

JOHANNESBURG WATER (SOC) Ltd.

BULK WASTEWATER

PARTICULAR SPECIFICATION

M01: H.O.W MECHANICAL SCREENING EQUIPMENT



Johannesburg Water (SOC) Ltd.
PO Box 61542
Marshalltown
2107




DOCUMENT CONTROL SHEET

Document Title: Particular Specification – M01: H.O.W MECHANICAL SCREENING EQUIPMENT

JW Reference:

Document Ref. No: **M01**

DOCUMENT APPROVAL

ACTION	FUNCTION	NAME	DATE	SIGNATURE
Prepared	Mechanical Engineer (Hatch)	Mbongiseni Mahlangu, Pr Eng.	01.06.2022	
Reviewed	Project Manager (Hatch)	Johan Prinsloo, Pr Eng.	01.06.2022	
Approved	JW Best Practice Manager	Rendani Davhana	13/06/2022	

RECORD OF REVISIONS

Date	Revision	Author	Comments
2021-09-17	5	J Prinsloo	Detailed Review
2013-10-23	4	J Ritchie	Minor updates and re-issued
2012-07-30	3	T Wellard	General review
2010-02-16	2	J Ritchie	General review
2009-05-12	1		Review of Mechanical / Electrical and Control / Instrumentation Standards, plus New Design Guidance

PARTICULAR SPECIFICATION: M01: H.O.W MECHANICAL SCREENING EQUIPMENT

CONTENTS

M01.1	SCOPE	5
M01.2	INTERPRETATIONS	5
M01.2.1	Definitions	5
M01.3	ABBREVIATIONS.....	6
M01.3.1	Standards	7
M01.3.2	Other Referenced Particular Specification	8
M01.4	DESIGN OF SCREENS	9
M01.4.1	General Design Parameters	9
M01.4.2	Specific Design Parameters	9
M01.4.3	Head of Works (HoW) Screens Design Parameters	9
M01.4.4	Head of Work (HOW) Screen Isolation	10
M01.4.5	Types of Screens.....	10
M01.5	COARSE HAND RAKE SCREEN(S) (WHERE APPLICABLE).....	11
M01.5.1	Design and Performance Requirements	11
M01.5.2	Coarse Hand Rake Screen Material of Construction	11
M01.6	COARSE HAND RAKE SCREEN(S) IN EMERGENCY BYPASS CHANNELS	11
M01.6.1	Design and Performance Requirements	11
M01.6.2	Coarse Hand Rake Screen in Emergency Bypass Channel Material of Construction.....	12
M01.7	TRASH RAKE SCREEN(S)	12
M01.7.1	Design and Performance Requirements	12
M01.7.2	Trash Rake Screen in Emergency Bypass Channel Material of Construction	13
M01.7.3	Equipment Design Features	14
M01.8	MECHANICAL (COARSE INCLINED FRONT RAKE BAR) SCREEN(S)	15
M01.8.1	Design and Performance Requirements	15
M01.8.2	Equipment Design Features	16
M01.8.3	Materials of Construction	19
M01.9	FINE PERFORATED SCREEN(S).....	19
M01.9.1	Design and Performance Requirements	19
M01.9.2	Materials of Construction	20
M01.9.3	Equipment Design Features	21
M01.10	SCREENINGS CONVEYOR	22
M01.10.1	General Specification.....	22
M01.10.2	Covered screw type conveyor:	23
M01.10.3	Covered Hydro Conveyors	24
M01.11	SCREW WASHER COMPACTOR	26
M01.11.1	General	26
M01.11.2	Design Parameters.....	26
M01.11.3	Helical Shaft Screws	27
M01.11.4	Trough	27
M01.11.5	Drive Unit	27
M01.11.6	Screw Wash Compactor Material of Construction	27
M01.12	FASTENERS.....	28
M01.13	RECOMMENDED SPARES AND SPECIAL TOOLS	29

M01.14	GUARANTEE OF PERFORMANCE	29
M01.15	CORROSION PROTECTION.....	29
M01.16	COLOUR CODES	29
M01.17	QUALITY MANAGEMENT (QM) AND QUALITY ASSURANCE	29
M01.17.1	General	29
M01.17.2	Material Tests	30
M01.17.3	Type Tests.....	31
M01.17.4	Manufacture	31
M01.17.5	Installation	31
M01.18	SYSTEM PERFORMANCE	31
M01.18.1	Works Testing.....	31
M01.18.2	Before Commissioning	32
M01.18.3	During Commissioning.....	32
M01.18.4	Before expiry of the Defects Liability Period.....	32
M01.18.5	Substandard Quality Control	32
M01.18.6	Access for Surveillance.....	32
M01.19	EQUIPMENT TRAINING PROCEDURE.....	32
M01.20	OPERATION AND MAINTENANCE MANUAL SUMMARY	33
M01.21	INTERCHANGEABILITY	33
M01.22	DRAWINGS	33
M01.23	MEASUREMENT AND PAYMENT	34
M01.23.1	General	34
M01.23.2	Supply and delivery to site with documentation	34
M01.23.3	Installation, Testing and Commissioning of the Equipment.....	34
M01.23.4	Trial Operations.....	35
M01.23.5	Employer's Operator Training.....	35
M01.23.6	Spares Equipment.....	35

M01.1 SCOPE

This specification covers detailed design parameters, manufacture, supply, off-loading on site installation, testing and commissioning of “trash” screens, inclined coarse mechanical front raked screens, screenings conveyor and screenings screw compactor for the screening of raw sewage incoming to a wastewater treatment works. The Specification shall be read in conjunction with the Project Specification and other relevant Particular Specifications.

M01.2 INTERPRETATIONS

This specification shall be interpreted as follows:

- For the Employer design components, it shall be regarded as a specification.
- For the Contractor design components obligations, it shall be regarded as an Employer's requirements.

M01.2.1 Definitions

For the purpose of this Specification the following definitions apply:

- a) “**Manufacture**” includes, as applicable, the purchase of materials or goods, fabrication and assembly, any specified corrosion protection measures and any off-site inspection or testing of materials or parts.
- b) “**Supply**” includes, as applicable, the purchase of materials or goods, manufacture and fabrication, any specified corrosion protection measures and all required off-site inspection or testing.
- c) “**Installation**” includes, as applicable, all handling and transport from storage, erection and aligning of Works.
- d) “**Factory Acceptance Test (FAT)**” shall refer to all tests done on Plant or Plant items at the factory to ensure its functionality
- e) “**Screenings**” shall refer to all debris or solid materials removed from the influent raw sewage in a wastewater treatment plant.
- f) “**Trash Screen**” shall refer a mechanical screen with a minimum of 100mm bar spacing raked by a mechanical device, which is installed upstream of the coarse mechanical screens to remove large and heavy objects
- g) “**Coarse Screen**” shall refer to a bar screen with a 12mm bar screen spacing which can be either mechanically or manually raked installed at an angle sufficient for ease of screening removal.
- h) “**Screenfield**” shall refer to the portion of any screen type where screening of wastewater will take place on the effective screening area of the screen.
- i) “**Fine Screen**” shall refer to a perforated screen with a screen perforation diameter of 6mm which is driven by a mechanical system to remove the screenings.

M01.3

ABBREVIATIONS

In this Specification the following abbreviations will apply:-

°C	: Temperature in degrees Celsius
A	: Ampere
AC	: Alternating Current
AGMA	: American Gear Manufactures Association
ANSI	: American National Standards Institute
API	: American Petroleum Institute
ASCE	: American Society of Civil Engineers
ASME	: American Society of Mechanical Engineers
ASTM	: American Society for Testing and Materials
BS	: British Standards Institution
BSPT	: British Standard pipe thread
CAD	: Computer Aided Drawing
CAM	: Computer Aided Manufacturing
CIP	: Cleaning in Place
COC	: Certificate of Conformance
Dia	: Diameter
dB(A)	: Sound pressure level, "A" weighed in decibels
DCS	: Distributed Control System
DFT	: Dry Film Thickness
DIN	: Deutsch Industry Normen
DN	: Nominal diameter
DP	: Differential Pressure
Eff.	: Filter efficiency in %
EPDM	: Ethylene Propylène Diène Monomer
ERW	: Electrical resistance weld
ETP	: Effluent Treatment Plant
FA	: Flange adaptor
FAT	: Factory Acceptance Tests
FBE	: Flanged both ends
FOE	: Flanged one end
FW	: Field weld
HDPE	: High Density Polyethylene
HoW	: Head of Works
ID	: Inside diameter
ISO	: International Organisation for Standardization
JW	: Johannesburg Water
ℓ/s	: Flow in litres per second
LV	: Low Voltage
m	: Distance in metre
m.a.s.l	: Metres above (mean) sea level
m/s	: Speed in metres per second
MCC	: Motor Control Centre
mm	: Dimension in millimetres
MPVC	: Modified Polyvinyl Chloride Pipes
MV	: Medium Voltage
N+1	: No of units in operation + 1 installed spare

Nm ³ /hr	: Normal cubic meters per hour
O&M	: Operation and Maintenance
OD	: Outside diameter
OHS	: Occupational Health and Safety
Pa	: Pressure in Pascals
PBE	: Plain both ends
PE	: Plain end
PN	: Nominal pressure (Rating)
PPE	: Personal Protective Equipment
PQP	: Project Quality Plan
PSV	: Pressure Safety Valve
QCP	: Quality Control Plan
RFA	: Restrained flange adaptor
rpm	: Rotational speed in revolutions per minute
SAECC	: South African Electrolytic Corrosion Committee
SANS	: South African National Standards
SAT	: Site Acceptance Tests
SAW	: Submerged arc weld
SCADA	: Supervisory Control and Data Acquisition
SIS	: Swedish Institute of Standards
SOC	: Slip-on coupling
SS	: Stainless Steel
STP	: Standard Temperature and Pressure (i.e. T = 20°C, P = 101, 3 kPa).
w.t.	: Wall thickness of pipes
TDS	: Total Dissolved Solids
uPVC	: Unplasticised Polyvinyl Chloride
VSD	: Variable Speed Drive
WP (B)	: Weld preparation (Butt)

M01.3.1

Standards

All design standards for the front raked screen equipment shall be subject to the latest amendments and editions of the following standard specifications: -

SANS 10400	: National Building Regulations
(PD 5304:2014)	: Guidance on safe use of machinery (British Standards Institution)
SANS 9606-1	: Testing of welders, where applicable to the type of welding required
BS ISO1312-1:2018	: Rolling bearings. Accessories for sleeve type linear ball bearings. Boundary dimensions, geometrical product specifications (GPS) and tolerances for series 1 and 3 (British Standards Institution)
SANS 10162-4	: Structural use of Steel Part 4: The design of cold-formed stainless steel structural
SANS 15614-1	: Specification and qualification of welding procedures for metallic materials - Welding procedure test Part 1: Arc and

	gas welding of steels and arc welding of nickel and nickel alloys.
SANS 10064	: The preparation of steel surfaces for coating
SANS 10102-14	: Selection of pipes for buried pipelines Part 1: General Provisions
SANS 10104	: Hand railing and balustrading (safety aspects)
SANS 10111-2-1	: Engineering Drawing Part 1: General principles Engineering Drawing Part 2: Geometric Tolerancing Section 1
SANS 10341	: Installation and maintenance of bearings – General guidelines
SANS 1700-5-9	: Fasteners Part 5: General requirements & material properties Section 8: Corrosion resistant stainless-steel fasteners-Bolts, Screws & Studs
SANS 1700-5-10	: Fasteners Part 5: General requirements & material properties Section 8: Corrosion resistant stainless-steel fasteners-Nuts
ISO 281	: Rolling bearings -- Dynamic load ratings and rating life (International Organization for Standardization)
BS 4999	: General requirements for rotating electrical machines. Specification for standard dimensions (British Standards Institution)
SIS 05 59 00	: Pictorial Surface Preparation Standards for Painting Steel Surface (Swedish Standards Institution)

M01.3.2

Other Referenced Particular Specification

This particular specification must be read in conjunction with the following specifications:-

E01: Particular Specification for Electric Motors

E03: Particular Specification for Isolator Push Button

G01: Particular Specification for Colour Codes

G02: Particular Specification for Corrosion Protection

M08: Particular Specification for Gearboxes

M16: Particular Specification for Conveyor Equipment

M17: Particular Specification for Actuator equipment

M34: Particular Specification for Sluice Gates, Adjustable Weirs and Hand Stops

Volume 1: Automation and Control Design Standards SCADA

Volume 6: Automation and Control Design Standards Cabling

Volume 9: Automation and Control Design Standards Level Measurement

M01.4 DESIGN OF SCREENS

M01.4.1 General Design Parameters

The Screening equipment shall be designed such that the following requirements are met:-

- To ensure reasonable standards of engineering in design, materials selection and construction processes.
- To facilitate manufacture, inspection, installation, maintenance, cleaning and repairs,
- Ensure safe and satisfactory operation for an acceptable life expectation of 15 years under the ambient conditions prevailing at the Site,
- The offered equipment shall be support in forms of spares by the original equipment manufacturer for at least 15 years in alignment with the specified life expectation of 15 years from project installation.
- The minimum availability of the equipment shall be 99 %;
- Prevent undue stresses being produced by expansion due to temperature changes,
- Keep maintenance costs to a minimum that represent the value for money in both the initial purchase and subsequent running costs.
- To comply with the legal such as the Occupational Health & Safety Act no. 85 of 1993 and Regulations requirements in respect of safety as well as the prevention of water and air pollution,
- To satisfy any specific requirement contained in the latest editions of the published statutory codes and legislation,
- Suitable for operation 365 days per year, 24 hours per day under specified design conditions, and
- To operate without undue vibration and excessive noise with maximum noise level of 75dBA measured at 1 metre generated from operating the equipment.

M01.4.2 Specific Design Parameters

The screening equipment shall remove the screenings from raw sewage to minimise the subsequent damage to equipment or that may result in unsatisfactory operation of downstream unit processes. This shall be considered as a pre-treatment process.

The influent characteristics received at the Head of Works (HoW) for the particular wastewater treatment works shall be given in the Project Specification.

M01.4.3 Head of Works (HoW) Screens Design Parameters

The design loads of the screenings for the head of works screens shall be based on the influent sewage characteristics at the particular wastewater treatment works.

The average daily screenings production rate is 0.025 m³ of dry screenings per mega litres.

The peak screening production shall be equal to 5 times that of the average daily load.

The inflow channel shall not be divided into more than two channels at any division of a channel to maintain the minimum required inlet flow velocity. No fewer than two

screens shall be in parallel, but the total number of screens shall be based on the influent flow characteristics or in accordance with and the project specification, the screening design shall be subject to approval by the Employer's Agent or employer's Representatives.

M01.4.4 Head of Work (HOW) Screen Isolation

The head of works screens are to be supplied with an Isolation gates as referenced in the M34 particular specification upstream and downstream of each screen for ease of isolation.

M01.4.5 Types of Screens

The incoming wastewater flow from the main sewer outfall to the Head of Works shall split into channels and screening sections. Refer to the Project Specific plant layout Tender Drawings.

Five (5) Types of bar screens are covered under this particular specification namely: -

1. Coarse Hand Rake Screen(s) (where applicable)
2. Coarse Hand Rake Screen(s) in Emergency Bypass Channels
3. Trash rake screen(s)
4. Coarse Inclined Front Rake Bar Screen(s)s (mechanical screen)
5. Fine or Perforated Screen(s)

NB. Inclined **Back** Rake Screens will not be considered.

M01.5 COARSE HAND RAKE SCREEN(S) (WHERE APPLICABLE)

M01.5.1 Design and Performance Requirements

1. Screenfield bars having a clear spacing between the bars of 100 mm minimum shall be installed at the head of works. with a minimum bar width of 10mm and a minimum depth of 40mm.
2. Manually hand raked screens shall be installed at an inclination of 60° from the horizontal unless otherwise specified in the Project Specification, not more than a convenient raking distance of 2m. A suitable lightweight rake shall be provided with the hand rake screen.
3. The bar screen and framework support shall be designed to withstand forces at peak flow with the screen 100% blinded at the water elevations shown on the Tender drawings.
4. The bar rack screen shall be manufactured from the bar sections with the longer dimension parallel to the flow. Bars shall be offset from the supports by a length sufficient to allow for full penetration of the rake teeth. Bars welded or directly connected to the horizontal supports shall not be acceptable.
5. The screen shall be supplied with a perforated drip tray to which the screenings will be deposited into when raked. The drip tray shall allow the conveyance of the screenings into the provided conveyor or skip bag as detailed in the project specification. The drip tray shall be wide enough to be able to accommodate the screening production from each screen.

M01.5.2 Coarse Hand Rake Screen Material of Construction

Coarse Hand Rake Screen components shall be constructed of the material specified in the following Table 5-1:

Table 5-1 Coarse Hand Rake Screen Material Specifications:

COMPONENT	MATERIAL TYPE
Bar Screen	304 L stainless steel
Support frame, walkways and handrails	304 L stainless steel
Drip tray (If Not Concrete Design)	304 L stainless steel
Rake	Aluminium

M01.6 COARSE HAND RAKE SCREEN(S) IN EMERGENCY BYPASS CHANNELS

M01.6.1 Design and Performance Requirements

1. Screenfield bars having a clear spacing between the bars of 100 mm minimum shall be installed at the head of works. with a minimum bar width of 10mm and a minimum depth of 40mm.
2. Manually hand raked screens shall be installed at an inclination of 60° from the horizontal unless otherwise specified in the Project Specification, not more than a convenient raking distance of 2m. A suitable lightweight rake shall be provided with the hand rake screen.
3. The bar screen and framework support shall be designed to withstand forces at peak flow with the screen 100% blinded at the water elevations shown on the Tender drawings.
4. The bar rack screen shall be manufactured from the bar sections with the longer dimension parallel to the flow. Bars shall be offset from the supports by a length sufficient to allow for full penetration of the rake teeth. Bars welded or

- directly connected to the horizontal supports shall not be acceptable.
5. The screen shall be supplied with a perforated drip tray to which the screenings will be deposited into when raked. The drip tray shall allow the conveyance of the screenings into the provided conveyor or skip bag as detailed in the project specification. The drip tray shall be wide enough to be able to accommodate the screening production from each screen.

M01.6.2

Coarse Hand Rake Screen in Emergency Bypass Channel Material of Construction

Coarse Hand Rake Screen in the Emergency Bypass Channel components shall be constructed of the material specified in the following Table 6-1:

Table 6-1 Coarse Hand Rake Screen in Emergency Bypass Material Specifications:

COMPONENT	MATERIAL TYPE
Bar Screen	304 L stainless steel
Support frame, walkways and handrails	304 L stainless steel
Drip tray (If Not Concrete Design)	304 L stainless steel
Rake	Aluminium

M01.7

TRASH RAKE SCREEN(S)

M01.7.1

Design and Performance Requirements

1. Screenfield bars having a clear spacing between the bars of minimum 100 mm shall be installed at the head of works.
2. The trash screens with a rake mechanism shall be installed at an inclination between 60° and 80° from the horizontal.
3. The screening installation shall comprise trash screens and with a corresponding number of overhead rake cleaning mechanisms typically on a duty and standby as a minimum. The cleaning mechanism will clean the trash screens and deposit the screenings into a skip positioned adjacent to the trash rake screening channels. The screen layout and design shall be subject to the approval of the Employer's Agent / Representative.
4. The raking mechanism shall not rake or collect wastewater together with the screenings into the skip bins. There shall be a drying area allowing the draining of screening before discharge into the skip bins. The drying area shall avoid the attraction of vectors by means of covering the screenings or odour control.
5. The trash screen field shall be removable for maintenance purposes under operating conditions and also under a blocked screen scenario.
6. Equipment shall be suitable for automatic and manual operation in raw sewage and shall be designed and arranged to remove trash, plastic bags, branches, tires and other debris from multiple bar screens, transport it to and discharge into the designated discharge area.
7. The Trash Rake System shall primarily consist of an overhead rail type track, a traversing carriage and a raking unit. The carriage shall travel along an overhead track until the desired section of the bar rack has been reached. The rake shall then be lowered to engage and penetrate the bar rack for debris removal to just above invert elevation. The rake shall then be closed, raised and debris transported to the designated discharge area.
8. The overhead track shall be fabricated as I-beam, which is the track for the traversing trolleys and the support the festoon system. The track shall be supported by steel support columns located where shown on plan or as

determined by the contractor to the approval of The Employer's Agent or Employer's Representative

9. The rake carriage unit shall contain the traversing trolleys with motor(s), hoisting gear motor(s) and a hydraulic power unit. Two trolleys mounted on top of the carriage shall traverse the carriage. The hoisting system shall consist of spirally grooved rope drums mounted on a common shaft within the carriage to raise and lower the rake. A geared motor unit shall drive the hoist shaft with brake. Electrical power to the carriage shall be supplied by a festooning system.
10. Gripper Trash Rake shall be designed to be operated both manually by an operator and automatically without an operator. The rake shall be lowered to engage and penetrate the bar rack for debris removal to just above invert elevation. The rake shall then be closed, raised and debris discharged to the appropriate discharge area. Trash rack cleaning must be possible up to the maximum clogged trash rack head differential at maximum flow.
11. The rake cleaner frame shall be rigid and dimensioned to carry the load of the hoist machinery and the maximum rake load.
12. The rake cleaning frame shall contain the electrically operated hoisting and lowering gear motor. The hoisting system shall consist of spirally grooved rope drums mounted on a common shaft within the carriage to raise and lower the rake. The hoist shaft shall be driven by a geared motor unit with brake.
13. The hoisting gear shall incorporate a power monitor to protect the motor if the rake becomes jammed by an obstruction on rising. A "slack rope" device shall be provided to operate a cut-out to stop the motor should the rake jam when lowering. Lowering the rake shall be accomplished by running the hoist motor in reverse, and limit switches shall be provided to limit upward and downward travel. An electromechanical brake shall be incorporated in the hoist gear to prevent movement of the rake immediately should the hoist motor stop or electricity supply fails.
14. The rake grab shall be supported by wire ropes and shall consist of a series of teeth designed to engage with the bar rack and shall be opened and closed by hydraulic cylinders. The rake head shall be prevented from excessive lateral swaying when traversing motion stops by a swing restrictor.
15. Each trash rake bar screen shall be front cleaned by one trash rake cleaning mechanism with stationary teeth/bars designed to penetrate the static bar field while descending from the overhead monorail mounted operating mechanism. A wire rope operated gripper assembly shall close over the collected debris for transportation back to surface and monorail to the designated discharge area into the screening skip.
16. Trash Rack screens shall be designed and constructed in accordance with the plant specific channel configuration requirements and the influent level in the channel.

M01.7.2

Trash Rake Screen in Emergency Bypass Channel Material of Construction

Trash Rake Screen components shall be constructed of the material specified in the following Table 6-1:

Table 7-1 Trash Rake Screen Material Specifications:

COMPONENT	MATERIAL TYPE
All wetted parts	304 L stainless steel
Trash Bar screen	304 L stainless steel
Gripper or rake	304 L stainless steel
Bar Rack	304 L stainless steel
Drum	304 L stainless steel

COMPONENT	MATERIAL TYPE
Trolleys	304 L stainless steel
Monorail and Support columns	stainless steel
Wire or slack robe	316 stainless steel
Guards or Covers	304 L stainless steel
Un wetted Fasteners	304 L stainless steel

M01.7.3 Equipment Design Features

M01.7.3.1. Screen Construction

- The bar screen is to be supplied by the same supplier as the gripper rake assembly. The bar screen and framework support shall be designed to withstand forces at peak flow with the screen 100% blinded at the water elevations shown on the Tender drawings.
- The bar rack screen shall be manufactured from the bar sections with the longer dimension parallel to the flow. Bars shall be offset from the supports by a length sufficient to allow for full penetration of the rake teeth. Bars welded or directly connected to the horizontal supports shall not be acceptable.

M01.7.3.2. Screen Rake and Gripper Assembly (Where Applicable)

- The gripper shall be manufactured with teeth spaced to match the openings in the bar screens. The gripper shall operate by being traversed over the required section of the bar screen during a cleaning cycle. The gripper shall be in the open position when being lowered.
- The rake rear teeth shall normally engage with the bar screen above the maximum high-water elevation pushing the debris to the channel invert. Teeth shall automatically engage and self-centre between the bars during the descent.
- The rake and gripper assembly will ride on non-metallic, non-lubricated wheels and guide the rake along guide channels while ascending and descending.
- The rake rear teeth shall be capable of passing all the way through the bar screen without interference from the bar screen horizontal supports. The gripper shall continue to be lowered until it reaches the invert elevation (or an immobile object). The gripper mechanism shall close, trapping the collected debris for removal.
- The gripper shall be closed under hydraulic power by controls above deck level when the invert has been reached (or at any time under manual control). The hydraulic cylinders shall be suitable for submerged service.
- When closing, the upstream teeth of the gripper shall be rotated towards the rear teeth and close in conjunction with the rear teeth to remove and lift objects or debris build up wider than the bar screen opening and within the lifting capacity of the hoist.
- With the gripper in the closed position, the front teeth shall form an "overbite" past the rear teeth. During the hoist raising operation, the "overbite" shall penetrate the screen bars to prevent heavy build-up of debris. Designs employing pivoting rear or lower teeth shall not be allowed.

M01.7.3.3. Trolley Assembly (Where Applicable)

- Trolley assembly shall contain all the necessary traversing and hoisting equipment to support and move the Rake and Gripper assembly. This includes the traversing drive and wheels, hydraulic power unit, hoisting drive, hoist drums, hoist cable, hydraulic hoses with spring tensioned hose reel, slack cable tension roller with limit switches, hoist raising and lowering limit sensors, over-travel limit switches

and position sensors for automatic operation.

- Each trolley shall include four wheels. Two of the wheels shall be driven by rack-wheel, fitted to the gearbox on one side. Each shall be independently driven and shall have their own gearbox and brake motor. The trolley drives shall be controlled via VSD's allowing the speed to be adjusted with the increasing influent flows.
- The hydraulic power pack shall provide for the operation of the hydraulic cylinders which open/close the gripper. Designs which utilize mechanical closing rakes shall not be allowed. Fluid power shall be transferred to cylinders through high strength hoses which are to be wound on spring tensioned drum(s) operating in sequence with hoisting drums. The hoses shall be located downstream of the hoisting cables for protection. The hydraulic fluid shall be biodegradable for environmental concerns.
- Electrical power to the trolley unit shall be supplied by a trailing cable which power and control leads supported on cable wagons inside the track or other festooning method acceptable to the gripper.

M01.7.3.4. Support Structure

- The track (monorail) support columns shall be manufactured from carbon steel that is hot dipped galvanized. The columns shall be adequately sized to support the track, spaced as indicated on the drawings and sized to withstand the conditions that will be experienced during operation. The columns shall be "U" shaped or "L" shaped with heavy flanged feet for fixing to the deck level or other location. The feet shall be anchored via properly sized anchor bolts supplied by the grab rake supplier and grouted in place by the contractor.
- Steel supports columns and monorail shall be corrosion protected after fabrication and welding (no fabrication and / or welding shall be allowed post corrosion protection).

M01.7.3.5. Guards

The trolley movement area shall be protected in accordance with Occupational Health and Safety Act, 1993. .

M01.8 MECHANICAL (COARSE INCLINED FRONT RAKE BAR) SCREEN(S)

M01.8.1 Design and Performance Requirements

1. The screenfield bars shall be accurately set and secured to give the clear spacing between the bars of 12 mm. The screen bars shall be manufactured from bars that have a tapered cross section.
2. The maximum velocity through the screenfield openings shall be 1.2 m/s.
3. The minimum approach velocity shall be 0.6 m/s. The screen shall be set in the channel at between 60° and 85° from the horizontal. with a maximum allowable headloss of 150mm.
4. The individual bars (or screenfield) shall welded into position and shall extend from the sole plate and shall extend to at least 200 mm above the maximum flow depth within the channel as indicated on the drawings. The bars shall be fitted with laser cut spacer plates that shall allow for easy removal in the event of damage to the spacer plates.
5. The screen shall be front raked and the rake shall operate by means of a suitably designed lifting device, the entire driving device shall be installed above the channel coping level.
6. The screen frame, superstructure and operating components above channel coping level shall be completely clad in 304L stainless steel panels which shall be removable for maintenance and repair purposes. Screens discharge chute and conveyors shall be provided with sufficient wind deflection shielding to prevent light screening's (e.g. paper and plastic) from being blown off the when

transferred.

7. Approach velocities shall be not more than 0.9 m/s at peak hourly flow rate and not less than 0.6 m/s at average dry weather flow. Should grit removal chambers follow the bar screens then the minimum velocity shall be greater than 0.6 m/s. These requirements shall be met in the design and detailing of the civil structures.
8. The Tenderer shall submit full details regarding the plant offered by him and shall submit full details of the requirements for fitting the units into the civil structure including all necessary illustrations, drawings and pamphlets, etc. The Tenderer shall submit with his tender complete references of clients who have installed screens identical to that offered by the Tenderer.

M01.8.2 Equipment Design Features

M01.8.2.1. Housing

The screen housing shall be manufactured from 304 stainless steel, with a minimum thickness of 4.5 mm and shall be recessed to accommodate the scraping mechanism, chain guides and idler sprockets in order to maintain the screening of the full channel width and depth shall be provided. The screen housing shall be fitted with a rubber skirt and stainless-steel diversion plates, to accommodate the total channel width not covered by the screen field. The diversion plates shall keep away any screenings that might settle on this region. Furthermore, the screenfield shall be selected based on the channel size requirements to which it will be installed in order to minimize the space between the screenfield support and the channel wall. The covers shall be hinged on both end and lockable in the middle.

M01.8.2.2. Access

The screens shall be provided with suitably designed 304 stainless steel hand railings and deck gratings which shall provide access to the screens for repair and maintenance. The screening channel shall be provided with electrically actuated channel gates manufactured from 304 L stainless steel on either side of the screen to facilitate the maintenance and the repair thereof.

M01.8.2.3. Sole Plate

The screening field shall be provided with a sole plate designed such and profiled as to induce the accumulation of debris material at the lower portion of the screen for effective removal. The leading edge of the sole plate shall be installed at the invert level of the receiving channel.

M01.8.2.4. Rake System

The screen design shall be based on continuous operation. The screen shall be periodically raked by a mechanized rake system which shall be controlled by the differential water level and timing devices or by continuous operation. Thus, the level upstream of the screen and shall be monitored by level instrumentation which shall be selected with reference to the Johannesburg Water (SOC) LTD Control & Instrumentation Particular specification; Volume 6 & 9: Automation and Control Design Standards SCADA and Level Measurement.

A scraper cleaning mechanism at the top of the travelling rake shall remove the screenings collected by the rakes and discharge onto a discharge chute without any screenings remaining. The moving rakes shall be suspended between two side chains, which shall be driven through a head shaft and sprocket.

The rakes shall be bolted with counter sunk bolts to the main comb frame for ease of removal when necessary.

M01.8.2.5. Screen Scraper

The scraper cleaning mechanism shall be positioned at the discharge chute area and shall comprise of a single UHDPE blade positioned above the upper edge of the screening retention plate which is activated as the rakes rotate. The blade shall be positioned so that it efficiently cleans the full width of each screen rake.

Scraper arms shall be attached to the side frame and designed to pivot so as to allow efficient cleaning of each rake as it passes. The bearing for the scraper arm shall be self-lubricating polypropylene. The discharge height of the rake mechanism and the discharge chute shall be sufficient to allow free and unhindered discharge to the conveyor.

M01.8.2.6. Discharge Chute

Screenings shall be removed from the rakes and dropped onto the discharge chute.

The discharge chute shall be manufactured from 304 L SS, shall at least be the length of the screen and shall be positioned such that the screenings are deposited into the screenings conveyor without spillage of any of the screenings. The discharge chute shall be hinged for easy maintenance and operation.

The discharge chute of the screen shall be able to rotate at least 90degrees away from the conveyor centre in order to allow the screening operation to continue in cases, where the conveyor is out of service.

M01.8.2.7. Drive Units

Refer to Particular Specification M08: Mechanical Gearboxes for a detailed specification on gearboxes. Also refer to Particular Specification and E01 for a detailed specification for the Electric Motors.

A torque arm shall be attached to the drive unit to accommodate vertical adjustment. A facility shall be incorporated within the drive mechanism, to enable the drive chains to be correctly tensioned, and the combs to be accurately positioned across the screen field face. The design shall ensure that the chain drive is selected with due consideration to the class of work, length of the chain and the position of the drive, effective safety factor shall be provided for the working chain tension and the bearing pressure to ensure the useful life expectancy of 15 years is attainable.

This adjustment shall be possible without the dismantling of any part of the screen frame and without the necessity for any special tools. The comb teeth shall make an approximate angle of 5° to the plane of the screen field when engaged.

The geared motor and moving comb system shall be protected from damage caused by jamming, by means of an Intelligent Motor Protection Relay type device with built in phase angle protection. As a backup device a torque overload coupling with a proximity shall be provided. The limit switch must have at least one SPDT contact or one normally open and one normally closed contact capable of switching at least 500mA at 230 Volts AC. The limit switch protection shall be minimum of IP 67. The motor and gears shall be correctly sized to avoid over stressing of parts. A facility for reversing the rake drive back to a stationary park position must be provided.

M01.8.2.8. Bearings

All bearings shall be enclosed in a watertight assembly suitable for and shall be design to continuously exposed to moisture. The bearing shall have an L-10 rating life of 100 000 hours while operating at maximum load. Internal bearing parts shall be

completely sealed from outside contamination. The bearing shall be accessible for maintenance without dismantling the entire screen mechanism.

M01.8.2.9. Screen Rake Control

The operation of the screen raking mechanism shall be automatically controlled by the upstream water level and shall be timer controlled incorporating; variable time between activation and variable operation duration. An override for continuous operation based on a maximum water level within the inlet structure shall be included. The automatic controls of the raking mechanism shall be supported by a manual override. The timing devices shall be supplied and installed by others.

M01.8.2.10. Channel Parameters

The channel preceding and immediately following the screen shall be shaped and sloped to eliminate the deposition of solids and permit draining of the channel. The channel shall be constructed by the Civil Contractor.

The Contractor shall be responsible for providing the Employer's Agent or Employer's Representative and the Civil Contractor with information regarding the civil requirements of their screening equipment on a timeous basis. This is to allow the Civil design to incorporate the necessary structures or changes to accommodate the installation of the equipment.

M01.8.2.11. Chains and Sprockets

The chain type shall be pin bush link type chain. The chain connecting the comb frames are to have vesconite rollers and 304L SS side plates and pins.

Preference will be given to a chain turn about track arrangement instead of bottom sprockets below water level. Chain links shall be straight line design and any oval shape design shall not be acceptable.

M01.8.2.12. Welds

All welds are to be in accordance with SANS 15614-1.

M01.8.2.13. Control Process

The screens shall be automatically controlled, based on:

- Timer controlled operation of the screen raking mechanism with a variable time between activation of the raking mechanism and variable duration of operation of the raking mechanism
- Override for continuous operation of the raking mechanism based on a water level in the inlet channel
- The activation of the raking mechanism shall be fitted with a manual override with "inching" facility in both the forward and reverse directions
- The screen control settings must be adjustable from the SCADA.

M01.8.3 Materials of Construction

Coarse Inclined Front Rake Screen components shall be constructed of the material specified in the following Table 6-1:

Table 8-1 Coarse Inclined Front Rake Screen Material Specifications:

COMPONENT	MATERIAL TYPE
Screen frame or Housing	304 L stainless steel
Discharge Chute	304 L stainless steel
Access platforms and handrails	304 L stainless steel
Screening Elements	304 L stainless steel
Screen rake	304 L stainless steel
Heavy-duty Drive Links and sprockets	304 L stainless steel
Screen scrapper (wearing part or squeegees)	UHDPE
Chain Pins	304 L stainless steel
rollers	Vesconite (Material Detail)
Resting Pads	UHMW-PE
Monorail and Support columns	stainless steel
Screening element	304 with UHMW-PE wear surface
Fasteners	316 stainless steel
All other accessories shall be of manufacturer's standard coated material.	

M01.9 FINE PERFORATED SCREEN(S)

M01.9.1 Design and Performance Requirements

- Fine screens of 6mm perforated type shall be installed downstream of the coarse screen.
- The minimum approach velocity shall be 0.6 m/s. Should grit removal chambers follow the bar screens then the minimum velocity shall be greater than 0.6 m/s. These requirements shall be met in the design and detailing of the civil structures.
- Solids will collect on a continuous belt of perforated filter panels perpendicular to the flow, elevating solids to the discharge point. The perforated filter panels shall be cleaned by means of an automatic adjusting rotating cleaner brush.
- The perforated filter panels shall be driven by drive sprockets secured to the main drive shaft.
- The Tenderer shall provide the spray water flow and pressure requirements for the screens offered as per the OEM recommendation and submit to the Employer Agent's or Representative for acceptance before procurement. Manual Isolation or control of the feed flow shall be allowed for and additionally consider a mechanical means of measurement.
- The minimum screening capture rate shall be 80% for the screens and must be confirmed by an independent testing authority. The documented report of the test which shows the result of screenings capture rate (SCR) must be provided with datasheets.
- The screen shall be designed to provide maximum solids filtration and thus maximize capture of debris and minimize rate of head loss increase through the screen. This shall be achieved by means of one piece perforated curved filter elements. The screen will be operated continuously by means of level

measurement upstream of the screen by means of a timer.

- The screen shall be mounted by fastening to the top of the channel. The screen mounting system shall be constructed in 304L stainless steel complete as required to function in accordance with the specification. The mounting system should be designed to allow easy dismantling to facilitate installation and removal of the screen.
- Routine service, repair or replacement of damaged parts, shall be possible with the screen installed in the channel.
- The use of roller chain, filter shafts and rollers and/or two or more motors for screen band rotation is not acceptable.
- The screen shall be designed so that maintenance of the drive mechanism can be accomplished at operating floor level. Screen elements shall be capable of removal at the operating level without taking the screens out of the channel or effecting the continuous or intermittent rotation of the screen.
- The screen shall be factory assembled and tested prior to delivery and shall be delivered to the site fully assembled (other than the motor/reducer unit, discharge chute, and support legs). It shall be capable of being set in place and field erected by the contractor with minimal field assembly.
- The screen shall be fitted with a rotating deflector to prevent bypassing of solids into the downstream channel, driven from the screen drive via a drive chain.
- All components shall be amply proportioned for all stresses that may occur during manufacturing, transportation, erection, and operation.

M01.9.2

Materials of Construction

All moving wetted parts, all wetted parts on which moving parts ride, all filter belt components under guiding, bearing, or driving loads shall be 316 stainless steel, wear resistant heat treated, high tensile, wear resistant steel, or UHMW-PE as detailed below:

Fine Inclined Perforated Screen components shall be constructed of the material specified in the following Table 6-1:

Table 9-1 Fine Inclined Perforated Screen Material Specifications:

COMPONENT	MATERIAL TYPE
Screen frame or Housing or covers	304 L stainless steel
Discharge Chute	304 L stainless steel
Access platforms and handrails	304 L stainless steel
Screen and brush drive shafts	304 L stainless steel
Screen rake	304 L stainless steel
Screening elements	304 L stainless steel
Heavy-duty Drive Links and sprockets	304 stainless steel
Seals	UHMW-PE
Screening element support rails	304 with UHMW-PE wear surface
Fasteners	316 stainless steel
Spray bars	304 stainless steel
All other accessories shall be of manufacturer's standard coated material.	

M01.9.3 **Equipment Design Features**

M01.9.3.1. Filter Screen Elements

- The one-piece curved screening elements shall be fixed by fasteners to the heavy-duty drive links. On every tenth screen panel a set of static, non-engaging 'finger' type lifters shall be attached to the lower edge of the panel, designed specifically to lift spherical and large size solids (stones, square lumber cans, bottles, rag clumps, etc...) from the bottom of the channel. Screens that use lifting ledge on top of the panel thereby preventing the removal of solids from the bottom of the channel floor will not be acceptable. To prevent metal to metal wear and bearing damage no submerged roller bearing wheels and spindles will be allowed as well as bearings that require lubrication. Screens which do not support the drive chains on the downstream side will not be acceptable.
- A submerged curved stainless-steel plate shall be provided at the base of the screen. The base of the screen shall be fitted with a rubber seal directly followed by a nylon brush along the full length of the filter panel to prevent ingress of stones and grit and to prevent solids bypass.
- To prevent deflection, the one-piece filter elements shall be made of curved stainless steel. This is required to ensure structural integrity and smooth operation. engaging tines, fingers or engaging elements, which can bind or jam, will not be acceptable.
- The screening elements are to be of the engineered curved shaped so that they can be cleaned with optimum efficiency with an automatic adjusting rotating cleaner brush. Minimum diameter of rotating cleaner brush is 450 mm. The rotation direction of the brush drive must be in the opposite direction of the belt drive.
- The screening elements must be sealed against the frame by means of special knuckle joint side plates attached to each perforated plate filter element. Side plates must be made in Stainless steel type 304L. Simple brush systems are not acceptable. This is to ensure that small items are not floated past the sides of the screening elements.

M01.9.3.2. Filter Screen Panels

- The screen filtration belt shall be provided with one piece perforated curved elements, which limits the maximum opening in any direction to the perforated opening size. This restricted opening profile prevents long thin materials from passing through the openings. Filter panels that are not curved shall not be acceptable. Filter panels with a flat face inclined and a horizontal ledge shall not be acceptable.
- Cleaning device that causes screenings to be pushed or dropped into the interior of the filtration belt will not be acceptable.
- The individual screening elements must not exert stresses on one-another, and the load transmission must be exclusively via chains. Systems which involve connecting the screen elements together with other or additional attachments are therefore not acceptable because of stressing. Furthermore, the elements must not be able to overlap one another, which would create spaces in which material could collect.

M01.9.3.3. Screen Drive Mechanism

- Motor: 400 V, 3 Phase, 50 Hz. Overload protection shall be provided by a true power monitor electrical overload device that senses the motor power factor.
- Gear Reducer:
 - Helical Worm type.
 - Hollow, shaft mounting.
- Chain shall be heavy-duty block chain, which is supported outside the frame by UHMW-PE, a hardwearing, high lubricity synthetic material. Breaking load of the chain shall be a minimum 90 kN.
- Chain shall have no rollers.

- Chain shall have no metal to metal wear associated with running roller chain in the screen frame.
- All drive components shall be designed to operate the screen continuously under a calculated load resulting from the differential water level between the upstream and downstream sides of the screen.

M01.9.3.4. Brush Drive Mechanism

- Motor: 380 V, 3 Phase, 50 Hz
- Gear Reducer:
 - Helical Worm type.
 - Hollow, shaft mounting.
- Rotating Deflector Drive Mechanism:
 - The rotating deflector shall be driven from the screen drive via a drive chain.
 - Screens that require a third motor for the rotary deflector shall not be acceptable.
 - The brush mechanism shall automatically adjust with reference to wear to ensure constant brushing efficiency.

M01.9.3.5. Discharge Chute/Hood

- A discharge chute/hood shall be provided that fully encloses the discharge section of the screen. The upper section of the discharge chute/hood shall be hinged to allow complete access to the screen cleaner brush. The hinged hood shall be secured with quick closing clamps and supplied with two (2) gas cylinders to aid opening and closing.
- Discharge chute shall be manufactured from stainless steel type 304L
- Each screen discharge chute/hood shall direct screenings directly to the hydro-conveyor designed to match the screenings hydro-conveyor with no water leaking or screenings dropping to the floor.

M01.9.3.6. Frame Enclosures / Covers

- The screen shall be provided with hinged covers.
- Covers shall be provided on the upstream and downstream portion of the screen above the operating floor.

M01.10 SCREENINGS CONVEYOR

Three Types of conveyors shall be covered under this particular specification namely:

- Covered screw type conveyor
- Covered Hydro type conveyor
- Belt conveyor type. Refer to M16: Particular Specification for Conveyor Equipment

M01.10.1 **General Specification**

- The screenings from the screening equipment will be discharged onto a transfer conveyor as per the installation layout shown in the Tender drawings.
- Screenings that are conveyed will be deposited in the feed hoppers of the duty washer/compactor unit.
- Dewatered screenings will be deposited into a skip that will be mounted on a motorized dolly to facilitate positioning of the skips for loading/unloading.

M01.10.2 Covered screw type conveyor:

M01.10.2.1. Design Parameters

- The design of the screw conveyor shall be of a spiral design enclosed in U-trough with the top closed with sectional hinged covers installed at an inclination that will allow the ease of flow of the screenings into the wash/screw compactor hopper unit or a collection skip. The diameter of the spiral screw shall be a minimum of 310mm. The U-trough shall be design and sized to facilitate the movement of the screw and conveyance of the screenings.
- The screening inlet or collection point shall have a hopper design along with the screens discharge chute to facilitate the ease of screenings deposit into the screw conveyor.
- The covers shall be manufactured from clear plastic which is UV resistance and hinged for easy inspection of the screw.
- A relatively low friction liner around the inside peripheral section of the U-trough shall be installed and secured. This shall be made from a minimum 10 mm UHDE liner, alternative material offers can be provided but will be subject to the approval of the Employer's Agent or Employer's Representative.
- The screw unit shall be manufactured from carbon steel which is as the per corrosion specification G01.
- Any drainage, spillage and wash water from the conveyor must be returned to the influent sewer upstream of the screens.
- The geared motor and moving comb system shall be protected from damage caused by jamming, by means of an Intelligent Motor Protection Relay type device with built in phase angle protection. As a backup device a torque overload coupling with a limit switch shall be provided. The limit switch must have at least one SPDT contact or one normally open and one normally closed contact capable of switching at least 500mA at 230 Volts AC. The motor and gears shall be correctly sized to avoid over stressing of parts.
- Refer to Particular Specification M08: Mechanical Gearboxes for a detailed specification on gearboxes and to Particular Specification E01 Electrical Motors for a detailed specification for the Electric Motors.
- The size of the screw, gearbox and motor shall be selected based on the plant specific screens production rate.
- Lower bearings shall be enclosed in a watertight assembly suitable for submerged operation in grit service. The bearing shall have an L-10 rating life of 100 000 hours while operating at maximum load. Internal bearing parts shall be completely sealed from outside contamination
- The spiral screw flights shall have easily replaceable bearing shoes on the leading edge which shall support the screw through the trough and keep drain holes clean.
- The bearings shall be designed to withstand the thrust forces imposed. The screw shall operate at a maximum speed of 10 rpm
- The bearing design shall make provision for self-alignment and allowance for axial movement of the shafts. Bearings for the lower stub shaft shall be designed to withstand bending, down pull, thermal expansion and radial loads imposed under 100% loading. The bearing can be provided as seal for life bearing or continuous lubricated bearing. Continuous lubricated bearing shall be preferable grease lubricated. Selection and design of screw bearing shall be subject to the approval of the Employer's Agent / Employer's Representative.
- The screw shaft shall be seamless and continuous. Where not practically possible to supply a continuous screw shaft. A multi-screw shaft(s) may be offered, the Contractor shall submit the full design of the screw shaft to the Employer's Agent or Representative for acceptance. The shaft shall not be jointed on maximum deflection. On sections where there is less deflection or bending.

M01.10.2.2. Covered screw type conveyor Material of Construction

Covered screw type conveyor components shall be constructed of the material specified in Table 10-1 below with a minimum thickness of 3mm.:

Table 10-1 Covered screw type conveyor Material Specifications:

COMPONENT	MATERIAL TYPE
U-trough frame	304 L stainless steel
U-trough Liner	UHDPE
Covers	Clear Plastic (UV protected)
Screw unit	Epoxy coated Carbon steel

M01.10.3 **Covered Hydro Conveyors**

M01.10.3.1. Design Parameters

- The selection and use of the hydro-conveyor shall be selected based on the screening production in the specific plant of installation.
- The hydro conveyor shall be design for continuous operation.
- The hydro-conveyor shall only utilise plant wash water from the final effluent streams which can contain up to 30 mg/l solids and chlorinated. Therefore, it is expected as part of this contract to screen the washwater before being used in this system by means on strainers. A secondary alternative, the hydro-conveyor medium can be the degritter wastewater supplied by a submersible pump. The use of the secondary medium shall be by-pass on solid sensitive inline equipment. The plant washwater for the hydro-conveyor shall be temporarily stored in a suitably sized tank, acting as a retention tank. This storage facility shall ensure adequate supply of wash water based on the required flowrate is achieve for a reasonable time of at least 8 hours.
- The hydro-conveyor shall be of a U-trough design i.e. straight sides and a curved bottom (flat bottom conveyor will not be acceptable) with a minimum radius of 200mm installed at an inclination that will allow the ease of flow of the screenings into the wash/screw compactor hopper unit.
- The top of the U-trough shall be covered (if Specified by the Project Specification) with sectional hinged access covers and opening handles installed at least on 1 metre intervals and on bends. The bends of the hydro-conveyor shall be long radius bends in order to avoid blockages.
- The hydro-conveyor shall have collection hoppers that will allow the screenings from the discharge chute of the screen to be dropped at the centre of the hydro-conveyor. The hydro conveyor hopper and the washer compactor receiver shall overlap to ensure no spillage.
- The detailed design of the hydro conveyor will be prepared by the contractor including the support legs which shall be submitted to the Employer's Agent or Employer's Representative for approval prior to manufacture. A typical layout of the hydro conveyor indicated on the tender drawings with regards to

the screening equipment and channel arrangement.

- The hydro conveyor shall be designed to handle the maximum loading screening and wash water loading selected base on the plant specific screen production rate and the no. of screening inlet/collection points
- The Wash water for the bar screens and washer/compactors will be supplied via the wash water pumps specified in the project specification. The wash water pressure shall have minimum pressure of 4 bar with a minimum injection flowrate that is be sized based on the screening feed requirements and any other variable required for effective operation of the conveyor. The injection flowrate shall be specified in the Project specification.
- The wash water supply shall have one main inlet at the beginning of the hydro-conveyor with a minimum diameter of 32mm. Higher diameters will be selected based on the loading conditions. There shall be an isolation ball valve on the wash water supply line prior to the inlet to the conveyor.
- At each screenings inlet or collection point there shall be spray nozzles directed such that they are able to wash away the screenings. Furthermore, there shall be additional spray nozzles on bends. Before each spray nozzles, there shall be a manual isolation valve.
- The hydro conveyor will incorporate an electric actuated “plug” for isolating the opening in the first (duty) washer compactor unit so that screenings can be transported onto the second (standby) washer compactor.
- The design of the water channel into the washer compactor shall be such that the flow of water is minimised by provision of screens and separation before the compactor i.e. perforated section before the washer compactor.
- There shall be an elevated platform along one side of the conveyor to allow access for operation and maintenance.
- The conveyor trough shall be sufficiently designed and supported to allow an operator to stand-on it.

M01.10.3.2. Covered Hydro conveyors Material of Construction

Covered Hydro conveyors components shall be constructed of the material specified in the following Table 10-2 below with a minimum thickness of 4.5mm.:

Table 10-2 Covered Hydro type conveyor Material Specifications:

COMPONENT	MATERIAL TYPE
Hydro-Conveyor Covers	Clear Plastic (UV Protected)
Collection Hoppers and Trough	304 L Stainless Steel
Opening Handles	304 L Stainless Steel
Support Structures	304 L Stainless Steel
Wash Water & Drainage Pipework	304 L Stainless Steel

M01.11 SCREW WASHER COMPACTOR

M01.11.1 General

A screw washer compactor shall be included if specified in the Project Specification to wash organics out of the screenings and to remove excess liquid from the screenings collected. The screenings removed from the screens shall be transported by a conveyor system to the compactor. After being washed and dewatered the screenings shall be discharge into receiving bin for the disposal thereof. The wash water from the washer compactor shall be routed to the inlet channel upstream of the screens via a suitably sized drainpipe. The screw compactor and bin shall be located within a bunded area in which spillage from the equipment shall be collected and returned to the inlet channel upstream of the screens.

Where specified in the project specification, the contractor shall supply the trolley and the hand / or electrically operated winches for handling of the bin.

The compactor shall accommodate feed from a number of conveyed sources.

M01.11.2 Design Parameters

The screw compactor shall consist of a washing zone, drainage zone, an inlet zone, a conveying zone and a compacting zone.

The design of the screw compactor shall be such that the extruded product shall have a moisture reduction of 70% minimum, a weight reduction of at least 65% and a volume reduction of no less than 70%. The screw compactor frame shall be manufactured from 304 L stainless steel.

The screenings shall enter the inlet hopper where it is washed and then transported and compressed by the screw and discharged. As the screenings are compressed, the liquid drains out of the holes in the bottom of the pan and discharges back into the inlet channel upstream of the screens.

Provision for bi-directional rotation of the screw compactor shall be made in order to remove any blockages that may occur. Access to the operation of this feature shall be by means of a key switch located locally in the field. A separate panel shall be provided to accommodate the relevant field control equipment. The materials used for the manufacturing of this field station shall conform to the requirements of the E03: Particular Specification for Isolator Push Button.

A high-pressure wash water spray system to wash the screenings shall be provided at the inlet Zone.

Inlet Zone

The inlet zone shall be designed to suit an inlet chute. The inlet chute shall have a minimum area of 0.4 m².

Drainage Zone

The drainage zone at the feed end of the compactor permits the drainage of free water. The drainage zone shall be a minimum length of 200 mm.

Conveying zone

As the screw rotates it conveys screenings along the length of the conveying zone up to the compacting zone. As the screw rotates the material, gravity and the surface friction react to force the water from the screenings. The conveying zone shall be a sized according to the specific plant layout and positioning of the collection skip.

Compacting Zone

The resulting compacted plug of screenings is forced out of the discharge. The compacting zone shall have a minimum length of 500 mm.

M01.11.3 **Helical Shaft Screws**

The screw shall have a helical flight and shall have a minimum of 6 flights per linear meter. The shaft screws shall be designed to withstand the subjected torsional forces imposed during the operation thereof. Lower bearings shall be enclosed in a watertight assembly suitable for submerged operation in grit service. The bearing shall have an L-10 rating life of 100 000 hours while operating at maximum load. Internal bearing parts shall be completely sealed from outside contamination

The helical screw flights shall have easily replaceable bearing shoes on the leading edge which shall support the screw through the trough and keep drain holes clean. The bearings shall be designed to withstand the thrust forces imposed. The screw shall operate at a maximum of 10 rpm.

A relatively low friction liner around the inside peripheral section of the U-trough shall be installed and secured. This shall be made from a minimum 10 mm UHDPE liner, alternative material offers shall be accepted provided it is of similar or better properties to the specified, alternative offer shall be subject to the approval of the Employer's Agent or Employer's Representative.

M01.11.4 **Trough**

The washing trough shall be totally enclosed to prevent spillage and contain odours. Hinged inspection covers (where applicable) shall however be provided for inspection and removal of objects if required.

M01.11.5 **Drive Unit**

The compactor-drive unit shall be mounted at the bottom of the inclined screw trough and shall be enclosed. The compactor shall be directly driven by an electric motor coupled to a shaft mounted gearbox. Refer to particular specification M08: Mechanical Gearboxes and refer to particular specification E01: for a detailed specification for Electric Motors.

M01.11.6 **Screw Wash Compactor Material of Construction**

Screw Wash Compactor components shall be constructed of the material specified in Table 11-1 below :

Table 11-1 Covered Hydro type conveyor Material Specifications:

COMPONENT	MATERIAL TYPE
Screw compactor frame	304 L stainless steel
Helical Shaft Screws	carbon steel
U-trough	304 L stainless steel
U-trough liner,	UHDPE
Support Structures	304 L stainless steel
Wash Water and Drainage Pipework	304 L stainless steel

M01.12

FASTENERS

Nuts, bolts, studs and washers for incorporation in the Works shall conform to the requirement of the appropriate approved standard.

Bolts shall be of such standard length that a minimum of two to four complete threads shall protrude beyond the nut when in the fully tightened condition. The same shall apply to stud units. Mating surfaces shall be adequately protected against corrosion whilst awaiting assembly of the faces and bolting, all to the approval of the Employer's Agent or Employer's Representative.

All high tensile bolts and studs used in the Works shall bear the letter HTS stamped or engraved on the end. Washers shall be provided under all bolt heads and nuts. The threads of bolts and studs shall be lubricated before assembly with a lubricating substance subject to the approval of the Employer's Agent or Employer's Representative. Washers, locking devices and anti-vibration arrangements shall be provided where necessary and shall be subject to the approval of the Employer's Agent or Employer's Representative.

Stainless steel bolts, nuts and washers shall be in accordance with SANS 1700 A70 and the grade of stainless steel shall be subject to the approval of the Employer's Agent or Employer's Representative. Hot Dip Galvanised fasteners shall comply with the requirements of SANS 121. High strength friction grip (HSFG) bolts, nuts, load indicator washers and washers shall be subject to the approval of the Employer's Agent or Employer's Representative and shall be hot dip galvanised. High strength friction grip bolts shall be tightened in accordance with the manufacturer's recommendations and the tension shall be re-checked not less than 3 hours after first tightening and then the bolts shall be retightened to the initial load all to the approval of the Employer's Agent or Employer's Representative.

All stainless-steel bolts, nuts and washers in contact with a dissimilar material shall be provided with isolating (non-metallic) washers and sleeves (insulating kit) where appropriate to prevent galvanic corrosion, unless otherwise specified in the project specification. The selection of the non-metallic washers shall consider the normal operating conditions of the installation. The bed plates and machinery shall be provided with means of adjustment for line and level to maintain the items of Plant in correct alignment during grouting. Packers used for adjustment shall be of non-corrosive material to the approval of the Employer's Agent or Employer's Representative. Holding down bolts which are to be tightened after grouting shall be provided with bond breakers where they pass through the grout.

Where there is a risk of corrosion, bolts and studs shall be designed so that the maximum stress in the bolt and nut does not exceed half of the yield stress of the bolt material under all conditions. The shear value of high strength friction grip bolts shall be reduced in proportion to the reduced tensile stress compared with the normal design stress.

No tapped holes in mild steel shall be allowed. Where tapped holes are unavoidable, this shall be done in stainless steel. Where bolts and nuts are required to be removed and re-assembled on a regular basis, these shall be of stainless steel. Metal coatings and other treatments applied to fasteners shall be carried out in a manner which will not cause hydrogen embrittlement of the parent material.

M01.13 RECOMMENDED SPARES AND SPECIAL TOOLS

The Tenderer must submit on the appropriate schedule a priced list of spare parts which is recommended should be kept by the water treatment plant for maintenance of the equipment. Spares which the Client decides to order must be manufactured simultaneously with the rest of the equipment and be subject to the same tests for dimensions, tolerances, strength, etc. All spares must be packed separately, and the cases appropriately marked. All spares must be new and unused.

For special tools being used on offered equipment. Tenderers shall submit a provisional price (where applicable) for a complete set of special spanners, keys and tools required for the operation, adjustment and overhaul of the plant supplied. All spanners, keys and tools shall be new and unused.

M01.14 GUARANTEE OF PERFORMANCE

The Defects Liability period shall be a period of at least 12 months calculated from the Completion as defined in the Contract Document.

However, should a portion or all of the plant and equipment fail / or require rectification during this period, the Employer's Agent or Representative reserves the right to extend the Defects Liability Period in respect of such portion or all of the plant and equipment for a further period of at least 12 months calculated from the date of Commissioning of such plant and equipment after rectification.

M01.15 CORROSION PROTECTION

Refer to G02 - Particular Specification for Corrosion protection.

M01.16 COLOUR CODES

The standard final colour codes for equipment supplied under this Contract shall be in accordance with Particular Specification G01: Colour Codes.

M01.17 QUALITY MANAGEMENT (QM) AND QUALITY ASSURANCE

M01.17.1 General

QM shall be categorised as 'critical and major' for this section of the Project. The Contractor's Quality Management System shall be in accordance with industry standard. The Contractor shall implement a comprehensive Quality Control programme and accept full responsibility for the quality of his workmanship and material used, irrespective of any quality surveillance that may be carried out by the Employer's Agent / Employer' Representative. In keeping with the basic principles Quality Management System, the Contractor and Subcontractor(s) shall:

- Be responsible for compliance with all the requirements of the Specification in every respect;
- Carry out all inspections and tests called for in the Specification in the presence of the Employer's Agent / Employer' Representative. The cost of these inspections and tests shall be carried out at the sole expense and under the responsibility of the Contractor;
- Draft a Quality Control Plan for manufacture for approval by the Employer's Agent / Employer' Representative and comply with the approved Quality Plan during manufacturing process of all components indicating all the intended stages of testing during manufacture, cleaning and preparation for application as well as

- necessary hold points for independent quality surveillance;
- Draft a Quality Control Plan for corrosion protection for approval by the Employer's Agent / Employer' Representative and comply with the approved Quality Plan during corrosion protection process of all components indicating all the intended stages of testing during corrosion protection as well as necessary hold points for independent quality surveillance;
 - Draft a Quality Control Plan for installation for approval by the Employer's Agent / Employer' Representative and comply with the approved Quality Plan during installation process of all components indicating all the intended stages of testing during installation as well as necessary hold points for independent quality surveillance; and
 - Draft Quality Control Plans for any other construction process as may be required for approval by the Employer's Agent / Employer' Representative and comply with the approved Quality Plan during the execution of the process indicating all the intended stages of testing as well as necessary hold points for independent quality surveillance.

The Quality Control Plans will not be compromised once approved and shall always be adhered to. The Contractor shall operate approved quality assurance and control programmes in the Supplier's and Manufacturer's premises and on Site in order to verify that the Works comply with this Section. Prior to the commencement of any work, the Contractor shall prepare and submit to the Employer's Agent / Employer' Representative for approval, quality plans describing the procedures, standards of acceptance, hold point inspections, routine and type tests to be carried out for each component both during manufacture and on Site.

Although it shall remain the responsibility of the Contractor to ensure that the Works conform to the Specification, the Employer's Agent / Employer' Representative shall be entitled to inspect, examine and test the materials, workmanship and performance of every item of Plant. The Employer's Agent / Employer' Representative will notify the Contractor which tests or inspections, detailed in the quality plan, they will attend.

Approval by the Employer's Agent / Employer' Representative of materials, workmanship, etc., during manufacture or at Site will not relieve the Contractor of his obligations to comply with all the requirements of the Contract.

All instruments and appliances necessary for the complete inspection and testing shall be provided by the Contractor. Calibration certificates for instruments shall be produced to the Employer's Agent or Employer's Representative for review prior to the commencement of any tests and, if required by the Employer's Agent / Employer' Representative, instruments shall be re-calibrated at the Contractor's own account before commencement of the tests.

In general, Quality Management System should be bench marked in accordance with the relevant ISO 9000 requirements.

M01.17.2

Material Tests

The Manufacturer's material test data and the Contractor's quality records shall be subject to examination by the Employer's Agent / Employer' Representative. Reasonable samples of the cleaning and coating materials to be used may be taken for testing.

Rejection of the samples shall place a hold on the use of the materials of the same batch number and any components that have already been cleaned/coated with rejected material shall be re-cleaned and coated.

M01.17.3 Type Tests

Where the Contractor offers Plant selected from the standard range of products from a specialist manufacturer, type tests in accordance with a recognised international standard are required on one unit of each type to prove satisfactory design and quality of manufacture of that Plant.

The Employer's Agent / Employer' Representative may waive the requirement for type tests if they are satisfied that tests have previously been performed on identical Plant. The Contractor shall submit the data and results with their Quality Plan in sufficient time to allow for repeat tests without delaying the Works should the Employer's Agent / Employer' Representative not approve the evidence submitted.

The above cost should be built into the supply of the equipment as per the project specification.

M01.17.4 Manufacture

Tenderers shall submit with their tender a detailed Project Quality Plan, stating how they control the flow of paperwork from commencement of the Project through final handover to the Client, a sample of their Quality Control Plan, (QCP) and Project Quality Plan, (PQP) both during the course of the Project, manufacture and finally, installation.

The successful Tenderer shall submit a QCP covering all aspects of the manufacturing process, indicating held points to allow the Employer's Agent or Representative opportunities to evaluate the equipment for compliance to this specification.

All items of equipment shall be subject to inspections by the Employer's Agent or Representative during design and manufacture per these QCP's.

In general, it is anticipated that this Project shall be in accordance with the relevant ISO 9000 requirements.

M01.17.5 Installation

The successful Tenderer shall submit a QCP covering all aspects of the installation of each item of equipment to be installed under this Project. The Employer's Agent or Representative shall be afforded every opportunity to certain stages of completion of the installation to ascertain compliance with the Specifications and to witness the Contractor's site activities at the Employer's Agent or Representative's discretion.

M01.18 SYSTEM PERFORMANCE

M01.18.1 Works Testing

All Equipment shall be subject to a Factory Acceptance Test (FAT) by the Manufacturer and witness by Employer's Agent / Employer' Representative at the Manufacturer's premises before despatch. All performance test results shall be made available to the Employer's Agent / Employer' Representative for verification or when the QCP's require intervention or hold points for inspection.

Equipment may only be despatch from factory once all relevant "hold points" on QCP's have been signed off by the Employer's Agent / Employer' Representative and/or the Approved Inspection Authority (AIA) in accordance with approved quality control plan.

M01.18.2 Before Commissioning

- Check for correct lubrications levels in all rotating equipment including gearboxes and that motor bearings are greased properly.
- Ensure all HD bolts are torque down correctly.
- The alignment and levelling of each assembly shall be checked and witnessed by the Employer's Agent or Employer's representative.
- The electrical functions and control shall be checked by a responsible inspector prior to attempting to start any motor on this Project.

M01.18.3 During Commissioning

The commissioning stages, shall include but not limited to the following checks:

- Ensure all axillary components of the equipment and the peripheral instrumentation such as level, flow or pressure switches are functional
- Measure the screenings removed from by the screen
- Measure the volume of screenings in the raw sewage downstream of the screens. These shall correspond to the size of the Screenfield spacing.

M01.18.4 Before expiry of the Defects Liability Period

The Employer requires the Contractor to visit the site every quarter to inspect together with the Employer's Agent or Representative for the correct operation of the installed equipment. A report after each visit shall be submitted in writing within 14 days after the inspection to the Employer's Agent.

M01.18.5 Substandard Quality Control

All material, certification and records of the Contractor shall be subject to examination by the Employer's Agent / Employer' Representative.

This shall include the checking and testing of the Plant at the Works and on Site, installation and pre-acceptance testing. If any deviation is found, additional testing and quality surveillance shall be carried out at the Contractor's own costs until approved by the Employer's Agent / Employer' Representative.

If the additional testing confirms inaccurate quality control by the Contractor on an item of Plant, all work shall be stopped on that item of Plant and shall only proceed after remedial action in the quality control system has been implemented.

M01.18.6 Access for Surveillance

For the purpose of carrying out quality surveillance, the Employer's Agent / Employer' Representative shall be granted access to any part of the Contractor's premises relevant to the work being carried out, at any reasonable time.

M01.19 EQUIPMENT TRAINING PROCEDURE

Training shall be provided by the Contractor (or specialist equipment suppliers) based on the supplied and approved operation and maintenance (O&M) manuals for all supplied equipment. This training shall be provided to the Operations and Mechanical including other support discipline staff of the Employer along with the Employer's Agent and/or Representatives. The duration of the training period shall be advised by the Contractor and agreed with the Employer's Agent and/or Representatives.

The training structure for the equipment and/or system should include both the theory and practical components of the equipment derived from the O&M manuals.

The preparation of the O&M manuals shall be based on the Johannesburg Water (SOC) Particular specification for Commissioning and Operation.

M01.20 OPERATION AND MAINTENANCE MANUAL SUMMARY

The Contractor shall hand over to the Employer' Agent or Employer's Representative four sets of the Operation and Maintenance Manual compiled for each installation not later than at the time of commissioning of the installation. These manuals are a prerequisite for final takeover of the plant. A copy of the Operating and Maintenance Manual for each equipment type shall be bound in with the Operating and Maintenance Manual for the project. The manual shall be A4 size and properly bound. Drawings larger than A3 size shall be contained in separate plastic pockets.

The Operation and Maintenance Manual will contain the following:

- (a) Brief description of the plant and installation.
- (b) Concise operating instructions including start-up, operating, shutdown and troubleshooting procedures.
- (c) Routine maintenance instruction this shall include failure mode analysis and preventative strategies.
- (d) Precautionary measures, elementary trouble location, rectifying measures and emergency actions.
- (e) Detailed information on equipment.
- (f) Lists of spare parts including names and addresses of suppliers.
- (g) Schematic Diagram and Drawings
- (h) Risk, Health and Safety Assessment with proposed control measures.

M01.21 INTERCHANGEABILITY

Where two or more similar types of equipment are required, these units shall be identical in all respects.

All similar parts of items supplied shall be interchangeable without any additional machining or fitting.

M01.22 DRAWINGS

The drawings included in the Tender Documents are the Employer's Agent or Employer's Representative. 's proposal for the plant layout. Should the Tenderer offer alternative layouts, he shall submit drawings with his Tender in order for it to be evaluated.

Before the Contractor carries out any work, they shall submit detailed working drawings to be approved by the Employer's Agent or Employer's Representative. . Approval of these drawings does not relieve the Contractor from their responsibility for the correctness of the drawings.

M01.23 MEASUREMENT AND PAYMENT

No separate payment will be made for required equipment unless otherwise specified in the detail/project specifications. All direct and indirect costs associated with such required equipment shall be deemed to be included in the rates tendered for the equipment.

Where separate payment is required for equipment and specified as such in the detail /project specifications, the following payment items shall be applicable:

M01.23.1 General

The following items shall be included in the rates:

- (a) Supply of all design and pre-manufacture documentation and obtaining approval thereof;
- (b) Procurement/manufacture of required equipment with associated equipment items and delivery to Site;
- (c) Installation of complete required equipment with associated equipment items and testing;
- (d) Services required during period of initial use before handover to the Employer.
- (e) Payment under scheduled items shall be made per complete installation as specified, electrical connections, etc and grouting, etc. Measurement and payment will distinguish between supply / delivery; installation and testing; and commissioning and trial operation of the equipment. A further training requirement shall be allowed for as specified in the scheduled items.

M01.23.2 Supply and delivery to site with documentation

<u>Item</u>	<u>Unit</u>
Supply and delivery to site with documentation	No

The tendered rates shall include for full compensation of all costs incurred in design, drawings, manufacture, supply, testing at the manufacturers works, inspections, quality control, quality assurance, factory acceptance testing, corrosion protection, packing, delivery to site including transportation costs and offloading on site including any craneage requirements. No claims whatsoever for extras will be allowed on the grounds that a necessary piece of equipment or a part thereof is not specifically mentioned.

M01.23.3 Installation, Testing and Commissioning of the Equipment

<u>Item</u>	<u>Unit</u>
Installation, Testing and Commissioning of the Equipment	No

The tendered rates shall include for full compensation of all costs incurred in installation, site testing, setting into operation, the supply of O & M manuals, commissioning and maintenance during the warranty period of all equipment specified on Site including the provision of all labour, supervision, instruments, equipment, transport, on-site quality assurance and quality control, inspection and testing (including attendance at tests witnessed by the Employer's Agent / Employer's Representative), materials and Temporary Works necessary to completely install, test and commission and render fully operational equipment.

The rate shall also include the cost of the installation of all auxiliary equipment not

specifically mentioned but obviously required, (e.g. all ancillaries, including all bolts, fastenings and brackets, safety guards and any work or material required for the proper installation of such equipment) to enable the equipment to be installed and/or function safely and correctly as specified until taken over by the Employer; the putting into service of the complete installation; remedial work and any other work as specified and necessary.

The rate shall also include for all preliminary testing and the provision of testing equipment therefore including all disruptions to installation caused by such testing.

Payment will only be effected after full compliance of the equipment items with this Section and associated documentation has been approved by the Employer's Agent / Employer' Representative.

M01.23.4 Trial Operations

<u>Item</u>	<u>Unit</u>
Trial Operations	No

This specification allows for a number of calendar days within which the system Trial Operation can be completed after completion of commissioning process. The Contractor shall programme and price for providing full technical and operational support during trail operation.

M01.23.5 Employer's Operator Training

<u>Item</u>	<u>Unit</u>
Training	No

Payment for Training of the Employer's Operational Staff will be made under this Section as set out in project specification or agreed with the Employer's Agent / Employer' Representative. The lump sum shall be inclusive of all costs associated with the training programme and on-site training of personnel.

M01.23.6 Spares Equipment

<u>Item</u>	<u>Unit</u>
Spares.....	No

The cost of spares, considered to be necessary by the Contractor other than spares required by the Employer, delivered to Site and handed over will be paid as a lump sum. A Spare Part Schedule subject to approval by the Employer's Agent/ Employer's representative shall be submitted before procurement of spares.

The actual lump sum to be paid shall be based on the unit rates priced in the Bill of Quantity for the actual spares ordered and supplied and the Employer is entitled to purchase all, some or none of the items listed. A provisional sum will be allocated in the Bill of Quantity for the complete list of spare parts as listed by the Contractor. The rate tendered shall provide for the manufacture, supply, delivery to Site and handing over of the spares ordered and shall include permanent packing for long term storage. The spares shall be manufactured at the same time as the installed items.

