



Llywodraeth Cymru
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Grass growth classes in Wales

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Contents

1	Introduction	2
2	Objectives.....	2
3	Grass growth class	2
3.1	Calculating grass growth class	3
3.2	Soil available water	5
3.3	Summer rainfall.....	7
3.4	Altitude.....	9
3.5	Baseline	10
3.6	UKCP18 Low scenarios	11
3.7	UKCP18 Medium scenarios	12
3.8	UKCP18 High scenarios	13
4	References	18

1 Introduction

- Welsh agriculture is dominated by grassland (permanent pasture, rough grazing and temporary grassland) which can be either improved, natural or semi-natural with contrasting management (i.e. stocking rate and cutting regime). In 2018, of the 1.9 million ha agricultural area in Wales, 89% (1.7 million hectares-ha) was grass, comprising 1.1 million ha of permanent pasture (of which enclosed semi-natural grassland has been estimated to cover 25-30,000 ha (NRW, 2016)), c.430,000 ha of rough grazing and c.154,000 ha of temporary grassland (i.e. under 5 years old) (Welsh Government, 2019).
- Outputs from the CSCP Project (WG 2018-2020), using the latest UKCP18 climate projections, clearly demonstrated that drought risk may become a major limitation on land capability and crop suitability post 2050. However, the impact on grass productivity (quantity and quality) was not considered as part of the CSCP project.
- Grass growth class is used in AHDB's Nutrient management Guide (RB209) to assess potential grass yield which is an essential component for determining nutrient applications required for optimum grass growth. Summer rainfall (April to September), soil type (as defined by RB209) and altitude are used to assign grass growth classes.

2 Objectives

- The current climatic conditions in Wales (i.e. warm temperatures and high summer rainfall) are very favourable for grass production for both grazing and cutting. Using data supplied by Welsh Government, we have assessed the effect of climate change on the distribution of RB209 Grass Growth Classes in Wales to produce the following maps:
 - Grass Growth Class map (50 m raster) using the baseline ALC dataset
 - Grass Growth Class map (50 m raster) for 2020 low, medium and high scenarios
 - Grass Growth Class map (50 m raster) for 2050 low, medium and high scenarios
 - Grass Growth Class map (50 m raster) for 2080 low, medium and high scenarios

3 Grass growth class

- The grass growth class (GGC) is the ability of site to respond to nitrogen, which depends on soil type and rainfall (Figure 1). On good/very good GGC sites, swards dominated by productive grass species respond well to increasing N supply, as soil drainage, temperature and water supply are conducive to growth. On poor/very poor GGC sites, grass does not respond as well to N applications because of factors such as poor drainage or cooler temperatures (due to aspect or altitude) (AHDB, 2020).
- Grass growth classes assess the risk of a summer drought on a site that would impair grass growth and are assigned based on summer rainfall, soil available water (based on soil type) and altitude.

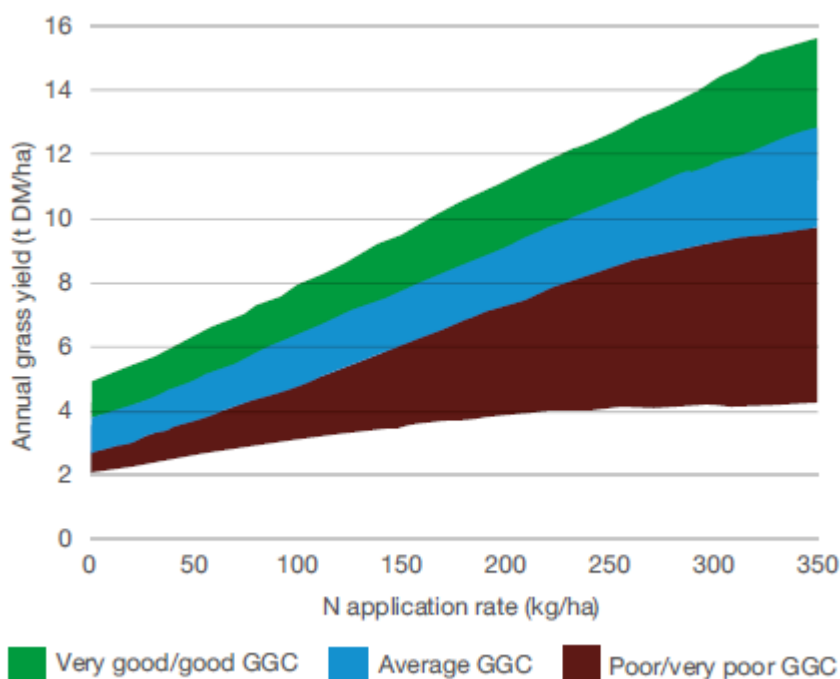


Figure 1. Indicative grass dry matter yield by Grass Growth Class (GGC). Source AHDB, 2020.

3.1 Calculating grass growth class

- Table 1, below is taken from RB209 and gives an indication of the grass growth potential in an average season, based on the risk of summer drought. The guidance in Table 1, was used to determine the grass growth classes for Wales. In brief, to calculate grass growth class the data was allocated to three soil available water classes (low, medium and high) based on Table 2 below from RB209 and then further assigned to rainfall classes (low: ≤300 mm; medium: 300-400 mm and high >400 mm). For sites above 300 m altitude, grass growth class was reduced by one class to reflect the effect of lower temperatures on growth.

Table 1. Determining Grass Growth Class (Source: AHDB, 2020).

Soil available water	Soil types ^a	Rainfall ^b (April to September)		
		up to 300 mm	300–400 mm	over 400 mm
Low	Light sand soils, gravels and shallow soils (not over chalk)	Very poor	Poor	Average
Medium	Medium soils, deep clay soils, and shallow soils over chalk	Poor	Average	Good
High	Deep silty soils, peaty soils and soils with groundwater (e.g. river meadows)	Average	Good	Very good

Table 2. Soil category assessment (Source: AHDB, 2020)

Soil category	Description of soil types within category	Properties
Light sand soils	Soils that are sand, loamy sand or sandy loam to 40 cm depth and are sand or loamy sand between 40–80 cm, or over sandstone rock.	Soils in this category have poor water-holding capacity and retain little nitrogen.
Shallow soils	Soils over impermeable subsoils and those where the parent rock (chalk, limestone or other rock) is within 40 cm of the soil surface. Sandy soils developed over sandstone rock should be regarded as light sand soils.	Soils in this category are less able to retain or supply nitrogen at depth.
Medium soils	Mostly medium-textured mineral soils that do not fall into any other soil category. These include sandy loams over clay deep loams and silty or clayey topsoils that have sandy or loamy subsoils.	Soils in this category have moderate ability to retain nitrogen and allow average rooting depth.
Deep clayey soils	Soils with predominantly sandy clay loam, silty clay loam, clay loam, sandy clay, silty clay or clay topsoil overlying clay subsoil to more than 40 cm depth. Deep clayey soils normally need artificial field drainage.	Soils in this category are able to retain more nitrogen than lighter soils.
Deep silty soils	Soils of sandy silt loam, silt loam or silty clay loam textures to 100 cm depth or more. Silt soils formed on marine alluvium, warp soils (river alluvium) and brickearth soils are in this category. Silty clays of low fertility should be regarded as other mineral soils.	Soils in this category are able to retain more nitrogen than lighter soils and allow rooting to greater depth.
Organic soils	Soils that are predominantly mineral but with between 10–20% organic matter to depth. These can be distinguished by darker colouring that stains the fingers black or grey.	Soils in this category are able to retain more nitrogen than lighter soils and have higher nitrogen mineralisation potential.
Peat soils	Soils that contain more than 20% organic matter derived from sedge or similar peat material.	Soils in this category have very high nitrogen mineralisation potential.

3.2 Soil available water

- Figures 2 and 3 show the soil available water and soil textural classes for Wales. Medium and high soil available water areas predominate, with low available water areas relating to areas with sandy soil types.

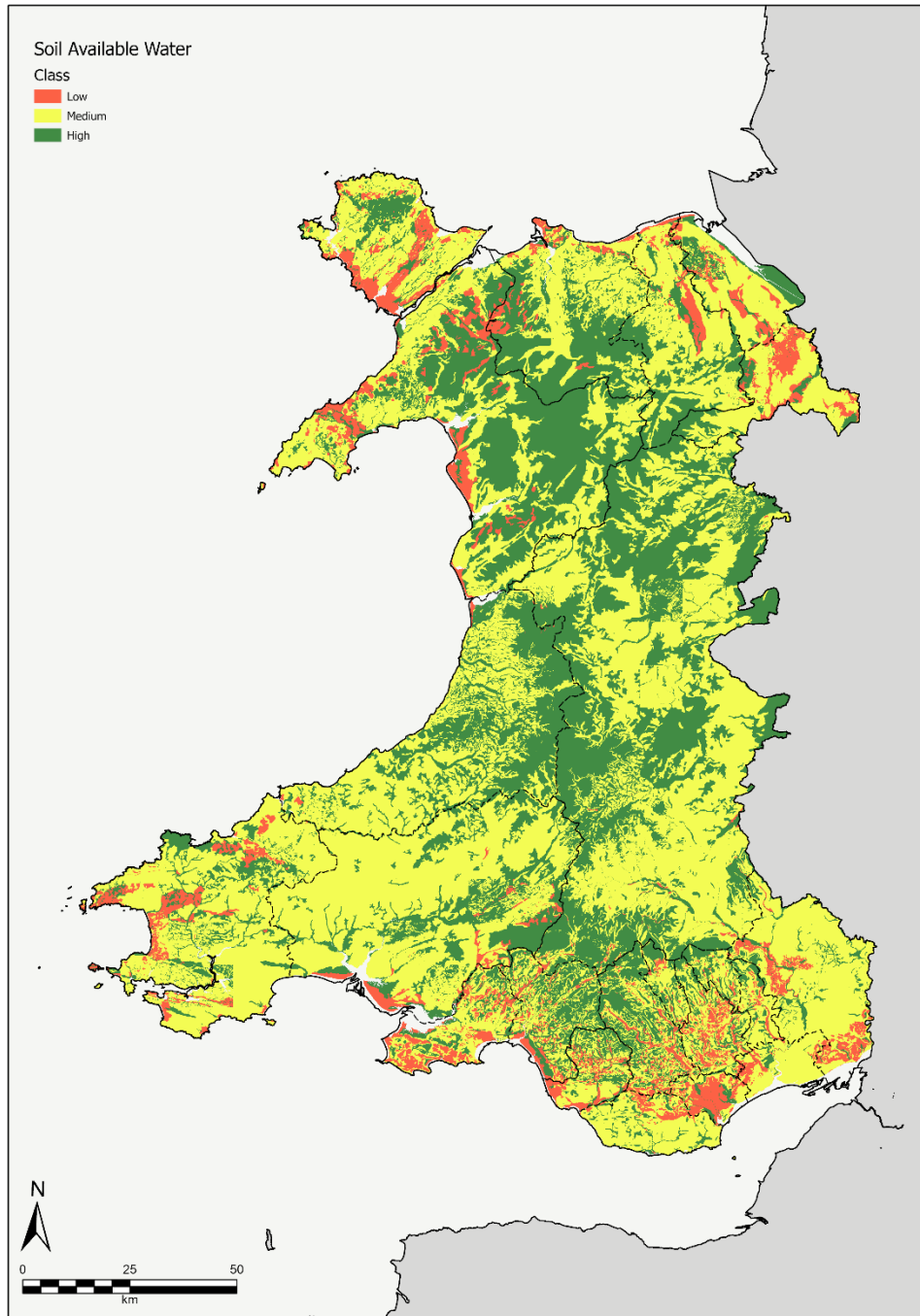


Figure 2. Soil available water classes (based on RB209 soil groups in Table 2) for Wales

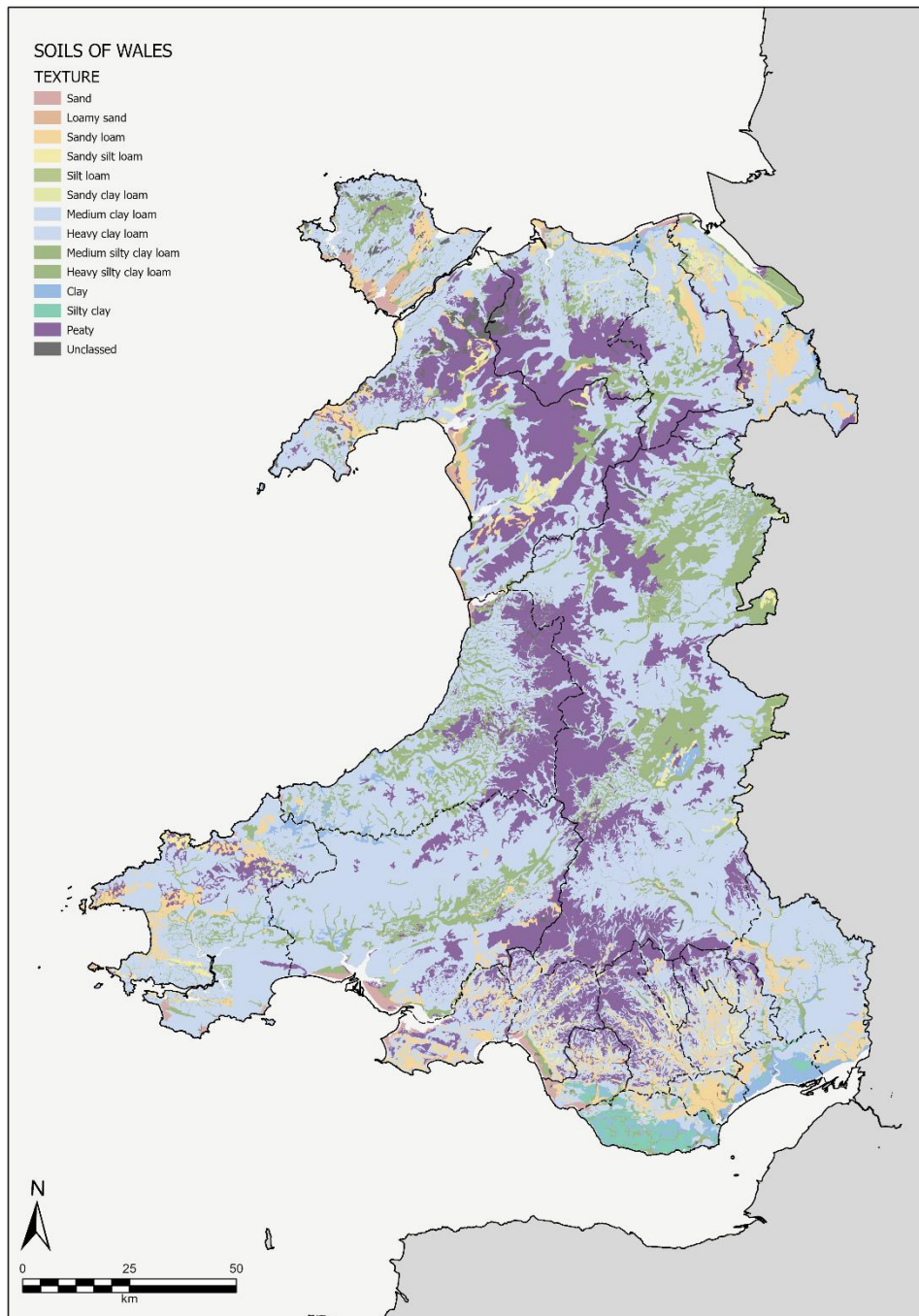


Figure 3. Soil textures in Wales

3.3 Summer rainfall

- Figure 4 shows the average summer rainfall (April to September) for Wales for the baseline data; most areas are in the 401-750 mm category meaning that the majority of the country was in the highest class for rainfall with a low risk of summer drought (Figure 5).

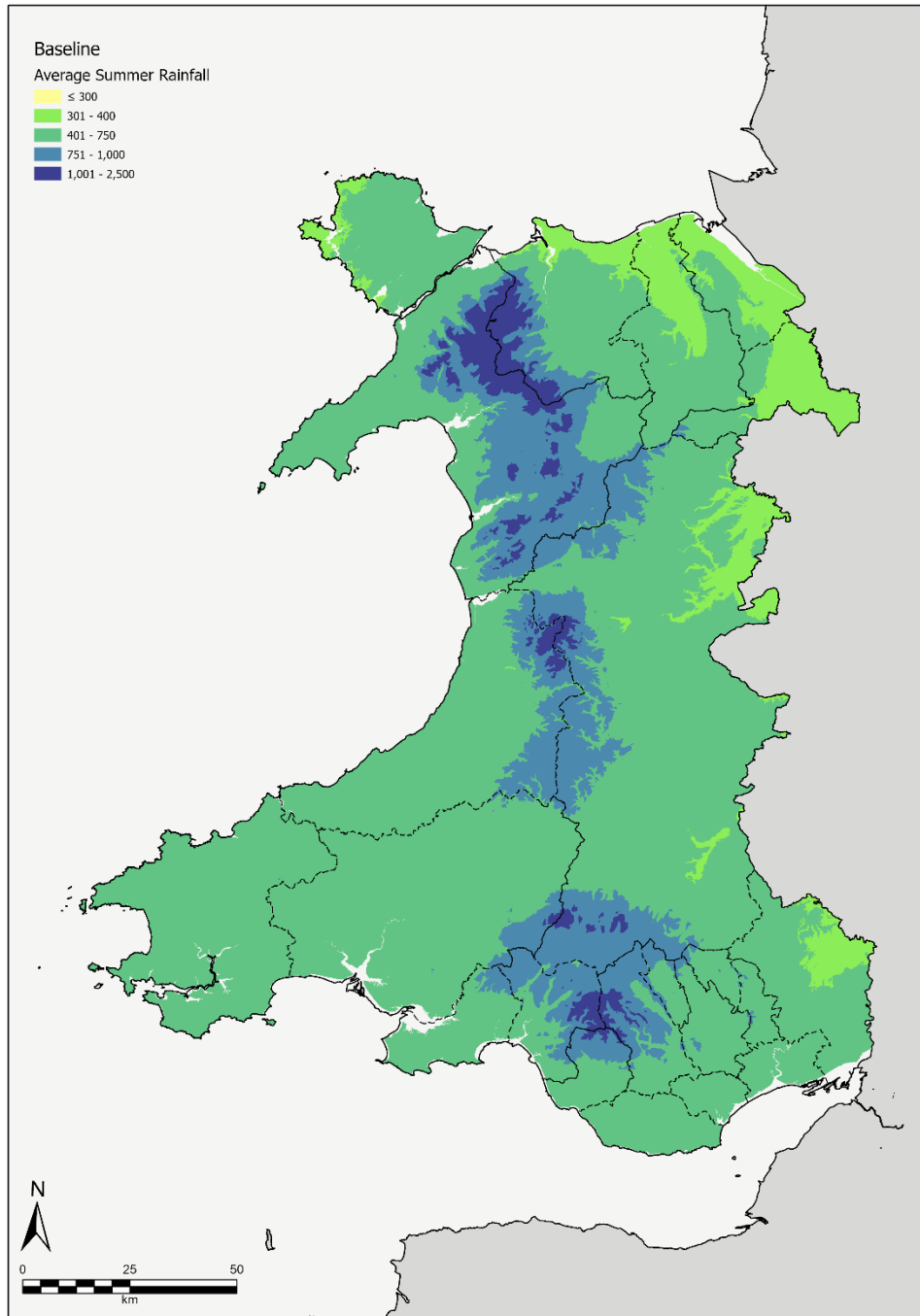


Figure 4. Baseline average summer rainfall (April to September)

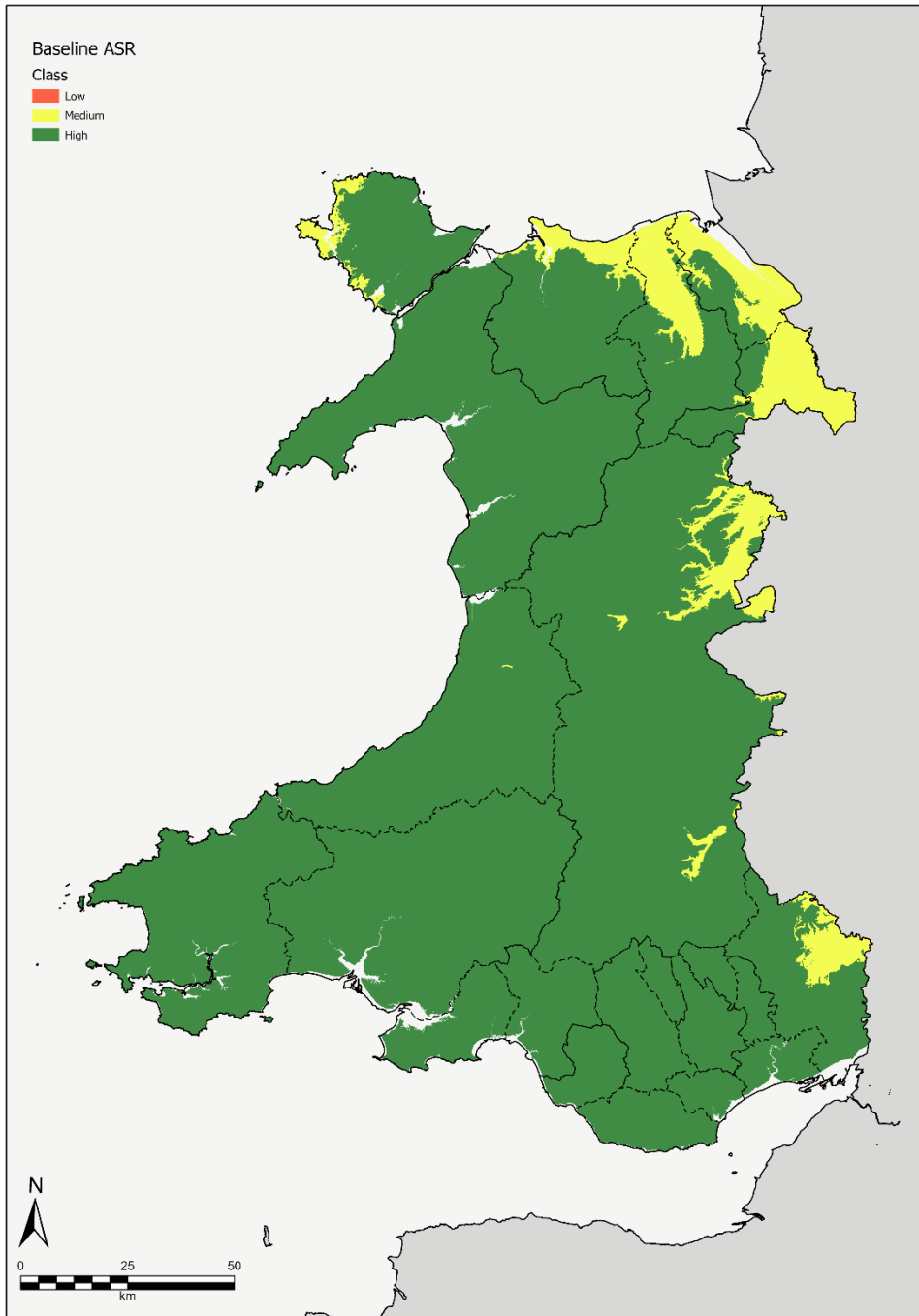


Figure 5. Baseline summer rainfall (April to September) classes (based on RB209 groups in Table 1).

3.4 Altitude

- Figure 6, indicates the areas of Wales where the grass growth classes were downgraded by one class for sites above 300 m.

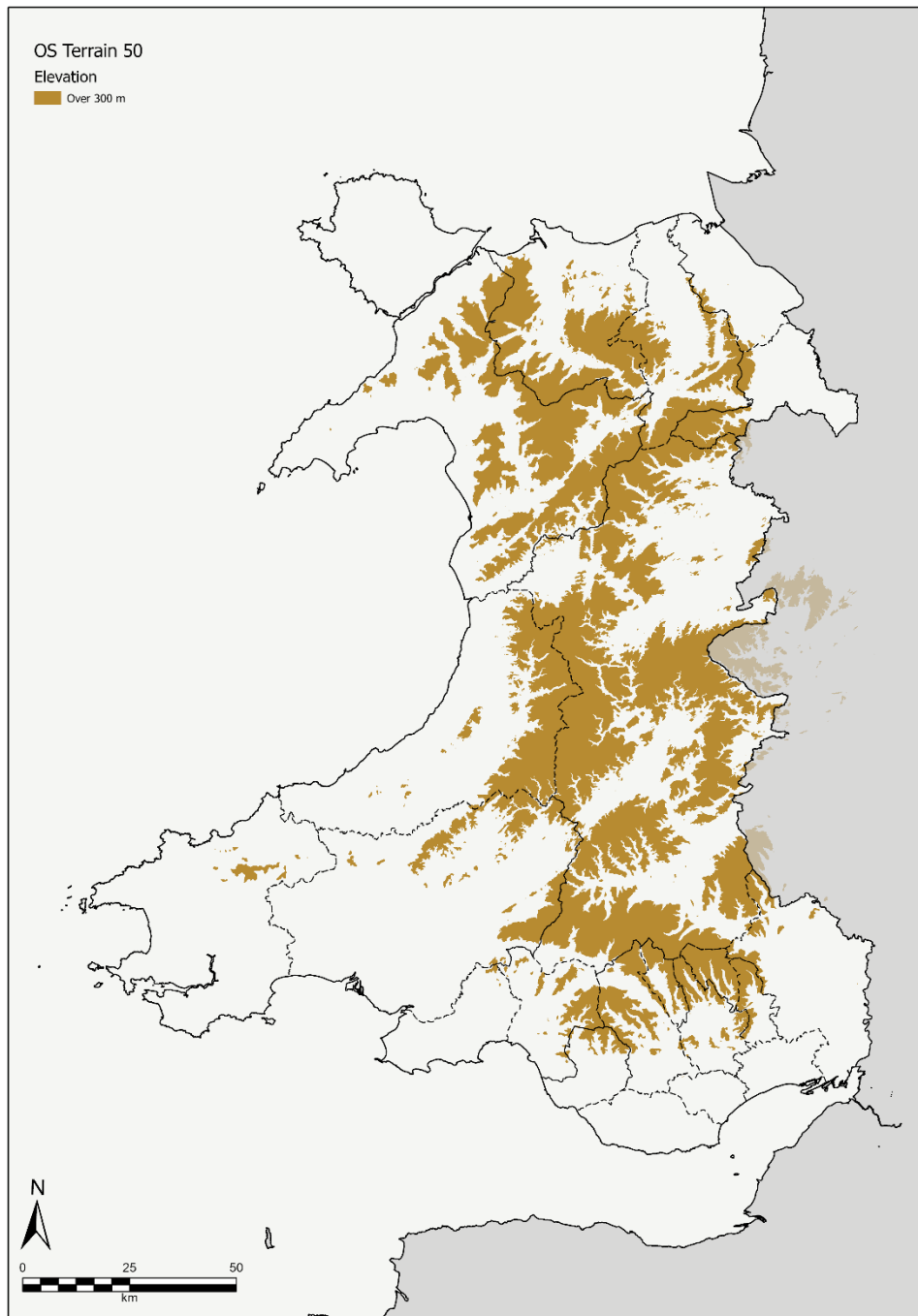


Figure 6. Areas of Wales with altitude >300 m

3.5 Baseline

- Figure 7 shows the grass growth classes for the baseline scenario. Most of Wales was classified as good (61%) or average (21%), with some very good areas (16%) and very small areas of poor grass growth (2%).

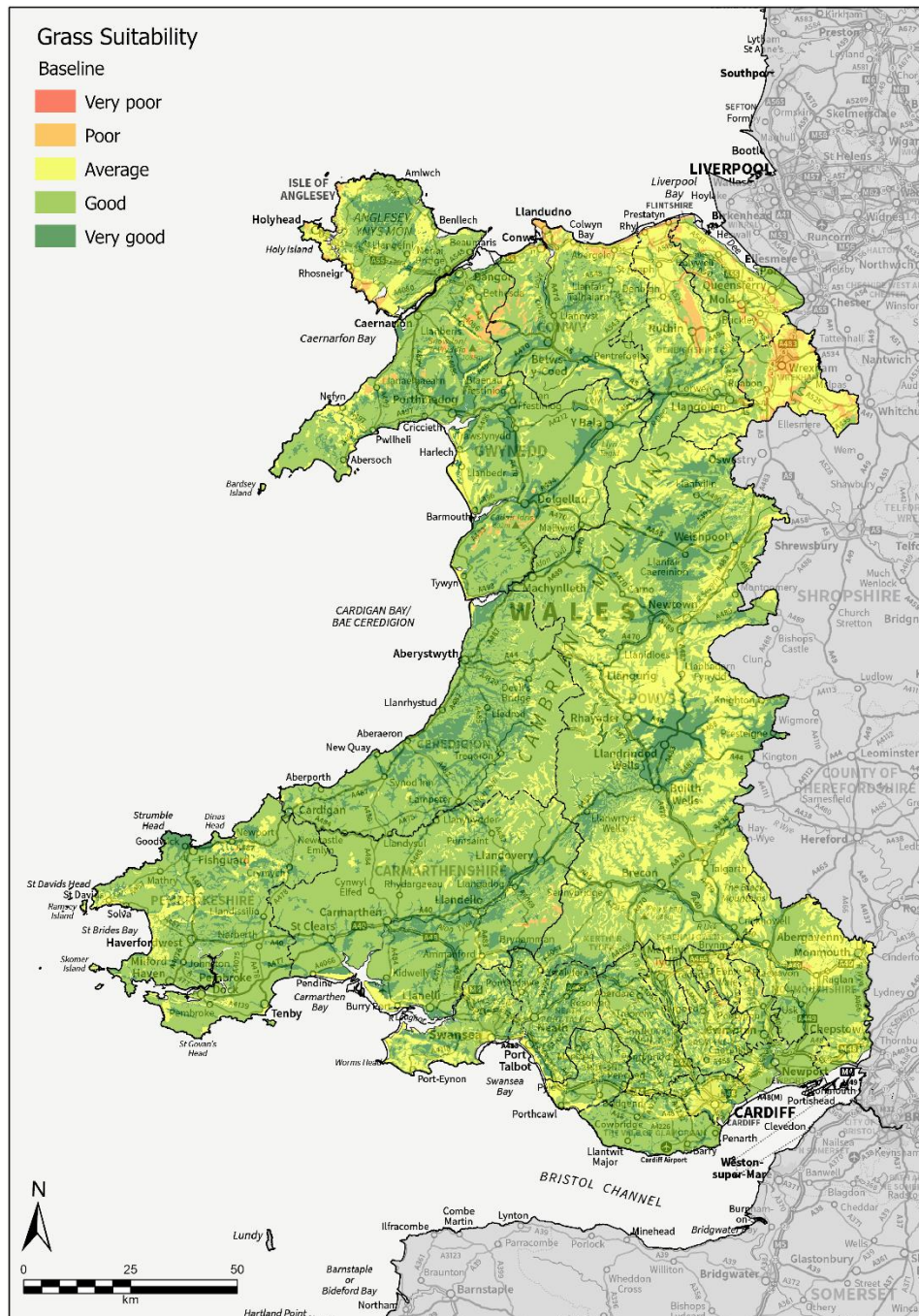


Figure 7. Baseline grass growth classes (very poor, poor, average, good and very good).

3.6 UKCP18 Low scenarios

- Figure 8 shows the percentage of Wales in each of the five grass growth classes (from very poor to very good) for the baseline compared to the UKCP18 2020, 2050 and 2080 low scenarios. Tabulated beneath the figure is the percentage change in grass growth class compared to the baseline for 2020, 2050 and 2080 (Table 3).
- Compared to the baseline, there is a very large proportional increase in the area classified as very poor, which increases from 2 ha in the baseline to 16,367 ha in the 2080 low scenario (Table 6). However, the area classified as very poor is always <1% of the total area. Likewise, there is a large increase in the area classified as poor over time so that by 2080 11% of the land area is classified as poor compared to 2% in the baseline. The proportion of land that is classified as average increases from 21% in the baseline to 32% by 2080. In contrast, the proportion of land that is good decreases from 61% in the baseline to 46% by 2080 and for very good it decreases from 16% to 10%.

Grass growth classes: UKCP18 low scenarios

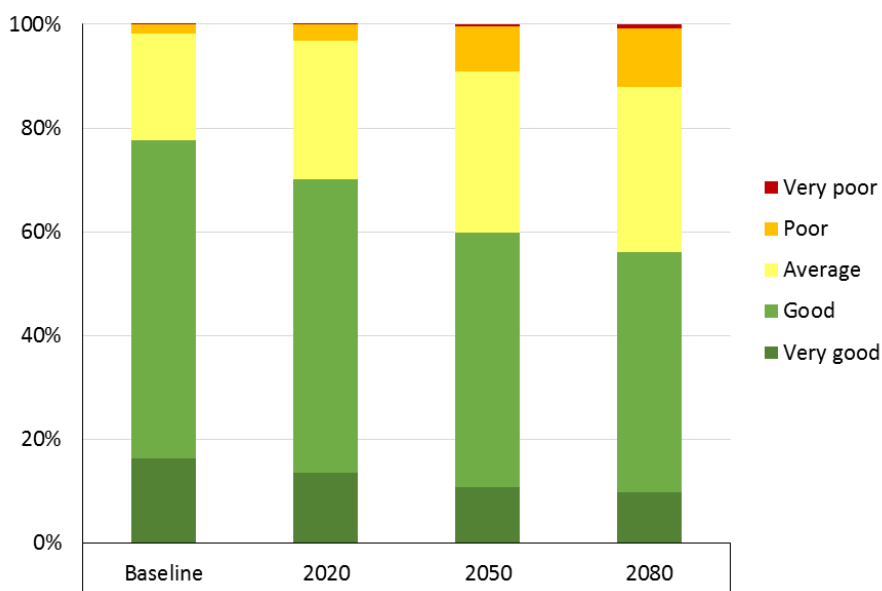


Figure 8. Grass growth class (% of total area) for the 2020, 2050 and 2080 UKCP18 low scenarios

Table 3. Percentage change in grass growth class (compared to the baseline) for the 2020, 2050 and 2080 UKCP18 low scenarios.

Growth Class	2020 L (% of baseline)	2050 L (% of baseline)	2080 L (% of baseline)
Very poor	5,750	623,900	1,091,150
Poor	173	473	615
Average	131	152	156
Good	92	80	75
Very good	83	67	61

- Figure 11 shows the distribution of the grass growth classes in Wales predicted by the UKCP18 low scenarios for 2020, 2050 and 2080.

3.7 UKCP18 Medium scenarios

- Figure 9 shows the percentage of Wales in each of the five grass growth classes (from very poor to very good) for the baseline compared to the UKCP18 2020, 2050 and 2080 medium scenarios. Tabulated beneath the figure is the percentage change in grass growth class compared to the baseline for 2020, 2050 and 2080 (Table 4).
- Compared to the baseline, there is a very large proportional increase in the area classified as very poor, which increases from 2 ha in the baseline to 18,920 ha in the 2080 low scenario. However, the area classified as very poor is always <1% of the total area. Likewise, there is a large increase in the area classified as poor over time (Table 6) so that by 2080 12% of the land area is classified as poor compared to 2% in the baseline. The proportion of land that is classified as average increases from 21% in the baseline to 32% by 2080. In contrast, the proportion of land that is good decreases from 61% in the baseline to 45% by 2080 and for very good it decreases from 16% to 10%.

Grass growth classes: UKCP18 medium scenarios

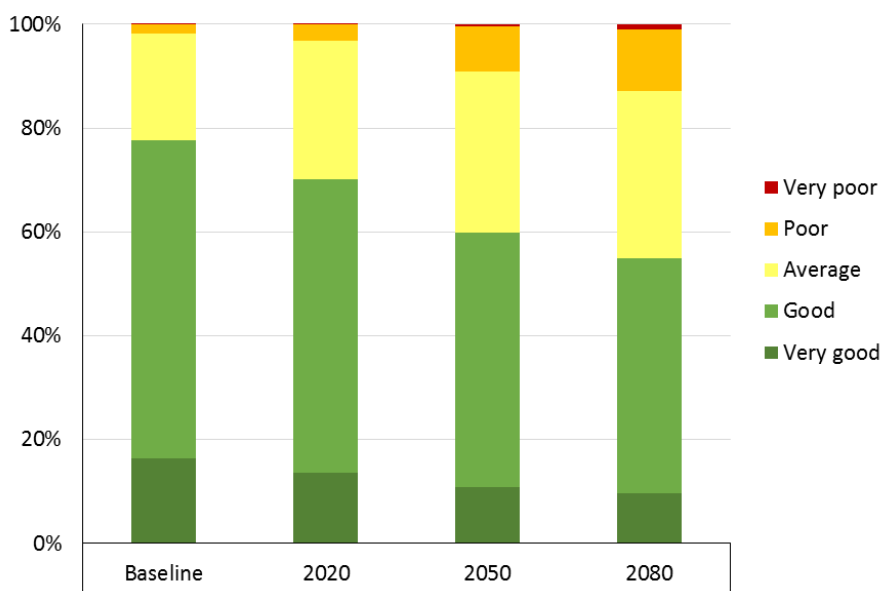


Figure 9. Grass growth class (% of total area) for the 2020, 2050 and 2080 UKCP18 medium scenarios

Table 4. Percentage change in grass growth class (compared to the baseline) for the 2020, 2050 and 2080 UKCP18 medium scenarios.

Growth Class	2020 M (% of baseline)	2050 M (% of baseline)	2080 M (% of baseline)
Very poor	5,267	620,400	1,261,300
Poor	171	471	655
Average	130	152	157
Good	92	80	74
Very good	83	67	59

- Figure 12 shows the distribution of the grass growth classes in Wales predicted by the UKCP18 medium scenarios for 2020, 2050 and 2080.

3.8 UKCP18 High scenarios

- Figure 10 shows the percentage of Wales in each of the five grass growth classes (from very poor to very good) for the baseline compared to the UKCP18 2020, 2050 and 2080 high scenarios. Tabulated beneath the figure is the percentage change in grass growth class compared to the baseline for 2020, 2050 and 2080 (Table 5).
- Compared to the baseline, there is a very large proportional increase in the area classified as very poor, which increases from 2 ha in the baseline to 32,818 ha in the 2080 high scenario. However, the area classified as very poor is still <1% of the total area. Likewise, there is a large increase in the area classified as poor over time so that by 2080 15% of the land area is classified as poor compared to 2% in the baseline. The proportion of land that is classified as average increases from 21% in the baseline to 33% by 2080. In contrast, the proportion of land that is good decreases from 61% in the baseline to 42% by 2080 and for very good it decreases from 16% to 8% (Table 6).

Grass growth classes: UKCP18 high scenarios

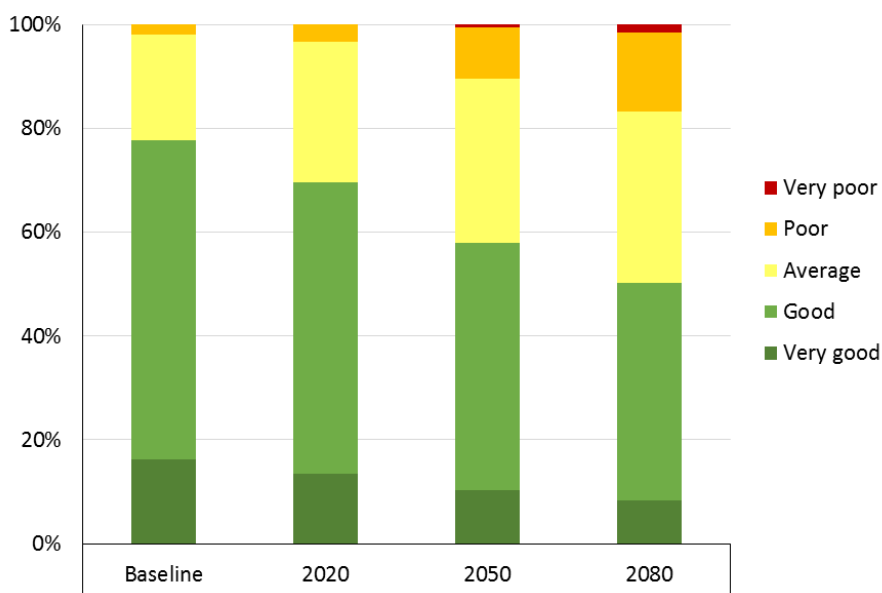


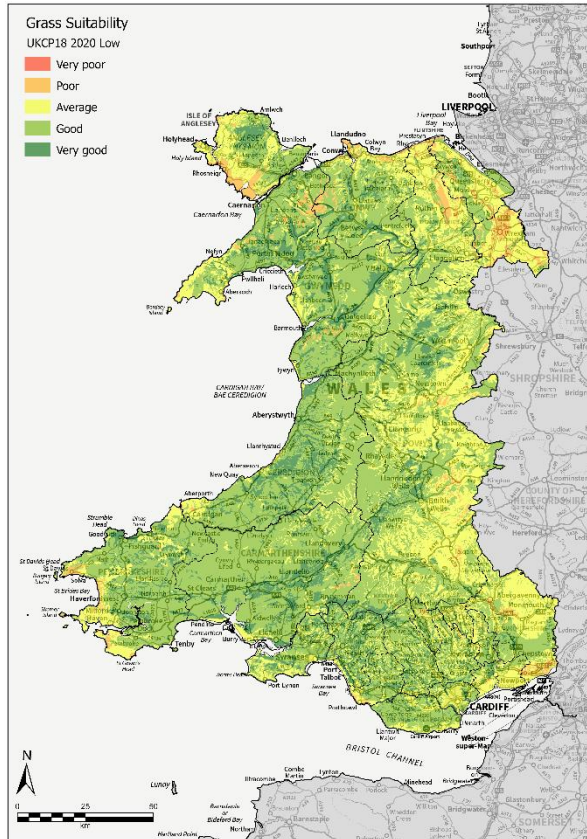
Figure 10. Grass growth class (% of total area) for the 2020, 2050 and 2080 UKCP18 high scenarios

Table 5. Percentage change in grass growth class (compared to the baseline) for the 2020, 2050 and 2080 UKCP18 high scenarios.

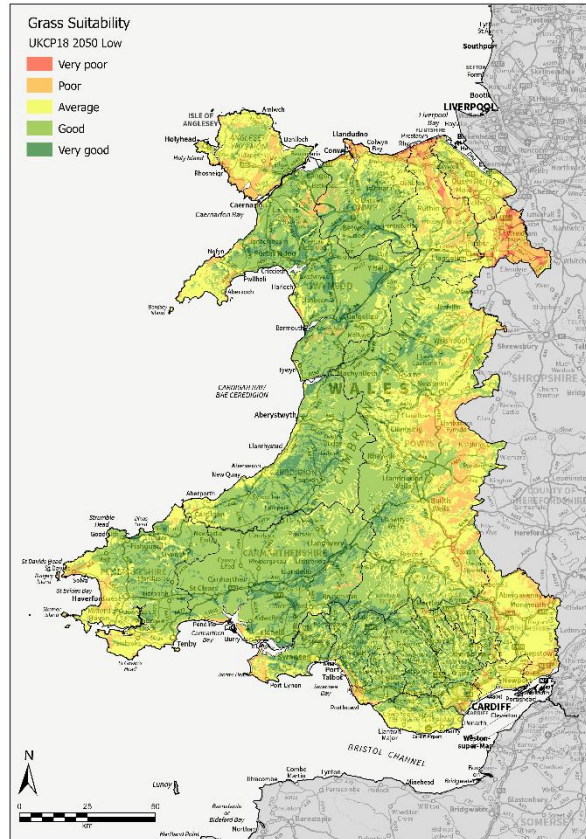
Growth Class	2020 H (% of baseline)	2050 H (% of baseline)	2080 H (% of baseline)
Very poor	10,200	830,633	2,187,867
Poor	179	540	832
Average	132	154	161
Good	92	77	68
Very good	82	64	51

- Figure 13 shows the distribution of the grass growth classes in Wales predicted by the UKCP18 high scenarios for 2020, 2050 and 2080.

a. 2020 low



b. 2050 low



c. 2080 low

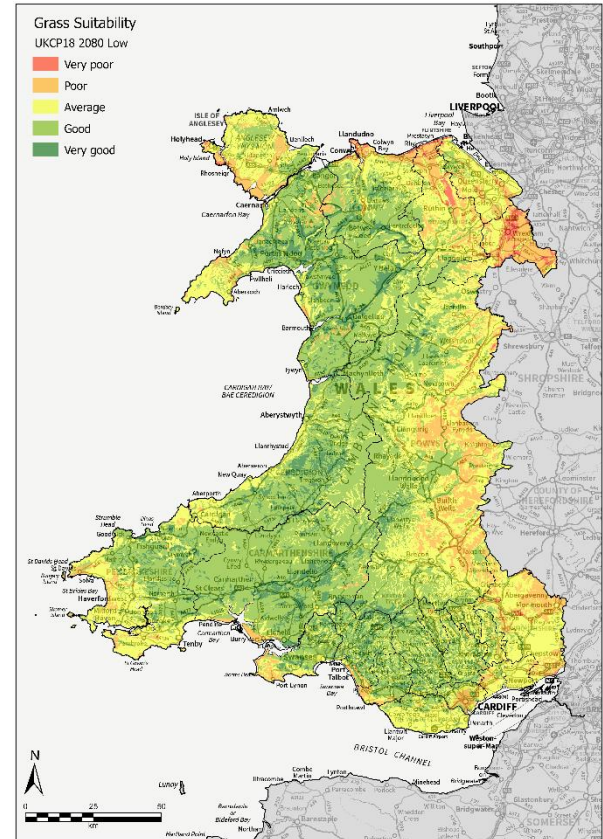
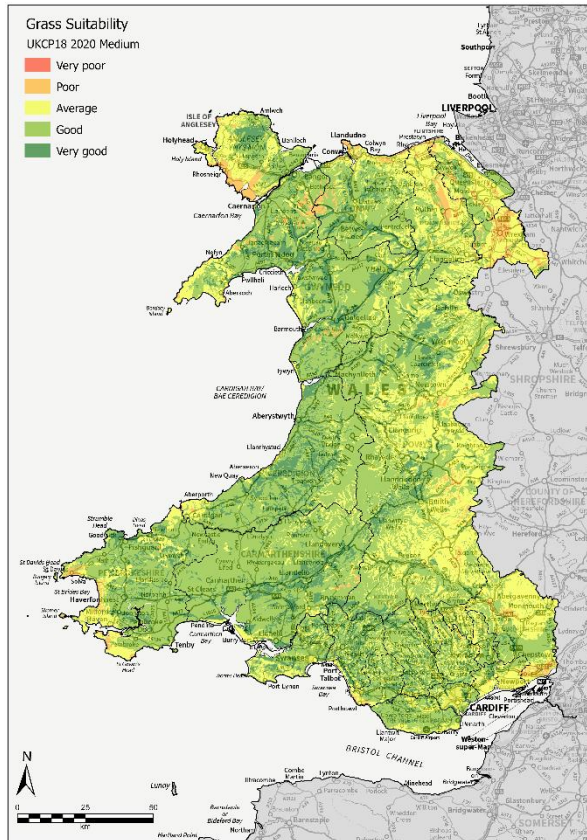
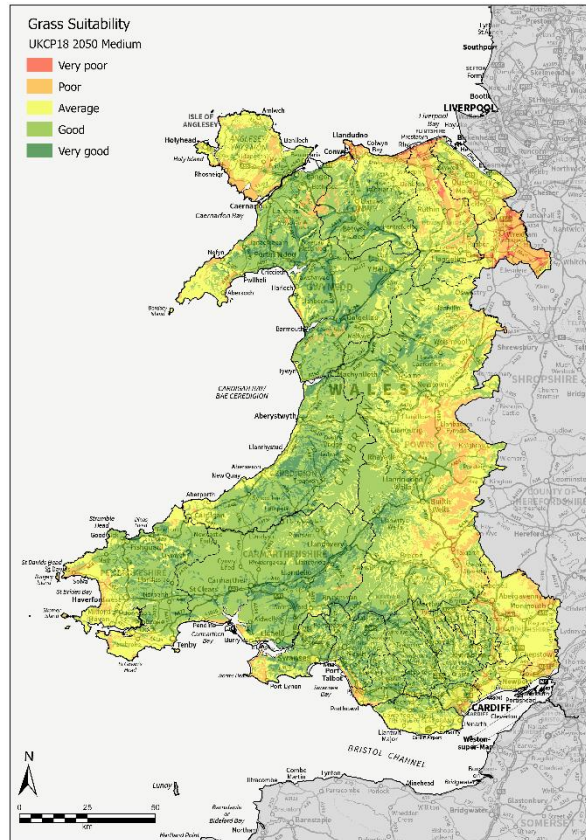


Figure 11. Grass growth classes for the UKCP18 low scenarios for a. 2020, b. 2050 and c. 2080

a. 2020



b. 2050



c. 2080

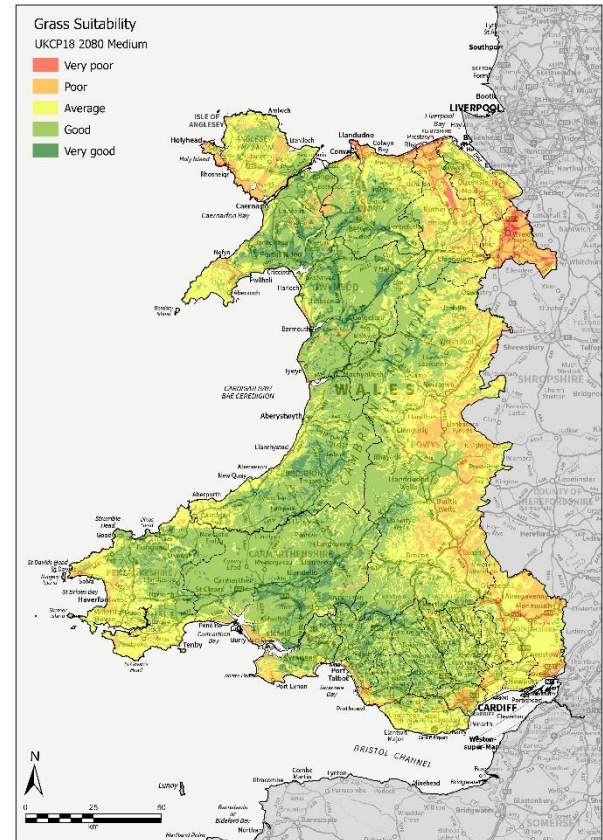
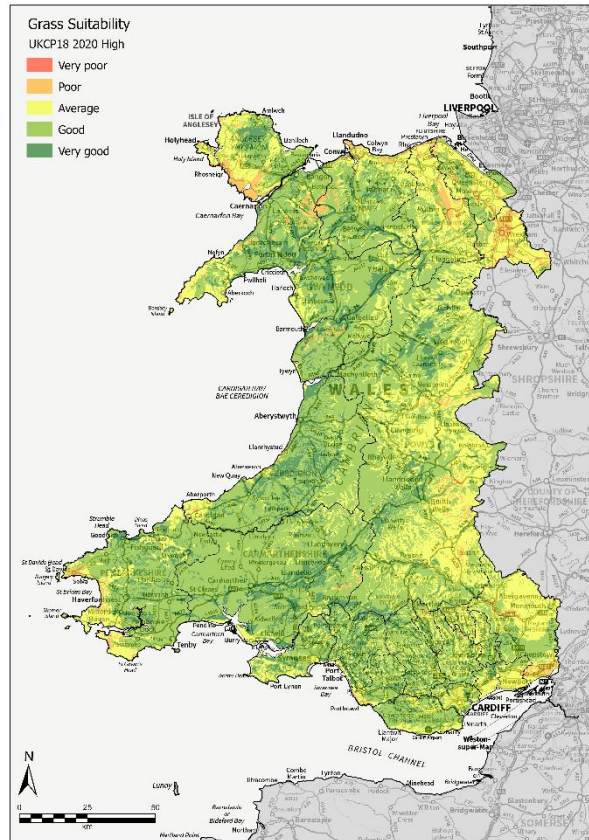
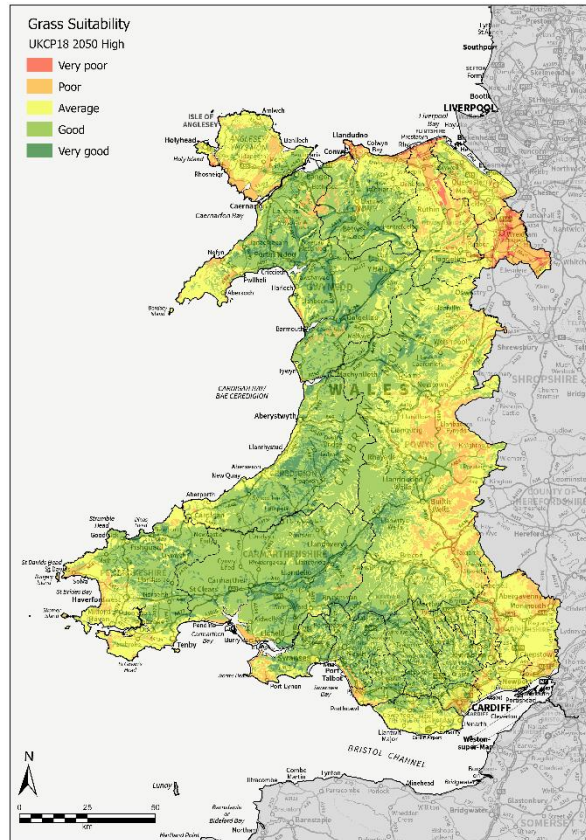


Figure 12. Grass growth classes for the UKCP18 medium scenarios for a. 2020, b. 2050 and c. 2080

a. 2020



b. 2050



c. 2080

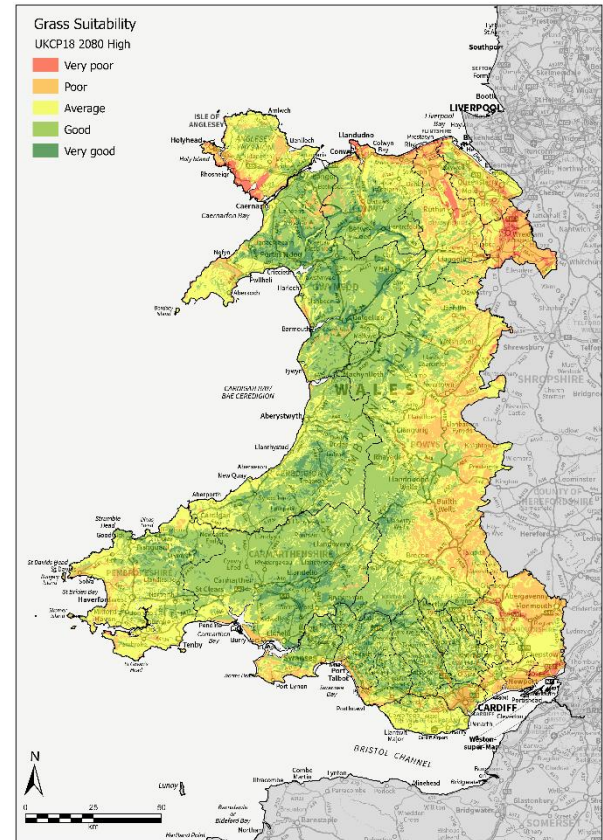


Figure 13. Grass growth classes for the UKCP18 high scenarios for a. 2020, b. 2050 and c. 2080

Table 6. Grass growth class area (hectares-ha) and proportion of total area (%) for the baseline, UKCP18 2020, 2050 and 2080, a. low, b. medium and c. high scenarios

a. Low

Grass growth class	Baseline		2020		2050		2080	
	Ha	%	Ha	%	Ha	%	Ha	%
Very poor	2	0.00	86	0.00	9,359	0.45	16,367	0.45
Poor	37,831	2	65,401	3	178,941	9	232,589	9
Average	425,906	21	556,483	27	646,813	31	664,428	31
Good	1,273,996	61	1,172,870	57	1,015,191	49	956,946	49
Very good	337,931	16	280,872	14	225,409	11	205,382	11

b. Medium

Grass growth class	Baseline		2020		2050		2080	
	Ha	%	Ha	%	Ha	%	Ha	%
Very poor	2	0.00	79	0.00	9,306	0.45	18,920	0.91
Poor	37,831	2	64,796	3	178,248	9	247,905	12
Average	425,906	21	554,791	27	646,503	31	669,814	32
Good	1,273,996	61	1,174,515	57	1,016,021	49	940,250	45
Very good	337,931	16	281,531	14	225,635	11	198,824	10

c. High

Grass growth class	Baseline		2020		2050		2080	
	Ha	%	Ha	%	Ha	%	Ha	%
Very poor	2	0.00	153	0.01	12,460	0.60	32,818	1.58
Poor	37,831	2	67,866	3	204,396	10	314,607	15
Average	425,906	21	563,367	27	657,565	32	684,368	33
Good	1,273,996	61	1,166,236	56	986,117	48	871,488	42
Very good	337,931	16	278,091	13	215,174	10	172,430	8

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