2022 Scientific Consensus Statement | Process

Methods for the Synthesis of Evidence

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Cover image: Mulgrave-Russell, Wet Tropics, Queensland.
Photo credit: Dieter Tracey

Contents

Glossary

Note that the Terms highlighted in italics in the Meaning are also defined in the glossary.

Term	Meaning
Bias	A preference for or against one idea, thing or person. In scientific research, bias is a systematic deviation between observations or interpretations of data and an accurate description of a phenomenon[1].
Body of evidence	All *evidence items* used to address a specific question.
Candidate studies	*Evidence items* identified through the *search strategy* that are retained for further assessment.
Confidence	Level of trust in the *body of evidence* used for each question. For the 2022 Scientific Consensus Statement, the 'overall confidence' of a *body of evidence* is determined by the *relevance* of studies that constitute it and by the *consistency* of the body of evidence' (UK Department for International Development, 2014).
Consistency	Level of convergence or agreement of findings between *evidence items*. This may be assessed as being consistent both in the direction and magnitude of effect.
Contextual variable	Any variable that modifies the magnitude or direction of an intervention or exposure effect. Contextual variables are one cause of heterogeneity in the outcome of interventions and are also known in the evidence synthesis literature as 'effect modifiers' (Collaboration for Environmental Evidence, 2013).
Diversity of study types	The type of studies being used as sources of *evidence* i.e. observational, experimental, modelling, theoretical or conceptual, and secondary studies such as reviews or summaries. In the context of the 2022 Scientific Consensus Statement, also associated with 'multiple lines of evidence'[2].
Evidence	Relevant information used in answering a question or hypothesis to determine its truth or validity.
Evidence item	An individual piece of *evidence* which may be a study, data or other documented evidence used to address a specific question.
Mendeley evidence library	An electronic reference database, using Mendeley bibliographic management software, for storing all *evidence items* used in the current and previous Scientific Consensus Statements.
S/PICO and variations	The Subject/ Population/ Intervention/ Comparator/ Outcome framework and variations are used to determine the key elements of a review question[3]. **Subject/Population**: Who or what is being studied or what is the problem. **Intervention/exposure**: Proposed management regime, policy, action or the environmental variable to which the subject populations are exposed[4].

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[1] How bias affects scientific research
[2] Deriving guideline values using multiple lines of evidence
[3] Systematic reviews: Defining the question
[4] Identifying the need for evidence, determining the evidence synthesis type, and establishing a Review Team

Term	Meaning
	Comparator: What is the intervention/exposure compared to? (e.g. other interventions, no intervention, etc.). This may also include a time comparator as in 'before or after' treatment or exposure. This can be optional if no comparison applies. **Outcome**: What are the outcomes relevant to the question resulting from the intervention or exposure?
Quantity of evidence	A relative assessment of the size of the *body of evidence* used to address each Scientific Consensus Statement question based on the total number of *evidence items*. While it is not possible to quantify the number of studies that is adequate for answering specific questions, authors must use their topic expertise to suggest whether the number of studies used is 'high', 'moderate' or 'low'.
Peer reviewed published literature	Any *evidence item* that has undergone a review by external independent experts in the same field and the feedback is addressed by the authors to generate a revised document. In the context of the Scientific Consensus Statement, this includes traditional academic literature, but also grey literature (e.g. reports, theses) as long as it has been independently peer reviewed and is publicly accessible.
Rapid review	A form of knowledge synthesis that follows the formal *Systematic Review* process (defined below), but parts of the process are simplified or omitted to produce information within specified resources, in a timely manner and to meet specific user needs (Khangura et al., 2012).
Relevance of evidence	The extent to which the *evidence* is relevant to the question being asked. Relevance is often referred to as the 'external validity' of the study (i.e. whether it can be generalised from the original study to address the review question).[2] For the 2022 SCS two aspects of relevance will be assessed: 1) the relevance of the study approach and results to the question and 2) the spatial and temporal relevance to the question.
Reliability of evidence	The extent to which a **study** is free from *bias* or confounding elements.
Search Strategy	An *a priori* description of the methods used to find *evidence items* relevant to a question. When conducting a systematic search for evidence this would include a list of the S/PICO elements, search terms, search strings, search sources and inclusion/exclusion criteria.
Synthesis	Synthesis occurs when disparate data, concepts, or theories are integrated in ways that yield new knowledge, insights, or explanations (Pickett et al., 2007). Synthesis creates emergent knowledge in which the whole is greater than the sum of the parts. By engaging experts with multiple perspectives, synthesis is capable of vetting a vast body of information for use by other disciplines or by society in general (Carpenter et al., 2009).
Systematic Review	A formal review of literature using systematic, explicit and accountable methods (Gough et al., 2017).

Acknowledgements

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[5] Professor Wilson's involvement was prior to her appointment as Queensland's Chief Scientist.

1. Background

The Reef 2050 Water Quality Improvement Plan (Reef 2050 WQIP) is a joint commitment of the Australian and Queensland governments. The Reef 2050 WQIP underpins a collaborative program of coordinated projects and partnerships designed to improve the quality of water flowing to the Great Barrier Reef (GBR). The Scientific Consensus Statement (SCS) is a foundational document which provides the scientific underpinning of Reef 2050 WQIP design and implementation. The SCS is updated periodically to support the update of the Reef 2050 WQIP.

The three primary outputs of the 2022 SCS are: 1) a comprehensive synthesis of the best available evidence to support water quality management for the GBR and the Reef 2050 WQIP in particular, and 2) a mid-level summary bringing together evidence across themes, and 3) high-level conclusions, including key points of consensus. The **synthesis of evidence** is structured as a series of questions about the influence of land-based runoff on the GBR, including the drivers, pressures and management responses. The **summary and conclusions** will form higher-level documents aimed at a target audience of management and policy makers and will act as an overarching summary and conclusions of the scientific findings developed through the synthesis of evidence, agreed by a broad range of experts.

C$_2$O Consulting is engaged by the Australian Government's Department of Climate Change, Energy, the Environment and Water (DCCEEW), in partnership with the Queensland Government's Department of Environment, Science and Innovation (DESI), to deliver the 2022 SCS. Evidentiary is engaged as the evidence rapid review expert for the process. C$_2$O Consulting coordinates the delivery of the 2022 SCS and the evidence synthesis specifically (herein referred to as the SCS Coordination Team).

Following a scoping exercise in 2021 (Thomas & Waterhouse, 2021), a number of key features required for the 2022 SCS were identified by policy and management representatives, scientific experts and potential additional users of the SCS. This included specific discussion of the approach to evidence synthesis and recommended '***Adoption of a systematic approach of <u>evidence synthesis</u> that minimises author bias, critically appraises quality and relevance of the evidence and provides an indication of confidence in the evidence'.***

Following further discussion with the Reef Water Quality Independent Science Panel (ISP) and representatives from policy and management (primarily DCCEEW and DESI), the methods for the 2022 SCS synthesis of evidence have been developed under the guidance of the following principles:

- A process that maintains **independence** from government policy and management.
- **Transparency** in the synthesis process and evidence used.
- **Minimise bias** through the appraisal of evidence reliability.
- The use of **fit for purpose** and relevant evidence.
- An assessment of the level of '**confidence**' or trust in the evidence.

A detailed description of the process undertaken for the development of methods for the synthesis of evidence within the 2022 SCS, including the background, scope, approach, principles and challenges, has been produced in a separate document (*2022 SCS Approach to the Development of Methods for the Synthesis of Evidence*) and is available from the 2022 SCS website.

A list of 30 questions have been defined in consultation with policy and management representatives, scientific experts and stakeholders. Lead authors have been selected through an independent Expression of Interest (EOI) process including individuals from a range of organisations including the Australian Institute of Marine Science, CSIRO, James Cook University, Central Queensland University, University of Queensland, Griffith University and private consultants). Lead authors are required to deliver the 2022 SCS questions using one of the methods described in Section 2.

Figure 1 illustrates the overarching conceptual framework for the 2022 SCS. The framework provides the foundation for the proposed structure of the 2022 SCS shown in Figure 2. Several author sub-groups for the main themes will be coordinated by the SCS Coordination Team to facilitate discussion and consultation between authors.

The purpose of this document is to provide authors of the 2022 SCS with instructional guidance for completing the following primary outputs for each SCS question:

1. The template (Appendix 1: 2022 SCS Template for the synthesis of evidence)
2. 'Data Extraction & Appraisal' spreadsheet (download here)
3. Summary list for all contributions and inputs to the Question (Appendix 2: 2022 SCS author contributions)
4. Addition of all evidence items to the Mendeley evidence library (Appendix 3: 2022 SCS Instructions for using Mendeley evidence library)

These fit for purpose evidence synthesis methods were developed in consultation with policy and management representatives, the Reef Water Quality Independent Science Panel (ISP) and the Reef 2050 Independent Expert Panel (IEP), and other experts, and have undergone a rigorous external peer review process by three experts in the field of systematic review and evidence synthesis.

Further details on the author selection and question setting processes have been produced as separate documents and are available on the 2022 SCS website.
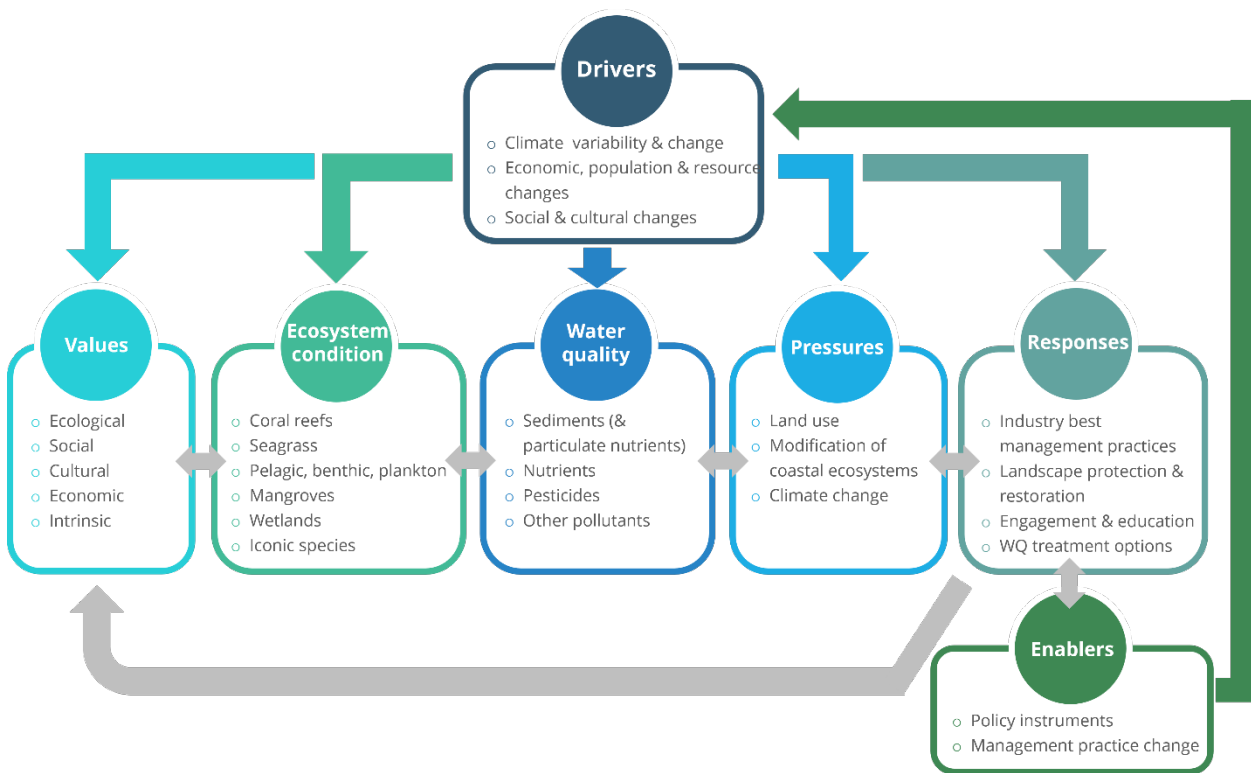
Figure 1. Overarching conceptual framework for the scope of the 2022 Scientific Consensus Statement.

Figure 2. Structure of the 2022 Scientific Consensus Statement.

2. Introduction to the 2022 SCS Evidence Synthesis Methods

At the core of the development of the 2022 SCS is the adoption of evidence based rapid reviews to provide an up-to-date overview of the key findings of the evidence for each of the 30 specific questions.

A rapid review process (see Cook et al., 2017) has been adopted to suit the resources and time available to deliver the project, which is approximately 6 months for the completion of the draft responses to the questions, **with approximately 15–30 days of funding available for each lead author conducting the search, synthesis and reporting of evidence.** Rapid review methods involve a reduction in, or omission of, some steps compared to full Systematic Reviews. These may include the search effort, quality appraisal of evidence and the amount of data extracted.

To accommodate the needs of GBR water quality policy and management, two different rapid review methods using narrative synthesis have been designed: the **SCS Evidence Review** and the **SCS Evidence Summary**. These methods have been tailored to the SCS needs, with different levels of rigour in the search and quality assessment of evidence to address different policy and management needs. With both methods, the existing **Mendeley evidence library** will be updated and structured to reflect the scope of the 2022, and where appropriate, previous SCS's.

- The **SCS Evidence Review** has been assigned to those questions where policy and management have indicated the highest priority and hence highest level of assessment of the confidence in the conclusions drawn from the evidence.
- The **SCS Evidence Summary** will be used for all other questions, and whilst still providing an assessment of confidence in the conclusions drawn, some limitations are imposed on the search and quality assessment of evidence.

Both methods used will greatly enhance the transparency, rigour, organisation and accessibility of evidence and evidence-based conclusions produced as part of the 2022 SCS.

Authors of questions for both methods must use a standard template (Appendices 1 and 2), in addition to completing the '**Data Extraction & Appraisal'** spreadsheet. Where appropriate, some flexibility has been built into the template for authors to tailor the approach to meet certain question needs. As a first step, authors will be given training about how to complete these documents. Coordination support and expert advice will be available throughout the drafting process.

It is recommended that a minimum of two authors (a lead and a support author) conduct the process as there are several steps where authors must confer with each other to ensure consistency is achieved. This is important in maintaining rigour.

The following material outlines the methods and provides guidance about how to follow the process and complete the outputs for the 2022 SCS questions. While most of this information is relevant to both methods, the documentation clearly identifies where the requirements vary between the methods and potentially, questions.

3. Overview of the process

As shown in Figure 3, the process involves a number of sequential steps moving from question definition through to completion of the templates and appendix. Some parts of the process are quite iterative particularly during development of the search strategy and defining the criteria for eligible studies to answer the question. The process has clear and well-defined steps enabling fit for purpose evidence to be searched, retrieved, assessed and synthesised into the final products for informing policy.

Several checkpoints are included in the process to ensure that authors are on track and applying the process consistently across all questions. At each checkpoint authors should consult with the SCS Coordination Team before proceeding to the next step (refer to Section 8 and Appendix 1 for more information; these will be contracted milestones).

The time taken to complete each step will be very dependent on each individual question. However, it has been estimated that approximately 4–5 days will be required for the searches and initial screening (Sections 3.1-3.4), 6–10 days for secondary screening (part of section 3.4.2, plus 3.4.3 and 3.4.4), data extraction (Section 3.5) and evidence appraisal (Section 3.6) (for SCS Evidence Summaries and SCS Evidence Reviews, respectively), and 5–6 days for completing the Evidence Synthesis (Section 4) and finalising the template and appendix (Sections 5, 6 and 7). These estimations should only be considered as a guide to ensure authors' time is properly allocated to all sections of the process and in particular that adequate time is allocated for the evidence synthesis.

The methods include a systematic literature search with well-defined inclusion and exclusion criteria as part of the process. It should be noted however that, whilst being systematic, the search will not be able to be as complete and exhaustive as in a full Systematic Review due to time constraints. For example, most searches will be restricted to 1990 onwards (with exemptions if required). Also, for most questions, the search will be confined to studies derived within the GBR only; although in some cases (as determined by the lead author), the search could also include evidence beyond the GBR if relevant.

3.1 Define primary question elements
- Define and structure the question(s)

3.2 Conceptual diagram, map or other visual

3.3 Search strategy
Define:
- Search locations
- Search terms
- Search strings

3.4 Eligibility & searching
- Scoping search
- Defining eligibility criteria
- Screen search results
  - Initial screening
  - Second screening
- Record search results
- Store eligible literature

3.5 Data coding & extraction
- Data coding
- Data extraction

3.6 Evidence Appraisal
Assess:
- Relevance of studies
- Consistency
- Reliability of articles (Evidence Reviews only)
- Overall Confidence in body of evidence

4 Evidence Synthesis
- Collate evidence into narrative that addresses primary and secondary questions

5 Complete Template for the synthesis of evidence & Appendix
- Complete all sections of the template
- Complete Executive Summary
- Complete 'Author Contribution to the Question'

Check point 1
Check in with the SCS Coordination Team when author's have finalised their proposed interpretation of the question.

Check point 2
The visual construct needs to be agreed by the lead author sub-group for each theme as an internal review step. Once all individual draft diagrams have been reviewed and accepted within the authors sub-group, submit to the SCS Coordination Team for final discussion.

Check point 3
Define search strategy and consult internally with lead authors and contributing authors from theme sub-group. SCS Coordination Team support

Check point 4
Perform searches, screening, data extraction and evidence appraisal (potential coordination at theme level). SCS Coordination Team to be consulted at the end of this process

Check point 5
Complete Evidence Synthesis section with assistance from SCS Coordination Team to select appropriate narrative synthesis tools.
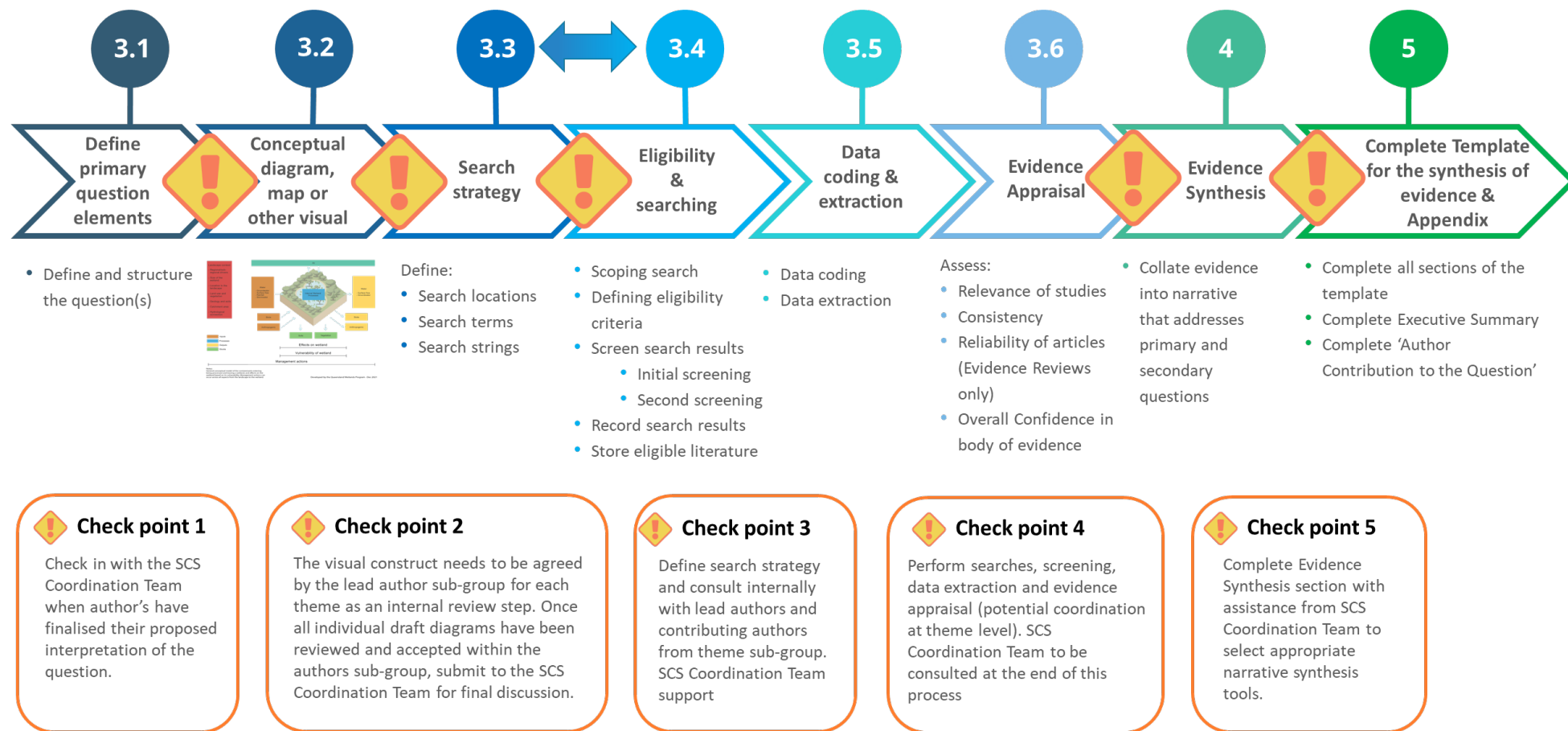
Figure 3. Key steps in the 2022 Scientific Consensus Statement evidence synthesis methods.

3.1 Define primary question elements

A rigorous process was used to develop the list of priority questions that form the basis of the 2022 SCS. These questions, some with secondary questions, are called the **primary questions**. Each question has been assigned to one of the methods described in Section 2.

An example primary question (used throughout this document) is: *What is the efficacy of natural/near natural wetlands, restored, treatment (constructed) wetlands and other treatment systems in GBR catchments in improving water quality (nutrients, fine sediments and pesticides)?*

Structuring the primary question is essential not only for an effective search strategy but also for developing the inclusion criteria, assisting during data coding and extraction, designing the data extraction spreadsheet and determining the synthesis method, and writing the final reviews.

Developing a list of search terms for each S/PICO element of the question (Subject/Population, Exposure/Intervention, Comparator, Outcome), greatly assists in defining, and refining, the search process. The S/PICO structure is the most commonly used structure in formal evidence synthesis methods but can be modified to suit the nature of the question. The example in Table 1 shows how this approach is applied to the example of the primary question included above.

Tips

Further information on structuring the primary question using the PICO method (and variations) can be found at: https://libguides.jcu.edu.au/systematic-review/define and https://guides.library.cornell.edu/evidence-synthesis/research-question

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In answering the primary question, other related or more detailed, secondary questions can be answered through the collection of evidence. Using the example above, example secondary questions are:

1. *What are the key factors that affect the efficacy of natural/near natural wetlands, restored/rehabilitated treatment (constructed) wetlands and other treatment systems in GBR catchments in improving water quality and how can these be addressed at scale to maximise water quality improvement?*
2. *What are the measured costs, and cost drivers associated with the use of natural/near natural wetlands, restored/rehabilitated, treatment (constructed) wetlands and other treatment systems in GBR catchments in improving water quality?*

Table 1 provides a description of the primary question elements, including components from the secondary questions (if relevant). Structuring the question using the S/PICO method is also useful for helping to define the inclusion and exclusion criteria in later steps.

Table 1. Description of primary question elements (examples provided in grey for the 'wetlands' example primary question above).

Question S/PICO element	Question term	Description
Subject/ Population	Nutrients, fine sediments, pesticides	**What is the subject or population of the primary question?** *A reduction in nutrients (nitrogen, phosphorus and carbon species), particulate nutrients, fine sediments often referred to as total suspended solids (TSS) and pesticides in GBR catchments. Pesticide groups considered are herbicides, insecticides and fungicides.* *Water sources considered are agricultural runoff from grazing, cropping, horticulture (including dryland and irrigation), semi-rural runoff and urban stormwater and wastewater.*
Intervention, exposure qualifiers	Natural/near natural wetlands, restored, treatment (constructed) wetlands and other treatment systems	**What is the exposure, treatment(s) or intervention(s) relevant to the question?** Including/listing qualifiers can add further detail to the intervention. These may include technical descriptions of the exposure or intervention. – *Natural, near natural, constructed and treatment wetlands in agricultural landscapes, urban storm water, freshwater aquaculture effluents, and agricultural runoff.* – *Restored/rehabilitated, natural and near natural wetlands include: palustrine, lacustrine, estuarine and riverine hydrological descriptions and saltmarshes and mangrove communities. These include riparian wetlands that have been restored to enhance either nitrogen and phosphorus retention or biodiversity.* – *Constructed wetlands include bioreactors, vegetated drains and treatment ponds.* – *Artificial, manmade or created wetlands include horizontal and vertical subsurface flow systems, as well as free surface flow systems.* – *Tropical and sub-tropical wetlands.*
Comparator (if relevant)	Secondary question: cost effectiveness of different treatments	**Does the question involve a comparison within treatments or interventions?** *This may involve a comparison of different wetland types or locations or the cost effectiveness of different wetland treatments.*
Outcome & outcome qualifiers	Efficacy in improving water quality in the GBR	**What is the outcome relevant to the question?** Including/listing qualifiers can add further detail to the outcome. These may include more specific descriptions of the outcome(s). *Improved water quality, removal or reduction of nutrients, sediments and pesticides measured by input vs output. Removal efficiency. Efficacy in retaining or removing nutrients (nitrogen, nitrate, ammonium, phosphorus), fine sediments and pesticides. Factors influencing the efficacy of retaining or removing nutrients, fine sediments and pesticides including landscape scale factors and in situ wetland factors.* *Cost, cost effectiveness, cost benefit and economic measures of using wetlands to improve water quality.*

In addition to the S/PICO elements of the question, it is important to define any terms used in the question. A shared definition will be used across questions using the same term, which will require liaison among authors with support from the SCS Coordination Team.

Definitions	Provide definitions for any relevant terms used in the question.
	For example, 'wetlands', 'nutrients' and 'fine sediments.

3.2 Conceptual diagram/map or visual

A conceptual diagram/map or other visual is needed to help visually define the primary question and map out the structure of the reviews, including to structure the evidence synthesis around all or various parts of the diagram/map/visual. This can be based on cause-and-effect relationships, an organising visual or a systems map describing key processes.

If a published conceptual diagram/map/visual already exists for a specific topic, authors might choose to start with it and use the evidence found to revise and validate the diagram during the review process. For questions addressing a new theory on how something works, then a new conceptual diagram/map/visual can be developed using the evidence. In both cases, the diagram/map/visual must be reviewed and evaluated during the evidence synthesis process and revised if necessary.

An example of a suitable model to support the example primary question is shown in Figure 4.

The SCS Coordination Team will facilitate sub-groups of authors for the main sections of the 2022 SCS (as per Figure 2), so authors can discuss and agree on their individual conceptual models. As the models are being refined through the process, major revisions (if needed) would have to be discussed within the sub-groups and with the SCS Coordination Team to ensure relevance and minimise overlap between questions.
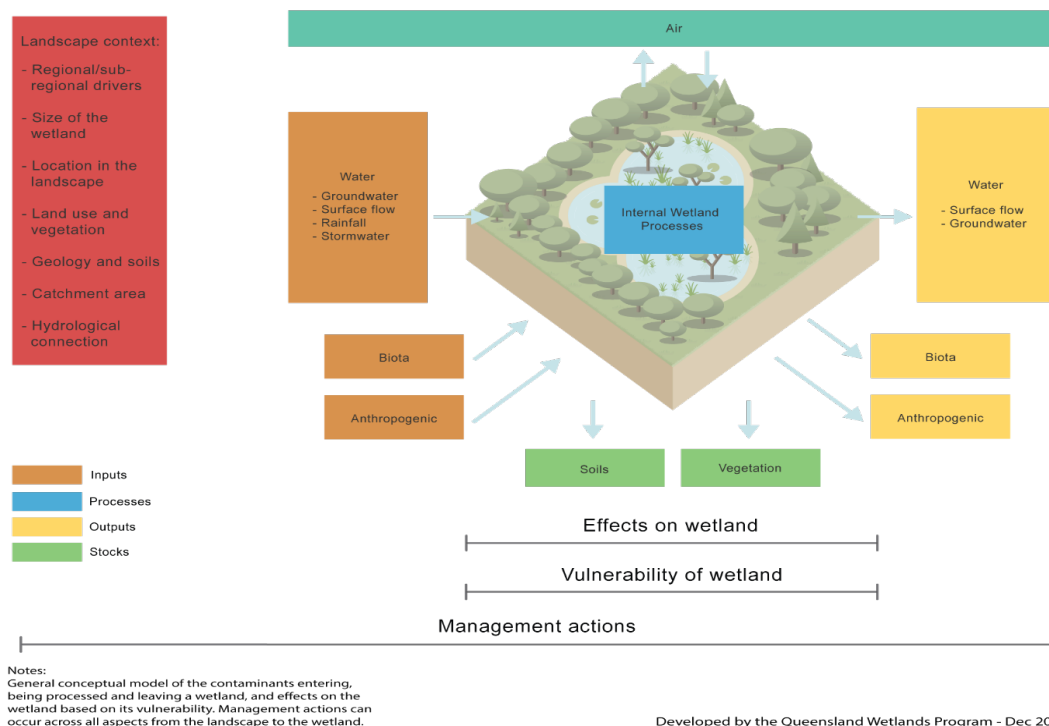

Figure 4. Example of a conceptual model of wetland function in removing nutrients, sediments and pesticides, based on the 'wetlands' example question on page 8 (Source: Queensland Wetland Program[6]).

3.3 Search strategy

Developing a search strategy is a key part of a transparent, robust and repeatable process. Librarian Services (where available) can usually offer advice and support in developing efficient search strategies, if assistance is needed.

The evidence can be sourced from internal studies (those conducted within the GBR) or external studies to the GBR (those conducted elsewhere). The nature of the question will determine if the search should be restricted to using GBR derived studies, or if the use of studies external to the GBR is also appropriate in answering the question. For example, there may be important contextual factors that have been identified by studies outside of the GBR but have not been studied or reported in GBR-based studies.

The search will aim to capture available evidence relevant to the primary and secondary questions. Given the rapid nature of the reviews, comprehensive searches (as would be conducted when doing a Systematic Review) will not be able to be conducted. The comprehensiveness of the search will be influenced by the nature of each individual question in setting the inclusion and exclusion criteria, and the author's input.

All evidence included within the SCS must be publicly available **peer reviewed published literature** (e.g. commercial in confidence or non-peer reviewed reports cannot be used). This may include a range of evidence items including academic literature in journals and books, technical reports and other grey literature. If authors are unsure as to whether a potential evidence item has been peer reviewed, authors should contact the SCS Coordination Team for advice. The SCS Coordination Team will create a register to document the peer review status of these items to minimise duplication of efforts. This will be shared with all authors and accessible on a shared file area (using Dropbox).

3.3.1   Search locations

Academic database and search engine searches

1. A minimum of two academic **databases** should be searched. These will be selected by each author according to their knowledge and experience of suitable such databases such as JSTOR, Web of Science collections, Elsevier SCOPUS etc. Open resources such as Lens.org or OpenAlex[7] can be used by authors if appropriate.
2. **Search engines such as Google Scholar**[8] can also be used after academic database searches have been conducted. The search terms used for these searches will be based on a subset of terms (further clarification will be provided during the author training session). Given the rapid nature of the process, it is recommended that at least the first 250 search results for each search string are examined from Google Scholar.
3. Other institutional databases (such as **Queensland Government**[9]) can be searched to provide coverage of additional literature.

Additional studies identified by experts

Authors may use additional studies identified from professional networks, personal libraries or other sources based on their expert knowledge. Third parties (e.g. stakeholders, policy and management groups) can also suggest publications that they think might be relevant to a question. However, these studies must be peer reviewed, and will be treated the same as items identified in the database searches in terms of the eligibility assessment(screening) and quality assessment. Like all items excluded at the full text assessment stage, if excluded, the reason must be recorded in the '**Data Extraction & Appraisal**' spreadsheet.

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[7] https://openalex.org/
[8] www.scholar.google.com
[9] https://www.publications.qld.gov.au/

A library of evidence used for the previous (2008, 2013 and 2017) and current SCS has been established using Mendeley bibliographic management software[10]. This database can also be searched for evidence items.

All evidence items must be included in the SCS Mendeley evidence library as part of the evidence synthesis outputs for each question. Appendix 3 provides guidance for authors about how to add items to the Mendeley evidence library. The SCS Coordination Team is available for support if needed.

3.3.2   Search terms

Search terms are terms used to electronically search for suitable evidence items. These terms are often synonyms used in the literature for the S/PICO elements used in defining the primary question. Given time restrictions, only English search terms will be used to interrogate online academic databases and internet search engines.

Search terms and strings can be developed in consultation with other lead authors where relevant, and/or the SCS Coordination Team (if required). A preliminary scoping search is a good way to test out search terms and strings to see if they return effective results (See Section 3.4.1). The SCS Coordination Team can help improve the effectiveness and efficiency of the search.

Table 2. Search terms for S/PICO elements of the primary question (examples provided in grey, based on the 'wetlands' example question above and Table 1.

Question element	Search terms
Subject/Population	*Nutrient, nitrogen, phosphate, suspended sediment, pesticide, herbicide, insecticide, fungicide*
Exposure/Intervention	*floodplain, riparian, pond, reed, mangrove, "constructed wetlands", "created wetlands", "restored wetlands", "rehabilitated wetlands", "artificial wetlands"*
Comparator (if relevant)	
Outcome	*Nutrient reduction, nutrient removal, nutrient uptake, nutrient trap, sediment accumulation, deposit, runoff, drainage, volatilisation, denitrification*

3.3.3   Search strings

Develop a set of search strings for electronic searches using 'Boolean operators'[11] and search syntax tips for specific academic databases. The terms will be joined together by "AND" or "OR" and the use of wildcards where an "*" can be used for multiple character searching.

Table 3 provides some examples of suitable search strings used for the example question.

In some cases, search strings can be more effective if they are broken into several smaller search strings that, in the case of this example, could focus on the type of nutrient (e.g. nitrogen, phosphorus, carbon) or the outcome (such as in the example above). Authors are encouraged to try several different search strings to test outputs (see Section 3.4.1). Search strings will be entered into the selected academic databases and search engines. Any differences in search strings between search engines and academic databases must be documented so that results can be reproduced in the future.

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[10] https://www.mendeley.com/
[11] https://southern.libguides.com/google/boolean

Table 3. Search strings used for electronic searches (Examples provided in grey, based on the 'wetlands' example question above and Table 2).

Search strings
Fine sediment search: (wetland OR pond OR floodplain OR riparian OR pond OR marsh OR drain) AND (sediment OR particulate OR "total suspended solids") AND (remov* OR retent* OR deposit OR atten* OR accum*) AND "water quality"
Nutrient search: (wetland OR pond OR *marsh OR floodplain OR riparian OR mangroves OR reed) AND (nitr* OR phosph* OR particulate) AND (remov* OR retent* OR sequestration OR denitrification OR uptake) AND "water quality"

Tips:

Some variations might be required when using Google Scholar. Additionally, given the normally large volume of search returns in Google Scholar, it may be more effective to make search terms more specific (e.g. search for just nitrogen or phosphorus, as per the example above). It is also recommended to use the 'Advanced search' if using Google Scholar. Be aware that Google Scholar, through search optimisation processes is not reliably repeatable and can favour particular journals. Google Scholar also has 256-character limitations on search strings.

A second author/contributor should be consulted to agree on the search strategy developed.

3.4 Eligibility and Searching

Optimising the search strategy usually requires trials and refinements by adding, changing or even reducing the number and type of terms used to find the right balance between sensitivity (getting all information relevant to the topic) and specificity (the proportion of 'hits' that are relevant to the specific question). Searches that are too sensitive will end up with too many search returns and, if it is too specific, suitable studies could be missed out. A scoping search should help to test the search strategy before proceeding to the full searches.

Searches may include these key sources of evidence:

1. Online academic databases and organisational websites
2. Search engines
3. Manual searching of known collections and personal networks

3.4.1 Undertake a scoping search

A scoping or trial search will help authors to optimise the effectiveness of the search strategy while gathering important information on:

- The likely amount of relevant evidence available;
- Search terms that are effective and search terms that are not effective in particular databases or search engines; and
- The discovery of new search terms.

Once the scoping search has been conducted and the search strategy refined, authors should contact the SCS Coordination Team to ensure searches are effective, efficient and as comprehensive as possible (given the constraints) and to discuss if an external search of evidence (e.g. outside of the GBR, if relevant) is needed and how to perform it.

3.4.2 Defining eligibility criteria and screening evidence

Inclusion and exclusion criteria

There are two stages where authors will need to assess search returns for eligibility and suitability: 1) at the title and abstract review stage (initial screening), and 2) when reviewing the full text. A set of inclusion and exclusion criteria will be used to do this along with the evidence appraisal.

Inclusion/exclusion criteria could include: geographical scope, climatic conditions, language restrictions, date restrictions, outcome conditions and other specific criteria as shown in Table 4. For example, most searches will be restricted to evidence items published after 1990 (with exemptions if required). Some questions may also have sufficient local evidence to restrict the searching to GBR-based studies, while others might need to include evidence from further afield (termed "external evidence"). The decision of whether searches should be restricted to GBR derived studies only should be made with the SCS Coordination Team prior to commencing the final search. The decision can be informed by the authors expertise and the results of the scoping search. This will then be included as an inclusion criteria. The decision will be based on the following criteria:

1. Does the context of the question justify the exclusion of external evidence based on the relevance of evidence? For example, does the question refer to a unique GBR context?
2. Can the inclusion of external evidence help reconcile or test inconsistencies within the findings from GBR evidence? Would external evidence contribute to reinforce GBR study findings or enhance the policy or management application of findings?
3. Is there weak or insufficient evidence to answer the question from GBR-only studies where external evidence could provide greater confidence?

Table 4. Inclusion and exclusion criteria for determining eligibility of search returns (Examples provided in grey, based on the 'wetlands' example question above).

Question element	Inclusion	Exclusion
Subject/Population	*Nutrients, specifically nitrogen (and species), phosphorus (and species including ammonia, fine sediments, pesticides*	*Other nutrients not nitrogen or phosphorus, coarse sediments*
Exposure/ Intervention	*Tropical or sub-tropical natural or near natural, constructed, restored or rehabilitated and treatment wetlands.* *Horizontal and vertical sub-surface flow, free surface flow* *NB: A standard definition of "tropical" and "sub-tropical" should be agreed*	*Cool climate, temperate boreal wetlands, near shore reefs* *Municipal, domestic, industrial or mining wastewater, intensive agriculture systems such as pig or dairy feeding, floating treatment wetlands. Urban wetlands.* *Urban treatment plants, Sewage Treatment Plants, processes that introduce chemicals, biochar or by-products to enhance removal efficiencies, multiple stage treatment processes including tertiary treatment, electrolysis, reverse osmosis*
Comparator	*(Not relevant)*	*(Not relevant)*
Outcome	*The efficacy of removal, retention or transformation of nutrients, fine sediments or pesticides* *Economic measures of costs or cost effectiveness or cost benefits*	*Improved water quality through other interventions than wetlands or the removal, retention or transformation of parameters other than nitrogen, phosphorus, fine sediments and pesticides* *Valuation of wetland ecosystem services or other environmental benefits other than water quality* *Pricing of water services*
Publication	*Peer reviewed and published including technical reports*	*Non peer reviewed studies*
Language	*English*	*Non-English written.*
Study type	*Studies that compare the nutrient/fine sediment/pesticide concentrations in the inlet water and in the outlet water.* *Studies including the retention of nutrients, fine sediments and pesticides in wetlands where effect modifiers such as hydraulic loading rate or vegetation type are varied.* *Studies that use measurement of the inlet condition as the control (control-impact (CI) study).*	*Studies that do not measure removal of nutrients, fine sediments or pesticides by comparing concentrations in the inlet and outlet water.*

Performing the searches

Once the search strategy has been tested, **full searches** can be performed using the selected academic databases and search engines (i.e. online searches).

Potential evidence items can also be located during the search phase through searching personal collections or contacting peers (i.e. manual searches). Examples include peer reviewed grey literature which may not be available online as yet at the time of the search. These items will be treated the same as items identified in the database searches in terms of the eligibility assessment, screening and appraisal.

Additional evidence items may also be discovered whilst assessing the full text of other items. These items should be assessed for eligibility, the same as any other item.

Initial screening

All search returns should be **assessed against the inclusion and exclusion criteria at the title and abstract level (initial screening)**. During the initial search phase, and as a **quality checking procedure** for this step, **a random sample of search returns should be assessed by two members of the team** (e.g. Lead and second author/contributor) separately. The proportion of items used for this consistency check should be agreed and justified by the authors (it is recommended to be around 5-10%, but if the number of search returns is very low then authors should use thier discretion as to what proportion of returns should be assessed), and the items compromising the subset should be selected randomly to avoid bias towards certain authors, topics, years or other factors. Any disagreements regarding the screening of studies between both authors should be discussed and resolved (and recorded within the '**Data Extraction & Appraisal**' spreadsheet), so the agreed criteria can be applied for the remainder of the search. It is good practice to retain studies for full text assessment where there is doubt of the eligibility based on title and abstract.

After the initial screening on the item's titles and abstracts, all eligible studies should be added to temporary sub-folders within the **Mendeley evidence library** (refer to next sections on 'Recording search results' and 'Storage of evidence').

The reasons for excluding candidate items at the initial screening stage do not need to be documented, but a summary of all search results must be captured within Table 5 (refer to next section on 'Recording search results').

Duplicate items added to the Mendeley temporary sub-folders will be identified and removed by authors at this stage, and before full text assessment. Identification of duplicate items can be automatically managed within Mendeley.

Second screening

Once searches have been performed, initial screening completed and all relevant items have been stored in the Mendeley evidence library temporary sub-folders, all stored items should be **screened against the inclusion and exclusion criteria at the full text level (second screening)** to determine their eligibility for use in the evidence synthesis. A random sample of 5-10% of evidence items should be used to assess for consistency of selection between the two members of the author team. At this stage, the reason for exclusion of any items should be recorded in the '**Data Extraction & Appraisal'** spreadsheet (i.e. one sentence explanation based on the pre-defined inclusion/exclusion criteria). This full text screening can occur in parallel with the data extraction and appraisal steps (see Sections 3.5 and 3.6 below) to save time. However, if on reading the full text the item is deemed not eligible, it should then be removed from the 'Data extraction' tab and placed in the 'Studies excluded' tab of the '**Data Extraction & Appraisal**' spreadsheet along with a reason for exclusion.

3.4.3   Recording search results

Search results must be recorded using Table 5 after the initial screening to capture a transparent record of how the search returns are processed through the screening process. Table 5 should list the search strings (for **online** searches) and sources used to identify the evidence for the review.

The number of items added **manually** should also be recorded using Table 5, with a brief description of their source (e.g. personal collection, Mendeley SCS database, etc).

As an indicator of the **comprehensiveness** of the online searches (i.e. to which degree all relevant evidence was identified through the online searches), authors should report the proportion of evidence items being retrieved online versus manually.

Table 5. Example table capturing the search results of a rapid search for each search string/source conducted after the initial screening in A) Academic databases, B) Search engines (i.e. Google Scholar) and C) Manual searches. The search results for A and B are provided in the format X (Z) of Y, where: X (number of relevant evidence items retained); Y (total number of search returns or hits); and Z (number of relevant returns that had already been found in previous searches).

Date /time	Search strings	Sources	
A) Academic databases		Database 1	Database 2
	Search string 1: (wetland OR floodplain OR riparian OR pond) AND (constructed OR rehabilitated OR artificial) AND (nutrient OR sediment OR pesticide OR herbicide OR insecticide OR fungicide) AND (removal OR retention OR trap OR 'water quality')	*50 of 1,320*	*22 (8) of 985*
	Search string 2		
	Search string 3		
B) Search engines (e.g. Google Scholar)			
	Search string 1: (wetland OR floodplain) AND (tropical OR "sub-tropical") AND (constructed OR artificial) AND (nutrient) AND (removal OR retention) AND 'water quality'	*64 of 28,240 (first 250)*	
	Search string 2		
	Search string 3		
	Total items online searches	*xxx (xx %)*	
C) Manual search			
Date/time	Source	Number of items added	
	(e.g. author personal collection)		
	(e.g. Mendeley – SCS database)		
	Total items manual searches	*xx (xx %)*	

The flow chart in Figure 5 must be completed to record the full outcomes of the search, including the number of items excluded and remaining after the initial screening and second screening steps.
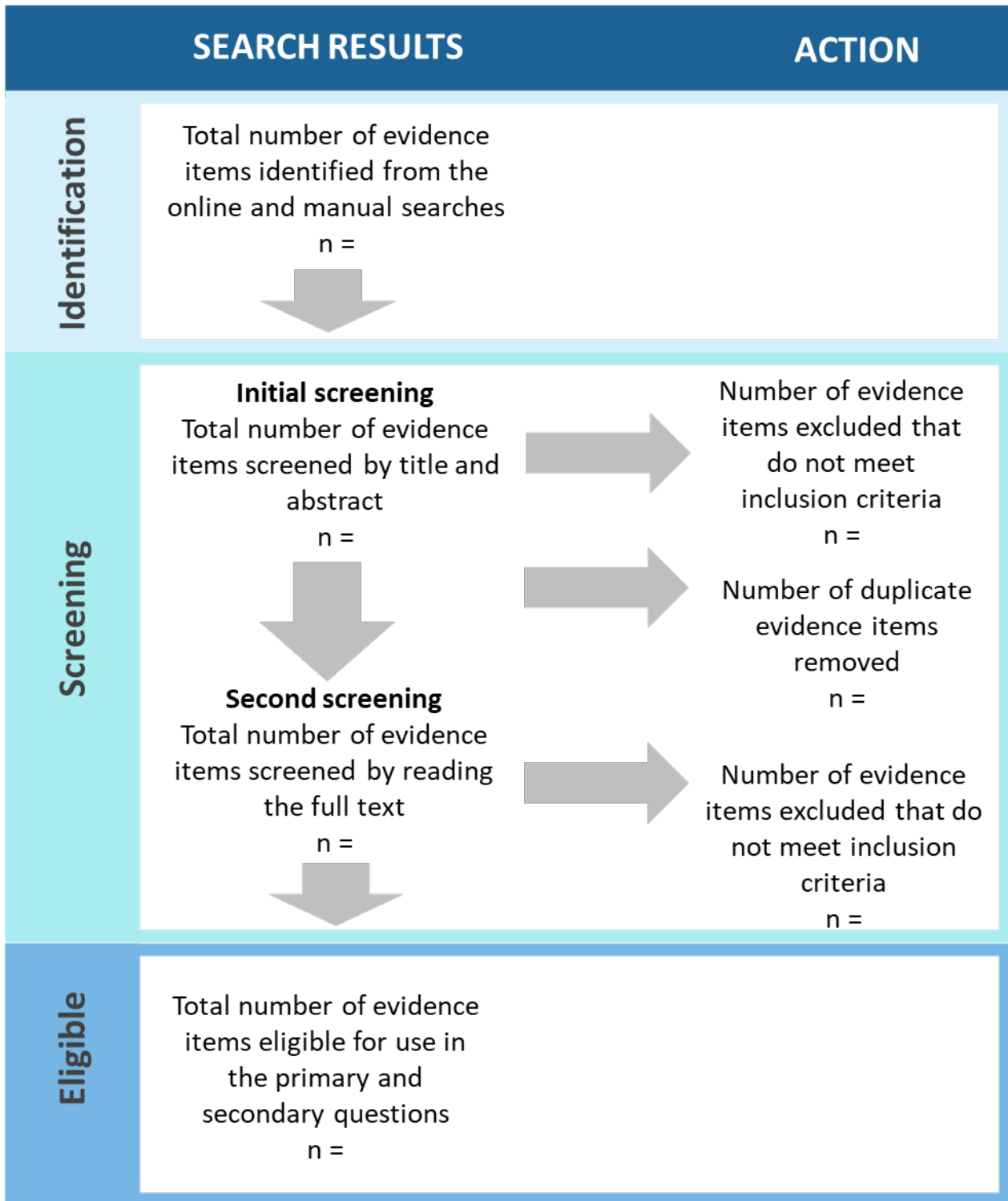
Figure 5. Process of screening search results (i.e. final results after second screening).

3.4.4 Storage of evidence

As described above, a set of hierarchical folders has been established to provide a record of the search results in the SCS Mendeley evidence library (see example in Figure 6), with temporary folders for the initial screening. This high-level folder structure reflects the overall structure of the 2022 SCS (Figure 2) including the sections and the individual questions. Authors will need to create temporary sub-folders for each search string under the primary question folder in the Mendeley evidence library. An example is provided in Figure 7 of the search strings used for Question 4.7. In this example, the search was also split into separate searches for nutrients, fine sediments, pesticides and landscape factors.

Only the items that pass the second screening will be copied to the final folders. This process helps to maintain currency, transparency, and accessibility of evidence.

Figure 6. Proposed Mendeley evidence library folder structure showing the sections and primary questions included in the 2022 SCS. Each primary question will have its own main folder.

Figure 7. Proposed Mendeley evidence library folder structure showing the (potential) folder structure within the Question folder. In this case, the search strategy for Question 4.7 was split into separate searches for nutrients, fine sediments, pesticides and landscape factors. The search strings used for these searches are shown below preceded by the academic database used (in this case, "JSTOR", "Scholar" and "SCOPUS").

3.5 Data coding and extraction

The processes of data coding and data extraction are essential to ensure that the correct and adequate information is retrieved and systematically recorded for use in the synthesis process. While every question will require a unique set of fields of information extracted from studies (guidance will be provided to authors) there will be some common fields of information recorded from each study including bibliographic meta-data, and aspects of the study findings and study design.

3.5.1 Data coding

Data coding should be undertaken prior to commencement of the review, based on the information required to answer the question. The minimum information required was determined in consultation with the end user(s) of the review, and gathered by the SCS Coordination Team, which will be used to assist in guiding authors at the beginning of the review to set up the appropriate data coding needs for each question. Data coding is guided by the inclusion and exclusion criteria. Planning needs to ensure the extracted data will answer the primary and secondary questions and complete the relevant fields of the template (Appendix 1).

Refinements can be made, however, to the required fields of data for extraction once authors have a better understanding of the nature of the data available from viewing the full text of eligible studies. The '**Data Extraction & Appraisal**' spreadsheet will be used to set up the required coding fields.

The SCS Coordination Team will assist with the coding process.

3.5.2 Data extraction

Once the full text of all stored evidence items has been screened (second screening), all relevant data and information will be extracted from each item using the '**Data Extraction & Appraisal**' spreadsheet. This spreadsheet will be used to store all the information needed for the synthesis stage. It is important that the data is extracted consistently across all evidence items so that quantitative or qualitative assessments can be made between items within fields.

The SCS Coordination Team will assist in tailoring the specific fields within the '**Data Extraction & Appraisal**' spreadsheet to the needs of each question at the beginning of the evidence synthesis process.

Information that will be extracted for all questions (for all evidence items) includes:

- ✓ Study name and location
- ✓ Study type
- ✓ Contextual variables (with specific mention to climate change, if relevant)
- ✓ Indigenous participation (yes/no, and a comment about it)
- ✓ Question specific information to answer the primary and secondary questions. This may be quantitative or qualitative information that will be used by authors in the narrative synthesis. Authors are encouraged to use verbatim statements of relevant study findings (when filling in the '**Data Extraction & Appraisal**' spreadsheet) where these are concise, to minimise the risk of bias associated with personal interpretations of the findings. When using 'verbatim statements' within the template, text needs to be included within quotation marks and be properly referenced.

Additionally, there are fields in the spreadsheet to synthesise information from all of the evidence used. This synthesised information will be used to populate Section 4 of the template (Appendix 1) and includes:

- ✓ Research findings to 2022
- ✓ Recent findings from 2016 to 2022 (from the last SCS to present)
- ✓ Key conclusions
- ✓ Significance to policy and management
- ✓ Key areas of uncertainty / limitations of the evidence
- ✓ Potential new monitoring and evaluation indicators
- ✓ Knowledge gaps

3.6 Evidence appraisal

As mentioned in Section 3.4.2, the data extraction and appraisal of the evidence can be done at the same time as the full text assessment (second screening) of each evidence item, to save time. However, if on reading the full text the item is deemed not eligible, it should be removed from the 'Data extraction' tab and placed in the 'Studies excluded' tab of the '**Data Extraction & Appraisal**' spreadsheet along with a reason for exclusion. On reading the full text it may be determined that the study does not meet the eligibility (inclusion criteria) or that there are other issues concerning the study's relevance or reliability.

The purpose of appraising the evidence is to ensure that only the most relevant and reliable studies are given appropriate emphasis in developing the synthesis report and to obtain an overall measure of the level of confidence of the evidence base for communication purposes. In undertaking a systematic style review of evidence, a core reason for evidence appraisal is to reduce the risk of bias. In this context, risk of bias refers to a systematic error or deviation from the truth. This may be represented as an over estimate or underestimate of an effect (Collaboration for Environmental Evidence, 2013).

As Rapid Review processes are being adopted, it is not feasible to conduct a full quality appraisal of each evidence item used. This would include a detailed assessment of components of the study design and reporting of results to determine the risk of bias. However, it is important that some measures are applied by undertaking an assessment of the relevance, consistency and quality of evidence to ensure that confidence can be assessed in the evidence used and the conclusions drawn.

It is important to note that the purpose of this appraisal step is to evaluate the evidence/findings extracted from a publication only in terms of the **suitability of that evidence in addressing the SCS question**, not to provide a peer-review style evaluation of the whole publication. However, all evidence and/or findings that are relevant to answering the SCS question should be extracted from the study (to ensure that there is minimal bias in 'selecting' the evidence).

The '**Data Extraction & Appraisal**' spreadsheet must be completed to inform the evidence appraisal. Appraisal will occur at two levels: 1) the individual evidence item and 2) the body of evidence used to answer the primary question.

A measure of **confidence** will be calculated for the **body of evidence**. This will involve an evidence appraisal summary table and the use of a (prototype) visual matrix to develop a narrative description based on: 1) the **relevance** of studies, and 2) the **consistency** of findings within studies. Authors will also provide a description of the number of studies used and the diversity of study types as part of the narrative synthesis. However, as the use of a generic visual matrix might not be appropriate for all questions, authors must ensure that all appraisal indicators (such as spatial relevance, temporal relevance, consistency, etc.) are adequately described within the narrative and rated within a summary table (when possible), so those separate results can be combined using alternative visuals/products if needed, in discussion with the SCS Coordination Team (refer to Section 3.6.5).

Questions using the **SCS Evidence Review method** will have an additional **quality assurance step**, through the assessment of **reliability** of all individual studies. This will allow authors to identify where weaknesses in the evidence might exist and offer insight into how reliable the scientific findings are for answering the priority SCS questions. This assessment considers the reliability of the study itself and will enable authors to place more or less emphasis on selected studies in the narrative synthesis.

The assessment of confidence and overarching evidence statements (see Section 5) resulting from each individual evidence review will also be further considered during the **consensus process**.

3.6.1 Assessing the Relevance of studies

This assesses the extent to which the evidence is relevant **to the question being asked.** The relevance of studies (i.e. whether the study approach is appropriate for the question and if the study findings are reported on a spatial and temporal scale that is relevant to the question) is assessed using different measures:

1) Whether the **study approach (objectives and design) and the results of the study** (i.e. how the outcome is measured and reported) are directly relevant to the question (Table 6).

It is important to understand whether the study uses an approach and reports the results in a way that is relevant to the question. This is particularly important in view of the contextual variables and a specific study design. For example, a question concerning the effectiveness of erosion control measures in GBR catchments would rate a study that measured paddock sediment loss before and after treatment as highly relevant to the question, while another study measuring and reporting on a proxy such as groundcover may be rated as moderately relevant to the question.

Table 6. Relevance of the study approach and results of the individual evidence item to the question.

Rating	Relevance (to the question)	Score
High	The study approach and results are directly relevant to the question	3
Moderate	The study approach and results are mostly relevant to the question or some elements of the findings are directly relevant (e.g. such as the reporting of contextual variables)	2
Low	The study approach and results are poorly relevant to the question	1

2) Whether the spatial extent and/or temporal coverage of the study are relevant to the question (Tables 7 and 8).

The assessment of the spatial and temporal coverage aims to provide some caveats (or qualifications) around the interpolation of individual study findings to greater or smaller spatial or temporal scales as per what is being asked in the question. Assessing the spatial and temporal relevance of studies requires authors to use their expert knowledge in their assessment. These two indicators should be assessed **separately** (and only when relevant to the question), within the '**Data Extraction & Appraisal**' spreadsheet, based on Table 7 (spatial) and Table 8 (temporal).

Examples of aspects that might be considered in assessing spatial or temporal relevance include how representative are the study locations in answering a question that relates to the whole GBR (i.e. to what extent could the study findings be generalised without missing important processes operating at different scales) (spatial), understanding of time lags that are often seen in ecological or social cause and effect relationships (temporal), hysteresis where an ecological state may have changed (temporal), experimental validation of an intervention contributing to the desired outcome (or answering the particular question) in a particular spatial or temporal setting, or whether or not the context of the work is directly applicable to decision making in only one or more regions of the GBR (spatial).

Authors will need to make a professional judgment call regarding the influence of these spatial and temporal factors on how the study is treated in their narrative synthesis.

Table 7. Spatial relevance of the individual evidence item to the question.

Rating	Relevance (spatial applicability)	Score*
High	The study has high spatial relevance to the question i.e. the study spatial scales are suitable for answering the question	3
Moderate	The study has findings with some spatial applicability to the question	2
Low	The study has findings with very limited spatial applicability to the question	1

Use ´N/A´ when the spatial scale is not relevant to the study being assessed.

Table 8. Temporal relevance of the individual evidence item to the question.

Rating	Relevance (temporal applicability)	Score*
High	The study has high temporal relevance to the question i.e. the study temporal scales are suitable for answering the question	3
Moderate	The study has findings with some temporal applicability to the question	2
Low	The study has findings with very limited temporal applicability to the question	1

*Use ´N/A´ when the temporal scale is not relevant to the study being assessed.

Once all relevant components have been assessed separately and ratings introduced in the '**Data Extraction & Appraisal**' spreadsheet (2. Evidence Appraisal), a combined rating for all three relevance indicators (i.e. relevance to the question, spatial and temporal relevance) for the body of evidence (all the studies) is then calculated as an average in columns J to L of the '**Data Extraction & Appraisal**' spreadsheet (2. Evidence Appraisal) following the same rating system as per Tables 6 to 8 (i.e. High, Moderate, Low).

The overall relevance for the body of evidence (all the studies) is calculated adding the individual relevance scores (columns J-L), in column M of the '**Data Extraction & Appraisal**' spreadsheet (2. Evidence Appraisal) and categorised as per Table 9.

Table 9. Overall relevance for the body of evidence.

Rating	Total Score (Question relevance + spatial relevance + temporal relevance)*
High	7-9
Moderate	4-6
Low	1-3

*Categories to be adjusted if spatial/temporal relevance does not apply to the Question (e.g. Low 1-2, Mod 3-4, High 5-6)

Authors will need to provide a narrative description for all three aspects of the relevance being assessed (i.e. relevance to the question, spatial and temporal relevance) and of the overall relevance rating (for the body of evidence), **identifying the proportion of studies rated as High, Moderate, or Low** in the narrative synthesis stage.

3.6.2   Assessing the Consistency of the body of evidence

The **overall Consistency of the body of evidence** is assessed by considering the **agreement of the findings within the body of evidence**, as per Table 10. Both the magnitude and direction of effect are considered as part of consistency.

Although the consistency is assessed at the whole body of evidence level for a question (i.e. not including secondary questions), the consistency of evidence could also be assessed within the narrative for all or parts of the conceptual framework/model/map, separately, for questions where this might be appropriate.

Table 10. Overall consistency for the body of evidence (adapted from Collins et al. 2015).

Consistency rating	Criteria
High [Consistent evidence]	Almost all evidence points to findings that have identical or similar conclusions. This may be regarding the existence of an effect or outcome including the direction or magnitude of the effect.

Moderate [Variable or mixed evidence]	The evidence might be strong on some concepts (or parts of the conceptual model) but mixed on others, with some inconsistent findings or uncertainties.
Low [Largely inconsistent/emerging evidence]	Studies have largely inconsistent findings. This could also apply to emerging concepts where the science is still not fully established.

3.6.3 Assessing the Quantity and Diversity of studies

In addition, and while it is not possible to quantify the **number of studies** that may be needed to adequately answer an individual question, authors are required to document the total number of studies used in the synthesis, and to consider whether the **Quantity** of studies within the whole body of evidence could be rated as Low / Moderate / High, based on their expertise in the topic (column N of the '**Data Extraction & Appraisal**' spreadsheet; '2. Evidence Appraisal' tab).

Authors will also need to record the **study type** in the '**Data Extraction & Appraisal**' spreadsheet. Documenting the different study types can provide a greater understanding of the potential types of biases or errors that may be associated with addressing primary questions. For instance, a high number of modelled or laboratory studies may impose some limitations regarding the application of results to 'in field' contexts (obviously, depending on the question).

The following **study types** will be recorded in the '**Data Extraction & Appraisal**' spreadsheet:

1) Observational studies (field monitoring);
2) Experimental studies (laboratory or field);
3) Modelling studies;
4) Theoretical or conceptual research; and
5) Secondary studies such as meta-analysis, reviews or summaries.

A measure of **Diversity** of study types (Low / Moderate / High) will then be assigned to the whole body of evidence in column O of the '**Data Extraction & Appraisal**' spreadsheet (2. Evidence Appraisal).

The quantity and diversity of study types will be used to provide commentary while describing the overall body of evidence. As these criteria will be very question dependent (e.g. some questions could have less evidence because it is a relatively new area of research, or could be more reliant on one kind of study type than others), authors will be asked to consider the quantity and diversity of study types that is likely to be applicable to their question as part of the initial step of defining the primary question and the conceptual model/visual so that a rating can be provided, relevant to the nature of the question.

3.6.4 Additional Quality Assurance step: Reliability of studies

This is an additional Quality Assurance step that applies exclusively to the SCS Evidence Review method.

This additional assessment is designed to help authors identify any potential issues regarding the **reliability** of a study with respect to addressing the SCS question, or any other potential biases within the study itself. **The assessment will help authors to place greater or lesser emphasis on individual studies while writing the <u>narrative descriptions</u>**. With this approach, the more reliable lines of evidence will drive the narrative, while transparency of other evidence that exists is maintained. However, if a study (i.e. evidence item) has several characteristics that affect its reliability, authors may decide to exclude it from the synthesis. This should be clearly justified in the '**Data Extraction & Appraisal**' spreadsheet.

Authors are required to consider potential criteria to assess the 'quality' of the evidence for answering the question, using the criteria in Table 11 as a guide. This will vary depending on the nature of the question. The '**Data Extraction & Appraisal**' spreadsheet ('2. Evidence Appraisal' tab, columns B-C) should be used to record any key biases or limitations that could influence the reliability/quality of the

study findings (column B for the assessment of the item, and column C for a brief justification, if any concerns were identified). This assessment aims to identify any **serious concerns/biases within the evidence item in itself or in relation to answering the question (to be specified in the spreadsheet)** (i.e. if any weaknesses/limitations are evident). If no concerns are raised regarding these criteria, then the cells can be left blank, or rated as 'no concerns'.

For example, a question relating to the adoption of management practices throughout the GBR catchments might need to consider whether the studies used involved a population of landholders that is representative of all GBR catchments (*criteria 2*). A question relating to understanding key factors that are influencing the results (such as multiple stressors), might need to consider if there are other factors that may be confounding the results and identify if any alternative explanations are provided to account for the results (*criteria 6*).

If authors consider that they are not able to perform this assessment in certain items due to lack of expertise/knowledge in the topic, it is **essential** that this is recorded within the '**Data Extraction & Appraisal**' spreadsheet and clearly identified within the narrative synthesis (i.e. how many items could not be 'quality checked' and which component of the question they address).

Table 11. Potential criteria to consider when assessing the reliability of evidence items in the SCS Evidence Reviews.

Criteria
1. Any obvious bias
2. Issues with Experimental Design or Data Analysis
3. Inadequate Model validation
4. Unjustified Extrapolation of results/conclusions drawn
5. Unreasonable assumptions
6. Alternative explanations/theories not considered

Of critical importance, authors will need to provide a narrative description in Section 4.0 of the Template about the overall reliability of studies (i.e. number of studies that raised concerns) and a brief justification. If the authors have placed greater emphasis on findings from certain studies, this should be explicitly stated, highlighting the value of the assessment outlined above.

3.6.5 Assessing the overall Confidence in the body of evidence

The rating system within the '**Data Extraction & Appraisal**' spreadsheet is used to calculate the overall **confidence** in the body of evidence, based on the overall relevance and the level of consistency of the body of evidence. However, it is critical that this is carefully described in the supporting narrative to prevent any misleading outcomes created as a result of the 'metric' (e.g. over-simplification of the key messages).

This confidence matrix must be completed to present a visual representation of the results, indicating whether the evidence presents High, Moderate or Limited confidence. Confidence in the body of evidence used to address the question increases towards the top-right corner, as explained in the colour legend (Table 12).

As noted above, because the use of a generic visual confidence matrix might not be appropriate for all questions, authors must ensure that all appraisal indicators are adequately described within the supporting narrative and rated within the summary table (when possible) below (Table 12), so those separate results can be combined using alternative visuals/products if needed.

As explained above, the questions using the **SCS Evidence Review** method will have an additional Quality Assurance step (i.e. assessment of the reliability of a study) that will be communicated as part of the summary table (Table 12).

Table 12. Summary of results for the evidence appraisal of the whole body of evidence in addressing the primary question. The overall measure of Confidence (i.e. Limited, Moderate and High) is represented by a matrix encompassing overall relevance and consistency (rated as High in the example below). The final row summarises the additional quality assurance step needed for questions using the SCS Evidence Review method.

Indicator	Rating	Overall measure of Confidence
Relevance (overall)	L/M/H	*Insert final matrix. For example:*
-To the Question	L/M/H	
-Spatial	L/M/H (or N/A)	
-Temporal	L/M/H (or N/A)	
Consistency	L/M/H	
Quantity	L/M/H *(relative to the nature of the question; add total number of items for context)*	
Diversity	L/M/H *(relative to the nature of the question; add proportion of main study types)*	
Additional QA (Reliability) **[SCS Evidence Reviews only]**	Narrative of reliability, for example: • Of the xxx studies reviewed, there were concerns regarding the reliability of xx studies (xx%) to address the question. • The common causes of reliability concerns were due to xx (e.g. biases, lack of model validation). • Studies with reliability concerns were identified during the synthesis stage, with less emphasis being placed on those findings.

The SCS Coordination Team can assist authors through the evidence appraisal process to ensure the appropriate indicators/rating systems are selected and to discuss the validity of the confidence matrix based on the specifics of the question. Once the evidence appraisal has been conducted, authors should contact the SCS Coordination Team to validate the process, seeking additional expert input if required.

4. Evidence synthesis

4.1 Why narrative synthesis?

The synthesis stage is where the results from suitable individual evidence items are all brought together to answer the questions, and to convey the key messaging of the 'story'. The synthesis will consider the amount and nature of the evidence available, consistencies in the findings, the suitability of the data in answering the question and what the findings mean for policy and management. Telling a trustworthy evidence-based story is at the core of narrative synthesis and is recognised as an effective form of synthesis for increasing the uptake of science in policy and practice (Popay et al., 2006). Narrative synthesis has been the primary form of synthesis adopted in previous SCSs.

Unlike other forms of synthesis, narrative synthesis can accommodate a wide range of questions such as those posed by the 2022 SCS. These include questions relating to intervention effectiveness or cost effectiveness, efficacy, influencing factors, how something works, appropriateness, etc.

Undertaking a narrative synthesis does not mean that quantitative data cannot be quoted from primary studies (or from secondary studies such as reviews, synthesis or meta-analysis) but further quantitative analysis of data from primary studies is unlikely to be possible within the timeframes and resources of the 2022 SCS.

4.2 Conducting a narrative synthesis

The exact form and content of the narrative synthesis might be different for the individual questions depending on the nature of the evidence, and could include:

- *Synthesis framed around the visual **conceptual framework** (i.e. diagram, map or visual) developed in Section 3.2*: In this case, data from studies can be aggregated against parts of a conceptual framework to test the validity of the framework or to develop or modify a framework based on new findings from studies.

- *Synthesis using **tables** to thematically organise the data*: Sub-groups of data may be thematically tabulated according to pre-defined groups such as land uses, locations, ecosystems, time periods, outcome types, effect sizes or direction, intervention methods, contextual variables, etc.

- *Synthesis that attempts to **aggregate** study findings to draw a set of combined conclusions*: Combining findings from multiple studies is appropriate where standard metrics (qualitative or quantitative) are used to measure and report on specific aspects in study findings (e.g. changes in net sediment or nutrients loads).

In synthesising the evidence, greater emphasis should be placed on those studies that have scored higher ratings during the appraisal process (Section 3.6 above). An explanation of the heterogeneity between study findings including the influence of contextual variables would also be appropriate in some cases.

For questions using the SCS Evidence Review method, in addition to the assessment of consistency and relevance (see Section 3.6 above), an assessment of reliability will be made, hence the synthesis should place more emphasis on those studies that have been assessed as being more reliable.

> **Tips:**
>
> The best approach to narrative synthesis for each specific question will be discussed with authors before commencing the synthesis process. Whilst support will be provided by the SCS Coordination Team, authors unfamiliar with narrative synthesis are encouraged to seek additional guidance from the literature (e.g. Popay et al., 2006).

4.3 Information to be covered in the synthesis

Authors are required to synthesise the following aspects of the question in Section 4.1 of the template, Narrative synthesis, within the Key Findings section:

4.3.1   Summary of Study Characteristics

Description of key characteristics of the evidence base, based on information collected in the '**Data Extraction & Appraisal**' spreadsheet. This may include information such as:

- The total number of studies included in the synthesis.
- A breakdown of study designs.
- A breakdown of locations of studies (countries if international studies were used).
- Other key characteristics relating to the question (i.e. ecosystem types, land use types, management practice types, impact types etc).

The support of tables is an effective way of representing this information.

4.3.2   Summary of evidence to 2022

Description of key findings in relation to the conceptual diagram/visual in Section 3.2. It may also include:

- A description of the underpinning processes and contextual variables where relevant to the question.
- Trends or patterns in observed outcomes or effects.
- Consistencies or heterogeneity between study findings and reasons why.
- Synthesis of secondary questions (if relevant).

4.3.3   Recent findings 2016-2022 (since the 2017 SCS)

Summary of findings from the period 2016-2022 (e.g. Are there new models, new data, new theories or consolidation from further research of existing beliefs? What has progressed since the findings of the last 2017 SCS?)

4.3.4   Key conclusions

The key conclusions should present several dot points that summarise the evidence for the question. If the question has several components (e.g. land use, ecosystem type, etc.) and/or sub-questions, a point will be needed for each sub-grouping, as this will form the bases of the evidence statements and key supporting points (Section 5).

4.3.5   Significance of findings for policy, management and practice

Discussion on 'How the findings have added to or changed previous understandings?', and 'Are new findings established or emerging'? This section does not aim to provide policy prescriptions, but evidence-based findings directly relevant to policy and decision making.

4.3.6   Uncertainties and/or limitations of the evidence

Dot-points listing any uncertainties or limitations of the body of evidence. For example, the way in which studies have been reported, the amount of evidence available for certain components, limitations imposed by the method (i.e. search period, locations searched, etc), limitation in the evidence found in answering the question, study design limitations in studies found, etc.

5. Evidence Statements and Consensus process

The **2022 SCS Summary and Conclusions (including overall points of consensus)** are based on the resulting synthesis of evidence from addressing the 30 questions about the influence of land-based runoff on the GBR. These higher-level documents are aimed at a target audience of management and policy makers and will act as an overarching summary of the scientific findings developed through the synthesis of evidence, agreed by a broad range of experts.

Based on the outcome of each individual synthesis of the evidence, authors of the 2022 SCS are required to prepare an **Evidence Statement** that summarises the SCS question being addressed, including several **supporting points**, as part of the Template (see Sections 6 and Appendix 1). If the question has multiple elements (i.e. secondary questions, land uses, ecosystems, etc), it may be appropriate to include one supporting point for each element. This can be discussed with the SCS Coordination Team when the statements are being drafted.

These Evidence Statements, together with the author's assessment of confidence (as per Section 3.6.5) will be considered in the preparation of the 2022 SCS Summary and Conclusions, through a consensus process with a broad expert group.

The SCS Coordination Team can assist authors through the narrative synthesis section (Section 4) and preparation of Evidence Statements (Section 5), to ensure the appropriate narrative synthesis approaches are selected and that the Evidence Statements address the question and provide the right level of detail. Once these sections have been completed, authors should contact the SCS Coordination Team to validate the process.

6. Completing the 2022 SCS Template for the synthesis of evidence

Authors are required to complete the evidence review template included as **Appendix 1**. The template identifies where to find specific instructions within the above Methods. It is advisable to keep checking this supporting document in parallel to completing all components of the template. **The SCS Coordination Team will be available throughout the process if additional guidance is needed.**

The template starts with an Executive Summary which should only be completed once the Evidence Synthesis section has been finalised. The rest of the template follows the order of the Methods described in Section 3.

Section 4.0 of the template (Key Findings) is the core synthesis of findings. There are several headings provided in the template that should be used to structure the narrative synthesis. While the preference is to have a standard set of headings for reporting so that information can be grouped and re-packaged for cross question knowledge synthesis, it is recognised that different questions may require different approaches to the presentation format including the use of maps, models, diagrams, graphs etc. (as per Section 4 on Evidence Synthesis). In some cases, answering the primary question may be accompanied by information to specifically answer any secondary questions. The SCS Coordination Team will assist authors in selecting the appropriate narrative synthesis approach(es) for each question.

Authors also need to complete Section 5.0 of the template (Evidence Statements) with their suggested evidence statements and key supporting points when completing the template for the synthesis of evidence.

7. Completing the 2022 SCS Author Contribution to the Question

Authors must record the **approach that has been followed to address the 2022 SCS question** assigned using **Appendix 2**, including the writing team composition: the list of all contributing authors to the question, their expertise, and the section/topics to which they have contributed.

8. Summary of the role and expectations of Authors

Lead authors and contributing authors have an essential role in the successful development of the 2022 Scientific Consensus Statement (SCS). Table 13 provides a checklist that authors should follow when completing the '2022 SCS template for the synthesis of evidence', and including several important 'check points' for authors that are identified in the template. The Payment Milestone corresponds to the Service Agreement between C$_2$O Consulting and the author's organisation for delivering these tasks.

Table 13. Checklist for authors in delivering the 2022 SCS responses to questions.

Checklist for authors	Due date	Payment Milestone
1. Submit all Conflict of Interest Declaration(s) and Confidentiality Deed Polls for all Authors and contributors.	14 Oct 22	A 14 Oct 22
2. Review the 2022 SCS Evidence Synthesis Methods, SCS Template, 'Data Extraction & Appraisal' spreadsheet and accompanying documentation.	14 Oct 22	B 18 Nov 22
3. Undertake author training for the 2022 SCS Evidence Synthesis Methods.	14 Oct 22	
4. Coordinate with additional contributing authors for the question. Additional coordination will also be organised at the theme level by the SCS Coordination Team.	14 Oct 22	
5. Refine/Clarify question and methods in collaboration with the SCS Coordination Team. Tailor the 'Data Extraction & Appraisal' spreadsheet to the question needs in consultation with the SCS Coordination Team. **(Step 3.1 in Fig. 3; Check point 1**)	28 Oct 22	
6. Develop a conceptual diagram/map or other visual to represent the scope and key elements of the question. Coordinate internal review by the author sub-group with assistance from the SCS Coordination Team. **(Step 3.2 in Fig. 3; Check point 2**)	18 Nov 22	
7. Following steps within the SCS Template for the synthesis of evidence (Appendix 1), define the search strategy and consult internally with contributing authors, and the Lead authors from the theme 'sub-group'. Check with the SCS Coordination Team if further assistance is required. **(Step 3.3 in Fig. 3; Check point 3**)	18 Nov 22	
8. Perform the searches, screening, data extraction and evidence appraisal. Potential coordination at the theme level assisted by the SCS Coordination Team. SCS Coordination Team to be consulted at the end of the evidence appraisal step. **(Steps 3.4, 3.5 and 3.6 in Fig. 3; Check point 4)**	19 Dec 22 (or up until 13 Jan 23 with prior approval from SCS Coordination Team)	C 17 Feb 23
9. Complete Evidence Synthesis section (Section 4.0 Key Findings, within the SCS Template for the synthesis of evidence) with assistance from SCS Coordination Team to select appropriate narrative synthesis tools for each question. SCS Coordination Team to be consulted at the end of the synthesis process. **(Step 4 in Fig. 3; Check point 5)**	27 Jan 23	
10. Ensure all new references are properly stored and organised using the SCS Mendeley evidence library (see Appendix 3 for further guidance). **(As per steps 3.4.3 and 3.4.4 in the Methods)**	17 Feb 23	

Checklist for authors	Due date	Payment Milestone
11. Complete all remaining sections of the SCS Template for the synthesis of evidence (Appendix 1), including the Executive Summary, and the Author Contribution to the Question (Appendix 2). *(Steps 5 in Fig. 3)*	17 Feb 23	
12. Deliver all evidence synthesis products to the SCS Coordination Team, including: Template (i.e. report; including the Evidence Statement to be considered during the consensus process), 'Data Extraction & Appraisal' spreadsheet, and the Author contribution to the Question, to be submitted for external peer review.	17 Feb 23	
13. Address and respond to the external peer review of the evidence reviews. Submit author response to peer review comments.	12 May 23	D 31 May 23
14. Submit final peer-reviewed evidence synthesis outputs to the SCS Coordination Team for endorsement by the Reef Water Quality Independent Science Panel.	31 May 23	
15. Participate in the consensus process for the 2022 SCS.	29 Sept 23	E 29 Sept 23

9. References

Carpenter, S. R., Armbrust, E. V., Arzberger, P. W., Chapin, F. S., Elser, J. J., Hackett, E. J., Ives, A. R. Kareiva, P. M., Leibold, M. A., Lundberg, P., Mangel, M., Merchant, N., Murdoch, W. W., Palmer, M. A., Peters, D. P. C., Pickett, S. T. A., Smith, K. K., Wall, D. H., Zimmerman, A. S. (2009) Accelerate Synthesis in Ecology and Environmental Sciences, *BioScience*, Volume 59, Issue 8, 699–701, https://doi.org/10.1525/bio.2009.59.8.11

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Thomas, C. & Waterhouse, J. (2021) Scientific Consensus Statement Planning Project. Recommendations for the 2022 iteration of the SCS. Report prepared for the OGBR (DES).

UK Department for International Development (2014) Assessing the Strength of Evidence: How to Note. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291982/HTN-strength-evidence-march2014.pdf

Appendix 1: 2022 SCS Template for the synthesis of evidence

Executive Summary (2-4 pages)

Question:

Question number and title

- (Secondary questions – where applicable)

Background

Summarise the background from Section 1.0 (in the Template), including what is the geographic scope and context of the question.

Methods

Summarise the methods from the Methods Section 2.0 (in the Template):

- A formal Rapid Review approach was used for the 2022 Scientific Consensus Statement (SCS) synthesis of evidence. Rapid Reviews are a systematic review with a simplification or omission of some steps to accommodate the time and resources available[12]. For the SCS, this applies to the search effort, quality appraisal of evidence and the amount of data extracted. The process has well-defined steps enabling fit-for-purpose evidence to be searched, retrieved, assessed and synthesised into final products to inform policy. For this question a <Evidence Summary/Evidence Review> method was used.
- Search locations were xxx.
- Main source of evidence: Studies undertaken in the GBR vs. studies undertaken in the GBR and external (and provide justification).
- Summary statistics of search results (total number of evidence items initially identified as relevant, *versus* number of items incorporated into the synthesis, etc.).

Method limitations and caveats to using this review

For this <Evidence Summary/Evidence Review>, the following caveats or limitations should be noted when applying the findings for policy or management purposes (for example, if applicable):

- Only studies written in English were included.
- Only two academic databases were searched.
- Only GBR derived studies were included.
- The review was restricted to peer reviewed journal publications as well as publications of the major government programs.
- Only studies published from 1990 onwards were included.
- Any other limitations/restrictions on the evidence used.

Key Findings

Summary of evidence to 2022

Provide a summary of key research findings to 2022 for the primary question (and secondary questions, if relevant) including describing the number of studies and the key contextual variables including climate change. Please dot point the key findings and then provide further detail under the dot points.

---

[12] Cook CN, Nichols SJ, Webb JA, Fuller RA, Richards RM (2017) Simplifying the selection of evidence synthesis methods to inform environmental decisions: A guide for decision makers and scientists. *Biological Conservation* 213: 135-145 https://doi.org/10.1016/j.biocon.2017.07.004

Recent findings 2016-2022

Provide a summary of any new research findings from 2016-2022 (since the last SCS) and what these new findings represent. Please dot point the key findings and then provide further detail under the dot points. Include a description of the number of studies and the key contextual variables (including climate change).

Significance for policy, practice, and research

Provide a summary of the significance of these findings for **GBR policy and management,** consider if/how these findings have added to or changed previous understandings, are they established or emerging, and what other considerations might be important (e.g. identified contextual variables).

Key uncertainties and/or limitations

Provide a summary of the key uncertainties and/or limitations in the evidence base that should be considered.

Evidence appraisal

Summarise overall evidence appraisal results (i.e. relevance, consistency, quantity and diversity of evidence), including the confidence level (from Table 8 in the template). For the SCS Evidence Reviews, the additional quality assurance results of the body of evidence should be included.

1.0 Background (1-2 pages)

Describe the background to the topic that the question relates to and describe why the topic is important in the context (including policy context) of water quality issues in the Great Barrier Reef and its management.

1.1 Question

To complete this section, refer to Section '**3.1 Define primary question elements**' above.

Primary question	
Secondary questions (where relevant)	

Brief description of Lead Author's **final interpretation of the question** (i.e. context, constraints, emphasis) informed by consultation feedback provided by the SCS Coordination Team from liaison with policy, management and stakeholder representatives, and your expert knowledge of the topic area.

Check point 1: Please check in with the SCS Coordination Team when you have finalised your proposed interpretation of the question.

1.2 Conceptual diagram/map or visual

To complete this section, refer to Section '**3.2 Conceptual diagram/map or visual**' in the Methods.

Paste your conceptual diagram/map or visual here and provide a general description on how it relates to the primary question and secondary questions. The diagram/map/visual must be reviewed and evaluated during the evidence review process and revised if necessary.

Figure 1. Conceptual Diagram legend.

1.3 Links to other questions

This synthesis of evidence addresses one of 30 questions that are being addressed as part of the 2022 SCS. The questions are organised into eight themes: values and threats, sediments and particulate nutrients, dissolved nutrients, pesticides, other pollutants, human dimensions, and future directions, that cover topics ranging from ecological processes, delivery and source, through to management options. As a result, many questions are closely linked, and the evidence presented may be directly relevant to parts of other questions. The relevant linkages for this question are identified in the text where applicable. The broad nature of this question links it to many other questions within the SCS but the primary question linkages are listed below.

Links to other related questions?	

Check point 2: It is important that the visual construct used is valid, appropriate, and agreed by expert peers. For this, and to minimise overlap between authors, consult with the lead author sub-group for your specific theme (as per <u>Figure 2</u> in the Methods) as an internal review step. Once all individual draft diagrams have been reviewed and accepted within the authors sub-group, submit to the SCS Coordination Team for final discussion. As the models are being refined through the process, major revisions (if relevant) would have to be discussed within the sub-groups and with the SCS Coordination Team to ensure relevance and minimise overlap.

2.0 Method (3-4 pages)

A formal Rapid Review approach was used for the 2022 Scientific Consensus Statement (SCS) synthesis of evidence. Rapid Reviews are a systematic review with a simplification or omission of some steps to accommodate the time and resources available[13]. For the SCS, this applies to the search effort, quality appraisal of evidence and the amount of data extracted. The process has well-defined steps enabling fit-for-purpose evidence to be searched, retrieved, assessed and synthesised into final products to inform policy. For this question, an Evidence Summary method was used.

2.1 Primary question elements and description

To complete this section, refer to Section '**3.1 Define primary question elements'** above.

The primary question is: "XXXXXXX"

The secondary questions are (if relevant[14]): "XXXXXXX"

S/PICO frameworks (Subject/Population, Exposure/Intervention, Comparator, Outcome) can be used to break down the different elements of a question and help to define and refine the search process. The S/PICO structure is the most commonly used structure in formal evidence synthesis methods[15] but other variations are also available.

- **Subject/Population:** Who or what is being studied or what is the problem?
- **Intervention/exposure:** Proposed management regime, policy, action or the environmental variable to which the subject populations are exposed.
- **Comparator**: What is the intervention/exposure compared to (e.g., other interventions, no intervention, etc.)? This could also include a time comparator as in 'before or after' treatment or exposure. If no comparison was applicable, this component did not need to be addressed.
- **Outcome:** What are the outcomes relevant to the question resulting from the intervention or exposure?

Table 1. Description of question elements for Question <x.x>.

Question S/PICO elements	Question term	Description
Subject/Population		
Intervention, exposure & qualifiers		
Comparator (if relevant)		
Outcome & outcome qualifiers		

Table 2. Definitions for terms used in Question <x.x>.

Definitions	
Term 1	Definition
Term 2	Definition
Term 3	Definition

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[13] Cook CN, Nichols SJ, Webb JA, Fuller RA, Richards RM (2017) Simplifying the selection of evidence synthesis methods to inform environmental decisions: A guide for decision makers and scientists. *Biological Conservation* 213: 135-145 https://doi.org/10.1016/j.biocon.2017.07.004

[14] Secondary questions were formally defined as part of the 2022 SCS Question Setting process.

[15] https://libguides.jcu.edu.au/systematic-review/define and https://guides.library.cornell.edu/evidence-synthesis/research-question

2.2 Search and eligibility

To complete this section, refer to Section '**3.3 Search strategy**' and '**3.4 Eligibility and Searching'** above.

The Method includes a systematic literature search with well-defined inclusion and exclusion criteria.

Identifying eligible literature for use in the synthesis was a two-step process:

1. Results from the literature searches were screened against strict inclusion and exclusion criteria at the title and abstract review stage (initial screening). Literature that passed this initial screening step were then read in full to determine their eligibility for use in the synthesis of evidence.
2. Information was extracted from each of the eligible papers using a data extraction spreadsheet template. This included information that would enable the relevance (including spatial and temporal), consistency, quantity, and diversity of the studies to be assessed.

a) Search locations

Searches were performed in:

*   (Insert your selected academic database(s))
*   (Google Scholar)
*   (Insert any additional databases or sources)

b) Search terms

Table 3 shows a list of the search terms used to conduct the online searches.

Table 3. Search terms for S/PICO elements of Question <x.x>.

Question element	Search terms
Subject/Population	
Exposure or Intervention	
Comparator (if relevant)	
Outcome	

c) Search strings

Table 4 shows a list of the search strings used to conduct the online searches.

Table 4. Search strings used for electronic searches for Question <x.x>.

Search strings

d) Inclusion and exclusion criteria

Table 5 shows a list of the inclusion and exclusion criteria used for accepting or rejecting evidence items.

Table 5. Inclusion and exclusion criteria for Question <x.x> applied to the search returns.

Question element	Inclusion	Exclusion
Subject/Population		
Exposure or Intervention		
Comparator (if relevant)		
Outcome		
Language		
Study type		

Check point 3: Once authors have defined search terms, search strings and inclusion/exclusion criteria (and after an initial test to ensure they are effective), internal consultation must be done with the lead author sub-group within each theme. Authors could also check with the SCS Coordination Team if further assistance is needed in optimising the search strategy.

At this stage, refer to the information above to complete Sections '**3.4 Eligibility and searching'**, '**3.5 Data coding and extraction' and '3.6 Evidence appraisal'** before proceeding with the template.

3.0 Search Results (2 pages)

To complete this section, refer to Sections '**3.4 Eligibility and Searching'** above and the '**Data Extraction & Appraisal**' spreadsheet.

A total of xx studies were identified through online searches for peer reviewed and published literature. xx studies were identified manually through expert contact and personal collection, which represented a xx% of the total evidence. xx studies were eligible for inclusion in the synthesis of evidence (Table 6) (Figure 2). xx studies were unobtainable.

Table 6. Search results table, separated by A) Academic databases, B) Search engines and C) Manual searches. The search results for A and B are provided in the format X (Z) of Y, where: X (number of relevant evidence items retained); Y (total number of search returns or hits); and Z (number of relevant returns that had already been found in previous searches).

Date /time	Search strings	Sources	
A) Academic databases		Database 1	Database 2
	Search string 1: (wetland OR floodplain OR riparian OR pond) AND (constructed OR rehabilitated OR artificial) AND (nutrient OR sediment OR pesticide OR herbicide OR insecticide OR fungicide) AND (removal OR retention OR trap OR 'water quality')	*50 of 1,320*	*22 (8) of 985*
	Search string 2		
	Search string 3		
B) Search engines (e.g. Google Scholar)			
	Search string 1: (wetland OR floodplain) AND (tropical OR "sub-tropical") AND (constructed OR artificial) AND (nutrient) AND (removal OR retention) AND 'water quality'	*64 of 28,240 (first 250)*	
	Search string 2		
	Search string 3		
Total items online searches		*xxx (xx %)*	
C) Manual search			
Date/time	Source	Number of items added	
	(e.g. author personal collection)		
	(e.g. Mendeley – SCS database)		
Total items manual searches		*xx (xx %)*	

Please add new lines for separate search strings.

Comment on any relevant points of note experienced during the search including the effectiveness of particular search strings or the way the search was conducted.

Complete Figure 2 with the final search results.

SEARCH RESULTS	ACTION

Identification

Total number of evidence items identified from the online and manual searches
n =

Screening

Initial screening

Total number of evidence items screened by title and abstract
n =

Number of evidence items excluded that do not meet inclusion criteria
n =

Number of duplicate evidence items removed
n =

Second screening

Total number of evidence items screened by reading the full text
n =

Number of evidence items excluded during second screening
n =

Eligible

Total number of evidence items eligible for use in the primary and secondary questions
n =

Figure 2. Flow chart of results of screening and assessing all search results for Question <x.x>.

Check point 4: The SCS Coordination Team can assist authors through the evidence appraisal process to ensure the appropriate indicators/rating systems are selected and to discuss the validity of the confidence matrix based on the specifics of the question. Once Authors have conducted the searches, screening, data extraction and evidence appraisal, contact the SCS Coordination Team to validate the process.

4. Key Findings (4-10 pages)

This section relates to the information and evidence extracted from the final list of studies (body of evidence) that will be used to answer the primary and secondary questions. To complete this section, refer to Section '**3.5 Data coding and extraction', '3.6 Evidence appraisal' and '4 Evidence synthesis'** above and the '**Data Extraction & Appraisal**' spreadsheet.

4.1 Narrative synthesis

The narrative synthesis of evidence will be conducted using guidance provided in Section 4 noting that there will be variation in the approach used between questions. The SCS Coordination Team can also provide support if required.

The sub-headings below (4.1.0 to 4.1.5) have been provided to guide the structure of the synthesis, as part of the worked example and the revised template (v1.4), noting that the content they cover was already included as dot points in previous versions of the template. For additional information, refer to Section 4.3 in the Methods document.

A summary of this section will be used in the Executive Summary.

4.1.0 Summary of Study Characteristics

Based on information collected in the Data Extraction spreadsheet, describe the key characteristics of the evidence base. This may include information such as:

- The total number of studies included in the synthesis.
- A breakdown of study designs.
- A breakdown of locations of studies (countries if international studies were used).
- Other key characteristics relating to the question (i.e. ecosystem types, land use types, management practice types, impact types etc).

The support of tables is an effective way of representing this information.

4.1.1 Summary of evidence to 2022

Description of key findings in relation to the conceptual diagram/visual in Section 1.2, including synthesis of secondary questions (if relevant). Sub-headings can be added to this section if required. It mat also include:

- A description of the underpinning processes and contextual variables where relevant to the question.
- Trends or patterns in observed outcomes or effects.
- Consistencies or heterogeneity between study findings and reasons why.
- Synthesis of secondary questions (if relevant).

4.1.2 Recent findings 2016-2022 (since the 2017 SCS)

Summary of findings from the period 2016-2022.

4.1.3 Key conclusions

Succint conclusions (i.e. dot points) that will form the basis of the Evidence Statements (Section 5). Include dot points for all components of the question (e.g. land use, ecosystem type, etc.) and/or sub-questions.

4.1.4 Significance of findings for policy, management and practice (if applicable)

Consider if/how these findings have added to or changed previous understandings, and are they established or emerging. This section does not aim to provide policy prescriptions but evidence-based findings directly relevant to policy and decision making.

4.1.5 Uncertainties and/or limitations of the evidence

Consider any uncertainties or limitations of the body of evidence.

4.2 Contextual variables influencing outcomes

Provide a few key referenced points summarising the influence of each contextual variable (**including climate change or climate variability** and episodic events) on the question outcomes or causal relationships. This may include site *in situ* factors (biophysical or human) or other external variables.

Table 7. Summary of contextual variables for your specific question (and secondary questions, if relevant).

Contextual variables	Influence on question outcome or relationships (referenced)
Climate change (or climate variability)	

4.3 Evidence appraisal

Relevance

Make a statement for all aspects of the relevance being assessed, and for the overall relevance of studies used to answer the question including any limitations (e.g. study approach/results relevance to the question, spatial or temporal relevance to the question).

For example: The relevance of the overall body of evidence was High. The relevance of each individual indicator was High for relevance of the study approach and reporting of results to the question, High for spatial relevance to the question, and Moderate for temporal relevance to the question. Of the 25 articles included in the review of <primary question>, all were given a 'High score for overall relevance to the question, while 20% (5 of 25) had a Moderate spatial relevance score, and 80% (20 of 25) had a 'Moderate temporal relevance score. In the context of this question, this means that… (e.g. explain caveats around the extrapolation of temporal results and the limitations of the evidence).

Consistency, Quantity and Diversity

Make a brief statement of the overall consistency, quantity and diversity of the body of evidence used to answer the question including any limitations or highlights, such as inconsistent/consistent findings, reduced/high number of studies or limited/good representation of study types.

For example, a high number of modelled or laboratory studies may impose some limitations regarding the application of results to 'in field' contexts (obviously depending on the question).

For example: Twenty-five studies were used as evidence for the primary question. This is considered to be a Moderate representative sample of studies (from the total pool of available evidence) in answering the question. The body of evidence used represents multiple lines of evidence ('experimental', 'observational' and 'modelling' study types), with High consistency based on the agreement of findings within the studies.
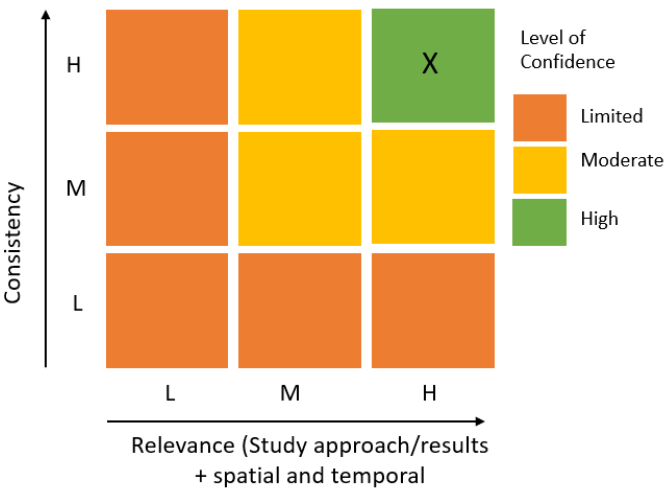
Additional Quality Assurance (Reliability) [SCS Evidence Review method only]

Provide a brief narrative description about the overall reliability of studies (i.e. number of studies that raised authors' concerns in relation to the quality of the study in regards to any obvious potential biases in the experimental design, conclusions drawn or other aspects of the study that may cause the study findings to be unreliable) and a brief justification if relevant. Indicate as well how the assessment of reliability of studies may have influenced the emphasis authors have placed on more 'reliable' studies than others. Add a brief summary on this additional quality assurance step in the final row of the appraisal summary table below (Table 8) for the questions using the SCS Evidence Review method.

Confidence

Describe the overall confidence in the body of evidence used to answer the primary question (and secondary questions if appropriate) using the evidence appraisal results (i.e. relevance, consistency, quantity and diversity of evidence) and the (prototype) confidence matrix (Table 8).

Table 8. Summary of results for the evidence appraisal of the whole body of evidence used in addressing Question <x.x>. The overall measure of Confidence (i.e. Limited, Moderate and High) is represented by a matrix encompassing overall relevance and consistency. The final row summarises the additional quality assurance step needed for questions using the SCS Evidence Review method.

Indicator	Rating	Overall measure of Confidence
Relevance (overall)	L/M/H	*Insert final matrix. For example:*
-To the Question	L/M/H	
-Spatial	L/M/H (or N/A)	
-Temporal	L/M/H (or N/A)	
Consistency	L/M/H	
Quantity	L/M/H *(relative to the nature of the question; add total number of items for context)*	
Diversity	L/M/H *(relative to the nature of the question; add proportion of main study types)*	
Additional QA (Reliability) **[SCS Evidence Reviews only]**	Narrative of reliability, for example: • Of the xxx studies reviewed, there were concerns regarding the reliability of xx studies (xx%) to address the question. • The common causes of reliability concerns were due to xx (e.g. biases, lack of model validation).. • Studies with reliability concerns were identified during the synthesis stage, with less emphasis being placed on those findings.

4.4 Indigenous engagement/participation within the body of evidence

Describe the level of Indigenous engagement and/or direct participation within the body of evidence.

4.5 Knowledge gaps

Describe any key research gaps and what the potential outcomes could be for policy/management if these research gaps were addressed. Knowledge gaps can be identified by authors for the full body of evidence for a question (not for individual studies).

Table 9. Summary of knowledge gaps for Question <x.x>.

Gap in knowledge (based on what is presented in Section 4.1)	Possible research or Monitoring & Evaluation (M&E) question to be addressed	Potential outcome or Impact for management if addressed

5. Evidence Statements (1 page)

Based on the outcome of this evidence review and your expertise, suggest a key evidence statement that summarises the question (plus key supporting points), to be considered in the preparation of the 2022 SCS Conclusions and overall points of consensus. If the question has multiple elements (i.e. secondary questions, ecosystems or land uses), include one key supporting point for each element.

Use the following **syntax** to create the Evidence Statement and key supporting points:

Evidence Statement:

The synthesis of the evidence for **Question <x.x>** was based on <number of studies>, undertaken in <location of studies used> and published between <period of studies used>. The synthesis includes a <*Diversity rating*> diversity of study types (<type of studies used / lines of evidence>), and has a <*Confidence rating*> confidence rating (based on <*Consistency rating*> consistency and <*overall Relevance rating*> overall relevance of studies).

Summary findings relevant to policy or management action

<summary of finding addressing the question>.

Supporting points

- <Points to substantiate text above, covering variability relevant to policy and management such as between regions, land uses, ecosystems and reference to multiple lines of evidence >

- <Point of key recent findings/new knowledge, if applicable>

Check point 5: The SCS Coordination Team can assist authors through the narrative synthesis section (Section 4) and preparation of Evidence Statements (Section 5), to ensure the appropriate narrative synthesis approaches are selected and that the Evidence Statements address the question and provide the right level of detail. Once these sections have been completed, authors should contact the SCS Coordination Team to validate the process.

6. References

Send a .ris or .bib file with all final references used in the synthesis to the SCS Coordination Team so they can be introduced into the Mendeley library.

Insert final reference list using Mendeley (or another reference manager) to ensure correct formatting.

Appendix 2: 2022 Scientific Consensus Statement Author Contributions

Appendix: 2022 Scientific Consensus Statement author contributions to the Question <x.x>

Theme xx

Question <x.x> *Insert question number and title*

Author team

List all contributing authors, their expertise and the section/topics to which they have contributed.

Name	Organization	Expertise	Role in addressing the Question	Sections/Topics involved
1.			*e.g. Lead Author*	*e.g. All Sections*
2.			*e.g. Contributor*	*e.g. Searches and data extraction*
3.			*e.g. Expert advice (wetlands)*	*e.g. Conceptual model, wetlands section within the narrative synthesis and final revision of overall report*
4.				

Appendix 3: 2022 SCS Instructions for using the SCS Mendeley evidence library

How to import and use references using the Mendeley Evidence Library for the 2022 Scientific Consensus Statement [download here]