What we know

…about water quality in the Hurunui catchment

Results from current monitoring and investigations

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Key messages

- Didymo appears to be the dominant algae in the upper reaches
- Cyanobacteria (*Phormidium*) is an issue in the lower reaches of the Hurunui River
- Nitrate from intensive land use in the Amuri Basin is the main source of N to the Hurunui mainstem, with increasing trend in concentrations at some tributary and groundwater sites and for SH1
- The lag in nitrate reaching the river from land use in Amuri Basin and Waitohi area is uncertain and more work needed.
- The impact of AIC piping, development of HWP and Balmoral forest conversion is still to be seen.

Key messages continued

- The impact of altering in-river N & P concentrations on periphyton growth and species composition remain uncertain. Notwithstanding this,
  - the management of N & P, microbial contamination and sediment is considered necessary to avoid an adverse deterioration in freshwater quality;
  - Flushes and small floods are effective in regulating periphyton accumulation;
- Ecological health occasionally indicates degradation for some sites
- Swimmability (*E. coli* levels) is an issue for the tributary streams and at SH1 much of the time

Wadeable and Swimmable

- **Wadeable** = People are exposed to a high risk of infection (>5% risk) from contact with water during activities with partial immersion and some ingestion of water
  - Annual median must not exceed 1000 MPN/100mL
- **Swimmable** = moderate risk of infection (< 5% risk) from activities likely to involve full immersion.
  - Annual 95th percentile must not exceed 540 MPN/100mL

From NPS-FM (2014)

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Wadeable and Swimmable

- Wadeable: All sites monitored are suitable for wading activities
- Swimmable:
  - 2013-14 : 5 of 6 sites do not meet minimum requirements
  - Tributary streams frequently do not meet minimum requirements for swimmability
  - Hurunui River at SH1 did not meet minimum requirements for past 4 years – reflected by a 'poor' suitability for recreation grading
  - Decreasing *E.coli* trends for Dry Stream, Pahau River and St Leonards Drain

Swimmable	2011-12	2012-13	2013-14	2014-15	2015-16
Hurunui River at Mandamus	A	A	B	A	A
Mandamus River – Tekoa Rd				B	B
Waitohi above Hurunui Confl.		B			
Dry Stream above Hurunui Confl.	Insufficient data for analysis				
Pahau River above Hurunui Confl.	B	B		A	
St Leonards Drain above Pahau					
Hurunui River SH1	B				

Sites coded red do not meet the minimum acceptable state for Swimmability for that year.

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Contact recreation (summer) monitoring

- Suitability for recreation monitoring only carried out for Hurunui River at the swimming site near SH7 bridge and at SH1.
- Recent improvement to "Fair" grading, but have both been previously considered unsuitable for recreation

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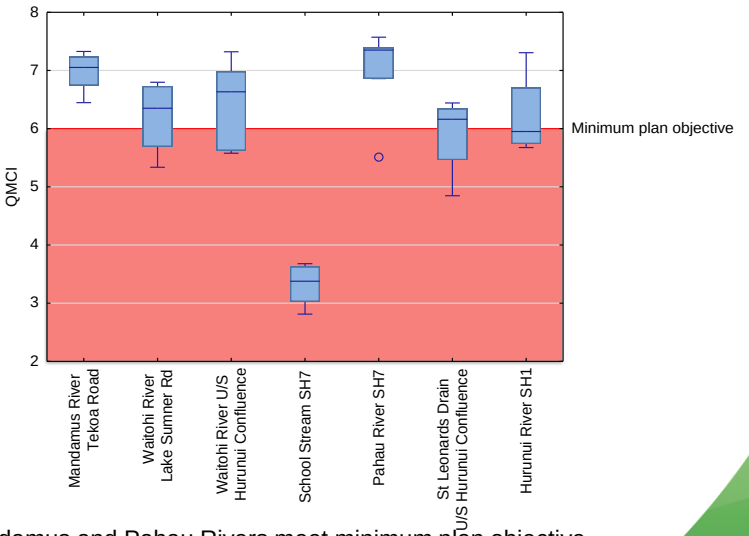
Aquatic ecosystem health

Monitoring of aquatic macro-invertebrates (bugs >0.5 mm) species as an indicator of overall water quality and stream habitat



- Mandamus and Pahau Rivers meet minimum plan objective
- Waitohi (2 sites), St Leonards Drain and Hurunui SH1 occasionally do not meet the minimum plan objective
- School Stream at SH7 does not achieve the minimum plan Objective

Key Messages: Aquatic Ecosystem Health

- 2 sites always meet plan objectives, 4 sites sometimes meet plan objectives,
- School Stream at SH7 does not meet the minimum plan objective
  - Stagnant flow, choked with macrophytes and floating algae
- AIC piping will reduce flows in many of the Amuri Basin streams

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What is periphyton


Green filaments


Black *Phormidium* mats

- Algae or cyanobacteria e.g didymo, green filaments, *Phormidium*
- In large quantities can be considered a nuisance due to impacts on river values
  - Recreation – *Phormidium* mats can be toxic
  - Ecological – can smother the benthic environment
  - Aesthetic appeal

Key factors driving Periphyton and Cyanobacteria

- River flow has greatest influence on periphyton growth, followed by nutrients when flow is optimal
- different periphyton appear to have different nutrient requirements
  - didymo = low nutrient requirements
  - cyanobacteria = elevated N, potentially low P in water
  - long filament = elevated N & P
  - Need to manage both N & P to meet requirements of different periphyton

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Total Periphyton - biomass

- NPS-FM National Objectives Framework – Benthic Periphyton – chlorophyll 'a'
  - Only have suitable data at 2 sites: Hurunui SH1 + Pahau River
- Pahau River at Top Pahau Rd generally good
- Hurunui River at SH1 variable and not suitable all years

Benthic Periphyton	No. samples	National Bottom line		C		B		A	
SQ30064	Hurunui River SH1								
3 yr	36	4	11%	5	14%	2	6%	22	61%
2011-12	12	3	25%	2	17%	0	0%	5	42%
2012-13	12	1	8%	1	8%	1	8%	8	67%
2013-14	12	0	0%	2	17%	1	8%	9	75%
SQ00540	Pahau River at Top Pahau Road								
3 yr	36	0	0%	0	0%	1	3%	34	94%
2011-12	12	0	0%	0	0%	0	0%	12	100%
2012-13	12	0	0%	0	0%	1	8%	10	83%
2013-14	12	0	0%	0	0%	0	0%	12	100%

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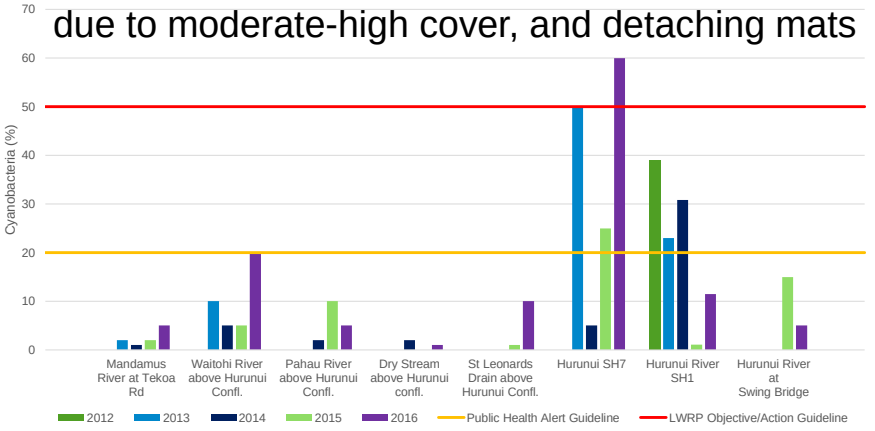
Cyanobacteria (*Phormidium*) mat cover in rivers

- Most problematic in Hurunui River
- Public Health Warnings often issued at SH7 (often on a side braid that is the swimming site) & SH1 due to moderate-high cover, and detaching mats



Didymo cover in rivers

- Monitoring indicates Didymo is the dominant periphyton in the upper catchment (upstream of SH7)
- Didymo appears to dominate under low nutrient conditions

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Nutrients and their impact on surface water quality

- **Nutrients**
  - At **low** concentrations - Beneficial in encouraging thin growths of algae in rivers (food for aquatic life)
  - At **higher** concentrations – encourage conspicuous nuisance growths of algae (periphyton)
  - At **very high** concentrations some nutrients (Nitrate-N, Ammonium-N) can be toxic
- Different guideline address different effects

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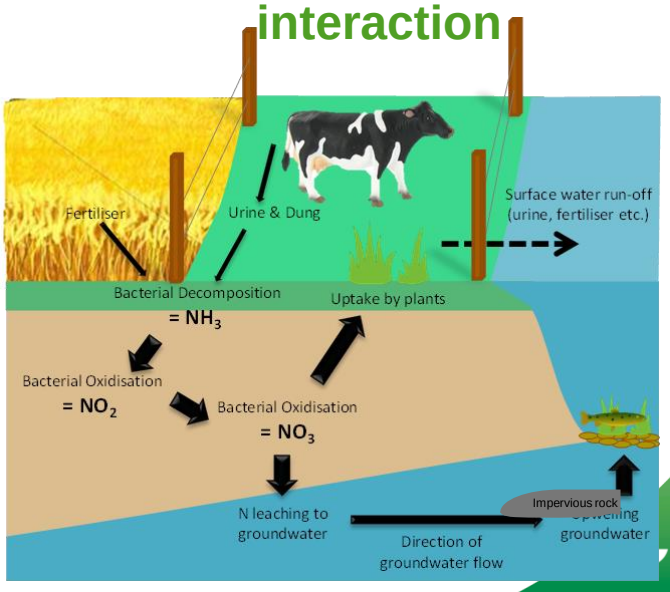
Surface water – groundwater interaction



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Lag time – uncertain and more work needed

- Can take years to decades for nitrogen from land use to re-emerge in surface water
- We first see effects of changes in a few years, but it takes longer to equilibrate (steady state)
- Lag is spatially variable and recharge dependent
- Tools for lag: time trends, age tracers, modelling
  - We need more information to apply these
  - e.g. timing of conversions/intensification

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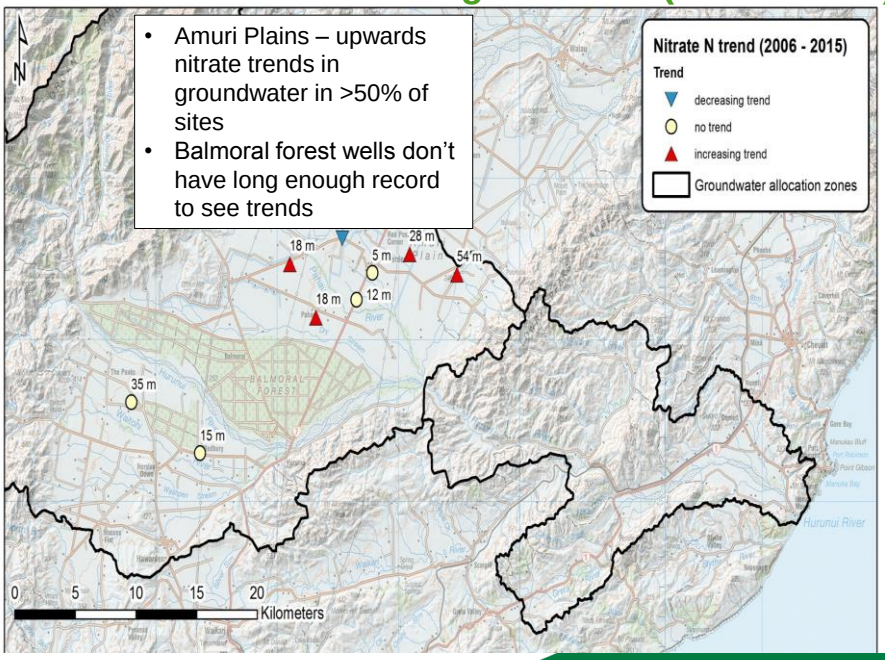
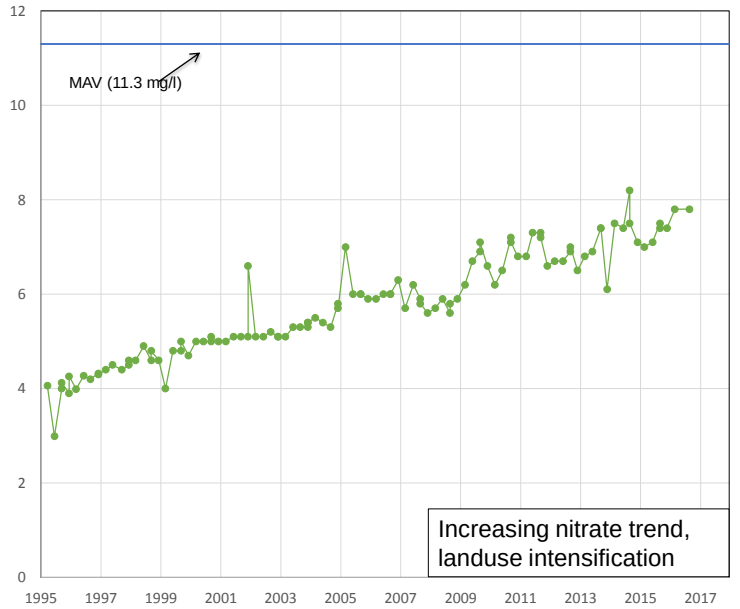
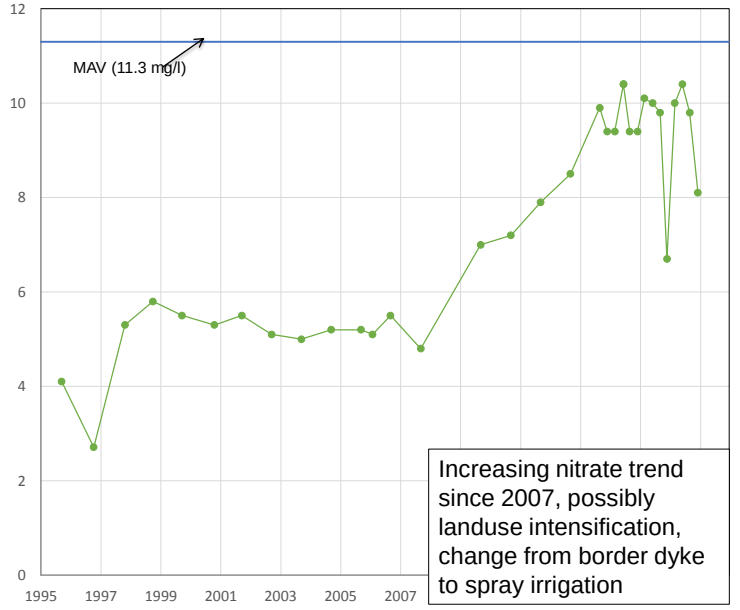
Groundwater: Nitrate-Nitrogen trends (2006 – 2015)



Amuri Plains well (N33/0205 – 28 m deep)

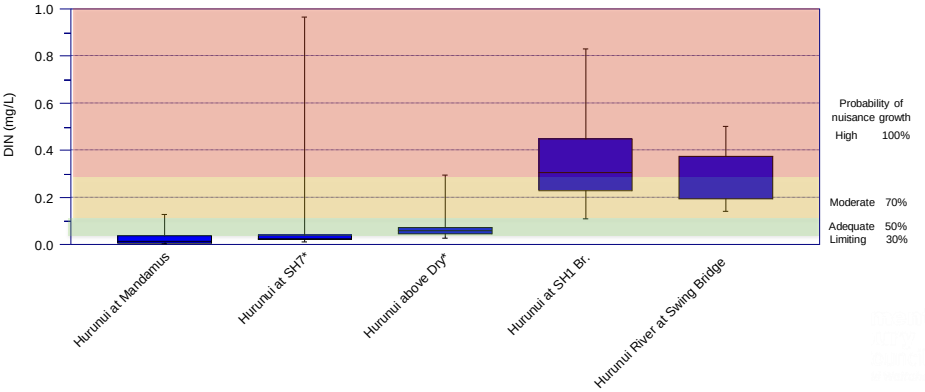


Amuri Plains well (N33/0219 – 18 m deep)



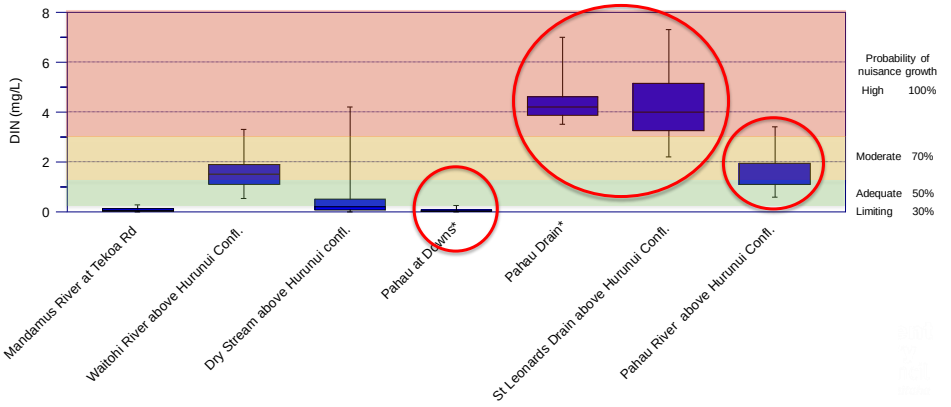
Nutrient impacts on periphyton – Nitrogen

- Increase in N from upper Hurunui (Mandamus/SH7) to lower (SH1/Swingbridge)
- From 1989 to 2016 nitrogen concentrations have significantly increased. Since 2006 there has been no significant trend observed (<1% annual change)



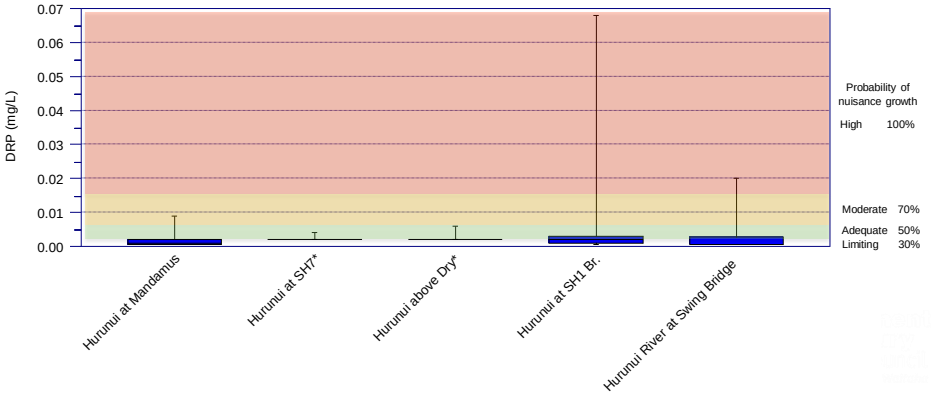
Nutrient impacts on periphyton – Nitrogen

- Increase in N from upper Pahau (Downs) to lower Pahau (above Hurunui)
- Nitrogen elevated in tributary streams (Amuri Basin)
- Greatest in spring-fed tributaries e.g Pahau Drain, St Leonards Drain
- Increasing trends from 2005 for Waitohi and St Leonards Drain, decreasing for Dry (irrigation race water – may change with AIC piping)



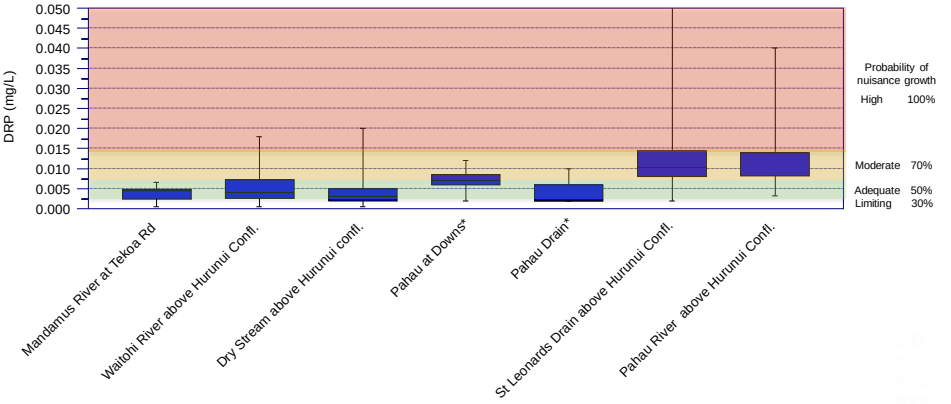
Nutrient impacts on periphyton – Phosphorus

- P concentrations indicates periphyton growth in the Hurunui mainstem is limited by phosphorus– does not account for sediment P sources i.e for *Phormidium* growth
- No significant trends 1989 – 2016 in mainstem, however slight decrease for SH1 when flow is taken into consideration
- Short term trend (2005 – Present) indicates a significant decrease in phosphorus when flow is taken to consideration



Nutrient impacts on periphyton – Phosphorus

- Tributaries show higher P than mainstem
- Decreasing trends from 2005 for Waitohi, Pahau, and Dry Stream



Key Messages: Nutrients and periphyton

- **Hurunui River mainstem:**
  - Upper river dominated by didymo, with both N & P limiting factors of periphyton growth
  - Lower river dominated by cyanobacteria
  - Cyanobacteria related to Increasing N concentrations, can be limited by P concentrations
    - Evidence that cyanobacteria can get P from fine sediment trapped in mats

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Key Messages: Nutrients and periphyton

- **Amuri Basin tributaries**:
  - Elevated nutrient concentrations, with N increasing in some tributaries, P decreasing in some
  - Tributaries do not appear to be susceptible to nuisance periphyton growths
  - Elevated nutrient concentrations important as a source to the mainstem

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Nutrient toxicity – National Criteria

- All river sites monitored have low ammonia toxicity risk
- Some nitrate toxicity effects on species for spring-fed streams i.e Pahau Drain and St Leonards Drain, and Dry Stream

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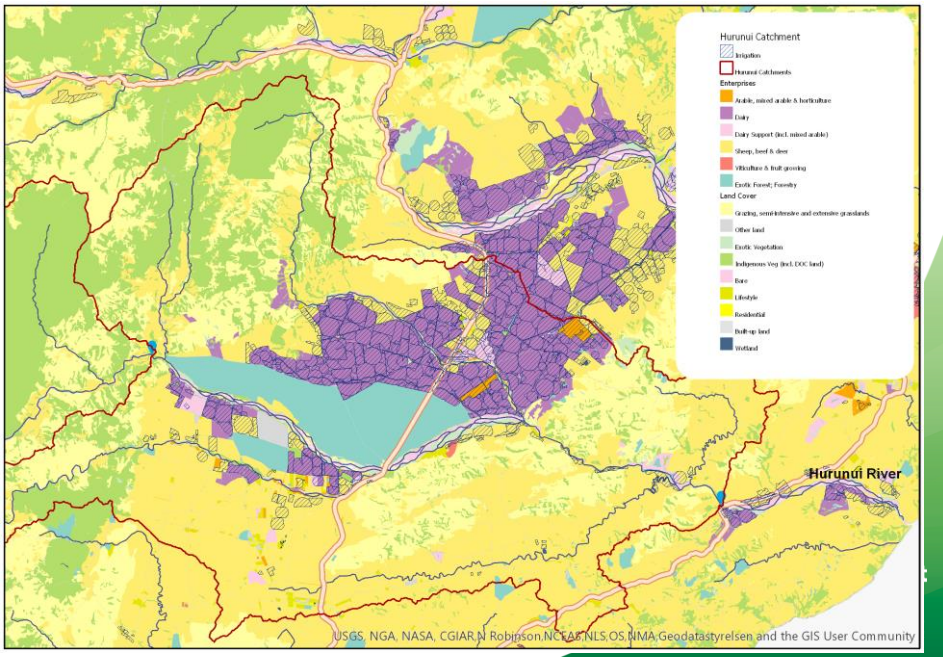
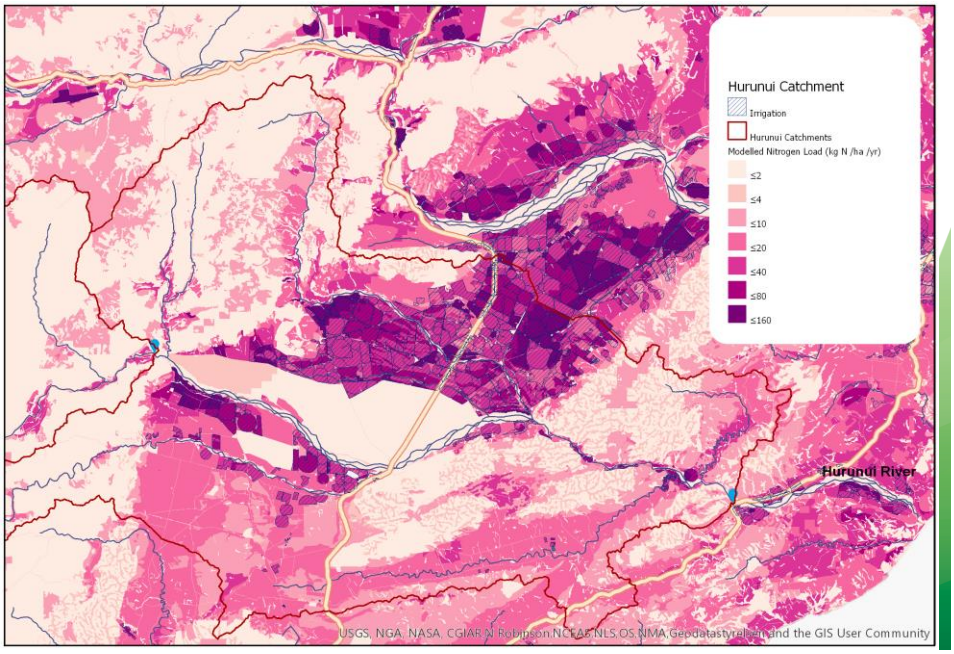
Current land use - Draft GIS layer



Nitrogen loss from land – Draft GIS layer



Comparing 'Source' and 'In-river' loads to existing Plan limits

Catchment	Area (ha)	'Source' loads (Nitrogen tonnes/yr)#	'In-river' loads (Nitrogen tonnes/yr)*	Existing Plan (In-river) load limits (DIN tonnes/yr)
Hurunui at Mandamus	105,754	**228**	**55*** (28-105)**	**39**
Hurunui at SH1 (Total)	252,395	**1,886**	**713*** (270-1451)**	**963**

Based on summing loads from draft GIS layers on previous slides
* Based on rolling 6 year average annual load estimate as at 2016
** Brackets show large range of annual load estimates for the period 2005 to 2016

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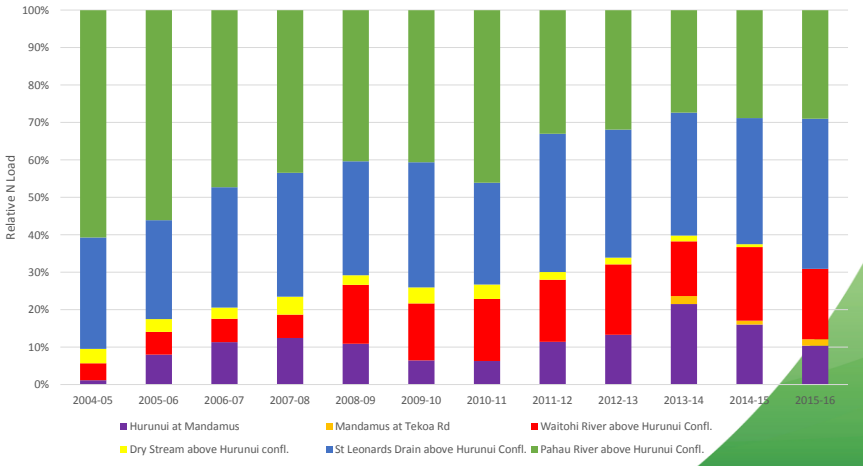
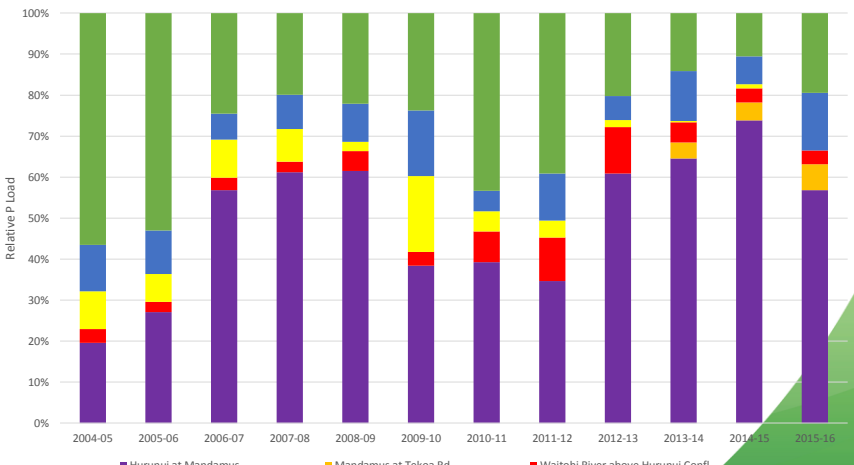
From our tributary monitoring most of the N comes from Amuri Basin tributaries (relative contribution)



From our tributary monitoring more of the P comes from the upper catchment (relative contribution)



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Key messages continued

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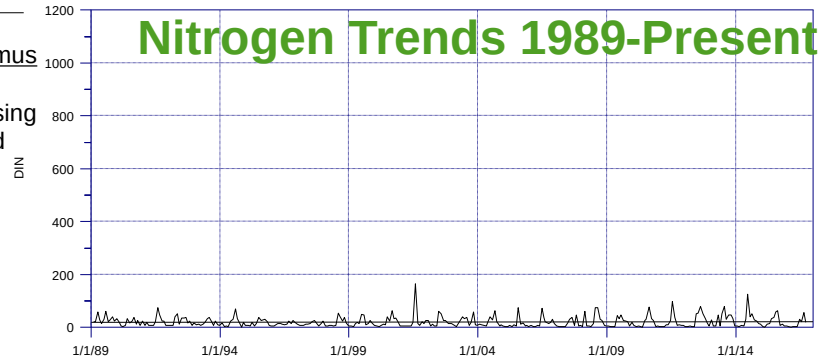
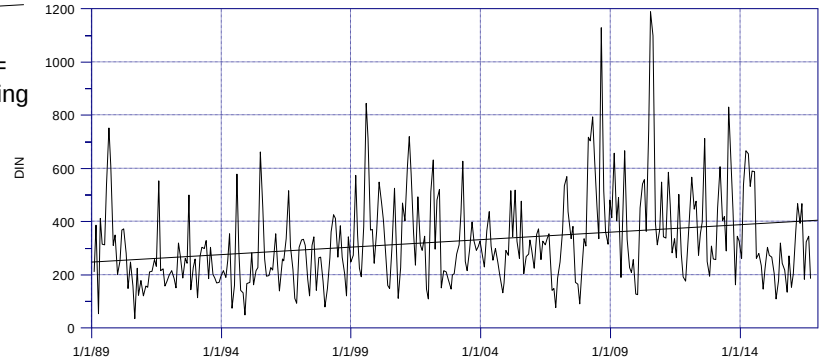
Nitrogen Trends 1989-Present

Mandamus = decreasing trend



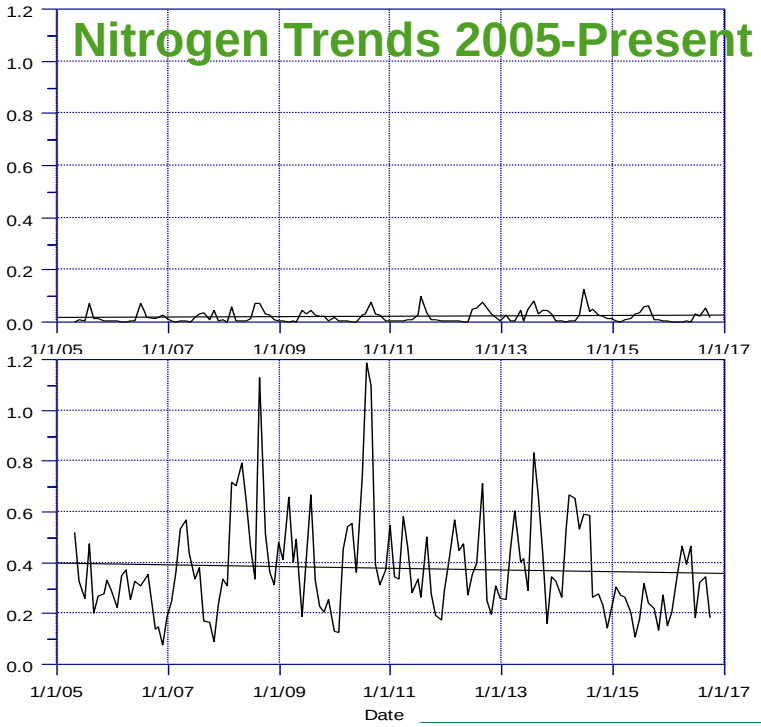
SH1 = Increasing trend



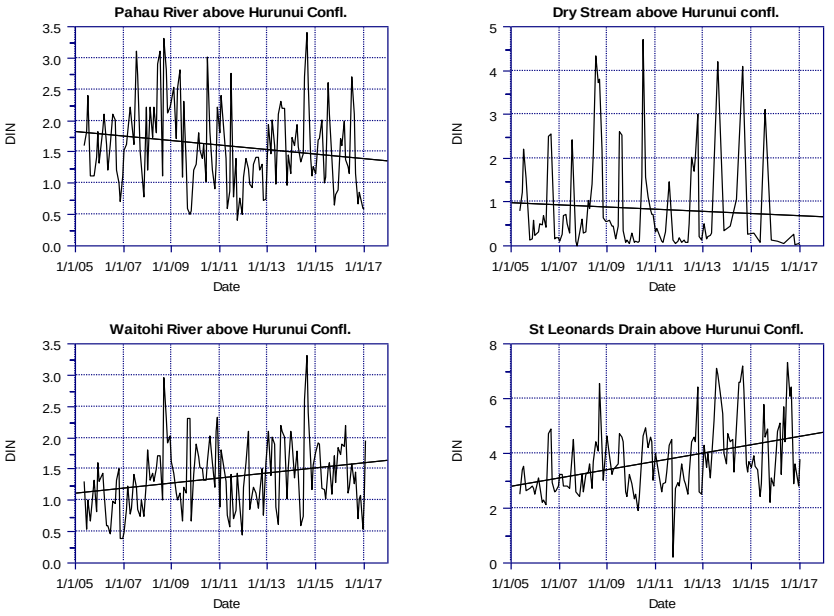
Nitrogen Trends 2005-Present

Mandamus = no significant or meaningful trend

SH1 = No significant or meaningful trend (<1% annual change)

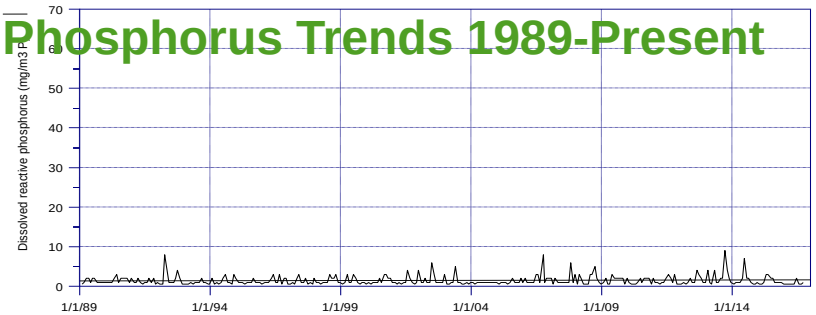


- Increasing N trends for Waitohi and St Leonards Drain, decreasing for Dry (irrigation race water). No significant trend for Pahau

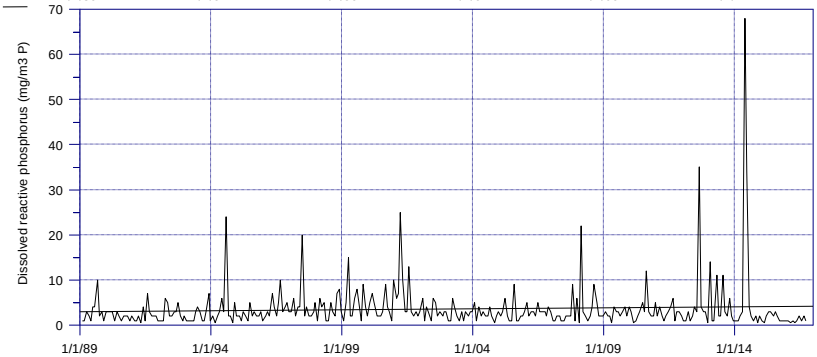


Phosphorus Trends 1989-Present

Mandamus

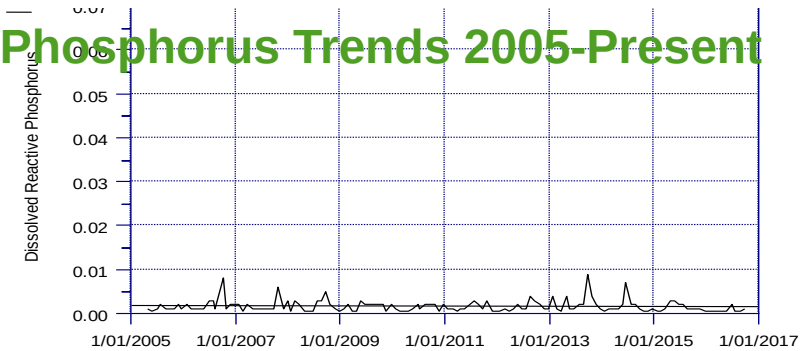


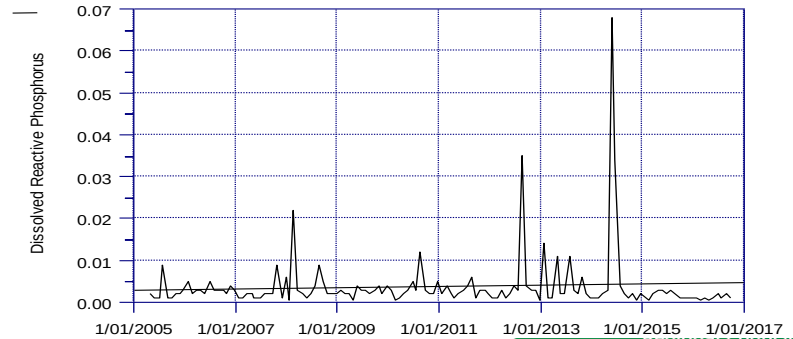
SH1



No significant trends in mainstem, however slight decrease for SH1 when flow is taken into consideration

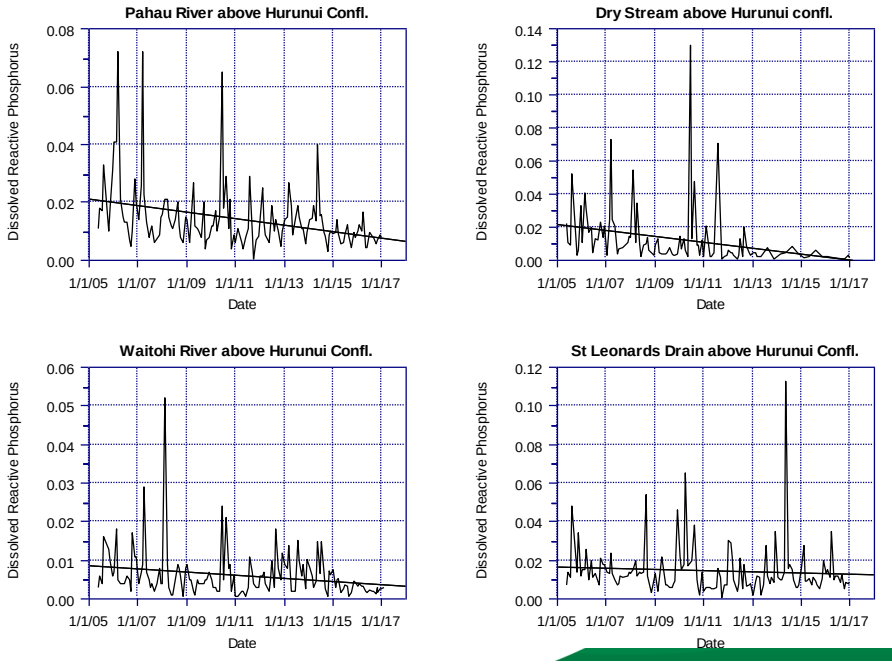
Phosphorus Trends 2005-Present





Decreasing phosphorus trends in mainstem, only when flow taken into consideration

- Decreasing P trends for Waitohi, Pahau, and Dry Stream (St Leonards Drain shows non-significant decreasing trend



- Decreasing *E.coli* trends for Dry Stream, Pahau River and St Leonards Drain