Morris Resource Economics Ltd

Cheshire and Warrington Natural Capital Audit and Investment Plan

2. Intervention and investment opportunities report

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1. Introduction

The Cheshire and Warrington Local Enterprise Partnership (C&W LEP) have identified the need for an assessment of the interrelationship between natural capital and its economic and social development ambitions for the area. Natural Capital is defined as:

> *"..elements of nature that directly or indirectly produce value or benefits to people, including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions"* (Natural Capital Committee 2014[1]).

It is the stock of natural assets (e.g. soils, water, biodiversity) that produces a wide range of ecosystem services that provide benefits to people. These benefits include food production, regulation of flooding and climate, pollination of crops, and cultural benefits such as aesthetic value and recreational opportunities.

Natural capital supports all other forms of capital on which human systems depend, whether man-made, human or social. However, many of the outputs produced by natural capital, such as the regulation of flooding and atmospheric gases by forest lands, are not included in the decisions of private individuals or organisations. This is because they often involve non-priced public goods that are not traded in the market place and are not subject to formal property rights and entitlements (TEEB, 2010[2]). Elements of natural capital are therefore liable to be overused, degraded, depleted and eventually lost, with consequences for long term welfare and the sustainability of economic systems. There is now much greater awareness of the role of natural capital in the design and achievement of economic and social development strategies, with strong links to business and enterprise[3]. The C&W LEP's interest in natural capital assessment is also set within its commitment to develop quality of place as a platform for sustained growth.

The C&W LEP have commissioned this project to produce a Natural Capital Audit, and support the development of a Natural Capital Investment Plan for the area. This is driven by the need not only to manage risks to the natural environment associated with economic development that could undermine successful achievement, but also to explore the opportunities to tap into new funding sources and mechanisms for innovative investments that can achieve substantial gains for people and the natural world. In this respect, there is a need to develop a strategic network of natural capital oriented projects to support and extend C&W LEP's strategy through to 2040, engaging key stakeholder interests in the process. The investment plan covers the three local authority areas of Cheshire West and Chester, Cheshire East, and Warrington.

An extensive evidence base has been built-up to support the development of the **Natural Capital Investment Plan** (NCIP). The evidence is summarised in the main NCIP report, but is presented in much greater detail in the form of five technical reports:

1. **Natural capital audit and policy analysis** – a baseline assessment of the natural capital assets currently present across Cheshire and Warrington, the benefits that flow from those assets and their monetary value, together with an analysis of policies at the local and national scale that effect natural capital, and an identification of priority themes and sectors.

[1] Natural Capital Committee 2014. Towards a Framework for Defining and Measuring Changes in Natural Capital. Working Paper 1, Natural Capital Committee.
[2] TEEB. 2010. The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations. Earthscan, Oxford & NY.
[3] TEEB. 2012. The Economics of Ecosystems and Biodiversity in Business and Enterprise. Earthscan. London; New York.

2. **Intervention and investment opportunities report** – habitat opportunity mapping to identify the best locations to deliver specific or multiple objectives, along with mapping of strategic themes based on local policies, to prioritise locations for investment.
3. **Workshop report** – write-up of stakeholder workshop to present the approach used to map natural capital opportunities, and to discuss key priorities across C&W.
4. **Future financing report** – review of emerging financing options, including a typology of different funding opportunities, the ecosystem services and habitats covered by each, and an approach to identifying the most appropriate funding mechanism for different projects.
5. **Case studies report** – presentation of five case studies to demonstrate how the opportunity maps can be used to identify habitat creation potential based on different objectives, to highlight the benefits of such projects, and to show how funding requirements and potential funding sources can be identified.

One of the key outputs from this project are the numerous GIS maps and layers. These are being supplied to project partners as a data package.

This report is the second of these technical reports; the Intervention and investment opportunities report. The aims of this report are to:

a) Use an evidence-based approach to identify the most appropriate locations where habitats can be created to deliver enhancements to biodiversity and a range of ecosystem services.
b) Combine these opportunity maps together to highlight where multiple benefits (multi-functionality) can be delivered for a range of objectives.
c) Prioritise locations for investment based on an analysis of spatial policies for the area, taking into account social, economic and environmental need.

Figure 1 shows the structure and components that make up the overall Natural Capital Audit and Investment Plan and how the intervention and investment opportunities workstream fits into the rest of the project.

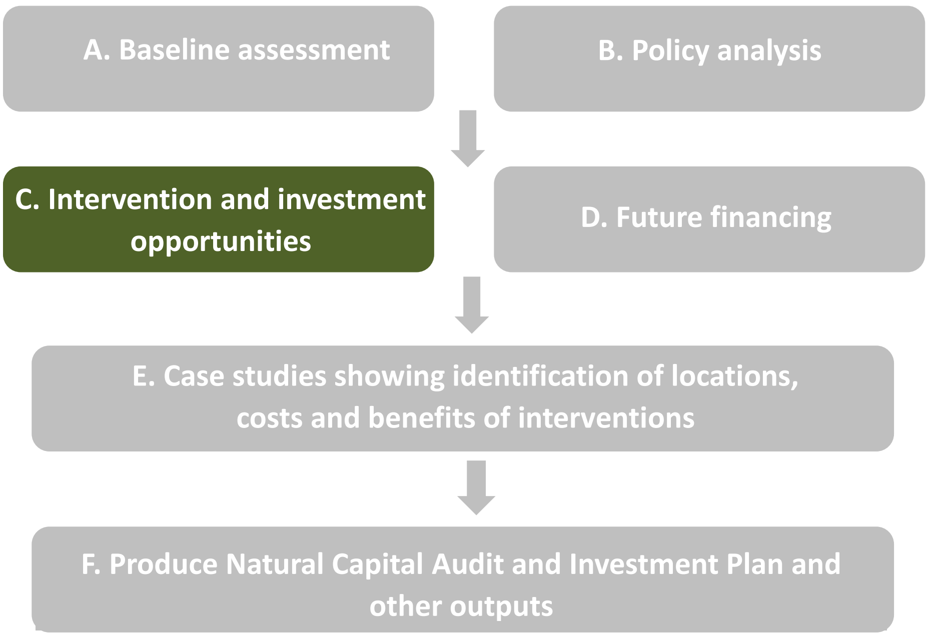

Figure 1 Overview of the overall project. The green box highlights the work reported here and shows how it fits into the other components of the overall project (grey boxes).

1.1 Report structure and scope

Habitat opportunity mapping is a Geographic Information System (GIS) based approach used to identify potential areas for the expansion of key habitats. It aims to identify possible locations where new habitat can be created that will be able to deliver particular benefits, whilst taking constraints (such as existing land uses or historic sites) into account. In this project, opportunities for new habitats across a range of different benefits have been mapped. This has included mapping opportunities for the following:

1) To enhance biodiversity
2) To reduce surface runoff
3) To reduce soil erosion (end enhance water quality)
4) To ameliorate air pollution
5) To reduce noise pollution
6) To regulate local climate (reduce urban heat)
7) To increase access to natural greenspace

Section 2 describes the approach to biodiversity opportunity mapping and presents the results for five broad habitats. Section 3 then considers ecosystem services opportunity mapping (numbers 2-7 in above list) and describes the approach taken and results obtained for each in turn. Maps were then combined to show areas that could deliver multiple benefits, and this is described in Section 4. Next, spatial policy priorities are identified and used to prioritise locations for habitat investment and this process and the results obtained are described in Section 5. The report finishes (Section 6) with a brief discussion of habitat opportunity mapping and how the maps can be used to identify specific projects to take forward, along with a range of potential applications.

Please note that the mapping identifies areas based on landscape-scale ecological principles or indicative ecosystem services models and does not take into account local site-based factors that may impact on suitability. Any areas suggested for habitat creation will require ground-truthing before implementation. The maps should be seen as a tool to highlight key locations and to guide decision making, rather than an end in themselves.

All the layers shown or referred to in this report are available in the GIS data package, available to project partners.

2. Biodiversity opportunity mapping

The importance of landscape-scale conservation and ecological networks has become increasingly recognised over recent years. Many wildlife sites have become isolated in a landscape of unsuitable habitats and efforts are now being directed towards linking existing habitat patches and increasing connectivity. Species are more likely to survive in larger habitat networks, are able to move and colonise new sites, and are more resilient to climate change and other detrimental impacts.

Habitat opportunity mapping to enhance biodiversity follows this ethos by using ecological networks to identify potential areas for new habitats. Identified areas will be ecologically connected to existing habitats, thereby expanding the size of the existing network, increasing connectivity and resilience, and potentially increasing the ecological quality of the new site. It was performed for four key habitat groupings, incorporating the main semi-natural habitats found in the study area. The broad habitats and their constituent types are shown in the table below:

Broad habitat	Specific habitats included
Semi-natural grassland	Acid, neutral, calcareous, rough and semi-improved grasslands
Wet grassland	Purple moor grass and rush pasture, marshy grassland, floodplain grazing marsh
Mire	Bogs and upland flushes, fens and swamps (reedbed)
Heathland	Includes all heathland types (including wet and dry heaths) and grass-heath mosaics
Woodland	Broadleaved and mixed woodland types (excludes coniferous woodland, parkland or individual trees)

Biodiversity opportunity mapping followed a four-step process, as explained below, and was based on the approach developed by Catchpole (2006)[4] and Watts et al. (2010)[5]. Note that opportunity areas for the five broad habitats often overlap, and no attempt has been made to ascertain the most suitable habitat at a particular location.

2.1 Method

1. <u>Landscape permeability</u>

This step involves assessing the permeability of the landscape to typical species from each habitat type and builds on work carried out by JNCC, Forest Research and others. Generic focal species are assessed for each habitat type as there is a lack of ecological knowledge to be able to repeat the process for multiple different individual species, and generic species provide an average assessment for species typical of each habitat type.

It is assumed that a species will have optimal dispersal capabilities in the habitat in which it is associated and hence the landscape is fully permeable if it consists only of this primary habitat. Each of the remaining habitat types is then assigned a permeability score that shows how likely and how far the species will travel through that habitat. Habitats are scored on a scale from 1 (most permeable) to 50 (least permeable). Permeability scores were based on expert scores compiled by JNCC and then adjusted by

[4] Catchpole, R.D.J. (2006). Planning for Biodiversity – opportunity mapping and habitat networks in practice: a technical guide. *English Nature Research Reports*, No 687

[5] Watts, K., Eycott, A.E., Handley, P., Ray, D., Humphrey, J.W. & Quine, C.P (2010). Targeting and evaluating biodiversity conservation action within fragmented landscapes: an approach based on generic focal species and least-cost networks. *Landscape Ecology,* 25: 1305–1318.

Natural Capital Solutions for the study area for each habitat type. Once tables had been compiled showing permeability scores for each habitat, high (10m) resolution maps were then produced using the EcoServ GIS package showing the permeability of the landscape for generic species from each broad habitat type.

2. Habitat networks

Step 2 uses the permeability map created above, along with information on average dispersal distances, to map which habitat patches are ecologically connected and which are ecologically isolated from each other. Dispersal distances were obtained from JNCC, which had performed a review of the scientific literature to ascertain the dispersal distances of a range of species for each habitat type. These were typically species of small mammals, smaller birds, butterflies, and plants. The average dispersal distance for each habitat is shown in the table below:

Dispersal distance in optimal habitat:	
Semi-natural grassland	2.0 km
Wet grassland	2.0 km
Mire	1.0 km
Heathland	1.2 km
Broadleaved and mixed woodland	3.0 km

3. Identifying constraints

The habitat network map created in Step 2 can be used to indicate where new habitat could be created; any habitat created within the existing network would be ecologically connected to existing patches. However, in reality a number of constraints exist that need to be taken into account when producing opportunity maps. The aim of this step, therefore, is to produce a series of maps of constraints that can be used to show where habitat cannot or should not be created. The following constraints were mapped and are shown on Figure 1(overleaf):

- *Land-use constraints* – infrastructure (roads, railways, and paths), urban (all buildings), gardens, and water (standing and running), as it is highly unlikely that these would be available for habitat creation.
- *High quality habitats* – all existing habitats of high nature conservation interest were identified from the basemap, as it would not make sense to destroy existing high-quality habitat to create new habitat of a different type. A full list of these habitats is shown in Box 3 (below).
- *Heritage assets* – data were obtained from Historic England on the location of Scheduled Monuments, Registered Parks and Gardens, and Registered Battlefields across the study area and a 30m buffer was applied around each individual site, as recommended by Historic England. This constraint was applied to woodland, and wet grassland and wetland opportunities, but not to grassland opportunities which may be possible on such sites.
- *National Grid gas pipelines, overhead lines and cables* – data were obtained from the National Grid and a 10m buffer was applied around both features. This constraint was only applied when woodland opportunities were being mapped, as it would not be possible to plant trees in these areas, although grassland and wetland habitats would be feasible.
- For wet grassland habitats it was assumed that hydrology (wetness) would be a limiting factor. Therefore, habitat opportunity areas were restricted to areas within the indicative floodplain, as indicated by the Environment Agency's Flood Zone 2 map.

Box 3: High quality habitats

The following habitats were identified from the basemap and used as constraints:

- Broadleaved woodland
- Mixed woodland
- Woodland/scrub with semi-natural habitats
- Unimproved and semi-improved acid grassland
- Unimproved and semi-improved neutral grassland
- Unimproved and semi-improved calcareous grassland
- Floodplain grazing marsh
- Marshy grassland
- Heathland
- Fen, marsh and swamp
- Bogs

4. *Habitat opportunity for biodiversity*

In the next step, the constraints map was used to exclude areas that would be unsuitable or unavailable for new habitat. Two layers of habitat opportunity were then created:

- **Buffer opportunity** – this layer identified habitat opportunity areas that are immediately adjacent to existing habitat patches and fall within the previously identified ecological network.
- **Stepping-stone opportunity** – this layer identified potential sites that fall outside of the ecological network, but are immediately adjacent to it. These areas could potentially be used to create stepping-stone habitats that could link up more distant habitat patches.

For both opportunity layers, a minimum threshold size was set at 0.1 ha, to remove tiny fragments of land and to replicate the minimum sizes of habitat creation grant schemes.

As the above maps identify portions of land in relation to the ecological network for each habitat, it often results in thin slivers of land being identified adjacent to existing habitats, which bear no relationship to existing fields and boundaries. As habitat creation or restoration projects usually operate on whole fields or land parcels, an additional step was taken to identify those fields that present buffer opportunities. To do this, the buffer layer was overlain over the basemap to identify whole fields and polygons that are immediately adjacent to existing habitat patches and are not constrained by the factors described in Step 3. Parts of these fields fall within the previously identified ecological network and creating new habitat will extend the network. To avoid the chance of identifying fields where only a tiny corner fell within a buffer zone, a minimum threshold was set, so that at least 10% of the field or polygon needed to fall within the buffer zone for the field to be identified. In the same way, the stepping-stone layer was also overlain to identify whole fields and polygons that fall outside of the ecological network, but are immediately adjacent to it.

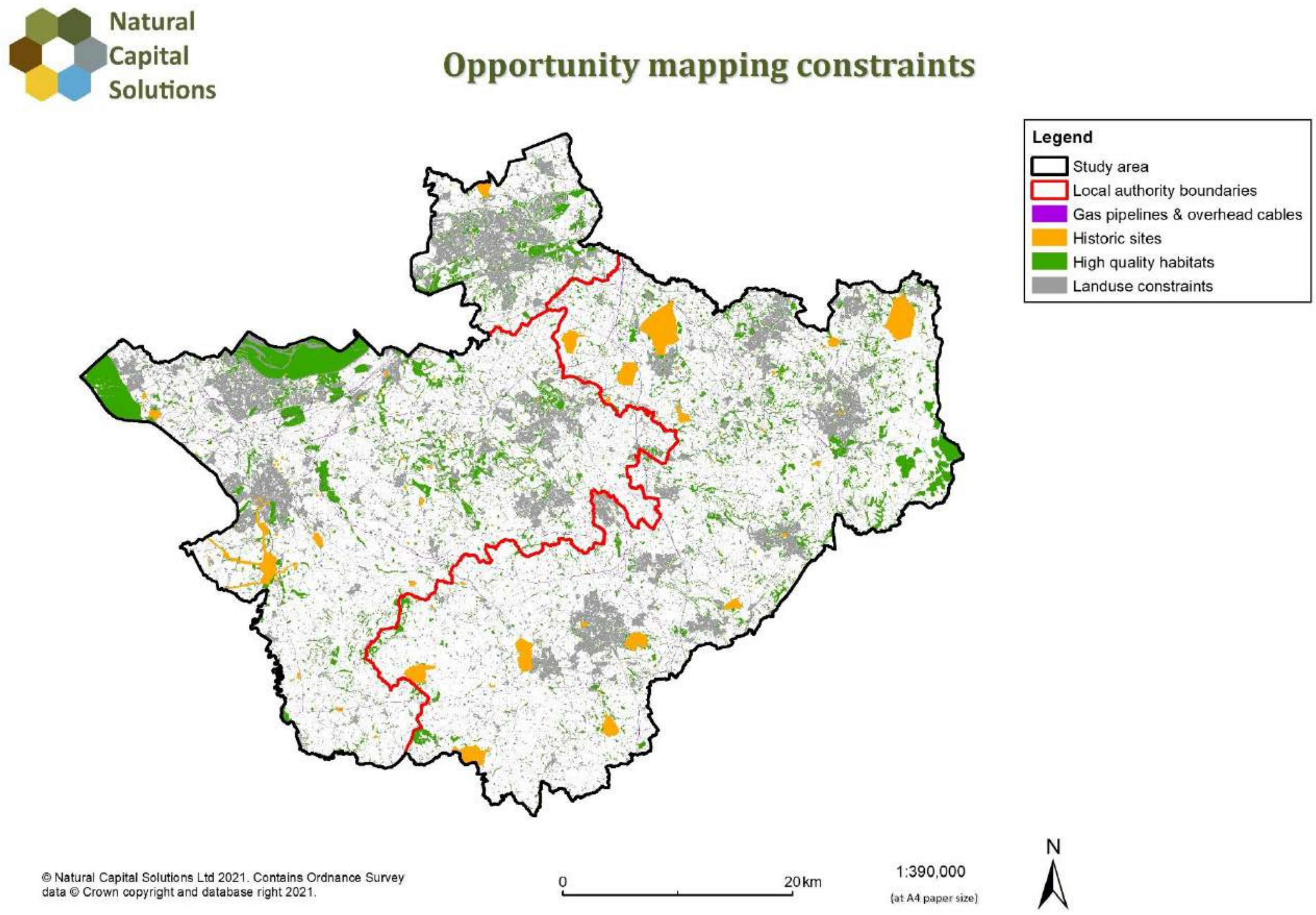

Figure 1 Key constraints taken into account during habitat opportunity mapping across Cheshire and Warrington.

2.2 Results

The permeability of the landscape for typical species for each habitat type is shown in Annex 1 (Figures A1 – A5). Darker areas are more permeable, meaning that typical species are expected to travel further across these habitats and hence will be less of a barrier to movement. For all five broad habitat types, urban areas and arable fields are the most significant barriers to movement.

The habitat network maps (not shown, but available in the GIS data package) indicate areas that are ecologically connected and show that for broadleaved and mixed woodland, habitat networks occur extensively over much of Cheshire and Warrington, particularly around Delamere and stretching to Northwich, around Warrington, and the northern half of Cheshire East. For semi-natural grassland, much of the Peak District in eastern Cheshire forms a continuous ecological network for this habitat, but patches are small and relatively isolated elsewhere. Wet grassland networks are restricted to parts of the Gowy floodplain, Lower Weaver, and Mersey to the east of Warrington, with most other habitat patches relatively small and isolated. Heathland tends to occur in small patches which are not ecologically connected to each other, although larger patches occur to the south-east of Macclesfield. Mire habitats, which includes upland blanket bog, lowland raised bog, fens and reedbeds, are also generally isolated, apart from on the eastern boundary of Cheshire in the Peak District, where an extensive ecologically connected network is present.

Once constraints have been removed, the resulting maps show biodiversity opportunity areas. Figures 2-6 highlight whole fields or polygons where habitats could be created for each of the five habitats in turn, as fields are a more meaningful management unit for conservation action (the non-field zones from which these were derived are available in the GIS data package).

Opportunities for broadleaved and mixed woodland (Figure 2) occur extensively throughout Cheshire and Warrington, and can be used to consolidate, extend and connect the existing woodland network, making it more resilient and enhancing its value for biodiversity. There are also opportunities to connect and spread woodland into the urban areas. Opportunities for semi-natural grassland (Figure 3) occur extensively in the Peak District part of Cheshire East and can be used to extend and connect the existing habitat network there. Numerous further opportunities occur, spread throughout much of the remainder of Cheshire and Warrington, for example between Tatton Park and Manchester airport, between the M62 and Manchester Ship Canal west of Frodsham, close to Carden Park, and between Sandbach and Middlewich. For wet grasslands, opportunities occur most extensively along the Lower Weaver and the Mersey to the east of Warrington and would enhance connectivity by joining together patches along the river valleys to create a larger and more resilient network (Figure 4). Other opportunities are present thought Cheshire but are generally small and would extend existing small patches of habitat. Opportunities for heathland creation (Figure 5) occur predominantly in the area to the SE of Macclesfield, and are primarily concerned with extending and consolidating the existing larger patches of heathland. For mire (Figure 6), opportunities are most extensive on the eastern boundary of Cheshire, around the existing areas of blanket bog and can be used to join and further consolidate this network. Opportunities are also present dotted over a number of locations across the areas, such as to the south of Macclesfield to extend Danes Moss Nature Reserve, around a number of the Meres and Mosses in lowland Cheshire.

Please note that in many places the biodiversity opportunity maps overlap, hence a piece of land may have been identified as being potentially suitable for habitat creation for two, three, or more different habitat types. This occurs where existing areas of the mapped habitat types are in close proximity to each other. This issue can be addressed by setting priorities for habitats to take forward in different locations.

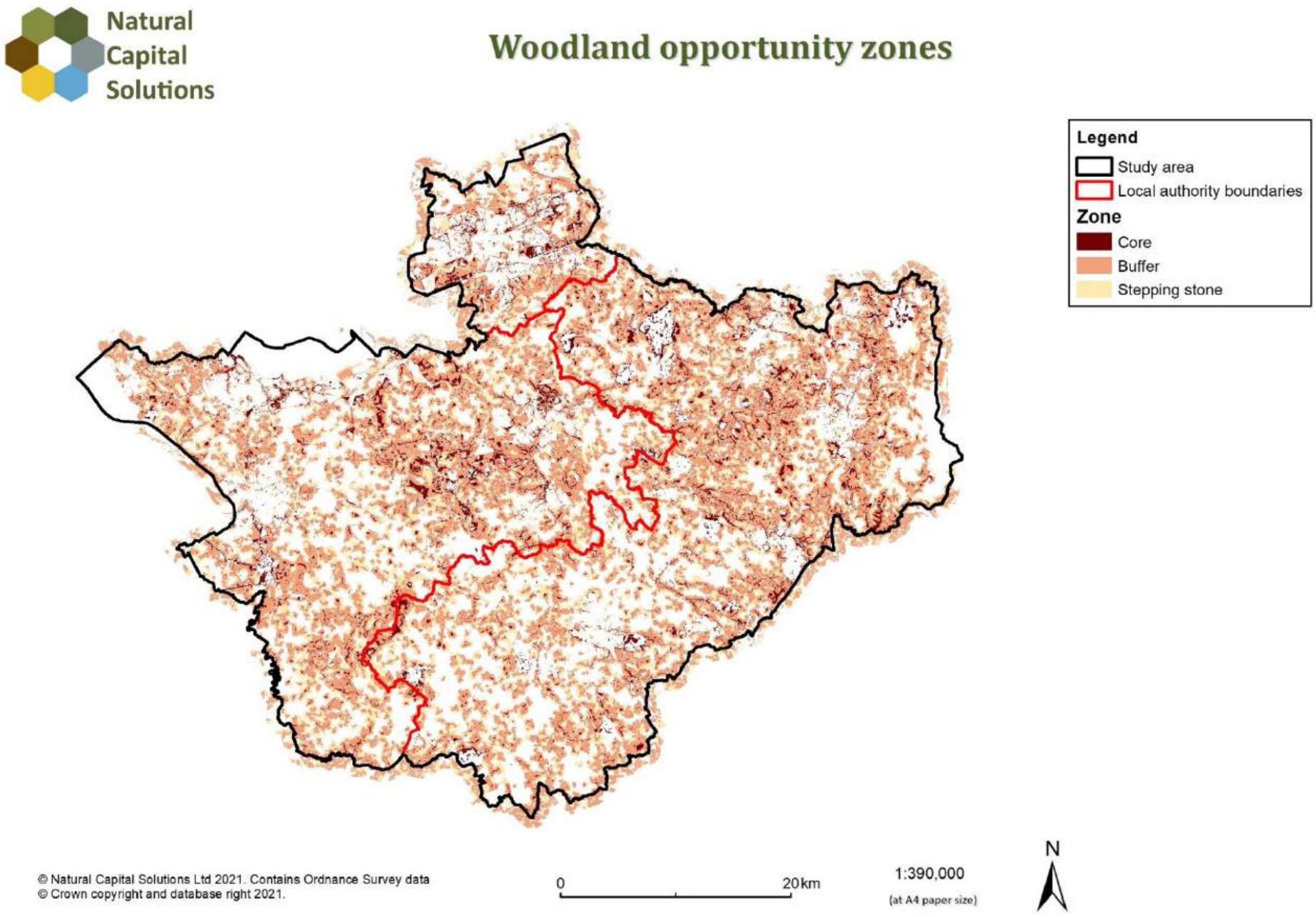

Figure 2 Broadleaved and mixed woodland opportunity zones across Cheshire and Warrington.

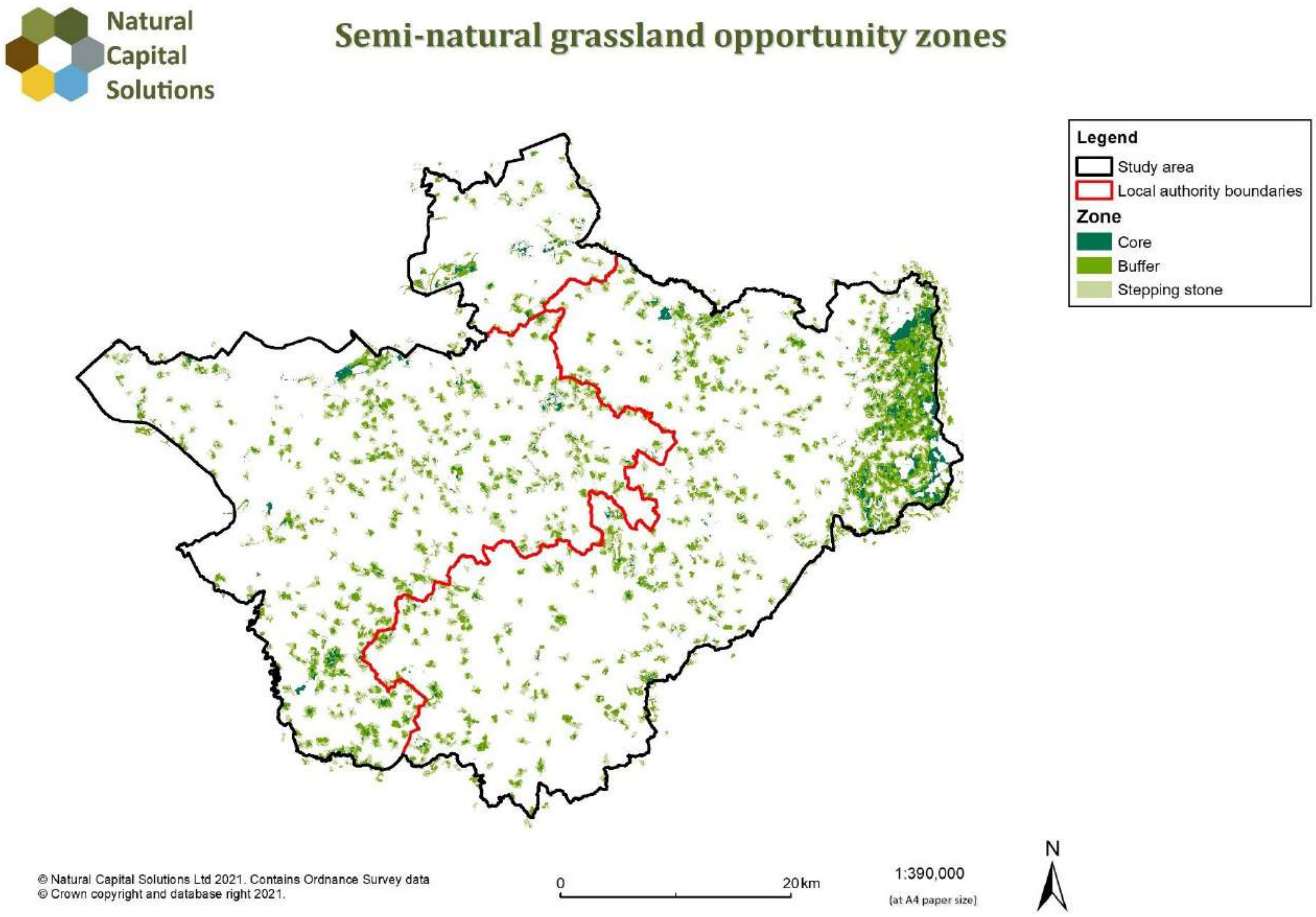

Figure 3 Semi-natural grassland opportunity zones across Cheshire and Warrington.

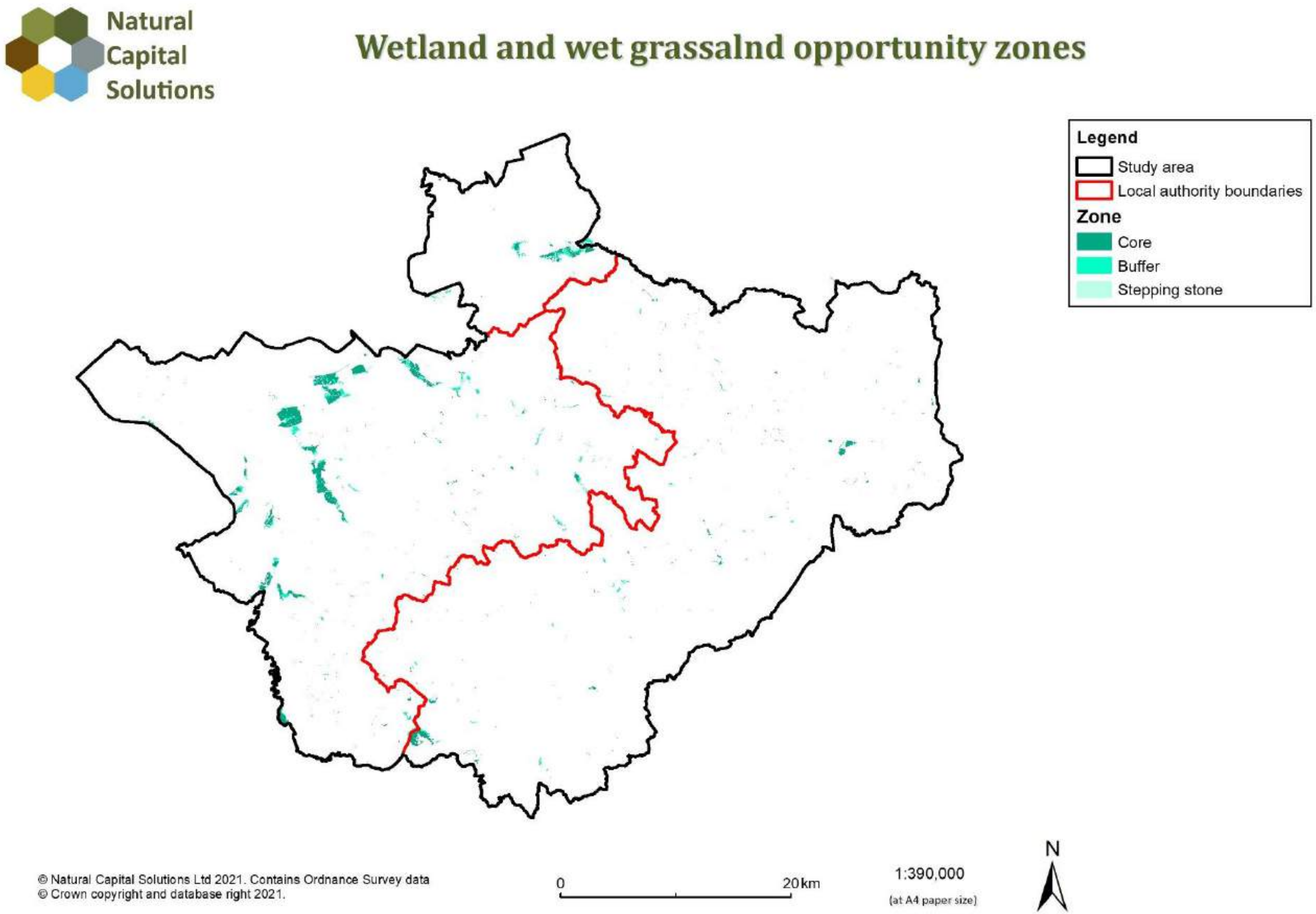

Figure 4 Wet grassland opportunity zones across Cheshire and Warrington.

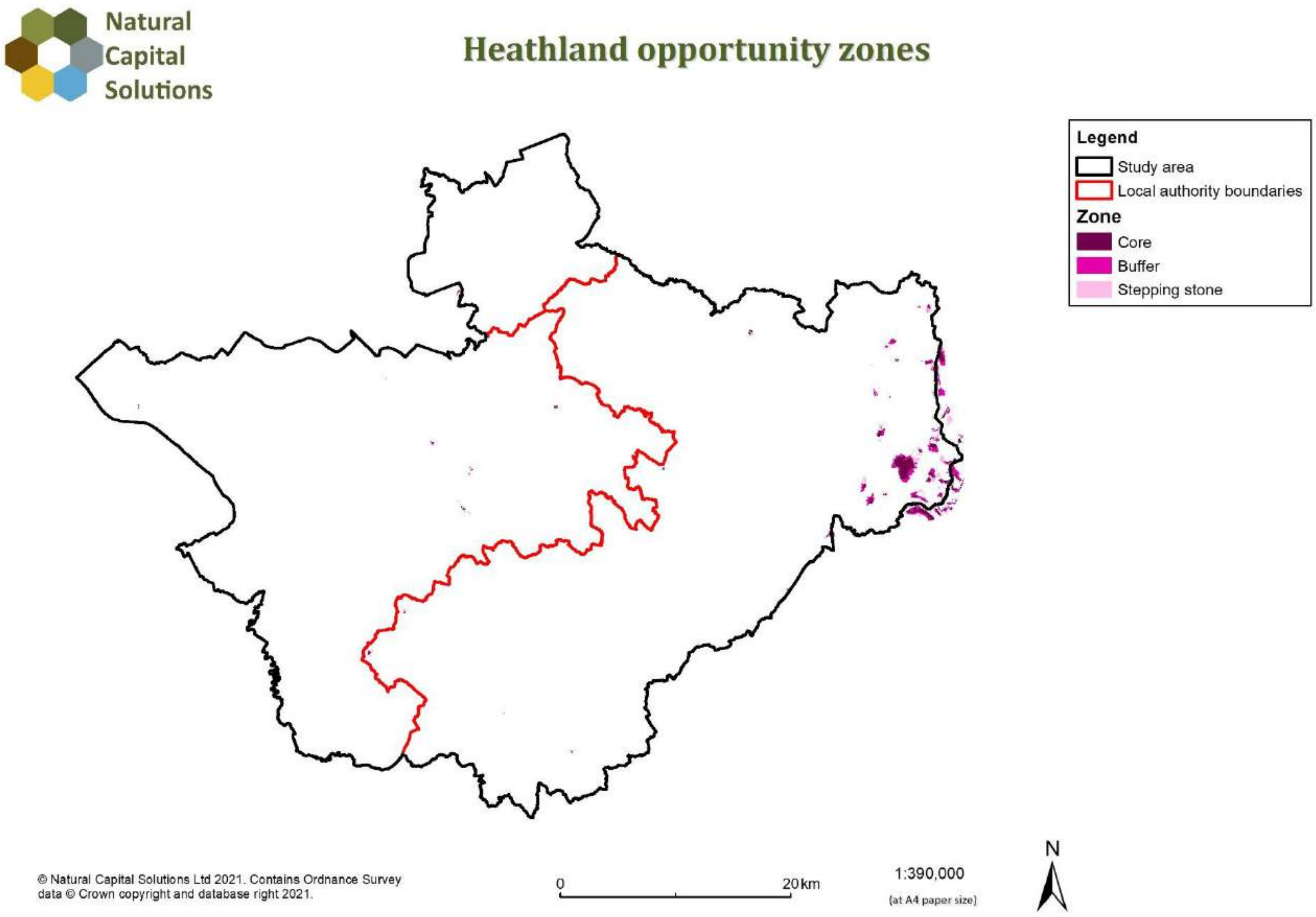

Figure 5 Heathland opportunity zones across Cheshire and Warrington.

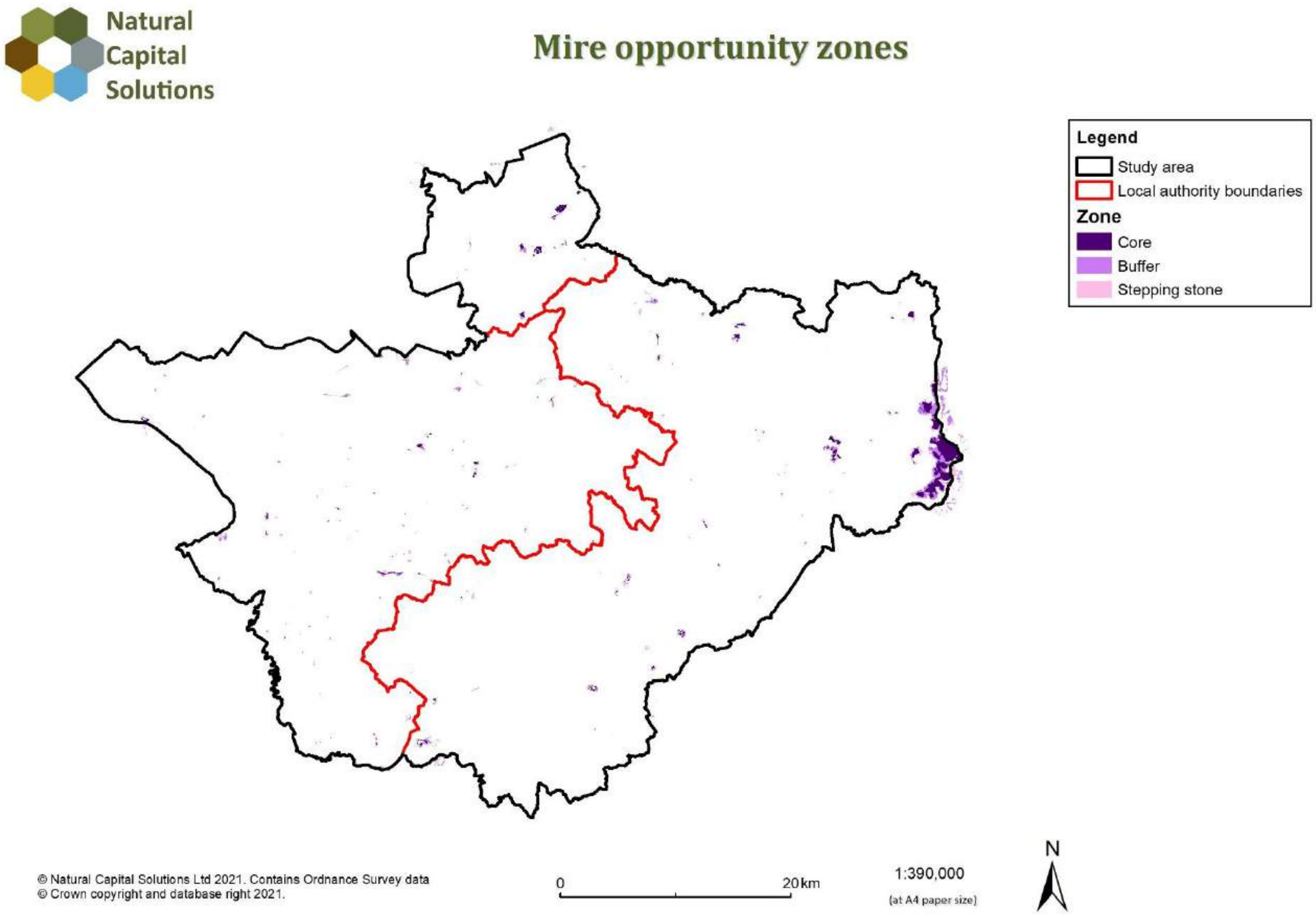

Figure 6 Mire opportunity zones across Cheshire and Warrington.

3. Ecosystem services opportunity mapping

3.1 Opportunity mapping to reduce surface runoff

There is growing interest in working with natural process to reduce downstream flood risk. These projects aim to “slow the flow”, reduce surface water runoff and retain water away from the main river channels for as long as possible. The most likely approach to achieve this aim will involve planting woodland, although measures could also include woody debris dams and attenuation ponds in upstream areas. Opportunity mapping to reduce surface runoff was undertaken based on the water flow model described in Technical Report 1 and highlights areas across the whole catchment where changing land-use would have the greatest impact on reducing runoff.

3.1.1 Method

Constraints were identified and mapped in the same way as described in Section 2.1 (Figure 1). These locations were the erased from the water flow regulation map developed previously, to leave a map showing water flow regulation in all unconstrained locations. This was then classified into quartiles and the top quartile was extracted into a different map layer. Therefore, this shows the top 25% of areas of land across the study area where surface water runoff is currently highest and where there are no constraints on potentially altering land use.

The final opportunity map identifies many very small polygons and many polygons do not coincide with fields, the scale over which management and land use change is likely to take place. Therefore, as for biodiversity opportunity areas, it was considered beneficial to identify whole fields offering the greatest opportunity to reduce surface water runoff. To do this, all the previously identified constraints were removed or erased from the underlying habitat basemap. The degree of intersection between the opportunity map and the underlying fields (polygons) in the basemap was then calculated. Fields where at least 50% of the field overlapped with the opportunity map were selected and exported to a new layer. Finally, very small polygons were deleted, so that only fields and plots at least 0.1 ha in size were included in the final map.

3.1.2 Results

Once land use constraints were removed, many areas that are currently poor for surface water runoff remained and these were identified as opportunity areas. The opportunity areas have been displayed in relation to fields and plots of land in Figure 7. Opportunities for water flow regulation are present over much of the study area, with the majority of opportunities relating to improved grassland and arable land uses in areas with soil types that are not very permeable and seasonally waterlogged. Fields on sloping land also present opportunities to reduce runoff.

Note that some of the worst areas for water flow regulation relate to buildings and infrastructure, which were not assessed as part of this project, although could be suitable for the installation of green roofs and other types of retrofitted Sustainable Drainage Systems (SuDS).

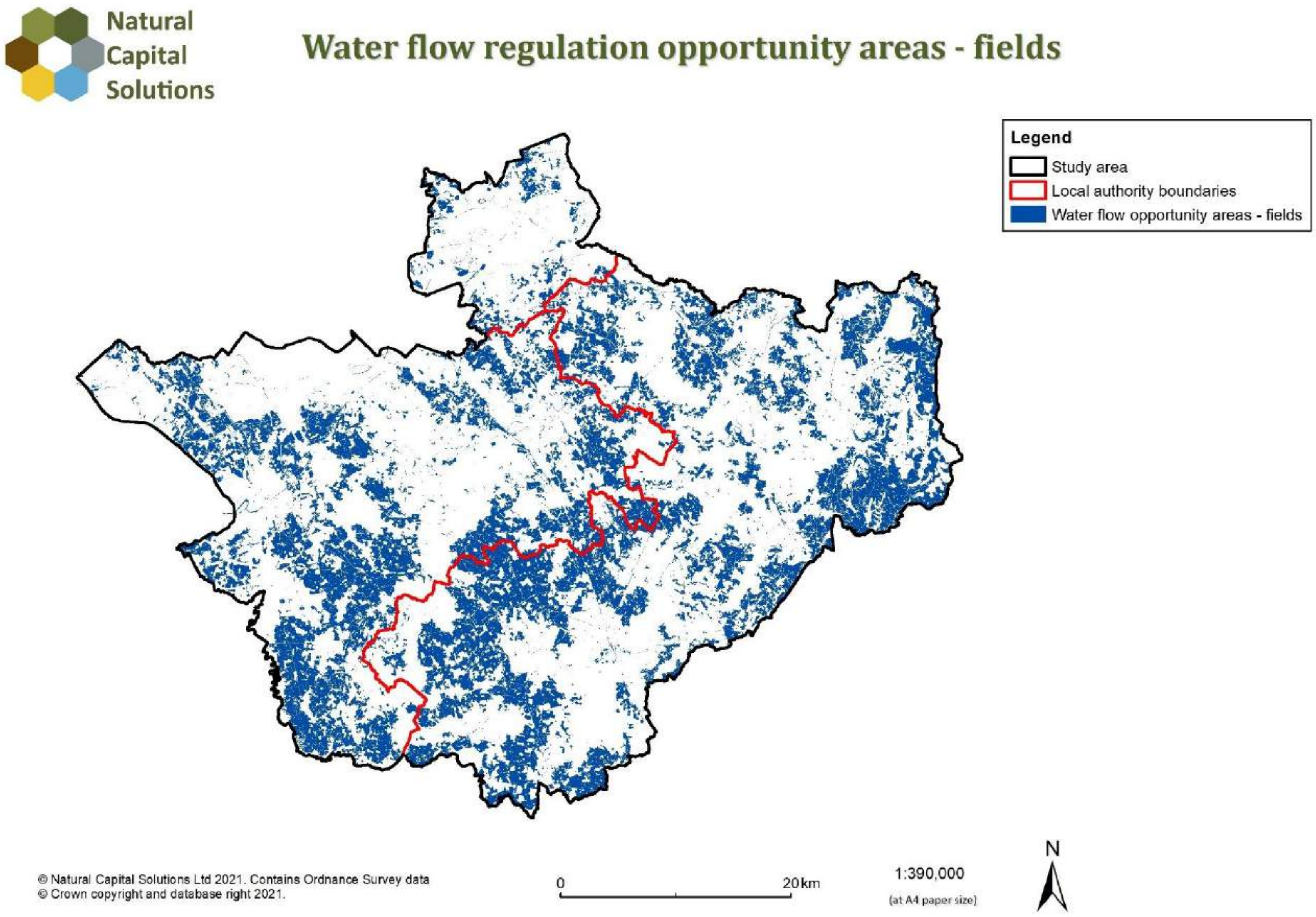

Figure 7 Field (plot) scale water flow regulation opportunity areas across the study area.

3.2 Opportunity mapping to reduce soil erosion and improve water quality

Agricultural and urban diffuse pollution have a major impact on water quality in lowland areas in the UK. There is growing interest in catchment sensitive farming and working with natural processes to tackle this issue. These aim to reduce the amount of sediment and pollutants entering the watercourses in the first place by, for example, adjusting farming practices and planting riparian buffer strips. Opportunity mapping focussed on identifying areas at highest risk of sedimentation and soil erosion, based on catchment land use characteristics, distance to watercourse, slope length and land use erosion risk. It highlights areas across the whole catchment where changing land use would have the greatest impact on reducing soil erosion and hence improving water quality. Note that the focus is on sedimentation risk from agricultural diffuse pollution, and built-up areas (urban diffuse pollution) are not as well accounted for in the existing model.

3.2.1 Method

Constraints were identified and mapped in the same way as before. These areas were erased from the water quality regulation map to leave a map showing water quality regulation in all unconstrained locations. This was then classified into quartiles and the top 25% were extracted into a different map. Therefore, this shows the top 25% of areas of land across the study area where sedimentation risk and soil erosion is currently highest and where there are no constraints on potentially altering land use.

As for water flow, the final opportunity map identifies a large number of very small polygons and long thin polygons that do not coincide with fields. The long thin polygons usually follow watercourses and are useful at identifying locations where riparian buffer stirps would be appropriate. However, there may also be opportunities for whole fields to be converted to other habitats (especially woodland). Therefore, whole fields offering the greatest opportunity to reduce soil erosion were identified. To do this, all the previously identified constraints were removed or erased from the underlying habitat basemap. The degree of intersection between the opportunity map and the underlying fields (polygons) in the basemap was then calculated. Fields where at least 50% of the field overlapped with the opportunity map were selected and exported to a new layer. Finally, very small polygons were deleted so that only fields and plots at least 0.1 ha in size were included in the final map.

3.2.2 Results

Arable farmland scores particularly badly when mapping water quality regulation (See Technical Report 1) at both a coarse and a fine scale of assessment, and these areas are, therefore, highlighted as the areas with the greatest opportunity to reduce sediment loads and enhance water quality on the opportunity map (Figure 8). In addition, distance to watercourses is another key factor. Sediment loads, and therefore opportunity areas, can be variable across short distances as it is partly dependent upon slope and distance to a watercourse, which changes rapidly over short spaces, and is why many of the identified areas are linear stretches adjacent to watercourses. These areas would be ideal places to install riparian buffer strips, possibly of woodland, but any habitat offering year-round cover would help and the most suitable habitat would depend on the location.

Comparing the opportunity maps for water flow (Figure 7) with water quality (Figure 8) reveals that opportunities to improve these ecosystem services do not always overlap. This is because the most effective locations for reducing surface water runoff tend to occur on slopes and on seasonally waterlogged soil types, whereas the most effective areas to enhance water quality are immediately adjacent to watercourses on arable fields. It is likely that habitat features created for one will still enhance the other; it is simply that the top 25% of target areas only sometimes overlap.

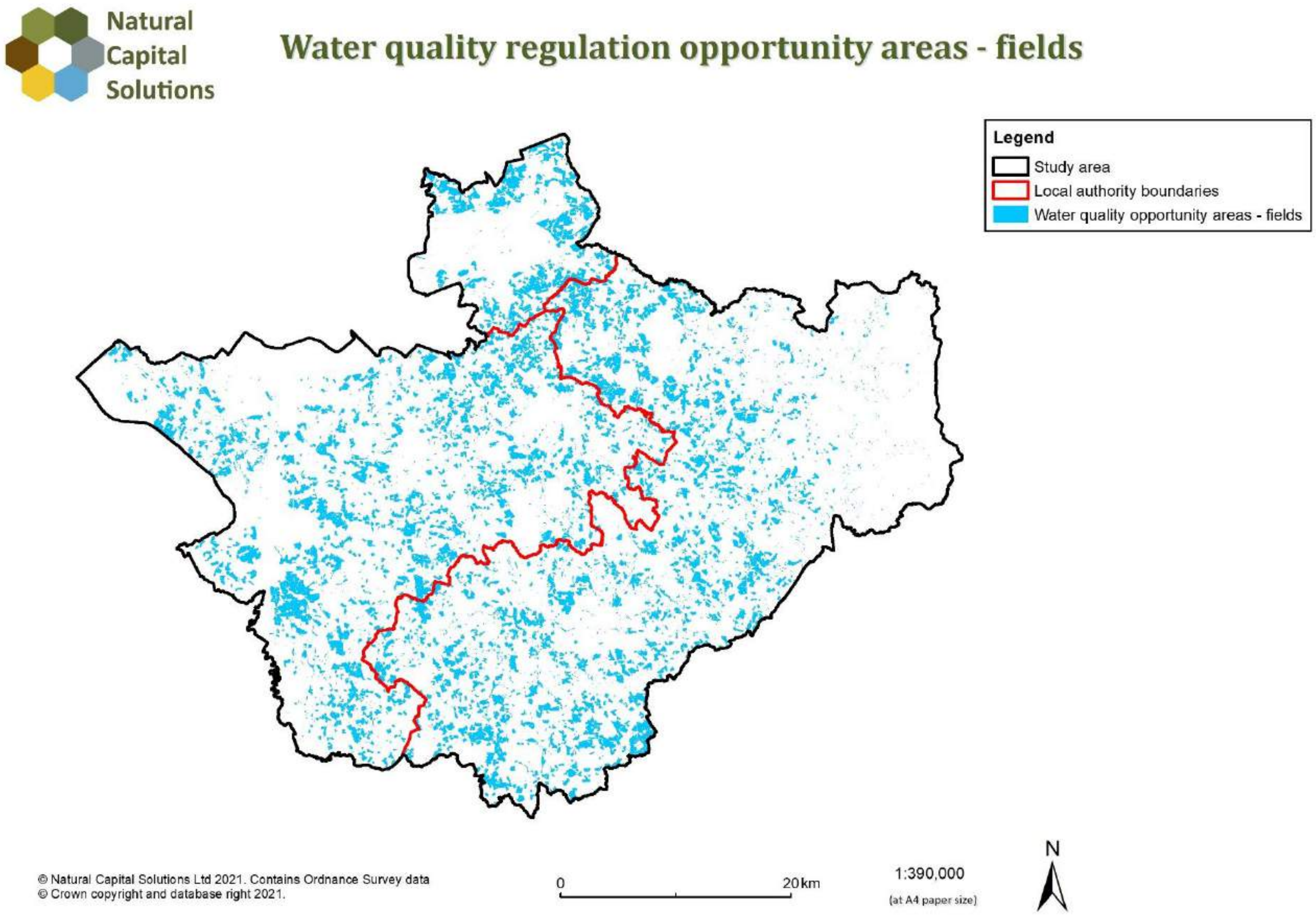

Figure 8 Field scale water quality regulation opportunity areas across the study area.

3.3 Opportunity mapping to ameliorate air pollution

To map opportunities to use the natural environment to ameliorate air pollution, a slightly different approach was used compared to water flow and soil erosion. Air pollution is often highly localised, and vegetation is most effective at mitigating pollutants when planted close to pollution sources. Opportunities to ameliorate air pollution were therefore focussed around areas with greatest demand. As described in Technical Report 1, demand is assumed to be highest in areas where there are likely to be high air pollution levels and where there are lots of people who could benefit from the air quality regulation service. The opportunity maps therefore highlight areas that currently have no trees, but where it would be most beneficial to plant them.

3.3.1 Method

The constraints identified previously were erased from the air quality regulation demand map, to leave a map showing demand in all unconstrained locations. As before, this was then classified into quartiles and the top quartile was extracted into a different map. This map therefore highlights the top 25% of areas of land across the study area where demand for air quality amelioration is greatest and where there are no constraints on potentially altering land use.

To match the other ecosystem services, the opportunity map was used to identify whole plots and fields in the basemap where the degree of intersection was at least 50% and a new layer was created. On this occasion very small polygons were not deleted, as it may be possible to plant an individual tree in very small plots of land.

3.3.2 Results

As described in Technical Report 1, demand for air quality regulation is highest in the main urban centres as these have both higher air pollution levels and higher populations that would benefit from better air quality, and along the main road networks. Inevitably, when the focus on air quality regulation is the major urban areas, large areas are constrained, where it would not be possible to plant trees or other green infrastructure. However, unconstrained areas do remain, and are particularly frequent at the edges of and identified fields and plots were highlighted on the opportunity map (Figure 9). These locations potentially provide the opportunity to plant trees that could trap air pollution in areas where there is the greatest need for this service. Note that this does not include pavements, where further opportunities may be present, if pavements are sufficiently wide.

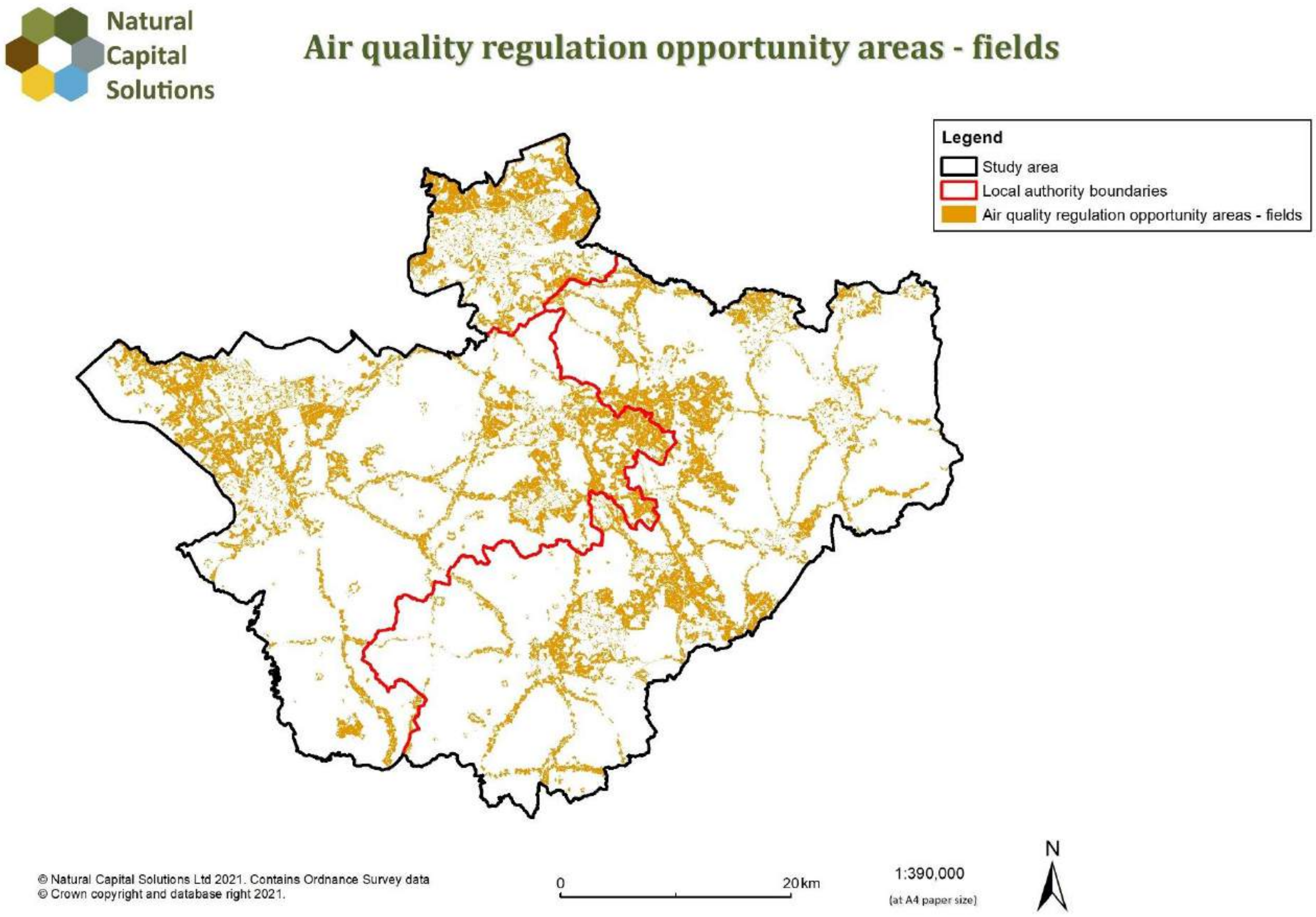

Figure 9 Field scale air quality regulation opportunity areas across the study area.

3.4 Opportunity mapping to reduce noise pollution

Opportunities to reduce noise pollution were mapped in a very similar way to the air quality regulation opportunity mapping just described. This was focussed around areas with greatest demand for noise regulation. Dense plantings of trees and scrub are the habitat type that could potentially reduce noise pollution; the opportunity maps therefore highlight areas that currently have no trees, but where it would be most beneficial to plant them.

3.4.1 Method

The constraints identified previously were erased from the noise regulation demand map, to leave a map showing demand in all unconstrained locations. As before, this was then classified into quartiles and the top quartile was extracted into a different map. This map therefore highlights the top 25% of areas of land across the study area where demand for noise regulation is greatest and where there are no constraints on potentially altering land use.

As before, the opportunity map was used to identify whole plots and fields in the basemap where the degree of intersection was at least 50% and a new layer was created. As individual trees or very small groups of trees are largely ineffective at blocking noise, polygons less than 200m^2 were deleted.

3.4.2 Results

Similarly to air quality regulation, demand for noise regulation is highest in the main urban centres and adjacent to the road and rail network, as these have both higher noise pollution levels and higher populations that would benefit from noise screening. Given the large number of constraints in urban centres, the majority of the opportunity areas identified fall on the outer fringes of urban areas and adjacent to the road network, although a number of urban centre locations have also been identified (Figure 10). These locations potentially provide the opportunity to plant trees and scrub belts that could help to block and screen noise pollution. The greatest area of opportunities occur immediately outside the main urban centres, especially in and around Warrington, Ellesmere Port, around Northwich and along the M6 corridor.

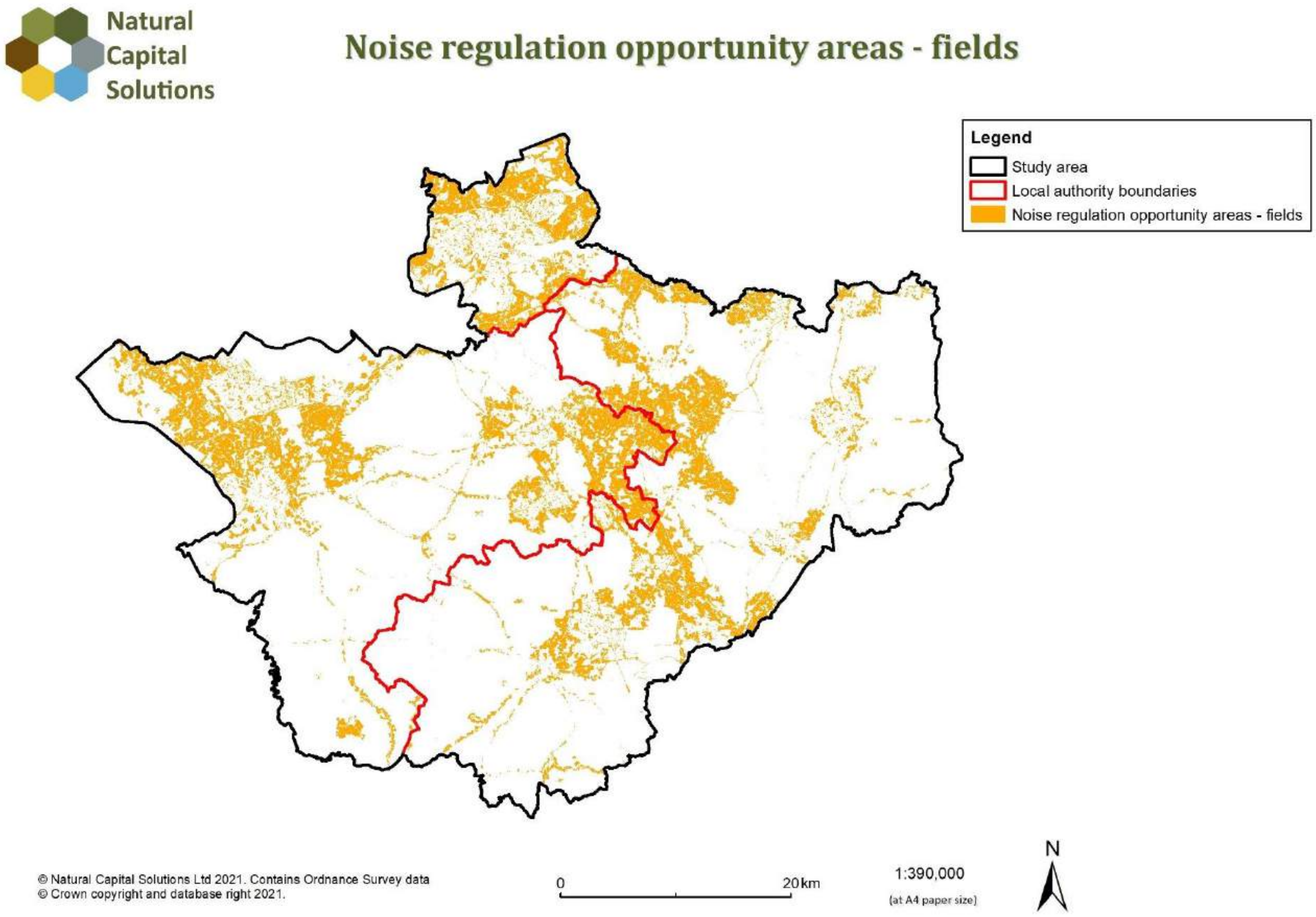

Figure 10 Field scale noise regulation opportunity areas across the study area.

3.5 Opportunity mapping to regulate local climate (reduce urban heat)

Opportunities to regulate local climate were mapped using the same approach as for air quality regulation and noise regulation. This, therefore, focuses on areas of highest demand, where there is currently low capacity. Using the natural environment to regulate local climate can best be achieved by either plating trees / woodland, or creating waterbodies such as ponds and lakes. The larger the area of habitat created, the greater the effect that it will have on urban temperatures, although even individual trees will have a small positive impact.

3.5.1 Method

The constraints identified previously were erased from the local climate regulation demand map, to leave a map showing demand in all unconstrained locations. As before, this was then classified into quartiles and the top quartile was extracted into a different map. This map therefore highlights the top 25% of areas of land across the study area where demand for local climate regulation is greatest and where there are no constraints on potentially altering land use.

As before, the opportunity map was used to identify whole plots and fields in the basemap where the degree of intersection was at least 50% and a new layer was created. All polygons were retained, as even planting individual trees could be beneficial, although will have a smaller effect.

3.5.2 Results

Demand for local climate regulation is highest in the main urban centres and the size of the urban heat island effect increase with size of urban area and amount of sealed surface. As with air pollution regulation and noise regulation, the majority of the opportunity areas identified fall on the outer fringes of urban areas, due to the large number of constraints in urban centres, although some urban centre locations have also been identified (Figure 11). These locations potentially provide the opportunity to plant trees and woodland or to create water features that could help to reduce the urban heat island effect. Note that the urban heat island effect is only relevant in larger urban areas, hence opportunities are restricted to these towns.

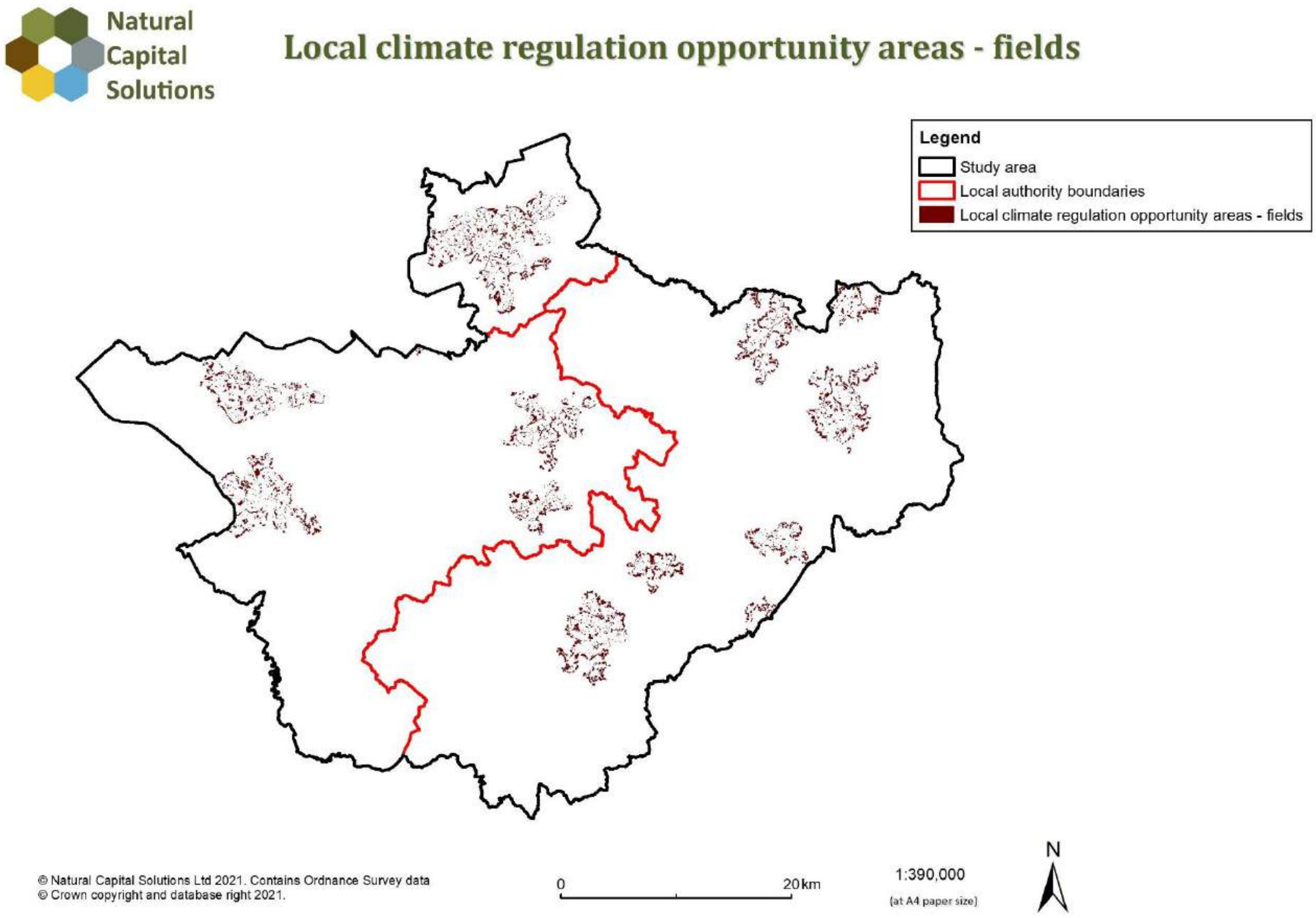

Figure 11 Field scale local climate regulation opportunity areas across the study area.

3.6 Opportunity mapping to enhance access to natural greenspace

There are many benefits of enhancing public access to natural greenspaces and the key features that maximise benefits are proximity to where people live and the naturalness of the habitats. Here, opportunities to provide accessible natural greenspace were mapped, based on creating new habitats at new sites or making existing habitats publicly accessible.

3.6.1 Method

It may be possible to create accessible natural greenspace simply by opening up public access to existing areas, rather than changing habitats. Therefore, many of the constraints that would need to be considered when planting new habitats for water flow, air quality regulation or the other ecosystem services, do not need to be taken into account. For example, opportunities do not need to be constrained by existing high-quality habitats and historic sites, although these areas would need to be carefully considered on a case-by-case basis to avoid any damage or disturbance to existing features. The only constraints taken into account were, therefore, the land use constraints identified previously – buildings, infrastructure, gardens and water. It would be possible to include water features as part of larger sites, but that was not investigated here. A map was created showing all the land use constraints on one map.

In addition to these constraints, a map was created from the basemap showing all areas of green infrastructure currently existing across the study area. This was based on the sites identified in the accessible nature capacity model, including public parks, amenity greenspace, play facilities, natural and semi-natural greenspaces, country parks and Local Nature Reserves.

The land use constraints identified above were erased from the accessible natural greenspace demand map, along with the existing areas of green infrastructure, to leave a map showing demand in all unconstrained locations where there is currently no green infrastructure. As before, this was then classified into quartiles and the top quartile were extracted into a different map. This map highlights the top 25% of areas of land across the study area where demand for accessible natural greenspace is greatest and where there are no constraints on potentially creating this. As before, the opportunity map was used to identify whole plots and fields in the basemap where the degree of intersection was at least 50%.

3.6.2 Results

Demand for accessible natural greenspace was described in Technical Report 1 and is strongly focussed around the urban areas in the study area. Therefore, it is perhaps unsurprising that the majority of the opportunity areas identified (Figure 12) are centred around the major and minor towns across the study area. As opportunities for new greenspaces are usually highly constrained within towns, opportunity areas tend to form a ring around the edges of these towns. These are also often locations that have been targeted for sustainable urban extensions and other development, so it is important that planners and developers take into account the strong demand for greenspace at these sites from both the new developments and from the existing population.

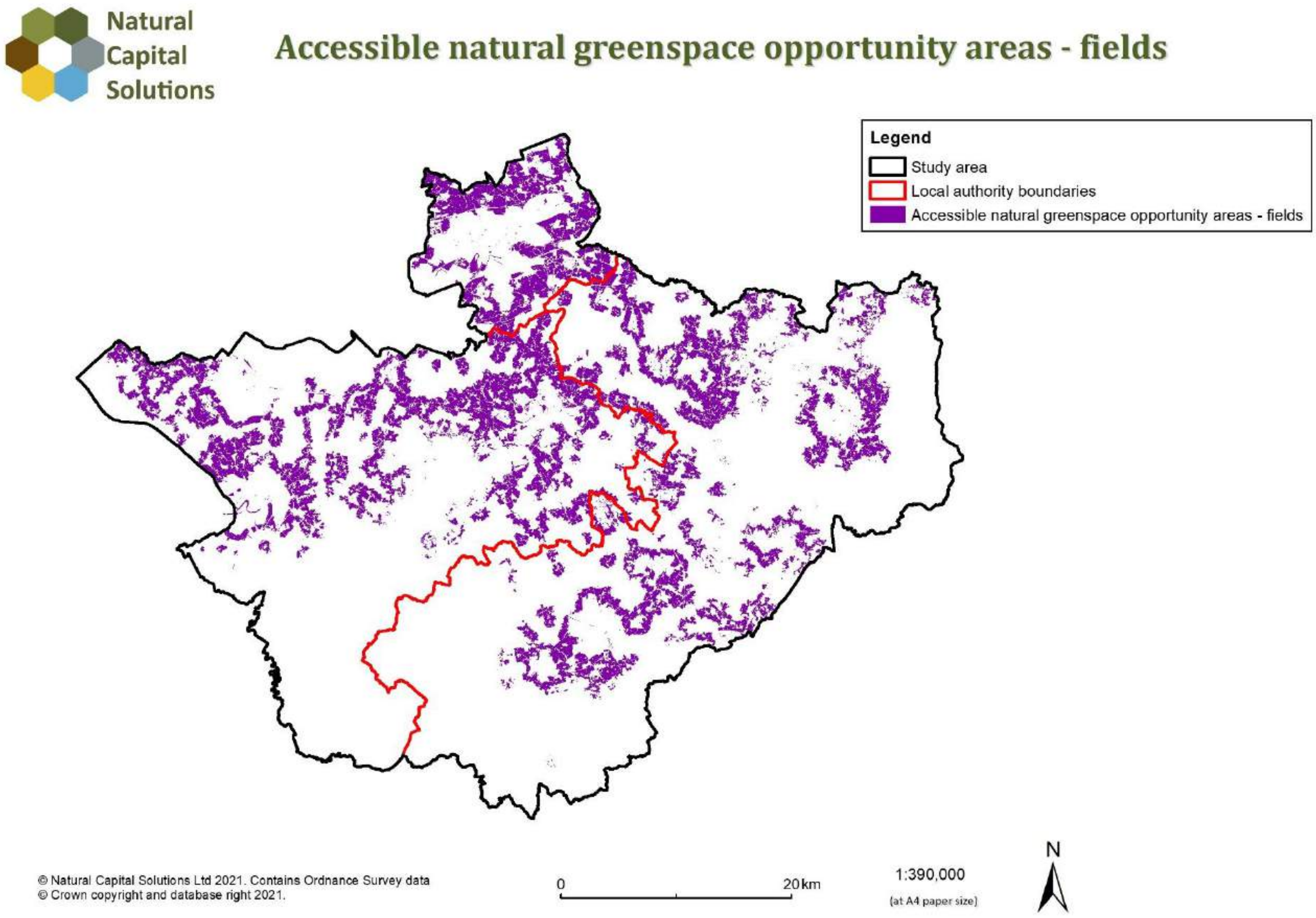

Figure 12 Field scale opportunities to enhance access to natural greenspace across the study area.

4. Combined opportunities for new habitats

In addition to mapping the individual opportunities presented in Sections 2 and 3, it is also possible to examine multiple opportunities, which are areas where new habitat can be created that provides opportunities to enhance more than one of the services mapped previously. These are areas that could deliver multifunctional outcomes. This is assessed by overlaying individual opportunity maps to determine the degree of overlap. Note that this is focussing on the top 25% of opportunity areas for each ecosystem service (or areas that are ecologically connected to existing habitats), so is only considering the higher levels of service provision. In reality, creating any new habitat for one ecosystem service is likely to provide benefits for other services, even if this does not fall within the top 25%.

The maps can be combined in a number of different ways, depending on the objective and in the sections below we explore examples of how they can be created and used. We have combined maps by treating biodiversity opportunities and all ecosystem service opportunities equally. It would also be possible to weight the different ecosystem services, depending on stakeholder priorities.

4.1 Biodiversity focus

4.1.1 Combined opportunities for new broadleaved and mixed woodland

Opportunities to deliver enhancement to water flow, water quality, air quality, noise, and local climate regulation (Sections 3.1-3.5), can all be best achieved through planting trees and woodland. Woodland is also one of the best habitats for creating high quality accessible natural greenspace (Section 3.6). Therefore, the opportunity maps for all of these services were overlain with the opportunity map for biodiversity enhancement through the creation of broadleaved and mixed woodland (Figure 2), to show the multiple opportunities that can be delivered by planting new woodland. Note that creating woodland habitats will also deliver benefits in the form of **carbon sequestration**. These have not been mapped separately as location is not especially important for carbon sequestration (although there will be some difference in the growth rate of trees in different places). Hence all of the locations identified in the map below would also deliver this service.

The results are shown on Figure 13, where all the ecosystem service opportunities are constrained to areas that present woodland biodiversity opportunities (the woodland opportunity zones). The map highlights the number of different opportunity areas that overlap (out of a maximum of seven) for each pixel across the study area. The results show that while there are large areas that only offer one opportunity, there are many areas that offer multiple opportunities. Locations at the edges of the urban centres are most often highlighted as being able to deliver multiple services. If the aim of woodland creation was to maximise the delivery of as many ecosystem services as possible whilst also planting in locations that are ecologically connected to existing woodlands, then it is these locations that would deliver the greatest benefits to society.

A map was also produced showing the multiple opportunities that can be delivered by planting woodland anywhere, and this is shown in Figure B1 in Annex B. Here the restriction for planting woodland that is ecologically connected to existing woodland is removed, so if the aim was to plant woodland do deliver greatest multifunctionality, then this map should be used.

4.1.2 Combined opportunities for new semi-natural grassland

Creating semi-natural grassland is likely to be effective at reducing water flow or enhancing water quality (although it may not be as effective as planting woodland). It will not, however, be very effective at ameliorating air pollution, reducing noise pollution, or regulating local climate (although better than sealed surfaces for each of these services). Hence combined opportunities were examined for four out of the seven services: water flow, water quality, accessible natural greenspace, and biodiversity enhancement, while air quality, noise, and local climate regulation were not included.

Combined opportunities for new semi-natural grasslands are not quite as extensive as for woodlands, but are spread across the whole region (Figure 14). The Peak District, in the east, holds the most opportunities. Similarly to woodland, there are many areas that support multiple opportunities, with the highest number of benefits being in sites close to the urban centres, especially around Warrington, Northwich and Macclesfield. If the constraint to create semi-natural grassland that is ecologically connected to existing habitat is removed, then the resulting map showing the number of opportunities delivered by planting grassland anywhere is shown in Figure B2 (Annex B).

4.1.3 Combined opportunities for new wet grassland

Opportunities for new wet grassland were mapped in the same way as for the semi-natural grasslands, except that all opportunities were restricted to areas within the indicative floodplain. Thus four out of the seven services were included, with air quality, noise, and local climate excluded. Wetland habitats can be effective at reducing water flow and enhancing water quality.

The location of opportunities for this habitat type is far more restricted than for the previous two (Figure 15), due to the requirement for being located on floodplains and ecologically connected to existing sites. Most of the areas identified only offer one or two opportunities, but a few locations are opportunity areas for three or occasionally four services. Figure B3 (Annex B), shows all opportunities for wet grassland creation and shows that there are opportunity areas spread along most of the river floodplains, most extensively along the Lower Weaver and the Mersey around Warrington, although opportunities to deliver multiple benefits are fairly limited.

4.1.4 Combined opportunities for new heathland

As with the grasslands, opportunities for creating new heathland were examined for four out of the seven services: water flow, water quality, accessible natural greenspace, and biodiversity enhancement, while air quality, noise, and local climate regulation were not included.

The location of opportunities for this habitat type (Figure 16) is more restricted than for any of the other habitat types, with opportunities for between one and four services being focussed on the Peak District part of Cheshire, and only a small number of locations elsewhere. If heathland was created in areas that aren't ecologically connected to existing sites, opportunities arise over much of the area, although the vast majority offer only one or two opportunities (Figure B4, Annex B). However, heathland creation requires specific conditions, such as nutrient poor acidic soils, for which information was not available under the current study, so habitat creation would only be possible at a subset of those shown. This would require further investigation.

4.1.5 Combined opportunities for new mire (bog and fen) habitats

Opportunities for new mires were mapped in the same way as above, with four out of the seven services included: water flow, water quality, accessible natural greenspace, and biodiversity enhancement. Mire habitats are particularly important for reducing water flow and enhancing water quality.

The location of opportunities for this habitat type is restricted (Figure 17), and opportunities are relatively few overall. Nevertheless, they occur to the greatest extent in the Peak District on the eastern edge of Cheshire, where one or two opportunities can be delivered from the same location. Opportunities for lowland mire creation are spread sparsely across the study area, with opportunities for mainly 2 ecosystem services but 3 or 4 in isolated places. When considering wider opportunities for mire creation (Figure B5, Annex B), sites were limited to areas of peat or seasonally waterlogged soils.

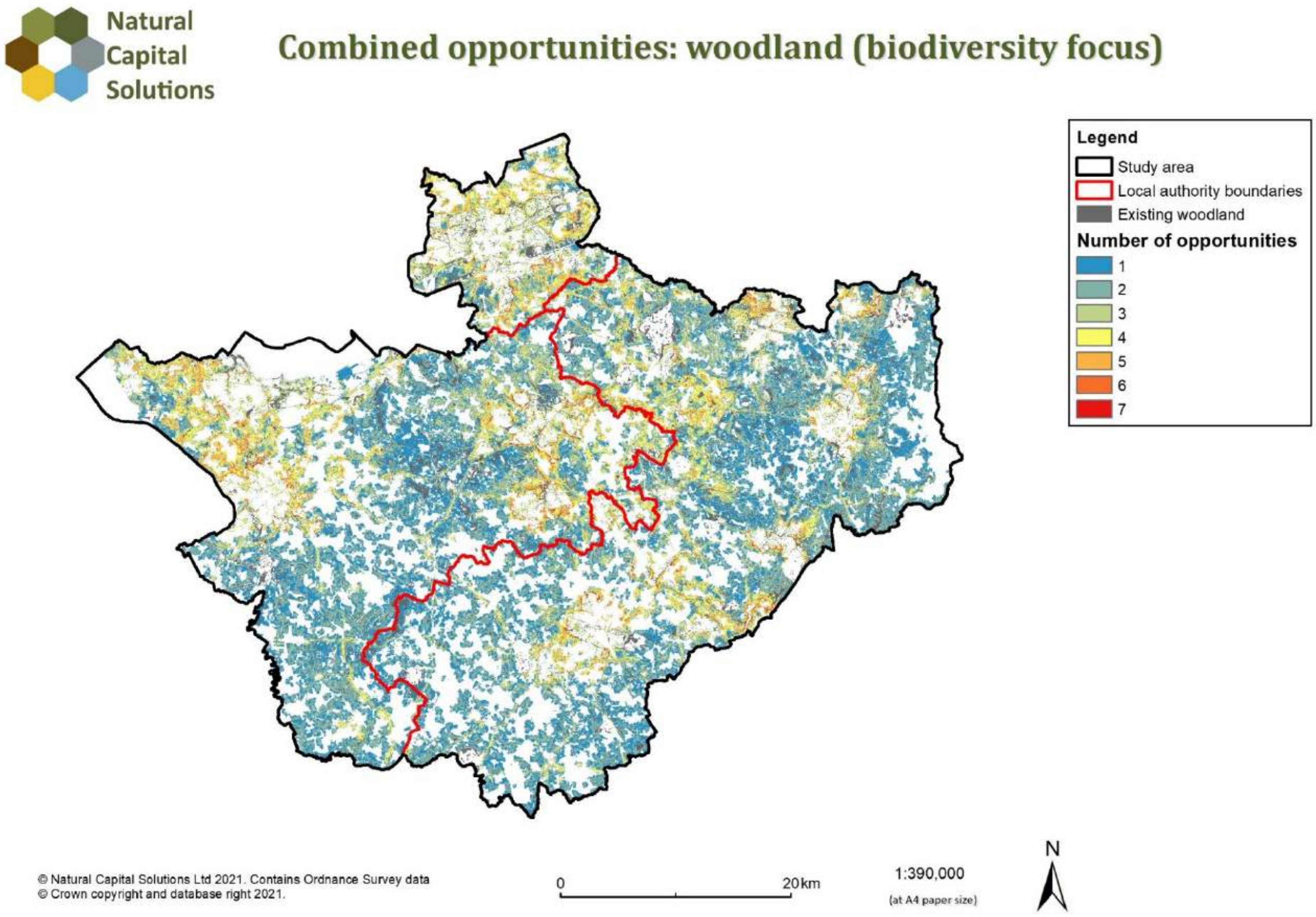

Figure 13 Combined opportunities for new woodland across Cheshire and Warrington, restricted to woodland opportunity zones.

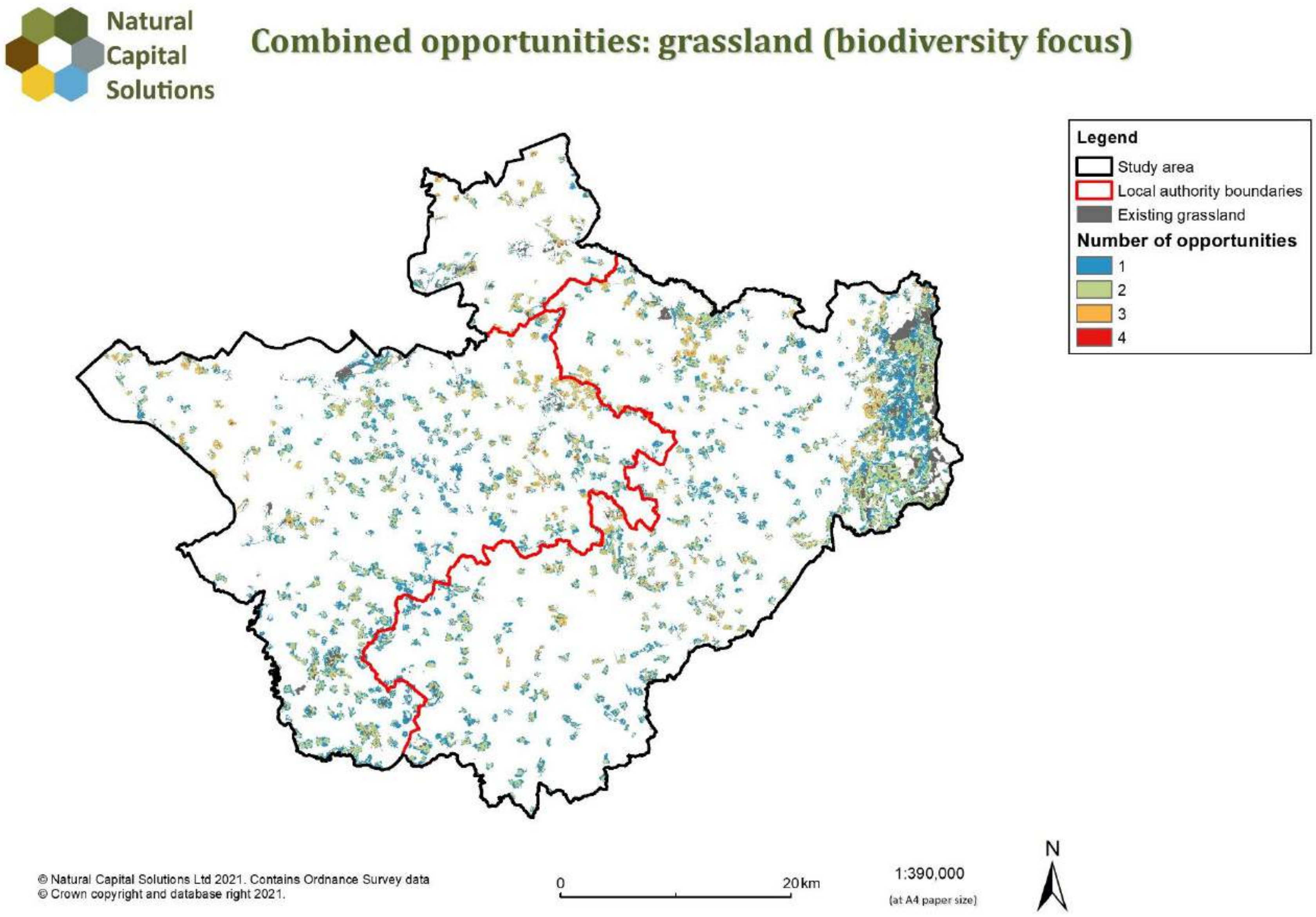

Figure 14 Combined opportunities for new semi-natural grasslands across Cheshire and Warrington, restricted to grassland opportunity zones.

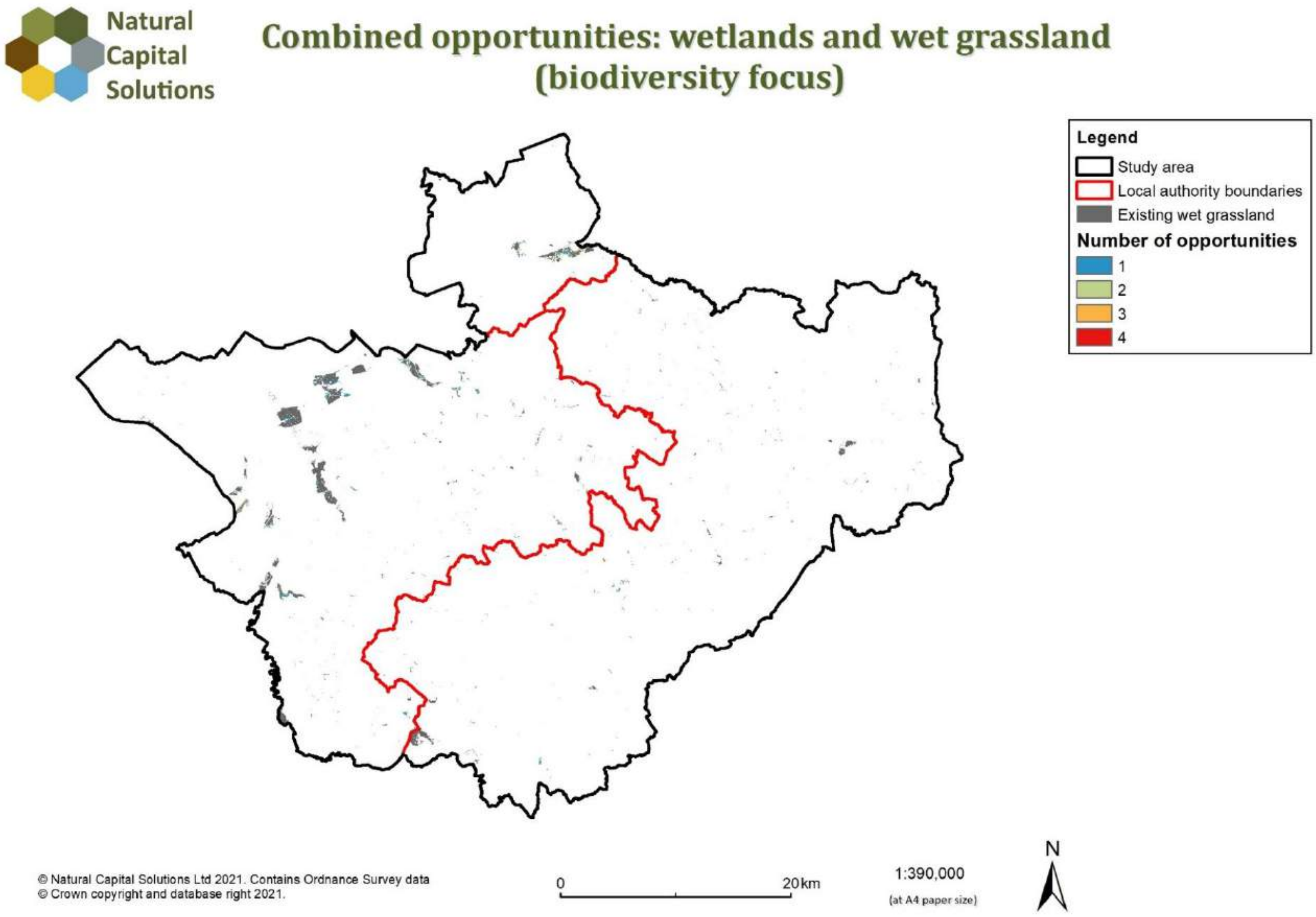

Figure 15 Combined opportunities for new wet grasslands across Cheshire and Warrington, restricted to wet grassland opportunity zones.

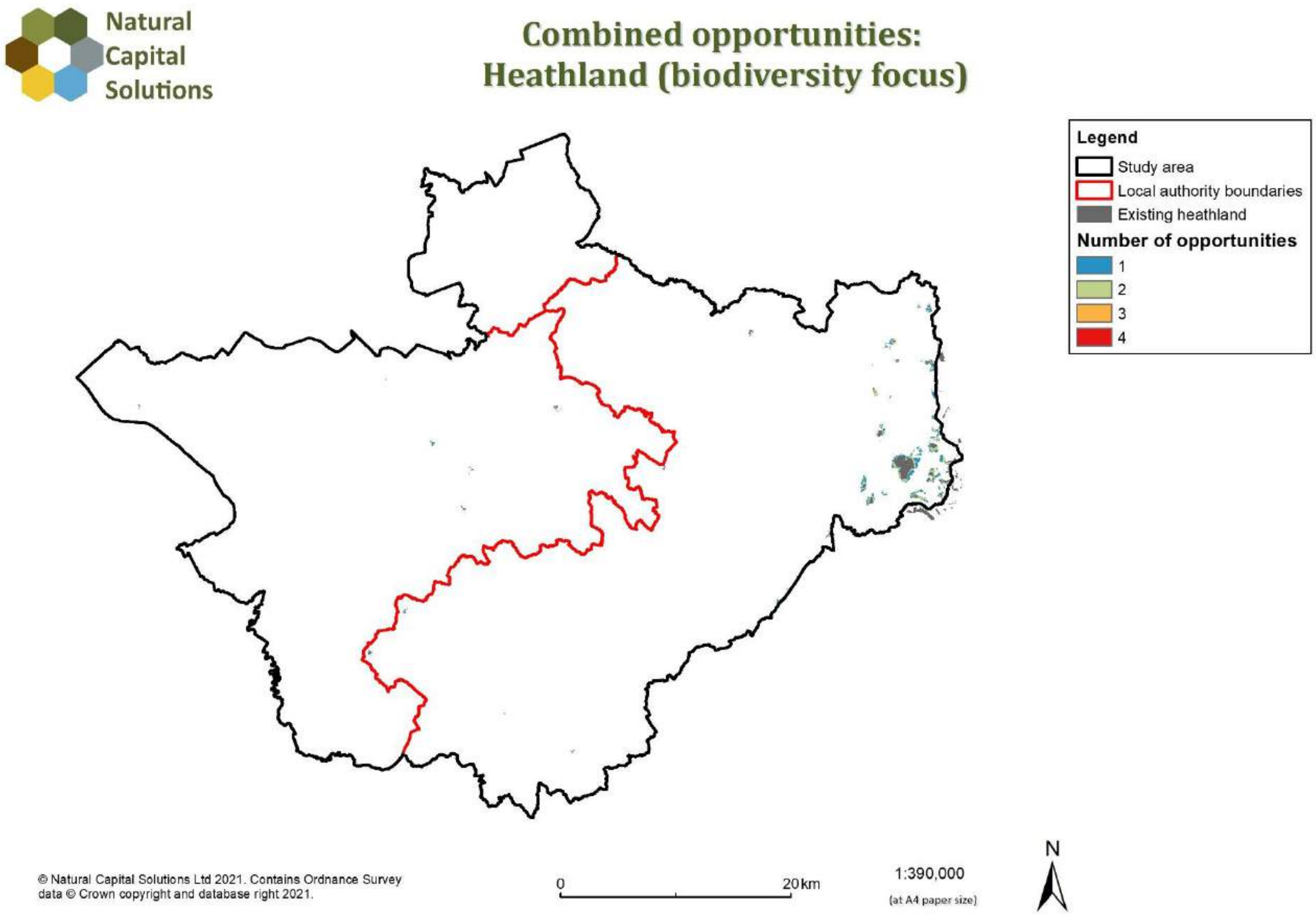

Figure 16 Combined opportunities for new heathland across Cheshire and Warrington, restricted to heathland opportunity zones.

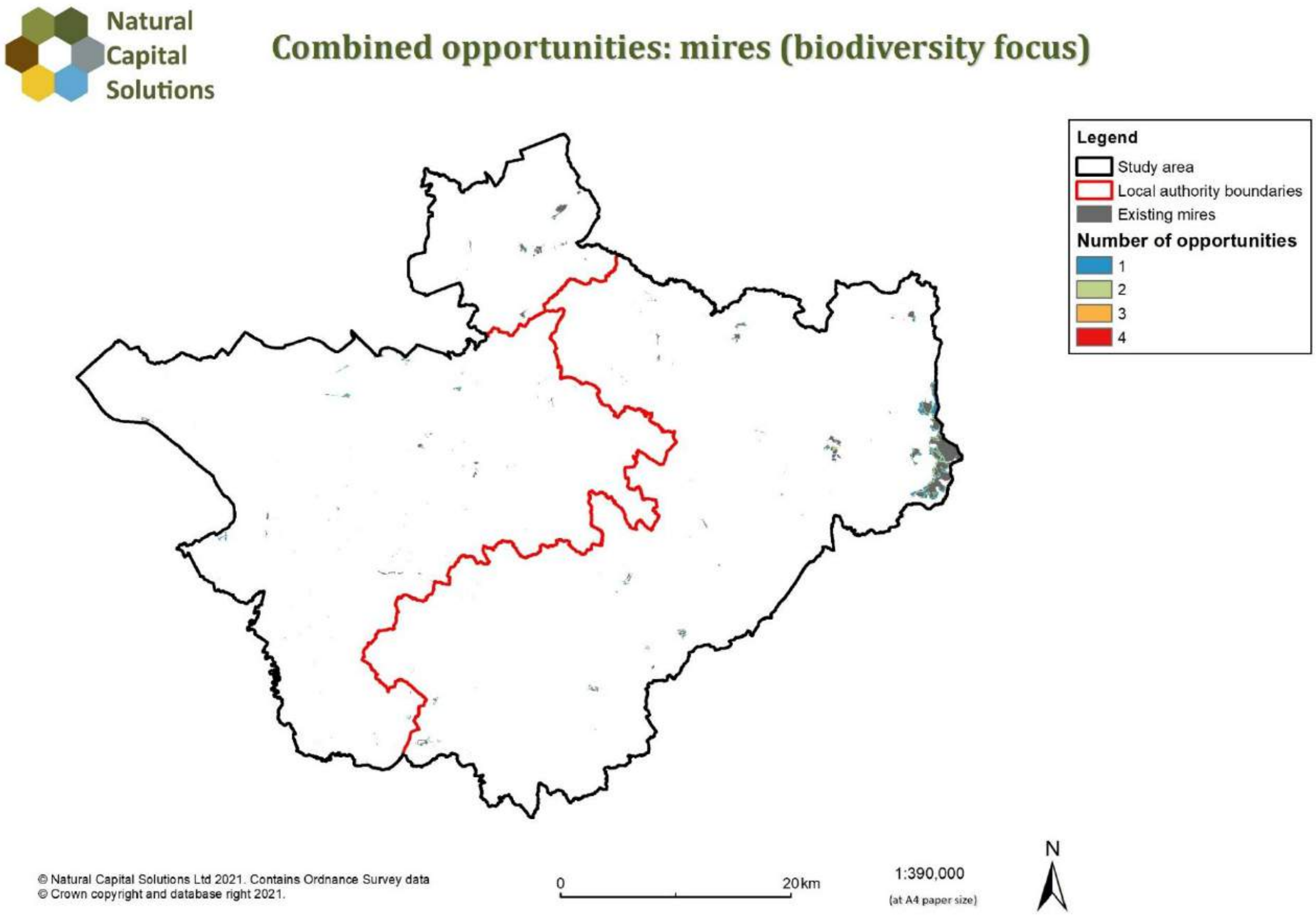

Figure 17 Combined opportunities for new mires across Cheshire and Warrington, restricted to mire opportunity zones.

4.2 Ecosystem services focus

A set of maps were produced focussing on each of the ecosystem service opportunity maps shown in Section 3 in turn, but assessing opportunities to enhance more than one of the services mapped previously. This is assessed by first combining all the biodiversity opportunity maps into one layer, and then overlaying this with each of the individual opportunity maps already created, to determine the number of opportunities that overlap across each pixel of the map. In these maps, all the locations shown provide good (top 25%) opportunities for the focal ecosystem service, but the colour on the map indicates the total number of opportunities that can be delivered at each location. The yellow, orange and red colours on the maps indicate where 4 to 7 opportunities can be delivered simultaneously. These maps therefore demonstrate how multifunctional green spaces can be delivered, the best locations for these, and the number of benefits that could be achieved, even when focussing on one key objective. Key findings are listed below with the maps shown in Figures 18-23:

- **Water flow regulation** – although large areas in rural Cheshire, especially to the south, provide only one or two opportunities, there are many locations close to built-up areas where habitat could be created for water flow regulation but also deliver multiple additional services (Figure 18). Key locations for achieving this multifunctionality include the area between Ellesmere Port and Chester, around Northwich and Winsford, the northern periphery of Crewe, areas around Warrington, and locations around Wilmslow and Poynton.
- **Water quality enhancement** – to help prioritise sites where projects that reduce soil erosion and enhance water quality should be focussed, a map of overall water quality was obtained for each waterbody catchment based on the Environment Agency's assessment under the Water Framework Directive. Waterbodies (sub-catchments) classified as having poor or bad overall water quality were extracted and were used to mask the water quality combined opportunities map (Figure 19), so only sites in these sub-catchments were retained. There are still a large number of areas retained and many of these present multiple opportunities. Key locations for delivering water quality enhancement and additional multifunctionality include areas to the north of Warrington, north-west of Chester, between Northwich and Winsford, around Sandbach, and a number of rural areas to the south of Knutsford.
- **Air quality regulation** – opportunity areas regularly overlap with other opportunity areas, with sites identified for air quality regulation most commonly providing 3 or 4 opportunities in the same location, and there are lots of locations that provide even more. Hence there are a lot of yellow and orange colours on the map (Figure 20), particularly in and around the larger urban areas. Creating habitat for air quality regulation is therefore genuinely multifunctional in most locations. This should be achieved through planting trees and woodland.
- **Noise regulation** – the combined opportunity map for noise regulation (Figure 21) is very similar to the map for air quality regulation. Again, most areas identified as providing opportunities for noise regulation also provide multiple other opportunities (typically 3-4, but often more). The opportunity areas delivering the most opportunities are situated in and around the larger urban centres across Cheshire and Warrington.
- **Local climate regulation** – opportunity areas for local climate regulation are restricted to urban areas (Figure 22), but most of these locations offer multiple benefits, especially sites at the edges of the big urban areas, which mostly offer at least four overlapping opportunities.
- **Access to nature** – opportunities are focussed in a ring around all of the towns across Cheshire and Warrington (Figure 23). This overlaps with many of the opportunity areas for the other ecosystem services, meaning that opportunity areas created to enhance access to nature will deliver multiple additional benefits.

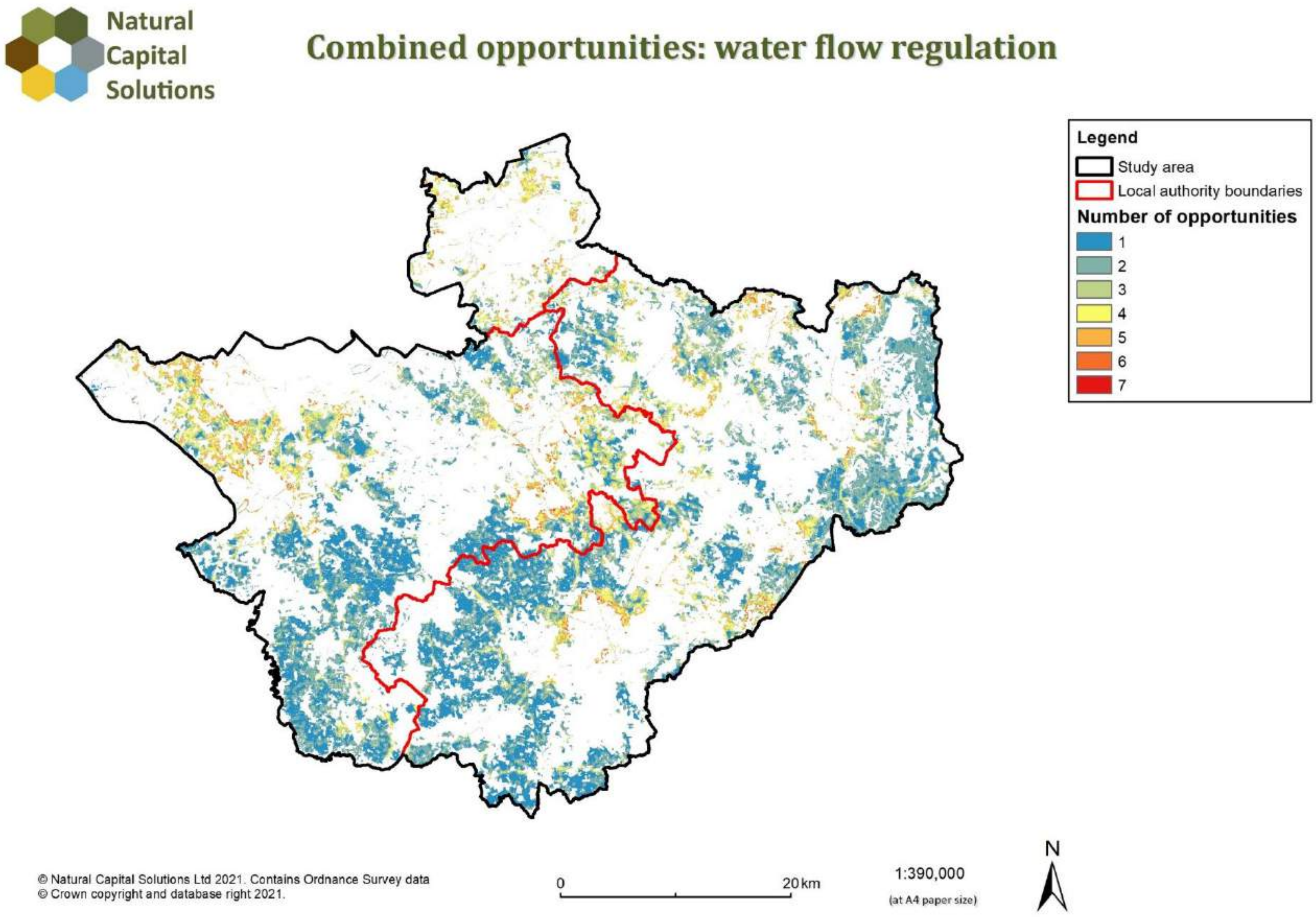

Figure 18 Combined opportunities for water flow regulation, showing the number of opportunities (benefits) that can be delivered at each location.

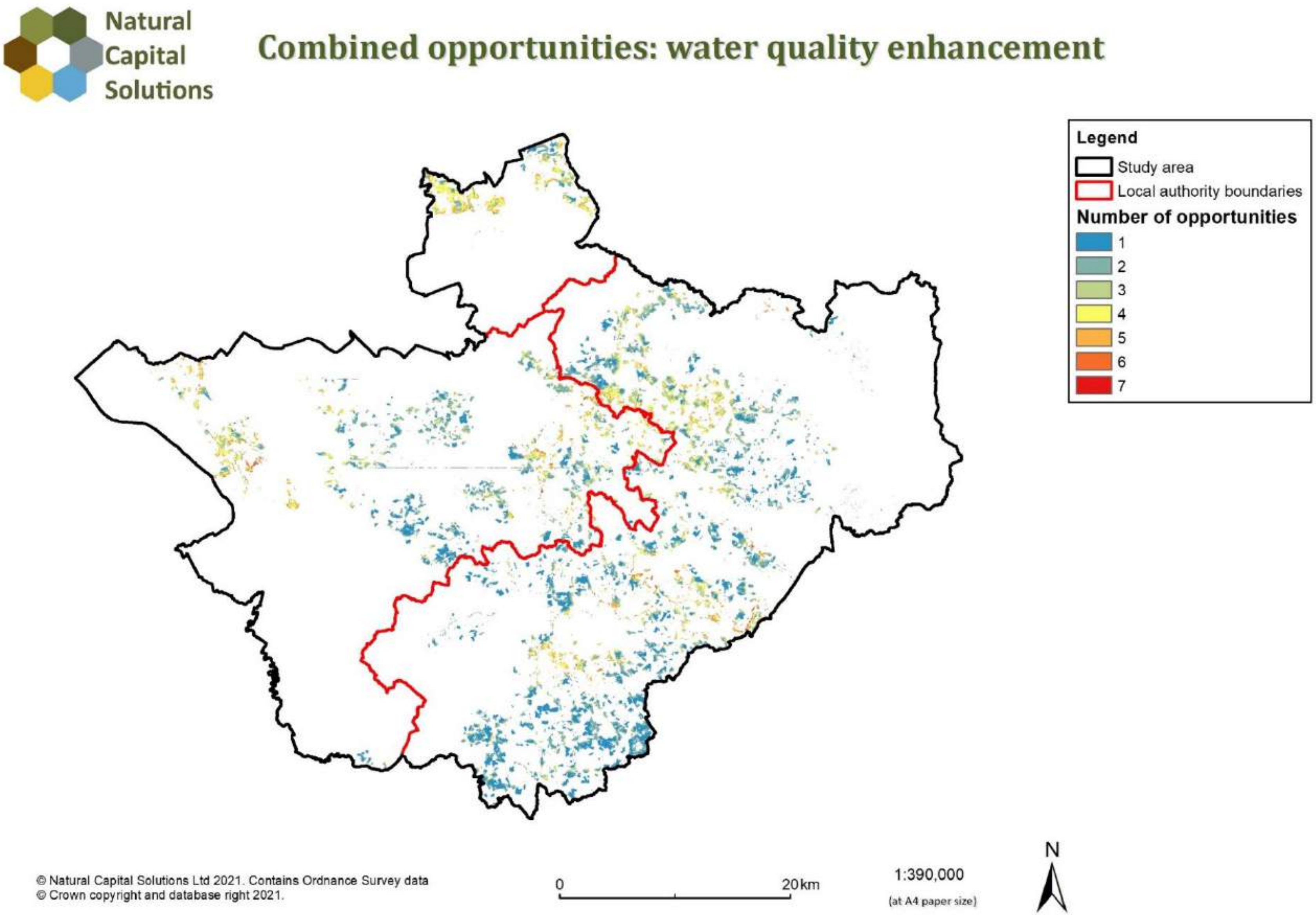

Figure 19 Combined opportunities for water quality enhancement, showing the number of opportunities that can be delivered at each location.

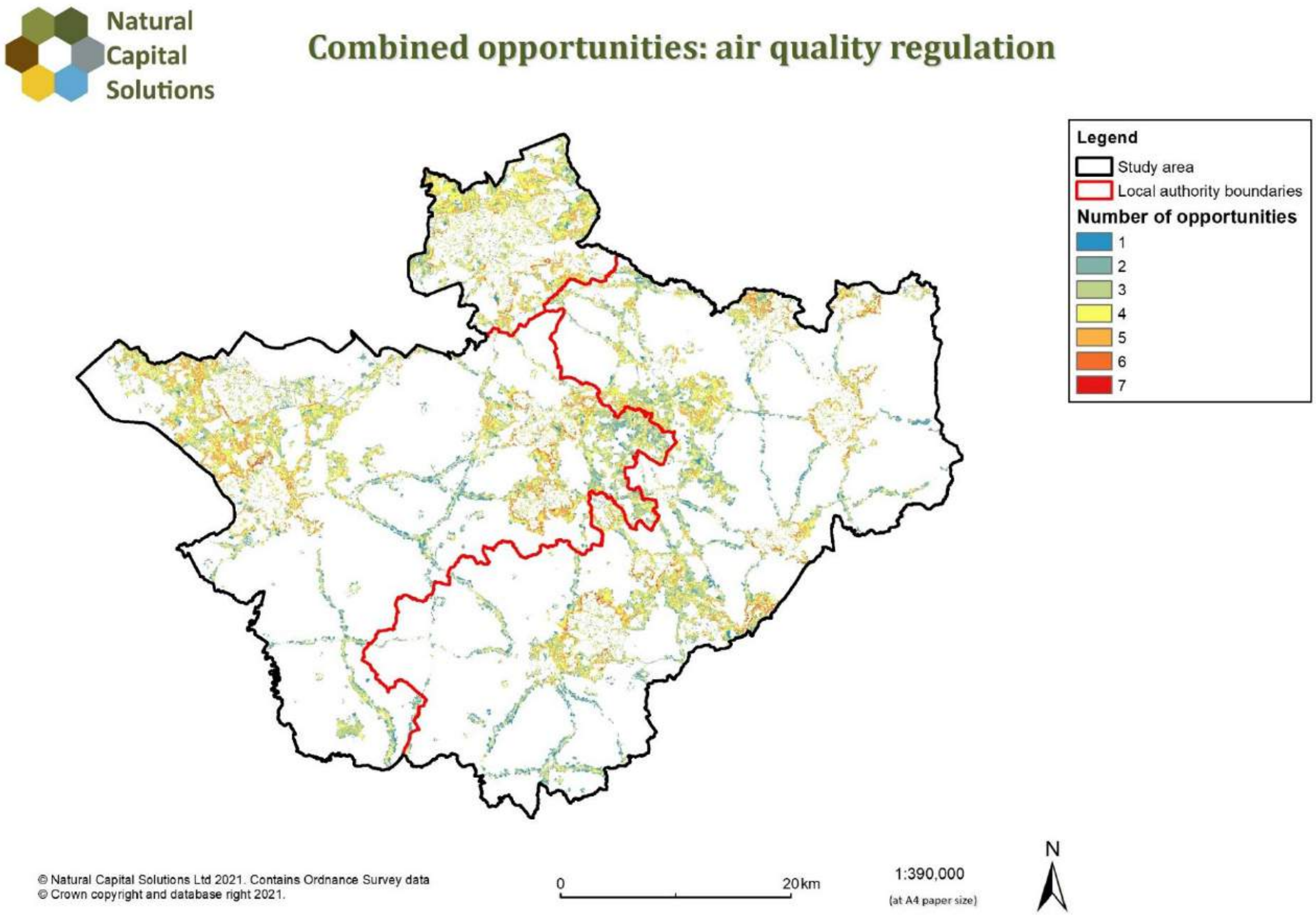

Figure 20 Combined opportunities for air quality regulation, showing the number of opportunities that can be delivered at each location.

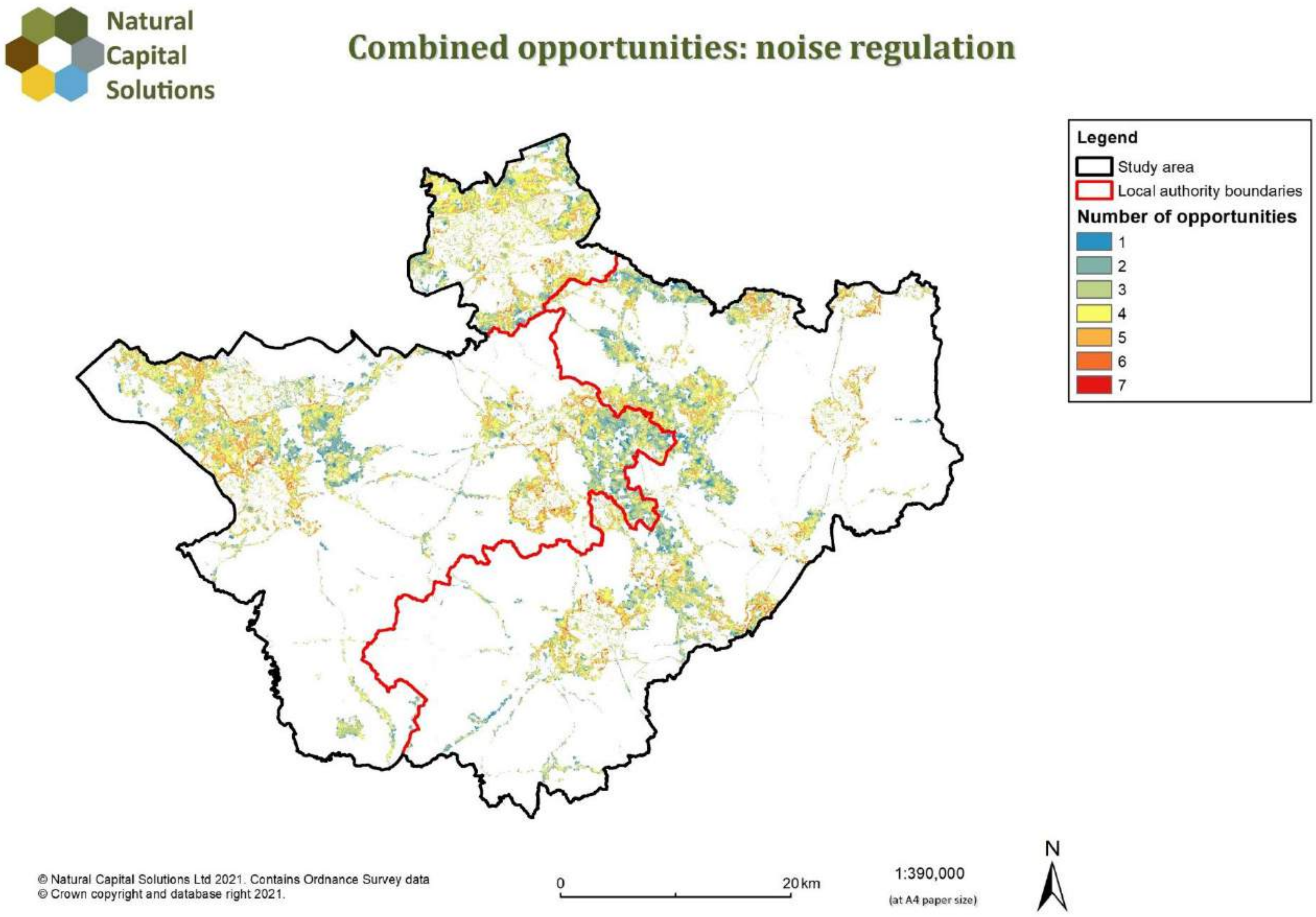

Figure 21 Combined opportunities for noise regulation, showing the number of opportunities (benefits) that can be delivered at each location.

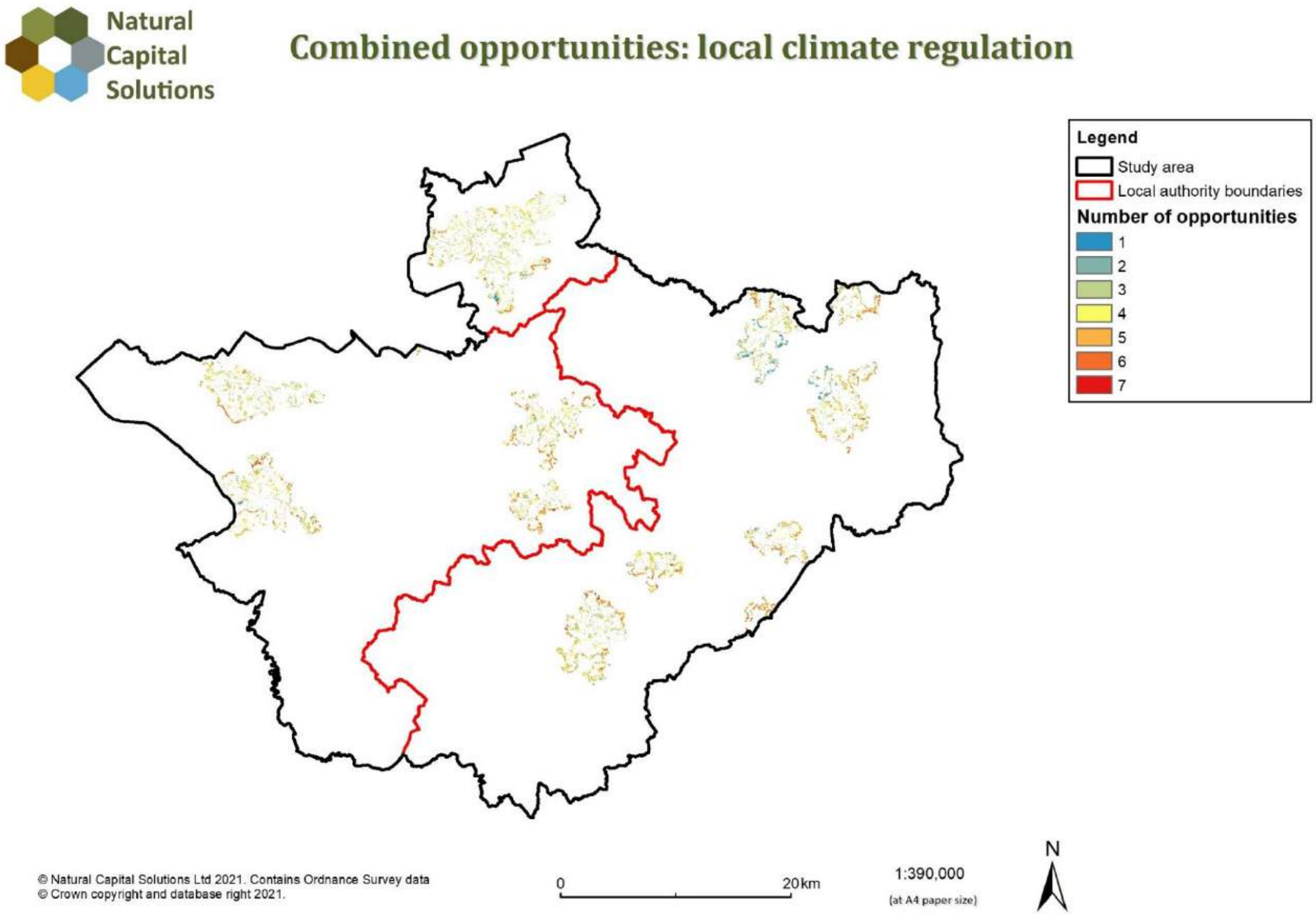

Figure 22 Combined opportunities for local climate regulation, showing the number of opportunities that can be delivered at each location.

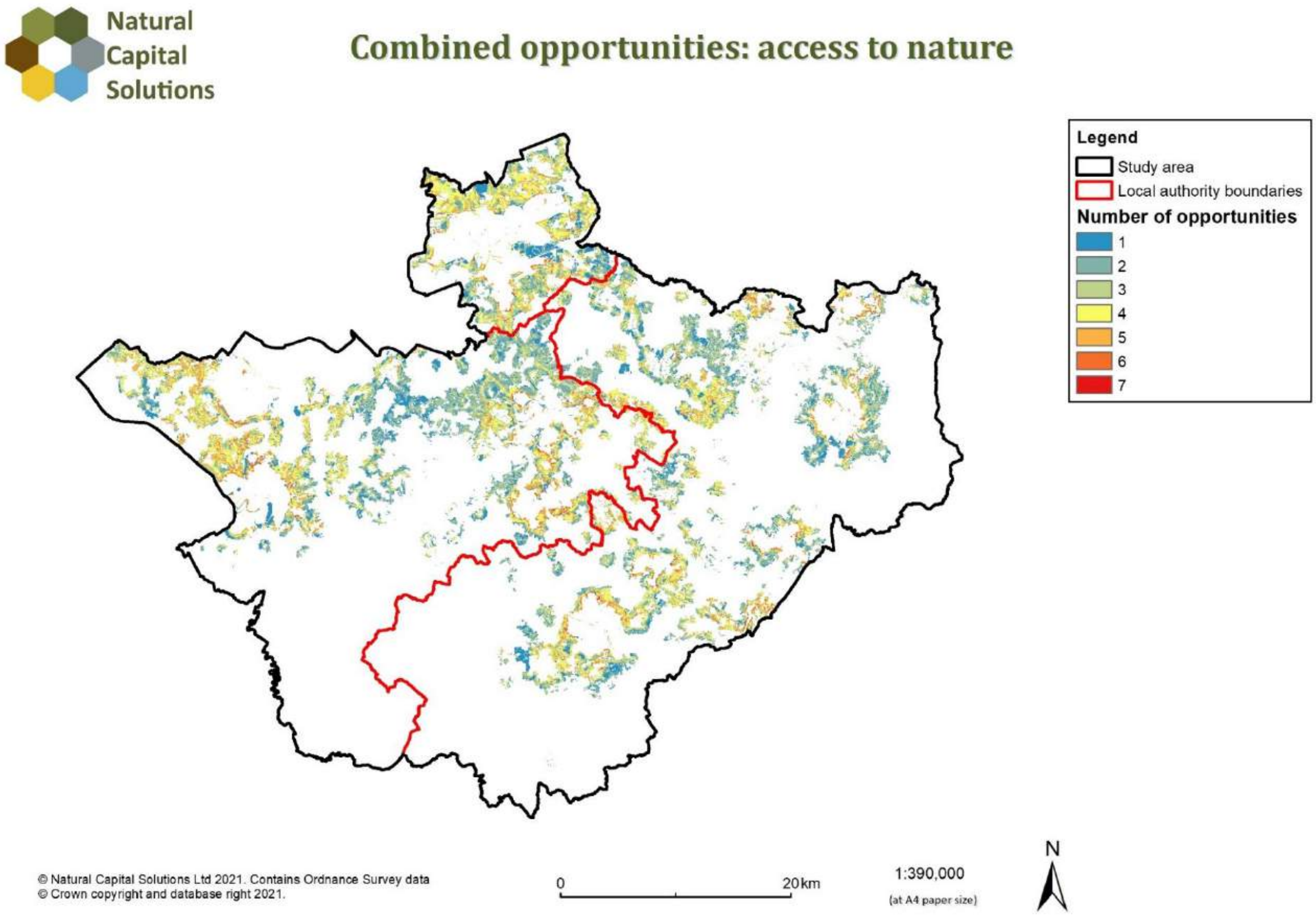

Figure 23 Combined opportunities for access to nature, showing the number of opportunities that can be delivered at each location.

4.3 All combined opportunities

The last example shows all opportunities combined together to highlight the best locations for delivering multiple benefits. Results are shown in Figure 24 and shows that once constrained areas are excluded (the white areas on the map), almost all remaining parts of the map present at least some opportunity for enhancing ecosystem services. However, most areas delivering multiple benefits occur in the urban areas, in rural locations immediately adjacent to the urban areas and adjacent to the road network.

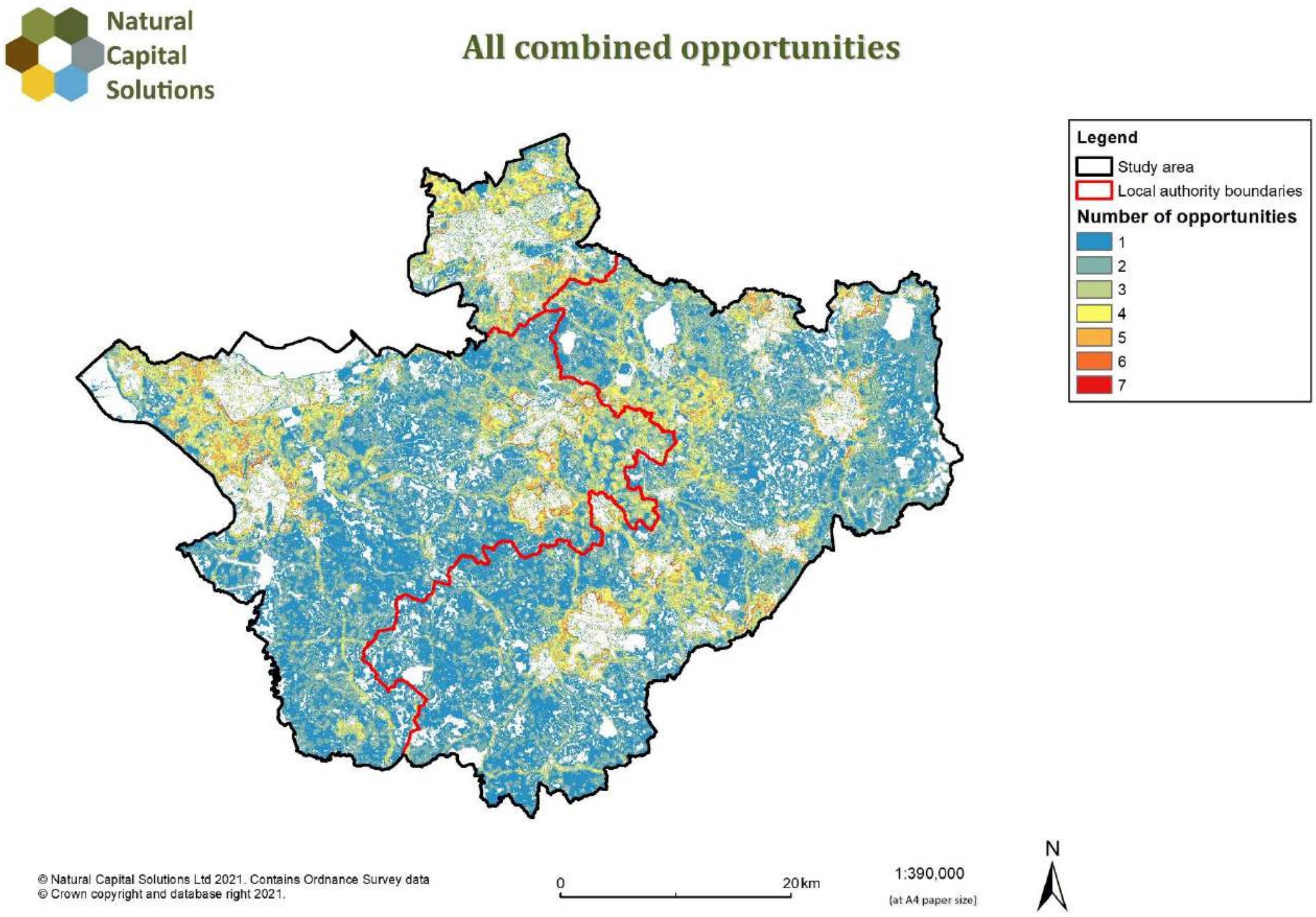

Figure 24 Combined opportunities for creating new habitats across Cheshire and Warrington.

5. Priority areas

Sections 2-4 have identified a large number of opportunity areas that can provide single or multiple benefits. These maps can either be used at a site scale to determine the most suitable locations and habitats to create at a given site, or can be used at a strategic scale, to determine the best locations across the landscape to enhance natural capital for particular objectives. When used at this landscape scale, there is a need to determine which areas are priority locations for investment. One approach to do this would be to focus on the areas delivering the most benefits at the same time, the yellow to red areas on Figures 13 to 24. However, there may be a desire to focus on areas that are priorities across a range of local policies. Hence this section describes an approach developed to prioritise investment based on a range of external environmental, social and economic priority areas.

5.1 Approach and results

The approach developed builds on and extends a method for selecting priority areas for GI investment in Cheshire East, described in the Cheshire East Green Infrastructure Plan (2019)[6]. We have identified seven key themes that bring together key environmental, social and economic policy drivers and spatial characteristics of the area. A number of these are based on spatial maps and policies within the Local Plans of the three local authorities (Cheshire East, Cheshire West and Chester, and Warrington), along with indicators of environmental and social need. In each case maps were created in GIS, bringing together a number of data sources to create a single layer for each theme. The seven themes and their constituent data sets are outlined below:

1. *Key locations for nature improvement:*
    - Nature Improvement Areas – Meres and Mosses and Great Manchester Wetlands
    - Meres and Mosses catchment buffer
    - Peak District National Park
    - Cheshire Wildlife Trust Focus Areas

2. *Green gaps and countryside*
    - Cheshire East (CE) Local Plan Strategic Green Gaps
    - Cheshire West and Chester (CW&C) Local Plan Sustainable Growth Policies

3. *Connectivity*
    - Ecological Network Core Areas (adopted by both CE and CW&C Local Plans)

4. *Water environment*
    - Waterbodies with bad or poor water quality under the Water Framework Directive (overall waterbody status)
    - Areas at greater than 1 in 1000 risk of flooding from rivers (Flood Zone 2)
    - Areas at greater than 1 in 1000 risk of flooding from surface water (RoFSW)

5. *Life chances and choices*
    - The top 25% most deprived areas in Cheshire and Warrington, based on index of Multiple Deprivation scores
    - Air Quality Management Areas

[6] TEP (2019) Cheshire East Green Infrastructure Plan. Appendix A - Evidence Base Mapping.

6. *Planning for Growth*
    - Allocated sites - housing, employment and mixed-use allocations and safeguarded land from CE, CW&C and Warrington Local Plans
    - HS2 safeguarding zone

7. *Minerals supply and safeguarding*
    - Existing sites and extension areas for sand and gravel, salt, brine, and silica sand, from CE, CW&C and Warrington Local Plans

As well as building on an approach already used in the area, the method and an iteration of the outputs were shown at a stakeholder workshop in December 2020 (see Technical Report 3). As a result of feedback received at the workshop and afterwards, some alterations were made to a number of the themes.

Maps of each theme are shown in Figures 25 and 26. The seven themes were then overlain to provide a map of combined priorities (Figure 27). This showed that themes overlapped in a number of locations, with up to five themes overlapping in any given area. It is suggested that areas where a number of themes overlap, hence areas that are key locations across a range of policy priorities, are the most important areas for investment. A simplified version of this map was produced (Figure 28), retaining only those areas where at least three themes overlapped, highlighting the high priority (3 overlapping themes) and highest priority (4-5 overlapping themes) areas for investment. Natural capital investments at two of the areas identified in this map, around Northwich and Warrington, were investigated as case studies 4 and 5 in the Case Studies Report (Technical Report 5).

5.2 Opportunities within high priority areas

As a final step, a map was created showing only opportunities that fell whin the high (and highest) priority zones. Furthermore, only locations where three or more opportunities could be delivered at the same location were included. Hence this map shows only the best opportunity areas able to deliver multifunctionality, within high priority zones. The map is shown in Figure 29 and identifies approximately 7,200 ha of land. The key areas highlighted on this map include land around Ellesmere Port, northern Chester, in and around Warrington (especially along the M62 corridor), Northwich, Winsford, the northern edge of Congleton, and in a belt of rural Cheshire East around Knutsford and Tatton Park.

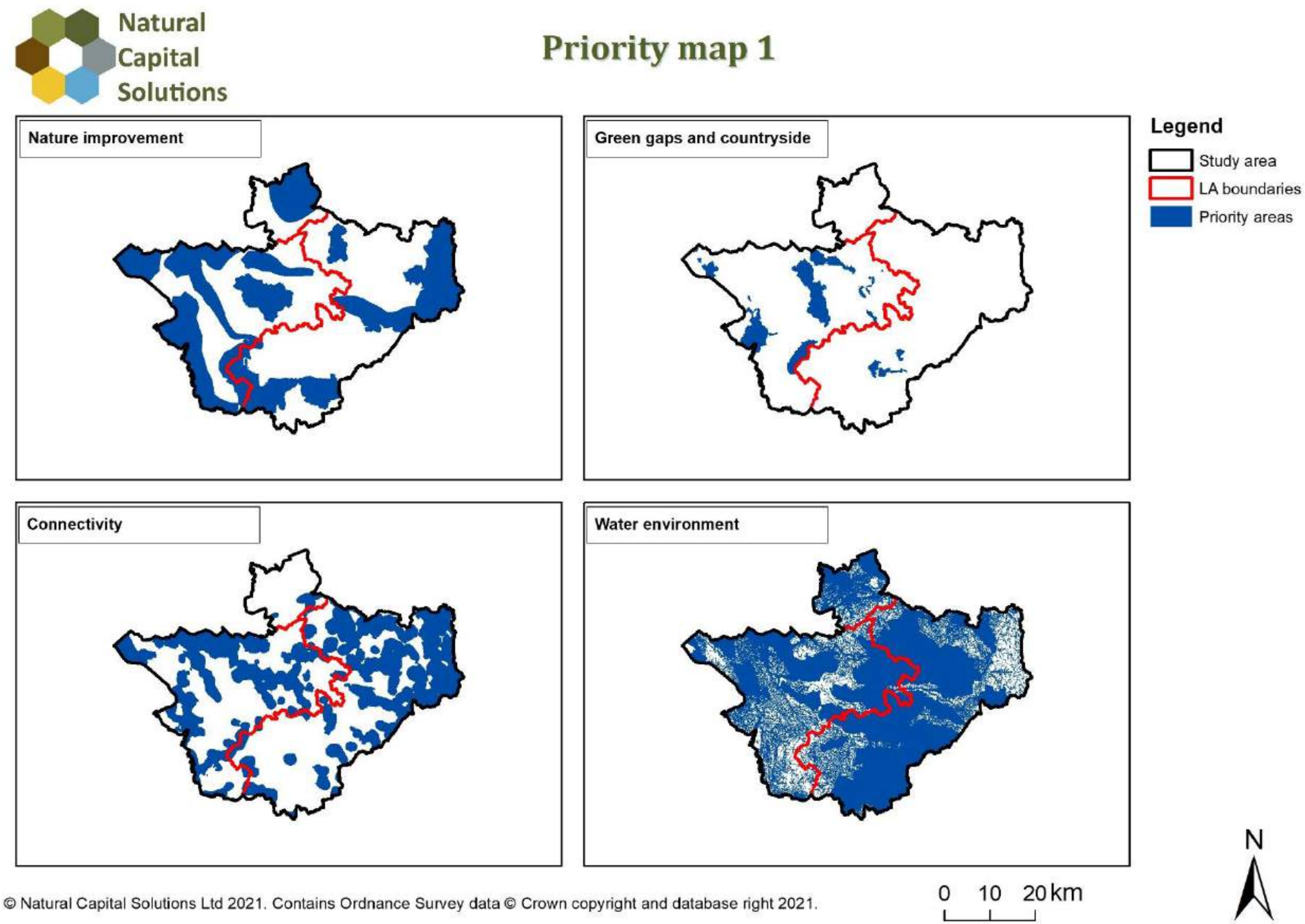

Figure 25 Priority locations across Cheshire and Warrington based on key environmental, social and economic themes (showing 4 of 7 themes).

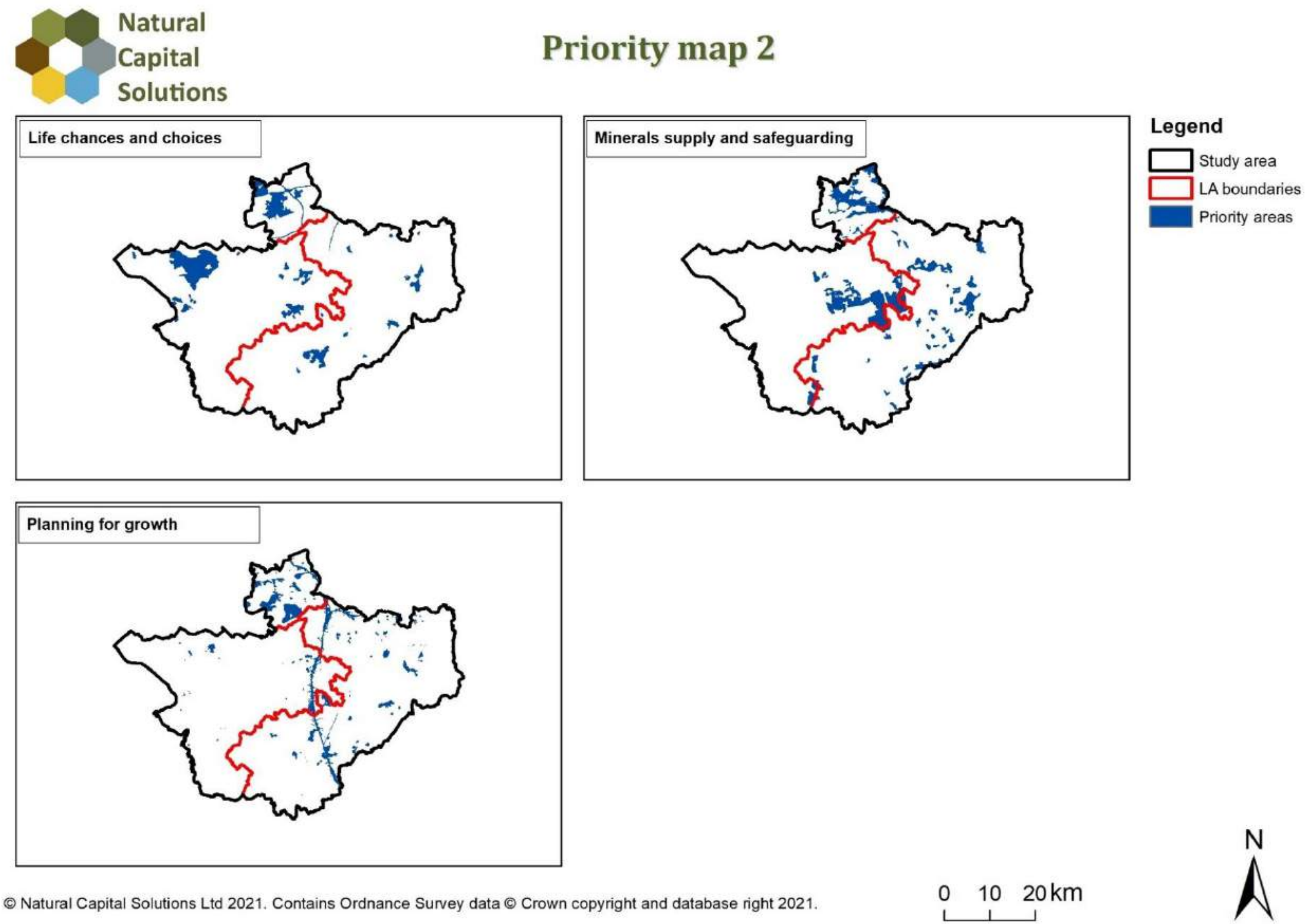

Figure 26 Priority locations across Cheshire and Warrington based on key environmental, social and economic themes (remaining 3 themes).

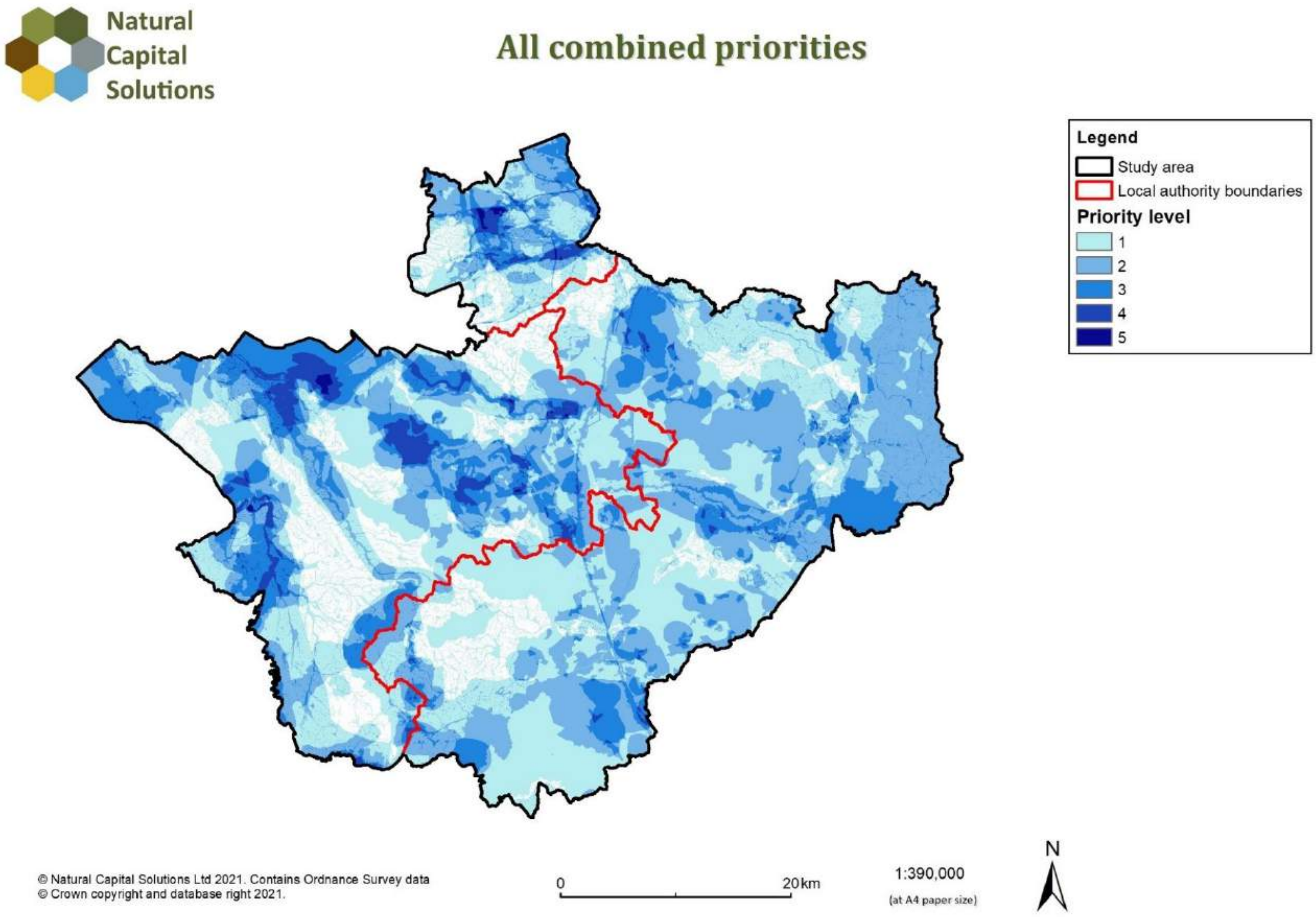

Figure 27 Overlay of all seven themes to highlight combined priority locations across Cheshire and Warrington.

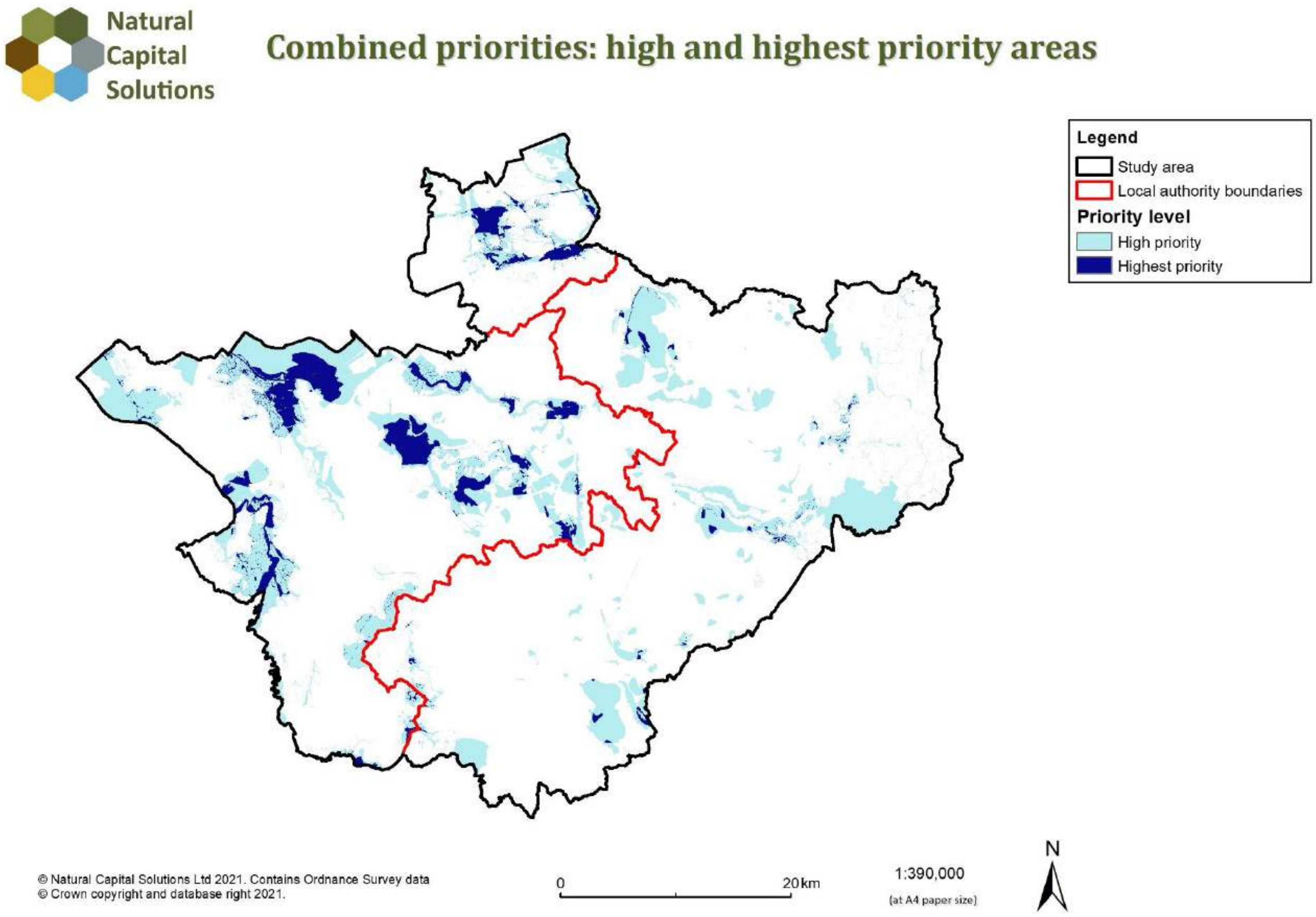

Figure 28 High priority areas across Cheshire and Warrington.

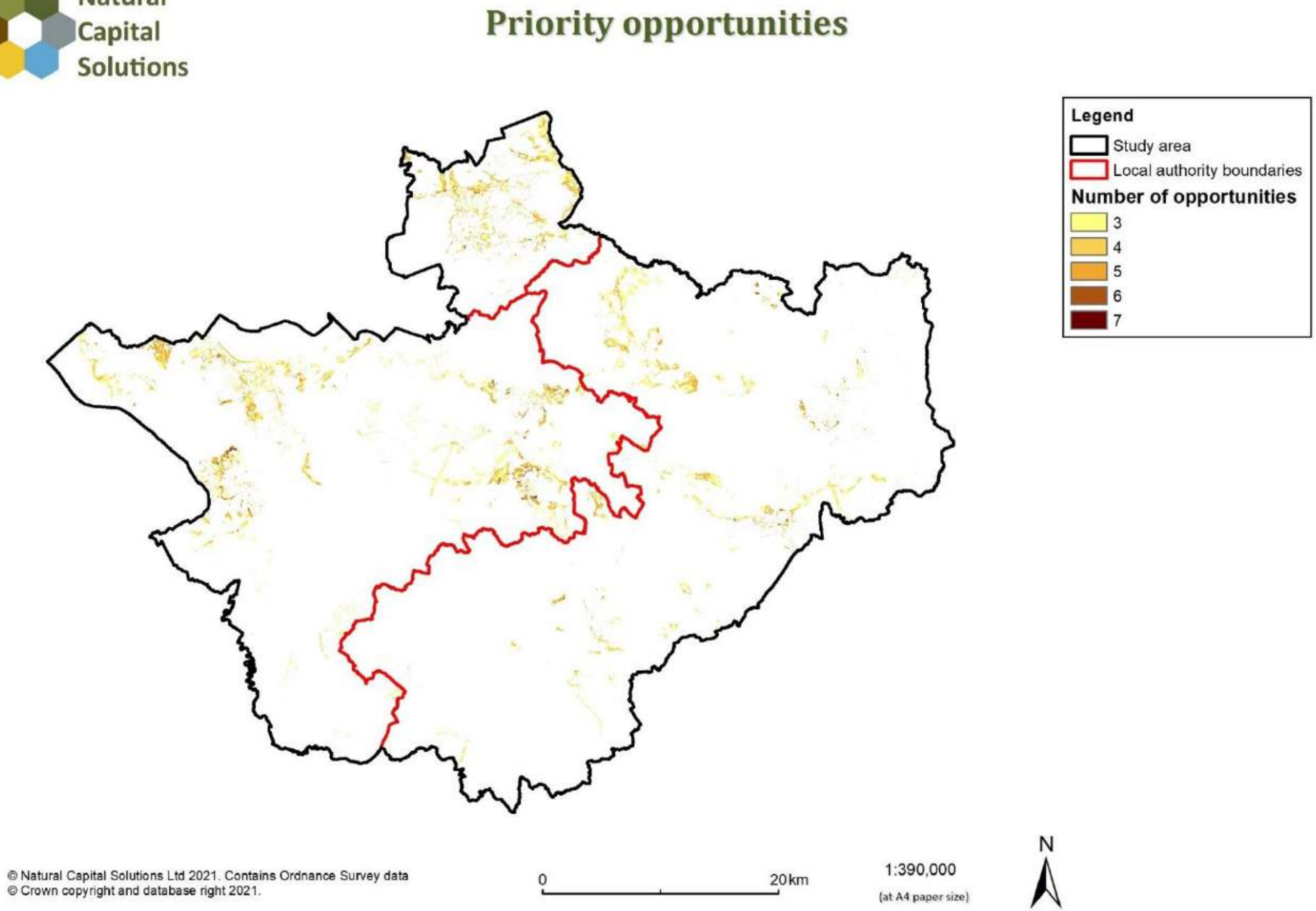

Figure 29 Locations delivering three or more opportunities within high priority areas across Cheshire and Warrington.

6. Discussion and applications

Habitat opportunity maps have been created showing where new habitats could be created for biodiversity enhancement for five broad habitat types, as well as for six different ecosystem services. Note, however, that the maps have not been ground-truthed or checked against other data, and so individual locations will need to be assessed further before being taken forward. The maps should be considered as a resource to highlight potential locations for habitat creation or restoration projects, rather than as an end in themselves. The maps are best examined on a Geographic Information System, and GIS layers have been provided to project partners.

The opportunity maps for biodiversity highlight areas that are best located in terms of their connectivity with existing habitat patches and are, therefore, most appropriate from an ecological point of view. Enhancing connectivity and expanding habitat networks is a key priority for biodiversity conservation and climate change adaptation at present, and these maps can be used as the basis for creating a Nature Recovery Strategy across the county. They also highlight areas where biodiversity offsetting should be focussed, under the forthcoming requirement (proposed in the Environment Bill) to achieve biodiversity net gain for all new developments.

The opportunity maps for ecosystem services highlight the best areas to create habitats to enhance the delivery of each ecosystem service in turn, based in most cases on where demand is high and capacity is currently low. These can be used to identify project locations to meet each particular need or can be combined to show areas where new habitat can deliver multiple objectives. When combined with the biodiversity opportunity maps, they can be used in offsetting projects to deliver additional benefits. Access to greenspace for people can be highly beneficial for physical and mental health and well-being and the monetary value of these benefits can be extremely high. Habitats for biodiversity and green infrastructure (GI) in general can also make important contributions to all the other ecosystem services mapped in this report. Semi-natural habitats are multi-functional, meaning that an investment focussing on one benefit (e.g. natural flood risk management), can deliver multiple additional benefits, hence offering excellent value for money.

Ecosystem services are inherently people-focused as they are based around assessing benefits to society. As such, the best areas, that deliver multiple benefits (multifunctionality) tend to be located on the edges of urban areas. If the aim of a project is to deliver the most overall benefits, then these are the locations to focus on, as shown in Figure 24. However, projects may often focus on a narrower objective, such as reducing runoff, or may be biodiversity focussed, hence the maps presented in Sections 4.1 and 4.2 can be used to focus on each particular objective, but demonstrate where additional benefits can be delivered at the same time.

The opportunity mapping presented in Sections 2-4 are effectively a bottom-up approach that uses data on capacity and demand and ecological connectivity to indicate the best locations to create new habitats that would provide the greatest additional benefit. On the other hand, the approach described in Section 5 takes more of a top-down approach to consider priorities for investment from a local policy perspective. It identifies locations that have previously been deemed as important in Local Plans and other strategic studies. The bottom-up and top-down approaches have then been brought together in the final map (Figure 29), demonstrating the best opportunities within high priority areas. Interestingly, the majority of locations offering the best combined opportunities (from Figure 24) are located within the high priority areas.

The overall intention of the mapping is that it can be used as a tool to identify and guide where natural capital interventions should be focussed. Given that natural capital projects cover a wide variety of different objectives, the maps have been compiled and presented in a number of different ways, so that the most appropriate map can be used, depending on the specifics of the project. It would be useful if an assessment was made of existing and planned projects to determine if there are gaps where projects are not currently planned, but would be beneficial. New projects could then be developed in these locations. An initial attempt was made to do this through the stakeholder workshop process, but the data provided was too incomplete to enable a full analysis.

6.1 Applications

There are a wide range of applications of the opportunity mapping presented here. These include:

- A number of specific habitat creation projects should be worked up into costed proposals. These could be offered as **biodiversity offsetting and biodiversity net gain projects** funded through the development process. The UK Government's 25 Year Environment Plan states that the intention is to start with biodiversity net gain, but then to move to environmental or natural capital net gain in the future. These maps can therefore be used to identify and work up projects to deliver this broader ambition of **natural capital net gain**.
- **A Local Nature Recovery Strategy**. These will become mandatory under the forthcoming Environment Act and overlap heavily with the work presented here. The emphasis of these is on biodiversity opportunities, but with consideration of wider natural capital benefits. Hence, the combined opportunity maps that focus on biodiversity opportunities (Figures 13-17) could form the basis of a LNRS. Work would be required to integrate the different habitats into one combined map, along with extensive stakeholder engagement to shape and prioritise the best areas to take forward in the Strategy.
- Opportunity areas could be targeted through agri-environment schemes, particularly the new **Environmental Land Management scheme (ELMs)** which will be paying farmers for environmental enhancements that deliver a range of public goods.
- The maps can be used to provide **evidence for Local Plans and green infrastructure strategies**. They can be used to guide the selection of housing / employment allocations and areas where development should be avoided. Work is also ongoing on how natural capital evidence can be fully integrated into green infrastructure strategies and this integration has been successfully achieved in a few areas around the country.
- Woodland areas could be taken forward through the **Carbon Guarantee Scheme** (based on the UK Woodland Carbon Code) or other carbon offsetting initiatives, as well as more traditional woodland grant schemes. Location has little impact on the amount of carbon sequestered by such schemes, so additional benefits (as described in this report) could be used to help determine the best locations for such projects.
- Similarly, carbon offsetting can be taken forward through peatland restoration and the **Peatland Code** and again, the maps can be used to highlight the best locations for such projects that will deliver additional benefits (such as water flow and quality regulation).
- A range of additional mechanisms exist for taking forward projects that deliver ecosystem services benefits. This includes projects that focus on **working with natural processes** for slowing the flow (natural flood risk management) and water quality, such as **catchment sensitive farming**. Opportunities for planting trees to enhance air quality could be part of **air pollution reduction strategies**, and increasing public access to natural greenspace could be incorporated into **wellbeing initiatives** and ideas around green prescribing.

A much more extensive range of funding sources is described in the **Future Financing Report** (Technical Report 4). The maps presented here can be used to guide the selection of sites for many of these funding mechanisms.

Annex A: Landscape permeability maps

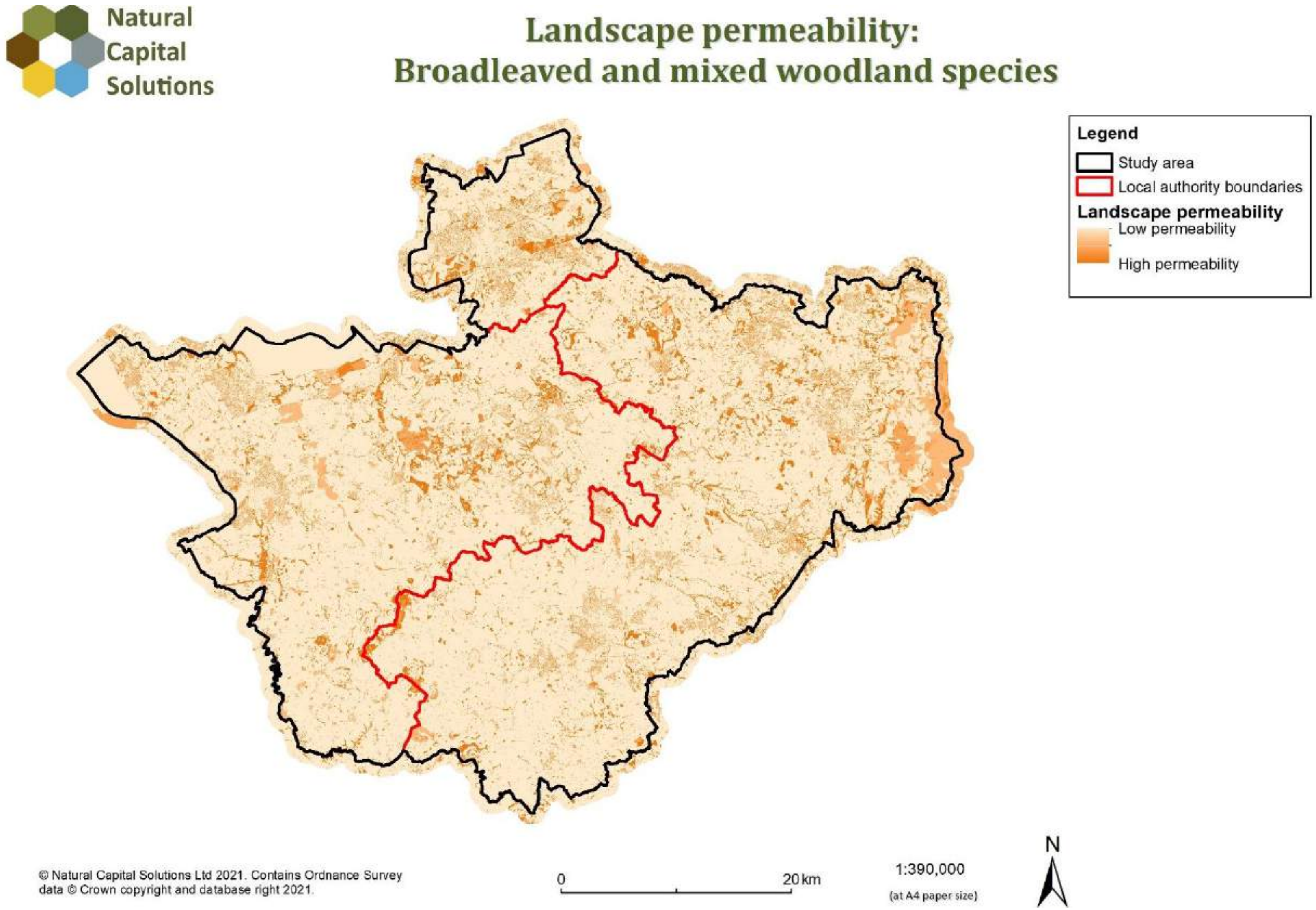

Figure A1 Landscape permeability for typical broadleaved and mixed woodland species across Cheshire and Warrington.

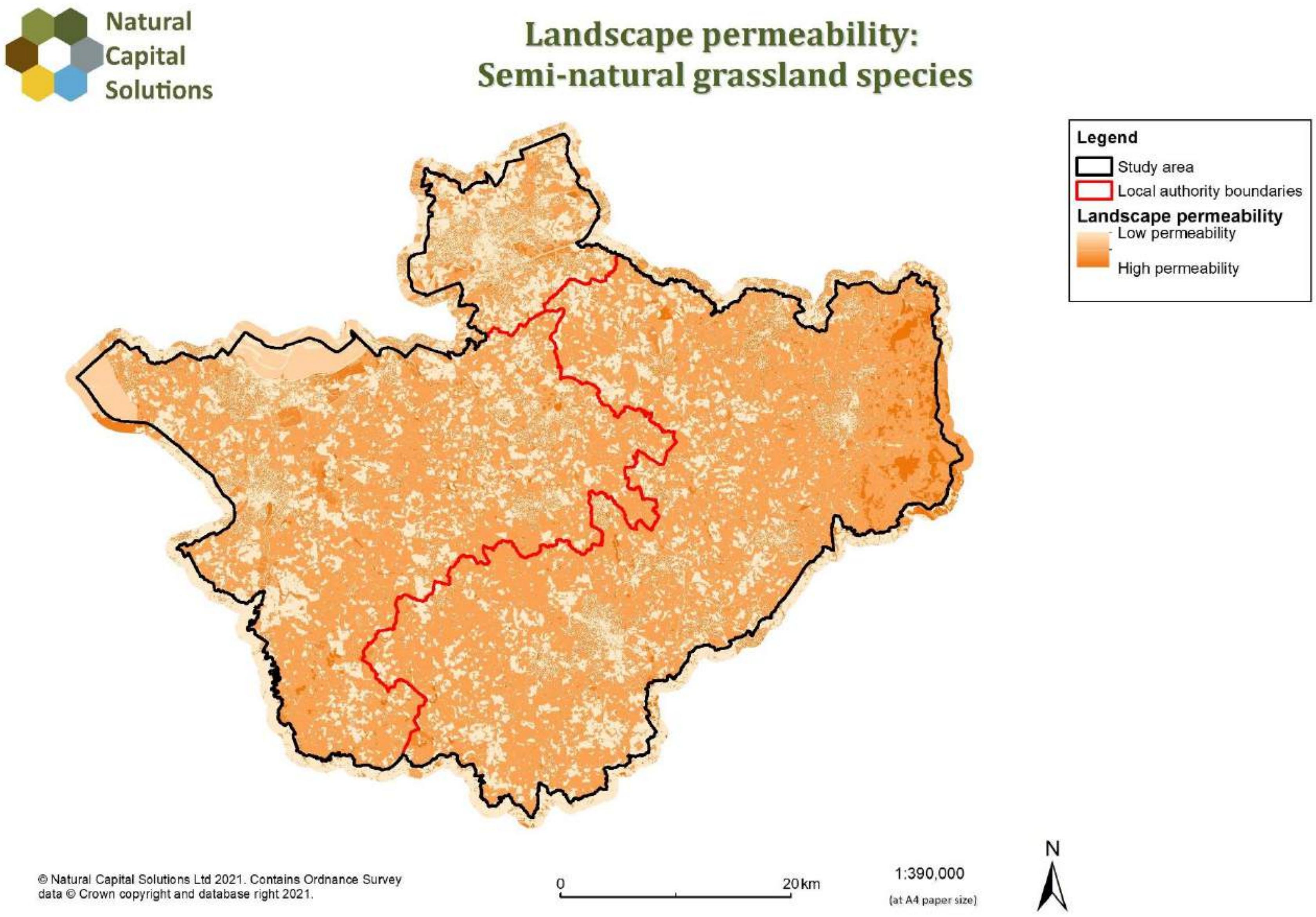

Figure A2 Landscape permeability for typical semi-natural grassland species across Cheshire and Warrington.

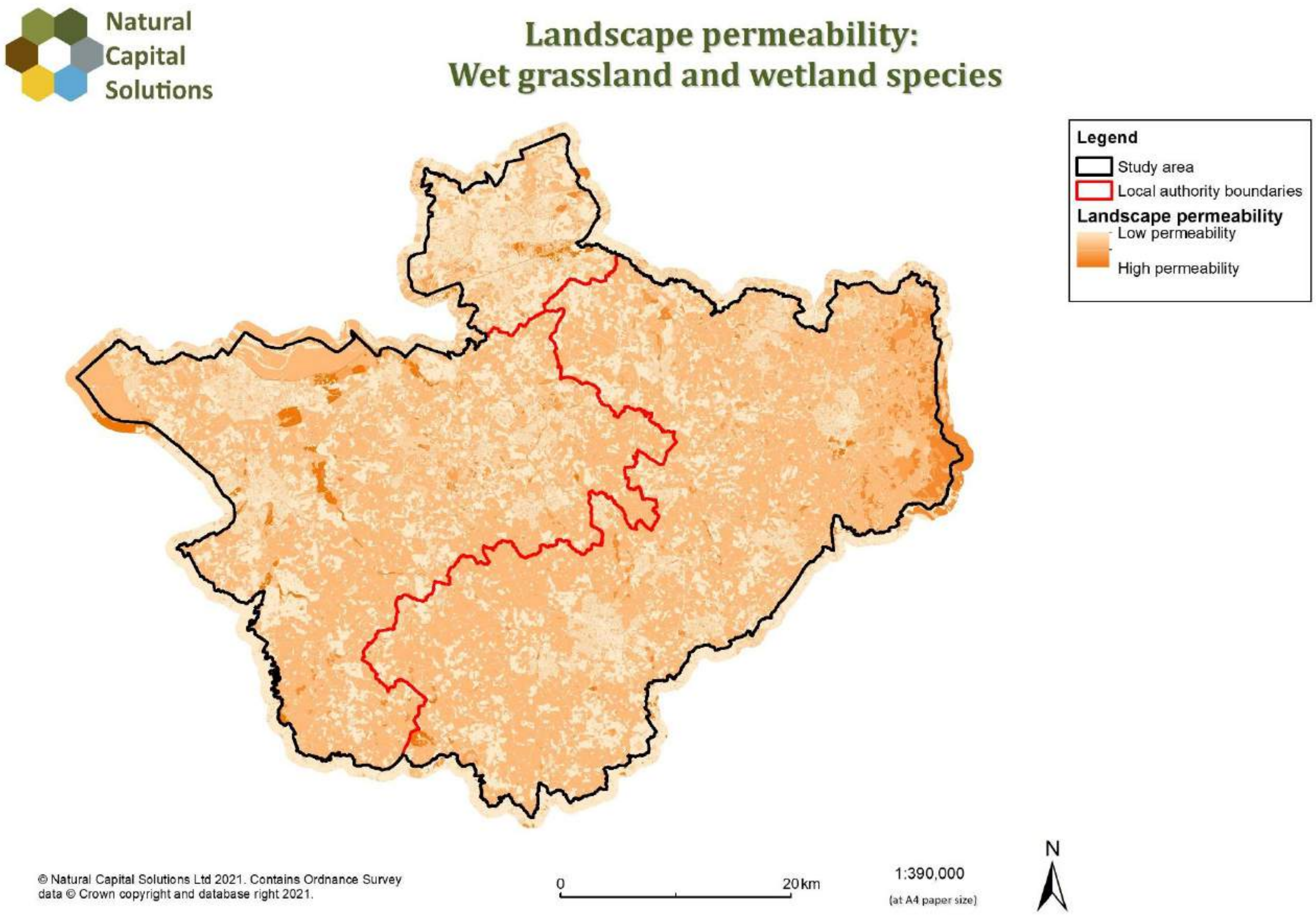

Figure A3 Landscape permeability for typical wet grassland species across Cheshire and Warrington.

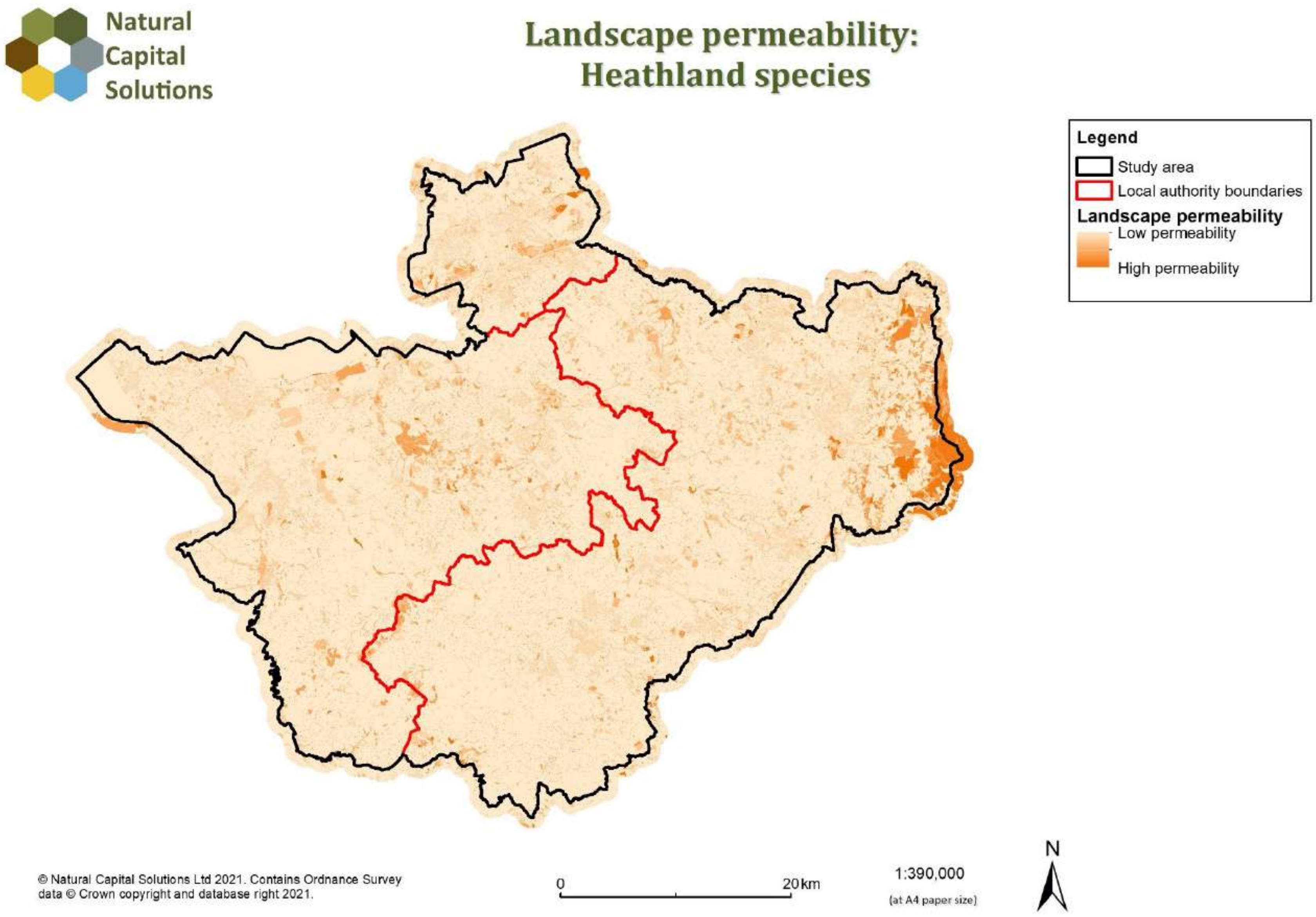

Figure A4 Landscape permeability for typical heathland species across Cheshire and Warrington.

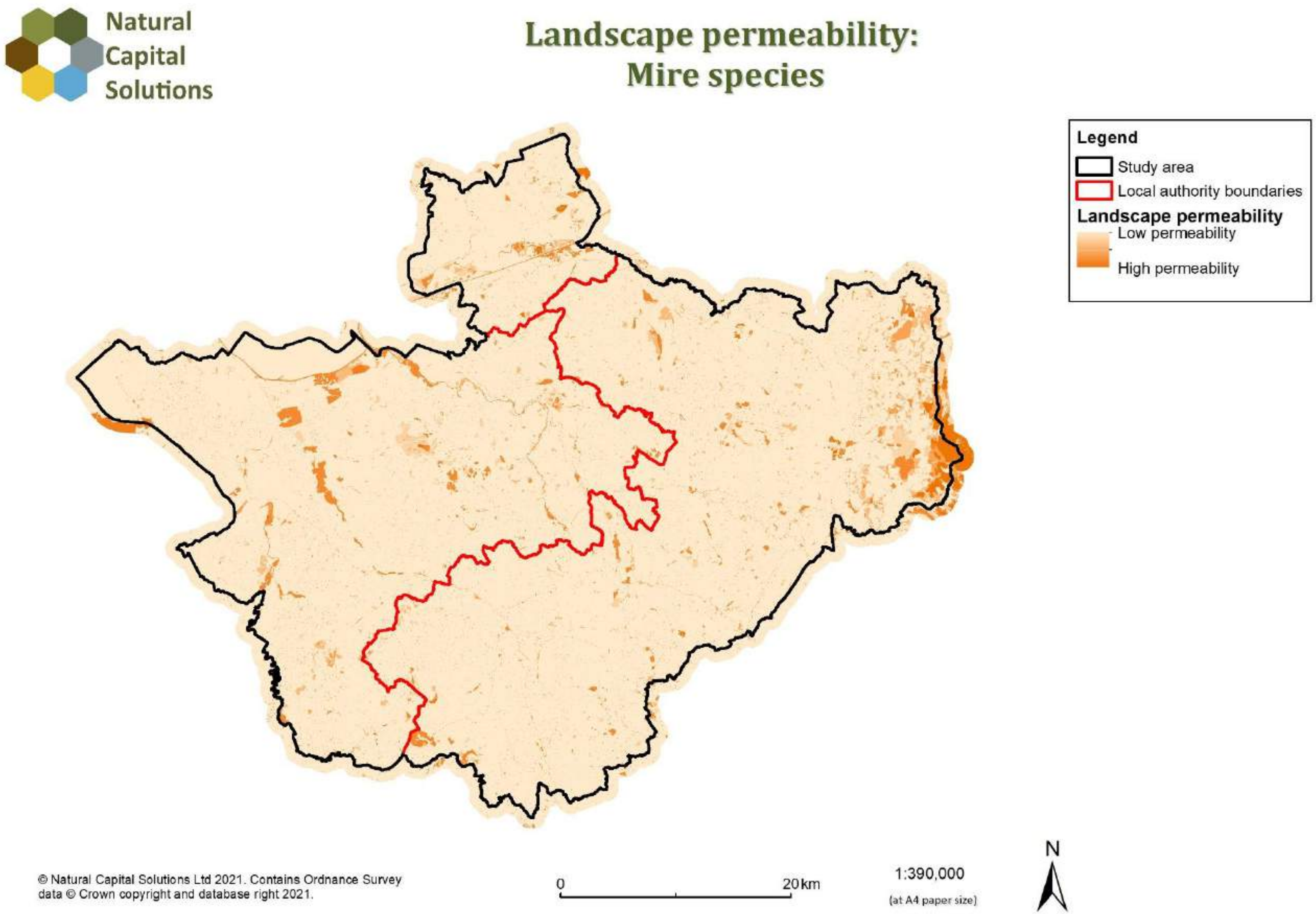

Figure A5 Landscape permeability for typical mire species across Cheshire and Warrington.

Annex B: Combined opportunities for new habitats

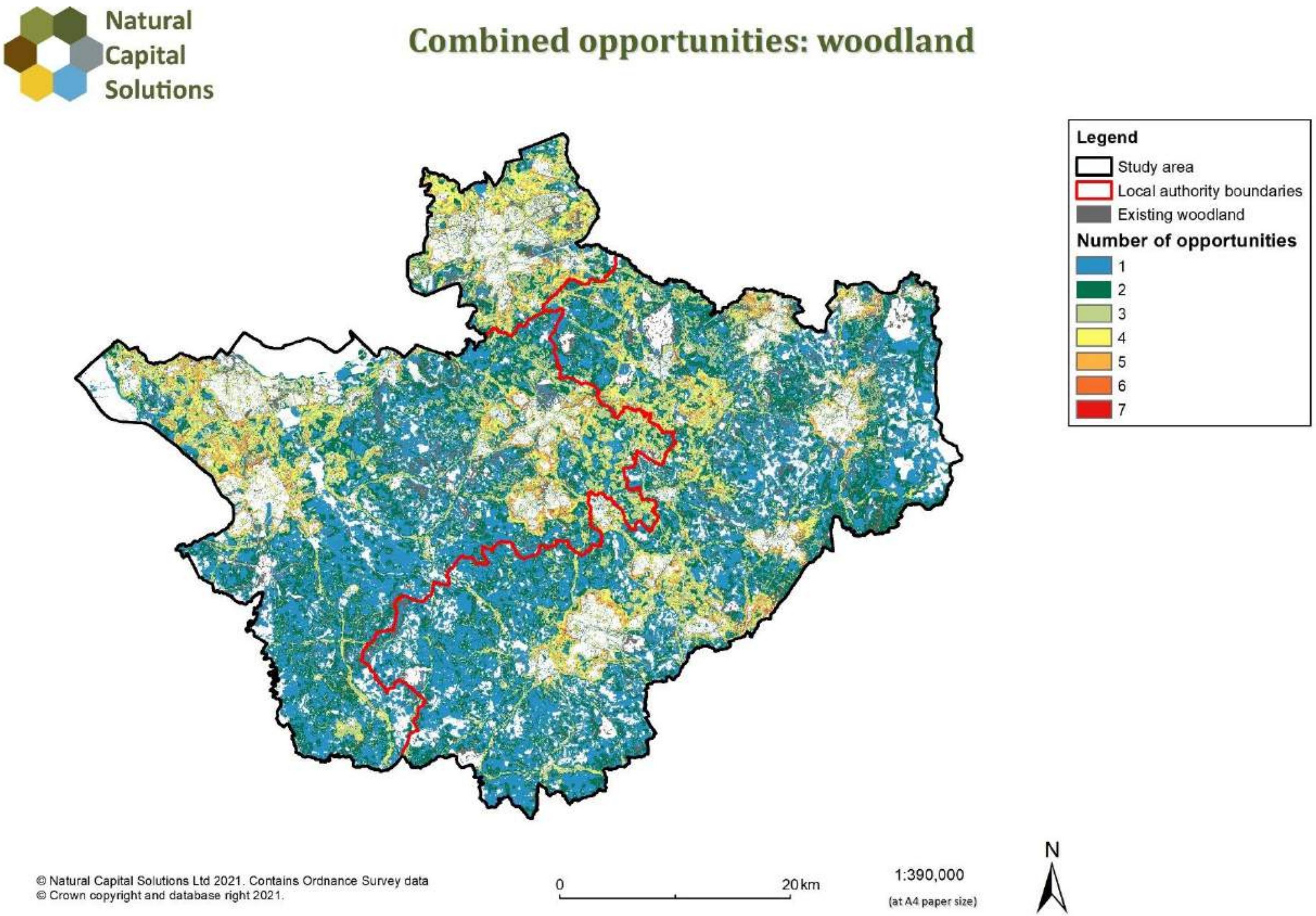

Figure B1 Existing broadleaved and mixed woodland and combined opportunities for new woodland across Cheshire and Warrington.

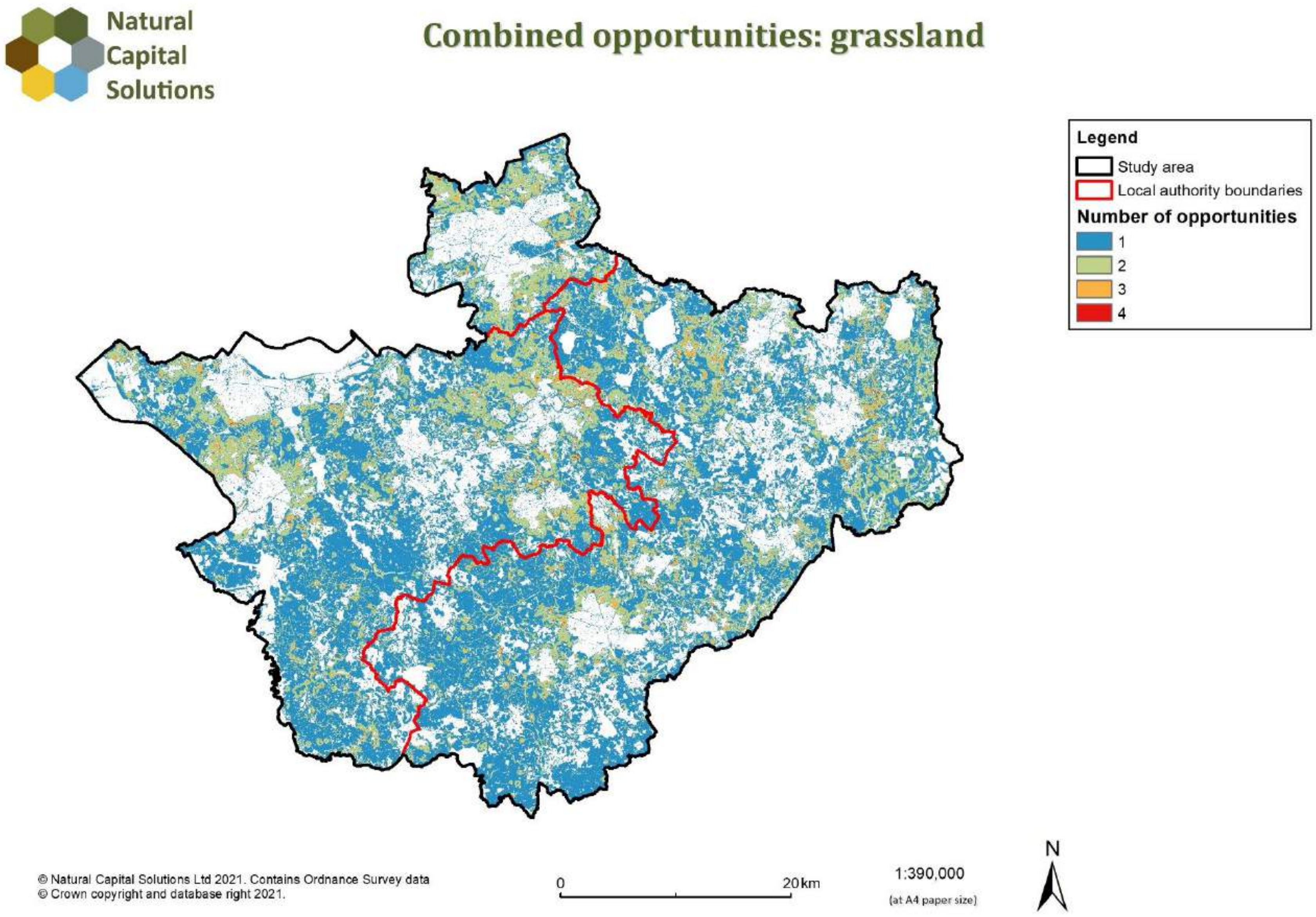

Figure B2 Existing semi-natural grassland and combined opportunities for new semi-natural grassland across Cheshire and Warrington.

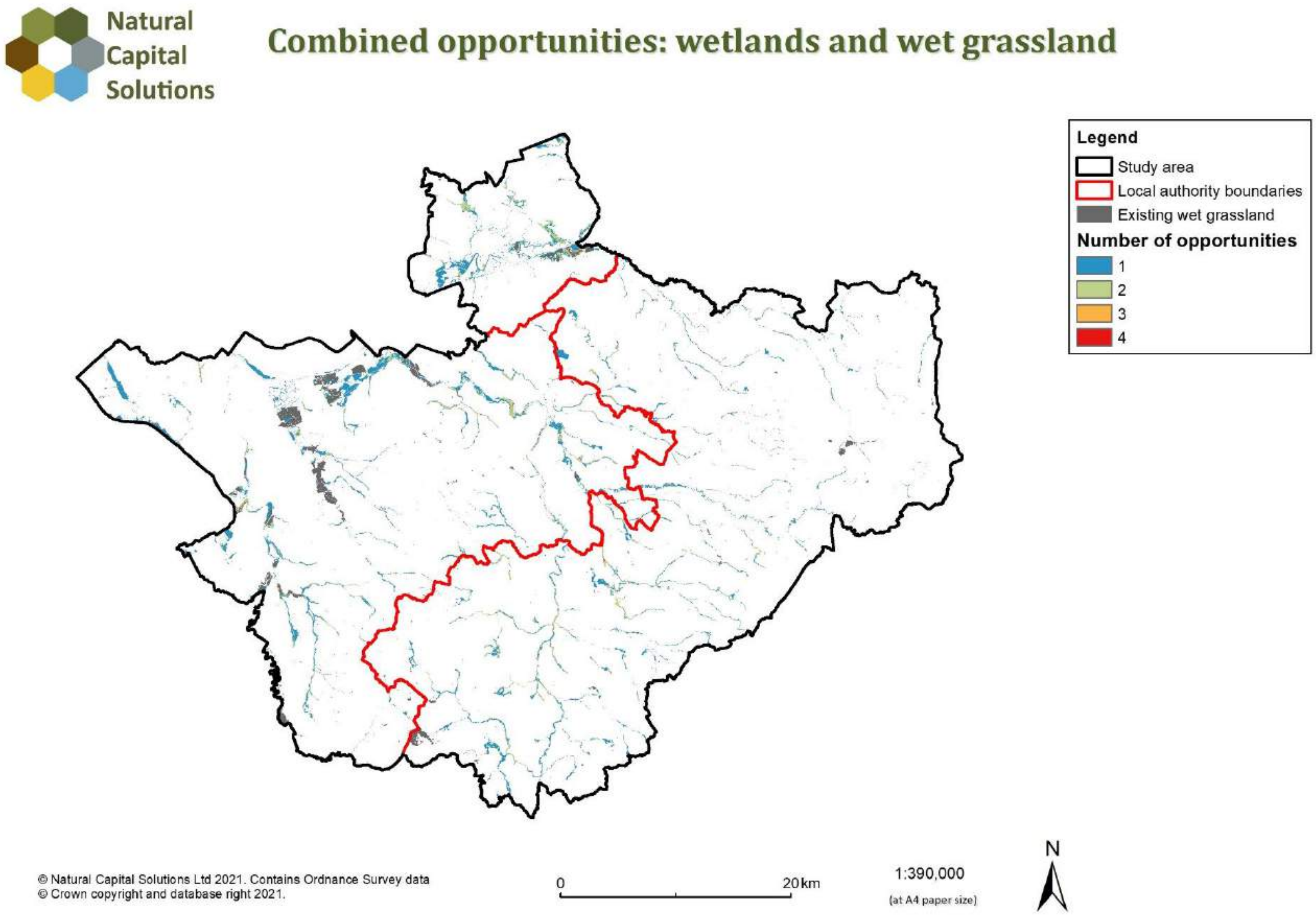

Figure B3 Existing wet grassland and combined opportunities for new wet grassland across Cheshire and Warrington.

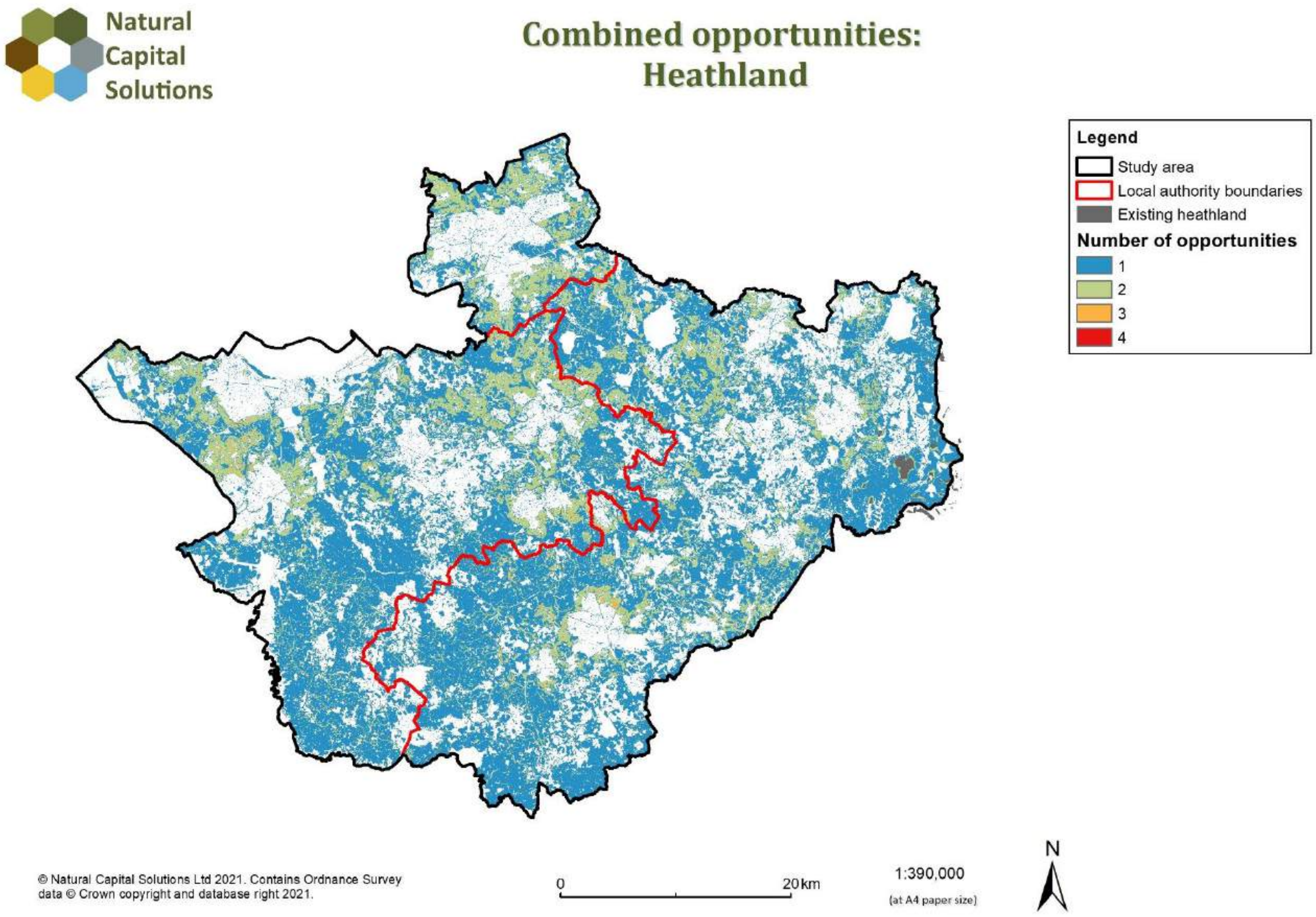

Figure B4 Existing heathland and combined opportunities for new heathland across Cheshire and Warrington.

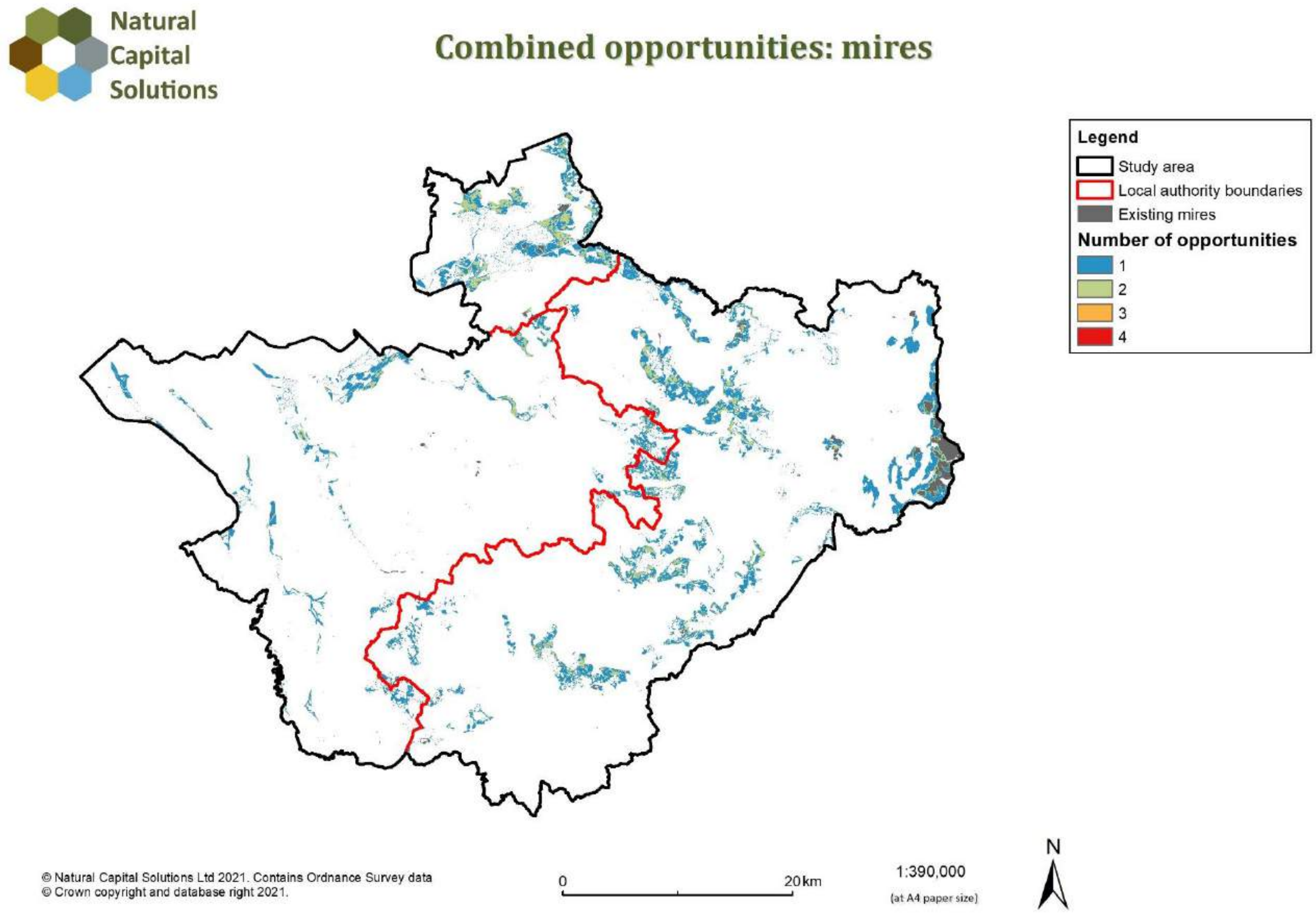

Figure B5 Existing mires and combined opportunities for new mires across Cheshire and Warrington