System of Environmental Economic Accounting

Update of the SEEA Central Framework

Draft Guidance Note

Issue B6

"Pressure Account: Recording Residual Flows to Ecosystem Types"

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Executive summary

Purpose of the Guidance Note

This Guidance Note addresses Issue B6 of the SEEA Central Framework 2028 Update: whether and how residual flows currently recorded in aggregate in the PSUT environment column can be spatially disaggregated to specific ecosystem types and linked to changes in ecosystem condition recorded in the SEEA Ecosystem Accounting Condition Account.

The core statistical question is:

> *How can residual flows recorded in the SEEA CF Physical Supply and Use Tables be spatially allocated to ecosystem types and translated into ecological pressure indicators that help explain changes recorded in the SEEA EA Condition Account?*

The Pressure Account is conceived as the accounting structure that provides this link, a bridge between the Physical Flow Accounts of the SEEA CF and the Condition Account of the SEEA EA.

Scope and Boundary

The Pressure Account is limited to pressures arising from residual flows recorded in the SEEA CF Physical Flow Accounts — specifically flows recorded as returns to the environment in the PSUT. This boundary ensures that the statistical foundation of the account is grounded in compiled, observable data.

Residual flow types in scope include:

- Emissions to air (gaseous pollutants, particulate matter, greenhouse gases)
- Discharges to water (nutrient loads, organic pollution, toxic contaminants)
- Releases to land (solid waste, mining waste, persistent contaminants)
- Diffuse releases from dissipative product uses (fertilisers, pesticides, pharmaceuticals)

The following are explicitly excluded from scope: pressures from harvesting activities, land-use change, passive environmental uses, invasive species, natural disturbances, and climate change drivers. These belong to other analytical frameworks and are not addressed in this Guidance Note.

Conceptual Framework

The Pressure Account addresses a structural gap in the SEEA system. Without it, residual flows in the PSUT remain attributed to the economic units that generated them, while ecosystem condition changes remain attributed to ecosystem types, with no statistical bridge connecting the two.

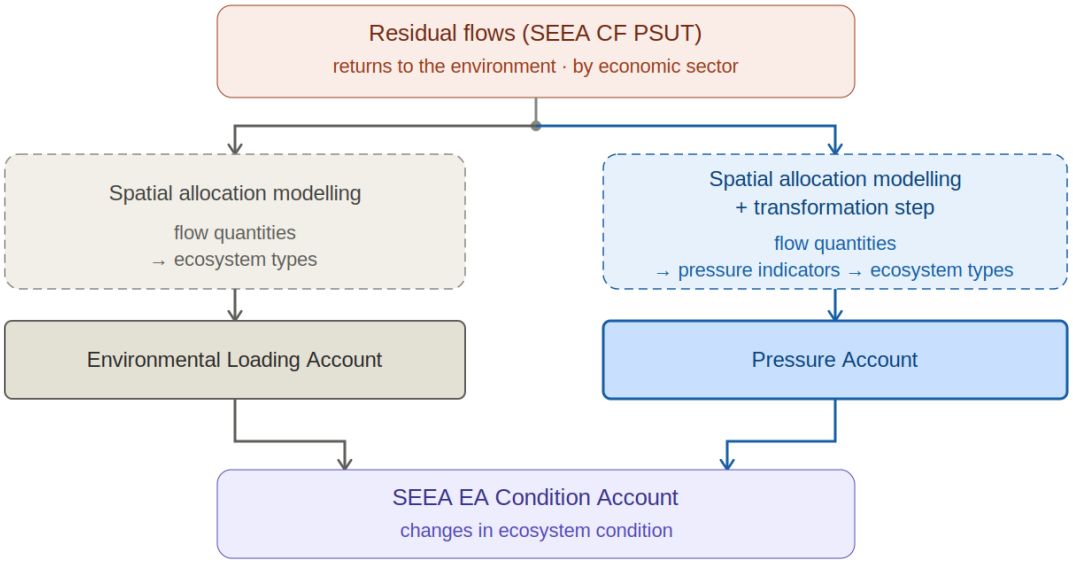
The key conceptual chain:

Residual flows (SEEA CF PSUT) → spatial allocation → ecosystem types → ecological pressures → changes in ecosystem condition (SEEA EA)

A critical distinction runs throughout the Guidance Note: a residual flow (recorded at the point of release from an economic unit) is not the same as an ecological pressure (which characterises the effect of that flow on a receiving ecosystem). The transformation from one to the other requires environmental fate and transport modelling, a step that sits outside the SEEA CF statistical boundary that must be explicitly documented. This distinction generates a two-tier naming convention:

Environmental Loading Account	Pressure Account
Entries are residual flow quantities spatially allocated to ecosystem types through environmental transport modelling	Entries have been further transformed into ecological pressure indicators through a documented transformation step
Records what each ecosystem type receives, in the physical units of the original residual flow data	Records pressure relative to ecological thresholds or benchmarks (e.g. kg N deposited per hectare relative to critical load)
Appropriate first step; likely compilable for countries with PSUT infrastructure	Appropriate where fate-and-transport modelling is available and documented

Figure 1 Conceptual chain diagram



Design Options

Six conceptual options for designing a Pressure Account are evaluated against four criteria: accounting consistency with SEEA CF principles; bridge function between SEEA CF and SEEA EA; compilation feasibility for national statistical offices; and analytical clarity for policy

users. A seventh option, a modular framework, reframes the question as one of accommodating multiple implementation patterns rather than prescribing a single design.

Option	Key characteristic and assessment
A — PSUT Extension	Disaggregates the PSUT environment column into ecosystem-type sub-columns. Highest accounting consistency; weakest analytical clarity (does not transform flows into pressure indicators).
B — Standalone Matrix	Separate table with pressure categories as rows, ecosystem types as columns. Best balance of feasibility and analytical clarity; recommended for immediate adoption.
C — PSUT-Style Pressure Account	Full supply-use structure with economic sectors on supply side, ecosystem types on use side. Strongest bridge function and analytical clarity; lowest feasibility; requires resolution of transformation and additivity questions.
D — Spatial Bridge / Gridded Maps	Georeferenced spatial data layer from which tabular accounts can be derived. A compilation pathway, not a standalone account design.
E — Medium-Based Accounts	Organises by environmental medium (air, water, soil). Most accessible entry point; a compilation pathway building toward Options A, B, or C.
F — Ecosystem-Receiving Account	Starts from ecosystem types and asks what pressures each receives. Most aligned with SEEA EA; weakest connection to SEEA CF without source attribution.
G — Modular Framework	Accommodates all options as compliant implementation patterns with a designated recommended baseline. Recommended approach.

Recommendations

Three recommendations follow from the comparative assessment:

Recommendation 1: Include a formal definition of the Pressure Account in the updated SEEA CF

The definition should make explicit: (a) the scope is limited to residual flows recorded in the PSUT; (b) the Pressure Account is conceptually distinct from both the PSUT and the SEEA EA Condition Account, it is an intermediate accounting structure bridging the two; and (c) entries must remain traceable to PSUT residual flows, with any transformation step explicitly documented.

Recommendation 2: Adopt a modular framework (Option G) with Option B as the recommended baseline

Option B, a standalone matrix with pressure categories as rows and ecosystem types as columns, derived from PSUT data, is recommended for immediate adoption. Option C is the preferred long-term structure pending resolution of open questions through global consultation. Options D and E are presented as compilation pathways rather than standalone

account designs. The two-tier naming convention (Environmental Loading Account / Pressure Account) provides a visible progression as methods and data mature.

Recommendation 3: Submit five key design questions to global consultation

- Question 1 - Transformation step and naming: should the Environmental Loading Account / Pressure Account distinction be formally adopted?
- Question 2 - Reporting granularity: at what level of spatial detail should compiled pressure indicators be reported, given that asset-level estimation is always required in the underlying calculation?
- Question 3 - Supply-use identity: should the identity in Option C be treated as a hard accounting requirement or a soft organising convention, given that pressure is not a physically conserved quantity?
- Question 4 - Additivity: should column totals across pressure types be explicitly disallowed, or should composite pressure indices be permitted subject to documented weighting assumptions?
- Question 5 - Scope extension: should the Pressure Account be extended to natural input flows from the PSUT, or should extraction pressures be addressed in a separate structure?

Unresolved Issues and Research Agenda

The following issues are identified as requiring further research before they can be resolved; they are distinct from the consultation questions above, which concern design choices:

- The treatment of cumulative and lagged pressures: many ecological effects operate over longer time scales than a single annual accounting period.
- The sub-annual dimension: some ecologically significant pressure dynamics (seasonal nutrient loading peaks, episodic discharge events) operate at sub-annual scales that annual accounts cannot capture.
- The relationship between the Pressure Account and the Condition Account in the presence of multiple simultaneous stressors, i.e. the cumulative effects problem: The account records pressures separately, but their combined ecological effects are rarely additive; a distinction from the issue of additivity as a statistical compilation issue.
- The boundary between residual-based and extraction-based pressures, and whether a unified framework covering both sides of the PSUT is feasible.
- Integration with other SEEA CF update issues, particularly GN A4 (spatial accounts), GN B1/B5 (PSUT description), and GN B7 (waste accounts).

Next Steps

Implementation of the recommendations requires: proposed text revisions to the 2012 SEEA CF at five locations (Chapters 2 and 3); insertion of a new Section 3.7 on Pressure Accounts; and submission of the five consultation questions to the global review process.

Three types of pilot testing are proposed prior to global adoption: testing of Option A spatial allocation methodology in countries with mature PSUTs (possible Denmark, the Netherlands, Germany); validation of the Option B structure using the EEA/JRC pilot nutrient account

methodology; and a regional marine pilot using the OSPAR/MSFD framework to test Option C transferability beyond the Dutch North Sea case.

Development of a subsequent Implementation Note will be required to address compilation guidance gaps identified in Section 5.1, including spatial allocation methods for residual flows, environmental fate and transport modelling protocols, treatment of diffuse versus point-source pressures, and statistical confidentiality in spatially disaggregated accounts.

Key References

- Bogaart et al. (2023). SEEA Ocean Ecosystem Accounting for the Dutch North Sea. Statistics Netherlands (CBS).
- European Environment Agency (2020). Measuring the Extent and Condition of European Ecosystems. EEA Briefing No. 24/2020.
- Obst, C. and Bogaart, P. (2025). Scoping Note for Issue B6. SEEA CF 2028 Update, UNSD.
- United Nations (2021). System of Environmental-Economic Accounting — Ecosystem Accounting (SEEA EA).
- United Nations et al. (2014). System of Environmental-Economic Accounting 2012 — Central Framework (SEEA CF).
- United Nations et al. (2025). System of National Accounts 2025 (pre-edit version).
- Moll et al. (February 2026). GN B1/B5 — Physical Supply and Use Tables. SEEA CF 2028 Update.

1 Description of the Issue

1.1 Background and context

1. The Physical Supply and Use Tables (PSUT) of the SEEA Central Framework (SEEA CF) record all physical flows between the environment and the economy. Flows from the economy to the environment, referred to as residual flows, are currently recorded in a single aggregate column labelled 'environment' in the PSUTs.[1] This column captures emissions to air, discharges to water, releases to land, and other residual flows from economic units, but does not identify the specific ecosystem asset or ecosystem type in which these residuals are deposited.

2. Issue B6 of the SEEA Central Framework 2028 Update process considers whether and how this aggregate treatment can be refined, with the specific intent to link it to the SEEA Ecosystem Accounting (SEEA EA) statistical standard. The core proposal is to extend the PSUT, or alternatively to develop a complementary Pressure Account, such that residual flows to the environment are recorded for specific ecosystem assets they impact or, alternatively, by the ecosystem types they affect. This would provide an explicit accounting link between economic activities recorded in the SEEA CF and changes in ecosystem condition recorded in the SEEA EA Condition Account.

3. An important starting point for this work is the definition of environmental pressures in the SEEA EA: “An environmental pressure is a human-induced process that alters the condition of ecosystems” (SEEA EA, paragraph 5.105). The SEEA EA provides this definition but does not include a formalised account linking specific pressures to identifiable economic flows within the accounting system. The Pressure Account is intended to fill this gap.

4. An important source of inspiration for considering a Pressure Account in the SEEA CF has been work done by Statistics Netherlands while developing ocean ecosystem accounts for the Dutch North Sea. In that work, the relevance of measuring environmental pressures was recognised explicitly. The identification of residual flows from economic activities as drivers of changes in marine ecosystem condition illustrated the analytical value of linking Physical Flow Accounts to ecosystem Condition Accounts at a more spatially refined level.

5. The term 'Pressure Account' is used in this Guidance Note to refer to an accounting structure that systematically records the residual flows from the PSUT in a form that can be linked to impacts in specific ecosystems or by specific ecosystem types. Note that it may be useful to consider the timing of the releases as well, given the potential seasonality of pressures. As discussed in Section 3, several alternative designs for such an account are possible, ranging from an extension of the existing PSUT environment column to a separate satellite account. The appropriate design depends on many factors, including accounting conventions, compilation feasibility and scientific rigour. These alternatives are evaluated in this Guidance Note.

1.2 Current accounting treatment in the SEEA CF

6. The current SEEA CF (2012) records residual flows in Chapter III as part of the Physical Flow Accounting framework. Residuals are defined as materials or energy that

[1] See, for example, Table 3.7 – Air emissions account, p. 82, SEEA Central Framework.

are returned to the environment as a result of the production and consumption activities of economic units. They are recorded in the Use Table of the PSUT under the column 'environment', which represents the totality of the natural environment as a receiving domain.

7. This treatment reflects the primary purpose of the PSUT, which is to account for the material, water and energy throughput of the economy in a manner consistent with the System of National Accounts (SNA). The aggregate environment column is appropriate for this purpose. However, it provides no information about the destination of residuals within the environment; that is, which specific ecosystems or ecosystem types receive which residual flows.

8. For example, the Air Emissions Account, a sub-system of the PSUT, record emissions of specific compounds by economic sector following the residence principle. This account provides a basis for constructing pressure-related indicators but does not, in its current form, link emissions to ecosystems they affect through atmospheric deposition or other transport processes. The Water Emission Account presents a similar case.

9. The SEEA EA Condition Account records the state of ecosystems using quantitative indicators of ecosystem characteristics, organised according to the SEEA Ecosystem Condition Typology (ECT). The ECT is a hierarchical classification with six classes grouped into three main categories: abiotic characteristics (physical state and chemical state), biotic characteristics (compositional and structural state), and landscape-level characteristics (functional state and landscape state). Indicators drawn from these six classes, such as water quality indices and soil chemical composition (abiotic), species abundance, habitat structure and ecological process rates (biotic), and ecosystem connectivity or fragmentation (landscape-level), collectively describe the overall quality of an ecosystem relative to a reference condition. Changes in these indicators may reflect the cumulative effects of pressures from economic activities, but the SEEA EA does not currently contain an account that explicitly links those pressures to the residual flows recorded in the SEEA CF PSUT. The Pressure Account is conceived as the accounting structure that would provide this link.

10. It should be noted that the 2012 SEEA CF deliberately does not use terms such as 'pressure', 'impact', or 'stress' within its accounting framework. It refers to them when discussing analytical interpretations and indicators. In considering the inclusion of a Pressure Account in the updated SEEA CF, it is therefore necessary to examine carefully the conditions under which pressure-related concepts can be represented within a statistical accounting framework in a manner that is objective, reproducible, and consistent with SEEA accounting principles.

1.3 Why this issue is relevant to the SEEA CF update

11. The inclusion of a Pressure Account in the updated SEEA CF would serve several objectives that have been identified as priorities for the 2028 update:

- Bridging the SEEA CF and SEEA EA: A central objective of the update is to strengthen the integration between the SEEA CF and the SEEA EA. The Pressure Account provides a direct accounting link at the interface between the Physical Flow Accounts of the SEEA CF and the Condition Account of the SEEA EA. Without this link, residual flows in the PSUT remain attributed to the economic units that generated them, while ecosystem condition changes remain attributed to ecosystem types, with

no statistical bridge connecting the two.. The Pressure Account would bridge these two different organising dimensions.

- Supporting policy-relevant analysis: From an ecosystem management perspective, the ability to trace observed changes in ecosystem condition back to specific residual flows from identifiable economic sectors is analytically valuable. It supports the identification of priority pressures and the design of targeted policy responses. This analytical function corresponds to the 'Pressures' component of the DAPSIR framework (Drivers, Activities, Pressures, State change, Impacts, Responses), which is widely used in environmental policy contexts.[2] The Pressure Account would support the application of this framework without requiring that the accounting structure itself adopt the DAPSIR model as its organising logic.
- Improving the spatial resolution of SEEA CF accounts: The current PSUT does not distinguish residual flows by the location from which they are emitted or in which they are deposited, nor the timing the deposition occurs. A Pressure Account would require some degree of spatial and, in some cases, temporal disaggregation of residual flows, contributing to the broader objective of making SEEA CF accounts more spatially explicit (Issue A4).
- Providing a foundation for indicator derivation: Pressure accounts would support the derivation of indicators relevant to international monitoring frameworks, including the Sustainable Development Goals (SDGs) and the Kunming-Montréal Global Biodiversity Framework (GBF), both of which include targets and indicators related to pollution, ecosystem degradation, and the effects of economic activity on the environment (SEEA CF Revision Issue A2, Indicators).

12. At the same time, the incorporation of a Pressure Account into the SEEA CF raises a number of conceptual and methodological challenges that this Guidance Note must address directly. These include: the distinction between a residual flow and an ecological pressure; the transformation steps required to convert recorded residual flows into pressure indicators; the spatial allocation of economy-wide emissions to specific ecosystem types; the issue of confidentiality; and the compilation feasibility of the account for national statistical offices. These challenges are examined in Sections 3 and 4.

1.4 Scope of the Guidance Note

13. In considering the concept of environmental pressure broadly, it is apparent that a wide range of human interactions with the environment could be characterised as exerting pressure on ecosystem condition. These include the harvesting of natural resources, changes in land use, the effects of marine transport, tourism, as well as the introduction of invasive species, and the effects of climate change.

14. For the purposes of this Guidance Note, the scope is limited to pressures arising from residual flows recorded in the SEEA CF Physical Flow Accounts. This boundary is

[2] DPSIR (Driving forces–Pressures–State–Impact–Response) and its refinement DAPSIR (Drivers–Activities–Pressures–State–Impact–Response) extend the earlier Pressure–State–Response (PSR) framework by separating underlying socio-economic drivers from direct pressures, adding impacts (the consequences of changes in environmental/ecosystem state for people and society), and, under DAPSIR, explicitly identifying economic activities as the mechanism generating those pressures. The PSR model itself originates in OECD work of the 1970s and was first formally applied in official statistics in Statistics Canada's 1986 *Human Activity and the Environment*.

established for two reasons. First, residual flows are the physical flows most directly linked to existing PSUT accounting structures, making them the most tractable starting point for an accounting-based treatment of pressures. Second, anchoring the Pressure Account to residual flows recorded in the PSUT ensures that the statistical foundation of the account is grounded in compiled, observable data. This boundary follows the initial scope established in the Scoping Note for Issue B6 (June 2025), which set the terms of reference for this Guidance Note. Section 4.4 (Question 5) reconsiders one element of that original scope — the exclusion of pressures arising from resource extraction — in light of the analysis developed in this Guidance Note.

15. The following types of pressure are therefore explicitly excluded from the scope of this Guidance Note:

- Pressures arising from the harvesting of natural resources (e.g. depletion of fish stocks, timber extraction)
- Pressures arising from land-use change (e.g. habitat conversion, urbanisation)
- Pressures arising from passive environmental uses (e.g. marine transport noise, light pollution, tourism-related disturbance)
- Pressures from invasive species and biological introductions
- Natural disturbances and extreme natural events
- Pressures attributable specifically to climate change.

16. While the design of specific accounts for these excluded pressures is outside the scope of this Guidance Note, it acknowledges that information on some of these pressures can be derived from existing SEEA CF accounts; for example, estimates of land use change from SEEA CF Land Accounts, or information on natural resource depletion from Physical Asset Accounts. Where relevant, the GN may provide brief guidance on how such information can be identified and presented, without proposing new account structures for these types of pressure.

17. Within the defined scope of residual flow-based pressures, the following types of residual flows are considered:[3]

- Emissions to air; including gaseous pollutants, particulate matter, and greenhouse gases emitted from industrial, transport, agricultural, and household sources.
- Discharges to water; including nutrient loads, oxygen-depleting organic matter and toxic substances, released to inland waters and marine environments via wastewater, agricultural runoff, and direct industrial discharge.
- Releases to land; including solid waste disposal, mining waste, and the accumulation of persistent contaminants in soils.
- Diffuse releases from dissipative product uses; including residuals from the application of fertilisers, pesticides, pharmaceuticals, road salts, and other products that partially enter the environment during use.

[3] Physical energy flows to the environment — including waste heat from industrial processes and thermal discharges to water bodies — are recorded in the PSUT energy accounts as residual flows and could in principle constitute a pressure category within this framework. However, they are excluded from the current scope of this Guidance Note on the grounds that internationally standardised methods for transforming thermal release quantities into ecosystem-type-level ecological pressure indicators are not yet sufficiently developed to support compilation guidance at the level of specificity required here.

18. Emissions from mobile sources (including road transport, aviation, and shipping) present specific spatial attribution challenges. For example, in Air Emission Accounts compiled following the residence principle, mobile source emissions are attributed to the country of the resident operator regardless of where the emission physically occurs. This creates a mismatch between economic attribution and physical location that requires careful treatment in any spatial allocation step.

19. A further complication arises even where territory-principle data are available: national greenhouse gas inventories compiled under the UNFCCC record mobile source emissions based on the location of fuel sales rather than the location of combustion, meaning that the spatial attribution problem is not fully resolved by switching from the residence principle to the territory principle. Fuel purchased in one location may be consumed, and emissions physically released, in a different location, creating a systematic mismatch between recorded emission attribution and actual spatial deposition relevant to Pressure Account compilation.

1.5 Key research questions

20. The Guidance Note addresses the following questions, as identified in the Scoping Note for Issue B6 (Obst and Bogaart, 2025).

- **(a) Types of residual flows.** What different types of residual flows should be considered e.g. air pollution, water pollutants, wastewater, etc?
- **(b) Prioritisation.** Are there specific residual flows of higher importance that should be the focus of additional descriptions? And if so, how should residual flows of higher importance be defined, e.g. in terms of expected environmental impact, vulnerability assessments, associated policies and regulation, current reporting requirements, etc?
- **(c) Economy-wide versus localised measurement.** How should the measurement and accounting approach balance between economy-wide measurement of residual flows and the likely localised impact of these flows (e.g. in terms of specific locations within a country)?
- **(d) Linking flows to impacts.** Generally, in the PSUT, the supply of residual flows is attributed to economic units. But to what extent will it be possible to link the impact of a residual flow in a particular location to economic units?
- **(e) Ecosystem types versus ecosystem assets.** Should the effects of residual flows be recorded only in terms of the ecosystem types that are affected (e.g. rivers, wetlands, seagrass beds), or should they also be recorded in terms of changes in other locations (i.e. connected ecosystems) or other environmental components (e.g. species)?
- **(f) Air pollutants and mobile sources.** Are there specific considerations to account for (i) air pollutants including, for example, LULUCF GHG emissions; and (ii) mobile sources of emissions (e.g. transportation activities)?
- **(g) Links to ecosystem condition.** How should the link to the measurement of ecosystem condition be described, considering both intrinsic (i.e., with respect to ecological integrity) and instrumental perspectives (i.e., with respect to ability to supply ecosystem services) on ecosystem condition?
- **(h) Statistical confidentiality.** What statistical issues (particularly concerning confidentiality) may arise in presenting statistics on pressures where the link between

the source of the pressure and the effects on the environment may be limited to a small number of economic units?

1.6 Links to other SEEA CF update issues and statistical frameworks

21. The Pressure Account is conceptually connected to several other issues under consideration in the SEEA CF update. The most direct links are summarised below.

22. Issue A1 (Overview of links between SEEA CF and SEEA EA). The Pressure Account is one of the most direct mechanisms by which the SEEA CF and SEEA EA can be analytically connected. It would provide an accounting structure linking physical flows from economic units recorded in the PSUT to the ecosystem type-based entries of the SEEA EA Condition Account. This link requires identifying where residual flows affect specific ecosystems, reinforcing the spatially explicit integration between CF flow data and EA ecosystem condition measures that Issue A1 seeks to advance.

23. Issue A2 (Indicators). The Pressure Account would provide a foundation for deriving indicators of environmental pressure that are consistent with the SEEA accounting system. Such indicators could support reporting against international frameworks including the SDG indicators and the targets and indicators of the Kunming-Montréal Global Biodiversity Framework, several of which concern pollution loads, ecosystem degradation, and the attribution of environmental change to economic activities.

24. Issue A4 (Accounting at different spatial scales). GN A4 explicitly identifies residual flow accounts as a primary candidate for spatial disaggregation within the SEEA CF, and notes that information for Issue B6 "will need to be predominantly spatially detailed to link to Ecosystem Accounting." The Pressure Account depends on principles and methods of spatial disaggregation that are being developed in the context of Issue A4. The two issues are therefore complementary, with A4 providing the methodological framework for spatial accounting and B6 applying that framework to residual flows.

25. Issue A6 (Strengthening links to policy). The Pressure Account would strengthen the policy relevance of the SEEA CF by providing a structured basis for presenting residual flows in a form that is directly relevant to environmental management, pollution control, and biodiversity policy. It would support thematic presentations of accounts linking economic activity to environmental outcomes without requiring changes to the core account structures of the SEEA CF.

26. Issue A8 (Linking environmental activity, asset, and flow accounts). The Pressure Account sits at the interface between Physical Flow Accounts and Environmental Asset Accounts. By allocating residual flows to ecosystem types, it creates a link between the economy–environment flow boundary in the PSUT and the ecosystem assets recorded in the SEEA EA. This contributes to the broader objective of Issue A8, which seeks to clarify and strengthen the connections between the different account types within the SEEA system.

27. Issue B1/B5 (Description of PSUTs). If the Pressure Account is structured as an extension of the PSUT, this has direct implications for the description and classification of the PSUT environment column in the updated SEEA CF. GN B1/B5 emphasises the flexibility of PSUT row and column classifications for practical applications, and notes that the theoretical PSUT framework should be clearly distinguished from its subsystem implementations. A Pressure Account would represent such a subsystem application, a policy-driven disaggregation of the PSUT environment column.

28. Issue B7 (Elaboration of Waste Accounts). Waste Accounts record a significant subset of the residual flows that would be relevant to the Pressure Account; specifically solid waste and managed waste flows. GN B7 addresses the distinction between waste as a residual and waste as a product or secondary raw material, a distinction that is directly relevant to determining which waste-related flows should be considered as inputs to the Pressure Account. Coordination between the GN B6 and B7 work streams is necessary to ensure consistency in the treatment of waste-related residuals.

29. Issue C6 (Potentially environmentally damaging subsidies). The Pressure Account records the environmental consequences of economic activity in physical terms. This information can be analytically combined with the monetary records of environmentally damaging subsidies developed under Issue C6, providing a more complete picture of the economic drivers behind specific environmental pressures. The Pressure Account can serve as a contextual reference for policy analysis linking subsidised activities to their ecological effects.

1.7 Stakeholders

30. The review of this Guidance Note and subsequent development of an Implementation Note will require engagement with experts and stakeholders across four broad categories:

- **National statistical offices with relevant compilation experience.** Priority engagement is needed with offices that have direct experience compiling Physical Supply and Use Tables, Air Emissions Accounts, Water Accounts, or Ecosystem Accounts, and in particular those that have already attempted pressure-related or spatially disaggregated accounts. Statistics Netherlands (CBS), Statistics Denmark, the German Federal Statistical Office (Destatis), and the UK Office for National Statistics are the most directly relevant given their existing work documented in Section 2 below. Statistical offices in countries implementing the EU SEEA regulation, which mandates Air Emissions Accounts, Material Flow Accounts, and Ecosystem Accounts, constitute a broader compilation community whose feasibility assessments will be critical for global consultation.
- **International organisations with methodological and coordination roles**. The European Environment Agency (EEA) and the EU Joint Research Centre (JRC) for their work on spatially explicit nutrient Pressure Accounts and ecosystem condition assessment; Eurostat for Air Emissions Accounts compilation guidance and the EU SEEA regulation; the OECD for its work on SEEA policy applications and natural capital accounting; the World Bank and UNEP for developing country implementation perspectives; the Food and Agriculture Organization (FAO) for links between residual flows from agriculture and ecosystem condition; and the Global Ocean Accounting Partnership (GOAP) for its prior integration of pressure-account concepts within the ocean accounting framework, offering a direct methodological precedent for marine and coastal applications.
- **Scientific and research experts in environmental pressure modelling.** Experts in atmospheric deposition modelling (EMEP), nutrient load modelling (JRC GREEN, MONERIS), and marine pressure assessment are needed to advise on the transformation step from residual flows to ecological pressure indicators. The authors of the Dutch North Sea Pressure Account (Bogaart et al., CBS and Wageningen University) are the most directly relevant given their role as originators of the experimental account on which Section 2 draws. Researchers active in the SEEA

Ecosystem Accounting community, including those involved in the development of the Ecosystem Condition Typology (ECT), are needed for the link to ecosystem condition.

- **Policy bodies and regulatory frameworks as data sources and consultation stakeholders.** Commissions and conventions for marine pressure data and classification frameworks such as the Baltic Marine Environment Protection Commission — Helsinki Commission (HELCOM) or the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR); the European Commission (DG Environment) for MSFD implementation and ecosystem assessment; the secretariat of the Convention on Biological Diversity (CBD) for links between Pressure Accounts and biodiversity policy indicators; and national environment ministries and environmental agencies that compile the emission registers and environmental monitoring data on which Pressure Account compilation depends. Environmental NGOs engaged in water-quality and biodiversity monitoring, particularly where they hold site-level monitoring data complementing official registers, are relevant both as a potential data source and as consultation stakeholders given their interest in how pressure indicators feed into biodiversity reporting frameworks.

2 Review of Existing Measurement and Research

2.1 Overview

31. This section documents the existing work, research, estimates, and methods that can underpin the development of a Pressure Account for the SEEA Central Framework. The focus is on ensuring that all relevant material is identified and recorded. Evaluation of alternative approaches and accounting options is addressed in Section 3.

32. Pressure Accounts linking SEEA CF residual flows to receiving ecosystem assets or types represent a frontier area in environmental-economic accounting. As of the writing of this note no country had yet published formal, spatially disaggregated Pressure Accounts as a standard SEEA statistical product. The existing knowledge base is therefore distributed across a small number of experimental national implementations, international pilot exercises, conceptual treatments in statistical standards, and established environmental modelling frameworks. Each of these is documented in turn below.

2.2 Conceptual treatment in the SEEA EA and the SNA 2025

33. The SEEA Ecosystem Accounting (2021) provides the foundational conceptual treatment of environmental pressures within the SEEA framework. Section 5.5.3 of the SEEA EA, "The use of data on environmental pressures" establishes that data on environmental pressures from the SEEA CF, in particular physical flow data on water use, energy use, air emissions, and solid waste, may serve as proxy measures of ecosystem condition, provided the linkage between pressures and state is well documented (SEEA EA, paragraph A1.30). Pressures are treated in the SEEA EA as ancillary or supplementary data to Condition Accounts rather than as primary accounting variables in their own right. No standalone Pressure Account with a defined supply-use or stock-flow structure is included among the five core SEEA EA accounts.

34. The SEEA EA is explicit, however, about the need for spatial disaggregation as a prerequisite for linking SEEA CF residual flows to ecosystem condition. Paragraph A1.17 states that integration of SEEA CF pressure data with ecosystem accounts "may require the spatial disaggregation of data on residual flows to locations within a country, such that the link between the residual flows and changes in ecosystem condition can be clearly established." This passage directly establishes the analytical requirement that Issue B6 seeks to address.

35. The SEEA EA also provides the closest existing structures to a Pressure Account in Chapter 14 on the use of SEEA data in policy analysis. Table 14.6 presents a set of SEEA-based pressure indicators drawing data from both the SEEA CF and SEEA EA, covering air emissions by industry, wastewater discharges, and solid waste generation. These are presented as combined indicator tables, not formal accounting structures, but they demonstrate the conceptual architecture, linking emitting economic units to receiving environmental domains, that a Pressure Account would formalise.

36. Beyond the SEEA EA, the 2025 System of National Accounts introduces an important new mandate that directly supports the concept of a Pressure Account. Paragraph 35.66 of Chapter 35, "Measuring the sustainability of well-being", states: "Generally, PSUT are compiled at national level but where they can be compiled at a sub-national scale (for example, water PSUT compiled by catchment) the variation in environmental pressures

and impacts across the country can be identified and, ideally, linked to data from the Ecosystem Accounting on the changing condition of ecosystem assets. For example, data on the condition of rivers might be linked to data from the water PSUT on abstraction of water and generation of wastewater". The significance of this passage is twofold. First, it establishes within the SNA itself that linking spatially disaggregated PSUT data to ecosystem condition is a recognised and desirable analytical goal, providing a high-level mandate for the type of structure that the Pressure Account would formalise. Second, the passage cites both water abstraction, a natural input flow, and wastewater generation, a residual flow, as examples of this linkage, implicitly encompassing both sides of the PSUT. The scope of the Pressure Account as defined in this Guidance Note is currently limited to residual flows; the question of whether it should be extended to natural input flows is addressed in Section 4.4 (Question 5).

37. On the residual flow side specifically, the 2012 SEEA CF itself acknowledged the gap that the Pressure Account is designed to fill. Paragraph 3.107 states that 'the measurement of the effect of flows of residuals on the state and quality of the ecosystems that receive them is addressed in SEEA Experimental Ecosystem Accounting', a cross-reference that the updated SEEA CF may be in a position to replace with a formal accounting structure within the Central Framework itself.

2.3 The Statistics Netherlands North Sea pressure account

38. The most fully realised Pressure Account compiled to date was developed by Statistics Netherlands (CBS) as part of its ocean Ecosystem Accounting programme for the Dutch North Sea (Bogaart et.al., 2023).

39. Chapter 5 of this report presents an experimental Pressure Account for North Sea ecosystems. The account is structured as a matrix linking economic activities, as sources of pressures, to marine ecosystem types, as receiving environments. The authors describe this structure essentially as a "mirror image" of the ecosystem services account: where ecosystem services are supplied by ecosystem assets and used by economic sectors, environmental pressures are caused by economic sectors and affect ecosystem assets (Bogaart, 2025). Economic sectors are classified using NACE, consistent with SNA and SEEA conventions. Pressures are drawn from three regulatory frameworks used in European marine governance: the EU Marine Strategy Framework Directive (MSFD), the OSPAR Convention, and the EU Bird and Habitat Directives (BHD). Ecosystem types in the analysis correspond to the Natura 2000 habitat types designated under the Habitat Directive, supplemented by OSPAR, MSFD and BHD condition and pressure descriptors. The authors note that a full quantitative population of the pressure account is not yet possible in most cases, and the account remains largely qualitative and experimental.

40. Methodologically, Chapter 5 demonstrates how data from existing policy reporting frameworks - in particular the EU MSFD, the OSPAR Convention quality status reporting, and the EU Birds and Habitats Directive - can be reorganised into a SEEA-consistent pressure structure. Detailed crosswalks were developed to reconcile differences between policy-driven pressure indicators and SEEA classifications. A key methodological principle applied throughout is what may be termed the "pressure-as-flow" rule: indicators originating from MSFD and OSPAR reporting were reclassified where necessary to ensure that pressures are recorded as flows generated by economic activities, while variables describing concentrations, status, or impacts within ecosystems are treated as ecosystem condition variables rather than pressure variables.

41. The account is explicitly described as experimental and incomplete in quantitative terms. As the authors state, “a full quantification of the pressure accounts will not yet be possible in most cases” (Bogaart et al., 2023, p. 83). The chapter nonetheless provides detailed qualitative and partial quantitative analysis of specific pressure categories, including eutrophication and nutrient loads (nitrogen and phosphorus), pollution by heavy metals and harmful substances, bottom trawling intensity, and offshore wind energy effects, demonstrating through worked examples how these pressures can be linked to economic sectors classified by NACE and recorded against specific North Sea ecosystem types and Natura 2000 sites. Spatial attribution is treated as essential to the design: pressures are analysed by their spatial footprint, distinguishing between localised point-source effects and diffuse non-point-source effects. This distinction maps directly onto the classification of residual flows discussed in Section 3 of this Guidance Note.

42. The report introduces a key structural principle for pressure account design. As the authors state: “information on environmental pressures can be organized in tables using the same accounting structure as ecosystem services, but reversed, in so-called "pressure accounts". Where ecosystem services are supplied by ecosystem assets, and used by economic sectors, environmental pressures are caused ("supplied") by economic activities and affect ("used by") ecosystem assets” (Bogaart et al., 2023, p. 83). This reversed supply-use logic — economic sectors as sources, ecosystem types as destinations — is directly compatible with PSUT structure and provides a clear accounting design principle for a Pressure Account. A companion presentation by Bogaart (2025) for the SEEA CF update process applies this same framework to a worked numerical example, using nitrogen deposition on Dutch Natura 2000 sites to illustrate spatial pressure allocation by sector and ecosystem type.

43. This North Sea work builds on a preceding CBS pilot study (Schenau et al., 2019). The broader Dutch Ecosystem Accounting programme, which includes terrestrial ecosystem Condition Accounts incorporating pressure indicators for acidification, eutrophication, and urbanisation, is documented in Hein 2020.

2.4 EEA and JRC pilot nutrient Pressure Accounts

44. The European Environment Agency (EEA), working with the EU Joint Research Centre (JRC), has produced pilot spatially explicit nutrient Pressure Accounts that represent the most systematic European-scale exercise in linking residual-type flows to receiving ecosystem types in an accounting context (European Environment Agency, 2020).

45. The EEA pilot accounts are explicitly built on the SEEA framework, and the nutrient pressure accounts are directly linked to the Ecosystem Extent Accounts through their shared CORINE Land Cover spatial foundation. This integration demonstrates that spatial pressure allocation by ecosystem type can be achieved using data and spatial infrastructure already developed for SEEA EA ecosystem Extent Accounting, without requiring separate bespoke spatial approaches.

46. A broader EU Ecosystem Accounting context for these pilots is provided by the INCA (Integrated Natural Capital Accounting) project (Vysna, V. et al., 2021). The INCA project, a joint product of Eurostat, JRC, DG Environment, and EEA, compiled ecosystem extent, condition, and service accounts using nine broad MAES ecosystem types. It incorporates nitrogen input as a pressure indicator within its agro-ecosystem condition accounts, providing an empirical illustration of how pressure data can be integrated into ecosystem Condition Accounts.

2.5 The FDES and existing residual flow statistics

47. The Framework for the Development of Environment Statistics (United Nations Statistics Division, 2013) provides the most comprehensive international classification of residual flow statistics relevant to pressure accounting. Component 3 of the FDES covers residuals across three sub-components:

- Sub-component 3.1: Emissions to air, including greenhouse gases, air pollutants, and particulate matter, by economic sector and fuel type.
- Sub-component 3.2: Generation and management of wastewater, including volumes and pollutant loads discharged to water bodies.
- Sub-component 3.3: Generation and management of waste, including solid waste, hazardous waste, and mining and construction waste.

48. FDES Component 3 statistics correspond directly to the residual flow categories recorded in the SEEA CF PSUT and constitute the primary data infrastructure from which a Pressure Account could draw. However, the key methodological step that is not covered by FDES is the spatial disaggregation of these flows by receiving ecosystem assets or types, which is the specific gap that a Pressure Account is designed to fill. On the other hand, the FDES explicitly maps Component 3 to the Pressure element of the DPSIR framework, confirming the conceptual alignment between existing residual flow statistics and the pressure accounting concept.

2.6 Other national and international implementations

49. Several countries have produced partial implementations relevant to pressure accounting, though none has published formal SEEA-aligned pressure accounts that spatially disaggregate residual flows by receiving ecosystem assets or type as a standard statistical product.

50. The United Kingdom Office for National Statistics compiles natural capital accounts by habitat type that include environmental pressure indicators as ancillary data in Ecosystem Condition Accounts. These are not structured as residual-flow-to-ecosystem-type tables but provide a model for incorporating pressure data into the Ecosystem Accounting framework (Office for National Statistics, 2022).

51. Germany's Federal Statistical Office has compiled ecosystem Condition Accounts incorporating pressure, management, and ancillary data alongside state variables, with spatial aggregation at municipal, district, and federal levels following the SEEA EA methodology (Destatis, 2023).

52. And as mentioned earlier, at the regional marine level, preliminary SEEA ecosystem accounts for the OSPAR area provide further context for integrating pressure data into marine Ecosystem Accounting (Alarcon Blazquez et al., 2023).

2.7 Spatial allocation modelling frameworks

53. Spatially allocating residual flows from economic units to specific receiving ecosystem types requires environmental transport, fate, and exposure data that are not produced by national statistical offices but may be available through established scientific modelling frameworks. These frameworks constitute the technical infrastructure upon which the spatial allocation step of a Pressure Account would draw. For example:

54. The EMEP MSC-W model is the standard European tool for estimating atmospheric deposition of pollutants such as nitrogen, sulphur, heavy metals, and persistent organic pollutants. It produces spatially explicit, gridded outputs across multiple land-use categories, allowing deposition to be coarsely allocated to ecosystem types. These datasets support transboundary air pollution assessments and are available annually; while the standard continental EMEP grid operates at approximately 50 km resolution, the model has also been applied at finer resolutions down to 5 km in national and nested applications, and several countries operate their own higher-resolution deposition models for domestic compilation purposes (Simpson et al., 2012).

55. Regarding nutrient load modelling, two models are particularly relevant to the spatial allocation of nutrient residual flows to freshwater and coastal ecosystem types. The MONERIS (Modelling Nutrient Emissions in River Systems) model estimates nitrogen and phosphorus inputs to river systems by pathway (agricultural drainage, urban runoff, atmospheric deposition, point-source discharges. The GREEN model developed by the European Commission Joint Research Centre (JRC) provides spatially explicit estimates of nutrient losses that are conceptually well suited for integration into SEEA-based pressure and ecosystem condition analyses.

56. Marine pressure assessment in Europe is primarily structured through the OSPAR Commission and the Marine Strategy Framework Directive. The MSFD defines eleven descriptors of environmental status, which describe ecosystem condition and impacts rather than pressures per se, although several (e.g. eutrophication, contaminants, marine litter, and underwater noise) are closely linked to underlying pressure indicators.

57. Standardised methods for characterising the pressure exerted by residual flows on ecosystems have also been developed in the context of life cycle assessment (LCA). The ReCiPe method for Life Cycle Impact Assessment (LCIA) provides substance-specific characterisation factors that convert emission quantities into pressure indicators across multiple environmental processes, including acidification, eutrophication, particulate matter formation, and photochemical ozone formation (Huijbregts et al., 2017). An important feature of these characterisation methods, directly relevant to Pressure Account design, is that a single substance may simultaneously exert pressure through multiple environmental processes; for example, ammonia contributes to both acidification and eutrophication, while NOx contributes to acidification, eutrophication, particulate matter formation, and photochemical ozone formation. This multi-pathway characteristic has implications for the additivity of pressure indicators across categories, and for the risk of double-counting when pressures from a single substance are recorded across multiple rows of a Pressure Account. The ReCiPe and LCIA frameworks are not designed as statistical accounting tools, but their characterisation factor approach represents a methodological resource for the transformation step from residual flow quantities to ecological pressure indicators.

2.8 Summary assessment of the existing evidence base

58. The existing evidence base for pressure accounts is substantial in conceptual terms but, unsurprisingly, limited in terms of compiled, formally structured accounts. Four conclusions are relevant to the development of this Guidance Note:

59. First, the conceptual mandate is well established. The SEEA EA calls for spatial disaggregation of SEEA CF residual flows as a prerequisite for linking Physical Flow Accounts to ecosystem condition (SEEA EA, paragraph A1.17), and the SNA 2025

explicitly envisions sub-national PSUTs linked to ecosystem condition (paragraph 35.66). The CBS North Sea account and the Bogaart (2025) presentation demonstrate that this conceptual mandate can be translated into a workable accounting structure using the "mirror image" PSUT logic.

60. Second, the EEA/JRC pilot nutrient accounts demonstrate that European-scale spatial allocation of pressures to MAES ecosystem types is feasible using data and spatial infrastructure already developed for SEEA EA ecosystem extent accounting. This is significant because it shows that Pressure Account compilation can, in principle, build on existing SEEA EA data systems rather than requiring entirely new data collection.

61. Third, established atmospheric deposition (EMEP), nutrient-load (GREEN, MONERIS), and marine pressure assessment (OSPAR, MSFD) modelling frameworks provide examples of spatial allocation infrastructure models needed to translate economy-wide residual flow statistics into ecosystem-type-specific pressure data. These frameworks are operational and their outputs are available for a wide range of countries and substances. However, they require a transformation step between the residual flow as recorded in the PSUT and the pressure indicator as received by the ecosystem. The nature of this transformation step, and how it should be handled within the accounting framework, is a central question for Section 3.

62. Fourth, the existing evidence base presented here is weighted towards atmospheric and nutrient pressures, reflecting the maturity of deposition modelling and nutrient accounting. Evidence on accounting approaches for solid waste releases, diffuse soil contamination, and mixed contaminant pressures is considerably thinner. The Guidance Note will need to acknowledge this asymmetry and assess its implications for the scope and ambition of initial Pressure Account compilation guidance.

3 Alternative Conceptual Options and Accounting Treatments

3.1 Introduction

63. This section presents the principal conceptual options for designing a Pressure Account within the SEEA CF. The Scoping Note for Issue B6 identifies one broad proposal, extending the PSUT Use Table to record residual flows by ecosystem location, but acknowledges that alternative account designs are possible without elaborating them. This section develops some of those possible alternatives, evaluates their strengths and weaknesses, and identifies relevant precedents from the literature.

64. The options are evaluated against criteria that stem from the Guidance Note and the constraints of the SEEA CF update. For example:

- Accounting consistency: compatibility with the structure, logic, and accounting principles of the SEEA CF PSUT.
- Bridge function: effectiveness in linking SEEA CF residual flow data to the SEEA EA Condition Account.
- Compilation feasibility: realistic implementability by national statistical offices given available data and capacity.
- Analytical clarity: the degree to which the design produces information that is interpretable and policy-relevant.

65. Six options are described, followed by a seventh option that reframes the question as a modular framework rather than a single account design. The options are not mutually exclusive, and in practice a national implementation may combine elements of more than one: Options A, B, and C are closely related and differ mainly in the degree to which they depart from the standard PSUT structure. Options D, E, and F approach the problem from different organising dimensions. Option G proposes that the Guidance Note adopt a modular approach that accommodates all of the above.

66. A preliminary conceptual clarification is necessary before the options are presented. The seven options face a common issue: the PSUT records residual flows from economic units to the environment in physical units (tonnes, cubic metres, kilojoules), measured at the point of emission or discharge. The Condition Account of the SEEA EA records the state of ecosystems using indicators that reflect the cumulative result of pressures over time. Between these two objects lies a transformation chain that includes spatial transport, environmental fate, and in some cases a change of measurement unit. None of the six options below resolves this transformation automatically. Each option makes a different assumption about where the transformation sits — inside the account, outside it, or left to the compiler — and this is one of the most important criteria by which they should be evaluated.

67. A related distinction that runs across all options is that between direct and indirect pressures. A direct pressure is one exerted by an economic activity on an ecosystem in close spatial proximity to the source; for example, a wastewater discharge directly entering an adjacent river ecosystem, or point-source air emissions depositing on nearby forest ecosystems. An indirect pressure is one transmitted through environmental transport pathways or through connected ecosystems; for example, nitrogen discharged to a river affecting a downstream coastal ecosystem through riverine transport, or atmospheric emissions from one region depositing on ecosystems in another. Direct

pressures require relatively straightforward spatial attribution, since the source and the receiving ecosystem are proximate. Indirect pressures require environmental fate and transport modelling to trace the pathway from source to receiving ecosystem, and this modelling step is precisely the transformation chain that separates an "Environmental Loading Account" from a full Pressure Account. This distinction is relevant to all six options but is most acute for Options C and D, where the transformation step is either built into the account structure or handled through a spatial bridge layer.

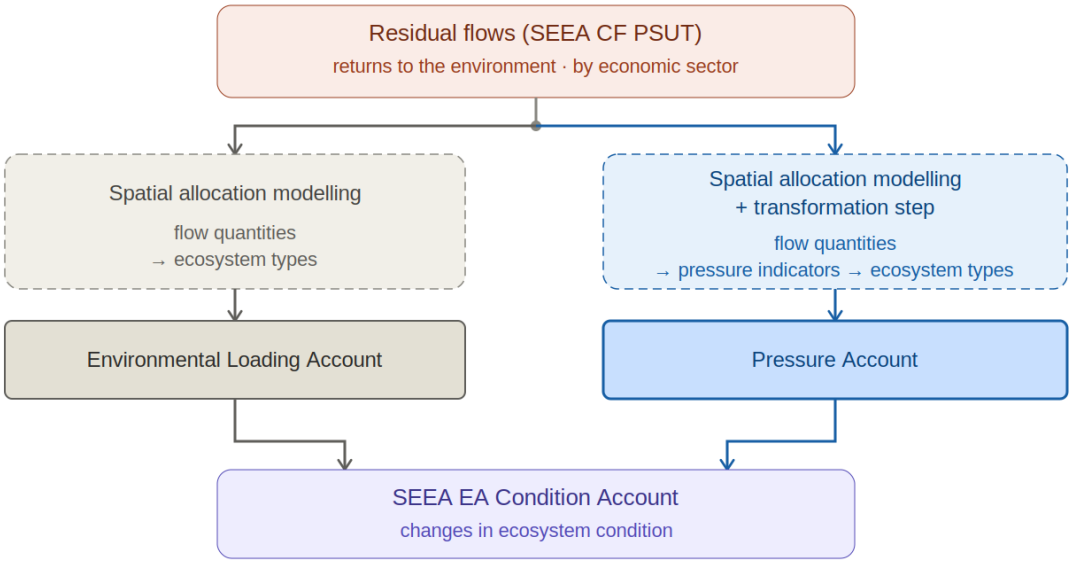
68. Table 1 below summarises the coverage of the SEEA CF Physical Supply and Use Tables in comparison with the Environmental Loading Account and the Pressure Account. It illustrates the specific dimensions that a Pressure Account would add to the existing PSUT structure, and provides a reference point for the option analysis presented in this section. Figure 1 illustrates the key conceptual chain linking these account types: the methodological choice between spatial allocation alone and spatial allocation combined with a transformation step determines whether the resulting account is an Environmental Loading Account or a Pressure Account, both of which connect to the SEEA EA Condition Account.

Table 1: Coverage comparison: SEEA CF PSUT, Environmental Loading Account, and Pressure Account

Coverage dimension	SEEA CF PSUT	Environmental Loading Account	Pressure Account	Notes
Product flows between economic units	✓	—	—	
Natural input flows (extraction from environment)	✓	—	—	
Residual flows (returns to environment)	✓	✓	✓	*Primary data input for both ELA and PA*
Economic sector attribution (ISIC/NACE)	✓	✓	✓	*Retained as optional dimension in ELA and PA*
National totals (aggregate)	✓	✓	✓	
Spatial disaggregation by ecosystem type	—	✓	✓	*Standard PSUT has a single environment column; Option A extends it*
Entries in physical units of original residual	✓	✓	—	*PA entries are transformed pressure indicators*
Transformation to ecological pressure indicators	—	—	✓	*Requires documented fate/transport modelling*
Link to SEEA EA Condition Account	—	(✓)	✓	*ELA provides indirect input; PA provides direct pressure link*
Supply-use balancing identity	✓	—	(✓)	*Option C applies supply-use structure by accounting convention*

✓ fully covered (✓) partially covered or covered in some implementations — not covered
ELA = Environmental Loading Account; PA = Pressure Account.

Figure 1 Key conceptual chain for the Environmental Loading Account and Pressure Account.



69. A further preliminary consideration applies across all account designs presented below. The PSUT is compiled on the residence principle: residual flows are attributed to the economic units that generate them, regardless of where those residuals physically travel or deposit. Environmental pressures, however, do not respect national boundaries. Residuals generated by domestic economic units may be transported by atmospheric or hydrological processes and deposit in ecosystems located in other countries (or, in some cases, never deposit); conversely, residuals generated abroad may deposit in domestic ecosystems and affect the condition of ecosystem types recorded in the national SEEA EA. Both of these cases create a mismatch between the economic boundary of the account and the physical boundary of the pressure. To address this, the following implementation patterns include Import and Export columns as balancing items alongside the ecosystem-type columns, following the same logic as the rest-of-world column in the standard PSUT. An additional column, 'unattributed', is included as a holding category for residual flows that have left the economy but have not yet been attributed to a specific receiving ecosystem type — whether because fate and transport data are not yet available, or because the flows are genuinely in transit at the time of recording. Together, these balancing columns preserve accounting completeness and allow the supply-use identity to hold at the national level without requiring full spatial attribution of every flow.

3.2 Conceptual Options

Option A — PSUT Extension by Ecosystem Type

Option A — PSUT extension by ecosystem type

Standard PSUT structure preserved · environment column disaggregated by ecosystem type on the use side only

Supply table

Products / natural inputs	Production; generation of residuals			Flows from rest of world	Flows from environment	Total
	Industries (classified by ISIC)	Households	Accumulation			
Natural inputs						Σ
Products						Σ
Residuals						Σ
Total supply						

Supply = use accounting identity · same economy columns both sides · same row categories

Use table

Products / residuals	Intermediate consumption; use of natural inputs			Flows to rest of world	Environment — by ecosystem type (NEW)				Tot.
	Industries (classified by ISIC)	Households	Accumu-lation		Forests	Rivers	Coastal	Unattr.	
Natural inputs									Σ
Products									Σ
Residuals									Σ
Total use									

NEW: environment column split by ecosystem type

Core Idea

70. The environment column of the PSUT Use Table is disaggregated into sub-columns corresponding to ecosystem types. Residual flows currently recorded in aggregate against the single 'environment' column are reallocated to specific ecosystem types (or remain in the atmosphere) based on spatial data and allocation rules. The structure of the PSUT — rows for physical flow categories, columns for economic units and the environment — is otherwise unchanged. Optionally, the same disaggregation could be applied symmetrically to the natural inputs rows of the Supply Table, so that the origin ecosystem of extracted natural inputs is also identified. Although natural resource extraction is out of scope for this Guidance Note, it could be argued that natural resources that have key roles in ecological processes, e.g. water, should be in scope.

71. This is the baseline proposal mentioned in the Scoping Note. It is the minimal structural change that would constitute a Pressure Account in the SEEA CF. The ecosystem type classification used for the column disaggregation would need to be consistent with, or directly mappable to, the ecosystem type classification used in the SEEA EA.

Strengths

- Represents the smallest departure from adopted PSUT practice; the accounting logic, row definitions, and balancing identities are unchanged.
- Easiest to implement for countries that already compile SEEA PSUTs *and* have sufficient data to trace where returns enter the supply chain; the structural change is limited to adding columns to an existing table.
- Retains the link to economic sectors as row or column entries, preserving the SEEA CF's core function of connecting economic activities to environmental flows.
- Compatible with GN B1/B5 recommendations on flexible classification of PSUT columns.

72. Option A is also the only option in which the PSUT balancing identity potentially still applies: the sum of residuals recorded in Use Table ecosystem columns, plus any residuals accumulation in the economy, should equal the total residuals generated in the Supply Table. This identity depends on completeness of spatial attribution.

Critical assessment

73. This option has four substantive weaknesses that should not be understated.

- First, since PSUTs are typically compiled separately for water, energy, and materials, there is no single presentation of all residual pressures on ecosystems; a user seeking a more complete picture of pressures on a given ecosystem type would need to consult multiple separate tables.
- Second, adding ecosystem-type columns to an already-wide PSUT makes the table less manageable, particularly for countries with fine-grained ecosystem type classifications.
- Third, and most importantly, the option records residual flows to ecosystem type columns but does not transform them into ecological pressure indicators. The entry in a cell remains an emission quantity in physical units, not a pressure measure. The table communicates spatial destination of flows but not ecological significance. This is the 'emission = pressure' problem that recurs across several options: for example, recording kg of nitrogen discharged to a river ecosystem is not the same as recording the eutrophication pressure on that river ecosystem.
- And fourthly, this option risks institutional and conceptual blurring with the Emissions Account already established under SEEA CF. A spatially disaggregated PSUT recording residual flows to ecosystem-type columns is structurally close to an extended Emissions Account, and countries that already compile SEEA CF emission accounts may reasonably question what Option A adds. The pressure account's value over an emission accounts lies precisely in transforming physical flows into ecological pressure indicators; an option that does not make that transformation offers limited justification for compilation as a distinct account.

74. This option is most tractable for direct pressures, where source and receiving ecosystem are proximate and spatial attribution is straightforward; indirect pressures requiring atmospheric or riverine transport modelling remain outside the account structure.

Literature

75. The PSUT extension logic is endorsed conceptually in GN A4 (spatial accounts), which identifies residual flow accounts as a primary candidate for spatial disaggregation within the SEEA CF. The water PSUT compiled by catchment, referenced in SNA 2025 paragraph 35.66, is a direct analogue at sub-national level. The SEEA-Water PSUT (SEEA-Water, 2012) further provides a structural precedent by distinguishing return flows by receiving environmental medium, separating discharges to surface water from discharges to land/soil.

Option B — Stand-Alone Pressure × Ecosystem Matrix

Option B — stand-alone pressure × ecosystem matrix

	Ecosystem types (SEEA EA classification)					
Residual flow / pressure category	Forests & woodland	Rivers & lakes	Coastal & marine	Cropland	Unattr.	Total
Atmospheric emissions (NOx, SOx, PM, GHG)	N dep. mol/ha/yr	N dep. mol/ha/yr	N dep. mol/ha/yr	N dep. mol/ha/yr		Σ
by economic sector ↓	Agriculture · Industry · Transport · Households · …					
Water discharges (N, P, BOD, toxics)	—	kg N/yr per catchment	kg N/yr marine load	—	—	Σ
by economic sector ↓	Agriculture · Industry · Households · …					
Releases to land (solid waste, contaminants)	t/ha	t/ha	t/ha	t/ha	t/ha	Σ
by economic sector ↓	Mining · Manufacturing · Households · …					
Diffuse releases (fertilisers, pesticides)	kg/ha	kg/ha	kg/ha	kg/ha	kg/ha	Σ
by economic sector ↓	Agriculture · Households · …					
Column total	Σ	Σ	Σ	Σ	Σ	Σ

Rows: residual flow or pressure categories derived from the PSUT (not additive across rows — different units)
Columns: ecosystem types consistent with SEEA EA classification
Cells: emission quantity (Environmental Loading Account) or pressure indicator (Pressure Account)
Sub-rows: optional sector dimension linking entries back to PSUT economic units
No supply-use balancing identity — column totals are formal sums within a pressure type only

Core Idea

76. A separate table is compiled with residual flow types (or pressure categories) as rows and ecosystem types as columns. Data are derived from residual flows compiled in PSUT but are presented independently of the PSUT structure. The economic sector dimension

can be retained as an optional third dimension or suppressed in the published table. The choice between them is the primary design decision for any Option B implementation.

77. This table is derived from PSUT residual flow data but does not itself constitute a PSUT. It carries none of the PSUT's structural requirements; no supply-use balancing identity, no conservation-of-mass constraint, and no requirement that all rows be expressed in a common physical unit. In the terminology of GN B1/B5, it is closer to a derived indicator presentation of existing account data than to a core physical flow account. This distinction has implications for where Option B sits in the updated SEEA CF: it would belong alongside thematic indicator presentations rather than among core Physical Flow Accounts.

Strengths

- Presents all pressure types in a single table, regardless of whether they are drawn from air, water, waste, or material flow PSUTs. This is a significant analytical advantage over Option A.
- The ecosystem-type orientation creates a cleaner and more direct analytical link to the SEEA EA Condition Account.
- Avoids further complicating the PSUT, which remains the core accounting table for economic-physical integration.
- Perhaps easier to communicate to policy users, who may be more accustomed to seeing pressure information organised by receiving environment rather than by emitting industry.

Critical assessment

78. The key weakness is the fact that it is a step removed from the core SEEA CF framework. By presenting data outside the PSUT, this option risks being perceived as an analytical product or indicator table rather than an accounting structure, potentially reducing its authority and adoption as a standard statistical product.

79. A second weakness mirrors the fourth weakness identified for Option A. Because ecosystem types receive deposition rather than emissions, any spatial allocation of residual flows to ecosystem types already entails a transformation step; at minimum, the conversion of an emission into a deposition or exposure quantity. There is therefore no zero-transformation variant of Option B: an 'Emissions Account by ecosystem type' is not a coherent intermediate product. The relevant distinction is instead one of degree: whether Option B stops at reporting deposition or exposure quantities by ecosystem type, or proceeds to convert these into pressure indicators with ecological meaning (for example, expressed relative to critical loads or thresholds). Countries that already compile SEEA CF Emissions Accounts may reasonably question what additional value a deposition-only variant of Option B adds beyond spatial disaggregation of existing emissions data. The Guidance Note should therefore require that Option B implementations state explicitly how far along this transformation chain the compiled indicators extend, and should present partial transformation (deposition or exposure by ecosystem type) and full transformation (pressure indicators with ecological interpretation) as distinct stages of the same product, rather than as alternative products with different accounting status.

80. The same direct/indirect constraint applies: Option B can be populated with direct pressure data from existing accounts but cannot resolve indirect pressures without the fate and transport modelling step.

81. Also, the question of whether pressure indicators should be reported at the level of ecosystem types or specific ecosystem assets is a genuine design decision, though it concerns reporting granularity rather than the underlying calculation: deriving a type-level total requires aggregating spatially resolved deposition data, whether or not those finer units are formally treated as ecosystem assets. Reporting at the ecosystem type level supports cross-country comparability but obscures the spatial specificity needed for local management; reporting at the ecosystem asset level provides spatial precision but creates confidentiality risks where only a small number of economic units, or a single dominant one, contribute to pressures on a specific mapped asset. This issue should be presented as an open question for global consultation.

82. There is also a risk of this option being seen as more aligned with FDES Component 3 than with SEEA CF. This is partly true; FDES Component 3 organises residual statistics by environmental medium (air, water, land) rather than by PSUT accounting logic. The distinction lies in whether the entries remain traceable to PSUT residual flows and whether the table preserves accounting relationships (supply = use). If those links are severed, Option B becomes an indicator table, not an account.

83. Finally, for the supply-use identity to hold arithmetically, both sides of the account must record entries in the same unit; specifically, total loads delivered to each ecosystem type (e.g., total kg of nitrogen deposited on forest ecosystem type X), not per-unit-area rates (e.g., kg per hectare). Per-hectare pressure indicators are derived from these totals using ecosystem area data and belong in an analytical layer built on top of the account, not in the account entries themselves.

Literature

84. The INCA project (Vysna et al., 2021) presents nutrient pressure data by MAES ecosystem type in a tabular format broadly consistent with Option B. The EEA pilot nutrient Pressure Accounts (EEA, 2020) is a clear European implementation. The CBS Dutch North Sea account's Table 51 (synthesis of pressure factors by ecosystem and economic sector) is an example of a matrix in which both dimensions are retained, though it remains largely qualitative.

Option C — Stand-Alone PSUT-Style Pressure Account

Option C — PSUT-style Pressure Account

Pressures "supplied" by economic sectors · "used" by ecosystem types · supply = use identity

Supply table — pressure generated by economic sectors

Pressure factor	Agriculture (NACE A)	Industry (NACE B–E)	Transport (NACE H)	Households (S14)	Import (abroad)	Total supply
Atmospheric pressure	NH_3, NOx	SOx, NOx	NOx, PM	NOx, PM	transbnd.	= Σ rows
Water pressure	N, P runoff	effluent	port runoff	wastewater	riverine	= Σ rows
Land / soil pressure	pesticides	mine waste	—	solid waste	—	= Σ rows
Total supply	= Σ cols	= Σ cols	= Σ cols	= Σ cols	= Σ cols	Grand Σ

Use table — pressure received by ecosystem types

Pressure factor	Forests & woodland	Rivers & lakes	Coastal & marine	Grassland / cropland	Exports & unattrib.	Total use
Atmospheric pressure	N dep. /ha	N dep. /ha	N dep. /ha	N dep. /ha	transbnd.	= Σ rows
Water pressure	kg N/yr (leaching)†	kg N/yr	kg N/yr	kg N/yr	riverine	= Σ rows
Land / soil pressure	t/ha	t/ha	t/ha	t/ha	—	= Σ rows
Total use	= Σ cols	= Σ cols	= Σ cols	= Σ cols	= Σ cols	Grand Σ

Supply rows = pressure types generated by sectors. Row totals (= Σ rows) sum across sectors for one pressure type — where physically meaningful.
Column totals (= Σ cols) sum across pressure types within one sector — a formal accounting sum; not physically meaningful given different units.
Use columns = ecosystem types receiving pressures (SEEA EA classification)
Grand Σ supply = Grand Σ use (accounting convention, not conservation law): the identity holds by construction, not from conservation of mass.
Pressure is not a physically conserved quantity. Preceded by Bogaart et al. (2023), Table 38.

Core Idea

85. Environmental pressures are recast as the objects of a supply-use account in their own right. Economic sectors are the 'suppliers' of pressures (source side); ecosystem types are the 'users' of pressures (receiving side). The account maintains a supply-use accounting identity: Total pressure generated by economic activities (plus pressures imported from abroad) equals total pressure received by ecosystem types (plus pressures accumulated in the economy and those exported to ecosystems in other countries). This is the structure mentioned in Bogaart et al. (2023, p. 83) and Bogaart (2025).

86. This option represents a departure from the standard PSUT logic: it treats pressure not as a residual flow recorded in a PSUT, but as the primary object of a dedicated supply-use account; structured, like ecosystem service accounts, around a supply side (economic sectors) and a use side (ecosystem types).

Strengths

- Maintains a formal supply-use accounting structure; the account has defined supply and use sides, explicit balancing items (imports/exports of pressure), and row-column discipline, giving it the formal character of an account rather than an indicator table, even though the accounting identity holds by construction rather than by conservation of mass.
- Explicitly ecosystem-oriented, creating a clear structural bridge between the SEEA CF and the SEEA EA.

- The reversed supply-use logic (‘pressures supplied by sectors, used by ecosystems’) mirrors the ecosystem service supply-Use Table in the SEEA EA, creating a conceptual symmetry across the full SEEA system.

Critical assessment

87. The following critical assessment identifies both issues specific to Option C's accounting structure and issues that apply across all genuine Pressure Account designs regardless of structural option; the latter are noted here because they are most visible in Option C's explicit supply-use framework.

88. All options have a common fundamental conceptual issue: pressure is not a flow in the physical sense. In the PSUT, rows represent physically conserved quantities; mass or energy that actually moves between economic units or between the economy and environment. Pressure, in this context and by contrast, is an ecological concept, a characterisation of the effect of a flow on an ecosystem. It is not itself conserved. The supply-use identity for a Pressure Account is therefore not grounded in a physical law but in an accounting convention: we define 'pressure generated' as equal to 'pressure received' by construction. This is a legitimate accounting convention, but it needs to be stated explicitly, and its implications worked through carefully. The underlying reason is that pressure, unlike mass or energy, is not a physically conserved quantity. In a standard PSUT, rows represent conserved physical substances; what leaves one cell must arrive somewhere else, and the accounting identity reflects this physical reality. Pressure, by contrast, is a relational concept: it characterises the ecological effect of a flow on a receiving ecosystem, and that effect is not 'transferred' from one ecosystem to another in any physical sense. The same NOx emission may simultaneously exert pressure on multiple ecosystem types through atmospheric transport; the pressure 'received' by a forest ecosystem does not diminish the pressure 'received' by an adjacent grassland ecosystem. There is therefore no physical law that requires supply of pressure to equal use of pressure; only an accounting convention that we impose by definition.

89. A further problem is the transformation step. To populate a Pressure Account in the sense of Option C, residual flows from the PSUT must be converted into pressure indicators; for example, tonnes of NO_x emissions must be converted into kg of nitrogen deposited per hectare of forest ecosystems. This conversion requires environmental fate and transport data and involves modelling choices that lie outside the SEEA CF statistical boundary. This is not specific to Option C: any transformation from a residual flow to a pressure indicator, regardless of pollutant pathway or structural option, depends on the same kind of external fate-and-transport modelling. Option C makes this dependency explicit by building the transformation into the account's structure, whereas Options A and B can leave it implicit or optional; but the underlying modelling requirement, and the question of where it sits relative to the SEEA statistical boundary, is unavoidable for any genuine Pressure Account. The Guidance Note needs to be explicit about where this transformation sits and who is responsible for it, regardless of which structural option is adopted. This is one of the central open questions identified in Section 1, research question (d), and is left for global consultation and an eventual Issue Paper.

90. Finally, the additivity issue cannot be ignored. If rows cannot be summed, column totals, the total pressure on a given ecosystem type, aggregated across pressure categories, are also problematic unless a common pressure currency is adopted (such as a dimensionless ecological status score). This is not a weakness specific to Option C: any

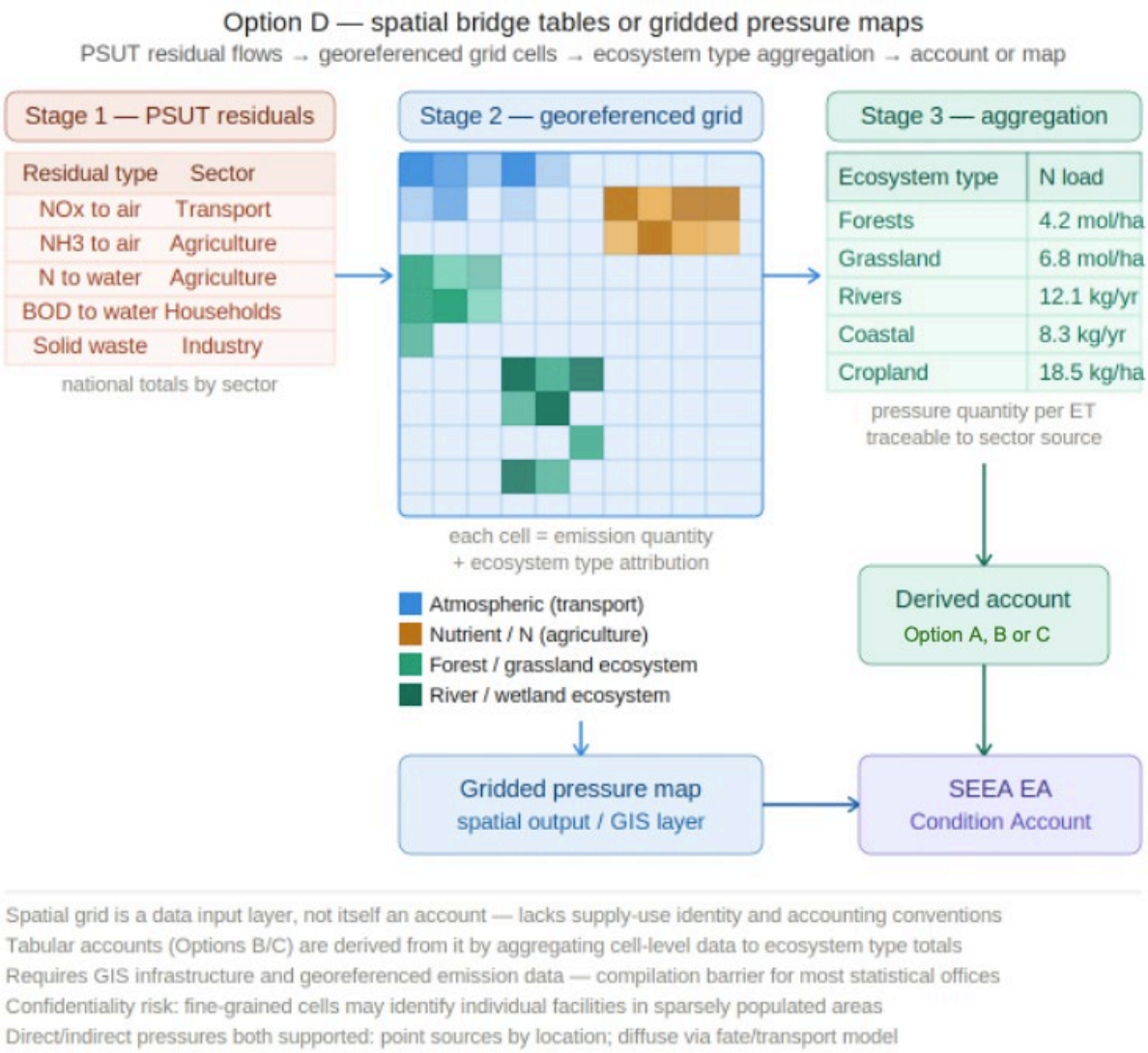
structural option that brings multiple pressure categories together for a given ecosystem type faces the same constraint, since pressures are measured in heterogeneous physical units (kg/ha, tonnes, pollutant loads) that cannot be summed without an implicit or explicit weighting scheme. Some countries and frameworks have attempted to construct composite pressure indices (e.g., cumulative impact assessments in marine ecology), but these involve normative weighting decisions that are inappropriate for a statistical accounting standard. An Issue Paper should address this explicitly rather than leaving it as a bracketed question, regardless of which structural option is ultimately adopted.

91. Option C implicitly requires handling both direct and indirect pressures to maintain the supply-use identity, since the use side must account for all pressure received by ecosystem types regardless of transport pathway, making it the most demanding option in terms of the transformation step.

Literature

Bogaart et al. (2023), Chapter 5, Table 38, is the primary reference. It presents a hypothetical Pressure Account with economic sectors on the supply side and ecosystem types on the use side, with imports and exports as balancing items. The OSPAR Intermediate Assessment (2017) and Quality Status Report (2023) use sector-by-ecosystem pressure assessments for the North-East Atlantic. However, neither provide actual matrices and therefore do not enforce a supply-use accounting identity, which is the novel contribution expected of Option C.

Option D — Spatial Bridge Tables or Gridded Pressure Maps



Core Idea

92. Rather than creating an accounting table in the traditional sense, this option uses georeferenced data (gridded maps or spatial registers) to record residual emissions by location, with each grid cell attributed to one or more ecosystem types. Pressure Accounts can then be constructed by aggregating cell-level data to ecosystem type totals. The spatial dataset serves as the bridge between the economy-wide PSUT and the spatially explicit SEEA EA. This option aligns closely with the work programme of GN A4 on spatial accounts.

93. This option represents a different conceptual approach to the structure of the account. Options A, B, and C all produce tabular accounting structures. Option D produces a spatial data layer from which tabular accounts can be derived, but the primary output is geographic rather than tabular.

94. This distinction has a structural implication for how Option D relates to the other options. Unlike Options A, B, C, and F — which are account designs specifying the structure of a statistical output — Option D is a data infrastructure layer from which any of those accounts can be derived. A country implementing Option D is not choosing an

alternative to Option A or B; it is choosing the spatial data foundation from which one of those options will subsequently be compiled. The Guidance Note should present Option D accordingly: It is not as a standalone account design but as a compilation pathway.

Strengths

- Provides maximum flexibility: accounts for any level of ecosystem type aggregation (or other geographies such as protected areas or watersheds) can be produced from the underlying spatial data, and the same data can simultaneously feed PSUT extensions (Option A), standalone matrices (Option B), Stand-Alone PSUT-Style Pressure Accounts (Option C), and ecosystem condition linkages (SEEA EA).
- Directly aligned with SEEA EA spatial structure, since the SEEA EA Ecosystem Extent Account is itself based on mapped ecosystem assets. Where a Register of Ecosystem Assets (REA) exists, grid cells can be attributed not only to ecosystem types but to individually identified ecosystem assets, enabling pressure accounting at the asset level rather than the type level — the most spatially precise form of the account (Soulard, 2022).
- Consistent with GN A4's framework for sub-national spatial accounts and spatial disaggregation of physical flow data.
- The most natural approach for atmospheric deposition (EMEP gridded data), nutrient load modelling (GREEN/MONERIS catchment outputs), and marine pressure mapping (OSPAR, MSFD), all of which already produce spatially explicit outputs.
- Gridded spatial data are better suited to handling indirect pressures than any tabular option, since atmospheric and hydrological transport models already produce spatially explicit outputs that can be directly ingested; this is one of Option D's genuine advantages over Options A, B, and C.

Critical assessment

95. The substantive weakness is that a gridded spatial dataset is not an account in the SEEA sense. It lacks the accounting identity, row-column structure, and double-entry consistency that characterise SEEA accounts. It is better described as an input data layer or a geospatial product that supports account compilation, rather than as an account itself. The Guidance Note should be careful not to present Option D as equivalent in accounting status to Options A, B, or C.

96. Spatial data capacity is a genuine compilation barrier. Many national statistical offices do not currently have geospatial data infrastructure capable of producing gridded emission maps linked to ecosystem type classifications. This gap can often be addressed through collaboration with other domestic agencies — national environmental agencies, mapping and cadastral authorities, or space agencies — that already hold relevant spatial data and modelling capacity, rather than requiring statistical offices to build this infrastructure independently. This option is therefore more feasible where regional (multi-country) infrastructure, mature national spatial data systems, or effective inter-agency arrangements are already in place, than for statistical offices working in isolation in the near term.

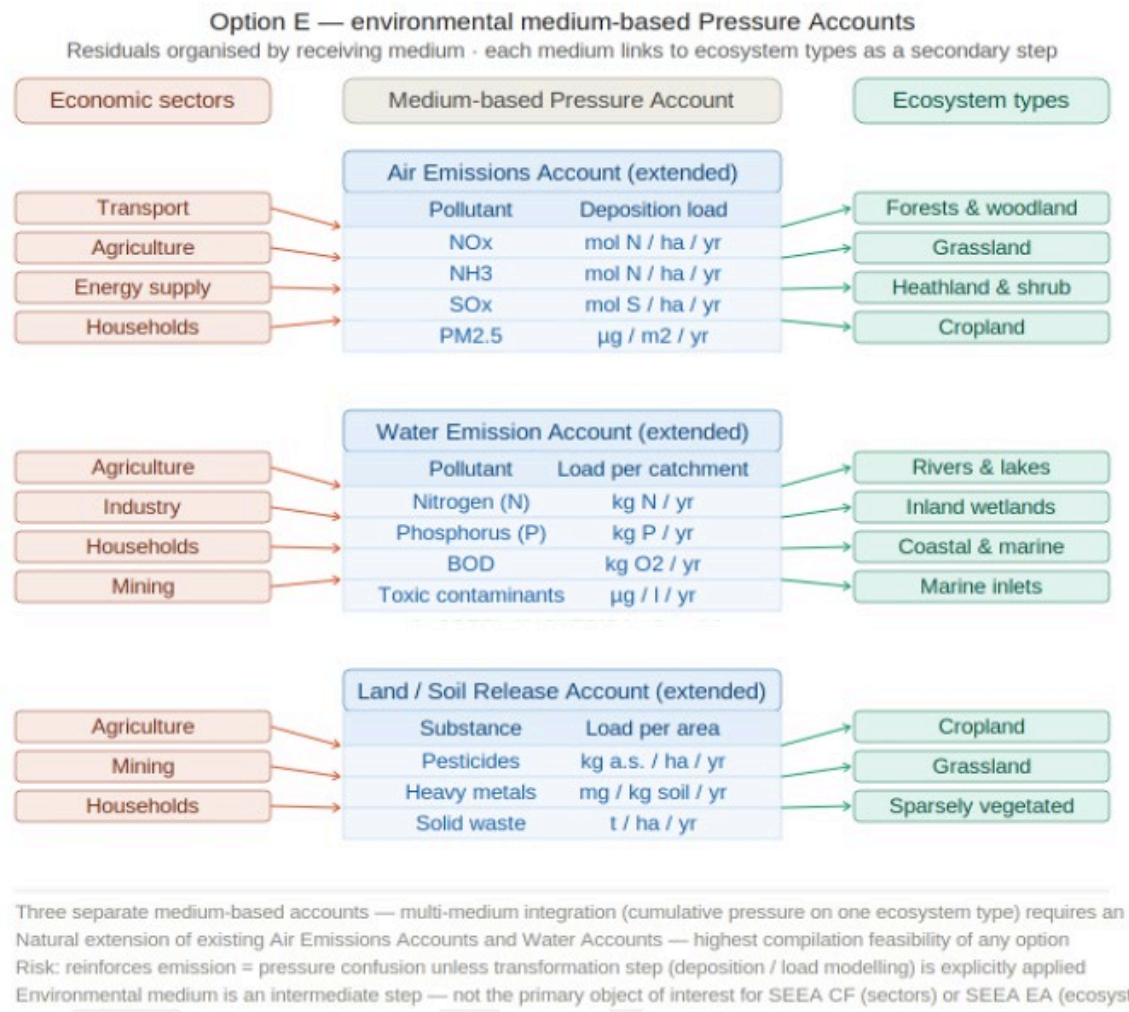
97. Statistical confidentiality is also an acute issue with this option; more so than with tabular accounts. When emission data are geographically disaggregated to fine grid cells,

it may be possible to identify individual facilities. This is the concern raised in research question (h) in Section 1.

Literature

The EEA/JRC pilot nutrient Pressure Accounts (EEA, 2020) are built on CORINE Land Cover spatial data and represent the most developed example of Option D applied in a SEEA-adjacent context. The EMEP MSC-W model (Simpson et al., 2012) provides gridded atmospheric deposition data across land-use categories that are directly applicable. The UN-GGIM spatial data framework and ISO 19115 geospatial metadata standards provide the technical documentation conventions within which Option D spatial outputs would be described and shared.

Option E — Environmental Medium-Based Pressure Accounts



Core Idea

98. Instead of organising the Pressure Account by receiving ecosystem type from the outset, this option structures it by environmental medium: an air Pressure Account recording atmospheric emissions and deposition effects; a water Pressure Account recording discharges and loads to freshwater and marine environments; a soil Pressure Account recording releases to land. Each medium-based account can subsequently be linked to the ecosystem types that are principally associated with that medium. This option is therefore best understood as a modular extension of the existing emissions accounts for air, water and waste, organised by medium rather than by ecosystem destination, but converging with Option C at the point where medium-specific flows are translated into ecosystem-linked pressure indicators, requiring the same fate and transport modelling step discussed under Option C above.

99. Air emissions accounts are widely compiled following established methodologies. Ecosystem condition accounts, as demonstrated for example in Lof (2019) and Destatis (2023), integrate environmental indicators and pressures spatially by ecosystem type. Building on this, one option is to extend emission accounts with an ecosystem-type attribution layer.

Strengths

- Represents a natural and incremental extension of existing compilation practice; countries with mature air emission accounts, water accounts, or waste accounts can extend progressively.
- Aligned with existing international compilation guidance (Eurostat Air Emissions Accounts manual, SEEA-Water, IRWS) and with the structure of major environmental policy and regulatory frameworks, which are also often organised by medium, including air quality legislation, water framework directives, and marine strategy frameworks.
- Medium-based organisation corresponds to the physical transport pathways through which emissions reach ecosystems (atmospheric deposition, riverine transport, direct discharge), which may make the spatial allocation step more tractable.
- The medium-based structure of Option E maps naturally onto the direct/indirect distinction: air accounts handle atmospheric transport, water accounts handle riverine transport, making the indirect pressure pathway more explicit than in Options A or B.

Critical assessment

100. This risk of an 'emission = pressure' misunderstanding is not specific to this option; it arises whenever spatial allocation of emissions to ecosystem types is presented without the transport and deposition step being explicitly carried out, regardless of structural option. An air Pressure Account that records tonnes of SO_2 emitted by economic sector and allocated to forest ecosystem types may appear to report the acid deposition pressure on those forests, but it does not unless the atmospheric transport and deposition step has been explicitly carried out. The distinction between emission and deposition must be stated explicitly within the account structure, whichever structural option is adopted.

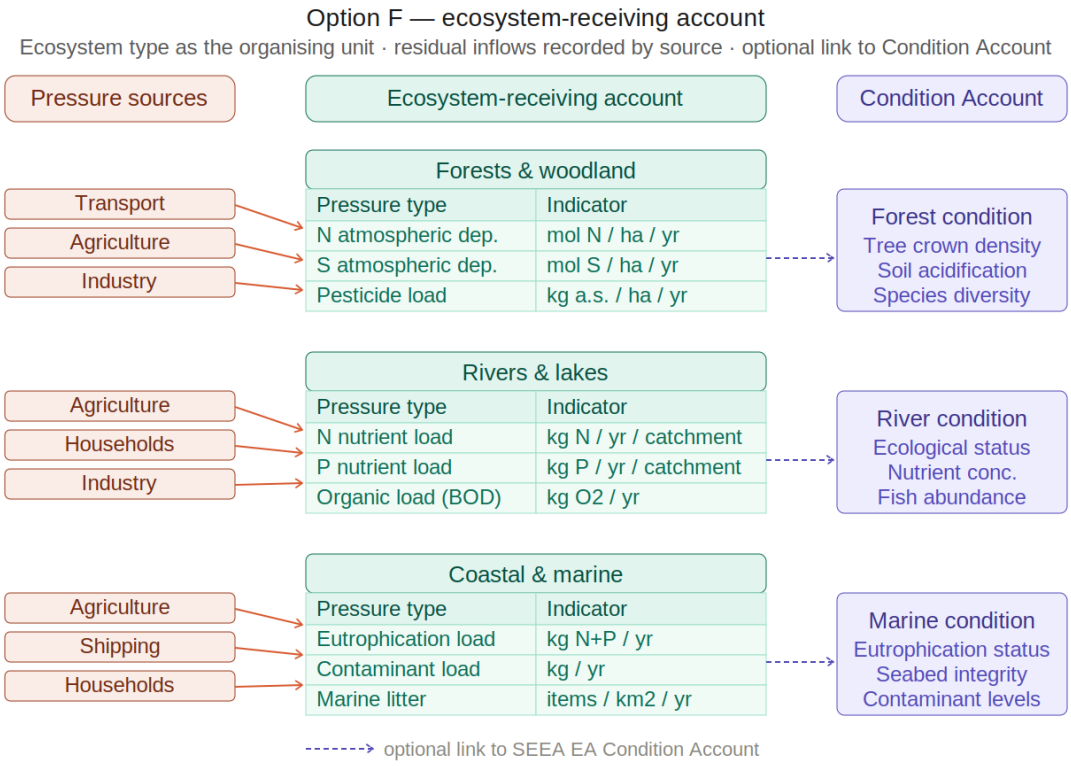
101. A second weakness is fragmentation. Presenting pressures across separate medium-based accounts means that the cumulative pressure on a specific ecosystem type, which may receive inputs through air, water, and land simultaneously, cannot be assembled without cross-referencing multiple accounts.

102. A third weakness is that the environmental medium is an intermediate step in the causal chain from economic activity to ecosystem condition, not the primary object of interest for either the SEEA CF or the SEEA EA. Organising the account around this intermediate step means the account is one step removed from the economic activity attribution that the SEEA CF requires, and one step removed from the ecosystem-type receiving structure that the SEEA EA requires. It may serve data compilation well, since emission data are naturally organised by medium, but it serves neither analytical framework directly. This suggests that Option E is most coherently presented not as a standalone account design but as a compilation pathway for countries building toward Options A, B, or C, analogous to the role Option D plays on the spatial side, and as a data source that feeds into Stage 2 (georeferenced grid) of Option D.

Literature

103. Eurostat (2015) provides a well-developed medium-based framework for air emission accounting methodology. The CBS North Sea account's eutrophication and pollution sections (5.6.3 and 5.6.4) in Bogaart et al. (2023) demonstrate how a water-medium approach can be linked to ecosystem receiving environments.

Option F — Ecosystem-Receiving Account



Inverts the organising logic of Options A-E: starts from the ecosystem's perspective, not from the emitting sector
Source attribution optional — where present, links back to PSUT; where absent, the account becomes EA-side only
Requires fate and transport data to identify what each ecosystem actually receives, not just what sectors emit
Statistical confidentiality less acute: aggregation by source category reduces facility identification risk
Without sector source attribution, connection to SEEA CF is lost — account becomes a condition input table, not a CF extension

Core Idea

104. This option inverts the organising logic of the other options. Rather than starting from residual flows generated by economic units and asking where they go, it starts from ecosystem types and asks what pressures each receives, from which sources. For each ecosystem type, the account records the inflows of residual flows by the economic sector or activity responsible for generating them, and optionally links these inflows to observed changes in ecosystem condition. Where source attribution to individual economic sectors is not feasible, residual inflows may be aggregated by environmental medium or pressure type, though this reduces the account's connection to the SEEA CF. The economic unit attribution may be present (if data permit) or absent. The emphasis is on characterising the pressure burden borne by each ecosystem type, not the causal responsibility of economic sectors.

105. This option has a different conceptual starting point from all the preceding options. It is ecosystem-centric rather than economy-centric, and is more naturally positioned as part of the SEEA EA framework than of the SEEA CF. However, if its source-side data are drawn from SEEA CF residual flow accounts, it can serve as a bridge between the two frameworks.

Strengths

- Most intuitively aligned with the perspective of ecosystem management and condition assessment; ecosystem assessments ask 'what pressures does this ecosystem face?' rather than 'where does this emission go?'
- Statistical confidentiality is less acute: by organising data from the receiving-ecosystem perspective and aggregating sources, individual facility-level data are less likely to be identifiable.
- Creates a cleaner link to the SEEA EA Condition Account, since condition indicators are also organised by ecosystem type.
- Avoids the supply-use balancing problems of Options A, B, and C, since there is no requirement for accounting identities to hold.

Critical assessment

106. This option has a weak connection to the SEEA CF compared to all preceding options. If source attribution is absent or aggregated, the link to economic activities recorded in the PSUT is lost, which undermines the primary purpose of the Pressure Account, bridging SEEA CF and SEEA EA. Without this link, Option F becomes an ecosystem condition input account that belongs in the SEEA EA, not a pressure account that extends the SEEA CF. Option F is more complementary to the SEEA EA than it is an extension of the SEEA CF.

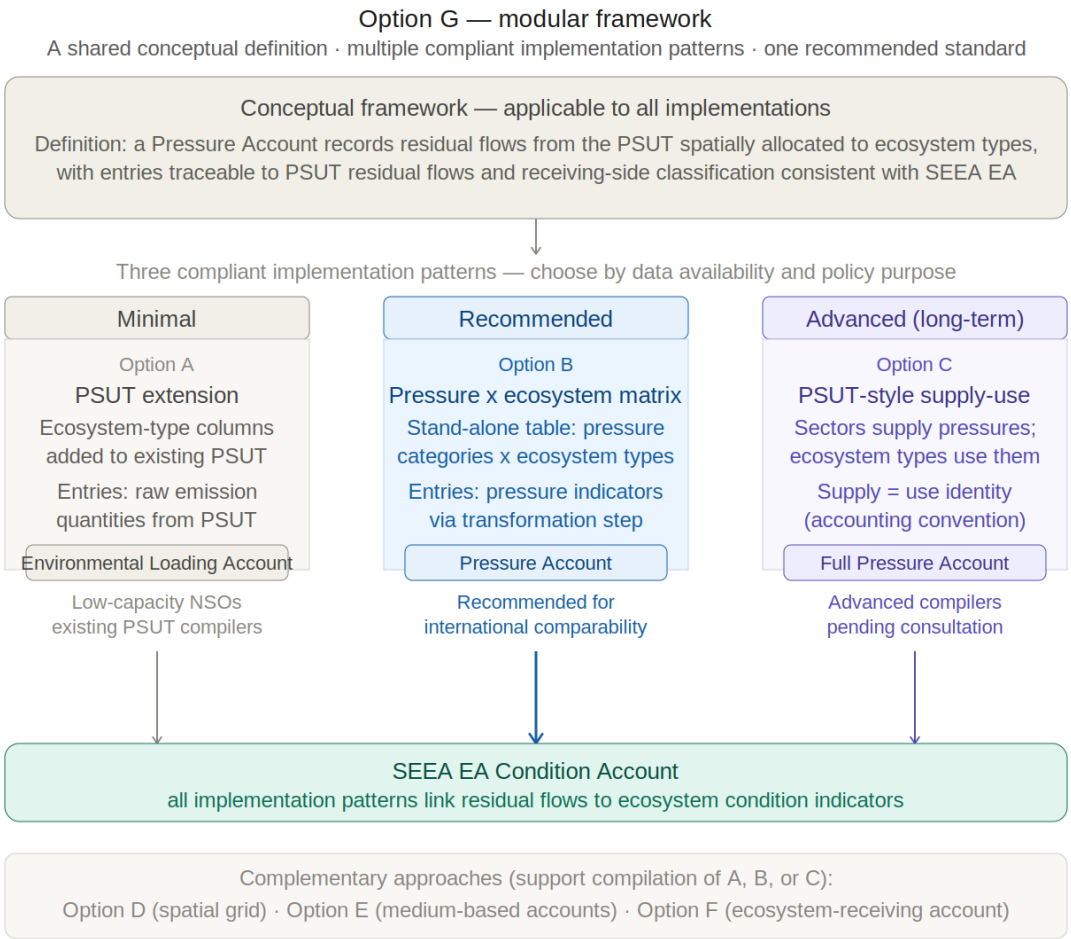
107. There is also a data problem. Constructing an ecosystem-receiving account requires knowledge not only of what is emitted (which the PSUT provides) but of what is received by each ecosystem type. This can be obtained either through environmental fate and transport modelling, which preserves a traceable link back to the emitting economic units recorded in the PSUT, or through direct environmental monitoring of deposition, concentration, or load at the ecosystem itself. Direct measurement avoids the modelling burden but typically cannot attribute the measured pressure back to its originating source or economic unit, which limits its usefulness for an account whose purpose is to connect PSUT residual flows to ecosystem outcomes. This is the same transformation and attribution challenge that affects Option C, but Option F makes it even more explicit because the receiving side is the organising dimension. In the absence of either fate-and-transport modelling or attributable monitoring data, Option F reduces to a spatial allocation exercise similar to Option D.

108. Option F is the most exposed to the indirect pressure problem: Organising the account from the receiving-ecosystem side requires knowing what arrives at each ecosystem, which for indirect pressures demands full fate and transport modelling as a precondition for compilation.

Literature

109. The SEEA EA Condition Account is the closest formal precedent: It is organised by ecosystem type and records state variables that reflect the cumulative outcome of received pressures, though it does not record the pressures themselves. The IPBES assessment framework uses an ecosystem-centric pressure classification that is analogous to Option F in its organising logic: IPBES structures its assessment of nature's status around direct drivers of change (land/sea use change, direct exploitation, climate change, pollution, and invasive species) as pressures received by ecosystems, rather than as emissions generated by economic sectors, the same ecosystem-first perspective that defines Option F (IPBES, 2019). The Bogaart (2025) presentation notes that the IPBES pressure typologies are "largely covered by SEEA CF and SEEA EA," suggesting this option could be operationally linked to both frameworks. The UK natural capital accounts by habitat type (ONS, 2024), which include pressure indicators per habitat, are a partial national implementation.

Option G — Modular Framework



Core Idea

110. Rather than prescribing a single account design, the Guidance Note defines the conceptual architecture of pressure accounting and presents multiple implementation

patterns as compliant options. The framework specifies: the definition of residual-based environmental pressures; the required data inputs (drawn from residual flows found in the PSUT); the minimum conceptual requirements for a product to qualify as a Pressure Account (traceability to PSUT flows, identification of receiving ecosystem type, documentation of any transformation steps); and guidance on choosing among implementation patterns depending on data availability, policy purpose, and existing account infrastructure. Options A through F are then presented as alternative implementation patterns within this framework.

111. This approach is explicitly parallel to the structure adopted in GN B1/B5, which distinguishes between the theoretical PSUT framework (all-encompassing and non-prescriptive) and its implementable subsystems (each of which is partial and policy-tailored). A Pressure Account modular framework would make the same distinction: a conceptual framework defining what Pressure Accounts are, and a set of described implementation patterns showing how they can be compiled.

Strengths

- Highest potential for adoption across countries at different levels of statistical capacity: a low-capacity country could implement Option E (medium-based, building on existing emission accounts) while an advanced country implements Option C or D.
- Consistent with the established logic of the SEEA CF, which already distinguishes theoretical frameworks from implementable subsystems.
- Avoids foreclosing innovation: as methods and data improve, new implementation patterns can be added to the framework without revising the conceptual definition.
- Reduces the risk of global consultation becoming deadlocked on a single design choice.

Critical assessment

112. The significant risk of Option G is incoherence. If all options are presented as equally valid, national Pressure Accounts will be incompatible with each other, cross-country comparisons will be impossible, and the Guidance Note will fail to advance the standardisation that is a primary purpose of the SEEA CF update. The modular approach is most credible if it is accompanied by a clear recommendation on which option is preferred for the purpose of international comparability, which would make it a hybrid of Option G and one of Options A through F. Without such a recommendation, Option G risks becoming an elaborate way of not deciding.

113. The incoherence risk is real but manageable if the modular framework is accompanied by two things: a clear statement of minimum requirements that any implementation must meet to qualify as a Pressure Account, and a recommended baseline option for international comparability. On minimum requirements, the framework should specify that a Pressure Account must at minimum: be traceable to PSUT residual flow data; identify the receiving ecosystem type; and document any transformation steps between emission and pressure. On the recommended baseline, Option B, a standalone pressure-by-ecosystem matrix derived from existing emission accounts, offers the best balance of accounting structure, compilation feasibility, and bridge function across SEEA CF and SEEA EA. Countries with greater capacity can implement Option C or D; countries at an earlier stage can implement Option E as a pathway toward Option B.

114. There is also a risk that a modular framework, by including very different types of outputs (tabular accounts, spatial datasets, indicator tables) under a single label, dilutes the accounting character of the Pressure Account. If Option D (spatial bridge maps) and Option F (ecosystem-receiving accounts without supply-use identities) are both called 'pressure accounts,' the term loses analytical precision. The modular framework requires a careful definition of minimum requirements that distinguishes Pressure Accounts from related but non-equivalent products.

Literature

115. GN B1/B5 (Moll et al., February 2026) provides the most direct methodological precedent for a modular framework approach within the SEEA CF update. The SEEA-Energy framework (UN, 2019) and SEEA-Water framework (UN, 2012) both adopt modular structures that allow partial implementations, providing precedent for this approach in other SEEA thematic accounts.

3.3 Comparative assessment

116. Table 2 summarises the assessment of all six options against the four evaluation criteria introduced in paragraph 65.

Table 2: Comparative assessment of Pressure Account design options

Option	Accounting consistency	Bridge function	Compilation feasibility	Analytical clarity
Option A PSUT extension	High	Partial	Moderate	Low–Moderate
Option B Pressure × ecosystem matrix	Moderate	Moderate–High	Moderate	Moderate–High
Option C PSUT-style pressure account	Moderate[1]	High	Low–Moderate	High
Option D Spatial bridge / gridded map [compilation pathway]	N/A (not an account)	Moderate–High	Low	Moderate
Option E Environmental medium-based [compilation pathway]	Moderate[2]	Low–Partial	High	Moderate
Option F Ecosystem-receiving account	Low	High (EA side)	Low–Moderate	High (EA users)
Option G Modular framework	Variable (A–F range)	Variable	Variable (flexible)	Variable

Notes

1: Option C: the supply-use accounting identity holds by convention, not conservation of mass.

2: Option E: accounting consistency score depends on whether the emission-to-pressure transformation step is carried out.

Options D and E: characterised as compilation pathways, not standalone account designs. Their scores reflect performance in that role.

Option G: accounting consistency score is "Variable (A–F range)" because the framework's score depends on which baseline option is designated as preferred.

117. Several observations follow from this comparative assessment. No single option dominates across all four criteria. Option A has the highest accounting consistency but the weakest analytical clarity (records spatial destinations of flows without transforming them into pressure indicators). Options C and F have the strongest bridge function (both are organised around ecosystem types as the receiving dimension) and analytical clarity (their outputs are directly interpretable in terms of pressure on specific ecosystems) but the lowest compilation feasibility and raise the challenging conceptual questions of supply-use identity and additivity, though as noted in the Option C discussion, the additivity constraint applies to any structural option that aggregates pressure categories for a given ecosystem type, not only to Options C and F. Option B occupies a middle ground that is analytically useful but risks being perceived as an indicator product rather than an account. Option D has a strong bridge function and flexibility but presupposes spatial data infrastructure that most national statistical offices do not have. Option E's primary strength is compilation feasibility (it is the most accessible entry point) but it serves neither the SEEA CF nor the SEEA EA directly.

118. The most tractable path forward for the Guidance Note may be a version of Option G that makes an explicit recommendation: Option B as the recommended implementation for immediate adoption, with Option C as the conceptually preferred long-term structure pending resolution of the transformation and additivity questions through global consultation. Option A is described as the minimal acceptable extension for countries that prefer to remain within the PSUT framework. Options D and E are described as compilation pathways (spatial and medium-based respectively) through which countries can build toward Options A, B, or C. Option F is described as a complementary approach oriented toward the SEEA EA rather than the SEEA CF.

4 Recommendations on Conceptual Treatments

4.1 Summary of recommendations

119. Section 3 developed and evaluated six conceptual options for designing a Pressure Account, together with a seventh option proposing a modular framework. The comparative assessment in Section 3.3 concluded that no single option dominates across all evaluation criteria, and that the most tractable path forward is a modular framework (Option G) with Option B as the recommended immediate implementation, Option C as the preferred long-term structure, and Option A as the minimal acceptable extension. The present section translates that analysis into concrete recommendations and identifies the specific changes required to the SEEA CF text.

120. Three recommendations follow from the analysis in Section 3. They are presented in order of priority, from the immediate conceptual requirement to the longer-term development agenda.

4.2 Recommendation 1: Include a definition for a Pressure Account in the SEEA CF

121. The updated SEEA CF should include a formal conceptual definition of a Pressure Account as a statistical structure that records residual flows from the PSUT in a form that can be linked to specific ecosystem types, for the purpose of supporting analysis of changes in ecosystem condition recorded in the SEEA EA. This definition should make three things explicit.

122. First, the scope of a Pressure Account is limited to residual flows recorded in the SEEA CF Physical Flow Accounts. Pressures arising from harvesting activities, land-use change, passive environmental uses, invasive species, natural disturbances, and climate change drivers fall outside the scope of the Pressure Account as defined here, though information on some of these may be derived from other SEEA CF accounts.

123. Second, the Pressure Account is, arguably, conceptually distinct from both the PSUT and the SEEA EA Condition Account. It is not a PSUT — it does not carry the PSUT's supply-use balancing requirements or, at least in the same sense as physical flow accounts, the conservation-of-mass constraint for the reasons developed in the Option C discussion in Section 3.2. It is not a Condition Account — it does not record the state of ecosystems but rather the residual flows that contribute to changes in that state. It is an intermediate accounting structure that bridges these two frameworks.

124. Third, the entries in a Pressure Account must remain traceable to residual flows recorded in the PSUT. If a transformation step is applied, for example, converting emissions quantities into deposition loads through atmospheric transport modelling, that transformation must be documented and its assumptions stated. The transformation step sits outside the accounting boundary of the PSUT but must not be conflated with the account entries themselves. Where the transformation step has not been applied and entries remain as residual flow quantities spatially allocated to ecosystem types, the account is more accurately described as an Environmental Loading Account. The distinction between these two account types, and the conditions under which each label applies, is addressed in Recommendation 2 (Section 4.3).

4.3 Recommendation 2: Adopt a modular framework in the implementation

125. The updated SEEA CF should adopt a modular framework for the Pressure Account, presenting multiple implementation patterns as compliant options while identifying a recommended pattern for the purpose of international comparability. A modular framework is consistent with the established logic of the SEEA CF, which distinguishes the theoretical PSUT framework from its implementable subsystems, each of which may be partial and policy-tailored.

126. The recommended implementation for immediate adoption is Option B: a stand-alone matrix in which rows represent residual flow or pressure categories and columns represent ecosystem types, with data derived from the PSUT. This option is recommended over Option A (PSUT extension) because it presents all residual types in a single integrated table regardless of the PSUT subsystem from which the data are drawn, and because it avoids further complicating the PSUT structure. It is preferred over Option C for immediate adoption because Option C requires resolution of the transformation and additivity questions that are left for global consultation, noting that Option C is the preferred long-term option. Furthermore, Option A risks conflation with SEEA CF Emission Accounts; without a documented transformation step, it offers limited justification as a distinct compilation from those accounts.

127. Within this modular framework, the label applied to a compiled account should reflect what its entries actually measure. A clear distinction is therefore drawn between two account types:

• **Environmental Loading Account** is an account whose entries are residual flow quantities from the PSUT, spatially allocated to ecosystem types through environmental transport modelling. It records what each ecosystem type receives from economic activities in physical units, without further converting those received quantities into indicators of ecological impact or stress. Spatial allocation and environmental transport modelling are required to determine what each ecosystem type receives; the distinction from a Pressure Account lies in the absence of the subsequent step that converts received quantities into pressure indicators relative to ecological thresholds or benchmarks. This is the appropriate label where that transformation step has not been applied.

• **Pressure Account** is an account whose entries have been transformed into ecological pressure indicators through a documented transformation step, for example, conversion of atmospheric emissions into deposition loads per hectare through atmospheric transport modelling, or conversion of discharge quantities into nutrient loads per catchment through hydrological modelling. This is the appropriate label where that transformation has been explicitly carried out and documented. A PSUT-style supply-use account (Option C) in which pressures are the primary accounting object and economic sectors appear on the supply side constitutes a Pressure Account provided that the transformation from residual flows to pressure indicators has been documented.

128. Both account types are valid implementations within the modular framework. The Environmental Loading Account requires no transformation step beyond spatial allocation of existing PSUT data, making it immediately "compilable" for countries with

a PSUT infrastructure. The Pressure Account requires additional methodological steps that depend on environmental fate and transport data, and its adoption as a standard product is therefore subject to the global consultation. This two-tier naming convention creates a visible progression: countries begin with an Environmental Loading Account and advance to a Pressure Account as methods and data mature.

4.4 Recommendation 3: Submit key design questions to global consultation

129. Several design questions identified in Section 3 are of sufficient conceptual significance that they should be submitted as explicit questions for global consultation rather than resolved unilaterally in the Guidance Note. These questions are:

- Question 1 — The transformation step and account naming: The Guidance Note proposes a distinction between an Environmental Loading Account (entries are residual flow quantities spatially allocated to ecosystem types) and a Pressure Account (entries have been transformed into ecological pressure indicators through a documented transformation step). Should this distinction and these names be adopted in the updated SEEA CF? And if so, should compilation of a Pressure Account in the full sense be a recommended standard, or should the Environmental Loading Account be the primary standard with the Pressure Account described as an advanced option?
- Question 2 — Reporting granularity on the receiving side: Given that deriving ecosystem-type totals requires estimating received quantities at the asset level or equivalent spatial unit, at what level of spatial detail should compiled pressure indicators be reported? Options range from aggregated ecosystem type totals (consistent with SEEA EA typology, supporting cross-country comparability) to finer spatial reporting units that preserve more spatial precision while remaining consistent with statistical confidentiality requirements.
- Question 3 — The supply-use identity in Option C: If Option C (PSUT-Style Pressure Account) is adopted as a long-term objective, should the supply-use identity be treated as a hard accounting requirement (total pressure generated equals total pressure received) or as a soft organising convention, given that pressure is not a physically conserved quantity and the identity cannot be grounded in conservation laws?
- Question 4 — Additivity and composite pressure indices: The rows of a Pressure Account are not additive across pressure types, since each pressure type carries different units and ecological meanings. Should the Guidance Note formalise this as a defining feature of the account, explicitly stating that column totals across pressure types are not meaningful, or should it permit the optional construction of composite pressure indices using documented weighting assumptions? If composite indices are permitted as an extension of the Pressure Account, what methodological constraints should apply to ensure that the weighting assumptions remain transparent and that the resulting indices can be reproducibly compiled by national statistical offices?
- Question 5 — Scope extension to natural input flows: The Guidance Note limits the scope of the Pressure Account to residual flows recorded in the PSUT. This exclusion follows the initial scope set out in the Scoping Note for Issue B6 (June 2025), which identified pressures from resource extraction as outside the boundary of this issue. The analysis developed in this Guidance Note, in particular the PSUT-

completeness argument, leads the authors to question whether that original exclusion should be maintained. Natural input flows recorded in the PSUT, including water abstraction, timber extraction, and fish harvesting, also exert pressures on ecosystem condition and are documented in the natural inputs rows of the same accounting framework. Should the scope of the Pressure Account be extended to include natural input flows from the PSUT, or should pressures arising from resource extraction be addressed in a separate accounting structure? If included, how should the conceptual distinction between extraction pressures and pollution pressures be handled within the account structure, given that natural inputs and residuals sit on opposite sides of the PSUT?

4.5 Required changes to the SEEA CF text

130. Implementing the recommendations above requires changes to the 2012 SEEA CF text in several locations. Table 3 identifies each location together with the nature of the change required. The proposed text for those changes is provided in Section 4.6

Table 3: Required changes to the 2012 SEEA CF

Paragraph	Location	Nature of change
Para 2.38–2.47	Chapter 2, Section 2.5 'Physical supply and Use Tables'	Add a new sub-paragraph introducing the concept of spatial disaggregation of the environment column by ecosystem type. Cross-reference to Chapter 3 (new Pressure Account section, 3.7), SNA 2025 and to SEEA EA.
Para 3.73–3.106	Chapter 3, Section 3.2.4 'Definition and classification of residuals'	Add a paragraph clarifying that residual flows recorded as 'returns to the environment' in the PSUT constitute the primary data input to a Pressure Account, and that this connection to the Pressure Account should be recognised in the classification and presentation of residuals.
Para 3.107	Chapter 3, Section 3.2.4 'Definition and classification of residuals'	Revise to replace the existing cross-reference to SEEA Experimental Ecosystem Accounting with a cross-reference to the new Pressure Account section and to the SEEA EA (2021). The existing text states that 'the measurement of the effect of flows of residuals on the state and quality of the ecosystems that receive them is addressed in SEEA Experimental Ecosystem Accounting'; this should be updated to reflect the formalisation of this connection in the Pressure Account.
Para 3.234–3.256	Chapter 3, Section 3.6.3 'Accounting for air emissions'	Add a paragraph noting that the Air Emission Account constitutes a primary data source for the Atmospheric Pressure Account, and that spatial disaggregation of air emission data by receiving ecosystem type, using atmospheric deposition modelling, provides the input for the air-pathway component of the Pressure Account.
New section	Chapter 3, after Section 3.6 'Physical Flow Accounts for materials'	Insert a new sub-section (proposed as §3.7) titled 'Pressure Accounts'. This section should contain: the conceptual definition of a Pressure Account (Recommendation 1); a typology of residual-based pressures; a description of the modular framework and implementation options (Recommendation 2); a schematic table illustrating the Option B structure; and

		cross-references to the SEEA EA Condition Account and to the spatial accounts guidance (GN A4); and a description of compilation pathways (spatial data approach and medium-based approach) through which countries may build toward the recommended implementation.

4.6 Proposed new text for inclusion in the updated SEEA CF

131. The following paragraphs constitute proposed text for inclusion in the updated SEEA CF. They are presented in the order in which they would appear in the document; that is, in the sequence of the 2012 SEEA CF chapter and paragraph structure. Text in the new 3.7 section constitutes the core Pressure Account content; revisions to existing paragraphs are indicated by the original paragraph reference and location. For each entry, the nature of the change is stated before the proposed text.

Proposed revision to para. 2.76 (Section 2.3.6 "Employment, demographic and social information.")

Nature of change: Minor revision to replace a spatially imprecise formulation and to add a sentence recognising Pressure Accounts as an analytical application of the SEEA CF, consistent with the GN A4 recommendation on spatial accounts.

Proposed text:

In the existing sentence referring to air emissions, replace 'air emissions at particular regions' with 'air emissions at particular spatial scales'.

Add the following sentence at the end of para. 2.76:

An important analytical application of the SEEA CF is the linking of physical flow data — in particular residual flows recorded in the Physical Supply and Use Tables — to measures of ecosystem condition. This connection is formalised through Pressure Accounts, which are described in Section 3.7 and which bridge the SEEA Central Framework and the SEEA Ecosystem Accounting.

Proposed paragraph after 2.47 (Chapter 2, Physical supply and Use Tables)

Nature of change: Addition of a new paragraph after 2.47, introducing the concept of spatial disaggregation of the PSUT environment column by ecosystem type and cross-referencing the new Pressure Account section in Chapter 3 and the SEEA EA.

Proposed text:

The environment column of the PSUT Use Table, which records the aggregate flow of residuals from the economy to the environment, may be spatially disaggregated into sub-columns corresponding to ecosystem types. This disaggregation allows the residual flows recorded in the PSUT to be linked to the specific ecosystem types that receive them, creating a connection between the Physical Flow Accounts of the SEEA Central Framework and the Condition Account of the SEEA Ecosystem Accounting. The resulting account structure, referred to as an Environmental Loading Account or a Pressure Account depending on the degree of transformation applied to the entries, is described in Section 3.7 of this Framework. The ecosystem type

classification used for this disaggregation should be consistent with, or directly mappable to, the classification used in the SEEA Ecosystem Accounting (see SEEA EA, Chapter 3).

Proposed paragraph to be added after paragraph 3.106 (Chapter 3, Section 3.2.4 — Definition and classification of residuals)

Nature of change: Addition of a new paragraph at the end of §3.2.4, clarifying that residual flows recorded as returns to the environment in the PSUT constitute the primary data input to a Pressure Account, and that this connection should be recognised in the classification and presentation of residuals.

Proposed text:

The residual flows classified and recorded in this section — in particular those recorded as returns to the environment in the PSUT Use Table — constitute the primary data input to Pressure Accounts as described in Section 3. The classification of residuals by type (emissions to air, discharges to water, releases to land, and diffuse releases from dissipative uses) corresponds to the principal pathways through which economic activities exert pressures on ecosystem condition. Compilers of residual flow accounts are therefore encouraged to retain sufficient detail in the classification and spatial attribution of residuals to support the subsequent compilation of Environmental Loading Accounts or Pressure Accounts, as appropriate to the data available and the policy purposes of the compilation.

Proposed revision to paragraph 3.107 (Chapter 3, Section 3.2.4 — Definition and classification of residuals)

Nature of change: Replacement of the existing cross-reference to SEEA Experimental Ecosystem Accounting with an updated cross-reference to the new Pressure Account section and to the SEEA EA (2021).

Proposed text (replacement for SEEA CF 2012, §3.107):

The environmental pressures imposed by residuals relate to residual flows from the current period as well as those from past periods, given the potential of residuals to accumulate in environmental assets. The measurement of the connection between residual flows and changes in the state and quality of the ecosystems that receive them is addressed through the Pressure Account described in Section 3.7. The Pressure Account provides the accounting structure that links residual flows recorded in Physical Flow Accounts to the ecosystem types and ecosystem condition indicators recorded in the SEEA EA Condition Account.

Proposed paragraph after paragraph 3.256 (Chapter 3, Section 3.6.3 — Accounting for air emissions)

Nature of change: Addition of a new paragraph at the end of Section 3.6.3, noting that air emission accounts constitute a primary data source for the atmospheric pathway component of Pressure Accounts, and describing the spatial disaggregation step required to connect air emission data to receiving ecosystem types.

Proposed text:

Air emission accounts compiled in accordance with this section constitute a primary data source for the atmospheric pathway component of Pressure Accounts as described in Section 3.7. The connection between the Air Emission Account and the Pressure Accounts involves a spatial disaggregation step in which emissions recorded by economic sector are attributed to the receiving ecosystem types, typically using atmospheric deposition modelling, to generate estimates of the deposition loads received by each ecosystem type. Where this disaggregation has been carried out and documented, the resulting data constitute the air-pathway input to either an Environmental Loading Account or a Pressure Account depending on whether the deposition transformation step has been applied. Where only the emission quantities are spatially allocated without applying a deposition model, the account records atmospheric loadings rather than deposition pressures, and should be labelled accordingly.

4.7 Proposed new section: SEEA CF Section 3.7 — Pressure Accounts

Nature of change: New sub-chapter to be inserted in Chapter 3 after Section 3.6. The section contains the conceptual definition of a Pressure Account (Recommendation 1 of this Guidance Note), the typology of residual-based pressures, a description of the modular framework and implementation options including compilation pathways (Recommendation 2), a schematic table illustrating the recommended Option B structure, and cross-references to the SEEA EA Condition Account and to the spatial accounts guidance (GN A4). It could also link back to the SNA 2025 (paragraph 35.66)

Proposed paragraph 3.7.1 (Introduction):

A Pressure Account is a statistical structure that records residual flows from the Physical Supply and Use Tables (PSUT) in a form that can be linked to specific ecosystem types, for the purpose of supporting analysis of changes in ecosystem condition as recorded in the Condition Account of the SEEA Ecosystem Accounting. The Pressure Account bridges the SEEA Central Framework and the SEEA Ecosystem Accounting by making explicit the connection between economic activities as sources of residual flows and ecosystem types as the receiving environments in which those flows exert ecological pressures.

Proposed paragraph 3.7.2 (Scope):

The Pressure Account as defined in this Framework is limited in scope to pressures arising from residual flows recorded in the physical flow accounts of the SEEA CF. These include emissions to air, discharges to water, releases to land, and diffuse releases from dissipative product uses. Pressures arising from harvesting activities, land-use change, passive environmental uses, invasive species, natural disturbances, and climate change drivers are not covered by the Pressure Account, though information on some of these pressures may be derived from other SEEA CF accounts, in particular physical asset accounts and land accounts.

Proposed paragraph 3.7.3 (Naming and the transformation step):

An Environmental Loading Account is an account whose entries are residual flow quantities from the PSUT spatially allocated to ecosystem types, recorded in the physical units of the original residual flow data. It records what each ecosystem type receives from economic activities without transforming those quantities into ecological pressure indicators. A Pressure Account is an account whose entries have been transformed into ecological pressure indicators through a documented transformation step; for example, conversion of atmospheric emissions into deposition loads per hectare through atmospheric transport modelling, or conversion of discharge quantities into nutrient loads per catchment through hydrological modelling. Both account types are consistent with this Framework provided that entries remain traceable to PSUT residual

flows. Where a transformation step has been applied, that transformation and its assumptions must be documented separately, as it is analytical in nature and sits outside the SEEA CF statistical accounting boundary.

Proposed paragraph 3.7.4 (Structure):

In its recommended form, the Pressure Account is presented as a matrix in which rows represent residual flow or pressure categories and columns represent ecosystem types classified consistently with the SEEA EA. Data are derived from residual flows recorded in the PSUT and, where applicable, from transformation procedures that convert emission quantities into ecological pressure indicators. The economic sector or activity responsible for generating each residual flow should be retained as an additional dimension where data permit, in order to preserve the connection to the economic activities recorded in the SEEA CF. Table 3.X provides a schematic illustration of the recommended Pressure Account structure.

Proposed paragraph 3.7.5 (Implementation patterns and compilation pathways):

Countries may implement accounts linking residual flows to ecosystem types at different levels of elaboration depending on data availability and policy priorities. Three implementation patterns are described, in order of elaboration: (a) extension of the PSUT environment column to include sub-columns for ecosystem types, as part of an existing PSUT compilation; (b) a stand-alone matrix derived from PSUT data in which rows represent residual flow or pressure categories and columns represent ecosystem types; and (c) a PSUT-style account that recasts pressures as the objects of a supply-use structure, with economic sectors on the supply side and ecosystem types on the use side. All three patterns are consistent with this Framework provided that entries remain traceable to PSUT residual flows and that the receiving-side classification is consistent with SEEA EA ecosystem type classifications. Where the entries in patterns (a), (b), or (c) are residual flow quantities spatially allocated to ecosystem types without further transformation, the account is an Environmental Loading Account. Where entries have been transformed into ecological pressure indicators through a documented transformation step, the account is a Pressure Account.

Two compilation pathways support countries building toward these implementation patterns. A spatial data pathway uses georeferenced gridded data to attribute emission data to ecosystem types by location, from which any of patterns (a), (b), or (c) can be derived; this pathway is most suitable where mature spatial data infrastructure exists and where atmospheric deposition or hydrological transport models are available. A medium-based pathway builds on existing air emission, water emission or waste accounts by extending them with an ecosystem type attribution layer, allowing countries to develop Pressure Account components progressively by environmental medium; this pathway is most accessible for countries with established SEEA CF Emission Accounts. Both pathways are complementary rather than alternative: a country may use the medium-based pathway to produce an Environmental Loading Account for air emissions in the short term while developing the spatial infrastructure needed for a full Pressure Account over the longer term.

Proposed paragraph 3.7.6 (Relationship to SEEA EA):

The Pressure Account provides an explicit link between the Physical Flow Accounts of the SEEA Central Framework and the Condition Account of the SEEA Ecosystem Accounting. Environmental pressures are defined in the SEEA EA as 'human-induced processes that alter the condition of ecosystems' (SEEA EA, paragraph 5.105). The Pressure Account records the residual flows that constitute the most directly measurable component of these pressures, organised by the ecosystem types that receive them. Changes in the pressure indicators recorded in the Pressure Account may be used, in conjunction with other condition variables, to help explain the changes in ecosystem condition observed over accounting periods in the SEEA EA Condition Account.

5 Other Considerations in Advancing the Issue

5.1 Existing compilation guidance and what additional guidance is needed

132. The development of a Pressure Account — or an Environmental Loading Account as a first step — will require compilation guidance that goes beyond what can be provided in a conceptual Guidance Note of this kind. The role of this section is to identify where existing guidance is available, where gaps exist, and what additional guidance will need to be developed in subsequent phases of the SEEA CF update programme.

133. Existing compilation guidance covers several of the component steps required for Pressure Account compilation but, for obvious reasons, does not yet integrate them into a pressure-oriented framework. The most relevant existing guidance is as follows.

- GN B1/B5 (Moll et al., February 2026) identifies required revisions to the PSUT framework, including the structure of the environment column and the classification of residual flows, that will directly support Pressure Account compilation. This relates directly to the spatial disaggregation step required for Option A (PSUT extension) and provides the residual flow data inputs for all other options.
- Air Emissions Accounts. The Eurostat Manual for Air Emissions Accounts (2015) provides detailed compilation guidance for air emission accounts compiled on a residence basis by NACE sector. These accounts constitute the primary data source for the atmospheric pathway component of any Pressure Account. Bridging items linking air emissions accounts to UNFCCC greenhouse gas inventories are also documented, providing a precedent for the kind of crosswalk tables that would be needed to link pressure accounts to regulatory reporting.
- Water accounts. SEEA-Water (UN, 2012) and the International Recommendations for Water Statistics (IRWS, UN, 2012) provide guidance on Water Emission Accounts, including discharges of pollutants to water bodies. These accounts are directly relevant to the water-pathway component of a Pressure Account covering nutrient loads, organic pollutants, and toxic contaminants.
- Spatial accounts. GN A4 (Meadows and Driver, February 2026) provides guidance on accounting at different spatial scales and identifies residual flow accounts as a primary candidate for spatial disaggregation. This guidance establishes the spatial accounting principles that underpin Option D (spatial bridge tables) and is directly relevant to the spatial allocation step required by all options.
- Ecosystem extent and Condition Accounts (SEEA EA, 2021, Chapter 5) provides guidance on ecosystem Condition Accounts, including the use of pressure data as proxy condition variables (section 5.5.3); specifically, the limited conditions under which environmental pressure data may serve as proxy variables for ecosystem condition variables, where direct state measurements are unavailable. The SEEA EA also establishes the receiving-side classification framework (ecosystem types, section 3.4).

134. The following gaps in compilation guidance have been identified through the development of this Guidance Note. These gaps should be addressed in subsequent technical notes or compilation manuals, which are not part of the conceptual SEEA CF update but should be initiated in parallel.

- Spatial allocation methods for residual flows. No single internationally agreed method appears to exist for allocating economy-wide residual flows from the PSUT

to specific ecosystem types or ecosystem assets. Guidance is needed on: the use of point-source versus area-source allocation approaches; the treatment of transboundary flows (residuals generated in one country but deposited in another); the use of georeferenced emission registers as a bridge between PSUT data and ecosystem-type maps; and minimum data requirements for spatial allocation.

- Environmental fate and transport modelling for Pressure Account compilation. The transformation from residual flow quantities to ecological pressure indicators requires environmental fate and transport data that are typically produced outside national statistical offices, by environmental research agencies, international bodies and academia. Guidance is needed on how statistical offices can access and use these external data sources and modelling outputs within the compilation process.
- Treatment of diffuse versus point-source pressures. Point-source residual flows (e.g. facility-level emissions reported to national emission registers) and diffuse residual flows (e.g. agricultural runoff, road runoff, atmospheric deposition from distributed sources) require different spatial allocation methods and have different data availability profiles. Compilation guidance should address these two source types separately and provide methods for combining them in a single ecosystem-type pressure table.
- Statistical confidentiality in spatially disaggregated Pressure Accounts. As noted in Section 3, spatial disaggregation of residual flows to detailed ecosystem types or actual ecosystem assets may allow the identification of individual facilities responsible for the emissions. Guidance is needed on disclosure control methods appropriate for pressure accounts, including aggregation rules, suppression criteria, and the use of ecosystem types rather than ecosystem assets typologies as a confidentiality-preserving default.
- Treatment of mobile source emissions. Emissions from mobile sources (road transport, aviation, inland waterway transport, and maritime shipping) present a specific spatial attribution challenge for Pressure Accounts. Under the residence principle applied in Air Emissions Accounts, mobile source emissions are attributed to the country of the resident operator regardless of where the emission physically occurs. This creates two problems for Pressure Accounts: emissions from resident operators occurring outside national territory cannot be allocated to domestic ecosystem types; and emissions from non-resident operators physically affecting domestic ecosystems are excluded from the national accounts. The result is a systemic gap for ecosystems near international transport corridors, ports, and airports. Guidance is needed on whether the territory principle should be applied for the spatial allocation step of a Pressure Account even where the underlying emission accounts follows the residence principle, and how any residual gap should be acknowledged in account metadata.

5.2 Options for testing the recommended approaches

135. Given that no country has yet published formal SEEA-aligned Pressure Accounts as a standard statistical product, testing of the approaches recommended in Section 4 will be an important step before global adoption. Testing should serve two purposes: validating the conceptual design of the recommended accounts structures, and assessing the feasibility of compilation across different national statistical systems and data environments.

136. Three types of testing are proposed, in order of feasibility and available precedent.

137. Several countries (notably Denmark, the Netherlands, and Germany) compile relatively complete PSUTs that include detailed residual flow data by economic sector. These countries are well positioned to develop and test a spatial allocation methodology for the Option A PSUT extension, using national land cover and ecosystem type maps to attempt the disaggregation of the existing PSUT environment column. This testing would generate methodological findings, data assessments, and documented decisions that would support the compilation guidance identified in Section 5.1 as a gap.

138. Pilot testing of Option B using the EEA/JRC nutrient account methodology. The EEA pilot nutrient pressure accounts (EEA, 2020) constitute an existing implementation of the Option B structure for nitrogen pressures on MAES ecosystem types across EU member states. These accounts can serve as a test bed for the Option B structure: assessing whether their methodology meets the primary condition proposed in Section 3 for a Pressure Account to be distinct from a spatially extended emissions account; specifically whether entries represent genuine ecological pressure indicators derived through a documented transformation step, rather than raw emission quantities. The EEA nutrient accounts cover a single pressure type delivered through a limited number of pathways and do not test the multi-medium integration condition; a separate pilot combining air, water, and land residual pathways for a single ecosystem type would be needed for that purpose.

139. Regional pilot for marine ecosystems using the OSPAR/MSFD framework. The Dutch North Sea account (Bogaart et al., 2023) is the primary existing example of an Option C-type structure — economic sectors on the supply side, ecosystem types on the use side — but it is explicitly qualitative and constitutes a proof of concept rather than a demonstration of operational feasibility. A regional pilot would test whether the Option C methodology can be replicated using the OSPAR and MSFD data available in other member states. Alarcon Blazquez et al. (2023) have compiled preliminary SEEA ecosystem accounts covering the full OSPAR area, demonstrating that the underlying spatial and condition data exist beyond the Dutch case. Building on that foundation, a pilot extending the Option C structure to one or more additional OSPAR member states would provide direct evidence on transferability and would generate findings relevant to the open consultation questions in Section 4.4; in particular on the supply-use accounting identity (Question 3) and the ecosystem classification unit (Question 2). It would also surface the statistical confidentiality challenges that arise when spatially disaggregated accounts cover marine areas with only a small number of operating economic units.

140. In all three cases, pilot testing should be designed to produce documented assessments of: compilation feasibility by data type and country capacity; the data gaps most frequently encountered; the sensitivity of results to methodological choices in spatial allocation; and the degree to which the resulting accounts are interpretable and useful for the ecosystem management and policy purposes identified in Section 1. These assessments should feed into the development of compilation guidance identified in Section 5.1 above.

5.3 Unresolved issues and research agenda

141. The development of this Guidance Note has identified a number of issues that remain unresolved and that should be placed on the research agenda for subsequent phases of

the SEEA CF update programme or for related statistical standards work. These are distinct from the global consultation questions identified in Section 4.4, which are questions of choice about account design; the issues listed here are questions of conceptual or methodological substance that require further research or inter-secretariat coordination before they can be resolved.

142. The scope boundary between residual-based pressures and extraction-based pressures: As discussed in Section 4.4 (Question 5), the current scope of the Pressure Account excludes pressures arising, for example, from resource extraction, including water abstraction, timber harvesting, and fish catch. This exclusion is pragmatically motivated but not conceptually necessary: natural input flows are recorded in the PSUT and demonstrably affect ecosystem condition. The research question is whether a unified pressure accounting framework can be designed that covers both sides of the PSUT — natural inputs and residuals — within a single coherent account structure, and if so, how the conceptual distinction between depletion pressures and pollution pressures should be handled in terms of account entries, units, and links to condition indicators.

143. The treatment of cumulative and lagged pressures. Residual flows recorded in the PSUT are annual flow measures: Many ecological pressures operate over longer time scales: contaminants accumulate in soils and sediments over decades; nutrient enrichment effects on aquatic ecosystems depend on historical loading as well as current inputs; habitat degradation from diffuse pressures may reach a threshold effect only after sustained exposure. The current Guidance Note does not address how cumulative or lagged pressure effects should be represented in an annual accounting framework. This is a research question with implications for both the account design and the link to the SEEA EA Condition Account, which also records annual changes against a reference condition.

144. The sub-annual dimension: The preceding paragraph addresses the problem of pressures whose effects unfold over time scales longer than a single accounting period. The opposite issue also exists: several ecologically significant pressure dynamics operate at sub-annual scales, and the annual accounting period may obscure them entirely. Seasonal nutrient loading peaks in agricultural catchments, episodic industrial discharge events, storm-driven runoff pulses, and short-duration atmospheric deposition episodes may exert disproportionate ecological effects that an annual account cannot capture. The SNA 2025 (paragraph 35.66) notes that higher-frequency compilation of PSUTs is possible — quarterly air emission accounts are cited as an example — but obviously does not develop the implications for pressure accounting. The research question is whether the Pressure Account framework should be extended to accommodate sub-annual compilation for specific pressure types and pathways, and if so, what the implications would be for the link to the SEEA EA Condition Account, which is also typically compiled on an annual basis. Sub-annual compilation would impose significant additional data and methodological requirements on statistical offices and would need to be evaluated against the analytical benefit of capturing temporal pressure dynamics that annual accounts obscure.

145. The relationship between the Pressure Account and the SEEA EA Condition Account in the presence of multiple stressors: Ecosystem condition responds to multiple simultaneous pressures, and the relationship between individual pressure indicators and observed condition changes is rarely linear or additive. The Pressure Account, as designed in this Guidance Note, records individual pressure types separately and does not model their combined ecological effect. The research question is how the Guidance

Note should describe the analytical step between a Pressure Account and a Condition Account without implying a causal relationship that the accounting data alone cannot support. This requires methodological guidance on the use of pressure-condition relationships in Ecosystem Accounting, which intersects with ongoing work in ecological science on multi-stressor assessment.

146. Consistency with the SNA 2025 treatment of environmental assets and flows: The SNA 2025 introduces updated treatments of natural resources, cultivated biological resources, and environmental assets that have implications for the scope of the Pressure Account. The SEEA CF PSUT already records natural input flows in physical units in the environment column of the Supply Table, and the SNA 2025 records the monetary value of depletion of those same resources in the National Accounts. In this sense, both frameworks already capture the extraction dimension, in physical and monetary terms respectively. The research question is therefore not one of consistency between the SNA 2025 and the SEEA CF, but of completeness of the Pressure Account itself: if the PSUT already records both natural input flows and residual flows, and the Pressure Account is designed to build a spatial bridge from PSUT flows to ecosystem condition, why should that bridge cover only the residuals side of the PSUT and not the natural inputs side? The argument for extending the Pressure Account scope to natural input flows, as proposed in Section 4.4 (Question 5), is one of internal completeness of the SEEA. The broader research question is whether a unified spatial pressure accounting framework can be designed that covers both sides of the PSUT within a single coherent structure, and whether the physical natural input flows recorded in the PSUT supply table can be linked to ecosystem condition indicators in the same way as residual flows.

147. The role of the Pressure Account in integrated SEEA reporting frameworks: The SEEA CF update is developing multiple new account structures across its 29 issues. The Pressure Account interacts with a number of these, in particular GN A4 (spatial accounts), GN A8 (linking flow and asset accounts), GN B1/B5 (PSUT description), and GN B7 (waste accounts). As the individual Guidance Notes are developed and move towards global consultation, a coherent integration of all account structures will be required. An unresolved question is how the Pressure Account fits within the overall sequence of accounts from economic activity to ecosystem condition, and in particular whether it should be presented in the updated SEEA CF as a standalone section (as proposed in Section 4.5) or as an integral part of the Physical Flow Accounts chapter. This integration question should be addressed in the final consolidation phase of the SEEA CF update.

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