Memorandum

To	Tabitha Manderson
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From	Nick Adams
Office	Nelson, Christchurch
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File/Ref	5-P1472.00
Subject	Rātana WWTP - Technical assessments for irrigation design & Overseer

1 Introduction

The purpose of this memo is to enable an irrigation supplier to calculate a cost estimate so RDC can move forward with some certainty as to what the capital costs for this project will be.

2 What is provided and not provided in this Specimen design.

2.1 What is provided in this Specimen design.

The purpose of this specimen design is to produce an estimated cost only. It is likely the final design will be considerably different in its overall shape.

The following key items are covered.

1 An updated water balance accounting for the change in area and inflow data.
2 A schedule of quantities to enable an irrigation contractor to price effectively.
3 Specimen design parameters.

The purpose of the design parameters is to provide the underlying background design criteria.

(a) Plan 1: Overview.
This plan shows the latest areas and designations combined with the overall irrigation plan split into separate zones overlaid.
(b) Plan 2: Irrigation Network.

4 Specimen design plans.

(a) Plan 1: Overview.
This plan shows the latest areas and designations combined with the overall irrigation plan split into separate zones overlaid.
(b) Plan 2: Irrigation Network.
This plan shows the irrigation network in terms of the location of the pipework, valves, pump and the overall flow and pressure performance of each element.
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2.2 What is not provided in this Specimen design.

1 At this stage the specimen does not include a specific planting plan. The emitters chosen are:

(a) Impact sprinklers for mixed trees and pasture. Choosing impact sprinklers means the on-going maintenance and the of risk of blockage is reduced. This is because the nozzle size are larger and the number of sprinklers are less than for smaller sprinklers. Detailed design will need to consider distribution uniformity carefully.
(b) Surface dripline for areas where the vegetation is not going to managed extensively.
(c) Subsurface dripline around the perimeter to enable shelter belt trees and hedges to be grown.

2 The specimen design is not suitable for tendering or construction.

3 Outputs

3.1 Updated Water Balance.

The current design storage volume and effective area of the site is shown in **Table 1** Table 1. It is based on the latest plan shown in **Figure 1.**

Overall Layout			
Current Design Storage		**28,500**	**m^3**
Land Area			
OA	**Overall Area**	**25.27**	**ha**
DB	Sub Surface Dripline around Perimeter	3.83	ha
A1	Impact Sprinkler Area	9.26	ha
A2	Impact Sprinkler Area	1.55	ha
D1	Surface Dripline Area	1.09	ha
D2	Surface Dripline Area	6.16	ha
DR	Surface Dripline Area - Restoration Area	1.00	ha
X	No Irrigation Area	-0.51	ha
P	Pond	-1.87	ha
	Effective Area	**22.9**	**ha**

Table 1

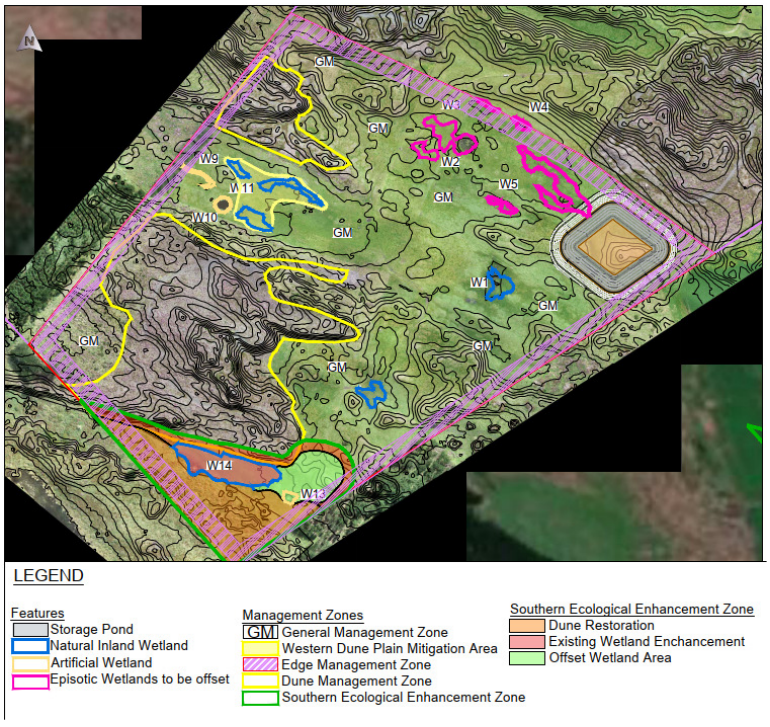

Figure 1

The effect of the change in area on the water balance is summarised in the following scenarios.

1. Scenario 1: Future Flows with median rainfall and evapotranspiration.

In this scenario deficit irrigation can be achieved within the current command area but not within the current design storage. Table 2, Figure 2 and Figure 3 summarise the key data.

Scenario 1: Future Flows with median rainfall and evapotranspiration.		
Irrigation Philosophy	Deficit	
Rainfall-Evapotranspiration Data Period	Median year	
WW water flow scenario	Based on future maximum average flows	
Operational time per day	12	hrs
Field Capacity of Soil	62	mm
Target Soil Moisture	42	mm
Distribution uniformity (DU_{lq})	80	%
Net Area Available	23.5	ha
Net Area Needed	20.0	ha
Months of deficit Irrigation	7	Oct - Apr
Months of non deficit irrigation.	0	
Months of no irrigation	5	May - Sep
Buffer Storage Required	30,200	m^3
Boundary Buffer Zones	20	m

Table 2

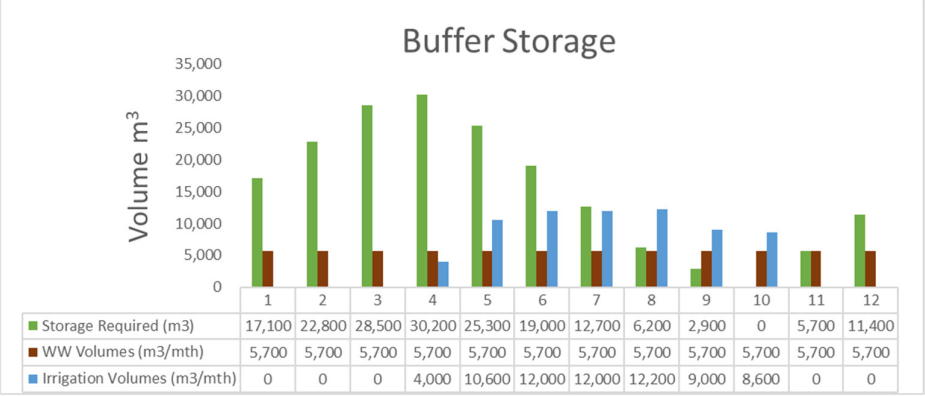

Figure 2

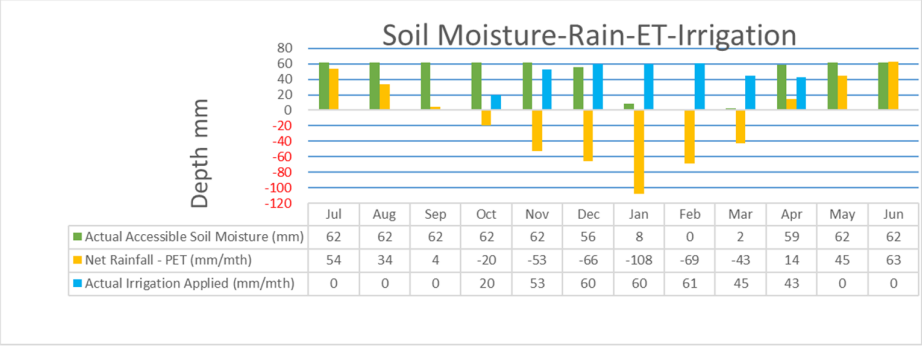

Figure 3

2. Scenario 2: Existing Flows with median rainfall and evapotranspiration.

In this scenario deficit irrigation can be achieved within the current command area and design storage. **Table 3**, **Figure 4** and **Figure 5** summarise the key data.

Scenario 2: Existing Flows with median rainfall and evapotranspiration.		
Irrigation Philosophy	Deficit	
Rainfall-Evapotranspiration Data Period	Median year	
WW water flow scenario	Based on Average flows over last 5 years	
Operational times per day	12	hrs
Field Capacity of Soil	62	mm
Target Soil Moisture	42	mm
Distribution uniformity (DUlq)	80	%
Net Area Available	21.5	ha
Net Area Needed	17.4	ha
Months of deficit Irrigation	6	Oct - Mar
Months of non deficit irrigation.	0	
Months of no irrigation	6	Apr - Sep
Buffer Storage Required	25,400	m3
Boundary Buffer Zones	20	m

Table 3

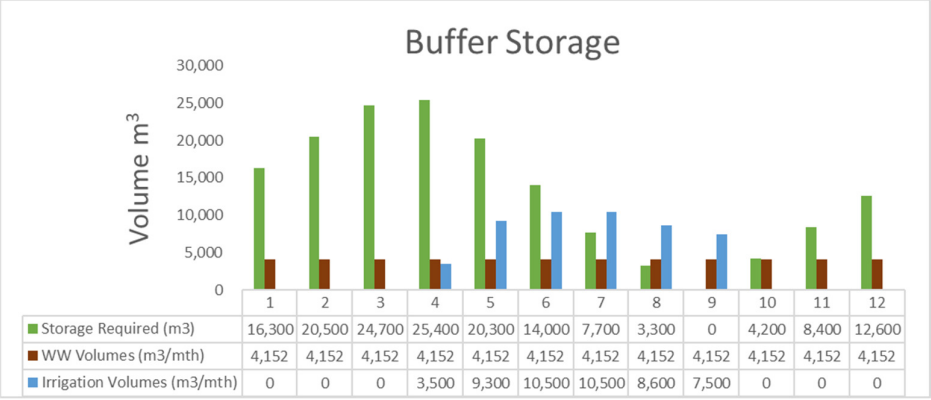

Figure 4

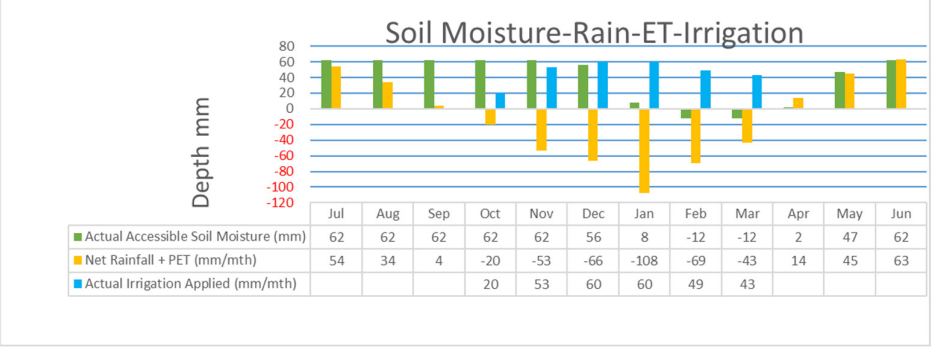

Figure 5

3. **Scenario 3: Future Flows with 1:5 year maximum rainfall with required area.**

In this scenario a significantly larger command area and storage volume is required to achieve deficit irrigation. **Table 4**, **Figure 6** and **Figure 7** summarise the key data.

Scenario 3: Future Flows with 1:5 year maximum rainfall and minimum evapotranspiration with needed area.		
Irrigation Philosophy	Deficit	
Rainfall-Evapotranspiration Data Period	1 in 5 wet year	
WW water flow scenario	Based on future maximum average flows	
Operational times per day	12	hrs
Field Capacity of Soil	62	mm
Target Soil Moisture	42	mm
Distribution uniformity (DUlq)	80	%
Net Area Available	21.5	ha
Net Area Needed	55.8	ha
Months of deficit Irrigation	5	Nov - Mar
Months of non deficit irrigation.	0	
Months of no irrigation	6	Apr - Oct
Buffer Storage Required	43,300	m3
Boundary Buffer Zones	20	m

Table 4

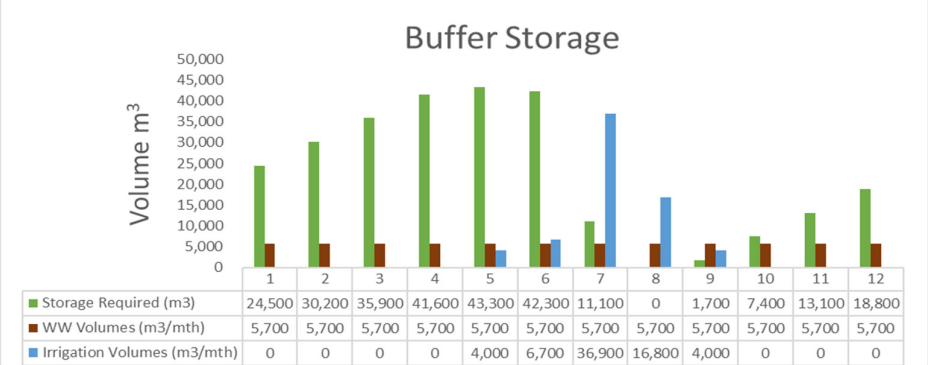

Figure 6

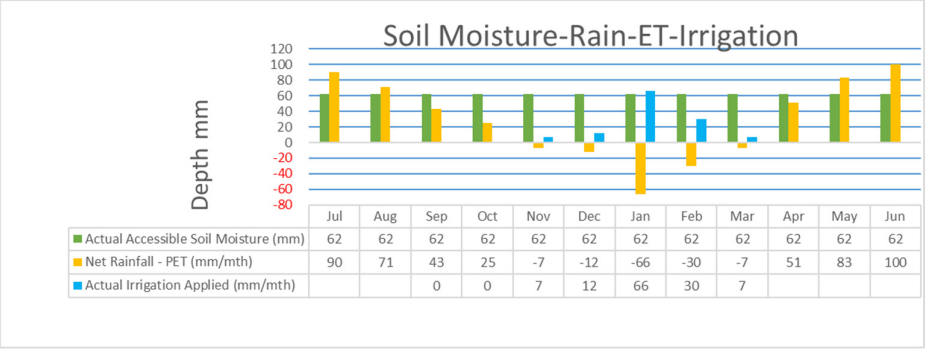

Figure 7

4. **Scenario 4: Future Flows with 1:5 year maximum rainfall with current area.**

In this scenario deficit irrigation cannot be achieved for the current command area and design storage. **Table 5**, **Figure 8** and **Figure 9** summarise the key data.

Scenario 4: Future Flows with 1:5 year maximum rainfall and minimum evapotranspiration with available area.		
Irrigation Philosophy	Non-Deficit	
Rainfall-Evapotranspiration Data Period	1 in 5 wet year	
WW water flow scenario	Based on future maximum average flows	
Operational times per day	12	hrs
Field Capacity of Soil	62	mm
Target Soil Moisture	42	mm
Distribution uniformity (DU_{lq})	80	%
Net Area Available	21.5	ha
Net Area Needed		ha
Months of deficit Irrigation	0	
Months of non deficit irrigation.	6	Nov to Apr
Months of no irrigation	6	May to Oct
Buffer Storage Required	37,300	m3
Boundary Buffer Zones	20	m

Table 5

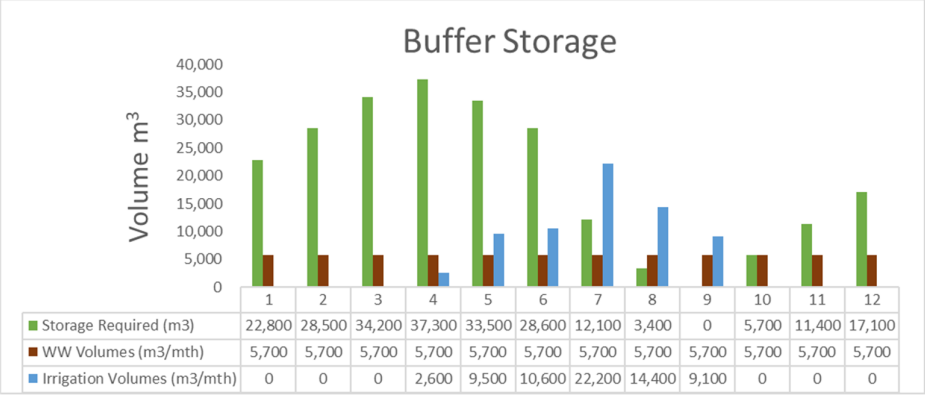

Figure 8

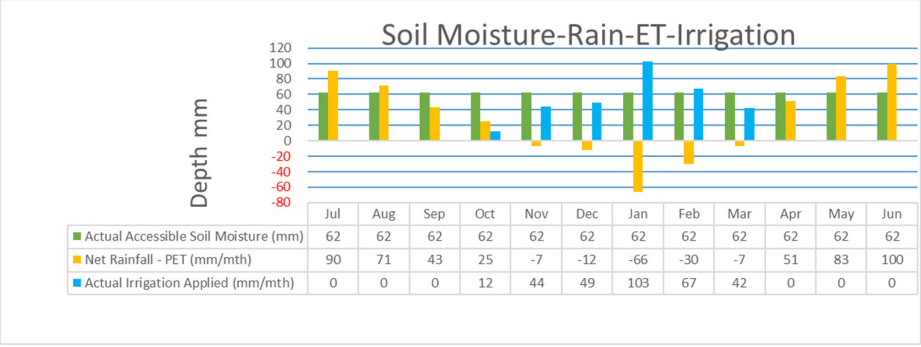

Figure 9

3.2 Schedule of Quantities.

Item	Description	Quantity	Unit	Unit Rate	Estimated Cost
1	**Supply and Install Sprinklers and Pipe for Areas A1 and A2. Note all pipe to installed above ground.**				
1.1	Impact Sprinkler, Naan 233B 3.5 x 2.5L Blue with Pressure Control or Similar.	359	ea		
1.2	Sprinkler Galv risers (3.5m)	359	ea		
1.3	PE080 DN40 PN06.3	3,560	m		
1.4	PE080 DN40 PN09	230	m		
1.5	PE080 DN50 PN06.3	870	m		
1.6	PE080 DN50 PN09	20	m		
1.7	PE080 DN63 PN06.3	1,850	m		
1.8	PE080 DN63 PN09	120	m		
1.9	PE080 DN75 PN09	90	m		
1.10	PE080 DN90 PN08	160	m		
1.11	PE080 DN110 PN06.3	10	m		
1.12	PE080 DN110 PN08	160	m		
1.13	PE080 DN125 PN08	100	m		
1.14	PE080 DN160 PN08	360	m		
1.15	All associated fittings; Lump sum	1	LS		
2	**Supply and Install Dripline and Pipe for Areas D1, D2 and DR. Note all pipe to installed above ground.**				
2.1	Hydro PC 1740 3.5lph 600mm or Similar suitable for sub-surface.	146,560	m		
2.2	PE080 DN40 PN06.3	210	m		
2.3	PE080 DN50 PN06.3	100	m		
2.4	PE080 DN63 PN06.3	160	m		
2.5	PE080 DN75 PN06.3	150	m		
2.6	PE080 DN90 PN06.3	1,320	m		
2.7	PE080 DN110 PN06.3	260	m		
2.8	PE080 DN125 PN06.3	200	m		
2.9	PE080 DN160 PN06.3	40	m		
2.10	Flushing Manifold Pipework:				
2.11	PE080 DN40 PN06.3	1,200	m		
2.12	40mm flushing valve assembly.	75	m		
2.13	All associated fittings	1	LS		

Item	Description	Quantity	Unit	Unit Rate	Estimated Cost
3	**Supply and Install Sub-surface Dripline and Pipe for Areas DB. Note all pipe to installed above ground.**				
3.1	Hydro PC 1740 3.5lph 600mm or Similar suitable for sub-surface.	65,000	m		
3.2	PE080 DN40 PN06.3	70	m		
3.3	PE080 DN50 PN06.3	30	m		
3.4	PE080 DN63 PN06.3	30	m		
3.5	PE080 DN75 PN06.3	30	m		
3.6	PE080 DN90 PN06.3	270	m		
3.7	PE080 DN110 PN06.3	250	m		
3.8	PE080 DN125 PN06.3	30	m		
3.9	PE080 DN160 PN06.3	10	m		
3.10	Flushing Manifold Pipework:				
3.11	PE080 DN40 PN06.3	400	m		
3.12	40mm flushing valve assembley.	25	m		
3.13	All associated fittings	1	LS		
4	**Supply and Install Mainline and Valves. Note all pipe to trenched as per current Irrigation Standards.**				
4.1	4-Valve Underground Box nest	1	ea		
4.2	3-Valve Underground Box nest	3	ea		
4.3	2-Valve Underground Box nest	6	ea		
4.4	1-Valve Underground Box nest	2	ea		
4.5	Supply and install 80mm Automatic Diaphragm Valve (Solenoid on/off, pilot hydraulic control). Plastic/ Metal	27	ea		
4.6	Supply 80mm Manual Gate Valve.	27	ea		
4.7	PE100 DN125 PN10	2150	m		
4.8	PE100 DN160 PN10	25	m		
4.9	2 wire control cable.	2175	m		

Item	Description	Quantity	Unit	Unit Rate	Estimated Cost
5	**Supply and Install Pump Station**				
5.1	Centrifugal Pump suitable for treated wastewater. 20l/s @ 100m (approx. 32kW)	2	ea		
5.2	VSD for Pumps (32kW), allow for Ventilation for Cooling	2	ea		
5.3	Mains Switch Board (50kW)	1	ea		
5.4	Power Supply (50kW)	1	LS		
5.5	Automatic Backwashing Filter 130 micron for Flow of 20l/s	1	ea		
5.6	Pump shed building and Pad rated to IL3. Nominal 6 m x 6 m (3m x 6m for pumps and pipes, 3 x 3 for Switch board and VSD and 3 x 3 for Scada, desk and amenities).	1	LS		
5.7	Outlet Headworks (SS Pipe, Flow meter, Pressure gauge, Isolation Valves x 3 and fittings)	1	LS		
5.8	Inlet Headworks (connection to buffer pond) (SS Pipe, Isolation Valve and fittings)	1	LS		
5.9	All associated fittings	1	LS		
6	**Supply and Install Soil Moisture Sensors - Provisional**				
6.1	Sentek probes, multi level moisture and nutrient monitoring or Similar All stand alone, back to cloud. 1 per Irrigation type.	6	ea		
7	**Supply and Install Control System**				
7.1	Control System: Galcon Galileo Cloud controller Modular with local I/O's, 2 way Radio coms to field valves nests/nodes or Similar	1	ea		
7.2	Weather Station (Wind speed, Wind direction, Solar Radiation, Rain sensor, Humidity sensor	1	ea		

3.3 Specimen Design Plans.

3.3.1 Plan 1: Overview.

See PDF

3.3.2 Plan 2: Irrigation Network.

See PDF

3.4 Specimen Design Parameters.

A	Overall Layout		
	Description	**Quantity**	**Unit**
	Current Design Storage	**28,500**	**m^3**
OA	**Overall Area**	**25.27**	**ha**
DB	Sub Surface Dripline around Perimeter	3.83	ha
A1	Overhead Sprinkler Area	9.79	ha
A2	Overhead Sprinkler Area	1.55	ha
D1	Surface Dripline Area	1.21	ha
D2	Surface Dripline Area	6.16	ha
DR	Surface Dripline Area - Restoration Area	1.00	ha
X	No Irrigation Area	-0.51	ha
P	Pond	-1.22	ha
	Effective Area	**23.55**	**ha**

B	Design Performance Parameters				
	Description	**Overhead Sprinklers**	**Surface Dripline**	**Sub-Surface Dripline**	**Unit**
B.1	Peak Allowable Daily Application rate	15	15	15	mm/d
B.2	Peak Allowable Instantaneous Application rate	5	5	5	mm/hr
B.3	Minimum Distribution Uniformity DU_{lq}	85	85	85	%
B.4	Nominal Make and Model	Impact Sprinkler Naan 233B 3.5 x 2.5L Blue or Similar With PC	Hydro PC 1740 3.5lph 600mm	Hydro PC 1740 3.5lph 600mm	
B.5	Material	Metal/ Plastic			
B.6	Lateral spacing	18	0.6	0.6	m
B.7	Emitter Spacing	18	0.6	0.6	m
B.8	Emitter flowrate	1,430	3.5	3.5	lph
B.9	Target Operating Pressure	40	20	30	m
	Max Operating Pressure	*50*	*30*	*20*	*m*
	Min Operating Pressure	*30*	*10*	*10*	*m*
B.10	Target Operating hours/day	9	6.5	3	hrs
B.11	Area	11.35	8.37	3.83	ha
B.12	Sprayline length	6,303	139,468	63,902	m
B.13	No. of emitters	350	232,447	106,503	ea.

B.14	Flow rate	500,744	813,565	372,761	lph
		139	226	104	l/s
B.16	Emitter Application Rate	4.4	9.7	9.7	mm/hr
B.17	Operating Time/day per Zone	1.13	0.51	0.51	hrs
B.18	Overall daily application	5.00	5.00	5.00	mm/day
B.19	Effective Instantaneous Application rate per hour	4.41	5.00	5.00	mm/hr
B.20	SDR	7,944	583	583	lph/100 m
B.21	No. of Zones	8.00	13.00	6.00	zones
B.22	Actual Operating hours/day	9.1	6.7	3.1	hrs
B.23	Area per Zone	1.4	0.6	0.6	ha
B.24	Flow per Zone	62,593	62,582	62,127	lph
		17.4	17.4	17.3	l/s
C	**Equipment Schedule**				
C.1	Sprinkler Layout	Assumed that planting will be managed Trees less than 3m high			
C.1.1	Nominal Make and Model	Impact Sprinkler Naan 233B 3.5 x 2.5L Blue or Similar With PC			
C.1.2	Sprinkler height above ground (m)	3.5			
C.1.3	Riser Type	GI pipe			
C.1.4	Pipe depth	Above ground			
C.1.5	Flushing manifolds	None			
C.1.6	Max no. of connecting pipes	None			
C.1.7	Nominal Pipe	None			
C.1.8	Manual Flushing	None			
C.2	Surface Dripline Layout				
C.2.1	Nominal Make and Model	Hydro PC 1740 3.5lph 600mm			
C.2.2	Dripline depth	Above ground			
C.2.3	Connecting pipe depth	Above ground			
C.2.4	Flushing manifolds	Yes			

C.2.5	Max no. of connecting pipes	10			
C.2.6	Nominal Pipe	PE80 MDOD63			
C.2.7	Depth	Below ground			
C.2.8	Flushing Valves	Manual			
C.3	Sub-Surface Dripline Layout				
C.3.1	Nominal Make and Model	Hydro PC 1740 3.5lph 600mm			
C.3.2	Dripline depth	Below ground			
C.3.3	Connecting pipe depth	Below ground			
C.3.4	Flushing manifolds	Yes			
C.3.5	Max no. of connecting pipes	10			
C.3.6	Nominal Pipe	PE80 MDOD63			
C.3.7	Depth	Below ground			
C.3.8	Flushing Valves	Manual			
C.4	Zone Pipe: Connecting Field valves to Emitters				
C.4.1	Type	PE80			
C.4.2	Max Pressure (% > working pressure).	25%			
C.4.3	Depth	Above Ground			
C.5	Main Pipe: Connecting Field valves to Emitters				
C.5.1	Type	PE80			
C.5.2	Max Pressure (% > working pressure).	25%			
C.5.3	Depth (m)	0.6			
C.6	Field Valves Controlling Sprinklers and Dripline				
C.6.1	Automatic valves				
	Type	Solenoid and Pilot controlled Diaphragm			
	Material	Plastic or metal			
C.6.2	Flow Max - Min (l/s)	20	10		
C.6.3	Functionality				

C.6.4	Manual On/Off	Yes			
C.6.5	Remote On/Off	Yes			
C.6.6	Hydraulic Pressure control	Yes			
C.6.7	Manual Valves				
	Type	Gate Valve			
	Material	Plastic or metal			
C.6.8	Flow Max - Min (l/s)	20	10		
C.6.9	Functionality				
	Manual On/Off	Yes			
	Remote On/Off	No			
	Hydraulic Pressure control	No			
C.7	Pumps, Headworks and Buildings				
C.7.1	Pumps				
	Duty range				
	Max Flow Duty (l/s)	20			
	Max Pressure Duty (m)	100			
	Min Flow Duty (l/s)	13			
	Min Pressure Duty (m)	44			
	Pump duty per pump				
	Flow (l/s)	20			
	Pressure (m)	100			
	Mech Efficiency %	70%			
	Electrical Efficiency %	90%			
	Electrical Power (kW)	32			
	Pump Configuration				
	No.	2			
	Hierarchy	Duty-Standby			
	Control	VSD			
	Type	Centrifugal suitable for Wastewater.			
	Inlet Conditions	Flooded suction from inlet pipe under storage pond embankment.			
C.7.2	Filtration	Automatic backwashing 130 micron			
C.7.3	Flow meter	Ultra sonic			
C.7.4	Pressure Gauges				

	Manual				
	Electronic				
C.7.5	Power Supply				
	Supply	50kW			
	Switch board	50kW			
	VSD	32kW			
C.7.6	Building to house pumps, headworks, electrical equipment, irrigation controller and small office.				
C.8	Scada, Monitoring and Control				
C.8.1	Controller to control, monitor and record system operation				
C.8.2	Weather Station (Wind speed, Wind direction, Solar Radiation, Rain sensor, Humidity sensor).				
C.8.3	Soil Moisture Sensors				
	Min number per Irrigation area	1			