



## Water Markets Research Group

John F. Raffensperger  
E. Grant Read  
Shane Dye  
Ranga Prabodanie  
Stephen Starkey



Mark W. Milke  
Thomas Cochrane  
Rebecca Teasley  
Antonio Pinto

**A water market with control.**

**Council runs a constrained auction  
for big commercial users to lease consent.**

I don't have an Apple iPad to show off like Steve Jobs, so I'll get straight to the point.  
[follow slide]

We propose to allow trading in the existing administrative right to use water which society has already granted to commercial users, i.e., consent. We do not propose any change in ownership of water. Control of the resource remains with the elected authorities as it is now. The proposal is only for the very large commercial users, and has nothing to do with water for sustenance. Small users, such as city residents, can completely ignore this new system, and would continue to get their water as they do now.

## About me



This falls under “full disclosure”. I got my MBA and PhD in operations research at the University of Chicago. The Chicago School was a group of economists, who held the view that government intervention is inefficient compared to a free market. While I am not an economist, I have been trained in a free market philosophy. But I don't believe that laissez faire economics can work for water.

I also care deeply about the environment. I bike to work. I drive a Prius. And my personal agenda in this is to **make a better world**, to help build a **practical solution** that will go a long ways toward helping to solve the world water crisis.

I am pro-business and pro-environment.

## Shared concerns

Business more profitable.  
Competitiveness:

Efficiency.  
A better environment.

Less contention.

Most controversial:  
use a market.



Almost everyone shares the same concerns about New Zealand's water management.

You want to see business more profitable. You want to see NZ more competitive.

✓ You want to see business use water efficiently. You also want to see more certain environmental flows.

✓ You want less contention between the public, businesses, and government.

Any solution must meet the needs of all parties. A purely environmental solution won't work. A purely business solution won't work. Pure government command and control won't work.

✓ The most controversial aspect of our proposal is that **we should use a market**. The science is clear about this. We should ignore the economic science no more than we should ignore the hydrological science.

Richard Howitt, of the University of California at Davis wrote "...efficient transfers rely on the detailed local knowledge of water use and value, known only to the ultimate user of the water... The price offered for water condenses a wide range of values and preferences into a single signal that is readily understood and usually persuasive." (Howitt, Calif Ag, 54(2) 2000.)

The question, though, is how to make a market work, especially with complex hydrology .

## We don't have all the answers.

Consent renewal?

Water charges?

Environmental quantities?

Claw back or compensate?

Has this been done before?



We don't have all the answers.

How are permanent consents renewed? Society must choose. We can provide better tools.

✓ Should gov't charge business for water? Society must choose. Our system works either way.

✓ How much water should be set aside for the environment? Society must choose. Our system allows easier implementation of the decision.

✓ When changes are made to required environmental flows, should government claw back users' rights, or compensate them? Yet again, our system works either way, and provides a mechanism for doing either one.

✓ Where has this been done before?

It's **new**. *Similar* markets are working for many other commodities, including electricity, natural gas, transportation, and radio spectra, with a thousand times higher reliability, security, and data precision requirements than would be needed for water. It could easily be tried in just one catchment as a test. But honestly, to my knowledge, no one is doing this anywhere in the world.

## Typical questions

Privatisation? Water is owned by the Crown.  
Trade permission to use.

Social values, environment?  
Simulate every take, every week,  
to ensure environmental flows.

Market power? "Free for all"?  
Unlikely. Spatially distributed resource, many users.

Control of the resource?  
Council controls the market.

Push out small users? Maybe.

Bad data? Maybe, but use data better.

Cheaters? Need the rule of law.



[www.teara.govt.nz/en/bird-migration/3/3/1](http://www.teara.govt.nz/en/bird-migration/3/3/1)

**Doesn't this privatise water?** It's NOT privatisation. Water is owned by the Crown. Only the administrative permission to use water is traded.

✓ **Does our system ignore "social" values?** Won't the environment get hurt? No – they are constraints. Non-commercial water is not for sale. The system simulates every take, for every future week, to ensure the environmental flows.

✓ **What about market power?** Won't the rich will get all the water? For a monopoly, someone would have to buy all the land. A user is likely to get monopoly power only over their own well. A typical catchment has many users, so pricing will probably be competitive. It's NOT "free market" nor "just a free for all". It is a **smart market**, a market with control, with water flows & accounting done by a computer, controlled by Council.

✓ **There's no control of the resource.** False - Council retains complete control. Council tells every user how much to take, every week. And users will be glad they do.

✓ **Will small producers be pushed out?** Maybe. Depends on their ability to use water effectively. But this is NOT about slamming poor people with high water charges. Intended for the large commercial users.

✓ **It won't work due to bad data.** Same with current system. Not even perfect data can resolve contention! Our system uses existing data much more effectively.

✓ **What if people cheat?** Yes, but this is true of the current system. We need to enforce the law, and use water meters. Now let's look at the problem that our system solves.

*Shining cuckoo, <http://www.teara.govt.nz/en/bird-migration/3/3/1>*



This is Ann. She raises cows. She has an allocation for water, but has decided that she needs more water. Ann is in for a long fight.

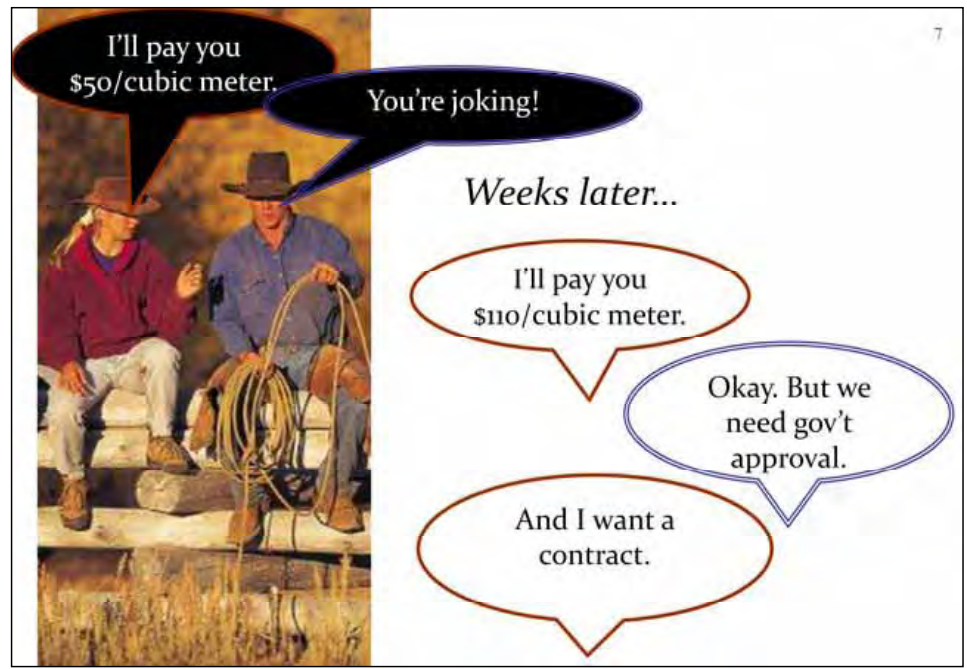
Why is water allocation so difficult? The problem with water is that it is shared, and each person's use affects many other people and the environment. Therefore, society has appropriately arranged for government to manage the commons, and this is reasonable. So government has to be involved with every transaction. This process takes considerable time and cost for all concerned.

First, Ann will go to government with an application. In New Zealand, this application process typically takes several months, and costs thousands of dollars. Ann will have to fill in lots of forms, and probably get a lawyer. This problem is this big transaction cost.

✓

The outcome is not at all certain, no matter how much money she is willing to pay. If the government won't give her water, perhaps she can find someone who will *sell* water to her.

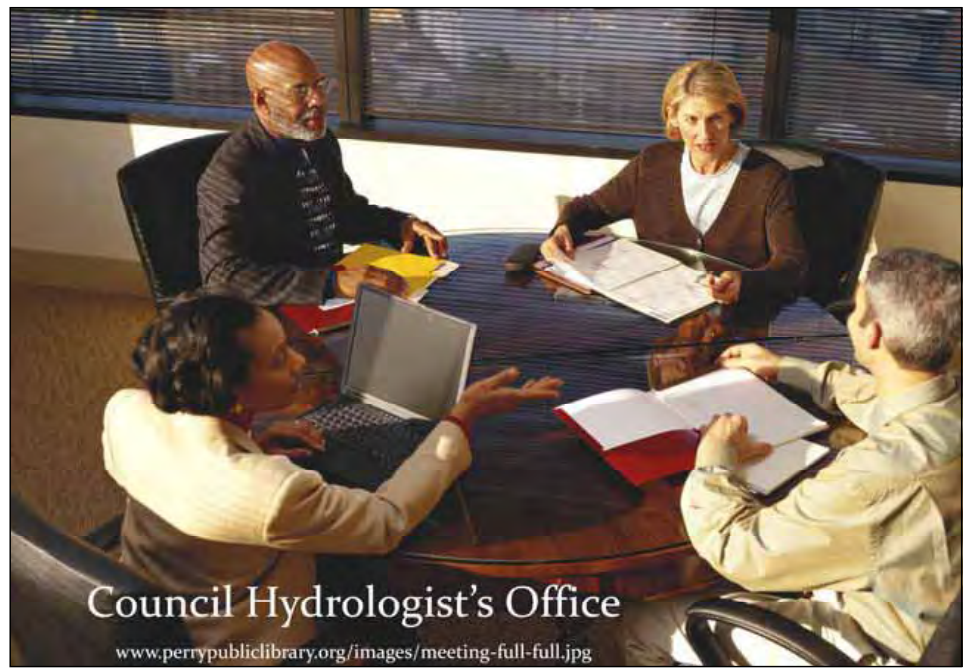
So Ann sends email to all her friends and family, puts up posters in the local pub, and even ads in the paper. Eventually, she finds someone who may be interested in selling her some water.



This is Ann with her neighbour, Bob. Ann figures that she will pay Bob to take less water, so she can take more water, and it will balance out. After weeks of negotiating, she finally comes to agreement with him.

✓ They have to get lawyers, write a contract, work out what to do if the other does not fulfil their end of the deal. And they still have to get government approval.

So Ann has searched for a trading partner, negotiated a deal, written a contract, paid a lawyer, and still has to go to government for approval. The transaction cost is getting bigger.

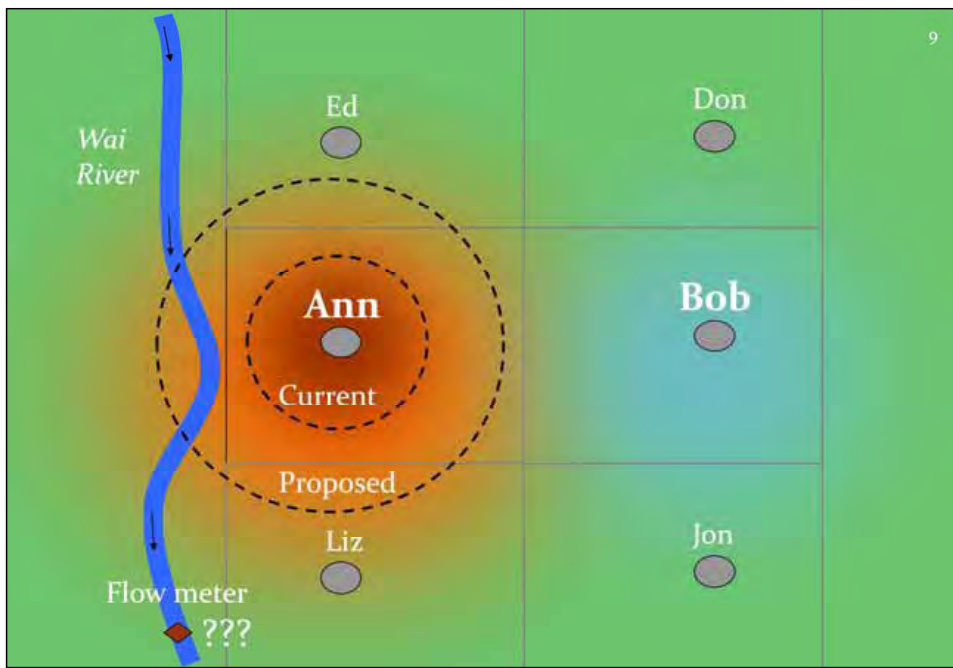


So Ann and Bob go together to the water authority. They explain what they want to do, and ask for approval.

Of course, everyone's use of common resources affects everyone else, so it is appropriate that government has a role in managing the commons.

At this point, government should look at the hydrology.

*Conference image from <http://www.perrypubliclibrary.org/images/meeting-full-full.jpg>.*



The government hydrologist observes that Ann’s well is close to the river, and Bob’s well is far from the river. With the proposed trade, Ann will take much more water from the river, even if Bob stops taking water completely. The trade would hurt the environment, as measured at the flow meter. Also, Ann’s increased consumption will encroach on Ed and Liz. So the government hydrologist says no.

But the government hydrologist also says – “Oh, it could work, if *all other* farmers in this catchment cut down their water use, especially Ed and Liz,” but that would require Ann to make deals with every other farmer in the catchment. This is too hard for Ann.

By now, Ann and Bob have invested so much in this deal, that they just can’t afford to let it fail. Since the river level is highly uncertain, they take their case to court. The transaction cost just keeps getting bigger.

This Australian bulletin board lowers one part of the transaction cost, the search. Notice the long term lengths – for the financial year, a permanent trade, for the water year. Trades are big and happen rarely, in a dry country that has worked hard to allow water trading.

Some people, even some economists, think that water trading will magically happen, simply if it is allowed. People trade contraband because they want to, even though government forbids it. Transaction costs for trading marijuana and P are small. But almost no one trades water, even though they badly want to, and even though government allows it. The transaction costs for trading water are just too big.

For surface water, traders can be matched nearly one-to-one, because the water is controlled. World wide, water markets are active primarily when water is controlled with reservoirs and canals. Hence, water users love expensive solutions of steel, concrete & pumps, especially with government subsidies. But they *still* have high transaction costs.

And not just in New Zealand, but world-wide. In fact, New Zealand is far better at managing water allocation than most countries, with greater transparency and honesty, and much stronger institutions. The problem of high transaction costs is **no one’s fault**, but rather is an inherent problem of managing a complex shared resource.

These transaction costs occur for *everyone* who wants to change water allocations, not just farmers. Utility companies, environmentalists, and government all face these large transaction costs. If government wants more water for the environment, government faces a contentious process in “clawing back” water from users. Even if government were willing to pay users to give up water, no process for such payment exists. So government has big committees that make crude decisions once every decade or so. So that’s the basic problem of water allocation. Now let’s see the benefits if Forever Fair were implemented.

## Benefits of Forever Fair

Make money in every trade.



Your fishing spot protected.



Gov't responsive,  
not the enemy.



[www.banknotes.com/NZ161.JPG](http://www.banknotes.com/NZ161.JPG), [www.newzealandnz.co.nz/methvenmthutt/fishing.jpg](http://www.newzealandnz.co.nz/methvenmthutt/fishing.jpg)

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### What are the benefits of our system?

Users make money in every trade. You can sell excess consent, or get water for production. This co-operative approach reduces risk. Participation is voluntary.

There is public data on water prices. Users & gov't can make better decisions about investment.

✓

**Your fishing spot is protected.** The system guarantees environmental flows at every auction. It responds in real time to environmental changes. **State-of-the-art approach.** It is unique world-wide in its complete combination of physics, economics, and sustainability.

✓

Gov't looks **responsive, impartial & fair.** Gives **opportunity**, not rigid rules. Gov't *enables* the market, while ensuring environmental flows. Over-allocated catchments become perfectly allocated, in near real time, under complex hydrology, and uncertain future flows, forever. No need to try to make artificial judgements about who "should" get water.

Simple **pay-for-itself mechanism**, a small commission on each trade. Hydrology modelling **investment is put to active every-day use.**

We can't make it rain, but we can do a much better job of allocating the available water.

[www.banknotes.com/NZ161.JPG](http://www.banknotes.com/NZ161.JPG), [www.newzealandnz.co.nz/methvenmthutt/fishing.jpg](http://www.newzealandnz.co.nz/methvenmthutt/fishing.jpg)

## Higher value of water from more productive use



Of course, a key benefit is the immediate improvement in the efficiency and productivity of one of New Zealand's most important assets.

[Pause]


And the lawsuits go away! Which is easier: going to court, or **clicking on a web site?**


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72-hour forecast

www.niwa.co.nz/news-and-publications/publications/all/wa/11-4/forecasts, www.radaronline.com/from-the-magazine/lady\_computer.jpg

7 a.m. 

8:45 a.m. 

9 a.m. 

9:05 a.m. 

7-14 Feb 2010	<input type="radio"/> Sell <input checked="" type="radio"/> Buy	1 ML	\$ 3 /ML
	<input type="radio"/> Sell <input checked="" type="radio"/> Buy	1 ML	\$ 1.5 /ML
15-21 Feb 2010	<input type="radio"/> Sell <input checked="" type="radio"/> Buy	1 ML	\$ 3 /ML
	<input type="radio"/> Sell <input checked="" type="radio"/> Buy	1 ML	\$ 1.5 /ML

Submit bid

Maximize  $\sum_{t=1}^T \sum_{w=1}^W \sum_{s=1}^S p_{t,w,s}^* q_{t,w,s}$  subject to:

- $0 \leq q_{t,w,s} \leq Q_{t,w,s}$  for tranches  $b = 1, \dots, B$ , wells  $w = 1, \dots, W$ , and periods  $t = 1, \dots, T$ .
- $q_{t,w} = \sum_{s=1}^S q_{t,w,s}$  for wells  $w = 1, \dots, W$ , and periods  $t = 1, \dots, T$ . (Dual variable  $p_{t,w}^*$ )
- $drawdown_{k,t} = \sum_{s=1}^S \sum_{w=1}^W F_{k,t}^{w,s} q_{t,w,s}$  for all control points  $k = 1, \dots, K$ , and periods  $t = 1, \dots, T$ .
- $I_t \leq N_t^* - drawdown_{k,t} \leq U_t^*$  for all control points  $k = 1, \dots, K$ , and periods  $t = 1, \dots, T$ .
- $LD_{k,t} \in (N_t^* - drawdown_{k,t}) = (N_t^* - drawdown_{k,t}) \in UD_{k,t}$  for control points  $\{k, t\} \in D$ , periods  $t = 1, \dots, T$ .

Feb 7-14. You sold 0.8 ML, \$1.76/ML. Firm rights for 4.2 ML.  
Feb 15-22. You bought 1 ML, \$1.22/ML. Provisional rights for 5.6 ML.

Here's the auction process, once per day or once per week.

1. A **market manager** serves as a broker. To ensure that environmental constraints can be met, the manager may reduce consents proportionally. Here, we see the market manager checking the weather before the auction, to calculate the available water.

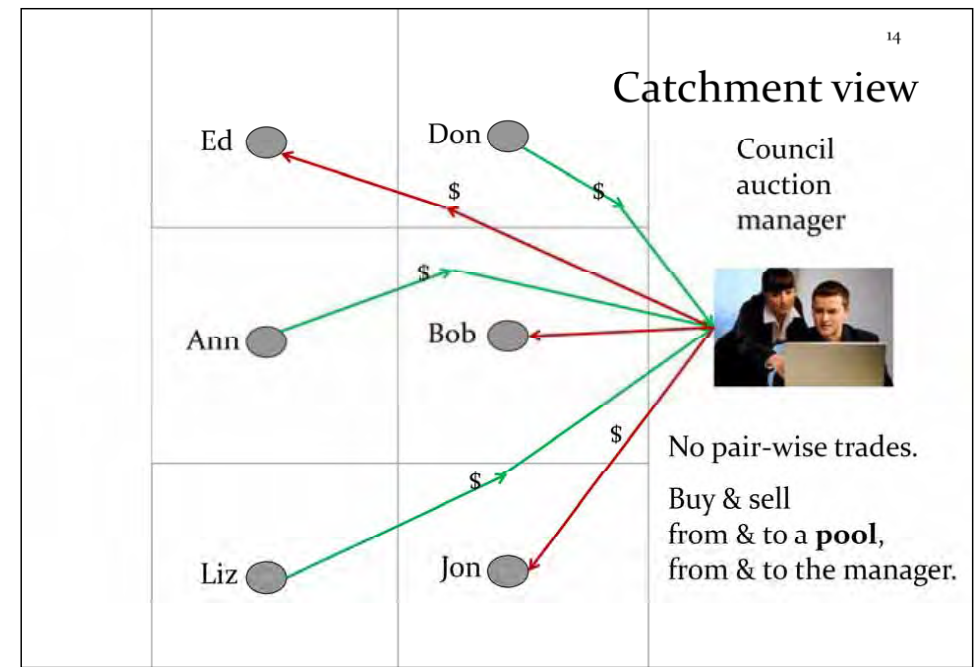
✓ 2. Ann logs onto the secure encrypted auction website, before 9 a.m. Monday. She has an **initial net consent** as a result of previous auctions. If Ann doesn't go on the website, she can still take her initial consent for free. Bids are **changes** to consent. A user can bid to sell for a high price *and* buy for a low price. Ann makes several bids at once. She will sell for a high price, and would buy for a low price. Critically, she can bid for water rights for future weeks in this week's auction, thus lowering her risk. So right now, she can change her full production plan, for every week in the remainder of the year, if she wants to. Ann's bids are private. Only she and the market manager can see them.

✓ At 9 a.m., bidding closes. Based on the bids, hydrology, and environmental constraints, the manager runs a **hydrological optimisation**. The computer model allocates all water in the catchment at once, for every remaining week in the hydrological year, taking into account expected future effects. The model calculates market-clearing prices following standard theory, and ensures environmental flows.

✓ The market manager announces allocations and prices at each well. These prices are public information. Each user's allocation becomes their **new consent for that period**. The auction manager updates Ann's web page with her allocation & price, and charges or pays her, if she has bought or sold. She now has firm rights to take water for this week, and provisional rights for water in future weeks.

No infrastructure is needed! We don't need reservoirs to trade water. We just need a reasonably good hydrology model. This is a water market with control.

Weather image from [http://www.niwa.co.nz/news-and-publications/publications/all/wa/11-4/forecasts,http://www.radaronline.com/from-the-magazine/lady\\_computer.jpg](http://www.niwa.co.nz/news-and-publications/publications/all/wa/11-4/forecasts,http://www.radaronline.com/from-the-magazine/lady_computer.jpg)



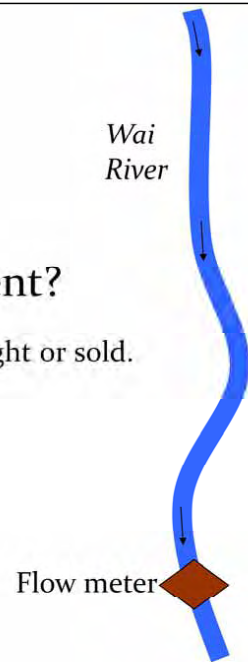
Here's a catchment view. All water is traded through the auction, as central pool.

And these models are easy! Operations research models are now used heavily by government and industry: crew scheduling at Air NZ, reservoir scheduling for hydrogenerators, census planning at StatisticsNZ, forestry planning, vehicle routing, facility location at Norske Skog, many many applications. These hydrological models are very simple by comparison. It's the politics that's difficult.

What about the environment, how does it fit in?

## The environment?

**Constraints.** Not bought or sold.



The environmental flows do not require a price or a bid; they are a constraint under which commerce must operate. This system would ensure that commercial water use never violates agreed-on environmental standards. All flows would be simulated before users were given permission to take water, at every auction. This is the “forever” part of “Forever Fair”.

The environmental flows are chosen by gov't & community, with help from hydrologists, just as they are now.

Will a user be penalised for being close to a sensitive region? Yes. Prices will be higher near sensitive places. That's good! We *want* to discourage water use near environmentally sensitive places.

What about the effect of water use over time? Water use now can hurt the environment in the future. The system simulates *future* water flow to prevent future problems. Whether prices are high or low, *even if users collude or monopolize*, these constraints ensure that the environment is protected.

Interestingly, this process allows buying of additional water on behalf of the environment, which anyone could do. An environmental agent could be tasked with buying and selling water rights so as to maximize environmental value subject to a budget. This would improve ecological outcomes drastically at very low cost! Users would be seamlessly compensated at fair prices.

So this is a water market with control. Now what exactly is being traded?

## Nature of the right

The right is to take water at a given location, for a given time period (e.g., a week), for acceptable use.

Tietenberg, 2002.

“... give ‘adequate’ (as opposed to complete) security to the permit holders, while making it clear that permits are not property rights.”

**The right is to take water at a given location, for a given time period (e.g., a week), for acceptable use.**

In 2002, Tom Tietenberg wrote an article, called “The Tradable Permits Approach to Protecting the Commons” Here's his comment on rights.

“...give ‘adequate’ (as opposed to complete) security to the permit holders, while making it clear that permits are not property rights. For example according to the title of the US Clean Air Act dealing with the sulfur allowance program: ‘An allowance under this title is a limited authorization to emit sulfur dioxide....Such allowance does not constitute a property right. (104 Stat 2591) In practice this means that administrators are expected to recognize the security needed to protect...[users’] investments by not arbitrarily confiscating rights. They do not, however, give up their ability to change control requirements as the need arises. In particular they will not be inhibited by the need to pay compensation for withdrawing a portion of the authorization to emit as they would if allowances were accorded full property right status. It is a somewhat uneasy compromise, but it seems to have worked.”

You can't have a property right to the commons. That means that this approach probably should *not* be left purely to the private sector, at least not without government supervision, because the incentives are wrong, and because the resource is public.

Our system relies on the ability of the environmental authority to scale users' rights to the available water. Let's see some implications of this.

$\alpha$  = % permit allowed, proportionally scaled.

$\alpha = 0\%$   $\alpha = 100\%$   
 Users pay gov't. Over allocated. Gov't pays users.

## Initial rights & over-allocation.

Alpha is the % permit allowed. So if alpha is 80%, then every user gets 80% of their consent.

✓

With  $\alpha = 0\%$ , the market manager is a monopolist, selling water in a user-pays system. Probably not acceptable to users. Unnecessary for efficiency.

With  $\alpha = 100\%$ , the catchment is likely over allocated (depending on weather conditions). In this case, because the environmental flows **must** be met as constraints, the computer requires the market manager to buy rights from users to protect the environment. This is more like government procurement. This is not a sustainable policy from government's point of view. Users can raise prices to infinity, and gouge taxpayers. Perverse incentives – users holding government to ransom.

What if we could find  $\alpha$  where net revenue = \$0? That would be a “user trades” system, where the market manager is a revenue-neutral broker.

So the market manager – that is, council - must have authority to adjust consents to match conditions. Council already has such authority, but our system would make this far more precise.

So how would this work legally in New Zealand? To see this, let's hear from some distinguished people.

**Ali Memon & Peter Skelton,**  
 “Institutional Arrangements & Planning Practices  
 to Allocate Freshwater Resources in NZ: A Way Forward,”  
*NZ J of Envl Law* 2002.

“*5.4.1 Auctions* The RMA permits regional councils to allocate surplus water by setting up an auctioning system in its regional water allocation plan.

As an example of a water auction framework, the *Raffensperger Milke model*...is designed to facilitate transfer of water permits or parts thereof within a particular catchment.

*Emphasis in original.*

This paper in a refereed law journal is the closest thing we've had to a legal review of our work, and it seems a pretty good one!

Ali Memon is Professor of Environmental Management at Lincoln University.

Peter Skelton is a retired judge who specialised in resource management law. He has written over 1,000 major legal decisions in resource management cases.

✓

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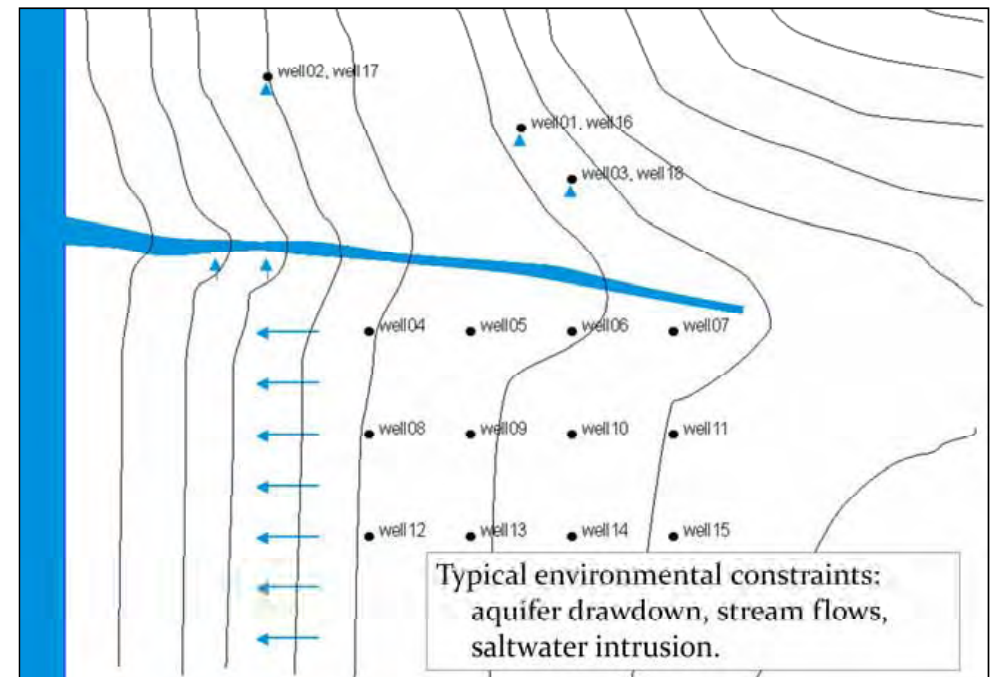
A regional council could make provision for this model in its regional water plan by specifying the parameters of the auction management system including details of the way the auction market would work as objectives, policies, methods, and rules. Rules in the plan would provide that:

- The “purchaser” of water can take/use more from his own existing source to the extent of his purchase as a *permitted* activity subject to the conditions of his existing permit.
- The taking/use by the “vendor” of water sold by him is a *prohibited* activity for the duration of the transaction.
- Such market mechanisms may operate at the broad level or more narrowly within allocations to particular uses, e.g. irrigation.”

*Emphasis in original.*

[follow slide]

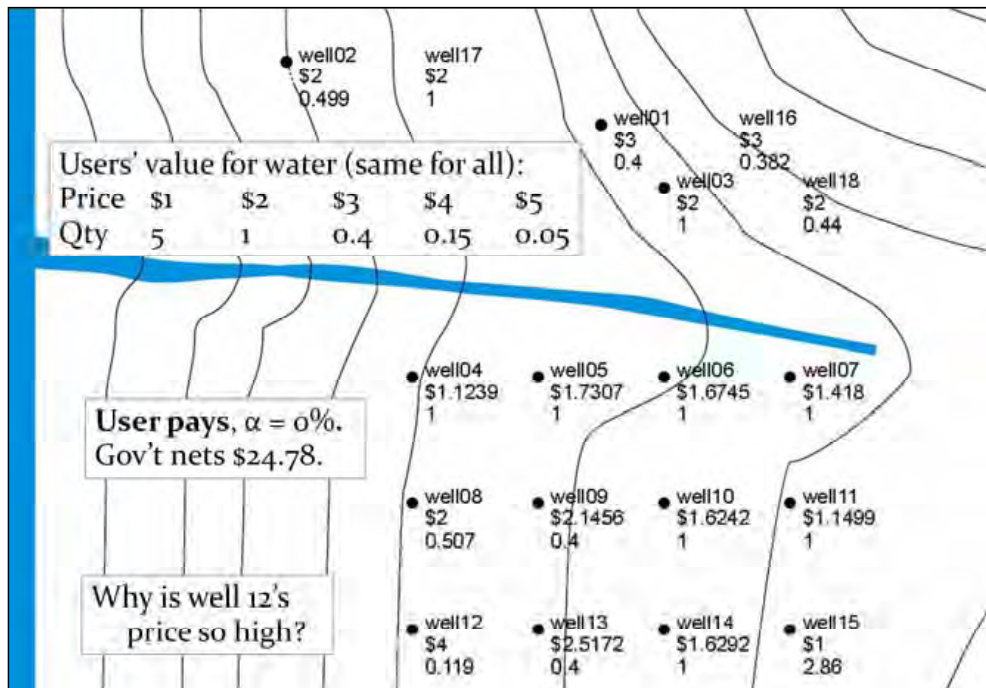
Alright, let's look at some scenarios, and in particular the ability of the authority to scale users' rights.



This is a schematic of a catchment with 16 wells. The ocean is at left. A stream runs through the middle. The dots are the wells.

The triangles indicate aquifer draw down constraints, that the aquifer may not be drawn down too far. The arrows indicate required head constraints, two to make sure the stream has flow, and seven to prevent salt water intrusion from the coast. The curved lines indicate the natural aquifer height.

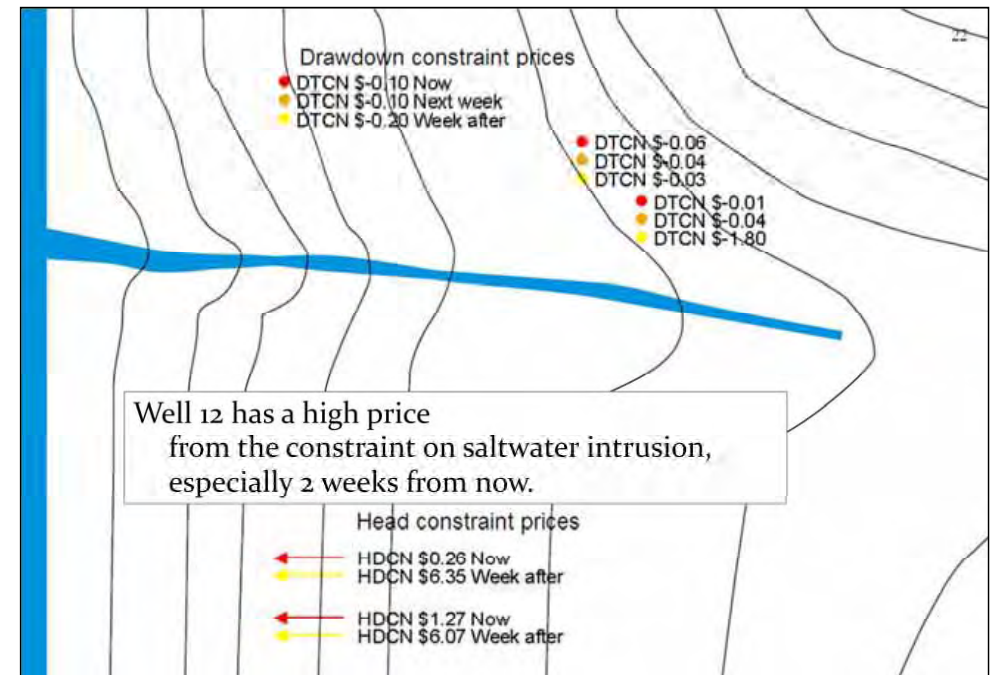
We'll see four scenarios: first user pays, second over-allocation, third proportional reduction, and last a really cool scenario that we call “user trades”.



We assume everyone has equal value for water. Users would sell all their water if the price were more than \$5.

In this example, we assume that users have no initial consents, and they must buy it from government.

Why is Well 12's price so high? Well 12 has a high price because it is right next to the coast. The salt water intrusion constraint is "binding," meaning that no one should take more water near the coast, to avoid damaging the freshwater aquifer. Even if well 12 bid up the water to a billion dollars, the computer would not allow the salt water intrusion constraint to be violated.

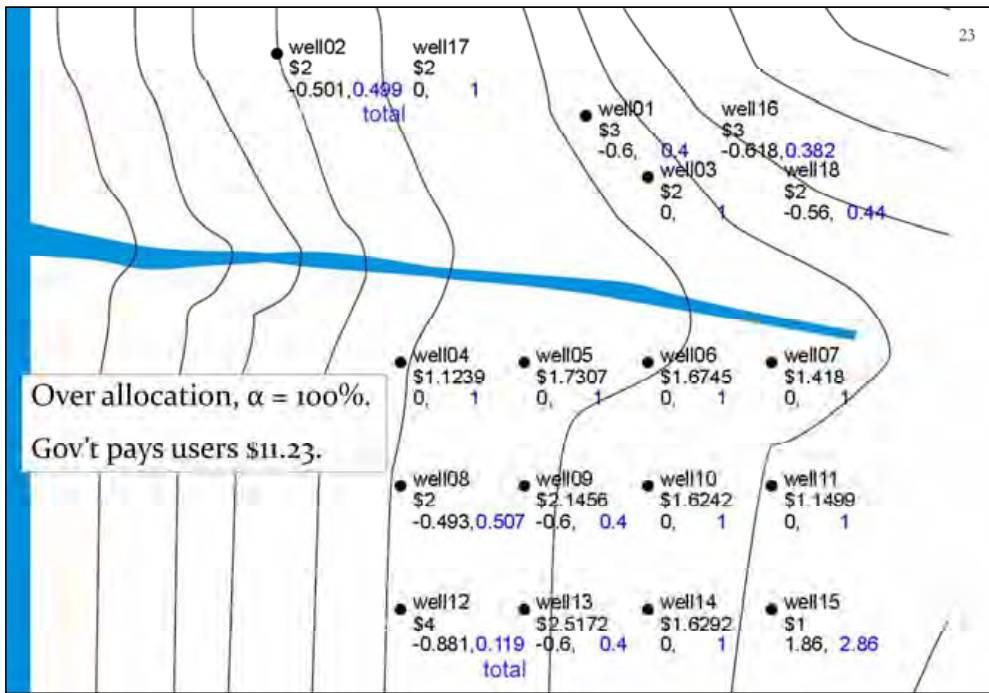


This shows the "shadow prices" of the constraints. Even though all users bid identically, the prices are not all equal, because the hydrology isn't uniform.

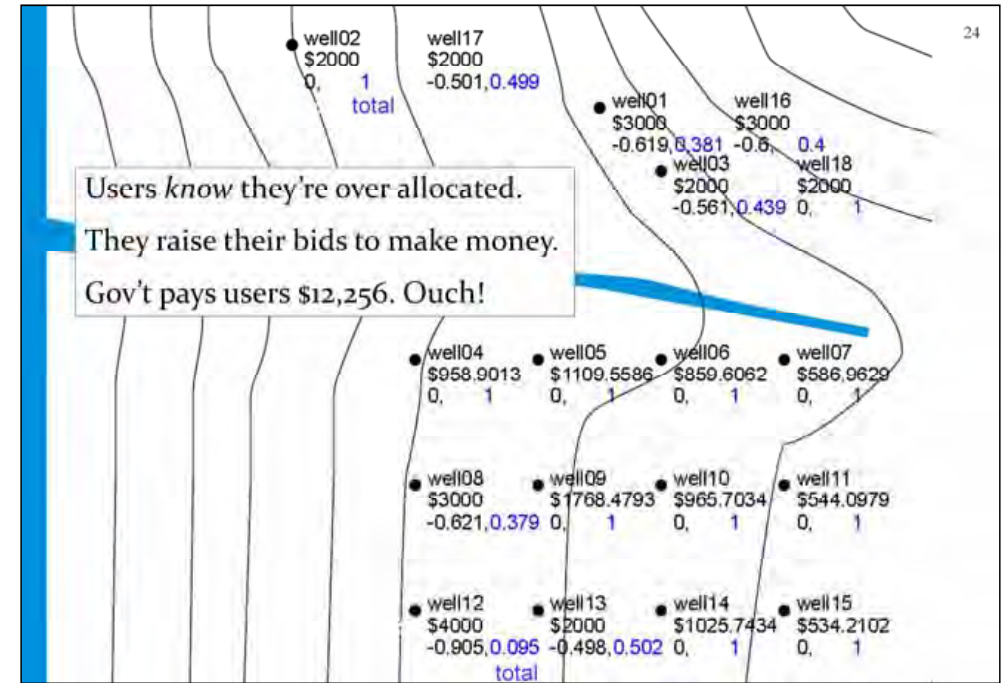
The DTCN labels show the aquifer drawdown prices.

The HDCN labels show the head difference constraints near the coast. Note that the "Week after" price is very high. What's happening is that the hydrological cone of abstraction will take about 3 weeks to hit the coast, so we need to discourage people from taking too much water now, to avoid future damage.

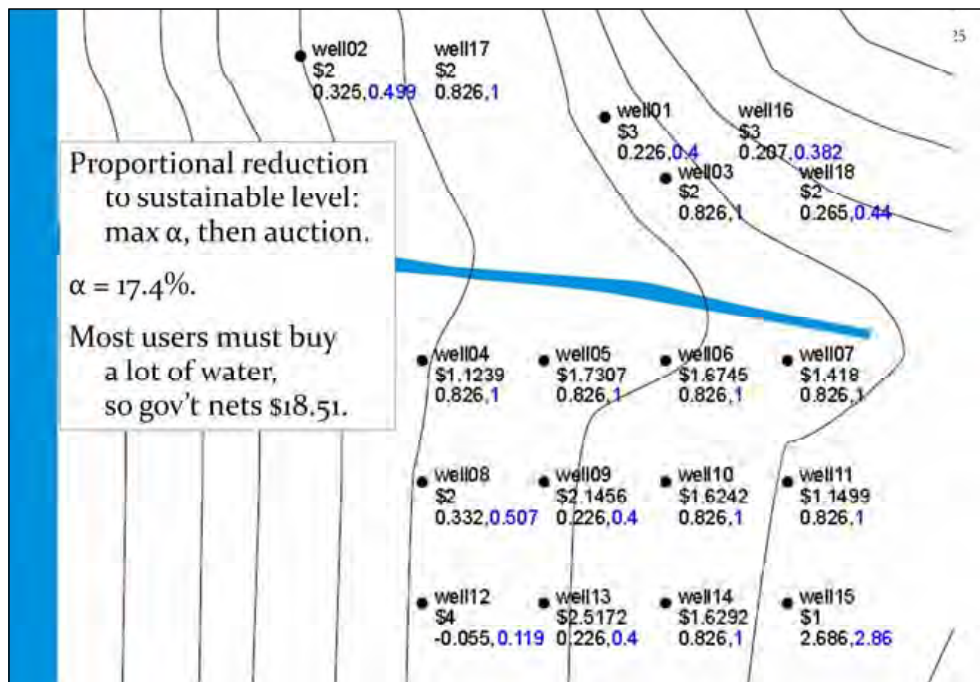
Not shown are some head difference constraints for the stream. These were omitted because the price is zero – the stream get more flow than required.



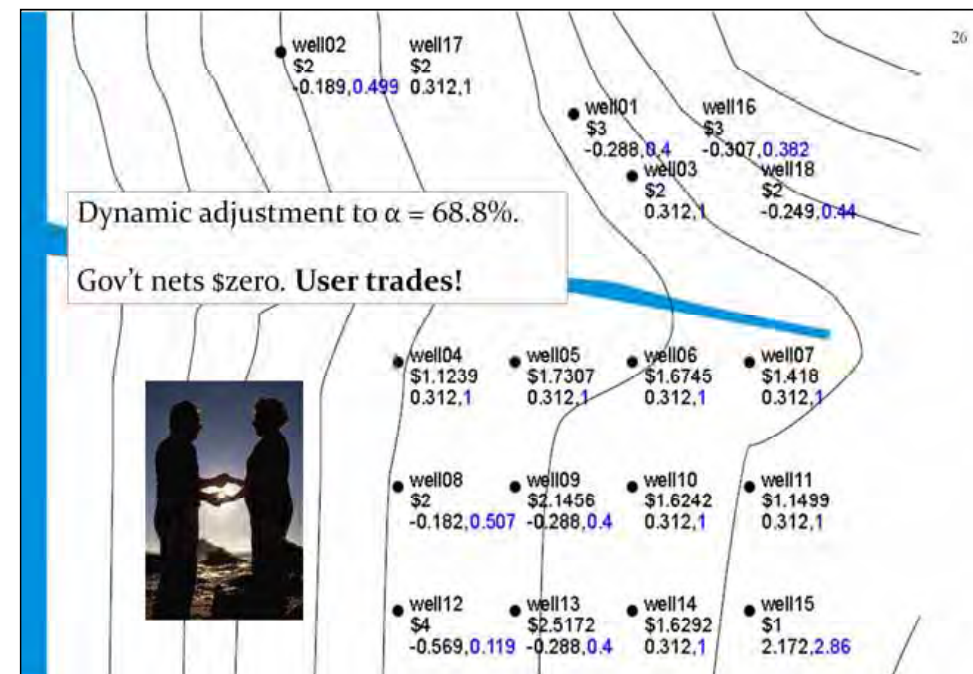
If we give users their full allocation, the computer still ensures that all environmental constraints are satisfied. The only way to achieve this is if government buys back consent from users. This is not very clever!



If users know that the catchment is over allocated, they will be tempted to hold government to ransom, and raise the price to infinity. And the computer, because the environmental flows are constrained, will force the government to pay it! Obviously, this is not a tenable situation.



So government can maximize the proportion that *all* users can get sustainably. Unfortunately, that proportion is determined by the “driest” well, well 12, which is right on the coast. So we see that most users have their consents cut back, and then the users buy the rights again. They are likely to complain about that.



Here, we have found a proportion where government nets \$0. This is much higher than before. Now government has no net financial interest in the market, and serves as a impartial broker.

In fact, we have found even better ways to set this alpha parameter. In any case, this user trades scenario appears to be much more acceptable politically, and we think it gives users the correct incentives.

Government could adjust alpha slightly to cover the costs of running the auction. This is a water market with control.

	well09 \$2,1456 0.4	well10 \$1,6242 1	well11 \$1,1499 1	27
User pays	well13 \$2,5172 0.4	well14 \$1,6292 1	well15 \$1 2.86	
Over allocation	well09 \$2,1456 -0.6, 0.4	well10 \$1,6242 0, 1	well11 \$1,1499 0, 1	
	well13 \$2,5172 -0.6, 0.4	well14 \$1,6292 0, 1	well15 \$1 1.86, 2.86	
Proportional reduction	well09 \$2,1456 0.226, 0.4	well10 \$1,6242 0.826, 1	well11 \$1,1499 0.826, 1	
	well13 \$2,5172 0.226, 0.4	well14 \$1,6292 0.826, 1	well15 \$1 2.686, 2.86	
User trades	well09 \$2,1456 -0.288, 0.4	well10 \$1,6242 0.312, 1	well11 \$1,1499 0.312, 1	
	well13 \$2,5172 -0.288, 0.4	well14 \$1,6292 0.312, 1	well15 \$1 2.172, 2.86	

Every scenario has the *same* prices and final allocations.

Trades are different, & who gets the money is different.

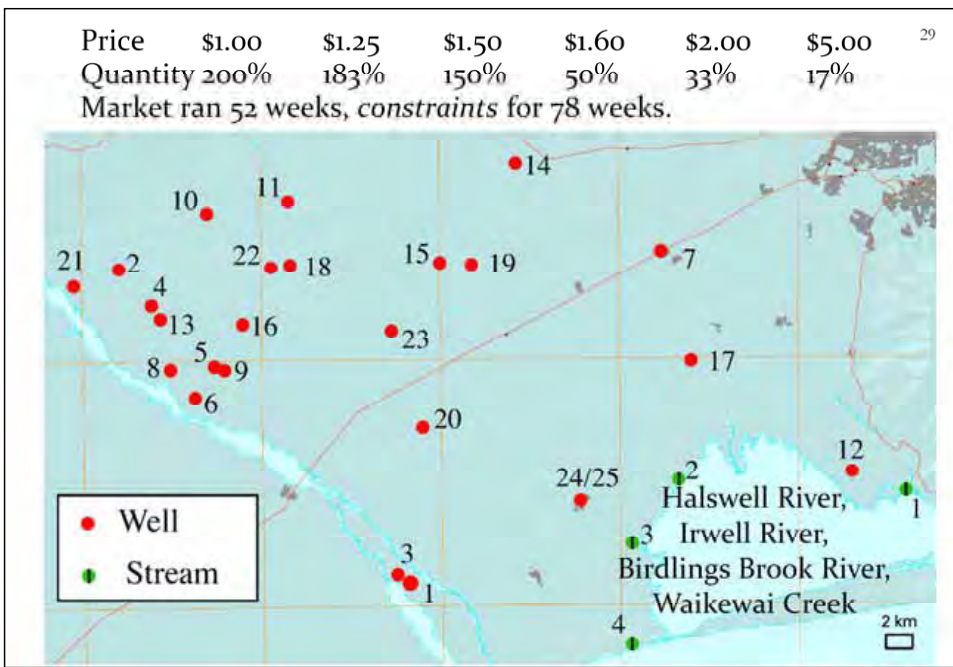
Ronald Coase from the University of Chicago proved that this would happen: given sufficiently low transaction costs, and no budget effects, then initial rights are independent of the final optimal allocation. Unfortunately, without the smart market, allocating environmental resources has huge transaction costs.

The point is that, from an economic point of view, the initial rights won't affect the final allocation. But business people know that the initial rights strongly affects who gets the money! So users will press for large free initial rights, just as the carbon emitters are pressing for free credits.

Now let's look at some realistic cases.



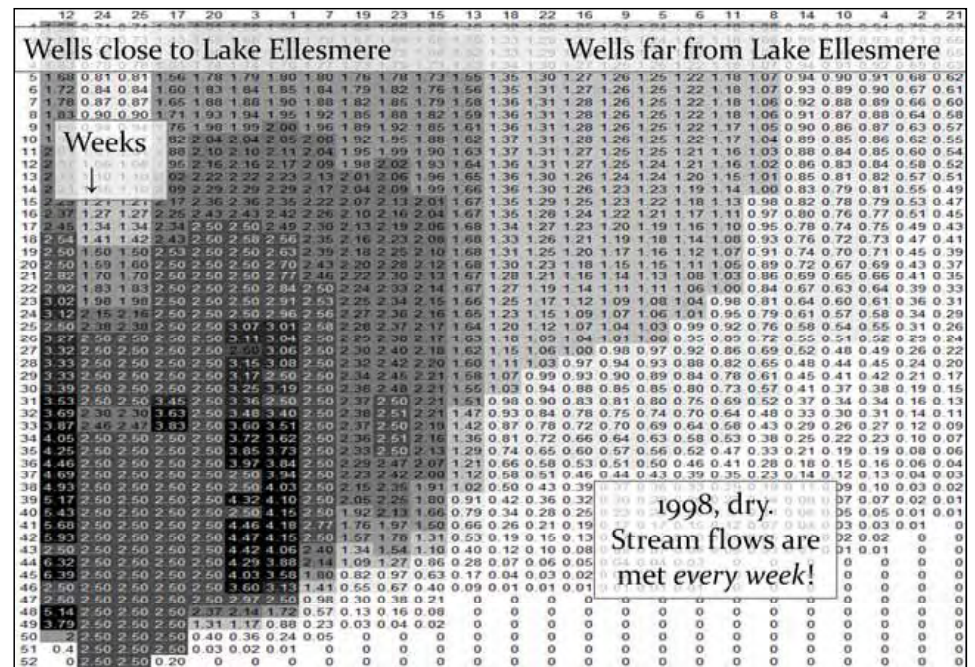
This work was done by an MBA student, Manfred Plagmann, and sponsored by Selwyn District Council. Our thanks to them for their support. The study area here is the farms around Lake Ellesmere. The concern is to ensure the flow of streams that flow into the lake.



[Explain map]

For price  $\leq$  \$1/ML, a user would buy a volume equal to his permit.  
 For more than \$5/ML, a user would sell all their permit.

Market ran 52 weeks, but *constraints* ran for 78 weeks to ensure sustainability into the future.



This is a simulation of a market in which we assume that all users would try to take water for the whole year. Instead of a one-period snapshot, we are looking at a schedule of prices over the course of a year. Each row is a week

Each column is one well, sorted from left to right by how close each well is to Lake Ellesmere. So well 12 is closest, and well 21 is furthest away.

The price is highest for wells close to Lake Ellesmere, and highest in the driest part of the year.

It is important to understand all flows for all four stream were guaranteed in every week of the year!

There's no way that anyone could guess these prices in advance! A flat water charge could never be set correctly over time and by location.

There's no way that pair-wise trading would have found this optimal solution. Free trade won't work, because the transaction costs are too high.

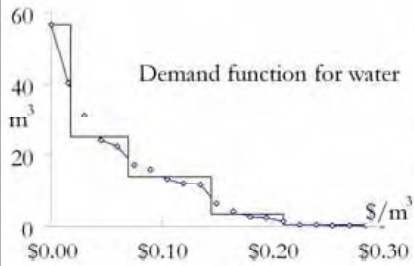
There's no way that any community-based committee could negotiate this – the streams would have gone dry before they'd made their decisions.

This will work, easily, if government facilitates trade with a central auction while protecting the commons with constraints.

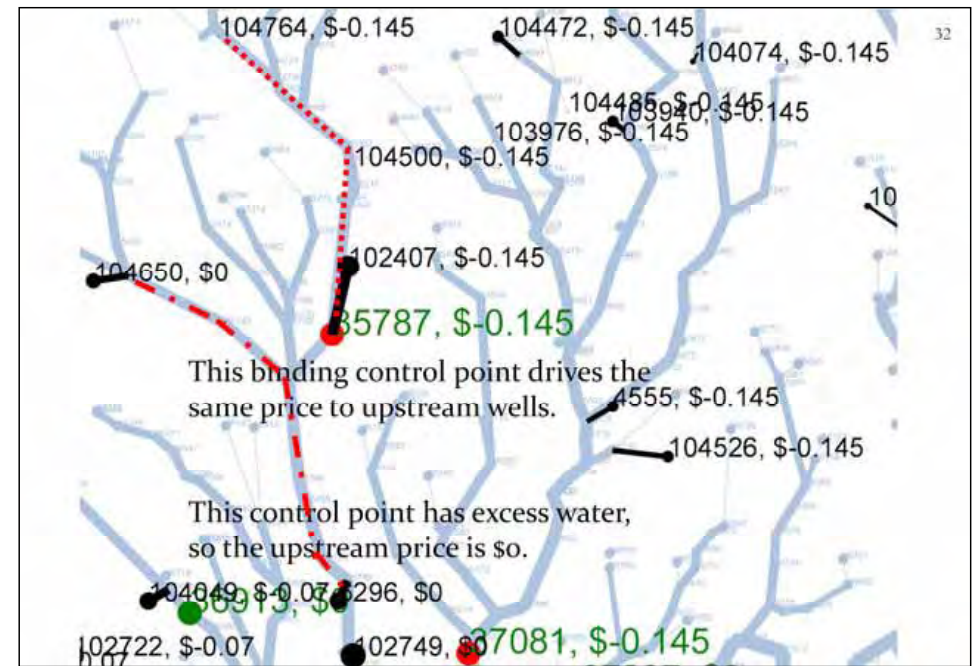
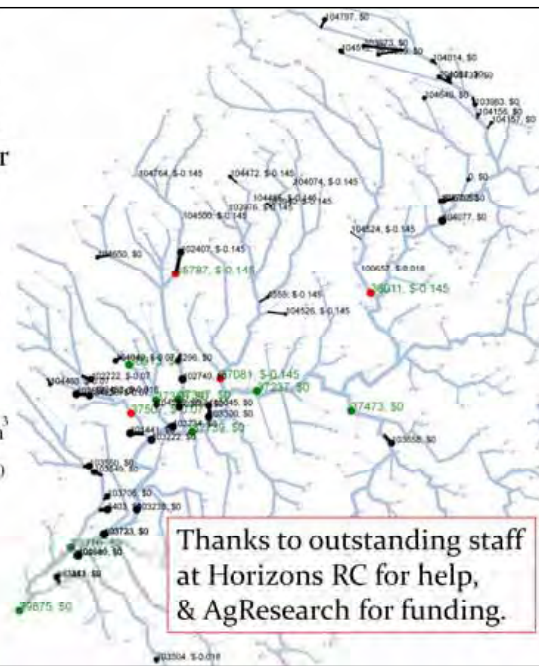
A water market with control.

## Market simulation,

Key idea: *not* pairwise trading.  
Many-to-many simultaneous tr  
Near zero transaction cost.



A gain of 7% to 150%,  
\$800 to \$9,000/user/year.  
depending on demand.



First let me say a big thank you to the excellent staff at Horizons Regional Council for their help in putting this case together, and to AgResearch for funding it.

This case study is for surface water, not ground water, in Upper Manawatu. The operations research for this type of problem is very old and well studied.

Remember, there's no pairwise trading, but rather this is a many-to-many simultaneous trade, with transaction costs near zero.

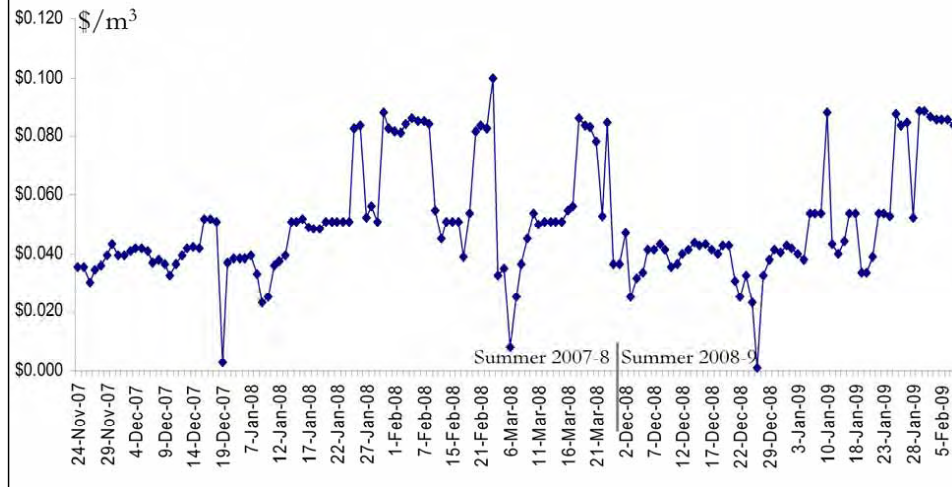
I created a synthetic demand curve from public data sources. In a real market, prices would be set by your own value for water. I wasn't able to interview every farmer in Manawatu to get their private value for water!

The result was a gain of 7% to 150%, depending on what was assumed about growth in demand.

[follow slide]

Here, we see that prices upstream are driven by the control point down stream. For example, the price at control point 35787 is fourteen point five cents. The price at each well upstream is the same.

## Simulated average catchment prices



This graph shows the simulated prices by day for two summers. Prices are determined by farmers and available rain. Note that these prices are the **shortage** cost: the lost farm profit per unit water.

Prices depend on daily rain, so this is a responsive allocation mechanism. It would be highly robust with immediate response to climate changes.

This price information would be valuable in planning any kind of water-related investment.

## Related work, already refereed & published.

Run-off, nitrate. Different time scales to water, not a combined market.

Impervious cover, sediment.  
Reduce flooding at low cost.

Easy to add ground + surface water & reservoirs.

Lake Taupo

[www.taupoconsulting.co.uk/whytaupo.html](http://www.taupoconsulting.co.uk/whytaupo.html)

Our work has been heavily refereed already, and much is now published in top journals. We've been at this a long time.

We've done additional work on run-off, especially nitrate, and we're looking at problems of impervious cover, especially to reduce flooding. Interestingly, in many cases, water quality will be a separate market to water quantity, because of the different time scales of their movement.

Our work on water markets for ground water easily generalizes to complex catchments, including surface water and reservoirs. In fact, ground water was the hard case.

We're working on writing open source software to run the auction models. Unlike the Apple iPad, I think our methods will still be used hundreds of years from now.

*Lake Taupo, NZ, [www.taupoconsulting.co.uk/whytaupo.html](http://www.taupoconsulting.co.uk/whytaupo.html)*

## Council runs a constrained auction for big commercial users to lease consent.

1. Metering, hydrology data, environmental limits.
2. Set initial rights. Manager must adjust initial rights to conditions.
3. Write web page, hold auction, run model, report results.



End. Thanks for coming!  
Email any questions,  
I'll answer

Godwits in flight

<http://www.teara.govt.nz/en/bird-migration/1/1?setlang=mi>

Connect a hydrological simulation to a constrained math model, to the internet.

Reduce costs for business *and* enable business in aggregate to act sustainably.

Users must be metered, preferably telemetered. Start with the largest users who would have the most to gain, and who have the largest impacts.

Get impact coefficients. Often, already available! Choose env. limits.

✓ Set initial rights. Just grandfather in existing consents. The auction manager must have authority to adjust initial rights to conditions, but councils already have this authority.

Write web page, announce auction, run the model, report the results. Enforce the law.

✓ So we are proposing a water market with control. The Forever Fair water market system would move water to the highest value use, incentivize efficiency, guarantee the environmental flows, and make governance far easier. Implementation cost would be cheap, maybe about the same as the feasibility study for a new reservoir.

If you're interested in trying this, please give me a call.

*Godwits in flight*, <http://www.teara.govt.nz/en/bird-migration/1/1?setlang=mi>.