

**BEFORE THE ENVIRONMENT COURT
I MUA I TE KOOTI TAIAO O AOTEAROA**

UNDER the Resource Management 1991

IN THE MATTER of of appeals under Clause 14 of the First Schedule of the Act

BETWEEN

TRANSPower NEW ZEALAND LIMITED
(ENV-2018-CHC-26)

FONterra CO-OPERATIVE GROUP
(ENV-2018-CHC-27)

HORTICULTURE NEW ZEALAND
(ENV-2018-CHC-28)

ARATIATIA LIVESTOCK LIMITED
(ENV-2018-CHC-29)

WILKINS FARMING CO
(ENV-2018-CHC-30)

(Continued next page)

**STATEMENT OF EVIDENCE OF DR ANTONIUS SNELDER ON BEHALF OF
THE SOUTHLAND REGIONAL COUNCIL
19 June 2023**

Judicial Officer: Judge Borthwick

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WYNN WILLIAMS

**GORE DISTRICT COUNCIL, SOUTHLAND DISTRICT
COUNCIL & INVERCARGILL DISTRICT COUNCIL**
(ENV-2018-CHC-31)

DAIRYNZ LIMITED
(ENV-2018-CHC-32)

H W RICHARDSON GROUP
(ENV-2018-CHC-33)

BEEF + LAMB NEW ZEALAND
(ENV-2018-CHC-34 & 35)

DIRECTOR-GENERAL OF CONSERVATION
(ENV-2018-CHC-36)

SOUTHLAND FISH AND GAME COUNCIL
(ENV-2018-CHC-37)

MERIDIAN ENERGY LIMITED Act 1991
(ENV-2018-CHC-38)

ALLIANCE GROUP LIMITED
(ENV-2018-CHC-39)

FEDERATED FARMERS OF NEW ZEALAND
(ENV-2018-CHC-40)

HERITAGE NEW ZEALAND POUHERE TAONGA
(ENV-2018-CHC-41)

STONEY CREEK STATION LIMITED
(ENV-2018-CHC-42)

THE TERRACES LIMITED
(ENV-2018-CHC-43)

CAMPBELL'S BLOCK LIMITED
(ENV-2018-CHC-44)

ROBERT GRANT
(ENV-2018-CHC-45)

**SOUTHWOOD EXPORT LIMITED, SOUTHLAND
PLANTATION FOREST COMPANY OF NZ,
SOUTHWOOD EXPORT LIMITED**
(ENV-2018-CHC-46)

**TE RUNANGA O NGAI TAHU, HOKONUI RUNAKA,
WAIHOPAI RUNAKA, TE RUNANGA O AWARUA & TE
RUNANGA O ORAKA APARIMA**
(ENV-2018-CHC-47)

PETER CHARTRES
(ENV-2018-CHC-48)

RAYONIER NEW ZEALAND LIMITED
(ENV-2018-CHC-49)

**ROYAL FOREST AND BIRD PROTECTION SOCIETY
OF NEW ZEALAND**
(ENV-2018-CHC-50)

Appellants

AND

SOUTHLAND REGIONAL COUNCIL

Respondent

Introduction

- 1 My full name is Antonius Hugh Snelder.
- 2 I am a director of LWP Ltd and consultant/researcher in the field of water and land resources management. My qualifications and experience are set out in my Statement of Evidence dated 14 December 2018 at paragraphs [3]-[6].
- 3 I have been engaged by the Southland Regional Council to prepare evidence for these proceedings, specifically to address what is meant by nitrogen (N), total nitrogen (TN), dissolved inorganic nitrogen (DIN), phosphorus (P), total phosphorus (TP) and dissolved reactive phosphorus (DRP). My evidence also addresses what the DIN and DRP maps convey.

Code of Conduct

- 4 I confirm that I have read the Code of Conduct for expert witnesses as contained in the Environment Court Practice Note 2023. I have complied with the Code of Conduct when preparing my written statement of evidence and will do so when I give oral evidence.
- 5 The data, information, facts and assumptions I have considered in forming my opinions are set out in my evidence. The reasons for the opinions expressed are also set out in my evidence.
- 6 Other than where I state I am relying on the evidence of another person, my evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Forms of Nitrogen and Phosphorus

- 7 At the outset, I note that as I am not a chemist, the explanation I offer below is a high-level explanation. However, the explanation is sufficient to understand why water quality scientists, and why my assessment of degraded catchments in particular, distinguishes the different forms of nitrogen and phosphorus.
- 8 Nitrogen (N) and phosphorus (P) occur in the environment in different forms. Water quality scientists distinguish between forms of N and P because they have different implications for impacts on ecosystem health.

- 9 Generally, the forms of N that water quality scientists distinguish are Ammoniacal Nitrogen (NH₄-N), Nitrate-Nitrogen (NO₃-N), Nitrite-Nitrogen (NO₂-N), Organic Nitrogen (Nitrogen in amino acids and proteins), and Total Nitrogen (TN).
- 10 Generally, the forms of P that water quality scientists distinguish are Dissolved Reactive Phosphorus (DRP) and Total Phosphorus (TP).
- 11 Total Nitrogen (TN) and Total Phosphorus (TP) refers to the sum of all N and P forms in a water sample or in an environment. That is:
- (a) TN = Ammoniacal Nitrogen (NH₄-N) + Nitrate-Nitrogen (NO₃-N), + Nitrite-Nitrogen (NO₂-N) + Organic Nitrogen.
 - (b) TP = Dissolved Reactive Phosphorus (DRP) + particulate Phosphorus.
- 12 All forms of N and P are nutrients for algae in rivers, lakes and estuaries in the right circumstances.
- 13 The dissolved inorganic forms are easily taken up by algae and are therefore often referred to as the “bio-available” forms of N and P.
- 14 Organic Nitrogen and the particulate component of Phosphorus are not immediately bio-available. These forms must be broken down into inorganic forms before they are bio-available and the breaking-down process takes time.
- 15 The dissolved inorganic forms of N and P are often considered to be more important in rivers. This is because when water is moving rapidly, algae that is attached to the riverbed (i.e., periphyton) can only utilise the bio-available forms of N and P.
- 16 In lakes and estuaries, the Total Nitrogen (TN) and Total Phosphorus (TP) are often considered to be most relevant measures of N and P. This is because water is retained in these systems for longer periods of time than rivers. The retention time provides for the break-down of organic forms of N, and the non-dissolved component of P, into dissolved forms. Therefore, in terms of impacts on ecosystem health, the total amount of N and P is generally considered relevant for lakes and estuaries.

- 17 I also note that Ammoniacal Nitrogen and Nitrate-Nitrogen are toxicants. This means that these forms of N are of interest because of their potentially toxic effects, irrespective of the type of environment.

DIN and DRP maps

- 18 I understand that the Court has asked for clarification as to what the DIN and DRP maps convey.
- 19 The maps of the catchments of degraded water bodies identify the catchments upstream of all water bodies that are designated as being degraded as described in my Statement of Evidence dated 11 February 2022.
- 20 Individual maps were prepared for several attributes. Appendix 1 to my Statement of Evidence dated 11 February 2022 included maps for DIN, DRP, suspended sediment, *E.coli*, MCI, TN and TP.¹
- 21 In order to be mapped, attributes had to meet two criteria:
- (a) First, the attribute had to have been identified by the water quality experts involved in the JWS Water Quality and Ecology dated 17 October 2019 (**JWS**). The water quality experts identified thresholds that define a degraded state for each of the attributes listed in the JWS.
 - (b) The second criteria for mapping an attribute was that its current state had to be able to be predicted for all water bodies in the region using an appropriate model. There are two reasons for this:
 - (i) First, measurements of the current state of attributes are made only at a small number of monitoring sites across the region.
 - (ii) Second, maps must be comprehensive and consistent, and therefore cannot be based on information pertaining to a small number of locations. Models are therefore used to predict the current state of attributes at locations that are not monitored. These models are calibrated with the available monitoring data. The model predictions are therefore the

¹ Statement of Evidence of Dr Antonius Snelder on behalf of the Southland Regional Council – Water Quality dated 11 February 2022, Appendix 1, pages 25-31.

best assessments of current attribute state we can make with the existing information.

- 22 The water quality experts involved in the JWS identified DIN and DRP as attributes for rivers because they are nutrients that stimulate the growth of algae. When high algal growth rates are possible, there are impacts on ecosystem health and therefore thresholds for these two nutrients are used to define degraded and not-degraded rivers as set out in Table 1 in my Statement of Evidence dated 11 February 2022.²
- 23 The maps of the catchments of degraded water bodies that pertain to DIN and DRP maps therefore indicate the catchments upstream of river locations that are predicted (by models) to exceed the degraded threshold shown in Table 1 of my Statement of Evidence dated 11 February 2022.³ The details of the statistical models that were used to make the predictions are also described in my Statement of Evidence dated 11 February 2022.⁴
- 24 The DIN and DRP maps therefore represent the best assessment we can make of catchments of river segments that can be considered degraded with respect to these two nutrients.
- 25 The geographic differences in area based on mapping TP as opposed to DRP, and TN as opposed to DIN, can be observed in the attached maps of each contaminant.

² Statement of Evidence of Dr Antonius Snelder on behalf of the Southland Regional Council – Water Quality dated 11 February 2022 at page 13.

³ Statement of Evidence of Dr Antonius Snelder on behalf of the Southland Regional Council – Water Quality dated 11 February 2022 at page 13.

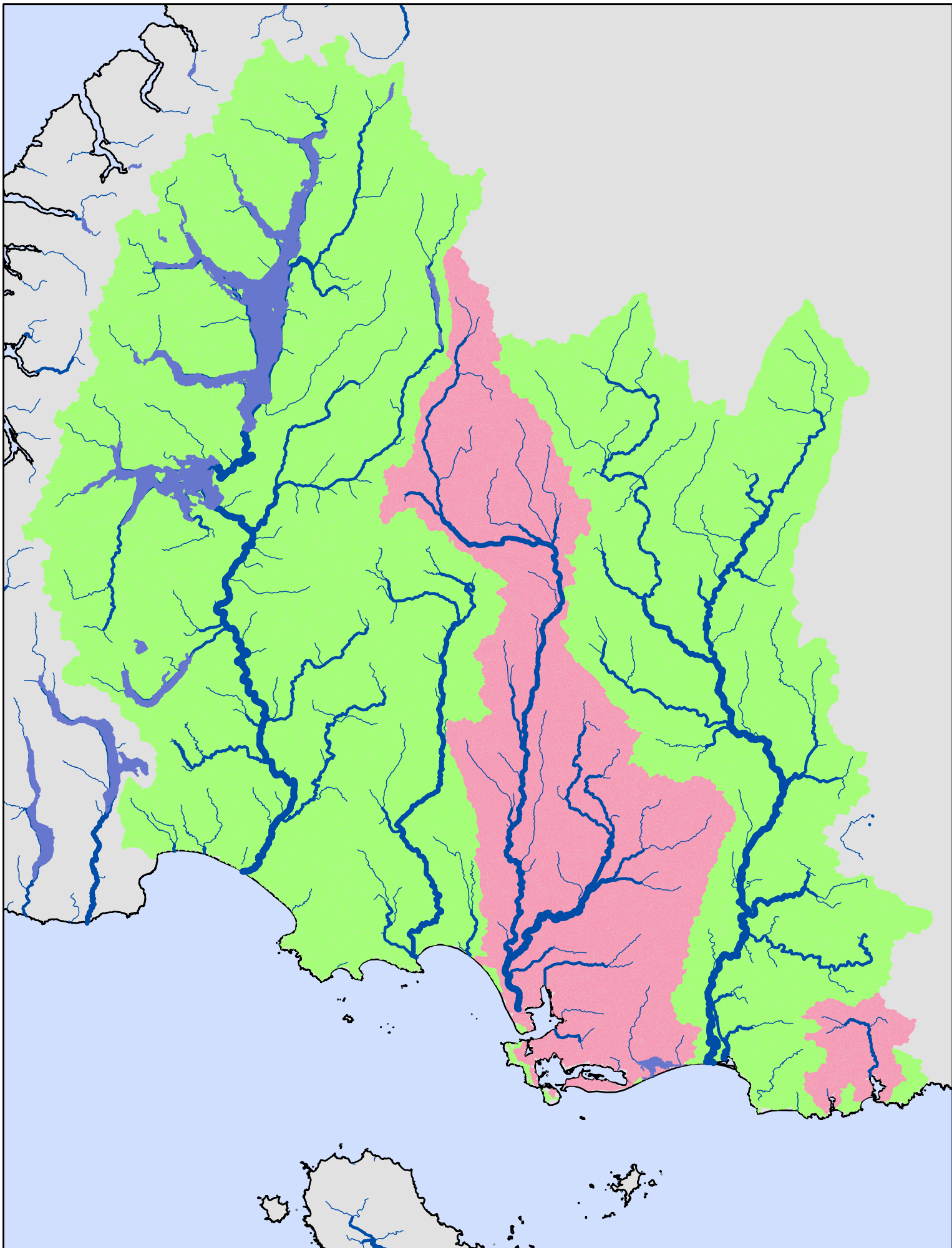
⁴ Statement of Evidence of Dr Antonius Snelder on behalf of the Southland Regional Council – Water Quality dated 11 February 2022 at [30]-[37].

DATED this 19th day of June 2023

A handwritten signature in black ink, appearing to read 'A. Snelder', written in a cursive style.

Dr Antonius Hugh Snelder

Maps of TP, DRP, TN, and DIN



Catchment Degradat on
Status for TP

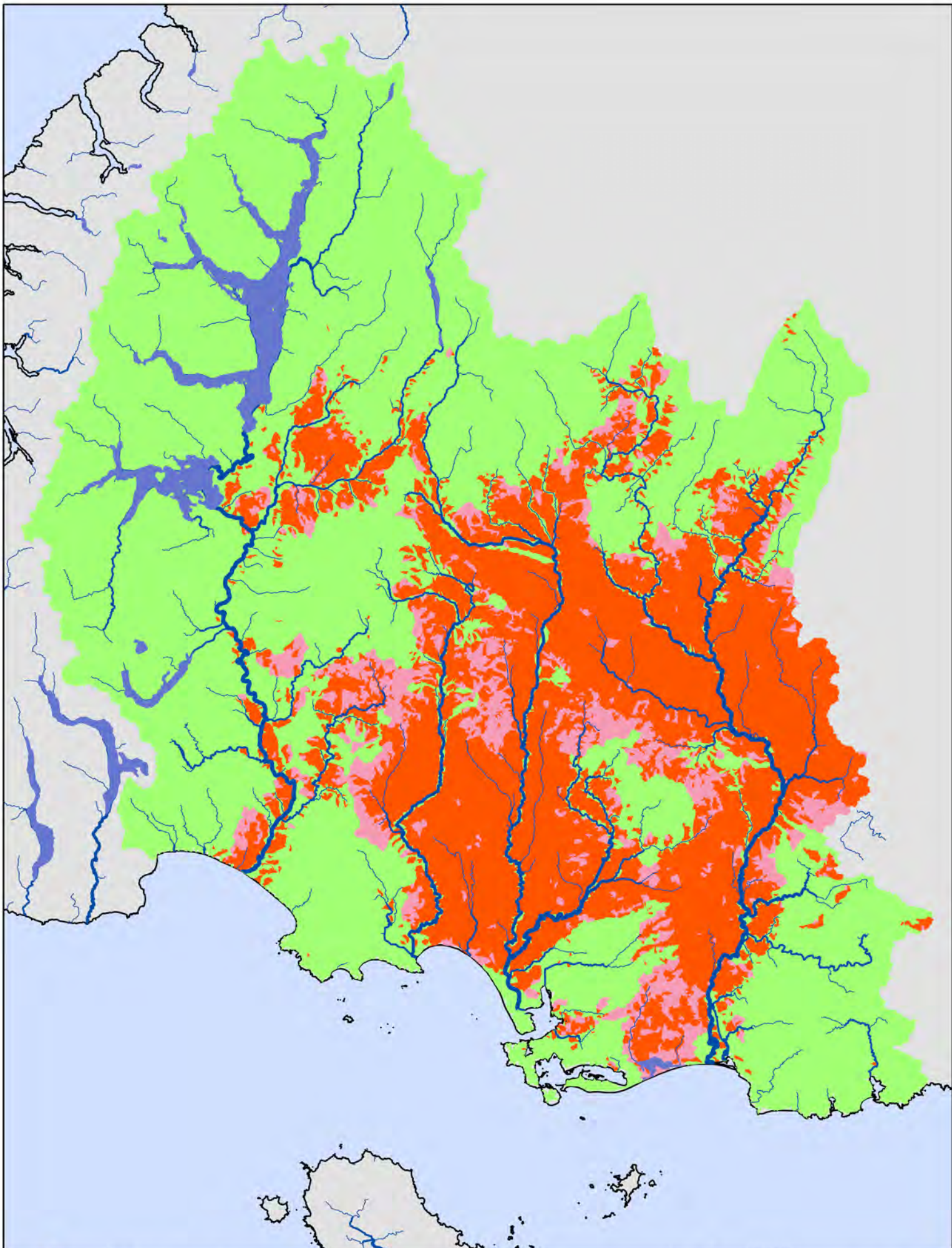
Date: 23/05/2023

- Degraded catchment
- Not-degraded

1: 900,000
At A4

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DATA SOURCE: ES GIS 2023



**Catchment Degradation
Status for DRP**

Date: 10/02/2023

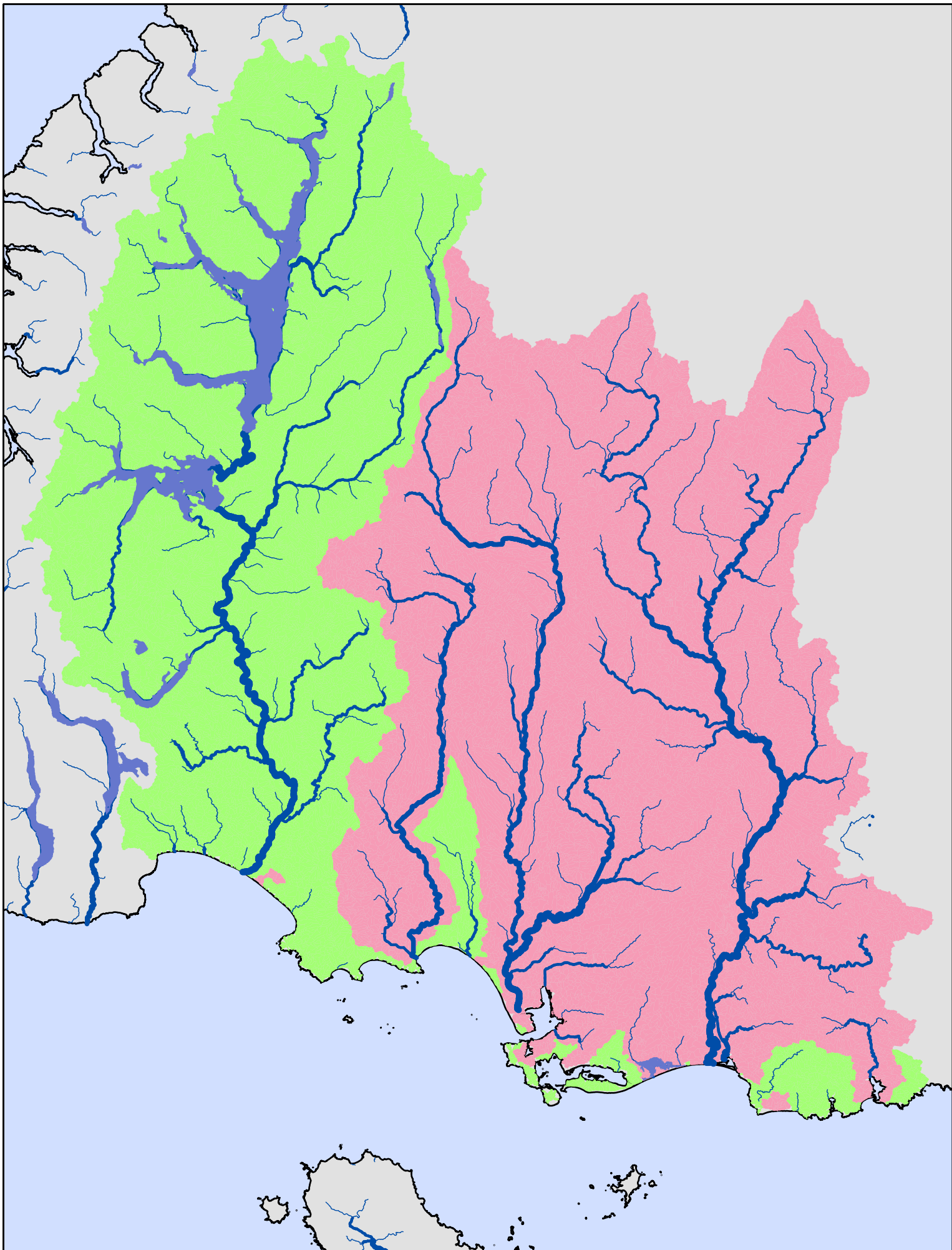
- Degraded catchment
- Degraded segment
- Not-degraded



1:900,000
At A4

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DATA SOURCE: ES GIS 2023



Catchment Degradat on
Status for TN

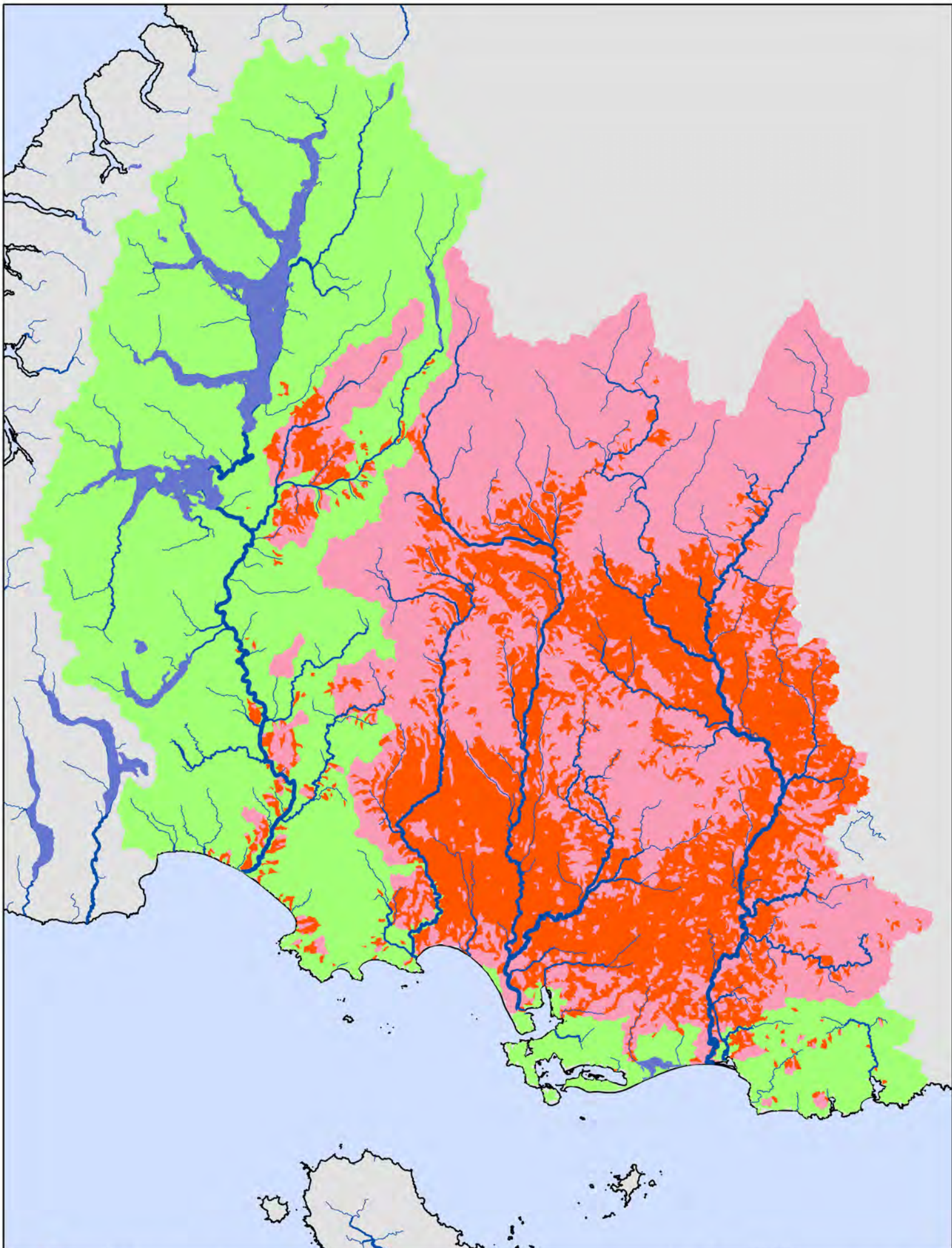
Date: 23/05/2023

- Degraded catchment
- Not-degraded

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1: 900,000
 At A4

DATA SOURCE: ES GIS 2023



**Catchment Degradation
Status for DIN**

Date: 10/02/2023

- Degraded catchment
- Degraded segment
- Not-degraded



1:900,000
At A4

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DATA SOURCE: ES GIS 2023