Standardised Ecosystem Typologies

Recommendations for New Zealand

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Contents

Executive Summary

The goal of this report and the associated workshops is to inform an investment plan that can support development of nationally standardised ecosystem typologies (or a typology) that meet the core needs of multiple agencies.

"Use case" statements were prepared that explained how each agency uses ecosystem typologies and what fundamental features they need in a typology. These use case statements are in Appendix 1. Appendix 2 is a summary of the major typologies referenced in the agencies' statements.

The agencies also provided ecosystem-specific information on:

- The typologies in use by the agency and how well they currently meet their needs
- Any existing typology that would be their preferred choice for standardisation.

That information can be found in Appendices 3-12 but is summarised in the body of the report.

Principles for Standardised Ecosystem Typologies

The principles of any typology were identified in Workshop 1 and validated by the discussions in the subsequent ecosystem-specific workshops. These are:

1. **Hierarchical structure** -- Groupings arranged in a hierarchical or nested structure to reflect the nature and magnitude of similarities.
2. **Spatially explicit** -- Distributions of units should be mappable through any practical combination of ground observation, remote sensing and spatial modelling. (References IUCN Global Ecosystem Typology 2.0).
3. **Reflects NZ ecological diversity and processes**
4. **Relatable** -- Easily translatable to, or builds on, other typologies.
5. **Accommodates transformed ecosystems** -- Recognises that many ecosystems now occur in modified states, for example, working landscapes.
6. **Updateable** -- as new information becomes available.
7. **Utility** -- No more complex than required to capture the essentials (References the use of "parsimonious" in IUCN Typology 2.0).
8. **Takes account of Te Ao Māori**
9. **Consistent use of species concepts** -- Updated as needed.

Important additional themes include:

- Replicable/repeatable – That a different person following the same process will reach the same conclusion. That the typology is data derived, not expert opinion.
- Coverage for ecotones – The typology should cover the areas of transition between ecosystems.
- Temporal explicitness – The typology results should be clear about the time period that was assessed. If done repeatedly, this should be able to reflect change over time.
- Flexibility/adaptability – The typology itself should be updateable over time, updating results with new information about an ecosystem. It should have rules or guidance about what will change or can change within the structure of the typology, and how often.

Differences observed between ecosystems

None of the ecosystem-specific workshops uncovered any additional issues that were not addressed by the "must have" principles from Workshop 1. Unsurprisingly, however, differences did occur in how those principles would be applied to specific ecosystems. For example, wetlands are primarily classified according to abiotic factors, whereas currently used typologies for forests tend to be biotic based on vegetation communities. This will naturally affect how classification should be approached for these ecosystems.

There were also notable differences in the state of knowledge associated with the different ecosystems. For example, terrestrial knowledge is quite well developed but there was no obvious single candidate for a standard typology. In contrast, marine ecosystems in New Zealand do not have the same knowledge base, but there was general agreement that the Coastal Marine Ecosystem Classification Standard would be a suitable standard typology once New Zealand-specific factors were incorporated.

Groundwater-dependent ecosystem typologies are the least well developed but arguably the most urgent ecologically because we know so little about them. Although we do know that they are biodiverse and under increasing use pressure, hence the urgency.

Agreement on goal and overarching typology

Across all ecosystems and throughout the workshops, there was strong enthusiasm for improved typologies that would better meet the multiple needs of agencies and councils. In this context "better" implies more than just more ecologically accurate and up to date. It also means giving New Zealand the ability to make more informed natural resource management decisions through nationally standardised naming, classification and mapping.

A single, overarching typology that accommodates all ecosystems and ecotones within a hierarchical structure is the most desirable outcome. This would potentially be aligned to the IUCN Global Ecosystem Typology, a comprehensive classification framework for Earth's ecosystems that integrates their functional and compositional features.

The alternative of standard typologies for different ecosystems is not necessarily inappropriate or an ineffective approach but would likely make it more difficult to reflect the natural interconnectedness of ecosystems in policy and management decisions.

In either case, the new typology or typologies should be able to link back to the terminology and classifications that were used by previous typologies.

Ecosystem-Specific Recommendations

Freshwater Wetlands: build from Johnson and Gerbeaux

Johnson and Gerbeaux (2004) is the preferred choice for a standardised typology. However, it does not accommodate less common ecosystem types particularly well. The next step for this ecosystem is to convene a small working group to review Johnson and Gerbeaux more closely to ensure it can deliver what is needed.

Freshwater Rivers: build from Freshwater Environments of New Zealand

There are more typologies for rivers and no single standout for standardisation in the way that there is for wetlands. Regional councils have special needs related to river typologies, such as supporting catchment management decisions, predicting floods and setting targets and limits for habitats within rivers and streams. None of the typologies meet all of the agencies' needs particularly well. The next

step for river ecosystems is to convene a small working group to examine Freshwater Environments of New Zealand (FWENZ) more closely while considering needs raised in the workshop. The group should explore opportunities to improve existing resources with new and better data.

Freshwater Lakes: needs collation of existing research

There is no actual typology for lakes, instead there are several sources of information that have elements of typology, each with distinct methodologies and purposes. There is considerable lakes-related work happening already to address these shortcomings. The recommendation is to convene representatives from these and other projects to explore whether a separate project is needed or whether the lakes typology issue is being addressed sufficiently through existing work.

Freshwater Groundwater: needs more research

Groundwater dependent ecosystems are the least developed in terms of typology and do not have the same direct and urgent policy drivers. However, groundwater systems are arguably more urgent ecologically because we know so little about them. Some fundamental research is needed before any useful discussion of classification systems or typologies for groundwater can occur.

Marine and Estuarine: Coastal Marine Ecosystem Classification

There are several marine typologies in use in New Zealand, however, none are entirely satisfactory. There was general agreement from agencies and councils that the Coastal Marine Ecosystem Classification Standard (CMECS) should become the standard typology for New Zealand. The next step should be to organise workshops to develop a strategic work plan for incorporating New Zealand's marine and estuarine habitat into CMECS.

Terrestrial: no consensus

There was no consensus on candidate for a standard typology for terrestrial ecosystems. Singers and Rogers is widely used by councils but is less common for other agencies. Even in the regional sector, there are issues with consistency across councils and it does not work well for restricted ecosystems. The main conclusion was that there are components of the existing terrestrial typologies that work well for some things and, if practical, these should be compiled and ultimately developed into something new. The next step is to continue these cross-agency conversations around the most critical gaps in existing typologies, to identify if and how these gaps can be addressed and develop a plan of work.

General Recommendations

The specific recommended next steps for this work vary by ecosystem. However, much of the general rationale and context needed to develop an investment plan can be taken from this report and the associated workshop materials. Any further details would need to be informed by additional scoping with technical experts. The following recommendations should be read in that context.

1. Explore the possibility of creating one overarching typology for New Zealand based on the IUCN Global Ecosystem Typology with the agency leads involved in these workshops and other technical experts. CMECS, the Coastal Marine Ecosystem Classification Standard, might also be adaptable to creating an overarching classification system.
2. Exclude agencies' "sunk costs" in existing typologies from consideration during this exploratory phase. Prior investment will be a consideration later in the exercise, but the initial focus should be on exploring all options to substantially improve New Zealand's ability to understand and manage its natural resources for decades to come.
3. Consider a "national triage system" or a set of criteria to prioritise different ecosystem typologies based on urgency and readiness.

4. Consider the development of NEMS for geospatial data standards, i.e., technical guidance on how geographic information should be collected and used, that would support mapping by regional councils and agencies.

Context and Background

Ecosystem typologies are used to describe and delineate ecosystem types to enable monitoring, reporting and management. There is currently no single agreed standardised ecosystem typology, and there are multiple in use by different sectors in different domains.

With no nationally consistent approach in ecosystem typology, ecological data cannot easily be compared or aggregated at the national level and current typologies or proxies for typologies are not fit for purpose and do not meet agency needs. Implementing a nationally consistent approach will enable New Zealand to gain far more value from the data that is already being collected by Regional Councils and other stakeholders, as well as supporting the development of more robust and comprehensive monitoring.

As the lead agency for reporting on the State of the Environment as well as leading the development of policies requiring data on ecosystems, MfE initiated discussions about how to improve ecosystem typologies. MfE funded this project to explore the use requirements of agencies and councils for an overarching ecosystem typology, the utility of current, commonly used, typologies and to recommend a way forward.

MfE convened a project team of subject matter experts from MfE, DOC, Regional Councils and MPI to discuss what ecosystem typologies agencies are currently using across domains and gain an understanding of what typology principles are the most important.

These early discussions also revealed that there is interest in an overarching typology to allow the natural interconnectedness of ecosystems to be better reflected in policy and monitoring. This could be based on the IUCN Global Ecosystem Typology and would enable a classification hierarchy to better meet the needs of multiple stakeholders.

Workshop Structure and Process

Prior to the first workshop, agency leads prepared “use case” statements that explained how each agency used ecosystem typologies and what fundamental features they needed in a typology. The full use case statements from each agency are in Appendix 1.

The “must have” features from those use case statements were summarised and entered into a decision support and conjoint analysis software called 1000minds. The software produced a choice modelling exercise through which the agency leads identified the principles that were most important to them. The prioritisation was done individually online prior to Workshop 1 where they were subsequently discussed and refined through group discussion. The discussion emphasised that the group was not choosing among typologies, just measuring what principles would be more or less important in a typology.

Workshop participants had been instructed to be aware that a future process to develop new typologies was likely to face financial trade-offs between what was essential and what was desirable. The rankings, therefore, reflect the relative importance of principles. They do not separate principles into important and unimportant.

Workshop 1 – Foundational principles of any ecosystem typology

Introduction

The purpose of Workshop 1 was to identify the common, foundational principles that any ecosystem typology must have regardless of the ecosystem being considered. Central government agencies and regional council representatives each presented these "must haves" from their own perspectives. This exercise gave each agency the opportunity to restate the needs they had included in their written use case statements.

Final Key Principles Wording

The final agreed principles of any standardised ecosystem typology were agreed by the agency leads in Workshop 1 and were the foundation of all subsequent, ecosystem-specific workshops:

1. **Hierarchical structure** -- Groupings arranged in a hierarchical or nested structure to reflect the nature and magnitude of similarities.
2. **Spatially explicit** -- Distributions of units should be mappable through any practical combination of ground observation, remote sensing and spatial modelling. (References IUCN Global Ecosystem Typology 2.0).
3. **Reflects NZ ecological diversity and processes**
4. **Relatable** -- Easily translatable to, or builds on, other typologies.
5. **Accommodates transformed ecosystems** -- Recognises that many ecosystems now occur in modified states, for example, working landscapes.
6. **Utility** -- No more complex than required to capture the essentials (References the use of "parsimonious" in IUCN Typology 2.0).
7. **Takes account of Te Ao Māori**
8. **Consistent use of species concepts** -- Updated as needed.

Ranking of Key Principles

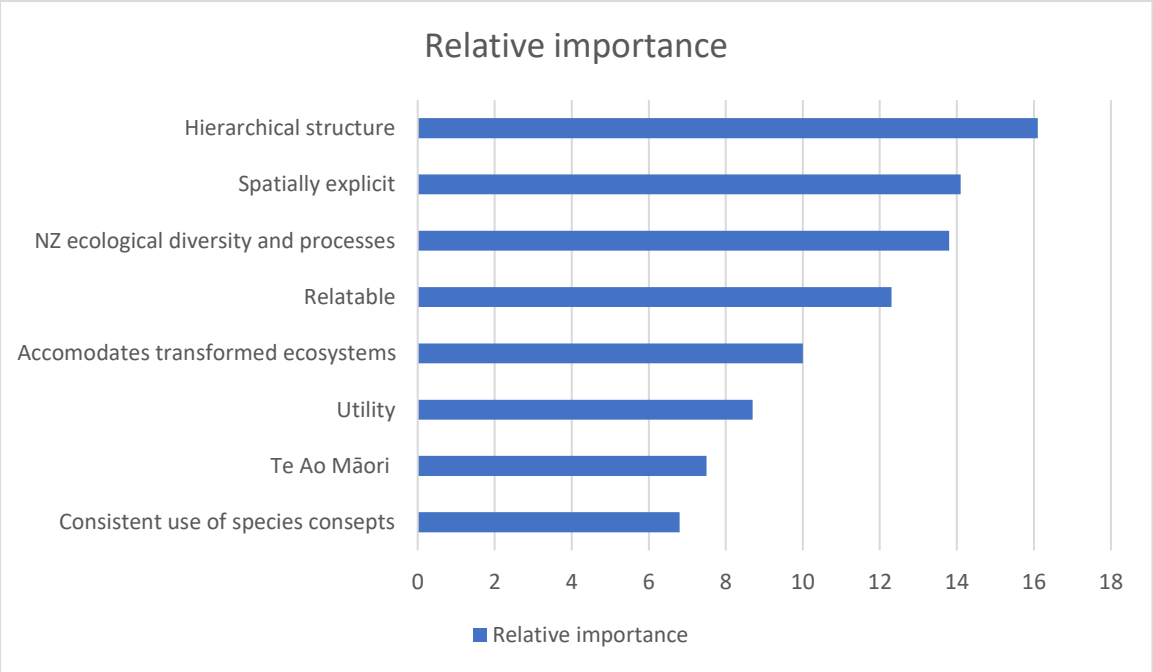
Table 1 below shows how the agency leads ranked each principle.

It is important to reiterate that principles further down the list were not considered "unimportant", just that they were relatively less important than those higher on the list. For example, "Hierarchical Structure" was roughly 2.5 times more important than "Consistent use of Species Concepts."

After the initial ranking exercise, the group added "updateable," the ability to be revised as new information becomes available. The group chose not to score this principle because it was deemed so fundamental that it should sit across all the others.

The group's view was that it would be ideal to develop a typology with all of these principles, but the ranking would be helpful if compromises must be made during the development process. This is shown through Table 1.

Table 1 – Relative ranking of key principles for any typology



Additional "Must Have" Principles

Workshop participants also considered whether there were any "must have" principles in addition to the nine listed above.

Key themes from that exercise included:

- **Replicable/repeatable** – That a different person following the same process will reach the same conclusion. That the typology is data derived, not expert opinion.
- **Coverage for ecotones** – The typology should cover the areas of transition between ecosystems.
- **Temporal explicitness** – The typology results should be clear about the time period that was assessed. If done repeatedly, this should be able to reflect change over time.
- **Flexibility/adaptability** – This referred to the typology itself being updateable over time, updating results with new information about an ecosystem. Referred to having rules or guidance about what will change or can change within the structure of the typology, and how often.

There was support for these principles to be added to the "must haves" list for any typology, however, the formal ranking exercise was not repeated with these included.

This overarching set of minimum agreed principles was used as the starting point for each of the subsequent ecosystem-specific workshops.

Workshop 2 – Freshwater Systems

The freshwater workshop (October 10, 2023) covered wetlands, rivers, lakes and groundwater. Agencies and regional councils were asked to submit in advance – *1) The typologies in use by the agency and how well they currently meet agency and council needs. 2) Is an existing typology the*

preferred choice for standardization? Or is an entirely new typology needed?[1] The agency and council responses for freshwater are in Appendix 3.

Wetlands Results Summary

Johnson and Gerbeaux (2004) is the preferred choice for a standardised typology, and it aligns reasonably well with "universal" typology requirements. Regional councils have previously agreed with MfE to use the Johnson and Gerbeaux wetland classes when they are mapping wetland types.

Singers and Rogers may also be able to contribute some useful features, e.g., finer vegetation details.

However, Johnson and Gerbeaux does not accommodate less common ecosystem types particularly well. The workshop agreed this was an important issue to address, i.e., how the naturally uncommon ecosystems can be rationalised with the Johnson and Gerbeaux classification scheme. Regional councils are running a project with Manaaki Whenua – Landcare Research to map some of the naturally uncommon ecosystems, which could be a useful contribution to refining Johnson and Gerbeaux.

The next step for this ecosystem is to convene a small working group to evaluate Johnson and Gerbeaux against the "must have" criteria identified here and propose specific improvements.

Key Discussion Themes[2]

Key themes from the wetlands discussion included:

- **Difficulty in Wetland Differentiation** -- Distinguishing between different types of wetlands is universally recognised as challenging.
- **Lack of Comprehensive National Mapping** -- New Zealand has struggled to achieve nationally consistent wetland mapping. While there are elements for national wetland mapping in the WONI (Wetlands of National Importance) and LCDB (Land Cover Database), a comprehensive and reliable nationwide map of wetlands is lacking. There are significant limitations with current mapping techniques, especially for accurately capturing the extent of bogs and fens without on-site ecological expertise.
- **Synergy between Different Systems** -- There are noted synergies between the Singers and Rogers and the WONI system, indicating some level of integration or compatibility.
- **Limitations in Current Classification Systems** -- The Singers and Rogers system misses certain wetland types like red tussocks. It also doesn't prioritise water regime as a primary attribute, which might be crucial for some wetlands, such as fens. The Freshwater Ecosystems of New Zealand (FENZ) approach takes a more water-centric view than Singers and Rodgers. The LCDB offers a simplified classification but with valuable time series data.
- **Regional Councils' Concerns** -- Regional councils widely use the Singers and Rogers system but have concerns about its inadequacy in capturing wetland diversity, with a need for more detailed information about vegetation communities. Some regions may require bespoke mapping solutions, such as Northland's dune lakes, underlining the need to accommodate regional variations in wetland mapping.

[1] The same questions were asked for each ecosystem workshop.

[2] "Discussion points" in this report are taken from the workshop transcripts. They are a synthesis and summary of participants' individual comments. They are not verbatim quotes. They represent a distillation of personal, albeit expert, views and should be read as such.

- **Standardisation and Improvement** -- Johnson and Gerbeaux's method is preferred for standardisation, but it's recognised that it needs improvement and detailed cross-referencing against universal requirements identified in previous workshops.

A detailed summary of comments made during the wetlands discussion is in Appendix 4.

Rivers Results Summary

There are more typologies for rivers and no single standout for standardisation in the way that there was for wetlands with Johnson and Gerbeaux. However, FWENZ (Freshwater Environments of New Zealand), is a good place to start. FWENZ is a classification system of New Zealand streams developed by NIWA that separates New Zealand streams into 20 groups. There also is REC (River Environment Classification), a database of catchment spatial attributes, summarised for every segment in New Zealand's network of rivers. The attributes were compiled for the purposes of river classification. More recently, regional councils such as Waikato have started looking at functional parts of rivers, particularly large rivers like the Waikato.

Rivers are unusual ecosystems in that they move around. They are not as discrete as lakes or some wetlands, and they actually occupy huge variety of environmental spaces.

Regional councils have special needs related to river typologies, such as supporting catchment management decisions, predicting floods and setting targets and limits for habitats within rivers and streams.

In short, there is more work that needs to be done to pull a standardised typology together than there is for wetlands. **The next step for river ecosystems is to convene a small working group to more closely examine FWENZ, while considering needs raised in the workshop. The group should explore opportunities to improve existing resources with new and better data.**

Key Discussion Themes

Key themes from the rivers discussion included:

- **Complexity of River Systems** -- The discussion highlighted the complexity of rivers and contrasted them with more discrete ecosystems like lakes.
- **Creating a Digital River Network** -- The creation of a cohesive, national Digital River Network – a digital geospatial database -- was identified as a major challenge. Such a database is crucial for informing river typology and management.
- **Limitations of Current Topologies** -- Current topologies are limited to specific river reaches and do not encompass a complete "mountains-to-sea" approach.
- **Focus on Catchment Management** -- The importance of catchment management and the need for classification systems that align with catchment areas was emphasised.
- **Potential for Improvement** -- The potential for reassessing and improving existing systems like FWENZ was discussed, with a focus on updating the underlying data. The constraints posed by data gaps and the foundational models for river classifications was noted. It was suggested to rerun older models with updated data to improve the results.
- **Importance of Flood Management** – The need for a classification system that helps regional councils manage and predict flood paths was highlighted.
- **Habitat Preservation and Freshwater Species** – The importance of understanding habitats within rivers, especially for the conservation of threatened freshwater species and setting environmental targets and limits, was stressed.

A detailed summary of comments made during the rivers discussion is in Appendix 5.

Lakes Results Summary

There is no typology for lakes in the sense that we have been using the word throughout these workshops. Instead, there are several sources of information that have elements of typology, each with distinct methodologies and purposes.

For example, Freshwater Ecosystems of New Zealand includes a classification with seven lake types. Geomorphic classification of lakes has been applied by DOC and can provide typology information to represent differences in lake biodiversity and functioning. DOC also has a simplified approach to defining reference conditions for New Zealand lakes. From MfE, there is some classification of lakes as part of the National Objectives Framework, under the NPS-FM (National Policy Statement for Freshwater Management).

The workshop discussed the potential trade-offs between simplification for broader applicability and detailed classification for specific purposes, such as ecological conservation or climate change impacts. Participants noted the need to address data gaps and update outdated classifications.

Encouragingly, there is considerable lakes-related work happening now:

- Cawthron has been commissioned to revisit the FENZ layer for lakes to try to find a consistent way of identifying lakes and potentially update the categories. There will be a workshop with councils on this.
- Bay of Plenty has been leading a project for a lake modelling platform to identify classifications of lakes.
- Cawthron's Lakes 380 project has new funding from MBIE and will be producing information that could be used to inform and improve typologies.

It was acknowledged that there are a number of people and projects working in this space. The group felt that a useful **next step for lakes would be to bring together representatives from these and other projects to explore whether a separate project is needed or whether the typology issue is being addressed sufficiently through existing work.**

Key Discussion Themes

Key themes from the lakes discussion included:

- **Improving Lake Classification** -- The need for a more comprehensive typology that includes both ecological and geomorphic aspects was emphasised. However, it is difficult to classify lakes, particularly due to the lack of basic information about biodiversity and physical data like maximum depth.
- **Importance of Basic Data** -- Before establishing a typology, the need for basic data about lakes was emphasised. Both geomorphic classification and ecological aspects are considered necessary for identifying Outstanding Water Bodies as per the NPS-FM.
- **Ecosystem Interconnectedness** -- The discussion touched on the similarity between different aquatic ecosystems, for example questioning the distinction between large wet wetlands and shallow vegetated lakes.
- **Needs of Regional Councils** -- Regional councils require detailed lake information for policy development, ecosystem restoration, and management prioritisation, particularly in the context of climate change.

- **Application of International Standards** -- The possibility of applying the IUCN Red List or a New Zealand variant to lake typology to assess threat status was discussed.
- **National Limits and Objectives** -- The necessity of a typology for setting meaningful national limits or objectives for lake health was emphasised.
- **Degradation Status and Conservation Planning** -- The importance of understanding the degradation status of lakes, like the loss of macrophyte communities, for conservation planning.
- **Limitations and Inclusivity** -- The discussion acknowledged the limitations of the typology approach, especially in respecting the Te Ao Māori perspective. A workshop involving all stakeholders to develop a comprehensive lakes typology would be valuable.

A detailed summary of comments made during the lakes discussion is in Appendix 6.

Groundwater Results Summary

Groundwater dependent ecosystems are the least developed in terms of typology and do not have the same direct and urgent policy drivers. There is, however, a link to other policies designed to protect wetlands and other freshwater resources.

Groundwater systems are arguably more urgent ecologically because we know so little about them. In most cases, we don't know how groundwater is related to springs or even to larger surface features like lakes and rivers. Nor do we know much about stygofauna, the creatures that live in groundwater.

What we do know is that New Zealand has unusually high stygofaunal biodiversity. New Zealand is reported to contribute 3.8% of the world's known stygofaunal species from just 0.18% of the world's land area.[3] Many species are confined to very restricted geographical ranges, which makes mapping and protecting them urgent, but currently difficult.[4]

Overall, the workshop highlighted the complexity and urgency of managing groundwater ecosystems in New Zealand, emphasising the need for better understanding, mapping, and policy integration. A certain amount of fundamental research is needed before we can have a useful discussion of how to classify these systems.

At a minimum, it is important to integrate groundwater information with rivers, lakes, and wetlands management, due to their interdependency. A process to do that more effectively, for example during resource consenting, is probably more urgent than the development of a groundwater typology.

Key Discussion Themes

- **Lack of National Policy for Groundwater** -- Groundwater has not received the same level of national policy attention as rivers and other water bodies. While not a current policy priority, there is growing interest in the risks to groundwater and its biological community, particularly stygofauna, with ongoing research by ESR and NIWA.
- **Vulnerability of Groundwater-Dependent Ecosystems** -- Ecosystems that rely on groundwater, such as springs are in danger, with many unmapped and disappearing without notice. River, lake, and wetland systems may also rely on groundwater. These dependencies need to be better understood.

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[3] "Lightless, not lifeless: New Zealand's subterranean biodiversity," https://niwa.co.nz/sites/niwa.co.nz/files/import/attachments/lightless.pdf

[4] MfE has a work programme looking at aquifers that are known to be not well explored in terms of stygofauna.

- **Limited Data and Understanding** -- The New Zealand Hydrogeological Systems database is the primary source of limited information on groundwater ecosystems.
- **Classification Challenges** -- There is a need to understand how groundwater dependency affects the classification of wetlands and lakes, and whether these should be classified based on biotic or abiotic factors.
- **Need for Dedicated Groundwater Research** -- A specific program is required to study groundwater ecosystems thoroughly to develop an appropriate classification system. Coordination between organisations like GNS, ESR, and NIWA is important, possibly through a national triage system to prioritise ecosystem studies.

A detailed summary of comments made during the groundwater discussion is in Appendix 7.

Workshop 3 – Marine and Estuarine Systems

Information from the agencies and councils regarding the marine and estuarine typologies they use and options for standardisation are in Appendix 8.

Marine Results Summary

There are several marine typologies in use in New Zealand.

These include:

- Marine Environment Classification (MEC)
- Seamount Classification (Rowden et al 2005)
- NZ Seafloor Community Classification (Stephenson et al 2020)
- Coastal and Marine Habitat and Ecosystem Classification (2008).

However, none are entirely satisfactory for a variety of reasons. For example, Marine Environment Classification (MEC) (Snelder et al 2005) does not apply well to shallow coastal habitats and its classes do not define substrate or biological structural elements; it is largely obsolete now. MEC has been replaced with the NZ Seafloor Community Classification (Stephenson et al 2020), which meets DOC's needs for large scale planning and reporting.

MfE also used MEC and is now using the Benthic-Optimised Marine Environment Classification (BOMEC) (Leathwick et al. 2012), but that is restricted to the Exclusive Economic Zone, which makes it difficult to manage anything that straddles the territorial sea limit.

There was general agreement from agencies and councils that the Coastal Marine Ecosystem Classification Standard (CMECS) should become the standard typology for New Zealand. Developed in the United States, CMECS is "a structured catalogue of ecological terms that also provides a framework for interpreting, classifying, and inter-relating observational data from all types of sensors and platforms."[5]

Some modifications will be needed, including how to best make it applicable to New Zealand's marine environments and specific biotic groups, but overall, the group felt that CMECS could provide a very effective typology. Participants noted its comprehensiveness and flexibility, as well as the fact that there is ongoing work to adapt the CMECS framework for New Zealand. The scope of CMECS in New Zealand currently includes defining biotic community types for both deep reef and shallow reef

[5] https://iocm.noaa.gov/standards/cmecs-home.html#:~:text=The%20Coastal%20and%20Marine%20Ecological,types%20of%20sensors%20and%20platforms.

habitats, and cross-walking existing habitat maps for marine reserves. CMECS potentially applies to most, if not all, ecosystems present in the marine environment, including pelagic and estuarine environments. Because of its flexibility, it also may be possible to integrate CMECS with existing typologies and classification systems.

The group felt that the **next step should be to organise workshops to develop a strategic work plan for incorporating New Zealand's marine and estuarine habitat into CMECS. There is a NIWA report that compares what has been used in the past in New Zealand to what is used overseas that might be useful.**

Key Discussion Themes

- **Evolution of Marine Typologies** -- There has been a shift from older classification systems like MEC to newer ones like the New Zealand Seafloor Community classification, reflecting advancements in marine typology. The Department of Conservation is working to standardise marine typologies, comparing domestic and international systems, with NIWA providing analytical support.
- **Relevance and Adaptability of CMECS** -- The Coastal and Marine Ecological Classification Standard is applicable to New Zealand, especially for thematic classification. CMECS is adaptable and covers various environments including dune systems and soft substrate environments, but concerns remain about its coverage of sandy and rocky shores.
- **Challenges in Classifying Transitional Areas** -- Integrating classifications for areas like estuaries and ecotones where different ecosystems intersect presents a challenge that is not limited to estuaries. CMECS is flexible and could potentially be further developed to integrate seamlessly with estuaries, as well as terrestrial and other classifications.
- **Extending Scope of CMECS** – There is a need to expand CMECS to cover the entire New Zealand Exclusive Economic Zone and to interface with terrestrial zones.
- **Prioritising Biotic Components** -- Refining the biotic component of CMECS and listing habitat types is a priority.
- **Funding and Collaboration Opportunities** -- There is potential for funding strategic work on marine typologies, with various agencies leading different aspects of the refinement process.

A detailed summary of comments made during the marine discussion is in Appendix 9.

Estuarine Results Summary

The agencies and councils varied in the typologies used for estuaries, including:

- Coastal Hydrosystem Classification (Hume et al., 2016)
- National Estuary Monitoring Protocol
- Estuarine Trophic Index Typology (Zeldis et al)
- Singers and Rogers.

Hume et al., however, seemed to be used most commonly. As with marine typologies, none of these are completely fit for purpose. For instance, the Hume typology focuses on geomorphology, which might not correlate with current environmental states. The estuary trophic index is considered too simplistic.

As noted in the marine section above, the workshop generally supported integrating estuarine classifications into CMECS. This should be possible because CMECS is noted for its comprehensive

nature, including a geoform component[6] and hierarchical structure that makes it versatile and adaptable for various ecosystems. Participants also discussed the integration of various regional data and typologies into CMECS. This includes broad-scale habitat mapping and specific habitat types like saltmarsh and seagrass.

As a next step, the group supported suggestions to further explore and implement CMECS, including the organisation of workshops and the formation of working groups. The importance of a unified approach and consistent application across regions was emphasised.

Key Discussion Themes

- **Applicability of CMECS to Estuaries** -- There was discussion of the suitability of CMECS for estuarine habitats, with a preference to integrate estuaries into this classification rather than having a separate typology. The discussion included how CMECS overlaps with other marine habitats and interfaces with terrestrial ecology, emphasising the need for a comprehensive, integrated approach. Transitioning existing estuarine monitoring and mapping to CMECS was seen as feasible without significant cost, aiming for uniformity in detail and methodology.
- **Standardisation Across Regions** -- Several regions have applied broad-scale estuarine habitat and substrate typologies, and there is a desire to incorporate these into CMECS for consistency.
- **Process for Updating and Adapting CMECS** -- The need for a structured process to incorporate changes and new habitats into CMECS was acknowledged, drawing on experiences from similar systems used in the US and other countries.

A detailed summary of comments made during the estuarine discussion is in Appendix 10.

Workshop 4 – Terrestrial Systems

Information from the agencies and councils regarding the terrestrial typologies they use and options for standardisation are in Appendix 11.

Terrestrial Results Summary

Unlike the marine and estuaries workshop that largely coalesced around CMECS as the prime candidate for a standard typology, no similar consensus was evident for terrestrial ecosystems.

The conversation revolved around the use and limitations of various terrestrial classification systems, such as Singers and Rogers, the Land Cover Database for vegetation, Williams et al 2007 and Wiser et al 2016.

Singers and Rogers is widely used by councils but is less common for other agencies and all agreed that it is not perfect. Williams 2007 is used by all agencies but is limited to rare and uncommon ecosystems. The Land Cover Database is used for widespread ecosystems but is relatively coarse and lacks subtlety to capture situations where indigenous dominance is depleted.

LENZ is used by the Carbon Sequestration team at MfE, but it is not a substitute for an ecosystem typology.

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[6] Geoforms—the physical structures of the underwater marine environment—include underwater topography, living (biogenic) structures that create their own physical environment, or man-made features such as shipwrecks, breakwaters, and dredge areas.

The group acknowledged the need for a new, more comprehensive system that can integrate various levels of specificity and adapt to different applications. They discussed the need for a hierarchical structure in the new system and the importance of it being mappable and relatable across different typologies. The conversation also touched upon the challenges of using existing data sets and classifications, which may be outdated or not comprehensive enough.

There was consensus on the need to have a system that can accurately classify and map ecosystems, considering both abiotic and biotic factors, and one that can be easily updated and expanded. This discussion largely reflected the overarching "must haves" that were identified in Workshop 1 as applying to all typologies.

In short, there was nothing unique about terrestrial ecosystems that had not been raised in previous workshops. The main message was that there are components of the existing typologies that work well for some things and that we should try to compile those and build up from there. A suggestion was that the best features from multiple typologies – IUCN, LENZ, Singers and Rogers, Williams, etc. – could be developed into something new.

Work will be needed to pull an agreed list of "the best bits" together. The material from these workshops provides a good starting point. Similarly, the use cases developed for this workshop already provide an initial list of what agency and council needs are <u>not</u> being met adequately by any current typology.

Key Discussion Themes

- **Inadequacy of Current Typologies** -- The typologies used by the Department of Conservation are not wholly adequate. A key requirement for the new typology is a hierarchical structure that allows varying levels of specificity for different applications within a single framework.
- **Mapping and Replicability** -- The new typology needs to be easily mappable, replicable, and updatable to avoid issues of out-of-date information and variable accuracy.
- **Integration Across Physical Domains** – There is a desire to develop a single typology covering different physical domains (freshwater, marine, terrestrial) at a higher level than current classifications.
- **Comparison Across Existing Typologies** -- The need to compare and potentially integrate existing approaches, such as LCDB and Singers and Rogers, into any new system was emphasised.
- **Regional Variability and Prioritisation** -- Different regions have varying levels of detail in their ecosystem mappings. There is a need for a system that prioritises ecosystems based on their current extent and conservation status. The ideal system would provide a national scale understanding of ecosystem threats and prioritisation, aiding in conservation and restoration efforts.
- **Affordability and Practicality** -- Considerations of cost-effectiveness and practicality, especially given existing investments in current systems like Singers and Rogers, are crucial. However, there also is a desire to look beyond sunk costs and create a system that serves long-term needs, regardless of the investments in current classifications.
- **Historical vs. Current Ecosystem Mapping** -- A distinction was made between mapping historical distributions and extent of current ecosystems, with an emphasis on the importance of mapping indigenous ecosystems for conservation purposes.

A detailed summary of comments made during the terrestrial discussion is in Appendix 12.

General Conclusions

The essential principles of any typology that were identified in Workshop 1 were validated by the discussions in the subsequent ecosystem-specific workshops. None of those workshops uncovered any new ecosystem-specific issues that were not addressed by the "must have" principles from Workshop 1.

Unsurprisingly, the differences occurred in how those principles would be applied to specific ecosystems. For example, current mapping of wetland ecosystems is primarily based on abiotic factors, whereas forests are currently broken down biotically into different forest types based on vegetation communities. This will naturally affect how classification should be approached for these ecosystems.

There were also notable differences in the state of knowledge associated with the different ecosystems. For example, terrestrial knowledge is quite well developed but there was no obvious single candidate for a standard typology. In contrast, marine ecosystems in New Zealand do not have the same knowledge base, but there was general agreement that the Coastal Marine Ecosystem Classification Standard would be a suitable standard typology once New Zealand-specific factors were incorporated.

Groundwater-dependent ecosystems face at least three significant challenges. There is quite limited knowledge about some of their basic features, they have the least developed typology, and they lack the same obvious and direct policy drivers as ecosystems such as freshwater. This lack of groundwater policy makes the need for a standard typology seem less urgent. However, groundwater systems are arguably more urgent ecologically because we know so little about them, how they connect to surface features like springs, lakes and rivers or the unique stygofauna that lives in them.

Across all ecosystems and throughout the workshops, there was strong enthusiasm for improved typologies that would better meet the multiple needs of agencies and councils. In this context "better" implies more than just more ecologically accurate and up to date. It also means giving New Zealand the ability to make more informed natural resource management decisions through nationally standardised naming and classification.

If it is true that "We can't manage what we don't measure," then it is equally true that "We can't measure what we can't name consistently."

One Typology for All?

An interesting possibility raised during the workshops was that instead of having individual typologies for the various ecosystems, MfE should consider an overarching typology that accommodates them all within a hierarchical structure.

This would potentially nest underneath the IUCN Global Ecosystem Typology. The IUCN typology is a comprehensive classification framework for Earth's ecosystems that integrates their functional and compositional features.[7] Many of the foundational principles discussed in Workshop 1 were drawn from the IUCN work.

The Global Ecosystem Typology (GET) has four core realms:

[7] https://global-ecosystems.org/

- Terrestrial
- Marine
- Freshwater
- Subterranean

and six "transitional realms" such as marine/terrestrial and subterranean/freshwater, with multiple biomes and functional groups underneath those six. This sort of hierarchical approach was strongly endorsed by the workshop participants, as was the importance of addressing ecosystem transitional zones. A NZ specific layer could be developed to meet needs for describing NZ's ecosystems whilst providing a line of sight to international reporting.

The pros and cons of adapting the IUCN approach for New Zealand are beyond the scope of this report. However, the UN Committee of Experts on International Statistical Classifications quite recently recommended the adoption of the GET as a global standard.[8] Given that, as well as the enthusiasm expressed by the workshop participants for the concept of an overarching typology, it certainly should be considered.

The alternative of standard typologies for different ecosystems is not necessarily inappropriate or an ineffective approach but would likely make it more difficult to reflect the natural interconnectedness of ecosystems in policy and management decisions. A key component of this approach would be the ability to compare across typologies that have been used before.

Recommendations

The specific recommended next steps for this work vary by ecosystem. However, much of the general rationale and context needed to develop an investment plan can be taken from this report and the associated workshop materials. Any future work should reference the key principles developed in these workshops, as well as being informed by additional scoping with technical experts to get the level of detail required.

The view of the workshop participants was that it would be ideal to develop a typology with all of the key principles, however the ranking done for the workshop would be helpful if compromises need to be made (see Table 1). The following recommendations should be read in that context.

1. Explore the possibility of creating one overarching typology for New Zealand based on the IUCN Global Ecosystem Typology with the agency leads involved in these workshops and other technical experts. CMECS, the Coastal Marine Ecosystem Classification Standard, might also be adaptable to creating an overarching classification system.
2. Exclude agencies' "sunk costs" in existing typologies from consideration during this exploratory phase. Prior investment will be a consideration later in the exercise, but the initial focus should be on exploring all options to substantially improve New Zealand's ability to understand and manage its natural resources for decades to come.
3. Consider a "national triage system" or a set of criteria to prioritise different ecosystem typologies based on urgency and readiness.
4. Consider the development of NEMS (National Environmental Monitoring Standards) for geospatial data standards that would support regional councils and agencies that need to do additional mapping before new typologies are developed.

[8] https://iucnrle.org/news/the-iucn-global-ecosystem-typology-recommended-as-an-international-statistical-classification

The following recommended next steps are ecosystem specific.

Wetlands

Preferred choice for a standardised typology -- Johnson and Gerbeaux (2004).

Next steps -- Convene a small working group to evaluate Johnson and Gerbeaux against the "must have" criteria identified here and propose specific improvements.

Rivers

Preferred choice for a standardised typology -- No single preferred typology; Freshwater Environments of New Zealand and River Environment Classification have potentially useful features, as does unpublished research.

Next steps -- Convene a small working group to closely examine FWENZ and REC with regard to needs raised in the workshop, particularly regional council needs linked to catchment management. Explore options to improve existing resources with new and better data.

Lakes

Preferred choice for a standardised typology – None although some data sources do exist.

Next steps – Convene representatives from projects underway in other agencies, particularly the Cawthron Institute, regional councils and DOC to determine if lakes typology is being addressed sufficiently through existing work.

Groundwater

Preferred choice for a standardised typology – None, groundwater typology is undeveloped.

Next steps – MfE lead a project to report on the urgency and priority of needs associated with groundwater, emphasising the need for better overall understanding, mapping, and policy integration. At a minimum, it is important to integrate groundwater information with rivers, lakes, and wetlands management, due to their interdependency. A process to do that more effectively may be more urgent than development of a groundwater typology.

Marine and Estuarine

Preferred choice for a standardised typology -- The Coastal Marine Ecosystem Classification Standard (CMECS).

Next steps – MfE develop a strategic work plan for incorporating New Zealand's marine and estuarine habitat into CMECS, building on work already done by other agencies and regional council staff.

Terrestrial

Preferred choice for a standardised typology -- No single preferred typology. Although several frameworks include useful features, a new, more comprehensive system is needed.

Next steps – Continue the cross-agency conversations around the most critical gaps in existing typologies, to identify if and how these gaps can be addressed and develop a plan of work.

Table 2 below summarises the ecosystem-specific recommendations.

Table 2- Recommended next steps by ecosystem type

Ecosystem type	**Next Steps**
Wetlands	Convene a small working group to evaluate Johnson and Gerbeaux against the “must have” criteria identified here and propose specific improvements.
Rivers	Convene a small working group to closely examine FWENZ and REC regarding needs raised in the workshop, particularly regional council needs linked to catchment management. Explore options to improve existing resources with new and better data.
Lakes	No preferred choice for a standardised typology was identified. Convene representatives from projects underway in other agencies to determine if lakes typology is being addressed sufficiently through existing work.
Groundwater	Groundwater typology is undeveloped. MfE should lead a project to report on the urgency and priority of needs associated with groundwater, emphasising the need for better overall understanding, mapping, and policy integration.
Marine and Estuarine	MfE should develop a strategic work plan for incorporating New Zealand's marine and estuarine habitats into the Coastal Marine Ecosystem Classification Standard, building on work already done by other agencies and regional council staff.
Terrestrial	No preferred choice for a standardised typology was identified. Continue the cross-agency conversations around the most critical gaps in existing typologies, to identify if and how these gaps can be addressed and develop a plan of work.

The expectation is that any future potential supplier would consider this report and the principles that were developed through the process and advise how the current typologies could be improved or a new typology developed. Options would be considered by a working group of central and regional government representatives for feedback.

Ecosystem Typologies Report -- Appendices

Contents

Appendix 1-- Typology use cases submitted by agencies and councils

Regional councils

Key features

The regional sector is seeking a hierarchical classification scheme, that operates at a national scale to describe the diversity, composition and structure of all the ecosystems across the land, freshwater and marine domains of New Zealand's territorial area and waters. Ideally, the hierarchical scheme should encompass and build on existing schemes where practicable, allowing for the development of further detailed tiers of classification to support conservation objectives.

Additional elements

The development of a typology needs to be accompanied by national mapping of the ecosystem types and would benefit from an associated national threat classification system for ecosystems, developed along the lines of the IUCN Red List for Ecosystems. This map and an accompanying conservation assessment needs to be updated at no more than five-year intervals. This will require a secure funding stream and workflows that enable engagement of local authorities in its production and verification.

Ministry for the Environment

MUST have:

1. **Must** be able to align with/ nest within the IUCN typology
2. **must** be able to be used to create maps that show extent and assess threats
3. The typology (and associated mapping) **must** meet the needs of Environmental Reporting requirements (wetland area, sand dune extent and rare ecosystem indicators)
4. The typology **must** be compatible with the needs of other key stakeholders – DOC and Regional Councils
5. **must** ensure that any development of component typology is in alignment with an overarching, robust typology that is interoperable with IUCN etc.

SHOULD have

1. The approach **should be able to be** inform the evidence base for legislative needs – eg, terrestrial for L&T,
2. The typology **should be able to be** extended to non-terrestrial ecosystems, ie freshwater, coast and marine.
3. It should also be inclusive of levels of ecosystem modification.
4. The typology **should** include rare and uncommon ecosystem, including the classification already developed
5. Investment in this space should take a pragmatic approach- with a long-term vision with clarity around need-to-haves vs nice-to-haves, and a phased approach to investing as funds are available
6. Mapping **should** be updated every 5-10 years as development and restoration activities etc.

Department of Conservation

Must have:

An effective ecosystem typology for DOC must:

- Be clear
- Be objective
- Be scalable/hierarchical to enable application at broader and finer scales
- Be comprehensive:
    - Including native ecosystems that have developed since human colonisation of Aotearoa New Zealand
    - Cover all domains, including boundary systems
- Be repeatable:
    - Allow description of ecosystems' extent over time
    - Include a plan for maintenance, and routine updates; as well as allow automated updates as source data are updated;
    - Support translation to older typologies which have been a useful basis for management planning and reporting (e.g., LCDB, FENZ)
- Be consistent in taxonomic concepts: species used as diagnostic (or attributes of) ecosystems should be the same as species concepts applied in other national planning and reporting tools.
- Apply to all Aotearoa NZ:
    - Take account of Te Ao Māori
    - Reflect the full range of abiotic context and species
    - Include species with variable range size, especially migrant and highly mobile species
    - Include offshore islands

Should have:

- Lend itself to description of ecosystem services
- Describe ecosystems' endemism (of species level and of type level)
- Include mechanisms for incorporating assessments of quality
- Include scores for confidence in the identification of the ecosystems or ecosystem components
- Include modifiers for ecosystem types or ecosystem components

Include brief description of ecosystem driver(s) (e.g., geologic, hydrologic) and notable biodiversity

Appendix 2-- Summary of Ecosystem Typologies

The below table sets out a description of the typologies that were discussed in cross-agency project on developing a national standardised ecosystem typology (2023-2024).

Domain	Typology Name	Description	Units	Main uses	Link
International – all domains	IUCN Ecosystem Typology	A hierarchical **ecosystem typology** that considers ecosystem functions and species composition (linked to function). Also aimed for conceptual consistency across biosphere and scalable structure.	5 Realms (terrestrial is one) 25 Functional biomes 108 Ecosystem Functional Groups	Framework to support international reporting on international commitments	IUCN Global Ecosystem Typology 2.0 - resource | IUCN
Wetlands, Land, Estuaries	Singers and Rodgers 2014	A hierarchical **ecosystem typology** based off abiotic (climatic variables, substrates, soils, and landforms) and biotic factors. Forest communities aided by GIS but placement of predominantly non-forest communities within environments was a subjective process.	152 ecosystems. 78 of these are zonal and are split into 8 broad groups based on temperature. 74 are azonal and are separated into 11 major groups.		A classification of New Zealand's terrestrial ecosystems (doc.govt.nz)
Wetlands	Johnson & Gerbeaux 2004	A hierarchal **ecosystem typology** that follows a 'top-down' approach, starting with the broad hydrological and landform setting, moving down to wetland classes based on substrate, water regime, and chemistry, and finally to the lowermost levels where vegetation becomes a defining factor.	9 hydrosystems Subsystem (descriptive) 9 wetland classes Wetland form (descriptive) 15 main structural classes Composition of vegetation (descriptive)	Field guide to classification of wetlands. Used by researchers, Regional Councils and community groups.	Wetland Types in New Zealand

Wetlands, Rivers, Lakes	Freshwater Ecosystems of NZ (FENZ)	A set of spatial data layers describing environmental and biological patterns in freshwater ecosystems. Includes a hierarchal **environmental typology** based on the 'environmental character' of a site. Provides information about geographical location, physical and biological attributes, and condition.	8 wetland classes based on Johnson & Gerbeaux 7 lake classes based on weighted environmental variables 4 levels of river classification, containing 20, 100, 200 and 300 groups respectively	Considered outdated in some regards. Used as a database for nation-wide freshwater environments.	FENZ User Guide
Rivers	REC (River Environment Classification)	The REC is a hierarchal structural typology that groups rivers and parts of river networks that share similar ecological characteristics, including physical and biological. The REC classification system groups rivers according to several environmental factors that strongly influence or cause the rivers' physical and ecological characteristics (climate, topography, geology and land cover).	6 controlling factors 6 levels of classification The first four levels group according to Climate, Topography, Geology and Land-Cover of their catchments. The fifth and sixth levels group according to similarities in attributes of the local section of the river network: Network-Position and Valley-Landform	A fundamental tool used for central government and Regional Councils for freshwater resource management and accounting.	REC User Guide
Marine	Marine Environment Classification (MEC; Snelder et al. 2005)	The MEC is a numerical classification based on physical characteristics (including depth, slope, tidal currents, SST). Biological datasets were used to tune the classification. It covers the entire EEZ (excluding	Hierarchical. Can be displayed at between 2 to 290 classes. Level of detail (ie number of classes) can therefore be	General classification system intended to have relevance to a broad range of biological groups and uses in environmental	The New Zealand Marine Environment Classification Overview | Ministry for the Environment

		estuaries) at 1km spatial resolution. A more detailed classification was also developed for the Hauraki Gulf at 200m spatial resolution.	chosen dependent on use.	and conservation management.	
Marine	New Zealand Seamount Classification (Rowden et al 2005)	A preliminary numerical classification based on a multivariate analysis of thirteen mostly physical environmental variables (eg, depth at peak, depth at base, elevation, distance from continental shelf; only one biological variable, chlorophyll a, was included).	Identified 12 seamount classes (ie, similarity groupings).	Unclear. Possibly, to help inform seamount protection.	Physical characterisation and a biologically focused classification of "seamounts" in the New Zealand region (deepwatergroup.org)
Marine	Coastal and Marine Habitat and Ecosystem Classification (CMHEC; MFish and DOC, 2008)	The CMHEC is a thematic classification based on physical variables. In the coastal environment (water depth less than 200m) it uses biogeographic region, environment type, depth, exposure, and substrate to classify habitat type. For waters deeper than 200m, it uses MEC classes, benthic vs pelagic, depth, substrate and limited data on habitat or ecosystem types. The deepwater classification was preliminary and so required further development.	The coastal classification scheme identifies 44 classes between mean high water and 200m depth.	Designed to underpin planning for the protection of marine biodiversity (ie marine protected areas). Note, however, many fundamental issues were identified with this classification system, which appears to have limited its utility.	Marine Protected Areas: Classification, Protection Standard and Implementation Guidelines (doc.govt.nz)
Marine	Benthic Optimised Marine Environment Classification (BOMEC; Leathwick et al. 2012)	The BOMEC is a numerical classification that uses distributional data for eight benthic taxonomic groups (asteroids, bryozoans, benthic foraminiferans, octocorals, polychaetes, matrix-forming	Hierarchical. Up to 300 groups are described but recommends using fifteen groups at EEZ scale (3 inshore groups, 3 continental shelf groups	Specifically designed to assess and manage the impacts of bottom trawling on benthic species.	A Benthic-optimised Marine Environment Classification (BOMEC) for New Zealand waters (fish.govt.nz)

		scleratinian corals, sponges, and benthic fish) and environmental variables (such as depth, temperature, salinity, and suspended sediment) to divide the benthic environment into ecosystem types. It covers parts of the EEZ where depth is less than 3000m.	and 9 deeper-water groups). Other levels of detail can be used if required.		
Marine	Coastal and Marine Ecological Classification Standard (CMECS; FDGC 2012)	CMECS is a thematic classification that was developed by NOAA in the US. Essentially, it is a structured catalogue of ecological terms that also provides a framework for interpreting, classifying, and inter-relating data. It covers marine, estuarine, and lacustrine habitats. It has not been extensively trialled or adapted for use in NZ.	Semi-hierarchical. Uses 6 elements (biogeographic and aquatic settings; water column, biotic, substrate, and geoform components) and subclasses within these, to describe each unit.	Intended to be used across a wide variety of projects, with broad relevance to environmental management.	Integrated Ocean & Coastal Mapping (noaa.gov)
Marine	NZ Seafloor Community Classification (SCC; Stephenson et al. 2021)	The SCC is a numerical classification of the seafloor environment and communities within the New Zealand EEZ. It uses environmental variables and biological (species occurrence) data.	Hierarchical. Identified and described 75 groups (but can be used to define groups at different levels of detail, eg 30 or 100 groups). Each group contains a unique assemblage of taxa, including reef fish, bottom-feeding fish, invertebrates (eg shellfish, coral, worms), and macroalgae (seaweed).	To inform conservation planning (MPAs) and environmental management.	Development of a New Zealand Seafloor Community Classification (doc.govt.nz)

Estuaries	NZ Coastal Hydrosystems (NZCH; Hume et al 2016)	The NZCH is a thematic geomorphic classification system of New Zealand coastal environments (including estuaries, lagoons, fjords, embayment's, and beach streams)	Results presented at level III (geomorphic) level of a hierarchy. 11 geomorphic classes (some with subclasses).	Intended to be broadly useful for environmental management, conservation, and restoration.	A classification of New Zealand's coastal hydrosystems | Ministry for the Environment
Estuaries	Estuary Trophic Index Typology (ETI; Robertson et al. 2016)	The ETI typology classifies NZ estuaries into four types based on their eco-morphology (and consequent susceptibility to eutrophication)	Four estuary types: 1. Shallow intertidal dominated estuaries, 2. Deeper subtidal dominated estuaries, 3. Shallow, short residence time tidal rivers, and 4. Coastal Lagoons	Intended to inform estuary monitoring and assessment of eutrophication susceptibility and expression.	The New Zealand Estuary Trophic Index | NIWA
Land	Land Cover Database (LCDB)	A hierarchical **land cover typology** based off satellite imagery (updated approximately every 5 years 1996, 2001, 2008, 2012, 2018). Land cover classes mix together ecosystem types.	Three-tiered land cover classification: 6 broad-level classes, 12 medium-level classes, 34 detailed land cover classes	Used for a range of purposes including monitoring and reporting land use change and broadscale management.	Browse GIS data | LRIS Portal (scinfo.org.nz)
Land	LENZ (Land Environments of New Zealand)	A hierarchical **environmental typology** based on a set of 15 underlying climate (7 variables from modelled 1950-80 data), landform (DEM slope), and soil variables (7 from NZLRI data). Variables were chosen for functional and statistical grounds and linked back to major indigenous tree species distributions	Hierarchical nature: Level I - 20 groups, Level II - 100 groups, Level III - 200 groups, Level IV - 500 groups.	Used in monitoring and reporting and identifying threatened environments (at a broad scale).	LENZ » Manaaki Whenua (landcareresearch.co.nz)

		(ultimately major plant physiological processes). Developed in 2002.			
Land	Williams *et al* rare and uncommon ecosystems (2007)	An **ecosystem typology** using physical and biotic factors to define and name the physical environments of historically rare ecosystem types.	72 rare ecosystems – does not cover all ecosystems of NZ.	Used in national environmental reporting, for conservation management purposes (e.g. Holdaway threat status assessments).	New Zealand's historically rare terrestrial ecosystems set in a physical and physiognomic framework | NZES (newzealandecology.org)
Land	Wiser *et al* vegetation classification (2016 – 2018)	A **quantitative vegetation typology** created using plot data and clustering algorithms. No abiotic data included. Note the alliances change when data is added, and the analysis rerun.	25 alliances – does not cover rare ecosystems.	Most useful for areas with a history of data collection.	New Zealand's plot-based classification of vegetation | Request PDF (researchgate.net) Expanding an existing classification of New Zealand vegetation to include non-forested vegetation | NZES (newzealandecology.org)

Note NZ coastal and marine habitat and ecosystem classifications were recently reviewed in this document prepared for DOC: mpa-habitat-classification-review-2018.pdf (doc.govt.nz)

Appendix 3-- Freshwater Ecosystem-specific typology use information

Ministry for the Environment

	Response as it relates to Lakes
The typologies in use by your agency and how well they currently meet agency and council needs	For example, NPS-FM require Total Nitrogen bottom lines to be specified based on mixing regime category. All lakes are unique/variable, including the significance of complex hysteresis and impact of future uncertainties. The purpose of the category will determine what information should be used for categorisation and in what ways. Below I have listed some of the research projects and investments related to categorisation/clustering. Unlike other water body types, lake categories will be assigned to the whole water body. This means it will be a simple exercise to associate each new categorisation/types with unique lake IDs as metadata, instead of creating unique polygon layers for typology purposes. In terms of 'practically' determining whether the water body should be categorised as lakes or not, should be addressed by MfE's FENZ database update project as discussed below. • MfE is working to update FENZ lakes database including the project team revisiting morphometric categorisation and additional metadata. The project will be initiated with workshop with stakeholders to ensure the categories we will establish on this project will be fit for purpose and timely. • Lakes modelling platform project (Waikato Uni) has been working on creating autonomous modelling capability that is based on preliminary categorisation of lakes to apply pre-existing parameter sets before starting the calibration process. We will work with this project for the above FENZ lakes database update. • Eye on Lakes project (Waikato Uni) has been looking into categorising lakes through hyperspectrum reflectance composition by aligning with international literature categorisation to improve remote sensing based phytoplankton/cyanobacteria concentration monitoring.

	• Newly funded MBIE full endeavour project (Cawthron) will provide holistic management options by integrating biophysical science and te ao Māori. This will be accompanied by another MBIE funded smart ideas project to create toolset to address lakes historical ecology through e-DNA technology. I'd expect some categorisation/hierarchical operation to take process in the project. • Some experts (esp. Otago University) have been working to establish "great lakes" categories throughout NZ, to identify conservation/management requirements unique to these types of lakes. • Some councils have historically categorising lakes into groups to apply high level management practices and apply similar planning purposes (eg lower Waikato Lakes FMU).
Is an existing typology the agency's preferred choice for standardization? Or is an entirely new typology needed?	Improved categorisation through the (soon to be) ongoing projects above should be sufficient to address immediate categorisation needs. If new categories are established, the updated FENZ dataset should be used to assign categories/typologies into individual lakes as metadata.

	Response as it relates to Wetlands
The typologies in use by your agency and how well they currently meet agency and council needs	MfE & Stats Environmental Reporting used LCDB5 wetland variables (including swamps, fens, bogs and marshes) for the Wetland Area indicator last published in 2021, and notes that some types/components of wetlands are not captured. The primary focus for development of this indicator is to better delineate wetlands in general and track changes in total area, so the typologies are not a priority for this use.
Is an existing typology the agency's preferred choice for standardization? Or is an entirely new typology needed?	Future environmental reporting is likely to push for ecosystem typologies in general, and would look to incorporate a standardised typology into its indicator once one is agreed and available.

	Response as it relates to Wetlands
The typologies in use by your agency and how well they currently meet agency and council needs	Relevant typology to wetland implementation is that in Johnson & Gerbeaux (2004). Regional councils are required to map and classify into typology the natural inland wetlands within their region. After discussion with councils at a workshop it was agreed that we would use Johnson & Gerbeaux (2004). There are no other aspects of the wetland implementation workstream currently relevant to discussion on typologies.
Is an existing typology the agency's preferred choice for standardization? Or is an entirely new typology needed?	NA

	Response as it relates to Groundwater
The typologies in use by your agency and how well they currently meet agency and council needs	There are no groundwater ecosystem typologies in wide use in New Zealand, and MfE does not use any that I'm aware of. The closest equivalent are hydrogeological systems, which have been comprehensively mapped in New Zealand. These are broadly used to delineate groundwater systems for management and research purposes, and are proposed to be incorporated into the Environmental Reporting Groundwater Quality indicator in the future (it currently does not delineate or describe aquifers).
Is an existing typology the agency's preferred choice for standardization? Or is an entirely new typology needed?	Hydrogeological systems are the preferred choice for many aspects of freshwater management and reporting, and are currently the best available equivalent to an ecosystem typology for groundwater. However they are not the preferred choice for understanding the state of groundwater ecosystems, and it would be highly desirable for environmental reporting and groundwater management to have a standardized ecosystem typology for groundwater in New Zealand.

	Response as it relates to Rivers
The typologies in use by your agency and how well they currently meet agency and council needs	Environmental Reporting uses the REC; REC classifications are foundational to the national models for river water quality and serve ER purposes quite well.
Is an existing typology the agency's preferred choice for standardization? Or is an entirely new typology needed?	

	Response as it relates to Freshwater in general
The typologies in use by your agency and how well they currently meet agency and council needs	REC embedded in the NPS-FM for sediment and periphyton attributes. In this regard, legislative changes may be needed if REC isn't continued. I am aware that some water bodies are incorrectly located, esp those related to groundwater sources. Likely an issue both for councils and MfE.
Is an existing typology the agency's preferred choice for standardization? Or is an entirely new typology needed?	Future environmental reporting is likely to push for ecosystem typologies in general, to approve the use and meaning for state. These would need to be standardised to enable national reporting.

Regional councils

The main typologies the regional sector uses, include:

- Landcover Database – for widespread ecosystems, typology is coarse and lacks subtlety to capture situations where the indigenous dominance is depleted
- Singers and Rogers 1994 – for widespread terrestrial ecosystems, mostly used for forests, has been refined over time (so there are issues with consistency across councils) and doesn't work well for restricted ecosystems

    Singers and Rogers 2014 – link found here. A primary division in this typology is the distinction between zonal and azonal ecosystems.

    One issue for the mapping of restricted ecosystems (as defined below) by councils with Singers and Rogers so far is that definitions for many of them were not operationalised, so most struggled to capture them plus because LCDB was heavily relied upon. Singers and Rogers for the restricted ecosystems did often lean upon the work by Williams et al. 2007 (they often just used different words). These definitions are being worked on in the contract below.

- Williams et al. 2007 – for restricted ecosystems, a.k.a. rare and naturally uncommon ecosystems, this is being reviewed through the current contract with MWLR and there's scope to expand

  The link to this paper is found here. Useful accompanying documents are this book chapter found here and the attached paper in Conservation Biology. Many of these ecosystem types occur in azonal environments that lack trees despite often being below regional treelines. Many of the wetland category (as there are six categories in total) of naturally uncommon ecosystems are identified in Johnson and Gerbeaux – see below.

  Note that the NPSIB refers to naturally uncommon ecosystems.

- Johnson & Gerbeaux 2004 – for wetland types, currently being reviewed by Olivia Burge from MWLR

  The book can be found here. Table 1 on page 15 is useful as an overview for this semi-hierarchical classification.

Singers and Rogers 1994, Williams et al. 2007 and Johnson & Gerbeaux 2004 have considerable similarity being function-based typologies. In other words, the ecosystems identified are not mutually exclusive and are often found in each of the typologies. If a hierarchical scheme was adopted similar to the IUCN function-based one, they would likely easily slot in or would fall as a subtype of the ones that are listed.

The Landcover Database (LCDB) is slightly different as a classification. The above typologies could fit back into LCDB as it's a coarser-type of classification than, e.g., Williams et al., Johnson & Gerbeaux.

The general feeling from regional councils is that we'd like a hierarchical scheme that incorporates these existing typologies if possible.

The key things are to (1) get a national typology that (2) can distinguish indigenous from exotic ecosystems and (3) incorporates widespread and restricted ecosystems.
One more key thing would be to accommodate transformed ecosystems, recognising that many ecosystems are now modified states such as working indigenous landscapes.

For regional council science generally, the critical requirement is the union of what drives ecosystems and what councils manage. So ability to predict species abundance/distribution should not be the sole measure of success. For example, ocean circulation drives whitebait recruitment, but we don't control that. Distance from sea is essential attribute for the things we don't control part of the classification. We do control how much water people take from streams, and a classification system that incorporates the physical drivers that constrain ecosystem response to allocation is therefore useful for grouping management response. The former might be a higher hierarchy than the latter.

Suggestion:
'**Align with scale of management** - Groups systems with similar physical processes that respond to resource management'

For example, alluvial valleys develop large aquifer systems that change the water quality and quantity response to land management (e.g. nutrient loss rates, spring dominance, reaeration, etc.).

Generally speaking, the attributes underpinning the classification are more important than the classification itself (e.g. REC) because the attributes can be re-analysed at an appropriate scale to align the management question of the time. So do what you like with a classification system - none of it is a 'must have' - except for: '**The attribute data underlying the typology is shared, accessible and updateable**'.

Department of Conservation

There are a range of existing typologies applied in freshwater conservation by DOC and partners, these include:

Lakes

- Freshwater Ecosystems of New Zealand – lake classification. Refer to FENZ User Guide Version One (envirolink.govt.nz). Typology (7 lake types) defined on a series of lake and catchment scale variables to discriminate variation in the natural and existing character of New Zealand's lakes.
- Geomorphic classification of lakes has also been applied by DOC (Aeolian, Glacial, Dune, Volcanic, etc) and in association with depth, temperature can provide valuable typology to represent differences in lake biodiversity and functioning.
- MfE classification of lakes in National Objectives Framework (under NPS-FM). Applied in catchment planning to define water quality targets for lakes. For example, refer to: NIWA Client report (environment.govt.nz)
- Simplified typology (shallow, deep, brackish) applied in defining reference conditions for NZ lakes. Refer to: Determining reference conditions for New Zealand lakes (doc.govt.nz)

Wetlands

- Freshwater Ecosystems of New Zealand – wetland classification. Refer to FENZ User Guide Version One (envirolink.govt.nz). Typology (9 wetland classes of palustrine wetlands: bog, fen, swamp, marsh, seepage, shallow water, ephemeral wetland, pakihi/gumland, and saltmarsh) as defined in Johnston Gerbeaux (2004).
- Terrestrial vegetation classification of wetlands (22 classes) and applied in ecosystem management prioritisation. Refer to Singers and Rogers (2014) https://www.doc.govt.nz/documents/science-and-technical/sfc325entire.pdf
- LCDB (multiple versions) provides a simplified wetland typology (limited representation of habitat diversity) but provides timeseries to enable assessment of changes in wetland extent.

Rivers

- Freshwater Ecosystems of New Zealand – river and stream classification. Refer to FENZ User Guide Version One (envirolink.govt.nz). The FWENZ river typology groups together river segments having similar environmental conditions, regardless of their geographical location. It was produced by combining environmental data contained in the river predictors layer with the two biological datasets – native freshwater fish and fresh-water macro-invertebrates. FWENZ segment types therefore reflect instream communities unlike the landscape-scale REC classification below.
- River Environment Classification (REC). Refer to: River Environment Classification | NIWA. REC2 or Digital River Network. NIWA and some councils (e.g. Northland) have used new DEMs and other data to derive DRNs (Digital River Networks) that are higher resolution and have very useful ephemeral, intermittent, and perennial typologies.

Note: none of the above typologies capture whole river or stream type i.e. they are attached to stream-river reaches-segments. This means, for example, that braided rivers aren't captured although there is a draft braided river feature developed by DOC analysts. Other whole of river/catchment typologies have also been developed; e.g. John Leathwick used FWENZ reaches within a watershed-catchment to classify source to sea water sheds nationally but not published other than use in Mohikinui River environment court and internal DOC use.

·Is an existing typology the agency's preferred choice for standardization? Or is an entirely new typology needed?

No single preferred choice with application depending on the management, science, RMA or other use.

National regulation (NOF etc.) struggles to set meaningful limits on contaminants or attributes without using some typology so some consistency and national coverage is needed.

Gaps also exist: For example approaches classification and mapping of springs, groundwater, karst and geothermal ecosystems.

·If building off an existing typology, what would be needed for it to meet the "must have" requirements of the Sept. 12 workshop?

A range of existing typologies are applied to freshwater ecosystem each with different strengths and weaknesses depending on the purpose of application. There may be some potential to integrate typologies in a combined, hierarchical geodata structure that preserves the underlying attributes of existing typologies to retain the ability for 'values' focused assessments (e.g. conservation planning), and 'driver' focused application (e.g. water quality target setting).

·Are there any ecosystem-specific "must haves" to be added to the Sept. 12 list?

Developing an integrated freshwater typology will need to consider the multiple applications for freshwater mapping across lake, wetland, river, groundwater and coastal (freshwater influenced) environments. The typology must take into account <u>both</u> physical/chemical/geomorphological characteristics (which relate to assessment of 'drivers') and biological (e.g. instream communities different typologies support) and Te Ao Māori characteristics (necessary for assessment of values).

Not sure of the 'transformed ecosystems' must have. Much prefer an ecosystem typology that includes ecosystem integrity/condition as a sub-element not as an attribute determining typology.

Appendix 4-- Wetlands discussion points[9]

- Differentiating among types of wetlands is challenging. MfE has had great difficulty trying to get nationally consistent mapping of wetlands.

- Wetlands have not been comprehensively and reliably mapped at the national level, although elements for mapping national coverage exist in two of our national databases: Waters of National Importance (WONI)[10], and the New Zealand Land Cover Database (LCDB)[11].

- There are synergies between the Singers and Rogers system and the WONI system.

- Singers and Rogers has 22 classes, but some wetland types are not captured by those classes. Things like red tussocks and some other habitats on poor draining soils are being missed from the Singers and Rogers classification. Also, it doesn't look at water regime as a primary attribute when it probably should for some wetland types, e.g., fens.

- The Freshwater Ecosystems of New Zealand (FENZ)[12] approach takes a more water-related view than Singers and Rodgers.[13] There are benefits to both.

- LCDB is used for research and other purposes, such as environmental reporting. It is much more simplified in terms of classification (focus on structural and vegetation composition), but it has a time series, which is very important.

- We are pushing the limits of what we can map regarding the extent of bogs and fens without putting a well-trained ecologist in the field.

- From an MFE perspective, it is always about national perspective so having the WONI database is a good start, but it isn't perfect in terms of mapping -- especially the delineation of bog and fen.

- Manaaki Whenua – Landcare Research is working on wetland classification, including looking at plant data to look at the variation, diversity or the similarity of different types of wetlands.

- Regional councils also use Singers and Rogers widely, but there is fairly widespread concern that it does not capture wetlands adequately. There is a desire for more information about the vegetation communities within different wetland types.

- Johnson and Gerbeaux wetland class for palustrine wetland primarily use hydrology and the pH to divide wetlands into bogs, swamps, marshes, fens. It includes a lower level

[9] "Discussion points" in this appendix are taken from the workshop transcripts. They are a synthesis and summary of participants' individual comments. They are not verbatim quotes. They represent personal, albeit expert, views and should be read as such.
[10] At wetland class level (bog, fen etc.)
[11] At vegetation structural class level.
[12] FENZ consists of a large set of spatial data layers and supporting information on New Zealand's rivers, lakes and wetlands. It contains data gathered from a wide variety of sources.
[13] Takes the upper part of the semi-hierarchical classification system from Johnson & Gerbeaux (hydrosystem and class), based on abiotic factors such as water regime and substrate.

classification with wetland landform, structural class and composition but these were not mapped in WONI as the information was not available (LCDB doesn’t provide sufficient information on wetland plant communities). But when we think about forests, the types are very much driven by the dominant plant communities in them. This means we have quite different approaches for different ecosystem types; it's complicated to compare them.

- There are some regions that may need their own bespoke mapping for example, dune lakes in Northland. Overall, there is a need to accommodate regional variety.

Johnson and Gerbeaux is the preferred choice for standardisation, but it doesn't mean to say that it is perfect. It needs to be improved and it needs cross referenced in detail against the universal requirements identified in Workshop 1.

Appendix 5-- River discussion points[14]

- Other river typologies include river styles and the River Natural Character Index.
- A lot of councils use REC because it is simpler from a hydrology point of view and the people doing the work don't necessarily have the science skills to understand FWENZ.
- The major challenge is getting a new cohesive Digital River Network that would then inform your typology.
- A major consideration is that the topologies we have are just reach typologies; they're not a whole mountains-to-sea approach.
- Rivers are actually quite long and thin and change over their course, or even change course entirely, so unlike a discrete wetland, lake or whatever, they actually occupy huge variety of environmental spaces and intersect with lakes and wetlands. There are some large rivers that are actually probably almost better managed as a wetland system.
- FWENZ has some good answers but needs a lot of tweaking. There is a big gap between the different levels -- 20 levels for the whole of New Zealand, the next level up is already at 100, then the next set is 1000. Having something that works better for classifications that sits between levels two and three is needed.
- Councils are very focused on catchment management and identifying the catchment management units because they are driven by the national direction. Councils need support from a classification that can align to catchments.
- To some degree, the current classification is constrained by the data gaps and the building blocks for the original models. If you ran the models again now, I think you would get a much better coverage. The other underlying data that drives these models is the predictors that are attached to a particular reach -- in stream slope, substrate, etc. There are a few new predictors out there and it would be worth looking again at them again, particularly with some of the new Digital River Network stuff.
- There is potential to reinvigorate something like FWENZ but with some reassessment of the underlying data that was used.
- DOC staff have unpublished work from an RMA case concerning the Mokihinui River that is a whole stream or a whole river approach and catchment focused.[15]
- But a large river like the Clutha will actually have several different rivers in it. A classification that broke up some of the large rivers into their component would be useful because they can be quite different along their course.

[14] "Discussion points" in this appendix are taken from the workshop transcripts. They are a synthesis and summary of participants' individual comments. They are not verbatim quotes. They represent personal, albeit expert, views and should be read as such.

[15] ENV-2010-CHC-115, 123, 124 AND 135, Statement of Evidence of John Leathwick, 14th May 2012, page 32.

- In terms of flooding, regional councils need a system that can consider not just the current flow path but the potential flow path…it is of real importance to councils.

We also need to know about habitats within rivers and streams, which are becoming more important for councils' work on threatened freshwater species, because they need to set targets and limits on those habitat types. We need a classification scheme that we can apply for that purpose.

Appendix 6-- Lakes discussion points[16]

- Dave Kelly (Cawthron) led the FWENZ lake classification, but it did not meet all needs. A topology report was commissioned from Tom Snelder, who was involved in the classification, to improve it.

- It is challenging to classify things that you don't even know the basics about. The major challenges around lake typology are lack of instream biodiversity information and physical data, such as maximum depth.

- We need a typology, but we also need this more basic stuff first.

- Compared to ecological aspects, geomorphic classification is relatively simple, but relevant for identification of Outstanding Water Bodies as required by NPS-FM. An integrated approach is required because elements of each have value.

- Mark Schallenberg has been identifying New Zealand great Lakes, including the deep lakes and those with large surface areas. It's quite subjective in definition but an interesting way of identifying the unique lakes in New Zealand's context.

- These ecosystems don't actually occur in isolation, what's the difference between a large wet wetland and a shallow vegetated lake? In reality they are probably very similar.
- University of Waikato is doing a lot of work on lakes. There may be some significant fresh information we are missing that could enable us to really drive lake classification.

- Regional councils need information to respond to national direction on lakes. They need to identify where to develop policy to counteract problems, where to start restoring ecosystems and how to prioritize management.

- Regional councils also are quite focused on climate change and these lake typologies need to be sensitive enough for them to record when ecosystems have shifted as a result of climate impacts.

- Think about applying the IUCN Red List for ecosystems approach, or a New Zealand variant, to a lakes typology to assess threat status.

- If we're going to have any meaningful national limits or even objectives for lake health, you need to hang it off some sort of typology. I'm a bit wary saying you don't need a typology because I think a lot of things meaningful things would hang off it. All the science panels are saying, we just can't set one generic level for nutrients because they vary by the type of lake.

- It's particularly important for lakes how you actually apply topology with regards to degradation status, for example whether a lake has lost its macrophyte community. It could be very valuable for conservation planning for that information to be available.

[16] "Discussion points" in this appendix are taken from the workshop transcripts. They are a synthesis and summary of participants' individual comments. They are not verbatim quotes. They represent personal, albeit expert, views and should be read as such.

There are limitations to the typology approach and there are caveats to that, especially when it comes to mātauranga and the Māori perspective; there is potential to oversimplify everything. A workshop to explore developing a lakes typology with all the players is a good idea in general.

Appendix 7-- Groundwater discussion points[17]

- From a policy perspective, ground water is perhaps not as urgent, but the there is a growing concern within the groundwater fraternity about stygofauna. Understanding the communities of stygofauna is becoming really important and there is some work being done on this by ESR and Graeme Fenwick of NIWA.

- There are not the same national policy drivers here as there are in rivers etc.

- There are groundwater dependent ecosystems, for example springs, which are groundwater dependent. In terms of urgency, unmapped features are disappearing, and we don't even know they have disappeared, but they are really important ecosystems.

- We also have river systems, lake systems and wetlands that are groundwater dependent, some more than others, and I think we need to know where those ones are.

- The only database available is their New Zealand Hydrogeological Systems. The understanding of groundwater ecosystem extent is very limited at the moment.

- How can we build into a wetland or lake typology attributes associated with groundwater dependency?

- NZ needs a dedicated program to understand the communities within groundwater ecosystems, because until we do that, we won't understand whether their classification should be driven by biotic or abiotic factors. Wetlands are primarily classified according to abiotic factors, whereas forests are biotically broken down into different forest types based on vegetation communities. But until we understand more about groundwater ecosystems, we can't decide how to create a classification system.

- Groundwater is the least developed of the freshwater systems, but urgent in a variety of ways. Research being done by GNS, ESR and NIWA should be coordinated, possibly as part of a national "triage system" to prioritize different ecosystem typologies based on urgency and readiness.

[17] "Discussion points" in this appendix are taken from the workshop transcripts. They are a synthesis and summary of participants' individual comments. They are not verbatim quotes. They represent personal, albeit expert, views and should be read as such.

Appendix 8-- Marine and Estuarine ecosystem-specific typology use information

Regional councils

Greater Wellington Regional Council

	Response
The typologies in use by your agency and how well they currently meet agency and council needs	Greater Wellington Regional Council (GWRC) has not really applied ecosystem typologies to marine systems until recently. We have simply mapped high biodiversity habitats and assessed them against NZ Coastal Policy Statement Policy 11 criteria. But now two years into a habitat mapping programme we have applied the Coastal Marine Ecosystem Classification Standard (CMECS) to the areas we have identified. This follows discussions with DOC and NIWA and broad agreement that CMECS is the best, most flexible standard to apply here.
Is an existing typology the agency's preferred choice for standardization? Or is an entirely new typology needed?	An existing typology such as CEMCS would be our preferred choice. It will still require refinement for NZ habitats and ecosystems, having been built for North American marine areas, but the framework is sound and would be more efficient that building a entirely new typology.

Auckland Council

For the more marine aspects of estuaries NIWA has done most of our mapping and used fairly consistent classification based on dominant species or substrate type. However, there is no one national classification for what is muddy sand versus sandy mud for example. Members of the coastal SIG have been sharing approaches to start addressing this. Mixed macroalgae on intertidal flats is also difficult to separate.

In the more subtidal **Marine** area we have been working with DOC to support their development of a national marine ecosystem classification using both numeric and thematic approaches. The thematic classification Coastal and Marine Ecological Classification Standard (CMECs) is most relevant for regional councils but currently the work DOC has done does not extend into the nearshore/estuarine area. Regional councils would be interested in extending this development but have been awaiting DOC to progress CMECs into a national discussion with working group. We are trialling CMECS with some ground truthing in the Hauraki Gulf at the moment which will be used as a case study by DOC.

Nelson City Council

	Response
The typologies in use by your agency and how well they currently meet agency and council needs	N/A- we do not have a standardised approach for marine mapping. We will be conducting a seabed mapping project with DOC this summer which will likely use CMECS.
Is an existing typology the agency's preferred choice for standardization? Or is an entirely new typology needed?	N/A

Ministry for the Environment

	Response
The typologies in use by your agency and how well they currently meet agency and council needs	Various classifications/typologies used for various purposes by MfE (often in joint projects, processes etc with MPI and DOC), including the Marine Environment Classification (MED; Snelder et al 2005). Benthic-Optimised Marine Environment Classification (BOMEC; Leathwick et al. 2012). Coastal and Marine Habitat and Ecosystem Classification (CMHEC; MFish and DOC 2008). DOC have recently commissioned Seafloor Community Classification (NIWA 2021). Those classifications are based on taxonomic records and taxa records and environmental predictor variables (e.g. slope, exposure). MEC/BOMEC are restricted to the EEZ I think, so makes it difficult to manage anything that straddles the TS limit. The SCC aims to be more unifying (e.g. covering form coastal to edge of the EEZ). They tend to be one-offs, and the lack of maintenance was an issue for the BOMEC, but hopefully the SCC will fare better in that regard as it's designed to be updated more easily.
Is an existing typology the agency's preferred choice for standardization? Or is an entirely new typology needed?	Different classification systems / typologies tend to be used for different purposes, so not sure one typology would be the preferred choice overall. Note advantages and disadvantages of NZ's marine and coastal classifications were reviewed recently in Rowden et al 2018 – see here - mpa-habitat-classification-review-2018.pdf (doc.govt.nz)

Department of Conservation

The typologies in use by their agency and how well they currently meet agency and council needs

1. Marine Environment Classification (MEC) (Snelder et al 2005)
    - Numerical classification using multivariate analysis based on eight physical variables, and "tuned" using biological data sets representing pelagic and benthic components of the biota
    - Doesn't apply well to shallow coastal habitats and classes do not define substrate or biological structural element
    - Not well understood or used within New Zealand's broader marine ecology community
    - Subsequent version used benthic information to create that Benthic-Optimised MEC (BOMEC). Not formally adopted, but performed better than the MEC.
    - Neither MEC nor BOMEC reflected patterns of biological diversity well (Bowden et al, 2011)
    - No maintenance mechanism, largely obsolete now
    - Used in a limited way for planning and reporting
    - Categorical, not hierarchical
    - Poorly validated

2. Seamount Classification (Rowden et al 2005)
    - Numerical classification based on a multivariate (group average hierarchical clustering) analysis of thirteen mostly physical surrogates
    - Only relates to seamounts so limited utility

3. NZ Seafloor Community Classification (Stephenson et al 2020)
    - Gradient Forest (GF) models used to produce a numerical classification of the seafloor environment and communities
    - 250 m grid resolution from the coastline to the edge of the Territorial Sea (12 NM from shore) and a 1 km grid resolution from the edge of the Territorial Sea to the edge of the Exclusive Economic Zone
    - Occurrence records for four biotic groups, demersal fish, benthic invertebrates, macroalgae and reef fish, used to inform the transformation of 33 gridded environmental variables to represent spatial patterns of taxa compositional turnover
    - Replaces the MEC, with process for maintenance developed
    - Large scale planning processes, limited application locally
    - Hierarchical i.e. groups are nested
    - Meets DOC needs for large scale planning and reporting, and defining biogeographic regions (potential input as a high level in a hierarchical typology)

4. NZ Marine Protected Areas Policy habitat classification (2007).
    - Five-level, multi-spatial scale thematic classification.
    - Based on physical surrogates of depth, substrate and exposure. Very limited biotic input.
    - Mostly used for planning and reporting of MPA representation
    - Doesn't capture patterns of biological features except in the broadest sense
    - Limited application at a local scale ~<1km

- Categorical, not hierarchical
- Poorly validated
- Does not meet DOC needs for marine reserve management due to absence of biological information

5. Reef habitats in northeastern New Zealand (Shears et al, 2004)
    - Based on qualitative biotic dominance, validated quantitatively
    - Not well tested beyond the NE
    - Categorical, not hierarchical
    - Various projects have used the classification as a starting point and added to or modified it e.g. Te Angiangi Marine Reserve mapping found some habitat types didn't fit well within the classes, so additional classes were added.
    - No formal process has been used to incorporate modifications into a broader classification, so has been on a case-by-case basis and 'lost' in reports
    - Only rocky reef habitats included

6. NZMHCS (Dohner)
    - Attempted to develop a more consistent approach based on the NZ MPA policy and Shears et al work
    - Builds biotic component into classification
    - Largely hierarchical
    - Used in several mapping projects
    - Has some issues and has never been formally adopted
    - Poorly developed soft substrate habitats
    - Doesn't meet DOC needs as not fully developed, but could provide input into new typology

7. Coastal Hydrosystem Classification (Hume et al., 2016)
    - Was designed to rationalise the existing, and inconsistently applied, New Zealand wetlands (Johnson and Gerbeaux 2004) and estuaries (Hume et al. 2007) typologies into a coherent, management applicable whole. Authors of the other two typologies (Hume and Gerbeaux) were part of the project team and authors of the combined typology.
    - Details 11 geomorphic classes and 21 subclasses that encompasses wetland, riverine, estuarine and marine types.
    - The classes are at a system level and have limited biological information but are designed to fit in a hierarchy above biological typologies. A six-level, multi-spatial scale thematic classification encompasses hydrology, geomorphology, tidal regime, structural class (e.g. vegetation, substrate) and composition (e.g. dominant biota).
    - It rationalises many different terms used to describe these coastal hydrosystems, often in conflicting or confusing ways.
    - Inconsistent spatial extents with some polygons, difficulty defining inshore and coastal extents of estuarine ecosystems.
    - Designed with input from central government and regional council practitioners

8. Sensitive marine benthic habitats defined (MacDiarmid, 2013)
    - Thirteen biogenic habitats were defined
    - Very specific habitats, some utility

9. *Interim Nearshore Marine Classification* (Walls, 2006)
    - grouped marine biogeographic units based on biological, geological and oceanographic information
    - Groups of organisms used to inform the classification included fish, molluscs, echinoderms, bryozoans, sponges, ascidians, antipatharians, foraminifera, brachiopods and algae
    - Divided the nearshore region (extending out to 12 nautical miles) into 8 biogeographic regions, with further divisions into smaller coastal and offshore island units (limited to 2 nautical miles) based on local expertise
    - Shelf units were also identified extending out to 200 m depth

10. Marine habitats for assessment of anthropogenic threats (MacDiarmid et al. 2012)
    - New Zealand habitat experts, via workshops and follow-ups, identified sixty-two distinct marine habitats occurring within New Zealand's territorial seas and EEZ. This was based on international work by Halpern et al (2007)
    - Habitats were defined by the type of benthic substrate or the dominant biological structural element, by depth and degree of exposure

11. Various regional council have developed maps and maybe typologies of estuaries in their regions. Local operations may use these typologies, but not nationally.

Is an existing typology the agency's preferred choice for standardization? Or is an entirely new typology needed?

DOC has been investigating the application of the US Coastal and Marine Environment Classification Standard (CMECS) [https://iocm.noaa.gov/standards/cmecs-home.html] as a basis for developing a national habitat classification for NZ. It would be DOCs preferred choice for standardisation but requires significant modification for NZ.

- Has hierarchical and categorical components (substrate and biotic are hierarchical)
- Spatially explicit framework to define habitats at a range of spatial scales
- Well tested in the US and has been adopted as a federal standard
- CMECS's architecture and underlying approach allow application to other parts of the world
- Highly flexible in how it is applied (includes a standard list of modifiers to increase the specificity and detail of resulting classification)
- Have 'cross-walked' two existing habitat mapping projects (Dohler based) into CMECS and maps well
- Video annotation tool is being developed
- Works across all habitat types i.e. reef, biogenic, soft substrate, pelagic
- Recent versions of CMECS have incorporated a temporal framework to capture predictable temporal variability in environmental parameters (as a Spatial-Temporal Framework for CMECS Components)

If building off an existing typology, what would be needed for it to meet the "must have" requirements of the Sept. 12 workshop?

1. **Hierarchical structure**
    - Already built in

2. **Spatially**
    - CMECS is not defined to a particular spatial scale, as it is essentially a naming convention. In order for it to be used as a national standard as a typology, confirmation of the mapping unit will need to be addressed.

3. Reflects **NZ ecological diversity** and processes
    - Currently the lower levels of classification have not been defined for NZ (i.e. the biotic community level). Projects are underway to start classifying deeper reef habitats, and some work has started in shallow reef habitats
    - For each biotic group under CMECS, biotic communities will need to be developed specifically for NZ ecosystems (e.g. deep reef, shallow reef, soft substrate habitats etc). For well-studied ecosystems these communities can be cross-walked over to CMECS. For less well studied ecosystems, this will require expert input and validation.

4. **Relatable**
    - CMECS comes with a 'crosswalk' tool. DOC has cross-walked 2 existing habitat mapping projects (using the Dohner classification) to CMECS, and they relate well.

5. Accommodates **transformed ecosystems**
    - Doesn't explicitly do this as part of the main classification, but modifiers are used to capture this and can be further developed to capture this information

6. **Utility**
    - CMECS is complex as a standard (300 page manual), but individual projects, or the development of a national typology doesn't need to be that complex. Components of particular importance can be introduced as a required part of the typology, allowing project specific features to be included as relevant.
    - It can be as simple as needed, but retains the flexibility to incorporate more complexity if needed.

7. Takes account of **Te Ao Māori**
    - Not currently, but there are several ways in which it could be incorporated.
    - Would require expert input in designing an appropriate way to incorporate Te Ao Māori, including data sovereignty etc.

8. Consistent use of **species concepts** that are updated as needed.

9. **Updateable** as new information becomes available. (added by Agency Leads on the day and not scored with the others).
    - A framework to allow new biotic communities to be included in the typology would need to be established. This is how CMECS is maintained in the US

Are there any ecosystem-specific "must haves" to be added to the Sept. 12 list?

- Ability to capture habitat quality of ecosystem
- Ability to quantify uncertainty

Appendix 9-- Marine discussion points[18]

- There have been many different typologies or classifications in the past. The first one was the MEC, which is a numerical classification, but it hasn't really been used that much and it's subsequently being replaced, at least for DOC, by the New Zealand Seafloor Community classification.

- DOC has been doing quite a bit of work over the last few years to try and standardize the marine typologies it uses. A NIWA report compares what has been used in the past, to what is used overseas.

- Probably 90% of that CMECS classification is relevant to New Zealand, but when you get down to the biotic groups, that's where we really need some additional input.

- CMECS is quite comprehensive, and it can pretty much take account of most things that you probably need in a thematic classification.

- Does CMECS extend to the beaches? Concern that sandy shores or rocky shores will drop through the cracks.

- Petty sure it does cover dune systems and things like that. That's one of the other things about CMECS, it's much better at capturing soft substrate environments as well, whereas all of the other classifications are pretty much devoid of soft sediment habitats.

- Potentially we could get a seamless classification abutting the active shore dunes. One of the challenges is how we deal with the estuaries and those ecotones between domains where classification systems sometimes break down a little bit.

- Hard to know at the moment, but it's quite flexible and there's no reason we can't develop it further if we need to.

- As an example, the CMECS does include things like estuarine shrublands and estuarine forests, so it does extend quite a bit into the estuarine marine terrestrial interface. No reason why we couldn't modify it so that if you had a terrestrial classification, it would butt up to the marine estuarine one.

- MfE has used many of the same classifications as DOC and keeping them updated has always been a problem. Any new typology needs to be designed to be easily updatable if it is to be of any use.

- Important to make sure any typology can be used by lay people. If you want to use it in a public participatory process, for example Marine Protected Areas, you'd want people to be able to understand your classification.

[18] "Discussion points" in this appendix are taken from the workshop transcripts. They are a synthesis and summary of participants' individual comments. They are not verbatim quotes. They represent personal, albeit expert, views and should be read as such.

- We work quite closely with the Marine Science Advisory Group, so I think we're pretty well aligned in terms of the marine classification work.

- I'm not sure about pushing for one preferred classification system for marine environments because I'd rather have the flexibility of being able to choose what works for the particular purpose. Needs could be quite varied and therefore the typology you need and the way you want to carve up the environment to answer those science questions would be similarly varied.

- A counter view is that you need to agree on a typology before we can actually talk about potential uses like planning, monitoring, reporting, evaluation, etc. There are multiple reasons why we want typologies and consistent thinking in New Zealand for many applications -- it's not driven by a specific question from a science perspective, it's a tool that people use to, manage, plan and prioritise more generally.

- CMECS is really a naming convention, it's about making sure that when we go out and map habitats, we are calling them the same thing. We don't do that in a consistent way at the moment so we can't compare apples with apples as we map the country and the marine habitats and estuarine habitats. We don't know how much we've got of certain things because we're not calling them the same. I can't imagine a situation when all agencies would not want something like this to help them understand the extent and changing extent of certain habitats.

- Let's get a scope of the range of modules we'd need to develop for CMECS to cover the entire New Zealand EZ, as well as address the other things we mentioned like how it interfaces at the terrestrial zone along the inshore habitats.

- I think it would be fair to say that for most of the marine community, the priority would be refining the biotic component of CMECS and listing the habitat types, then prioritizing them and just stepping through them. As a marine collective, we just haven't had the resources or the funding to do that.

- This is a great opportunity to look to MfE to fund that strategic program of work, with the various refinements being led by different agencies.

Appendix 10-- Estuarine discussion points[19]

- I see no reason not to use CMECS for estuaries; it's totally applicable and it would be a shame to separate estuaries out.

- If you can crosswalk from established estuarine habitat types over to CMECS, then I don't see a problem. I think most regional councils will be in the same boat.

- Several regions have had Salt Ecology apply the broad scale estuarine habitat and substrate types or typologies, so we'll all have the same quite coarse information. We've used the Hume Hydrosystem classification as well and I see no reason why all of those can't be incorporated into CMECS.

- My preference would be to not have a separate typology from all other marine habitats and ecosystems and rather bundle up the estuaries into this one.

- CMECS came out of a series of reports and workshops that various people contributed to, and there's a series of technical reports backing up selection for use in Auckland. I think similar to other councils we've done a lot of broad scale mapping.

- When it we get into the kind of more salty part for where we're mapping wetland and coastal vegetation, we overlap with our terrestrial ecologists and Singers and Rogers have been used in the detailed classification.

- Would adopting CMECS for estuarine monitoring require a finer scale level of detail with the mapping in future?

- It's not the typology or the classification that sets the level of detail, it's what you need to use the information for.

- CMECS is quite flexible as to what level in the hierarchy you need to go to. It includes things like modifiers so if there's something specific that sits outside the actual CMEC system itself, you can still add and modify and capture what you need.

- So CMECS is a chance to do new stuff, but is it worth changing what we're doing, which is simple for the estuaries?

- I don't think it's a case of changing what you've done, particularly at the level at which we've all mapped, which is seagrass and saltmarsh and things.

- What CMECS provides is the ability that if you are going into more detail, we start doing that in the same way. I don't think it would cost anything to change our estuary monitoring or mapping as we currently do to use CMECS.

[19] "Discussion points" in this appendix are taken from the workshop transcripts. They are a synthesis and summary of participants' individual comments. They are not verbatim quotes. They represent personal, albeit expert, views and should be read as such.

- I am in favour of trying to integrate into CMECS, especially if we're using CMECS for marine that makes sense to try and do the same for estuaries and try to be consistent across both bodies of water.

- Will CMECS deal with novel ecosystems and naturally uncommon ecosystems? Can it map ecosystems which are particularly restricted and not widespread? Regional councils are going through a process with Landcare, reviewing the naturally uncommon ecosystems and trying to map some. Is there a need to do a similar piece of work in the marine space to identify those ecosystems that we're really just don't want to lose?

- I'd say yes, CMECS could handle it, but is it a priority?

- I think it's a priority, we've identified it in our long list for next year for research topics. Naturally, rare and uncommon systems need to be identified within the marine space

- In terms of in terms of novel ecosystems, I'm not aware of anyone that's particularly looking at that in the marine space.

- For CMECS, I assume you might have some sort of committee which manages proposed changes so that so if new habitats are identified or defined, then they could be added to the classification.

- Yes, the US system is based on probably two decades of scientists getting together to define what suits them and in the vast majority of cases that would be applicable to New Zealand, but there might be some cases where we need something else. As long as there's a process for doing that in a sensible way, then that should be all good.

- Is DOC already working and planning for what needs to be done to make it useful for New Zealand?

- We've been looking at it for the last two years and it looks good. We can draw on a lot of existing literature to start forming these biotic communities, but some areas we just don't have enough information and we're going to be starting from scratch. That's what we need to look at and prioritize.

- My overarching comment would be that the most important thing is to pick one and resource it and stick with it and have a process for ensuring it is used nationally and consistently. The longer we wait the more people have to do their own thing and we get more disparity.

- I think pull a working group together and including NIWA and some other key people who work in this space and start developing a program of work.

- Imagine CMECS is just a big tree with all these roots going down into the ground and the further down you go, the more detailed it gets, but right back up at the surface, you can have

freshwater or terrestrial. You can have any number of domains and you just plug them in or clip them on.

- This is often considered the most difficult of the domains to work in, but we've actually got something that we can push forward with.

Appendix 11 – Terrestrial ecosystem-specific typology use information

Regional Councils

The main typologies the regional sector uses, include:

- Landcover Database – for widespread ecosystems, typology is coarse and lacks subtlety to capture situations where the indigenous dominance is depleted
- Singers and Rogers 1994 – for widespread terrestrial ecosystems, mostly used for forests, has been refined over time (so there are issues with consistency across councils) and doesn't work well for restricted ecosystems
- Williams et al. 2007 – for restricted ecosystems, a.k.a. rare and naturally uncommon ecosystems, this is being reviewed through the current contract with MWLR and there's scope to expand
- Johnson & Gerbeaux 2004 – for wetland types, currently being reviewed by Olivia Burge from MWLR
- The general feeling from regional councils is that we'd like a hierarchical scheme that incorporates these existing typologies if possible.
- The key things are to (1) get a national typology that (2) can distinguish indigenous from exotic ecosystems and (3) incorporates widespread and restricted ecosystems. (4) accommodate transformed ecosystems, recognising that many ecosystems are now modified states such as working indigenous landscapes.

The key things are to (1) get a national typology that (2) can distinguish indigenous from exotic ecosystems and (3) incorporates widespread and restricted ecosystems.

Please note that of the four typologies and with emphasis on the three that are function-based (Gerbeaux and Johnson 2004; Williams et al. 2007; Singers and Rogers 2014) could easily fit into something like the IUCN typology as its also function based, with incorporation either at another level below the current hierarchy or by including as subtypes (it should not be too hard for this to happen).

Preference would be to work towards something like the IUCN typology while keeping the elements of those local government have statutory obligations to report on, i.e., Williams et al. 2007. Many of the ecosystems in Gerbeaux and Johnson and Singers and Rogers also would fit easily into the IUCN typology, and actually also fit into other typologies that other agencies have used.

Of all the typologies currently in use in Aotearoa and by the regional sector, the one that works best is the Williams et al. 2007 on naturally uncommon ecosystems – note, however, this is not definitive for these types of ecosystems so is still incomplete. It also has to be reminded around the definition that this is only for rare, i.e., <0.5% of the land area, before humans arrived in Aotearoa. This is why the IUCN can complement it nicely, as covers those ones relatively easily. The other benefit of the IUCN is that this is what the NZ Government agreed to in Montreal last year.

The LCDB is also useful for regional councils to assess change in landuse over time, but that's slightly different as that's not function based and can be incorporated or addressed in other ways. The way to integrate that is slightly different, but a cross-over table to translate the information could easily facilitate this. Moreover, the LCDB is often coarser for indigenous (or transformed) ecosystems so allows for this translation from the more function-based ecosystem typology as in the IUCN typology.

The main typologies the regional sector uses, include:

- Landcover Database – for widespread ecosystems, typology is coarse and lacks subtlety to capture situations where the indigenous dominance is depleted
- Singers and Rogers – for widespread terrestrial ecosystems, mostly used for forests, has been refined over time (so there are issues with consistency across councils) and doesn't work well for restricted ecosystems.
- *Singers and Rogers 2014 – link found here. A primary division in this typology is the distinction between zonal and azonal ecosystems.*
- *One issue for the mapping of restricted ecosystems by councils with Singers and Rogers so far is that definitions for many of them were not operationalised, so most struggled to capture them plus because LCDB was heavily relied upon. Singers and Rogers for the restricted ecosystems did often lean upon the work by Williams et al. 2007 (they often just used different words). These definitions are being worked on in the contract below, which Roger mentions.*

- Williams et al. 2007 – for restricted ecosystems, a.k.a. rare and naturally uncommon ecosystems, this is being reviewed through the current contract with MWLR and there's scope to expand
- *The link to this paper is found here. Useful accompanying documents are this book chapter found here . Many of these ecosystem types occur in azonal environments that lack trees despite often being below regional treelines. Many of the wetland category (as there are six categories in total) of naturally uncommon ecosystems are identified in Johnson and Gerbeaux – see below.*

- Johnson & Gerbeaux 2004 – for wetland types, currently being reviewed by Olivia Burge from MWLR. *The book can be found here. Table 1 on page 15 is a useful overview for this semi-hierarchical classification.*
-
- *Singers and Rogers 1994, Williams et al. 2007 and Johnson & Gerbeaux 2004 have considerable similarity being function-based typologies. In other words, the ecosystems identified are not mutually exclusive and are often found in each of the typologies. If a hierarchical scheme was adopted similar to the IUCN function-based one, they would likely easily slot in or would fall as a subtype of the ones that are listed.*
-
- *The Landcover Database (LCDB) is slightly different as a classification. I do think that the above typologies could fit back into LCDB as it's a coarser-type of classification than, e.g., Williams et al., Johnson & Gerbeaux.*

Auckland Council

We use Singers and Rogers to classify both the potential extent of terrestrial ecosystems and we have also used it to map our current extent. We worked with Nick Singers to amend some of the descriptions for Auckland, adding variants to some of the categories to better align with what we see. This culminated in the development of a published guide for Auckland's ecosystems: https://knowledgeauckland.org.nz/media/1399/indigenous-terrestrial-and-wetland-ecosystems-of-auckland-web-print-mar-2017.pdf

We have been using this system since 2015 and have used it primarily to map vegetation and identify Significant Ecological Areas for the Unitary Plan. More recently we have used it to assist with ecosystem prioritisation and management.

Singers and Rogers has been adopted as the primary ecosystem classification system by most of the ecological consultants across the region, used primarily for ecological impact assessments and to assist with consenting.

In collaboration with mana whenua we have also (as of yesterday), published a restoration guide for the region (Te Haumanu Taiao), using Singers and Rogers as the technical tool to determine restoration
objectives https://www.tiakitamakimakaurau.nz/media/dj5mav0c/tehaumanutaiao_a4p_web.pdf

Nelson City Council

Many and varied with little consistency.

Comment is that existing knowledge holders should be included to pull together a complete typology. Should not be built from scratch. Also how does is mesh with IRIS Next Generation (below) who are working to include a species list database.

Would be great if typology included Latin name, common names and te reo names that are relevant to location

Be aware that RSHL and the member councils will replace the IRIS software platform via IRIS NextGen within the next 2-4 years. IRIS Next Generation (IRIS NextGen) will be a cloud-based Software as a Service solution (SaaS) based on the Datacom Datascape platform. Might be relevant to LCDB.

See IRIS https://rshl.co.nz/

Ministry for the Environment

1. **The typologies in use by your agency and how well they currently meet agency and council needs?**
   - The only terrestrial ecosystem-based typology used is the naturally rare and uncommon ecosystem classification. While a useful contribution, this does not adequately meet the current or future needs of the organisation. Other broad-scale classifications are used such as land cover classes from LCDB, LENZ, and the land use map produced by the Carbon Sequestration team, however none of these are a substitute for an ecosystem typology.

2. **Is an existing typology the agency's preferred choice for standardization? Or is an entirely new typology needed?**

   - Amendments to an existing typology, so that it meets the needs of all stakeholders, is our preference.

Department of Conservation

Response	
The typologies in use by your agency and how well they currently meet agency and council needs	<u>Singers and Rogers 2014 (pre-publication version)</u> Does not meet DOC's needs well. Issues include: • variable specificity/generality of types; • many-to-many matches to other typologies (e.g. Williams et al); • high judgement / low transparency in allocation of sites to types; • poor congruence to plot-level quantitative data • low ability to update or expand type maps; no national coverage <u>Williams et al 2007 (internally revised version):</u> Meets DOC needs adequately for one work area. Issues include: • variable specificity/generality of types; • many-to-many matches to other typologies (e.g. Singers and Rogers) <u>Wiser et al 2007 and 2016</u> Meets DOC needs adequately for one work area. Issues include: • low specificity for non-forest types • low ability to expand type maps outside plots; no national coverage • high temporal/site specificity creating poor congruence to existing national maps Newsome et al (1987) Does not meet DOC's needs well. Issues include: • low specificity • dated / some areas have low accuracy • low ability to update or expand Nicholls (NZFS map series) Does not meet DOC's needs well. Issues include: • low specificity • dated / some areas have low accuracy • low ability to update or expand LCDB (2018) Meets DOC needs adequately for one work area. Issues include: • low specificity
Is an existing typology the agency's preferred choice for standardization? Or is an entirely new typology needed?	An entirely new typology is needed

Appendix 12-- Terrestrial ecosystems discussion points[20]

- None of the things DOC uses are wholly adequate. I believe that we need something new which starts again.

- The first attribute is the hierarchical structure, if we can move up and down different levels of specificity for different applications, but do that within one framework, I think there can be one that meets all needs.

- It does need to be able to be mapped, but the main thing is the hierarchical aspects of it.

- The important consideration here is – Are the building blocks needed for a typology even available? Could we proceed? Those things need to be on the table, which will guide what we can do.

- I think the "out of date, variable accuracy" problem would not be a worry if we didn't have the problem that existing methodologies are not easy to replicate, update, or expand. We would not particularly back one above all the others, my feeling is we need something new.

- We've been having similar discussions with freshwater and marine, and the idea is to have a single topology which covers all three physical domains, so there would have to be some sort of topology which started at that level, which is higher than anything that we currently have.

- Agree a different approach is needed, but you still need to be able to compare across typologies that have been used before.

- A lot of these typologies, like LCDB, whilst useful, they're not all ecosystem typologies, they're just typologies for classifying the environment. I wouldn't consider LCDB to be an ecosystem typology, it's not classifying ecosystems.

- LCDB does separate different types of grassland, different types of woody vegetation, so it is at a coarse level ecosystem classification.

- As far as I'm aware, the only typology that MfE uses is the naturally rare and uncommon ecosystem classification for environmental reporting, but this does not adequately meet current and future needs as it's quite limited in scope.

- MfE would also use the Wiser et al classification for reporting back on carbon by forest type.

- I think in some ways we are moving towards LCDB, but neither of them is ideal.

[20] "Discussion points" in this report are taken from the workshop transcripts. They are a synthesis and summary of participants' individual comments. They are not verbatim quotes. They represent a distillation of personal, albeit expert, views and should be read as such.

- For Auckland, Singers and Rogers, as much as it's imperfect, is a great improvement on what we've previously had and a basis that we can use for identifying threats and conservation objectives for ecosystems and the region.

- Potential current extent is a really key part of our prioritization for ecosystem types, e.g., alluvial forests where there's less than 2% of their historic remaining. That has a big impact on our management decisions and which projects we prioritize.

- The ideal would be to have something like the IUCN Red List for ecosystems that we could apply to what we map to understand the threat statuses of various ecosystems. Not just at a regional scale, which is what a number of us have done now based on Singers and Rogers, but at a national scale, so we can understand which ecosystems might be rare in our regions, but might be well represented elsewhere and may not be the highest conservation priority nationally. That's really important, particularly for the national policy statement and indigenous biodiversity, which is asking local government to restore ecosystems. So where do we start? We need prioritisation.

- The NPSIB needs significant areas to be remapped. I envision it being an incremental process with a big push to update regional mapping for the unitary plan.

- We know that almost all of regional councils have mapped using Singers and Rogers, except for Canterbury and West Coast, so that seems like quite a useful, cost-effective starting point.

- We recognise that Singers and Rogers isn't perfect, and it doesn't capture everything, but we've got a lot of investment in it already so a key part of practicality will be affordability.

- It's easy to worry about sunk costs, but I'm hoping that we're creating something that will set us up for decades to come, so it's better to get it right and get a system that we can all use and works in a hierarchical fashion or all the multiple purposes that we've identified.

- DOC funded the original Singers and Rogers classification, but I see the department moving to something else, whether or not there's a new classification. So, I don't think that sunk cost needs to be an important consideration.

- It's a good opportunity to revisit and think about what we're trying to achieve here.

- We basically use Singers and Rogers and then LCDB to try and figure out what should be there and what is there. Those two are probably the most useful for us at the moment.

- We have used Singers and Rogers as well. One thing that we have found is that it talks about what we think the vegetation was like prior to 1840 when there was widespread clearance. But what it doesn't provide is a way to describe a novel ecosystem that has evolved since then or our mixed urban and exotic indigenous ecosystems, which are now ecosystems in their own right.

- Bay of Plenty has done quite a lot of detailed vegetation mapping over different ecosystem types. Some very detailed, in fact too detailed, too many different types. We need something

that's a bit higher level, one example being geothermal vegetation. I know that Landcare also did a classification that's never actually been applied on the ground.

- I think having something that's hierarchical should be able to cover what you're getting around with the detail issue because it would have the scalability across the different biomes.

- Something for MfE to think about as an intermediate step in this project would be develop some geospatial data standards, i.e., between developing a typology and actually going out and mapping it, setting rules about how the mapping is going to be done. That would allow regional councils or DOC to go and do additional mapping when and where they need it.

- A NEMS, a national environmental monitoring standard, for geospatial data standards would be useful.

- One way to tackle that might be to think about having a more data-driven first cut at mapping and then a staged field validation or ground truthing step. That way the standard might apply to the ground truthing, but the first cut mapping might be something that is possible to do in a one-step national process.

- From DOC's perspective, we do some regular reporting using the LENZ classification just to address big picture indicator of whether the range of ecosystem types in New Zealand is adequately legally protected and under indigenous cover. I think it's OK for that purpose. But when we've tried to use it for finer scale tasks for instance like stratifying and monitoring design across the central North Island, it's not been accurate enough to be useful at that scale.

- In the pest management area, we've been using the LENZ classification for determining predictive distribution of some invasive species like Wallabies, we've been using that to classify and predict how far they would spread outside of their containment zone etc.

- MfE has been looking at it recently in the absence of there being an agreed ecosystem typology that we would potentially use in its place.

- LENZ can be a little bit dangerous sometimes. We've had district councils using LENZ for formulating some of their district plans around vegetation clearance, but when we go and look on the ground, we find that the vegetation communities or the ecosystem types are actually incredibly rare and should have greater protection than the LENZ system would give them.

- I think if we're starting from scratch with something brand new that captures the best of everything, LENZ has aspects to contribute.

- I agree it would be worthwhile revisiting if there were an updated approach to the basic information which went into LENZ, noting that the landscape has changed and that some of those datasets have been updated or refined since it was developed.

- There are two sets of maps that we need to develop, or at least regional councils would like to see. One is the historical distribution over which we predict vegetation types or ecosystems occurred. Then there's the current distribution of ecosystems. The important thing here for us is being able to map the extent of indigenous ecosystems that are remaining because we want this typology to ultimately drive conservation of indigenous biodiversity. That's a primary use for production landscapes.

- We shouldn't be thinking so much about words like “historical” or “potential” in these contexts. We should be looking at things like the present natural because we can't assume that we're going to be restoring to a certain baseline.

- It would be useful for us to get descriptions of the variables that underpin a particular ecosystem type, whether it's abiotic or biotic drivers. Not just to get a classification scheme with a bunch of names, but something that we can then go away and apply, particularly at the finer scale levels. So the product should be more than just a classification scheme or hierarchy, there should be descriptors with it.

- Definitely agree that you want not just the typology, but also a description of the process, then the data which we used to develop it, and ideally access to those things. Those are the building blocks for the maintenance, updatability, repeatability issues that seem really important for this project.