BIODIVERSITY BASELINE STUDY –

Survey and Monitoring Framework

For

NORWICH City Council

By

Norfolk County Council

NBIS Norfolk Biodiversity Information Service

February 2024

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Final		02/02/2024

This framework can be read as a standalone document, as well as an annex of the main BBS report.

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Section 1: Introduction

1.1 Section outline

1. This section provides a short introduction to the Norwich Biodiversity Baseline Study (BBS) and explains how this 'Survey and Monitoring Framework' relates to the wider study.

1.2 The Norwich Biodiversity Baseline Study

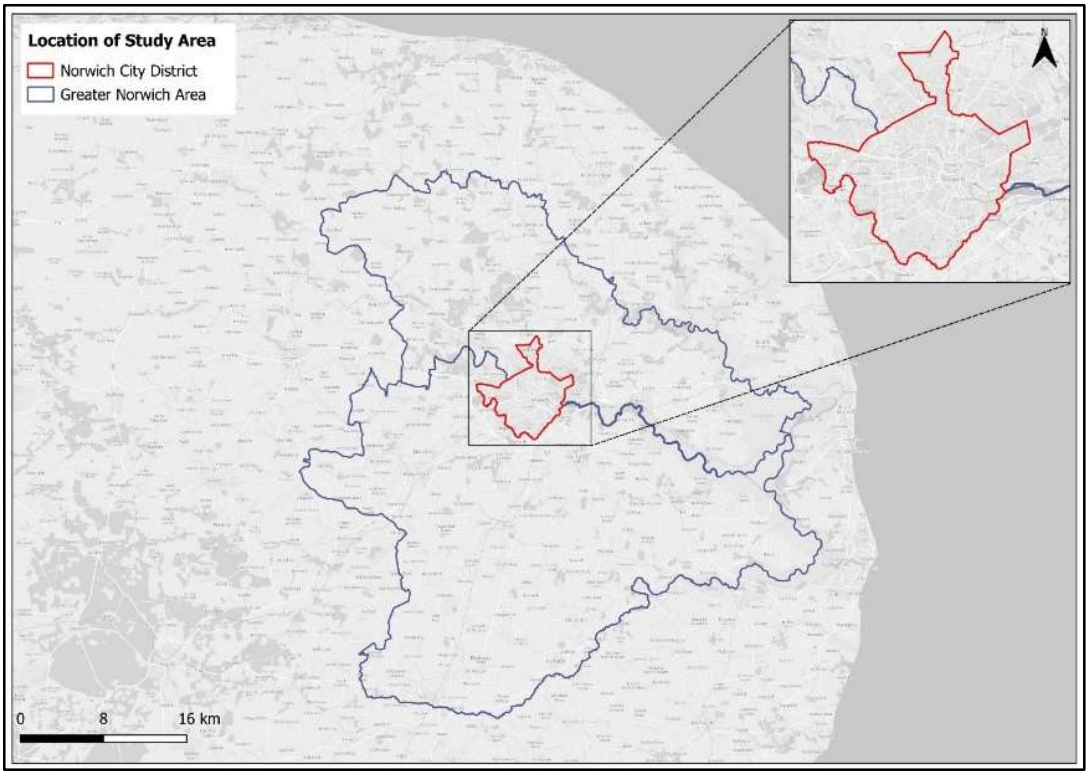
1.2.1 Aims of the Biodiversity Baseline study

2. The BBS was commissioned by Norwich City Council (Norwich CC) to:
    - Provide a baseline assessment of biodiversity in the city.
    - Identify threats to and opportunities for biodiversity.
    - Serve as an evidence base for policy development and decision making and to develop a framework for ongoing biodiversity survey and monitoring.

3. The BBS for Norwich CC provides a valuable assessment of the location, condition, health and status of wildlife and habitats in Norwich. It identifies areas for creating and improving habitats, aligning with wider environmental and nature goals, as well as Professor John Lawton's Principles for improving the resilience and coherence of England's nature network (Lawton, 2010) which describe a nature network consisting of core areas, corridors, 'stepping stones', restoration areas, buffer zones and sustainable use areas (see Section 7: Definition of terms). Norwich CC will be able to apply these principles through its existing Biodiversity Strategy, with the BBS providing the baseline evidence.

1.2.2 The study area

4. The study area for the BBS was the Norwich CC administrative boundary (Location of the Norwich City study area within the Greater Norwich Area).



Map 1: Location of the Norwich City study area within the Greater Norwich Area

1.2.3 Norwich Biodiversity Baseline Study Outputs

5. The study outputs comprise:

- A final report which includes:
    - A district-scale biodiversity baseline of natural assets. This includes current species, sites and habitat/land use data, results from stakeholder engagement and expert interpretation of biodiversity data for Norwich.
    - Locally distinctive Biodiversity Character Areas (BCAs) to enable targeting for nature recovery, mirroring an approach used for National Character Areas (NCAs).
    - A table identifying opportunities and threats to Norwich's biodiversity. Identification of a set of opportunities for conserving and enhancing biodiversity (nature recovery), scored by a prioritisation matrix, which are presented under the Lawton Principles (bigger, better, more, joined). This is a strategic assessment, highlighting key site-specific opportunities where identified (Norwich BBS Appendix BBS7- Threats and Opportunities Table).

- Recommendations for enhancing biodiversity in Norwich. Recommendations generally fit into one of the following broad themes for action: a) governance, policy and leadership; b) for all stakeholders; c) for planners; d) for land managers; e) for conservation strategy and f) for wider public engagement.

- A survey and monitoring framework (this document - Norwich Biodiversity Baseline Study Annex 1 Survey and Monitoring Framework) which sets out how to address local gaps in biodiversity data, monitor biodiversity change and measure conservation success. The framework also identifies opportunities to engage citizens and encourage a sense of ownership of positive nature recovery.
- Additional appendices, which contain supplementary materials from the final report, such as maps and tables, to provide supporting evidence that is too extensive or specialised to be included in the main body of the report.

1.3 The Survey and Monitoring Framework

1.3.1 Survey and Monitoring Report Purpose

6. To understand whether nature is in recovery or decline, it is necessary to monitor change in species diversity and abundance, habitats and site condition. It is difficult to meaningfully report on biodiversity without having a clear understanding of baseline assets and ways of measuring success and change. This is important to fulfil biodiversity reporting requirements for the Strengthened Biodiversity Duty and to track success and change towards nature recovery within the LNRS, BNG and more widely. Effective survey and monitoring support the delivery of the bigger, better and more joined up habitats needed across the city as part of the opportunities and recommendations of the Norwich Biodiversity Baseline Study. A programme of Survey and Monitoring is an effective and auditable long-term tool. Piloting proposed opportunities at a limited number of sites, before roll-out to other sites is pragmatic and cost effective. Before a pilot is rolled out, survey and monitoring is needed to assess if it was successful.

7. The survey and monitoring framework presented here, outlines a manageable, structured foundation for recording species, sites and habitats across Norwich CC's administrative area. These are with a view to address local gaps in biodiversity data, monitor biodiversity change and measure conservation success. Where possible this is through existing surveys, methodologies and monitoring programmes. The framework provides advice on how best to start tracking change and progress towards nature recovery, alongside measuring the success of actions taken, particularly the implementation of opportunities and

recommendations provided in the BBS. It is important to note that this framework is not intended as a detailed step-by-step set of instructions, but rather a prioritised formula to work from in developing a **Survey and Monitoring Programme**, with advice on further study where required.

8. The surveys recommended within this framework incorporate insights gained though stakeholder engagement during the project. Surveys were chosen based on the identified needs from gaps analysis, a review of existing survey/monitoring/surveillance methods, especially where results could inform national recording schemes and monitoring targets, and the survey and monitoring required to support the delivery of opportunities and recommendations outlined in the BBS. These have focused on the requirements to monitor nature recovery and where survey and monitoring is required under legislation this has been identified along with recommendations. A broader range of desirable surveys are also suggested which will, if implemented, provide a more robust and comprehensive evidence base for ongoing decision making. Recommendations made as part of the survey and monitoring framework inform the recommendations in the Norwich Biodiversity Baseline Study final report, where they are also repeated.

9. Undertaking surveys and monitoring is an essential component of good biodiversity management. Evidence from records helps with understanding the status of biodiversity, as well as monitoring changes and measuring successes resulting from biodiversity conservation actions.

10. The terms 'survey', 'surveillance' and 'monitoring' are sometimes used interchangeably in biodiversity literature. For the purposes of this report, they are defined as follows:

    - Survey: A single visit to measure and record, often involving multiple species and individuals, without plans for repetition.
    - Surveillance: Repeated, standardised surveys to detect change, without differentiating if the change is acceptable or not.
    - Monitoring: Regular, standardised recording in the same area to ensure adherence to set standards (JNCC 1998), particularly against a predefined conservation objective. This method provides the best data for assessing species' changing fortunes.

11. To assist the development of feasibility studies and the development of a Survey and Monitoring Programme, this framework offers guidance on undertaking surveys and adhering to ecological and data best practices.

12. There are costs associated with an effective survey and monitoring framework, including capital and staff resource needs. This report outlines where these resources could be met by either paid or volunteer capacity. The true costs will necessitate feasibility studies in relation to policies, capacity for survey and monitoring, skills, and potential for partnership working

across both the city council and other organisations, particularly the efficiencies of working with other local authorities as part of Nature Recovery. While the initial setup costs of a Survey and Monitoring Programme, such as staff and equipment, can be significant, they need to be weighed against the benefits of filling data gaps for informed decision making for nature recovery. Citizen engagement and associated improvements to peoples' health and well-being will also be beneficial.

13. Once collected, it is vital to validate, verify and manage data effectively and appropriately. This report details the necessary steps to ensure that high-quality data is generated and how that data can be best used for decision making.

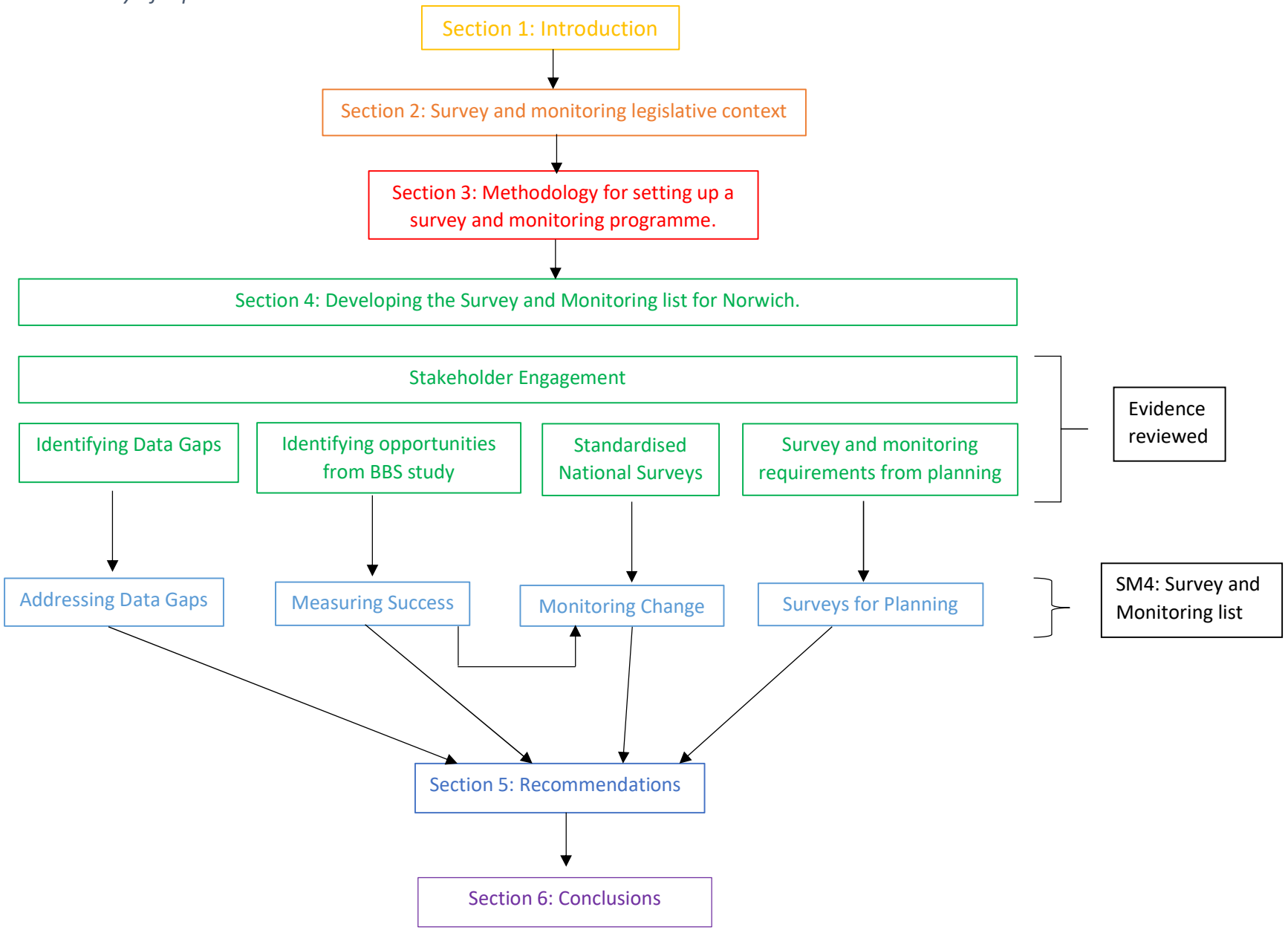
14. This framework does not suggest or infer Norwich CC is responsible for all recommendations, actions or to undertake all surveys. Implementation of such a framework is about partnership working with other local authorities, government agencies, NGOs, local conservation and 'Friends of' groups, volunteers and other relevant stakeholders. It is recommended that Norwich CC takes a lead role, integrating recommendations from this work into the existing council Biodiversity Strategy and Development Plan and coordinating the implementation following review and feasibility work.

15. This framework is being produced ahead of any target or indicator setting for the Local Nature Recovery Strategy (LNRS) process. Lessons learnt from this study and knowledge gained will be used to develop LNRS monitoring, alongside other evidence studies, whilst following the national guidance. The actions recommended in this report are more specific than those within the LNRS process, which will cover all of Norfolk and be coordinated with Suffolk. This will enable more appropriate and detailed monitoring to take place than would otherwise have happened in the LNRS process.

1.3.2 Status of the Survey and Monitoring Framework

16. This Survey and Monitoring Framework is a key output and integral part of the Norwich BBS. It is designed to serve both as a standalone document for relevant practitioners, and to be read alongside the BBS. It is also intended as a resource to use when putting together feasibility studies, or when reviewing next steps for integrating these outputs into the Biodiversity Strategy and wider policies and plans. The report structure is summarised in Figure 1: Summary of report structure.

Figure 1: Summary of report structure



Section 2: Survey and monitoring policy context

2.1 Introduction

17. A literature review of relevant legislation, statutory frameworks and guidance was undertaken. This section sets out a summary of that analysis, bringing together the key information related to Survey and Monitoring. This review includes concepts introduced under the Environment Act 2021: Local Nature Recovery Strategies (LNRS), Biodiversity Net Gain (BNG) and a significant focus on the Strengthened Biodiversity Duty for local authorities. Other relevant documents that have also been reviewed include: the Water Framework Directive, Common Standards Monitoring and the National Planning Policy Framework, are also discussed. The section concludes with a summary statement on the legislative context. This statement applies to the whole Survey and Monitoring Framework, including the surveys listed in the SMF Appendix SM1 BBS - Survey and Monitoring List, detailing what is and is not required to be delivered by current legislation.

18. This section provides the context to the legislation that is relevant to survey and monitoring. It is not possible at this stage to clarify how the BBS will be able to deliver on these but ideally should be able to contribute to all relevant policy and legislation in the benefit of nature recovery. It will depend on which elements of the BBS are implemented and how they are implemented before one can say how the BBS is contributing to addressing some of the requirements.

19. It is recommended that the current Norwich CC Biodiversity Strategy and its Development Plan be reviewed and updated in line with the findings, opportunities, and recommendations of the BBS. This could be achieved by using this Survey and Monitoring Framework to develop a Survey and Monitoring Programme, to set goals and targets, and subsequent monitoring.

20. It should be noted that mechanisms for monitoring change and measuring success at a UK and international level have recently been undergoing many changes and most are still under review. The government's Environmental Improvement Plan (EIP) 2023 (a revision of the 25-year Environment Plan), is the government's delivery plan for the environment and sets out goals for improving the environment (DEFRA, 2023a). This is matched with interim targets to measure progress through the Outcome Indicator Framework detailed in section 2.2.3 National goals and targets: Environment Improvement Plan (EIP) Outcome indicator framework (DEFRA,2022a). The EIP has been created using targets and indicators developed in the Environment Act 2021 and laid in parliament in 2022. England biodiversity indicators linked to the Biodiversity 2020 strategy for England and the updated Convention on Biological Diversity (CBD) indicators/commitments within the Kunming-Montreal Global Biodiversity Framework (KMGBF) are being reviewed (DEFRA,2024; DEFRA, 2011; CBD,

2024). A proposal for a new set of UK Biodiversity Indicators to report progress towards the KMGBF goals and targets is expected to be finalised in 2024. When this work has been completed, the references to Biodiversity 2020 and the Aichi Global Biodiversity Framework Targets (previous CBD framework) will be updated and any changes to indicators will be explained in the relevant guidance and EIP. Technically, until then England biodiversity indicators are relevant but have not been included or referenced in this report or the SMF Appendix SM1 BBS - Survey and Monitoring List due to the immediacy of anticipated change.

2.2 Relevant Policy

2.2.1 Environment Act 2021 (LNRS, BNG)

21. Under the Environment Act 2021 local authorities (the responsible body for this being Norfolk County Council) must develop a LNRS for Norfolk (including any species conservation strategies or protected site strategies) by March 2025. This must include a set of priorities, measures to implement them, and a framework for monitoring against targets. Survey and monitoring will be a requirement of the development and ongoing monitoring of the LNRS. Assessing the feasibility of ongoing survey and monitoring in conjunction with LNRS requirements may offer the opportunity to access shared resources.

22. The Environment Act 2021 outlines a mandatory BNG framework, which details how survey and monitoring may integrate with Development Planning, including how to best deliver on BNG (DEFRA, 2023b) and District Level Licencing (DLL) (DEFRA, 2022b). Implementation of the recommendations from this mandatory framework into a Survey and Monitoring Programme, will involve Norwich CC in partnership with a wide range of stakeholders, including NBIS. More information on monitoring BNG will be available once the secondary legislation has been through parliament in 2024, but as a minimum it will be a requirement of local authorities to report on:
    - The actions carried out to meet BNG obligations.
    - Details of BNG resulting, or expected to result, from biodiversity gain plans that have been approved.
    - How BNG obligations will be met in the next reporting period.

23. Local planning authorities will need to report on habitat creation being carried out (both 'on-site' at the development site and 'off-site' away from the development site) under BNG.

24. Environmental Impact Assessment Regulations 2017 require monitoring of the effects of development plans and projects (DLUHC & MHCLG, 2020).

2.2.2 Environment Act 2021 (Strengthened Biodiversity Duty)

25. The Environment Act 2021 introduced the strengthened 'biodiversity duty' which requires public authorities operating in England to consider what they can do to conserve and enhance biodiversity in England (DEFRA, 2023f). Local authorities (excluding parish councils) and local planning authorities must write and publish a biodiversity report. The first

reporting period should be no later than 1 January 2026. After this, the end date of each reporting period must be within five years of the end date of the previous reporting period. By law, these reports must include:

- A summary of the action taken to comply with the biodiversity duty.
- How compliance with the biodiversity duty will be ensured in the next reporting period.
- Any other information considered appropriate.

26. Quantitative data can help monitor and evaluate the results of conservation actions. Guidance (DEFRA, 2023g) suggests this quantitative data could include:
    - The condition of sites of special scientific interest from the latest assessment.
    - The results of monitoring carried out to fulfil the requirements of the Environmental Impact Assessment Regulations 2017.
    - How many local sites within the local authority area have positive conservation management and information on its effectiveness.
    - Areas of land owned or managed that include habitats of principal importance (priority habitats).

27. Where possible, reporting could include monitoring and evaluation of:
    - How biodiversity on land owned or managed by local authorities was recorded.
    - Progress towards biodiversity outcomes and targets in the EIP or towards international targets.
    - Any relevant environmental assessments.
    - Changes to the conservation status of habitats managed, or for which programmes, ensuring their protection are delivered.
    - Changes to the ecological health of land owned or managed.
    - Records of low water or soil quality.
    - Increases or decreases in the number and type of species present.
    - Improved habitats or ecological status, and/or
    - Notable species identified on land owned or managed.

2.2.3 National goals and targets: Environment Improvement Plan (EIP) Outcome indicator framework

28. The Office for Environmental Protection, 2023, which annually assesses government progress on its EIP, provides crucial guidance that can be used in establishing the Survey and Monitoring Programme. This guidance emphasises the need to:
    - Establish clear governance for effective delivery.
    - Create a unified strategic plan with distinct plans for each goal.
    - Set interim targets to realise early benefits alongside long-term goals.
    - Ensure robust and current data for baseline development and target support.
    - Use the framework to evaluate progress and actions.

- Utilise the framework to monitor species trends, assess population health and habitat conditions, and predict biodiversity changes and drivers.

29. The EIP 2023 sets out a comprehensive strategy for improving the UK's environment. It commits the government to the following:

    By 2030

    - Halt the decline in species abundance.
    - Protect 30% of UK land.

    By 2042

    - Increase species abundance by at least 10% from 2030, surpassing 2022 levels.
    - Restore or create at least 500,000 ha of a range of wildlife rich habitat.
    - Reduce the risk of species extinction.
    - Restore 75% of terrestrial and freshwater protected sites to favourable condition.

30. Its Outcome Indicator Framework presents 66 indicators to define measurable targets across 10 themes, including improving water quality and preserving wildlife (DEFRA, 2022). The development of output indicators is still ongoing, it is therefore recommended that survey and monitoring methodologies make use of these indicators as they are developed.

31. Notable indicators include:
    - B7 Health of freshwater assessed through fish populations.
    - D3 Area of woodland in England.
    - D4 Relative abundance and/or distribution of widespread species.
    - D6 Relative abundance and distribution of Priority Species in England.
    - D7 Species supporting ecosystem functions.

2.2.4 Water Environment (Water Framework Directive) (England and Wales) Regulations 2017

32. This legislation transposes the EU Water Framework Directive (WFD) into UK law. It sets out provisions for protecting and improving the quality of water bodies, includes requirements for assessing and monitoring water status, and procedures for setting environmental objectives (Water Framework Directive Regulations 2017).

33. The key objective of the WFD Regulations was for all water bodies (other than those categorised as artificial or heavily modified) to achieve 'good' ecological status, or higher, by 22 December 2021 (s 13(2) (b) of the Regulations).

34. The UK's Environment Agency is to maintain monitoring programmes, covering ecological and chemical status and ecological potential of surface waters, including monitoring of the volume and level or rate of flow where relevant to ecological status (s11(2) of the Regulations).

35. The relevant biological quality elements for surveillance monitoring include the composition and abundance of aquatic flora, benthic invertebrates and fish fauna; the age structure of fish fauna; phytoplankton abundance (for lakes); and other chemical/morphological factors that support the biological elements (s11(5) of the Regulations).

36. Management plans are required for individual river basins to be reported on every six years, including an assessment of the pressures and water body status (s 19(6) of the Regulations).

2.2.5 Common Standards Monitoring

37. The Natural Environment and Rural Communities Act (NERC; 34(2)c) 2006) defines one of the special functions of the UK statutory Country Nature Conservation Bodies (Natural England in England and the Joint Nature Conservation Committee (JNCC) across the UK), to establish "…common standards throughout the United Kingdom for the monitoring of nature conservation…". Common Standards (JNCC, 1998) were established in 1998 for statutory site monitoring and as a universal set of common principles that could be adopted by Statutory Nature Conservation Bodies in the UK. A revised Common Standards Monitoring Statement in October 2019, further updated in 2022 (JNCC, 2022), aims to address site monitoring priorities and to incorporate new monitoring methods that will work alongside traditional field-based monitoring and the Common Standards Monitoring guidance to monitor the UK's protected sites.

38. This statutory site monitoring of protected sites covers sites designated under:
    - National legislation (Sites of Special Scientific Interest (SSSIs).
    - European Directives (Special Areas of Conservation (SACs) and Special Protection Areas (SPAs)) or
    - International Conventions (Ramsar sites).

39. Common Standards Monitoring is intended to be:
    - A simple, quick, assessment of feature condition.
    - Supported by limited, more detailed monitoring.

40. 'Features' are the species, habitats and geological and geomorphological characteristics for which sites are protected. For example, they might be butterflies, breeding birds, woodlands, heathlands, fossils and landforms.

2.2.6 National Planning Policy Framework (NPPF) irreplaceable habitat

41. The NPPF (DLUHC, 2023) defines Irreplaceable habitats as "Habitats which would be technically very difficult (or take a very significant time) to restore, recreate or replace once destroyed, taking into account their age, uniqueness, species diversity or rarity. They include

ancient woodland, ancient and veteran trees, blanket bog, limestone pavement, sand dunes, salt marsh and lowland fen." This is consistent with LNRS and BNG guidance (DEFRA, 2023c), and information on irreplaceable habitats is presented in this report.

42. Paragraph 185 of the NPPF sets out. To protect and enhance biodiversity and geodiversity, plans should: "promote the conservation, restoration and enhancement of priority habitats, ecological networks and the protection and recovery of Priority Species; and identify and pursue opportunities for securing measurable net gains for biodiversity".

2.3 Summary statement on legislative context

43. Norwich CC are not currently required by law to undertake any of the surveys listed in SMF Appendix SM1 BBS - Survey and Monitoring List, except for SMp1. Those listed for DEFRA agencies to complete are their legal responsibility.

44. Otherwise, survey and monitoring are strongly recommended but not explicitly required. The strengthened Biodiversity Duty under the Environment Act 2021 requires local authorities to create Biodiversity Reports to demonstrate their progress against targets set. Reporting on survey and monitoring of these targets is stated in the writing Biodiversity Reports guidance as being good practice. It could therefore be inferred that it would be best practice for the appropriate surveys from SMF Appendix SM1 BBS - Survey and Monitoring List to be used to monitor and report progress on any biodiversity opportunities taken forward from the Norwich BBS.

45. It is not within the remit of a BBS to assess Norwich CC's legal requirements. The details of what Norwich CC are required to do or not by law presented within the BBS reports is to the best of the authors' ecological, planning and legislation knowledge and is NOT an exhaustive assessment of Norwich CC's legal obligations. As such, Norwich CC should satisfy themselves of any extra advice where these are lacking or need further clarity from DEFRA agencies, internal legal experts or other relevant experts.

Section 3: Methodology for setting up a survey and monitoring programme.

3.1 Introduction

46. This section sets out key considerations for setting up a Survey and Monitoring Programme for a defined area (summarised in Figure 2: Key considerations for developing an area-based biodiversity survey and monitoring programme). These can be summarised as follows:
    - Types of surveys and monitoring required to meet the needs.
    - How to identify suitable sites.
    - Deciding on the best sampling methodology.
    - Considering the resources and skills needed.
    - Long-term planning.

Figure 2: Key considerations for developing an area-based biodiversity survey and monitoring programme

3.2 Survey and monitoring needs

47. It is important to set out the survey and monitoring needs at the start to steer the approach and the area covered. Effective survey and monitoring strategies are fundamental components of biodiversity conservation and management. They provide the necessary information for understanding and managing ecosystems. Outlined below are four key areas to consider in order to identify survey and monitoring needs. More detail on planning and implementing survey and monitoring activities can be found in SMF Appendix SM2 BBS - Supplementary Methodology.

3.2.1 Addressing baseline data gaps

48. Survey and monitoring are of greatest value when based on a robust and comprehensive baseline against which change, successes and targets can be assessed. It is therefore standard practice to undertake a baseline assessment before setting up a survey and monitoring programme.

49. Baseline studies may have data gaps where it has not been possible to collate all the desired information. Baseline data gaps need to be addressed to obtain a complete, up-to-date understanding of biodiversity within the study area, to provide a robust evidence base for decision making.

50. Strategies to address data gaps are detailed in Norwich BBS Section 2 – Data Gaps and Norwich BBS Section 5 -Biodiversity Hotspots, and in the 'Baseline Gaps' tab of SMF Appendix SM1 BBS - Survey and Monitoring List in this report.

3.2.2 Measuring success

51. It is important to measure the success of actions taken, to assess their impact and guide future actions. This requires pre and post action to measure the impact. Control sites, where no action is taken, help attribute any changes to the actions implemented.

52. Identifying pilot sites for testing conservation approaches helps measure their effectiveness, crucial for planning broader area-based strategies. If surveys reveal that conservation actions at pilot sites are unsuccessful, the gathered data should be used to modify the planned actions, known as adaptive management. Furthermore, testing at pilot sites aids in assessing the feasibility of conservation methods provides more accurate time and cost estimates for future actions plans.

3.2.3 Monitoring change

53. Monitoring biodiversity change involves recording changes over time in pre-defined variables such as abundance, diversity, extent and condition. Observing the nature and magnitude of changes within an ecosystem offers valuable insights into the factors driving these changes, for example specific land use practices. Change is measured and assessed against a predetermined baseline.

54. Monitoring change enhances the understanding of changes in local species, sites and habitats, crucial for informed decision making. Moreover, the data obtained is beneficial not only at a local level, but can inform national studies, providing a means to assess local outcomes in a national context.

55. Monitors of change will prioritise identifying natural variations like those seen in population dynamics. For instance, butterfly populations naturally fluctuate in cycles over multiple years, making a single survey insufficient for accurate assessment. Monitoring changes helps to evaluate threats from factors like invasive species by tracking their rate of spread or impact on native populations. Assessing the rate of change in habitat condition helps inform the nature and urgency of conservation actions.

3.2.4 Planning

56. As part of the planning process there are likely to be monitoring requirements for developers and this data, alongside other useful information will be collated via Natural England and should be available to the Local Environmental Records Centre (in Norfolk this is Norfolk Biodiversity Information Service (NBIS)).

57. For BNG: As a minimum as part of the Biodiversity Reporting for the strengthened Biodiversity Duty, it is a requirement for local planning authorities to include the details of biodiversity net gains resulting, or expected to result, from biodiversity gain plans that have been approved. All these gains and losses registered will need to be monitored and will provide evidence of change in habitats over time. Biodiversity gain conditions will normally be in the form of a planning obligation (known as section 106 agreements) or a conservation covenant, both for at least 30 years. The creation of a Habitat Management and Monitoring Plan (HMMP) for BNG is required to be agreed with the LPA or responsible body for significant on-site and all off-site biodiversity gains, as part of this condition (DEFRA & Natural England, 2023). For the HMMP, developers will need to give information about: a) when and how they will monitor habitats (this will vary for different types of habitat); and b) when and how they will report monitoring results. These data again will show change in site condition and development of more semi-natural habitats over the 30-year period and hence can be used as monitoring change and would usefully be also noted in the Biodiversity Reports.

58. Monitoring data from Great Crested Newt (GCN) district level licensing (DLL) (DEFRA, 2022b) is potentially very useful and can add to or update habitat mapping. There may be data showing compensatory ponds created, potentially with monitoring or surveys of change if the landowner/manager wishes and in addition there will be the repeated eDNA surveys for GCN and other recording of GCN that Natural England will undertake or collate to update the risk zone mapping. All of this, if collated in the right way and reported

appropriately, could constitute a set of monitoring or at least survey data that will improve the evidence base collated in this BBS.

3.3 Selecting a survey and monitoring approach.

59. Biodiversity data can be collected in the following ways:
    - Unstructured/ad hoc recording.
    - Semi structured/effort recording.
    - Structured recording.

Each plays a role in a comprehensive recording strategy when applied appropriately. Terminology used for these different data collection approaches varies across the conservation sector. For the purposes of this study, the terminology (adapted from Broughton and Pocock, 2022) and relative merits are described in SMF Appendix SM2 BBS - Supplementary Methodology Section 3.

3.4 Considerations when selecting a survey and monitoring approach.

60. Each survey and monitoring approach has specific skills, time, and cost requirements, which vary depending on what is being recorded. Any of the approaches could be suitable for addressing data gaps, measuring success and monitoring changes when applied correctly. The below, outlines some key considerations for selecting a survey and monitoring approach:

    - Standardised survey and monitoring protocols exist for recording sites, habitats and species data which is typically taxon group specific. This use of standardised survey and monitoring methodologies, as outlined in Bane & Pocock 2023, is important to avoid “reinventing the wheel”.

    - Several pilot projects have set up networks of volunteers to survey or monitor particular sites repeatedly to show change, including the NBIS led Norfolk Species Surveillance Network and the Natural England Norfolk/Suffolk citizen science pilot. Involving amateur experts in these networks can provide support to volunteers, for example with identification.

    - Repeated surveillance and monitoring is time intensive, and volunteers are under no obligation to continue if they are not sufficiently motivated.

    - Volunteers with an affinity to a particular site, such as those involved with ‘Friends of’ groups, are well placed to survey their site repeatedly. Additionally, many people already monitor particular taxon groups as part of national survey and recording schemes. Some of these existing volunteers may be willing to extend their surveys to other sites where no surveying is currently taking place, filling existing data gaps.

3.5 Selecting a survey design

3.5.1 To address baseline gaps

61. There are various methods and tools for collecting baseline data; these include surveys, sampling, measurements, observations, literature/data reviews or interviews with experts.

62. Gaps caused by lack of data will require surveys that have been tailored to address this. Gaps in geographic and temporal coverage are best addressed by updating or expanding existing datasets.

63. Literature reviews and consultation with relevant experts will need to be conducted before a baseline study can be established.

64. Comprehensive survey design is required to address baseline data gaps and ensure that sufficiently robust data is obtained for the evidence base. Key baseline assessment methods are summarised in SMF Appendix SM2 – BBS Supplementary Methodology, Section 4.1 and include:
    - Creating inventories.
    - Species distribution atlases.
    - Accuracy assessments.

3.5.1 Measuring Success

65. Measuring the success of conservation actions is essential to understand their impact and are key for evaluating the effectiveness of conservation efforts, especially in pilot studies that test the feasibility and outcomes of these actions. These methodologies, emphasising the need for thorough planning and appropriate resource management in conservation projects, are summarised in SMF Appendix SM2 - BBS Supplementary Methodology, Section 4.2 and include:
    - 'Before-after' methods.
    - Using pilot sites to assess conservation outcomes.

3.5.2 Monitoring Change

66. Monitoring change in biodiversity is vital for conservation, involving various methods to track changes in species and habitats over time. These approaches, essential for understanding ecosystem dynamics, range from detailed surveys at specific sites to broad habitat mapping. These strategies and their significance in monitoring ecological conservation change are outlined in SMF Appendix SM2 BBS - Supplementary Methodology, Section 4.3 and include:
    - Species surveillance.
    - Fixed point monitoring.
    - Aerial and satellite photography.

3.6 Selecting a sampling approach

67. The sampling approach determines the proportion of species, sites and habitats that need to be surveyed to be representative of the whole; complete coverage is rarely possible or practicable. Selecting the correct sampling approach is important to ensure that the questions being posed can be answered. Methods used will depend on the species, site and habitat being surveyed.

68. A scientific sampling design is needed to ensure results are as representative as possible. The accuracy of different sample methods will vary, depending on the variable being assessed. Providing details of sampling approach is useful to inform interpretation. The main sampling types (Adapted from Field Studies Council, 2023) are:

    - Random sampling: Where each member of the population is equally likely to be included. This is how ad-hoc observations can be recorded.
    - Stratified sampling: Where a proportionate number of observations is taken from each part of the population. For example, species surveillance, and.
    - Systematic sampling: Where the study area includes an environmental gradient. For example, assessing change along the course of the river using fixed point photography.

69. Choosing the right sampling sites for survey and monitoring is important to ensure the resulting data are meaningful. Sample sites and survey locations within those sites must have representative features or consistent areas of habitat, avoiding habitat edges or ecotones. In an urban area it is difficult to choose sites randomly. The choice of survey locations needs to be as representative of the site or habitat type as possible. Factors such as access, anti-social behaviour and the proximity to other locations also need to be considered when selecting suitable sites.

70. Further information on options for selecting a sampling approach is provided in SMF Appendix SM2 BBS - Supplementary Methodology, Section 4.4.

3.7 Resourcing biological recording activities

71. To assist with the development of an action plan from this framework, SMF Appendix SM3 BBS - Guidance on Conducting Wildlife Surveys compiles useful resources and guidance for conducting wildlife surveys. This includes what is needed prior to implementing a survey and monitoring programme (for example funding, skills and equipment), some resources to support wildlife recording and an explanation of how biological records will be managed.

3.8 Revisions and successive iterations

72. Biodiversity assets are not static and will change in response to both natural factors and conservation actions. As a result, revision of targets and plans for conservation action is needed as new information becomes available to ensure that the evidence base is as robust and up to date as possible. Figure 3: Components of a survey and monitoring framework to support the delivery of enhanced biodiversity. illustrates the need for data gathered from surveys and monitoring to be evaluated and reported as soon as possible to inform this revision process.

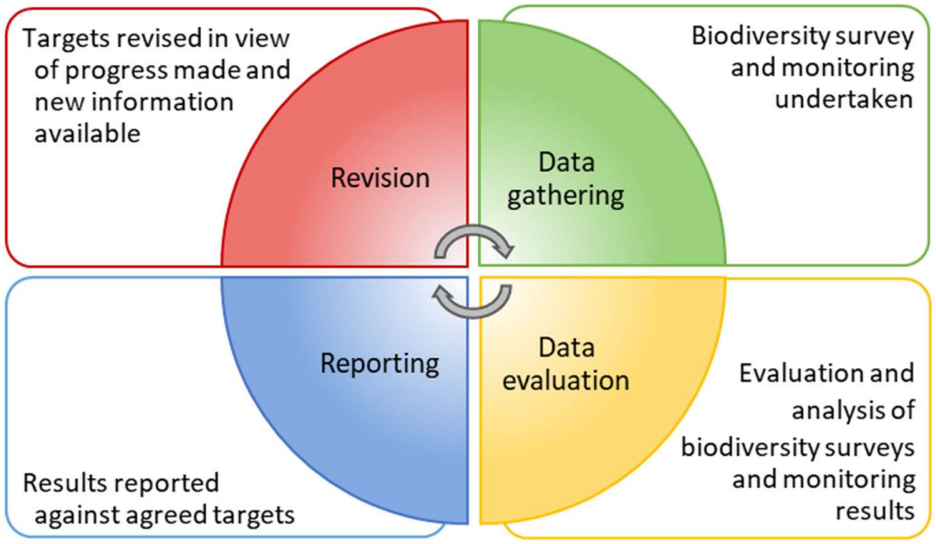


Figure 3: Components of a survey and monitoring framework to support the delivery of enhanced biodiversity.

3.9 NBIS as a resource for biological monitoring and recording

73. As a Local Environmental Records Centre, NBIS are experienced in the collection, collation and management of biodiversity data. As such they are well placed to advise on how the survey and monitoring data should be collected and formatted to ensure it is as useful as possible.

74. NBIS also have a wide network of contacts, including experts in species recording and other environmental professionals. Working alongside these experts, NBIS can advise on sampling site selection and survey techniques. NBIS can provide distribution maps to support specialist recording interests and to identify specific gaps in taxon groups that need to be addressed. NBIS will work with their network to mobilise existing biodiversity data that are currently not available, including data from iRecord and the NBN Atlas.

75. All data submitted to NBIS are validated and verified by species experts before being made available to decision makers or other enquirers. All records collected through survey and

monitoring should be submitted to NBIS, using a mutually agreed method, as part of a quality control process. NBIS will also work with species experts to resolve current bottlenecks in verification and ensure that verified records are made available to Norwich CC as soon as possible.

3.10 Section summary

76. This section has outlined the following important elements that should be considered when devising an approach to a large-scale survey and monitoring strategy:

- Identify the needs to be met by survey and monitoring activities (further developed in Section 4: Developing a survey and monitoring list for Norwich and supported by SMF Appendix SM1 BBS - Survey and Monitoring List).
- Identify and address baseline data gaps.
- Ensure successes can be measured and change monitored.
- Select survey and monitoring design methods.
- Select sampling approaches.
- Ensure resources are available for undertaking biological recording.
- Consider the use of pilot studies to assess feasibility in terms of cost, required expertise, number of samples required, and data quality.
- Consider the importance of future revisions and successive iterations to ensure the evidence base remains robust.

Section 4: Developing a survey and monitoring list for Norwich

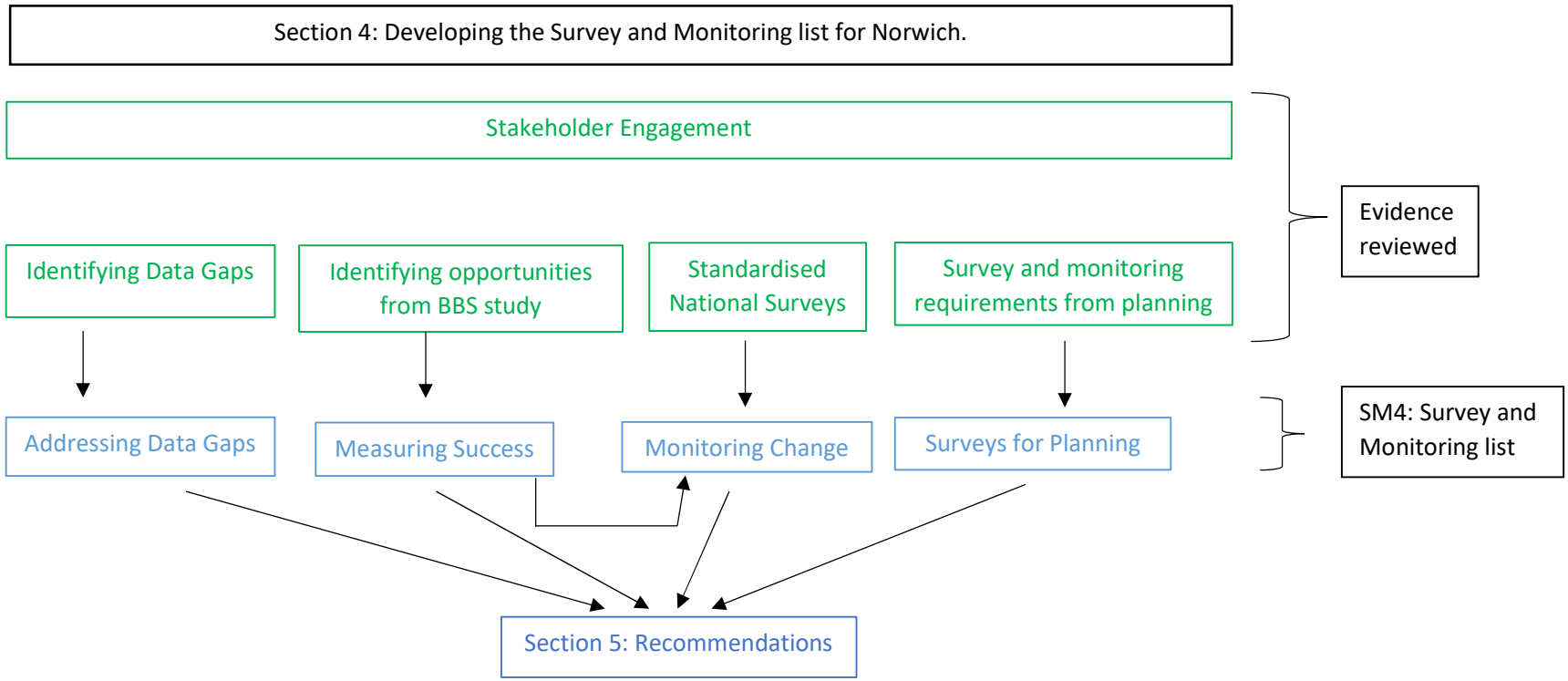
4.1. Introduction

77. This section describes how information has been brought together to identify the survey and monitoring requirements specific to Norwich and presents these as SMF Appendix SM1 BBS - Survey and Monitoring List.

78. The SMF Appendix SM1 BBS - Survey and Monitoring List details the survey and monitoring needed to:
    - Address baseline gaps: Fill data gaps identified during the BBS.
    - Measure success: Conduct before-and-after surveys at pilot sites to evaluate the effectiveness of conservation actions proposed in the BBS.
    - Monitor change: Implement ongoing survey and monitoring to track biodiversity changes over time.
    - Undertake surveys for planning: Fulfil the survey and monitoring requirements of the planning system

79. The structure of Section 4: Developing a survey and monitoring list for Norwich, and how it feeds into the recommendations of this Survey and Monitoring Framework is summarised in Figure 4: Summary of section 4.

Figure 4: Summary of section 4



4.2. Compiling the Survey and Monitoring List

4.2.1 Subsection outline

80. This section describes how the SMF Appendix SM1 BBS - Survey and Monitoring List was created, how it is set out and information on the types of surveys suggested.

4.2.2 Review of Evidence

81. The SMF Appendix SM1 BBS - Survey and Monitoring List was created by bringing together evidence gathered from the five key sources listed below.
    - Considering feedback from stakeholders regarding current survey and monitoring activity in Norwich and future needs.
    - Reviewing the gaps identified in Norwich BBS Section 2 – Data Gaps and recommending how these can be filled.
    - Reviewing the opportunities identified in Norwich BBS Section 8 – Opportunities and recommending how survey and monitoring can be used to measure their success.
    - Reviewing the literature to determine standardised national methodologies for monitoring biodiversity change over time.
    - Determining the survey and monitoring requirements of the planning system.

    This process, and how it relates to the recommendations of this report, is summarised in Figure 4: Summary of section 4.

4.2.3 Development of the list

82. From the evidence gathered it has been possible to identify four purposes for undertaking survey and monitoring. To fill current data gaps, to effectively report on the success of implementing the BBS opportunities and recommendations, to monitor change in biodiversity over time, and to implement the survey and monitoring requirements of the planning system. The relationship between these and the types of evidence reviewed is shown in Figure 4: Summary of section 4.

83. The evidence gathered was compiled as a spreadsheet SMF Appendix SM1 BBS - Survey and Monitoring List, which contains the following tabs on to which the survey and monitoring activities are split out by purpose. An introduction tab describes the content of the spreadsheet and explains the table fields for the four main tabs. It is strongly recommended that the introduction tab is read before using the other tabs. For ease of use, the spreadsheet can be sorted and filtered on all fields, allowing, for example, the surveys to be embedded against appropriate actions in the Norwich CC's Biodiversity Development Plan.

- Baseline Gaps – filling the data gaps identified during the BBS. Actions on this tab are given a code starting SMg
- Measuring Success – surveys to measure the success of conservation action implemented as a result of opportunities proposed in the BBS. Actions on this tab are given a code starting SMs
- Monitoring Change – ongoing survey and monitoring to monitor biodiversity change over time. Actions on this tab are given the code SMc
- Surveys for Planning – survey and monitoring required for planning. Actions on this tab are given the code SMp.

Note: Some surveys appear on more than one tab where they serve more than one purpose. Where this is the case, they have the same number following the letters in the Survey Code (e.g., SMs2 and SMc2).

4.2.4 Note on the survey and monitoring actions included in the list

84. Due to the complexity of the biodiversity in Norwich, and the time, skills, and resources currently available for survey and monitoring, it is necessary to identify surveys that are sufficiently evidenced and scientifically rigorous, but that are feasible to implement.

85. Where possible, the surveys included are those that skilled volunteers or volunteers with appropriate training could undertake. Occasionally, a survey may need to be undertaken by a paid professional, for example when a professional licence is required or when the skill level or equipment required is higher. Where this is the case, it is stated in SMF Appendix SM1 BBS - Survey and Monitoring List.

86. For survey and monitoring to be most effective measures should be simple, promptly reported and aligned with national biodiversity targets and goals. Suggested surveys in the SMF Appendix SM1 BBS - Survey and Monitoring List have been matched with existing national targets where relevant, including where possible, specified goals, targets, and suggested reporting periods.

87. The SMF Appendix SM1 BBS - Survey and Monitoring List suggests a range of survey types that all use standardised and nationally recognised methodologies. Using such methods not only increases the quality of the data collected but also its value, as it can feed into national projects as well as being used locally. Making a difference nationally as well as locally can help to increase and sustain recorder motivation.

88. Many of the survey suggestions made are designed to collect information that can act as a proxy indicator (or substitute indicator) to measure change and success, where comprehensive survey is unfeasible and unrealistic:

    - Many of the species or species groups included in the SMF Appendix SM1 BBS - Survey and Monitoring List are Priority or protected species that are sensitive to

changes in habitat condition and management, or likely to be impacted by development and climate change, for example riverflies (SMc18) or macroinvertebrates (SMc17) being used as a proxy for river biodiversity.

- Designated sites such as CWS and SSSI have each been designated for a particular 'feature of interest' – be that habitat, species or geology – against which site condition and management changes can be assessed. Such sites can act as a proxy to other sites on which similar management has been implemented.
- On non-designated sites, an axiophyte survey (SMc34) can act as a proxy for good site management and condition without the need to survey for a wider suite of species. This survey requires less knowledge than site condition monitoring and can be surveyed as part of the wider plant monitoring (SMc11), without the need for separate survey.
- Proxies can also be used when assessing the success of habitat creation or restoration. For example, rapid grassland and pollinator abundance surveys can be used as proxies to assess the success of heathland and acid grassland restoration and creation (SMs15).

4.2.5 Sub section summary

89. The SMF Appendix SM1 BBS - Survey and Monitoring List has been created using the outcomes of stakeholder engagement, the data gaps analysis from the BBS, reviewing the BBS opportunities and literature reviews to determine best practice.

90. The SMF Appendix SM1 BBS - Survey and Monitoring List is spilt into different tabs to demonstrate the purpose of the surveys contained within. The surveys included are suggested as being sufficiently evidenced and scientifically rigorous, but feasible to implement, mostly using trained volunteers. Proxies are used to measure change and success, where comprehensive survey are deemed unfeasible and unrealistic.

4.3 Stakeholder engagement to understand existing survey and monitoring being undertaken in Norwich

4.3.1 Sub section overview

91. This section outlines the key findings from the survey and monitoring questionnaire undertaken for this Survey and Monitoring Framework and stakeholder engagement undertaken in Norwich BBS Section 2 – Data Gaps. This includes identifying what survey and monitoring is already taking place in Norwich and noting where focus could be beneficial for future data capture efforts.

4.3.2 Results of the survey and monitoring online questionnaire

92. To understand the biodiversity survey and monitoring already taking place in Norwich a short online survey was run from the 11/07/2023 to 17/07/2023. The online survey was sent to the same forty delegates as for the stakeholder workshop (see Norwich BBS Section 2 – Data Gaps). Fourteen responses were received. The results of the online survey were collated in SMF Appendix SM4 BBS - Survey and Monitoring Questionnaire Results.

93. Based on the online survey responses, discussions at the stakeholder workshop and with site managers, there is a significant amount of ad hoc recording and opportunistic survey going on in Norwich, across a reasonable spectrum of species groups. There is some focused survey work going on via 'Friends of' groups, but very little monitoring. There are a significant number of volunteers, expertise, and resources to help with species identification, but little in the way of funding, paid surveys and general resources for training, equipment and support.

94. Survey respondents made the important point that long-term monitoring requires a significant time commitment and specialist skills that may not be consistently available from volunteer recorders. Long term monitoring may therefore not deliver on overarching needs and other types of survey and monitoring should be considered.

4.3.3 Proposed key actions from stakeholder engagement

95. The following points are the key actions proposed by stakeholders regarding survey and monitoring:
    - To suggest standardised and simple surveillance methods that provide a broad coverage across the taxonomic spectrum, that act as a proxy to track change and success.
    - Undertake monitoring, but only within and contributing to the standard national schemes/methods that already exist.
    - Considerable increase in training in identification (ID) skills and methods – focused on existing volunteer groups but allowing for publicity and wider engagement and increasing the numbers of committed volunteers.
    - Funding for equipment, training, support, and general resources is essential. Funding should be sourced or diverted to support survey and monitoring.

4.3.4 Sub section summary

96. The engagement identified a considerable amount of ad hoc recording and opportunistic surveying with some focused efforts by 'Friends of' groups but minimal long-term monitoring due to a greater time and/or skills requirement. Despite a significant number of volunteers and expertise there are resource constraints in terms of funding and for training and support.

4.4. Addressing Data Gaps identified in BBS study

4.4.1 Sub section overview

97. The Norwich Biodiversity Baseline Study established the baseline and conducted a gaps analysis of existing biodiversity data. The BBS identified gaps in existing species, site and habitat data (Norwich BBS Section 2 – Data Gaps and summarised in Figure 5: Overview of Identifying Data Gaps). The impact of the data gaps on the BBS project was determined as 'limited to moderate' for species data and 'moderate' for site data. This sub section summarises these gaps and explains how they might be addressed.
98. Where suggested surveys from the SMF Appendix SM1 BBS - Survey and Monitoring List are described, they reference their Survey Code which is colour coded to reflect its priority. Details on how priority level was assigned can be found in Norwich BBS Appendix BBS 1 - Study Approach and Methodology, Task 4.6. Where gaps are more appropriately addressed though the recommendations being made by this study, the recommendation number is given against each action.

Priority level: ● – high; ● – medium; ● – lower

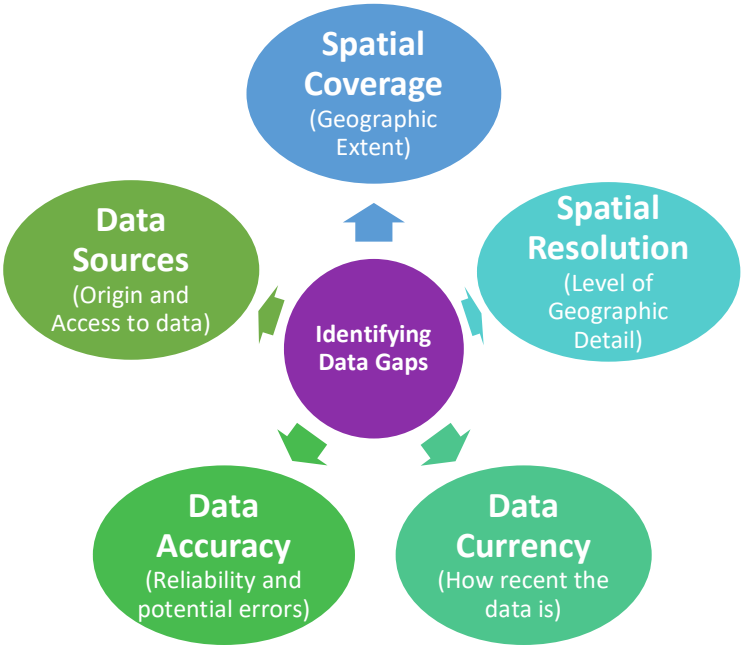


Figure 5: Overview of Identifying Data Gaps

4.4.2 Species data gaps

4.4.2.1 Spatial Coverage

99. The spatial coverage of records across an area is not even, often because there are differences in how well recorded certain areas are. These differences can arise from biases towards certain sites, and from variations in recording behaviours (Pocock et al. 2023).

Variations in recorder effort were quantified as part of the Norwich BBS, using the total number of records per 100m grid square as a proxy for recording effort. More detailed methods for how this was calculated are set out in Norwich BBS Section 2 – Data Gaps. This analysis confirmed that there was uneven recording across Norwich, with many areas having no intersecting records.

100. Number of unique records with resolution <=100m, excluding moths and birds, apportioned to 100m hex grid (see biodiversity hotspot methodology, Norwich BBS Appendix BBS1 – Study Approach and Methodology, Task 4.2, or further explanation). Darker colours represent a greater number of records, and so a higher indicative recorder effort, with empty grid cells indicating no intersecting records. shows recorder effort across the city and illustrates a bias towards recording on sites that are considered 'better' or 'more interesting' for biodiversity, and those located close to active recorders or where there are active volunteer groups.

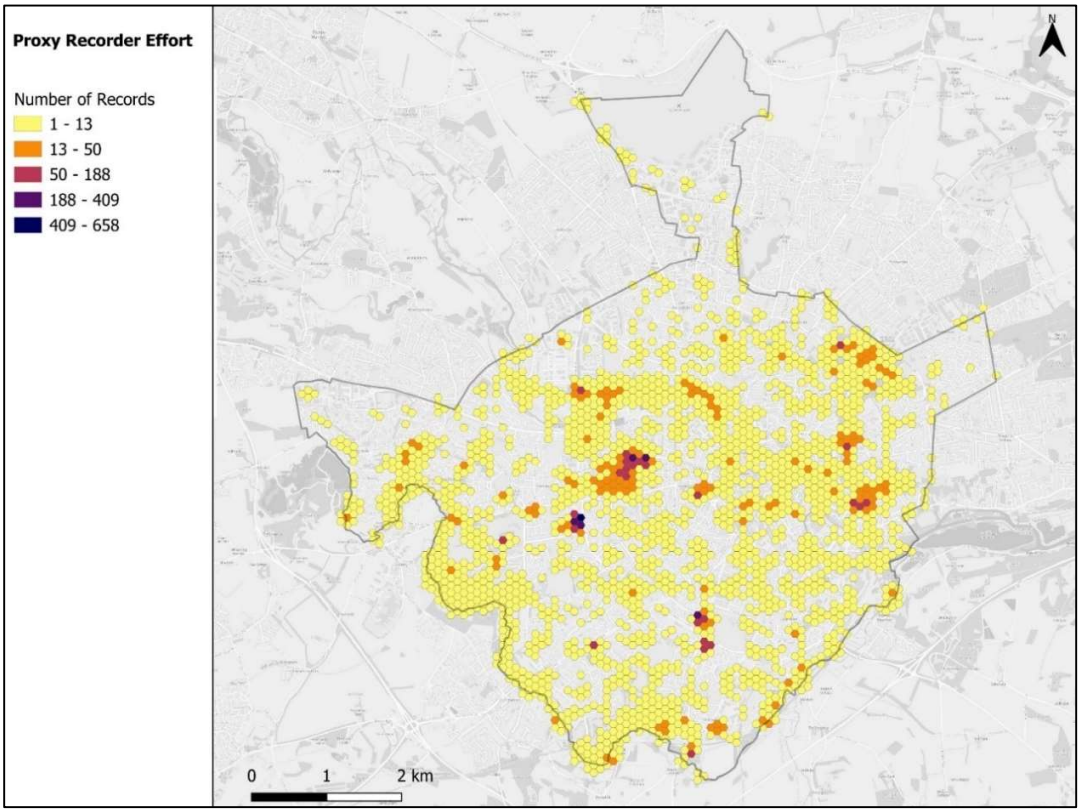
101. Maps 2, 3 and 4 show filtered versions of the same recorder effort information for statutory sites, non-statutory sites, and priority habitats, respectively. From Map 3 it can be seen that sites such as Eaton Chalk Pit have a high density of records within a small area. Similarly, certain areas adjacent to the Wensum in the northwest of the city have a higher indicative recorder effort, particularly Sycamore Crescent and Mile Cross Marsh LNRs, which each have a high number of records per hectare. There is also variation within individual sites, for instance the southern portion of the Mousehold Heath LNR (St James' Hill) has a high number of records compared to other parts of the site.

102. One of the clearest disparities in recorder effort can be seen in Map 4, which shows the distribution in records across non-statutory designated sites. Earlham Cemetery (CWS) shows the highest indicative recorder effort, with over 67 records per hectare, or >1800 unique records in total within the site, with particular recording focus in the northernmost corner. In comparison, Carrow Abbey Marsh (CWS) had the lowest indicative recorder effort for sites within the Norwich City boundary, with only 42 total records (4.5 records per hectare).

103. Map 5 shows the indicative recorder effort for each priority habitat type and indicates that the highest recorder effort has been for areas of scrub and semi-improved (scrub), which have an average of 41 records per hectare and 38 records per hectare respectively across Norwich. There were no records intersecting areas of lowland heathland, likely because the Norfolk Living Map identifies only a small patch of this habitat class within Norwich.

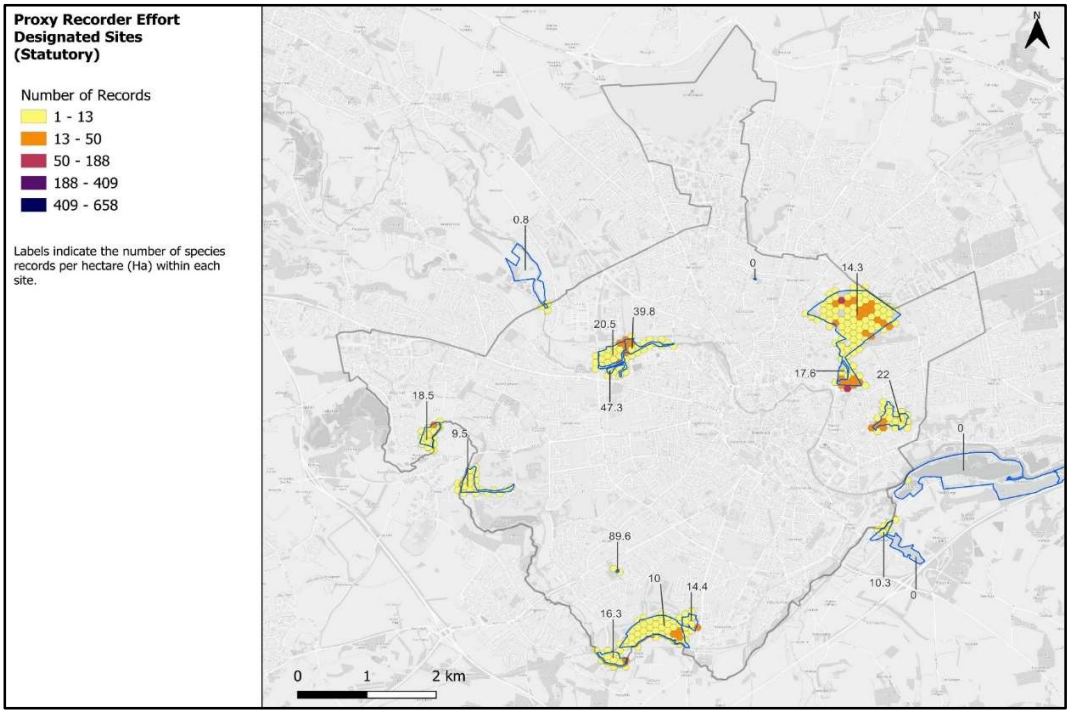
104. To reduce the effect of recorder effort:

- Encourage recording at sites throughout the city that currently have lower recorder effort, to get a more accurate picture of biodiversity distribution. This includes in private residential gardens, which are an important wildlife resource in urban areas, but are currently under-recorded **(R50)**.

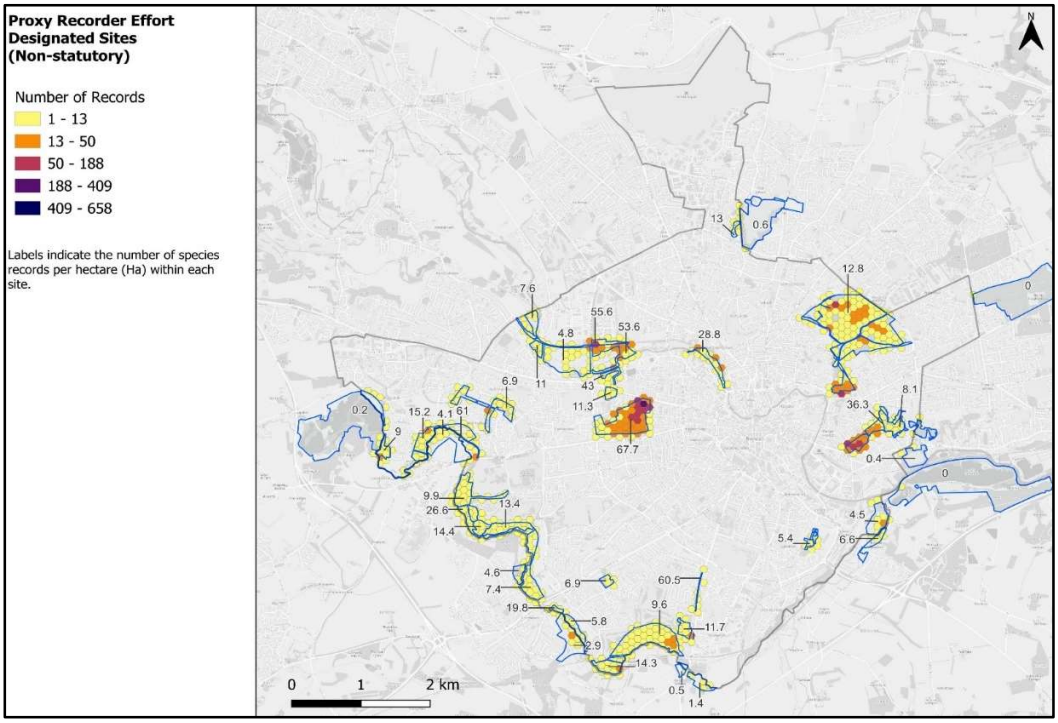


Map 2: Indicative Recorder Effort
Number of unique records with resolution <=100m, excluding moths and birds1, apportioned to 100m hex grid (see biodiversity hotspot methodology, Norwich BBS Appendix BBS1 – Study Approach and Methodology, Task 4.2, or further explanation). Darker colours represent a greater number of records, and so a higher indicative recorder effort, with empty grid cells indicating no intersecting records.

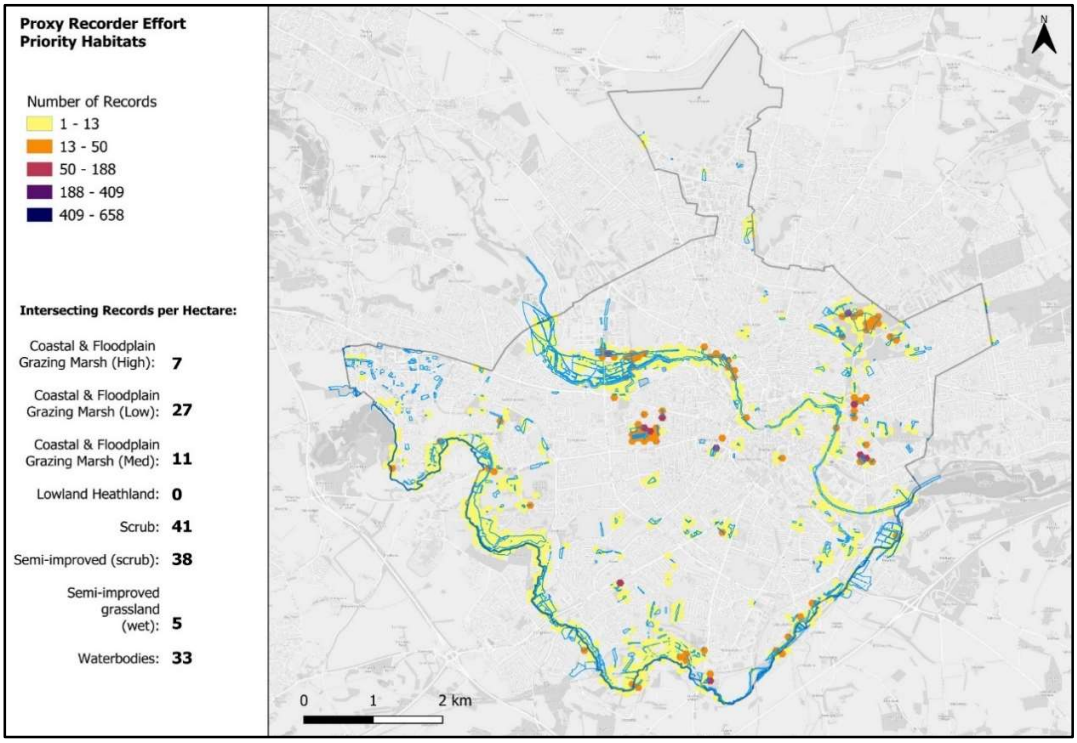
[1] Moth records were omitted as there are a large number of records generated from each moth trap (often in a recorder's garden over multiple trapping sessions) which would skew the results. Record distribution would additionally reflect the location of moth traps rather than the moths themselves. Bird records were similarly omitted due to their mobile nature, and the lack of details required to distinguish breeding/roosting records. Many of the bird records held were also recorded at a relatively low resolution.



Map 3: Indicative recorder effort for statutory designated sites.
Darker colours represent a greater number of records, and so a higher recording effort. Uses a subset of the data from Number of unique records with resolution <=100m, excluding moths and birds, apportioned to 100m hex grid (see biodiversity hotspot methodology, Norwich BBS Appendix BBS1 – Study Approach and Methodology, Task 4.2, or further explanation). Darker colours represent a greater number of records, and so a higher indicative recorder effort, with empty grid cells indicating no intersecting records.



Map 4: Indicative recorder effort for non-statutory designated sites.
Darker colours represent a greater number of records, and so a higher recording effort. Uses a subset of the data from Number of unique records with resolution <=100m, excluding moths and birds, apportioned to 100m hex grid (see biodiversity hotspot methodology, Norwich BBS Appendix BBS1 – Study Approach and Methodology, Task 4.2, or further explanation). Darker colours represent a greater number of records, and so a higher indicative recorder effort, with empty grid cells indicating no intersecting records.



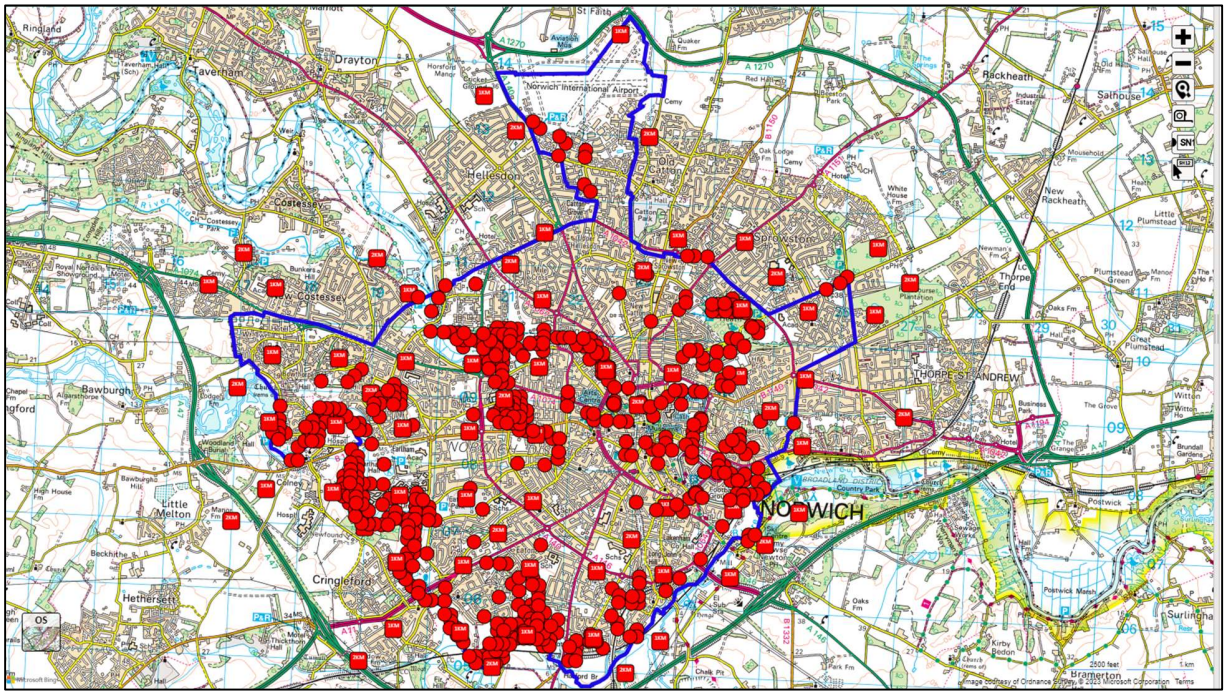
Map 5: Indicative recorder effort for priority habitats.
Darker colours represent a greater number of records, and so a higher recording effort. Uses a subset of the data from Number of unique records with resolution <=100m, excluding moths and birds, apportioned to 100m hex grid (see biodiversity hotspot methodology, Norwich BBS Appendix BBS1 – Study Approach and Methodology, Task 4.2, or further explanation). Darker colours represent a greater number of records, and so a higher indicative recorder effort, with empty grid cells indicating no intersecting records. Numbers of intersecting records shows how many records overlap with that habitat type

4.4.2.2 Spatial Resolution

105. Analysis of records (Norwich BBS Section 2 – Data Gaps) showed that not all species data have been recorded at the desired spatial resolution. This means that some of the data has a lower level of precision than is ideal.

106. To improve data precision and represent a fuller picture of Norwich's biodiversity, recorders should be encouraged to record at the highest spatial resolution that is appropriate. In particular the following are recommended to improve data resolution:
    - Record bird breeding and roosting sites at high-resolution to allow these records to be included in biodiversity hotspot mapping (Norwich BBS Section 5– Biodiversity Hotspots) **(R51)**.
    - Record vascular plants at high-resolution for axiophyte mapping and monitoring changes in habitat conditions. Axiophyte record resolution.

- Data resolution for axiophytes species across Norwich City. Records represented with a dot have a high spatial resolution of 100m (the recorded individual is found within a specific 100m x 100m area) or better. Records represented with a square have a low spatial resolution of 1km (the recorded individual is found within a specific 1km x 1km area) or lower. Areas with mainly low resolution axiophyte records are priorities for survey to improve data resolution. shows that high resolution data (represented by dots on the map) does not exist for all locations where axiophytes are recorded **(R51)**.
- Obtain high resolution records of rare and scarce species to clarify which Biodiversity Character Areas (BCAs) they are found in. Address this through collating existing records for these species that are not currently available through the NBIS database, and through targeted field survey work **(R51)**.
- Survey at the highest possible resolution under-recorded groups including beetles, fungi, lichens and non-vascular plants **(R53)**.



Map 6: Axiophyte record resolution.
Data resolution for axiophytes species across Norwich City. Records represented with a dot have a high spatial resolution of 100m (the recorded individual is found within a specific 100m x 100m area) or better. Records represented with a square have a low spatial resolution of 1km

(the recorded individual is found within a specific 1km x 1km area) or lower. Areas with mainly low resolution axiophyte records are priorities for survey to improve data resolution.

4.4.2.3 Data Currency

107. It is recommended as best practice that data no older than 10 years is the most useful for biodiversity assessment, however where this is unavailable, older data still has value and is useful in the assessment of change. In Norwich, the BBS analysis (Norwich BBS Section 2 – Data Gaps) showed that many taxon groups are lacking in recent records. These include beetles, butterflies, amphibians and reptiles, 'other' invertebrates, white-clawed crayfish, water vole and badger.

108. To improve data currency to allow up to date biodiversity assessment it is recommended to:

- Collect up-to-date records for the taxon groups listed above, both by collating existing records for these groups that are not currently available through the NBIS database, and through new, targeted field survey work **(R51, R64)**.
- Collect and collate any recent records of taxa important in the planning process such as bats and great crested newts, as well as for indicator species to enable monitoring of the environment **(R51, R64)**.
- Engage with volunteers and organisations currently recording in the city to submit their records to NBIS so their data can become available for biodiversity assessment and other uses **(R64)**.
- Work with species experts to address the current bottlenecks in the verification of records **(R65)**.

4.4.2.4 Measuring change

109. BBS analysis (Norwich BBS Section 2 – Data Gaps) showed that the records NBIS holds for Norwich are mostly ad hoc records or from one-off surveys. These types of records do not allow an assessment of the health of species, or to determine long-term trends.

110. To collect species records suitable for assessing change over time it is recommended to:

- Implement repeated standardised surveillance and long-term species monitoring, using and contributing to standard national schemes and methods that already exist **(R54)**.

4.4.2.5 Species coverage

111. Analysis carried out as part of the BBS (Norwich BBS Section 2 – Data Gaps) showed that some species and taxon groups were better represented in the NBIS database than others. Species that are smaller, more obscure, less well-liked, hard to find or difficult to identify were generally underrepresented. Many obscure species, such as under-reported invertebrate groups, are important to ecosystem services like pollination and soil

function. It is therefore important that these groups are better recorded to improve understanding of their status in Norwich. Better recording of rare and scarce species will also enable the production of rare and scarce lists for each BCA.

112. To fill gaps in species coverage in Norwich it is recommended to:
    - Encourage survey of under-recorded invertebrate groups both by experts and by skilled volunteer recorders trained in their identification **(R53)**.
    - Use improved species indicator lists as they become available as a basis for monitoring to detect change over time, for example the new Red Data Book list for bees and wasps due to be released in 2024 **(R55)**.
    - Consider commissioning a specialist survey for aquatic invertebrates such as white-clawed crayfish, American signal crayfish and Desmoulin's whorl snail in the river channels to ascertain if these species are present within Norwich. Specialist survey rather than volunteers would be required here due to the difficulties in surveying and identifying these species **(R52)**.
    - Consult with species experts to identify key rare and scarce species across taxonomic groups to be included in future monitoring schemes **(R52)**.

4.4.2.6 Data Sources and or resources

113. BBS analysis (Norwich BBS Section 2 – Data Gaps) showed that there are gaps in the data currently collated on the NBIS database, including datasets on the National Biodiversity Network (NBN) Atlas and iRecord. Addressing these gaps will be a coordinated process led by NBIS, but with input from Norwich CC and others to ensure that all relevant data is captured.

114. To address gaps in NBIS data it is recommended to:
    - Access and collate known datasets that are not currently on the NBIS dataset, including those from the NBN Atlas, iRecord, data on the Norwich CC Planning Portal and data recorded by 'Friends of' groups and other volunteer groups and organisations that is not currently being submitted **(R64)**.
    - Strongly encourage ecological consultants undertaking surveys for planning purposes to submit their records to NBIS in a timely manner, as this is an important source of data on protected species. It is recommended that this is included in biodiversity planning guidance **(R54)**.

4.4.3 Sites data gaps

115. BBS analysis of site data for Norwich (Norwich BBS Section 2 – Data Gaps) showed that the currency of much of the site data was old, with only half of the sites having been surveyed since 2010. Assessing current site condition, particularly of locally designated sites such as County Wildlife Sites (CWS), is therefore not possible in many cases. The two veteran tree datasets used in the BBS study also contained gaps, such as missing information about last

survey dates, current status and condition. The accuracy of the grid references of these two datasets also required updating.

116. To fill these sites data gaps it is recommended to:
    - Resurvey those Local Sites (particularly CWS) that have not been visited since the 1980s or 90s to ascertain current condition, management and up-to-date species and habitat information **(SMc21)**.
    - Conduct a survey of veteran trees in Norwich, to correct any grid reference errors, to identify any veteran trees not included in the current dataset, and to ascertain the current condition of the trees. Data capture should follow standard NBIS guidelines. The tree database held by Norwich CC should be used to help inform the survey work **(SMg4)**.
    - Update the Ancient Woodland Inventory dataset (project currently in progress by NBIS) for use in future revisions of the BBS analysis **(R59)**.
    - Obtain any remaining site management plans that have not already been analysed for those sites managed by the Norwich CC Parks and Open Spaces Team, and for churchyards and cemeteries, to enable any relevant information to be extracted **(R60)**.

4.4.4 Habitat data gaps

117. Most of the habitat data used in the BBS was generated using computer algorithms to analyse remotely sensed satellite imagery, combined with a small amount of field survey data. Some of the imagery used to create the remotely sensed maps was taken between 2006-2012, and therefore may not reflect the current habitats. The accuracy of the two remotely sensed habitat maps also varied due to methodological differences. While geographic coverage of the remotely sensed habitat mapping was very good, remote sensing techniques are currently unable to differentiate accurately between certain habitats such as types of grassland.

118. To fill these habitat data gaps it is recommended to:
    - Use the definitive habitat map created by the ongoing work by Norfolk County Council via the Norfolk and Suffolk Mapping Group once it is complete for future mapping revisions of the BBS analysis. The new map will fill many of the data gaps identified and address the issues raised regarding habitat mapping methodologies **(R63)**.
    - Use targeted habitat surveys to improve the accuracy of the habitat assessment made using satellite imagery. The work by the Norfolk and Suffolk Mapping Group will inform where such ground truthing to verify the data and further increase the accuracy of the mapping would be useful, and whether this could be done by volunteers or would require professional survey work **(R63)**.

- Use historic mapping, geodiversity, geology and soils datasets, all used in the BBS study to develop the BCAs, to improve the accuracy of current habitat mapping **(R63)**.

4.4.5 Sub section summary

119. This section outlines the gaps in species, sites and habitat data in Norwich which were identified during the BBS analysis. These gaps have a limited to moderate impact on the BBS, which remains a valid baseline assessment. This section describes how these gaps can be addressed using survey and monitoring.

4.5 Measuring the success of the delivery of BBS Opportunities

120. Opportunities to improve biodiversity in Norwich are presented in the Norwich BBS Section 8 – Opportunities. It is important that, where these opportunities are implemented at pilot sites, survey and monitoring is used to measure if they are successful. This section sets out the best practice for measuring the success of these biodiversity actions.

121. It is best practice to undertake surveys before and after implementing new biodiversity conservation actions, or changes in management. This is particularly important when piloting the proposed BBS opportunities for potential widespread implementation. Before and after surveys provide the required evidence that that the action successfully enhanced biodiversity. Ideally, monitoring should run for at least two years prior to conservation actions, but this is not always possible and one year may be sufficient. There are often situations where funding is available for immediate implementation, not allowing time for before survey. In these cases it is possible to assess success by conducting after surveys at sites where the action was implemented and at control sites that are very similar (Bane & Pocock (2023)). If conservation actions follow established methodologies with extensive research, surveys may be omitted before implementation, as would be justified in pond restoration using the Norfolk Pond Project (NPP) methodologies.

122. The decision tree (Figure 6. Decision tree: The approach for implementing surveys to measure the success of conservation action at pilot sites.) sets out the approach for implementing surveys to measure the success of conservation action at pilot sites, including determining the viability of changes, interventions, or actions and when they are unlikely to succeed.

123. The species and habitats recommended for surveying to measure success were chosen based on their relevance to the opportunities outlined in the Norwich BBS Section 8 – Opportunities.

124. For species this includes water voles and otters **(SMs16)** to assess the success of riverbank improvements; solitary bees, wasps and beetles **(SMS14)** to assess the success of bare ground creation, ground disturbance and deadwood habitat creation for invertebrates;

great crested newts **(SMs20)** to assess the success of pond restoration/creation; and field voles or barn owls **(SMs12)** to measure the success of tussocky grassland management.

125. For habitats this includes lowland mixed deciduous woodland **(SMs2)**, where before and after National Vegetation Classification (NVC) surveys show the change in ground flora communities due to opening up the canopy; lowland acid grassland and lowland heath **(SMs15)** where rapid grassland and pollinator abundance surveys can be used to assess the success of habitat restoration or creation; priority wetland habitats **(SMs19)** where before-and-after surveys capture changes in plant communities and invertebrate diversity in ditches during wetland habitat restoration or creation.

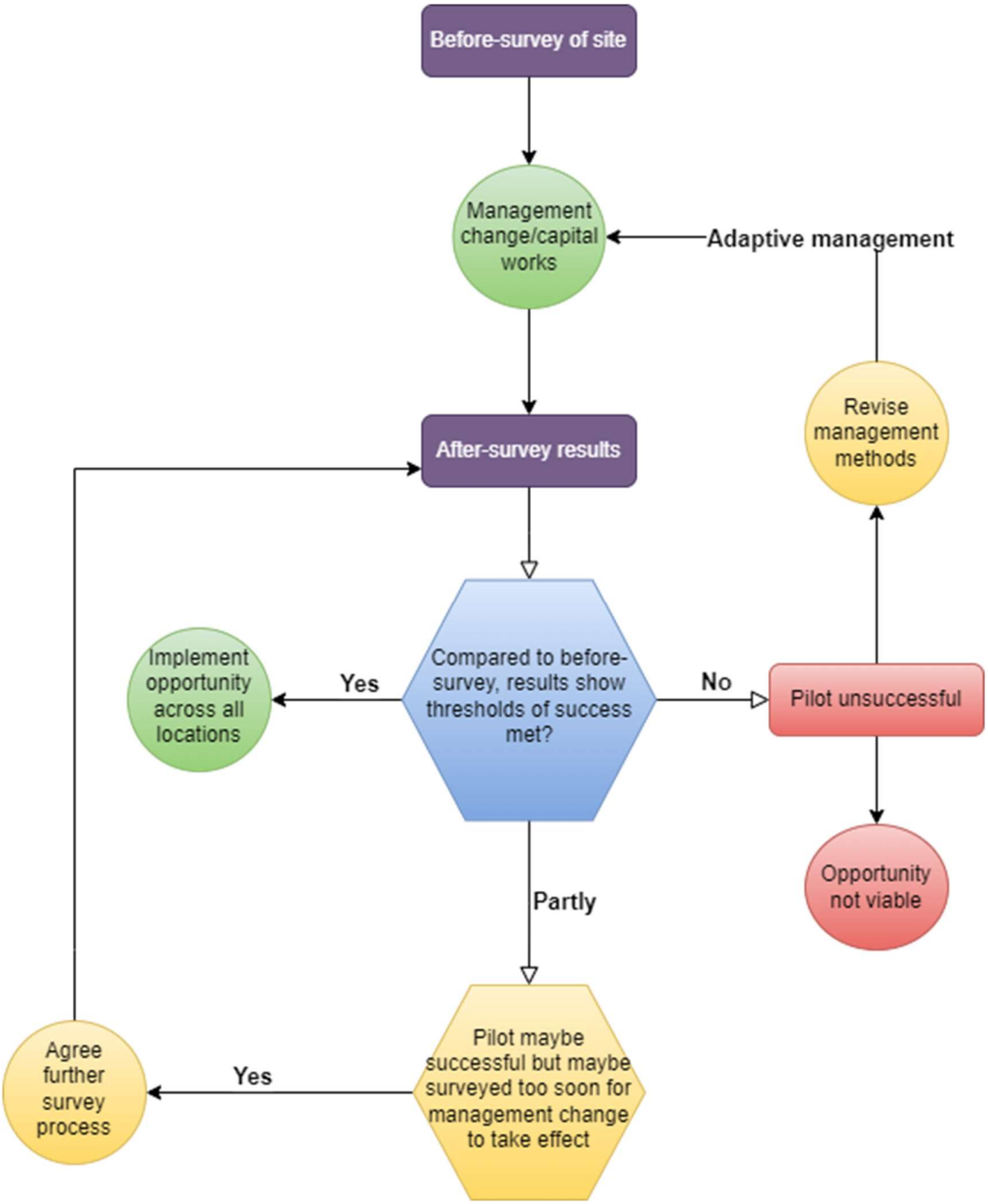


Figure 6. Decision tree: The approach for implementing surveys to measure the success of conservation action at pilot sites.

4.6 Monitoring change using standardised national surveys

126. Monitoring changes in biodiversity is critical for informing conservation efforts and policies by providing essential data on the population trends of key species, habitat health, and the impacts of expanding human activity over time. Standardised national surveys conducted

systematically year after year offer a consistent methodology for gathering comparable measurements. This allows a more accurate assessment of the rate, nature, and geographic distribution of biodiversity change.

127. Changes to be monitored include nature recovery or deterioration and site condition improvement or decline. If effective targets are set for nature recovery in Norwich as this study recommends, then ongoing survey and monitoring will be essential to report on these targets. Aside from targets and policy or legislative obligations, it is vital to monitor changes from the baseline to ensure that decision-making is underpinned by a current and robust evidence base.

128. The literature and web-based resources on current methods to monitor biodiversity change were reviewed to determine those methods that are:

- Scientifically sound.
- With quick and relatively easy to understand methods which are equally as effective and scientifically rigorous as more onerous surveys.
- Appropriate to the sites, habitats and species in Norwich.

129. Resources accessed included the NBIS Structured Species Surveillance Pilot methods and handbook; Norfolk Wildlife Trust web resources for survey; national reviews and summaries of surveys and monitoring, including Bane & Pocock (2023); and the linked resources and summaries available via the Natural History Museum's (NHM) Nature Recording Hub (National History Museum, 2023).

130. Various species, habitats, and elements of site condition can be monitored to assess changes in biodiversity. Those chosen for inclusion within the SMF Appendix SM1 BBS - Survey and Monitoring List reflect the opportunities identified in the Norwich BBS Section 2 – Data Gaps which can - once their success has been measured - be monitored regularly to assess further change, and those that are considered the best indicators of biodiversity change.

131. Two surveys are recommended for monitoring species change in general, which will be key in developing LNRS targets. These are for Priority Species abundance and Priority Species distribution **(SMc29, SMc30)**. These surveys will require development through the LNRS process, led by NBIS, using a small representative collection of species that can be classed as 'indicator' species. The development of the indicator list could use ideas developed by UEA in 'An easy to use assessment tool for cultivated margins in the Brecks' (Breckland Farmers Wildlife Network, 2023).

132. Other recommendations cite specific species such as: water vole and otter **(SMc16)** for ongoing surveillance to monitor change to meet any requirements of water vole DLL risk zone mapping; white clawed crayfish **(SMc1)** where monitoring against the baseline can

track eradication of INNS; bats **(SMc22)** to monitor bat populations and establish the condition of bat hibernation roosts; and swifts **(SMc26)** where monitoring changes in nest occupancy can help show where further boxes would help swift colonies.

133. Three surveys are recommended for local and national sites. For CWS **(SMc21)** to meet the target of achieving 70% in favourable or recovering condition by 2030, management changes can be implemented and an agreed timeframe for monitoring surveys established. The percentage of CWS and CGS in positive conservation management **(SMc37)** can be assessed and reported on. For SSSI/SAC **(SMc36),** Common Standards Monitoring of site condition to track change would ideally be maintained to ensure that the management is appropriate for the features the site is designated for.

134. Monitoring change in habitats is challenging and is best achieved at a county level through the LNRS process. However, SMF Appendix SM1 BBS - Survey and Monitoring List includes two government-monitored habitat indicators—woodland cover **(SMc35)** and surface water ecological status **(SMc40)**—to provide a general overview of change. It's important to recognise that these indicators are monitored by proxy via site condition monitoring.

135. To monitor the roll out of pilot management change it is recommended that ongoing surveillance is carried out at: wildflower areas **(SMc9)**, 'conservation cut' amenity grassland/meadows **(SMc8)**, road verges **(SMc13)** and tussocky grassland margins **(SMc12).** Ongoing surveillance for wetland habitats **(SMc19)** and ponds **(SMc20)** are particularly important for pond restoration and GCN DLL. Known sites for GCN or sites that become known from surveillance need to be monitored annually with full GCN surveys by licenced individuals**.** For Lowland mixed deciduous woodland **(SMc2)** assessing woodland sites for NVC communities is suggested to influence further management.

4.7 Survey and monitoring to meet planning requirements

4.7.1 Biodiversity Net Gain

136. Mandatory Biodiversity Net Gain (BNG) is one of the key mechanisms delivered by the Environment Act 2021 that will contribute to nature recovery. Because of this, it is vital that BNG is monitored as on-site/ off-site units or via statutory credits, to confirm it is delivering as per planning approvals and in accordance with local policy and legislation. BNG monitoring data will also add important up to date information on Norwich's biodiversity, in particular contributing to the habitat map that is under development for the Norfolk Local Nature Recovery Strategy (LNRS).

137. The BBS includes opportunities to use BNG units to deliver biodiversity benefit in parks and open spaces (e.g., looking into the feasibility of setting aside 10% of each site, where appropriate, for biodiversity).

138. Credits can either be sold as off-site units through the Natural England statutory credit register if viable within the DEFRA metric or be managed by Norwich CC for biodiversity. Either way, it is a requirement to manage significant on site and all offsite biodiversity net gain for 30 years, either via s106 agreements, planning condition or a Conservation Covenant (DEFRA,2022b). Securing a longer agreement would be beneficial because after 30 years, these agreements cease, and there is no obligation to continue habitat management. However, should re-entry into the off-site market occur, a re-run of the baseline analysis would be required. Monitoring over the 30 years allows changes to be monitored effectively, ensuring successful management and good habitat condition in the long run. If the BNG units are for woodland creation, this is deemed a permanent land use change (due to a felling licence being required to fell trees) and hence continuation as woodland is all but secured by planning at the start of the first 30 years.

4.7.2 District Level Licences

Great Crested Newt

139. Survey and monitoring for Great Crested Newt (GCN) as part of district level licensing (DLL) (DEFRA & Natural England, 2022a) is important on a long -term basis. As part of district level licensing (DLL)GCN metapopulations have been mapped in red, amber and green risk zones. Development is not ordinarily allowed in red zones but can be acceptable in amber and green zones subject to DLL procedures.

140. The survey suggestion **(SMc20)** includes annual GCN monitoring at known and new sites. Having up to date data on the ever-changing distribution of GCN will help to keep this protected species safe from the impacts of development. The data provided to update risk zone mapping also need to meet the following criteria set out by Natural England:

- The amber risk zones will only incorporate GCN records from Local Environmental Record Centres (LERCs), class licence returns and Natural England eDNA records which have been recorded post 2000, with a higher spatial resolution than 100m x 100m.
- For red zones, datasets currently used by Natural England do not always hold population data (peak counts). In future. new locations which potentially meet the criteria for red zone designation will need to be supported with survey data before Natural England will consider them. This data must include peak counts (normally 100+ GCNs) and the year of survey, with three years of survey data required, although some level of flexibility on survey effort may be permitted.

141. GCN recording in Norfolk is mainly undertaken as part of ecological consultant surveys, casual recording by amateur experts and members of the public. It is therefore unlikely that three years of consecutive recording has taken place in most locations, as both these groups have little need to return to a site once they have recorded GCN.

142. It is therefore recommended that all existing and new sites for GCN in Norwich are monitored annually, so that this data can be provided to Natural England to update the GCN DLL risk zone maps.

Water Vole and other protected species DDLs

143. Natural England are currently looking at Norfolk and Suffolk as pilots for a DLL approach for water voles, both for planning reasons and to deliver on species abundance targets for 2030 through the Environment Act 2021. Although this is in its early stages, it is important to note the direction of travel for Protected Species within the planning system and how the GCN risk zones requirements for survey could mean that water voles will need to be monitored annually. Such a survey is already in the SMF Appendix SM1 BBS - Survey and Monitoring List **(SMc16)**.

144. Based on this direction of travel it is recommended that Norwich City support working towards annually monitoring key protected species within the planning system that require DLL or other licencing for survey and mitigation.

4.8 Section summary

145. This section has outlined how the SMF Appendix SM1 BBS - Survey and Monitoring List was developed, through stakeholder engagement, data gaps analysis, reviewing the BBS opportunities, and through literature reviews. It describes how the SMF Appendix SM1 BBS - Survey and Monitoring List is set out, an overview of what information it contains and how it can be used.

146. Stakeholder responses to a questionnaire about current Survey and Monitoring in Norwich and future survey needs are summarised, and the key points noted.

147. Gaps in the biodiversity data for Norwich, including for species, sites and habitats, were clearly demonstrated through the analysis of the Norwich BBS Section 2 – Data Gaps. This section describes these gaps, and how survey and monitoring can be used to help to fill them.

148. Measuring success is important to deliver pilots of opportunities recommended in Norwich BBS Section 8 – Opportunities. The surveys listed look to cover assessment of this process and to help land managers determine the success of pilots, assessing at which stage it is appropriate to roll out those opportunities as conservation actions across Norwich.

149. Creating a baseline dataset as part of the BBS allows change to be monitored against that baseline. This can provide evidence for nature recovery, allowing targets to be set as part of LNRS, and for biodiversity reporting as part of the strengthened Biodiversity Duty on all local authorities. Without a baseline, setting targets and monitoring change against those targets, there is no scientifically rigorous evidence to support the work being implemented.

150. The planning needs for biodiversity survey and monitoring are also described, particularly in relation to BNG and GCN District Level Licencing.

Section 5: Recommendations

5.1 Introduction

151. This section makes detailed recommendations to take forward regarding setting up a survey and monitoring programme and includes other key messages from the work undertaken. This Survey and Monitoring Framework is intended as a toolbox for future work. These recommendations are grouped under 5 key themes: Setting up a Survey and Monitoring Programme in general; Species, Sites and Habitats related recommendations; and recommendations for the Norfolk Biodiversity Information Service (NBIS).

152. It should be noted that these recommendations are not binding commitments, but rather suggestions put forward for further assessment and feasibility review as to their viability and fit with overall goals and priorities. Their ultimate adoption would depend on a variety of factors including budgetary constraints, community input, and integration with existing policies and programmes.

153. The recommendations in this section are duplicated in the Survey and Monitoring recommendations in the Norwich BBS Section 10 - Recommendations, and as such they are numbered accordingly, based on their order in the Norwich Biodiversity Baseline Study.

154. These recommendations and this report should be read in conjunction with all the BBS report outputs and decisions should therefore be based on all reports as one combined evidence-base.

5.2 Setting up a survey and monitoring programme recommendations

R42. Investigate creating a 'Survey and Monitoring Programme', to implement actions from the Survey and Monitoring Framework to fill data gaps, measure change and monitor success of conservation actions.

R43. Consider conducting a feasibility study to look at the details for implementing recommendations from Survey and Monitoring List, including budget calculation and identification of funding sources as appropriate.

R44. Consider creating a series of key goals and targets/indicators for biodiversity using the information in the Survey and Monitoring Framework which are closely aligned to national environment monitoring targets but can also be used at a local level. These could be integrated in the Biodiversity Development Plan.

R45. Using information from the BBS and support NBIS and other experts to investigate the creation of an appropriate network of sampling sites and locations within them on which the Survey and Monitoring Programme will take place.

R46. Consider including in planning guidance the requirement for ecological consultants to submit their records to NBIS.

R47. When conducting surveys, consider best practice guidance to conduct survey both before and after conservation actions, following the BACI survey design approach where possible.
R48. Consider recruiting a Volunteer and Survey Coordinator (linked to R5). This post could coordinate volunteers, help coordinate surveys and the partnerships needed to deliver them and manage the collation of data and data exchange with NBIS (this is covered more in SMF Appendix SM3 BBS - Guidance on Conducting Wildlife Surveys).
R49. Consider setting up a 'Small Grants Fund' for local groups to apply for equipment, training and resources. [Potentially this fund or some of could be annually sourced from the Norwich Neighbourhood CIL (Community Infrastructure Levy) and agreed with communities.]
R50. Explore the facilitation of a 'Local Groups' Programme' to exchange skills, knowledge, equipment and expertise. Some of which could be facilitated through Lumi.
R51. S or divert funding to survey and monitoring where appropriate (for equipment, training, support and general resources).
R52. Investigate creating indicators for comparative analysis between successive iterations of the Norwich BBS outputs to provide a mechanism for monitoring change. Ideally these indicators would be agreed prior to revision and shortly after completion of this study.
R53. Explore reporting results from this survey and monitoring framework's activities as part of the Biodiversity Reporting required under the Strengthened Biodiversity Duty , using the recommended report structure (Section 8: Monitoring and evaluating your actions) to capture biodiversity monitoring in one place. Suggested reporting periods for each survey are provided in SMF Appendix SM1 BBS - Survey and Monitoring List.

5.3 Species recommendations

R54. Encourage recording at sites that currently have low recorder effort.
R55. Encourage recording at high spatial resolution across taxonomic groups, especially for axiophytes, breeding and roosting birds, rare and scarce species, and species important in planning (including all European Protected Species and badgers, further information see Table 3 in NBIS Best Practice and Ecological Standards).
R56. Encourage targeted field surveys of rare and scarce species, following advice from local experts on identifying key species.
R57. Encourage recording, at high resolution, under-recorded groups e.g., beetles, fungi, lichen, non-vascular plants and more obscure invertebrates.
R58. Encourage long term monitoring, using and contributing to standard national schemes/methods to enable change to be measured.
R59. Identify and use improved species indicator lists as they become available.
R60. Encourage the submission of ecological data collected from planning-related survey to NBIS via the BNG planning guidance note/SPD.
R61. Investigate increasing training in species identification skills and survey and monitoring methods, initially focusing on existing volunteer groups, but then also using wider engagement to increase the number of committed volunteers.

R62. Aim to ensure all records generated from the survey and monitoring programme are collated and submitted to NBIS as well as national schemes.

R63. Continue to support the work required to annually monitor all species protected within the planning system that need District Level Licensing or other licensing to survey and mitigate. It is imperative that all existing and new sites for great crested newt in Norwich are monitored annually.

5.4 Sites recommendations

R64. Aim to Incorporate the Ancient Woodland Inventory update into the baseline data when available.

R65. Extract relevant information from site management plans from the Parks and Open Spaces Team, as well as those for churchyards and cemeteries where they exist to include in the next revision of the baseline study.

R66. Site surveys which reference the biodiversity interests and how they will be protected and enhanced are recommended to inform management plans for each site.

R67. Consider setting up a Service Level Agreement (SLA) with Norfolk Wildlife Trust to fund an ongoing Local Wildlife Site survey, monitoring and advice programme.

5.5 Habitats recommendations

R68. Support improvements to the LNRS habitat map through encouraging targeted field survey and the consideration of the use of historic mapping datasets, geodiversity, geology and soils data, all of which have been vital to the development of the BBS.

5.6 NBIS recommendations

R69. Source and collate records not currently on their database – National Biodiversity Network (NBN)/iRecord, consultants, volunteer groups etc.

R70. Work with species experts to ease current bottlenecks in verification of volunteer/citizen science data.

R71. Lead on the coordination of records data flow to ensure all records from survey and monitoring are submitted to NBIS for quality control, before being made available to Norwich CC and other decision makers.

R72. Set up a Data Exchange Agreement or Data Sharing Agreement between NBIS and Norwich CC.

Section 6: Conclusions

155. To understand whether nature is in recovery or decline, it is necessary to monitor change in species diversity and abundance, habitats and site condition. It is difficult to meaningfully report on biodiversity without having a clear understanding of baseline assets and ways of measuring success and change. This is important to fulfil biodiversity reporting

requirements for the Strengthened Biodiversity Duty and to track success and change towards nature recovery within the LNRS, BNG and more widely. Effective survey and monitoring supports the delivery of the bigger, better and more joined up habitats needed across the city as part of the opportunities and recommendations of the Norwich Biodiversity Baseline Study. A programme of Survey and Monitoring is an effective and auditable long-term tool. Piloting proposed opportunities at a limited number of sites, before roll-out to other sites is pragmatic and cost effective. Before a pilot is rolled out, survey and monitoring is needed to assess if it was successful.

156. Important elements that need to be considered when devising an approach to large scale survey and monitoring include identifying the needs to be met, ensuring that successes can be measured and change monitored, selecting appropriate sampling approaches and considering the importance of future revisions to ensure the evidence base remains robust.

157. This report makes survey recommendations in the SMF Appendix SM1 BBS - Survey and Monitoring List on how gaps in data identified in the BBS can be filled, and how survey and monitoring can be used to measure conservation success, assess changes in biodiversity and provide data for planning needs. The recommendations incorporate stakeholder feedback and a review of current best practice in the literature.

158. The suggested surveys use standardised and nationally recognised methodologies and most are suitable to be conducted by trained volunteers. They have been matched with existing national environmental monitoring targets where possible. The SMF Appendix SM1 BBS - Survey and Monitoring List is sortable and filterable on all fields, allowing the surveys to easily be embedded against appropriate actions in the Norwich CC Biodiversity Development Plan.

159. While none of the surveys listed in the SMF Appendix SM1 BBS - Survey and Monitoring List are a legal requirement for Norwich CC to undertake, survey and monitoring is strongly recommended to ensure that Norwich CC can demonstrate their progress against targets set through the Strengthened Biodiversity Duty under the Environment Act 2021.

160. Recommendations are presented in Section 5: Recommendations for setting up a survey and monitoring programme in Norwich, incorporating surveys listed in the SMF Appendix SM1 BBS - Survey and Monitoring List. They are not binding commitments and are not actions solely for Norwich CC to implement but are put forward for further assessment and feasibility review.

161. The recommendations in this report have also been replicated in the BBS report (Norwich BBS Section 10 - Recommendations) for completeness.

Section 7: Definition of terms

Table providing definitions of biodiversity terms used in the report.

Term	Definition
Ad hoc records	Where a species is recorded in an impromptu manner, rather than following a structured sampling or monitoring protocol.
Ancient Woodland Inventory	An inventory that documents Ancient Woodland sites in England. Ancient Woodland is identified from old maps, name and boundary information, ground survey and aerial photography.
Axiophytes	Species, often termed "worthy plants," that constitute as indicators of ecologically significant habitats, aiding in the determination of conservation priorities. They are selected based on criteria such as their predominant association with conservation habitats, uncommon occurrence (recorded in less than 25% of tetrads), historical decline, moderate rarity, ease of identification, and representation of diverse habitats (Norfolk Flora Group, 2023).
Bioblitz	An event that focuses on finding and identifying as many species as possible in a specific area over a short period of time.
Biodiversity	The variety of plant and animal life on Earth or in a particular habitat. A high level of biodiversity is important and beneficial for maintaining and supporting ecosystems.
Biodiversity Character Area	Using National Character Areas as a basis, these are thematic character areas with consistent attributes. They were created to profile Norwich's biodiversity value into spatially contiguous, locally distinctive, and thematically consistent areas, based on natural features and delivering on a common set of needs.
Biodiversity Duty	Strengthened by the Environment Act 2021, this states that public authorities must: • Consider what they can do to conserve and enhance biodiversity. • Agree policies and specific objectives based on their consideration. • Act to deliver their policies and achieve their objectives.

Biodiversity hotspots	An area characterised by a high level of biodiversity.
Biodiversity Net Gain	An approach that aims to leave the natural environment in a measurably better state then it was before it was developed (DEFRA, 2023d).
Buffer Zones	As defined in (Lawton, 2010): These are areas that closely surround core areas, restoration areas, 'stepping stones' and ecological corridors, and protect them from adverse impacts from the wider environment.
Citizen Science	Citizen science is scientific research conducted with participation from the general public.
Control Sites	Control sites have the same characteristics as site undergoing conservation management, but no actions are taken. Control sites can then be compared with managed areas to assess the impacts of conservation actions.
Core Area	As defined in (Lawton, 2010): These are areas of high nature conservation value which form the heart of the network. They contain habitats that are rare or important because of the wildlife they support or the ecosystem services they provide. They generally have the highest concentrations of species or support rare species. Core areas provide places within which species can thrive and from which they can disperse to other parts of the network. They include protected wildlife sites and other semi-natural areas of high ecological quality.
Corridors or 'Stepping Stones'	As defined in (Lawton, 2010): These are spaces that improve the functional connectivity between core areas, enabling species to move between them to feed, disperse, migrate or reproduce. Connectivity need not come from linear, continuous habitats; a number of small sites may act as 'stepping stones' across which certain species can move between core areas. Equally, a land mosaic between sites that allows species to move is effectively an ecological corridor.
County Recorders	Expert volunteers in a particular taxonomic group (e.g. birds, beetles, freshwater fish etc.) who, as well as contributing their own records, also verify records from other people to help ensure their accuracy.

County Wildlife Site (CWS)	An area of land that is designated and conserved due to containing significant populations of locally or nationally important, threatened or vulnerable wildlife species and habitats. They do not have any legal or statutory status and are locally designated through voluntary processes and wildlife audits rather than being formally established in law.
Data currency	How current the data is relative to the time it was created or last updated. Having data with good currency means it accurately reflects the most recent state of what it describes.
Data resolution	The precision and accuracy of spatial information associated with the record. For example, a low-resolution record may consist of four-figure grid reference which indicates the species has been recorded somewhere within a 1km x 1km square. In contrast a high-resolution record, may provide a ten-figure grid reference which indicates the species has been recorded somewhere within a 1m x 1m square.
Data validation	Process of confirming the accuracy, completeness, and consistency of the data ensuring that it confirms to predefined rules and formats (i.e. the date and the grid reference are correct format etc.). This process is often automated.
Data verification	Process of confirming the accuracy and correctness of the identification of the species being recorded.
District Level Licensing	An alternative approach to great crested newt licensing, aiming to increase numbers of great created newt by providing new or better habitats in targeted areas to benefit their wider population.
Ecological network	The basic, joined up infrastructure of existing and future habitat needed to allow populations of species and habitats to survive in fluctuating conditions.
Ecosystem	All of the organisms and the physical environment with which they interact.
Ecosystem Services	The many and varied benefits to humans provided by the natural environment and healthy ecosystems.
Ecotone	A transitional zone or boundary area between two or more different ecological communities or habitats. It contains characteristics and species of

	both bordering communities or environments, as well as unique organisms and processes only found in the ecotone.
eDNA	Environmental DNA is DNA that is collected from a variety of environmental samples such as soil, seawater, snow or air, rather than directly sampled from an individual organism. As organisms interact with the environment, DNA is expelled and accumulates in their surroundings.
eNGOs	Environmental non-governmental organisation.
Hectad	A 10km x 10km square.
Indicators	A particular species or designated group of species that is systematically monitored over time in order to make inferences about the state of the wider ecosystem or biodiversity. Species selected to indicate broader ecological change tend to be sensitive and responsive to environmental pressures or shifts.
Lawton Principles	A result of the 2010 'Making Space for Nature' report by Sir John Lawton which recommended the principles of making wildlife sites bigger, better, and more joined up to help rebuild nature to reverse biodiversity declines, preserve ecosystem services and adapt to climate change (Lawton, 2010).
Local Environmental Record Centre	Organisations which have been established, usually through a partnership of interested parties, in order to bring together local information on wildlife and to supply this to local users.
Local Nature Recovery Strategy	A local nature recovery strategy is a strategic plan developed by local authorities, communities and partner organisations to identify opportunities and priorities for restoring and connecting nature across a defined geographical area (DEFRA, 2023e)
Metapopulation	Distinct groups of a single species that are geographically separated but connected by movement or dispersal between the groups.
Monitoring	Surveillance undertaken to ensure that formulated standards are being maintained (JNCC 1998) and needs to be done against a predefined conservation objective. Monitoring is the regular recording of the same area following a

	standardised, repeatable method and comparing the results to help understand changes. It generates the best data for assessing the changing fortunes of species.
National Forest Inventory	A rolling programme designed to provide accurate information about the size, distribution, composition and condition of forests and woodlands and also about the changes taking place in the woodlands through time (Forestry Commission, 2023).
Nationally Rare	Species that have been recorded in 15 or fewer hectads across Britain, this accounts for 0.5% of Britain's 10km grid square network. As such, nationally rare species have highly restricted ranges and small surviving populations making them extremely vulnerable to extinction.
Nationally Scarce	While not as limited in distribution as nationally rare, these are species that are found in between 0.5 and 3% of Britain's 10km grid square network. Nationally scarce species fall into one of two subcategories - "Notable A" and "Notable B" - depending on their frequency of occurrence: • Notable A: species recorded in 16 to 30 hectads • Notable B: species recorded in 31 and 100 hectads. A status of Local is also sometimes used, referring to species found in between 101 and 300 hectads.
Nature Improvement Areas	Nature Improvement Areas (NIA) were established to create joined up and resilient ecological networks at a landscape scale. They are run by partnerships of local authorities, local communities and landowners, the private sector and conservation organisations with funding provided by the Department for the Environment, Food and Rural Affairs (Defra) and Natural England (Natural England, 2016)
Nature Recovery	The process of restoring habitats, protecting wildlife and combating climate change through collective action.

Nature Recovery Networks	An initiative to enhance and restore biodiversity across the country by creating a connected network of habitats that support wildlife and ecosystems (DEFRA & Natural England, 2022b).
Norfolk Living Map	The current habitat map for Norfolk, created using remote sensing methods
Pilot Sites	Sites for testing out conservation approaches ahead of a wider scale roll out. The success of approaches would be monitored on these sites and where necessary changes made to the proposed approach.
Priority habitats (Habitats of Principal Importance)	Habitats listed under section 41 of the 2006 Natural Environment and Rural Communities (NERC) Act.
Priority Species	Species listed under section 41 of the 2006 Natural Environment and Rural Communities (NERC) Act.
Recorder effort	The frequency of visits to a site for the purpose of biological recording. This effort may vary across different areas with potential bias towards recording at more aesthetically pleasing or ecologically interesting sites, perhaps with more 'interesting' species to see. The level of recorder effort can influence the recorded biodiversity of a site, with frequently visited locations appearing more biodiverse than those that are infrequently visited, even if the actual biodiversity is not necessarily higher.
Remotely sensed habitat data	Habitat mapping created using algorithms to analyse various types of satellite imagery combined with some field data and OS MasterMap boundaries. The algorithm classifies each map pixel based on the likely presence of a habitat using a set of rules. This process generates a habitat probability map for the area.
Restoration Areas	As defined in (Lawton, 2010): These are areas where measures are planned to restore or create new high value areas (which will ultimately become 'core areas') so that ecological functions and species populations can be restored. They are often situated so as to complement, connect or enhance existing core areas.
Site condition	Elements of the condition of a site that can be measured or monitored to appraise its ecological

	health. For designated sites, site condition monitoring assesses the condition of the features of interest.
Surveillance	Making repeated, standardised surveys to detect change (does not differentiate between acceptable and unacceptable change).
Survey	Making a single observation to measure and record, without the intention to repeat these recordings. This can involve recording multiple species and multiple individuals thereof.
Sustainable Use Areas	As defined in (Lawton, 2010): These are areas within the wider landscape focused on the sustainable use of natural resources and appropriate economic activities, together with the maintenance of ecosystem services (Bennett and Mulongoy 2006). Set up appropriately, they help to 'soften the matrix' outside the network and make it more permeable and less hostile to wildlife, including self-sustaining populations of species that are dependent upon, or at least tolerant of, certain forms of agriculture. There is overlap in the functions of buffer zones and sustainable use areas, but the latter are less clearly demarcated than buffers, with a greater variety of land uses.
Targets	Targets refer to clearly defined desired outcomes that signatory countries or organisations aim to achieve by a specified date. Biodiversity targets typically establish quantitative goals and milestones for the state of ecosystems, habitats, species populations or genetic diversity at either global or national levels over a set timeframe.
Taxonomic groups	A cluster of organisms from the same or closely related taxonomic categories, which could be at levels like class, order or family, that are classified as a unit based on their evolutionary relationships and characteristics. e.g., birds, mammals, vascular plants, beetles etc.
Tetrad	A 2km x 2km square.
UKHabs	The UK Habitat Classification System is a new, unified and comprehensive approach to classifying terrestrial and freshwater habitats across the UK.

Vagrants	A species which appears well outside of its normal range.
Veteran Tree	Trees that exhibit the deteriorating characteristics that come with being near or at the oldest stage of their lifespan, such as decay, cavities or dead wood. These features provide important ecological niches which make them especially important for wildlife.

Section 8: References

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