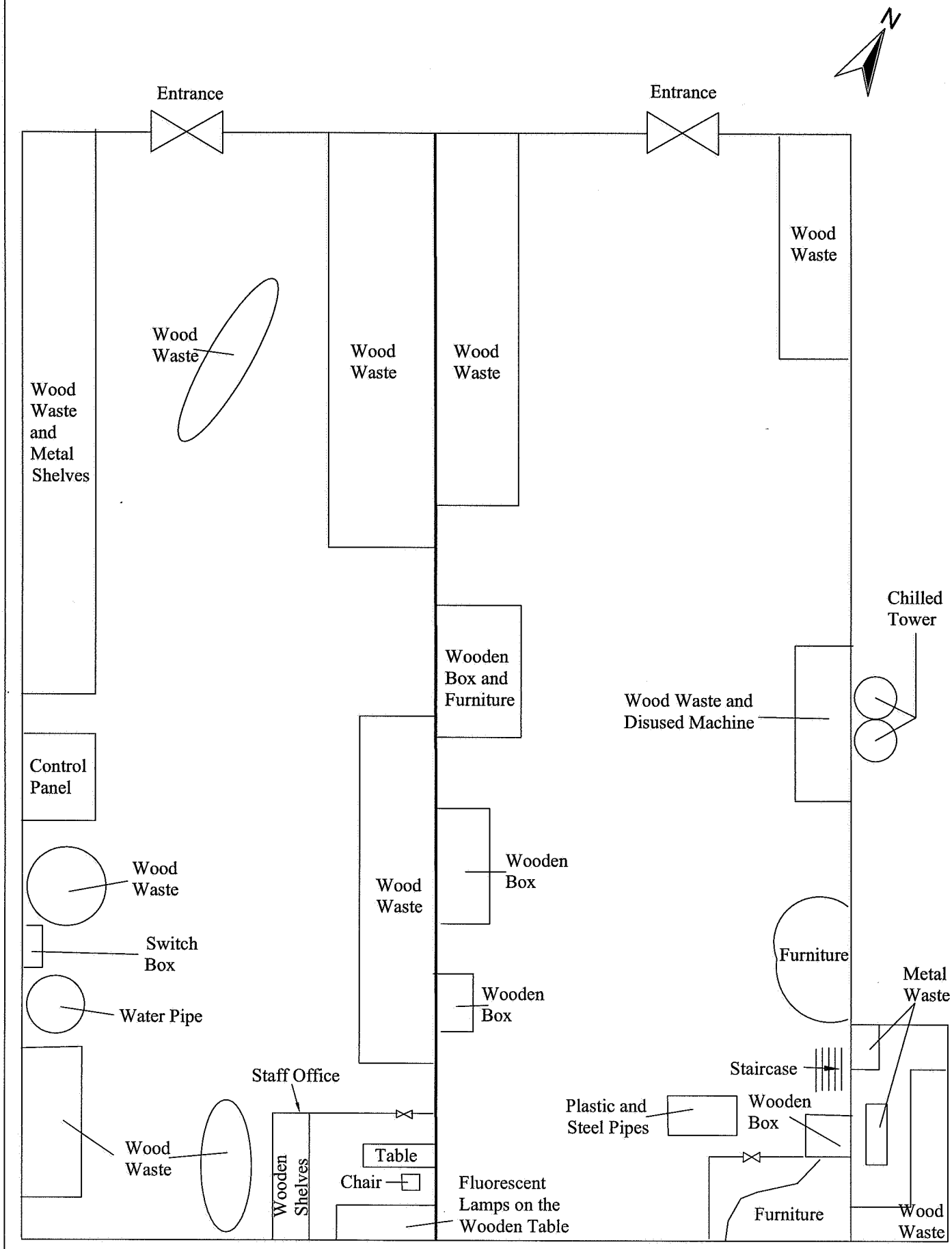

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building O, G/F	Scale: N.T.S. Date: Jan 2002	Project No.: R06100 Figure No.: 6.1q	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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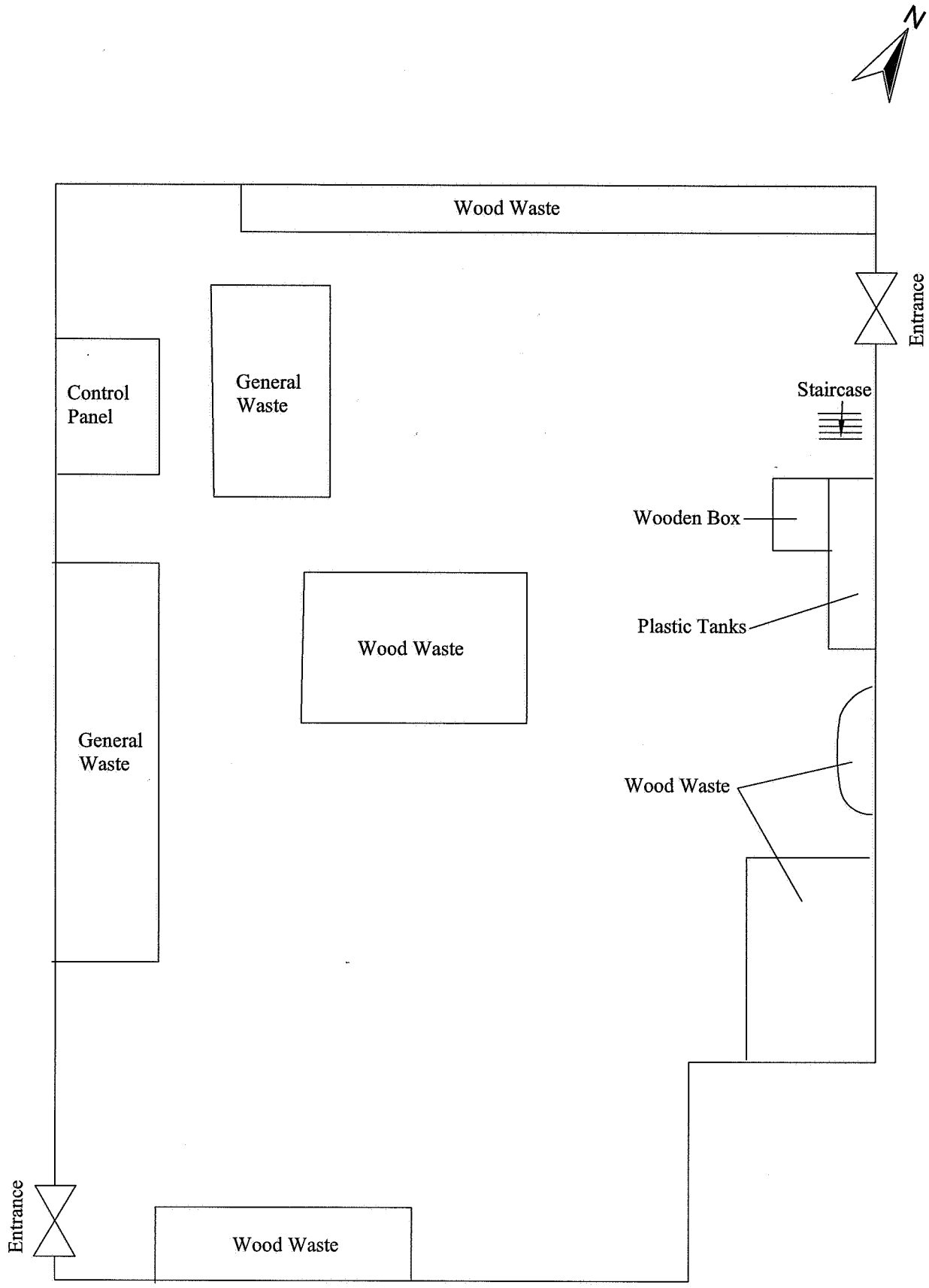

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building P, G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1r	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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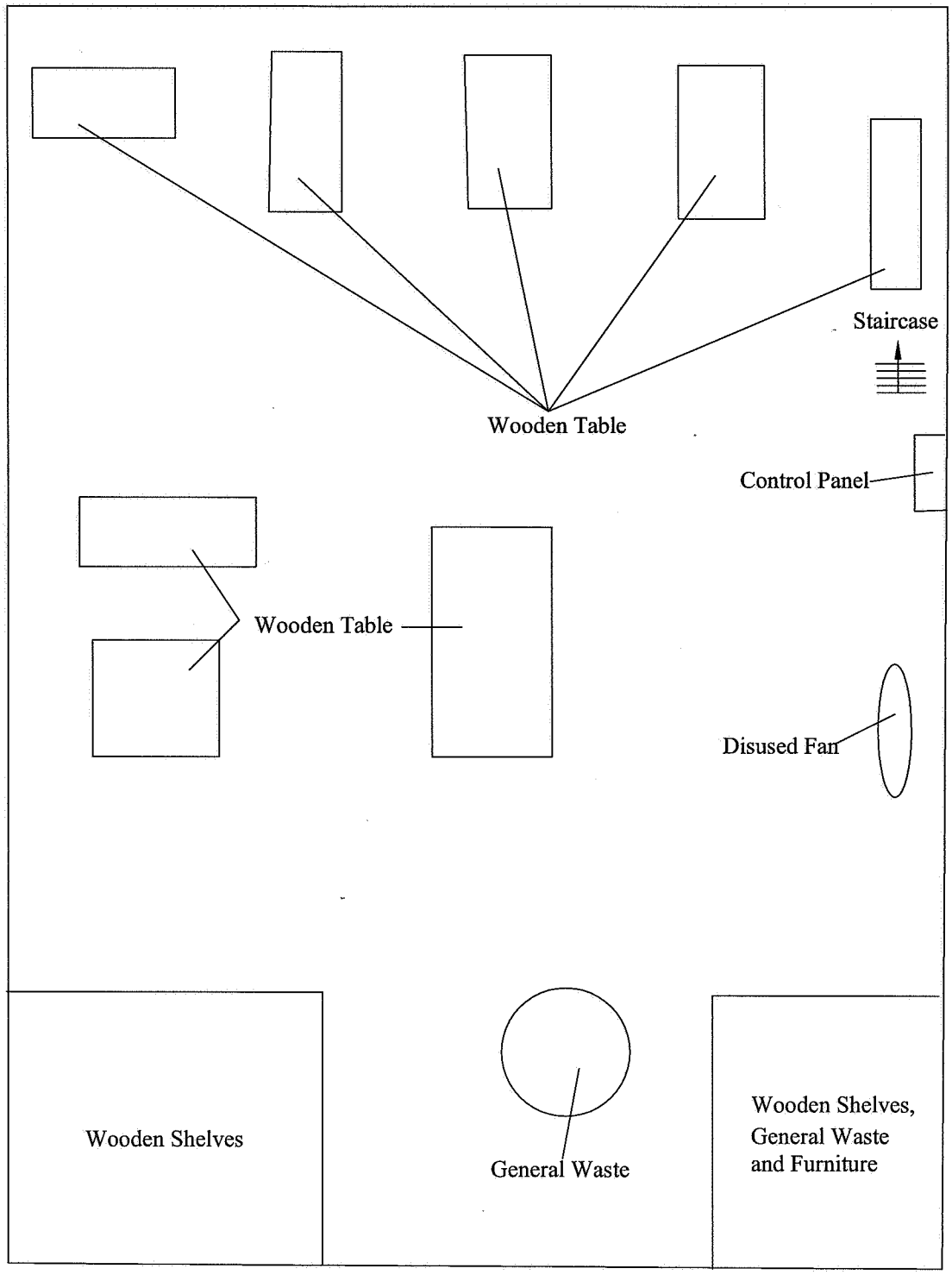

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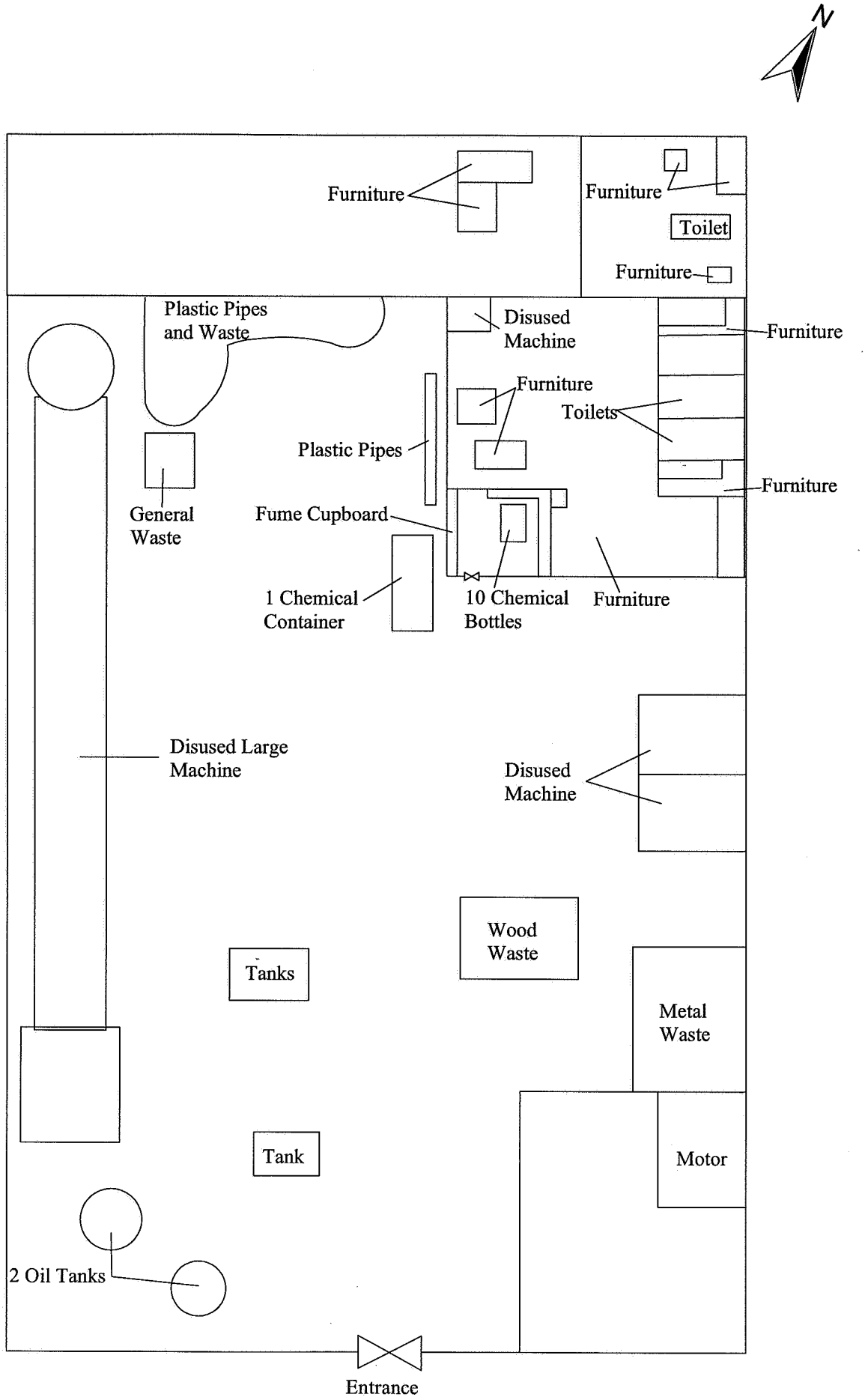

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building B, G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1t	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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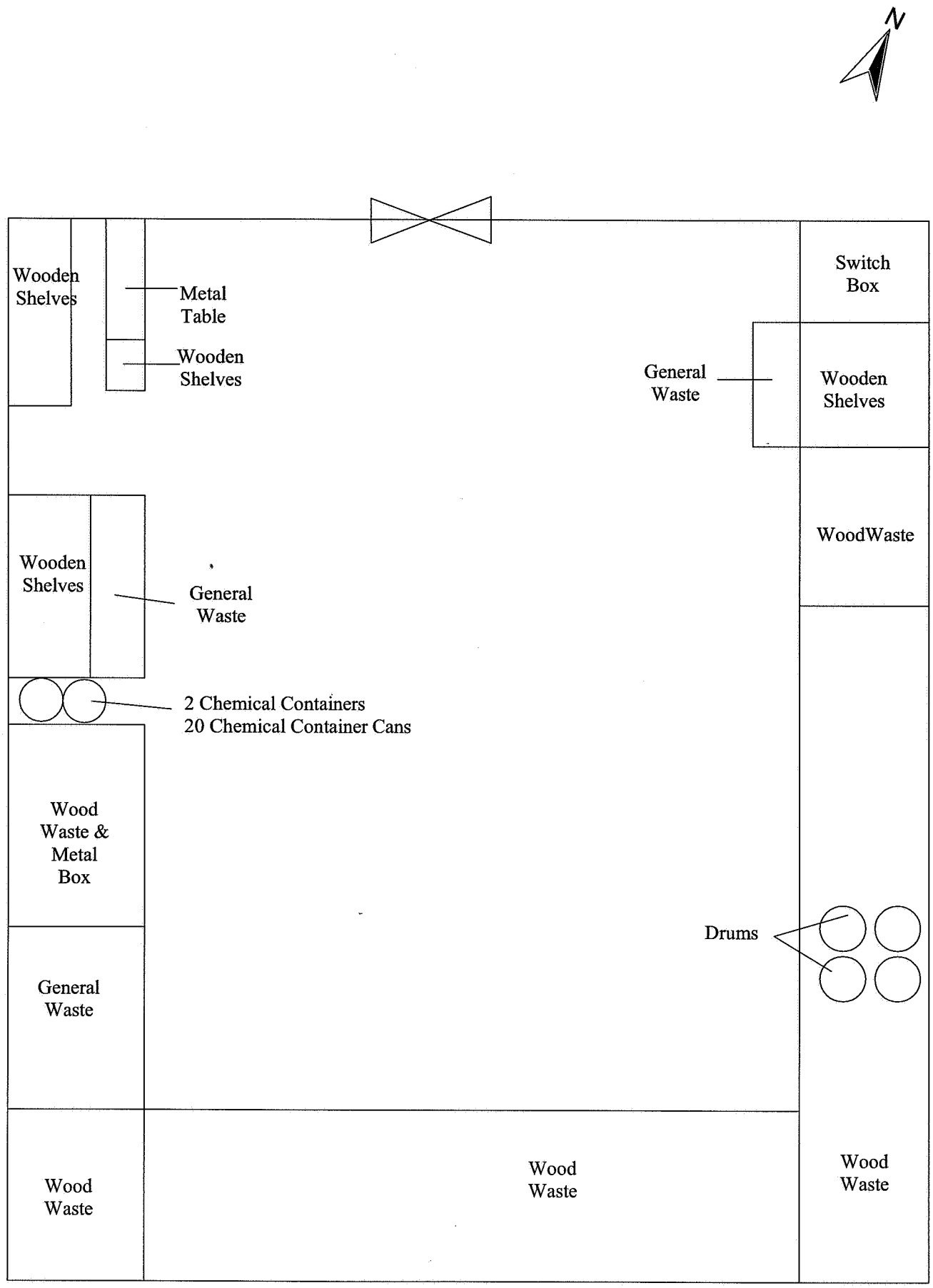

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building A, G/F	Scale: N.T.S. Date: Feb 2002	Project No. R06100 Figure No. 6.1u	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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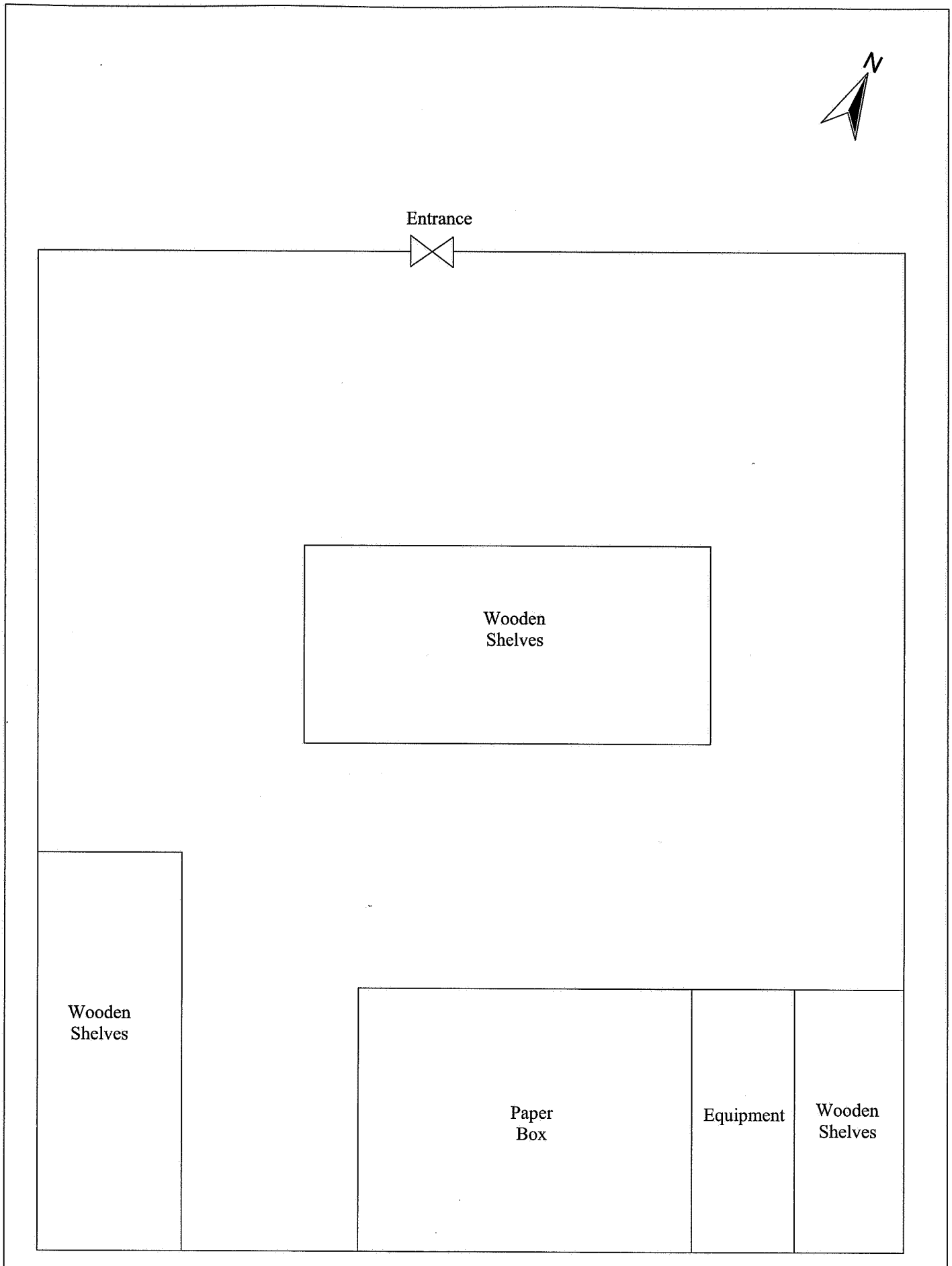

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building A, 1/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1v	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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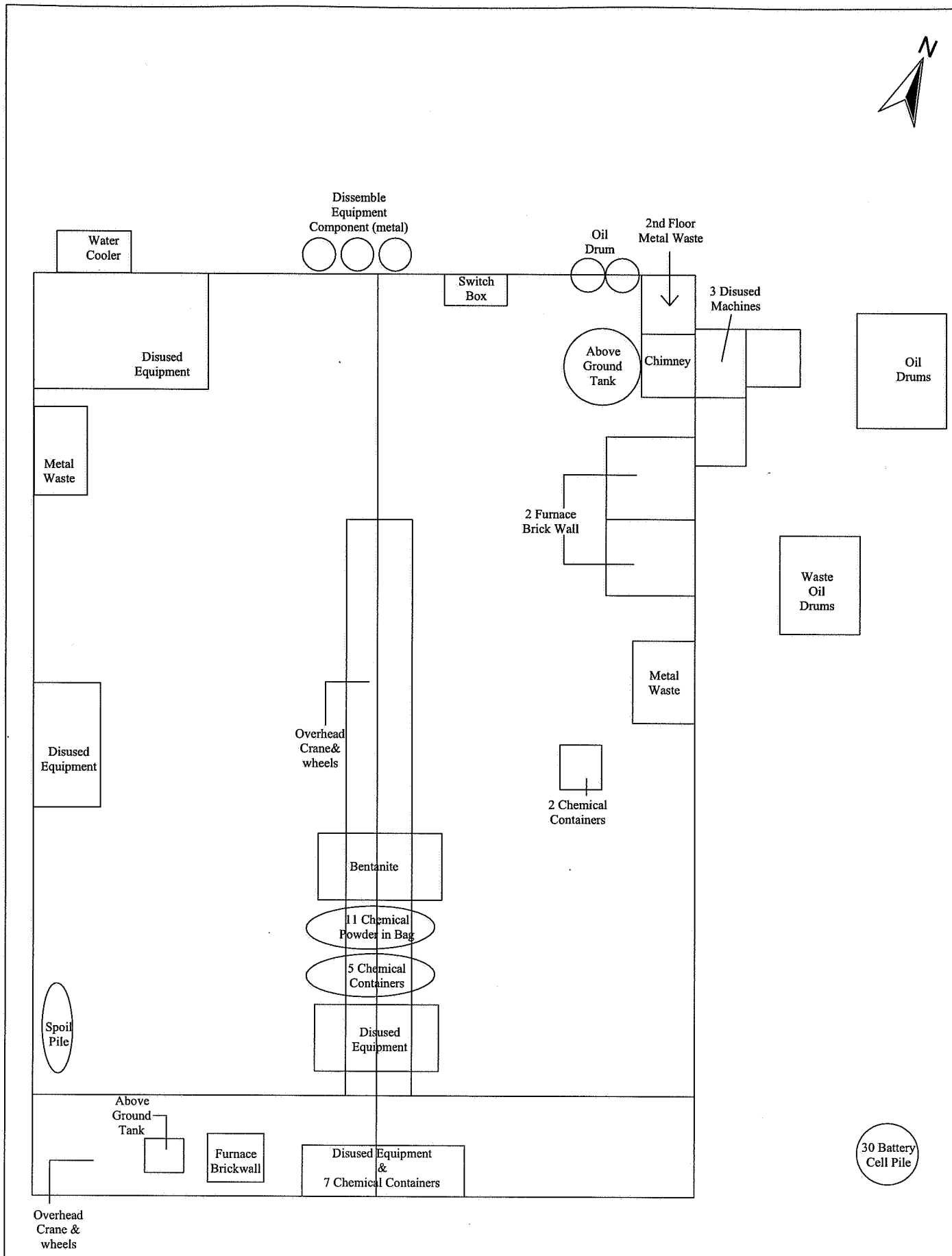

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building L, G/F	Scale: N.T.S. Date: Feb 2002	Project No. R06100 Figure No. 6.1w	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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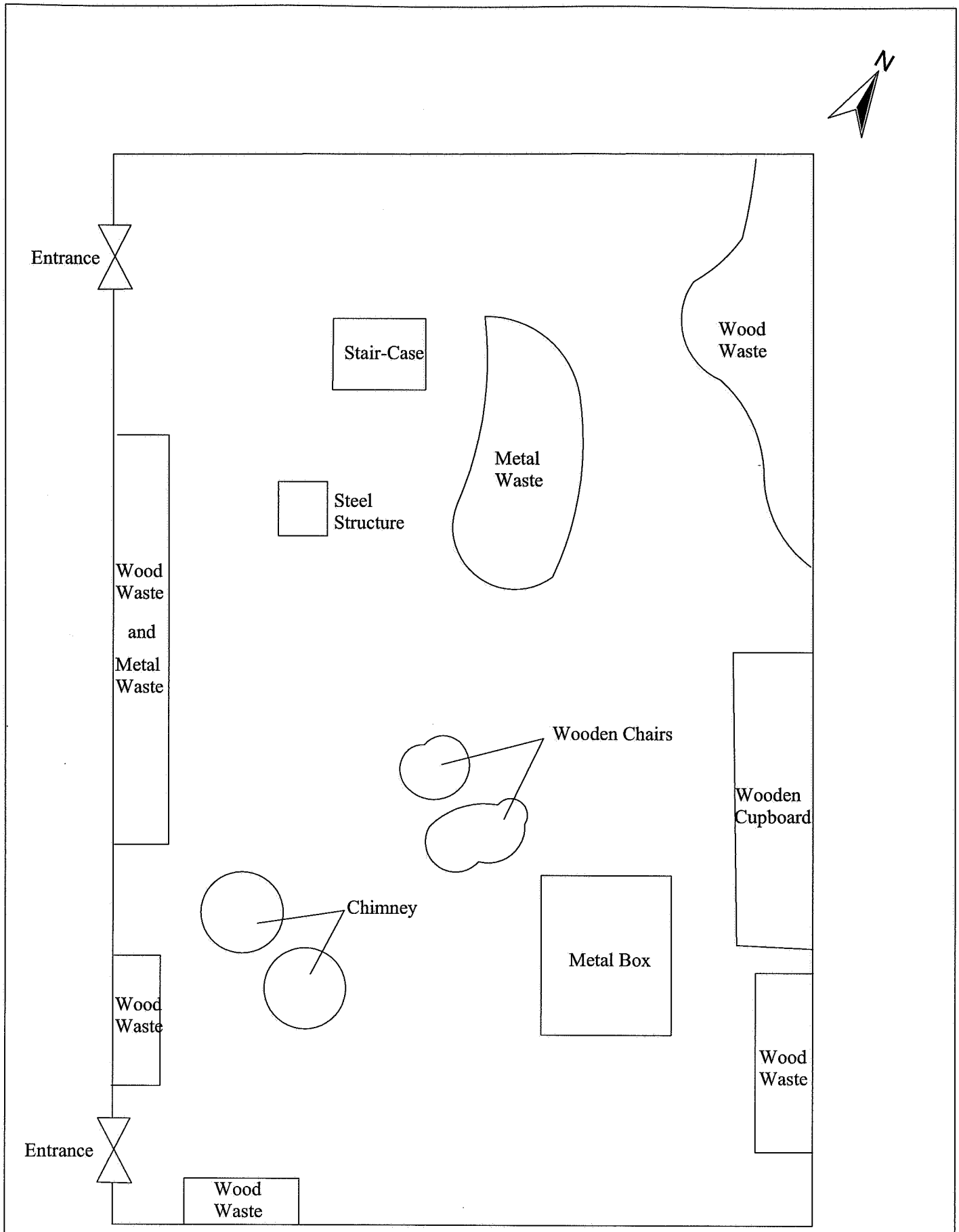

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building K, G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1x	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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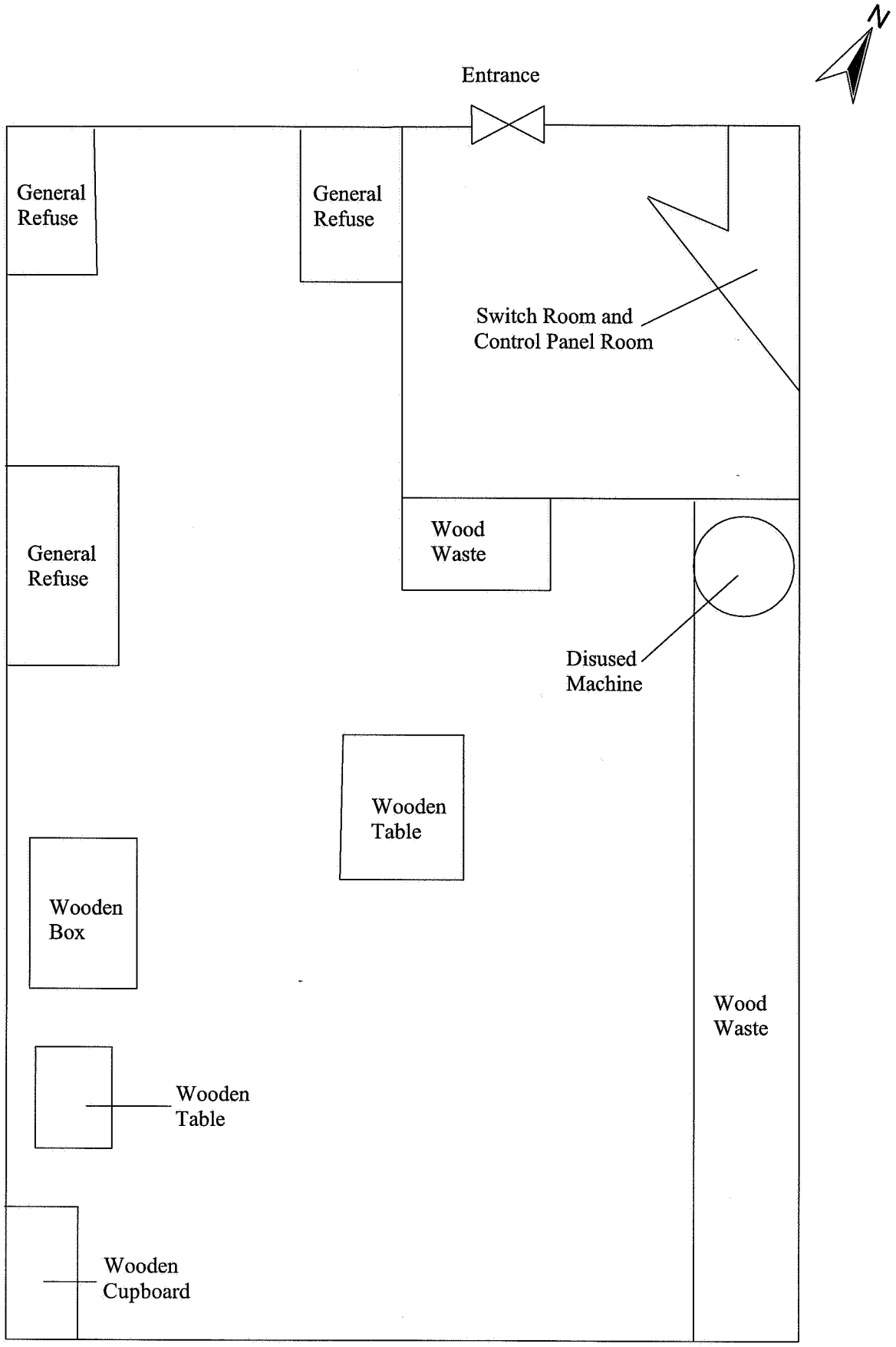

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building D , G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1y	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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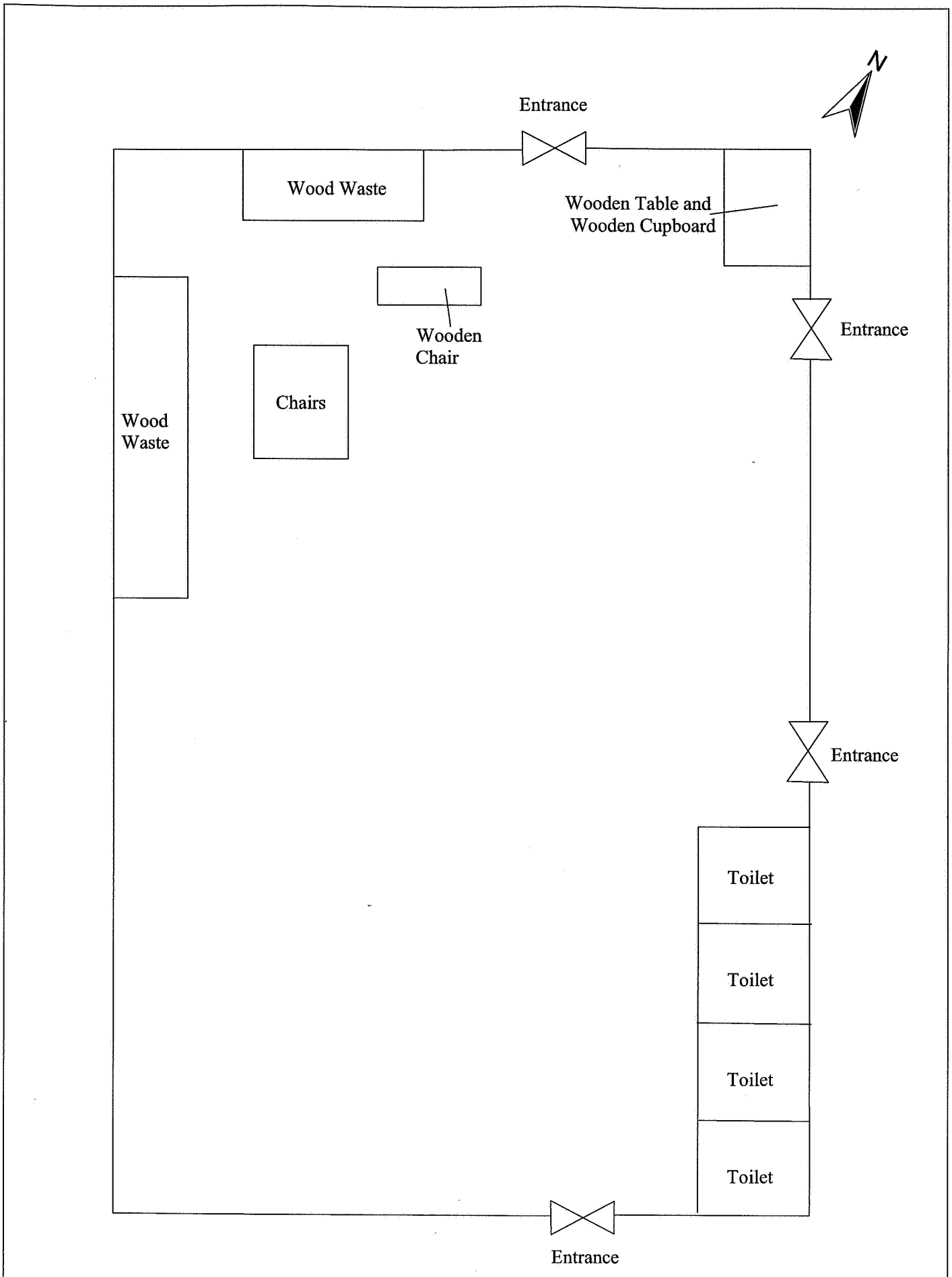

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building C, G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1z	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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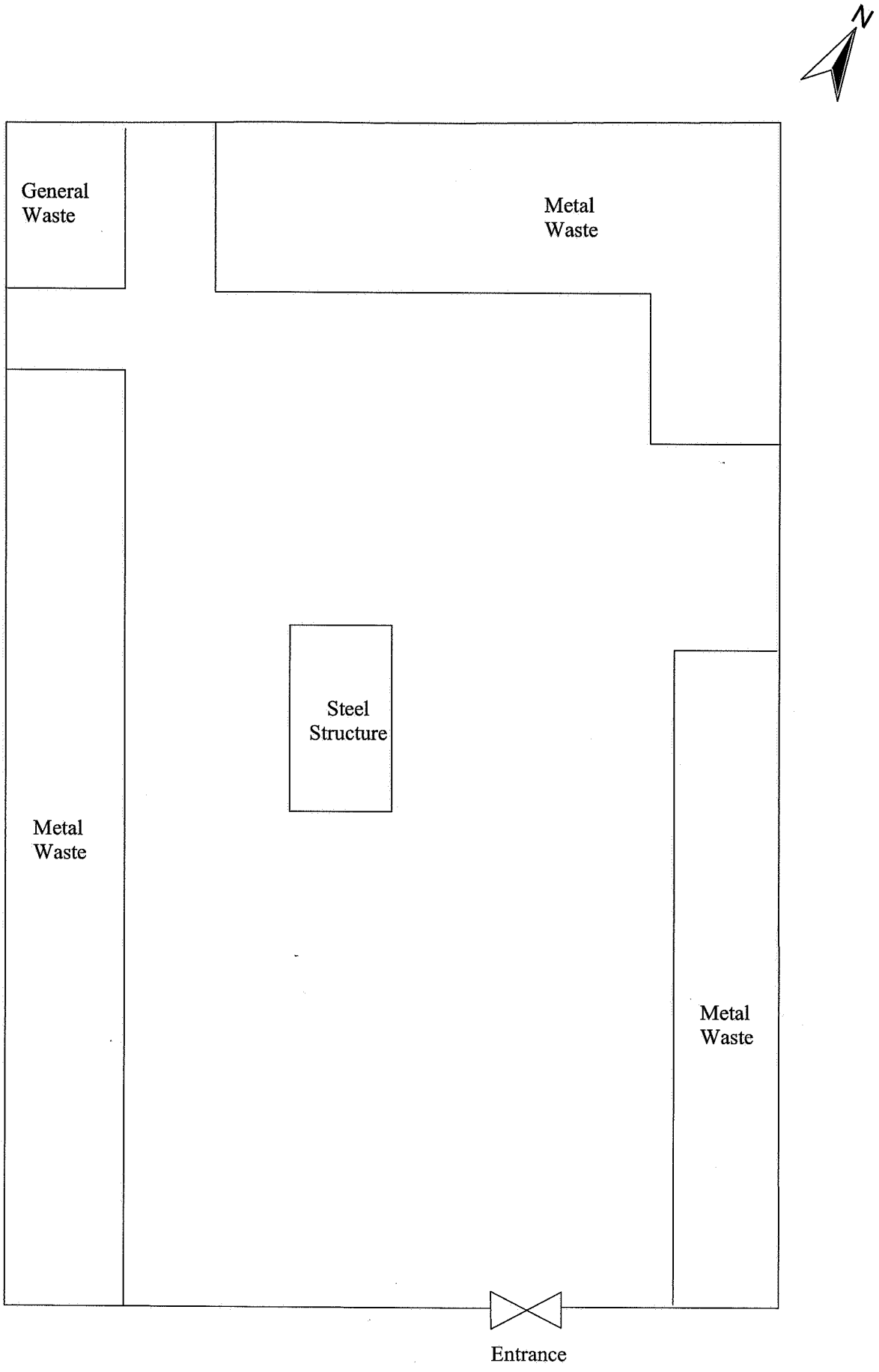

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building J, G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1aa	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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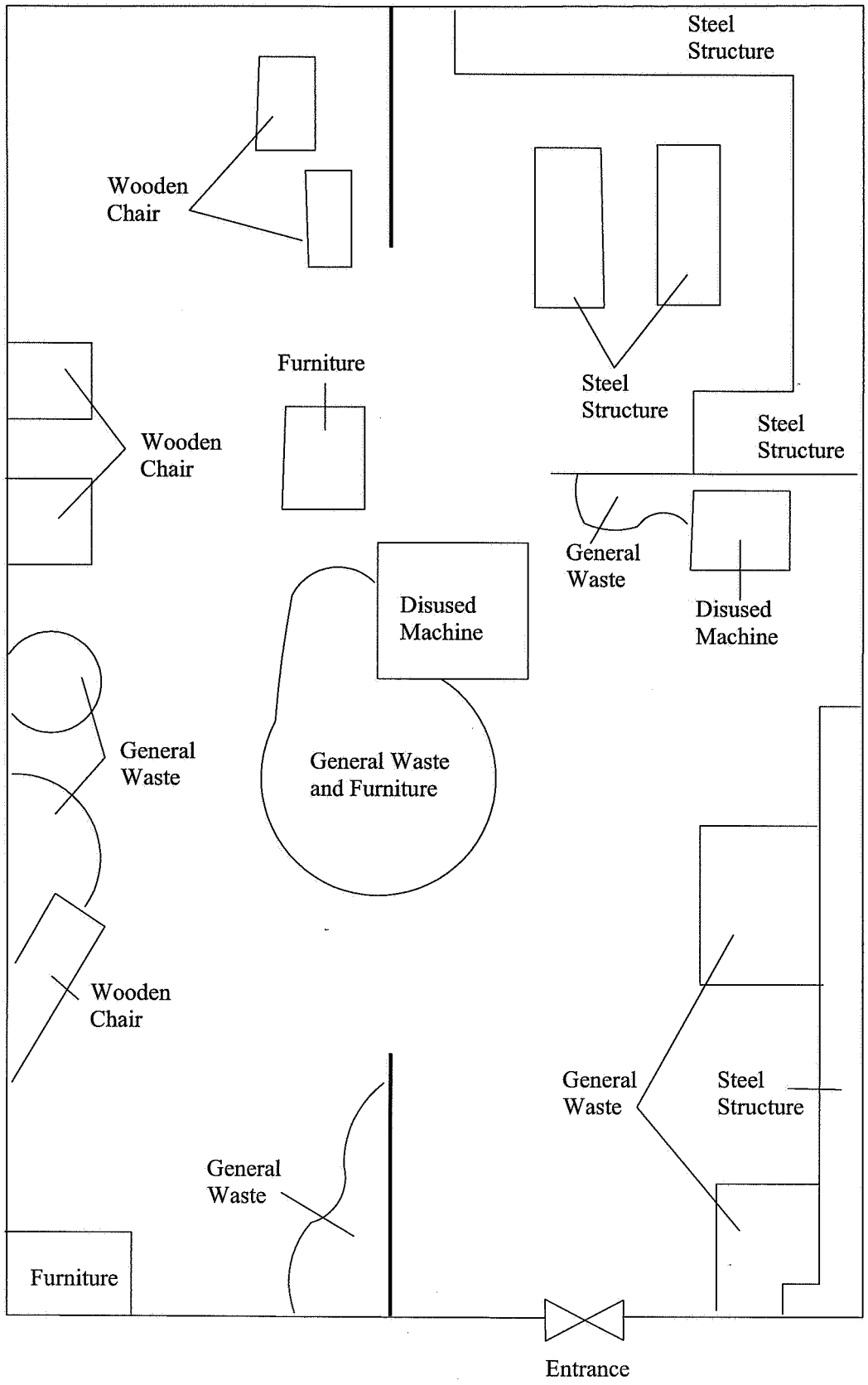

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building I , G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1ab	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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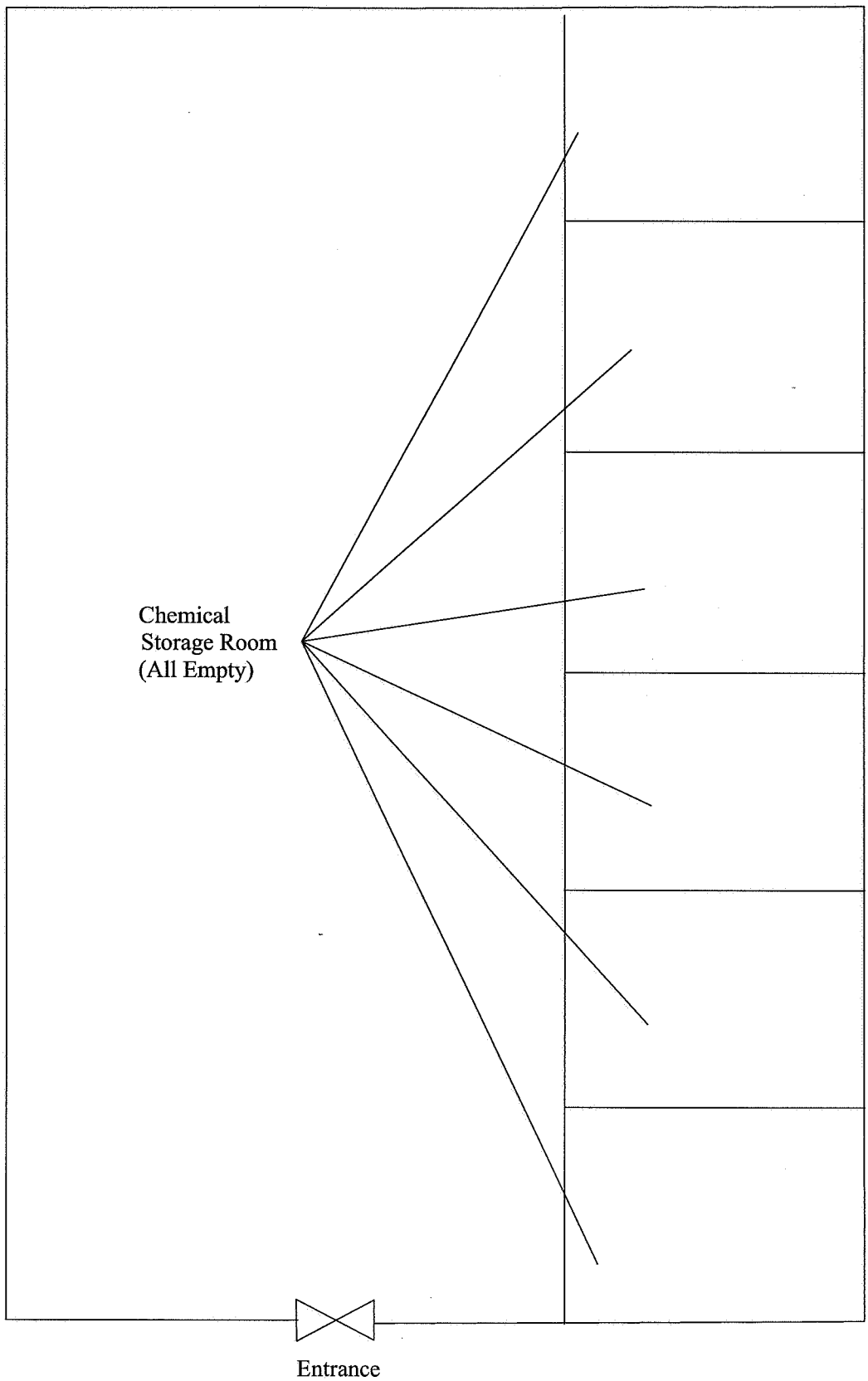

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building H, G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1ac	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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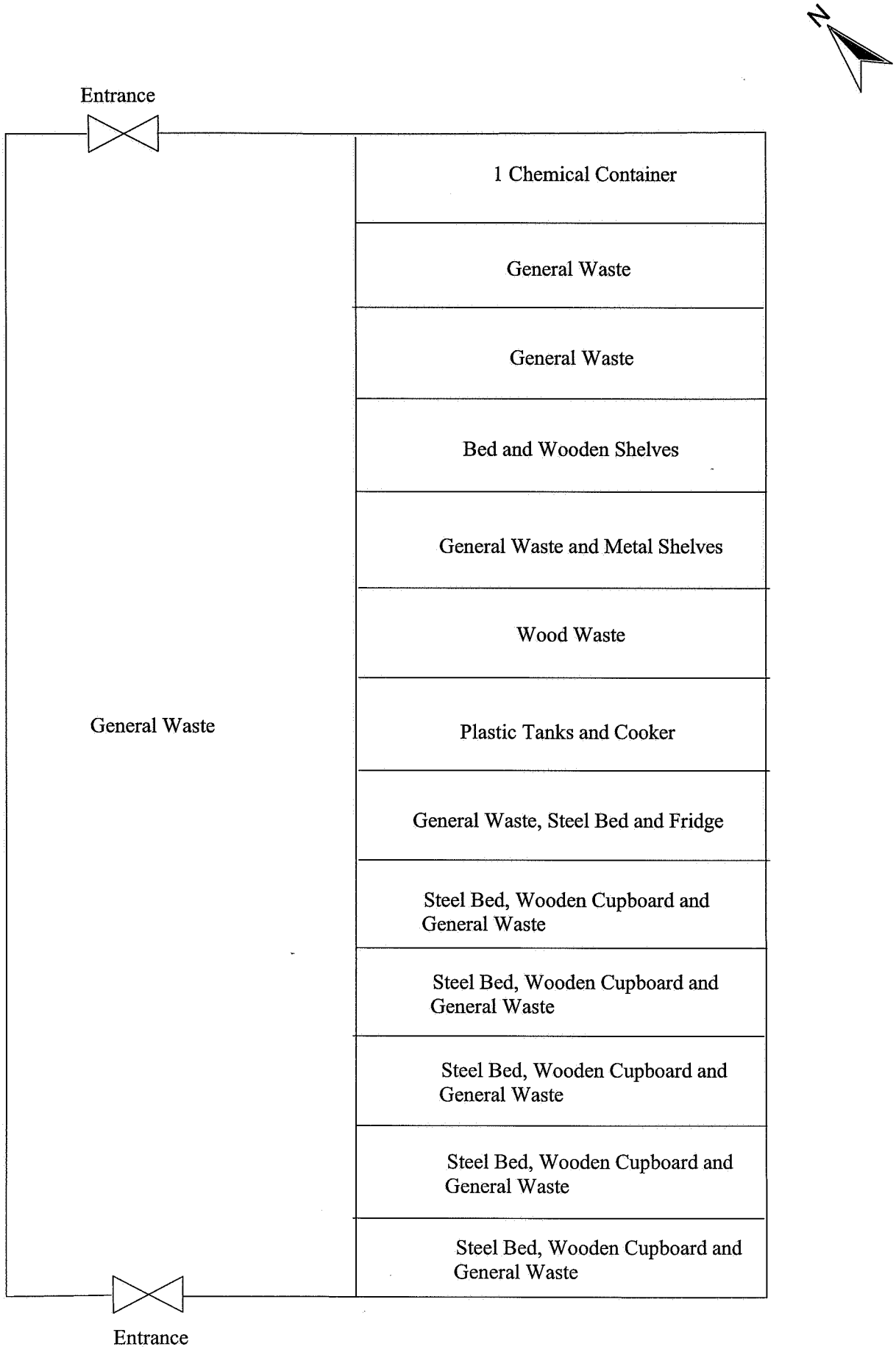

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building E, G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1ad	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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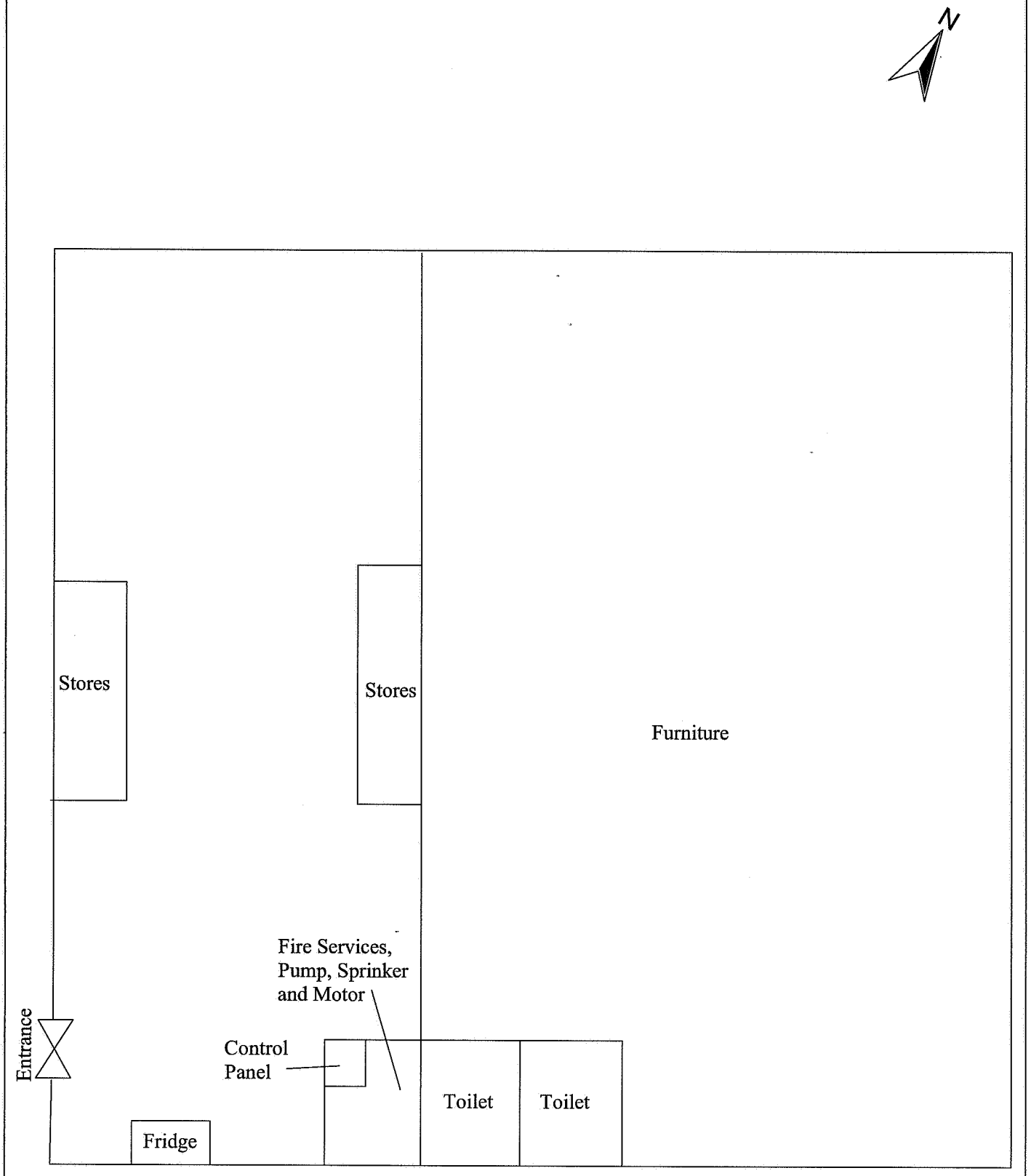

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Schematic Waste Location Plan of Building G, G/F	Scale: N.T.S. Date: Feb 2002	Project No.: R06100 Figure No.: 6.1ae	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

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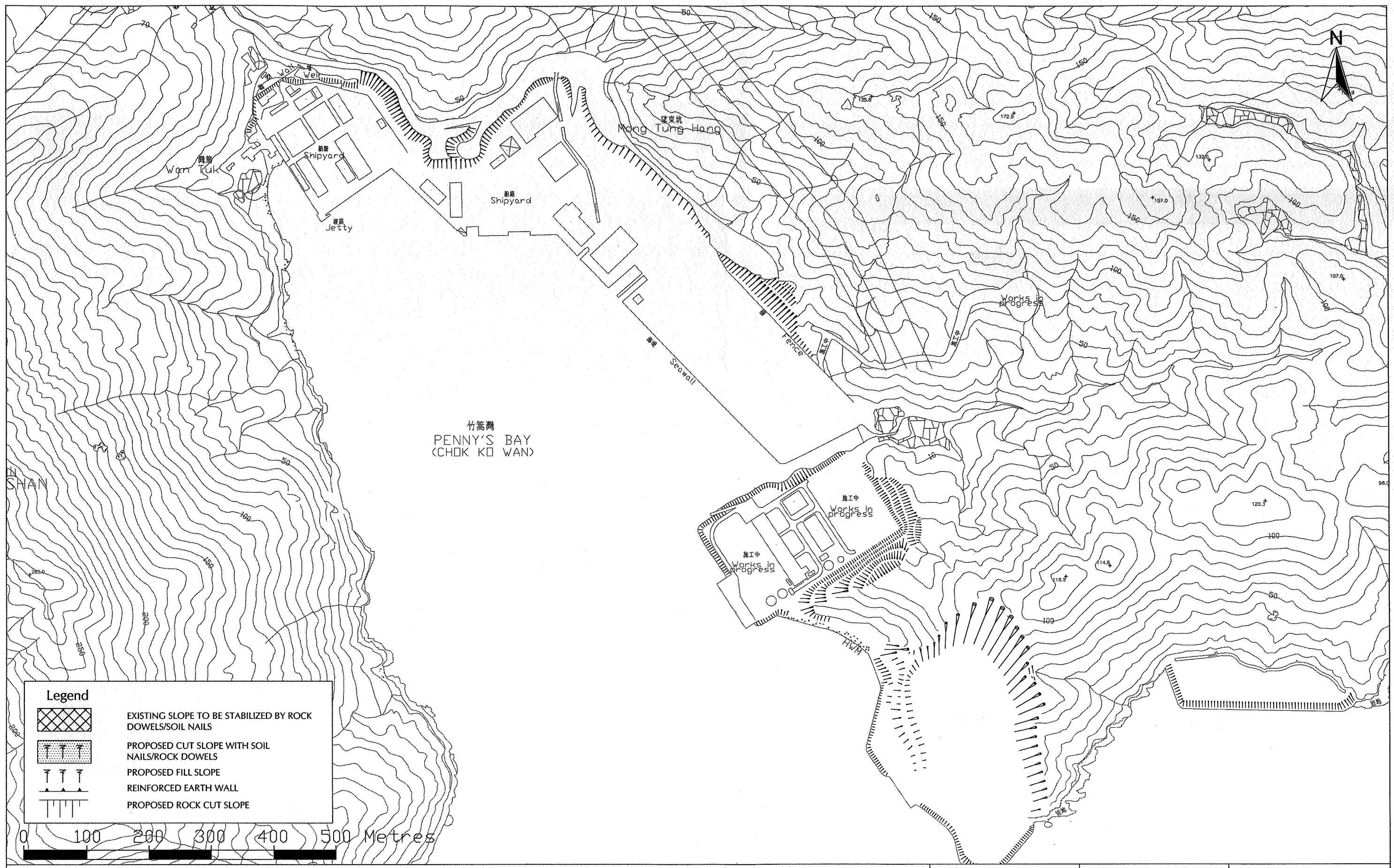

Title	Agreement No. CE 68/99 Infrastrusture for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard Layout Plan of Slope Improvement Works	Scale: As Shown Date: Feb 2002	Project No.: R06100 Figure No.: 6.2

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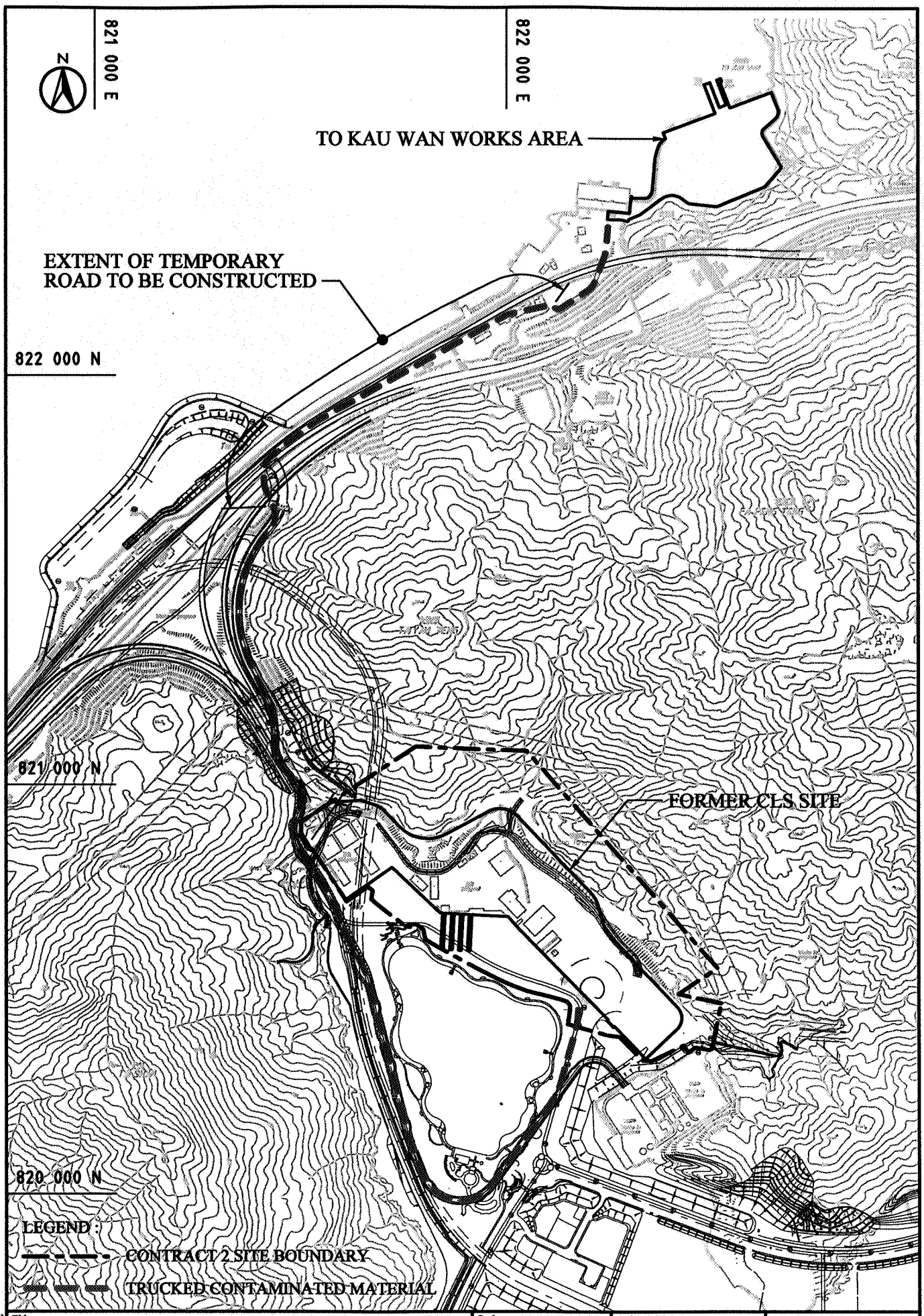

Title: Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction Decommissioning of Cheoy Lee Shipyard TRANSPORTATION ROUTE : TO KAU WAN DECONTAMINATION SITE	Scale: 1:12500	Projects No. R06100	Maunsell MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD
	Date: Feb. 2002	Figure No. 6.3	

Date = 02/06/02

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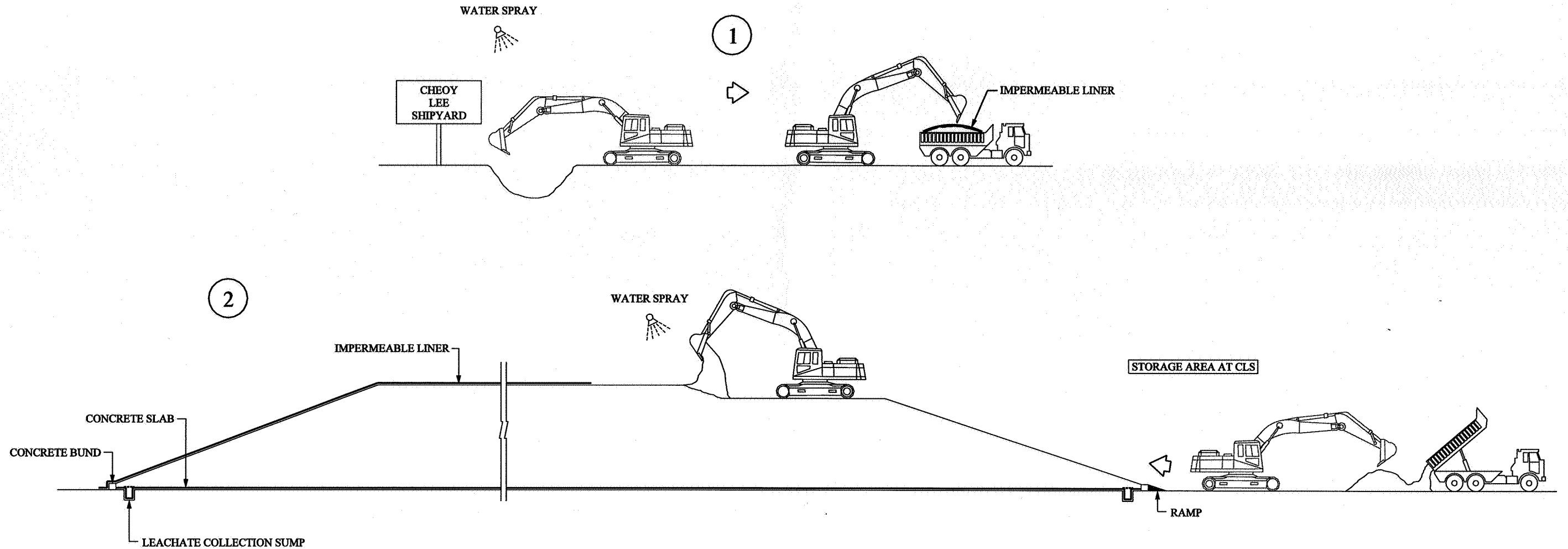

NOTE : THE HANDLING METHODOLOGY SHOWN ON THIS DRAWING IS ONE OF SEVERAL FEASIBLE METHODOLOGIES AND IS PRESENTED AS AN EXAMPLE ONLY

Title

Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction
Decommissioning of Cheoy Lee Shipyard

MATERIAL HANDLING METHODS - GENERAL CONTAMINATED MATERIAL REQUIRING SOLIDIFICATION ONLY

Scale	N.T.S.	Projects No.	R06100
Date	Feb. 2002	Figure No.	6.4a

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Date = 02/06/02

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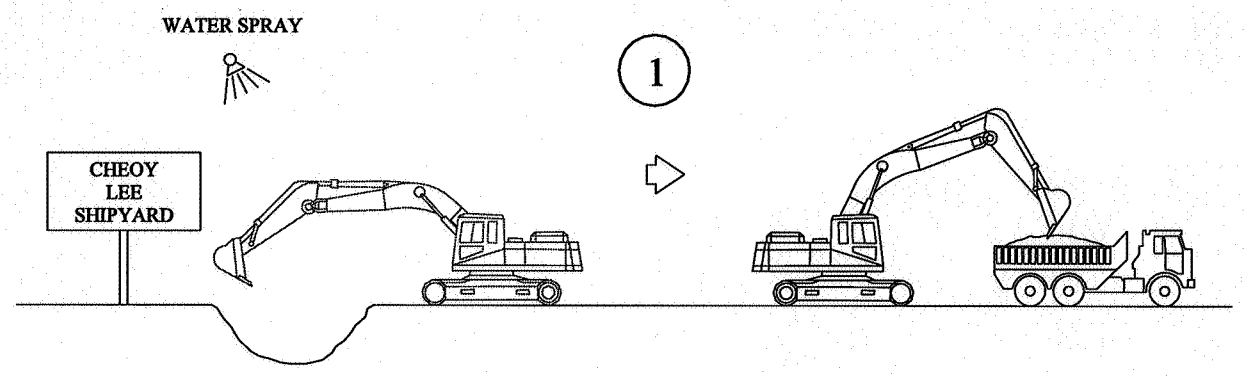

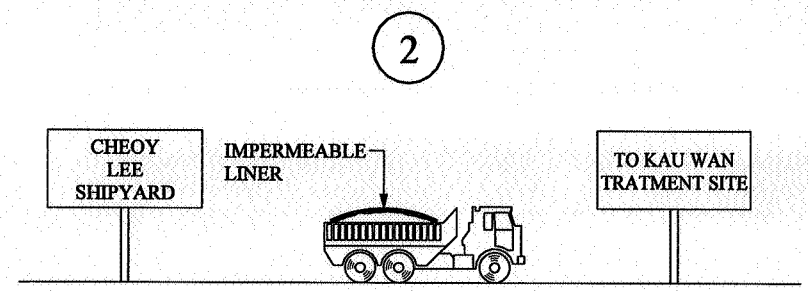

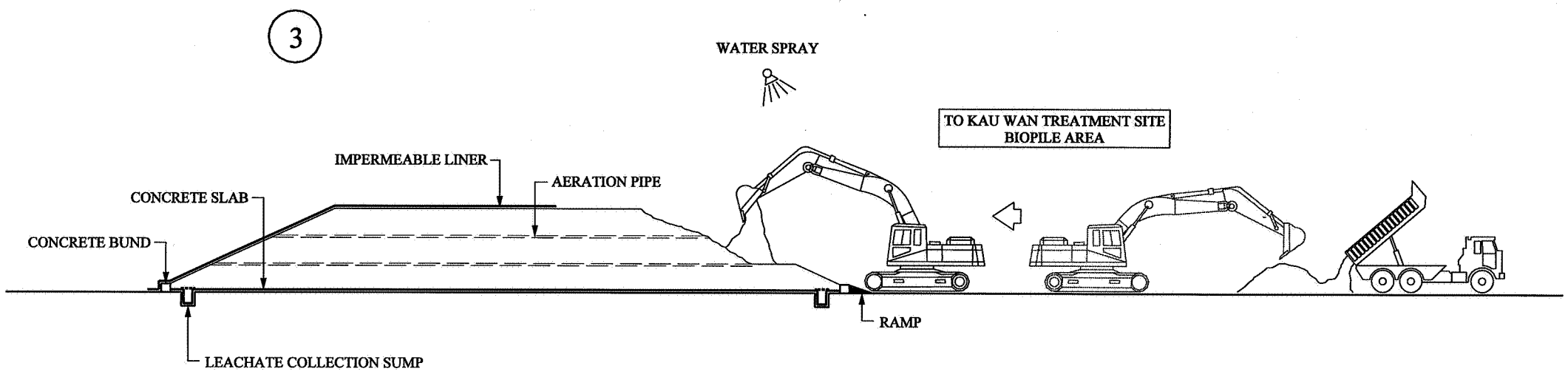

NOTE : THE HANDLING METHODOLOGY SHOWN ON THIS DRAWING IS ONE OF SEVERAL FEASIBLE METHODOLOGIES AND IS PRESENTED AS AN EXAMPLE ONLY

Title

Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction
Decommissioning of Cheoy Lee Shipyard

MATERIAL HANDLING METHODS - GENERAL CONTAMINATED MATERIAL FOR BIOPILING

Scale	N.T.S.
Date	Feb. 2002
Projects No.	R06100
Figure No.	6.4b

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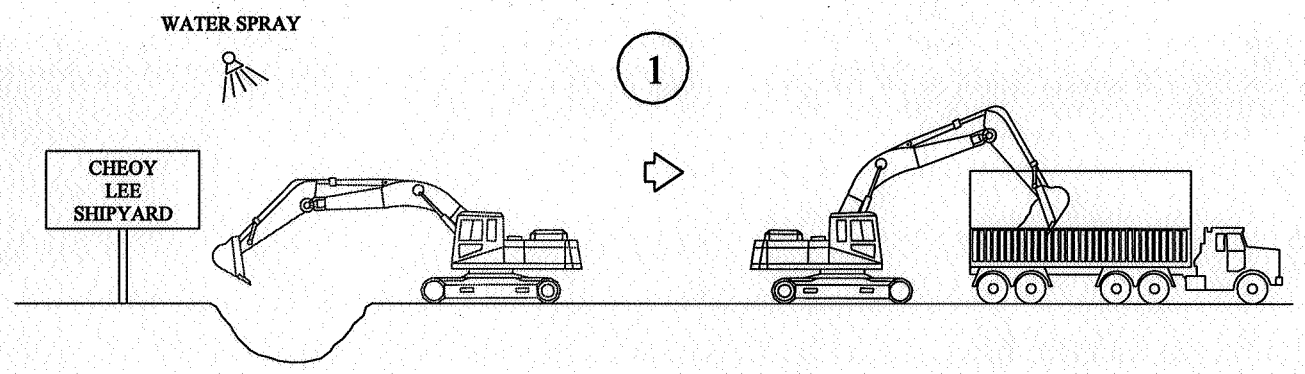
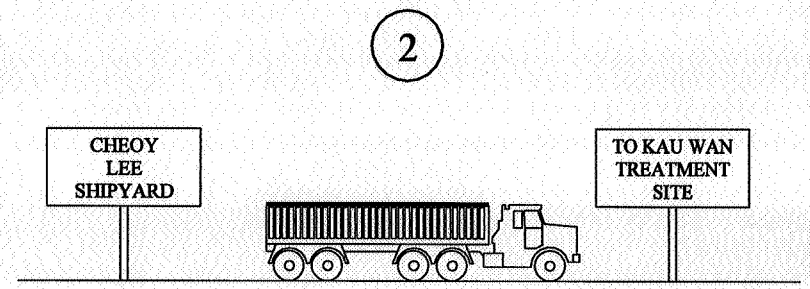
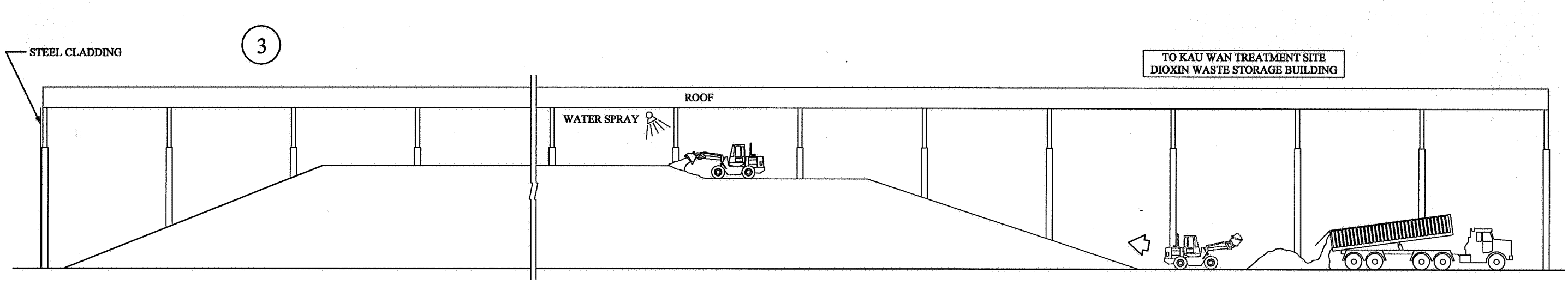
MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

[N8B] P:\PROJECTS\91800\PRE\513\513.DGN Date = 02/06/02







NOTE : THE HANDLING METHODOLOGY SHOWN ON THIS DRAWING IS ONE OF
SEVERAL FEASIBLE METHODOLOGIES AND IS PRESENTED AS AN EXAMPLE ONLY

Title

Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction
Decommissioning of Cheoy Lee Shipyard

MATERIAL HANDLING METHODS - DIOXIN CONTAMINATED MATERIAL

Scale	N.T.S.
Date	Feb. 2002
Projects No.	R06100
Figure No.	6.5

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MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

Date = 02/06/02

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N

TO KAU WAN WORKS AREA

822 000 N

821 000 N

822 000 E

823 000 E

COLLECTION POINT FOR DIOXIN CONDENSATE
(TO BE TRANSPORTED TO CWTC BY ROAD)

FORMER CLS SITE

LEGEND :

CONTRACT 2 SITE BOUNDARY

TRUCKED DIOXIN CONDENSATE

Title

Agreement No. CE 68/99 Infrastructure for Penny's Bay Development - Engineering Design and Construction
Decommissioning of Cheoy Lee Shipyard

COLLECTION POINT FOR DIOXIN CONDENSATE BY CWTC

Scale	1:10000	Projects No.	R06100
Date	Feb. 2002	Figure No.	6.6

Maunsell
MAUNSELL ENVIRONMENTAL MANAGEMENT CONSULTANTS LTD

Date = 02/08/02

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