

5.9. APPLICATION FOR BUILDING OUR REGIONS FUNDING

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DEPARTMENT: CEO Unit - *Connected Communities*

RECOMMENDATION

That Council resolves to:

- 1. support an application under the current round of the State Government 'Building Our Regions' Fund, for \$370,000 towards the Sludge Handling System Upgrade Project; and**
- 2. contribute 50% (\$370,000) towards the total project cost.**

EXECUTIVE SUMMARY

The purpose of this report is to confirm Council's commitment to apply for \$370,000 in grant funding under the State Government's Building Our Regions program to contribute towards the delivery and project management of the Sludge Handling System at the Port Douglas Waste Water Treatment Plant. The funding guidelines identify that Council will be required to contribute 50% of the total project cost in grant funding. With a total project cost of \$740,000 Council contribution of 50% will be \$370,000.

BACKGROUND

Douglas has two Wastewater Treatment Plants (WWTP), one located in Mossman and the other in Port Douglas. At these WWTPs, waste is removed from the water so it can be either safely reused or returned to the environment.

The Port Douglas WWTP treats wastewater to a Tertiary standard using Liquid Stream treatment via a Sequencing Batch Reactor. Effluent is treated with UV and discharged into Dickson's inlet or recycled and used on the two golf courses in Port Douglas, Mirage and Palmer Sea Reef.

Unlike the treated liquid effluent, the remaining sludge requires further processing before the dewatered sludge is transported to the Springmount Waste Management Facility in Mareeba, for agricultural reuse or for further composting at the Bedminster facility in Cairns. This project is about replacing the 18-year-old Belt Filter Press which has a predicted useful life of 20 years. Other ancillary pieces of equipment will be replaced at the same time so the Port Douglas WWTP can better cope in times of peak demand, and process the sludge more efficiently.

In the last 12 months, Council has replaced 20 rollers and two motors. The bearings are all nearing the end of their life and will need replacing within the year. The down time over the past twelve months has added up to 19 days. When the BFP breaks down, in times of high rainfall, it is not possible to stop the system and the sludge material must be recirculated.

Following the Councillor workshop held 16 February 2017, Council submitted an Expression of Interest for the Sludge Handling System Upgrade to the Building our Regions Round 3 Funding program on 24 February 2017. The project was short listed with a notification to proceed to the full application stage.

Douglas Shire Council will need to proceed with the upgrade regardless of whether it is successful in this round of Building Our Region's funding.

COMMENT

The upgrade of the sludge handling system at the Port Douglas Wastewater Treatment Plant will involve:

- replacement of the Belt Filter Press (BFP) system
- an upgrade to the existing filtrate pump station
- an upgrade of one 30kW digester blower
- upgrade works to the electrical switchboard
- SCADA integration works
- shed extension
- new platform and walkway installation

The upgrade will relieve strain on the plant and decrease the amount of nutrients being recirculated, and the power saving is estimated at 800-1000 Kw per year.

Staff costs will be reduced with the SCADA integration which will automate aspects which are currently manually operated. For example, the system needs to be turned on each morning, and polymer needs to be added manually. With the upgrade, the system can be set to come on automatically, and polymer will be added automatically. This means the system can be set to come on earlier, spreading operating times to reduce loads during peak times. With an increase in visitor numbers in 2016, the Port Douglas WWTP experienced the most concentrated flows since construction of the Plant was completed in 2000.

The new BFP unit will be made of 316 stainless steel rather than painted galvanized steel to give it greater durability in the marine environment. The BFP will also have a belt width of 2 metres which is an increase of 14% over the current unit. This will provide increased dewatering capacity for future as well as the option of operating at lower feed rate with enhanced dewatering.

PROPOSAL

Projects that are eligible under Building our Regions Round 3 include Capital works projects that involve the construction of new infrastructure, or the upgrade or replacement of existing infrastructure.

There are a number of infrastructure type categories identified in the guidelines that the project must match. Water/Sewerage/Waste Infrastructure is the best fit for the Sludge Handling System Upgrade.

To proceed with the funding application, Council's commitment to apply for \$370,000 in grant funding under the State Government's Building Our Regions program to contribute towards the delivery and project management of the Sludge Handling System at the Port Douglas Waste Water Treatment Plant is required.

The funding guidelines identify that Council will be required to contribute 50% of the total project cost in grant funding. With a total project cost of \$740,000 Council contribution of 50% will be \$370,000.

FINANCIAL/RESOURCE IMPLICATIONS

If selected as one of the projects to be funded, Council will need to have resolved to enter into an agreement with the State Government to deliver the project. It is estimated that Council's contribution will be 50% (\$370,000) of the overall project costs of \$740,000.

RISK MANAGEMENT IMPLICATIONS

Council completed an options report in February 2017, identifying the alternative sludge handling options. With the BFP nearing its end of life and multiple breakages, the risk of breaching environmental licence has increased significantly.

SUSTAINABILITY IMPLICATIONS

Economic: With an increase in visitor numbers in Port Douglas, there is significant reliance upon the continued operation of the Sludge Handling System.

Environmental: Renewal of the existing infrastructure significantly decreases the possibility of a breach of the environmental licence.

Social: A full operational Waste Water Treatment Plant is a basic requirement of the community.

CORPORATE/OPERATIONAL PLAN, POLICY REFERENCE

This report has been prepared in accordance with the following:

Corporate Plan 2014-2019 Initiatives:

Theme 5 - Governance

5.1.1 - Establish and develop long term financial, resource and infrastructure planning to ensure ongoing capacity to fund operations and capital works programs.

5.1.3 - Monitor and regularly review procurement practices to ensure legislative compliance and "value for money".

COUNCIL'S ROLE

Council can play a number of different roles in certain circumstances and it is important to be clear about which role is appropriate for a specific purpose or circumstance. The implementation of actions will be a collective effort and Council's involvement will vary from information only through to full responsibility for delivery.

The following areas outline where Council has a clear responsibility to act:

Asset-Owner Meeting the responsibilities associated with owning or being the custodian of assets such as infrastructure.

CONSULTATION

Internal: Information regarding the proposed funding application was presented to Councillors at the Councillors' workshop held on Wednesday 22 February 2016.

External: Nil

ATTACHMENTS

1. Port Douglas Waste Water Treatment Plant Sludge Handling System Upgrade Options
[5.9.1]



**PORT DOUGLAS
WASTEWATER TREATMENT PLANT**

**SLUDGE HANDLING SYSTEM UPGRADE
OPTIONS**

**February 2017
(Rev 1)**

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Document Control

Version	Description of Change
Report 07/04/16	Issued to Douglas Shire Council.
Rev 1, 08/02/17	Revised report with scope of works and costings adjustment. Issued to Douglas Shire Council.

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1. Introduction

1.1. Introduction

Douglas Shire Council is responsible for the operation of the Port Douglas Wastewater Treatment Plant (WWTP). The plant was upgraded to an SBR treatment system in 1999. As part of the upgrade the WWTP was equipped with aerobic sludge digesters, with pre-thickening of the waste activated sludge (WAS) via a Gravity Drainage Deck (GDD) and a new Belt Filter Press (BFP).

WAS from the SBRs is pumped to the GDD for sludge thickening (to approx. 1.8% to 2.1%w/w dry solids) prior to digestion in 2 No. Aerobic Digesters. Filtrate from the GDD gravitates to the head of the SBRs. The Digesters are operated in series, with thickened WAS flowing into Digester 1 and then overflowing into Digester 2. Digester 1 remains full unless maintenance is required (diffuser replacement or tank cleaning) in which case it is then emptied and Digester 2 operates in sole duty mode.

The Digesters are aerated with fine bubble diffusers and 3 No. blowers (1 No. 30 kW blower for Digester 1 duty, 1 No. 15 kW blower for Digester 2 duty and 1 No. 15 kW blower as a standby for either Digester 1 or 2).

Digested sludge is then pumped primarily from Digester 2 for dewatering to the BFP, which dewateres the sludge to approx. 13 to 14% w/w/ dry solids. Dewatered sludge is transported under contract for either agricultural reuse at Springmount or for further composting at the Bedminster facility. In recent times the biosolids has been transported to Springmount.

The larger 30 kW blower for Digester 1 duty was installed in 2014, due to insufficient aeration input. The WAS thickening GDD was also replaced in 2014.

The existing BFP is nearing its end of mechanical life (17 years of operation out of a maximum life of 20 years nominally). The BFP is suffering from structural corrosion and requires replacement. As part of the future upgrade of the BFP Council wishes to assess alternative options for upgrading of the sludge dewatering system, focussing on two main options, these being:

- Option 1: Belt Filter Press (BFP), as per existing capacity, but ensuring 316 SS structural elements that are wetted parts; and
- Option 2: High speed Centrifuge, which while higher in capital cost will provide drier sludge cake thus reducing the on-going off-site transport costs.

Douglas Shire Council commissioned Yabbie Pond Pty Ltd to undertake a review of the above two sludge dewatering options. The overall scope of work was as follows:

- Specification for new BFP and obtain quotations for BFP, including polymer dosing system, belt washwater pump and sludge cake conveyors;
- Specification for new centrifuge and obtain quotations for centrifuge dewatering system, including polymer dosing system, washwater pump and sludge cake conveyors;
- Specification for upgrade to existing filtrate pump station to allow both sludge dewatering and Equalisation Basin sludge transfer operations to occur simultaneously;
- Review of WAS pumping frequency and recommendation of alternative WAS wasting regime to ensure more consistent performance of the Aerobic Digester and sludge thickening;

- Optional upgrade of one of the smaller 15 kW Digester 2 blowers to a larger 30 kW blower similar to that recently installed on Digester 1;
- Preparation of cost estimates (capital and O&M) for BFP and centrifuge upgrade options;
- Cost-benefit analysis of BFP versus centrifuge, including on-going operational costs;
- Other advantages and disadvantages of each upgrade option; and
- Recommended upgrade option.

This report presents the outcomes of the sludge dewatering options assessment and provides a recommended upgrade option with capital and operating cost budgets.

2. Current Sludge Handling System

2.1. General

Currently, waste activated sludge (WAS) from the SBRs is pumped to the GDD for sludge thickening (to approx. 1.8% w/w dry solids) prior to digestion in 2 No. Aerobic Digesters. Filtrate from the GDD gravitates to the head of the SBRs. The Digesters are operated in series, with thickened WAS flowing into Digester 1 and then overflowing into Digester 2. Digester 1 remains full unless maintenance is required (diffuser replacement or tank cleaning) in which case it is then emptied and Digester 2 operates in sole duty mode.

The Digesters are aerated with fine bubble diffusers and 3 No. blowers:

- 1 No. 30 kW blower for Digester 1 duty;
- 1 No. 15 kW blower for Digester 2 duty; and
- 1 No. 15 kW blower as a standby for either Digester 1 or 2.

Digested sludge is then pumped (primarily from Digester 2) for dewatering to the BFP, which dewater*s the sludge to approx. 13.5 to 14% w/w/ dry solids. Dewatered sludge is transported under contract for either agricultural reuse at Springmount or for further composting at the Bedminster facility.

2.2. Sludge Quantity

The current quantity of sludge produced annually is approx. 1,600 wet tonnes/year at a dry solids content of typically 13.5 to 14.0% w/w. This is equivalent to 224 dry tonnes/year.

The current annual influent flow is 1,100 ML/year, which equates to an average influent flow is 3 ML/d. Assuming a raw wastewater BOD₅ concentration of 250 mg/L, the annual BOD load is 275 tonnes BOD₅/year. The annual dry solids generation expressed in terms of influent BOD load is then estimated as 0.81 kgTSS/kgBOD₅. This is considered appropriate allowing for a solids generation of 0.9 kgTSS/kgBOD₅ in the SBRs and a solids reduction of 10% through the Aerobic Digesters.

The quantity of sludge varies through the year from the low season (November to May) and peak season (June to October). Due to the higher loads during the peak season sludge generation, and consequently sludge wasting, is significantly higher.

2.3. Sludge Wasting

The current sludge wasting program, via the WAS pumps in each of the SBR basins, is based on time of cycle and/or wasting volume per cycle. Current limitations with sludge wasting are due to rat-holing through the sludge blanket and drawing liquid or thinner sludge rather than solids. This results in reduced solids wasting per cycle and requires additional wasting time to ensure sufficient solids is wasted to maintain the appropriate sludge age.

The WAS concentration is reasonable consistent throughout the year, ranging from 6100 to 6800 mg/L.

The daily volume of WAS varies seasonally. During low season the daily WAS rate is typically 100 kL/d. During the peak season the WAS rate can go up to 300 kL/d, which is also influenced by drawing thinner sludge at times due to liquid rat-holing through the sludge blanket.

2.4. Gravity Drainage Deck (GDD) for WAS Thickening

The GDD thickens the WAS from 6,100-6,800 mg/L (0.61 to 0.68 % solids) up to 18,000-21,000 mg/L (1.8 to 2.1 % solids). Polymer is added to the WAS stream during the GDD operation. The same type of polymer as is used for the BFP operation is used for the GDD.

Polymer dose rate is approx. 1 L/min (0.25% w/v poly solution), which equates to approx. 1 kg poly per tonne dry solids in the WAS. This is considered appropriate.

2.5. Aerobic Digesters

The aerobic digesters are designed to provide additional digestion for sludge stabilisation. There are two digesters that operate in series. The volume of each digester is 315 kL at TWL, giving a total maximum digester volume of 630 kL.

The aerobic digestion sludge age varies from low season to peak season due as a result of the variation in influent loads and thus sludge generation. During low season the daily WAS rate is typically 100 kL/d of 6,400 mg/L average MLSS. The volume of thickened WAS is approx. 31 kL/d @ 2.1% solids. Therefore the aerobic digester sludge age during low season equates to $630/31 = 20$ days. This is considered sufficient for stabilisation to Grade B category.

During peak season the daily WAS rate is typically 300 kL/d of 6,100 mg/L average MLSS. The volume of thickened WAS is approx. 102 kL/d @ 1.8% solids. Therefore the aerobic digester sludge age during low season equates to $630/102 = 6$ days. This is also considered just sufficient for stabilisation to Grade B category as long as sufficient aeration can be provided.

The digesters achieve lower nutrient levels in the low season as a result of the longer sludge age for digestion. The ammonia-N and phosphorus concentrations in the digester liquor are typically 8 to 48 mgN/L and 42 mgP/L respectively during the low season. During peak season the ammonia-N and phosphorus concentrations in the digester liquor are typically 55 to 100 mgN/L and up to 180 mgP/L respectively. This would indicate that the digesters require more aeration during the peak season and therefore there is justification for additional blower capacity. Therefore, it is recommended that one of the existing Digester 2 15 kW blowers be upgraded to a 30 kW blower similar to the unit installed for Digester 1.

2.6. Belt Filter Press (BFP)

BFP operation is manually initiated by the operator at the BFP switchboard. At present there is no SCADA control for BFP operations. As part of the BFP upgrade, Council requires that the new system be integrated with the existing SCADA system on site as part of a new electrical switchboard upgrade.

The existing BFP is a 1.75m wide Tema unit and has been in services for 17 years. The current BFP typical operation is 4 to 5 days per week for approx. 7 hours per day in peak season and 1 to 2 days per week for a total of 14 hours per week during the low season.

The feed rate to the BFP is approx. 2.7 L/s at an average of 1.9% solids.

The existing polymer make-up and dosing system is manual. Powdered polymer is used and is batched in a 5,000 L tank. The solution strength is made up to 0.25%. Dilution water at a rate of 10:1 is also injected into the polymer prior to mixing with the feed sludge through the flocculator which is ahead of the BFP. The typical polymer dosing rate is 6.5 L/min, which is equivalent to approx. 5.3 kg poly/tonne ds feed. This is considered appropriate and typical of polymer usage for sludge dewatering on BFPs.

Dewatered sludge cake is conveyed via two conveyors (1 No. 2.2m horizontal transverse conveyor and 1 No. 12m inclined (20°) conveyor) into a covered sludge bunker. The bunker can store a maximum of 35 to 40 tonnes (m³) of wet sludge, which represents about 3 to 4 days storage during peak season.

The BFP washwater pump (Lowara) capacity is 11 L/s @ 70m head (11 kW). The pump is used to provide washwater for the GDD as well, when it operates intermittently during sludge wasting. Considering that the BFP sludge feed rate is 2.7 L/s typically, a washwater rate of 11 L/s is considered very high.

During BFP operation the total filtrate flow rate can be 10 to 14 L/s, depending on the wash water rate.

2.7. Polymer Dosing System

The existing polymer dosing system is a manual batching operation using powdered polymer product. The same polymer for GDD and BFP duty is used. The polymer is batched at 0.25% solution. There are 3 No. polymer dosing pumps, one for GDD duty, one for BFP duty and one for standby for either GDD or BFP.

As part of the upgrade of the BFP, Council wishes to explore the option of a separate dedicated polymer dosing system for the GDD so as to allow it to use an alternative polymer that may provide better sludge thickening performance.

Council operators are happy with the manual batching of polymer. Automatic batching systems are available, but rely on the polymer catching unit being enclosed within a building with humidity control. The building works would add significantly to this option and was deemed not to be cost-effective.

2.8. Filtrate Return Pump Station

The existing filtrate return pump station is used to return BFP filtrate and sludge from the Equalisation Basin (EB) to the head of the SBR tanks. However, due to pump and return pipe size limitations, during peak season the sludge pumping from the EB needs to be limited. This then results in build-up of solids in the EB and greater solids load to the Tertiary Filters.

The existing filtrate return pumps capacity is 15 L/s at 11m head.

The capacity of the EB sludge pump (Gorman-Rupp model 12B20-B) is approx. 5 L/s (at 6m head). Hence, when both the BFP and EB sludge pump operate, the combined flow can be approx. 15 to 19 L/s. This exceeds the capacity of the filtrate return pumps, which have a nominal capacity of 15 L/s, but typically operate at 10 to 13 L/s because of flow restriction due to reduced size of the filtrate return pipe. The filtrate return pipe size is 200mm dia from the filtrate pump station up to near the saline plant tank. The pipe size then reduces to between 90 and 100mm.

The operators need to manage EB sludge pumping times when the BFP is not operating so as not to overload the filtrate pump station. This becomes particularly challenging during peak season periods because the BFP is operated for longer times.

Note that Council has at times used the site washwater supply pump (Grundfos), which has a capacity of 4.7 L/s @ 67m head (5.5 kW). This pump provides sufficient washwater for BFP operation, but it is insufficient for additional GDD wash water duty. However, this lower washwater rate is considered more appropriate for BFP duty and would reduce the required filtrate return pump duty (estimated as 11 to 13 L/s) and would allow the EB sludge pump to operate without restriction. This would also result in overall reduced volume of washwater having to be re-processed through the SBR.

It is recommended that the configuration of the washwater pumps be changed so that the Grundfos pump (4.7 L/s duty) be used for BFP duty and the Lowara pump (11 L/s duty) be used for GDD and other site washwater duty.

The filtrate pumps also need to be upgraded to 20 L/s capacity (@ 12m head).

3. Sludge Dewatering Specifications

This section provides the technical specifications for the upgrade of the sludge dewatering system.

1. Provision of a new Belt Filter Press (BFP) or Centrifuge for sludge dewatering. All structural components and wetted parts to be 316SS.
2. New access walkways for the new BFP or centrifuge.
3. Sludge maximum flow rate: 4 L/s (allowance for increased sludge production in future).
4. Sludge solids concentration: 1.8 to 2.1 % solids.
5. Required solids cake: > 14% solids.
6. Required solids capture: > 95%.
7. Polymer system: manual make-up system, with optional automatic batching system. System to have 5,000 L batching tank.
8. Separate polymer dosing system for GDD dosing, with 1,000 L batching tank.
9. New polymer dosing pumps for GDD and BFP or Centrifuge duty.
10. New air compressor as part of BFP upgrade.
11. New sludge cake conveyors.
12. New switchboard for dewatering system. The new switchboard also needs to integrate the filtrate return pump station pumps and controls, the EB sludge pump and the EB sludge scraper/bridge drive.
13. Re-location of the switchboard and polymer make-up and dosing system to a "dry" area on the concrete slab adjacent to the sludge dewatering shed. This will require a new building structure as an extension to the existing shed and provision for bunding and drainage connection into the existing system.

The proposed sequence of works for upgrading of the BFP is as follows:

It is recommended that the upgrade works be undertaken in low season, when the sludge production from the plant is at its lowest. Both aerobic digesters would be emptied just prior to the upgrade by running the BFP at maximum rate for 2 to 3 weeks. This would then provide a window of 3 weeks with no BFP operation required. Council also has the contingency to cart digested sludge to the Mossman WWTP sludge lagoon if required.

4. Alternative Sludge Handling Options

The two options considered for sludge dewatering are as follows:

- Option 1: Belt Filter Press (BFP), as per existing capacity, but ensuring 316 SS structural elements that are wetted parts; and
- Option 2: High speed Centrifuge, which while higher in capital cost will provide drier sludge cake thus reducing the on-going off-site transport costs.

These options are assessed in the following sections.

4.1. Option 1 – Belt Filter Press (BFP)

The existing BFP is a 1.75m wide belt manufactured by Tema. The BFP has sufficient capacity to process the current quantity of digested sludge.

Council would require a similar replacement unit with the similar duty. The BFP unit would be made of 316 stainless steel rather than painted galvanized steel so as to give it greater durability in the marine environment.

Currently the dewatered sludge cake ranges from 13.5 to 14 % dry solids. This is typical for aerobically digested sludge. The option of installing a GDD with BFP was explored to see whether additional dewatering benefit could be afforded. After discussions with BFP suppliers and operators from other plants, the conclusion was that having a GDD/BFP would not afford any greater dewatering capability at Port Douglas WWTP, because for this type of sludge, the plant is already operating at its maximum dewaterability. The GDD would only be of benefit if the current BFP was hydraulically limited. This is not the case. Hence it is recommended that Council upgrade with just a BFP.

It is recommended that the new BFP have a belt width of 2.0m. This is an increase of 14% over the current unit and provides increased dewatering capacity for future as well as the option of operating at lower feed rate with enhanced dewatering.

The estimated capital cost of a new 2.0m wide BFP installation is approx. \$725,400, excl. GST, but inclusive of 20% contingency (see Appendix A for cost breakdown). This includes all new conveyors, access walkway and platform, air compressor, modifications to the BFP shed to create a “dry” area for installation of the new switchboard and new polymer make-up and dosing systems, installation of new filtrate return pumps and installation of new 30 kW blower for Aerobic Digester duty. It also includes integration of the BFP control system with the main site SCADA.

The operating cost of the installation would be similar to the current cost which includes power (1.5 kW for BFP, 0.75 kW for conveyors, 11 kW for washwater pump and 0.5 kW for poly pumps and 1.6 kW for air compressor, for a total of 15.4 kW), polymer (5.3 kg poly/tds) and offsite sludge disposal (\$76.80/tonne wet). The operating cost breakdown is as follows:

- Offsite transport and disposal of sludge = 1600 wet tonnes/year X \$76.80/wet tonne = \$122,880/year;
- Power cost = 15.4 kW X 1250 hours/year X \$0.20/kWh = \$3,850/year;
- Polymer cost = 5.3 kg poly/tds X 223 tds/year X \$5.76/kg = \$6,808/year;
- Total operating cost (not including labour and maintenance) = \$133,500.

4.2. Option 2 – Centrifuge

The alternative to the BFP is a high speed centrifuge. The main advantage of the centrifuge is the ability to dewater the sludge to a higher cake solids content of 16 to 18%, typically 16.5% dry solids for aerobically digested sludge. This results in reduced quantity of sludge requiring offsite transport and thus reduced transport and disposal cost. The overall annual tonnage of wet sludge requiring offsite disposal would drop to 1350 wet tonnes/year at 16.5% dry solids.

The disadvantages of operation of a centrifuge in comparison to a BFP is a higher power consumption and higher polymer usage (due to the higher shearing forces that the sludge is exposed to in the centrifuge). The start-up current is quite high with a full load power demand on start-up of 45 kW. Once the power consumption once the centrifuge is normal operation is approx. 20 kW.

The proposed centrifuge is a 304SS horizontal solids wall unit. New concrete pedestals would be required for the installation of the centrifuge within the existing BFP shed.

The estimated capital cost of a new Centrifuge installation is approx. \$801,000, excl. GST, but inclusive of 20 contingency (see Appendix B for cost breakdown). This includes all new conveyors, access walkway and platform, new pedestals for the centrifuge mounting and installation of new filtrate return pumps and installation of new 30 kW blower for Aerobic Digester duty. It also includes integration of the BFP control system with the main site SCADA. There is no need to modify the BFP shed to create a “dry” area for installation of the new switchboard and new polymer make-up and dosing systems as the centrifuge is a “dry” operation compared to a BFP.

The operating cost of the centrifuge installation would include power (20 kW for Centrifuge during normal running, 0.75 kW for conveyors, 11 kW for washwater pump and 0.5 kW for poly pumps for a total of 32.3 kW), polymer (10 kg poly/tds) and offsite sludge disposal (\$76.80/tonne wet). The operating cost breakdown is as follows:

- Offsite transport and disposal of sludge = 1350 wet tonnes/year X \$76.80/wet tonne = \$103,680/year;
- Power cost = 32.3 kW X 1250 hours/year X \$0.20/kWh = \$8,075/year;
- Polymer cost = 10 kg poly/tds X 223 tds/year X \$5.76/kg = \$12,845/year;
- Total operating cost (not including labour and maintenance) = \$124,600.

4.3. Comparison of BFP vs Centrifuge

The following table provides a comparison of BFP versus Centrifuge.

Parameter	BFP	Centrifuge
Capital cost of installation (excl. GST, plus 20% contingency)	\$725,400	\$801,000
Operating cost (power, polymer and sludge transport costs only):	\$133,500	\$124,600
Capital payback period:	-	9 years, minimum
Maintenance:	Council has 20+ years experience with BFP operations and	Council has no experience with centrifuge. No local support services. Heavy

	maintenance. Local support available. Annual change of belts.	maintenance would require sending centrifuge offsite for servicing, which is not an option.
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On the basis of the above analysis, we would recommend that Council upgrade the sludge dewatering system with a BFP system.

4.4. Digester 2 Aeration Blower Upgrade

As discussed, during peak season the aerobic digesters struggle to provide sufficient aeration, particularly in Digester 2. This is evidenced by higher ammonia-N and phosphorus release during sludge digestion compared to low season operation.

It is recommended that one of the existing 15 kW blower be upgraded with a 30 kW blower similar to the unit that was installed on Digester 1. The second 15 kW blower should be retained as a standby unit.

The capital cost of a new 30 kW blower has been included in the overall sludge dewatering cost estimates above for the belt filter press and centrifuge options. The additional blower is necessary for optimal sludge conditioning prior to any of the dewatering options. The cost estimate is inclusive of blower and motor supply, acoustic enclosure, delivery and mechanical and electrical installation.

5. Conclusions & Recommendations

The following conclusions are made in relation to sludge management upgrade at the Port Douglas WWTP.

1. The existing Belt Filter Press (BFP) sludge dewatering unit requires upgrading due to age and significant corrosion of structural elements. The unit is 17 years old and has a limited maximum life of another 2 years approx.
2. Options for upgrading the BFP unit including replacement with another BFP unit and replacement with a high speed centrifuge. Both types of units are typically used for sludge dewatering in the water industry in Australia.
3. The estimated capital cost of a new 2.0m wide BFP installation is approx. \$720,500, excl. GST, but inclusive of 25% contingency. This includes all new conveyors, access walkway and platform, air compressor, modifications to the BFP shed to create a "dry" area for installation of the new switchboard and new polymer make-up and dosing systems, installation of new filtrate return pumps and installation of new 30 kW blower for Aerobic Digester duty. It also includes integration of the BFP control system with the main site SCADA.
4. The operating cost of the new BFP system (not including labour and maintenance) for a new BFP is estimated as \$133,500, of which 92% is for sludge transport.
5. The estimated capital cost of a new Centrifuge installation is approx. \$798,800, excl. GST, but inclusive of 25% contingency.
6. The operating cost (not including labour and maintenance) for a centrifuge is estimated as \$124,600. While there was a significant reduction in wet sludge produced due to higher dry solids cake produced by a centrifuge (16.5%) compared to a BFP (14%), the centrifuge has a higher power cost.
7. The current BFP washwater pump (Lowara) has a capacity of 11 L/s which is considered excessive and results in high volumes of filtrate return. The lower capacity (4.7 L/s) Grundfos pump should be used for BFP duty.
8. Aerobic Digester 2 has limited aeration capacity during the peak season. The capital cost of a new 30 kW blower is estimated as \$32,000 (excl. GST), inclusive of blower and motor supply, acoustic enclosure, delivery and mechanical and electrical installation.

The following recommendations are made for the upgrade of the sludge handling system:

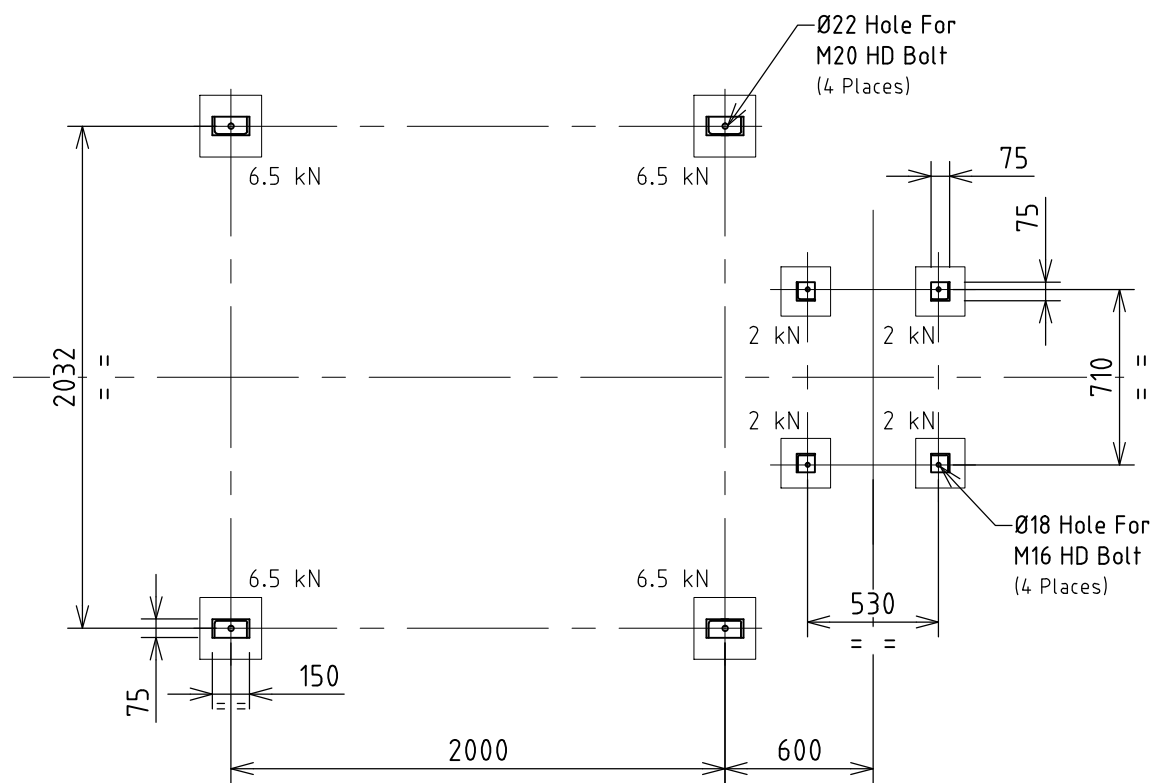
1. Council install a new BFP system with a 2.0m wide belt at a budget capital cost of \$720,500 (excl. GST). This works is inclusive of all new conveyors, access walkway and platform, air compressor, modifications to the BFP shed to create a "dry" area for installation of the new switchboard and new polymer make-up and dosing systems. installation of new filtrate return pumps and installation of new 30 kW blower for Aerobic Digester duty. It also includes integration of the BFP control system with the main site SCADA.
2. Council use the Grundfos washwater pump for BFP duty and the Lowara pump for GDD and other site washwater duty.

Appendix A – Belt Filter Press Cost Estimate

Port Douglas WWTP - Sludge Dewatering System Upgrade Works - Cost Estimate
Option 1 - Belt Filter Press
SUMMARY ESTIMATE SHEET

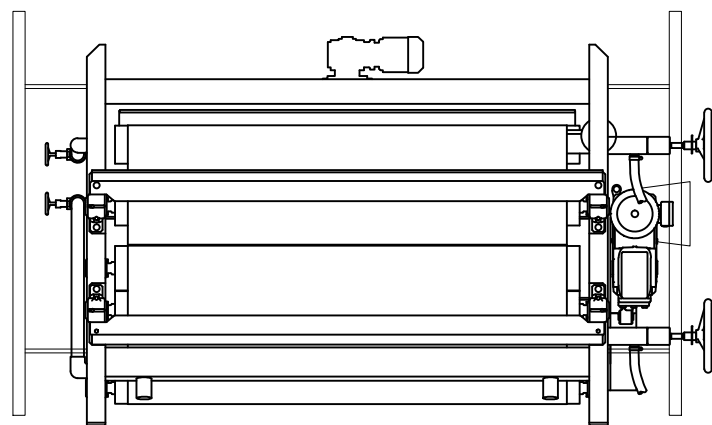
NOTE : ALL COSTS ARE EXCLUSIVE OF TAX

	Budget Cost February 2017		Comments
	Totals		
1 New Belt Filter Press			
<i>Mechanical</i>			
1 No. BFP (2.0m wide)	\$171,525		Budget price provided by Tema, Magytec
1 No. Air compressor	\$3,431		
1 No. 2.2m X 450mm conveyor	\$28,588		
1 No. 12.0m X 450mm wide inclined conveyor	\$51,458		
1 No. Polymer make-up unit for BFP (manual)	\$18,868		
2 No. poly dosing pumps for BFP (with VSD)	\$10,292		
1 No. Polymer make-up unit for GDD (manual)	\$18,868		
1 No. poly dosing pump for GDD (with VSD)	\$5,146		
2 No. Filtrate return pumps (20 L/s, 12m head)	\$7,318		
1 No. 30 kW Blowers for Aerobic Digester duty Valves	\$36,592		
Mechanical installation	\$3,659		
	\$28,588		
	Mechanical total:	\$384,330	
<i>Electrical & Control</i>			
New electrical switchboard	\$74,328		
Electrical installation	\$34,305		
SCADA control system intergration	\$13,722		
	Electrical & Control:	\$122,355	
<i>Civil</i>			
Painted/gal steel platform and walkway	\$28,588		
Shed extension to "dry" area, including bunding and design	\$49,171		
Drainage modifications	\$17,153		
	Civil total:	\$94,911	
	Sub-total:	\$601,595	
<i>Project Management</i>			
	Sub-total:	\$29,138	
		\$630,733	
<i>Contingency (15%)</i>			
		\$94,610	
	Total:	\$725,343	



HD BOLT PLAN

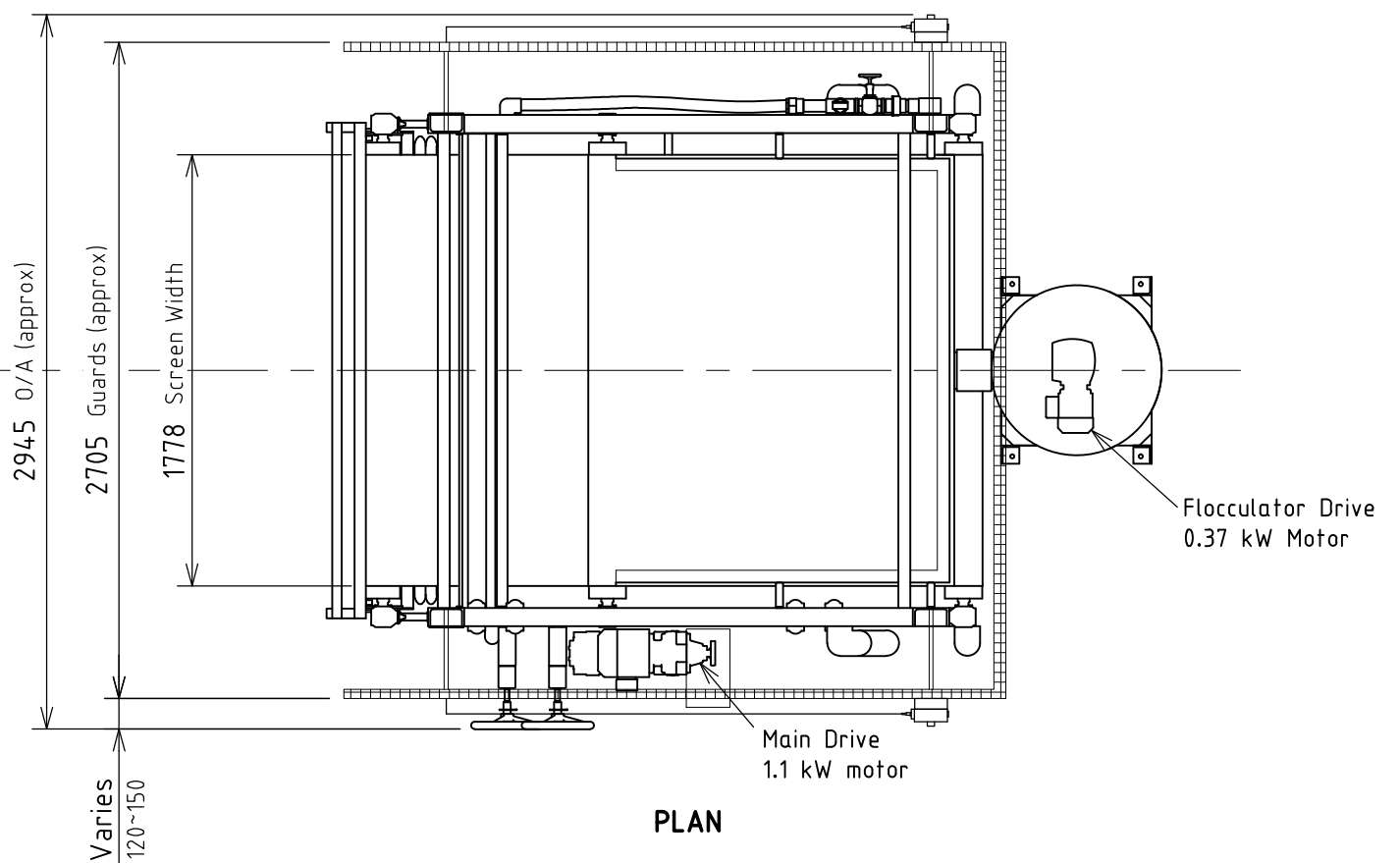
PRELIMINARY
 SUBJECT TO CHANGE PENDING FINAL DESIGN



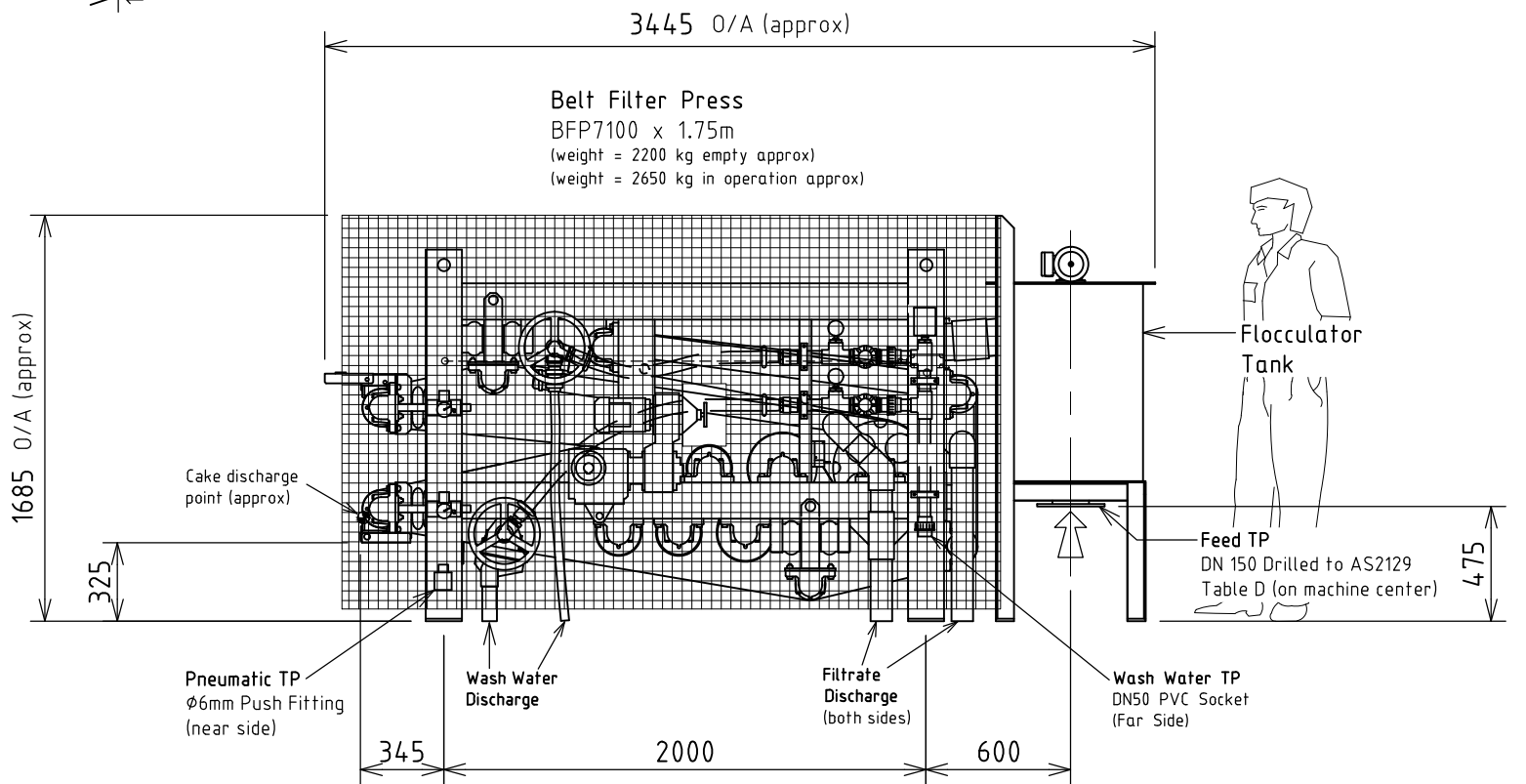
END ELEVATION

Notes:


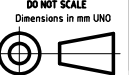
1. Foundation fasteners by others (Chemset or equivalent)
2. Electrical connections to drives and instrumentation on machine by others
3. All connecting pipework to be independently supported from client's structure



PLAN



ELEVATION

Rev	Description	By	Date	Name	Date	TEMA ENGINEERS PTY LTD ABN 31 004 478 826 MINERAL PROCESSING / WATER & WASTEWATER SYSTEMS 	Title	General Arrangement								
				Drawn	GR		23/09/13	Equip	BFP Series 7100 x 1.75m							
				Checked	AR		23/09/13	Drg No	3-4620	Sheet	1/1	Revision	0	Scale	U.N.O. 1:30	Size
				Job No	Sales		THIS DRAWING IS CONFIDENTIAL AND IS THE PROPERTY OF TEMA ENGINEERS PTY. LTD. IT MUST NOT BE DISCLOSED TO A THIRD PARTY, LENT OR COPIED WITHOUT THE WRITTEN CONSENT OF TEMA ENGINEERS PTY. LTD. Ordinary Council Meeting - 28 March 2017		 DO NOT SCALE Dimensions in mm UNO							



SERIES 7100/7500/7600 BELT FILTER PRESSES



Design

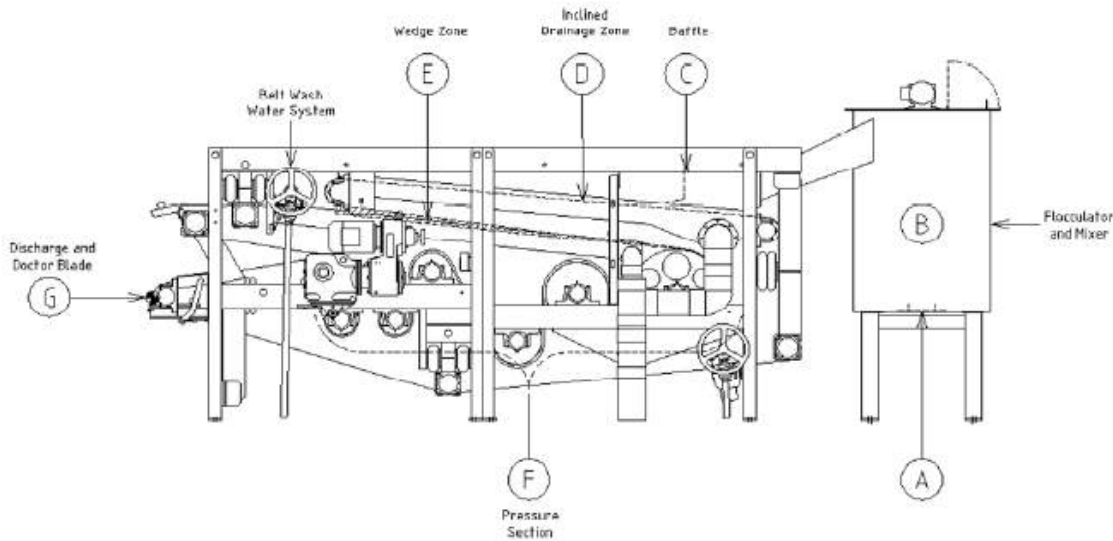


Manufacture



Assembly





HOW IT WORKS

- A. Sludge mixed with polymer is introduced.
- B. The mixture gradually rises where the polymer and sludge separate.
- C. Mixture is evenly and gently spread across belt width by the levelling baffle.
- D. The mixture "pools" and then is conveyed upward during which time free water drains through the belt. The thickening process can be aided by the use of ploughs.
- E. Thickened sludge is trapped between the two screens and gradually subjected to increasing pressure.
- F. Shearing and compression occurs as the sludge travels around rolls of decreasing diameter due to the forces exerted by the independent pneumatic tensioning of both belts.
- G. The dewatered sludge is discharged away from the belts which is then doctored and washed before returning to accept more sludge.

APPLICATION DATA

<i>Series 7000-7500</i> Municipal & Industrial sludges			<i>Series 7600</i> Industrial & mineral processing		
Available Width	0.5 – 2.5	m	Available Width	2.0 - 3.0	m
Flow rate	2.0 – 32.0	m ³ /h	Flow rate	15 - 30	m ³ /h
Dry Solids Load	40 – 800	kg/h	Dry Solids Load	400 – 30,000	kg/h
Feed Solids	0.8 – 5.0	% w/w solids	Feed Solids	5.0 – 50	% w/w solids

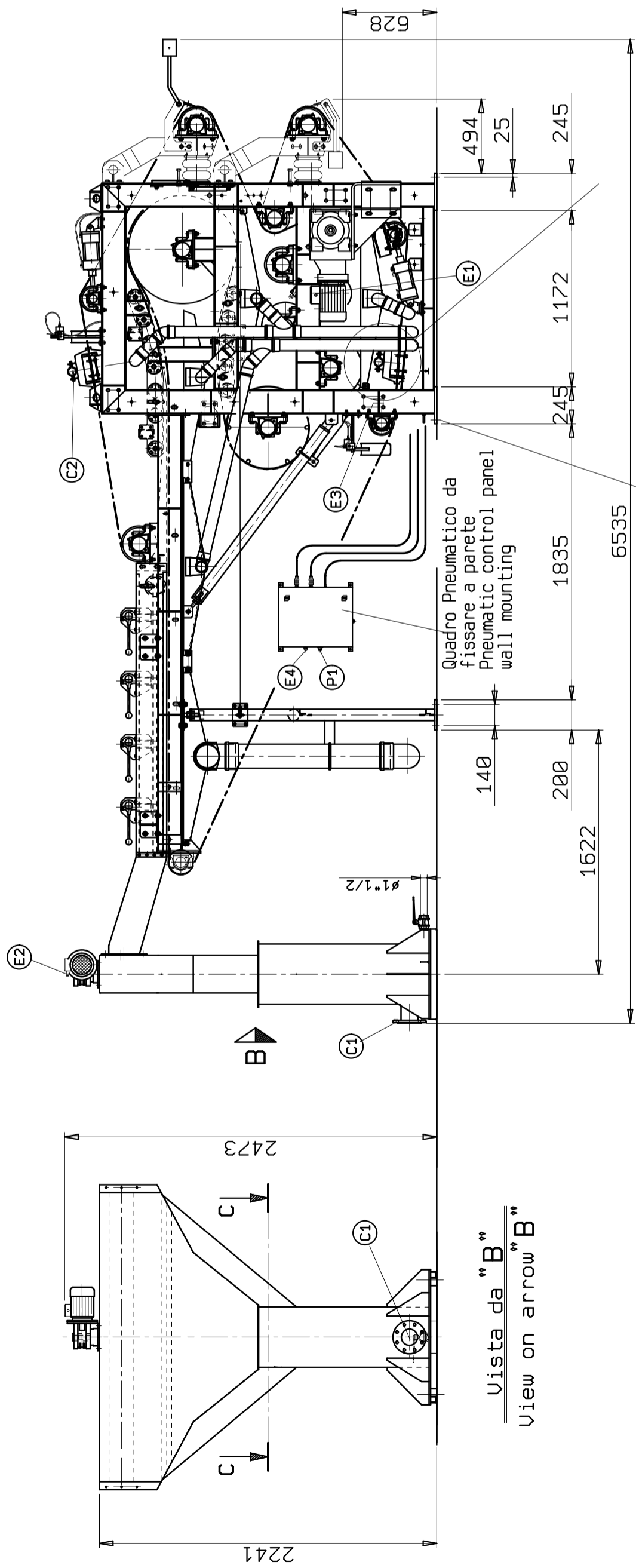
SLUDGE TYPES

- Sinter
- Coal tailings
- Sand / clay / mud
- Municipal sewage sludges
- Abattoir / rendering /tannery
- Drilling/Tunnelling
- Other mineral processing
- Paper Industry
- Various industrial sludges

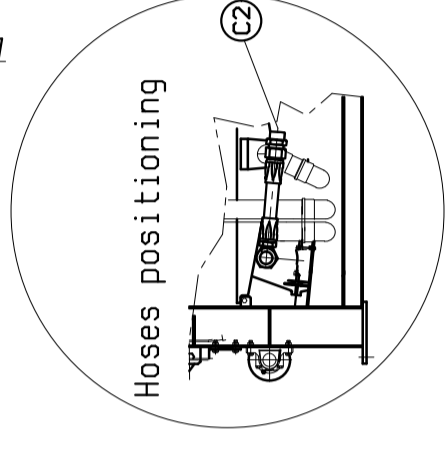


Dimensioni in millimetri
All dimensions are millimeter.

Nota: Tutte le tubazioni devono essere supportate
Nessun carico deve gravare sulle tubazioni
della macchina.
Note: All piping must be supported. No loads
allowed on the flanges or pipes of the machine.

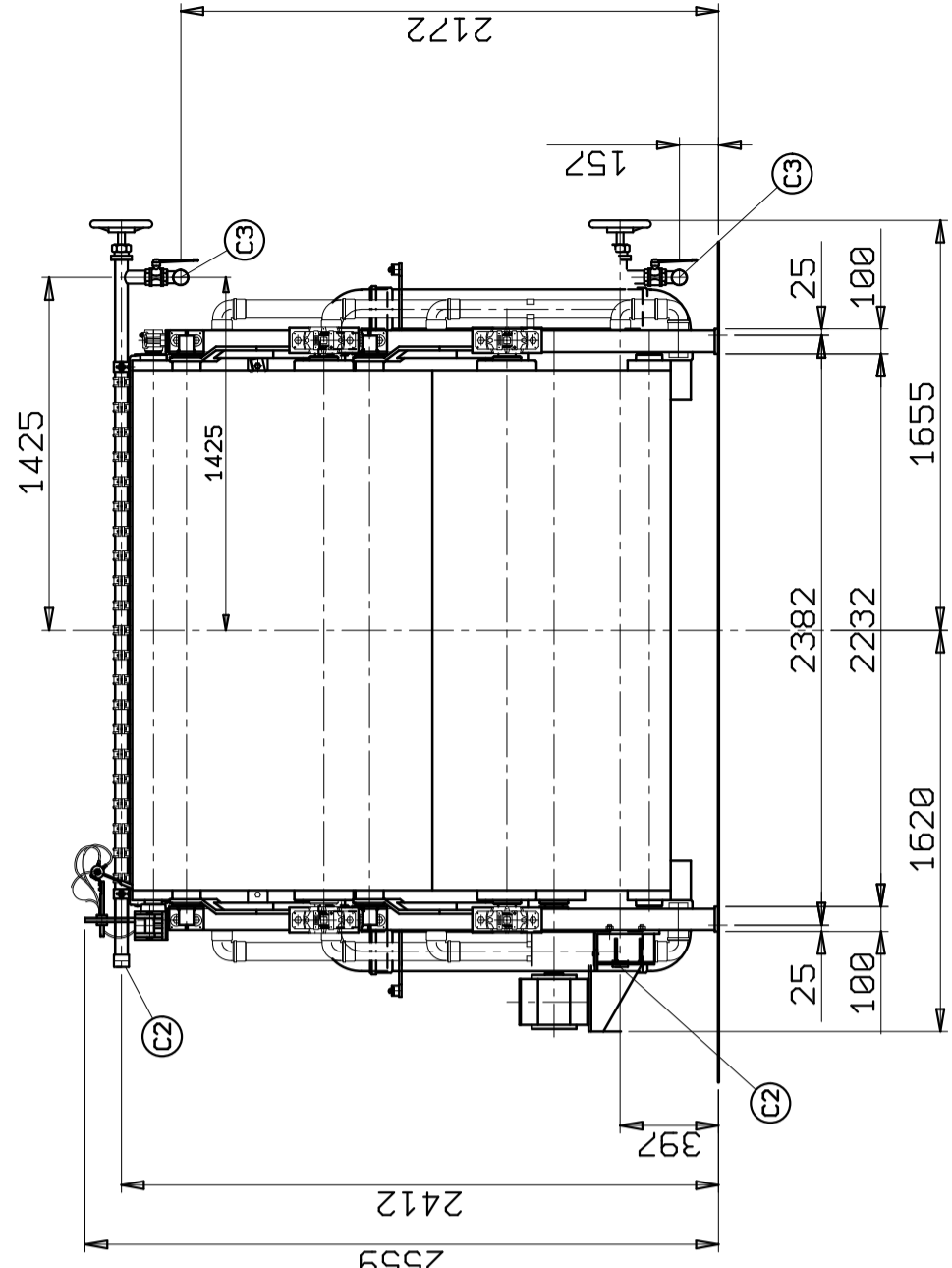


Vista da "B"
View on arrow "B"

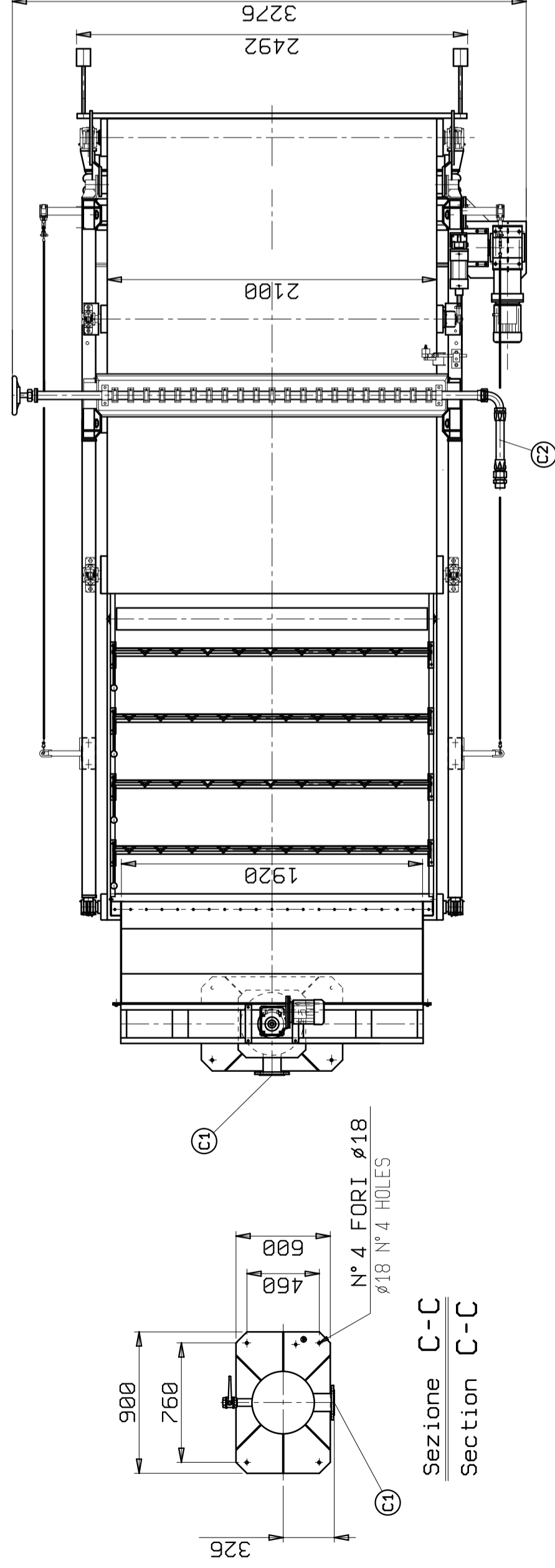


Hoses positioning

Vista da "A"
View on arrow "A"



PRELIMINARY FOR APPROVAL



Sezione C-C
Section C-C

Peso macchina: A vuoto Kg.7600 - In funzione: Kg.8600
Machine weight: Dry Kg.7600 - Operating: Kg.8600
Peso mixer: A vuoto Kg.310 - In funzione: Kg.700
Head box weight: Dry Kg.310 - Operating: Kg.700
Dimensioni teli: Superiore 2100x14000 - Inferiore 2100x18350
Belts dimensions: Upper 2100x14000 - Lower 2100x18350
Velocita' teli / Belts speed: 2.5 - 7.5 m/min. (20-60 Hz. by VFD not supplied)
Giri alb. mixer / Shaft mixer speed: 56 - 220 rpm (20-80Hz by VFD not supplied)
Pressione acqua-aria / Water-air supply pressure: 6 Bar
Consumo acqua / Wash water consumption: m³/h.17.5 Consumo aria / Air consumption:Nm³/h.7

Motore elettrico telai: 2.2 Kw. Belts drive electric motor:2.2 Kw.	Pressac.PG / Cable gland PG	1	E1
ME miscel./Belts drive mixer:0.75 Kw.	Pressac.PG / Cable gland PG	1	E2
Morsett.aux / aux contacts j.box	Pressac.3/4" / Cable gland 3/4"	1	E3
Morsett.aux / pressure switch termin.	Pressac.1/2" / Cable gland 1/2"	1	E4
Ingresso aria/Air inlet supply	ø1/4" gas F / D 1/4" F.BSP	1	P1
Scar. acqua lav./Belts wash water disch.	ø 2" gas F./ Dia. 2" F. BSP	2	C3
Ingr. acqua lav./Belts wash water inlet	ø 2" gas M./ Dia. 2" M. BSP	2	C2
Ingresso prodotto/Product inlet	Flangia/Flange 100NB NP10 UNI2277	1	C1
DESCRIZIONE/DESCRIPTION			
CONNESSIONI/CONNECTION			
CONNESSIONE / TITLE			
DESIGNER	DATE		
BALLADORE	12/1/10		
CHECKED	DATE		
APPROVED	DATE		
SCALE / SCALE	FORMATO / SHEET SIZE		
1:30	A3		
FILE:	REV	QTY	SHEET
	60408941	-	1 of 1
ASSIEME MACCHINA DESTRA/RIGHT HAND ASSEMBLY			
MACCHINA TIPO / MACHINE TYPE			
BPF OPTIMA 2000 SH H1 L M S9			
SIEMENS			
SIEMENS S.P.A. I-15-UT-Cod. VIA TORINO 114 - 20145 GATECRO (MI)-ITALY TELEPHONE +39028886711 - TELEFAX +39028886722 e-mail : sermagiocto.water@siemens.com			

Appendix B – Centrifuge Cost Estimate

Port Douglas WWTP - Sludge Dewatering System Upgrade Works - Cost Estimate
Option 2 - Centrifuge
SUMMARY ESTIMATE SHEET

NOTE : ALL COSTS ARE EXCLUSIVE OF TAX

	Budget Cost February 2017		Comments
	Sub-total	Totals	
1 New Centrifuge			
<i>Mechanical</i>			
1 No. Centrifuge (UCF 466 unit)	\$220,000		Budget price provided by GEA Westphalia
1 No. 2.2m X 450mm conveyor	\$25,000		
1 No. 12.0m X 450mm wide inclined conveyor	\$45,000		
1 No. Polymer make-up unit for Centrifuge (manual)	\$16,500		
2 No. poly dosing pumps for Centrifuge (with VSD)	\$9,000		
1 No. Polymer make-up unit for GDD (manual)	\$16,500		
1 No. poly dosing pump for GDD (with VSD)	\$4,500		
2 No. Filtrate pumps (20 L/s, 12m head)	\$6,400		
1 No. 30 kW Blowers for Aerobic Digester duty	\$32,000		
Valves	\$3,200		
Mechanical installation	\$25,000		
	Mechanical total:	\$403,100	
<i>Electrical & Control</i>			
New electrical switchboard	\$85,000		
Electrical installation	\$30,000		
SCADA control system intergration	\$12,000		
	Electrical & Control:	\$127,000	
<i>Civil</i>			
Footings for Centrifuge installation	\$12,000		
Painted/gal steel platform and walkway	\$25,000		
Shed extension to "dry" area, including bunding	-		Shed extension not required due to drier operation than BFP
Drainage modifications	\$5,000		
	Civil total:	\$42,000	
	Sub-total:	\$572,100	
Contractor Profit and Overhead (12%)		\$68,652	
Design and Project Management (8%)		\$45,768	
	Sub-total:	\$686,520	
Contingency (20%)		\$114,420	
	Total:	\$800,940	

Decanter UCF 465 / 466 – The New Class of Efficiency

Technical Data | Dewatering requirements of industrial and municipal waste water sludge



The decanter UCF 465/466 from GEA Westfalia Separator Group is a continuously operating horizontal solid wall centrifuge for dewatering requirements of industrial and municipal waste water sludge. The frame is of open design with gravity discharge of the clarified phase.

Features

- All parts coming into contact with the product are made of CrNiMo stainless steel
- Standard motor
- Lowest power consumption of <math>< 0.9 \text{ kW/m}^3</math>

- Highest g-force for min 2% DS higher solids output compared to conventional decanters
- Adjustable bowl speed via VFD
- Automatic adjustment of differential speed via VFD
- In-line secondary motor
- Belts for main drive motor only
- Lightweight version

Advantages

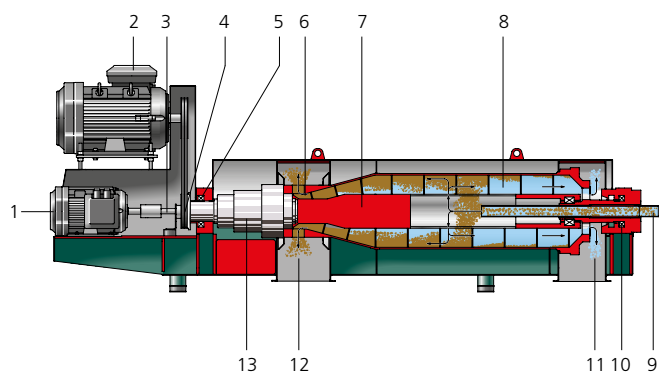
- Easy installation
- Easy operation and maintenance
- Low space requirement (easy retrofitting)

Additional equipment (at extra cost)

- Control unit for automatic operation
- Tools
- Bearing temperature monitoring
- Vibration control
- Automatic grease lubrication
- Set of spare parts
- Liquid and solids chutes
- Solids gate valve

Technical Data UCF 465 / 466

Operating principles and constructional features

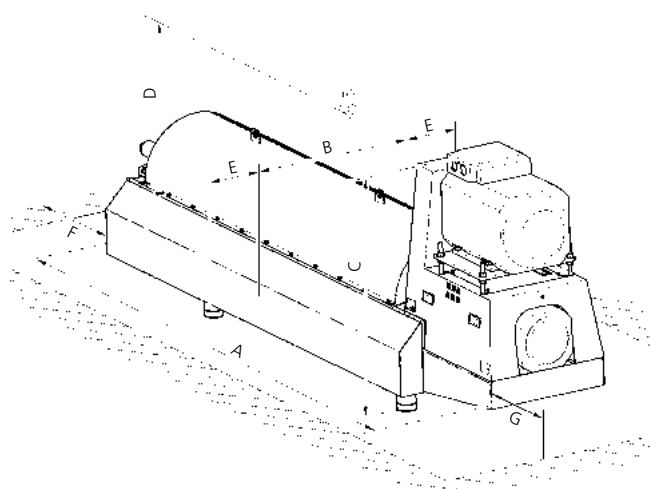


- 1 Secondary motor
- 2 Main motor
- 3 Scroll drive
- 4 Bowl drive
- 5 Bowl bearing
- 6 Bowl
- 7 Scroll
- 8 Separation chamber
- 9 Feed
- 10 Main bearing
- 11 Free discharge of the clarified liquid
- 12 Free solids discharge
- 13 Gear

Technical Data	
Total weight	3300 kg (7275 lb)
Max. bowl speed / operating bowl speed	3850/3500 min ⁻¹
Length / diameter ratio	4
Max. g-force	3811 g

Component	Standard	Option
Bowl and scroll	Stainless steel CrNiMo	—
Liquid outlet	Open, by gravity	—
Flight hard-facing	Tungsten carbide	—
Solids outlet ports	Exchangeable on site	—
Seals, inner bearings	NBR (Perbunan)	P.T.F.E /Viton
Back drive	2-gear drive 11 kW motor	—
Main drive	30 kW to 45 kW with frequency converter	—

Dimensions in mm (inch)



A	B	C	D
3670 (144)	1000 (39)	1445 (57)	> 1430 (> 56)
E	F	G	
> 500 (> 20)	> 1000 (> 39)	> 700 (> 28)	

GEA Mechanical Equipment

GEA Westfalia Separator Group GmbH

Werner-Habig-Straße 1, 59302 Oelde, Germany
 Phone: +49 2522 77-0, Fax: +49 2522 77-2950
www.gea.com

BFP filtrate return line proposed modifications

Attachment 5.9.1

21/03/17 3:18

