Silver Fern Farms Limited
Dunedin Office, 283 Princes Street
PO Box 941, Dunedin 9054
New Zealand

t +64 3 477 3980
0800 362 362

www.silverfernfarms.com

Hawkes Bay Regional Council
159 Dalton Street
Napier 4110

barret@hbrc.govt.nz

6 April 2020

Dear Paul

RE SILVER FERN FARMS TAKAPAU CONSENT REPLACEMENTS APP-123778

In response to your e-mail dated 27 March 2020, Silver Fern Farms Limited are writing to amend their application for the Discharge of Wastewater to Land (DP180248L).

The amendments are in relation to:

- Wastewater irrigation system, and
- Consent duration.

Wastewater Irrigation System

The original application (June 2018) proposed that wastewater would be applied to blocks A, B, C, D and E via the existing ring-main and 12 Briggs 25 travelling irrigators (6 of which have been modified with GPS locators, pressure control and telemetry).

Silver Fern Farms has subsequently received approval in principle from its Board for a capital plan to upgrade the wastewater irrigation system. It is proposed that the system will be upgraded over a period of three years (starting in 2020).

The upgrade includes an upgrade to the stockyards contrashear, redirecting all waste streams through the existing DAF (Dissolved Air Floatation) a new ring-main distribution network (including a separate freshwater line) and eight centre pivot irrigators over the five existing irrigation blocks.

Table 1 below outlines the proposed workstream timings.

Table 1: Proposed infrastructure upgrade timeline

Year	Workstream
2020	On plant works, pump house modification, commission pivot and K-line in Block B, sand filtration (if required)
2021	Commission pivots and K-line in Block A & C
2022	Commission pivots and K-line in Block D & E

The aim of the upgrade to centre pivot irrigators is to provide for uniform application (maintained in most weather conditions), lower application rates and discharges over a large area in a short timeframe. The upgrade will help to maintain pasture growth and optimise nutrient take-off, reducing

potential nutrient loss to groundwater. to the freshwater line will enable freshwater irrigation, should sufficient water be available. This will also help optimise pasture health and nutrient take-off.

In addition, the upgrade will address the reliability issues of the current network that has been plagued by pipeline breaks and irrigator breakdowns.

Bay Irrigation were used to provide an initial concept plan for the design and layout of the new distribution network and irrigators. The final design is still to be confirmed. The proposed layout out and design specs are attached.

As agreed, PDP will use their model to look at the change in drainage / nutrient loss between the current irrigation system and for the proposed upgrade.

This modelling work is now underway and is expected to take approximately 5 weeks.

Consent Term

In the June 2018 application Silver Fern Farms Limited sought for a replacement consent with a term of 10 years. This was based on the current irrigation system of 12 Briggs 25 travelling irrigators.

With the commitment to upgrading the irrigation system to centre pivots, it is requested that the consent term sought be amended to 25 years. This longer term reflects the improvement in management these changes will support and provides a level of security and certainty for the investment being made in the irrigation system.

Timings of the modelling, report and installation of the irrigation system upgrades are subject to any constraints or impediments that may result from the current COVID-19 situation. Silver Fern Farms will keep the Council updated with progress and of any delays.

Yours Sincerely

Alison Johnstone
Group Environmental Manager

BAY IRRIGATION

P O Box 2358 Stortford Lodge
Hastings. 4153
P: 06 879 5577
F: 06 879 4932
Free phone: 0800 65 55 45
www.bayirrigation.co.nz
ash@bayirrigation.co.nz

01 Aug 2019

Attn: Bevan Oliver

Silver fern Farms

Fraser Road

Takapau

Re: Waste water irrigation project

Dear Bevan

Thank you for the opportunity to offer our services for the design, supply and installation of an irrigation system for Silver Fern farms waste water system. Our proposal is for the installation of eight (8) centre pivot irrigators. This proposal includes pricing to supply, assemble and commission the irrigation equipment. The existing pumping system will be used, while new PVC pipe will come off the existing PVC mainlines and connect to the new pivots. A complete new mainline has also been priced as there has been problems with the existing pipework splitting. Additional filtration is recommended to be installed at the pump station to remove any fibres from the waste water. This will reduce nozzle blockages or valve leakage, and, ensure an even and accurate application rate

As always, our objective with this proposal has been to design an irrigation system that combines equipment of the highest quality with the latest technical specification therefore ensuring efficiency and irrigation uniformity that meets or exceeds irrigation industry standards. The whole package will still be based on the principles of; fitness for purpose, simplicity, and cost effectiveness.

The report is broken into the following sections.

- Design Parameters
- Machine detail & specification
- Mainline detail and specification
- Pricing
- Installation and Contractual details

If, after reading this report you have any questions, or need further clarification on any aspect of the report, please do not hesitate to contact me.

Kind regards

Ashley Hampton

Contents

Design Parameters

Design Brief

Design and supply a waste water irrigation system that can apply 5,000 m^3 of waste water every 24hrs, with a 5-day return. The preferred application rate is 27mm per week. The system must have Proof of Placement monitoring

Design and price a new mainline system as the existing system has had several splits

Block A

Irrigation Design Concept

The design is for the supply and install of two, part circle centre pivot irrigators. This would allow the power lines running down the centre headland to remain in place. An existing transformer could be utilized to supply power for the two pivots

The design concept is for the centre pivot irrigator to be supplied water from the existing pump and irrigation mains network with an extension to that to be laid connecting into the pivots.

The pivots will have FieldNet™ installed, which allows the operator to remotely programme and operate the pivot, either from a computer, tablet or smart phone, via an internet connection. Alerts are also sent out to operators via FieldNET of any system faults or changes in machine status

Each pivot will be installed with a solenoid valve at the pivot base to allow the pump to pump water to other irrigators when one pivot is not in use. This valve will open when the pivot is commanded to irrigate but remain closed if the pivot is being walked dry. The valve will also close automatically should the pivot have a problem causing it to shut down when it is in irrigation mode. Water to the pilot valve will pass through an external filter to ensure correct operation of the valve is not compromised by dirty water.

Block A Irrigation Area.

The area irrigated by the pivot and the flow utilised from the pumping system for the irrigation are as per the tables below.

386m PC Fixed Pivot 1 Block A						
Length of pivot	386	metres		Application rate per day	8.75	mm/day
Degrees of Arc	182	degrees		Flow required by pivot	23.97	litres/sec
Area Irrigated under pivot	23.67	hectares		Run time per day	24	hours
	0.00					
End gun 1 radius	30	metres		Application rate for end gun 1	8.75	mm/day
Degrees of arc for end gun	141	degrees		Flow required for end gun 1	3.87	litres/sec
Area irrigated by end gun 1	2.96	hectares				
End gun 2 radius	15	metres		Application rate for end gun 2	8.75	mm/day
Degrees of arc for end gun 2	0	degrees				
Area irrigated by end gun 2	0.00	hectares				
Total area irrigated	**26.63**	**hectares**		**Total flow required**	**27.84**	**litres/sec**

386m PC Fixed Pivot 2 Block A						
Length of pivot	386	metres		Application rate per day	8.75	mm/day
Degrees of Arc	201	degrees		Flow required by pivot	26.47	litres/sec
Area Irrigated under pivot	26.14	hectares		Run time per day	24	hours
End gun 1 radius	30	metres		Application rate for end gun 1	8.75	mm/day
Degrees of arc for end gun	89	degrees		Flow required for end gun 1	4.27	litres/sec
Area irrigated by end gun 1	1.87	hectares				
End gun 2 radius	15	metres		Application rate for end gun 2	8.75	mm/day
Degrees of arc for end gun 2	0	degrees				
Area irrigated by end gun 2	0.00	hectares				
Total area irrigated	**28.01**	**hectares**		**Total flow required**	**30.75**	**litres/sec**

Pivot Specification

Specification for Block A

Pivot Layout summary for				**SFF Block A**		
Date			30 May 2019			
Pivot Point	6-5/8" Heavy Duty					
Span	**Span length (m)**	**Pipe diameter**	**Total metres**	**Tower profile**	**Tyre size/profile**	**Sprinkler Type**
Span 1	47.85	6 5/8	47.85	Standard	14.9x 24/Tractor	Orbitor
Span 2	54.56	6 5/8	102.41	Standard	14.9x 24/Tractor	Orbitor
Span 3	54.56	6 5/8	156.97	Standard	14.9x 24/Tractor	Orbitor
Span 4	54.56	6 5/8	211.53	Standard	14.9x 24/Tractor	Orbitor
Span 5	54.56	6 5/8	266.09	Standard	14.9x 24/Tractor	Orbitor
Span 6	54.56	6 5/8	320.65	Standard	14.9x 24/Tractor	Orbitor
Span 7	54.56	6 5/8	375.21	Standard	14.9x 24/Tractor	Orbitor
	0	0	375.21	0	0	0
Overhang	10.06	5 9/16	385.27			Orbitor
Boost Pump		130gpm	**Pivot Controller**		FieldBoss	
End Gun		Komet Ultra	**Flow required**		27.97	(l/sec)
Machine Length		387 (m)	**Application depth**		8.75	(mm)
Irrigated Length		415.87 (m)	**Power requirement**		13.39	(Amps)
Pivot base pressure		25.13 (p.s.i.)	Before any elevation changes			

Pivot Layout summary for				**SFF Block A**		
Date			30 May 2019			
Pivot Point	6-5/8" Heavy Duty					
Span	**Span length (m)**	**Pipe diameter**	**Total metres**	**Tower profile**	**Tyre size/profile**	**Sprinkler Type**
Span 1	47.85	6 5/8	47.85	Standard	14.9x 24/Tractor	Orbitor
Span 2	54.56	6 5/8	102.41	Standard	14.9x 24/Tractor	Orbitor
Span 3	54.56	6 5/8	156.97	Standard	14.9x 24/Tractor	Orbitor
Span 4	54.56	6 5/8	211.53	Standard	14.9x 24/Tractor	Orbitor
Span 5	54.56	6 5/8	266.09	Standard	14.9x 24/Tractor	Orbitor
Span 6	54.56	6 5/8	320.65	Standard	14.9x 24/Tractor	Orbitor
Span 7	54.56	6 5/8	375.21	Standard	14.9x 24/Tractor	Orbitor
	0	5 9/16	375.21	0	0	0
Overhang	10.06	5 9/16	385.27			Orbitor
Boost Pump		130gpm	**Pivot Controller**		FieldBoss	
End Gun		Komet Ultra	**Flow required**		30.16	(l/sec)
Machine Length		382 (m)	**Application depth**		8.75	(mm)
Irrigated Length		415.87 (m)	**Power requirement**		13.39	(Amps)
Pivot base pressure		25.9 (p.s.i.)	Before any elevation changes			

Speed / Application Rate

The application depth over 24 hours are as per the calculations below

386m PC Fixed Pivot 1				
Fixed Pivot Speed vs Application				
Design Application Rate/Time	8.75	mm		
Time required for design application rate	24	hours		
Distance from Centre to last drive tower	376	metres		
Total machine length	387	metres		
Degrees of Arc irrigated	182	degrees		
Maximum speed of tower at 100%	2.59	metres/minute		
Circumference of last tower	1194	metres		
Time taken (mins) for rotation at 100%	460.71	minutes		
Time taken (hours) for rotation at 100%	7.68	hours		
Flow required to deliver design rate in 24 hrs	86.73	m³/hr	24.09	l/sec
Radius of throw for end gun	30	metres		
Degrees of arc of end gun	141	degrees		
Additional flow required for end gun	13.97	m³/hr	3.88	l/sec
Total flow required	100.70	m³/hr	27.97	l/sec

386m PC Fixed Pivot 2				
Fixed Pivot Speed vs Application				
Design Application Rate/Time	8.75	mm		
Time required for design application rate	24	hours		
Distance from Centre to last drive tower	376	metres		
Total machine length	382	metres		
Degrees of Arc irrigated	201	degrees		
Maximum speed of tower at 100%	2.59	metres/minute		
Circumference of last tower	1318.554	metres		
Time taken (mins) for rotation at 100%	508.81	minutes		
Time taken (hours) for rotation at 100%	8.48	hours		
Flow required to deliver design rate in 24 hrs	93.33	m³/hr	25.93	l/sec
Radius of throw for end gun	30	metres		
Degrees of arc of end gun	89	degrees		
Additional flow required for end gun	15.23	m³/hr	4.23	l/sec
Total flow required	108.57	m³/hr	30.16	l/sec

The various rates of water applied relative to the speed of the pivots are given below.

386m PC Fixed Pivot 1				
% Speed	Appn Depth		Hours	
100%	2.80	mm	7.68	Hrs/Rev
90%	3.11	mm	8.53	Hrs/Rev
80%	3.50	mm	9.60	Hrs/Rev
70%	4.00	mm	10.97	Hrs/Rev
60%	4.67	mm	12.80	Hrs/Rev
50%	5.60	mm	15.36	Hrs/Rev
40%	7.00	mm	19.20	Hrs/Rev
30%	9.33	mm	25.60	Hrs/Rev
20%	14.00	mm	38.39	Hrs/Rev
10%	27.99	mm	76.79	Hrs/Rev

386m PC Fixed Pivot 2				
% Speed	Appn Rate		Hours	
100%	3.09	mm	8.48	Hrs/Rev
90%	3.44	mm	9.42	Hrs/Rev
80%	3.86	mm	10.60	Hrs/Rev
70%	4.42	mm	12.11	Hrs/Rev
60%	5.15	mm	14.13	Hrs/Rev
50%	6.18	mm	16.96	Hrs/Rev
40%	7.73	mm	21.20	Hrs/Rev
30%	10.31	mm	28.27	Hrs/Rev
20%	15.46	mm	42.40	Hrs/Rev
10%	30.92	mm	84.80	Hrs/Rev

Pivot Sprinkler Application Intensities

The amount of water that a pivot sprinkler applies is determined by the size of the nozzle. Nozzle selection is performed by computer modelling to try and achieve a 100% uniformity. Pivot uniformity should be around 80-90%. Application depth is the amount of water that is applied in a pass. Instantaneous application is the rate at which the water is applied during a pass.

The tables below show the instantaneous application rates at three positions along the pivot; the end, the middle and near the beginning.

Instantaneous Application Rate				**Inputs**		
386m PC Fixed Pivot 1				Machine Radius	387	metres
Constant	7200		constant	Machine arc	182	degrees
Machine Flow	27.97	l/sec	Qf is discharge for the whole pivot	End gun radius	30	metres
Radius	387		R is the distance from pivot centre to a sprinkler	Application rate	8.75	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	18	m	W is the wetted width (diameter of sprinkler)	Flow Rate	28.0	
	417		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate	**28.91**	**mm/hr**				

Instantaneous Application Rate				**Inputs**		
386m PC Fixed Pivot 1				Machine Radius	387	metres
Constant	7200		constant	Machine arc	182	degrees
Machine Flow	27.97	l/sec	Qf is discharge for the whole pivot	End gun radius	30	metres
Radius	193.5		R is the distance from pivot centre to a sprinkler	Application rate	8.75	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	16	m	W is the wetted width (diameter of sprinkler)	Flow Rate	28.0	
	417		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate	**16.26**	**mm/hr**				

Instantaneous Application Rate				**Inputs**		
386m PC Fixed Pivot 1				Machine Radius	387	metres
Constant	7200		constant	Machine arc	182	degrees
Machine Flow	27.97	l/sec	Qf is discharge for the whole pivot	End gun radius	30	metres
Radius	9		R is the distance from pivot centre to a sprinkler	Application rate	8.75	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	11	m	W is the wetted width (diameter of sprinkler)	Flow Rate	28.0	
	417		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate	**1.10**	**mm/hr**				

Instantaneous Application Rate

386m PC Fixed Pivot 2

				Inputs		
Constant	7200		constant	Machine Radius	382	metres
Machine Flow	30.16	l/sec	Qf is discharge for the whole pivot	Machine arc	201	degrees
Radius	382		R is the distance from pivot centre to a sprinkler	End gun radius	30	metres
Sprinkler	Orbitor		Sprinkler type used at this location	Application rate	8.75	mm/day
Sprinkler Wetted Width	18	m	W is the wetted width (diameter of sprinkler)	Hours/day	24	
	412		re is the effective radius of the full irrigated circle	Flow Rate	30.2	
Instantaneous Application Rate			**31.58 mm/hr**			

Instantaneous Application Rate

				Inputs		
				Machine Radius	382	metres
Constant	7200		constant	Machine arc	201	degrees
Machine Flow	30.16	l/sec	Qf is discharge for the whole pivot	End gun radius	30	metres
Radius	191		R is the distance from pivot centre to a sprinkler	Application rate	8.75	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	16	m	W is the wetted width (diameter of sprinkler)	Flow Rate	30.2	
	412		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate			**17.76 mm/hr**			

Instantaneous Application Rate

				Inputs		
				Machine Radius	382	metres
Constant	7200		constant	Machine arc	201	degrees
Machine Flow	30.16	l/sec	Qf is discharge for the whole pivot	End gun radius	30	metres
Radius	9		R is the distance from pivot centre to a sprinkler	Application rate	8.75	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	11	m	W is the wetted width (diameter of sprinkler)	Flow Rate	30.2	
	412		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate			**1.22** mm/hr			

Block B

Irrigation Design Concept

The design is for the supply and install of two, part circle centre pivot irrigators. This would allow the power lines running down the centre headland to remain in place. Power for the two pivots would come from the existing pump shed

The design concept is for the centre pivot irrigator to be supplied water from the existing pump and irrigation mains network with an extension to that to be laid connecting into the pivots.

The pivots will have FieldNet™ installed, which allows the operator to remotely programme and operate the pivot, either from a computer, tablet or smart phone, via an internet connection. Alerts are also sent out to operators via FieldNET of any system faults or changes in machine status

Each pivot will be supplied with a solenoid valve at the pivot base to allow the pump to pump water to other irrigators when one pivot is not in use. This valve will open when the pivot is commanded to irrigate but remain closed if the pivot is being walked dry. The valve will also close automatically should the pivot have a problem causing it to shut down when it is in irrigation mode. Water to the pilot valve will pass through an external filter to ensure correct operation of the valve is not compromised by dirty water.

Block B Irrigation Area.

The area irrigated by the pivot and the flow utilised from the pumping system for the irrigation are as per the tables below.

212m PC Fixed Pivot 1						
Length of pivot	212	metres		Application rate per day	23	mm/day
Degrees of Arc	180	degrees		Flow required by pivot	18.80	litres/sec
Area Irrigated under pivot	7.06	hectares		Run time per day	24	hours
	0.00					
End gun 1 radius	30	metres		Application rate for end gun 1	23	mm/day
Degrees of arc for end gun	125	degrees		Flow required for end gun 1	5.70	litres/sec
Area irrigated by end gun 1	1.49	hectares				
End gun 2 radius	15	metres		Application rate for end gun 2	23	mm/day
Degrees of arc for end gun 2	0	degrees				
Area irrigated by end gun 2	0.00	hectares				
Total area irrigated	**8.55**	**hectares**		**Total flow required**	**24.49**	**litres/sec**

253m PC Fixed Pivot 2						
Length of pivot	253	metres		Application rate per day	23	mm/day
Degrees of Arc	180	degrees		Flow required by pivot	26.77	litres/sec
Area Irrigated under pivot	10.06	hectares		Run time per day	24	hours
End gun 1 radius	30	metres		Application rate for end gun 1	23	mm/day
Degrees of arc for end gun	106	degrees		Flow required for end gun 1	6.72	litres/sec
Area irrigated by end gun 1	1.49	hectares				
End gun 2 radius	15	metres		Application rate for end gun 2	23	mm/day
Degrees of arc for end gun 2	0	degrees				
Area irrigated by end gun 2	0.00	hectares				
Total area irrigated	**11.54**	**hectares**		**Total flow required**	**33.49**	**litres/sec**

Pivot Specification

Specification for Block B

Pivot Layout summary for				**SFF Block B**		
Date			30 May 2019			
Pivot Point	6-5/8" Heavy Duty					
Span	**Span length (m)**	**Pipe diameter**	**Total metres**	**Tower profile**	**Tyre size/profile**	**Sprinkler Type**
Span 1	61.28	6 5/8	61.28	Standard	14.9x 24/Tractor	Orbitor
Span 2	61.28	6 5/8	122.56	Standard	14.9x 24/Tractor	Orbitor
Span 3	61.28	6 5/8	183.84	Standard	14.9x 24/Tractor	Orbitor
Span 4			183.84	Standard	14.9x 24/Tractor	Orbitor
Overhang	26.83	5 9/16	210.67			Orbitor
Boost Pump		130gpm	**Pivot Controller**		FieldBoss	
End Gun		Komet Ultra	**Flow required**		24.49	(l/sec)
Machine Length		212 (m)	**Application depth**		23	(mm)
Irrigated Length		241.27 (m)	**Power requirement**		10.33	(Amps)
Pivot base pressure		23.24 (p.s.i.)	Before any elevation changes			

Pivot Layout summary for				**SFF Block B**		
Date			30 May 2019			
Pivot Point	6-5/8" Heavy Duty					
Span	**Span length (m)**	**Pipe diameter**	**Total metres**	**Tower profile**	**Tyre size/profile**	**Sprinkler Type**
Span 1	61.28	6 5/8	61.28	Standard	14.9x 24/Tractor	Orbitor
Span 2	61.28	6 5/8	122.56	Standard	14.9x 24/Tractor	Orbitor
Span 3	54.57	6 5/8	177.13	Standard	14.9x 24/Tractor	Orbitor
Span 4	54.57	6 5/8	231.7	Standard	14.9x 24/Tractor	Orbitor
Overhang	20.12	5 9/16	251.82			Orbitor
Boost Pump		130gpm	**Pivot Controller**		FieldBoss	
End Gun		Komet Ultra	**Flow required**		33.49	(l/sec)
Machine Length		253 (m)	**Application depth**		23	(mm)
Irrigated Length		282.42 (m)	**Power requirement**		10.33	(Amps)
Pivot base pressure		25.144 (p.s.i.)	Before any elevation changes			

Speed / Application Rate

212m PC Fixed Pivot 1				
Fixed Pivot Speed vs Application				
Design Application Rate/Time	23	mm		
Time required for design application rate	24	hours		
Distance from Centre to last drive tower	184	metres		
Total machine length	212	metres		
Degrees of Arc irrigated	180	degrees		
Maximum speed of tower at 100%	2.59	metres/minute		
Circumference of last tower	580	metres		
Time taken (mins) for rotation at 100%	223.62	minutes		
Time taken (hours) for rotation at 100%	3.73	hours		
Flow required to deliver design rate in 24 hrs	67.67	m³/hr	18.80	l/sec
Radius of throw for end gun	30	metres		
Degrees of arc of end gun	125	degrees		
Additional flow required for end gun	20.51	m³/hr	5.70	l/sec
Total flow required	88.17	m³/hr	24.49	l/sec

253m PC Fixed Pivot 2				
Fixed Pivot Speed vs Application				
Design Application Rate/Time	23	mm		
Time required for design application rate	24	hours		
Distance from Centre to last drive tower	232	metres		
Total machine length	253	metres		
Degrees of Arc irrigated	180	degrees		
Maximum speed of tower at 100%	2.59	metres/minute		
Circumference of last tower	729.8866	metres		
Time taken (mins) for rotation at 100%	281.65	minutes		
Time taken (hours) for rotation at 100%	4.69	hours		
Flow required to deliver design rate in 24 hrs	96.37	m³/hr	26.77	l/sec
Radius of throw for end gun	30	metres		
Degrees of arc of end gun	106	degrees		
Additional flow required for end gun	24.21	m³/hr	6.72	l/sec
Total flow required	120.58	m³/hr	33.49	l/sec

The application depth over 24 hours are as per the calculations below

212m PC Fixed Pivot 1				
% Speed	Appn Depth		Hours	
100%	3.57	mm	3.73	Hrs/Rev
90%	3.97	mm	4.14	Hrs/Rev
80%	4.46	mm	4.66	Hrs/Rev
70%	5.10	mm	5.32	Hrs/Rev
60%	5.95	mm	6.21	Hrs/Rev
50%	7.14	mm	7.45	Hrs/Rev
40%	8.93	mm	9.32	Hrs/Rev
30%	11.91	mm	12.42	Hrs/Rev
20%	17.86	mm	18.64	Hrs/Rev
10%	35.72	mm	37.27	Hrs/Rev

253m PC Fixed Pivot 2				
% Speed	Appn Rate		Hours	
100%	4.50	mm	4.69	Hrs/Rev
90%	5.00	mm	5.22	Hrs/Rev
80%	5.62	mm	5.87	Hrs/Rev
70%	6.43	mm	6.71	Hrs/Rev
60%	7.50	mm	7.82	Hrs/Rev
50%	9.00	mm	9.39	Hrs/Rev
40%	11.25	mm	11.74	Hrs/Rev
30%	15.00	mm	15.65	Hrs/Rev
20%	22.49	mm	23.47	Hrs/Rev
10%	44.99	mm	46.94	Hrs/Rev

Pivot Sprinkler Application Intensities

The amount of water that a pivot sprinkler applies is determined by the size of the nozzle. Nozzle selection is performed by computer modelling to try and achieve a 100% uniformity. Pivot uniformity should be around 80-90%. Application depth is the amount of water that is applied in a pass. Instantaneous application is the rate at which the water is applied during a pass.

The tables below show the instantaneous application rates at three positions along the pivot; the end, the middle and near the beginning.

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Instantaneous Application Rate				**Inputs**		
212m PC Fixed Pivot 1				Machine Radius	212	metres
Constant	7200		constant	Machine arc	180	degrees
Machine Flow	24.49	l/sec	Qf is discharge for the w hole pivot	End gun radius	30	metres
Radius	212		R is the distance from pivot centre to a sprinkler	Application rate	23	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	18	m	W is the w etted w idth (diameter of sprinkler)	Flow Rate	24.5	
	242		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate	**46.21**	**mm/hr**				

Instantaneous Application Rate				**Inputs**		
212m PC Fixed Pivot 1				Machine Radius	212	metres
Constant	7200		constant	Machine arc	180	degrees
Machine Flow	24.49	l/sec	Qf is discharge for the w hole pivot	End gun radius	30	metres
Radius	106		R is the distance from pivot centre to a sprinkler	Application rate	23	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	16	m	W is the w etted w idth (diameter of sprinkler)	Flow Rate	24.5	
	242		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate	**25.99**	**mm/hr**				

Instantaneous Application Rate				**Inputs**		
212m PC Fixed Pivot 1				Machine Radius	212	metres
Constant	7200		constant	Machine arc	180	degrees
Machine Flow	24.49	l/sec	Qf is discharge for the w hole pivot	End gun radius	30	metres
Radius	9		R is the distance from pivot centre to a sprinkler	Application rate	23	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	11	m	W is the w etted w idth (diameter of sprinkler)	Flow Rate	24.5	
	242		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate	**3.21**	**mm/**hr				

Instantaneous Application Rate

253m PC Fixed Pivot 2

				Inputs		
Constant	7200		constant	Machine Radius	253	metres
Machine Flow	33.49	l/sec	Qf is discharge for the w hole pivot	Machine arc	180	degrees
Radius	253		R is the distance from pivot centre to a sprinkler	End gun radius	30	metres
Sprinkler	Orbitor		Sprinkler type used at this location	Application rate	23	mm/day
Sprinkler Wetted Width	18	m	W is the w etted w idth (diameter of sprinkler)	Hours/day	24	
	283		re is the effective radius of the full irrigated circle	Flow Rate	33.5	
Instantaneous Application Rate			**52.95 mm/hr**			

Instantaneous Application Rate

				Inputs		
				Machine Radius	253	metres
Constant	7200		constant	Machine arc	180	degrees
Machine Flow	33.49	l/sec	Qf is discharge for the w hole pivot	End gun radius	30	metres
Radius	126.5		R is the distance from pivot centre to a sprinkler	Application rate	23	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	16	m	W is the w etted w idth (diameter of sprinkler)	Flow Rate	33.5	
	283		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate			**29.79 mm/hr**			

Instantaneous Application Rate

				Inputs		
				Machine Radius	253	metres
Constant	7200		constant	Machine arc	180	degrees
Machine Flow	33.49	l/sec	Qf is discharge for the w hole pivot	End gun radius	30	metres
Radius	9		R is the distance from pivot centre to a sprinkler	Application rate	23	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	11	m	W is the w etted w idth (diameter of sprinkler)	Flow Rate	33.5	
	283		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate			**3.08** mm/hr			

Block C

Irrigation Design Concept

The design concept for Block C is for the supply and install of one, part circle centre pivot irrigator. This machine would do a 294° arc, avoiding the SW corner of the block, which is designated for clean water irrigation only

A new transformer would need to be installed on the Fraser rd. roadside. This transformer would supply Blocks C & D

The design concept is for the centre pivot irrigator to be supplied water from the existing pump and irrigation mains network with an extension to that to be laid connecting into the pivot.

The pivot will have FieldNet™ installed, which allows the operator to remotely programme and operate the pivot, either from a computer, tablet or smart phone, via an internet connection. Alerts are also sent out to operators via FieldNET of any system faults or changes in machine status

The pivot will be supplied with a solenoid valve at the pivot base to allow the pump to pump water to other irrigators when one pivot is not in use. This valve will open when the pivot is commanded to irrigate but remain closed if the pivot is being walked dry. The valve will also close automatically should the pivot have a problem causing it to shut down when it is in irrigation mode. Water to the pilot valve will pass through an external filter to ensure correct operation of the valve is not compromised by dirty water.

Block C Irrigation Area.

The area irrigated by the pivot and the flow utilised from the pumping system for the irrigation is as per the table below.

266m PC Fixed Pivot					
Length of pivot	266	metres	Application rate per day	11	mm/day
Degrees of Arc	294	degrees	Flow required by pivot	23.11	litres/sec
Area Irrigated under pivot	18.16	hectares	Run time per day	24	hours
	0.00				
End gun 1 radius	25	metres	Application rate for end gun 1	11	mm/day
Degrees of arc for end gun	147	degrees	Flow required for end gun 1	4.55	litres/sec
Area irrigated by end gun 1	1.79	hectares			
End gun 2 radius	15	metres	Application rate for end gun 2	11	mm/day
Degrees of arc for end gun 2	0	degrees			
Area irrigated by end gun 2	0.00	hectares			
Total area irrigated	**19.94**	**hectares**	**Total flow required**	**27.66**	**litres/sec**

Pivot Specification

Specification for Block C

Pivot Layout summary for **SFF Block C**						
Date			30 May 2019			
Pivot Point	4-1/2" Heavy Duty					
Span	**Span length (m)**	**Pipe diameter**	**Total metres**	**Tower profile**	**Tyre size/profile**	**Sprinkler Type**
Span 1	61.28	6-5/8"	61.28	Standard	14.9x 24/Tractor	Orbitor
Span 2	61.28	6-5/8"	122.56	Standard	14.9x 24/Tractor	Orbitor
Span 3	61.28	6-5/8"	183.84	Standard	14.9x 24/Tractor	Orbitor
Span 4	54.57	6-5/8"	238.41	Standard	14.9x 24/Tractor	Orbitor
Span 5	0	6-5/8"	238.41	Standard	14.9x 24/Tractor	Orbitor
	0	6-5/8"	238.41	0	0	0
Overhang	26.83	5-9/16"	265.24			Orbitor
Boost Pump		130gpm	**Pivot Controller**		FieldBoss	
End Gun		Komet Ultra	**Flow required**		27.66	(l/sec)
Machine Length		266 (m)	**Application depth**		11	(mm)
Irrigated Length		290.84 (m)	**Power requirement**		11.35	(Amps)
Pivot base pressure		24.13 (p.s.i.)	Before any elevation changes			

Speed / Application Rate

266m PC Fixed Pivot					
Fixed Pivot Speed vs Application					
Design Application Rate/Time		11	mm		
Time required for design application rate		24	hours		
Distance from Centre to last drive tower		239	metres		
Total machine length		266	metres		
Degrees of Arc irrigated		294	degrees		
Maximum speed of tower at 100%		2.59	metres/minute		
Circumference of last tower		1227	metres		
Time taken (mins) for rotation at 100%		473.32	minutes		
Time taken (hours) for rotation at 100%		7.89	hours		
Flow required to deliver design rate in 24 hrs		83.21	m³/hr	23.11	l/sec
Radius of throw for end gun		25	metres		
Degrees of arc of end gun		147	degrees		
Additional flow required for end gun		16.38	m³/hr	4.55	l/sec
Total flow required		99.59	m³/hr	27.66	l/sec

The application depth over 24 hours are as per the calculations below

266m PC Fixed Pivot				
% Speed	Appn Depth		Hours	
100%	3.62	mm	7.89	Hrs/Rev
90%	4.02	mm	8.77	Hrs/Rev
80%	4.52	mm	9.86	Hrs/Rev
70%	5.17	mm	11.27	Hrs/Rev
60%	6.03	mm	13.15	Hrs/Rev
50%	7.23	mm	15.78	Hrs/Rev
40%	9.04	mm	19.72	Hrs/Rev
30%	12.05	mm	26.30	Hrs/Rev
20%	18.08	mm	39.44	Hrs/Rev
10%	36.16	mm	78.89	Hrs/Rev

Pivot Sprinkler Application Intensities

The amount of water that a pivot sprinkler applies is determined by the size of the nozzle. Nozzle selection is performed by computer modelling to try and achieve a 100% uniformity. Pivot uniformity should be around 80-90%. Application depth is the amount of water that is applied in a pass. Instantaneous application is the rate at which the water is applied during a pass.

The tables below show the instantaneous application rates at three positions along the pivot; the end, the middle and near the beginning.

Instantaneous Application Rate				**Inputs**		
266m PC Fixed Pivot				Machine Radius	266	metres
Constant	7200		constant	Machine arc	294	degrees
Machine Flow	27.66	l/sec	Qf is discharge for the w hole pivot	End gun radius	25	metres
Radius	266		R is the distance from pivot centre to a sprinkler	Application rate	11	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	18	m	W is the w etted w idth (diameter of sprinkler)	Flow Rate	27.7	
	291		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate	**41.60**	**mm/hr**				

Instantaneous Application Rate				**Inputs**		
266m PC Fixed Pivot				Machine Radius	266	metres
Constant	7200		constant	Machine arc	294	degrees
Machine Flow	27.66	l/sec	Qf is discharge for the w hole pivot	End gun radius	25	metres
Radius	133		R is the distance from pivot centre to a sprinkler	Application rate	11	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	16	m	W is the w etted w idth (diameter of sprinkler)	Flow Rate	27.7	
	291		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate	**23.40**	**mm/hr**				

Instantaneous Application Rate				**Inputs**		
266m PC Fixed Pivot				Machine Radius	266	metres
Constant	7200		constant	Machine arc	294	degrees
Machine Flow	27.66	l/sec	Qf is discharge for the w hole pivot	End gun radius	25	metres
Radius	9		R is the distance from pivot centre to a sprinkler	Application rate	11	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	11	m	W is the w etted w idth (diameter of sprinkler)	Flow Rate	27.7	
	291		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate	**2.30**	**mm**/hr				

Block D

Irrigation Design Concept

The design concept for Block D is for the supply and install of one, part circle centre pivot irrigator. The machine would do a 182° arc, with the Pivot point on the Northern (Station rd.) side of the block

A new transformer would need to be installed on the Fraser rd. roadside. This transformer would supply Blocks C & D

The design concept is for the centre pivot irrigator to be supplied water from the existing pump and irrigation mains network with an extension to that to be laid connecting into the pivot.

The pivot will have FieldNet™ installed, which allows the operator to remotely programme and operate the pivot, either from a computer, tablet or smart phone, via an internet connection. Alerts are also sent out to operators via FieldNET of any system faults or changes in machine status

The pivot will be supplied with a solenoid valve at the pivot base to allow the pump to pump water to other irrigators when one pivot is not in use. This valve will open when the pivot is commanded to irrigate but remain closed if the pivot is being walked dry. The valve will also close automatically should the pivot have a problem causing it to shut down when it is in irrigation mode. Water to the pilot valve will pass through an external filter to ensure correct operation of the valve is not compromised by dirty water.

Block D Irrigation Area.

The area irrigated by the pivot and the flow utilised from the pumping system for the irrigation are as per the tables below.

363m PC Fixed Pivot					
Length of pivot	363	metres	Application rate per day	11	mm/day
Degrees of Arc	182	degrees	Flow required by pivot	26.65	litres/sec
Area Irrigated under pivot	20.93	hectares	Run time per day	24	hours
	0.00				
End gun 1 radius	25	metres	Application rate for end gun 1	11	mm/day
Degrees of arc for end gun	88	degrees	Flow required for end gun 1	3.80	litres/sec
Area irrigated by end gun 1	1.44	hectares			
End gun 2 radius	15	metres	Application rate for end gun 2	11	mm/day
Degrees of arc for end gun 2	0	degrees			
Area irrigated by end gun 2	0.00	hectares			
Total area irrigated	**22.37**	**hectares**	**Total flow required**	**30.45**	**litres/sec**

Pivot Specification

Specification for Block D

Pivot Layout summary for **SFF Block D**						
Date			30 May 2019			
Pivot Point	4-1/2" Heavy Duty					
Span	**Span length (m)**	**Pipe diameter**	**Total metres**	**Tower profile**	**Tyre size/profile**	**Sprinkler Type**
Span 1	61.28	6-5/8"	61.28	Standard	14.9x 24/Tractor	Orbitor
Span 2	61.28	6-5/8"	122.56	Standard	14.9x 24/Tractor	Orbitor
Span 3	54.57	6-5/8"	177.13	Standard	14.9x 24/Tractor	Orbitor
Span 4	54.57	6-5/8"	231.7	Standard	14.9x 24/Tractor	Orbitor
Span 5	54.57	6-5/8"	286.27	Standard	14.9x 24/Tractor	Orbitor
Span 6	54.57	6-5/8"	340.84	Standard	14.9x 24/Tractor	Orbitor
Overhang	20.12	5-9/16"	360.96			Orbitor
Boost Pump		130gpm	**Pivot Controller**		FieldBoss	
End Gun		Komet Ultra	**Flow required**		30.45	(l/sec)
Machine Length		363 (m)	**Application depth**		11	(mm)
Irrigated Length		386.56 (m)	**Power requirement**		13.39	(Amps)
Pivot base pressure		25.51 (p.s.i.)	Before any elevation changes			

Speed / Application Rate

363m PC Fixed Pivot					
Fixed Pivot Speed vs Application					
Design Application Rate/Time		11	mm		
Time required for design application rate		24	hours		
Distance from Centre to last drive tower		341	metres		
Total machine length		363	metres		
Degrees of Arc irrigated		182	degrees		
Maximum speed of tower at 100%		2.59	metres/minute		
Circumference of last tower		1085	metres		
Time taken (mins) for rotation at 100%		418.58	minutes		
Time taken (hours) for rotation at 100%		6.98	hours		
Flow required to deliver design rate in 24 hrs		95.93	m³/hr	26.65	l/sec
Radius of throw for end gun		25	metres		
Degrees of arc of end gun		88	degrees		
Additional flow required for end gun		13.67	m³/hr	3.80	l/sec
Total flow required		109.60	m³/hr	30.45	l/sec

The application depth over 24 hours are as per the calculations below

363m PC Fixed Pivot				
% Speed	Appn Depth		Hours	
100%	3.20	mm	6.98	Hrs/Rev
90%	3.55	mm	7.75	Hrs/Rev
80%	4.00	mm	8.72	Hrs/Rev
70%	4.57	mm	9.97	Hrs/Rev
60%	5.33	mm	11.63	Hrs/Rev
50%	6.39	mm	13.95	Hrs/Rev
40%	7.99	mm	17.44	Hrs/Rev
30%	10.66	mm	23.25	Hrs/Rev
20%	15.99	mm	34.88	Hrs/Rev
10%	31.97	mm	69.76	Hrs/Rev

Pivot Sprinkler Application Intensities

The amount of water that a pivot sprinkler applies is determined by the size of the nozzle. Nozzle selection is performed by computer modelling to try and achieve a 100% uniformity. Pivot uniformity should be around 80-90%. Application depth is the amount of water that is applied in a pass. Instantaneous application is the rate at which the water is applied during a pass.

The tables below show the instantaneous application rates at three positions along the pivot; the end, the middle and near the beginning.

Instantaneous Application Rate				**Inputs**		
363m PC Fixed Pivot				Machine Radius	363	metres
Constant	7200		constant	Machine arc	182	degrees
Machine Flow	30.45	l/sec	Qf is discharge for the w hole pivot	End gun radius	25	metres
Radius	363		R is the distance from pivot centre to a sprinkler	Application rate	11	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	18	m	W is the w etted w idth (diameter of sprinkler)	Flow Rate	30.4	
	388		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate	**33.55**	**mm/hr**				

Instantaneous Application Rate				**Inputs**		
363m PC Fixed Pivot				Machine Radius	363	metres
Constant	7200		constant	Machine arc	182	degrees
Machine Flow	30.45	l/sec	Qf is discharge for the w hole pivot	End gun radius	25	metres
Radius	181.5		R is the distance from pivot centre to a sprinkler	Application rate	11	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	16	m	W is the w etted w idth (diameter of sprinkler)	Flow Rate	30.4	
	388		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate	**18.87**	**mm/hr**				

Instantaneous Application Rate				**Inputs**		
363m PC Fixed Pivot				Machine Radius	363	metres
Constant	7200		constant	Machine arc	182	degrees
Machine Flow	30.45	l/sec	Qf is discharge for the w hole pivot	End gun radius	25	metres
Radius	9		R is the distance from pivot centre to a sprinkler	Application rate	11	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	11	m	W is the w etted w idth (diameter of sprinkler)	Flow Rate	30.4	
	388		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate	**1.36**	**mm**/hr				

Block E

Irrigation Design Concept

The design concept for Block E is for the supply and install of two, part circle centre pivot irrigators. The machines would each do a 180° arc. The larger machine would have the pivot point on the Northern (SH 2) boundary. The smaller machine would have the pivot point on the Western boundary

A new transformer would need to be installed on the fourth or fifth power pole, from SH, which would supply power to both irrigators

The design concept is for the centre pivot irrigator to be supplied water from the existing pump and irrigation mains network with an extension to that to be laid connecting into the pivots.

The pivots will have FieldNet™ installed, which allows the operator to remotely programme and operate the pivot, either from a computer, tablet or smart phone, via an internet connection. Alerts are also sent out to operators via FieldNET of any system faults or changes in machine status.

Each pivot will be supplied with a solenoid valve at the pivot base to allow the pump to pump water to other irrigators when one pivot is not in use. This valve will open when the pivot is commanded to irrigate but remain closed if the pivot is being walked dry. The valve will also close automatically should the pivot have a problem causing it to shut down when it is in irrigation mode. Water to the pilot valve will pass through an external filter to ensure correct operation of the valve is not compromised by dirty water.

Block E Irrigation Area.

The area irrigated by the pivot and the flow utilised from the pumping system for the irrigation are as per the tables below.

559m PC Fixed Pivot 1						
Length of pivot	559	metres		Application rate per day	7.5	mm/day
Degrees of Arc	180	degrees		Flow required by pivot	42.61	litres/sec
Area Irrigated under pivot	49.09	hectares		Run time per day	24	hours
	0.00					
End gun 1 radius	30	metres		Application rate for end gun 1	7.5	mm/day
Degrees of arc for end gun	144	degrees		Flow required for end gun 1	4.70	litres/sec
Area irrigated by end gun 1	4.33	hectares				
End gun 2 radius	15	metres		Application rate for end gun 2	7.5	mm/day
Degrees of arc for end gun 2	0	degrees				
Area irrigated by end gun 2	0.00	hectares				
Total area irrigated	**53.42**	**hectares**		**Total flow required**	**47.31**	**litres/sec**

272m PC Fixed Pivot 2						
Length of pivot	272	metres		Application rate per day	7.5	mm/day
Degrees of Arc	180	degrees		Flow required by pivot	10.09	litres/sec
Area Irrigated under pivot	11.62	hectares		Run time per day	24	hours
End gun 1 radius	25	metres		Application rate for end gun 1	7.5	mm/day
Degrees of arc for end gun	83	degrees		Flow required for end gun 1	1.94	litres/sec
Area irrigated by end gun 1	1.03	hectares				
End gun 2 radius	15	metres		Application rate for end gun 2	7.5	mm/day
Degrees of arc for end gun 2	0	degrees				
Area irrigated by end gun 2	0.00	hectares				
Total area irrigated	**12.65**	**hectares**		**Total flow required**	**12.03**	**litres/sec**

Pivot Layout summary for SFF Block E

Date			30 May 2019			
Pivot Point	6-5/8" Heavy Duty					
Span	**Span length (m)**	**Pipe diameter**	**Total metres**	**Tower profile**	**Tyre size/profile**	**Sprinkler Type**
Span 1	54.56	6 5/8	54.56	Standard	14.9x 24/Tractor	Orbitor
Span 2	54.56	6 5/8	109.12	Standard	14.9x 24/Tractor	Orbitor
Span 3	54.56	6 5/8	163.68	Standard	14.9x 24/Tractor	Orbitor
Span 4	54.56	6 5/8	218.24	Standard	14.9x 24/Tractor	Orbitor
Span 5	54.56	6 5/8	272.8	Standard	14.9x 24/Tractor	Orbitor
Span 6	54.56	6 5/8	327.36	Standard	14.9x 24/Tractor	Orbitor
Span 7	54.56	6 5/8	381.92	Standard	14.9x 24/Tractor	Orbitor
Span 8	54.56	6 5/8	436.48	Standard	14.9x 24/Tractor	Orbitor
Span 9	54.56	6 5/8	491.04	Standard	14.9x 24/Tractor	Orbitor
Span 10	54.56	6 5/8	545.6	Standard	14.9x 24/Tractor	Orbitor
Overhang	13.41	5 9/16	559.01			Orbitor
Boost Pump		130gpm	**Pivot Controller**		FieldBoss	
End Gun		Komet Ultra	**Flow required**		47.31	(l/sec)
Machine Length		559 (m)	**Application depth**		7.5	(mm)
Irrigated Length		589.61 (m)	**Power requirement**		16.45	(Amps)
Pivot base pressure		35.40 (p.s.i.)	Before any elevation changes			

Pivot Layout summary for SFF Block E

Date			30 May 2019			
Pivot Point	4-1/2" Heavy Duty					
Span	**Span length (m)**	**Pipe diameter**	**Total metres**	**Tower profile**	**Tyre size/profile**	**Sprinkler Type**
Span 1	54.57	6 5/8	54.57	Standard	14.9x 24/Tractor	Orbitor
Span 2	54.57	6 5/8	109.14	Standard	14.9x 24/Tractor	Orbitor
Span 3	54.57	6 5/8	163.71	Standard	14.9x 24/Tractor	Orbitor
Span 4	47.85	6 5/8	211.56	Standard	14.9x 24/Tractor	Orbitor
Span 5	47.85	6 5/8	259.41	Standard	14.9x 24/Tractor	Orbitor
	0	0	259.41	0	0	0
Overhang	13.41	5 9/16	272.82			Orbitor
Boost Pump		130gpm	**Pivot Controller**		FieldBoss	
End Gun		Komet Ultra	**Flow required**		12.03	(l/sec)
Machine Length		272 (m)	**Application depth**		7.5	(mm)
Irrigated Length		298.42 (m)	**Power requirement**		11.35	(Amps)
Pivot base pressure		22.188 (p.s.i.)	Before any elevation changes			

Speed / Application Rate

559m PC Fixed Pivot 1				
Fixed Pivot Speed vs Application				
Design Application Rate/Time	7.5	mm		
Time required for design application rate	24	hours		
Distance from Centre to last drive tower	546	metres		
Total machine length	559	metres		
Degrees of Arc irrigated	180	degrees		
Maximum speed of tower at 100%	2.59	metres/minute		
Circumference of last tower	1716	metres		
Time taken (mins) for rotation at 100%	662.24	minutes		
Time taken (hours) for rotation at 100%	11.04	hours		
Flow required to deliver design rate in 24 hrs	153.41	m³/hr	42.61	l/sec
Radius of throw for end gun	30	metres		
Degrees of arc of end gun	144	degrees		
Additional flow required for end gun	16.91	m³/hr	4.70	l/sec
Total flow required	170.32	m³/hr	47.31	l/sec

272m PC Fixed Pivot 2				
Fixed Pivot Speed vs Application				
Design Application Rate/Time	7.5	mm		
Time required for design application rate	24	hours		
Distance from Centre to last drive tower	260	metres		
Total machine length	272	metres		
Degrees of Arc irrigated	180	degrees		
Maximum speed of tower at 100%	2.59	metres/minute		
Circumference of last tower	816.951	metres		
Time taken (mins) for rotation at 100%	315.25	minutes		
Time taken (hours) for rotation at 100%	5.25	hours		
Flow required to deliver design rate in 24 hrs	36.32	m³/hr	10.09	l/sec
Radius of throw for end gun	25	metres		
Degrees of arc of end gun	83	degrees		
Additional flow required for end gun	6.98	m³/hr	1.94	l/sec
Total flow required	43.31	m³/hr	12.03	l/sec

The application depth over 24 hours are as per the calculations below

559m PC Fixed Pivot 1				
% Speed	Appn Depth		Hours	
100%	3.45	mm	11.04	Hrs/Rev
90%	3.83	mm	12.26	Hrs/Rev
80%	4.31	mm	13.80	Hrs/Rev
70%	4.93	mm	15.77	Hrs/Rev
60%	5.75	mm	18.40	Hrs/Rev
50%	6.90	mm	22.07	Hrs/Rev
40%	8.62	mm	27.59	Hrs/Rev
30%	11.50	mm	36.79	Hrs/Rev
20%	17.25	mm	55.19	Hrs/Rev
10%	34.49	mm	110.37	Hrs/Rev

272m PC Fixed Pivot 2				
% Speed	Appn Rate		Hours	
100%	1.64	mm	5.25	Hrs/Rev
90%	1.82	mm	5.84	Hrs/Rev
80%	2.05	mm	6.57	Hrs/Rev
70%	2.35	mm	7.51	Hrs/Rev
60%	2.74	mm	8.76	Hrs/Rev
50%	3.28	mm	10.51	Hrs/Rev
40%	4.10	mm	13.14	Hrs/Rev
30%	5.47	mm	17.51	Hrs/Rev
20%	8.21	mm	26.27	Hrs/Rev
10%	16.42	mm	52.54	Hrs/Rev

Pivot Sprinkler Application Intensities

The amount of water that a pivot sprinkler applies is determined by the size of the nozzle. Nozzle selection is performed by computer modelling to try and achieve a 100% uniformity. Pivot uniformity should be around 80-90%. Application depth is the amount of water that is applied in a pass. Instantaneous application is the rate at which the water is applied during a pass.

The tables below show the instantaneous application rates at three positions along the pivot; the end, the middle and near the beginning.

Instantaneous Application Rate				**Inputs**		
559m PC Fixed Pivot 1				Machine Radius	559	metres
Constant	7200		constant	Machine arc	180	degrees
Machine Flow	47.31	l/sec	Qf is discharge for the w hole pivot	End gun radius	30	metres
Radius	559		R is the distance from pivot centre to a sprinkler	Application rate	7.5	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	18	m	W is the w etted w idth (diameter of sprinkler)	Flow Rate	47.3	
	589		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate	**33.85**	**mm/hr**				

Instantaneous Application Rate				**Inputs**		
559m PC Fixed Pivot 1				Machine Radius	559	metres
Constant	7200		constant	Machine arc	180	degrees
Machine Flow	47.31	l/sec	Qf is discharge for the w hole pivot	End gun radius	30	metres
Radius	279.5		R is the distance from pivot centre to a sprinkler	Application rate	7.5	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	16	m	W is the w etted w idth (diameter of sprinkler)	Flow Rate	47.3	
	589		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate	**19.04**	**mm/hr**				

Instantaneous Application Rate				**Inputs**		
559m PC Fixed Pivot 1				Machine Radius	559	metres
Constant	7200		constant	Machine arc	180	degrees
Machine Flow	47.31	l/sec	Qf is discharge for the w hole pivot	End gun radius	30	metres
Radius	9		R is the distance from pivot centre to a sprinkler	Application rate	7.5	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	11	m	W is the w etted w idth (diameter of sprinkler)	Flow Rate	47.3	
	589		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate	**0.89**	**mm/**hr				

Instantaneous Application Rate

272m PC Fixed Pivot 2

				Inputs		
Constant	7200		constant	Machine Radius	272	metres
Machine Flow	12.03	l/sec	Qf is discharge for the w hole pivot	Machine arc	180	degrees
Radius	272		R is the distance from pivot centre to a sprinkler	End gun radius	25	metres
Sprinkler	Orbitor		Sprinkler type used at this location	Application rate	7.5	mm/day
Sprinkler Wetted Width	18	m	W is the w etted w idth (diameter of sprinkler)	Hours/day	24	
	297		re is the effective radius of the full irrigated circle	Flow Rate	12.0	
Instantaneous Application Rate			**17.69 mm/hr**			

Instantaneous Application Rate

				Inputs		
				Machine Radius	272	metres
Constant	7200		constant	Machine arc	180	degrees
Machine Flow	12.03	l/sec	Qf is discharge for the w hole pivot	End gun radius	25	metres
Radius	136		R is the distance from pivot centre to a sprinkler	Application rate	7.5	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	16	m	W is the w etted w idth (diameter of sprinkler)	Flow Rate	12.0	
	297		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate			**9.95 mm/hr**			

Instantaneous Application Rate

				Inputs		
				Machine Radius	272	metres
Constant	7200		constant	Machine arc	180	degrees
Machine Flow	12.03	l/sec	Qf is discharge for the w hole pivot	End gun radius	25	metres
Radius	9		R is the distance from pivot centre to a sprinkler	Application rate	7.5	mm/day
Sprinkler	Orbitor		Sprinkler type used at this location	Hours/day	24	
Sprinkler Wetted Width	11	m	W is the w etted w idth (diameter of sprinkler)	Flow Rate	12.0	
	297		re is the effective radius of the full irrigated circle			
Instantaneous Application Rate			**0.96** mm/hr			

Pivot Running Cost

The estimated daily running cost of the pivots is as per the following table

Pivot Running Costs (estimate)**	386m PC Fixed Pivot 1 Block A	386m PC Fixed Pivot 2 Block A	212m PC fixed Pivot 1 Block B	253m PC Fixed Pivot 2 Block B
Minimum kW required	7.42	7.42	5.16	5.73
Cost per kWHr (daytime running) *enter client cost*	$ 0.31	$ 0.31	$ 0.31	$ 0.31
Cost per kWHr (nighttime tarrif) *enter client cost*	$ 0.13	$ 0.13	$ 0.13	$ 0.13
Pivot running cost per hour (daytime)	$ 2.30	$ 2.30	$ 1.60	$ 1.77
Pivot running cost per hour (night time)	$ 0.96	$ 0.96	$ 0.67	$ 0.67
Cost of 16 hours daytime running	$ 36.81	$ 36.81	$ 25.59	$ 28.40
Cost of 8 hours night time running	$ 7.72	$ 7.72	$ 5.37	$ 5.37
Cost per 24 hours constant running	$ 44.53	$ 44.53	$ 30.96	$ 33.76
Irrigation days per season	1	1	1	1
Number of days @ peak	1	1	1	1
Total annual pivot running cost	$ 44.53	$ 44.53	$ 30.96	$ 33.76

Pivot Running Costs (estimate)**	266m PC Fixed Pivot Block C	363m PC Fixed Pivot Block D	559m PC Fixed Pivot 1 Block E	272m PC Fixed Pivot 2 Block E
Minimum kW required	5.73	6.86	9.12	6.29
Cost per kWHr (daytime running) *enter client cost*	$ 0.31	$ 0.31	$ 0.31	$ 0.31
Cost per kWHr (nighttime tarrif) *enter client cost*	$ 0.13	$ 0.13	$ 0.13	$ 0.13
Pivot running cost per hour (daytime)	$ 1.77	$ 2.13	$ 2.83	$ 1.95
Pivot running cost per hour (night time)	$ 0.67	$ 0.67	$ 0.67	$ 0.67
Cost of 16 hours daytime running	$ 28.40	$ 34.01	$ 45.22	$ 31.20
Cost of 8 hours night time running	$ 5.37	$ 5.37	$ 5.37	$ 5.37
Cost per 24 hours constant running	$ 33.76	$ 39.37	$ 50.59	$ 36.57
Irrigation days per season	1	1	1	1
Number of days @ peak	1	1	1	1
Total annual pivot running cost	$ 33.76	$ 39.37	$ 50.59	$ 36.57

**To be used as a guide only, actual power costs may vary

Irrigation System Spec/Features

All the centre pivot irrigators will be supplied to the following spec

- 6-58” span pipe
- 14.9 x 24 Tractor style tyres
- Heavy-duty towers
- Heavy-duty centre point
- Minimum 3.0m span clearance
- FieldBOSS computerised control panel
- Pressure regulated inlet control valve
- Mag flow water meter at pivot inlet
- Additional filtering of the control valve pilot
- Auto grease kits at the pivot point
- Nelson Orbitor sprinklers for better uniformity
- PE sprinkler droppers to prolong hose life
- Low sprinkler height to lessen spray drift
- Komet endgun with boost pump
- Lowered endgun height to lessen spray drift
- GPS telemetry on each pivot for proof of placement
- Weather station compatible telemetry
- Air control/Anti hammer valves every 600m (as per Manufacturers recommendation)
- Mainline upgraded to MDPE pipe for increased pipeline longevity
- PVC mainline installed with 150mm bedding material (as per Manufactures recommendation) *(optional)*
- Service contract *(optional)*
- Extended tower base beams for greater stability/wind resistance *(optional)*
- FieldNET pivot control on each pivot *(optional)*

Pumping/Filtration System

Pumping/Filtration

An existing electric pump will be used to supply waste water to the irrigation system.

The pump currently takes water, which has been through a DAF filtration system in the factory, from a settling pond. So, most solids and fibres have been removed by the initial filtration and the settling period in the pond.

We would recommend the installation of an additional sand filtration system after the pump to remove any remaining wool fibres or debris from the water supply. Any fibres or solids left in the waste water, could possibly, block sprinkler nozzles, or cause the diaphragm valves at the pivot inlet to remain open or weep. We have also priced in the installation of a pilot valve on every pivot control valve. The reason for the pilot valve is to regulate the pressure going in to the pivot so that it is always a constant pressure regardless of the numbers of pivots in operation or the combination of pivots in operation at any one time. Having this pressure regulating valve has allowed us to dispense with pressure regulators on every sprinkler outlet. A regulator on every sprinkler is normal, but in this system, where the potential for blockages from fibres exists, removing one more potential blockage area makes practical sense, as long as the pressure into the pivot can be maintained at a set point.

The effluent water at Silver Fern Farms Takapau has a greater than average quantity of suspended solids and add to this the fibrous material in the form of wool and hair, there is the potential to overwhelm filtration unless there is sufficient capacity.

The filtration system specified for Silver Fern Farms Takapau is comprised of fourteen (14) x 48" polyester powder coated carbon steel tanks. This will ensure that when individual tanks are back-flushing there is capacity in the remaining tanks to cope with the flow. When you consider that a two tank system is designed for 24-39 litres per second and a twelve tank system is designed for 142-238 litres per second, you will see that there is sufficient capacity in the fourteen tank system as specified when the flow rate to be filtered is 58 litres per second. There is this level of capacity because of the information supplied to us by silver Fern Farms in the form of the "Water Quality for Filtration' spreadsheet.

We considered 'barrier' type filtration, such as screens or disc filtration but decided against these because of the fibrous material. During the filtration process and during the backflush of screen or disc types of filtration it is possible for fibres to lodge between discs, or to be forced into screens. The fibres caught between discs may act as a 'wedge' between discs allowing passage of solids through the filter. With screen filtration fibres may 'clog' the surface of the screen and get forced into the screen or create a large differential from the unfiltered side of the screen to the filtered side whereby the screen may distort. Sand filtration allows water to percolate through a sand bed trapping solids and fibres in the top 50-80mm. The rest of the media depth is there to make sure that the water passes evenly through the media without channeling.

We also had to consider the potential for some 'fats' in the water as well and whether this would 'seal off' the filtration. We posed that question to our filtration supplier and their answer was that the finer sand at the surface will contain/absorb most contaminant (and cause the pressure

differential gauge to trigger a backwash cycle) and contaminants in that top 2-3 inches are most easily backwashed away.

The backwash cycle flushes trapped organic matter from the filter tanks. Each tank in the filtration system is flushed individually for effective removal of captured organic matter. Triggered by either pressure differential or elapsed time, each tank's backwash valve restricts inflow to that particular tank and allows outflow of backwash water. Filtered water from other tanks is directed through the particular tank's underdrains – effectively flushing captured organic matter. After a pre-determined period of time, the backwash valve returns to normal position allowing the tank to continue filtering water. Backwash water with captured organic matter will be piped back to the effluent pond.

The sand filtration system will sit on a raised 10m x 5.5m on a concrete pad, near the existing pump shed. The pad will be contoured so that any spillage would run into a sump in the centre of the pad, and from there it will flow into the concrete bunkers that catch the filter discharge

The sand filtration will reduce the pressure in the mainline by 0.5bar, so we may need to fit a boost pump after the filtration or raise the pressure at the existing pump to regain this pressure loss. We will need to do some pressure and flow checks to see if this is required or not

As the machines are fitted with VRI, additional filtration will be fitted at each pivot tower to provide clean water to the VRI solenoid valves. This is an added precaution we deem necessary to prevent any problems with the VRI valves leaking, or, remaining open when they shouldn't be.

The discharge water from the sand filtration will be collected in 2 concrete bunkers at the base of the Sand filtration system. The first Bunker will have a series of baffles which will slow water movement through it, allowing any solids to settle out of the liquid

The water will then overflow into a second bunker, from where it will be pumped back into the storage dam. A level switch in the bunker will start and stop the pump automatically. There will also be a high-level alarm which will alert operators if the bunkers reach a set high level point

There will be two pumps installed to pump the water back to the dam, one pump will the duty pump, the other would be a standby pump. The pumps will be connected to the existing pump monitoring network, and will advise the operators of any system fault

The primary Bunker will need to be cleared of the build-up of solids periodically

A post and rail fence will be installed around the bunker to prevent someone or stock accidentally falling into the bunkers

Mainline

We have priced two options for a complete new mainline, as the existing mainline has been repaired many times in the past due to splitting. The splitting may be due to how the pipe has been installed

It is our recommendation that the new PVC pipe has a minimum of 150mm of pea-metal or sand surrounding the pipe as per the manufacturer's recommendation. This will allow some movement in the pipe during normal operation.

Lime sand has been used in the previous install, but the PVC manufacturer would not recommend this practice. Lime sand can compact down over time and cause bruise points on the pipe surface, and these can eventually burst

As an alternative to PVC, we have priced a complete MDPE pipeline. The MDPE would be supplied in 12m sections and then the pipe and fittings would be plastic welded onsite to form the mainline.

The advantage of MDPE is

- it would not require bedding with sand or pea-metal
- the expected lifespan of MDPE is 100+ years vs PVC at 50 years
- Having a thicker wall section, the chance of pipe bursting is greatly reduced.
- Ground movement doesn't affect MDPE as much as PVC, as the sections are welded together rather than being a push fit.
- MDPE doesn't have rubber seals every 6m which can degrade over time
- MDPE is used for the majority of National & Municipal gas, water and waste water or sewerage installations due to its robustness and lifespan

With the problems Silver Fern Farms is experiencing with burst PVC mainlines, due to pipe degradation or installation, and the environmental issues due to these leaks, going to MDPE pipe should eliminate this issue

Air relief/anti-hammer valves will be installed at approximate 500m intervals along the pipeline as per the pipe manufacturers recommendation. Where possible these will be placed on a fence line, so they will not be damaged by machinery. Where this is not possible, we will have the valve in a concrete chamber. The lid of this chamber will be made of galvanised steel and be flush with the ground

Isolation valves will be on each branch of the mainline, so if there is an issue at some stage or alterations are made to the system, that part of the mainline can be closed off and the rest of the system will still be able to operate

Permits for work around the Rail corridor will be an additional cost. These Permits can take up to 30 days to obtain

Pump Running Cost

The estimated cost of running the pump is as per the following table

Pump Running Costs (estimate)*			Existing pump
Flow rate required		litres/second	58.00
Pressure required from pump		metres/head	40.00
Pump efficiency			70%
Minimum kW required		kW	33.14
Cost per kWHr (daytime running)		per hour	$ 0.31
Cost per kWHr (nighttime tarrif)		per hour	$ 0.13
Cost of 16 hours daytime running			$ 164.39
Cost of 8 hours night time running			$ 34.47
Cost per 24 hours constant running			$ 198.86
Average run hours for irrigation season			120
Irrigation days per season		days	5
Number of days @ peak		days	5
Pumping cost for peak of season			$ 994.29
Average pumping hours per day (shoulder season)		hours	12.00
Cost of 4 hours daytime running			$ 41.10
Cost of 8 hours night time running			$ 34.47
Pumping cost per day shoulder season			$ 75.57
Total pumping cost for 5 day cycle			$ 994.29

System metering/monitoring

A new flow meter will be fitted to the outlet of the filtration plant. This will only be recording the waste water going out to the irrigators, not any water used for flushing the filters, which will be recycled back into the dam

Meters at the inlet of each irrigator will record the flow through each machine and send data back to the central server via your Scada system

The centre pivot irrigators can be connected to the Lindsay FieldNet platform and a Scada system for Proof of placement

FieldNET will give operators and management full remote control of the machines as well as real time view of the machine parameters. FieldNET will also alert the operators of any fault. Bay Irrigation will also receive any alerts, which allows us to respond promptly to breakdowns

The Scada system will monitor machine flows, speed and GPS position of the machine which will provide proof of placement data. It will gather flow information from a water meter (to be installed at each pivot inlet) and get the speed from a GPS unit on the end of the pivot as well as a sensor on the pivot wheel. Then calculating the mm application rate. Having the 2 sensors will provide a very accurate machine speed as well as having the backup if one system faults.

The Scada system will also record soil moisture content from probes at each location, as well as environmental data from the two weather stations

The data will be sent back to the Irrigation Management office for storage and forwarding on to Council

The FieldNET system will communicate through the GSM network and require annual subscription fees.

Sprinklers

The specified sprinklers used are the Nelson O3000 Orbitor using standard Nelson 3000 nozzles. We have based this on what has been experienced at the Pareora plant. They originally installed Trash-buster sprinklers with pressure compensating nozzles. These nozzles were then changed to standard Nelson 3000 nozzles due to blockages. Their Trash-buster sprinklers overwater the first 2-3 spans and create puddles. They then have to manually close off individual sprinklers until the puddles soak in. The Orbitor has a larger wetted diameter and provides a much better uniformity which will reduce this over-watering. The sprinklers will be on LDPE droppers, finishing approximately 1.0 meter above the ground. This will reduce any spray drift

We have selected a blue plate for the Orbitor as this features low angle trajectory making it the best plate for wind-fighting and reducing spray-drift in the Orbitor range.

Bay Irrigation will conduct a uniformity test on the pivot after commissioning to check that the uniformity of the sprinkler package is at or above industry standard uniformity.

Orbitor

The O3000 Orbitor features new technology that eliminates the struts of a sprinkler body to provide outstanding uniformity and optimal droplets at low operating pressures.

Designed with an innovative, bracketless assembly, debris hang up and water pattern misting common to conventional sprinklers are mitigated. Irrigators can expect long wear life, reliable operation, and durability, even in the toughest water conditions.

The O3000 is streamlined for excellent movement through canopy and over field obstacles. This off-axis sprinkler replaces the old-style Nelson N3000 Nutator.

Special Features of the Zimmatic™ Pivots

- Heavy Duty Pivot Structure. 3/8" galvanised angle steel legs and 3/16" steel galvanised cross members across 9500 series

- Externally mounted collector ring eliminates water flow restriction. A major advantage over competitive systems.

- For longer life and increased structural integrity, Zimmatic™ use 15% thicker pipe than competitive systems, and Zimmatic™ use an exclusive "V-Jack" truss design to evenly distribute span load again ensuring greater longevity.

- Wider, heavier stabiliser angles that are crossed for more uniform load distribution on rough terrain and which are spread wider than alternative systems because they attach directly to the "V Jack" and truss system for better structural support.

- Heavy duty span "universal joint connectors" that pivot at the centre of the connection point of the spans rather than underneath or inside the boot such as is found on competitive systems which can reduce the flow and place stress on rubber connections used by other systems.

- The industry's strongest and most durable and efficient drive-train, where the rotor and stator can be replaced independently simplifying maintenance, and a triple reduction spur gear which is the most efficient in the industry.

- The toughest gearbox in the industry because of features such as the shorter output shaft which eliminates high overhang load, thereby extending bearing life and the multi-barrier sealing system which prevents ingress of dust and moisture thus prolonging the life of the input and output shafts

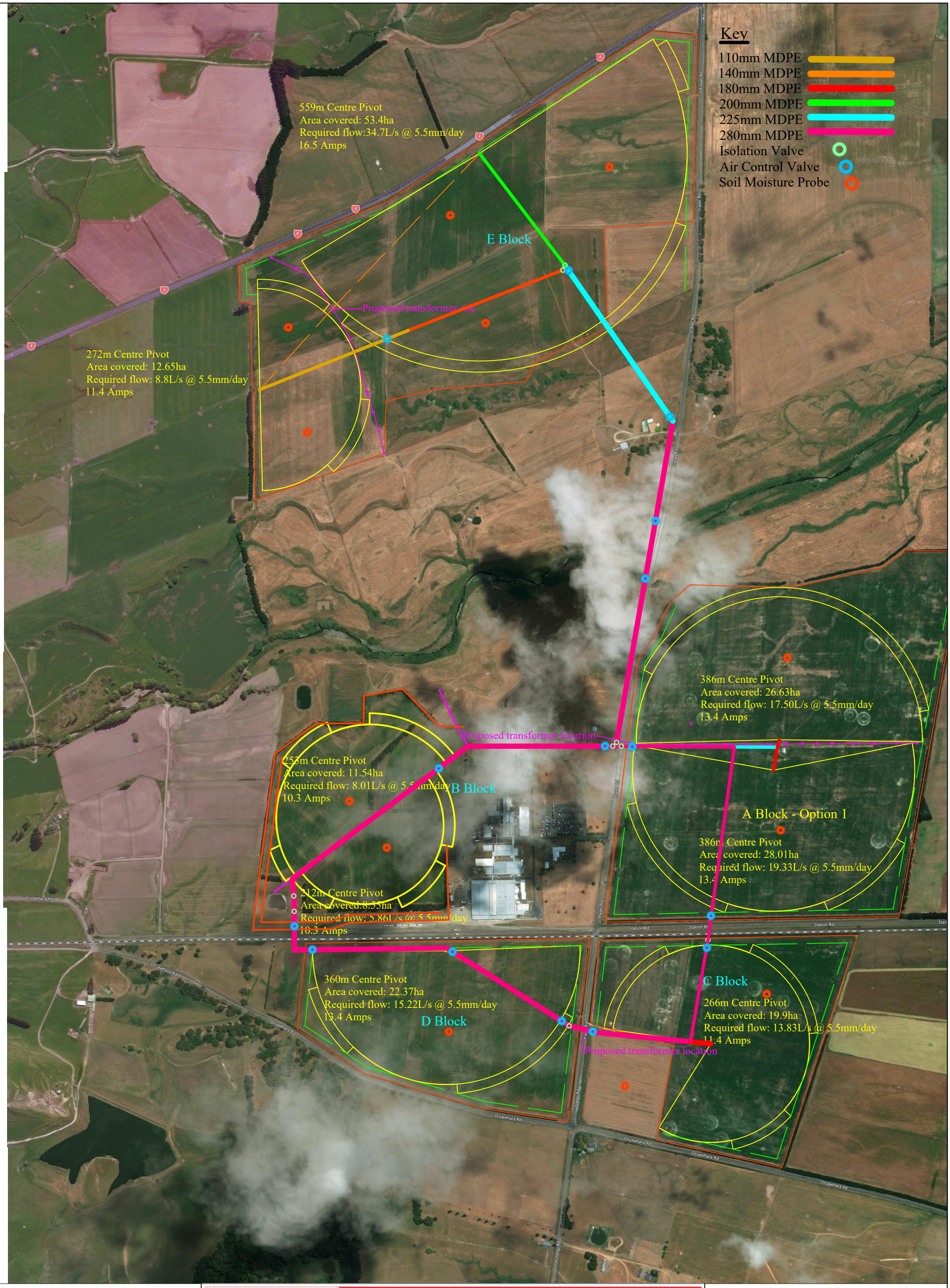
- FieldBOSS™ and FieldVISION™ Control Panels, featuring fast access to common or regularly used programmes, water application can be tailored to specific crop requirements, application rates can be adjusted to match soil-water holding capacity, easy scheduling for multiple crops, part circles or uneven terrain and a self-diagnostic function that finds problems minimising downtime.

- Zimmatic ™ pivot base beams are longer, approx by 180mm, and stronger (11 gauge steel as opposed to 12 gauge) and the heavy duty angled brace provides double the A frame and gearbox support of other designs across the 9500 series irrigators

Power Supply to Pivots

We have included in our pricing for the Earthworks contractors to supply and lay sand in the trenches to protect the electrical cable to the pivots, signal cable to the soil moisture probes and Fibre Optic cable from damage from stones or rocks which may be in the soil. We have estimated 600m³ of sand will be required, if all the trenches require bedding material. This may be vastly overestimated, but we will not know for sure how much is required until the trenches are opened up, and we are able to assess the ground composition

All other electrical, monitoring and communication content is being quoted separately by EPD Ltd



Silver Fern Farms
Takapau

BAY IRRIGATION
1420 Omahu Road, Hastings Ph 06 879 5577 F 06 879 4932

Designer: B.H.
Date: May 2019
Scale: