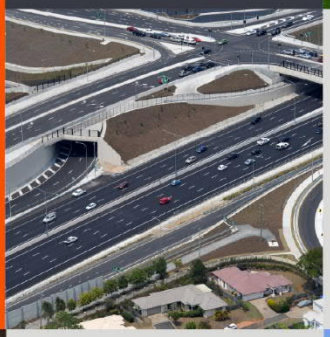
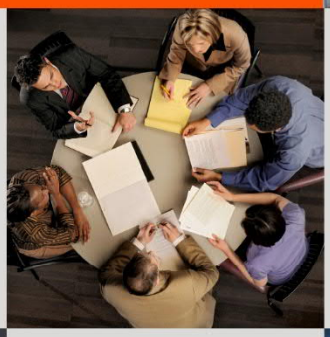
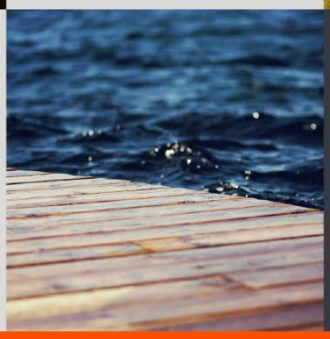






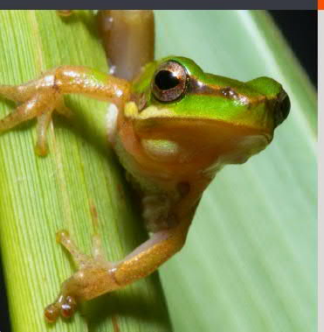
OPERATING MANUAL AND FUNCTIONAL SPECIFICATION

Byron Bay Sewer Treatment Plant Additional Flow Path & Distribution Pit

Prepared by Planit Consulting Pty Ltd

May 2023

Job No. J6811



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Tables

1 Introduction

1.1 Purpose of Document

This document is an Operating Manual and Functional Specification describing the strategy required to distribute effluent via the revised effluent discharge flow paths at the Byron Bay Integrated Water Management Reserve. This document does not include the maintenance activities required to maintain the scheme components in a serviceable condition nor does it cover environmental or Work Health and Safety considerations.

1.2 Background Information

The Byron Bay Sewage Treatment Plan (STP) has an ultimate capacity of 2,200ML / year. It being predicted this facility will reach full capacity in 2025 due to current growth patterns within the servicing area.

The historical arrangement for the treatment plant involved up to 4.865ML/day of treated effluent is discharged to Belongil Creek via the Belongil Union Drain (shown in blue in Figure 1) and the 24ha Melaleuca regeneration area.

When investigating options for increasing discharge rates from the STP to meet the required demand some local land holders expressed concerns regarding the management and use of this flow path. To address these concerns, Council adopted a new strategy involving splitting the flow and discharge offsite utilising an existing drain through the Byron Industrial Estate as an additional dry weather flow path (shown in red Figure 1).

This additional flow path provides future opportunity for increasing discharge rates up to 8ML/day, while taking pressure off the Belongil Union Drain. During wet conditions, to ensure the Industrial Drain can accommodate stormwater runoff, effluent discharge is redirected back to the existing Belongil Union Drain.

As the Union Drain is known to intersect known areas of Acid Sulphate Soils (ASS) and have a significant role in the export of Acidic waters to the Belongil it is important that commissioning of the additional flow path maintains surface and groundwater processes within the Union Drain. To ensure that there are no adverse outcomes from the drying of this drain and these soils during dry weather it is a requirement that the drain remain wet and that water level in the drain be maintained at a minimum level. To facilitate the requirements of the 24 ha Melaleuca Forest plus the need to keep minimum water levels in wetland cells H, I and J, some effluent flow is directed to the drain during wet weather.

Figure 1.Historical (blue) and new (red) Byron Bay STP excess effluent discharge pathways

2 Operating Strategy

The effluent discharge strategy at Byron Bay Integrated Management Reserve operates in two modes, an dry weather mode which is the normal operating mode and wet weather mode. Dry weather mode delivers flows to Cell I and J, the 24ha and the additional flow path. A schematic diagram showing how flows are distributed is provided in Figure 2 below.

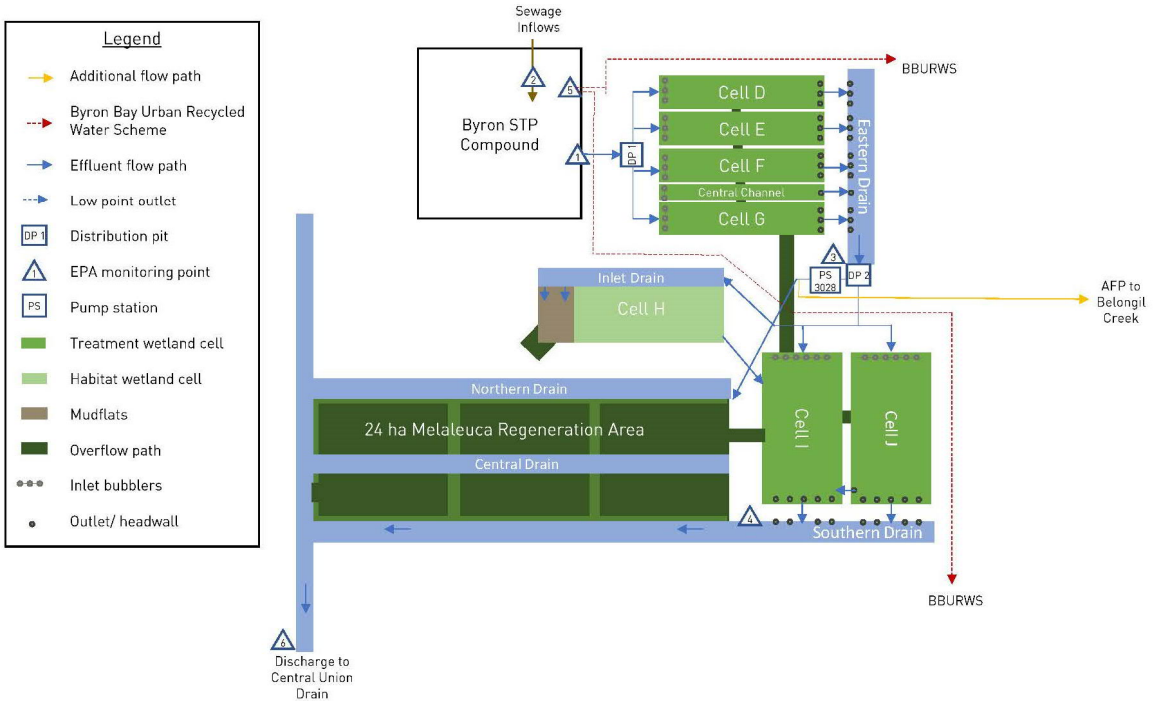


Figure 2.Flow Diagram

In the dry weather mode the effluent flow paths are controlled by a pre-set algorithm in the Council's Water and Sewerage SCADA system which is informed by a network of automatic water level loggers located in the Industrial Estate Drain, Cells I and J and the 24ha irrigation area and a weather station recording rainfall.

The dry weather operating strategy comprises the five elements listed below. The flow paths and control details are shown on Drawings 1 to 5. The Points referenced in the strategy below are shown on Drawings 1, 2 and 3.

1. During normal conditions, there is a requirement to deliver a minimum dry weather flow of between 0.5 to 1ML/day to wetland cells I and J to maintain the environmental health of the wetland, with an operating water level greater than 150mm. Periodically flows may also need to be provided to Cell H of approximately 0.3ML/day This is achieved by piping a gravity flow from the Central Channel Distribution Pit No 2 to the cell inlets. This flow is prioritised over all other flows in the effluent discharge strategy. Once this requirement is satisfied the balance of the flow into the Central Channel Distribution Pit No 2 is utilised in accordance with the priorities set out in points 2 to 5 below.
   Finally, there is a potential for the cells I and J requiring no flow due to cell health of servicing requirement. In these cases, the gravity flow will be shut down to allow emptying of the cells.

2. Under dry weather conditions, the pump station PS 3028 receiving treated effluent from the Central Channel Distribution Pit No 2, pumps effluent through a new 300mm diameter pipeline to a drainage channel in the Byron Industrial Estate. From here flow gravitates through the drainage channel until it meets the Belongil Union Drain and ultimately through to Belongil Creek. Flow to the Byron Industrial Estate Drain is measured by a flow meter and recorded in Byron Shire Councils SCADA system.

3. If during a rainfall event, water levels in the Byron Industrial Estate Drain (Pedestrian Bridge) rise above the maximum set point measured by the automatic water level loggers the pump at PS 3028 will be turned off and the Motorised stop valve on the 300mm rising main closed. Flow will gravitate to Cells I & J from the Central Channel Distribution Pit No 2. Those cells subsequently discharge from EPA 4 into the Upper Belongil Union Drain.

4. If during dry weather conditions, the water level in the Belongil Union Drain as measured by automatic water level logger in the cell J falls below the minimum groundwater level required to prevent the formation of acid sulphate soils, PS3028 is turned off and the Motorised stop valve on the 300mm rising main closed. Flow will gravitate to Cells I & J, which in turn discharges into the Upper Belongil Union Drain, subsequently recharging the groundwater levels. This raises water levels in the Belongil Catchment thereby preventing the oxidation of the acid sulphate soils and/or possible formation of iron (pyrite). Once the required water level in the Belongil Union drain is achieved, the automatic water level logger will send a signal to the SCADA which will cause the motorised stop valve on the 300mm rising main to open and pump station 3028 to start, redirecting flows to the Byron Industrial Estate drain.

5. During dry weather, there is also a requirement to maintain a minimum water and pH level in the 24Ha Melaleuca Forest to prevent the oxidation of Acid Sulphate Soils. When the water level in the 24Ha Melaleuca Forest cells falls below the minimum set level, flow from pump station 3028 is diverted away from the Byron Industrial Estate Drain by opening the motorised stop valve on the 150mm rising main, and closing the motorised stop valve on the 300mm rising main to allow flows to the 24ha Melaleuca Forest. Flow to the 24Ha Melaleuca Forest is measured by two water level loggers and a flow meter at the PS and recorded in Byron Shire Councils SCADA system. Once the required water level in the 24Ha cells is achieved, the flow from the pump station is redirected to the Byron Industrial Estate drain by opening the motorised stop valve on the 300mm rising main and closing the motorised stop valve on the 150mm rising main. All control will be via Council's SCADA system.

3 Operating Methodology

3.1 Flow Control

The automated control of the water level in the Byron Industrial Estate Drain, the Belongil Union Drain and the 24Ha Melaleuca Forest to achieve the Operating Strategy set out in Chapter 2 is undertaken using Byron Shire Councils Water and Sewerage SCADA system.

Automatic loggers in the Byron Industrial Estate Drain, CellJ, in the Belongil Union Drain and in the 24Ha Melaleuca Forest measure the water level at each of the respective points and that information is transmitted by telemetry to Councils Water and Sewerage SCADA system.

The Effluent Pump Station can pump effluent to either the Byron Industrial Estate Drain or the 24Ha Melaleuca Forest. When the pump station is operating flow to each of the location is controlled by two motorised stop valves comprising a 150mm diameter valve on the pipeline to the 24Ha Melaleuca Forest and a 300mm diameter motorised stop valve on the pipeline to the Byron Industrial Estate Drain. The operation of the pump station and the position of each valve is controlled by a signal from the SCADA wherein the water level at each of the automatic water level loggers is compared with a set point for the respective gauge to determine if flow should be directed to either the Byron Industrial Estate Drain, the Belongil Union Drain or the 24Ha Melaleuca Forest. The set points will be adjustable within a prescribed range. The set point for the water level loggers in the Byron Industrial Estate Drain may be obtained from the findings of the Byron Industrial Estate STP Discharge Drain Modelling, BMT April 2019 whilst the set point for the Belongil Union Drain have not yet been set and will be confirmed after an initial trial and calibration regime. The set points for the water level loggers in the 24Ha melaleuca Forest will be set by observation of the forest.

There is an opportunity to estimate these flows based on the readings of the weir level from the EPA4 point. The measuring range and set point for each of the Automatic Water Level Gauges will be updated in Table1.

Table 1. Automatic Water Level Logger Set Points

DRAIN	GAUGE	UPPER RANGE (m AHD)	LOWER RANGE (m AHD)	SET POINT (m AHD)
Byron Industrial Estate Drain	Gauge 1 Pedestrian Bridge	TBA	TBA	TBA
Byron Industrial Estate Drain	TBC for system redundance	TBA	TBA	TBA
Belongil Union Drain	Gauge 2 Cell J	TBA	TBA	TBA
Belongil Union Drain	TBC for system redundance	TBA	TBA	TBA
24Ha Melaleuca Forest	Gauge 3	TBA	TBA	TBA
Future allocation?				

The Decision-Making Matrix shown in Table 2 will be update in the original set up in Councils SCADA. To achieve the flow to the location shown in the FLOW CONDITION column each of the tests shown for the respective water level gauge shown under the AUTOMATED WATER LEVEL GAUGE READING must be true.

Flows to the Byron Industrial Estate Drain and to the Belongil Union Drain are measured by a dedicated flow meter each and recorded in Byron Shire Councils SCADA.

Table 2. Flow Decision Making Matrix

FLOW CONDITION	INPUTS					OUTPUTS	
	AUTOMATED WATER LEVEL GAUGE READING AT EACH POINT					PUMPS	MOTORISED STOP VALVE POSITION
	1	2	3	4?		150mm to Belongil Union Drain	300mm to Byron Industrial Estate Drain
0.5 to 1ML/day gravity flow to Cells I & J	Any	Any	Any	Any	Any	Any	Any
0 ML/day gravity flow to Cells I & J (During servicing/ maintenance/ health requirement for the cells)	Any	Any	Any	Any	Any	Any	Any
Dry weather flow to Byron Industrial Estate Drain	< Set Point	> Set Point	> Set Point	> Set Point	On	Closed	Open
Dry weather flow to Belongil Union Drain	Any	> Set Point	> Set Point	> Set Point	Off	Closed	Closed
	Any	> Set Point	> Set Point	> Set Point	Off	Closed	Closed
Dry Weather Flow to 24Ha Melaleuca Forest	Any	< Set Point	> Set Point	> Set Point	On	Open	Closed
	Any	> Set Point	< Set Point	> Set Point	On	Open	Closed
	Any	Any	Any	Any	On	Open	Closed

3.2 Rake

An automatic debris removal rake has been installed in the Central Channel Distribution Pit No 2. The rake is removes channel debris including leaves, branches and other organic matter prior to effluent entering the distribution pit.
The rake is controlled by a variable timer which is monitored and adjustable from Councils SCADA. The rake shall also be capable of starting and stopping upon a digital signal from Councils SCADA. The SCADA would typically derive this signal from a water level logger. This function will be programmed in the SCADA and initially turned off in the SCADA. The rake shall also be capable of variable speed operation which will be monitored and adjustable from Councils SCADA.

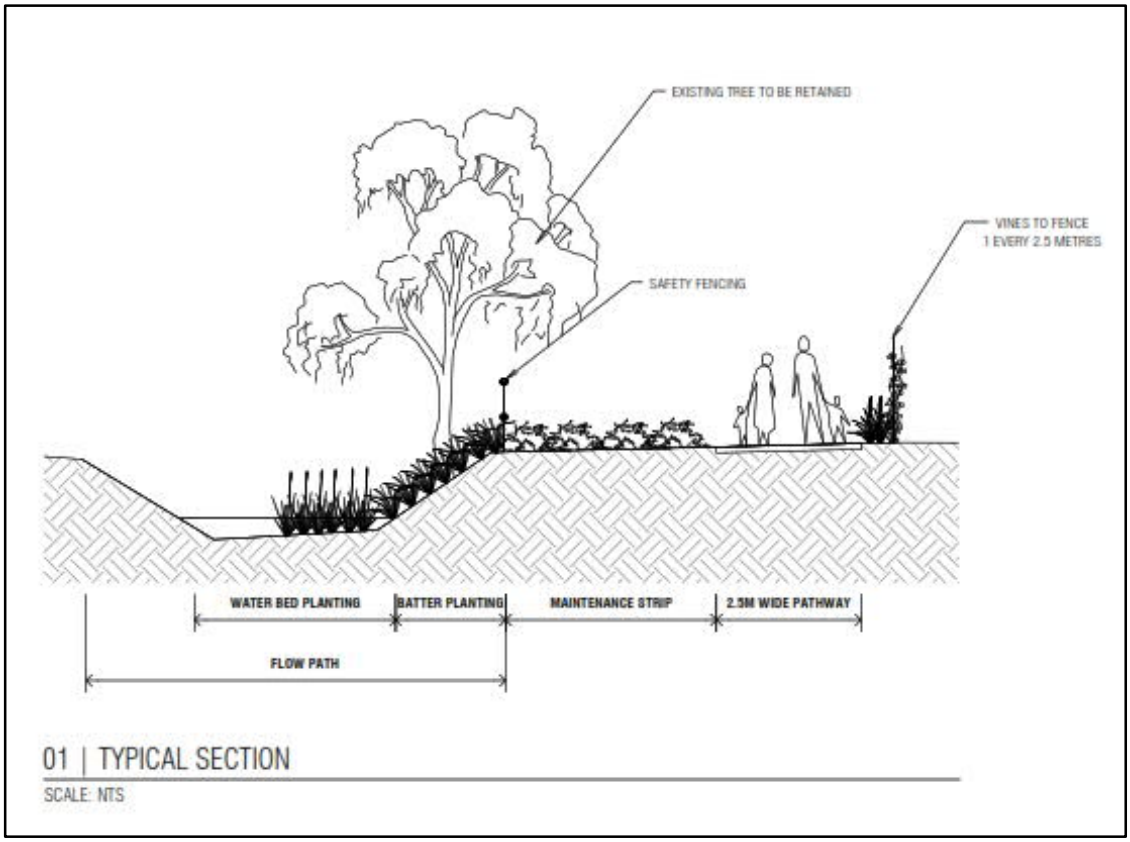
3.3 Drain Maintenance

An important factor in the successful operation of the flow paths is the maintenance of the vegetation cover in the Byron Industrial Estate Drain at design levels. Excess vegetation growth in the drain above the design level will result in localized damming of the drain and reduced flow capacity. It is likely that this will result in false high-level water readings on the Automated Water Level Gauges meaning that flow will be inappropriately redirected to the Belongil Union Drain.
The loss of drainage capacity may also result in unnecessary overflow of the drain in wet events even though the flow in the drain is only transmitting stormwater.

Periodical checks and mechanical removal of vegetation overgrowth is recommended.

A typical cross section of the drain is shown in Figure 3.

Figure 3. Typical Section of Drain



3.4 Modes of Operation

Byron Shire Council staff may select the following modes of operation for standard devices. These modes are selected via the selector mechanisms in SCADA. For each device, a mode of operation determines how it is monitored and controlled.

Table 3. Modes of Operation

Mode	LCP Selector Switch	SCADA	Applicable Devices
Off	OFF	N/A	PS, Valves and Rake
SCADA Automatic	REMOTE	Automatic	PS, Valves and Rake
SCADA Manual	REMOTE	Manual	PS, Valves and Rake
Manual (Field)	LOCAL	N/A	PS, Valves and Rake
Out of Service	REMOTE	Out of Service	PS, Valves and Rake

Devices (drives, valves) can only be operated in SCADA Automatic and SCADA Manual modes when they are In Service (i.e., not in Out of Service mode) and are not prevented from operating by trips or interlocks.

SCADA AUTO mode shall allow control of the Rake via adjustable parameters, timers and operator pre-sets / setpoints. The process shall operate without operator intervention for varying lengths of time.

SCADA MANUAL mode shall allow an operator to manually control each device via screens from the SCADA terminals. Interlocks shall be required preventing operation of a particular device if certain conditions are present e.g. high level.

Signals from Instruments (level / flow transmitters, contact inputs etc.,) are displayed on the SCADA and used by the PLC.

Under normal operation, all devices will be in Automatic and Available and all instruments will be In Service (Available). In this situation, the entire operation is monitored and controlled automatically by the PLC. The operator (or engineer) can select alternative modes of operation for individual pieces of equipment through the SCADA and the LCP selector switches when equipment failure or other conditions prevent the PLC from adequately controlling the processes.

The mode of operation of the device / instrument affects:

- Personnel, Device and Plant Protection – Trips and Interlocks
- Availability of the device for automatic and manual control
- Availability of the device for duty operation

Table 4. Mode – Functionality

Mode	Functionality
SCADA (Manual) (Auto Selected on LCP)	SCADA control: Enabled LCP selector switch: “Remote” SCADA setting: Manual Has alarms enabled Is Unavailable and Not Ready Does not affect the running of any other related device being operated by the sequence. The LCP must be switched to “Auto”, and “Manual” mode selected at the SCADA Terminal. Running the unit in SCADA Manual mode shall disable all automatic operating actions. Stop/start functions of the PS, Valves and Rake shall be possible via the SCADA. All set points, such as Rake speeds and Valve position shall be manually adjustable via the SCADA during operation. All personnel safety and equipment interlocks shall be enabled. Indication and alarms shall be visible

	from the SCADA. Does not apply operator adjustable ramp rates for changes in VSD speeds. If the Rake is running in SCADA Auto Mode and SCADA Manual Mode is selected, the Rake shall continue operating, however it shall be removed from any automatic sequences or control loops currently in operation. The Valves shall remain at their current positions, which shall be recorded for when the system is re-set to SCADA Auto mode.
SCADA (Auto) (Auto Selected on LCP)	SCADA control: Enabled LCP selector switch: "Remote" SCADA setting: Auto The LCP must be selected to "Auto", and "Auto" mode selected at the SCADA Terminal. Running the unit in SCADA Auto mode shall operate the system automatically as dictated by the PLC. All set points shall be automatically determined or applied from the PLC during operation. All safety equipment shall be enabled (both hardwired and software). Indication and alarms shall be visible at the SCADA Terminal. If the unit is operating in SCADA Manual Mode and SCADA Auto Mode is selected at the SCADA Terminal, the PLC shall determine its operating status (whether duty 1 or duty 2) and adjust the motor speed or valve position (as applicable) to meet the required set points.
Out of Service Mode	SCADA control: Disabled LCP selector switch: "Auto" SCADA setting: Auto Out Of Service (OOS) Mode applies to devices and instruments and is typically used when the device or instrument has failed and is awaiting maintenance. Out of Service mode is not available when the device is in Manual Mode. Switching the LCP Selector Switch to Manual mode, automatically cancels Out Of Service. Out of Service has a slightly different meaning for devices (Rakes, valves etc.,) and instruments (transmitters, contact inputs etc.). For devices in Out of Service Mode the device: • Is Unavailable and Not Ready and therefore cannot be automatically controlled by the sequence logic programmed in the PLC or by the operator from SCADA. • Has alarms disabled. For Instruments in Out of Service Mode the instrument: • Has alarms disabled. • Transmitter's reports minimum engineering value (zero for level for example). • Contact Inputs reports inactive. Note: Out of Service mode does not disable hardwired interlocks.

3.4.1 Mode Changes and Resulting Actions

The tables in this section describe all possible mode changes and the resulting action for different types of standard devices.

The following Table describes the behaviour of each device when switching between the SCADA adjustable modes while a device is placed in the Off Mode.

Table 5. Mode change while in Off mode (LCS)

SCADA Mode Change	Device
Auto → Manual	Drive Does Not Start
Manual → Auto	Drive Does Not Start
In Service → Out of Service	Drive Does Not Start Disable Alarm
Out of Service → In Service (When in Auto Or Manual)	Reset Trips Enable Alarms Drive Does Not Start

The following Table describes the behaviour of each device when switching between the SCADA adjustable modes while a device is placed in the Automatic Mode on LCS.

Table 6. Mode change while in Remote mode (AUTO on LCS)

SCADA Mode Change	Device
Auto → Manual	Keep Current Condition
Manual → Auto	Operate as Determined By PLC Sequence
In Service → Out of Service	Immediate Stop Disable Alarms
In Service → Out of Service (When in Auto)	Reset Trips Enable Alarms Operate as Determined By Sequence
Out of Service → In Service (When in Manual)	Reset Trips Enable Alarms Drive Does Not Start

The following Table describes the behaviour of each device when switching between the SCADA adjustable modes while a device is placed in the Manual Mode on LCS.

Table 7. Mode change while in Manual mode (on LCS)

SCADA Mode Change	Device
Auto → Manual	Drive Operation Unaffected
Manual → Auto	Drive Operation Unaffected
In Service → Out of Service	Cannot Be Selected – Field Mode Cancels Out of Service
In Service → Out of Service (When in Automatically Occurs When Field Selected)	Reset Trips Enable Alarms Drive Does Not Start

Note: Valves will stop at current position when its mode is changed to SCADA Manual. The valve will close when its mode is changed to Out of Service, Field or Off.

3.4.2 Status Indication

The status of all valves, pumps and the Rake shall be indicated at the SCADA Terminal as defined:

- PLC Availability / Unavailable
- Control Supply Healthy / Not Healthy
- Motor Isolated / Not Isolated
- Motor Running / Not Running
- Motor Fault / No Fault
- Emergency Stop Operated / Not Operated
- Communication Fault / No Fault

Additional status indication shall be provided in line with specific "non-standard" drive features.

Interlocks shall prevent the Rake from running under a range of specified conditions.

Personal Safety interlocks shall cause the Rake to trip, and an alarm shall be generated.

When running the system in Manual Mode, the Rake is controlled locally by Hard Wired Control. No signal sent to VSD. No Interlocks or Permissives are enabled / latched.

While in SCADA Manual Mode safety interlocks shall be enabled. All interlocks shall be enabled while in SCADA Auto Mode.

3.4.3 Alarms

When scheduling the required alarms, the alarm priority must be nominated. All devices and instrumentation shall be assigned alarms and alarm priorities. The alarm priorities will range Low, Medium and High.

NB: Before an alarm is activated the condition causing the alarm must be continuously present for a pre-set time (time to be set based on circumstance and consequence).

The following alarm statuses will be available in the control system:

- Active unacknowledged
- Active acknowledged
- Inactive unacknowledged
- Inactive acknowledged – alarm log

Alarm Actions

When an alarm is generated, it shall be displayed on the Alarm Status Bar, which must be visible to the SCADA user at all times, at the SCADA Terminal. Sound and colour indication for each alarm priority must be provided. Colour indication shall also be provided for acknowledged and unacknowledged alarms. Existing colour standards will be applied to active / inactive / acknowledged / disabled alarms.

Alarms shall be logged on the Alarm Page and shall indicate transitions between Active, Inactive and Operator-Acknowledge transitions.

The following information must be made available at the SCADA Terminal when an alarm is generated (where relevant):

- Time and date when alarm became active, inactive, acknowledged (in an alarm history log)
- Alarm tag name
- Alarm description
- Alarm status – active, inactive, acknowledged, unacknowledged
- Alarm Priority (indicated by text colour)

3.4.4 Device and Instrument Input Outputs

Table 3. Device and Instument Input Outputs

FACILITY	DEVICE	INPUT OUTPUT
Effluent Pump Station	Switchboard	Power Failed
		Unauthorized Access
	Wet Well	High Effluent Level
		Low Effluent Level
	Pump 1	No Flow
		Over Temperature
		Over Current
		Hours Run
	Pump 2	No Flow
		Over Temperature
		Over Current
		Hours Run
300mm Main	Flowmeter	Analogue Flow
		Digital Flow
		Flow Totaliser
	Motorised Valve	Valve Open
		Valve Close
		Failed to open
		Failed to close
150mm Rising Main	Flowmeter	Analogue Flow
		Digital Flow
		Flow Totaliser
	Motorised Valve	Valve Open
		Valve Close
		Failed to open
		Failed to close
	Water Level	High water level
Automatic Logger		Low water level
	pH	High pH
		Low pH
Central Channel Distribution Pit No 2	Rake	Rake Speed
		Rake Speed Adjust
		Rake Timer Setting
		Rake Timer Adjust
		Over Temperature
		Digital Signal On
		Digital Signal Off
		Over Current
		Jammed
		Power Failed
		Chute Blockage