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East Yorkshire Solar Farm

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A Predictive ALC map for East Yorkshire Solar (Version 1 and 2)

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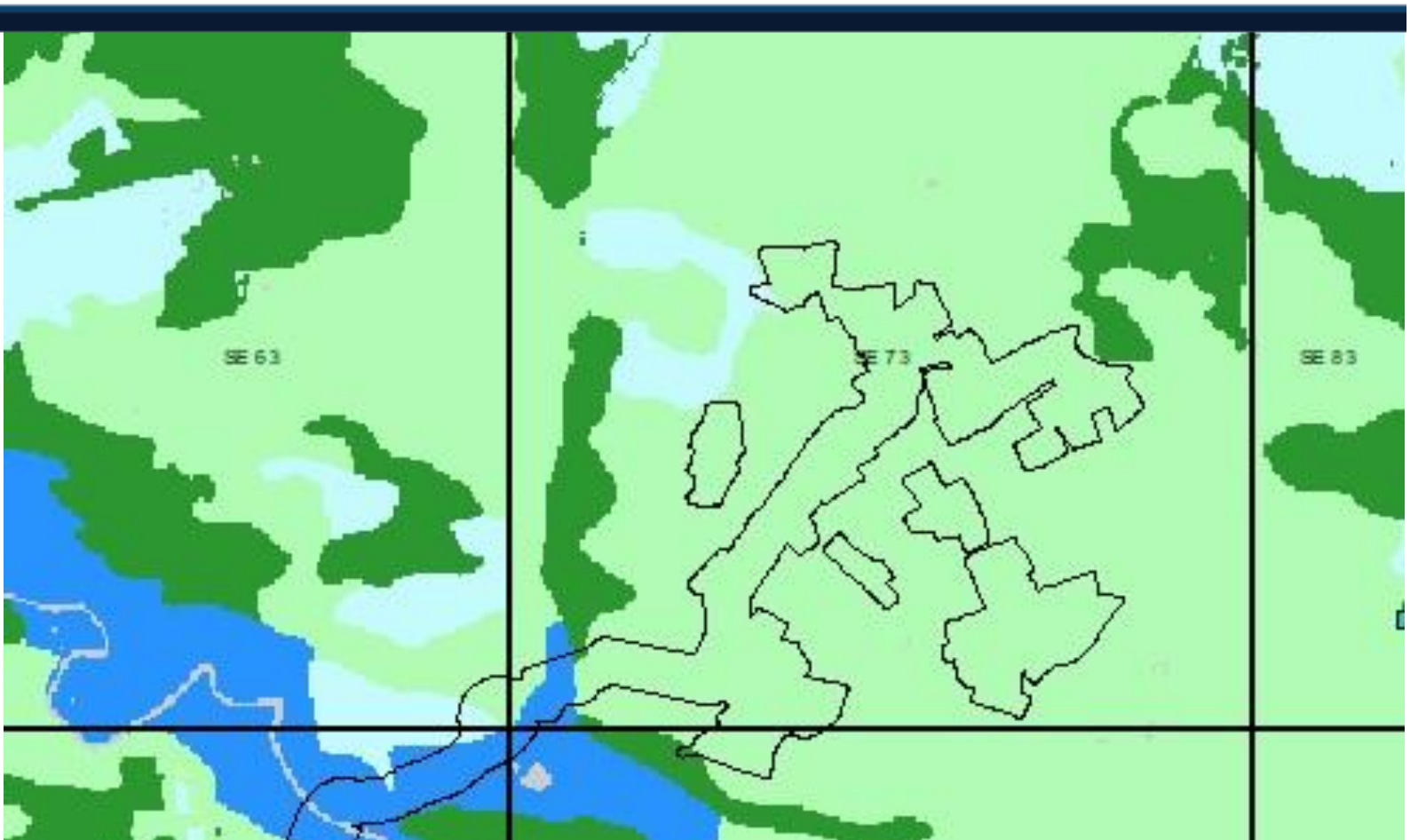

A Predictive ALC map for East Yorkshire Solar (Version 1 and 2)

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CHANGE HISTORY

Version	*Date*	*Summary of change*
1.0	10/10/2022	First Issue

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Contents

1 Introduction 5
2 Method 6
2.1 ALC Criterion: Climate 8
2.2 ALC Criterion: Gradient 8
2.3 ALC Criterion: Soil Depth 8
2.4 ALC Criterion: Soil Wetness 8
2.5 ALC Criterion: Droughtiness 8
2.6 ALC Criterion: Stoniness 9
3 Results 10
4 References 13
5 APPENDIX 1 – Individual ALC Criteria Maps 14
6 APPENDIX 2 – Climate Maps 24

Figures

Figure 1 Areas covered by detailed soil mapping 7
Figure 2 Overall ALC Grade (version 1) 10
Figure 3 Overall ALC Grade (version 2) 11
Figure 4 Detailed ALC mapping carried out by Natural England 12
Figure 5 ALC grade according to climate calculated on a 50m cell 14
Figure 6 ALC grade according to gradient/slope 15
Figure 7 ALC grade according to soil wetness (version 1) 16
Figure 8 ALC grade according to soil wetness (version 2) 17
Figure 9 ALC grade according to droughtiness (version 1) 18
Figure 10 ALC grade according to droughtiness (version 2) 19
Figure 11 ALC grade according to soil depth (version 1) 20
Figure 12 ALC grade according to soil depth (version 2) 21
Figure 13 ALC grade according to stoniness (version 1) 22
Figure 14 ALC grade according to stoniness (version 2) 23
Figure 15 Average Annual Rainfall (AAR) 24
Figure 16 Average Summer Rainfall (ASR) 25
Figure 17 Accumulated Temperature above 0° (Jan-Jun) (AT0) 26
Figure 18 Accumulated Temperature above 0° (Apr-Sep) (ATS) 27
Figure 19 Duration of Field Capacity in days (FCD) 28
Figure 20 Moisture deficit for Wheat (mm) (MDMWHT) 29
Figure 21 Moisture deficit for Potatoes (mm) (MDMPOT) 30

Tables

Table 1 Agricultural Land Classification Grades 5

Glossary

AAR Average Annual Rainfall (January to December)

ASR Average Summer Rainfall (April to September)

AT0 Accumulated Temperature >0 ºC from January to June (ºC days)

ATS Accumulated Temperature >0 ºC from April to September (ºC days)

FCD Field Capacity Days

MD potatoes Moisture Deficit for Potatoes

MD wheat Moisture Deficit for Wheat

1 Introduction

This report describes the production of a new predictive Agricultural Land Classification (ALC) map of East Yorkshire Solar. The methodology and data production is described and the resulting ALC maps presented. The work has been undertaken by staff of Cranfield University's Cranfield Environment Centre, who hold, in Cranfield's 'Land Information System (LandIS[1]), the National soil maps for England and Wales. Table 1 describes the grades used in the Classification of Agricultural Land in England and Wales. The classification system uses the guidelines described in MAFF 1988.

Table 1 Agricultural Land Classification Grades

Grade	Description of Agricultural Land	Detail
1	Excellent Quality	No or minor limitations on agricultural use. Wide range of agricultural and horticultural crops grown. High yielding and consistent.
2	Very Good	Minor Limitations on crop yield, cultivations or harvesting. Wide range of crops but limitations on demanding crops (e.g. winter harvested veg). Yield high but lower than Grade 1.
3 (subdivided)	Good to Moderate	Moderate limitations on crop choice, timing and type of cultivation, harvesting or level of yield. Yields lower and more variable than Grade 2
3a	Good	Moderate to high yields of narrow range of arable crops (e.g. cereals), or moderate yields of grass, oilseed rape, potatoes, sugar beet and less demanding horticultural crops.
3b	Moderate	Moderate yields of cereals, grass and lower yields other crops. High yields of grass for grazing/ harvesting.
4	Poor	Severe limitations which restrict range and/or level of yields. Mostly grass and occasional arable (cereals and forage), but highly variable yields.
5	Very Poor	Severe limitations which restrict use to permanent pasture or rough grazing except for pioneering forage crops.

[1] See http://www.landis.org.uk

2 Method

The Meteorological Office book 'Climatological data for Agricultural Land Classification', published in 1989, provides a listing of all the required climate data for the standard ALC process. This data is provided on a 5x5km grid for the whole of England and Wales with instructions for interpolating the data to a site of interest based on its location (easting and northing) and altitude. For the purposes of creating a detailed ALC map for East Yorkshire Solar we used the Ordnance Survey OS terrain 50[2] product to produce the ALC climate data on a 50x50m raster.

The OS terrain 50 product does, however, contain a very large number of points so takes a lot of processing. The process is run on the full 50m raster, divided into 50km square areas for computational reasons, in this case the 50km^2 area covering the South East Quadrant of National Map Square SE (SESE). The Altitude (m) and Slope (Degrees) were extracted for each of the 1 million points in SESE.

The interpolation routines for each of the ALC climate criteria are written as software functions in the Oracle PL/SQL language. These functions take the easting, northing and altitude of the site of interest, draw in the appropriate climate value and altitude from the surrounding points (up to 4) and then perform the interpolation as described in the Meteorological Office document noted above (1989).

The National Soil Map for England and Wales at 1:250,000 scale was rasterised onto the same 50x50m raster as the OS terrain 50 data. The dominant soil association by area within each 50m square was then selected to represent the whole 50m square.

The ALC for each of the 6 criteria (climate, depth, gradient, wetness, drought and stoniness) was calculated for each 50m using the interpolated climate data, and the soil series composition information of the national soil associations. The ALC class was calculated for each criterion that depends on the soil series (depth, wetness, droughtiness and stoniness) and the percentage series within the soil associations summed to give the coverage of each class within the 50m cell. For each of these 4 criteria, the ALC class which has the largest summed percentage composition of the map unit is then used to classify the 50m cell. For example if an association has 3 series, series A covers 40%, series B 35% and Series C 25% and series A is classified as 3a for drought while series B and C are both class 2 then the ALC drought for the cell is set to class 2 as it covers 60% of the area. The ALC criteria for climate and gradient were calculated for each 50m cell.

A 7th criterion was added to provide a method for limiting specific series to a maximum ALC class for other reasons not covered. For example, 551a Bridgenorth and 631b Delamere associations are limited to class 2 as they are loamy sand.

The Overall ALC Grade for each 50m cell was then set as the lowest grade from the 7 individual criterion (Figure 2).

For the Version 2 mapping each 50m cell is assigned a single series from the dominant series in the cell as shown on published detailed soil mapping at 1:25,000, 1:50,000 or 1:63,000 scale surveyed by the Soil Survey of England and Wales, where it existed in the 50km^2. Figure 1 shows the distribution of this mapping in the area. Where no detailed mapping exists, the cell is assigned to the dominant soil series in the soil association from the rasterised National

[2] See https://www.ordnancesurvey.co.uk/business-and-government/products/terrain-50.html

Soil Map. Note the Climate and Slope map are unchanged between version 1 and version 2 as they are not reliant on soil information.

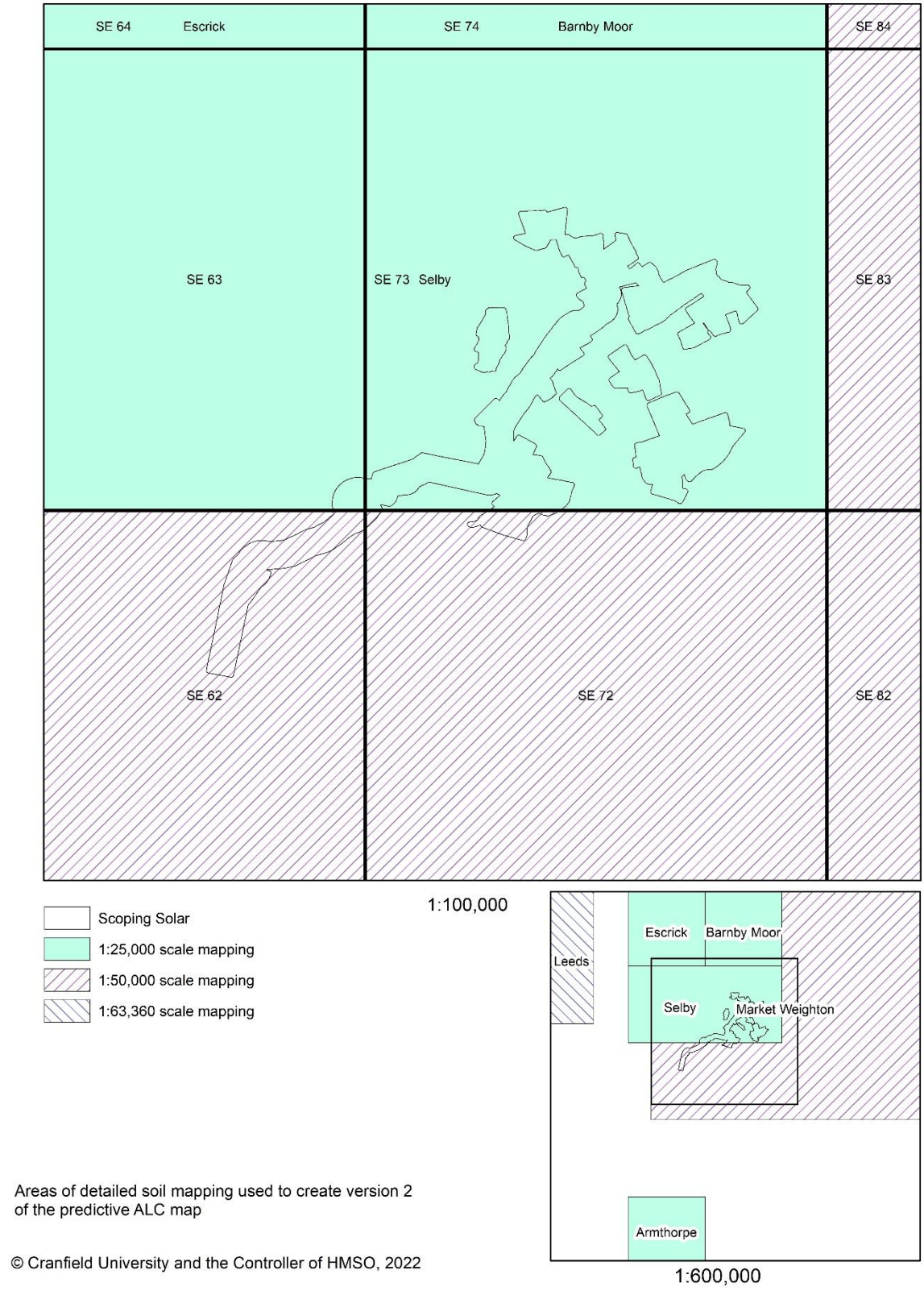


Figure 1 Areas covered by detailed soil mapping

Appendices for this report contain the individual ALC criterion maps for both version 1 and version 2 plus the climate property maps. The maps also show the properties in the extended 50km^2 area SESE.

For Comparison areas in SESE are presented where detailed ALC mapping has been produced by Natural England (available to view on The MAGIC Website)

2.1 ALC Criterion: Climate

The ALC climate map (Figure 5) is created from the Annual Average Rainfall (Figure 15) and Accumulated Temperature above 0° (Jan-Jun) (Figure 17) with each 50m point being classified according to the graph in Figure 1 on page 6 of MAFF 1988. For NATMAP ALC the AAR and AT0 were interpolated to a 1km grid and the ALC calculated at each 1km point and then contours drawn between each class.

2.2 ALC Criterion: Gradient

The OS terrain 50 DTM was processed into a slope map using standard ArcGIS functionality, this slope map is already available via the UKSO.org. The slope map was then classified for the ALC (table 1 p11 MAFF 1988) (Figure 12). For NATMAP ALC the OSTerrain50 data was contoured to produce smoothed polygons of the 4 slope zones (<7, 7-11, 11-18 and >18).

2.3 ALC Criterion: Soil Depth

For each soil series in the soil association the standard depth to rock property is used to determine the ALC classification according to the depth limits (table 4 p13 MAFF 1988). The percentage of each soil in each ALC class is then totalled. The dominant ALC class by depth is then taken as the classification for that cell (Figure 11). For NATMAP ALC the ALC by depth was classified in the same way on a soil association basis.

2.4 ALC Criterion: Soil Wetness

The grade of soil wetness classification requires several factors. The Wetness class of the soil series is derived from the field capacity zone (FCD) (SERIES_FCZONE table), the topsoil texture has been classified using the topsoil texture dataset created from the HORIZON fundamentals table and adjusted. The split between whether a series is a mineral soil or an organic mineral/peaty soil determines which table is used (table 6, p23 and table 7 p24 of MAFF 1988) (Figure 7). For NATMAP ALC the wetness class was taken from the dominant wetness in the NATMAPwetness product and the dominant texture in the NATMAPtopsoiltexture product to assess the ALC for wetness

2.5 ALC Criterion: Droughtiness

The droughtiness for wheat and potatoes is calculated using the latest volumetric water content data for each series/crop from the HORIZONhydraulics dataset. The Moisture deficit for wheat and potatoes is taken from the interpolated climate data (Figure 20 and Figure 21 respectively). The class was calculated for each series in the soil association according to table 8 p27 (MAFF 1988) and then the percentages of soils totalled per class to determine the dominant droughtiness class (Figure 9). In NATMAP ALC the Available Water for Potatoes and Wheat was taken from the NATMAPavailablewater product. This product assigns an average available water to each national soil map polygon from the available water of each component soil series weighted by the percentage of that series in the association. The Moisture deficit for Wheat and Potatoes was interpolated to the 1km grid and contoured using

10m interval contours, this was then intersected with the NATMAPavailablewater to produce zones with unique available water and moisture deficit values from which the ALC class was assigned.

2.6 ALC Criterion: Stoniness

The topsoil stoniness of each series within the soil series was estimated for each standard soil series by a soil surveyor. This only takes into account the percentage stones and not the size of stones so only the stones larger than 2cm grading is used (see table 5 p19 MAFF 1988). For each series the ALC stones class has been set in the Soil Properties. (Figure 13). For the NATMAP ALC the stoniness of each soil association was classified in the same way.

3 Results

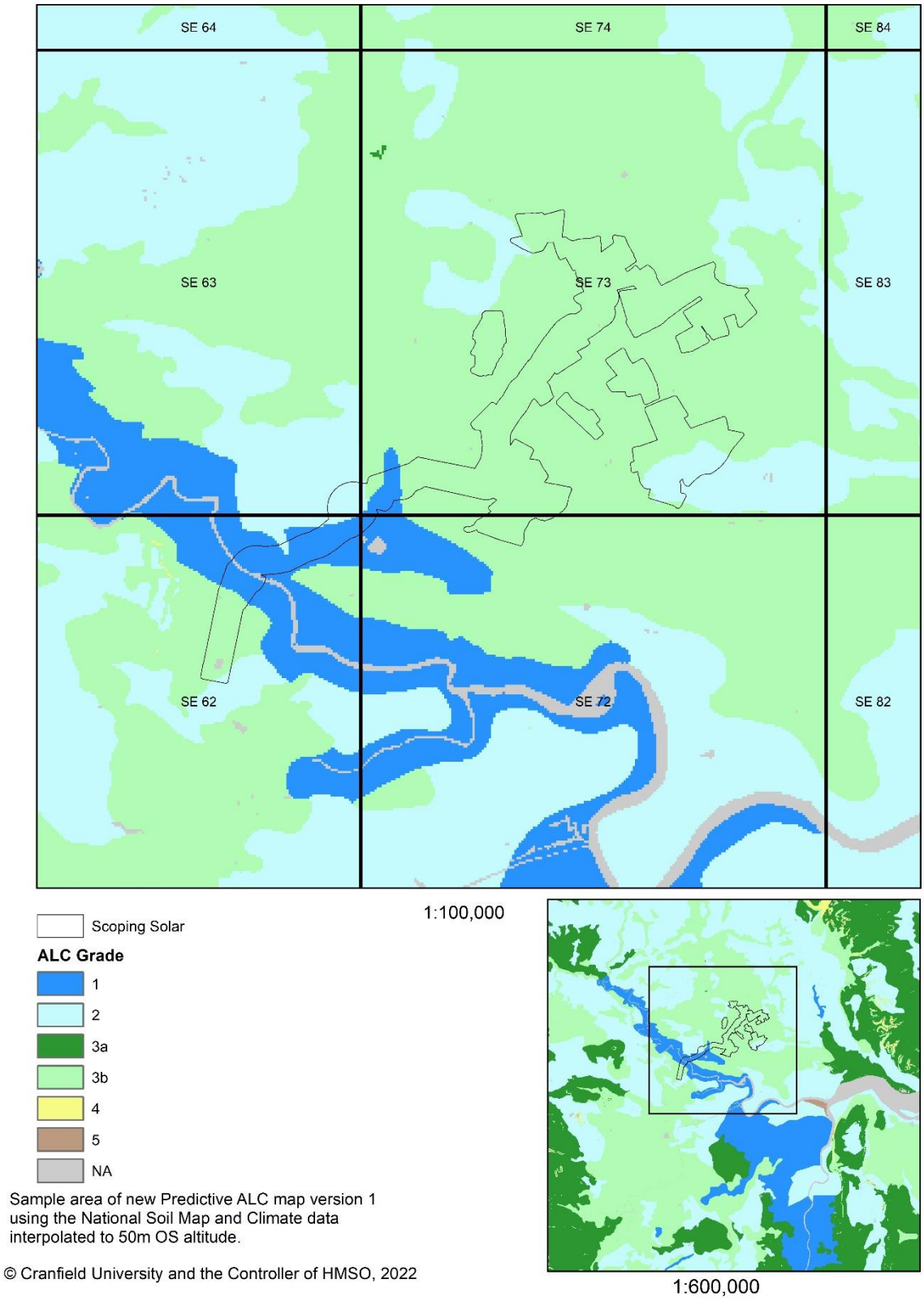
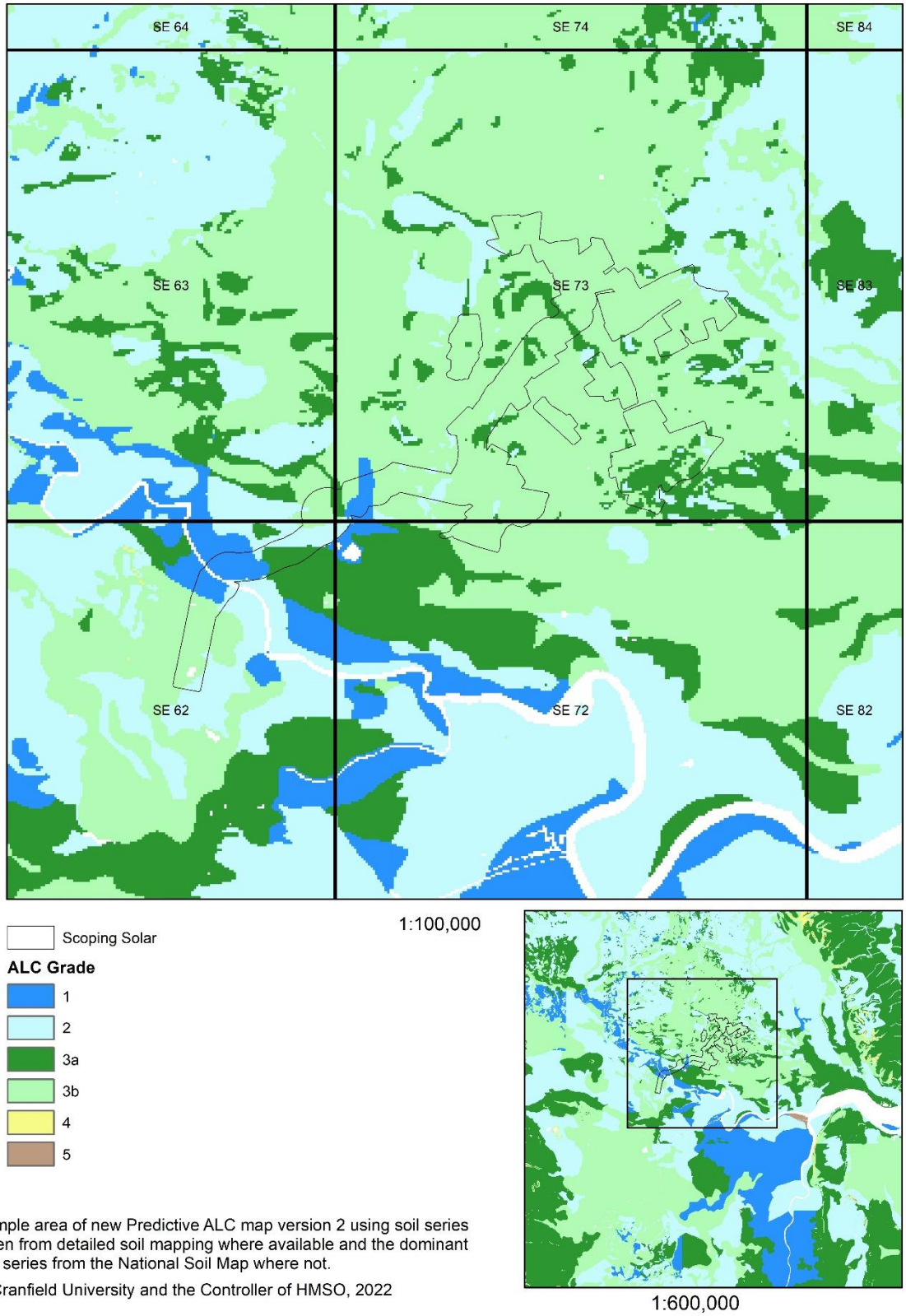


Figure 2 Overall ALC Grade (version 1)



Sample area of new Predictive ALC map version 2 using soil series taken from detailed soil mapping where available and the dominant soil series from the National Soil Map where not.

Figure 3 Overall ALC Grade (version 2)

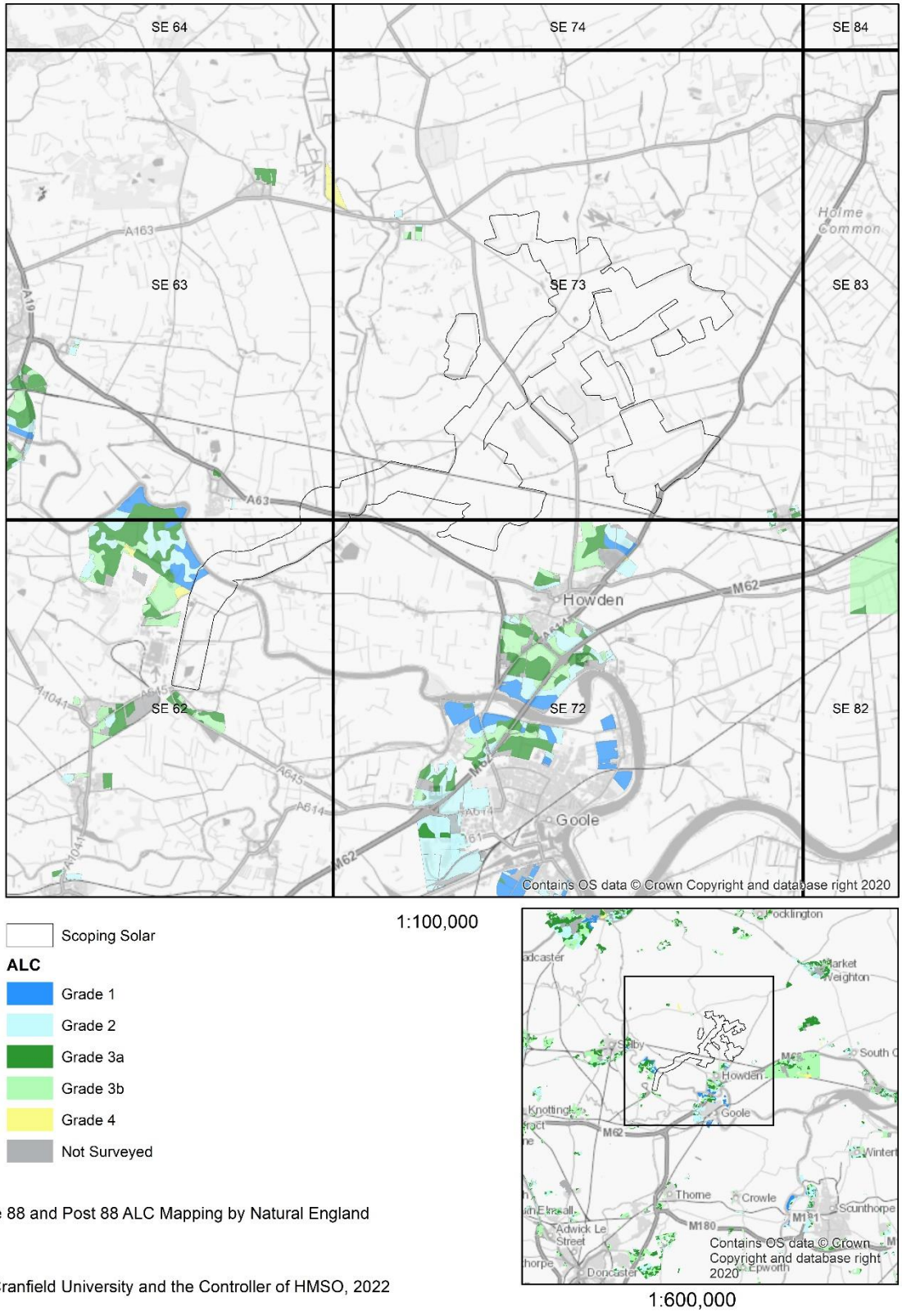


Figure 4 Detailed ALC mapping carried out by Natural England

4 References

Keay, C. (2020) The National Agricultural Land Classification Map of England and Wales. Cranfield University.

MAFF (1988) Agricultural Land Classification of England and Wales Available from Natural England

Meteorological Office (1989). Climatological data for Agricultural Land Classification. HMSO, ISBN-0-86180-249-7. Available from Natural England

Attributions to be used in the mapping:

> Mapping derived from soils data © Cranfield University (NSRI) and for the Controller of HMSO 2020. OS data © Crown copyright and database right 2020.

5 APPENDIX 1 – Individual ALC Criteria Maps

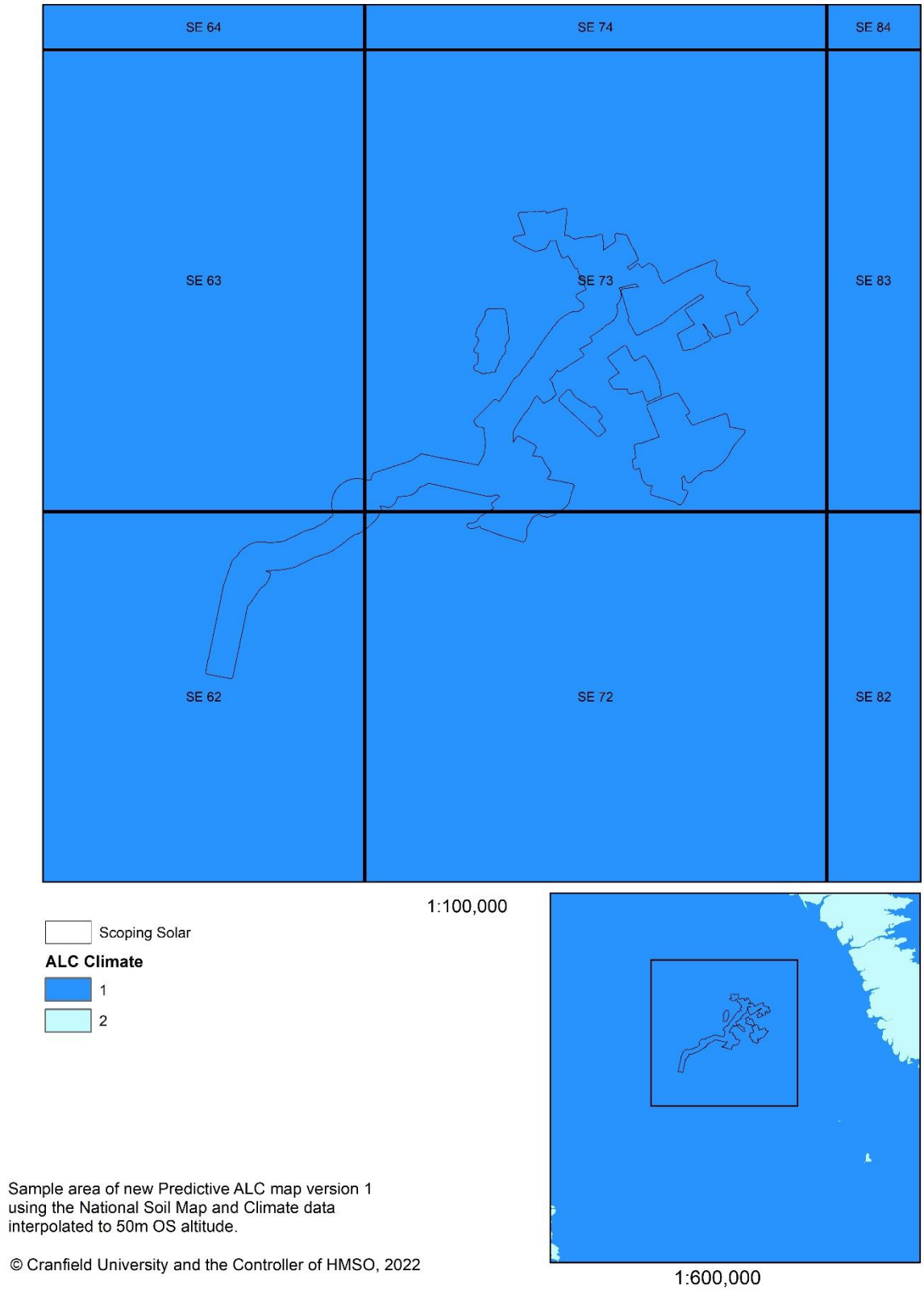


Figure 5 ALC grade according to climate calculated on a 50m cell

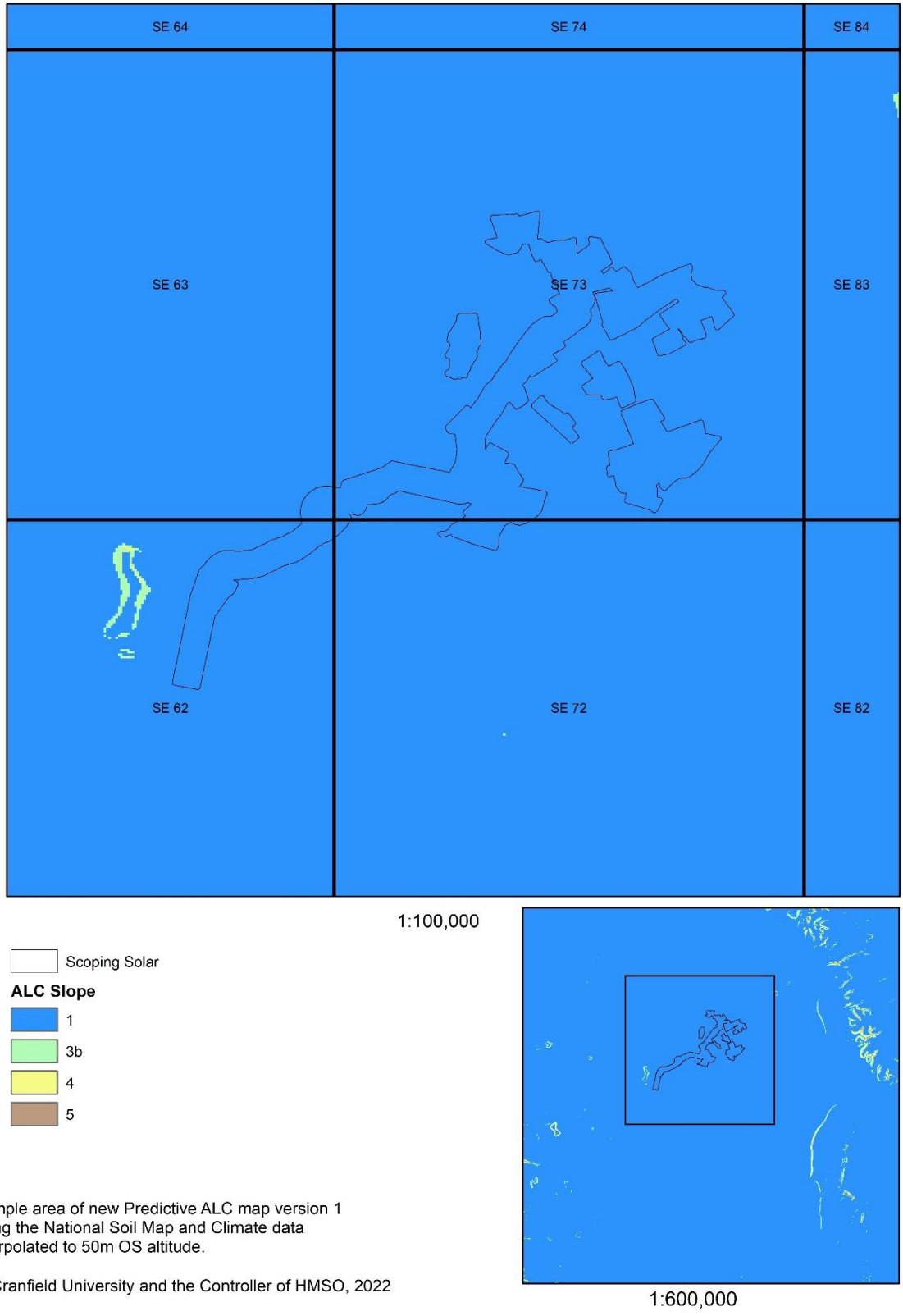


Figure 6 ALC grade according to gradient/slope

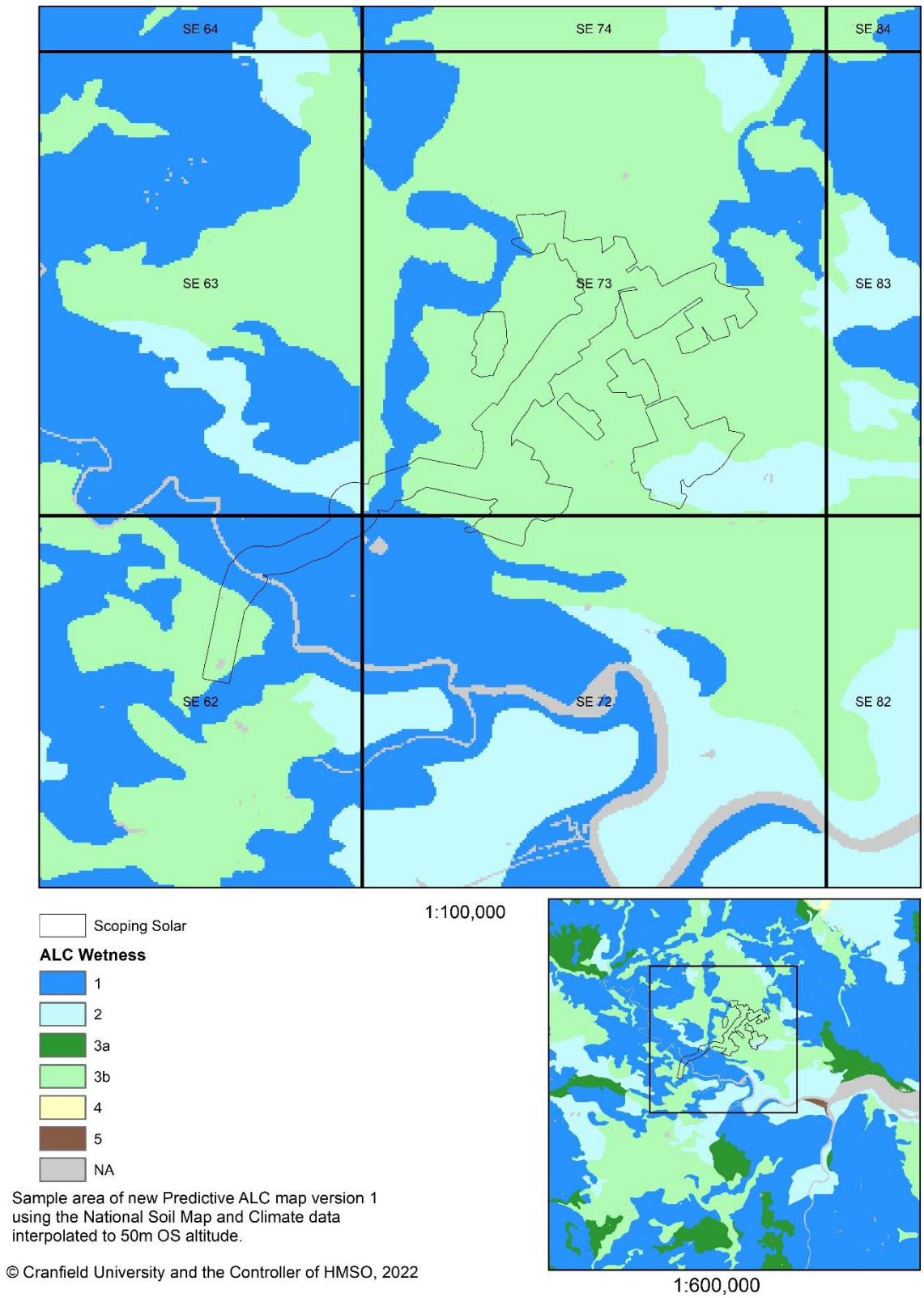


Figure 7 ALC grade according to soil wetness (version 1)

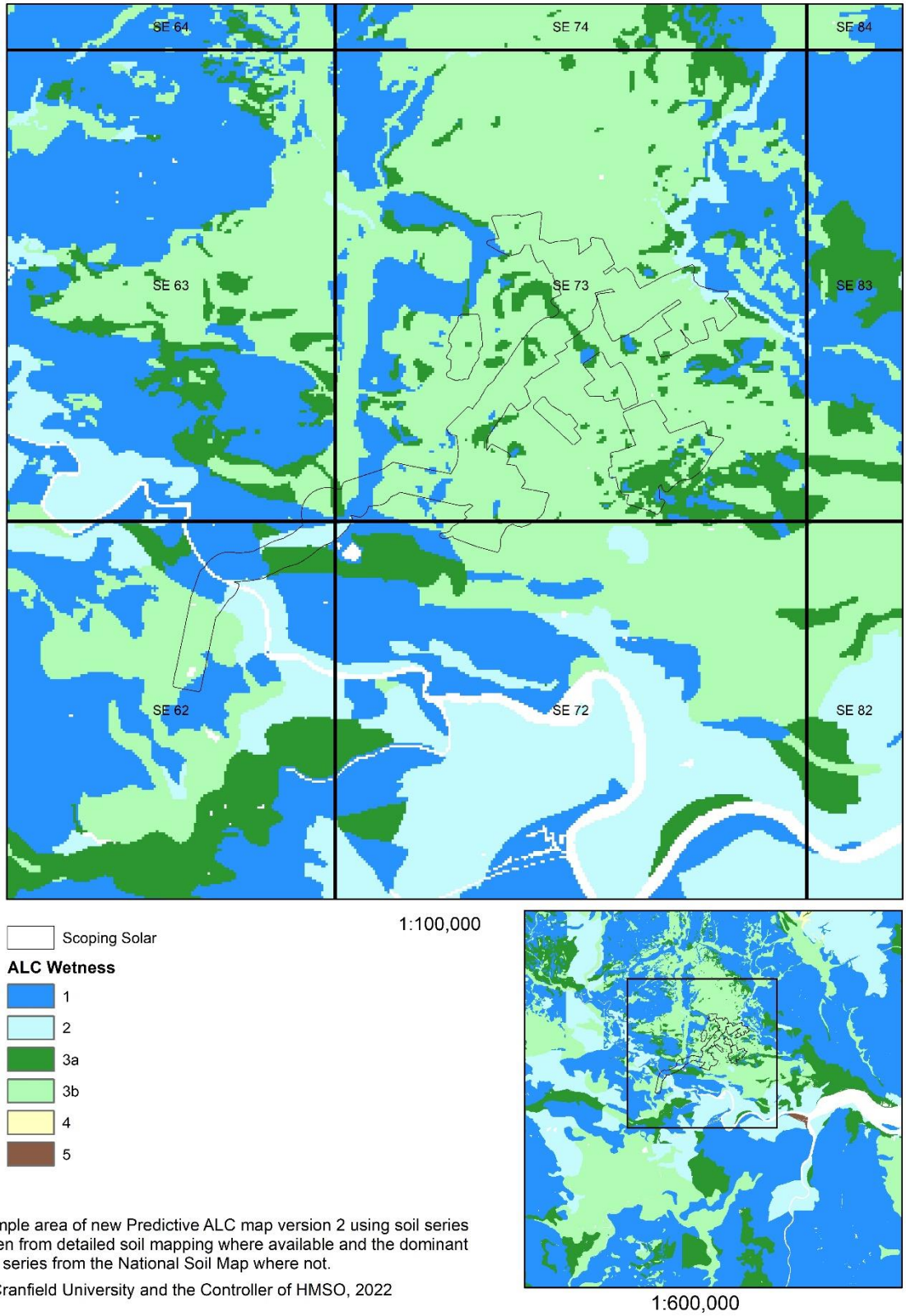


Figure 8 ALC grade according to soil wetness (version 2)

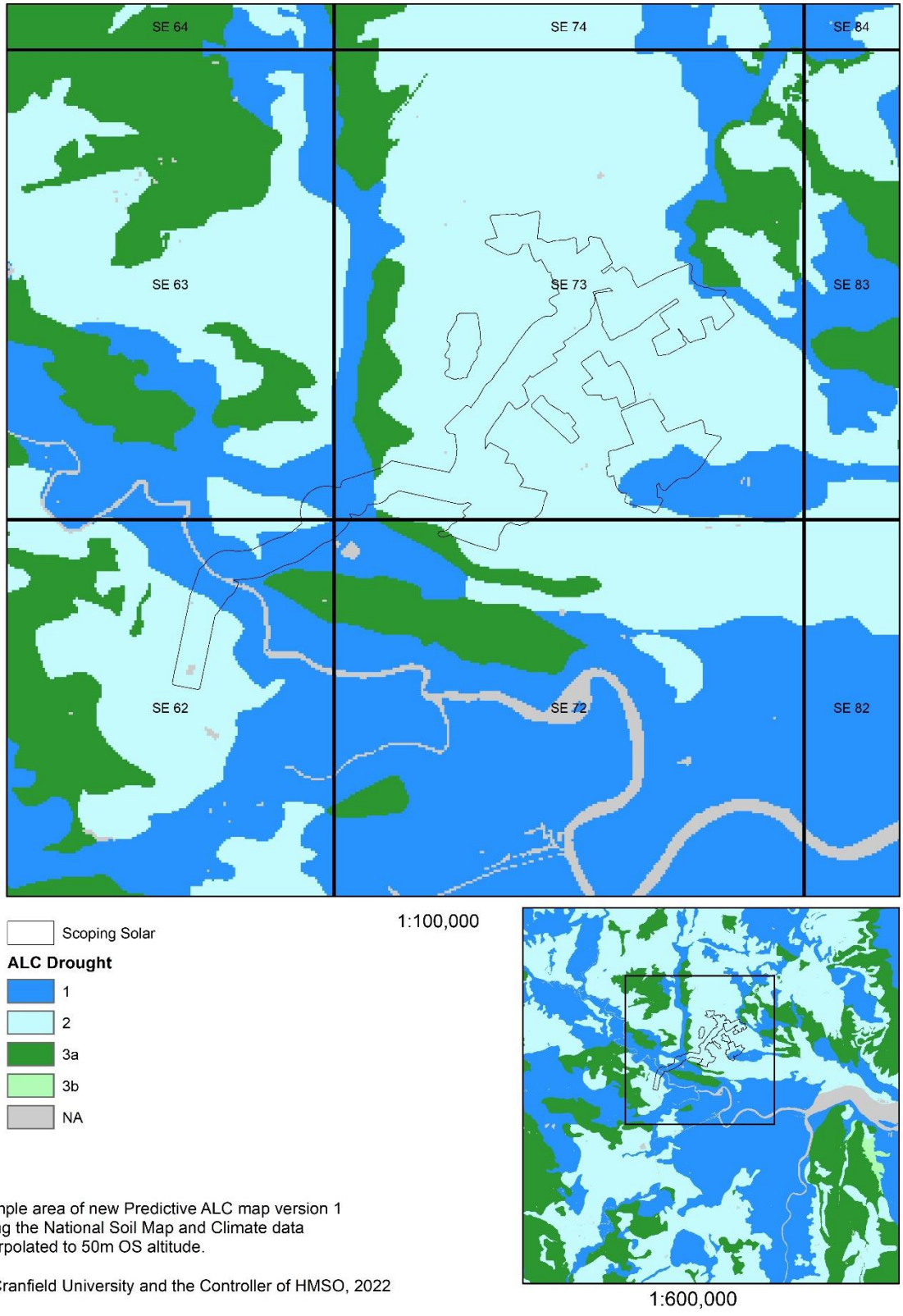


Figure 9 ALC grade according to droughtiness (version 1)

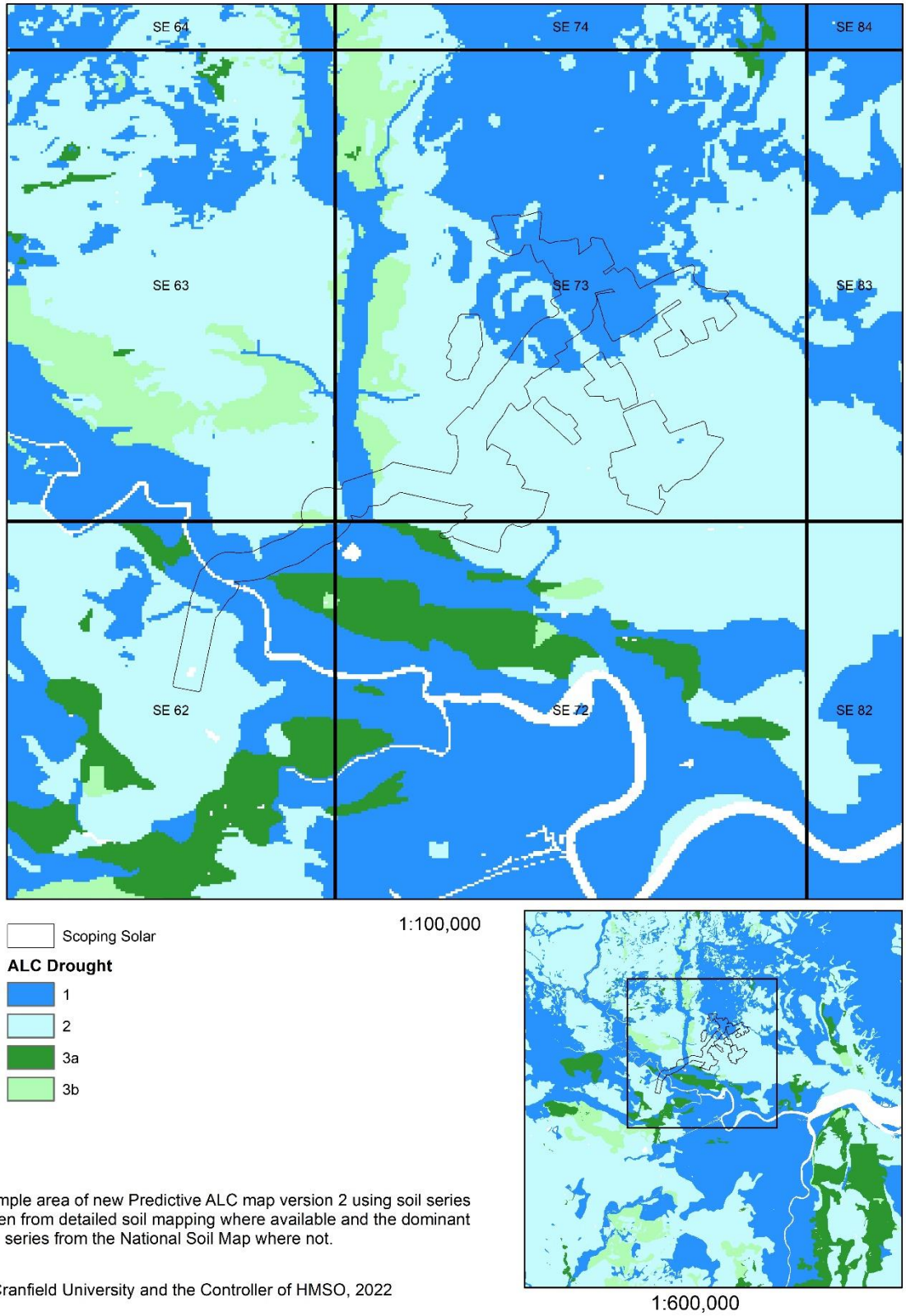


Figure 10 ALC grade according to droughtiness (version 2)

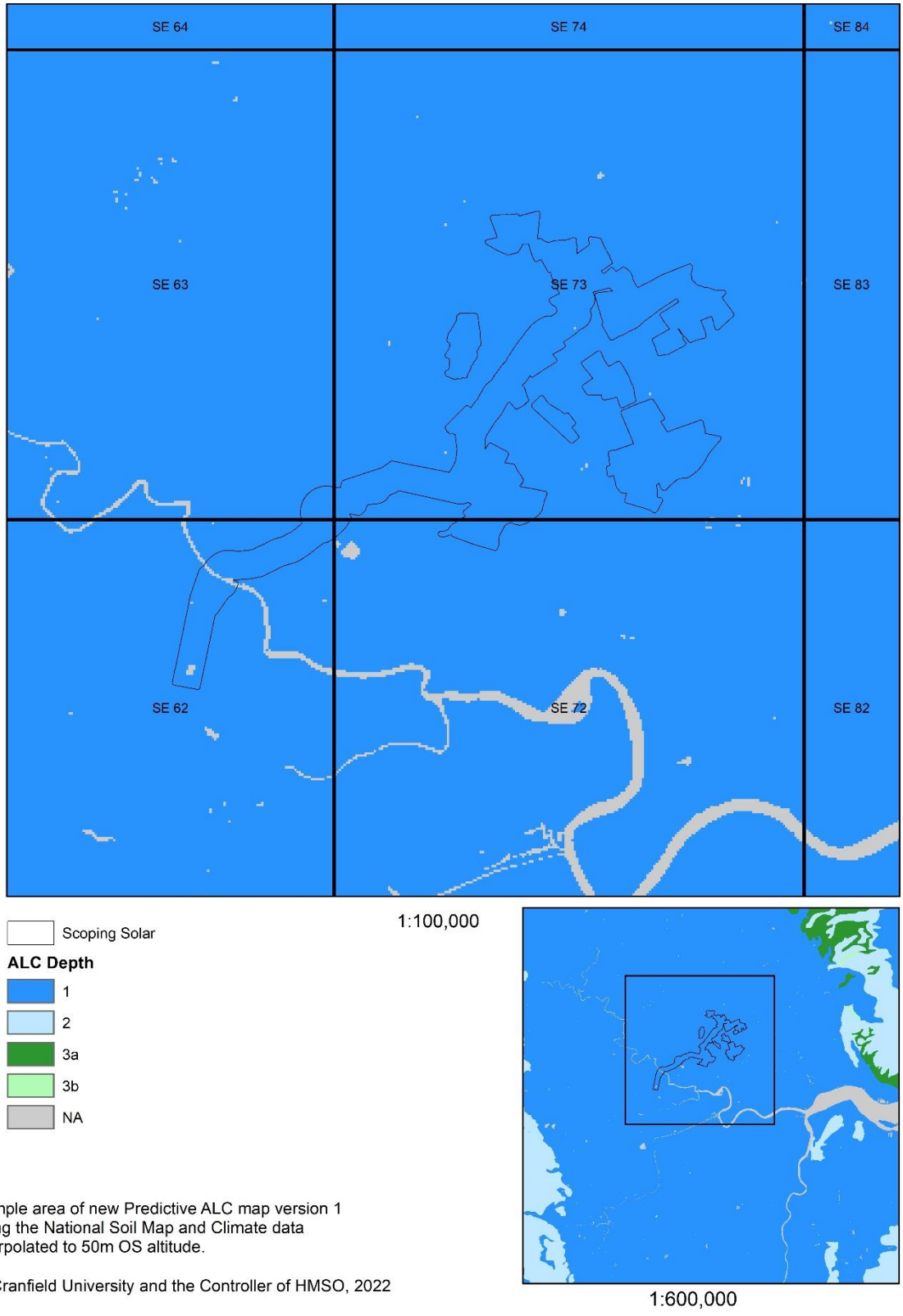


Figure 11 ALC grade according to soil depth (version 1)

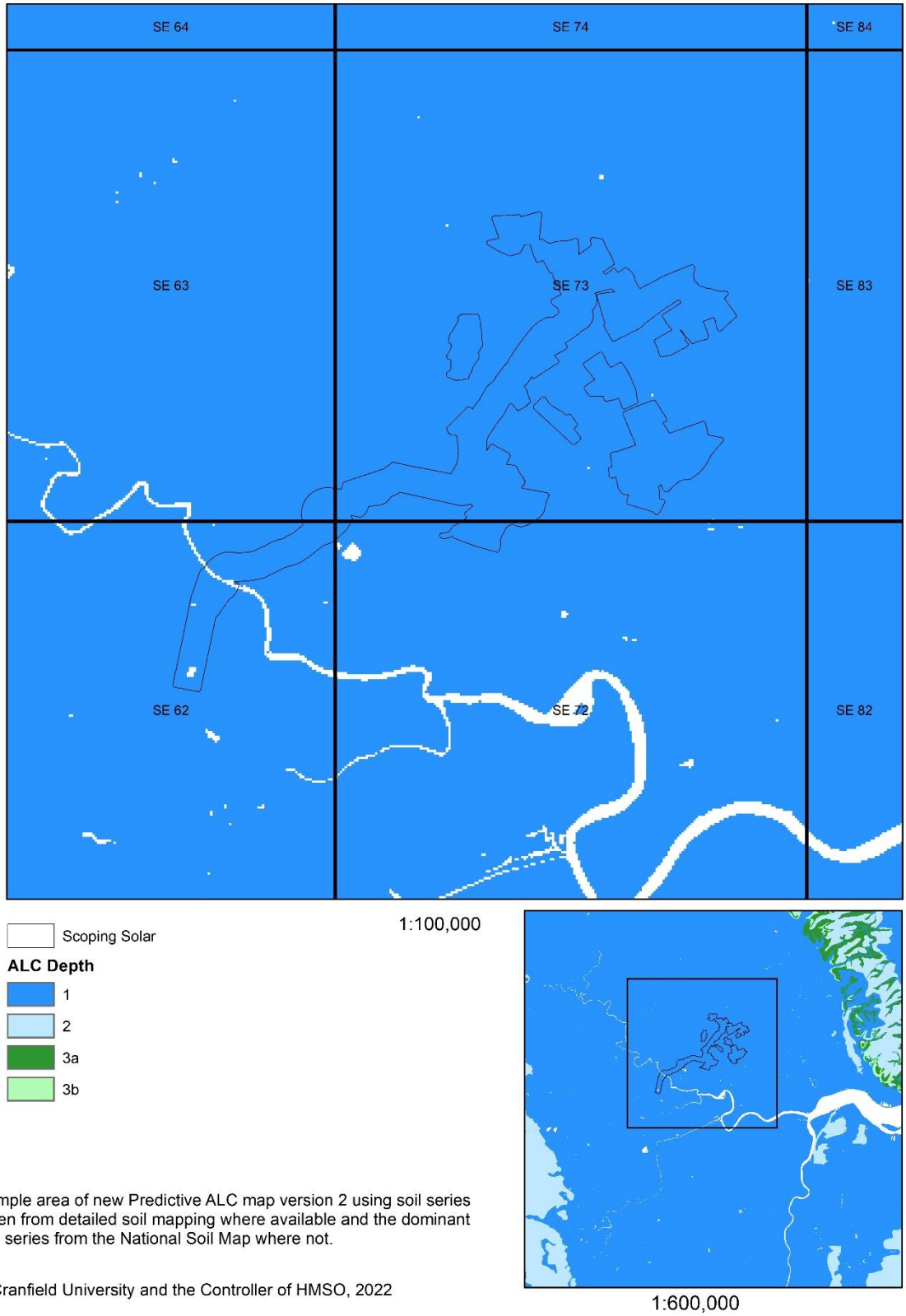


Figure 12 ALC grade according to soil depth (version 2)

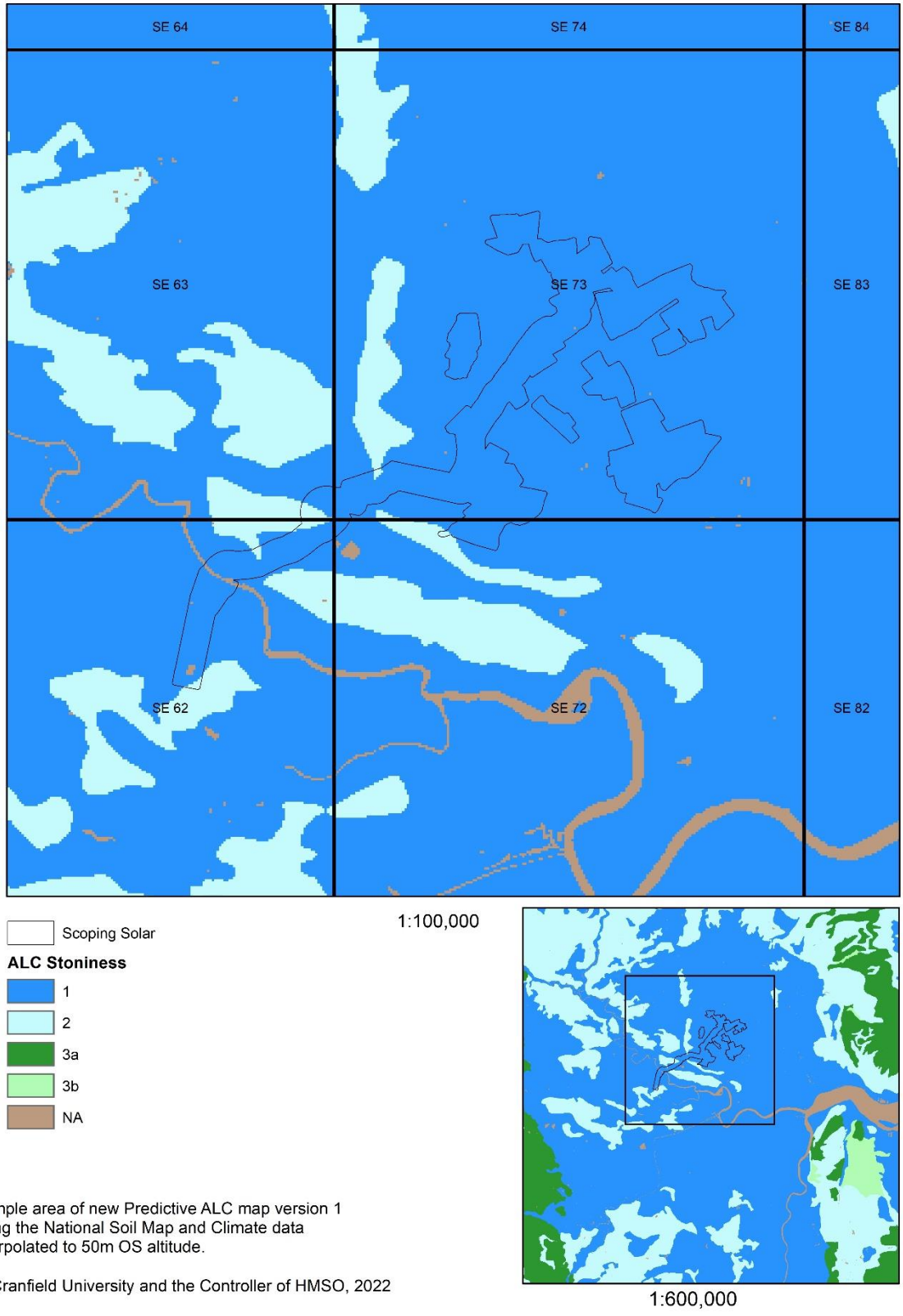


Figure 13 ALC grade according to stoniness (version 1)

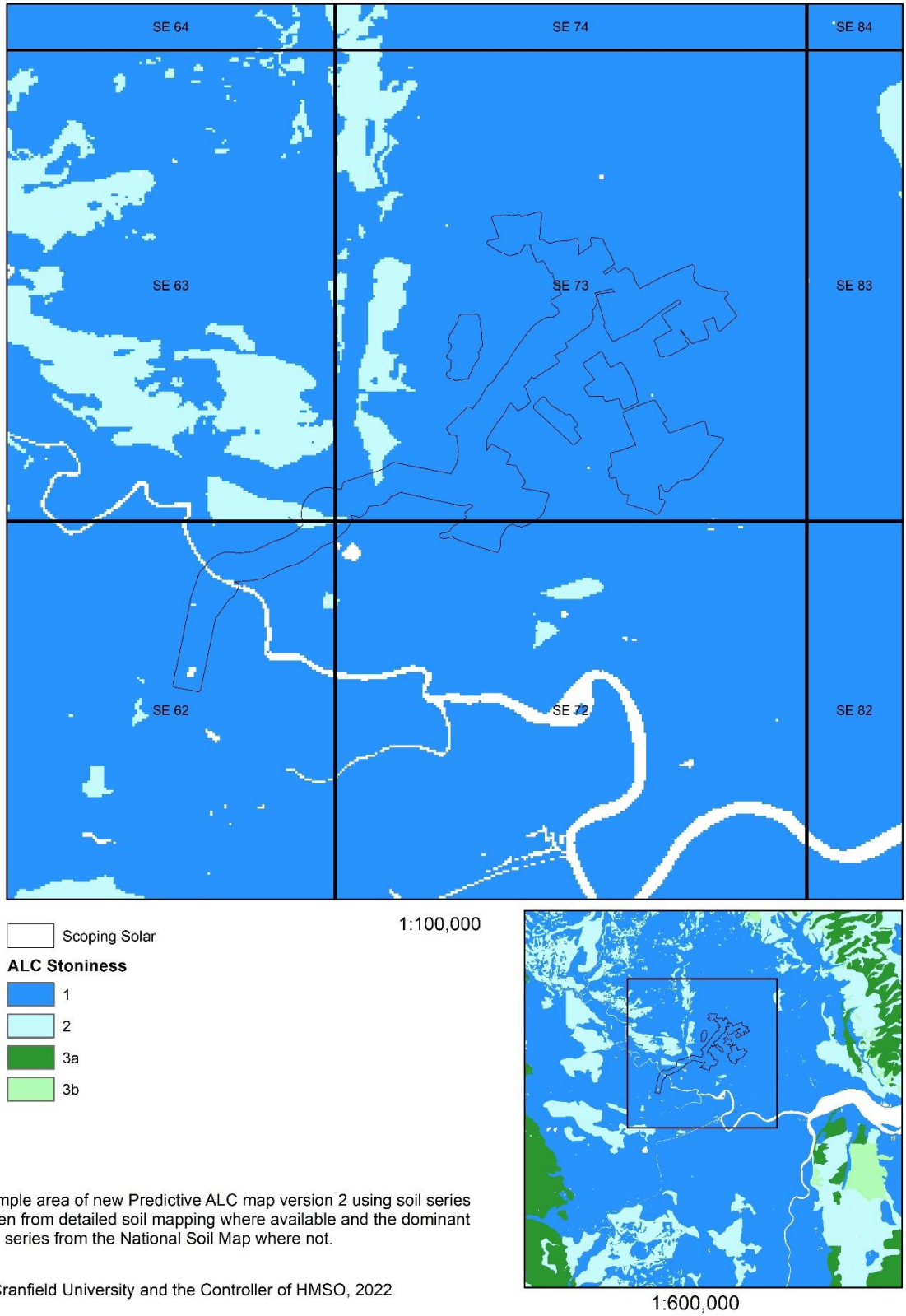


Figure 14 ALC grade according to stoniness (version 2)

6 APPENDIX 2 – Climate Maps

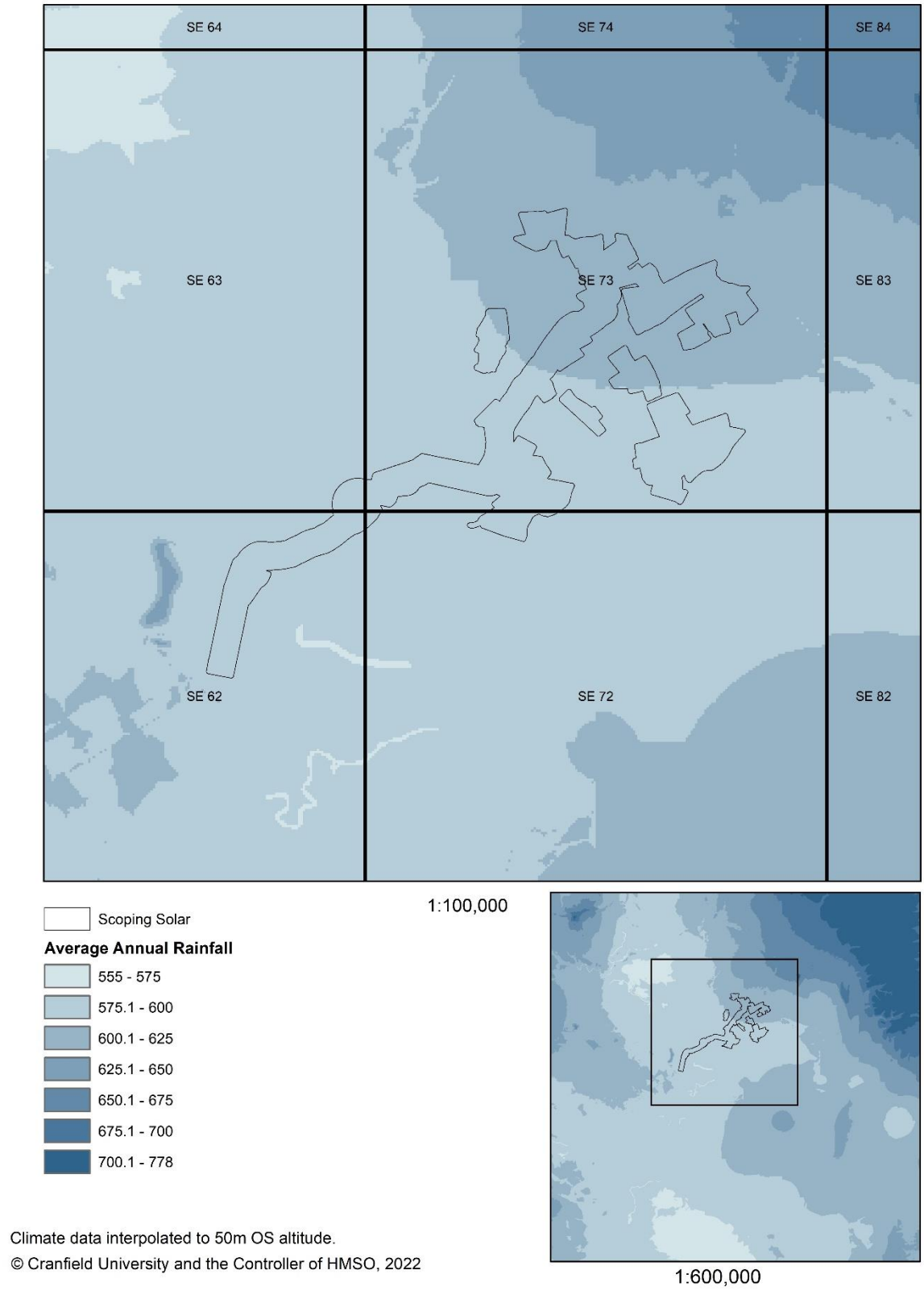


Figure 15 Average Annual Rainfall (AAR)

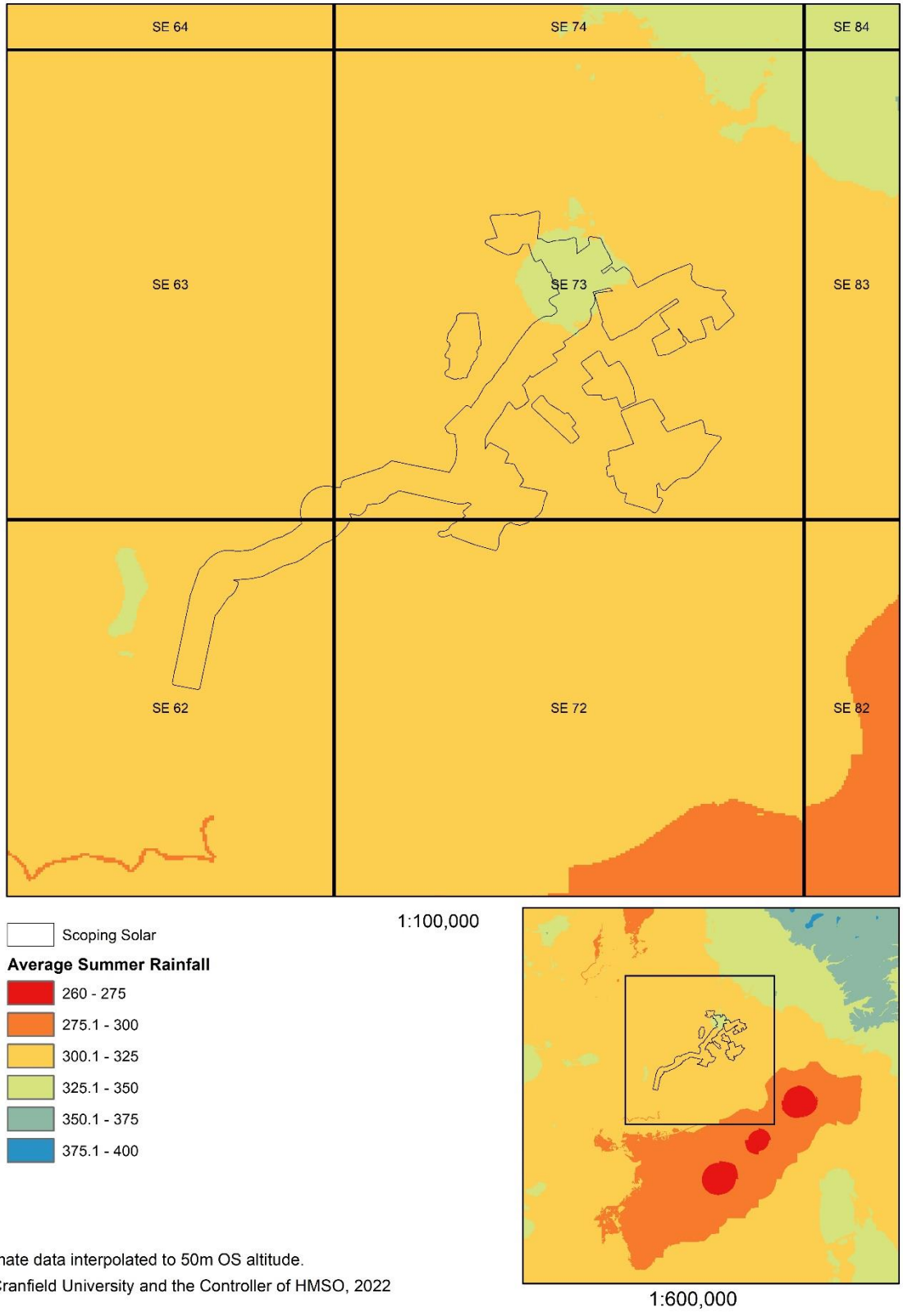


Figure 16 Average Summer Rainfall (ASR)

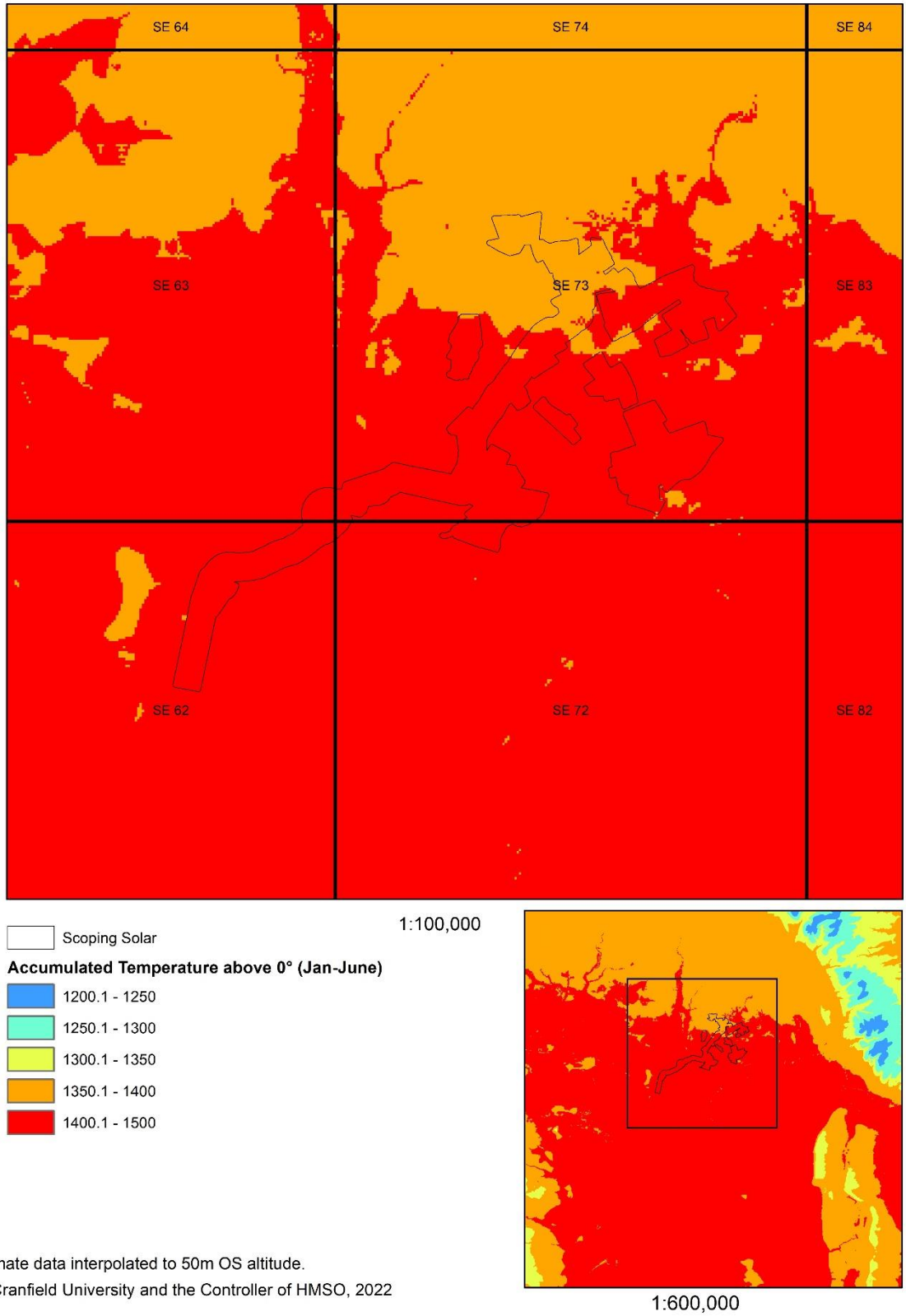


Figure 17 Accumulated Temperature above 0° (Jan-Jun) (AT0)

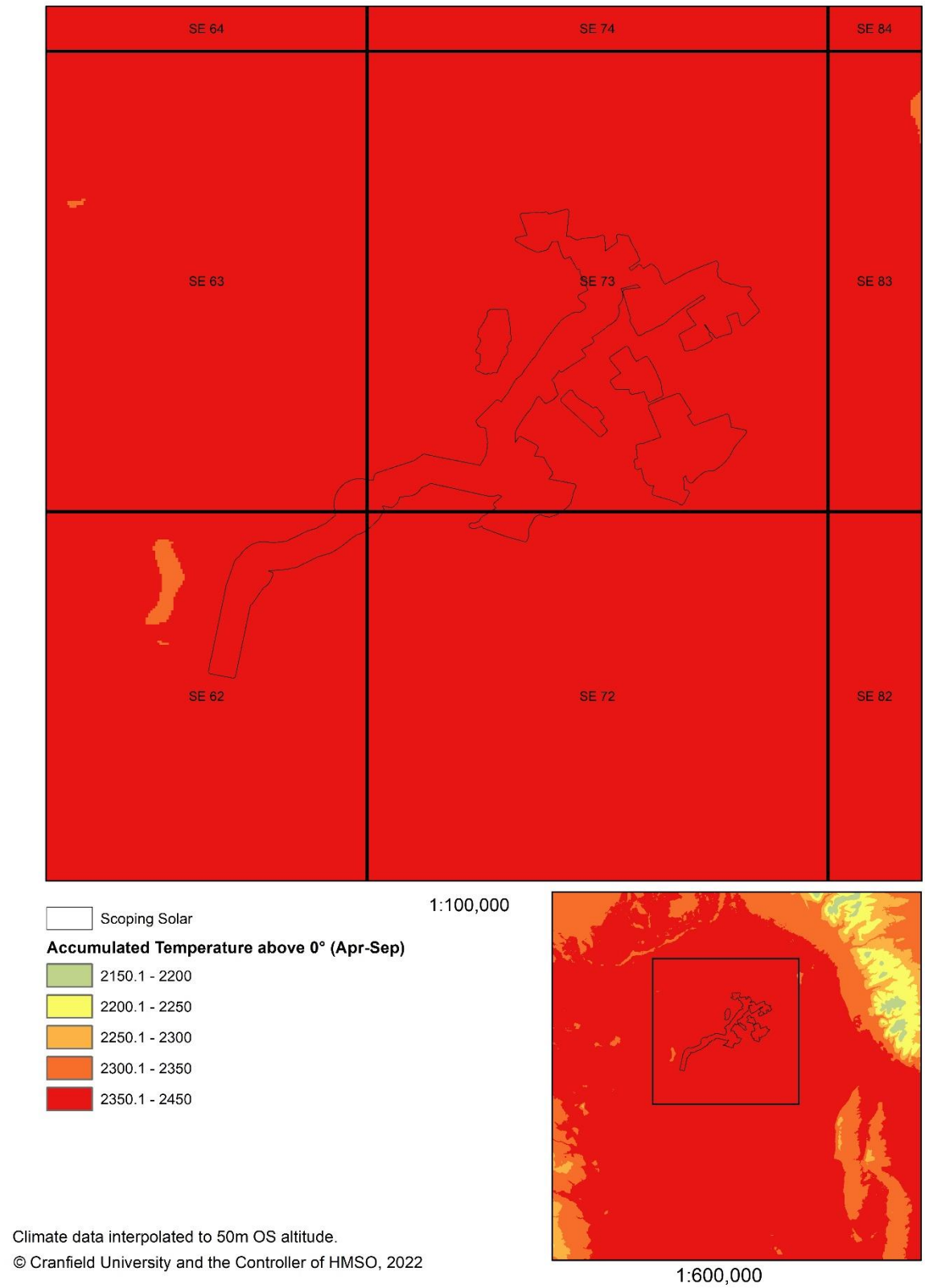


Figure 18 Accumulated Temperature above 0° (Apr-Sep) (ATS)

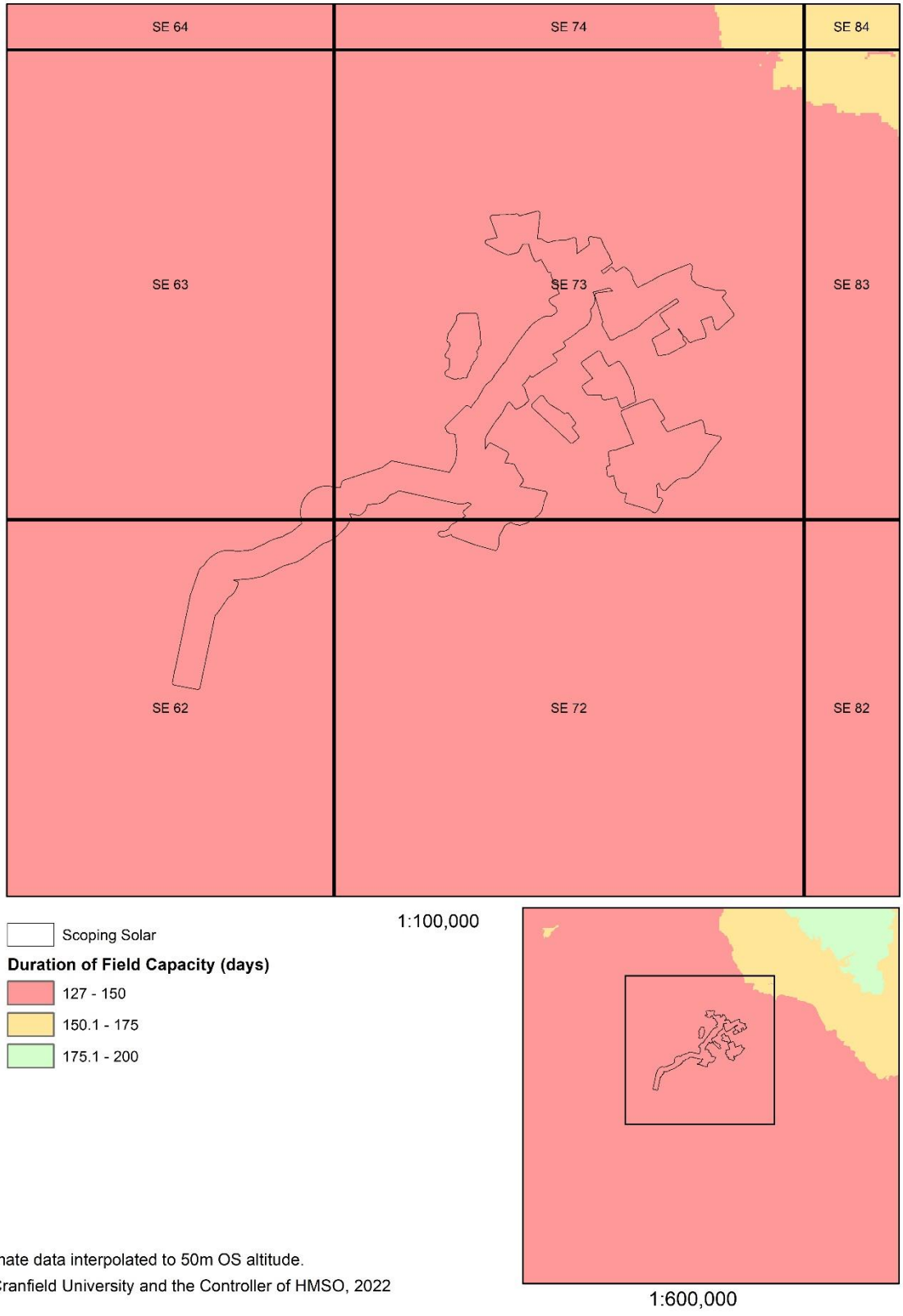


Figure 19 Duration of Field Capacity in days (FCD)

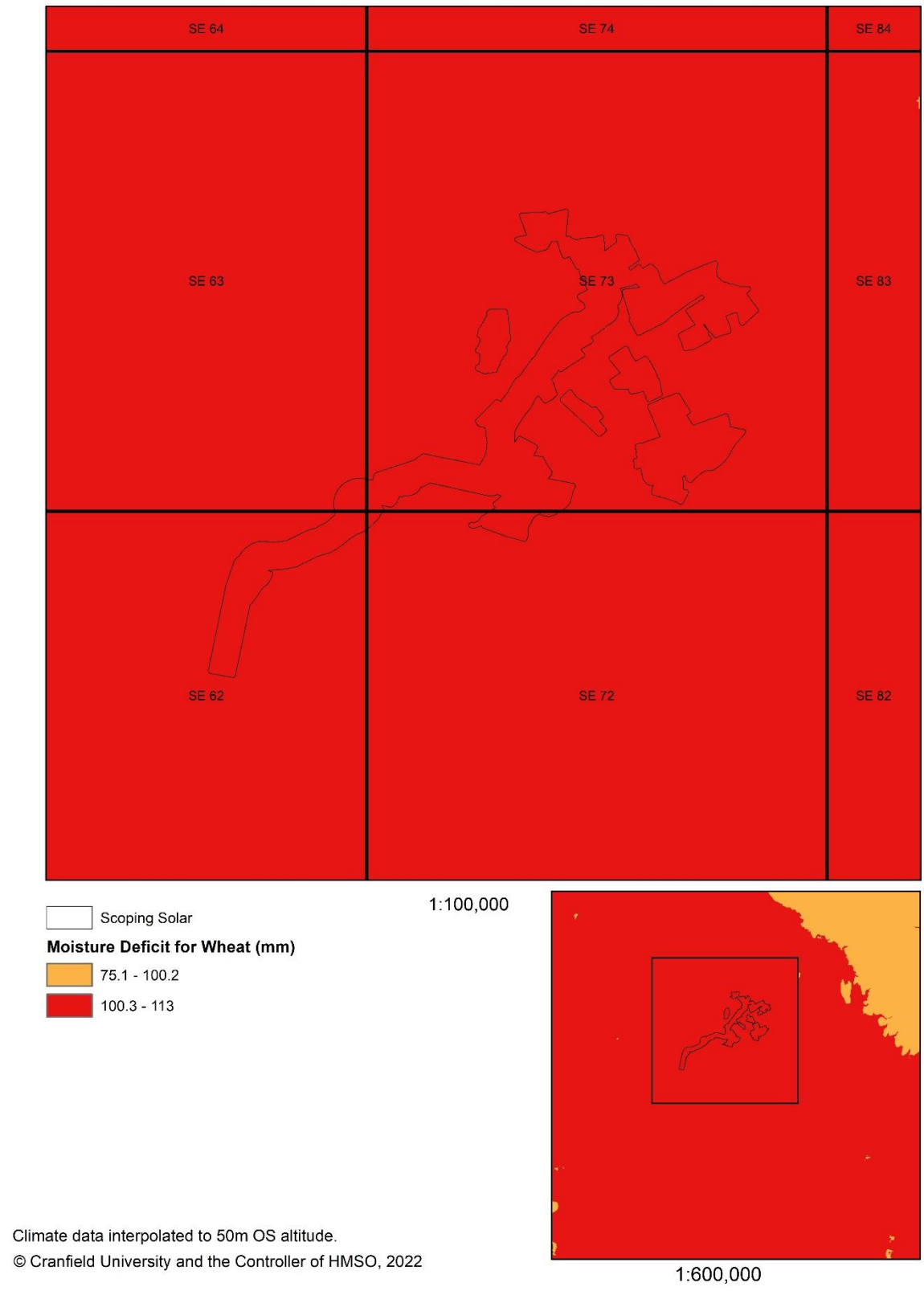


Figure 20 Moisture deficit for Wheat (mm) (MDMWHT)

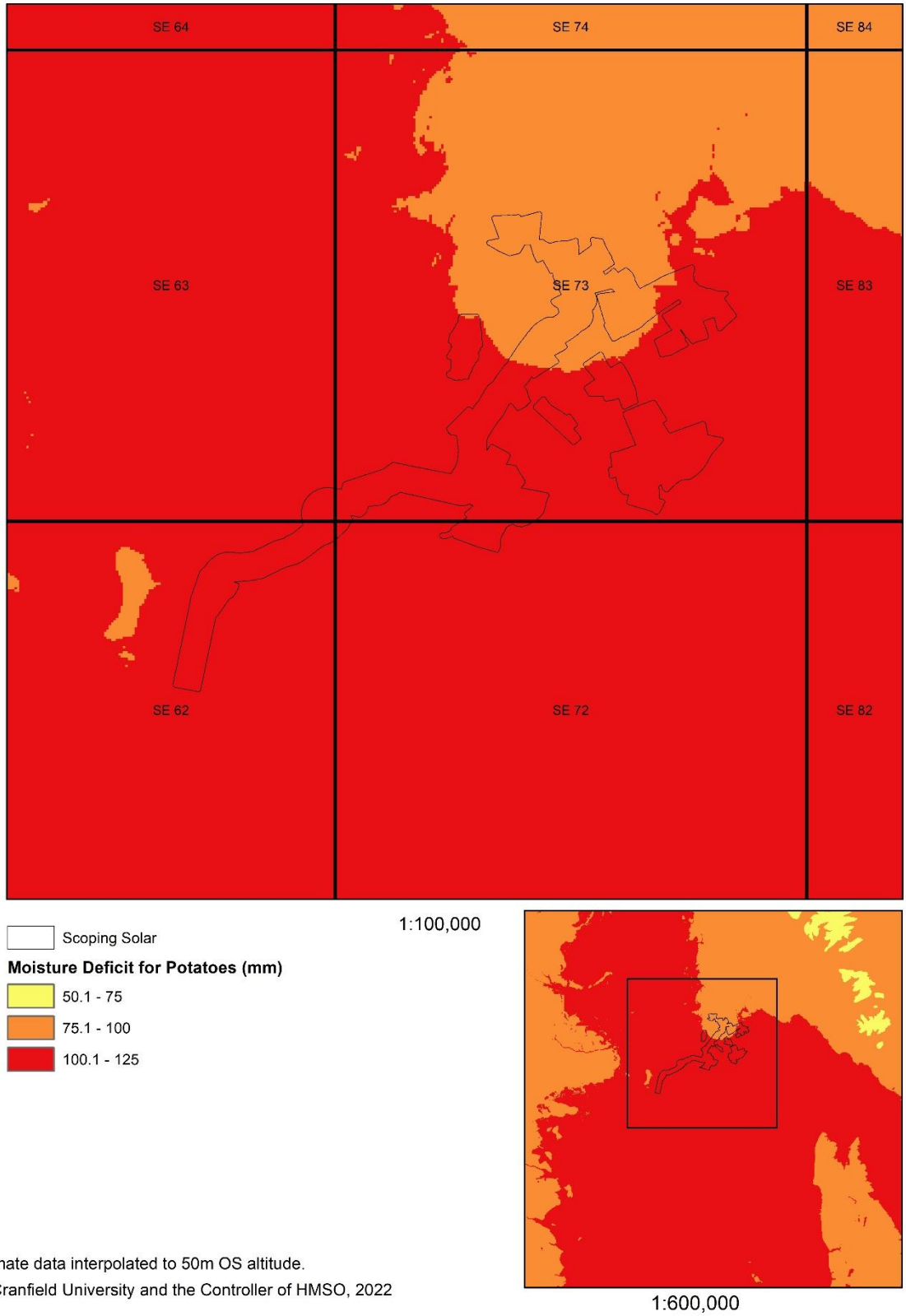


Figure 21 Moisture deficit for Potatoes (mm) (MDMPOT)

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