

Western Cape York groundwater study

2. Groundwater dependent ecosystems investigation
supporting the assessment of groundwater
sustainability in the Great Artesian Basin of Cape York

Attachment 1: Spatial analysis technical description
and maps of potential groundwater dependent
ecosystems

April 2014

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Contents

Description of spatial analysis methods	1
Data preparation	3
Data selection	3
Stage 1 – Pre-field assessment	4
Field Site Selection	4
Stage 2 – Post-field GDE assessment	9
Data Inputs	9
GDE likelihood Extrapolation Model	10
Identifying areas containing potential GAB dependent GDEs	12
Discussion	14
References.....	15
Maps of potential GDEs of Cape York Peninsula.....	17

Description of spatial analysis methods

Spatial analysis incorporating Landsat satellite images, field data and existing GIS layers were used to determine vegetation patches which may be groundwater dependant ecosystems (GDEs). Vegetation persistently maintaining vigour throughout inter-annual and annual climate regimes and variable surface water supply may be accessing water from groundwater sources for consistent water supply. A regional assessment of potential groundwater dependent ecosystems (GDEs) was conducted from vegetation signals in long-term vegetation trend data using satellite imagery. This project used Landsat data as part of a multiple line of evidence approach to detect potential GDE locations.

The Landsat program is the longest continuous Earth-observing satellite in operation (USGS, 2014). The program consists of numerous satellites including Landsat 5 Thematic Mapper (TM); Landsat 7 Enhanced Thematic Mapper + (ETM+) and Landsat 8 Operational Land Imager (OLI), which together have repeatedly captured observations over the same location on Earth every 16 days since 1985.

Thirteen Landsat scenes were required to cover the Cape York study area (Figure 1). For each of the Landsat scenes, Landsat 5TM (Years 2000–2011), Landsat 7 ETM+ (Year 2012) and Landsat 8 OLI (Year 2013) were acquired for GDE modelling purposes.

The GDE spatial analysis assessment was undertaken in two stages. Stage one consisted of the pre-field assessment which aimed to identify field data collection locations additional to existing known spring locations. Stage two consisted of the spatial analysis of remote sensing derived inputs, field data and existing GIS environmental spatial layers in order to generate a Spatial Analysis GDE likelihood product. The Spatial Analysis GDE likelihood layer contained locations ranked from 1–6 (Lowest–Highest) in order of likelihood of supporting GDEs.

The Spatial Analysis GDE likelihood layer was then used to identify terrestrial vegetation patches (as represented by regional ecosystem mapping), wetlands, baseflow streams and potential spring locations that may be accessing groundwater across the Cape York project area. The results of which were used to conduct a risk assessment of GDEs that may be potentially vulnerable to further Great Artesian Basin (GAB) groundwater extraction.

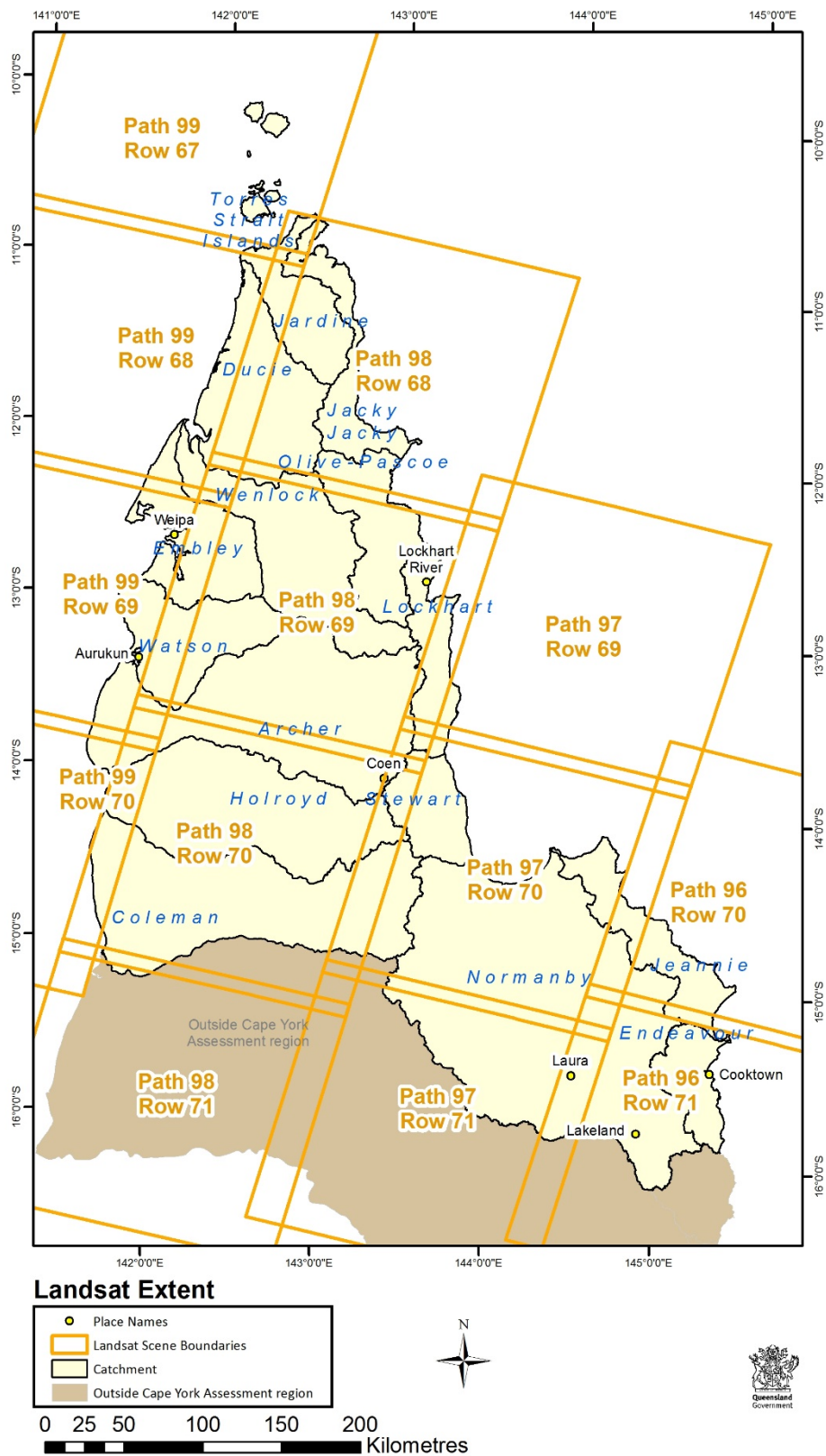


Figure 1 Extent of Landsat scenes across the catchment areas within the Cape York Peninsular project area

Data preparation

Data selection

Both time-series and single-date images were used in the spatial analysis modelling. Single-date Landsat imagery from the years 2002 (Stage 1 pre-field assessment) and 2013 (Stage 2 GDE likelihood assessment) were used in combination with long-term time-series Landsat imagery in the pre-field and GDE assessments.

A search was conducted to select the single-date images with the least cloud cover for each scene across the project area. Table 1 outlines the scenes selected for Stage 1 and Stage 2 of the analysis. Both the optical band (surface reflectance) and thermal band information was collected for each scene. Cloud masks were also used to remove cloud cover artefacts, where present in the single-date images.

Table 1 List of Landsat scene dates selected for single-date assessment of GDEs

Path/Row	Stage 1 Single-date – Pre-field Assessment	Stage 2 Single Date – GDEs Assessment
99/70	30 May 2002	08 August 2013
99/69	02 August 2002	08 August 2013
99/68	14 May 2002	08 August 2013
99/67	17 July 2002	08 August 2013
98/71	07 May 2002	18 September 2013
98/70	10 July 2002	18 September 2013
98/69	10 July 2002	04 October 2013
98/68	10 July 2002	04 October 2013
97/71	16 May 2002	27 September 2013
97/70	04 August 2002	20 April 2013
97/69	-	20 April 2013
96/71	-	02 July 2013
96/70	-	02 July 2013

The remote sensing analysis required the selection of:

- dry-season medoid (a multi-dimensional median) dominant green fraction products (Flood, 2013)
- single-date fractional cover products (Scarath et al. 2010)
- single-date Normalised Difference Vegetation Index products (Rouse et al. 1973)
- single-date thermal Landsat 8 products (Roy et al. 2014)
- single-date water masks (Feysia et al. 2014; Muir and Danaher 2010)
- time-series mean green fraction and coefficient of variation products (developed from Scarath 2013).
- Long-term persistent green fraction products (Gill et al. 2013)

Fractional cover separates Landsat pixels into proportions of the land's surface that are bare, non-green and green. Bare land covers include rock, exposed soil and infrastructure, non-green land covers include leaf litter and senescent grasslands, and green land covers include woody vegetation and vigorously growing non-woody vegetation. In this project, the 'green-faction' was used to indicate areas potentially accessing water despite climate and rainfall patterns.

Single-date and seasonal dry-season fractional cover products were used in Stage 1 while the long-term persistent green and time-series mean green fraction and coefficient of variation products were used in Stage 2 extrapolation.

Stage 1 – Pre-field assessment

A desktop pre-field assessment was undertaken to ascertain a range of field sites for use in the GDE spatial analysis model calibration and validation. Hydrographs across the Cape York peninsular were assessed to determine the most recent extended dry season following relatively dry wet-season conditions. The year 2002 was selected and single-date Landsat 5TM imagery was assessed (as per Table 1).

Time-series dry season seasonal medoid fractional cover products and single-date fractional cover and NDVI products were used to predict the location of dry-season dominant green vegetation and coincident high vigour vegetation patches.

Field site selection

Sites were selected based on the spatially coincident agreement with the pre-field criteria analysis and proximity to access roads. A variety of sites were selected in order to discriminate between once-off high-vigour vegetation patches and those exhibiting long-term, sustained, dominantly green vegetation. Sites which were detected in the Fractional Cover products and not the NDVI (and vice versa) were also sampled in order to understand the on-ground conditions at those locations and how they relate to spring detection.

An example of the dry-season single-date 2002 fractional cover derived product in relation to the selected field sampling polygons is shown in Figure 2. Blue areas depict areas with the highest fractions of green cover. Yellow areas depict the lowest fractions of green cover.

An example of the dry-season medoid fractional cover in relation to the pre-field polygons selected for field sampling is shown in Figure 3. The areas in dark green depict pixels which on average during the dry season of 2002 maintained a dominant fractional green cover signal.

An example of the dry-season single-date 2002 NDVI product used in the selection of the targeted field sampling sites is shown in Figure 4. Areas in bright green depict pixels which exhibited the highest vigour across the scene (greater than a value of 180 in the scaled NDVI image).

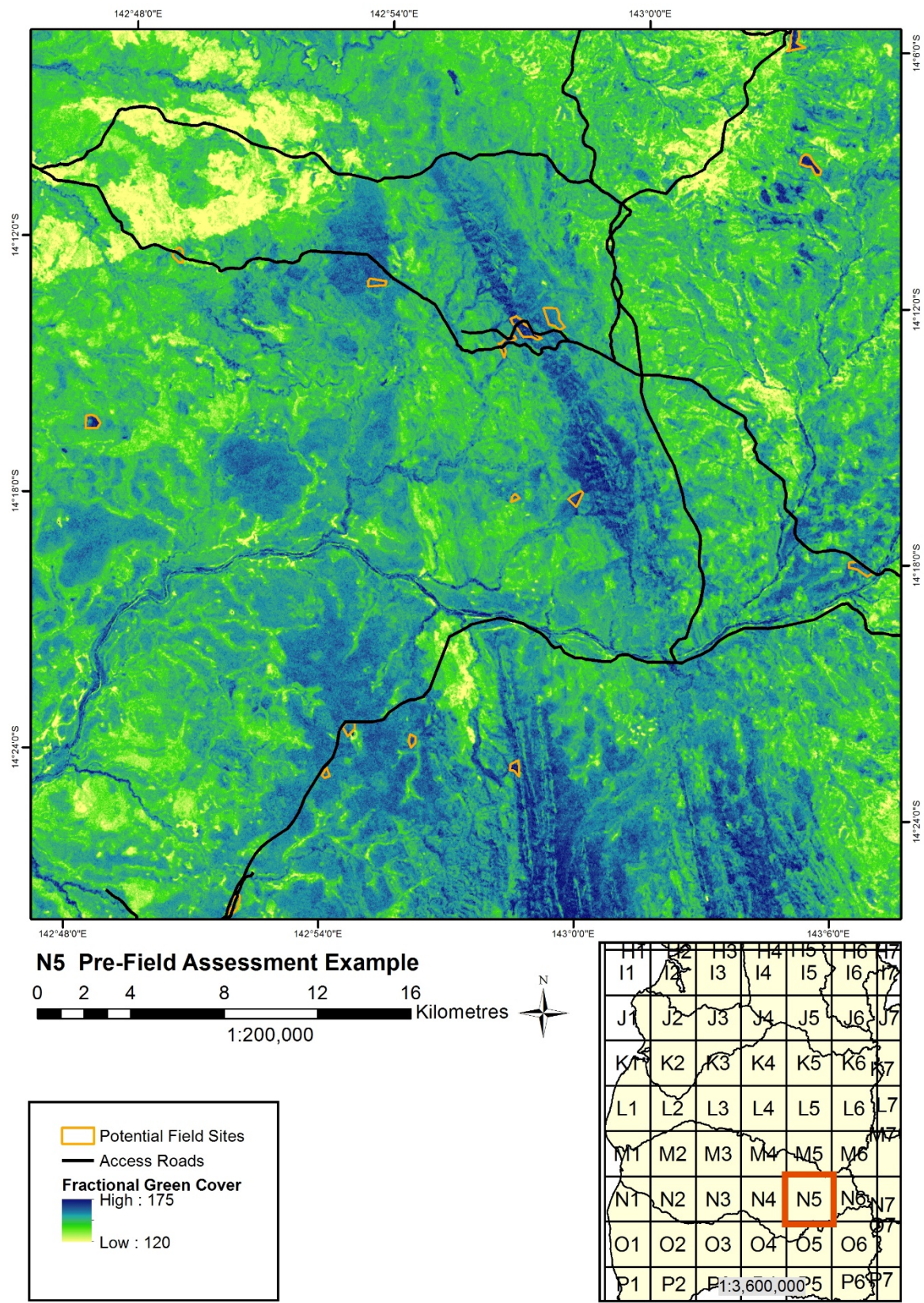


Figure 2 Pre-field single-date Fractional Cover (green fraction) investigation

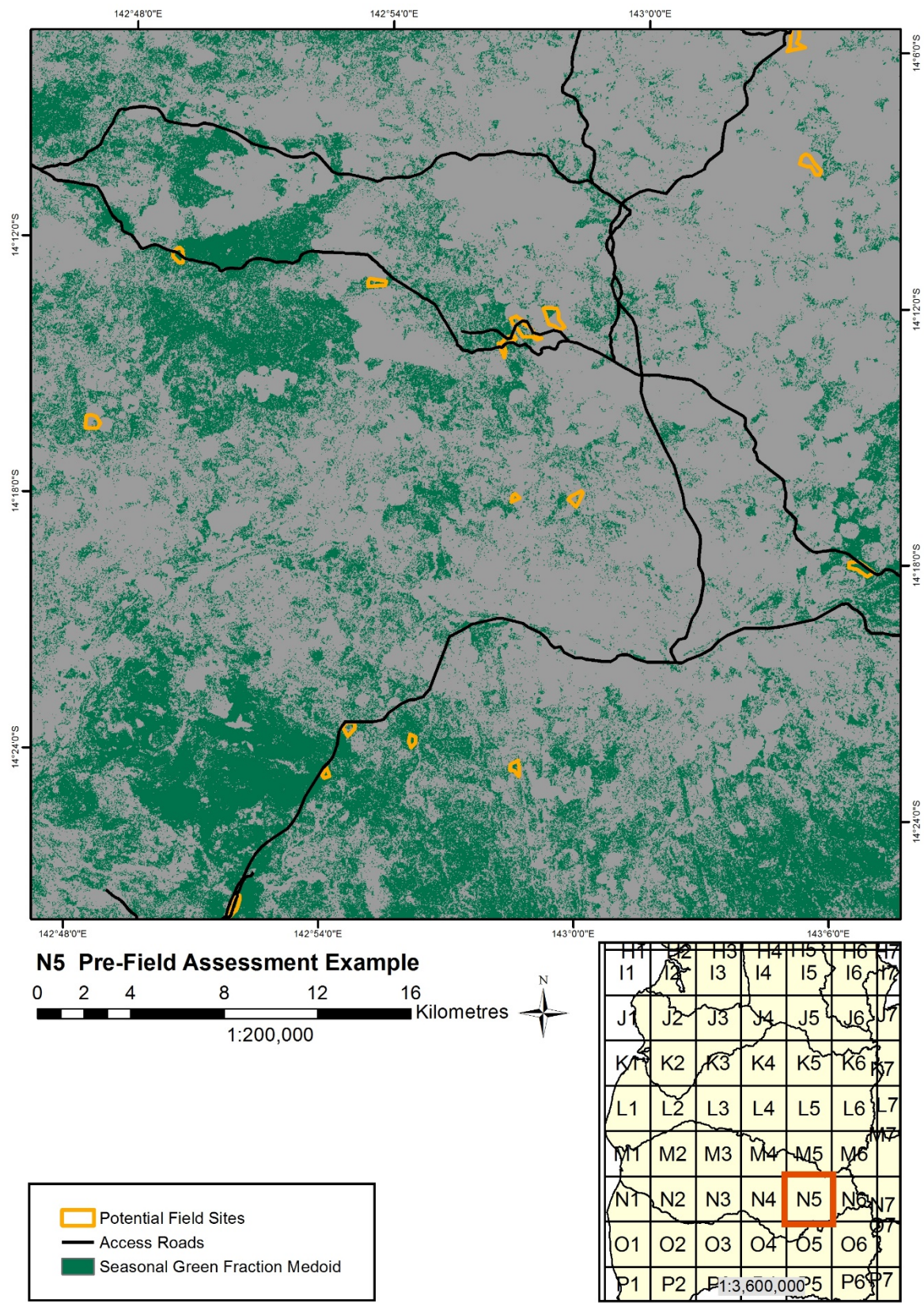


Figure 3 Pre-field Seasonal Green Fraction Medoid (a multi-dimensional median) investigation

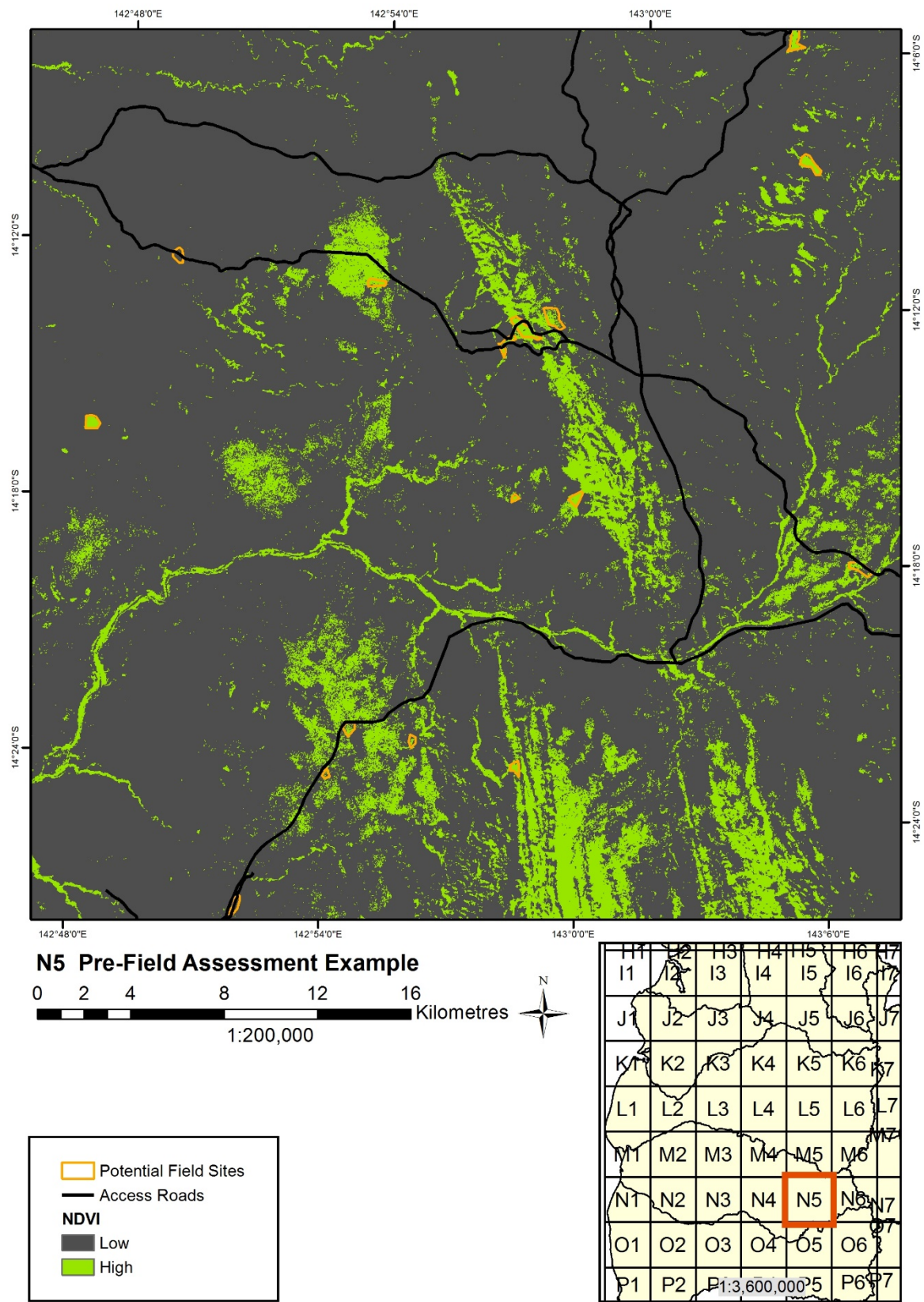


Figure 4 Pre-field Normalised Difference Vegetation Index (NDVI) investigation

Stage 2 – Post-field GDE assessment

Field observations were used to calibrate Stage 2 – Post-field GDE assessment. The field observations revealed that the 2013 dry-season would be ideal to use as the single-date input, superseding the 2002 assessment. The use of 2013 Landsat scenes would also contribute to better assessing the most recent dry-season land covers across the Cape York project area.

Additionally, thermal band imagery and two water indices were introduced and correlated with the field-based calibration sites to determine whether the sites could be separated based on thresholding the additional algorithms as part of the decision criteria approach.

Pixels in a 3 x 3 grid around field data points were sampled and correlated with the input Landsat derivatives. Thresholds were chosen based on the separation of the spring sites from non-spring sites as observed in the field. The thresholds were then applied to all pixels within the project area to determine other potential sites which could support GDEs.

Data inputs

Seven data inputs were applied to account for six decision criteria (as specified in Table 2). Two time-series of the same product were input in order to minimise temporal noise signals. The two data inputs (two time-series of the mean green fraction and coefficient of variation) were analysed in combined rule criteria for a total potential criteria maximum of “6”.

Long-term persistent green product

The extent of persistently green woody vegetation was classified using the long-term persistent green product (Gill et al. 2013) whereby a time-series of fractional cover (from 2000–2010) were analysed and the fraction of persistent green cover calculated (Table 2). This layer was used to locate terrestrial vegetation extent.

Fractional cover mean and variability products

Two time-series (across the years 2000–2005 and 2008–2013) were analysed to determine the mean green fractional cover and the coefficient of variation for the two discrete time-series (Scarth 2013). The time-series used all the Landsat images available between the years 2000–2005 and also between the years 2008–2013 to produce a mean fractional green estimation. The coefficients of variation for each pixel in the time-series were also calculated. Only those pixels with low coefficients of variation and high mean fractional green were selected as potential areas for groundwater dependant ecosystems with surface expressions (Table 2). This rule set classified areas of persistently maintaining a high green fraction as distinguished from vegetation experiencing green flushing and drying conditions driven by climate regimes.

Normalised Difference Vegetation Index (NDVI)

The Normalised Difference Vegetation Index (NDVI) (Rouse et al. 1973) is a widely used vegetation index. The NDVI product used in this project was calculated based on the top-of-atmosphere reflectance Landsat scene and scaled from a range of -1 to 1 into 8-bit range (0–255). Pixels with a higher value (i.e. greater than 180) are considered to signify healthy green vegetation pixels. Pixels with lower values (i.e. less than 100) are considered to signify infrastructure/bare pixels and pixels with values lower than 50 are considered to signify waterbodies. Only those pixels with high values (greater than 180) were considered potential areas for groundwater dependant ecosystems (Table 2).

Thermal

Landsat 8 OLI contains thermal bands which are sensitive to plant functional characteristics and land/water management and soil/water relationships and condition (Roy et al. 2014). The Landsat TM/ETM+ thermal bands have been used previously in evapotranspiration studies as an input to understanding physical processes of the transfer of water from soil and vegetation through to the atmosphere (Kalma et al. 2008).

Water availability is a key component as part of the evapotranspiration budget; thus vegetation communities with a relatively cooler thermal response (actively transpiring) may be one line of evidence that the vegetation patch or community may be accessing sub-surface aquifers. The 'cool pixels' indicate that they have maintained high transpiration rates in dry season conditions, where surface water availability is scarce. Table 2 outlines the criteria used to determine 'cool pixels' of interest. The Landsat Thermal product used in this project was the thermal brightness temperature in Kelvin.

Water indices

The water indices were used to detect waterbody extent and also to identify moisture-holding terrestrial vegetation communities. Two water indices, the SLATS Water Index developed by Muir and Danaher, (2008) and the Automated Water Extraction Index (AWEI) developed by Feyisa et al. (2014) were used as both indices provided information with varying sensitivities to waterbodies and vegetation moisture signals. In the context of the multi-criteria approach, both water indices were applied to minimise errors of omission and commission across the project area. The water indices were used in a two-fold approach to classify areas which contained water bodies and also vegetation communities with relatively high moisture signatures.

Water bodies were extracted using values from the lower (darker) values of the SLATS Water Index and higher (brighter) values of the AWEI index. Vegetation communities which appeared 'bright' in the SLATS Water Index and or were adjacent to the water signal within the AWEI index were classified as moisture holding vegetation communities.

GDE likelihood extrapolation model

Spectral indices were derived from the single-date images to obtain layers relating to vegetation vigour, vegetation moisture and percent of the pixel covered by green, actively photosynthesising vegetation. Time-series products were also used to model the location of persistent green vegetation patches across the Cape York project area.

The thresholds and rules based on the calibration from field observations were applied to the images within the project area as outlined in Table 2. The criteria were processed for each path/row described in Table 1.

Table 2 Criteria and thresholds applied for spatial analysis GDE likelihood product creation

Criteria	Threshold	Classified True Value	Classified False Value
Time-series Persistent Green (2000-2010)	Pixel ≥ 155	10	1
Time-series Mean Fractional Cover AND Coefficient of Variation (2000-2005 and 2008-2013)	Pixel ≥ 155 AND Coefficient of Variation ≤ 12 for each time series	10	1
2013 Normalised Difference Vegetation Index (NDVI) [^]	Pixel ≥ 180	10	1
2013 Thermal band [^]	Pixel ≤ 30150	10	1
2013 SLATS Water Index (WI) [^]	(a) Pixel ≤ 70	80	See (b)
	(b) Pixel ≥ 89	10	1
2013 Automated Water Extraction Index (AWEI) [^]	(a) Pixel ≥ 120	80	See (b)
	(b) Pixel ≥ 40 AND < 120	10	1

[^] The single date images were not analysed in locations where clouds were present in the Landsat scene date.

Water was given a value of 80 and masked all other classifications. A pre-existing Queensland Regional Geology Structures layer (created and owned by the State of Queensland, 2014) was buffered by 500m (to account for scale limitation of the Geology layer) and then intersected with the GDE likelihood layer. This buffered zone represented a Geology contact zone. An additional score was applied to those GDEs located within the Geology contact zone layer.

All values were summed and categorised into likelihood ranks based on the number of criteria which were classified as "True" (Table 3).

Table 3 Categorisation of summed values into GDE criteria ranks

Criteria Rank	Summed Value
1	60–65
2	50–55
3	40–45
4	30–35
5	20–25
6	10–15
80	80–85 (water)
125	Cloud Mask

The output model scenes were clipped using a standardised template derived to minimise overlap of USGS WRS2 path/row boundaries as per the Queensland Government Statewide Landcover and Trees Study methodology (Queensland Department of Science, Information Technology, Innovation and the Arts, 2012). The individual scenes were then mosaicked in order of paths from South to North and rows from West to East.

The mosaicked product was then clumped into patches containing the same Criteria Rank Value. Patches of values less than 6 pixels in area were removed to account for potential geometric shifts in the time-series analysis and to minimise noise in the classified GDE likelihood product.

Potential GDEs were classified as all patches containing Criteria Ranks 1 and 2. The GDE likelihood product was then used as part of the criteria for determining the potential presence of GDEs.

Identifying areas containing potential GAB dependent GDEs

In order to identify locations within the Western Cape York study area which may contain potential GAB dependant GDEs, modelled hydrogeology layers were introduced. Modelled potentiometric surfaces for the years 2005 (pre-development) and 2058 (post-extraction) were intersected with the 1-second hydrologically-corrected Shuttle Radar Topographic Mission (SRTM) Digital Elevation Model (DEM) (Farr et al. 2007; Dowling et al. 2011). The pixel resolution of the modelled potentiometric surfaces was 100 metres.

Areas in the modelled potentiometric surface intersect with the ground surface level (with a -5 metre buffer applied to account for minimum mapping units in the z direction), were considered to be in a zone where the GAB has sufficient water pressure to provide a hydrologic connection to the ground surface should flow pathway be present.

The difference in area between the two modelled scenarios (2005 and 2058) indicates the modelled change in potentiometric surface, and represents the 'potential drawdown area'.

Based on the premise that upward leakage is more likely to occur where the confining beds are thin and hydraulic gradients are high (CSIRO, 2009), such areas were represented by a ratio of

confining layer thickness relative to the hydraulic gradient. These potential leakage areas were identified using the ratio between the early 1970's pre-development modelled hydraulic gradient and confining bed thickness. A ratio value of 0.5 was selected after a sensitivity analysis was conducted to examine a range of ratio values. The spatial area did not significantly change by increasing the ratio value. The 0.5 ratio value represented the most robust threshold from which to assess potentially vulnerable GDEs. Intersecting the defined 'potential drawdown area' with these potential leakage areas produced the spatial extent considered to be the Area of Vulnerability (AoV). The three new spatial boundaries created were:

- zone of 2005 modelled potentiometric surface above the DEM (potential connectivity zone);
- zone of drawdown (difference between 2005 and 2058 connectivity zones); and
- zone of Area of Vulnerability.

The three new spatial boundaries were intersected with the spatial data layers containing the GDE types (terrestrial vegetation/wetlands/baseflow streams and springs) and metrics calculated to determine the extent, range and type of GDE classified within each zone.

Discussion

The GDE likelihood layer was designed to be used at the regional scale for determining vegetation patches, which could be dependent on groundwater. The method assumes that vegetation accessing groundwater will maintain ecosystem health despite climate variability.

The water indices were not optimised to classify moisture-holding vegetation communities; therefore, the thresholds identified in this project could be refined with further investigations into the biophysical relationship between Landsat and moisture holding vegetation communities.

Fire was not masked out of the assessment. Cape York experiences significant 'scars' from fire events. DSITIA has released a Historical Fire Mapping product which could be integrated into the product in the future. The timing of this project did not allow for the integration of the Fire product as part of this assessment. Fire scar artefacts may result in a lower classified rank; however, it was noted in the field observations that fires did not affect spring locations due to presence of water on the surface. Fire may still affect marginal expressions of groundwater seeps.

Some locations within the Cape York study area experienced persistent cloud conditions. These areas may contain GDEs but were mapped with either a mask value (if no data was available for assessment) or have a reduced rank as not all information was available for the assessment.

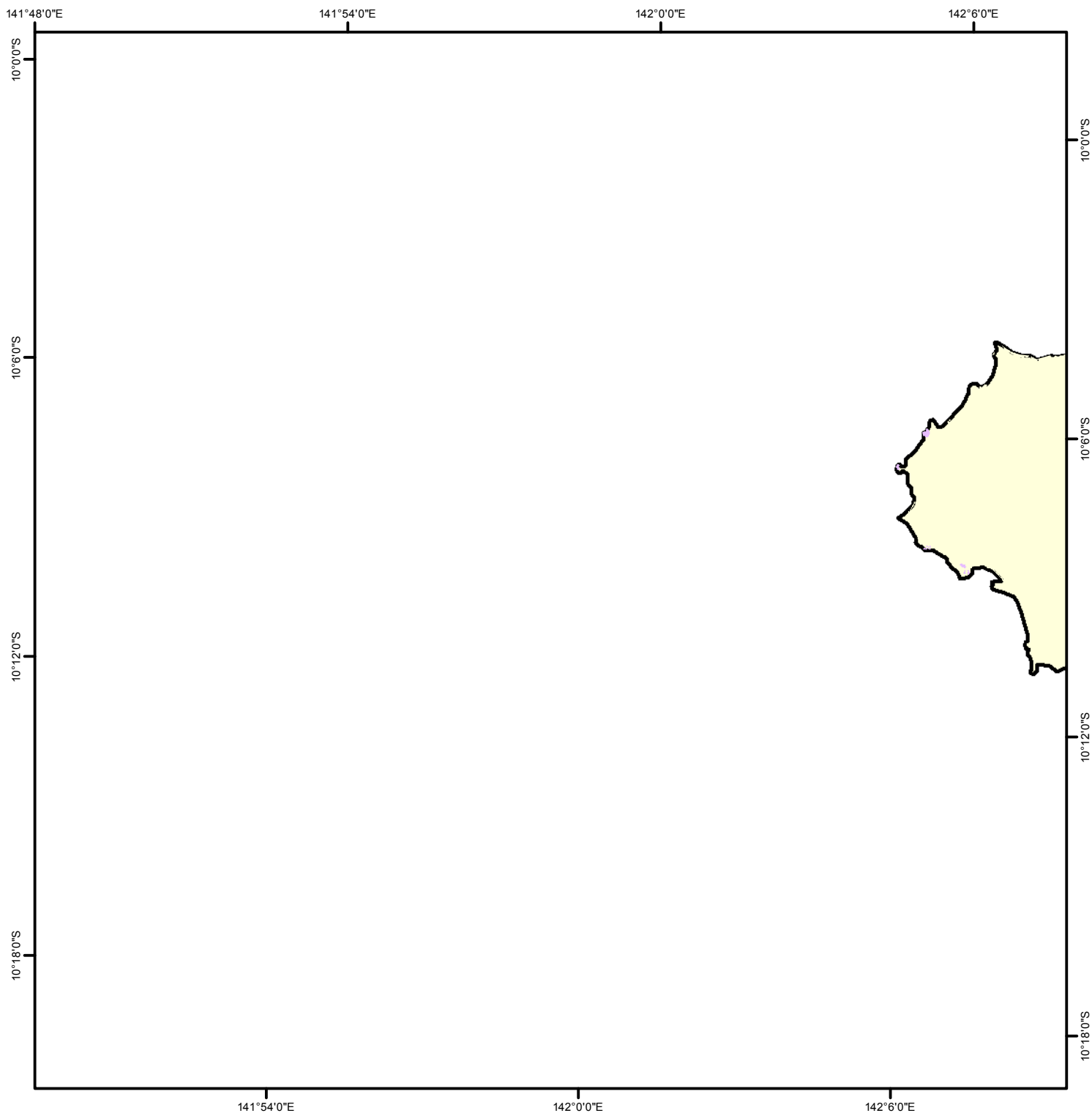
Uncertainty in the GDE likelihood layer produced needs to be quantified. Additional field data on spring locations needs to be collected across the Cape area. The additional field information can be used to train, validate and refine errors of omission and commission in the GDE likelihood layer. The additional field data may also be used to better understand the sensitivities of input spatial layers, such as the water indices, and create new spatial layers which are optimised for detecting spring locations and GDEs.

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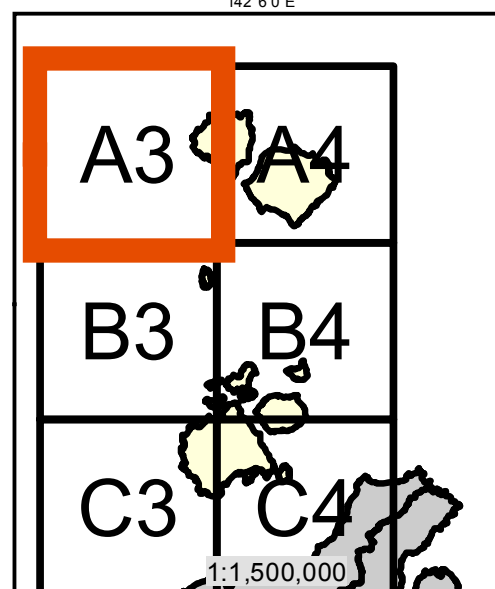
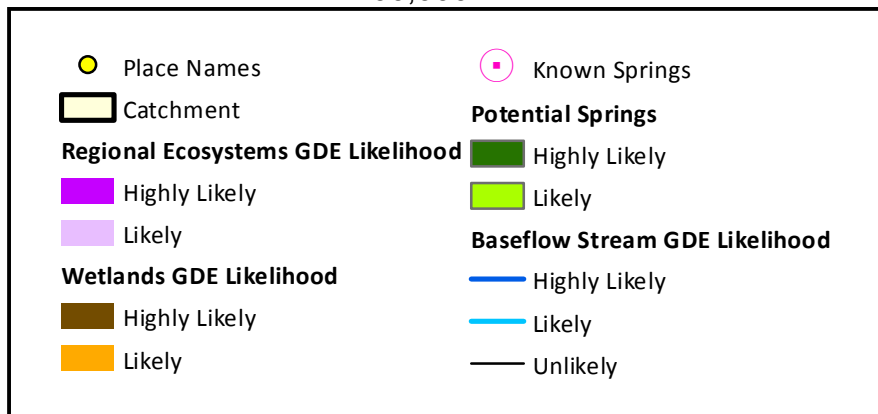
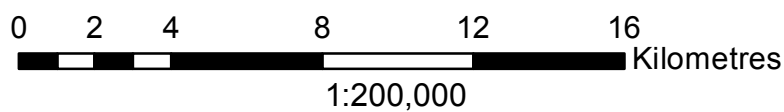
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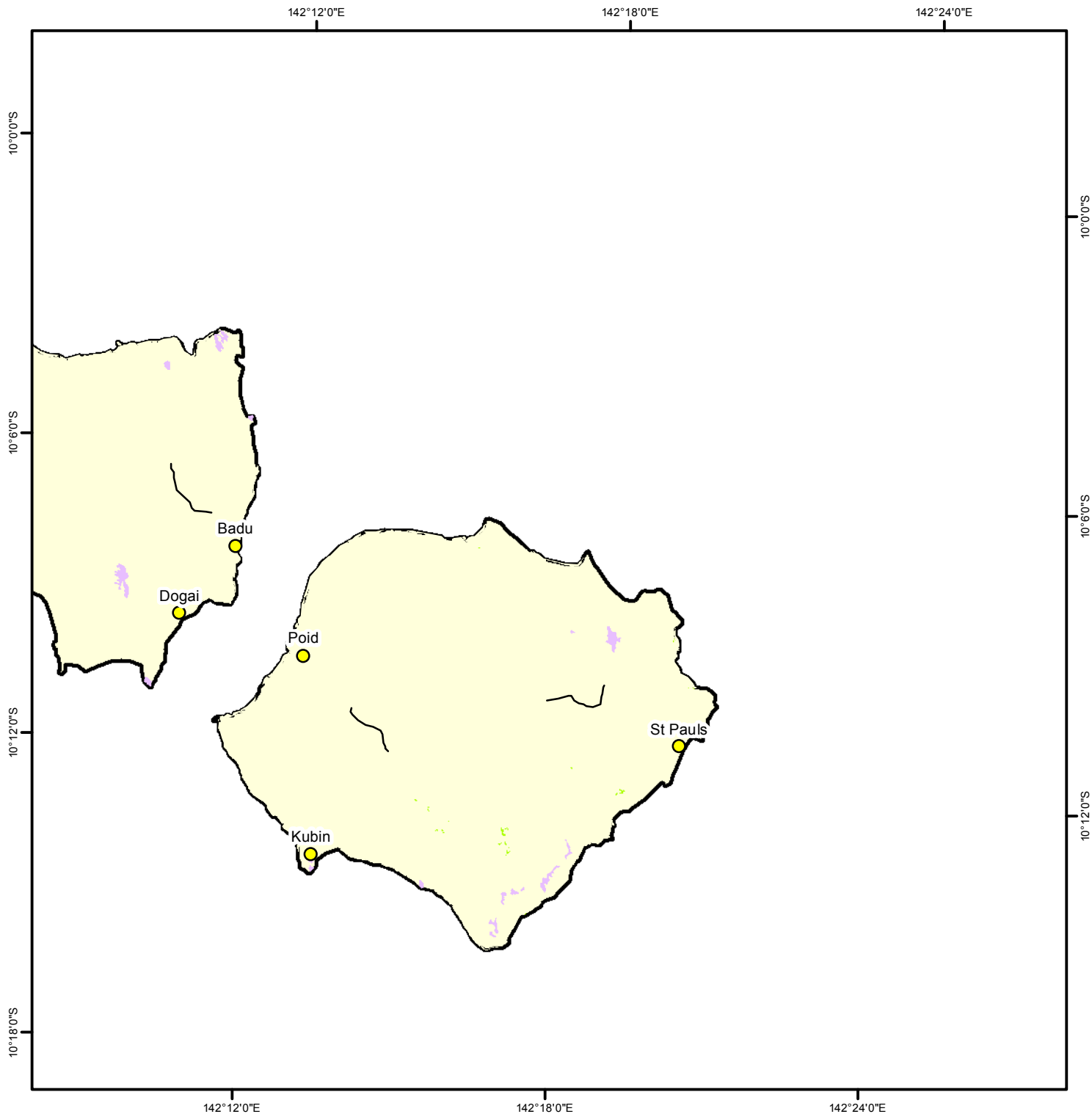
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Maps of potential GDEs of Cape York Peninsula

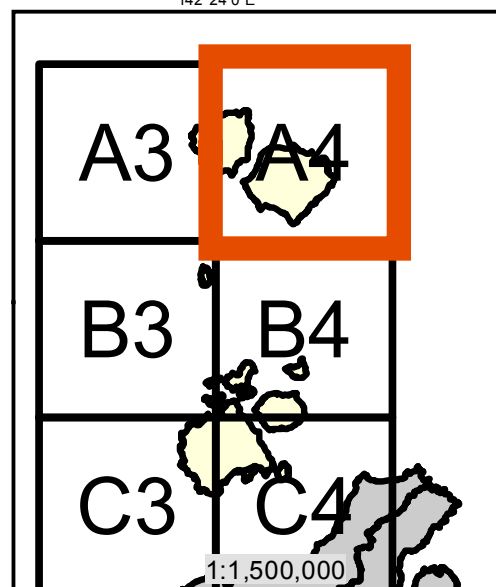
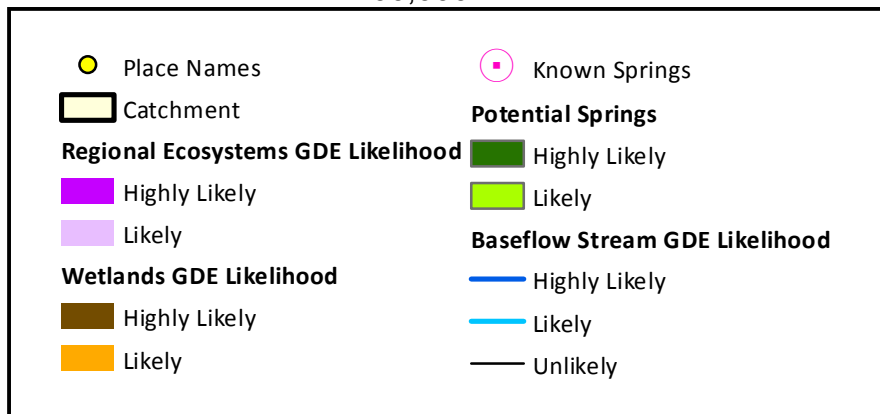
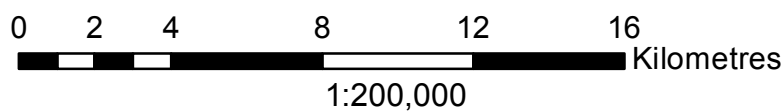


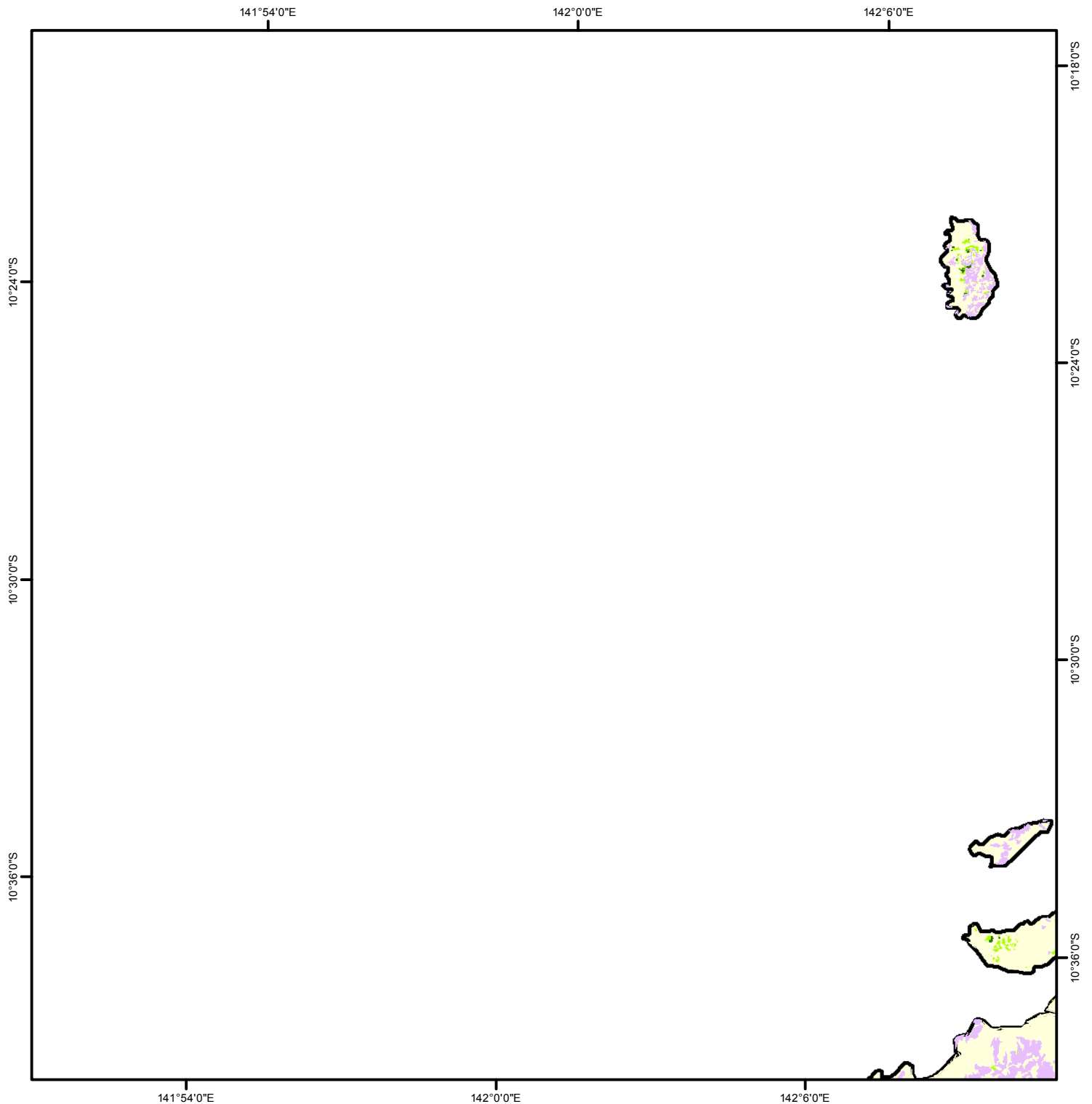
A3 Torres Strait Islands Catchment



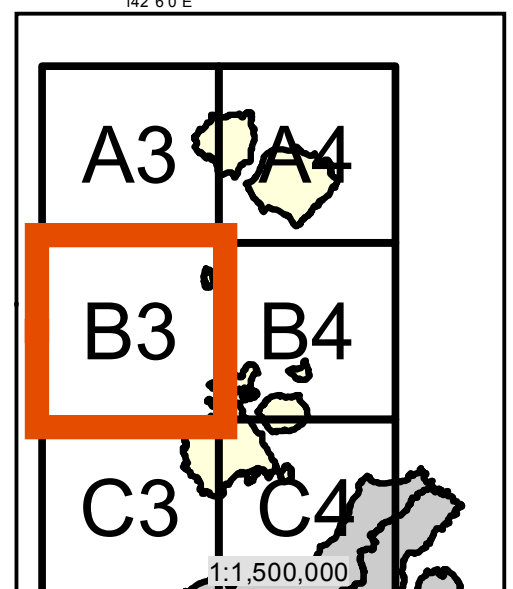
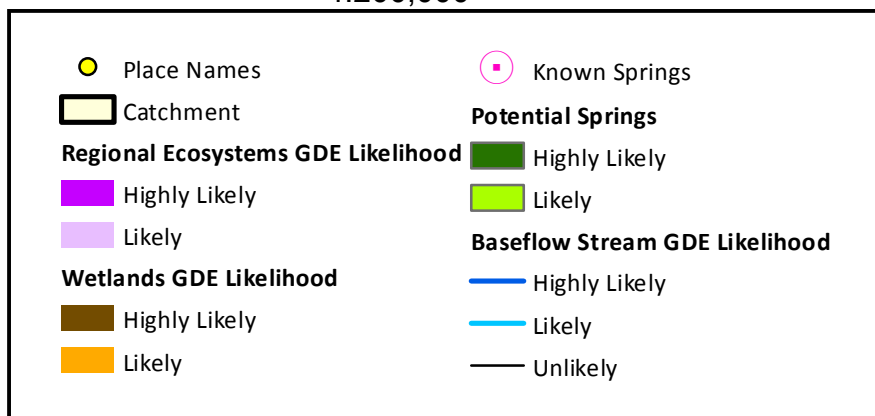
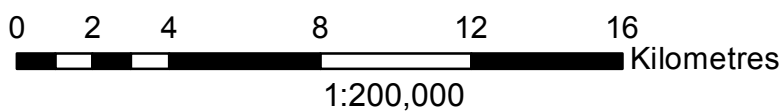


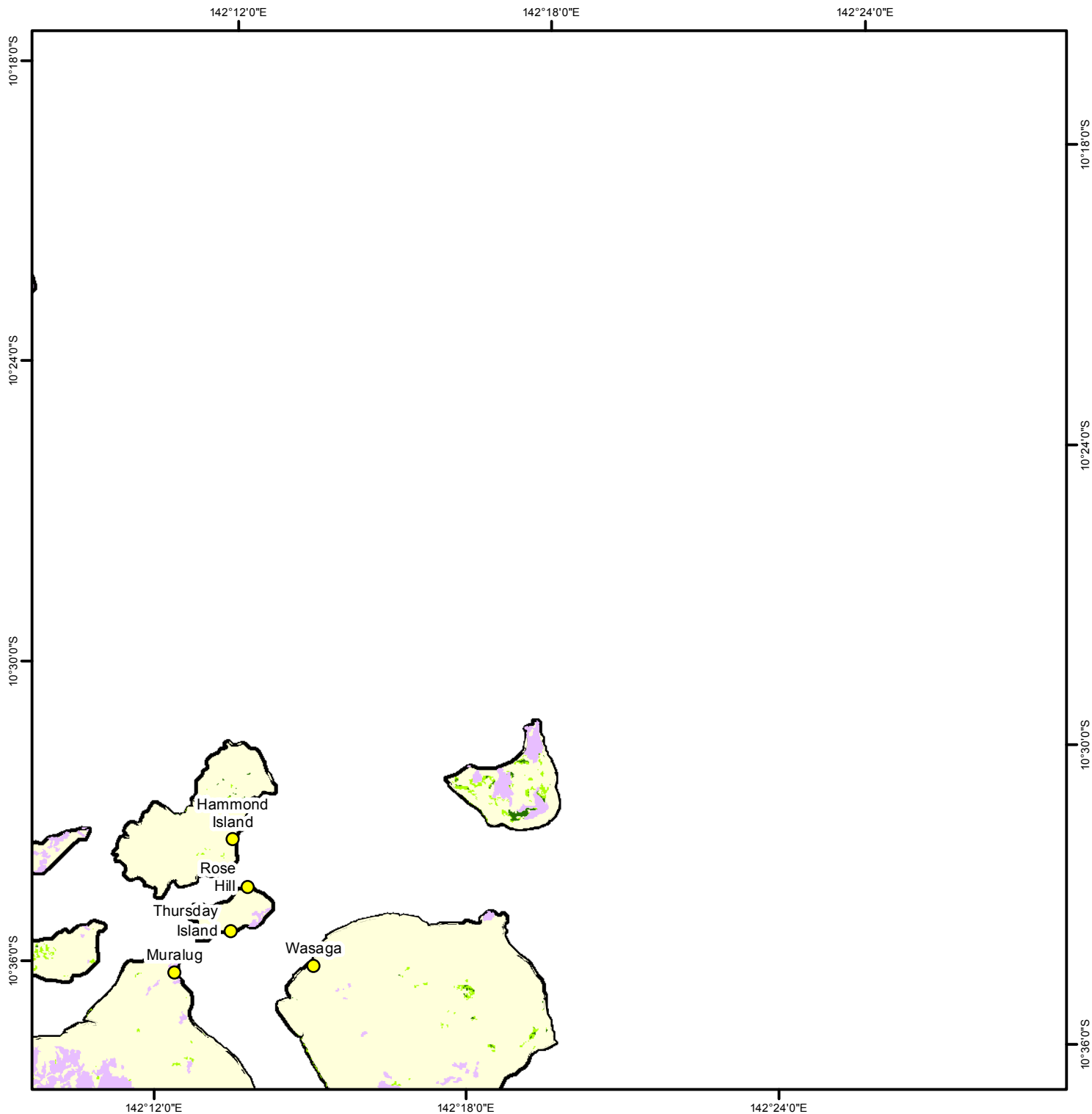
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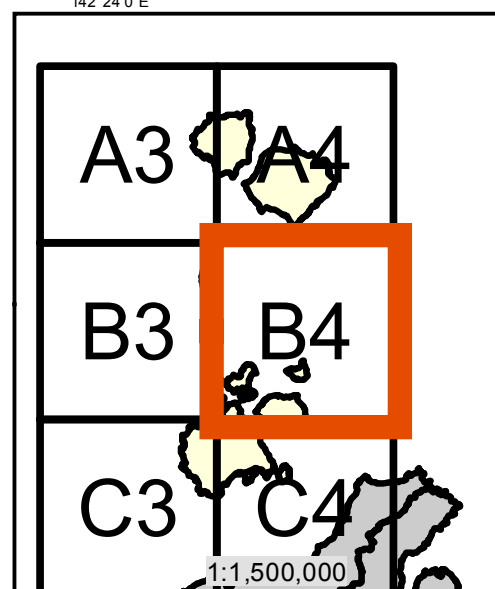
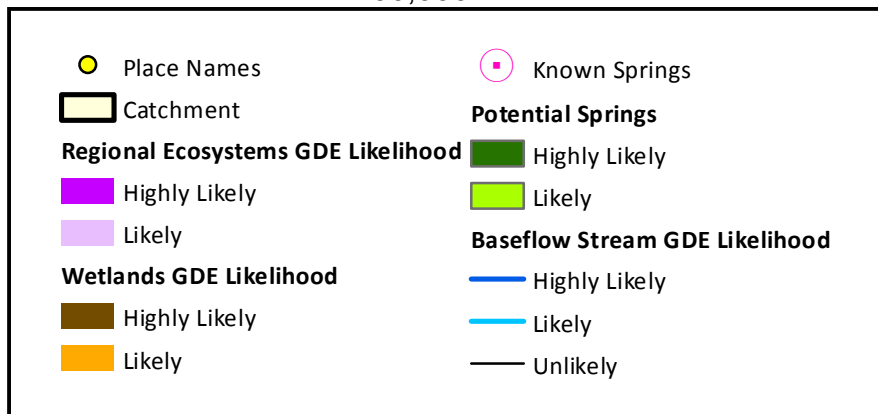
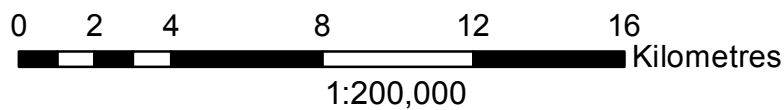


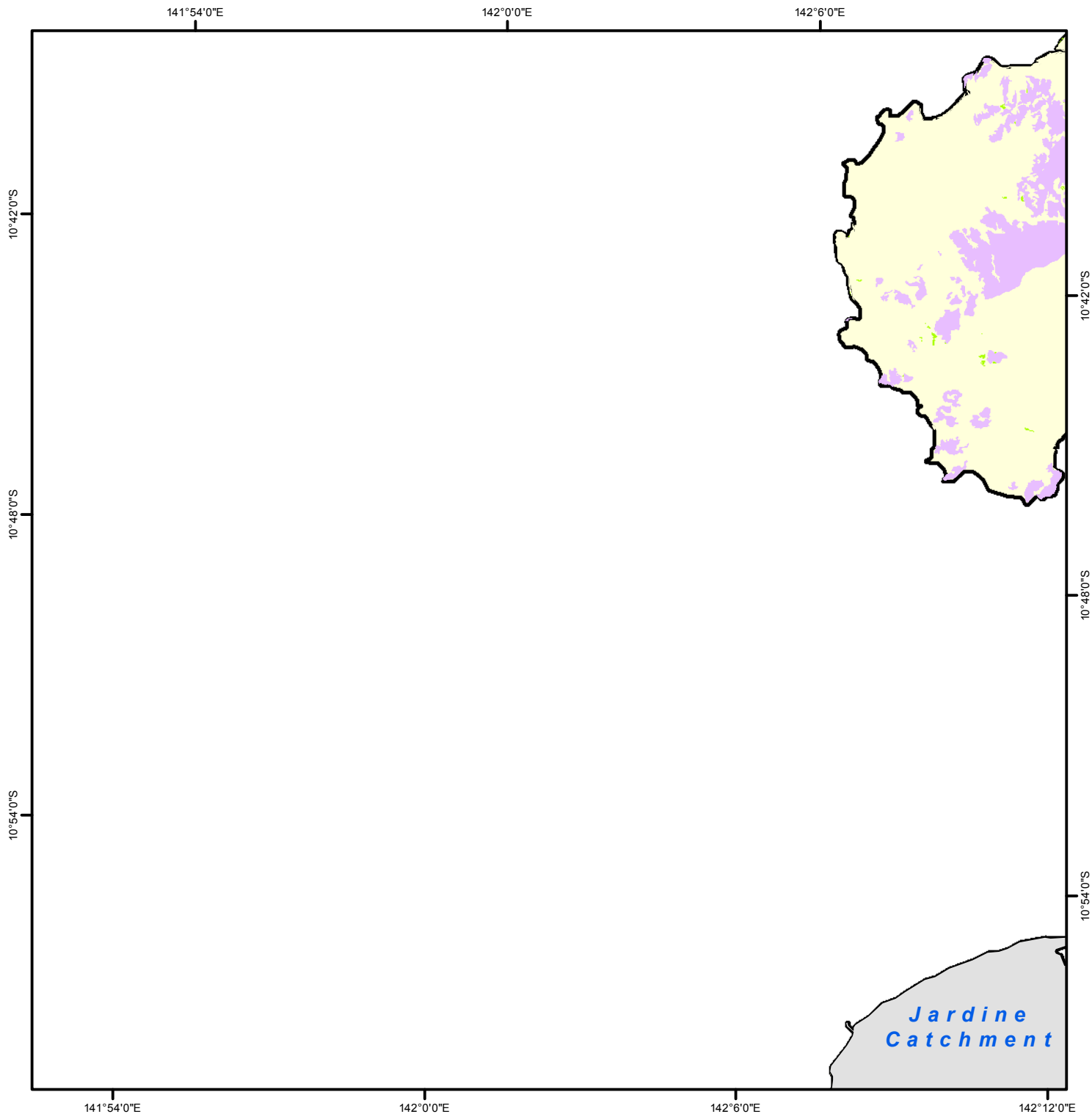
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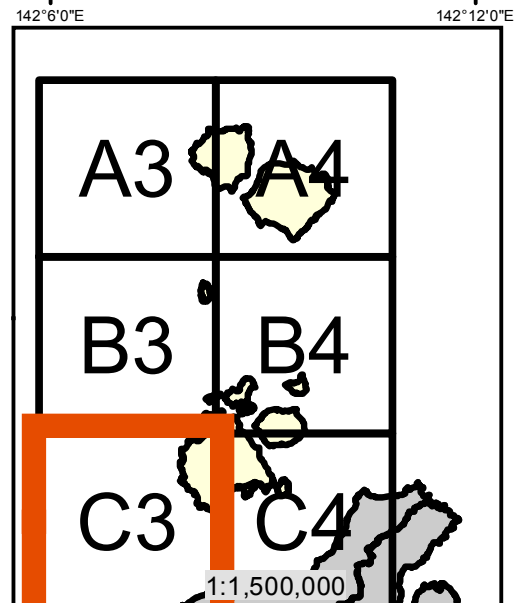
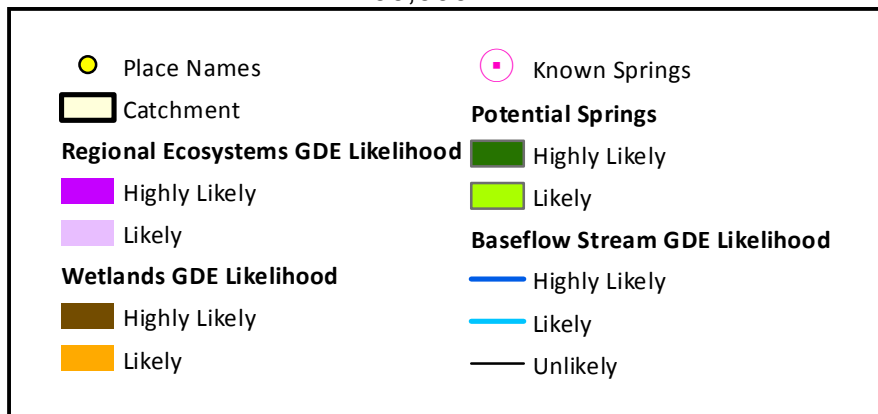
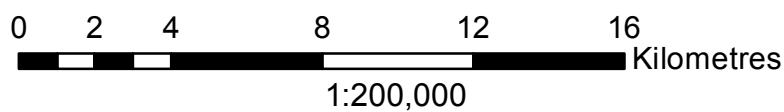


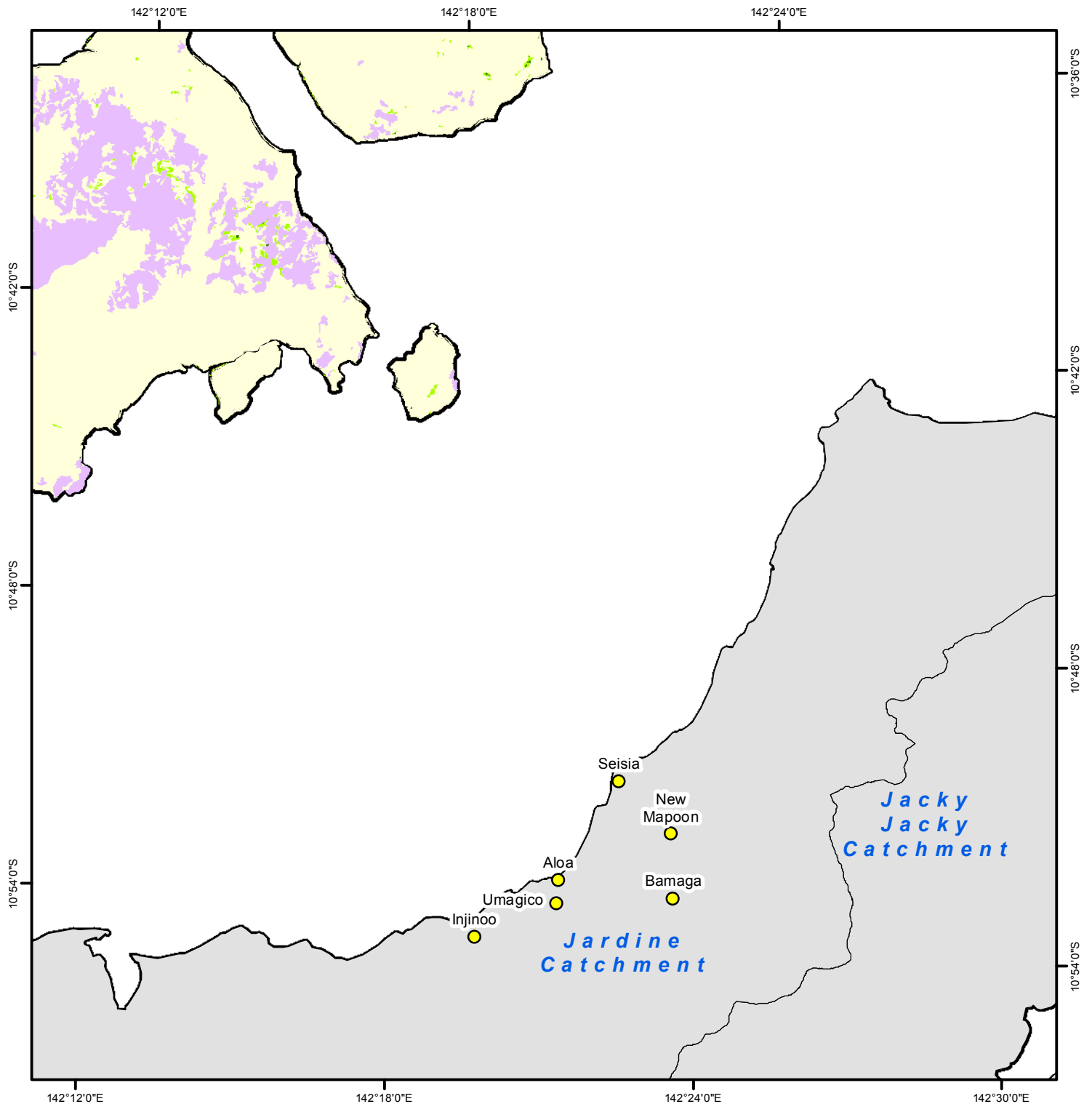
B4 Torres Strait Islands Catchment



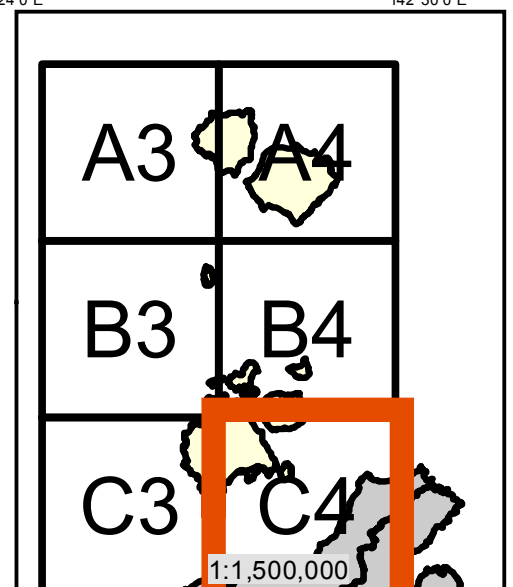
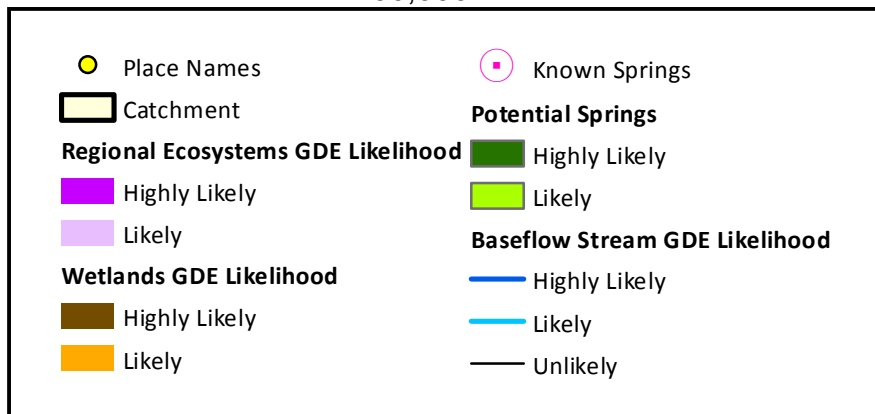
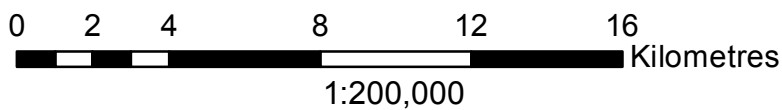


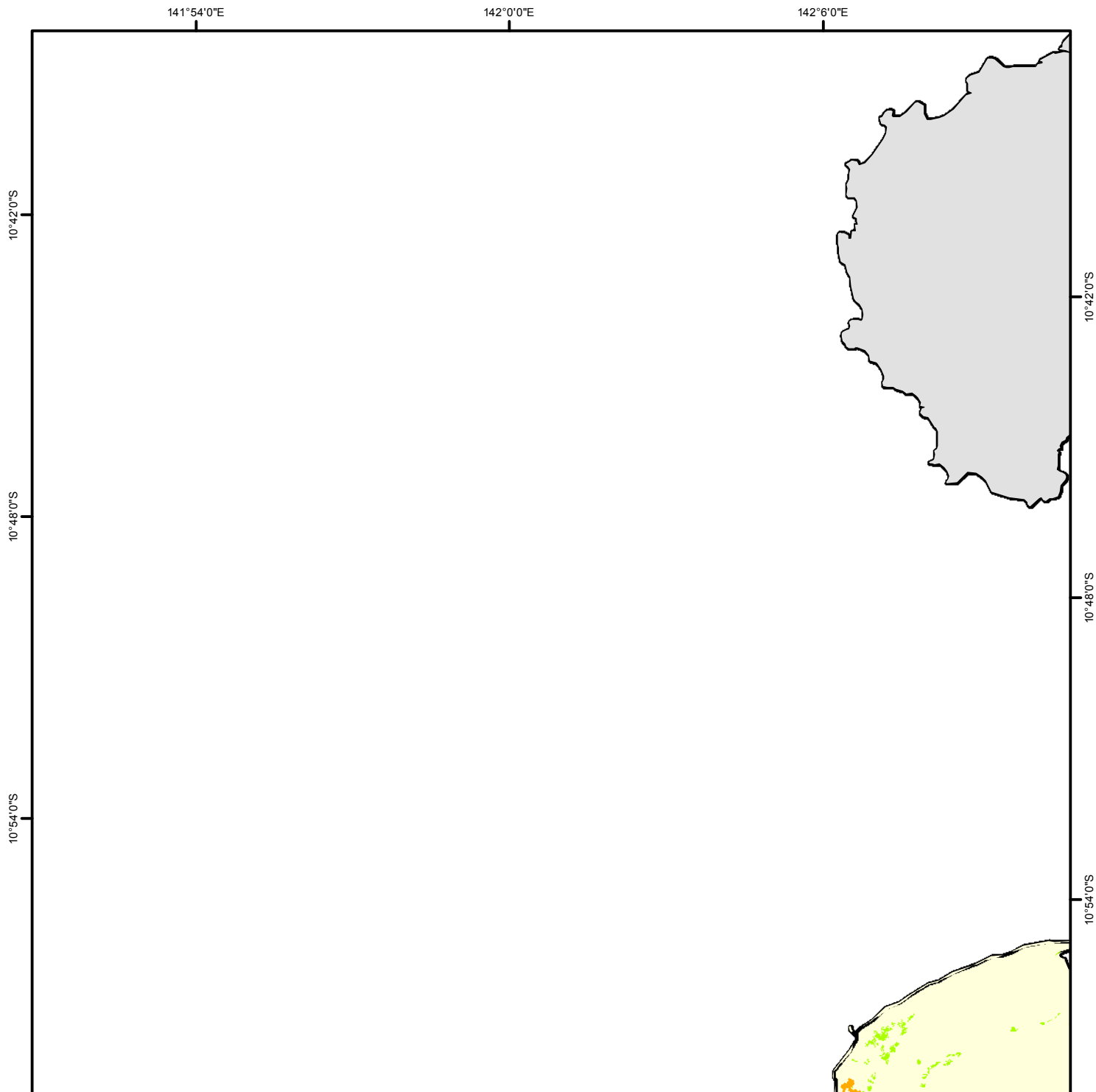
C3 Torres Strait Islands Catchment



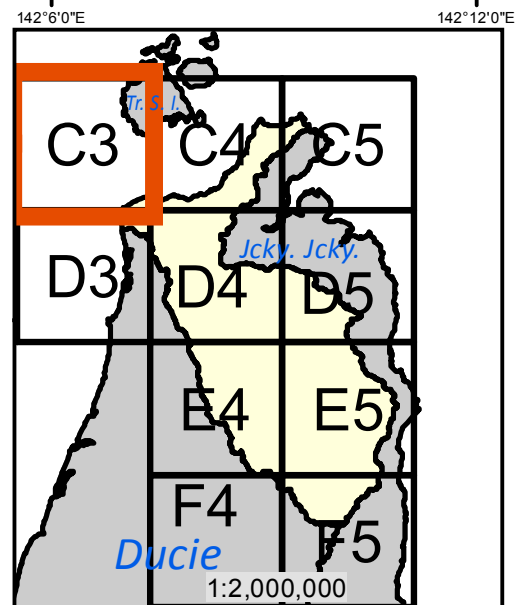
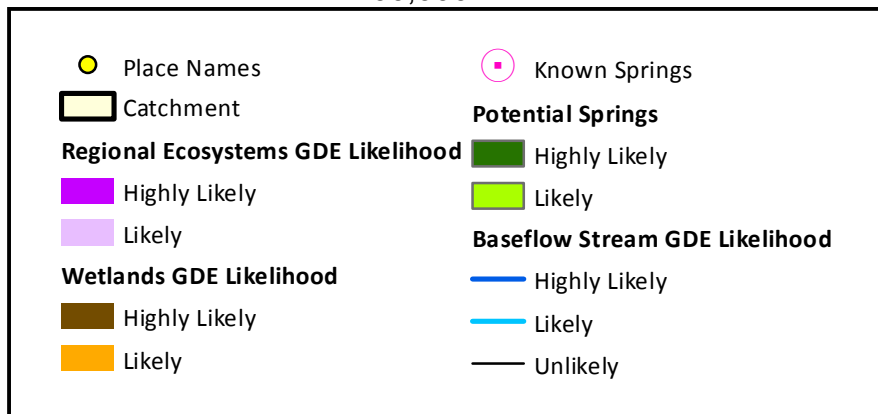
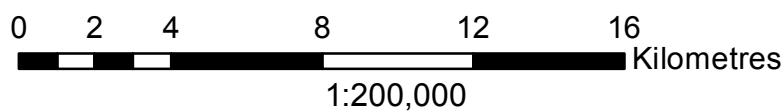


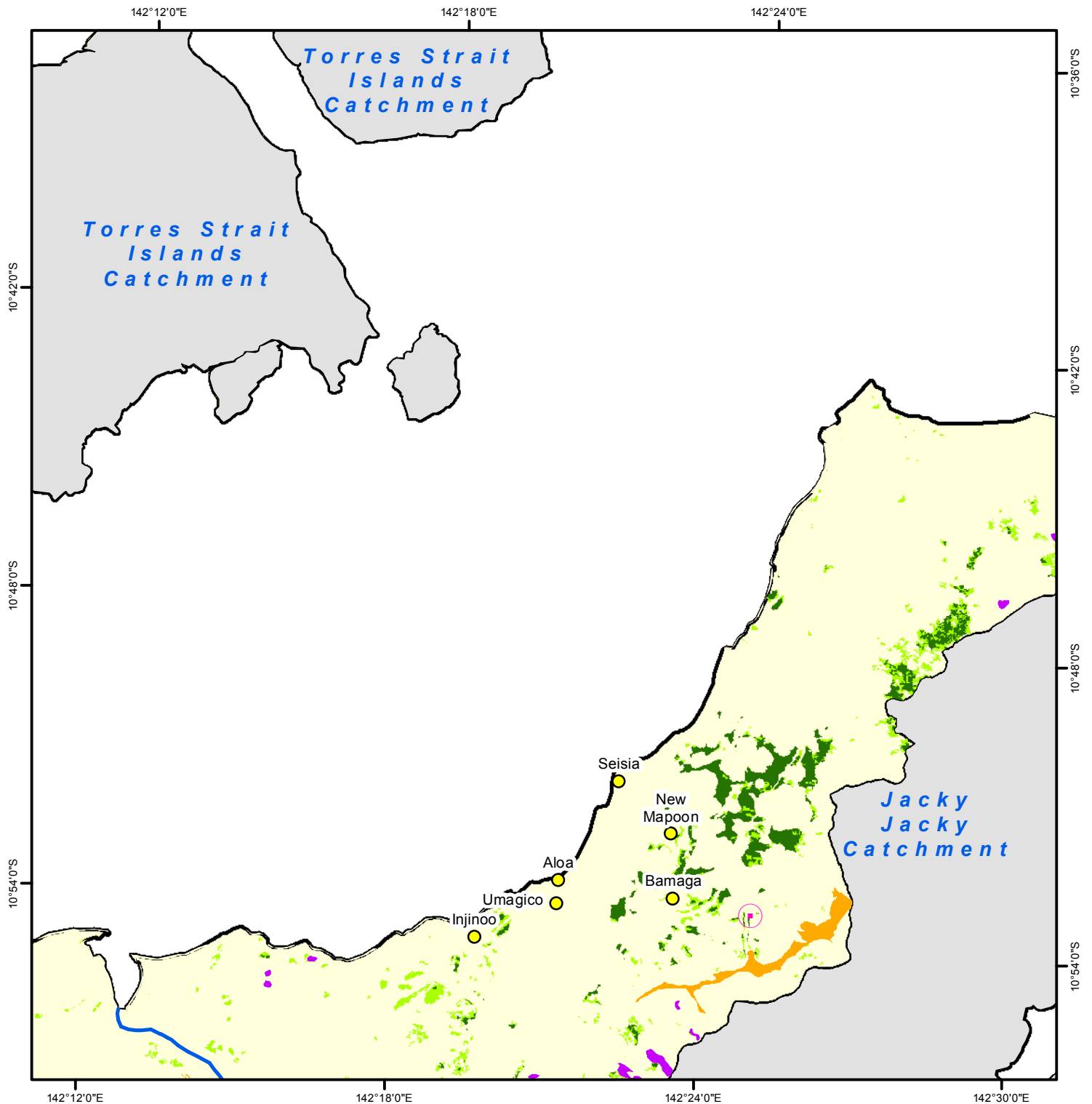
C4 Torres Strait Islands Catchment



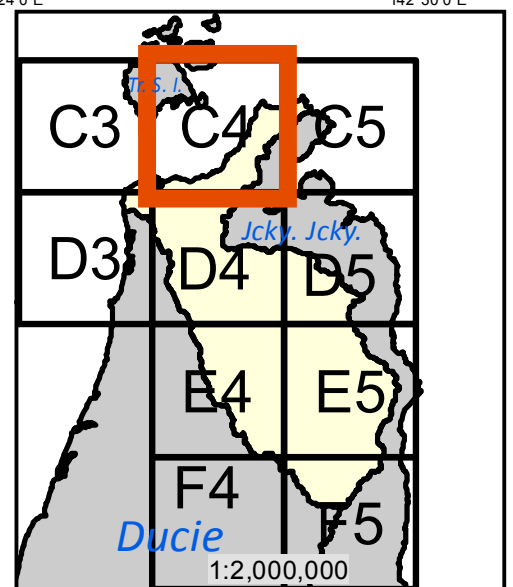
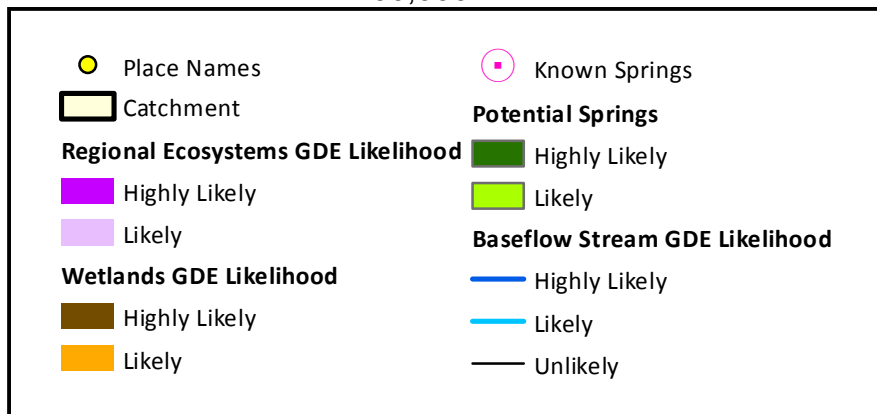
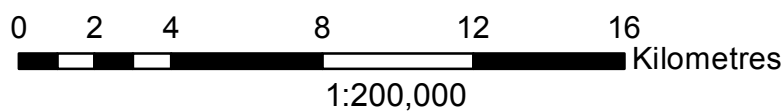


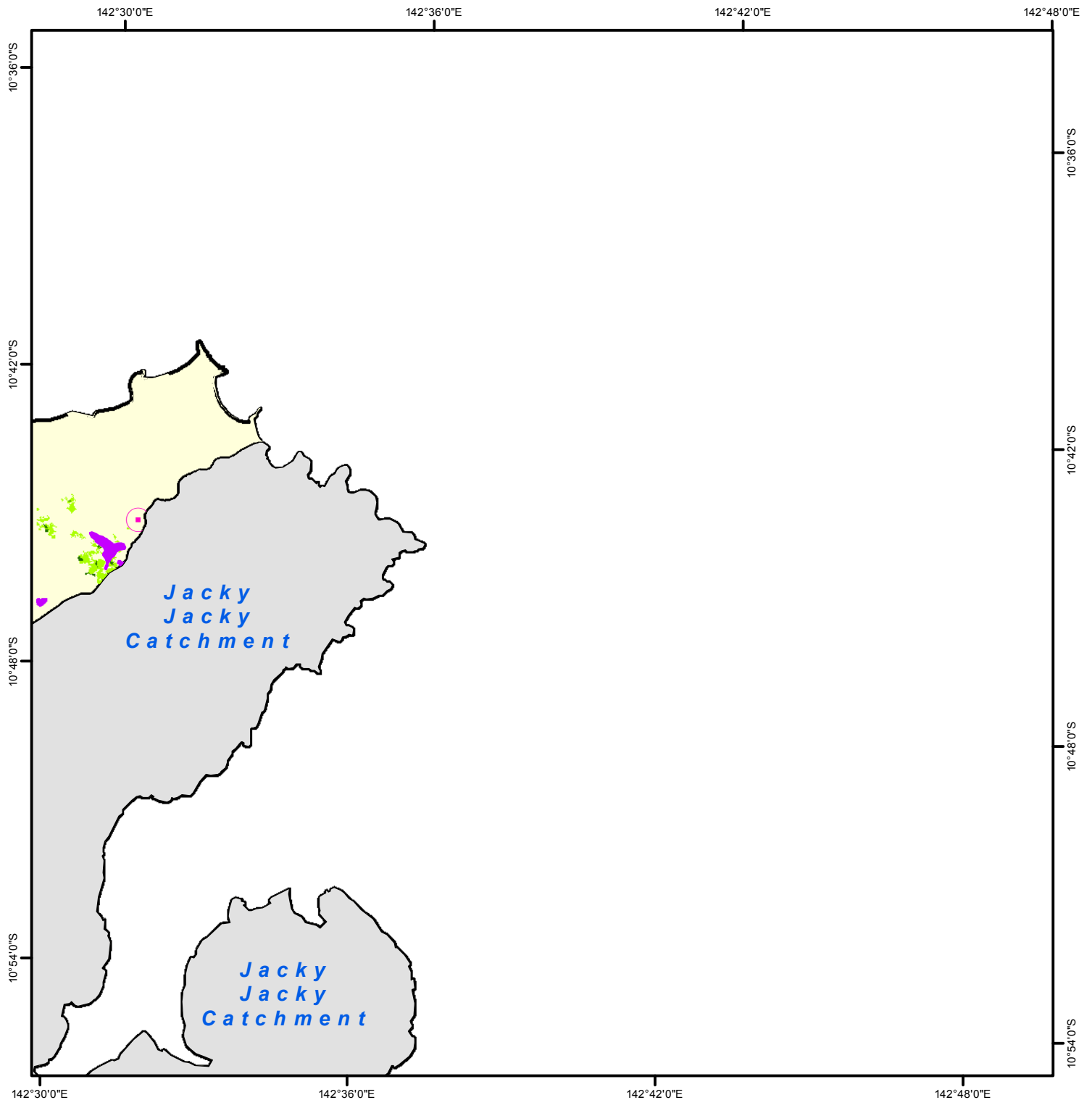
C3 Jardine Catchment



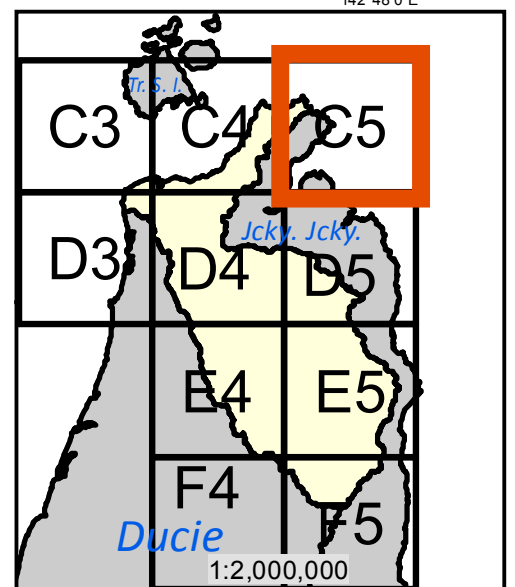
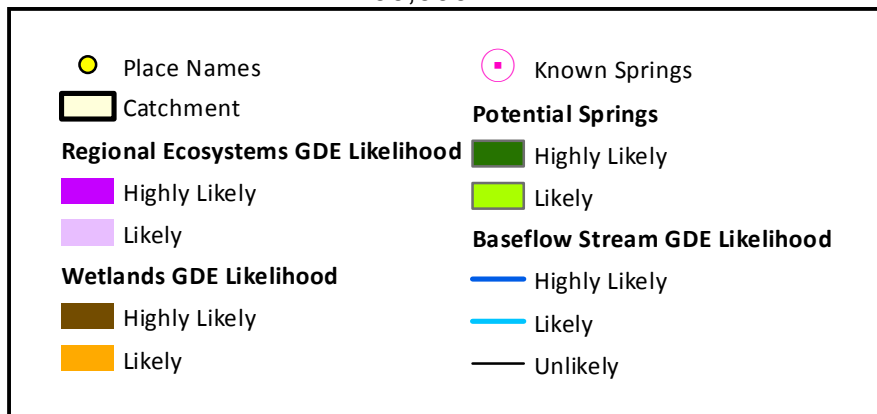
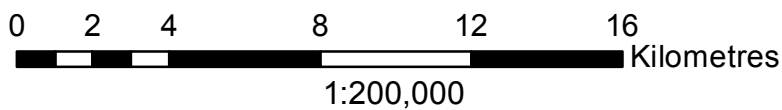


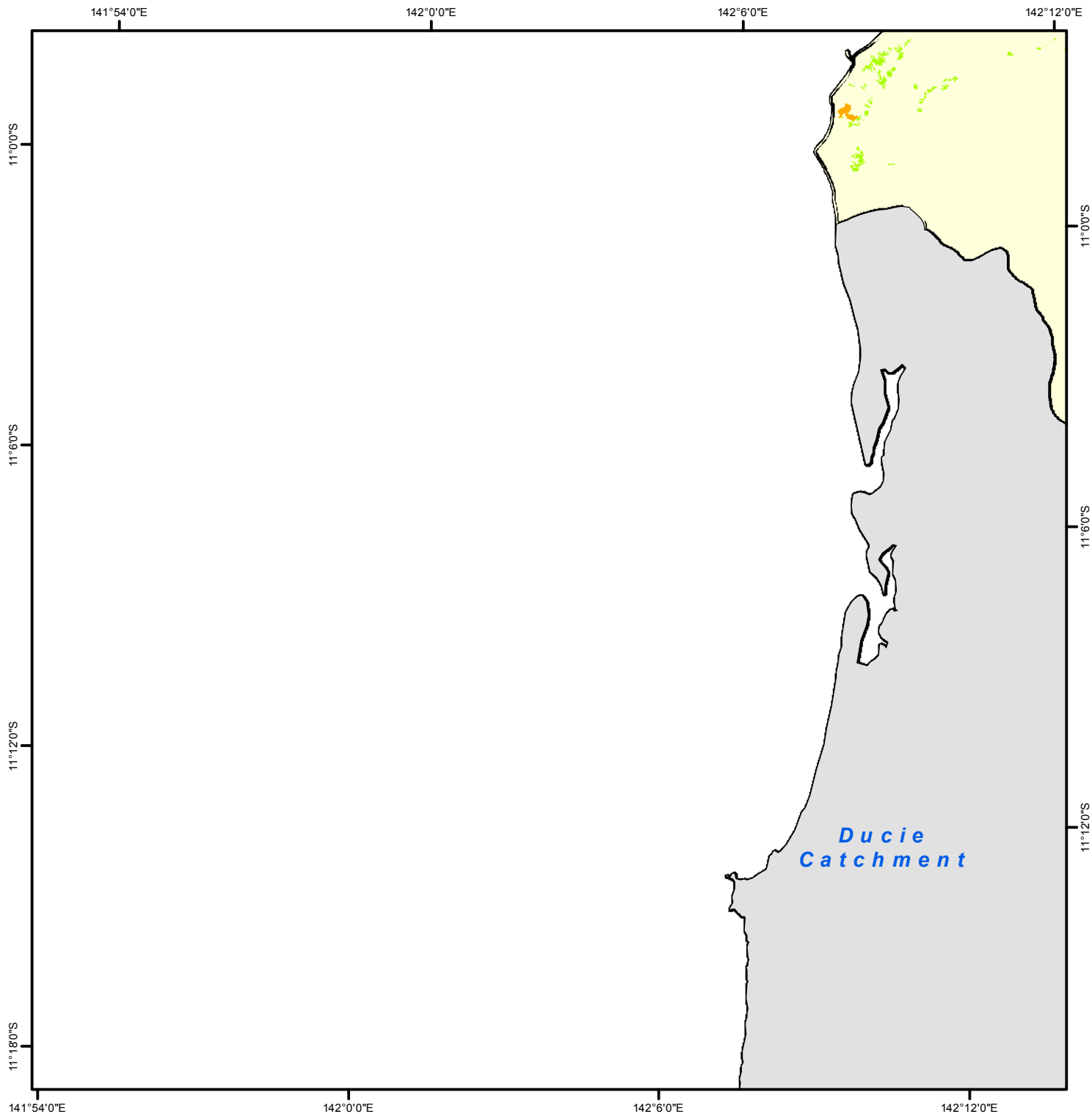
C4 Jardine Catchment



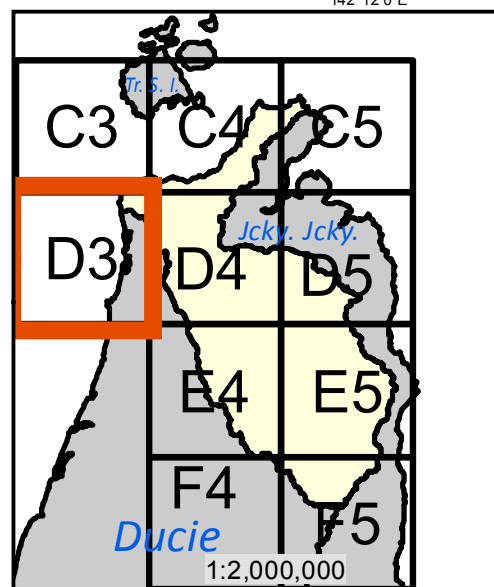
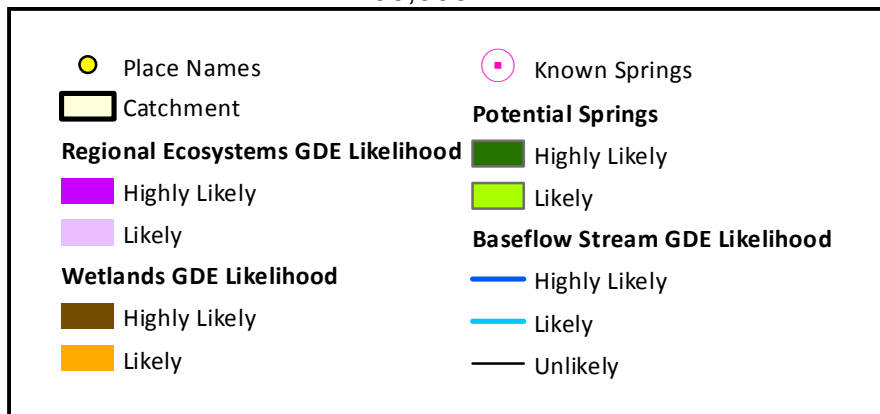
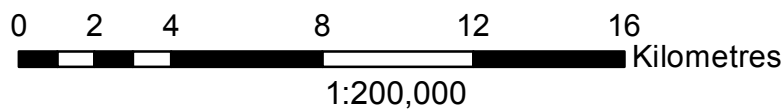


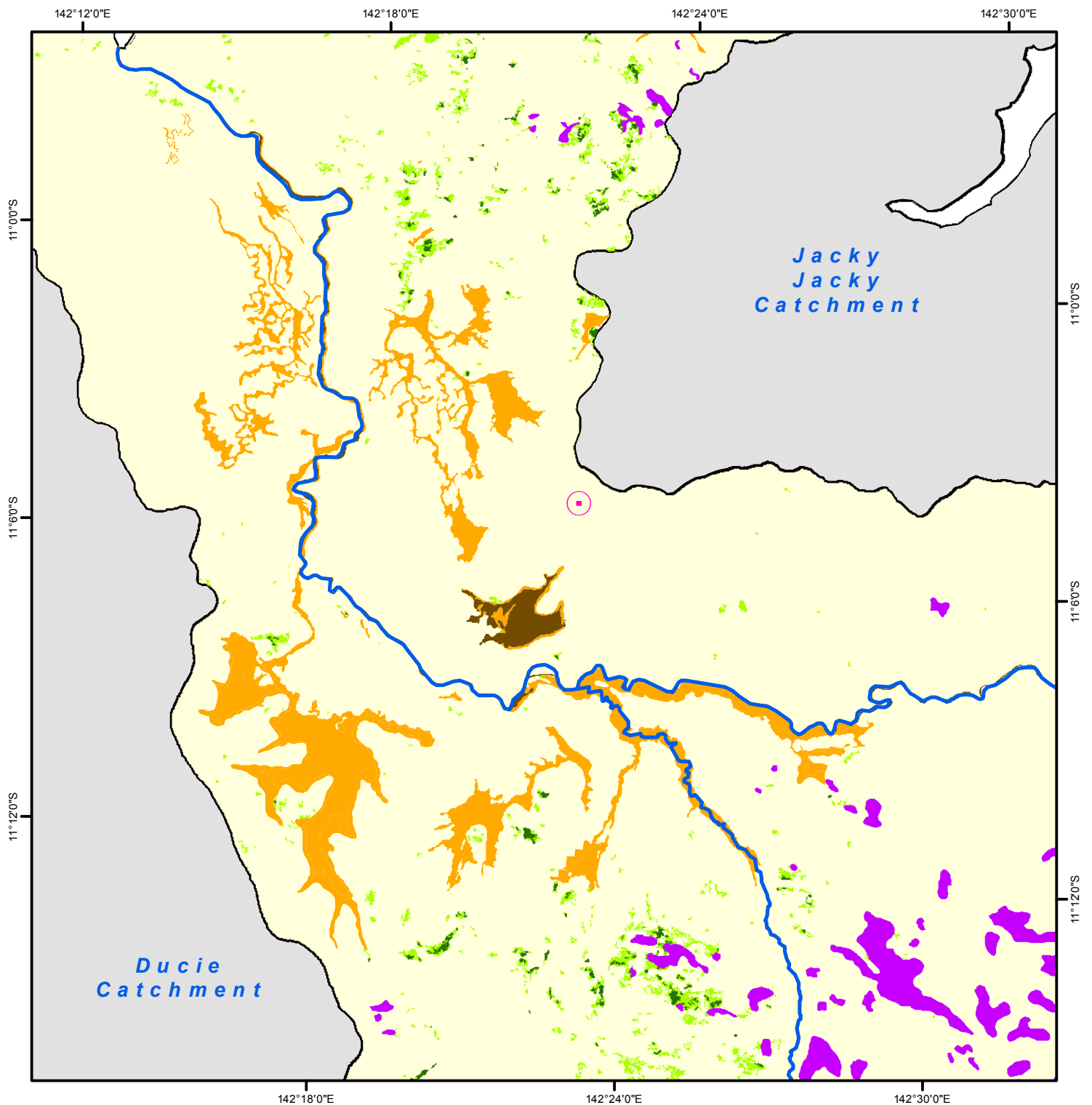
C5 Jardine Catchment



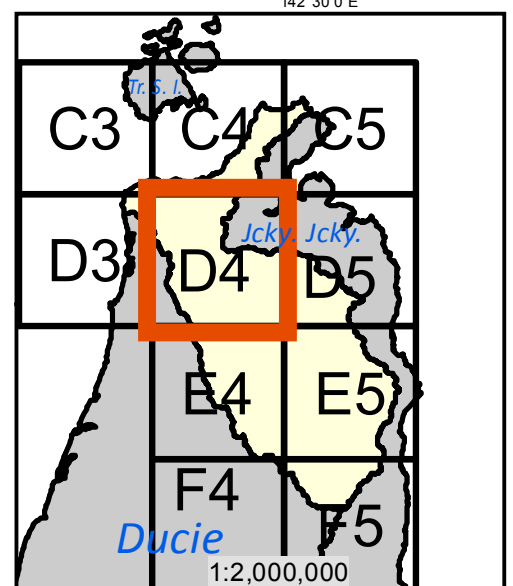
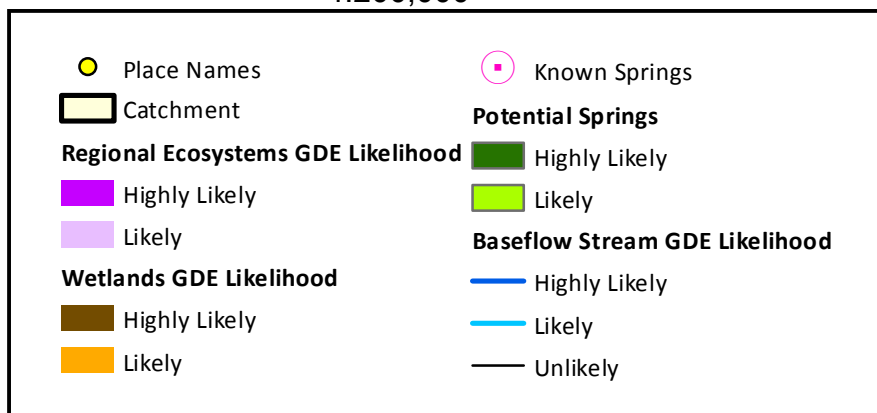
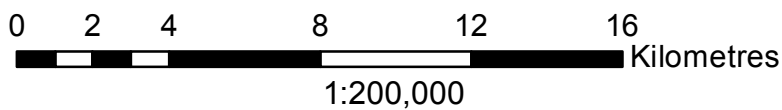


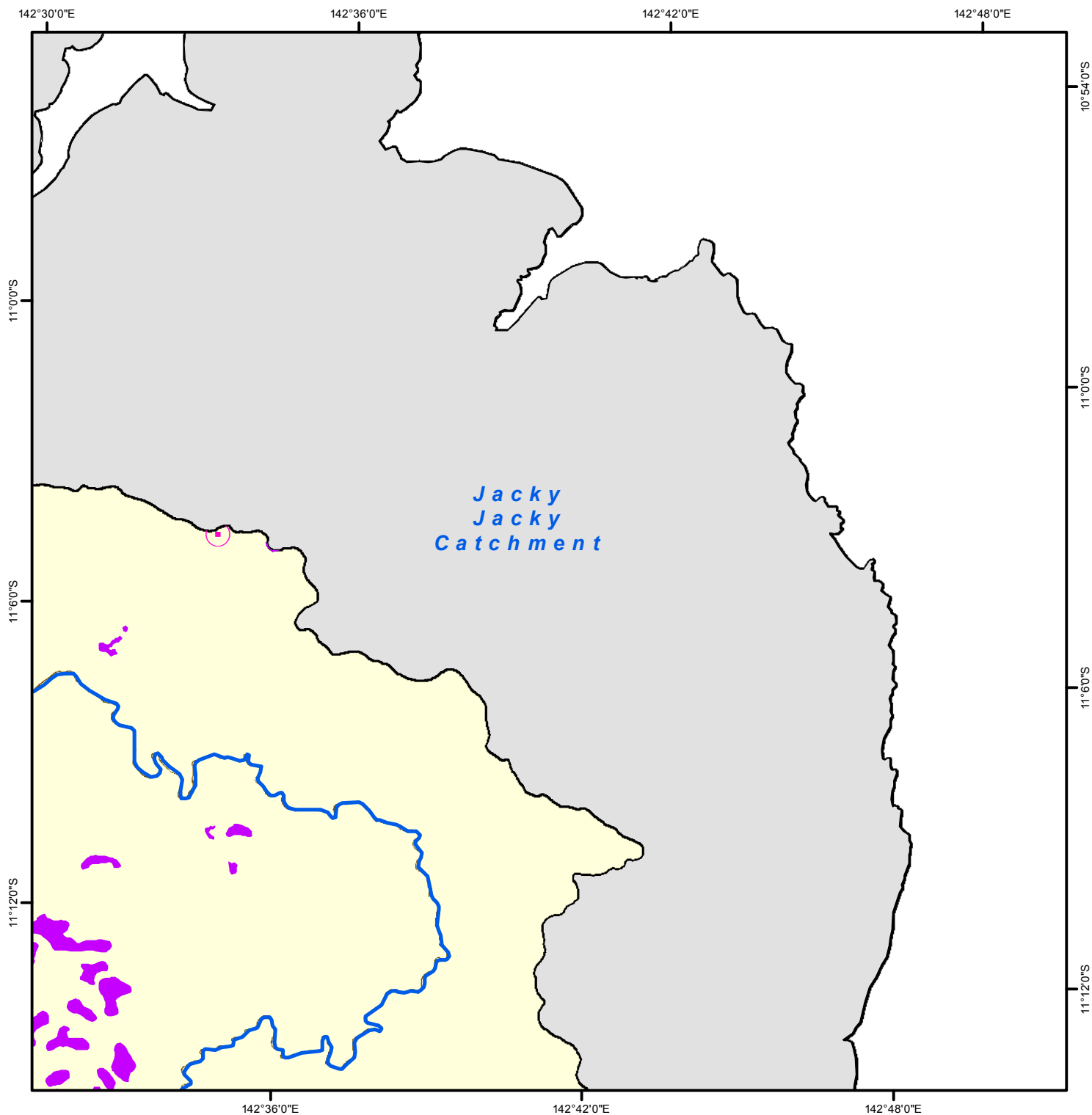
D3 Jardine Catchment



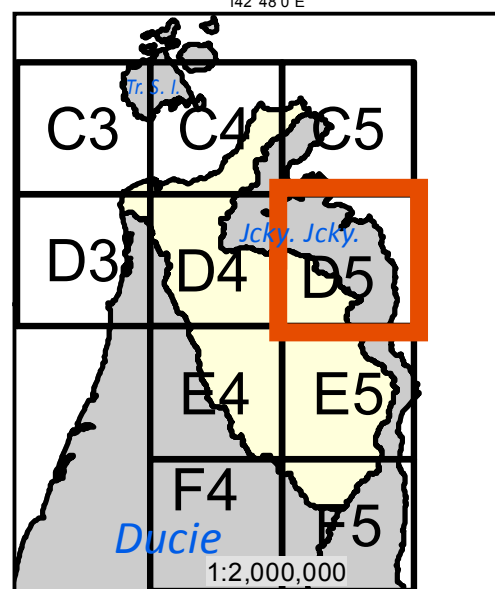
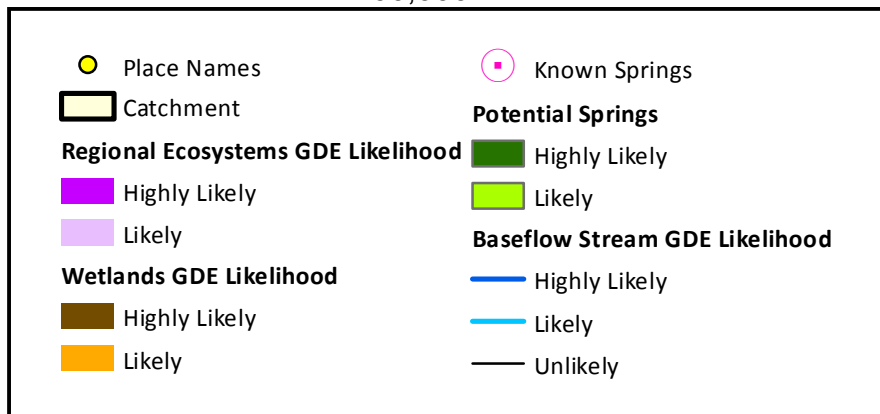
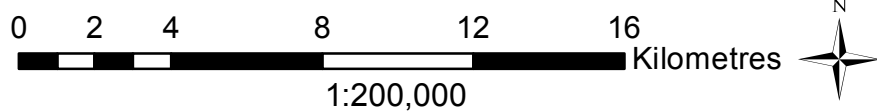


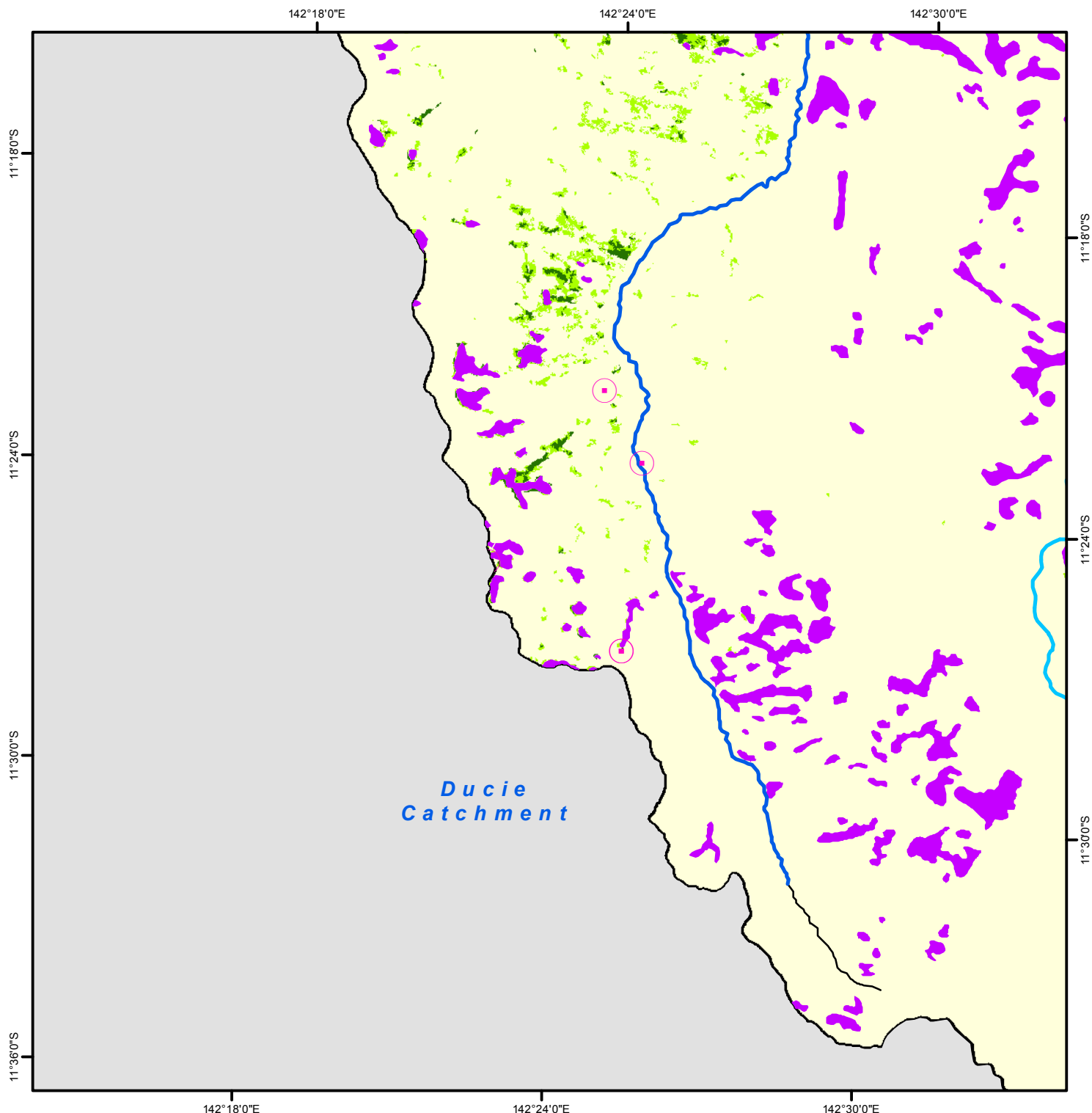
D4 Jardine Catchment



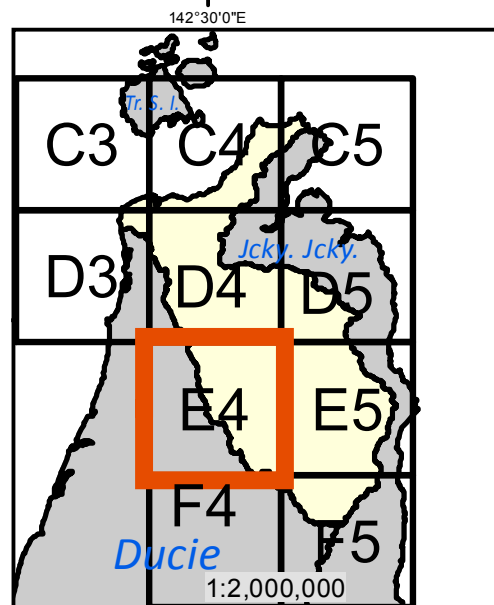
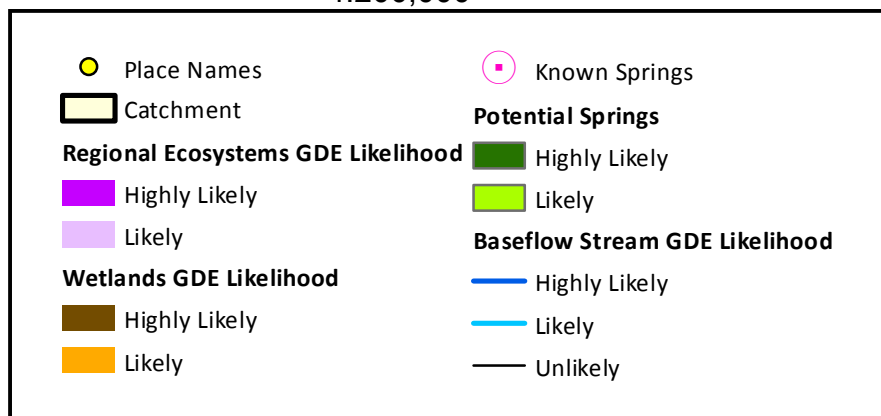
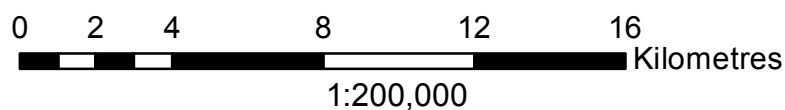


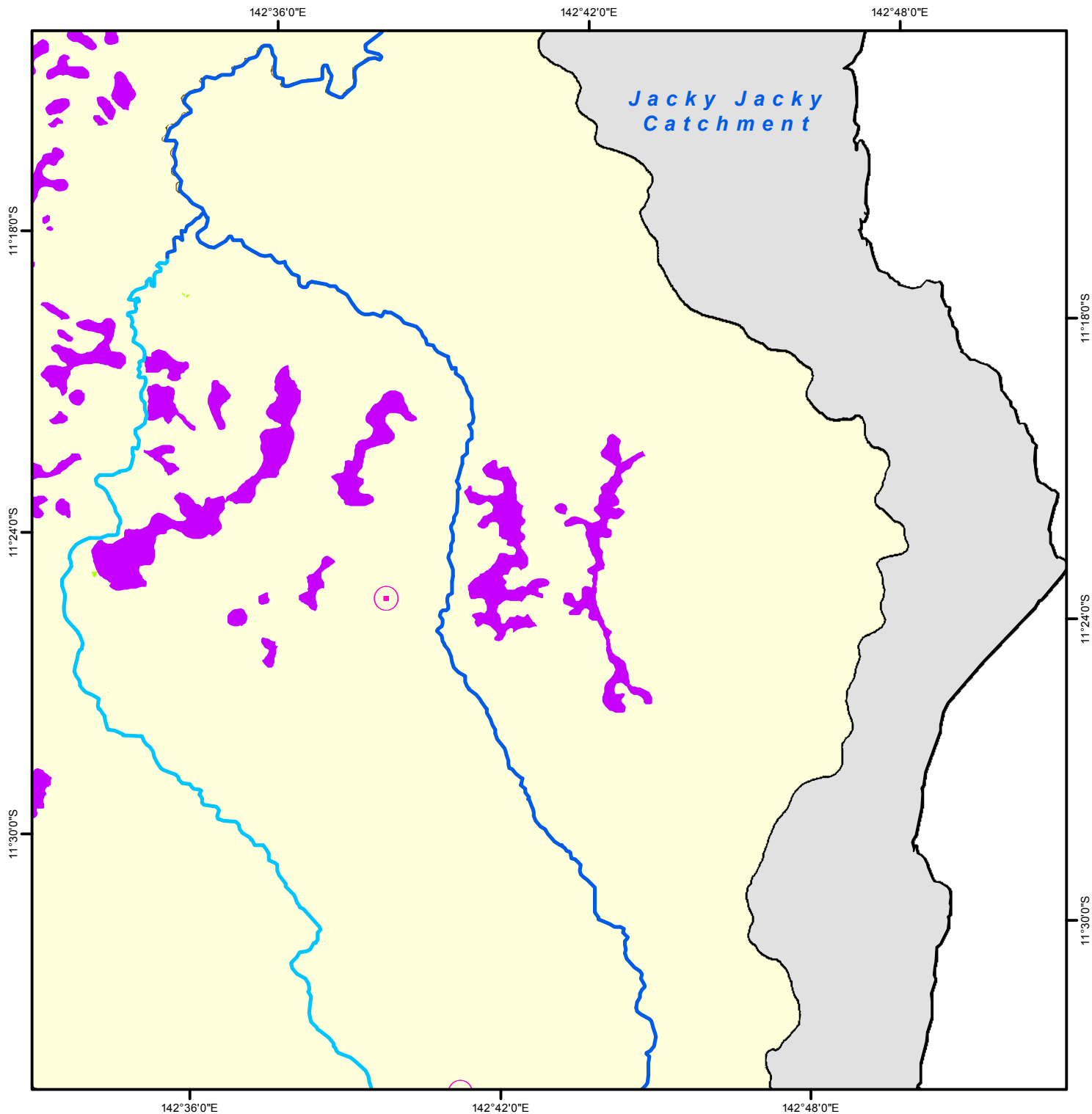
D5 Jardine Catchment



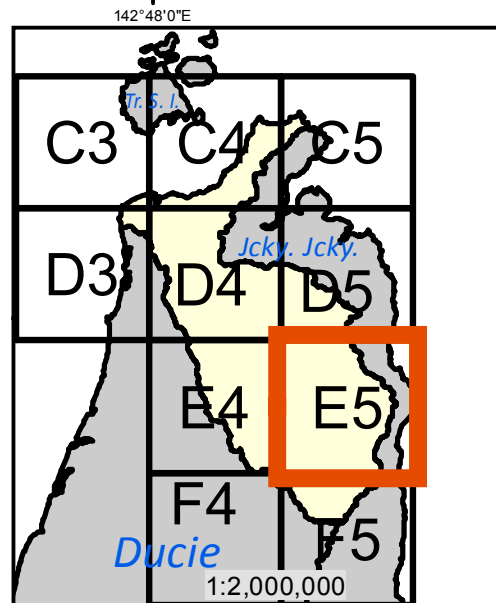
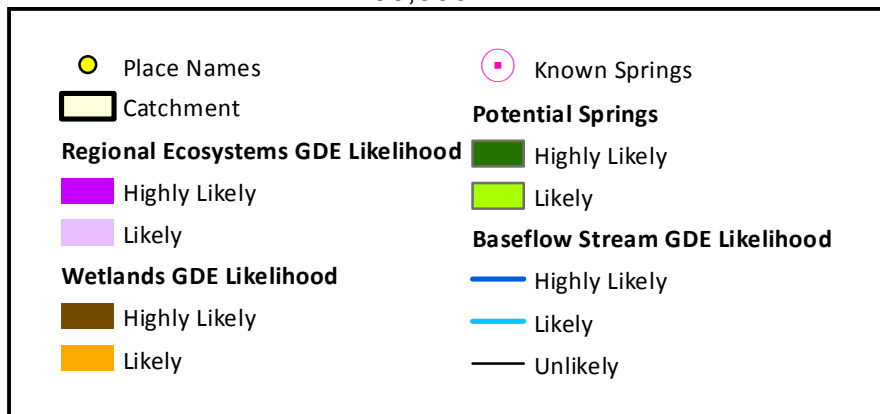
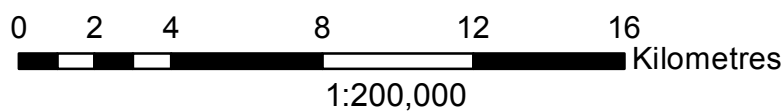


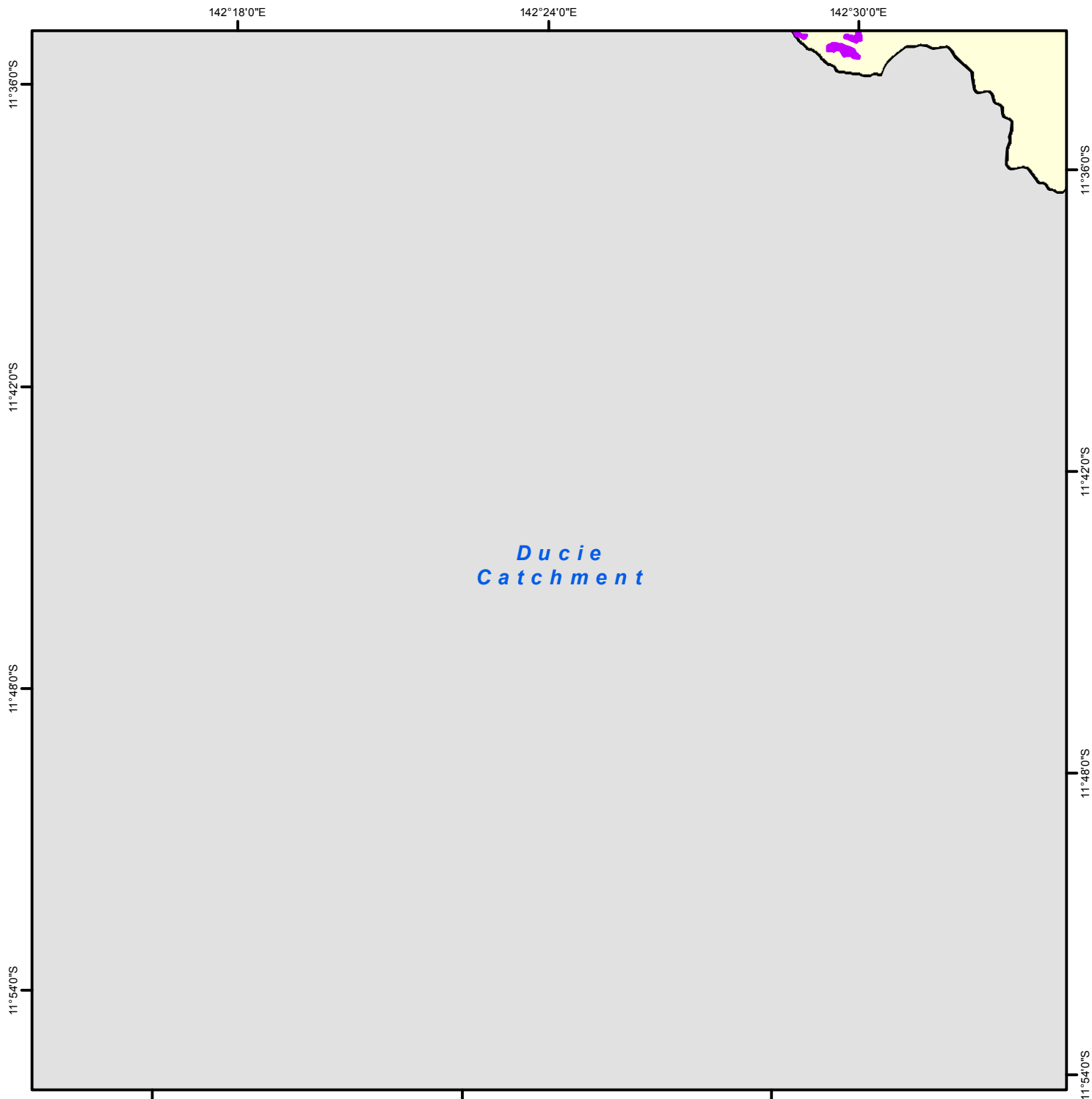
E4 Jardine Catchment



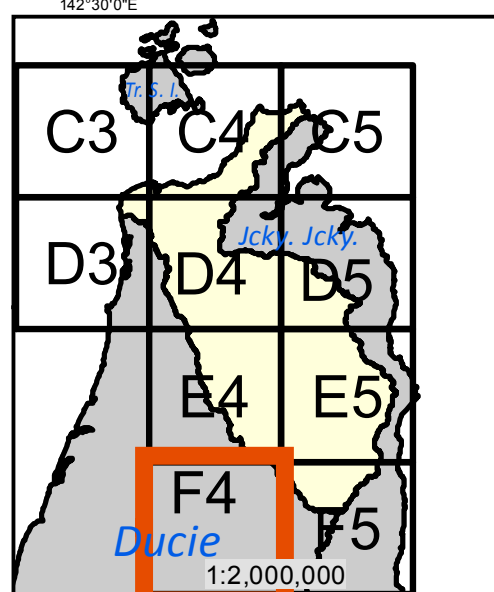
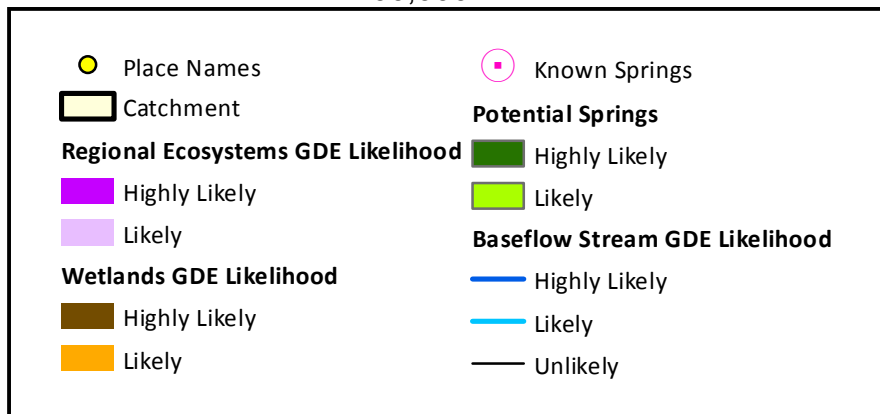
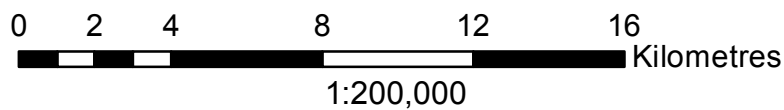


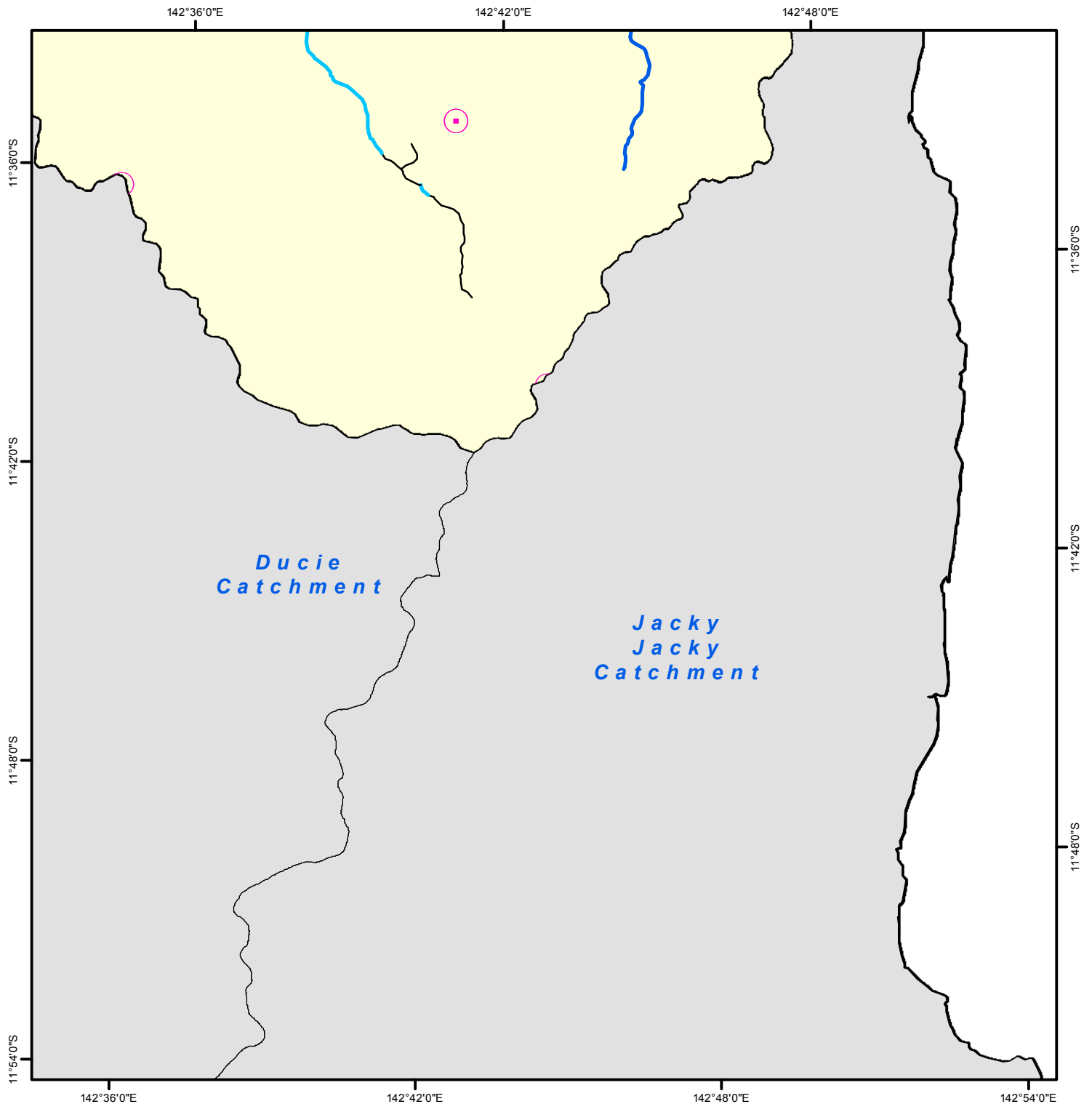
E5 Jardine Catchment



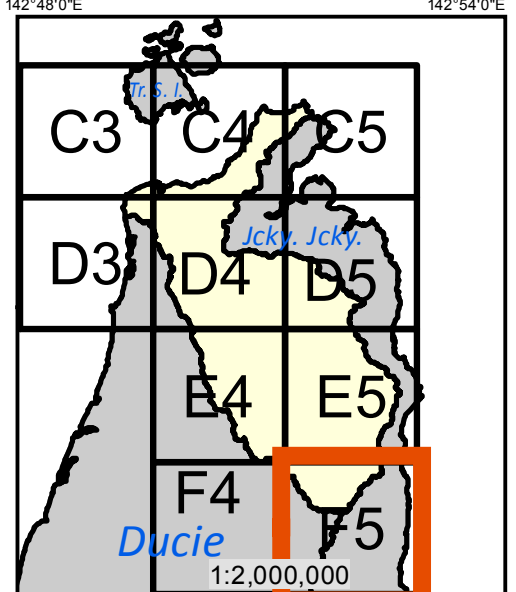
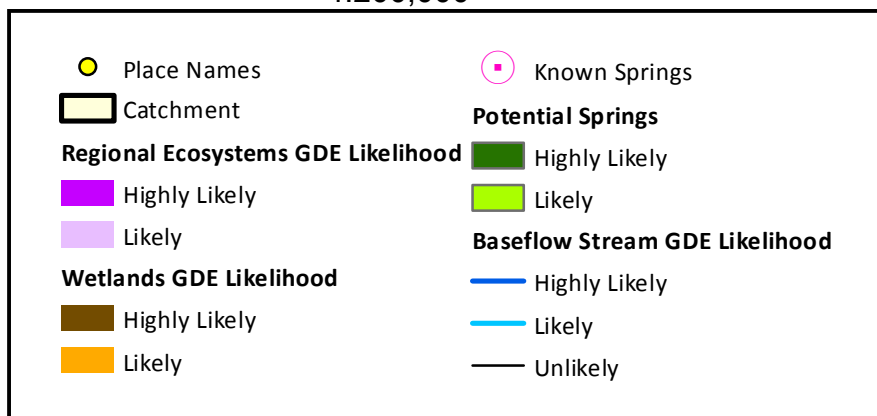
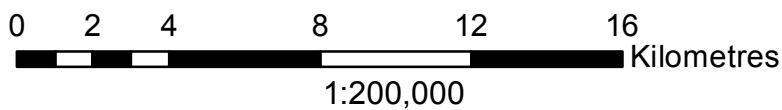


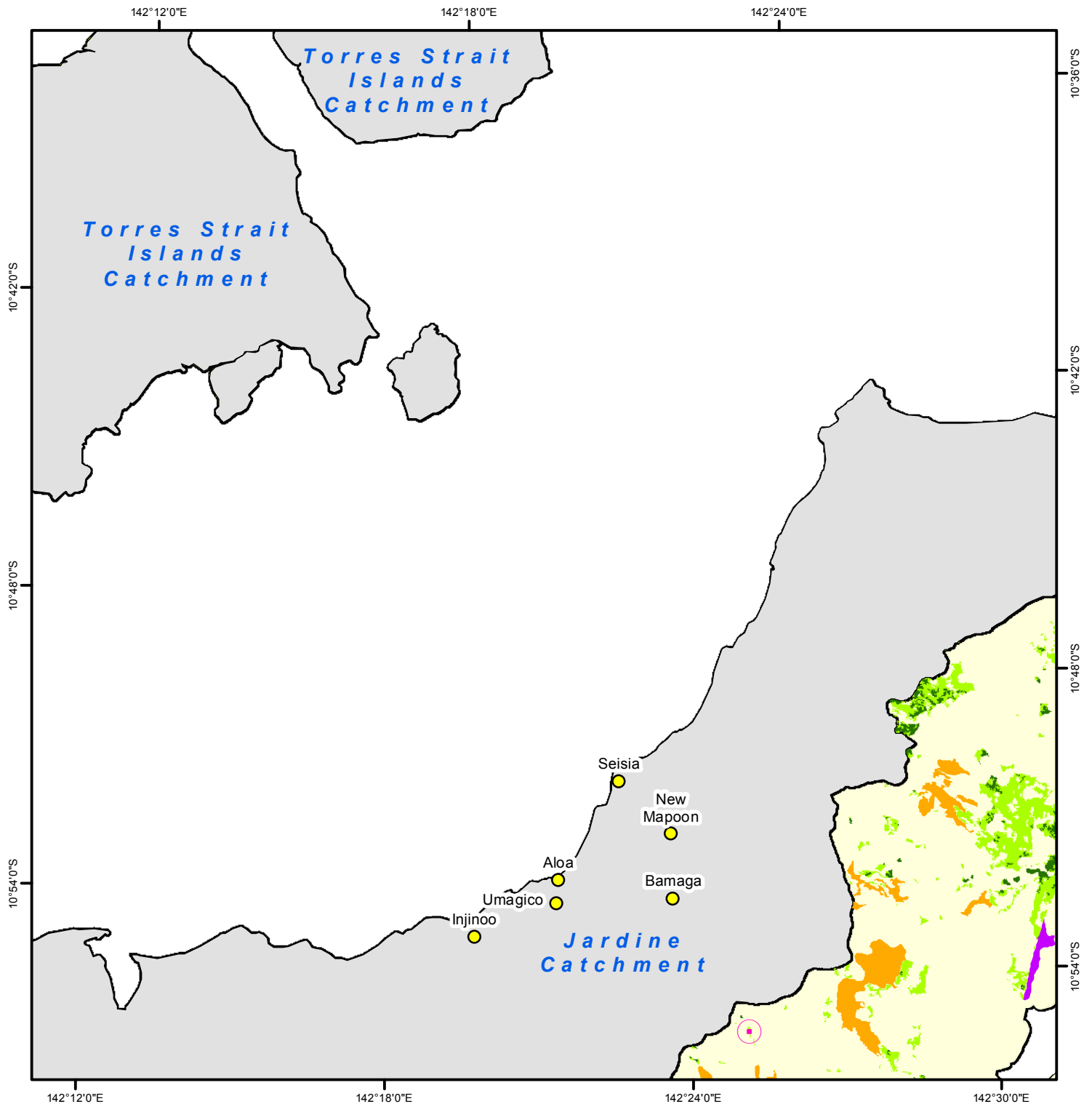
F4 Jardine Catchment



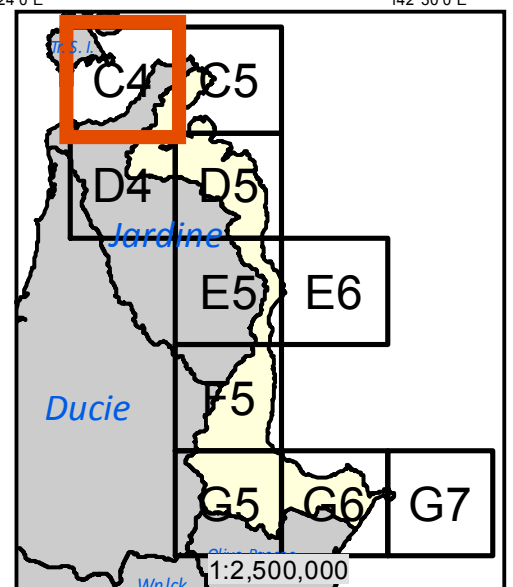
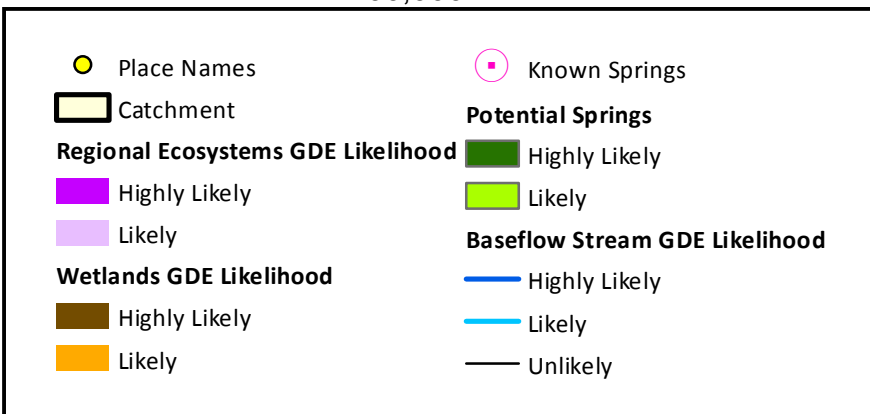
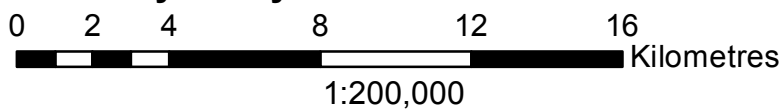


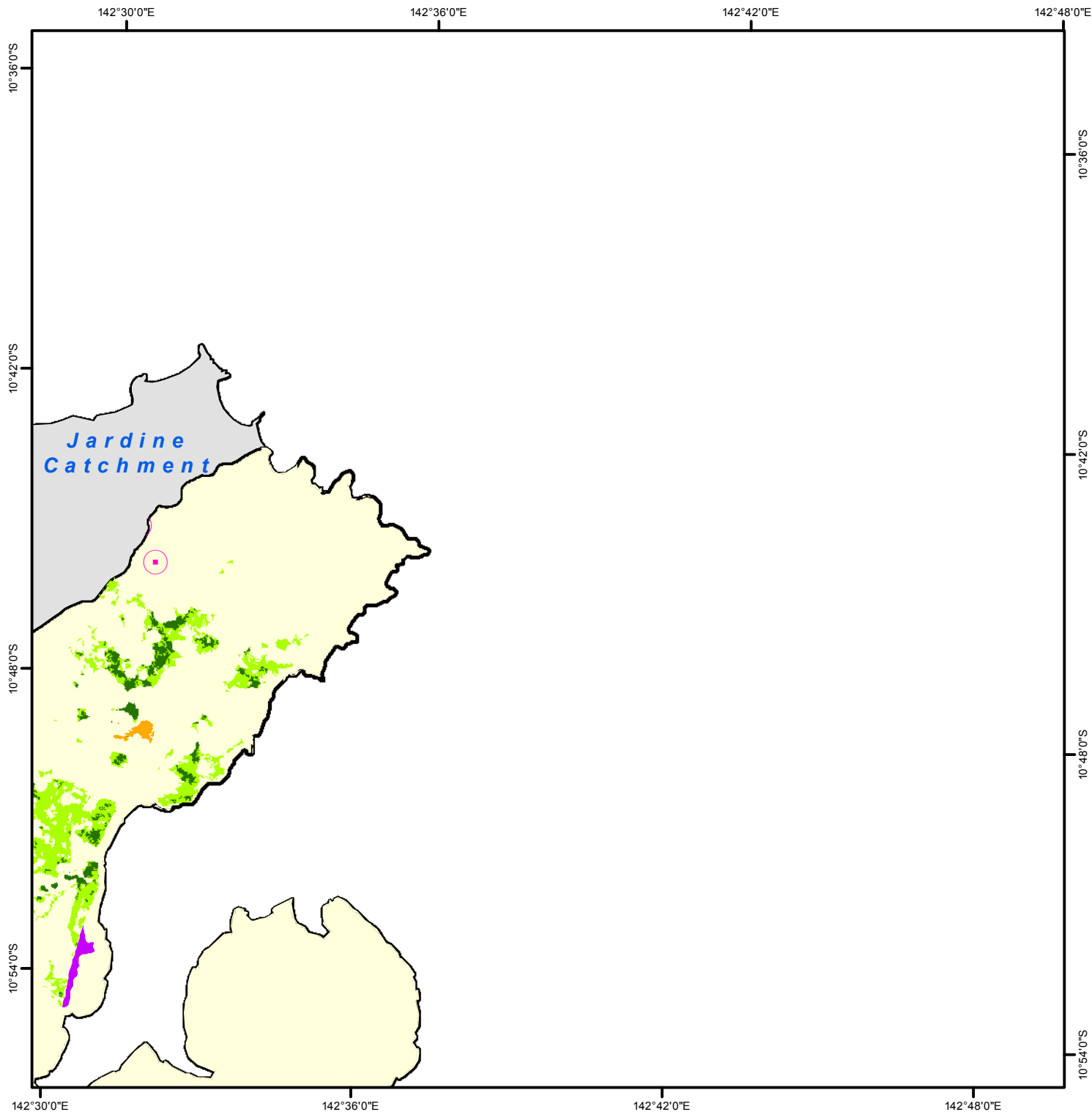
F5 Jardine Catchment



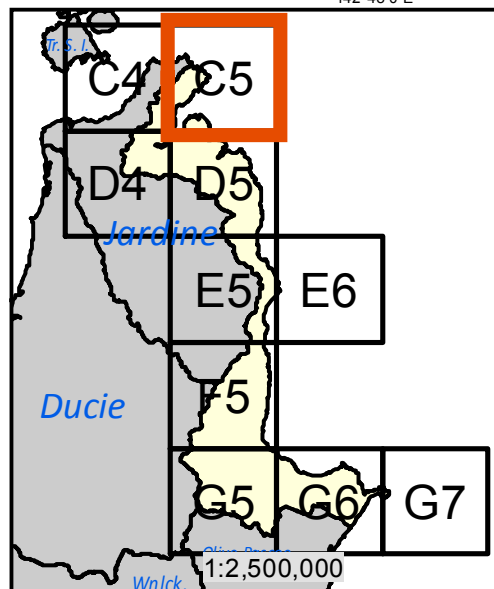
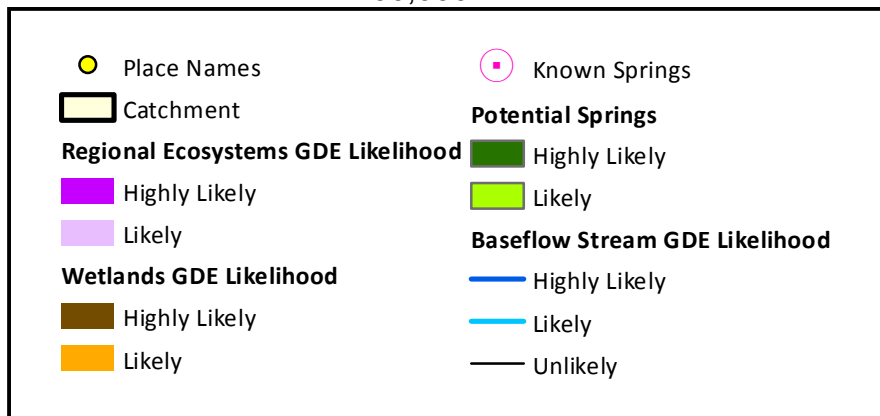
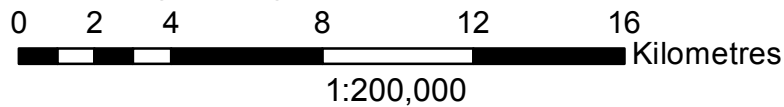


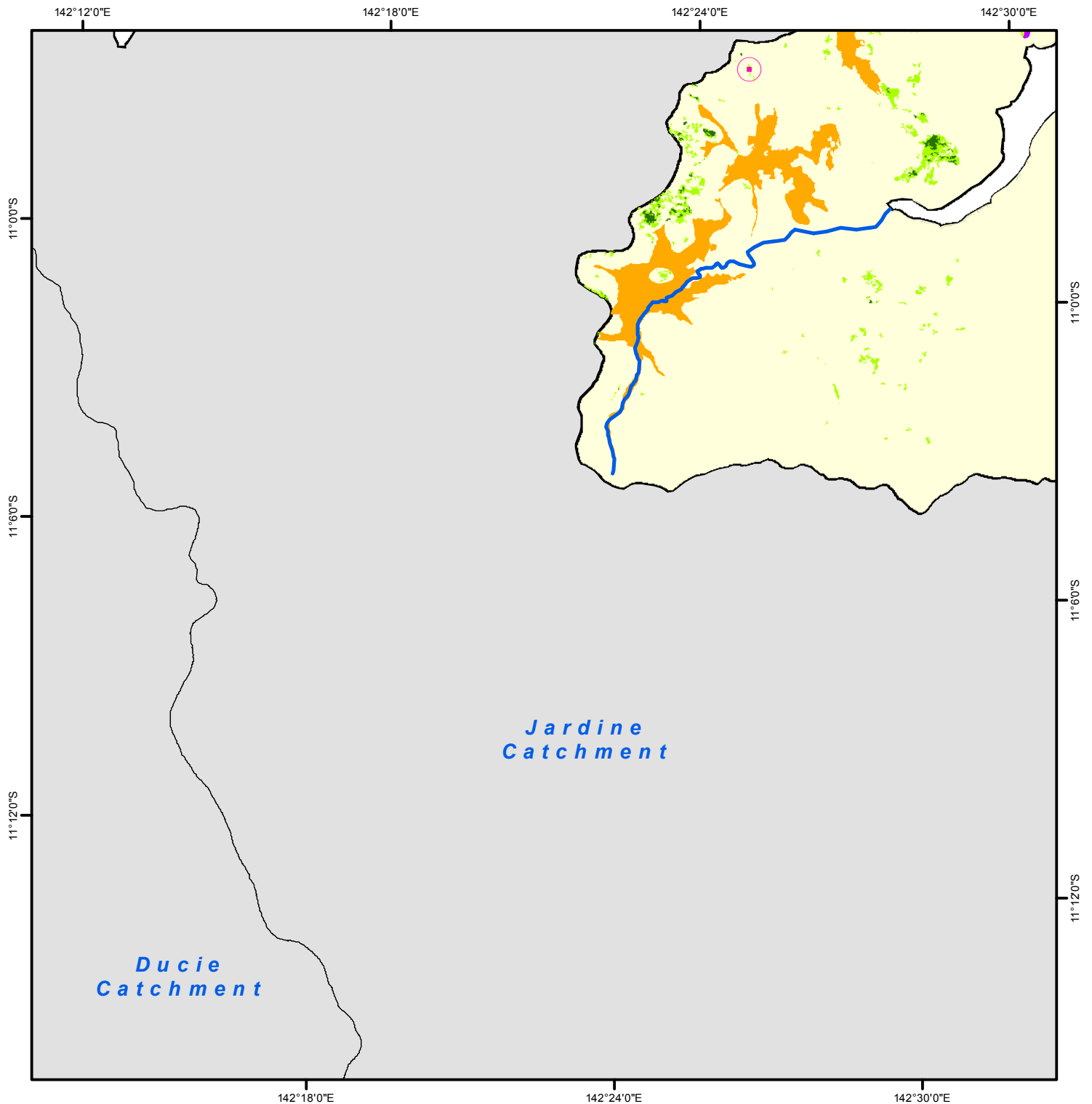
C4 Jacky Jacky Catchment



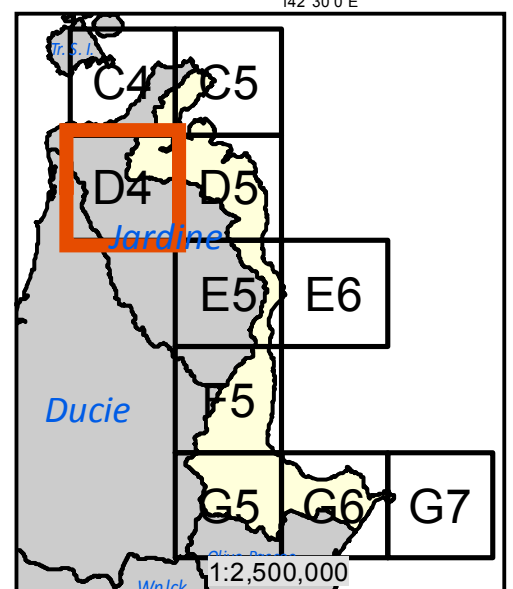
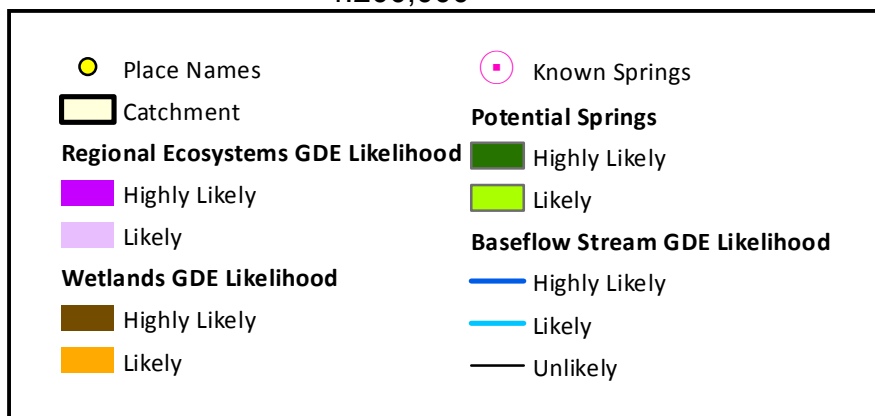
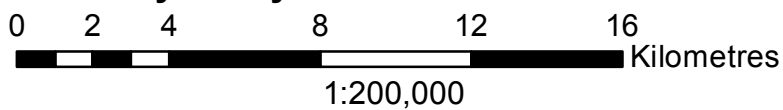


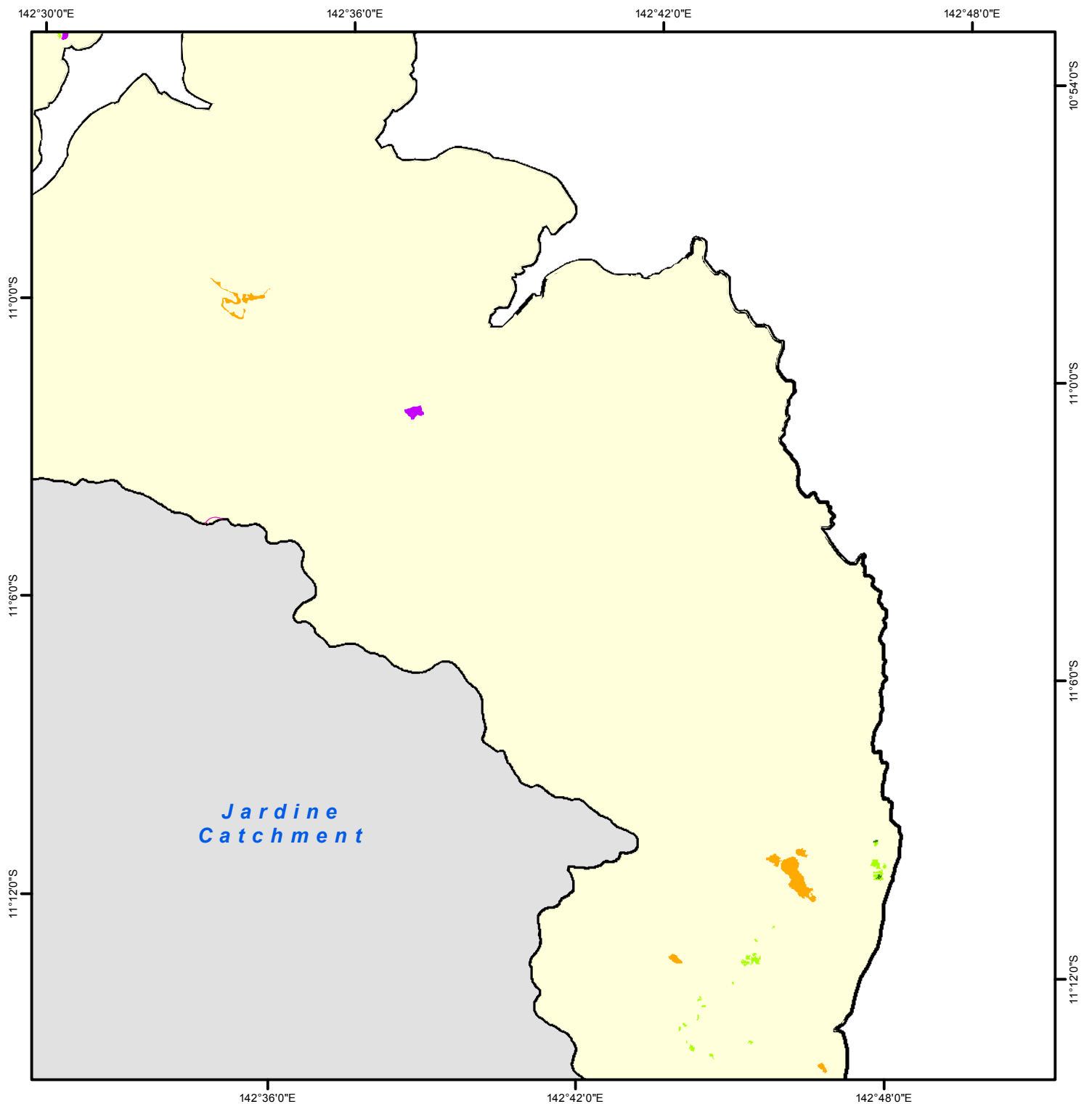
C5 Jacky Jacky Catchment



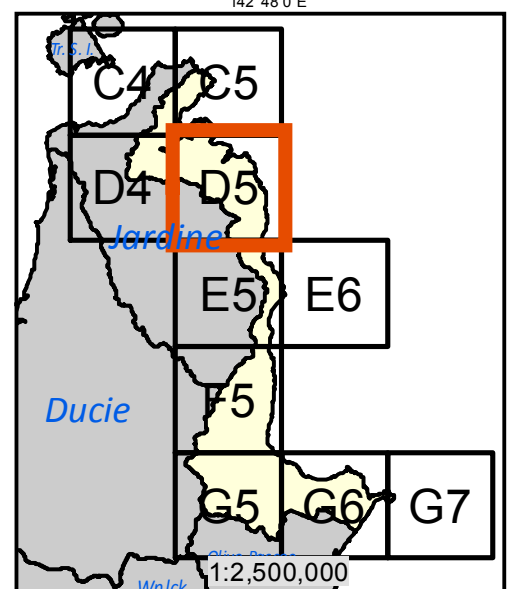
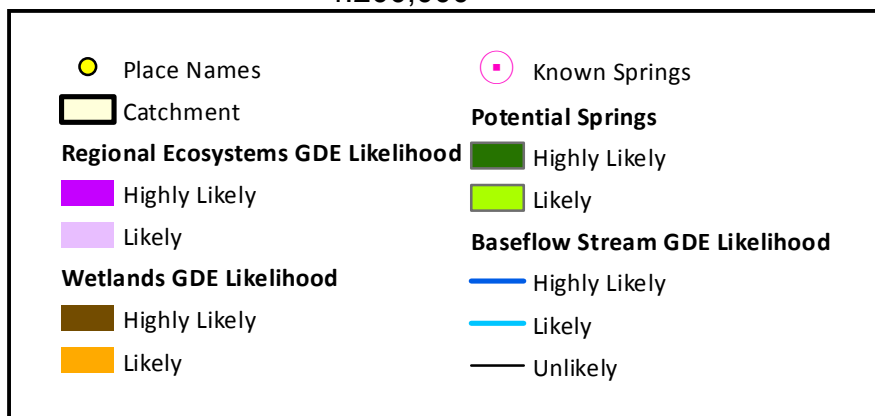
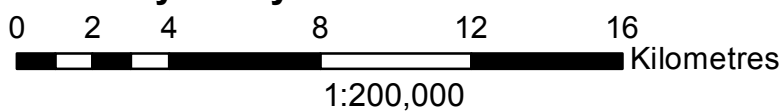


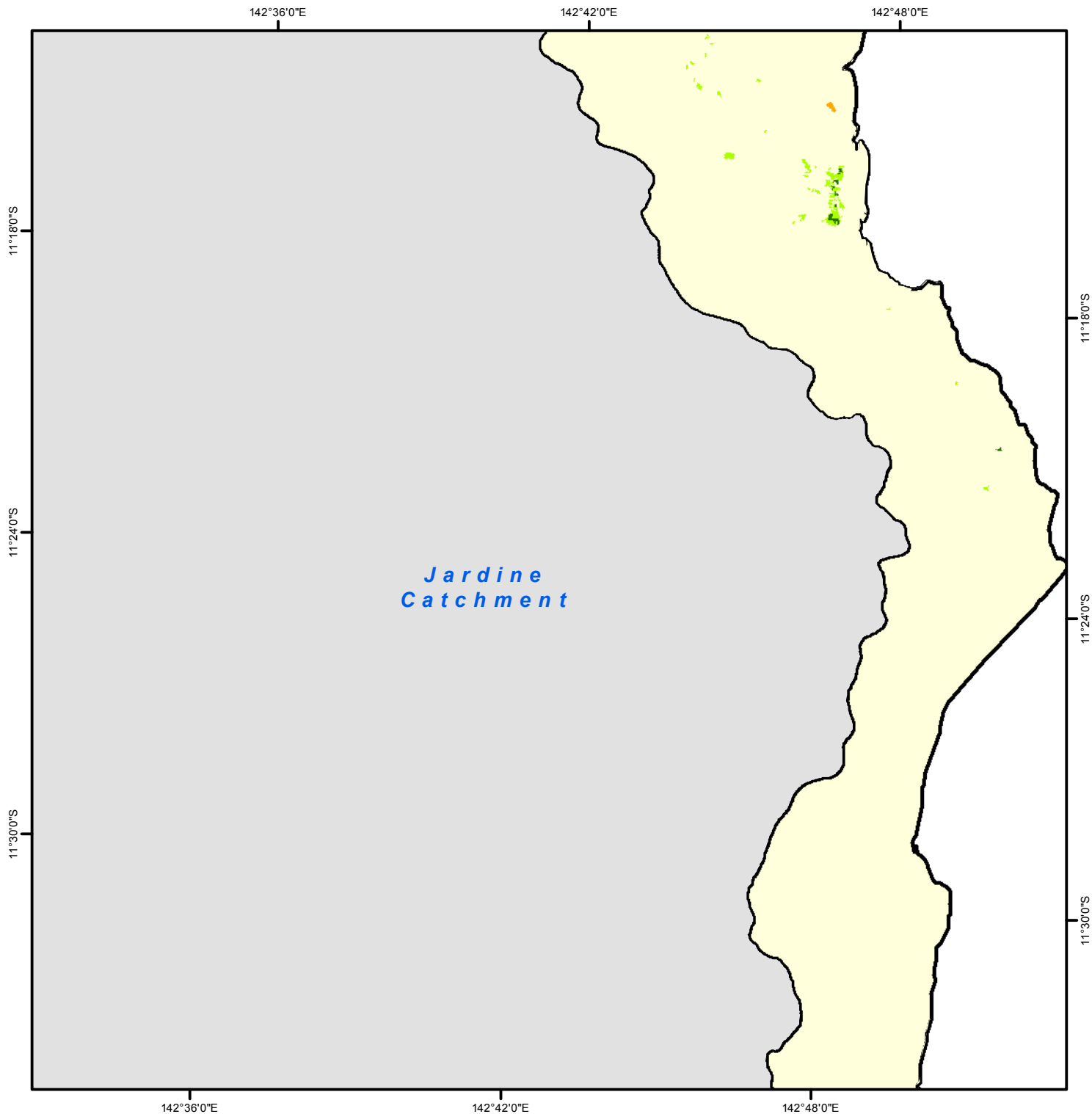
D4 Jacky Jacky Catchment



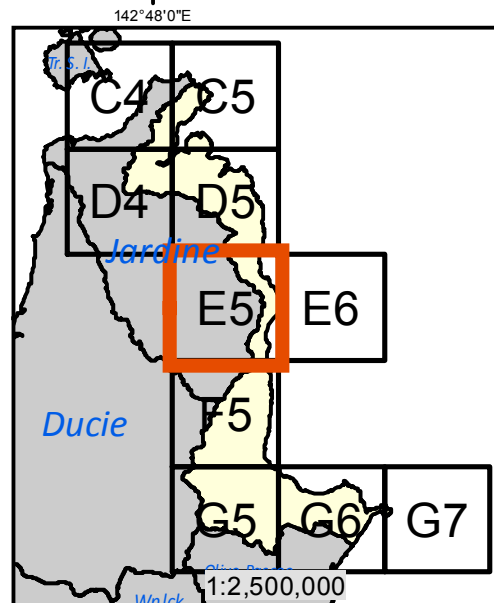
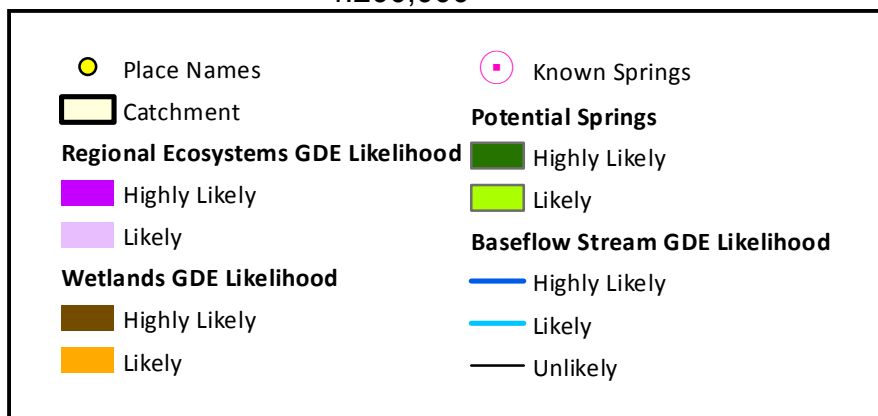
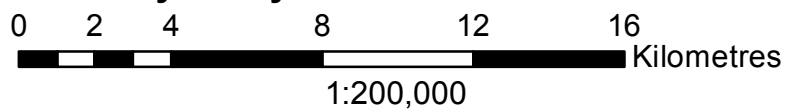


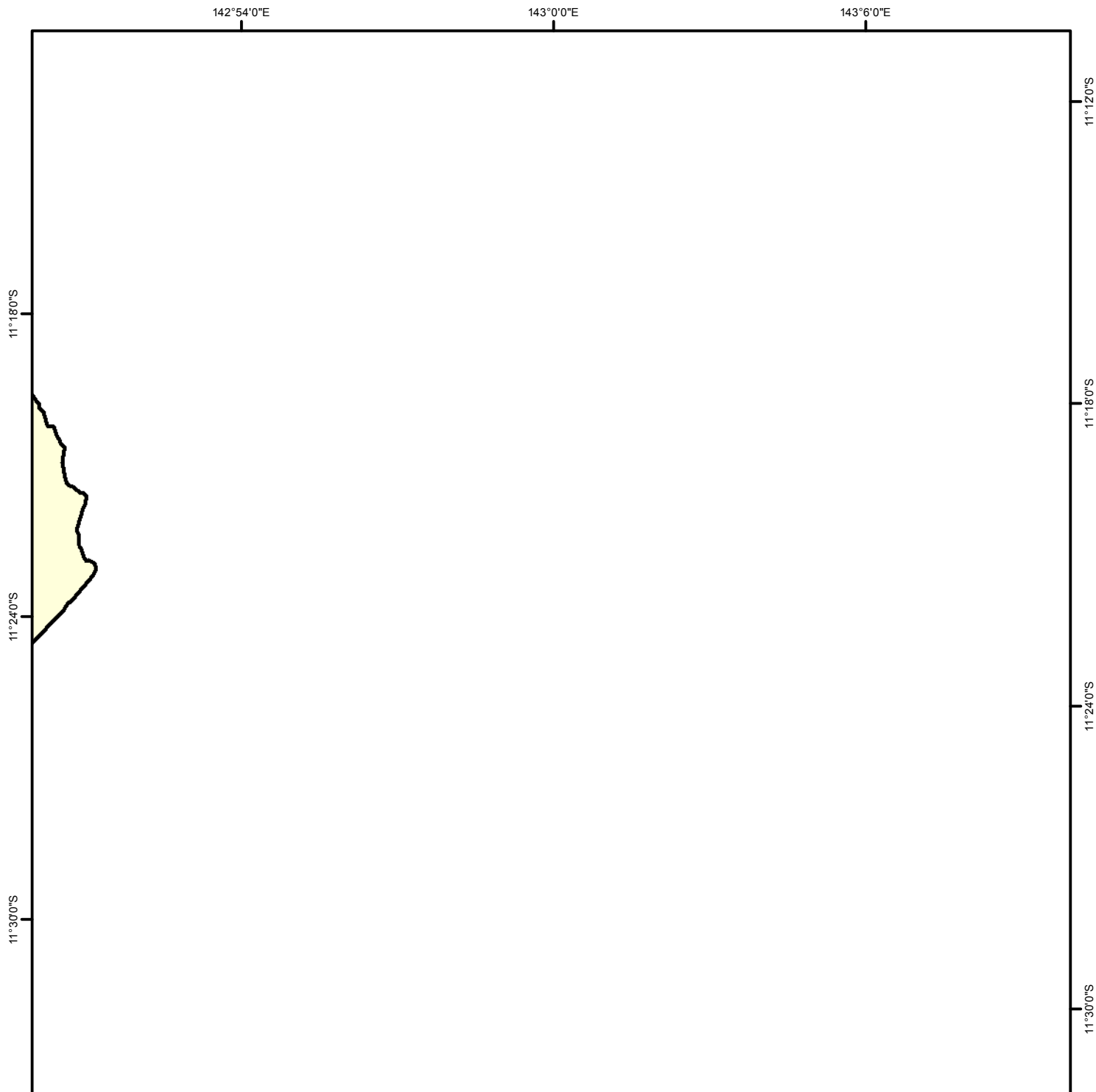
D5 Jacky Jacky Catchment



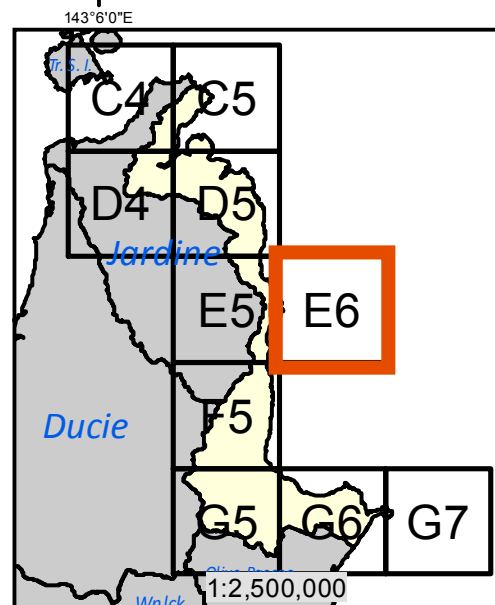
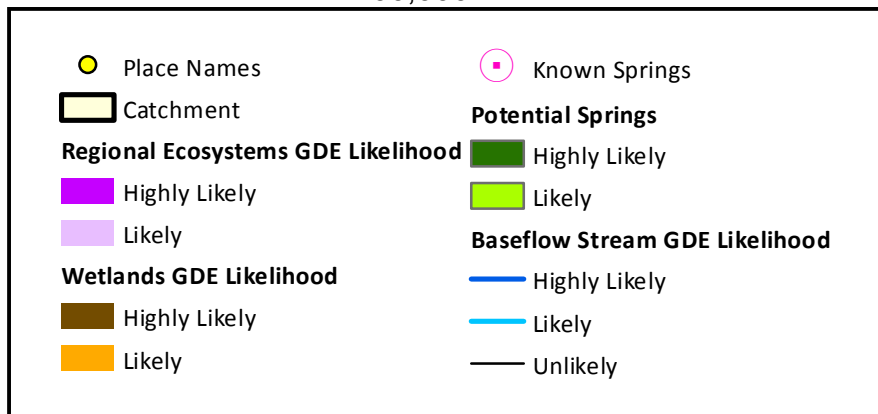
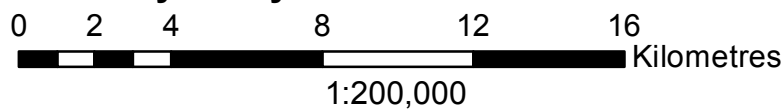


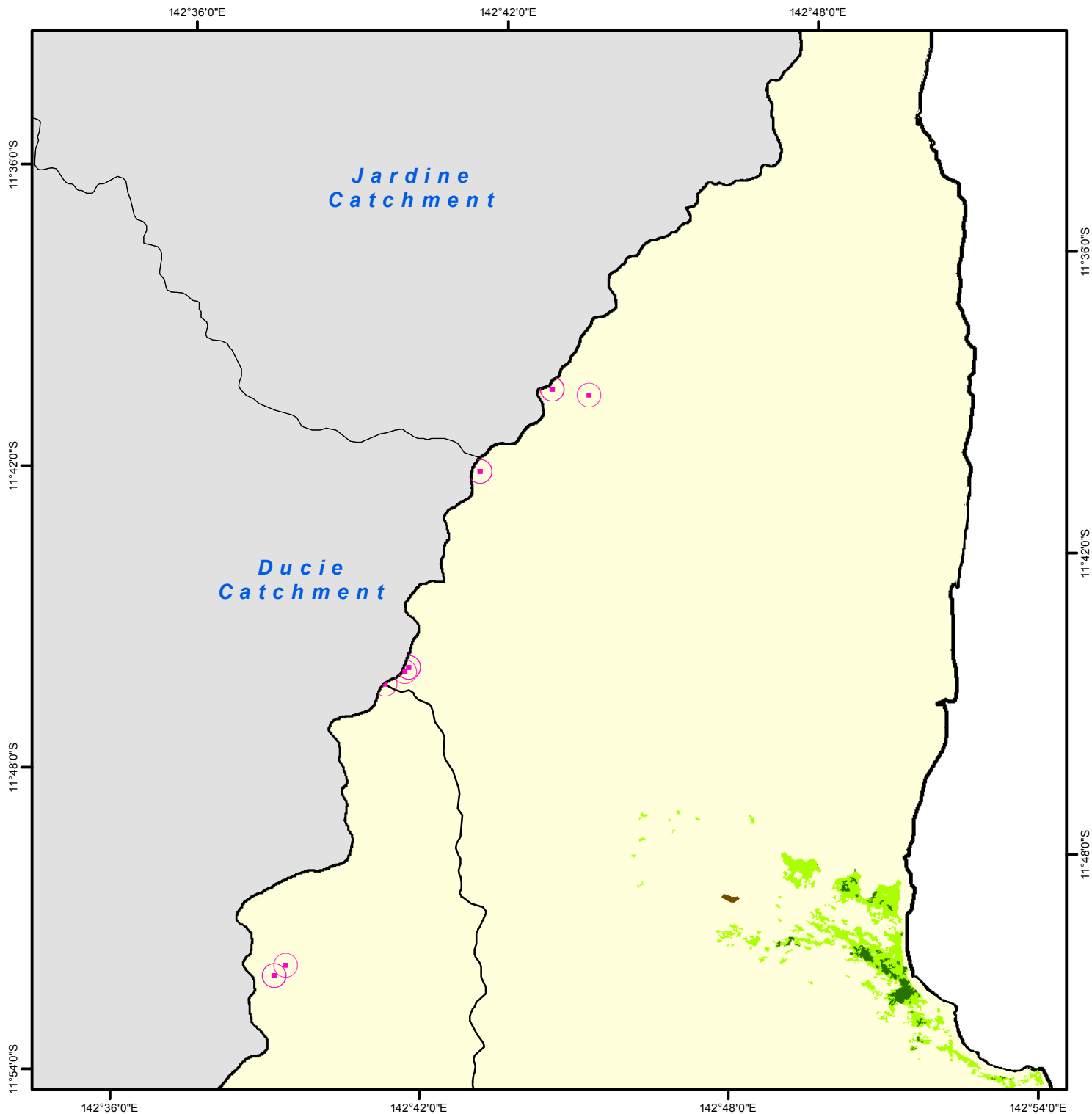
E5 Jacky Jacky Catchment





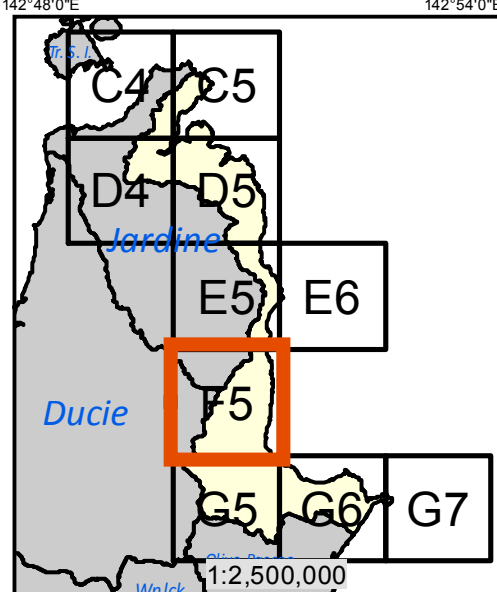
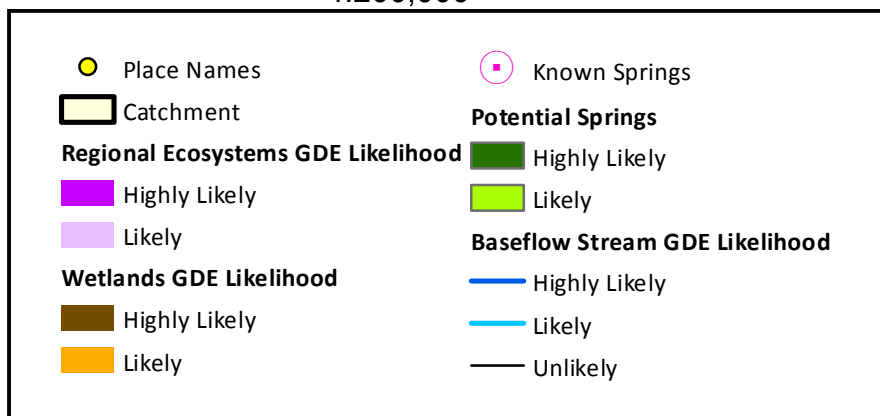
E6 Jacky Jacky Catchment





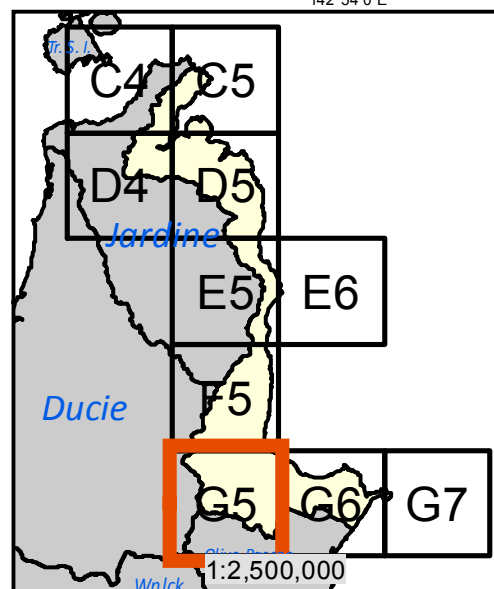
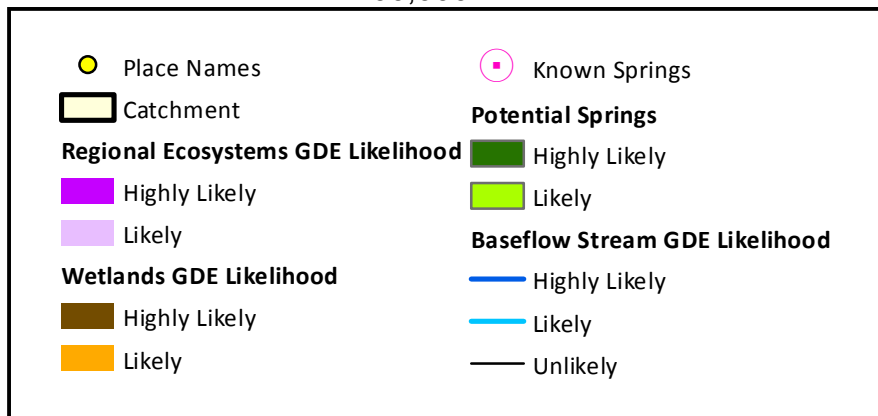
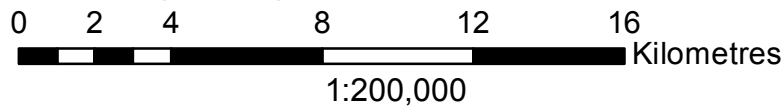
F5 Jacky Jacky Catchment

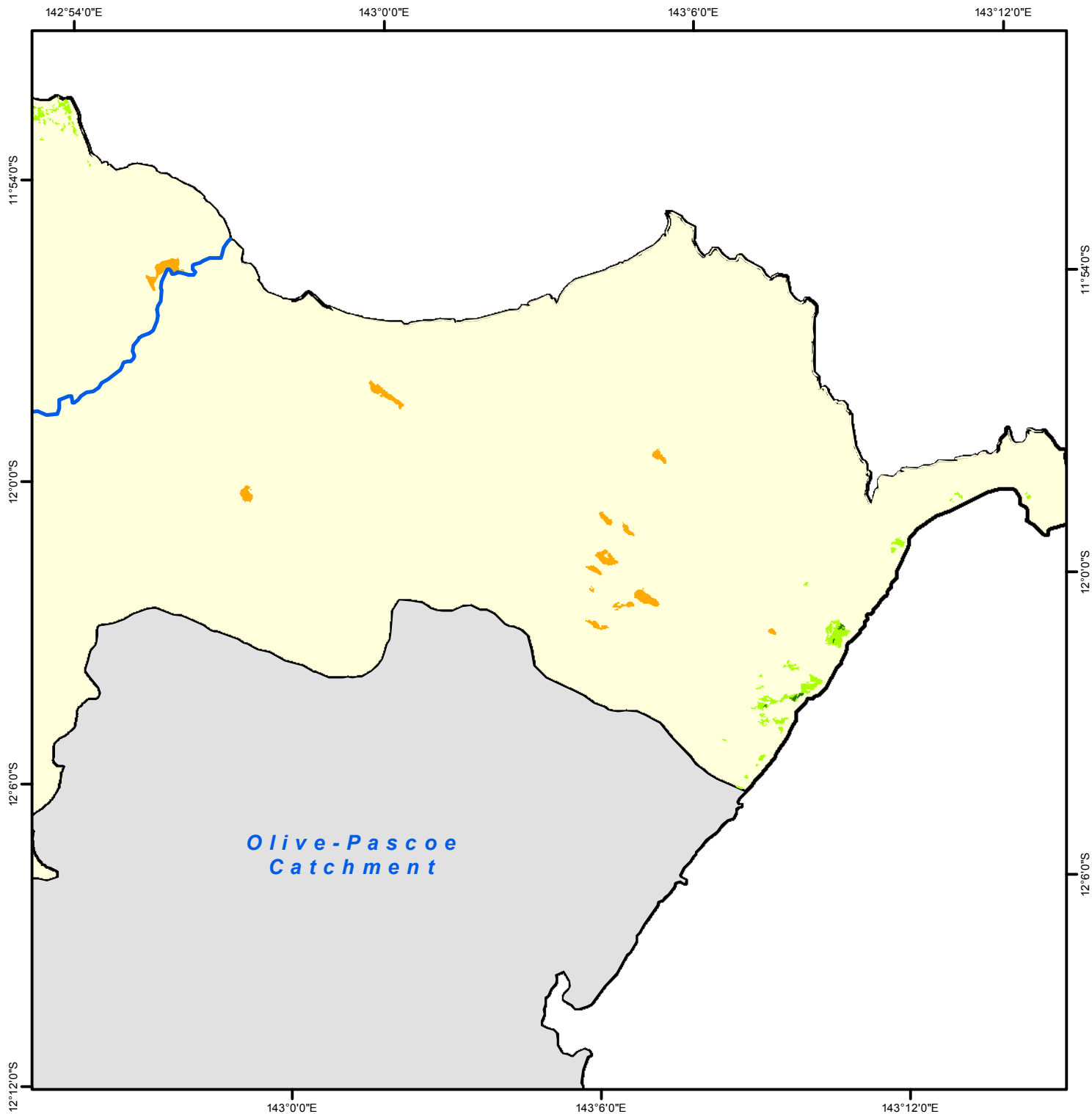
0 2 4 8 12 16 Kilometres
1:200,000



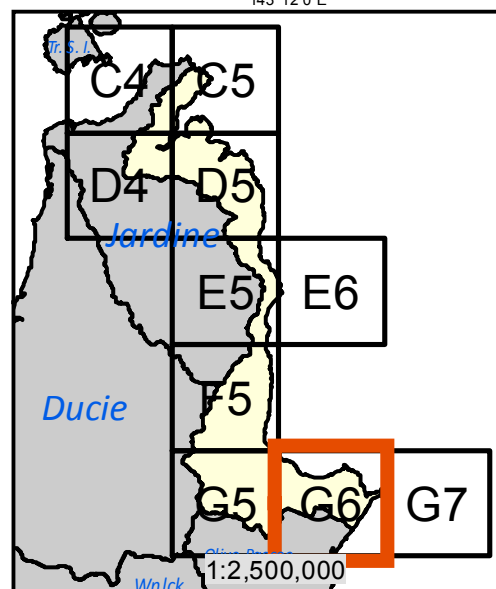
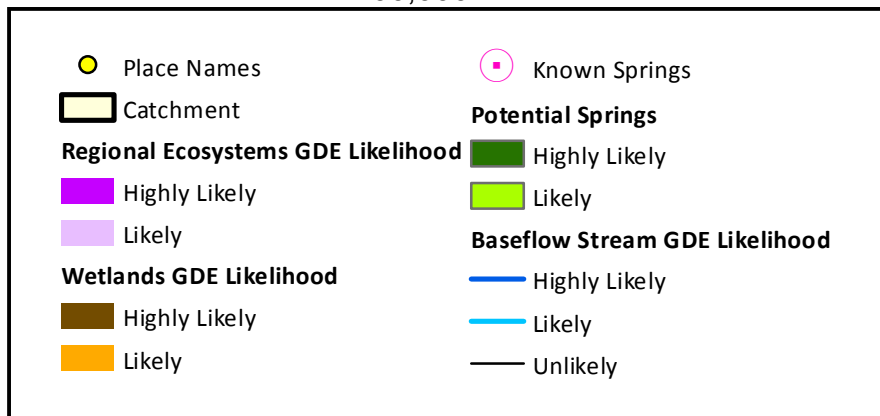
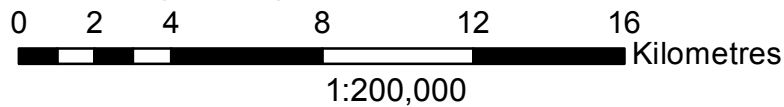


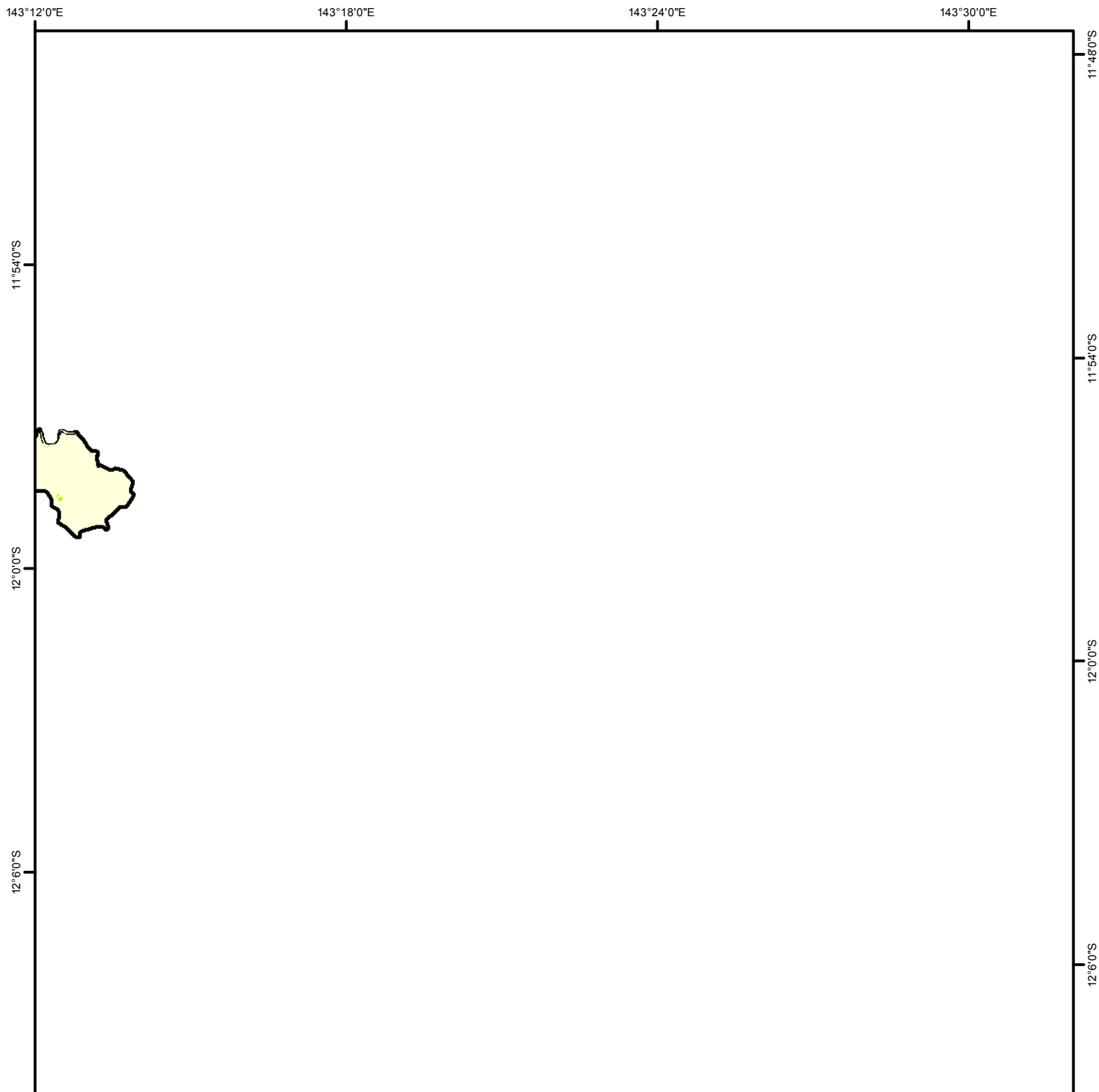
G5 Jacky Jacky Catchment



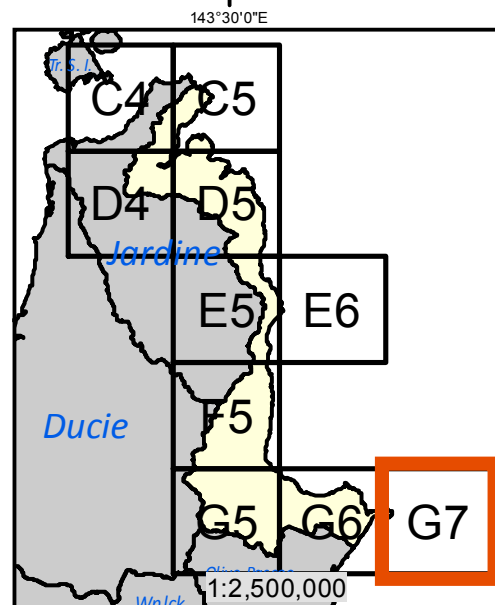
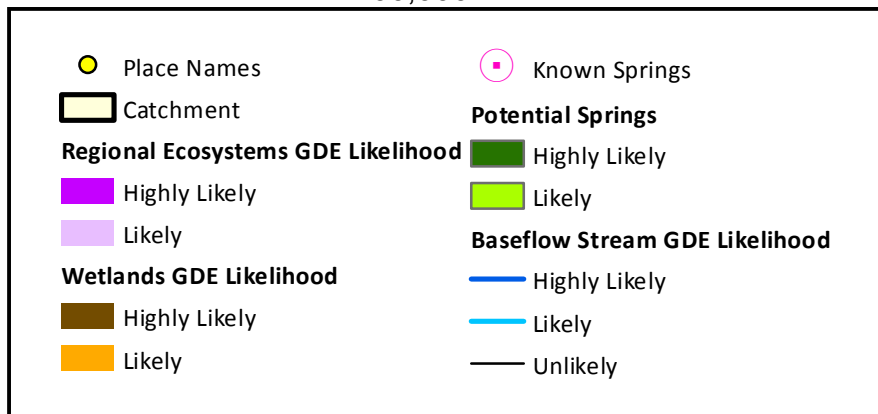
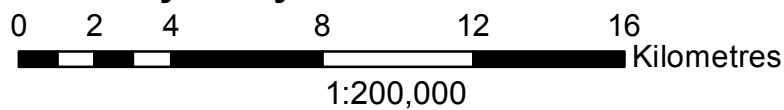


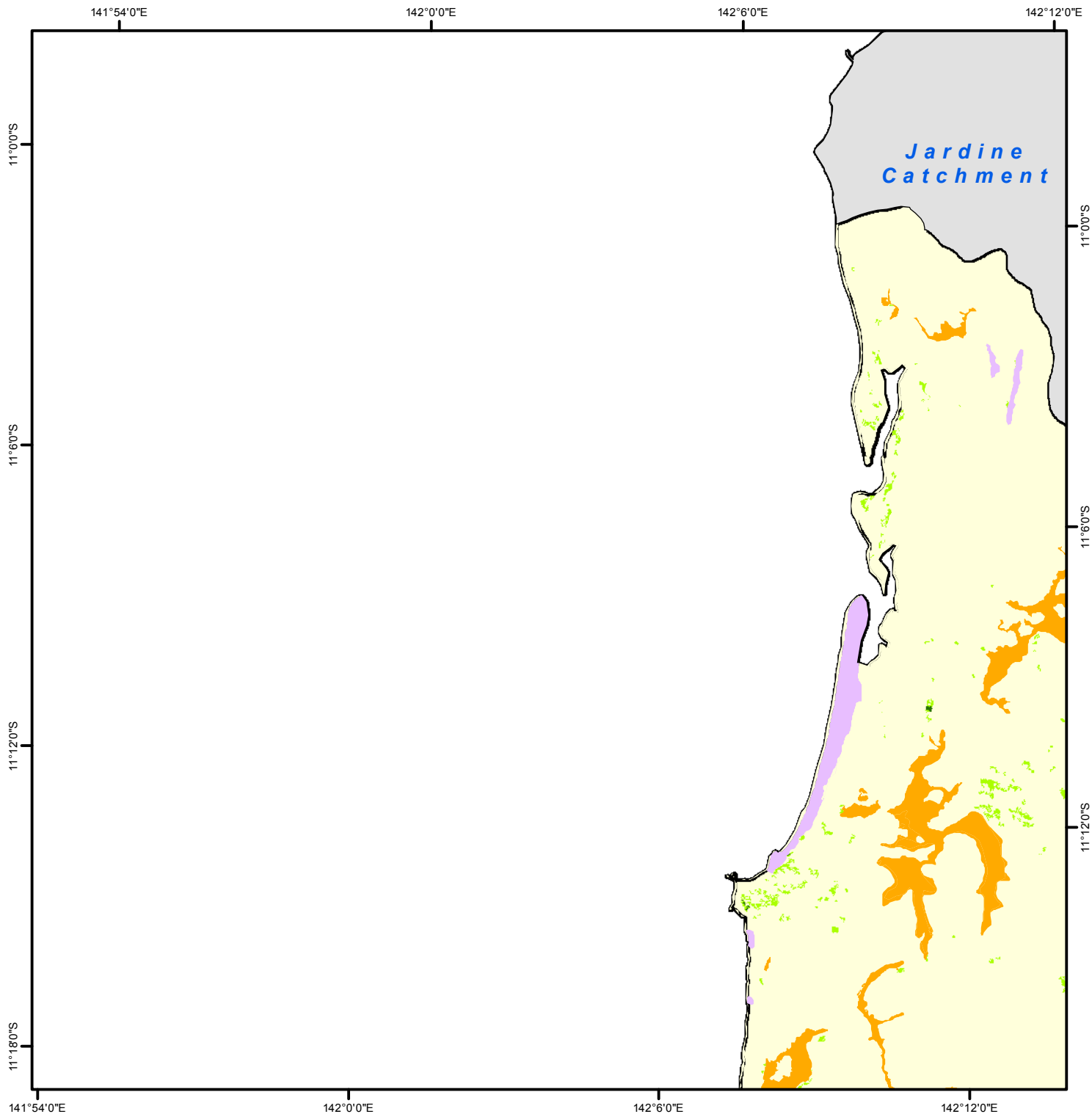
G6 Jacky Jacky Catchment



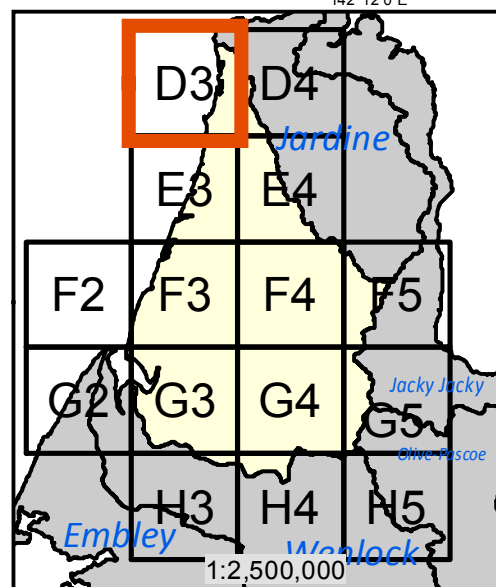
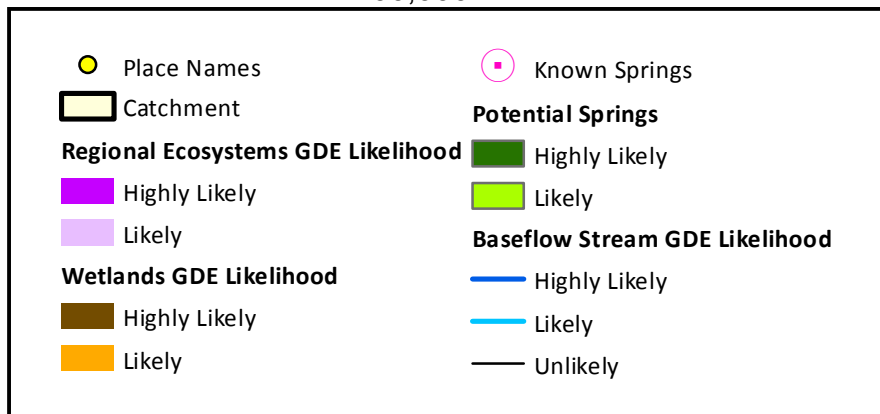
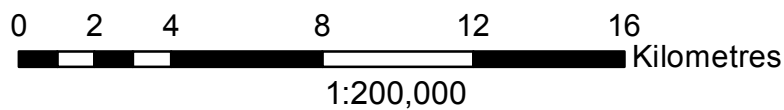


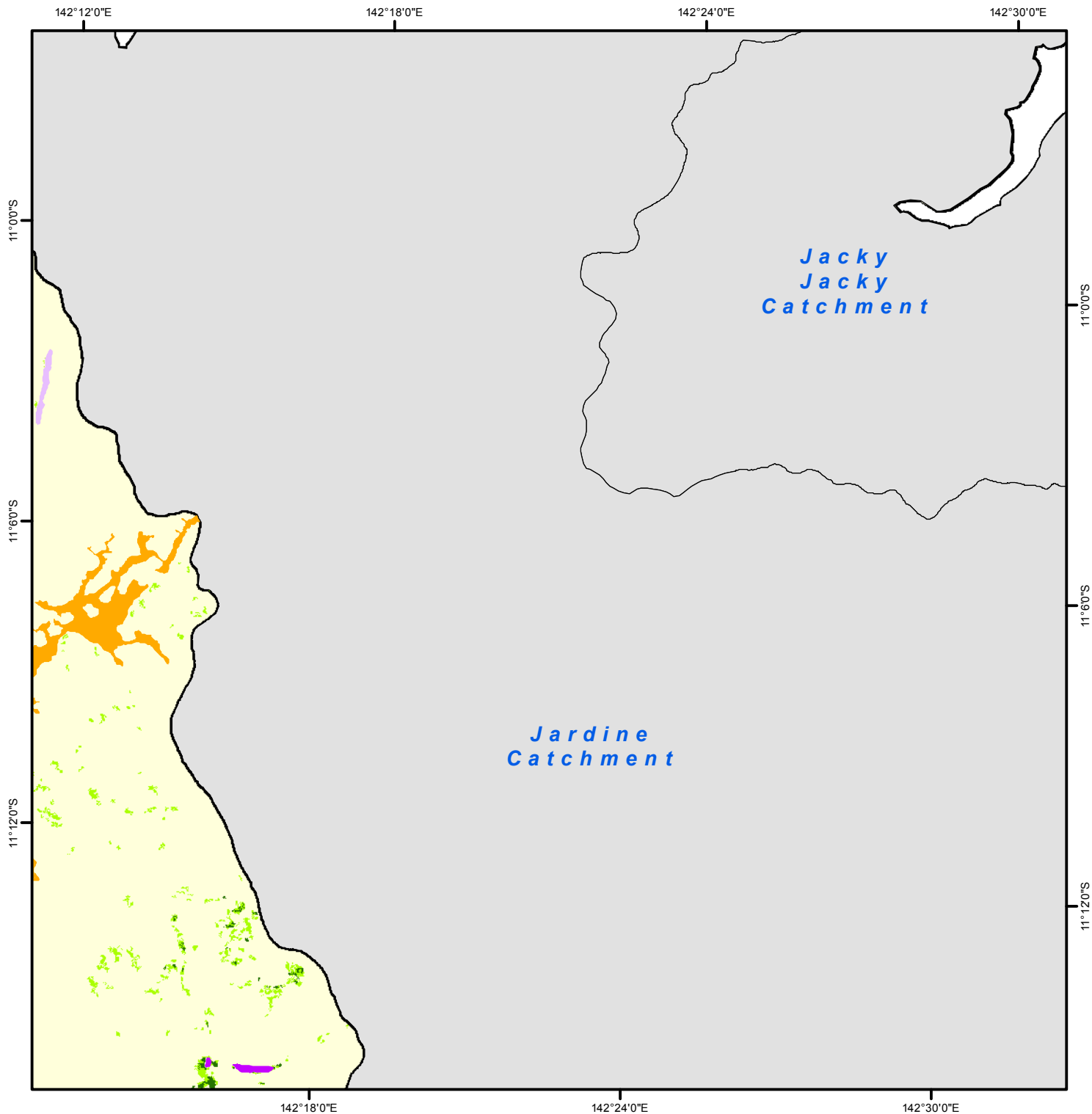
G7 Jacky Jacky Catchment



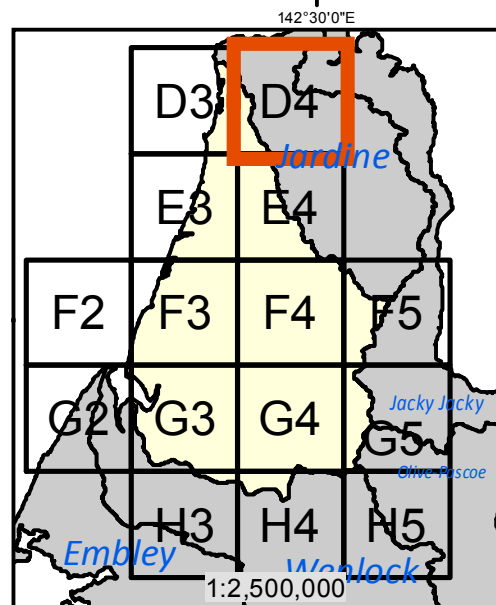
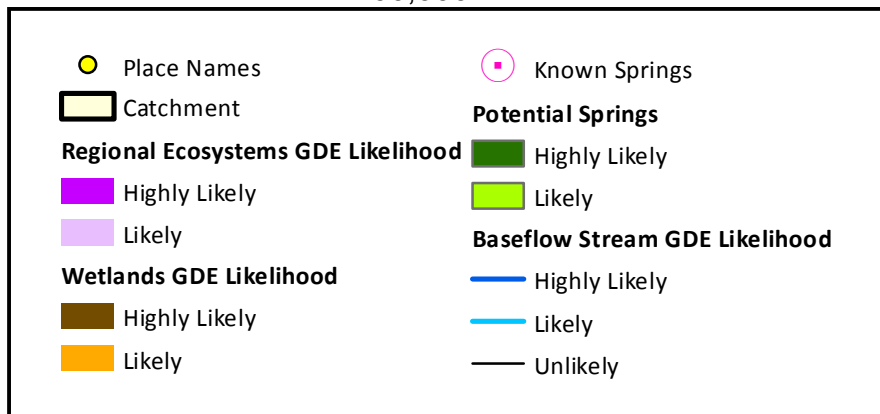
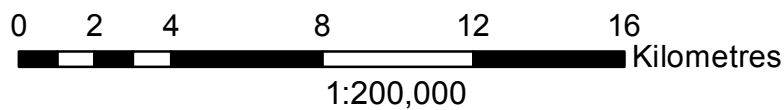


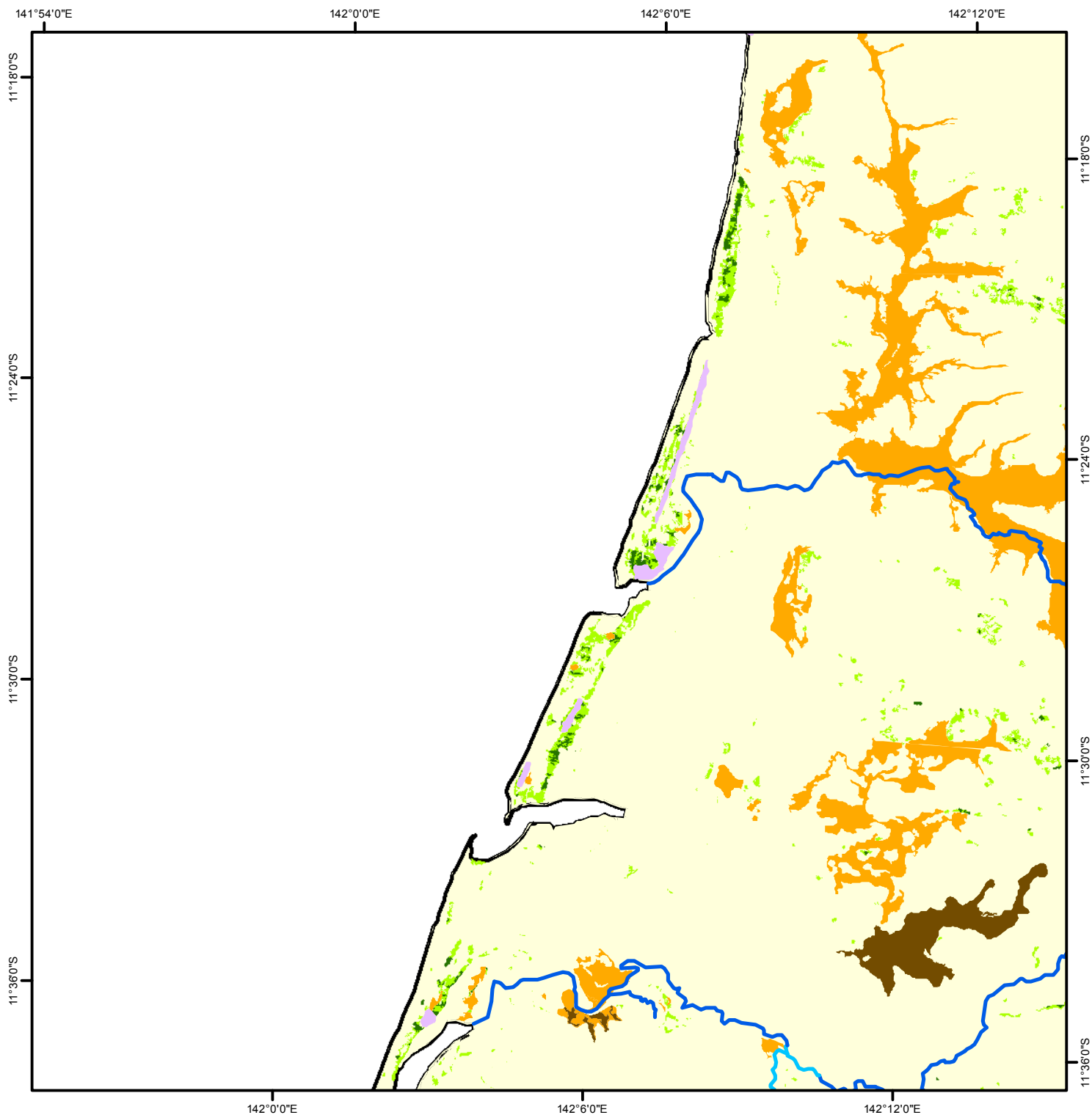
D3 Ducie Catchment



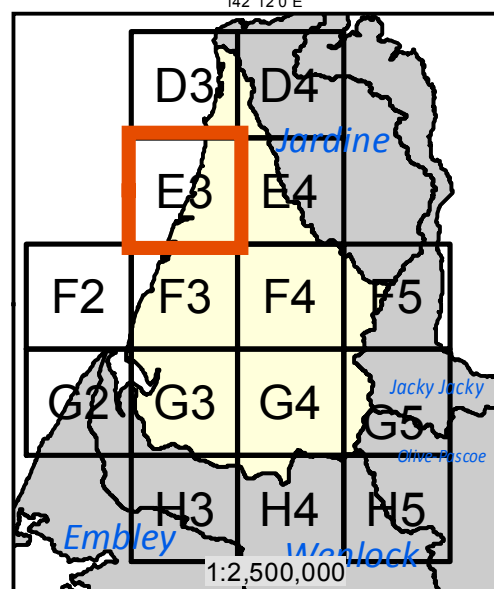
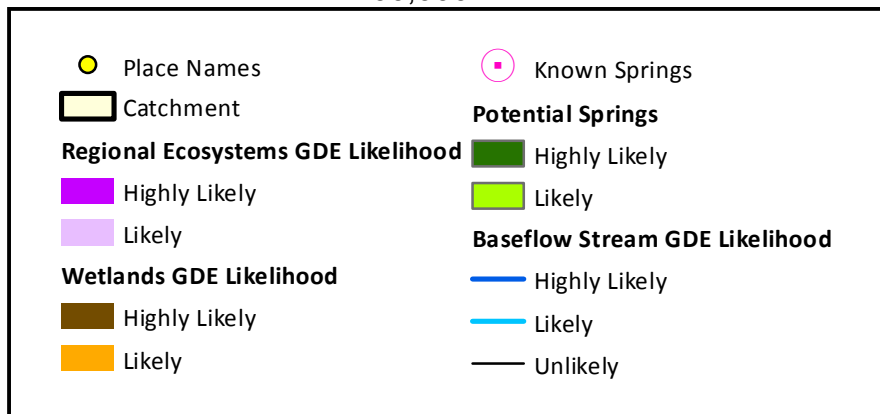
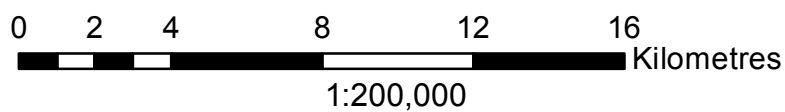


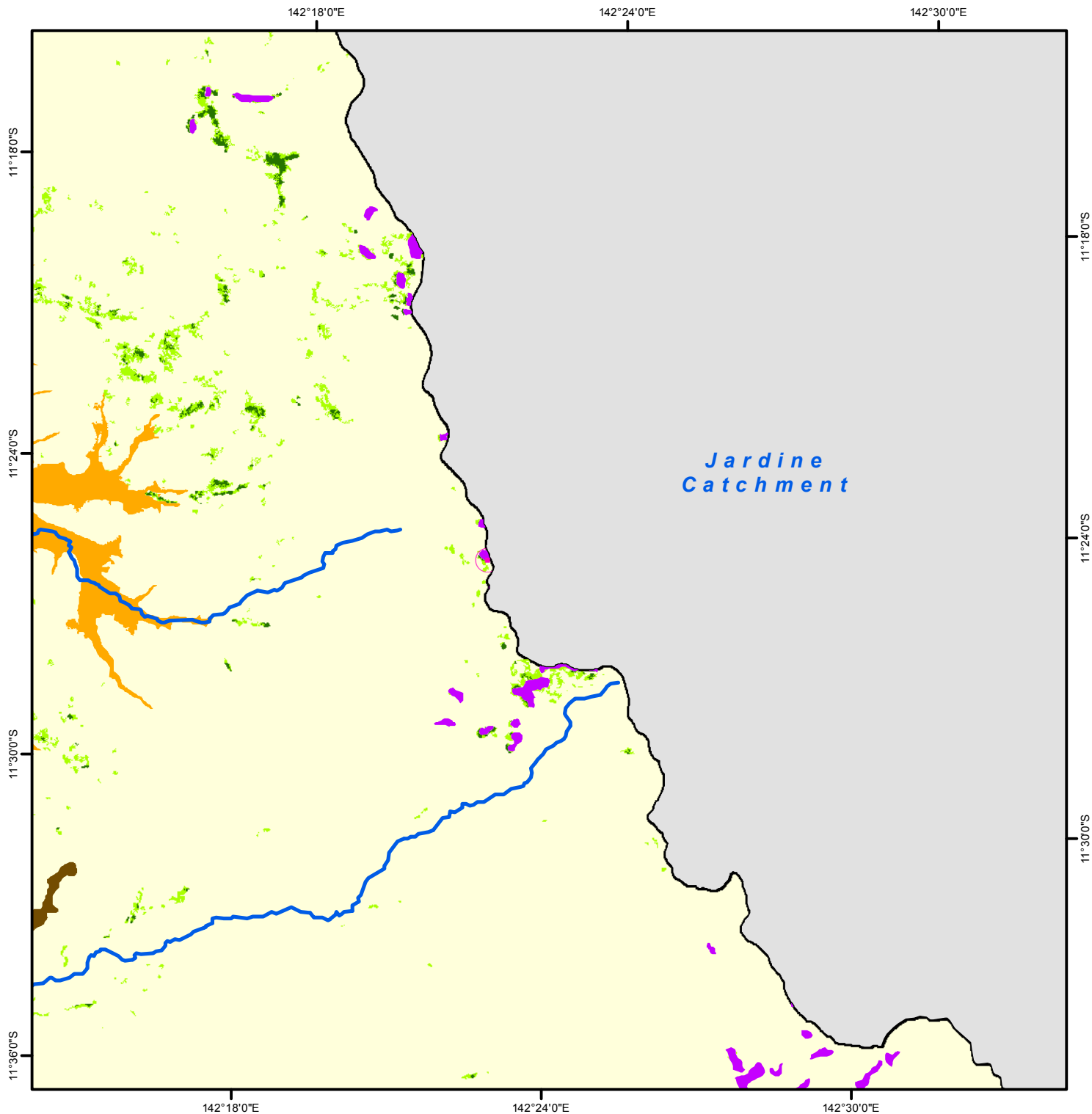
D4 Ducie Catchment



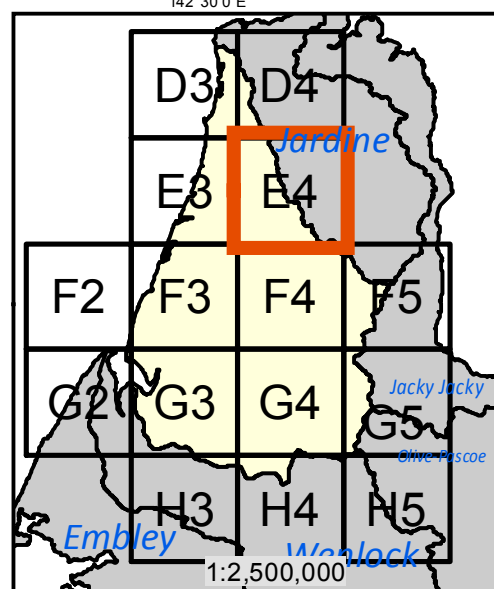
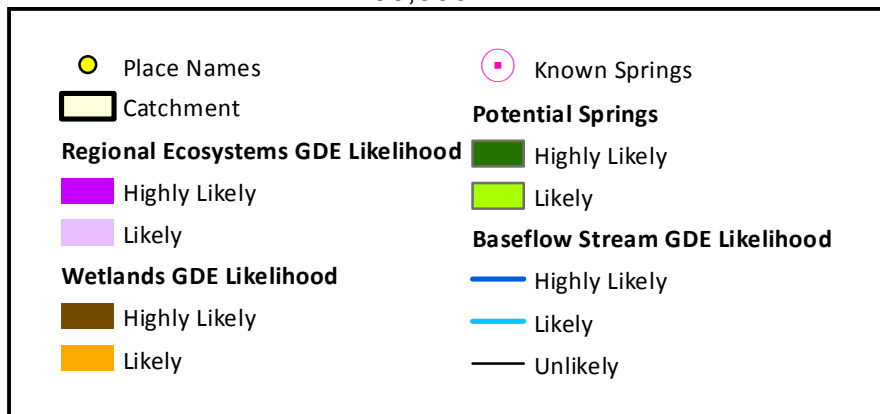
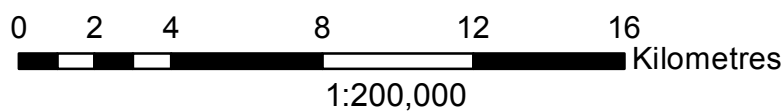


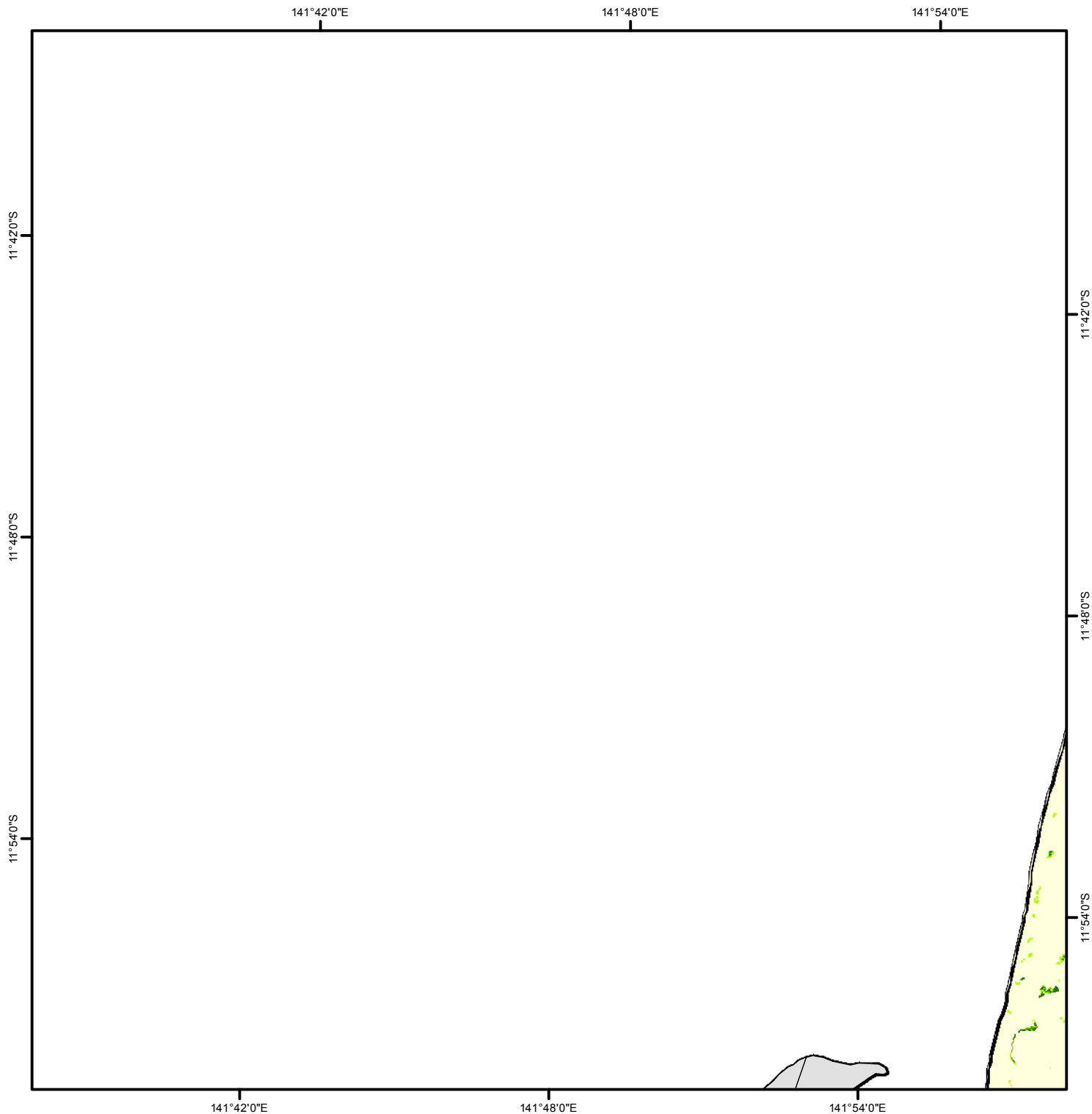
E3 Ducie Catchment



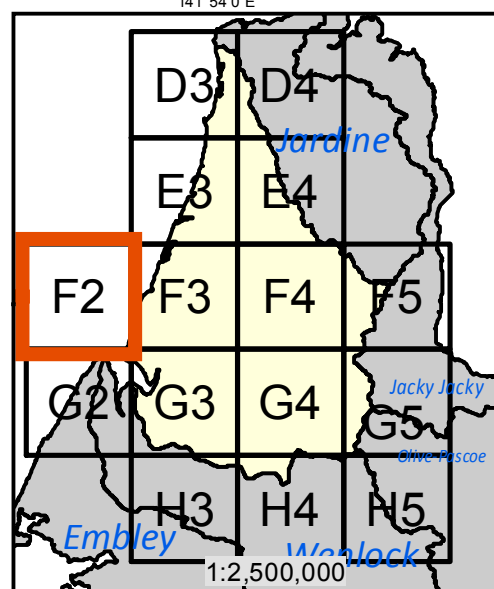
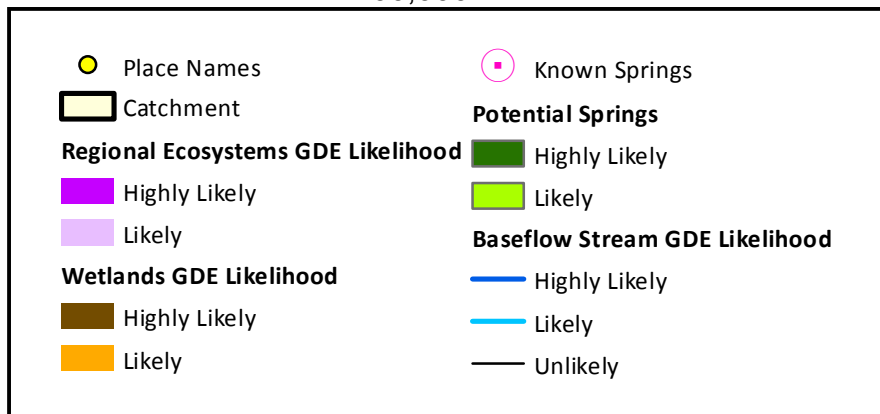
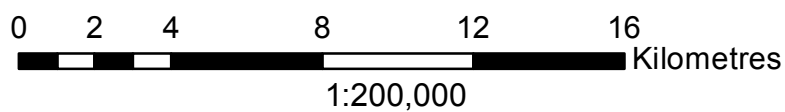


E4 Ducie Catchment





F2 Ducie Catchment



142°0'0"E

142°6'0"E

142°12'0"E

11°42'0"S

11°36'0"S

11°42'0"S

11°48'0"S

11°48'0"S

11°54'0"S

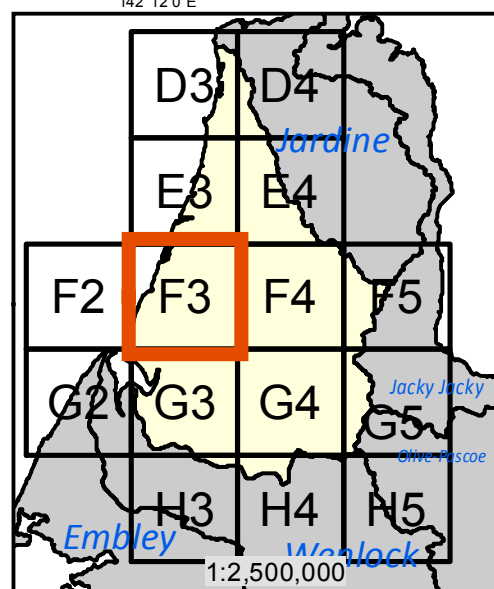
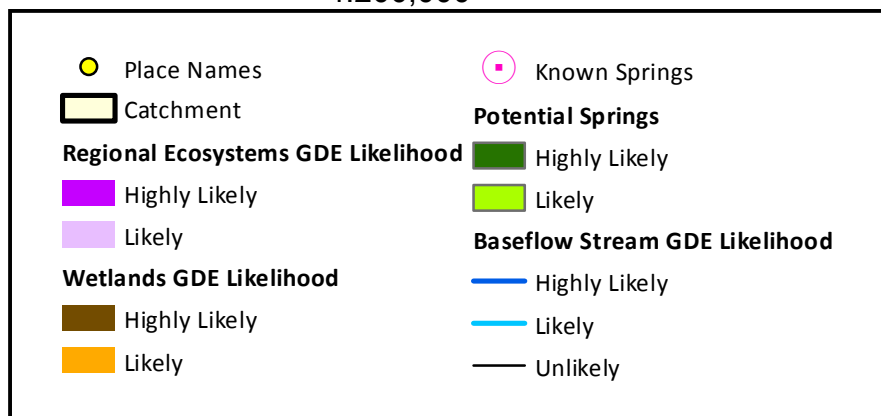
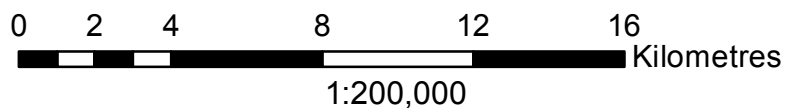
11°54'0"S

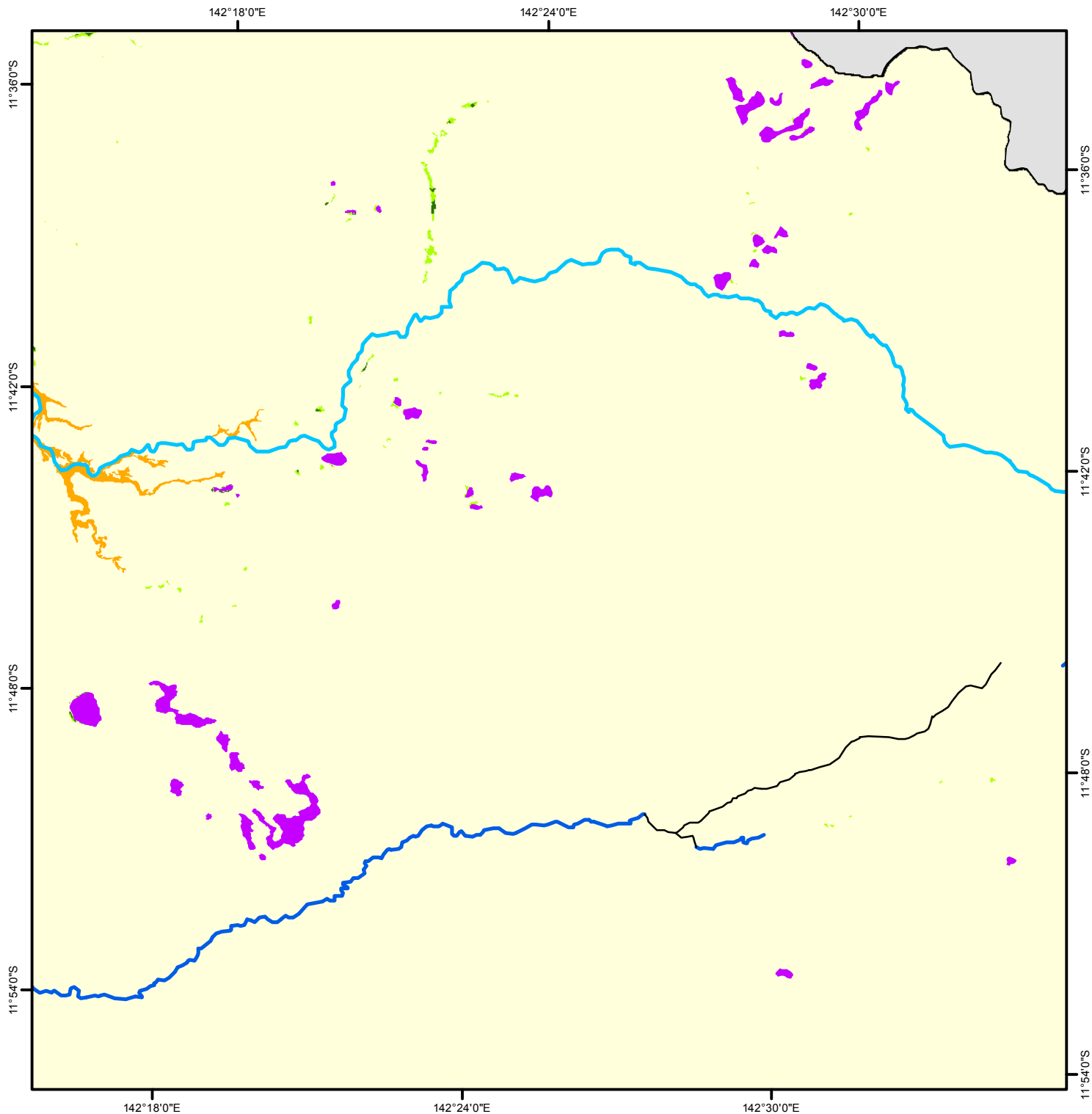
142°0'0"E

142°6'0"E

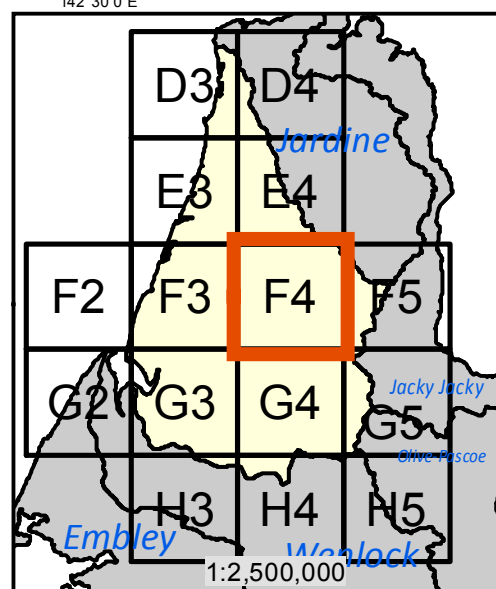
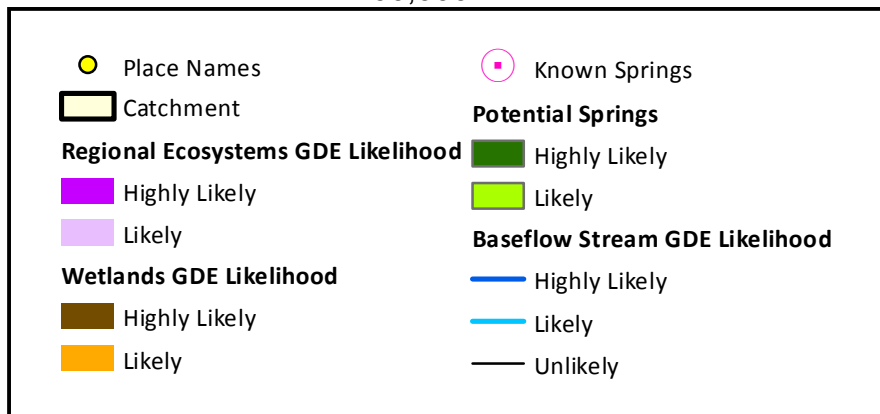
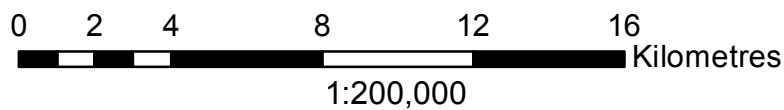
142°12'0"E

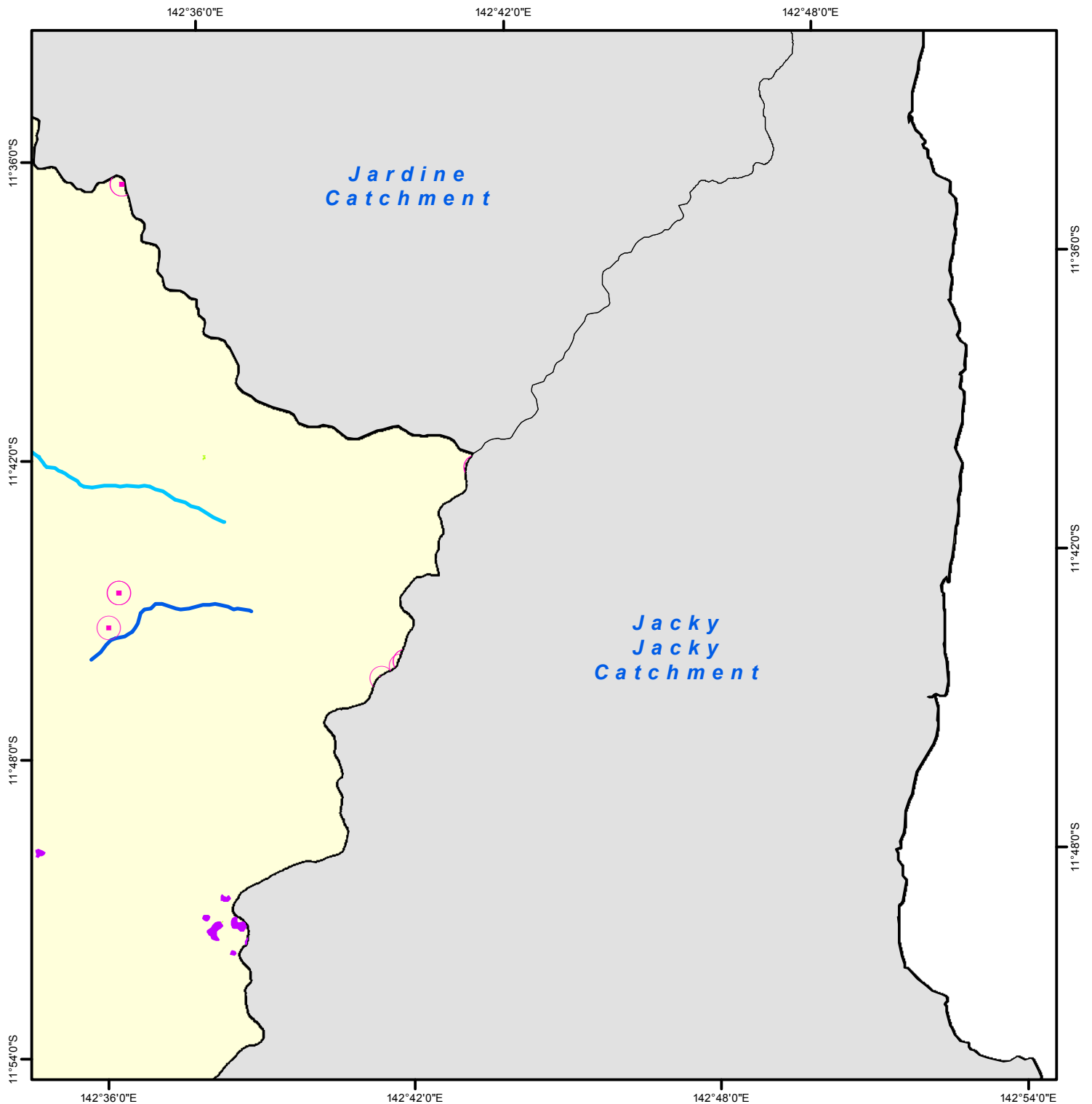
F3 Ducie Catchment



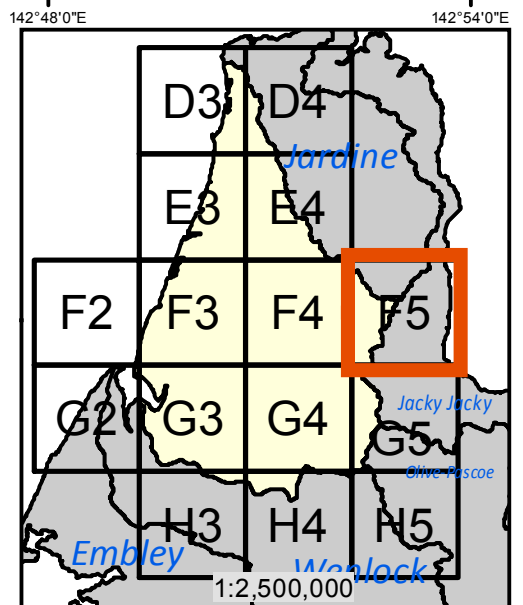
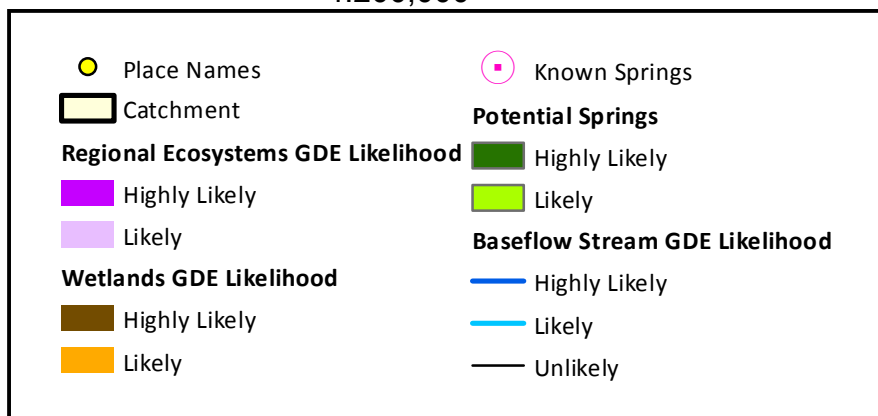
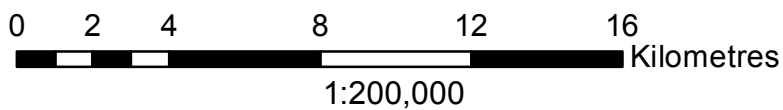


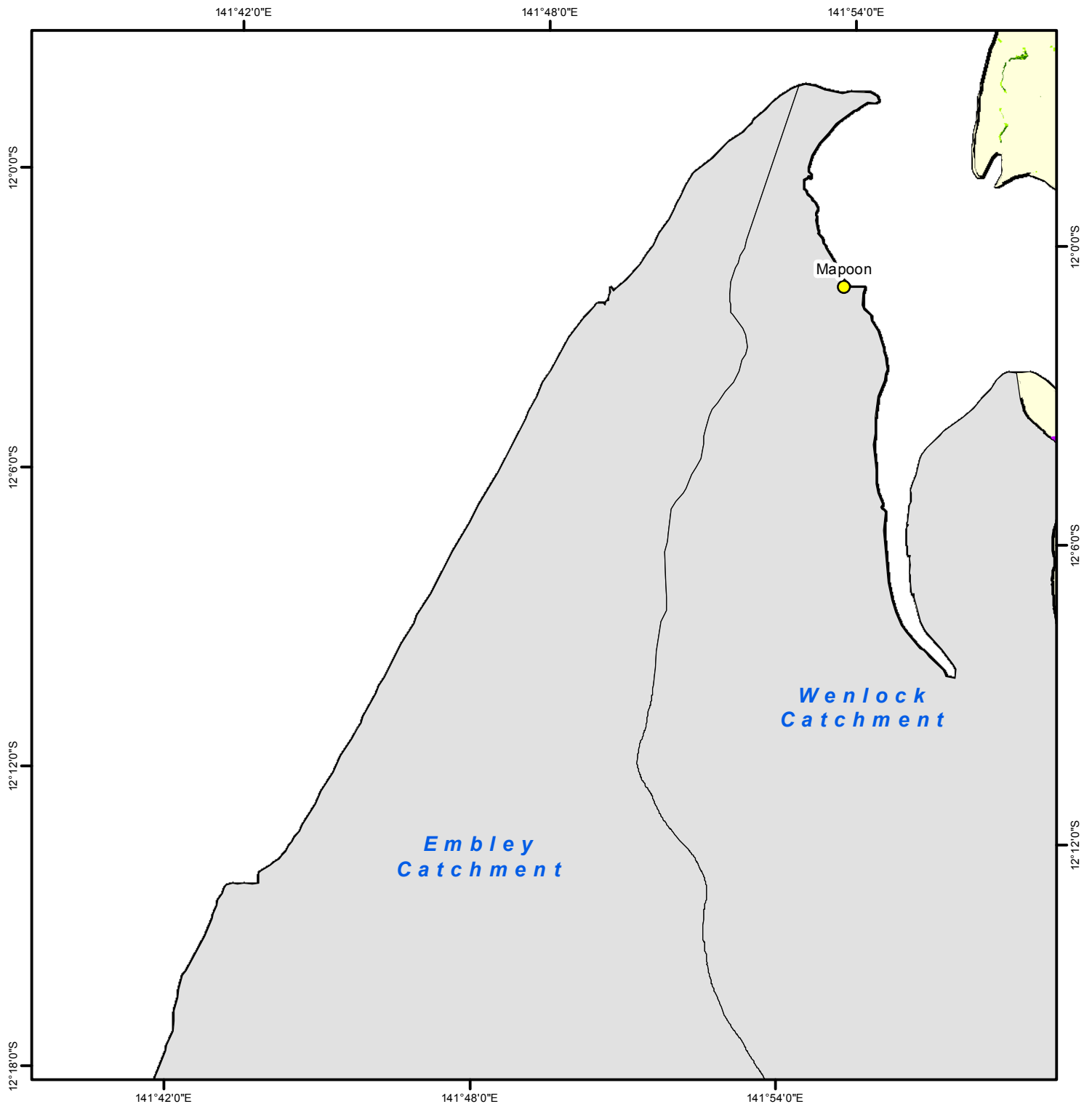
F4 Ducie Catchment



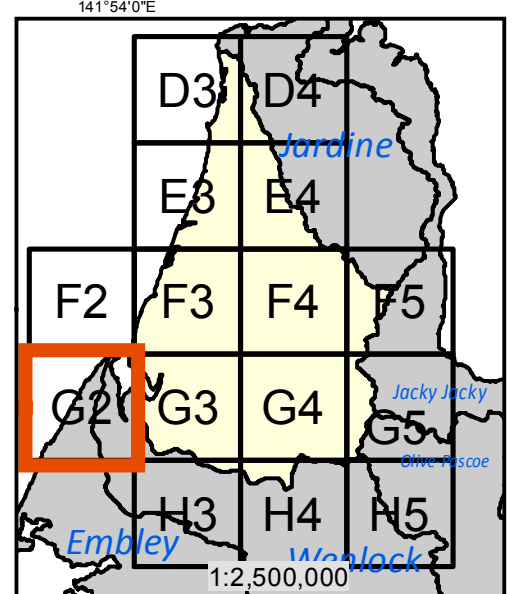
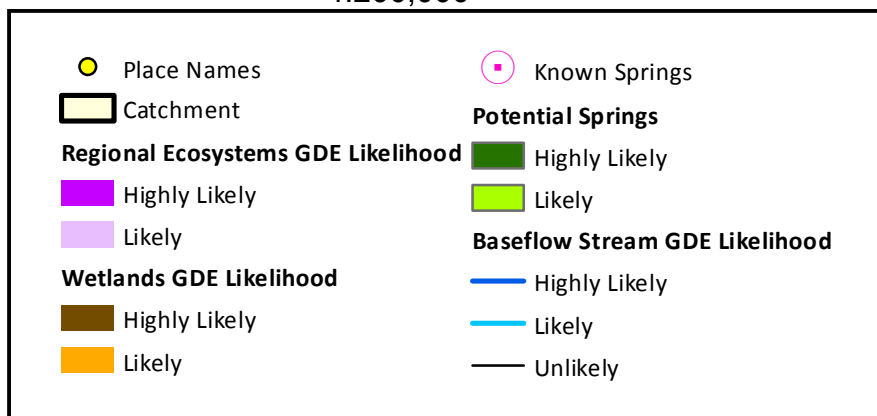
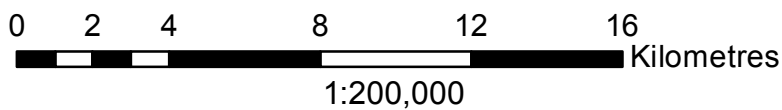


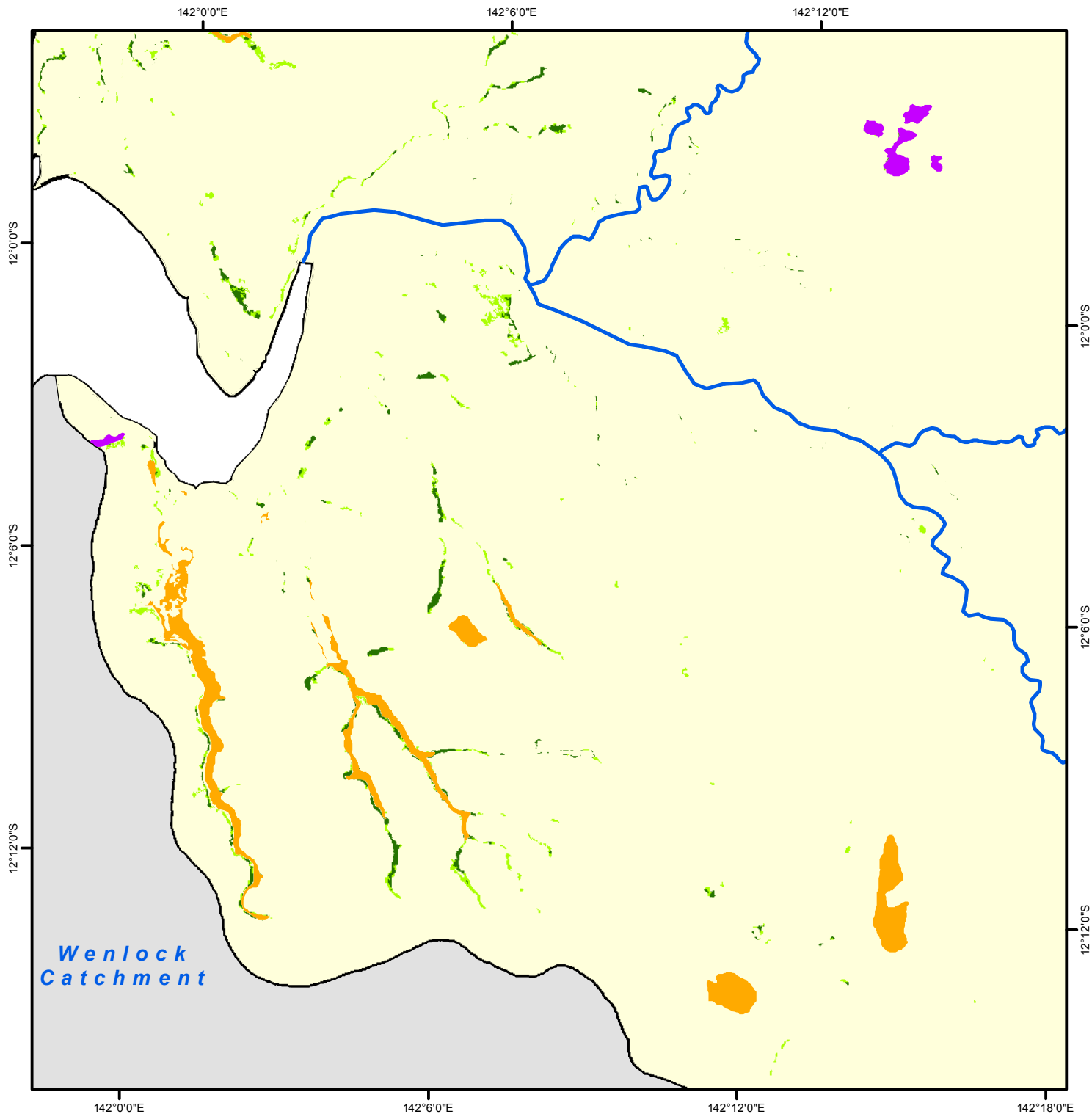
F5 Ducie Catchment



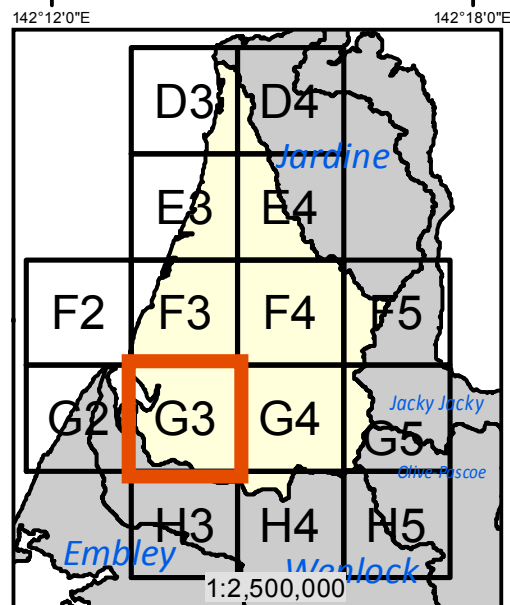
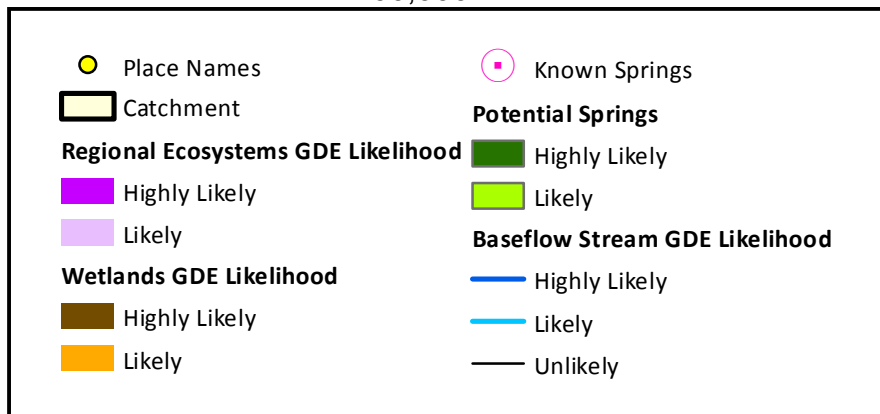
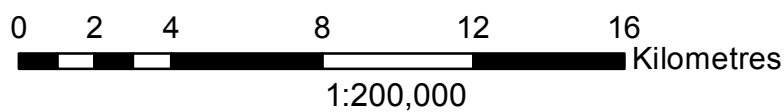


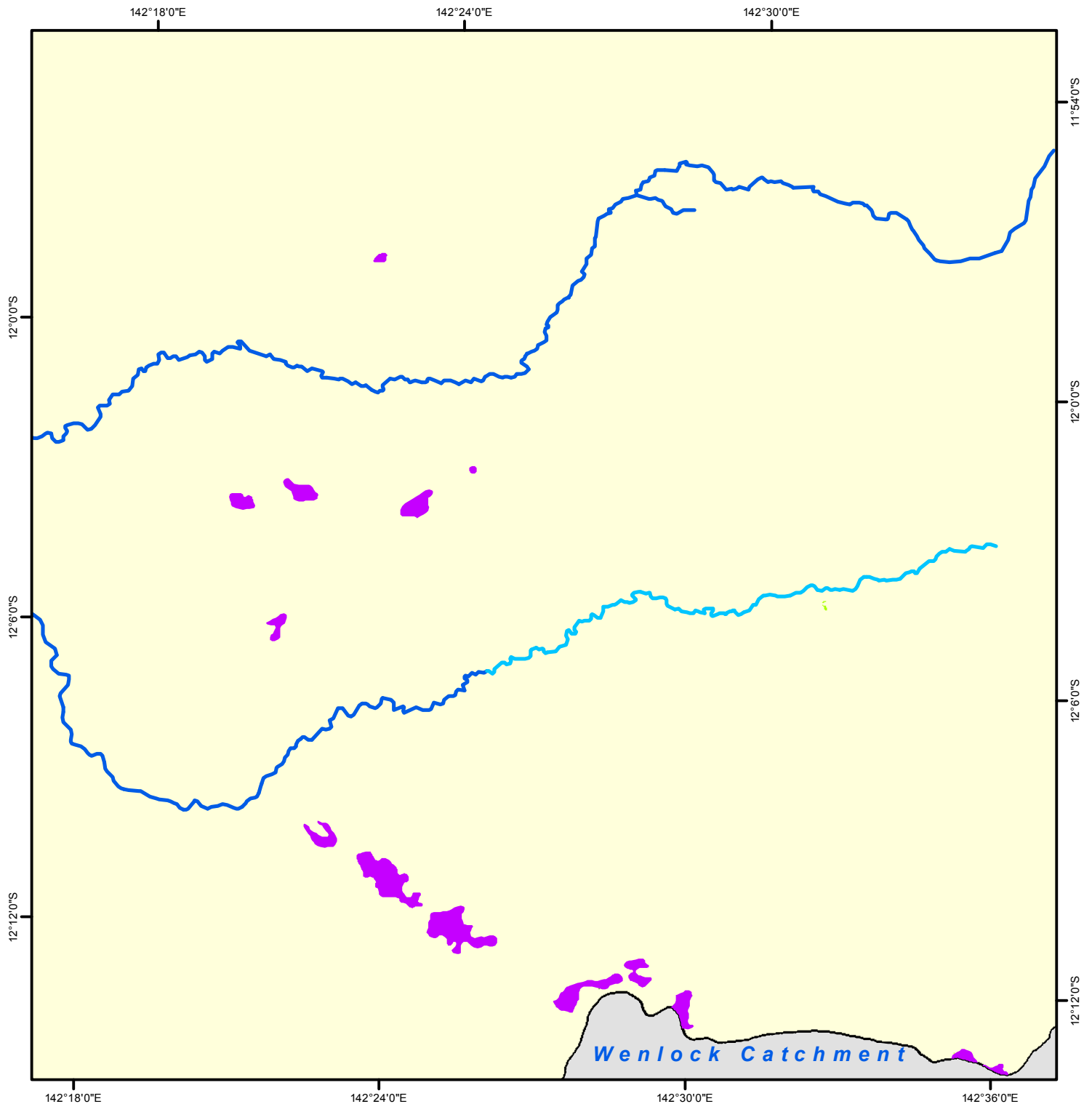
G2 Ducie Catchment



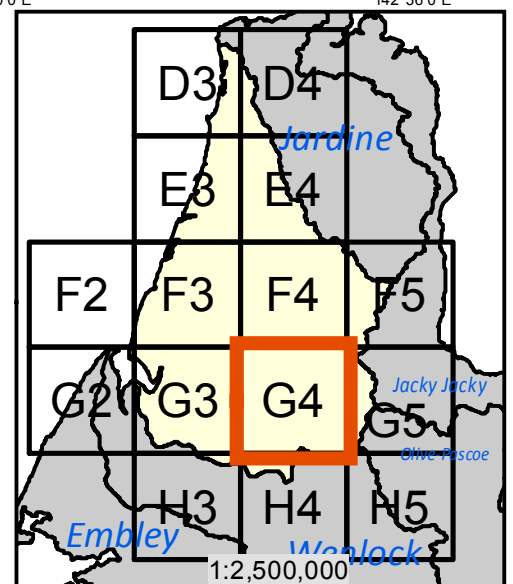
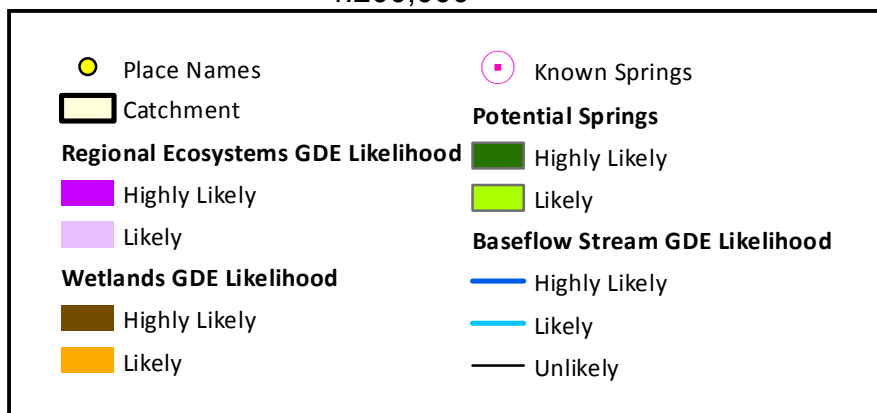
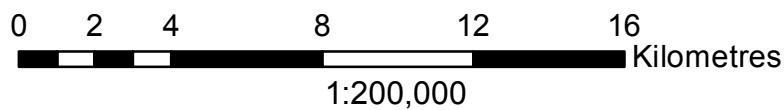


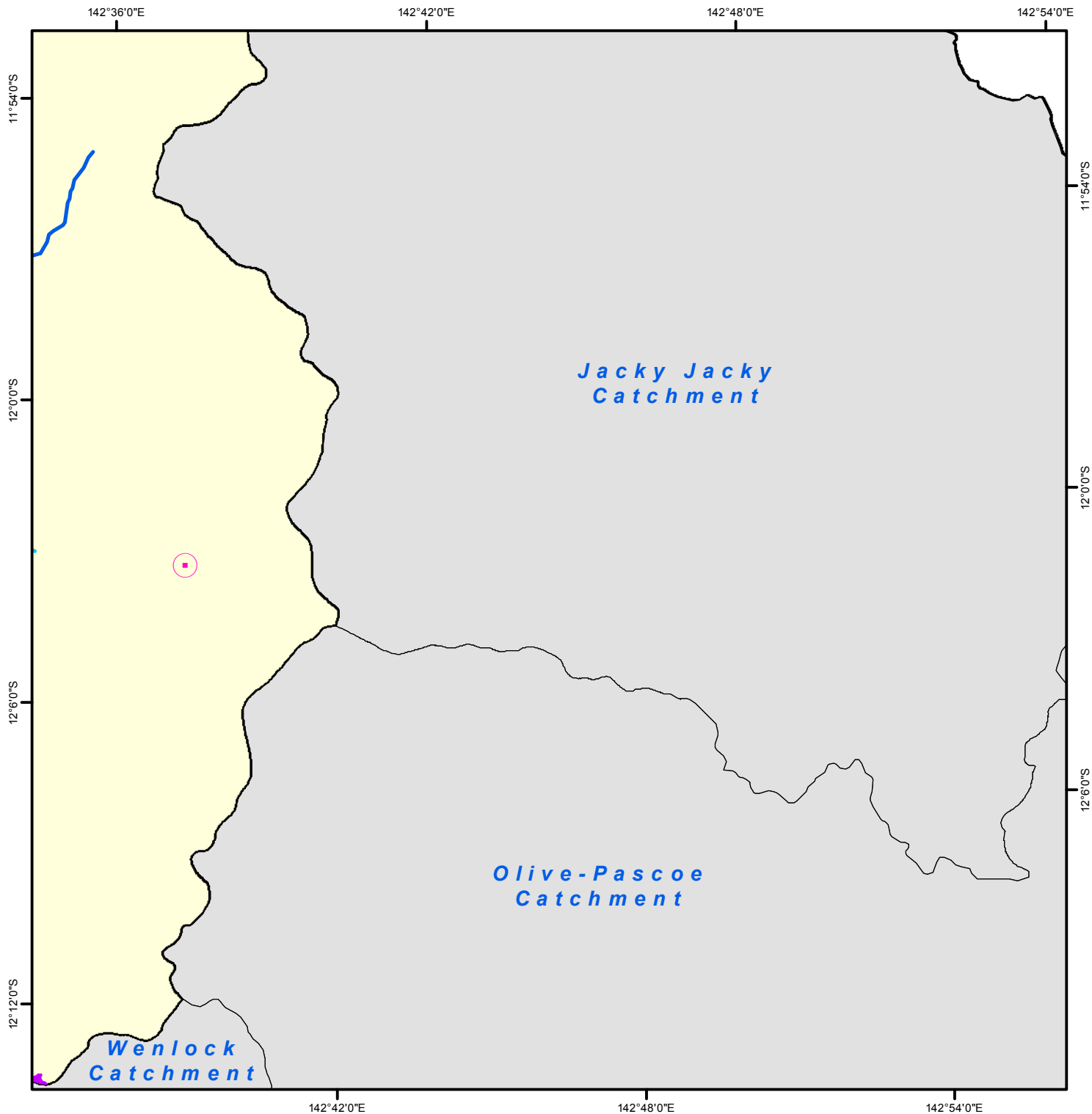
G3 Ducie Catchment



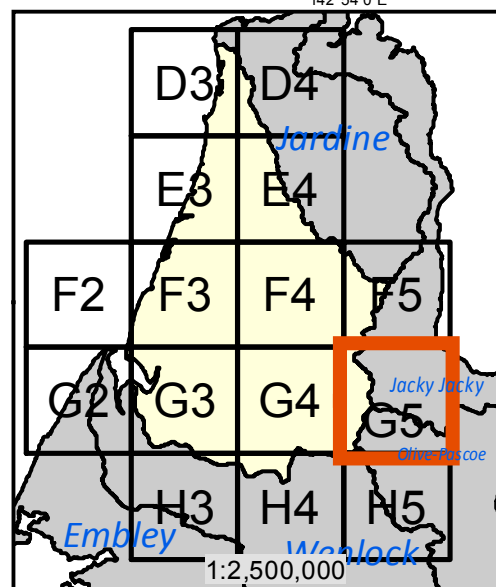
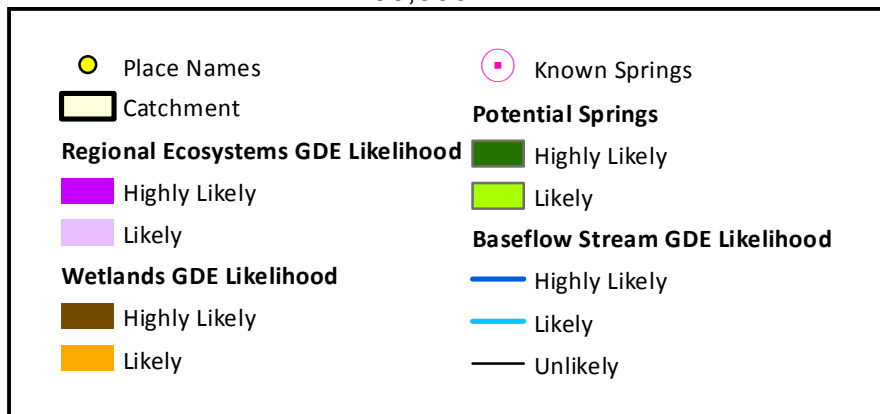
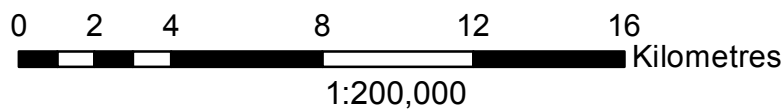


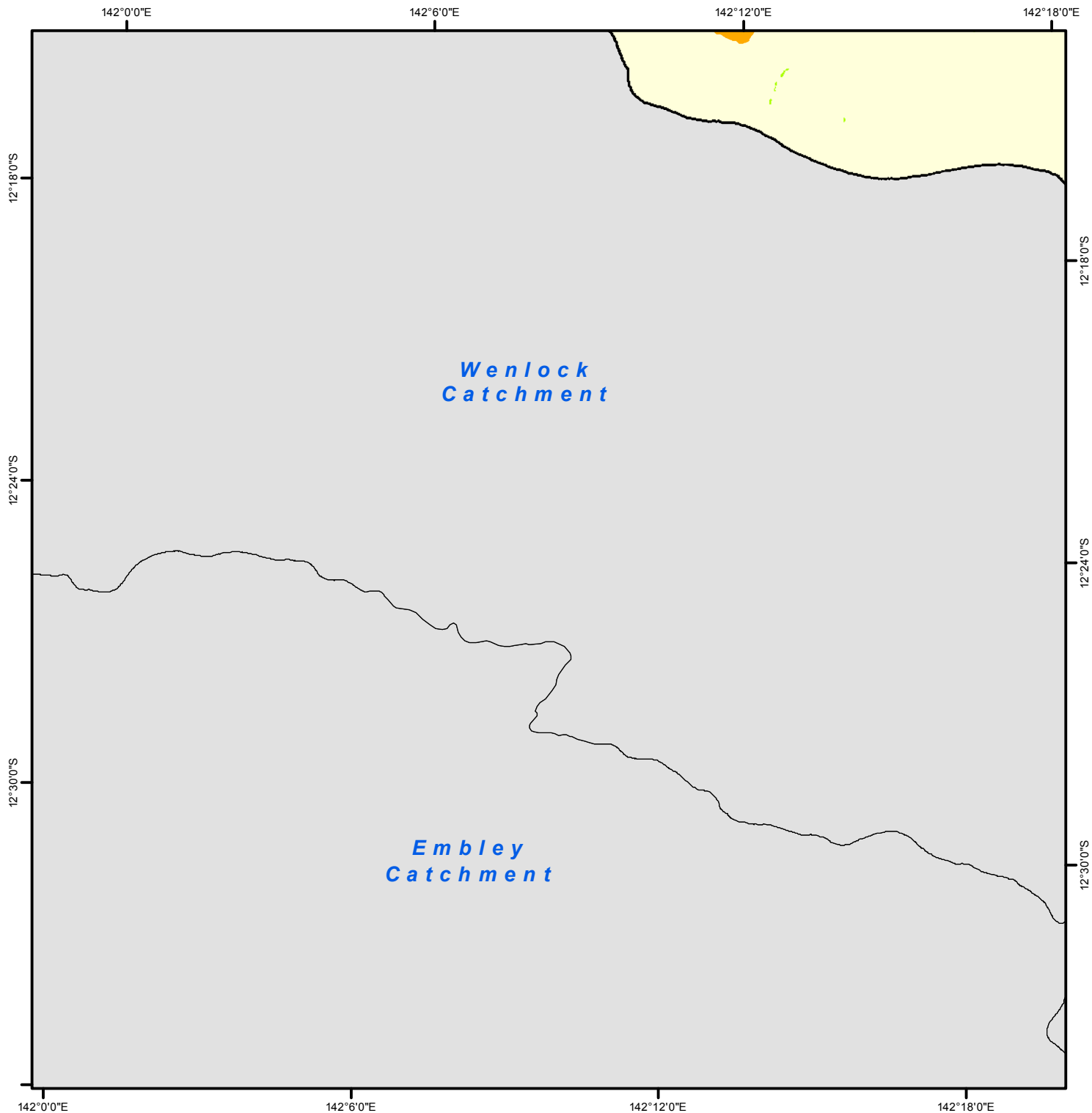
G4 Ducie Catchment



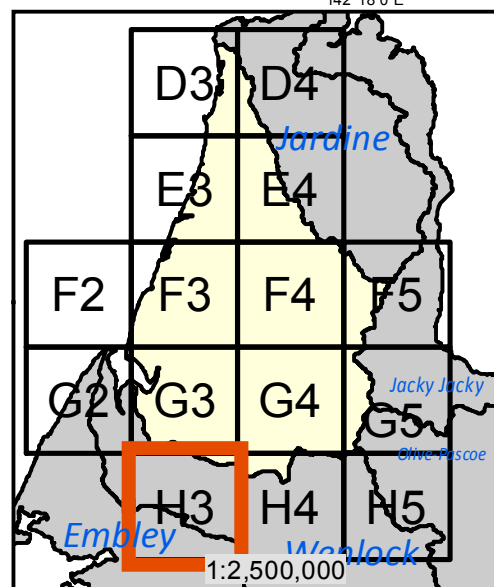
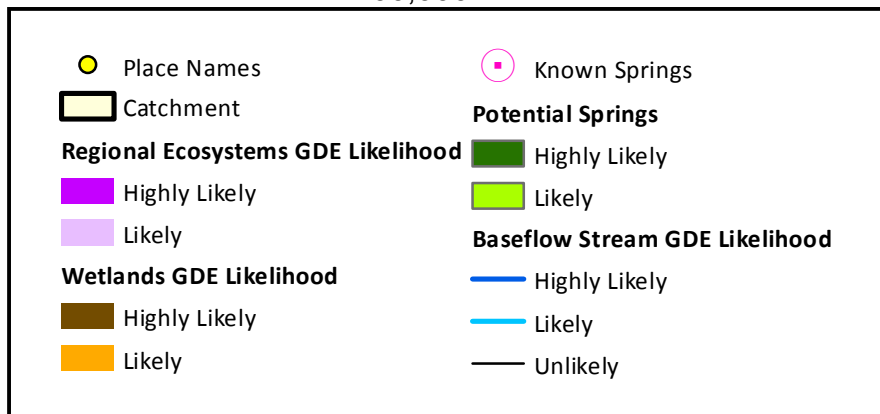
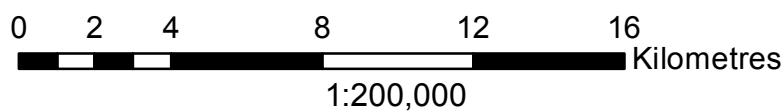


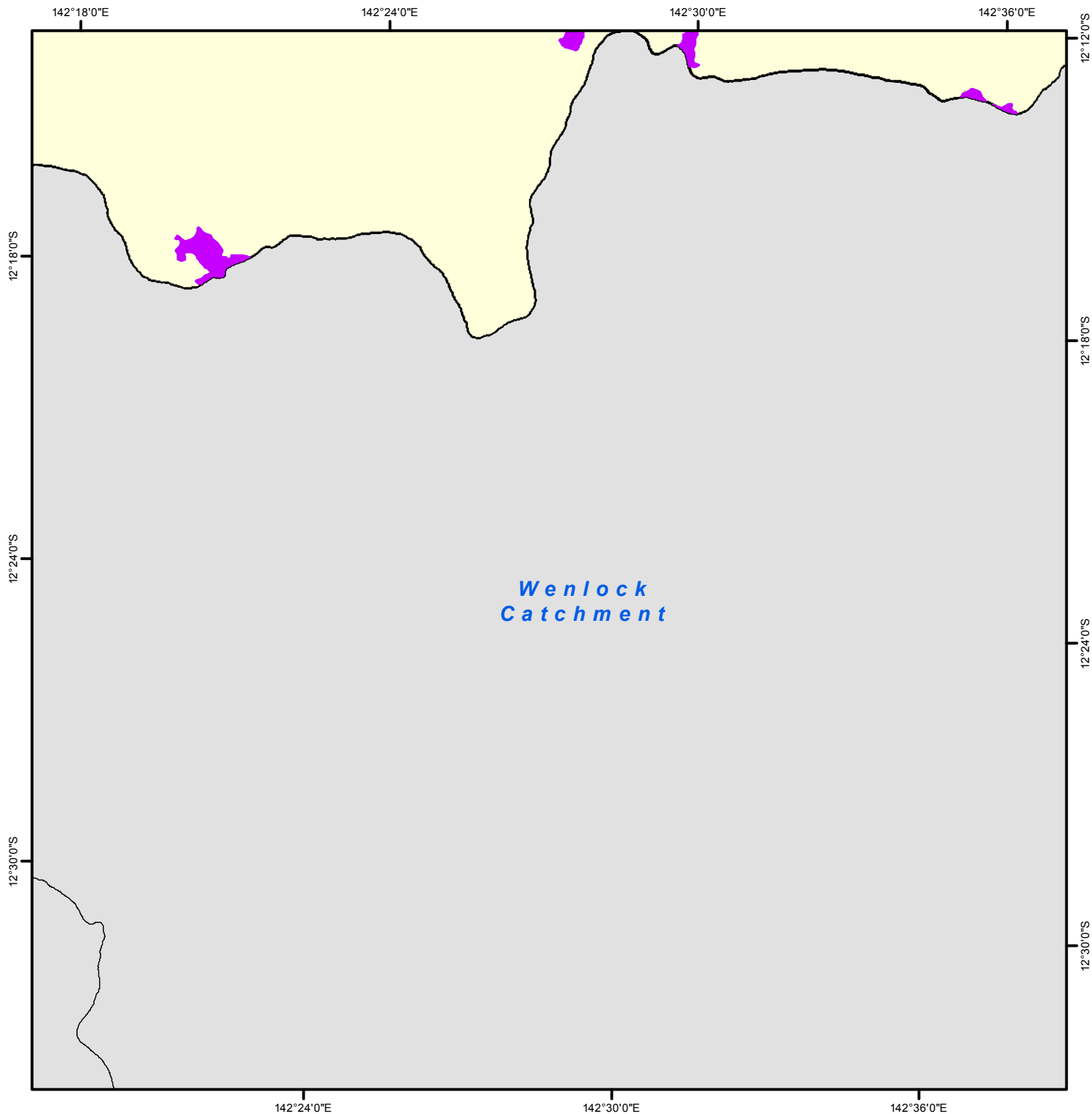
G5 Ducie Catchment



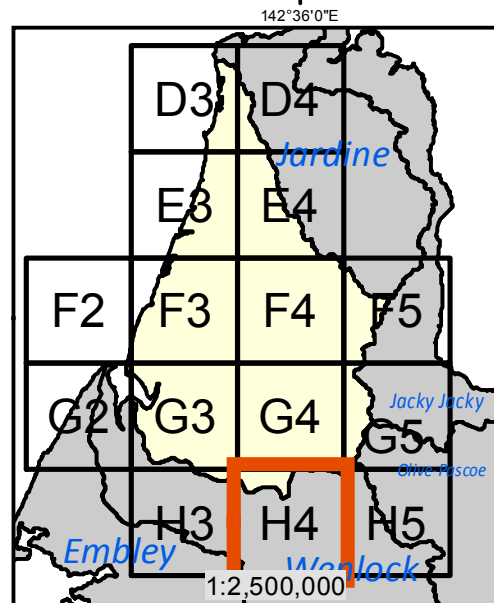
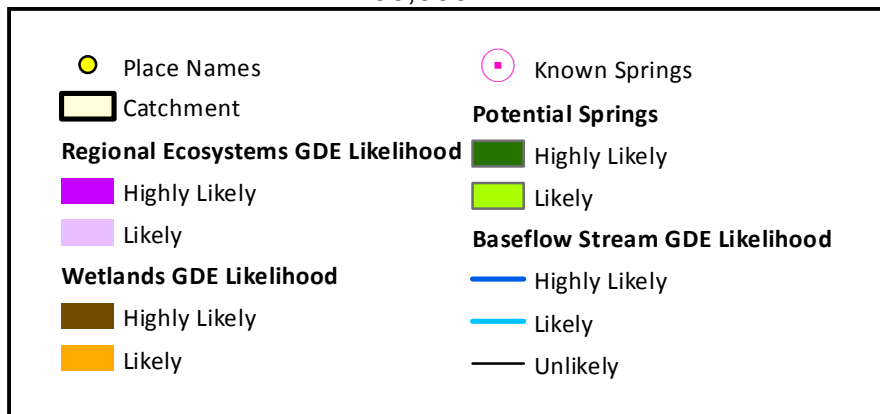
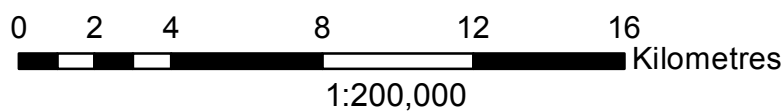


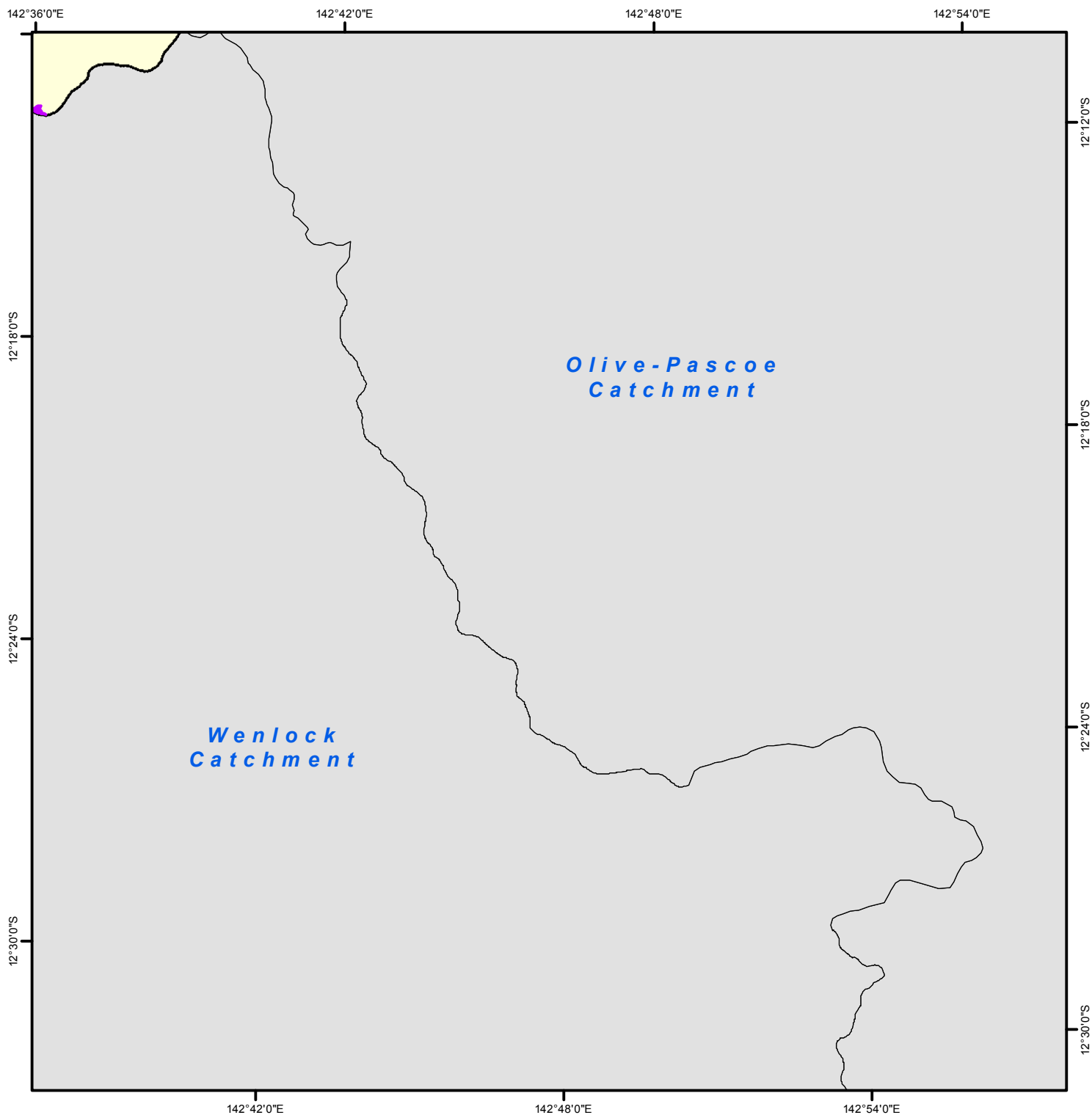
H3 Ducie Catchment



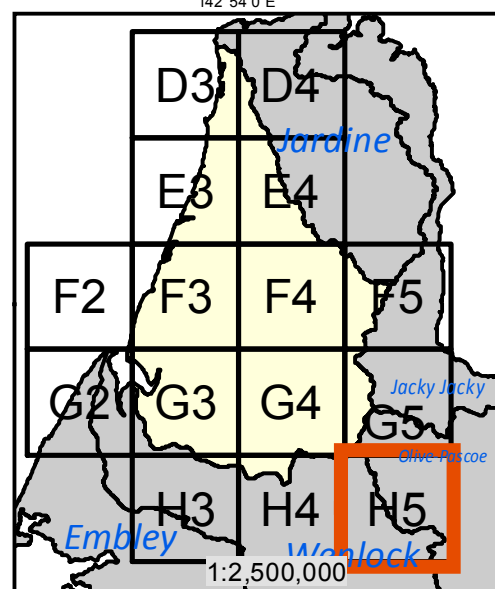
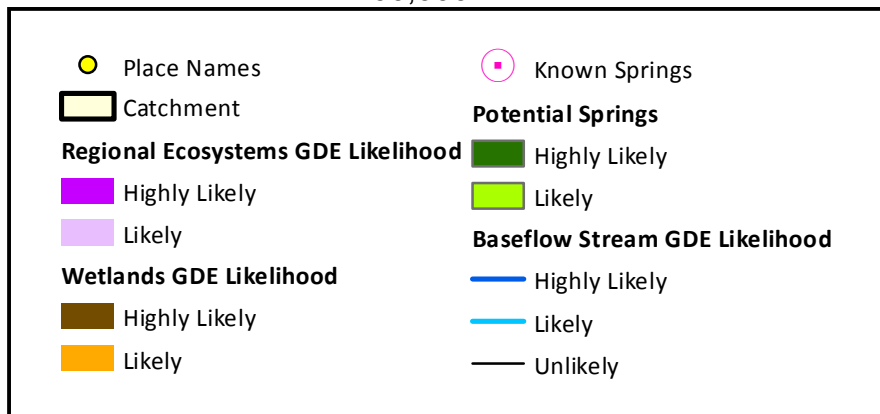
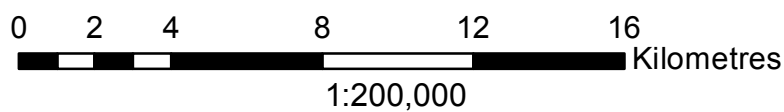


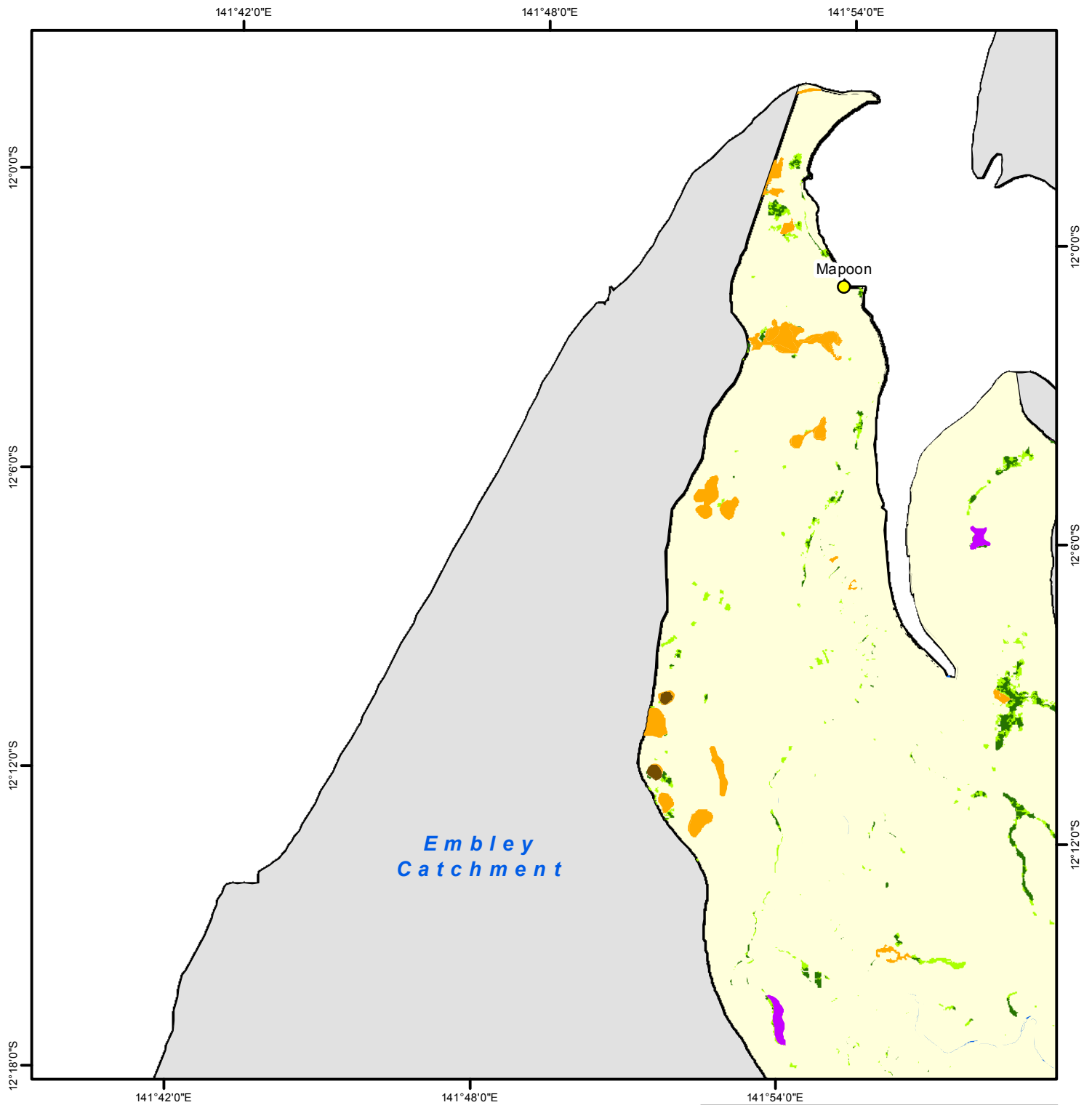
H4 Ducie Catchment



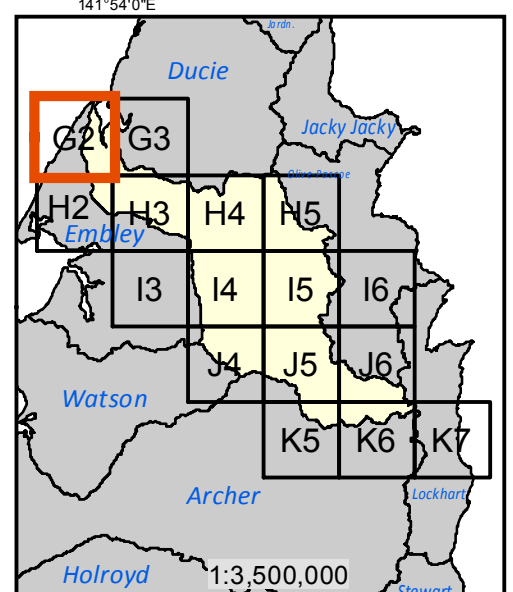
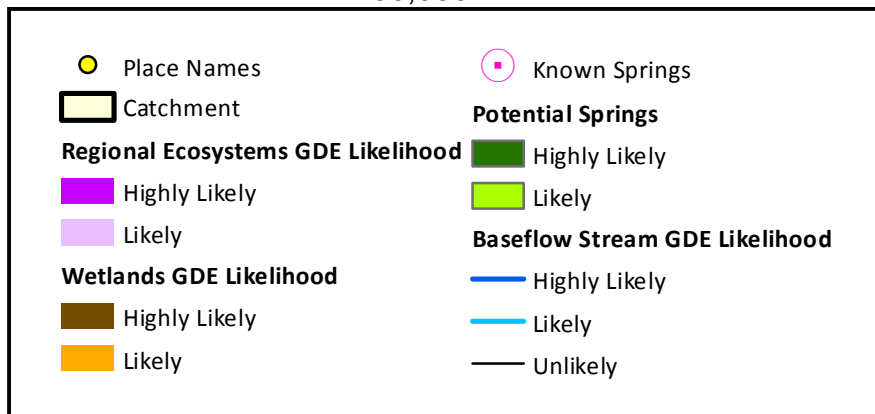
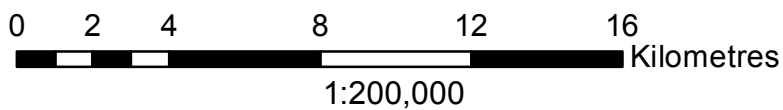


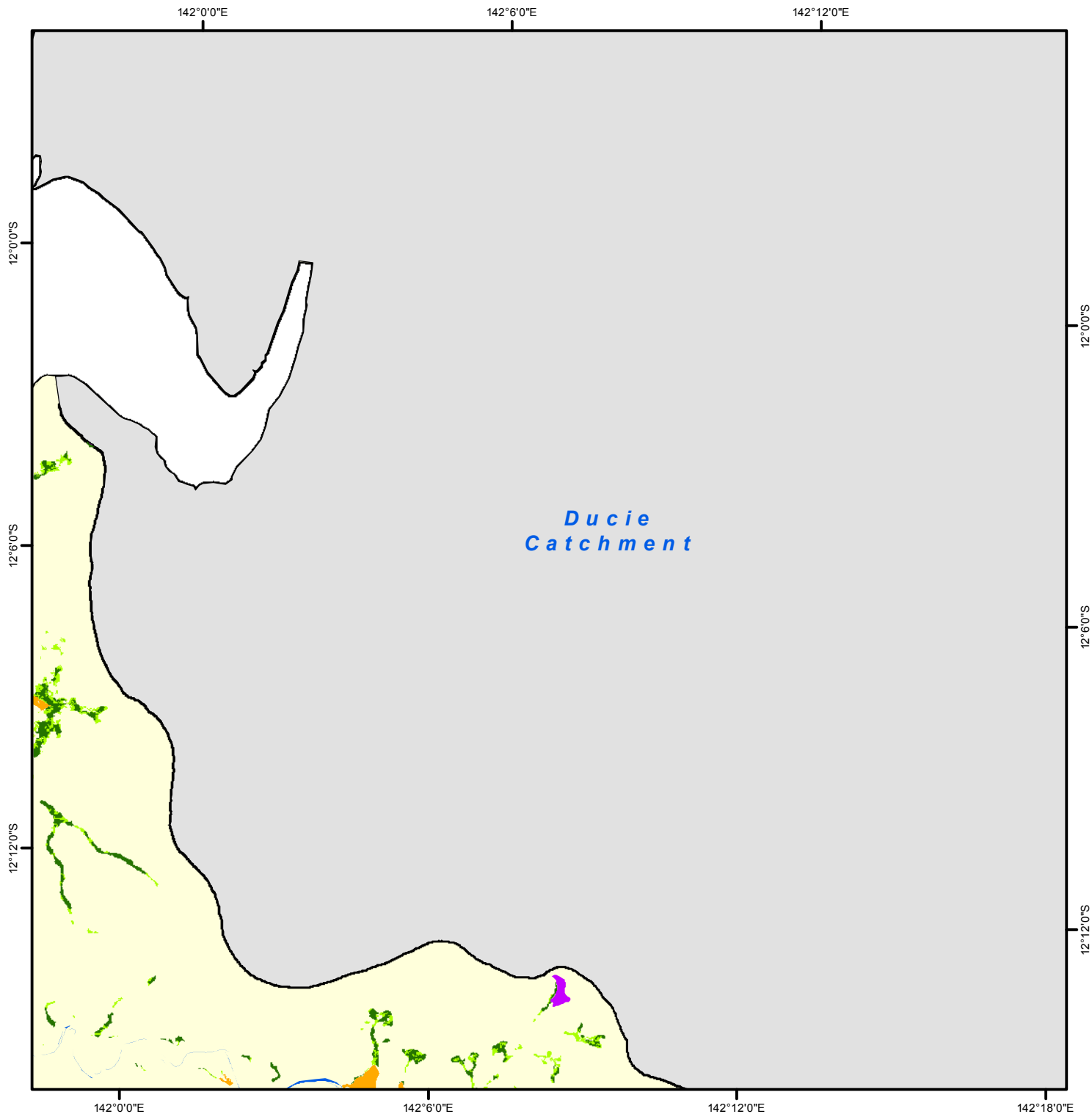
H5 Ducie Catchment



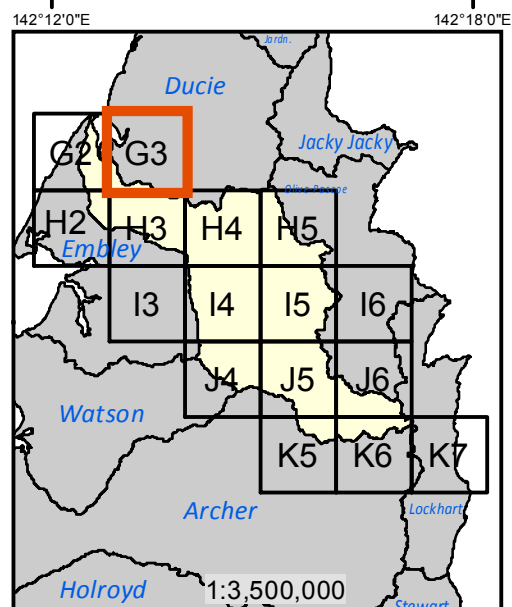
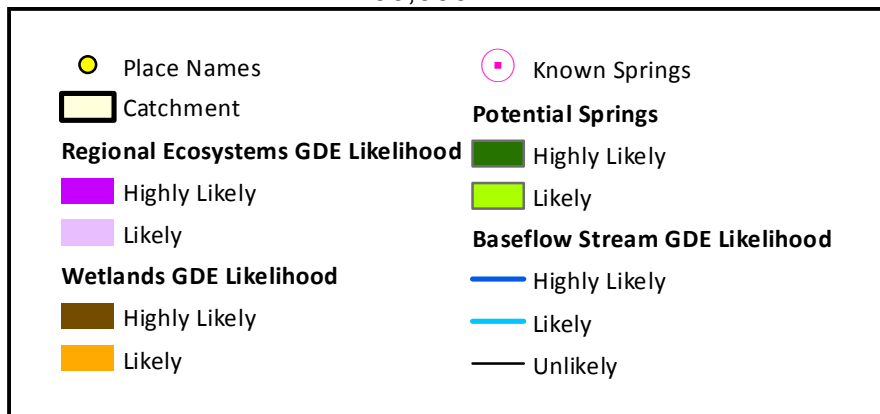
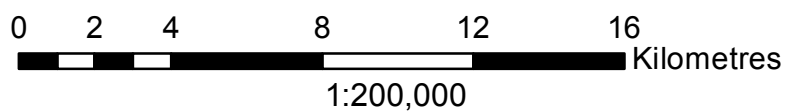


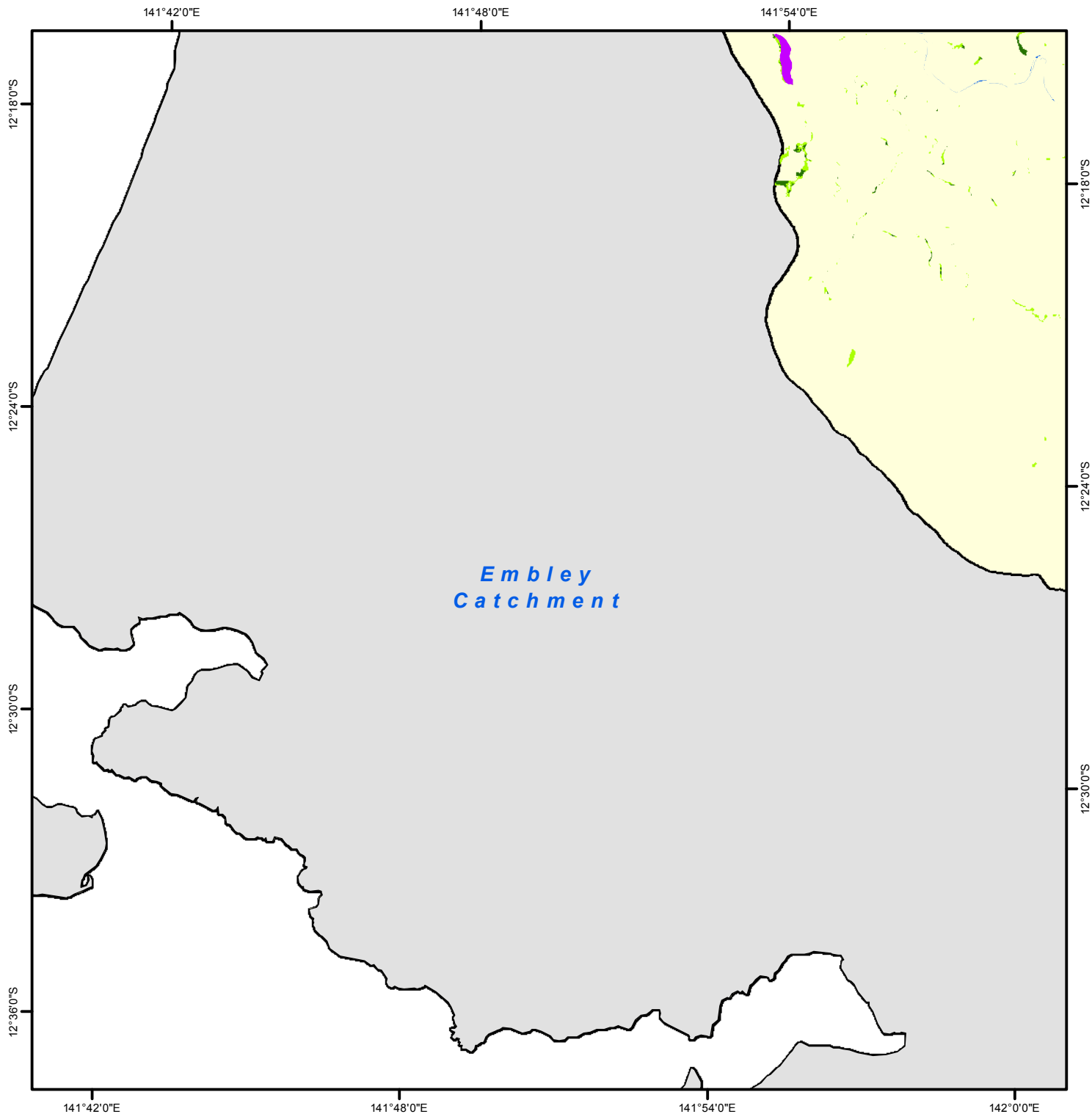
G2 Wenlock Catchment



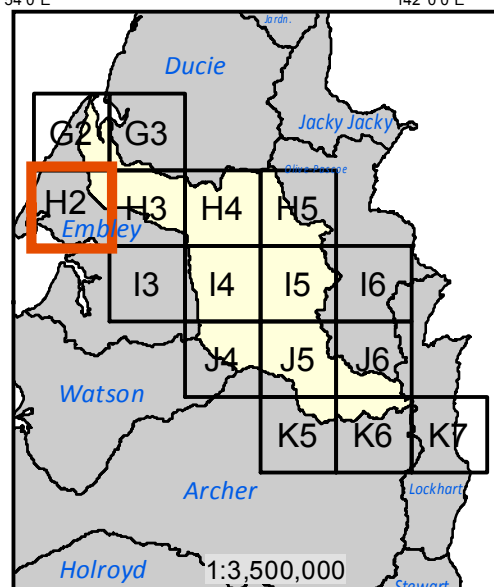
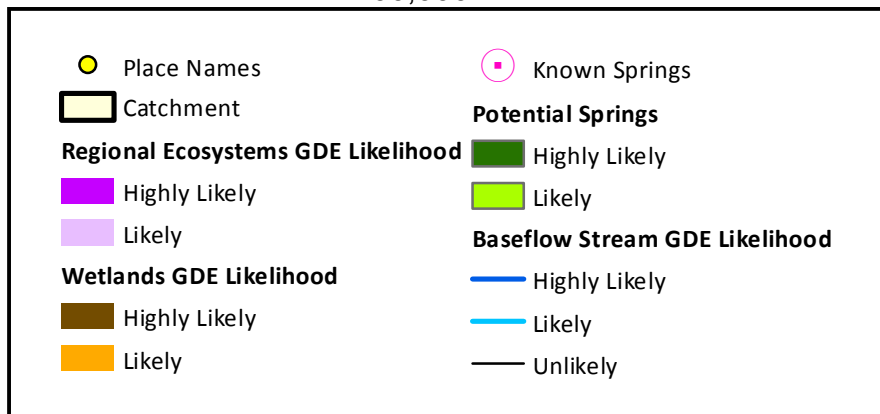
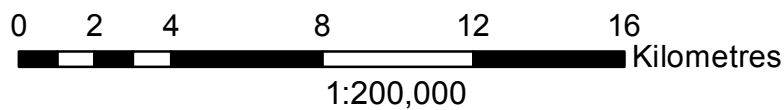


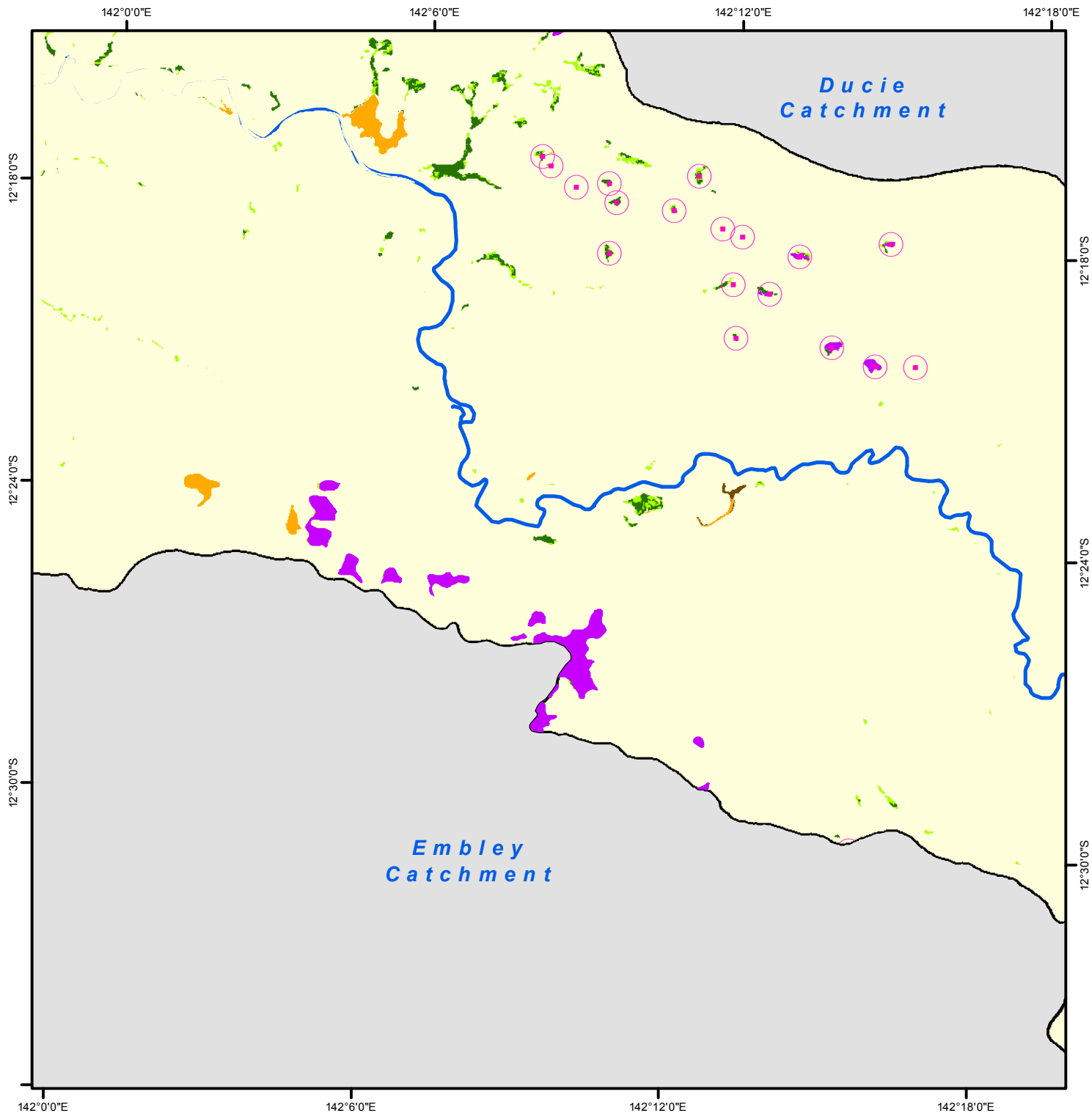
G3 Wenlock Catchment



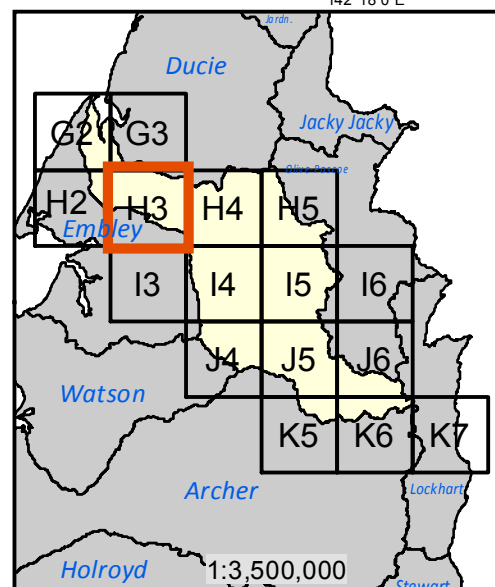
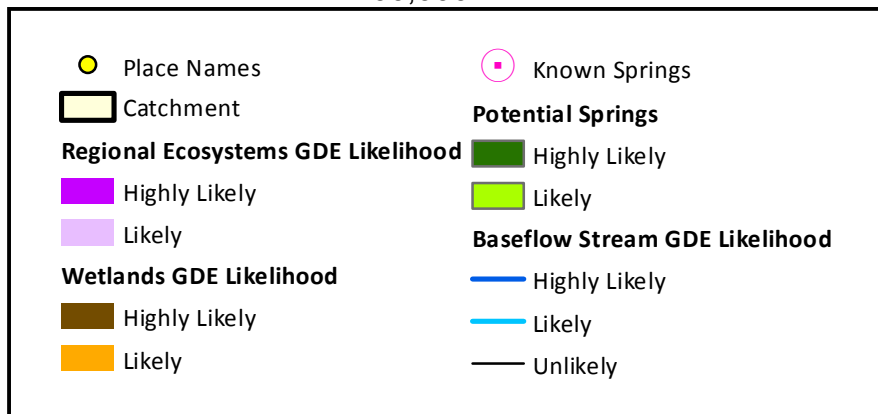
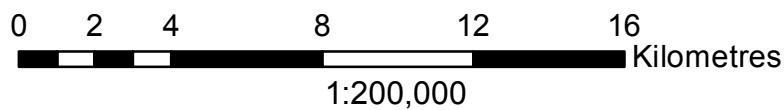


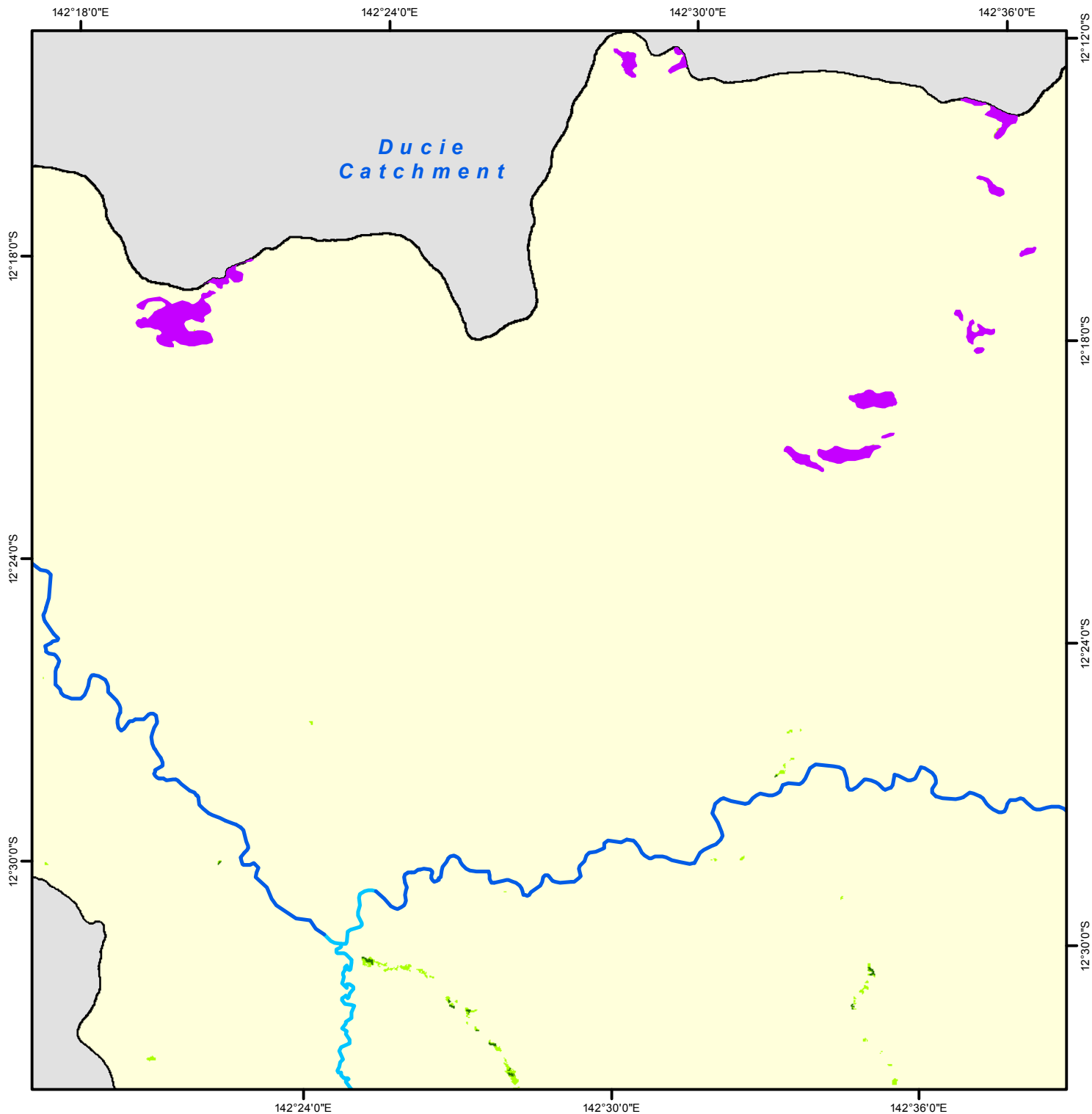
H2 Wenlock Catchment



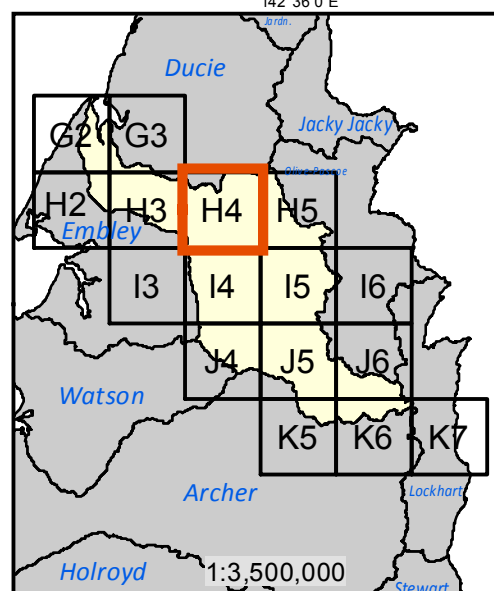
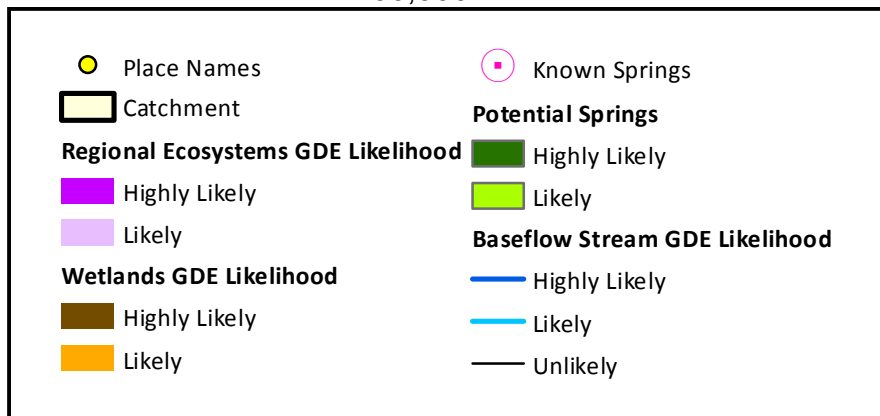
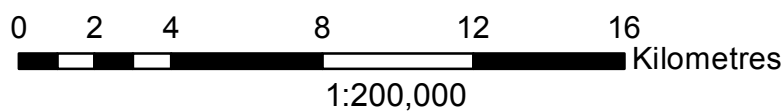


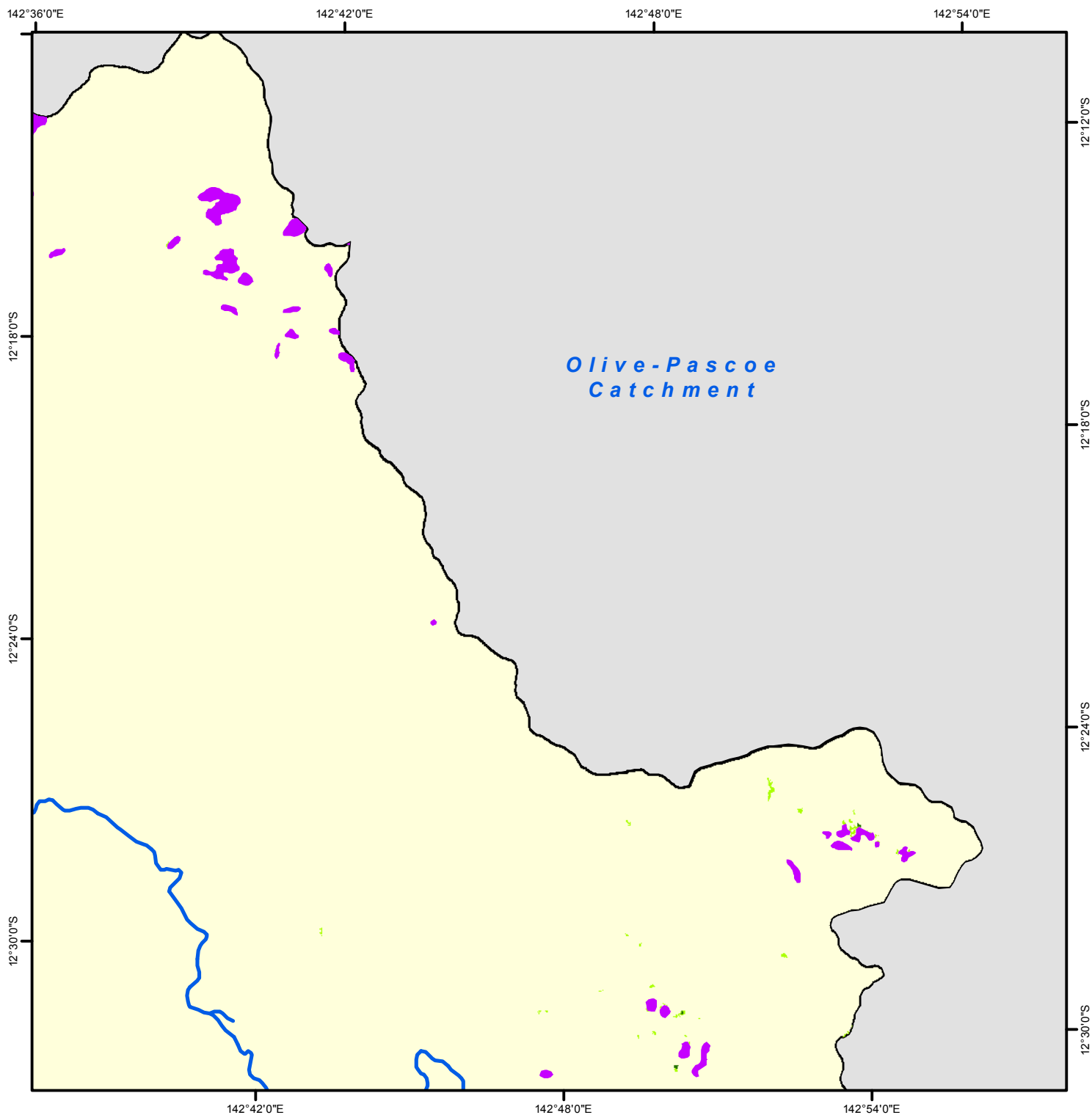
H3 Wenlock Catchment



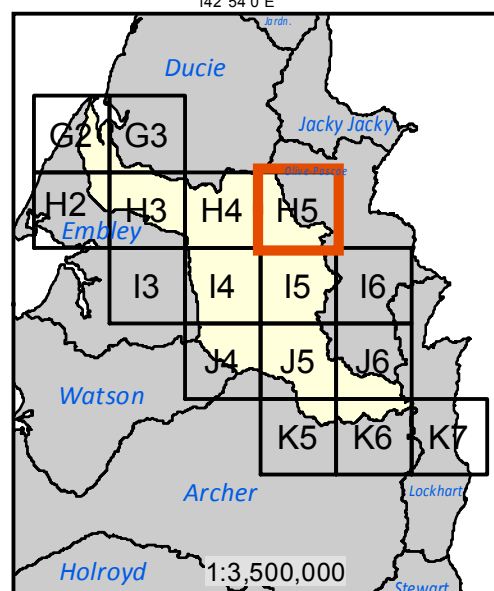
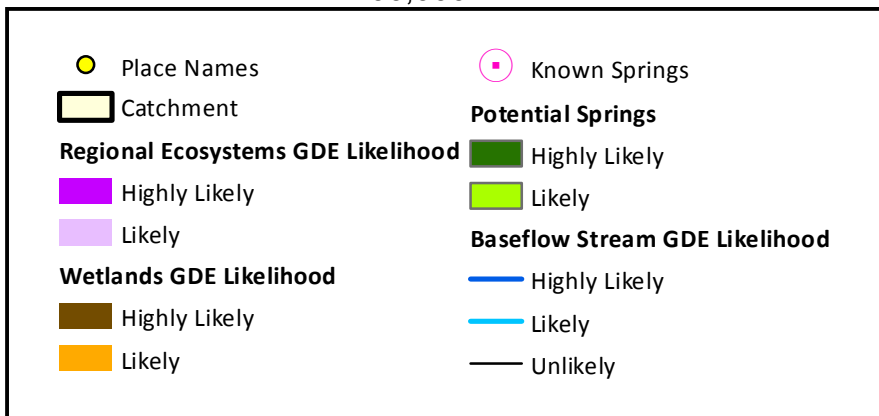
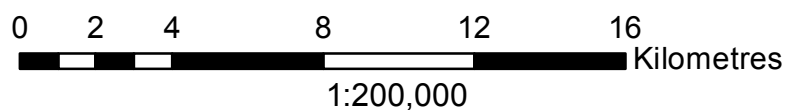


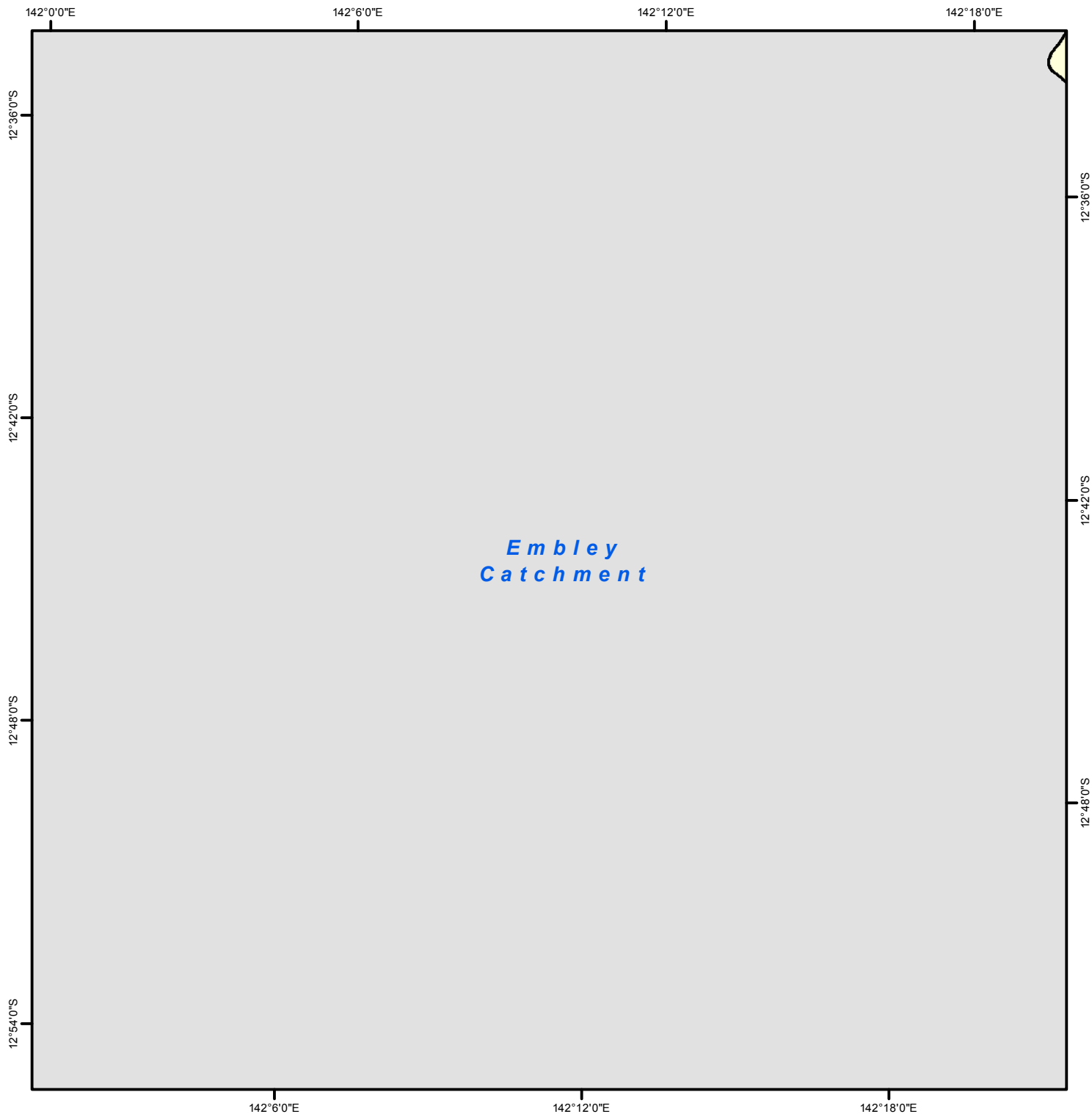
H4 Wenlock Catchment



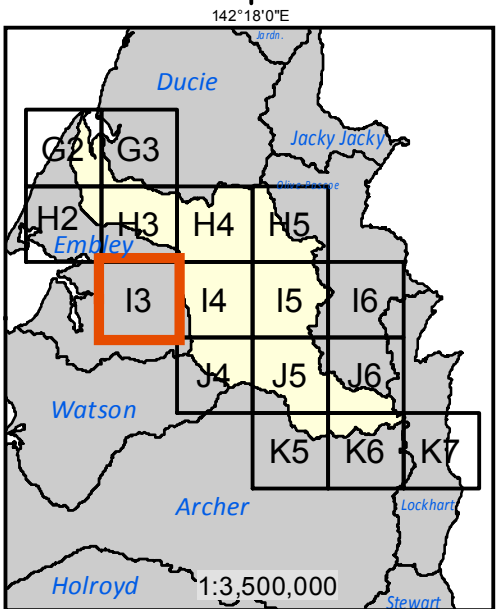
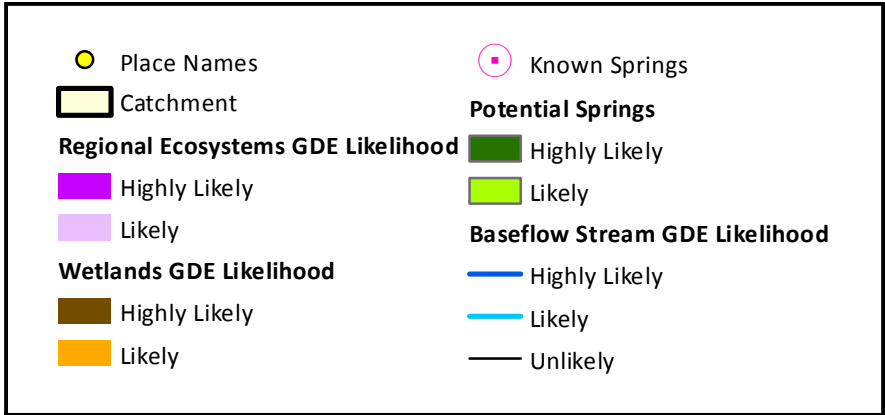
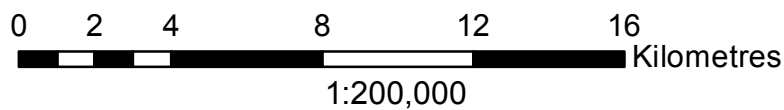


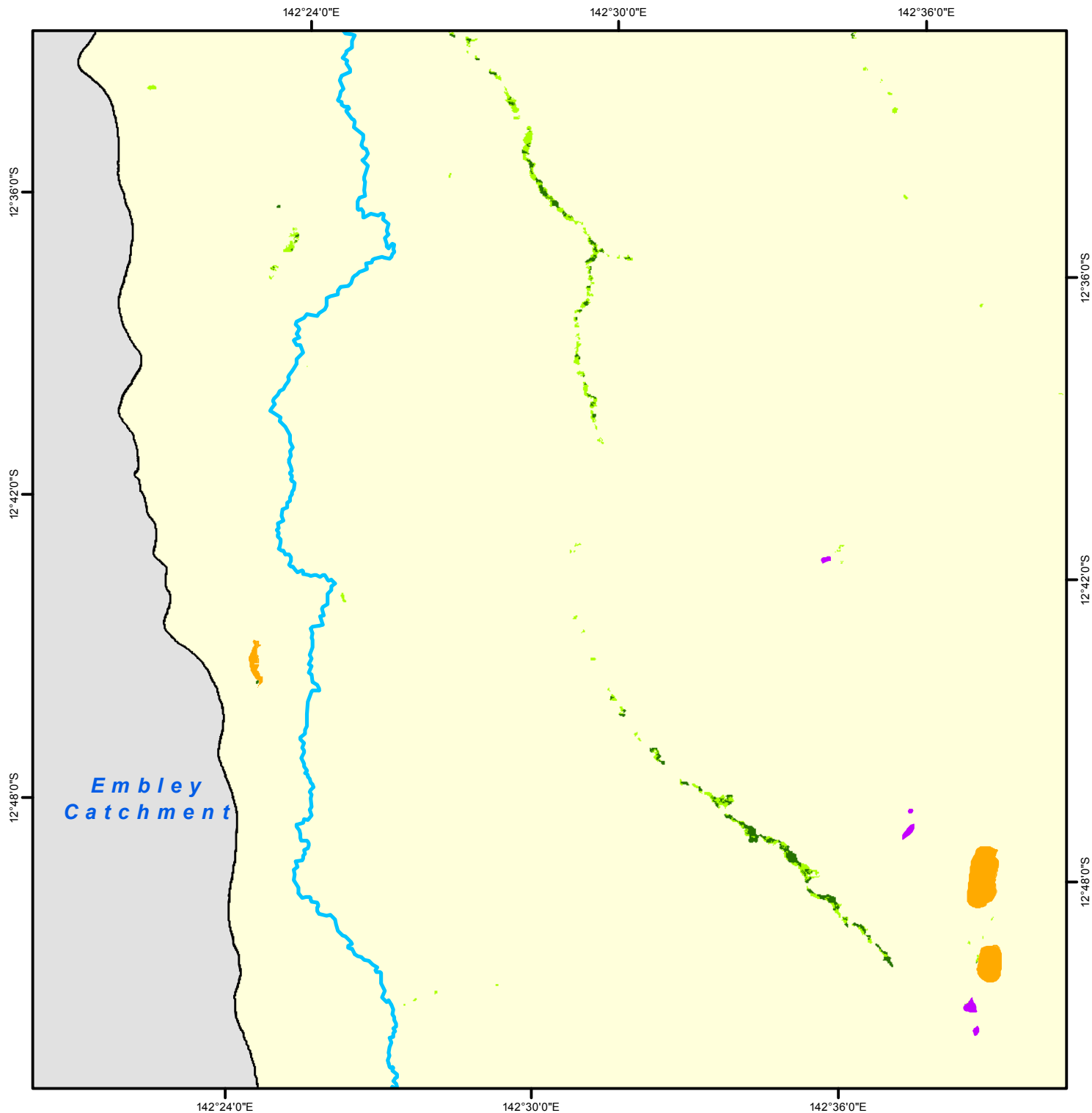
H5 Wenlock Catchment



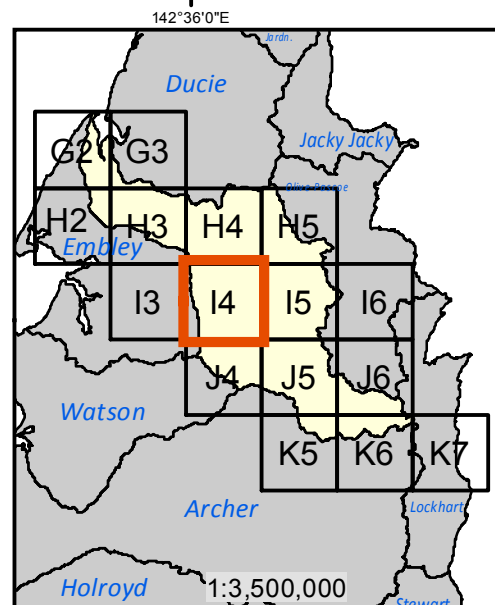
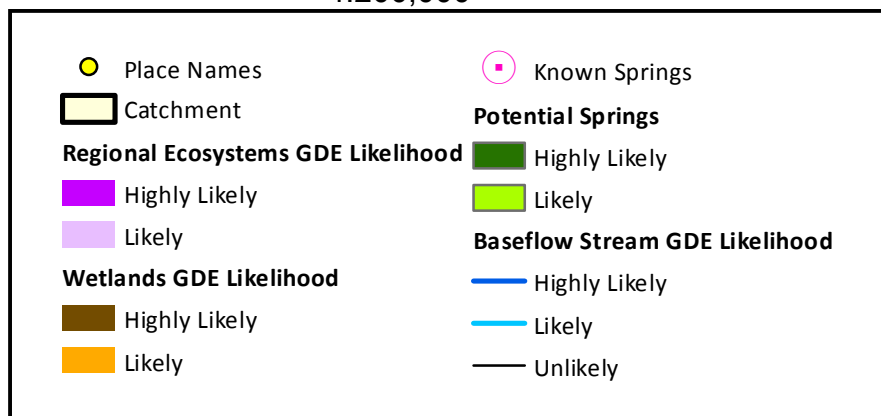
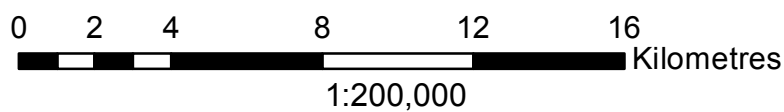


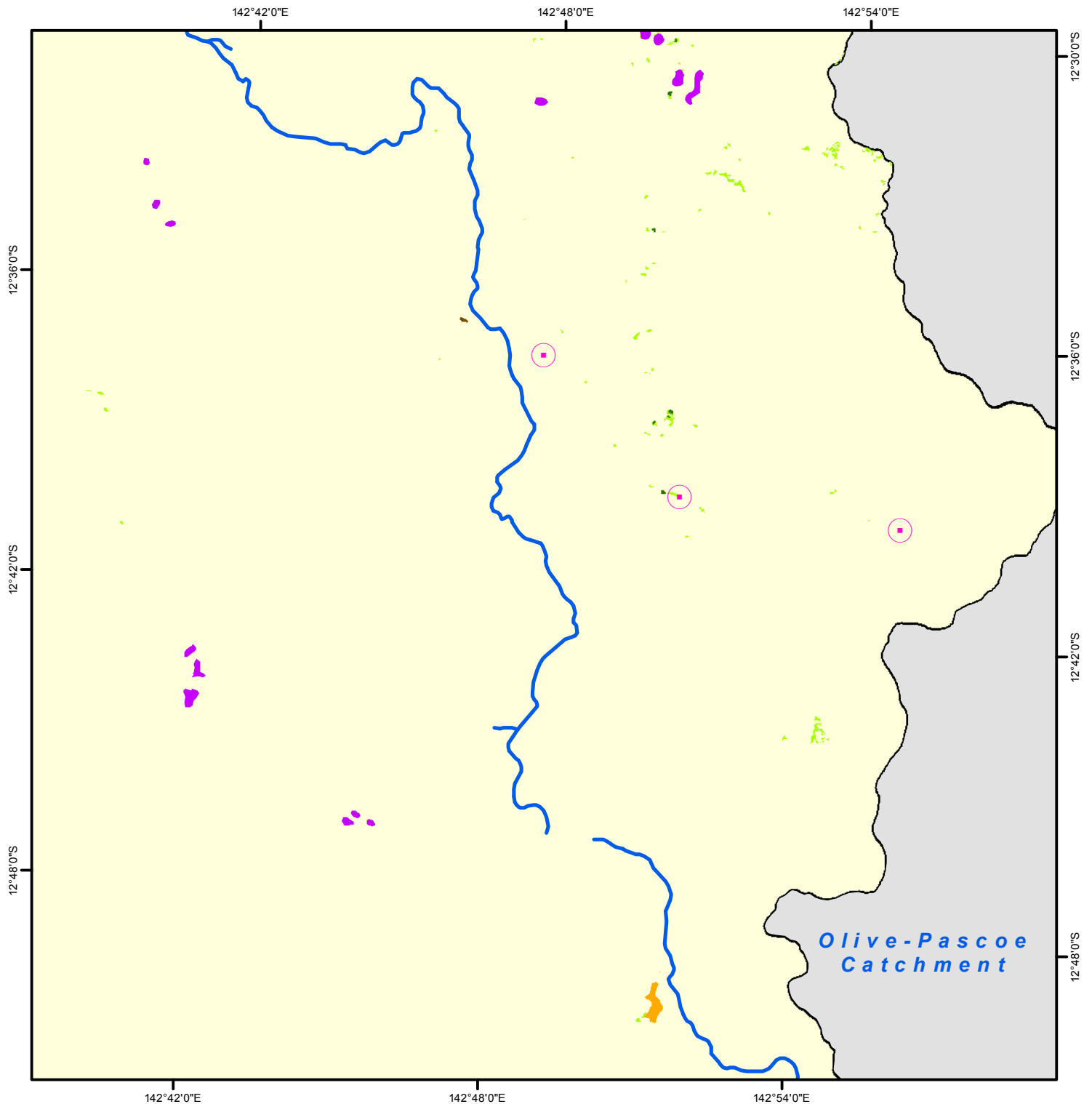
I3 Wenlock Catchment



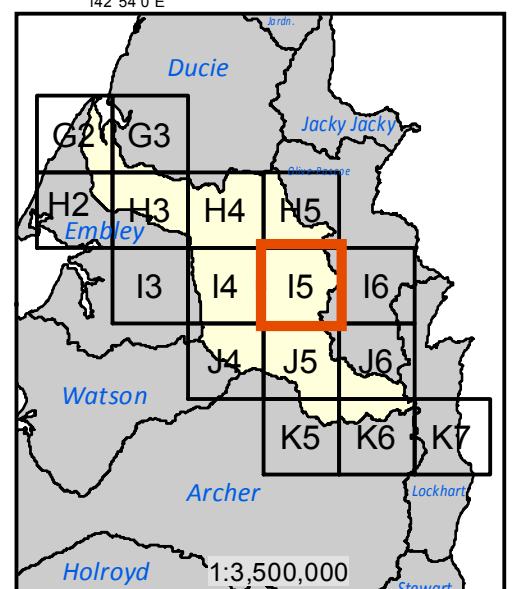
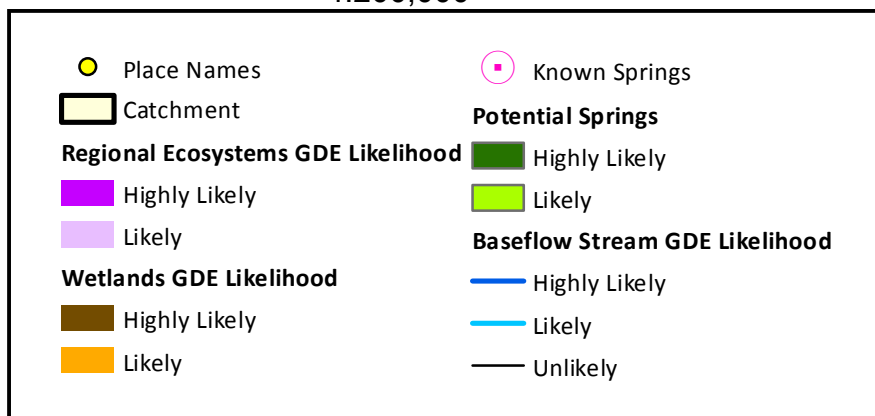
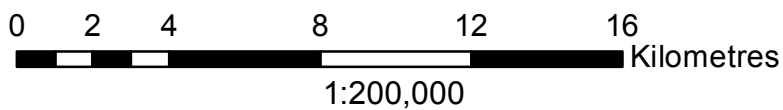


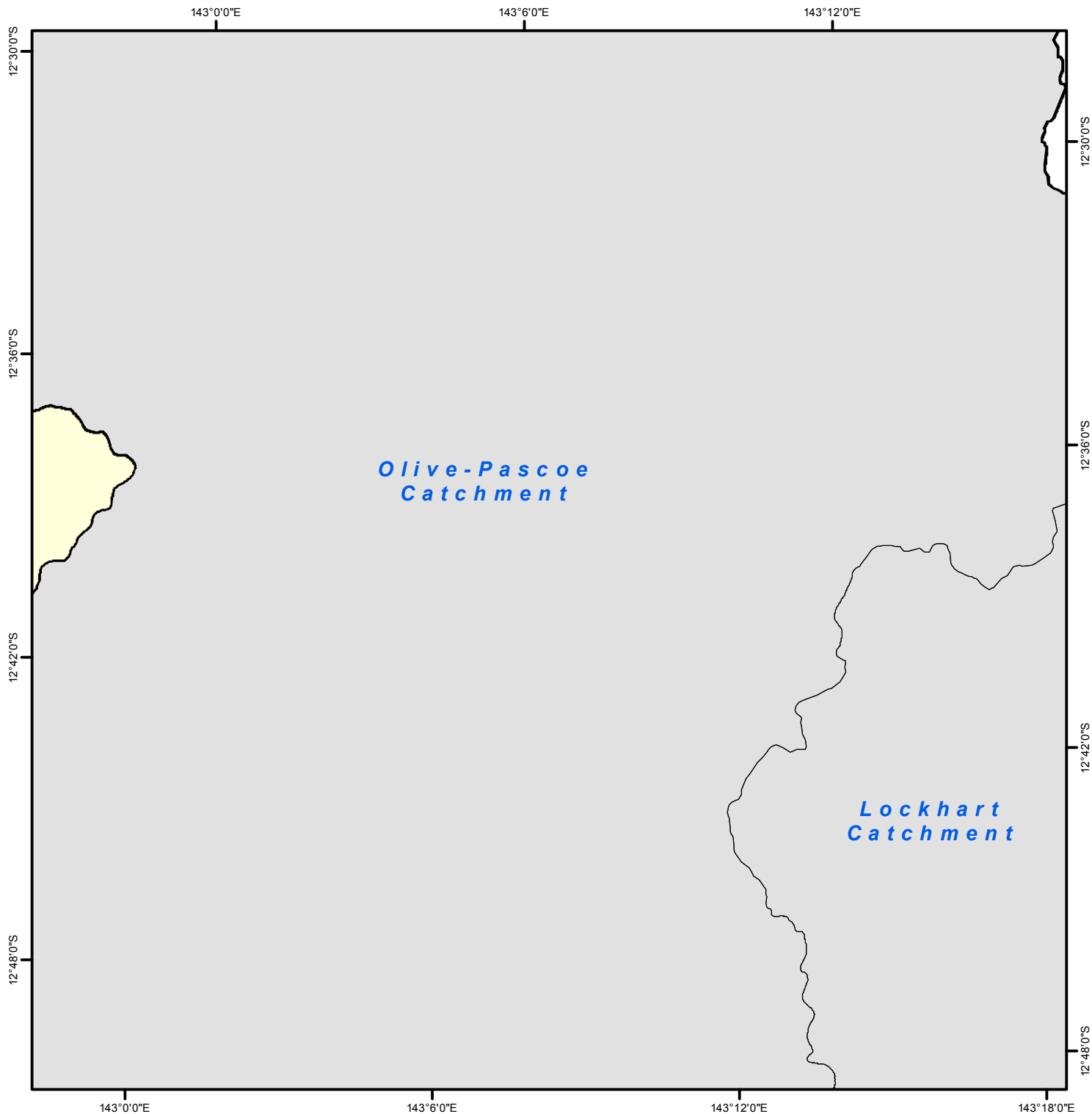
I4 Wenlock Catchment



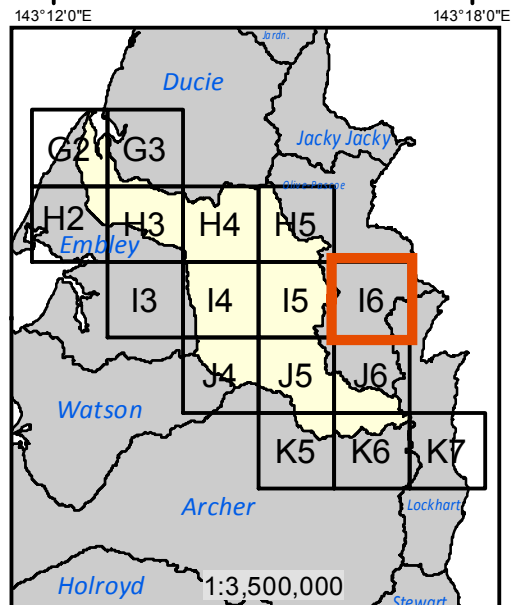
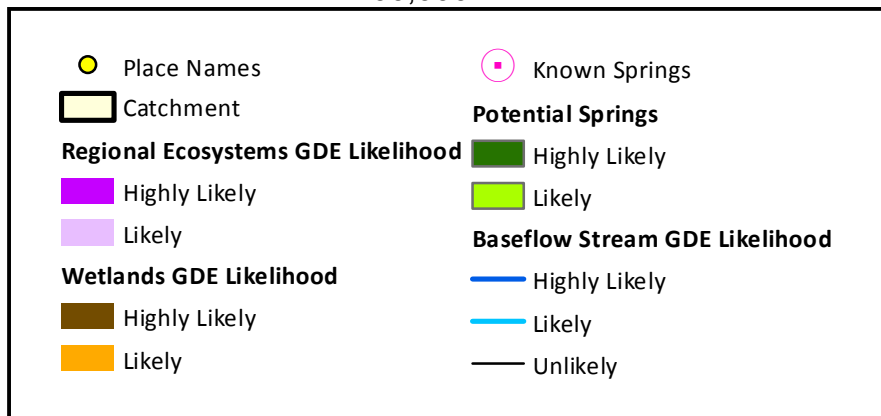
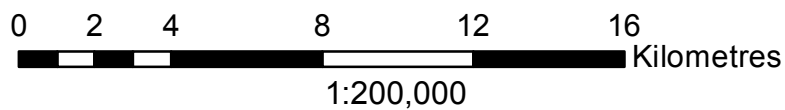


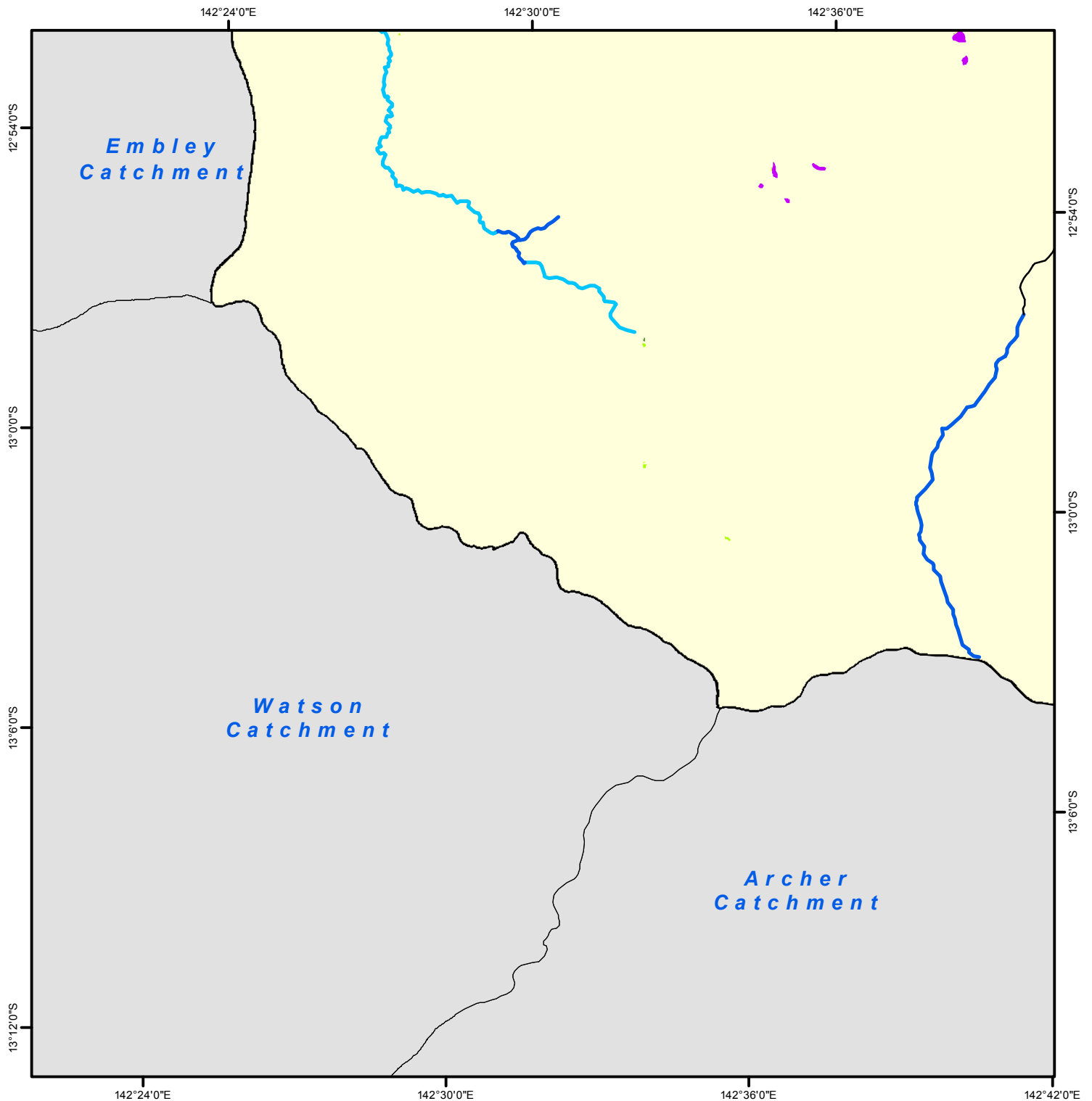
I5 Wenlock Catchment



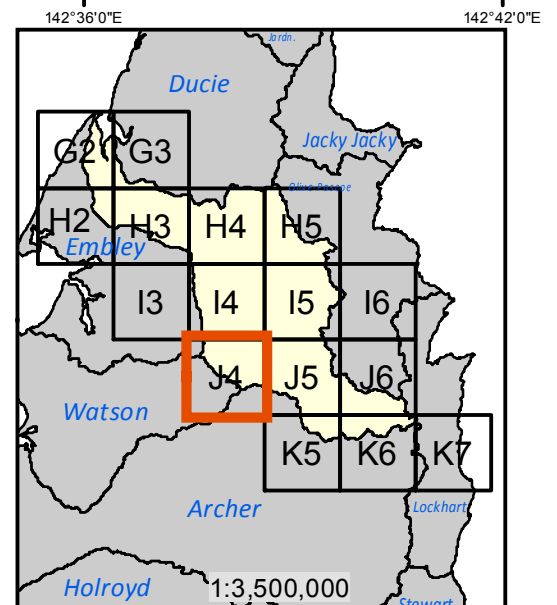
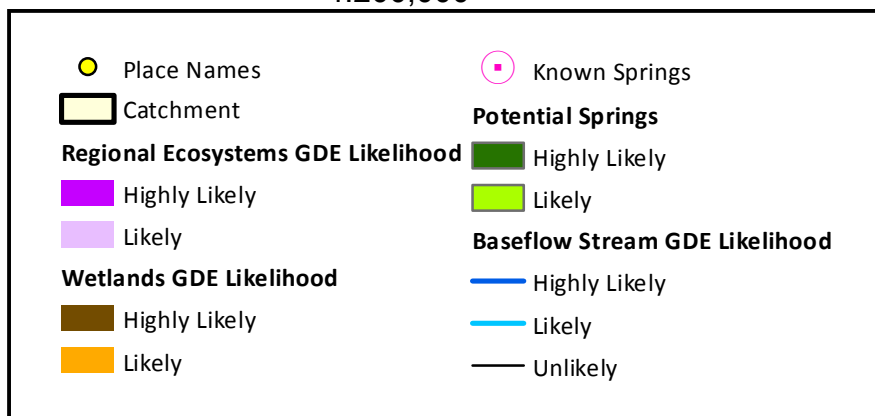
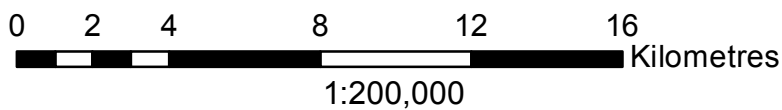


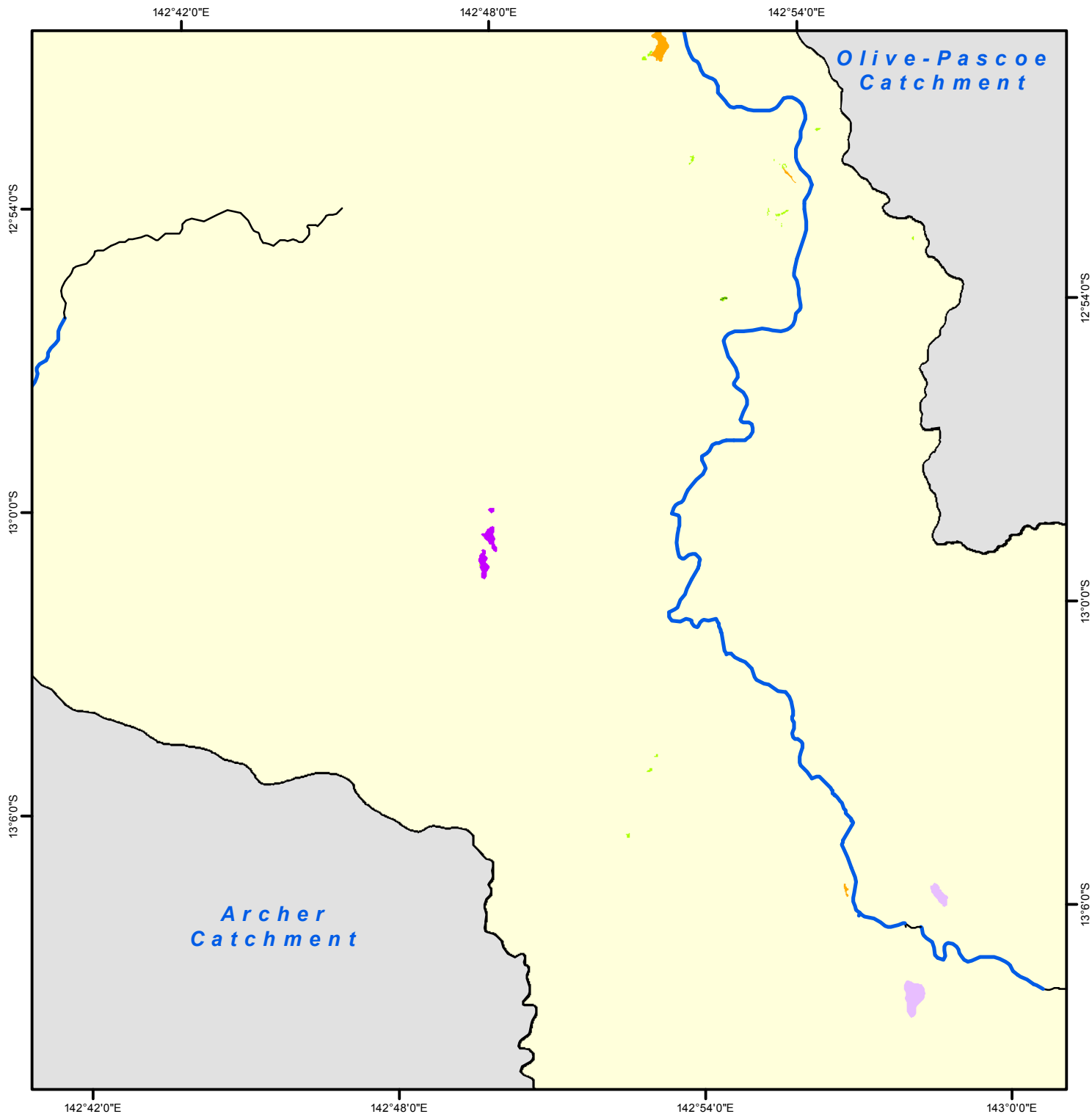
I6 Wenlock Catchment



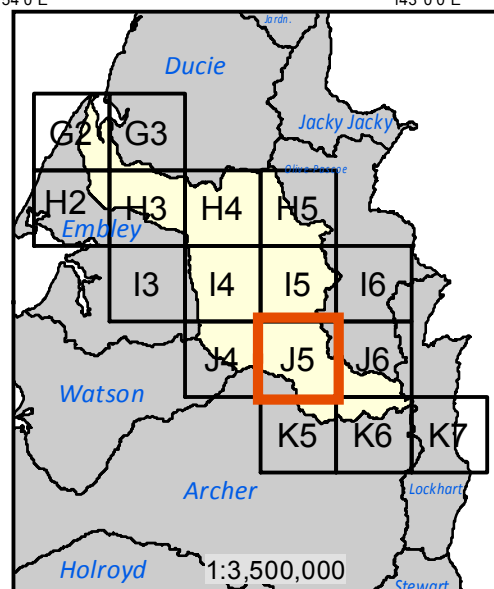
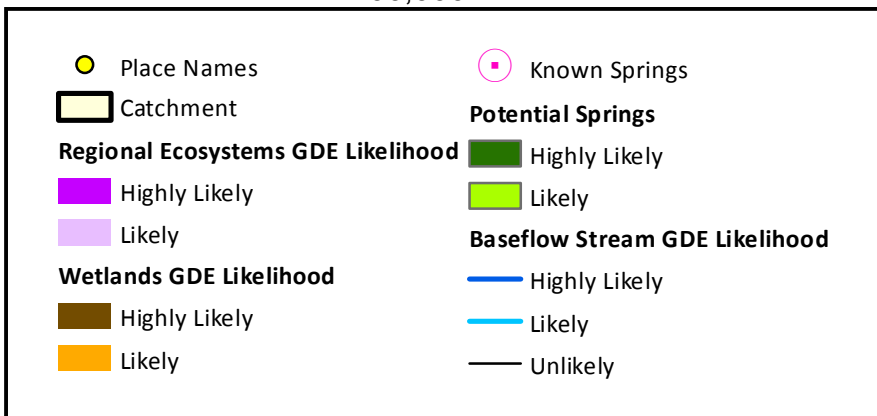
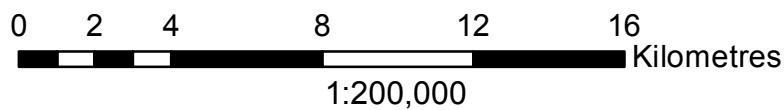


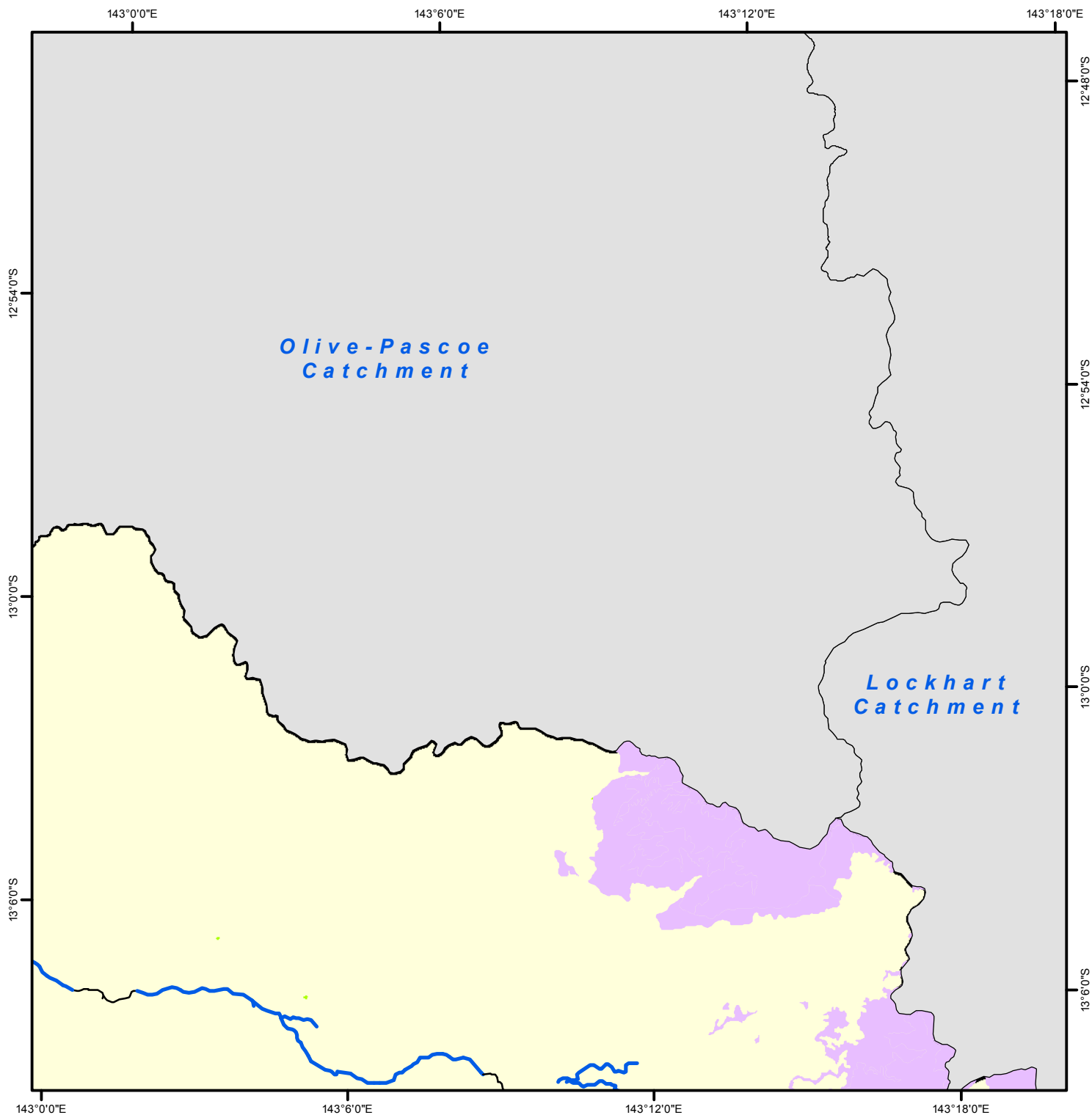
J4 Wenlock Catchment



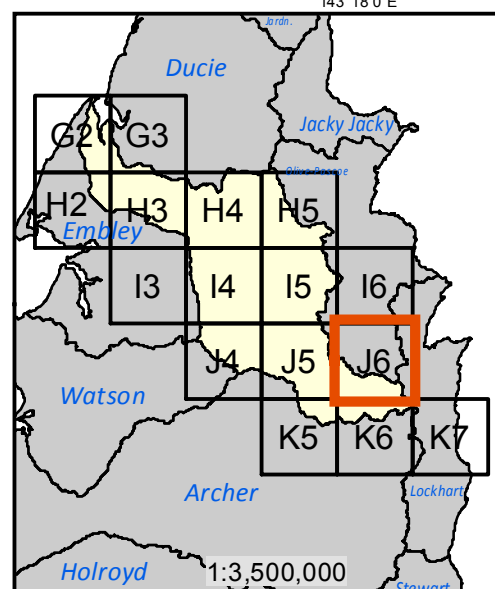
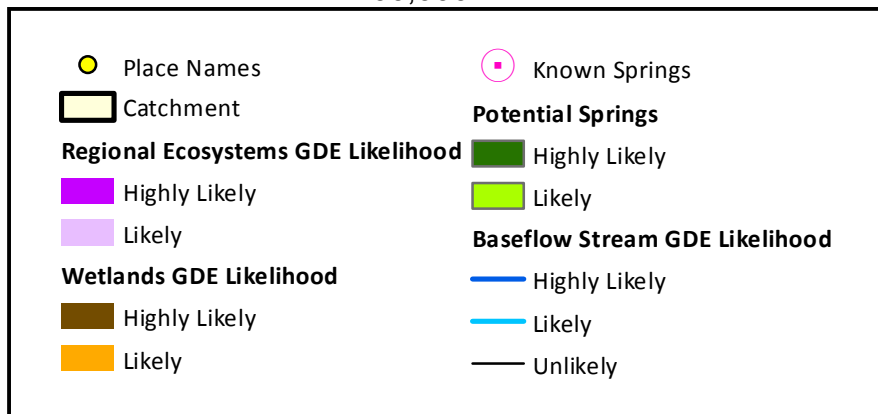
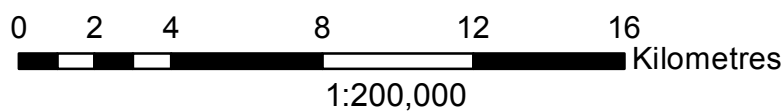


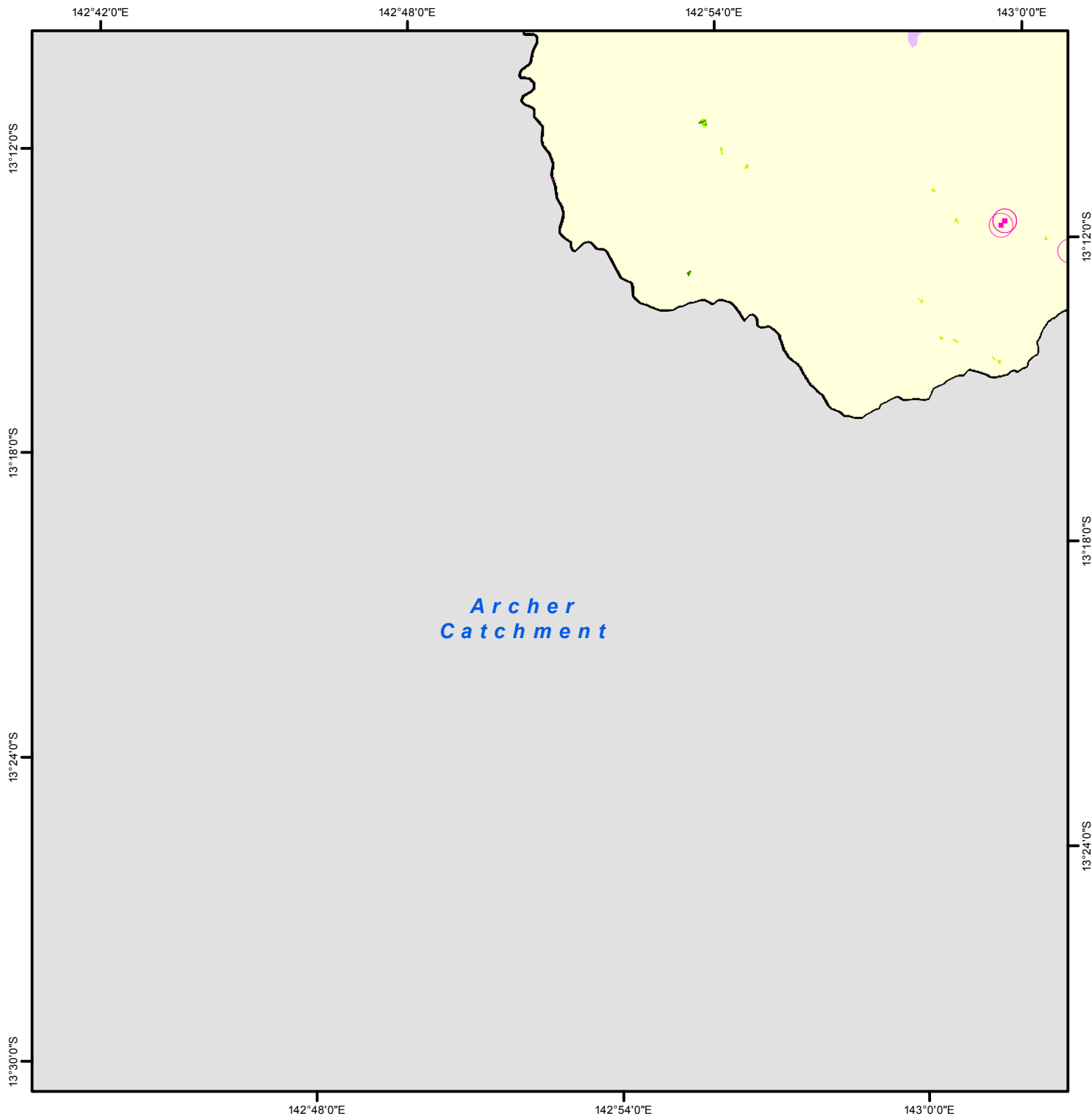
J5 Wenlock Catchment



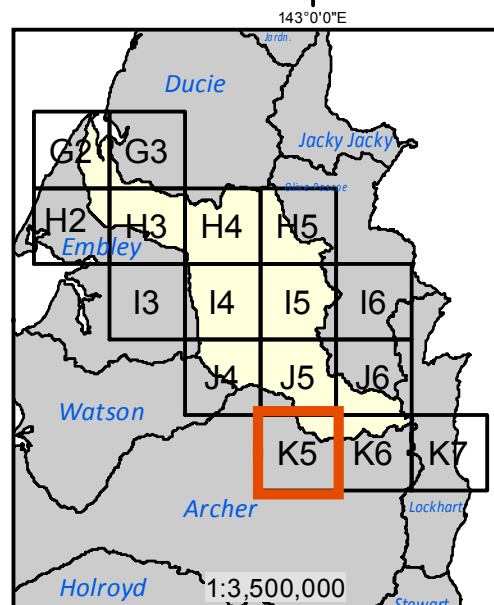
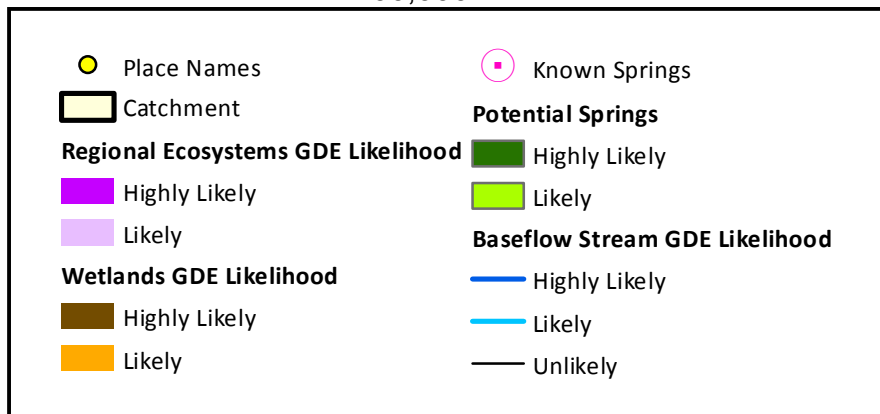
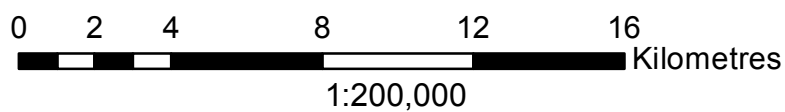


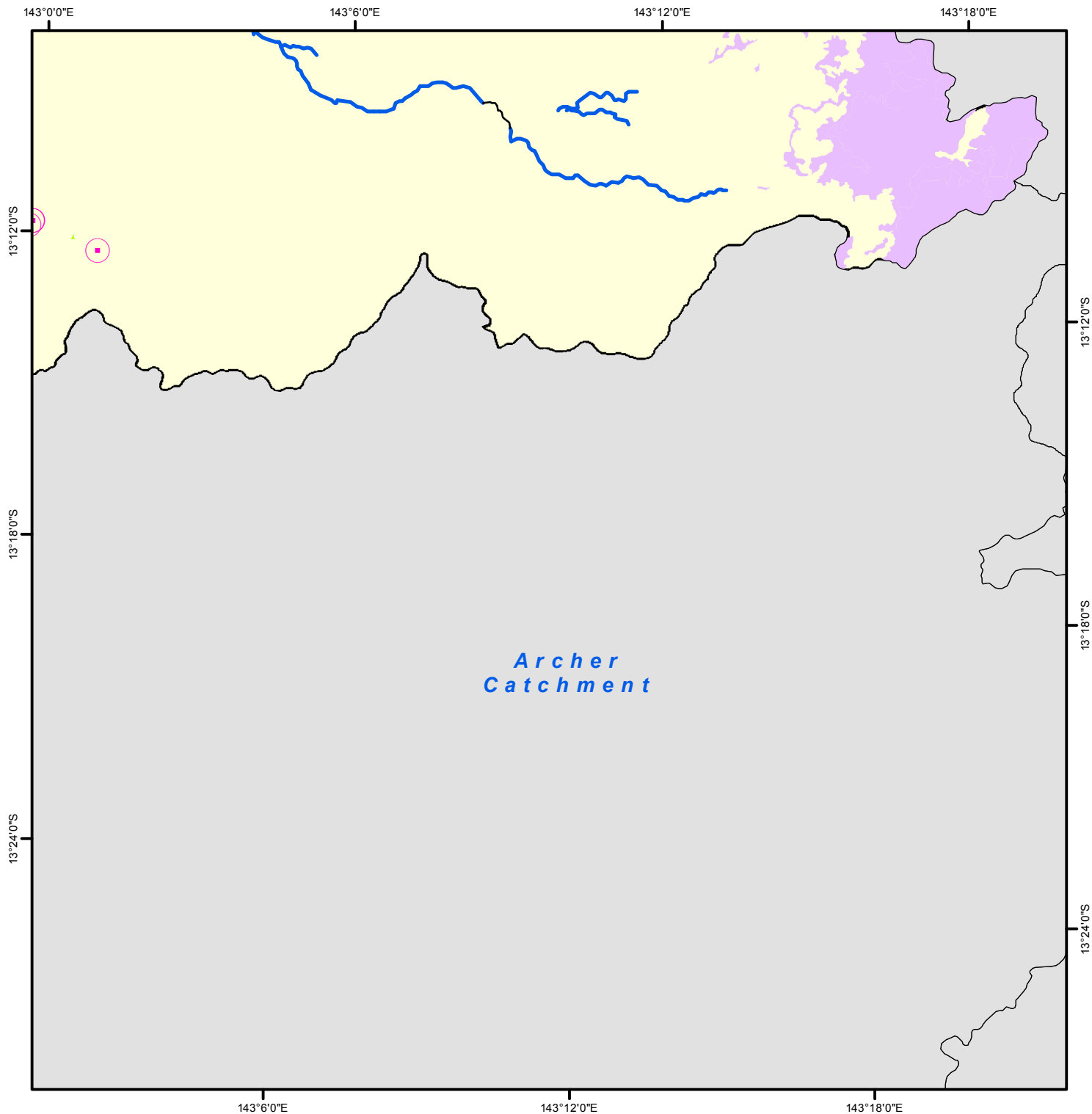
J6 Wenlock Catchment



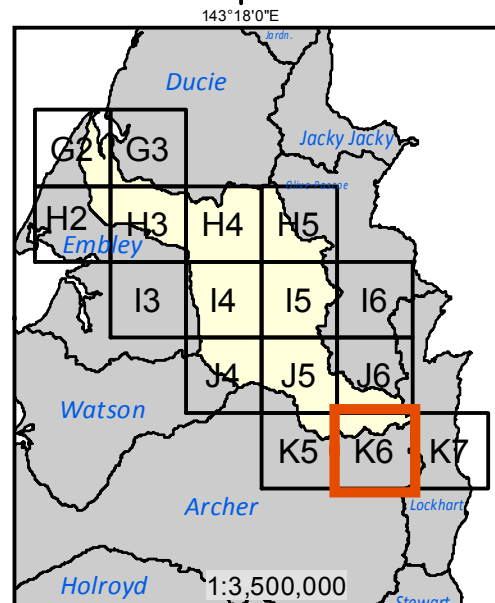
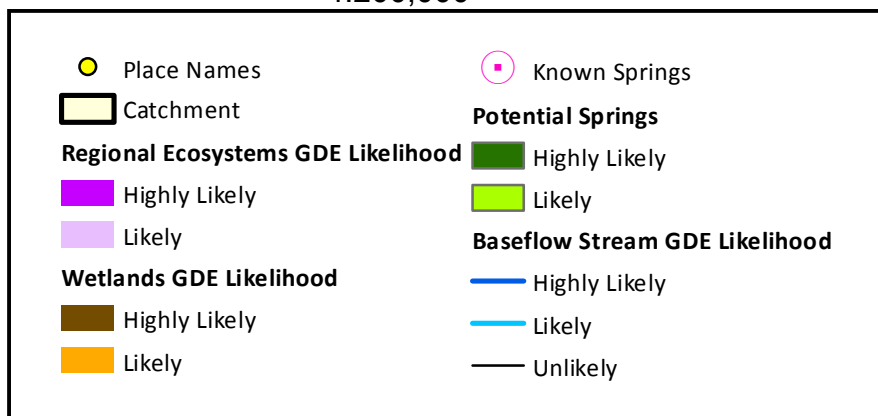
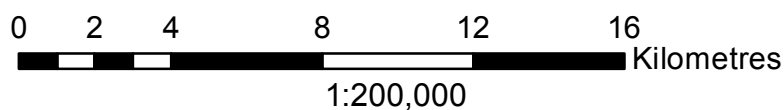


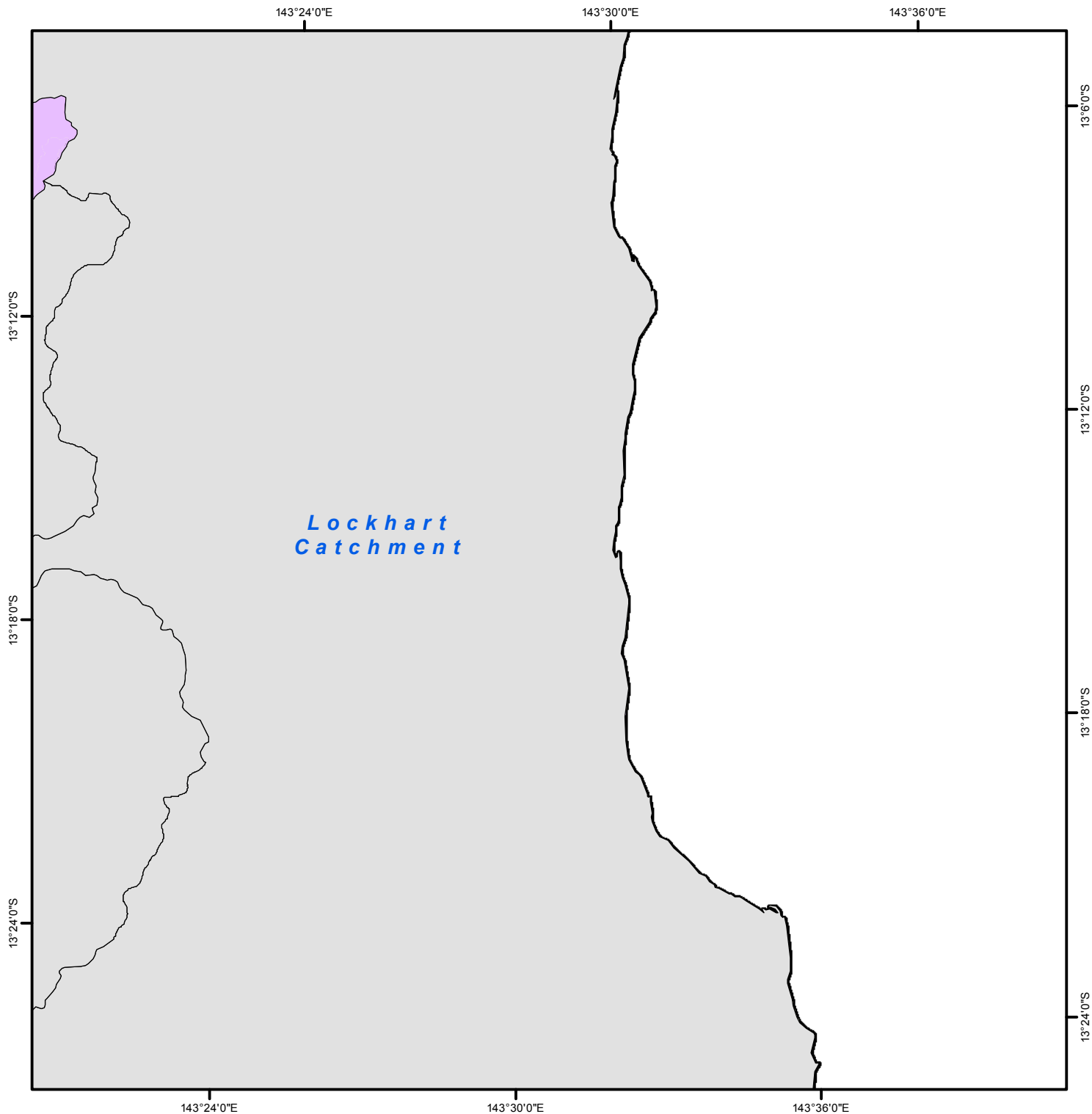
K5 Wenlock Catchment



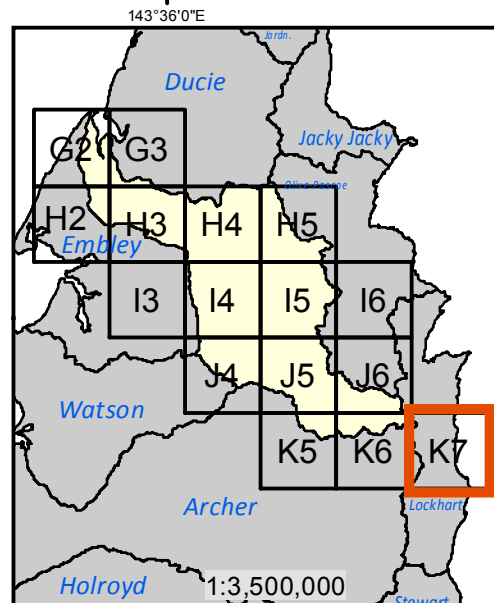
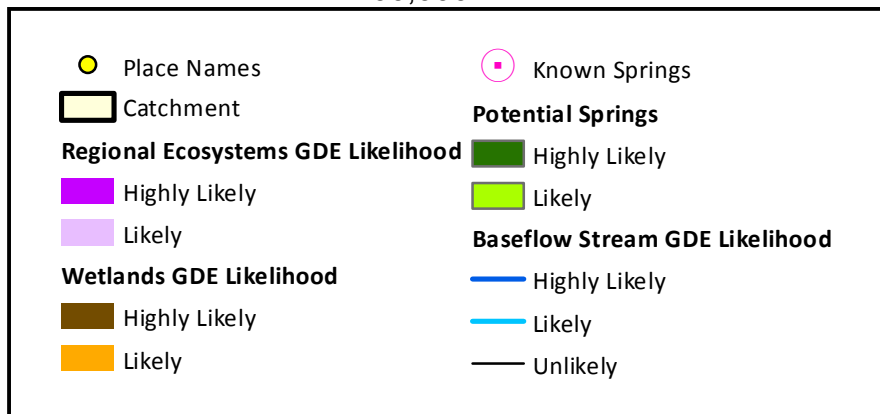
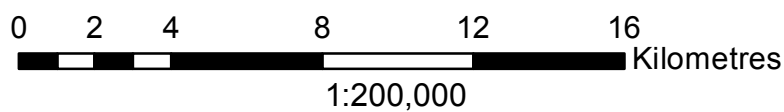


K6 Wenlock Catchment



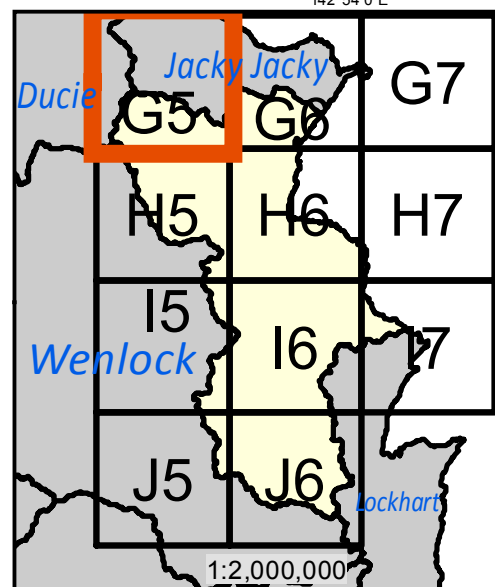
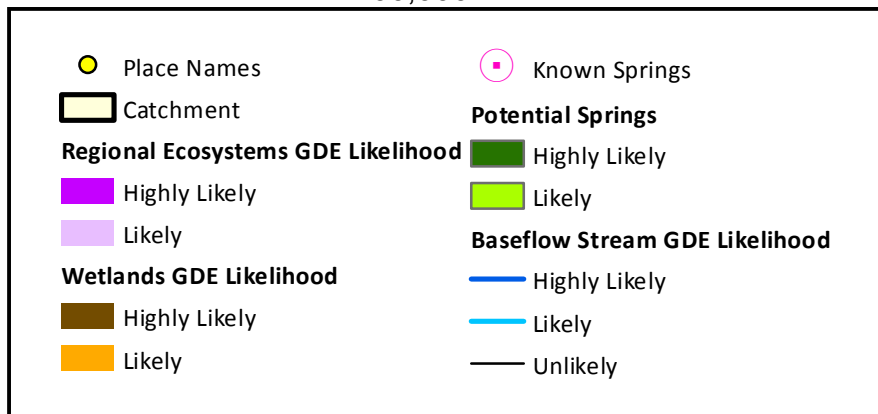
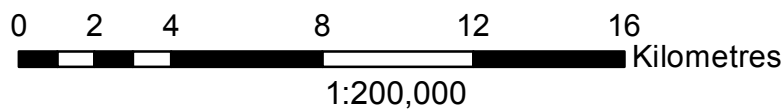


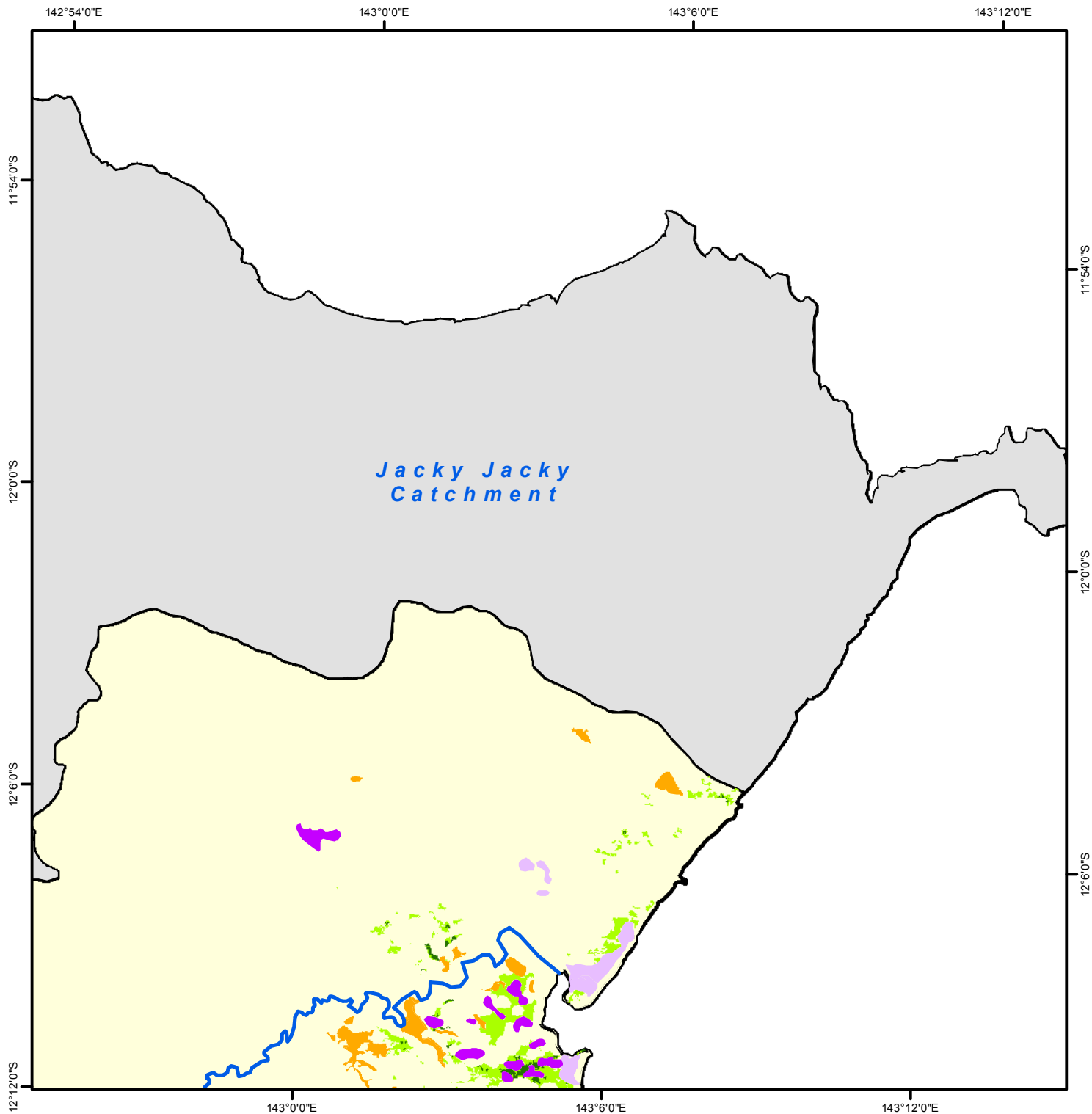
K7 Wenlock Catchment



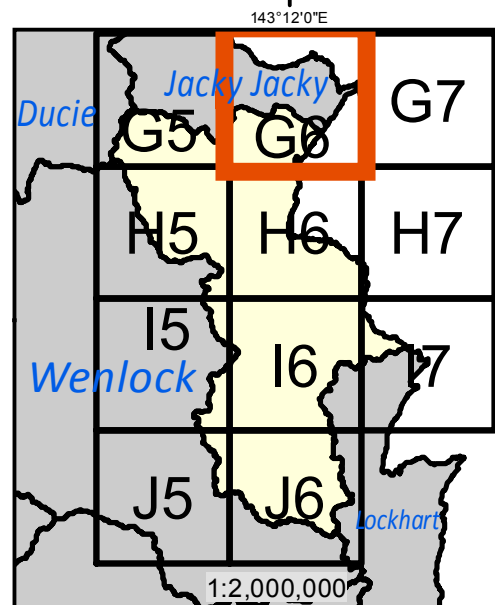
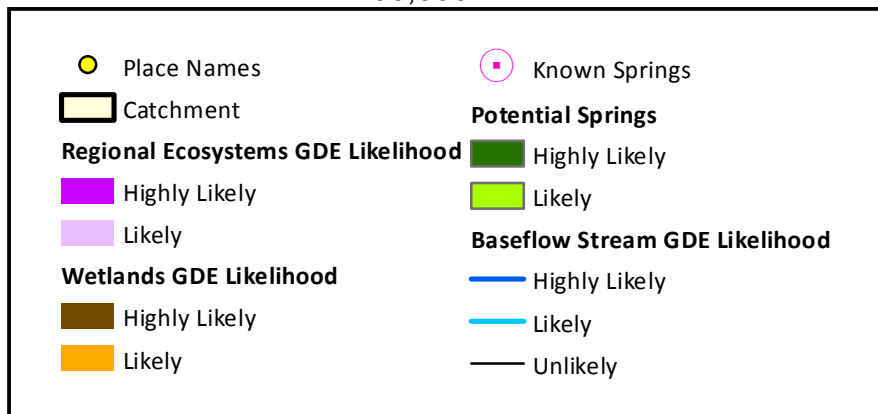
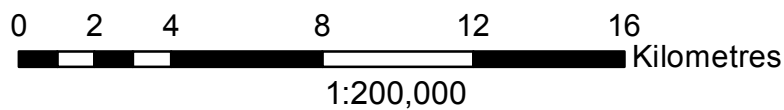


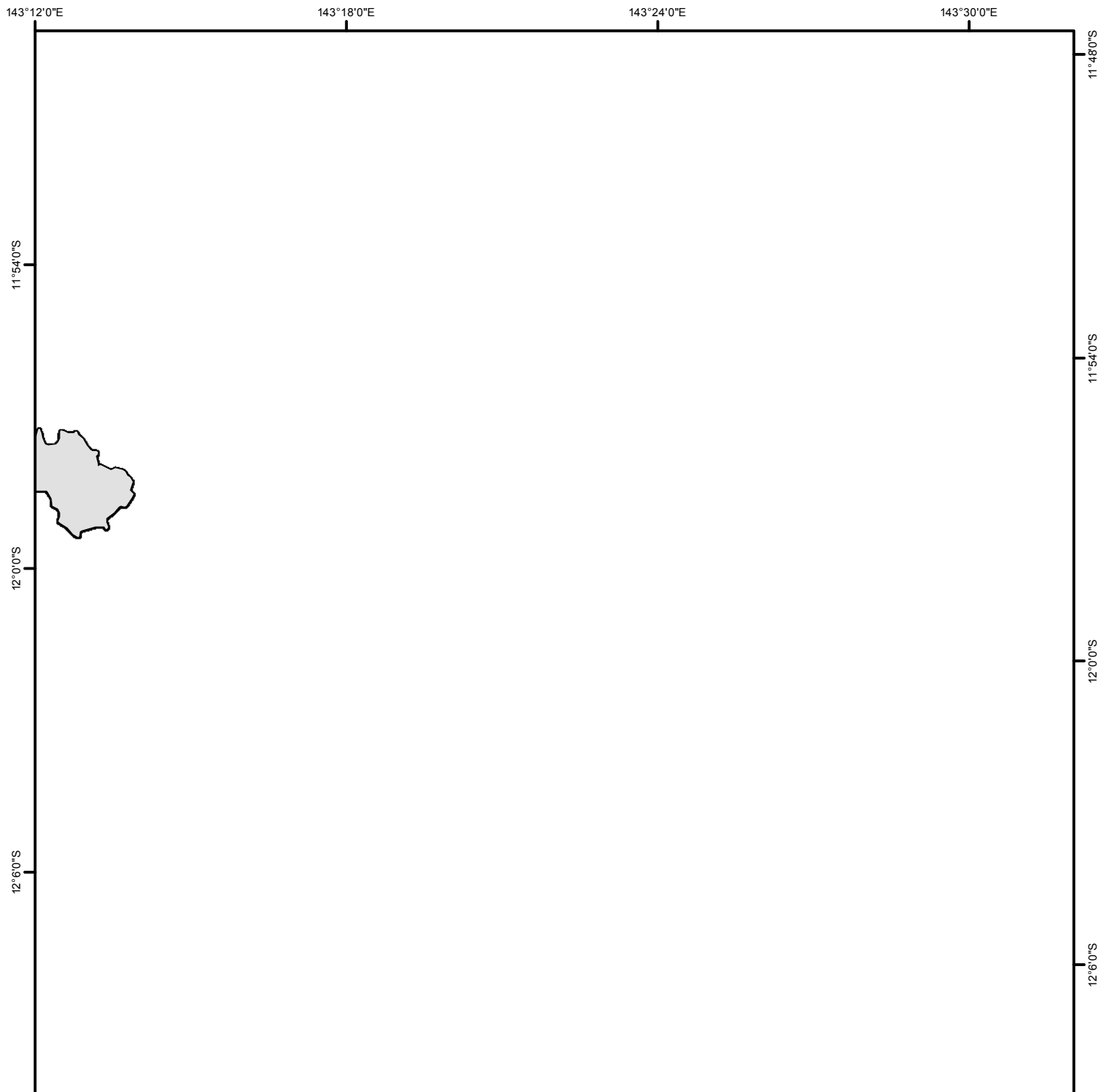
G5 Olive Pascoe Catchment



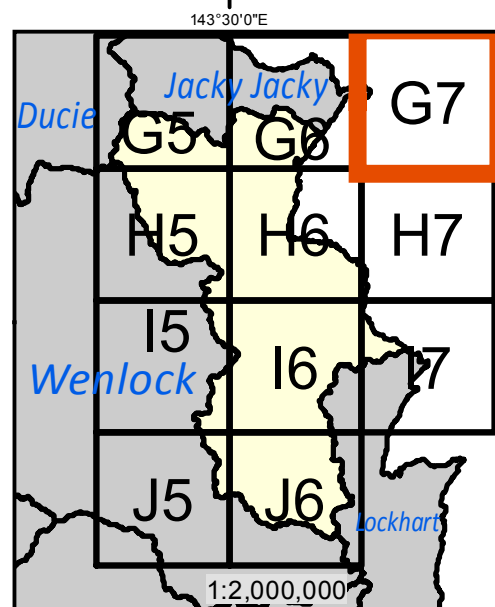
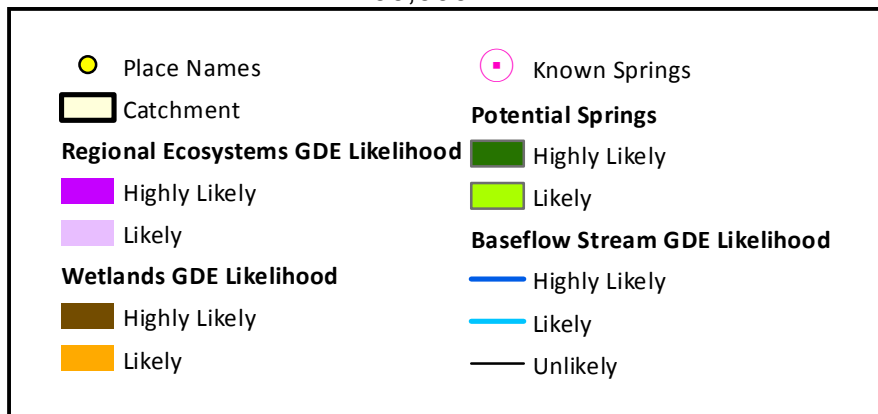
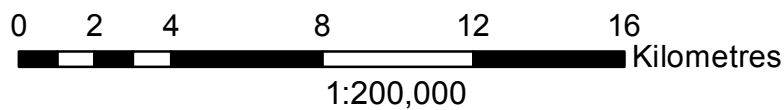


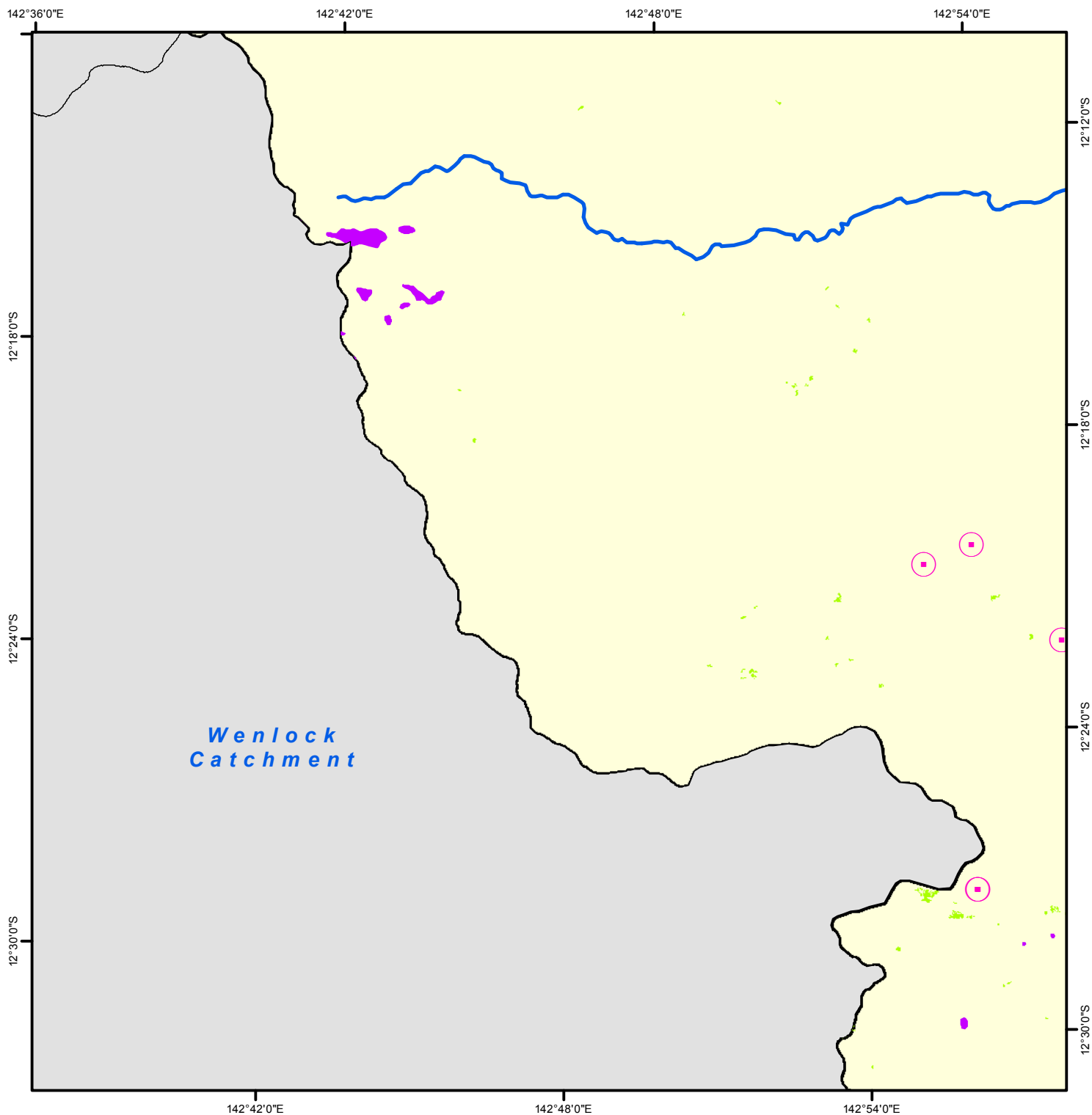
G6 Olive Pascoe Catchment



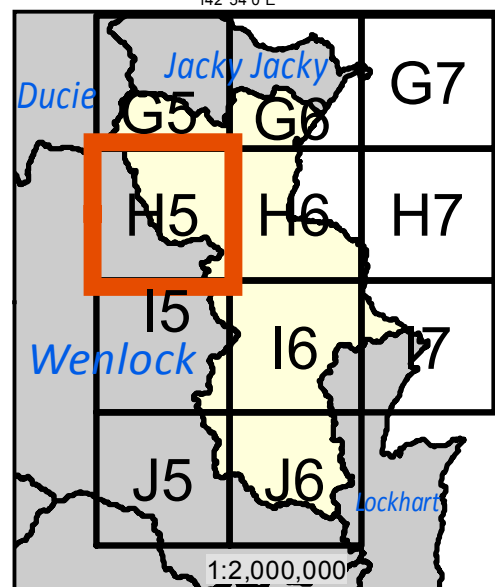
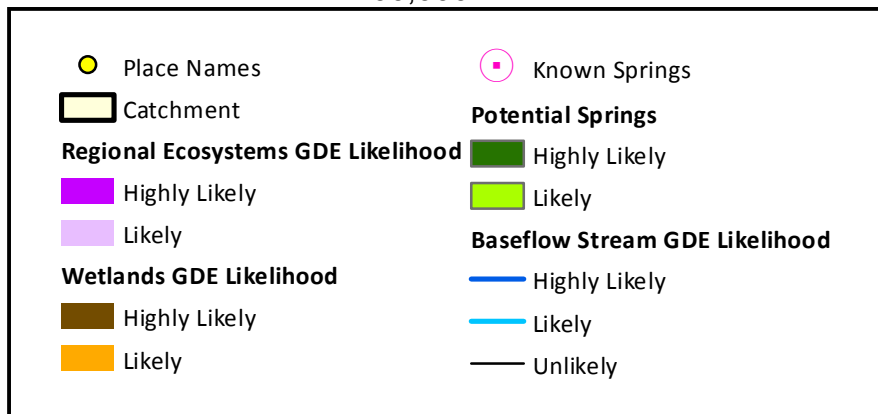
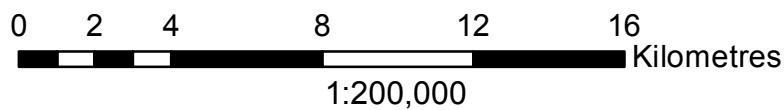


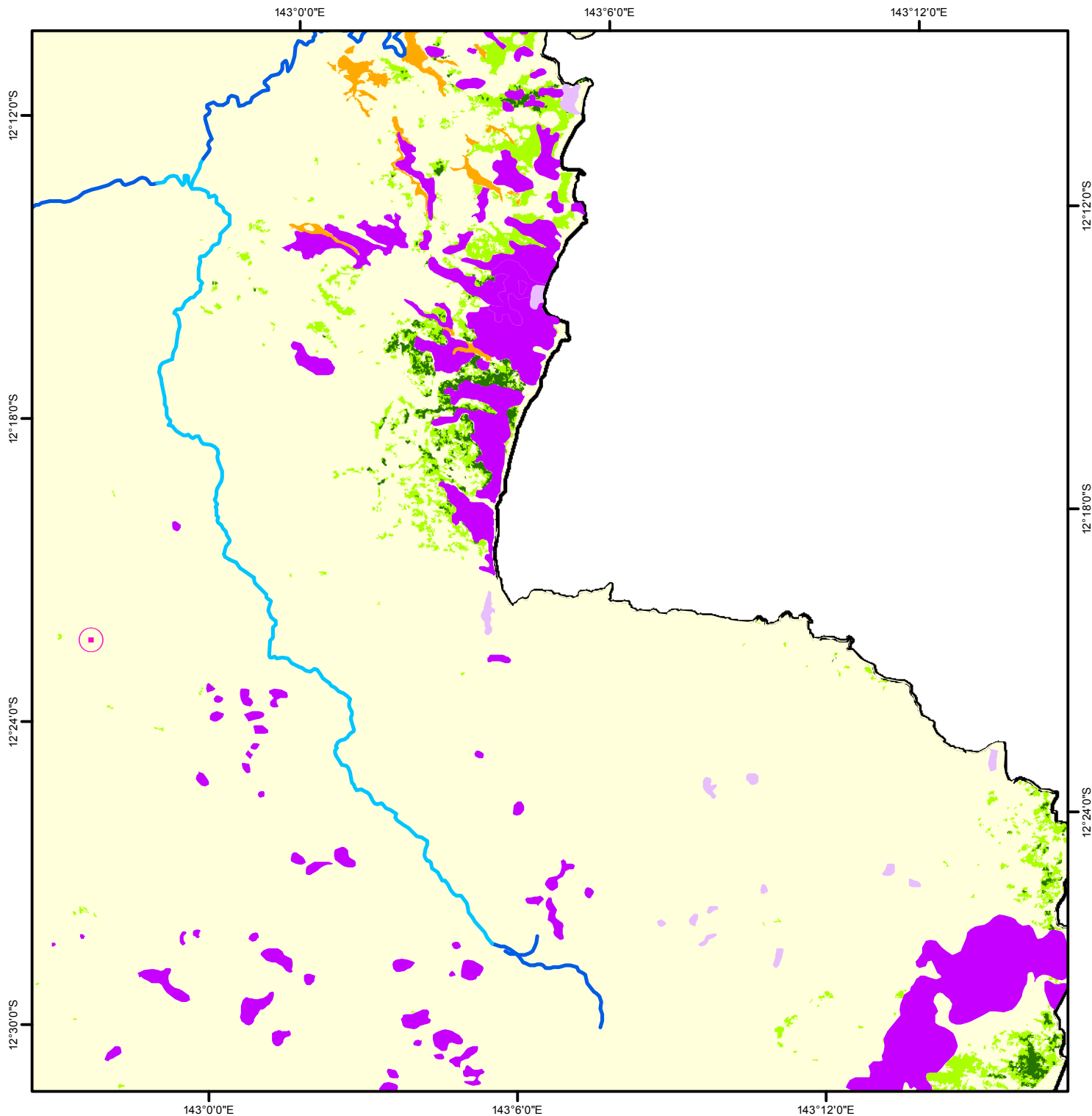
G7 Olive Pascoe Catchment



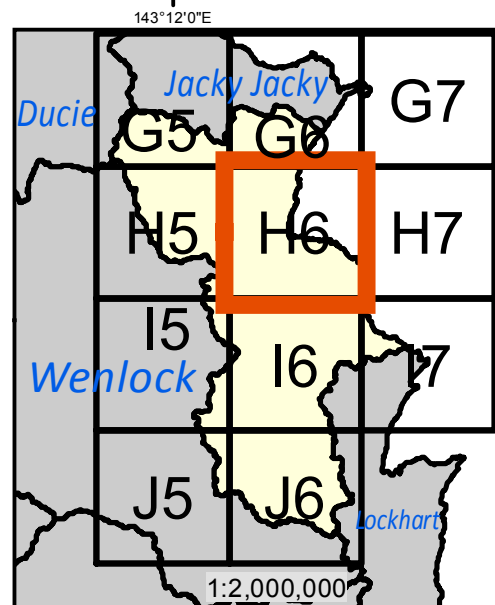
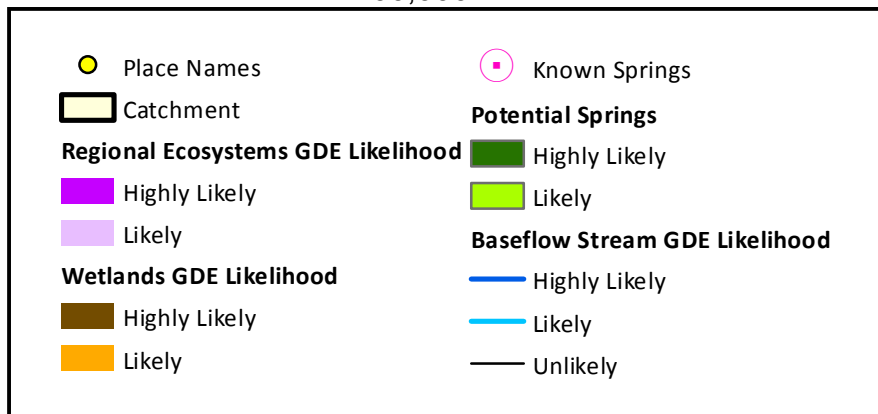
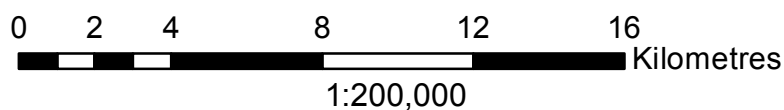


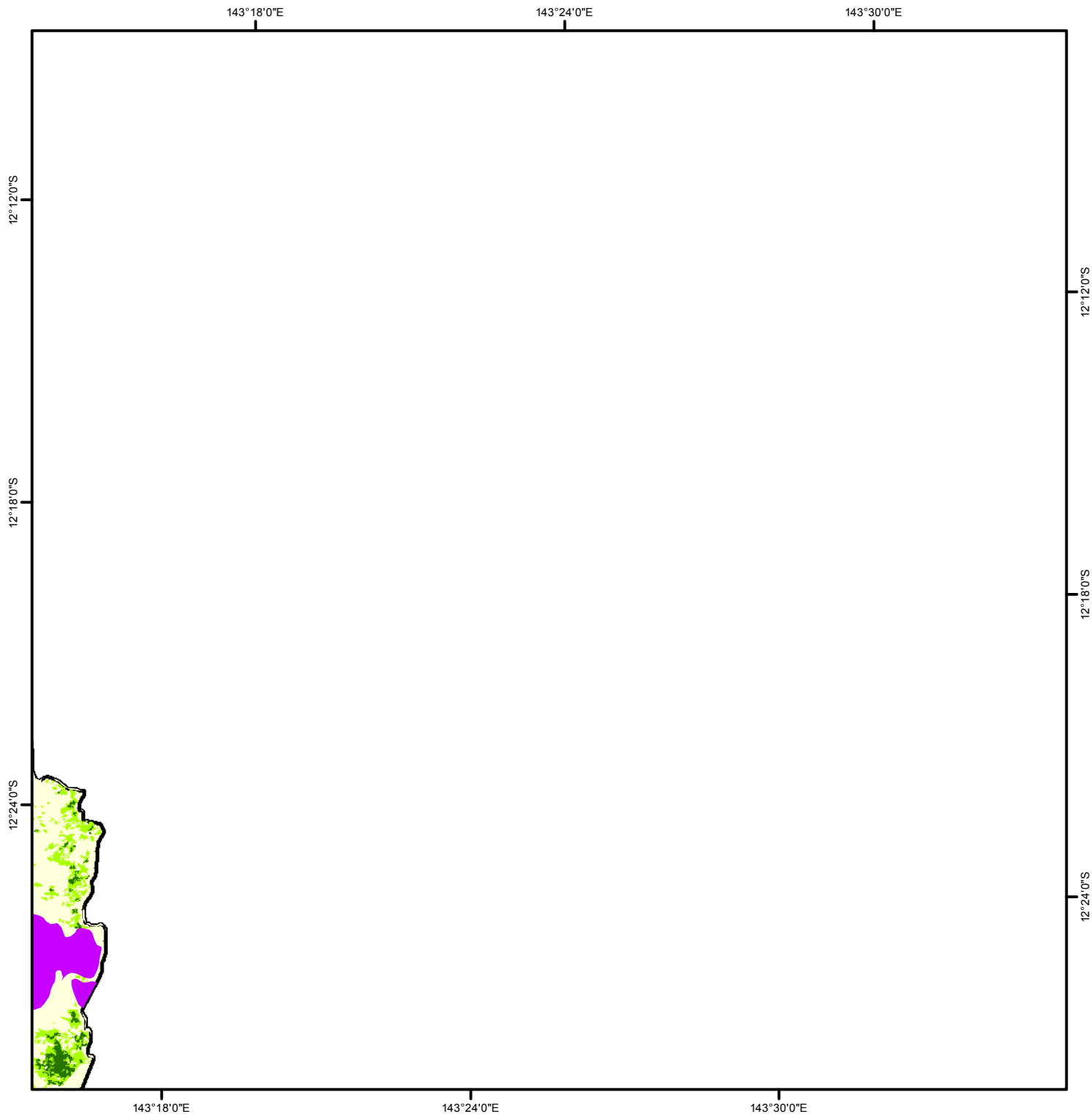
H5 Olive Pascoe Catchment



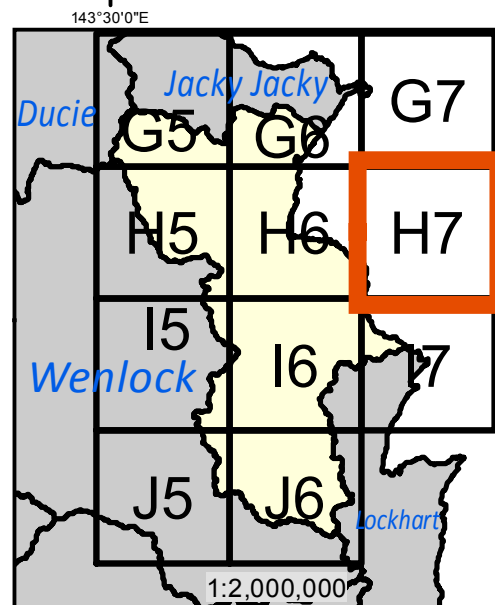
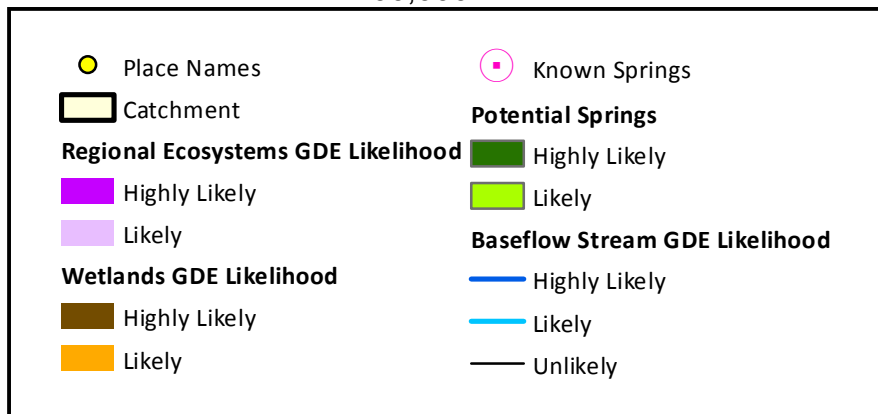
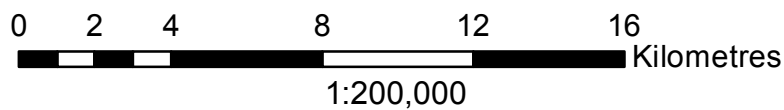


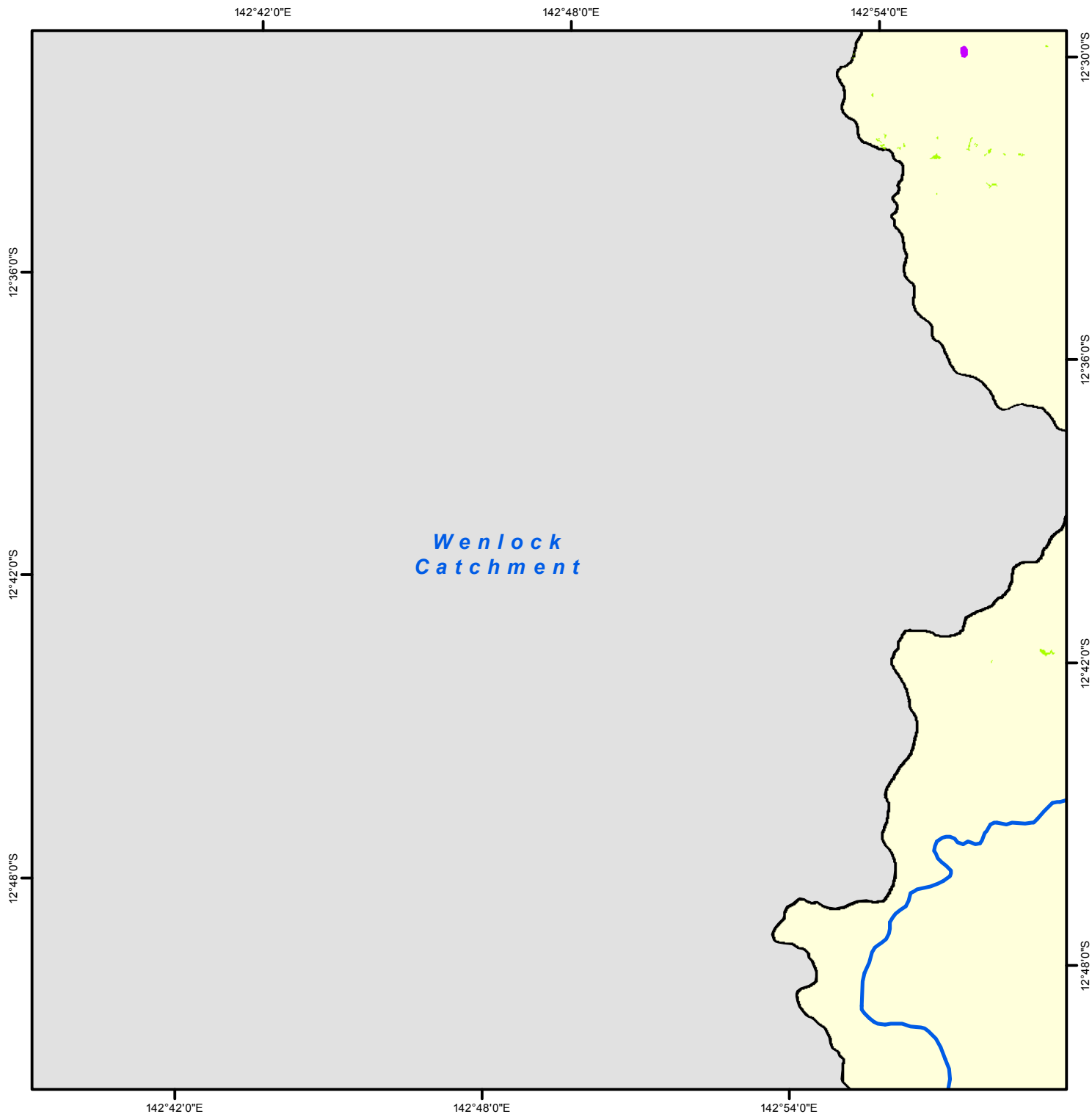
H6 Olive Pascoe Catchment



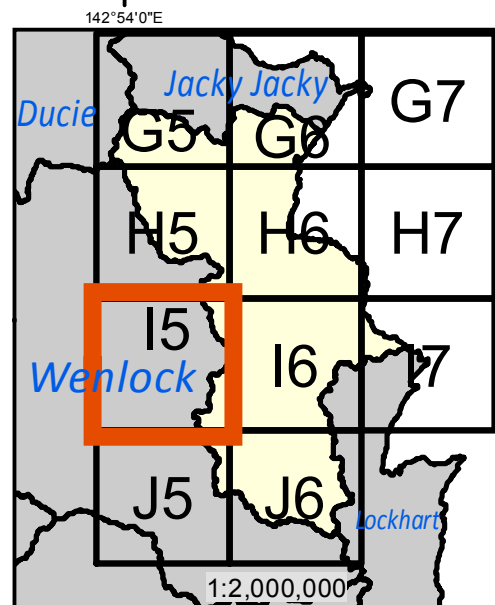
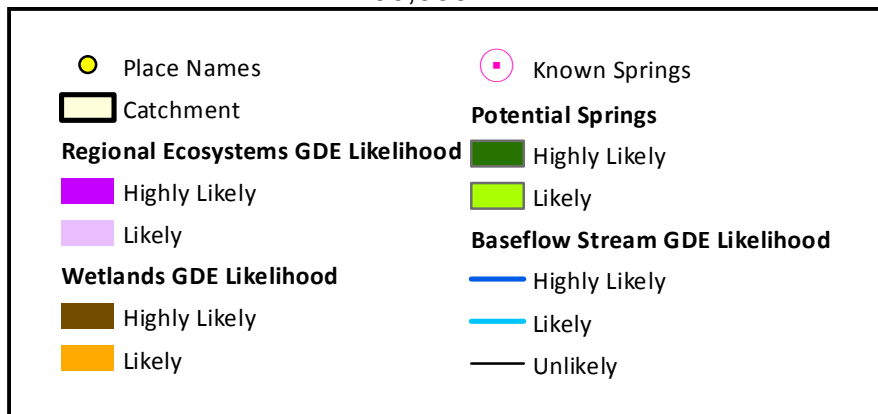
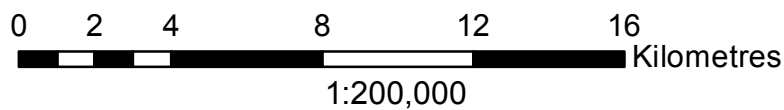


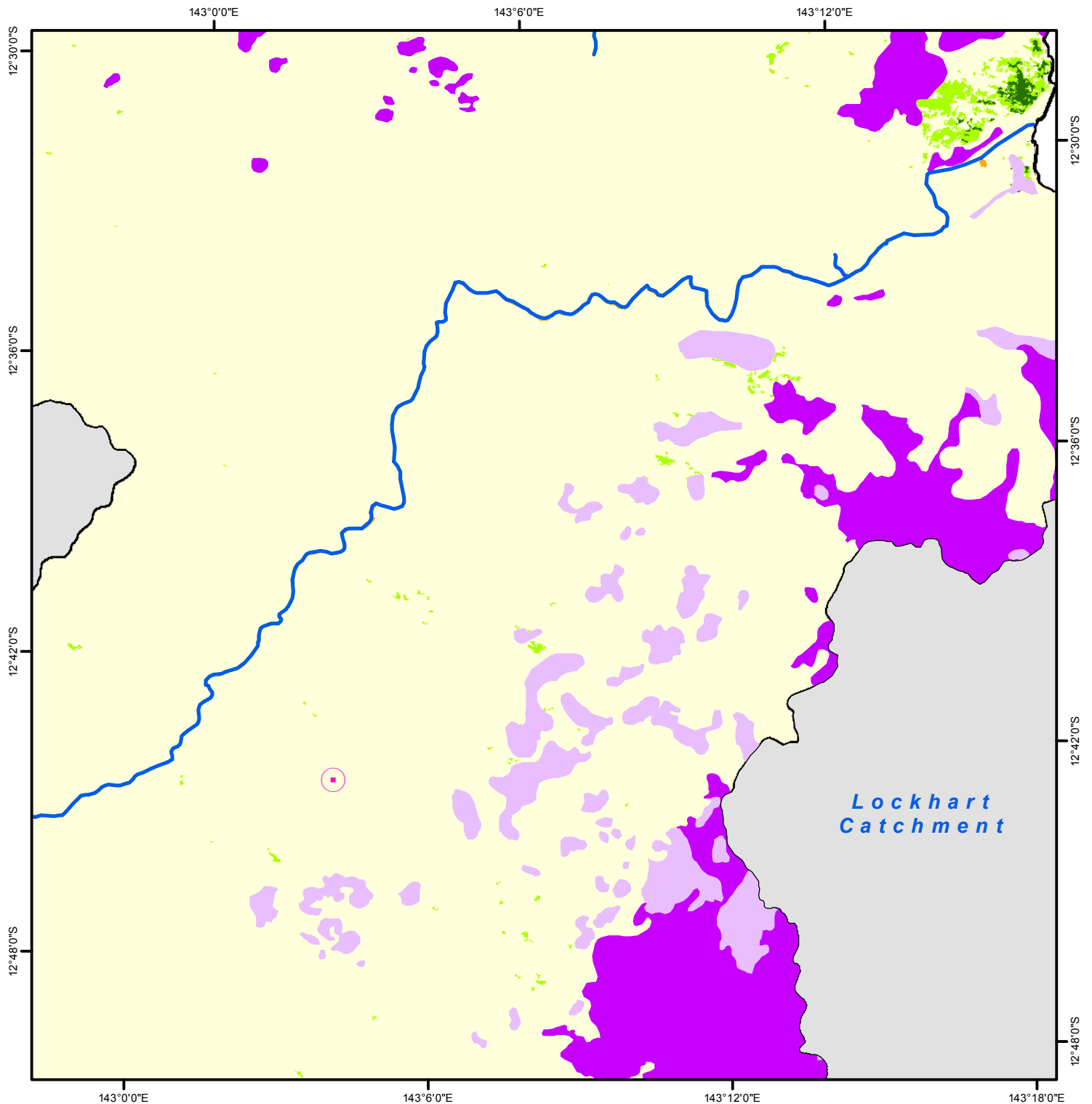
H7 Olive Pascoe Catchment



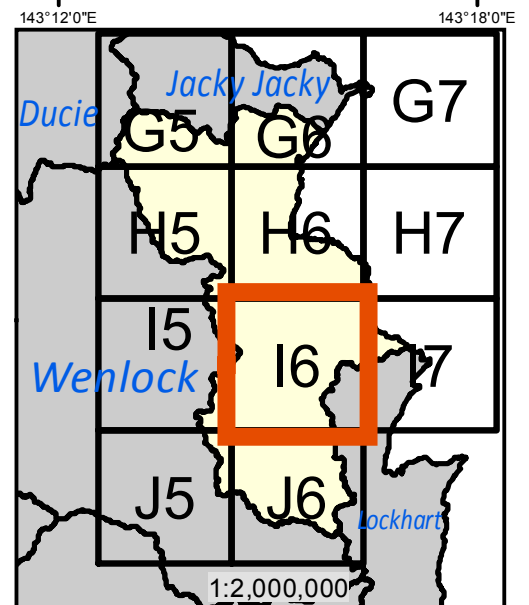
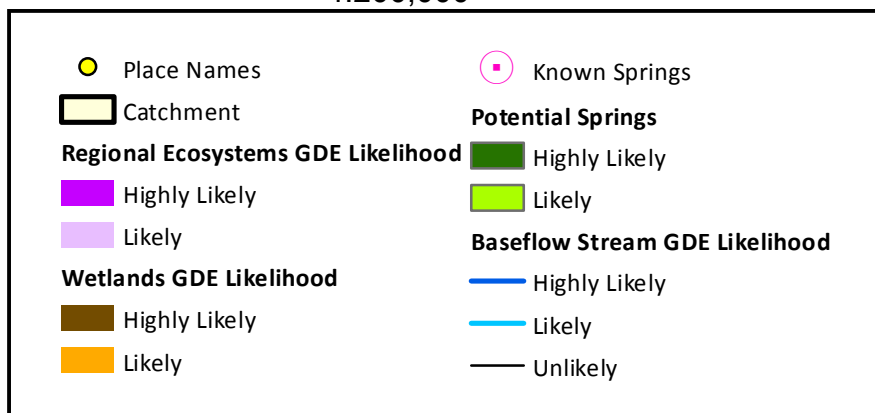
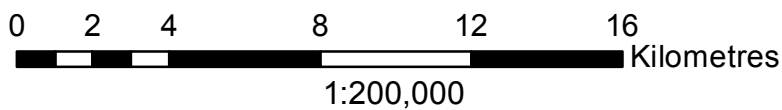


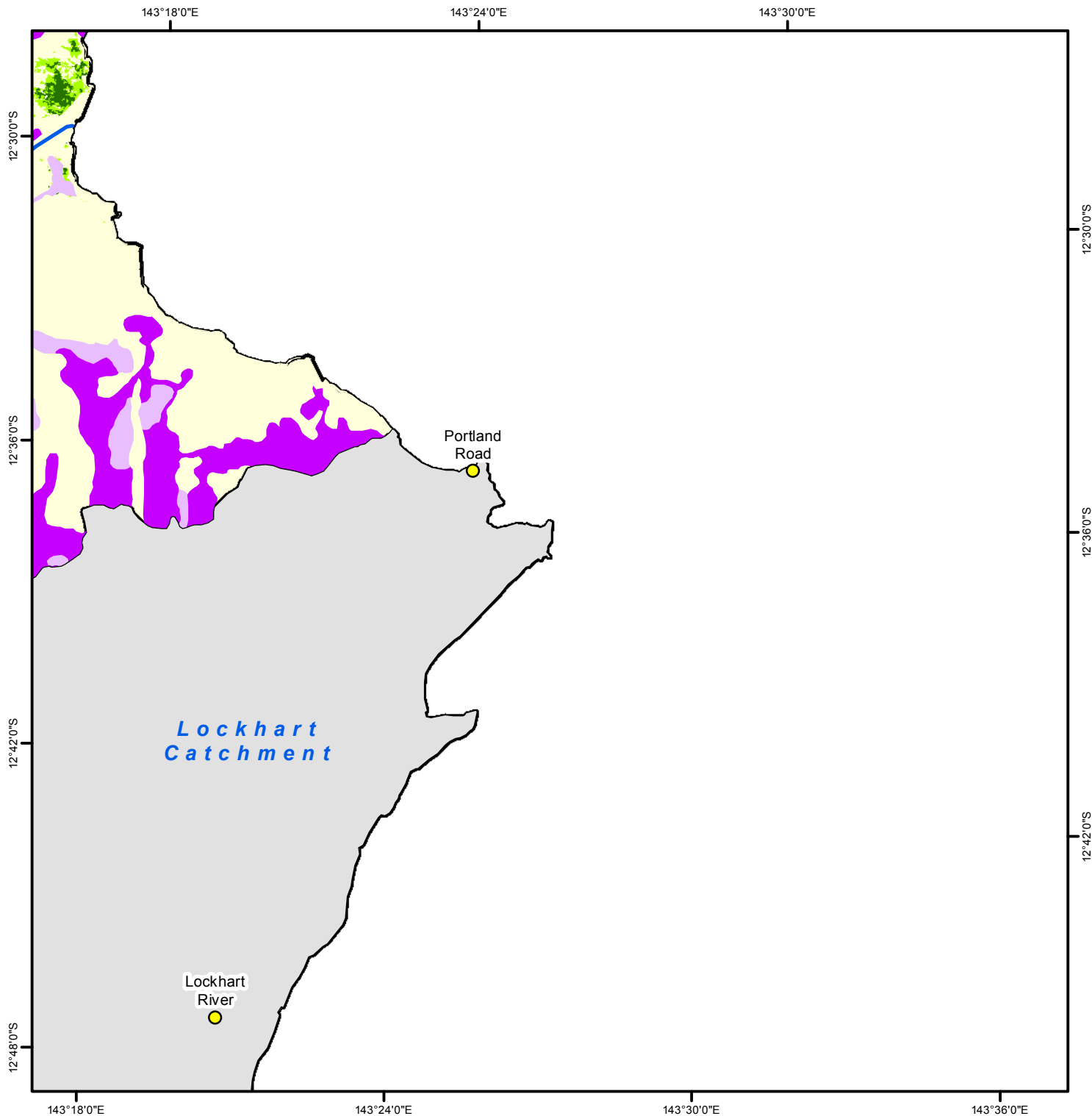
I5 Olive Pascoe Catchment



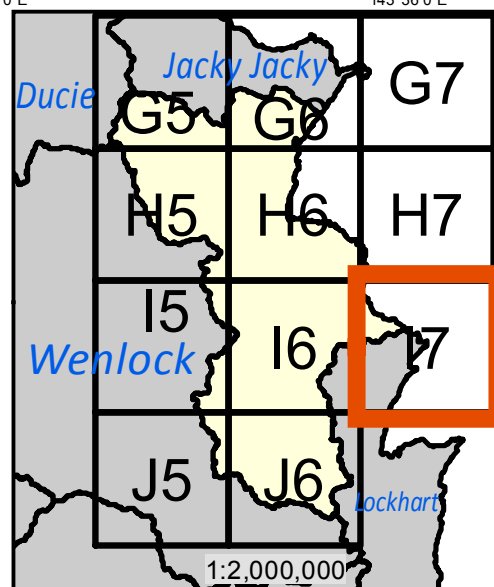
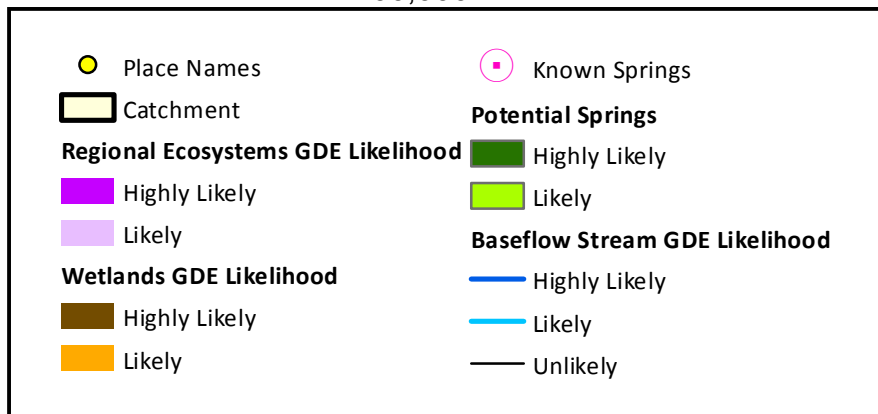
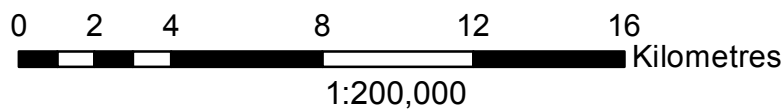


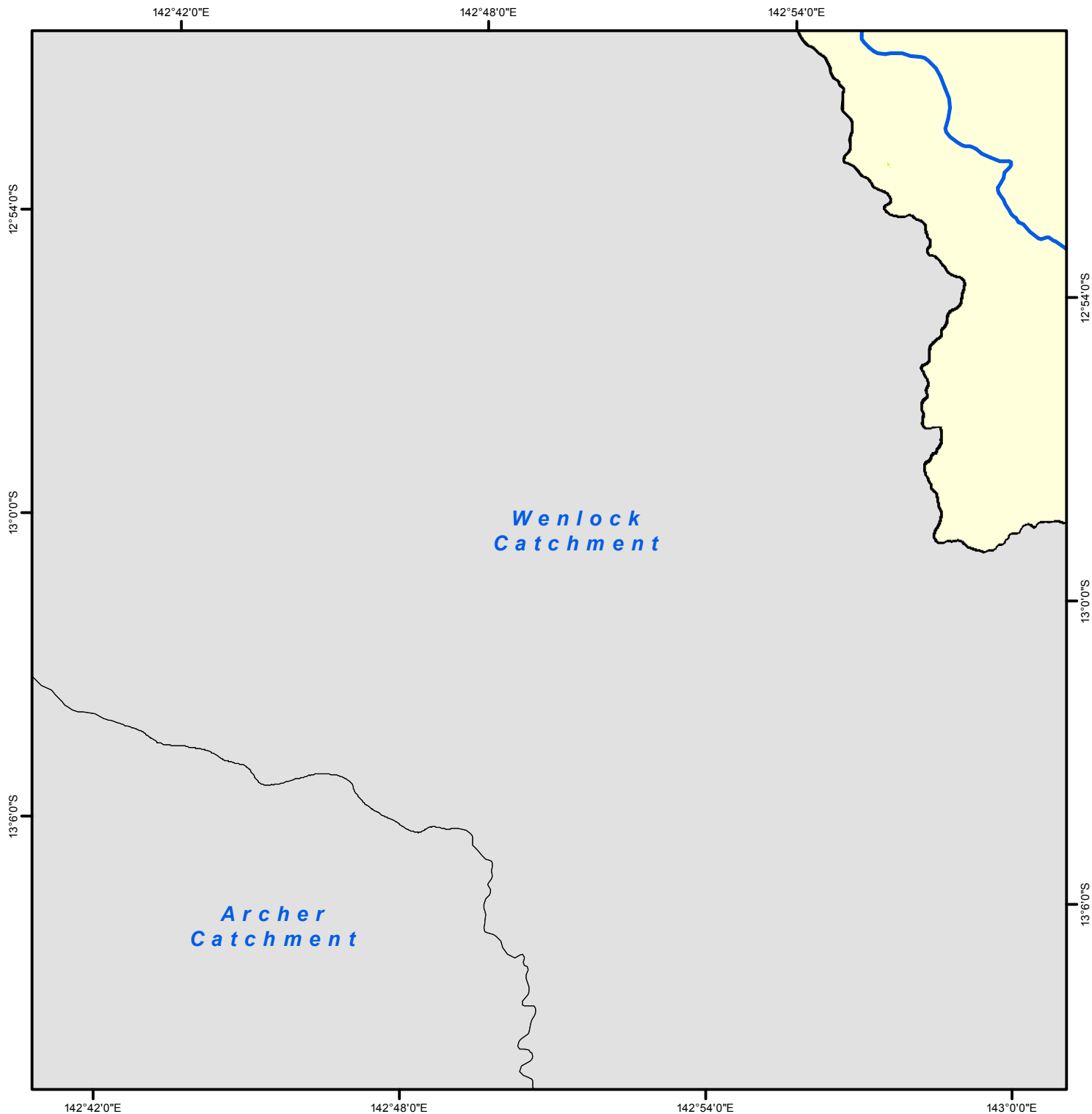
I6 Olive Pascoe Catchment



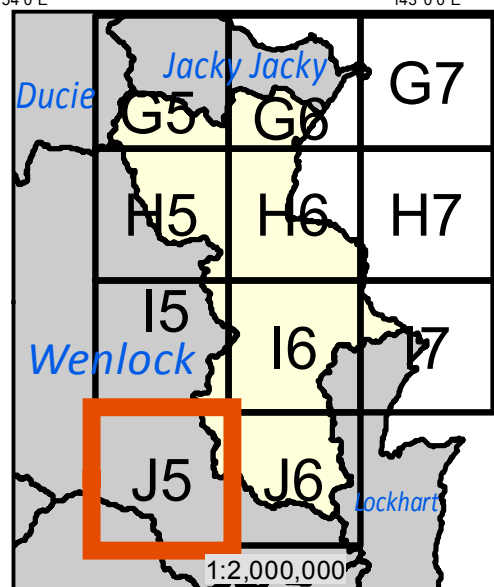
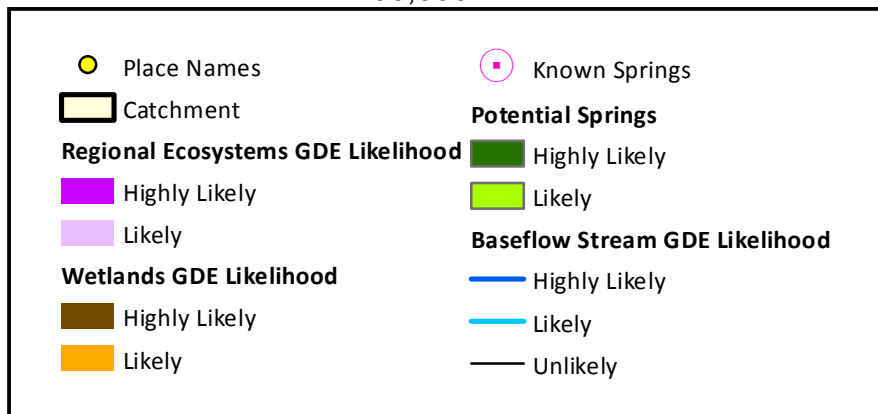
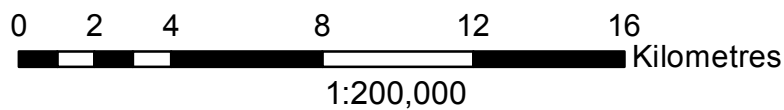


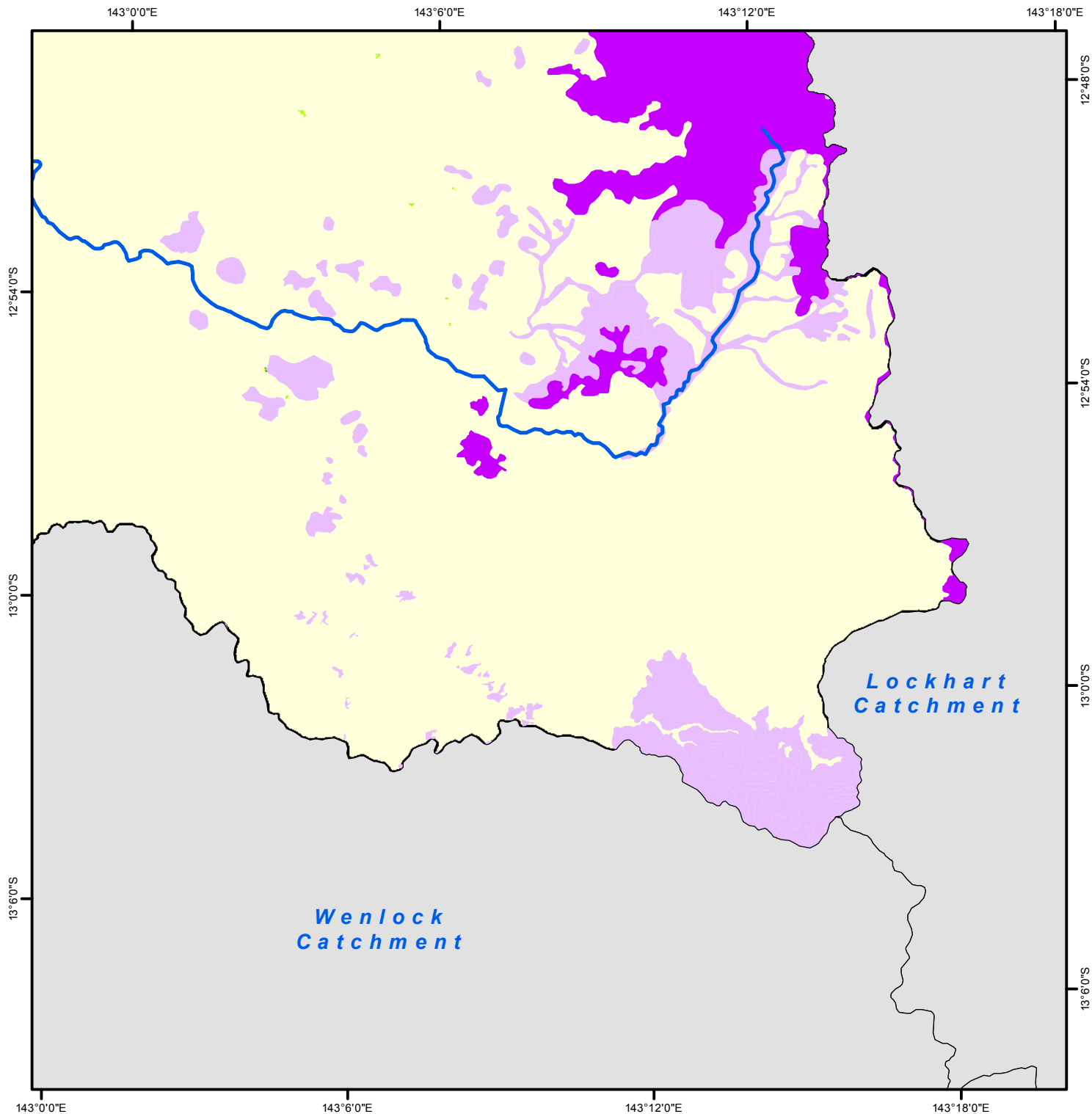
17 Olive Pascoe Catchment



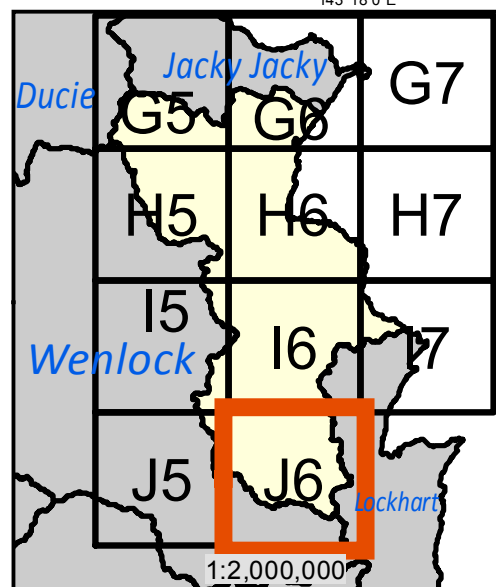
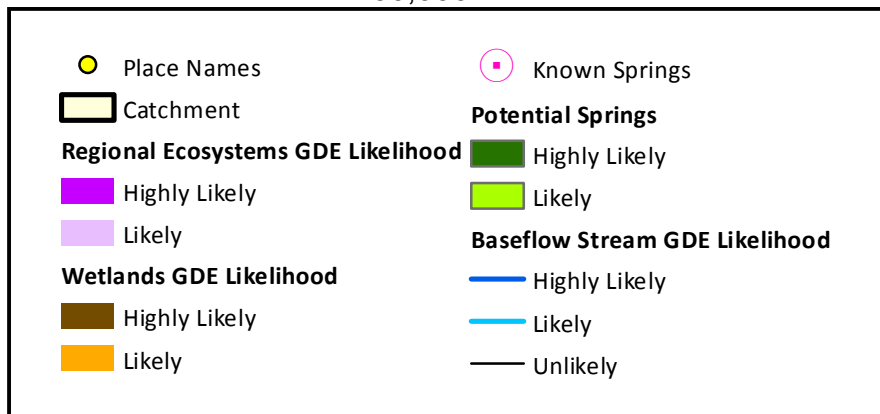
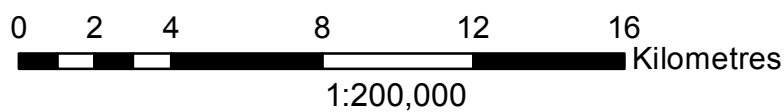


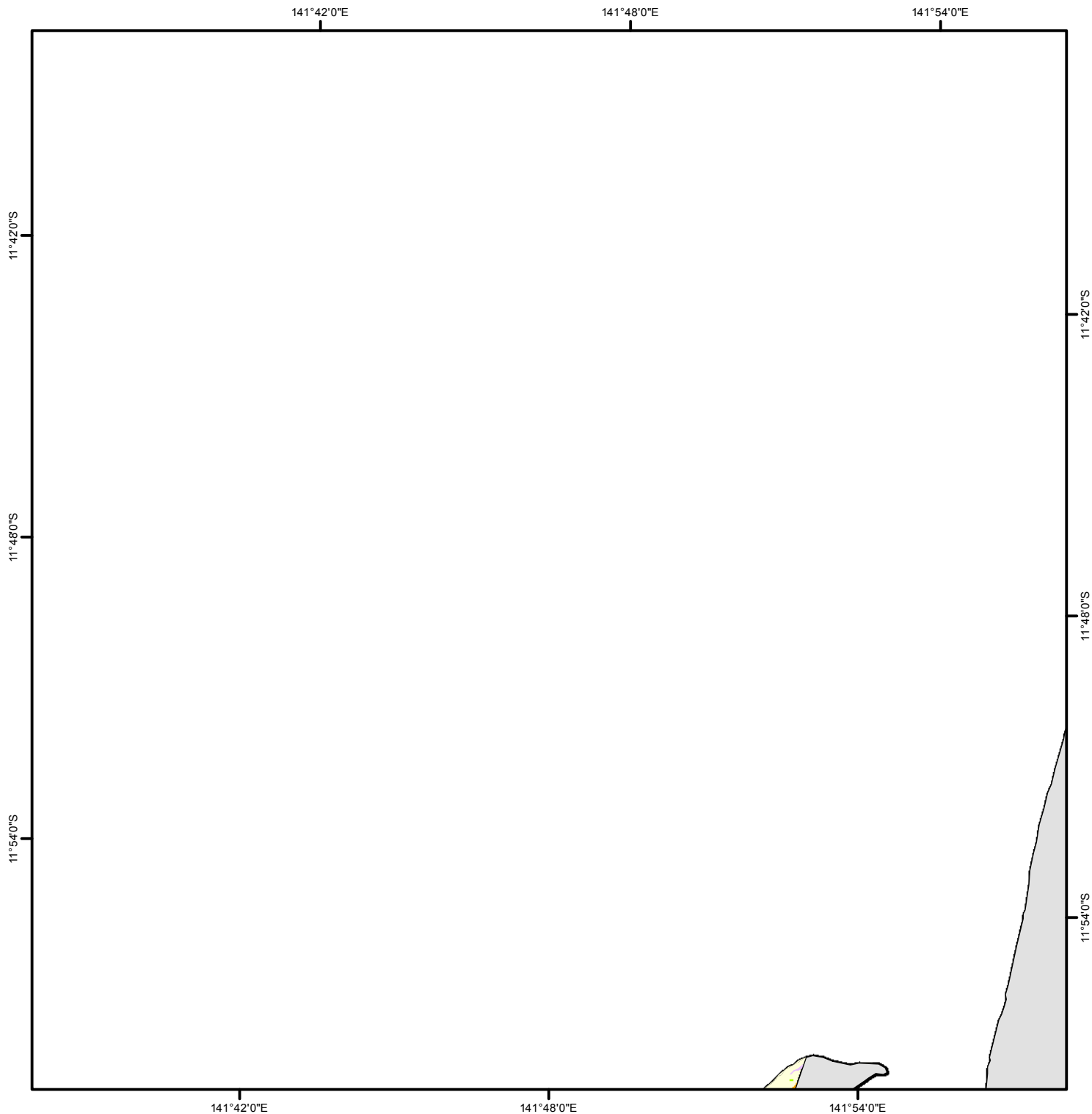
J5 Olive Pascoe Catchment



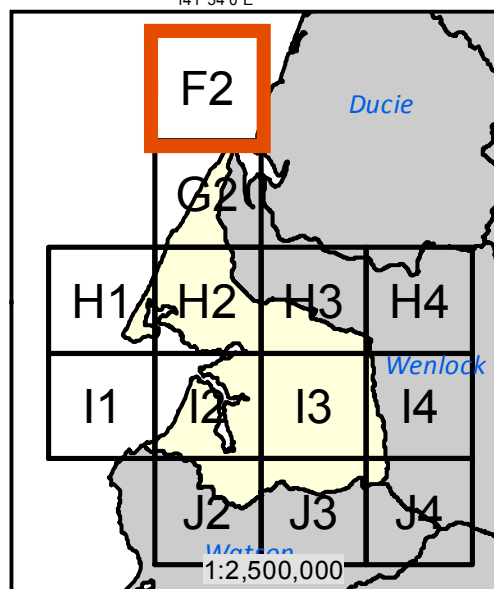
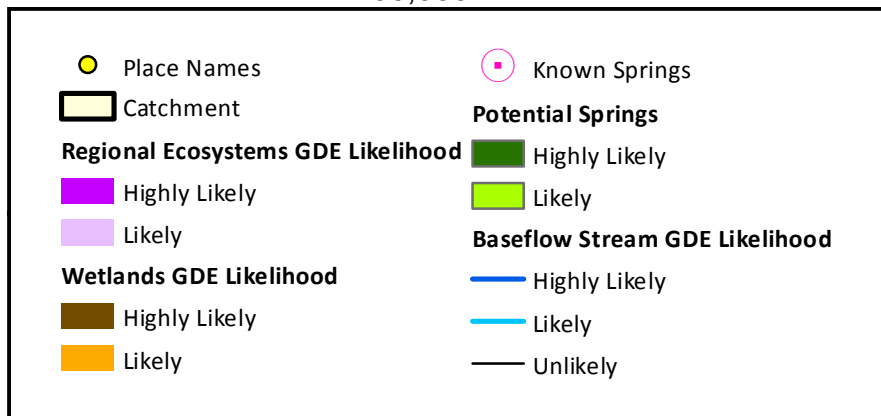
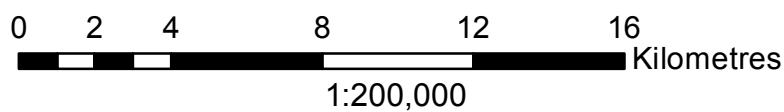


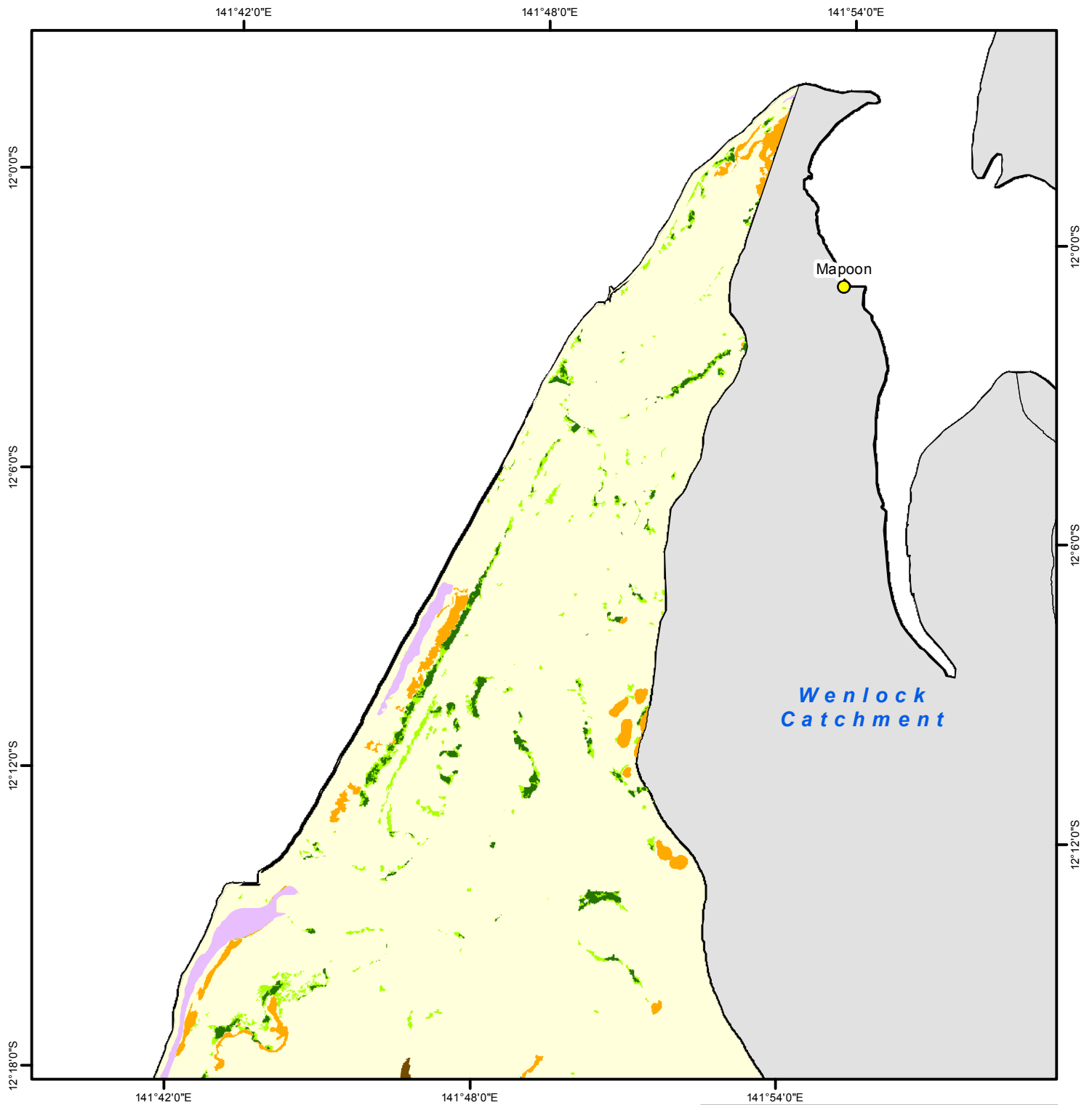
J6 Olive Pascoe Catchment



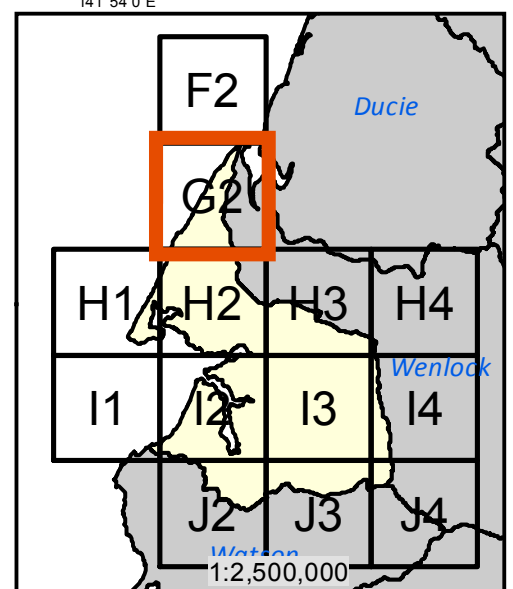
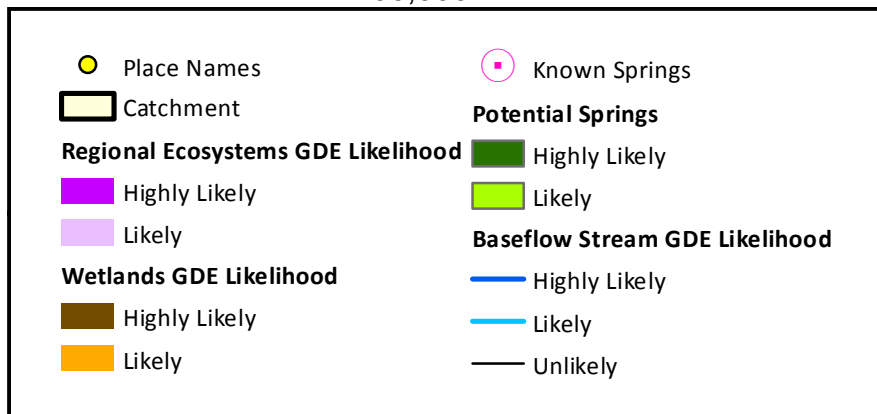
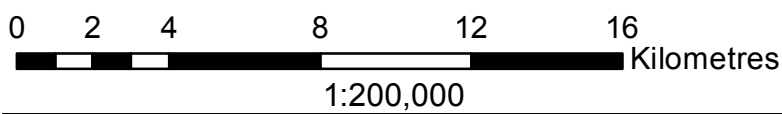


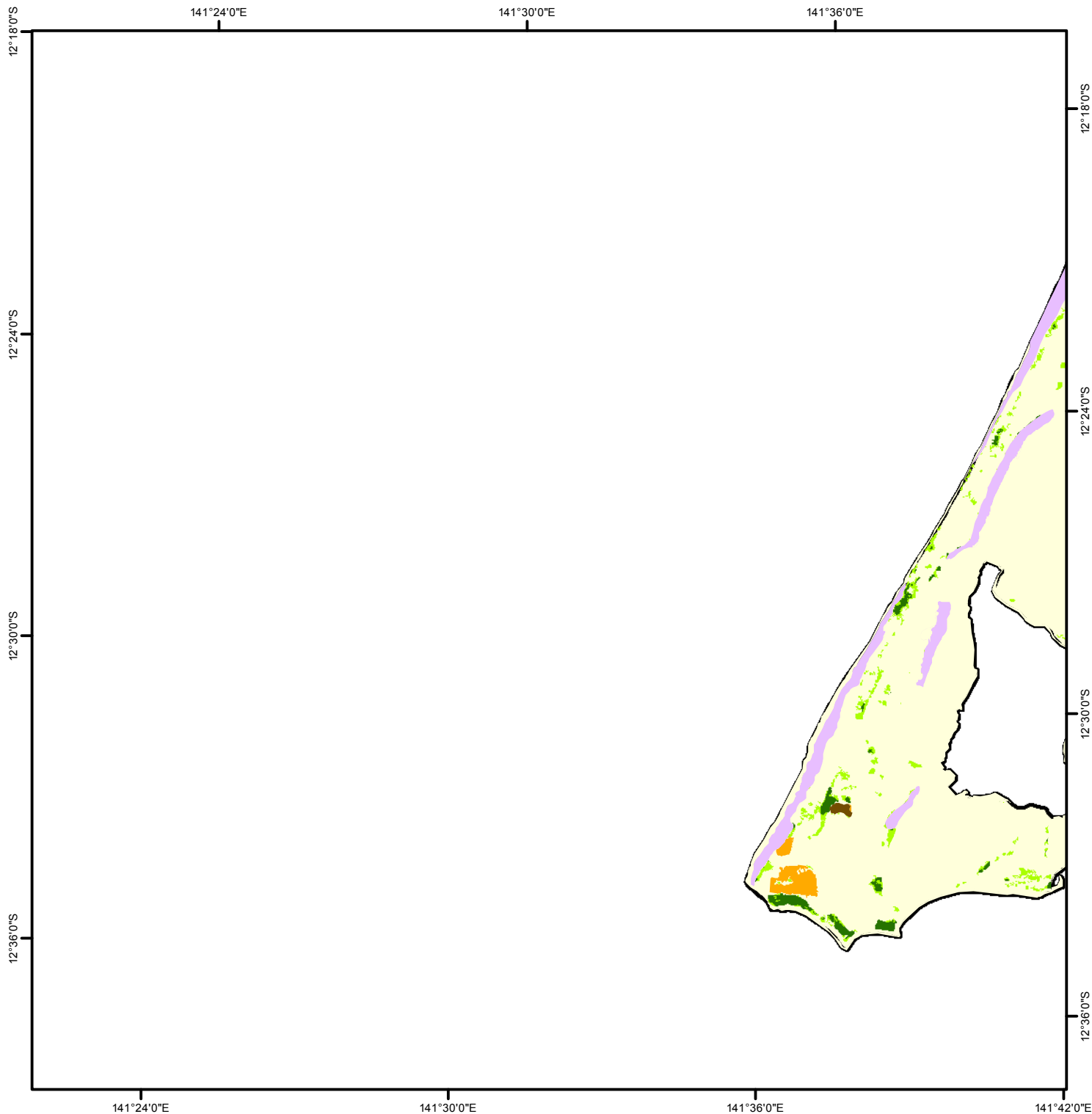
F2 Embley Catchment



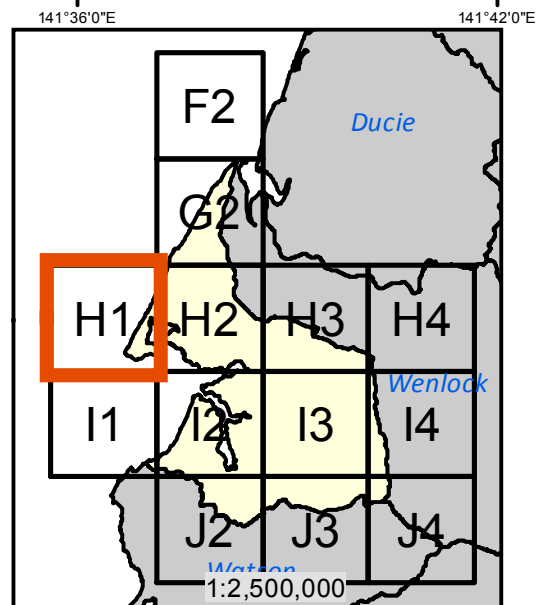
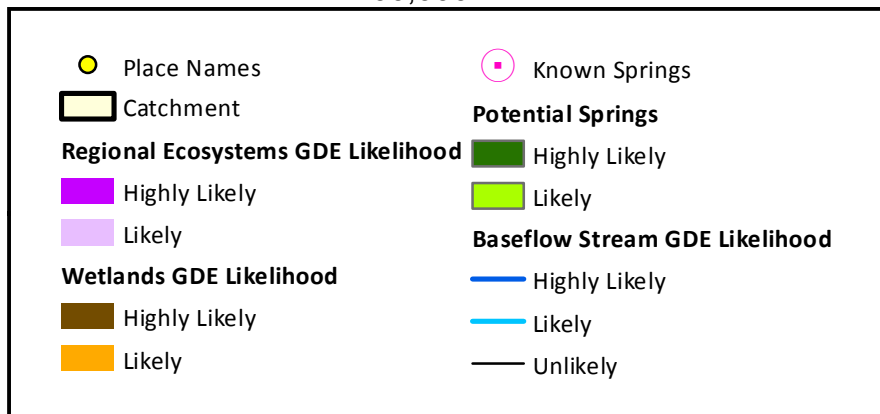
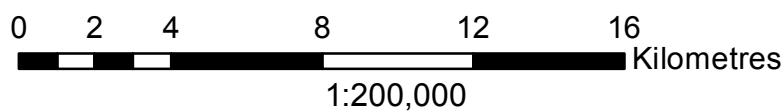


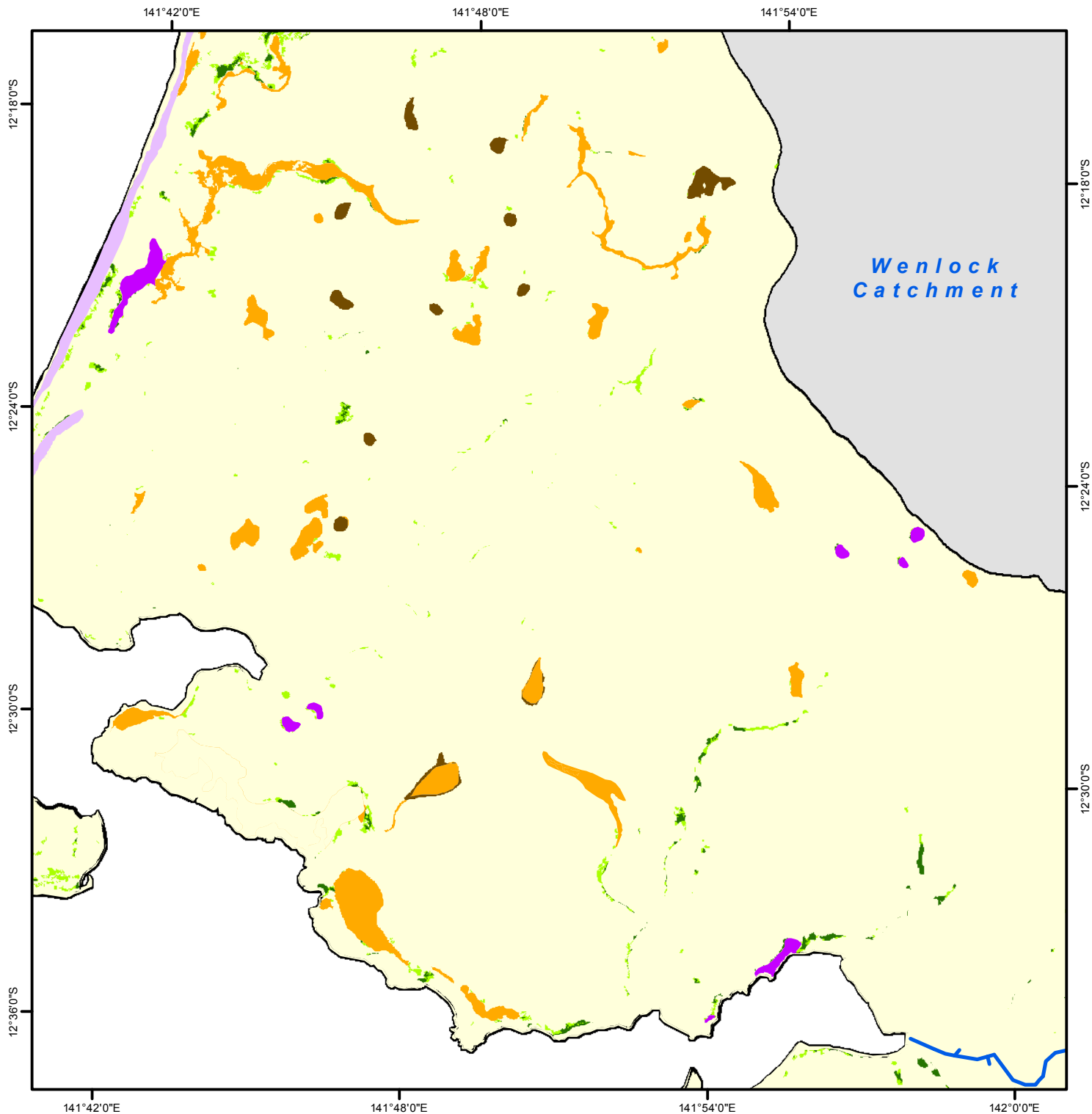
G2 Embley Catchment



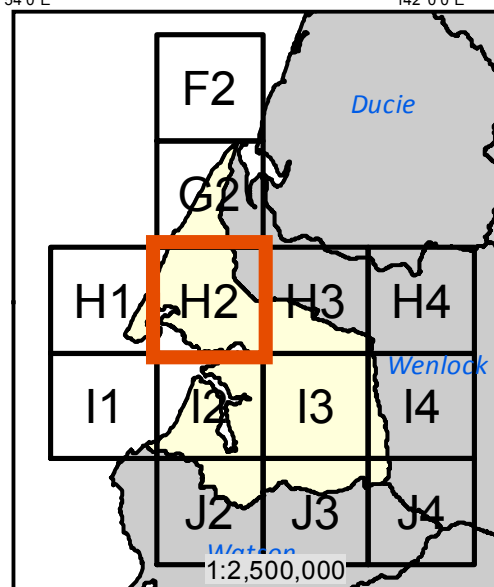
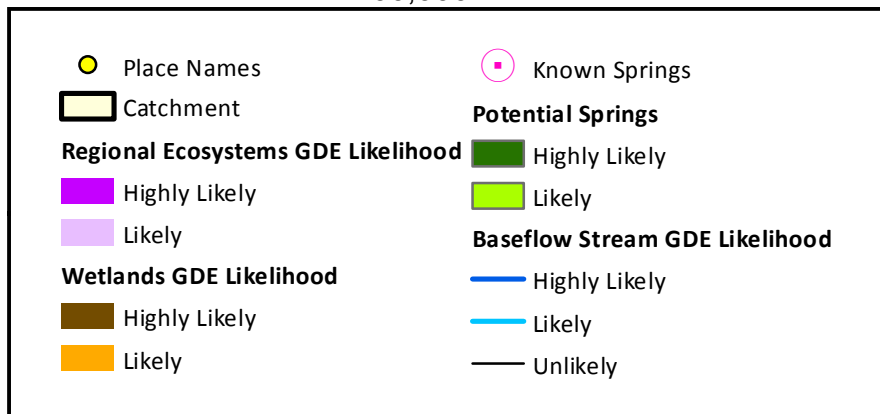
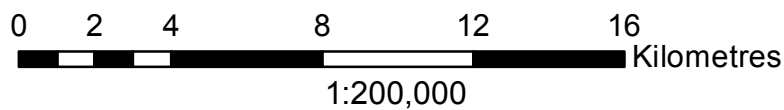


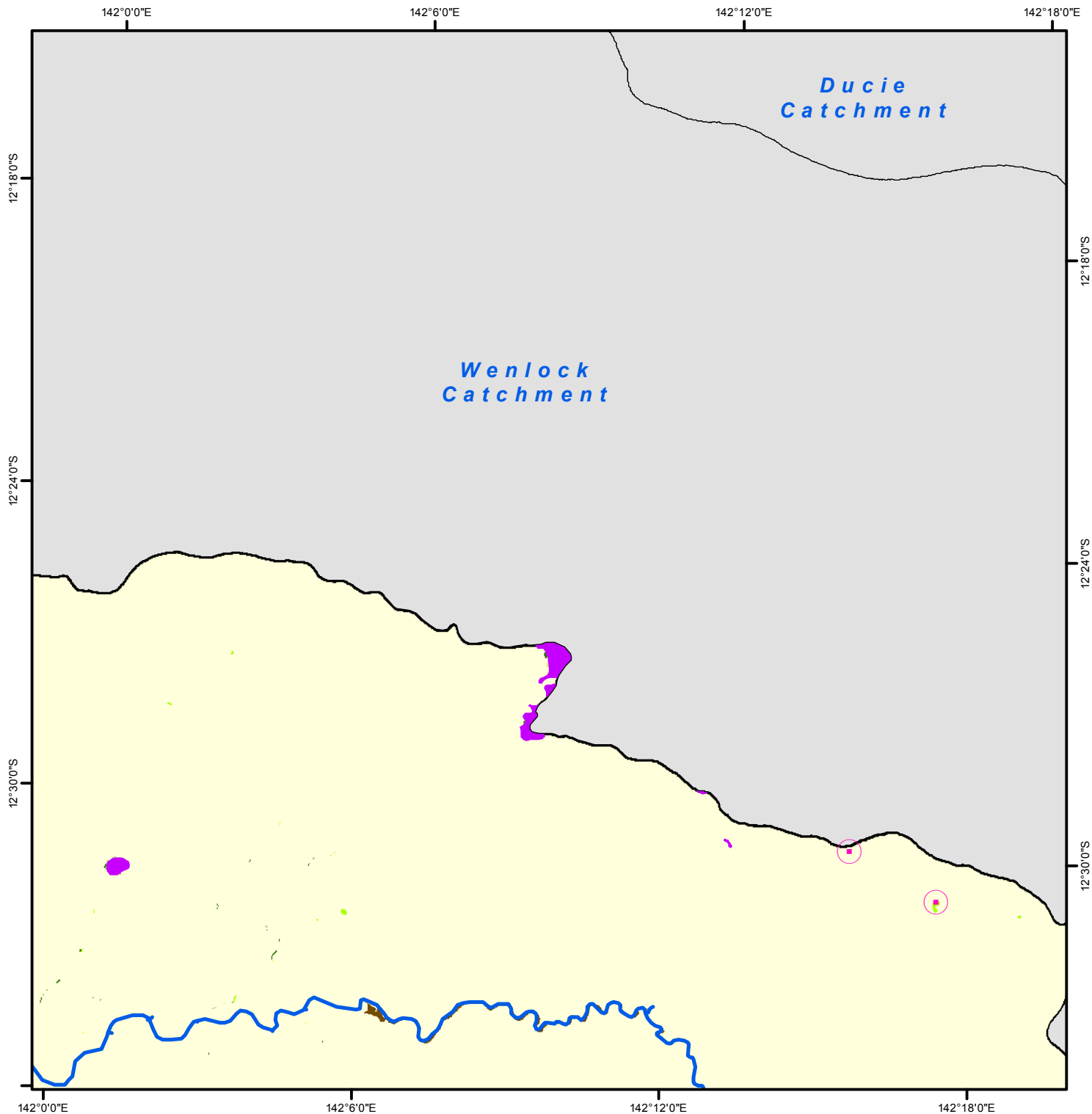
H1 Embley Catchment



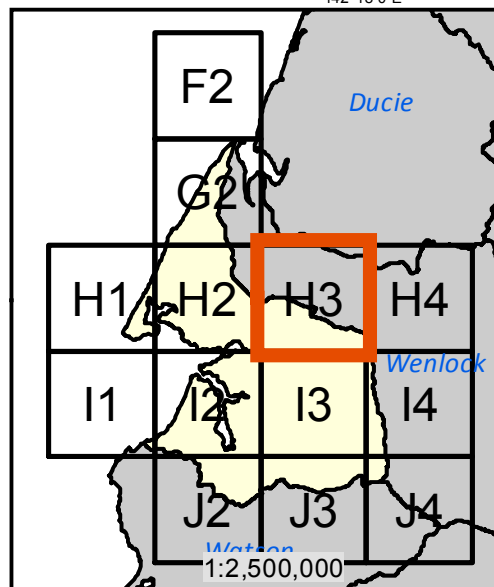
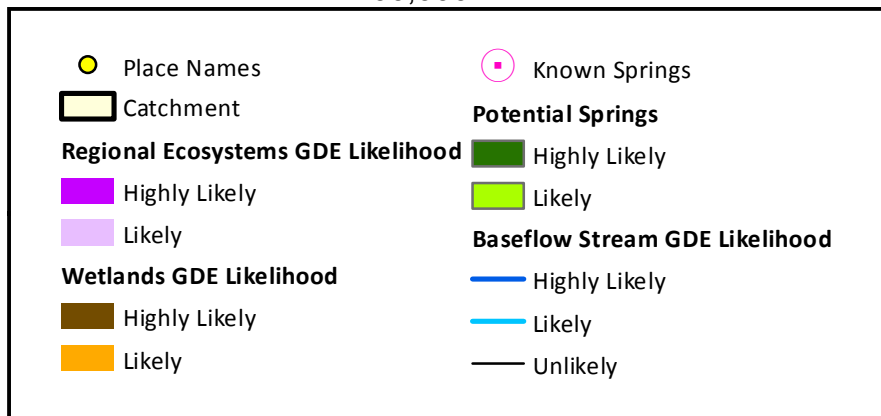
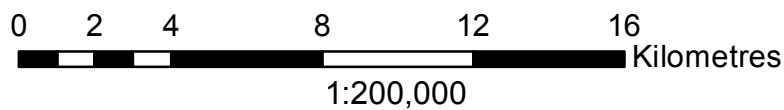


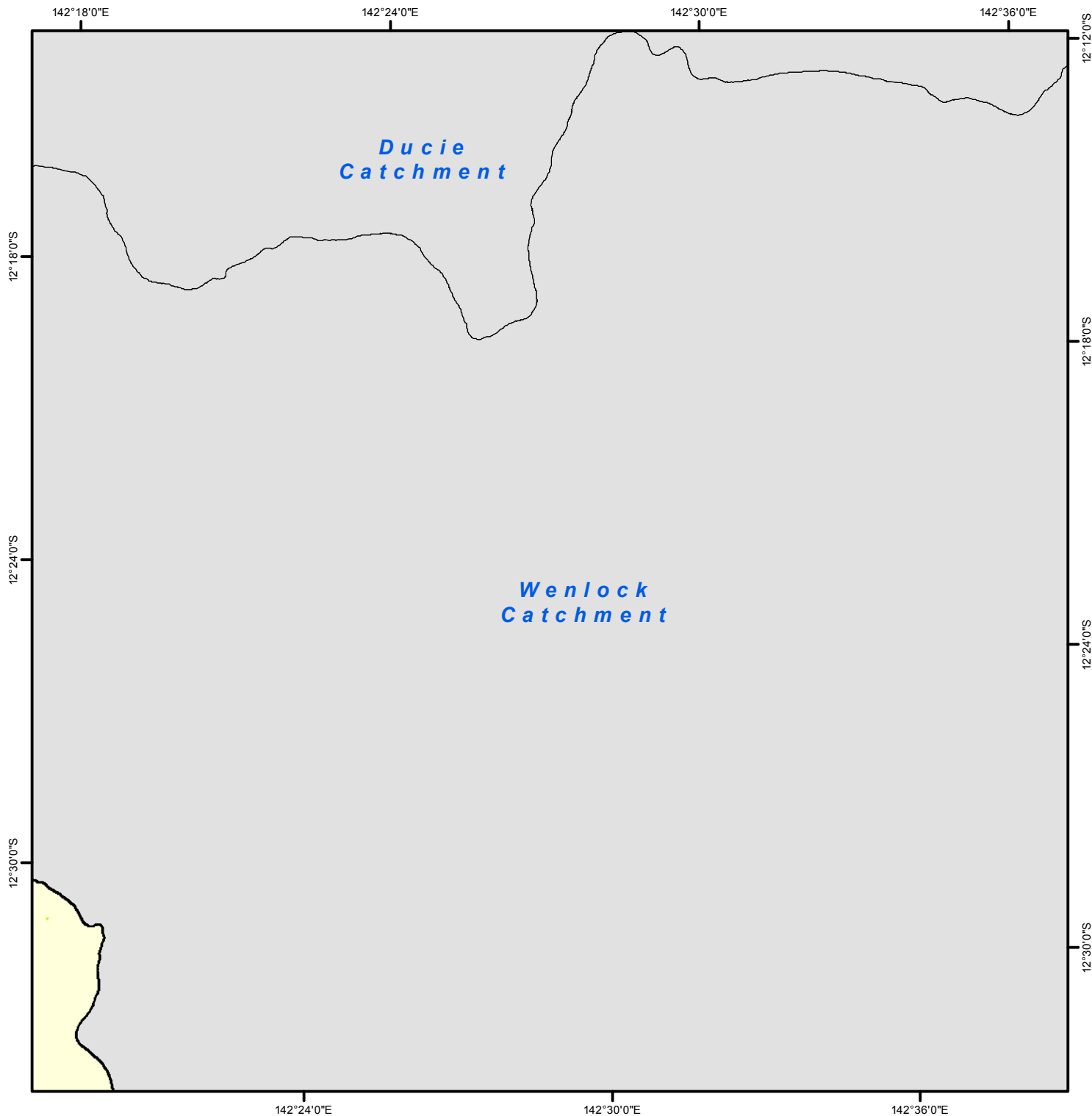
H2 Embley Catchment



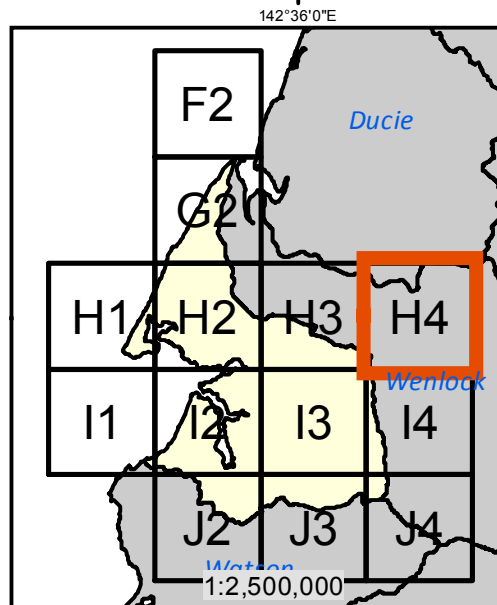
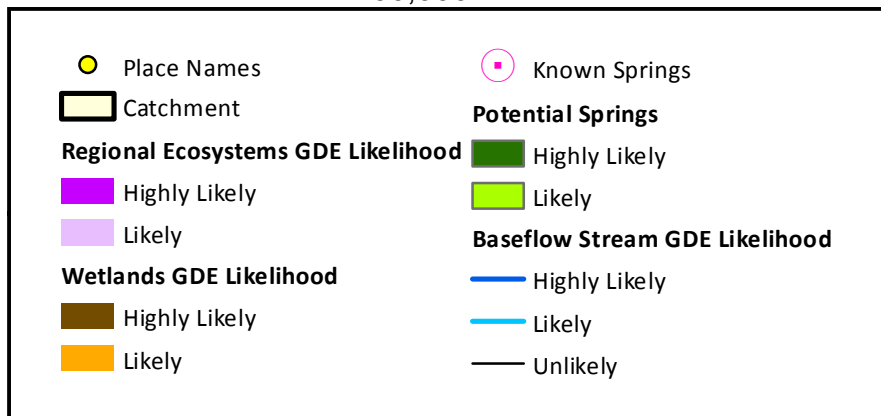
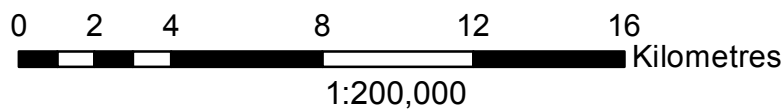


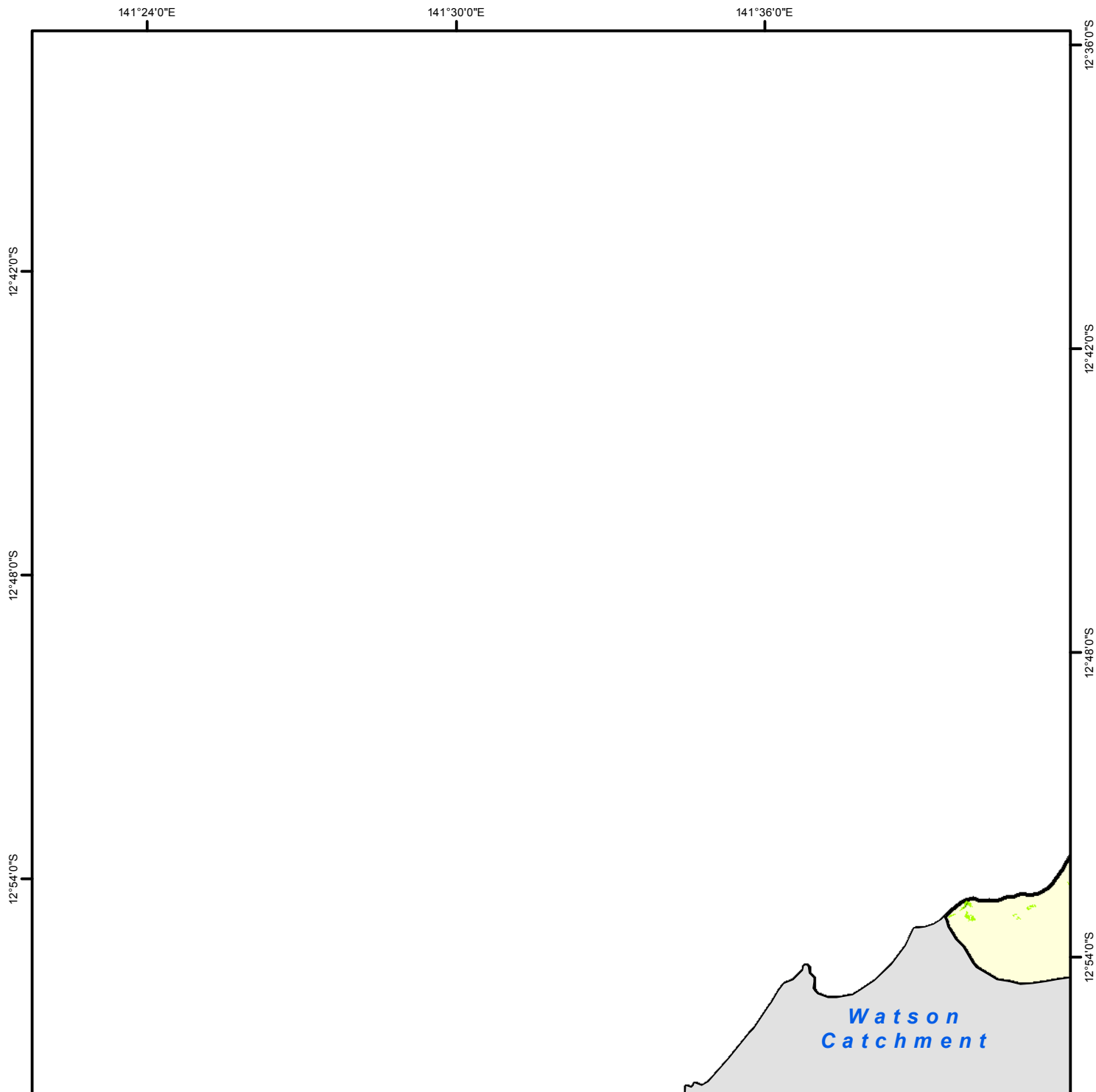
H3 Embley Catchment



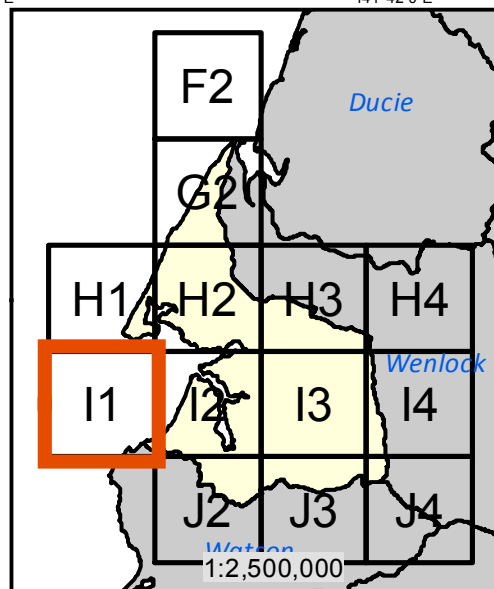
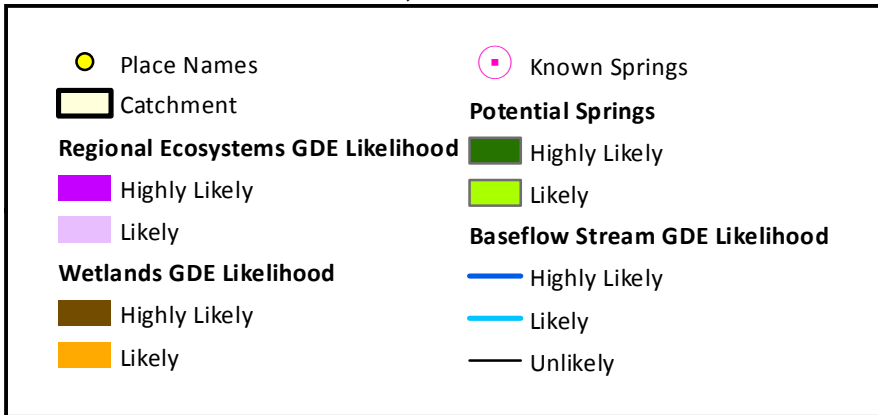
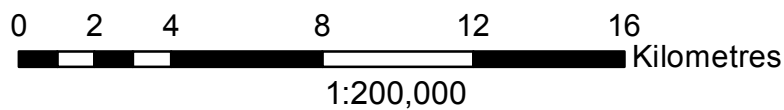


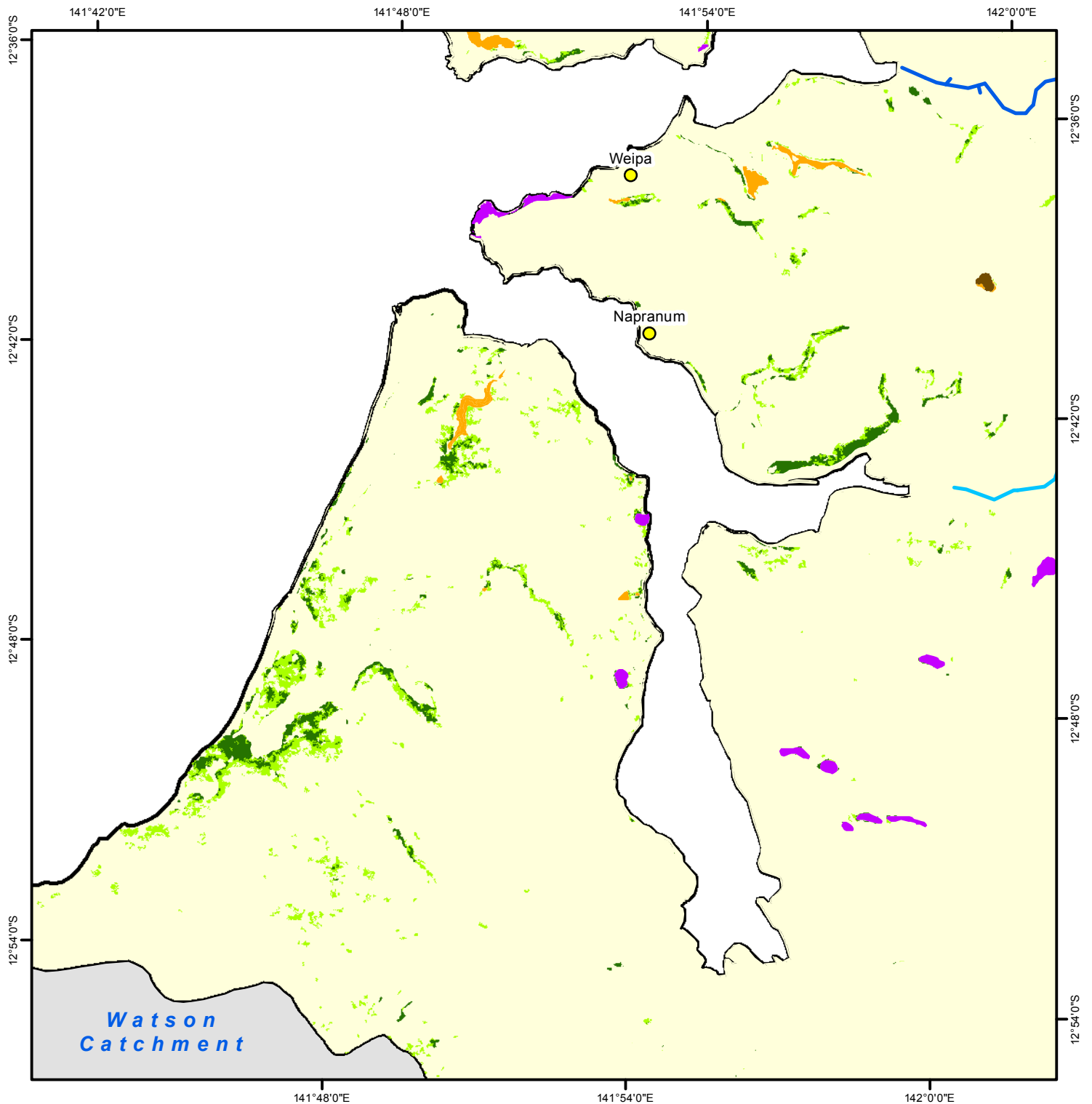
H4 Embley Catchment



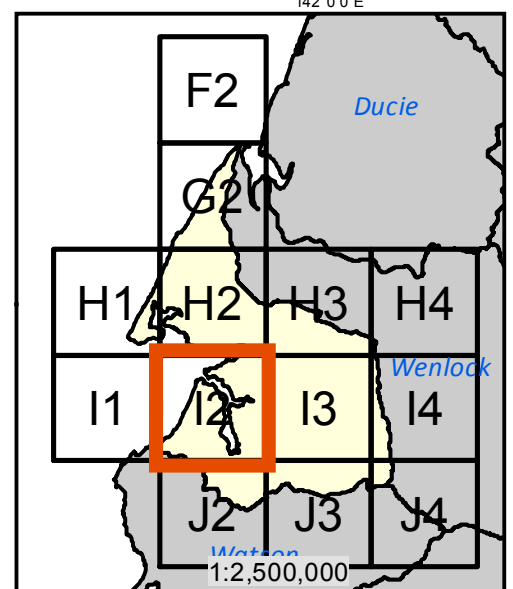
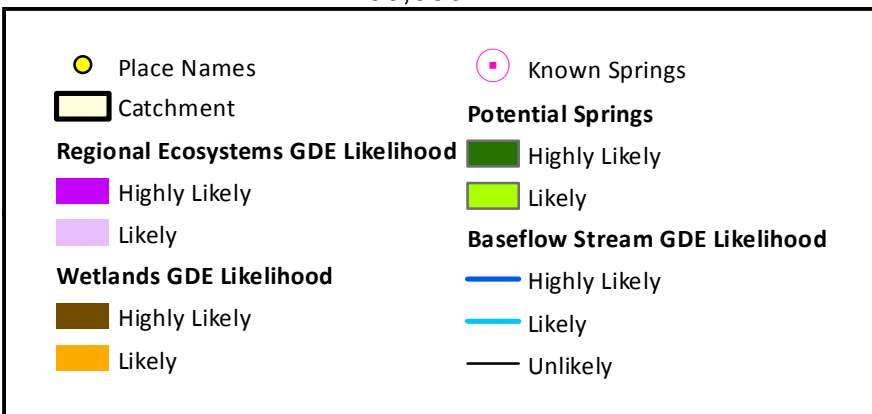
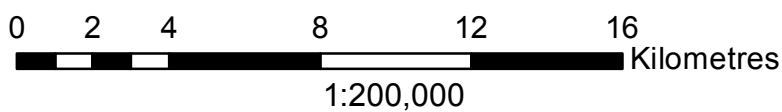


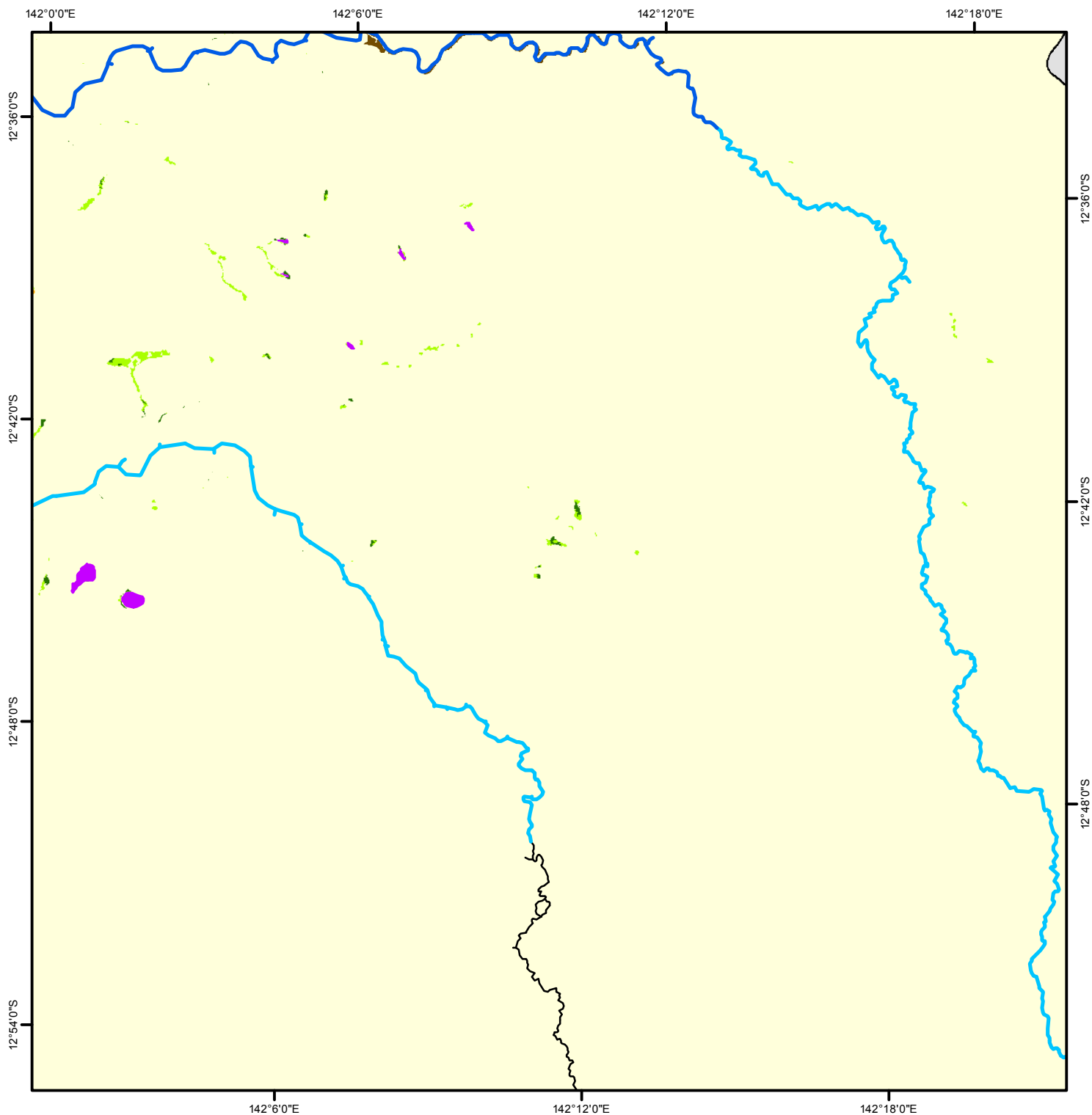
I1 Embley Catchment



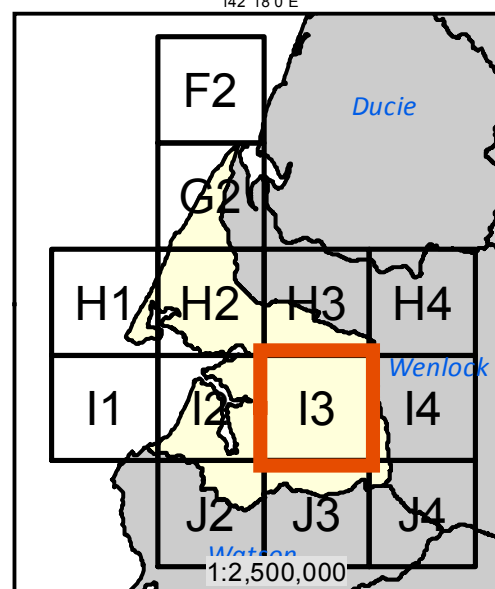
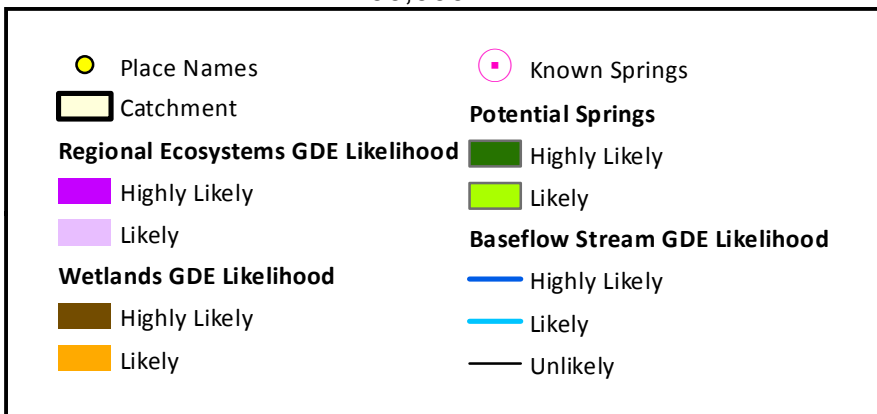
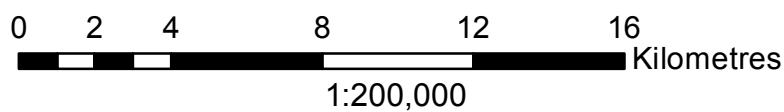


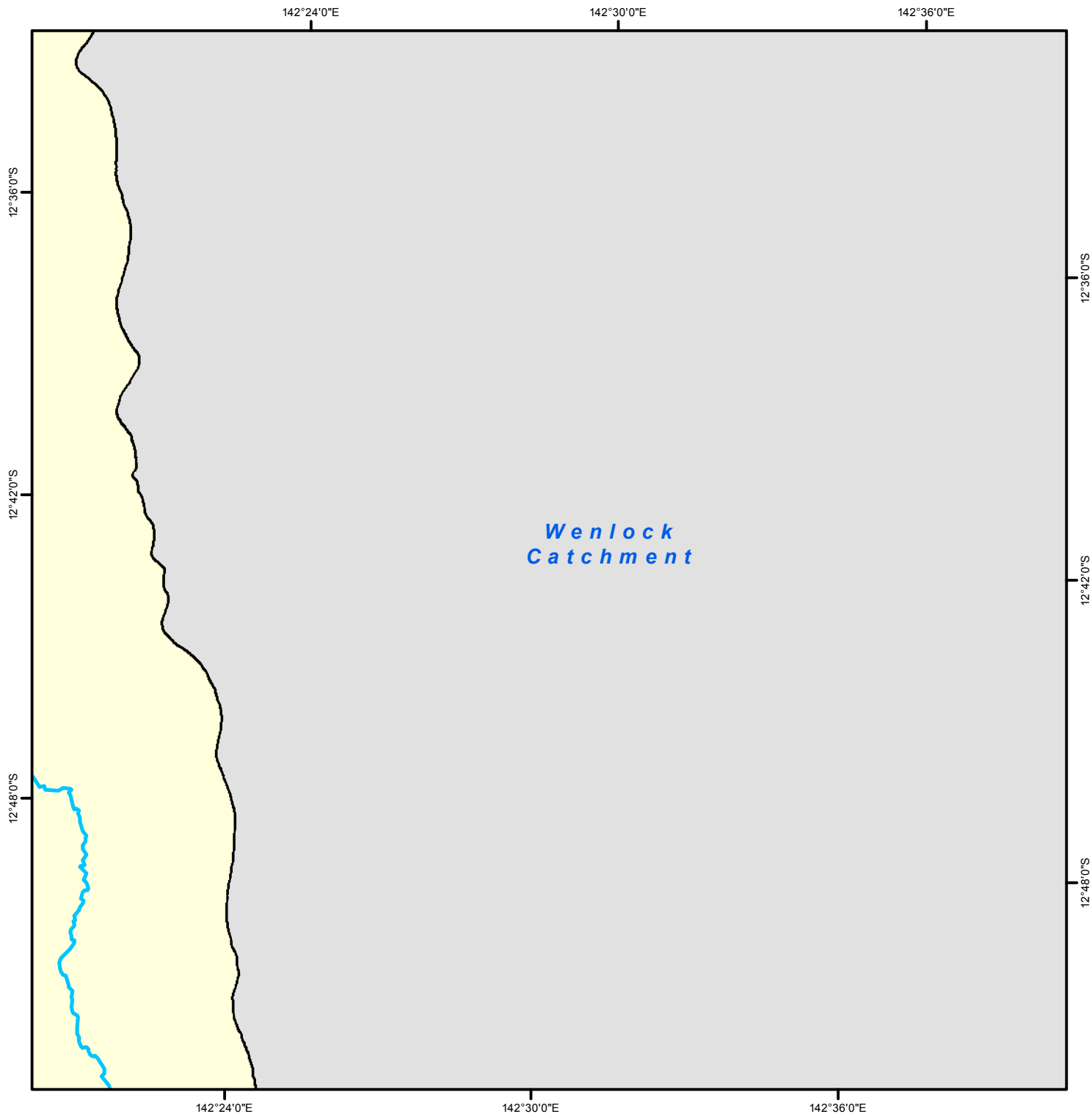
I2 Embley Catchment



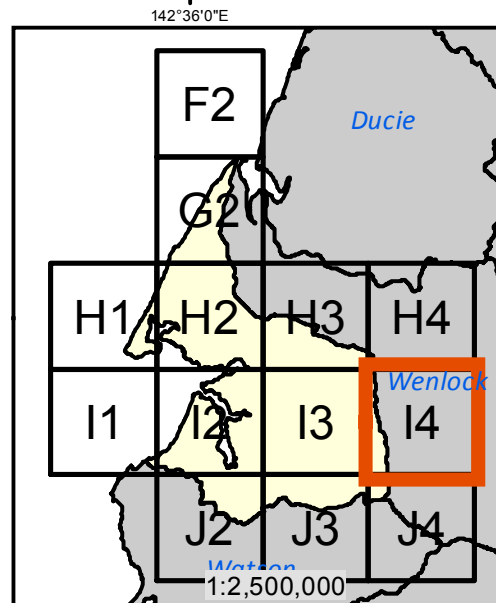
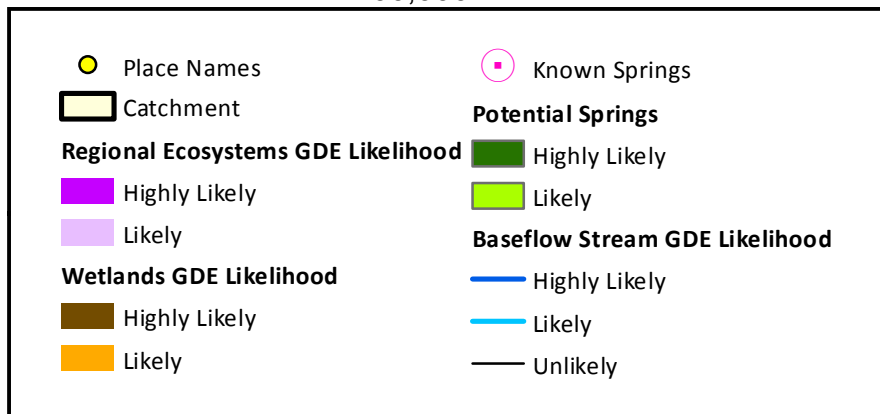
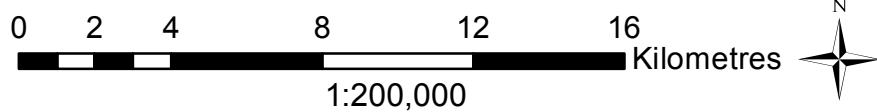


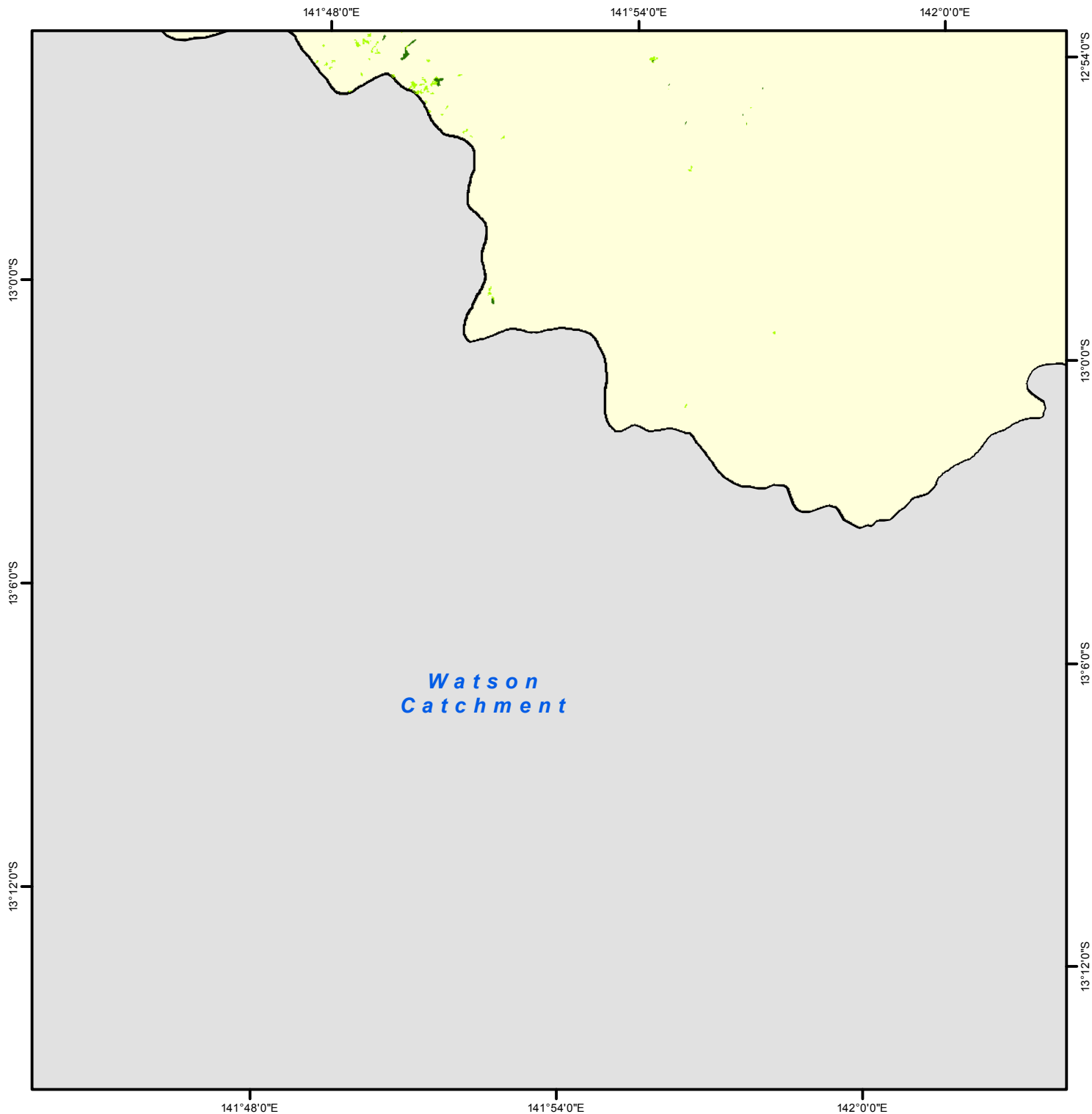
I3 Embley Catchment



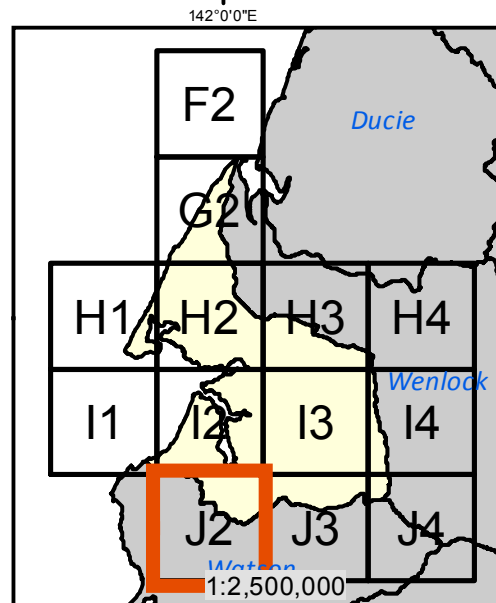
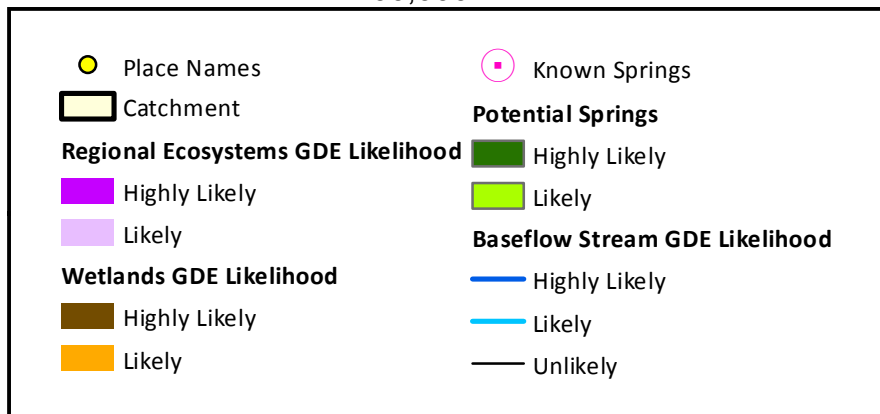
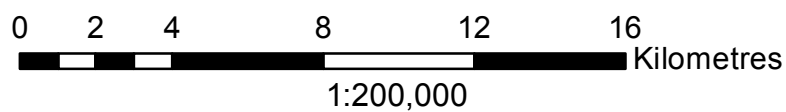


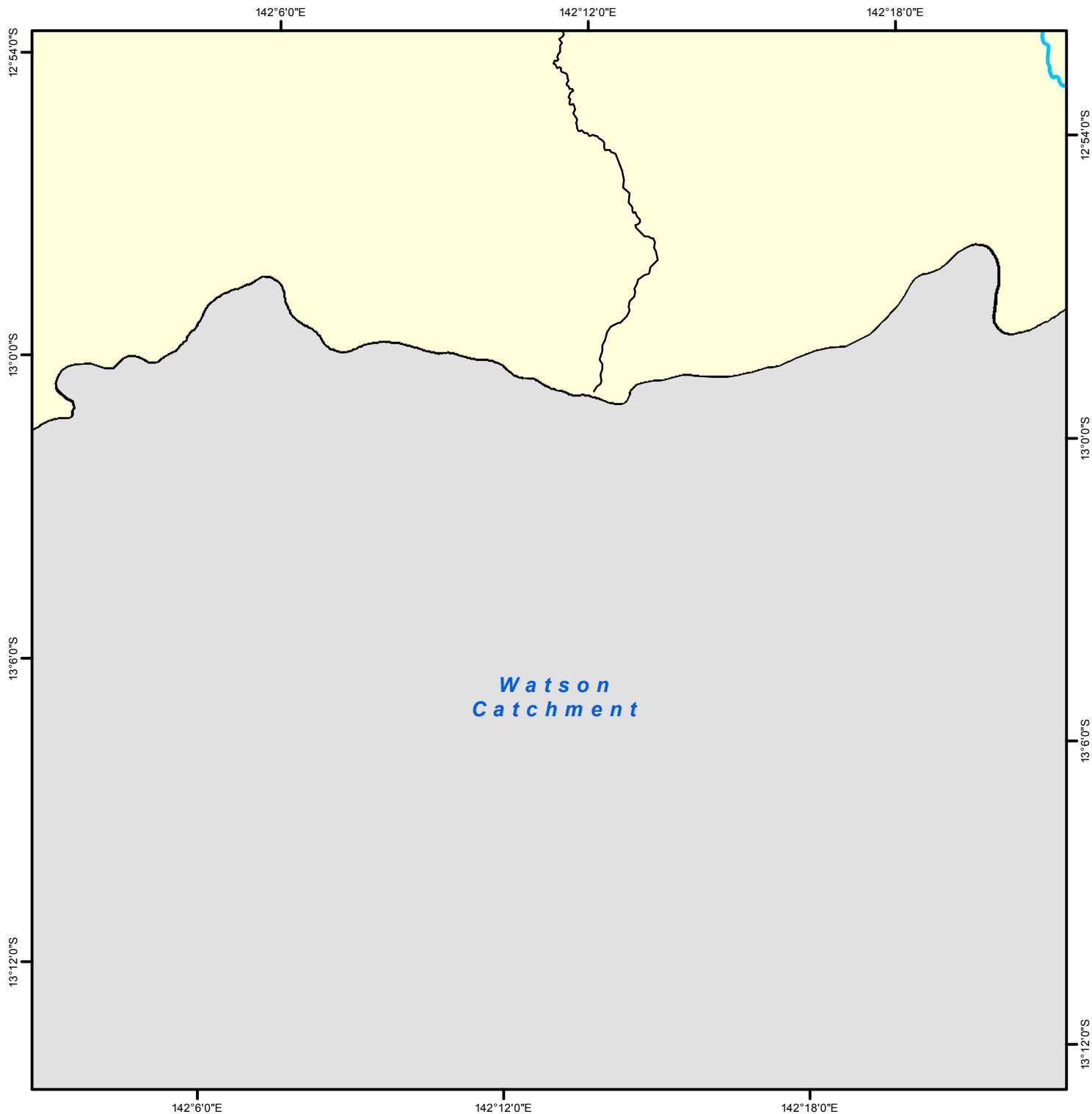
I4 Embley Catchment



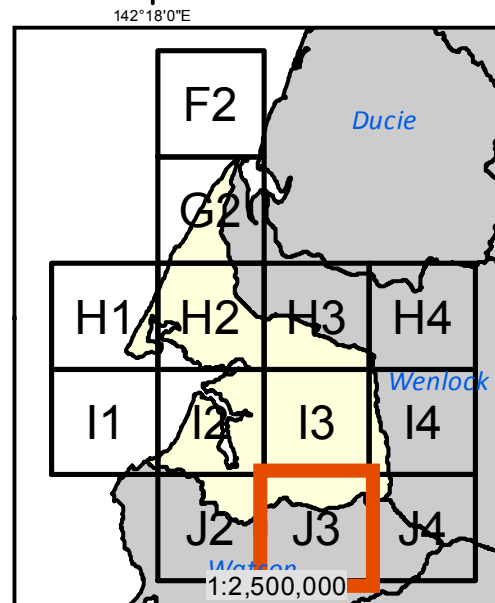
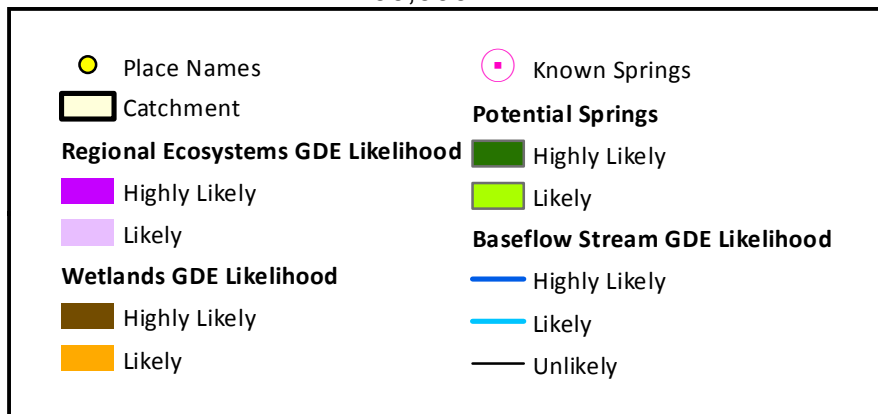
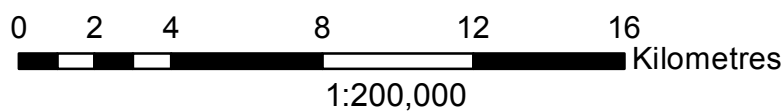


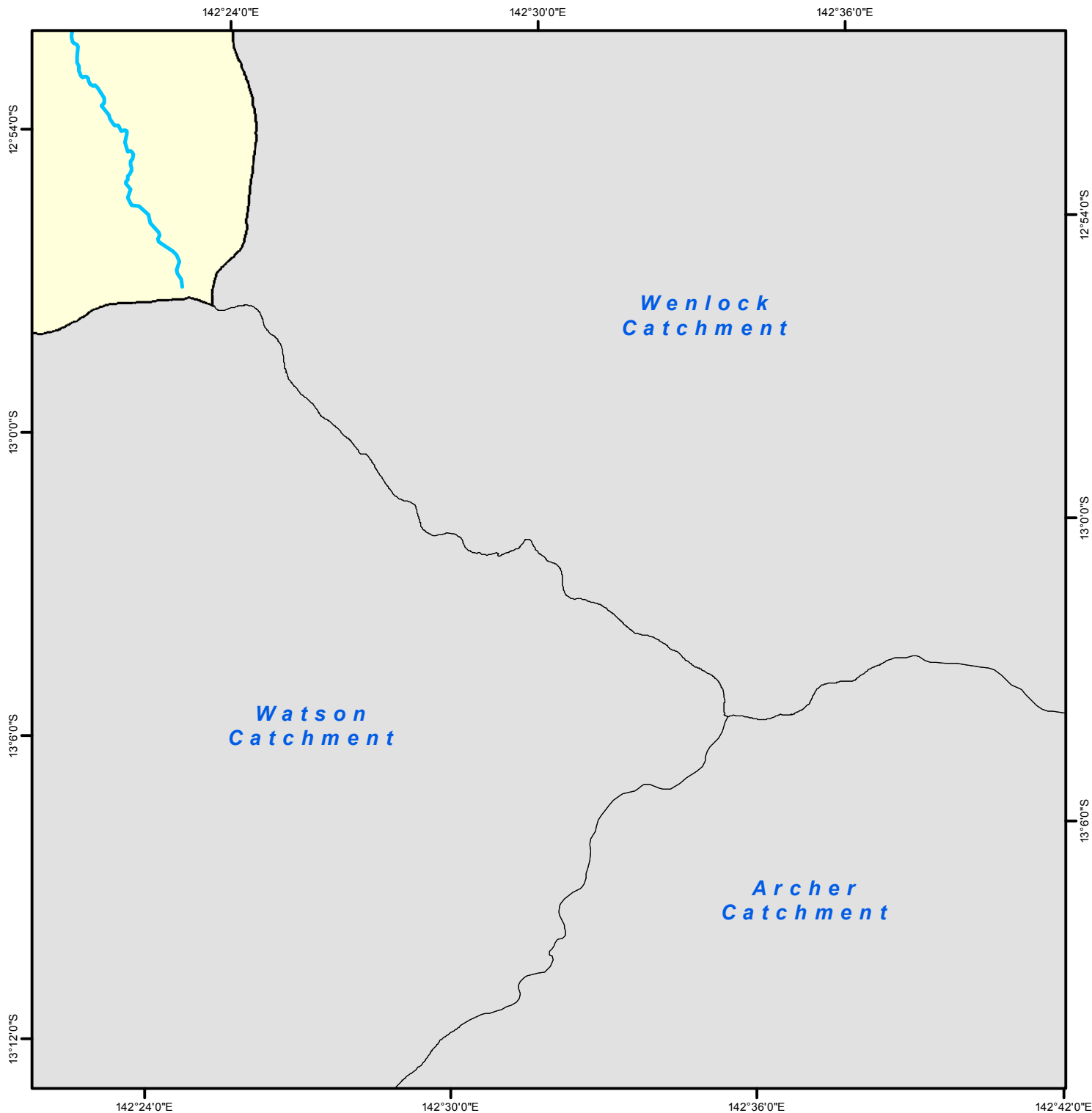
J2 Embley Catchment



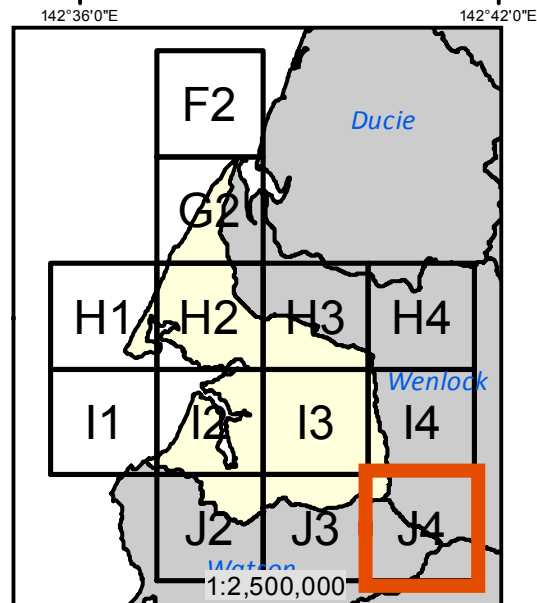
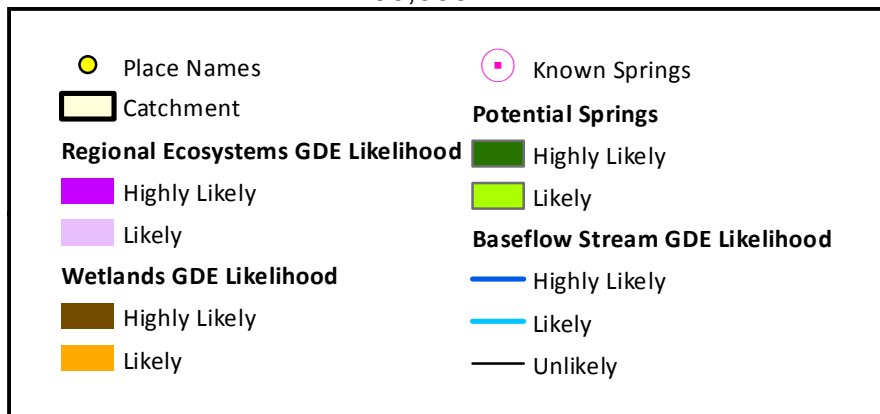
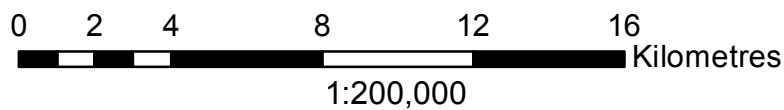


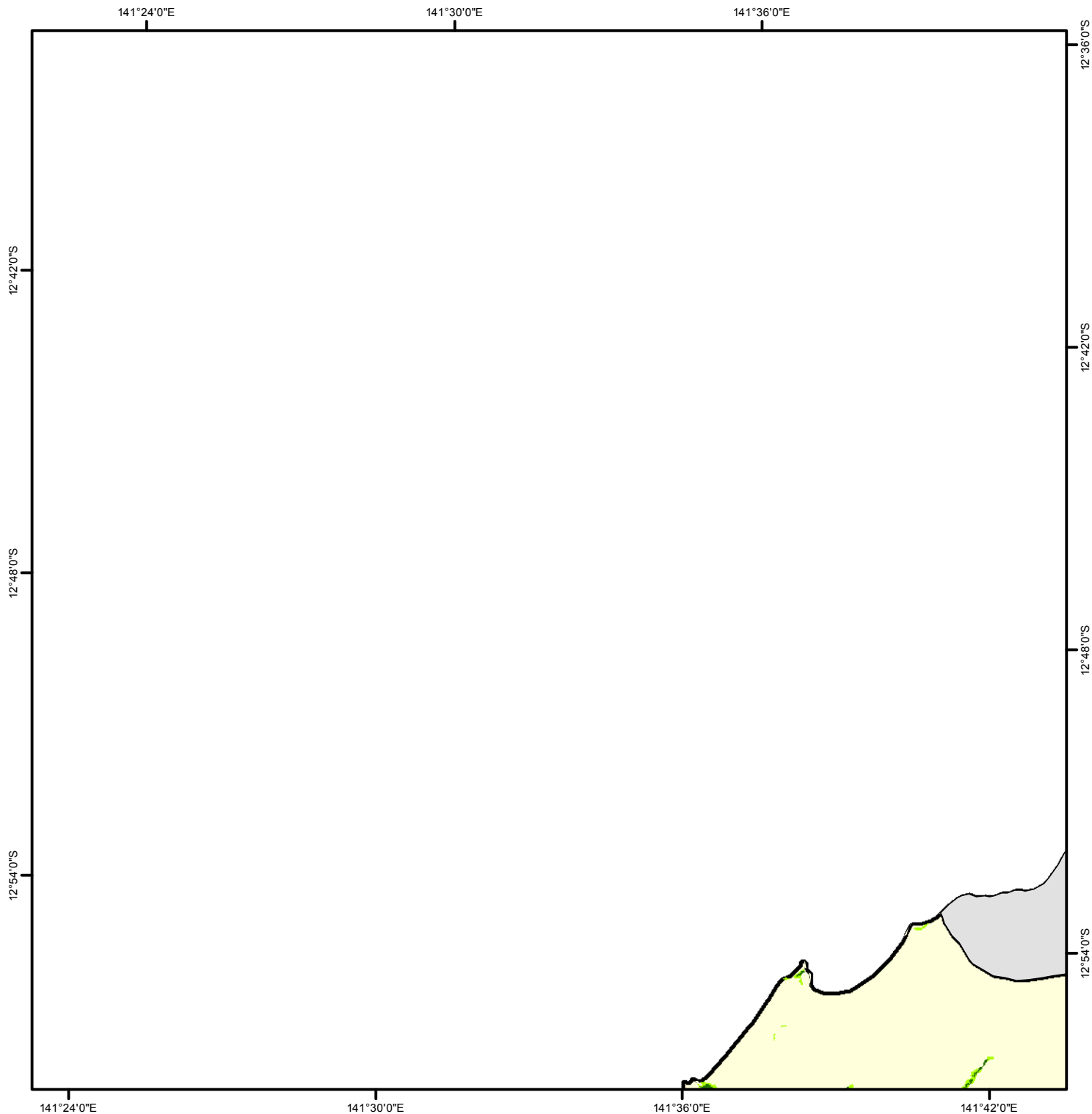
J3 Embley Catchment



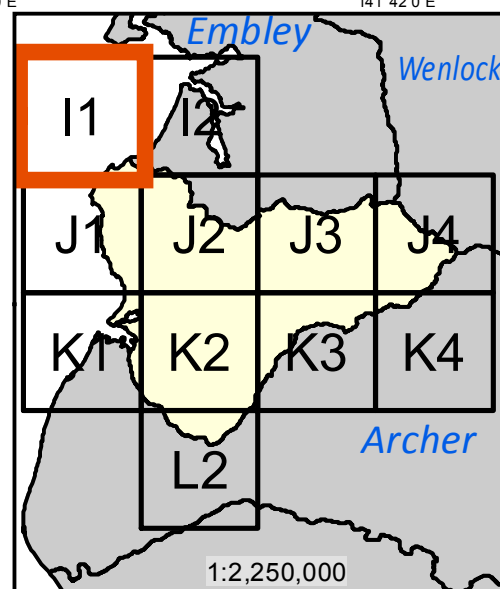
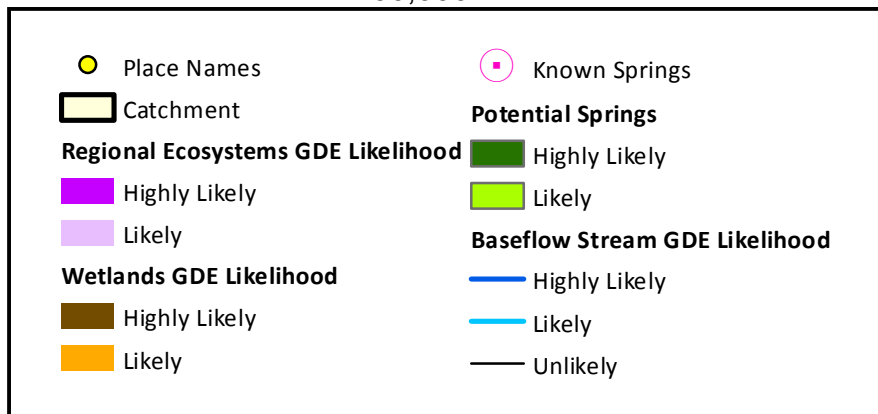
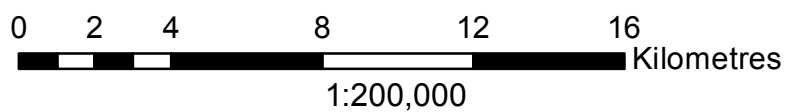


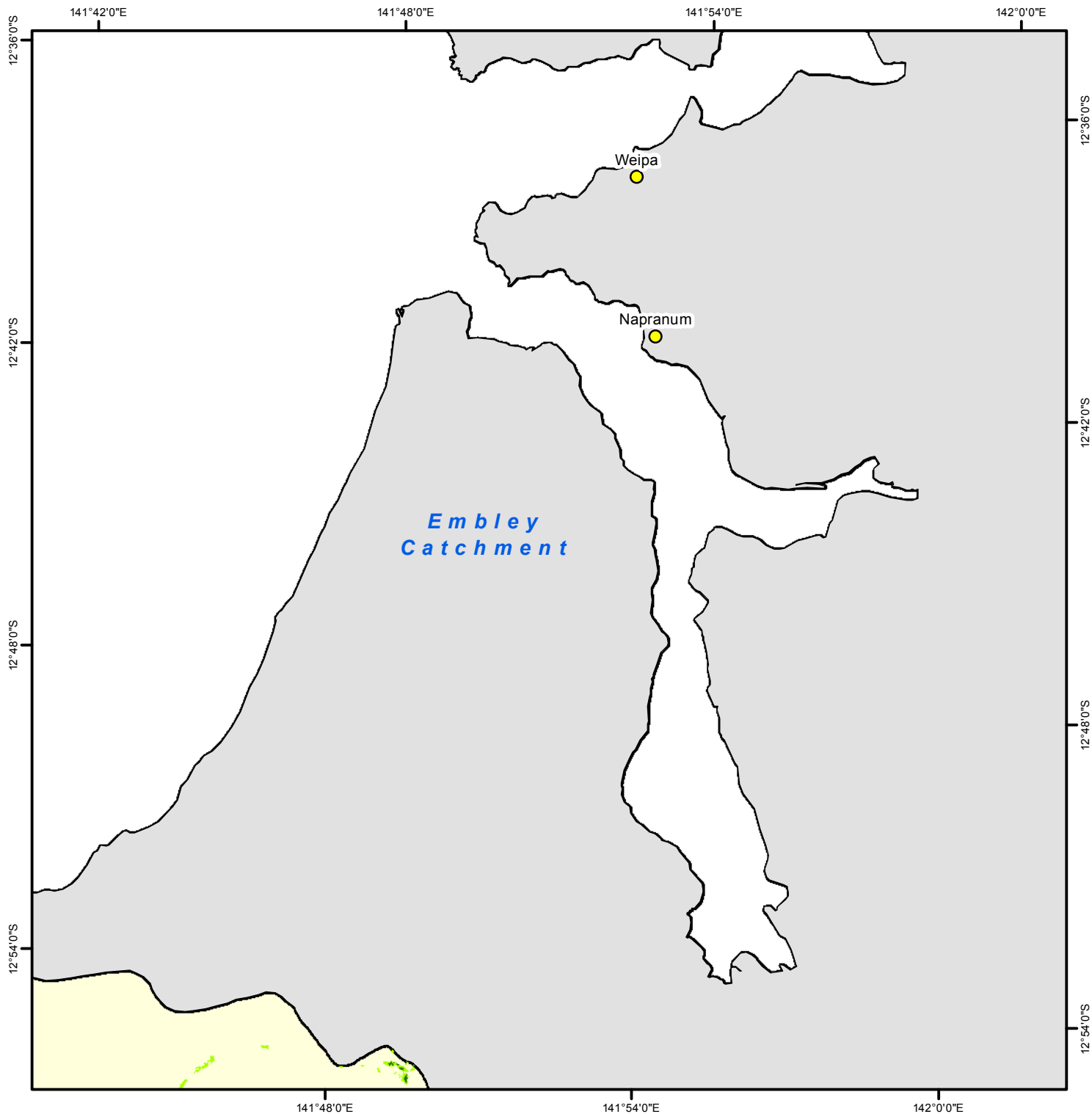
J4 Embley Catchment



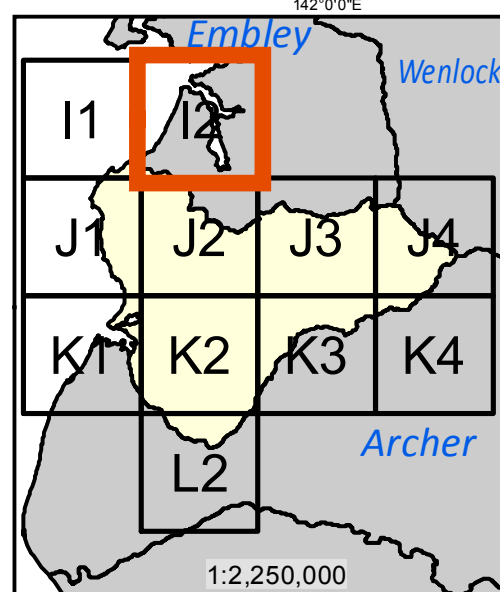
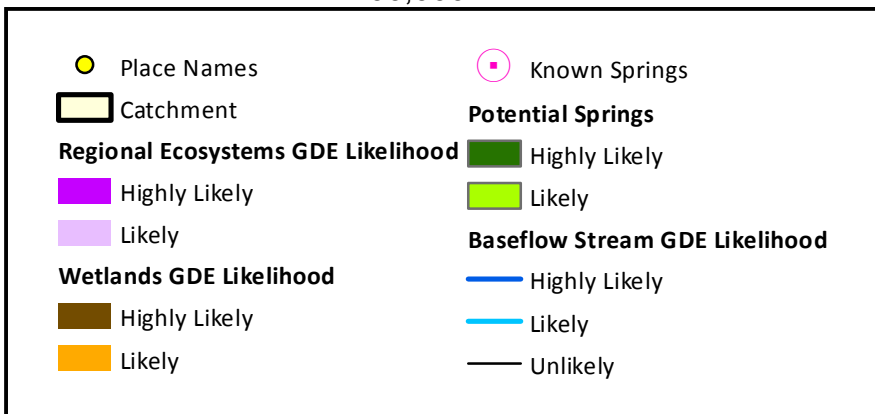
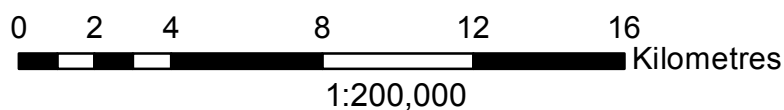


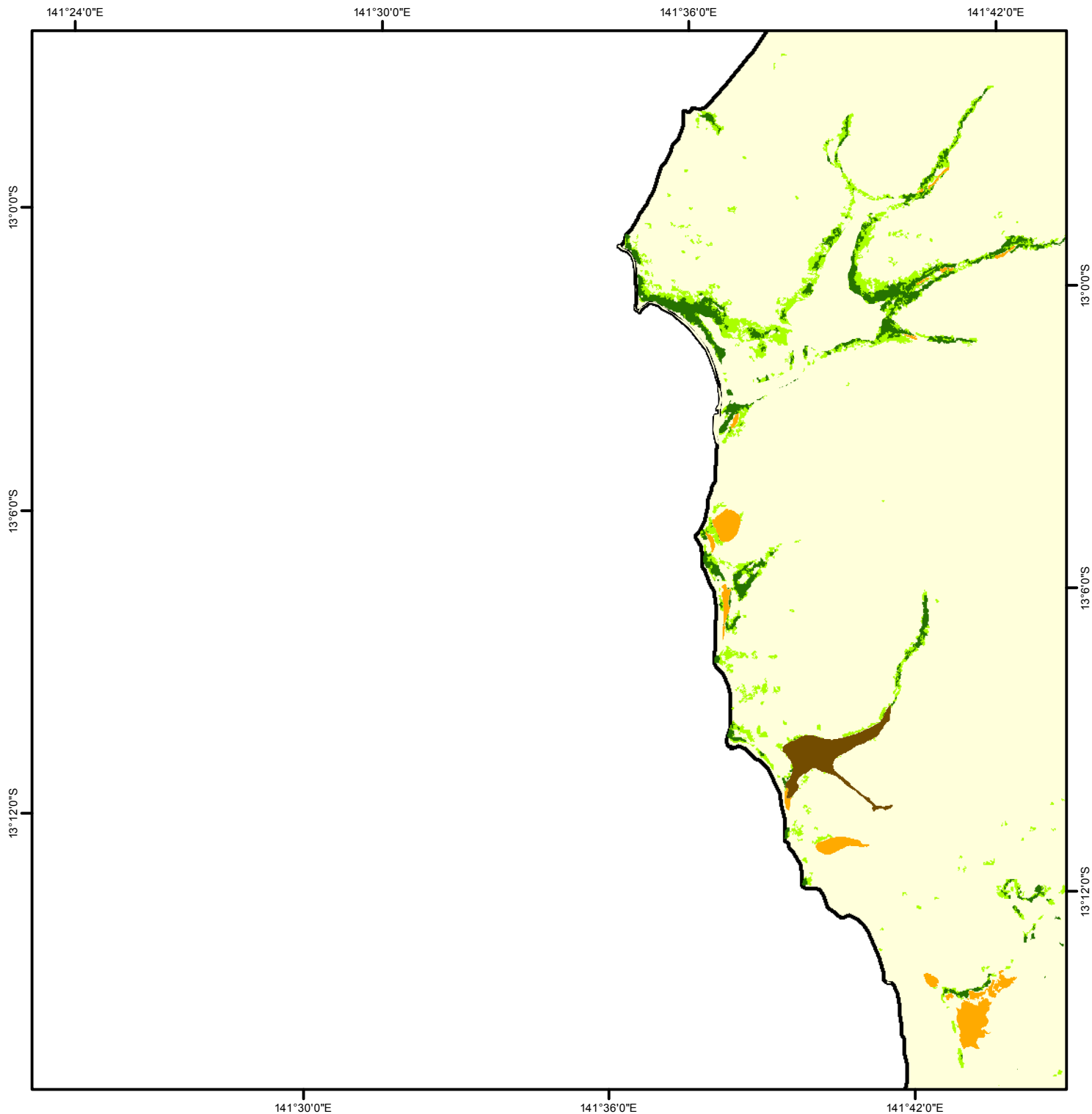
I1 Watson Catchment



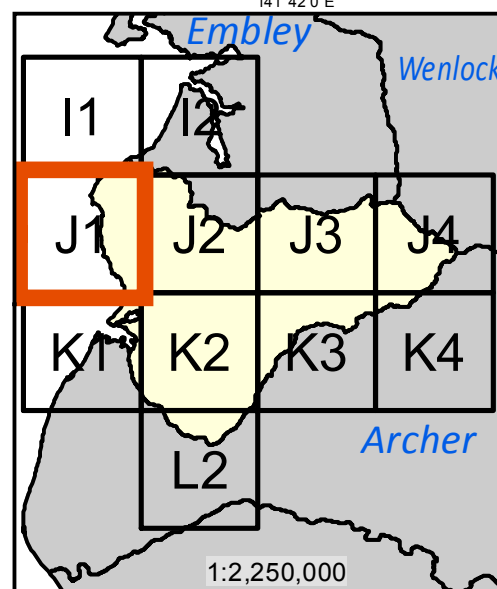
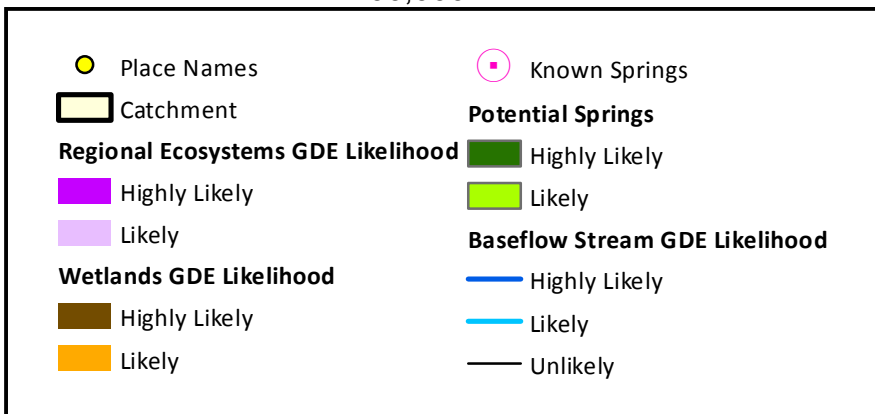
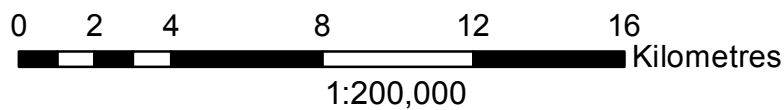


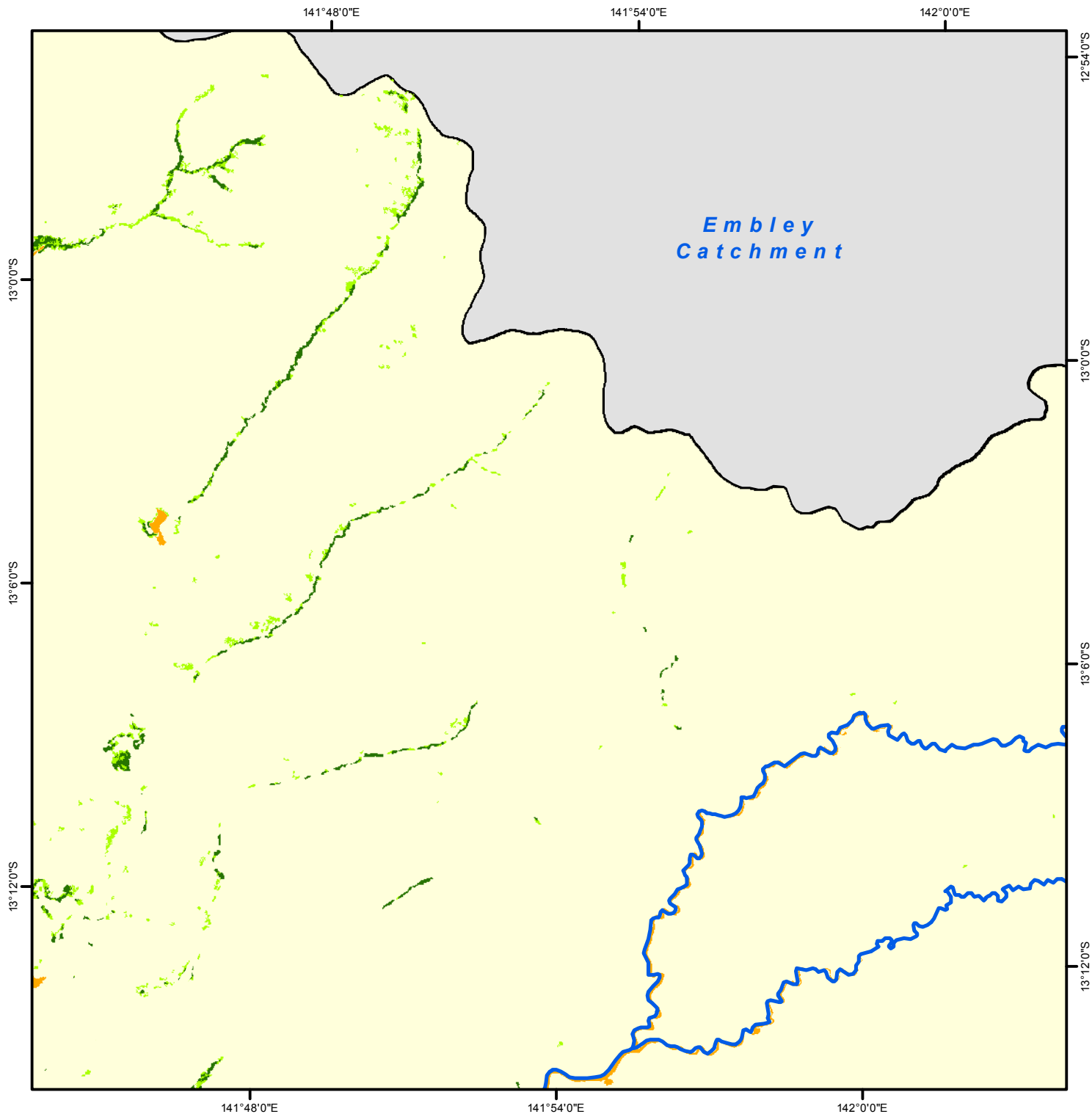
I2 Watson Catchment



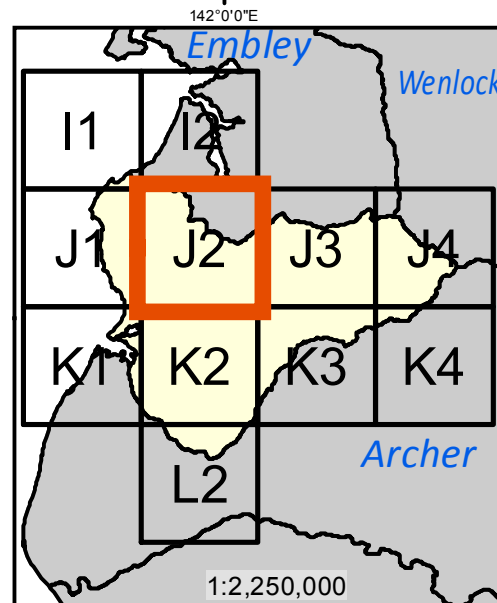
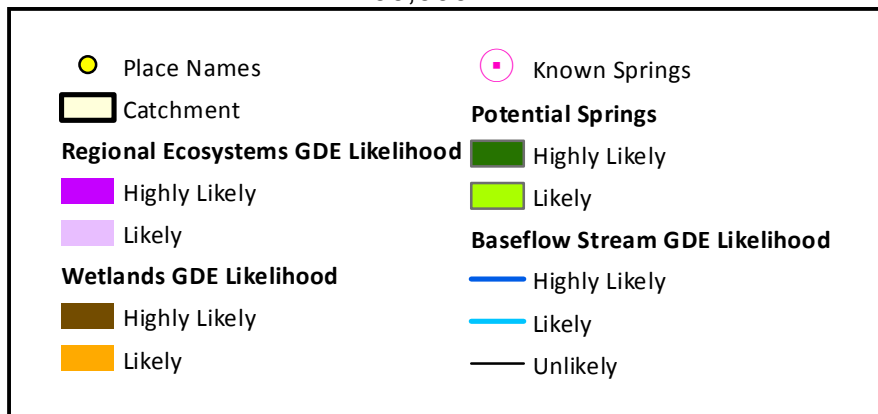
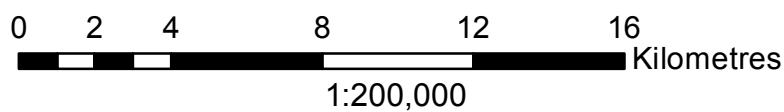


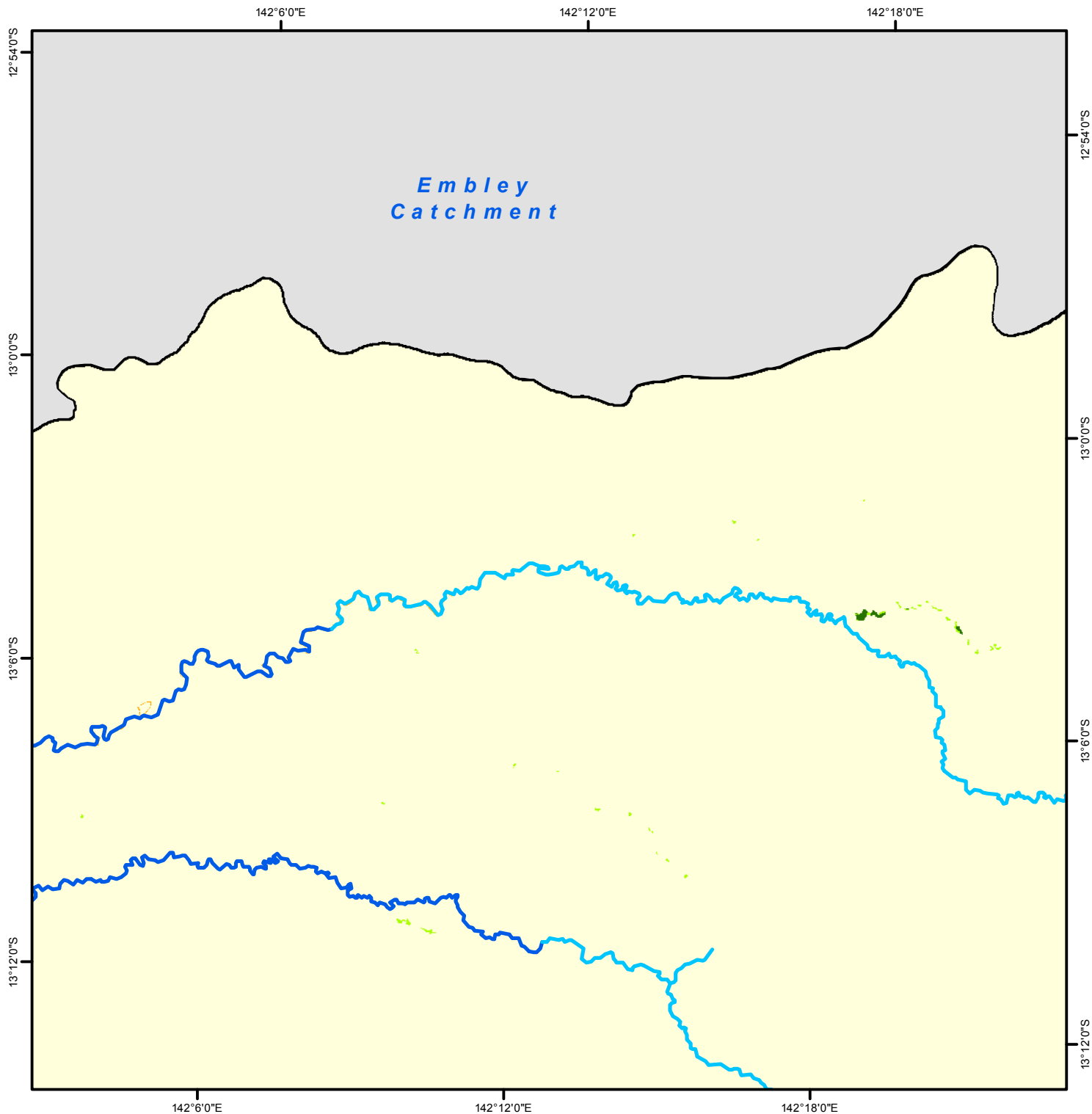
J1 Watson Catchment



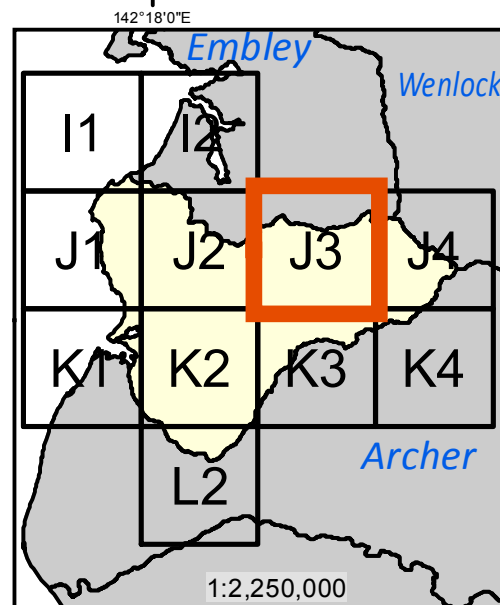
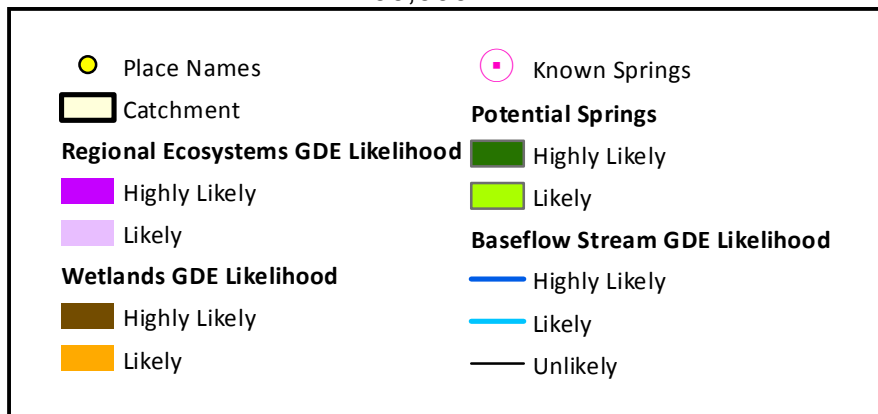
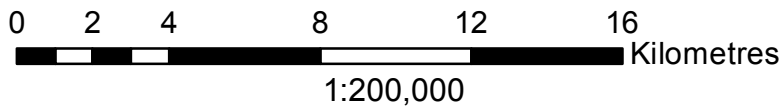


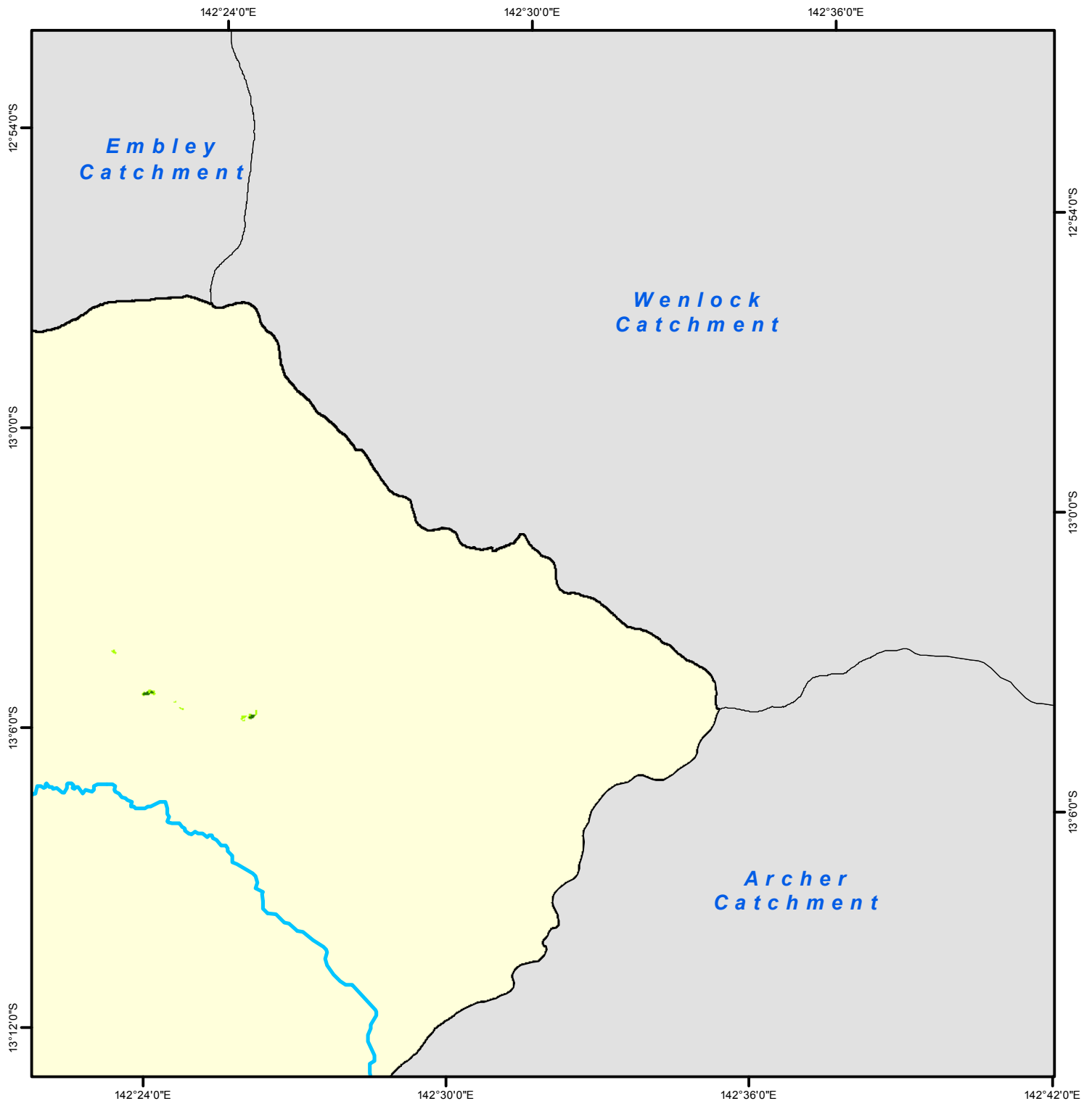
J2 Watson Catchment



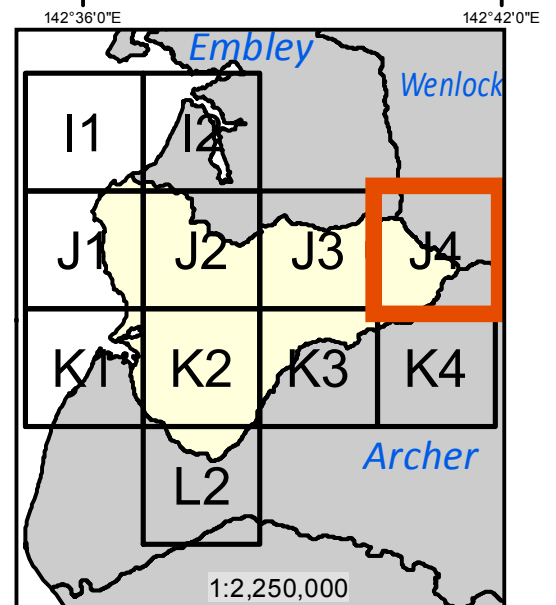
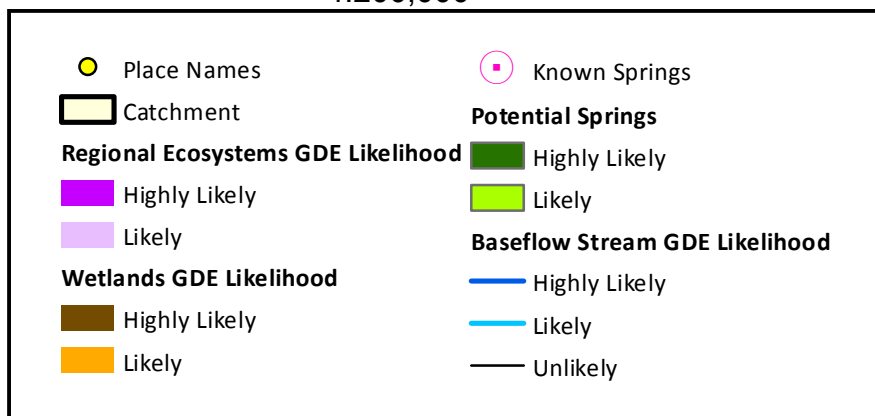
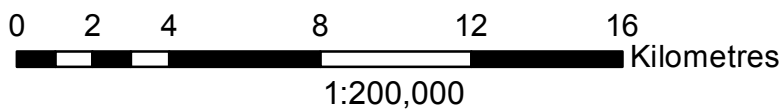


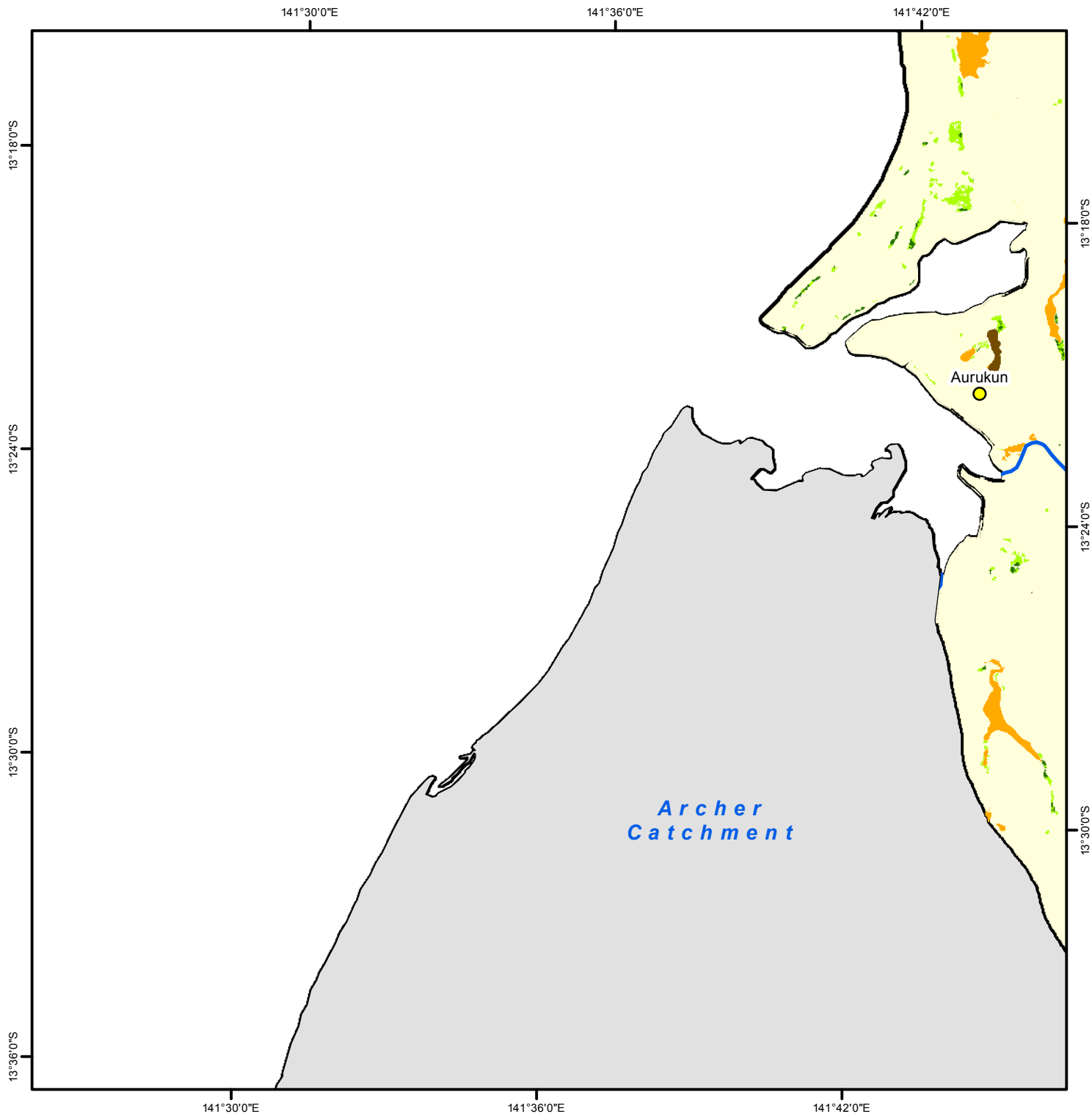
J3 Watson Catchment



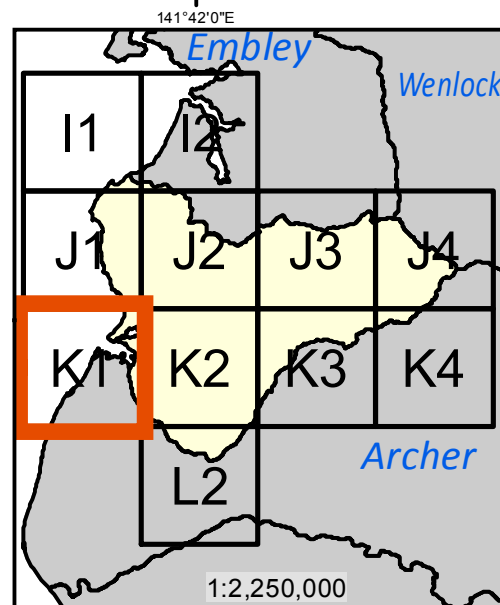
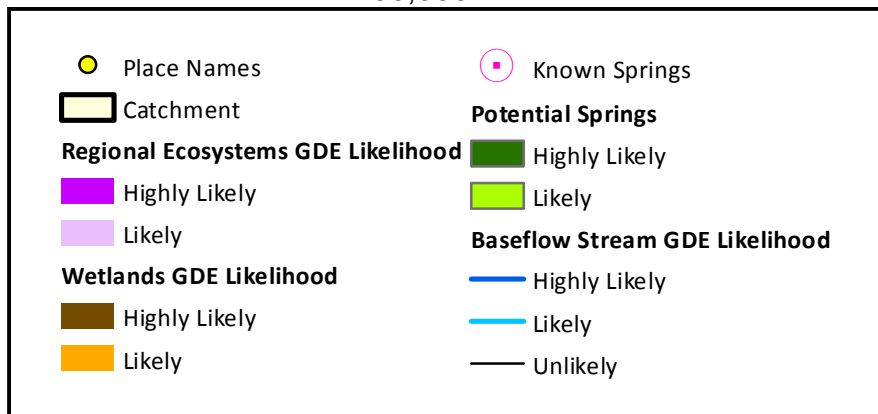
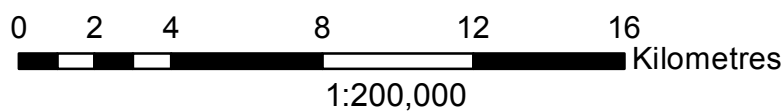


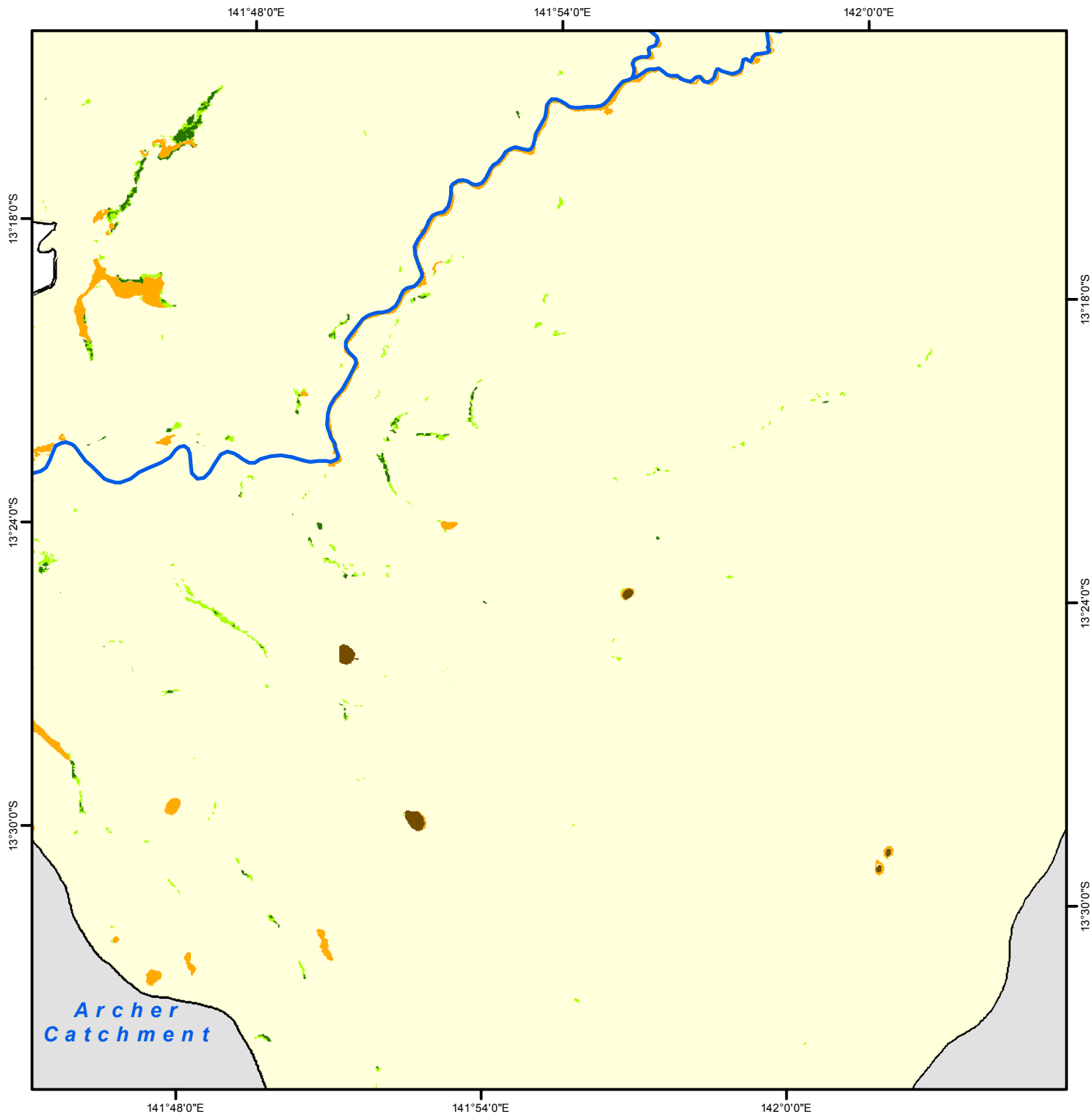
J4 Watson Catchment



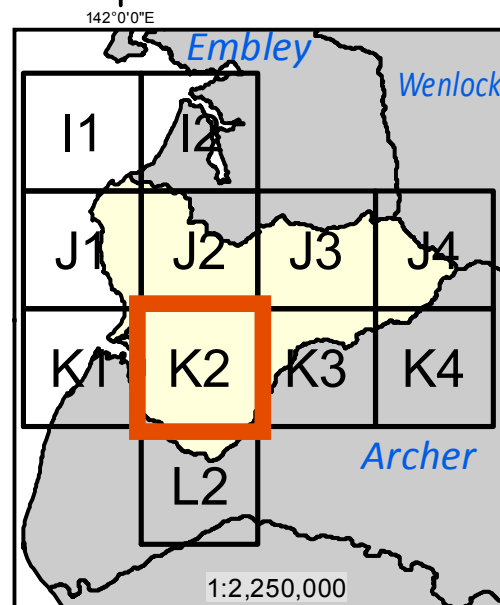
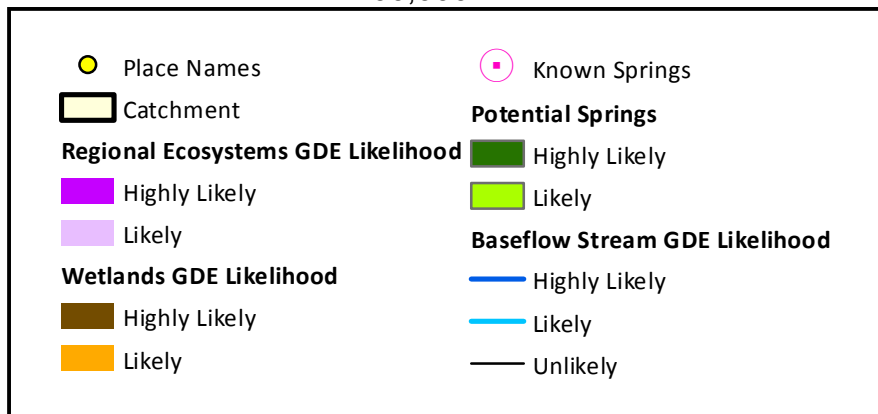
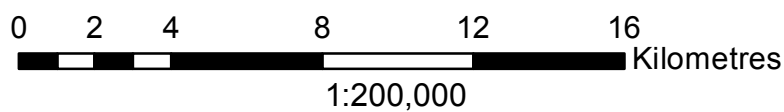


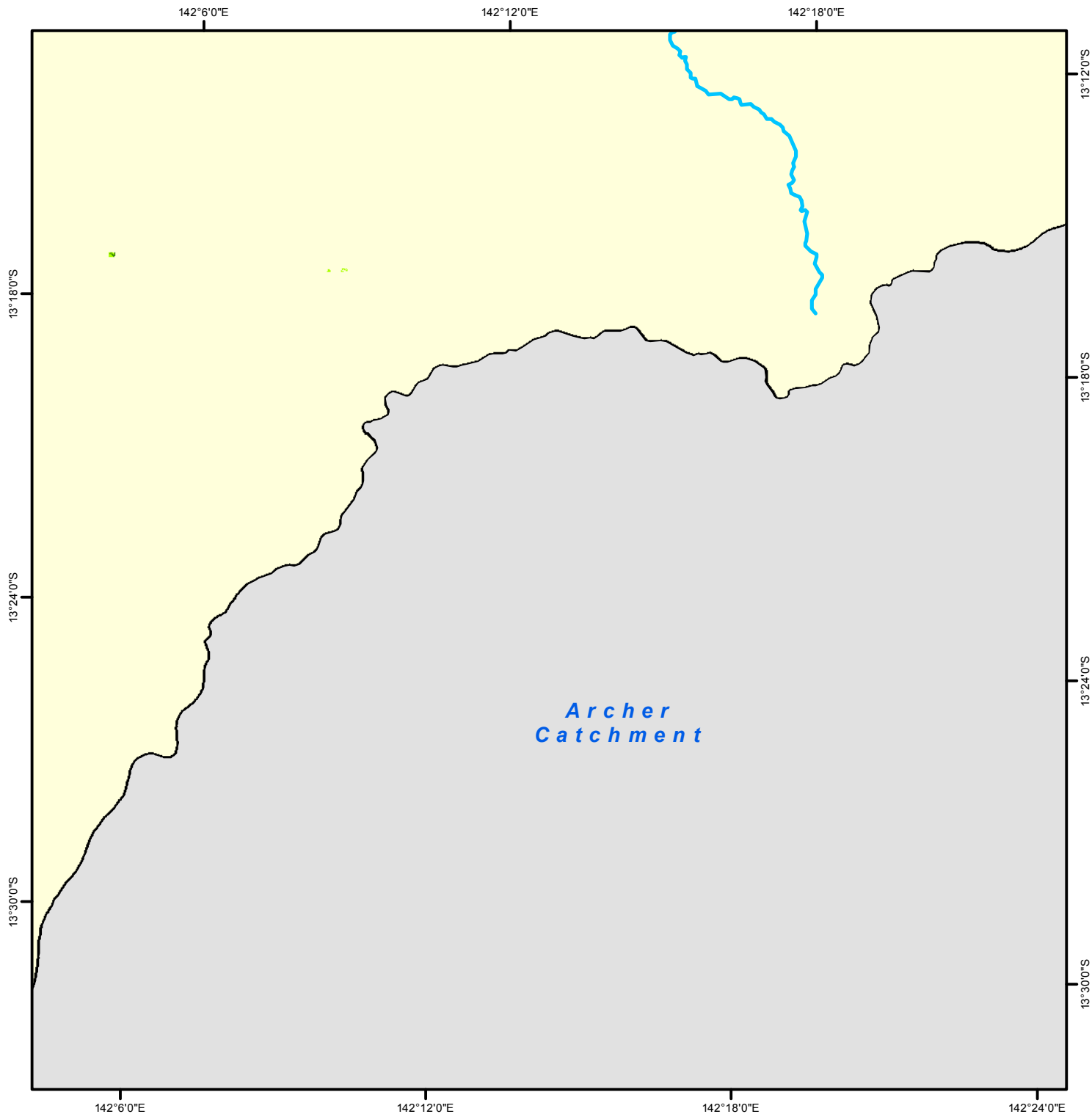
K1 Watson Catchment



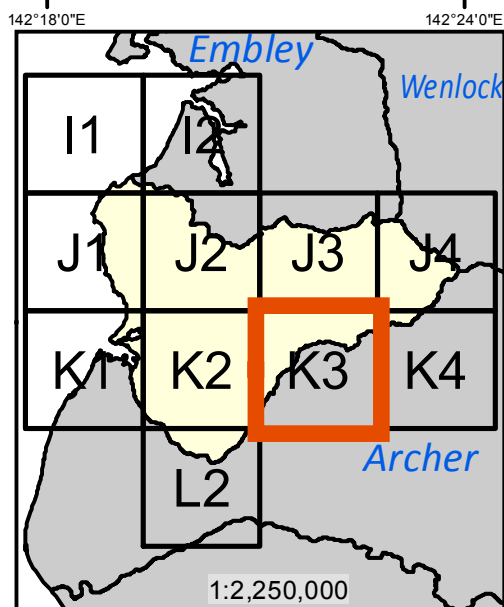
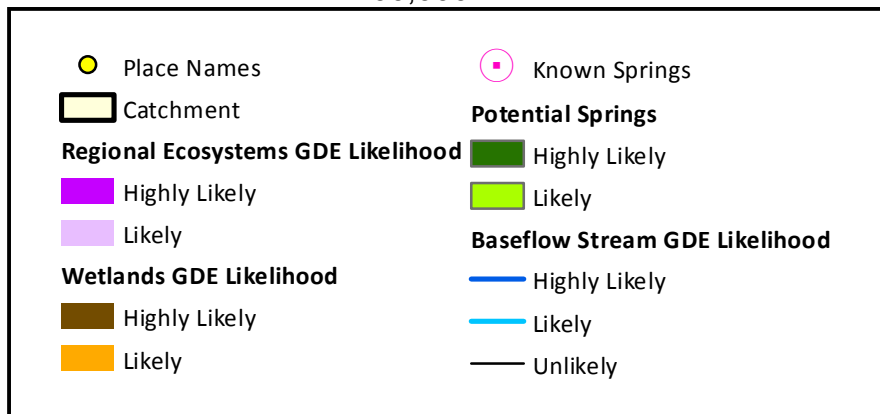
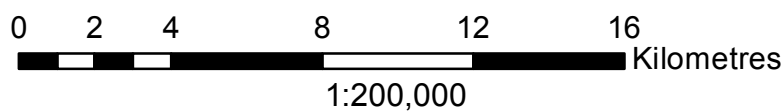


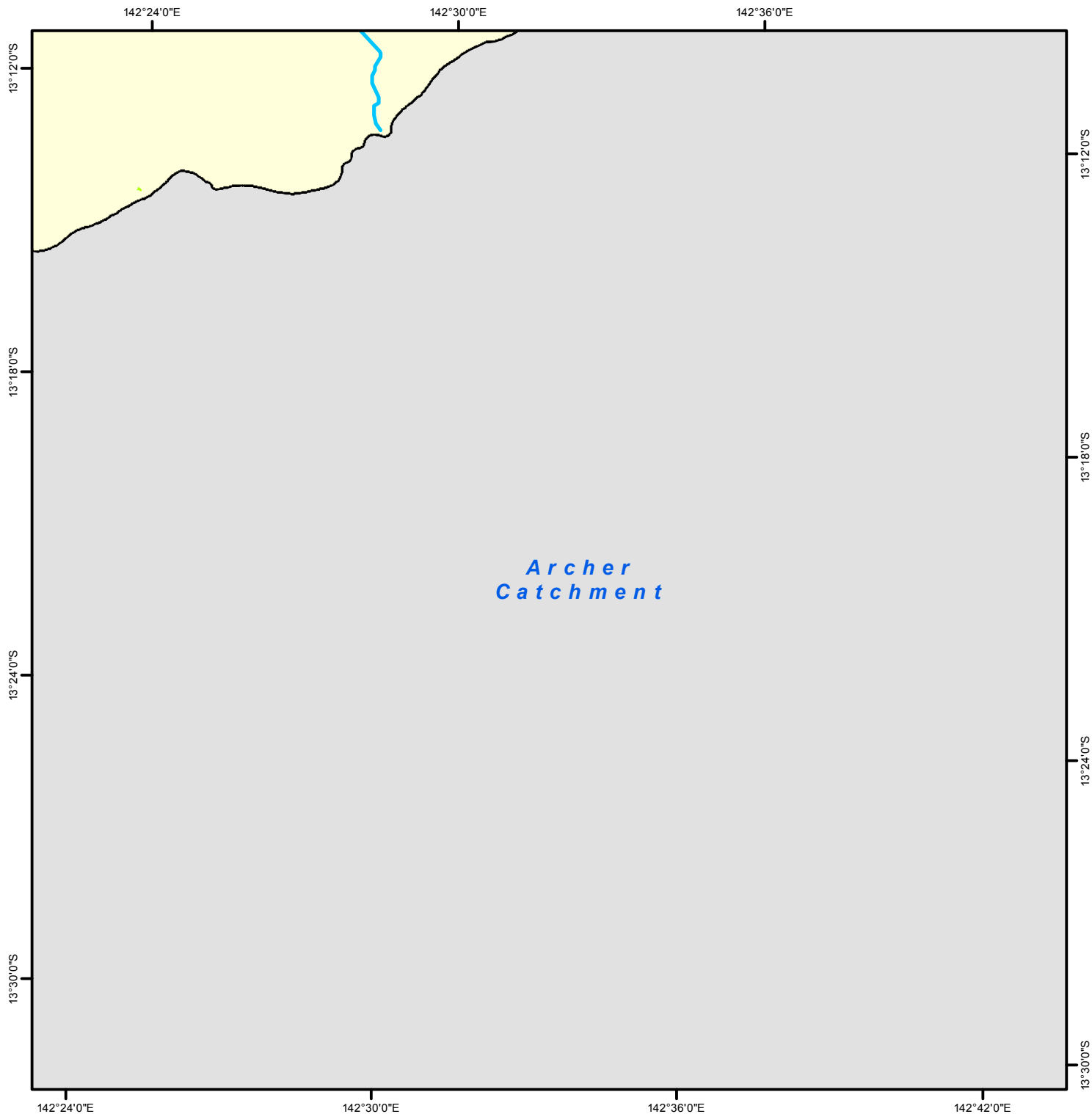
K2 Watson Catchment



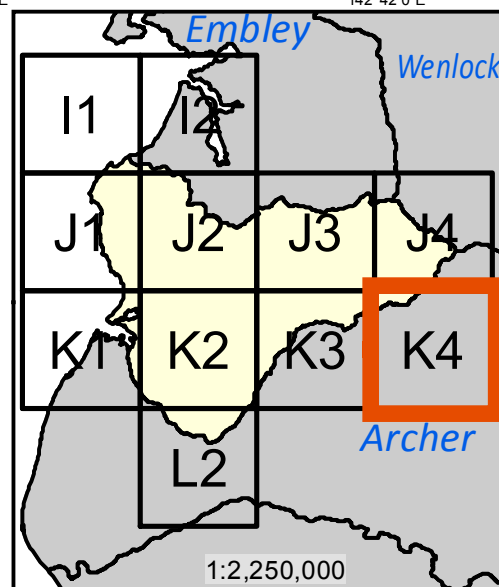
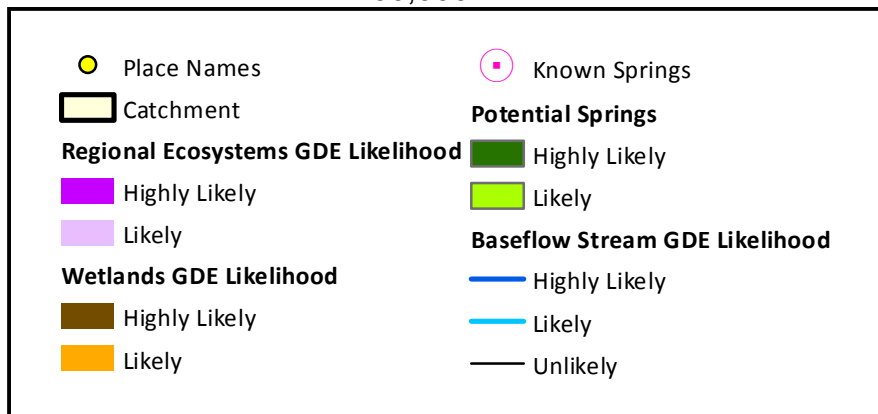
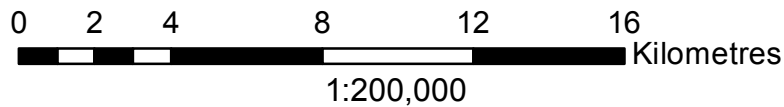


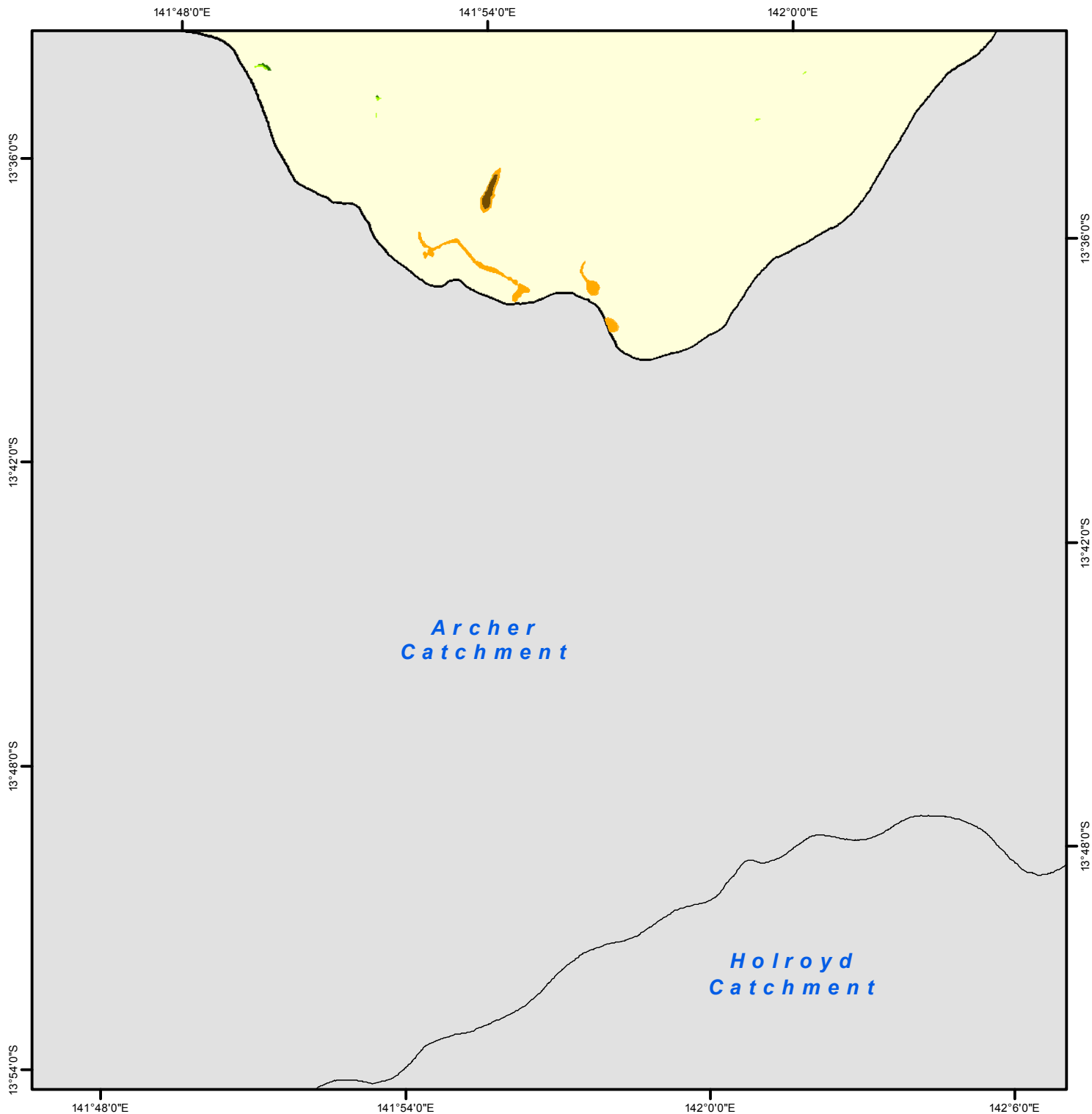
K3 Watson Catchment



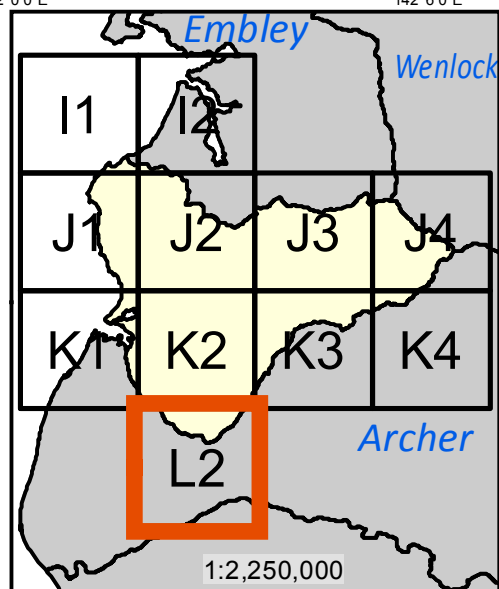
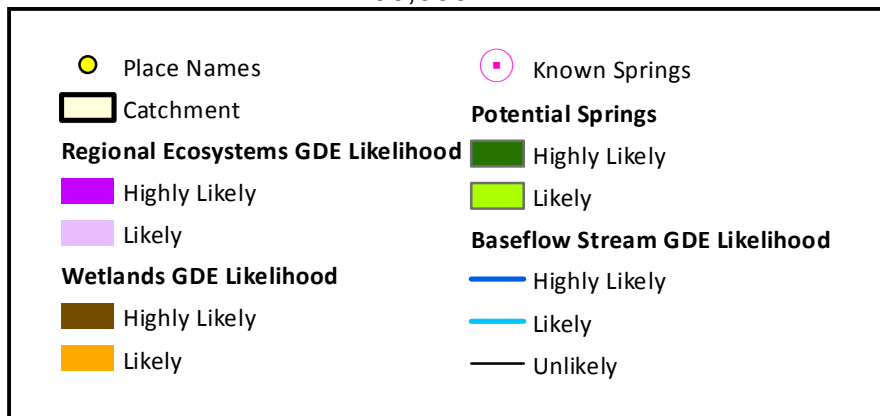
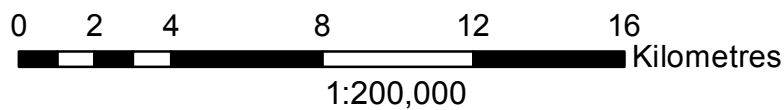


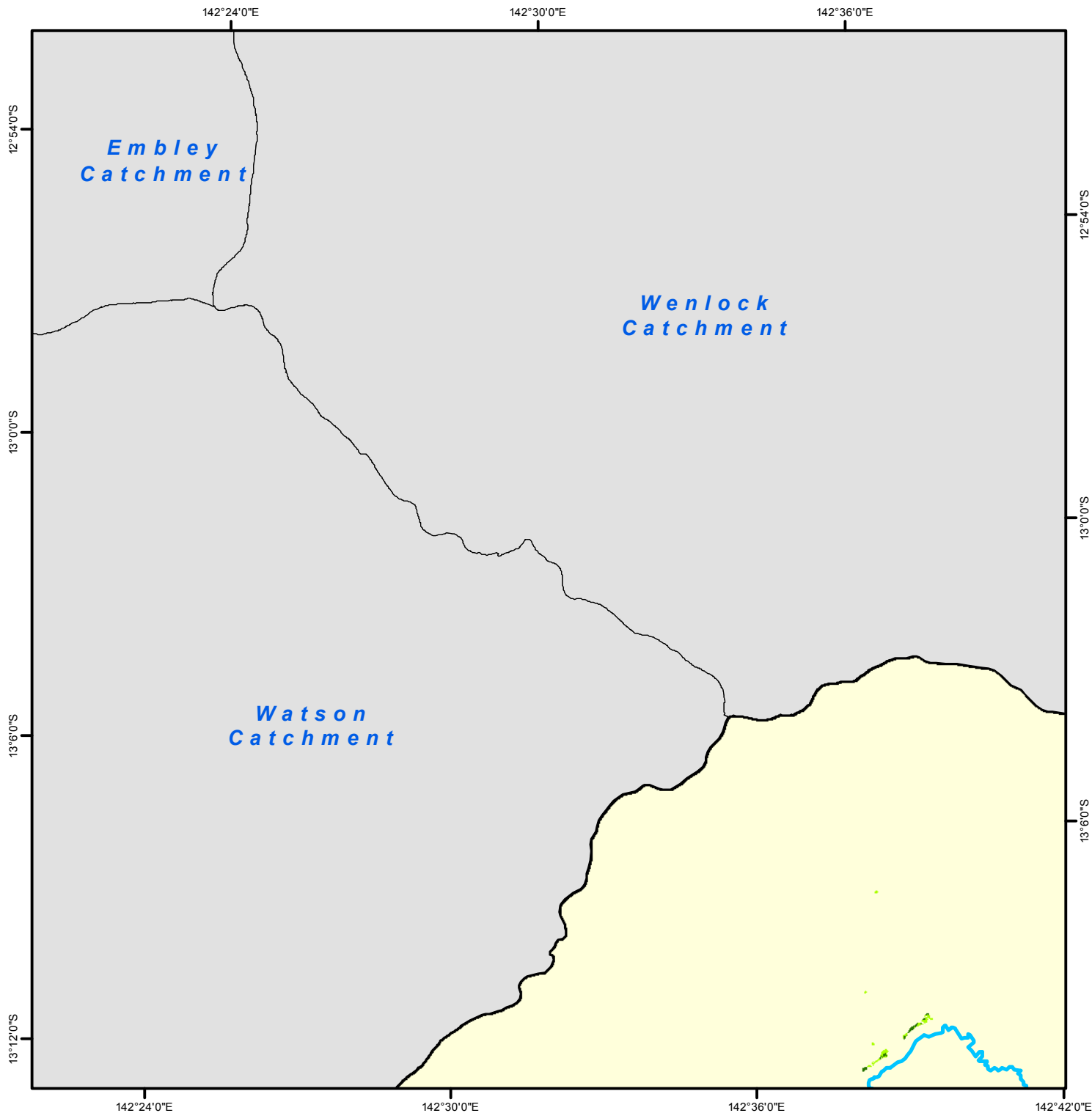
K4 Watson Catchment



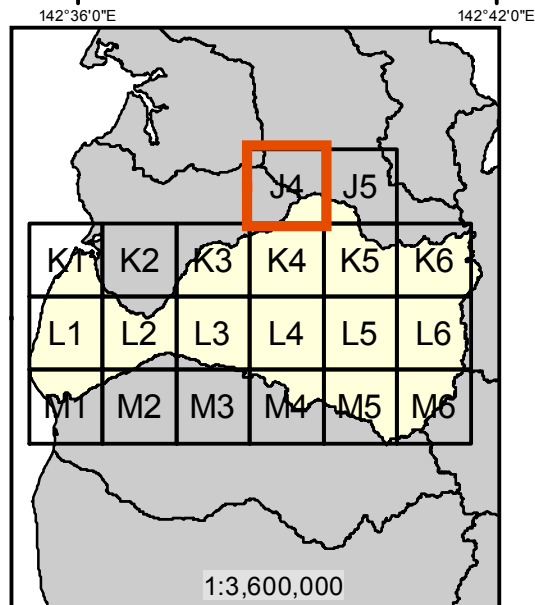
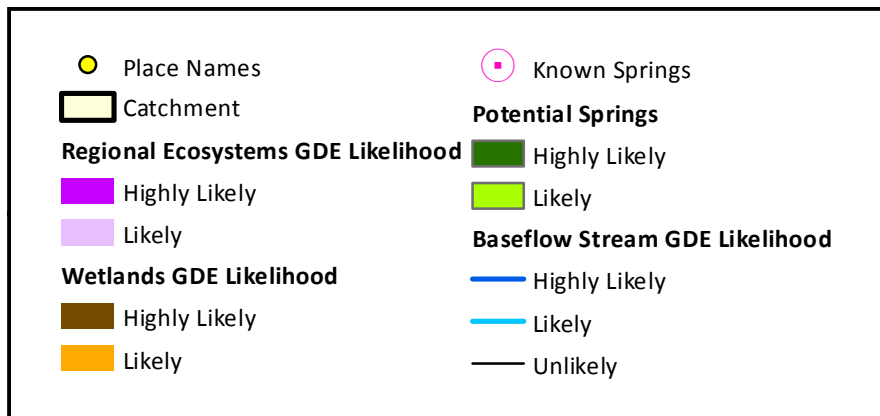
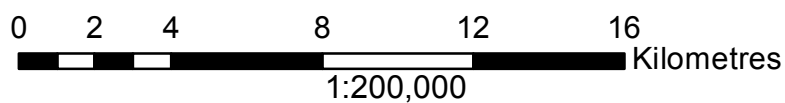


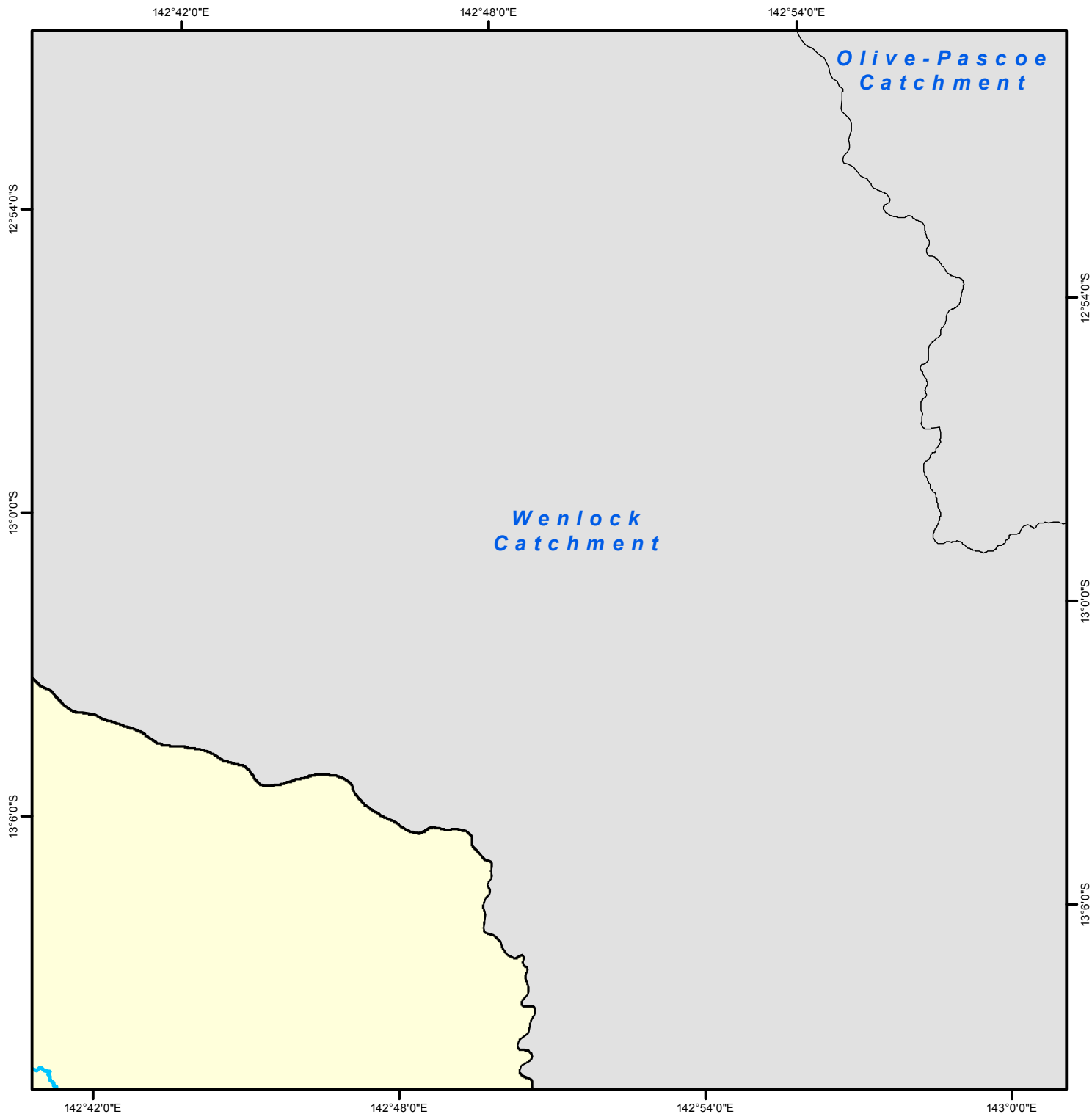
L2 Watson Catchment



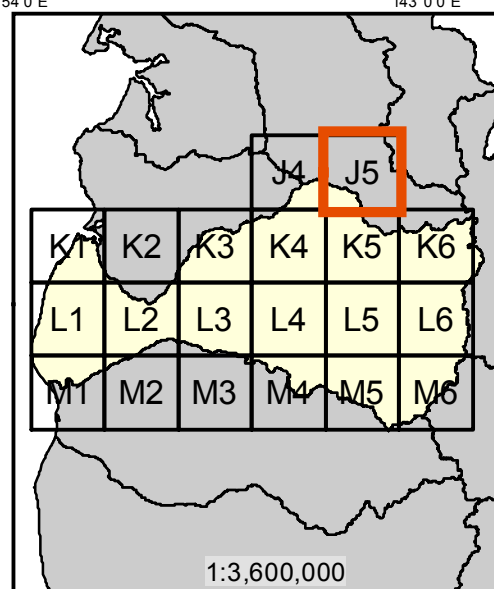
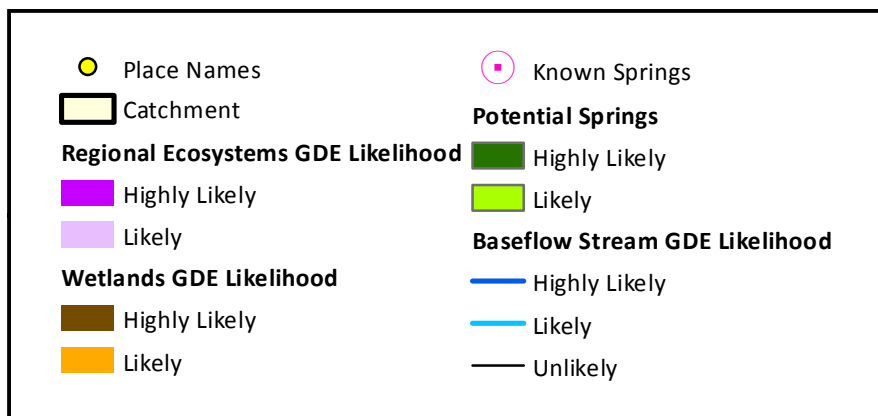
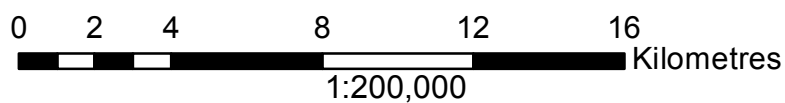


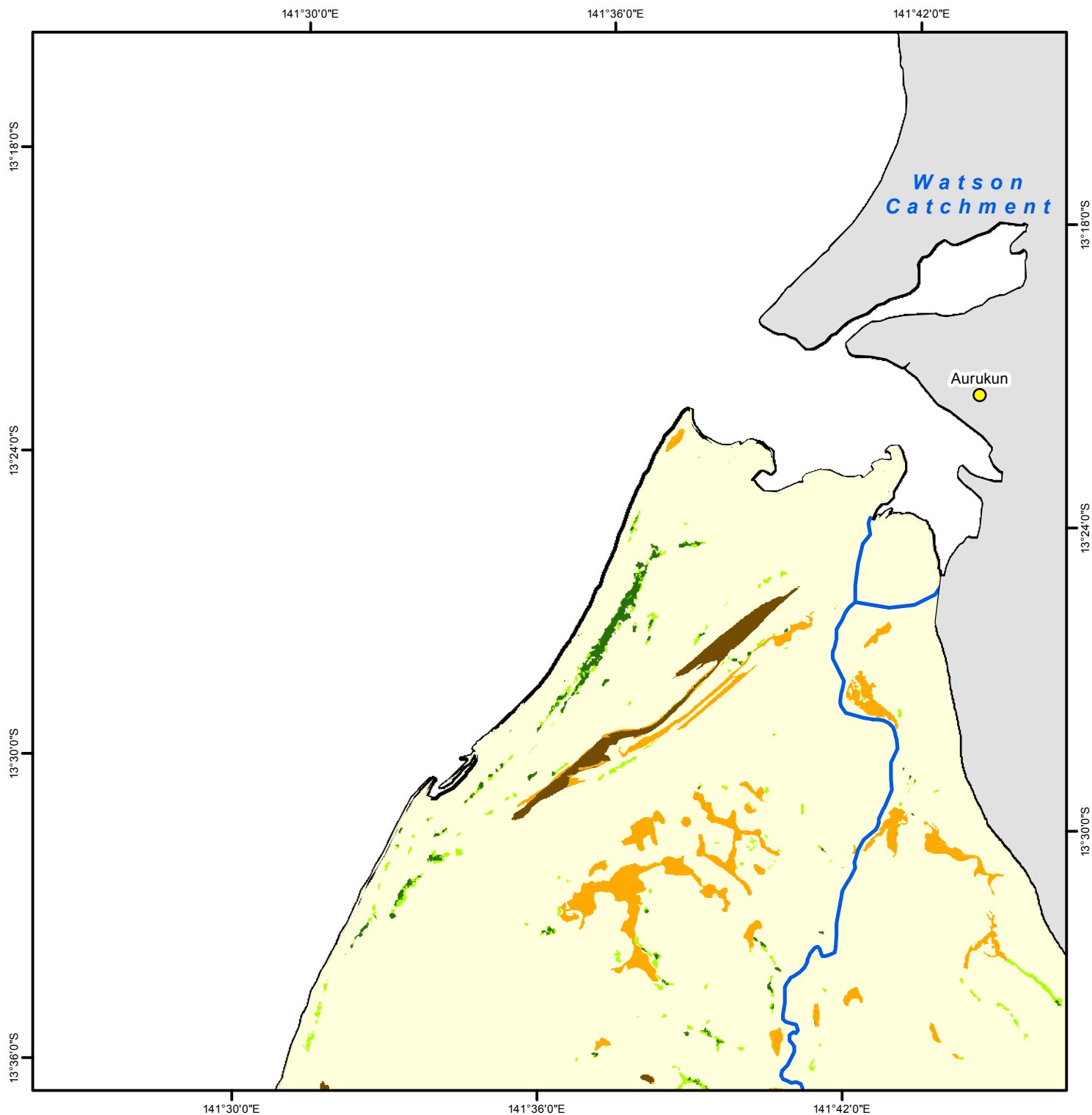
J4 Archer Catchment

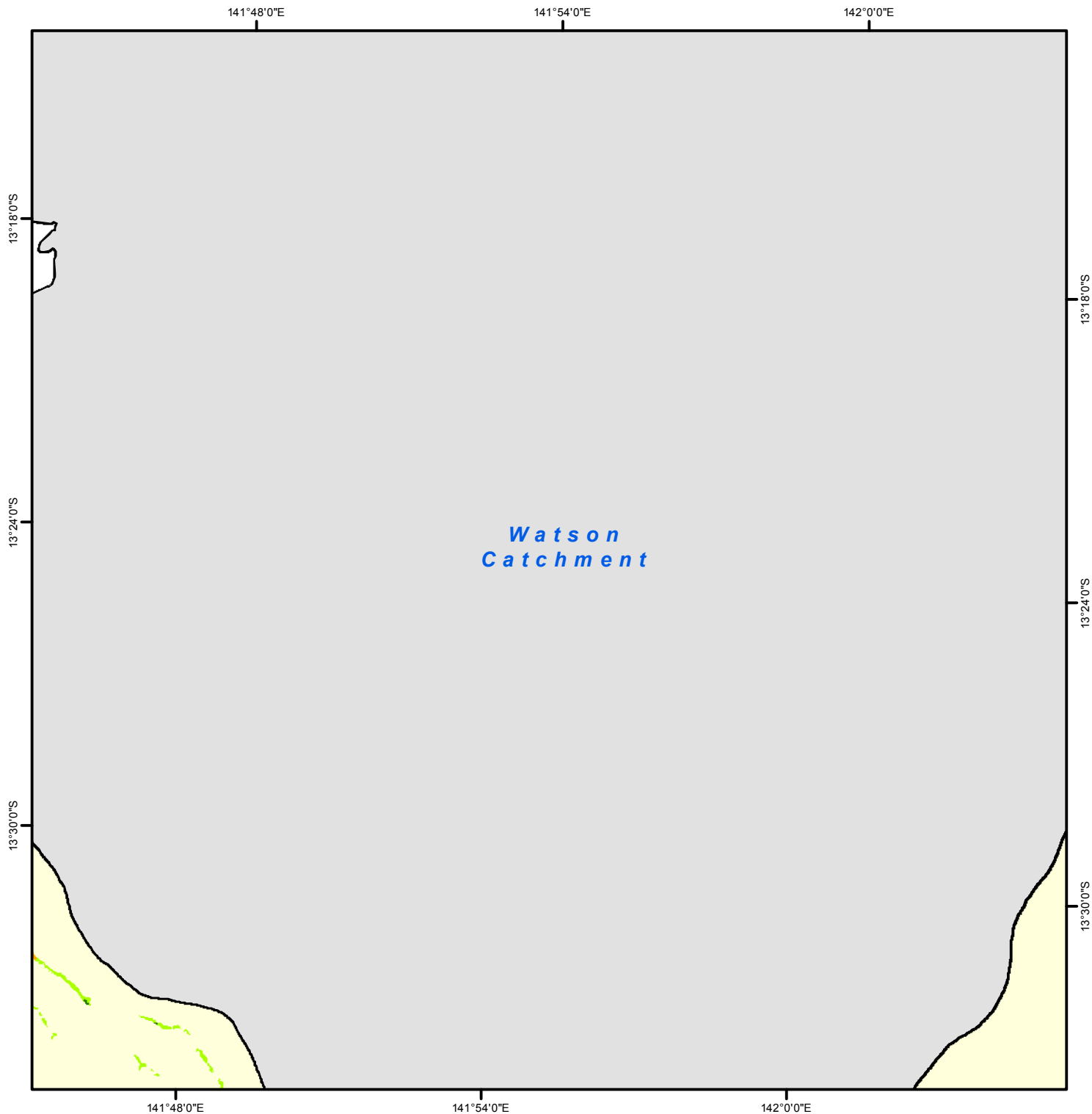




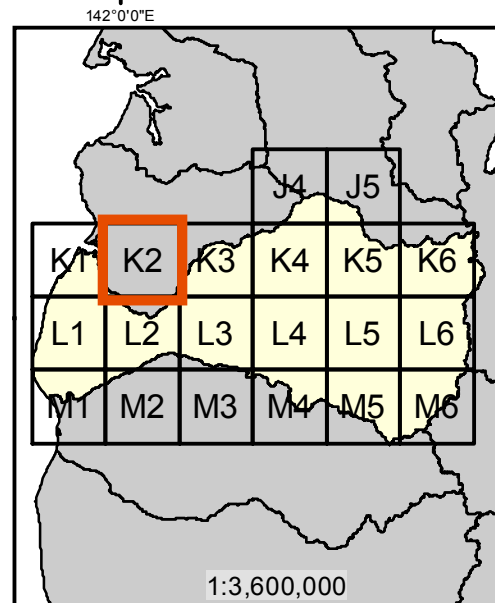
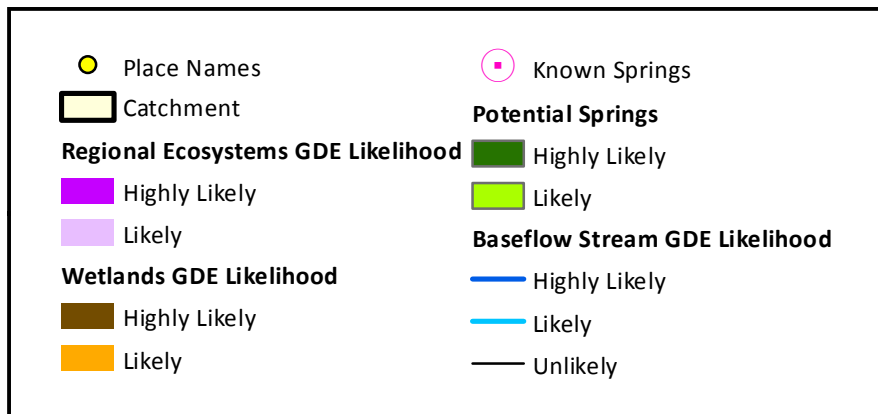
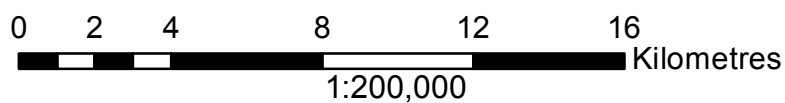
J5 Archer Catchment

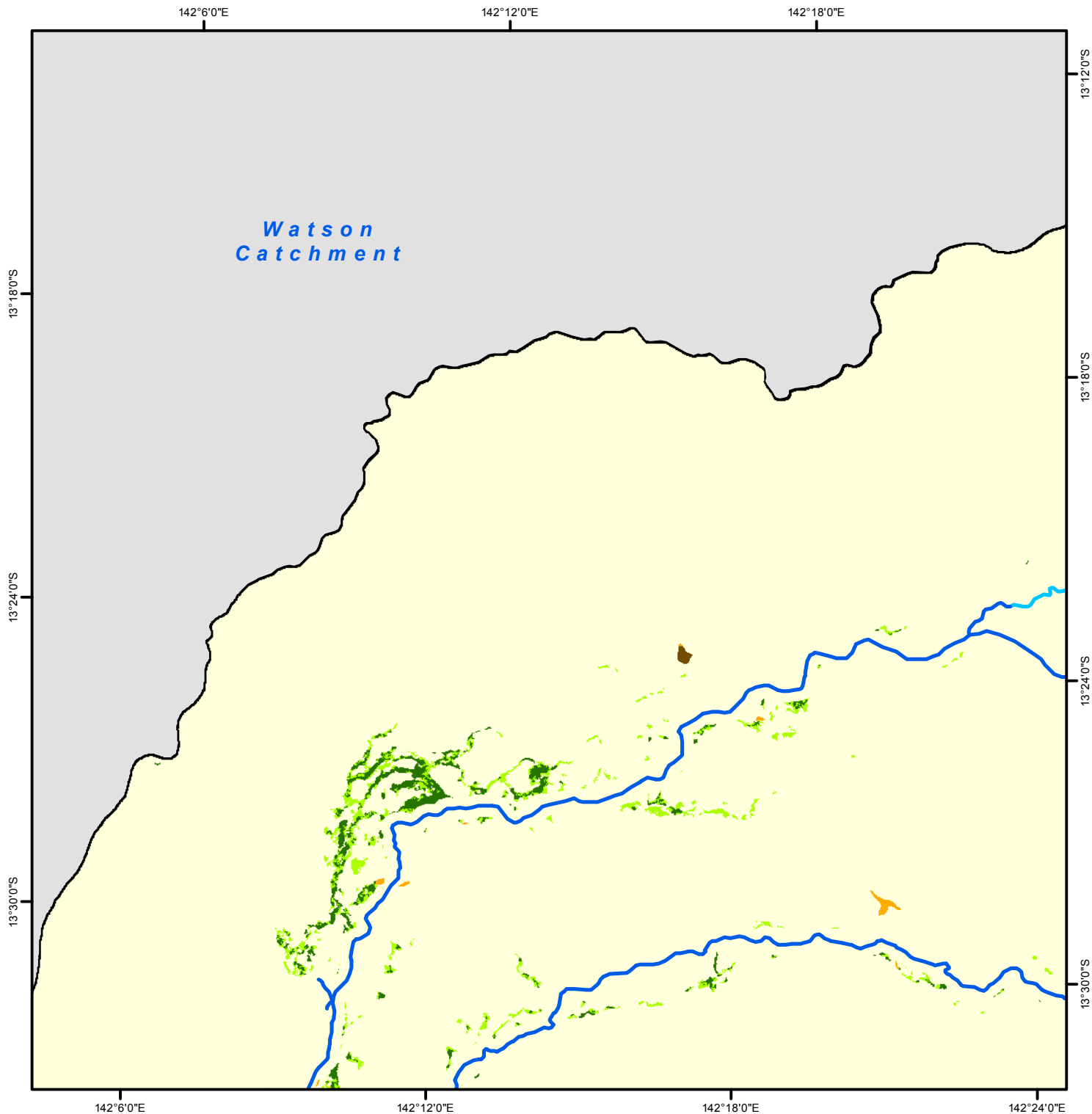




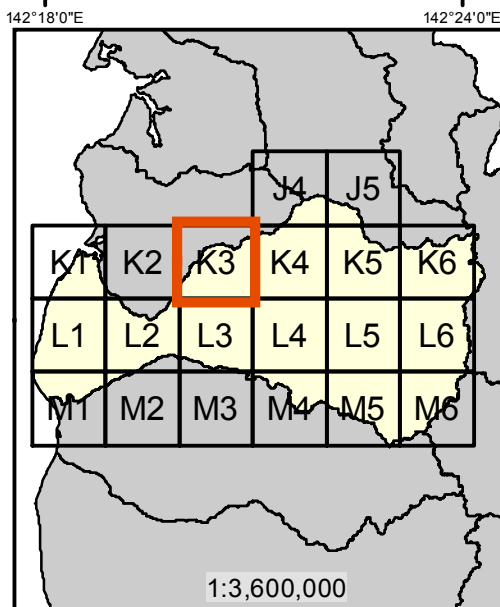
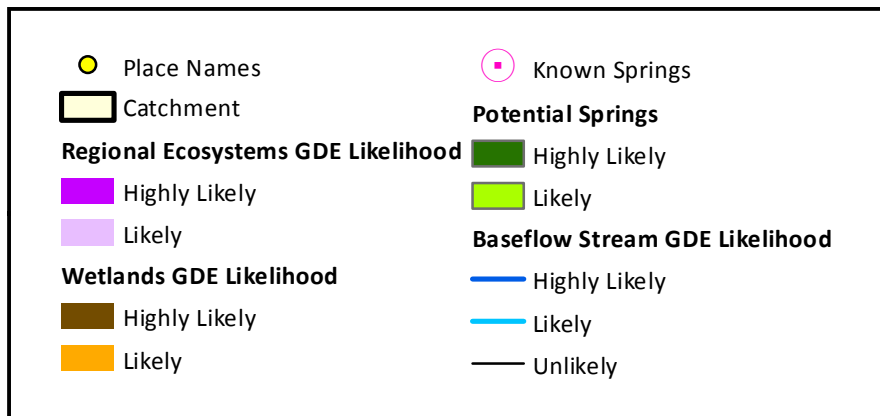
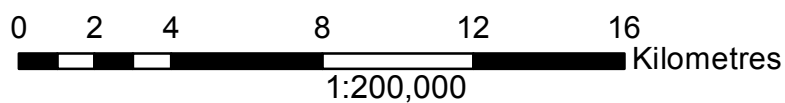


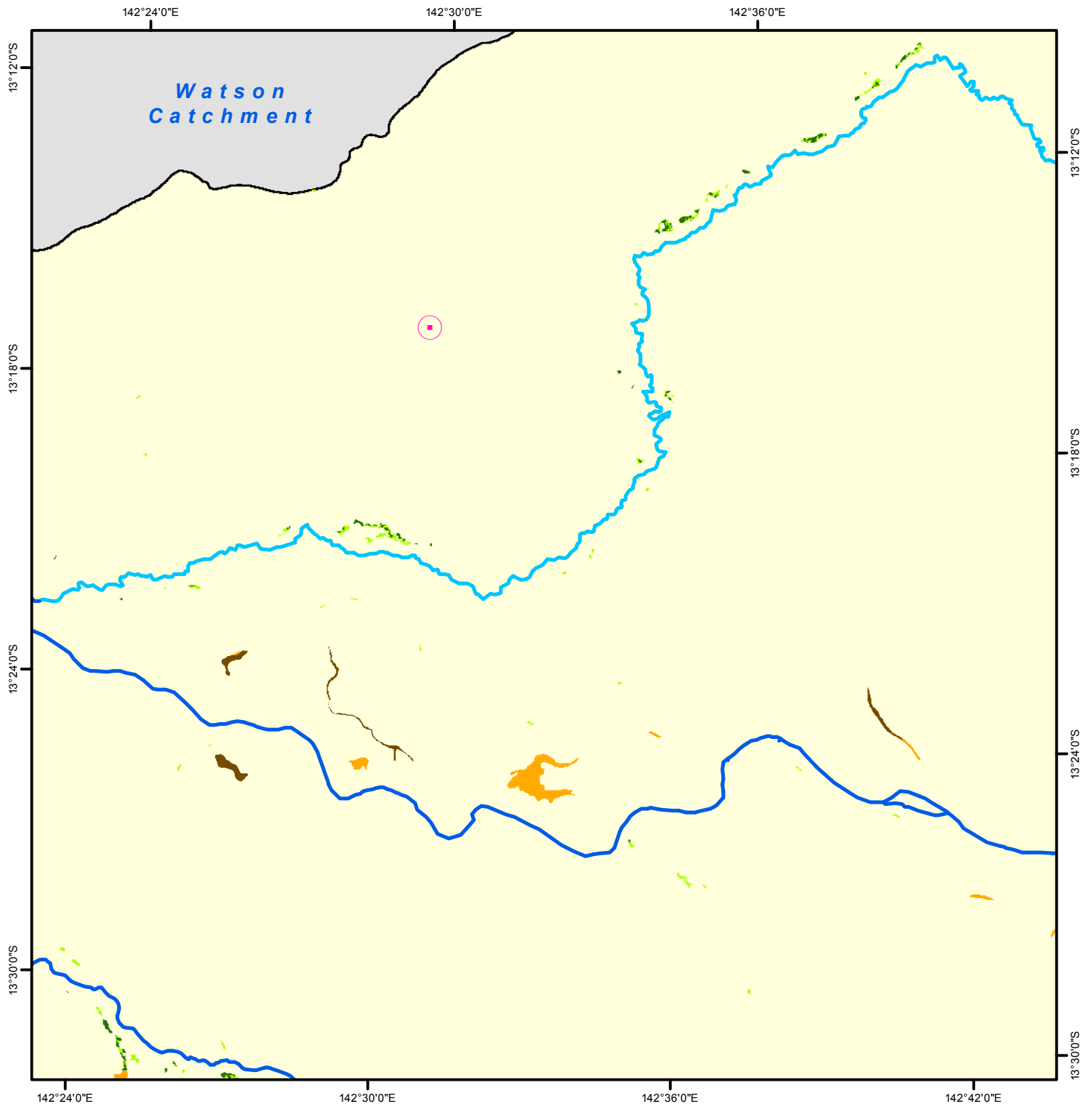
K2 Archer Catchment



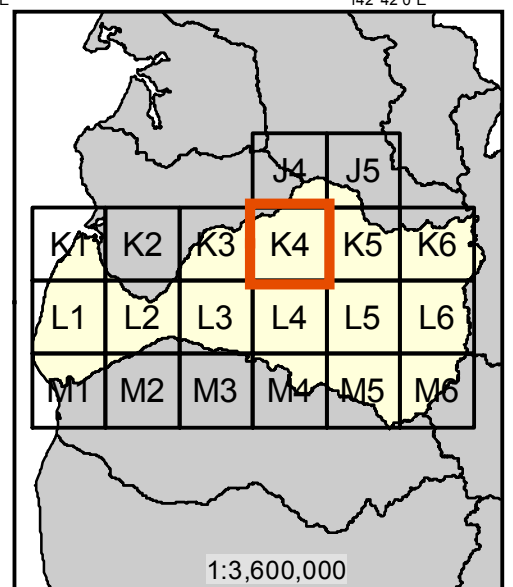
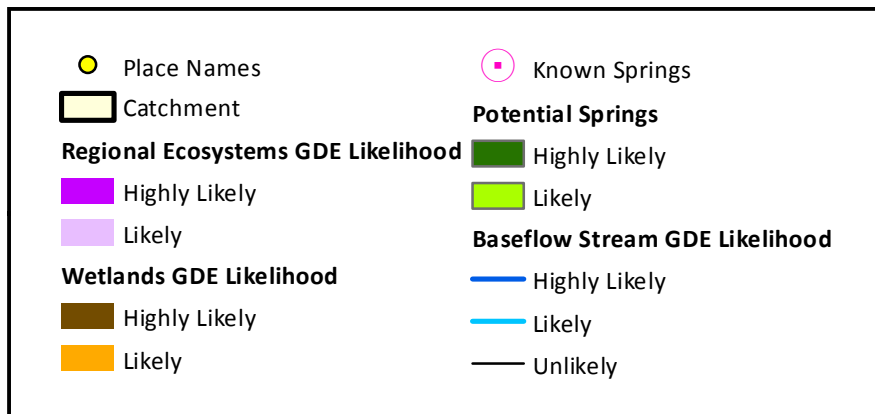
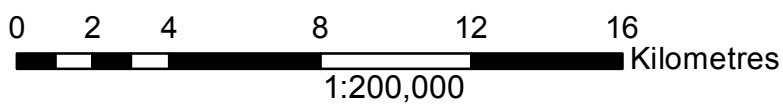


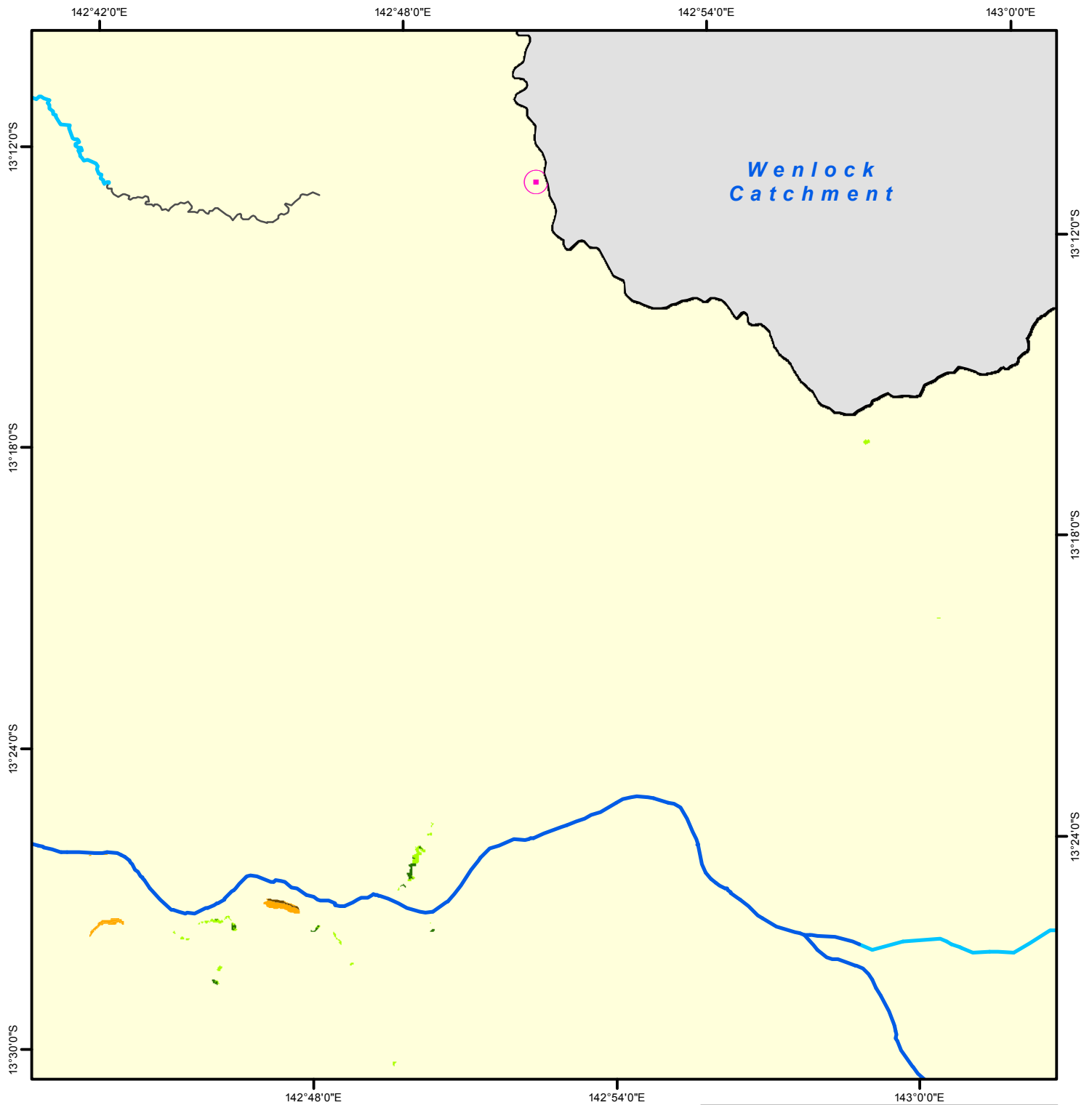
K3 Archer Catchment



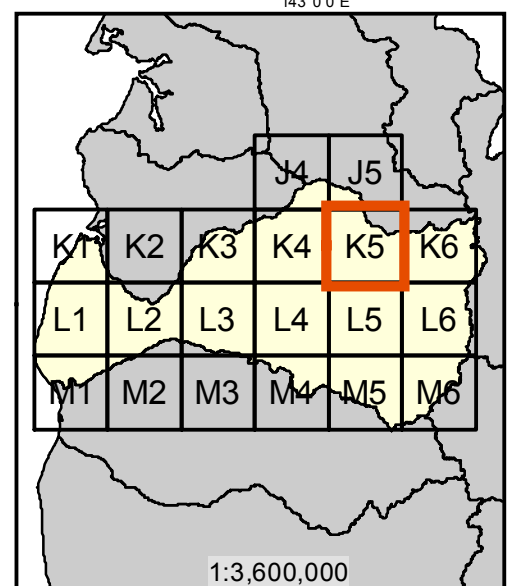
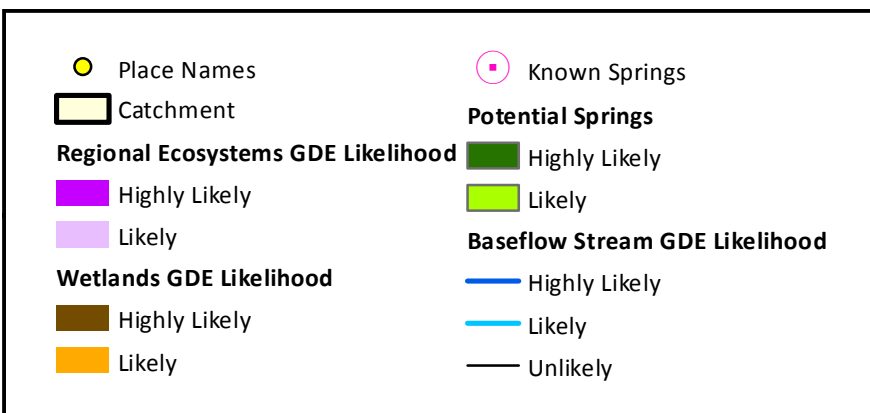
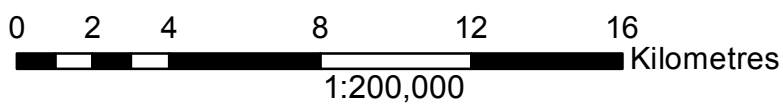


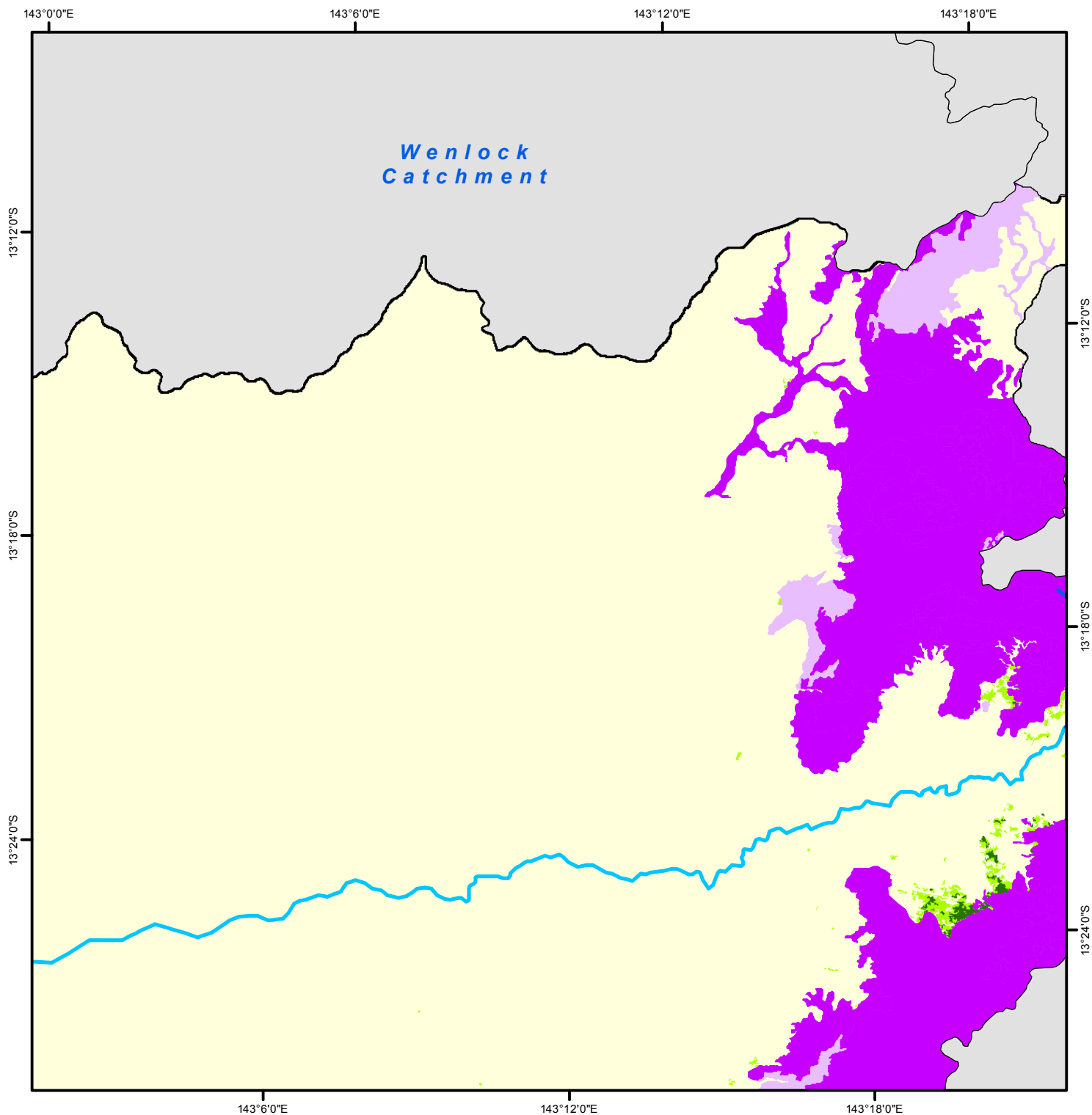
K4 Archer Catchment



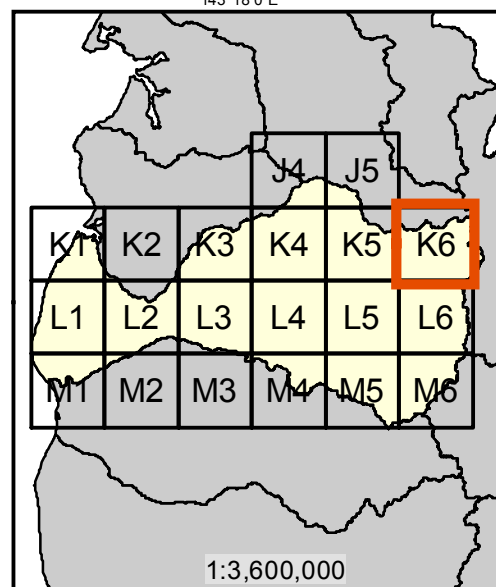
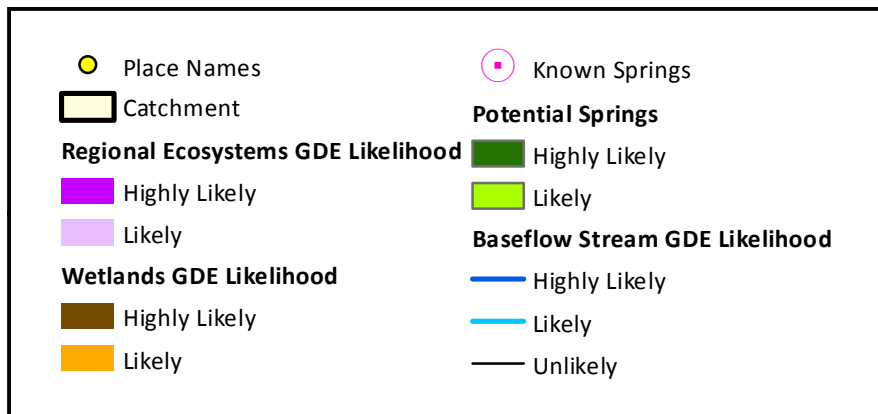
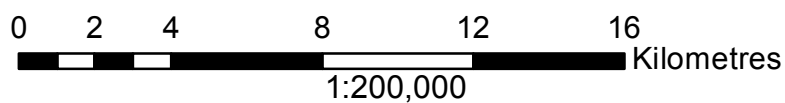


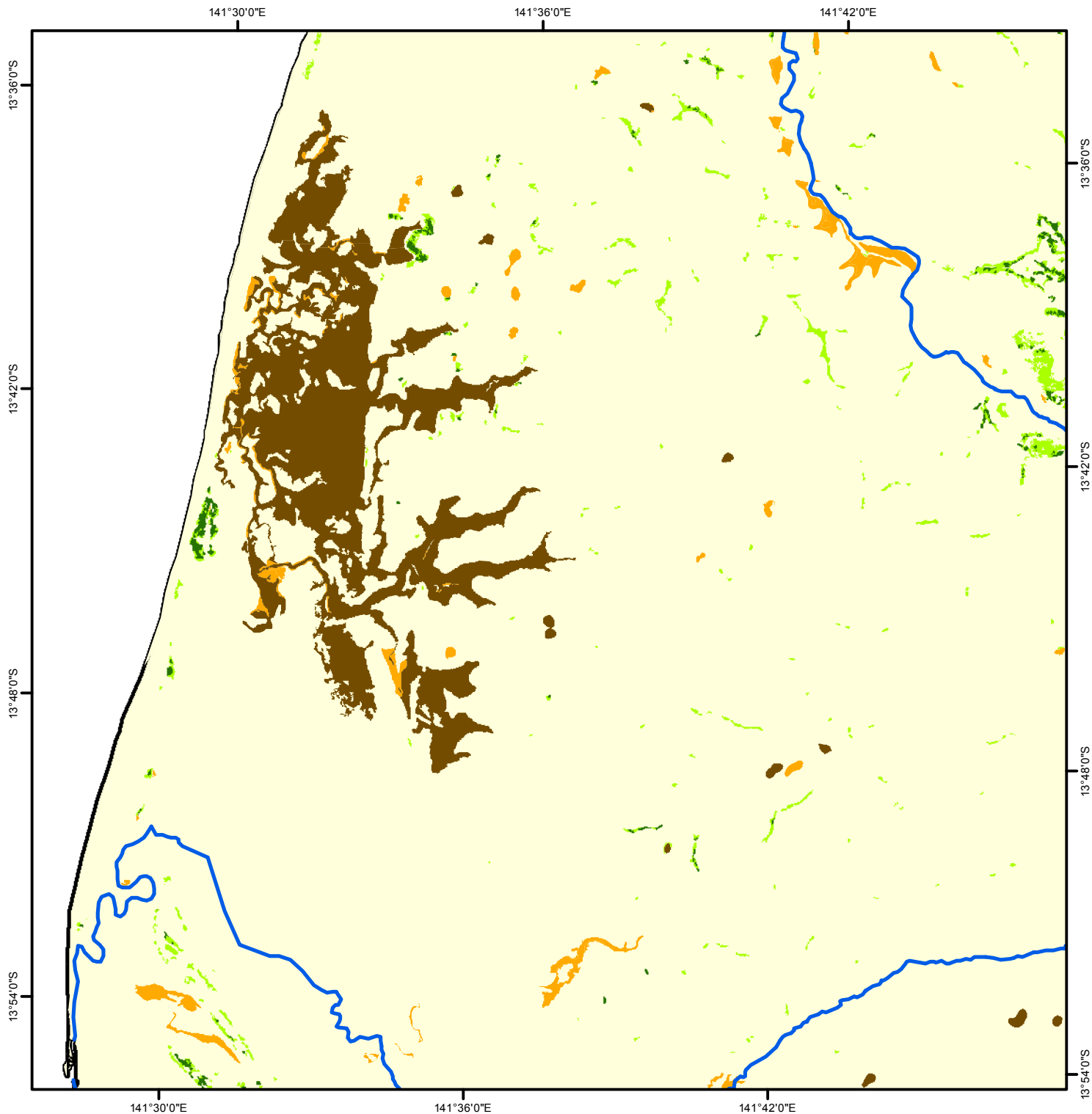
K5 Archer Catchment





K6 Archer Catchment





L1 Archer Catchment

0 2 4 8 12 16 Kilometres
1:200,000



● Place Names

■ Catchment

Regional Ecosystems GDE Likelihood

■ Highly Likely

■ Likely

Wetlands GDE Likelihood

■ Highly Likely

■ Likely

● Known Springs

Potential Springs

■ Highly Likely

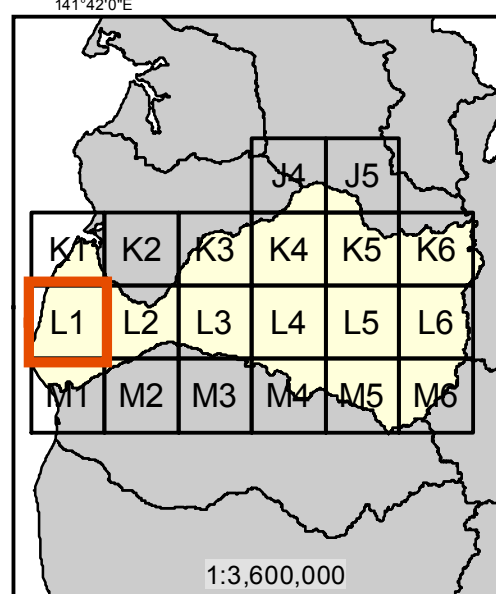
■ Likely

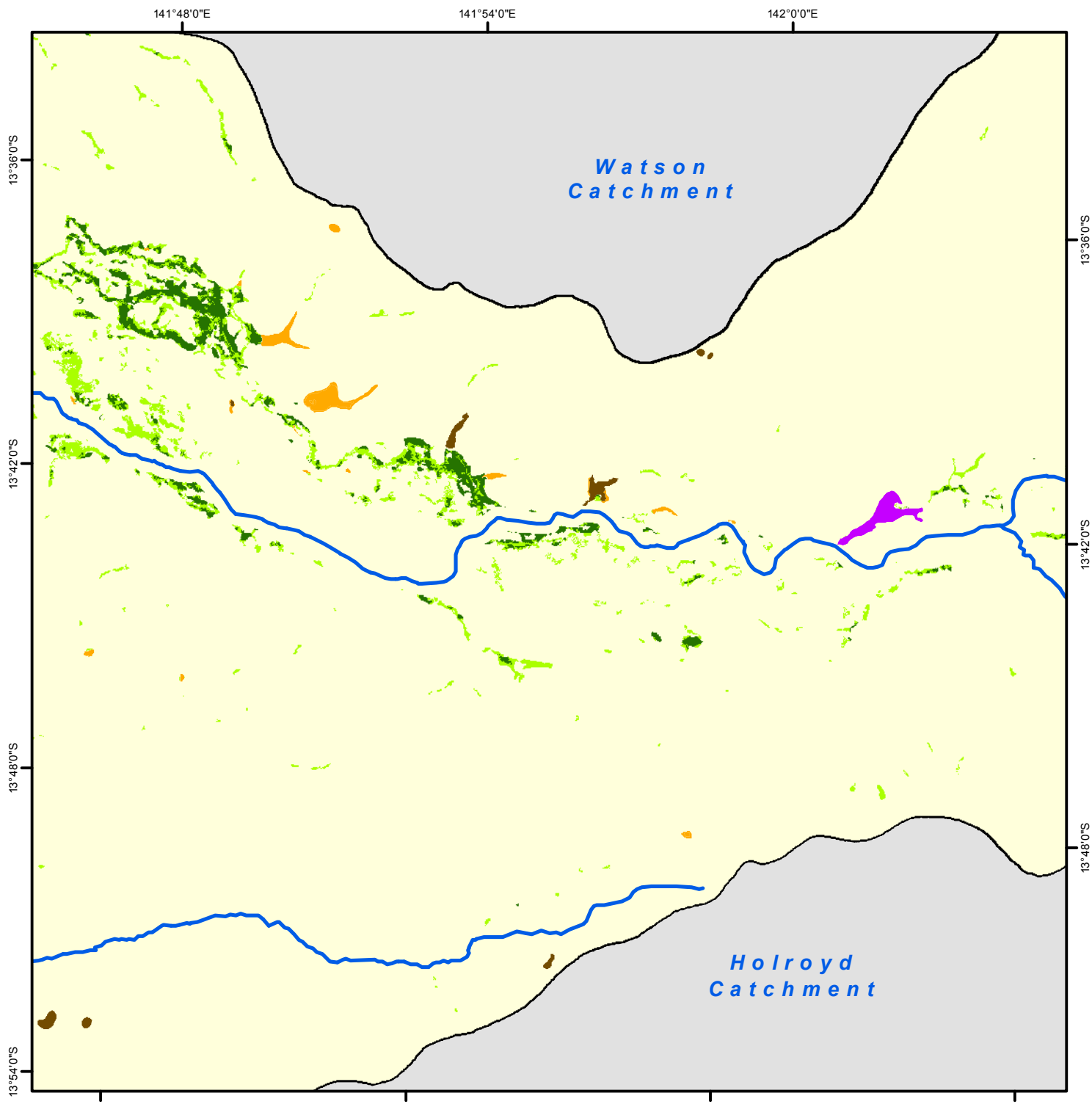
Baseflow Stream GDE Likelihood

— Highly Likely

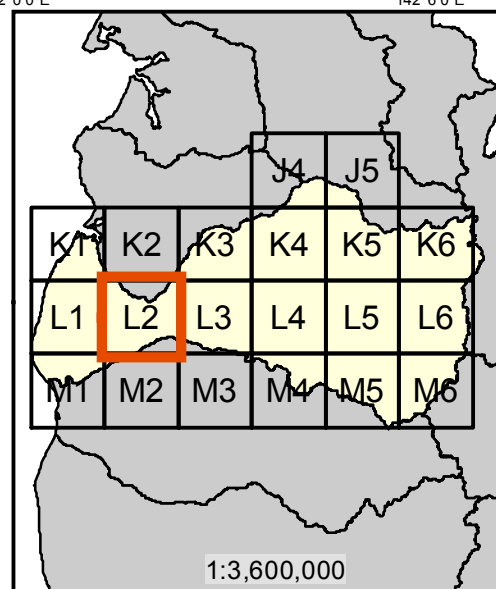
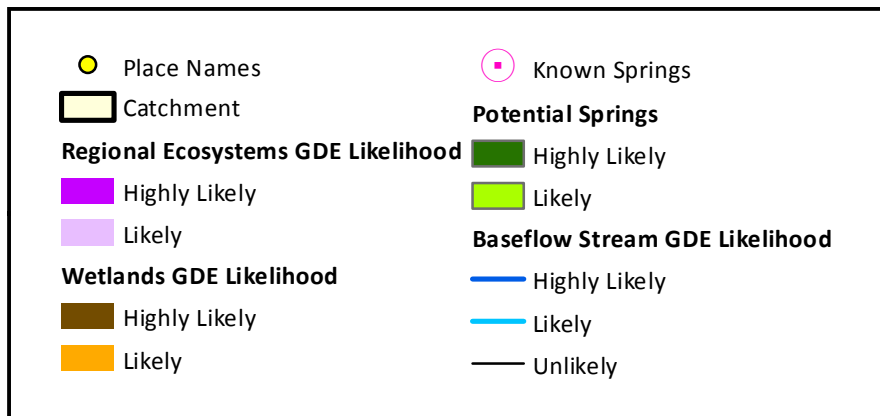
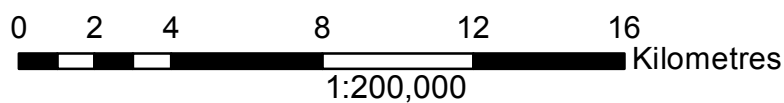
— Likely

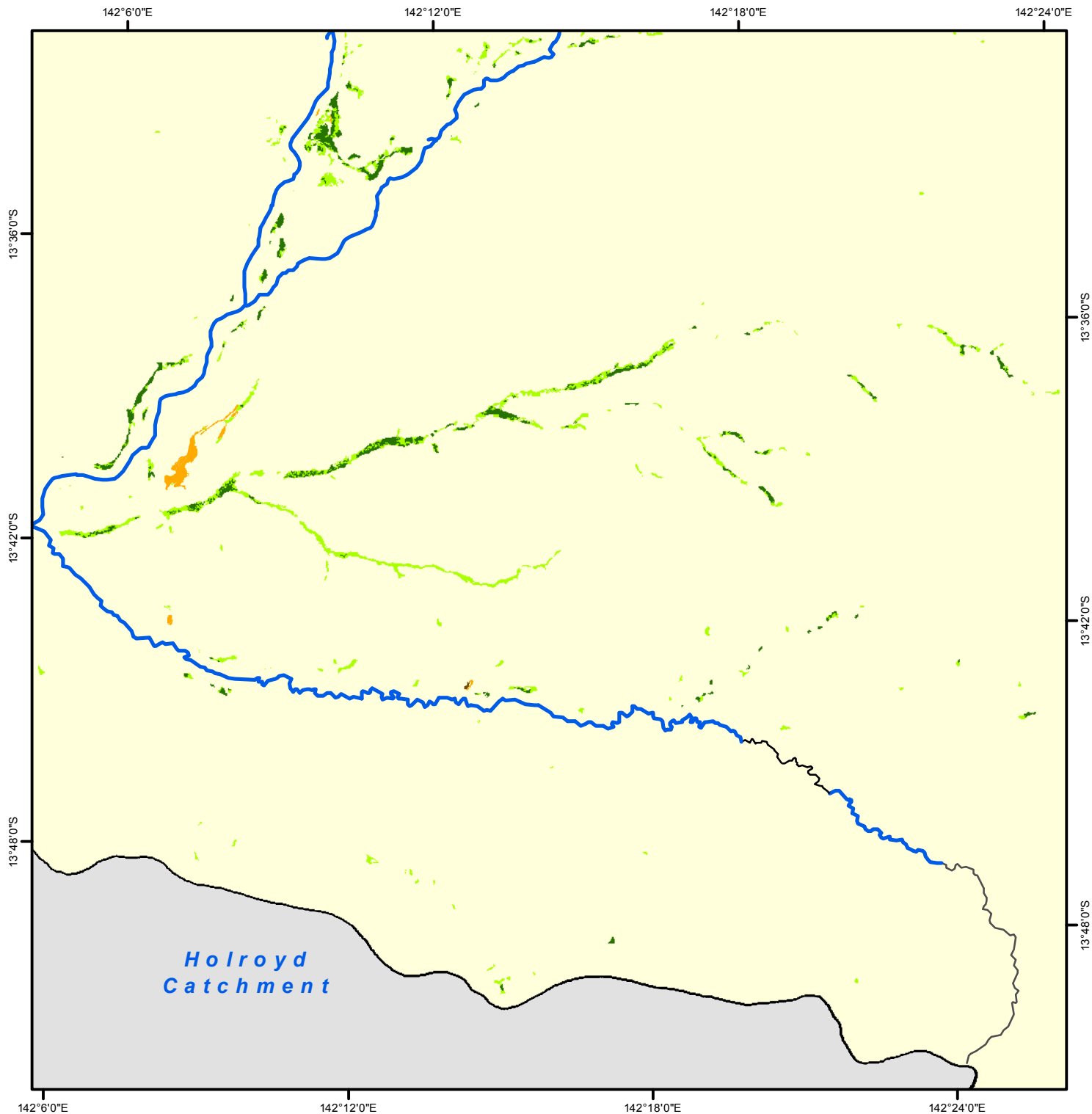
— Unlikely





L2 Archer Catchment

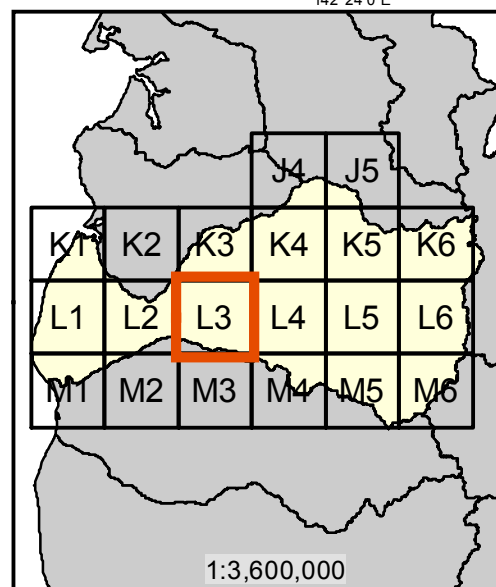
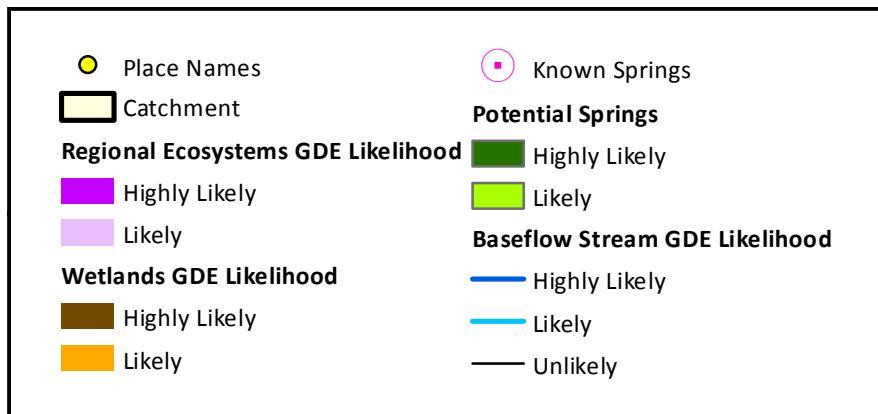


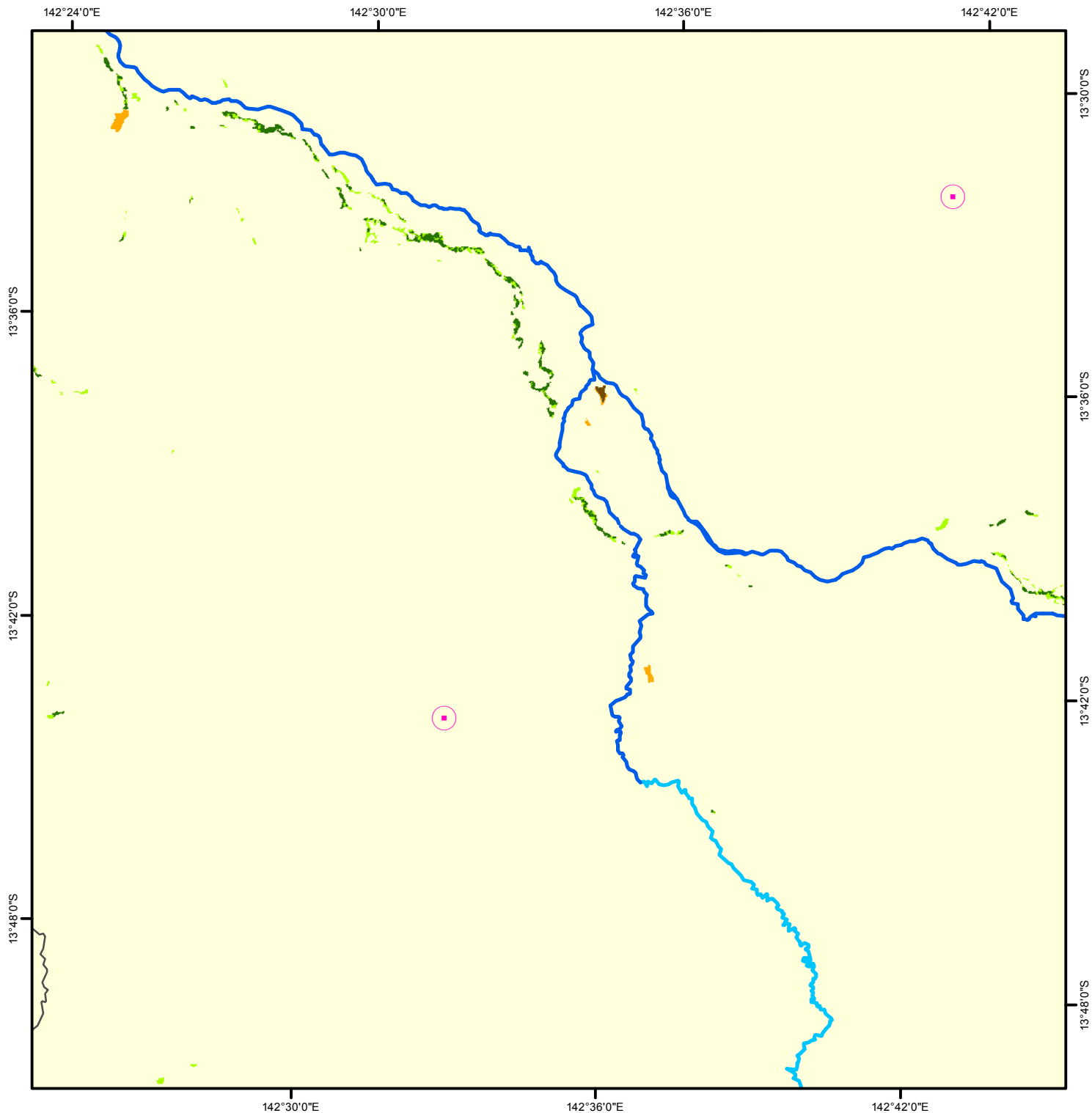


L3 Archer Catchment

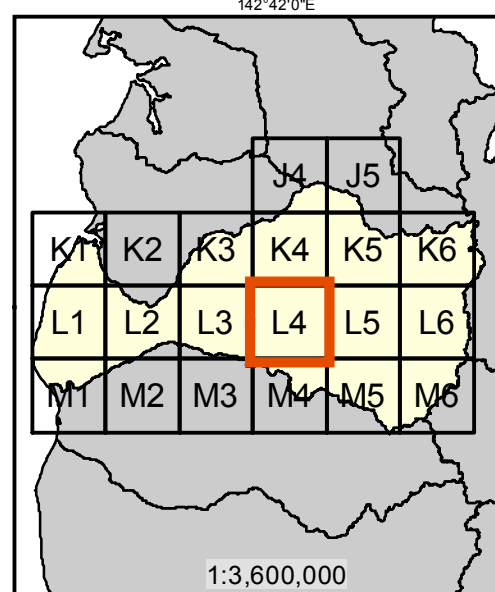
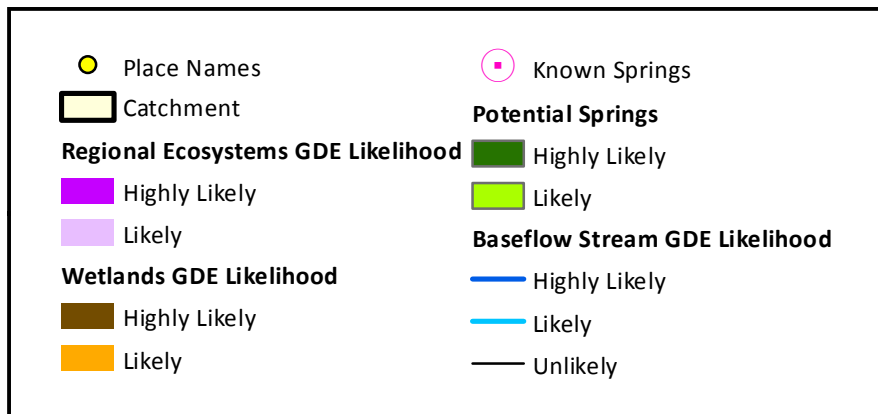
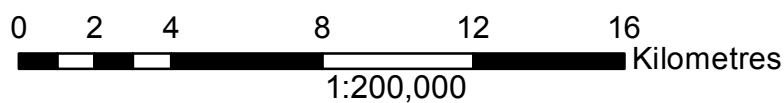
0 2 4 8 12 16 Kilometres

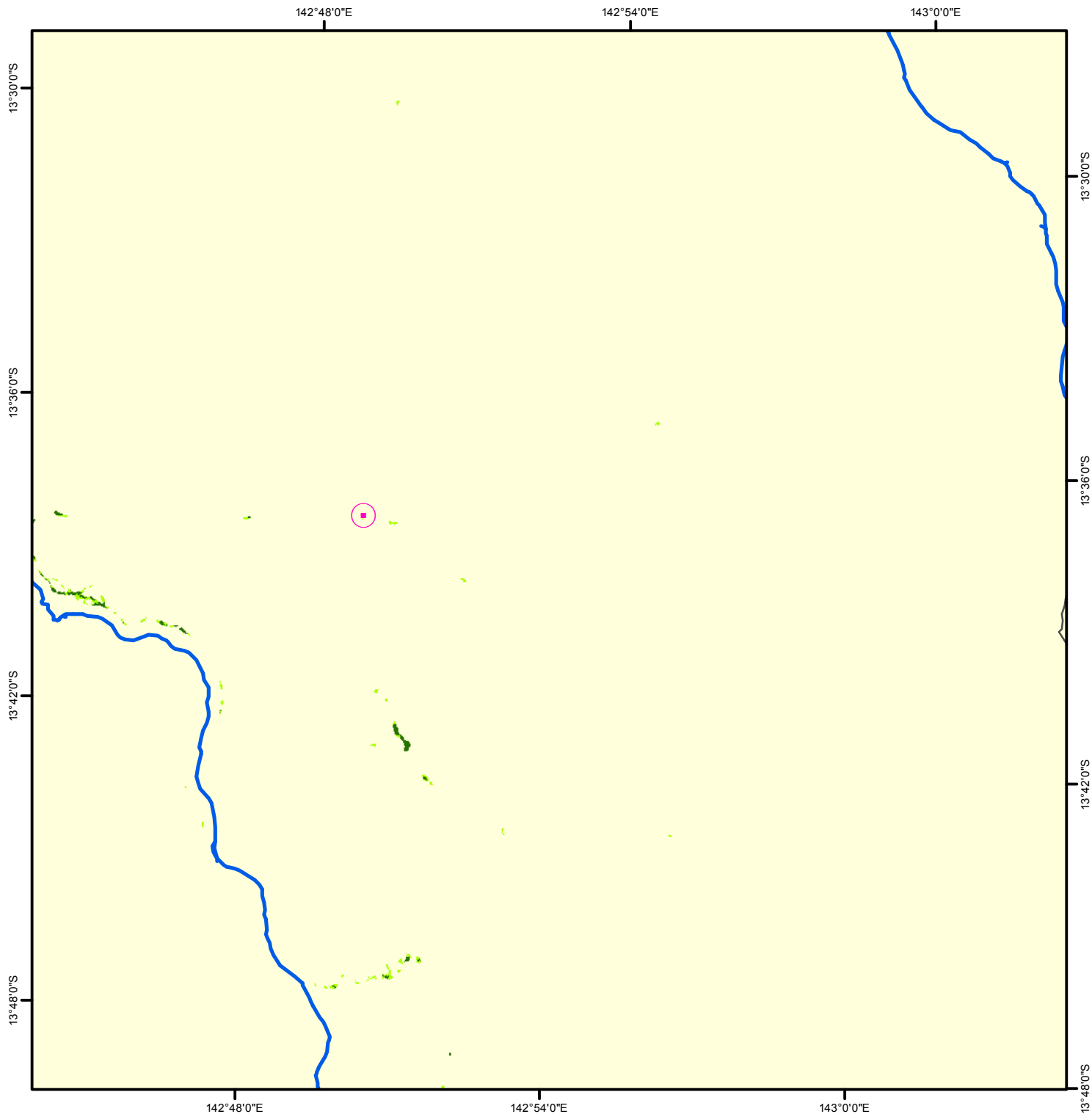
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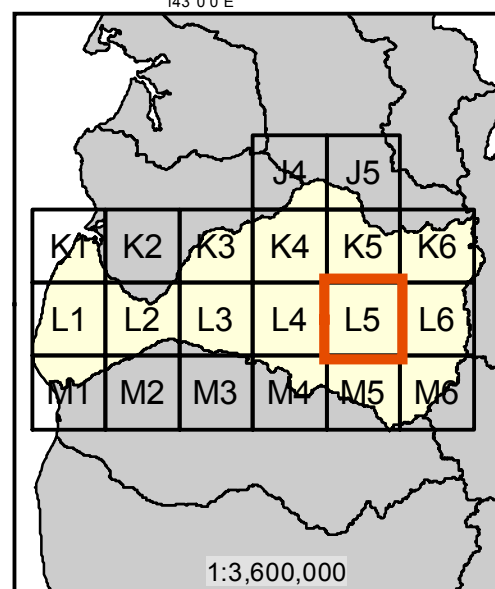
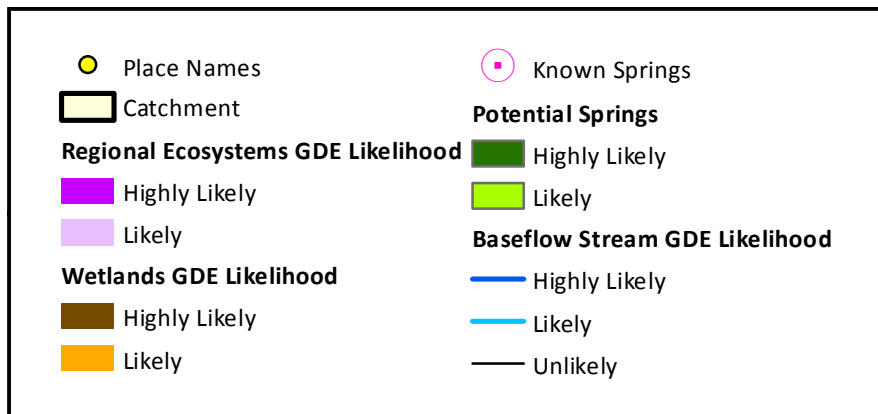
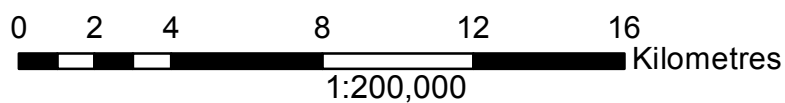


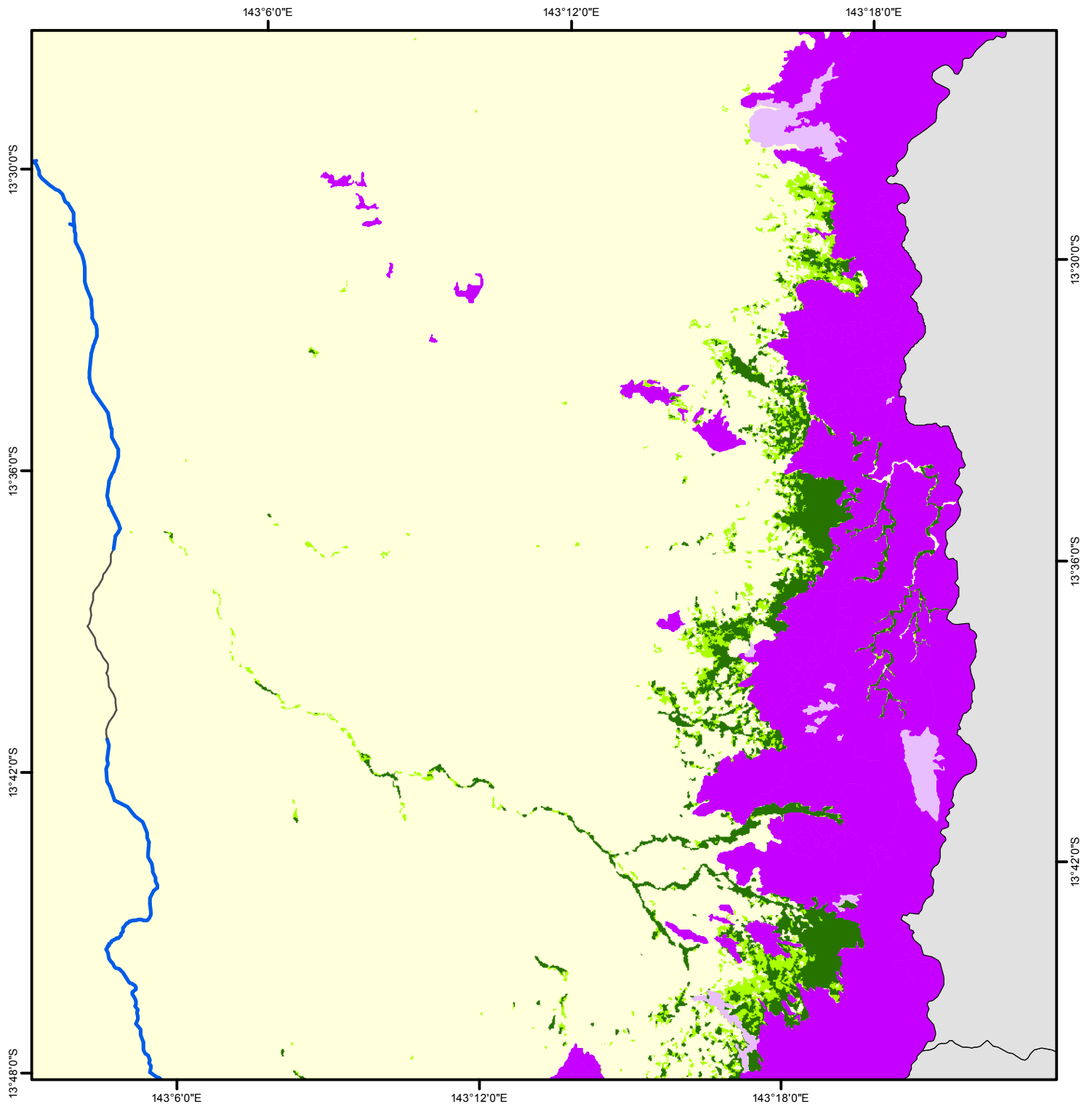
L4 Archer Catchment



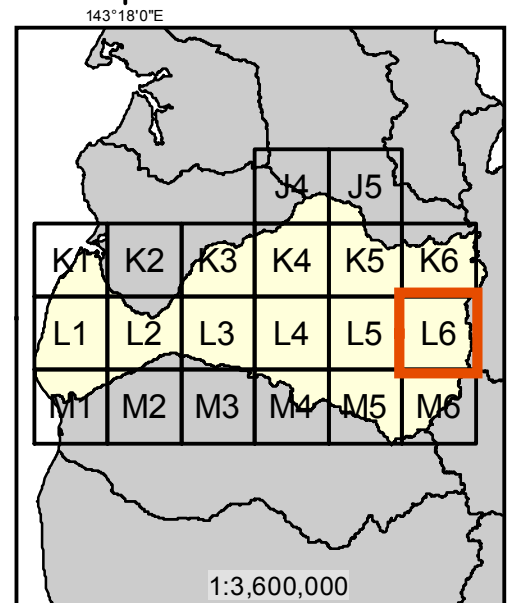
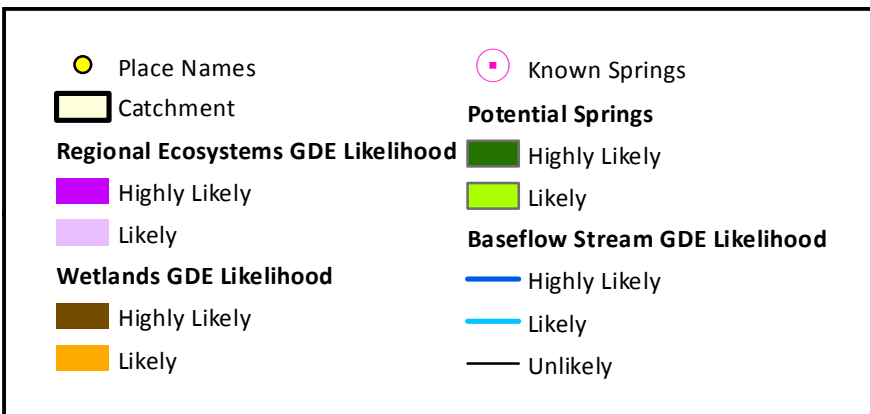
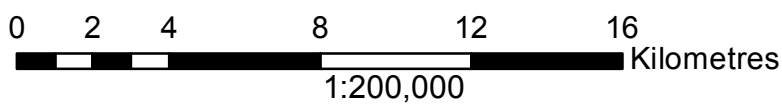


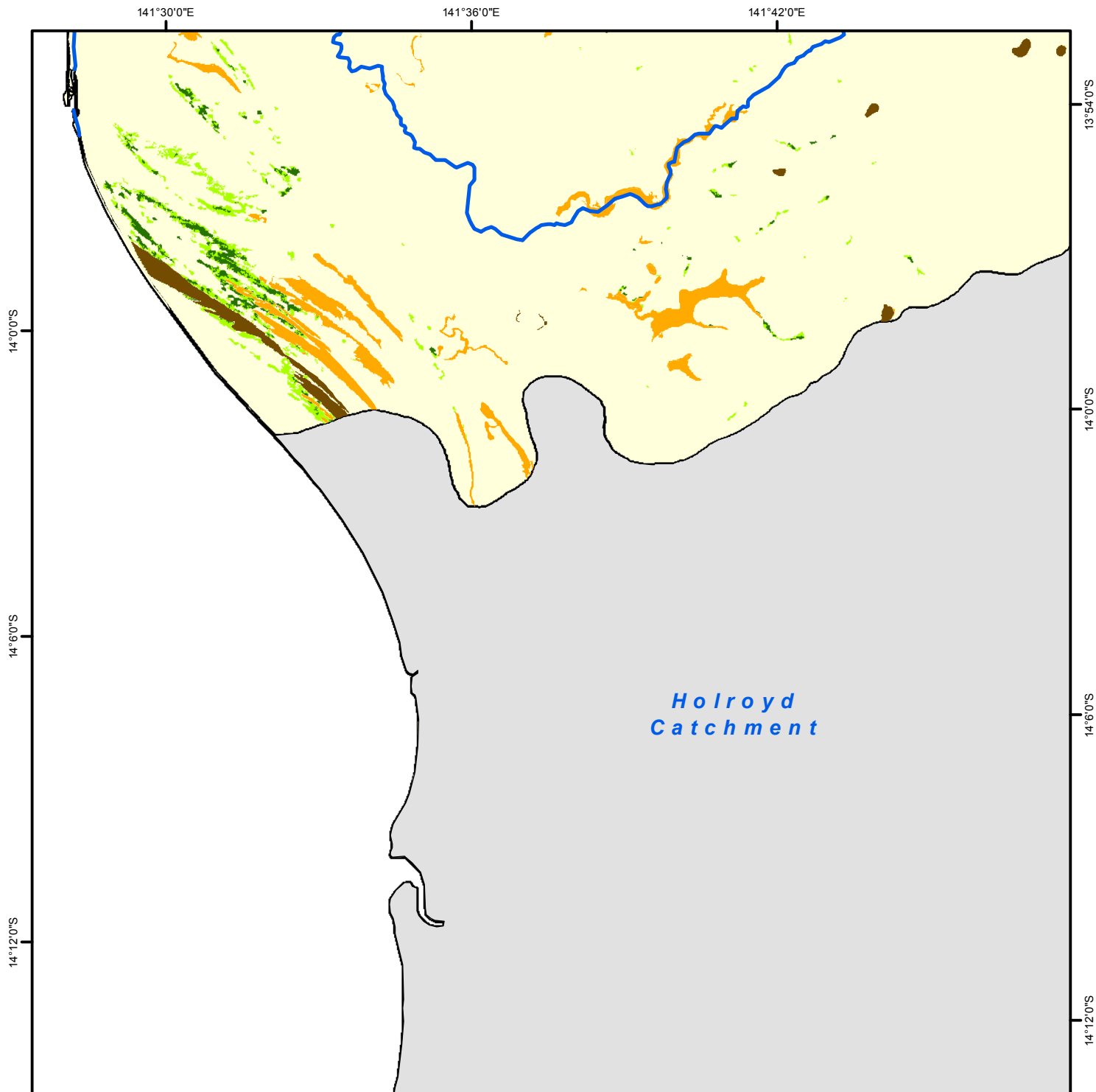
L5 Archer Catchment



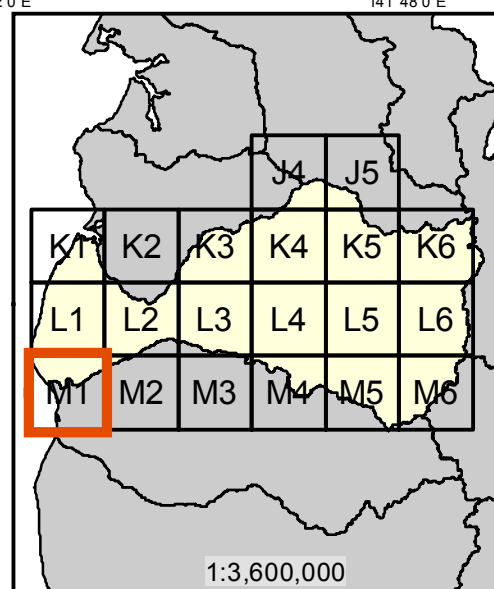
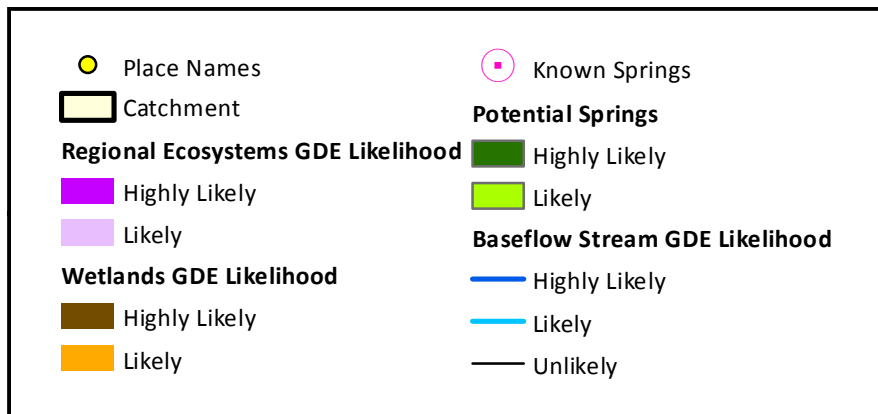
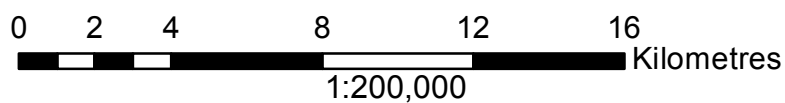


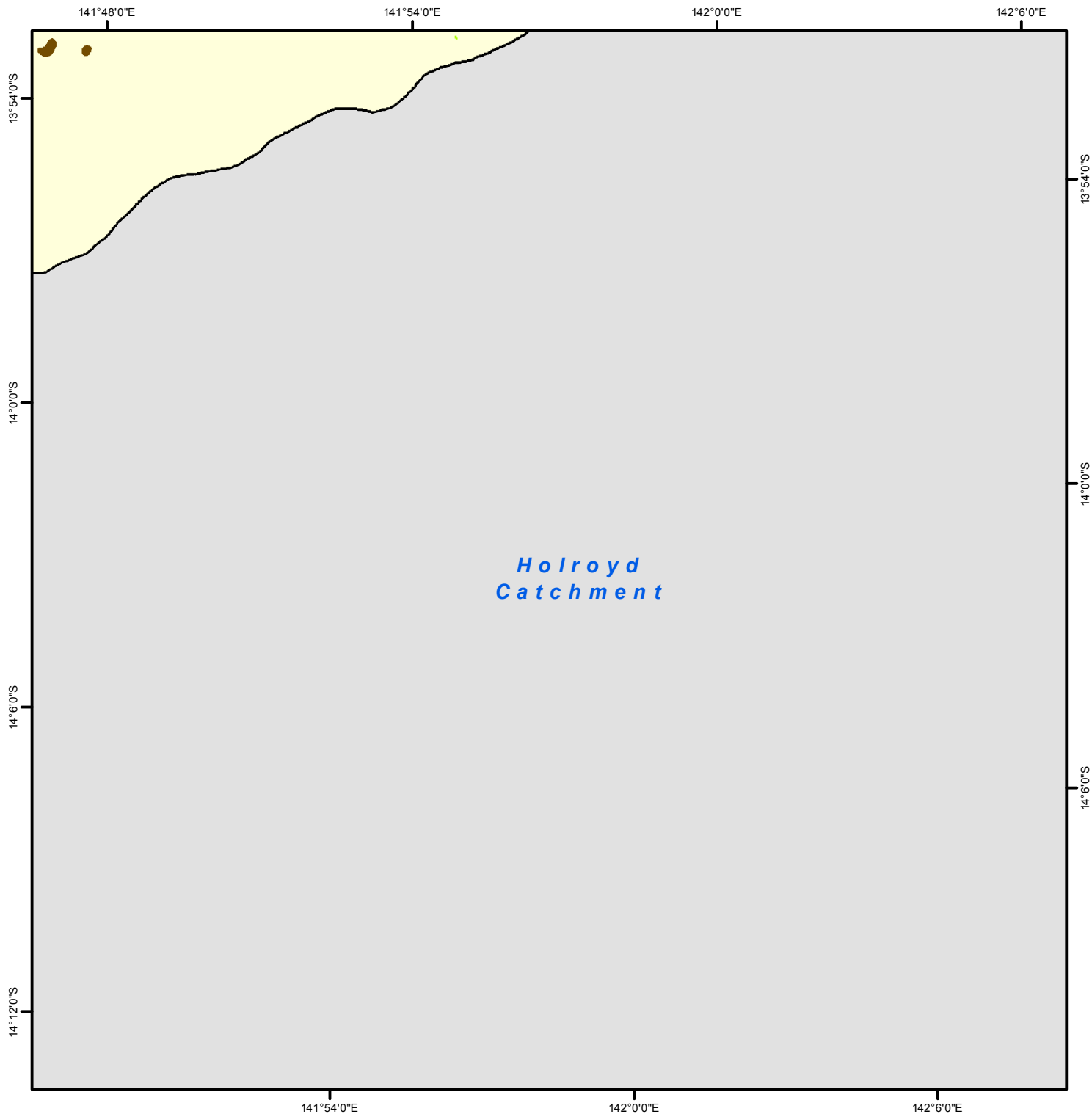
L6 Archer Catchment



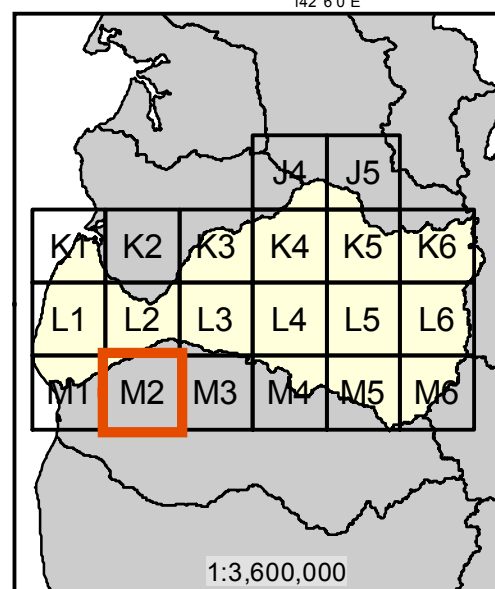
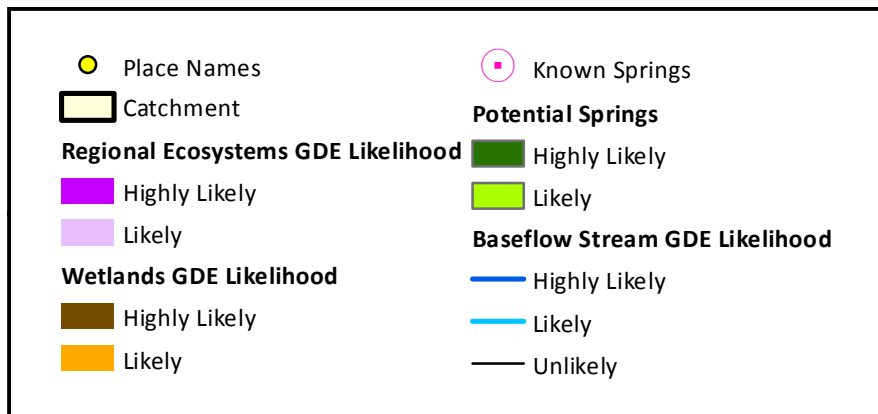
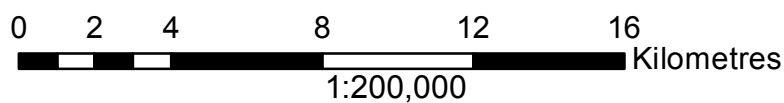


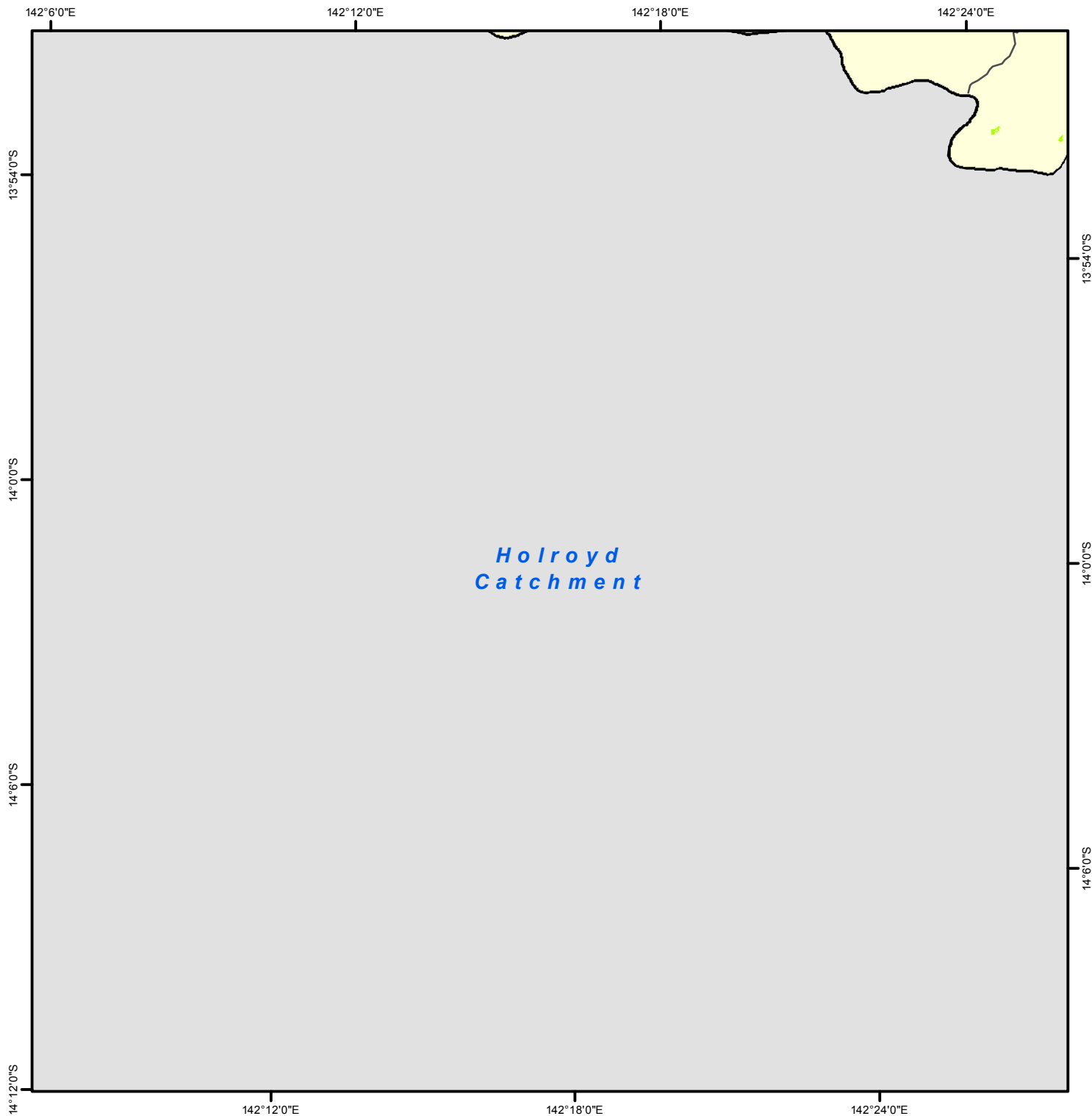
M1 Archer Catchment



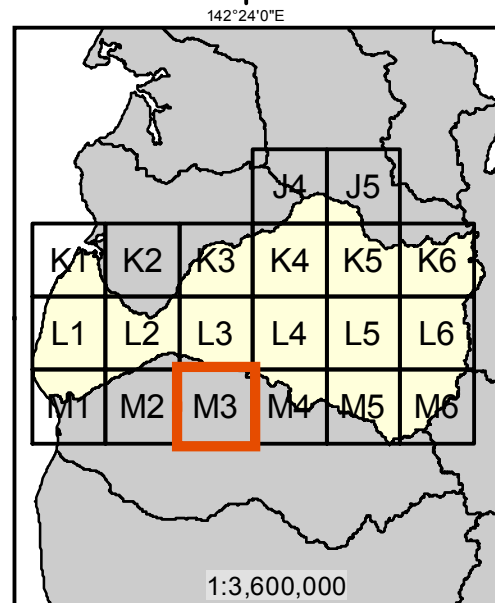
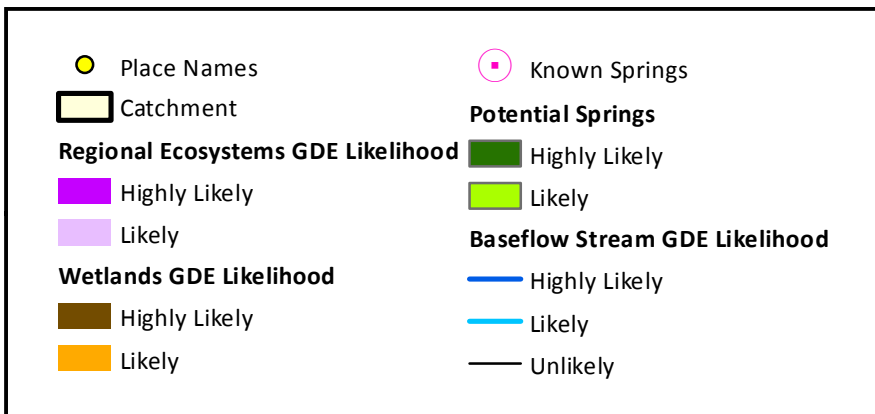
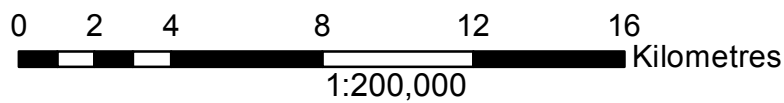


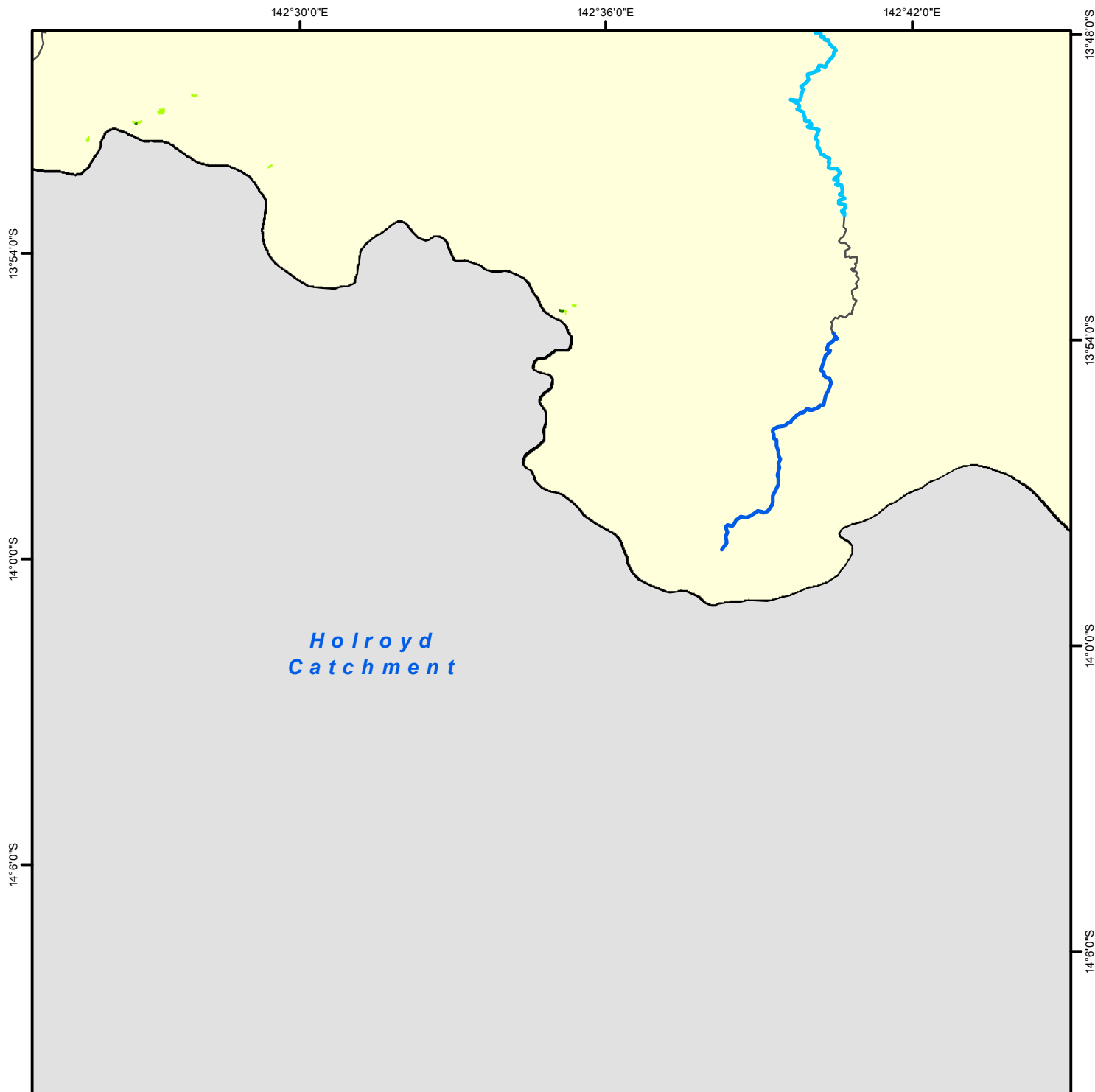
M2 Archer Catchment



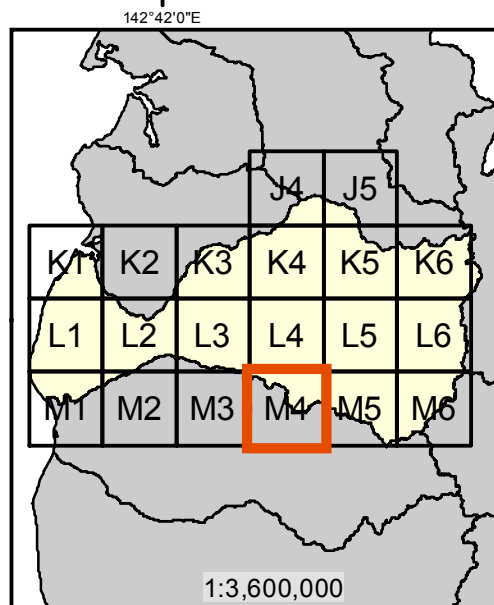
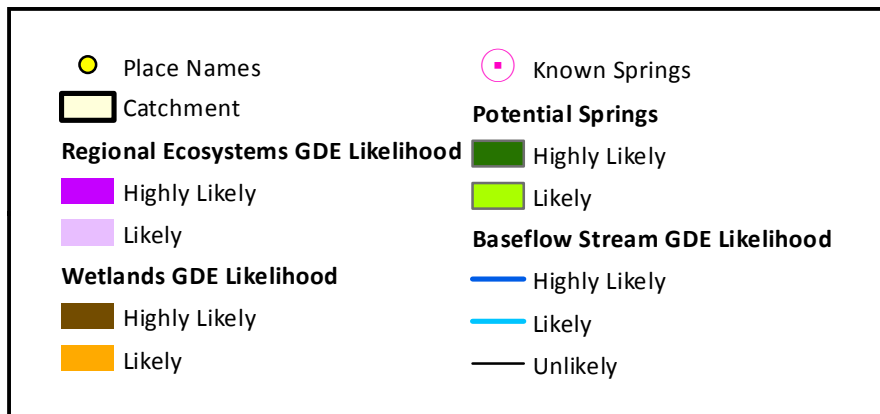
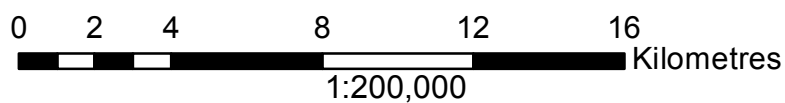


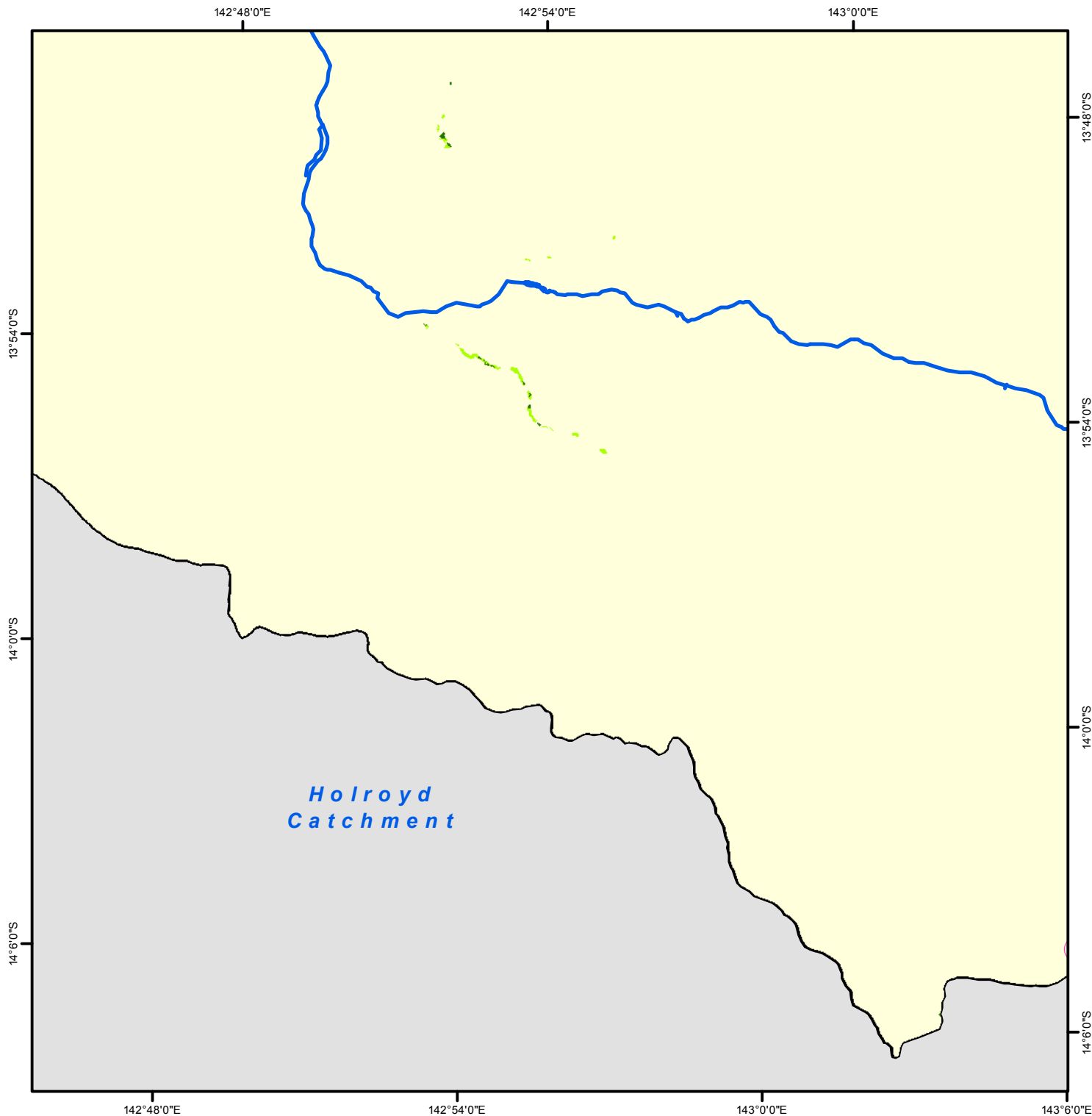
M3 Archer Catchment



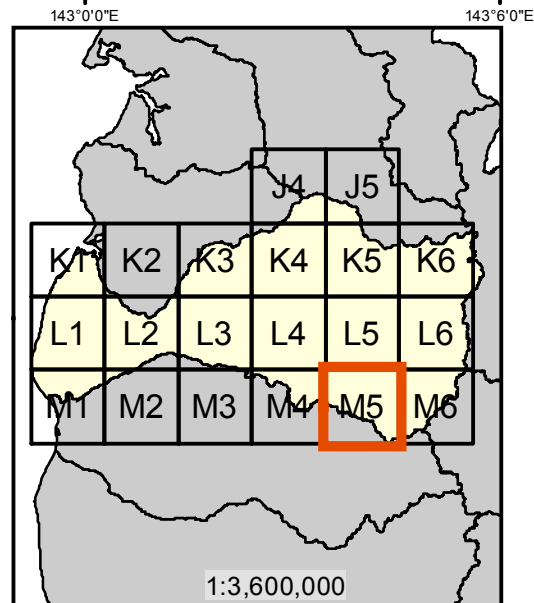
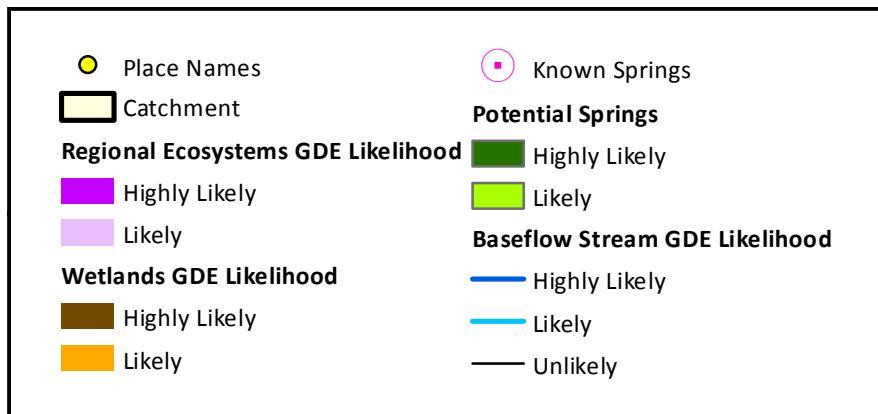
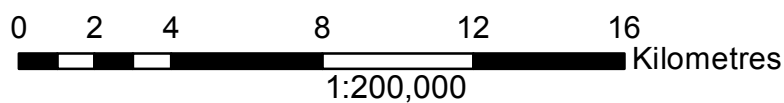


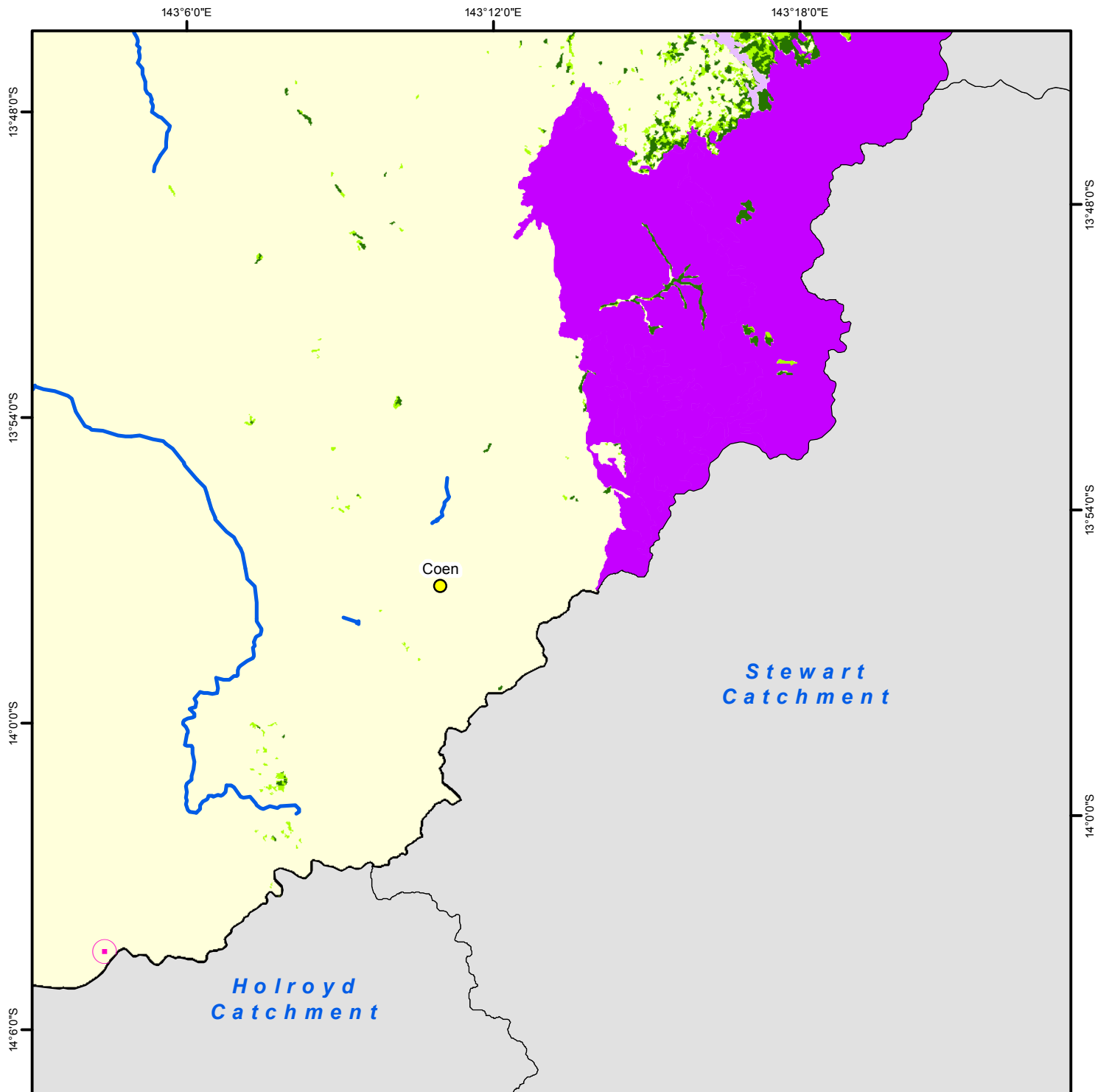
M4 Archer Catchment





M5 Archer Catchment





M6 Archer Catchment

0 2 4 8 12 16 Kilometres
1:200,000



● Place Names

■ Catchment

Regional Ecosystems GDE Likelihood

■ Highly Likely

■ Likely

Wetlands GDE Likelihood

■ Highly Likely

■ Likely

■ Known Springs

Potential Springs

■ Highly Likely

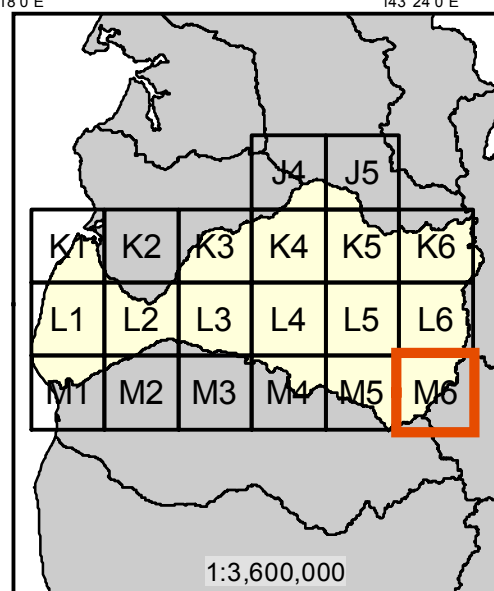
■ Likely

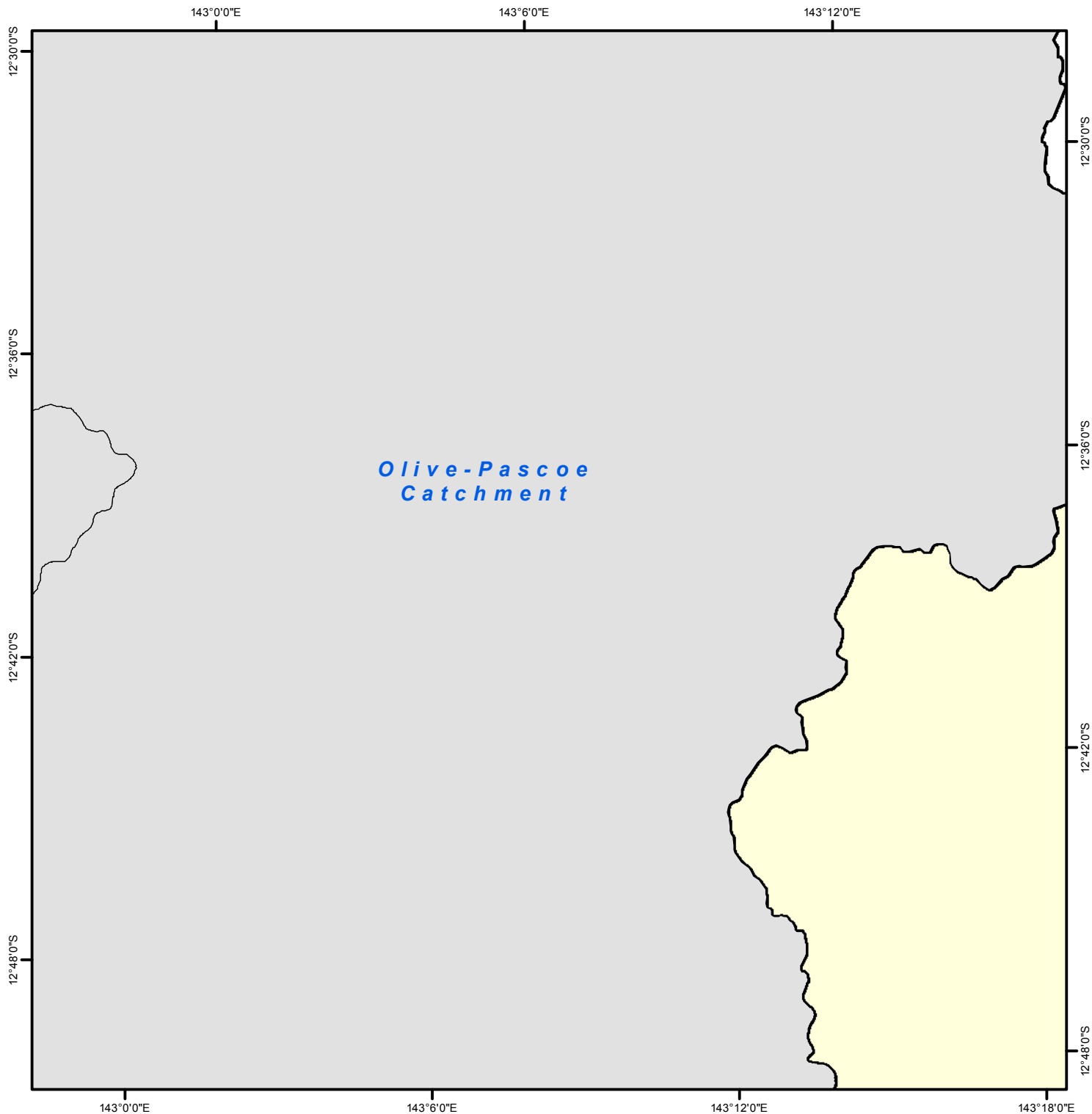
Baseflow Stream GDE Likelihood

■ Highly Likely

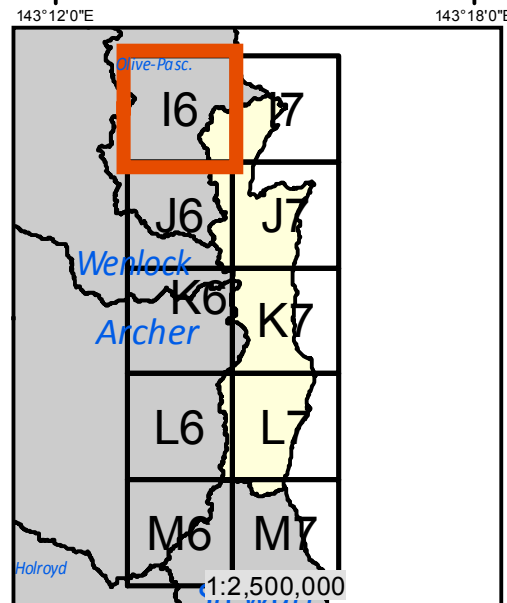
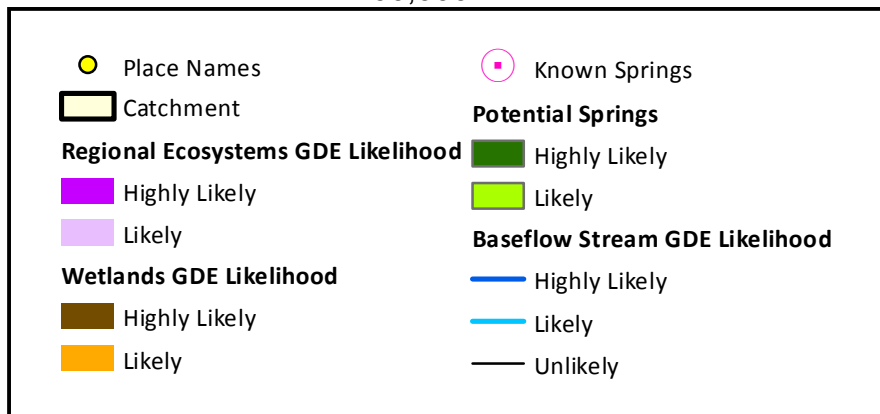
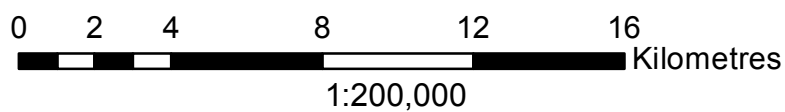
■ Likely

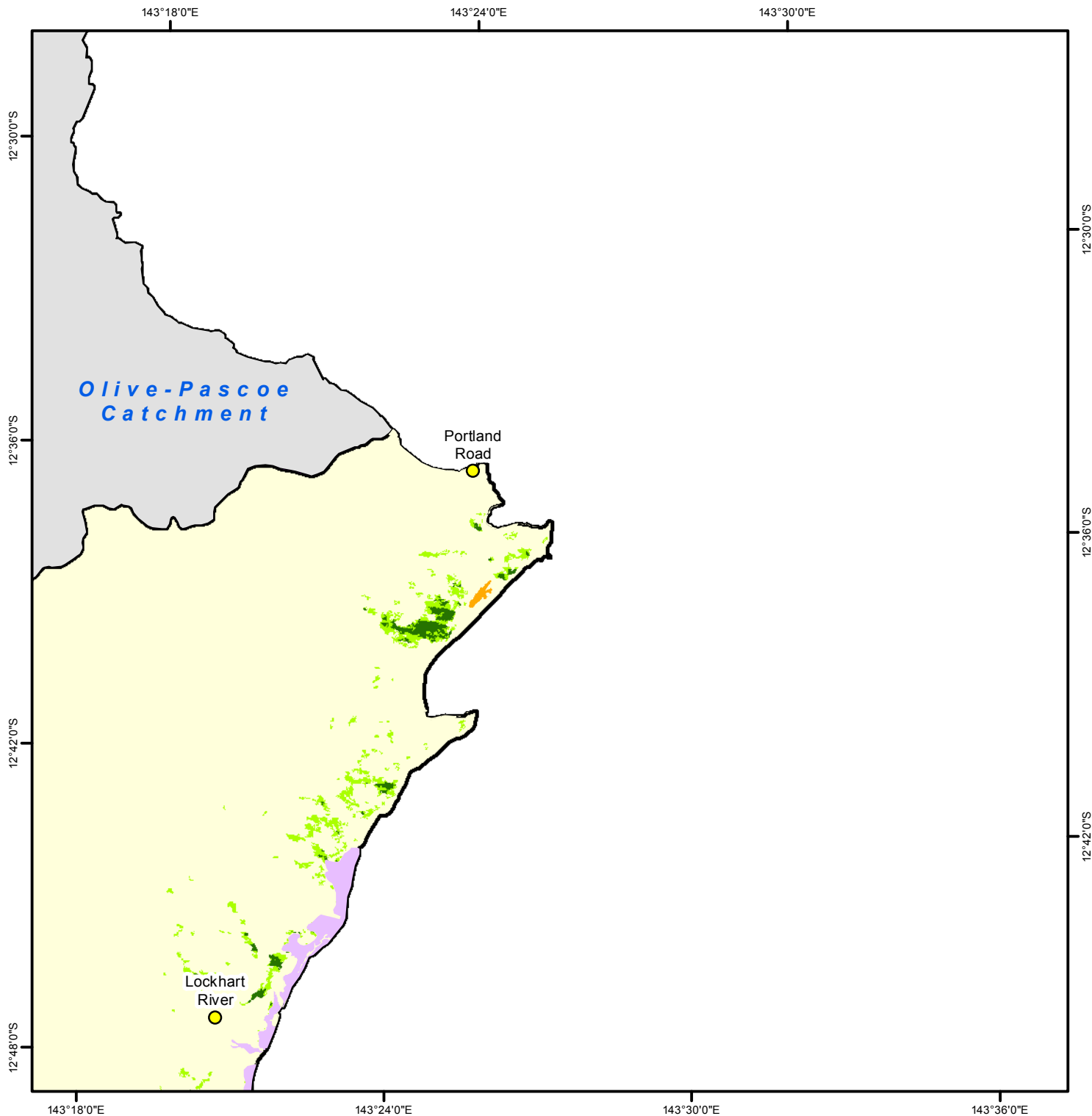
— Unlikely



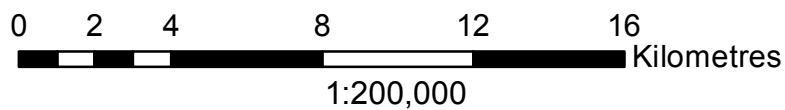


16 Lockhart Catchment





17 Lockhart Catchment



● Place Names

■ Catchment

Regional Ecosystems GDE Likelihood

■ Highly Likely

■ Likely

Wetlands GDE Likelihood

■ Highly Likely

■ Likely

● Known Springs

Potential Springs

■ Highly Likely

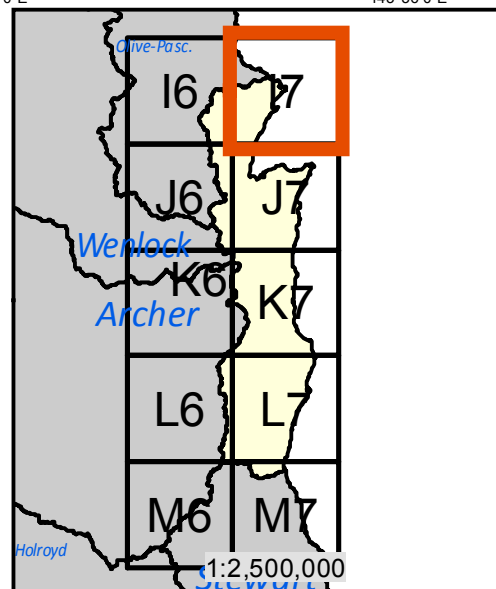
■ Likely

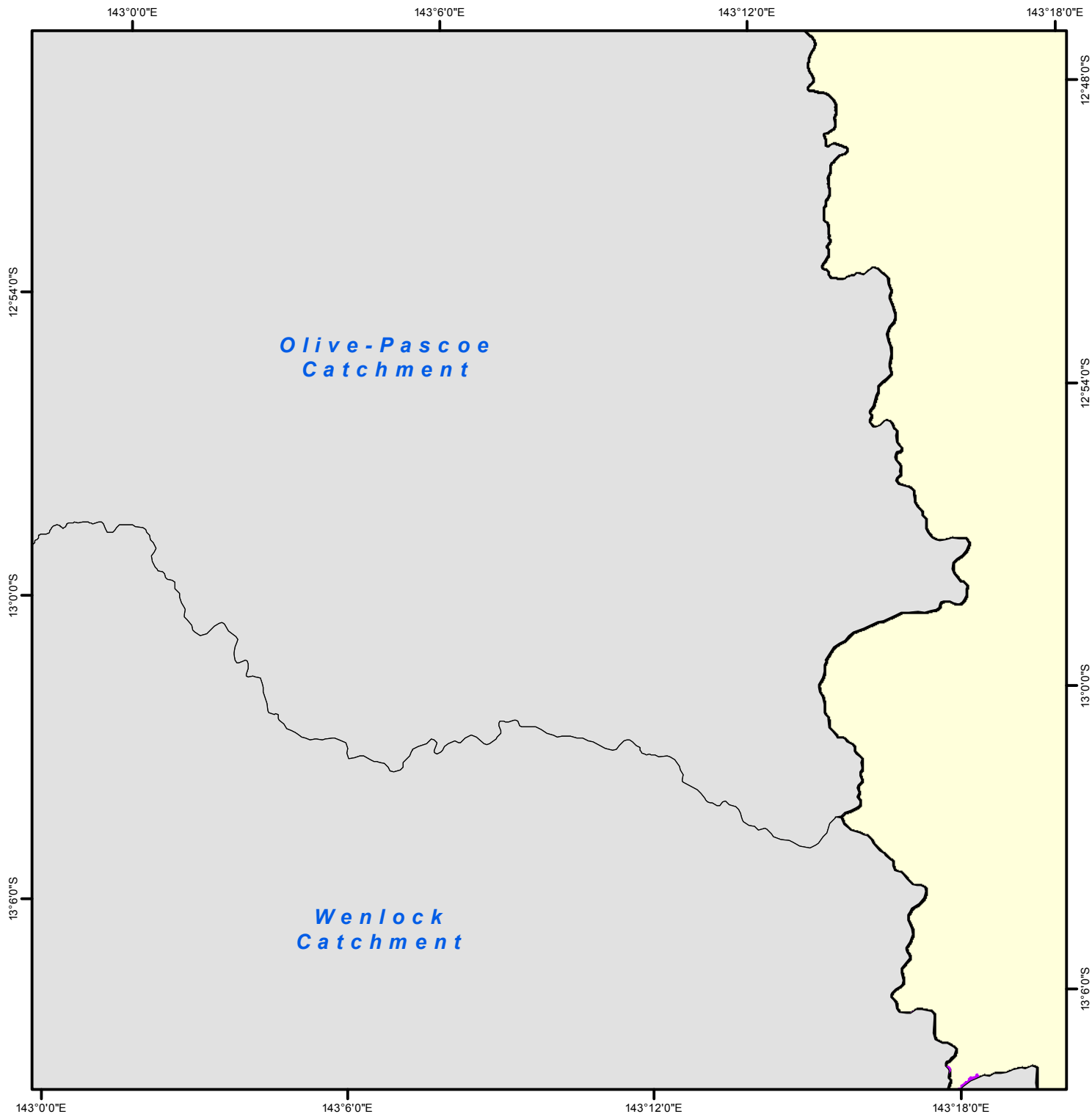
Baseflow Stream GDE Likelihood

— Highly Likely

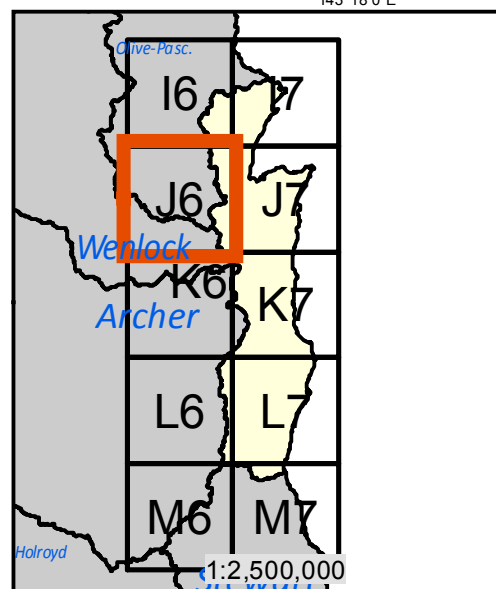
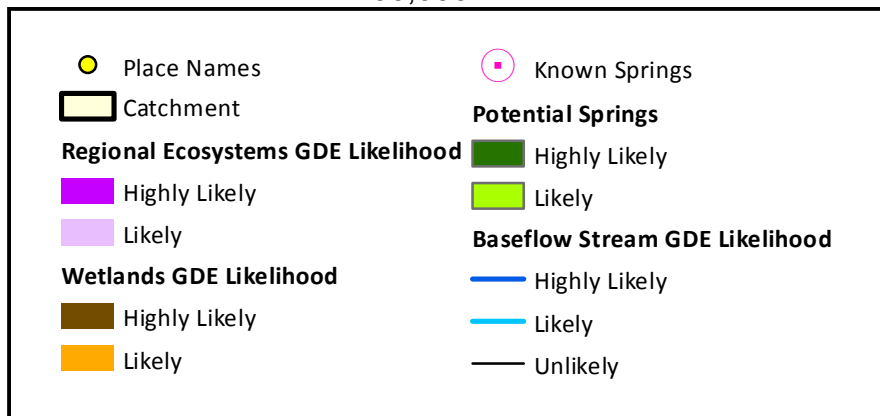
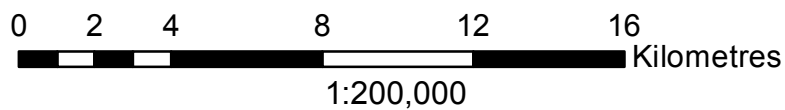
— Likely

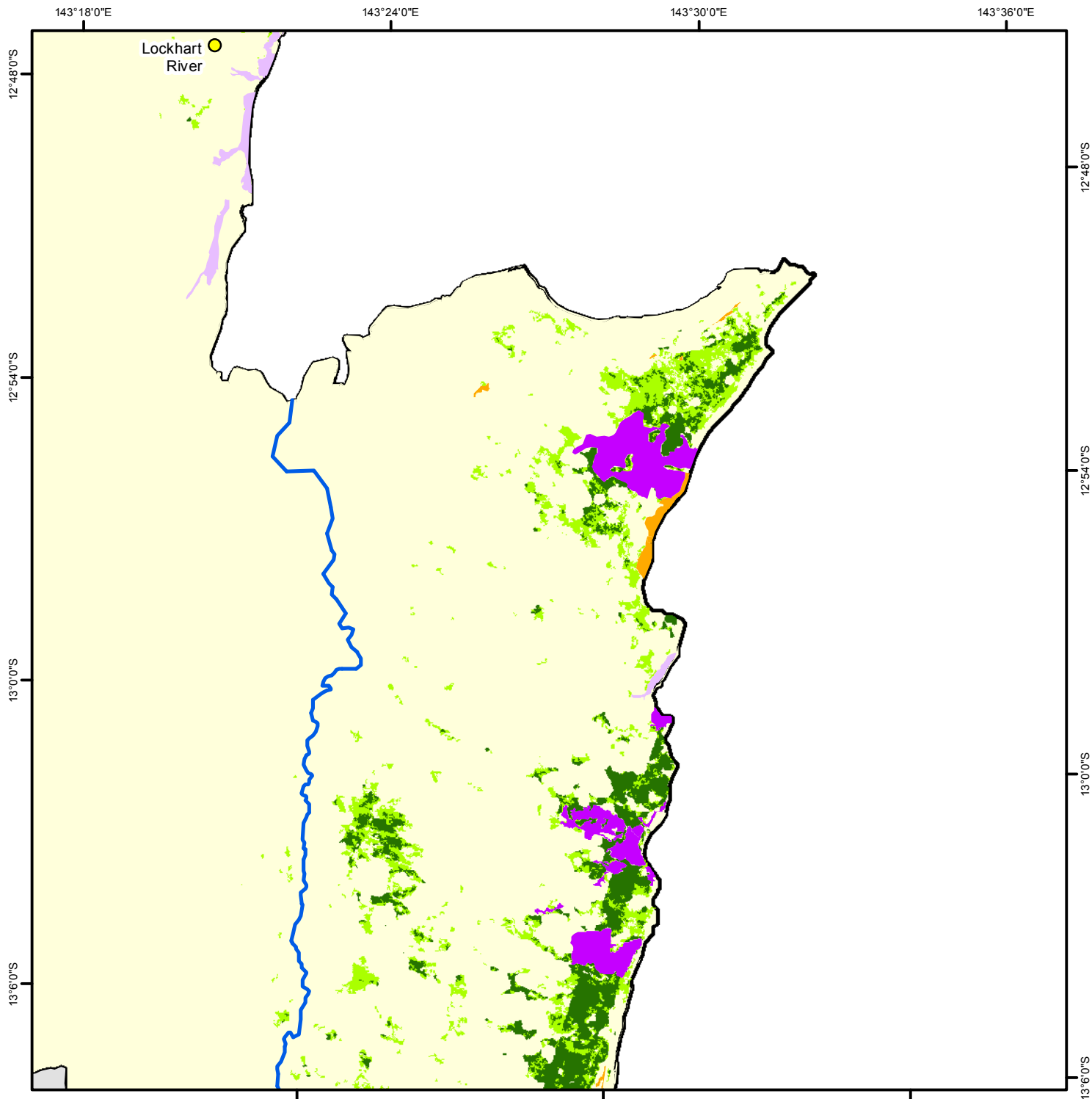
— Unlikely



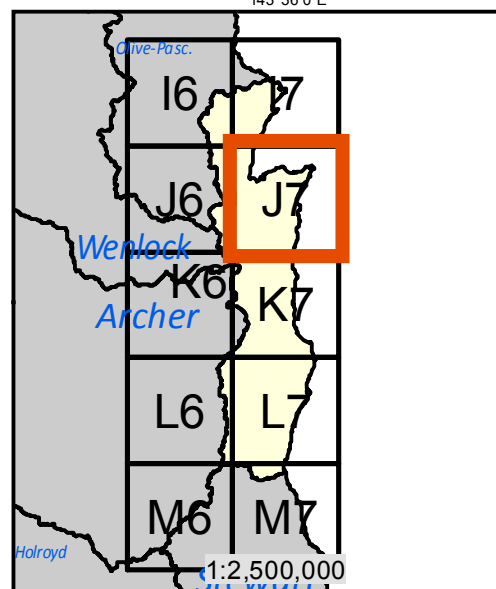
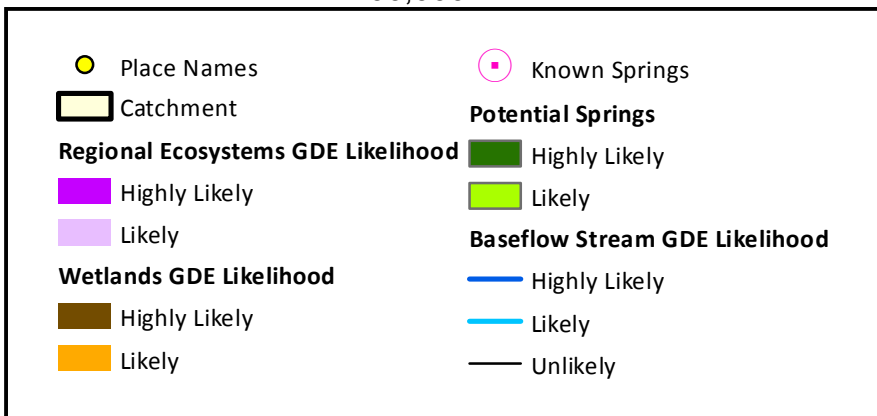
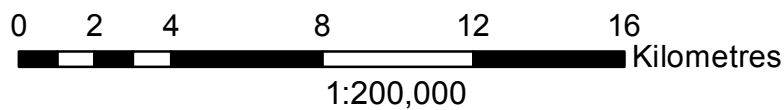


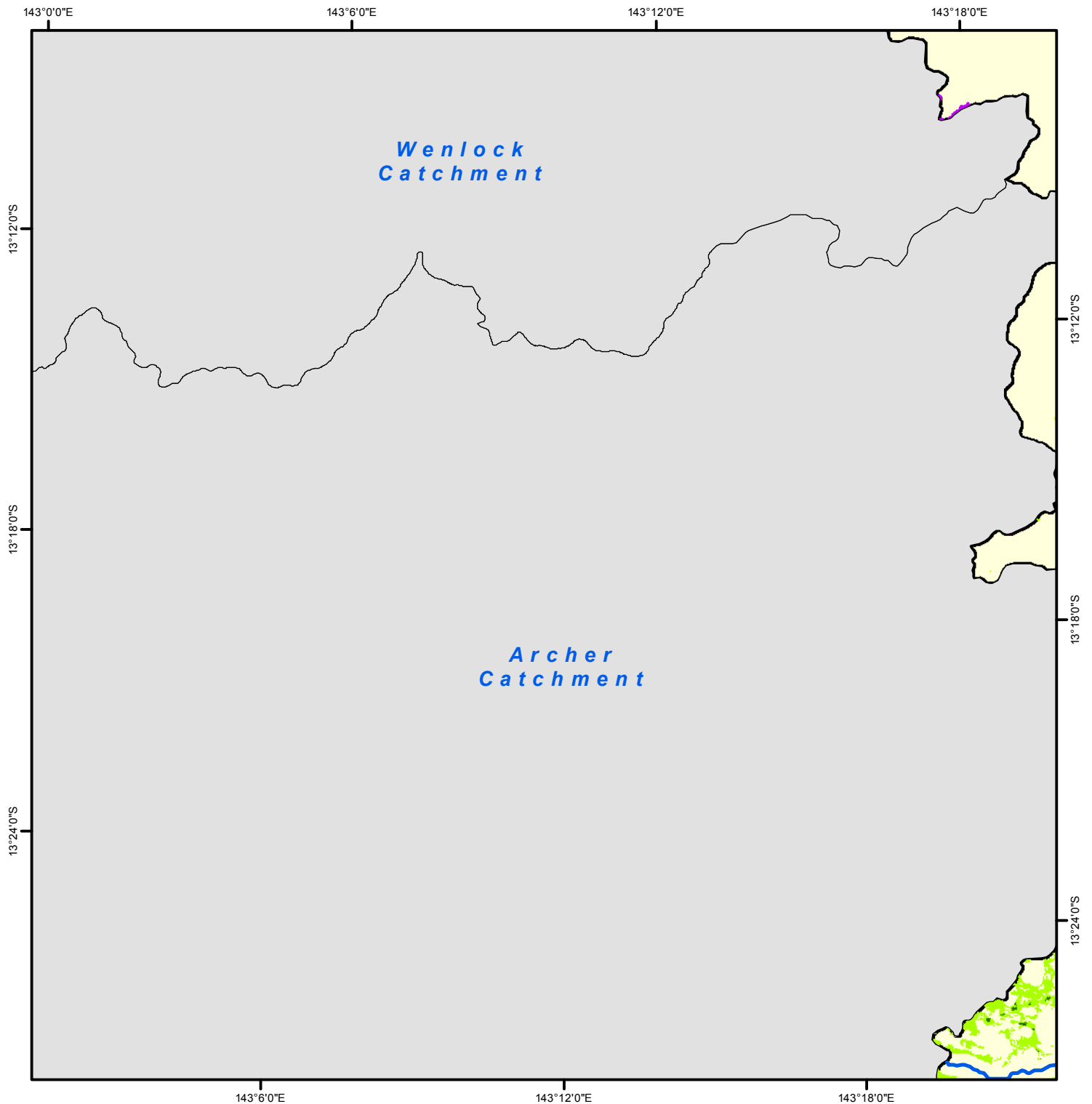
J6 Lockhart Catchment



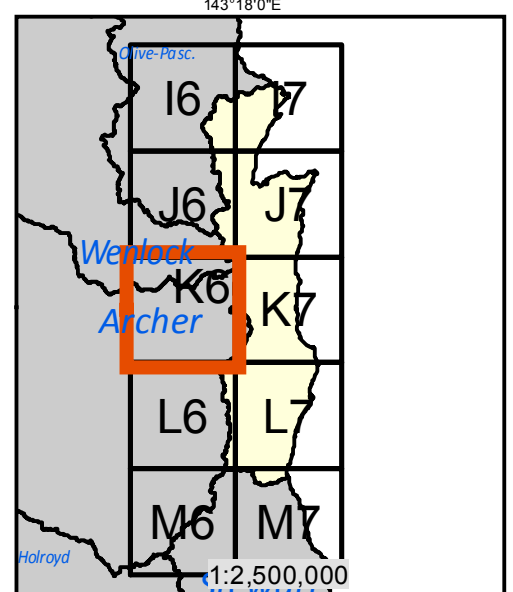
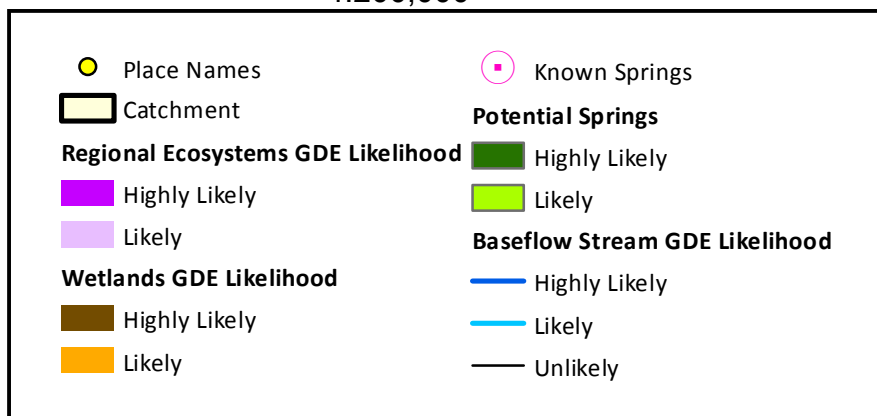
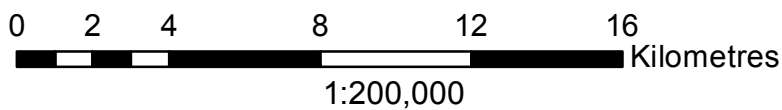


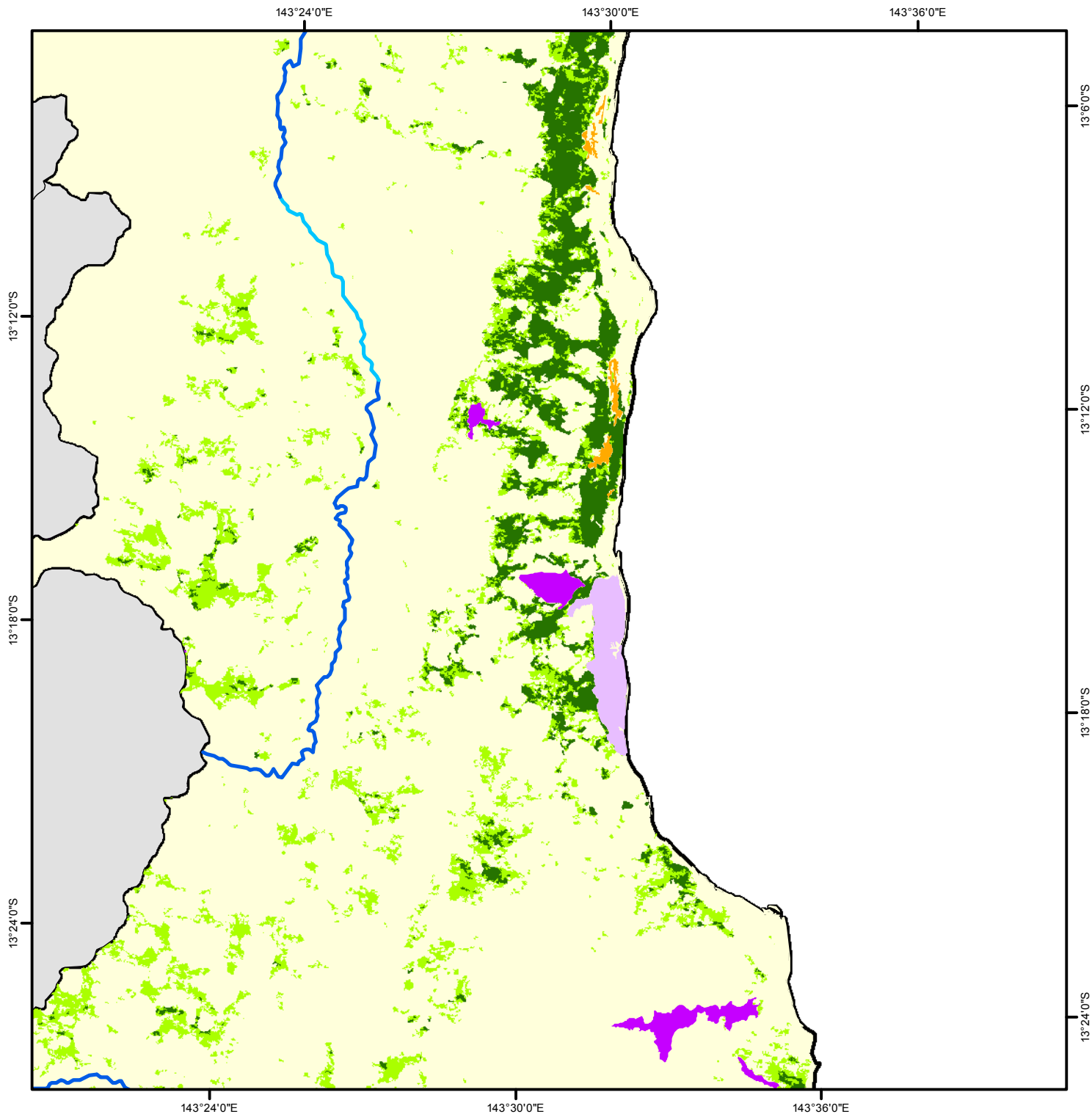
J7 Lockhart Catchment



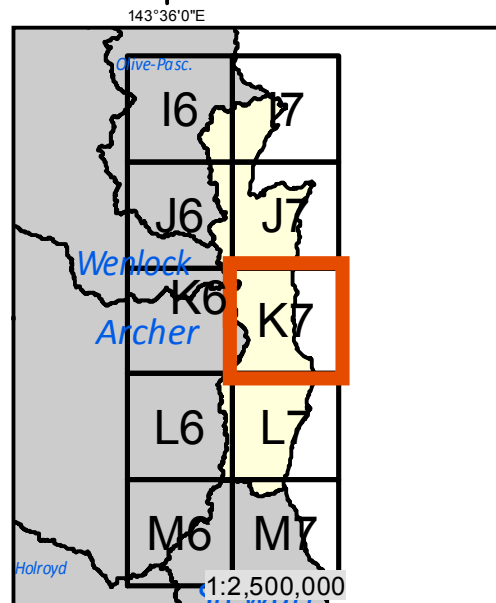
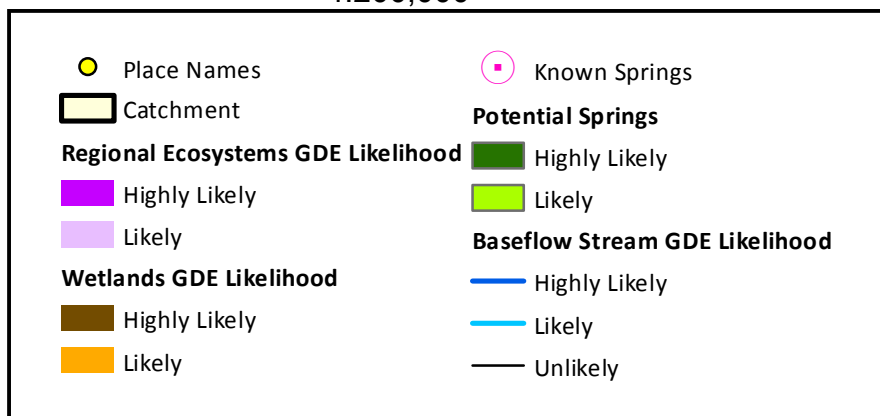
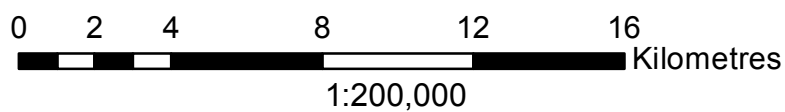


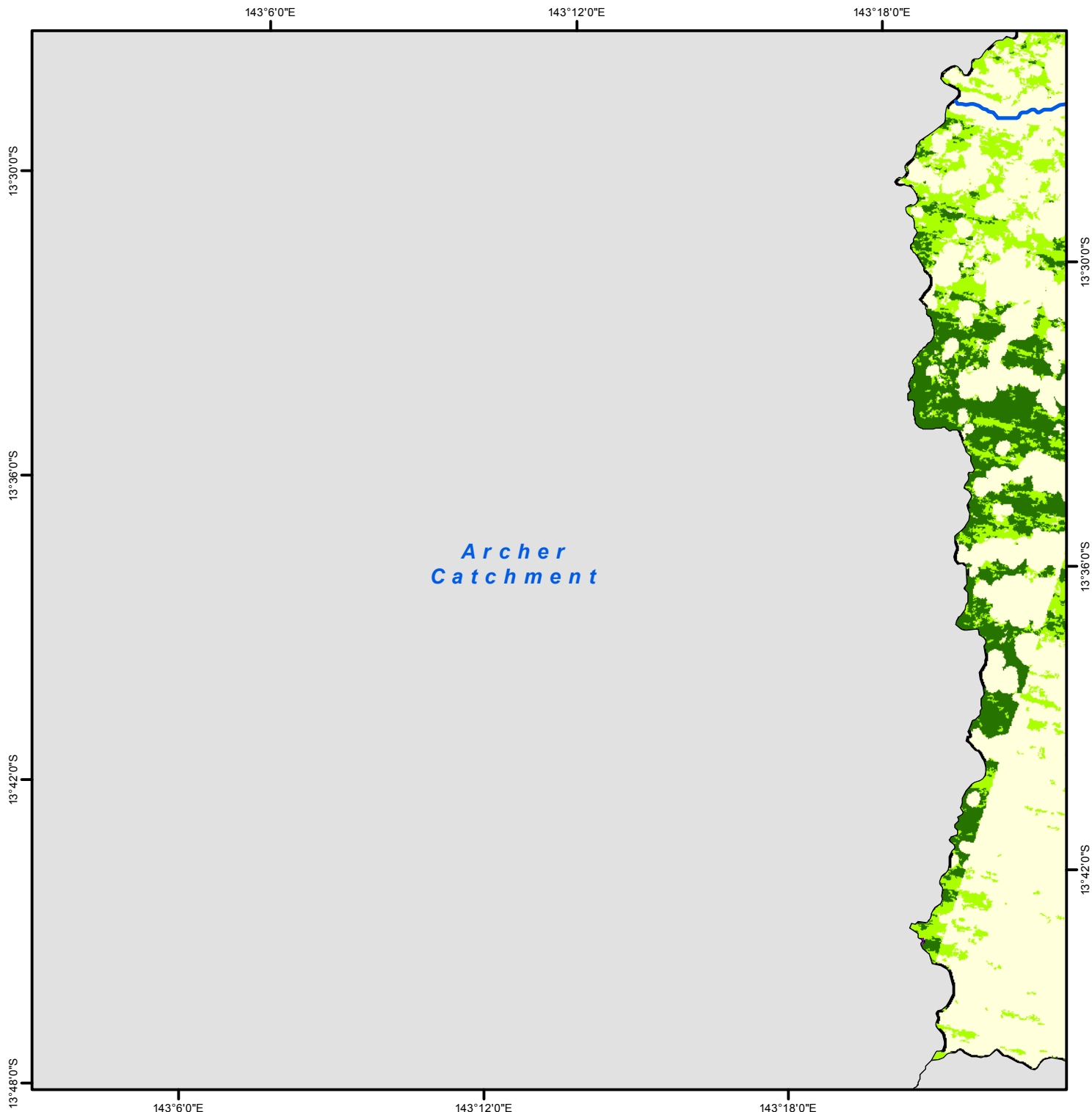
K6 Lockhart Catchment



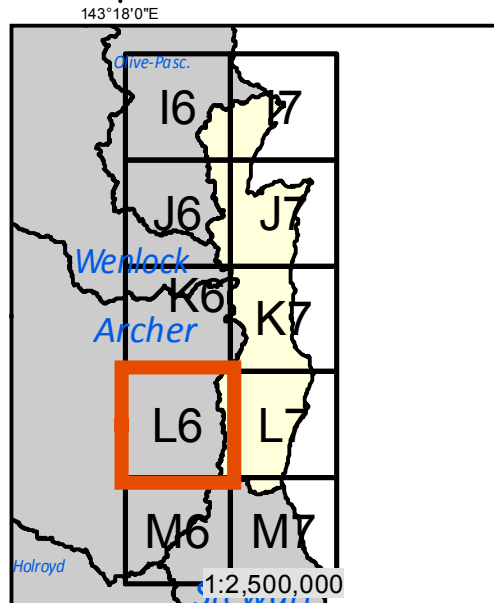
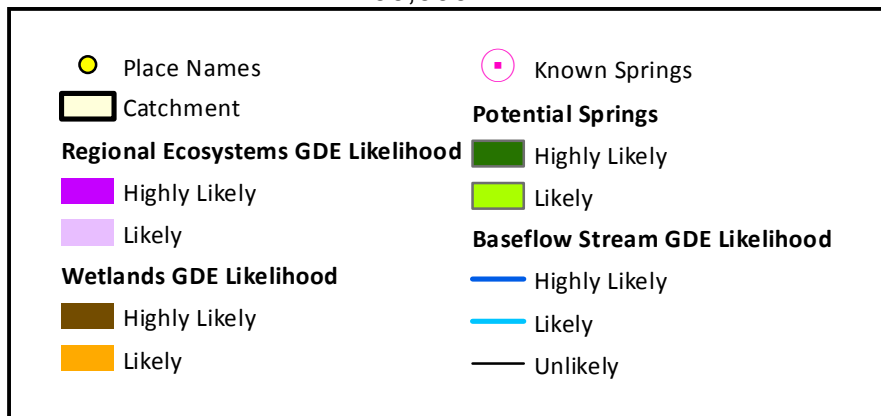
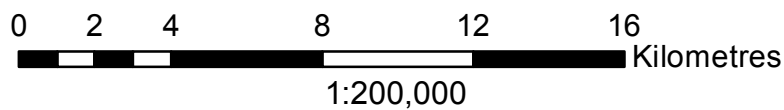


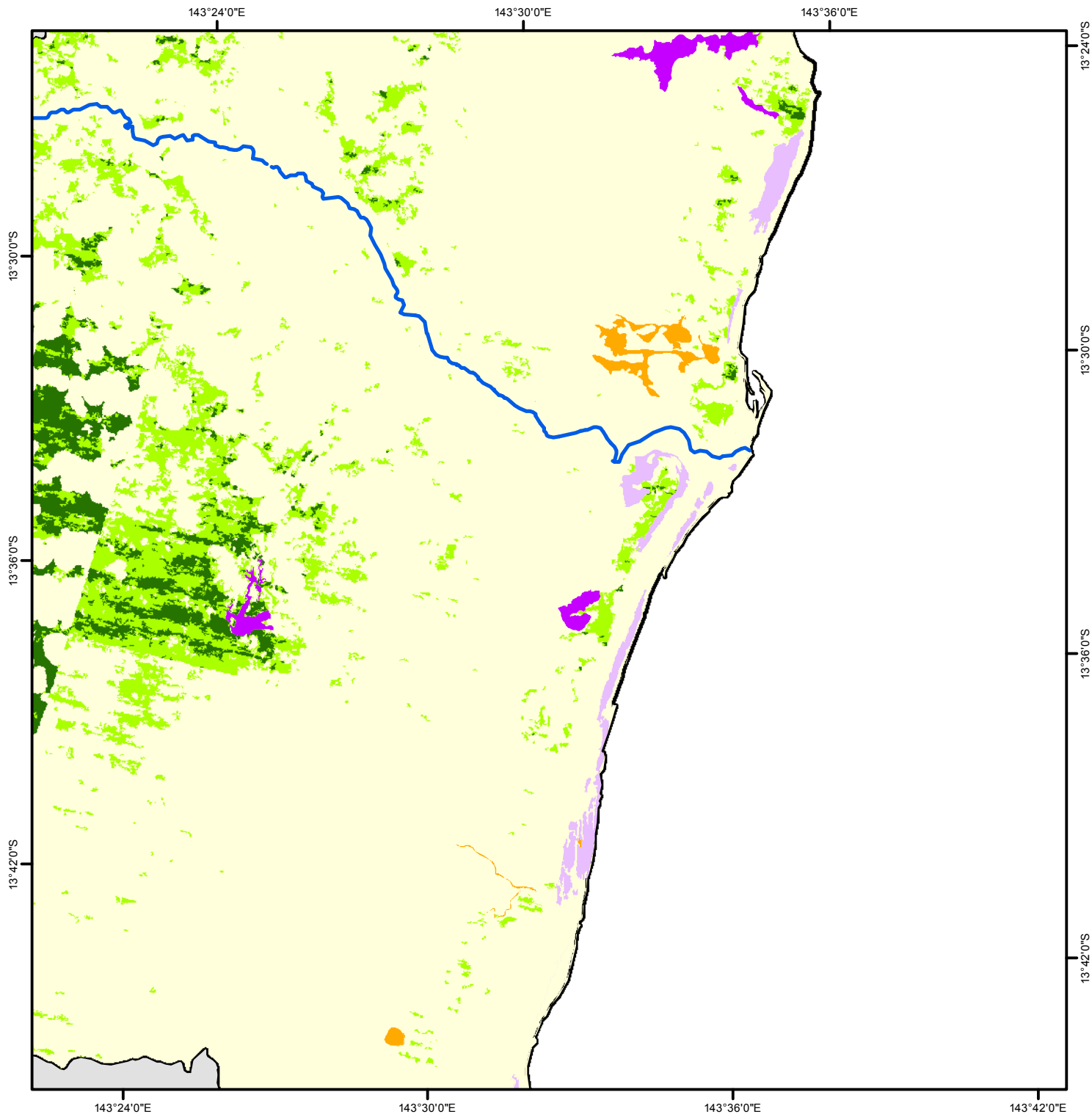
K7 Lockhart Catchment



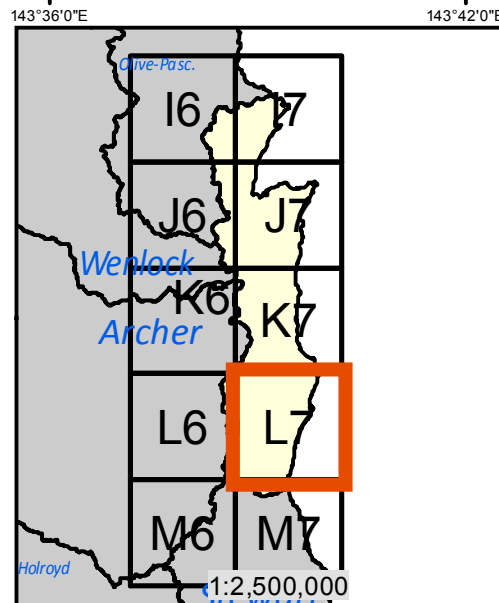
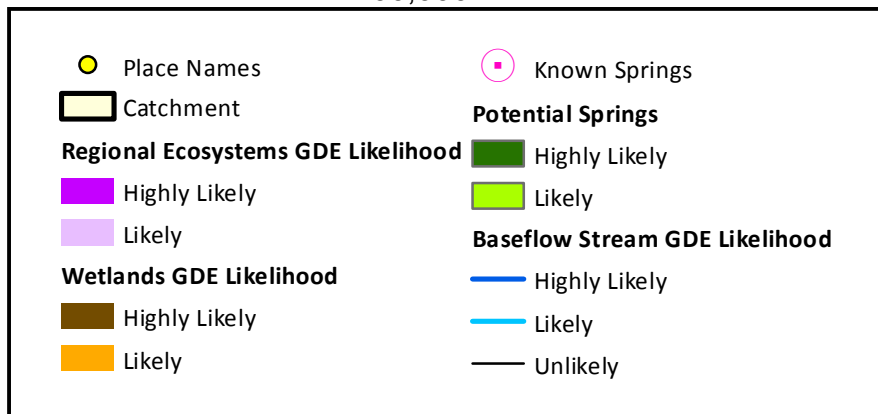
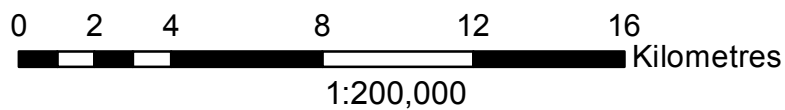


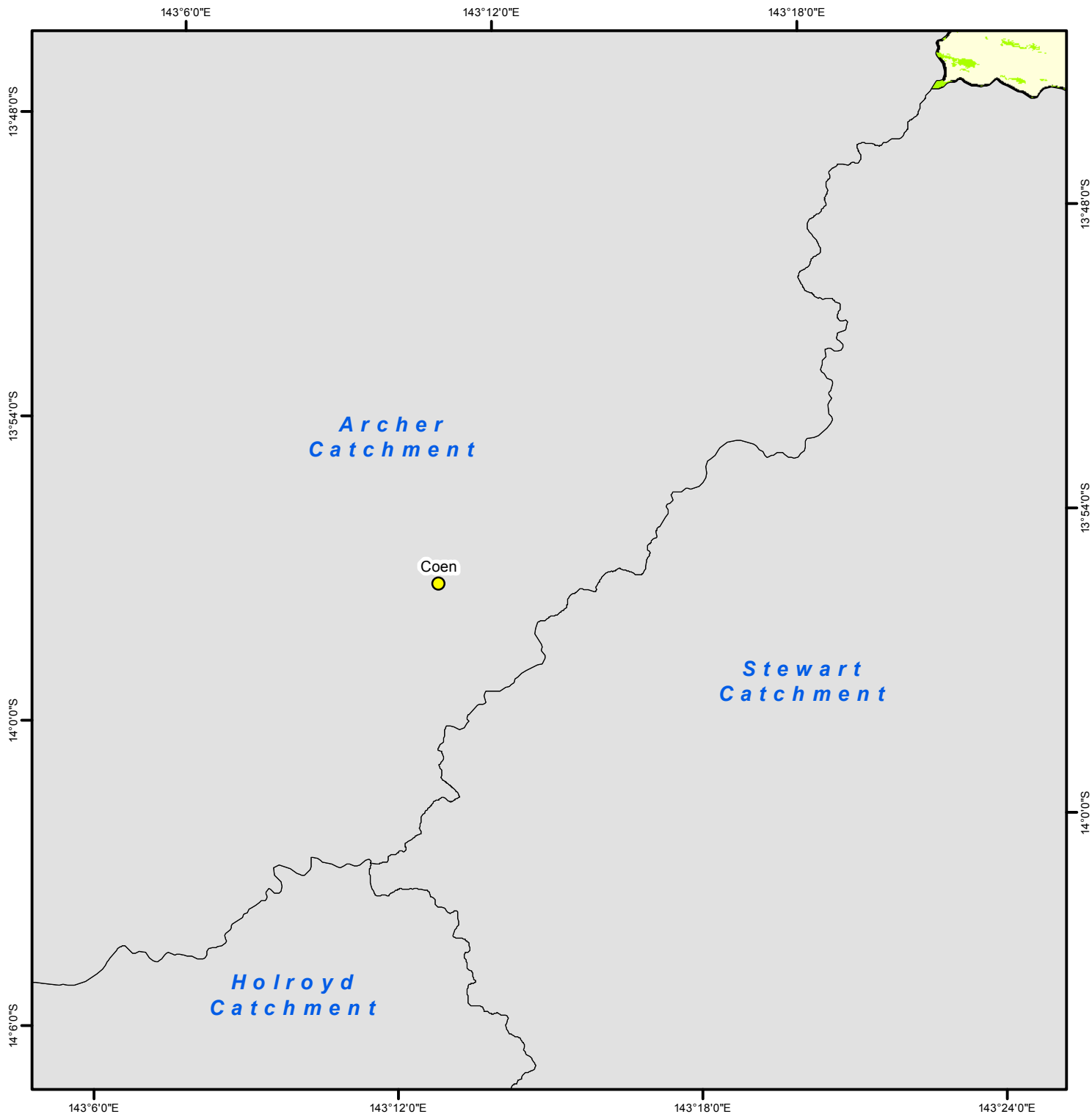
L6 Lockhart Catchment



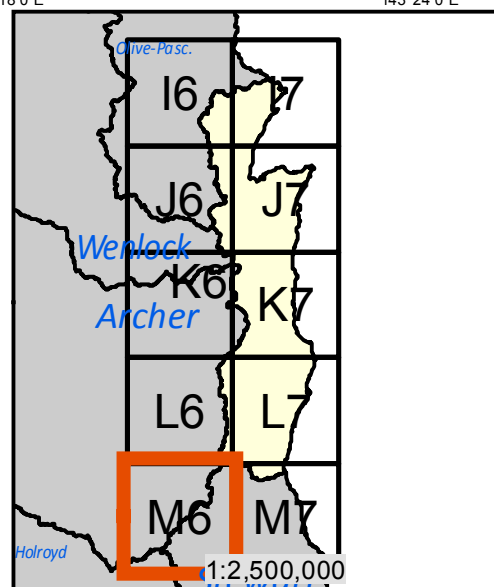
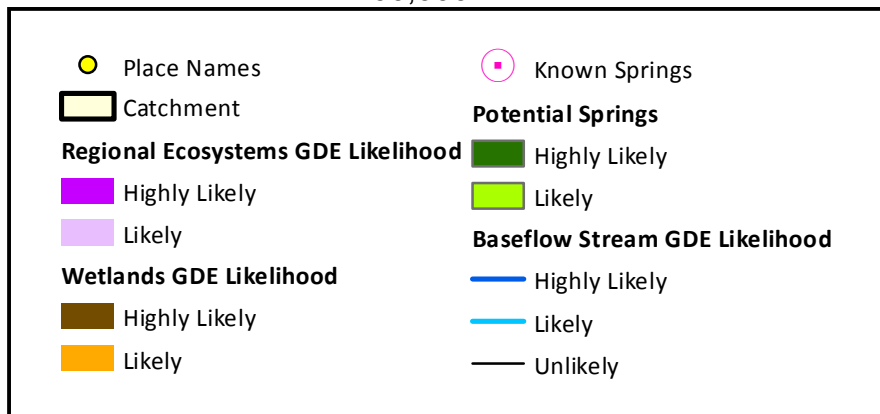
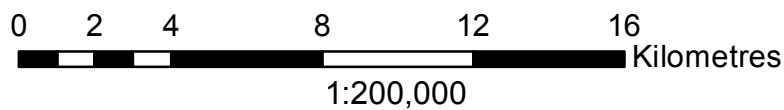


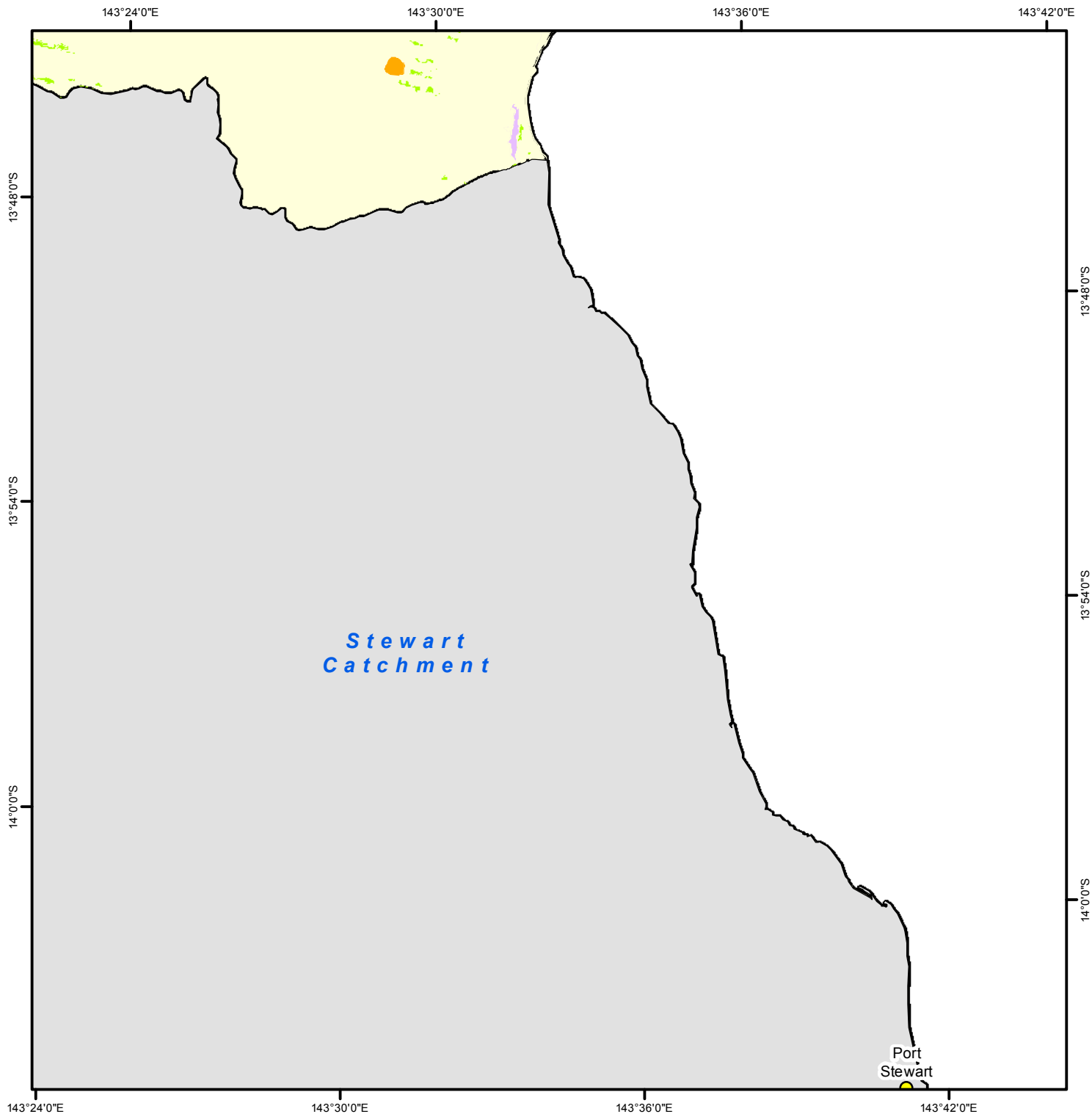
L7 Lockhart Catchment



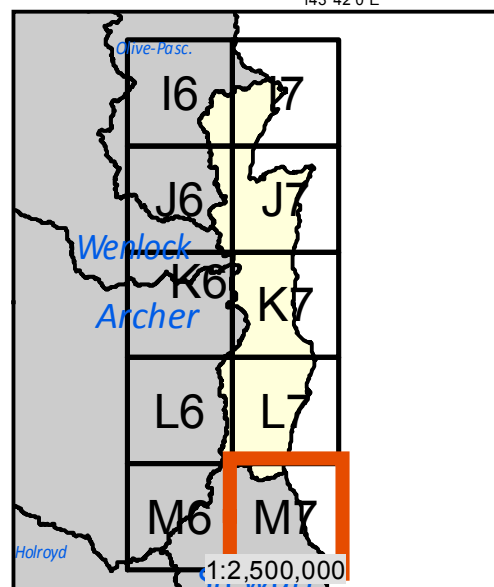
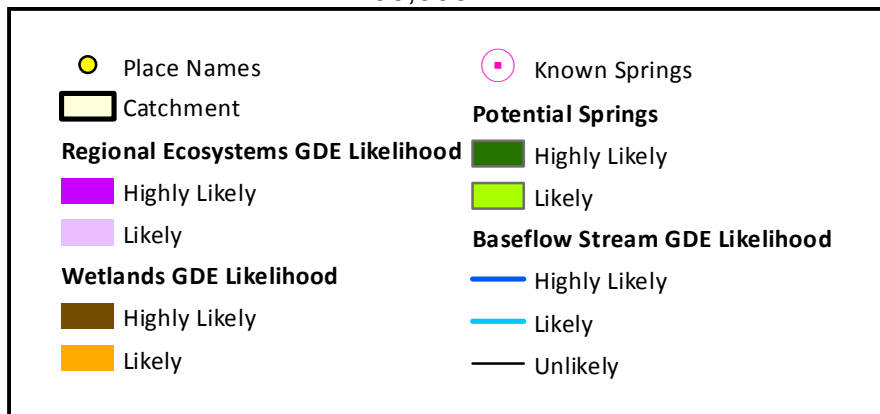
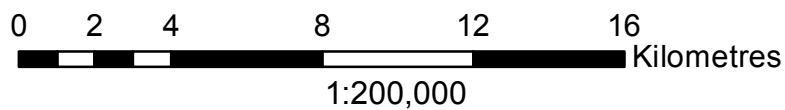


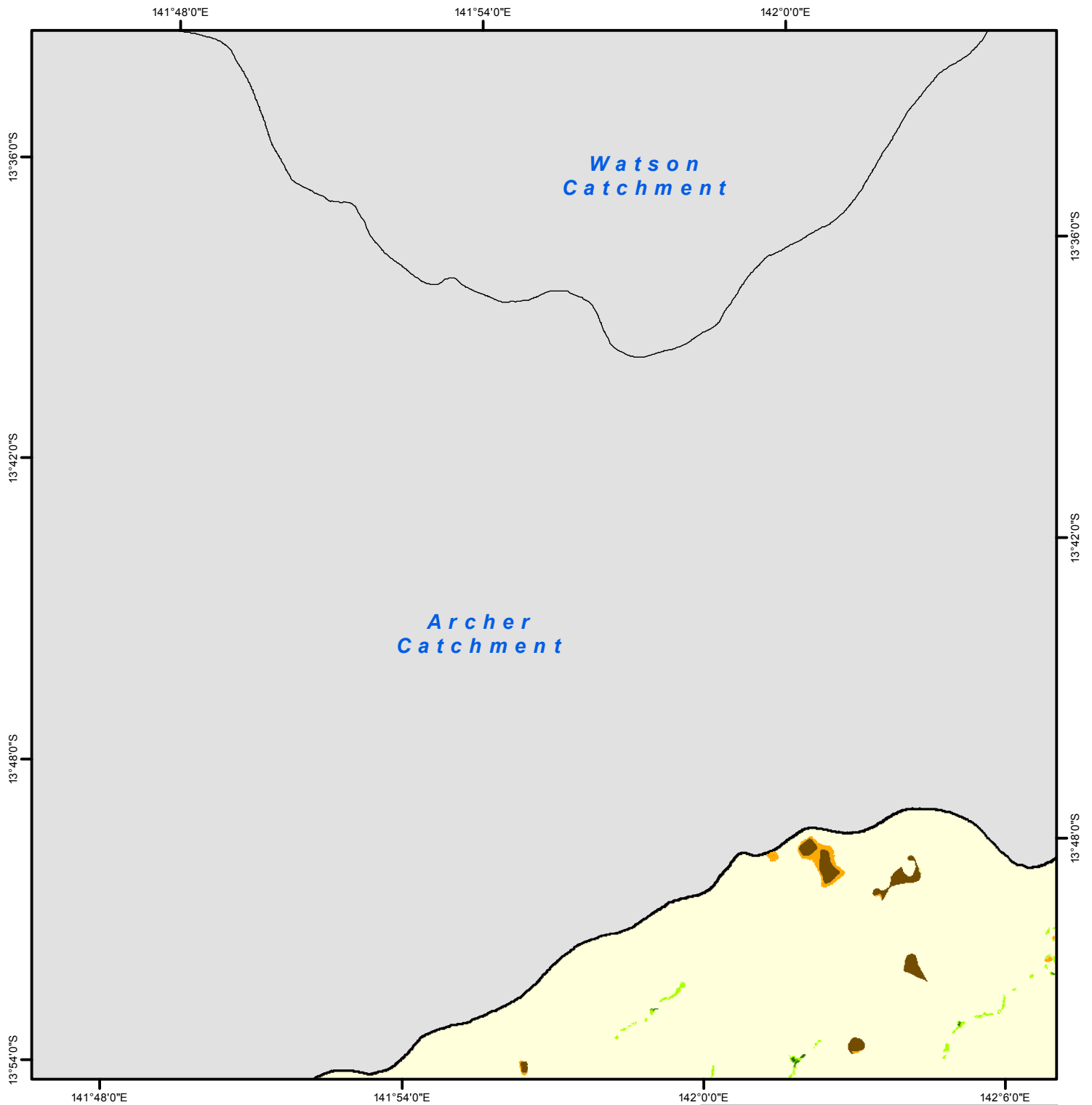
M6 Lockhart Catchment



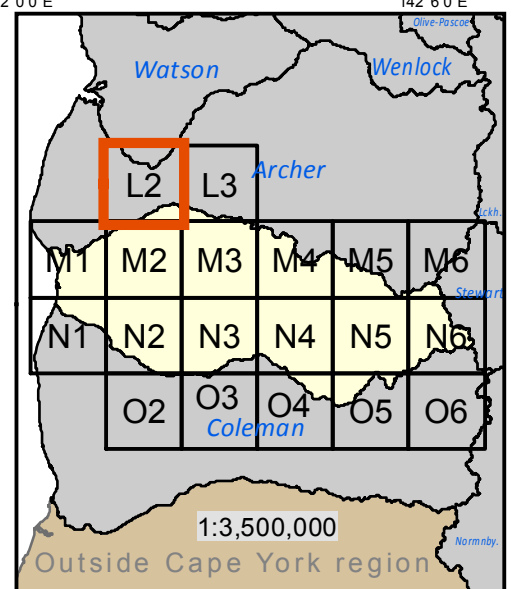
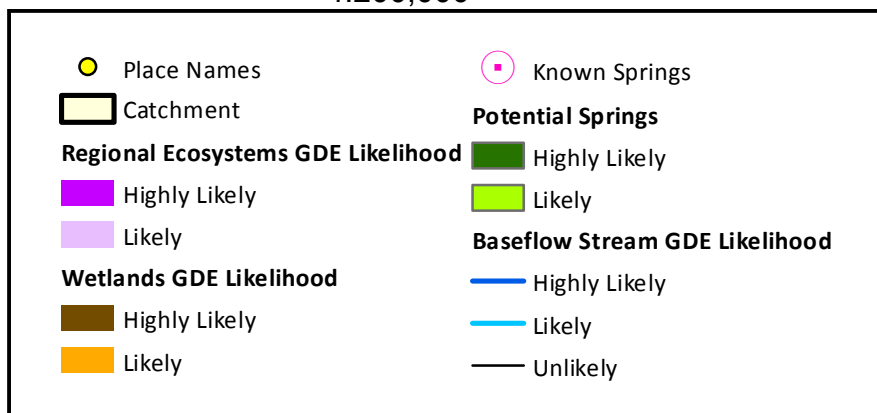
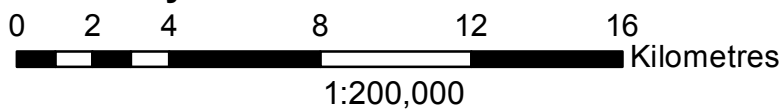


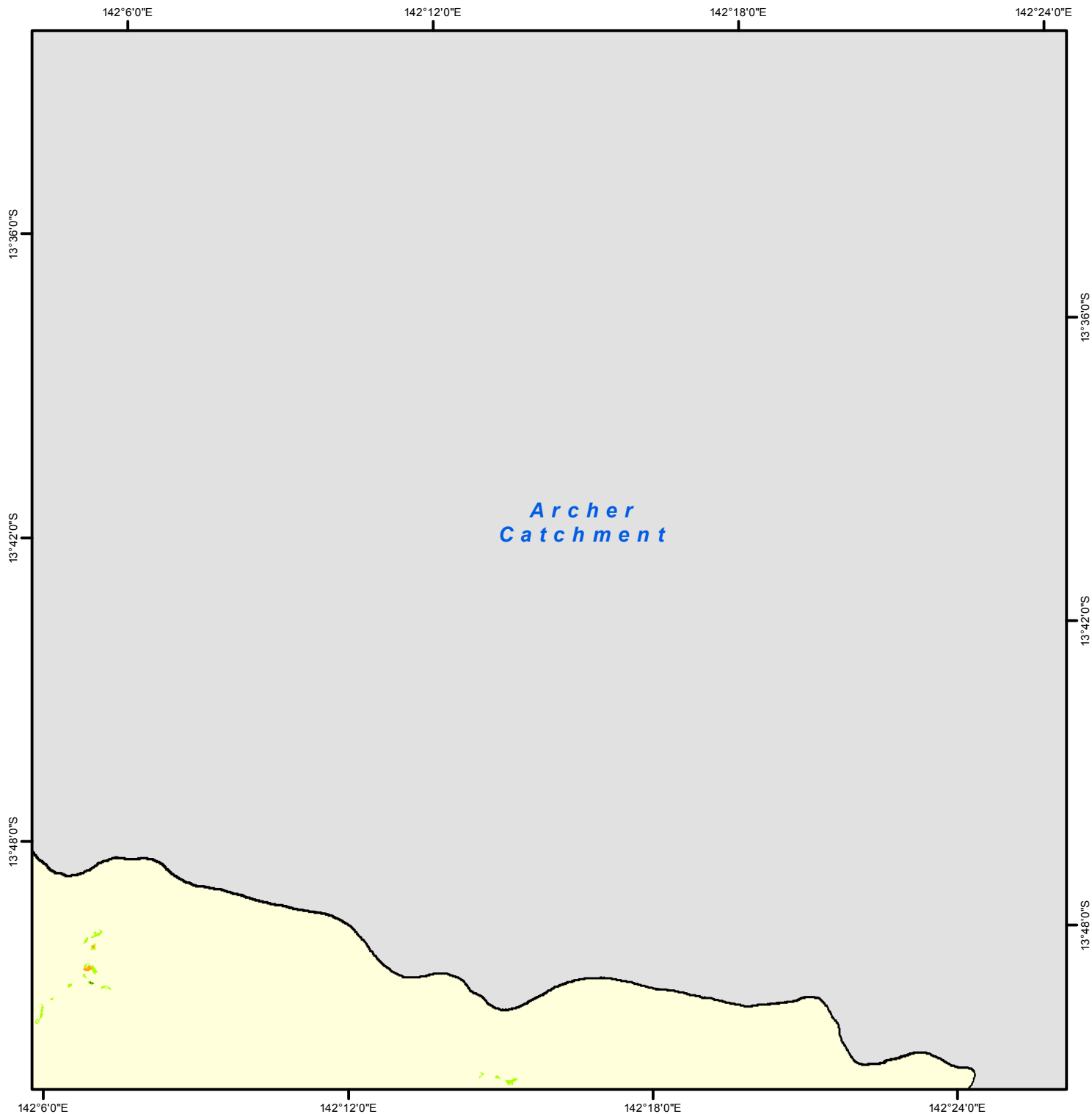
M7 Lockhart Catchment



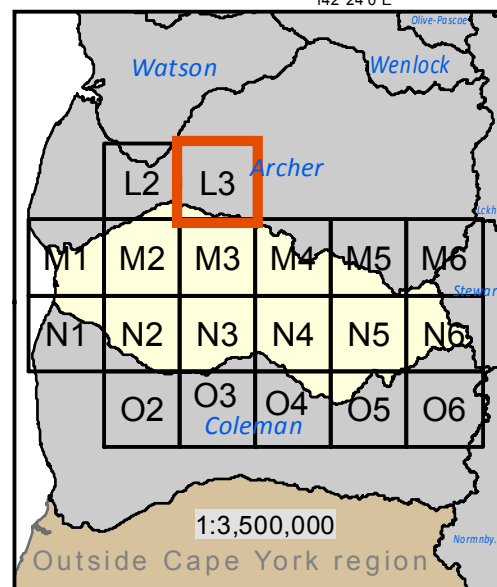
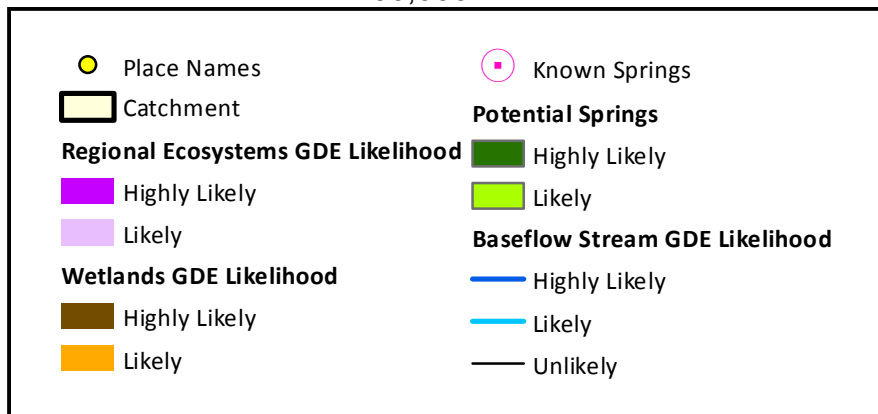
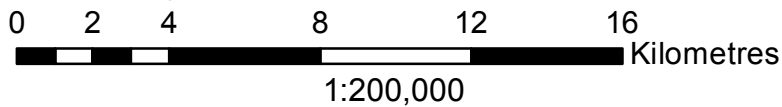


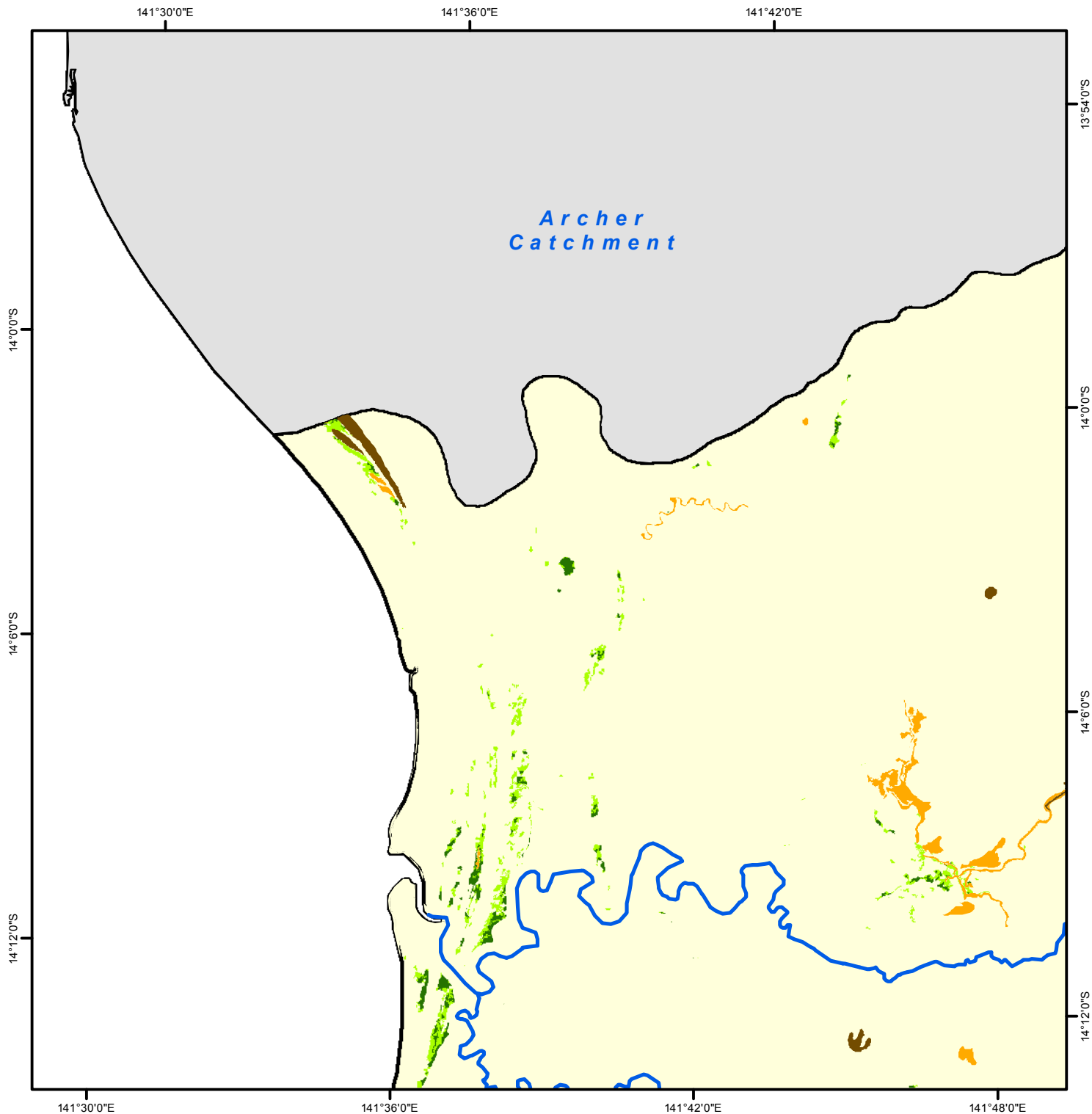
L2 Holroyd Catchment



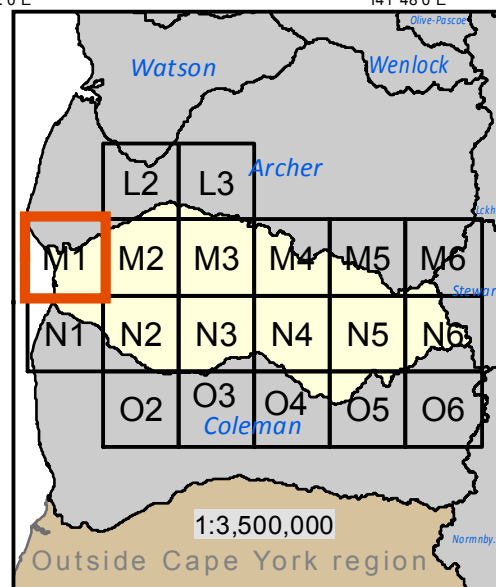
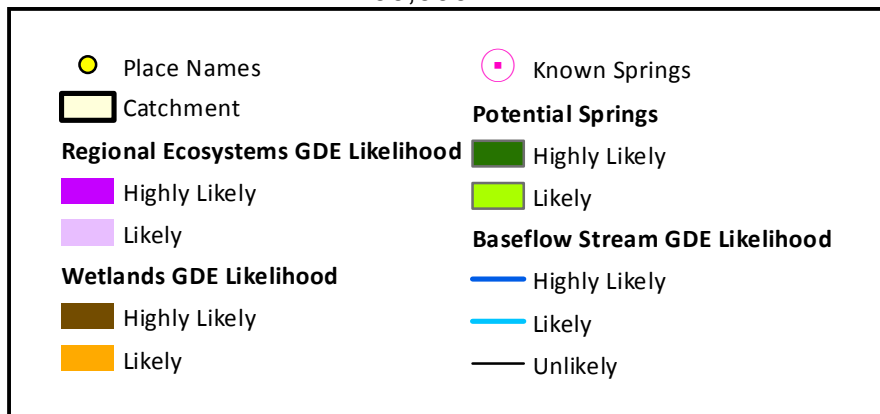
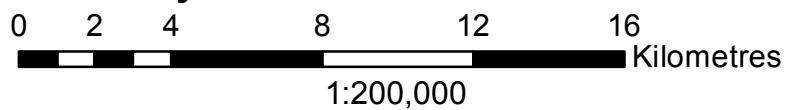


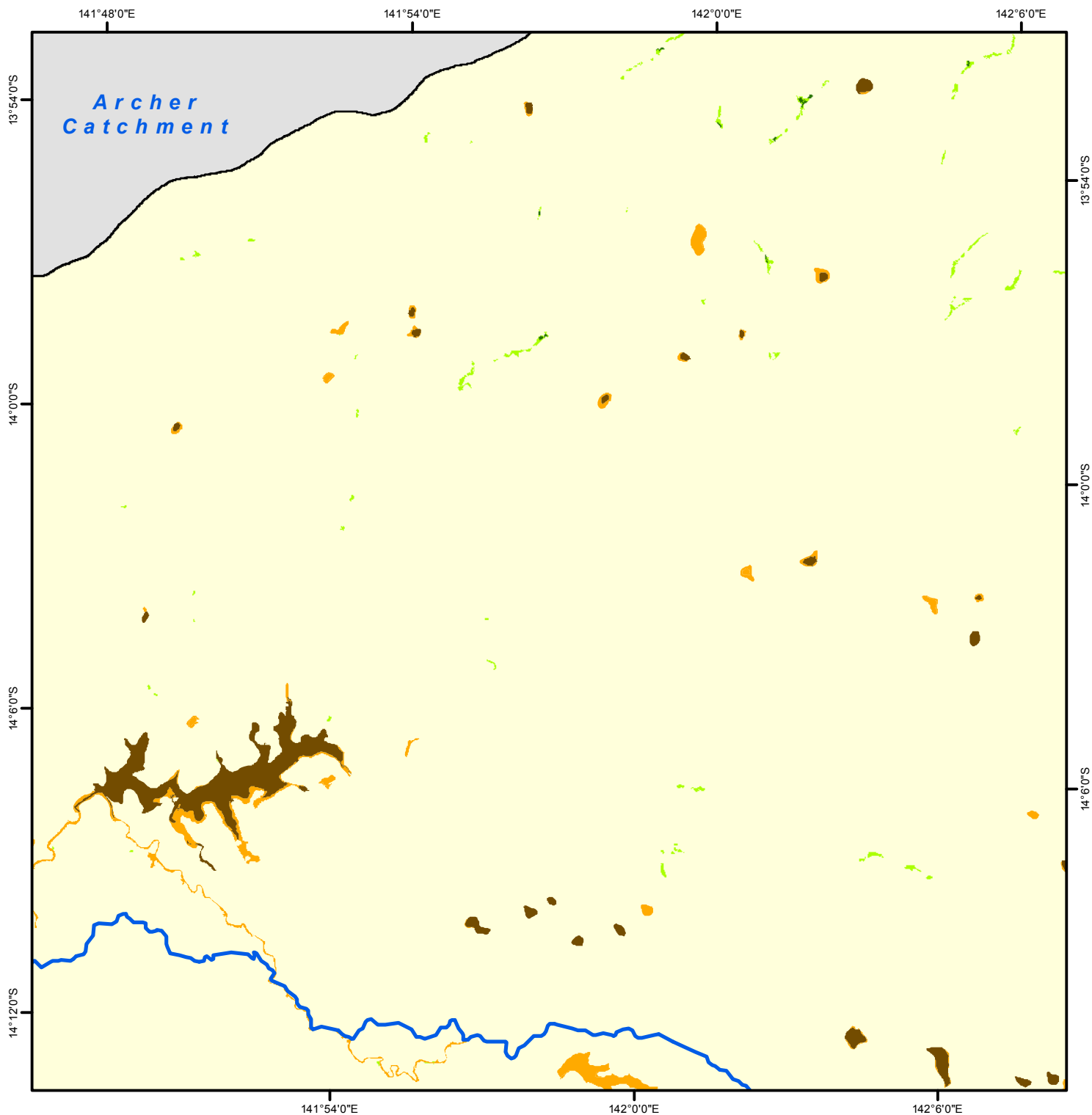
L3 Holroyd Catchment



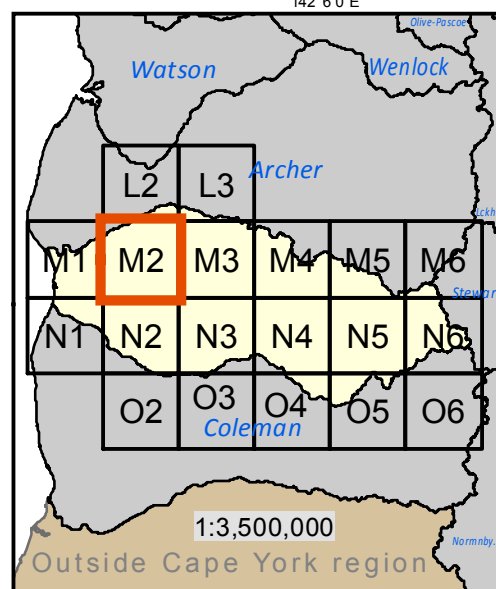
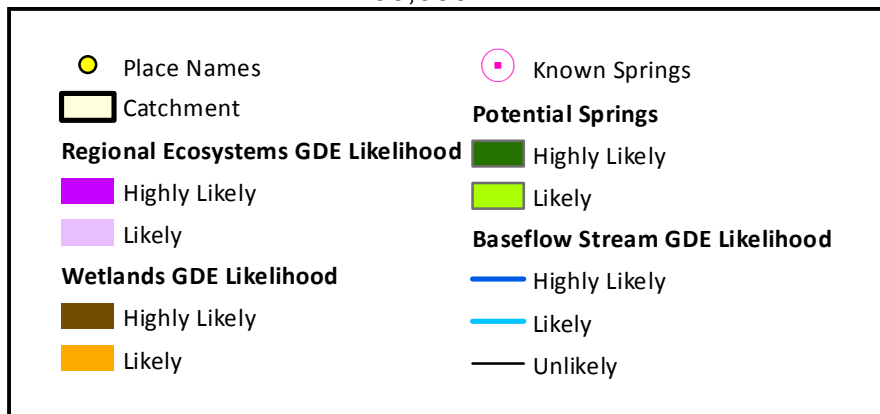
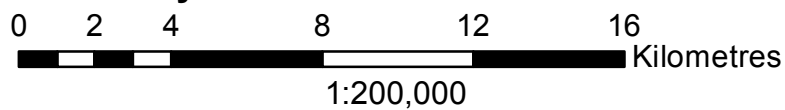


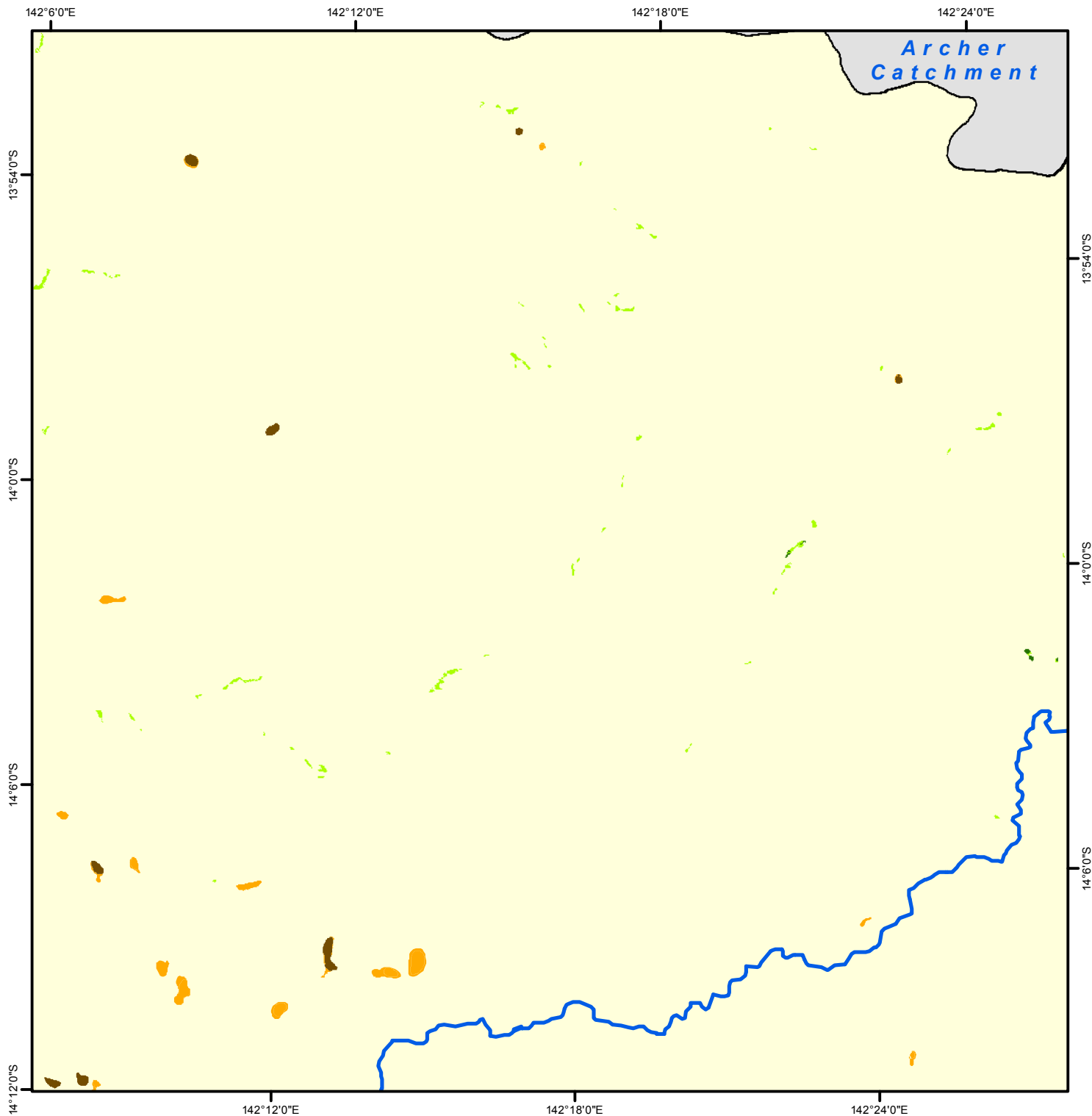
M1 Holroyd Catchment



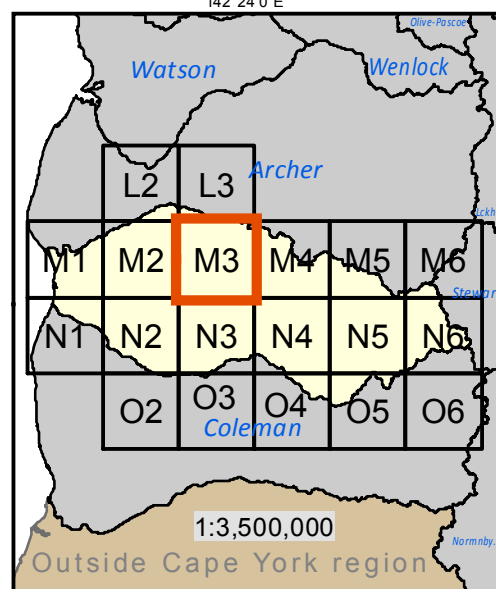
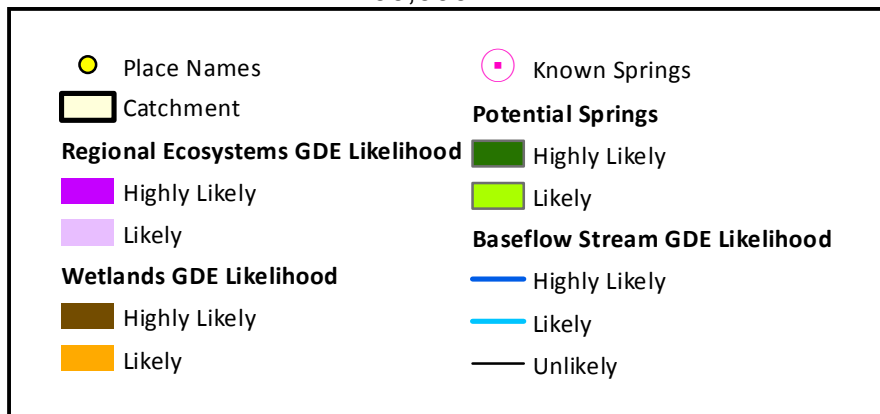
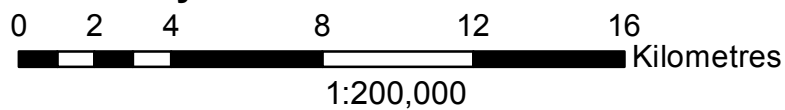


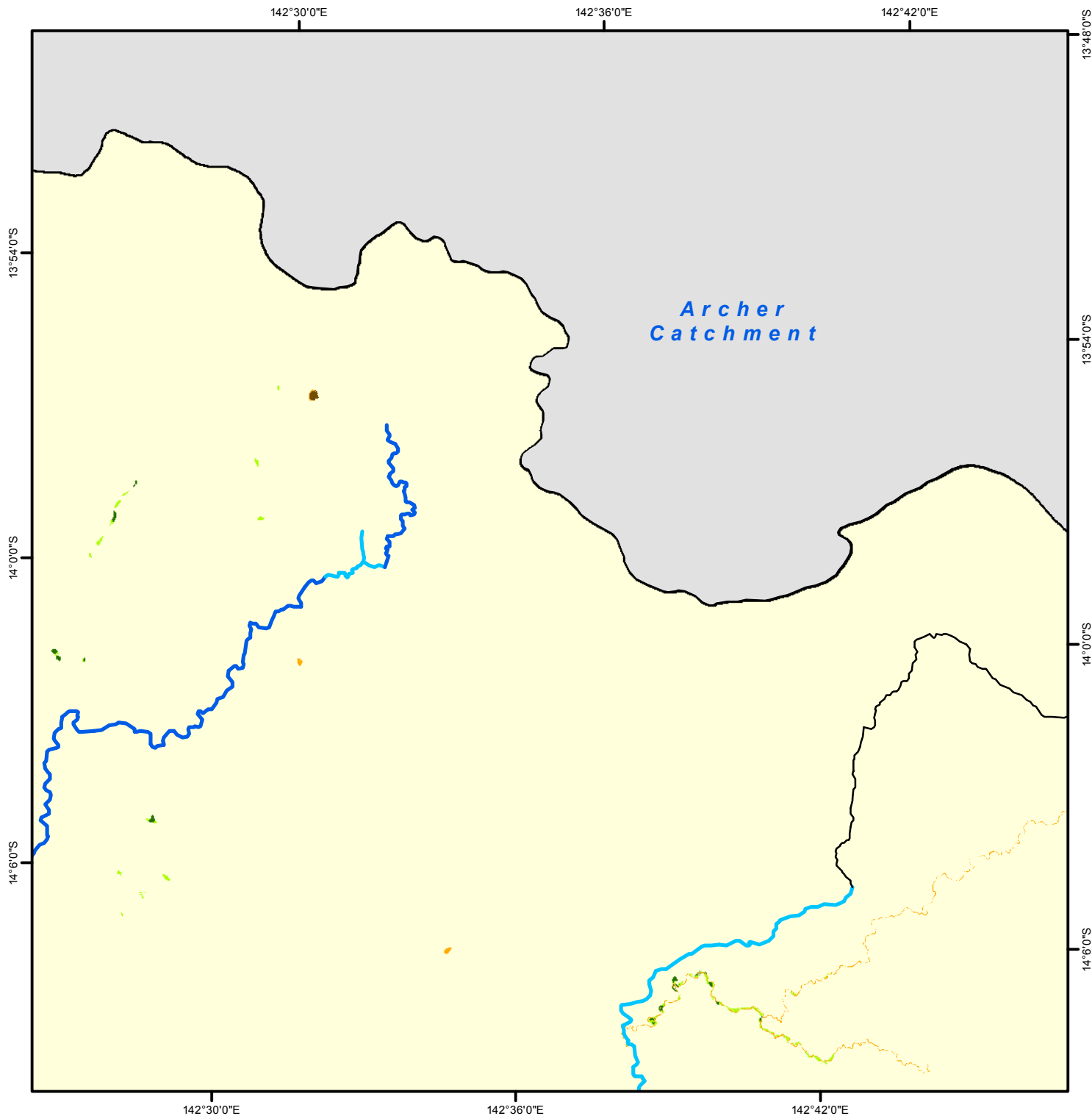
M2 Holroyd Catchment



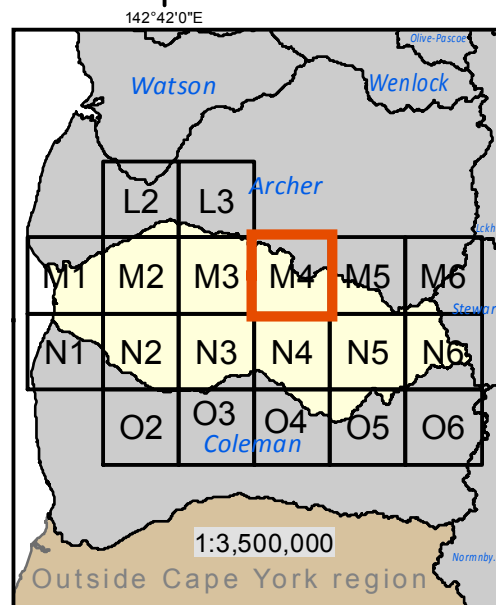
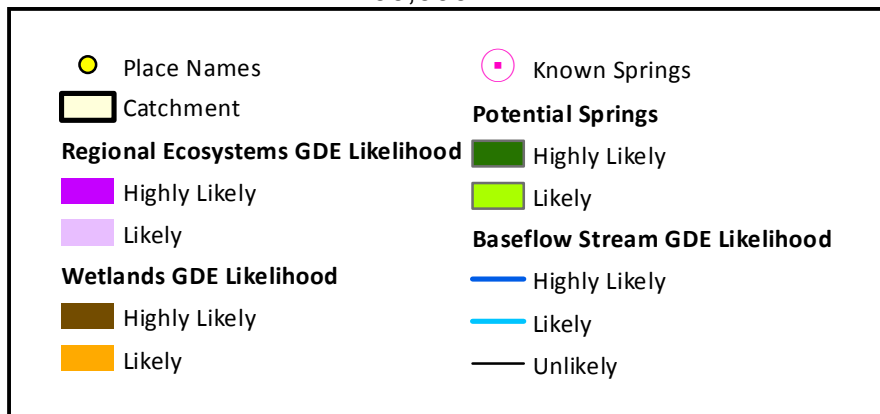
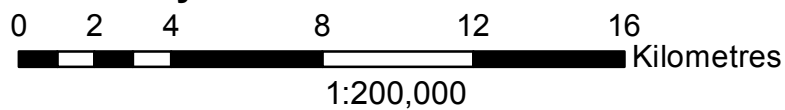


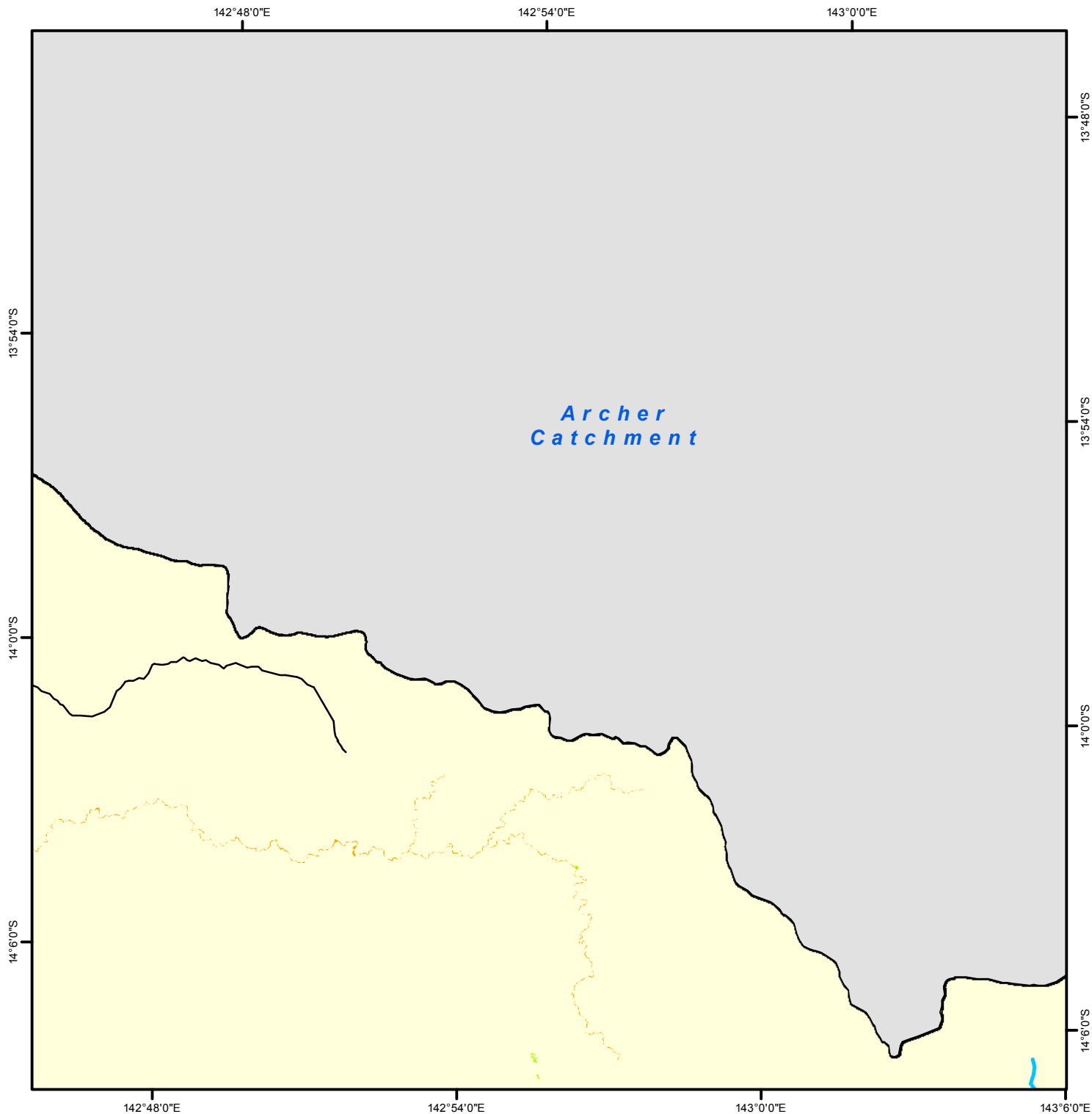
M3 Holroyd Catchment



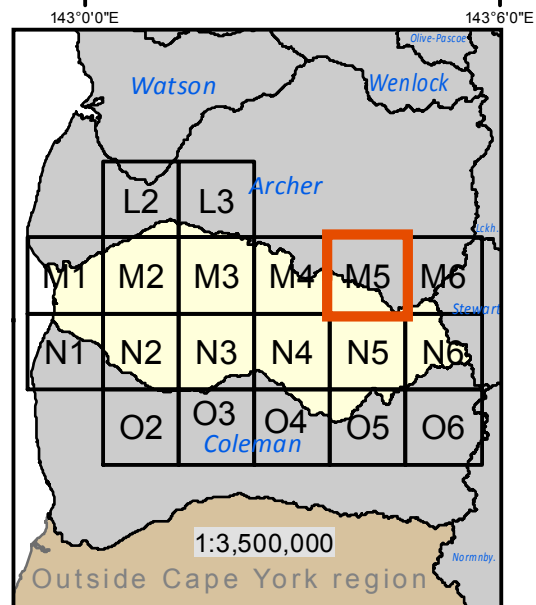
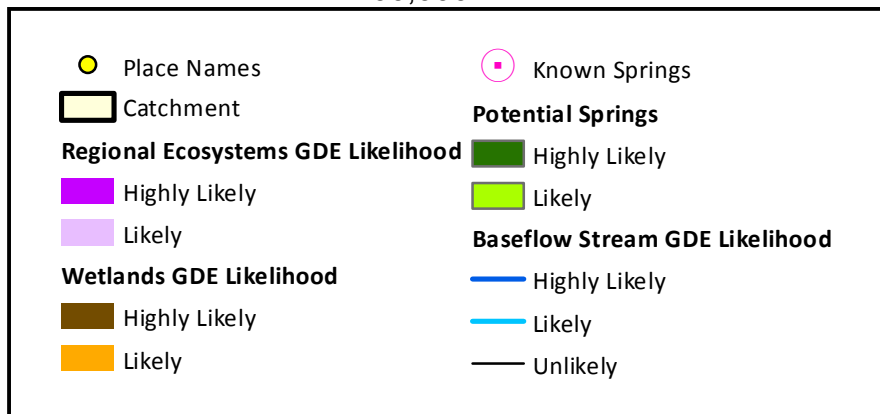
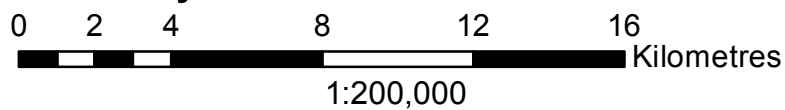


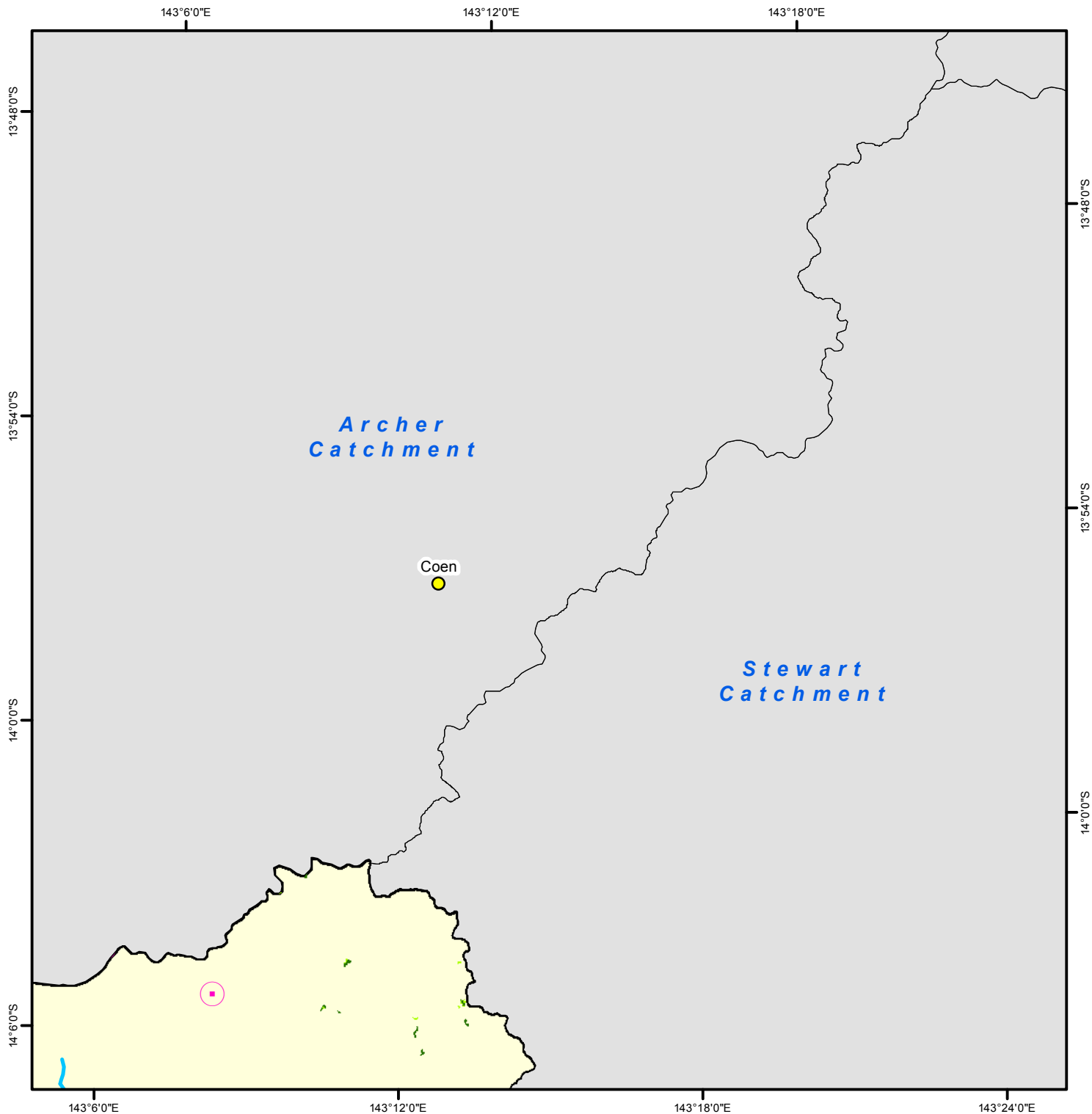
M4 Holroyd Catchment



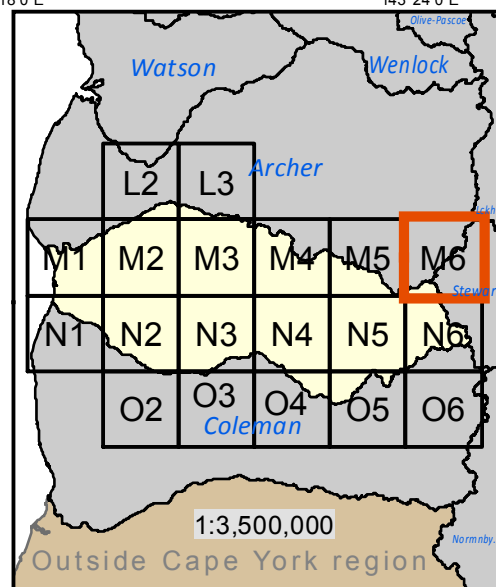
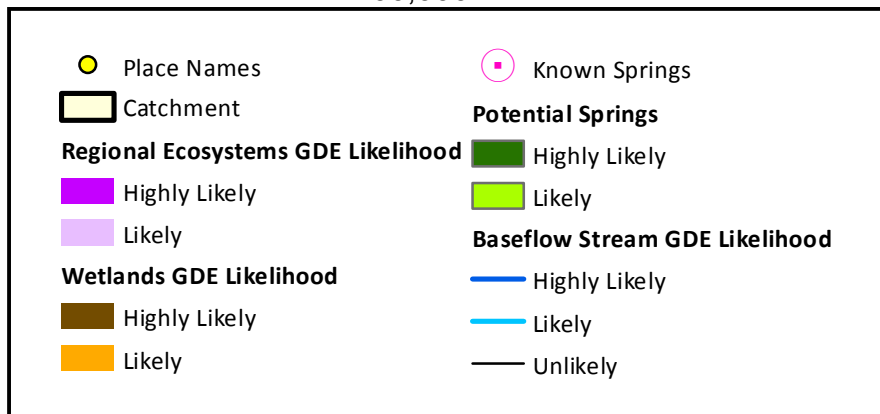
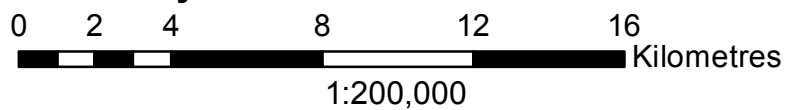


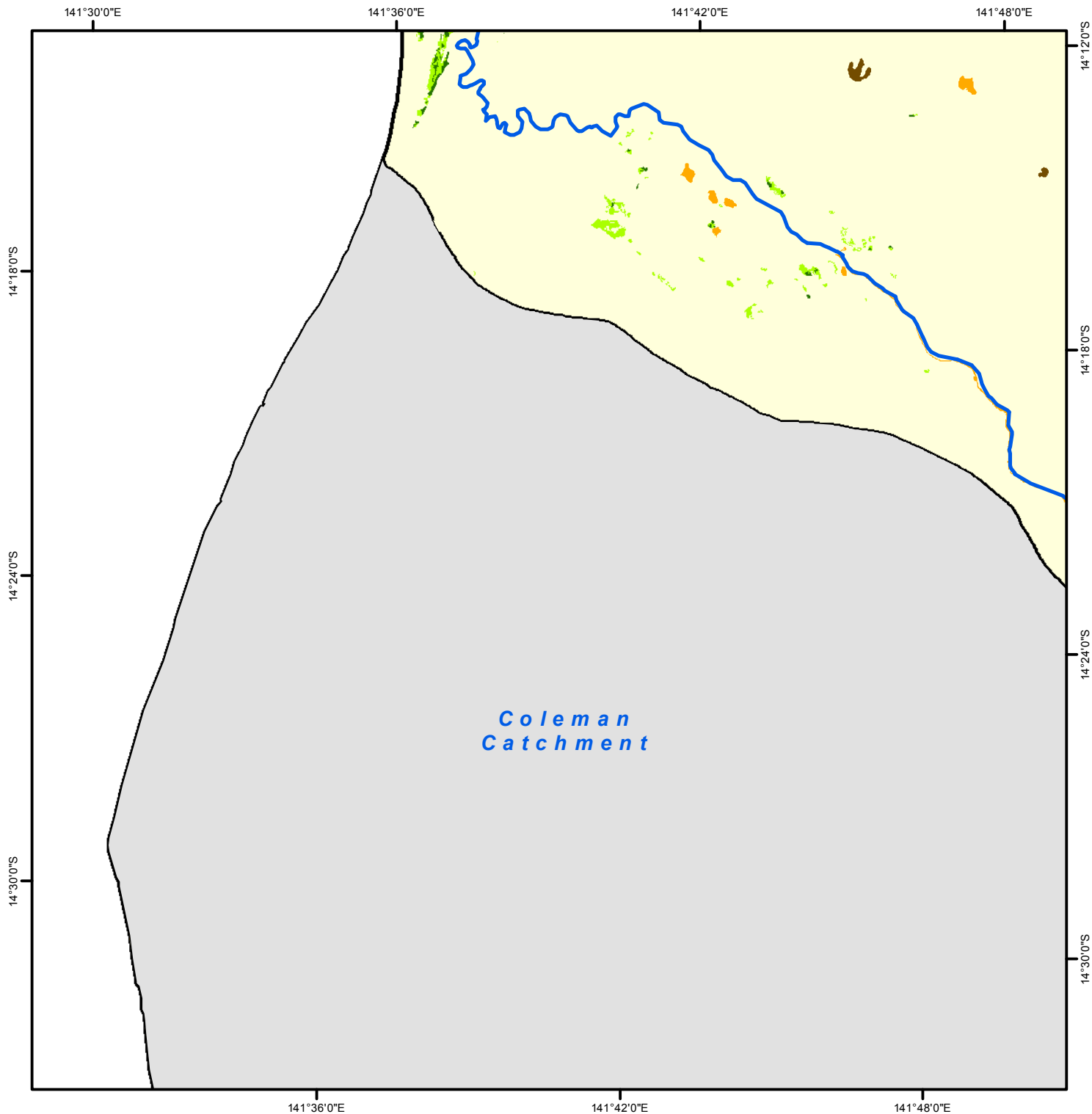
M5 Holroyd Catchment



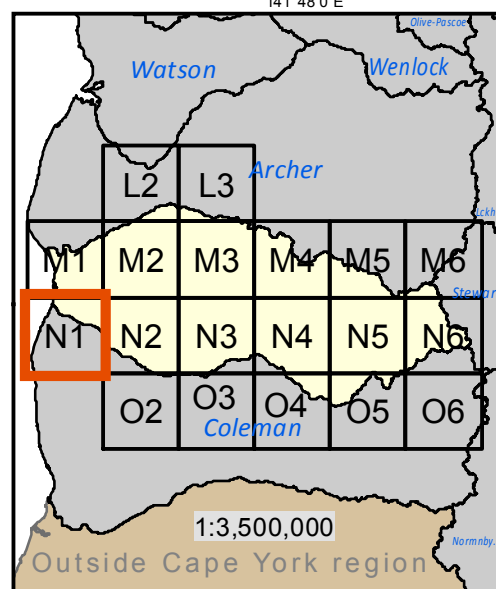
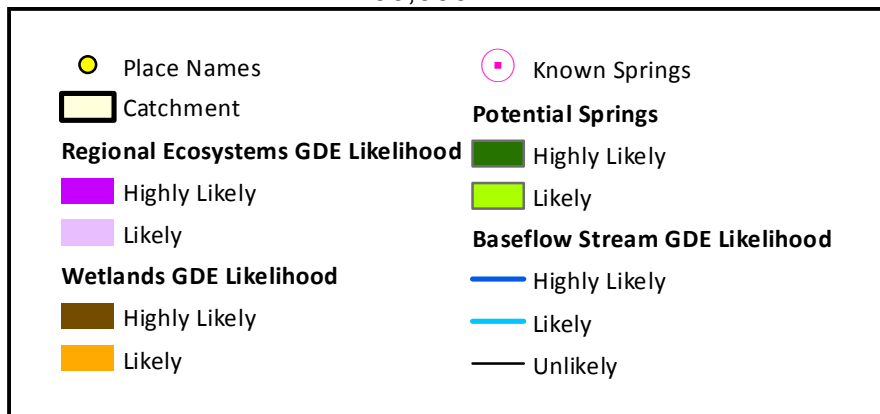
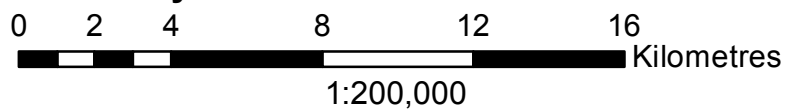


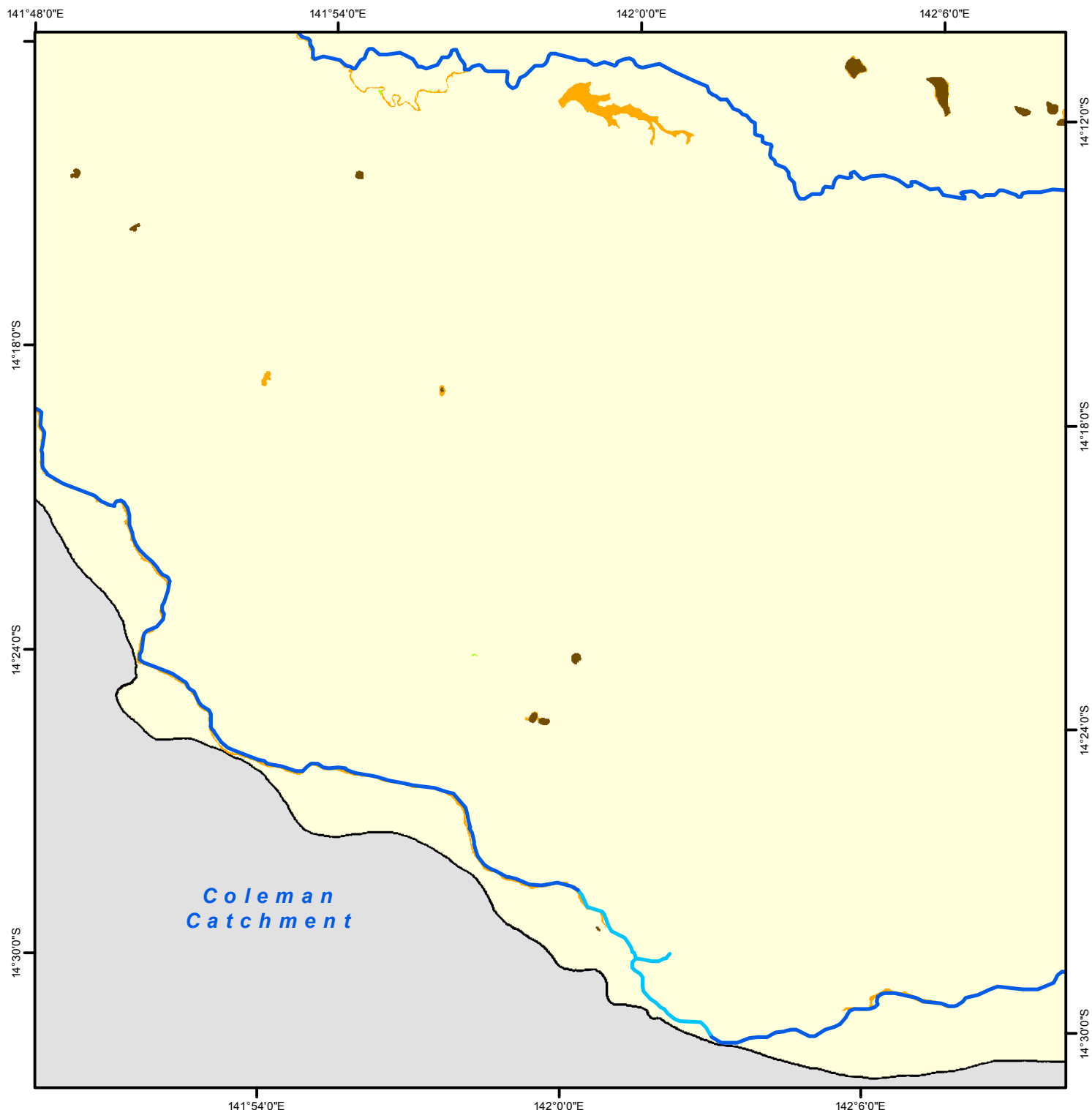
M6 Holroyd Catchment



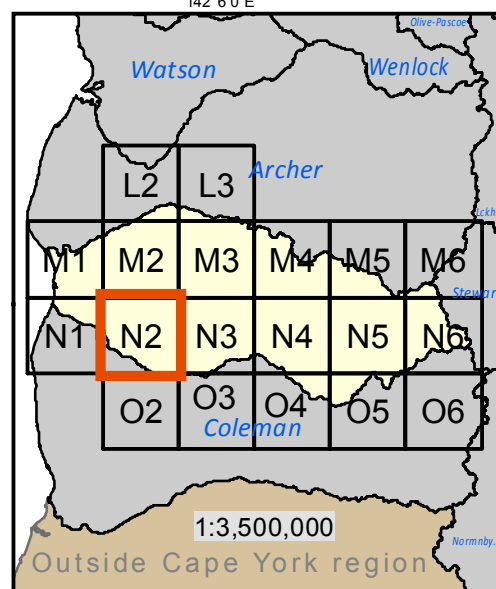
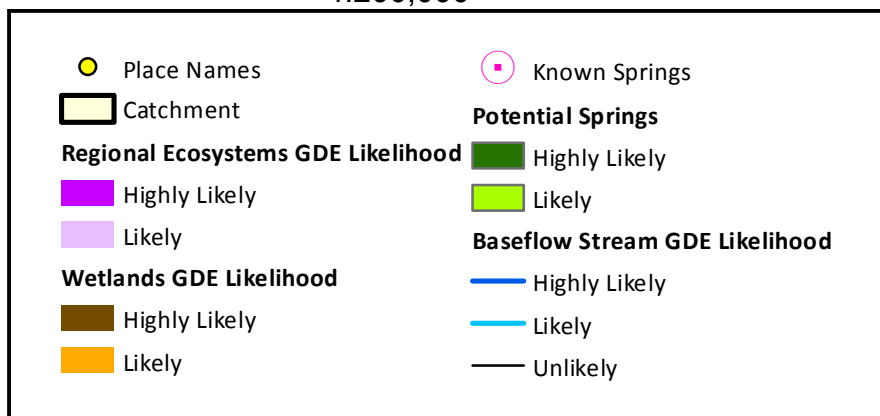
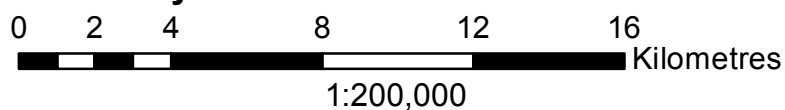


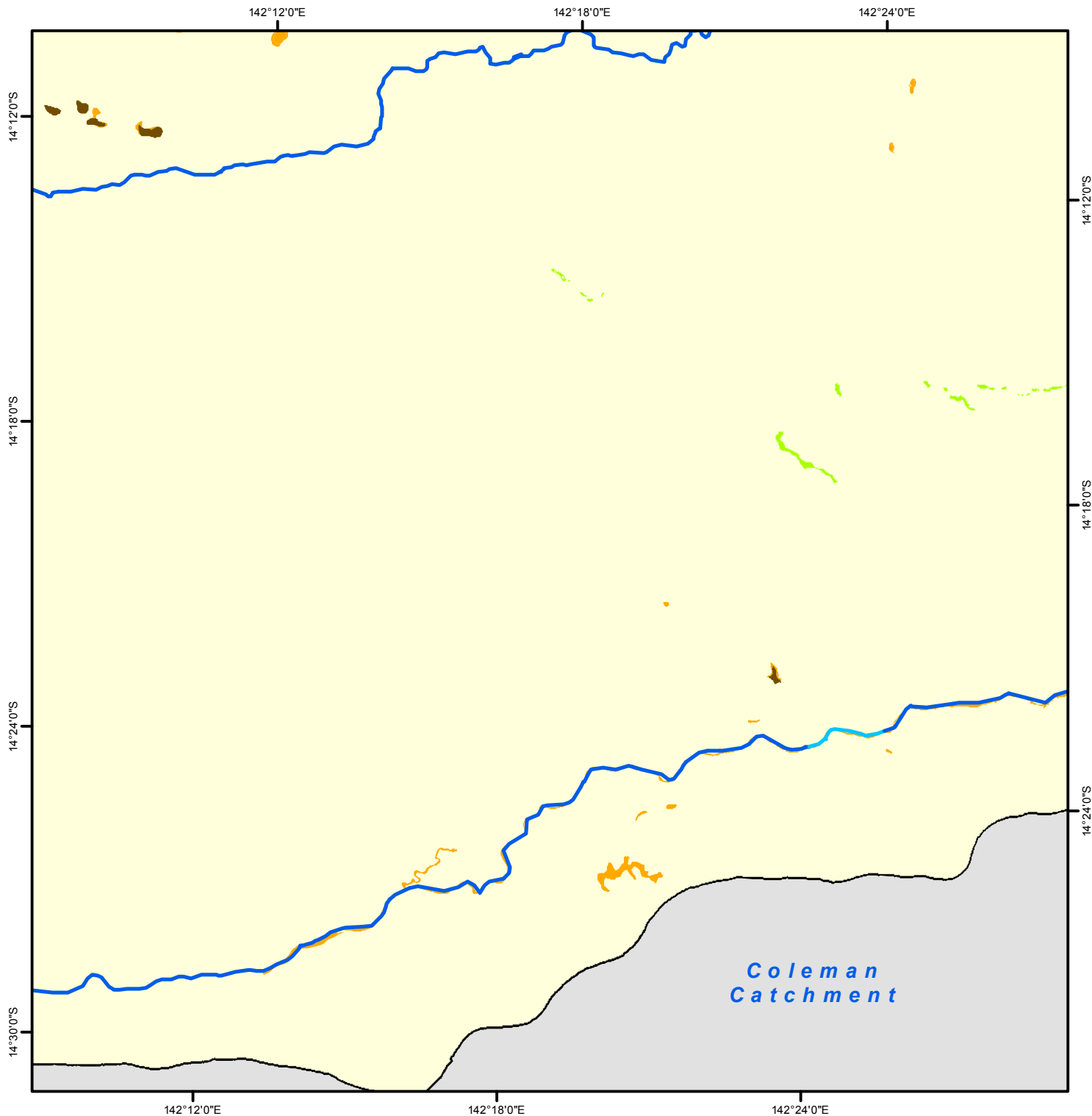
N1 Holroyd Catchment



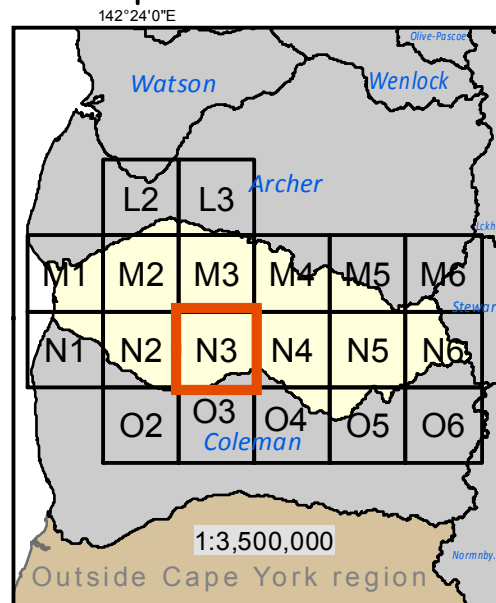
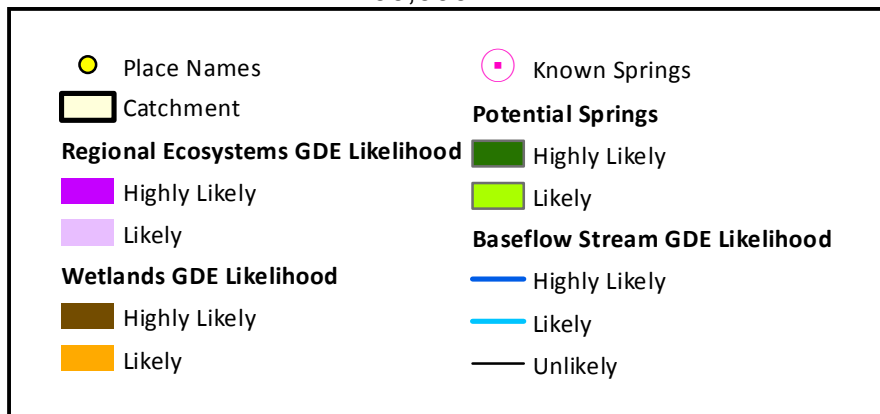
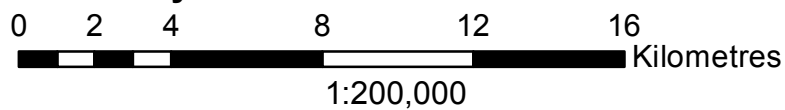


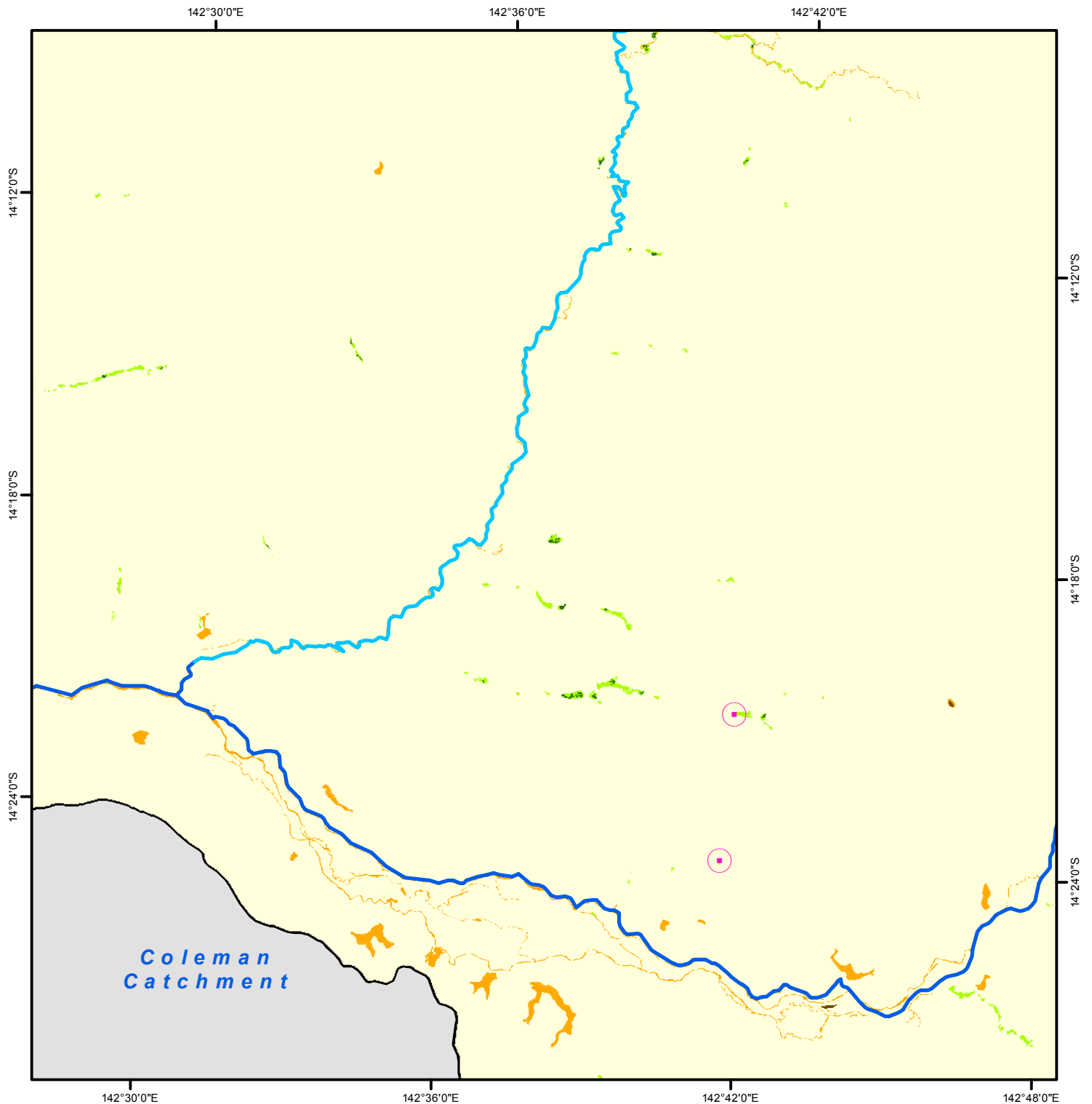
N2 Holroyd Catchment



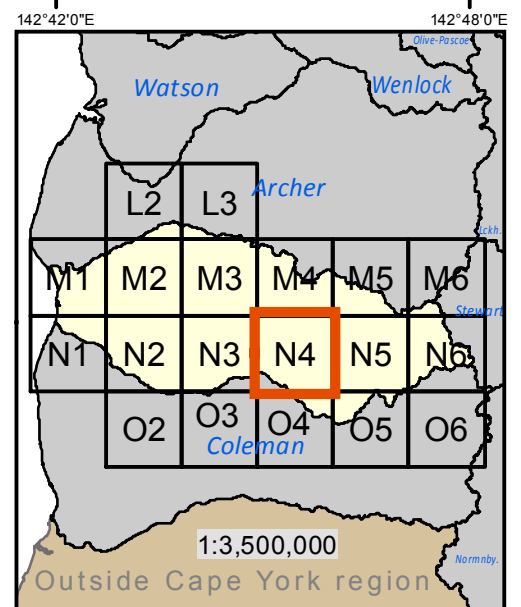
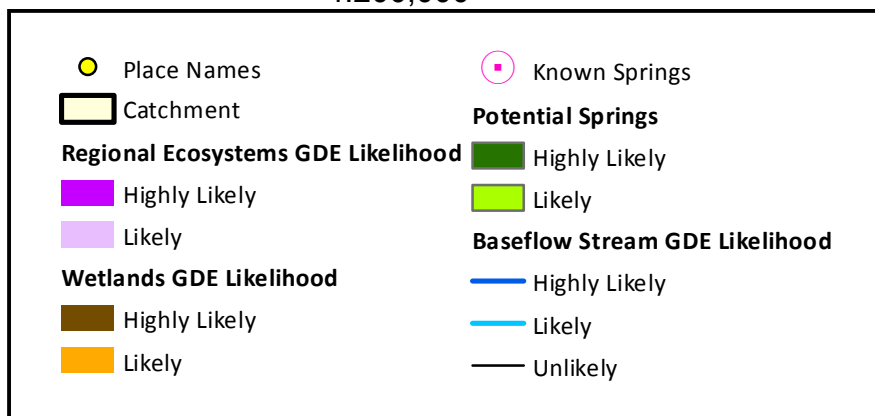
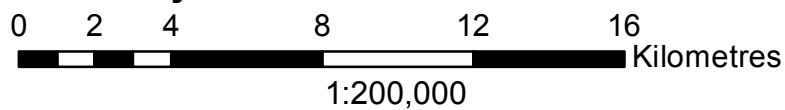


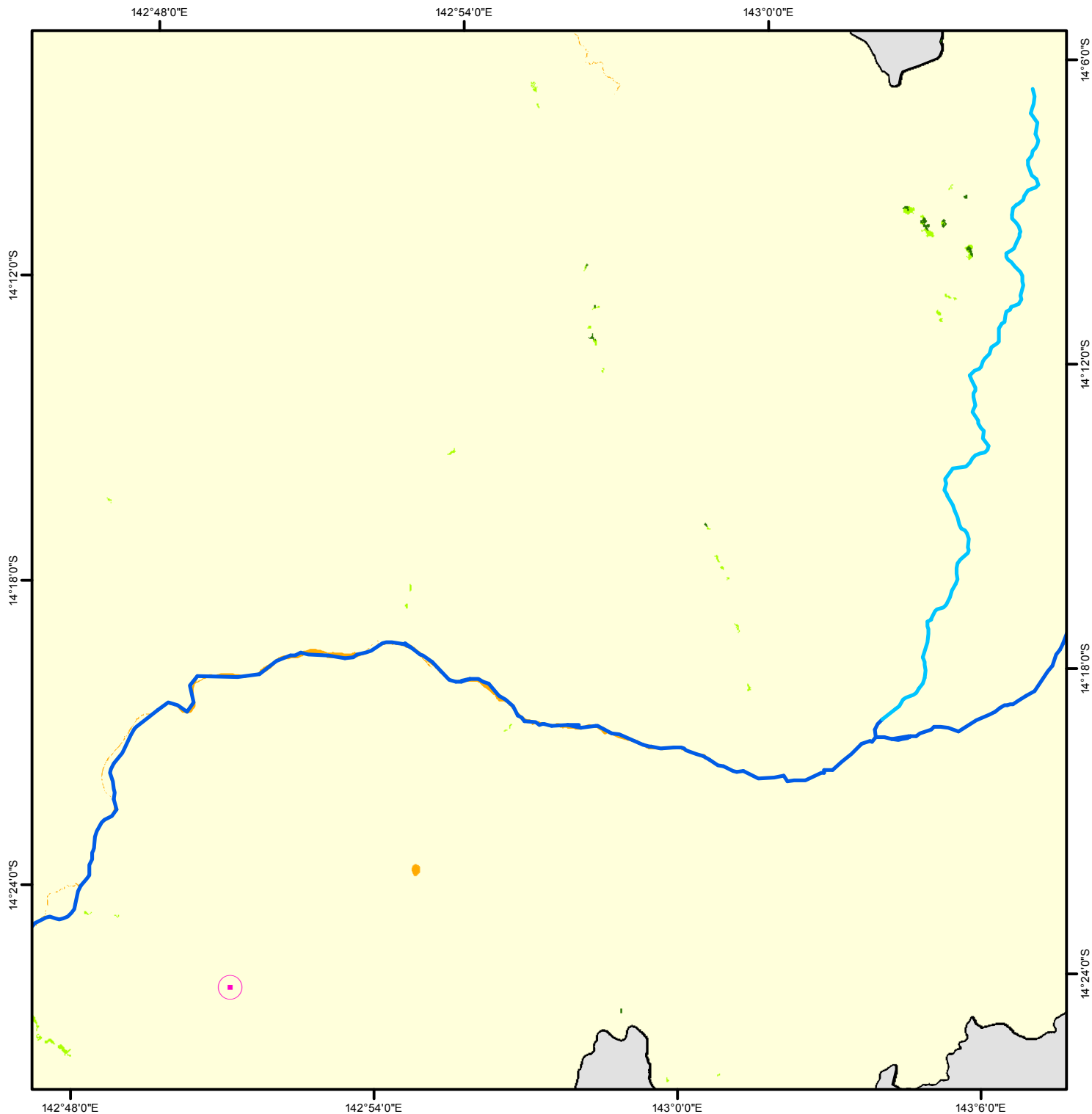
N3 Holroyd Catchment



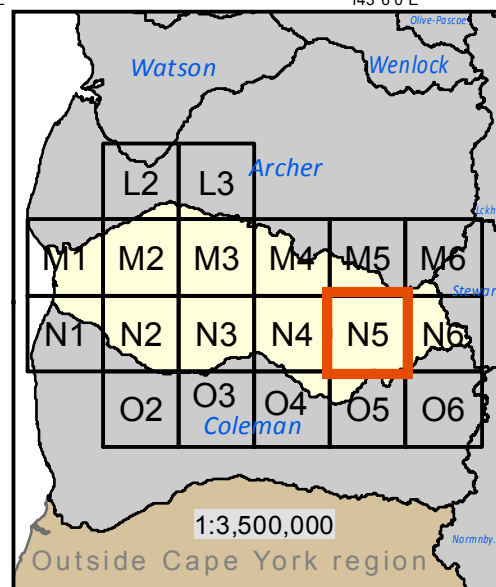
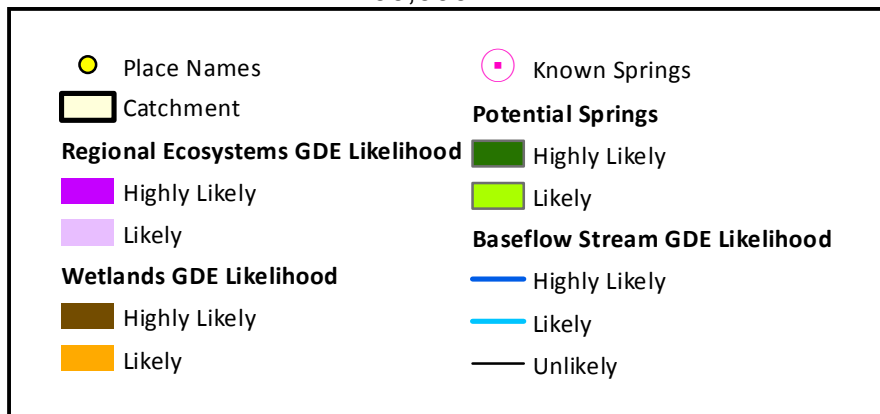
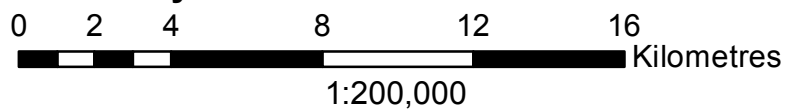


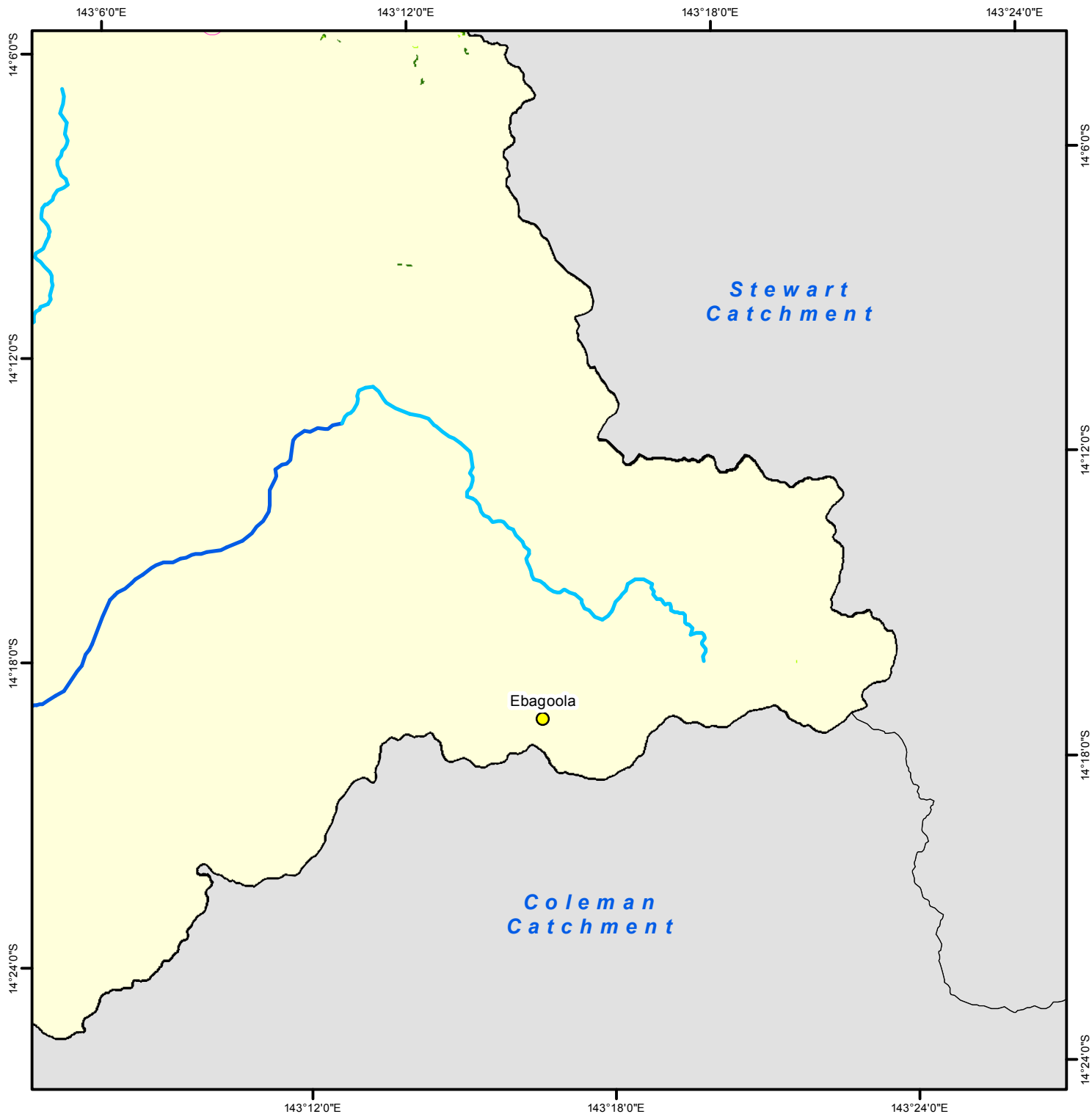
N4 Holroyd Catchment



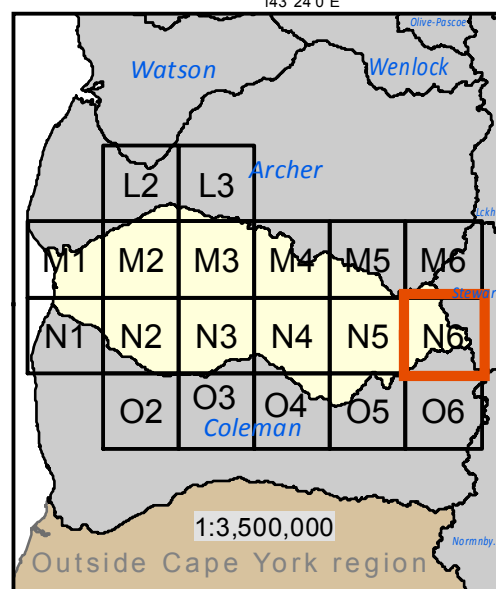
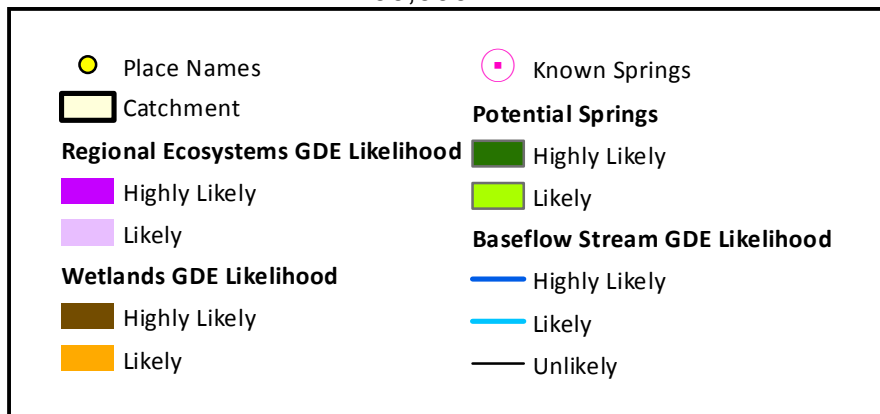
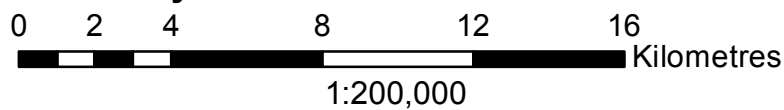


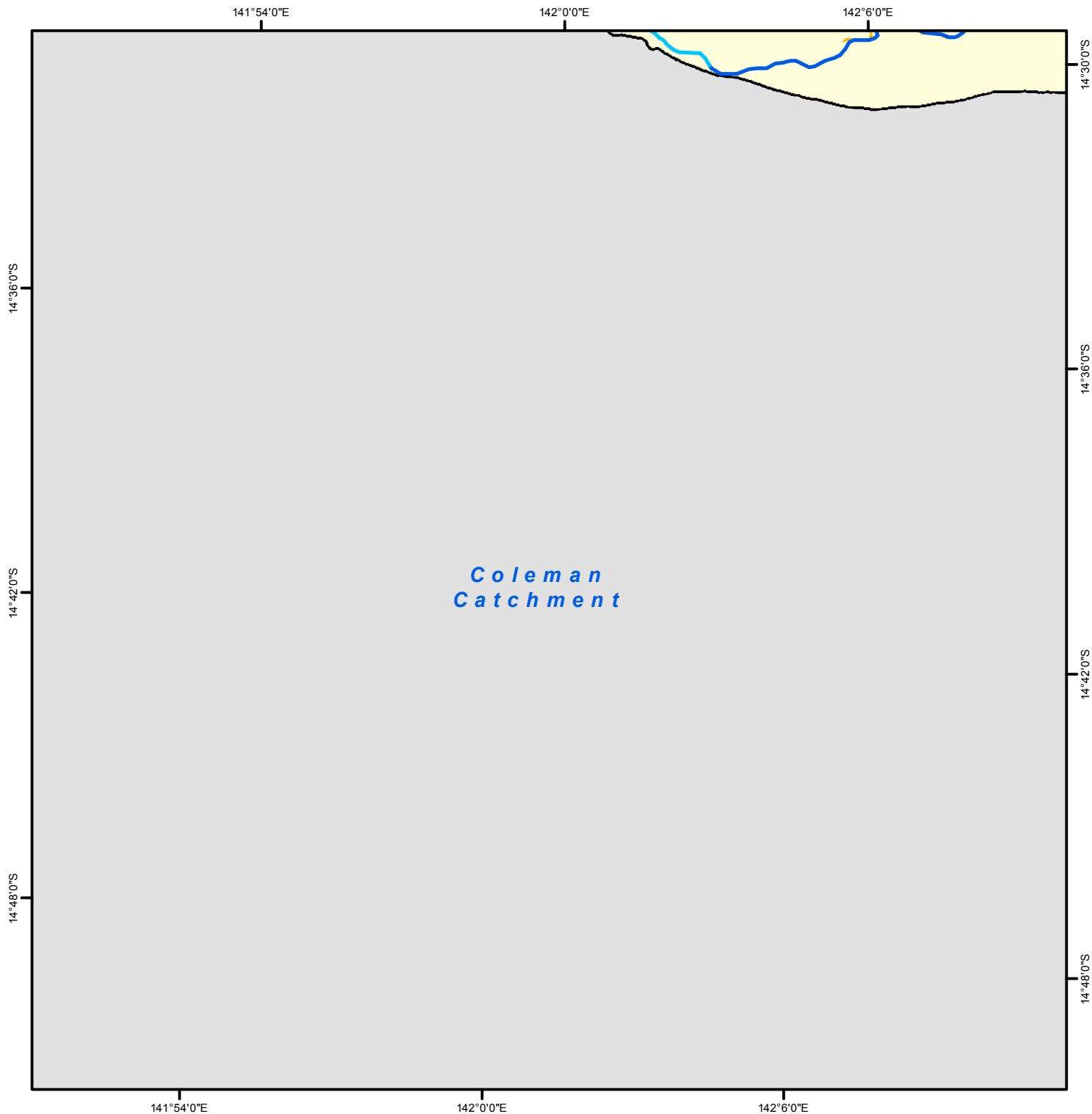
N5 Holroyd Catchment



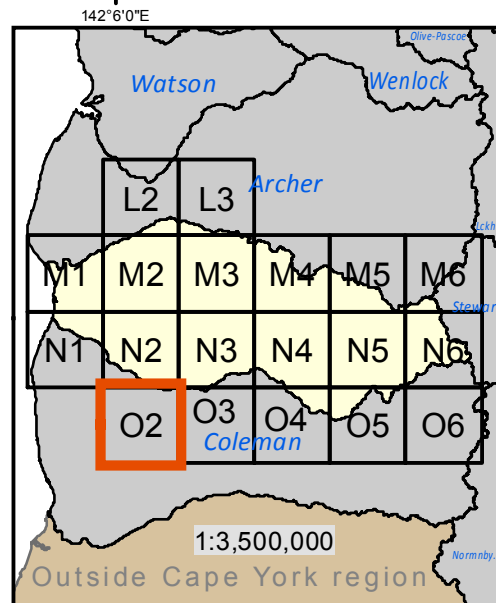
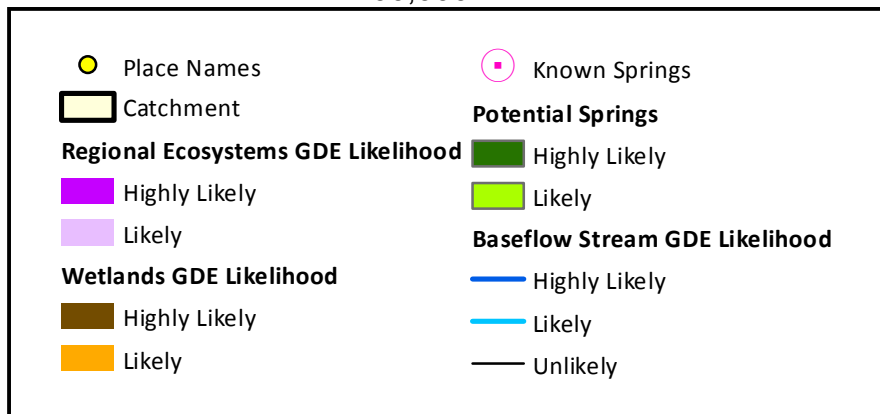
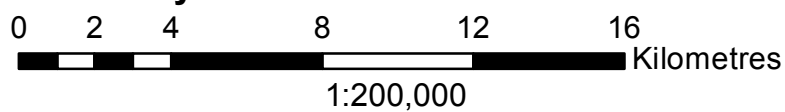


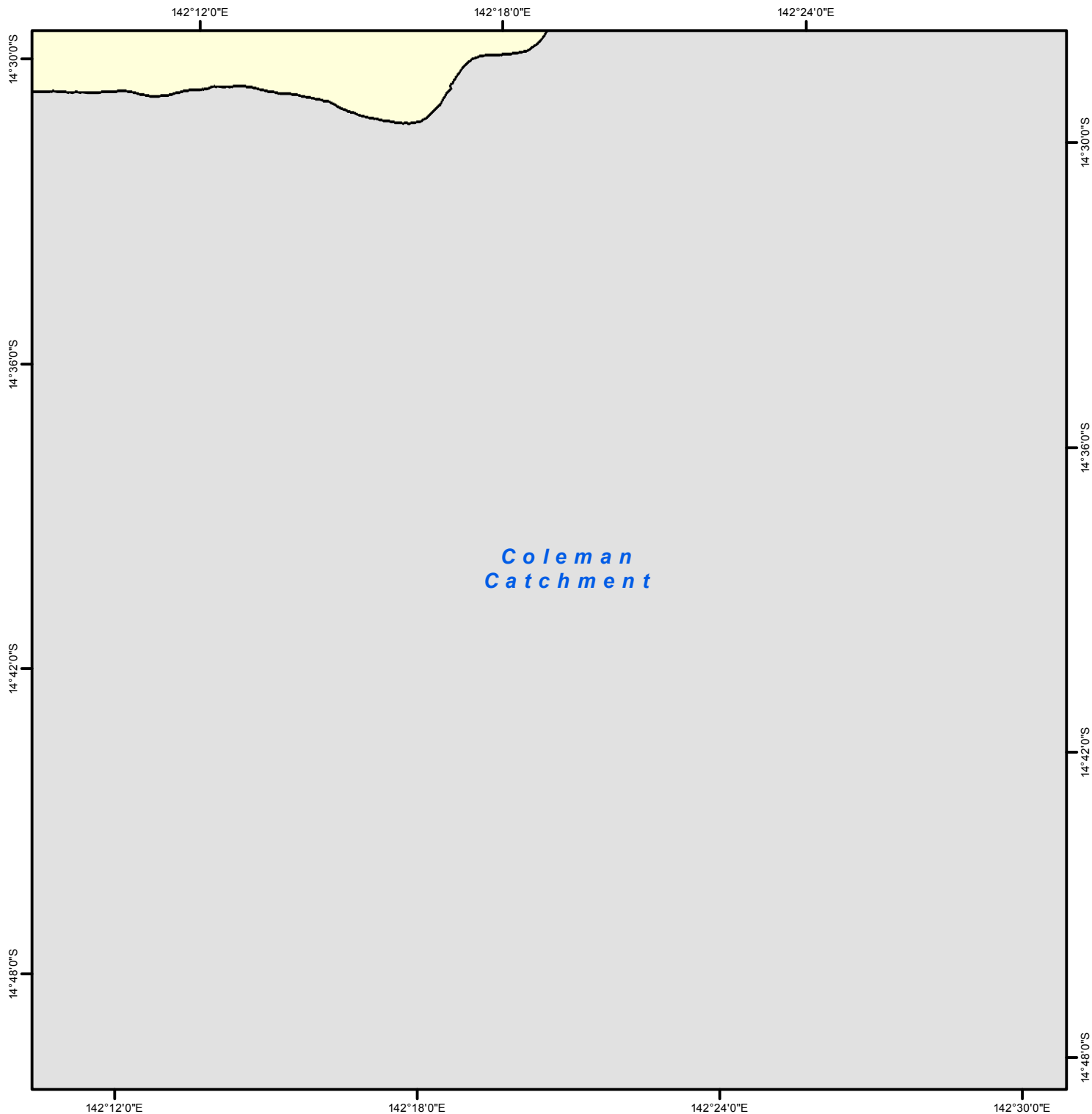
N6 Holroyd Catchment



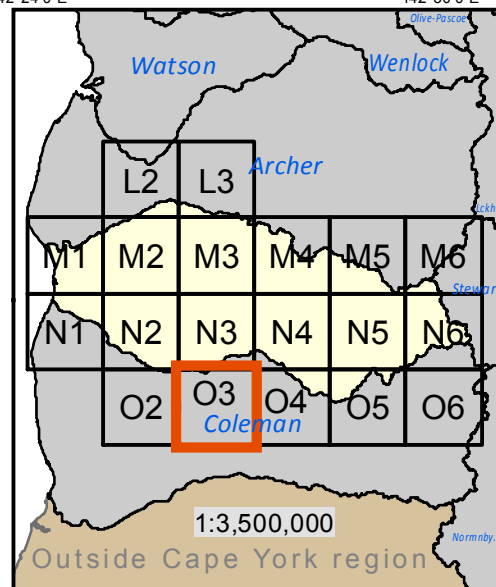
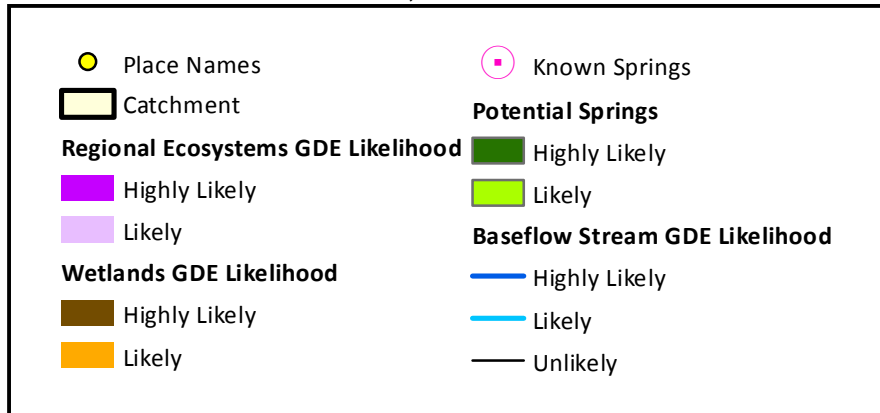
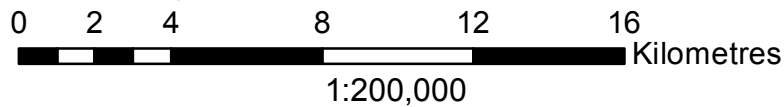


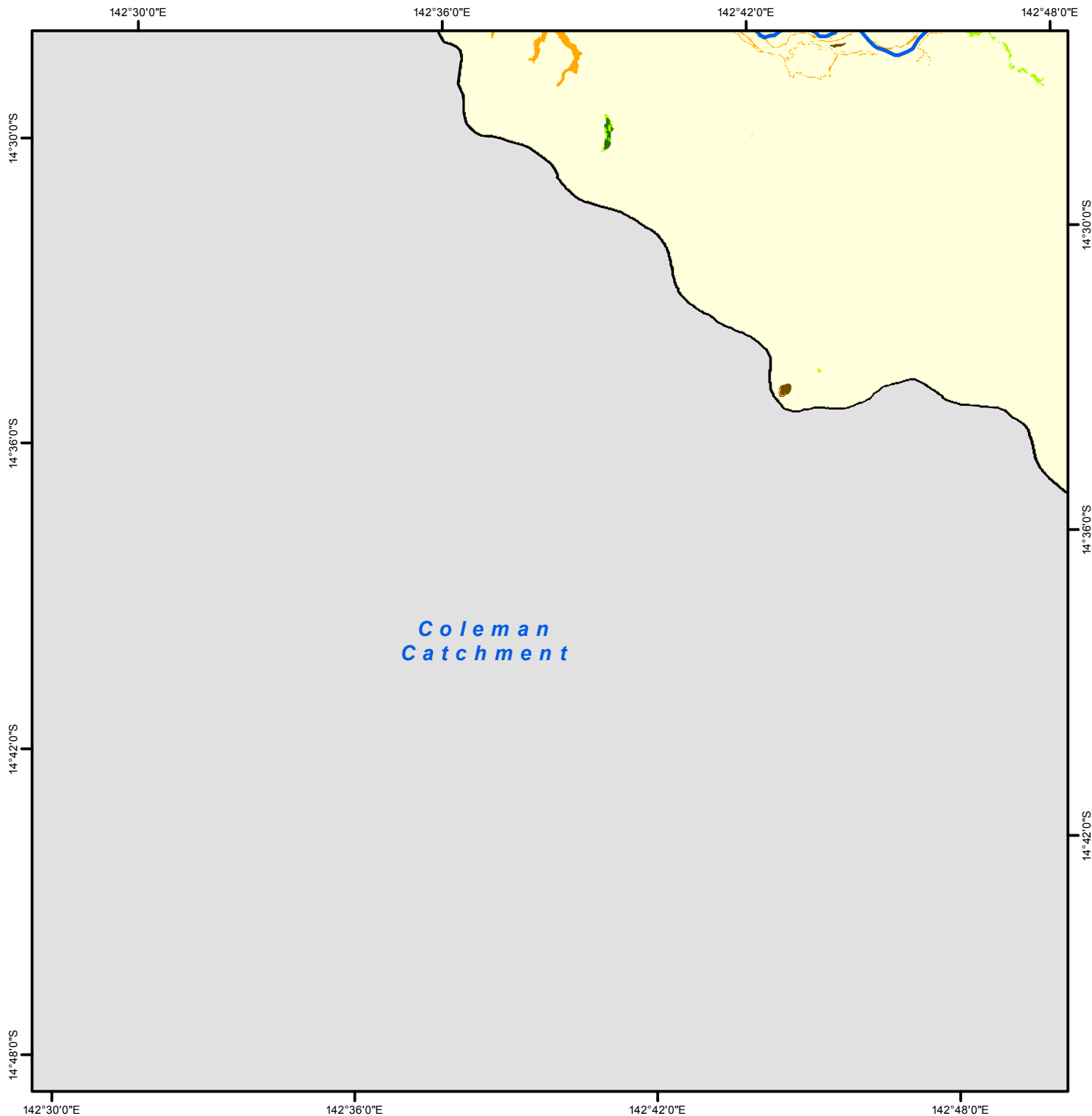
O2 Holroyd Catchment



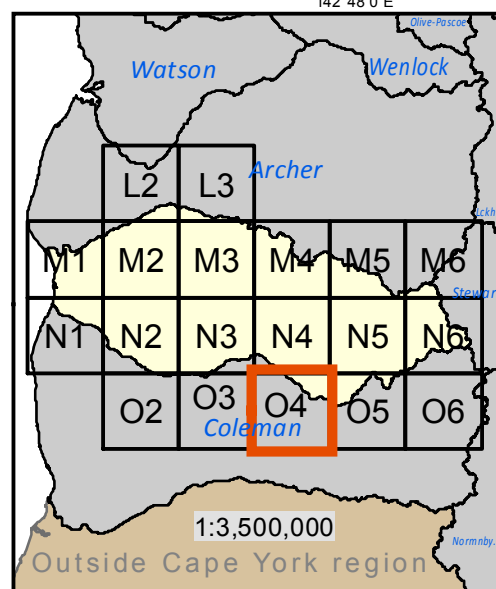
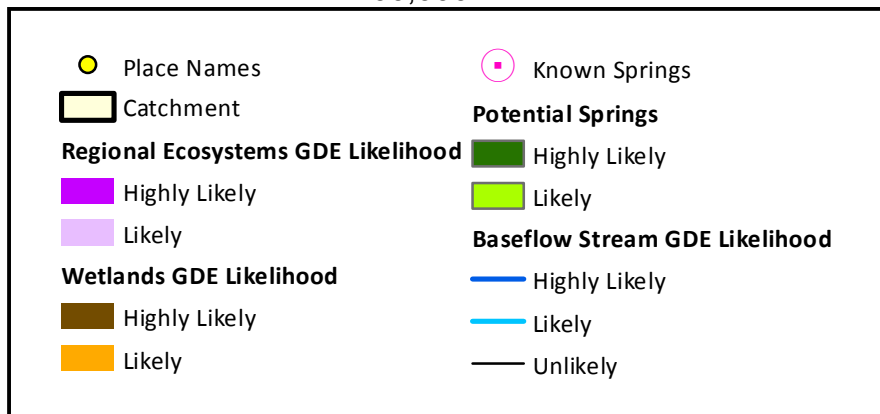
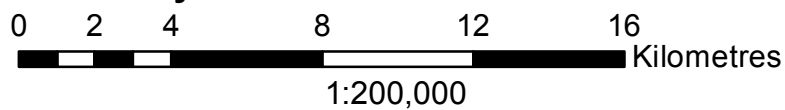


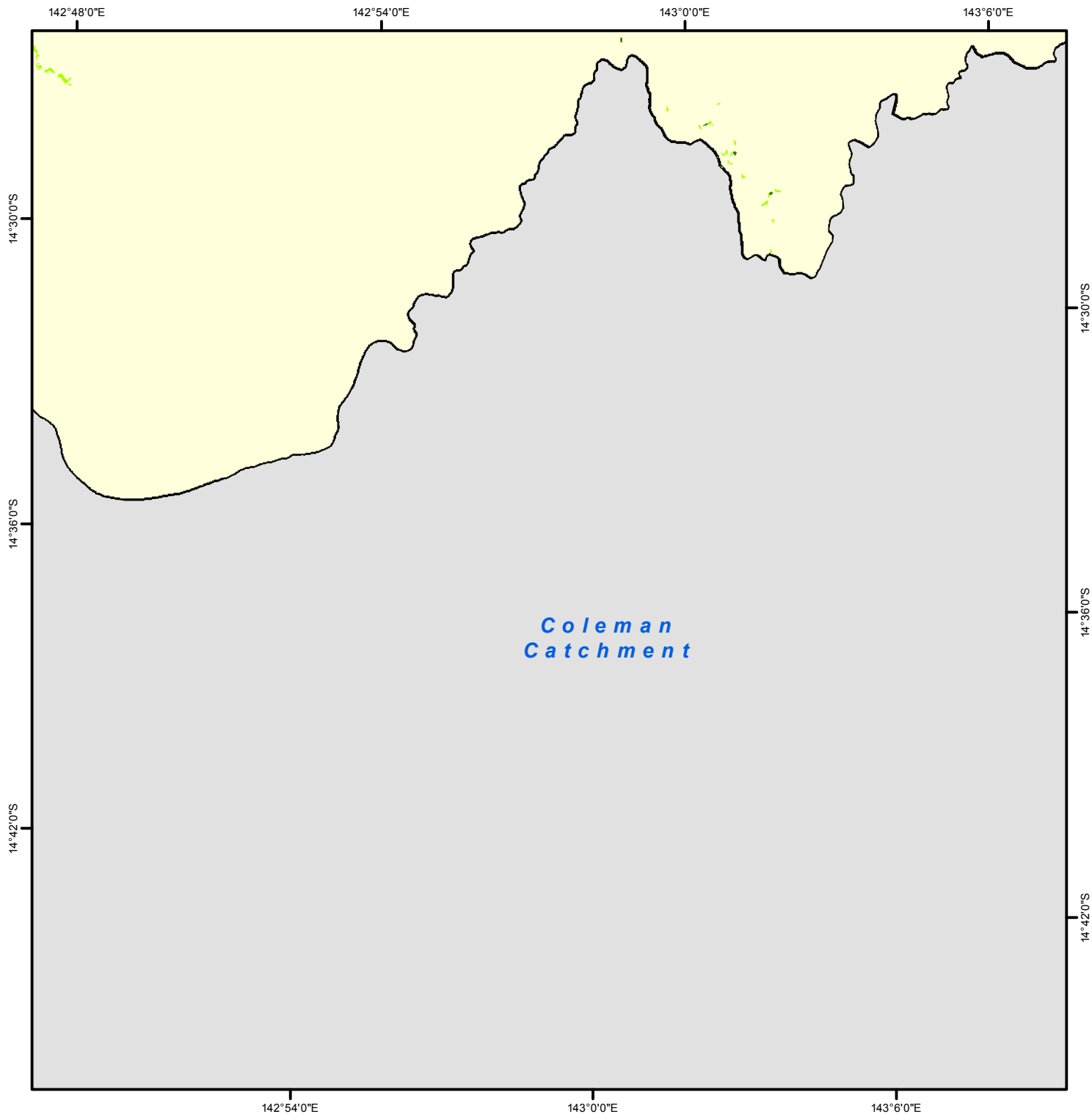
O3 Holroyd Catchment



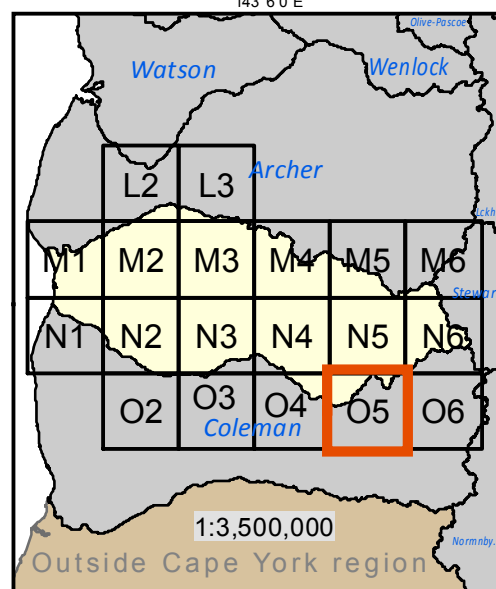
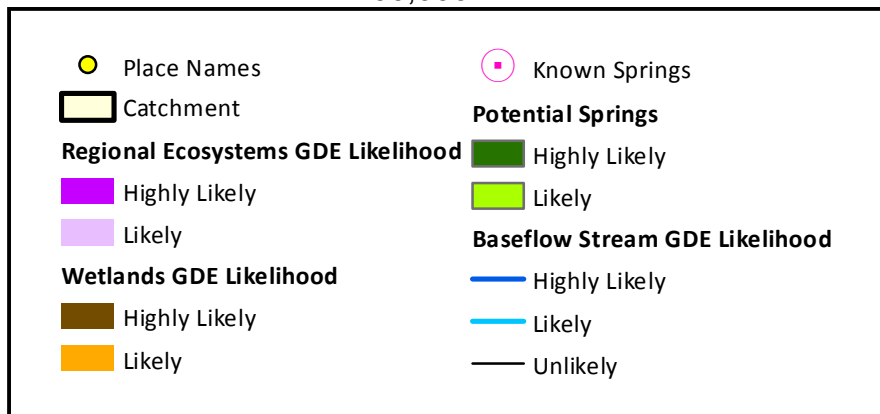
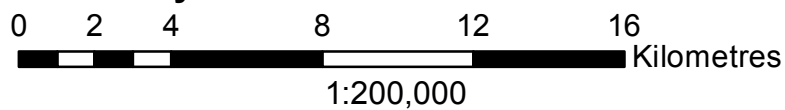


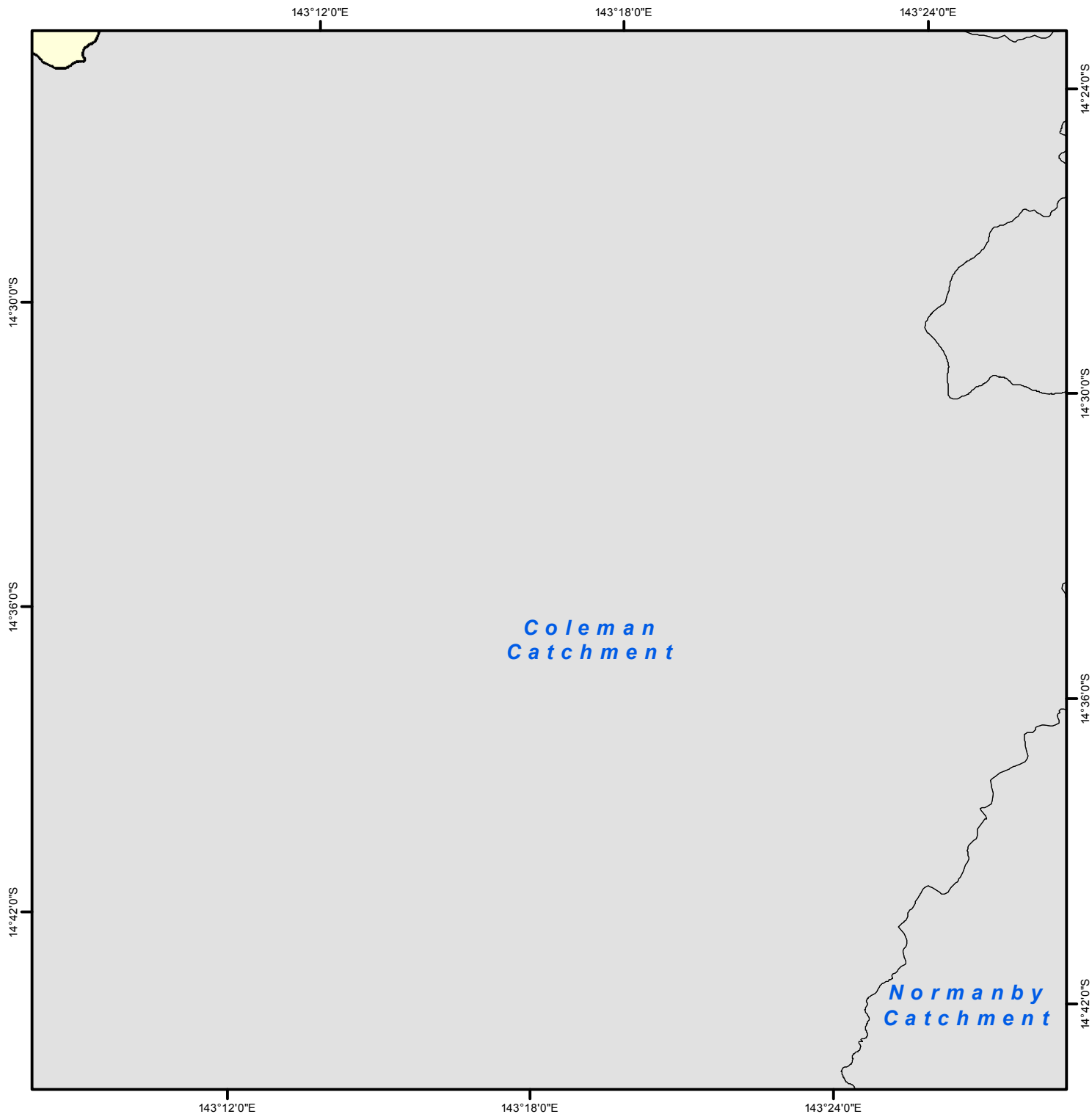
O4 Holroyd Catchment



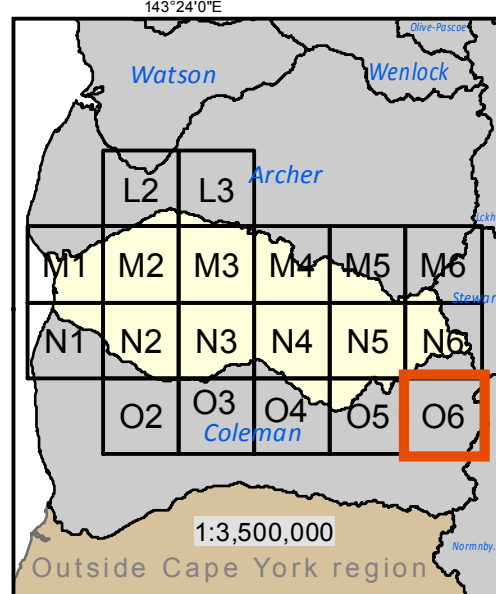
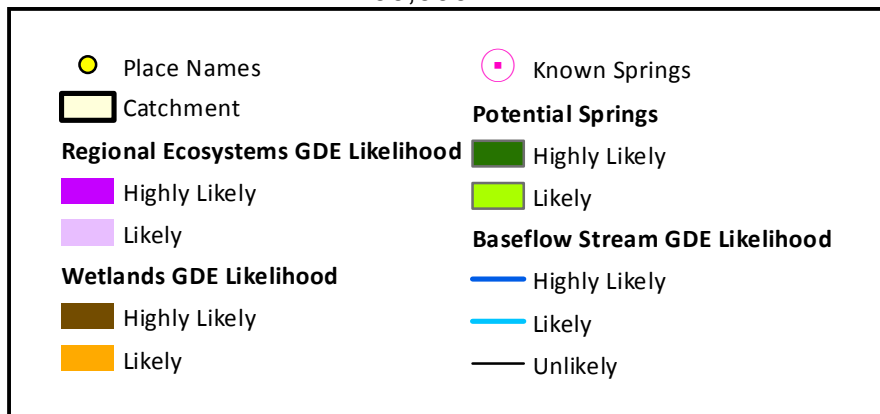
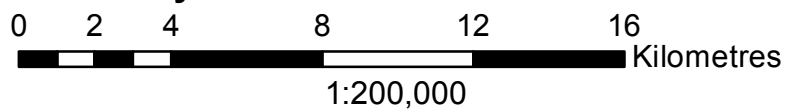


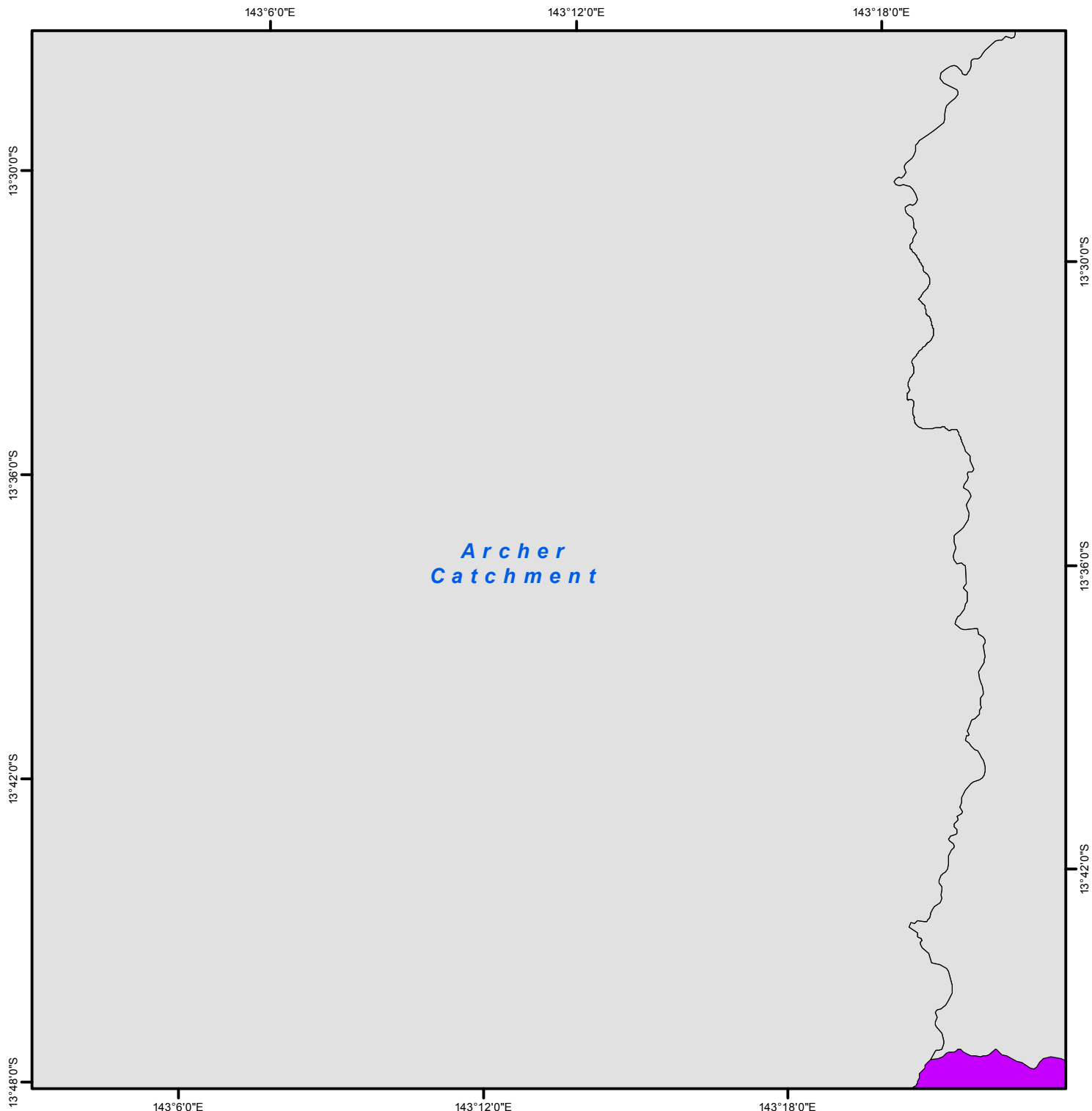
O5 Holroyd Catchment



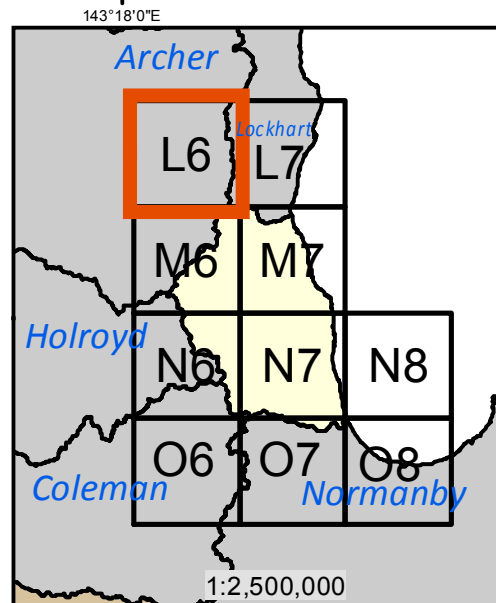
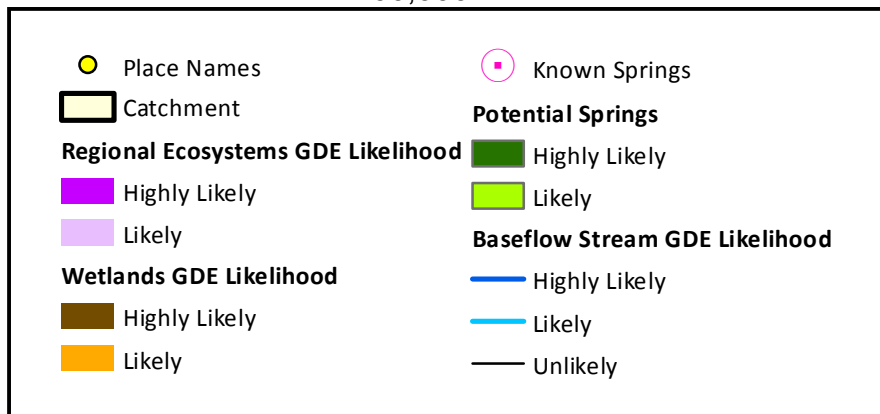
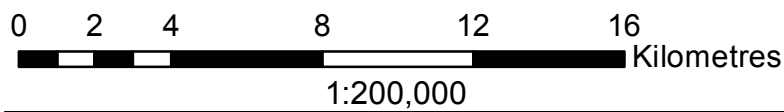


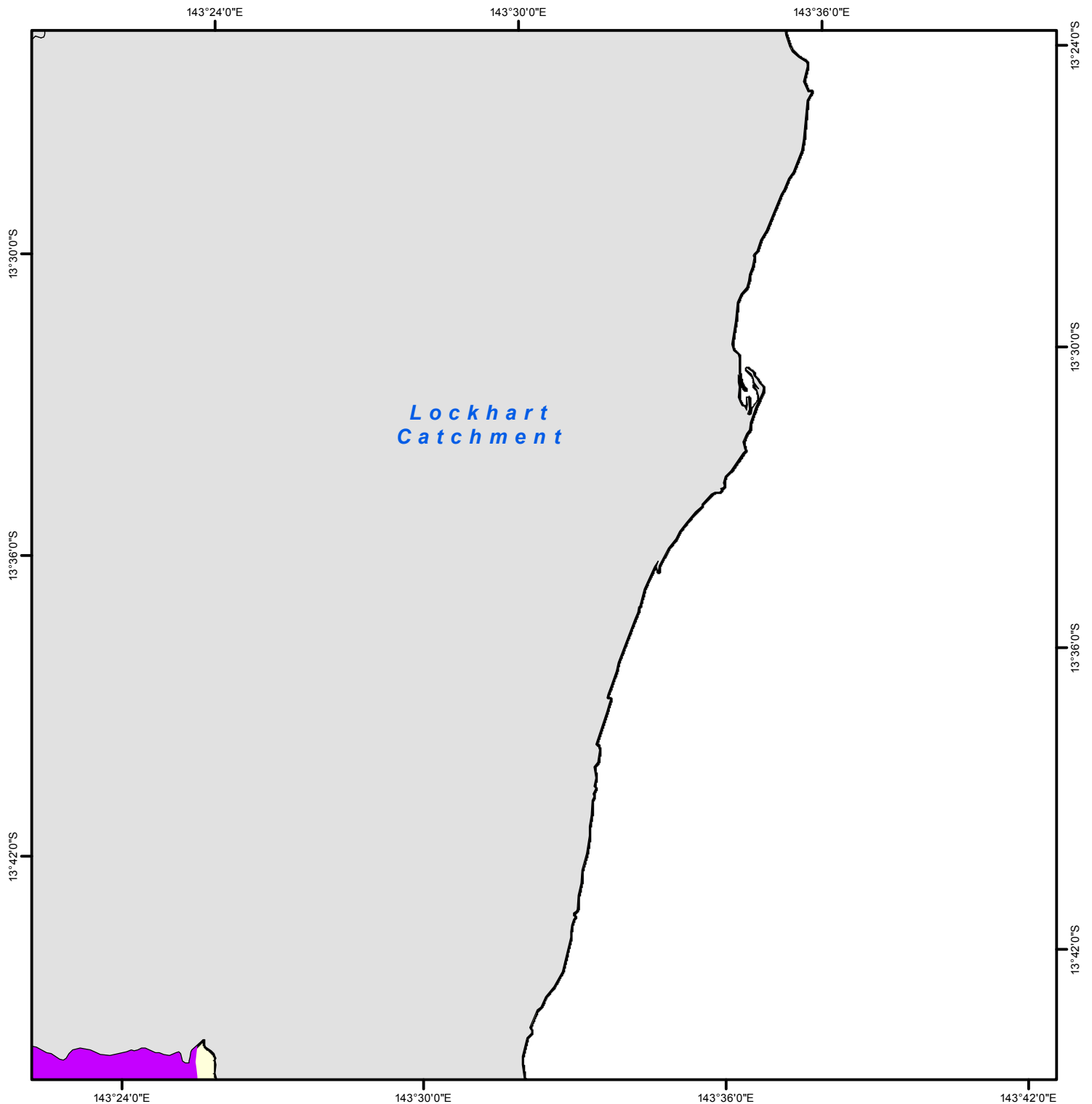
O6 Holroyd Catchment



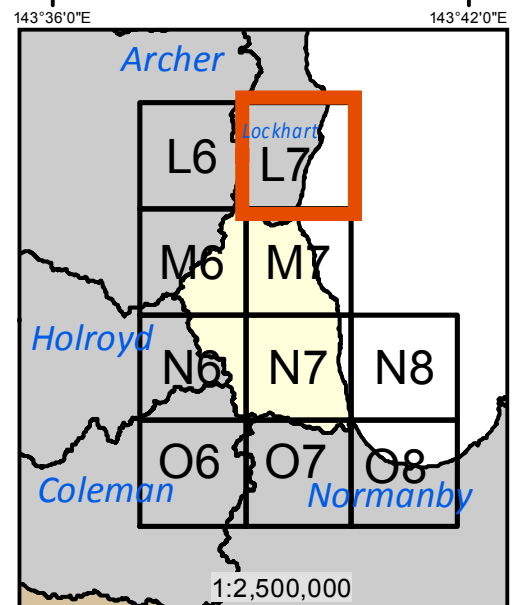
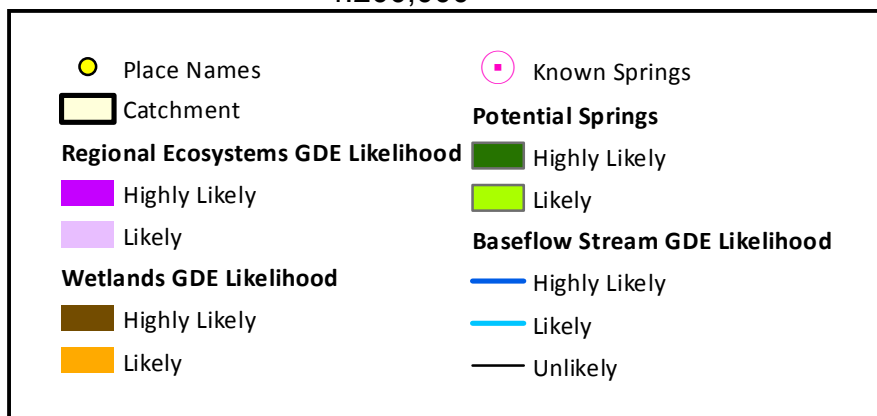
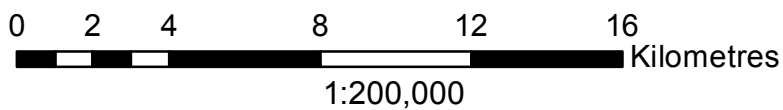


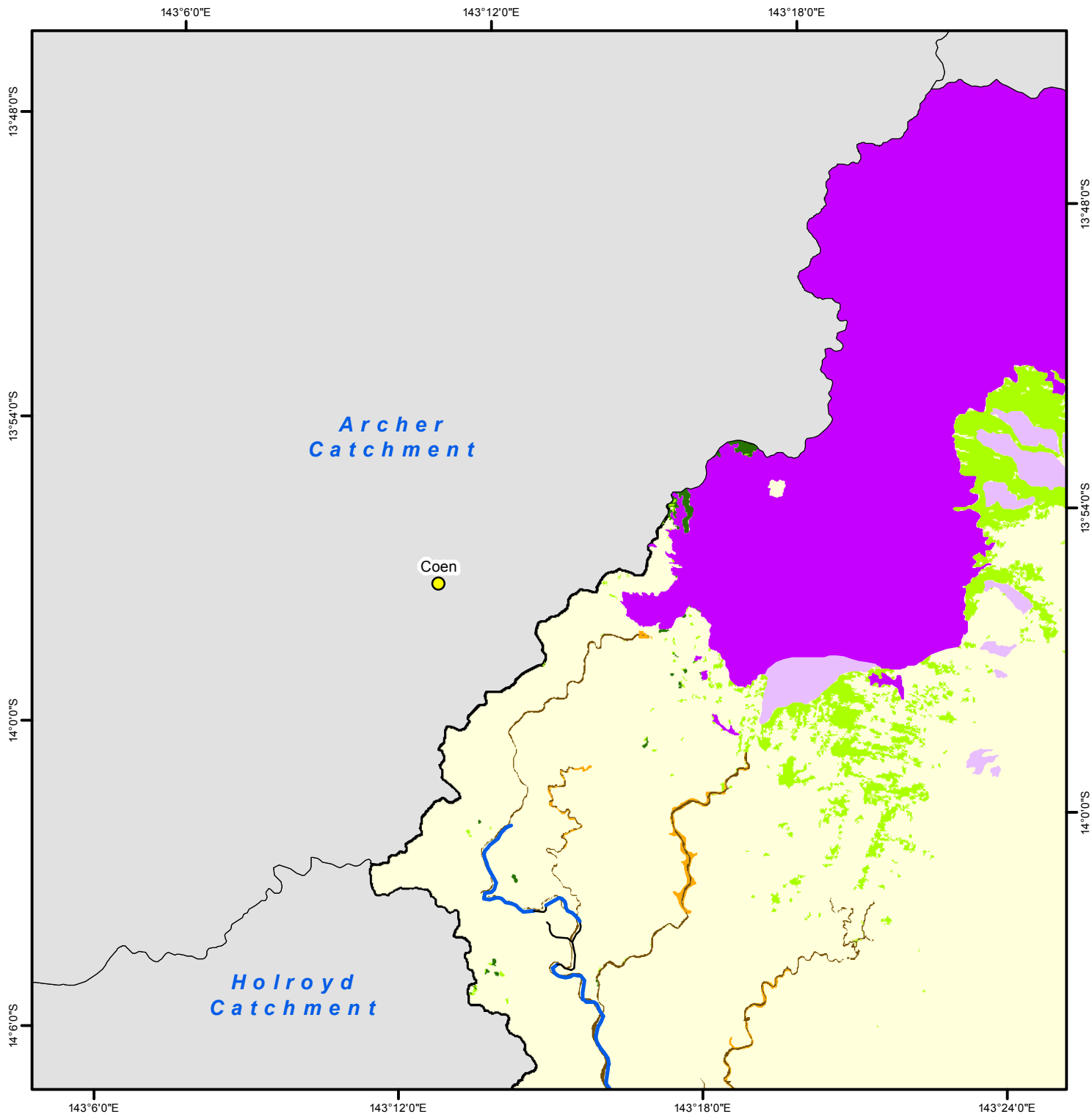
L6 Stewart Catchment



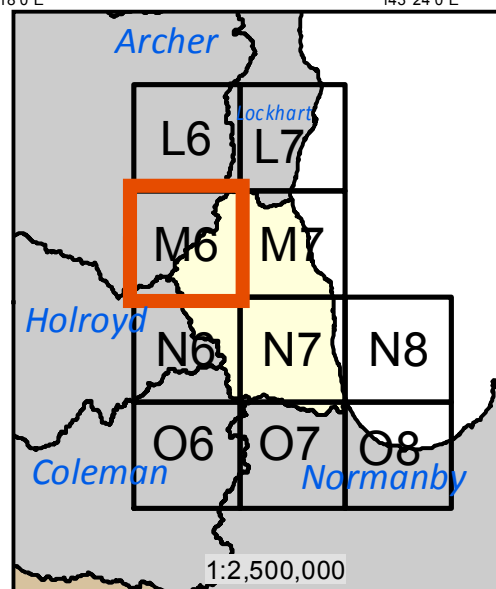
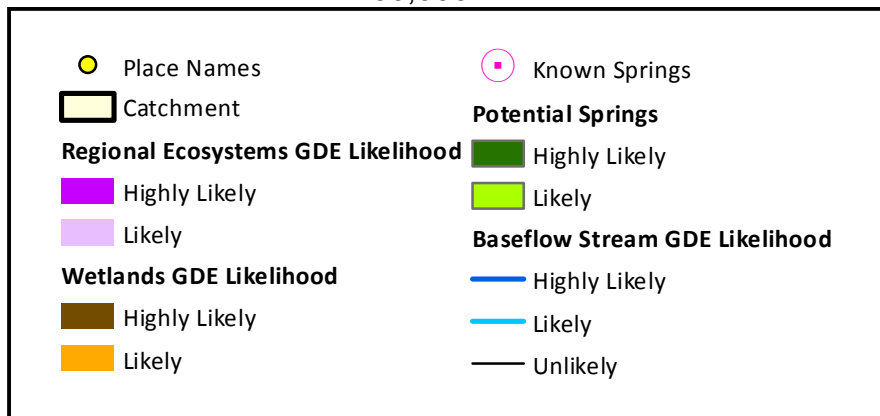
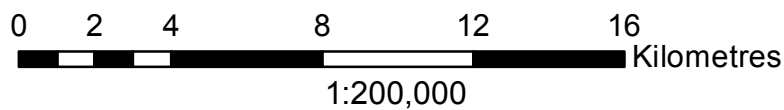


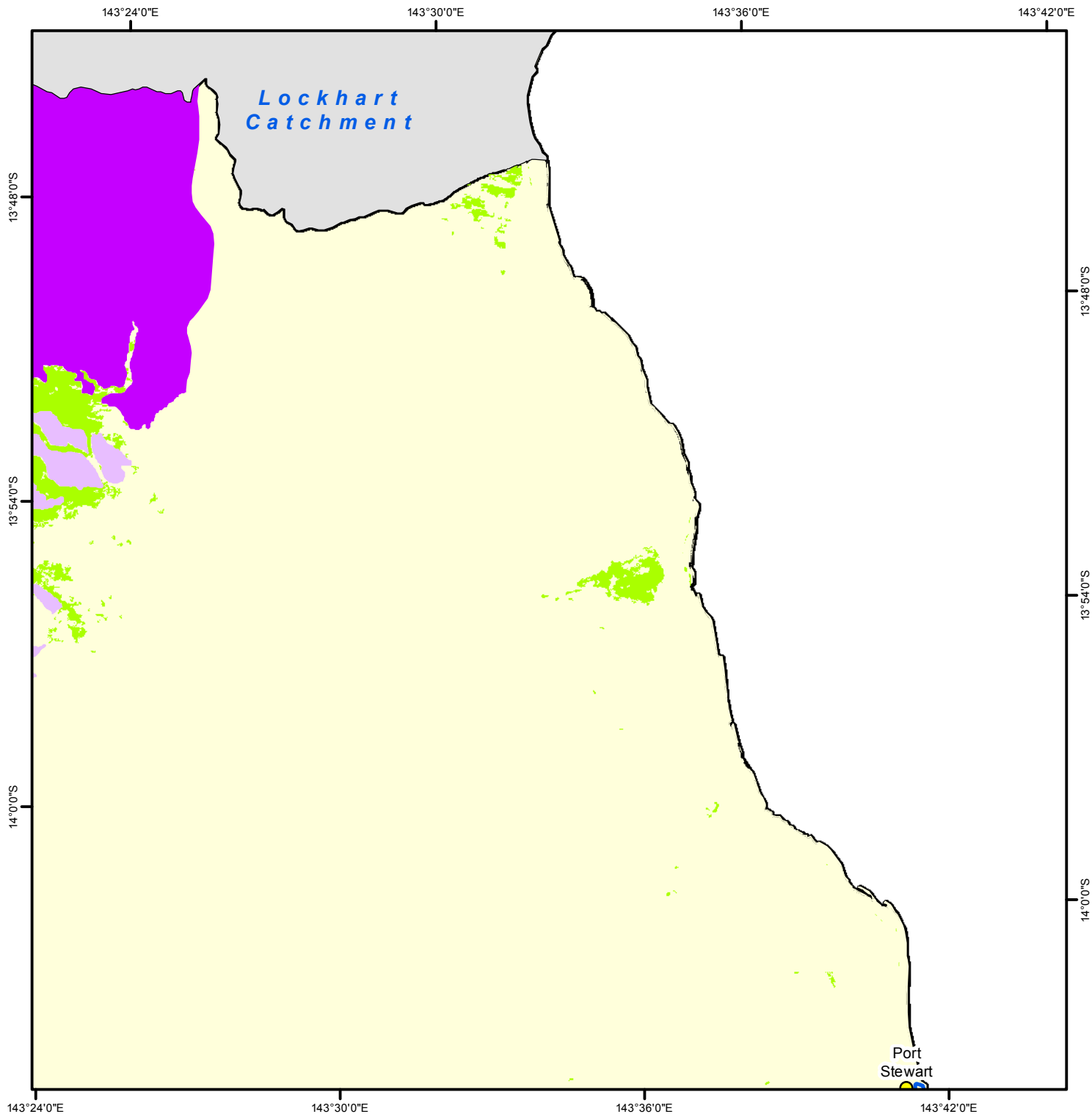
L7 Stewart Catchment





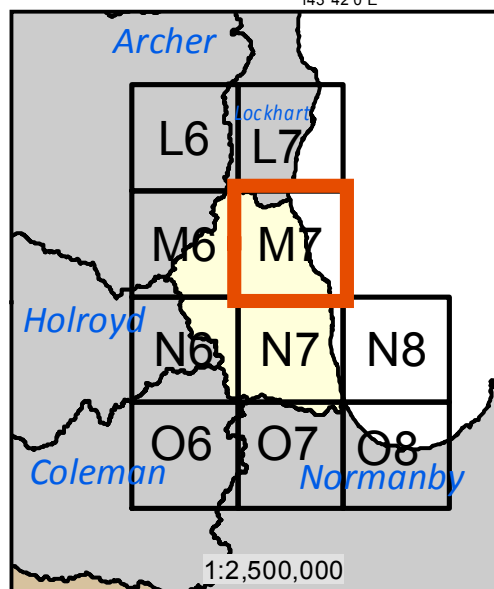
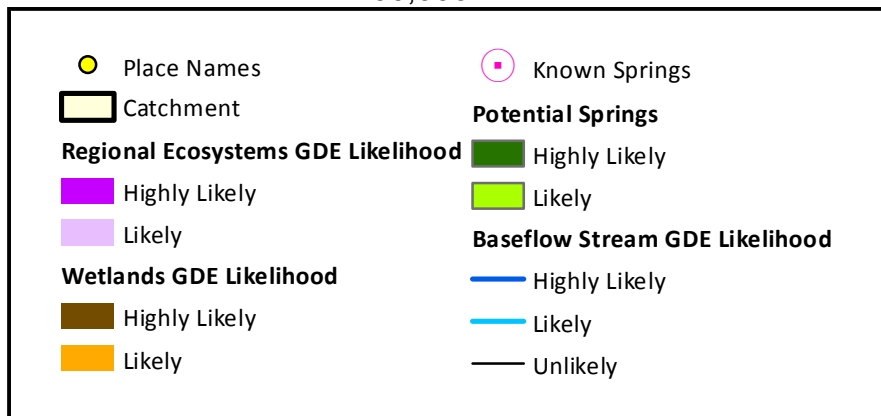
M6 Stewart Catchment





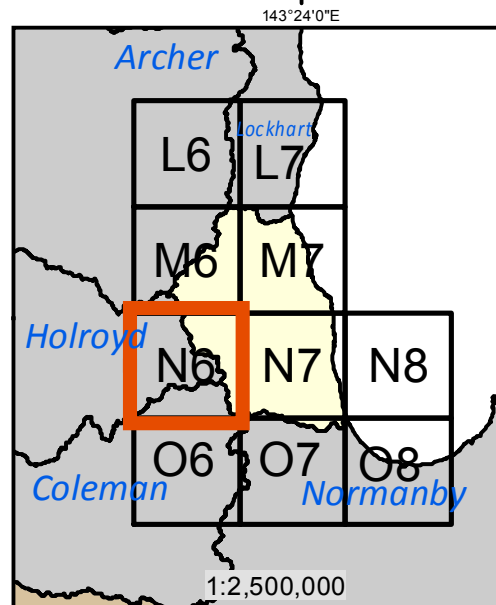
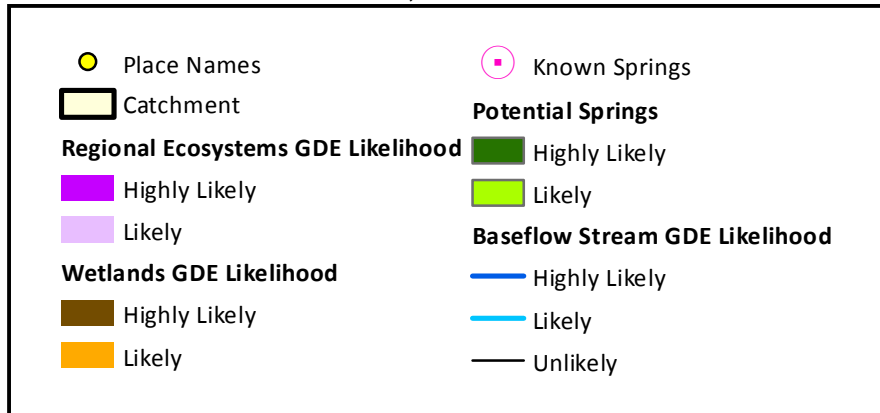
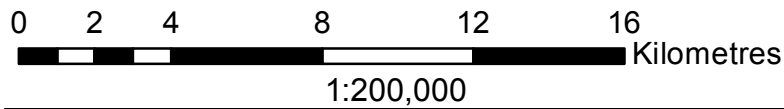
M7 Stewart Catchment

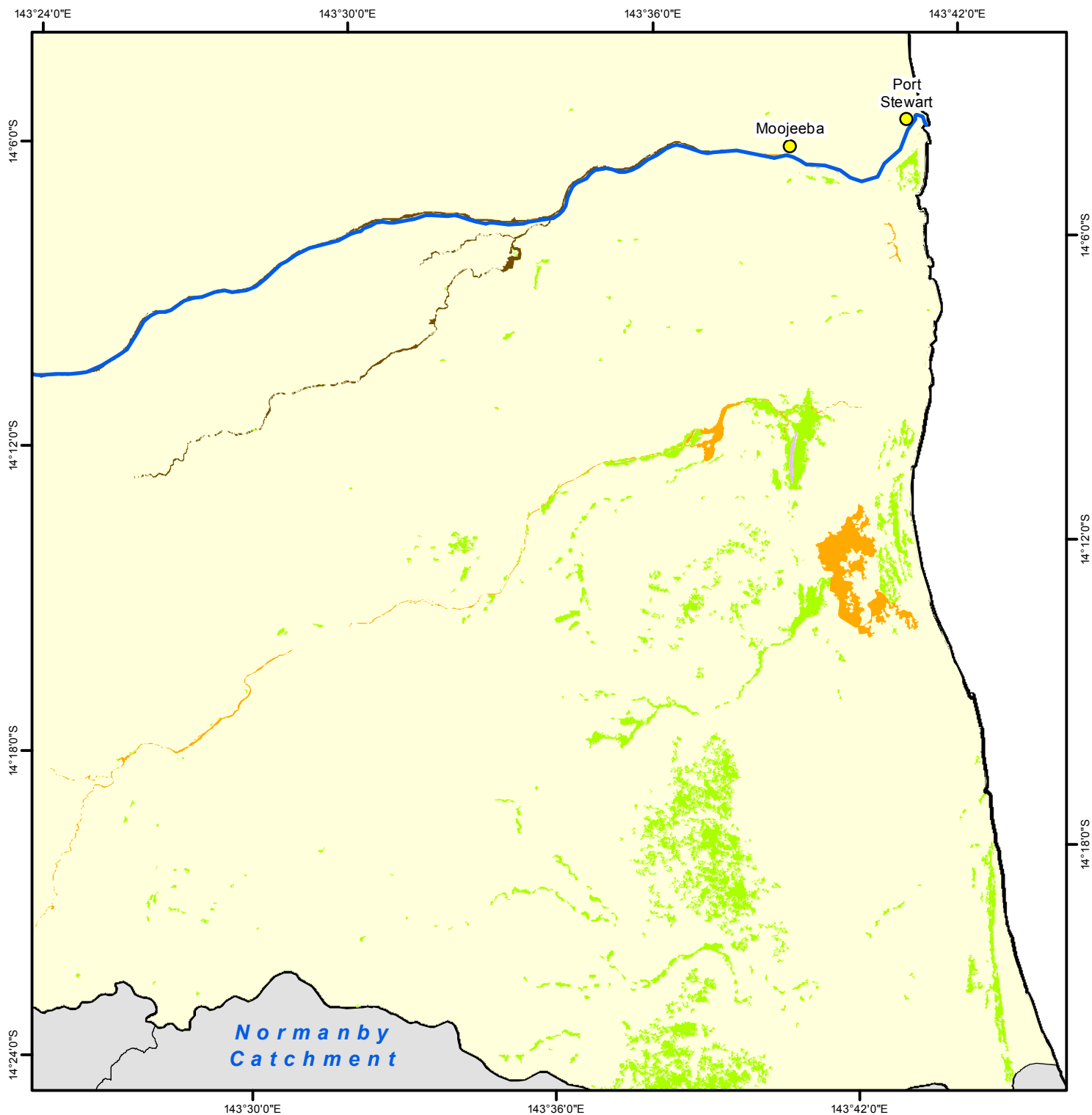
0 2 4 8 12 16 Kilometres
1:200,000



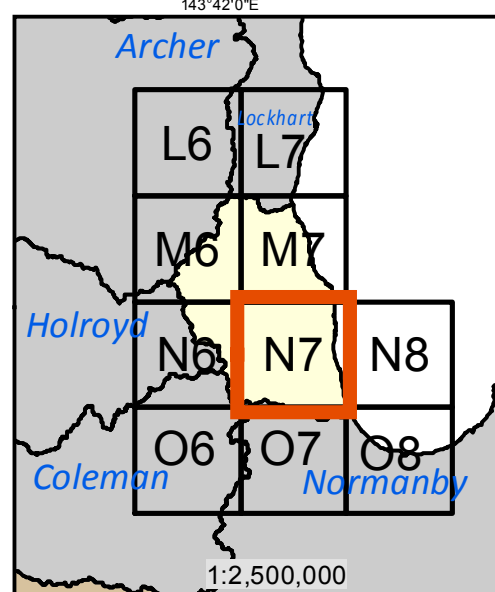
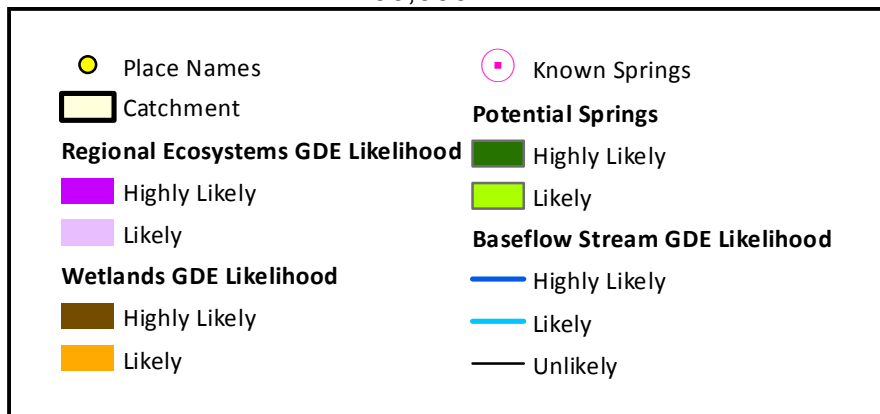
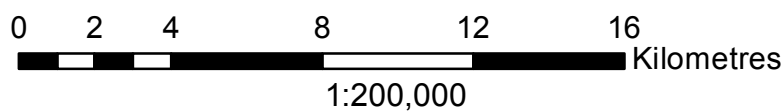


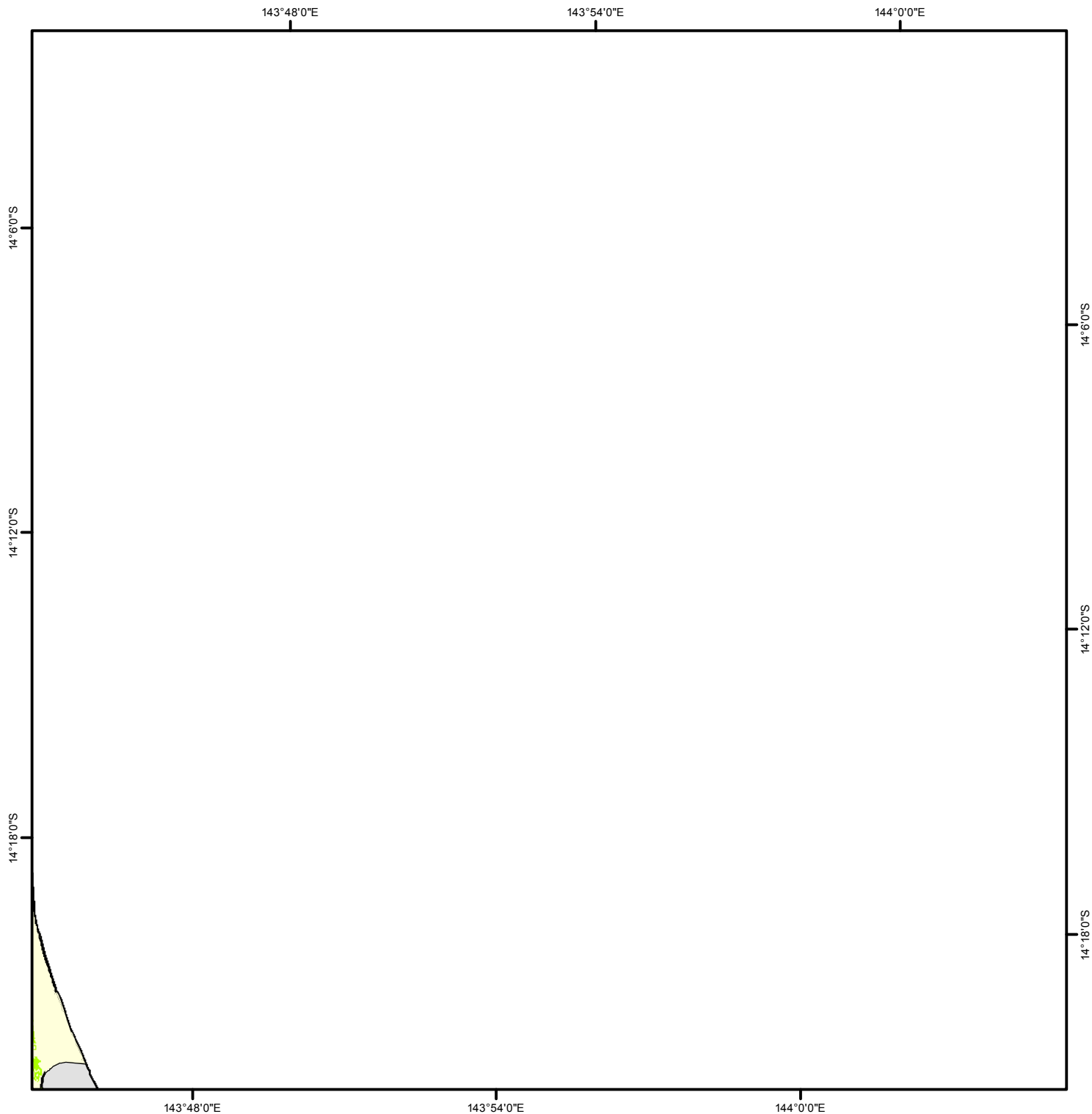
N6 Stewart Catchment



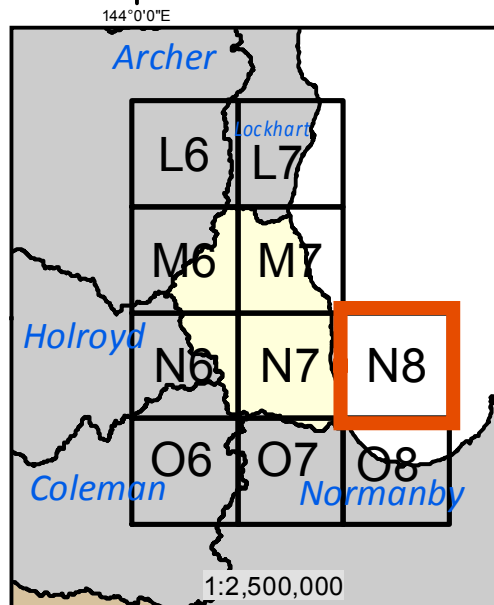
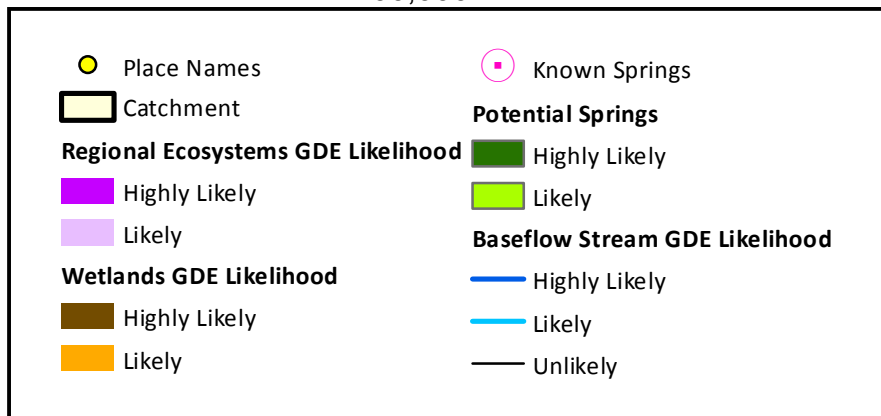
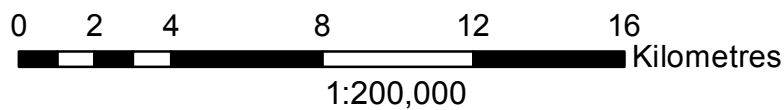


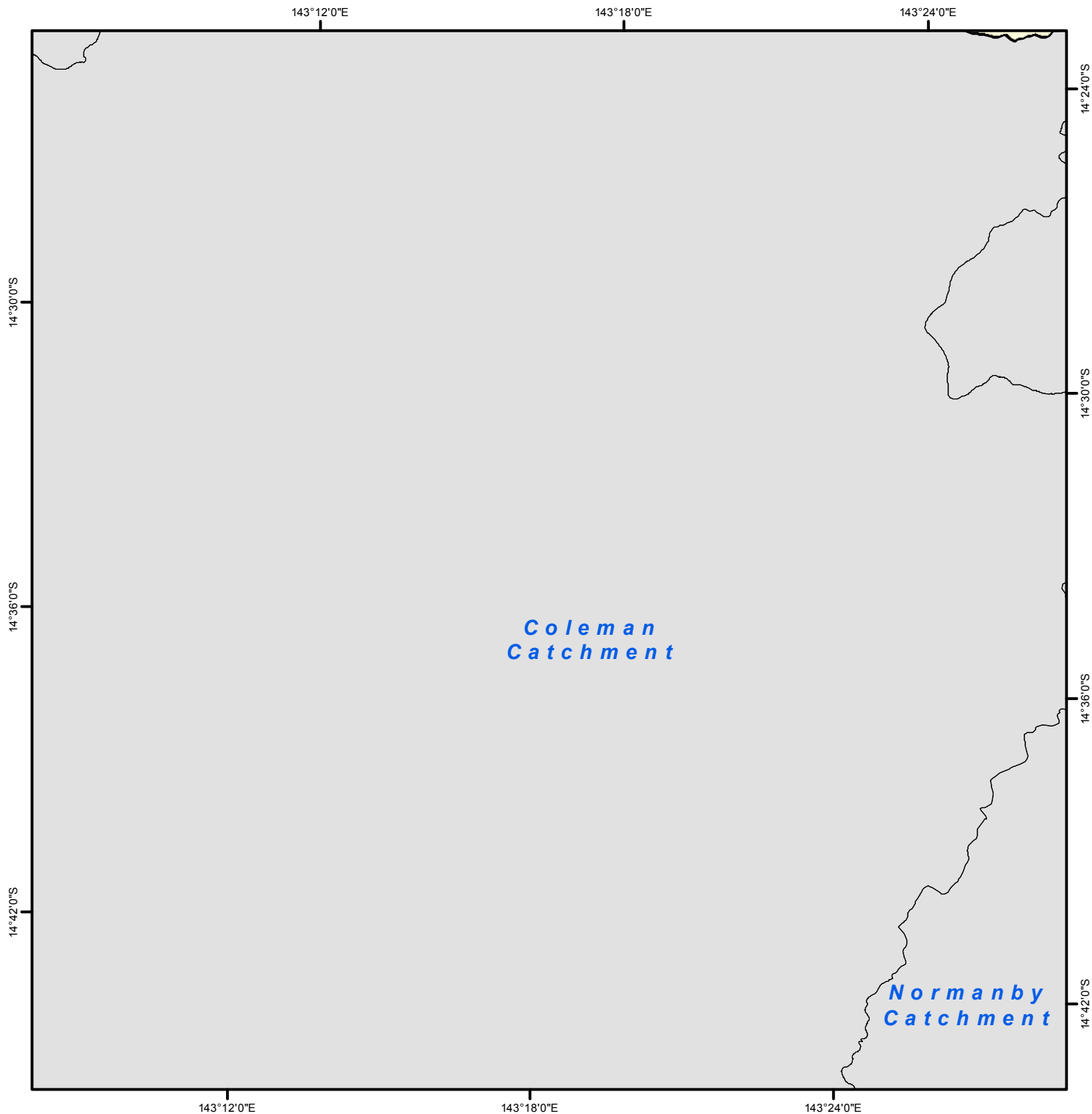
N7 Stewart Catchment



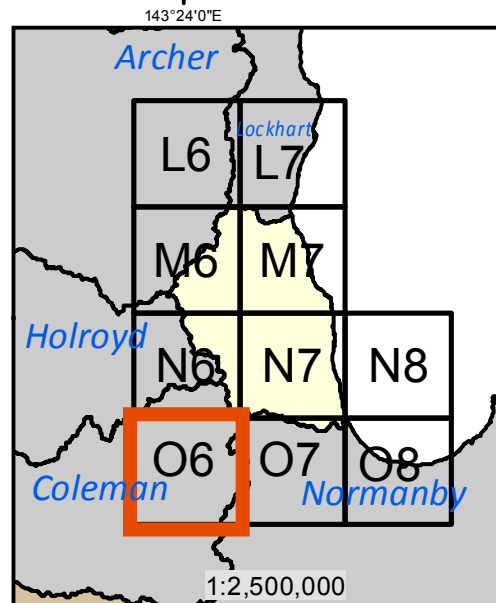
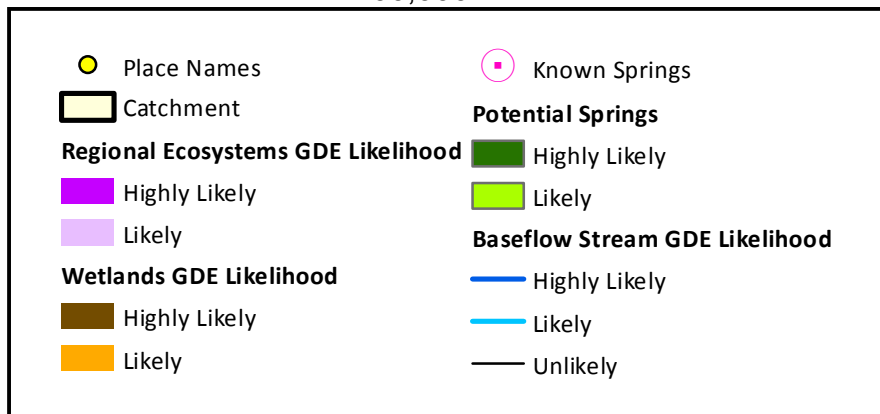
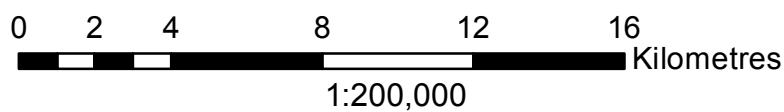


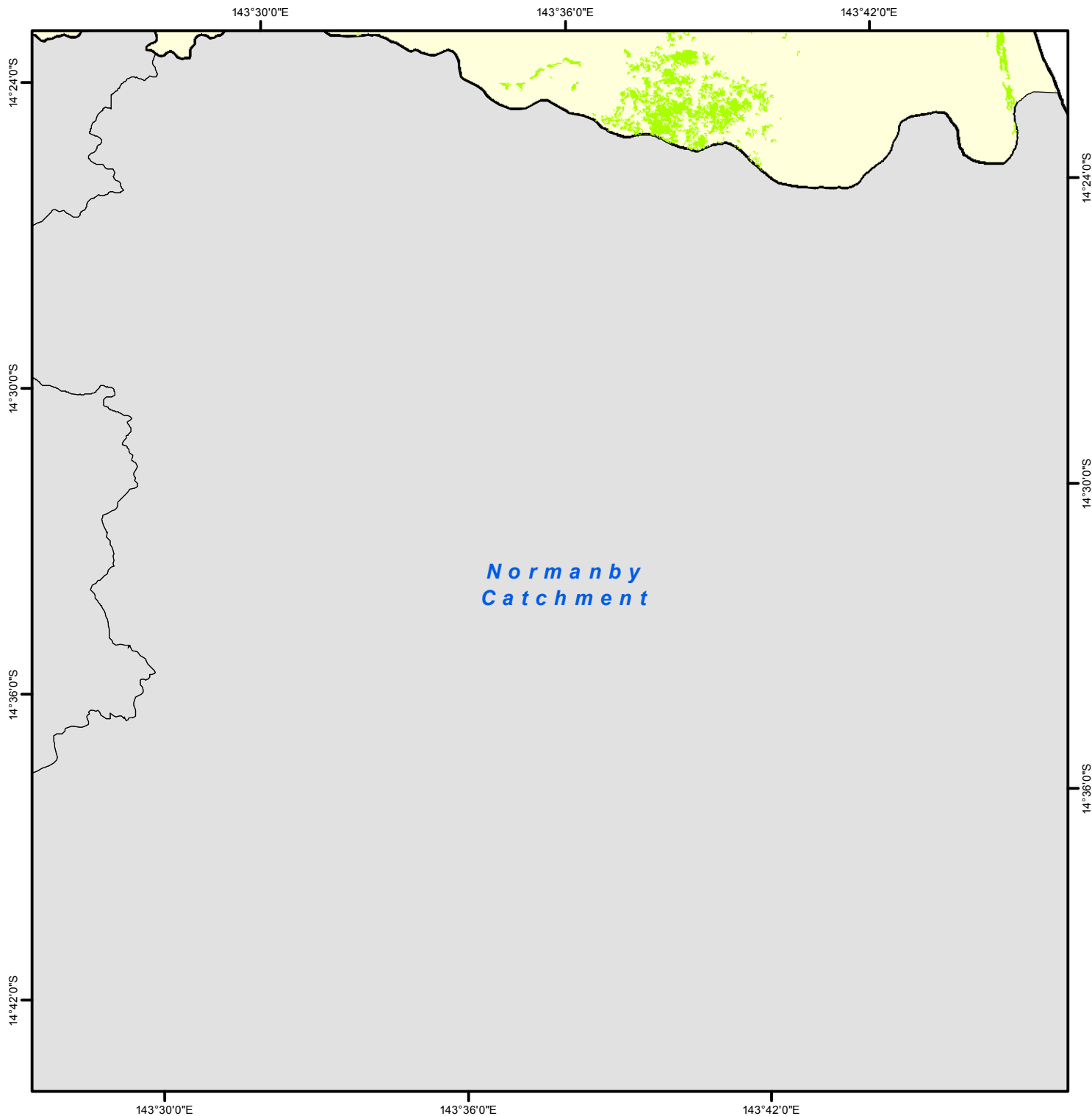
N8 Stewart Catchment



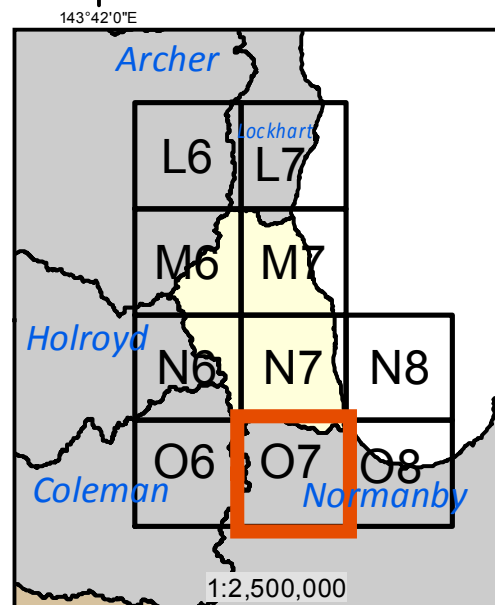
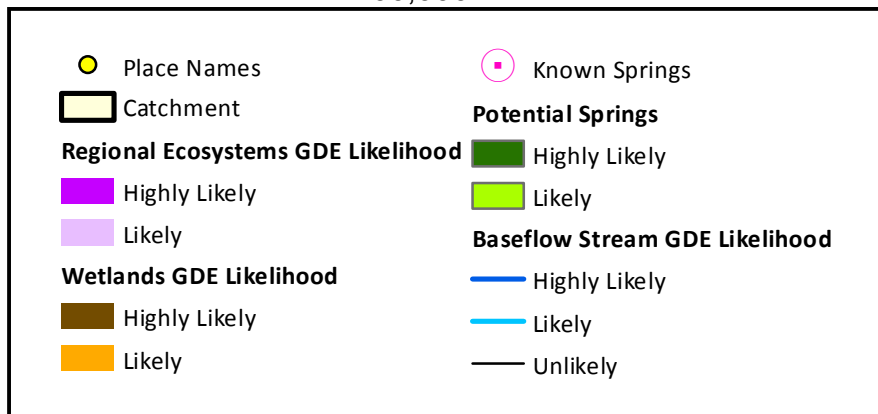
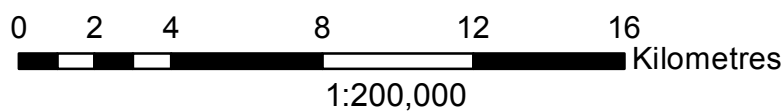


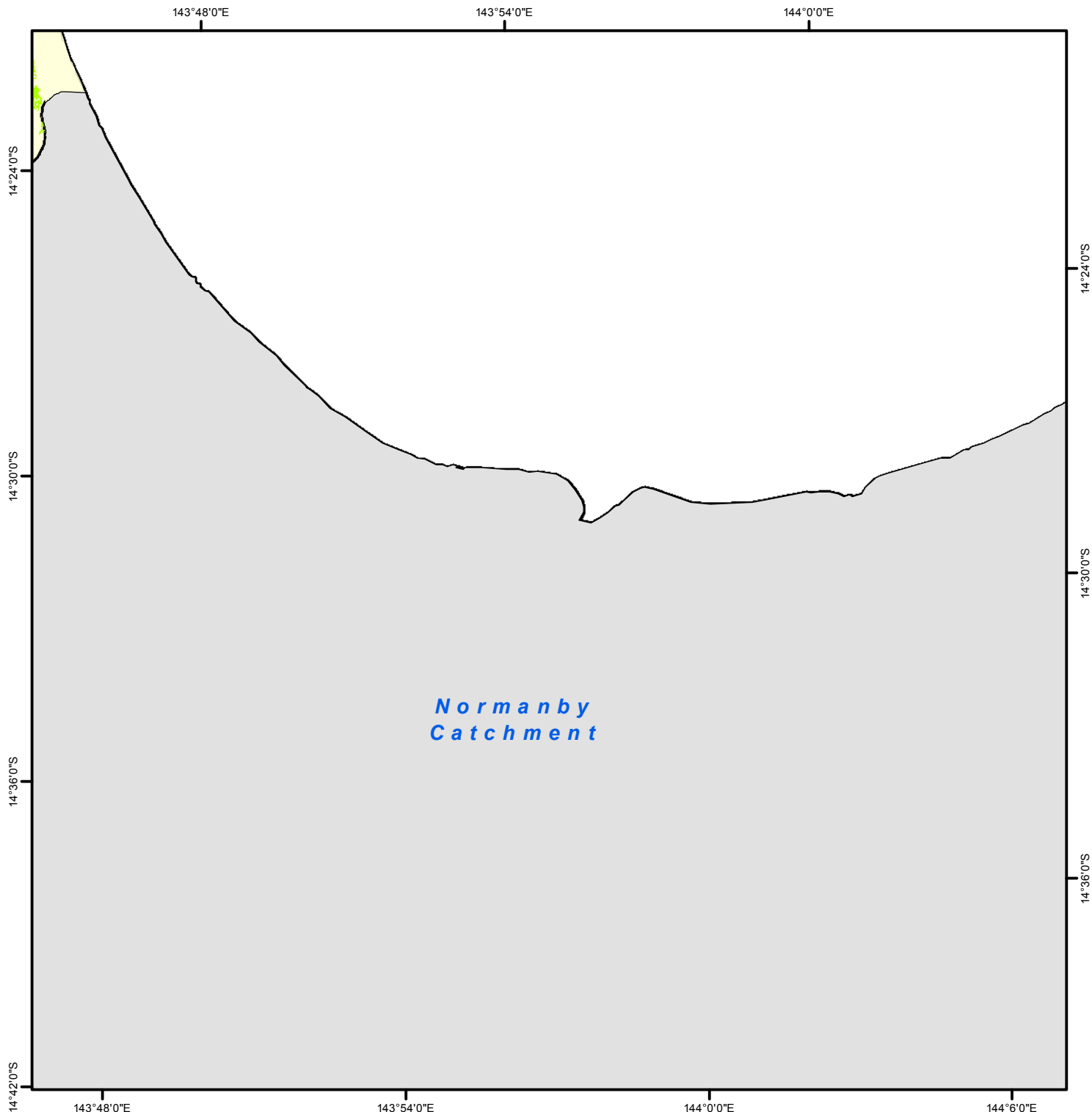
O6 Stewart Catchment



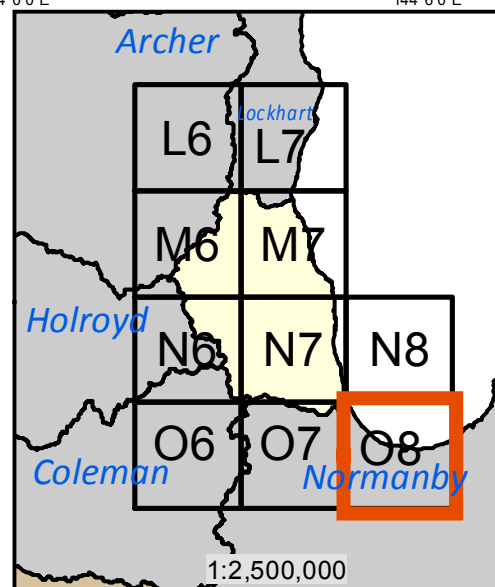
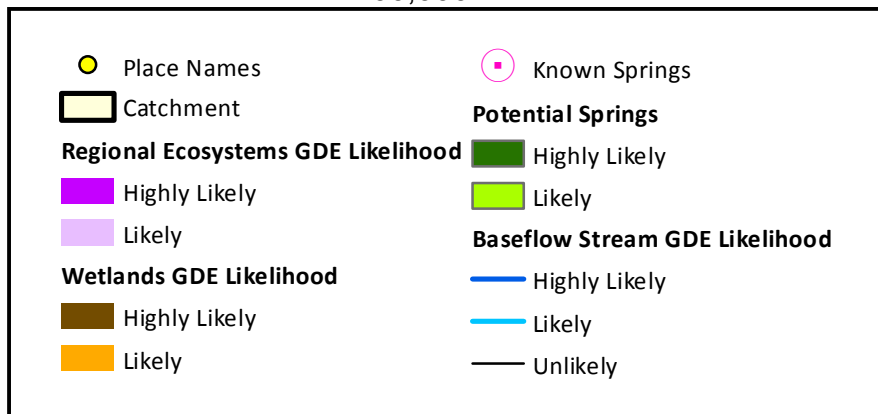
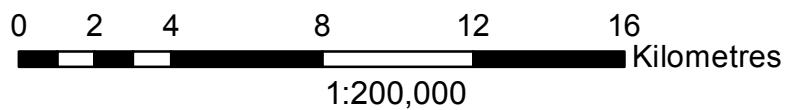


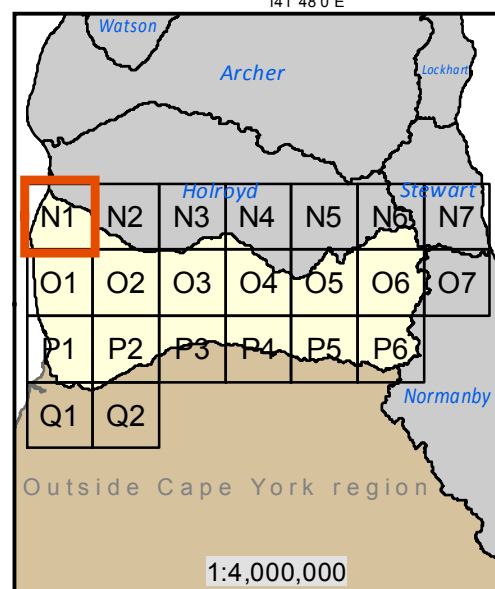
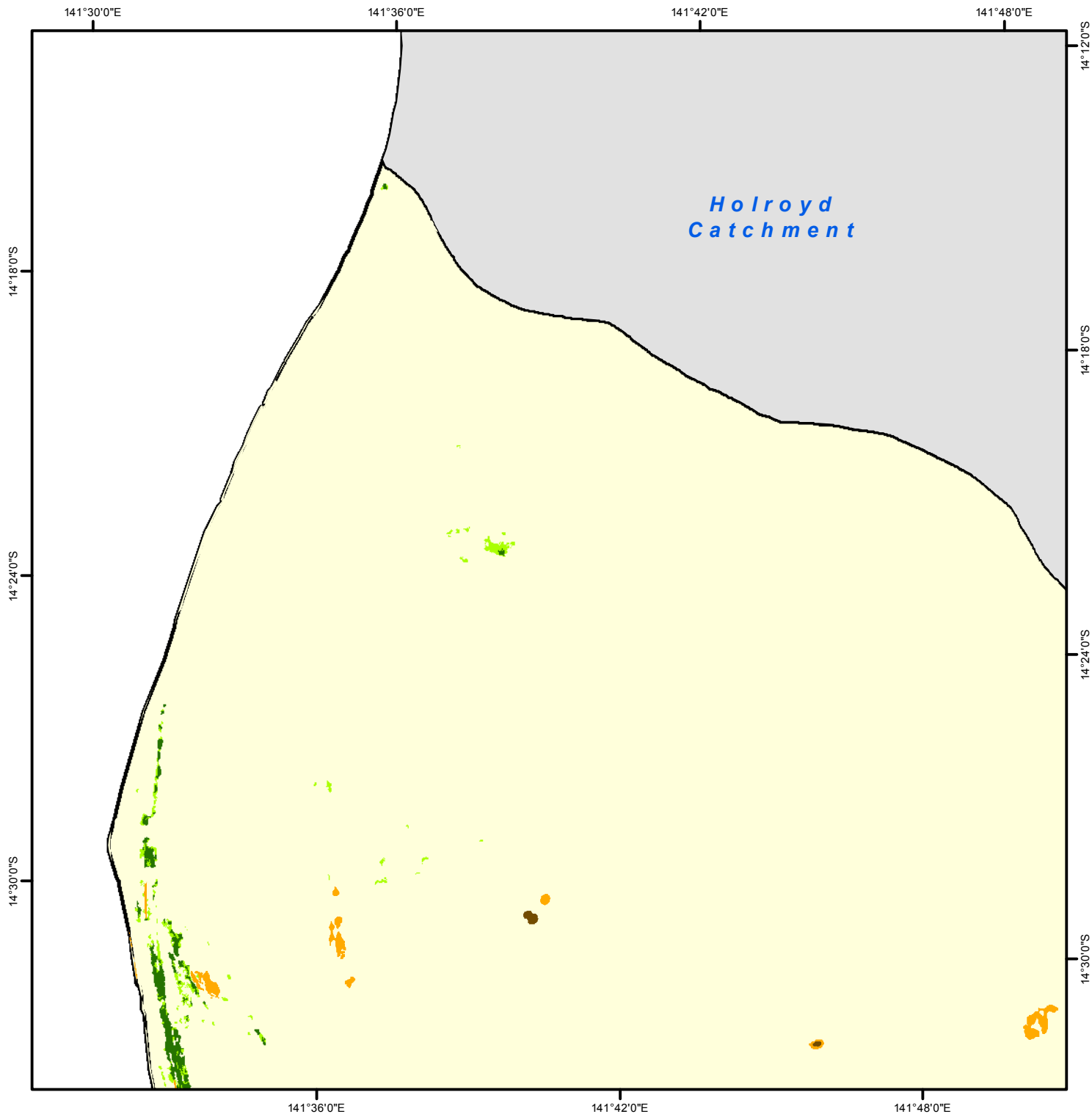
07 Stewart Catchment

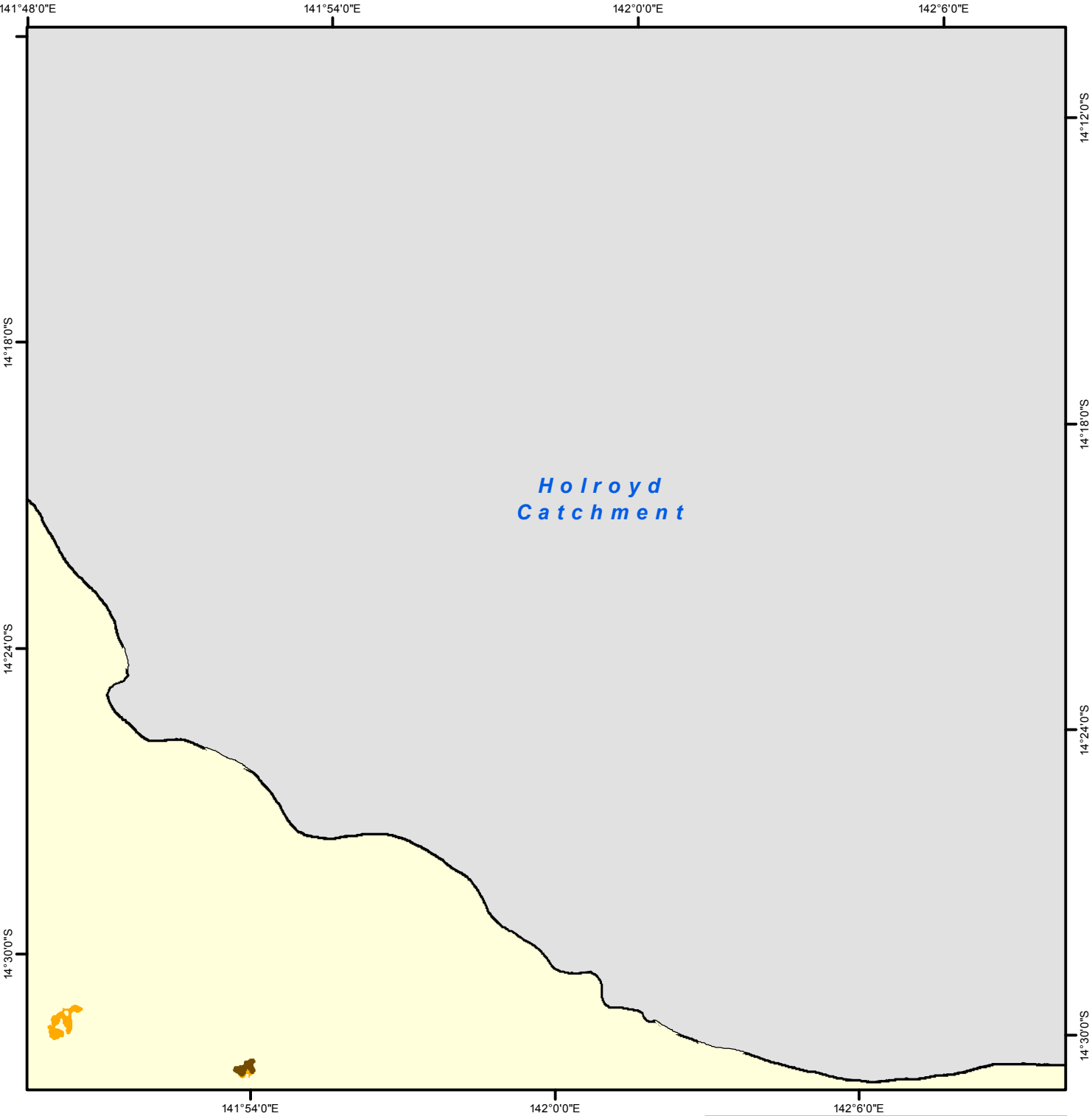




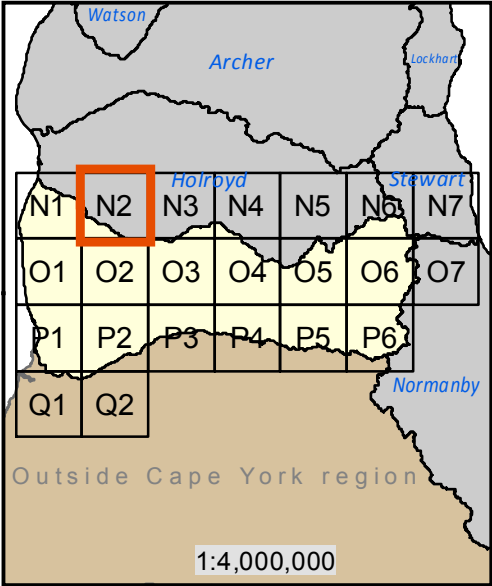
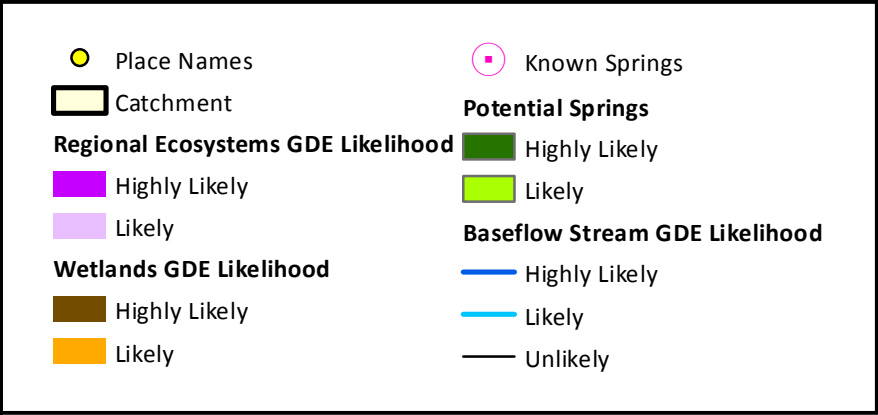
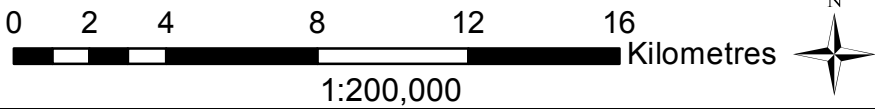
O8 Stewart Catchment

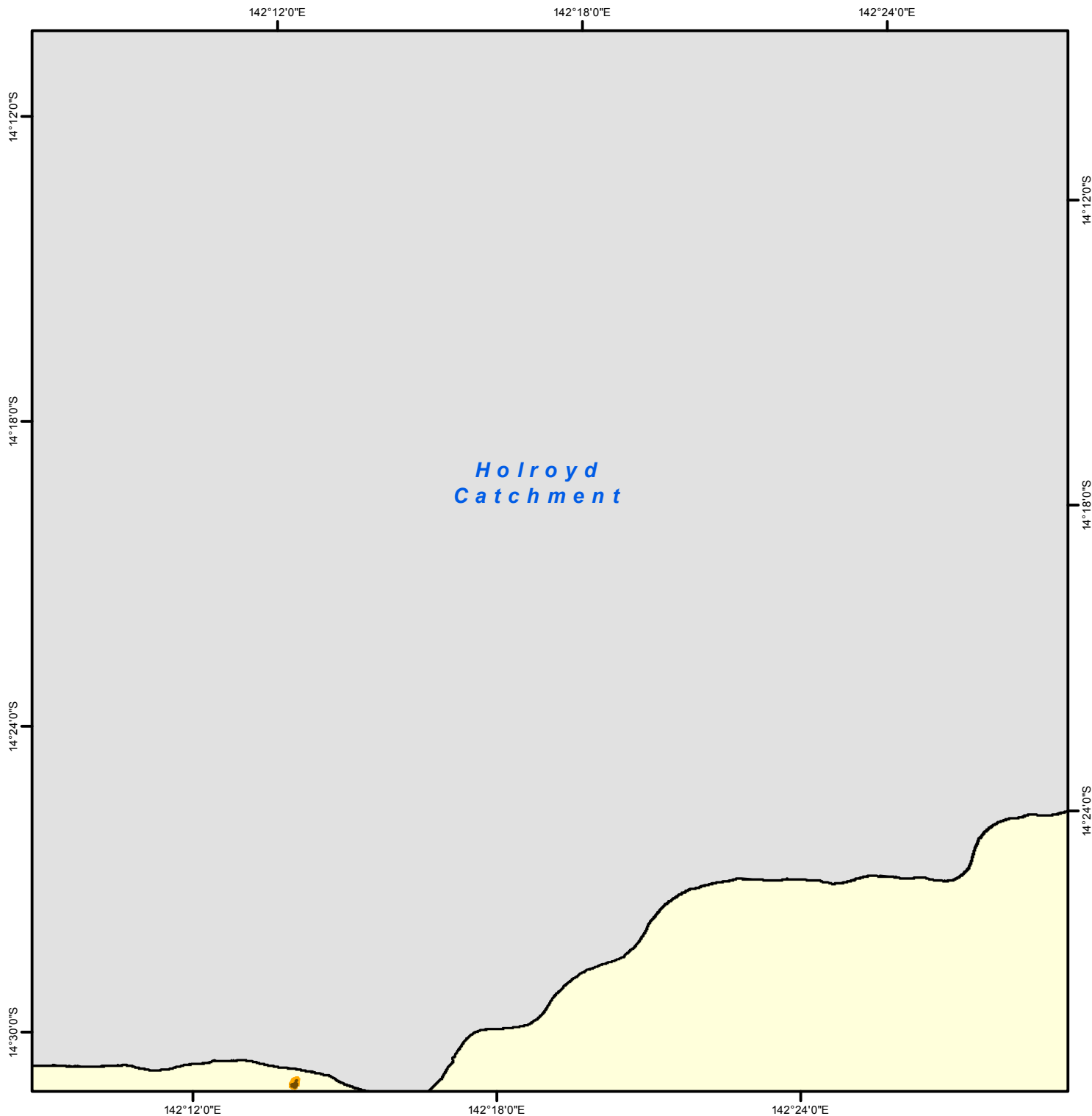




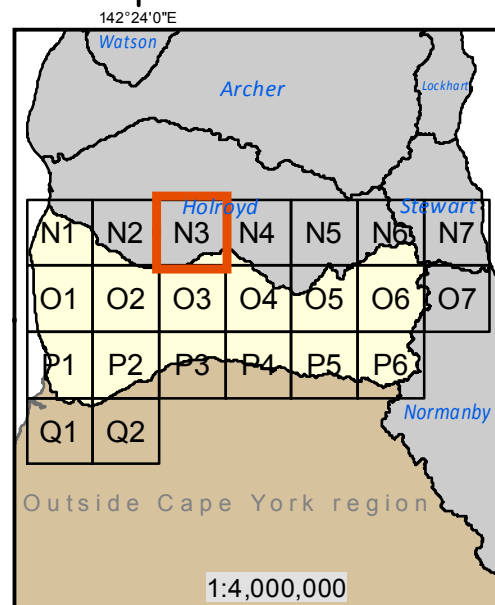
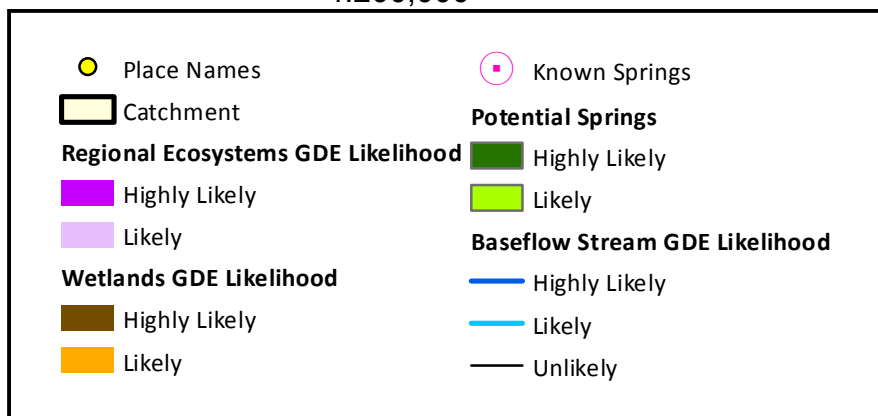
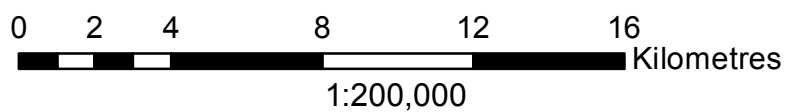


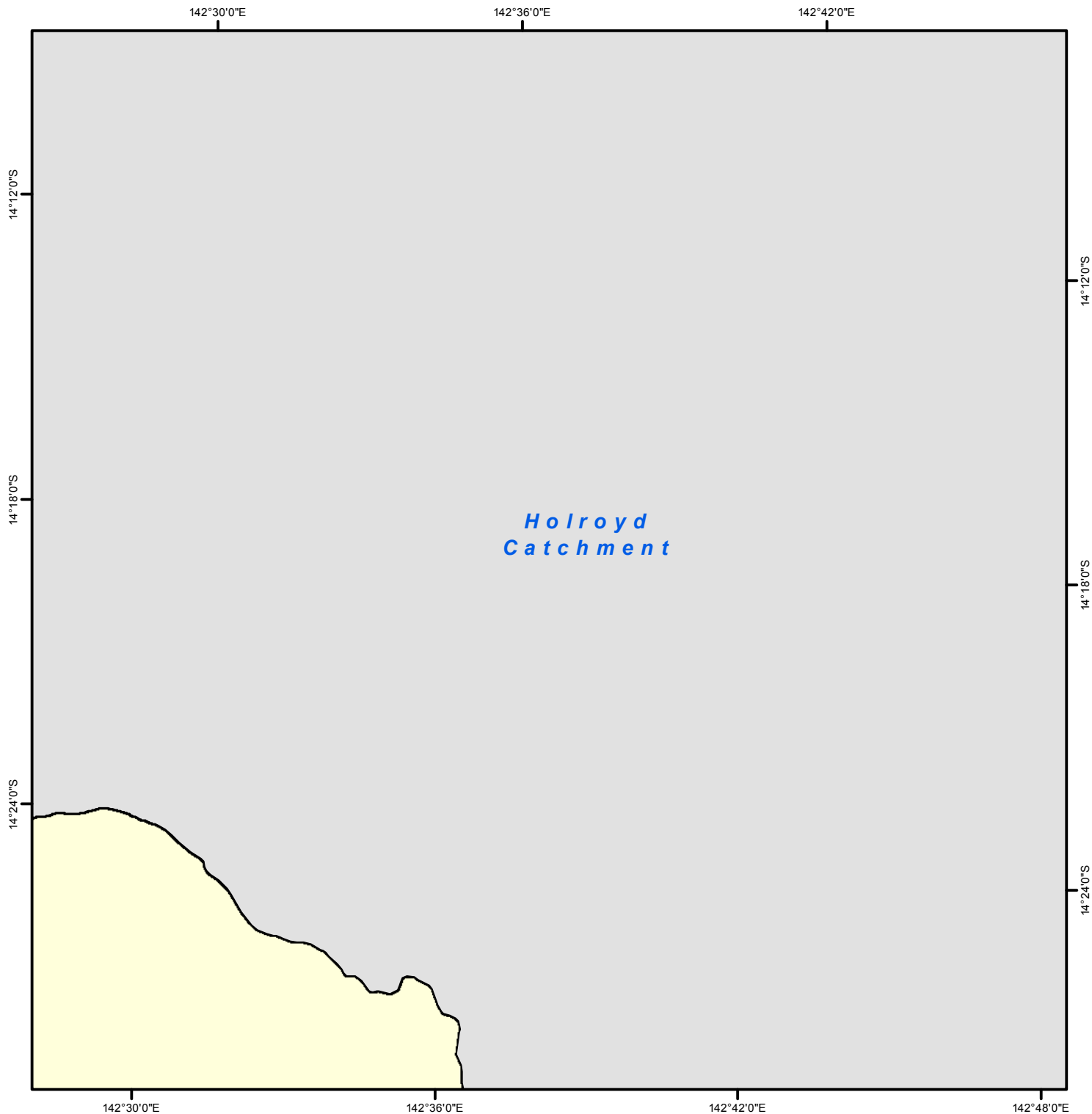
N2 Coleman Catchment



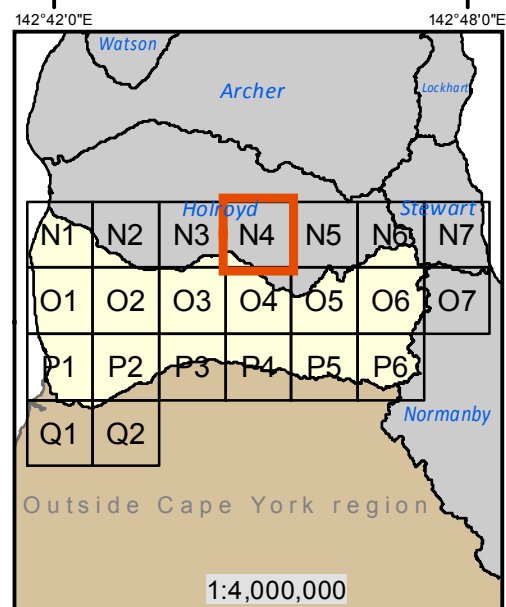
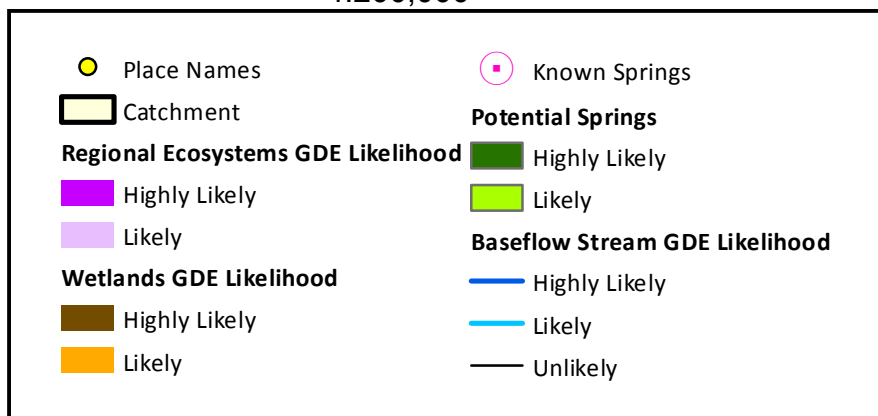
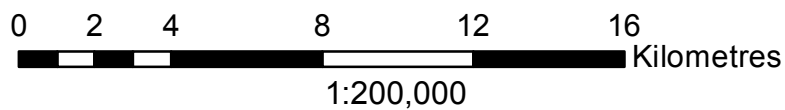


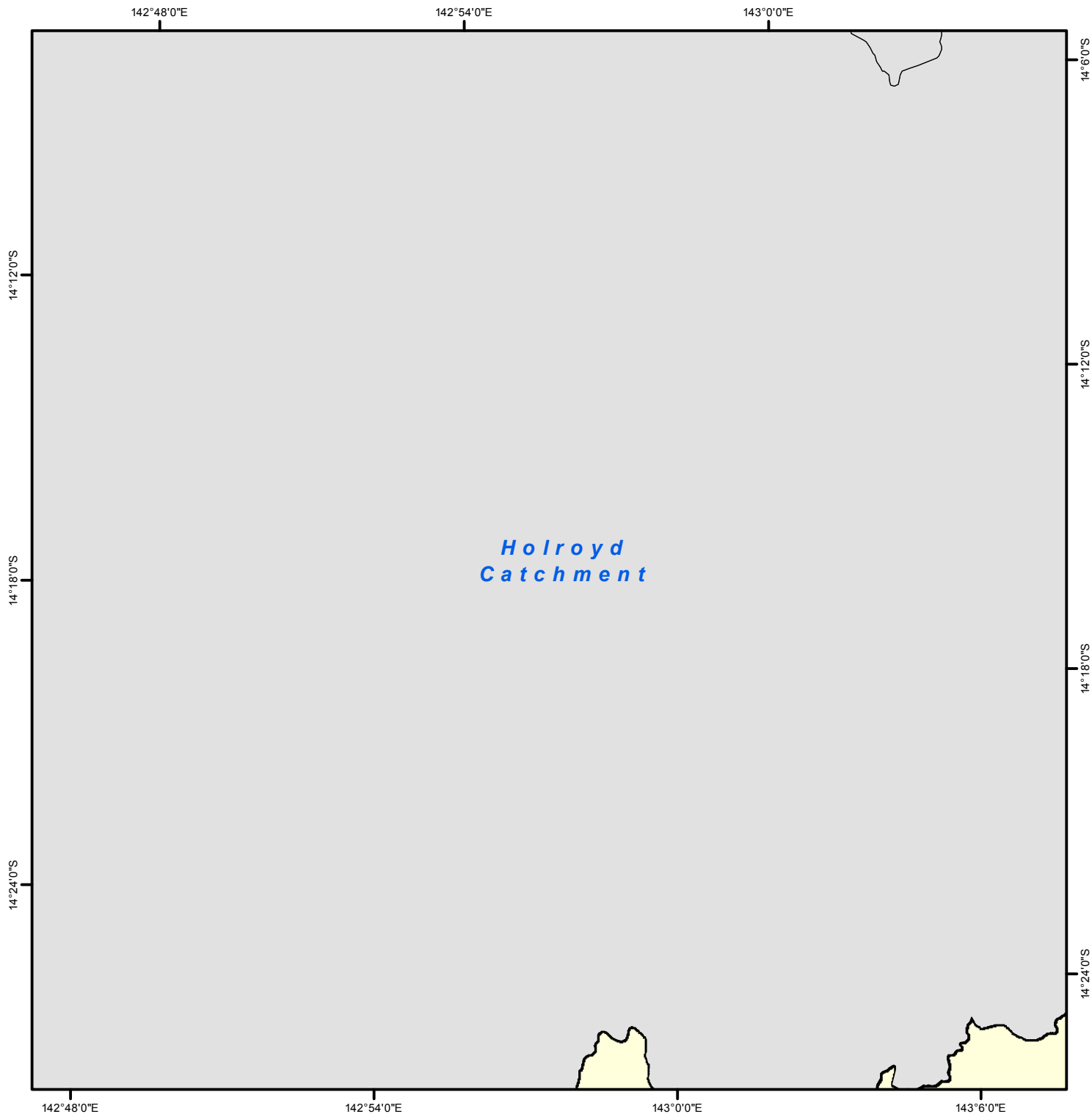
N3 Coleman Catchment



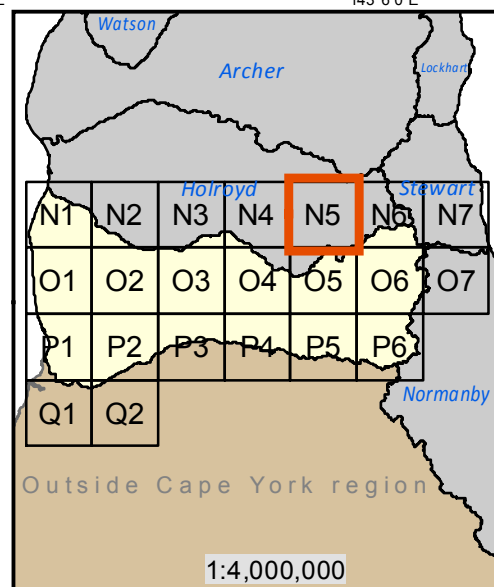
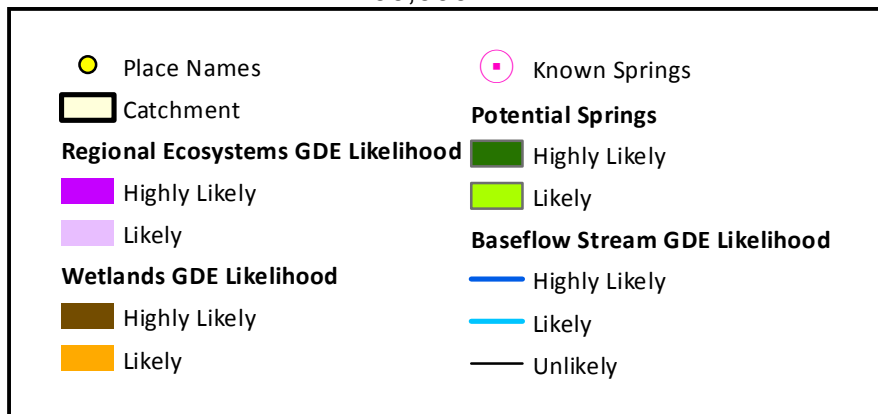
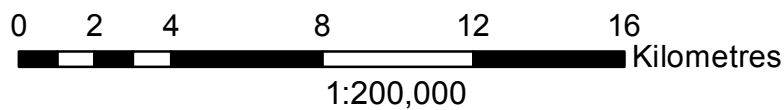


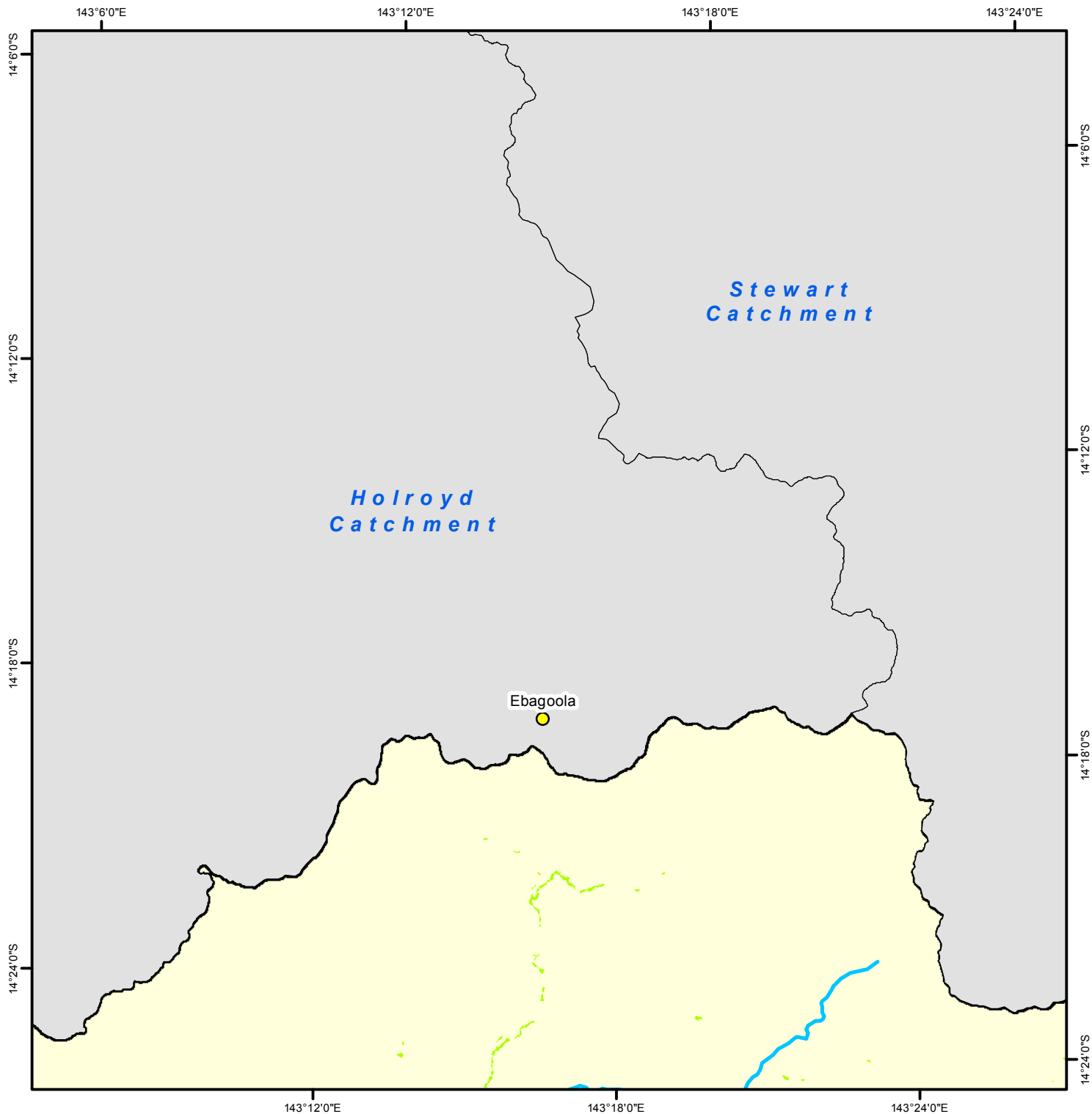
N4 Coleman Catchment



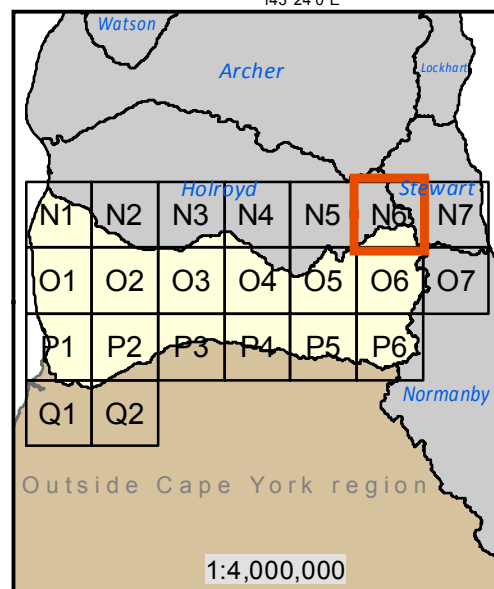
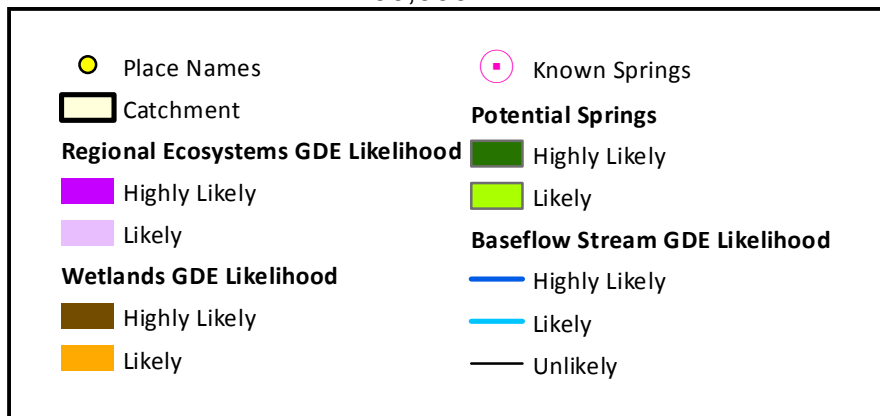
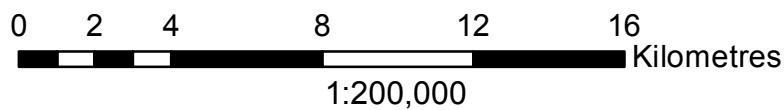


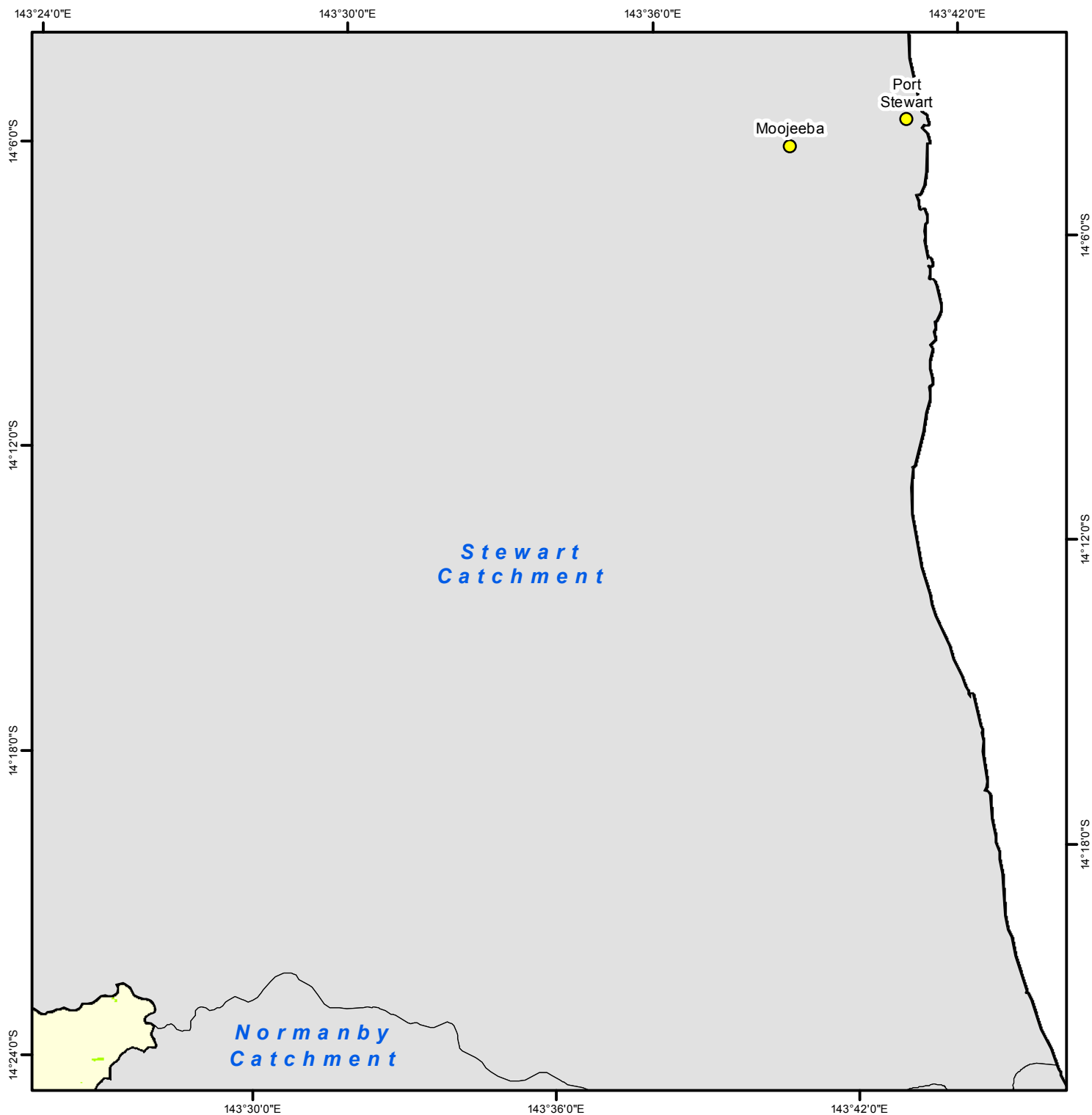
N5 Coleman Catchment



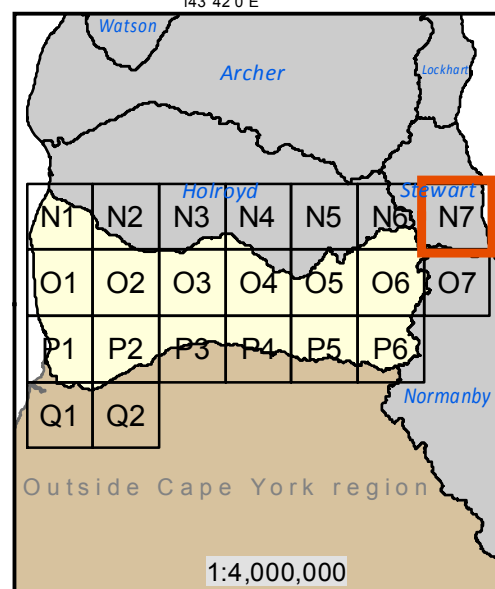
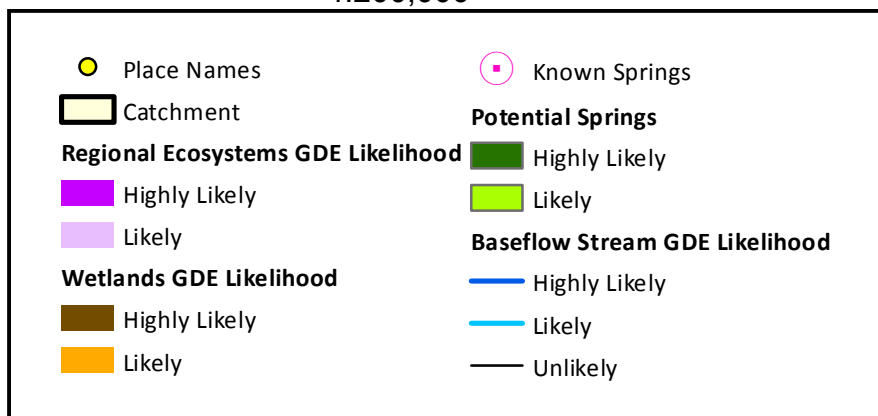
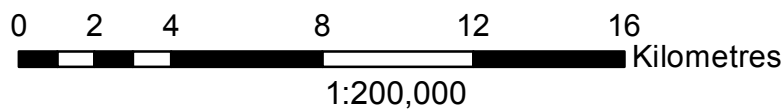


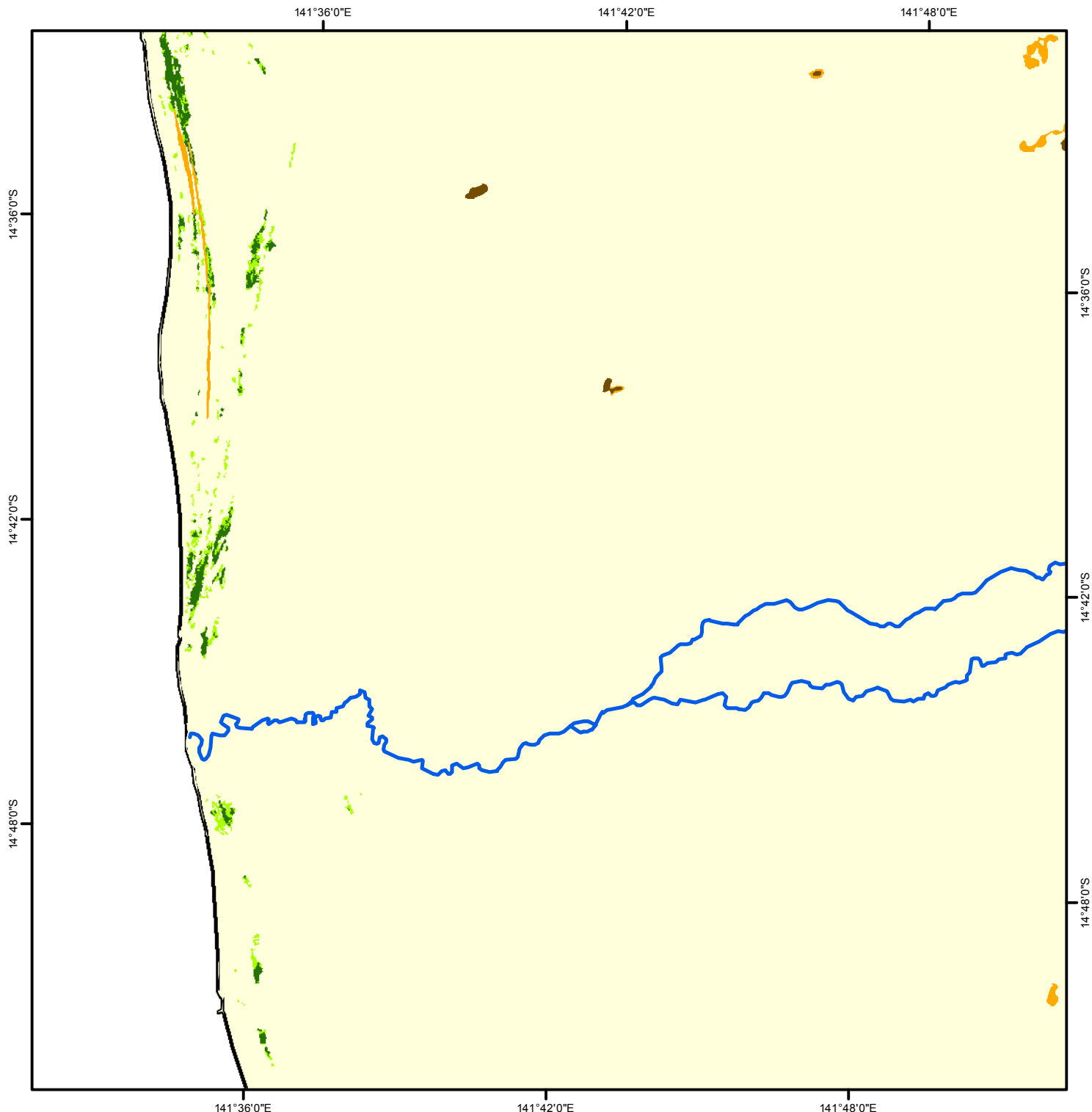
N6 Coleman Catchment



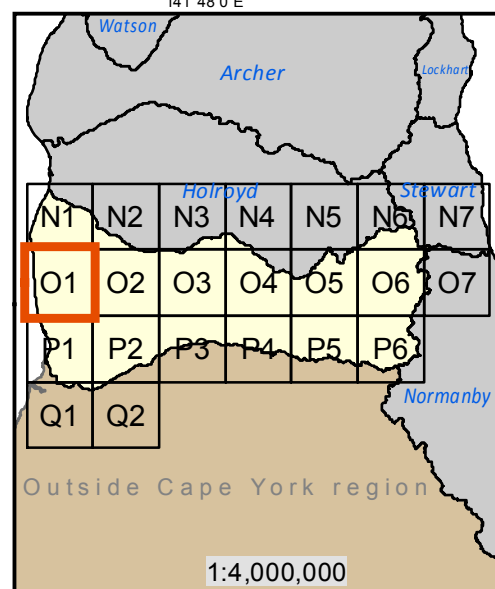
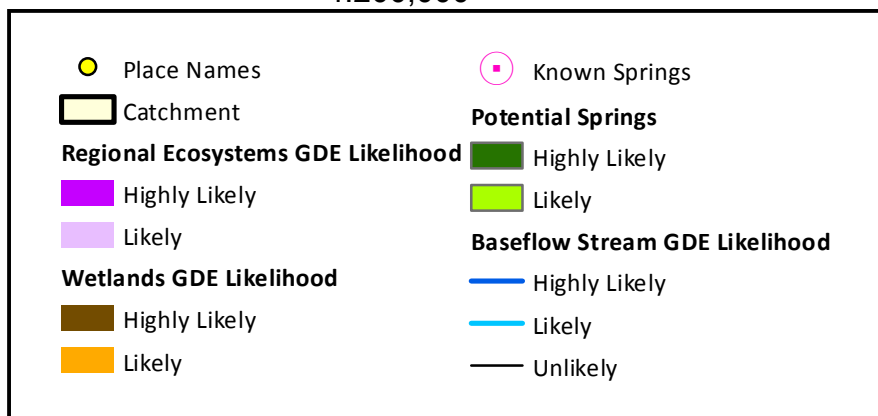
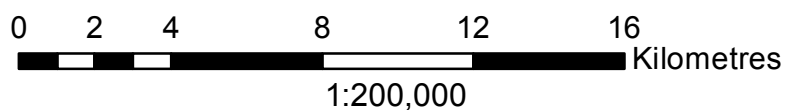


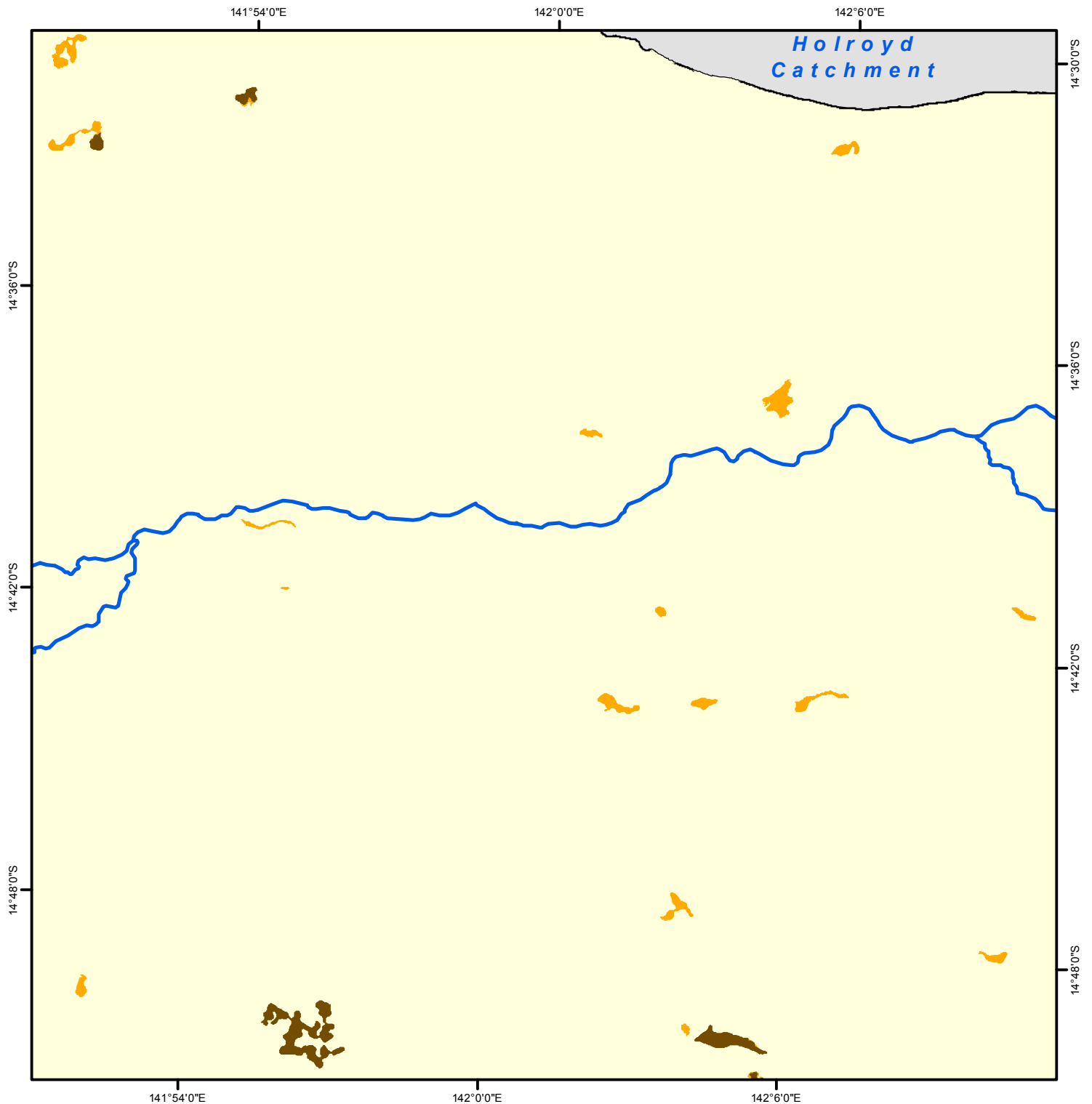
N7 Coleman Catchment



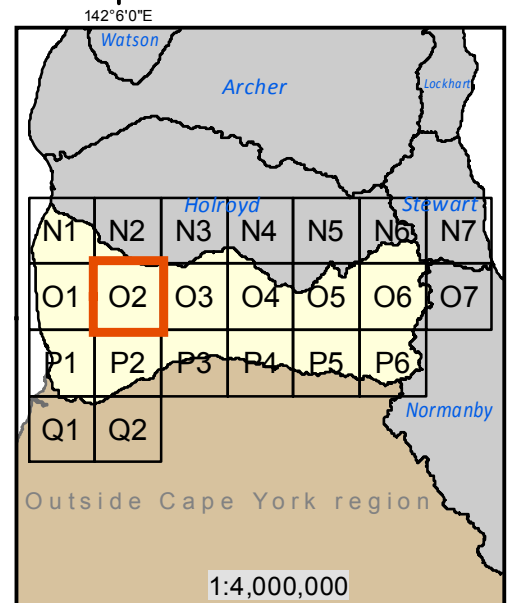
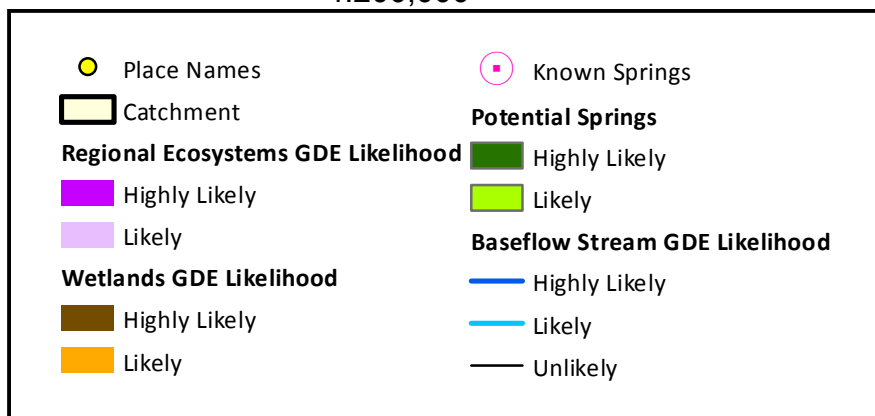
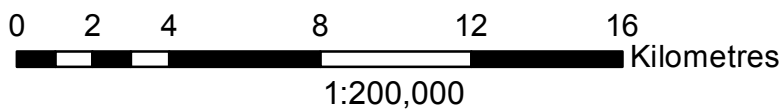


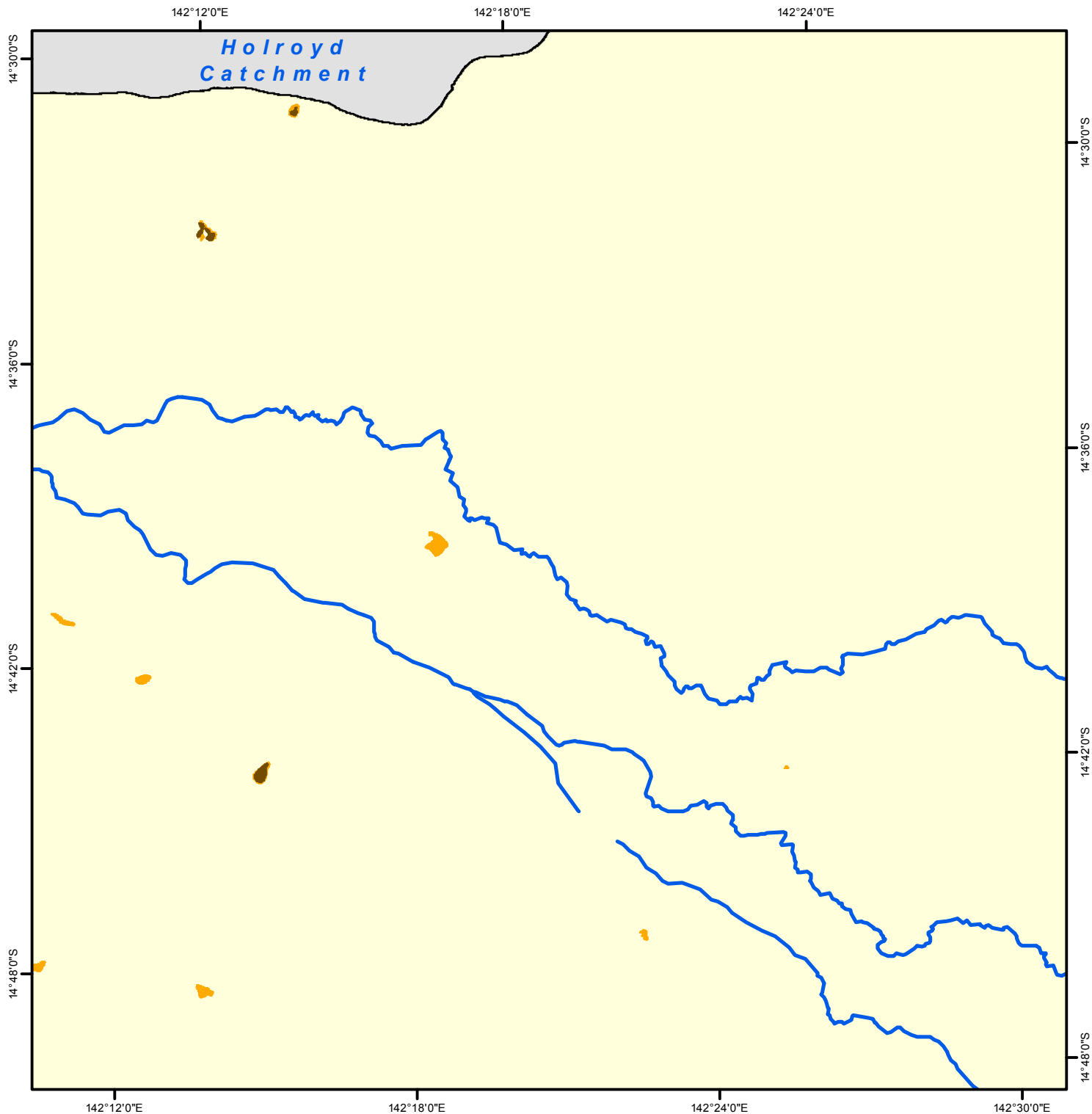
O1 Coleman Catchment



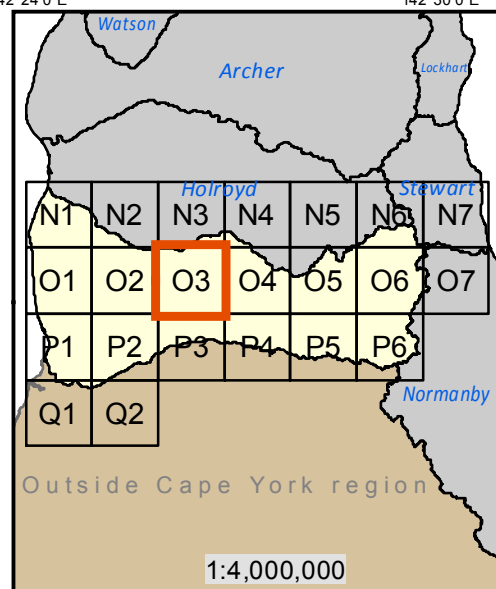
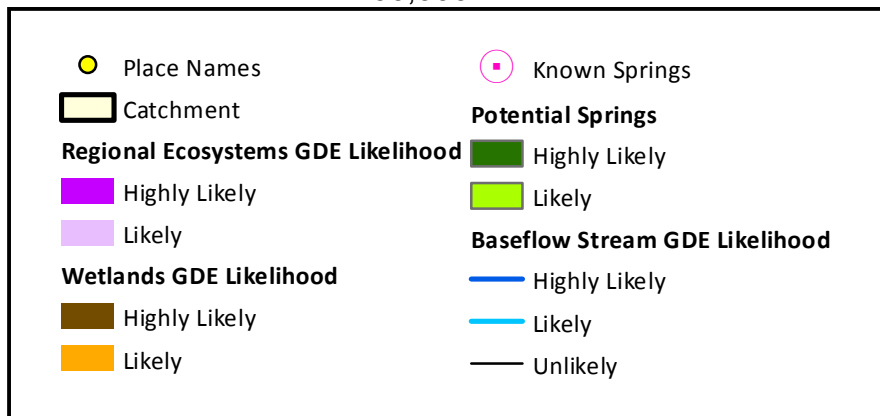
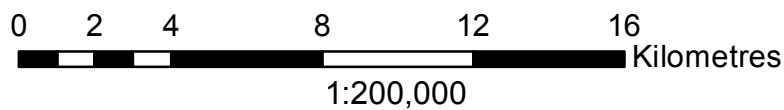


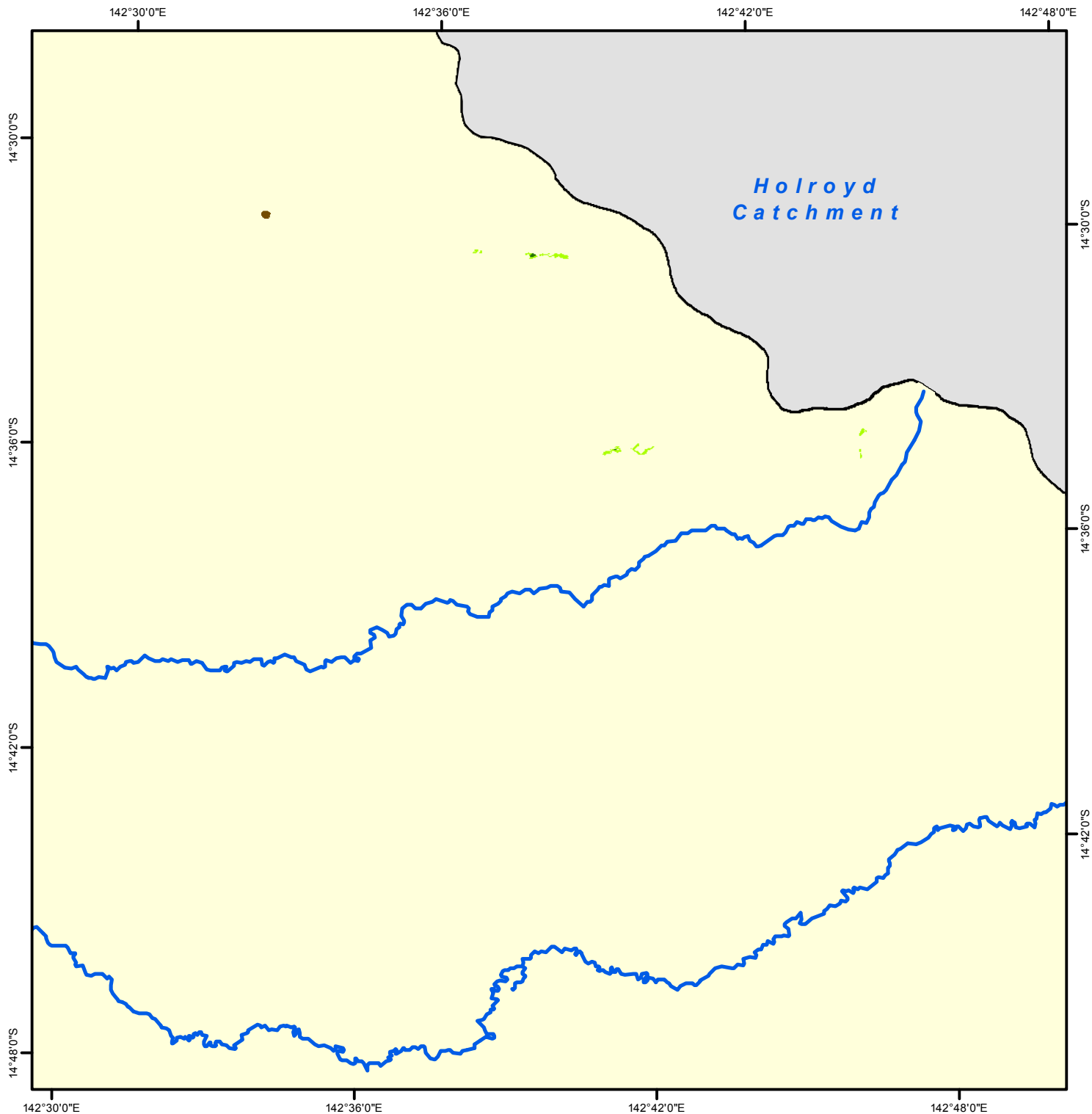
O2 Coleman Catchment





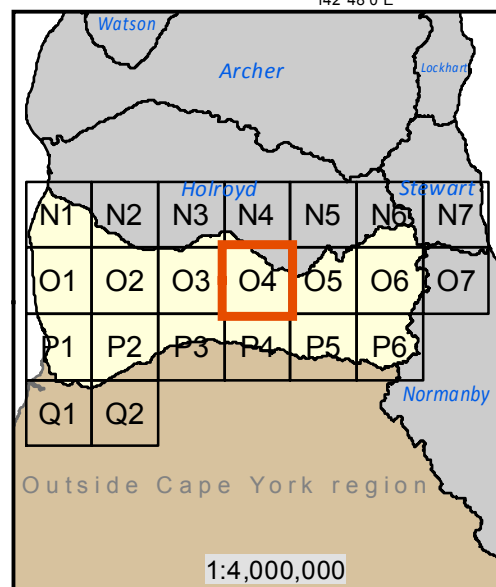
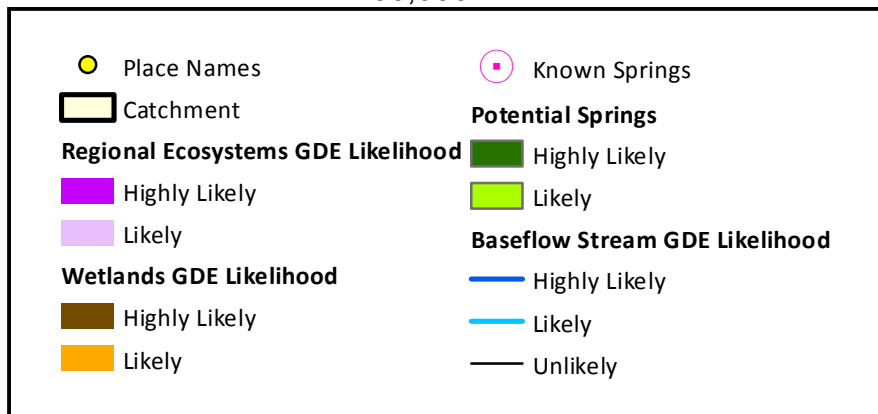
O3 Coleman Catchment

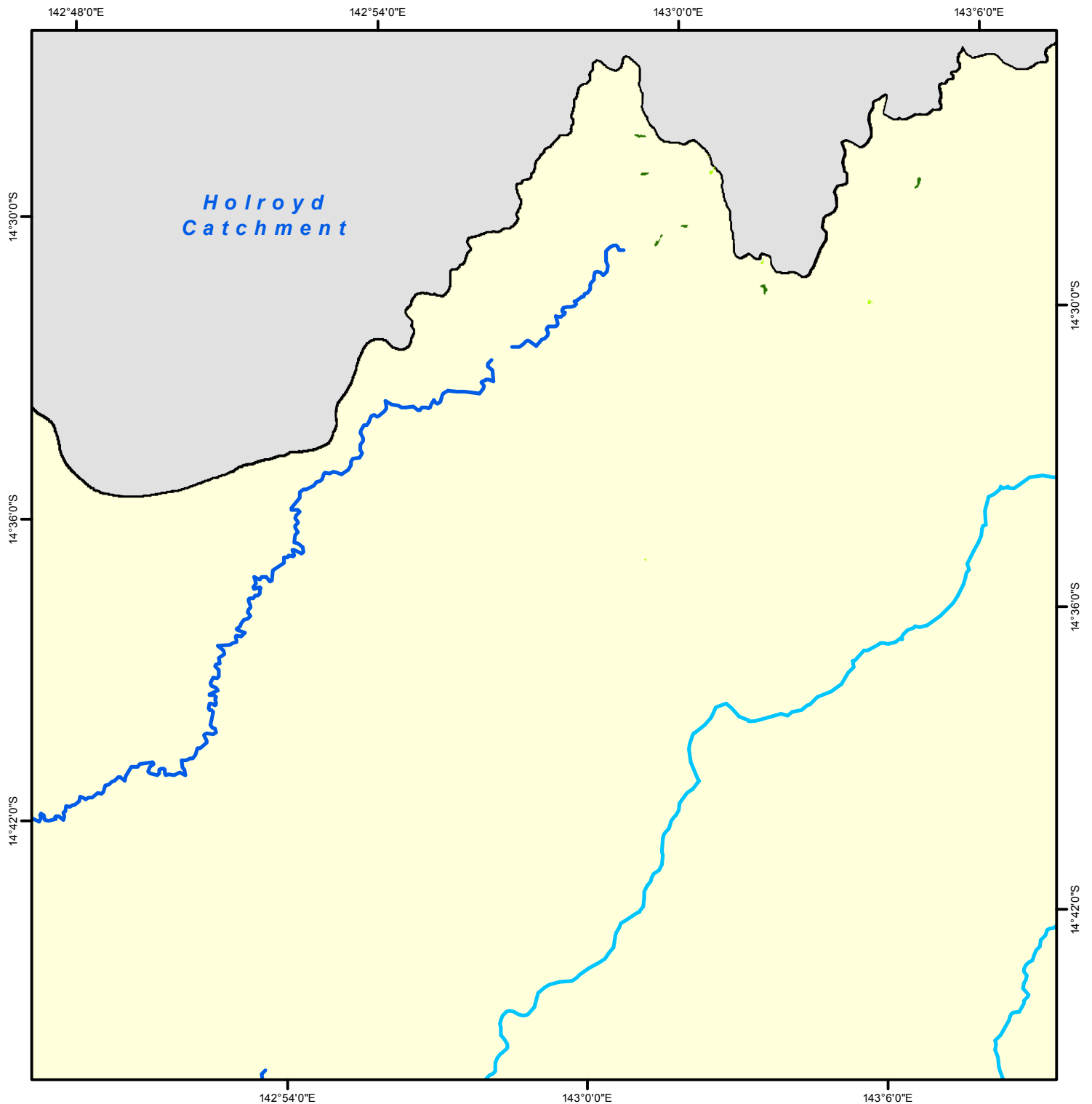




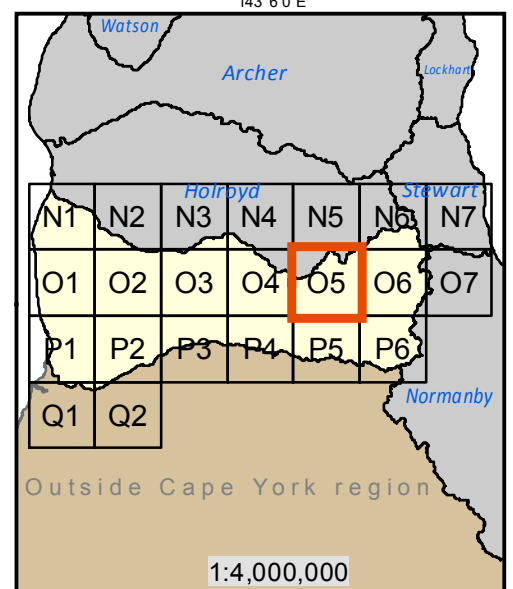
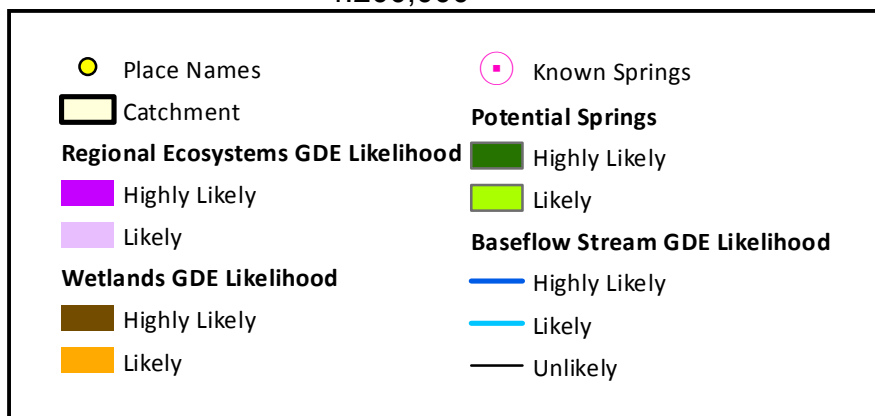
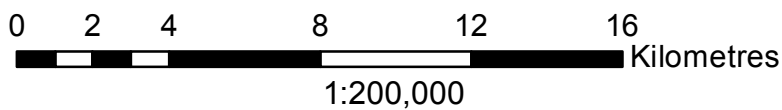
O4 Coleman Catchment

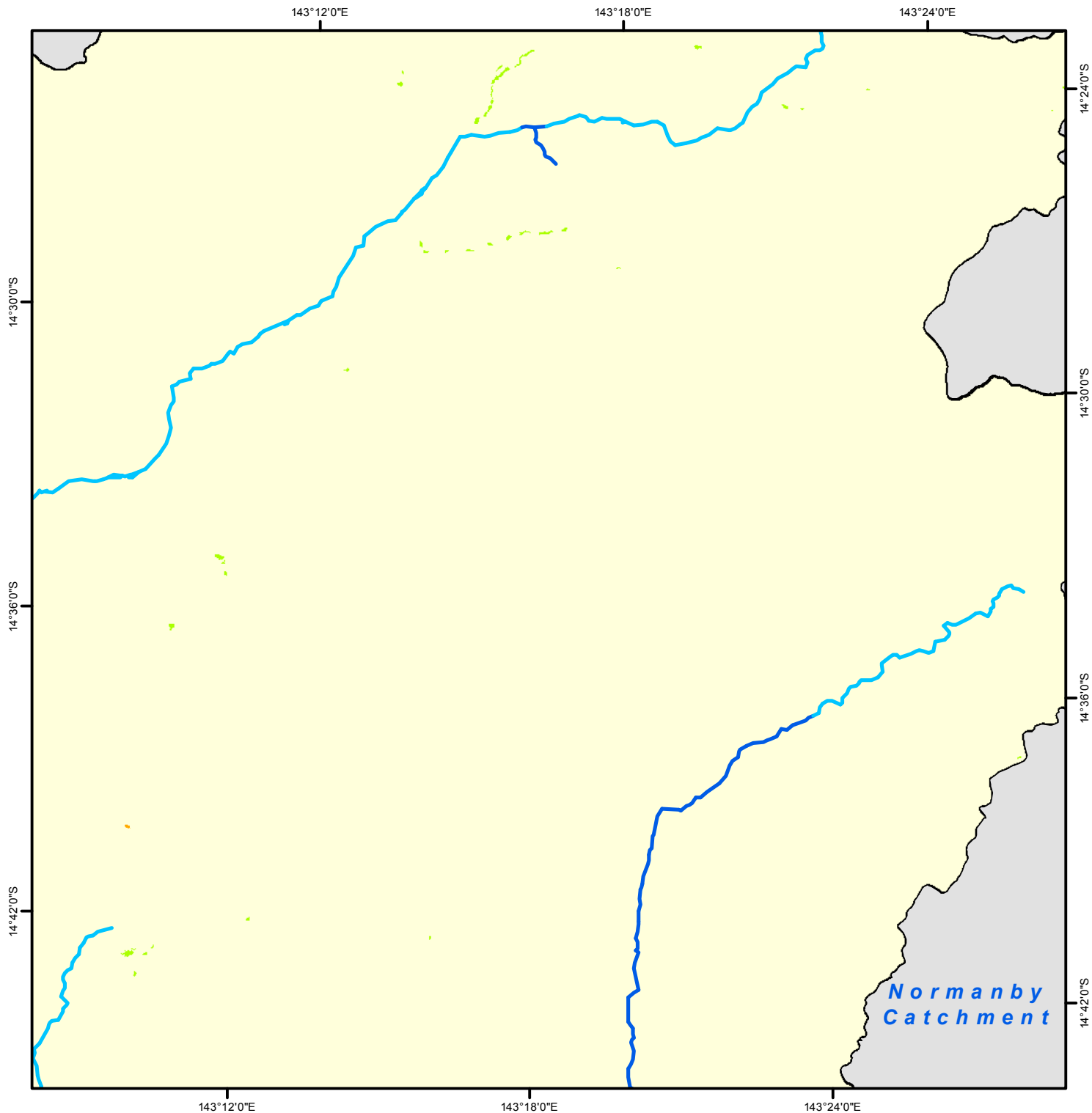
0 2 4 8 12 16 Kilometres
1:200,000



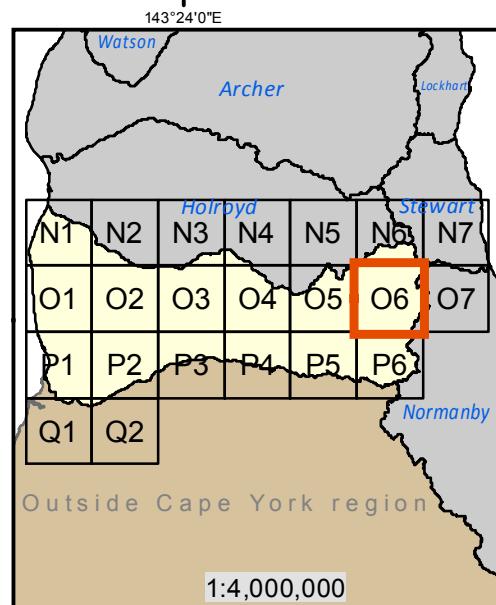
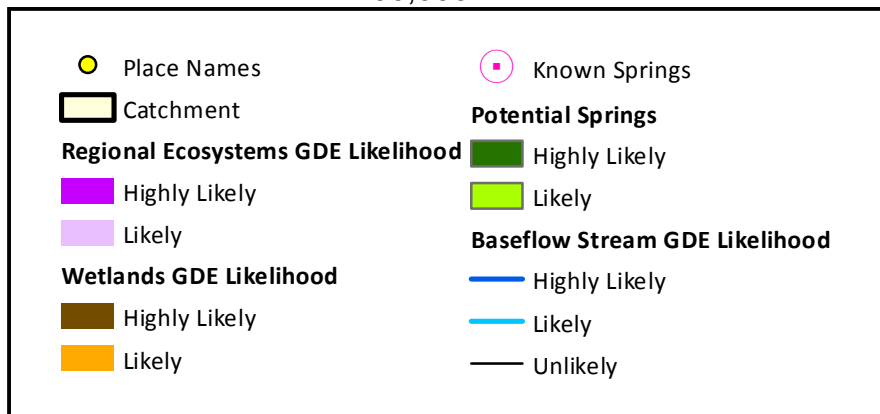
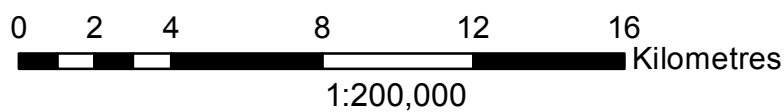


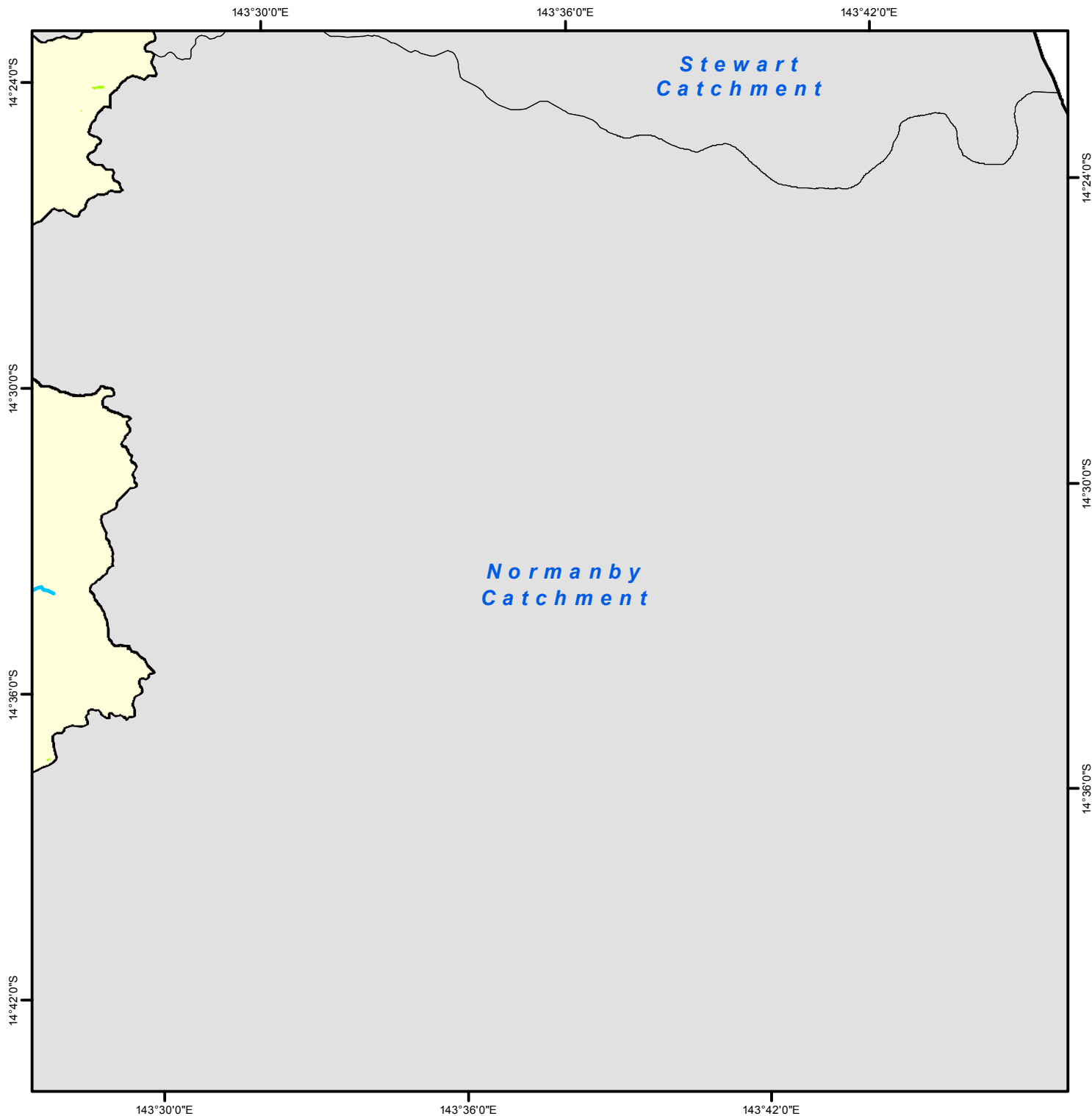
O5 Coleman Catchment



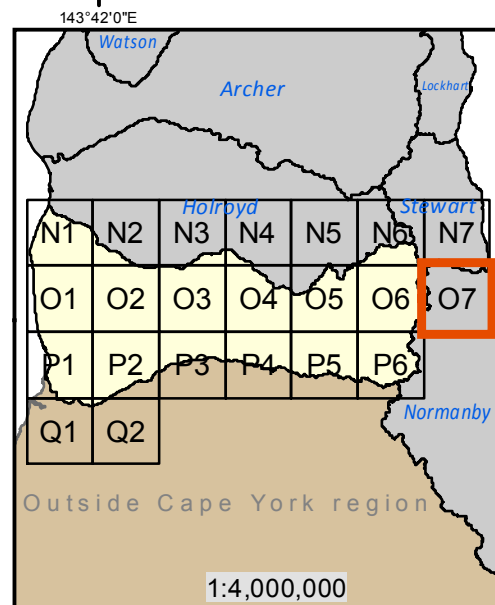
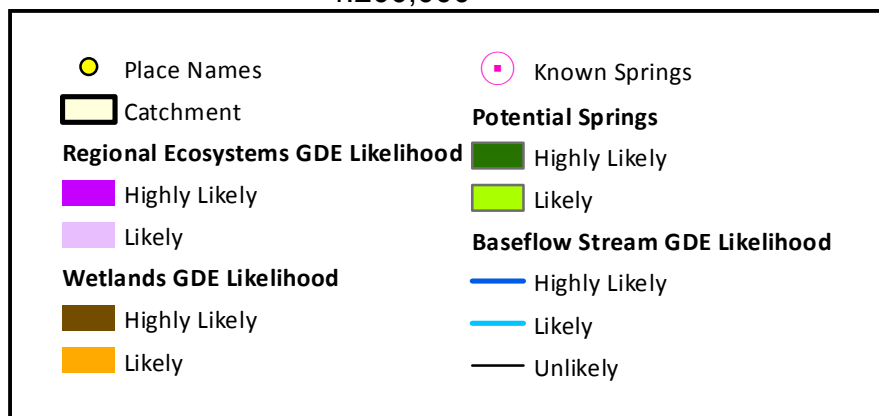
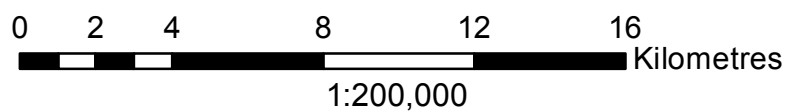


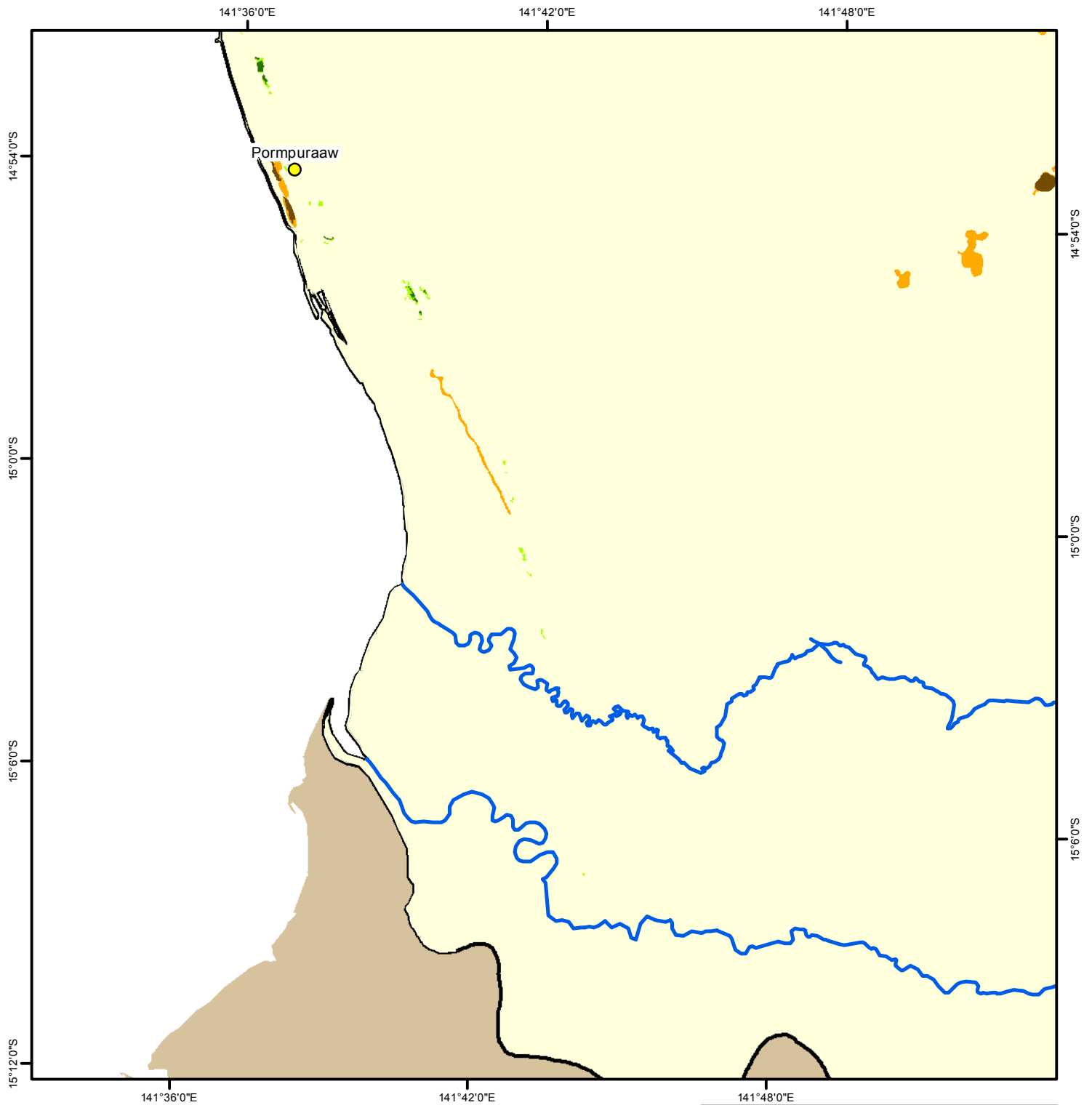
O6 Coleman Catchment



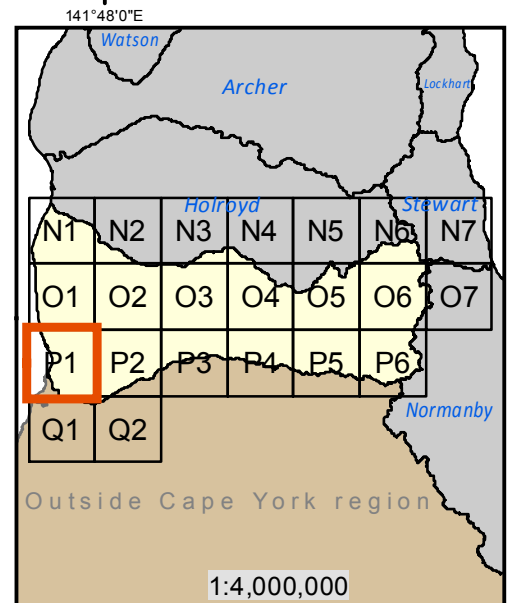
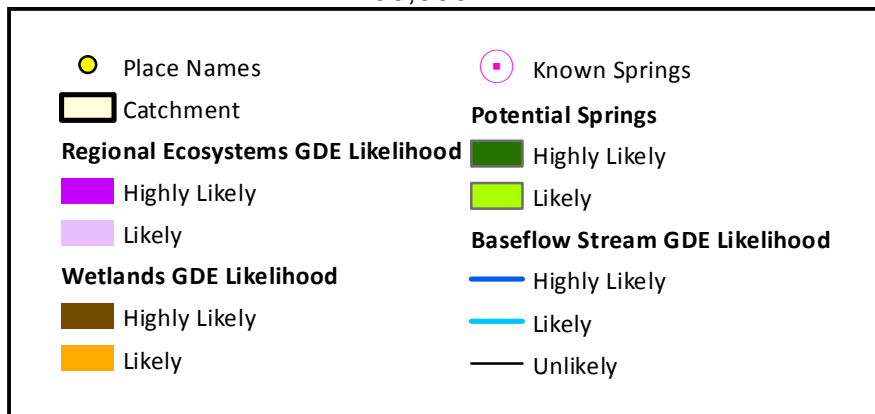
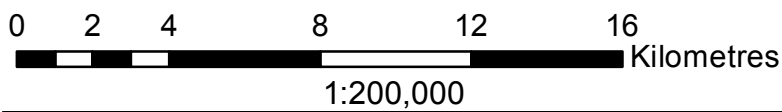


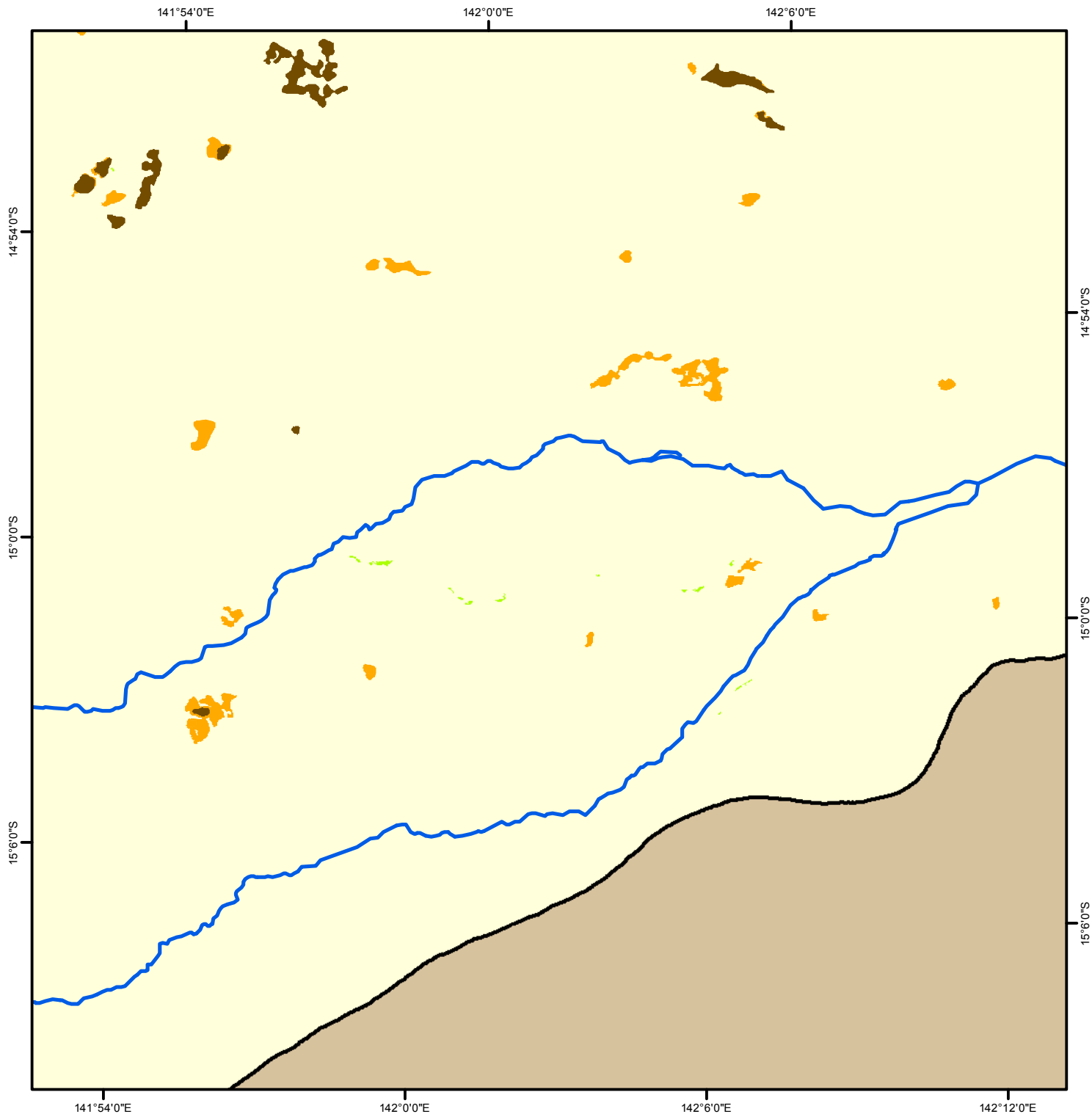
O7 Coleman Catchment



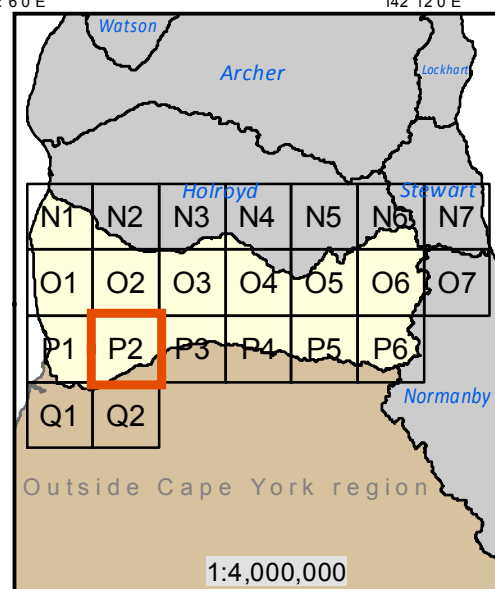
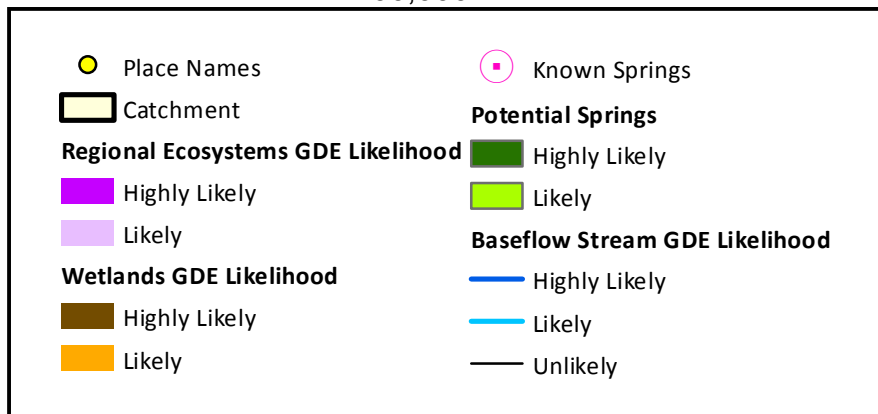
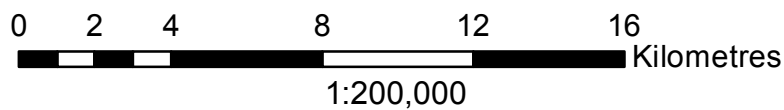


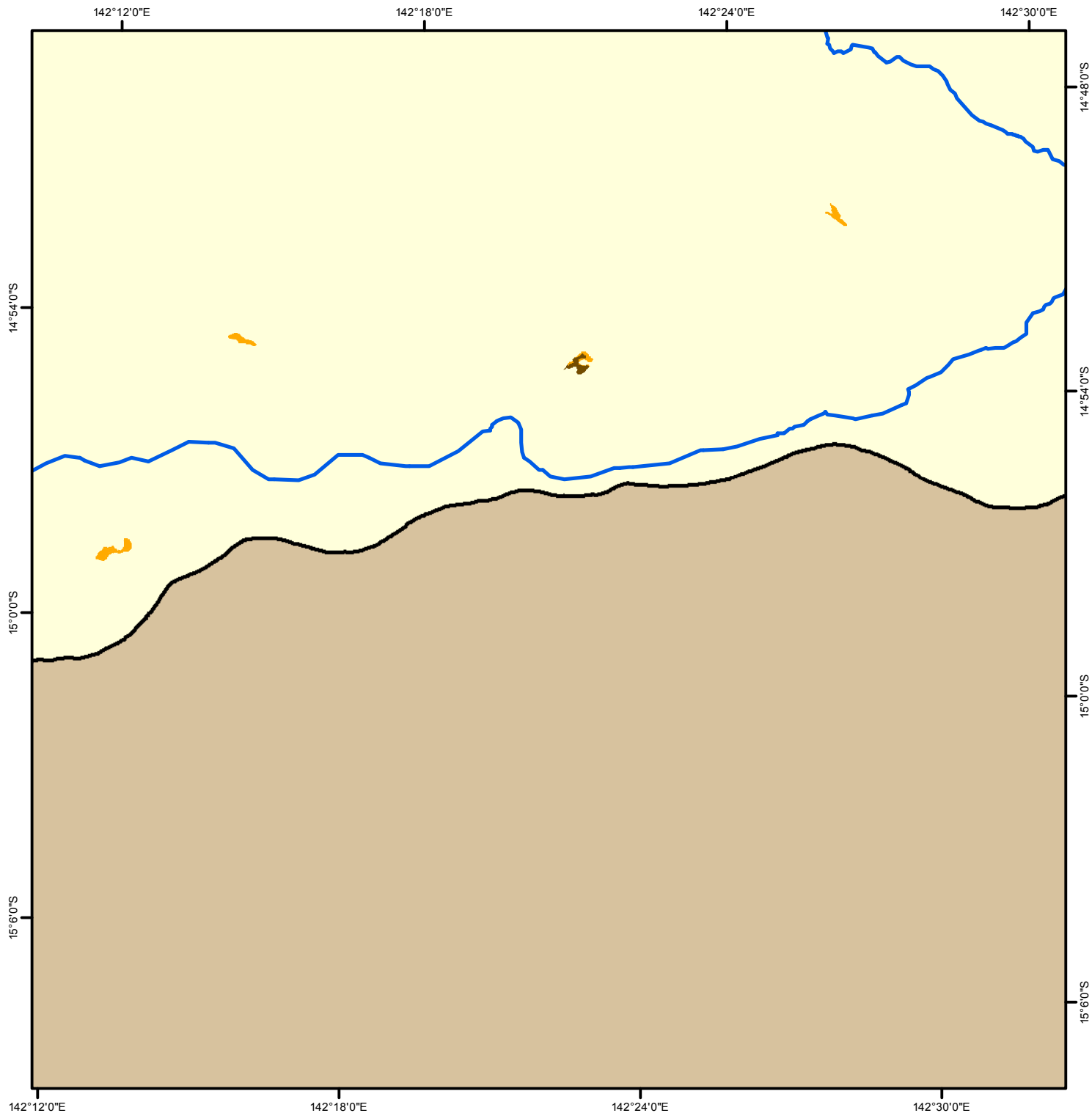
P1 Coleman Catchment



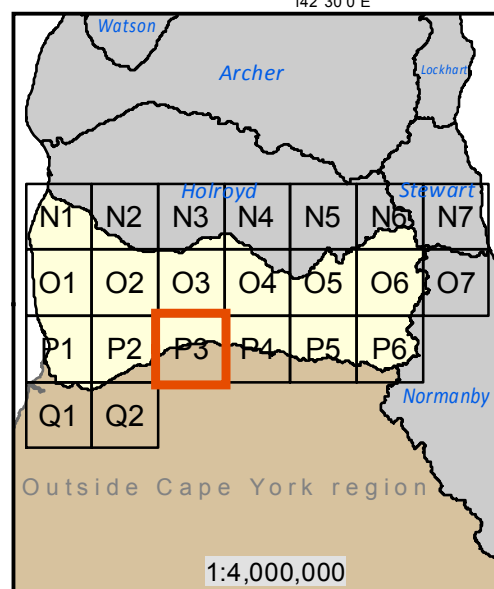
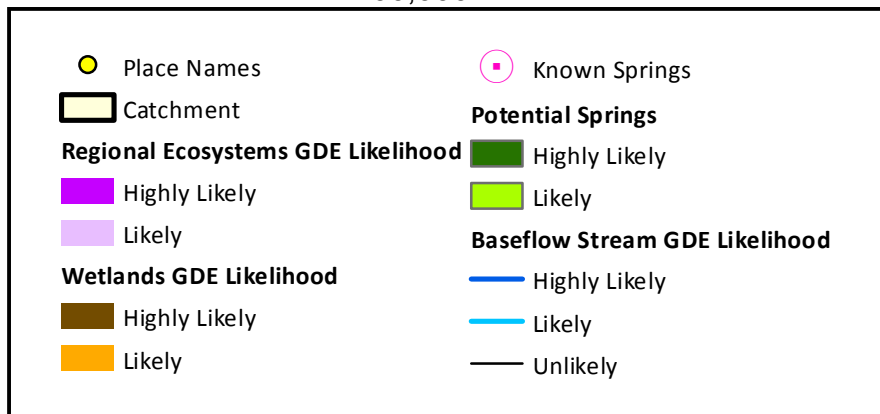
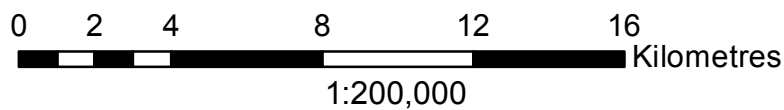


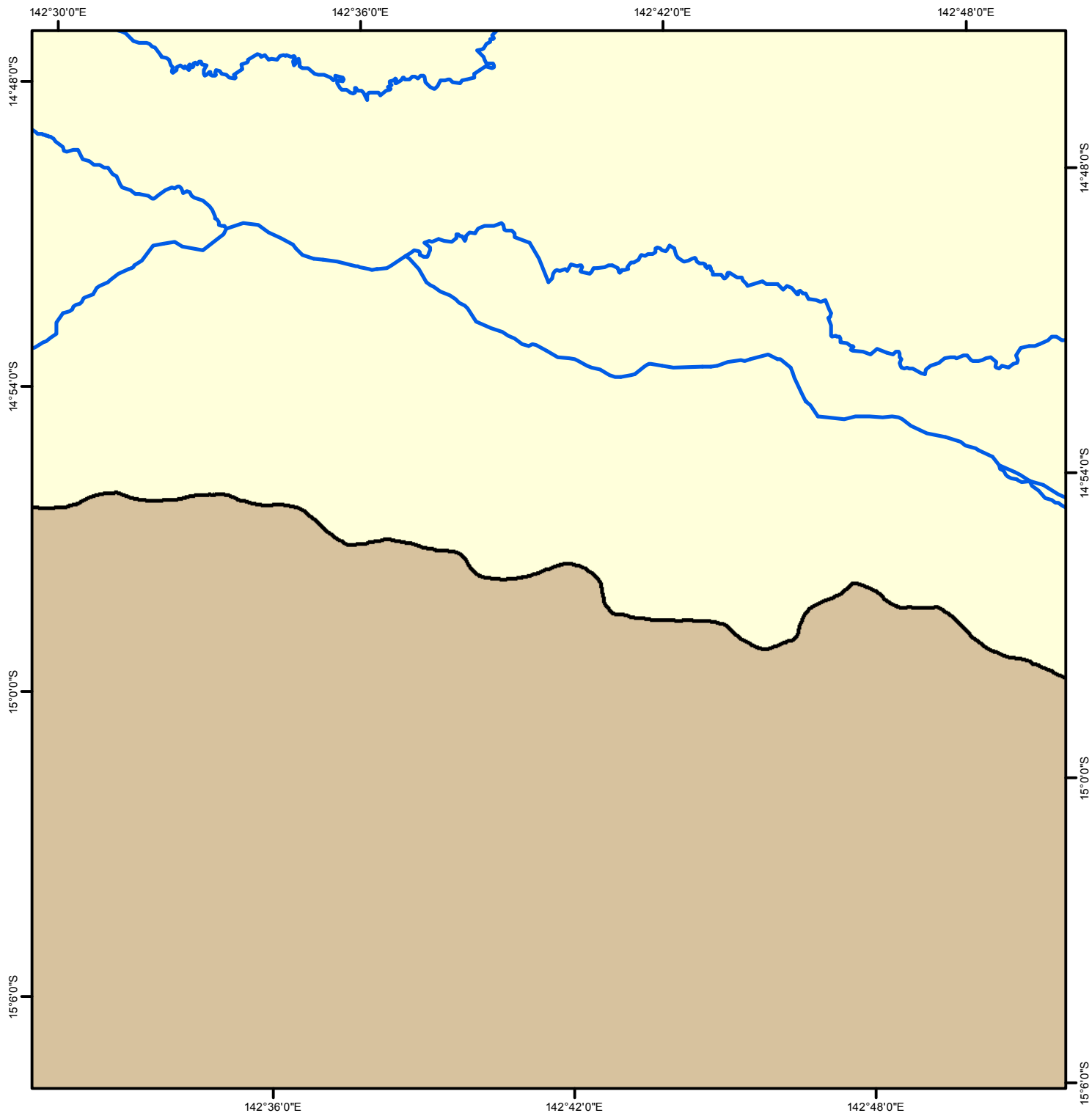
P2 Coleman Catchment



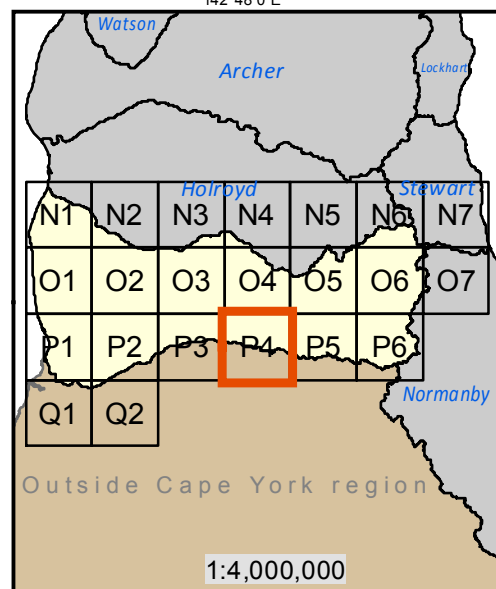
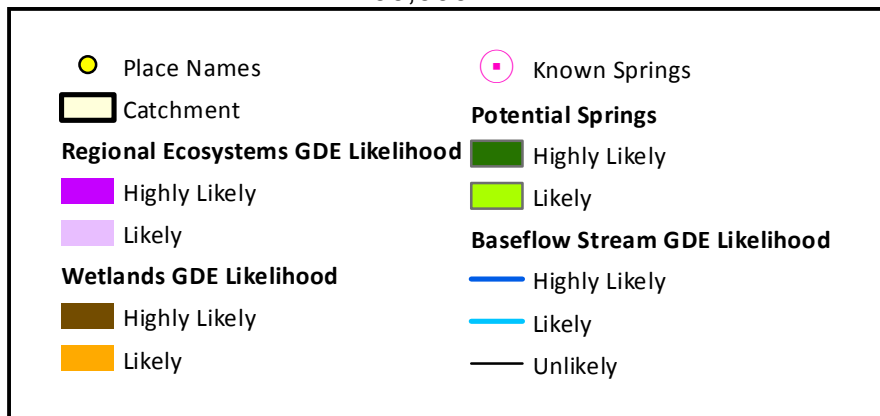
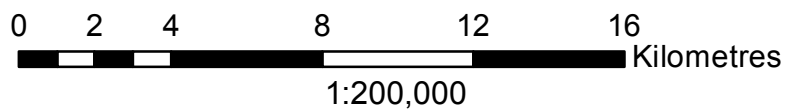


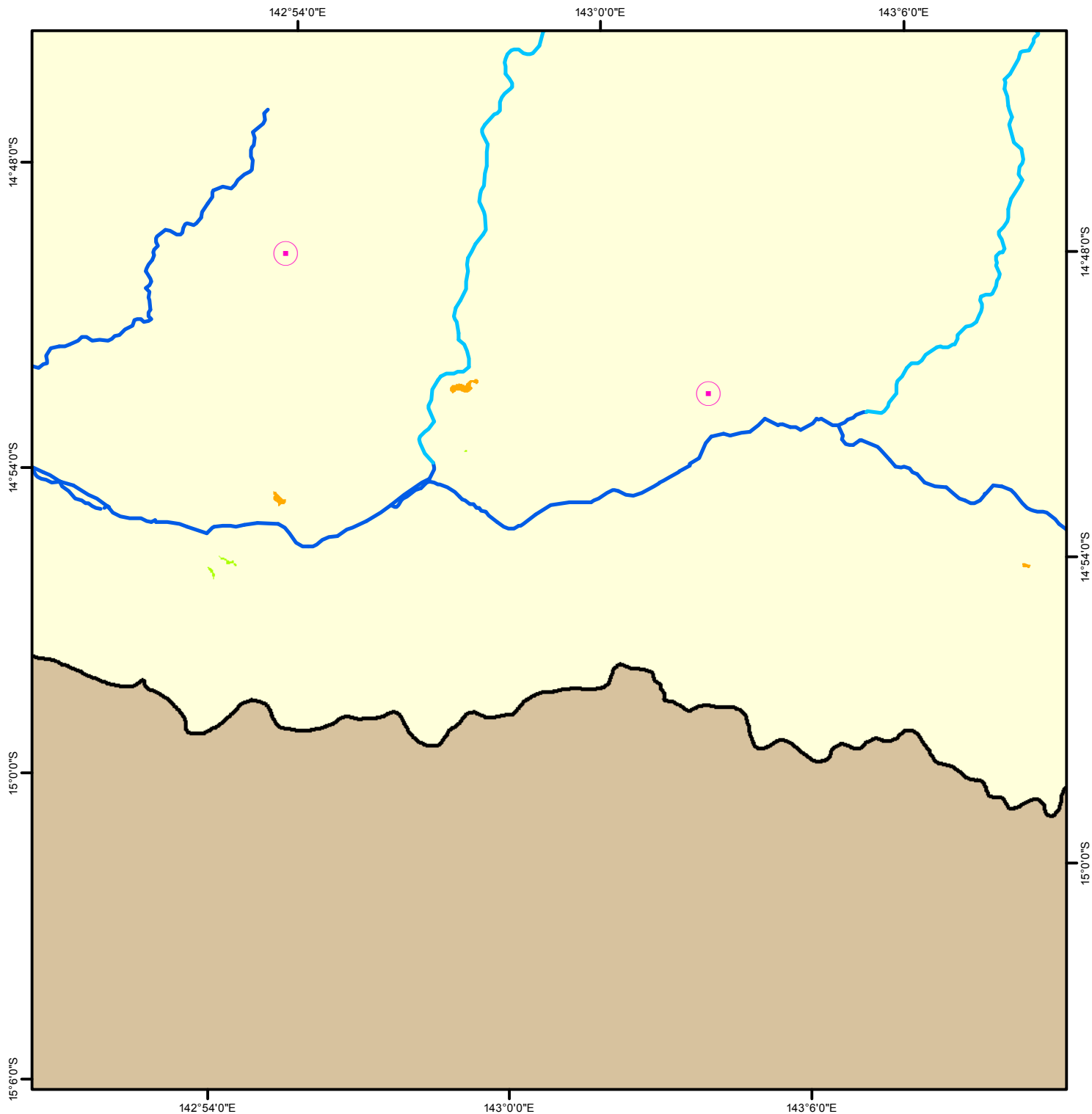
P3 Coleman Catchment



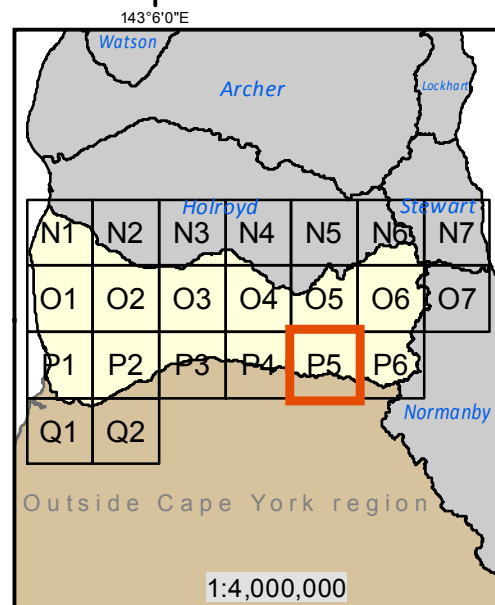
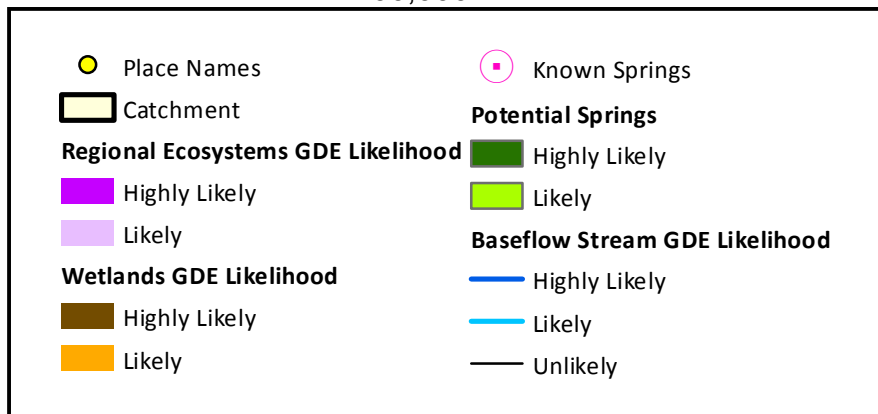
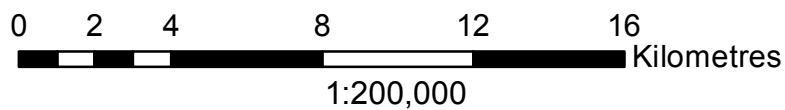


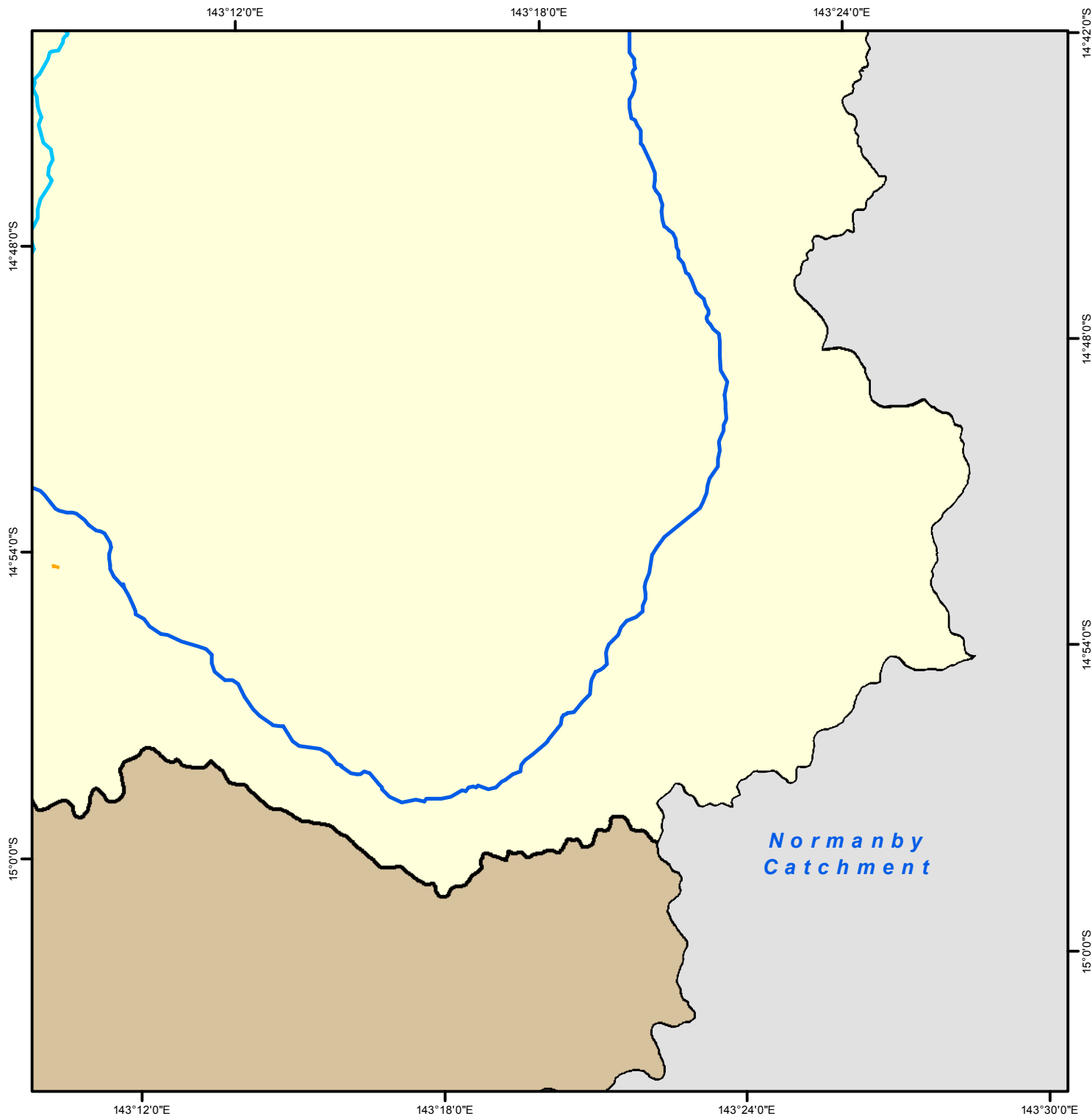
P4 Coleman Catchment



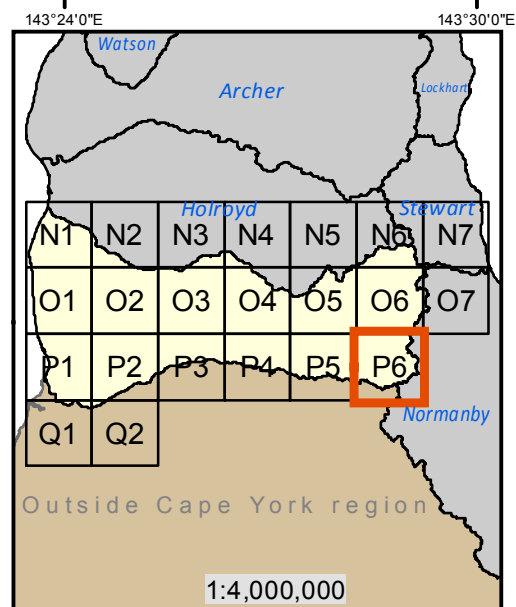
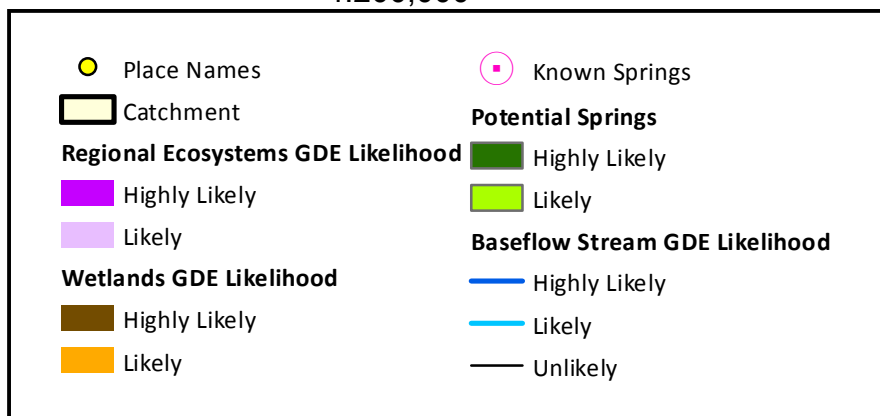
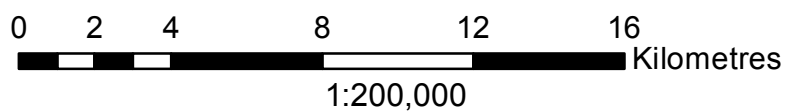


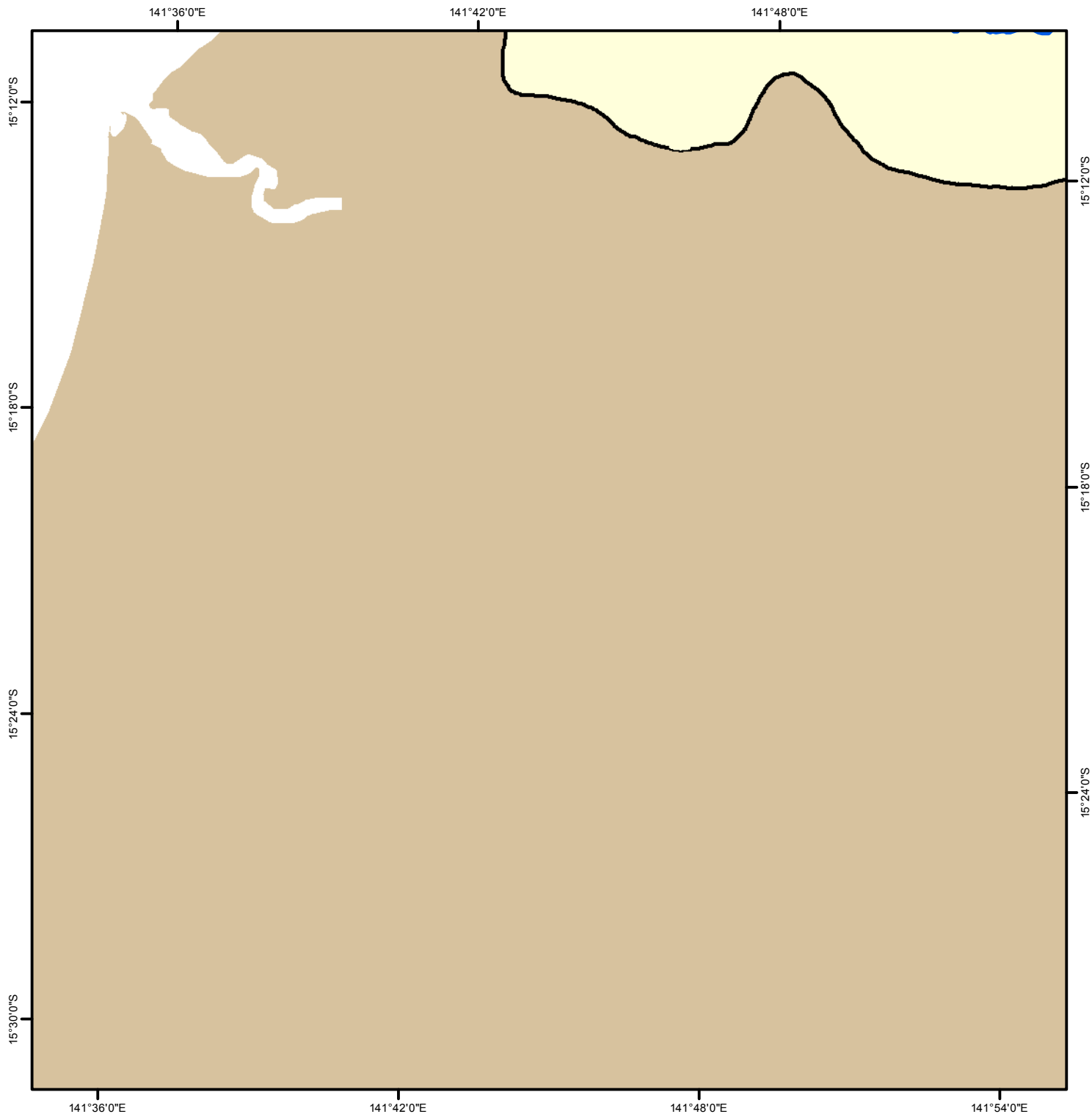
P5 Coleman Catchment



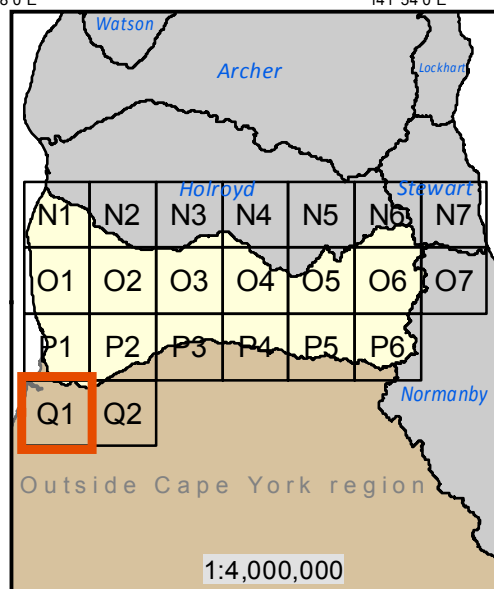
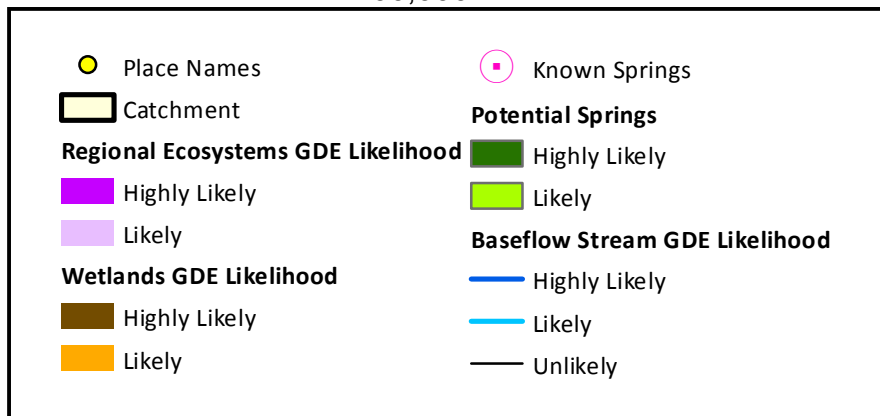
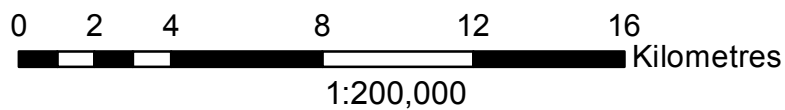


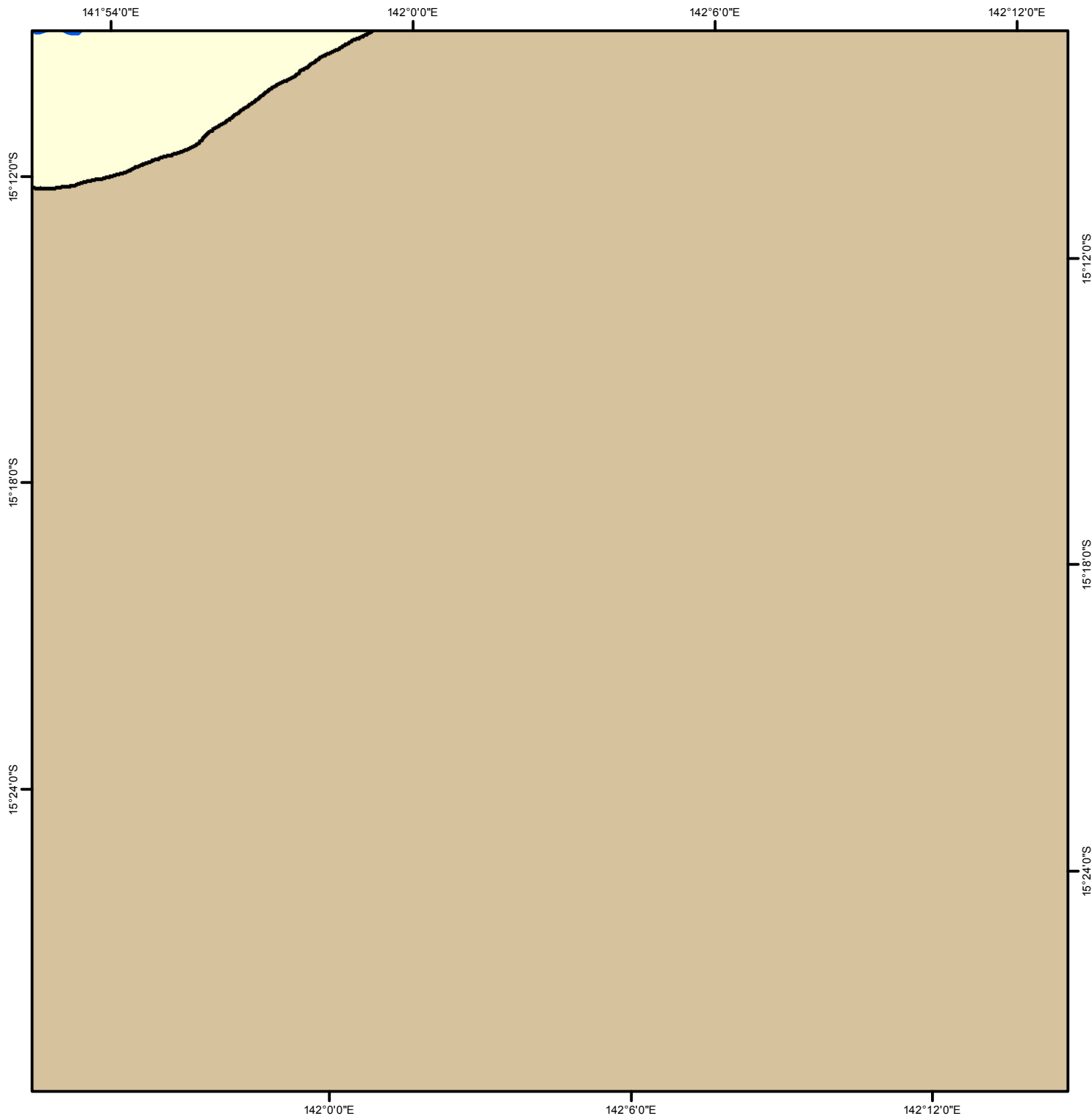
P6 Coleman Catchment



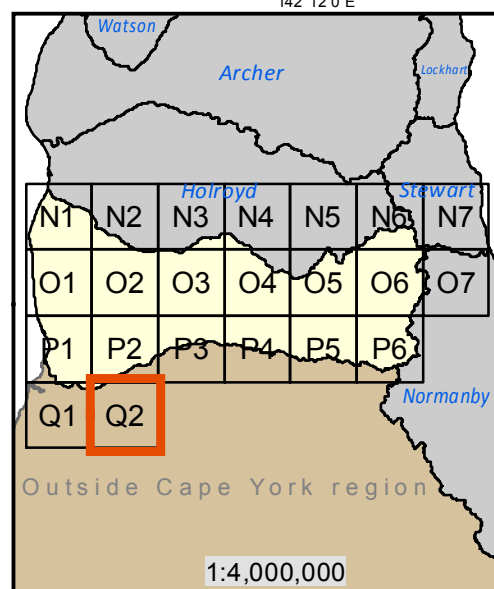
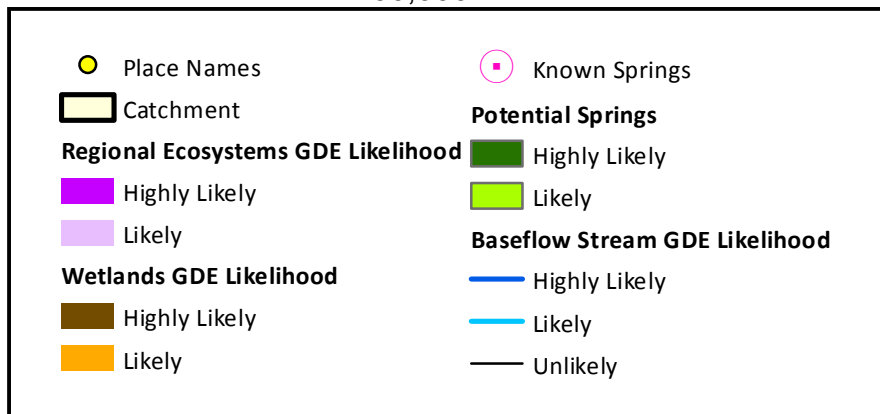
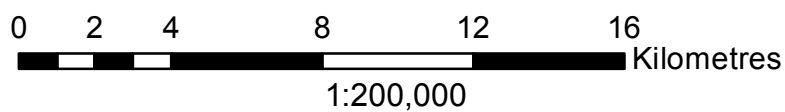


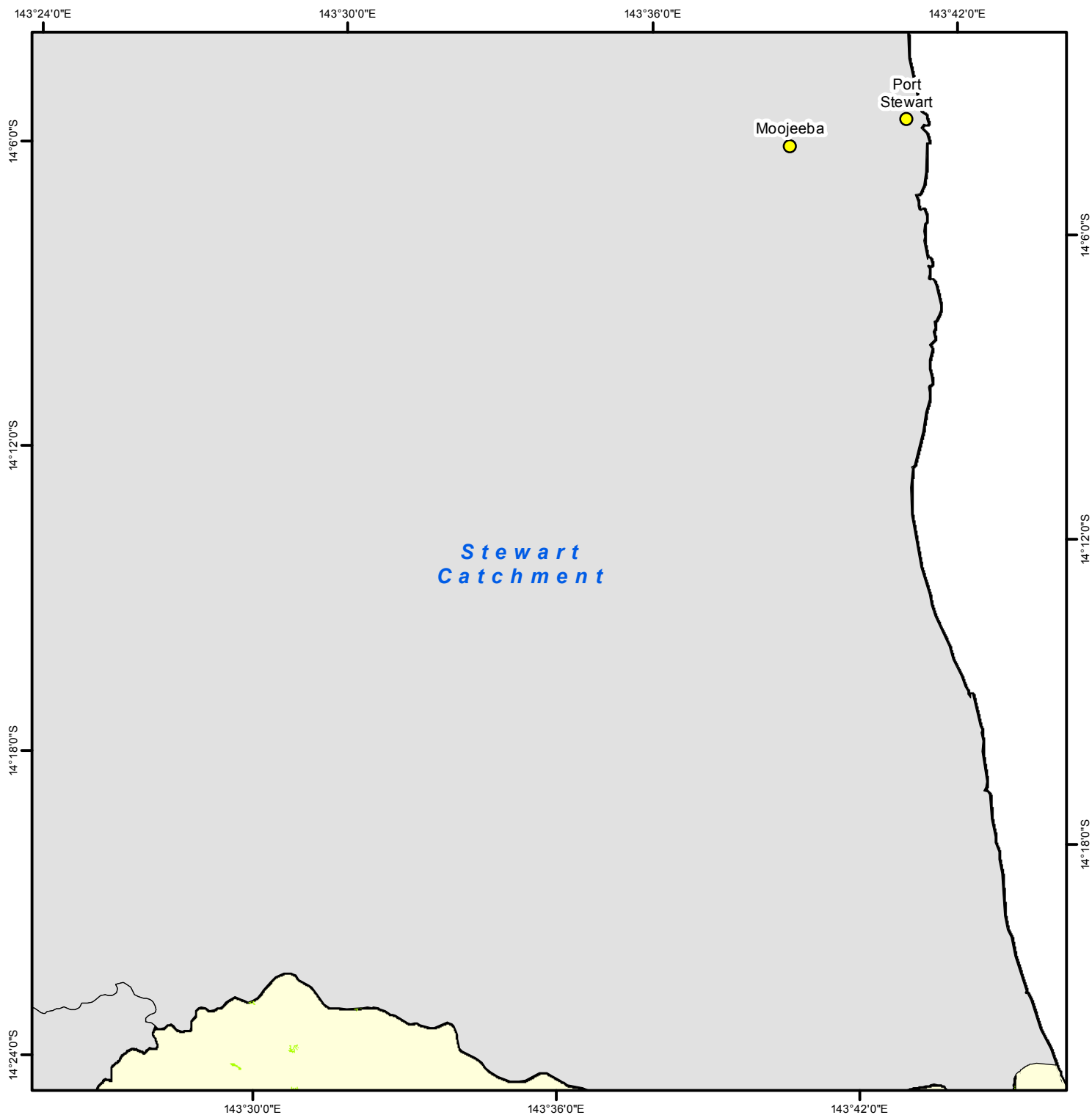
Q1 Coleman Catchment



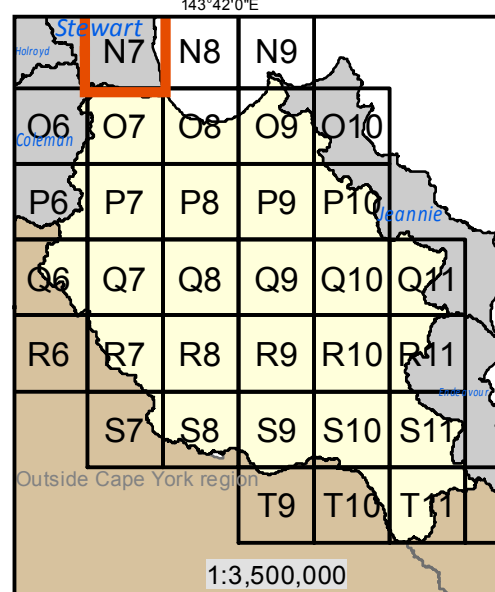
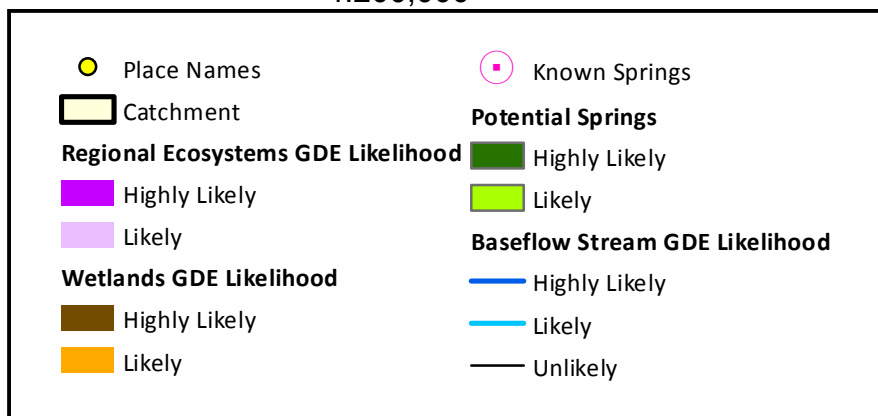
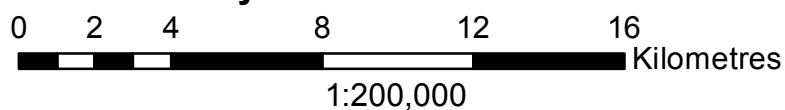


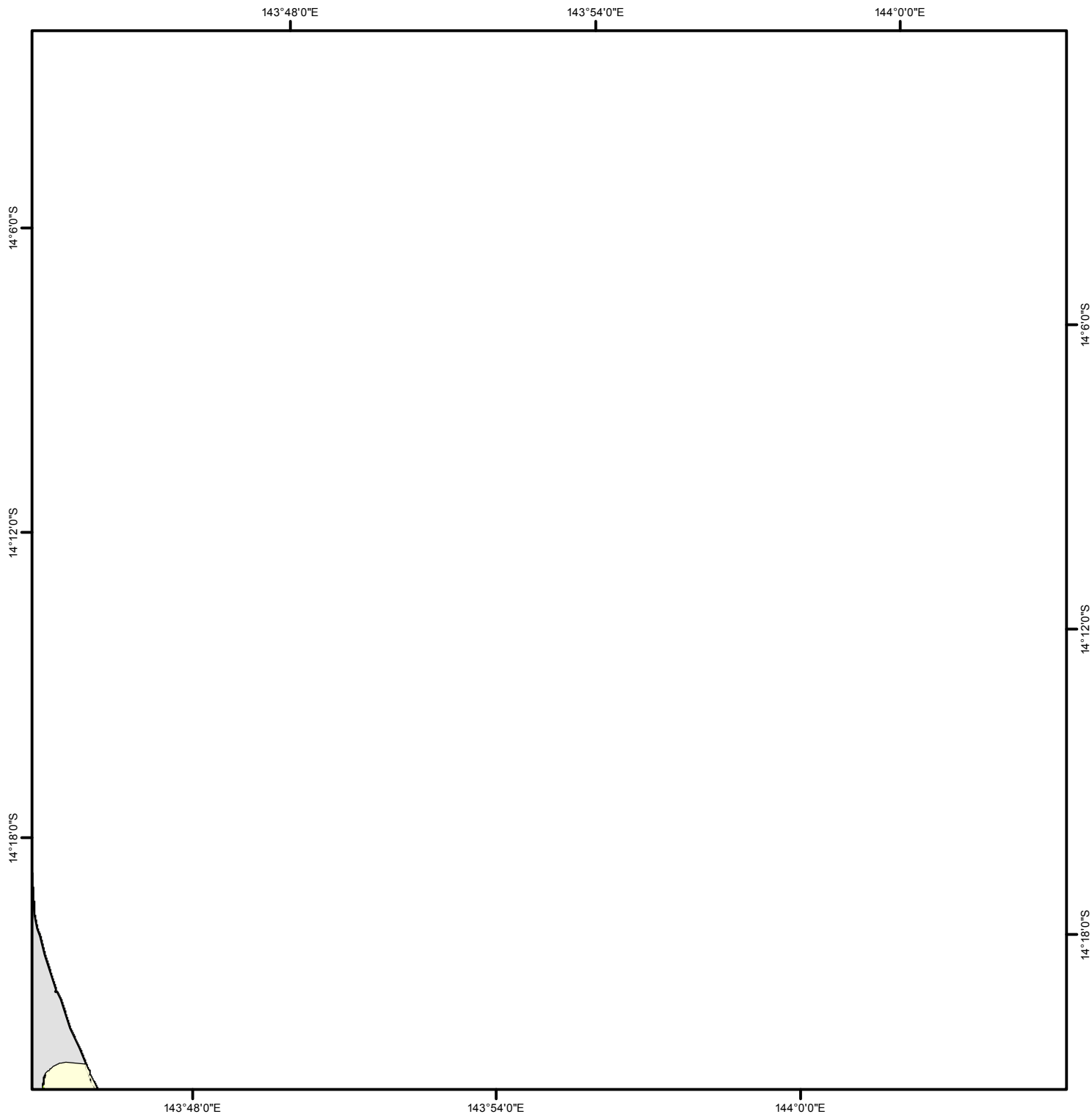
Q2 Coleman Catchment



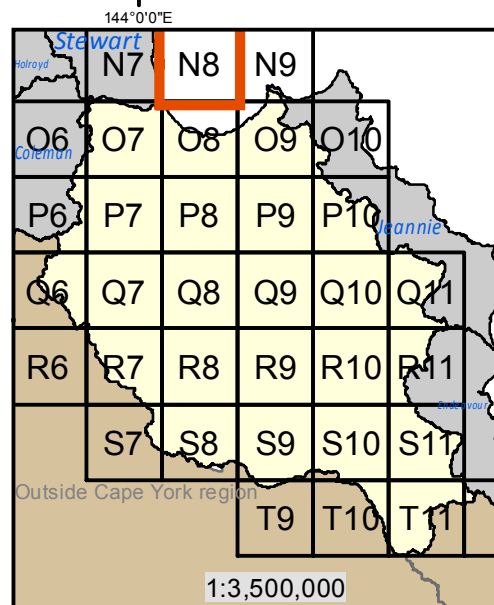
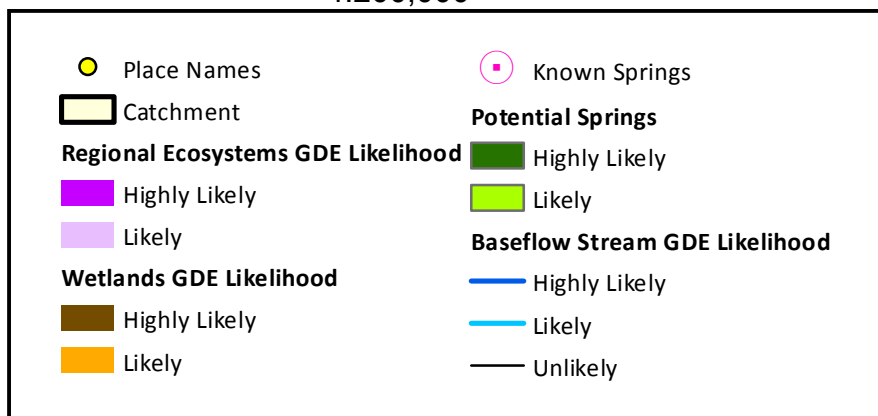
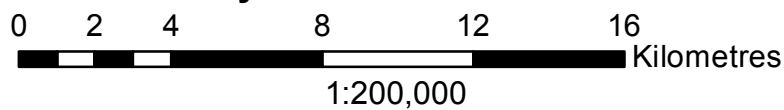


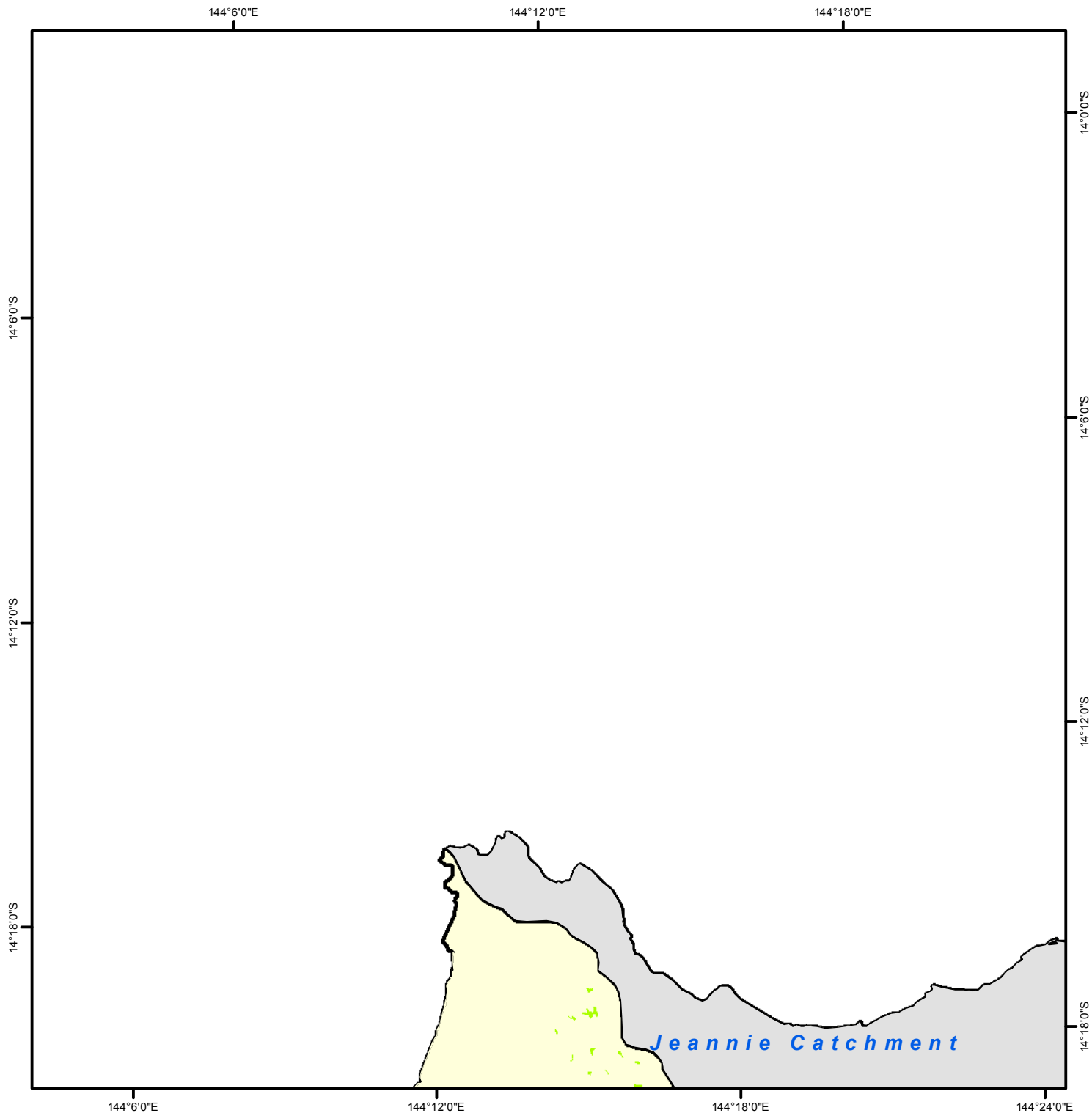
N7 Normanby Catchment



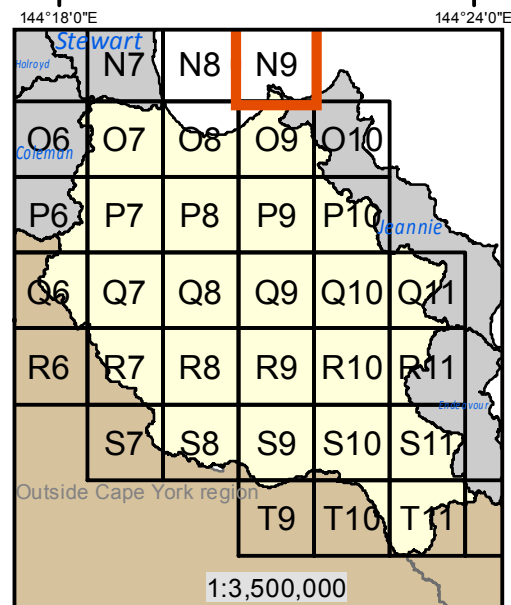
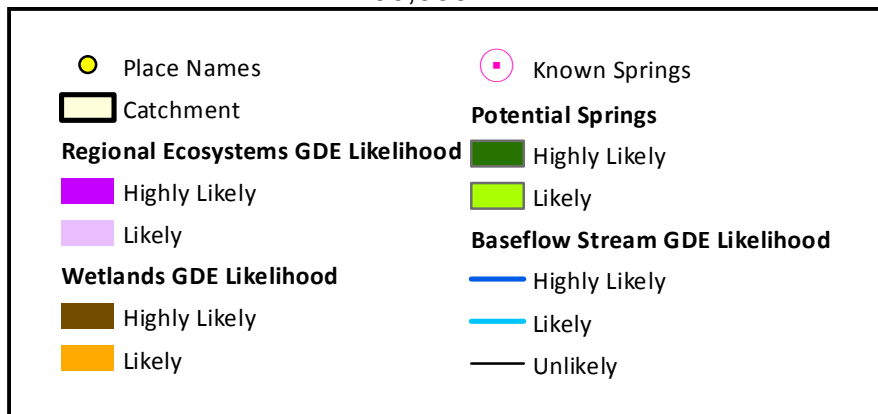
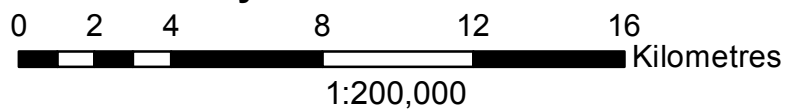


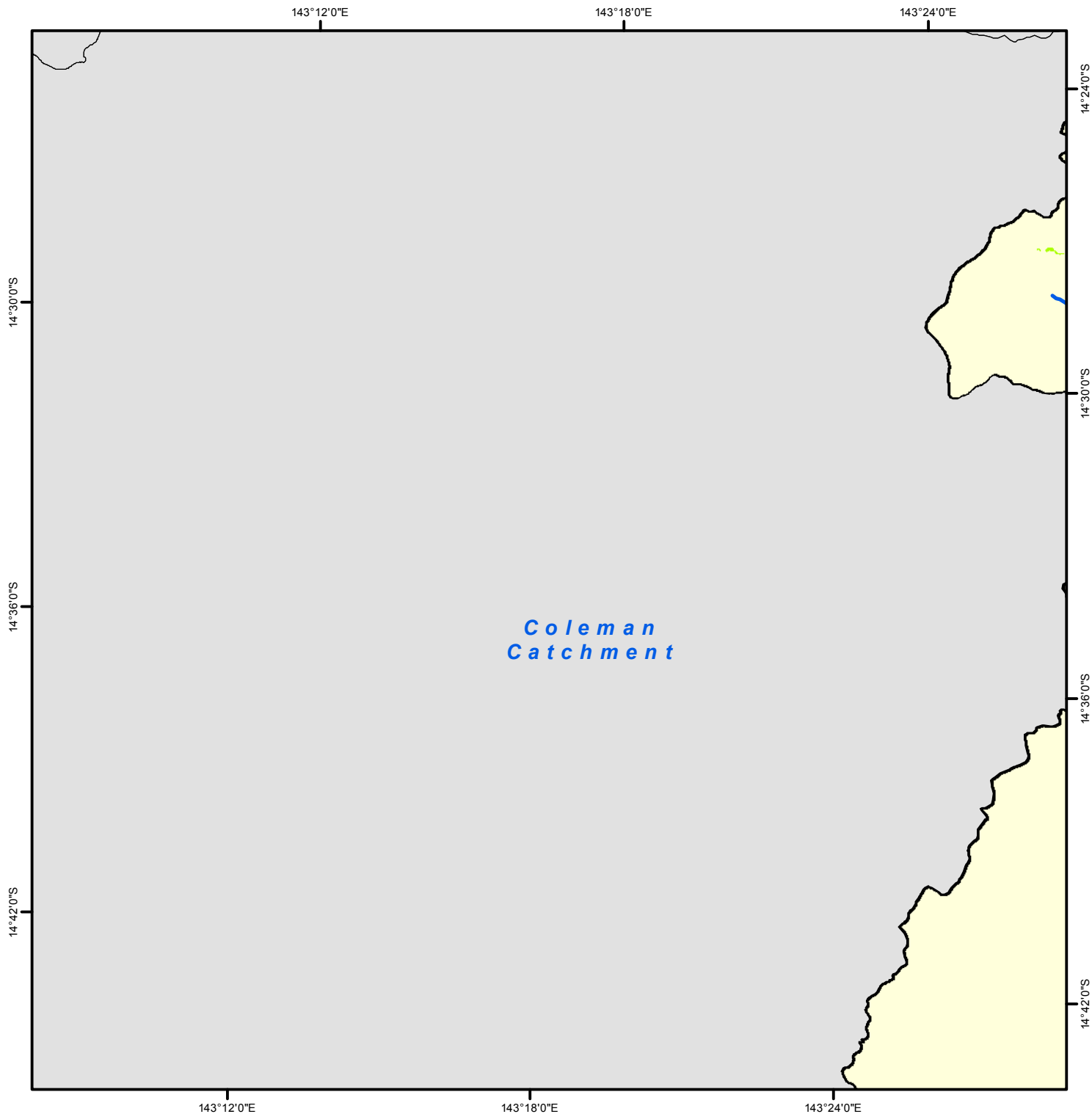
N8 Normanby Catchment



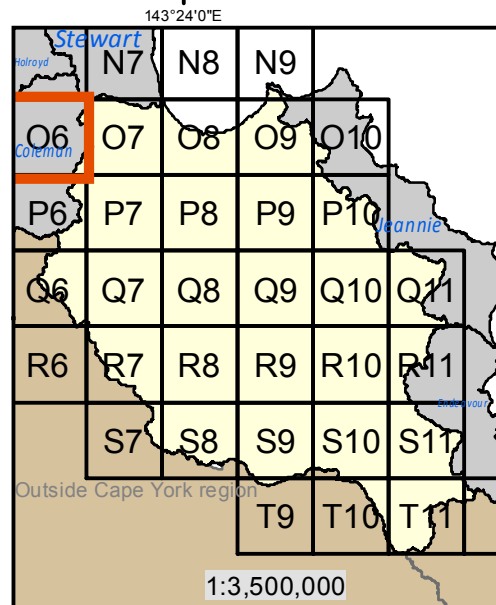
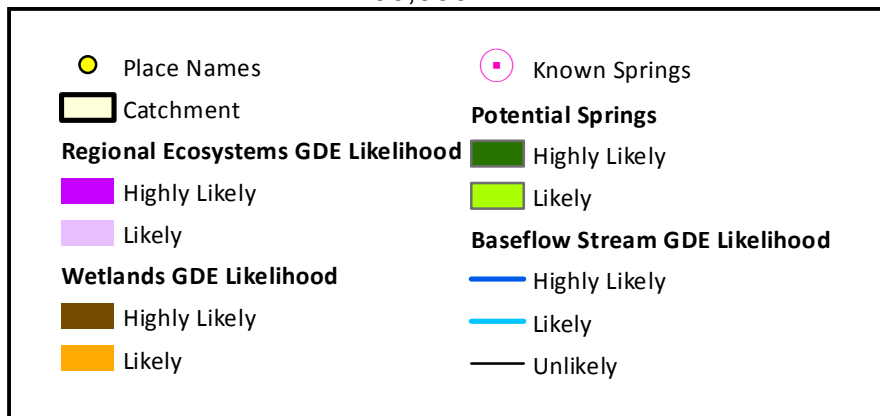
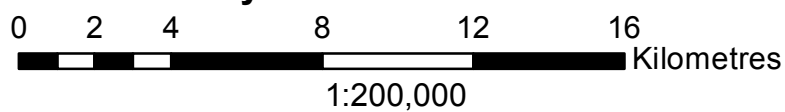


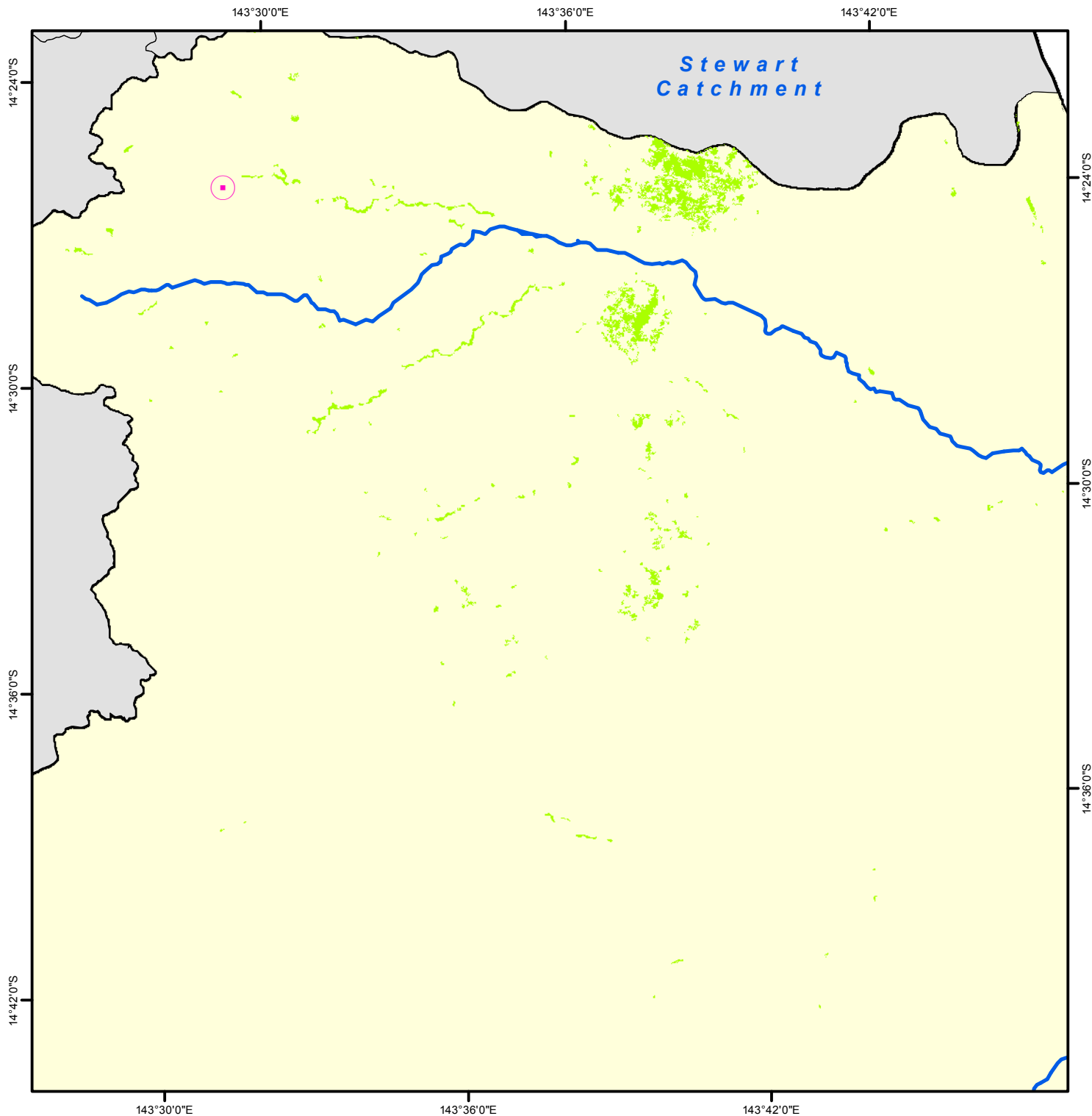
N9 Normanby Catchment



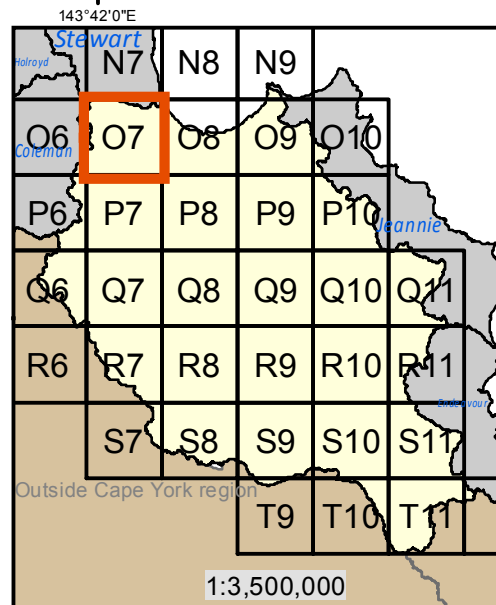
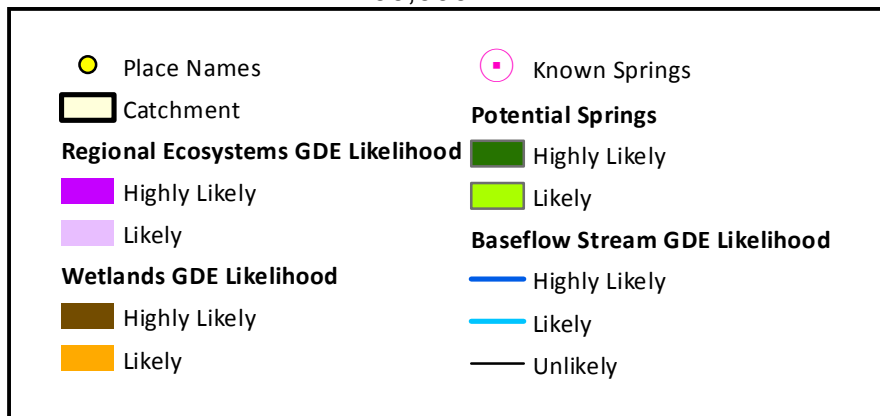
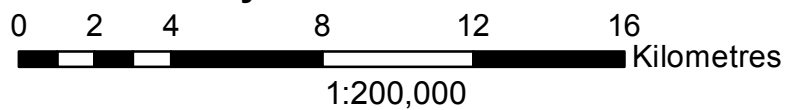


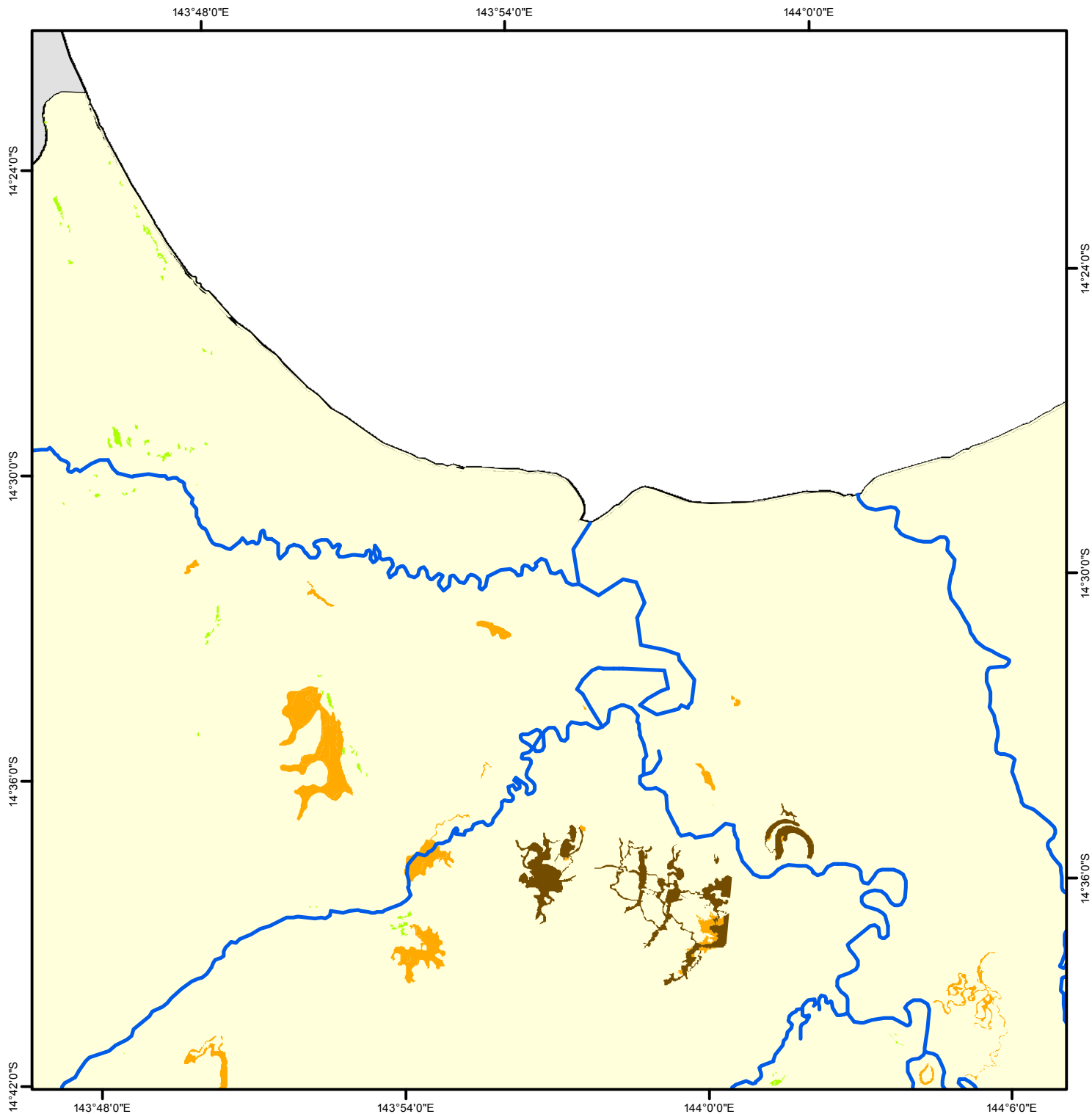
O6 Normanby Catchment



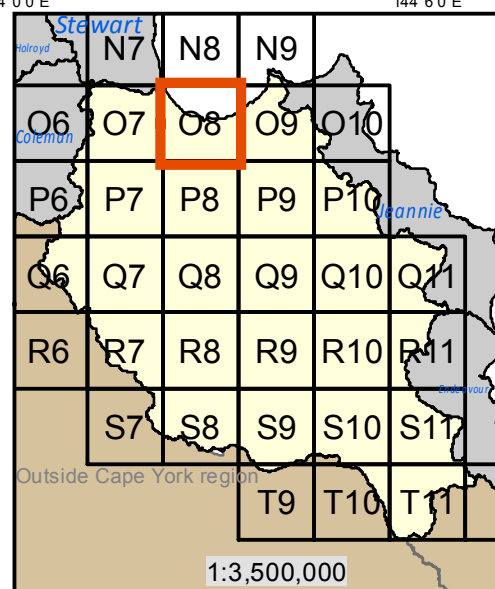
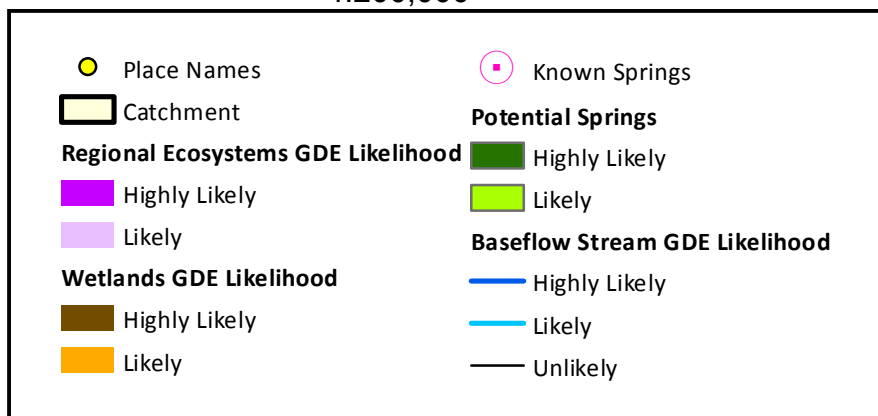
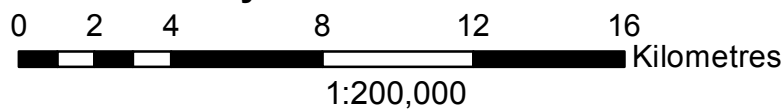


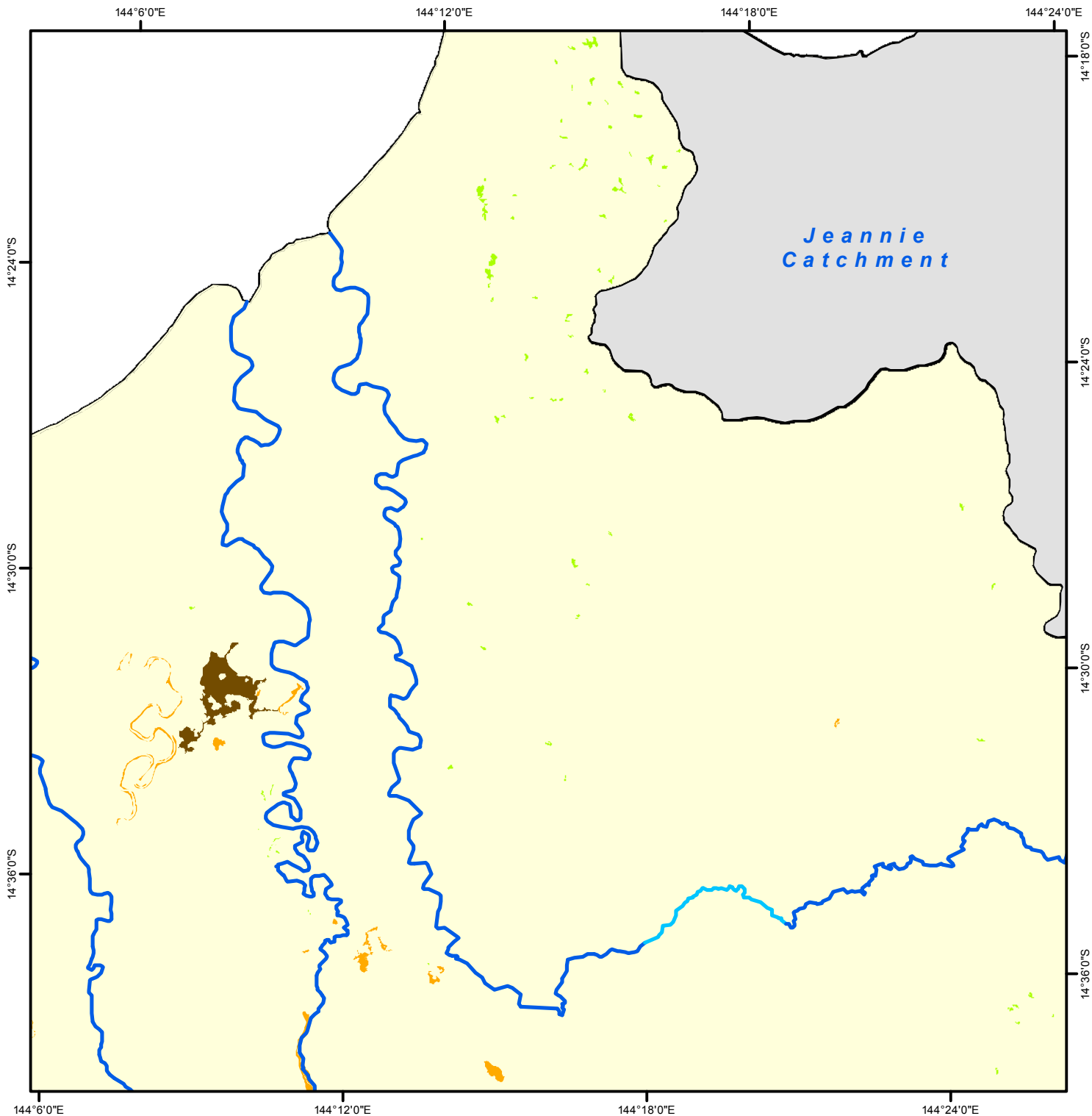
O7 Normanby Catchment



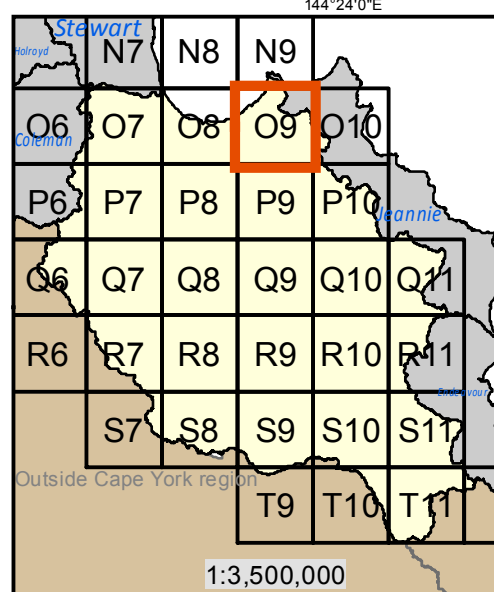
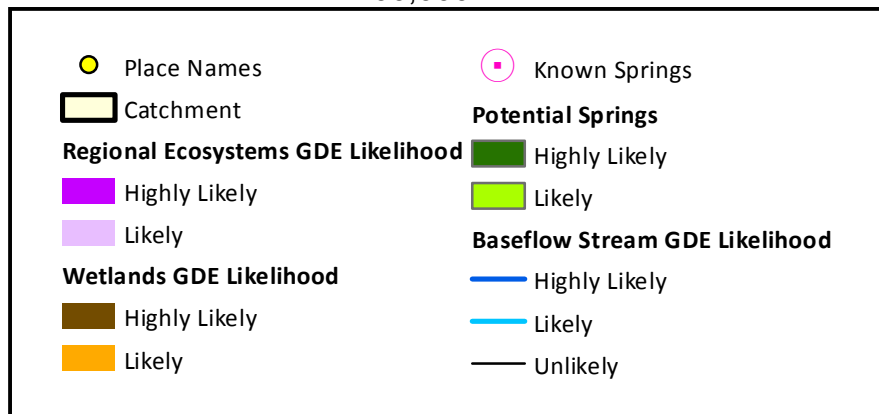
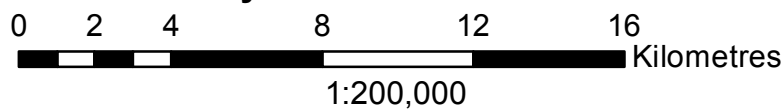


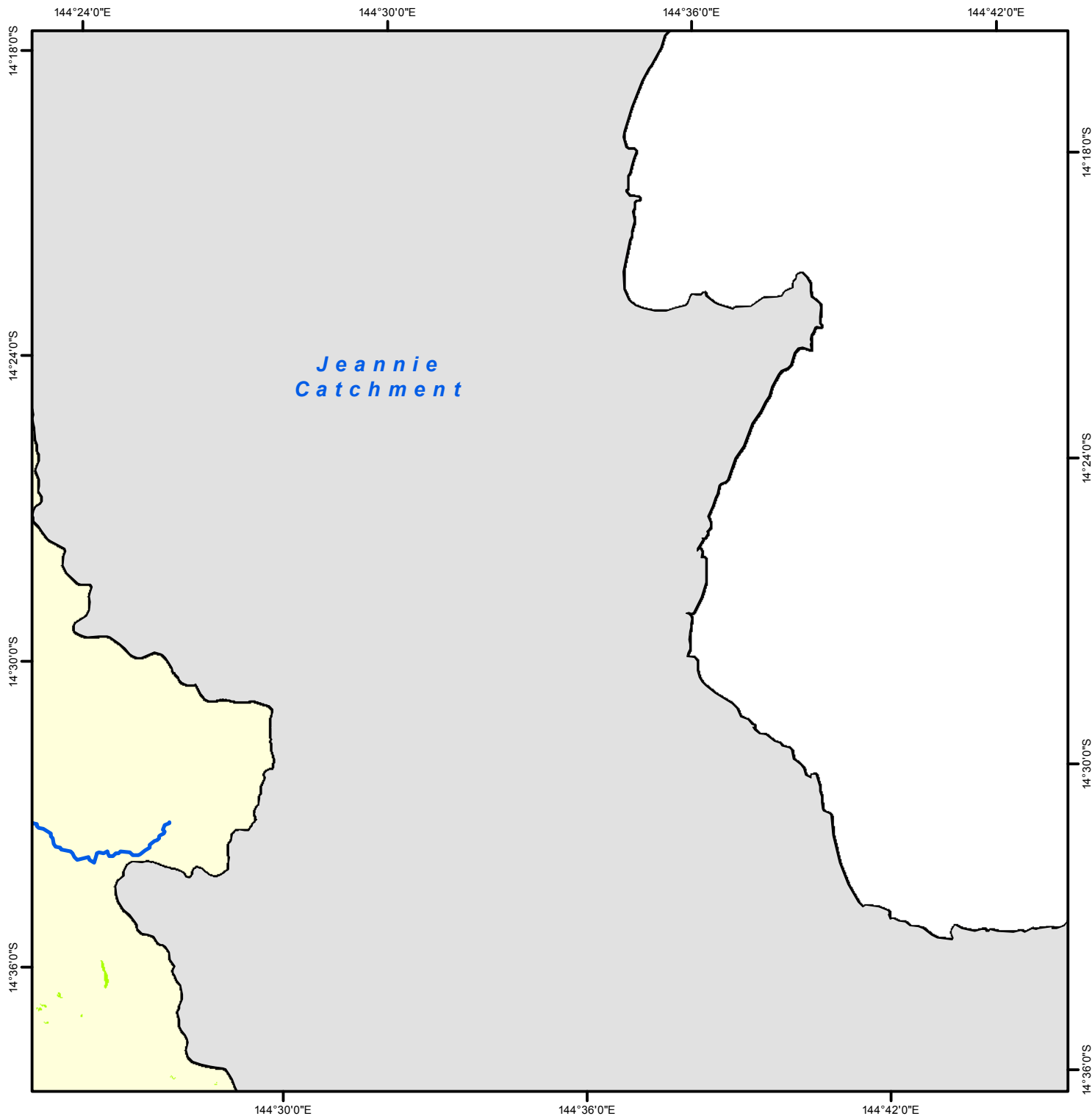
O8 Normanby Catchment



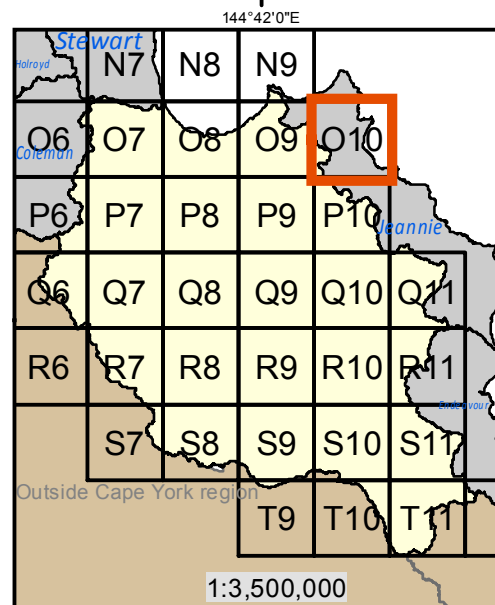
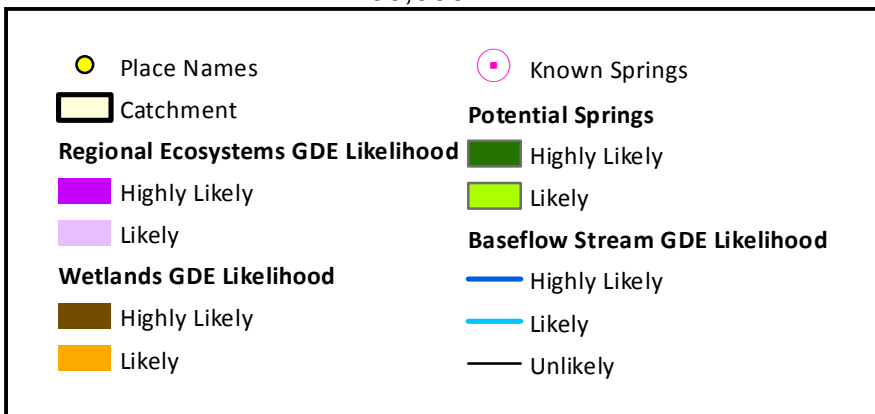
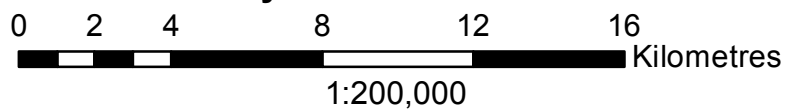


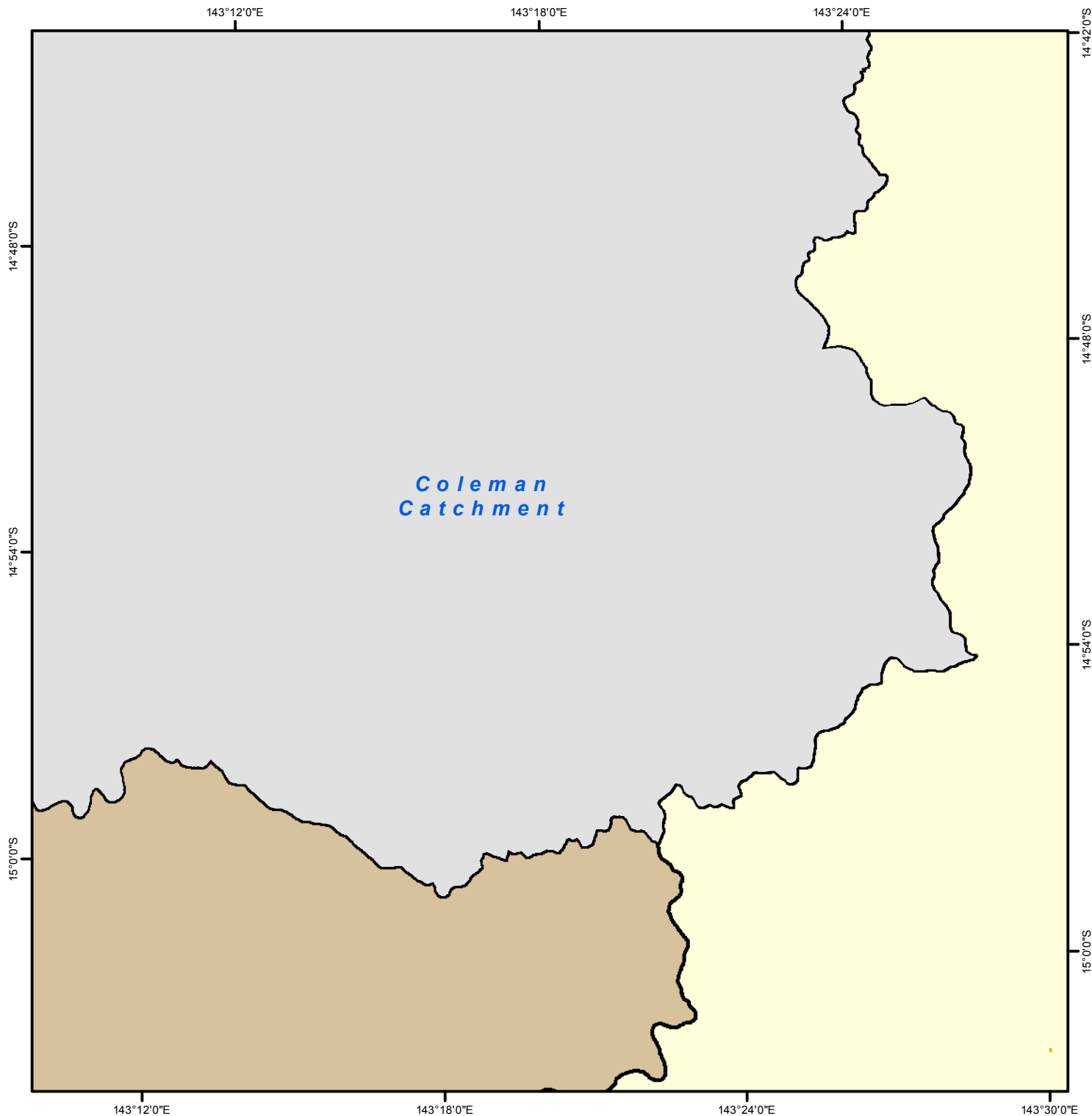
O9 Normanby Catchment



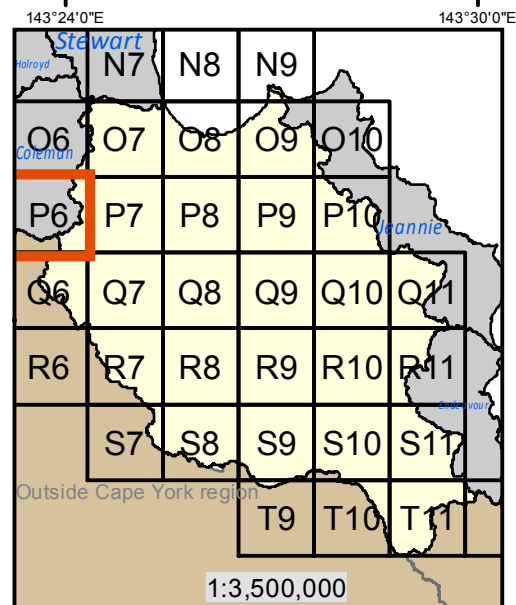
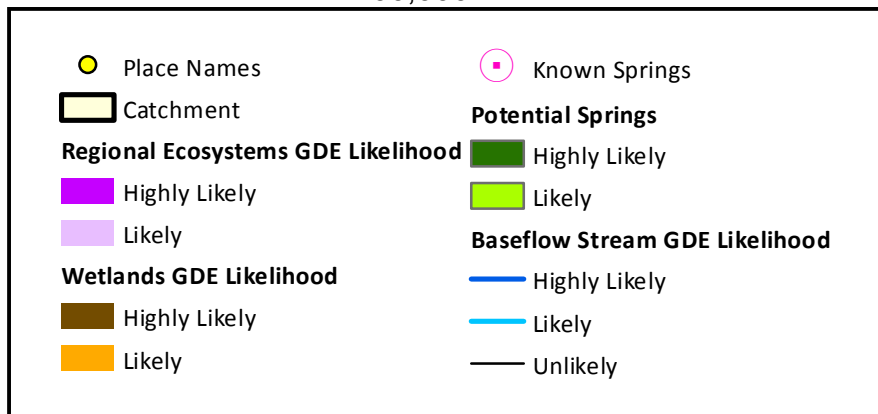
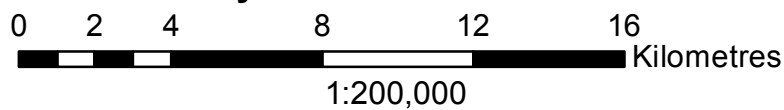


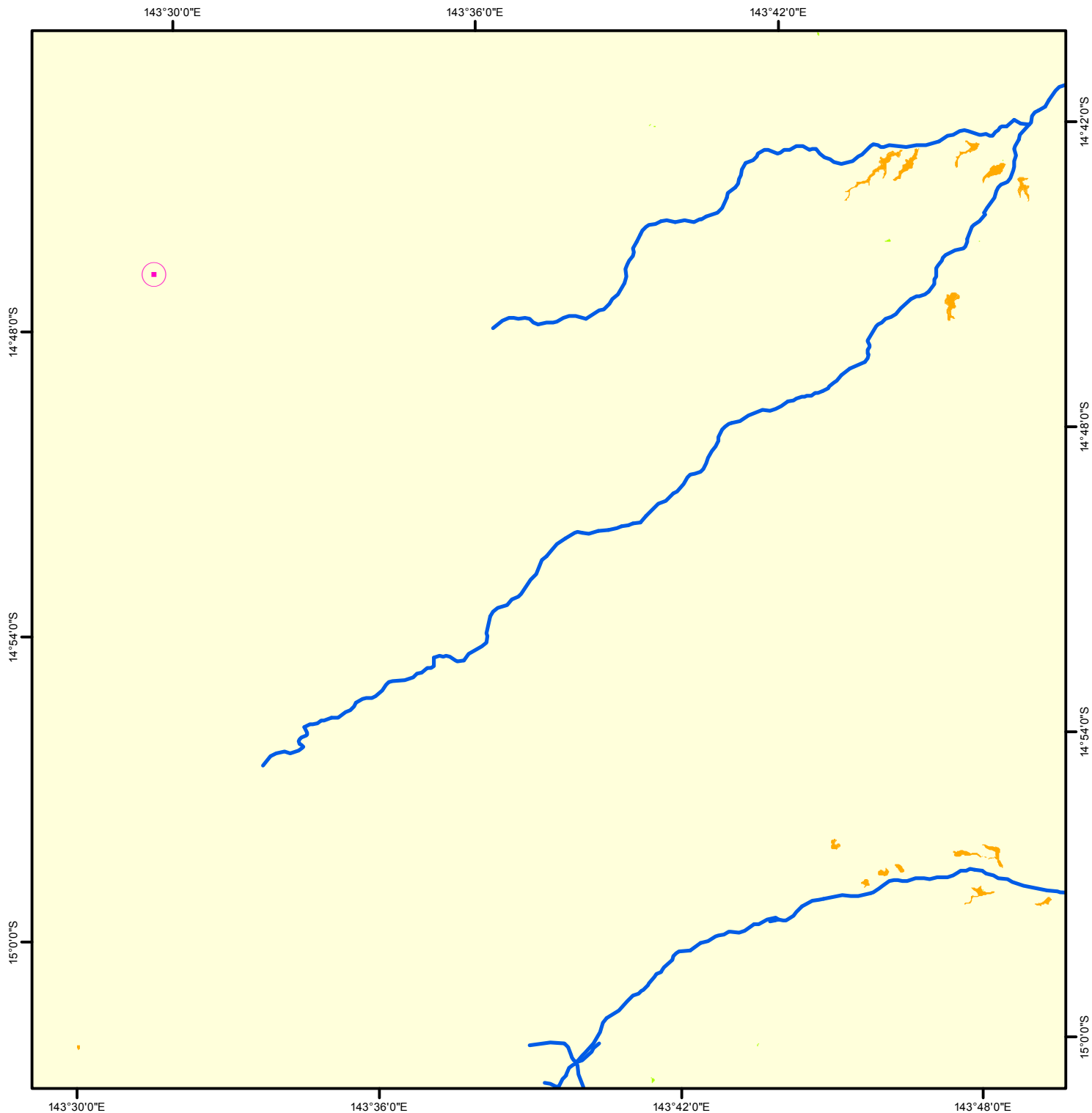
O10 Normanby Catchment



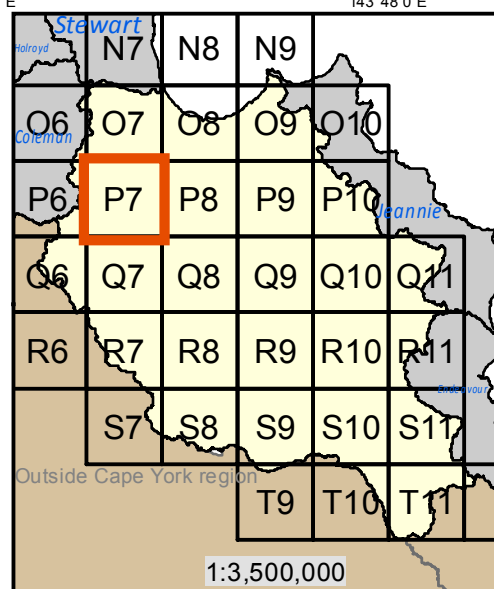
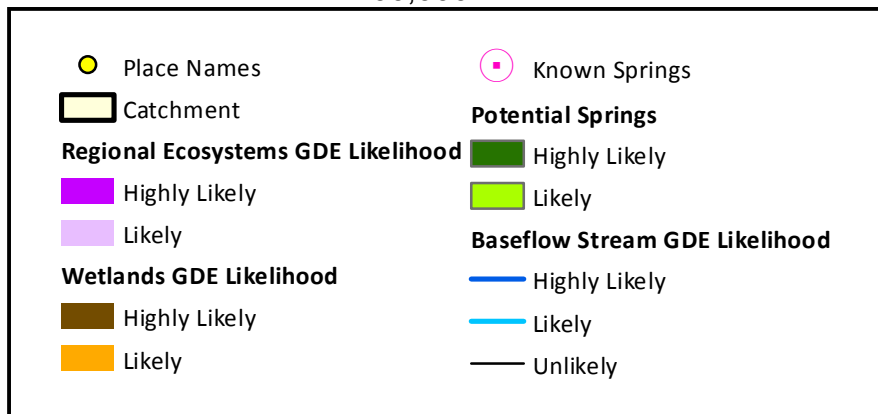
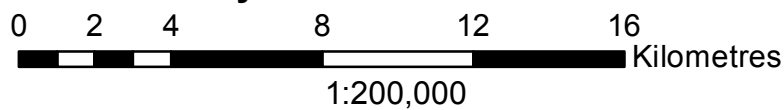


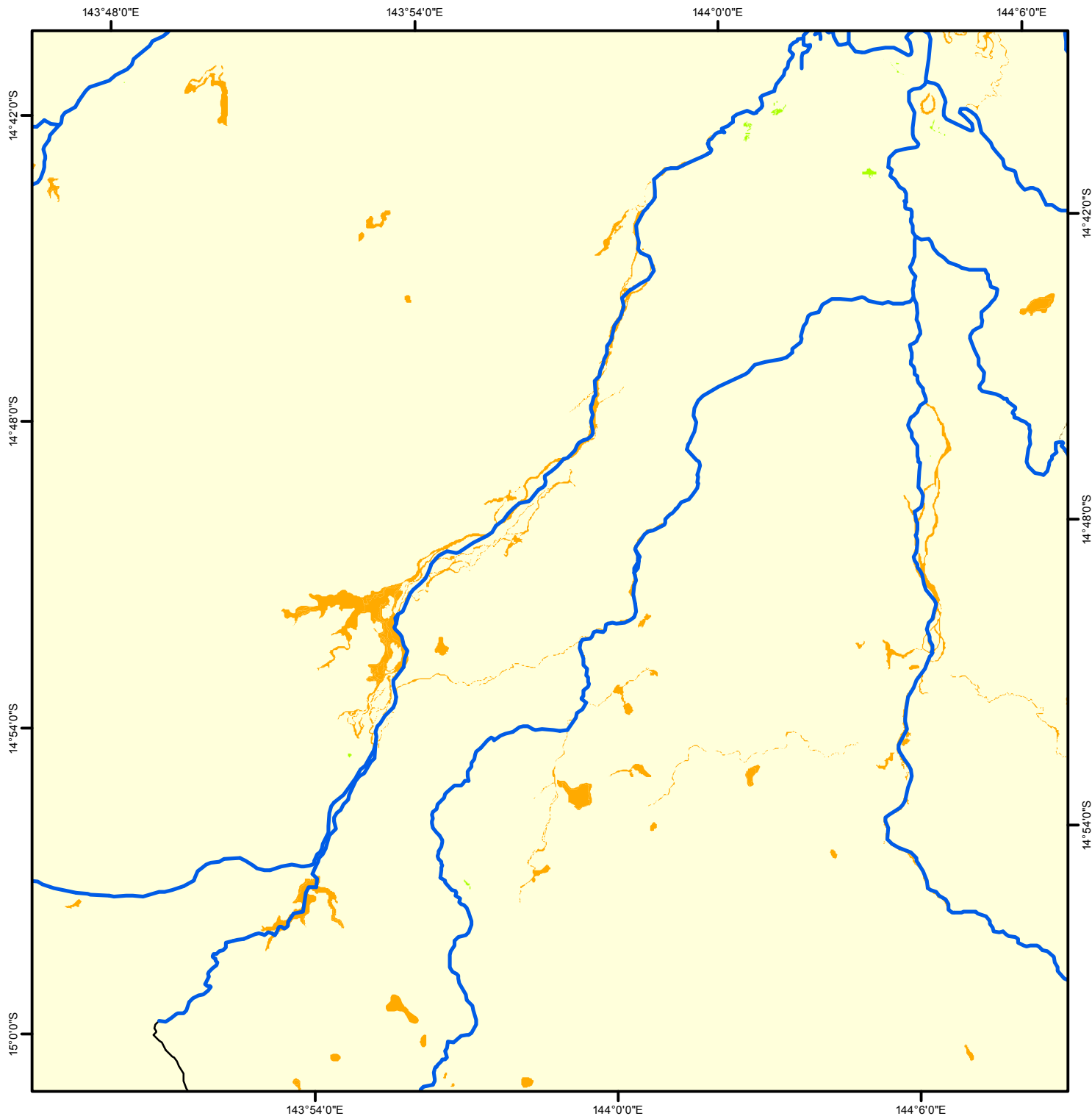
P6 Normanby Catchment



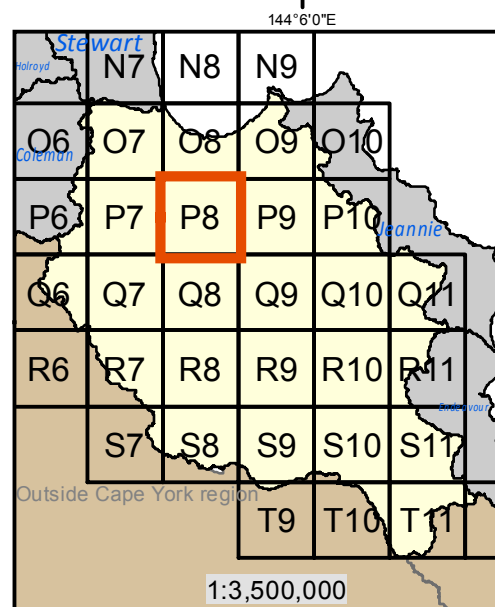
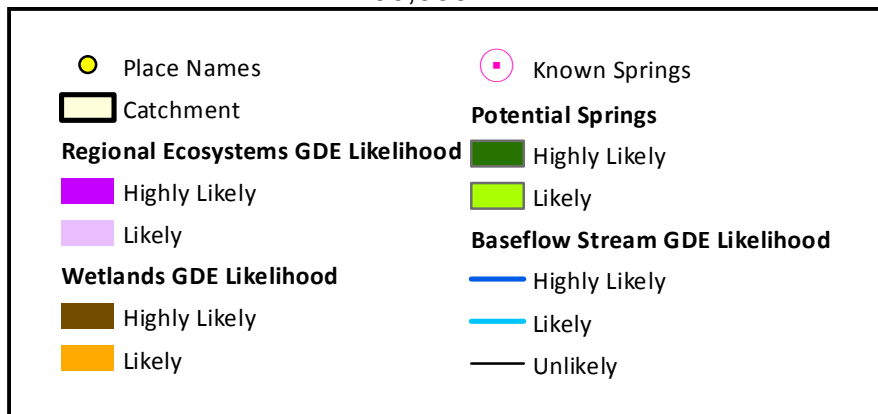
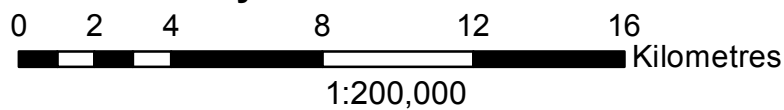


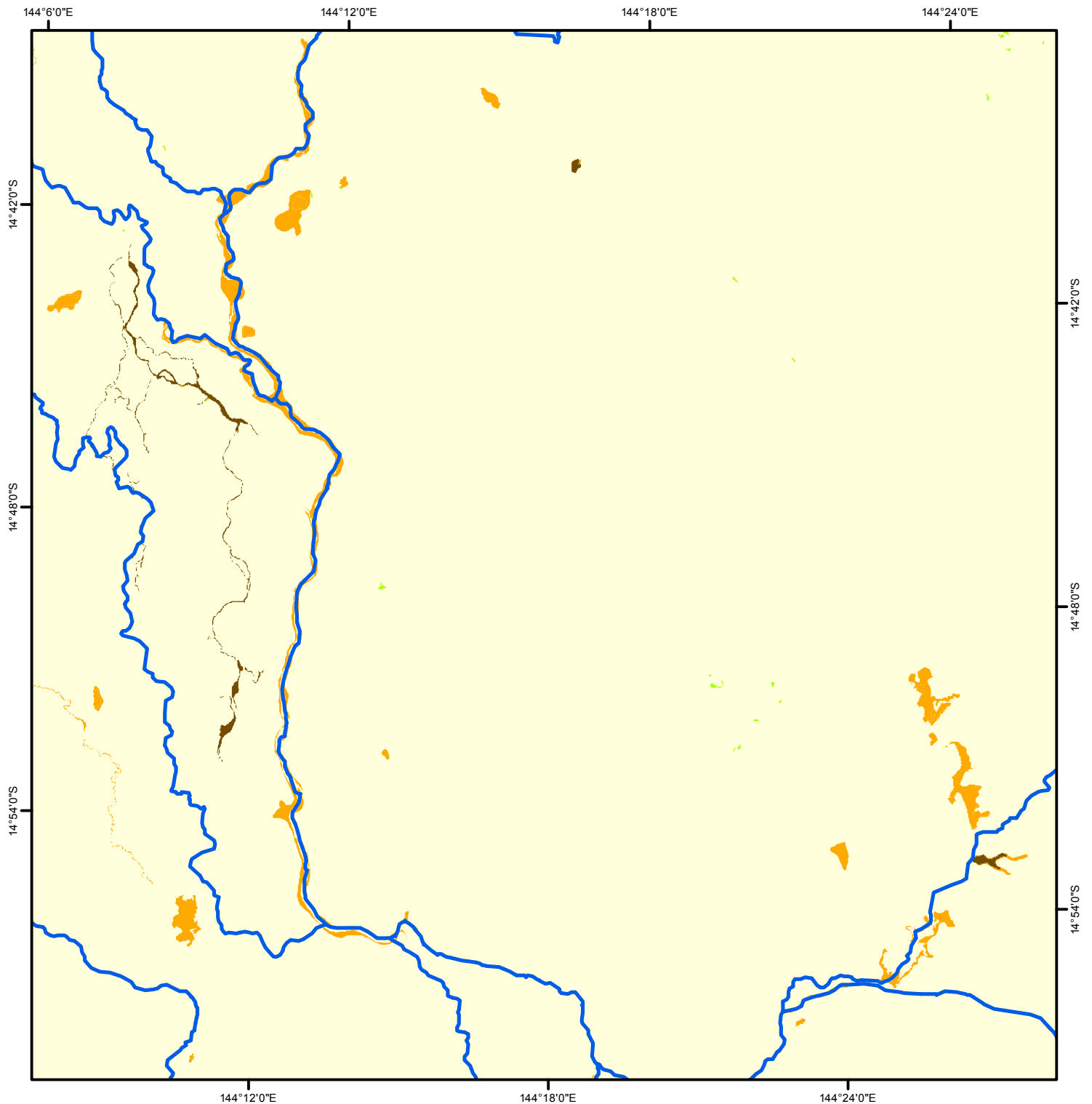
P7 Normanby Catchment



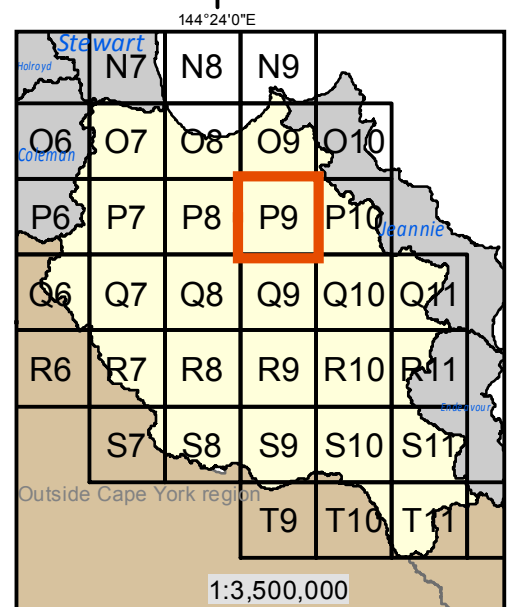
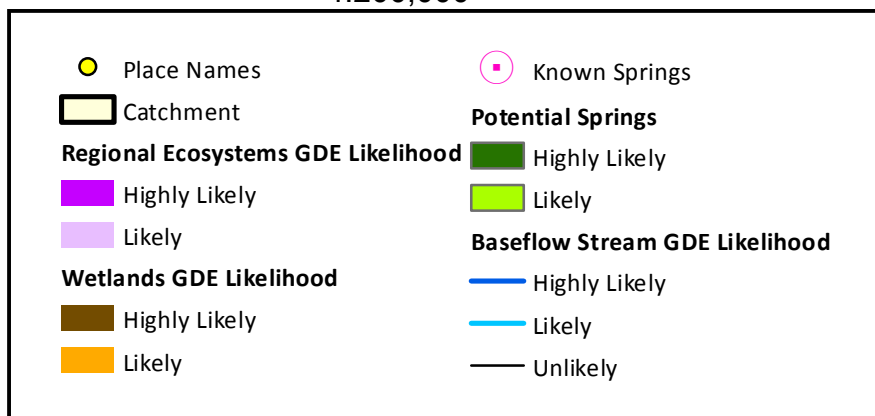
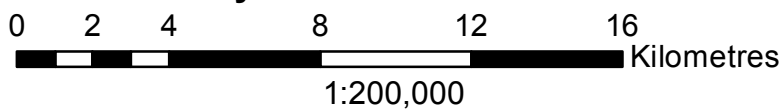


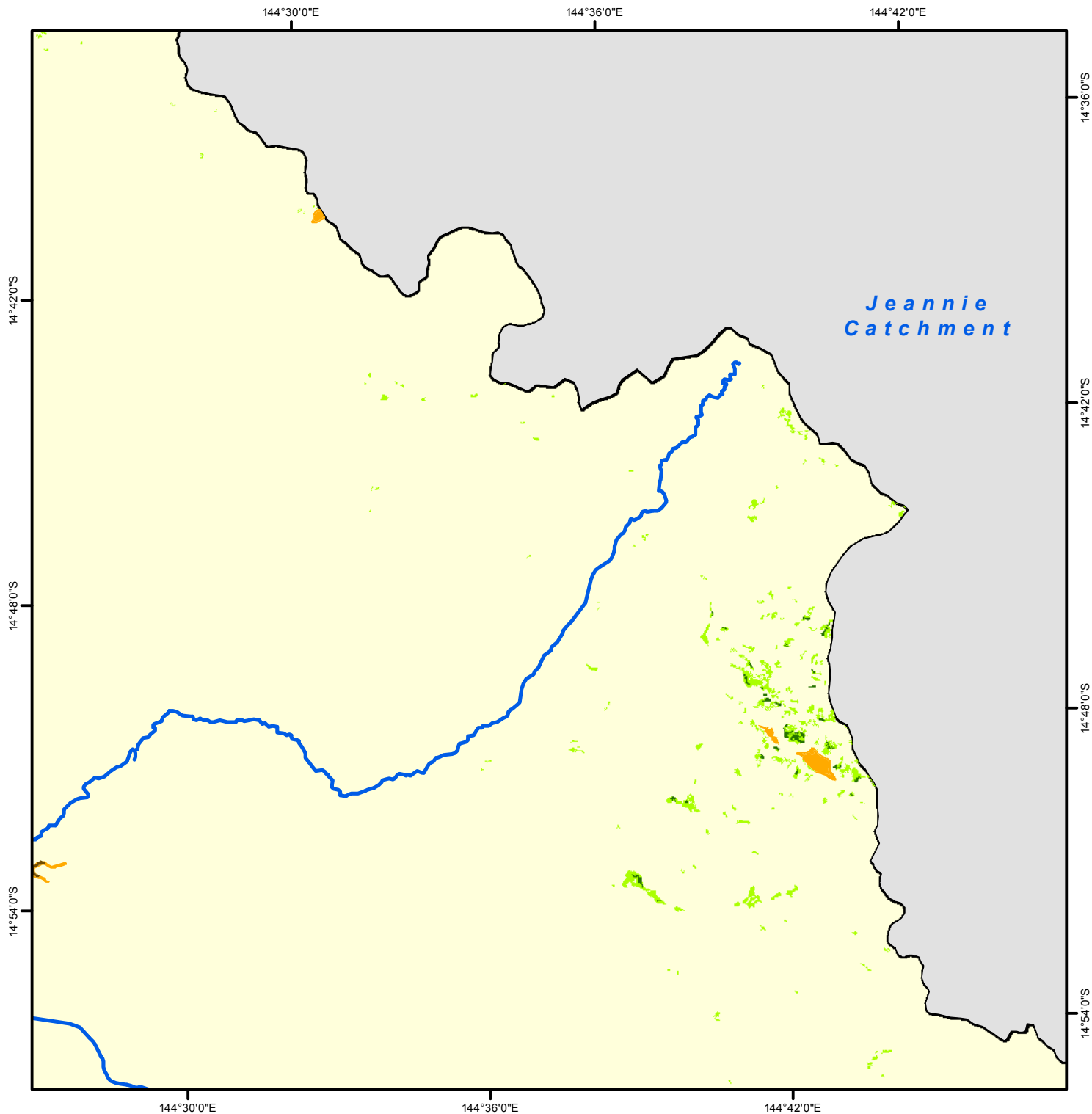
P8 Normanby Catchment



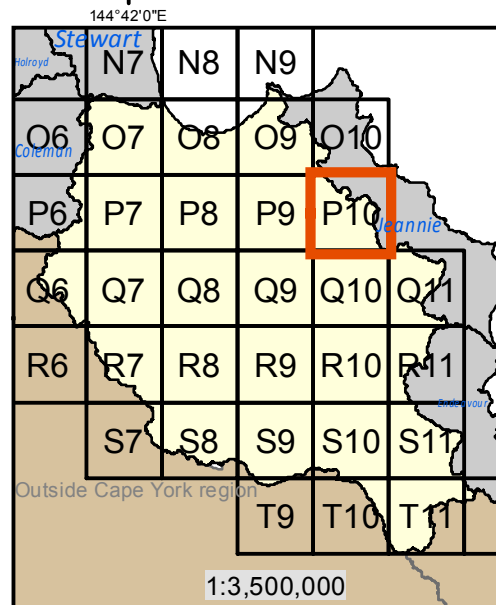
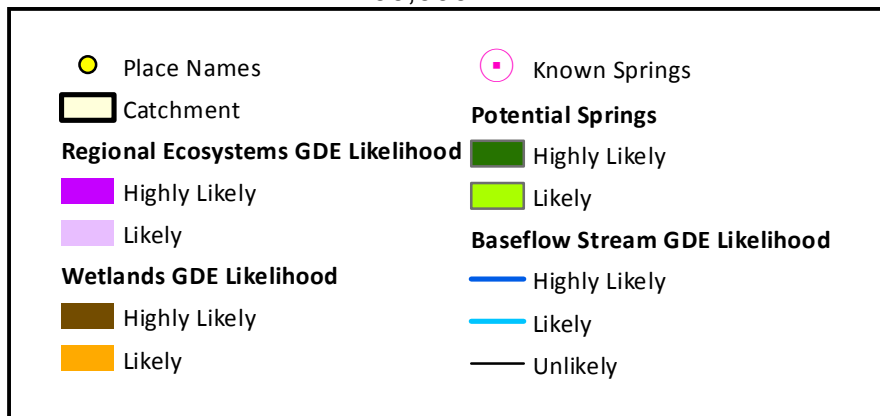
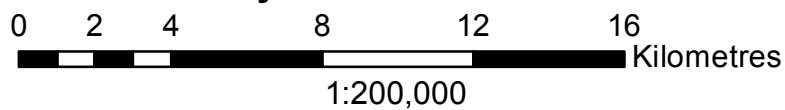


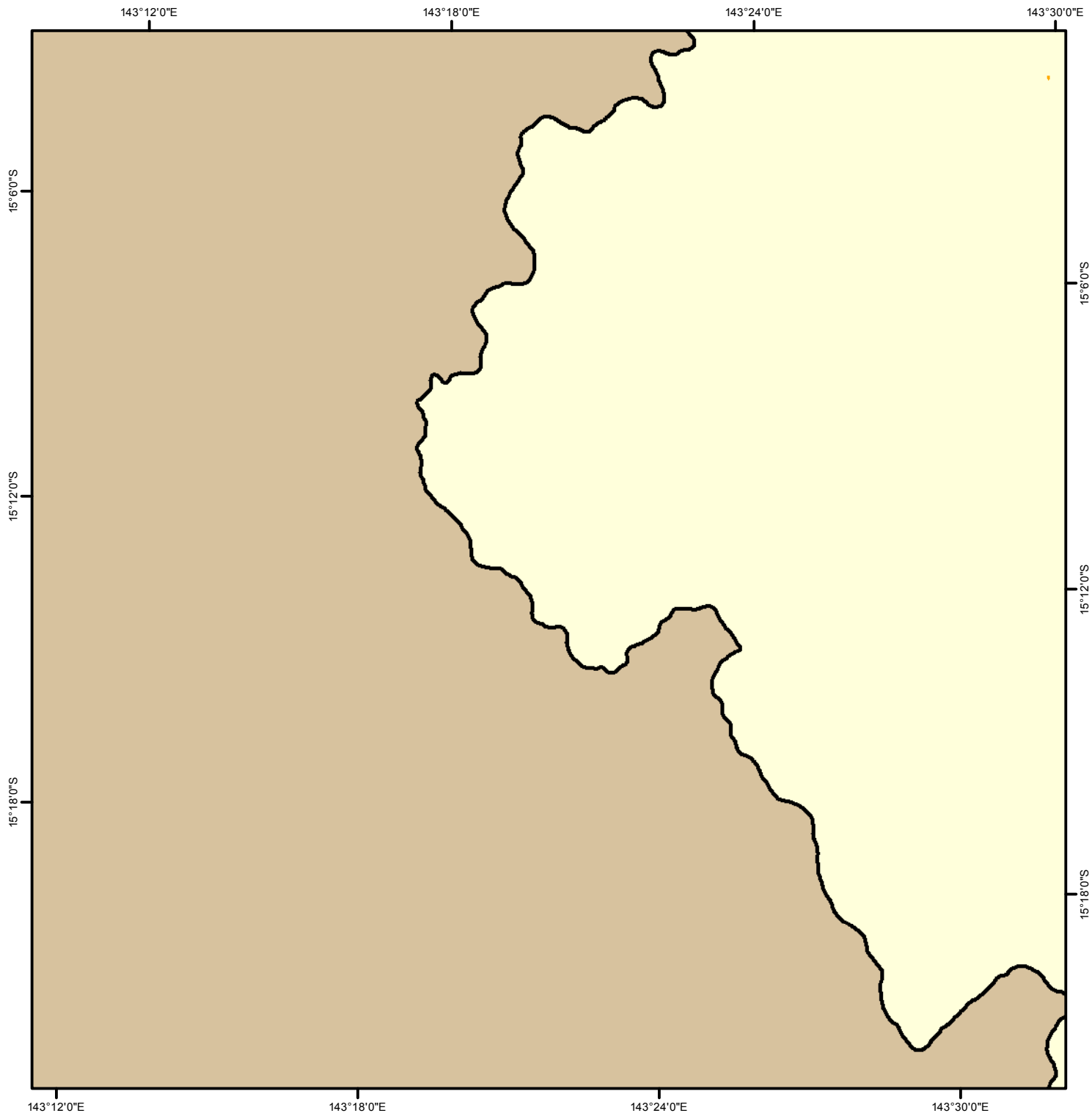
P9 Normanby Catchment



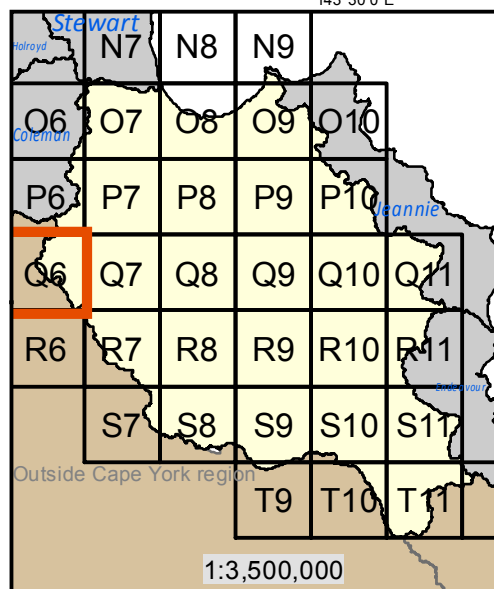
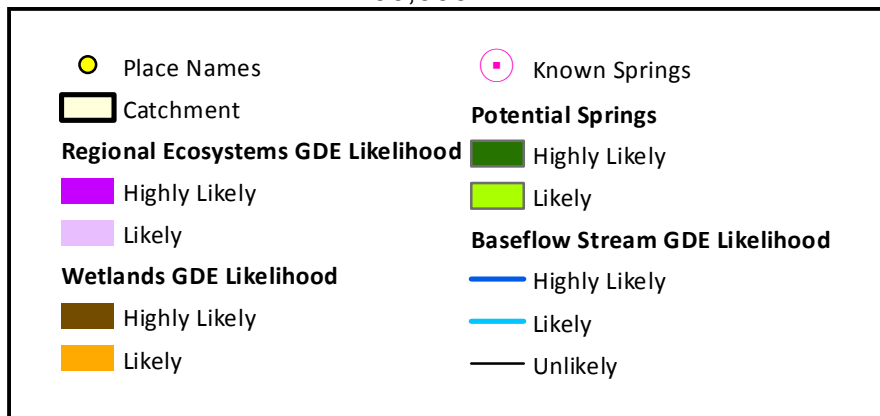
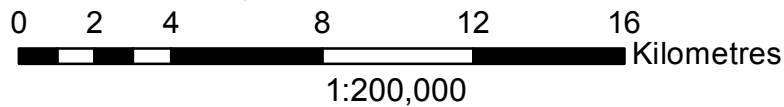


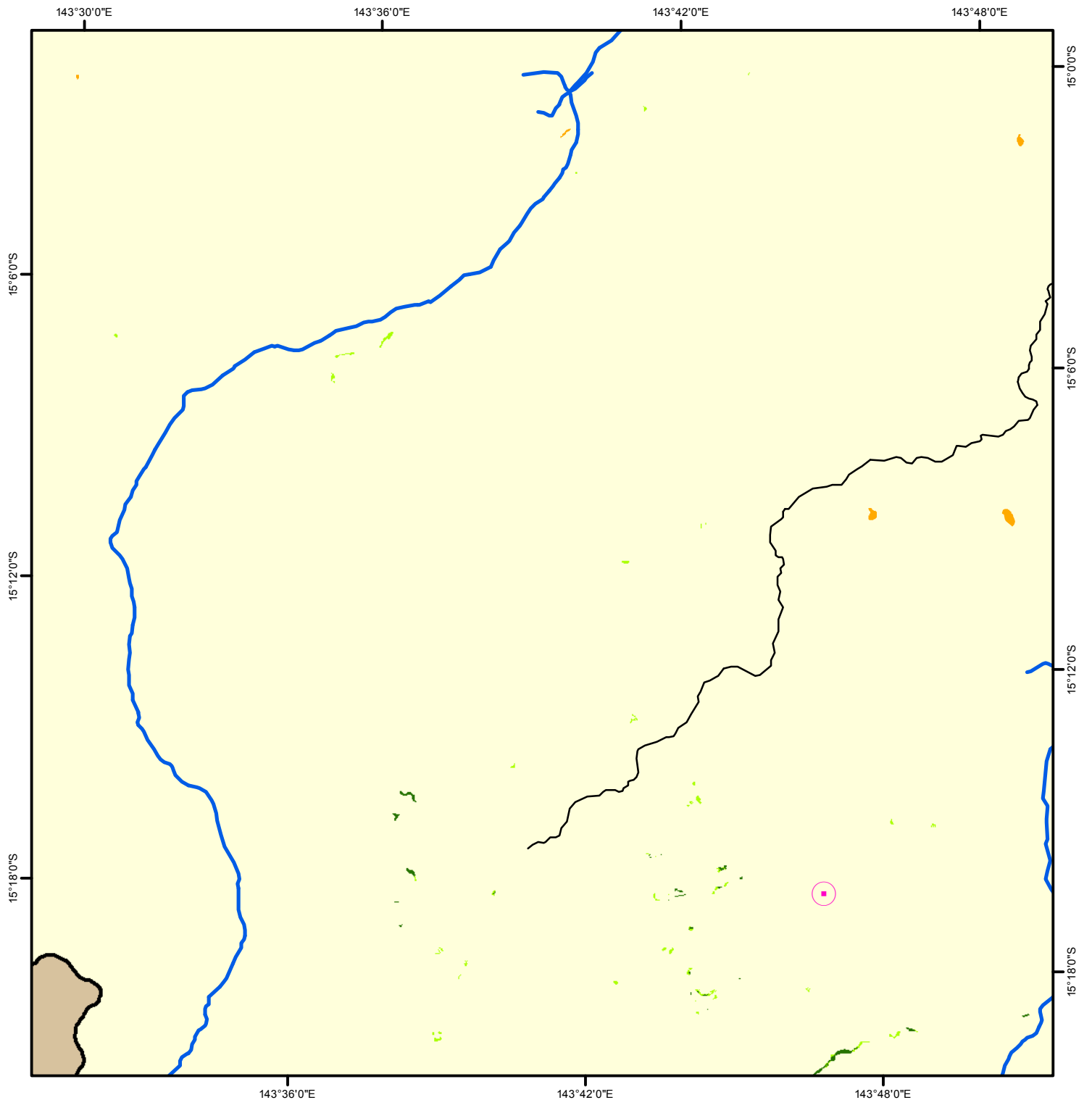
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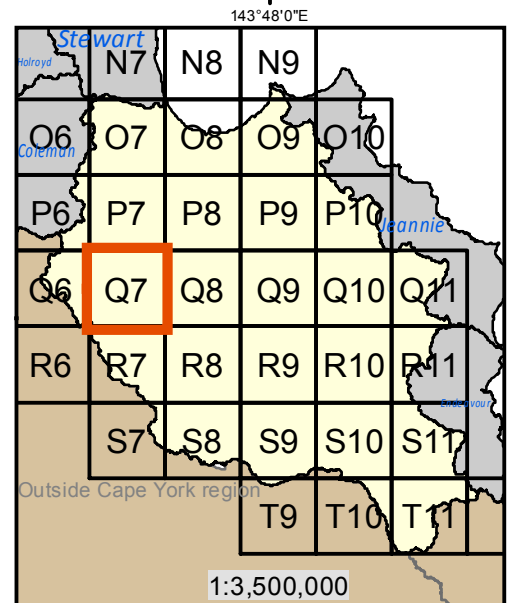
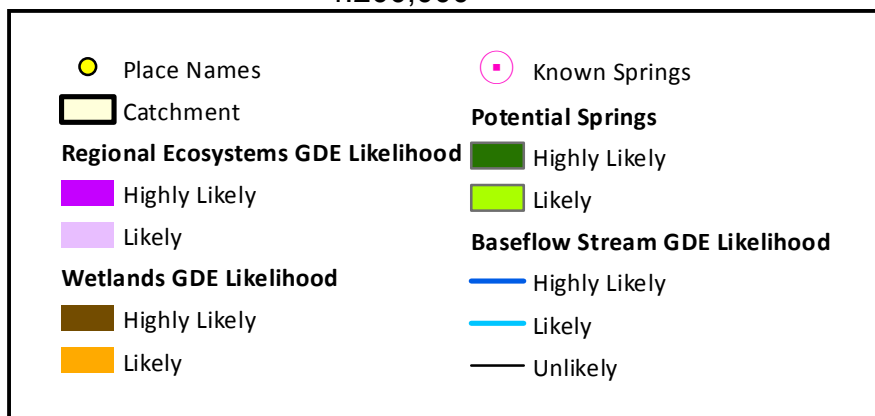
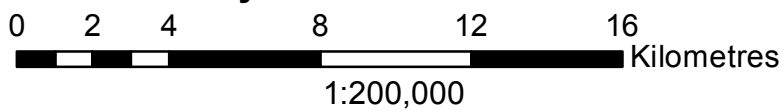


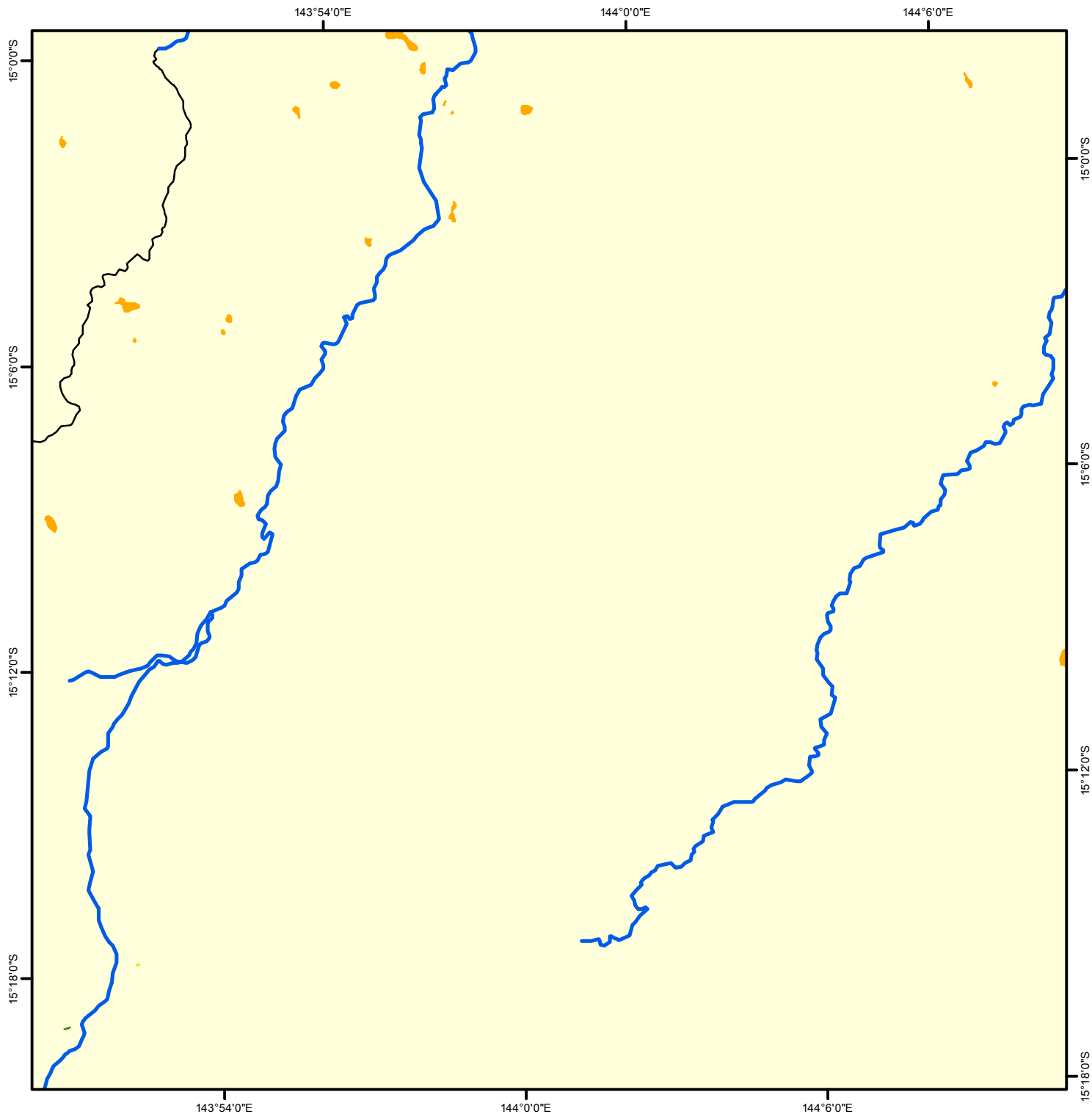
Q6 Normanby Catchment



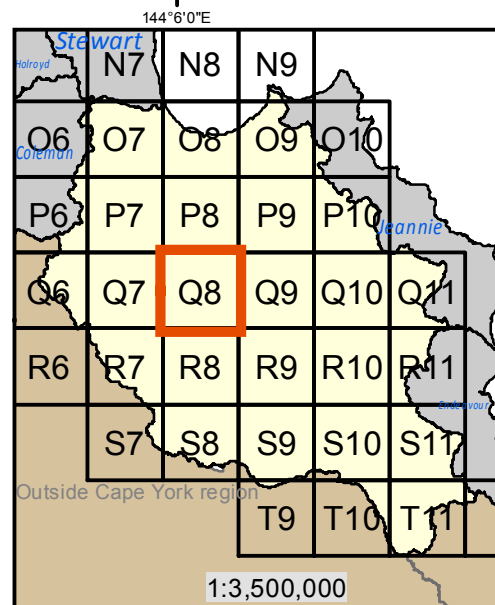
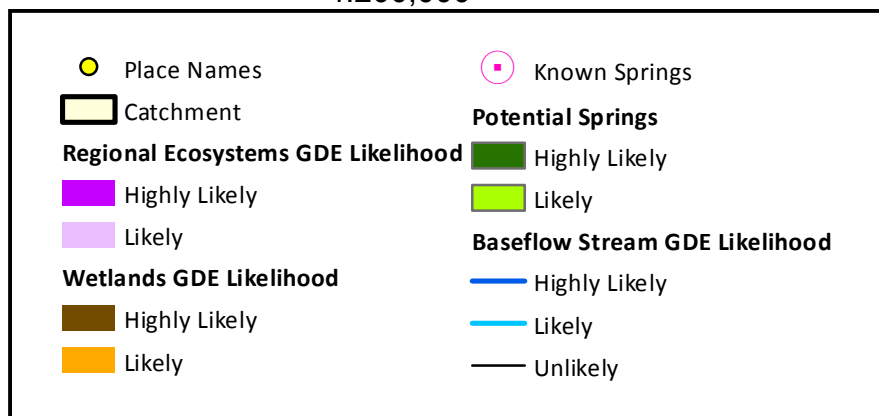
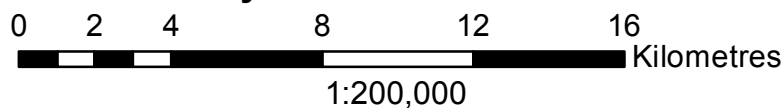


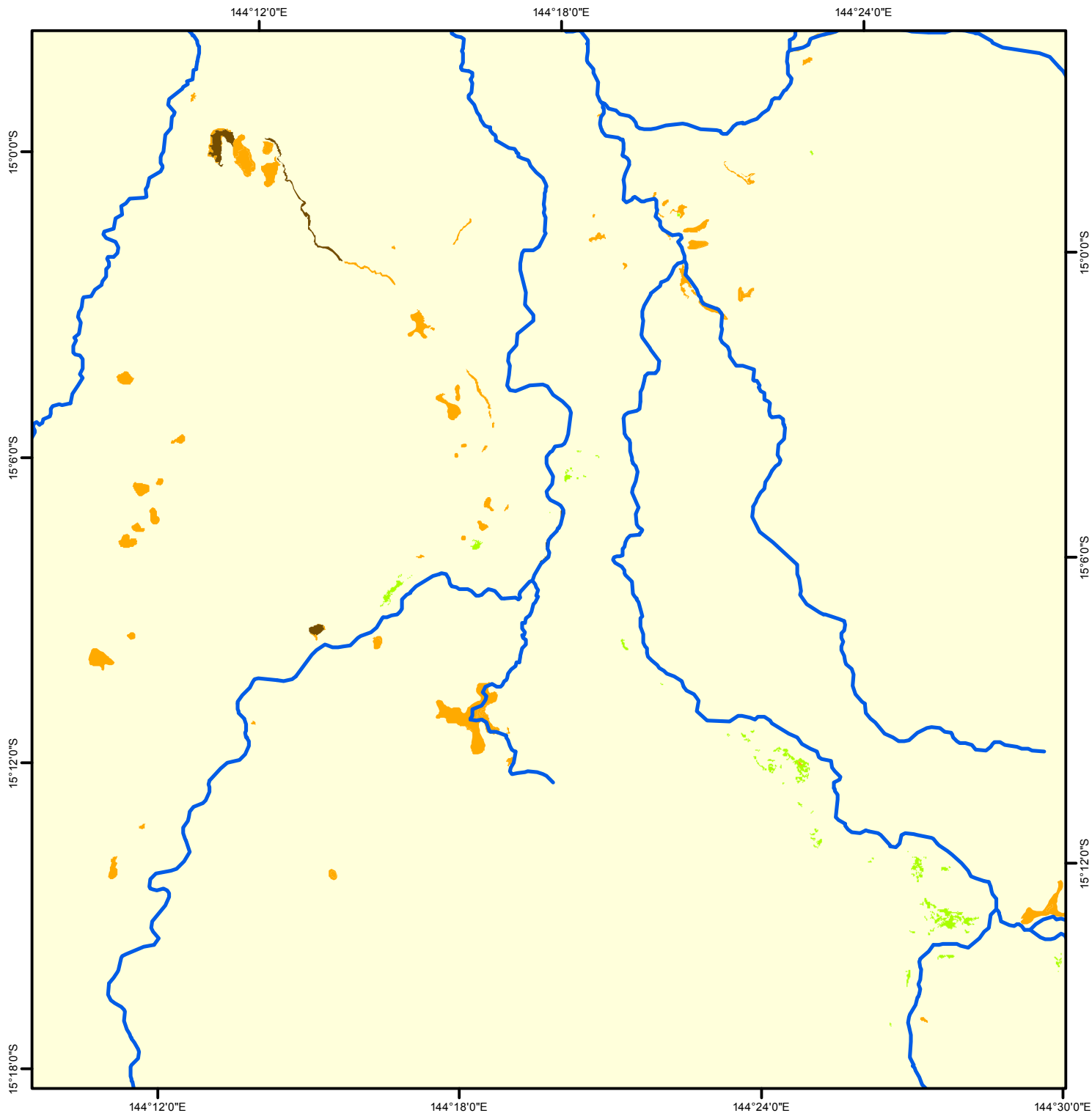
Q7 Normanby Catchment



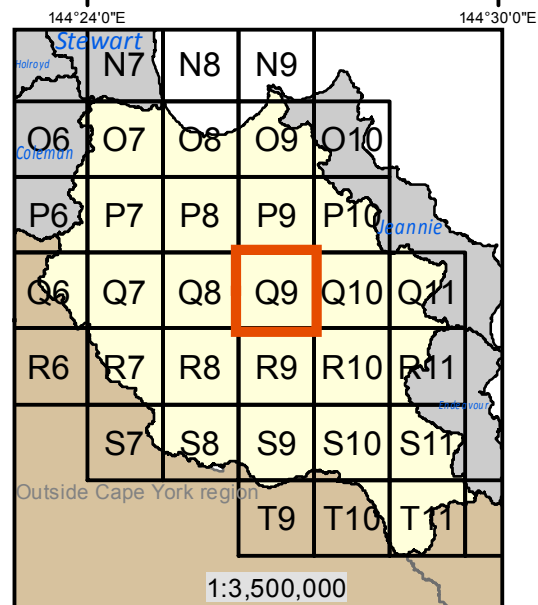
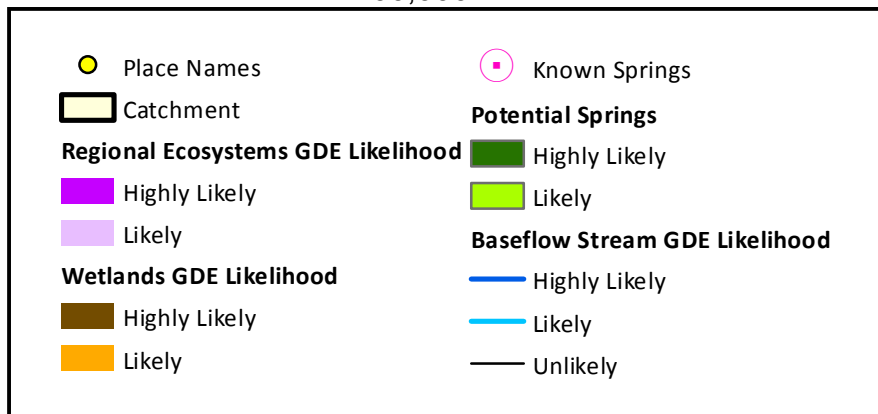
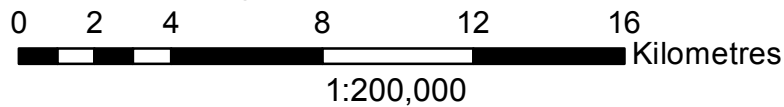


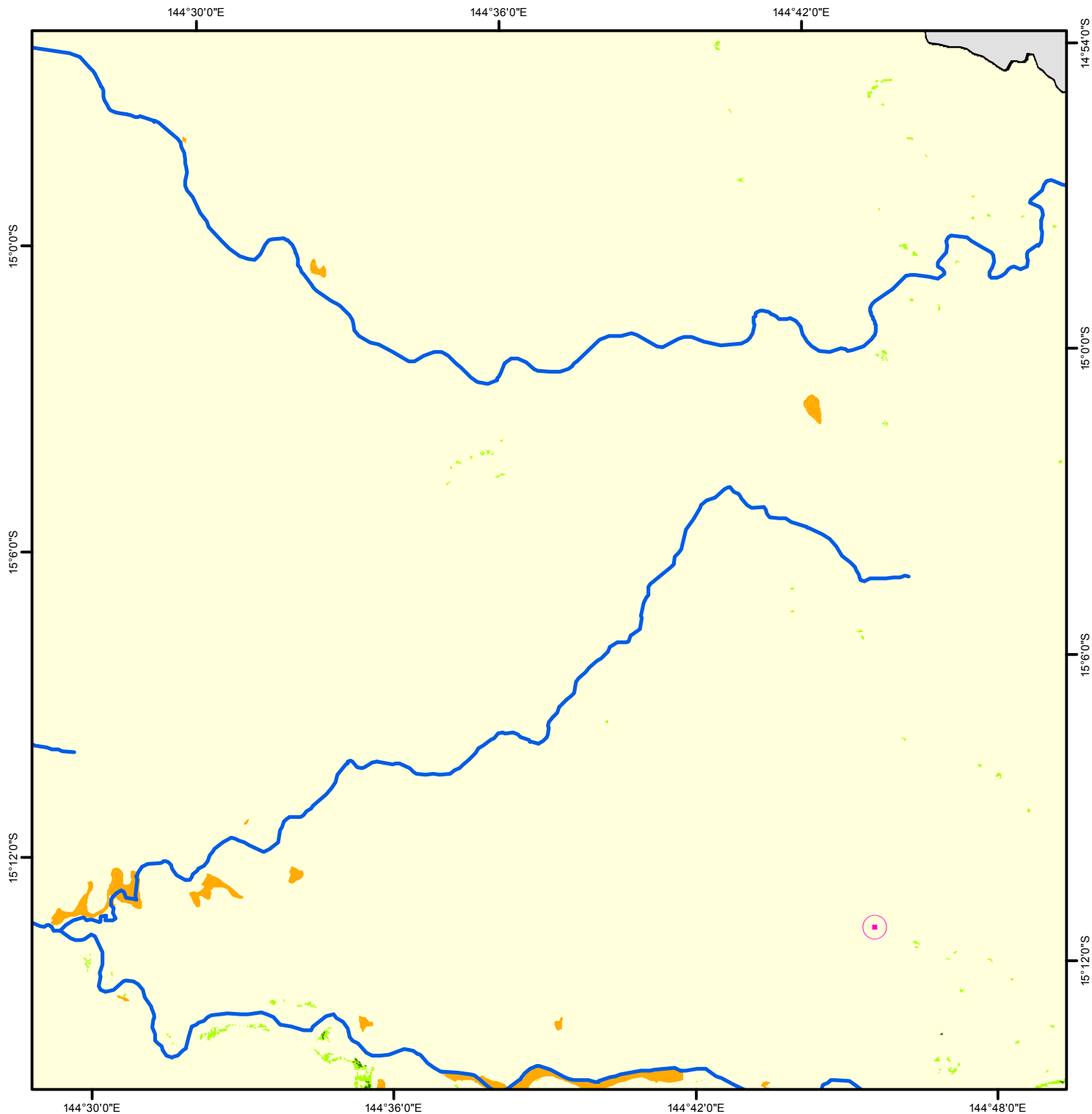
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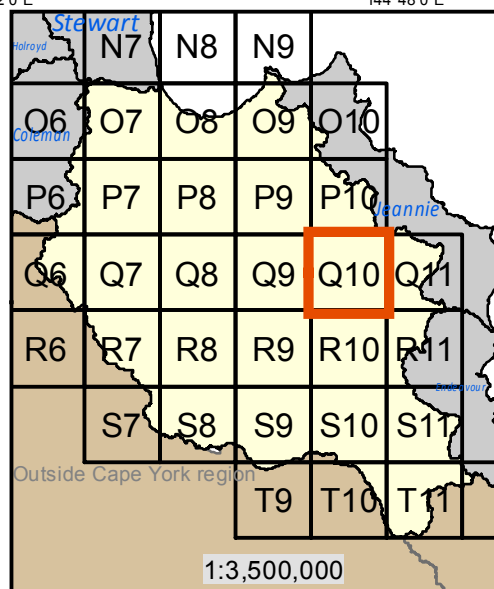
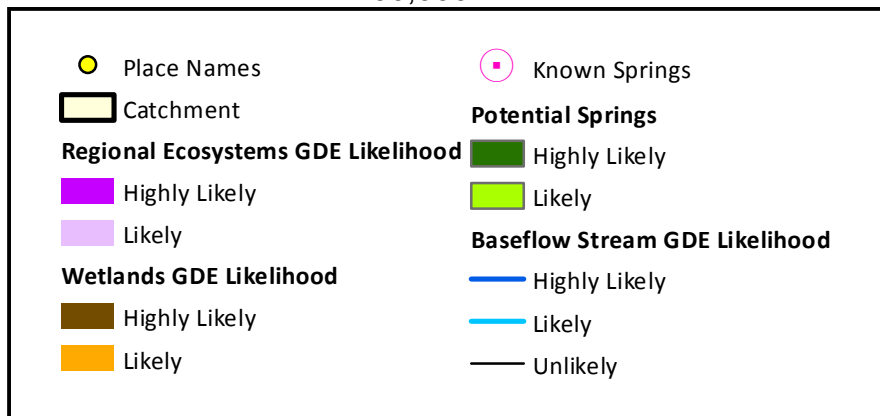
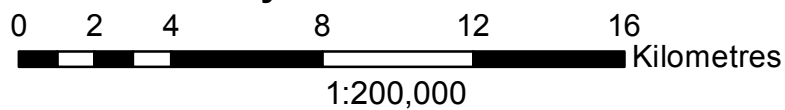


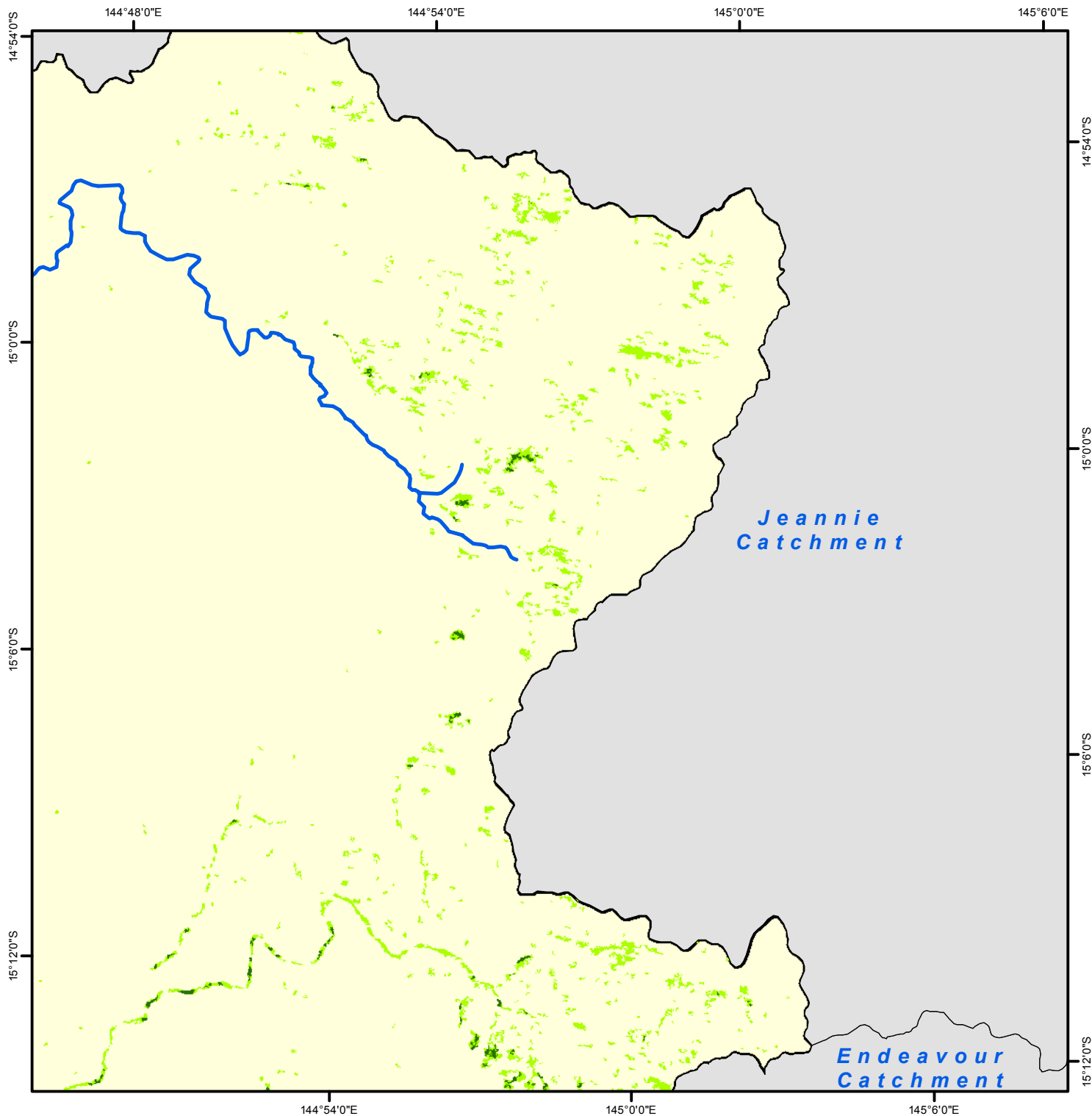
Q9 Normanby Catchment





Q10 Normanby Catchment

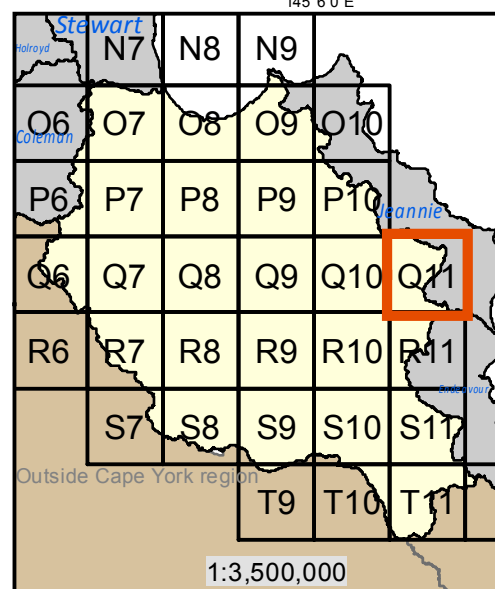
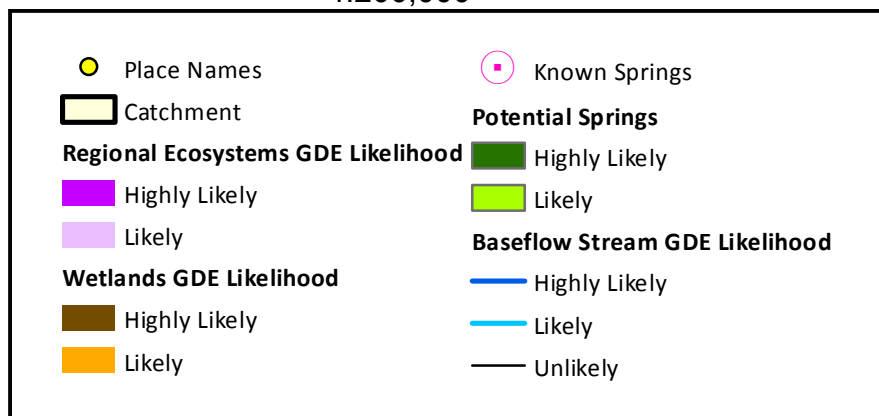


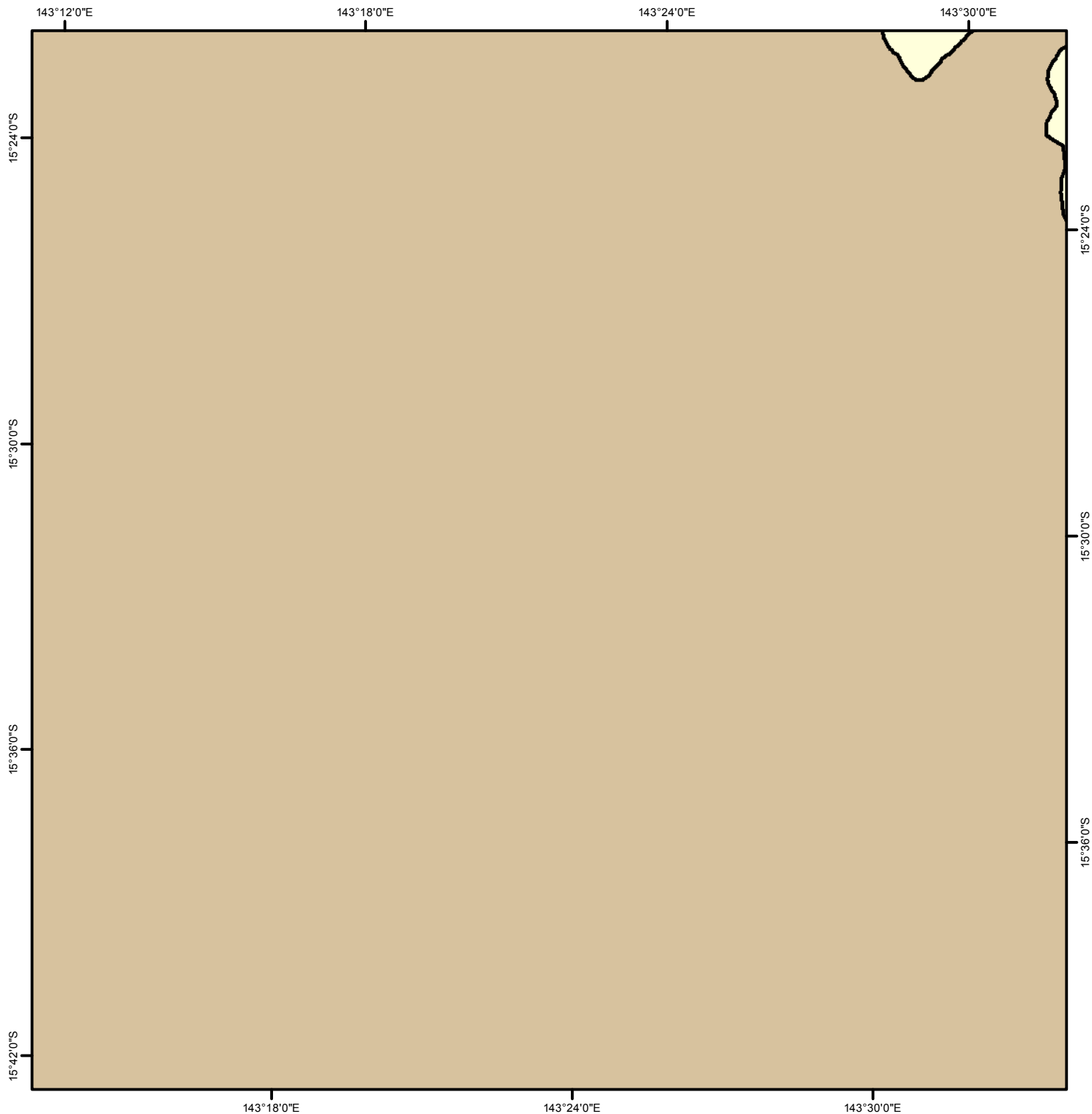


Q11 Normanby Catchment

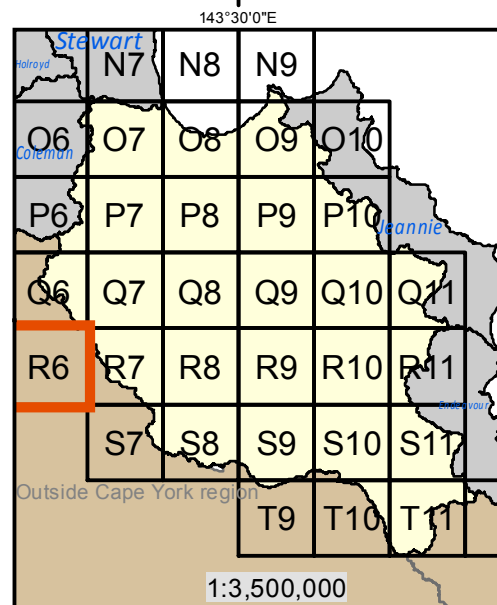
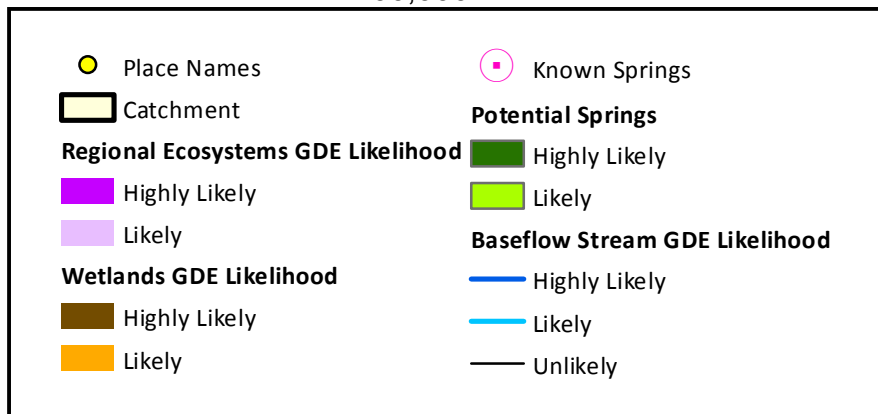
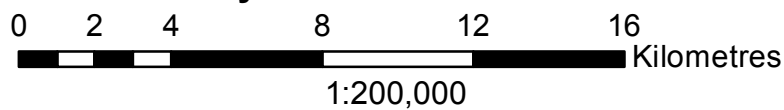
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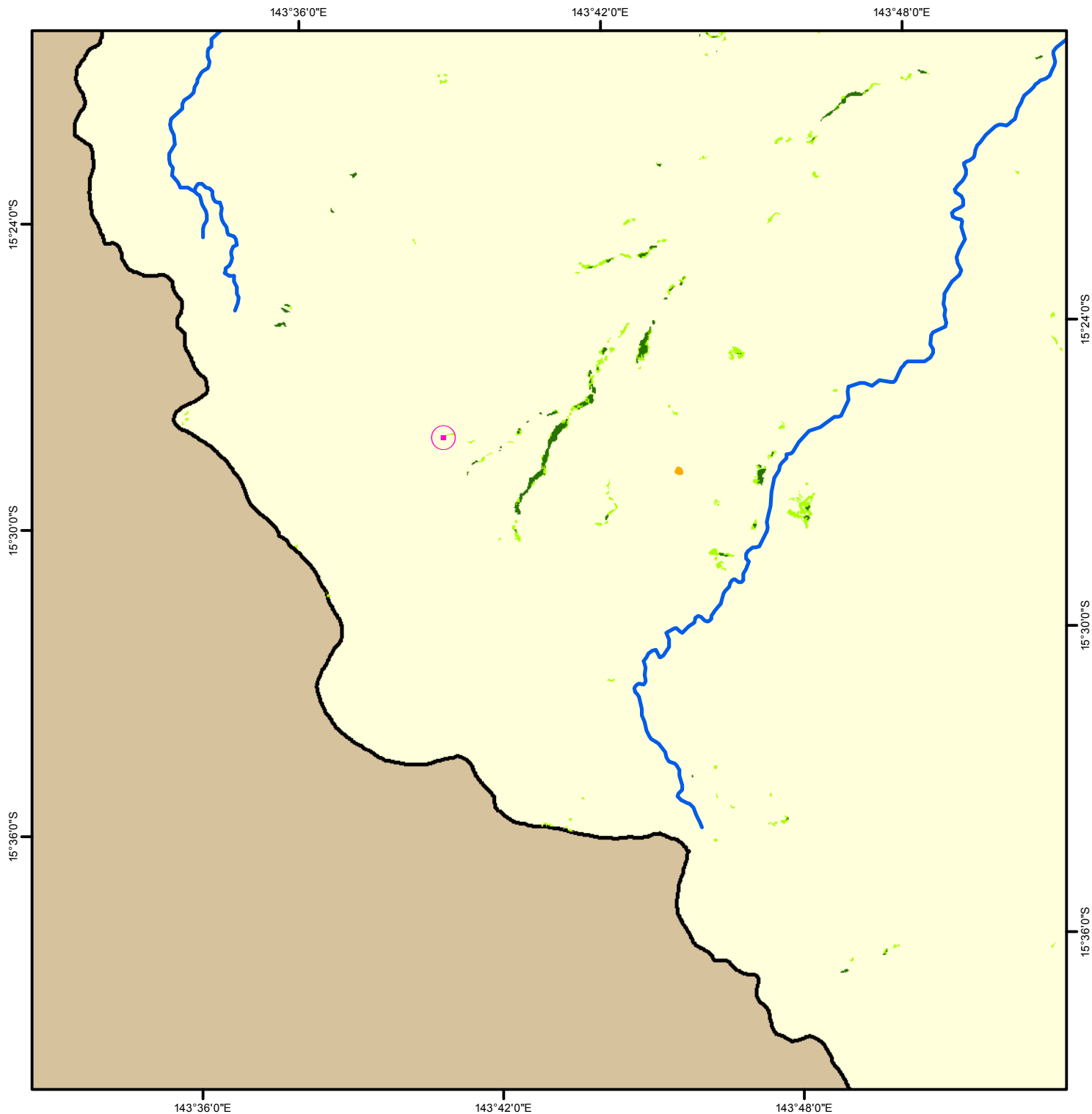
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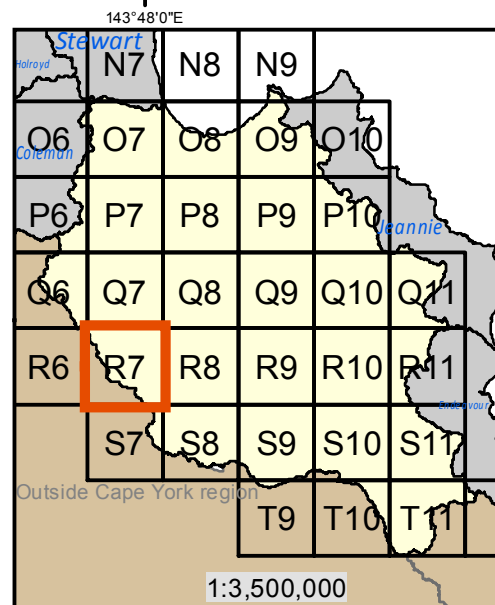
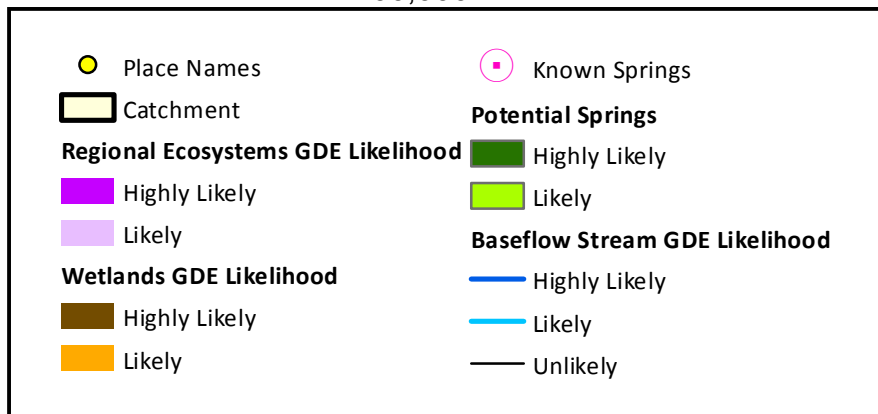
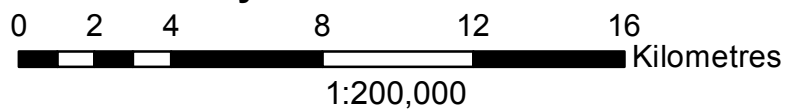


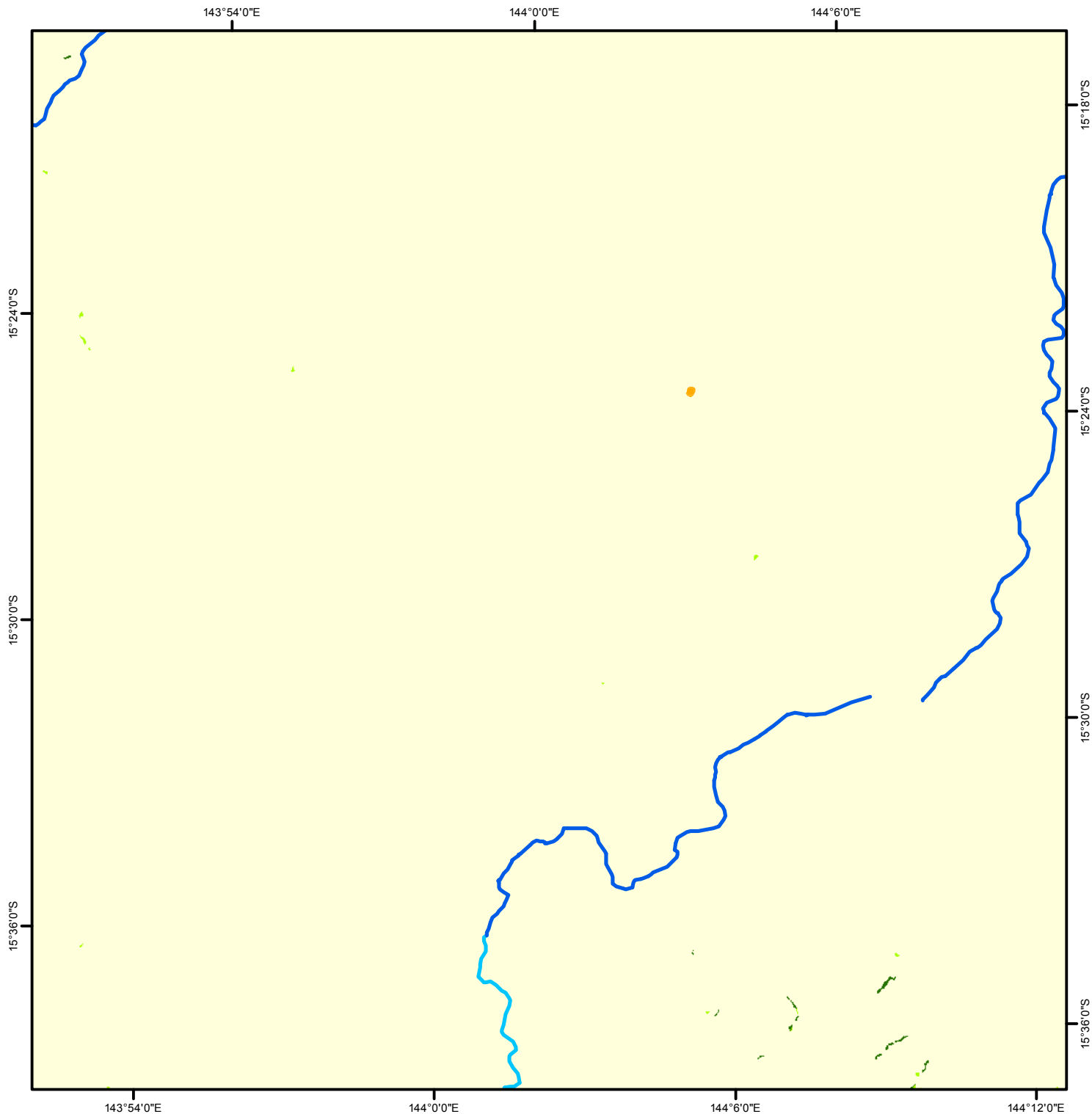
R6 Normanby Catchment



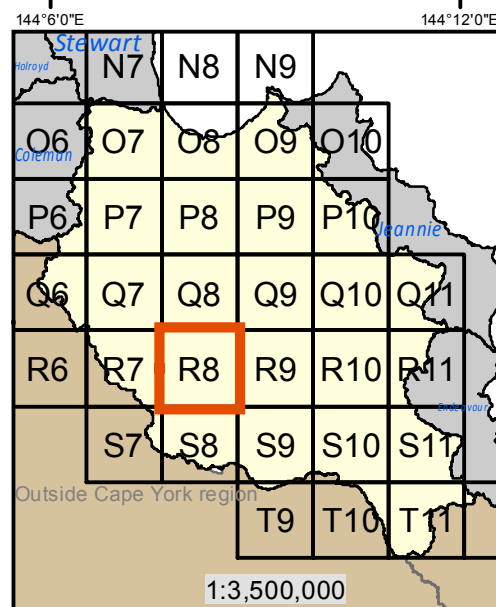
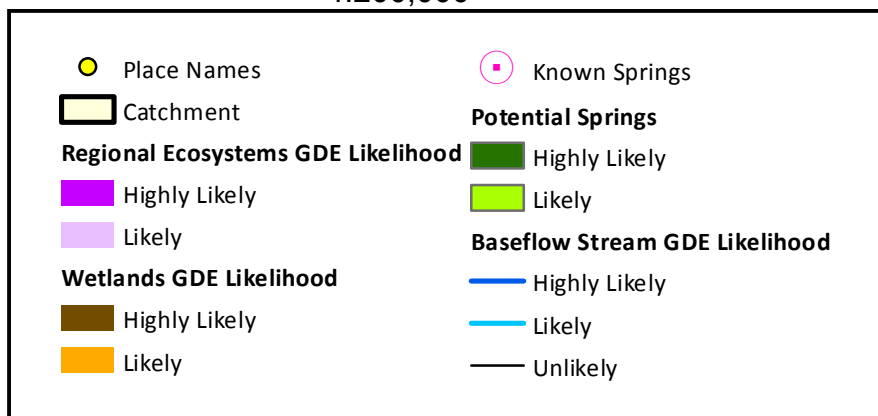
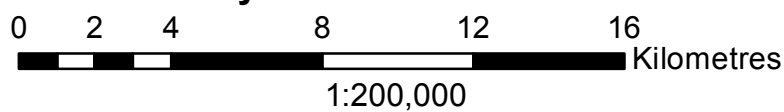


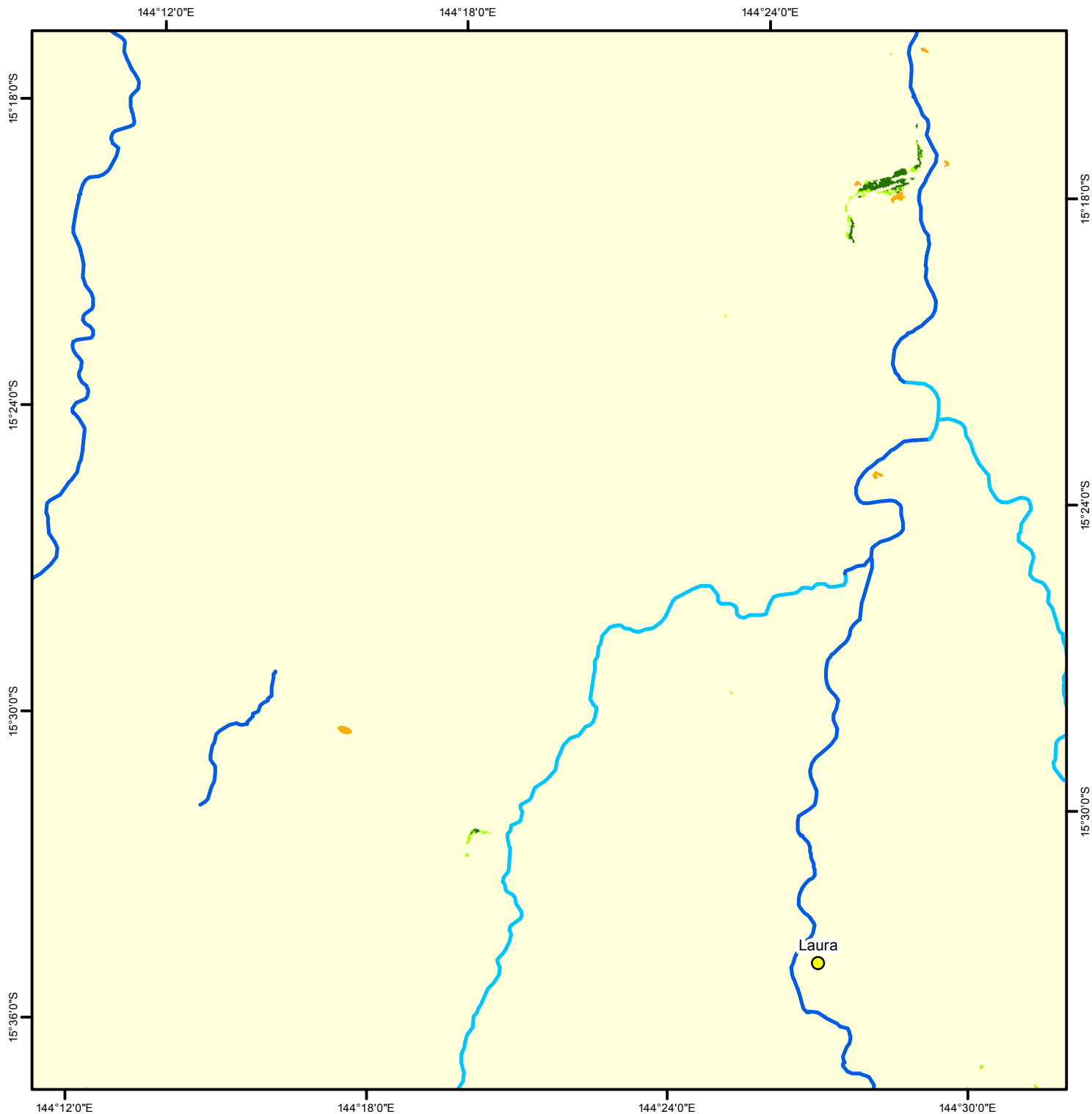
R7 Normanby Catchment



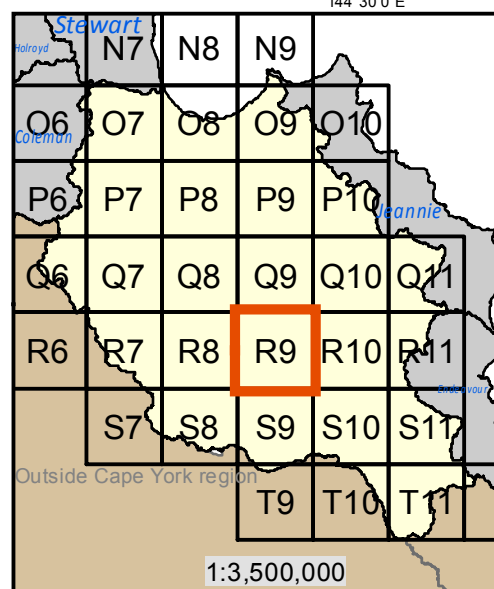
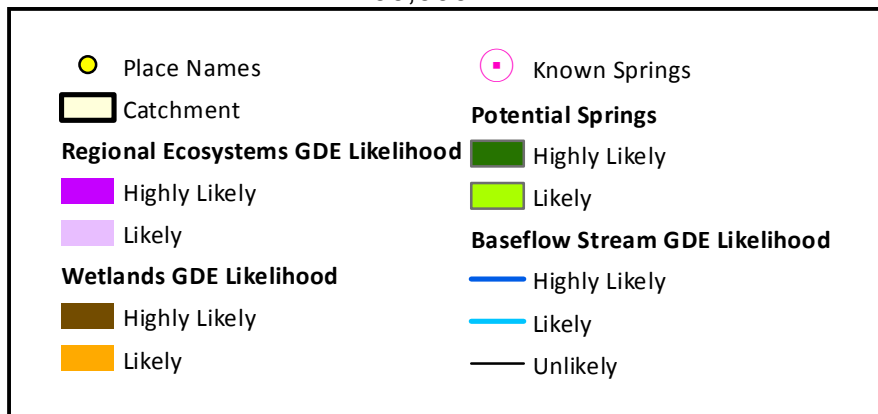
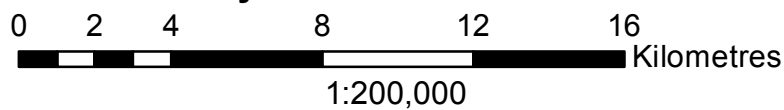


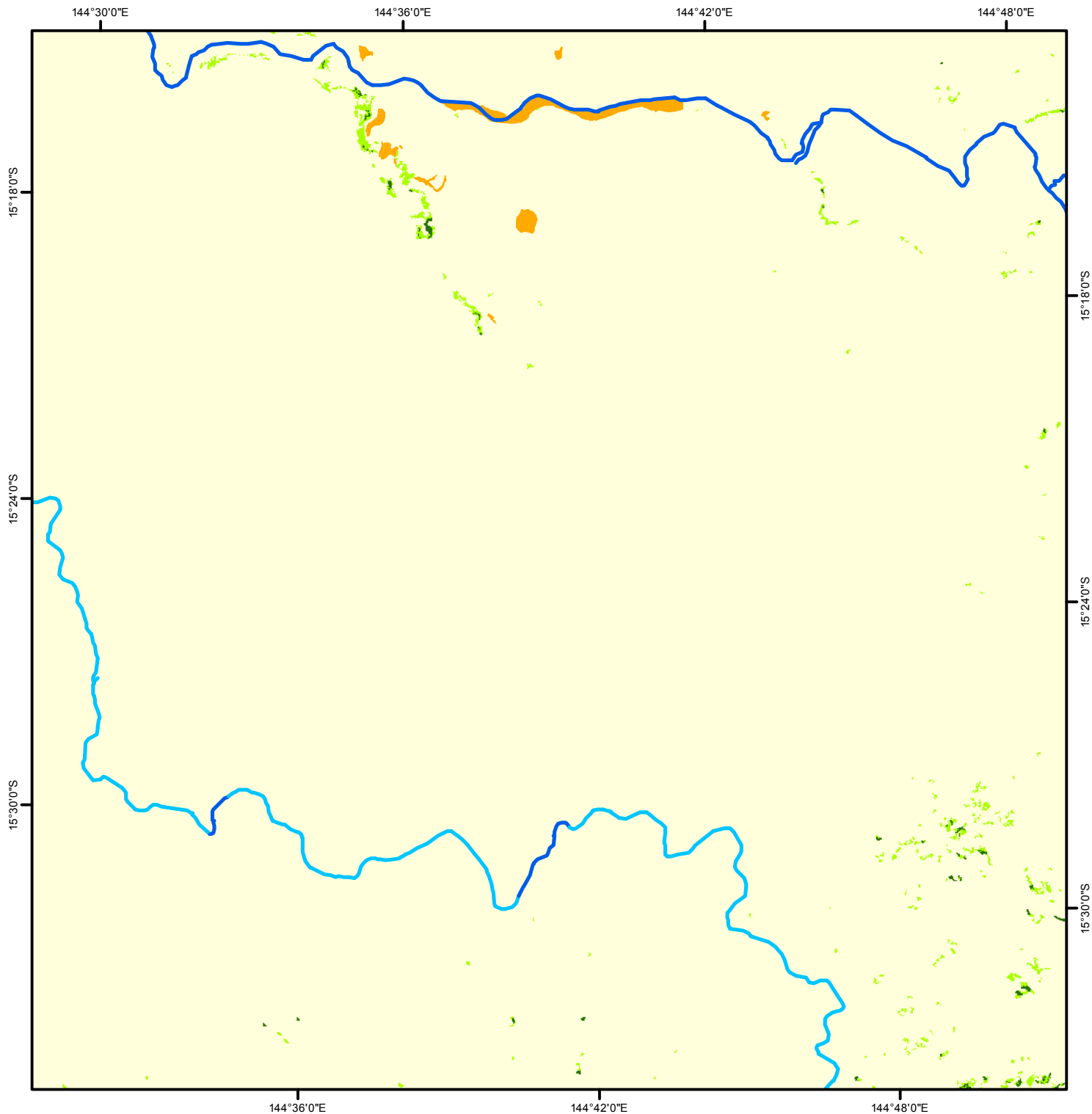
R8 Normanby Catchment



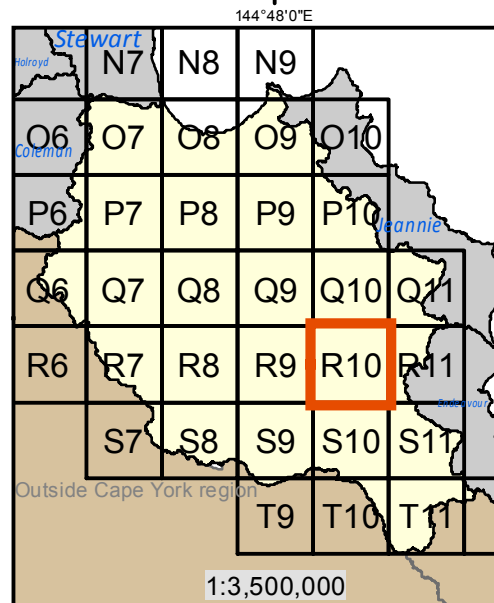
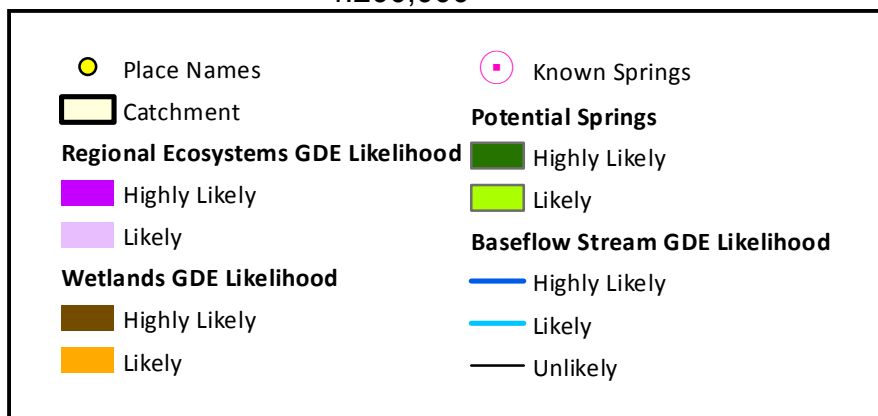
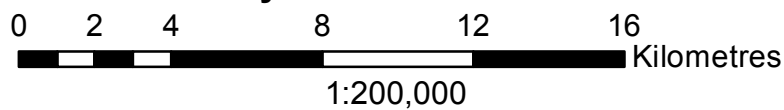


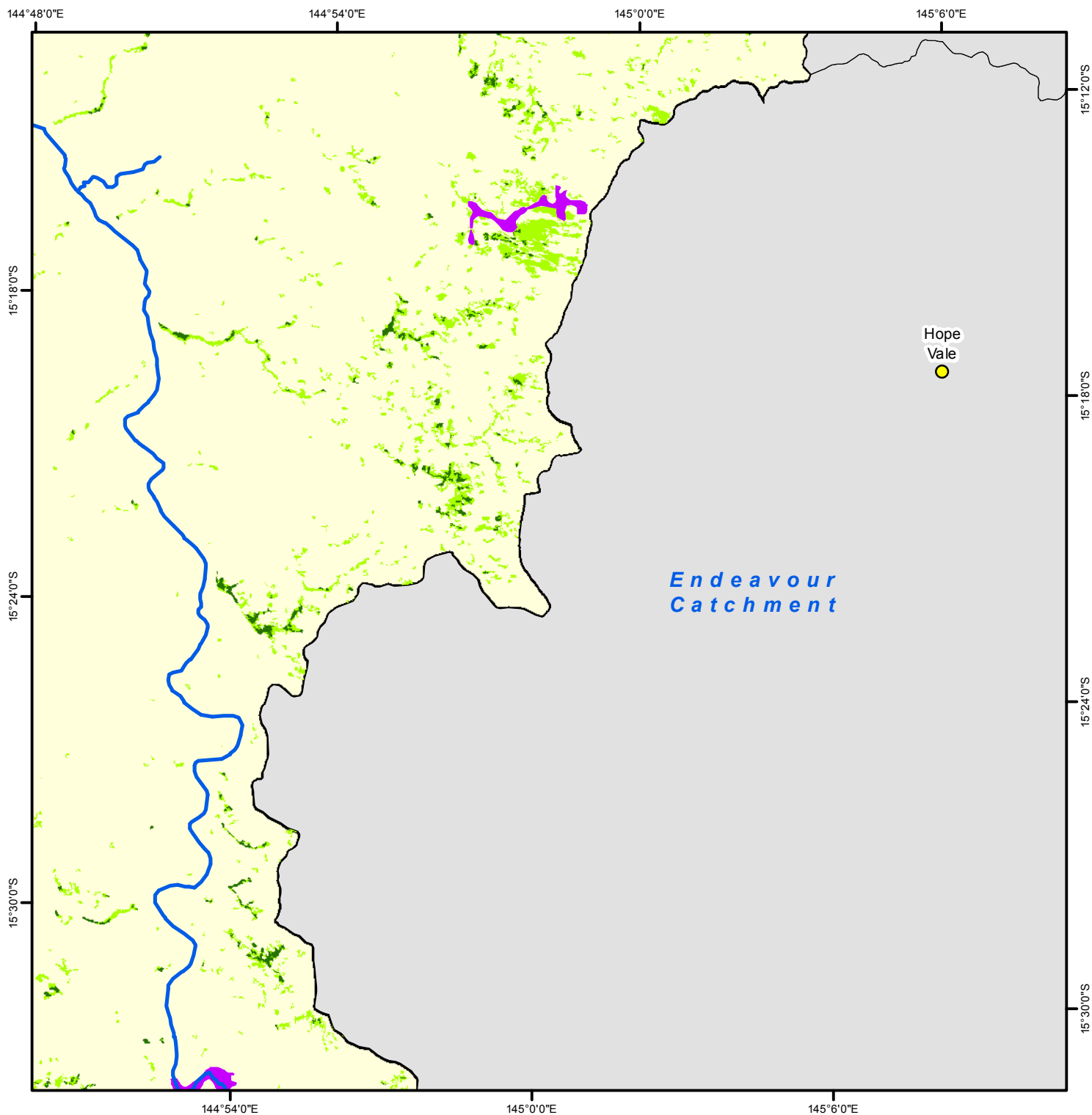
R9 Normanby Catchment



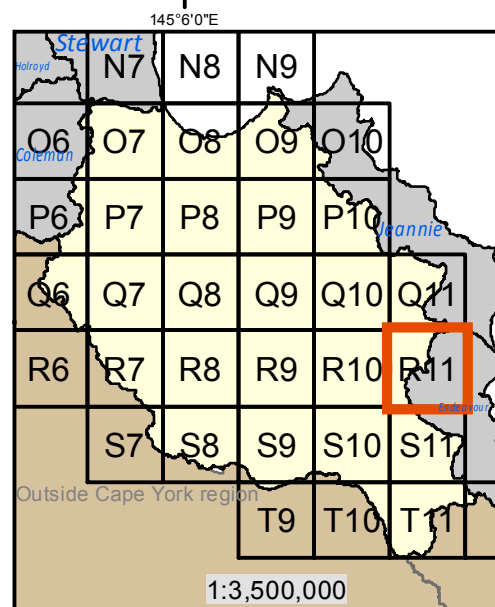
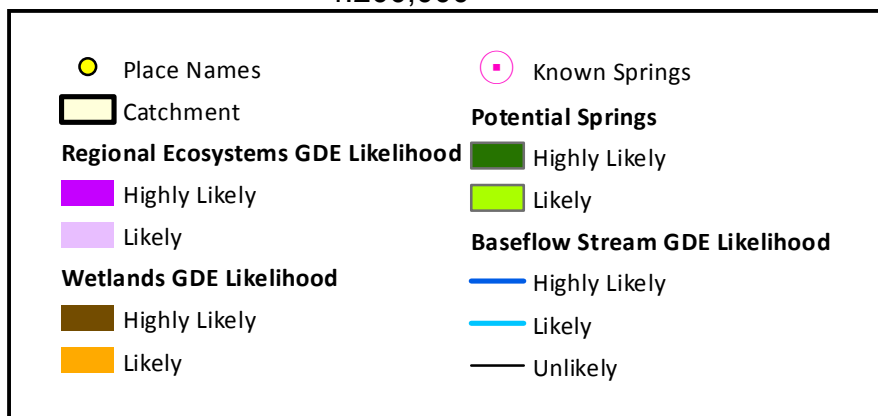
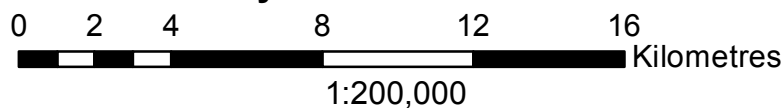


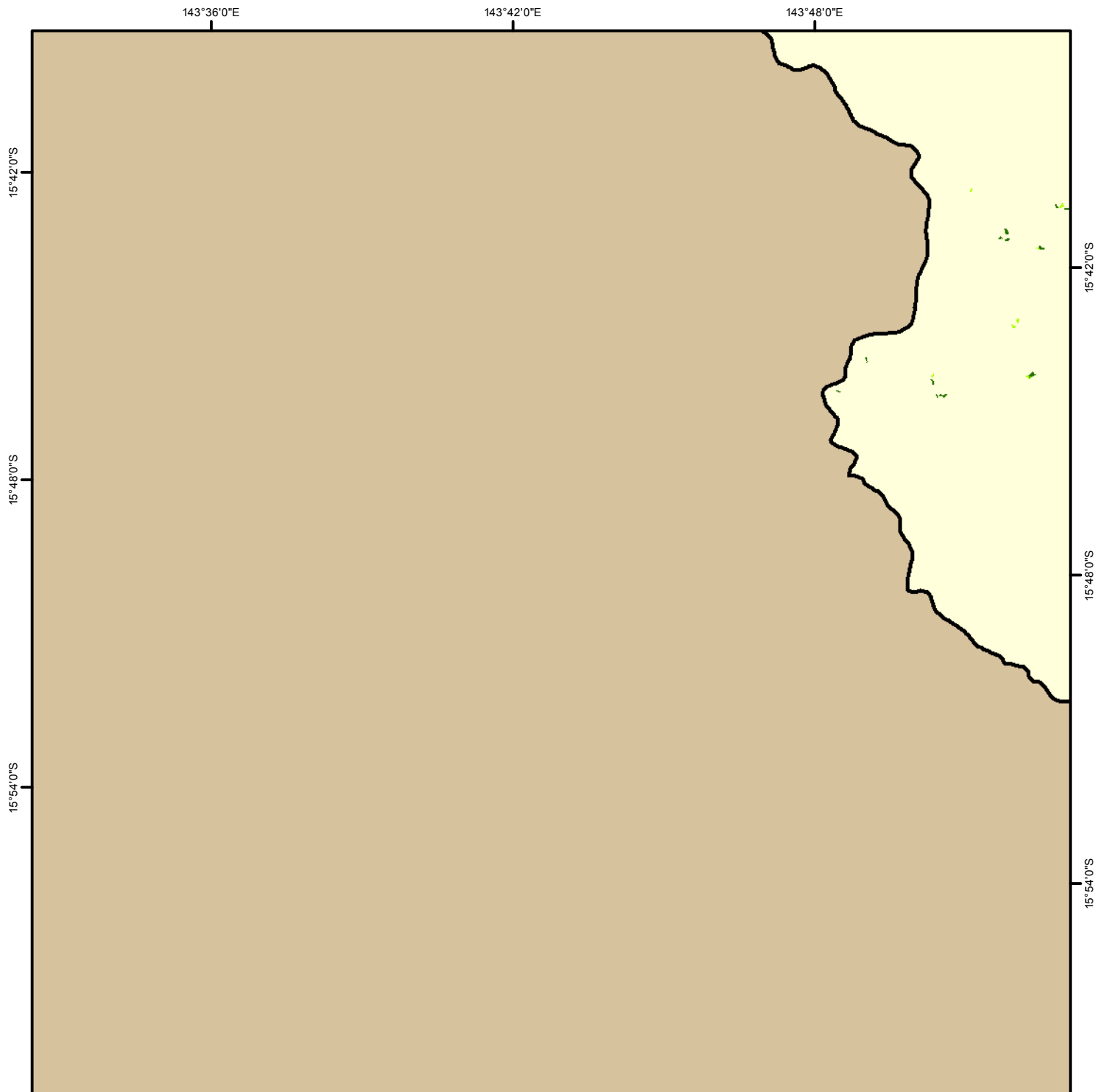
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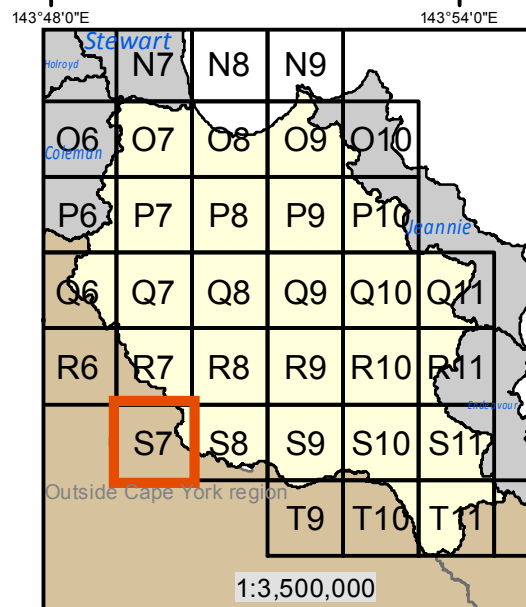
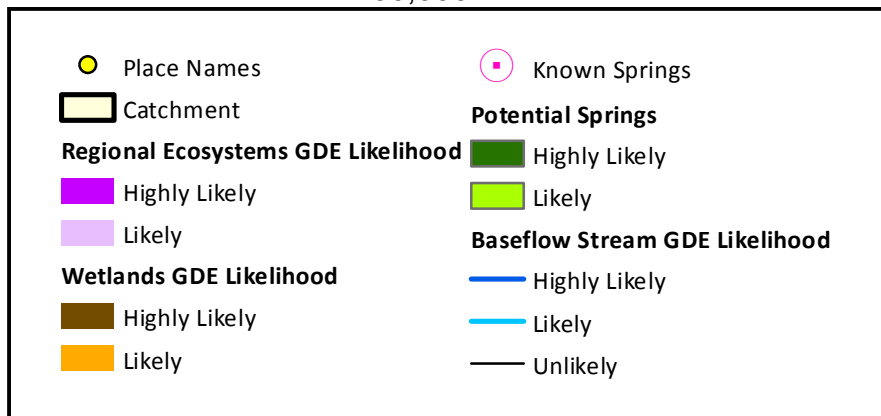
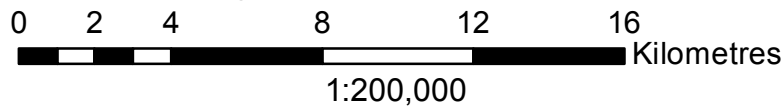


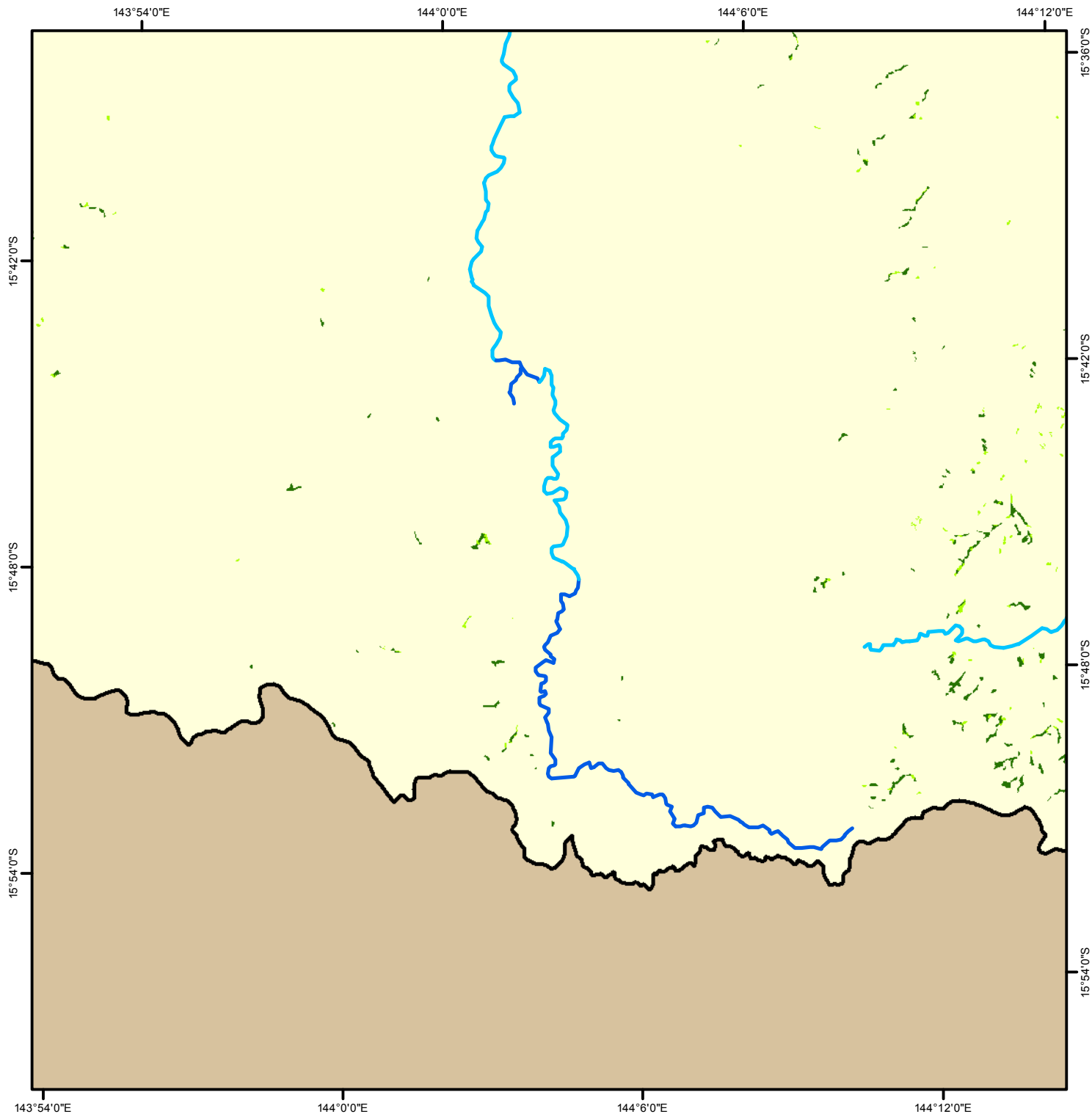
R11 Normanby Catchment



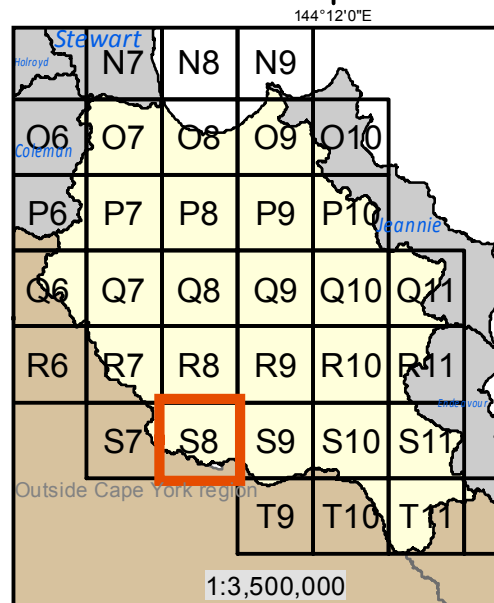
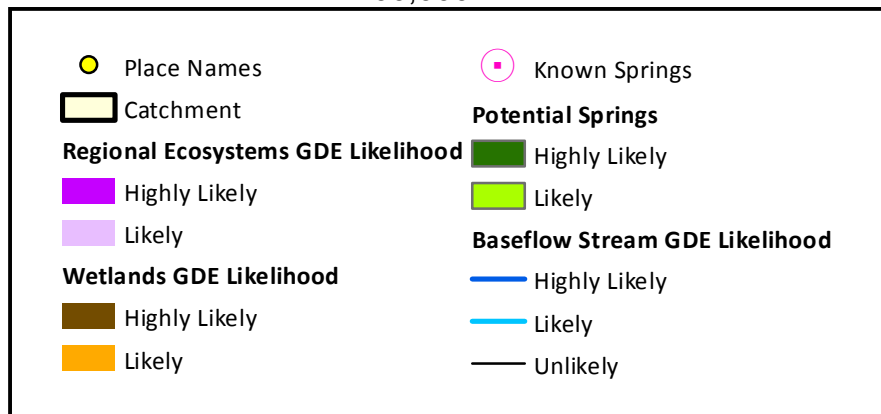
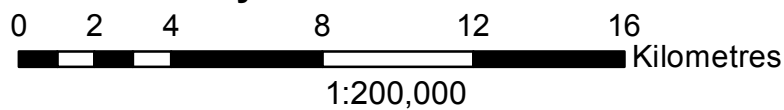


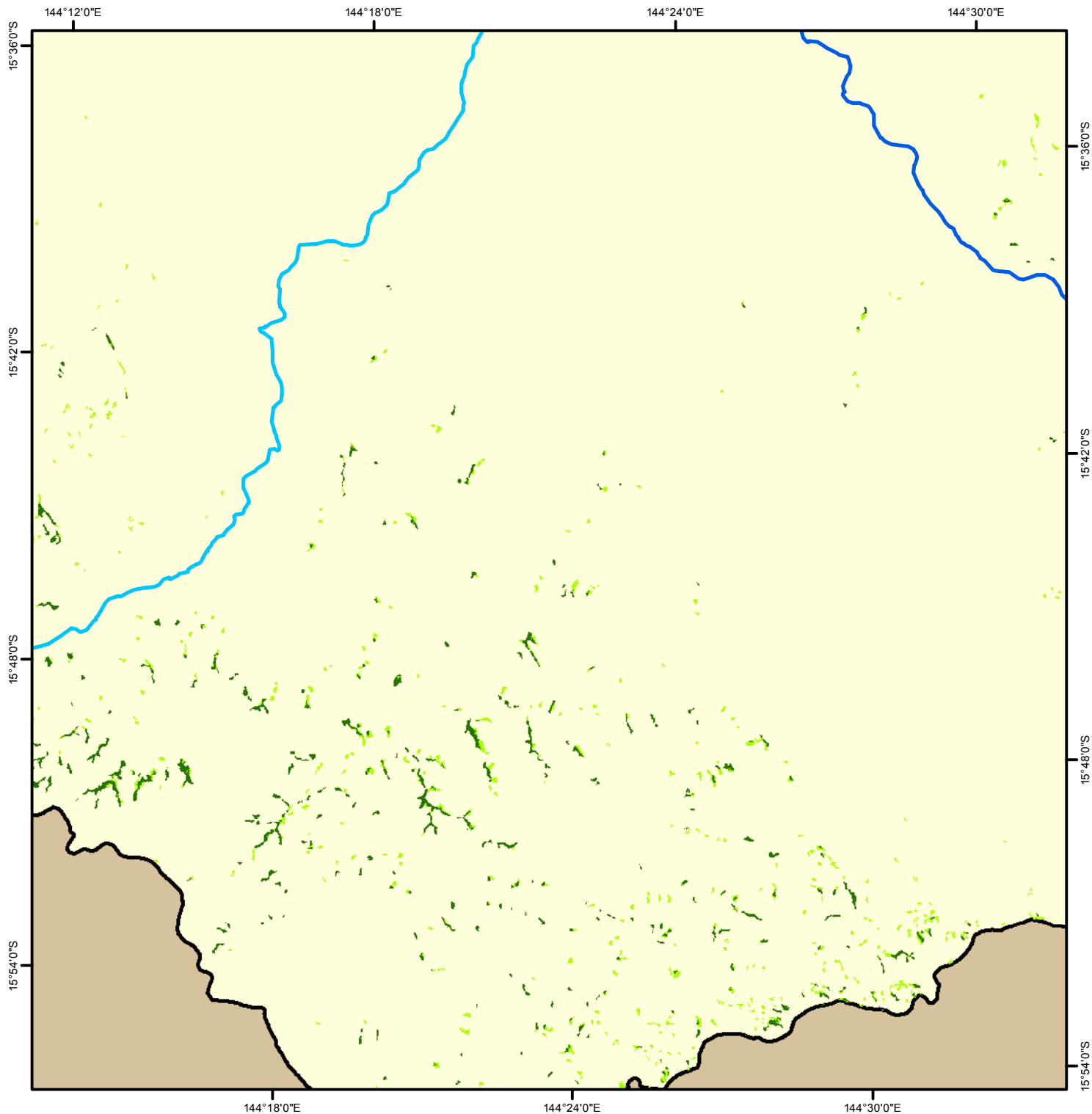
S7 Normanby Catchment



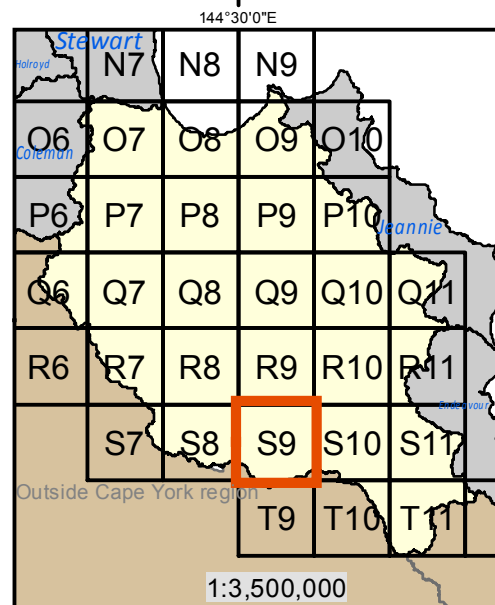
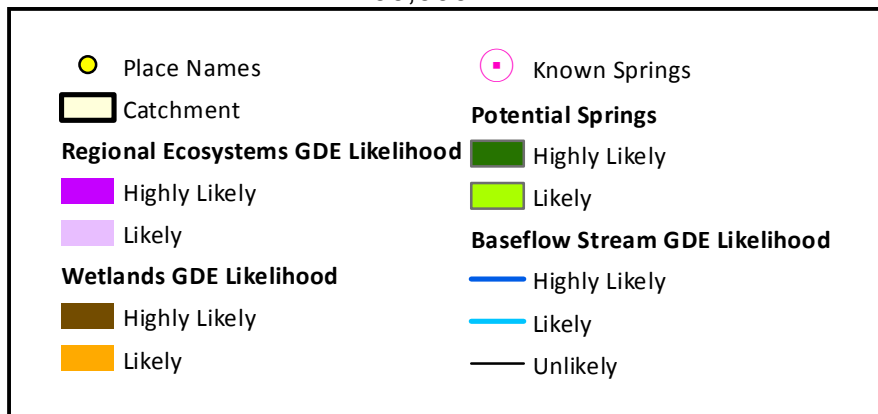
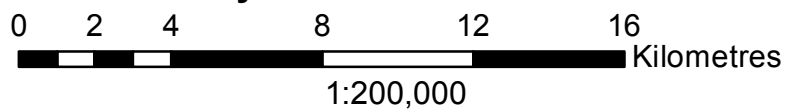


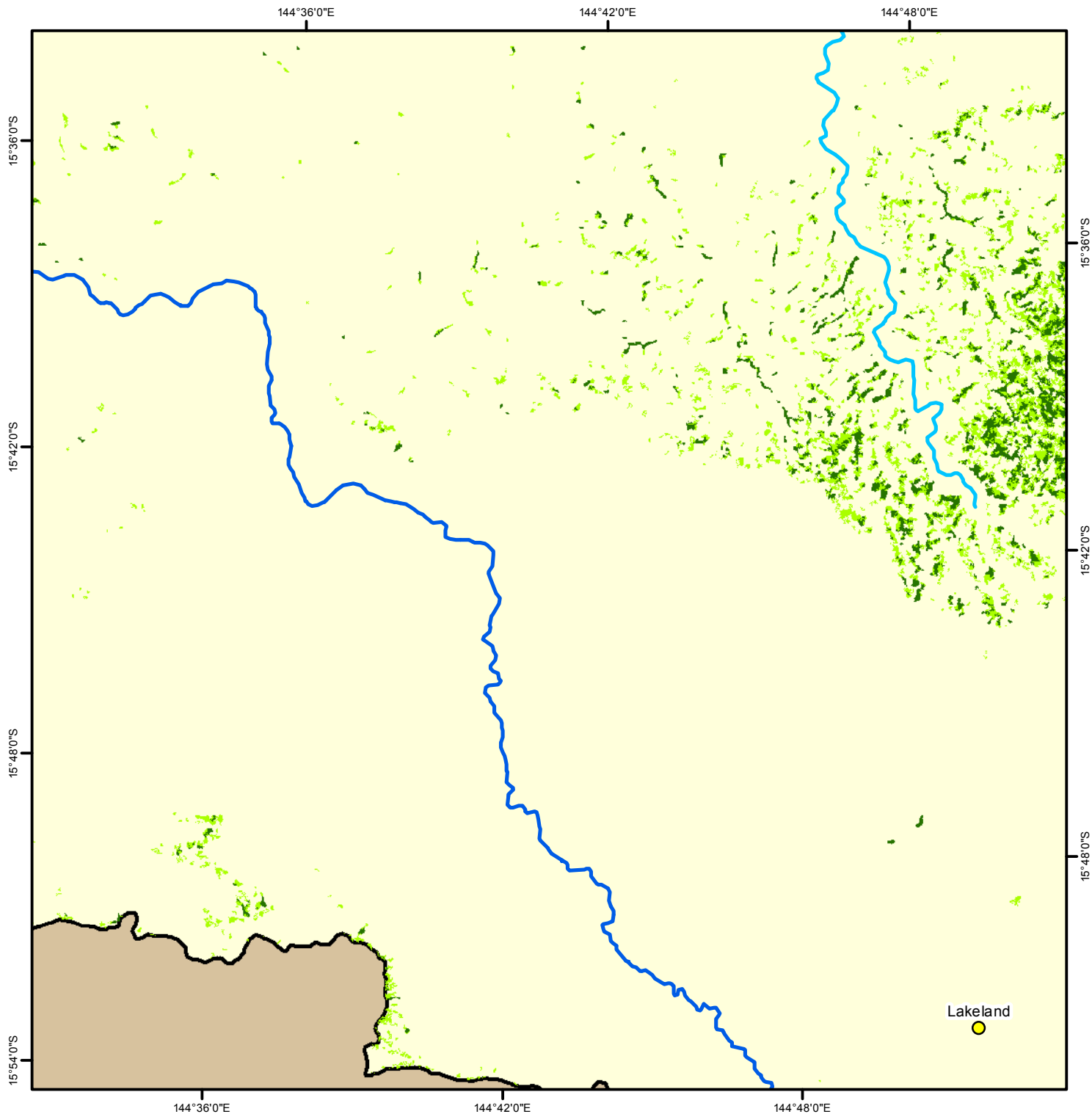
S8 Normanby Catchment





S9 Normanby Catchment





S10 Normanby Catchment

0 2 4 8 12 16 Kilometres
1:200,000



● Place Names

▭ Catchment

Regional Ecosystems GDE Likelihood

■ Highly Likely

■ Likely

Wetlands GDE Likelihood

■ Highly Likely

■ Likely

● Known Springs

Potential Springs

■ Highly Likely

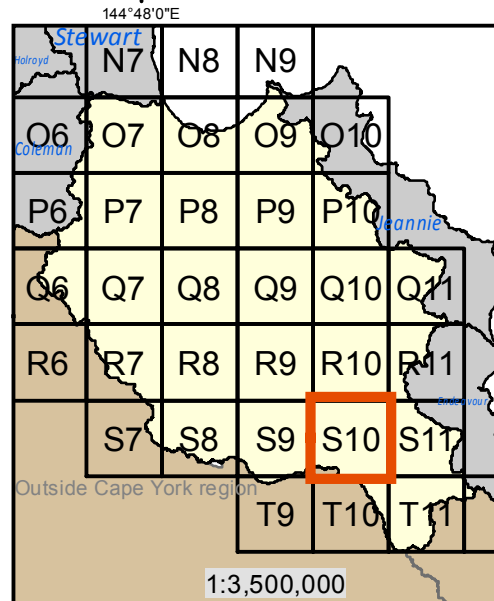
■ Likely

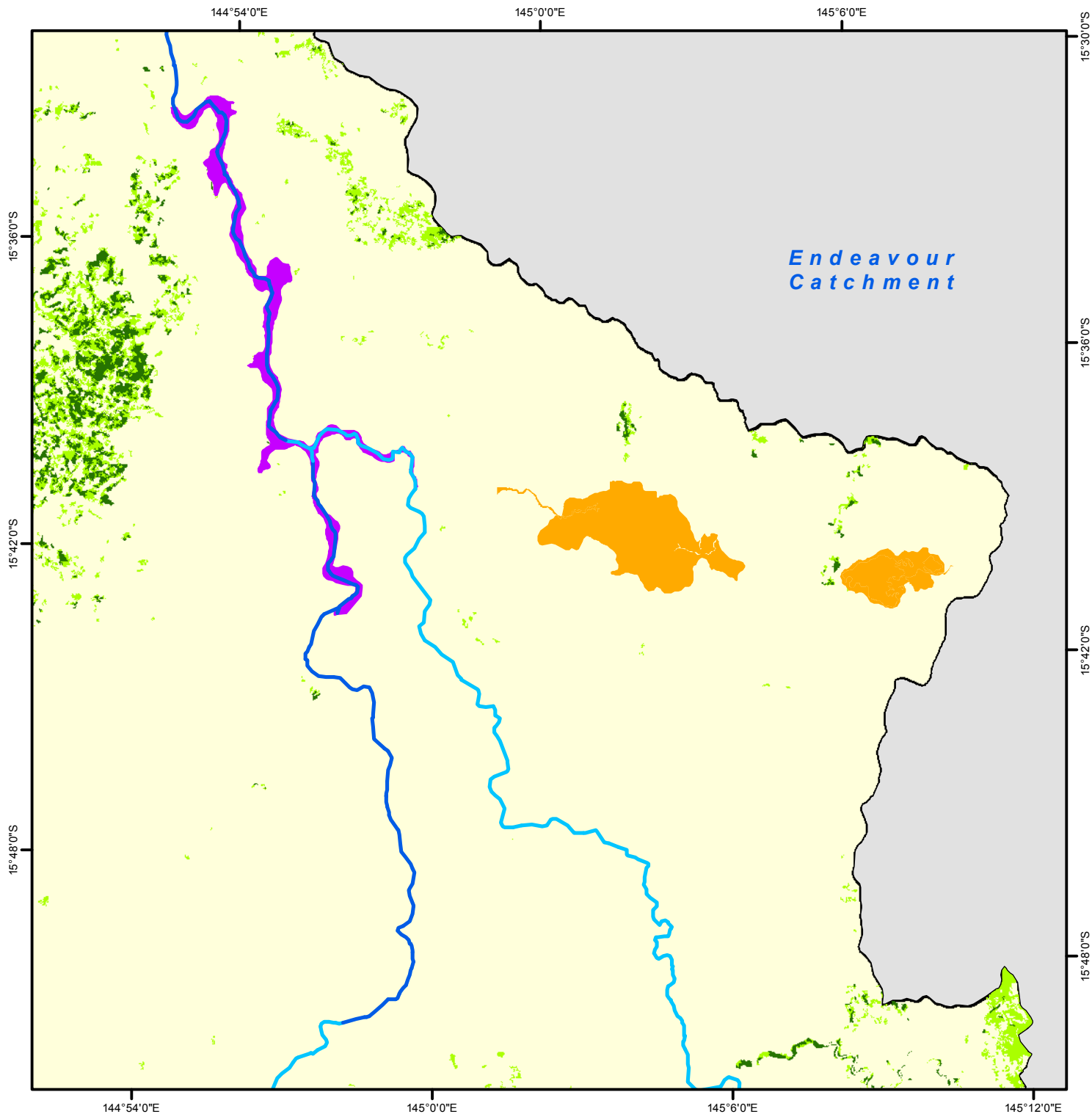
Baseflow Stream GDE Likelihood

— Highly Likely

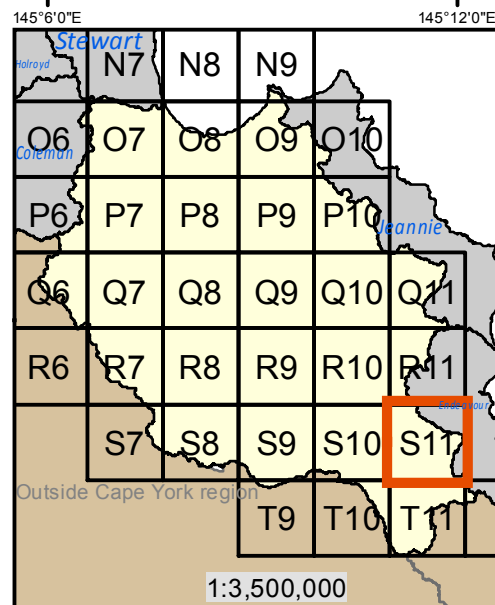
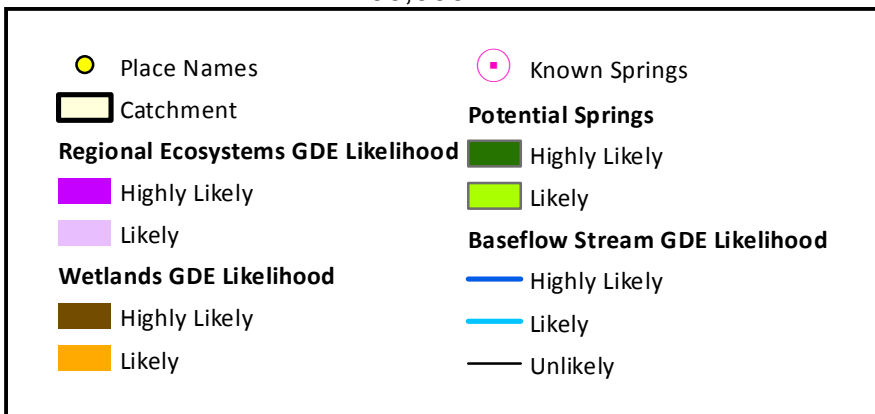
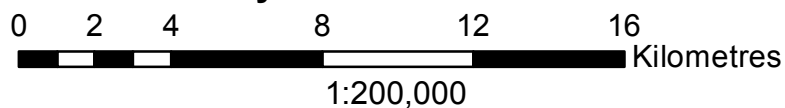
— Likely

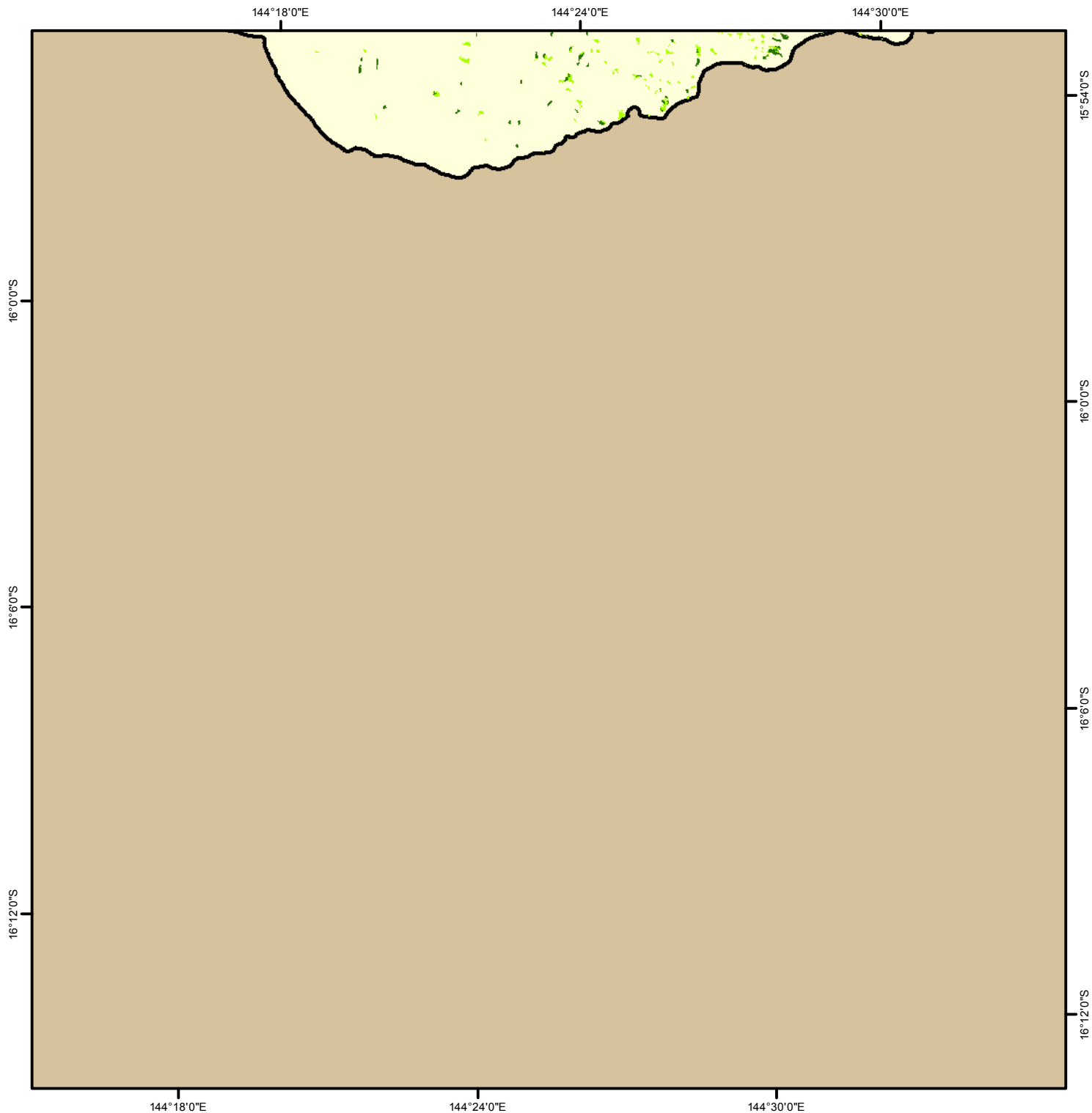
— Unlikely



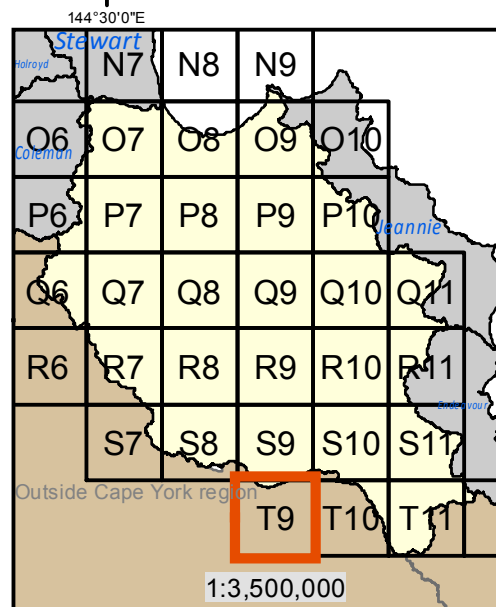
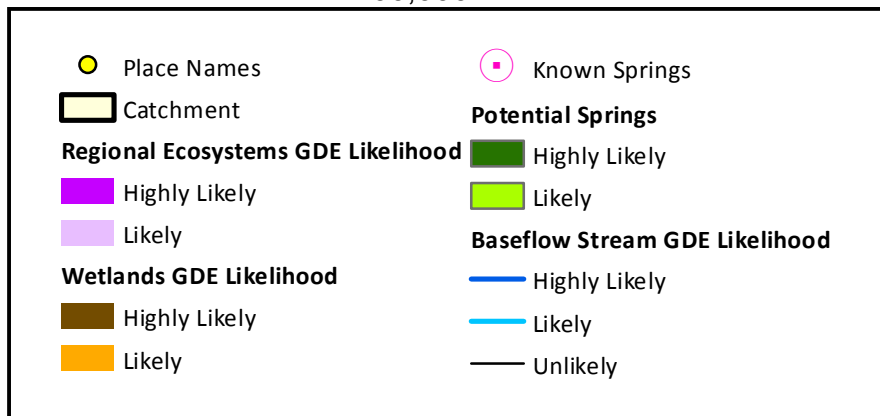
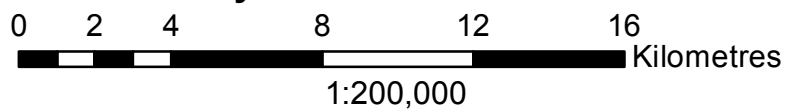


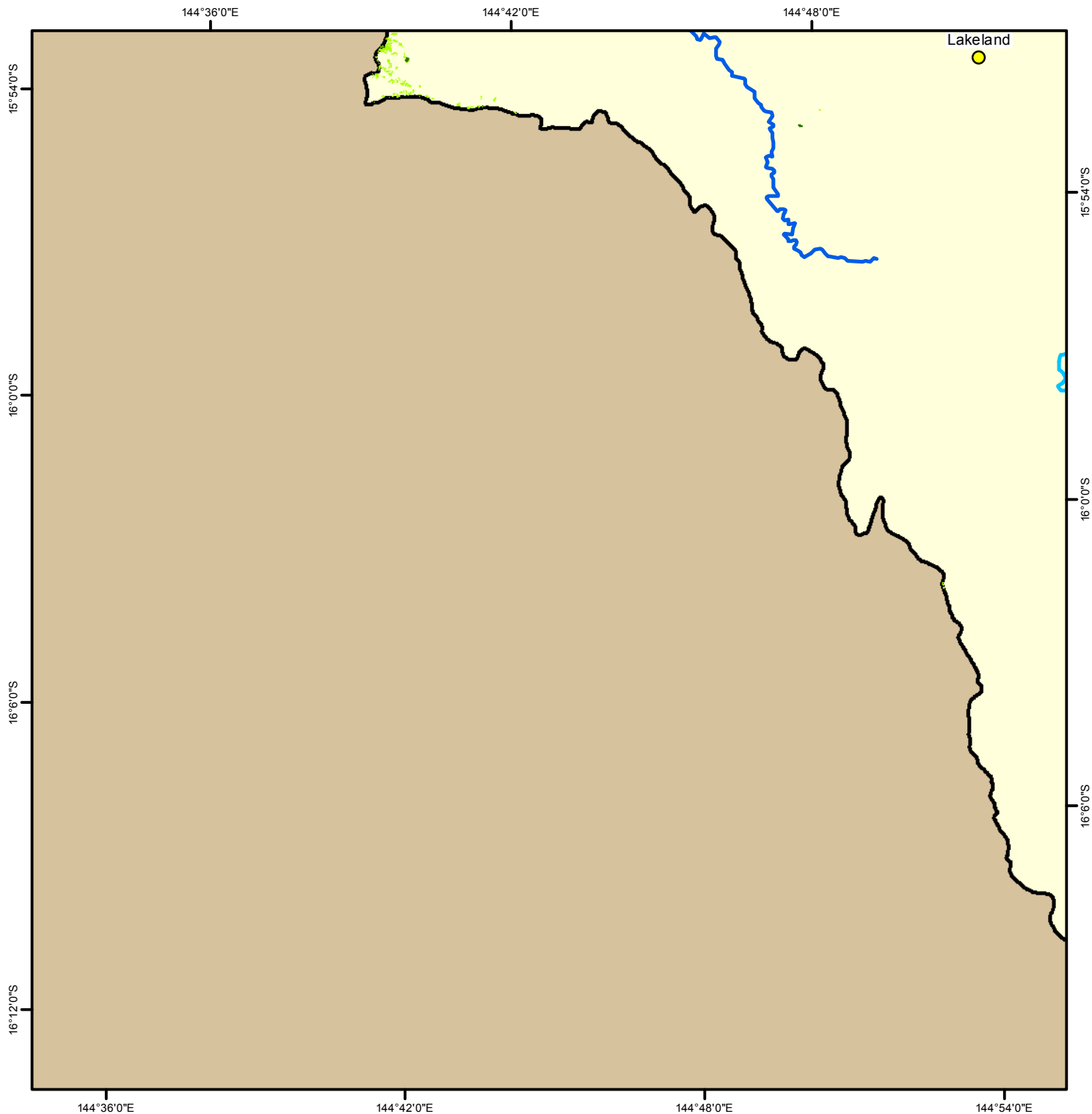
S11 Normanby Catchment



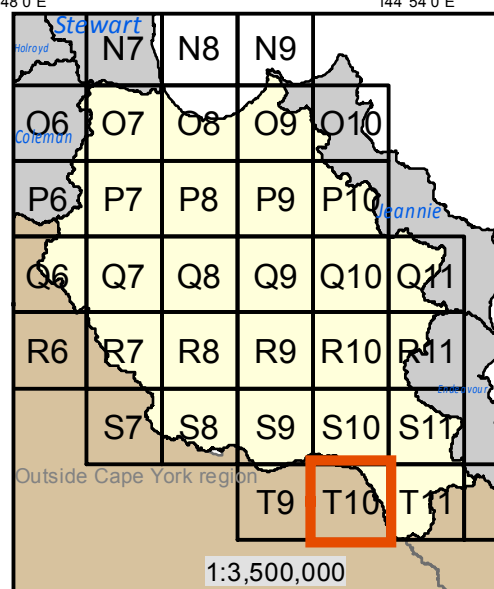
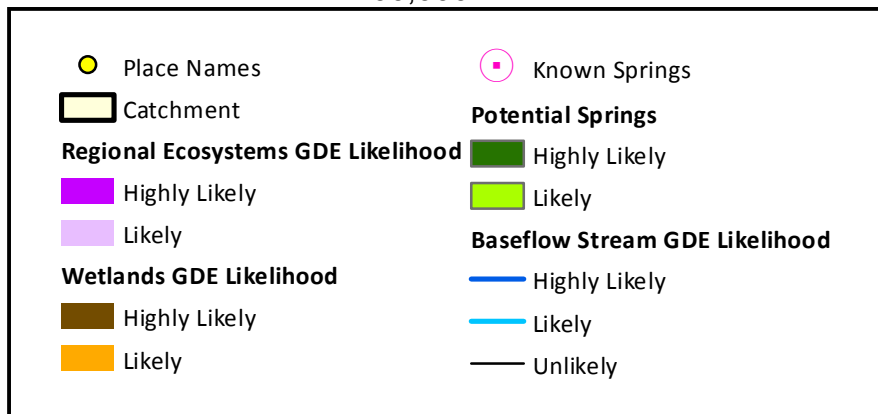
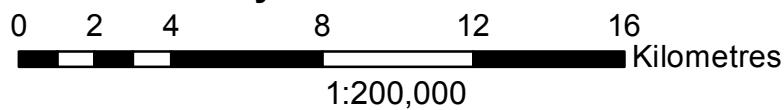


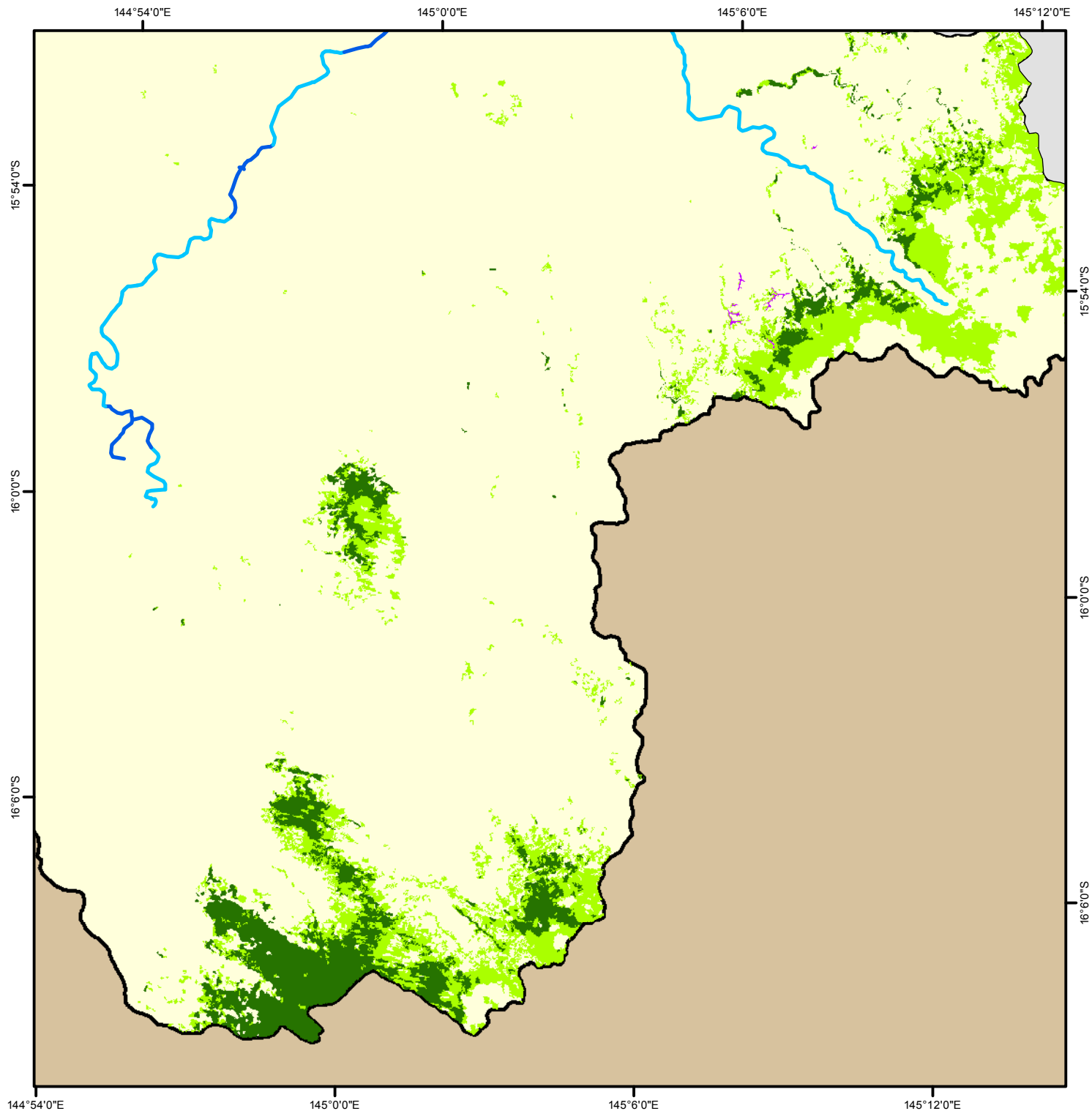
T9 Normanby Catchment



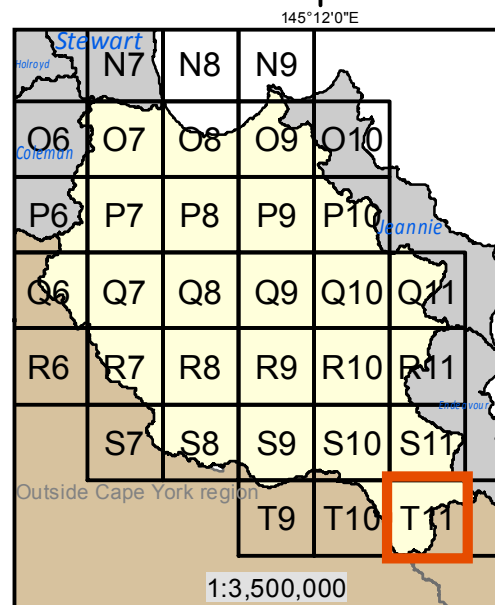
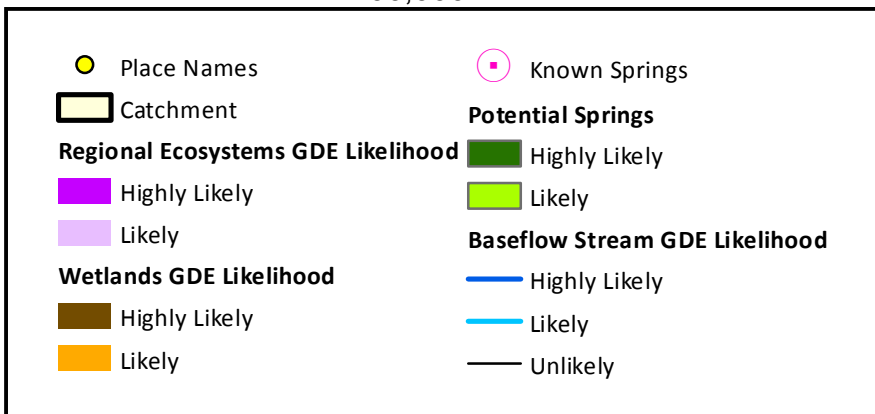
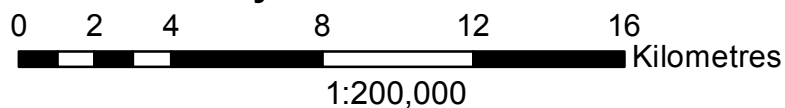


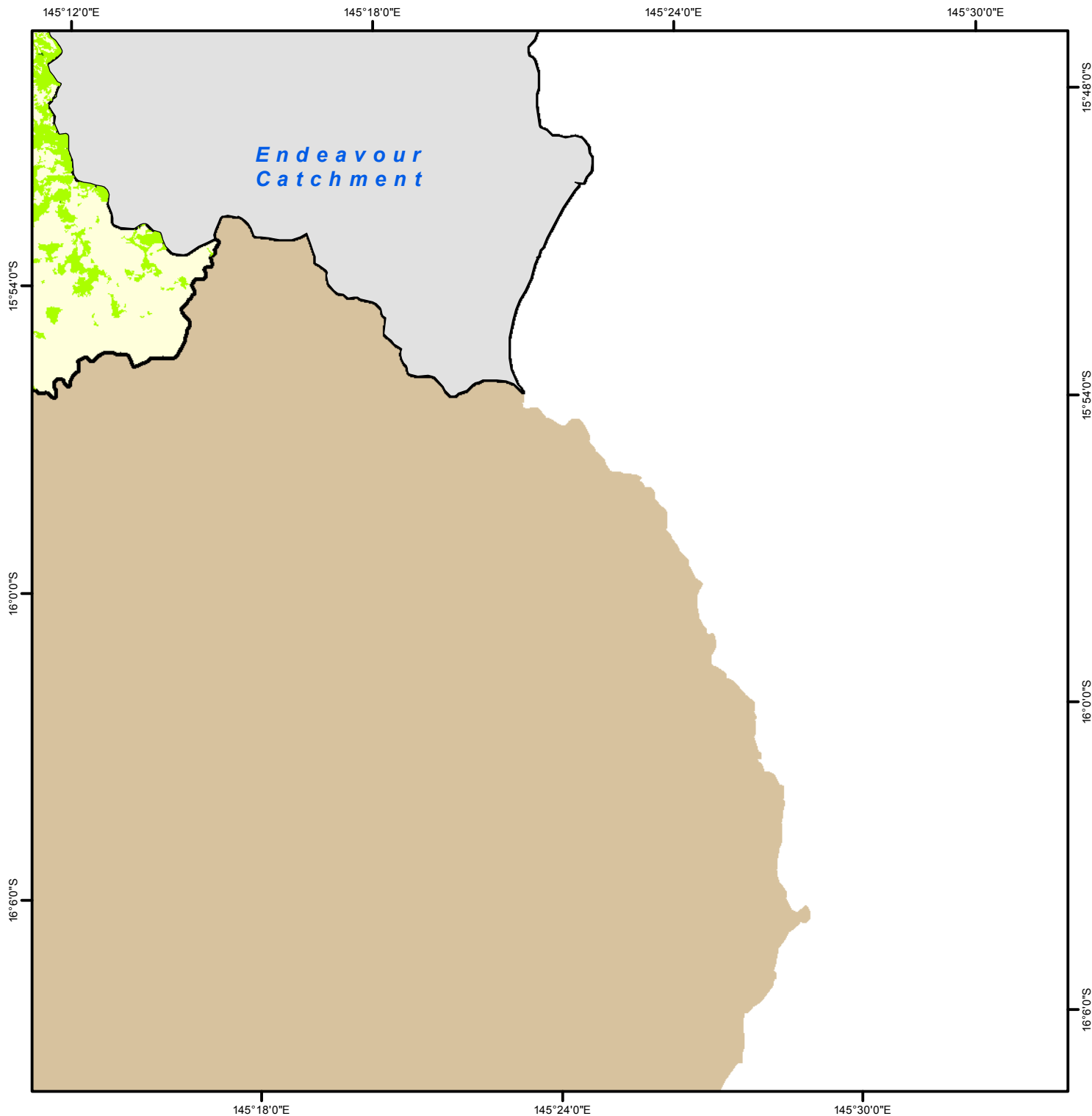
T10 Normanby Catchment



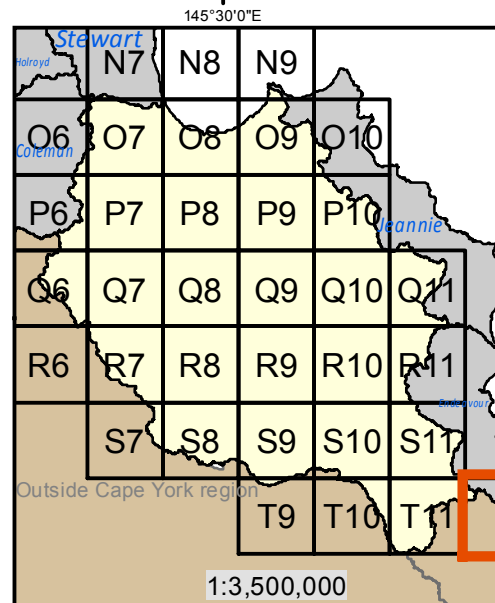
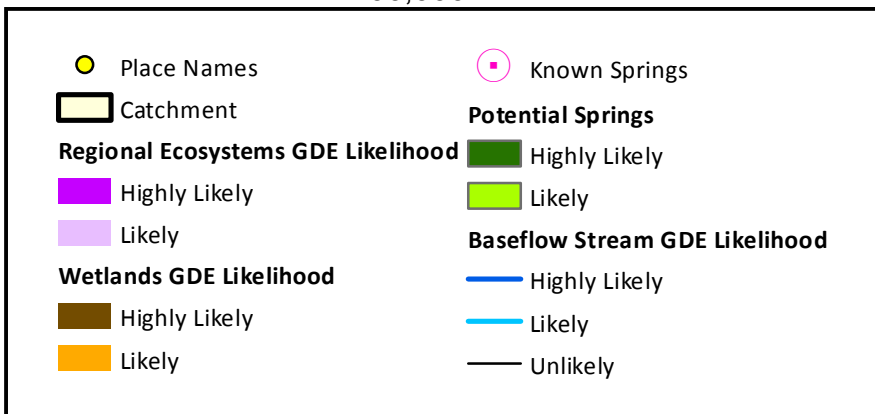
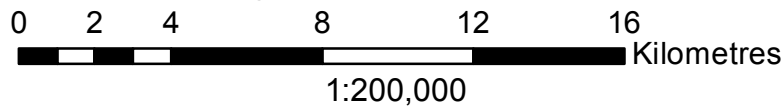


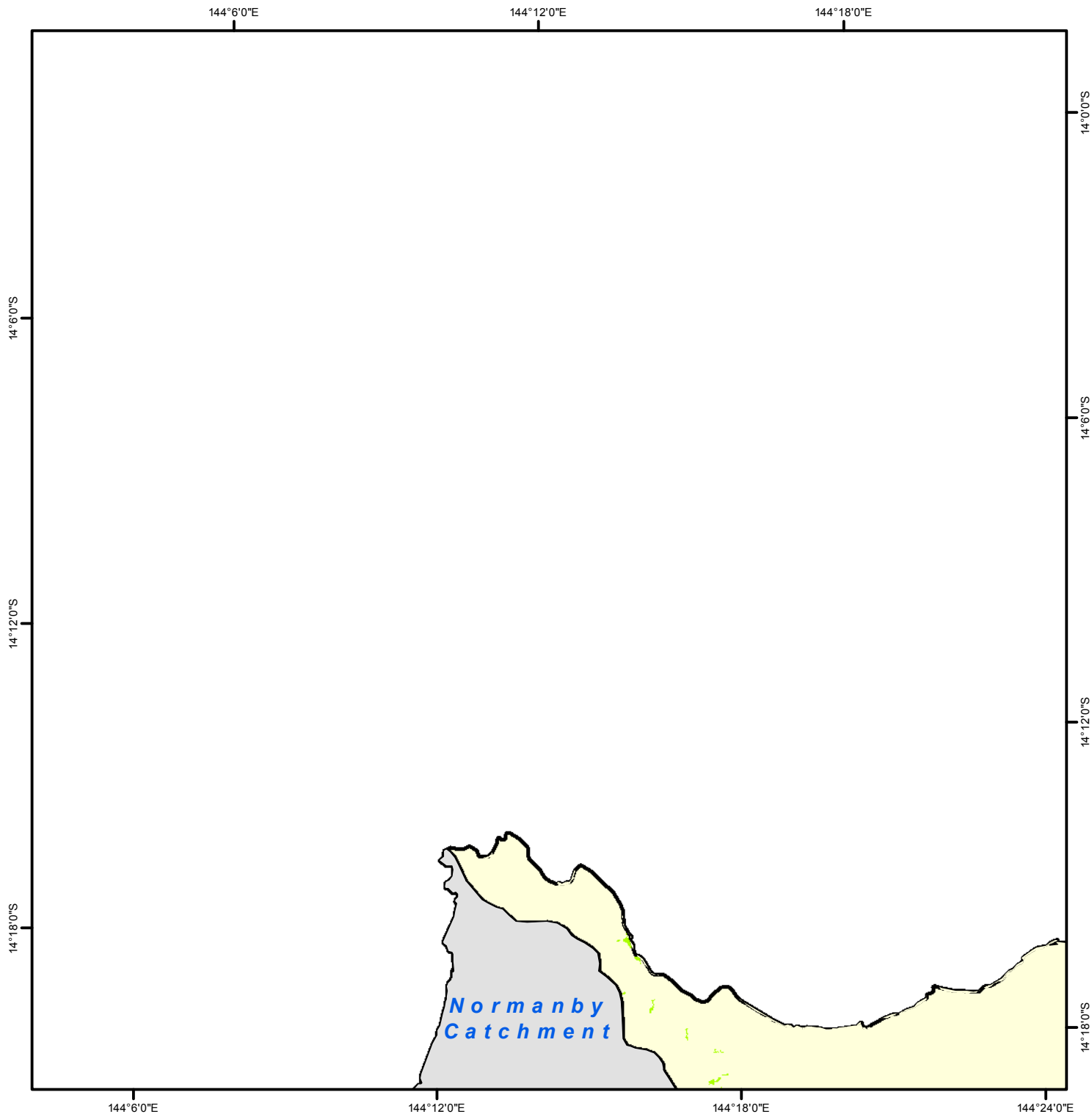
T11 Normanby Catchment



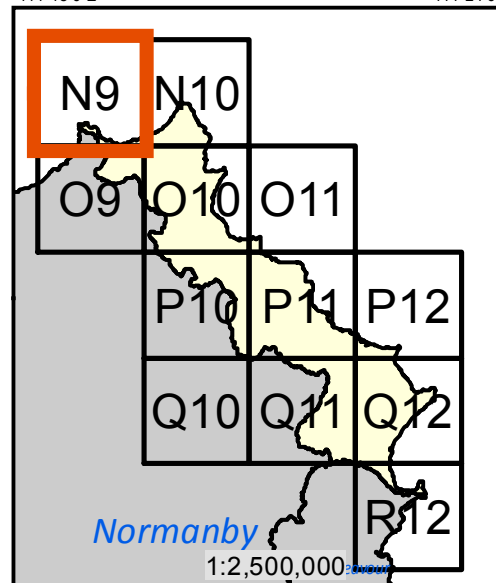
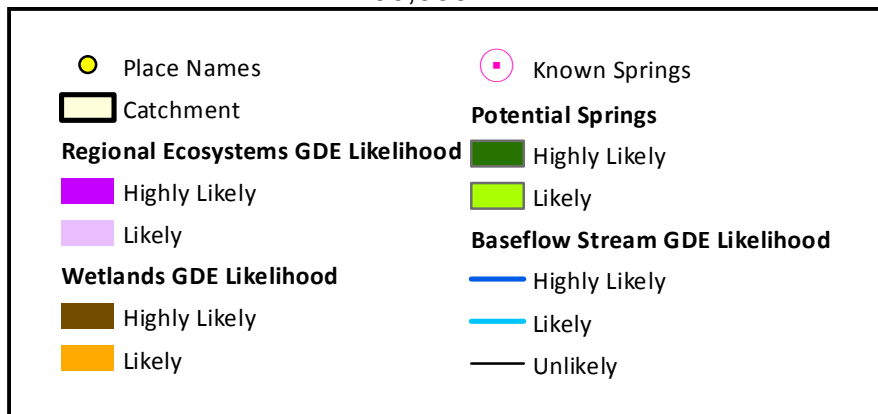
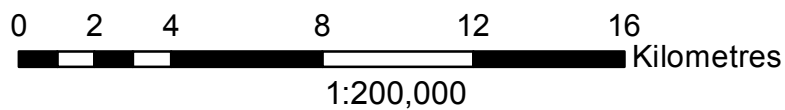


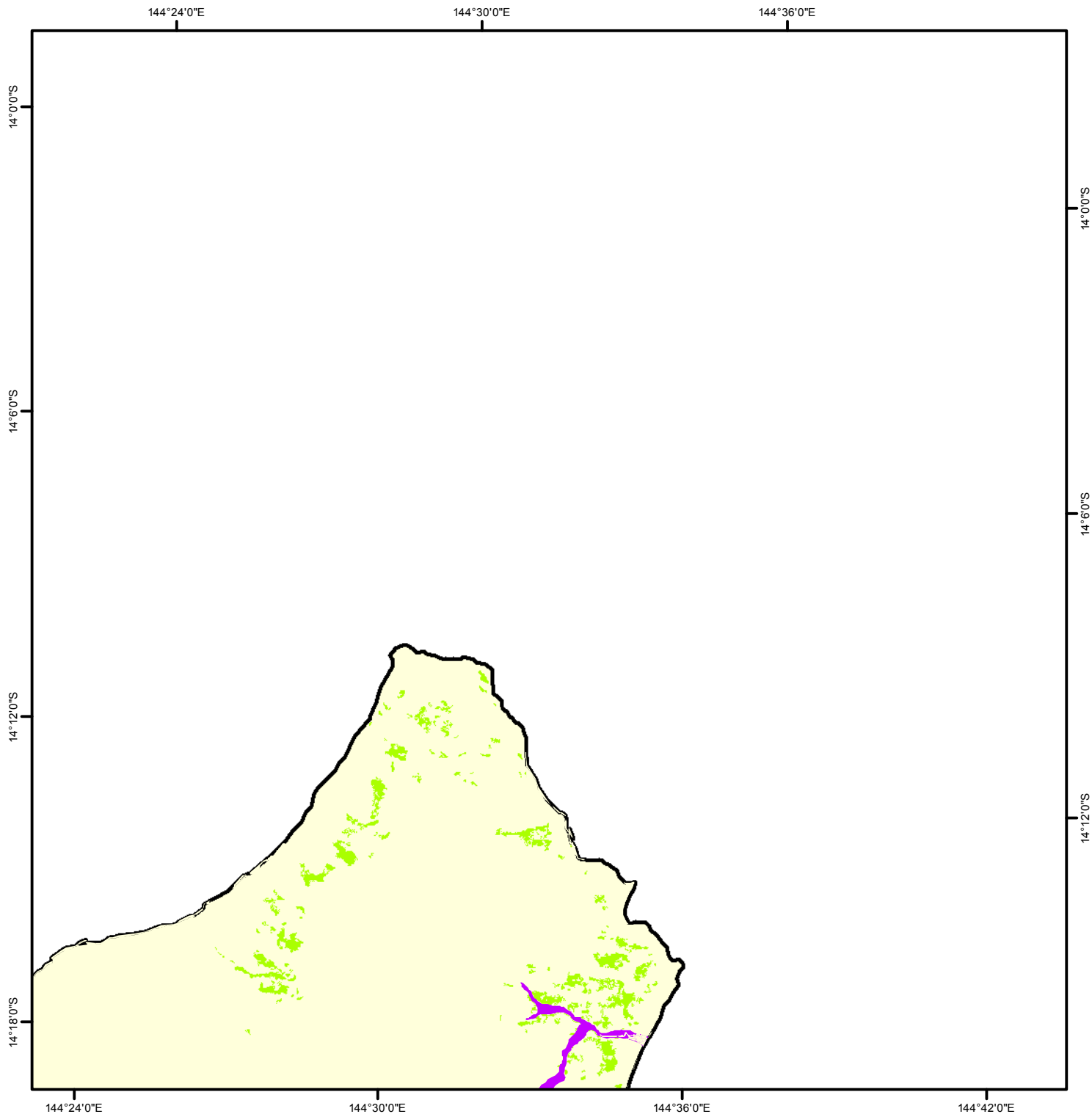
T12 Normanby Catchment



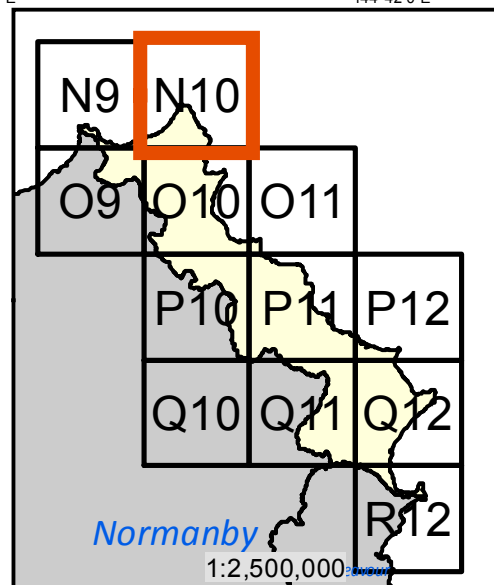
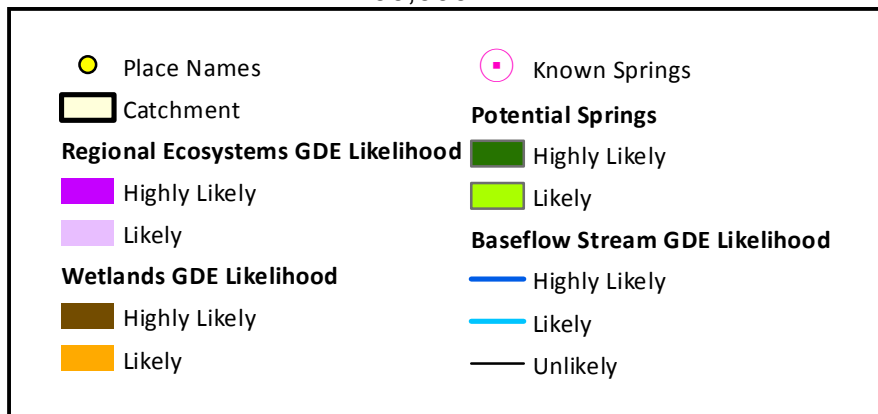
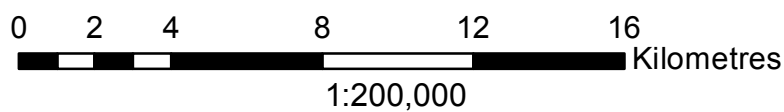


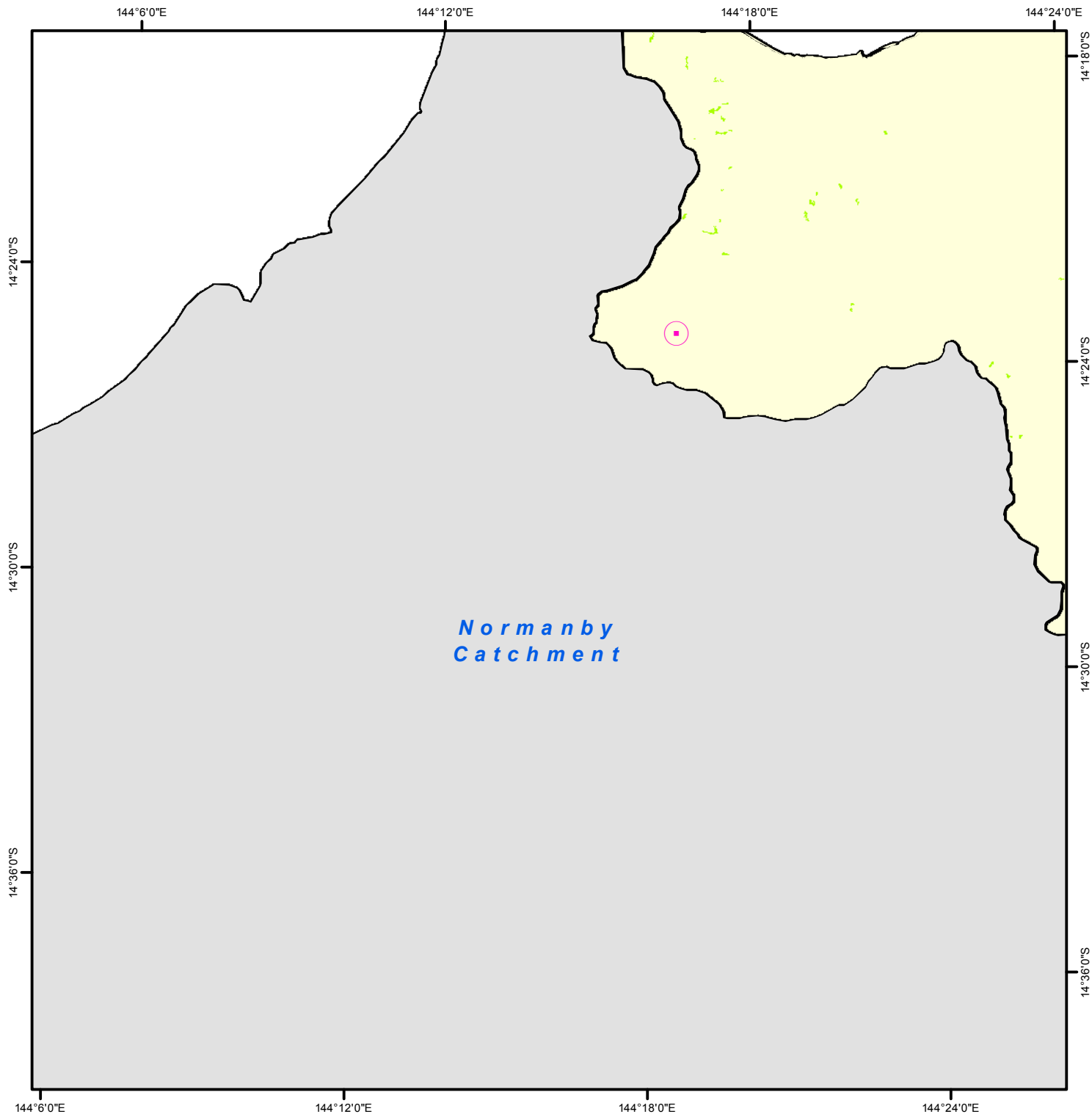
N9 Jeannie Catchment



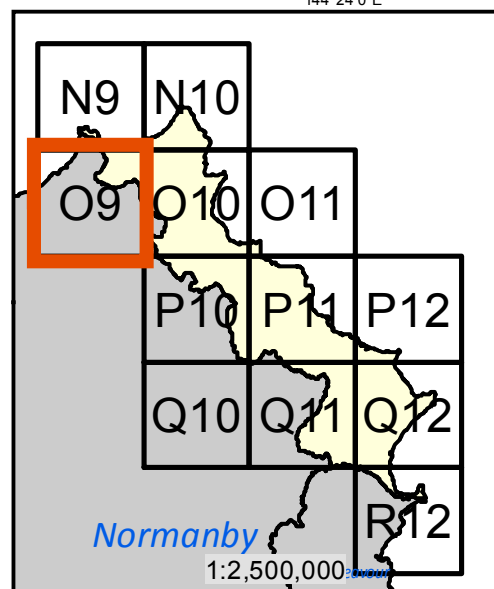
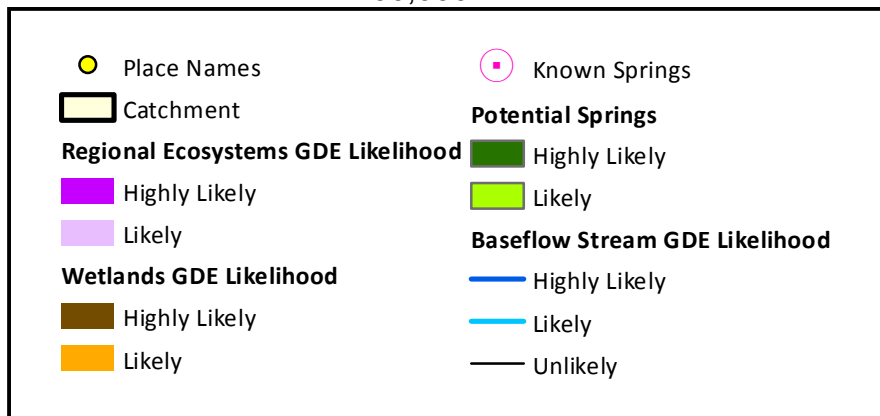
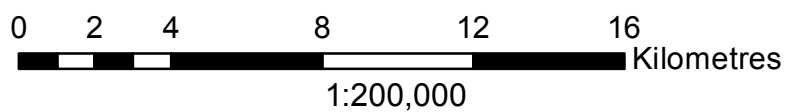


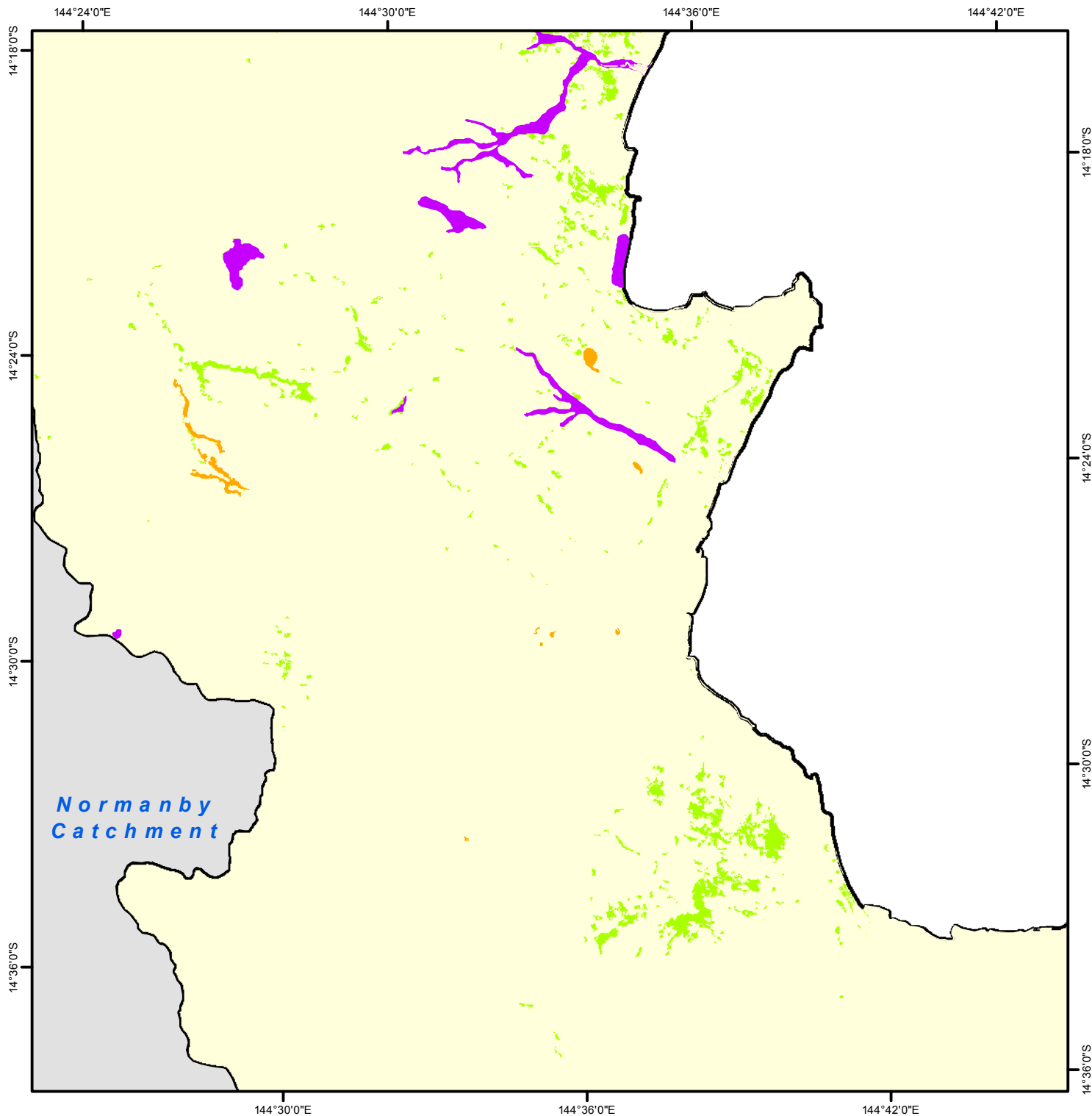
N10 Jeannie Catchment



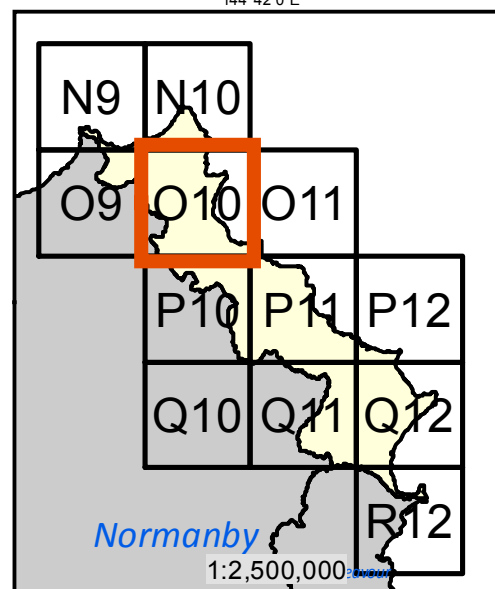
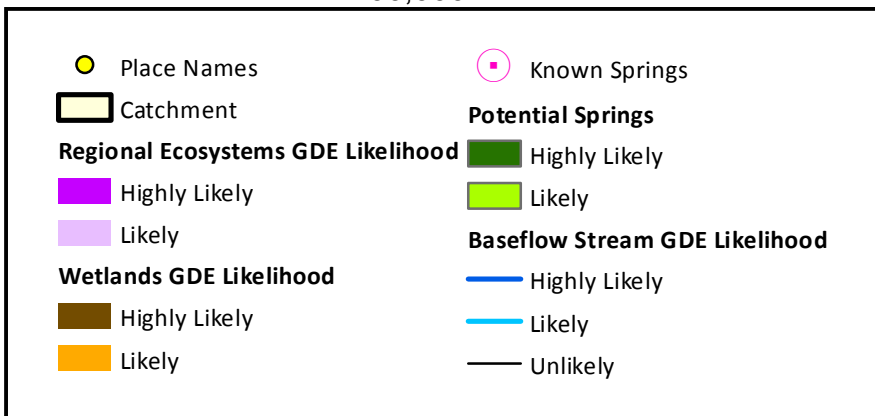
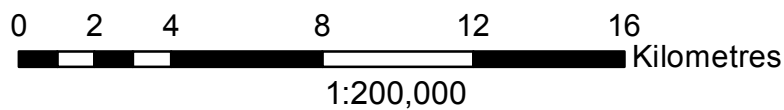


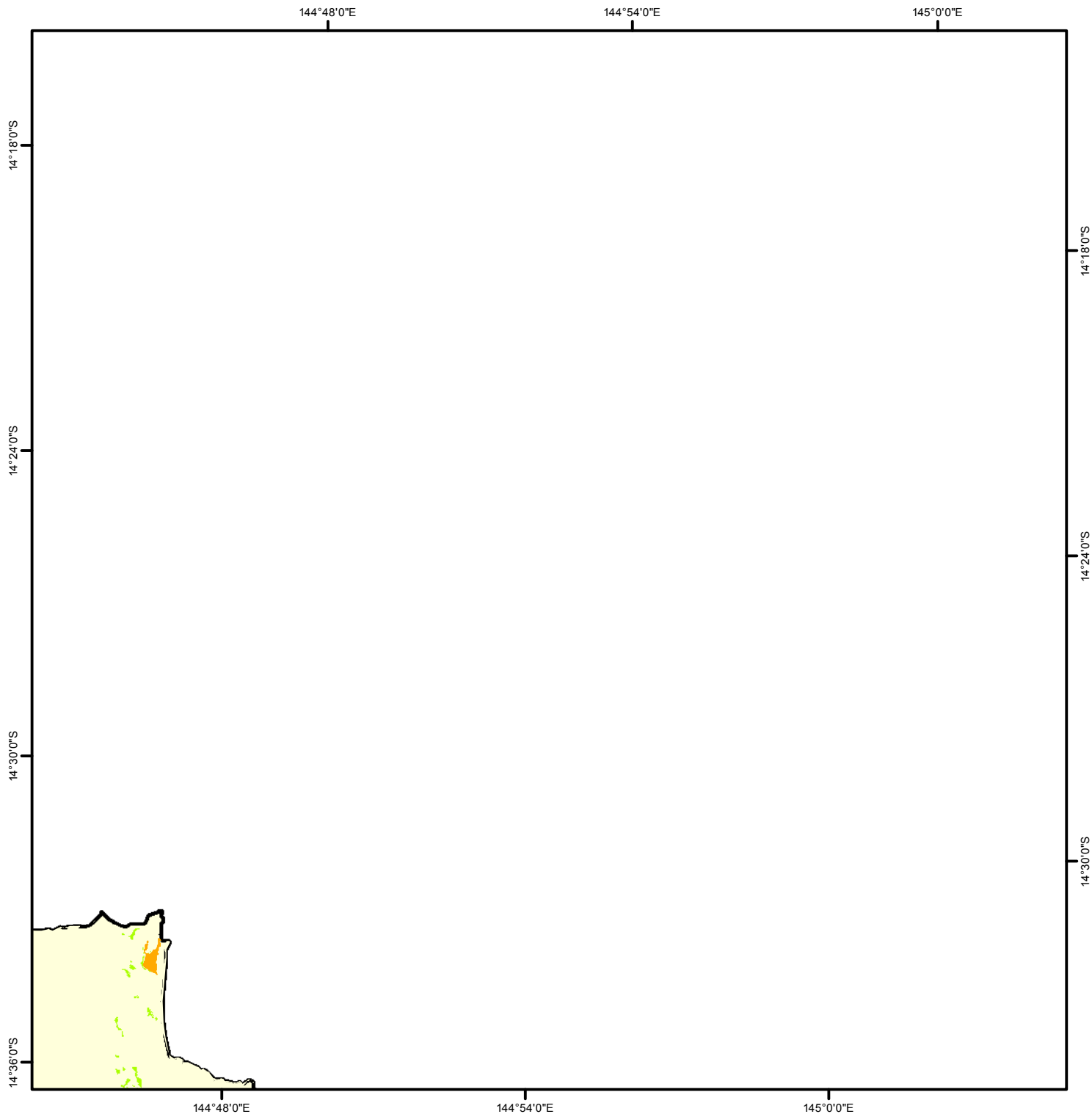
O9 Jeannie Catchment



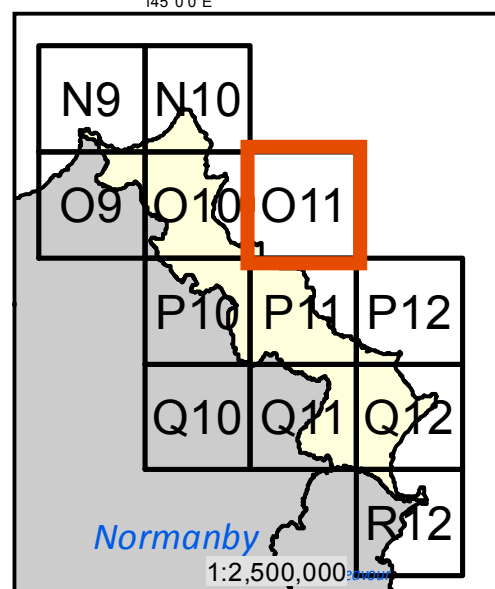
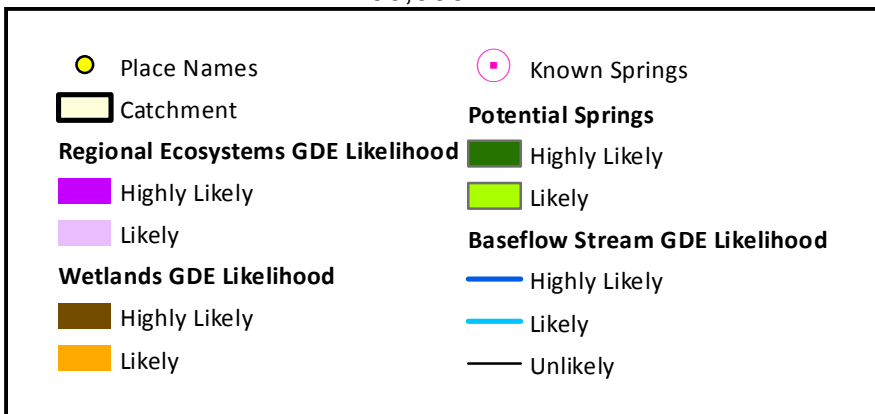
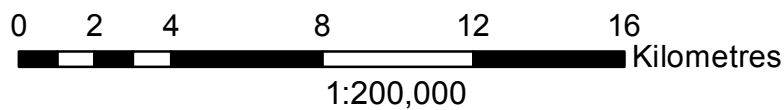


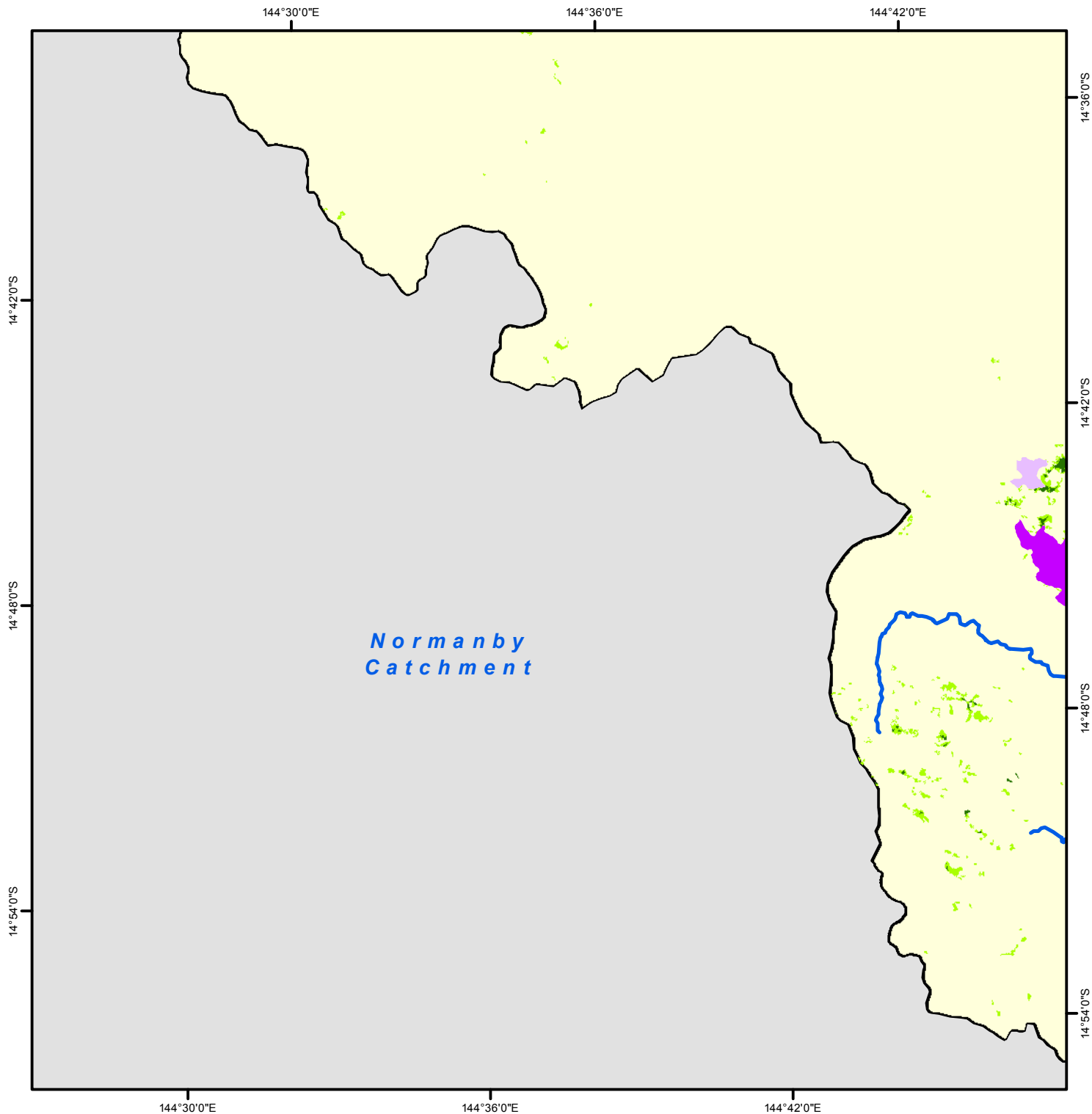
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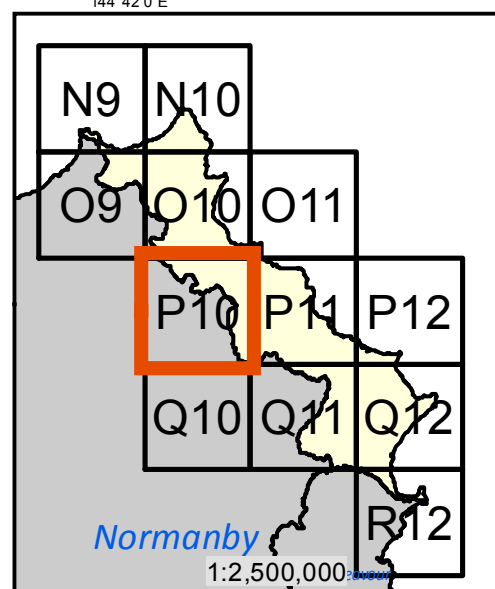
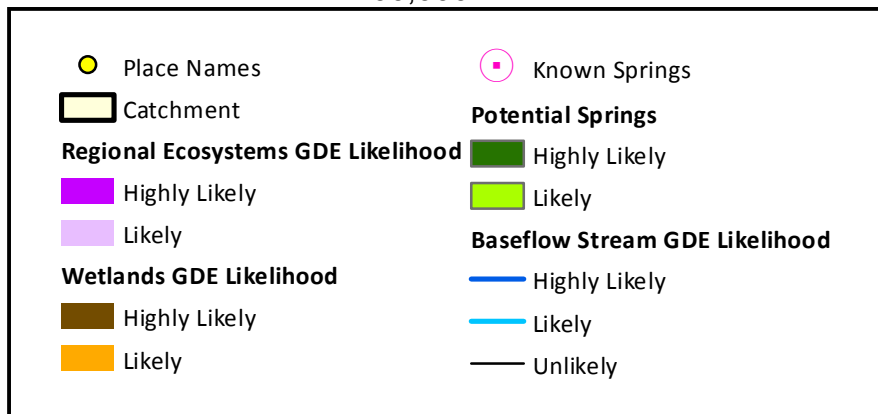
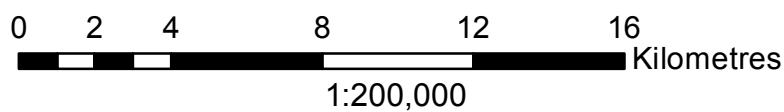


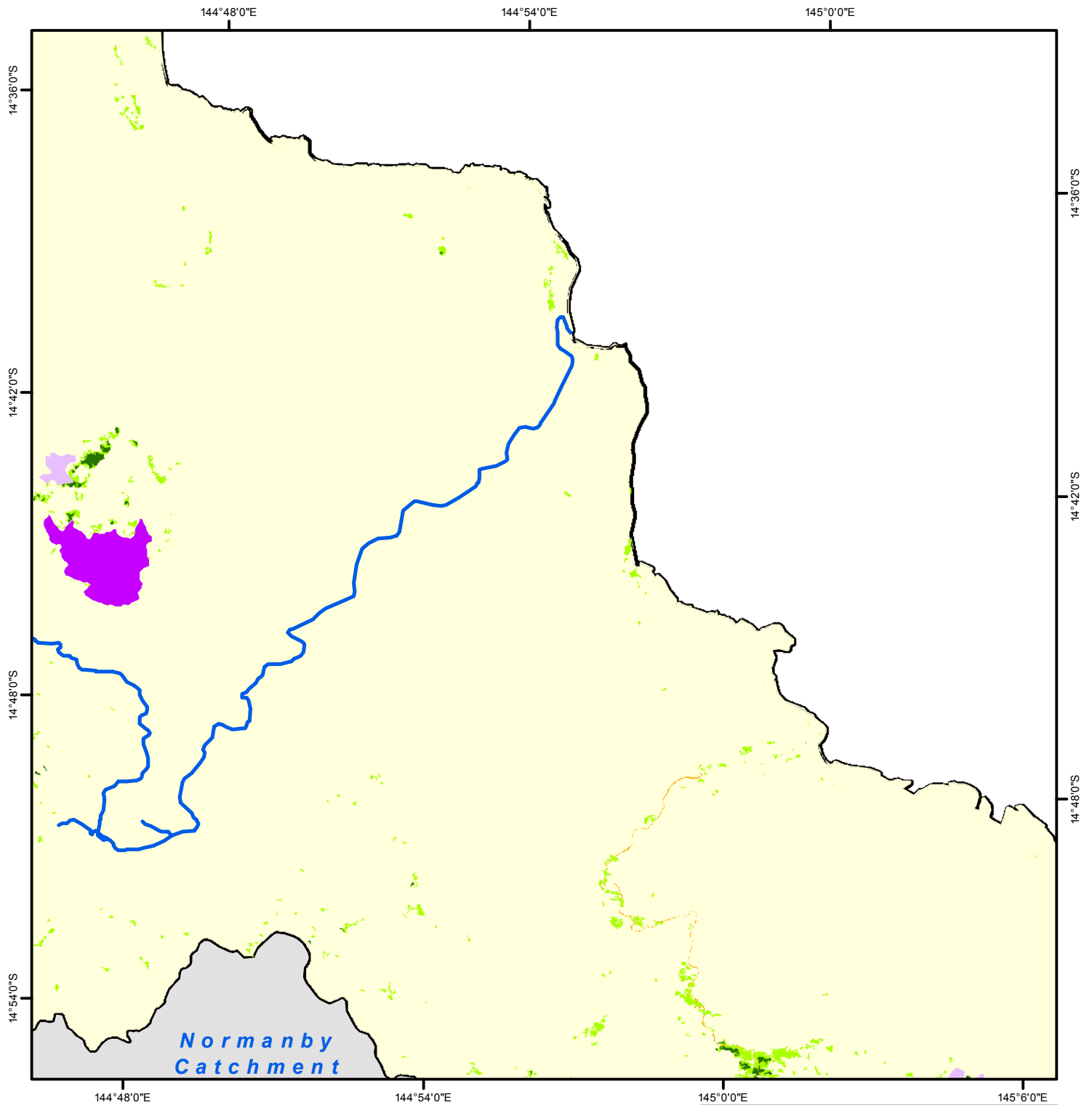
O11 Jeannie Catchment



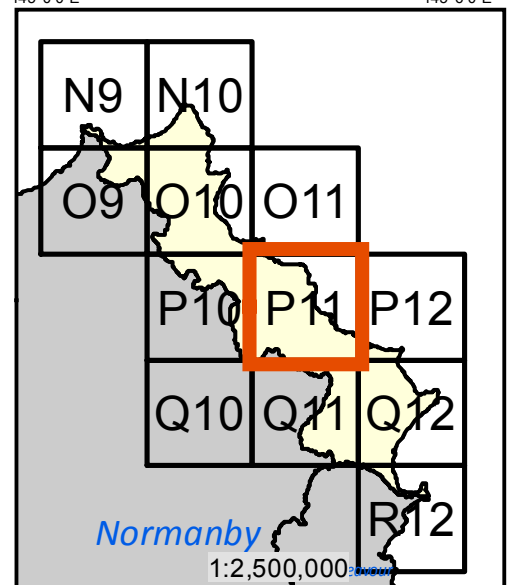
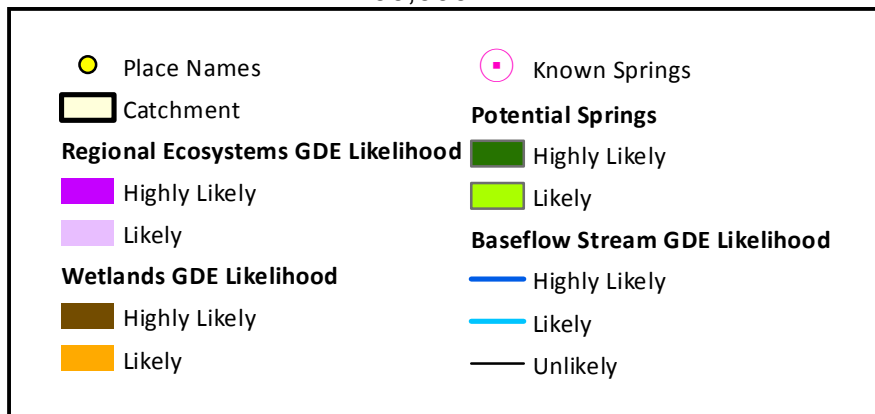
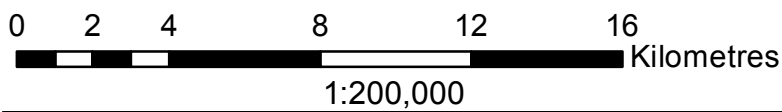


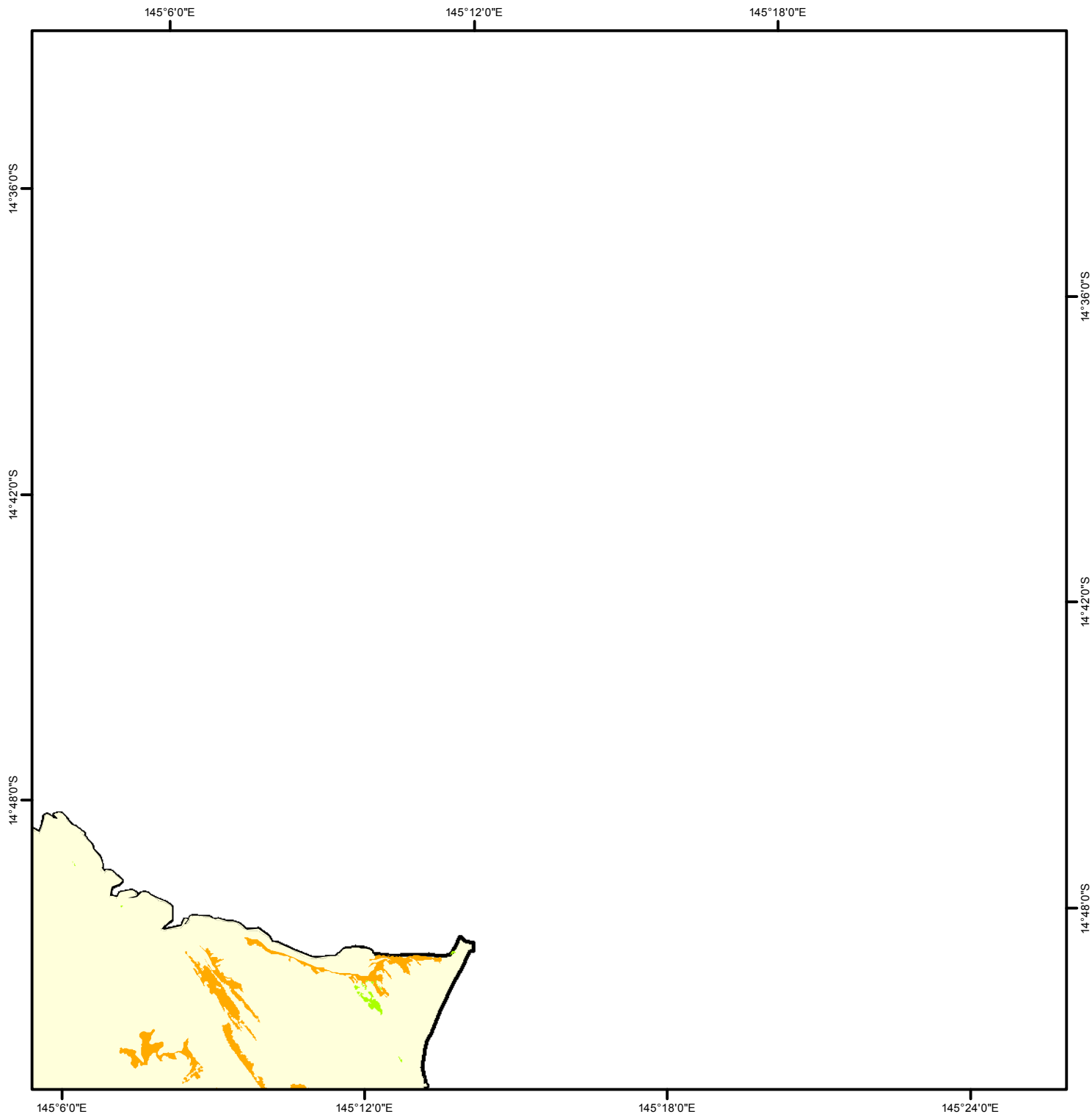
P10 Jeannie Catchment



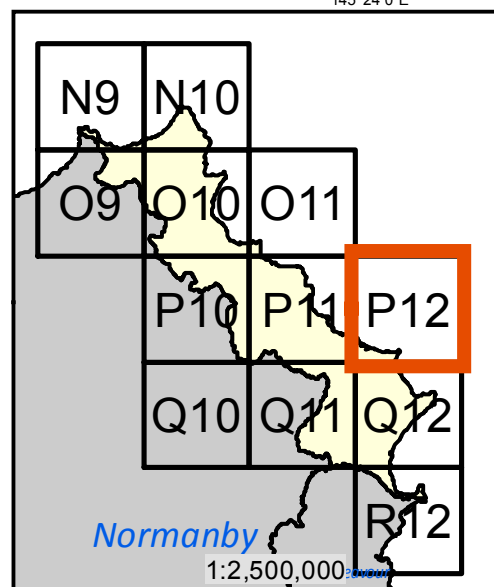
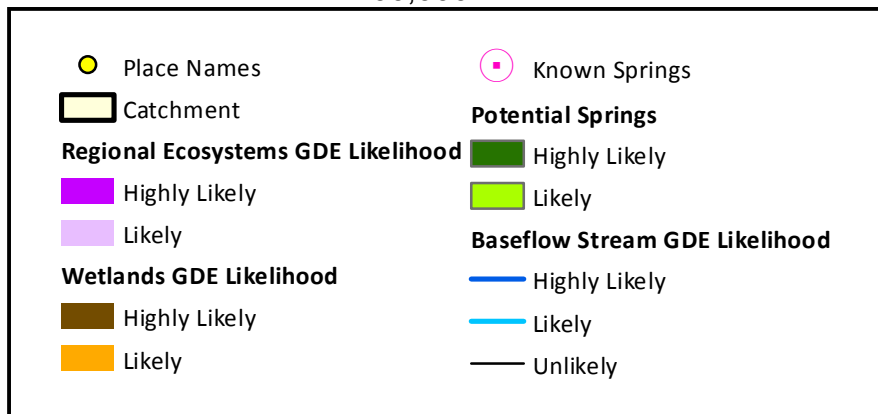
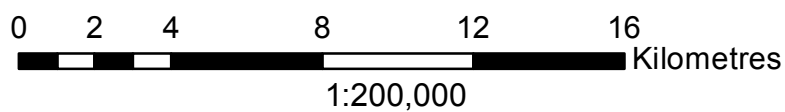


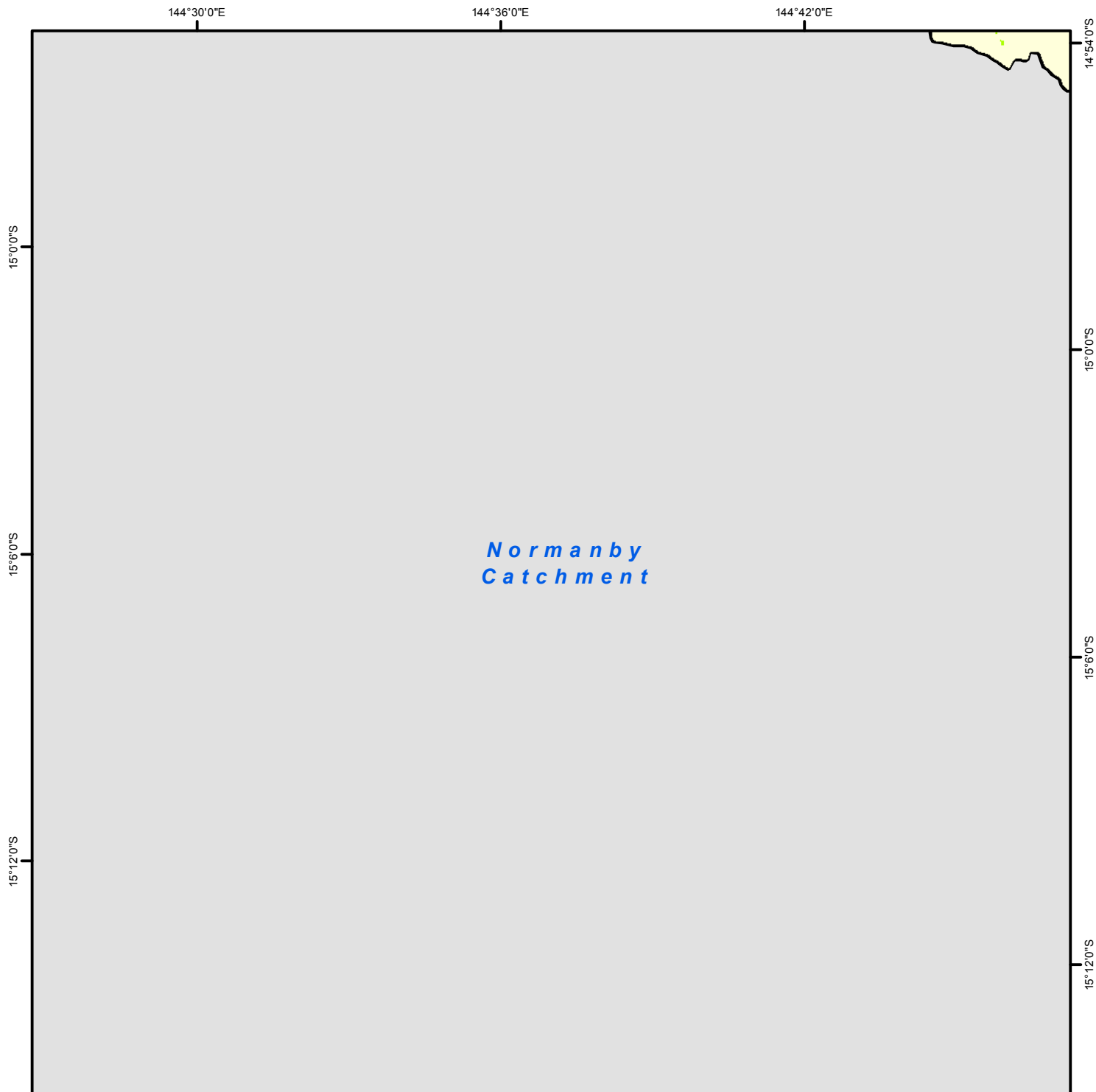
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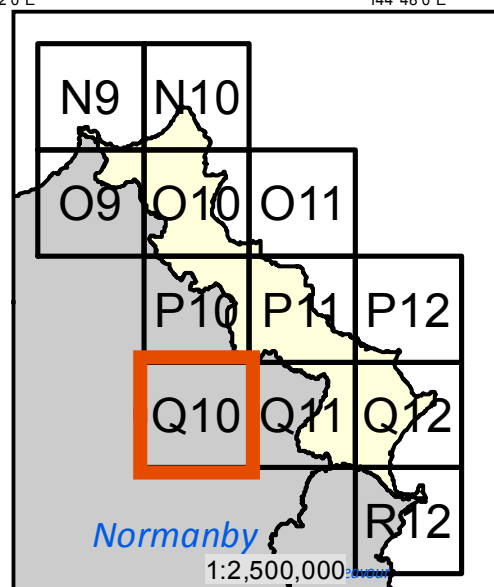
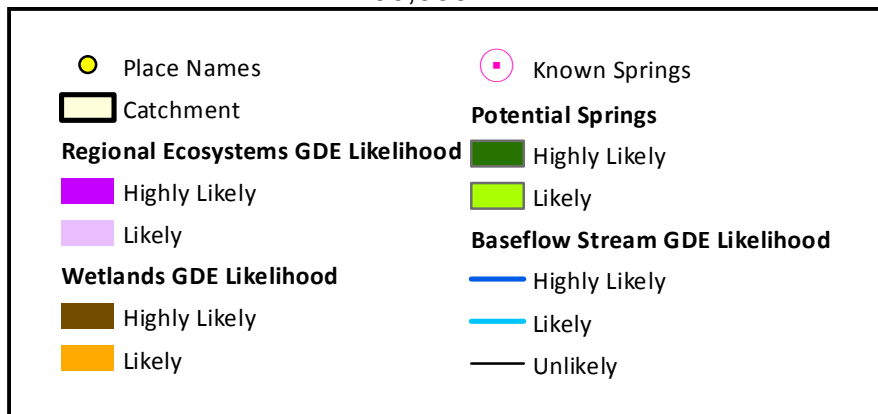
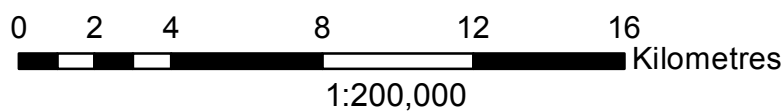


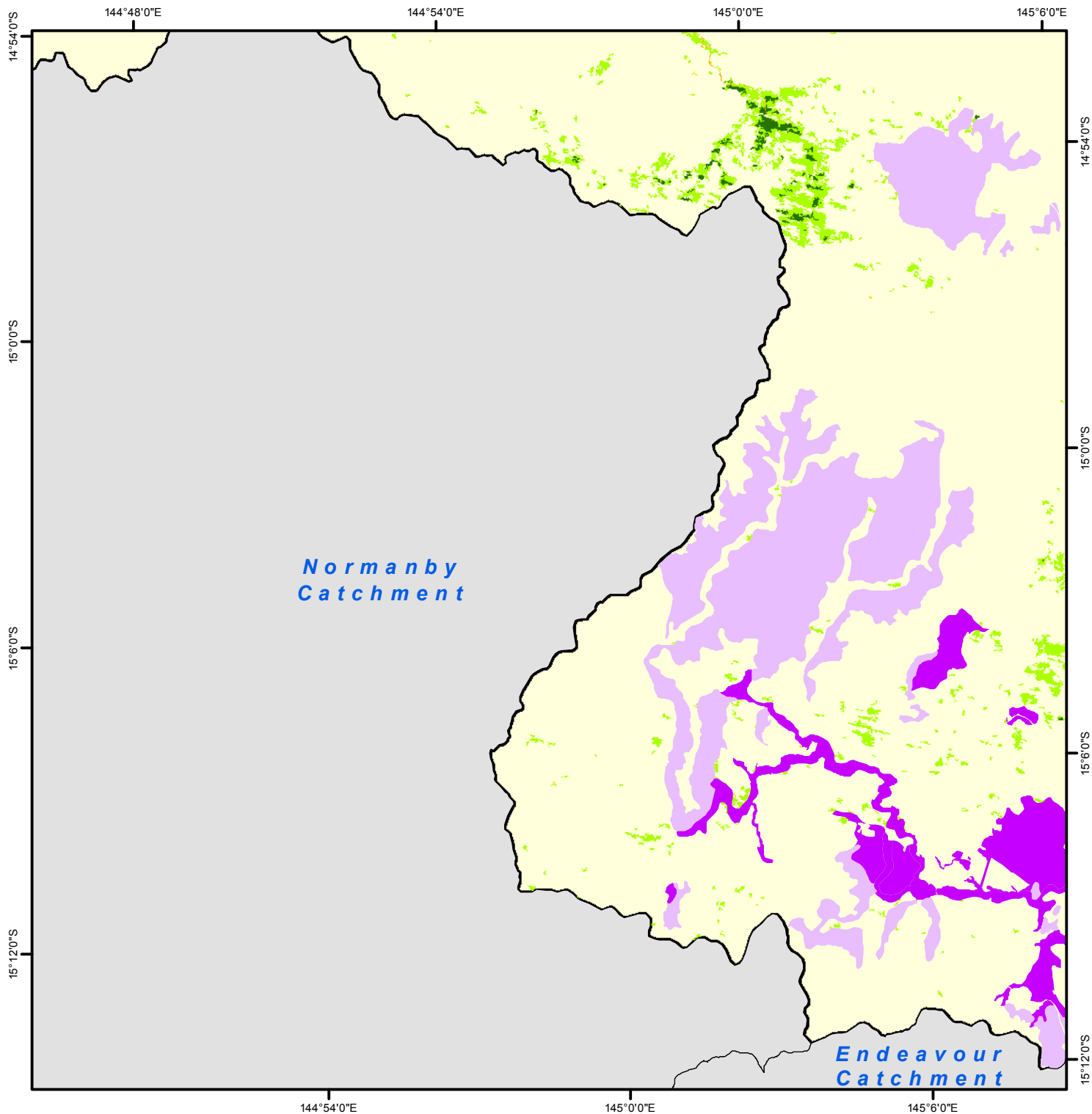
P12 Jeannie Catchment



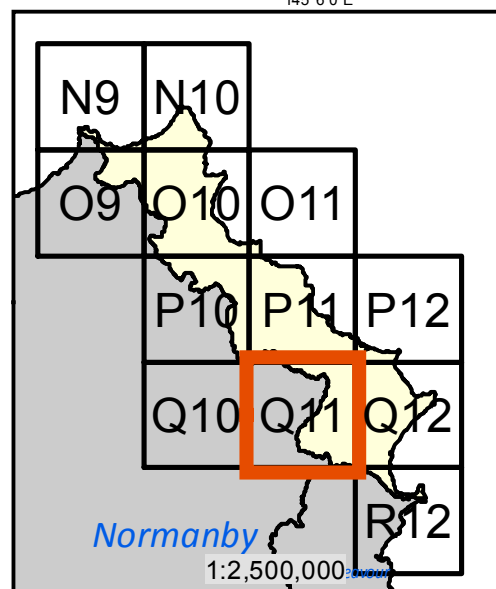
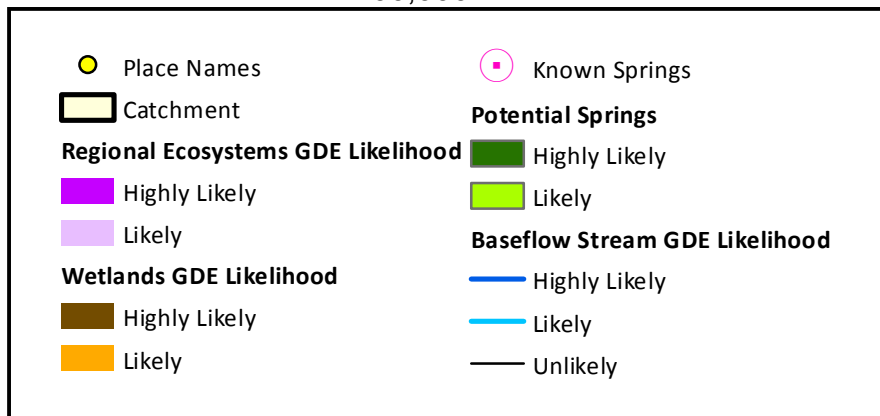
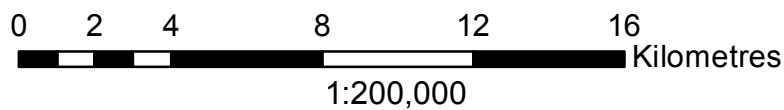


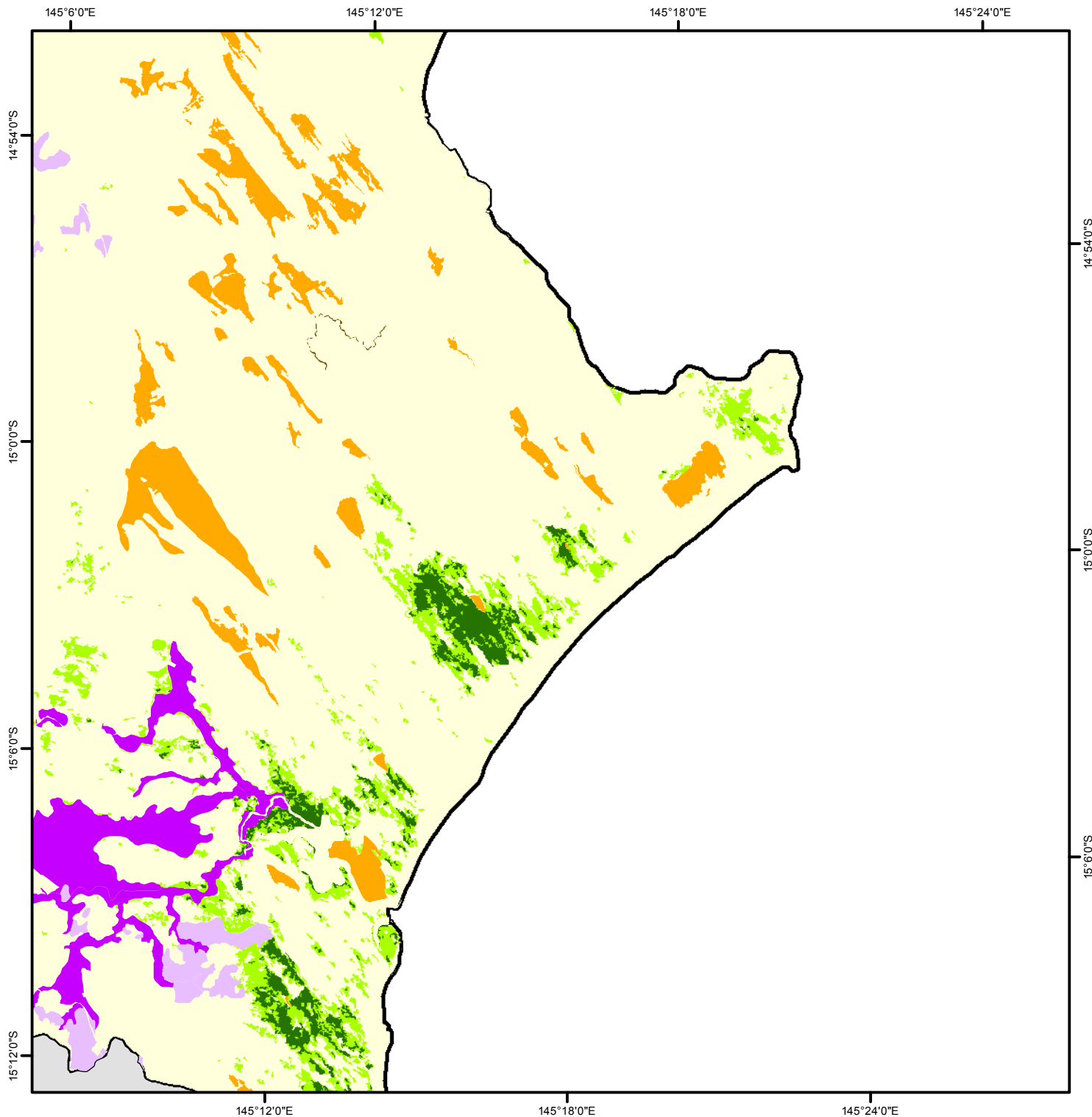
Q10 Jeannie Catchment



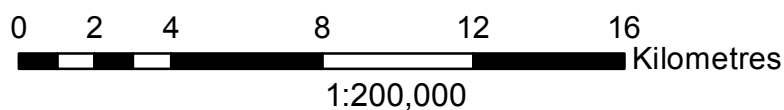


Q11 Jeannie Catchment

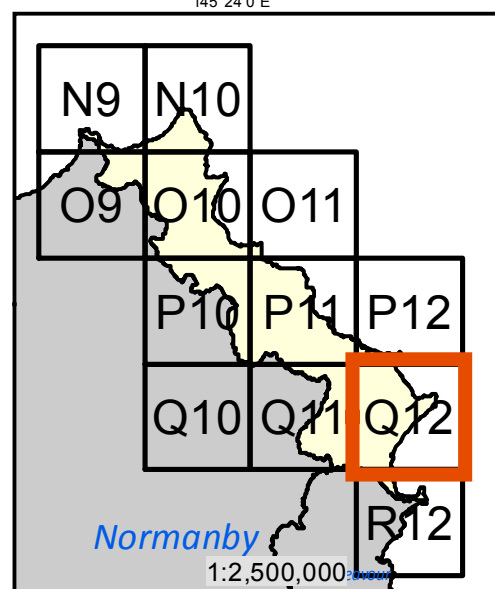


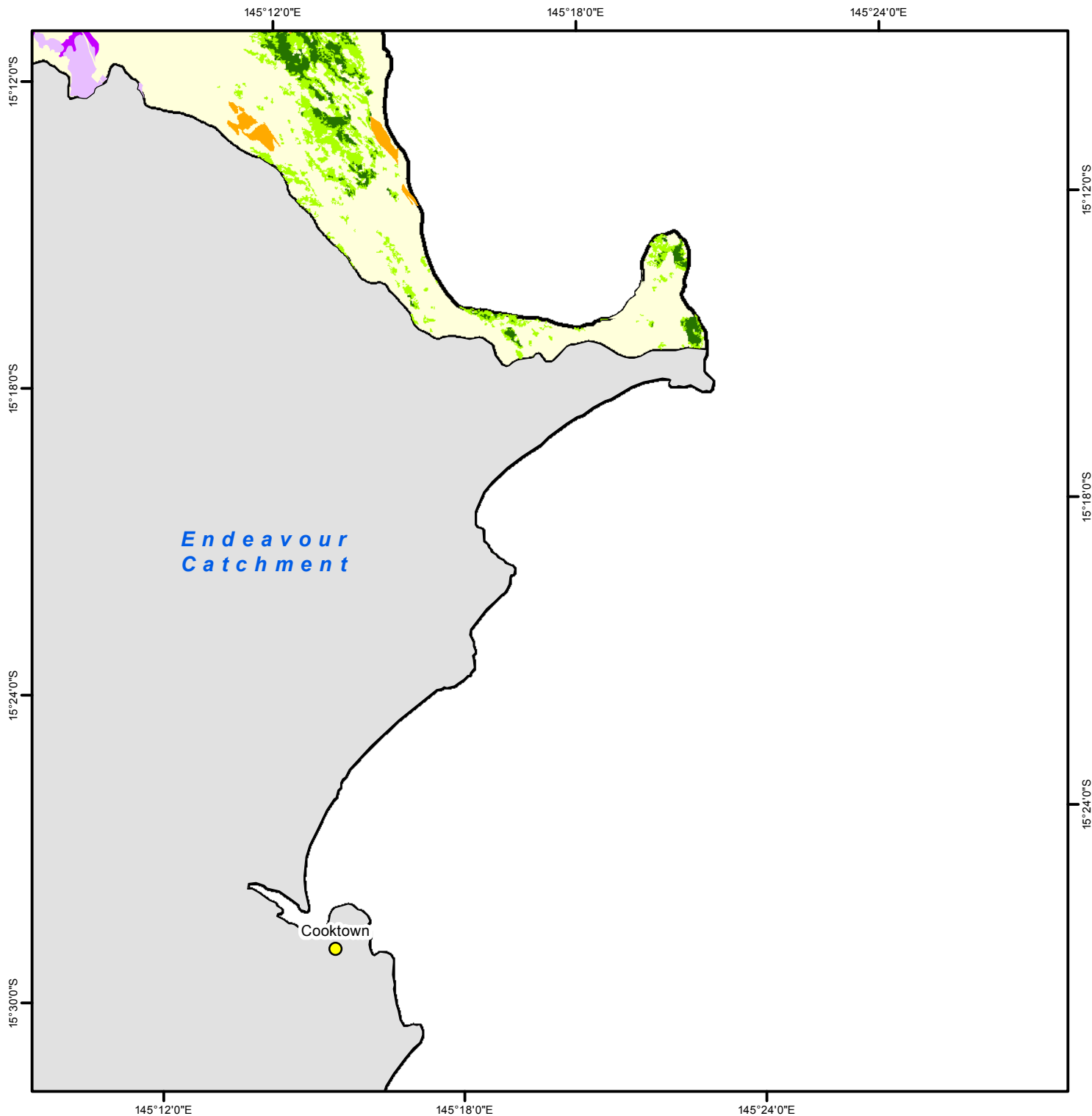


Q12 Jeannie Catchment

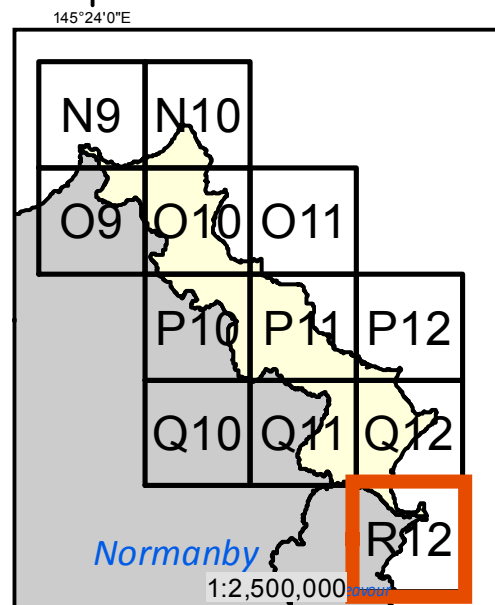
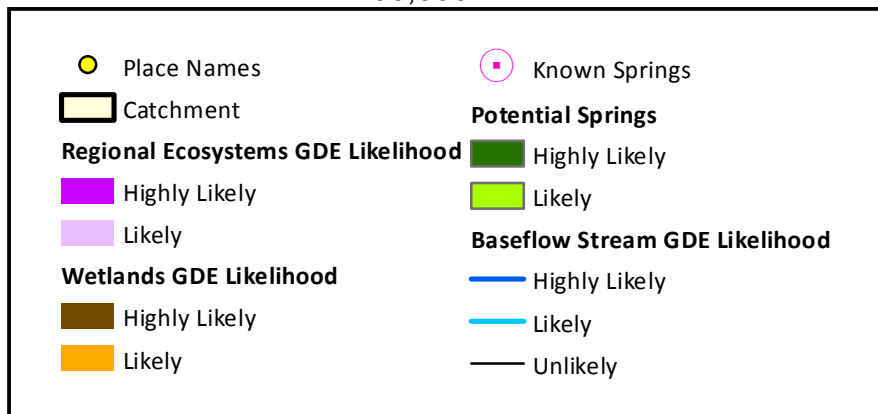
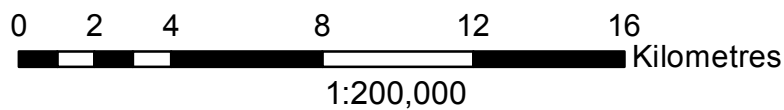


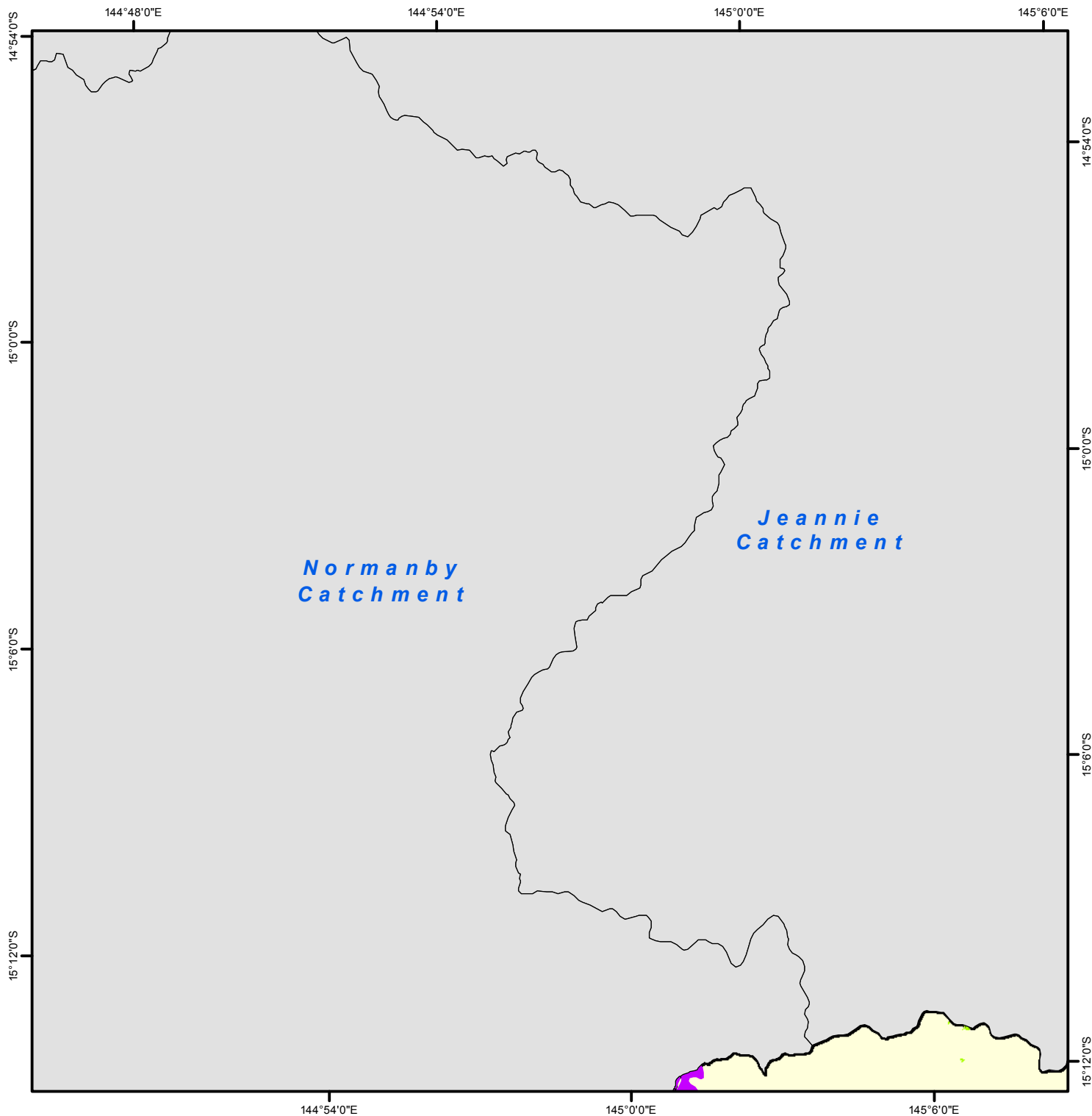
- | | |
|-------------------------------------------|---------------------------------------|
| Place Names | Known Springs |
| Catchment | Potential Springs |
| Regional Ecosystems GDE Likelihood | Highly Likely |
| Highly Likely | Likely |
| Likely | Baseflow Stream GDE Likelihood |
| Wetlands GDE Likelihood | Highly Likely |
| Highly Likely | Likely |
| Likely | Unlikely |



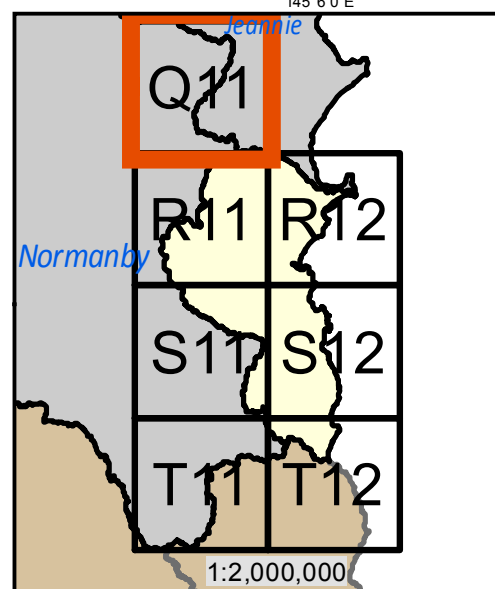
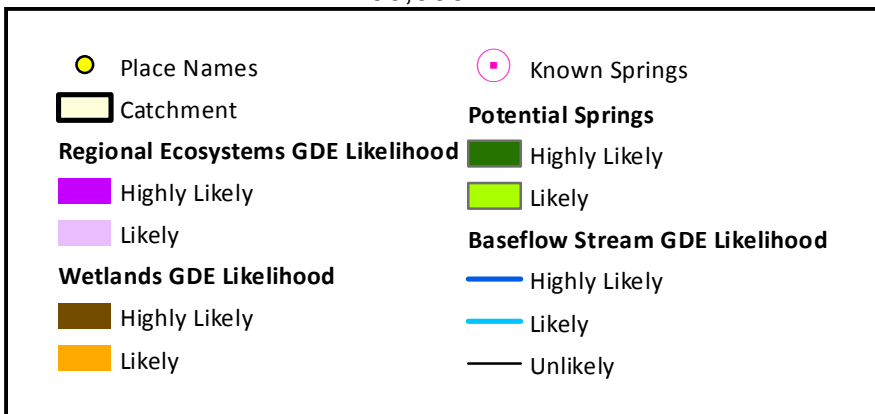
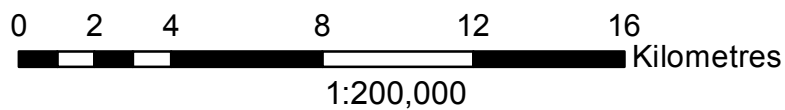


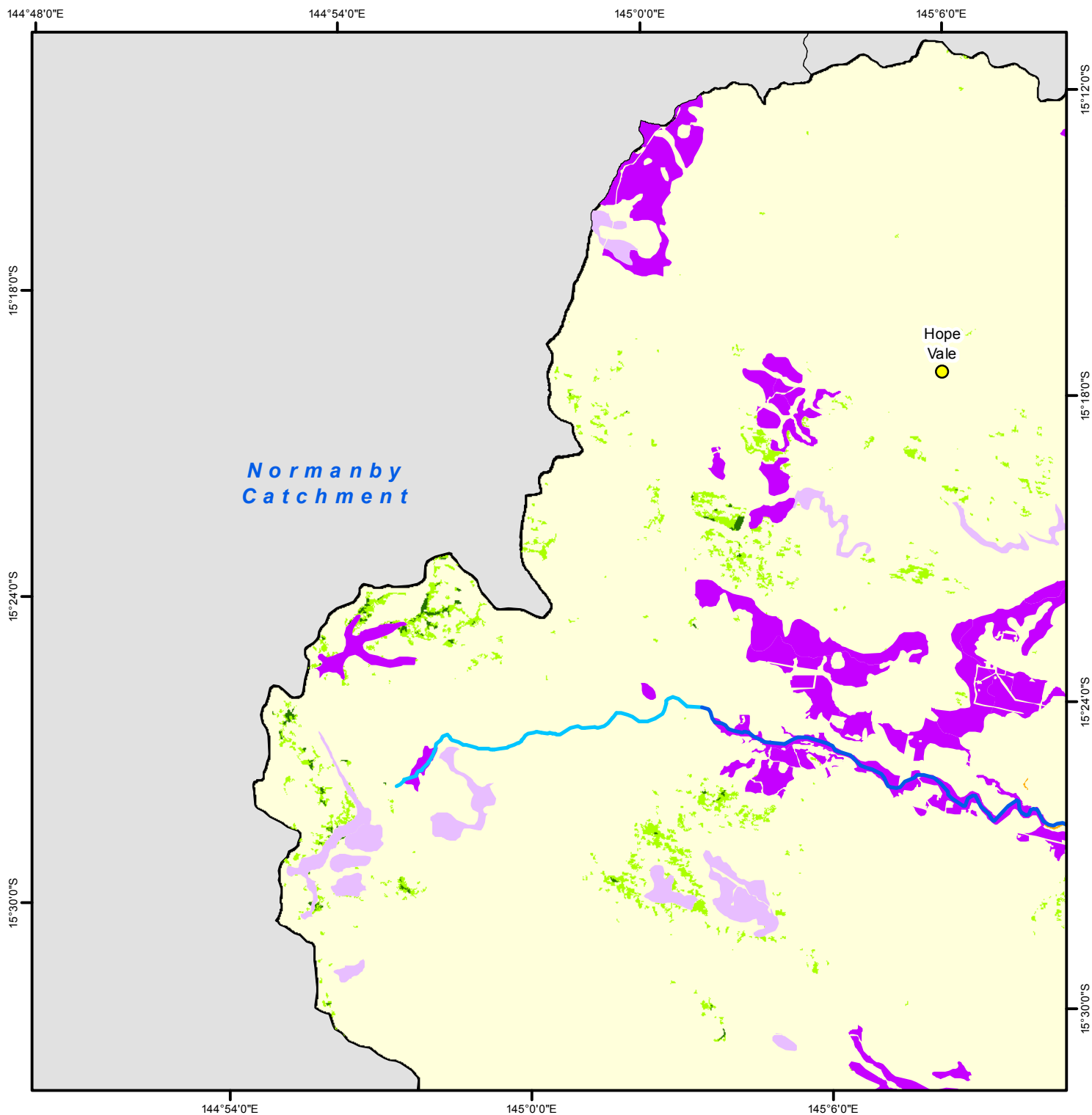
R12 Jeannie Catchment



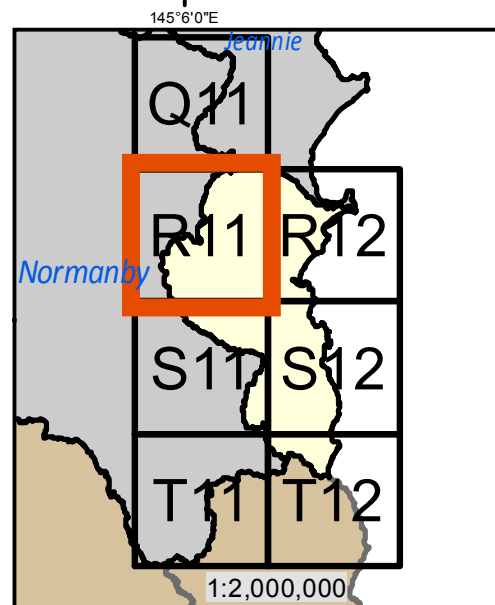
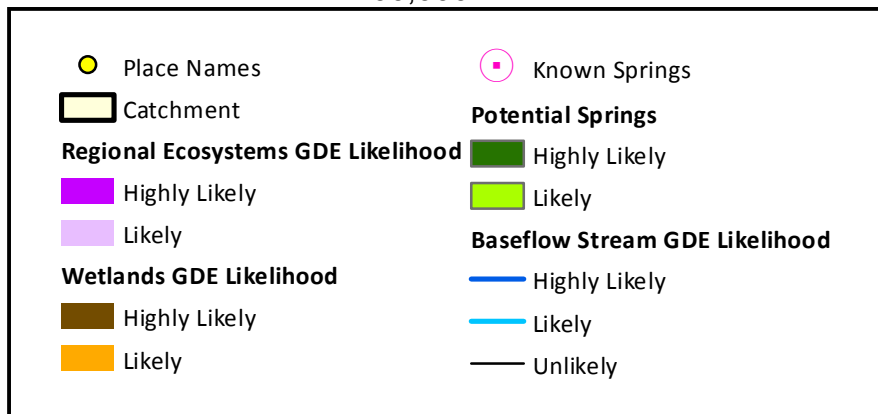
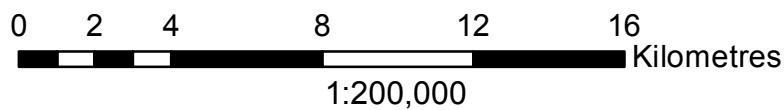


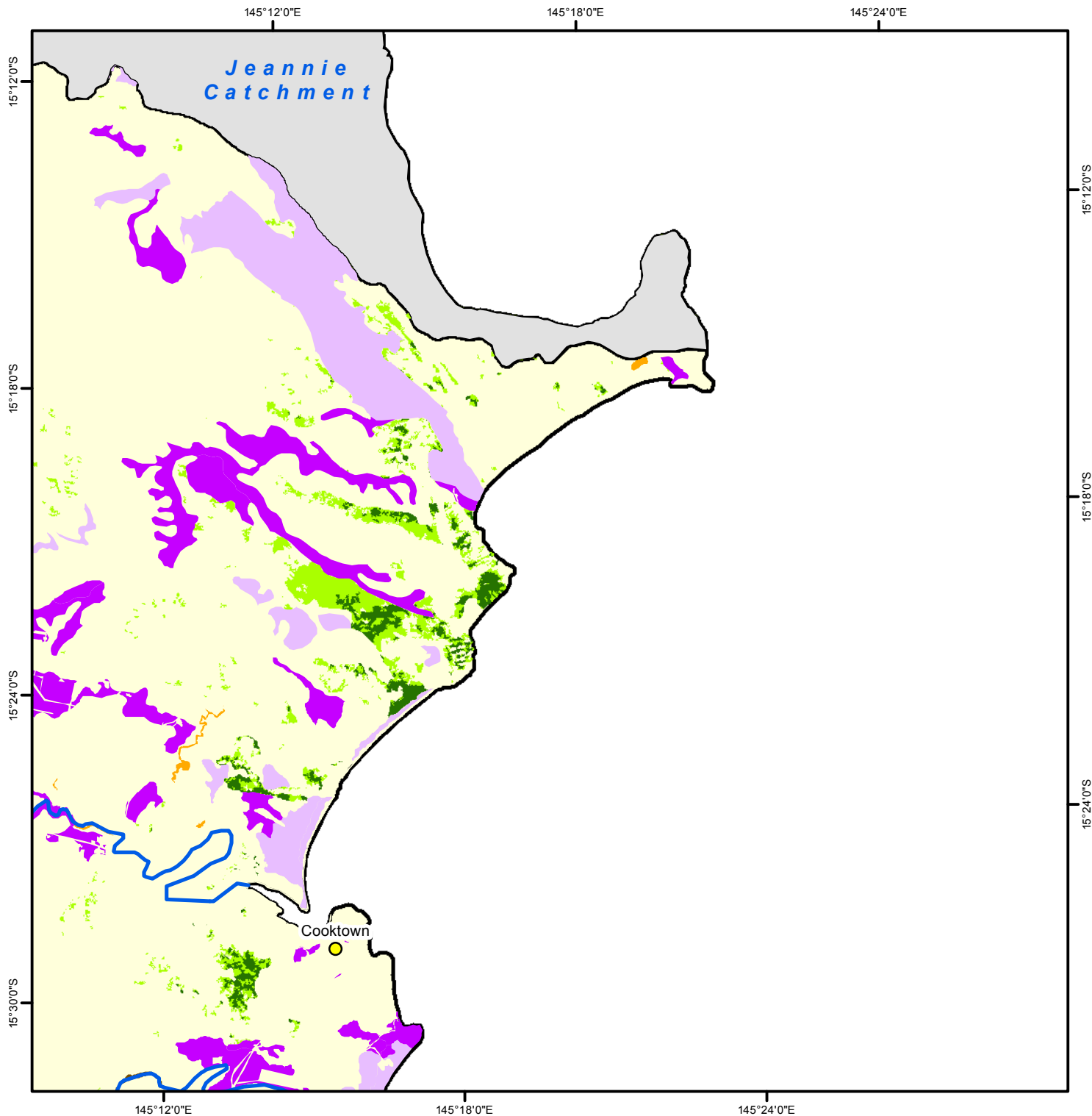
Q11 Endeavour Catchment



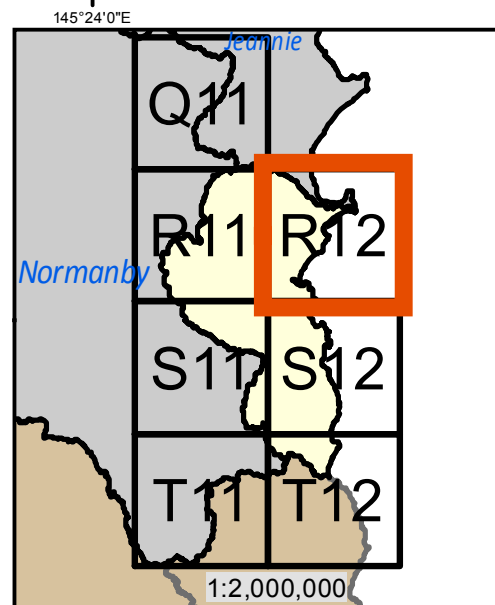
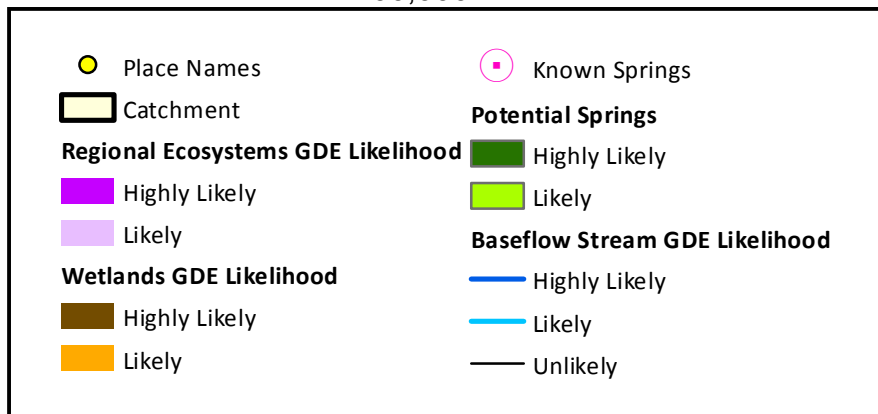
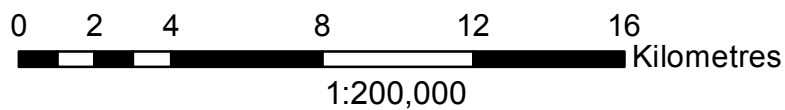


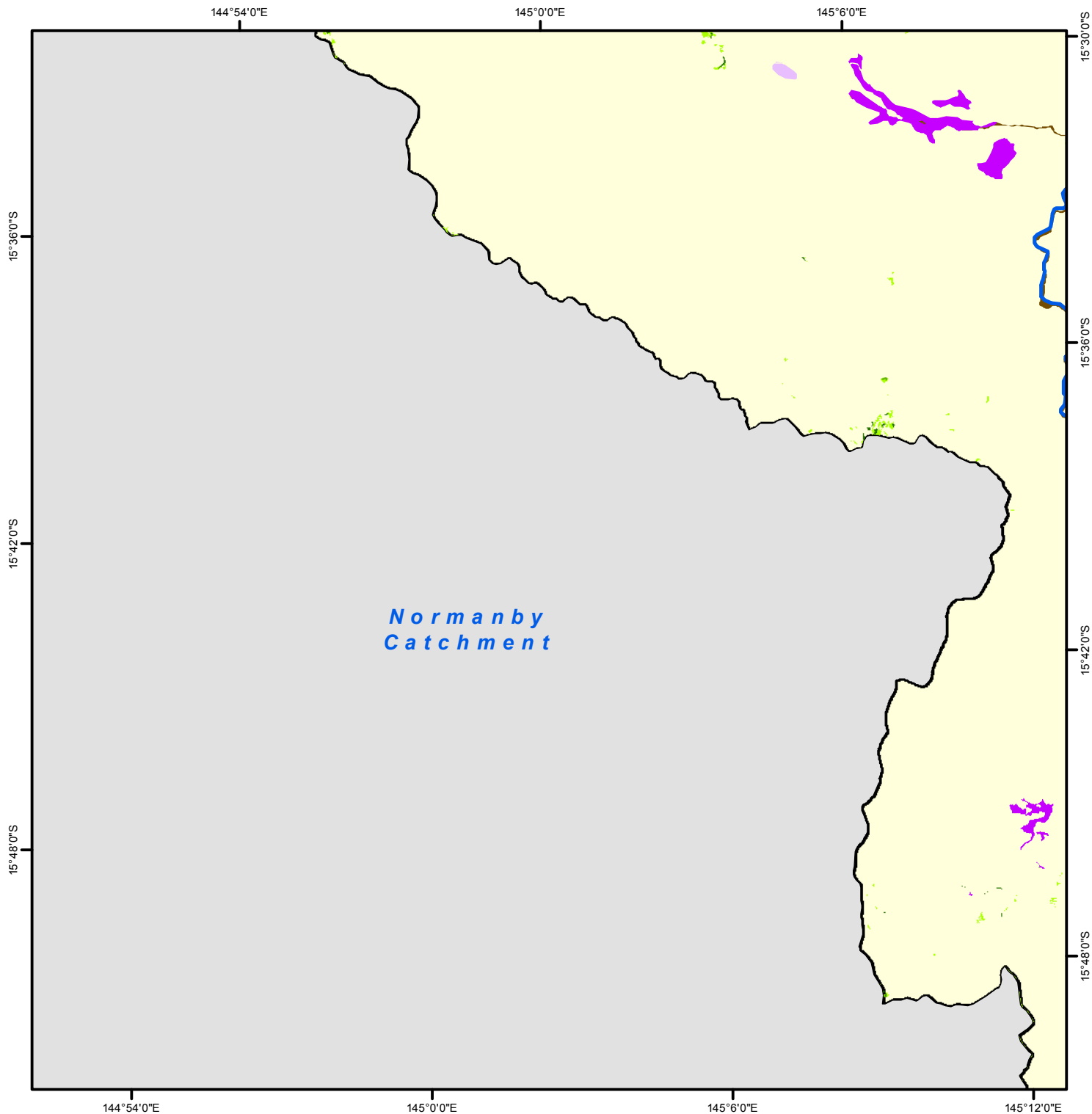
R11 Endeavour Catchment



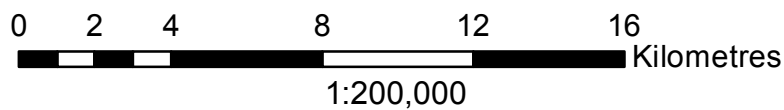


R12 Endeavour Catchment

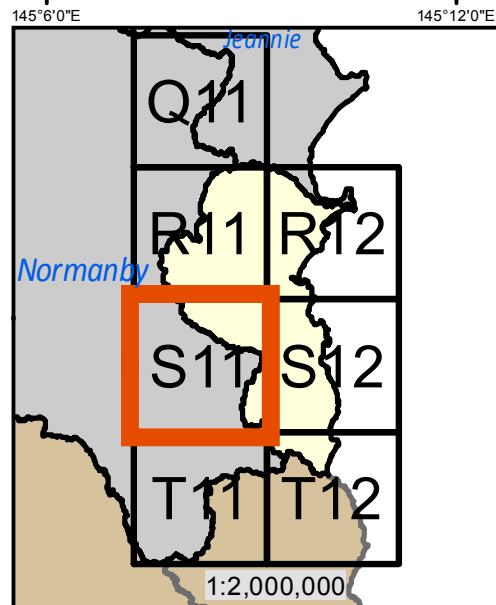


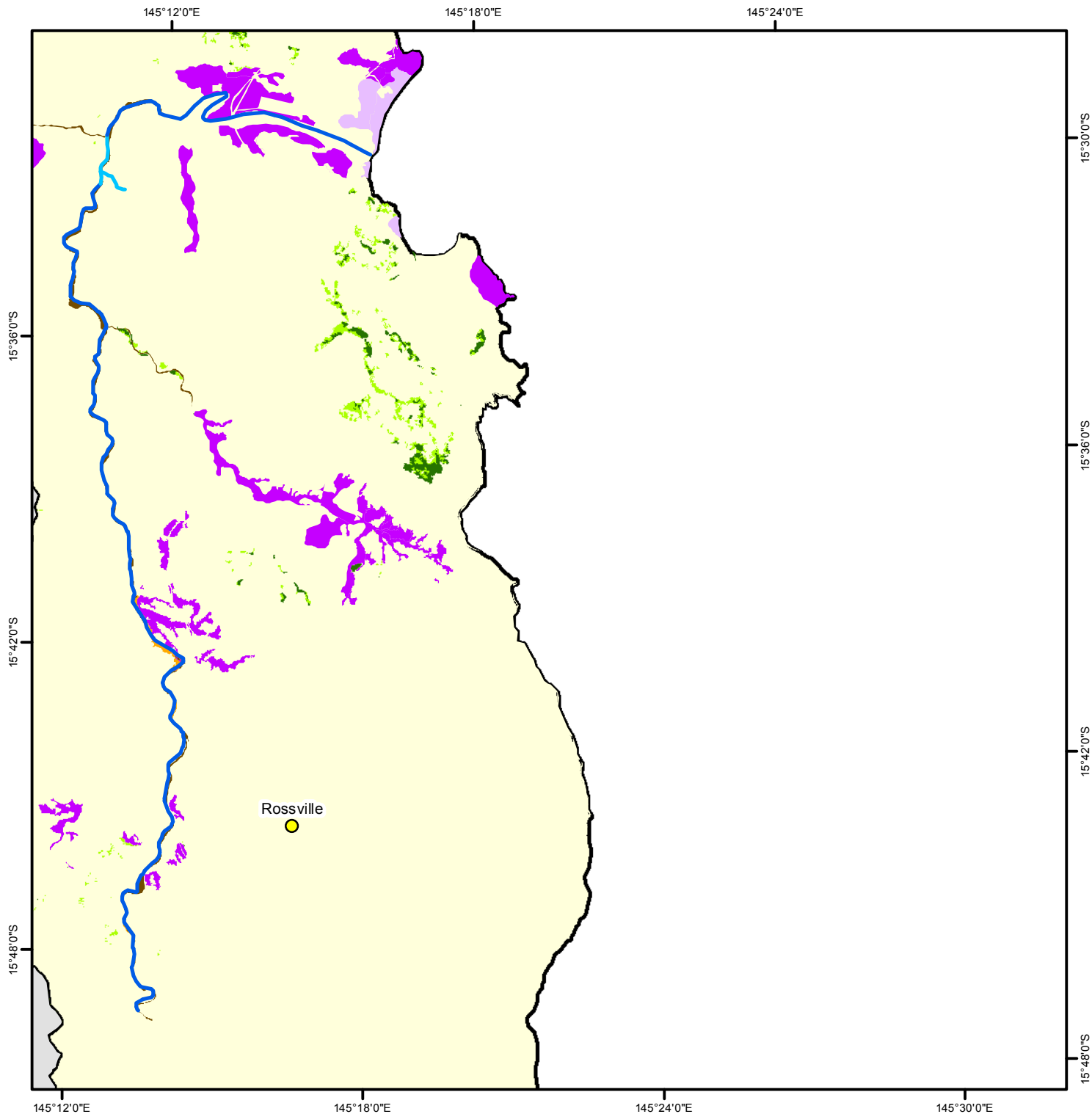


S11 Endeavour Catchment

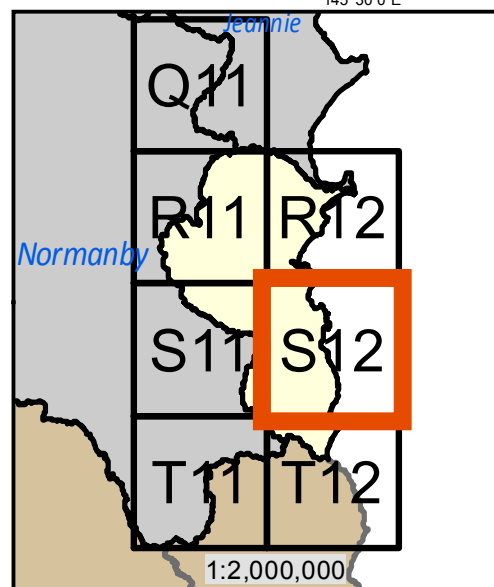
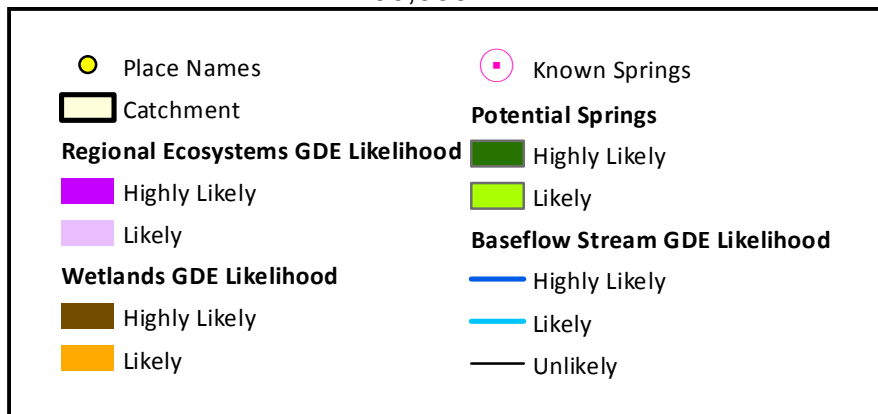
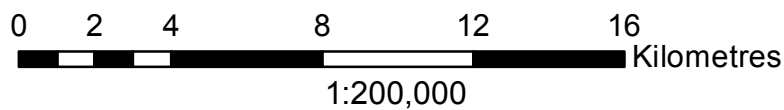


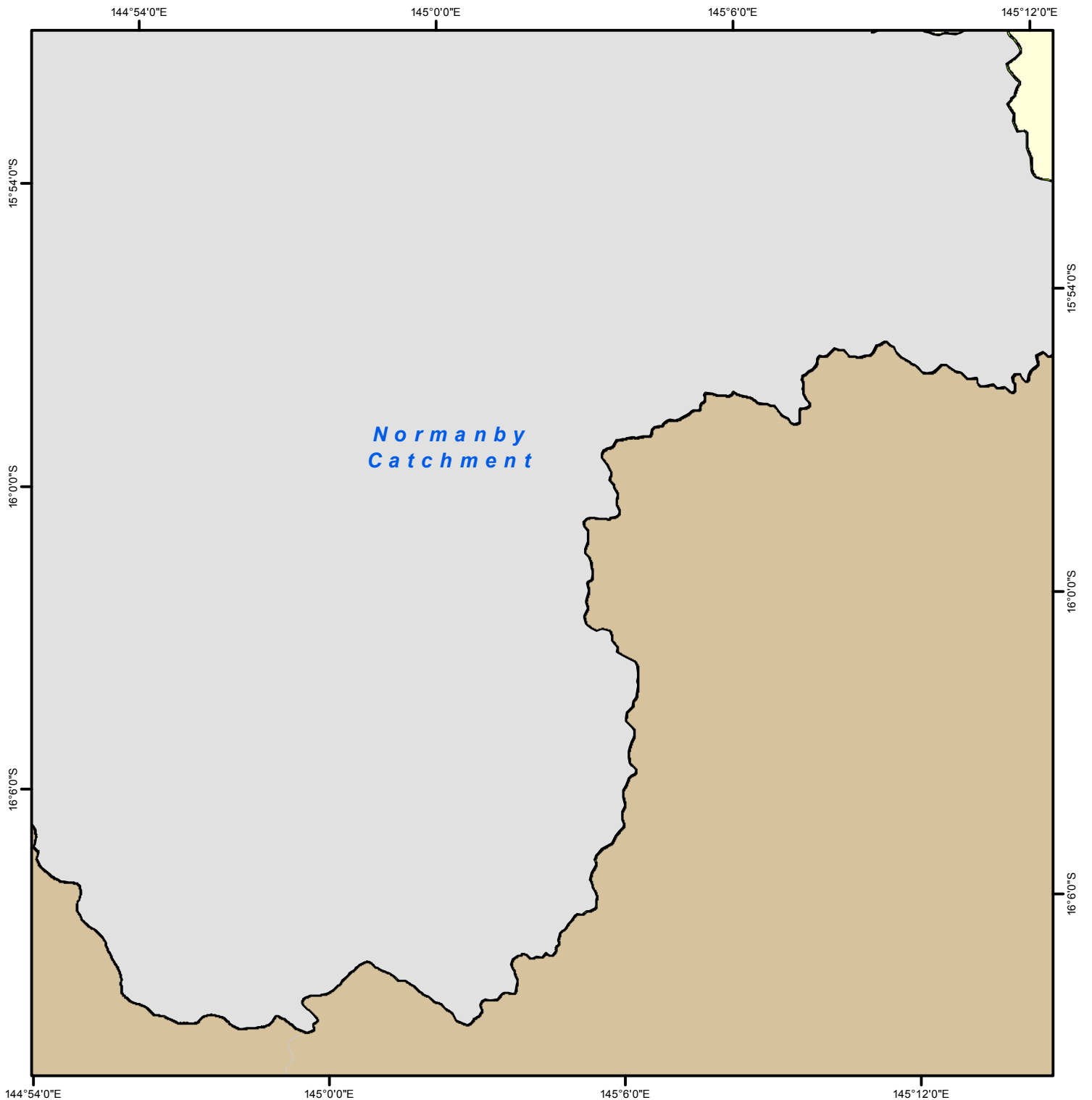
- | | |
|-------------------------------------------|---------------------------------------|
| Place Names | Known Springs |
| Catchment | Potential Springs |
| Regional Ecosystems GDE Likelihood | Highly Likely |
| Highly Likely | Likely |
| Likely | Baseflow Stream GDE Likelihood |
| Wetlands GDE Likelihood | Highly Likely |
| Highly Likely | Likely |
| Likely | Unlikely |



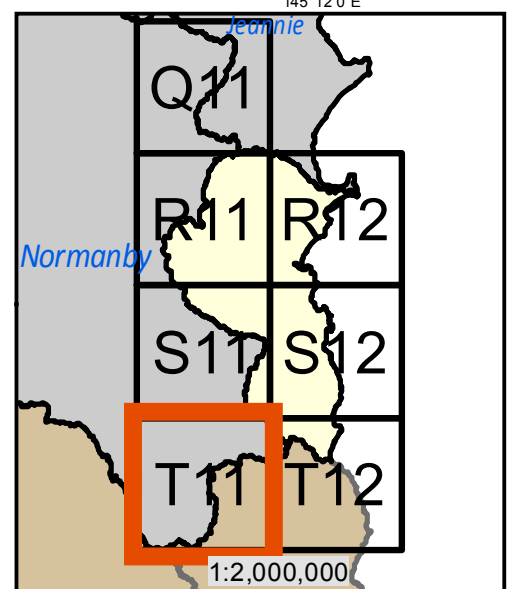
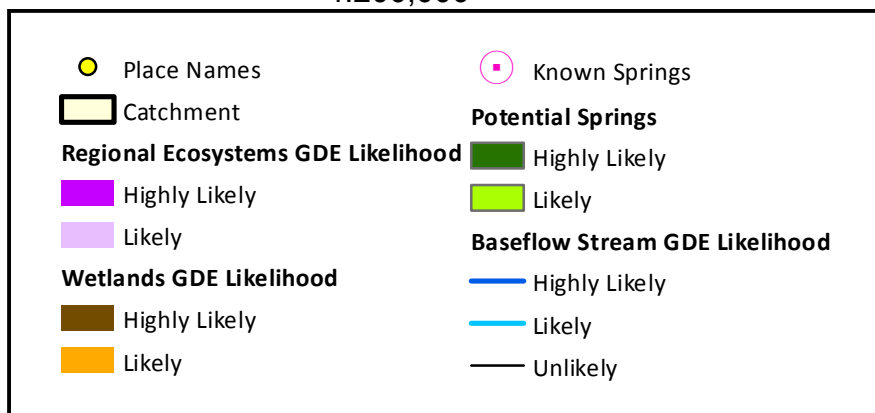
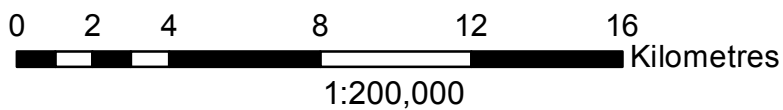


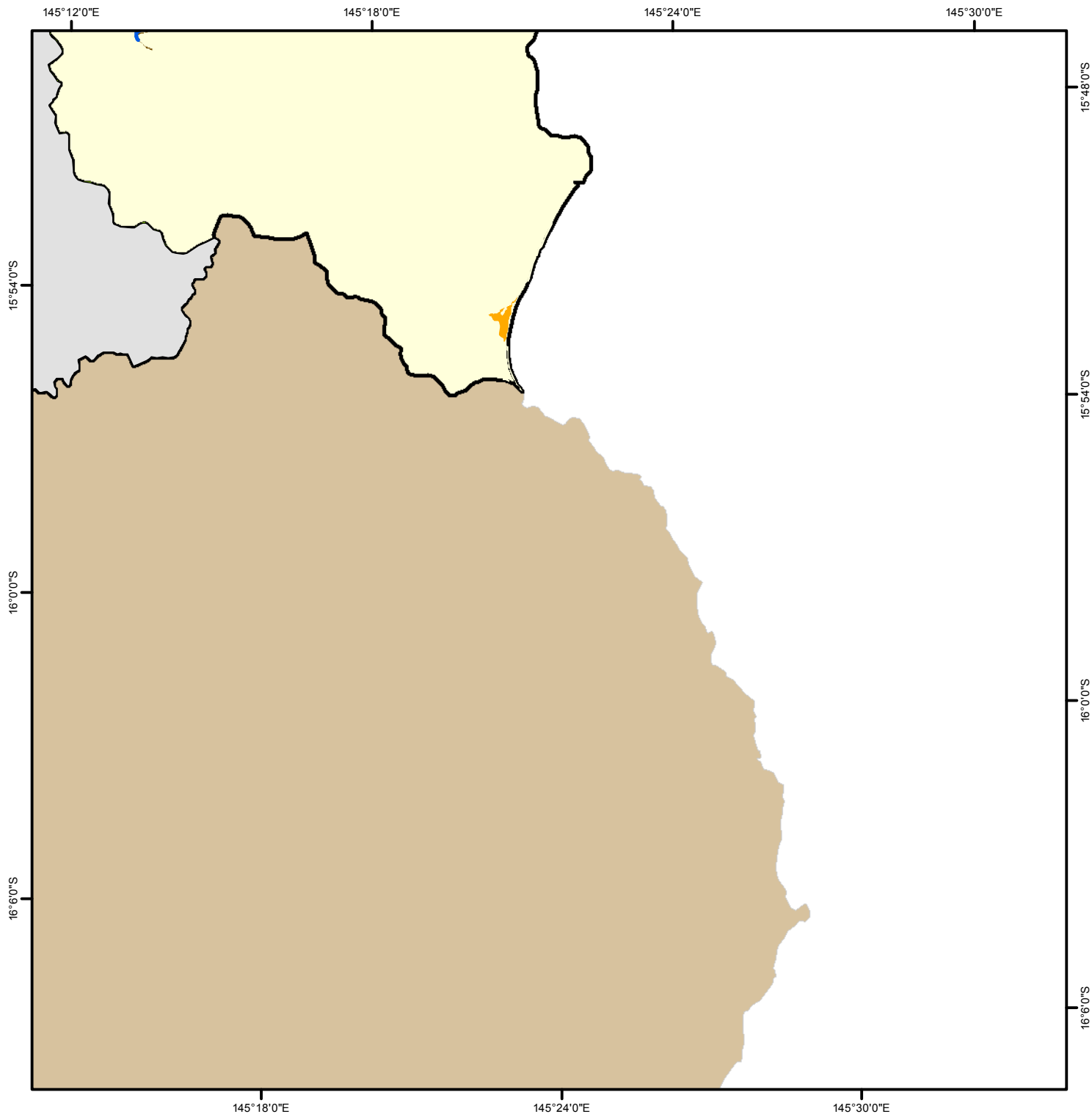
S12 Endeavour Catchment





T11 Endeavour Catchment





T12 Endeavour Catchment

