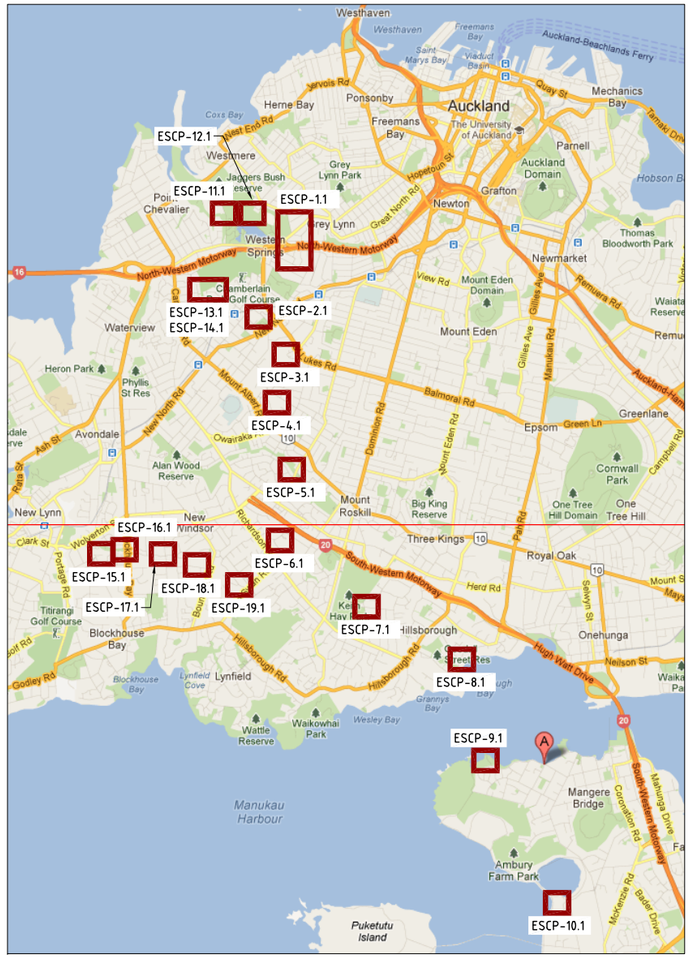
Section 92 Response Attachments

Attachment 3 - Draft Construction Discharge Management Plan

CENTRAL INTERCEPTOR AND ASSOCIATED WORKS
WATERCARE SERVICES LTD
MAIN TUNNEL AND LINK SEWERS
EROSION SEDIMENT CONTROL PLANS

DRAWING SCHEDULE		
DRAWING #	DESCRIPTION	REVISION
MAIN-ESCP-1.0	TITLE PLAN	D
MAIN-ESCP-1.01	GENERAL NOTES AND LEGEND	C
MAIN-ESCP-1.02	TP90 STANDARD DETAILS - SHEET 1	B
MAIN-ESCP-1.03	TP90 STANDARD DETAILS - SHEET 2	B
MAIN-ESCP-1.1	WESTERN SPRINGS (WS1) - EROSION SEDIMENT CONTROL PLAN	C
MAIN-ESCP-2.1	MT ALBERT WAR MEMORIAL RESERVE (AS1) - EROSION SEDIMENT CONTROL PLAN	D
MAIN-ESCP-3.1	LYON AVENUE (AS2) - EROSION SEDIMENT CONTROL PLAN	C
MAIN-ESCP-4.1	HAVERSTOCK ROAD (AS3) - EROSION SEDIMENT CONTROL PLAN	D
MAIN-ESCP-5.1	WALMSLEY PARK (AS4) - EROSION SEDIMENT CONTROL PLAN	D
MAIN-ESCP-6.1	MAY ROAD (WS2) - EROSION SEDIMENT CONTROL PLAN	D
MAIN-ESCP-7.1	KEITH HAY PARK (AS5) - EROSION SEDIMENT CONTROL PLAN	D
MAIN-ESCP-8.1	PS23 (AS6) - EROSION SEDIMENT CONTROL PLAN	D
MAIN-ESCP-9.1	KIWI ESPLANADE UTILITIES (AS7) - EROSION SEDIMENT CONTROL PLAN	D
MAIN-ESCP-10.1	MANGERE PUMP STATION (WS3) - EROSION SEDIMENT CONTROL PLAN	C
MAIN-ESCP-11.1	MOTIONS ROAD (L1S1) - EROSION SEDIMENT CONTROL PLAN	D
MAIN-ESCP-12.1	WESTERN SPRINGS DEPOT (L1S2) - EROSION SEDIMENT CONTROL PLAN	D
MAIN-ESCP-13.1	RAWALPINDI RESERVE (L2S1) - EROSION SEDIMENT CONTROL PLAN	C
MAIN-ESCP-14.1	NORGROVE AVENUE (L2S2) - EROSION SEDIMENT CONTROL PLAN	D
MAIN-ESCP-15.1	PS25 (L3S2) - EROSION SEDIMENT CONTROL PLAN	D
MAIN-ESCP-16.1	MIRANDA RESERVE (L3S2) - EROSION SEDIMENT CONTROL PLAN	C
MAIN-ESCP-17.1	WHITNEY STREET (L3S3) - EROSION SEDIMENT CONTROL PLAN	C
MAIN-ESCP-18.1	DUNDALE AVENUE (L3S4) - EROSION SEDIMENT CONTROL PLAN	C
MAIN-ESCP-19.1	HAYCOCK AVENUE (L3S5) - EROSION SEDIMENT CONTROL PLAN	D



LOCALITY PLAN
SCALE N.T.S.

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ISSUE	DATE	AMENDMENT	BY	APPD.
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C	08/08/12	INCLUSION OF CSO SITES		
B	26/6/12	ISSUED FOR CONSENT		
A	7/6/12	ISSUED FOR CONSENT		

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OPERATIONS

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CENTRAL INTERCEPTOR
GENERAL
TITLE PLAN

CAD FILE MAIN-ESCP-1.0	DATE 7-Jun-12
ORIGINAL SCALE A1 N.T.S.	CONTRACT No. 0538
DRAWING No. MAIN-ESCP-1.0	ISSUE D

GENERAL NOTES:

1. PLAN SHOWS INDICATIVE LAYOUT REQUIRED DURING MAIN TUNNEL, SHAFT AND CHAMBER CONSTRUCTION. FINAL LAYOUT WITHIN THE CONSTRUCTION BOUNDARY WILL BE DETERMINED BY THE CONTRACTOR TO SUIT THEIR METHODOLOGY.
2. SERVICES FROM COUNCIL GIS
3. NOT ALL SERVICES HAVE BEEN SHOWN ON THESE PLANS, REFER TO RELEVANT AUTHORITIES FOR SERVICE LOCATIONS.
4. CONTRACTOR TO CONFIRM AND PROTECT ALL SERVICES IN THE VICINITY OF WORKS.
5. CONTROLS HAVE BEEN DESIGNED FOR WORST CASE SCENARIO AND MAY BE ABLE TO BE REDUCED BASED ON CONTRACTOR'S CONSTRUCTION METHODOLOGY.
6. CONSTRUCTION PHASE OF WORKS ARE STABILISED AS REQUIRED BY TP90 EROSION CONTROL METHODS. USLE EQUATION CONSERVATIVELY ASSUMES ALL FORMS OF STABILISATION ARE EQUIVALENT TO NEW GRASS (E).

LEGEND

- SS — EXISTING SEWER
- WS — EXISTING WATER SUPPLY
- SW — EXISTING STORMWATER
- EXISTING BOUNDARIES
- DECANTING EARTH BUND (DEB)
- SEDIMENT RETENTION POND (SRP)
- CLEAN WATER DIVERSION (CWD)
- SEDIMENT LADEN DIVERSION (SLD)
- STREAM
- SW — 100ø uPVC SW PIPE
- SF — SILT FENCE
- EXISTING PRIVATE DRAIN
- CONSTRUCTION HOARDING PLYWOOD FENCCE
- CONSTRUCTION ACCESS ROAD
- CONSTRUCTION BOUNDARY
- DESIGNATION BOUNDARY
- CENTRAL INTERCEPTOR TUNNEL

CONSENT ISSUE

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B	25/7/12	NOTES ADDED	AC	
A	7/6/12	ISSUED FOR CONSENT		

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OPERATIONS

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CENTRAL INTERCEPTOR
GENERAL
GENERAL NOTES AND LEGEND

CAD FILE MAIN-ESCP-1.01 DATE 7-Jun-12

ORIGINAL SCALE A1	CONTRACT No.
N.T.S.	0538

DRAWING No.	ISSUE
MAIN-ESCP-1.01	C

Maintenance

Maintain the Stabilised Construction Entrance in a condition to prevent sediment from leaving the construction site. After each rainfall inspect any structure used to trap sediment from the Stabilised Construction Entrance and clean out as necessary.

When wheel washing is also required, ensure this is done on an area stabilised with aggregate which drains to an approved sediment retention facility.

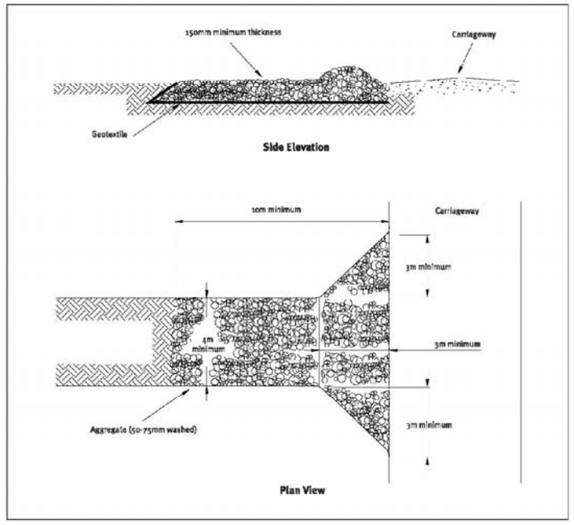
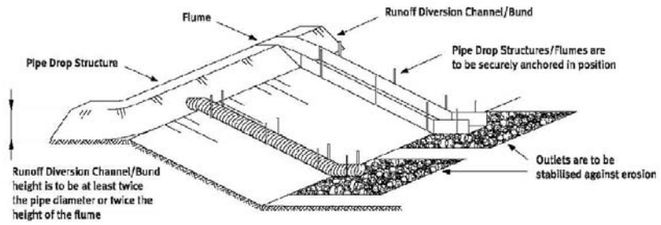
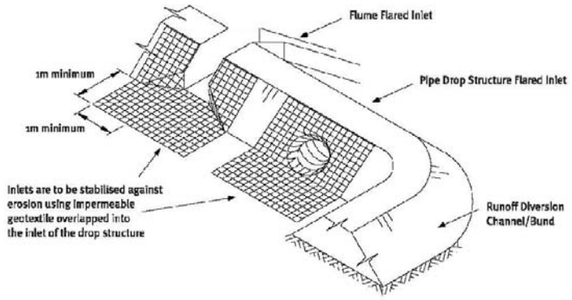


Figure 1.8 Stabilised Construction Entrance





Design Criteria for Pipe Drop Structure

Pipe Diameter (mm)	Maximum Catchment Area (ha)
150	0.05
300	0.20
450	0.60
500	1.00
600	1.00

Specific designs are required for flume sizing

FIGURE 1.9 - PIPE DROP STRUCTURE

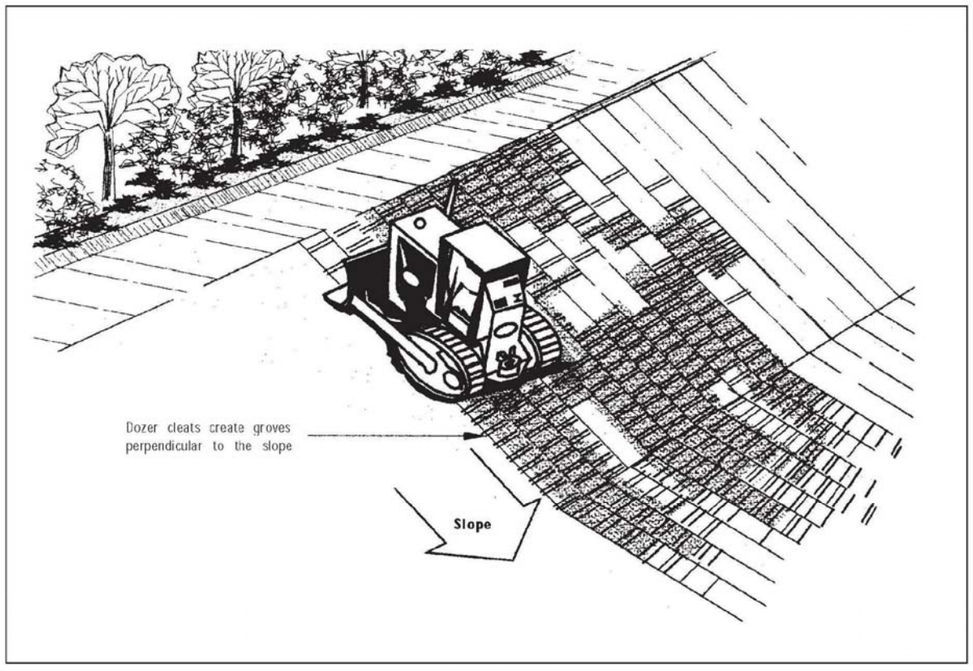


FIGURE 1.11 - TRACKING

NOTES:

1. NOT ALL DETAILS HAVE BEEN SUPPLIED ON THIS PLAN, PLEASE REFER TO TP90 FOR ANY MISSING DETAILS REQUIRED.

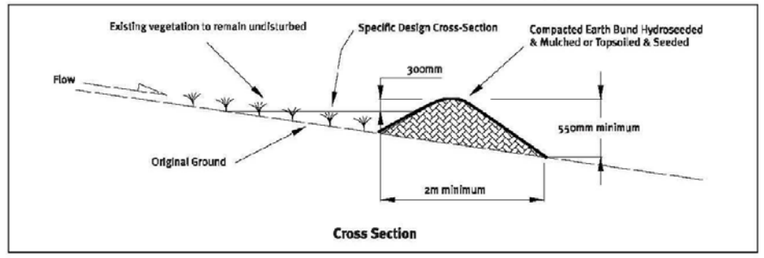


Figure 1.1.1 *Clearwater Runoff Diversion Bund*

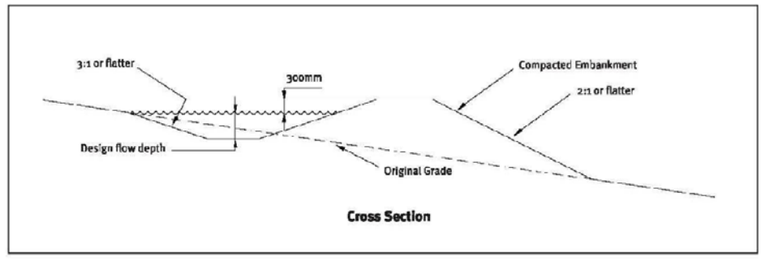


Figure 1.1.2 Runoff Diversion Channel

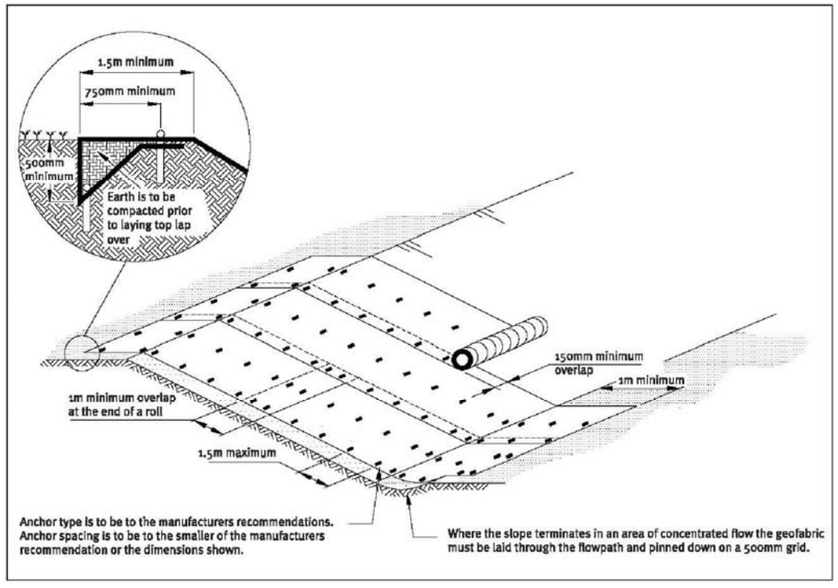


Figure 1.7.1 Geotextile Laid on Slope

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OPERATIONS

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CENTRAL INTERCEPTOR
GENERAL
TP90 STANDARDS – SHEET 1

CAD FILE MAIN-ESCP-1.02 DATE 7-Jun-12
ORIGINAL SCALE A1 N.T.S.
CONTRACT No. 0538
DRAWING No. MAIN-ESCP-1.02
ISSUE B

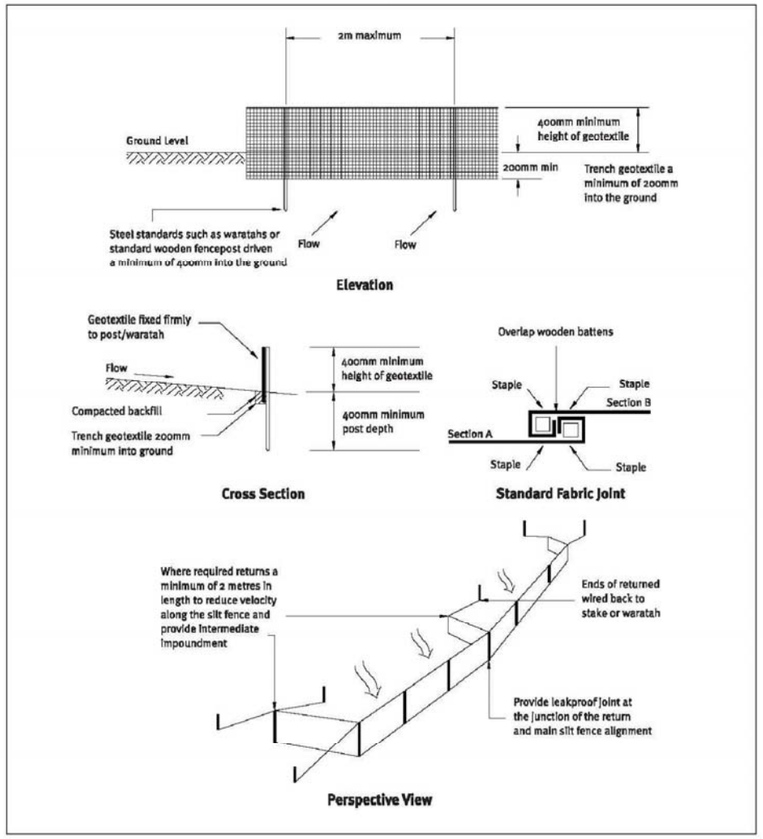
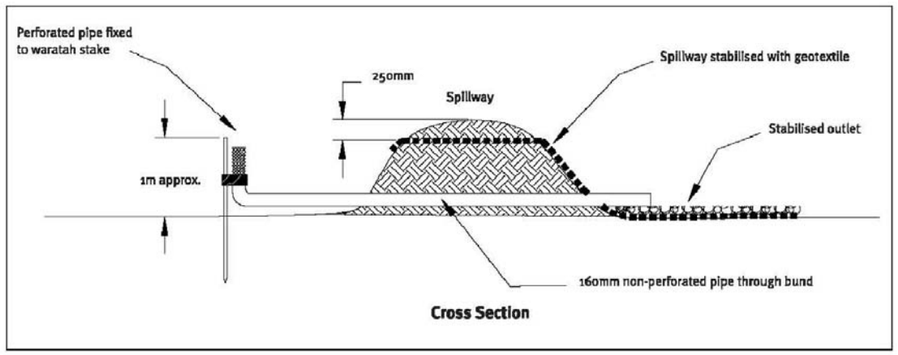


Figure 2.2 Silt Fence



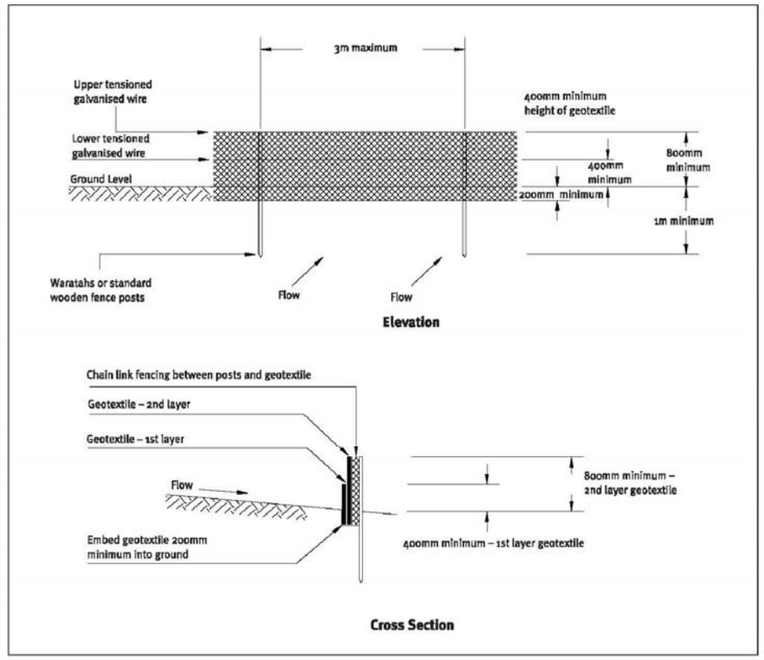


Figure 2.3 Super Silt Fence

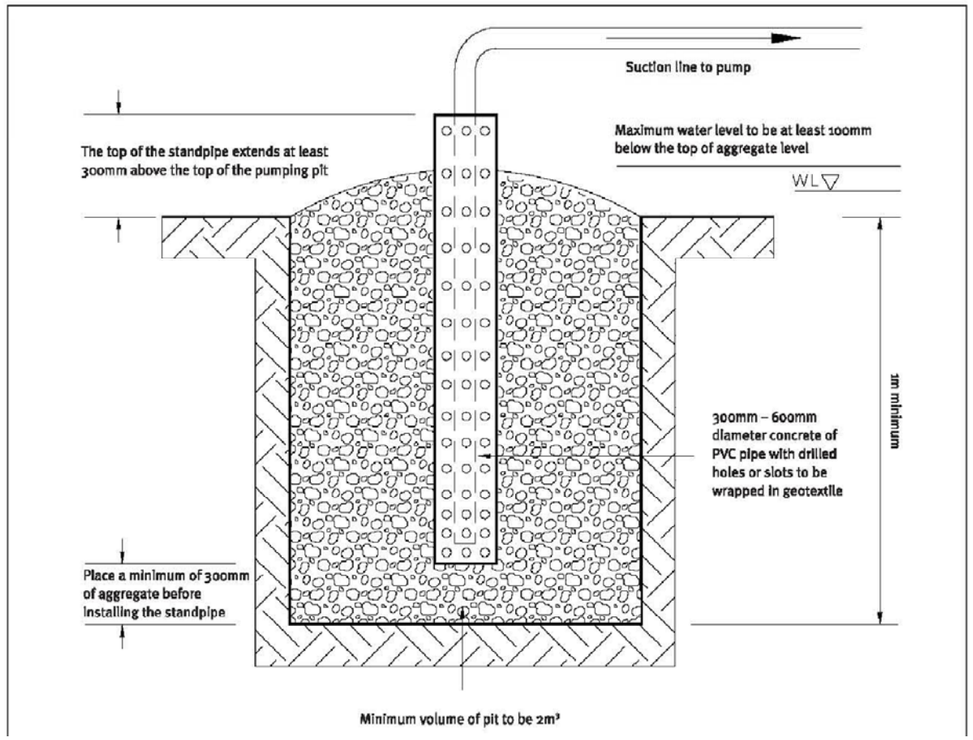


FIGURE 2.7 - SUMP/SEDIMENT PIT

NOTES:

1. NOT ALL DETAILS HAVE BEEN SUPPLIED ON THIS PLAN, PLEASE REFER TO TP90 FOR ANY MISSING DETAILS REQUIRED.

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OPERATIONS

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CENTRAL INTERCEPTOR
GENERAL
TP90 STANDARDS – SHEET 2

CAD FILE MAIN–ESCP–1.03	DATE 7–Jun–12
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Central Interceptor Main Project Works

Draft Construction Discharge Management Plan

12 December 2012

CONTENTS

DOCUMENT HISTORY AND STATUS

Revision	***Date***	***Name***	***Signature***	***Status***
Author				
Reviewed by				
Approved by				

1. INTRODUCTION

1.1 Project overview

Watercare Services Limited (Watercare) is proposing to construct a new underground interceptor within the Auckland Isthmus to collect, store, and convey wastewater to the Mangere Wastewater Treatment Plant (WWTP). This new interceptor is called the Central Interceptor. The Central Interceptor main project works comprise a 13 km gravity tunnel from Western Springs to the Mangere WWTP, four link sewers extending from the main tunnel, a series of connections to the existing Watercare wastewater network, and a new pumping station at the Mangere WWTP to pump wastewater from the tunnel to the plant. These works will provide the network capacity required for future growth within the Auckland Isthmus, will duplicate the southern section of the Western Interceptor and will provide overflow mitigation at a number of Watercare's largest wastewater overflow points.

1.2 Purpose

The main project works involve a number of construction sites of varying sizes. This draft Construction Discharge Management Plan (CDMP) addresses discharge activities associated with construction, including those by subcontractors or suppliers and describes how surface water and groundwater associated with construction works will be managed to avoid, remedy, or mitigate adverse effects on the environment. The draft CDMP establishes the general principles for the management of site discharges.

The project documentation has been developed to a concept design stage and it is likely that design and construction details will change as the project is optimised in the detailed design and construction stages. This draft CDMP will be updated and finalised prior to commencement of construction.

This draft CDMP sets out information on construction and construction sequencing, along with management approaches for the potential site related discharges set out in Section 1.4 below.

1.3 Key contacts

[to be completed when contractor appointed]

1.4 Potential discharges to the environment

Water discharged from the construction sites may contain contaminants arising from the physical activity of construction and the use of equipment to complete the project. Potential discharge sources include:

- Sediment from unstabilised excavations and earthworks, eroded and discharged from the site in storm events.
- Sediment picked up on trucks, plant and other vehicles which is tracked out of the site onto the road network, where it is washed into the natural environment.
- Groundwater pumped from excavations, particularly from shafts and tunnels, which entrain sediment from the excavated soils and potentially contain material from the liner installation works (e.g. cement, grout).
- Spoil excavated from shaft and tunnel operations may be very wet and there is a risk of sediment from such material being discharged to the environment.

- Discharges of wet concrete or water containing cement particles that have a high pH, associated with activities undertaken on site.
- Discharges of polymers and other additives used to assist excavation and removal of cuttings from the work face. The discharges could potentially include bentonite where this is required in tunnelling operations.
- Discharges of oils and other hydrocarbons from vehicles, plant and refuelling activities on site.

The management of these potential discharges is addressed in Section 3.

2. WORKS DESCRIPTION

2.1 Overview

The Central Interceptor main project works will be constructed by tunnelling methods with construction largely occurring underground. This will be facilitated by surface construction sites where associated construction activities, such as spoil removal; storage of tunnel lining segments; and treatment of construction discharges will occur. The construction sites (shown on Figure 1-1) are at 19 locations along the main tunnel and link sewer routes as follows:

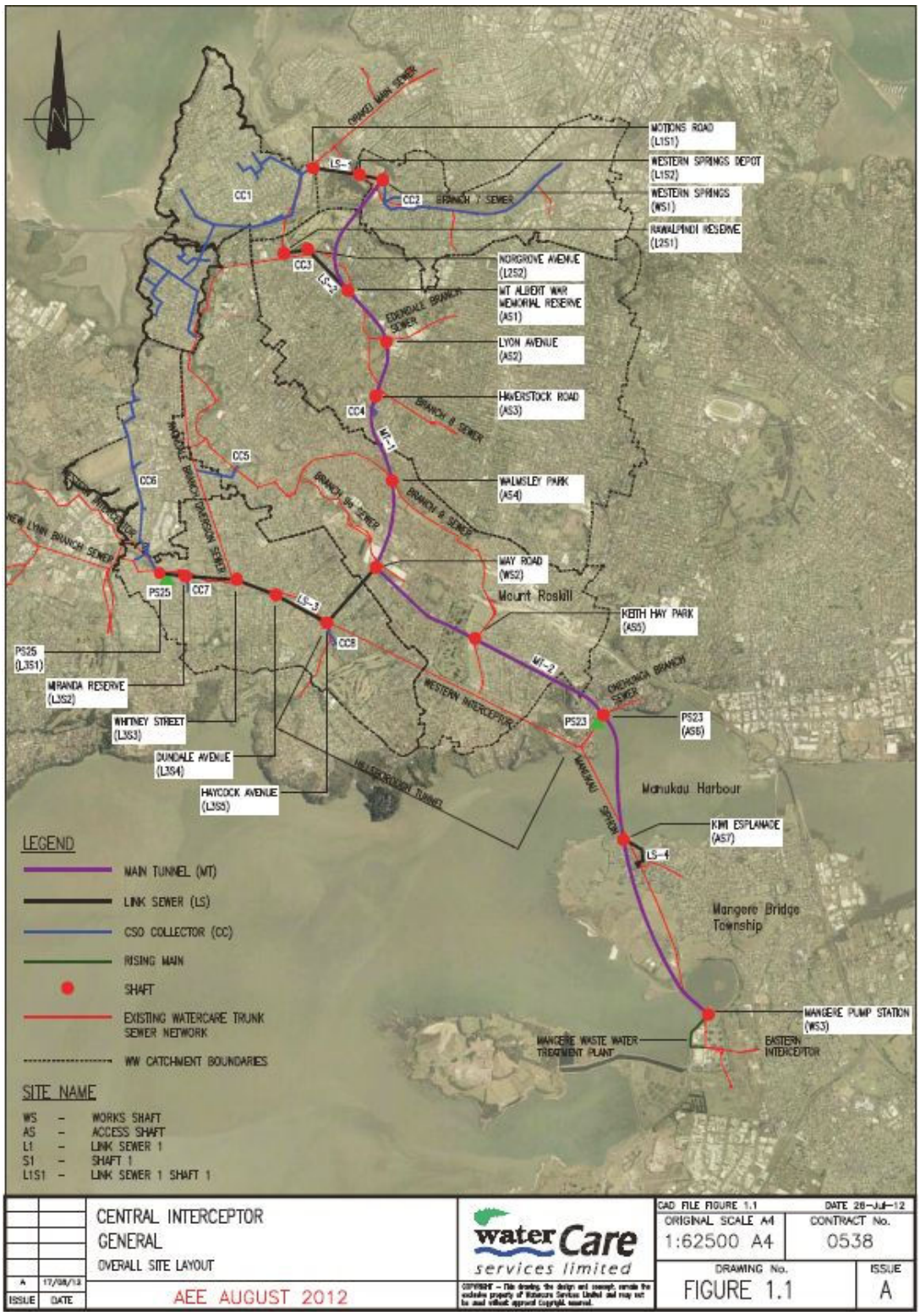
- Three primary construction sites which will serve as the main construction bases for the tunnelling activities. Earth (spoil) from the tunnelling work will be removed from these sites via the construction shaft, which will also provide access to the tunnel, will serve to launch the tunnel boring machine (TBM) and will provide access for the supply of construction materials and services. These construction sites could operate for around five to six years, depending on the construction methods employed, and are located at:
    - Western Springs (WS1)
    - May Road (WS2)
    - Mangere WWTP (WS3)
- Sixteen secondary construction sites to provide permanent connections to the main tunnel and to the link sewer tunnels. Seven of these sites are on the route of the main tunnel and are likely to involve active construction works for around 12 to 18 months each as the shaft is excavated and permanent works are constructed. These sites are:
    - Mount Albert War Memorial Reserve (AS1)
    - Lyon Avenue (AS2)
    - Haverstock Road (AS3)
    - Walmsley Park (AS4)
    - Keith Hay Park (AS5)
    - Pump Station 23 (Frederick Street) (AS6)
    - Kiwi Esplanade (AS7)

  The remaining nine of the 16 secondary construction sites provide connections to the link sewers. These sites would likely involve active construction works for around 6 to 18 months each (depending on the scale of works at the site) as the shaft is excavated and permanent works are constructed. However, the pipe installation method utilised to construct the link tunnels is likely to be microtunnelling due to the smaller pipe size required and these sites may also have a range of additional

construction activities to facilitate those works. These additional link sewer sites are located at:

- Motions Road (L1S1)
- Western Springs Depot (L1S2)
- Rawalpindi Reserve (L2S1)
- Norgrove Avenue (L2S2)
- Pump Station 25 (in Miranda Reserve) (L3S1)
- Miranda Reserve (L3S2)
- Whitney Street (L3S3)
- Dundale Avenue (L3S4)
- Haycock Avenue (L3S5)

Open trenching is likely to be used to construct shallow (less than about 4 m deep) connections between proposed structures and to connect to the existing wastewater network. However, the selection of either microtunnelling or trenching methods has not been finalised and will also be dependent on factors including ground conditions, surface obstructions and surface features.



2.2 Construction phases

Phased construction will take place along the alignment at different times, with sites being at different stages of construction and completion to service the overall project delivery programme. The construction phase commences when the Contractor takes possession of a site and starts site clearing and preparation for the works. The construction phase ends when all works at a particular site are completed and the site has been stabilised and reinstated to the agreed condition. Depending on the Contractor's programme and

methodology, individual sites may be occupied for periods varying from a few months to several years.

In broad terms, the construction activities at the main project works sites comprise the following activities:

1) **Site establishment**: Includes establishing areas of hardstanding, site access, wheel wash and the erosion and sediment control measures that are required to protect the environment generally and the stormwater network in particular.

2) **Shaft and tunnel excavation:**
   a) Shaft excavation: The excavation and "sinking" of shafts that facilitate the tunnelling works and for the construction of permanent structures. Associated activities include the excavation and removal of spoil, the installation of permanent or temporary shaft lining and the dewatering of any inflows into the excavation. Discharges may include concrete wash water and groundwater.
   b) Construction of temporary sheds over the tunnel access shafts (only applies to the primary construction sites at Western Springs and May Road): Note that clean roof rainwater runoff would be discharged to the clean water diversion channels that run around the outside of the site or directly to a stormwater manhole, if one is readily accessible.
   c) Tunnel excavation: The use of specialist equipment to excavate and line completed tunnels up to 5 m diameter. Only three sites along the main tunnel (Western Springs, May Road and Mangere Pump Station) are earmarked launch shafts for the TBM. Works at all other main tunnel sites will be limited to constructing the permanent access and drop structures. Construction activities at all link tunnel sites will either include works related to a launch or reception shaft. Discharges may include tunnel cuttings, concrete wash water, bentonite, foaming agents and ground water.
   d) Post tunnelling operations: On completion of tunnelling, removal of equipment and surplus tunnelling and lining materials from sites will occur.
   e) Construction of permanent access structures into the tunnels, including access and entry drop structures. Discharges from this work may include concrete wash water and pumped groundwater.

3) **Trenching:** The excavation of trenches and construction of wastewater pipework and manholes as required to connect to the existing wastewater network.

4) **Site disestablishment:** Final clean up of site and site remediation.

As parts of the scheme are completed, surplus equipment and supplies will be removed and sites disestablished and reinstated.

It is noted that the areas available for the construction sites vary significantly in terms of size and adjacent environments. Some are restricted in size and are set within urban residential areas. Other sites are in open areas of grass and remote from the public, where there is considerable space and good access during construction. Some sites are close to open watercourses and three sites are close to the coastal marine area (CMA). Different solutions will be required at different sites to provide the level of environmental management required under TP90.

2.3 Site Establishment

The initial phase of work at any site is the preparation of a suitable working area for sinking shafts and supporting tunnelling operations.

The site establishment activities at the primary and secondary sites will include a wide range of activities, including the removal of vegetation; minor earthworks; checking infrastructure service locations and relocating where necessary; and the establishment of a stabilised site access, construction yards and lay down areas. In addition, at the existing Watercare pump station (PS 23) on the edge of the Manukau Harbour at Hillsborough Bay, a temporary construction platform will be required in the CMA to facilitate the construction activities.

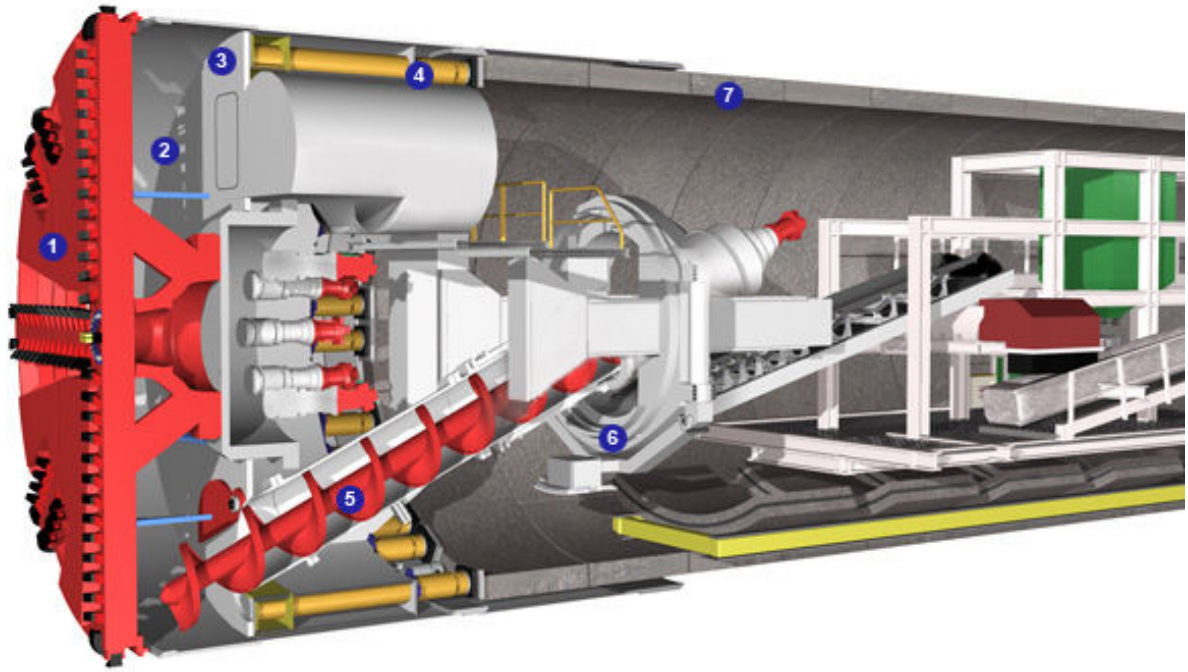
Generally, where there are wheel washes, Erosion and Sediment Control Ponds or Decanting Earth Ponds, these will remain in place at each site throughout the construction period, providing treatment facilities to intercept, clean and treat potential discharges prior to the discharge of any sediment that may be dropped or spilled onto the site during shaft sinking, tunnelling works and the construction of permanent underground drainage structures.

2.4 Main tunnel construction (primary construction sites)

2.4.1 General

The proposed main tunnel is a 3.5m to 5m diameter bore constructed using an Earth Pressure Balance capable tunnel boring machine (TBM), erecting a gasketed segmental lining. Intermediate shafts are constructed as required to provide link connections or access. Refer to Figure 2 for a schematic of an Earth Pressure Balancing TBM.

Figure 2: Schematic of Earth Pressure Balancing TBM (Source: Herrenknecht)



Each of the three primary construction sites may be used as TBM launch/retrieval sites for the main tunnel.

2.4.2 Construction sequence

A typical construction sequence is described below.

- Establishment and stabilisation of the work site.
- Launch shaft construction. Once the launch shaft is completed a temporary shed will be constructed over the launch shafts at Western Springs and May Road which will protect the work area and spoil stockpile from adverse weather (and also provide noise attenuation).
- Tunnel excavation and lining installation. During the tunnelling phase all surface works (handling of pipe segments, removing spoil, treatment of groundwater etc) are carried out at the primary construction sites.
- Prior to the completion of the tunnel drive the reception shaft is constructed (at Western Springs/May Road). This may also serve as a launch shaft for the next drive. Once the tunnel drive is completed, the tunnel boring machine is either redirected to carry out the next drive or lifted from the reception shaft and relocated to the next launch site.
- Once the tunnelling work at the primary construction sites is completed, the permanent structures (main tunnel shaft, wastewater network connections) are constructed. The launch shaft backfilled, the work site disestablished and the surface reinstated.

2.4.3 Use of cement, polymers and bentonite

TBM tunnelling frequently employs spoil conditioners usually in the form of foam, such as Meyco SLF20 which was used on the Rosedale project. Small quantities of the foam are injected at the tunnelling face to assist the cutting and handling of spoil through the machine. The foaming agent does not contain any hazardous substances which require labelling. The foam generally remains in the spoil which is disposed of at a designated fill site.

The use of this foaming product agent and the suitability of the spoil for disposal to land was investigated and approved by the former Auckland Regional Council for use in tunnelling works in 2008. This product has proven effective in similar ground conditions and is expected to be the contactor's first choice of spoil conditioner for this project.

Cement and cement / bentonite grouts will also be used in the shaft and tunnel excavation to fill rock discontinuities, to spray as shotcrete for primary support and to backfill around the tunnel segmental lining. Groundwater removed from the excavations is therefore likely to contain traces of cement and bentonite clay. Bentonite is a naturally occurring clay product.

Small quantities of cement are likely to be suspended or go into solution in water pumped from the shaft excavations, increasing the pH of the discharge water. This water could be discharged to sewer, or to the stormwater network, or to a watercourse. Chemical dosing to adjust the pH, along with sediment removal, may be required before the water is discharged to the stormwater network or a watercourse.

2.4.4 Spoil removal

Cuttings from the tunnel head are loaded into "muck wagons" and transported back through the completed section of tunnel to the launch shaft. There the "muck wagons" are lifted to the surface and emptied inside the temporary shed built over the tunnel shaft (at Western Springs and May Road). If required the stockpiled material will remain inside the temporary

shed for dewatering prior to being removed off site by conventional road truck or truck and trailer. Otherwise the removal of spoil will be carried out as required during approved working hours.

2.4.5 Dewatering

Shaft dewatering is usually managed by directing groundwater inflows to sumps from where it is pumped to settling tanks before discharge to the stormwater system. The amount and quality of water varies from site to site, and depends on the method of shaft construction and groundwater inflow along the tunnel.

The settling tanks are generally set up on a pallet or container base and may include several treatment stages. The first treatment stage may remove coarse solids, followed by a treatment stage that allows mixing of flocculants to remove fine solids, followed if required by a third stage to "polish" the water prior to discharge.

2.5 Pipe installation by Microtunnelling

2.5.1 General

Microtunnelling will generally be used for the installation of the link tunnels.

Common to all microtunnelling or pipe jacking is the concept of installing a pipe from a *launch shaft* to a *reception shaft*. A schematic of this concept is shown in Figure 3 below.

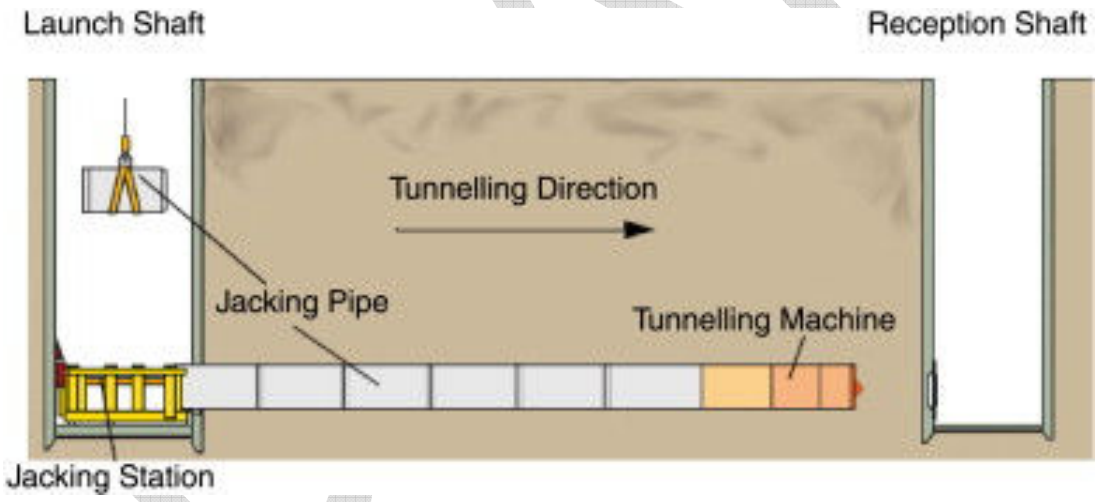


Figure 3 (Source: Science Direct)

Distances between the launch shaft and reception shaft can vary widely and are mainly dependent on pipe diameter, ground conditions and locating suitable locations for jacking or receiving shafts.

The bulk of the physical works are carried out at the launch shaft sites, which need to cater for site sheds, pipe stockpile areas, trucks, cranes, and any support equipment. Reception shaft sites only need to provide access for a crane and trucks to retrieve the tunnelling machine from the reception shaft. A single launch shaft may be used to drive pipes in several directions.

2.5.2 Construction sequence

The following outlines a typical microtunnelling construction sequence:

- Establishment and stabilisation of the work site.
- Construction of the launch shaft.
- The pipe installation commences towards the reception shaft once the launch shaft is completed and the microtunnelling machine or jacking shield installed.
- The construction of the reception shaft is likely to be timed so that its completion coincides with the arrival of the tunnelling machine or jacking shield. (Note: This could be months after the start of the pipe installation).
- During the pipe installation phase all work (installing pipes, removing spoil, etc) is carried out at the launch site.
- Prior to the completion of a tunnel drive the reception shaft is constructed. Once the tunnel drive is completed the tunnelling machine or jacking shield is lifted from the receiving shaft and set up for the next tunnel drive.

Once a shaft site is no longer required to install pipe or receive a micro tunnel machine/ jacking shield, the permanent access structure (manhole) is then constructed, the shaft backfilled, the work site disestablished and the surface area reinstated.

2.5.3 Use of polymers and bentonite

Polymers and bentonite are generally used to treat the material at the tunnel head, lubricate the pipe annulus to reduce jacking forces or to transport cuttings from the cutting head to the recycling plant.

Treatment of the material at the tunnel head may be required in reactive clays in order to prevent the cuttings from sticking to the tunnel machine head. In this case small quantities of polymers are used which stick to the cuttings and are removed off site with the spoil. As the polymers are removed with the cuttings off site no additional treatment is required on site.

Lubricating the pipe annulus applies to all shield microtunnelling techniques installing pipes greater than 900mm in diameter. An automatic lubrication system is used to pump polymer or bentonite into the annulus between the pipe and the tunnel to reduce friction. In this case it is likely that polymer or bentonite will mix with the water removed from the shaft and the water will require treatment prior to disposal.

Transporting cuttings from the cutting head to the recycling plant applies to slurry microtunnelling machines only. The method is regarded as a ‘closed loop’ system, with slurry pipes the sole means of spoil transport. In the separation plant solids are removed from the fluid and the “cleaned” slurry reused and pumped to the tunnel head.

2.5.4 Spoil removal

Open face microtunnelling machines or jacking shields
Cuttings from the tunnel head are loaded into “muck wagons” and transported back through the completed section of tunnel to the launch shaft. There the “muck wagons” are lifted to the surface. The excavated material may be loaded directly into a truck, or loaded into skips that are removed as required, or placed at a temporary stockpile area from which spoil is removed from the site at regular intervals.

Slurry microtunnelling machines
Cuttings from the tunnel head are mixed with water to form a slurry at the tunnel face and are then pumped to a separation plant. In the separation plant the fluid is removed and the

solids either placed into bins or stored in temporary bunded stockpile areas and removed from the site at regular intervals.

2.5.5 Dewatering

Shaft dewatering is usually managed by directing groundwater inflow to underground sumps from where it is pumped to settling tanks before discharge to the stormwater system. The amount and quality of water varies from site to site and depends on the method of shaft construction and groundwater inflow along the tunnel.

The settling tanks are generally set up on a pallet or container base and may include several treatment stages. The first treatment stage may remove coarse solids, followed by a second treatment stage that allows mixing of flocculant to remove fine solids, followed by a third stage if required to "polish" the water prior to discharge.

2.6 Trenching

Some connections to the existing network may be made using microtunnelling equipment, but most will be installed at shallow depth using open trenching. The construction duration for installation of each connection is generally only a few days, but may extend to weeks depending on the size of the connection, ground conditions and the presence of intervening services. Link Sewer 4 in Mangere Bridge will be trenched and may take around a month.

Excavated spoil may be removed directly from the site if the trench is to be hardfilled, or spoil may be retained for compaction over the pipe and ground reinstatement on completion. In general, trenches will be progressively backfilled as the pipe installation progresses and only short lengths of excavations are expected to be open at any given time.

2.7 Dis-establishment and site restoration

At the conclusion of construction works, all materials and equipment will be removed and sites will be reinstated.

3. DISCHARGE MANAGEMENT

Erosion and sediment control measures will be put in place during construction to minimise potential adverse effects. These will employ measures which meet industry best practice guidelines such as reflected by Auckland Council's Technical Publication Number 90 Erosion and Sediment Control Guidelines for Land Disturbing Activities (TP 90).

This draft CDMP outlines the general principles guiding the erosion and sediment control measures. Draft erosion and sediment control plans (ESCPs) and supporting text have been prepared and are contained in Appendix A of this document. These documents will be updated and the erosion and sediment control and stormwater management measures for each site will be confirmed prior to construction commencing.

Generally, erosion and sediment control measures will be undertaken and implemented with a hierarchy and priority order as follows:

1) Avoidance of adverse effects will be the first priority. Discharge locations will be carefully selected and stream works will only be undertaken where they are a necessary component of the project.

2) Erosion Control is the preferred option to control sediment discharge, and will utilise suitable approaches to prevent sediment generation through a range of structural and non-structural means.

3) Sediment Control measures will be adopted that are suitable for the particular site location and configuration and meet the requirements of TP90.

A number of construction sites are located in close proximity to watercourses and the coastal marine area. Where sediment control treatment devices discharge directly into a watercourse, suitable erosion protection measures will be installed in the watercourse to prevent localised stream bank/bed erosion.

Generic details of the treatment systems are set out below. All erosion and sediment controls are in accordance with the requirements of TP90. The proposed treatment train approach uses best practice options for specific construction activities as are currently in use around Auckland.

This draft CDMP provides the general principles and methodology for managing earthworks associated with the project construction. Site and activity specific erosion and sediment control plans will be prepared and submitted to Auckland Council for approval immediately prior to construction, however, draft plans are presented in Appendix A.

The proposed works will generally involve four main phases. Sections 3.1 to 3.4 below outline the general principles and standards to be applied during each of these phases:

1. Site establishment;
2. Shaft excavation and tunnelling;
3. Trenching.
4. Dis-establishment and site restoration

3.1 Site Establishment – Earthworks

Sites vary between 1,000 to 22,500 m^2 in area. A number of sites are located in reserves, with some sites in road reserve, residential land and industrial land. Site establishment work will principally involve site clearance, establishing formed and metalled access and the stabilisation of the working area. This phase of work is expected to take in the order of 2 to 3 weeks.

1. At the conclusion of the establishment works, the site, where applicable, will have:
   - Stabilised access from the public road to the work site;
   - A stabilised route and wheel wash within the work area or alternate site specific options such as to discharge spoil directly to skips or trucks and to maintain standby arrangements to rapidly mobilise road sweeping/cleaning equipment to respond to any spillages.
   - Clean stormwater diversion bunds in place as required to keep clean surface flows from entering the work areas; and
   - A sediment retention pond (SRP) or at smaller sites a decanting earth bund (DEB) or a tank system where needed, to retain any sediment that is deposited on the site by construction activities.
   - Where necessary, additional site specific features including filtersock dams around street cesspits and in channels, to prevent sediment discharge to the stormwater system.

2. Initially, the site will be protected with clean water diversion bunds or channels on the uphill side and a silt fence on the lower side. Dirty water runoff diversion channels will

be sized to cater for the 1% AEP rainfall event which will ensure that all storm events up to this design will be diverted to the control measures without overtopping. Where sufficient space is available the Contractor will install a wheel wash, with its own discharge tank and the associated treatment device will be constructed and commissioned, prior to stripping vegetation and topsoil from work areas in the site. In roadside verges, alternative methodologies may be adopted, as noted in Section 1 above. Once stripping is complete, the contractor will import and place aggregate to construct hardstanding areas and an access road to and within the site. If sufficient space is available, grassed areas may be retained as material laydown areas.

3. Cleanwater diversion channels are to be designed to cater for the 1% AEP rainfall event and will be installed to divert all possible upslope cleanwater away from the earthworks areas. Where this cannot occur in practice, SRP volumes will be increased to allow for the cleanwater catchment area that cannot be diverted.

4. Where needed, all SRPs will be based on TP90 design with the 3% volume criterion applied in relationship to catchment size (i.e. $3m^3$ SRP volume per $100m^2$ of contributing catchment). Each SRP will include a spillway for the 1% AEP rain event, with the outlet weir channel designed to minimise scour.

5. On sites less than 3,000 m^2, a DEB or tank system may be used, designed to the 3% volume criterion if sufficient space is available, but to be no smaller than 2% of the contributing catchment. All spillways from the DEBs will be installed as per TP90 guidelines which ensures that they safely pass the 1% AEP rain event with the outlet designed to prevent scour at the design flow.

6. In general, chemical treatment will be applied by manual batch dosing to the SRP or DEB. However, where surface water is pumped to the settling system (DEB or tank) then a flow activated dosing system may be used. It is noted that the initial construction period is short and manual dosing during this period is likely to be most effective. In the subsequent phases of construction, the SRP, DEB or tank will provide a secondary component of the treatment train on site and will only require dosing when there is a spill of soil. This would be undertaken manually.

7. All SRPs and DEBs will be fitted with floating decants and a mechanism to control outflow; e.g. a manual decant pulley system.

8. The wheel wash is likely to be in the form of a permeable grid suspended over a pit, with a high pressure water blaster unit to be used to clean trucks over the pit, minimising water usage. During the initial phase of work, the pit would be cleaned by sucker truck, with the ability to be pumped out for treatment in the next phases of construction. For construction sites within the road reserves, there is unlikely to be sufficient space to set up effective wheel wash facilities. Alternative site specific options may be established, such as to discharge spoil directly to skips or trucks to minimise handling and to maintain standby arrangements to rapidly mobilise road sweeping/cleaning equipment to respond to any spillages.

9. Once the area is stabilised, any sediment in the SRP, DEB or tanks will be removed. The silt fence will be removed and the area left stabilised and ready for the next phase of work.

3.2 Shaft Excavation and Tunnelling

1. Prior to the commencement of shaft excavation, a pumped dewatering treatment system will be installed based on automatic dosing with settlement tanks or bunded chambers

to remove sediment from dewatering flows. In addition, the discharge from the wheel wash will also be pumped to the treatment system, which will be designed to treat simultaneous flows from both the wheel wash and dewatering pumps.

2. The wheel wash, if required, will continue to operate throughout this phase of work and all vehicles will be inspected and washed down, before leaving the site.

3. The wheel wash pit will be inspected daily and when a significant amount of solid material has accumulated, it will be removed either by sucker truck (wet material) or by excavator (dry material) and trucked from the site.

4. Excavated material removed from the shaft excavation will be placed either
   (a) In skips that are progressively removed by truck;
   (b) Directly into trucks; or
   (c) In a bunded temporary stockpile area on site and removed progressively by truck.

   If the material is wet or sloppy, all skips or trucks collecting the spoil will be lined to contain the water. Any dirty water discharged from the bunded area will be pumped and flocculant added before being treated in the treatment system (item 10 above).

5. The wheel wash will continue to operate throughout this phase of work and all vehicles will be inspected and washed down, before leaving the site.

6. In the event of a soil spill, the area will be cleaned up as soon as possible. If sediment is discharged to the SRP or DEB, the pond will be batch dosed to promote settlement within the pond prior to discharge.

7. Concrete truck, concrete pump and shute cleanout water will be discharged to a skip and allowed to settle. During high summer, the water is expected to evaporate, while at other times of the year, it may build up in the skip. The water may be discharged to the SRP, DEB or tank after it has been neutralised (pH range 5.5 – 7.5). When the skip is full of concrete, it will be removed and replaced by another.

8. Fuel and Oil: It is anticipated that fuel bowser trucks will be used to refuel plant and equipment. The refuelling will be undertaken within the site and a spill clean-up kit will be available at all times when refuelling is in progress. Where a permanent fuel tank is maintained on site, it will be contained within a bund and secured against unauthorised access. Fuelling and refuelling may only be carried out when the spill clean-up equipment is available at the re-fuelling site.

9. Storage of Fuel, Oil and Chemicals: These will be stored in secured containers.

10. Tunnelling – small amounts of polymers may be applied to the cutting head while excavating through certain types of soils. The polymers generally remain attached to the spoil which is removed from the tunnel and then trucked to a landfill. Refer comments in section 2.5.3. Any polymers mixing with groundwater will be pumped to a closeby wastewater system or into a container and taken off site.

11. Bentonite may be used to lubricate the pipes during jacking and is often mixed with groundwater before it is pumped to the surface. The groundwater bentonite mix will be dosed with flocculant and sediment removed by settlement tank(s) prior to discharge from the site.

12. The use of chemical dosing is required to achieve a high standard of discharge quality that has minimal adverse effects on the environment. Chemical treatment is likely to use PAC for both flocculant and pH adjustment for concrete washings. A draft Chemical

Treatment Plan (CTP) is included as Appendix C to this document. The CTP will be updated before works are undertaken to ensure that the site-specific issues such as soil type, suitability of proposed chemical compound and settlement tank design are appropriate for the subject work area and activity. The criterion for quality of discharges from the project work sites is 100mm clarity prior to any discharge.

13. Note that clean roof rainwater runoff from buildings on site is to be discharged to the diversion channels that run around the outside of the site or directly to a stormwater manhole, if one is readily accessible.

3.3 Trench Excavation

Some trenching works will be undertaken to connect to the existing network, including for the construction of Link Sewer 4 in Mangere Bridge. These trenches will extend outside of the main construction areas.

Generally, trench excavation will commence at the shaft, which will be the lowest point along the alignment of the new connections. If dewatering is required, the outflow can be discharged via the progressively installed pipe to the treatment system that is already located on the worksite and any sediment removed prior to discharge.

The progress of trench excavation, pipe laying, backfilling and reinstatement is progressive and it will be rare to have more than 30 m of trench open at any time during construction. This limits the sediment generation potential of this phase of work.

The following principles and standards will be applied to trenching work:

1. When working through grassed or reserve areas, the excavated material will be placed in “windrows” along either side of the alignment, with topsoil and general material separated for reuse. As the pipes are laid and jointed in the trench, they will be progressively backfilled and the surface reinstated, with the surplus excavated materials removed.

2. Where such work is undertaken close to a watercourse or the coastal marine area a super silt fence will be erected and maintained between the work areas and the watercourse or coastal marine area to prevent sediment from unstabilised areas of work being discharged into those environments. Stabilisation options include progressive mulching and grassing once the surface is reinstated.

3. Where the trench excavation is undertaken under or adjacent to a road or pavement, the trench will generally be backfillled with hardfill. The excavated material will generally be removed from the site as it is excavated. Once backfilled with hardfill, the site will be stabilised.

3.4 Dis-establishment and Site Restoration

At the conclusion of construction works, all materials and plant will be removed and the site will be reinstated to the agreed condition. Once the remedial works are completed to the extent that the site is stabilised, the site erosion and sediment controls will be dis-established and any affected areas reinstated.

3.5 Temporary coastal work

At Pump Station 23, off Frederick Street, the work site extends below the level of high tide, out into the Manukau Harbour. A specific construction methodology will be required for

works in the CMA in order to mitigate the potential adverse effects of releasing sediment into the harbour and this will be developed as part of the detailed design and confirmed by the contractor.

One option is to construct a granular bund in the harbour to form the outer perimeter of the work platform and create a robust barrier to the discharge of general fill sediment to the harbour. The work would be carried out around tidal and weather conditions.

A typical methodology which may be utilised is to lay the geotextile on the sea bed as the tide falls, with plenty of spare material on the seaward side. Granular material (clean GAP 40 or SAP 40 scoria) would be end tipped onto the geotextile and then moved in to place to form the bund wall using an excavator. The excavator would track roll the granular materials and progressively build up the outer bund. If the work is incomplete when the tide comes back in, the surplus geotextile is pulled up and over the completed section of bund and pinned in place. This process would be repeated over subsequent tidal cycles, until the bund wall is completed. During this work, as sections of the bund are completed, rock armour units are progressively placed on the face of the bunduntil the entire bund is protected.

Once the outer bund is completed, the seafloor would be covered with geotextile and bulk fill (which may also be granular) and compacted inside the bund to form the work platform. The platform would be completed with the surface graded from the seaward edge to the land, so that any contaminated runoff is directed to the sediment sump. If the platform settles due to compression of underlying silts and mud, then the internal fill would be topped up to maintain the required fall to the sump.

At the conclusion of the work, the fill will be removed and trucked from the site using sealed trucks to cart any saturated material. Once the general fill is removed, the rock armour unitswill be progressively removed and the original bund excavated. Finally, where possible, the geotextile is removed and the intertidal zone reinstated to its original condition.

Similarly, at the Mangere Pump Station site, works to construct the emergency pressure relief structure in the CMA would be undertaken around tidal and weather conditions.

4. OVERALL EROSION AND SEDIMENT CONTROL APPROACH

This section provides an outline of the erosion and sediment control measures to be implemented, consistent with the principles identified above. Further design and detail will be developed through refinement of the draft site specific erosion and sediment control plans in Appendix A (with supporting text in Appendix B). These will be subject to a Manager approval process prior to commencement of construction, in accordance with normal resource consent conditions.

The erosion and sediment control measures are designed to be in accordance with TP90 and to minimise soil erosion and sediment yield from the construction sites.

A number of sites are located in close proximity to watercourses. These sites are:

- Lyon Avenue (Meola Creek);
- Haverstock Road (Meola Creek, partly piped);
- Walmsley Park (Oakley Creek);
- May Road (connects to Oakley Creek);
- Keith Hay Park (Oakley Creek);
- Rawalpindi Reserve (Meola Creek);
- Norgrove Avenue (Meola Creek);
- PS 25 (Miranda Reserve) (Whau Creek); and
- Miranda Reserve (Whau Creek).

Three sites (PS 23 (Frederick Street), Kiwi Esplanade, and Mangere Pump Station) are near the coastal marine area (Manukau Harbour).

The typical control measures applicable to the project are:

- Clean water runoff diversion channels and bunds;
- Dirty water collection channels;
- Super silt fence;
- Rapid revegetation and stabilisation;
- Stabilised, durable construction access and egress;
- Wheel wash at the site exit;
- Use of Sediment Retention Ponds and Decanting Earth Bunds for sediment removal;
- The use of chemical flocculants to promote settlement of entrained sediment;
- Setting up purpose built treatment facilities with automatic flocculant dosing for treatment of pumped dewatering discharges and the wheel wash discharge.

The Contractor will be responsible for the management and maintenance of all erosion and sediment control measures for the duration of the period of construction at each site. If construction activities cease for a period at any site, the Contractor will (as a minimum), inspect and monitor site discharges and maintain the measures that are in place once a week and at any time there is a significant rainfall event. When construction activities resume, the Contractor will revert to the “active site” monitoring and inspection programme.

4.1.1 Dust control

This is not generally an issue in Auckland with the type of soils that are expected to be encountered and given that the work generally is taking place on stabilised sites.

Any potential dust effects will be managed to avoid the emission of dust beyond the boundaries of the sites. Methods for minimising and monitoring dust generated by

construction activities will be included in the Construction Management Plan(s). Dust suppression measures will be implemented in accordance with the "*Good Practice Guide for Assessing and Managing the Environmental Effects of Dust Emissions"* published by the Ministry for the Environment in 2001.

For example, the following additional measures may be appropriate to minimise potential dust nuisance:

- Areas of exposed earth stabilised as soon as possible;
- Stockpiles covered or dampened in dry windy conditions;
- Water carts used in dry windy conditions to dampen areas of exposed earth.

4.1.2 Wheel washes

Where practical and necessary sites will be provided with a wheel wash which will be maintained until work on that site is completed and the site reinstated. The wheel wash will comprise a heavy duty grid over a sealed sump and a means of washing down the truck body over the sump. There are various options including using a standard tap and hose, possibly including recycling of settled water from the sump; and of using high capacity water blasters, which are an efficient way to clean trucks with low water consumption.

When the wheel wash is first set up on site, it is proposed to be cleaned using sucker trucks until the dewatering treatment plant is operational. Once that is completed, water from the sump will automatically be dosed and pumped for treatment, prior to discharge.

4.1.3 Access roads

Where access roads are required, they will typically be formed and metalled, and standard road crossings constructed. Sealed access roads may be utilised at primary construction sites, or at other sites as determined by the contractor's methodology.

4.1.4 Monitoring and maintenance

The Contractor will be required to plan, undertake and record the outcomes of environmental monitoring and maintenance at each site. This is to ensure that the proposed erosion and sediment control measures have been installed correctly, and are functioning effectively throughout the duration of the works.

4.1.5 Groundwater

Groundwater may enter through the shaft lining or tunnel wall during construction and will accumulate at the tunnel head and/or the shaft. The amount of groundwater entering the underground work area will be site specific and is dependent on ground conditions and the shaft lining system selected.

Groundwater entering construction trenches is likely to be transferred to the downstream shaft site via the progressively installed pipe system. The amount of groundwater entering a trenched excavation is likely to be minimal.

All groundwater entering the underground work area will be pumped to the surface where it will be treated prior to discharge to a receiving environment. The treatment of the groundwater will be dependent on its quality and may include flocculation and a series of settling devices in order to achieve the required quality.

Any groundwater deemed unfit for discharge to surface water following treatment will either be disposed of directly to the wastewater system or transported off site for disposal. This could be triggered by concreting work within the tunnel if it raises the pH above 7.5. There

are options for lowering the pH which would also be considered in evaluating the appropriate wastewater or off-site disposal option.

5. STORMWATER MANAGEMENT

Stormwater runoff will generally be managed during construction with the use of TP 90 devices. At some of the larger sites where there will be temporary sheds over the shafts (Western Springs and May Road) additional rain detention tanks are also proposed to provide attenuation.

At the following sites it is proposed to discharge stormwater directly into streams:

- Lyon Avenue;
- Walmsley Park;
- May Road;
- Keith Hay Park;
- Motions Road;
- Western Springs Depot;
- Rawalpindi Reserve;
- Norgrove Avenue;
- PS 25 (Miranda Reserve);
- Miranda Reserve;
- Dundale Avenue; and
- Haycock Avenue.

The catchments of the streams adjacent to the construction sites are substantial in area and the increased discharge resulting from additional hardstanding on each site will not materially affect the flow in the stream. Where runoff is to be directed to a stream on any site, temporary scour protection (e.g. riprap on geotextile) will be constructed where necessary on the banks and bed of the stream to mitigate the risk of erosion at the point of discharge.

Where stormwater is discharged to the CMA (at PS 23 (Frederick Street) and potentially at Mangere Pump Station and Kiwi Esplanade) the stormwater volume will be minimal in the context of the receiving environment. Where necessary, temporary scour protection will be installed at the point of discharge to mitigate the risk of erosion.

Appendix A: Erosion and Sediment Control Drawings and Supporting Text

Appendix B – Draft Chemical Treatment Management Plan