Woodland Park green business case - refer to section 6.4

6.2.9 Miscellaneous Plant Items

Other miscellaneous improvements to be included in final design are as follows:
- Relocate plant non-potable water intake
- Evaluate compressed air needs
- Evaluate additional laboratory equipment and testing needs
- Add four parking spaces on the east side of the facility.

(6.3) Environmental Review of Selected Alternative

Please see Appendix A the completed Environmental Checklist related to the selected alternative. Proposed plant expansion will take place inside the existing fenced treatment plant site perimeter in previously disturbed areas. The only noted exception is the relocation of the road behind the proposed additional aeration basin, and this will still be located inside the existing fenced perimeter.

(6.4) Green Project Reserve

The proposed wastewater treatment plant expansion contains several components that are eligible for Green Project Reserve Funds. Those project components are summarized in the table below:

Component	Category	Section	Description	Business Case
#1	Water Efficiency		Installation of tertiary treatment of wastewater effluent to replace irrigation of golf course with reclaimed WWTP effluent	Categorical
#2	Environmentally Innovative		Dewatering Rotational/Press Type	Business Case

Component #1, installation of tertiary treatment is categorically approved as eligible for Green Project Reserve funding based on Section 2.2-6 of EPA 'Attachment 2 - 2012 Clean Water State Revolving Fund 10% Green Project Reserve: Guidance for Determining Project Eligibility'. The entire cost of the proposed tertiary treatment is eligible as a water re-use project that replaces another source; in this case the re-use water will be used for irrigation of the neighboring golf course vs. use of a potable water source. The proposed tertiary treatment is further supported in 2.2-6a, where wastewater effluent reuse systems are specifically mentioned. The eligible cost of tertiary treatment is $1,255,841.

Component #2, the proposed rotational, low power dewatering press, is supported as an Environmentally Innovative technology in a business case presented in Appendix V to this PER. The above-referenced Green Project Reserve Guidance Document supports application of a business case to the rotational, low power dewatering press technology in Section 4.4-1b, describing a 'Technology or approach that is not widely used in the State, but does perform as well or better than conventional technology/approaches at lower cost'. As stated in the Section 6.2.7, final equipment choices will be determined during final design, but are referred to as 'rotational, low power dewatering press' technologies in this report. The final technology choice may be of a more standard screw press design, or may be more of a rotary fan press design; both of these equipment options are innovative and 'cutting edge' in the State of Colorado. The business case is presented based on the most conservative estimates between the actual equipment technologies.

Green Project Reserve Funding Requirements require that 20% of the total project capital cost can be supported as 'Green'. The following table presents total estimated project cost, along with the Green Project Reserve Components as a percentage of the total.

Total Project Capital Cost	→	**$8,075,175**
Component	***Cost of Component***	***% of Total Cost***
#1 - Tertiary	$1,255,841	15.6%
#2 - Dewatering Technology	$ 910,159	11.3%
Total Green Cost %	→	26.9%

As demonstrated, over 20% of the total project cost can be attributed to Green Project Reserve Funding, making the first $2 million of the SRF loan eligible for a 0% interest rate.

APPENDIX V

Green Project Reserve
Rotational, Low Power Dewatering Press
Environmentally Innovative Business Case

According to the EPA Green Project Reserve Guidance Document, an environmentally innovative technology or approach that is not widely used in the State, but performs as well or better than a more conventional technology at a lower cost, may be supported by a business case (Section 4.41-b). Rotational, low power dewatering presses (either screw presses or rotary fan presses) are a relatively new technology in Colorado.

The Woodland Park Wastewater Treatment Facility currently dewaters via a belt filter press. The proposed use of a rotational, low power dewatering press as part of the Woodland Park plant expansion will allow discontinuation of the use of the belt press. The belt press is at the end of its useful life, and is not the best technology available at this point in time. The product from the belt press is not consistent, and leads to composting and filtrate challenges. The dewatering process is more thoroughly visited in the Plant Performance Evaluation (PPE) included in Appendix U of this Preliminary Engineering Report (PER).

Belt filter press results are very dependent on the process operator, and a frequent turnover of this position has led to inconsistent results. Solids to the belt press are at approximately 1.3% - 1.5%, or 13,000- 15,000 ppm. Filtrate solids from the press back to the aeration basins range from 200 - 1500 mg/L TSS, placing a heavy solids load back through the treatment process.

A screw press pilot test was performed on a side stream of the Woodland Park facility, and that report is located in Appendix U, in its entirety. These pilot results allow for an 'apples to apples' comparison of the two processes, since both were presented with identical materials.

Side-by-side data points are presented below for the screw press and belt filter press. Future screw press results may exceed those presented below, since improved sludge holding will potentially increase the solids percentage to approximately 3% as fed to the dewatering device. Rotary fan press results are expected to be comparable to those of the screw press pilot based on available industry information.

Dewatering Unit	**Solids to unit (% as mg/L)**	**Filtrate TSS, mg/L**	**% Capture of Solids**	**Cake Solids, %**
Filter Belt Press	~1.3 % or 13,000 mg/L	200-1500 mg/L	88.5% - 98.4%	13 - 15%
Screw Press	~1.3 % or 13,000 mg/L	~600 mg/L at average solids capture %	More consistent 95.3% during pilot	16 - 20%

The rotational, low power dewatering press is a power saving option in comparison to the existing belt filter press. Continuous consumption values during operation are presented below. Only the dewatering devices themselves are included, since ancillary equipment will be similar. The two (2) proposed dewatering press units will not be run together at all times, but electric costs are presented under that 'worst case scenario'.

Power Supply	Power, hp	Power, kW	Operation Mode	Hrs/day	kWHours /day	Electric Cost /kwh	Cost per day	Work days per year	Cost per year
Rotational Dewatering Press, 2 small units @ 1.5 hp each	3	2.238	Continuous	8	17.904	$ 0.1231	$ 2.20	260	$ 573
Belt Filter Press	7.5	5.595	Continuous	8	44.76	$ 0.1231	$ 5.51	260	$ 1,433

The existing belt filter press would require replacement in the near future due to its age. The savings cost in electricity is considered a pure cost savings under this assumption, at $860/year. Additional cost savings is anticipated in reduced polymer consumption.

Pilot Test RoS3 Q280
Woodland Park WWTP, CO

Pilot Test from:	06/06 – 06/10 - 2011	
Execution of the test:	Sebastian Jürgens	Huber Technology, Inc.
Facility:	RoS3 Q280	
Project:	Woodland Park, CO WWTP	
Job number:	4914	
Attendants:	Sebastian Jürgens Frank Kaylor	Huber Technology, Inc. Goble Sampson

9735 NorthCross Center Court, Suite A, Huntersville, NC. 28078
Office (704) 949-1010 / Fax (704) 949-1020 / www.huber-technology.com

1. Pilot Unit RoS3 Q 280

Pilot testing is a useful tool in evaluating sludge and its suitability for dewatering with screw press technology. This testing allows for a full range of testing with different parameters to find the most optimal method of operation and to see what ranges of operation are achievable from maximum throughput to minimum polymer consumption.

The tests carried out provide the following:

- Most efficient set points for peak cake solids performance
- Polymer consumption rates for varying capture rates and cake solids
- Range of good or acceptable performance
- Absolute maximum throughput

The dewatering machine is a screw press with a conical shaft and cylindrical sieves. The machine is subdivided into the entering zone, the three part thickening- and dewatering zone and the pressing zone with pneumatic backpressure cone. The pilot unit is mounted on a trailer that contains all necessary matters to run the dewatering machine.

This includes:

- Screw press RoS3Q 280
- Thin sludge pump: progressive cavity pump, SEEPEX 2-10 LBN
- Polymer station: make Velodyne, inline mixing
- Flow meter for thin sludge and polymer
- Injection - and mixing devices for polymer
- Sludge polymer mixing devices: Reactor pipe (29 feet)
- Controller: Allen Bradley programming control (PLC) and operator interface

The controls are equipped with a PLC and an operator interface (HMI). The screw press can be operated fully automatically.

The most important parameters are:

- Desired volume flow rate of thin sludge and polymer in [GPM]
- Dry solids (DS) of sludge IN and OUT in [%]
- polymer consumption in [lbs poly / ton DS]
- speed of screw press in [%]

Technical Data:

- HUBER ROTAMAT®Screw Press RoS3Q280
    - Screw Drive: BAUER motor and gearbox
        - Type: BF40Z-34/D06XA4-TF/AMUL-C2-SP
        - Class I, Div 2 with 0.37 kW (0.5 HP), 460 V AC, 60 Hz ; speed motor 1680 rpm, shaft 1.4 (with 60 Hz)
          VFD controlled (12 – 120 Hz)
    - Pressure Gauge, inlet of press: make IFM
    - Wash System Solenoid Valves: Burkert type 5282 A
        - 120 V AC, 60 Hz, 2 – 10 bar (30 – 145 PSI)
    - Polymer Feed System: Velodyne
        - Model max. 1 GPH, serial: 21471 (revision: January 2009)
            - Mixing Motor: BALDOR, 90 V AC, 60 Hz
            - Polymer Dosing Pump: progressive cavity
                - Seepex, Model: serial 0505956152-7
                - max. capacity: 1.5 GPH / 50 PSI

- Flocculation System: polymer injection ring, mixing device (mounted to the feed pipe, size: 1 1/2") and pipe flocculation reactor

- Feed Pump: progressive cavity pump, make: SEEPEX (VFD controlled: max. capacity 20 GPM)

- Flow meters: ENDRESS + HAUSER (Thin Sludge and Polymer)
- Control panel for full automatic operation (manufacturer: EII) including HMI for easy change of set points

Power Supply:	Voltage / Hz	Power [kW] / [hp]	FLA [Amps]	operation mode	VFD
Feed pump	460 V / 60 Hz	4.0 / 5.0	7.5	Continuous, consumption: 3.25 kWh	Yes
Screw press	460 V / 60 Hz	0.37 / 0.5	1.1	Continuous consumption: 0.30 kWh	Yes
Polymer system	120 V / 60 Hz		9.2	Continuous Consumption: 0.83 kWh	Yes
Compressor	120 V / 60 Hz		10.5	Intermittent consumption: 0.1 kWh	No
Flow Meter, solenoid valve	120 V / 60 Hz		0.5	0.1 kWh	No

Water Supply:	requirements	Pressure	Operation mode	Demand
Polymer	Potable water/ filtered plant water	60 - 70 PSI	Continuous	Normal solid load (80 – 100 lbs DS): 1 – 1.5 GPM High solid load (120 – 200 lbs DS): 2 – 3 GPM
Wash water	Filtered plant water	min. 50 PSI	Intermittent; standard setting: every 30 minutes for one wash cycle	Water demand: 15 gallons per wash cycle (at 22.5 GPM)

Plant Address:

27601 North Hwy 67
Woodland Park, CO. 80866

Set up at Woodland Park WWTP, CO

2. Situation of the waste water treatment plant

- daily flow (design):	2 MGD design flow
- System:	aeration basins
- Sludge:	Secondary
- sludge age:	~ 3 days
- waste sludge flow:	36000 – 144000 gal/week
- solid content:	1.29 % DS average
- volatile solids:	85%
- existing solid handling system:	Belt Filter Press

3. Polymer jar test:

The first step of the pilot test is conducting tests to determine which polymers are suitable for the sludge generated at Woodland Park WWTP, CO. The jar tests were carried out using polymers as manufactured by Ashland Chemical and BASF. The products were: K260FL, K274FLX, K275FLX, K279FLX, K290FL, K290FLX and K292FLX by Ashland and ZETAG 7879 by BASF.

The tests showed that the sludge reacts very well with the ZETAG 7879, K274FLX and K279FLX polymers, although there were no significant differences observed between the three polymers at this stage.

The tests results with the other polymers were not very satisfying and it was therefore decided that these polymers will not be used during the pilot tests.

The pilot unit was installed and the following settings were tested:

1. Throughput
2. Speed of screw press auger
3. Polymer consumption
4. Concentration of polymer solution
5. Various pressures at discharge of screw press
6. Conditions at mixing valve
7. Pipe flocculator (pressure feeding of screw press only)
8. Different polymers

4. Pilot Test and Results

Testing is mainly carried out to determine the operating conditions/ranges for the Screw Press to achieve best performance. The performance is quantified by several parameters:

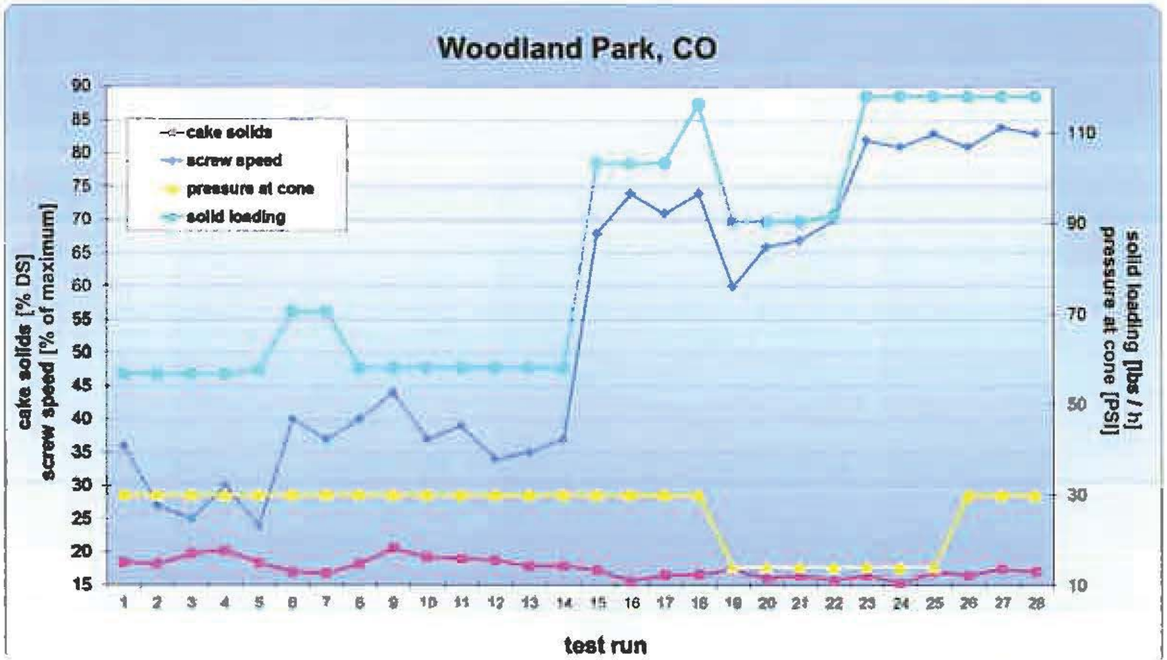
- cake solids
- polymer consumption
- capture rate
- solids / hydraulic loading
- screw speed
- solid loading
- pressure settings

The testing program is sometimes modified during test runs in case of unusual operating conditions or performance characteristics.

The test program included:

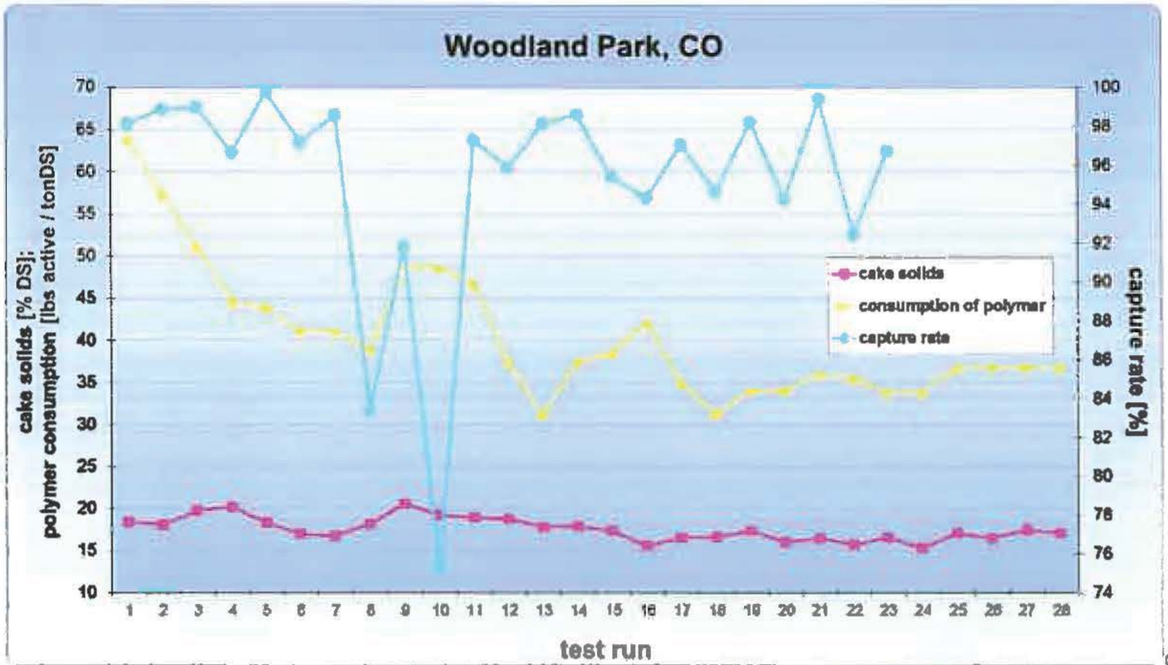
Day	Test run(s)	Polymers Used
Tuesday	1 through 7	K279 FLX
Wednesday	8 trough 10 11 trough 14	ZETAG 7879 K274 FLX
Thursday	15 through 23	K274 FLX
Friday	24 through 28	K274 FLX

The following two graphs give an overview of the main parameters and conditions the screw press was operated with:



GRAPH 1: general overview 1

The cake solids ranged between 15 % and 20 % DS depending on the polymer type, the sludge type and polymer injection/mixing energy. The polymer consumption was maintained in a range of 31 and 64 lbs / ton.



APH 2: general overview 2

Testing was conducted using the following ranges:

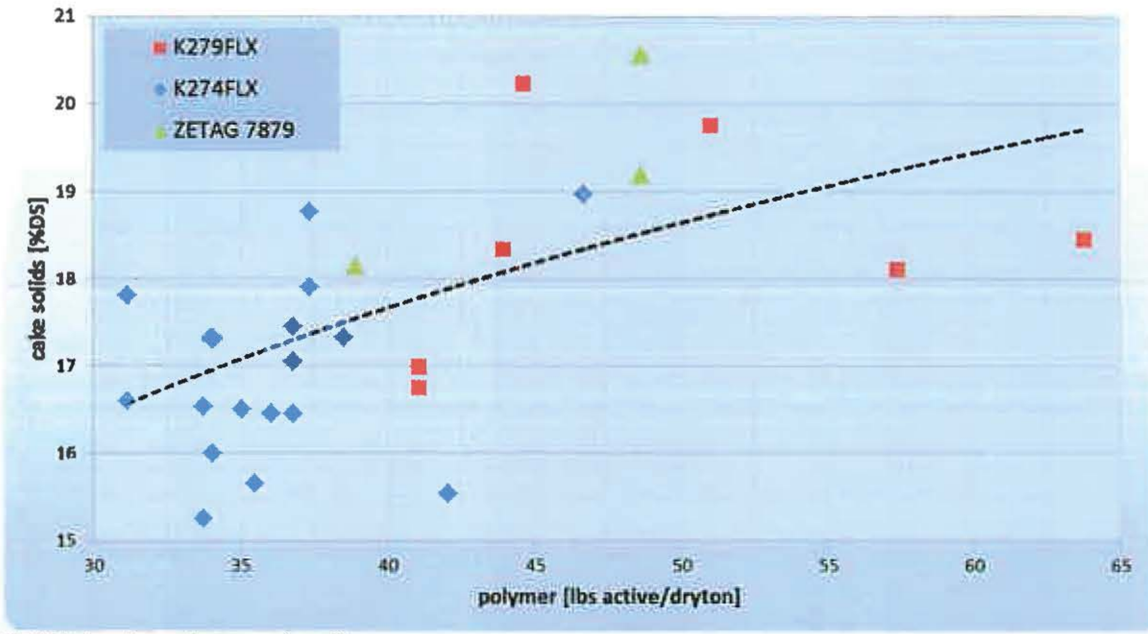
- flow rate: 9 – 18 GPM (@ 1.25 % DS)
- solid loading: 57 – 118 lbs DS / h
- screw speed: 0.7 – 2.4 rpm
- polymer consumption: 31 – 64 lbs active / ton DS
- pressure at dewatering cone: 14 - 30 PSI

These set points cover a wide range to determine the best performance settings. The above ranges are not intended to be the final design parameters for any construction or upgrades. The optimal operational set points and ranges are defined in section 6 conclusions.

4.1 Polymer Dose / Response and Effect on Cake Solids

The screw press was operated with different polymers using different dosing rates ranging from 30 – 60 lbs active / ton DS.

The graph 3 illustrates the effect the polymer dose has on the cake solids depending on the type of polymer.



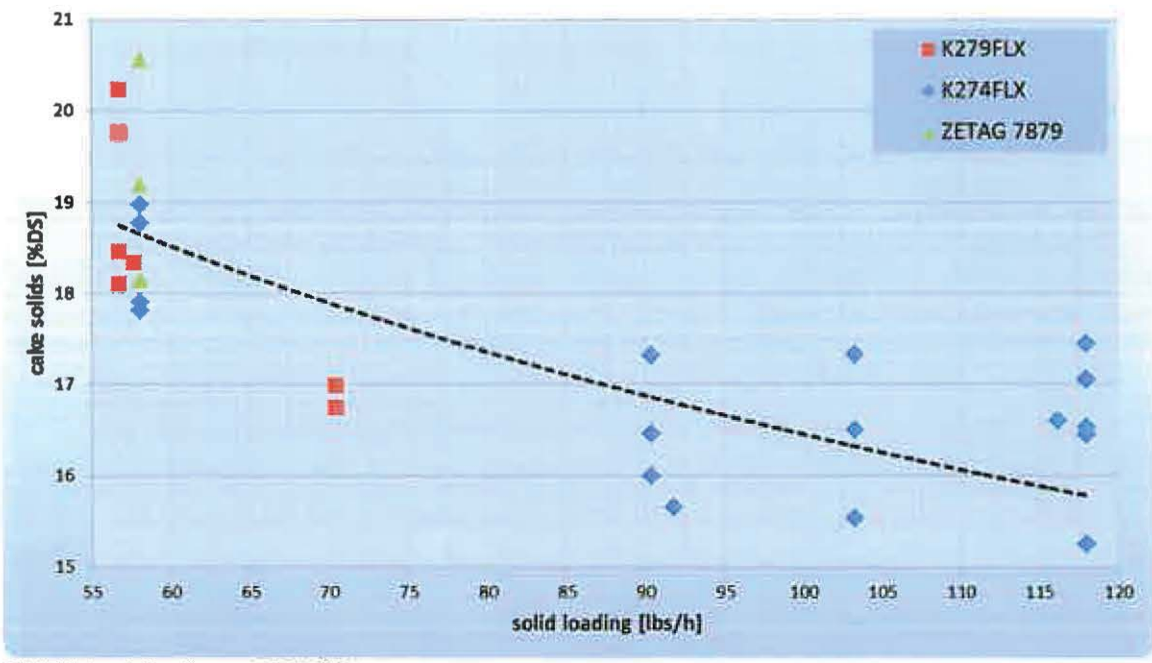
GRAPH 3: polymer dose on cake solids

As can be seen, above it appears that to maintain cakes solids production above 18% then a polymer consumption rate of approxmaitely 42lbs active/dry ton is required

4.2 Effect of Hydraulic and Solids Loading on Cake Solids

The screw press was operated using sludge with an average inlet solids content of about 1.29 % DS. The sludge flow rates were set between 9 and 18 GPM resulting in a solid loading of 57 – 118 lbs/h d.s.

The results are presented below in graphs 4 and 5. The hydraulic loading / solids loading certainly affects the performance of the screw press with there always being an optimum loading for a certain set of parameters. Graph 4 shows that the highest cake solids are achieved with 57 lbs/h but were still pretty consistently above 16% DS even with higher solids loading rates.

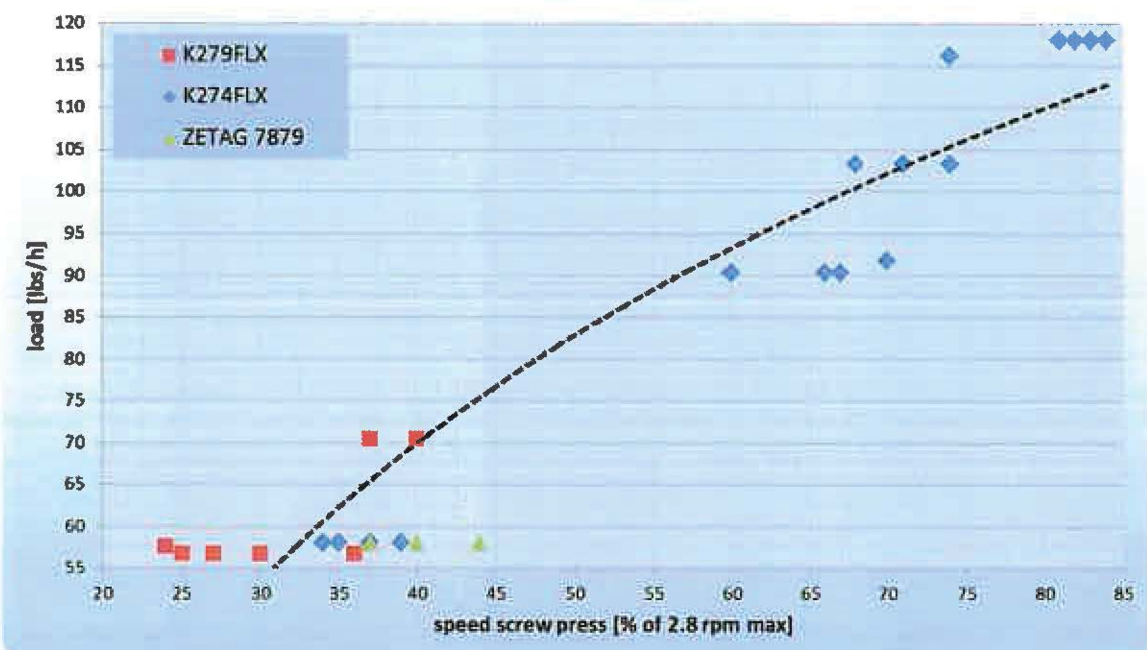


GRAPH 4: solid loading on cake solids

In general the effect of the solids loading on the discharged cake solids is also related to the screw speed. The solids loading determines the speed of the auger with higher loading rates requiring higher screw speeds which can often result in lower discharged cake solids (see graph 5).

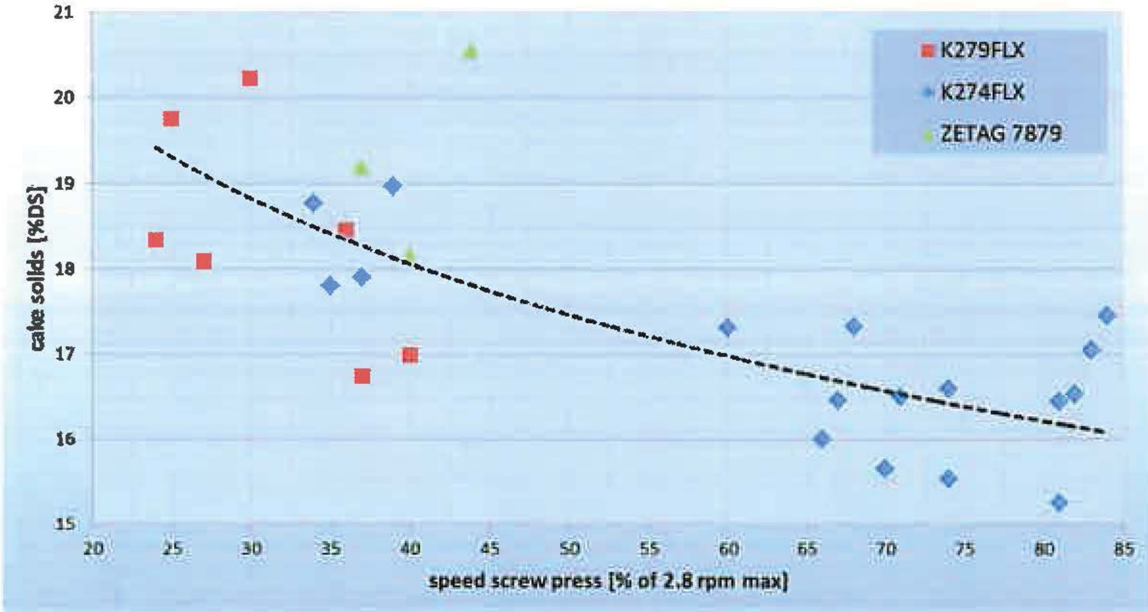
There is always a compromise when setting the operational parameters of the screw press trying to achieve the highest possible high cake solids with the maximum possible throughput. In theory the optimal performance solution is to utilize an oversized machine allowing for an extended retention time. This however is not the most cost effective solution. Therefore the system should be designed with a careful balance in mind allowing for high cake solids with an acceptable throughput and carefully calculated life cycle costs.

The highest performance rating is determined by the conveyance capacity of the screw press which is mainly a function of the screw speed and how fast the water can drain in the dewatering and thickening zones. The screw press is operated at its optimum when the parameters are in balance and the fill rate of the auger volume is completely filled. This means the maximum dewatering performance can be achieved as the screw press can build up pressure the entire length of the auger up to the discharge point. If the system is not balanced (e.g. screw speed is too high) the auger will not fill completely and sludge will merely be conveyed prior to building up pressure in the dewatering zone.



GRAPH 5: screw speed effect on throughput

This point of operation changes with all kind of parameters: polymer dosing, polymer injection and mixing system, hydraulic and solids loading, screw speed, and cone pressure. It is a very complex relationship and very sensitive to fluctuations. For peak efficiency and performance the screw press should be operated just below the point that it is overloaded.

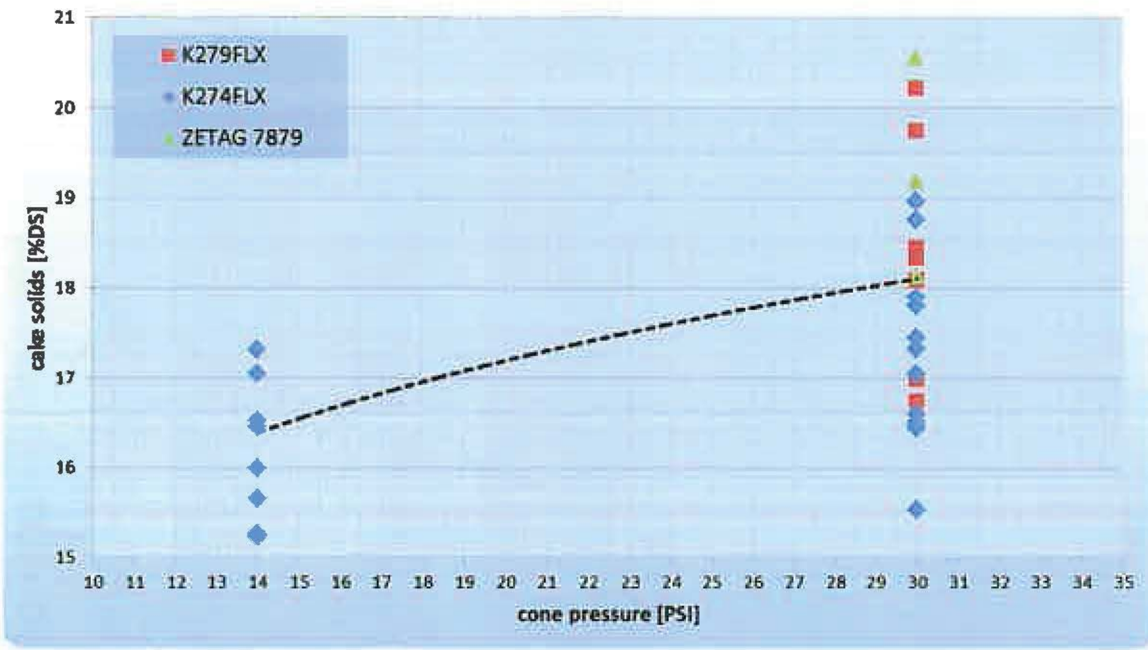


GRAPH 6: screw speed effect on cake solids

If the screw press is overloaded (i.e the screw speed is too low for desired hydraulic loading) the pressure build up will continue down into the inlet chamber – if this happens the screw press can no longer operate in a steady state. The system will need to shut down temporarily due to the high pressure in the inlet box (this can happen very frequently when overloading the system). Due to this it would be ideal to if the feed pumps are controlled automatically via the press system to allow real-time throttling thereby keeping the press(es) operational efficiency at their peak.

4.3 Effect of Outlet Pressure Cone Position on Cake Solids

The screw press was operated with several different pressure settings at the cone: 14 - 30 PSI.



GRAPH 7: cone pressure effect to cake solids

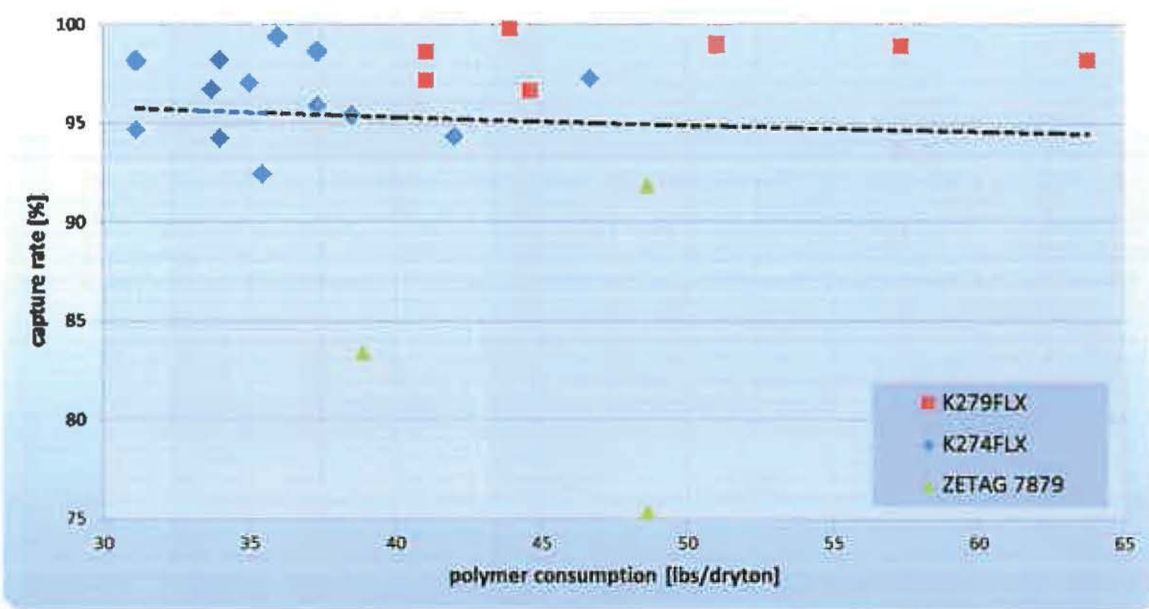
There seems to be a tendence for higher cake solids with a higher cone pressure.

4.4 Capture rate

The average capture rate of 95.3 % was an excellent result for a dewatering system, and is fairly typical for the inclined screw press. Nevertheless it is worth investigating the results in a little more detail.

The capture rate is effected by several parameters:

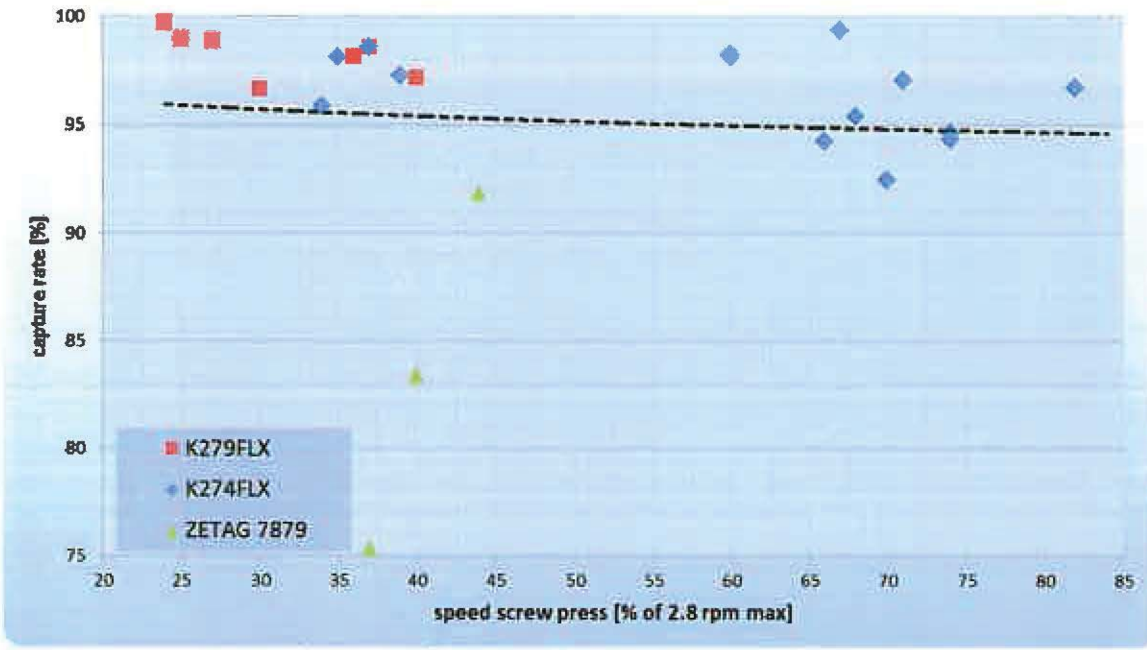
- polymer consumption (graph 8)
- screw speed (graph 9)
- pressure at inlet flange (graph 10)



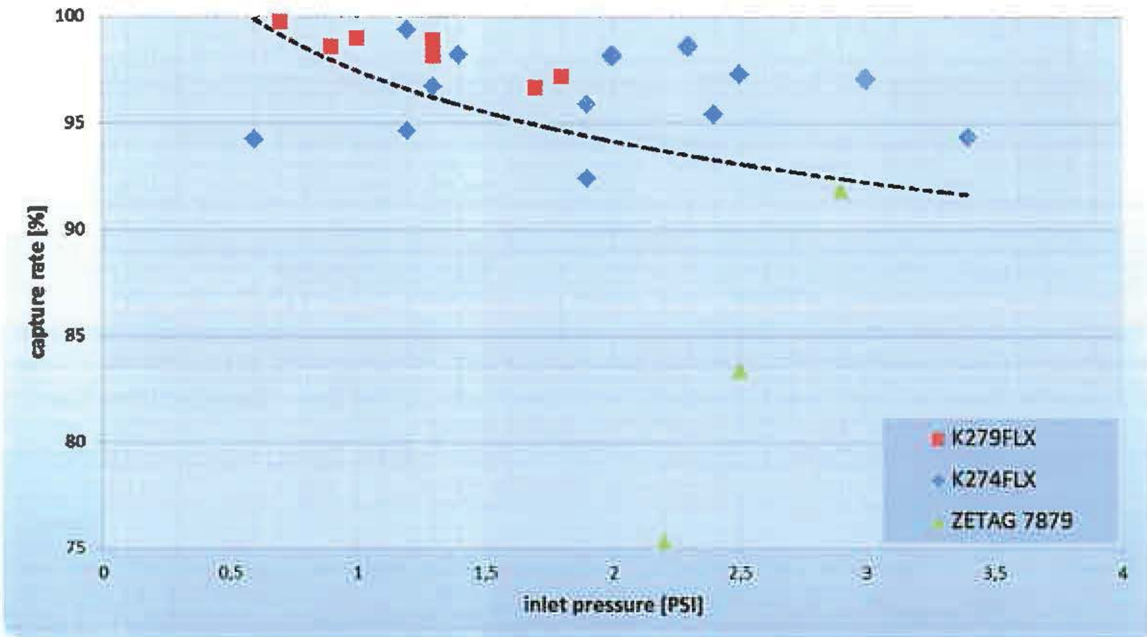
GRAPH 8: effect of polymer consumption on capture rate

The capture rate improves with increasing polymer consumption. The data points shown at a lower capture rate are typical during initial press set-up while searching for the optimal settings and can be seen by the consistently high results once the earlier break-in period was complete. The capture rate was 94 % or better with a polymer consumption rate between 36 and 64 lbs active / ton DS. The capture rate when using the plant polymer didn't produce the same kind of results and so it was decided that for the remainder of the pilot test only Ashland products would be used.

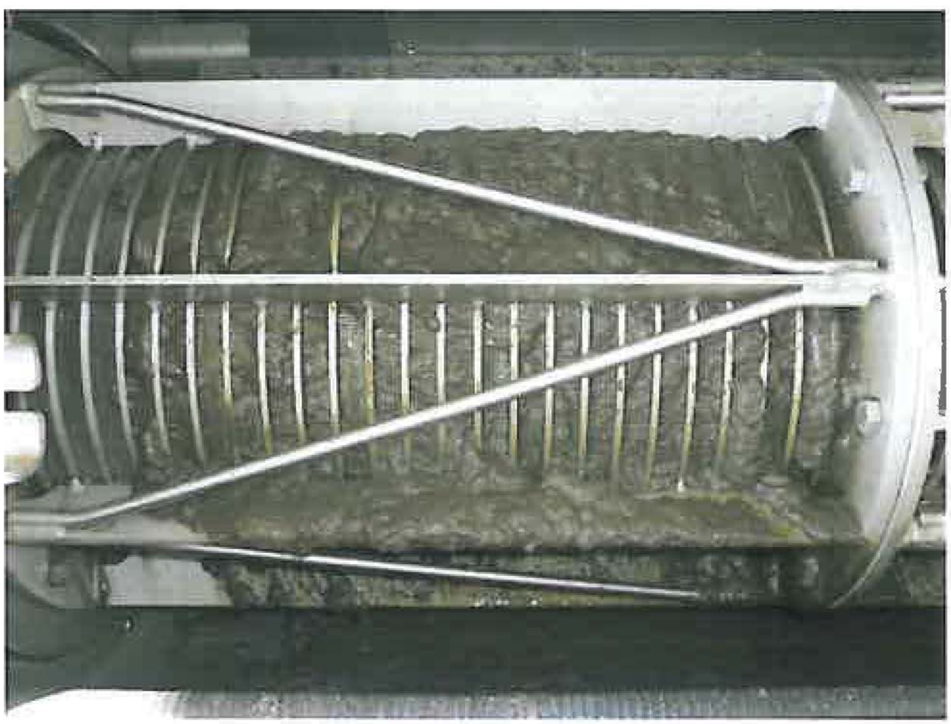
The capture rate is also affected by the screw speed (see graph 9). On the other hand the pressure at the inlet flange applied to the feed has a significant effect on the capture rate.



GRAPH 9: capture rate effected by screw speed



GRAPH 10: effect of feed pressure on capture rate

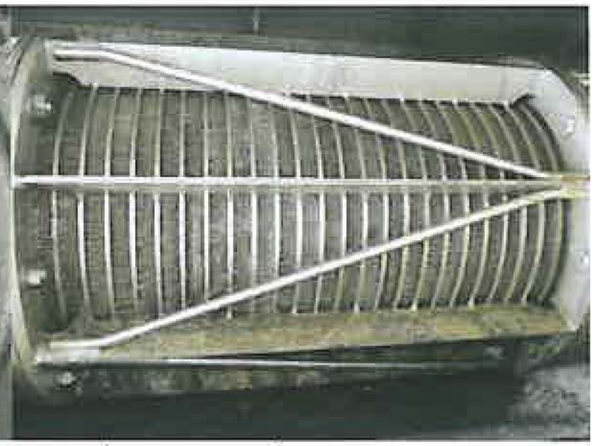


3rd screen during the dewater mode

It was a lot sludge coming out through the last screen which is left in the filtrate.

The average capture rate with over 95% is still good but when looking to the estimated filtrate sample (test # 22) with the flow during the wash cycle, the capture rate drops down to only 92%.
Maybe that could be prevented by using a finer screen in the last section

First screen section



second screen section

Cake (Pilot Test)

Filtrate (Pilot Test)

Lab (Pilot Unit)

Cone (pilot unit)

5. Conclusion

The pilot test proved the capability of the HUBER screw press to dewater the sludge at the Woodland Park WWTP, CO. The screw press is able to handle the sludge and produce cake with up to 20 % DS.

The best results were achieved with the settings:

- flow rate: 9 GPM
- solid loading: 58 lbs DS / h (with feed at 1.29 % DS)
- polymer consumption: 48 lbs active / ton DS
- screw speed: 44% (max = 1.2 rpm)
- pressure at cone: 30 PSI
- polymer type: ZETAG 7879 (BASF)
- cake produced: 20.56%

In general cake can be expected around 16% with a filtrate which is clear and contains only a few solids during dewatering mode. The average capture rate of 95.3 % is very good.

Huber Technology would like to extend our gratitude to the staff of the waste water treatment plant in Woodland Park, CO and for allowing us the opportunity to present our Screw Press RoS3Q. We appreciate all the help provided by the plant personnel in Woodland Park WWTP, CO in making this pilot possible and a success.

6. Activities

Monday
June 6th, 2011

- arrival at the plant
- set up of the pilot unit

Tuesday
June 7th, 2011

- tests with different settings, polymer flows and – concentrations
- different settings, sampling for cake dryness and capture rate

Wednesday
June 8th, 2011

- tests with different settings, polymer flows and – concentrations
- tests with Plant polymer
- different settings, sampling for cake dryness and capture rate

Thursday
June 9th, 2011

- tests with different settings, polymer flows and – concentrations
- different settings, sampling for cake dryness and capture rate

Friday
June 10th, 2011

- tests with different settings, polymer flows and – concentrations
- different settings, sampling for cake dryness and capture rate
- Disconnected the machine, cleaned it and the pilot site
- loaded and prepared trailer for departure
- leaving Plant

Memorandum

To:	Jeff Hlad, PE, Senior Reviewing Engineer, WQCD, CDPHE
From:	John McGinn, PE, JDS-Hydro Consultants, Inc.
Date:	June 12, 2014
Subject:	City of Woodland Park, Wastewater Treatment Facility Expansion, PER Additional Information Relating to Rotational Low Power Dewatering Press Environmentally Innovative Business Case

Appendix V of the May 2014 City of Woodland Park Wastewater Treatment Facility Expansion PER provided an Environmentally Innovative Business Case in support of the addition of a rotation low power dewatering press.

Initially, the focus was on power savings related to actual operation of the press units. Additional cost savings exist based on the utilization of the selected dewatering technology, and those are presented below:

- The need for composting improvements, specifically increasing static pile capacity, has been deemed unnecessary at this point in the plant's life. This is largely due to the fact that the plant will experience at least a 20% reduction in volumetric loading which will directly equate to a 20% increase in available composting capacity. Expansion of aerated static piles was estimated at just over $1 million, but was not included in the project cost. It was removed from the project due to the 20% increase in composting capacity that will be achieved via a more robust dewatering process.

- The 2014 budget contains a line item for $15,000 for compost supplies. These supplies include composting admixtures. The approval of the Rotational Low Power Dewatering Press will allow for a linear 20% reduction in that line item (~$3000 annual), and that will carry forward through the 20-year budget projection. That decrease was not presented in the original PER projection.

- Not included in the Compost Supply budget line item, is the diesel fuel cost associated with equipment used in composting work. Three pieces of diesel equipment are regularly used, and annual hours have been averaged over the past 4 -5 years. This equipment includes Case W11B (small loader), Case 621 (large loader) and a McCloskey 512 AP Screener. The annual cost for fuel is estimated at $15,495, and a 20% linear reduction in cost can be applied; this reduction results in immediate fuel savings of approximately $3100 annually, and that will be realized in the WW department's portion of payment that covers jointly provided services by the City.

545 EAST PIKES PEAK AVENUE SUITE 300, COLORADO SPRINGS, CO 80903
(719) 227-0072 FAX (719) 471-3401

- An additional environmental benefit exists in the reduction of emissions produced by composting loader. This would be roughly 20% based on a linear allocation of loader run time.

- Additional benefits that will provide cost savings (less easily quantified) include:

    - Reduced solids loading to the A-basins due to improved dewatering
    - Delayed need for capital investment in composting facilities
    - Reduced man-hours devoted to composting

Please include this document as an addition to Appendix V (Environmentally Innovative Business Case in support of the addition of a rotation low power dewatering press) of the May 2014 City of Woodland Park Wastewater Treatment Facility Expansion PER.

545 EAST PIKES PEAK AVENUE SUITE 300, COLORADO SPRINGS, CO 80903
(719) 227-0072 FAX (719) 471-3401