Power Point Notes

(1) K line Sprinklers

This is an "Introduction". I'm Roger Lundie

This submission is all about my irrigation setup and how a couple of rule changes mean that in the future I will be placed on 98% restrictions compared with the irrigation I have done over the last six irrigation seasons.

Firstly a bit about my irrigation setup.

(2) A wide view of my three farm blocks and Peasant Point

Two of the blocks are on clay downs and relevant to todays discussion one is situated about one km from the Te Ngawai River.

Prior to 1994 I had on two occasions three wells drilled (two the first time and one the second) on my home block looking for water. (As I don't have any Farm A/cs on my computer prior to this date I'm not really sure of the dates – but it will be somewhere between 1986 and 1993.

From memory each was about 30 M deep and there was no sign of water in any of them.

Then from 1994 to 1996 I purchased 64 shares in SCFIS as we were promised that irrigation water would be delivered into the headwaters of the Te Ngawai which would be available to be used by farms in our area. I had plans to irrigate my 45 ha block near the river and also some of the flatter areas of the two clay downs blocks.

The Opuha dam and its irrigation scheme went ahead but they soon decided there would be no water coming across for the Te Ngawai area.

In hindsight I guess it was just a cunning plan to get more starter finance for the scheme.

(3) My first Gallery (irrigation block including the river)

As it became obvious that the Opuha scheme would not be delivering water to us, I made the decision to concentrate on the block nearest the river and decided to have a gallery dug. This was done in 2001.

(4) Site of first Gallery on map

From my observations then (and when two additional galleries were later dug) it seems that much the block below the top soil is made up of alluvial gravel sitting on what I used to refer to as "white clay" but which I now understand is actually called "siltstone".

I knew nothing about galleries when I started, in fact I had never even heard of them in relation to "harvesting water".

This first one was 207 M long. A trench was dug down in a V shape with the 2M wide base, sitting on top of the siltstone, about 7M below the surface and the base sloped towards one end where the well where the water was extracted from was situated.

Novaflow pipe was laid along the base of the trench, this was covered with 1M of boulders, then a polythene sheet and then finally it was all filled back in again.

This first gallery was built parallel with Cross Road which was found to be almost at right angles to the flow of the water found.

Ecan pointed out to me that it was important that I was able to show that I was not connected to the river so that I would never be placed on restrictions whenever the river had a low flow. They recommended that I contact Bob Hall and he estimated that if I extracted 15L/sec I was only affecting the river flow by 2.6L/sec. this was worked out using the "30 day rule". Anything under 5L/sec

Ecan worked out that the stream depletion effect of the gallery and its well as being 3.3l/sec and it was felt that this was a minor effect.

(5) A pond on the end of the gallery

I don't have any photos of the construction of that first gallery. It was before I had a digital camera.

When the gallery was being dug the contractor pumped the water away so he could see what he was doing. At the time there seemed to be a massive amount of water but once it was all finished and all set up it became very obvious that there was only a fraction of 15L/sec available.

At that stage the block was divided into six paddocks and watering one of those paddocks with four sets of k-lines was about the limit.

Three years later (2004) I decided to construct a pond at the well end of the gallery. I was finding that the gallery was very quickly running out of water each time I turned it on. So, there was a small pond dug down into the siltstone so that more water could be captured before the water in the gallery built up and continued its natural flow.

(6) Digging a second gallery

In 2007 I did a lot of development. I decided to have a second gallery dug, the pond was enlarged and electricity was brought to the site.

I felt that a problem with the first gallery was the fact that its base was the top of the siltstone. This had the effect that once I pumped out the well the pump switched off, then the well and gallery soon filled up again and the natural flow of water continued again underground. Building the small pond at the end of the gallery in 2004 did help.

When the second gallery was built, I persuaded the contractor to dig the base of the gallery down a meter into the siltstone. I felt that if the water level ever got really low then this might capture a greater proportion of the underground flow.

Now I'm up to the age of the digital camera – so have a record of the digging of a gallery. I am now going to rush through the next few slides – they are just here in case anyone would like to know what a gallery is – just for interest and nothing really to do with my submission. If you would like me to skip them then let me know.

If you have a look at the map – the digging started in the middle of the paddock which is where we decided to put the final well.

(7) Construction of a Gallery – the begining

Because the siltstone is only 7 M down the contractor can dig most of it out in two sweeps.

The first time he does it from the top and places the gravel, etc. on one side.

Then for the second sweep he deposits the gravel on to the other side.

The pump is going all the time to pump out all the water to make life much easier

(8) Where the well is going

This is where the pump in the previous slide is pumping the water from.

The plastic pipe is the base of the future well. There is another one fits in the top of it. The slits are made with a chain saw and they are to let the water flow in. (It is straight up and down – the photo was taken on a slight angle.)

That is siltstone down around the water – there are better shots to come.

(9) Water flowing out of gravel above the siltstone

(10) The first section all dug out

(11) A closer view

Notice the ripples where the water is flowing into the trench.

We tried to be at right angles to the flow of water – when first dug water can be seen flow out either side – one the natural flow and the other back flow because the pressure has been released.

A good view of the white siltstone

(12) The Novaflow Pipe

This is another section of the length of the gallery.

Novaflow pipe is laid along the length of the base of the gallery. This helps the flow of water to the well.

(13) Boulders and Pasture

Tons and tons of boulders are purchased to lay on the bottom of the trench

This land has never been irrigated. The pasture is green because it is green. But it is of very poor quality. The red plant is sorrel which is an indication that it needs to be limed.

The wooly mullien is also a sign of poor-quality pasture. It is found in drier eastern areas of both islands – mostly in dry stony places.

(14) Filling in with Boulders

After the Novaflow boulders are placed about a meter deep along the bottom of the trench.

(15) Then a plastic sheet

The boulders are covered with a plastic sheet and then some finer looking gravel. Then the whole trench is filled back in, the second plastic pipe added to the one already there.

When it is all finished all that is showing is the plastic pipe which the pump is placed in.

This gallery plus the first were not to exceed the original 15L/sec limit. The water from this second gallery was pumped over to the pond at the end of the first gallery. While there was more water than previously there still wasn't enough to water the whole block. I added K-lines to another three paddocks so that two-thirds of the block were able to be irrigated.

(16) The Well Today

The same spot today. Everything has been filled in. All that is showing is the top pipe that was fitted into the one you just saw. The water is pumped out and goes over to the pond at the end of the first gallery

(17) Enlarged Pond

The pond was enlarged in 2007 to hopefully hold more than a day's water. If it got full then it flowed away from the natural flow of the first gallery. So that there was no wastage I had to turn the irrigation pump on each day.

This photo was taken in 2014 (9-9-14) (just before the pond was again going to be altered).

Note that the water comes into the well (white pipe from the second and later the third galleries) and that it is now pumped out through the steel pipe. Changed to an electric in 2007.

(18) Full pond in the Spring

Photo taken 17-8-2012. This is the fullest I had ever seen this pond. This is entirely due to the level of the groundwater.

(19) A Third Gallery

In 2011 I decided to add a third gallery – it was at the NE corner of the block.

As it is really better not to have the well in the middle of a paddock – this time I put it at its northern end about two meters from the boundary fence.

It was a shorter gallery – probably just about 100 M.

Because of the direction of the underground flows I have probably tapped into most of the very small streams flowing under my block.

The water from the third gallery joined with the pipe from the second gallery and flowed into the pond at the first gallery.

I then extended the k-lines over the last two paddocks. There are now 22 k-lines with 195 pots – each K-line has 12 shifts to give one complete watering. In other words, it takes 12 days to completely water the block. The block is now subdivided into 22 small paddocks for better stock management.

(20) A Pond becomes a much larger Lined Pond

Let's have a look at my pond again. This is the last day [9-9-2014] it was like this – the digger is actually just visible on the right hiding behind either a gorse bush or part of a wattle tree.

At this stage the water from galleries two and three join to flow into it to join with the water from the first gallery.

The next major development major development was due to Ecan stipulating that each water take had to have a water meter installed so that they had a constant record being radioed to them of the water being extracted.

Up until that point every day when I shifted my k-lines I recorded the running total on the irrigation meter. So I actually knew how much water I was using during the season but they wanted a record of it sent to them as it was extracted from the galleries.

(21) The new lined pond

So, I went to the expense of partially filling in the base of the existing pond and then, over that base, building a much enlarges lined pond.

At 15L/sec this pond could probably hold about 5 days of water – possibly a bit more. Another advantage was that while the gallery wells could be going 24 hours a day it was possible to have a day of from shifting k-lines if I wished and I wasn't losing water as happened previously.

(22) Water in and out

The water from the three galleries was combined and measured as it entered the new pond. The water flowing in can be seen falling from the silver pipe. The day this photo was taken [15-11-2015] I recorded the flow rate at 11.9L/sec.

The white box behind it is where the electronic equipment records the flow rate and the running total and it is from there the data is sent to Ecan.

The water required for irrigation is then pumped from that pond. The irrigation pump is under the corrugated iron cover with all the electronic gear in a shed out of sight to the left. This includes the flow rate and running total for the irrigation, a clock to set for how many hours the irrigation should go for and a running total for the hours pumped.

Each day that I was shifting my k-lines I first noted the in-flow rate at the pond, then as I passed each of the three galleries, I measured the distance down to the water level and, if necessary, fractionally opened or closed the gate valve of each to get the most water from each without lowering the water level too much. I like to envisage that there is a huge pond of water underground at each well and I try to take as much as possible (but not over 15L/sec) while at the same time lowering the later level as little as possible. I record all of these measurements.

I hardly ever suck down to the level of the siltstone. I envisage that within these underground ponds of water (or is it one huge pond??) the water is very slowly moving eastwards towards the sea and I am just extracting a small proportion of it.

While my water right allows me to extract up to 15L/sec it is extremely rare for me to get near this amount. Normally there are times in the season (usually near the start) where it is in the 11 to 13L/sec range (very occasionally it gets to 14L/sec) and then at other times it eases down to 8 or 9L/sec. One year it went right down to 4L/sec.

So, I finally had my irrigation system well set up to best use the water I had available.

Over the years I have spent a total of $465,075.22 on "Irrigation capital expenditure".

Up to this point all I have really done is offer you a brief introduction to my irrigations scheme. Now I am starting to get to the reason that we are here today.

I thought that everything was going well until Ecan decided to introduce their “Plan 7 Changes”. It turns out that these proposed changes will have a catastrophic effect on my irrigation scheme.

Two years ago, I made a number of submissions to the OTOP committee and really heard nothing back. Last year I updated what I had written and sent it as a submission to Ecan – submission 82. For today’s hearing I have slightly altered that submission (added an extra year’s supporting data and a few other slight alterations).

This updated submission is available and now I will just quickly pick out a few relevant bits to help highlight the problems.

(23 and 24) Stream Depletion Analysis

As I have just said all was well until about two years ago when Ecan started discussing their Plan 7 changes. In 2018 I went to three “workshops” run by the OTOP committee. The message I received was that, they felt that in times of low flow in the Te Ngawai they are looking at bringing in restrictions at a higher flow rate – going from the current minimum of 400 L/sec to 475 and then to 550 over time. To try and impose these restrictions on more people than are being affected at the moment, for those with groundwater takes, they talked of keeping the 5L/sec depletion rate limit but working this out over 150 days rather than the 30 days that is used at the moment.

To recap, as long as the extraction of water is not affecting the flow of the river by 5L/sec or more the well is deemed to be “not connected”. Such a well will not be put of restrictions if the river flow is low.

In 2001 Bob Hall estimated that my gallery (the first) would alter the river flow by only 2.6L/sec and the Ecan investigating officer estimated that it would be affecting it by 3.3L/sec. This was using the “30 day rule”.

So that I could get an idea of what the results would be using the 150 day rule Dan Clark (Ecan) suggested that I download the program “The Thesis (Jenkins) Solution” from the Ecan website. He suggested I use the figures **1000m^2/d** for transmissivity and **0.1** for the storage coefficient. Using these figures, I obtained the figure of **2.7L/sec** using Bob Hall’s midpoint distance of 1050M and 2.4 using Ecan’s midpoint distance of 1100M.

The reason the Ecan Investigating Officer obtained a higher level [3.3L/sec] was because he used a higher transmissivity figure [1357m^2/day] – Bob Hall in his report used the figure 1000m^2/day but noted that under typical summer conditions this could reduce to 800 and in drought conditions to 600 – if these figures had been used the resulting estimate would have been even lower. I used the figure suggested by Dan Clark.

The fact that I obtained similar figures to those of Bob Hall and the Ecan investigating officer showed that I was working the tool correctly – this also showed me that **over 150 days** I would be affecting the river by **8.1L/sec** – this would mean that I would be deemed to be connected to the river and so in the future go on restrictions the same as if I was pumping straight from the river.

(25) Flows in the Te Ngawai River

I then wanted to know how these future restrictions would affect my water usage.

So, Dan Clark (Ecan) supplied me with the data from the Cave recorder where the Te Ngawai River’s flow was measured. In my submissions to OTOP I included the data for the four seasons [2014/15 to 2017/18] since my Ecan recorder was installed. I added a fifth in last years submission to Ecan [2018/19] and I have updated it with a sixth season [2019/20] for today’s hearing.

To the six seasons of Cave flow data I have gone through and added my daily reading (from my Ecan recorder) for those days I was extracting water from my galleries. So, this data should correspond to the data sent every few minutes to Ecan.

As the future restriction level for the Te Ngawai is going to be set at 550L/sec I have gone through and highlighted (in green) all those days where I would have been put on restrictions.

This slide is an example of a month [February, 2019] from those six seasons. For this month I actually extracted water all 28 days. Applying the future rules (550L/sec limit) there are two periods (one of three days and another of four days) where I would not have been able to irrigate

(26) Summary of the restriction periods - the2015/16 season

This was a long season (229 days) and during that period I irrigated for 172 days. There were 10 periods where there would have been restrictions if I was deemed to be connected to the river and the minimum flow of the river was less than550L/sec. For each of these restriction periods I then averaged the flow rate over the period.

(27) The Thesis (Jenkins) Solution for a 75 day period of restriction

Over the six seasons the longest period of restriction was a 75 day period in the 2014/15 season. For that 75 day period the average extraction rate was only 5.58L/sec. Using these figures I find that extracting water for that length of time and at that rate would lower the flow of the river by 2.18L/sec. Is it safe to assume that turning my galleries off for that period would have the effect of adding this amount back into the river?

As already stated, this was the longest period of restriction. There was another of 27 days (2019/20 season) that was estimated to add 1.54L/sec back into the river and another of 20 days (2015/16) that would have added 1.13L/sec back into the river.

Of the 36 periods of restrictions over the six seasons these were the only three that would have added over 1.0L/sec into the river. 21 restriction periods would have had no effect on the river flow and the other 12 were shown to have <1.0L/sec effect.

So, none of the 36 restriction periods were anywhere near the critical point of adding 5L/sec back into the river. Most were shown to have zero effect on the river flow and a few had less than 1.0L/sec. There were only three over the six years that were over the 1.0L/sec level [[a 1.13L/sec, a 1.54L/sec and 2.18L/sec] and none of these even got to half the critical 5L/sec mark.

(28) Summary of the result of a change to the 150 day rule.

1. For the last six seasons I have been deemed to be not connected to the river – using the "30 day rule".
2. Over the six seasons I have irrigated on a total of 684 days [158 + 172 + 76 + 67 + 94 + 117] an average of 114 days per irrigation season.
3. Using the "150 day rule" (which would deem me connected) and the new proposed 550L/sec river flow restriction level I would go on restrictions for 301 [101 + 55 + 26 + 26 + 30 + 60] of the 684 days I actually irrigated.

4 In other words I would have been placed on restrictions 44% of the days where I would have irrigated over the last six years.

5. The really galling thing about all of this is that, because I am so far from the river, putting me on restrictions can be shown to have no effect on the flow of the river – so it seems, to me, to be all a rather pointless exercise.

(29) I thought that I had Problems

(30) The Second Problem - apparently, I am a "BN Extractor"

Dan Clark (Ecan) was the one that pointed out to me that the problem that I have pointed out above is minor compared with the fact that I am classed as a "BN extractor".

I must admit that I had never heard of this classification before he pointed it out to me. There are four possible classifications: AA, AN, BA and BN.

The first "A" applies to those who obtained their permit prior to 1994 and the "B" to those who obtained their permit after that date. The second "A" refers to those with Opuha shares and the "N" to those without.

So, "yes" I would be classed as a "B" as I didn't get my permit until 2001 and "yes" I would be an "N" because I no longer have any Opuha shares.

Concerning the Opuha dam shares: As I have already stated, over the 1994 to 1996 period, I purchased 64 SCFIS shares in four instalments.

I purchased these as they promised to deliver water from the Opuha dam down the Te Ngawai river and I purchased enough so that I could irrigate all my Cross Rd block and some of the flatter parts of my two clay downs blocks.

As I have already said I'm not really sure if they ever really intended to put the water they promised into the upper reaches of the Tengawai or if it was just a "cunning plan" to get more starting finance.

They soon decided against the Te Ngawai part of the plan and, because of that, in 2001 I began the big process of developing my own irrigation setup.

Ecan had said that I was not connected to the river at 15L/sec so there was no need to have the shares.

We were strongly encouraged to sell our shares back to the company so that they could be on sold to farmers who could source the Opuha water.

So, they were sold back in 2002.

The problem with being both a "BN extractor" and being "connected" is that I will only be allowed to extract water when the flow of the Te Ngawai is over 2500L/sec.

(31) The Problem with being a "connected" "BN extractor"

The problem with being both a "BN extractor" and being "connected" is that I will only be allowed to extract water when the flow of the Te Ngawai is over 2500L/sec.

This definitely doesn't often happen on the days that I irrigate.

I've selected out a fairly typical period (43 days I this case) to show that on the days that I actually irrigate it is rare to have one where the river is over 2500L/sec.

There is one in this period – there were only two in that year.

There were though some with this high rate of flow in the period where I didn't need to irrigate.

(32) A summary of being "connected" and a "BN rextractor"

Over the last six seasons I would have only been able to irrigate on 16 days

On average I have irrigated on 114 days/season and I would have been able to irrigate on 2.67 of these days.

In other words I would have been on restrictions 97.6% on the time

(33) What an absolute disaster

This is definitely worse that the initial 44% restrictions I had previously worked out.

Dan Clark was definitely correct!!

(34) Is there a way out of this mess?

I've gone from what the Ecan "investigating officer" termed a "Minor effect" on the flow of the river to being placed on 97.7% restrictions.

The bid questions is – is there a way out of this mess?

This then set me thinking about the calculations of the "30 day rule" and the "150 day rule.

But first I've made a little error that I would like to correct.

(35) Correcting an error of mine

I'm very conscious of the fact that if I've made any errors in my arguments then anyone who opposes my proposals (to come) could use them to argue against what I am proposing.

In the original version of my submission (submission 82) last year. I calculated just what my water take would have to be reduced to to be deemed not connected.

I came up with the figure of 9.25L/sec. Using Bob Hall's mid point for the first gallery (1050M) from the river I found that at 9.25L/sec I was not connected 54% of 9.25 = 4.995.

The Ecan "Investigating Officer had the well end of the gallery 1200M from the river and the midpoint 1100M.

Using Google Maps I found that he used the distance to the river parallel with Cross Rd.

But I am actually taking water from three galleries (not just the one) and the second and third are a little closer to the river. This means that my estimate of 9.25L/sec is a fraction high.

I've made two estimates of where the midpoint of the three galleries – one on a line parallel with Cross Rd (1000M) and the other at the midpoint on a line between the southern end of the first gallery and the northern end of the third gallery (the blue dot).

I've chosen the one on the line parallel with Cross Rd as it is the closest to the river – using this point there will be no argument that I should have used the other one.

Before I go on to the "Thesis (Jenkins) Solution" a note about the **flow of the water underground**.

Zarour, *et al*. (2018) note that the flow of the water in the Sutherlands Valley (where this block of land is situated) is parallel with the flow of the river. When we dug the galleries, it seemed to be in the direction of the river to the west – 2 km or more away.

I realise that it is very possible that it changes to being parallel with the river west of my block. In either case I'm sure if we were to use these distances then I would be able to show that we were not connected to the river – in fact I can – using a distance of 2000M the 15l/sec x 25% = 3.75L/sec so I am not connected.

Even though I feel that this would be a sensible solution to my troubles I can't really see Ecan accepting it.

So I'll now work out the rate at which the midpoint of the three galleries (combined) are not connected using the 150 day rule.

(36) The rate where the three galleries are not hydraulically connected to the river.

Using the midpoint parallel with Cross Rd (1000M) at the flow rate of 8.9L/sec these three galleries can be shown to be not hydraulically connected 8.9L/sec x 56% = 4.984.

(37) A Summary of the Water used over six Irrigation Seasons

When the "150 day rule" (the same applies to the "30 day rule") is used to calculate whether a well is deemed to be connected to a river it is assumed that water is actually extracted at this rate for all of the 150 days.

How I must admit that this is a logical assumption if the extraction is coming straight out of the river and it goes for the all the 150 days.

From my experience with a combined three galleries situated over a km from the river this is definitely not the case. For a start it is only very rarely that I even get to 14L/sec let alone 15L/sec. Usually at the start of the season I hover around 10 to 13L/sec and then as the season progresses this lowers to the 8 to 9L/sec range and one season actually got down as low as 4L/sec.

There is also the fact that there are always periods in the season when the extraction is actually stopped.

So although (in my case) the water right is for 15L/sec for a continuous period this does not happen – the water is taken out at a much lower rate almost all of the time and it is not taken out continuously.

So my next question was – how much water do I actually use in a season?

As I keep daily records for my irrigation this is easy to work out. In fact, all I needed were the starting and finishing running totals and the season length (from the first to the last days that I extracted). I can get my starting and finishing totals from both the Ecan meter and my irrigation pump and these correspond closely.

This table presents the Ecan data (the one in the submission also includes the irrigation data), the days extracted and the season length.

Doing the calculation over 150 day or the actual season length (if that it longer) it can be seen that the seasons average flow rate ranges from 5.31 to 7.90L/sec. So every year the average extraction rate has been quite a bit less than the critical 8.9L/sec above which I would be deemed to be connected.

Before farmers were compelled by Ecan to instal their flow meters it could be argued that Ecan were justified for assuming that all wells were run at the allowed rate for the whole season.

Now things have changed. Now Ecan has information coming in from each extraction point all of the time.

(40) My proposal

(41) Reasons for this proposal

(47) I would like to comment on this. My whole submission has been to fix a problem that is affecting me drastically. And the wording of my proposal is aimed at my problem. So, I have used the data I have collected over the last six seasons to argue my case. Putting it rather simply: I suggest that if irrigators can show that they haven't altered the flow of the river by more than 5L/sec in the past they should be allowed to carry on as usual in the future.

I do realise that most farmer will probably not have been keeping the detailed records that I have for my wells. So, should this whole thing be looked at in a way that might help more farmer who have been affected by the change from the "30 day rule" to "the 150 day rule". If Ecan could supply them (each affected farmer) with their start and finish dates and total volumes for those dates, then they could just see what their average water use over the season actually was. Maybe some of them (probably those furthest from their river) are close to the situation I am in.

Even if in the past some farmer who were deemed not connected to the river using the 30 day rule but will be using the "150 day rule" and their actual season flow might find it better to reduce their actual season flows a little and stay non connected.

So, while I really want to fix my situation I'm sure there are others in a similar situation who also need to be considered.