ALEXANDRA WASTEWATER SLUDGE DEWATERING PLANT

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ABSTRACT

Central Otago District Council (CODC) owns and operates a wastewater treatment plant at Graveyard Gully. The plant provides wastewater treatment for the domestic and commercial wastewater within Alexandra. The plant is an extended aeration oxidation ditch system provided with a mechanical aeration system. The resident population in Alexandra is approximately 5,000 people and increases to approximately 8,000 during the peak Christmas holiday period.

To minimise transport and disposal costs, historically sludge from Alexandra's Wastewater Treatment Plant (WWTP) was dried on sand drying beds. However drying beds function poorly in cold winters and sludge dewatered in geotextile bags had created odour problems.

The sludge in general was Grade b under the New Zealand Biosolids Guidelines due to the cadmium, copper, mercury and zinc concentrations. The consented method of disposal was to the Victoria Flats landfill near Queenstown.

Sludge dewatering trials by centrifuge were undertaken in the summer and winter of 2011 to determine future targets for dry solids of the dewatered sludge, polymer usage and centrate solids content.

In October 2011 CODC advertised for a Design and Build Contract for the sludge dewatering equipment with acceptance of Contract in December 2011. The dewatering equipment had 24 week manufacture and delivery lead time to the site.

As beds become unusable throughout winter and no future use of geotextile bags was proposed a tight project timeframe of seven months had to be met to implement a centrifuge based sludge dewatering plant.

A separate Head Contract for construction of civil, mechanical installation, electrical and telemetry control work was accepted in February 2012 and the complete dewatering plant commissioned in June 2012.

This paper describes the key elements of the project and the Road Map approach to contract management interfaces for project delivery.

KEYWORDS

Alexandra, Central Otago, Wastewater, Sludge Dewatering, Centrifuge, Contract

1 INTRODUCTION

Central Otago District Council (CODC) owns and operates a wastewater treatment plant at Graveyard Gully. The plant provides wastewater treatment for the domestic and commercial wastewater within Alexandra. The plant is an extended aeration oxidation ditch system provided with a mechanical aeration system.

The biological sludge is thickened in a gravity thickener and historically was dried on sand drying beds and in geotextile bags in winter conditions. Alexandra has a continental climate with winter temperature down to minus 12 C and in summer temperatures of 35C.

However, insufficient land for drying beds and odour from removal of sludge dewatered in geotextile bags had created issues for the WWTP operator. To avoid further use of geobags as drying beds become unusable in winter a tight project timeframe of seven months had to be met to investigate, design, build and commission a purpose built sludge dewatering facility.

1.1 LOCATION AND LAND OWNERSHIP

The WWTP is located approximately 500 metres from the Alexandra town centre, on the true left side of the Clutha River, as shown on Figure 1. The site is designated as "sewage treatment" (Designation D50) in the Central Otago District Plan.

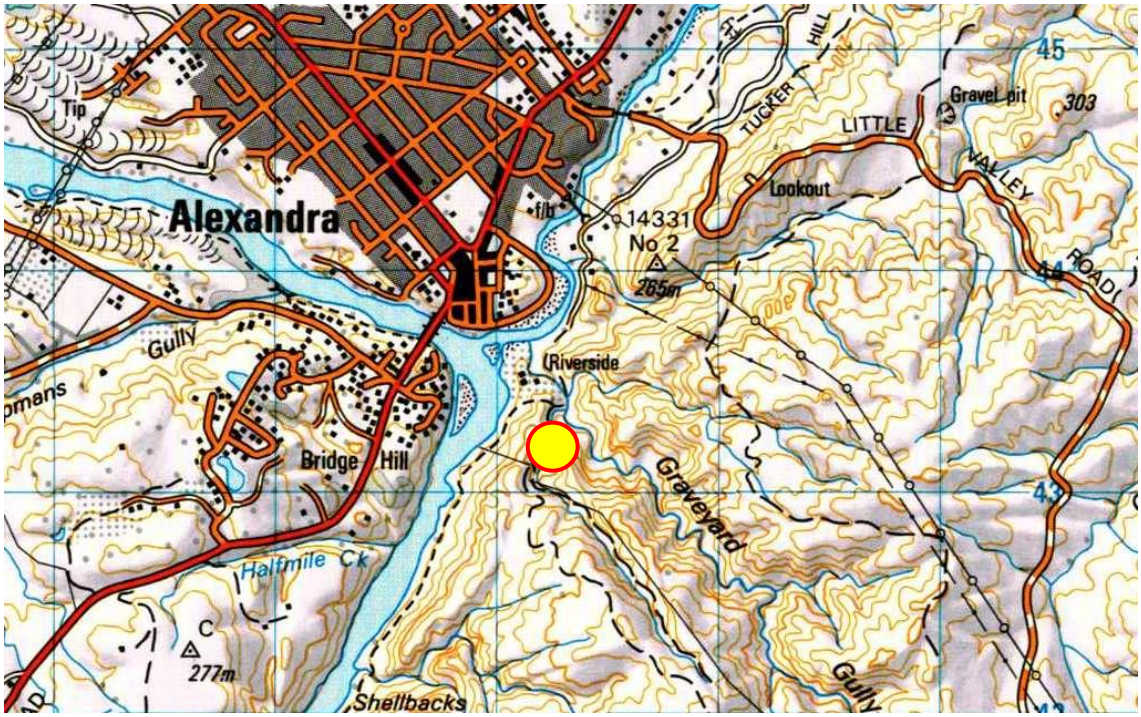


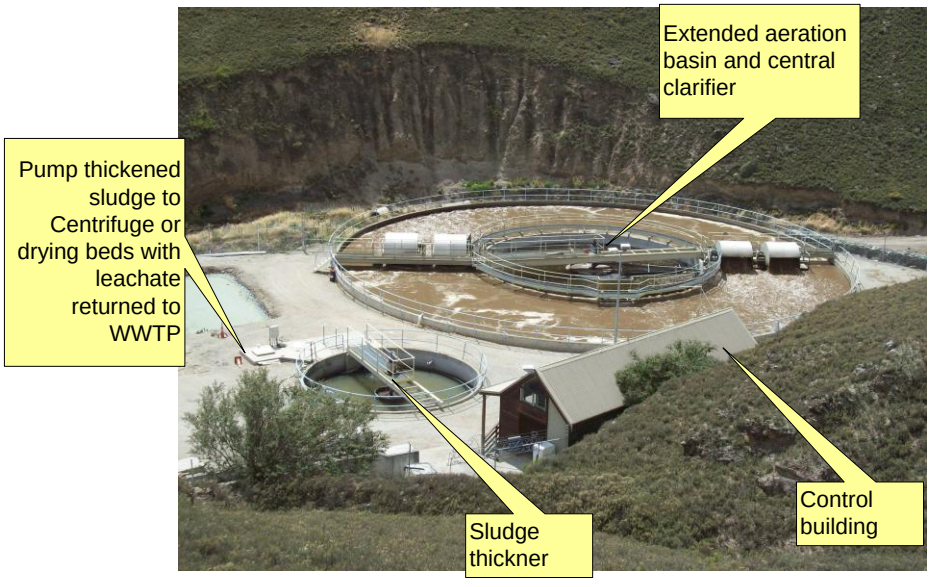
Figure 1: AWWTP – Site Location (Source: NZMS260. Scale is 1:50,000)

1.2 POPULATION

The resident population in Alexandra was recorded as 5432 based on the 2011 census data. This compares to a resident population of 4480 in 2001. The population increases to over 8,000 during the peak holiday period from Boxing Day to 10th January when the two camping grounds are near full capacity.

1.3 WWTP DESCRIPTION

1.3.1 WASTEWATER TREATMENT PLANT UNIT PROCESSES



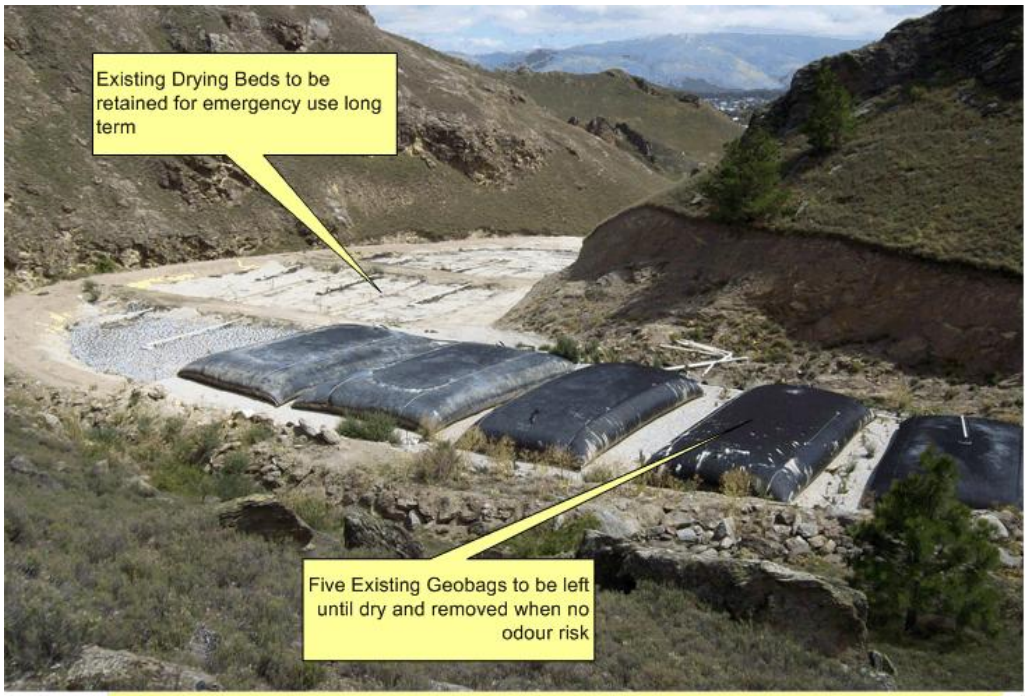
Alexandra WWTP

Photograph 1: Overview of WWTP

The process train in the existing Alexandra Sewage Treatment Plant is shown in Photograph 1 and the treatment system comprises:

- Flow measurement through Parshall flume
- Screening (1 No. 5mm Contra-shear, 110 L/s)
- Extended aeration (annular, 34m outer diameter, 2.7m depth, mechanical aeration)
- Clarifier sedimentation (15m diameter)
- Return Activated Sludge pumping station (2 No. each 40 L/s)
- Sludge thickener (1 No. 8m diameter, 2.5m sidewall depth).

The waste activated sludge is thickened in a gravity thickener and was formerly pumped to sludge drying beds and/or geobags.



Photograph 2: Geobags and Sludge Drying Beds

1.4 WASTEWATER INFLOWS

Table 1: Wastewater Inflows to WWTP

	Current Peak Inflow (m^3/day)	Proposed Peak Inflows in 2038 (m^3/day)
Dry Weather Flow	1,400	1,540
Stormwater Flow	1,225	1,225
Total Inflow	2,625	2,765

2 SLUDGE

2.1 PRODUCTION

Table 2 presents the sludge production quantities for summer and winter months adopted for this project.

Table 2: Sludge Quantities of Waste Activated Sludge

Time of Year	Adopted Sludge Quantity (m^3/month)
Summer	840
Winter	520

Sludge produced during summer months equals 62% of total sludge production over a year and winter sludge production equals 38%.

2.2 QUALITY OF BIOSOLIDS PRODUCED

The dried sludge is analysed on a regular basis to demonstrate the sludge quality for Victoria Flats landfill disposal. A summary of the results from 18 December 2008 is given in Table 3.

Table 3: Biosolids Analysis

Determinand	Units	Grade a Biosolids limits	Grade b Biosolids limits	Geobags (2 months drying)	Dry Bed (17 days drying)	Wet Bed (2 days drying)
Arsenic	mg/kg dry wt	20	30	6.2	6	5.6
Cadmium	mg/kg dry wt	1	10	1.5	1.6	1.4
Chromium	mg/kg dry wt	600	1500	16	17	15
Copper	mg/kg dry wt	100	1250	310	370	320
Lead	mg/kg dry wt	300	300	29	32	28
Mercury	mg/kg dry wt	1	7.5	3	2.5	7.1
Nickel	mg/kg dry wt	60	135	18	21	18
Zinc	mg/kg dry wt	300	1500	650	660	650
Total Dry Solids	%	-	-	11	70-80	7.6

The monitoring indicated that, in general, the biosolids would be Grade b (and not Grade a) due to the cadmium, copper, mercury and zinc concentrations.

3 SLUDGE DEWATERING TRIAL PRIOR TO TENDER

3.1 TRIALS

Sludge dewatering trials were undertaken in the summer and winter of 2011 using a leased portage centrifuge supplied by GEA Westfalia Separator NZ Ltd (GEA).

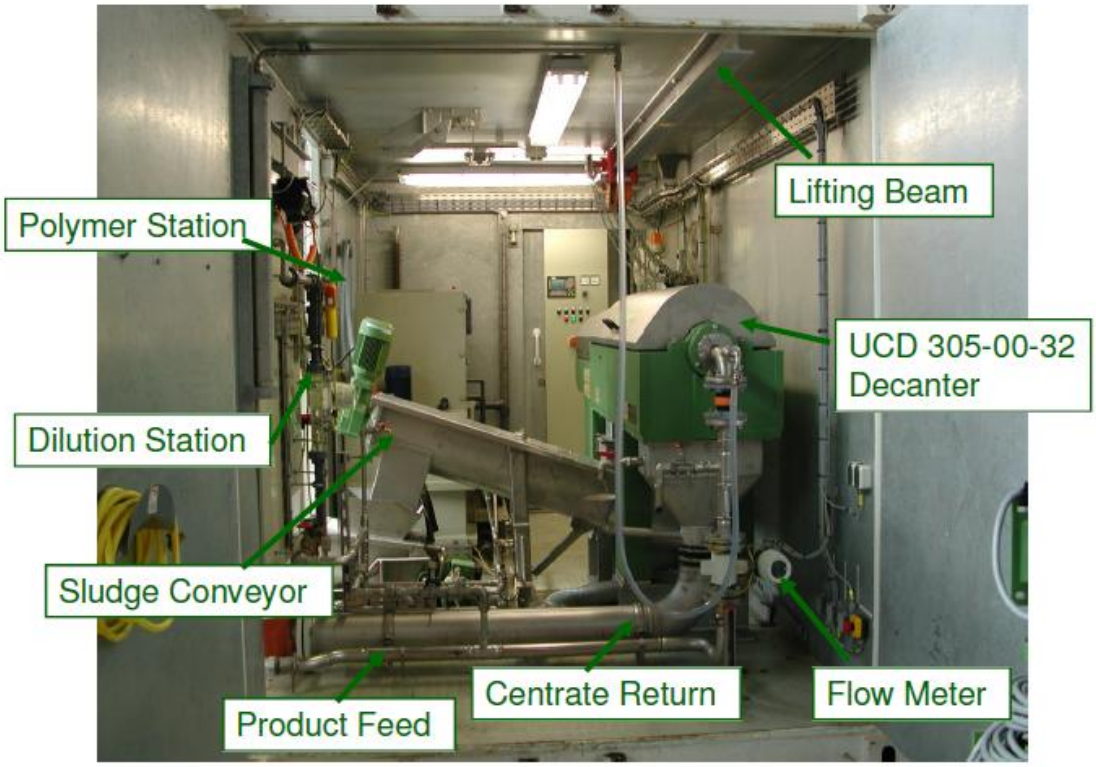


Figure 2: UCD 305 Containerised Centrifuge

GEA centrifuge personnel provided setup and training in the use of the GEA-Westfalia Separator Decanting type UCD 305-00-32, refer Figure 2 above.

This trial established that the non-digested, extended aeration activated sludge with Volatile Suspended Solids to Total Suspended Solids (VSS/TSS) ratio of 80% was able to be dewatered to 18-21% dry solids and meet the acceptance criteria at the Victoria Flats landfill.

3.2 TENDER

In October 2011 CODC advertised for a Design and Build Contract for the design, supply, installation, supervision, testing and commissioning and service support associated with the dewatering and disposal of sludge from the Alexandra WWTP.

The specified sludge throughput required was 4.1m^3per hour, minimum dry solids of 19% of dewatered cake and 95% solids capture.

Tenders were received from a number of sludge dewatering equipment suppliers and a centrifuge supply option from GEA was selected as the preferred solution. Following acceptance of Contract the dewatering equipment had 24 week construction and delivery lead time to the site.

A separate Head Contract for construction of civil, mechanical installation, electrical and telemetry control work was proposed and MWH were engaged in December 2011 to provide project management, design coordination of the multiple parties and preparation of the Head Contract.

4 ROAD MAP FOR DELIVERY

While this could be considered a small sludge dewatering facility the complexity of the project involved a number of process units, several parties to the contract(s) and the potential risks associated with lack of clarity around roles and responsibilities in terms of design, construction, commissioning, operation and maintenance.

To minimize potential problems, two detailed design team meetings were held in December 2011 and January 2012 comprised of the CODC project manager, Council's operations staff, the WWTP operator, the centrifuge/polymer dewatering equipment designers and suppliers and Council's electrical/telemetry designer. The meetings were coordinated by MWH to create a coherent plan, specifications and "road map" for the project to ensure agreement on the end product.

The meetings initially focused on the requirements of the WWTP operator in terms of useable space and maintenance needs. This was followed by value engineering inputs to confirm design requirements, the boundaries of responsibilities, future contract relationships and future flexibility for expansion. MWH documented and coordinated the multiple process interfaces and prepared civil designs and tender documents for the Head Contract, civil and building construction contract.

The building features includes hot water heating to 10C for ease of polymer mixing, option of liquid polymer, building heated to greater than 5C, gantry beam for centrifuge uplift and maintenance, linkage of process controls to alarms and monitoring to CODC's main telemetry system, electrical control room heating and cooling, and air and odour extraction.

A Head Contract was tendered in February 2012, and let in mid-March 2012 to a local construction firm Breens Construction with 10 week delivery time.

The Head Contract included detailed design (excluding the foundations) and construction of the building. Essential elements of the building included:

- Adequate insulation of structure to achieve specified heat control
- Simplicity of design and construction to achieve desired early completion date.
- Exterior colouring and low reflectivity sympathetic with surroundings and to District Plan requirements
- Detailed design drawings to building consent standard.

The 10 week time frame available to complete the works was tight and completion of the project was required prior to the onset of winter conditions which denied adequate drying opportunities in the existing sludge drying beds.

5 CONTRACTUAL ARRANGEMENTS

The CODC project manager managed the CODC's contractor for electrical and telemetry design, and installation. MWH managed the Head Contract for the building construction, services installation and the Centrifuge Contract to supply, supervise, and commission the centrifuge equipment. This is further shown in Table 4 below.

Table 4: Contractual Arrangements and Responsibilities

Party	Responsibility	Contract description
Central Otago District Council CODC Projects Manager	Client Agreements and management of Electrical Contractor and Maintenance contractor. Coordination of Maintenance Contractor	Principal
MWH Project and Contract Management	Engineer to Contract for Head Contract and Centrifuge Equipment Supply Contracts. Design Coordination Site layout, design and tender documentation.	Engineer to Contract(s)
Breen Construction Civil and Building Construction	Overall project management health and safety responsibility with Separate Contractors. Design of the building excluding foundations investigations surcharge proof loading. Responsible for the installation of dewatering equipment and supply and installation of pipework sufficient to enable the equipment to fully operate.	Head Contractor
GEA Centrifuge and Polymer Supply	Centrifuge equipment design, supply and commissioning	Nominated Separate Contractor under section 5.5 NZS 3910 under Head Contract
Switch Build Electrical and Telemetry	Telemetry Electrical equipment supply and commissioning	Nominated Separate Contractor under section 5.5 NZS 3910 under Head Contract
Alexandra WWTP Maintenance Contractor Delta	Overall WWTP site responsibility Dewatering Operations Preparation of building platform and rearrangement of drying bed pipework to provide centrate return line	Under Maintenance Contract with CODC

The project was successfully commissioned in June 2011.

Photograph 3: Completed Sludge Dewatering Building

Photograph 4: Polymer Mixing Unit- Tomal Polyrex 1.0

Photograph 5: Centrifuge UCD 305-00-32 and Gantry

5.1 EMERGENCY WORKS

During site work, a plumbing subcontractor punctured the return activated sludge line. Emergency procedures were required by the WWTP operator to control and isolate the discharge of sludge with earth bunds, repair of the damaged pipeline and site cleanup.

5.2 PERFORMANCE, BUDGET AND TIMING

The Contract included the following minimum and targets performance requirements as shown in Table 5;

Table 5: Contract Performance Target and Optimum from Commissioning

	Dewatered Cake Dry solids (%)	Polymer usage (kg per tonne of dry solids)	Centrifuge solids capture (%)
Contract requirement (a)	>19.0	<10.0	>75
Contract requirement (b)	>17.5	<10.0	>95
Target	>19.0	<10.0	>90
Post commissioning compliance achievement	17.9	10.1	99

The post commissioning compliance performance was accepted under the Contract.

The upgrade was completed within budget, 7 months project deadline and meets its overall performance requirements in term of polymer consumed, centrate solids concentration and dry solids content of the dewatered cake.

The overall value of the project was NZ$900,000.

6 CONCLUSIONS

The Alexandra WWTP sludge dewatering plant was investigated, designed, built and commissioned within a tight seven month timeframe. The key element in the successful implementation was the use of "Road Map" pre-planning involving the Council capital and operations staff, WWTP operator, dewatering and electrical telemetry equipment suppliers and engineering consultant. The best ideas came from shared inputs and an agreed documented approach.

ACKNOWLEDGEMENTS

CODC- Nigel Saunders, Peter Morton, Russell Bond, Peter Greenwood

GEA Goran Erdevicki, Nathaniel Barling, Garth Coffey

Delta-Brent Ashton

Switchbuild – Brent Fraser

MWH- Graeme Glasgow, Neville Jelley, Richard Bennett

Breens Construction Andrew Kerr

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