DEPARTMENT OF JUSTICE OF WESTERN AUSTRALIA

Wooroloo Prison Farm Wastewater Treatment Plant Upgrade Works: Works Approval Application

Application Narrative and Attachments
to the Application Form

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1 Attachment 3 Narrative: Proposed Activities

1.1 Synopsis of the proposed activities

The Department of Justice (DoJ) proposes to expand its existing registered (R530/1992/1) wastewater treatment plant (WWTP) at Wooroloo PF to 220kL/day, from a category 85 (<100 kL) to category 54 (>100 kL) prescribed premise. No clearing is required.

1.2 Structure of this narrative attachment

Pursuant to a pre-application meeting with the Department of Water and Environmental Regulation (DWER) and written enquiries (Feb 2019), the Department provided DoJ with additional guidance (See *Attachment 8.1*). This guidance included the form of the application: separate Works Approval application that includes construction and operation of the entire WWTP facility (including existing infrastructure).

In the same letter, DWER provided additional guidance through Schedule 1 for preparation of this application, particularly with regards to Part 4: Proposed activities and Part 9: Emissions, discharges and waste. Also included were general requirements for the irrigation (discharge) of treated wastewater.

To simplify consideration of the Works Approval application for the WWTP, the *Part 4 Attachment* of this narrative is separated conceptually into two subsections: (a) WWTP and (b) downstream to include storage and irrigation. There are no infrastructure changes to the downstream components in this Works Approval application. However, because DWER has requested a holistic view of the entire facility, the downstream information is included.

The structure of this *Part 4 Attachment* is as follows:

- Overview of the facility
- Current WWTP
- Proposed WWTP activities
- Current downstream storage and irrigation

The response to those items specifically included in DWER's letter of guidance are so noted with an "*."

1.3 Overview of the facility (See *Attachments 2.7 and 2.1 – 2.5*)

DoJ operates the Wooroloo Prison Farm (Wooroloo PF), a minimum security prison 55 km east of Perth, Western Australia. As of July 2019 the prison houses 410 prisoners and is managed by a shift staff of seventy-five guards, program facilitators and other staff. There are two residential houses and one overnight staff house with a capacity of six staff. The prisoner population will increase to 458 on completion of the WWTP upgrade.

1.3.1 Land Use and Zoning

Wooroloo PF is zoned "Public Use – Prison" under the Metropolitan Region Scheme (Department of Planning, Lands and Heritage 2015). The site is partially cleared and contains isolated pockets of native vegetation. The site is a reserve established under management order, managed by DoJ. DoJ now incorporates the Department of Corrective Services, designated as the Primary Interest Holder on the Land Title (*Attachment 1A*).

1.3.2 Topography

The prison is located on Beachina Hill on an approximately 25 hectare (ha) plot of land. Within the prison boundary, the topography can be described as flat to gently undulating, falling from approximately 322 m AHD in the southwest, to approximately 282 m AHD in the northeast of the site, adjacent to the sports oval. Extending beyond the prison boundary, but still within the Wooroloo PF site, the topography slopes downward to the northeast towards the prison's WWTP and Wooroloo Brook.

1.3.3 Facility history and proposed activities overview

The existing Wooroloo PF WWTP plant was commissioned in 1998. It operates under DWER Registration R530/1992/1, in line with the description of Category 85 (Sewage facility) under Schedule 1 of the Environmental Protection Regulations 1987: sewage facility from which treated sewage is discharged onto land with a design capacity of more than 20 but less than 100 cubic metres per day.

The proposed works for which this DWER Works Approval is sought are to upgrade the plant production capacity to 220 cubic metres per day. (Details of the proposed upgrades are contained in Section 1.5). The upgraded WWTP will meet the criteria for a Category 54 Sewage Facility: sewage facility from which treated sewage is discharged onto land with a design capacity of 100 cubic metres or more per day.

The current premises are comprised of two major components: (a) the WWTP plant and pre – plant infrastructure such as grit removal and (b) downstream storage and irrigation. This Works Approval application encompasses proposed upgrades to the plant, including the addition of processing capacity, upgrading of aged electrical and mechanical components, new plant instrumentation, and plant automation.

The sludge ponds, storage and effluent disposal area are not part of the works, will not change, and will remain as described in Section 1.6.

1.3.4 Current Approvals (DWER, Department of Health (DoH), and other) and compliance

The Department of Corrective Services is approved to operate the facility under DWER Registration R530/1992/1 but only up to 100 cubic metres per day. The site is currently operating at approximately 175 cubic metres per day and is out of compliance with that Registration. DoJ undertaking actions to resolve this noncompliance and is seeking to obtain both a Works Approval for additional WWTP capacity as well as an Operating License.

The Department of Corrective Services is approved to operate a Recycled Water Scheme under Approval Number F18/00000 (29 January 1999) but with updated conditions of approval (16 January 2014) that specify a number of compliance conditions, not all of which have yet been met. The details of the updated conditions of approval can be found in the DOH Recycled Water Scheme Approval 16 January 2014 (*Attachments 5.1 and 5.2* and section 1.5.4 below). The site is operating out of compliance with that Approval as stated in a letter from DoH (*Attachment 5.2*). DoJ is undertaking actions to resolve these noncompliance issues (section 1.5.4).

1.4 WWTP (*Attachment 3A.1*)

The limits of the WWTP described below include all infrastructure between the sewerage inflow (manhole), and IAT tank. It does not include sludge lagoons, holding pond, irrigation dam, chlorination, or any other infrastructure up to including irrigation, all of which are discussed in Section 1.6.

1.4.1 Existing WWTP design, capacity, and process

The Average Dry Weather Flow (ADWF) capacity of the existing plant is estimated to be 175 kL per day. Based on 2017 populations of prisoners (360) and staff, the wastewater flow was estimated at 156.0 kL/day. The increase in prison muster from 360 to the current 410 has necessitated the expansion of the existing WWTP with a subsequent estimated average wastewater flow increase to 220.0 kL/day. Because no influent or effluent measuring devices are installed, the current flows and processing capacity are estimated.

The existing WWTP was designed and built by Henry Walker Water Treatment. It is an Intermittently Decanted Extended Aeration (IDEA) type plant with the following stages:

- An in-line muncher (inlet works),
- Demand Aeration Tank (DAT),
- Alum dosing for phosphorus removal,
- Soda Ash dosing to maintain optimum pH for treatment,
- Intermittent Aeration Tank (IAT),
- Effluent from the IAT is released into a holding pond which overflows into an irrigation dam,
- An internal recycle, which recycles mixed liquor from the IAT to the DAT,
- Sludge is wasted from the IAT during aeration times.

The source water is domestic sewage produced at Wooroloo PF. Currently the wastewater passes through an in-line muncher before treatment in the onsite IDEA WWTP. This process involves an aeration, settling and decanting period which are successively repeated.

During aeration the influent is mixed with the activated sludge within the DAT. This rapid surface mixing action aids in dissolving oxygen into the water whilst forcing the sludge into suspension from its settled state. During this stage nitrification and aerobic metabolic processes occur.

Aeration is then interrupted with the initiation of the settling period. This stage occurs within the IAT. During this stage, active sludge starts to homogenously settle, and dissolved oxygen concentrations decrease. The purpose of the settling period is the de-nitrification and release of phosphorus in the sludge layer via anaerobic processes as well as forming a clear supernatant above the settled layer. During these periods alum and soda ash are added to remove phosphorus and maintain optimum pH respectively.

Upon completion of the settling period, the treated, clear wastewater above the settled layer is skimmed and decanted. The effluent is then transferred to a holding pond and then an irrigation dam, or directly to the irrigation dam. Prior to being pumped to the irrigation areas, the effluent is disinfected with chlorine via a chlorinator system followed by media filtration in a 24" gravel filter.

The WWTP is operational 24 hours per day, 365 days per year. Sufficient standby is therefore required to account for downtime associated with plant maintenance.

1.4.2 Plant monitoring, testing, influent and effluent quality

The source water for the WWTP is from domestic waste, produced on site. Expected raw sewage characteristics are included in *Table 1*.

Parameter	Unit	Average	90 percentiles
Biochemical Oxygen Demand	mg/L	200	285
Total Nitrogen	mg/L	61	98
Average Total Phosphorus	mg/L	8	12
Total Alkalinity	mg/L	215	330
Total Suspended Solids	mg/L	225	350
pH	pH units	7-9	-

Table 1 Expected raw sewage characteristics

DoJ conducts monthly testing of the WWTP at the following sampling points:

- Influent pipe (DAT)
- Effluent pipe (IAT)
- Influent Tank (DAT)

- Effluent Tank (IAT)

The WWTP is operated and maintained according to the guidelines contained in *Watercon Operation and Maintenance Manuel: Wooroloo Wastewater Treatment Plant for Programmed Facility Management (Attachment 3A.7).* The Plant Monitoring section of the Manual describes the type and frequency of testing.

	Frequency			
Test Name	**Influent**	**DAT**	**IAT**	**Treated Effluent**
Settled Sludge Volume (S.S.V.)		Weekly	Weekly	
Dissolved Oxygen Level		Weekly	Weekly	
Sludge Volume Index (S.V.I.)		Monthly	Monthly	.
pH Test	Weekly	Weekly	Weekly	Weekly
Turbidity Test				Weekly
Mixed Liquor Temperature Test		Weekly	Weekly	
Colour and Odour Test				Weekly
NH3 (N) Test	Weekly	Weekly	Weekly	Weekly
NO3 (N) Test		Weekly	Weekly	Weekly
PO4 (P) Test		Weekly	Weekly	Weekly
Mixed Liquor Suspended Solids Test		Monthly	Monthly	
BOD5	Monthly			Monthly
Suspended Solids				Monthly
Total Nitrogen				Monthly
Total Phosphorus				Monthly
Thermo tolerant Conforms		.		Monthly

Table 2 WWTP test type and frequency of testing

Table 3 contains the characteristics of the effluent as sampled at the IAT outlet pipe on 15 May 2019. This sample was specifically taken to not only identify the current effluent characteristics but to expand that analysis to include metals and other organics. The comparison standards are from the *Department of Environment and Conservation (NSW), Environmental Guidelines: Use of effluent by irrigation, October 2004.*

	Current effluent at WWTP (15/5/2019 measured at IAT)	NSW Effluent characteristics for low exposure risk (SDR 2)[1]	NSW trigger values for metals in irrigation effluent for long term use (up to 100 years)[2]
Total nitrogen	74 mg/L	<50 mg/L	
Total phosphorus	4.1 mg/L	<10 mg/L	
E coli, total and faecal	>2419 MPN/100mL	<1000 cfu/100mL[3]	
Total dissolved solids	1000 mg/L	<600 mg/L	
CBOD5	68 mg/L	<40 mg/L	
Oil and grease	37 mg/L	<1,500 mg/L	
Aluminium	18000 µg/L		5.0 mg/L[4]
Arsenic	<1µg/L		0.1 mg/L
Cadmium	<0.1 µg/L		0.01 mg/L
Chromium	<1 µg/L		0.1 mg/L
Cobalt	<1 µg/L		0.05 mg/L
Copper	9 µg/L		0.2 mg/L
Iron	110 µg/L		0.2 mg/L
Lead	<1 µg/L		2.0 mg/L
Lithium	<5 µg/L		2.5 mg/L
Manganese	21 µg/L		0.2 µg/L
Mercury	<.00005 µg/L		0.002 mg/L
Molybdenum	<1 µg/L		0.01 mg/L
Nickel	1 µg/L		0.2 mg/L
Selenium	<1 µg/L		0.02 mg/L
Zinc	36 µg/L		2.0 mg/L

[1] From NSW Environmental Guidelines: Use of effluent by irrigation, Table 3.1: Classification of effluent for environmental management, pg. 19.
[2] From NSW Environmental Guidelines: Use of effluent by irrigation, Table 3.3: Trigger values for metals in irrigation effluent for long term use on all soil types (up to 100 years)
[3] From NSW Environmental Guidelines: Use of effluent by irrigation, Appendix 1. Urban type reuse with controlled public access (sportsground) and agricultural use for food production with no direct contact, e.g. trickle irrigation, both thermotolerant coliforms <1,000 cfu/100mL, pp. 105 – 106.
[4] Comments in Table 3.3 above state that "High toxicity in acid soils. Not a concern if pH of soil is above 6.5.

(continued)	Current effluent at WWTP (15/5/2019 measured at IAT)	NSW Effluent characteristics for low exposure risk (SDR 2)	NSW trigger values for metals in irrigation effluent for long term use (up to 100 years)
Pesticides: TCMX	61 µg/L	<0.001 mg/l[5]	
Pesticide: 2-flourobiphenyl	58 µg/L	<0.001 mg/l[6]	
Pesticide: d14-p-terphenyl	72 µg/L	<0.001 mg/l[7]	

Table 3 Current effluent characteristics and *NSW Effluent Guide* standards[8]

The current prison and staff population would tend to indicate that the existing WWTP is accommodating the flow capacity of the proposed upgraded WWTP, with expected effluent quality observations in *Table 3* indicating that it is not coping well.

1.4.3 Plant operations and maintenance

Day to day operations and monitoring of the WWTP, storage, and associated irrigation infrastructure are the responsibilities of the Maintenance Officer, an employee of DoJ. The Maintenance Officer is also responsible for repairs to the irrigation infrastructure. Many of the plant operations activities, including chemical dosing, are done manually by prison staff.

Specialist tasks, servicing, and repairs of the WWTP and chlorination system are done by sub-contractors.

- Watercon. Provides a monthly service of the WWTP and resolves all issues in the event of breakdown of the WWTP.
- Hydramet. Services and repairs the chlorinator system.
- Russell's Mechanical. Services and repairs fittings, electrical maintenance, pipe and pump repairs.

The WWTP is operated and maintained according to the guidelines contained in Watercon Operation and Maintenance Manuel: Wooroloo Wastewater Treatment Plant for Programmed Facility Management (*Attachment 3A.7*).

[5] From NSW Environmental Guidelines: Use of effluent by irrigation, section on Synthetic organic compounds, pp. 25-26
[6] Ibid.
[7] Ibid.
[8] Department of Environment and Conservation (NSW). Environmental Guidelines: Use of effluent by irrigation. Sydney: Department of Conservation NSW, October 2004.

1.4.4 Plant asset condition assessment

Table 5 describes only the plant infrastructure. The downstream storage, sludge ponds, and irrigation assets are described below in a separate section. The plant infrastructure has undergone a condition assessment specialist engineers in April – June 2019. The remaining asset life for each component is listed. For assets of 25 years estimated life or less, repair and replacement is undertaken as part of normal maintenance.

1.4.5 Proposed WWTP activities (*Attachments 3A.2 and 3A.3*)

The proposed works are required due to an increase in prison population. The works will not only add capacity, but will replace equipment that is at the end of its life cycle. Most important, a significant portion of plant operations, including chemical dosing, will be automated.

DoJ awarded the contract for the works to Watercon in 23 January 2019. The works are expected to be completed by November 2019 with commissioning that same month.

1.4.6 WWTP design basis (new infrastructure) and existing infrastructure incorporated.*

The plant does not have flow meters. Thus, design flow calculations were based on estimates (*Table 4*).

Resident type	Total persons	Flow (L/p/day)	Total Daily Flow (m^3/day)
Prisoners	465	325	151.1
Live in staff	20	225	4.5
Staff (equivalent 10 hr shifts)	13	75	1
Staff (equivalent 12 hr shifts)	108	90	9.7
Plus: Allowance for 20% groundwater infiltration			33.3
Subtotal			**199.6**
Plus: Allowance for 10% buffer capacity			20
TOTAL DESIGN AVERAGE DRY WEATHER FLOW (m^3/day, rounded)			**220**

Table 4 Design occupancy and ADWF

CURRENT ASSET CONDITION ASSESSMENT: PLANT ONLY	Commissioned or Constructed	Asset Type	Condition and Verifier	Estimated Asset Life	Remaining Asset Life
PLANT					
Concrete manhole	1998	Civil/Concrete	Good/Jacobs	80	59
Muncher	1998	M&E	Good/Watercon	15	-6
IAT (existing)	1998	Civil/Concrete	Good/Jacobs	80	59
DAT (existing)	1998	Civil/Concrete	Good/Jacobs	80	59
RAS pump	1998	M&E	Needs replacement	25	0
Alum dosing pump DP-02	2017	M&E	Excellent/Watercon	25	23
Soda ash pump DP-01	N/A	M&E	Very good/Watercon	25	15
Liquid alum storage tank T-02	N/A	M&E	Very good/Watercon	25	15
Soda Ash tank T-01	N/A	M&E	Very good/Watercon	25	15
Gas locked syphon and associated pipework	N/A	M&E	Good/Watercon	25	15
Remaining M&E	1998	M&E	Needs replacement	15	0
Plant process controls and electronics	1998	M&E	Needs replacement	15	0

Table 5 Current asset condition of existing WWTP infrastructure (plant only)

Base on the above, the design flows for the upgraded WWTP were as follow:

- Design Average Dry Weather Flow (ADWF) – 220 m^3/day
- Peak Dry Weather Flow (PDWF) – 2.5 x ADWF (550 m^3/day)
- Peak Wet Weather Flow (PWWF) – 4 x ADWF (10.2 L/s)

The influent characteristics are the same as for the existing WWTP described in *Table 1* above.

Other design considerations were operability. The rational for duplicating the system is that the process is simple, including simple to operate. Since the intent is to continue with prison staff operating the WWTP, retaining a process with which they were familiar, and which works, was a consideration.

However, the simplicity of the process required an assessment to determine whether increased volumes would be satisfactorily accommodated. Watercon, the contractor and current WWTP maintenance contractor, proposed the duplication of the WWTP (*Attachment 3A.3* Process flow diagram). GHD undertook a process review of the proposed duplication and confirmed its design basis (*Attachment 3A.4)*. While the modelling did include the sludge lagoons, the other downstream infrastructure was not included.

Of note is that while the infrastructure will be duplicated, with the original design estimated at 175 kL/day, the process design flow requirements were specified at 220kL ADWF per day (*Attachment 3A.4*, *Table 2*).

Attachment 3A.3 shows conceptually that the new major infrastructure will be a demand aeration tank (138 m^3), intermittent aeration tank (138 m^3), and inlet screening & degritting facility. *Table 6* below provides the expected asset condition of the WWTP upon completion of the works.

All mechanical and electrical (M&E) equipment will be refurbished or replaced as required to achieve a very good/excellent condition assessment. New plant process controls and electronics will be installed, automating much of the current manual process.

An important addition to the plant will be that flow meters are installed and capable of measuring the influent and effluent volumes.

POST-WORKS CONDITION ASSESSMENT: PLANT ONLY	Commissioned or Constructed	Asset Type	Condition and Verifier	Estimated Asset Life	Remaining Asset Life
PLANT					
Concrete manhole	1998	Civil/Concrete	Good/Jacobs	80	59
Inlet screen and washer	2019	M&E	New	25	25
IAT (existing)	1998	Civil/Concrete	Good/Jacobs	80	59
DAT (existing)	1998	Civil/Concrete	Good/Jacobs	80	59
RAS pump (new 1)	2019	M&E	New	25	25
IAT (new)	2019	Civil/Concrete	New	80	80
DAT (new)	2019	Civil/Concrete	New	80	80
RAS pump (new 2)	2019	M&E	New	25	25
Alum dosing pump DP-02	2017	M&E	Excellent/Watercon	25	23
Soda ash pump DP-01	N/A	M&E	Very good/Watercon	25	15
Liquid alum storage tank T-02	N/A	M&E	Very good/Watercon	25	15
Soda Ash tank T-01	N/A	M&E	Very good/Watercon	25	15
Gas locked syphon and associated pipework	2019	M&E	Refurbished/Excellent	25	25
Remaining M&E	2019	M&E	New	15	15
Plant process controls and electronics	2019	M&E	New	15	15

Table 6 Post-works asset condition of WWTP infrastructure (plant only)

1.4.7 Construction approach to the new infrastructure, including construction quality assurance or compliance processes*

Watercon is ISO 9001:2015 certified for the provision of design, construction and maintenance services to the water and wastewater industry. Its recent certificate was issues 7 September 2017. This certification extends to Watercon's subcontractors for the project (*Attachment 3A.5*).

Watercon has provided a Construction Environmental Management Plan that addresses its environmental risk management and controls as well as its audit procedures (*Attachment 3A.6*).

1.4.8 Commissioning requirements*

The commissioning process includes four steps: pre-commissioning, commissioning, operator training, and 12 months of on-site Watercon operation of the plant (*Attachment 3A.8* which is included in the Contractors Scope of Works).

Item 3.10 in *Attachment 3A.8* specifies that operations and maintenance manuals are to be provided as part of the works.

Item 3.11 states that training manuals will be provided. Operations training and maintenance training will be provided on site.

Item 3.12 provides a pre-commissioning checklist to verify the operation of all installed equipment.

Item 3.13 describes commissioning and process proving steps which will cover six weeks after the diversion of raw sewage to the upgraded WWTP. During such time, sampling and testing will be undertaken daily for the first seven days and, if proven, reduced to two days thereafter. Any non-compliance observed during the testing period will extend the process proving period by two weeks.

Item 3.14 describes additional testing to be undertaken during the six week proving period.

Item 3.15 describes the Contractor's obligation to operate and maintain the plant as well as complete process and effluent testing during those twelve months following the commissioning and proving period.

1.4.9 Planned operational processes and maintenance activities*

The current Operation and Maintenance Manual (*Attachment 3A.7*) encompasses plant operations, maintenance, and monitoring. As a condition of contract, it will be upgraded to reflect the new infrastructure and operations and provided to DoJ. This manual applies only

to the WWTP itself and not to sludge ponds, storage, and irrigation which will be described in Section 1.6 below.

Overflow events, which are not expected but if they do occur, will be managed according to *The Department of Health Wastewater Overflow Response Procedures, March 2013.*

1.4.10 Plant monitoring, testing, influent and effluent quality

Plant monitoring and testing will continue according to the regime described in Section 1.4.3 above. The influent quality is not expected to change. The design outcomes for the upgraded works achieve compliance with: total nitrogen, total phosphorus, *E. coli* (thermotolerant coliforms), suspended solids, and CBOD5.

All the preceding currently exceed the standards in the *NSW Environmental Guidelines: Use of effluent by irrigation* for low exposure risk effluent.

The design parameters for the upgraded works do not include metals, oil and grease, or other organics (pesticides) all of which, since the influent quality is not expected to change, will remain as they are currently. All these parameters with the exception of aluminium are within standard. Because the pH of the irrigated land is not acidic (see soils investigation in the Nutrient and Irrigation Management Plan (NIMP) (*Attachment 6A.8*), the levels of aluminium are not a concern.[9]

Nitrogen (19 mg/L) and phosphorus (3.1 mg/L) levels have been set at the expected limits of performance for the upgraded plant. They are significantly below the NSW Effluent characteristics and are consistent with recommended limits contained in *Table 2* (based on *Table* 1: Risk Category C) of the Water Quality Protection Note 22 (*Attachment 6A.3*).

The Aquacell Process Design Report (*Attachment 3A.11*) indicates the anticipated effluent characteristics based on the estimated flows with *Table 6.* The future system columns reflect the effluent characteristics singly for each of the two processing trains for ADWF ($110m^3$/day), PDWF ($275m^3$/day), and PWWF ($440m^3$/day).

[9] From NSW Environmental Guidelines: Use of effluent by irrigation, comments in Table 3.3 state that "High toxicity in acid soils. Not a concern if pH of soil is above 6.5, p. 25.

	Upgraded WWTP effluent measured at IAT	NSW Effluent characteristics for low exposure risk (SDR 2)[10]	NSW trigger values for metals in irrigation effluent for long term use (up to 100 years)[11]
Total nitrogen	<19 mg/L	<50 mg/L	
Total phosphorus	<3.1 mg/L	<10 mg/L	
E coli, total and faecal	<1000 cfu/100mL	<1000 cfu/100mL[12]	
Total suspended solids[13]	30 mg/L	30 < mg/L	
CBOD5	20 mg/L	<40 mg/L	
Oil and grease	37 mg/L	<1,500 mg/L	
Aluminium	18000 µg/L		5.0 mg/L[14]
Arsenic	<1µg/L		0.1 mg/L
Cadmium	<0.1 µg/L		0.01 mg/L
Chromium	<1 µg/L		0.1 mg/L
Cobalt	<1 µg/L		0.05 mg/L
Copper	9 µg/L		0.2 mg/L
Iron	110 µg/L		0.2 mg/L
Lead	<1 µg/L		2.0 mg/L
Lithium	<5 µg/L		2.5 mg/L
Manganese	21 µg/L		0.2 µg/L
Mercury	<.00005 µg/L		0.002 mg/L
Molybdenum	<1 µg/L		0.01 mg/L
Nickel	1 µg/L		0.2 mg/L
Selenium	<1 µg/L		0.02 mg/L
Zinc	36 µg/L		2.0 mg/L

[10] From NSW Environmental Guidelines: Use of effluent by irrigation, Table 3.1: Classification of effluent for environmental management, pg. 19.
[11] From NSW Environmental Guidelines: Use of effluent by irrigation, Table 3.3: Trigger values for metals in irrigation effluent for long term use on all soil types (up to 100 years)
[12] From NSW Environmental Guidelines: Use of effluent by irrigation, Appendix 1. Urban type reuse with controlled public access (sportsground) and agricultural use for food production with no direct contact, e.g. trickle irrigation, both thermotolerant coliforms <1,000 cfu/100mL, pp. 105 – 106.
[13] The performance contract for construction specifies total suspended solids (TSS), not total dissolved solids (TDS). In this way Table 6 differs from Table 3 herein. The NSW Environmental Guidelines: Use of effluent by irrigation do not provide a low risk TSS standard, but do indicate that secondary effluent generally achieves a TSS < 30mg/L which may rise to > 100 due to algal solids in lagoon or pond systems, p. 102.
[14] Comments in Table 3.3 above state that "High toxicity in acid soils. Not a concern if pH of soil is above 6.5.

(continued)	Current effluent at WWTP (15/5/2019 measured at IAT)	NSW Effluent characteristics for low exposure risk (SDR 2)	NSW trigger values for metals in irrigation effluent for long term use (up to 100 years)
Pesticides: TCMX	61 µg/L	<0.001 mg/l[15]	
Pesticide: 2-flourobiphenyl	58 µg/L	<0.001 mg/l[16]	
Pesticide: d14-p-terphenyl	72 µg/L	<0.001 mg/l[17]	

Table 7 Upgraded WWTP ADWF effluent characteristics

1.4.11 Emission and discharge points

The discharge points are at:

- At the IAT pipe at the holding pond
- At the holding pond pipe at the irrigation dam
- Storage tank at the sports oval
- On the irrigated areas – sports oval, visitors' area, and orchards

1.5 Storage and irrigation (*Attachments 2.1 – 2.5*)

The three sludge ponds, holding pond, irrigation dam, chlorination equipment, and all components downstream of the IAT are as currently described below. They are not part of the works and no changes are envisaged.

No "As Constructed" drawings are available for the three sludge ponds, holding pond, or irrigation dam. Oracle Surveys completed a topographical survey of the sludge ponds in February 2018. The holding pond and irrigation dam volumes were calculated from the Oracle topographical survey and a pond depth survey conducted by Anchor Hydraulics in December 2019. These two surveys were combined to calculate the volumes referenced in the recently submitted Recycled Water Quality Management Plan.

[15] From NSW Environmental Guidelines: Use of effluent by irrigation, section on Synthetic organic compounds, pp. 25-26
[16] Ibid.
[17] Ibid.

1.5.1 Existing storage and irrigation overview

There are three unlined sludge lagoons with a total capacity of 8,300 cubic metres. The desludging and disposal history of sludge from these lagoons is unknown.

Processed effluent is directed to an existing holding pond (1,800 cubic metres) then on to an existing irrigation dam (8,800 cubic metres) also referred to as an irrigation dam. From the irrigation dam, effluent is then subjected to tertiary disinfection via a Hydramet continuous online chlorinate disinfection system before being pumped to the following irrigation areas:

- Sports oval (1ha)
- Prison Visitor's Area (0.1ha)
- Orchard (2ha DoH approved with the intent to seek DoH approval for an additional 3.2 ha orchard increase to 5.2ha)

The pump station at the irrigation dam carries treated wastewater to either the orchard or a covered underground storage tank adjacent to the oval. The orchard is irrigated via a drip reticulation system, with four stations. Each station operates for two hours every Monday, Wednesday and Friday. Access to these areas is restricted during and following irrigation to allow for soil drying.

Recycled wastewater at the oval storage tank is supplemented by potable (scheme) water as required and pumped to the sports oval or visitor's area via the dedicated oval pump house.

Irrigation of the sports oval occurs on alternate days during the night after 9:00pm when access restrictions are in place. The reticulation system is comprised of eight I-41 Hunter gear drive pop-up sprinklers and six stations which run for 30 minutes per station.

The visitor's area lawns are irrigated for 30-40 minutes (depending on the temperature) after 10:00pm when prisoner movement is restricted. The reticulation system is set to run on alternate days to the irrigation to the sports oval and is comprised of I-20 Hunter pop-up sprinklers.

The current Department of Health (DoH) Recycled Water Scheme Approval (Approval F18/00000, File Number F-AA-25325) was granted 29 January 1999 with updated conditions issues 16 January 2014. The approved effluent disposal area is: sports oval (1ha), visitor's area (0.1 ha), and orchard (2ha), a total of 3.1ha.

1.5.2 Design capacity for water storage ponds and irrigation infrastructure*

The storage at the facility is that which existed in 1998 with the following estimated design capacity:

- Sludge lagoons (estimated 8,300 m^3). These lagoons are unlined. In the past two years the vegetation surrounding them has been removed.
- Holding pond (estimated 1,800 m^3). As designed, this pond remains full at all times and provides to no residual storage capacity. The pond is HDPE lined, approximately 1998, and was assessed as in good condition in 2019.

- Irrigation dam (estimated 8,800 m^3). The dam is HDPE lined, approximately 1998, and was assessed in good condition in 2019.

A review of the irrigation dam capacity (*Attachment 3A.10*) concludes that with 500mm freeboard the irrigation dam will "most likely accommodate most rainfall events." While historically and prior to the increase in prison population, few potential overflow events have occurred, the practice has been to turn on the irrigation system to lower the storage and avoid over topping when such a situation eventuated.

The DOH approved recycled water scheme of 3.1 ha (1999) has evolved since 1998 on an "as needed" basis. Most recently, 3.2 ha of new orchard have been developed and planted with citrus. On 30 July 2019 DoJ applied to DoH for an amendment to its current Recycled Water Scheme Approval F18/0000 to increase the recycled water sites from 3.1 ha to 6.3 ha.

Thus, design, capacity, and process documentation is limited. A copy of the schematic water balance used to date is included in *Attachment 3A.9*.

The reader is referred to *Part 9 Attachment* of this application narrative which will discuss water balancing, nutrient storage and uptake capacity of the irrigation area, and the NIMP, which tend to indicate that the storage and irrigation are insufficient to meet DWER's environmental requirements for the projected effluent volumes.

1.5.3 Details on effluent discharge to land including the proposed irrigation area, size, details of underlying soils, and separation distance to groundwater and surface water resources (receptors).*

Because there are no flow meters on the system, the volume of effluent discharge can only be estimated. Given the current population, the estimate is: approaching 199.6 m^3/day as in *Table 4* less the buffer capacity of 10%.

The irrigation area and size are:

- Orchard – old approved (2ha)
- Visitors' area – approved (0.1ha)
- Sports oval – approved (1ha)
- Orchard – new with DOH licensing being sought (additional 3.2ha)

Total irrigation area and size currently in use: 6.3ha (*Attachments 2.1 – 2.5*).

The sports oval and visitor areas are turf. From a desktop review, the soils underlying them are Yalanbee 1 Phase (253WnYA1), described as gently undulating lateritic uplands with moderately deep, to deep, fine gravelly brownish sands that are free draining.

The orchard appears to be bisected by Yalanbee 1 Phase on the uphill side. On the downhill side are Murray 3 Phase (255Mv) described as very gentle to moderately inclined slopes (<15%)(with very few areas of rock outcrop) with duplex soils that are variable and moderately free draining.

The topography of the land as well as the location of Wooroloo Brook is contained in *Attachment 2.6*. The separation distance to surface water resources (receptors) and other sensitive land uses is described in *Attachment 7*.
Pursuant to onsite investigations, additional soils and hydrogeological information are contained in the Nutrient Irrigation Management Plan (*Attachment 6A.2*).

1.5.4 DOH Recycled Water Scheme Approval (updated conditions January 2014) and results of on-site compliance check (*Attachments 5.1 and 5.2*)

The existing WWTP and associated recycled water scheme is licensed by the Western Australian Department of Health (DOHWA) under approval F18/00000. DoJ was advised by DOHWA (dated 16 January 2014) after a site inspection that the following would be required to maintain compliance with F18/00000:

- Maintenance of recycling scheme infrastructure:
    - Performance of Wastewater Treatment Plant (WWTP) is not in accordance with the "Low" Exposure Risk level of the Guidelines. It appears the wastewater volumes are above WWTP capacity/
    - Above ground pipes and fittings used to transfer recycled water should be painted purple in accordance with AS/NZS 35005:2000
    - Chlorinator system is not electrically interlinked with the pumps supplying treated effluent that are fail safe (i.e. no chlorine, no pumping) and upon failure activate an alarm system
    - Relocation of the safety shower close to the chlorine has shed required
- Scheme irrigation
    - Relocation of playground equipment outside the visitors' irrigation area may be required. It is recommended that the DCS conduct a risk assessment and implement mitigation measures as indicated in the attached report.
    - Sprinklers need to be adjusted to ensure adequate buffer distances from picnic tables and playground equipment and in compliance at all times.
    - Sprinkler arcs need to be adjusted to minimise spray drift onto sensitive amenities
    - Ponding at the orchard need[s} to be fixed
    - Oval fence needs some repair
- Warning signs

  - Warning signs, in accordance with the attached conditions of approval, need to be located as per report recommendations
  - Safety signs close to shower facility at the WWTP need to be installed

- Written procedures
  - Operational and maintenance manuals of the WWTP and irrigation system need to be implemented

- Sampling procedures
  - Implement monthly sampling program as per attached conditions of approval
  - Chlorine readings are to be performed daily or continuous online

- Recycled Water Quality Management Plan
  - Required before the end of 2016

An action log for local, non-capital works, items (*Attachment 5.4*) documents their status, which is in most cases "Complete." A Recycled Water Quality Management Plan was submitted to DOH the week of 2 August 2019 (*Attachment 5.4*).

On 30 July 2019 DoJ applied to DoH for an amendment to its current Recycled Water Scheme Approval F18/0000 to increase the recycled water sites from 3.1 ha to 6.3 ha. The DoH application has requested an increase in the orchard effluent disposal area from 2ha to 5.2ha for a total land disposal area, with the sports oval (1ha) and visitors' area (0.1ha), of 6.3 ha.

1.5.5 Monitoring and testing

A monthly sampling program at the two Critical Control Points (orchard and sports oval) assesses the thermotolerant coliform account.

There are no environmental monitoring sensors installed. As part of the soil and hydrogeological assessment work conducted for the NIMP preparation, four water monitoring bores will be installed: one at the sports oval, one on the uphill and two downhill side of the orchard. At this time, there is no plan to sample from these bores other than their post construction sampling, reported in the NIMP (*Attachment 6A.8*).

1.5.6 Downstream storage and irrigations operations and maintenance

Operation and maintenance manuals do not exist for the downstream storage and irrigation. Maintenance occurs on an "as needed" basis and is performed by prison staff. Operations are likewise managed by the Maintenance Officer.

The pump station at the irrigation dam carries treated wastewater to either the orchard or a covered underground storage tank adjacent to the oval. The orchard is irrigated via a drip

reticulation system, with four stations. Each station operates for two hours every Monday, Wednesday and Friday. Access to these areas is restricted during and following irrigation to allow for soil drying.

Recycled wastewater at the oval storage tank is supplemented by potable (scheme) water as required and pumped to the sports oval or visitor's area via the dedicated oval pump house.

Irrigation of the sports oval occurs on alternate days during the night after 9:00 pm when access restrictions are in place. The reticulation system is comprised of eight I-41 Hunter gear drive pop-up sprinklers and six stations which run for 30 minutes per station.

The visitors' area lawns are irrigated for 30-40 minutes (depending on the temperature) after 10:00pm when prisoner movement is restricted. The reticulation system is set to run on alternate days to the irrigation to the sports oval and is comprised of I-20 Hunter pop-up sprinklers.

The current irrigation area includes visitors' area (0.1ha), Sports Oval (1ha), and Orchard (2ha). An application to the Department of Health (DoH) is requesting an expansion of the orchard by 3.2ha to 5.2ha. The total area available for irrigation with DoH approval will be 6.3ha.

The visitors' area and sports oval are turf. The orchard consists of three varieties of oranges (early, mid, and late cropping), three varieties of mandarins (early, mid, and late cropping), one variety of lemons, and one variety of grapefruit. The old orchard has 700 trees with no further development planned. The new orchard is currently planted with 1750 trees with an additional 100 scheduled for planting as fill-ins.

The current system operation involves sewage continuously fed to the IDEA WWTP where it is aerated, settled and decanted. These processes occur within the DAT and IAT. Treated effluent is then stored in an irrigation dam and is disinfected before being pumped onto the nominated irrigation areas.

Irrigation will continue year round and only stop (a) during and immediately after rain events or (b) if water-logging or surface run-off is observed. Irrigation will be operated to avoid water logging or surface run-off. If either condition is observed, irrigation will cease until the issue has abated.

Irrigation will be operated to avoid infiltration of water below the root zone. No instrumentation is planned.

No monitoring of surface water, groundwater and soil is currently undertaken or planned. DoH has advised that the effluent may not be used to irrigate edible crops from the market garden, which is no longer irrigated with treated wastewater, but irrigation of the orchard via drip irrigation is allowed.

Overflow events, which are not expected but if they do occur, will be managed according to *The Department of Health Wastewater Overflow Response Procedures, March 2013.*

1.5.7 Key infrastructure and equipment

Table 4 describes the storage and irrigation infrastructure components. The sludge lagoons have been identified as needing maintenance. Presently brush and trees are being removed from the berms, erosion control measures are being restored, and stormwater cut-off trenches are being re-established. Additional irrigation piping infrastructure has been installed on approximately 3.2ha of new orchard.

1.5.8 Fertigation system

DoJ has recently installed an automated liquid fertiliser dispensing system (fertigation system) designed by AMIAD. The system is connected between the storage pond and the orchard, with in-line valves on the orchard side of the sand filters that allow it to be isolated. Liquid fertiliser, Wormco 1000 L IPC concentrate, will be used with a typical composition of :

- Total Nitrogen: 492 mg/kg
- Total Phosphorus: 130 mg/kg
- Total Potassium: 700 mg/kg
- Total Sodium: 84 mg/kg
- Total Calcium: 118 mg/kg
- Total Magnesium: 7.1 mg/kg

The application rates are unavailable at this time. The dispensing schedule will run from August to through April, starting at 8am and then 2h/station for each of the four stations. The expected commissioning date of the system is August 2019.

CURRENT ASSET CONDITION ASSESSMENT: STORAGE AND IRRIGATION ONLY	Commissioned or Constructed	Asset Type	Condition and Verifier	Estimated Asset Life	Remaining Asset Life
STORAGE AND IRRIGATION					
Sludge lagoon 1	Unknown (appx 1970's)	Civil	Maintenance required:	80	59
Sludge lagoon 2	Unknown (appx 1970's)	Civil	brush and tree removal on berms	80	59
Sludge lagoon 3	Unknown (appx 1970's)	Civil	Erosion control; stormwater cut-off	80	59
Existing holding pond	1998	Civil	Good/Jacobs	80	59
Existing holding pond liner	1998 or older	HDPE	Good/Jacobs	25	3
Existing irrigation dam	1998	Civil	Good/Jacobs	80	59
Existing irrigation dam liner	1998 or older	HDPE	Good/Jacobs	25	3
Chlorine disinfection unit	1998	M&E	Good condition except scales (fair/poor); controller (fair)	15	-6
Pump at chlorination unit	N/A	M&E	Unknown	15	-6
Storage tank	1998	M&E	Unknown	15	-6
Pump to sports oval/visitor area	N/A	M&E	Unknown	15	-6

Table 8 Current asset condition of existing storage and irrigation infrastructure only

2 Attachment 6A Narrative: Emissions and Discharges

2.1 Structure of this attachment

Construction will involve emissions and discharges that are separate from those produced during normal operations and maintenance. Construction emissions are likely to be more varied. Post construction emissions will be those at the WWTP as well as at storage and irrigation areas. These sources will be discussed separately to include:

- Construction
- WWTP
- Sludge lagoons
- Downstream storage and irrigation

2.2 Construction emissions, discharges, and waste

Source of emission or discharge	Emission or discharge type	Volume and frequency	Proposed controls	Location
Construction	See *Watercon Environment Management Plan* (*Attachments 3A.6 and 2.1*)			

Table 9 Emissions and discharge table: Construction

A full description of the construction emissions, discharges, and wastes as well as how they will be managed are contained in *Watercon Environment Management Plan (EMP): Wooroloo Prison Farm WWTP*, Doc Ref: 4324-HSE-PLAN-CEMP, 6 May 2019 (Appendix).

The identified environmental management activities and their controls are described fully in Section 3.2 of the EMP and include the management and control of:

- Roads and Nominated Work Areas
- Ground Disturbance
- Topsoil Management and Rehabilitation
- Weeds
- Flora
- Fauna
- Water Management

- Heritage and Items of Significance
- Ground/Surface Water Contamination
- Sewage
- Concrete Batching
- Metal Coating (Spray Painting)
- Hydrocarbon Storage
- Atmospheric Emissions
- Dust Management
- Waste Management
- Management of Hazardous Substances
- Noise Management

Provisions are included in the EMP for monitoring, auditing, and review of discharge, emissions, and waste management throughout construction and commissioning (Section 4).

2.3 Operational and maintenance emissions, discharges, and waste

2.3.1 WWTP

Source of emission or discharge	Emission or discharge type	Volume and frequency	Proposed controls	Location
WWTP Operations	Effluent	220kl / day avg	See 9.5.3 and 9.5.4 below	*Attachment 2.1*
WWTP Operations	Aeration Tank Sludge	Small maintenance amount	Disposed of to sludge lagoon	*Attachment 2.1*
WWTP Operations	Noise	Small	None	*Attachments 2.1 and 7*

Table 10 Emissions and discharge table: WWTP

The primary emissions and discharges, and waste from the plant are the treated effluent, described in 9.5.3 and 9.5.4 below and sludge. The description for plant operations and maintenance is currently contained in *Watercon Operation and Maintenance Manuel: Wooroloo Wastewater Treatment Plant for Programmed Facility Management* (see Appendix). This manual will be updated to include the

new construction changes. However the sludge management process will be the same.

The extended aeration process of the Wooroloo PF WWTP uses both cell synthesis and endogenous decay in the same tank to remove dissolved and suspended organics from the water and also to greatly reduce the volume of activated sludge. Activated sludge is returned from the IAT to DAT for continued processing through the Return Activated Sludge (RAS) pump. There is one RAS pumps in each IAT tank.

Waste excess activated sludge is pumped from the IAT to existing oxidation ponds that are utilised as sludge lagoons. The RAS pump is used to prevent a build-up of activated sludge in the WWTP. Supernatant from the sludge lagoons flows back to the DAT.

Alkalinity of the sludge and effluent can be controlled by soda ash dosing into the DAT to achieve levels defined in the Plant Testing section of the manual (Section 5).

Small amounts of sludge will build up over time in the DAT's and will be removed periodically.

2.3.2 Downstream (excluding irrigation) emissions, discharges, and wastes

Source of emission or discharge	Emission or discharge type	Volume and frequency	Proposed controls	Location
WWTP Operations	Sludge in Sludge Pond	unknown	unspecified	*Attachment 2.1*

Table 11 Emissions and discharge table: Sludge lagoons

2.3.3 Irrigation (discharge) of treated wastewater during commissioning and full operations (from DWER 8MARCH19 Letter)

Source of emission or discharge	Emission or discharge type	Volume and frequency	Proposed controls	Location
Irrigation	Effluent	220 kL/day avg	As described in 1.5.6	*Attachments 2.1 – 2.5*
Contaminated or potentially contaminated stormwater	Effluent during heavy rainfall events	unknown	As described in 1.6.6	
Waste and leachate	Seepage, leaks and spills from storage	unknown	As described in 1.6.6	
Odour	From irrigation	small	None	

Table 12 Emissions and discharge table: Irrigation

2.4 Additional requests for information per DWER's response to pre-application enquiries*

DWER provided additional guidance on a number of items related to emissions, discharges, and waste. These items were specific to the irrigation (discharge) of treated wastewater during commissioning and full operations. The responses are below.

2.4.1 Water quality objectives for the irrigation discharge including but not limited to pH, salinity, nutrients, heavy metals and persistent organic pollutants*

Table 13 contains all DoJ's water quality objectives for irrigation discharge.

Parameter	Units	Value
E. coli	cfu/100 mL	< 1,000
Biological Chemical Demand (BOD)	mg/L	< 20
Suspended Solids (SS)	mg/L	30
pH	pH units	6.5 – 8.5
Total Chlorine Residual	mg/L	0.2 – 2

Table 13 Water quality objectives for recycled water

2.4.2 Irrigation design details: water balance*

As previously mentioned, the flow estimates for the facility are estimates since flow meters are not installed. There is no historical flow information. Thus, a rigorous water balance modelling exercise was deemed inappropriate because it would tend to represent a level of precision that does not exist.

Instead, an elementary water and nutrient balance calculation was completed by GHD (See *Attachment 6A.1*). It is described as "elementary" only in that it was not completed with industry standard modelling software using historical flow data. However, the calculations are precise and based on the following scope and assumptions:

Water and Nutrient Balance Scope and Assumptions

1. Purpose. To create an elementary water balance for the proposed Wooroloo PF WWTP upgrade and irrigation scheme. Because the comprehensive historical data required to complete a water balance model are unavailable, assumptions are required to provide a basic understanding of the capacity of the system to dispose of treated effluent. It is understood that the elementary water balance using these assumptions will need to be verified in the future using data obtained for the purpose.

2. Assumptions. The following are the assumptions were used:

    - Wastewater inflow = 220 kL/d, constant year-round (includes a factor for infiltration).
    - Impact of sludge lagoons on water balance (summer loss/winter gain) ignored (simplistic).
    - Volume in storage on 1 Jan = 0.88 ML, i.e. 10% capacity (nominal).
    - Storage includes HDPE lined Irrigation Dam (8,800 kL) with a total storage of 8,800 kL.
    - Storage pond leakage = nil (conservative).
    - Total storage pond operational capacity assumed to be 8.8ML with pond dimensions: base 36.4m x 11.4m, and side slope 1:3.
    - Average climatic conditions (rainfall based on best data available; pan evaporation based on Muresk Institute, effective rainfall = 70% x gross rainfall).
    - Lake evaporation = 82% x Class A pan evaporation.
    - Total turf area of 1.1 ha assumed.

- Turf crop factor = 0.7 (upper bound typically only used for high-end sporting fields - non-conservative), irrigation efficiency = 80%. https://www.sawater.com.au/__data/assets/pdf_file/0015/54204/FINAL-Irrigated-Public-Open-Space-Code-of-Practice.pdf

- Turf not irrigated when theoretical monthly irrigation demand <0.

- Citrus orchard area of 5.2 ha assumed.

- Citrus orchard crop factor = 0.7, applicable to canopy area only, which is assumed to 50% x gross orchard area. https://www.agric.wa.gov.au/water-management/citrus-irrigation-recommendations-western-australia?page=0%2C2 (refer imagery below – canopy cover assumption non-conservative as actual likely less than 50%).

- Minimum orchard irrigation demand, including over winter months when theoretical monthly irrigation demand <0, is 10mm/week (nominal).

- Leaching allowance of 10% assumed (over-irrigation to manage salt build-up) for oval, entry area and orchards.

- Soils as determined by currently available mapping and refined as necessary by the soils evaluation work expected to be undertaken by GHD.

3. Effluent Analysis Additional Assumptions.

    - Orchard N & P uptake rates were sourced from: https://www.agric.wa.gov.au/citrus/citrus-nutrition (based on recommended application rates for navel oranges, mid-range yield assumed)

    - Turf N uptake rate [maximum value] sourced from: WA Environmental Guidelines for the Establishment and Maintenance of Turf Grass Areas (Swan River Trust, 2014)

    - Turf P uptake rate [assuming Kikuyu grass] sourced from: NSW Guideline: Use of Effluent by Irrigation (Department of Environment and Conservation, 2003)

The results of the elementary water balance provided implications for both storage, irrigation area, and nutrient loading. The operating assumption was that irrigation would occur twelve months a year. Section 5 of the report concludes:

> Based on the water and nutrient balance calculations completed for this project, if future inflows to the Wooroloo Prison Farm WWTP are 220kL.d as assumed it is concluded that:
>
> Water Balance
>
> - With the limited storage capacity currently available irrigation over winter months will be required to prevent Storage Dam overflows.

- The level of irrigation possible during winter months without causing runoff problems and associated nutrient export from the site is uncertain.
- To achieve a sustainable water balance (no uncontrolled discharge from the Storage Dam to the environment, no requirement to irrigate orchards over winter months at high rates that could lead to ponding or surface runoff) it will likely be necessary to:
  - increase the irrigation area only, in which case (to avoid issues with summer month irrigation deficits) consideration should be given to irrigating vegetation such as woodlots planted with appropriate species or pastures that does not require irrigation over summer months. This option would only be viable if regulatory agencies allow winter irrigation; or
  - increase both irrigation area and the storage capacity.

Nutrient Balance

- Without increasing the irrigation area it will be possible to maintain nutrient application rates below300 kgN/ha/year and 50 kgP/ha/year (maximum rates recommended in WQPN 22 for Risk Category C sites, consistent with rates imposed in Acacia Prison Farm's DWER Licence) provided the upgraded WWTP achieves average TN and TP concentrations achieve average TN and TP concentrations of less than 24 and 4 mg/L, respectively.
- If DWER impose significantly lower application rate limits than these either the WWTP will need to achieve average TN and TP concentrations proportionately lower than 24 and 4 mg/L, respectively, or the irrigation area will need to be proportionally increased.

The information contained in *Attachment 6.1A* was used in the preparation of the NIMP (*Attachment 6A.8*) and assumed Scenario 1 as the basis.

2.4.3 Nutrient storage and uptake capacity of the irrigation area*

This question is initially addressed by the elementary water balance but more comprehensively in the NIMP which is included as *Attachment 6A.8*.

2.4.4 Contingency planning (for management of water during wet weather, etc.).*

As per item 1.6.6., Irrigation will continue year round and only stop (a) during and immediately after rain events or (b) if water-logging or surface run-off is observed. Irrigation will be operated to avoid water logging or surface run-off. If either condition is observed, irrigation will cease until the issue has abated.

Overflow events, which are not expected but if they do occur, will be managed according to The Department of Health Wastewater Overflow Response Procedures, March 2013.

2.4.5 Provide details of proposed monitoring (surface water, groundwater and soil).*

None currently undertaken or planned.

2.4.6 Provide evidence of consultation with the Department of Health.*

See item 1.6.4.

2.4.7 DWER's additional general requirements contained its response.*

DWER also provided notes about its general requirements which DoJ has considered with responses below:

- DoJ represents that the application of wastewater will not lead to the infiltration of water below the root zone of vegetation (Section 1.6.6).
- DoJ represents that the application of wastewater will not cause waterlogging or surface runoff from the irrigation area. These representations are based on DoJ's current operating procedures as contained herein (Section 1.6.6).
- DoJ represents that the rate of irrigation will not exceed the capacity of soil microorganisms and vegetation to take up and metabolise nutrients from wastewater to minimise the risk of groundwater contamination being cause by seepage of the nutrients and other chemical constituents of environmental concern past the root zone of the water table. This representation is based on DoJ's current operating procedures as contained herein (Section 1.6.6).
- DoJ intends to and is irrigating during the wet season (Section 1.6.6).

3 Attachment 6B Narrative: Waste Acceptance

No waste will be accepted or buried by the Contractor during construction. Some waste will be stored during construction but disposed of at the end of the works in an approved manner as described in the Contractor's Construction Environment Management Plan.

In or about 2017, Wooroloo PF accepted sewage sludge from desludging activities at Acacia Prison. This sludge was used to condition the soils at the new orchard and was tilled into the soil there. The amounts accepted are unknown as is the composition of the sludge.

DoJ also intends to dispose of sludge from its existing ponds on site. No operations or maintenance information is available related to this activity.

4 Attachment 7 Narrative: Siting and Location

DoJ undertook a desktop survey of environmental receptors as well as a field soils and hydrogeological study.

4.1 Desktop environmental study

The circumference of the survey area was 2.5km centring on the orchard site. Aside from Wooroloo Brook, no environmental receptors of significant consequence were identified (See *Attachment 7.2*). Significantly larger sites in the survey area include Acacia Prison, Linley Park Pork, and El Caballo Resort.

4.2 Soils and hydrogeological study

The purpose of the soils study was to investigate the subsurface geological profile beneath the orchard and sports oval effluent disposal area as well as to determine the groundwater interface. The Visitor Area was not included because its small size and location prohibited drilling equipment. The work also established the accurate root ball size for the plantings. The results of this study are included in *Attachment 7.3*. All this information was sued in the formulation of the Nutrient and irrigation Management Plan.

The boring tends to indicate a significant clay layer between the surface and groundwater, which would appear to provide an adequate barrier to infiltration. Three deep monitoring bores were constructed to serve in the future, if needed.

- Six (6) wells were drilled and constructed using a combination of push tube advancement and solid auger methods,
- Paired wells (deep and shallow) were constructed at two locations (MB01, and MB02),
- A deep well only was constructed at MB04 (south of the new orchard area),
- A shallow well only was constructed at MB05 (inside the prison, north of the oval),
- Both paired bores encountered a silty, organic layer at the surface, grading into lateritic gravels, before grading into a stiff white clay at approximately 3-4m. This clay extended for several meters before grading to sandy clays and gravels which held water.
- Shallow bores were set against the gravel profile, above this impermeable white clay layer (no perched water was observed in the shallow wells post construction),
- Deeper wells were drilled until water was encountered and screened against saturated material,

- MB05 within the prison was drilled using push tube to 4.3m, with the same stiff white clay layer observed at 2.5m,
- Shallow well was constructed at MB05 to monitor potential perching on this clay layer over winter (no perched water was observed post construction),
- Wells containing water were purged and completed with a monument cover,
- Additionally, soil bores were hand augered to 1m at various locations across the site, with samples from varying horizons submitted for particle size analysis, and for a suite of other parameters (metals, PRI, PBI, etc.).

Static water levels were recorded in the following bores: (note these levels may change, and will be re-measured when the wells are sampled next week).

- MB01s – DRY, no perched water table observed.
- MB01d – SWL = 6.2mBGL, total depth drilled = 13.3mBGL. Note that water-table is slightly confined and rose to 6.2m, with water strike occurring at 10.3mBGL.
- MB02s – DRY, no perched water table observed.
- MB02d – SWL = 8.8mBGL, total depth drilled = 20mBGL. Note that water-table is slightly confined and rose to 8.8m, with water strike occurring at 13mBGL.
- MB04 – SWL = 17.5mBGL, total depth drilled = 19.7mBGL. Water strike occurring at 16mBGL.
- MB05 – DRY, no perched water table observed.

5 List of Attachments

Attachment 1
- 1A Proof of occupier status

Attachment 2
- 2.1 Site map
- 2.2 Visitors' area
- 2.3 Sludge lagoons and new plant works location
- 2.4 Orchard irrigation area
- 2.5 Sports oval irrigation area
- 2.6 Topographical map showing Wooroloo Brook
- 2.7 Aerial showing boundary

Attachment 3A
- 3A.1 Process schematic
- 3A.2 Process flow diagram with new works
- 3A.3 Process flow diagram with critical control points
- 3A.4 GHD Process review of proposed upgrade
- 3A.5 Contractor - Watercon - Quality Assurance
- 3A.6 Watercon Construction Environmental Management Plan
- 3A.7 Wooroloo WWTP Operation and Maintenance Manual
- 3A.8 Pre and commissioning and operator training
- 3A.9 Schematic of scheme water balance
- 3A.10 Storage pond assessment
- 3A.11 Aquacell Process Design report RevB June 2019

Attachment 4 Not required

Attachment 5
- 5.1 DOH Recycled Water Scheme Approval Jan 2014
- 5.2 DOH conditions to approval of Jan 2014
- 5.3 DoJ non capital works status Aug 2019
- 5.4 RWQMP Wooroloo Prison V1.3 Final

Attachment 6
- 6A.1 NIMP Water and nutrient balance calculations
- 6A.2 16May19 WQ Analytic Report metals organics
- 6A.3 19JUN19 Effluent Quality Analytical Report
- 6A.4 18JUN19 Effluent Quality Sample PE135766
- 6A.5 19JUL19 Effluent Quality Analytical Report
- 6A.6 18JUL19 Effluent Quality Sample PE136511
- 6A.7 DOW Water Quality Protection Note 22
- 6A.8 Nutrient and Irrigation Management Plan

Attachment 7
- 7.1 Distance to sensitive receptors
- 7.2 Desktop Environmental Survey
- 7.3 Soils and Hydrogeological Survey

Attachment 8
- 8.1 DWER response to pre-application enquiry
- 8.2 Item 3.3 additional GPS coordinates for infrastructure
- 8.3 Foreshore Assessment of Wooroloo Brook Catchment

Attachment 9
- 9.1 Fee calculations