Cornwall
ONTARIO CANADA

CORNWALL WASTEWATER TREATMENT PLANT
ENVIRONMENTAL ASSESSMENT UPDATE

TECHNICAL MEMORANDUM NO. 3
SEWAGE PUMPING STATION AND FORCEMAIN REVIEW

December 1, 2009

Prepared by:

J.L.Richards
ENGINEERS · ARCHITECTS · PLANNERS

J.L. Richards
& Associates Limited
203-863 Princess Street
Kingston, ON Canada
K7L 5N4
Tel: 613 544 1424
Fax: 613 544 5679

In Association with:

XCG
6 Cataraqui Street
Woolen Mill, West Wing, Suite 105
Kingston, ON K7K 1Z7

CH2MHILL
1101 Prince of Wales Drive, Suite 330
Ottawa, Ontario
K2C 3W7

JLR 23695

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1 INTRODUCTION

The City of Cornwall owns and operates the Cornwall Wastewater Treatment Plant (WWTP), which provides primary treatment with chemical addition for enhanced treatment and phosphorus removal as well as disinfection. The existing WWTP has an average rated capacity of 54 432 m^3/day and a peak design capacity of 108 864 m^3/day. Biosolids are treated onsite in anaerobic digesters and dewatered using centrifuges before being disposed of at the City's landfill. Sewage from the City of Cornwall is collected and transferred by gravity to a pumping station at the entrance to the Cornwall WWTP and pumped into the plant, as shown on figure 1. Following a plant-wide evaluation for required upgrades in 2003, a Schedule C Class Environmental Assessment (Class EA) for these upgrades was completed in 2005.

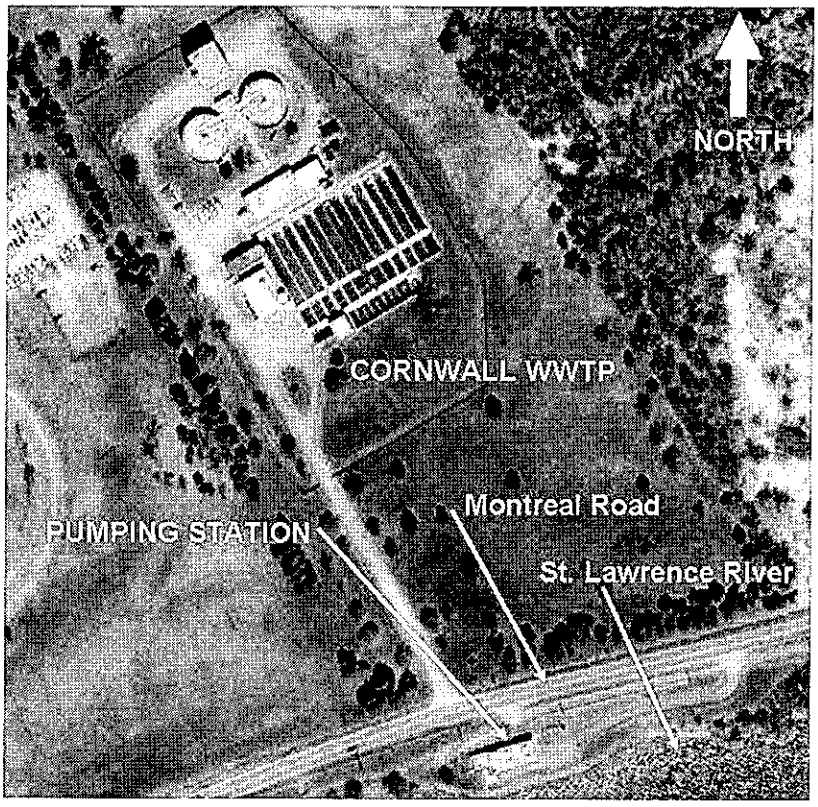


Figure 1 - Satellite photograph of the Cornwall WWTP (courtesy of GoogleMaps)

A Pollution Control Planning (PCP) study was undertaken in 1995 to address concerns raised as part of the Remedial Action Plan (RAP), which stemmed from the designation of the St. Lawrence River (Cornwall Area) as an Area of Concern (AOC) by the Water Quality Board and the International Joint Commission. The PCP is currently being updated to review hydraulic assessment of critical sewer infrastructure and determine compliance with MOE Procedure F-5-5.

In addition to other recommendations, the RAP recommended the following upgrades for the Cornwall WWTP:

- Upgrading the existing primary treatment plant to the equivalent of secondary treatment.
- Achieve phosphorous removal to a compliance limit of 1.0 mg/L, with an objective of 0.5 mg/L
- Increase removal efficiency of other toxic contaminants
- Reduce bacteria levels
- Reduce nuisance aquatic plants

These requirements were considered in the Class EA, where a Biological Aerated Filter (BAF) and Ultraviolet Light (UV) disinfection system were recommended.

In May 2009, the City retained J.L. Richards & Associates Limited, in association with CH2M HILL Canada Limited and XCG Consultants Limited to update the Class EA completed in 2005 and to develop a budget for capital upgrades required as well as life-cycle costing for the next 20 years.

The purpose of Technical Memorandum No. 3 (TM3) is to provide a review of the existing raw sewage pumping station and recommendations for improvements to be included in the forthcoming WWTP upgrade project.

2 BACKGROUND

The Cornwall WWTP and raw sewage pump station/forcemain were originally constructed in 1968. The treatment plant has undergone several upgrades since that time. The WWTP serves approximately 46 000 people, commercial and industrial properties, and receives leachate from five waste disposal sites. The plant was transferred to MOE ownership in 1970, and to the City of Cornwall in 2000. An expansion completed in 1988 resulted in the current layout and allowed for a dry weather capacity of 54 432 m^3/d.

Incoming sewage first passes through a mechanical screen located in the raw sewage pumping station. Sewage is then pumped through a 900 mm dia. forcemain to the main treatment plant for further treatment prior to discharge to the St. Lawrence River.

The basic details with respect to the existing pumping station capacity are included in Table 1. Further detailed information is provided in subsequent sections.

Table 1 – Raw Sewage Pumping Station Description – Major Equipment

Unit Process	Unit Size	Existing Capacity/Rating
Screening (Aquaguard screen located in the pumping station)	1 unit	108 000 m^3/day (controlled by the differential level transmitter)
Pumping Station – Equipped with Worthington Centrifugal pumps	2 Variable Speed Pumps, Worthington, 176 HP, 39,932 m^3/day (6100 IGPM) @ 24.4m TDH (Both duty) 2 Fixed Speed Pumps, Worthington, 169 HP, 37,510 m^3/day (5730 IGPM) @ 24.4m TDH (One used for standby to variable speed pumps)	108 000 m^3/day (controlled by the PLC)

Unit Process	Unit Size	Existing Capacity/Rating
Forcemain from the Pumping Station to the degritting tanks	900 mm diameter reinforced concrete pipe (Type C-300 per original construction drawings)	velocity of 2.38 m/s at a flow of 130 000 m^3/d

3 PUMP STATION CONDITION ASSESSMENT

The main wastewater pump station was reviewed by a team of engineers from JL Richards and CH2M HILL on July 7, 2009. A high level review of the building facility and mechanical equipment was completed. More detailed review will be required during detailed design.

3.1 Existing Equipment

The following is a listing of equipment presently installed in the pumping station.

3.1.1 Process Mechanical Equipment

- 2 Variable Speed Pumps, Worthington, 176 HP, 39 932 m3/day (6 100 IGPM) @ 80 feet TDH (Both duty), installed in 1968. Pumps 1 and 3.
- 2 Fixed Speed Pumps, Worthington, 169 HP, 37 510 m^3/day (5 730 IGPM) @ 80 feet TDH (One used for standby to variable speed pumps), installed in 1968. Pumps 2 and 4.
- Sluice gate between wastewater screen and downstream channel for flow isolation, (1 244 mm x 1 524 mm, as noted from the original 1967 design drawings).
- Aquaguard wastewater screen, installed in 1991/92.

3.1.2 Wastewater Pump Motors

- Two Siemens motor, 200 HP, installed on VFD Pumps 1 and 3. Pump 1 motor was rewound (according to plant staff) within the last five years.
- Two Westinghouse motors, 200 HP, installed on constant speed Pumps 2 and 4.

3.1.3 Wastewater Pump Drives

- One newer variable frequency drive, Allen Bradley, installed approximately 2007 on Pump 1.
- One older variable frequency drive, Siemens, installed on Pump 3.

- Two constant speed drives installed approximately in 1988, Pumps 2 and 4, across the line starters.

The following sections discuss findings and recommendations from the site visit. In general, the existing facilities are well maintained and in working condition, although older and will require upgrade and/or replacement of specific components.

3.2 Structural

Please refer to Technical Memorandum No. 4.

3.3 Electrical

Please refer to Technical Memorandum No. 4.

3.4 Building Mechanical

Please refer to Technical Memorandum No. 4.

3.5 Process Mechanical

The main sewage pumps are original equipment (1968), maintained over the years in good working order. Ideally, these pumps would be replaced as they are at or beyond their normal service life. Pump motor life is expected to be 20-25 years. The pumps normal service life would be expected to be 30-40 years. However, there are many plants with pumps older than this that can be reliable beyond this time frame with regular maintenance, bearing and/or shaft replacement as needed. Items such as the sluice gate, valves, etc. are all likely beyond their normal service life, and replacement would depend on their ability to continue to perform their intended purpose with respect to leakage when needed for maintenance shutdowns. Individual valves and the sluice gate should be reviewed in more detail during preliminary design to prioritize replacement based on maintenance records.

Replacement of process mechanical equipment such as the pumps, motors and drives will have to be evaluated with respect to cost, within the context of the overall wastewater treatment upgrade project, to determine project priorities. This should occur during preliminary design, at the first stage of cost estimating.

3.6 Instrumentation and Control

The Instrumentation and Control of the pumping station is rudimentary, reflective of industry practice during the last facility upgrades in 1988. Start / Stop control of the screen is based on the differential level measured across the screen, hardwired from the level instrument to the screen starter. No remote control and very limited monitoring and alarming of the screen operations and any adverse operating conditions are presently provided.

Control of the main sewage pumps and their associated discharge valves is implemented by an obsolete Texas Instruments Series 305 PLC, located within the old MCC section of the pumps. Although the PLC remains in operation, it has reached its end-of-life. Texas Instruments sold the product line to Siemens Automation in 1991. Siemens no longer manufactures parts for or supports this product, however some spare parts remain available from third party sources. Furthermore, the PLC programming software is DOS based and a new Windows based version does not exist. As such, making any modifications to the existing PLC logic is becoming increasingly difficult. Similar to the screen operations, very limited monitoring and alarming of the pump operations and any adverse operating conditions are presently provided.

Of primary concern is the age of the majority of the motor starters and variable speed drives located within the MCC sections at the pumping station. Although these systems are well maintained and were indicated to be operating reliably, these components have reached their effective end-of-life primarily from obsolescence, resulting in non-existent or very limited access to manufacturer's service support and spare parts. This situation can place the continued operation of the pumping station plant at risk in the event hardware failures. In extension of this issue, the proposed future automation of these systems becomes increasingly difficult as extensive modifications within the motor and drive controls would likely be required. Existing starter control enclosures may not be suitably sized or have sufficient spare terminals to facilitate integration of the new monitoring and controls signals into the existing control circuits. Furthermore construction activities necessary during the integration of these systems often result in incidental damage to existing internal components, greatly elevating the construction risk from, as previously mentioned, the non-existent or very limited access to manufacturer's service support and spare parts. Finally, these on-site modifications would require special inspections of the modified systems to be conducted. This adds both substantial cost and again additional risk if inspectors deem certain components to be non-compliant with present day standards and codes.

For additional information regarding the remainder of the Plant's Instrumentation and controls, please refer to Technical Memorandum No. 4.

4 CAPACITY REVIEW

The existing installed pump capacity at the station is 154 000 m^3/day, based on all pumps running. However, firm capacity with the one of the largest pumps out of service is 114 000 m^3/day. These capacities are based on the nameplate rating of the pumps. However, as discussed below, the maximum firm capacity indicated from the modeling is 12 802 m^3/day, that is, with three pumps running.

The current design average flow of the WWTP is 54 432 m^3/d and the peak flow is 108 864 m^3/day. The pumping capacity of the pump station is currently limited by controls to 108 000 m^3/day, which is consistent with the peak approved capacity of the treatment plant. As stated in the 2005 Environmental Study Report, the maximum peak daily instantaneous flow between 1997 and 2001 as recorded in March 1997 was 113 000 m^3/day. Detailed flow discussion and review of plant capacity requirements are further outlined in Technical Memorandum No. 2.

A hydraulic review of the existing pump station and forcemain system was completed using an AFT Fathom computer model generated to represent the piping/hydraulic system in place at the main pumping station. The model was created based on drawings provided for this study by the City, original plant as constructed drawings 1969, plant upgrade drawings 1985 (no indication if these are as constructed) and pump curve/system info provided by Mr. Carriere via email (attached as an Appendix to this memo).

The existing average day and peak flow conditions were simulated to determine what actual head conditions are expected to exist for the currently operating system. The review of the existing plant hydraulic setup resulted in a predicted head condition of approximately 24.4 m, close to the noted head condition of 24.4 m TDH on the pump nameplate/curve information.

Following this initial system check, increased capacity scenarios were run in the model to determine what maximum capacity could be accommodated within the system. Table 2 provides a review of the simulated pump station operation indicating at what flow rates and wet well levels pumps would come on. Forcemain velocity is also shown in Table 2. A maximum velocity of 3 m/s was used as the limiting factor for this simulation in the existing forcemain, as the condition of the forcemain is unknown. As this is an older reinforced concrete pipe higher velocities resulting in increased pressure within the forcemain were not considered desirable without further knowledge of forcemain condition. Pump start and stop, and operating wet well levels, were taken from the figures provided by the City for the original pump station design.

Table 2 – Raw Sewage Pumping Station – Flow Modelling Results

Wetwell Elevation (m)	Pump Operating	Speed (%)	Flow (m^3/day)	Total Dynamic Head (m)	Forcemain Velocity (m//s)	Comments
42.61	1	84%	18,103	22.9	0.30	Min flow
42.82	1	100%	40,964	24.7	0.67	Max flow one pump
42.82	1+2	100%	80,980	25.0	1.34	Two pumps start elevation
42.89	1+2	100%	81,176	25.0	1.34	
42.89	1+2+3	100%	119,055	25.4	1.95	Three pumps start elevation
42.98	1+2+3	100%	119,480	25.3	1.95	
43.49	1+2+3	100%	**121,802**	25.0	1.98	**Firm capacity** without surcharge
43.49	1+2+3+4	100%	157,774	25.5	2.59	Non-firm capacity without surcharge
43.49	1+2+3+4	120%	186,424	27.1	3.05	Theoretical Max from station (max velocity). Note larger pumps would be required (pumps running at 120% capacity)

The results of the modeling indicate that the predicted maximum flow capacity through the existing system is approximately 186 400 m^3/day. This would require increased pump sizes to provide the additional flow. The maximum flow rate with the existing pumps in place would be 157 774 m^3/day, with all pumps in service. Further investigation during preliminary design could determine whether or not increased impeller size is possible for the existing pumps to increase flow without the requirement for a new pump. Increased impeller size would likely require larger pump motors. This approach would not be recommended based on the equipment age, replacing the entire pump and motor is the preferred approach.

The maximum firm capacity indicated from the modeling is 121 802 m^3/day, that is, with three pumps running, as indicated in Table 2. Two pumps running would provide sufficient flow to cover an increased average day flow of 20% to 64 000 m^3/day – in fact the modeling indicates that a flow rate of 81 176 m^3/day could be achieved with two pumps.

Pump scenarios were run using the existing forcemain size, with estimated parameters based on pipe type and age. The modeling indicates that the flow rates as shown in Table 2 could be achieved with the existing forcemain. A new twin forcemain could be installed for redundancy, based on the age of the existing pipe. Either pipe could be used to achieve the desired increased capacities.

5 OPERATIONAL REVIEW

At the site visit of July 7, 2009, a discussion with plant manager Mr. Patrick Carriere and several operations staff was held with regard to operation concerns and desired upgrades at the main sewage pumping station. The following items were presented to the consultant team as concerns, either during verbal discussions, or on a list of desired upgrades provided by Mr. Carriere at the meeting:

- Plant bypass/screen maintenance – Because there is no main pumping station bypass around the existing screen, maintenance of the screen is difficult. The screen below grade depth is approximately 6.1m, and access to mechanical components at the bottom is difficult.
- Replace the screen with a grinder pump, with possible bypass to allow for maintenance.
- Replace existing sluice gate downstream of the screens.
- Replace existing pumps and drives.

The following sections provide discussion on the desired upgrades.

5.1 Bypass/Screen Maintenance/Grinder Installation

A conceptual review of the potential to install a bypass around the existing screen in the pump station reveals two possibilities: 1) to install an external bypass essentially twinning the existing concrete pump suction channel, from the inlet chamber west of the pump station, around the north side of the building, or 2) to install an internal bypass using the existing weir overflow chamber from the screen, through the interior wall near the west staircase/sump pump area. Both of these options are challenging, would require a qualified experienced contractor, and

would likely be significant in cost. Detailed feasibility assessment for both options would be required during preliminary design to determine actual implementation requirements.

Option 1 would require difficult excavation access between the pump station and Montreal Road on the north side of the pump station, access/work platform construction at the top of the road, and careful construction around the existing inlet, forcemain and outfall piping in the vicinity of the station. This is likely the most feasible option.

Option 2 would require significant interior renovation to the pump station, including the west stairwell to the pump level, which is required for health and safety egress, and relocation or reworking of the sump pump drainage area. Access to the existing suction conduit between the stairwell and existing pump piping would also require detailed review to determine if this option would be ultimately feasible.

If a bypass installation is determined not to be feasible due to either construction constraints or cost, screen maintenance will continue to be a challenge as no shutdown time will be available at the station unless bypassing or bypass pumping is in place, or the screen itself is removed through the existing roof hatch. Options exist to install a more easily maintainable screen, such as that which was demonstrated at the July 7, 2009 site visit, the Duperon Flexrake. This type of screen reduces the requirement for maintenance on mechanical parts below grade/water level.

The City has suggested removal of the screen and installation of a grinder pump as an alternative. This is not recommended, as experiences at other plants have indicated that grinding of the raw sewage simply moves the problem downstream into other process areas, where ground up material recombines and/or cut up particles cause pump clogging. One example of this based on CH2M HILL's experience is the Amherstview WWTP, which was one of the first with a large Channel Monster installed as their "headworks" (approximately 1999) - the plant is fed by an upstream pumping station that has a two-inch aperture climber screen. The plant staff had schedule constraints in driving out to the pump station and picking up screenings from the pumping station, therefore the screen was shut off and the sewage allowed to bypass around.

It was found that their RAS pump impellers were pitting and being damaged beyond repair every few months. It was determined that the cut up screenings were building up in the activated sludge system, partially clogging the RAS pump intake and causing cavitation. Once they re-started the upstream screen, the clogging / cavitation problem was eliminated. Additional experience from CH2M HILL staff indicates that grinders or comminutors grind up the incoming material, but often the material is just changed to long stringy pieces that recombine in

the downstream process. Some plants we have worked at that used grinders include Moose Jaw, Prince Albert, and Banff. Based on a recommendation by CH2M Hill, the comminutor was taken out of service in Banff when the plant was converted from an aerated lagoon to a mechanical plant. Again, this experience suggests that grinding in lieu of screening is not a recommended practice.

Another possible solution to this issue would be installation of a front cleaned bar rake, with 100 mm (4") openings at the sewage pumping station, with new finer screening (approximately 6-10 mm) in a new facility at the upgraded wastewater plant. This would reduce significantly the screenings material, with no need for washing, at the pump station as it would remove only the very large material that might damage the pumps. Finer screening at the plant would allow for easier handling of washed/compacted materials in a less constrained space, and remove finer particles that may cause problems with downstream process such as RAS pumping and digestion.

5.2 Replace Existing Sluice Gate, Pumps and Drives

Due to the age of the existing equipment, mostly all original, the sluice gate downstream of the screen, pumps and drives require replacement. This is simply a lifetime/maintenance issue, and thus these items can be flagged for replacement as part of preliminary design. Final detailed hydraulic modeling and plant capacity requirements determined during preliminary design will allow for final pump sizing.

5.3 Instrumentation and Control Systems

Within the automation industry, obsolescence of PLC hardware typically occurs after 7 to 10 years, depending upon the specific manufacturer, commonly arising from the manufacturer ceasing production of specific product lines and/or components.

HMI software, if not kept current with recent versions, commonly transitions from active feature development, support and maintenance by the software vendor to these older versions no longer being actively supported or maintaining. HMI software longevity is further challenged by older HMI software versions no longer supporting newer operating systems, combined with the issues that older operating systems are no longer compatible with or available for purchase on newer computer hardware. Resultantly, within the automation industry, obsolescence of HMI software typically occurs after 3 to 6 years, again depending upon the specific software vendor(s) involved.

In discussions with operations staff, they indicated a strong desire to implement a plant wide SCADA system that would include full remote monitoring and control capabilities of all process equipment within the sewage pumping station, and the remainder of the treatment plant. Their preferred approach includes the use of a modern PLC and HMI based approach in achieving this goal. Staff also requested that the PLC hardware and HMI software be compatible and/or common with that already in use at the Water Treatment Plant, specifically Allen-Bradley SLCs and Wonderware Intouch HMI software. From a future system design standpoint, Ethernet based Allen-Bradley CompactLogix or ControlLogix PLCs would likely be implemented.

City staff also indicated that they are internally completing the automation of a CSO project, whereby the gate controls to be implemented at this remote facility would need to communicate with and be directly common / compatible with the future PLC to be located at the main sewage pumping station and the treatment plant itself. This is desired to ensure both standardization and reliable, straightforward communications and control of the CSO facility based on the wet well level within the main sewage pumping station at the treatment plant. In this effort, automation of both the CSO facility and the pumping station will be completed with their own forces, using the aforementioned PLC Hardware and HMI software.

For the purposes of this memorandum, it is assumed the City would implement only the minimum required networking, PLC hardware and HMI systems to achieve integration of the CSO facility with the pumping station wet well level, and that this future project would include the full scale replacement of the pumping station instrumentation and controls in conjunction with related process mechanical and electrical upgrades anticipated at that time.

6 RECOMMENDED UPGRADES AND OPINION OF PROBABLE COST

This Technical Memorandum was discussed with City staff on August 27, 2009. It was agreed that the following upgrades should be considered for implementation as part of this project.

- Replace all existing pumps with new pumps to provide a firm capacity of 160 000 m^3/day (possibly up to 186 000 m^3/day) and taking into account that minimum flows can be as low as about 16 000 m^3/day. Preliminary modeling indicates that a four pump arrangement with two smaller pumps using VFD's and two larger pumps with constant speed motors will provide the required flow range as shown in Table 3. Firm capacity would be provided with one large pump out of service. The smaller pumps on VFD would be approximately 257 HP, and the larger pumps approximately 308 HP. Pipe fittings to accommodate the new pumps would require changing. Pump sizes and fittings will be finalized during the next phase of design for the station upgrades. Sample pump information is included in the Appendix to this

memorandum. An opinion of probable cost for replacement of the pumps including modification to fittings to accommodate the larger pump sizes is $337,000 ($225,000 equipment cost plus 50% for installation), per pump for a total of approximately $1,350,000. This is for pump and motor equipment only and does not include electrical, wiring, or instrumentation and control upgrades.

Table 3 – Raw Sewage Pumping Station – Flow Modeling Results

Wetwell Elevation (m)	Pump Operating	Speed (%)	Flow (m^3/day)	Total Dynamic Head (m)	Forcemain Velocity (m//s)	Comments
42.61	1	70%	14,167	22.8	0.8	Min flow
42.82	1	100%	53,883	26.9	2.9	Max flow one pump
42.82	1+2	100%	106,425	27.4	5.7	Two pumps start elevation
42.89	1+2	100%	106,632	27.3	5.7	
42.89	1+2+3	100%	156,127	28.1	8.4	Three pumps start elevation
42.98	1+2+3	100%	156,476	28	8.4	
43.49	1+2+3	100%	158,466	27.6	8.5	Firm capacity without surcharge
43.49	1+2+3+4	100%	203,687	28.6	10.9	Non-firm capacity without surcharge

- While it is recommended to proceed with the previously noted scenario to replace all pumps based on expected service life and minimization of construction mobilization/demobilization costs, should the City prefer to phase the implementation of pump replacements with respect to capital expenditure, the following options could be considered:
  - Keep the existing VFD pumps and replace the two fixed speed pumps with new 78,000 m^3/day (approximately 430 HP) pumps. This will require replacement/rework of the existing piping fittings around the pumps. The pump operations sequence would require review during preliminary design. Given that these pumps are larger than replacement pumps would be if all four pumps were replaced as in the scenario notes previously, this option may not in fact be significantly less expensive from a capital perspective. The estimated cost for this pump replacement would be $371,250 per pump ($247,500 plus 50% for installation), for a total of $742,500. This would result in a system with maximum firm flow rate of 160,000 m^3/day (with one large pump out of service). This includes the

pump and motor, but no additional electrical or instrumentation and controls costs. Sample pump information is included in the Appendix to this memo.

- A lower flow option of 135,000 m^3/day could be pursued. For this scenario, Cornwall would keep the existing VFD pumps (approx. 41,000 m^3/day each for a total of 82,000 m^3/day) and replace the two fixed speed pumps with new 53,000 m^3/day pumps. This would result in a system with maximum firm flow rate of 135,000 m^3/day (with one large pump out of service). The estimated cost for this pump replacement would be $337,000 per pump ($225,000 plus 50% for installation), for a total of approximately $675,000. This includes the pump and motor, but no additional electrical or instrumentation and controls costs.

- Replace the existing screen with a new "coarse" screen to simply protect the pumps. The new screen must be easier to maintain and have a hydraulic capacity of at least 160 000 m^3/day. The new screen is recommend to have 25 mm openings, and may be selected from a number of products for this application including the Flex Rake by Duperon, a back raked bar screen such as the Mahr Bar Screen from Headworks Inc., or a climber type screen such as Degremont's. Finalization of product will be completed through discussions with Cornwall during preliminary design in order to determine the desired screen to minimize maintenance. Sample screen brocures are included in the Appendix to this memorandum. An opinion of probable cost for replacement of the existing screen including removal of the existing screen ranges from $147,000 to $304,000 depending on screen selection for equipment cost, and with removal of existing screen and installation costs for the new screen, would range from $377,000 to $534,000 overall cost. The three screens previously mentioned were priced. The highest price option for the Climber Screen requires very high head clearance above floor level so may be impractical, but final screen selection will be considered during preliminary design. This is the screen equipment only and does not include electrical, wiring, or instrumentation and control upgrades.

- Replace the existing sluice gate. An opinion of probable cost for replacement of the gate is $37,000 ($25,000 plus 50% installation). This is the gate, stem and actuator only and does not include electrical, wiring, or instrumentation and control upgrades.

- Implement a new fine screening facility at the plant. An opinion of probable cost for this upgrade will be presented in the Environmental Study Report Addenda.

- Replace the existing instrumentation and control systems. An opinion of probable cost for replacement is $187,000 including supply and installation costs. This cost assumes that the existing motor starters and most variable speed drives would be replaced. This cost also includes supply and installation of a new PLC panel, all new field wiring and replacement of critical instrumentation. As agreed, costs include programming of the station PLC and the

overall integration of the SCADA system by the Contractor, with the associated HMI programming being completed by City staff.

It should be noted that the challenges and costs associated with implementing a bypass around the existing screen are deemed to outweigh the net benefits particularly with the implementation of a new (and easier to maintain) screen. Therefore, the City does not wish to pursue implementation of a screen bypass at the pumping station as part of this project.

APPENDIX – EQUIPMENT INFORMATION

Model: SSF	Size: 16X14	60Hz	RPM: 880	Stages: 1

Job/Inq.No. :
Purchaser : UNDEFINED
End User :
Item/Equip.No. : ITEM 001
Service :
Order No. :

Issued by : Eric Benoit
Quotation No. : EB09-09-15 01

Date : 09/15/2009
Rev. : 0

Operating Conditions

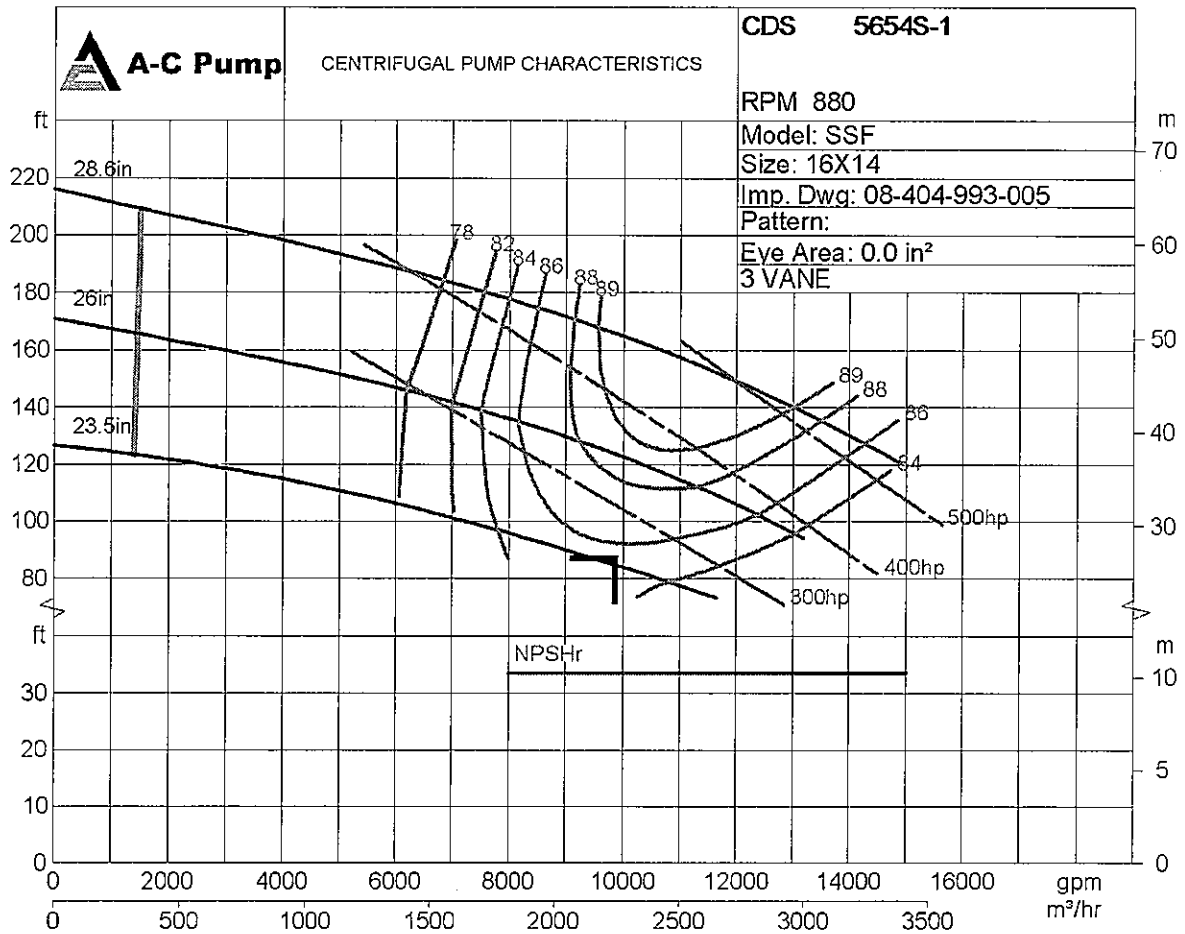
Liquid:	Water
Temp.:	70.0 deg F
S.G./Visc.:	1.000/1.000 cp
Flow:	9,906.0 gpm
TDH:	87.3 ft
NPSHa:	
Solid size:	
% Susp. Solids (by wtg):	
Max. Solids Size:	0.0000 in

Pump Performance

Published Efficiency:	86.0 %
Rated Pump Efficiency:	86.0 %
Rated Total Power:	257.7 hp
Non-Overloading Power:	273.0 hp
Imp. Dia. First 1 Stg(s):	23.7500 in
NPSHr:	24.8 ft
Shut off Head:	130.6 ft
Vapor Press:	

Suction Specific Speed:	12,381 gpm(US) ft
Min. Hydraulic Flow:	1,404.9 gpm
Min. Thermal Flow:	N/A

Notes: 1.The Mechanical seal increased drag effect on power and efficiency is not included, unless the correction is shown in the appropriate field above.2. Magnetic drive eddy current and viscous effect on power and efficiency is not included.3. Elevated temperature effects on performance are not included.4. Non Overloading power does not reflect v-belt/gear losses.



Model: SSF	Size: 16X14	60Hz	RPM	Stages: 1

Job/Inq.No. :
Purchaser : UNDEFINED
End User :
Item/Equip.No. : ITEM 001
Service :
Order No. :

Issued by : Eric Benoit
Quotation No. : EB09-09-15 01

Date : 09/15/2009
Rev. : 0

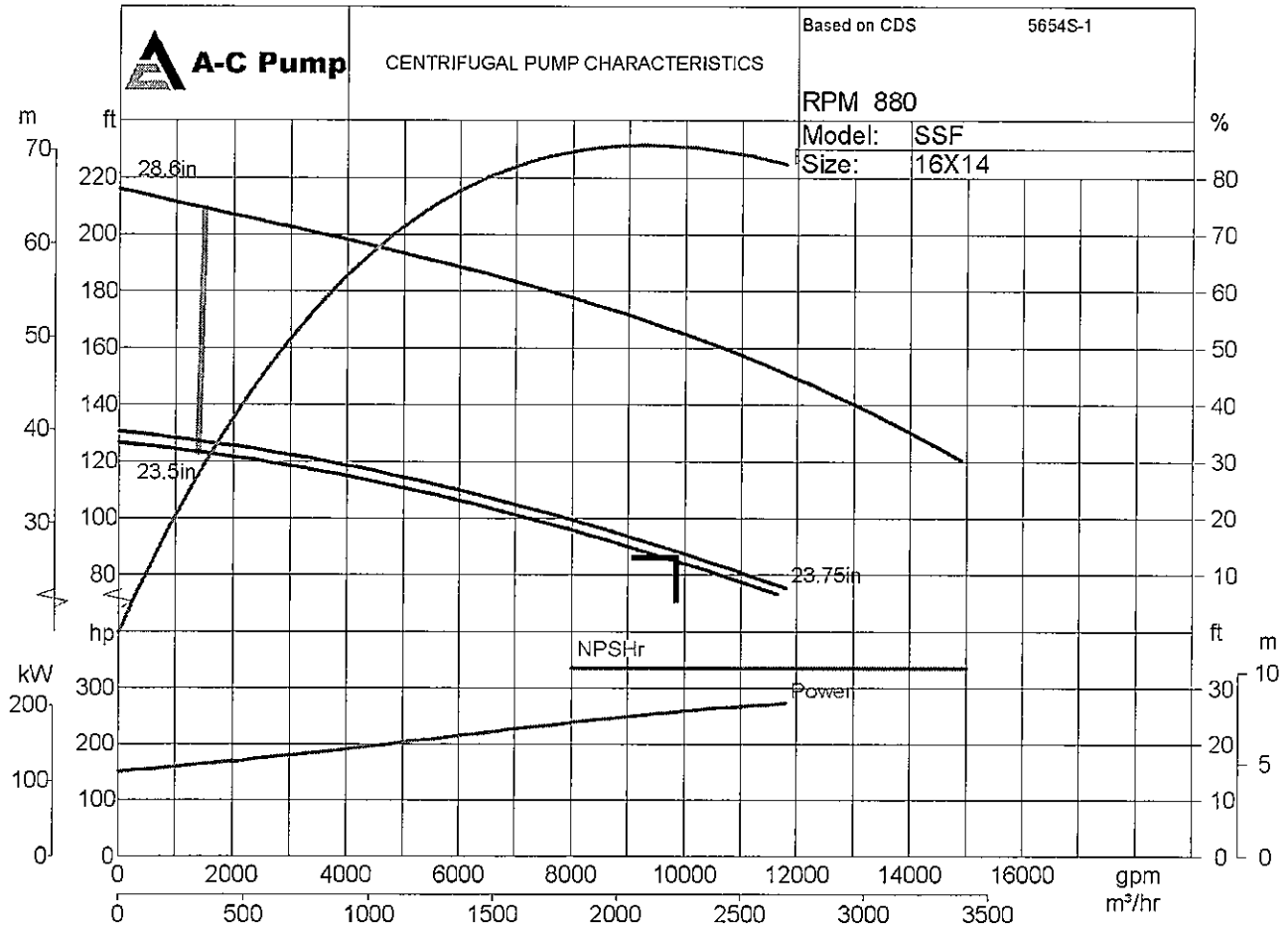
Operating Conditions

Liquid:	Water
Temp.:	70.0 deg F
S.G./Visc.:	1.000/1.000 cp
Flow:	9,906.0 gpm
TDH:	87.3 ft
NPSHa:	
Solid size:	
% Susp. Solids (by wtg):	
Max. Solids Size:	0.0000 in

Pump Performance @ 880 RPM

Published Efficiency:	86.0 %	Suction Specific Speed:	12,381 gpm(US) ft
Rated Pump Efficiency:	86.0 %	Min. Hydraulic Flow:	1,404.9 gpm
Rated Total Power:	257.7 hp	Min. Thermal Flow:	N/A
Non-Overloading Power:	273.0 hp		
Imp. Dia. First 1 Stg(s):	23.7500 in		
NPSHr:	24.8 ft		
Shut off Head:	130.6 ft		
Vapor Press:			

Notes: 1.The Mechanical seal increased drag effect on power and efficiency is not included, unless the correction is shown in the appropriate field above.2. Magnetic drive eddy current and viscous effect on power and efficiency is not included.3. Elevated temperature effects on performance are not included.4. Non Overloading power does not reflect v-belt/gear losses.



Model: SSF	Size: 14X12	60Hz	RPM: 1180	Stages: 1

Job/Inq.No. :
Purchaser : UNDEFINED
End User :
Item/Equip.No. : ITEM 001
Service :
Order No. :

Issued by : Eric Benoit
Quotation No. : EB09-09-15 01

Date : 09/15/2009
Rev. : 0

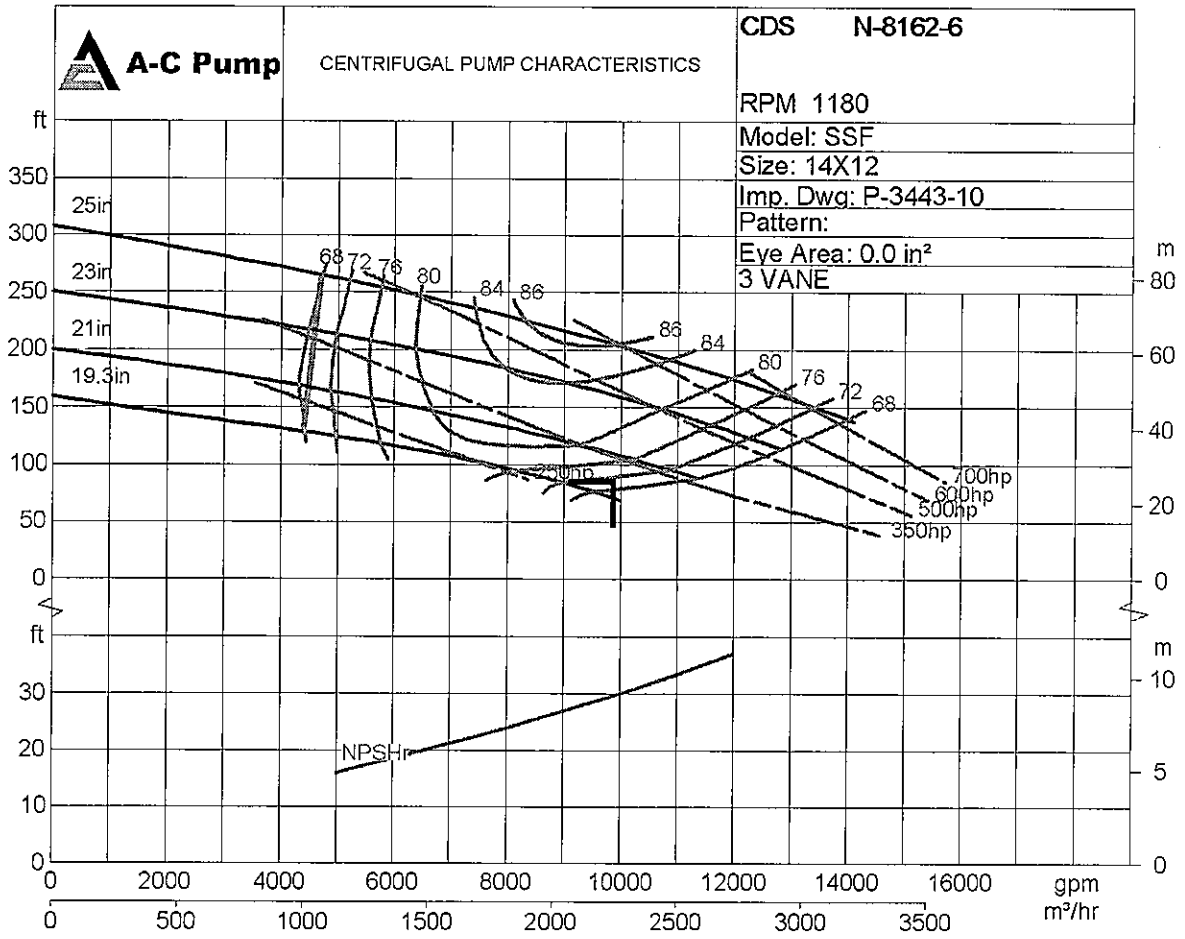
Operating Conditions

Liquid:	Water
Temp.:	70.0 deg F
S.G./Visc.:	1.000/1.000 cp
Flow:	9,906.0 gpm
TDH:	87.3 ft
NPSHa:	
Solid size:	
% Susp. Solids (by wtg):	
Max. Solids Size:	0.0000 in

Pump Performance

Published Efficiency:	71.0 %	Suction Specific Speed:	16,172 gpm(US) ft
Rated Pump Efficiency:	71.0 %	Min. Hydraulic Flow:	4,443.4 gpm
Rated Total Power:	308.6 hp	Min. Thermal Flow:	N/A
Non-Overloading Power:	313.5 hp		
Imp. Dia. First 1 Stg(s):	20.1250 in		
NPSHr:	29.7 ft		
Shut off Head:	178.2 ft		
Vapor Press:			

Notes: 1.The Mechanical seal increased drag effect on power and efficiency is not included, unless the correction is shown in the appropriate field above.2. Magnetic drive eddy current and viscous effect on power and efficiency is not included.3. Elevated temperature effects on performance are not included.4. Non Overloading power does not reflect v-belt/gear losses.



Model: SSF	Size: 14X12	60Hz	RPM	Stages: 1

Job/Inq.No. :
Purchaser : UNDEFINED
End User :
Item/Equip.No. : ITEM 001
Service :
Order No. :

Issued by : Eric Benoit
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Operating Conditions

Liquid:	Water
Temp.:	70.0 deg F
S.G./Visc.:	1.000/1.000 cp
Flow:	9,906.0 gpm
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Pump Performance @ 1180 RPM

Published Efficiency:	71.0 %	Suction Specific Speed:	16,172 gpm(US) ft
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Non-Overloading Power:	313.5 hp		
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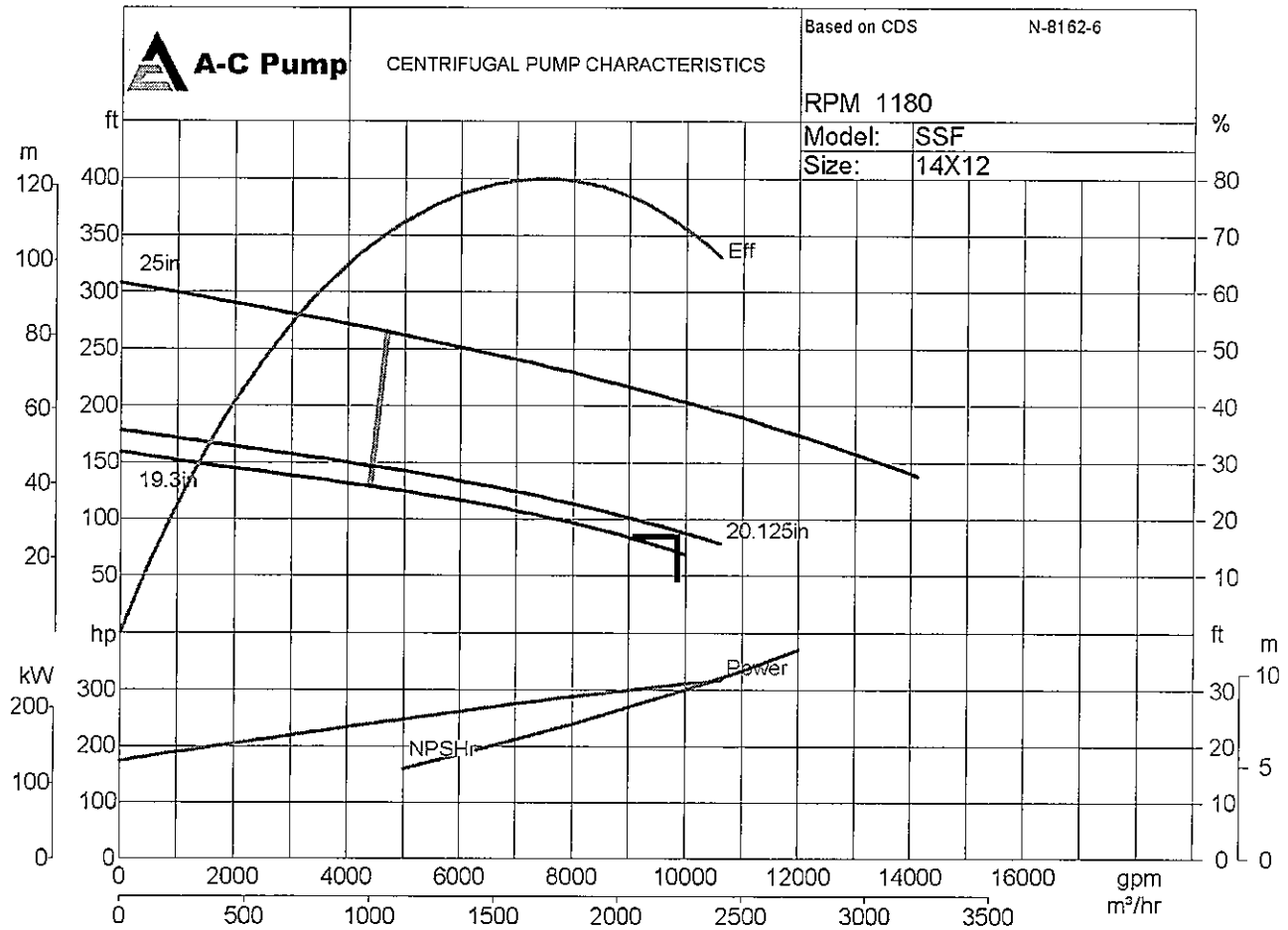
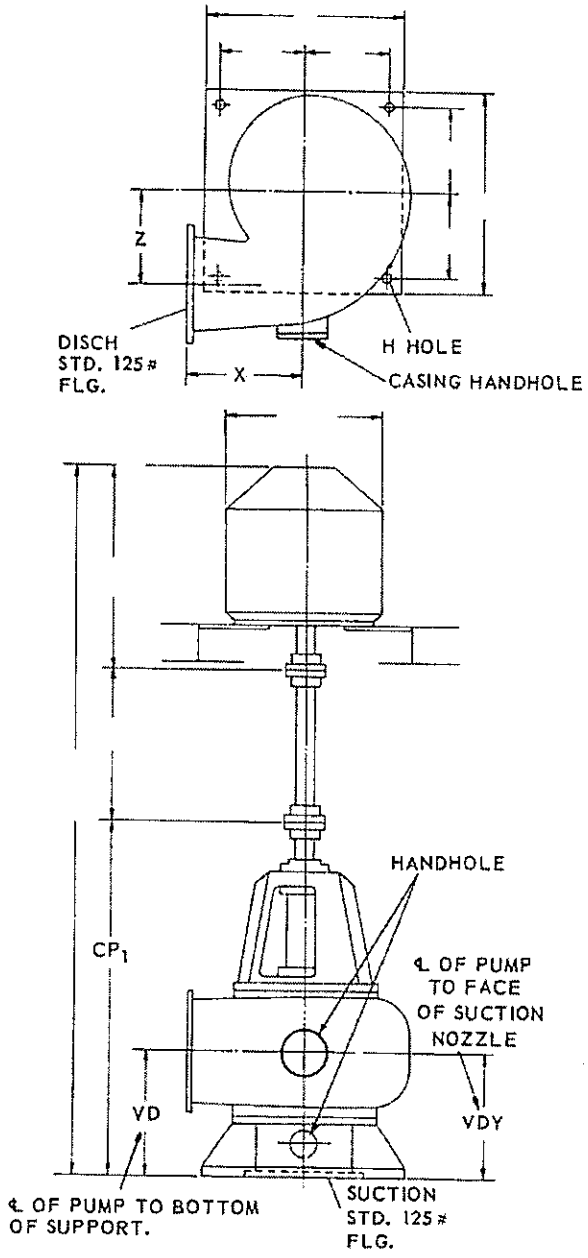


ITT

18 x 16 SSF Models 200 - 250



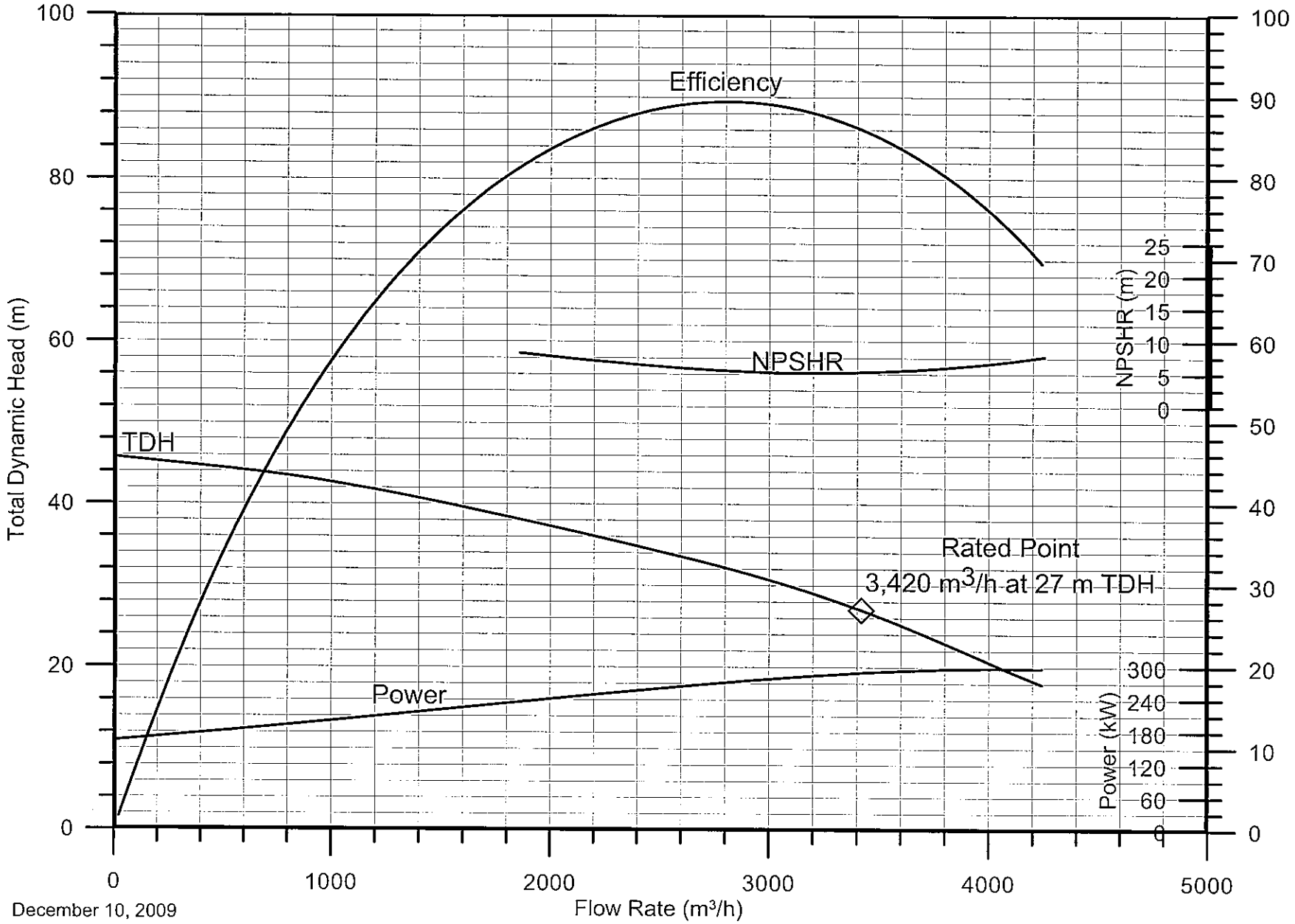
Dimensions in Inches

Suction	=	18
Discharge	=	16
CP_1	=	82
VD	=	18
VDY	=	28
X	=	26
Z	=	24.75

Dimensions are Approximate and Subject to Change

CORNWALL WWTP
ITT Flygt Curve Number 73828
18 X 16 SSF at 705 RPM

ITT



December 10, 2009

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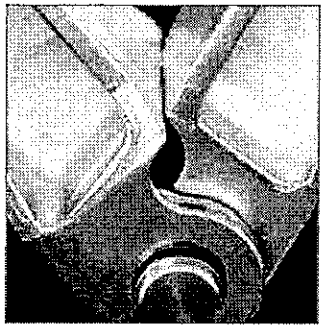
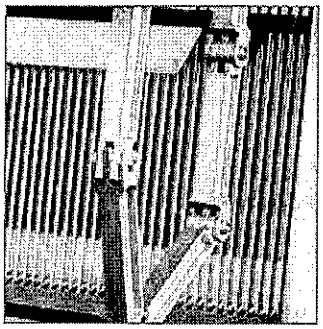
FLEXRAKE FEATURES & BENEFITS - WASTEWATER



SIMPLE

The Duperon FlexRake is simple, consisting of three basic components: a powerful drive head, durable raking device, and a rugged bar screen. This simplicity is possible through the multi-functioning action of the FlexLink. This clever patented design allows the link to function as a frame, lower sprocket, and connection point for scrapers. Additionally, this technology allows the rake to be driven by a single sprocket.

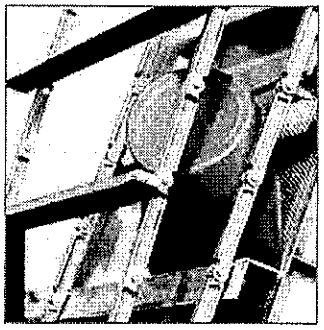
Bottom line: simplicity works when it achieves a simple cleaning mechanism with trouble-free longevity.



NO LOWER SPROCKET

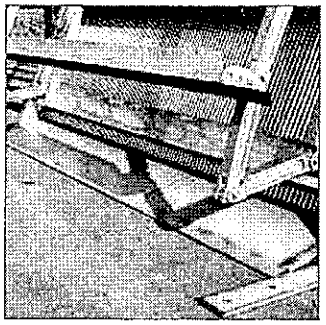
Patented FlexLink design creates its own frame, lower sprocket, and scraper connection point, eliminating the need for a lower sprocket and the common problems that come with it.

- No lower sprocket means no drive shaft, drive sprockets, or bearings requiring in-channel lubrication.
- No tracks, gaskets, seals or other close tolerances prone to wear due to grit.
- No underwater maintenance means no divers and no dewatering... all operations performed above the deck.



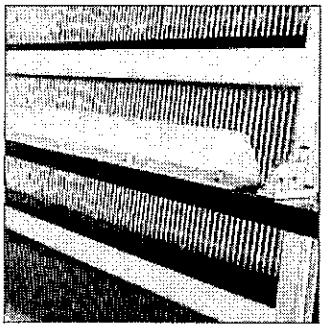
DESIGNED TO RUN

Patented FlexLink™ technology effortlessly removes debris of all sizes without interruption. Instead of complex mechanisms requiring reversal of mass, proximity switches and shutdowns, the FlexRake® continually and reliably removes debris in a wide range of conditions. No alarms, no operators, no fuss.



EXCLUSIVE CHANNEL BOTTOM PLATE

Due to the "square" sprocket action of the FlexLink, the FlexRake has the unique ability to hit the base plate of the frame with a scraping, shoveling action that moves debris up the screen eliminating accumulation at the bottom of the channel.

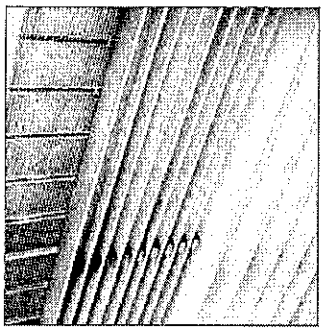


TOUGH MATERIALS

State-of-the-art materials such as UHMW and stainless steel are used for all wetted parts, eliminating corrosion in the harsh wastewater environment. Such materials ensure the highest duty of performance, designed such that the pressures and velocities exerted by the equipment and environment will assure a long life cycle.

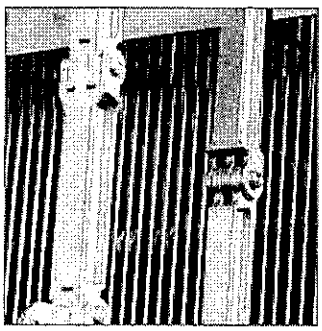
TOUGH GEARMOTOR

Powerful drive lifts up to 1,000 lbs. Duperon's use of premium efficiency Sumitomo Cyclo gear motors eliminates abrasive sliding contact. Unique rolling contact, low operating speeds and the grease-filled non-vented gearbox allow for 5 year maintenance schedules.



BEST SCREENING EFFICIENCY

Duperon's bar screen utilizes custom tear-shaped bars with a 50% screening efficiency for .25 inch bar openings, resulting in more favorable flow characteristics and less headloss. The unique tear drop shape keeps large debris on the surface of the screen for removal by scrapers. Small debris flows right through, and full penetration scrapers assure that no debris can accumulate, even on horizontal cross members.



TOUGH LINKS

The FlexLink design utilizes a stainless steel link system to create a frame, lower sprocket, and scraper connection point. With 33,000 lb. yield and 60,000 lb. break point, it forms a chain that is stronger and more hard-wearing than any other in the industry. That's strength where it's needed most!

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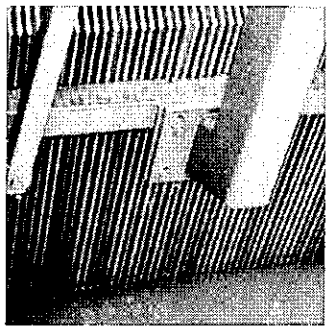
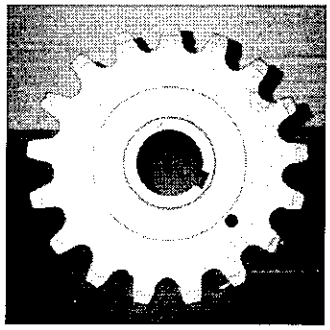
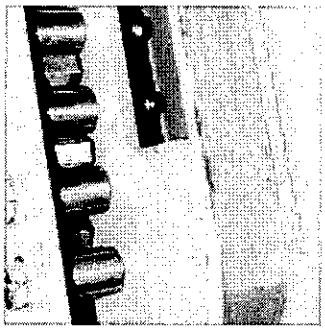
ONDEO
Degrémont

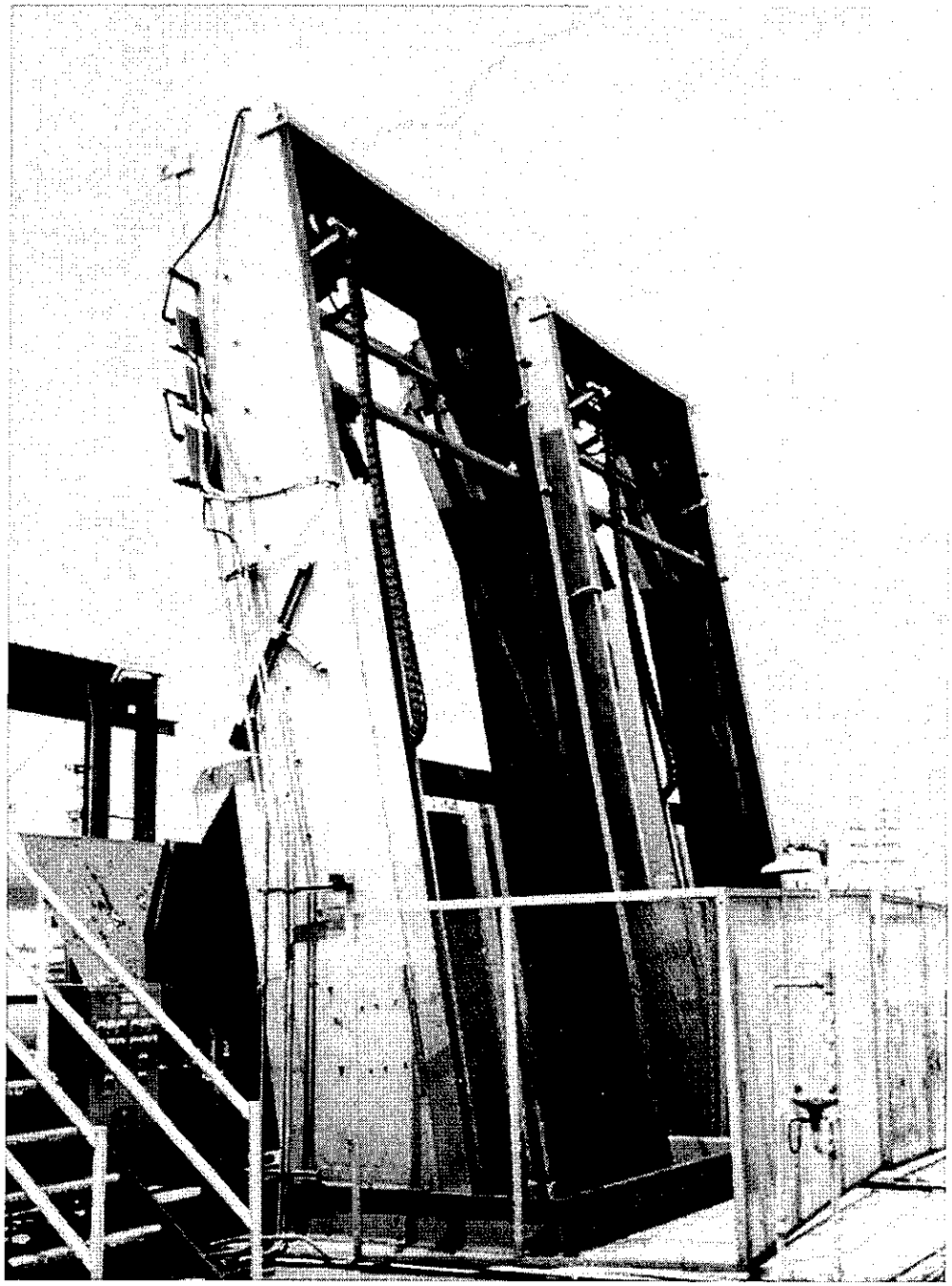
DB-803

Climber Screen®
Mechanically Cleaned
Bar Screen









SUEZ

The Screen That Set the Headworks Standard

In 1978 our company, then known as Infilco Degremont, was the first to introduce a precision-fabricated mechanical bar screen for wastewater debris removal. Known as the Climber Screen®, the unit was designed component-by-component with efficient, trouble-free operation in mind.

Today ONDEO Degremont's Climber Screen unit is still the screen by which others are measured. Thousands of discerning clients have standardized on the Climber Screen bar screen. Owners and operators of wastewater plants, pumping stations and CSO's know the Climber Screen has the structural integrity to withstand years of severe duty operation in a corrosive environment.

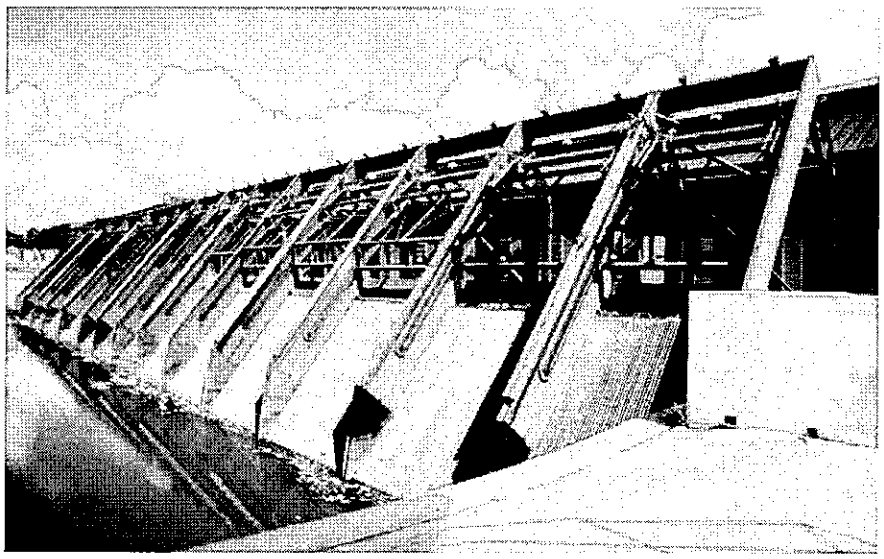
A Reliable Investment With Years of Return

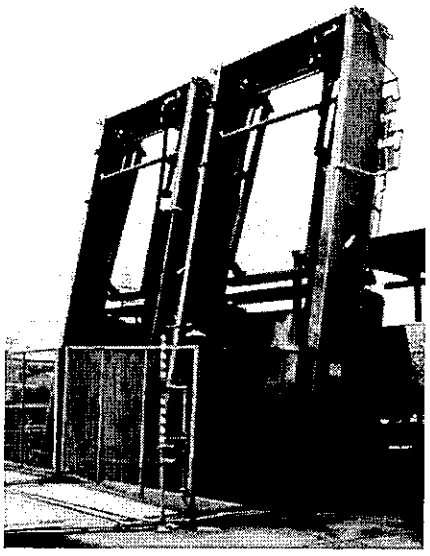
Maximizing screenings capture in the headworks makes sense. Equipment downstream will be more lightly loaded, so it will last longer and have fewer mechanical problems.

Investing in a premium Climber Screen unit from ONDEO Degremont, Inc. also makes sense. Its smooth, vibration-free bilateral pin rack and roller bushing endless track system are designed specifically for linear track application. Along with an involute gear, this system is located above maximum water level for corrosion prevention.

The Climber Screen unit is engineered to last and to be virtually maintenance-free. Finely-tuned components, like the pin racks, custom bearing design, and close tolerance cam tracking pay for themselves in longevity and reduced maintenance costs.

With ONDEO Degremont's Climber Screen mechanical bar screen, owners can avoid the high price of premature failure and early replacement associated with inferior screens. It's the screen of choice for owners who seek to maximize screenings capture while minimizing run time and maintenance.





ONDEO Degremont's Climber Screen® mechanical bar screen can be specified for virtually any flow and any size channel.

Flexible, Durable Design for Any Size Application

Because the Climber Screen is a custom engineered product, flexibility is maximized. It is easily retrofitted in existing plants, often without modification to existing channels.

The unit can be used with bar rack openings as small as 1/4" and as large as 6". Opening widths are based on individual plant flow and debris conditions.

The Climber Screen® mechanical bar screen can be designed to fit virtually any channel width or depth and can be installed at angles from 52°-90°.

ONDEO Degremont offers a choice of four standard duty screens for sanitary applications where there is no CSO contribution. For heavy duty applications, such as CSO, SSO and flows with excessive grit, four severe duty screens are available.

Low Profile Screen

A low profile screen is available for low headroom projects with unusually restricted clearances.

Sequence of Operation

A cycle begins when the drive assembly is activated to remove the screenings deposited on the bar rack. The drive assembly descends from its stopped position with the rake arm in an extended position.

When the cogwheels reach the bottom, they rotate around the bottom of the pin rack, engaging the rake shelf tines with the bar rack. As the cogwheels walk up the pin rack, the rake arm transports the screenings upward toward the discharge position.

Positive Screenings Discharge

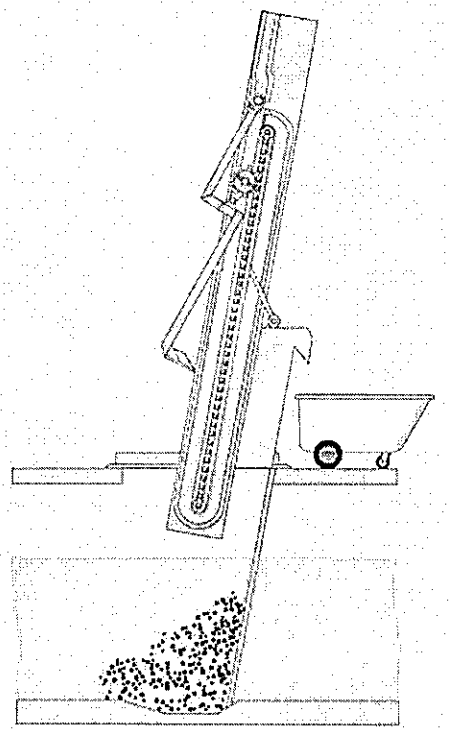
A hinged wiper assembly aids in discharging the screenings from the rake shelf by engaging the shelf as it reaches the discharge point. The rake shelf swings out over the discharge chute and, as it returns, the wiper discharges the screenings onto the chute. This ensures that the screenings fall directly onto the discharge chute and not back into the channel.

The wiper mechanism is equipped with shock absorbers which cushion its descent as it disengages from the edge of the rake. The discharge height may be varied depending on the specific conditions of each project.

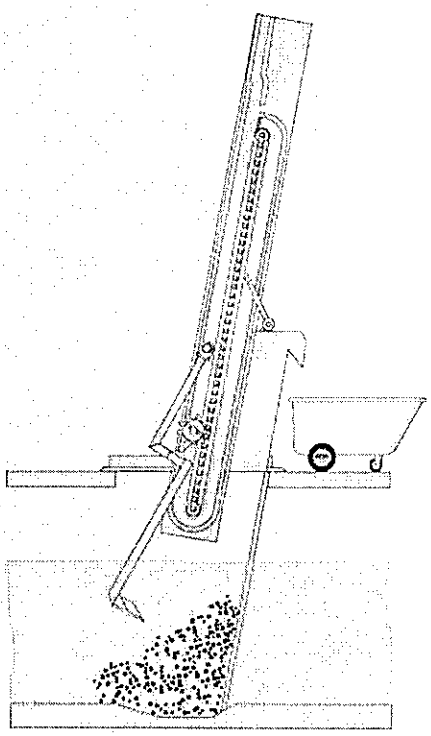
Reversing Capability for Clearing Large Obstructions

If the Climber Screen rake should encounter an object that is too large to be removed, special procedures are automatically initiated. The rake will clear most objects by actually disengaging from the bar rack and then re-engaging the bar rack above the object. Often, such objects can be removed on subsequent passes of the device.

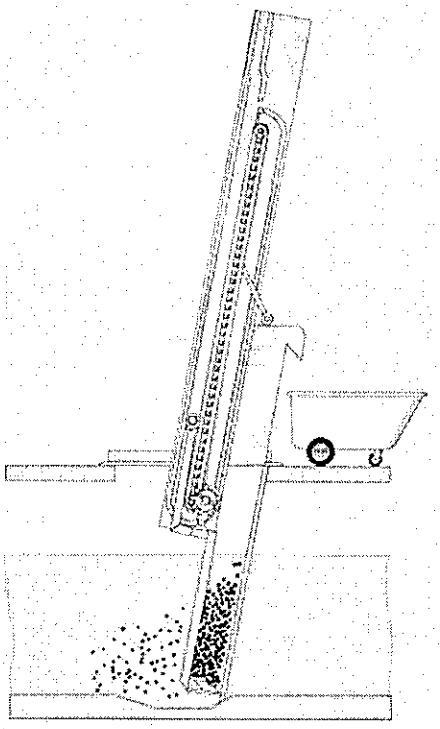
Occasionally, a very large object becomes lodged in the bar rack and the rake cannot avoid it. Under this circumstance, an alarm is activated. The rake unit can then be reversed and removed completely from the channel, facilitating access to the bar rack and manual removal of the object.



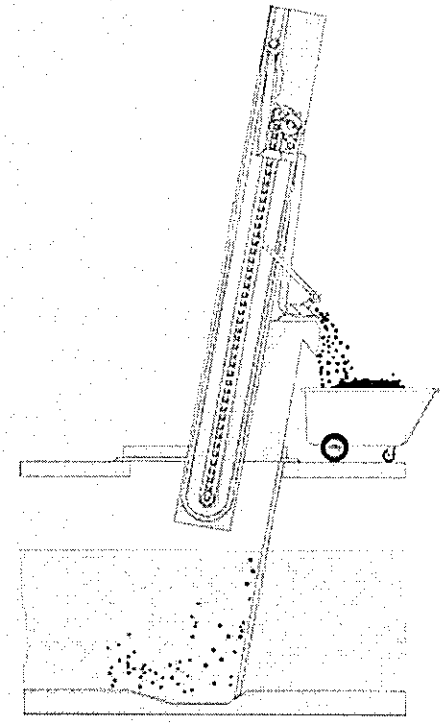
The cleaning cycle begins when the mechanism is activated. The cogwheels move down the pin rack with the rake arm in the extended position.



The rake arm enters the water on the upstream side of the screen in the extended position.

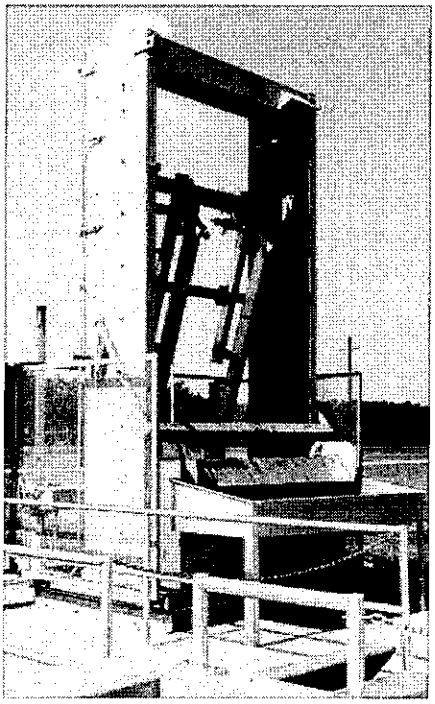


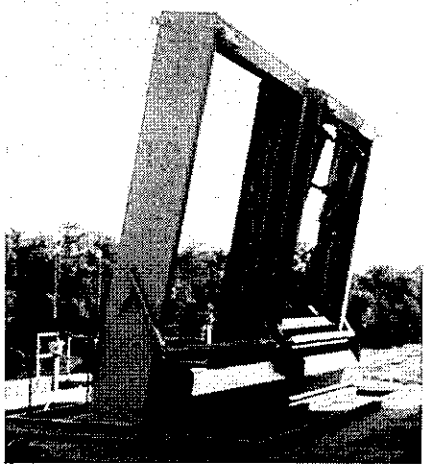
As the cogwheels rotate around the bottom pin of the pin rack, the rake arm engages the tines of the rake arm with the bar rack.



The cogwheels walk up the pin rack and the rake arm transports the screenings up to the discharge chute for disposal.

When it comes to the Climber Screen bar screen, the difference really is in the details. From afar, all suppliers' screens may look similar. But up close, the differences are clear. ONDEO Degremont's Climber Screen® unit is precision engineered component-by-component for dimensional accuracy and longevity. Multiple design features set it apart from ordinary screens.





Heavy Side Frame Construction

A wide, stable 3/8" plate side frame is utilized on all Climber Screen units. A precision-machined spacer block is used to align the pin rack to the side frames and cam tracks.

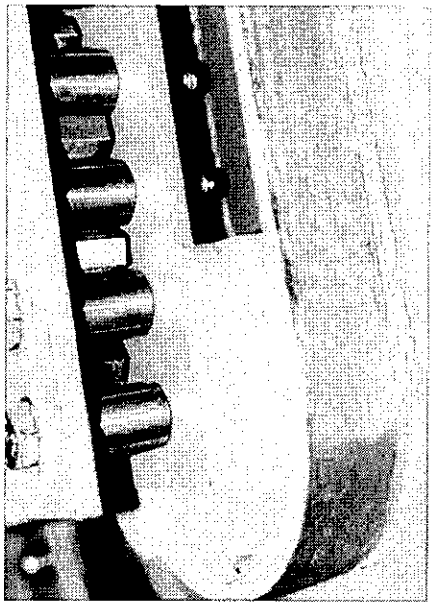
A wrap-around base frame support encases the side frame during transit, erection and startup, ensuring the load imparted to concrete bearing walls is evenly distributed.

Precision Pin Rack Design for Even Wear and Balanced Load

ONDEO Degremont utilizes a precision pin rack and cogwheel design to maximize the distribution of carriage load and minimize wear on pins and gear teeth, thus extending the life of the unit. Each pin is independently located and mounted to ensure close tolerance and ease of removal. The elimination of chain components on the pin rack minimizes carriage vibration, allowing the system to operate with a smooth rolling motion.

The mounting holes on the pin rack side plates are precision located on a boring machine, ensuring a close tolerance on the hole diameter and pitch.

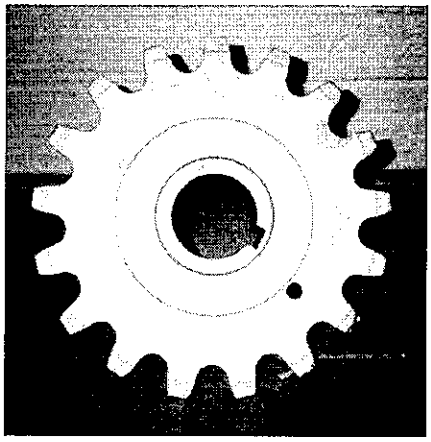
The bright appearance of the pin rack, regardless of age, indicates its smooth, non-wearing mechanical operation.



Nickel Plated Involute Gear

Designed specifically for use on a linear rack, ONDEO Degremont's nickel-plated involute gear ensures that contact between the cog wheel tooth and the pin is smooth and rolling, minimizing wear. Nickel plating was chosen for the involute gear due to its inherent resistance against wear and corrosion.

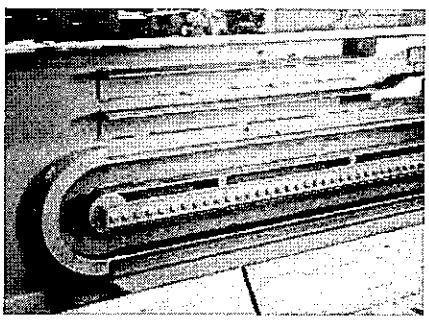
Stability is ensured since two teeth of the involute gear are in almost constant contact with the pin rack.



Cam Track

Excessive wear is prevented partly with the Climber Screen unit's cam track offset guides, which control the rake arm so that it swings out over the conveyor before engaging the wiper assembly. The offset guides are milled from solid steel for added strength and durability.

During periods when heavy debris and obstructions are present, the Climber Screen's standard 1" thick machined end returns are capable of absorbing loads from the carriage assembly, thus sustaining the integrity of the pin rack and tracking.



Precision-machined Components

ONDEO Degremont does not use "off the shelf" components for its screens. Precision machining and close tolerances of Climber Screen components provide years of smooth, trouble-free operation.

One example is the unique torque design of the pin rack mount. When the carriage is at its lowest postion—where grit often accumulates—the stress of the load is transferred back to the pin rack mounting.

ONDEO Degremont's pin racks are machined from solid stock, providing a rigid inner surface for the roller bearings. They also incorporate a machined groove to mount the pin rack side plates and maintain close tolerance between the pin rack, cam follower tracks, and the pitch diameter of the involute gear.

Easy Maintenance and Control

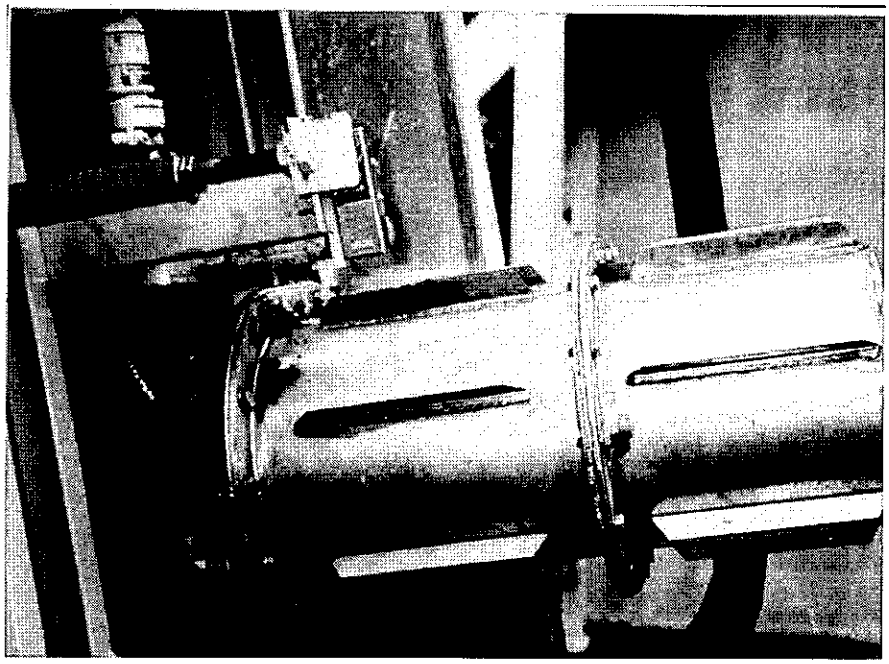
Little preventive maintenance is required with the smooth-running Climber Screen bar screen. When maintenance is required, it is performed at the operating floor level.

Instrumentation Control

The Climber Screen unit's primary control feature is a differential level instrument panel which is backed up by repeat cycle timers. The operator can reset the scquence interval of the timers and the differential level set point to maximize screenings capture.

Integral Brake Motor Gear Box

An integral brake motor allows the unit to be stopped at any level on the pin rack. This feature allows the operator to place the mechanism in the best position for easy, accessible maintenance. When the unit is not in operation, the drive assembly remains at the top, above the operating floor and out of the channel flow.



Motor Submergence Protection

Frequently, despite careful design considerations, maximumwater levels are exceeded, posing a threat to the carriage-mounted drive motor. To respond to this threat ONDEO Degremont offers the following options.

Auto-Retreat™/Auto-Reverse™

ONDEO Degremont's Auto-Retreat™ system is comprised of a carriage mounted level probe that senses an abnormally high water level in the inlet channel. If an increase in the water level above the maximum designated level occurs, an alarm will sound and the system will initiate the retreat of the carriage to the park position via the shortest path.

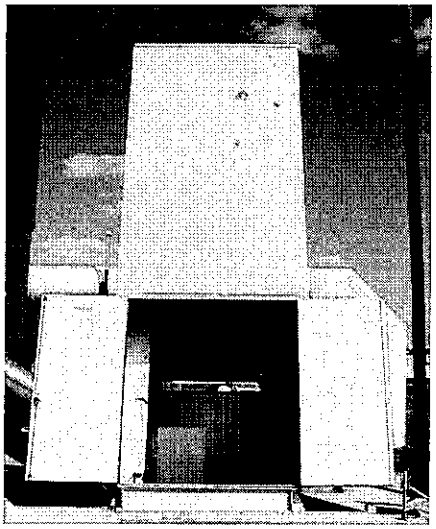
Another means to prevent the motor from becoming submerged is ONDEO Degremont's Auto-Reverse™ system. The Auto-Reverse™ system provides overload protection against objects that are too large for the unit to bypass. During an overload condition, excessive rotation of the rake arm will cause the motor to stop and automatically reverse the carriage to the park position. This feature is essential when impassable debris restricts flow through the bar rack, causing the water to rise above the maximum designated level.

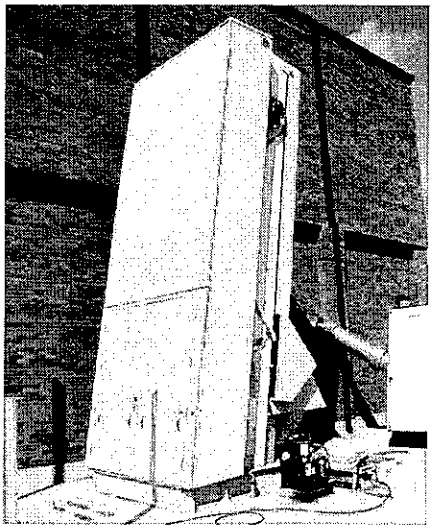
Patented Motor Enclosure

In applications where submergence is an occasional occurrence, ONDEO Degremont offers its submersible motor enclosure. The housing is comprised of two stainless steel sections for maintenance accessibility, gasketing, and heat dissipation.

Hydraulic Drive

A hydraulic drive systemoption is available for installations where the potential exists for frequent motor submergence.

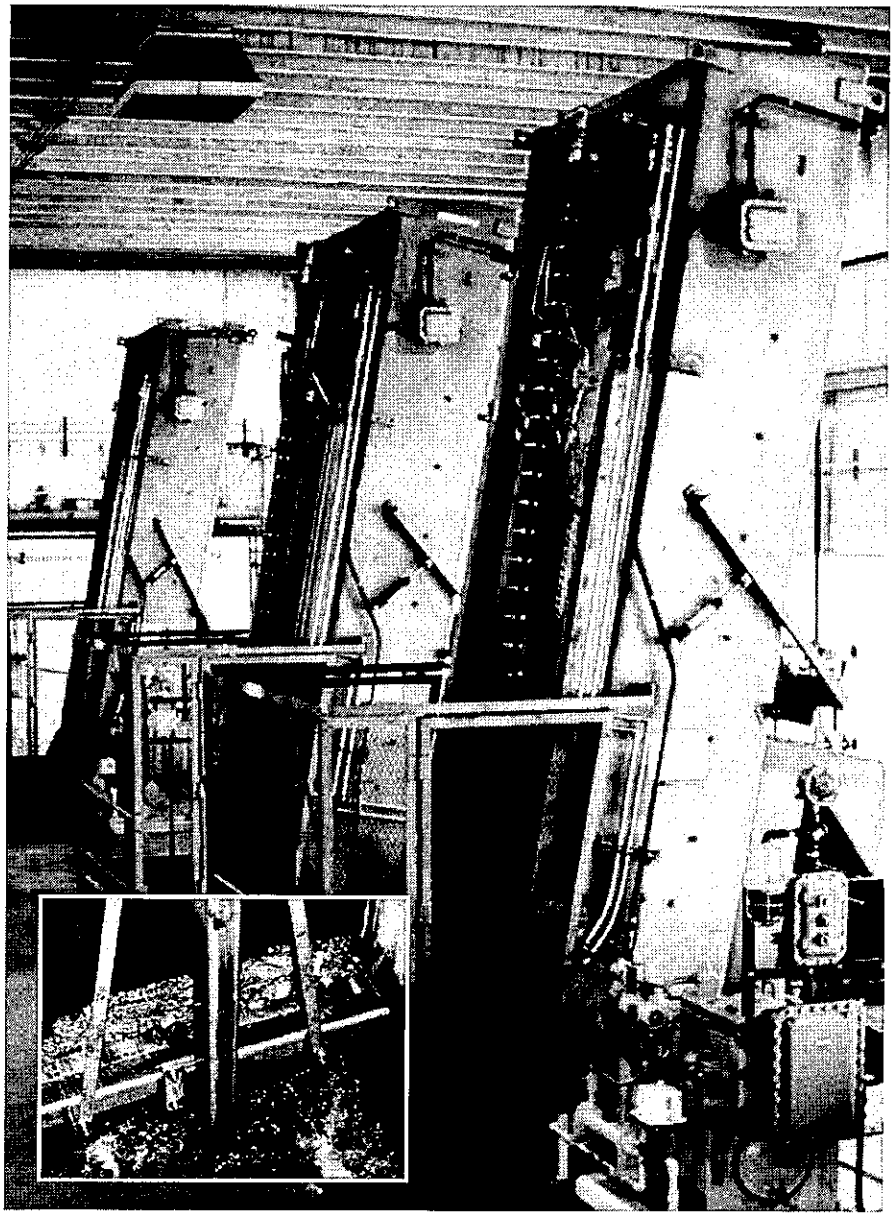




Custom Enclosures

Headworks screens are often located in buildings for the purpose of aesthetics and odor control. A custom enclosure by ONDEO Degremont is a functional, attractive alternative that provides odor control and conserves floor space.

This fiberglass enclosure encases the bar screen, yet it still allows easy access for maintenance and control.



With over two decades of successful operating experience as a guide, ONDEO Degremont has continually added improvements and refinements to its Climber Screen® unit.

Each additional feature has served to increase the unit's versatility and reliability, while achieving even lower maintenance costs. Features like automatic lubrication of all roller bearings and shock absorbers on the wiper assembly are popular with operators.

The many imitations of today's Climber Screen® device bear testimony to its success, but none approaches its quality. Thousands of installations provide positive proof to the excellence of the Climber Screen® mechanically cleaned bar screen. ONDEO Degremont's engineering and the experience of thousands of units ... an unbeatable combination.

USA Headquarters

ONDEO Degremont, Inc.
P.O. Box 71390
Richmond, Virginia 23255-1390 USA
2924 Emerywood Parkway
Richmond, VA 23294 USA
Telephone: (804) 756-7600
Telefax: (804) 756-7643
E-mail: info@ondeo-degremont-usa.com
www.ondeo-degremont-usa.com

Manufacturer's Representatives in most major cities

USA Affiliates

Degrémont North American Research and Development Center
P.O. Box 26442
Richmond, VA 23261-6442
Telephone: (804) 225-0778
Telefax: (804) 225-8121

Ozonia North America
P.O. Box 455
491 Edward H. Ross Drive
Elmwood, NJ 07407 USA
Telephone: (201) 794-3100
Telefax: (201) 794-3358

Anderson Water Systems
44 Head Street, Dundas
Ontario L9H 3H3 Canada
Phone: (905) 627-9233
Fax: (905) 628-6623

North American Affiliates

ONDEO Degrémont Ltée.
1375, route Transcanadienne #400
Dorval, Québec H9P 2W8
Telephone: (514) 683-1200
Telefax: (514) 683-1203
E-mail: info@degremontna.ca

ONDEO Degrémont de Mexico S.A de C.V.
Bahia de Santa Barbara No. 157
Col. Veronica Anzures
C.P. 11300 Mexico, D.F.
Telephone: (525) 255-9000
Telefax: (525) 260-1377

World Headquarters

ONDEO Degrémont, S.A.
183 avenue du 18 juin 1940
92508 Rueil-Malmaison
France
Telephone: 33 1 46 25 60 00
Telefax: 33 1 42 04 16 99

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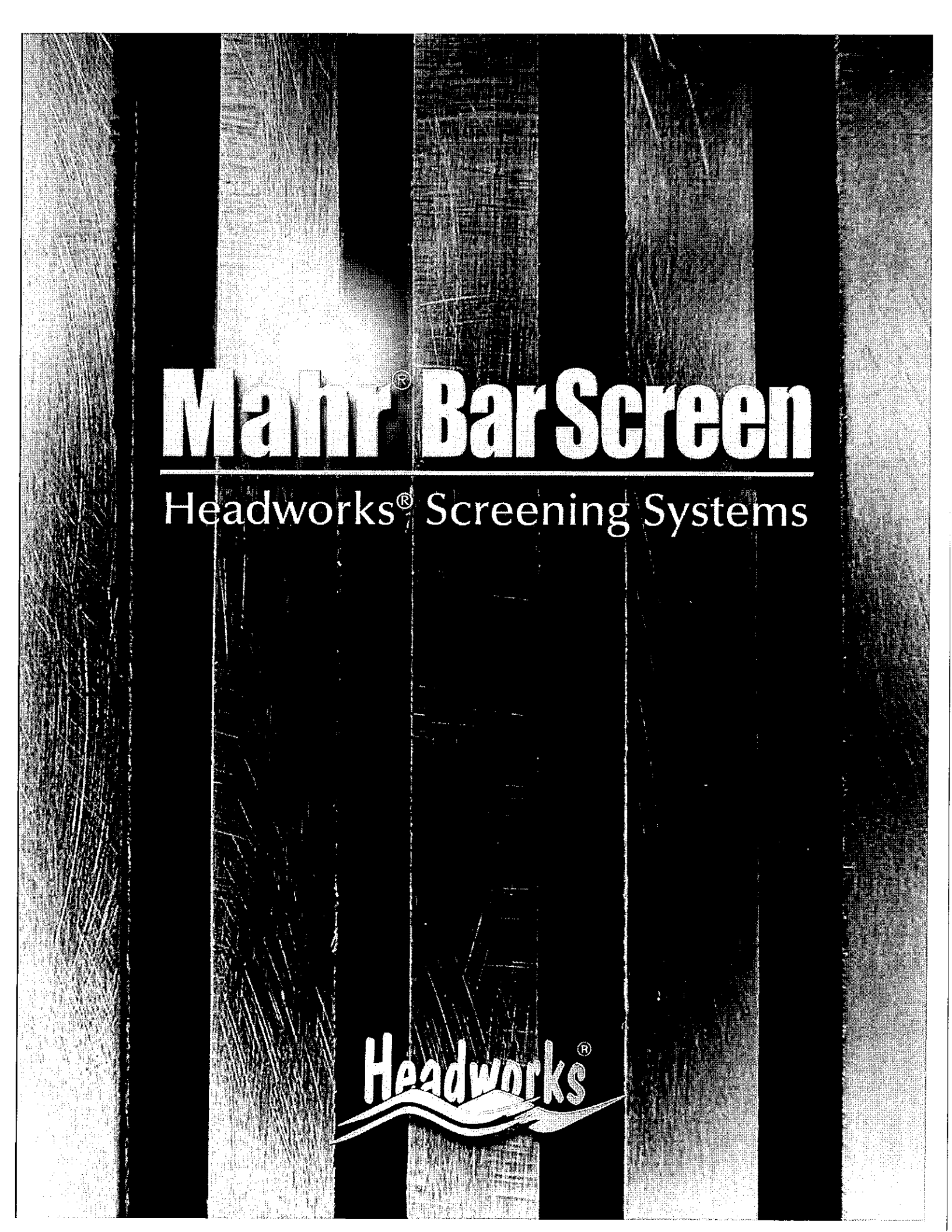
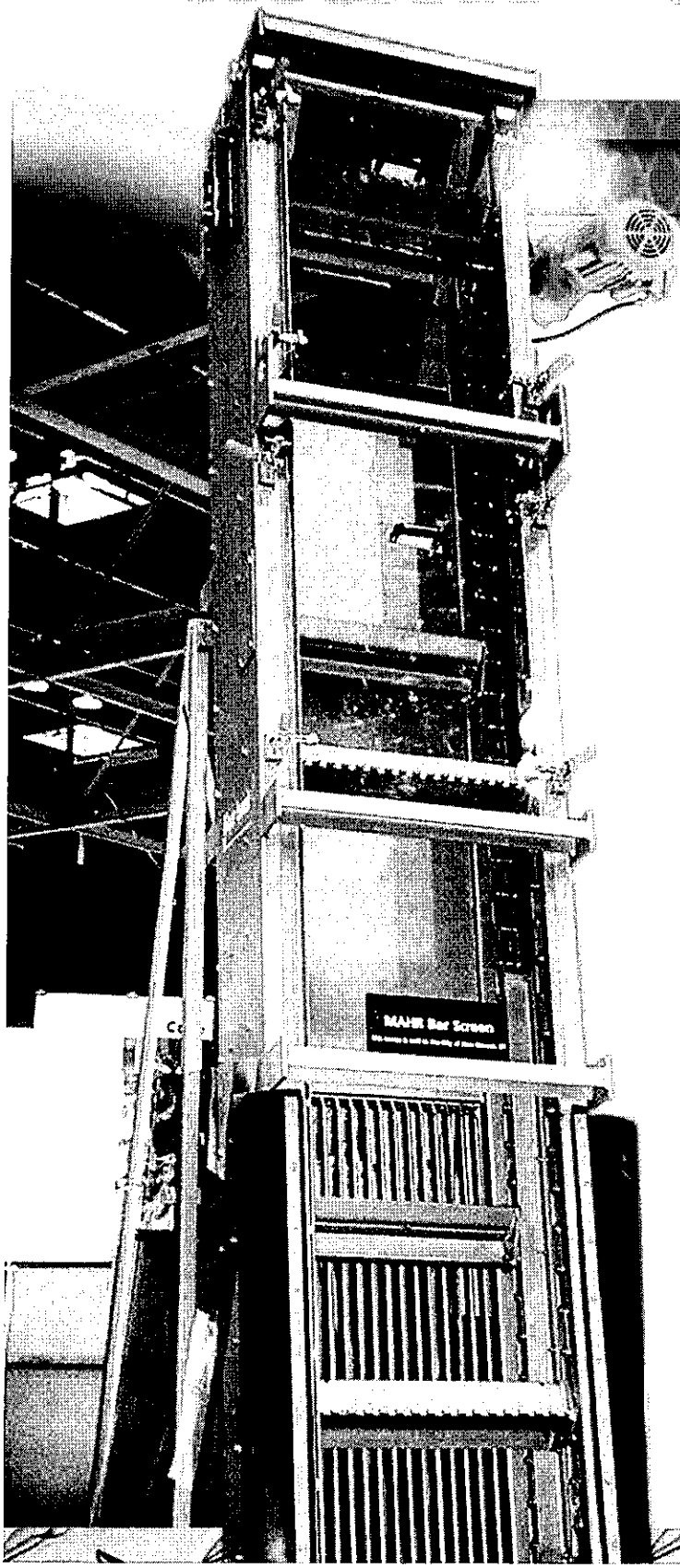

Mahr® BarScreen
Headworks® Screening Systems
Headworks®

Mahr® Bar Screen

The First: Still Setting the Standard



- Two in one solution: strength of a coarse screen, performance of a fine screen
- Openings as fine as 3/16" (4mm)
- Patented jam protection clears obstructions automatically
- Variable speed operation handles high solids loading
- Hydraulic capacity of 2 MGD/ft² (1m³/s/m²) of screenfield area
- Lowest headloss in the industry
- Positive rake engagement
- DBO's equipment of choice
- Individually replaceable screenfield bars
- All stainless steel construction
- Lowest lifecycle cost

Go to **www.headworksusa.com** to receive a budgetary proposal for your Mahr Bar Screen application.

Seeing is Believing™

Advances in water and wastewater treatment processes, increased regulations, and wide acceptance of MBR, MBBR, and IFAS treatment processes within the industry have driven the need for fine screening devices. For over twenty years, the Mahr Bar Screen, an all stainless steel, front raked, front return bar screen, is the benchmark for the industry with proven reliability. Even in the toughest applications, such as deep channels, high flows, combined sewers with large debris, Mahr Bar Screens operate consistently day after day. Robust craftsmanship reduces capital costs by delivering coarse bar screening durability together with fine screen separation.

Experience: With hundreds of Mahr Bar Screen units installed around the world, Headworks' global experience runs the gamut of applications: from small package plants to screening units as long as 150 feet (45m). The ability to handle over 200 MGD (8.8m³/s) per screen is no challenge for the powerful Mahr Bar Screen. Its robust construction makes it the replacement equipment of choice for tough applications where other screens have failed.

Durability: Headworks is often asked how long our equipment lasts – a question we can't answer as we have yet to see any of our screens fail! Tried and tested screens have been operating in the field, trouble free, for decades. In 1980, the first Mahr Bar Screen was installed in Vienna, Austria, in a pump station under the Danube River. This very same screen is currently still in operation. The state of the art technology incorporated into our equipment today is built on many of the original robust design traits.

Smart Screen™ Automatic Jam Protection: The patented reversing feature automatically clears obstructions lodged in the screenfield over 90% of the time without operator involvement. The VFD and PLC controls sense the obstruction and reverse the rake direction. Thus, the rake above the obstruction is forced down on the jammed object. This reverse pressure either successfully dislodges the object or the cycle is repeated in the forward direction. This 'shuttling' motion is repeated up to four times. In the rare event that the obstruction remains, an alarm sounds for the operator and the machine shuts down, protecting the equipment.

Rapid Cleaning Cycle Equals No Blinding: The rakes engage into the screenfield every 5 to 10 seconds depending on flow conditions keeping the screenfield clean. This eliminates the possibilities of blinding and the associated risks of flooding.

Minimal Headroom Requirements: The Mahr Bar Screen requires less than 8 feet (2.4m) of overhead clearance, regardless of channel depth, making it ideal for indoor installations.

Rake Operation: The multiple rake bar teeth positively engage with the screenfield bars even with openings as fine as 3/16" (4mm). The rakes travel in a continuous circuit from the bottom of the channel, up the bar rack and past the debris plate. The screenings are simply scraped off the rake bars into the discharge chute and dropped into a conveyor, compactor or dumpster. The design eliminates the possibility of solids carryover and can easily be totally enclosed for improved odor control and hygiene.

Stainless Steel Roller Chains: The multiple rake bars are mounted on all stainless steel true roller chains. The chains are engineered for continuous, submerged duty without any lubrication and run within tracks on both sides of the self contained frame.

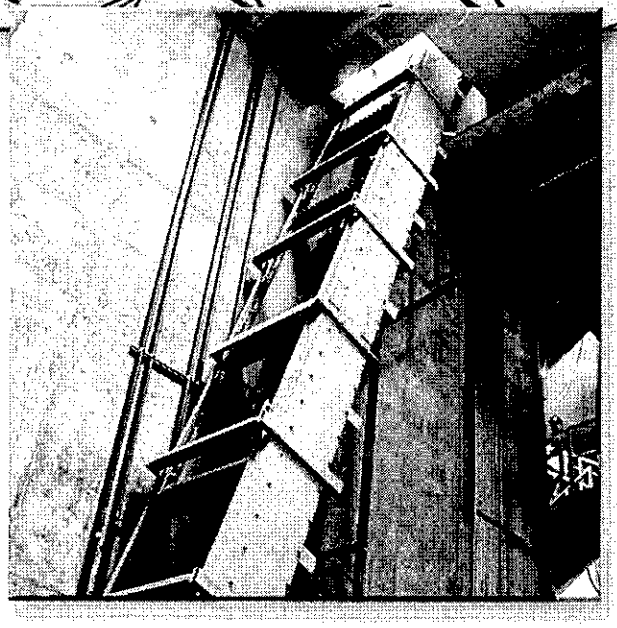
Lowest Headloss in the Industry: Headworks was the first to standardize the use of tapered or trapezoidal shaped screenfield bars into the market. The shape of the bars, together with the rapid cleaning cycle, eliminates blinding factors when sizing applications needs. Thus, headloss across the screen can be as low as 2" (5cm) at 50 MGD (2m³/s) or higher. The Mahr Bar Screen comes with patented replaceable bars.

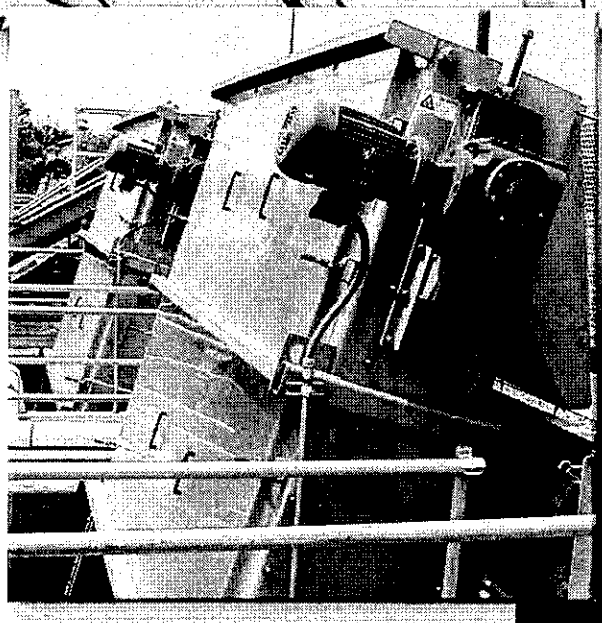
No Lower Bearing Maintenance: The Mahr Bar Screen utilizes either a lower turnaround or a sprocket assembly. The lower sprocket assembly utilizes an exclusive self-lubricating ceramic bearing. The assembly is maintenance free, highly wear resistant and covered by a standard 5-year warranty. Units have been in operation for over 10 years without a single part being replaced.

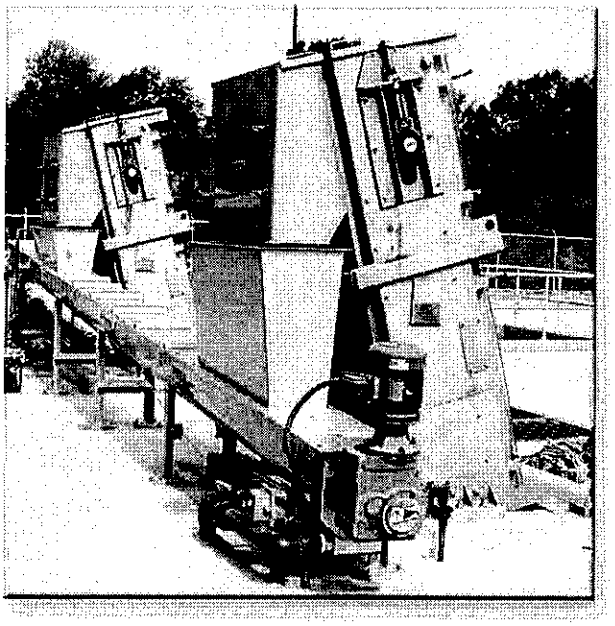
Easy Installation: The Mahr Bar Screens robust design is fully assembled at the factory. On site, the screen is simply dropped into the channel. Flanged units are also available for applications with restricted access. The sections are simply bolted together during installation and lowered into the channel.

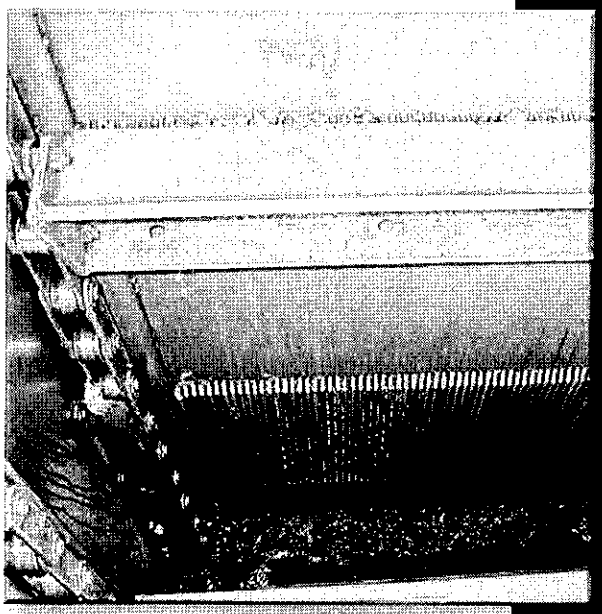
Five Year Limited Warranty

Many of the exclusive features of the Headworks equipment are either patented or patent pending.



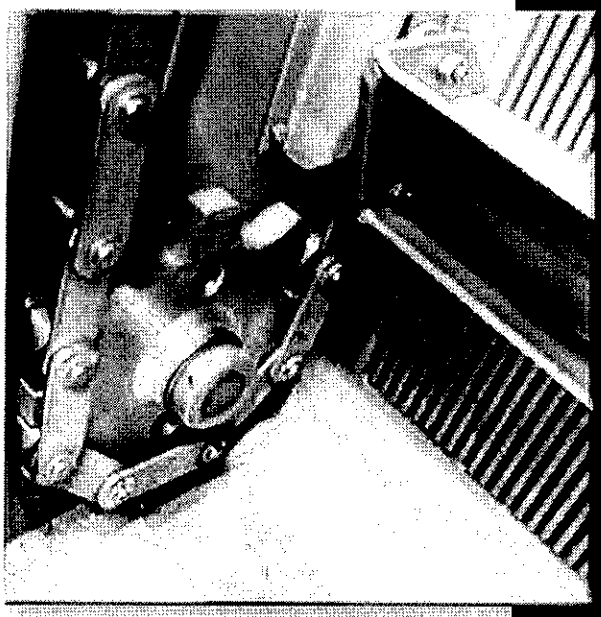


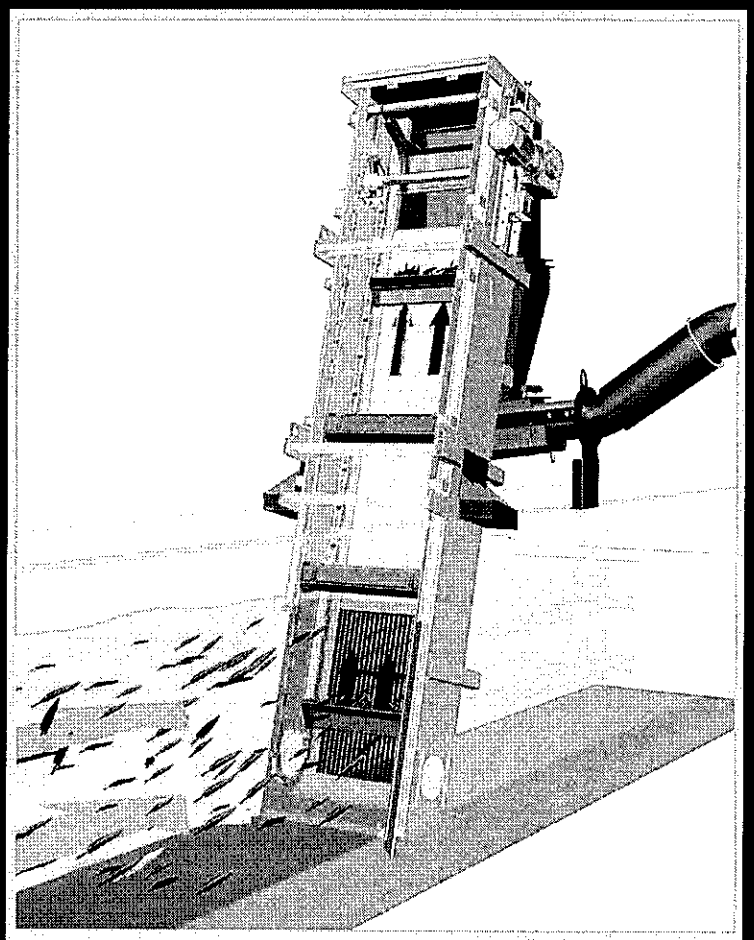




Cost Effective!

- Low lifecycle costs
- Low maintenance
- Low installation costs
- Easy retrofit
- Highly efficient
- Two in one solution





Multiple rakes engage into the screenfield every 5 to 10 seconds depending on flow conditions to keep the screenfield clean.

Headworks®

800 Wilcrest, Suite 340 | Houston, Texas 77042 | USA
Phone: +1.713.647.6667 | Fax: +1.713.647.0999 | E mail: hw@headworksusa.com
www.headworksusa.com