Buckinghamshire and Milton Keynes Natural Environment Partnership (NEP)

Biodiversity Accounting

Strategic Habitat Mapping Methodology and Final Mapping Outputs

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Contents

Maps

Tables

Figures

Report Version Control

Version	Date	Author	Checked By
V1. DRAFT	25.11.2020	Ben Wood ACIEEM	Louise Mapstone CEcol
V2. FINAL	15.12.2020	Ben Wood ACIEEM	Louise Mapstone CEcol

Executive Summary

Warwickshire County Council were commissioned by the Buckinghamshire and Milton Keynes NEP to help facilitate the delivery of Biodiversity Net Gain in the county by drawing on delivery in Warwickshire. Part of this work involved the creation of a range of maps for consultation with the NEP to help determine where in the county biodiversity offset sites should be prioritised. The final map will become integral to the NEP Criteria to be used by the NEP's Expert Panel. This will aid the selection of sites, put forward by Buckinghamshire Council, landowners, agents, farmers and Non-Governmental Organisations for use as biodiversity offset sites to Buckinghamshire Council. These sites will provide compensation for habitat loss through the planning system. This report outlines the methodology used to create the maps and the consultation undertaken to help refine the mapping for agreement with the NEP. The final county-wide map will be used to aid in offsetting site selection when the NEP's Biodiversity Net Gain / Biodiversity Offsetting / Biodiversity Accounting scheme is launched in 2021. Clarification is also provided on how the final output map links with the categories for Strategic Significance within the current version of the Natural England / Defra Biodiversity Metric 2.0 (which is to be imminently updated). It is anticipated that this mapping work will be reviewed initially at six months, followed by an annual review thereafter, once the scheme is operational.

Introduction

Warwickshire County Council (WCC) were commissioned by Buckinghamshire and Milton Keynes Natural Environment Partnership (NEP) to help facilitate (through a Service Level Agreement) the delivery of Biodiversity Net Gain / Biodiversity Accounting / Biodiversity Offsetting in Buckinghamshire and Milton Keynes drawing on the Warwickshire experience of delivery of Biodiversity Net Gain over a number of years. Part of this work involved the creation of maps, for consultation with the NEP, to help determine where the NEP would look to prioritise habitat creation and enhancement in line with the Lawton approach of 'Bigger, Better and More Joined'[1].

The aim of the mapping work is to incentivise protection and enhancement of the most strategically ecologically important areas in the county, through the Biodiversity Net Gain process. A range of different mapping scenarios were created for consultation and agreement with the NEP during meetings in July 2019, January, March and August 2020 and email consultation in November 2020. This report provides the final maps to be used when the Buckinghamshire Net Gain / Biodiversity Accounting / Biodiversity Offsetting system is launched (anticipated to be in the spring of 2021).

It should be noted that these maps will not be used in isolation when deciding if a biodiversity offset site should be pursued. A series of criteria have been drawn up by the NEP for site selection which, along with the final maps, will help guide the Expert Working Panel when determining which Biodiversity Offset sites will be added to the register of sites in Buckinghamshire. It is currently anticipated that maps used to aid in the incentivisation of offset sites in Buckinghamshire will be updated initially on a 6-month and subsequently on a 12-month basis.

Maps are produced with the former Buckinghamshire District/Borough boundaries from Ordnance Survey Open Data © Crown copyright and database right 2020.

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[1] Lawton, J. 2010. 'Making Space for Nature' available here:
https://webarchive.nationalarchives.gov.uk/20111108131510/http://archive.defra.gov.uk/environment/biodiversity/documents/201009space-for-nature.pdf

Stage 1: Replicating the Warwickshire Strategic layer for Buckinghamshire

The strategic habitat mapping approach is based on that used by Warwickshire County Council in determining a spatial multiplier for biodiversity offset sites. The WCC strategic mapping can be viewed under the 'Strategic Areas' heading here: http://maps.warwickshire.gov.uk/greeninfrastructure/

Methodology

Buckinghamshire and Milton Keynes were divided into 1km Ordnance Survey grid squares (cells) with the total area of Woodland (all woodland habitats including plantation and scrub) or Grassland (all semi-natural grasslands including species-poor semi-improved neutral grassland) recorded. Cells were then classified using digital Phase 1 habitat data as follows:

Core areas
Cells that contain enough habitat to be considered functional. This was defined as areas with greater than or equal to 20ha of defined habitat (Woodland or Grassland). *(In Warwickshire, habitat creation is incentivised in these areas but not as much as for strategic cells)*.

Strategic areas
Cells that contain a significant amount of habitat but not enough to be considered functional. This was defined as areas with between 5ha and 20ha of defined habitat (Woodland or grassland). *(In Warwickshire these areas are given the maximum incentive for new habitat creation)*.

Non-strategic areas
Cells that do not contain the minimum amount of habitat. This was defined as areas with less than 5ha of defined habitat. *(Habitat creation is disincentivised in these areas in Warwickshire)*.

The above approach, adopted in Warwickshire, encourages habitat creation in those areas where target habitat is already present, and more so where small areas of target habitat are present and would therefore benefit from additional habitat creation.

GIS Method

The following steps were carried out using the Phase 1 Habitat Data supplied by Buckinghamshire and Milton Keynes Habitat Mapping Project.

1. Extract habitats

The habitats in Box 1 below were extracted from the Phase 1 data using Quantum Geographic Information System (QGIS) software, by selecting habitat type and exporting to a new layer.

Box 1

Woodland Habitats	Grassland Habitats
Broadleaved woodland	Acid grassland
Broadleaved, mixed and yew woodland	Calcareous grassland
Coniferous woodland	Grass and grass-clover leys
Lowland beech and yew woodland	Grass strip
Lowland mixed deciduous woodland	Grassland, possibly unimproved
Mixed woodland	Grassland, probably improved

Other beech and yew woodlands Other broadleaved woodland Other coniferous woodland	Lowland calcareous grassland Lowland dry acid grassland Lowland meadows Other neutral grassland Purple Moor Grass & Rush pastures Purple moor grass and rush pastures [*Molinia-Juncus*]

2. Generate OS grid

The FSC plugin 'Tombio Tools' and Ordnance Survey Grid Reference (OSGR) tool were used to generate an Ordnance Survey grid of every 1km grid square within or partially within Buckinghamshire.

At this stage, additional habitat data was added (using the same methodology outlined in 1. above), for areas outside of Buckinghamshire but within the grid squares. This was taken from CEH Land Cover Map 2007 (LCM2007 © NERC (CEH) 2011. © Crown Copyright 2007, Licence Number 100017572 © third party licensors). LCM2007 was made available to Warwickshire County Council for use in strategic landscape mapping. This was the best data available at the time of map creation. This allowed full coverage and prevented grid squares from being downgraded by partial coverage at the county boundary. The LCM2007 habitat types that were used are provided in Box 2.

Box 2

Woodland Habitats	Grassland Habitats
Broadleaved, mixed and yew woodland (1) Coniferous woodland (2)	Rough low-productivity grassland (5) Neutral grassland (6) Calcareous grassland (7) Acid grassland (8)

3. Transform habitat data

The QGIS Processing Tools 'Intersection' and 'Dissolve' were used to convert the data so that a single polygon existed or was created for each 1km grid square. Prior to this step, the 'Fix Geometries' tool was also run to remove snags and spikes that would prevent the process from running correctly. Box 3 below illustrates the three steps in the process.

Box 3

- ***Step 1***: run 'Fix Geometries' on Habitat layer (Result layer: Habitat_Fixed).
- ***Step 2***: run 'Intersection' using Habitat_Fixed as the input layer and OSGR Grid Squares layer generated by Tombio tools as the intersect layer (Result layer: Habitat_Intersection).
- ***Step 3***: run 'Dissolve' on Habitat_Intersection, using GridRef as the unique ID field (Result layer: Habitat_Dissolve).

4. Calculate area

Using the field calculator tool in QGIS, a new field 'Area_ha' was generated in the Habitat_Dissolve layer to measure area in hectares. The field type was specified as a decimal number with precision of 3 (3 decimal places). The field was then populated using the expression '$area/10000' to convert the measurement from metres (standard map unit) to hectares.

5. Join attributes table

At this stage, the habitats layer was discarded, and the area measurement transferred into a copy of the OS grid squares layer, which became the strategic map layer. Box 4 outlines the process used.

Box 4

> - **Step 1:** use 'Join Attributes Table' with OSGR Grid Squares as the Input layer, GridRef as the common Table Field, Habitats_Dissolve as Input Layer 2 and 'Area_ha' as the field to copy. (Result layer: Habitat Strategic)
> - **Step 2**: delete all columns in Habitat Strategic except for Area and GridRef. Discard other working habitat layers or save for reference.

6. Define strategic column

A new column was created to define the strategic or semi-strategic status of each square. The column was populated using the following expression:

CASE WHEN "Area_ha"<5 THEN 'Non-Strategic' WHEN "Area_ha"<20 AND "Area_ha">=5 THEN 'Strategic' WHEN "Area_ha">=20 THEN 'Core' ELSE 'x' END

Results

The resulting layer can be seen in Maps 1 and 2.

At the request of the NEP, a composite of the two strategic layers was produced with priority given to **Strategic Cells over Core Cells**, and **Core Cells over Non-Strategic Cells** in either habitat type. Map 3 illustrates this combined layer.
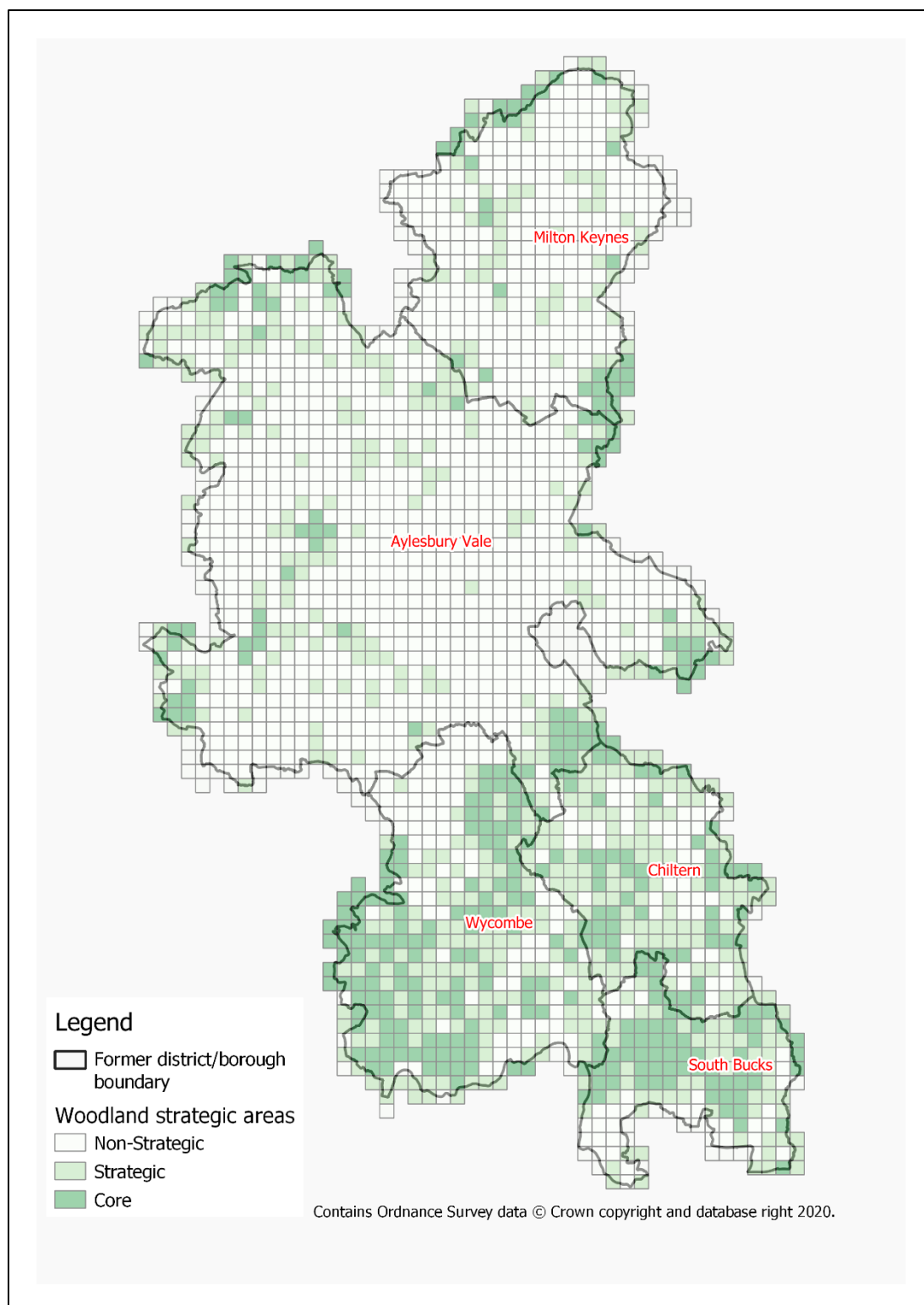
Map 1: Map of core and strategic woodland cells in Buckinghamshire following Warwickshire Methodology.
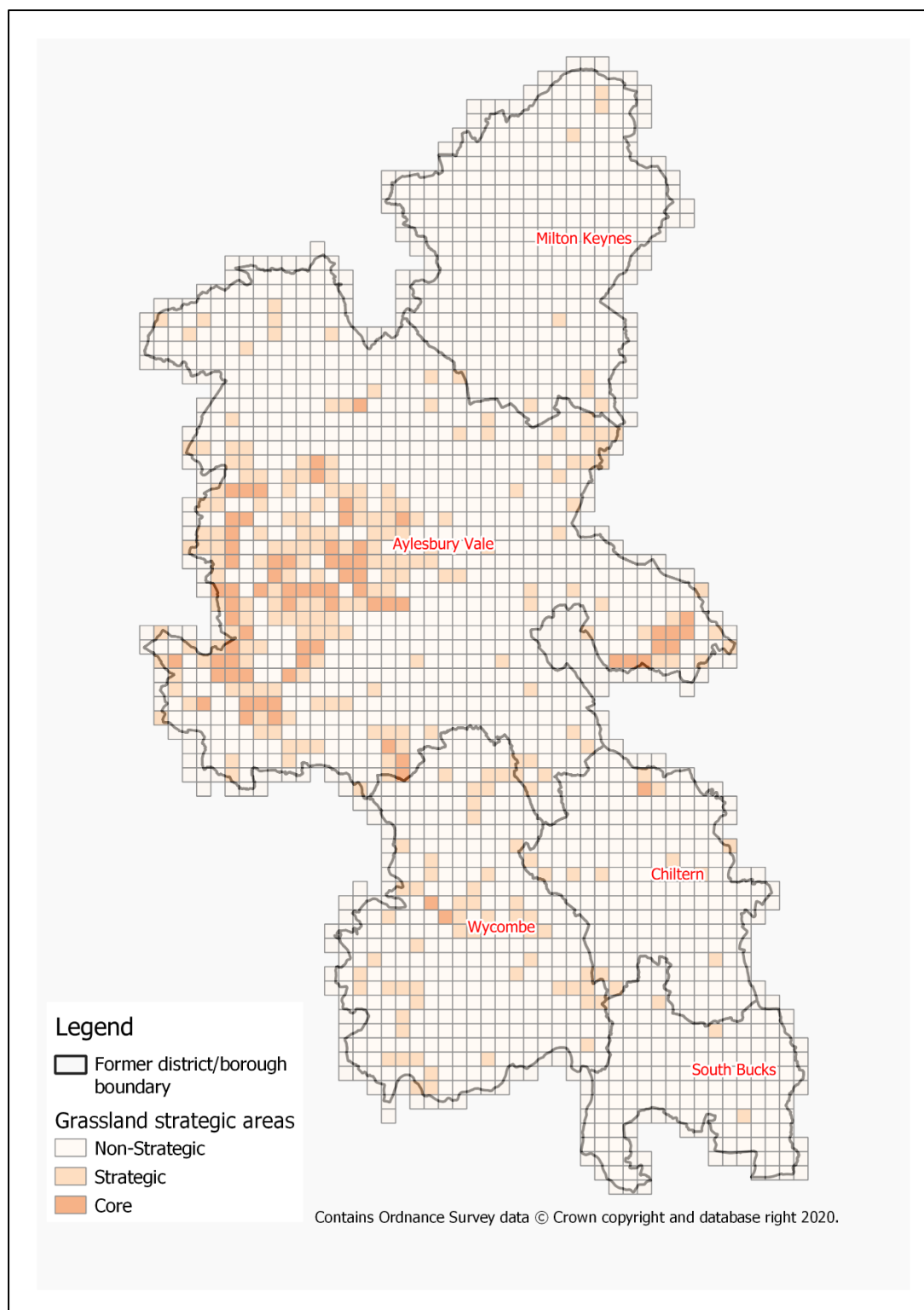
Map 2: Map of core and strategic grassland cells in Buckinghamshire following Warwickshire Methodology
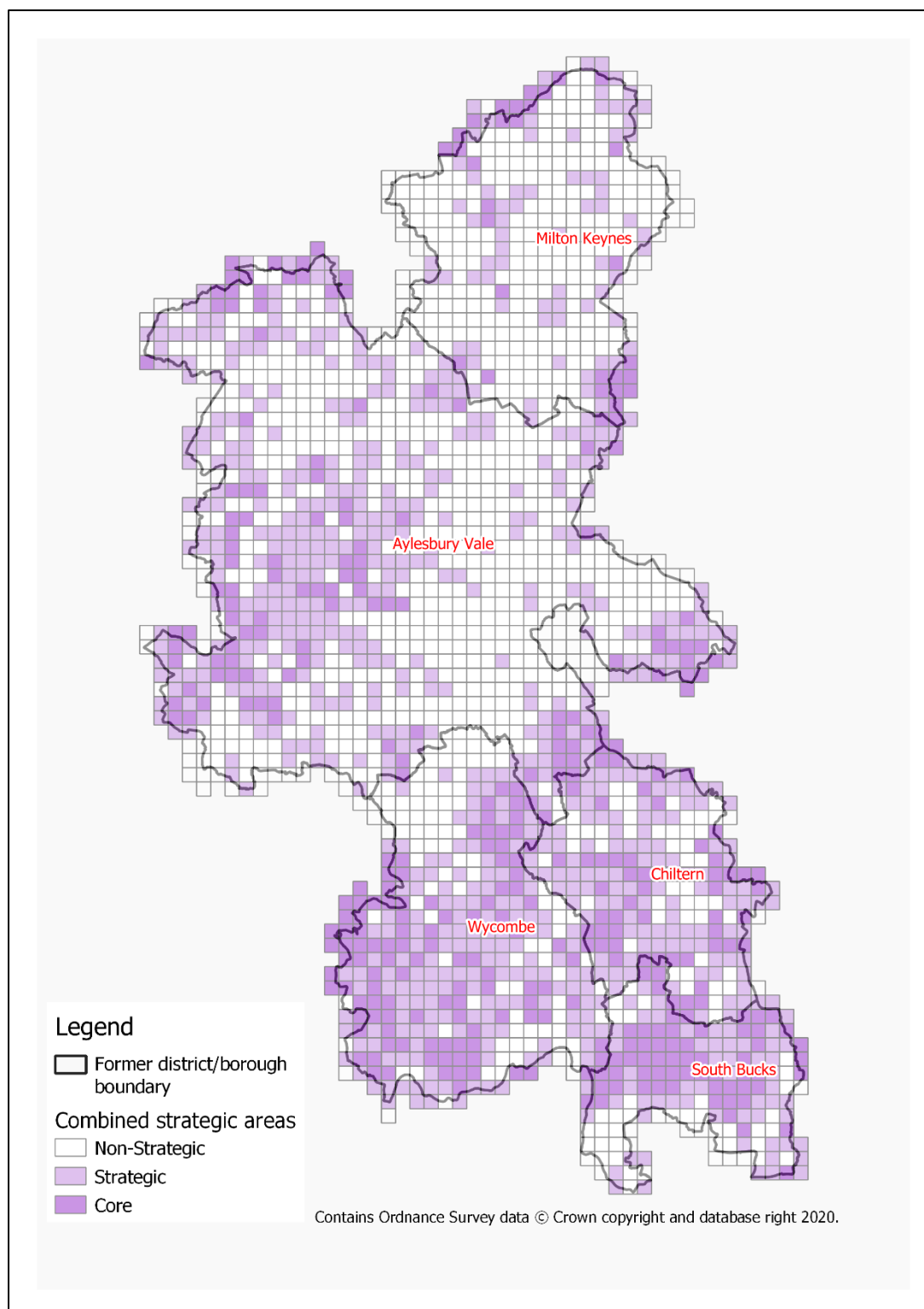
Map 3: Map of core and strategic cells in Buckinghamshire following Warwickshire Methodology, showing grassland and woodland cells combined.

Stage 2: Demonstrating variable thresholds

To aid in the decision making for the NEP on final thresholds, a range of potential values were used (following agreement on suggested trial thresholds during NEP meetings in July 2019 and January 2020). These were used to create multiple 'scenarios' showing how the distribution of these cells changes depending on the thresholds set for Core, Strategic and Non-strategic areas. These were then presented to the NEP in a meeting in March 2020.

Areas have been defined as follows:

Core areas = *Cells that contain enough habitat to be considered functional*

Strategic areas = *Cells that contain a significant amount of habitat but not enough to be considered functional*

Non-strategic areas = *Cells that do not contain the minimum amount of habitat*

Method

Thresholds for minimum strategic habitat were set, following consultation with the Buckinghamshire NEP, at 5ha, 10ha and 15ha per 1km square (expressed hereafter as percentages; 5%, 10% and 15%). Thresholds for minimum core habitat were set at 20ha and 30ha (20% and 30%). Scenarios are labelled as illustrated in Table 1 below:

			Min. Core area (% cover per km)	
			20%	30%
Min Strat. Area (% cover per km)		5%	A	D
		10%	B	E
		15%	C	F

Table 1: Threshold Scenarios

It is important to note that:

- Scenarios labelled A and D have the lowest threshold for strategic areas.
- Scenarios C and F have the highest.
- Hence Scenarios C and F will have a smaller number of cells defined as strategic.
- The number of core cells is dependent on the minimum core threshold and will therefore be higher for scenarios A-C than D-F.
- Scenario A is the strategy used in Warwickshire and detailed in Stage 1.

The scenarios were further defined separately for grassland (e.g., GA, GB, GC) and for woodland (WA, WB, WC). A combined strategic definition was also created (WGA, WGB, WGC), **favouring Strategic Areas over Core Areas for both Grassland and Woodland.**

Results

Eighteen different scenarios were created. Figure 1 below shows how the proportion of core and strategic cells varies depending on the combinations of thresholds considered.
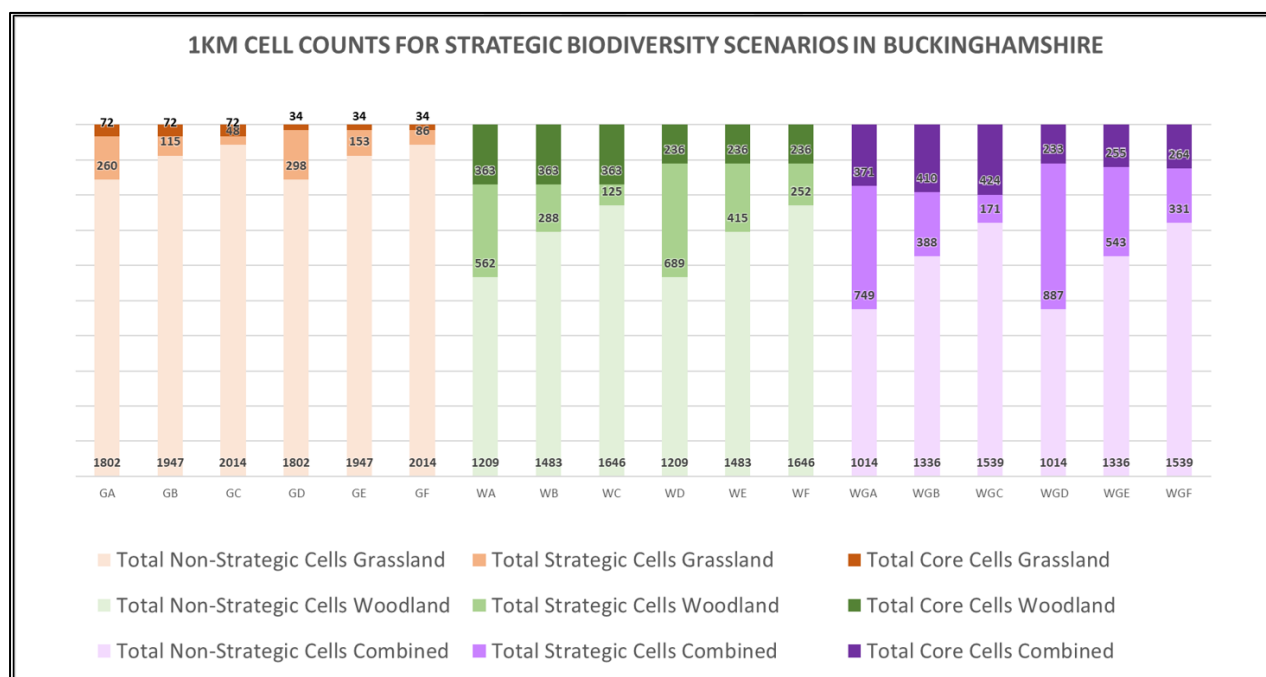
Figure 1: Graph showing total core and strategic cell counts for multiple scenarios with varying habitat area thresholds.

Comparisons of the resulting scenarios are illustrated in Maps 4 and 5. These show the number of paler 'strategic' cells diminishing as the lower threshold is raised (left to right) and the number of darker 'core' cells reducing when the upper threshold is raised (top to bottom).

Map 4: Strategic Habitat Mapping Scenarios for Buckinghamshire, based on grassland habitat density.
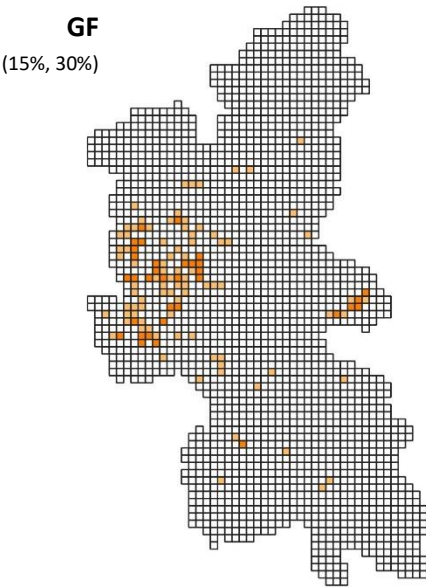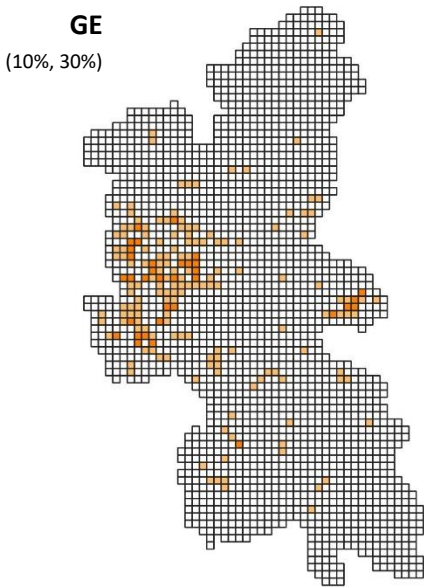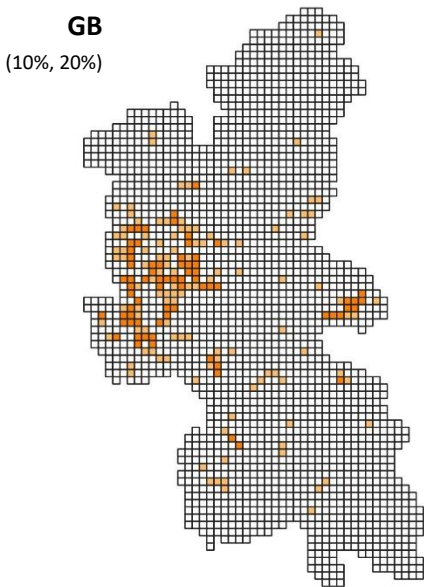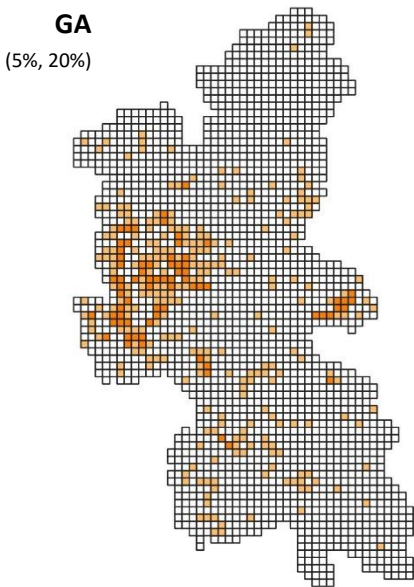
		Min. Core area (% cover per km)	
		20%	30%
Min Strat. Area (% cover per km)	5%	A	D
	10%	B	E
	15%	C	F

Core Cell

Strategic Cell

Non-Strategic Cell

Map 5: Strategic Habitat Mapping Scenarios for Buckinghamshire, based on woodland habitat density.

WA
(5%, 20%)

WB
(10%, 20%)

WC
(15%, 20%)

WD
(5%, 30%)

WE
(10%, 30%)

WF
(15%, 30%)

		Min. Core area (% cover per km)	
		20%	30%
Min Strat. Area (% cover per km)	5%	A	D
	10%	B	E
	15%	C	F

- Core Cell
- Strategic Cell
- Non-Strategic Cell
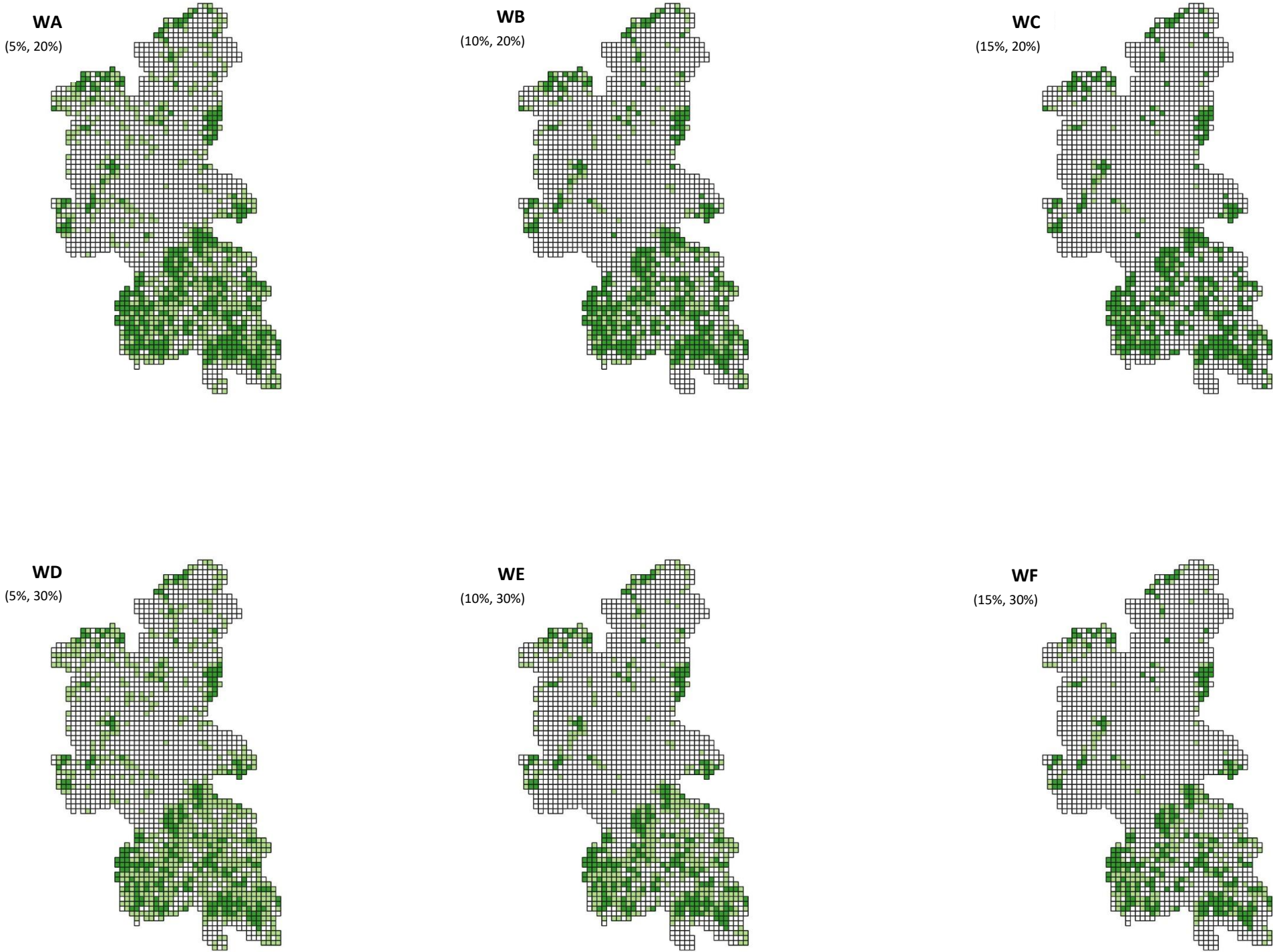
Map 6: Strategic Habitat Mapping Scenarios for Buckinghamshire, based on combined grassland and woodland habitat density.

WGA
(5%, 20%)

WGB
(10%, 20%)

WGC
(15%, 20%)

WGD
(5%, 30%)

WGE
(10%, 30%)

WGF
(15%, 30%)

		Min. Core area (% cover per km)	
		20%	30%
Min Strat. Area (% cover per km)	5%	A	D
	10%	B	E
	15%	C	F

- Core Cell
- Strategic Cell
- Non-Strategic Cell

Stage 3: Determining ecological flow using Condatis

Introduction to Condatis

Condatis is an ecological modelling tool developed by Jenny Hodgson and David Wallis at the University of Liverpool[2]. It was developed as a decision support tool to identify the best locations for habitat creation and restoration to enhance existing habitat networks and increase connectivity across landscapes.

The model uses 'electronic circuit theory' to measure 'conductance' across a grid of cells of varying resistance. Resistance is based on percentage/area cover of selected habitats and simulates range expansion, over several generations, of a species associated with that habitat. Reproductive rate and dispersal range can be adjusted depending on the ecology of the target species. The direction of flow is determined either by specifying source/target cells or by pre-set north-south or east-west directions, which create a line of source/target cells along the edges of the grid. More information about Condatis can be found at http://wordpress.condatis.org.uk/.

As the reproductive rate and dispersal range make only very small changes to appearance of the direction of flow, it is possible to use Condatis to represent a range of species associated with a habitat, based on hypothetical or 'umbrella' species. This is how Condatis has been utilised in Warwickshire. At Warwickshire County Council, Condatis has been used to produce flow maps to estimate woodland and grassland connectivity at 2km resolution across Warwickshire and mainland Great Britain. These flow maps can be seen at http://maps.warwickshire.gov.uk/greeninfrastructure/.

Methodology

Within Buckinghamshire, the same method was used to split target habitats by grid square as for the Core and Strategic areas, with the same habitat definitions (see Box 5 below and GIS Method).

Box 5

Woodland Habitats	Grassland Habitats
Broadleaved woodland	Acid grassland
Broadleaved, mixed and yew woodland	Calcareous grassland
Coniferous woodland	Grass and grass-clover leys
Lowland beech and yew woodland	Grass strip
Lowland mixed deciduous woodland	Grassland, possibly unimproved
Mixed woodland	Grassland, probably improved
Other beech and yew woodlands	Lowland calcareous grassland
Other broadleaved woodland	Lowland dry acid grassland
Other coniferous woodland	Lowland meadows
Other lowland mixed deciduous woodland	Other neutral grassland
Other wet woodland	Purple Moor Grass & Rush pastures
Scrub woodland	Purple moor grass and rush pastures [*Molinia-Juncus*]
Wet woodland	

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[2] www.condatis.org.uk

In order to better connect the habitats in Buckinghamshire and Milton Keynes with those in the surrounding landscape and prevent a 'coastline' effect, cells outside of the county were populated using CEH Land Cover Map (LCM2007). At the time of map creation in February 2020, this data was considered to be the best data set available in terms of complete coverage. The habitats used to define target habitats outside of Buckinghamshire are illustrated in Box 6 below.

Box 6

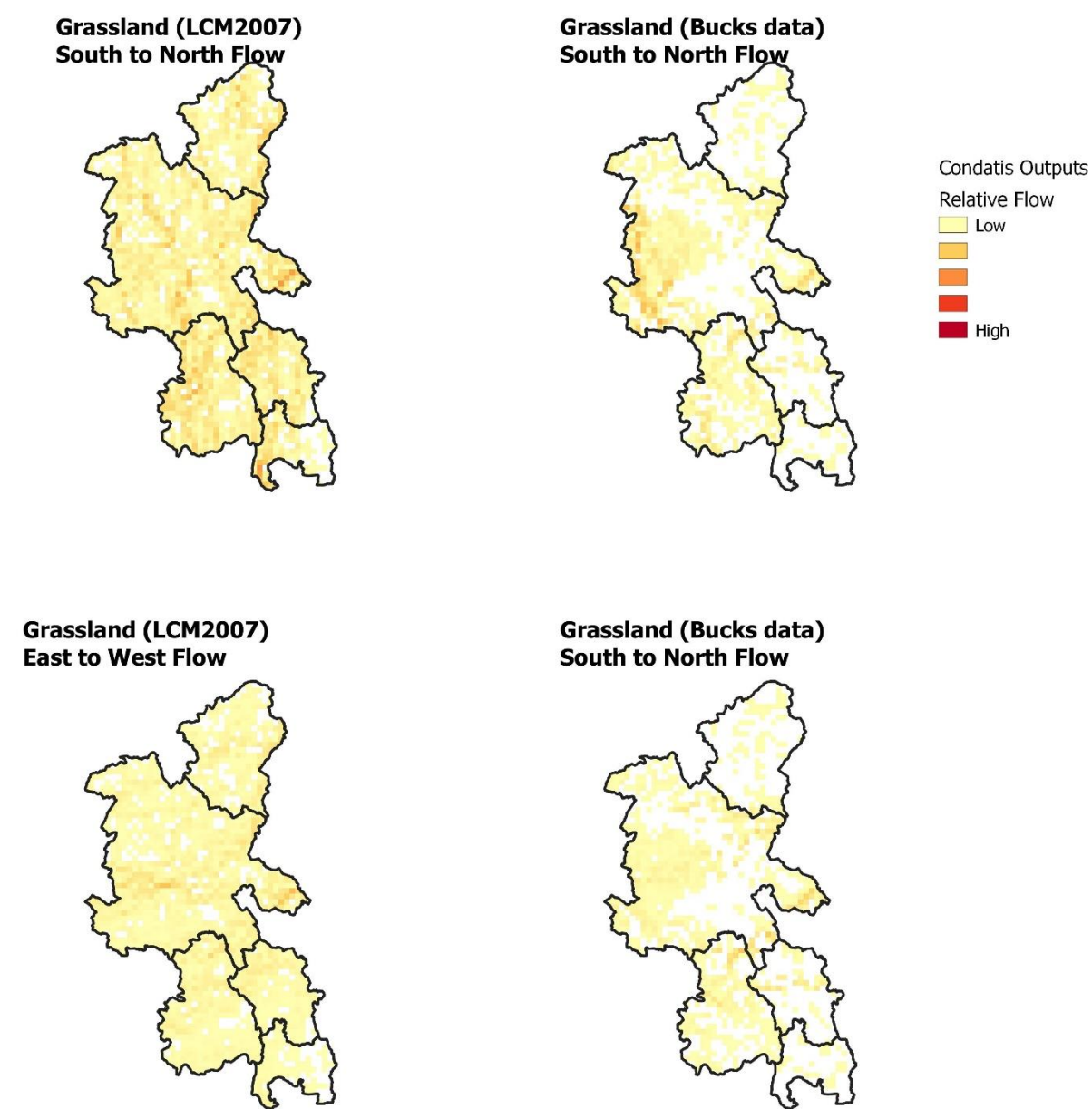| Woodland Habitats	Grassland Habitats
Broadleaved, mixed and yew woodland (1) Coniferous woodland (2)	Rough low-productivity grassland (5) Neutral grassland (6) Calcareous grasslan0d (7) Acid grassland (8)

Flow models were also run based entirely on the LCM2007 data for comparison. The dispersal distance of 1km was used for all models. Using larger dispersal distances has been shown to produce wider, fainter flow routes. The outputs are summarised as follows:

Baseline Data	Grid	Input layer	Direction	Dispersal	Output
Buckinghamshire Habitats	1km	Grassland (G2)	S>N	1km	G2SN_1km
		Grassland (G2)	E>W	1km	G2EW_1km
		Woodland (W2)	S>N	1km	W2SN_1km
		Woodland (W2)	E>W	1km	W2EW_1km
LCM2007	1km	Grassland (G)	S>N	1km	GSN_1km
		Grassland (G)	E>W	1km	GEW_1km
		Woodland (W)	S>N	1km	WSN_1km
		Woodland (W)	E>W	1km	WEW_1km
LCM2007	500m	Grassland (G500)	S>N	1km	GSN_500m
		Grassland (G500)	E>W	1km	GEW_500m
		Woodland (W500)	S>N	1km	WSN_500m
		Woodland (W500)	E>W	1km	WEW_500m

Interpretation

The resulting flow maps are shown on Maps 7 and 8. These flows can be observed to follow the clusters of habitats shown in the Core and Strategic cells. The woodland data for both Buckinghamshire Habitat Mapping and LCM2007 shows similar results. However, there is a difference between the cover of grassland and thus the flow, depending on which data are used. This was discussed at the mapping meeting on 25th March 2020.

Map 7: Grassland flow maps for Buckinghamshire with 1km resolution.　　　　*Map 8: Woodland flow maps for Buckinghamshire with 1km resolution.*

**Grassland (LCM2007)
South to North Flow**　　**Grassland (Bucks data)
South to North Flow**

Condatis Outputs
Relative Flow
Low
High

**Grassland (LCM2007)
South to North Flow**　　**Grassland (Bucks data)
South to North Flow**

Condatis Outputs
Relative Flow
Low
High

**Grassland (LCM2007)
East to West Flow**　　**Grassland (Bucks data)
South to North Flow**

**Grassland (LCM2007)
East to West Flow**　　**Grassland (Bucks data)
South to North Flow**
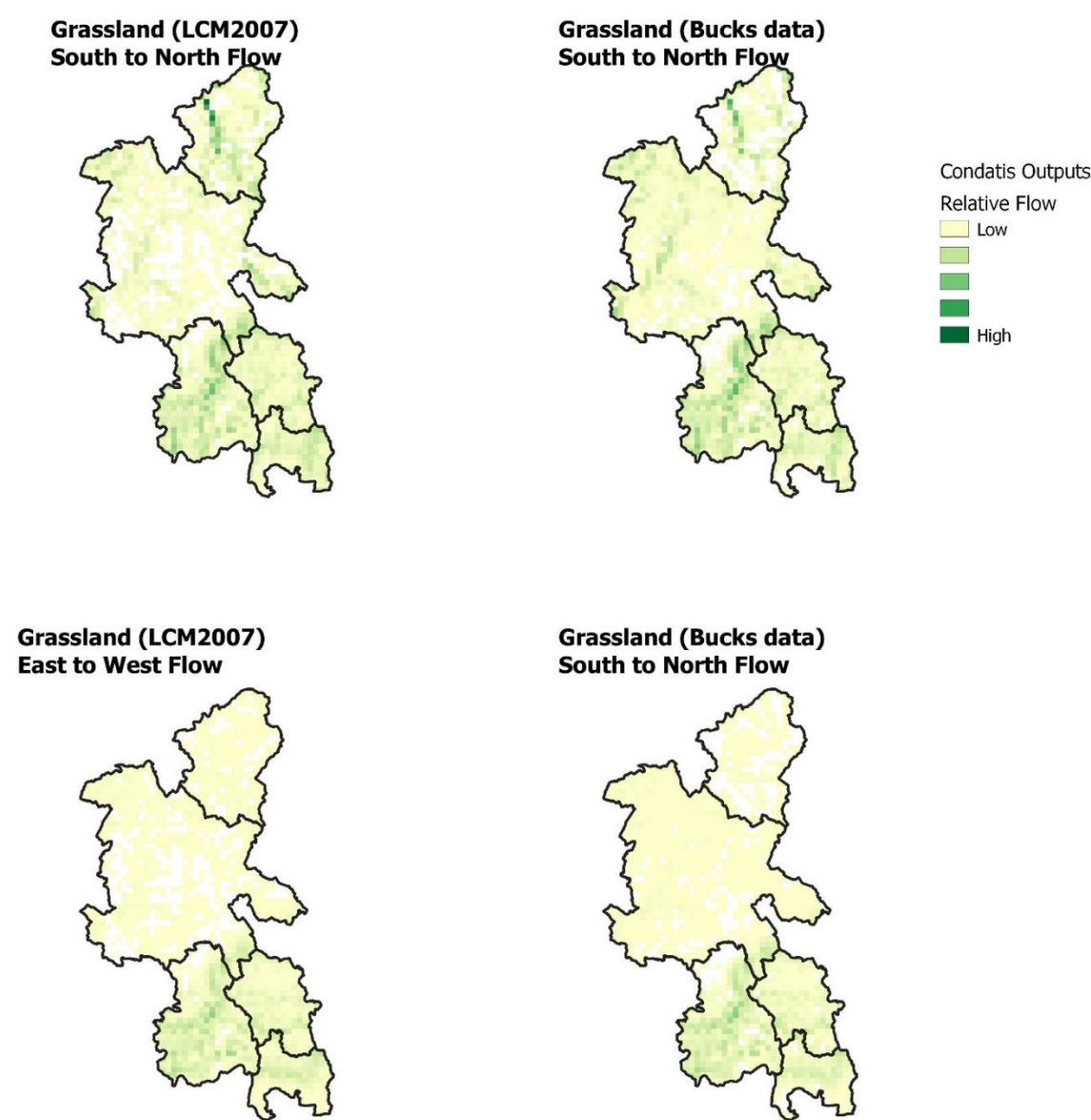
Stage 4: Producing the end-use maps

Following the mapping meeting on 6th August 2020; a previous discussion with the Buckinghamshire and Milton Keynes Records Centre (BMERC); and further discussion with NEP members, the following course of action was decided:

- **Strategic cells for grassland and woodland would be combined to create one strategic mapping layer.**
- **The lowest thresholds from Stage 2 (5ha, 20ha, Scenario WGA) would be used to define strategic and core cells.**
- **The highest spatial factor would be applied to Biodiversity Opportunity Areas (BOAs) (Strategic)**
- **Cells previously referred to as core and strategic cells would be treated together as 'semi-strategic'.**
- It was decided by the NEP during the meeting on 6th August 2020 that the Condatis output would not be used for the final end-use maps. This was because the highlighted areas of high connectivity were already covered by the strategic/core areas and BOAs. It was agreed at the meeting that Condatis was, however, a useful decision tool in determining potential gaps within the threshold (semi-strategic) and BOA (strategic) mapping.

It was also highlighted that Sites of Special Scientific Interest (SSSIs) and some priority habitats, particularly wetlands and heathlands, were outside of the strategic layers but should not be excluded from incentivisation and that adding these additional areas would create more potential connectivity between the BOAs (strategic). The following changes were therefore made in October 2020:
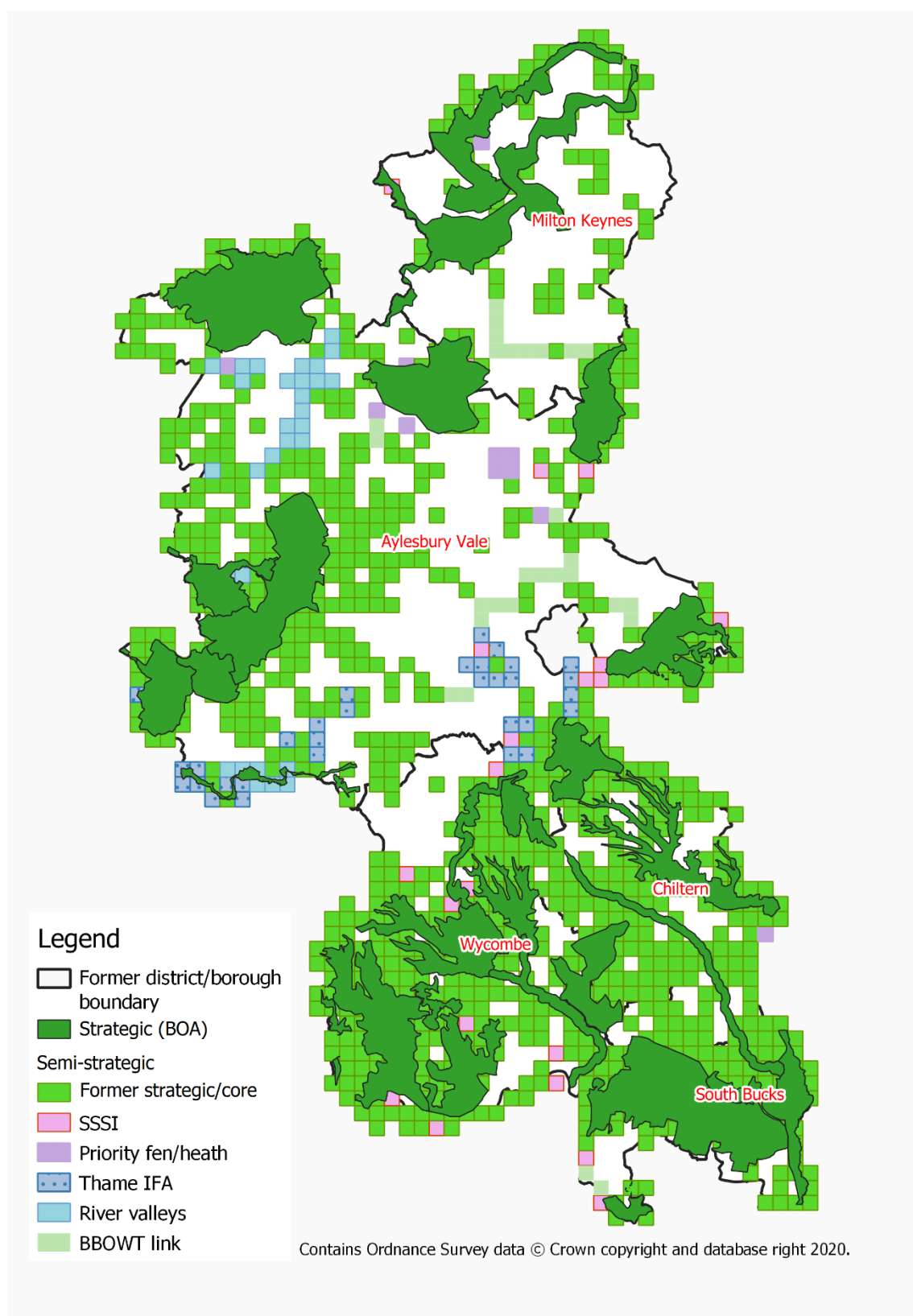
- 1km grid squares containing SSSI were made 'semi-strategic'.
- 1km grid squares containing wetland and heathland habitats from Natural England's Priority Habitat mapping were added to the layer. The habitats which fell in Buckinghamshire were:
    - Lowland Fens
    - Lowland Heath
- 1km grid squares containing Important Freshwater Areas (IFA) for the Thame Catchment, provided by the Freshwater Habitats Trust, were added. IFAs were only available for the Thame Catchment at the time. The NEP understands from the Freshwater Habitat Trust that there is an aspiration for IFAs to be mapped for the entire of Buckinghamshire.

Following advice from NEP members in October 2020 additional squares were added to cover:

- the Ray, Thame and Ouse valleys (as recommended by a Buckinghamshire Ecologist), and
- Additional squares recommended by BBOWT to provide connective linkages between fragmented areas.

All the areas that were added to the mapping since the August 2020 meeting are illustrated in detail on Map 9. Map 10 combines all these additional requested areas into Semi-strategic areas. It is this final map 10 that will be used to launch the Biodiversity Offsetting / Biodiversity Accounting / Biodiversity Net Gain scheme in Buckinghamshire.

Map 9: Final map showing strategic grid squares and additional grid squares

Legend

Former district/borough boundary

Strategic (BOA)

Semi-strategic

Former strategic/core

SSSI

Priority fen/heath

Thame IFA

River valleys

BBOWT link

Milton Keynes

Aylesbury Vale

Chiltern

Wycombe

South Bucks

Contains Ordnance Survey data © Crown copyright and database right 2020.

Map 10: Final map showing strategic (BOAs) and semi-strategic (Strategic grid squares).

Milton Keynes

Aylesbury Vale

Chiltern

Wycombe

South Bucks

Legend

Former district/borough boundary

Strategic

Semi-strategic

Contains Ordnance Survey data © Crown copyright and database right 2020.
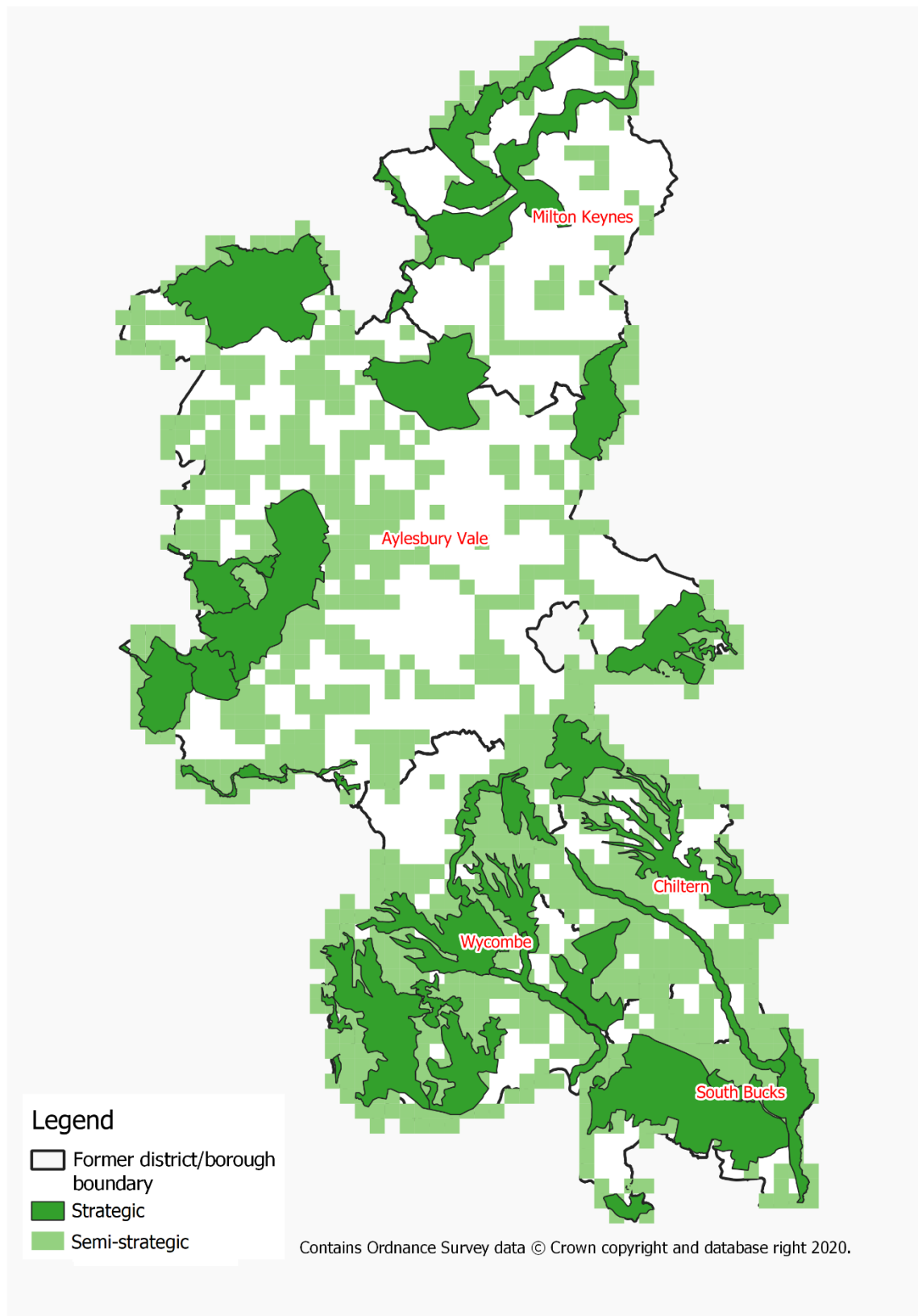
Stage 5: Linkage to the Defra / Natural England Biodiversity Metric

Following the production of the first draft of this report in November 2020, some NEP members requested clarification in this report on how map 10 is intended to link to the Natural England / Defra Biodiversity Metric.[3]

At the time of writing (December 2020), the published metric on Natural England's website remains The Biodiversity Metric 2.0 Beta version. It is understood that the publication of the final Biodiversity Metric version 3.0 is imminent.

Table 5.5 on page 41 of The Biodiversity Metric 2.0 User Guide defines how Natural England / Defra break down '**Strategic Significance**' into three categories. These are: **High Strategic Significance**, **Medium Strategic Significance** and **Low Strategic Significance** with scores of 1.15, 1.1 and 1 points respectively.

It is envisaged that when the Buckinghamshire Biodiversity Offsetting / Biodiversity Accounting / Biodiversity Net Gain scheme becomes operational (anticipated in spring 2021), those areas identified as '**Strategic**' (**dark green** on Map 10) would comprise areas of '**High Strategic Significance**' within the Natural England / Defra Metric. Those identified as '**Semi-strategic**' (**light green** on Map 10) would be of '**Medium Strategic Significance**'. All other areas (**white** on Map 10) are '**non-strategic**' and would fall within the '**Low Strategic Significance**' category as per Table 5.5 in The Biodiversity Metric 2.0 User Guide 2019.

Table 2 below is adapted from Table 5.5 in The Biodiversity Metric 2.0 User Guide dated July 2019, and shows how the Buckinghamshire Strategic, Semi-strategic and Non-strategic areas directly translate to the terminology used in the current version of the Biodiversity Metric 2.0. This should aid those completing the Defra / Natural England metric for any potential offsetting site. It is not currently anticipated that the three categories of High, Medium and Low will change in version 3.0 of the Biodiversity Metric.

Defra / Natural England Metric Category	Buckinghamshire Mapping Category (as per Map 10)	Defra / Natural England Score	Point applied to calculation	
			Pre-impact	Post-impact
High Strategic Significance	Strategic Area	1.15	Yes	Yes
Medium Strategic Significance	Semi-Strategic Area	1.1	Yes	Yes
Low Strategic Significance	Non-Strategic Area	1	Yes	Yes

Table 2: How Defra / Natural England Strategic Significance translates to the Buckinghamshire Mapping categories in Map 10.

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[3] The current version of the Biodiversity Metric at the time of writing is outlined in Natural England. 2019. The Biodiversity Metric 2.0 auditing and accounting for biodiversity. Natural England Joint Publication JP029. Available to download here: http://publications.naturalengland.org.uk/publication/5850908674228224

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