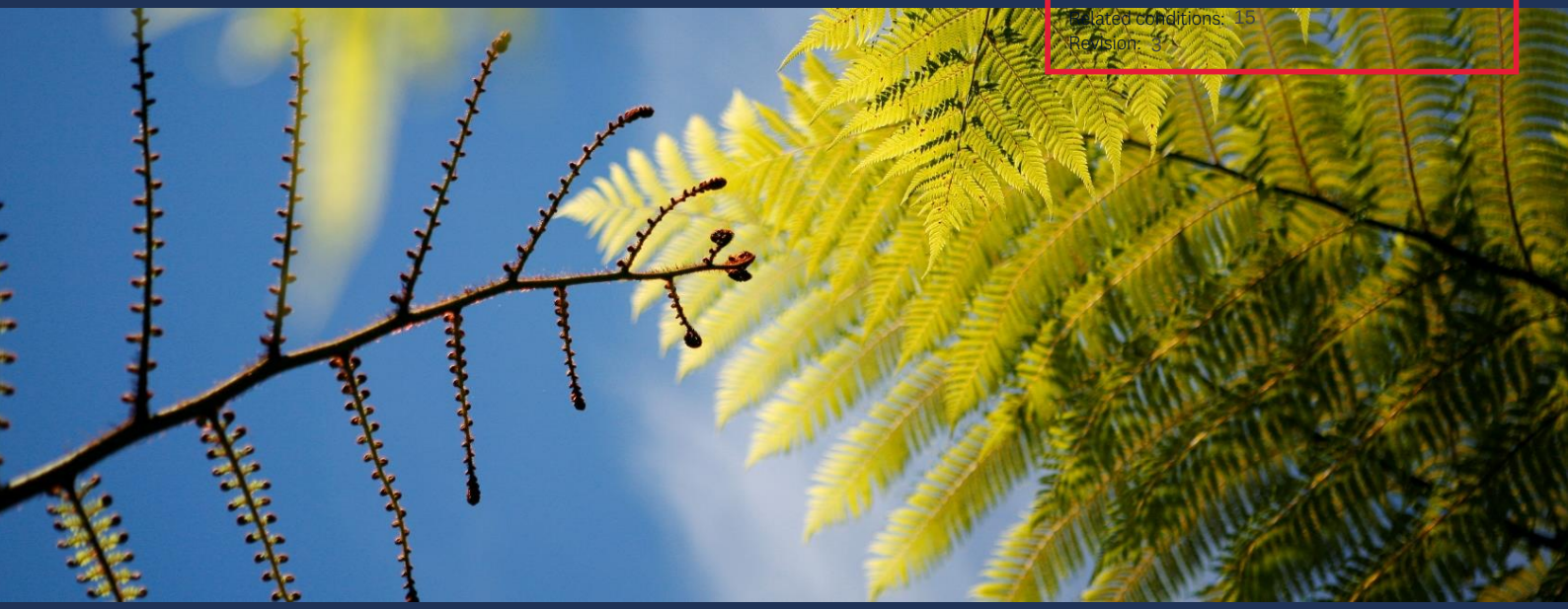
SOUTHERNSKIES ENVIRONMENTAL



Chemical Treatment Management Plan

Drury Town Centre

133 Fitzgerald Road, Drury

October 2022

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1.0 INTRODUCTION

SouthernSkies Environmental (SouthernSkies) has been engaged by Ross Reid to prepare a Chemical Treatment Management Plan (CTMP) to provide treatment during the earthworks phase of the construction for the Drury Town Centre.

This CTMP details the flocculation system that will be implemented on the site to treat the sediment laden runoff during the earthworks phase. Sediment Retention Ponds (SRPs) and Decanting Earth Bunds (DEBs) will be used during the earthworks phase as detailed on the Erosion and Sediment Control Plans prepared by Aurecon. The CTMP will be updated with details for future stages as the earthworks progress. Prior to earthworks commencing within each stage the CTMP will be updated to suit the proposed erosion and sediment control measures for that stage.

The recommended methodology to be used on site is based on a rainfall activated dosing system.

2.0 METHODOLOGY

The testing methodology used is based on the SRP flocculation system and guideline developed on behalf of the Auckland Regional Council.

Two soil samples from the subsoil were taken from Stage 1 of the site. The samples are considered representative of the material that will be earth worked during Stage 1 of the project.

Bench test flocculation trials were undertaken using chemicals to determine soil reactivity to chemical treatment in accordance with the Auckland Regional Council document titled *"The Use of Flocculants and Coagulants to Aid the Settlement of Suspended Sediment in Earthworks Runoff" (Technical Publication 227 – dated June 2007)* and Auckland Council Guideline Document 2016/005 *'Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region'*, Incorporating Amendment 1 (GD05).

The chemicals tested with were:

- Poly Aluminium Chloride (PAC)
- Superfloc (a blend of PAC and PolyDADMAC)

Chemicals were supplied to SouthernSkies by IXOM Chemicals (IXOM).

3.0 BENCH TEST TRIALS

The chemical and dose rate required to achieve satisfactory removal of suspended solids from earthworks runoff depends on physical and chemical characteristics of the soil.

The soil samples from the site were used to make up artificial stormwater for testing to evaluate the dose required for treatment.

Bench testing has been undertaken to determine the optimum chemical and dose rate for suspended solids removal, and the effects of the chemical dose on pH of the treated water.

Ongoing monitoring of treated sediment retention devices will also be required, as outlined in Appendix B. If the monitoring highlights any deficiencies further bench testing will be undertaken.

Highlighted rows in green identify the optimal dose rate identified during the test. Highlighted rows in red determine dose rates that cause the pH to fall below 5.5. As recommended by GD05 the pH of the discharge must not fall outside of the range 5.5 to 8.5.

3.1 Sample 1

Initial pH: 7.17 *Initial turbidity: 1020 NTU*

PAC (liquiPAC)

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final turbidity after 60mins
0	20	30	35	7.30	333
2	60	70	80	7.11	79
4	95	115	120	7.05	40
6	120+	120+	120+	6.93	32
8	115	120+	120+	6.90	36
10	100	120+	120+	6.82	41

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

Superfloc BXS

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final turbidity after 60mins
0	20	30	35	7.30	333
2	50	60	75	6.80	86
4	45	50	60	6.79	120
6	40	55	70	6.77	119
8	30	50	75	6.73	113
10	30	55	80	6.67	99

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

3.2 Sample 2

Initial pH: 7.10 *Initial turbidity: 1350 NTU*

PAC (liquiPAC)

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final turbidity after 60mins
0	15	30	35	7.82	467
2	50	55	85	7.51	110
4	65	75	100	7.32	63
6	70	80	100	7.12	60
8	65	85	115	6.96	62
10	50	95	120+	6.77	52

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

Superfloc BXS

Aluminium Dose (mg/L)	Clarity (mm) after 5mins	Clarity (mm) after 30mins	Clarity (mm) after 60mins	Final pH after 60mins	Final turbidity after 60mins
0	15	30	35	7.82	467
2	50	60	80	7.12	112
4	40	50	65	7.05	203
6	35	45	55	6.97	223
8	35	45	65	6.88	180
10	30	45	75	6.75	147

Control 2mg/L 4mg/L 6mg/L 8mg/L 10mg/L

4.0 DISCUSSION

Various dose rates of Polyaluminium Chloride (PAC) and Superfloc (Superfloc BXS) were successful in providing an improvement in clarity and turbidity over the control tests. PAC provides the most consistent rate of settlement for the soil tested. Therefore, the recommended chemical to be used on site is PAC.

The recommended dose rate for the site is 4 milligrams of aluminium per litre. This is equivalent to 62mls of PAC to 1 cubic meter of sediment laden runoff.

Throughout the project, if poor clarity in a device is observed then the dose rate should be altered. Soil samples can be collected and retested to ensure that the project is using the correct dose rate. Adjustments to the dose rate will be made as required to optimise the use of chemical treatment.

Note: Different PAC products may have different aluminium content and specific gravity and thus, respond at different rates. The product tested has a specific gravity of approximately 1.2 and has greater than or equal to 10% Al2O3. If PAC is sourced from different suppliers, the specific gravity and aluminium oxide concentration should be checked and if differing from those tested, may need to be re-tested to confirm dosage rates.

It is recommended that the project utilises a rainfall activated dosing method for any runoff from the site. A batch dosing criteria and method is also provided.

In summary:
Chemical recommended: **PAC**
Dose rate: **62mls/m^3**
Dosing system: **Rainfall Activated Dosing System**

5.0 RECOMMENDED FLOCCULATION SYSTEM

5.1 Rainfall Activated Dosing System

The rainfall activated dosing system has been developed specifically for earthworks sites. The system uses a rainfall catchment tray to capture rainfall with the size of the tray being determined by the required chemical dose and the land catchment size.

Rainwater caught by the catchment tray is piped into a header tank, and then into a 400L displacement tank which floats in a larger tank containing the flocculant filled to the level of an outlet pipe leading to the sediment laden diversion about 10m upstream of the sediment control device. The greater the rate of rainwater flow into the displacement tank the greater the flow of flocculant into the sediment laden runoff channel. The header tank is designed to provide for no dosing during the initial rainfall of up to 12mm of rain under dry conditions, and for attenuation of the chemical flow during the initial stages of a storm and after rain has ceased at the end of a storm.

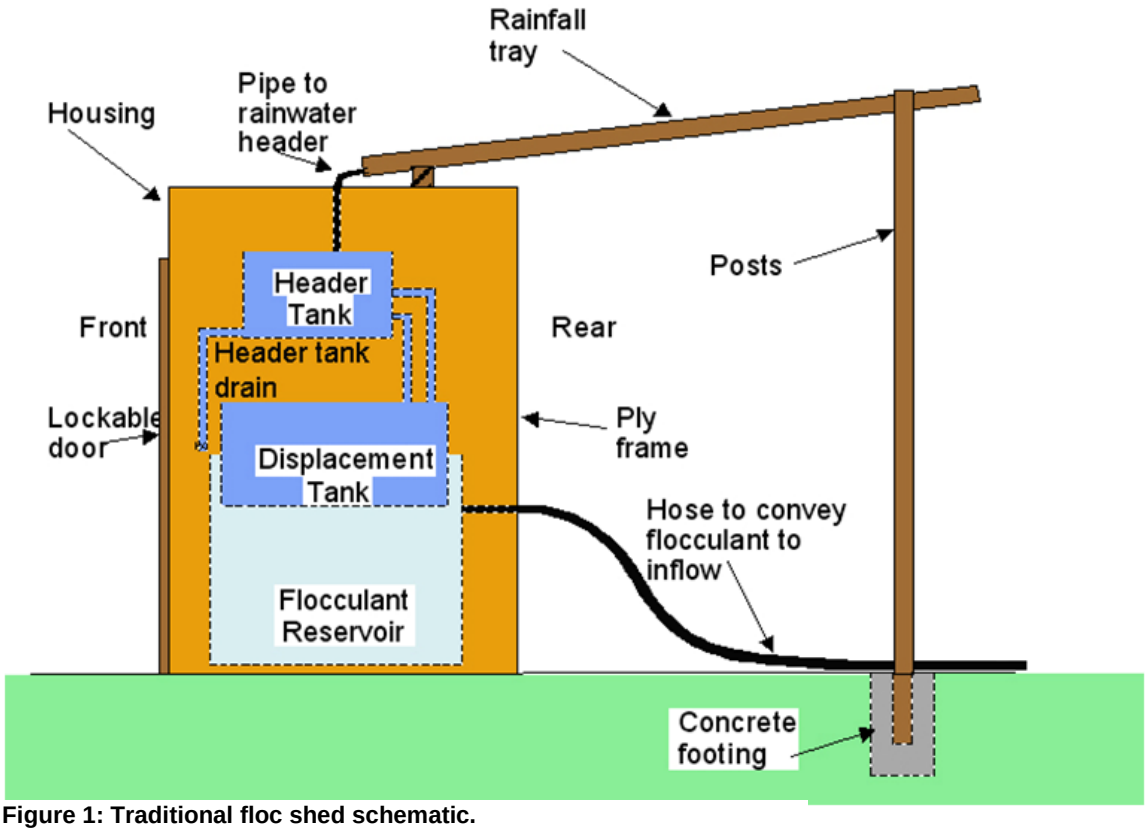

Figure 1: Traditional floc shed schematic.

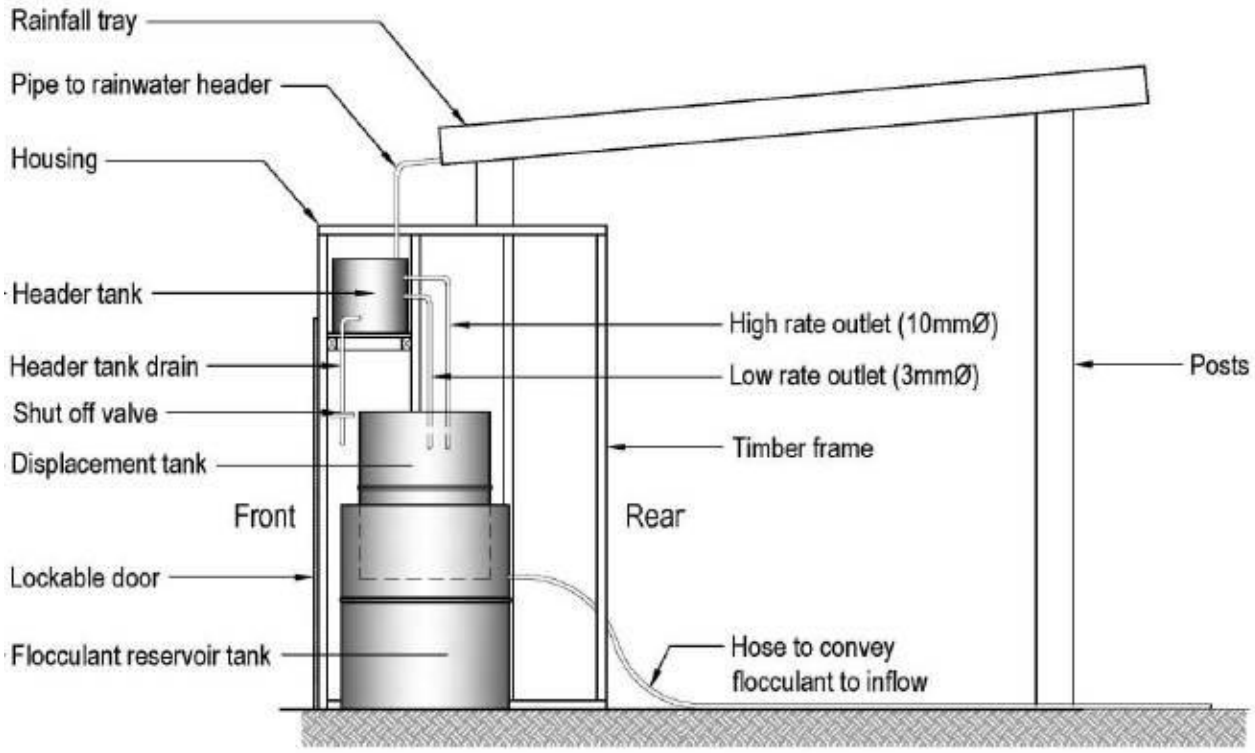

Figure 2: Components of the floc shed.

5.1.1 Area of rainwater catchment tray required for rainfall activated system

The area of the rainwater catchment tray is determined by the dose required, and the area of the earthwork's catchment draining to the sediment control device.

All water flowing into the sediment control device needs to be treated, and the rainwater catchment tray size is determined by the total land catchment area draining to the sediment control device including both the 'open' area and stable areas. If the catchment area is changed, then the catchment tray size should also be changed in proportion. Reduction of the tray size is easily achieved by placing a piece of plywood on top of the upstand over the lower end of the tray, thereby allowing the rain which falls on the plywood to run to waste.

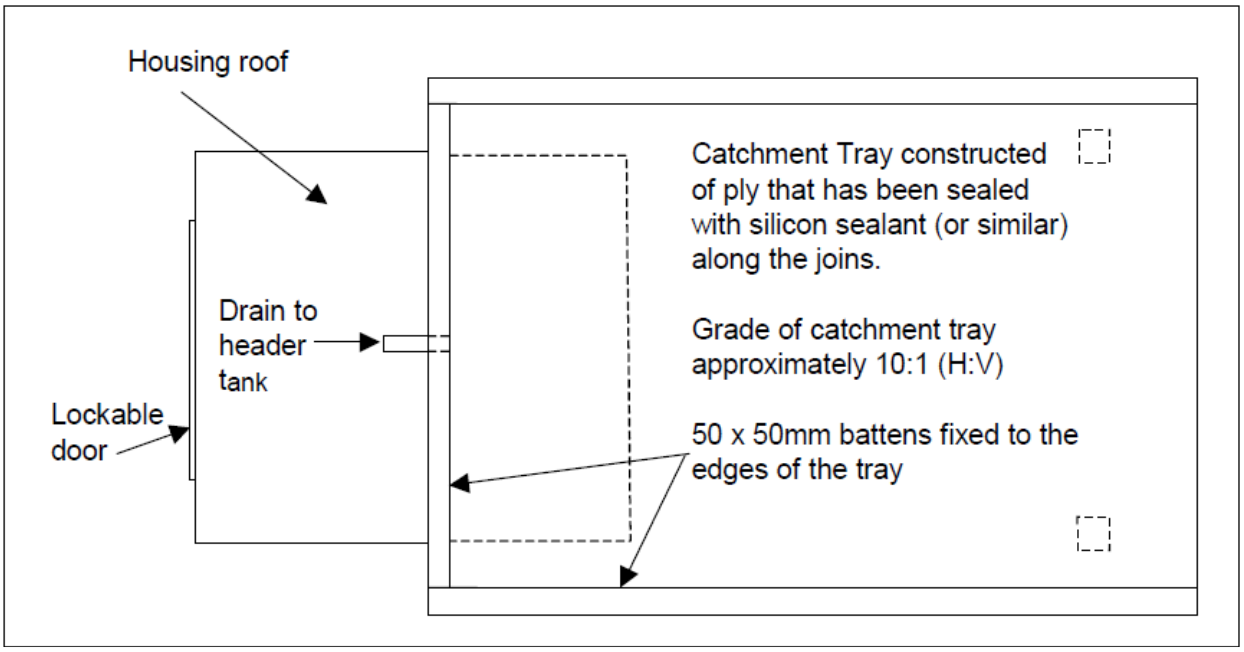

Figure 3: Roof tray design.

The required tray size is 0.75 square metres per hectare of exposed land catchment draining to the sediment control device. This is the area inside the upstand around the edge of the tray.

Appendix C provides the chemical dosing systems setup details, including the sediment control device, catchment area, roof tray size and header tank spacing. Appendix C will be updated as required.

Note: It is recommended that roof tray sizes greater than 3m^2 is split between two chemical dosing systems. In this situation the roof tray and header tank spacing would be divided evenly between the two dosing systems.

5.1.2 Header Tank Outlet Spacing

Rainfall from the catchment tray is drained into a header tank. This provides a storage capacity that avoids dosing during initial rainfall following a dry period and to attenuate dosing at the beginning and end of a rainstorm event.

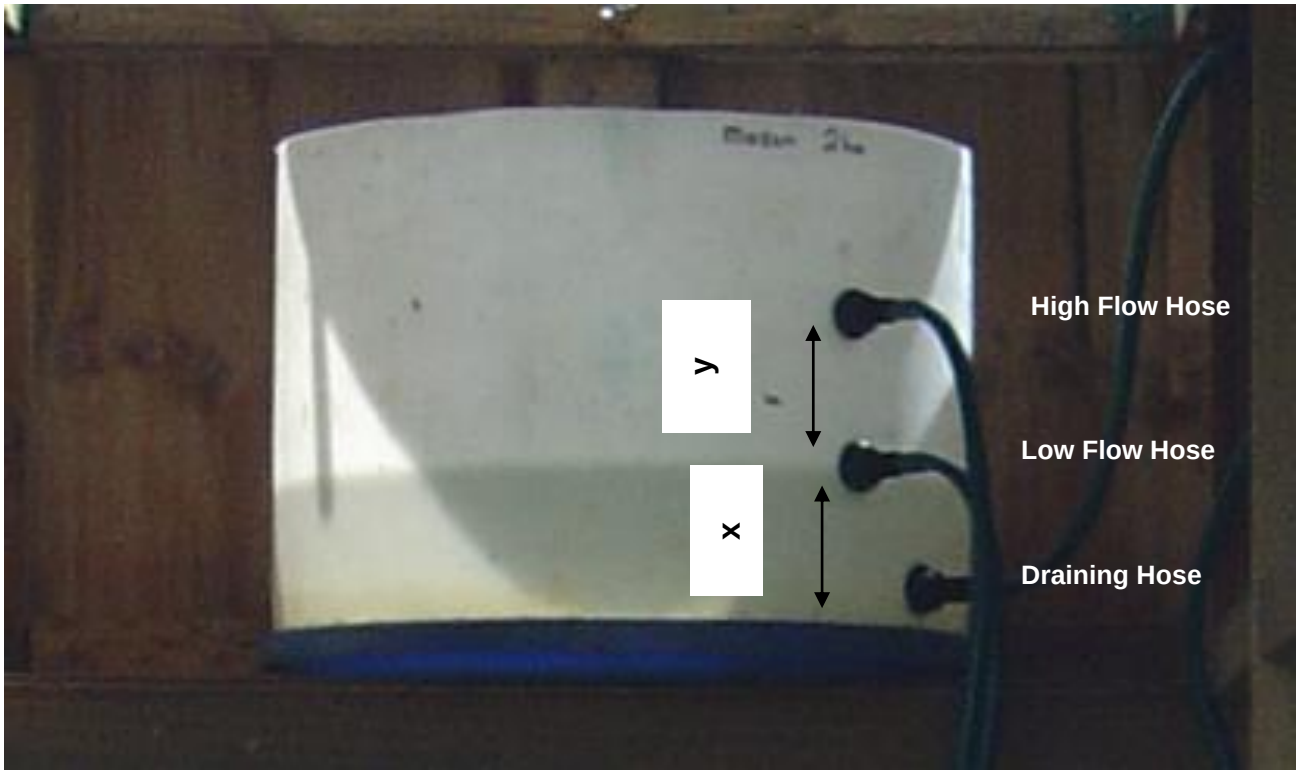

Figure 4: Header tank spacing.

Appendix C provides the header tank spacing details for each chemical dosing device. This will be updated as required.

The distances provided are between the base of the header tank (or height from draining hose if the draining hose is higher than the base of the header tank) and the first dosing outlet which is equal to the volume of 12mm of rainfall on the catchment tray (distance x). The distance between the first dosing outlet and the high flow outlet is the same (distance y).

Note: If the roof tray is split between two chemical dosing systems, then the header tank spacing would also be divided evenly between the two dosing systems.

Header Tank management in summer months to be as per the GD05 guidelines:

- After 3 days without rain – reduce volume by 50%
- After 6 days without rain – empty completely

5.1.3 Sediment Laden Runoff Channel and Dosing Point for Rainfall Activated System

The PAC needs to be added to the sediment laden runoff channel to provide mixing with the sediment laden runoff before it reaches the area of ponded water of a DEB or a SRP forebay.

All sediment laden runoff from the catchment should be combined into a single channel if possible before it reaches the chemical dosing point which should be located at 5 - 10 metres prior to the point where the runoff reaches the ponded water of the forebay, so the PAC can be added to and mixed with the total inflow.

The dosing point should be at a location where the chemical will fall into the sediment laden flow during periods of low flow. The end of the dosing pipe should be installed about 200mm above the diversion channel to ensure that the chemical falls into the sediment laden runoff and is not blown away during periods of strong wind.

5.2 Batch Dosing

Batch dosing is not recommended as the primary dosing system. It can be utilised as additional dosing where adequate water quality has not been achieved, but with careful monitoring of pH.

The criterion to establish the need for batch dosing is the clarity of the sediment laden runoff. Clarity is measured using a black disk lowered vertically into the water to be tested. A small black disc of 50-80mm diameter is attached to a 1m long stick with a centimetre scale starting at the disc. The disc is lowered into the water until it disappears, and then is raised until it just reappears. The depth of reappearance is recorded as the clarity of the water.

Water with a clarity of 100mm or greater is considered to be acceptable for discharge. Water with a depth of clarity of less than 60mm should be batch dosed. If the sediment laden runoff has clarity between 60-100mm after rainfall has ceased, it should be left for 48 hours to settle. If the clarity has not reached 100mm after 48 hours, or if sediment laden runoff has to be discharged within 48 hours because the pond is full, the sediment laden runoff should be batch treated.

Batch Dose Rate

The batch dose rate is 62ml of PAC per m^3 of runoff.

Batch dosing rate based on volume of stormwater to be treated.

Volume of stormwater in pond (m^3)	Amount of chemical to be added (L)
1	0.062
50	3.1
100	6.2
200	12.4
300	18.6
400	24.8
500	31
1000	62
1500	93

Application Procedure (batch dosing)

The chemical dose should be applied evenly over the surface of the SRP or DEB as quickly as practicable. It is best to apply the dose in one application, rather than going over the surface of the device two or more times.

The total dose may be applied in one of two ways.

a) Spray.
The chemical can be applied to the surface of the pond using a sprayer that produces large drops.

b) Bucket.
Place no more than 1 litre of chemical in a 10-litre bucket and throw the chemical onto the pond surface so that the chemical divides into drops before hitting the surface.

Following batch treatment and the settlement of the coagulated solids the water can be discharged. Settlement generally requires 1-2 hours.

6.0 MONITORING AND MAINTENANCE REQUIREMENTS

6.1 Routine Management and Maintenance

Instructions for routine management and maintenance of the chemical treatment system are provided in Appendix A. It is recommended that a copy of this table be kept onsite and available for review.

All monitoring records and maintenance checks and actions should be recorded on the monthly record sheet provided in Appendix B. The systems should be checked after each rainfall event, and during dry periods the systems should be checked weekly.

It is also noted that chemical treatment increases the sediment removal efficiency of the sediment controls. The sediment controls will need to be regularly desilted to ensure that the maximum volume is re-established after rain events.

6.2 Contingency Management

Contingencies could include poor performance of the treatment system, or effects of other influences on sediment laden runoff quality, such as reduced pH, that might make the use of PAC inappropriate.

If the treated water in the sediment control device is consistently very clear it could indicate overdosing, and the possibility of lowered pH which can present a risk to receiving waters as a result of elevated free aluminium concentration in the discharge. If treated water is consistently clear, then the pH of the water in the sediment control should be tested.

Contingencies such as poor treatment performance or consistently very clear treated water should be dealt with by consulting the Auckland Council and SouthernSkies or some other person qualified to advise on appropriate action.

A chemical spill contingency plan is provided in Section 10 below.

7.0 RECORD KEEPING AND REPORTING

A copy of the maintenance record for the chemical treatment system will be kept on site (Appendix B).

A copy of the maintenance record for the chemical treatment system is to be held on site and provided to the Auckland Council on request.

8.0 STORAGE OF FLOCCULENT ON SITE

Bulk PAC, which can be supplied by the manufacturer in 200L polyethylene drums, should be kept in secure storage, either in a locked shed or container. PAC drums should always be stored on end with the screw caps uppermost. Topping up of flocculent chemical will be made weekly as part of the regular inspection regime.

9.0 PROCEDURE FOR TRANSPORTATION

PAC will normally be delivered to the site by commercial carriers in accordance with current Hazardous Goods, Traffic and Transport regulation. PAC can be requested from the supplier generally in 20 litre containers, 200 litre drums and/or 1,000 litre IBCs. 200L drums of PAC weigh about 250kg and is most easily moved within the site in a loader bucket. The use of these or any other chemical must be done in accordance with the Site Health and Safety Plan.

10.0 CHEMICAL SPILL CONTINGENCY PLAN

If there is a spill of chemical onto the ground it should be immediately contained using earth bunds to prevent it entering water. The spilt chemical should be recovered if possible and placed in polyethylene containers. If the spilt chemical cannot be recovered, it should be mixed with a volume of soil equal to at least ten times the volume of spilt chemical. This will effectively neutralize the chemical. The soil with which the chemical has been mixed should be buried in the ground a minimum of 0.5 metres below the surface.

If there is a spill of PAC into ponded water, discharge from the pond to natural water should be prevented. If there is a spill of PAC into flowing water:

1. Auckland Council should be advised immediately.
2. The volume of the spill should be recorded.
3. If possible, the water and spilt chemical should be pumped into a bund or pond until all the spilt chemical has been removed from the watercourse.
4. If the chemical cannot be removed from the watercourse any downstream users should be identified and advised.

11.0 CHAIN OF RESPONSIBILITY FOR MONITORING AND MAINTAINING

Ross Reid shall have primary responsibility for maintenance and monitoring the effectiveness of the chemical treatment system. The contractor will check the effect of PAC dosing on the pH of the treated water once the sediment control devices have filled for the first time and monitor pH and overall performance throughout the duration of works.

12.0 TRAINING OF PERSON RESPONSIBLE FOR MONITORING AND MAINTENANCE

If a person with experience in the monitoring and maintenance of the chemical treatment system is not available, SouthernSkies will train a person nominated by the contractor to carry out the routine monitoring and maintenance of the chemical treatment system, and to keep the required records.

APPENDIX A. INSTRUCTIONS FOR MONITORING TREATMENT SYSTEMS FOR EARTHWORKS STORMWATER

A) PAC *Dosing System*

REDUCING THE HEADER TANK WATER VOLUME.

The header tank is used to avoid dosing during the initial stages of rainfall when site conditions are dry, and no runoff is to be expected.

The volume in the header tank is lowered using the lowest of the three outlet tubes.

After 3 days without rain - reduce volume to 50%.

After 6 days without rain - reduce volume to empty (level at lowest outlet).

REFILLING THE CHEMICAL RESERVOIR.

The chemical reservoir tank should be refilled when the white displacement tank is half full, or sooner if heavy rain is predicted. This is done by first emptying the white tank (baling with a bucket is efficient), and then refilling the black reservoir tank until the PAC level is at the lower edge of the outlet.

OBSERVATION OF WATER QUALITY IN POND.

The pond water quality will be observed at least weekly, and the clarity determined using a black disk and recorded on the monitoring sheet. pH shall be recorded once the pond has filled up to ensure that chemical dosing does not have an unacceptable effect.

PERIODIC SYSTEM CHECKS.

Check that the rainfall catchment tray is not leaking – especially along the lower edge of the tray. This should be done after rainfall has ceased.

Check the lower hose with the small tube outlet, from the header tank to the displacement tank, is not blocked.

MONITORING RECORDS.

A separate sheet is provided for monitoring records for each month. The information to be recorded is as follows:

Visual check

Check the tray for leaks, the plumbing, and the hoses from the header tank. Record ‘ok’, or if maintenance is required write ‘M’ and note the requirement in the ‘Notes’ column.

How full is the header tank (%)

This is the volume between the lowest and middle outlets. After rain this should be either 100% after 12mm or more rain, or between 0-100% after less than 12mm rain. In summer: 50% when lowered after 3 dry days; 0% when emptied after 6 dry days.

Depth in Displacement Tank (%)

Measure depth of water in cm. Reduces to 0 when emptied.

Chemical *volume added*

Record the volume of chemical added. 1 drum of PAC = 200L, 9cm in 200L drum = 20L. The volume can also be calculated from change in water level in displacement tank where 1cm change = 4 litres of chemical.

Pond Clarity: Record using black disc near pond outlet. (Refer above).

APPENDIX B. CHEMICAL TREATMENT SYSTEM MONITORING AND MAINTENANCE RECORD

A) PAC *Dosing System*

Site: Drury Town Centre

Sediment Control Device: **Month:** **Maintenance Person:**

Date	Visual check	% Header Full	Water depth In Displacement Tank (cm)	PAC Volume Added	Water Clarity (cm)	pH	Notes on maintenance required or additional information	Initial
01								
02								
03								
04								
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APPENDIX C. CHEMICAL DOSING SYSTEM DESIGNS

			Header tank spacing	
Dosing system	**Catchment area**	**Roof tray**	**Low flow (3mm ø)**	**High flow (10mm ø)**
SRP-1 (A9)*	4.9ha	3.67m^2	350mm	700mm
SRP-6 (A8)*	4.87ha	3.65m^2	348mm	696mm
DEB-1 (75L floc box)	0.3ha	0.22m^2	42mm	83mm
DEB-2 (75L floc box)	0.3ha	0.22m^2	42mm	83mm

* The requirements above (roof tray and header tank spacing) for SRP-1 and SRP-6 exceed the capacity of a Large Portafloc device. The below table provides the details for two Large Portafloc systems where the required roof tray size and header tank spacing is split evenly between two systems.

			Header tank spacing	
Dosing system	**Catchment area**	**Roof tray**	**Low flow (3mm ø)**	**High flow (10mm ø)**
SRP-1 Portafloc 1	2.45ha	1.8m^2	175mm	350mm
SRP-1 Portafloc 2	2.45ha	1.8m^2	175mm	350mm
SRP-6 Portafloc 1	2.435ha	1.825m^2	174mm	348mm
SRP-6 Portafloc 2	2.435ha	1.825m^2	174mm	348mm