# Impacts of the Flood Control Scheme on Lake Waikare and Whangamarino Wetland

# and Potential Mitigation Options

January 2012

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# Project objectives and methods

**Project objectives**

- Review impacts of Flood Control Scheme on Lake Waikare and Whangamarino Wetland
- Identify sediment and nutrient sources
- Identify potential options for reducing sediment inputs

**Methods**

- Review of existing literature, WRC datasets
  - Water quality, hydrology, biology, vegetation mapping, sediment, mitigation options
- Interviews with DOC / WRC staff
- Workshop with DOC/WRC staff

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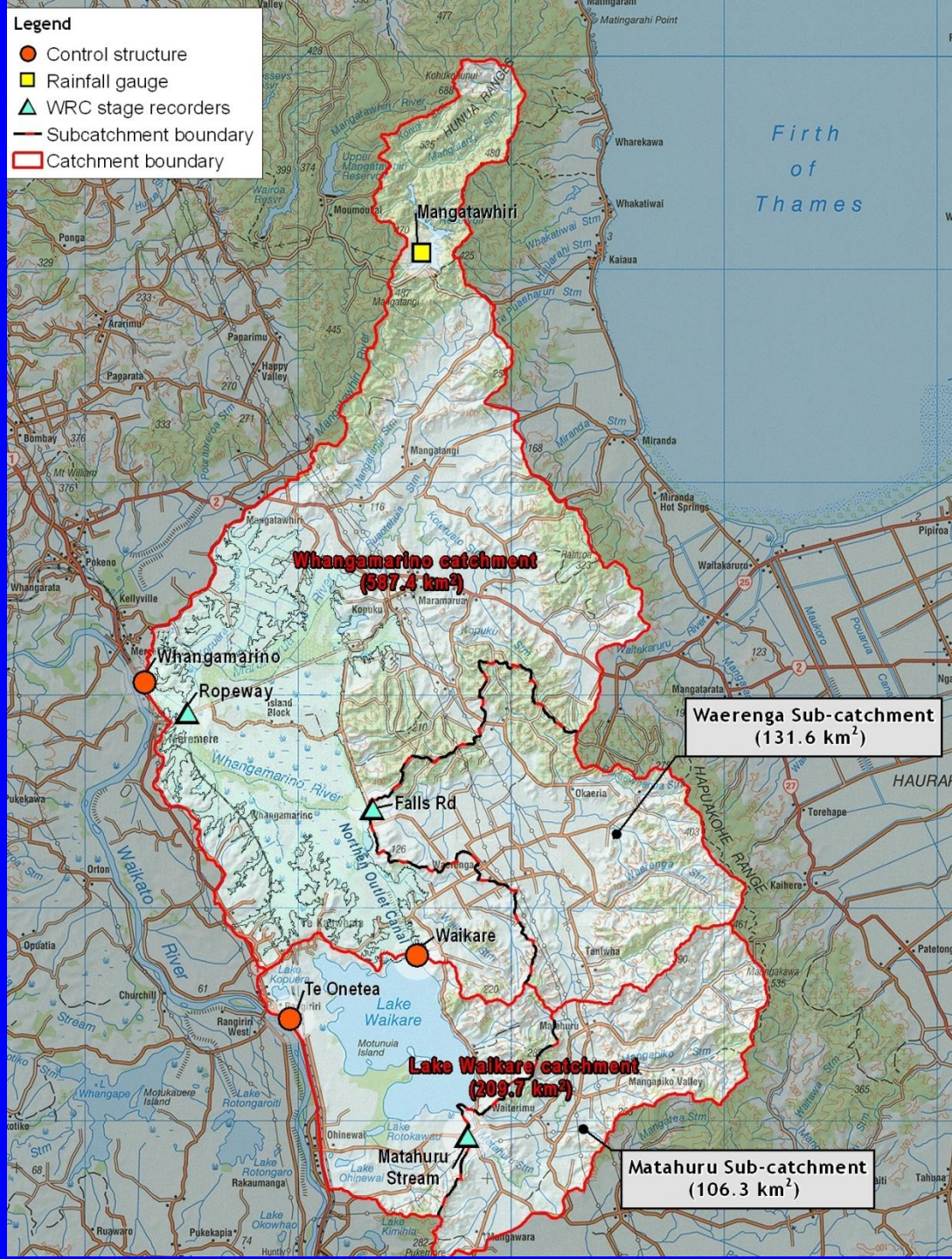
# Study area

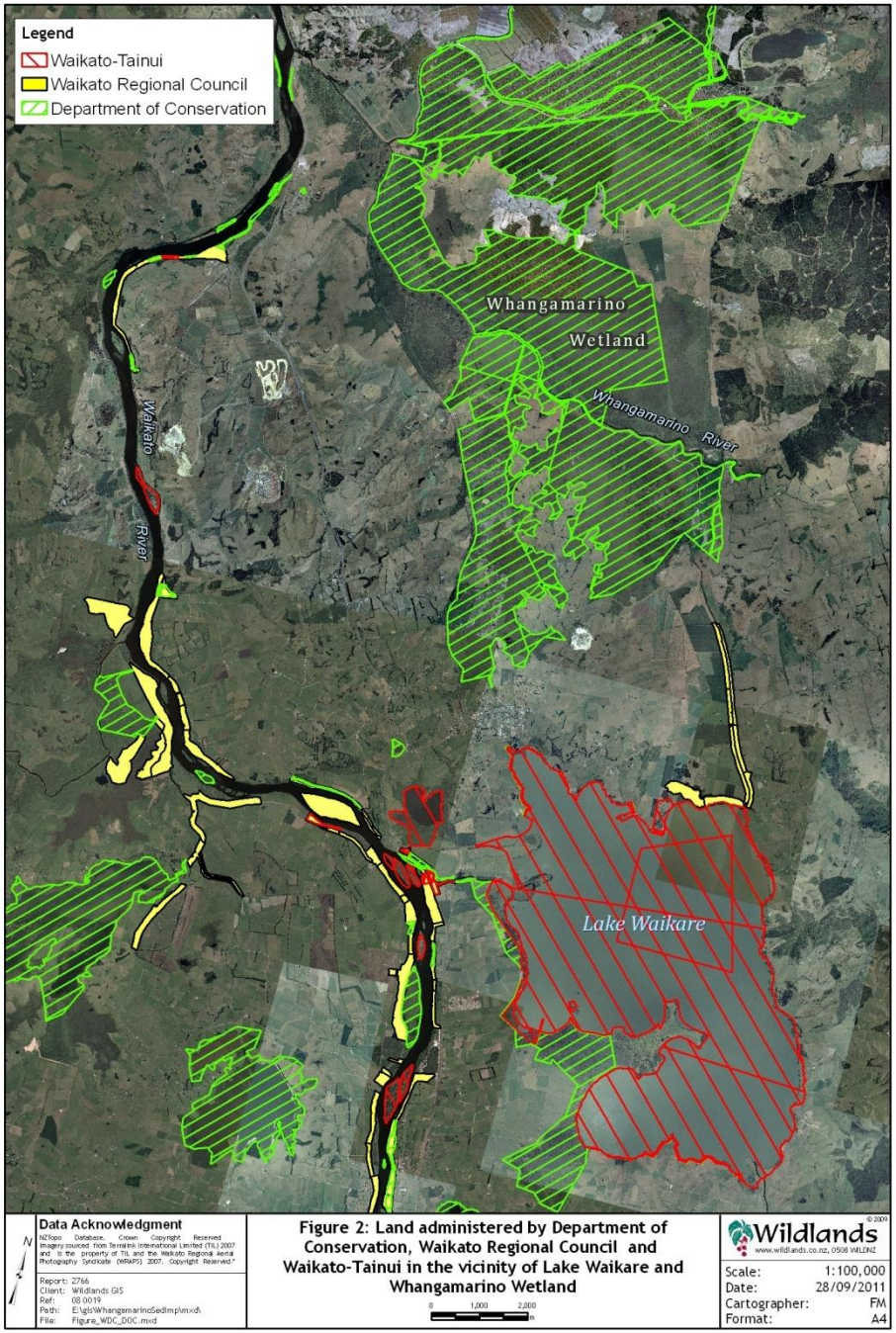
## Whangamarino Wetland

- 7100 ha (originally 10, 320 ha)
- catchment area = 587 $km^2$
- Ramsar site, Arawai Käkäriki Wetland
- Significant conservation values
- Hypertrophic, pest and weed invasion

## Lake Waikare

- 34 $km^2$, 3rd largest lake in North Island
- lake volume of 43 million $m^3$
- max depth 1.8 m, ave depth 1.26 m
- Regional priority = 39 (of 96)
- Hypertrophic, high turbidity






# Land tenure

**Whangamarino Wetland**

DOC 4640 ha

AWFG 748 ha

Private ownership 1192 ha

**Lake Waikare**

Waikato-Tainui lakebed, marginal reserves

WRC 95.91 ha

DOC approx. 500 ha

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# Direct Impacts of Flood Control Scheme

- Protection of 17,200 ha low lying land from flooding = significant economic gains for the Region

- Change in water level regime at Lake Waikare
- Re-direction of water movement

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# Change in water level regime

| | 1958 – 1965 PRE | | | 2006-2011 LAST 5 YEARS |
|---|---|---|---|---|
| Maximum water level | 8.38 m | | | 6.02 m |
| Minimum water level | 5.67 m | | | 5.20 m |
| **Average water level** | **6.67 m** | | | **5.54 m** |
| **Winter average (May – Oct)** | **6.84 m** | | | **5.55 m** |
| **Summer average (Nov – April)** | **6.47 m** | | | **5.54 m** |
| Fluctuation Range | 2.71 m | | | 0.82 m |

Source: Sledger, 1980. Reeves et al. 2002, WRC data

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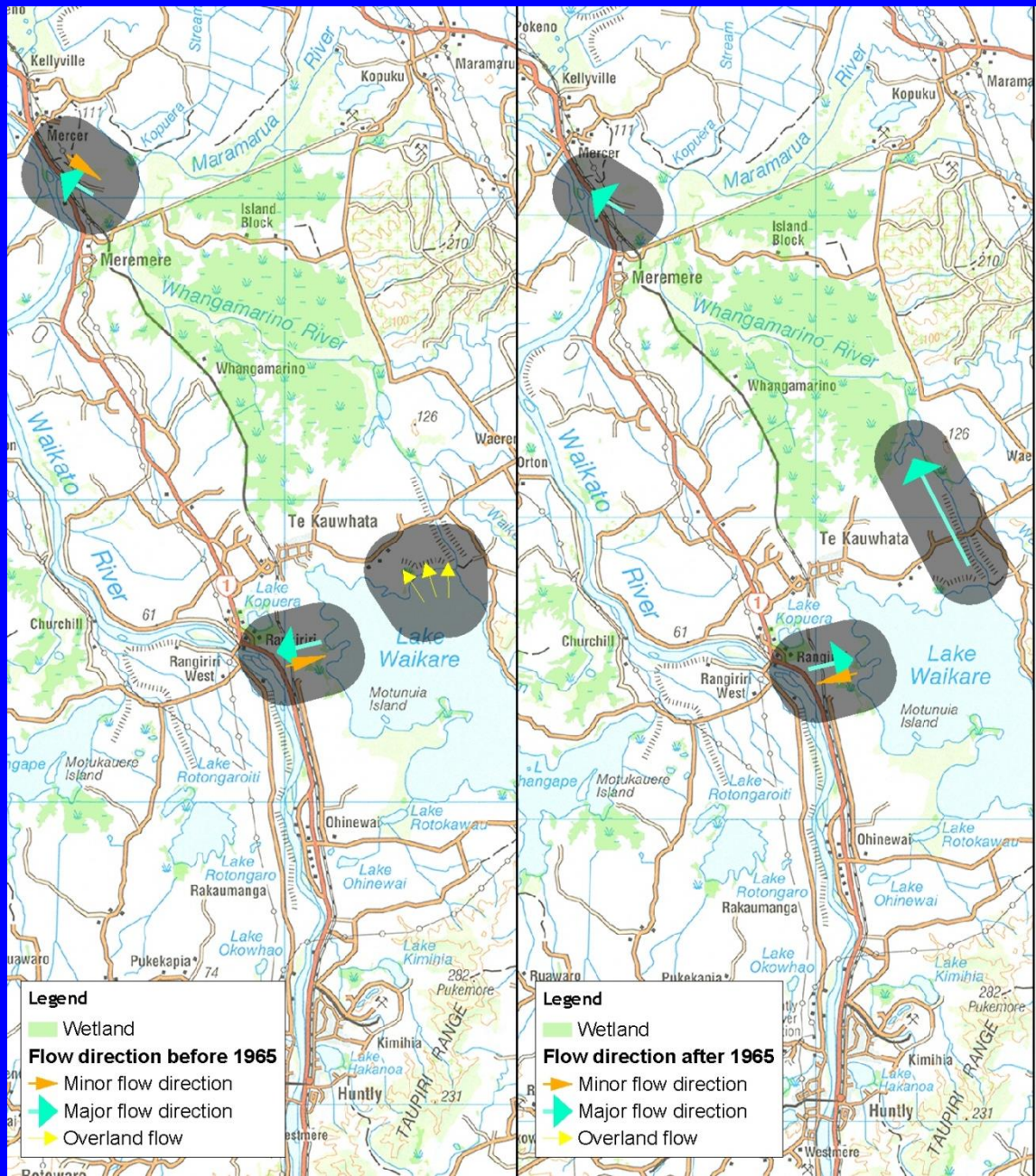
# Re-direction of water movement

## Before Flood Control Scheme

Lake Waikare > Waikato River

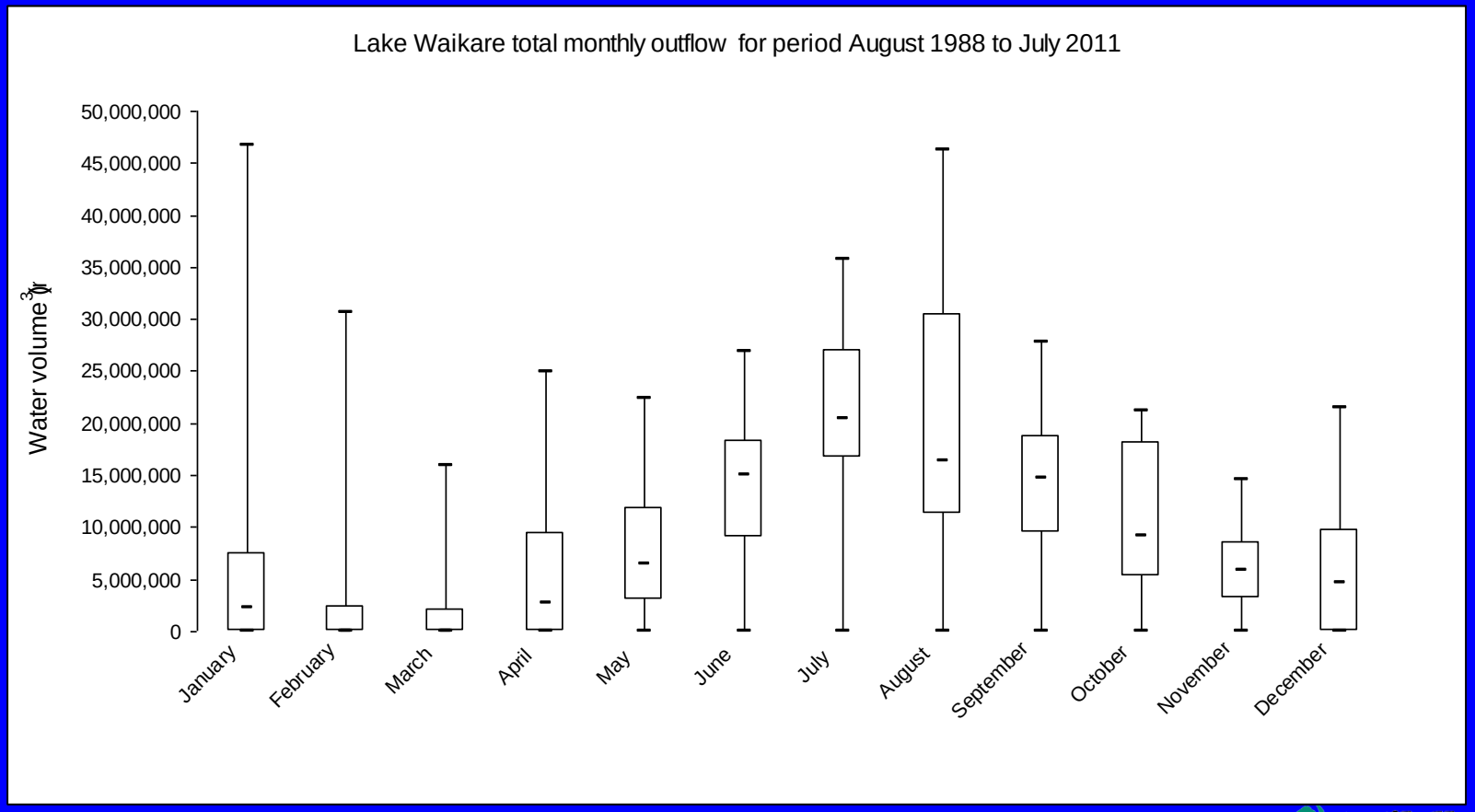
## After Flood Control Scheme

Waikato River > Lake Waikare
Lake Waikare > Whangamarino



# Re-direction of water movement

**Significant increase in water volume discharged to Whangamarino Wetland ~ 117.4 million $m^3$ per year**

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# Indirect Impacts of Flood Control Scheme

- Increase in the turbidity of water in Lake Waikare
- Erosion of the shoreline at Lake Waikare
- Loss of wetland habitat at both Lake Waikare and Whangamarino Wetland (estimated 40% decline in wildlife)
- Increase in sedimentation in the Whangamarino Wetland, between 2.5 mm/y to 16.8 mm/y
- Increase in frequency and extent of flooding in the Whangamarino Wetland
- Greater risk of weed invasion

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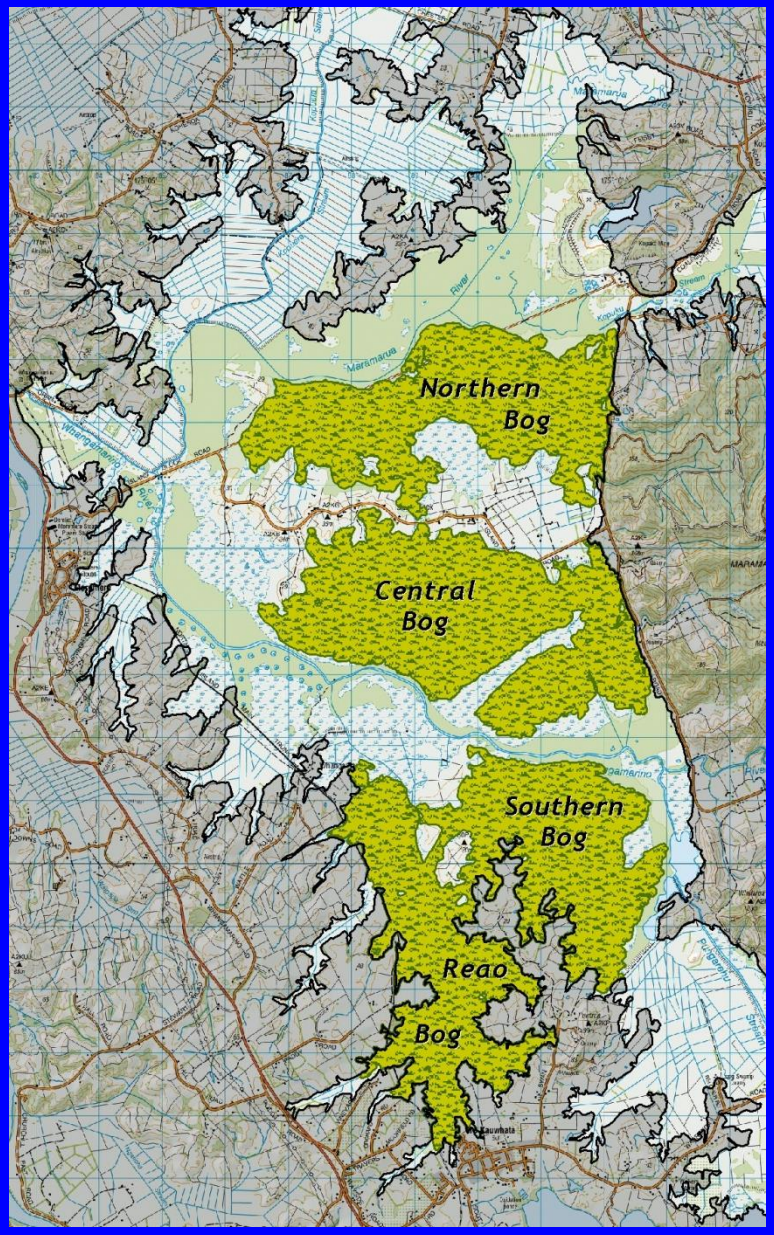
# Whangamarino Wetland Peat Bogs




**Peat Bogs**

**Elevated**

**Fed by rainwater**

**Sensitive to ↑ nutrients**

**Significant conservation values**

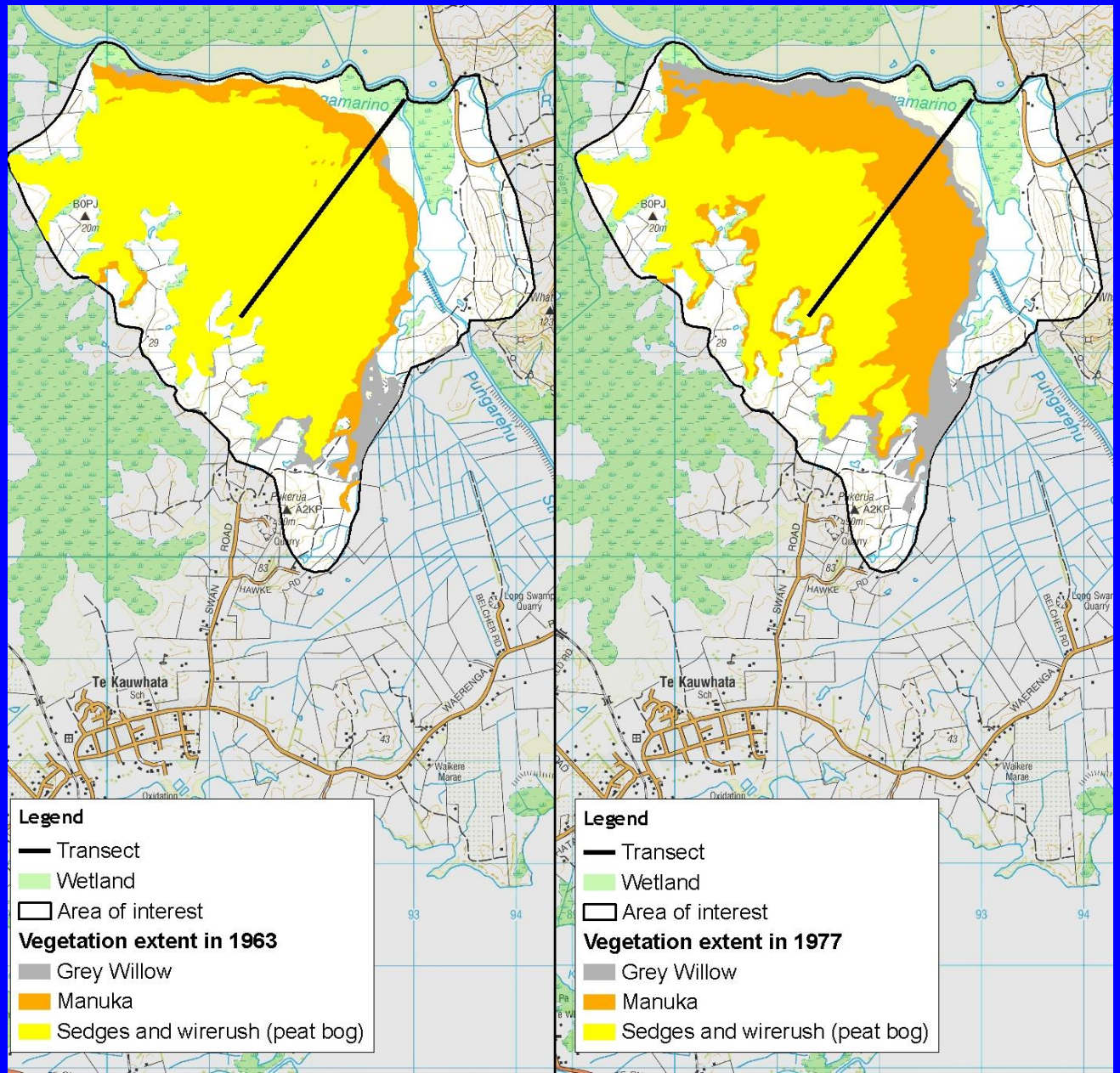
**Unique and rare habitat**

**Few weeds**

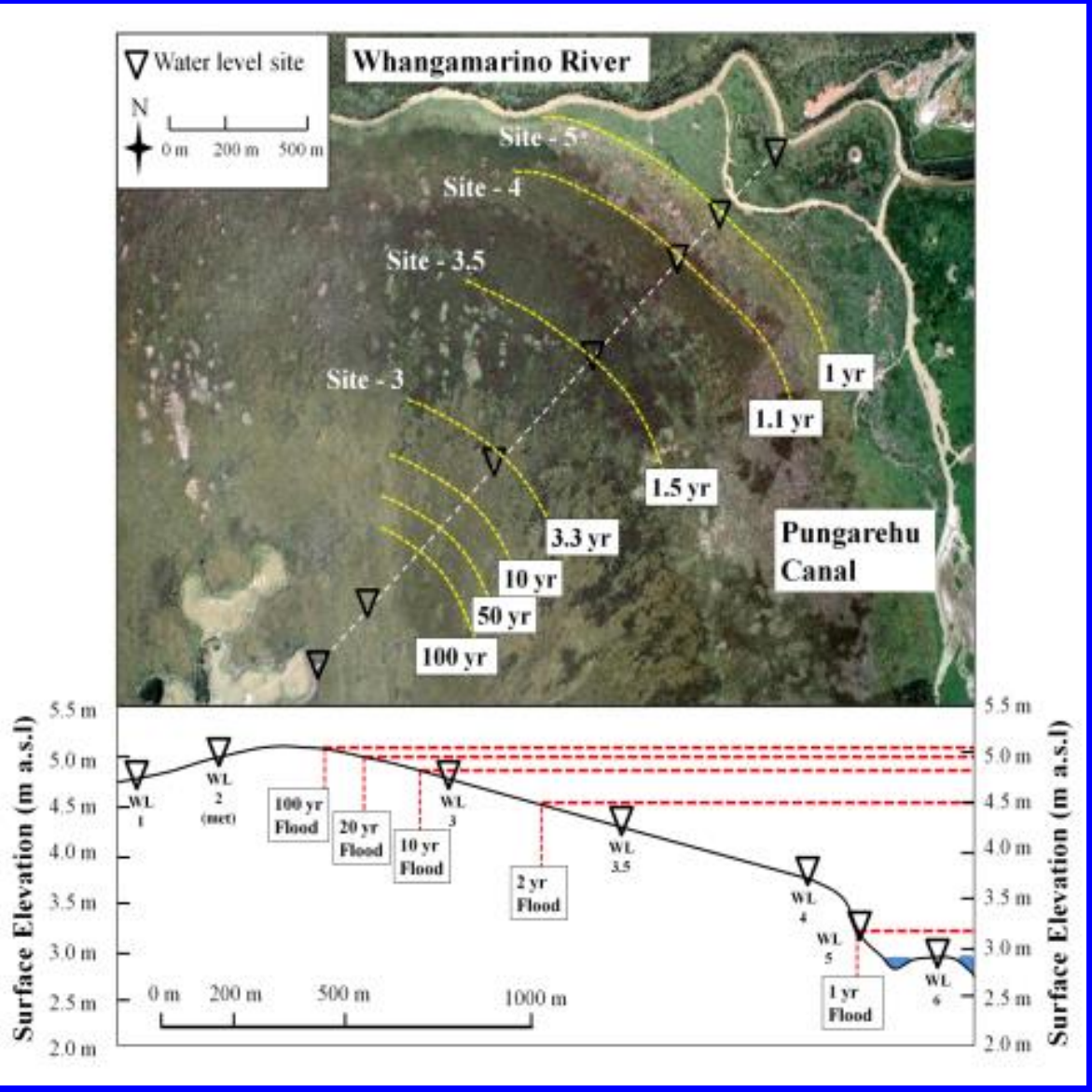
**8 threatened plant species**

Photo: Craig Purvis

# Change in vegetation cover at Southern Bog



# Increase in flooding extent and frequency




Source: Blyth. 2011

**Extent of manuka occurs at the flood return period of 3.3 years when water levels reach 5.17 m at Falls Rd stage**

**Bog would be protected if water levels at Falls Road < 4 m (currently 1.1 yr return period)**

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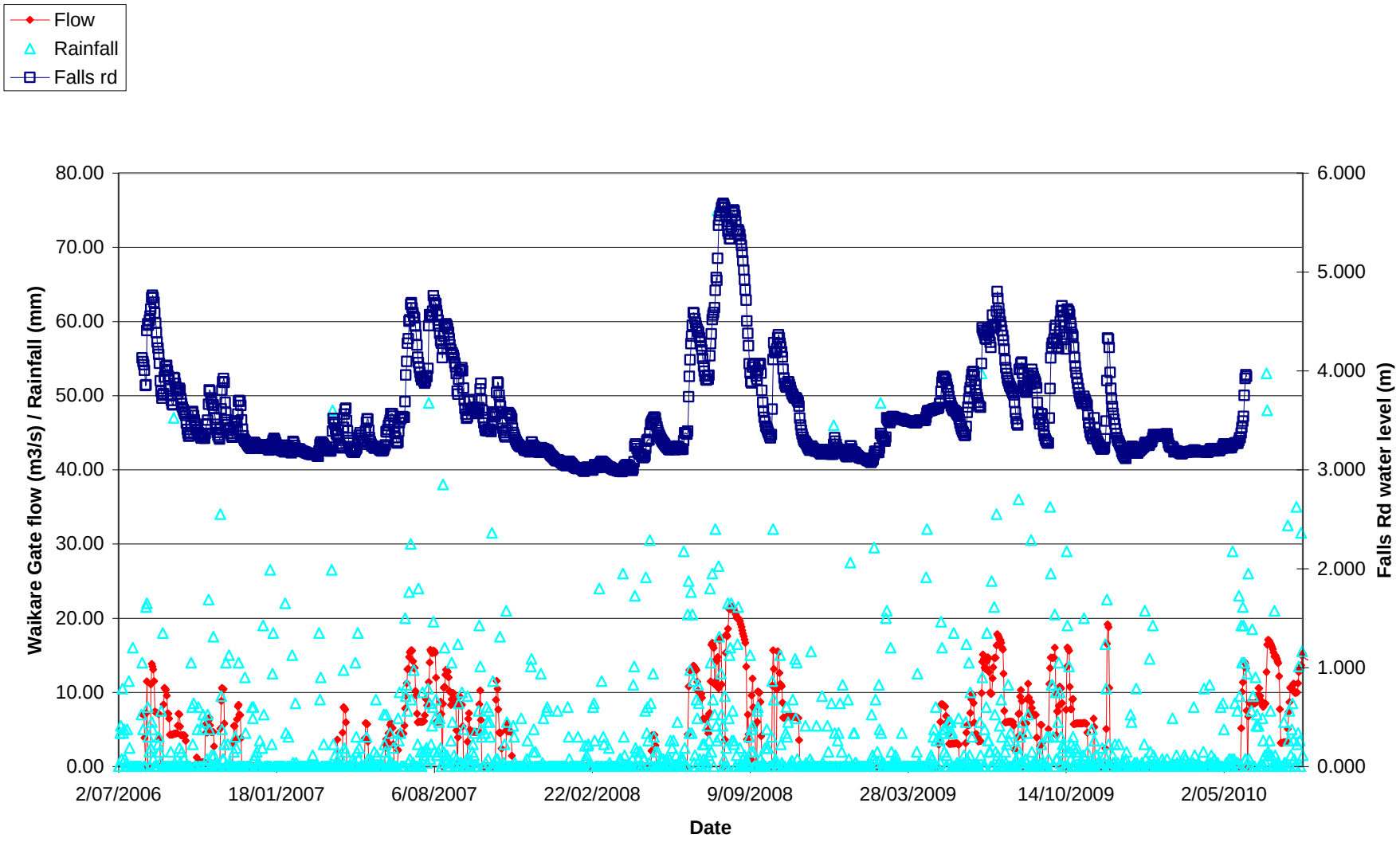
# Daily flows from Lake Waikare vs daily water levels at Falls Road and rainfall

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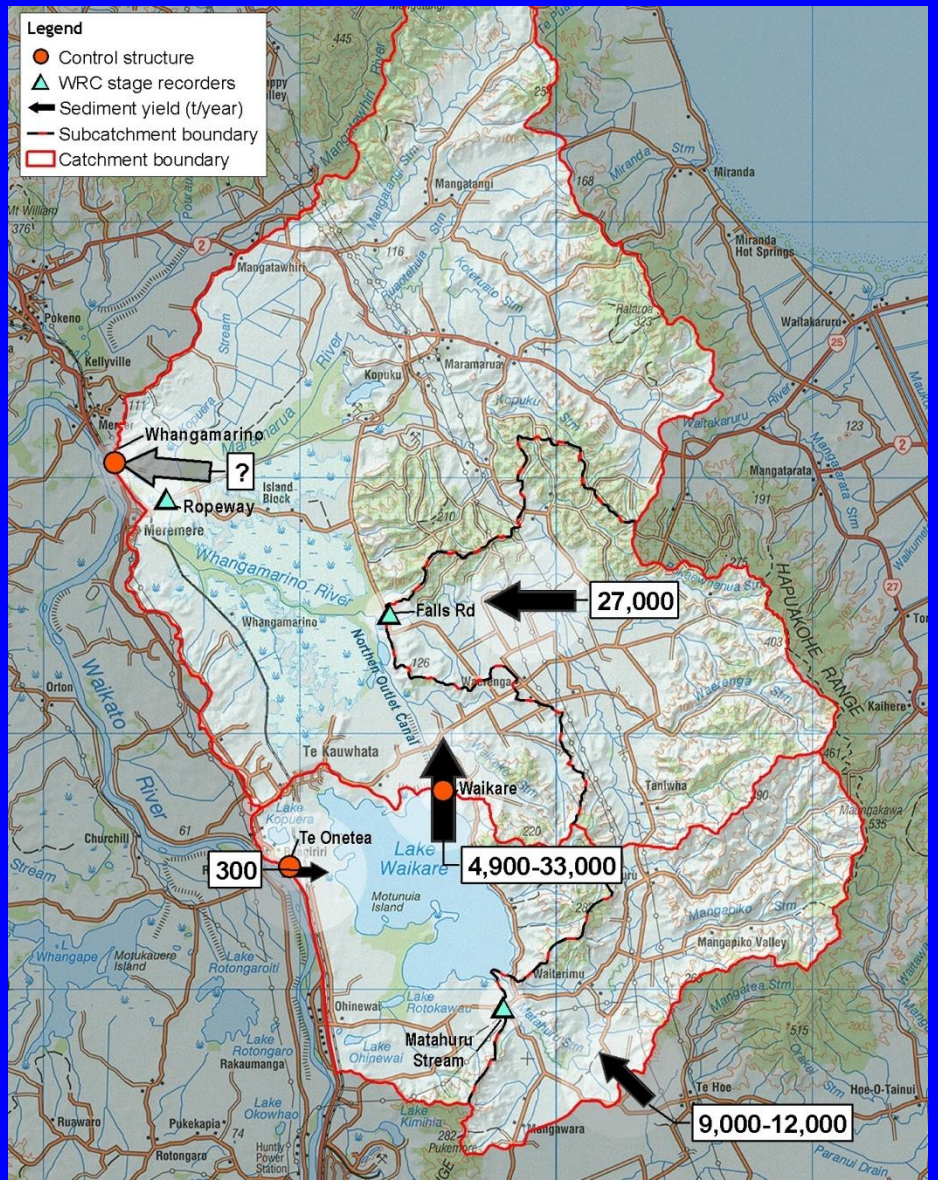
# Barriers to mitigation

- Current water quality
- Pest fish
- Sediment inputs
- Lake turbidity



# Mitigation options - previous investigations

Lake Waikare Steering Group

Vision: ‘To restore Lake Waikare to a healthy stable ecosystem, supporting abundant plants and wildlife while providing a valuable flood storage role.’

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# Conclusions from previous investigations

**Mitigation options that were not considered feasible**

- Dredge the lake
- Flocculate lake sediments
- Drawdown lake to consolidate sediments
- Divert Matahuru Stream to Waikato River
- Increase Te Onetea Stream inflows to flush lake
- Increase populations of freshwater mussels to filter out sediments

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# Conclusions from previous investigations

**Mitigation options with low effectiveness**

- Lake margin enhancements
- Divert Matahuru Stream through a natural wetland
- Re-direct wastewater from Te Kauwhata sewage treatment plant
- Reduction of introduced fish
- Island creation to reduce wave energy
- Constructed wetlands on major drains

**Mitigation options with potentially moderate effectiveness**

- Increase water level fluctuation range in Lake Waikare
- Wave barriers

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# Current investigation of mitigation options

Broad scale

Addresses sediment inputs to Lake Waikare and Whangamarino Wetland

Types of mitigation options

- Reducing sources (i.e. catchment management practices)
- Reducing sediment in suspension within Lake Waikare
- Preventing sedimentation within Whangamarino Wetland

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# Mitigation options - catchment management

## Range of catchment management practices

Farm design to reduce runoff to waterways
Land retirement and/or reforestation
Livestock exclusion
Grass filter strips / riparian planting
Drain management to retain sediments
Sediment traps
Detention ponds
Enhance natural seeps/wetlands
Constructed wetlands (many small or single large at bottom of catchment)

## Progress to date

29.6 km Matahuru Catchment fenced and 4,211 plants in ground using WRC assisted funding

## Outcome

Increase in sediment loads

## Way forward

Better understanding of sediment origins / flow paths.

Match sediment reduction tools to flow paths at farm scale.

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# Mitigation options
# Reduce sediments in suspension within Lake Waikare

## Increase average water levels and fluctuations

Reduce wave energy

Modelling of different lake levels to determine best option

Other benefits include increase in emergent vegetation, improvement in water quality

Issues

May not significantly improve turbidity

Likely to affect adjacent landowners

## Wave barriers

Reduce wave energy in localised areas

Further investigation required to improve certainty of outcome

Other benefits include increase in emergent vegetation, improvement in water quality

Issues

Improvements likely to be localised

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# Mitigation options
# Prevent sedimentation in Whangamarino Wetland

## Constructed wetland between lake and wetland

Significant reduction in sediment load possible

Other benefits include significant improvement in water quality, increase in wetland habitat, flood attenuation

Issues

Wetland size - 440 ha?

Land purchase would be required

## Confine Waikare control gate outflows

Option 1: Timing and / or reduction of outflows

Option 2: Stopbanking or bunding

Other benefits include flood attenuation, improvement in water quality

Issues

Increase water levels in Lake Waikare

Stopbanking / bunding will affect hydrology, biology and recreational values of adjacent wetland

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# Evaluation of mitigation options

| •Mitigation option | Evaluation criteria | | | | | Other considerations | | |
|---|---|---|---|---|---|---|---|---|
| | **Effectiveness** (0-9) | **Certainty of outcome** (0-8) | **Cost** (0-6) | **Other benefits** (0-5) | **Total** (0-28) | **Acceptable to DOC** | **Does not impact flood control scheme** | **Will not require action on private land** |
| Catchment management - targeted farm-scale actions | 5 | 2 | 4* | 4 | 15 | √ | √ | X |
| Catchment management - constructed wetlands at bottom of catchment | 5 | 2 | 0 | 4 | 11 | √ | √ | X |
| Increase lake levels / fluctuation range in Lake Waikare | 3* | 3 | 4 | 3* | 11 | √ | X | √ |
| Wave barriers in Lake Waikare | 2* | 3 | 4 | 2 | 11 | √ | √ | √ |
| Constructed wetland between Lake Waikare and Whangamarino Wetland | 3* | 7 | 0 | 4 | 14 | √ | ? | X |
| Confine Waikare control gate outflows by controlling timing and volume of outflows | 2 | 6 | 4 | 2 | 14 | √ | X | √ |
| Confine Waikare control gate outflows by stopbanking / bunding | 2* | 5 | 4 | 2 | 13 | X | ? | ? |

* Low confidence in score.

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# Mitigation options Conclusions

Combination of mitigation options required

All options have significant drawbacks

Re-evaluate objectives – set specific targets

Fill information gaps of best options

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