Waimakariri land and water solutions programme: Economic assessment of the impacts of changes in flow and N management in the Ashley River catchment

MEMORANDUM

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Executive Summary

This memorandum is an adjunct to the Current State report that described the state of the economy in 2015/16. This report analyses the impacts of changing flow regimes, changing grounwater and surface water reliability with increased abstraction, and the potential to reduce N loads to the Ashely estuary.

Economic implications of changes to flow regimes

The proposed changes to minimum flow differentiate into the following categories:

- Reliability currently poor and made worse by the minimum flow changes – Ashley river B block.
- Reliability good to very good with minimum flow changes significantly decreasing reliability – Little Ashley.
- Reliability good to very good with minimum flow changes rendering it verging non-viable as an irrigation source – Saltwater Creek, Taranaki Creek and Waikuku.

The proposed changes to allocation can be described in the following categories:

- Reduced allocation achievable at current estimated use – Ashley, Little Ashley. In these catchment allowing an increased abstraction as per LWRP (adj) allocation would reduce reliability for existing users.
- Reduced allocation achievable at current estimated use and with time to adjust and allow for land use change – Saltwater Creek, Waikuku, Taranaki Creek. In these catchments reducing allocation to LWRP (adj) would have a small improving effect on reliability for current irrigators.

These descriptions of impacts assume there are no alternate sources of water available to the irrigators, which may not be the case for all consent holders. It should also be noted that the analysis assesses only one band for Current which was generally the band with the most takes. However consent holder in different bands will experience different reliability and the conclusions here may not be applicable to them.

Table 1: Summary of economic impacts for changes to reliability and allocation

Catchment	Current	LWRP	Ecological	Cultural	Allocation target
Ashley	(mixed)				
Little Ashley					
Saltwater Creek					
Taranaki Creek					
Waikuku Stream					

Changes in reliability with increased abstraction and PC5 thresholds

Allowing increased abstraction and PC5 permitted activity thresholds to be reached would result in significant decreases in reliability for existing irrigators. Given the potential impacts of changes to the flow regimes, the preference from an economic point of view would be to prevent further abstraction in the catchment if possible.

There are also potential changes for groundwater reliability, but these are small and fall below the threshold of the modelling error.

Reducing N loads to the Ashley estuary

Reductions in N loads into the Ashley estuary are possible, but are problematic because of the scarcity of highly intensive, high contribution land uses. Depending on the mechanisms available, significant changes are likely to require changes in land use and removal of low emitting sheep and beef farming from the catchment. While this does not have a huge cost in regional terms, it is disruptive and likely to be highly problematic for the individual landholders involved. If forestry is not a viable replacement for sheep and beef in the catchment because of its effect on water quantity concerns, making major reductions in N losses will become even more difficult and costly.

There is potential for focus on reducing N loads in specific sub catchments with higher proportions of intensive land use. These catchments would need to be identified and assessed separately.

1 Background

This technical assessment focusses on the Waimakariri Canterbury Water Management Strategy (CWMS) zone and the process managed by Environment Canterbury (ECan) to assist the Waimakariri Water Zone Committee with the Waimakariri land and water solution programme. The output from the Waimakariri land and water solution programme is recommendations for on the ground actions (e.g. riparian planting) and, if needed, instructions for the Waimakariri sub-regional chapter of the Canterbury Land and Water Regional Plan.

The CWMS Waimakariri zone is the Waimakariri district, which spans from the north bank of the Waimakariri River to just north of the Ashley River (see Figure 1). It is bounded by the Hurunui District to the north, and by Christchurch City and Selwyn District to the south. In this technical assessment, the whole Waimakariri zone is considered.

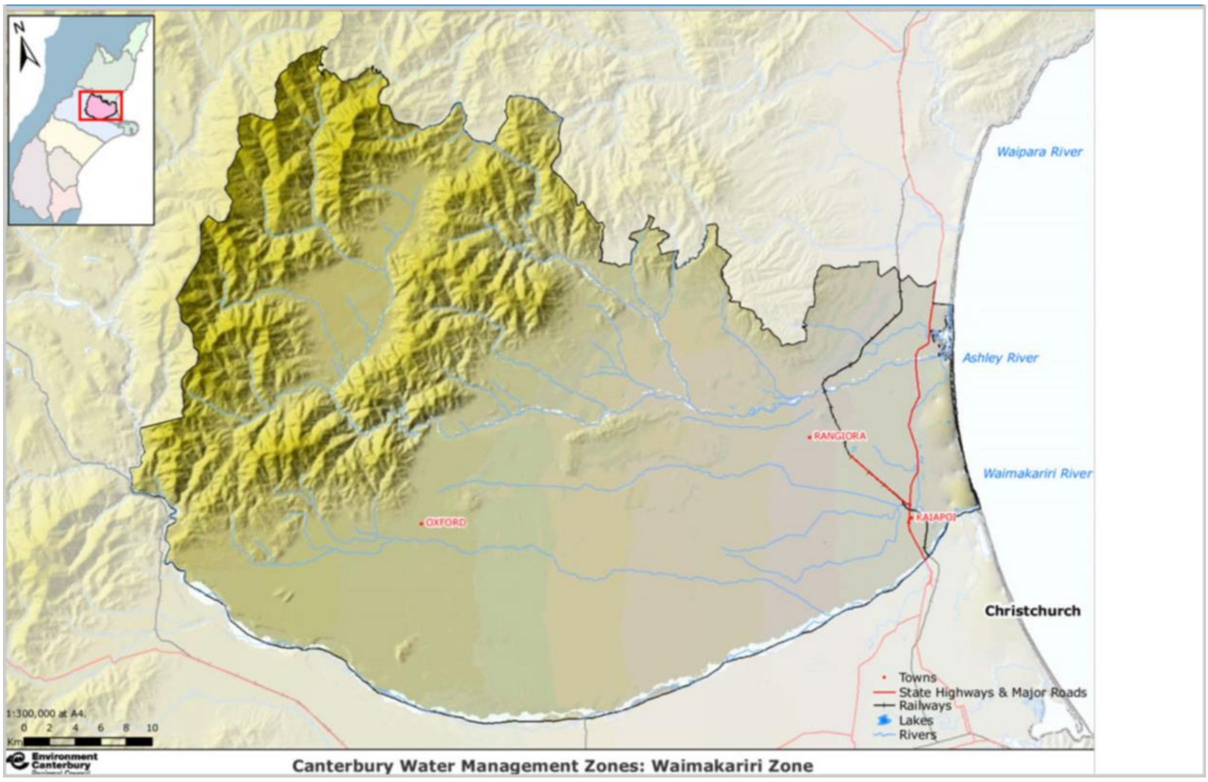

Figure 1: Waimakariri water management zone

The assessments utilise outputs from ECan's other technical assessments of land uses, nutrients, surface and ground water quality, and stream ecology. It should be noted that many bio-physical effects have economic consequences, for instance, ecological effects are important for the consequences they have for industries using water-and tourist activity. Similarly, economic effects are interconnected with social ones. For instance, employment growth affects population levels which in turn affect community vitality. Where relevant and possible, these chains of effects are noted in this assessment.

This memorandum discusses the economic impacts of changes to the minimum flows in catchments of the northern part of the Waimakariri zone, and potential changes to the load limit for N going into the Ashley estuary.

2 Method

The impact of changing minimum flows was assessed for five streams. Data were supplied by ECan on the annual and monthly restrictions for the available time periods, for which the earliest record varied between 1973 (Ashley main stem) and 1995 (Taranaki Creek and Waikuku Stream). The data uses current estimates of flows and current abstraction. While modelling indicates that the efficiency requirements of PC5 will potentially have some impact on flows due to decreased groundwater recharge, the magnitude of the estimated changes are considered to be below the error for the modelling analysis. It should also be noted that for most resources the full groundwater allocation has not been taken up, and if this were to occur there would be a further reduction in available water.

A model was constructed that aggregates the monthly restrictions for each irrigation season, and compares this with a measure of likely demand (whether the PET exceeds rainfall over the previous 15 days). Thus the reliability figures reported here are a measure of supply/demand reliability, not simply supply reliability and may differ from figures that report only supply reliability.

Where a supply shortage exists, this is assumed to translate directly into lost production for that period, using a growth curve from reported data for Lincoln[1]. The conversion into lost production is conservative and is likely to overestimate the actual losses. However extensive consultation with farmers on the impacts of poor reliability suggest that the difficulties associated with negative events in farming such as irrigation restrictions, far exceed the direct production losses, and these may include managing feed curves, sourcing replacement feed, feeding out costs and transitioning difficulties, animal health, stress and cashflow difficulties. It is considered therefore that the overestimate of losses is compensated for by the other difficulties that variability create for farm management that cannot be accounted for in this type of modelling.

The irrigated area from each surface water allocation zones (SWAZ) was provided by ECan. However in a number of cases the SWAZ irrigated area and the allocation from the catchment were significantly mismatched, suggesting that irrigation water was being transferred across SWAZ boundaries. Therefore the total area irrigated was estimated assuming a 0.6 l/s/ha application rate and any peak use statistics available for that catchment[2], and the land use mix from the SWAZ was assumed to apply to the allocation from that water resource. The land use mix used by scenario is shown in Table 2 below. The farm models developed for the Current State reporting in consultation with industry and farmers were applied for the five farm types – dairy, dairy support, sheep and beef, horticulture and arable.

[1] **Source of data: Lincoln dairy farm 2006 - 2010 irrigated farm cited in DairyNZ SI pasture growth data http://www.dairynz.co.nz/feed/pasture/pasture-growth-data/. Accessed 2 March 2-18**

[2] So for example the Waikuku allocation is 1033l/s multiplied by peak use of 62% gives 640l/s. This is applied at an assumed 0.6l/s/ha giving 1067ha irrigated.

Table 2: Irrigated land use by catchment (ha)

Catchment and scenario assessed	Dairy (ha)	Arable (ha)	Sheep and Beef (ha)	Dairy support	Horticulture (ha)	Total (ha)
Ashley B block	232	0	0	0	0	232
Little Ashley Stream	77	0	28	0	0	105
Saltwater Creek	224	22	419	0	0	665
Taranaki Creek	259	0	8	38	1	306
Waikuku Stream	868	0	109	90	0	1067

The results are reported as levels of restriction over the irrigation season on average, and for events that occur 1 in every 10 years. Figures for the 1 in 4 year and worst year on record events are also available but not reported here. The impacts at a farm level, and aggregated for the catchment and region are also provided.

Because the modelling of the water resource uses estimated flows and reliability, and an allocation that does not reflect actual use, so the results may not be entirely reflective of the situation that will occur. For this reason some comparative information of the current state is provided based on feedback from stakeholders through the consultation process and irrigator survey.

For each catchment four scenarios are assessed – the Land and Water Regional Plan (LWRP), an assessment of the preferred Cultural flows and Ecological flows, and an estimate of the Current reliability. The modelling is undertaken only for one band or block in each scenario, and where multiple bands are present some discussion is undertaken of the likely reliability for other bands. For all catchments apart from the Ashley the A block is assessed for the LWRP, Ecological, and Cultural scenarios, and in the Ashley the B block is assessed because the A block is the same for these scenarios. For the Current scenario the band with the largest allocation is used apart from the Ashley where Band 10 is used because it most closely resembles the B block allocation. The scenarios and reliability bands assessed are shown in Table 3.

Table 3: Scenarios assessed for Ashley zone

Catchment	Measurement site	Scenario	Band assessed
Ashley River / Rakahuri	Gorge	ECO	B
Ashley River / Rakahuri	Gorge	CURRENT	10
Ashley River / Rakahuri	Gorge	LWRP	B
Little Ashley Stream		CULTURAL	A
Little Ashley Stream		ECO	A
Little Ashley Stream		CURRENT	2
Little Ashley Stream		LWRP	A
Saltwater Creek	Toppings Rd	CULTURAL	A
Saltwater Creek	Toppings Rd	ECO	A
Saltwater Creek	Toppings Rd	CURRENT	2
Saltwater Creek	Toppings Rd	LWRP	A
Taranaki Creek	Preeces Rd	CULTURAL	A
Taranaki Creek	Preeces Rd	ECO	A
Taranaki Creek	Preeces Rd	CURRENT	1
Taranaki Creek	Preeces Rd	LWRP	A
Waikuku Stream	Waikuku Beach Rd	CULTURAL	A
Waikuku Stream	Waikuku Beach Rd	ECO	A
Waikuku Stream	Waikuku Beach Rd	CURRENT	2
Waikuku Stream	Waikuku Beach Rd	LWRP	A

3 Results

3.1 Ashley River

3.1.1 Flow regime

The minimum flow regime, allocation and estimated use for the Ashley are shown in Table 4 below. There are no changes proposed for the A and C blocks, other than potentially capping at current estimated water use. Capping at current use will have limited economic impact to current users, and because reliability is so low it is unlikely that there is significant additional potential for irrigation that is not being utilised. The analysis therefore assesses only the B block take for which there is a change proposed under the ecological regime.

Table 4: Proposed flow management regimes for the Ashley river

Site (name)	LWRP	Ecological	Allocation (l/s	Estimated use
Ashley River / Rakahuri A block	2500-4000-3000	2500-4000-3000	1082	100%
Ashley River / Rakahuri B block	3200-4700-3700	4000-5500-4500	139	NA
Ashley River / Rakahuri C block	6000	6000	292	NA

Site (name)	Minimum flow options (L/s)			Allocation limit options (L/s)		Estimated use of Current Allocated amount
	Current LWRP	Ecological recommend ation	Cultural recommend ation	Current Allocated amount	Current LWRP (adj) limit	
Ashley River / Rakahuri A block	2500-4000-3000	2500-4000-3000		1082	700	100%
Ashley River / Rakahuri B block	3200-4700-3700	4000-5500-4500		139	500	NA
Ashley River / Rakahuri C block	6000	6000		292	3000	NA

3.1.2 Land use

Takes within the Ashley SWAZ are used for sheep and beef, the Loburn irrigation scheme, and 2 – 3 dairy farms. Feedback at the meeting identified that there was an irrigated dairy property with a take in the B block. The allocation for the B block is 139 l/s, and because the utilisation of the water is so low, and the reliability of the B block is poor, it is considered unlikely that there are significant other irrigated land uses within this band. Therefore the land use adopted for this analysis is 100% dairy, and uses the full allocation available in this band.

3.1.3 Results

The restriction events for the Ashely B block are shown in Table 5. They indicate that the LWRP regime has approximately 30% restriction over an irrigation season on average, and 58% in a 1 in 10 year event. There are 64 days of full restriction in an average year, and 104 in a 1 in 10 year event. The reliability for the LWRP flow regimes is very similar to the Current Band 10, which most of the B block holders are currently on. This description of reliability concords with the description provided by irrigators, who indicated that the river is a poor irrigation source after Christmas.

The proposed Ecological flow regime will increase the average restrictions to 39% and the 1 in 10 year event to 66%, which significantly worsens the availability of water relative to the LWRP and Current flow regimes.

Using the LWRP allocation, which is greater than the current allocation, has limited impact on the reliability with volume restrictions showing a small increase for the LWRP and Ecological scenarios.

Table 5: Restriction events for Ashley River B block

		Allocation limit option: Current Allocated amount			Allocation limit option: LWRP (ADJ) limit		
Area = Ashley B block		**Days of partial restriction**	**Days of full restriction (100% restriction)**	**Volume restriction**	**Days of partial restriction**	**Days of full restriction (100% restriction)**	**Volume restriction**
Ashley Current Band 10 minimum flow	**Average**	0	64	29%			
	1 in 4 year event	0	91	45%			
	1 in 10 year event	0	104	57%			
	Maximum	0	158	73%			
Ashley B block LWRP Current minimum flow	**Average**	5	64	30%	16	64	32%
	1 in 4 year event	7	91	45%	23	91	48%
	1 in 10 year event	8	104	58%	26	104	60%
	Maximum	14	158	74%	28	158	75%
Ashley B block Ecological recommended flow	**Average**	3	86	39%	10	86	41%
	1 in 4 year event	5	113	54%	12	113	56%
	1 in 10 year event	5	129	66%	16	129	67%
	Maximum	8	174	82%	20	174	84%

Table 6 shows the per ha outcomes for the area irrigated from the B block. They show a reduction in total revenue and a larger reduction (13%) in cash farm surplus as a result of the reduced reliability for the Ecological regime relative to the LWRP regime. During a 1 in 10 year event Table 7 the CFS outcomes for the dairy property are $0 or slightly negative across the LWRP and Ecological scenarios. Under the Current Band 10 a dairy property would be slightly negative even on a cash basis during a 1 in 10 year event indicating the poor reliability of the Ashely regardless of the regime adopted. Note that these outcomes are before depreciation, interest, and wages to any working owner so the results will be substantially negative after these items are accounted for. These results suggest that the Ashley is not a high-quality irrigation resource and this is reflected in the comments received from existing irrigators in the catchment.

Table 8 shows the average outcomes aggregated up to the regional level, and including the flow on impacts. They show a $60,000 difference in CFS, a $180,000 reduction in contribution to regional GDP, and a loss of 1 FTE as a result of lower reliability associated with the Ecological regime relative to the Current regime.

Table 6: Per ha average outcomes by land use for Ashley B block ($/ha/annum)

Per ha		Dairy ($/ha/yr)	Arable ($/ha/yr)	Sheep and Beef ($/ha/yr)	Dairy support ($/ha/yr)	Hort ($/ha/yr)	Total ($/ha/yr)
Ashley Current Band 10 minimum flow	Revenue	$7,400	$0	$0	$0	$0	$7,400
	Expenses	$5,700	$0	$0	$0	$0	$5,700
	Cash Farm Surplus	$1,600	$0	$0	$0	$0	$1,600
Ashley B block LWRP Current minimum flow	Revenue	$7,300	$0	$0	$0	$0	$7,300
	Expenses	$5,700	$0	$0	$0	$0	$5,700
	Cash Farm Surplus	$1,600	$0	$0	$0	$0	$1,600
Ashley B block Ecological recommended flow	Revenue	$6,700	$0	$0	$0	$0	$6,700
	Expenses	$5,300	$0	$0	$0	$0	$5,300
	Cash Farm Surplus	$1,400	$0	$0	$0	$0	$1,400

Table 7: Per ha 1 in 10 year event outcomes by land use for Ashley B block ($/ha/annum)

per ha		Dairy ($/ha/yr)	Arable ($/ha/yr)	Sheep and Beef ($/ha/yr)	Dairy support ($/ha/yr)	Hort ($/ha/yr)	Total ($/ha/yr)
Ashley Current Band 10 minimum flow	Revenue	$5,400	$0	$0	$0	$0	$5,400
	Expenses	$5,700	$0	$0	$0	$0	$5,700
	Cash Farm Surplus	-$300	$0	$0	$0	$0	-$300
Ashley B block LWRP Current minimum flow	Revenue	$5,700	$0	$0	$0	$0	$5,700
	Expenses	$5,700	$0	$0	$0	$0	$5,700
	Cash Farm Surplus	$0	$0	$0	$0	$0	$0
Ashley B block Ecological recommended flow	Revenue	$5,300	$0	$0	$0	$0	$5,300
	Expenses	$5,300	$0	$0	$0	$0	$5,300
	Cash Farm Surplus	$0	$0	$0	$0	$0	$0

Table 8: Regional outcomes for Ashley B block ($ million/annum, FTEs)

	Cash farm surplus ($m/annum)	Regional GDP ($m/annum)	Regional Household Income ($m/annum)	Regional Employment (FTE)
Ashley Current Band 10 minimum flow	$0.38	$1.98	$0.95	14
Ashley B block LWRP current minimum flow	$0.37	$1.96	$0.95	14
Ashley B block Ecological recommended minimum flow	$0.32	$1.80	$0.87	13

3.1.4 Allocation

While the Ashley is overallocated on paper, there is considerable uncertainty about actual use. A reduction in allocation would have economic impacts, but because of the low existing reliability the value of such a loss would not be as great as for a highly reliable resource, and the loss of the additional future allocation for such a poor quality resource is not likely to result in major reduction in potential economic output.

3.1.5 Ashley Summary and recommendations

The Ashley is a poor-quality irrigation resource. Under Current Band 10 there are substantial cutbacks every year. While there are some high value crops grown within the Loburn irrigation scheme, and some limited area of dairying, the utilisation of the resource is likely to be limited because of its poor reliability. The LWRP regime would have a similar reliability to the Current Band 10, and this reliability would decrease further if the Ecological regime were implemented.

From an economics point of view there is no substantial value in enabling additional irrigation from the Ashley, and a pragmatic course of action would be to maintain current reliability for the B block, limit further takes from the resource overall, and restrict current takes to their actual use. This would provide for some protection of reliability for existing economic values whilst recognising the ecological and cultural values attached to the catchment. The adoption of the LWRP will have similar outcomes to the Current Band 10.

Table 9: Summary of Ashley outcomes

Scenario name	No. days partial restriction		No. days full restriction		Regional impact	Individual-level impact
	Average	1:10 yr	Average	1:10 yr		
Current (full allocation)	0	0	64	104	*Moderate contribution despite poor reliability*	
LWRP (full allocation)	5	8	64	104	Small decrease in CFS and Regional GDP contribution	1 – 2 irrigators. May affect viability
Ecological (full allocation)	3	5	86	129	Larger decrease in CFS and Regional GDP contribution	1 – 2 irrigators. Likely to affect viability
LWRP (LWRP adj allocation)	16	26	64	104	Not assessed	Larger allocation will reduce reliability and further affect viability
Ecological (LWRP adj allocation)	10	16	87	129	Not assessed	Larger allocation will reduce reliability and further affect viability

3.2 Little Ashley Stream

3.2.1 Flow regime

The minimum flow regime for the Little Ashley Stream is shown in Table 10Table 4 below. The Little Ashley is not a large resource, with takes of only 63 L/s and estimated peak use of about 80% of this amount. The proposed minimum flows are similar for the LWRP and Cultural regimes, with the Ecological flows higher.

Table 10: Proposed flow management regimes for the Little Ashley Stream

Site (name)	Minimum flow options (L/s)			Allocation limit options (L/s)		Estimated use of Current Allocated amount
	Current LWRP	Ecological recommendation	Cultural recommendation	Current Allocated amount	Current LWRP (adj) limit	
Little Ashley Stream	50, 30 4 days/month	70	50	63	344	80%

3.2.2 Land use

The irrigated area within the SWAZ is approximately ¾ in dairy and ¼ in sheep and beef. It is unclear whether this reflects the actual use from the resource because no irrigators from the Little Ashley were present at the community feedback meetings. This ratio of land use is used to estimate the impacts of different flow regimes.

3.2.3 Results

The restriction events for the Little Ashley are shown in Table 11Table 5. They show that the highest reliability occurs under the Current regime where there are no cutbacks because irrigators are not subject to minimum flows. The Cultural and LWRP regimes have a higher reliability than that experienced under the Ecological regime. Importantly for irrigators in this catchment, the Current, LWRP and Cultural scenarios show limited full restrictions, which allows for irrigators to manage restriction events while maintaining some irrigation. The Ecological scenario has a substantial number of days on full cutback, ranging from 28 on average to 113 in the worst event over the period of record.

The reliability experienced by irrigators with the LWRP allocation deteriorates significantly, because with the greater allocation the partial restrictions are triggered more frequently.

Table 11: Restriction events for Little Ashley

		Allocation limit option: Current Allocated amount			Allocation limit option: LWRP (ADJ) limit		
Area = Little Ashley		**Days of partial restriction**	**Days of full restriction (100% restriction)**	**Volume restriction**	**Days of partial restriction**	**Days of full restriction (100% restriction)**	**Volume restriction**
Current minimum flows	**Average**	0	0	0%			
	1 in 4 year event	0	0	0%			
	1 in 10 year event	0	0	0%			
	Maximum	0	0	0%			
LWRP current minimum flow	**Average**	140	0	28%	208	0	75%
	1 in 4 year event	165	0	38%	212	0	79%
	1 in 10 year event	173	1	45%	212	1	85%
	Maximum	196	2	59%	213	2	90%
Ecological recommended minimum flow	**Average**	143	28	49%	180	28	79%
	1 in 4 year event	160	40	61%	206	40	84%
	1 in 10 year event	172	73	70%	212	73	91%
	Maximum	202	113	80%	213	113	94%
Cultural recommended minimum flow	**Average**	140	0	28%	208	0	75%
	1 in 4 year event	165	0	38%	212	0	79%
	1 in 10 year event	173	1	45%	212	1	85%
	Maximum	196	2	59%	213	2	90%

Table 12Table 6 shows the impacts for the area irrigated from the Little Ashley. They show that the Current outcomes are significantly better than the LWRP/Cultural and Ecological (worst) flow regime outcomes. The returns from all these land uses as irrigated properties are low relative to the potential, and it would be difficult to sustain large capital investments at this level of reliability. During the 1 in 10 year events all flow regimes other than Current become only slightly positive or negative, suggesting that when capital is taken into account there is the potential for irrigators to generate significant net losses in poor years.

Table 14Table 8 shows the average outcomes aggregated up to the regional level, and including the flow on impacts. They show a $100,000 difference in contribution to regional CFS between the best and worst outcomes, but on a regional scale these impacts are not likely to be large. There may be the loss of two FTEs in contribution to regional employment as a result of moving to the more restrictive Ecological recommendation, but it is likely that this would be spread across a range of different positions including part time staff.

Table 12: Per ha average outcomes by land use for Little Ashley ($/ha/annum)

Per ha		Dairy ($/ha/yr)	Arable ($/ha/yr)	Sheep and Beef ($/ha/yr)	Dairy support ($/ha/yr)	Hort ($/ha/yr)	Total ($/ha/yr)
Current minimum flows	Revenue	$9,200	$0	$3,000	$0	$0	$7,600
	Expenses	$6,900	$0	$2,200	$0	$0	$5,700
	Cash Farm Surplus	$2,300	$0	$800	$0	$0	$1,900
LWRP current minimum flow	Revenue	$7,400	$0	$2,300	$0	$0	$6,100
	Expenses	$5,800	$0	$1,900	$0	$0	$4,700
	Cash Farm Surplus	$1,700	$0	$500	$0	$0	$1,300
Ecological recommended minimum flow	Revenue	$6,100	$0	$1,800	$0	$0	$5,000
	Expenses	$4,900	$0	$1,600	$0	$0	$4,000
	Cash Farm Surplus	$1,200	$0	$300	$0	$0	$900
Cultural recommended minimum flow	Revenue	$7,400	$0	$2,300	$0	$0	$6,100
	Expenses	$5,800	$0	$1,900	$0	$0	$4,700
	Cash Farm Surplus	$1,700	$0	$500	$0	$0	$1,300

Table 13: Per ha 1 in 10 year event outcomes by land use for Little Ashley ($/ha/annum)

per ha		Dairy ($/ha/yr)	Arable ($/ha/yr)	Sheep and Beef ($/ha/yr)	Dairy support ($/ha/yr)	Hort ($/ha/yr)	Total ($/ha/yr)
Current minimum flows	Revenue	$9,200	$0	$3,000	$0	$0	$7,600
	Expenses	$6,900	$0	$2,200	$0	$0	$5,700
	Cash Farm Surplus	$2,300	$0	$800	$0	$0	$1,900
LWRP current minimum flow	Revenue	$6,500	$0	$2,000	$0	$0	$5,300
	Expenses	$5,800	$0	$1,900	$0	$0	$4,700
	Cash Farm Surplus	$700	$0	$100	$0	$0	$600
Ecological recommended minimum flow	Revenue	$4,700	$0	$1,300	$0	$0	$3,800
	Expenses	$4,900	$0	$1,600	$0	$0	$4,000
	Cash Farm Surplus	-$200	$0	-$200	$0	$0	-$200
Cultural recommended minimum flow	Revenue	$6,500	$0	$2,000	$0	$0	$5,300
	Expenses	$5,800	$0	$1,900	$0	$0	$4,700
	Cash Farm Surplus	$700	$0	$100	$0	$0	$600

Table 14: Regional outcomes for Little Ashley ($ million/annum, FTEs)

Little Ashley scenarios	Cash farm surplus ($m/annum)	Regional GDP ($m/annum)	Regional Household Income ($m/annum)	Regional Employment (FTE)
Current minimum flow	$0.20	$0.95	$0.46	7
LWRP current minimum flow	$0.14	$0.76	$0.37	6
Ecological recommended minimum flow	$0.10	$0.62	$0.30	5
Cultural minimum flow	$0.14	$0.76	$0.37	6

3.2.4 Allocation

The Little Ashley LWRP allocation limit (adjusted) is much larger than the current amount of allocated water and the estimated current use. As such there would be no major impacts from reducing allocation to individuals from adoption of the LWRP allocation limit, but there would be a reduction in reliability because of a greater number of partial restriction days.

Adopting the recommended ecological allocation limit (25 L/s) would result in significant impacts to current irrigators from the Little Ashley Stream, and it would largely become an unviable irrigation water resource for them.

3.2.5 Little Ashley Summary and recommendations

The Little Ashley is a moderate to poor quality irrigation resource. LWRP and Cultural are worse than the Current (because current has no restrictions) but better than Ecological, the difference being the number of full days restriction.

From an economic point of view the preference would be for use of the LWRP or lower minimum flow and the Current allocation to minimise impacts on the regional contribution from those currently using the water resource.

Table 15: Summary of Little Ashley outcomes

Scenario name	No. days partial restriction		No. days full restriction		Regional impact	Individual-level impact
	Average	1:10 yr	Average	1:10 yr		
Current (full allocation)	0	0	0	0	Strong contribution for size	
LWRP (full allocation)	140	173	0	1	Significant decrease in CFS and Regional GDP contribution	1 – 4 irrigators. May affect viability
Ecological (full allocation)	143	172	28	73	Halving of CFS and 30% reduction Regional GDP contribution	1 – 4 irrigators. Likely to affect viability
Cultural (full allocation)	140	173	0	1	Significant decrease in CFS and Regional GDP contribution	1 – 4 irrigators. May affect viability
LWRP(adj)	208	212	0	1	Not assessed	Larger allocation will reduce reliability and further affect viability
Ecological (LWRP adj allocation)	180	212	28	73	Not assessed	Larger allocation will reduce reliability and further affect viability
Cultural (LWRP adj allocation)	208	212	0	1	Not assessed	Larger allocation will reduce reliability and further affect viability

3.3 Saltwater Creek

3.3.1 Flow regime

The minimum flow regime for the Saltwater Creek is shown in Table 16Table 4 below. It is a substantial irrigation resource with approximately 550l/s allocation of which 67% is estimated to be used in a peak month. The minimum flows are lowest for the LWRP scenario and higher for the Ecological and Cultural scenarios. Because of data problems with the flows database the Current reliability is assumed to be 100% which is a reasonable reflection of the comments from community feedback.

Table 16: Proposed flow management regimes for the Saltwater Creek

Site (name)	Minimum flow options (L/s)			Allocation limit options (L/s)		Estimated use of Current Allocated amount
	Current LWRP	Ecological recommendation	Cultural recommendation	Current Allocated amount	Current LWRP (adj) limit	
Saltwater Creek	100	148	148	550	417	67%

3.3.2 Land use

The data on irrigated area within the SWAZ estimates the irrigation as almost entirely in sheep and beef. However feedback from community meetings has indicated that there is a 224ha irrigated dairy property and a small take (20l/s) used for cropping and this information was used to adjust the irrigated area proportions. This ratio of land use is used to estimate the impacts of different flow regimes.

3.3.3 Results

The restriction events for the Saltwater Creek are shown in Table 17. They show that the proposed LWRP, Cultural and Ecological regimes have very low reliabilities – with below 40% water available on average. The Ecological and Cultural are the worst of the scenarios, with 7 full restriction days on average and 50 full restriction days in the worst year. Irrigation is unlikely to be a viable proposition under these levels of reliability.

If the lower LWRP allocation limit were implemented, there would be a small improvement in reliability for the LWRP, Ecological and Cultural scenarios relative to the current allocation limit as a result of fewer partial restrictions. These would not however be significant in the context the very large degradation of reliability that would be experienced by irrigators relative to Current.

Indicative regional outcomes are shown in Table 18 below. While they are unlikely to be realistic because the level of restrictions means that more intensive irrigation operations are not likely to be viable, they show the substantial reductions that would occur to regional CFS, GDP and employment with the adoption of alternative flow regimes. When costs associated with debt, depreciation and management are taken into account the irrigators from this resource would experience substantial losses.

Table 17: Restriction events for Saltwater Creek

		Allocation limit option: Current Allocated amount			Allocation limit option: LWRP (ADJ) limit		
Area = Saltwater Creek		**Days of partial restriction**	**Days of full restriction (100% restriction)**	**Volume restriction**	**Days of partial restriction**	**Days of full restriction (100% restriction)**	**Volume restriction**
Current minimum flows	**Average**	0	0	0%			
	1 in 4 year event	0	0	0%			
	1 in 10 year event	0	0	0%			
	Maximum	0	0	0%			
LWRP current minimum flow	**Average**	207	0	64%	205	0	56%
	1 in 4 year event	212	0	69%	211	0	63%
	1 in 10 year event	213	0	76%	212	0	70%
	Maximum	213	1	82%	213	1	77%
Ecological recommended minimum flow	**Average**	201	7	71%	199	7	66%
	1 in 4 year event	212	2	77%	211	2	73%
	1 in 10 year event	212	24	84%	212	24	80%
	Maximum	213	50	89%	213	50	87%
Cultural recommended minimum flow	**Average**	201	7	71%	199	7	66%
	1 in 4 year event	212	2	77%	211	2	73%
	1 in 10 year event	212	24	84%	212	24	80%
	Maximum	213	50	89%	213	50	87%

Table 18: Regional outcomes for Saltwater Creek ($ million/annum, FTEs)

Saltwater Creek scenarios		**Cash farm surplus ($m/annum)**	**Regional GDP ($m/annum)**	**Regional Household Income ($m/annum)**	**Regional Employment (FTE)**
Current minimum flow	**Saltwater Creek Current**	$1.09	$5.51	$2.80	49
LWRP current minimum flow	**Saltwater Creek LWRP**	$0.30	$2.92	$1.48	26
Ecological recommended minimum flow	**Saltwater Creek Ecological**	$0.20	$2.62	$1.32	23
Cultural minimum flow	**Saltwater Creek Cultural**	$0.20	$2.62	$1.32	23

3.3.4 Allocation

The Saltwater Creek LWRP adjusted allocation limit is 417l/s which is 75% of current allocation. Given that use of allocation is 67% in a peak month, the targeted allocation should be achievable through reductions of allocation to current use without major impact on economic outcomes.

3.3.5 Saltwater Creek Summary and recommendations

Saltwater Creek is currently a high-quality irrigation resource with very limited restrictions in the band investigated here, although it should be noted that other bands will have different levels of restrictions. All the proposed regimes would reduce its reliability to the point where it was no longer a viable irrigation source for intensive agriculture.

From an economic point of view the preference would be for only minor changes to the current reliability if major adverse impacts to irrigators are to be avoided. Reducing allocation to current use would improve reliability slightly and would have limited consequences so is a worthwhile approach from an economic point of view.

Table 19: Summary of Saltwater Creek outcomes

Scenario name	No. days partial restriction Average	No. days partial restriction 1:10 yr	No. days full restriction Average	No. days full restriction 1:10 yr	Regional impact	Individual-level impact
Current (full allocation)	0	0	0	0	Strong contribution for size	
LWRP (full allocation)	207	213	0	0	Almost complete reduction in CFS and very significant reduction in Regional GDP contribution	~27 irrigators. Viability unlikely
Ecological (full allocation)	201	212	7	24	Almost complete reduction in CFS and halving of Regional GDP contribution	~27 irrigators. Viability unlikely
Cultural (full allocation)	201	212	7	24	Significant decrease in CFS and Regional GDP contribution	~27 irrigators. Viability unlikely
LWRP(adj)	205	212	0	0	Not assessed	Minor difference only with LWRP allocation
Ecological (LWRP adj allocation)	199	212	7	24	Not assessed	Minor difference only with LWRP allocation
Cultural (LWRP adj allocation)	199	212	7	24	Not assessed	Minor difference only with LWRP allocation

3.4 Taranaki Creek

3.4.1 Flow regime

The minimum flow regime for the Taranaki Creek is shown in Table 20Table 4 below. Taranaki Creek is a reasonably important irrigation resource locally with allocation of 274l/s and estimated use of slightly less. Stakeholders note that 12 centre pivots have been installed in thie area in the last decade, which is significant for a catchment of this size. The proposed minimum flows are similar for all three of the LWRP, Cultural and Ecological regimes, with the Ecological minimum flows marginally higher.

The irrigators on Taranaki Creek currently manage their takes through a water user group to ensure that as flows fall the minimum flow is not breached by abstraction. A number of irrigators reported having groundwater takes in addition to their surface water take, but it is not clear whether these will be deemed connected under the LWRP.

Table 20: Proposed flow management regimes for the Taranaki Creek

Site (name)	Minimum flow options (L/s)			Allocation limit options (L/s)		Estimated use of Current Allocated amount
	Current LWRP	Ecological recommendation	Cultural recommendation	Current Allocated amount	Current LWRP (adj) limit	
Taranaki Creek	120	158	120	274	149	67%

3.4.2 Land use

The irrigated area within the SWAZ has been based on feedback from public meetings and ECan data. Stakeholders indicated that most of the irrigation is in dairy and dairy support, with one small tunnel house and 5l/s used for sheep and beef. 15% of the irrigated area was in sheep and beef or dairy support according to the ECan data, and this was divided into sheep and beef (8ha) based on the 5l/s take and the remainder assigned to dairy support. 1ha was allowed for horticulture and the remainder was assigned to dairy. This ratio of land use is used to estimate the impacts of different flow regimes.

3.4.3 Results

The restriction events for the Taranaki Creek are shown in Table 21Table 5. The reliability for the Cultural and LWRP regimes are identical, and the reliability for the Current is approximately half the restriction experienced under the other scenarios. For the LWRP and Cultural scenarios there are very few days on full restrictions, which allows for the irrigators to manage their takes as a group and ensures that there is generally some water available for everybody. However the Ecological scenario experiences a significant number of days full restriction both on average and in the 1 in 10 year (93 days). Moving from Current to any of the alternate regime will result in a significantly decreased availability of water for users.

If the LWRP allocation were to be implemented, the reliability for the LWRP, Ecological and Cultural scenarios would be significantly improved. Bulk volume reliability would improve from an average of 57% to 37% in the LWRP and Cultural scenarios, which is a decrease from the Current reliability but is within more manageable bounds particularly with very few days of full restriction. The Ecological scenario has improved reliability with the lower allocation, but it remains with a large number of days of full restriction.

Table 21: Restriction events for Taranaki Creek

		Allocation limit option: Current Allocated amount			Allocation limit option: LWRP (ADJ) limit		
Area = Taranaki Creek		Days of partial restriction	Days of full restriction (100% restriction)	Volume restriction	Days of partial restriction	Days of full restriction (100% restriction)	Volume restriction
Current minimum flows	Average	111	0	21%			
	1 in 4 year event	137	0	31%			
	1 in 10 year event	167	0	36%			
	Maximum	188	1	48%			
LWRP current minimum flow	Average	184	0	57%	150	0	37%
	1 in 4 year event	205	0	66%	167	0	48%
	1 in 10 year event	210	0	71%	194	0	55%
	Maximum	211	3	74%	206	3	62%
Ecological recommended minimum flow	Average	160	28	68%	139	28	55%
	1 in 4 year event	199	47	77%	171	47	69%
	1 in 10 year event	207	93	81%	176	93	75%
	Maximum	208	105	87%	193	105	78%
Cultural recommended minimum flow	Average	184	0	57%	150	0	37%
	1 in 4 year event	205	0	66%	167	0	48%
	1 in 10 year event	210	0	71%	194	0	55%
	Maximum	211	3	74%	206	3	62%

Table 22Table 6 shows the per ha economic outcomes for the area irrigated from the Taranaki Creek. They show that the Current produces significantly greater CFS than the alternate scenarios, which is a result of higher production from fewer cutbacks under this scenario. The modelling of the LWRP, Cultural and Ecological regimes does not produce realistic outcomes because the more intensive dairy and horticultural operations would not be viable under these levels of reliability.

Table 24Table 8 shows the average outcomes aggregated up to the regional level, and including the flow on impacts. They show that moving from the Current to the LWRP/Cultural/Ecological scenarios will halve the CFS generated, reduce regional GDP contribution by more than a 1/3rd, and result in the loss of up to 8 FTEs. Note that because of the lack of realism in the modelling of dairy and horticulture this underestimates the impact of the reliability changes.

Some of the impacts outlined here may be ameliorated by alternate sources of water available to irrigators, and the ability to continue to take water even at low flows is likely to mean that some businesses such as the horticultural operation can continue to operate with manageable impacts. There are also some operations in the catchment which have access to alternate sources of groundwater, although it is not clear which of these would be captured by the revised stream depletion calculations and experience the surface water reliability issues outlined here.

Table 22: Per ha average outcomes by land use for Taranaki Creek ($/ha/annum)

Per ha		Dairy ($/ha/yr)	Arable ($/ha/yr)	Sheep and Beef ($/ha/yr)	Dairy support ($/ha/yr)	Hort ($/ha/yr)	Total ($/ha/yr)
Current minimum flows	Revenue	$7,900	$0	$2,500	$2,800	$13,100	$7,100
	Expenses	$6,100	$0	$1,900	$1,800	$8,600	$5,400
	Cash Farm Surplus	$1,800	$0	$500	$1,000	$4,500	$1,700
LWRP current minimum flow	Revenue	$5,600	$0	$1,700	$1,800	$8,800	$5,000
	Expenses	$4,600	$0	$1,500	$1,800	$8,600	$4,200
	Cash Farm Surplus	$1,000	$0	$200	$100	$200	$900
Ecological recommended minimum flow	Revenue	$4,900	$0	$1,400	$1,600	$7,400	$4,400
	Expenses	$4,100	$0	$1,300	$1,800	$8,600	$3,800
	Cash Farm Surplus	$700	$0	$100	-$200	-$1,200	$600
Cultural recommended minimum flow	Revenue	$5,600	$0	$1,700	$1,800	$8,800	$5,000
	Expenses	$4,600	$0	$1,500	$1,800	$8,600	$4,200
	Cash Farm Surplus	$1,000	$0	$200	$100	$200	$900

Table 23: Per ha 1 in 10 year event outcomes by land use for Taranaki Creek ($/ha/annum)

per ha		Dairy ($/ha/yr)	Arable ($/ha/yr)	Sheep and Beef ($/ha/yr)	Dairy support ($/ha/yr)	Hort ($/ha/yr)	Total ($/ha/yr)
Current minimum flows	Revenue	$6,900	$0	$2,100	$2,400	$11,300	$6,200
	Expenses	$6,100	$0	$1,900	$1,800	$8,600	$5,400
	Cash Farm Surplus	$900	$0	$200	$600	$2,700	$800
LWRP current minimum flow	Revenue	$4,500	$0	$1,300	$1,400	$6,600	$4,000
	Expenses	$4,600	$0	$1,500	$1,800	$8,600	$4,200
	Cash Farm Surplus	-$100	$0	-$200	-$400	-$2,000	-$200
Ecological recommended minimum flow	Revenue	$3,700	$0	$1,000	$1,100	$5,200	$3,300
	Expenses	$4,100	$0	$1,300	$1,800	$8,600	$3,800
	Cash Farm Surplus	-$400	$0	-$300	-$700	-$3,400	-$400
Cultural recommended minimum flow	Revenue	$4,500	$0	$1,300	$1,400	$6,600	$4,000
	Expenses	$4,600	$0	$1,500	$1,800	$8,600	$4,200
	Cash Farm Surplus	-$100	$0	-$200	-$400	-$2,000	-$200

Table 24: Regional outcomes for Taranaki Creek ($ million/annum, FTEs)

Taranaki Creek scenarios		Cash farm surplus ($m/annum)	Regional GDP ($m/annum)	Regional Household Income ($m/annum)	Regional Employment (FTE)
Current minimum flow	**Taranaki Creek Current**	$0.78	$3.74	$1.80	27
LWRP current minimum flow	**Taranaki Creek LWRP**	$0.39	$2.64	$1.27	19
Ecological recommended minimum flow	**Taranaki Creek Ecological**	$0.27	$2.29	$1.11	17
Cultural minimum flow	**Taranaki Creek Cultural**	$0.39	$2.64	$1.27	19

3.4.4 Allocation

The Taranaki Creek is currently overallocated (274l/s) with respect the LWRP adjusted allocation limit of 149l/s. However because utilisation is 67% in a peak month, there is considerable scope to reduce allocation by constraining to current use. Furthermore analysis of the consents suggests that there is in the order of 10% - 20% of the takes are of less than 20l/s. There was a lack of engagement by these smaller consent holders in the survey and community feedback meetings, and of those who did attend many noted that they did not use their consents regularly or at all. This suggests further potential to bring the actual allocation close to the LWRP adjusted limit – for example removing 10% of consents, then applying a 67% current use to the remainder give a total of 165 l/s. Furthermore the strong trend in this area of subdivision into urban, peri-urban and lifestyle blocks suggests that over time there will be reducing demand for the large scale irrigation takes. It is likely therefore that with sufficient time and the loss of only one large irrigator from the catchment, the LWRP target allocation can be achieved without the need to cause impacts for existing users. It should be noted that this would also significantly improve reliability for existing users.

3.4.5 Taranaki Creek Summary and recommendations

Feedback from stakeholders indicates that Taranaki Creek is a moderate to high quality irrigation resource and important locally. The LWRP/Cultural/Ecological regimes would significantly decrease the reliability of the resource from that currently experienced. A reduction in allocation to the LWRP target is likely to be achievable over time through a variety of mechanisms without impacting on the economic outcomes from irrigation.

In order to minimise impact on economic values, the preference would be for a retention of the current reliability and a sinking cap on allocation with sufficient time for adjustment from the irrigation consent holders. There is some scope to raise the minimum flow small amounts as the allocation reduces without having major impacts on reliability.

Table 25: Summary of Taranaki Creek outcomes

Scenario name	No. days partial restriction Average	No. days partial restriction 1:10 yr	No. days full restriction Average	No. days full restriction 1:10 yr	Regional impact	Individual-level impact
Current (full allocation)	111	167	0	0	Strong contribution for size	
LWRP (full allocation)	184	210	0	0	Halving of CFS and very significant reduction in Regional GDP contribution	~32 irrigators. Viability unlikely
Ecological (full allocation)	160	207	28	93	65% reduction in CFS and 40% reduction in Regional GDP contribution	~32 irrigators. Viability unlikely
Cultural (full allocation)	184	210	0	0	Halving of CFS and very significant reduction in Regional GDP contribution	~32 irrigators. Viability unlikely
LWRP (adj)	150	194	0	0	Not assessed	Minor difference only with LWRP allocation
Ecological (LWRP adj allocation)	139	176	28	93	Not assessed	Minor difference only with LWRP allocation
Cultural (LWRP adj allocation)	150	194	0	0	Not assessed	Minor difference only with LWRP allocation

3.5 Waikuku Stream

3.5.1 Flow regime

The minimum flow regime for the Waikuku Stream is shown in Table 26Table 4 below. Waikuku Stream is a reasonably important irrigation resource locally with allocation of 1033l/s and use of approximately 62% in a peak month. The proposed minimum flows range from 100l/s under the LWRP, up to 600l/s for the Cultural regime.

As with Taranaki Creek the irrigators on the Waikuku currently manage their takes through a water user group to ensure that as flows fall the minimum flow is not breached by abstraction.

Table 26: Proposed flow management regimes for the Waikuku Stream

Site (name)	Minimum flow options (L/s)			Allocation limit options (L/s)		Estimated use of Current Allocated amount
	Current LWRP	Ecological recommendation	Cultural recommendation	Current Allocated amount	Current LWRP (adj) limit	
Waikuku Stream	100 (150)	250	600	1033	831	62%

3.5.2 Land use

Because of the very significant disparity between the irrigated area in the SWAZ and the irrigation allocation, the irrigated land use area is based on the actual use at 0.6l/s/ha. The land use breakdown is based on ECan data for irrigated land use within the SWAZ which is primarily (81%) dairy.

3.5.3 Results

The restriction events for the Waikuku Stream are shown in Table 27. The reliability is poor for the all regimes, with decreasing reliability from Current to LWRP to Ecological with the Cultural regime the worst. The Current regime appears poor, but as noted above the low utilisation, water user group, and lack of days of full restriction means that the reliability actually experienced is likely to be higher than is noted here. However the Cultural regime, with 154 days of full restriction on average would mean that Waikuku stream ceased to be a viable irrigation source.

The impact on reliability of reducing allocation to the LWRP limit is significant for the LWRP scenario, but small in the context of the changes for the Ecological and Cultural scenarios. However even for the LWRP scenario the overall volume reliability (55%) is very low and would be problematic for irrigators.

Table 27: Restriction events for Waikuku Stream

		Allocation limit option: Current Allocated amount			Allocation limit option: LWRP (ADJ) limit		
Area = Waikuku Stream		**Days of partial restriction**	**Days of full restriction (100% restriction)**	**Volume restriction**	**Days of partial restriction**	**Days of full restriction (100% restriction)**	**Volume restriction**
Current minimum flows	**Average**	135	1	35%			
	1 in 4 year event	155	0	47%			
	1 in 10 year event	179	1	54%			
	Maximum	201	5	63%			
LWRP current minimum flow	**Average**	185	0	61%	180	0	55%
	1 in 4 year event	205	0	69%	201	0	64%
	1 in 10 year event	210	0	72%	209	0	69%
	Maximum	211	1	77%	210	1	72%
Ecological recommended minimum flow	**Average**	152	36	72%	148	36	69%
	1 in 4 year event	189	64	79%	184	64	78%
	1 in 10 year event	195	94	85%	193	94	83%
	Maximum	208	110	90%	205	110	88%
Cultural recommended minimum flow	**Average**	35	154	84%	35	154	83%
	1 in 4 year event	49	171	90%	48	171	89%
	1 in 10 year event	62	199	94%	60	199	93%
	Maximum	65	208	97%	65	208	96%

Table 28 shows the per ha economic outcomes for the area irrigated from the Waikuku Stream. They show that the Current produces significantly greater CFS than the alternate scenarios, which is a result of higher production from fewer cutbacks under this scenario. During the 1 in 10 year events all the flow regimes are significantly reduced, with all the alternate regimes producing a negative cash outcome, and when capital is taken into account irrigators will generate significant net losses in poor years.

Table 30 shows the average outcomes aggregated up to the regional level, and including the flow on impacts. They show that moving from the Current to the LWRP/Cultural/Ecological scenarios will approximately halve the CFS generated, reduce regional GDP contribution by 1/3rd – ½ and result in the loss of 2 – 4 FTEs. As noted above under the Cultural scenario irrigation would be very marginal and even the outcomes noted here may not be achieved.

LWRP is likely to be the most viable because there are no days of full cutback which would allow irrigators to continue some irrigation even in poor years.

Table 28: Per ha average outcomes by land use for Waikuku Stream ($/ha/annum)

Per ha		Dairy ($/ha/yr)	Arable ($/ha/yr)	Sheep and Beef ($/ha/yr)	Dairy support ($/ha/yr)	Hort ($/ha/yr)	Total ($/ha/yr)
Current minimum flows	Revenue	$7,000	$3,000	$2,200	$2,400	$0	$6,700
	Expenses	$5,500	$1,900	$1,800	$1,800	$0	$5,300
	Cash Farm Surplus	$1,500	$1,100	$400	$700	$0	$1,500
LWRP current minimum flow	Revenue	$5,300	$3,000	$1,600	$1,700	$0	$5,100
	Expenses	$4,400	$1,900	$1,400	$1,800	$0	$4,300
	Cash Farm Surplus	$900	$1,100	$100	$0	$0	$800
Ecological recommended minimum flow	Revenue	$4,600	$3,000	$1,300	$1,400	$0	$4,400
	Expenses	$3,900	$1,900	$1,300	$1,800	$0	$3,800
	Cash Farm Surplus	$600	$1,100	$0	-$300	$0	$600
Cultural recommended minimum flow	Revenue	$3,800	$3,000	$1,000	$1,100	$0	$3,600
	Expenses	$3,500	$1,900	$1,100	$1,800	$0	$3,300
	Cash Farm Surplus	$400	$1,100	-$100	-$600	$0	$300

Table 29: Per ha 1 in 10 year event outcomes by land use for Waikuku Stream ($/ha/annum)

per ha		Dairy ($/ha/yr)	Arable ($/ha/yr)	Sheep and Beef ($/ha/yr)	Dairy support ($/ha/yr)	Hort ($/ha/yr)	Total ($/ha/yr)
Current minimum flows	Revenue	$5,700	$3,000	$1,700	$1,900	$0	$5,500
	Expenses	$5,500	$1,900	$1,800	$1,800	$0	$5,300
	Cash Farm Surplus	$200	$1,100	-$100	$100	$0	$200
LWRP current minimum flow	Revenue	$4,300	$3,000	$1,200	$1,300	$0	$4,100
	Expenses	$4,400	$1,900	$1,400	$1,800	$0	$4,300
	Cash Farm Surplus	-$200	$1,100	-$200	-$500	$0	-$200
Ecological recommended minimum flow	Revenue	$3,400	$3,000	$900	$1,000	$0	$3,200
	Expenses	$3,900	$1,900	$1,300	$1,800	$0	$3,800
	Cash Farm Surplus	-$500	$1,100	-$400	-$800	$0	-$600
Cultural recommended minimum flow	Revenue	$3,000	$3,000	$700	$800	$0	$2,800
	Expenses	$3,500	$1,900	$1,100	$1,800	$0	$3,300
	Cash Farm Surplus	-$500	$1,100	-$400	-$1,000	$0	-$500

Table 30: Regional outcomes for Waikuku Stream ($ million/annum, FTEs)

Waikuku scenarios		Cash farm surplus ($m/annum)	Regional GDP ($m/annum)	Regional Household Income ($m/annum)	Regional Employment (FTE)
Current minimum flow	**Waikuku Stream Current**	$0.23	$1.20	$0.58	9
LWRP current minimum flow	**Waikuku Stream LWRP**	$0.13	$0.91	$0.44	7
Ecological recommended minimum flow	**Waikuku Stream Ecological**	$0.09	$0.78	$0.38	6
Cultural minimum flow	**Waikuku Stream Cultural**	$0.05	$0.65	$0.31	5

3.5.4 Allocation

The Waikuku Stream is currently overallocated the LWRP adjusted allocation limit of 831l/s. However because use is only 62%, it is likely that reducing allocations to current, and with sufficient time the allocation can be reduced without major economic impacts. The imposition of minimum flows as indicated here would mean that there would be considerably less demand for the water from the catchment, and together with efficiencies in irrigation, and land use change with lifestyle and urban development in the catchment mean that the allocation should be readily reduced.

It should be noted that reducing the allocation limit also has the benefit of improving reliability for irrigators because of the reduced threshold for partial restrictions. This would be important for the LWRP minimum flow, but would not be a significant effect for the Ecological and Cultural minimum flows.

3.5.5 Waikuku Stream Summary and recommendations

Feedback from stakeholders indicates that Waikuku Stream is a moderate to high quality irrigation resource. The LWRP/Cultural/Ecological regimes would significantly decrease the reliability of the resource from that currently experienced. A reduction in allocation to the LWRP adjusted allocation limit appears achievable given sufficient time.

In order to maintain economic values the preference would be for a retention of the current reliability and reduction of allocation to Current use.

Table 31: Summary of Waikuku Stream outcomes

Scenario name	No. days partial restriction Average	No. days partial restriction 1:10 yr	No. days full restriction Average	No. days full restriction 1:10 yr	Regional impact	Individual-level impact
Current (full allocation)	135	179	1	1	Strong contribution from large irrigation source	
LWRP (full allocation)	185	210	0	0	45% reduction of CFS and 25% reduction in Regional GDP contribution	~19 irrigators. Viability threatened
Ecological (full allocation)	152	195	36	94	60% reduction in CFS and 33% reduction in Regional GDP contribution	~19 irrigators. Viability unlikely
Cultural (full allocation)	35	62	154	199	80% reduction in CFS and very halving of Regional GDP contribution	~19 irrigators. Viability unlikely
LWRP(adj)	180	209	0	0	Not assessed	Minor difference only with LWRP allocation
Ecological (LWRP adj allocation)	148	193	36	94	Not assessed	Minor difference only with LWRP allocation
Cultural (LWRP adj allocation)	35	60	154	199	Not assessed	Minor difference only with LWRP allocation

3.6 Summary

The proposed changes to minimum flow differentiate into the following categories:

- Reliability currently poor and made worse by the minimum flow changes – Ashley river B block.
- Reliability good to very good with minimum flow changes significantly decreasing reliability – Little Ashley.
- Reliability good to very good with minimum flow changes rendering it verging non-viable as an irrigation source – Saltwater Creek, Taranaki Creek and Waikuku.

The proposed changes to allocation can be described in the following categories:

- Reduced allocation achievable at current estimated use – Ashley, Little Ashley
- Reduced allocation achievable at current estimated use and with time to adjust and allow for land use change – Saltwater Creek, Waikuku, Taranaki Creek,

Table 32: Summary of economic impacts for changes to reliability and allocation

Catchment	Current	LWRP	Ecological	Cultural	Allocation target
Ashley	(mixed)				
Little Ashley					
Saltwater Creek					
Taranaki Creek					
Waikuku Stream					

3.7 Preferences to maintain economic values

Ashley: Retain current reliability for Band B, allocation to current measured use.

Little Ashley: Retain the current minimum flow and cap allocation at current use.

Saltwater Creek: Only minor changes to minimum flows and reduce allocation to current use.

Taranaki Creek: Only minor changes to minimum flows and reduce allocation to current use.

Waikuku Stream: Only minor changes to minimum flows and reduce allocation to current use.

4 Changes in reliability with increased abstractions and PC5 permitted activity thresholds

ECan[3] provided the following assessments for changes in reliability under different scenarios of use. They show that reliability has the potential to decrease significantly, particularly with increased allocation and use of the resource. Given that the proposed LWRP regime for these catchments could result in significant decreases in reliability, the desirability of allowing further allocation is questionable, and there would be advantages for existing users to limiting takes to their current use. While these limitations would reduce the potential for further economic outputs from use of irrigation, because of the low reliability post LWRP, and the need to maintain or reduce N losses, they are not highly desirable resources for development anyway and the gains may be limited.

[3] M. Megaughin, March 2018 pers.comm.

Table 33: Changes in reliability with increased allocation and use

Site (name)	PC5, 80% of full allocation, Current use	Full allocation, full use
Ashley River	0%	0%
Little Ashley Stream	6%	21%
Saltwater Creek	0%	10%
Taranaki Creek	9%	23%
Waikuku Stream	6%	21%

5 Changes in reliability for deep groundwater

ECan[4] has provided estimates of changes in reliability of wells in the area under a range of scenarios. These suggest that currently 19% of wells experience a shortfall, and this would increase to ~22% under the PC5 GMP requirements, and allowing for a range of different abstractions and use. While this is a decrease in reliability, it is small and likely to be below the realistic resolution of the modelling, particularly when the background variability is taken into account. This potential for changes in reliability should be taken into account, but from an economic point of view does not require an immediate action for mitigation, and should form part of the issues for ongoing monitoring in the catchment.

6 Nitrogen loads in the Ashley River catchment

The Ashley estuary has levels of nutrients in some parts which may cause adverse impacts on ecological, cultural and recreational values. This analysis assesses the potential implications for agriculture of reducing the N loads into the estuary to between 5% and 20% lower than they are currently.

6.1 Method

ECan provided estimated losses from the root zone for various land uses and soil types across the catchment. This information is summarised in Figure 2 below and shows that while there is a contribution to the total N load from dairy (9%), the majority of the load comes from intensive and extensive sheep and beef. By soil type, 64% of the losses come from light, very light and extremely light soil types. The high proportion of losses from sheep and beef mean that it is difficult to achieve meaningful reductions without requiring mitigations from land uses that only limited capacity to achieve those reductions.

The modelling adopts two indicative approaches to achieving reductions of 5%, 10%, 15% and 20% in the total N load coming into the Ashley River estuary:

- The first applies an even reduction to all land uses in the catchment. This results in dairy and dairy support undertaking mitigation to reduce their N losses, while sheep

[4] Z. Etheridge, March 2018 pers.comm

and beef and arable, which have limited options for mitigation beyond GMP, move land into forestry to achieve the reduction. The profit outcomes for this approach are reported as changes in Cash Farm Surplus (CFS), changes in CFS after the capital costs of transition, and changes in CFS assuming that additional forestry is not possible in the catchment because of water constraints and the land is left fallow.

- The second approach targets reduction to those land uses with high losses but low returns[5]. This minimises the profitability implications, but results in the reductions occurring almost exclusively on sheep and beef operations on light soils.

The modelling assumes a 1:1 relationship between reductions in losses from land and reductions in load to the estuary. This is likely to be reasonably appropriate where reductions are spread across all existing land uses. However where more targeted approaches are used, spatial differentiation in land uses may mean that the 1:1 relationship does not hold because of differences in attenuation between source and the estuary.

CFS figures for each land use are derived as for the reliability from the work with farmer stakeholders.

6.2 Results

The results from this modelling should be seen as indicative. They have been developed with available information, and using the information on mitigation developed through the farmers stakeholder group and in conjunction with DairyNZ. The profitability figures for land use can be highly variable, and the differential between land uses can vary similarly. This modelling adopts a limited range of financial returns and N losses, and this means that the modelling is reasonably simplistic in the context of the true likely complexity. However it is sufficiently robust to identify the likely scale of costs and the difficulties of achieving some the percentage reductions assessed in the analysis.

Because not all land use in the catchment is productive, and because losses from some of the productive land (i.e. forestry) cannot be reduced, the required percentage land use load reductions when evenly spread across land uses exceed the overall catchment percentage reductions. These outcomes are shown in Figure 4, where the reductions required in losses on land are greater than the overall % reduction in load, and the changes required in land use for sheep and beef are proportionately greater again.

- As noted above the higher proportional reductions in load arise because reductions are required from only productive land uses that are able to reduce – so for example forestry cannot reduce losses further even by ceasing to undertake forestry.
- The proportionately greater reductions in land use arise because a change in land use does not reduce the losses from that land to 0 – for example forestry has losses of 1 – 2kgN/ha. Where the losses from a land use are high, percentage conversion from that land use to forestry is approximately equal to the reductions in load achieved. However changing lower leaching extensive sheep and beef to forestry may only achieve a 50% reduction in N loss (ie from 4kgN/ha to 3kgN/ha), meaning that twice as much has to be converted to achieve a given reduction in N loss from that land use.

[5] Ranked by CFS $/kgN.

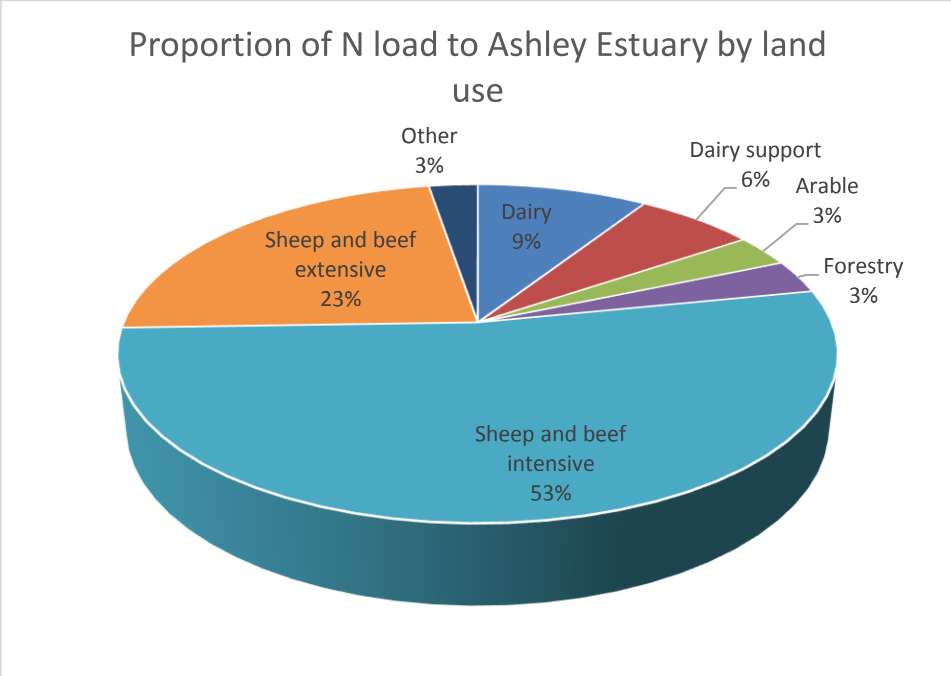

Figure 2: Proportion of load to Ashley estuary by land use

In profitability terms the implications are important, but because of the relatively low returns from the majority of the land uses targeted, the impacts are not as severe as they may be in a catchment that is dominated by dairying or other intensive land uses. The changes are shown in Figure 3 and suggest that the losses would range between $3 million – $8 million CFS/annum. The lower figure would arise from an approach that targeted the lowest returning highest leaching land uses, typically sheep and beef on the light soils. The higher figure would involve the cutbacks equally spread across land uses and soil types, and a situation where forestry was precluded because of the reductions in surface and groundwater recharge that would result from increased plantings of forestry in the catchment.

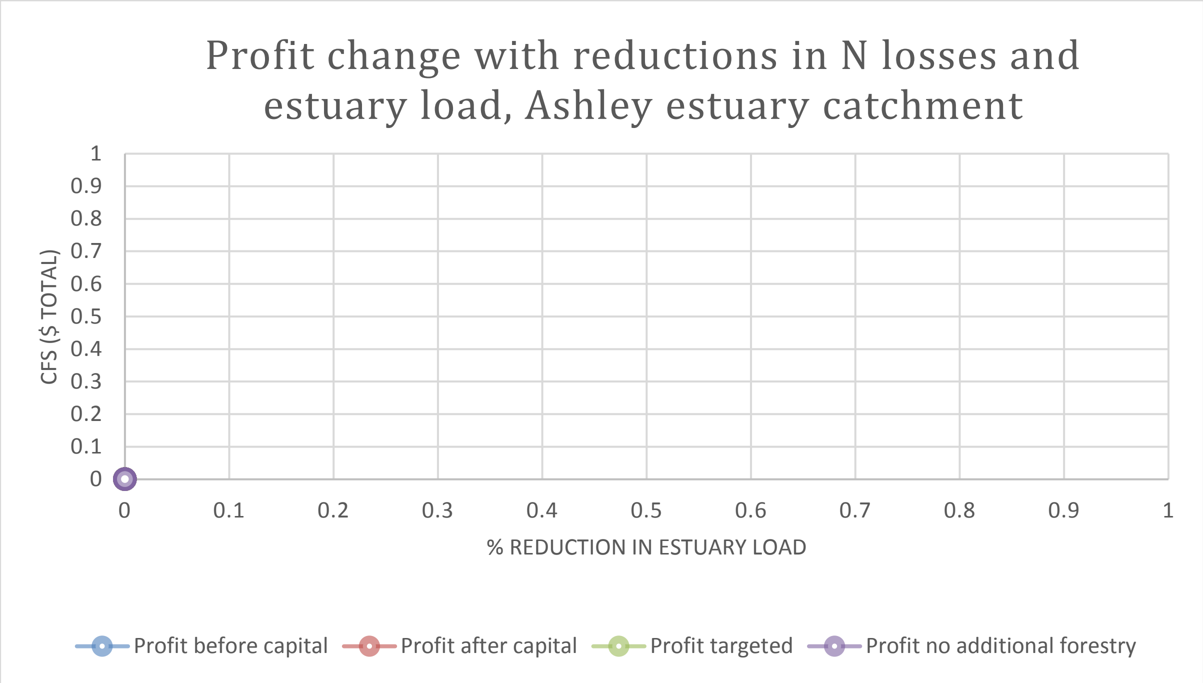

Figure 3: Change in CFS with changes in estuary load for Ashley River catchment

It should be noted that there are other approaches that could be adopted – for example a reduction in the order of 5% - 8% is potentially achievable by targeting dairying only and removing it from the catchment, but this would have a significantly higher cost and could not be used for greater catchment reductions because of the limited contribution of dairying to the catchment load.

If the aim were to reduce loads within specific sub catchments of the Ashley, such as Saltwater Creek, where there are higher proportions of intensive land use, approaches targeting more intensive land uses specifically are likely to be more viable.

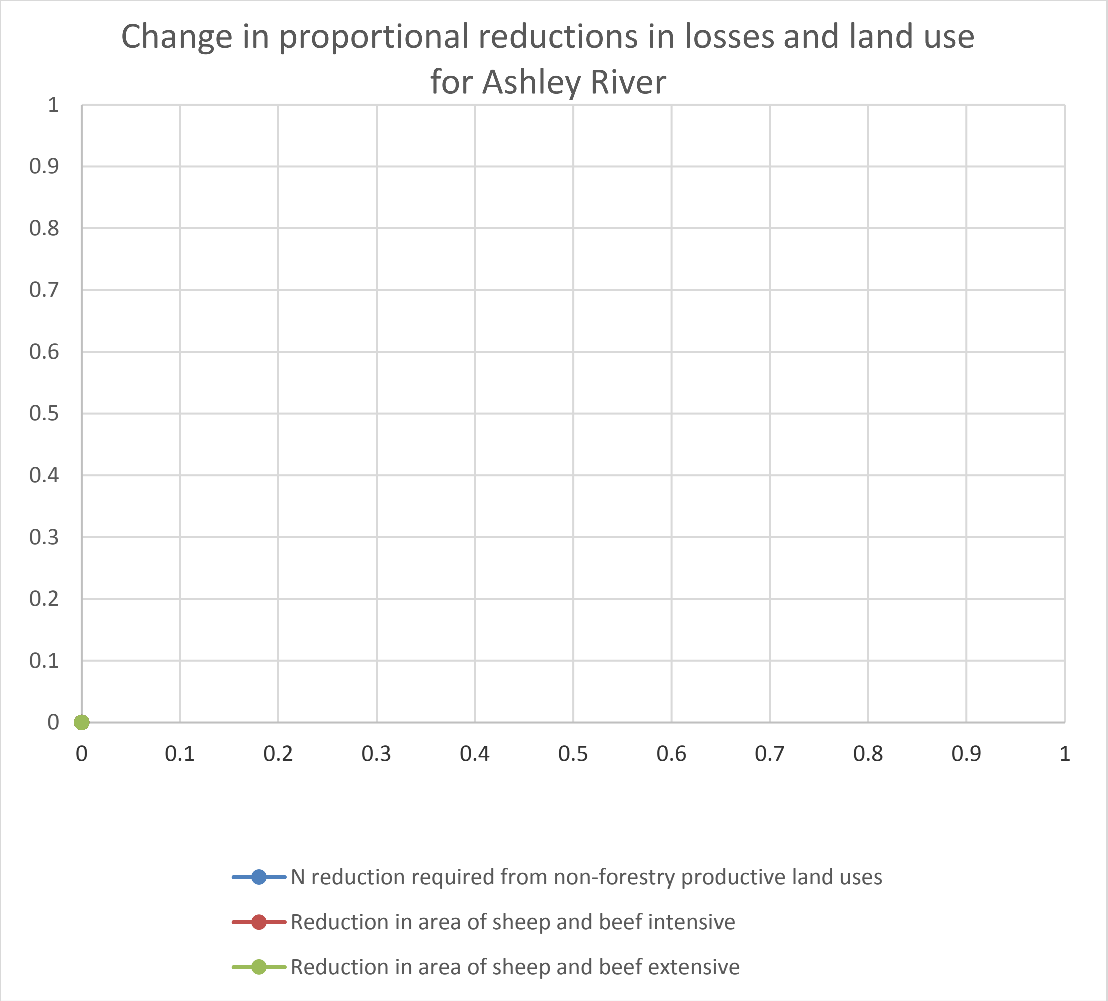

Figure 4: Relationship between the desired reduction in N load and the reductions required from on farm in N losses and resulting changes in land use

6.3 Summary N load reductions

Reductions in N loads into the Ashley estuary are possible, but are problematic because of the scarcity of highly intensive, high contribution land uses. Depending on the mechanisms available, significant changes are likely to require changes in land use and removal of low emitting sheep and beef farming from the catchment. While this does not have a huge cost in regional terms, it is disruptive and likely to be highly problematic for the individual landholders involved. If forestry is not a viable replacement for sheep and beef in the catchment because of its effect on water quantity concerns, making major reductions in N losses will become even more difficult and costly.

There is potential for focus on reducing N loads in specific sub catchments with higher proportions of intensive land use. These catchments would need to be identified and assessed separately.

7 Bibliography

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