Scottish Government
Riaghaltas na h-Alba
gov.scot

A Quality Management Review of Scotland's Sectoral Marine Plan for Tidal Energy

Scottish Marine and Freshwater Science Vol 7 No 18

S J Sangiuliano

marinescotland

A Quality Management Review of Scotland's Sectoral Marine Plan for Tidal Energy

Scottish Marine and Freshwater Science Vol 7 No 18

Stephen J Sangiuliano

Published by Marine Scotland Science

ISSN: 2043-772

DOI: 10.7489/1795-1

Marine Scotland is the directorate of the Scottish Government responsible for the integrated management of Scotland's seas. Marine Scotland Science (formerly Fisheries Research Services) provides expert scientific and technical advice on marine and fisheries issues. Scottish Marine and Freshwater Science is a series of reports that publishes results of research and monitoring carried out by Marine Scotland Science. It also publishes the results of marine and freshwater scientific work that has been carried out for Marine Scotland under external commission. These reports are not subject to formal external peer-review.

This report presents the results of marine and freshwater scientific work carried out by Marine Scotland Science. This report is in partial fulfillment of the requirements for a Master of Environmental Studies (Planning) degree at the Faculty of Environmental Studies, York University, Toronto, Canada for Stephen J Sangiuliano. The work was supervised by Dr Ian M Davies (Marine Scotland Science).

A Quality Management Review of Scotland's Sectoral Marine Plan for Tidal Energy

Stephen J Sangiuliano

*Marine Scotland Science, Marine Laboratory
375 Victoria Road, AB11 9DB

**Faculty of Environmental Studies, York University
4700 Keele St, Toronto, ON M3J 1P3, Canada

Dr. Ian M Davies (Marine Scotland Science)

Abstract

As coastal communities continue to increase in geographical size and population, associated marine economies will have to expand in unison. This relationship gives rise to an increase in user – user and user – environment conflicts, as users of the marine environment proliferate in size, number, and intensity. Such conflicts demand the implementation in marine spatial planning (MSP) in order to effectively manage various users and uses taking place within the marine environment. Furthermore, negative implications arising from global climate change increasingly threaten the integrity of ecosystem services within the marine environment, thereby effecting natural marine ecosystem functions and the economies of coastal communities relying upon such ecosystem services. Such a dilemma has increased political support for the adoption of commercial-scale offshore renewable energy implementation in order to assist in the global energy transition away from a carbon-based economy. These drivers have triggered Scotland to construct and implement the world's first sectoral marine plan for tidal energy (SMPTE) in an effort to streamline the licensing and permitting processes of tidal current turbines (TCTs), subsequently facilitating the commercial-deployment of TCTs within a structured governance framework. This paper undertakes a quality management review of Scotland's SMPTE against guidelines set out in the International Council for Exploration of the Sea's *Marine Spatial Planning Quality Management System* (ICES MSP QMS). Conformity of the SMPTE to criterion set out in the ICES MSP QMS document pertaining to the establishment of external and internal contexts, and risk identification, analysis, evaluation, and treatment, and monitoring and review are ranked and gaps in quality management are analyzed in order to construct recommendations for areas for further improvement.

1. Introduction

Historically, the seas adjoining coastal nations have acted as a resource conduit to assist in the proliferation of the development and expansion of city states and nations, as can be seen by some of the world's largest empires such as Greece, Rome, England, and France. The value that the seas provide to human settlements remains a theme in modern societies, with 44% of the global population living within 150 km of the coast (UN Atlas of the Oceans, 2010). This trend is projected to rise further in years to come due to ongoing rural-urban migration to megacities that currently host 2.5 million inhabitants within the 150 km coastal buffer zone. However, while traditional coastal activities such as fishing, shipping, dredging, mineral extraction, and tourism have proved to be an economic stronghold for coastal communities (Douvere & Ehler, 2009), the proliferation of coastal populations, in conjunction with the estimated 382 existing and emerging uses of the marine environment (Lester, Costello, Halpern, Gaines, White, & Barth, 2013) have acted in a synergistic manner to compromise the ecosystem integrity of marine environments over the last half century at a pace greater than any other in human history (World Resource Institute, 2005). This dilemma is further exacerbated by the rapid warming of the Earth's climate due to the excessive combustion of fossil fuels for the purpose energy provision. The combination of such regional user conflicts and global ecosystem stressors have lead to scientific analysis suggesting that no portion of the Earth's oceans have escaped the influence of anthropogenic activities (Halpern, Walbridge, Selkoe, Kappel, Micheli, D'Agrosa, Bruno, Casey, Ebert, Fox, Fujita, Heinemann, Lenihan, Madin, Perry, Selig, Spalding, Steneck, Watson, 2008)

Such user – user conflicts (interactions amongst various users of the marine environment) and user – environment conflicts (interactions between various users of the marine environment with natural ecosystem properties) (Douvere, 2008) arising from the proliferation of marine activities in size, number, and intensity demand the application of marine spatial planning (MSP) as a means to effectively manage the environmental, ecological, economic, and social implications associated with their usage across time and space (Foley, Halpern, Micheli, Armsby, Caldwell, Crain, Prahler, Rohr, Sivas, Beck, Carr, Crowder, Duffy, Hacker, McLeod, Palumbi, Peterson, Regan, Ruckelshaus, Sandifer, & Steneck, 2010). Congruently, such negative implications arising from global climate change have prompted a shift in local, regional, provincial, national, continental, and international government policy and legislation towards the implementation of greenhouse gas (GHG) free renewable energy. These two prerogatives become ever the more intimately intertwined when examining the notion of tidal current energy development and implementation, as such renewable energy technology essentially becomes another player in the usage

of finite and already stressed marine space.

Anticipating such conflicts in marine spatial usage, Scotland has become the first and only nation to draft a sectoral marine plan for tidal energy (SMPTE) with the intent of promoting the sustainable deployment of tidal current turbines (TCTs). The SMPTE takes into consideration areas characterized by strong tidal energy resources and the potential environmental, ecological, economic, and social constraints associated with developing such areas, ultimately resulting in the identification of ten commercial scale tidal energy sites. However, TCT deployment currently resides in the pre-commercial stage (Myers, Keogh, & Bahaj, 2011), and, therefore, while many scholars have advocated the deployment of TCTs based on their suggested environmentally benign operational nature (Pelc & Fujita, 2002), favorable long term economics (Fraenkel, 2006), and ideal location of implementation on the seabed reducing public resistance generated from visual and/or audio pollution (Fraenkel, 2002), tidal current energy has not yet been extracted on a large commercial scale and thus such effects can not yet be confirmed. Since the underlining function of MSP is to allocate portions of the three-dimensional marine space to specified uses in order to achieve environmental, ecological, economic, and social goals on a temporal continuum and in an adaptive capacity (Ehler & Douvere, 2006), the shear infancy of a SMPTE must employ effective quality management protocols adopted from best practice guidelines in order to avoid adverse implications on a complex and sensitive marine environment and associated economy.

This paper undertakes a quality management review of Scotland's SMPTE against guidelines set out in the most recent MSP quality assurance document published, the International Council for Exploration of the Sea's (ICES) *Marine Spatial Planning Quality Management System* (Cormier, Kannen, Elliott, & Hall, 2015). Consistencies between the SMPTE and the ICES criterion are identified and gaps in quality management are analyzed in order to recommend areas for further improvement.

2. Tidal Energy and the Scottish Context

TCTs operate analogous to wind turbines via extracting the kinetic energy from the lateral movements of tidal currents and converting the resulting mechanical energy into electricity (O'Rourke, Boyle, & Reynolds, 2010). Because water is approximately 800 times denser than air, TCTs can produce more output energy than wind turbines for equal areas swept by the rotors (Kerr, 2007). Other advantageous aspects of TCTs are their inherent reliability and predictability resulting from the use of tidal movements as energy source, as tidal physics operate

on the unyielding principals of gravity enacted upon the Earth by the moon and sun, thereby resulting in flood, ebb, and slack tides occurring within 24 hour, 48 minute lunar days subsumed within 29.5 day lunar months (Tarbotton & Larson, 2006). These principles allow nations with tidal current resource potential, where mean spring tides have a flow velocity of 2m/s or more (Fraenkel, 2006), to model the output of electricity to a power grid decades in advance, thereby easily accommodating energy storage and overcoming intermittency issues that hinder the ability of most renewable energy technologies to provide base load power.

Scotland's national waters possess substantial tidal current resources, estimated at 32TWh/yr (Crown Estate, 2012), 25% of Europe's tidal energy resource (Marine Scotland, 2014). Subsequently, Scottish waters, industries, and government have assumed a leading role in the development of tidal energy over the broad spectrum of research, design, policy, and regulation. Scottish waters have hosted four key stages along the timeline of tidal energy development. The first recorded attempt at harnessing energy from tidal currents took place in the early 1990s at Loch Linnhe, in the Western Scottish Highlands (Esteban & Leary, 2012). Although progress has continued since then, most research and development (R&D) has been focused on emulating sea conditions in test tanks, downscaled real sea prototype testing, and individual commercial scale testing. Much of this R&D has taken place at specifically tailored marine energy test centers, the first and largest of which is the European Marine Energy Centre (EMEC), located in the Orkney Islands, north Scotland, which has been operational since May of 2005 and hosts eight grid connected berths for TCTs (EMEC, 2016).

While commercial scale deployment of TCTs has yet to be realized (Johnson, Kerr, & Side, 2012), Scotland is taking another industry-leading step with the first phase of the MeyGen project, located in the Pentland Firth, being scheduled for implementation this summer, 2016 (MeyGen, 2016). Four 1MW TCTs will be deployed, marking the first commercial array deployed in the world, and monitored rigorously to inform a plethora of real-time issues of speculation including marine species interactions, hydrology alteration, benthic habitat impacts, and inter-turbine effects. The project aims at ultimately deploying 398MW of installed capacity by the early 2020s. The MeyGen project was awarded a seabed lease by the Crown Estate in 2010 on an *ad hoc* basis in order implement the project plan. Since then, Marine Scotland (MS) has taken a more strategic approach to promote the sustainable deployment of TCTs by becoming the first and only nation to develop a SMPTE (Marine Scotland, 2013a), thereby marking the most recent leadership initiative undertaken by Scotland in the tidal energy industry.

Figure 1: Atlantis Resources Corporation AK-1000 tidal current turbine set to be deployed for the MeyGen project at the Pentland Firth (EMEC, 2011).

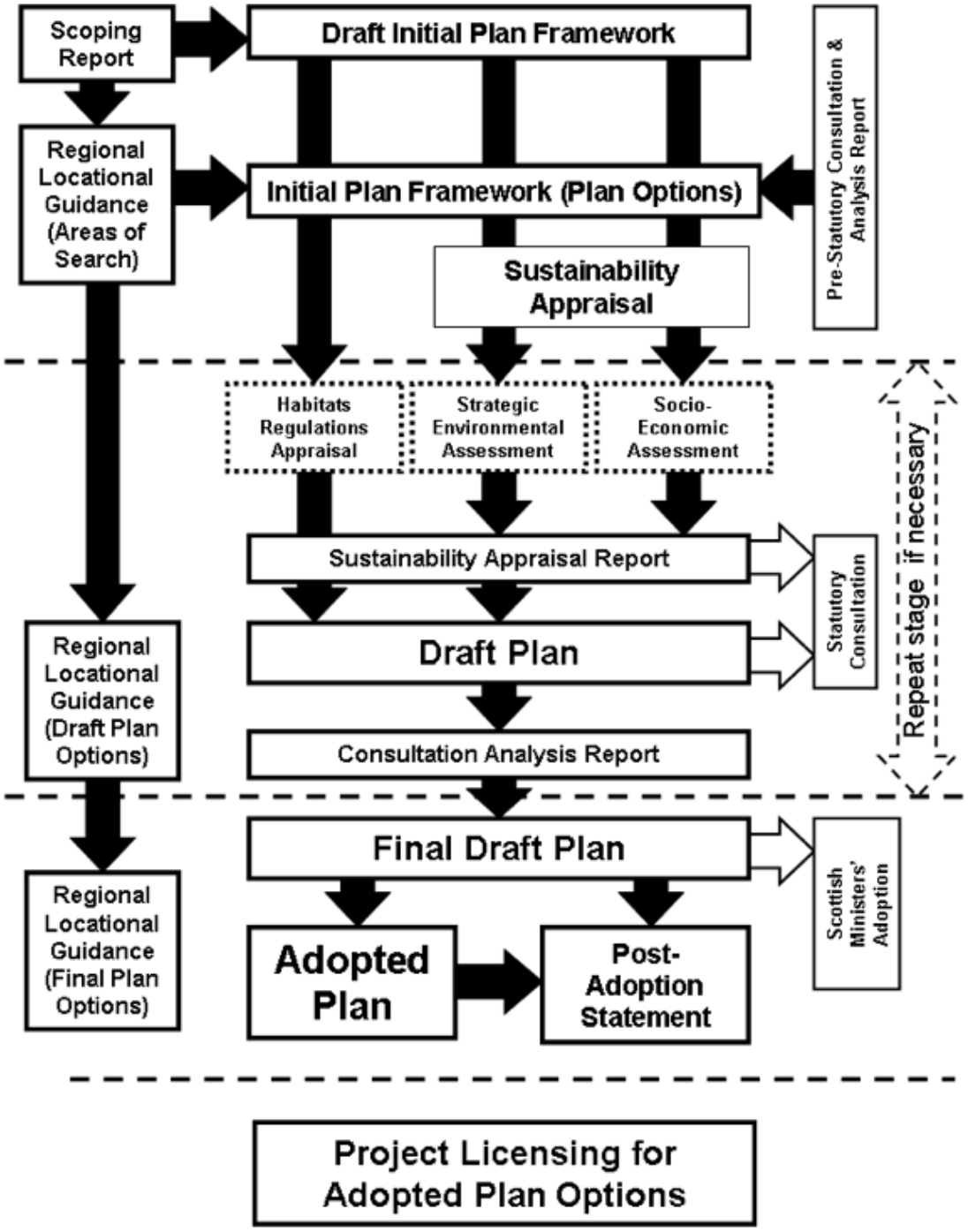

Figure 2: Scotland's SMP framework

3. Scotland's SMPTE

3.1. Legislative and Policy Framework

Scotland's SMPTE was first drafted in July 2013 from the earlier plan for the Saltire Prize (Marine Scotland, 2014), as powers to plan for the UK's exclusive economic zone (EEZ) between 12-200 nm out from Scotland's coasts were devolved from the UK Government to the Scottish Government (SG) in 2010, thereby empowering Scottish Parliament with planning authority over both their territorial waters zone (TZ, 0-12 nm) and EEZ (Marine Scotland, 2014). However, while plans for both the TZ and EEZ are uniform and published under Scotland's national marine plan (NMP), the authority to plan and manage development within the TZ and EEZ is derived from different legislation, with the TZ legislated by the Marine Scotland Act 2010 and the EEZ legislated by the Marine and Coastal Access Act 2009.

The SMPTE was constructed with the strategic aims of identifying preferred development areas for tidal energy implementation in Scotland, facilitating enhanced economic development, investment, and employment, and minimizing adverse implication on people, other sectors, and the environment (Marine Scotland, 2013a). The four key drivers that prompted the development of the SMPTE include:

- Climate change and energy: to assist the SG in achieving GHG emissions reduction targets of 42% below 1990 levels by 2020 and 80% below 1990 levels by 2050, as stated in the Climate Change (Scotland) Act 2010. Furthermore, to assist the SG in achieving its commitment of providing 30% of it's energy demand from renewables by 2020, with an interim embedded target of 100% renewably generated electricity.

- Marine planning: to inform the national and future regional marine plans with regards to the strategic siting of TCTs.

- Marine licensing: to streamline the licensing and consenting process of TCT testing and development.

- Transition to a low carbon economy: to exploit Scotland's tidal current resource in a sustainable manner in order to position Scotland as a world leader in the low carbon economy transition in the resulting four decades.

3.2. SMPTE Process

The following provides a broad overview of Scotland's SMPTE process (see Figure 2. for reference):

3.2.1. Scoping – Areas of Search

The initial scoping stage employs the Crown Estate's spatial modeling tool MaRS in order to determine the most suitable sites for tidal energy development based on the presence of substantial tidal energy resources in relation to a series of constraints including fishing, aquaculture, offshore oil and gas, Natura sites, recreational areas, potential archeological sites, and visual/landscape considerations (Davies, Gubbins, & Watret, 2012). The scoping stage was undertaken as a purely scientific and technical planning exercise informed by experts within MS, as no stakeholder input was employed at this preliminary stage of the SMPTE process.

3.2.2. Draft Initial Plan Framework

The results produced from the scoping study are used to inform draft initial plan framework, which essentially begins the transition towards building the planning process of the most suitable tidal energy sites (Marine Scotland, 2013a).

3.2.3. Draft Regional Locational Guidance (RLG)

At this stage, RLG becomes a part of the SMPTE process and remains persistent throughout until project licensing for adopted plan options. RLG contributes to the SMPTE process by providing direction to developers on the level of constraint pertaining to suitable tidal energy sites within the SMPTE by analyzing detailed considerations concerning technical, environmental, socio-economic, and planning factors.

3.2.4. Pre-Statutory Consultation

This is the first stage where stakeholder consultation becomes a part of the planning process, as workshops are used to engage relevant sectors and communities and events are held to disseminate information pertaining to the SMPTE process. After becoming familiarized with the planning process, relevant stakeholders are then given the chance to provide insight into the continual development of the SMPTE via their contribution of specific local and sectoral knowledge.

3.2.5. Pre-Statutory Consultation Analysis Report

At this stage, MS will release a report on the key findings identified through stakeholder input obtained from the pre-statutory consultation process.

3.2.6. Initial Plan Framework (IPF)

At this stage, information from the RLG and key themes addressed in the pre-statutory consultation analysis report are employed to refine the identified suitable sites for tidal energy development last modified in the draft initial plan framework into draft plan options. The plan options documented in the IPF are then put forward to Scottish Ministers in order to obtain approval and subsequently commence the formal planning process.

3.2.7. Sustainability Appraisal

In compliance with the Environmental Assessment (Scotland) Act 2005 and the UK Marine Policy Statement, a sustainability appraisal is undertaken in order to inform the development of the formal SMPTE. The sustainability appraisal investigates the potential environmental, ecological, cultural, and socio-economic spatial conflicts and compatibilities specific to each site identified as a plan option in the IPF. The sustainability appraisal contains the following:

3.2.7.1. Strategic environmental assessment (SEA)

The SEA identifies key environmental receptors that are likely to display degrees of sensitivity resulting from stressors produced from tidal energy developments, as well as quantifying potential impacts and exploring potential mitigation measures. The results of the SEA are then used as a basis to inform detailed site specific environmental assessments (EAs) for both strategic review at a regional scale and individual project developments as applicable (Marine Scotland, 2015c).

3.2.7.2. Socio-economic assessment

A socio-economic assessment is undertaken to identify how project developments within plan options will interact, whether positively or negatively, with existing marine spatial uses already in place in the region being assessed. The socio-economic assessment establishes a framework for measuring, both quantitatively and qualitatively, the user – user conflicts and user – environment conflicts that tidal energy development will have on a community in economic and social contexts. The assessment then offers judgment into the degree of such impacts and whether they are deemed acceptable or not (Marine Scotland, 2015a).

3.2.7.3. Habitats Regulations Appraisal (HRA)

The HRA identifies spatial conflicts between tidal energy developments in purposed plan option area with areas designated either currently, or have the potential to be designated in the future as special areas of conservation (SACs) under the Habitats Directive and special protection areas (SPAs) under the Birds Directive, as specified under the EU-wide biological conservation legislation Natura 2000. If effects on a Natura site are determined to be plausible then plan alterations will be made (Marine Scotland, 2015b).

3.2.8. Sustainability Appraisal Report

Drawing upon key findings produced from the SEA, socio-economic assessment, and HRA, a sustainability appraisal report is published and subject to consultation with relevant sectoral and community stakeholders for a minimum period of 16 weeks (Marine Scotland, 2013a).

3.2.9. Draft Plans

Drawing upon key findings produced from the SEA, socio-economic assessment, and HRA presented in the sustainability appraisal report, in conjunction with knowledge obtained from RLG, formal draft plans are developed. Draft plans are subject to consultation with relevant sectoral and community stakeholders for a minimum period of 16 weeks.

3.2.10. Statutory Consultation

In conformity with the Environmental Assessment (Scotland) Act 2005, the draft plan, SEA report, and HRA must undergo statutory consultation. The consultation authorities for the SEA report are Scottish Natural Heritage (SNH), Scottish Environmental Protection Agency (SEPA), Historic Scotland (HS), and the Joint Nature Conservation Committee (JNCC). The consultation authority for the HRA report is SNH.

3.2.11. Consultation Analysis Report

At this stage a consultation analysis report is drafted with the intention of ensuring that the key issues raised by relevant sectoral and community stakeholders have been taken into account throughout the sustainability appraisal report and draft plans in order to inform the final draft plan. In conformity with the Environmental Assessment (Scotland) Act 2005, if statutory consultation determines that considerable alterations to the draft plan are required, further research and amendments must be made beginning from the SEA, socio-economic assessment, and HRA onward to this stage.

3.2.12. Final Draft Plans

Beginning from the SEA, socio-economic assessment, and HRA onward to the consultation analysis report, pertinent information identified and consolidated inform the development of the final draft plan. The final draft plan presents recommended areas suitable for commercial scale (30MW>) tidal energy development.

3.2.13. Scottish Ministers' Approval

The final draft plan is put forward for Scottish Ministers' for confirmation to adopt or reject the SMPTE.

3.2.14. Adopted Sectoral Plan

If the plan is adopted, demonstrating compliance with various EU Directives pertaining to MSP, including the SEA Directive, Habitats Directive (*92/43/EEC*), Birds Directive (*2009/147/EC*), MSP Directive, and the Marine Strategy Framework Directive (MSFD), the final plan is produced and plan options contained within the SMPTE are formally accepted.

3.2.15. Post-Adoption Statement

In conformity with the Environmental Assessment (Scotland) Act 2005, when a final plan is adopted a post-adoption statement justifying why the plan was adopted and how environmental and stakeholder concerns, the socio-economic assessment and HRA were taken into consideration must be published.

3.2.16. Project Licensing for Adopted Plan Options

Although plan options identified in the SMPTE are chosen due to their overall resource, environmental, economic, and social suitability to host commercial scale tidal energy project developments, given the complexity of the marine environment in conjunction with the distinct risks associated with different project developments, there is no guarantee that a project within a plan option area will receive consent to obtain a license. If deemed necessary, commercial developments will be required to undertake project-level assessments that take into account issues raised during plan adoption, SEA, socio-economic assessment, and HRA during screening and scoping stages for environmental impact assessments (EIAs).

3.2.17. Plan Review Process

It is suggested within the SMPTE that a sectoral plans review group (SPRG) be established in order to oversee the implementation of SMPTE and undertake strategic monitoring and research to fill information gaps identified in the sustainability appraisal report.

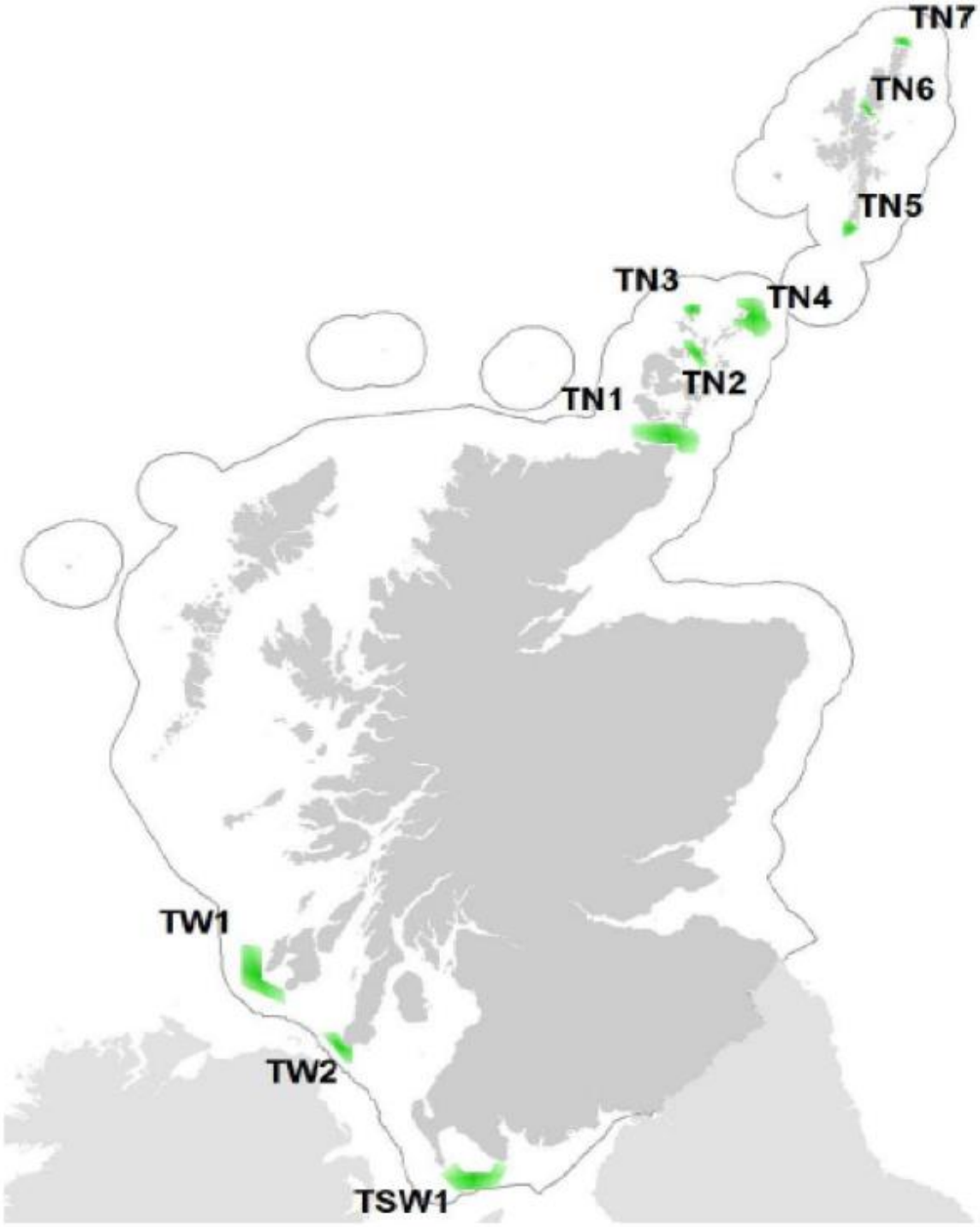

Figure 3:SMPTE final plan option areas.

4. ICES MSP Quality Management System (QMS)

4.1. QMS

Anthropogenic uses of the marine environment are increasing in number, spatial scale, and intensity, and have thus conjured up the necessity for government bodies ranging from local to national to devise policy tools in order to maintain ecosystem services that are essential to the health of the marine environment and coastal economies (Cormier *et al*., 2015). For example, the North Sea is home to some of the busiest marine transport activity in the world, while new uses of marine space such as aquaculture and offshore renewable energy are picking up momentum (OSPAR, 2010). Furthermore, in 2012 Europe's Blue Economy supported 5.4 million jobs, producing €500 billion (EU, 2012). Taking this into consideration, compounded by the adverse implications arising from the declining integrity of the marine environment and associated economies resulting from climate change, marine-based industries and governments are beginning to advocate for the implementation of MSP as a means of balancing economic interests and ecological considerations (Cormier *et al*., 2015).

In February 2010, ICES (2012) held a Workshop on Quality Management of MSP Processes (WKQAMSP). Key findings of the workshop revealed that the overwhelming majority of QMSs linked to MSPs were implemented on an *ad hoc* basis throughout the entire planning process, including data collection and dissemination, policy advisory, stakeholder consultation, conformity auditing, and policy development and implementation. This in turn led to the development of MSP processes that lacked a solid QMS that could ensure buy-in from relevant sectoral and community stakeholders. The aim of ICES's *Marine Spatial Planning Quality Management System* document is to put forward a uniform MSP QMS structure to enable the standardization of best practices towards MSP processes (Cormier *et al.,* 2015), thereby providing confidence to internal and external stakeholders that the output of the plan fulfills the objectives established at the onset of the MSP process (Hoyle, 2011). Best practices examined entail that MSP and QMS frameworks draw upon four key elements:

- Defining stressors and identifying appropriate management measures of such stressors.
- Constructing risk assessment and risk management measures.
- Defining stakeholders, identifying stakeholder interactions, and ascertaining the vertical stratification of multilateral government institutions.

- Identifying ecosystem services, the societal benefits of such services, and adopting an ecosystem approach to management.

In order to apply these four key elements of best MSP practices to the construction of a QMS framework, the ICES document draws upon the works of figureheads within the MSP field to integrate themes of MSP processes (Ehler & Douvere, 2009; Schultz-Zehden, Gee, & Scibior, 2008), ecosystem management systems (Sardà, Diedrich, Tintoré, Pablo Lozoya, Cormier, Hardy, & Ouellette, 2010; Sardà, O'Higgins, Cormier, Diedrich, & Tintoré, 2014), ecosystem approaches to management (Rice, Trujillo, Jennings, Hylland, Hagstrom, Astudillo, & Nørrevang-Jensen, 2005), and ecosystem risk management (Cormier, Kannen, Elliott, Hall, Davies, 2013). While all of the elements and themes listed above can inform the development of a MSP QMS, none of works of MSP field figureheads were written from a quality management perspective, thus ICES sought to fill the void through the creation of their MSP QMS best practice document (Cormier et al., 2015). In addition to the guiding elements, themes, and documents listed above, the ICES document draws upon ISO 9000 (ISO, 2005) quality systems suite of standards in order to construct its QMS and the ISO 31000 (ISO 2009) risk management standards in order to manage interrelated processes within the overall MSP framework.

Table 1
ICES MSP QMS document structure

ICES Document Structure	Acronym	Literature Drawn Upon
Quality Management System	QMS	Cormier *et al.,* 2013; Ehler and Douvere, 2009; Rice *et al.*, 2005; Sardà *et al.,* 2010; Sardà *et al.,* 2014; Schultz-Zehden *et al.,* 2008
Quality Management Programme	QMP	ISO, 2005; ISO, 2009
Quality Objectives of the Plan	QOP	Elliott, 2013
Quality Management Objectives	QMO	Hoyle, 2011

In order to properly implement an effective, transparent QMS for MSP, a quality management programme (QMP) with an itinerary that specifies required inputs and targeted outputs, quality objectives of the plan (QOP) that document the desired outcome of the end product, and quality management objectives (QMO) that deal with interrelated processes are all essential components (Cormier et al., 2015).

4.2. QMP

A QMP structures the sequence of activities in order to determine how the MSP will establish its "scope and objectives, identify issues or conflicts, evaluate management options, develop and implement the plan, monitor and review the plan, in addition to establishing who is part of the governance structure, who makes decisions, who will be consulted and provide advice, and how information is managed". A QMP must be comprised of four compulsory elements in order to achieve its purpose, notably:

- Mandate and commitment: by a government institution headed by a Competent Authority (CA) in order to maintain political, sectoral, and community engagement throughout the MSP process.
- Communication and consultation: from both statutory and non-statutory actors in order to develop a knowledge base of potential risks and search for methods to manage, and if necessary, mitigate such risks.
- Information and record management requirements: in order to demonstrate the methodology behind management decisions within the MSP process and prove conformity with criteria set out in the QMS.
- Evaluations and performance assessments: in order to assess the performance of the MSP and the conformity of objectives with overarching policy goals within the MSP as determined by the applicable political framework.

4.3. QMO

QMOs are "principles upon which the conduct of governance, consultation, advisory, and decision-making will ensure that the process remains within the scope, objectives, and outcomes established at the onset of the planning initiative, that the steps and outputs of the planning process are relevant to achieving the plan, and that the plan addresses the quality assurance elements outlined by the QOPs". QMOs are essentially the quality objectives for the MSP as a process in and of itself. The ICES MSP QMS document draws from Hoyle's (2011) seven process principals to establish the QMO framework, consisting of:

- P1 – Consistency of purpose: between the purpose of the MSPs outputs and QMOs in order to allows for outputs to be informed by CAs and sectoral and community stakeholders.
- P2 – Clarity of purpose: quantifiable objectives with defined outputs throughout each step of the MSP process, thereby allowing those involved in

the process to understand their roles, the MSPs purpose, and how performance will be measured.

- P3 – Connectivity with objectives: activities undertaken in the MSP process justify the ability of the MSP to achieve it's QMOs, and subsequently ensure that those involved in the MSP are working towards achieving the QMOs
- P4 – Competence and capability: of those involved in the MSP process to ensure that roles are properly assigned and individual inputs hold weight.
- P5 – Certainty of results: are enhanced if performance indicators and stipulated periodic reporting are a part of the MSP process, thereby allowing those involved in the MSP process, both internally and externally, to comprehend the performance and progress of the MSP process.
- P6 – Conformity to best practices: to ensure that the MSP process is structured off of past success, thereby providing confidence in it's effectiveness and efficiency.
- P7 – Clear line of sight: undertaking periodic reporting to insure CAs and sectoral and community stakeholders are can identify the connectivity between their expectations and the QOPs, thereby providing a better understanding of the MSP process and facilitating the continual improvement of the MSP process over time.

4.4. QOP

QOPs are a "comprehensive list of the quality assurance elements that should be addressed by the plan in terms of legislation, policies, governance, cultural, social, economic, and technological considerations in its management strategies". QOPs provide a framework for what the MSP process should achieve. The ICES MSP QMS document draws from Elliot's (2013) Ten Tenets to establish the QOP framework, consisting of:

- T1 – Environmentally/ecologically sustainable: enacting measures to ensure that ecosystem services are sustained.
- T2 – Technologically feasible: tools required to sustain ecosystem services are readily available.
- T3 – Economically viable: cost-benefit analysis of sustaining ecosystem services demonstrates viability.
- T4 – Socially desirable/tolerable: management processes are understood and tolerated by society and result in societal benefit.
- T5 – Legally permissible: policy and legislation are in place to enact and/or enforce management measures.

- T6 – Administratively achievable: statutory bodies are in place to ensure sustainable management.
- T7 – Politically exponent: management measures are in conformance with prevailing policy and obtain support from political leaders.
- T8 – Ethically defensible: ensuring that management measures that allow for some degree of environmental deterioration can be justified.
- T9 – Culturally inclusive: cultural ecosystem values are incorporated into management measures.
- T10 – Effectively communicable: management measures are understood by all stakeholders in relation to the nine other tenets.

5. SMPTE Quality Review Against ICES MSP QMS Quality Management Checklist

The development and implementation of TCTs exemplifies an intriguing cross section between the issues concerning climate change and marine spatial usage, as TCTs are an upcoming emissions-free renewable energy technology that ultimately becomes another user of marine space that is already stressed and generally lacking strategic coordination across the globe. While Scotland is renowned for its tidal current resources, estimated at approximately 32TWh/yr of available resource (Crown Estate, 2012), the North Sea is also one of the busiest marine regions in the world (OSPAR, 2010). In light of such a dilemma, the SG has delegated MS to draft a SMPTE in order to promote the sustainable development and implementation of TCTs while giving due consideration to other marine spatial uses currently in existence as well as potential interactions with marine ecosystems (Marine Scotland, 2013a).

However, due to the SMPTE's status as the first MSP of it's kind, in conjunction with the infancy of commercial TCT deployment and the sensitivity of the marine environment, it is important that Scotland's SMPTE be constructed and updated with an effective QMS. This paper aims to assess the conformity of Scotland's SMPTE with a QMS framework by undertaking a quality review of Scotland's SMPTE against criteria set out in the ICES MSP QMS document. In accordance with ISO 3100 risk management standards, the ICES MSP QMS structures its quality review by first establishing external and internal contexts in order to ensure that risk identification, risk analysis, risk evaluation, risk treatment, and monitoring and review are intrinsically linked to support the goals and objectives set out at the beginning of the MSP process (Cormier *et al.,* 2015). Since the ICES MSP QMS has structured the QMOs within the document to guide any MSP, whether economically, environmentally, or socially oriented, it provides a perfect framework for the SMPTE

to be analyzed against. The SMPTE will be assessed against the 178 questions provided in the ICES MSP QMS quality management checklist (QMC). The assessment process will be informed by the SMPTE, the detailed supporting documents published to inform the SMPTE construction and adoption process, Scotland's NMP, the detailed supporting documents published to inform the NMP construction and adoption process, and interviews with internal members of the SG where information on the SMPTE is not published.

The QMCs are drafted from subtopics under the internal, external, and risk identification, analysis, evaluation, and treatment, and monitoring and review framework sections listed above (e.g. *5.2. Establishing the MSP internal context: 5.2.1. Marine Planning Legislation, Policies and Authorities*). Within each subtopic, headings are organized under one of four themes to denote the context in which the subtopic should be interpreted as:

- External Organization: competent authorities, industry stakeholders, communities of interest or the public.
- Internal Organization: organizations supporting the MSP process such as scientific, technical or policy advisory bodies.
- Function: function lead by the Competent Authority or the Governance group
- Inputs or Outputs: metric in relation to a completed task such as a result of a procedure or a process.

Where subtopics provide more than one heading, the headings are titled, and the themes are specified for each heading (*5.2.1. Marine Planning Legislation, Policies and Authorities*: Marine planning legislation and policies – Inputs or outputs, MSP competent authority - Function), which are meant to be interpreted independent from one another rather than in a conjunctive manner. Subtopics are then categorized as either a QMO, with the specific process principal (Hoyle, 2011) referred to denoted adjacent (e.g. *5.1.2. Marine development public policy agenda:* QMO = P1 - Consistency of purpose), or a QOP, with the specific tenet (Elliot, 2013) referred to denoted adjacent (e.g. *5.1.2. Marine development public policy agenda:* QMO = T7 - Politically exponent). The remaining sections and subsections within section 5. SMPTE quality review against ICES MSP QMS QMC detail the subtopics, themes, and associated principals and tenets, and how the SMPTE addresses or does not address such criteria set out in the QMC.

5.1. Establishing the External Context

In order to devise a successful MSP process, the external context consisting of cultural, social, political, legal, regulatory, financial, technological, economic, and environmental factors that may influence the ability of the MSP to achieve its objectives must be taken into consideration (Cormier *et al.,* 2015).

5.1.1. Public Policy Governance

- External
  - QMO = P1
  - QOP = T7

5.1.2. Marine Development Public Policy Agenda

- Inputs or outputs
  - QMO = P1
  - QOP = T7

1) What is the marine development public policy agenda that would trigger or support the need to initiate a planning process?

In relation to the SMPTE's strategic aims of maximizing the aggregate installed capacity of tidal energy in Scotland, facilitating enhanced economic development, investment, and employment, and minimizing adverse implications on people, other sectors, and the environment (Marine Scotland, 2013a), the public policy that would trigger or support the need to initiate the SMPTE process is the SG's Economic Strategy, the Electricity Generation Policy Statement, and the Climate Change (Scotland) Act 2010, which work together to promote economic development while safeguarding the environment by meeting GHG emissions reduction targets via the generation of electricity from renewable energy technologies.

2) What are the strategic goals, socio-economic targets and completion timeframes for the proposed planning process?

The strategic goals of the SMPTE are to maximize the aggregate installed capacity of tidal energy in Scotland, facilitate enhanced economic development, investment, and employment, and minimize adverse implications on people, other sectors, and the environment, with the later two being representative of the economic and social targets, respectively (Marine Scotland, 2013a). The SMPTE process did not follow a strict completion timeframe, rather, a defined number of steps were undertaken to construct the SMPTE in chronological order in conformity with the sectoral marine planning (SMP) process illustrated in Figure 2.

3) What are the goals, objectives and timeframes of the industry stakeholders and communities of interest in relation to the planning area?

The goals and objectives of industry and community stakeholders are not formally published as definitive targets, as the SMPTE takes a strategic approach towards planning. The SMPTE takes into consideration that planning is an ongoing process and monitoring and review may reveal new knowledge that may result in a change in industry and community stakeholder goals and objectives, as may the introduction of new scientific data and the advent of new technology. Therefore, the SMPTE allows for ongoing industry and community input throughout the planning process.

5.1.3. Ecosystem Protection Public Policy Agenda

- Inputs or outputs
  - QMO = P1
  - QOP = T7

4) What is the public policy agenda that sets ecosystem sustainability goals and timeframes for the implementation of protection and conservation measures?

The Birds Directive and Habitats Directive together form the EU-wide biological conservation legislation Natura 2000, designating Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) respectively. Such sites were taken into consideration when scoping for suitable tidal energy development sites for the SMPTE in order to safeguard the sensitive marine ecosystems and features while achieving the SMPTE's strategic aim of identifying preferred development areas for tidal energy developments in Scotland, facilitating enhanced economic development, investment, and employment, and minimizing adverse implications on people, other sectors, and the environment (Marine Scotland, 2013a). Furthermore, the Environmental Assessment (Scotland) Act 2005, which provides for the requirement of SEA to identify key environmental receptors, quantifying potential impacts, and exploring potential mitigation measures, and the UK Marine Policy Statement, which provides the requirement of incorporating the results of SEA in a sustainability appraisal, work in conjunction to implement protection and conservation measures stipulated under Natura 2000.

5) What are the ecosystem management outcome indicators and targets to be achieved?

The SMPTE identifies broad ecosystem indictors, including biodiversity and seabed and coastal processes distinct to each of the three regions where suitable tidal energy development sites have been allocated (North, West, South West).

However, although the SEA for SMPTE has been undertaken in compliance with the Environmental Assessment (Scotland) Act 2005, which in and of itself sites an abundance of applicable plans, programmes, and strategies quantifying ecosystem protection measures such as unacceptable fish stock depletion targets (EU Biodiversity Strategy, 2011), and must be in compliance with the Birds and Habitats Directives, consideration of ecosystem management outcomes and targets for the SMPTE itself have not been explicitly defined (Marine Scotland, 2015c).

6) What are the boundaries of the ecosystem?

The SMPTE is divided into six regions; North, North East, East, South West, West, North West. These regions extend to the outer boundary of the 200nm EEZ and do not explicitly take into consideration ecosystem boundaries in their construction (Marine Scotland, 2013a).

5.2. Establishing the MSP Internal Context

In order to devise a successful MSP process, the external context consisting of governance, organizational structure, roles and accountabilities, and human and financial resources, that may influence the ability of the MSP to achieve its objectives must be taken into consideration (Cormier *et al*., 2015). The ICES MSP QMS establishes terms of references, business rules, communication and consultation procedures, auditing framework, and scientific and technical advisory protocols.

5.2.1. Marine Planning Legislation, Policies and Authorities

Marine planning legislation and policies:

- Inputs or outputs
  - QMO = P2
  - QOP = T5

MSP competent authority:

- Function
  - QMO = P3
  - QOP = T5

7) What is the marine spatial planning legislative and policy framework that sets the scope of the planning initiative?

The Scottish NMP, bounded by the Marine Scotland Act 2010 within the TZ and the

Marine and Coastal Access Act 2009 within the EEZ sets the scope for the SMPTE.

8) What are the agreements and/or statutes needed to develop and implement a marine spatial plan?

The Marine Scotland Act 2010, which provides the legislative and management framework for the marine environment, and the Marine and Coastal Access Act 2009, which provides the legislative and management framework for MSP within Scottish waters, are the statutes required to develop and implement the SMPTE as the SMPTE is to be in conformity within the broader context of the NMP (Marine Scotland, 2013a).

9) What are the local or regional statutes or international agreements that have to be respected within boundaries of the management area being planned?

The statutes and agreements that have to be respected within the management boundaries of the SMPTE include the Marine Scotland Act 2010, Marine and Coastal Access Act 2009, Environmental Assessment (Scotland) Act 2005, UK Marine Policy Statement, Birds Directive, Habitats Directive, Habitats Regulations, etc. (Marine Scotland, 2014). This list is not exhaustive, as there are many local and regional statutes and international agreements that have to be respected within boundaries of the management area, rather, this list provides an outlook at the primary policy tools directly associated with the construction, implementation, and management of the SMPTE. The SMPTE must abide by an extensive list of local and regional statutes and international agreements across sectors in order to achieve its strategic aims of identifying preferred development areas for tidal energy implementation in Scotland, facilitating enhanced economic development, investment, and employment, and minimizing adverse implication on people, other sectors, and the environment. These statutes and agreements have been taken into consideration in the scoping stage for suitable tidal energy development sites.

10) Who is the MSP Competent Authority that is delegated under the MSP legislation or under agreement from the governance structure?

MS is the MSP CA designated under the Marine Scotland Act 2010 (Marine Scotland, 2013a).

11) What is the span of responsibility and accountability of the MSP Competent Authority?

MS is responsible and accountable for determining the suitability of tidal energy development sites within Scottish waters, drafting the SMPTE, issuing permits, granting consent, engaging stakeholders, enforcing management measures, and monitoring and review of the SMPTE (Marine Scotland, 2013a).

5.2.2. Ecosystem Legislation, Policies and Authorities

Ecosystem legislation and policies:

- Inputs or outputs
  - QMO = P2
  - QOP = T5

Ecosystem competent authority:

- Function
  - QMO = P3
  - QOP = T5

12) What is the ecosystem legislative and policy framework that sets the ecological context or constraints for the planning initiative?

The ecosystem legislative and policy framework that sets the ecological context or constraints for the SMPTE include the Marine Scotland Act 2010, Environmental Assessment (Scotland) Act 2005, UK Marine Policy Statement, Birds Directive, Habitats Directive, Habitats Regulations, etc. (Marine Scotland, 2014). This list is not exhaustive, as there is an abundance of ecosystem legislative and policy framework that sets the ecological context and constraints of the SMPTE. This legislative and policy framework has been taken into consideration in the scoping stage for suitable tidal energy development sites.

13) What are the prohibitions, protection or conservation regulation that have to be met by planning process within the management area?

The prohibitions, protection or conservation regulation that have to be met by planning process within the SMPTE management area include, but are not limited to, the Marine Scotland Act 2010, Marine and Coastal Access Act 2009, Environmental Assessment (Scotland) Act 2005, UK Marine Policy Statement, Birds Directive, Habitats Directive, Habitats Regulations, etc. (Marine Scotland, 2014).

14) What are the local or regional statutes or international agreements that have to be respected within the boundaries of the ecosystem?

The statutes and agreements that have to be respected within the ecosystem boundaries that fall within the SMPTE management area include the Marine Scotland Act 2010, Marine and Coastal Access Act 2009, Environmental Assessment (Scotland) Act 2005, UK Marine Policy Statement, Birds Directive, Habitats Directive, Habitats Regulations, etc. (Marine Scotland, 2014). This list is not exhaustive, as there are many local and regional statutes and international agreements that have to be respected within boundaries of the management area, rather, this list provides an outlook at the primary policy tools directly associated with the construction, implementation, and management of the SMPTE. The SMPTE must abide by an extensive list of local and regional statutes and international agreements across sectors in order to achieve its strategic aim of minimizing adverse implication on the environment while obtaining economic and development goals. These statutes and agreements have been taken into consideration in the scoping stage for suitable tidal energy development sites.

15) Who is the Ecosystem Competent Authority that is delegated under the ecosystem legislative or under agreement from the governance structure?

MS is both the MSP and ecosystem CA designated under the Marine Scotland Act 2010 (Marine Scotland, 2013a).

16) What is the span of responsibility and accountability of the Ecosystem Competent Authority?

MS is responsible and accountable for determining the suitability of tidal energy development sites within Scottish in relation to their potential interactions with SACs and SPAs, undertaking SEAs and HRAs, issuing permits and granting consent to project leases that are in compliance with ecological prohibitions, protection or conservation regulations and local and regional statutes and international agreements, enforcing ecosystem management measures, and monitoring and review of ecosystem conditions within the SMPTE management area (Marine Scotland, 2013a).

5.2.3. Competent Authorities

- External
  - QMO = P4
  - QOP = T5, T6

17) What are the other competent authorities that have legislative mandates related to the activities of the drivers operating in the management area and that will be managed by the marine spatial plan?

MS is the only CA for the SMPTE (Marine Scotland, 2013a).

18) Are there any relevant industry agreements/statutes involving external or international organizations that should be included in the planning process?

There are numerous relevant industry agreements/statutes involving external or international organizations that should be included in the SMPTE process, all of which are listed throughout the NMP, SEA Directive, Marine Scotland Act 2010, and the Marine and Coastal Access Act 2009 (Marine Scotland, 2014).

5.2.4. Industry stakeholders

- External
  - QMO = P4
  - QOP = T2

19) Who are the industry associations or organizations that represent the drivers that are operating in the management area and that will be managed by the marine spatial plan?

Key industry associations and organizations that represent drivers operating in the management area of the SMPTE specified in the SMPTE are categorized under fishing, shipping and navigation, grid, industry, and tourism and recreation. For a complete list of key industry associations and organizations refer to the SMPTE document (Marine Scotland, 2013a).

20) Under what legislation and policy framework are the implicated industry sectors managed?

Under the policy framework of the NMP, which draws its legitimacy from the Marine Scotland Act 2010 and the Marine and Coastal Access Act 2009, early and ongoing engagement with stakeholders should be undertaken in the SMPTE process (Marine Scotland, 2013a). The SMPTE has allowed for stakeholder engagement with the IPF, SEA, socio-economic assessment, HRA, sustainability appraisal report, draft plans, and RLG which spans the entirety of the SMPTE process.

21) How is the industry sector delegate appointed to ensure that they represent the views and concerns of their sector?

Industry sector representatives under each industry category identified are specified within the SMPTE. Industry sector representatives are appointed by members of the industry in question via stakeholder consultation events (Interview, 2016c).

5.2.5. Communities of interest

- External
  - QMO = P4
  - QOP = T3, T4, T9

22) Who are the communities of interest that depend on or have a vested interest in the sustainability or integrity of the ecosystem and its services that may be influenced by the activities of the drivers managed under the marine spatial plan?

Communities of interest identified in the SMPTE include fishers, natural environmental organizations (both NGOs and statutory bodies), local government, the local community, and tourist/leisure interests (Marine Scotland, 2013a).

23) How is the community of interest delegate appointed to ensure that they represent their constituency?

Representative organizations of the fishing, natural environment (both NGOs and statutory bodies), local government, local community, and tourism that are invited to events and encouraged to provide feedback are specified in the SMPTE (Marine Scotland, 2013a). Representatives are appointed to ensure that they represent their constituency by members of the community of interest in question via stakeholder consultation events.

24) Are the communities of interest located outside the management area?

Yes, some communities of interest are located outside the management area either transnationally, such as the Welsh Assembly Government, or in the context that they do not directly interact with the marine management area allocated in the SMPTE, such as Scottish local terrestrial planning authorities (Marine Scotland, 2013a).

5.2.6. Consultation and Feedback Process

- Function
  - QMO = P1, P2
  - QOP = T10

25) What are the consultation procedures for the members of the governance body?

The consultation procedures for members of MS are not formally structured, and therefore, internal input occurs on an as needed basis to inform the development of the SMPTE process (Interview, 2016a).

26) What are the feedback procedures to inform members as to why and how advice was either integrated or not integrated in the planning process?

The feedback procedures in place within MS to inform members as to why and how advice was either integrated or not integrated in the SMPTE process are not formally structured, rather, email chains and minutes for meeting support this function on an as needed basis determined by those internal to MS (Interview, 2016a).

27) What are the requirements for record keeping for communication products as well as consultation and feedback documents received by the members of the governance body?

There are no formal requirements for record keeping for communication products (beyond standard public body filing systems) as well as consultation and feedback documents received by the members of MS in relation to the SMPTE process (Interview, 2016a).

28) What is the most appropriate language, fora and media for communicating the material and views?

The appropriate language, fora and media for communicating the material and views within MS in relation to the SMPTE process are not formally structured, rather, email chains and minutes for meeting support this function on an as needed basis determined by those internal to MS (Interview, 2016a).

5.2.7. Public

- External
  - QOP = T4

29) What are the public constituencies that should be consulted?

The SMPTE specifies that the CA must consult with members of the general public such as Local Community and Parish Councils, Local Trusts, and any other interested parties or groups from the pre-statutory consultation phase through to statutory consultation in order to provide a platform for public voices to be heard and local knowledge to be incorporated into the final draft plan, whereby the incorporation or disregard of such input into the SMPTE process id justified in the Scottish Ministers' post adoption statement (Marine Scotland, 2013a).

5.2.8. Public Communication Procedures

- Function
  - QMO = P2, P3
  - QOP = T10

30) What is the communication plan and tools used to communicate key decisions?

The SG makes available the draft plan, sustainability appraisal report, SEA, socio-economic report, and the RLG on the government website where members of the public can familiarize themselves with the documents and the progression of the SMPTE (Marine Scotland, 2013a). The HRA report is also made available on the SG website. Each report is then subject to a 16-week statutory consultation period where members of the public (individuals and organisations) are encouraged to provide feedback and perspective on the SMPTE. IPFs and RLGs, which are publically available in a disaggregated form through the National Marine Plan Interactive (NMPi) database, are also made available through the SG website, encouraging community stakeholders to provide current information as applicable. Finally, the SG has an email alert system where community members can register to receive weekly consultation information in order to keep community members invested in the SMPTE up to date on current events.

31) Is there an appeal process where a decision is not being understood/accepted/ tolerated by the public?

Although community stakeholders can provide ask the SG questions about and provide feedback into the SMPTE process, there is no legislative right to an appeal process where a decision is not being understood, accepted, and/or tolerated by the public.

32) Who approves the communication plan?

The communication structure is approved by Scottish Ministers and executed by MS as the acting CA (Interview, 2016c).

33) What controls exists on the dissemination of the key decisions and products of the MSP?

MS makes available the draft plan, sustainability appraisal report, SEA, and socio-economic report on the government website where members of the public can familiarize themselves with the documents and the progression of the SMPTE (Marine Scotland, 2013a). The HRA report is also made available on the SG website. Each report is then subject to a 16-week statutory consultation period where members of the public are encouraged to provide feedback and perspective on the SMPTE. IPFs and RLGs are also made available through the SG website, encouraging community stakeholders to provide current information as applicable. Finally, the SG has an email alert system where community members can register to receive weekly consultation information in order to keep community members invested in the SMPTE up to date on current events.

5.2.9. Scientific and Technical Advisory Bodies

Ecosystem advisory body:

- Function
  - QMO = P4
  - QOP = T1

Social advisory body:

- Function
  - QMO = P4
  - QOP = T4, T9

Economic advisory body:

- Function
  - QMO = P4
  - QOP = T3

Policy advisory body:

- Function
  - QMO = P4
  - QOP = T2, T5

34) What are the scientific and technical advisory bodies that the planning process will turn to for advice?

The scientific and technical advisory bodies internal to the SG that are called upon for advice throughout the SMPTE process consist of various of experts categorized under the learning and justice, enterprise, environment, and innovation, health and social care, finance, strategy and external affairs, and communities divisions. The scientific and technical advisory bodies that are external to the SG that are called upon for advise throughout the SMPTE process consist of SNH, SEPA, HS, and the JNCC for the SEA, and SNH for the HRA (Marine Scotland, 2013a), in conformity with the Environmental Assessment (Scotland) Act 2005.

35) What are the terms of reference or accreditation related to their area of expertise for their organization or association?

There is no standard for obligatory accreditation regarding the employment of scientific and technical expertise within MS (Interview, 2016a).

36) What are the Best Available Techniques (BAT) that are internationally recognized and accredited?

Due to the pre-commercial stage in which TCTs currently reside, resulting in the fact that Scotland's SMPTE is the first of its kind, BATs for ecosystem, social, economic, and policy bodies have yet to be devised. Therefore, Scotland's SMPTE can pave the way to become the standard for SMPTE processes if it has been constructed, implemented, and monitored effectively and in due consideration of ecosystem, social, economic, and policy functions. A way to determine the effective structuring of Scotland's SMPTE is to conduct quality reviews against international best practice policy documents such as the ICES MSP QMS, as is the scope of this paper.

37) Are there any conflicts of interest or link between the experts and the stakeholders impacted by the proposed MSP?

The SMPTE is designed not to have conflicts of interest between experts and relevant stakeholders. However, due to the intertwined relationships between such

actors, MS has undergone judicial reviews undertaken by the Royal Society for the Protection of Birds (RSPB) in the past, although no significant findings of malpractice has been identified and confirmed (Interview, 2016a).

38) Who are the legal advisors supporting the MSP process?

The legal advisors supporting the development of the SMPTE process are internal to the SG (Interview, 2016a).

5.2.10. Scientific and Technical Advisory Process

- Function
  - QMO = P1, P3, P6
  - QOP = T10

39) What is the source/reliability of the information used to formulate the advice?

Scientific and technical advice is garnered from baseline and scoping assessments undertaken by members internal to MS (Marine Scotland, 2013a).

40) What is the metadata for the data used to validate if it is fit for purpose in the formulation of the advice?

An extensive amount of metadata is used throughout the entire SMPTE ongoing process to in order to be projected into decision support system tools to validate if information is fit for purpose in the formulation of scientific and technical advice. Such metadata is organized in conformity with UK Crown Estate procedures as they are allocated in Inspire compliant metadata repositories (Interview, 2016a).

41) What is the process to set the terms of references and questions to be answered by the advisory bodies?

The SG's Marine Strategy Forum (MSF), a strategic oversight group comprised of relevant stakeholders and scientific and technical advisory bodies are encouraged to engage in the development of the SEA and socio-economic assessment processes that inform the sustainability appraisal through to the statutory consultation stage in order to set the terms of references for the SMPTE process, ultimately formulating questions pertaining to relevant legislation and the SMPTE process itself throughout these stages to be answered during statutory consultation (Interview, 2016b).

42) Who approves the process and who chairs to ensure that advice reflects the

questions asked and that the advice is fit for the purpose of planning initiative?

The SMPTE process is approved by Scottish Ministers and chaired by the relevant planning Policy Lead in conjunction with scientific and technical specialists applicable to specific stages and processes of the SMPTE (e.g. the Environmental Assessment Specialist in relation to the SEA, the Government Economist in relation to socio-economic assessment, etc.). Decisions regarding whether or not to incorporate such advice arising from specific stages and processes of the SMPTE and in what capacity are then published in the Scottish Ministers' post-adoption statement in order to reflect a participatory and transparent planning process (Interview, 2016b).

5.2.11. Governance Body

- Function
  - QMO = P1, P2, P3, P4
  - QOP = T10

43) What is the governance structure needed to address the legislative implications, ecological considerations, development priorities and community concerns as part of the scope of the planning initiative?

The governance structure needed to address the legislative implications, ecological considerations, development priorities, and community concerns as part of the scope of the SMPTE falls under the Marine Scotland Act 2010, designating MS as the CA and therefore the governance body who structured the SMPTE process, from the scoping stage to the plan review process (Marine Scotland, 2013a).

44) What are the agreements or memorandum of understandings needed to create the governance structure?

The agreement/memorandum of understanding implemented to facilitate the governance structure of the SMPTE was the devolution of powers from UK Parliament to Scottish Parliament to plan the marine environment within the former UK EEZ bordering Scotland's TZ under the Marine and Coastal Access Act 2009 (Marine Scotland, 2013a).

5.2.12. Governance Terms of References

- Function
  - QMO = P2, P6
  - QOP = T8

45) How many members are required to form a quorum for decision-making or to reach a consensus on recommendations?

There are no formal obligations in the SG planning structure to incorporate a specified number of members within decision-making quorums or to reach a consensus on recommendations, rather, the emphasis for MS n relation to the SMPTE process is to identify and engage the most relevant stakeholders who wish to have a say with the proper scientific and technical experts and advisory bodies (Interview, 2016b).

46) How do members communicate within the governance structure?

Members of MS communicate within the SMPTE governance structure in an informal manner via email chains and minutes for meetings on an as needed basis (Interview, 2016a).

47) What is the expected response timeframe of the governance structure?

There is no formal legislated expected response timeframe within the MS governance structure, rather, email chains and minutes for meeting support this function on an as needed basis, determined by those internal to MS (Interview, 2016a).

48) How does the governance structure communicate with senior MSP management?

There is no formal senior SMPTE management communication protocol within the MS governance structure, rather, email chains and minutes for meeting support this function on an as needed basis (Interview, 2016a).

49) How does the governance structure connect with the political leaders to demonstrate support from political leaders?

The SMPTE process itself requires the involvement and approval of Scottish Ministers through the final draft plan to the post-adoption statement (Interview, 2016b).

50) What are the competent authorities identified in the Terms of References for the planning process?

MS, as the sole acting CA, is identified in the terms of reference for the planning process (Interview, 2016a).

5.2.13. Governance Business Rules

- Function
  - QMO = P2
  - QOP = T10

51) How is the advice and feedback from the industry stakeholders and communities of interest taken into consideration in the governance and oversight of the planning initiative?

Input from relevant industry and community stakeholders is taken into consideration in order to obtain sectoral and local knowledge and values when searching for potentially suitable tidal energy development sites during the pre-statutory consultation stage, and continually updated during advancing stages of the SMPTE (RLG, IPF, SEA, socio-economic assessment, HRA, SA, consultation analysis report) (Marine Scotland, 2013a). Industry and community stakeholder input is then documented and published in the pre-consultation analysis report, IFP, consultation analysis report, with the post-adoption statement detailing how such input was incorporated into the SMPTE final plan options.

52) Do the recommendation(s) follow the established decision-making protocols and rules in accordance with the terms of reference?

Given that established decision-making protocols for the SMPTE demand the incorporation of relevant industry and community stakeholder inputs, as well as documented and published proof of the methods in which such input was taken into consideration to inform the SMPTE process and final plan options, recommendations made are easily verifiable in terms of being in accordance with the terms of reference via the post-adoption statement (Marine Scotland, 2013a).

53) Are the recommendations aligned with the public policy agenda of the mandated government?

The recommendations are aligned with the broader policy agenda of the NMP, legislated under the Marine Scotland Act 2010 and the Marine and Coastal Access Act 2009 (Marine Scotland, 2013a).

54) Where and when in the recommendation process is the approval from political leaders sought and by whom?

MS seeks the Scottish Ministers' approval of SMPTE plan option areas during final draft plan stage through to the post-adoption statement Interview, 2016b).

55) What are the delegation instruments for the MSP Competent Authority and the other competent authorities?

The delegation instruments employed by MS for the SMPTE consist of steering groups who act as technical and scientific advisory bodies for the SEA, socio-economic assessment, and the HRA which are driven by policies of the SMPTE in conformity with the NMP approved by Scottish Ministers (Interview, 2016b).

5.2.14. Marine Spatial Planning Risk Criteria

- Inputs or outputs
  - QMO = P2, P5
  - QOP = T10

56) What are the criteria used to assess the severity of impacts?

Due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first

sectoral tidal energy plan devised in the world, the SMPTE process undertook an opportunities and constraints approach rather than a pressures and impacts approach to assess the suitability of areas for development. The SA took draws upon a list of regionally inclusive environmental, social, and economic receptors in the SEA, socio-economic assessment, and HRA. For environmental receptors, the SEA took into consideration technology specific TCT installation and operation and assessed their associated dynamics against a criteria of baseline conditions categorized as biodiversity, flora, and fauna, population and human health, water and the marine environment, marine geology and coastal processes, historic environment, and landscape and seascape (Marine Scotland, 2015c). Such baseline criteria were then used to determine how the associated TCT growth scenarios, categorized quantitatively as low (indicative occupancy of 0.8-2.5%), medium (2.6%), and high (5.1%), may influence the level of associated risks, categorized qualitatively as low, medium, or high. The socio-economic assessment draws from the EIAs and socio-economic impacts of past offshore renewable energy projects in order to qualitatively determine the socio impacts and quantitatively measure the economic impacts of low (0.5GW of installed capacity), central (1.25GW), and high (2.5GW) growth scenarios on different locations and population demographics within Scotland (Marine Scotland, 2015a). The HRA assessed the potential for likely significant impacts of tidal energy development on SACs and SPAs located within a 100km buffer zone from draft plan options (Marine Scotland, 2015b).

57) How were these criteria established and validated?

As alluded to above, the criteria of environmental, ecological, social, and economic constraints were established by gathering baseline data specific to stressors and receptors, site characteristics, geographical proximity, and various population dynamics and demographics, in combination with drawing from past experiences of similar sectors, and qualitatively and quantitatively assessing risk ranging from low to high in relation to different TCT growth scenarios, also ranging from low to high (Marine Scotland, 2015a; 2015b; 2015c).

58) What are the risks being perceived by all participants involved in the planning process.

The risks being perceived by all stakeholders of the SMPTE include marine animal collision and displacement, benthic and pelagic habitat alteration, hydrodynamic alteration, sediment disposition, visual pollution, user – user conflicts, negative disruption of the current economic climate as a result of user – user conflicts and the

resulting social costs associated with negative scenarios, and the absence of consideration of draft plan options on contrasting population demographics in given local, municipal, and regional settlements (Marine Scotland, 2015a; 2015b; 2015c).

59) Are the risk criteria described in plain language to ensure that they will be understood by all participants?

All associated reports with the NMP and SMPTE process and framework include a a non-technical summary in order to be easily understood by all stakeholders of the SMPTE (Marine Scotland, 2015a; 2015b; 2015c).

5.2.15. Ecosystem Management Outcomes

- Inputs or outputs
  - QMO = P2, P3
  - QOP = T1, T10

60) How are the ecosystem management outcomes aligned with the ecosystem boundaries and significant ecosystem features and ecosystem services to be safeguarded?

Due to the strategic nature of the SMPTE, ecosystem boundaries are not employed to devise ecosystem management framework. However, MS will employ a deploy and monitor scenario as tidal development draft plan areas are given consent in order to safeguard significant ecosystem features and services (Marine Scotland, 2013a). Furthermore, the strategic allocation of SMPTE plan option areas are in compliance with various EU Directives pertaining to MSP, including the SEA Directive, Habitats Directive, Birds Directive, MSP Directive, and the MSFD.

61) Can the ecosystem management outcomes be achieved from the marine spatial plan within the management area?

The NMP stresses the importance of devising and implementing coordinated national, regional, and site/development specific monitoring strategies as the status of TCTs develops into a commercial scale sector. Given that the current iteration of SEA becomes an ongoing process, as suggested in the SMPTE consultation draft as being subject to two-year time intervals (Marine Scotland, 2013a), in conjunction with the legislated requirement of undertaking project-level EIAs for plan areas put forward as a mitigation measure under the HRA (Marine Scotland, 2015b), it is highly plausible that the SMPTE will achieve ecosystem management outcomes within the management area.

62) Are some of the ecosystem management outcomes dependent on management measures or marine spatial plans that are outside the management area?

While ecosystem management outcomes of the SMPTE are indeed inherently intertwined with management measures and MSPs outside of the SMPTE management area, these potential conflicts and anticipated interactions are taken into consideration in the broader NMP from which the SMPTE conforms its policies must conform to (Marine Scotland, 2013a).

63) Are the ecosystem management outcomes described in plain language that will be understood by all participants?

All associated reports with the NMP and SMPTE process and framework include a non-technical summary in order to be easily understood by all stakeholders of the SMPTE (Marine Scotland, 2015a; 2015b; 2015c).

5.2.16. MSP Management Outcomes

- Inputs or outputs
  - QMO = P2, P3
  - QOP = T7, T10

64) How do the MSP management outcomes align with the industry sector development priorities of the management area?

The key aims of the SMPTE are to maximize the aggregate installed capacity of tidal energy in Scotland, facilitate enhanced economic development, investment, and employment, and minimize adverse implication on people, other sectors, and the environment (Marine Scotland, 2013a). Taking this into consideration, in conjunction that the policies constructed in the SMPTE are derived from those of the NMP which is multi-sectoral in nature, the SMPTE was essentially constructed to align industry development priorities in a sustainable growth scenario context.

65) How do the MSP outcomes reconcile the needs of industry with the public and the communities of interests?

Since the SMPTE was essentially constructed to align industry development priorities in a sustainable growth scenario context, SMPTE outcomes reconcile the needs of industry and community stakeholders through the engagement of such stakeholders throughout the SMPTE process (pre-statutory consultation stage, RLG, IPF, SEA, socio-economic assessment, HRA, SA, consultation analysis report) (Marine Scotland, 2013a).

66) Can the MSP management outcomes be achieved with the marine spatial plan of the management area?

The NMP stresses the importance of devising and implementing coordinated national, regional, and site/development specific monitoring strategies as the status of TCTs develops into a commercial scale sector (Marine Scotland, 2013a). Given that the current iteration of sustainability appraisal becomes an ongoing process, as stated in the SMPTE as being subject to two-year time intervals suggested in the consultation draft, in conjunction with the low, medium, and high growth scenarios outlined in the NMP, it is highly plausible that the SMPTE will achieve ecosystem management outcomes within the management area.

67) Are some of the MSP management outcomes influenced by activities outside the management area or by other jurisdictions or policies?

While management outcomes of the SMPTE are indeed inherently intertwined with management measures and MSPs outside of the SMPTE management area, these potential conflicts and anticipated interactions are taken into consideration in the broader NMP from which the SMPTE conforms its policies must conform to (Marine Scotland, 2013a).

68) Are the MSP management outcomes described in plain language that will be understood by all participants?

All associated reports with the NMP and SMPTE process and framework include a non-technical summary in order to be easily understood by all stakeholders of the SMPTE (Marine Scotland, 2015a; 2015b; 2015c).

5.2.17. MSP Secretariat

MSP Secretariat:
- Function
  - QMO = P2, P4, P5, P6
  - QOP = T6

Information management:
- Inputs or outputs
  - QMO = P5, P6

Record keeping:
- Inputs or outputs
  - QMO = P5, P6

Work plans – project plan – tracking:
- Inputs or outputs
  - QMO = P5, P6

Human and financial resource tracking:
- Inputs or outputs
  - QMO = P5, P6

69) How and where is information (e.g. data, records, advice) stored?

All pertinent information related to the SMPTE process is stored in the SGs electronic records management system (Interview, 2016b).

70) What is the information and document management system?

The information and document management system related to the SMPTE process is the SGs electronic records management system (Interview, 2016b).

71) How are versions maintained and controlled?

The information and document management system related to the SMPTE process is the SGs electronic records management system (Interview, 2016a).

72) What are the security requirements to access and safeguard information?

Unpublished information pertaining to the SMPTE in any manner can only be accessed by and are safeguarded through a secured built-in version control SCOTS IT account system internal to SG employees (Interview, 2016c).

73) Who, from the MSP secretariat, is responsible for managing the information?

The information and document management system related to the SMPTE process is the SGs electronic records management system. However, there is no single member of MS who is responsible for the management of information pertaining to the SMPTE, rather, individual SG employees are responsible for managing their own individual information in which they produced (Interview, 2016a). This information is disseminated amongst SG internals on an as needed basis, and is available through the SG corporate records management system.

74) Is the MSP Secretariat included in terms of references of the Governance Body?

Yes, the MSP Secretariat is included in terms of references of the Governance Body (Interview, 2016a).

75) What are the copyright or proprietary requirements of the data and information submitted to the advisory processes?

Any data and information created by MS in relation the SMPTE and submitted to the advisory processes is be copyrighted under the Crown Copyright Marine Scotland. However, this does not necessarily present any constraints to third party use, as most information is available through the NMPi, and the SG is subject to the provisions of the Freedom of Information regulations (Interview, 2016c).

76) What are the filing plans for all documents produced during the planning and implementation process?

The information and document management system related to the SMPTE process is the SGs electronic records management system (Interview, 2016a).

77) What is the file retention period and requirements for the documents produced during the planning and implementation process?

All pertinent information related to the SMPTE process is stored for relevant periods of time in conformity with Freedom of Information/Environmental Information regulations (Interview, 2016b).

78) What are the privacy and accesses to information requirements for the documents on file?

The information produced by MS in relation to the SMPTE is classified as official sensitive, as opposed to secret or top secret, and can be accessed by an SG employee via their secured built-in version control Scots account system (Interview, 2016a).

79) What is the financial system used to track the human and financial resources?

The financing division of the SG within MS is the responsible authority for tracking human and financial resources in relation to the SMPTE process. All relevant expenditures are recorded under and traceable to the SG Enterprise Accounting System (Interview, 2016c).

5.3. Risk Identification

Drawing upon the ISO 31000 risk management standard, risk identification is defined as the the process of finding, recognizing and describing risks, including all possible sources, events, causes, and consequences of risk both within and outside the management area in which operational and environmental events resulting from the activities of drivers have the potential to produce ecological, cultural, social, economic, and legal repercussions (Cormier *et al.,* 2015). In the context of a MSP QMS, risk identification produces a risk profile which informs the construction of a risk assessment that will estimate the probability and impact of each risk identified. Therefore, it is essential that the risk identification process is scoped appropriately as any risk excluded from the risk identification, and subsequently the risk profile, will not be taken into consideration for the remainder of the MSP process.

5.3.1. Significant Ecosystem Components

Ecosystem biogeographic classification:

- Inputs or outputs
  - QMO = P2
  - QOP = T1

Significant ecological and biological criteria:

- Inputs or outputs
  - QMO = P2
  - QOP = T1

Significant ecosystem components:

- Inputs or outputs
  - QMO = P2
  - QOP = T1

80) What criteria are used to establish the ecosystem boundaries?

The SMPTE is a strategic MSP, therefore ecosystem boundaries have not been established.

81) Are the boundaries drawn by topographical or process-related criteria?

The SMPTE is a strategic MSP, therefore ecosystem boundaries have not been established.

82) What are the criteria to identify the significant ecosystem features and processes that need to be safeguarded to avoid ecosystem level consequences?

The SMPTE placed high constraint levels on SACs, SPAs, sites of scientific interest (SSSI), national scenic areas (NSAs – areas of outstanding scenic value from a national context) (Scottish National Heritage, 2016), and European RAMSAR sites, which are considered ecologically significant and sensitive when evaluating suitable sites for tidal energy development during the scoping stage (Interview, 2016c).

83) How were these criteria established and validated?

SACs and SPAs are established and evaluated under EU biological conservation

legislation within Natura 2000. Together with some coastal SSSIs, SACs and SPAs combine with designated MPAs to form Scottish marine protected area network under the Marine Scotland Act 2010 and the Marine and Coastal Access Act 2009 (Marine Scotland, 2013a). NSAs are established by SNH and legislated under the Planning etc. (Scotland) Act 2006 (Scottish National Heritage, 2016), and European RAMSAR sites established by the JNCC and legislated under the Wildlife and Countryside Act 1981 and the Nature Conservation (Scotland) Act 2004 (JNCC, 2016).

84) In terms of ecosystem integrity, what is the zone of influence of the activities of the drivers operating in the management area?

Drivers identified in the SMPTE as operating within the SMPTE management areas include potential tidal energy development and associated grid infrastructure, shipping and navigation, and recreation. Potential impacts are documented by the SEA as being site and technology specific, but generally of low overall risk to compromising ecosystem integrity (Marine Scotland, 2015c). Receptor pathways acknowledged in the SEA include fish, marine mammal, and diving sea bird collision risk with TCTs and alteration of hydrodynamics and associated interwoven coastal processes.

85) In terms of ecosystem integrity, what is the zone of influence of the activities of drivers operating outside the management area?

Drivers operating outside the SMPTE management areas are not specified in detail within the SMPTE, the detailed supporting documents published to inform the SMPTE construction and adoption process, the NMP, and the detailed supporting documents published to inform the NMP construction and adoption process. Therefore, exact judgements concerning the activities of drivers operating outside the SMPTE management area impacting the ecosystem integrity within the SMPTE management area cannot be made.

86) What are methods used to conduct the risk identification?

The criteria used to identify risk to valued ecosystem components are presented in the SEA and the HRA. The SEA takes into consideration technology specific TCT installation and operation and assessed their associated dynamics against a criteria of baseline conditions categorized as biodiversity, flora, and fauna, population and human health, water and the marine environment, marine geology and coastal processes, historic environment, and landscape and seascape (Marine Scotland,

2015c). Such baseline criteria were then used to determine how the associated TCT growth scenarios, categorized quantitatively as low (indicative occupancy of 0.8-2.5%), medium (2.6%), and high (5.1%), may influence the level of associated risks, categorized qualitatively as low, medium, or high (Marine Scotland, 2015a). The HRA assessed the potential for likely significant impacts of tidal energy development on SACs and SPAs located within a 100 km buffer zone from draft plan options (Marine Scotland, 2015b).

5.3.2. Significant Ecosystem Services

Significant ecosystems services criteria:

- Inputs or outputs
  - QMO = P2
  - QOP = T3, T4, T9

Significant ecosystem services:

- Inputs or outputs
  - QMO = P2
  - QOP = T3, T4, T9

87) What criteria are used to identify the significant traditional, cultural, social and economic ecosystem services?

The socio-economic assessment identifies significant traditional, cultural, social and economic ecosystem services by drawing from the EIAs and socio-economic impacts of past offshore renewable energy projects in order to qualitatively determine the socio impacts and quantitatively measure the economic impacts of low (0.5GW of installed capacity), central (1.25GW), and high (2.5GW) growth scenarios on different locations and population demographics within Scotland (Marine Scotland, 2015a).

88) Are the ecosystem services vulnerabilities related to the activities of the drivers occurring within the management area?

The ecosystem services, including the marine space, that support key stakeholders identified in the SMPTE (fishing, shipping/navigation, natural environment, local government, grid, national/devolved government, industry, community, and tourism/recreation) are potentially vulnerable to drivers occurring within the SMPTE management area, both from a user – user and user – environment conflict context (Marine Scotland, 2013a). This is the primary trigger for the SMP framework from

scoping to post-adoption plan in order to promote the SMPTEs strategic aims of identifying preferred development areas for tidal energy implementation in Scotland, facilitating enhanced economic development, investment, and employment, and minimizing adverse implication on people, other sectors, and the environment.

89) Are the ecosystem services vulnerabilities related to the activities of drivers occurring outside the management area?

Drivers operating outside the SMPTE management area have been taken into consideration via weighting allotted to them within the constraints layer applied in the scoping and RLG stages (Interview, 2016).

90) Does the human capital (complementary assets) exist to produce societal benefits from ecosystem services?

Ecosystem services have not been quantified by the SMPTE process, therefore, it is not possible to determine whether the human capital exists in order to produce associated societal benefits.

91) What was the process to validate the findings of the significant ecosystem services with the relevant communities of interest?

Although valued ecosystem components were identified in the SEA and HRA, significant ecosystem services have not been quantified by the SMPTE process.

5.3.3. Significant Driver Activities and Pressures

- Inputs or outputs
  - QMO = P2
  - QOP = T3

92) How are the current and future activities of drivers being identified and kept current?

The current and future activities of drivers within the SMPTE management area are being identified and kept current through two-year monitoring and review periods of the SMPTE suggested in the consultation draft undertaken by MS (Marine Scotland, 2013a). The current and future activities of drivers outside the SMPTE management area that may impact environmental, ecological, social, and economic processes and functions are being identified and kept current through five-year monitoring and review periods of the NMP undertaken by MS (Marine Scotland, 2014).

93) What criteria are used to select the “significant” drivers in terms of the risks they introduce in the management area in relation to other drivers and the ecosystem?

There are no quantifiable criteria employed to select significant drivers within the SMPTE management area, however, scoping studies, baseline environmental, ecological, economic, and social data published in the sustainability assessment report, and RLG are used to determine the potential impacts resulting from the activities of drivers within the SMPTE management area.

94) How is the marine development agenda used to inform the marine spatial planning process and its plan of new/emerging drivers?

The marine development agenda is used to inform the SMPTE process and potential new emerging drivers through RLG and two-year time interval monitoring and review periods suggested in the consultation draft (Marine Scotland, 2013a).

95) What are the activities emanating from those drivers and, subsequently, the pressures generated from those activities?

The activities emanating from drivers specified within SMPTE plan option areas include fishing, shipping and navigation, grid, industry, tourism and recreation, and tidal energy development (Marine Scotland, 2013a). These drivers are projected to generate pressures related to the functioning and integrity of benthic habitats and species, nature conservation areas, priority marine features, seabirds, cetaceans, elasmobranchs, seals, protected fish, shellfish, water quality, sediments, soils, and bathymetry

5.3.4. Management Area Regulatory Requirements

- Inputs or outputs
  - QMO = P2
  - QOP = T5

96) What are the legislative statutes or agreements that are used to manage the activities of the drivers operating in the management area?

The Marine Scotland Act 2010 provides the legislative and management framework for the marine environment within Scotland’s TZ and the Marine and Coastal Access Act 2009 provides the legislative and management framework for MSP within

Scottish waters out to Scotland's EEZ (Marine Scotland, 2014).

97) What is the occupation rate and location of the drivers operating in the management area?

The location of drivers operating within the SMPTE management area are listed in the socio-economic assessment, however, further specifications related to the occupation rate and micro-siting of TCTs within plan area options in relation to the magnitude of spatial and temporal uses of drivers within the SMPTE management area will be undertaken in more detail as licenses for commercial scale development are issued (Interview, 2016b).

98) How is the inventory of legislation and policies maintained current and up-to-date?

The SEA Directive requires that a baseline of all policies and legislation applicable to every stage of the SMPTE process is compiled by MS and listed in the SMP SEA (Interview, 2016b).

99) Are transnational issues handled and what is the relationship to regional bodies such as Regional Seas Commissions?

Transnational issues (including bio-regional marine issues) are handled by the UK government, which coordinates all EU Member States potentially affected or with an expressed interest in the SMPTE of the statutory consultation process in conformity with the SEA Directive (Interview, 2016b).

5.3.5. Risk Profile

- Inputs or outputs
  - QMO = P2, P7
  - QOP = T10

100) What were the consultation and feedback processes to ensure that competent authorities, industry stakeholders and communities of interest concur with the description of the risks in the risk profile?

Consultation amongst the CA and relevant industry and community stakeholders is taken into consideration in order to obtain sectoral and local knowledge and values when searching for potentially suitable tidal energy development sites during the pre-statutory consultation stage, and continually updated during advancing stages of the

SMPTE (RLG, IPF, SEA, socio-economic assessment, HRA, SA, consultation analysis report) (Marine Scotland, 2013a). Industry and community stakeholder input is then documented and published in the pre-consultation analysis report, IFP, consultation analysis report, with the post-adoption statement detailing how such input was incorporated into the SMPTE final plan options.

101) What verification is being done to ensure that the risk profile is linked to the MSP management outcomes and the ecosystem management outcomes?

MS will employ a deploy and monitor scenario as tidal development draft plan areas are given consent in order to determine the impact of drivers on ecosystem components and/or processes, incrementally gathering information to inform mitigation measures as appropriate in order to ensure that SMPTE strategic aims are met (Marine Scotland, 2013a).

102) Is the language, media and techniques used to describe the risk profile adapted to the audience?

All associated reports with the NMP and SMPTE process and framework include a non-technical summary in order to be easily understood by all stakeholders of the SMPTE (Marine Scotland, 2015a; 2015b; 2015c).

5.4. Risk Analysis

Drawing upon the ISO 31000 risk management standard, risk analysis is defined as the process of comprehending and determining the probability and impact of risks both within and outside the management area in which operational and environmental events resulting from the activities of drivers have the potential to produce ecological, cultural, social, economic, and legal repercussions (Cormier *et al*., 2015). Informed by the risk profile generated from the risk identification process, the contents of the risk analysis will feed into the risk evaluation process which will establish the severity of the risks to inform risk treatment procedures.

5.4.1. Cause and Effect Analysis

- Function
  - QMO = P3, P6
  - QOP = T10

103) What are the ecosystem components or processes that would be altered or degraded as a result of the pressures occurring from the activities of the drivers?

The ecosystem components or processes that would be altered or degraded as a result of the pressures occurring from the activities of the drivers include benthic habitats and species, nature conservation areas, priority marine features, seabirds, cetaceans, elasmobranchs, seals, protected fish, shellfish, water quality, sediments, soils, and bathymetry (Marine Scotland, 2015c).

104) Has the pressure-activity-state change–impact chain been defined for relevant developments?

Due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, the pressure-activity-state change–impact chain has yet to be defined. The SMPTE process undertook an opportunities and constraints approach rather than a pressures and impacts approach to assess the severity of impacts. However, MS will employ a deploy and monitor scenario as tidal development draft plan areas are given consent in order to determine the impact of drivers on ecosystem components and/or processes, incrementally gathering information to inform mitigation measures as appropriate (Marine Scotland, 2013a).

105) What would be the duration and trajectory or trajectories of the recovery?

Due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, the duration and trajectory of recovery to ecosystem components or processes that would be altered or degraded as a result of the pressures occurring from the activities of the drivers within and outside the SMPTE management area have not been estimated. However, MS will employ a deploy and monitor scenario as tidal development draft plan areas are given consent in order to determine the impact of drivers on ecosystem components and/or processes, incrementally gathering information to inform mitigation measures as appropriate (Marine Scotland, 2013a).

106) What is the feasibility of the mitigation or restoration strategies that could be implemented if natural recovery is not possible?

Due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, the feasibility of mitigation and/or restoration strategies have yet to be determined. However, MS will employ a deploy and monitor scenario as tidal development draft plan areas are given consent in order to determine the impact of drivers on ecosystem components and/or processes, incrementally gathering information to inform the feasibility of mitigation and/or restoration strategies as appropriate (Interview, 2016c).

107) What method was used to conduct the cause and effect analysis?

Due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, the formulation of a cause and effect analysis is an ongoing process. Although individual commercial-scale TCT test results have been obtained from various developers and EMEC, MS will employ a deploy and monitor scenario as tidal development draft plan areas are given consent in order to determine the impact of drivers on ecosystem components and/or processes, incrementally gathering information to inform mitigation measures as appropriate (Marine Scotland, 2013a).

5.4.2. Impacts Consequences and Repercussions

Ecosystem impacts:

- Inputs or outputs
  - QMO = P2
  - QOP = T1, T10

Ecosystems services consequences:

- Inputs or outputs
  - QMO = P2
  - QOP = T4, T9, T10

Economic consequences:

- Inputs or outputs
  - QMO = P2
  - QOP = T3, T10

Driver conflicts:

- Inputs or outputs
  - QMO = P2
  - QOP = T5, T10

Legal repercussions:

- Inputs or outputs
  - QMO = P2
  - QOP = T5, T10

108) What are the ecosystem features and process that may be altered or degraded as a result of the pressures introduced by the activities of the drivers operating in the management area?

The ecosystem features and processes that would be altered or degraded as a result of the pressures occurring from the activities of the drivers include benthic habitats and species, nature conservation areas, priority marine features, seabirds, cetaceans, elasmobranchs, seals, protected fish, shellfish, water quality, sediments, soils, and bathymetry (Marine Scotland, 2015c).

109) What are the traditional, cultural and social consequences if a given ecosystem service is impacted by pressures or changes introduced by the activities of the drivers operating in the management area?

The SMPTE socio-economic assessment report estimates that the potential consequences categorized under the “social” umbrella resulting from the disruption of ecosystem services such as benthic habitats and species, nature conservation areas, priority marine features, seabirds, cetaceans, elasmobranchs, seals, protected fish, shellfish, water quality, sediments, soils, and bathymetry (Marine Scotland, 2015c), via the deployment of tidal energy projects are limited to commercial fisheries, recreational boaters, sea kayakers, and sea anglers (Marine Scotland, 2015a). However, such impacts are expected to be negligible in the broad picture, as any negatively affected social receptor should be balanced out by the positive impacts of another, although this would mean that impacts are rather localized and be assessed as such.

110) What societal benefits would be impeded or impacted by the ecosystem alteration and loss or reduction of ecosystem services?

The SMPTE socio-economic assessment report estimates that the societal benefits

that would be impeded or impacted by ecosystem alteration and loss or reduction of ecosystem services such as those provided by benthic habitats and species, nature conservation areas, priority marine features, seabirds, cetaceans, elasmobranchs, seals, protected fish, shellfish, water quality, sediments, soils, and bathymetry (Marine Scotland, 2015c), via the deployment of tidal energy projects are limited to commercial fisheries, recreational boaters, sea kayakers, and sea anglers (Marine Scotland, 2015a). However, such impacts are expected to be negligible in the broad picture, as any societal benefit impeded should be balanced out by the positive impacts of another, although this would mean that impacts are rather localized and be assessed as such. The potential effects on such societal benefits produced from sectors have been quantified in monetary terms under three TCT growth scenarios, low (0.5GW), central (1.25GW), and high (2.5GW), for the three plan option regions, southwest, west, and north. The impact on aggregate presented value (PV) and gross added value (GVA) for commercial fisheries amongst all regions and averaged across all scenarios can be calculated as £1.5 million. This demonstrates a miniscule impact on societal benefits, although only the high TCT growth scenario has estimated a potential negative impact on sectors in the North region in particular, estimated at £9.93 million.

111) What is the size of the community or electorate that would react to the consequences?

The SMPTE socio-economic assessment report estimates that the potential consequences categorized under the “social” umbrella resulting from the disruption of ecosystem services such as benthic habitats and species, nature conservation areas, priority marine features, seabirds, cetaceans, elasmobranchs, seals, protected fish, shellfish, water quality, sediments, soils, and bathymetry (Marine Scotland, 2015c), via the deployment of tidal energy projects is negligible on a national and regional scale. However, very minor affects are estimated on a local scale, therefore local communities situated in close proximity to plan option areas engaging in commercial fishing, recreational boating, sea kayaking, and sea angling may react to such consequences of tidal energy development.

112) What are the potential economic losses or liabilities if activities are displaced or encroached on by the activities of other drivers occurring in the management area?

The potential economic loses produced from sectors have been quantified in monetary terms under three TCT growth scenarios, low (0.5GW), central (1.25GW), and high (2.5GW), for the three plan option regions, southwest, west, and north

(Marine Scotland, 2015a). The impact on aggregate presented value (PV) and gross added value (GVA) for commercial fisheries amongst all regions and averaged across all scenarios can be calculated as £1.5 million. This demonstrates a miniscule impact on societal benefits, although only the high TCT growth scenario has estimated a potential negative impact on sectors in the North region in particular, estimated at £9.93 million.

113) What strategic or international repercussions could occur if the ecosystem management outcomes are not achieved?

In the event that ecosystem management outcomes of the NMP in management areas of the SMPTE are compromised, EU marine legislation including the MSFD and the MSP Directive set out the strategic and/or international repercussions that are to ensue (Interview, 2016b).

114) Is there a conflict resolution / appeal process when management outcome is not being achieved?

In the event that ecosystem management outcomes of the NMP in management areas of the SMPTE are not achieved EU marine legislation including the MSFD and the MSP Directive establish a framework for a conflict resolution/appeal process (Interview, 2016b).

5.4.3. Risk Matrix

- Inputs/Outputs
  - QMO = P2
  - QOP = T7, T10

115) How are the contributions of the various causes integrated to determine management priorities?

The contributions of various causes are integrated to determine management priorities manifested as strategic aims through the scoping stage all the way through to the Scottish Ministers' approval of the final draft plan, with contributions concerning specific scientific and technical advisory exclusive of the sustainability appraisal persistent throughout the SMPTE process via RLG (Interview, 2016a).

116) Are the risk criteria integrated in the classification of the likelihood and extent of the events and consequences?

The environmental and ecological, social, and economic risk criteria are measured in likelihood and magnitude of risk under probability of risk occurring via the SEA and HRA, with social and economic risk measured in relation to three growth scenarios, low (0.5GW), central (1.25GW), and high (2.5GW), via the socio-economic assessment, although only economic risk has been quantified (Marine Scotland, 2015a).

117) How was the likelihood and severity of a risk occurring described and validated with the participants?

The likelihood and severity of environmental, ecological, social, and economic risks are validated internally within MS by measuring it against baseline data and sharing results with external stakeholders from the sustainability appraisal report to the post-adoption statement (Marine Scotland, 2013a).

5.5. Risk Evaluation

Drawing upon the ISO 31000 risk management standard, risk evaluation is defined as the process of comparing the output of the risk analysis with risk criteria in order to discern whether risks are acceptable and/or tolerable by all stakeholders engaged within the planning process (Cormier *et al.,* 2015). Outputs of the risk evaluation process inform the management and/or mitigation measures formulated during the risk treatment process.

5.5.1. Management Measures Evaluations

- Function
  - QMO = P2, P6
  - QOP = T5, T6

118) What are the criteria used to evaluate and classify the effectiveness and feasibility of the management options, given that information obtained from competent authorities on the effectiveness of selected management measures may be confidential?

The criteria used to evaluate and classify the effectiveness and feasibility of the management options within SMPTE plan option areas are the assessment of policy tools and objectives of the NMP in which the SMPTE must be consistent with, and

will be undertaken when licenses for commercial tidal energy developments have been issued (Interview, 2016b).

119) Were the management measures derived from the inputs of all relevant players?

Management measures were derived from the inputs of MS staff, as the sole acting CA, through the entirety of the SMPTE process, Scottish Ministers from the final draft plan to the post adoption statement, scientific and technical experts engaged with steering groups such as the MSF to inform the sustainability appraisal, and all relevant community and industry stakeholders from the pre-statutory consultation stage through to the post-adoption statement (Interview, 2016b).

120) What are the existing legislations, regulations, directives, policies, best management practices, standard operating procedures that may need to be implemented for each management option being considered?

The methods used to identify the existing legislations, regulations, directives, policies, best management practices, standard operating procedures that may need to be implemented within SMPTE plan option areas are garnered from the assessment of policy tools and objectives of the NMP in which the SMPTE must be consistent with (Interview, 2016b).

121) How is the evaluation of the management measures being conducted (e.g. technique, qualifications of assessors, etc.) and documented?

The evaluation of the management measures of the SMPTE are conducted through the assessment of policy tools and objectives of the NMP in which the SMPTE must be consistent with, and will be documented and stored in the SGs electronic records management system (Interview, 2016b).

5.5.2. Existing Management Measures Acceptable for the Marine Spatial Plan

- Inputs or outputs
  - QMO = P1, P3
  - QOP = T1, T2, T5

122) What could be the legal and policy liabilities and repercussions arising from not achieving the MSP or ecosystem management outcomes?

In the event that ecosystem management outcomes of the NMP in management

areas of the SMPTE are compromised, EU marine legislation including the MSFD and the MSP Directive establish the legal and policy liabilities and repercussions that are to ensue (Interview, 2016b).

123) What could be the strategic or international repercussions if the MSP or ecosystem management outcomes are not achieved?

In the event that ecosystem management outcomes of the NMP in management areas of the SMPTE are compromised, EU marine legislation including the MSFD and the MSP Directive set out strategic and/or international repercussions that are to ensue (Interview, 2016b).

124) What are the monitoring plans needed to evaluate the effectiveness of the existing management measures?

The two-year monitoring and review period suggested in the SMPTE consultation draft is employed to evaluate the effectiveness of the existing management measures (Interview, 2016b).

5.5.3. New or Enhanced Management Measures Needed for the Marine Spatial Plan

- Inputs or outputs
  - QMO = P1, P3
  - QOP = T1, T2, T5

125) What could be the legal and policy liabilities and repercussions arising from not achieving the MSP or ecosystem management outcomes?

In the event that ecosystem management outcomes of the NMP in management areas of the SMPTE are compromised, EU marine legislation including the MSFD and the MSP Directive sets out legal and policy liabilities and repercussions that are to ensue (Interview, 2016b).

126) What could be the strategic or international repercussions if the MSP or ecosystem management outcomes are not achieved?

In the event that ecosystem management outcomes of the NMP in management areas of the SMPTE are compromised, EU marine legislation including the MSFD and the MSP Directive set out strategic and/or international repercussions that are to ensue (Interview, 2016b).

127) What are the monitoring plans needed to evaluate the effectiveness of the existing, enhanced or additional management measures?

The two-year monitoring and review period suggested in the SMPTE consultation draft is employed to evaluate the effectiveness of the existing, enhanced, or additional management measures (Interview, 2016b).

128) What criteria were used to evaluate the tolerability of the risks?

The criteria employed to evaluate the tolerability of environmental, ecological, economic, and social risks are presented as assessment objectives listed in the annexes of the SEA, socio-economic, and HRA reports used to inform the sustainability appraisal report (Interview, 2016b).

129) Who is involved in that evaluation from the competent authorities, the industry stakeholders and the communities of interest?

Decisions concerning the evaluation of the effectiveness of the SMPTE process and management measures within its boundaries involve the input of MS, relevant stakeholders and scientific and technical advisory bodies apart of the SG's Marine Strategy Forum (MSF), approved by Scottish Ministers and chaired by the Policy Lead in conjunction with scientific and technical specialists applicable to specific stages and processes of the SMPTE (e.g. the Environmental Assessment Specialist in relation to the SEA, the Government Economist in relation to socio-economic assessment, etc.). The evaluation is then published in the Scottish Ministers' post-adoption statement in order to reflect a participatory and transparent planning process (Interview, 2016b).

5.5.4. Marine Spatial Risk Register

- Inputs or outputs
  - QMO = P2, P6, P7
  - QOP = T10

130) Where is the risk register maintained and filed and how is its access controlled?

All responses emanating from the statutory consultation stages of the SMPTE process are stored in the SGs electronic records management system and published in the post-adoption statement (Interview, 2016b).

131) How is the risk register made available to all participants for communication purposes?

All inputs and outputs used to inform and establish the risk register are published online and justified through the publication of the post-adoption statement (Interview, 2016b).

132) Who reviews and keeps the risk register up-to-date as decisions to develop new or enhanced management measures are made?

Due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, there has not been a need as of yet to review the risk register in order to develop new or enhanced management measures based real-time commercial deployment interaction data. Furthermore, although all data concerning the SMPTE is documented and stored in the SGs electronic records management system, no individual MS employee has been delegated with the responsibility of reviewing and updating the risk register, rather, it is the responsibility of each individual SG employee to keep the information they have produced up to date based on the availability and accessibility or pertinent information and the priorities set forth by the SG through project delegation.

5.6. Risk Treatment

Drawing upon the ISO 31000 risk management standard, risk treatment is defined as the process of either modifying risk through avoidance, eliminating risk sources, or reducing risk through prevention or mitigation of consequences (Cormier *et al.,* 2015). Drawing upon management options identified in risk evaluation and documented in the risk register, risk treatment devises spatial and temporal management measures that take into consideration the costs, benefits, and feasibility of implementing the MSP as its output.

5.6.1. Spatial and Temporal Management Options

- Inputs or outputs
  - QMO = P1, P3
  - QOP = T10

133) Are the proposed management options able to reduce the risks of not achieving the MSP and ecosystem management outcomes to a level as low as reasonably practicable (ALARP)?

Due to the strategic deploy and monitor management protocol adopted by the SC in relation to TCT implementation projects, such as that of MeyGen, the risks of ecosystem stressors outlined in the SEA can be managed in the SMPTE in accordance with the ALARP principal (Marine Scotland, 2015c).

134) What is the economic and technical feasibility of the proposed management options in terms of implementation, enforcement and integration into operational activities?

The economic and technical feasibility of the proposed management options in terms of implementation, enforcement and integration into operational activities has not been quantified by the SMPTE process.

135) Are the management measures SMART?

While the management measures are SMART (Specific, Measurable, Achievable, Realistic, Time-bound) in that they plan for a monitoring and review period in two-year time intervals suggested in the SMPTE consultation draft, with the discovery of any criteria evoking a change in the SMPTE becoming subject to formal consultation and reporting, there is a lack of clarity and solidity on how management measures will be undertaken, the quantification of detrimental impacts that will deem tidal development projects no longer sustainable and acceptable, and the quantification of development objectives to be achieved.

5.6.2. Management Options Costs, Benefits and Feasibility

Management options – ecosystem benefits:
- Inputs or outputs
  - QMO = P3
  - QOP = T1

Management options – cultural and societal implications:
- Inputs or outputs
  - QMO = P3
  - QOP = T4, T8

Management options – economic options:
- Inputs or outputs
  - QMO = P3
  - QOP = T2, T3

Management options – legal and policy repercussions:

- Inputs or outputs
  - QMO = P3
  - QOP = T5, T6

136) What are the indicators and thresholds used to forecast the ecosystem benefits as a result of implementing the management options?

The ecosystem benefits resulting from the implementation of the SMPTE management options include the assistance that TCT implementation will provide in helping Scotland transition into a carbon-free nation and therefore assisting in the mitigation of global climate change (Marine Scotland, 2013a). The criteria to indicate this outcome consists of the amount of current GHG emission reductions displaced by the implementation of TCTs via the aggregate electricity generated.

137) What are the operating procedures and standards that will need to be updated as a result of implementing the management options?

Due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, the two-year monitoring and review period suggested in the SMPTE consultation draft will inform the environmental, ecological, social, and economic interactions arising from commercial-scale TCT implementation and allow operating procedures put in place for the current plan to be updated as information becomes available (Marine Scotland, 2013a).

138) What are the costs of implementation as a result of implementing the management options in terms of training, equipment acquisition, changes to procedures, and impacts on production efficiency?

The costs of implementing the management options such as training, equipment acquisition, changes to procedures, and impacts on production efficiency have not been quantified for the SMPTE.

139) What are the criteria used to assess and classify the level of social demand, acceptance and/or tolerance?

Social demand, acceptance, and/or tolerance have not been classified to a discernable level, however, this id due to the strategic nature of the SMPTE and the fact that social sciences do not demand the quantification of human emotion. The

SMPTE process is structured to engage all relevant stakeholders from the pre-statutory consultation stage through to the post-adoption statement, with input being garnered between two-year planned review and monitoring reports suggested in the consultation draft undertaken and published as required (Marine Scotland, 2013a).

140) What is the legislative and regulatory framework under which the management options would be implemented?

Under the management framework stipulated in the NMP, the SMPTE legislative and regulatory framework is bounded by the Marine Scotland Act 2010 and the Marine and Coastal Access Act 2009 (Marine Scotland, 2013a).

141) What are the policy and program of the competent authorities that will need to be updated or changed as a result of implementing the management measures?

Due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, the updating of policies and programs resulting from the implementation of management measures undertaken by MS can not yet be determine, although the two-year monitoring and review period will inform any necessary alterations required in the political framework as information becomes available (Marine Scotland, 2013a).

142) What are the criteria and consultation processes used to demonstrate how the management measures reduce risks to traditional, cultural, social, and economic ecosystem services?

Due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, the criteria and consultation processes used to demonstrate how the management measures reduce risks to traditional, cultural, social, and economic ecosystem services has yet to be determined by the SMPTE process. However, monitoring and review of the SMPTE will be conducted in two-year time intervals as suggested in the consultation draft, with the discovery of any criteria evoking a change in the SMPTE becoming subject to formal consultation and reporting being published and made publically available (Marine Scotland, 2013a).

5.6.3. Marine Spatial Plan

- Inputs or outputs
  - QMO = P2, P7
  - QOP = T1-10

143) What is the process that the MSP Competent Authority must follow to obtain approval for the implementation of the marine spatial plan?

As the acting CA, MS must follow the SMP process detailed in Section 3.2. in order to obtain approval for Scottish Ministers' for the implementation of SMPTE final plan options (Marine Scotland, 2013a).

144) What is the process that the other competent authority must follow to obtain approval for the implementation of the marine spatial plan?

MS is the sole CA for Scotland's SMPTE (Marine Scotland, 2013a).

145) What is the type of agreement needed to implement the marine spatial plan to ensure accountability of the competent authorities and industry stakeholders?

The legislative agreement required to implement the SMPTE to ensure accountability of MS and industry stakeholders is derived from the Marine Scotland Act 2010 and the Marine and Coastal Access Act 2009 which delegate MS as the CA for the NMP and devolve marine planning matters of UK's EEZ to Scottish Parliament respectively (Marine Scotland, 2013a). Together, these legislative agreements coincide to formulate the NMP, from which the SMPTE's policies must conform to, which regulates the activities of industry stakeholders in the management area and facilitates engagement of industry stakeholders in the SMP process.

146) Who is accountable for reporting on the implementation of the marine spatial plan?

MS, as the acting CA, is accountable for reporting on the implementation of the SMPTE (Marine Scotland, 2013a).

147) What are the human and financial resource implications for the implementation of the marine spatial plan from the perspective of the governance structure, secretariat, competent authorities and industry stakeholders?

The human and financial resources have been quantified and documented by the financing division of the SG within MS (Interview, 2016).

148) What are the complaints and feedback procedures once the marine spatial plan has been implemented?

Monitoring and review of the SMPTE will be conducted in two-year time intervals as suggested in the consultation draft, with the discovery of any criteria evoking a change in the SMPTE becoming subject to formal consultation and reporting being published and made publically available, at which point, MS will allow for all relevant stakeholder input on the performance of the SMPTE (Marine Scotland, 2013a).

5.7. Monitoring and Review

Drawing upon the ISO 31000 risk management standard, monitoring and review is defined as the process of continuously checking, supervising, and observing the risk management plan in order to determine if the plan remains suitable to achieve its objectives, and the broader MSP development and environmental objectives, over an unremitting timescale (Cormier *et al.,* 2015).

5.7.1. Marine Spatial Plan Implementation

- Function
  - QMO = P5
  - QOP = T5, T6

149) What is the work plan for the implementation of the marine spatial plan?

Following Scottish Ministers' adoption of the finalized SMPTE, and the release of a post-adoption statement, MS will implement project licensing for tidal energy development proposals for adopted plan options, as legislated under the Marine Scotland Act 2010 (Marine Scotland, 2013a).

150) Who is responsible for oversight, direction and reporting as to the implementation of the marine spatial plan?

MS, as the acting CA, is responsible for oversight, direction, and reporting regarding the implementation of the SMPTE (Interview, 2016b).

5.7.2. Compliance Verification and Auditing

Compliance verification:

- Function
  - QMO = P5
  - QOP = T5

Conformity performance audits:

- Function
  - QMO = P5
  - QOP = T2

MSP performance reports:

- Inputs or outputs
  - QMO = P5
  - QOP = T10

151) What are the compliance verification procedures to determine compliance of the regulated parties?

The compliance verification procedures employed to determine compliance of the regulated parties with respect to the SMPTE manifested through compliance of the SMPTE with the policy tools and objectives of the NMP in which the SMPTE must be consistent with, in conjunction with the marine licensing manual and any post-consent monitoring strategies (Interview, 2016).

152) Who are the competent authorities that have the necessary jurisdiction to conduct compliance verification?

MS, as the sole acting CA, has the necessary jurisdiction to conduct compliance verification for the SMPTE (Interview, 2016b).

153) What are the regulated activities of the drivers that are regulated under the marine spatial plan?

The regulated activities of drivers operating within the SMPTE management area are regulated under the NMP. The specific spatial and temporal uses of such activities are identified in the scoping stage of the SMPTE and taken into consideration through out the entire SMPTE process in order to select the most suitable commercial plan option areas (Interview, 2016b).

154) Who is accountable for initiating conformity or performance audits?

MS, as the sole acting CA, is accountable for initiating conformity or performance audits of the SMPTE under the framework of the NMP, with the Scottish Ministers' post-adoption statement in conjunction with the two-year review and monitoring process suggested by the SMPTE consultation draft acting as the defacto audit process (Interview, 2016b).

155) How are joint audit process initiated and under what agreement?

MS, as the sole acting CA, is accountable for initiating conformity or performance audits of the SMPTE under the framework of the NMP, with the Scottish Ministers' post-adoption statement in conjunction with the two-year review and monitoring process suggested in the SMPTE consultation draft acting as the defacto audit process. Therefore, there are no joint audit processes for the SMPTE (Interview, 2016b).

156) What is the conformity and performance audit framework?

MS, as the sole acting CA, is accountable for initiating conformity or performance audits of the SMPTE under the framework of the NMP, with the Scottish Ministers' post-adoption statement in conjunction with the two-year review and monitoring process suggested in the SMPTE consultation draft acting as the defacto audit process (Interview, 2016b).

157) Who is accountable for preparing the audit report and responding to the findings?

MS, as the sole acting CA, is accountable for preparing the audit report for the SMPTE and responding to the findings under the framework of the NMP, with the Scottish Ministers' post-adoption statement in conjunction with the two-year review and monitoring process acting as the defacto audit process (Interview, 2016b).

158) What is the formal approval process to initiate an audit and request corrective action plans?

MS, as the sole acting CA, formally approves the audit initiation process and request for corrective action plans for the SMPTE under the framework of the NMP, with the Scottish Ministers' post-adoption statement in conjunction with the two-year review and monitoring process acting suggested in the SMPTE consultation draft as the

defacto audit process (Interview, 2016b).

159) How will the MSP performance report be communicated and made available to all participants of the MSP plan?

Monitoring and review of the SMPTE will be undertaken by MS in two-year time intervals AS suggested in the consultation draft, with the discovery of any criteria evoking a change in the SMPTE becoming subject to formal consultation and reporting being published and made publically available (Marine Scotland, 2013a).

5.7.3. Ecosystem Status and Trends Monitoring

Monitor ecosystem status and trends:

- Function
  - QMO = P5
  - QOP = T1

Ecosystem status and trends report:

- Inputs or outputs
  - QMO = P5
  - QOP = T10

160) Who is accountable for implementing the ecosystem monitoring program and conducting the data collection and analysis?

MS, as the acting CA, is accountable for implementing the ecosystem monitoring program and conducting the data collection and analysis, while individual project developers are responsible for conducting EIAs and implementing site specific monitoring programs for their developments (Marine Scotland, 2013a).

161) How are the management measures of the marine spatial plan linked to the ecosystem monitoring activities?

Management measures of the SMPTE are inherently intertwined with ecosystem monitoring activities, as the strategic aims of the SMPTE are to maximize the aggregate installed capacity of tidal energy in Scotland, facilitate enhanced economic development, investment, and employment, and minimize adverse implication on people, other sectors, and the environment (Marine Scotland, 2013a).

162) What are indicators used to monitor the environmental effects occurring at the ecosystem level?

Indicators used by the SMPTE to monitor the environmental effects occurring at the ecosystem level include baseline ecosystem data collected for the SEA categorized as biodiversity, flora, and fauna, population and human health, water and the marine environment, marine geology and coastal processes, historic environment, and landscape and seascape (see the SEA report for details) (Marine Scotland, 2015c).

163) What are the threshold and criteria to ascertain the effectiveness of the management measures of the marine spatial plan at achieving the management outcomes?

Due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, thresholds and criteria to ascertain the effectiveness of the management measures of the SMPTE in achieving the management outcomes have yet to be determined. However, MS will employ a deploy and monitor scenario as tidal development draft plan areas are given consent in order to determine the impact of drivers on ecosystem components and/or processes, incrementally gathering information to better quantify the success or failure of management measures (Marine Scotland, 2013a).

164) What resources are available to conduct the ecosystem monitoring program?

Due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, resources available to conduct the ecosystem monitoring program have not been quantified.

165) Are the results biased by other sources of risk not covered by the marine spatial plan or are they biased by ecological change?

Although individual commercial-scale TCT test results have been obtained from various developers and EMEC, there is currently a lack of ecosystem monitoring results with respect to commercial-scale TCT array deployment of which the MeyGen project will be the first. However, the monitoring results of the SMPTE are not formulated to be biased toward any criterion, rather, the environmental, ecological, social, and economic impacts outlined in the sustainability appraisal report are designed to be weighted as appropriate to each tidal energy development

as consent is granted and project leases are permitted.

166) Who is accountable for preparing the ecosystem status and trends report and responding to the findings?

MS, as the acting CA, is accountable for preparing the ecosystem status and trends report and responding to the findings in two-year time intervals suggested in the SMPTE consultation draft (Marine Scotland, 2013a).

167) How will the ecosystem status and trends reports be communicated and made available to all participants of the MSP plan?

Monitoring and review of the SMPTE will be undertaken by MS in two-year time intervals as suggested in the SMPTE consultation draft, with the discovery of any criteria evoking a change in the SMPTE becoming subject to formal consultation and reporting being published and made publically available (Marine Scotland, 2013a).

5.7.4. Cultural and Socio-Economic Monitoring

Cultural and social trends:

- Function
  - QMO = P5
  - QOP = T4, T9

Sector economic performance:

- Function
  - QMO = P5
  - QOP = T3

Cultural socio-economic reports:

- Inputs or outputs
  - QMO = P5
  - QOP = T10

168) Who is accountable for monitoring the cultural and socio-performance of the marine spatial plan?

MS, as the sole acting CA, is accountable for monitoring the cultural and socio-performance of the SMPTE (Marine Scotland, 2013a).

169) What are indicators used to monitor the cultural trends and the socio-economic performance of the marine spatial plan?

Due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, no socio-economic assessment monitoring has been constructed at the moment, therefore, no indicators of socio-economic performance monitoring have been developed and finalized. However, monitoring and review of the SMPTE will be conducted in two-year time intervals as suggested in the consultation draft, with the discovery of any criteria evoking a change in the SMPTE becoming subject to formal consultation and reporting being published and made publically available (Marine Scotland, 2013a).

170) What human and financial resources are available to conduct these analyses?

Due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal plan devised in the world, no socio-economic assessment monitoring has been constructed at the moment, therefore no agenda for the allotment of human and financial resources have been developed and finalized.

171) Who is accountable for preparing the cultural and socio-economic reports and responding to the findings?

MS, as the sole acting CA, is accountable for preparing the cultural and socio-economic reports and responding to the findings of the SMPTE (Marine Scotland, 2013a).

172) How will these reports be communicated and made available to all participants of the MSP plan?

The final socio-economic assessment report for the SMPTE has been published and made publically available. However, due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal plan devised in the world, no socio-economic assessment monitoring has been constructed at the moment.

5.7.5. Marine Spatial Plan Periodic Review

- Function
  - QMO = P7
  - QOP = T1-10

173) What is the schedule for the review of the plan?

At this early stage, it is suggested that the SMPTE is reviewed every two years as suggested in the consultation draft (Marine Scotland, 2013a).

174) Is the MSP competent authority accountable to initiate and perform the review?

MS, as the acting CA, is accountable to initiate and perform the review of the SMPTE (Marine Scotland, 2013a).

175) What is the formal approval process to initiate the review?

The SMPTE suggests that a monitoring and review process be initiated by MS every two years (Marine Scotland, 2013a). Although this remains a suggestion due to the early stages of SMPTE implementation, however, legislation guiding the NMP in which the SMPTE must be consistent with dictates a review period of every five years at the minimum. The current monitoring and review timeline is dependent on results stemming from the scientific and technical assessments which suggest the current plan option areas are unacceptably conflicting with the marine environment and other users of the marine environment within the SMPTE management areas, demand from relevant stakeholders and Scottish Ministers to undertake a further process to identify new plan option areas, and the need to review in line with the five-year legislated monitoring and review period of the NMP in which the SMPTE must be in consistent with (Interview, 2016b).

176) Who has the authority to make changes to the marine spatial plan?

MS, as the acting CA, has the authority to make changes to the SMPTE (Marine Scotland, 2013a).

177) What is the selection process to identify a review team? What are their qualifications?

MS members appointed to the NMP monitoring and review team are delegated as the monitoring and review team for the SMPTE (Interview, 2016b).

178) Are the reviewers “independent” from the approvers?

MS acts as the reviewers of the SMPTE while approvers are Scottish Ministers, therefore, reviews are approvers are independent bodies from one another, thereby reducing biased and conflict of interest (Interview, 2016b).

6. Results and Discussion

A quality review of Scotland’s SMPTE against the ICES MSP QMS QMC demonstrates a 79.5% conformity with best practice standards as set out in the ICES document, scoring 140/176, with two neutral scores. Answers drawn from the SMPTE pertaining to questions emanating from the QMC were considered to be in conformity if the SMPTE could demonstrate that the appropriate internal and/or external organizations could be aligned to stated roles within the SMPTE process, and if inputs and outputs and/or functions of the SMPTE process took into consideration the criteria put forth in the ICES document. However, as the purpose of this paper is to undertake a quality review of the SMPTE in accordance with the ICES MSP QMS, it must be acknowledged that the ICES document is not free from criticism itself, and the 79.5% conformity ranking is only in relation to this document rather than a general quality review of the SMPTE against numerous best practice MSP policy guideline documents (e.g. UNESCO’s *Marine spatial planning: A step by step approach toward ecosystem based management,* the European Commission’s *MSP Directive (2014/89/EU)*, etc.). This consideration is especially pertinent as the SMPTE is not a contemporary MSP in and of itself, rather, it is a sectoral plan siting the most strategic location for tidal energy development within Scottish waters with the broader intent of informing Scotland’s NMP. Therefore, the following subsections provide the ranking percentage breakdown for each section and subsection of the ICES QMC.

A colour legend (Table 2) has been applied to figures 4-10 demonstrating the conformity ranking of the various components analyzed, as well as the broader context of the QMS system itself (e.g. establishing the external context). For example, Figure 5 depicts a deep blue box labeled “industry stakeholders”, with an arrow pointing from said box into the direction of a dark purple box labeled

“consultation and feedback process”, which then produces an arrow directed towards a deep purple box labeled “governance body”. The arrows signify what components inform others within the broader context of the QMS system being analyzed. The example provided would suggest that industry stakeholders (deep purple) have been well established and feed into the consultation and feedback process, however, the consultation and feedback process (red) is weak, and although it feeds into a well structured governance body (deep purple), there may be gaps or issues present in the function of the governance body as the function of the consultation and feedback process derived from industry stakeholders is weak.

Table 2

SMPTE – ICES MSP QMS conformity key

Conformity with ICES MSP QMS (%)	Colour legend
0-9.9	
10-19.9	
20-29.9	
30-39.9	
40-49.9	
50-59.9	
60-69.9	
70-79.9	
80-89.9	
90-100	
N/A	

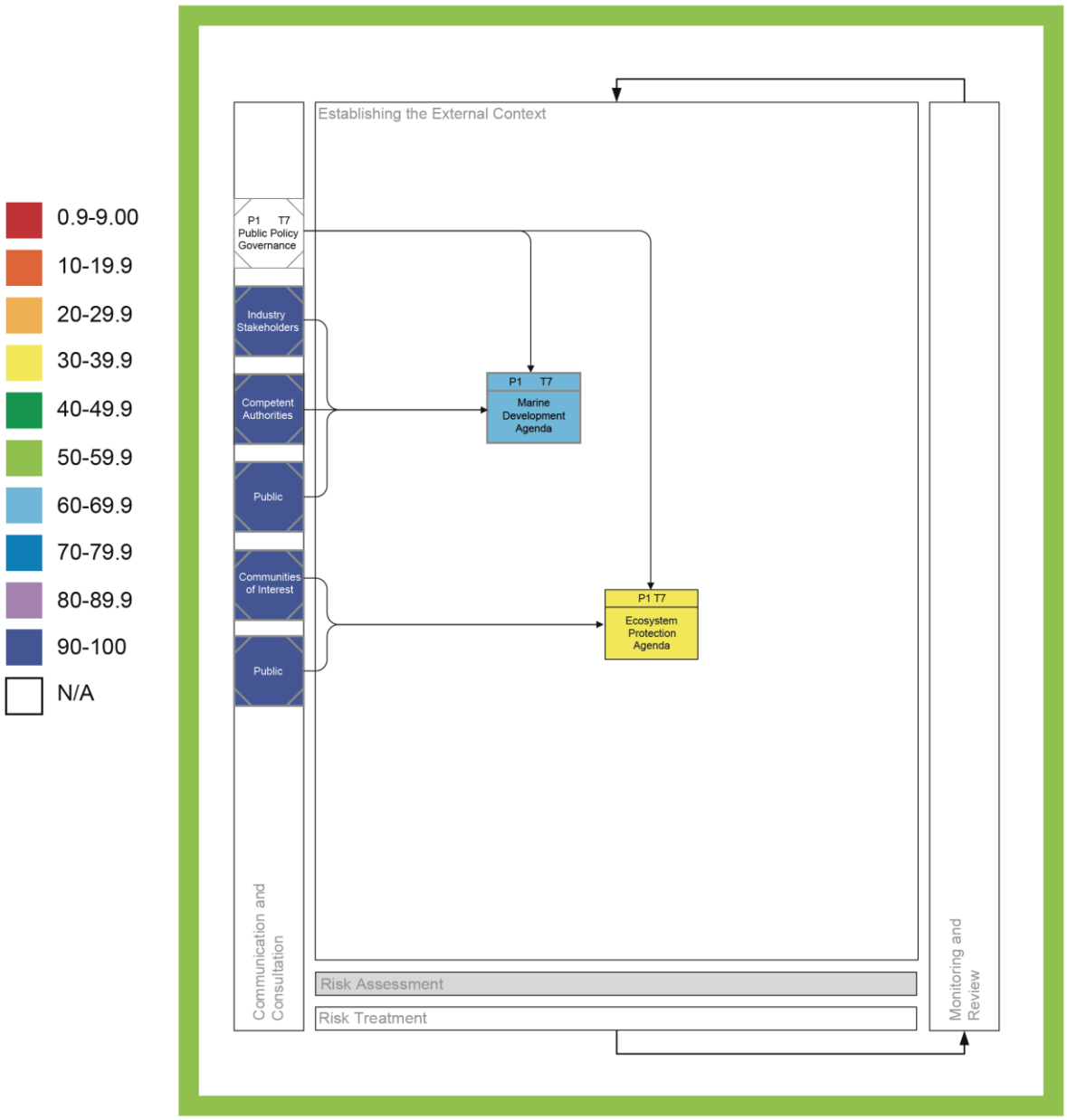

Figure 4: Establishing the external context – SMPTE conformity to ICES MSP QMS

6.1. Establishing the External Context (Figure 4)

The SMPTE demonstrated a 50% conformance ranking in relation to the ICES QMC specific to establishing the external context, scoring 3/6, plus one neutral score. This represents the lowest conformity ranking amongst all seven sections of the ICES QMC. There were no questions listed in the ICES QMC under *Public policy governance*, and, therefore, a neutral score was given. Regarding questions listed in the QMC under *Marine development public policy agenda*, a ranking of 66.7% was attributed, scoring 2/3, as the SMPTE identifies public policies and strategic aims of the SMPTE, and goals, objectives, and timeframes for stakeholder involvement. However, goals, objectives and timeframes of the industry and community stakeholders have not been published. Although the SMPTE does account for the thorough involvement of all relevant stakeholders throughout the SMPTE process, from pre-statutory consultation through to monitoring and review, with the post adoption statement publishing how stakeholder input was used with the development of the SMPTE, the ICES MSP QMS would suggest that industry and community stakeholder goals and objectives be established and published at the beginning of the engagement process in order to refer to a definitive baseline upon which set timeframes can demonstrate the evolution of stakeholder input, thereby providing for a more transparent, accountable, and defensible engagement process (Cormier *et al.,* 2015).

Regarding questions listed in the QMC under *Ecosystem protection public policy agenda*, a ranking of 33.3% was attributed, scoring 1/3, as, although the SMPTE identifies applicable environmental legislation related to the safeguarding of marine ecosystem features and services, ecosystem management indicators and targets have not been explicitly defined. Furthermore, ecosystem boundaries have not been employed within the siting of plan option areas. Although biological conservation areas such as SACs and SPAs under the Natura 2000 belt have been allotted high constraint rankings, there is no mention of consideration given to specific ecosystem boundaries within the SMPTE.

This later finding can be viewed from two different lenses. The first lens is that the SMPTE is strategic in nature and its construction is predicated on the notion of informing the strategic siting of tidal energy development within the broader context of the NMP, and, therefore, due to the site specific nature of commercial TCT deployment, the identification of ecosystem boundaries is either redundant or should be left to the broader NMP process. The second lens is that this is an error in the SMPTE process, as models suggest that commercial scale TCT deployment, if not sited properly and/or if individual TCTs are situated too close within an array,

excessive blockage ratios extracting over 25% of the available kinetic energy flux can alter natural hydrology patterns (Bryden, Couch, Owen, & Melville, 2007) and cause sediment deposition in the far field (Ahmadian, Falconer, & Bockelmann-Evans, 2012), thereby effecting the larger marine ecosystem up and downstream. However, due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, this issue surrounding the absence of ecosystem boundaries in the SMPTE in relation to far-field effects can be defended by the deploy and monitor scenario adopted by MS in conjunction with the suggested two-year monitoring and review period of the SMPTE (Marine Scotland, 2013a).

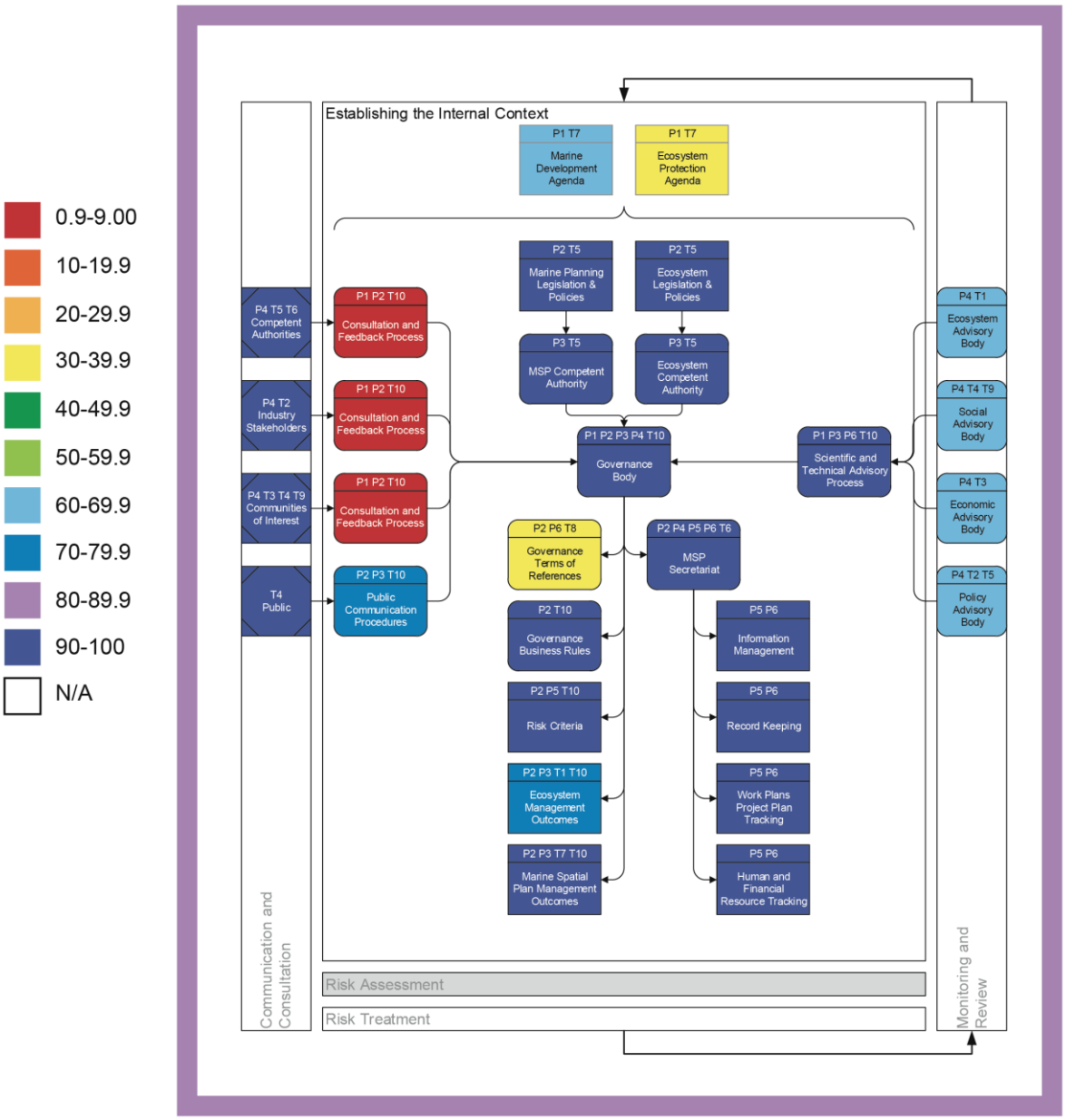

Figure 5: Establishing the internal context – SMPTE conformity to ICES MSP QMS

6.2. Establishing the Internal Context (Figure 5)

The SMPTE demonstrated an 84.5% conformance ranking in relation to the ICES QMC specific to establishing the internal context, scoring 60/71 plus one neutral score. This represents the third highest conformity ranking amongst all seven sections of the ICES QMC. Regarding questions listed in the QMC under *Marine planning legislation, policies, and authorities*, a ranking of 100% was attributed, scoring 5/5, as the SMPTE clearly defines the national, regional, and international legislation and policies required to scope, develop, and implement the plan, as well as the CA and their responsibility and accountability. Regarding questions listed in the QMC under *Ecosystem legislation, policies, and authorities*, a ranking of 100% was attributed, scoring 5/5, as the SMPTE clearly defines the national, regional, and international legislation and policies pertaining to the ecological context of the plan, as well as the CA and their responsibility and accountability. Regarding questions listed in the QMC under *Competent authorities*, a ranking of 100% was attributed, scoring 2/2, as the SMPTE clearly defines MS as the CA and their responsibilities and accountabilities.

Regarding questions listed in the QMC under *Industry stakeholders*, a ranking of 100% was attributed, scoring 3/3, as the SMPTE clearly defines the representative organizations operation within the management area, the legislative and policy framework managing such industry stakeholders, and how industry representatives are appointed. Regarding questions listed in the QMC under *Communities of interest*, a ranking of 100% was attributed, scoring 3/3, as the SMPTE clearly defines who communities of interest are, how community representatives are appointed, and their geographical location in relation to the SMPTE management area.

Regarding questions listed in the QMC under *Consultation and feedback process*, a ranking of 0% was attributed, scoring 0/4, as the consultation and feedback procedures for members of MS in relation to the SMPTE are not formally structured, rather, they occur on an as needed basis. Furthermore, record keeping and communication do not follow any formal requirements or standardized procedures. While such findings may demonstrate a testament to the tight-knit coordination and dynamic operation of MS, as one could argue is intrinsic to MSP due to the multi-disciplinary nature of the MSP process, the ICES MSP QMS would suggest that a more structured approach towards undertaking, documenting, and sharing consultation and feedback within MS is required in order to mimic best practices and facilitate a more concise method of disseminating information (Cormier *et al.,* 2015). In this case, it is advised that MS develop a formally structured consultation and

feedback process internal to MS where filing systems and communication tools (e.g. secure forums) are specific to the SMPTE process.

Regarding questions listed in the QMC under *Public*, a ranking of 100% was attributed, scoring 1/1, as the SMPTE clearly defines the public constituencies that should be consulted in the SMPTE process. Regarding questions listed in the QMC under *Public communication procedures*, a ranking of 75% was attributed, scoring 3/4, as the SMPTE defines the public communication plan, the tools used to communicate key decisions to the public, the approval process of the communication structure, and the controls in place to disseminate key decisions to the public. However, there is no formal legislated appeal process in place for members of the public to refute a misunderstood, unaccepted, and/or intolerable decision. The ICES MSP QMS would suggest that such an appeal process be put in place, although it could be argued that ongoing stakeholder participation beginning from the pre-statutory consultation stage through to the consultation analysis report (Marine Scotland, 2013a) allows for ample opportunity for public input during various stages of the SMPTE process, thereby negating the need for an appeal process on a specific decision as the SMPTE framework is in constant flux and can be continuously challenged and altered.

Regarding questions listed in the QMC under *Scientific and technical advisory bodies*, a ranking of 66.7% was attributed, scoring 2/3, as the SMPTE defines the scientific and technical bodies that are referred to for advice, as well as legal advisory bodies, and demonstrates the processes in place to ensure that conflicts of interest between experts and stakeholders are avoided and dealt with as needed. Due to the pre-commercial stage in which TCTs currently reside, resulting in the fact that Scotland's SMPTE is the first of its kind, BATs for ecosystem, social, economic, and policy bodies have yet to be devised, and therefore a neutral ranking was applied to the relevant question. However, there are no obligatory terms of reference or accreditation to demonstrate the quality of expertise for MS employees. In relation to the ICES QMS, the document would suggest that standardized accrediting bodies be established or existing ones incorporated into the selection process of technical and scientific advisors in order to insure their competence in their respective fields (Cormier *et al*., 2015), similarly to how the expertise of professional planners are validated through accreditation under their province of practice in Canada (PSB, 2016).

Regarding questions listed in the QMC under *Scientific and technical advisory process*, a ranking of 100% was attributed, scoring 4/4, as the SMPTE clearly identified the source and reliability of information employed to formulate scientific

and technical advice, the metadata used to validate advise, the process to set the terms of references and questions to be answered by the advisory bodies, and the advisory process approval authority and Chair. Regarding questions listed in the QMC under *Governance body*, a ranking of 100% was attributed, scoring 2/2, as the SMPTE clearly identifies the governance structure needed to address the legislative implications, ecological considerations, development priorities, and community concerns, as well as the agreements or memorandum of understandings needed to create the governance structure.

Regarding questions listed in the QMC under *Governance terms of reference*, a ranking of 33.3% was attributed, scoring 2/6, as, although the SMPTE identifies the CA in the terms of reference, and processes are set in place to connect political leaders to the SMPTE governance structure, there is no formal structure to incorporate a specified number of members within decision-making quorums or to reach a consensus on recommendations, and there is no formal communication structure or response timeframe. The ICES MSP QMS would suggest that a set number of members be allocated to inform decisions within the governance structure, which can potentially manifest in the form of an elected decision making quorum, as well as employing formal communication structures and timeframes in order to provide consistency and confidence in the decision making process (Cormier *et al.,* 2015).

Regarding questions listed in the QMC under *Governance business rules*, a ranking of 100% was attributed, scoring 5/5, as the SMPTE clearly identifies how advice and feedback from relevant industry and community stakeholders is taken into consideration, how recommendations follow the established decision-making protocols and are aligned with the public policy agenda, how the recommendation process is approved and by whom, and the delegation instruments employed by MS as the sole acting CA. Regarding questions listed in the QMC under *Marine spatial planning risk criteria*, a ranking of 100% was attributed, scoring 4/4, as the SMPTE clearly identifies the criteria used to assess the severity of impacts from an opportunities and constraints approach, how such criteria was established and validated, and the risks perceived by all relevant stakeholders, all of which are described in plain language via a non-technical summary.

Regarding questions listed in the QMC under *Ecosystem management outcomes*, a ranking of 75% was attributed, scoring 3/4, as the SMPTE identifies how ecosystem management outcomes can be achieved in the management area and how ecosystem management measures outside the SMPTE management area that may interact with processes within the SMPTE management area are taken into

consideration in the broader NMP, all of which are described in plain language via a non-technical summary. However, due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, ecosystem boundaries have not been defined in relation to the SMPTE management area, therefore, ecosystem management outcomes are not aligned with ecosystem boundaries and significant ecosystem features (Marine Scotland, 2013a).

With regards to this issue, the ICES MSP QMS would suggest that ecosystem boundaries be defined in order to better quantify far-field ecological impacts which could possibly be challenged and, therefore, hinder the deployment of commercial-scale TCT arrays and subsequently Scotland's GHG emissions reductions targets as well (Cormier *et al*., 2015). However, the management process of the SMPTE in relation to far-field effects can be defended by the deploy and monitor scenario adopted by MS in conjunction with the suggested two-year monitoring and review period of the SMPTE (Marine Scotland, 2013a). Furthermore, it should be noted that that the SMPTE is strategic in nature and its construction is predicated on the notion of informing the strategic siting of tidal energy development within the broader context of the NMP, and therefore, due to the site specific nature of commercial TCT deployment, the identification of ecosystem boundaries is either redundant or should be left to the broader NMP process.

Regarding questions listed in the QMC under *Marine spatial planning management outcomes*, a ranking of 100% was attributed, scoring 5/5, as the SMPTE clearly identifies how SMPTE management outcomes align with industry sector development priorities, reconcile the needs of industry with the public and communities of interests, how management outcomes can be achieved within the management area, how they are influenced by activities outside the management area, and how this is taken into consideration within the NMP, all of which is described in plain language via a non-technical summary.

Regarding questions listed in the QMC under *MSP secretariat*, a ranking of 90.9% was attributed, scoring 10/11, as the SMPTE identifies how and where information is stored, the information and document management system, how versions are maintained and controlled, the security requirements to access and safeguard information, the MSP secretariat, the copyright or proprietary requirements of the data and information submitted to the advisory processes, the filing plans for documents, the file retention period and requirements for documents, the privacy and accesses to information requirements for documents, and the system used to

track the human and financial resources. However, there is no single member of MS who is responsible for the management of information pertaining to the SMPTE, rather, individual SG employees are responsible for managing their own individual information which they produced. The ICES MSP QMS would suggest that, in order to make the MSP secretariat structure more secure, accountable, accessible, and reliable, an individual or individuals must be delegated the responsibility to managing all documents produced in relation to the SMPTE (Cormier *et al*., 2015).

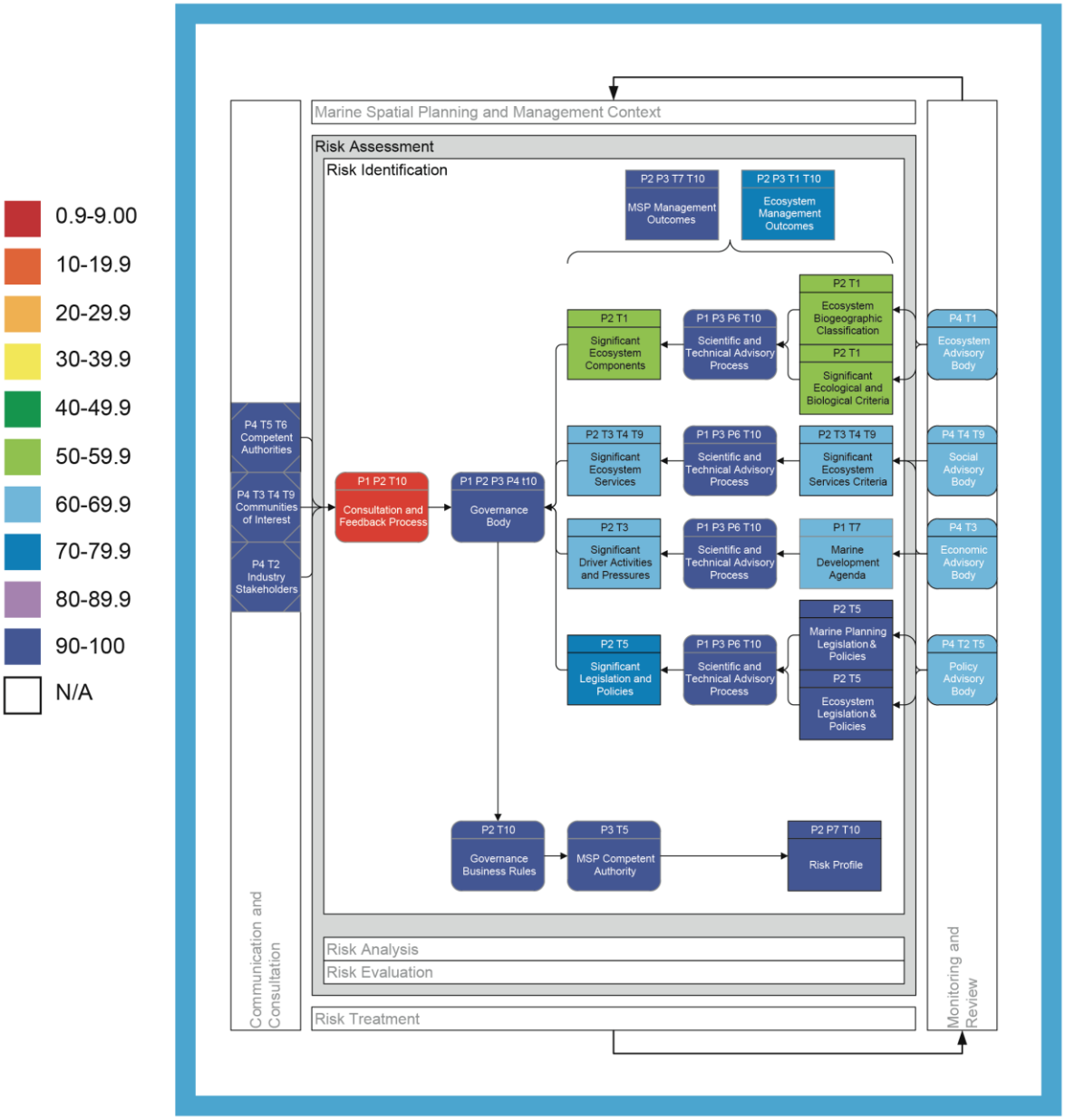

Figure 6: Risk identification – SMPTE conformity to ICES MSP QMS

6.3. Risk Identification (Figure 6)

The SMPTE demonstrated a 69.6% conformance ranking in relation to the ICES QMC specific to risk identification, scoring 16/23. This represents the third lowest conformity ranking amongst all seven sections of the ICES QMC. Regarding questions listed in the QMC under *Significant ecosystem components*, a ranking of 57.1% was attributed, scoring 4/7, as the SMPTE identifies the criteria employed to identify significant ecosystem features, how these criteria were established and validated, and the methods used to conduct the risk identification. However, due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, ecosystem boundaries have not been defined in relation to the SMPTE management area, therefore, criteria were not established in relation to them. Furthermore, the zone of influence of the activities of drivers operating outside the management area are not specified in detail within the SMPTE, the detailed supporting documents published to inform the SMPTE construction and adoption process, the NMP, and the detailed supporting documents published to inform the NMP construction and adoption process.

With regards to this issue, the ICES MSP QMS would suggest that ecosystem boundaries be defined via the establishment of specified criteria in order to better quantify far-field ecological impacts which could possibly be challenged and therefore hinder the deployment of commercial-scale TCT arrays and subsequently Scotland's GHG emissions reductions targets as well (Cormier *et al.,* 2015). Furthermore, the ICES MSP QMS would suggest that the activities of drivers operating outside the management area be specified within the SMPTE in order to account for the influence of external drivers on the activities occurring within the SMPTE management area. However, the management process of the SMPTE in relation to far-field effects can be defended by the deploy and monitor scenario adopted by MS in conjunction with the suggested two-year monitoring and review period of the SMPTE (Marine Scotland, 2013a). Furthermore, it should be noted that that the SMPTE is strategic in nature and its construction is predicated on the notion of informing the strategic siting of tidal energy development within the broader context of the NMP, and, therefore, due to the site specific nature of commercial TCT deployment, the identification of ecosystem boundaries is either redundant or should be left to the broader NMP process.

Regarding questions listed in the QMC under *Significant ecosystem services*, a ranking of 60% was attributed, scoring 3/5, as the SMPTE identifies the criteria employed to identify significant traditional, social, and economic ecosystem services,

as well as the vulnerability of such ecosystem services in relation to drivers operating within and outside the SMPTE management area. However, ecosystem services have not been quantified by the SMPTE process, therefore, they could not be validated by relevant community stakeholders and the human capital to produce societal benefits related to ecosystem services could not be measured. The ICES MSP QMS would suggest that such ecosystem services need to be quantified in order to provide a magnitude rating which can better measure the potential for risks early in the risk identification stage (Cormier *et al.,* 2015).

Regarding questions listed in the QMC under *Significant driver activities and pressures*, a ranking of 75% was attributed, scoring 3/4, as the SMPTE identifies the current and future activities of drivers related to the management area, the process to identify new emerging drivers, and the pressures generated from the activities of drivers. However, there is no quantifiable criteria employed to select significant drivers within the SMPTE management area. The ICES MSP QMS would suggest that employing such criteria could possibly help scope the potential for risk, prioritize the severity of risk to a degree acceptable at the early risk identification stage, and set a standard for identifying risks so that they are not left out of the eventual risk register, subsequently eliminating them from the entire resulting risk management process (Cormier *et al.,* 2015).

Regarding questions listed in the QMC under *Management area regulatory requirements*, a ranking of 75% was attributed, scoring 3/4, as the SMPTE identifies national, regional, and international legislation pertaining to drivers operating within the management area. However, while the location of drivers operating within the SMPTE management area are listed in the socio-economic assessment, a more refined analysis of the location and occupation rate of drivers is left until site specific licensing is granted to an application for commercial-scale TCT deployment. Although this method may save time and resources by avoiding the repetitive micro-scale assessment of a specific site, as individual EIAs are legislated under the Environmental Assessment (Scotland) Act 2005, the ICES MSP QMS would suggest that identifying detailed risks at an early stage can help scope the potential for risk, prioritize the severity of risk to a degree acceptable at the early risk identification stage, and set a standard for identifying risks so that they are not left out of the eventual risk register, subsequently eliminating them from the entire resulting risk management process (Cormier *et al.,* 2015).

Regarding questions listed in the QMC under *Risk Profile*, a ranking of 100% was attributed, scoring 3/3, as the SMPTE clearly identifies consultation and feedback procedures between MS as the acting CA and industry and community stakeholders

in relation to the risk identification stage and verification protocols to ensure the risk profile is linked to management outcomes, all of which are described in plain language via a non-technical summary.

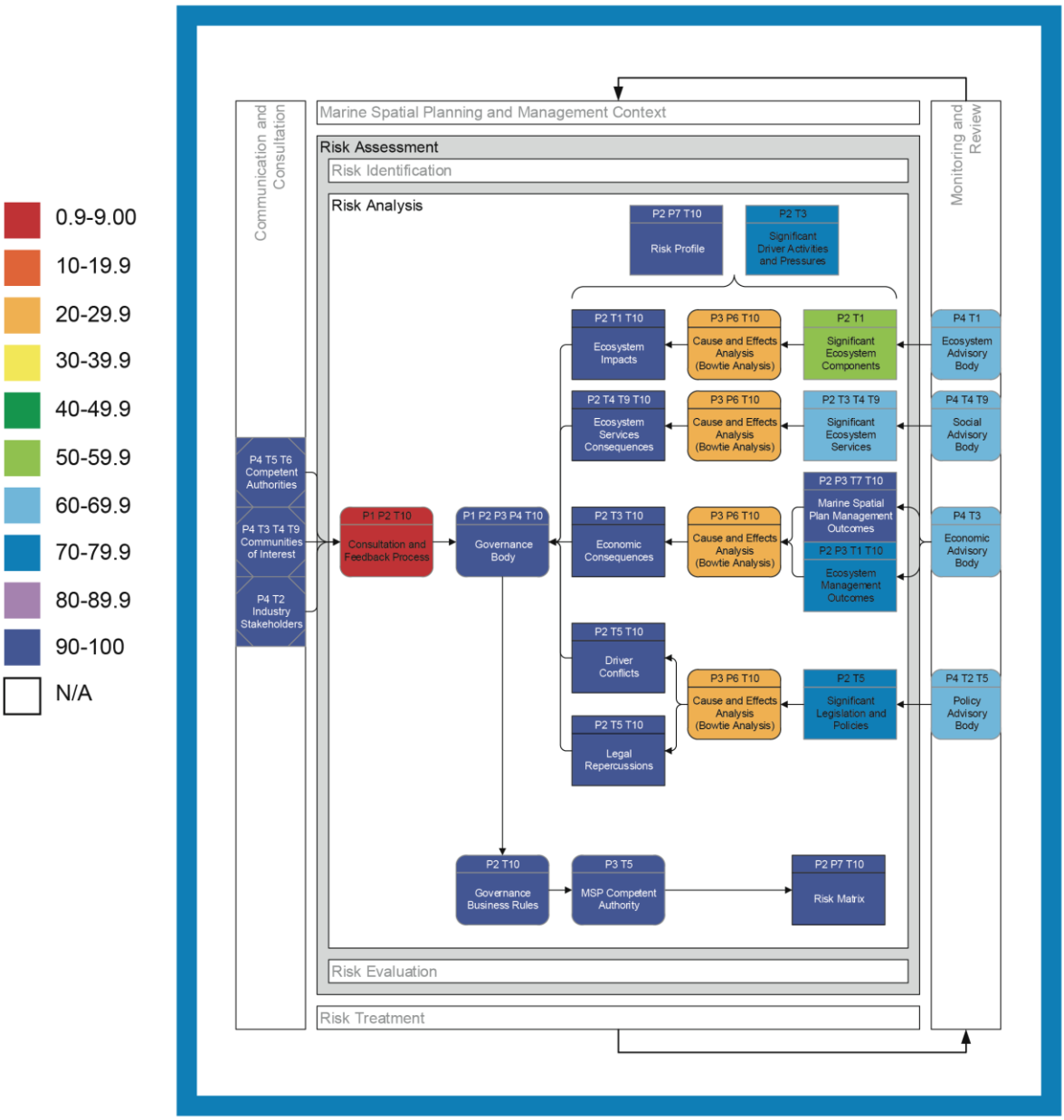

Figure 7: Risk analysis – SMPTE conformity to ICES MSP QMS

6.4. Risk Analysis (Figure 7)

The SMPTE demonstrated an 73.3% conformance ranking in relation to the ICES QMC specific to risk analysis, scoring 11/15. This represents the middle range conformity ranking amongst all seven sections of the ICES QMC. Regarding questions listed in the QMC under *Cause and effect analysis*, a ranking of 20% was attributed, scoring 1/5, as, although the SMPTE identifies the ecosystem components or processes that would be altered or degraded as a result of the pressures occurring from the activities of the drivers, the pressure-activity-state change-impact chain, duration and trajectory of recovery, feasibility of mitigation or restoration strategies, and methods used to conduct cause and effect analysis have not been quantified. The ICES MSP QMS would suggest that such methods categorized under the cause and effect analysis umbrella be quantified in order to establish a measurable change in ecosystem function relative to identified baselines (Cormier *et al.,* 2015), although, due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, this is not yet a possibility, and the current deploy and monitor scenario adopted by MS in conjunction with the suggested two-year monitoring and review period of the SMPTE will have to suffice at this time.

Regarding questions listed in the QMC under *Impacts, consequences, and repercussions*, a ranking of 100% was attributed, scoring 7/7, as the SMPTE clearly identifies the ecosystem features and process that may be altered or degraded by activities introduced by drivers operating within the management area, traditional, cultural and social consequences if a given ecosystem service is impacted by pressures or changes, societal benefits impacted by ecosystem alteration, the size of the community or electorate that would react to the consequences, potential economic losses or liabilities, strategic or international repercussions, and applicable conflict resolution appeal processes. Regarding questions listed in the QMC under *Risk matrix*, a ranking of 100% was attributed, scoring 3/3, as the SMPTE clearly identifies the contributions of the various causes integrated to determine management priorities, criteria employed to classify the likelihood and extent of the events and consequences, and the validation of the severity of risk.

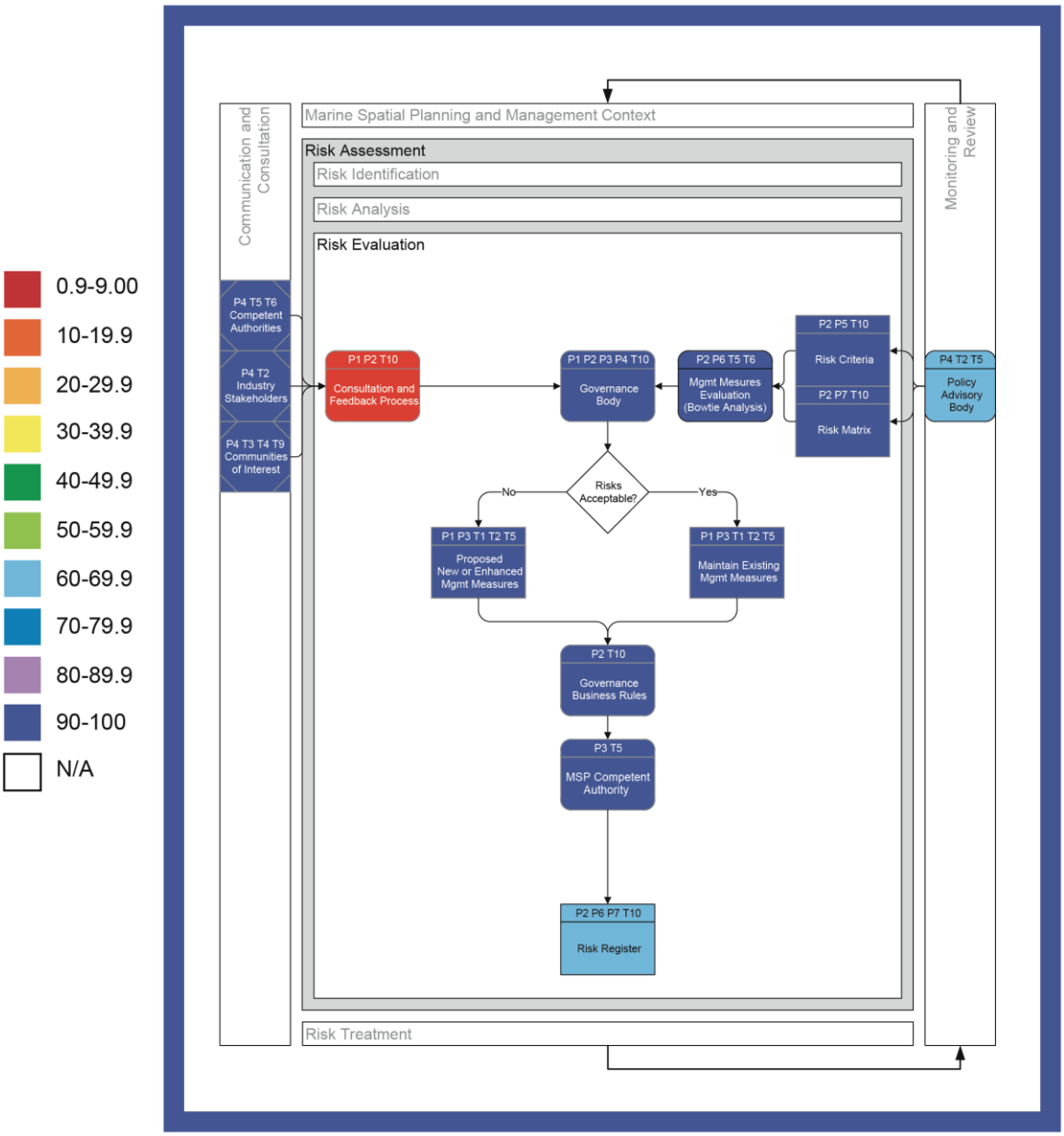

Figure 8: Risk evaluation – SMPTE conformity to ICES MSP QMS

6.5. Risk Evaluation (Figure 8)

The SMPTE demonstrated a 93.3% conformance ranking in relation to the ICES QMC specific to risk evaluation, scoring 14/15. This represents the highest conformity ranking amongst all seven sections of the ICES QMC. Regarding questions listed in the QMC under *Management measures evaluations*, a ranking of 100% was attributed, scoring 4/4, as the SMPTE clearly identifies the criteria used to evaluate and classify the effectiveness and feasibility of the management options, how management measures were derived from the inputs of all relevant stakeholders, methods used to identify the existing legislations, regulations, directives, policies, best management practices, and standard operating procedures, and how the evaluation of management measures is conducted and documented. Regarding questions listed in the QMC under *Existing management measures acceptable for the marine spatial plan*, a ranking of 100% was attributed, scoring 3/3, as the SMPTE clearly identifies legal, policy, strategic, and international liabilities and repercussions arising from not achieving the MSP or ecosystem management outcomes, and the monitoring plans needed to evaluate the effectiveness of the existing management measures.

Regarding questions listed in the QMC under *New or enhanced management measures needed for the marine spatial plan*, a ranking of 100% was attributed, scoring 5/5, as the SMPTE clearly identifies legal, policy, strategic, and international liabilities and repercussions arising from not achieving the MSP or ecosystem management outcomes, the monitoring plans needed to evaluate the effectiveness of the existing, enhanced, or additional management measures, criteria employed to evaluate the tolerability of risks, and those involved in the evaluation.

Regarding questions listed in the QMC under *Marine spatial risk register*, a ranking of 66.7% was attributed, scoring 2/3, as the SMPTE identifies how the risk register is maintained, filed, controlled, and made available to relevant stakeholders. However, due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, there has not been a need as of yet to review the risk register in order to develop new or enhanced management measures. Furthermore, no individual MS employee has been delegated with the responsibility of reviewing and updating the risk register. Even though it is apparent that the SMPTE and the tidal energy industry is too young to properly address this question in the QMC, the ICES MSP QMS would suggest that, in order to make the risk register more secure and accessible, an individual or individuals must be

delegated the responsibility of reviewing and updating the risk register of the SMPTE (Cormier *et al.,* 2015).

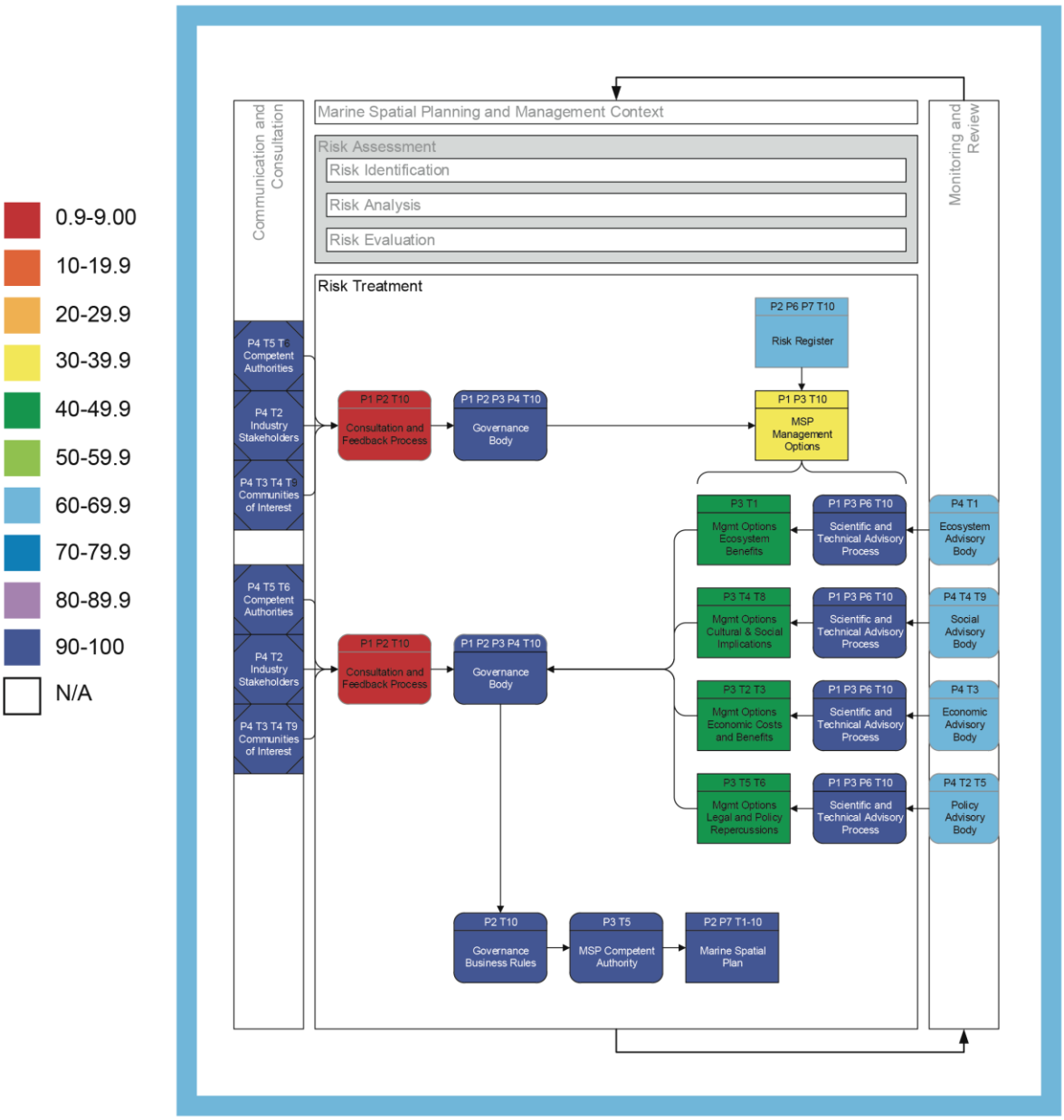

Figure 9: Risk treatment – SMPTE conformity to ICEA MSP QMS

6.6. Risk Treatment (Figure 9)

The SMPTE demonstrated an 62.5% conformance ranking in relation to the ICES QMC specific to risk treatment, scoring 10/16. This represents the second lowest conformity ranking amongst all seven sections of the ICES QMC. Regarding questions listed in the QMC under *Spatial and temporal management options*, a ranking of 33.3% was attributed, scoring 1/3, as, although the proposed management options are able to reduce the risks resulting from failure to achieved MSP and ecosystem management outcomes to an ALARP level, economic and technical feasibility of management options related to SMPTE implementation, enforcement, and integration into operational activities has not been quantified, and there is a lack of clarity on how management measures will be undertaken.

The ICES MSP QMS would suggest that the economic and technical feasibility of the SMPTE be quantified in order to bolster an increased sense of confidence, reliability, transparency, and accountability to the SMPTE process, thereby allowing the provision of resources to be allocated in a consistent and defensible manner (Cormier *et al*., 2015). The transparency offered by the quantification of economic and technical feasibility, in conjunction with an increased clarity in how management measures will be undertaken, may provide a decrease in the potential for public backlash, as opaque plans and management measures pertaining to renewable energy systems deployment have consistently been a hindrance to the deployment of such systems in the past, such as the case of a wind farm development in the Rheinland-Pfalz region of Germany where lack of a transparent planning process resulted in public lawsuits, thereby delaying the planning process and increasing costs to local planning authorities (Pendleton, Atiyah, & Moorthy, 2007).

Regarding questions listed in the QMC under *Management options costs, benefits, and feasibility*, a ranking of 42.9% was attributed, scoring 3/7, as, although the SMPTE identifies the indicators to inform ecosystem benefits, operating procedures and standards that will need to be updated, as well as the legislative and regulatory framework under which the management options would be implemented, the costs of implementing management options has not been quantified. The ICES MSP QMS would suggest that costs associated to management operation be quantified in order to allow for the provision of resources to be allocated in a consistent and defensible manner (Cormier *et al.,* 2015). The transparency offered by this quantification may provide a decrease in the potential for public backlash, allowing for MS budget expenditures to be justified to the public if required, therefore garnering an increase in public trust of regulators and subsequently providing for greater support for renewable energy adoption (Bronfman, Jiménez, Arévalo, & Cifuentes, 2012).

Furthermore, the notion of determining levels of public acceptance itself has not been taken into consideration in the SMPTE process, which can therefore act in a synergistic manner with missing ICES QMS criteria such as the lack of quantification of economic and technical feasibility and implementation costs discussed above, thereby potentially delaying targeted TCT deployment.

Finally, the SMPTE does not identify the policy and programs that will need to be updated or changed as a result of implementing the management measures, nor does it identify the criteria and consultation processes used to demonstrate how the management measures reduce risks to traditional, cultural, social, and economic ecosystem services. However, this can be considered less of a gap in quality management of the SMPTE and more a product of the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world. As the SMPTE gains more mileage with regards to implementation, the deploy and monitor regime, in conjunction with the suggested two-year plan review and monitoring period, such factors can be properly informed and addressed on an as needed basis.

Regarding questions listed in the QMC under *Marine spatial plan*, a ranking of 100% was attributed, scoring 6/6, as the SMPTE clearly identifies the SMPTE approval process, accountable authorities, agreements to ensure plan accountability amongst MS and industry stakeholders, human and financial resource considerations, and complaints and feedback procedures.

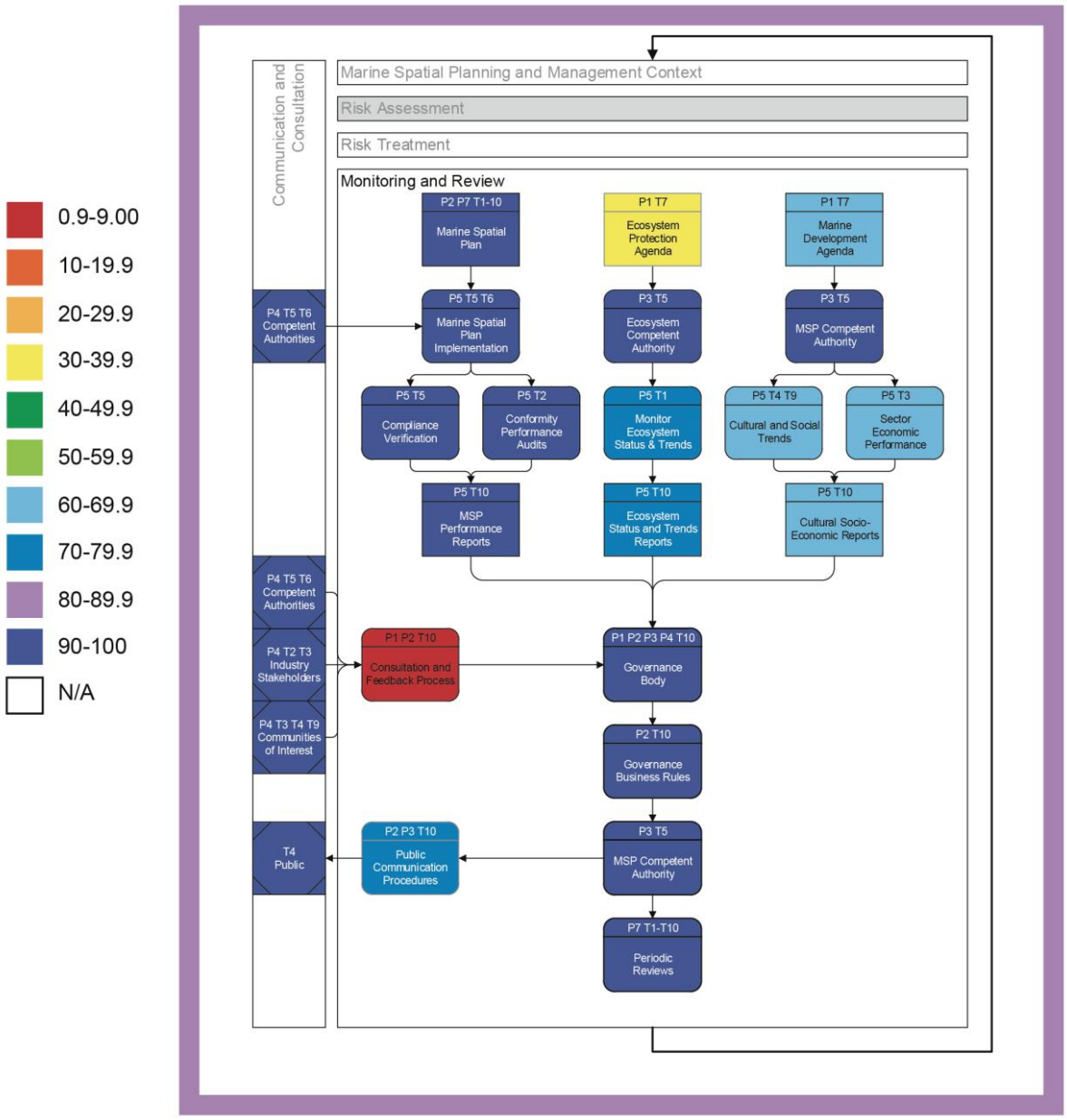

Figure 10: Monitoring and review – SMPTE conformity to ICEA MSP QMS

6.7. Monitoring and Review (Figure 10)

The SMPTE demonstrated an 86.7% conformance ranking in relation to the ICES QMC specific to monitoring and review, scoring 26/30. This represents the second highest conformity ranking amongst all seven sections of the ICES QMC. Regarding questions listed in the QMC under *MSP implementation*, a ranking of 100% was attributed, scoring 2/2, as the SMPTE clearly identifies the implementation the work plan and the associated responsible authority. Regarding questions listed in the QMC under *Compliance verification and auditing*, a ranking of 100% was attributed, scoring 9/9, as the SMPTE clearly identifies procedures to determine compliance of the regulated parties, the associated responsible and accountable authority, the regulated activities of drivers, the audit initiation approval process, and how the report will be communicated and made accessible to relevant stakeholders.

Regarding questions listed in the QMC under *Ecosystem status and trends monitoring*, a ranking of 75% was attributed, scoring 6/8, as the SMPTE identifies the associated accountable authority, the link between management measures and ecosystem monitoring activities, the indicators used to monitor the environmental effects, and how results will be communicated and made accessible to relevant stakeholders. However, the SMPTE has not established thresholds and criteria to ascertain the effectiveness of the management measures, nor does it quantify the resources available to conduct the ecosystem monitoring program. These issues can be argued to be a product of the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, and, therefore, such monitoring data is yet available. Although, the ICES MSP QMS would suggest that thresholds and criteria to ascertain the effectiveness of the management measures be established in order to provide an initial baseline to measure the expenditure of human, financial, and temporal resources against (Cormier *et al.,* 2015), a theme in line with the SMPTEs absence of the quantification of resources available to conduct the ecosystem monitoring program. If included, such factors may make budget expenditures more defensible, while a thorough and transparent plan can increase public trust in regulators (Bronfman *et al.,* 2012).

Regarding questions listed in the QMC under *Cultural and socio-economic monitoring*, a ranking of 60% was attributed, scoring 3/5, as the SMPTE identifies the associated accountable authority and how reports will be communicated and made accessible to relevant stakeholders. However, the SMPTE has not established indicators used to monitor cultural trends and the socio-economic performance, nor does it quantify the human and financial resources available to conduct cultural and

socio-economic analysis. These issues can be argued to be a product of the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, and, therefore, such monitoring data is yet available. Although, the ICES MSP QMS would suggest that cultural and socio-economic indicators be established in order to provide an initial baseline to measure the well-being of communities and their responses to commercial-scale tidal energy development, while the quantification of resources available to conduct cultural and socio-economic monitoring may make budget expenditures more defensible (Cormier *et al.,* 2015), providing for a thorough and transparent plan that can increase public trust in regulators (Bronfman *et al.,* 2012).

Regarding questions listed in the QMC under *Marine spatial plan periodic review*, a ranking of 100% was attributed, scoring 6/6, as the SMPTE clearly identifies timelines, the associated accountable authority, the approval process, and the review team.

Table 3

ICES MSP QMS component scores and rankings

ICES MSP QMS Components	Score	Conformity %
Establishing the external context	3/6	50
Public policy governance	N/A	N/A
Marine development policy agenda	2/3	66.7
Ecosystem protection public policy agenda	1/3	33.3
Establishing the internal context	60/71	84.5
Marine planning legislation, policies, and authorities	5/5	100
Ecosystem legislation, policies, and authorities	5/5	100
Competent authorities	2/2	100
Industry stakeholders	3/3	100
Communities of interest	3/3	100
Consultation and feedback process	0/4	0
Public	1/1	100
Public communication procedures	3/4	75
Scientific and technical advisory bodies	2/3	66.7
Scientific and technical advisory process	4/4	100
Governance body	2/2	100
Governance terms of reference	2/6	33.3
Governance business rules	5/5	100
MSP risk criteria	4/4	100
Ecosystem management outcomes	3/4	75
MSP management outcomes	5/5	100
MSP secretariat	10/11	90.9
Risk identification	16/23	69.6
Significant ecosystem components	4/7	57.1
Significant ecosystem services	3/5	60
Significant driver activities and pressures	3/4	75
Management area regulatory requirements	3/4	75
Risk profile	3/3	100
Risk analysis	11/15	73.3
Cause and effect analysis	1/5	20
Impacts, consequences, and repercussions	7/7	100
Risk matrix	3/3	100
Risk evaluation	14/15	93.3
Management measures evaluations	4/4	100
Existing management measures acceptable for the marine spatial plan	3/3	100
New or enhance management measures needed for the marine spatial plan	5/5	100
Marine spatial risk register	2/3	66.7
Risk treatment	10/16	62.5
Spatial and temporal management options	1/3	33.3
Management options costs, benefits, and feasibility	3/7	42.9
Marine spatial plan	6/6	100
Monitoring and review	26/30	86.7
MSP implementation	2/2	100
Compliance verification and auditing	9/9	100
Ecosystem status and trends monitoring	6/8	75
Cultural and socio-economic monitoring	3/5	60
Marine spatial plan periodic review	6/6	100
Total	**140/176**	**79.5**

6.8. Summary of Results

Taking the allotted ranking system applied to the SMPTE in relation to its conformity to the ICES MSP QMS QMC at face value, it can be surmised that the SMPTE has established a very strong internal context, complete with the appropriate MSP and ecosystem authorities, legislation, policies, strategic aims, goals, and objectives, while clearly engaging both internal and external stakeholders. However, the external context has ranked comparatively weak, although, an in depth analysis would show that this is only in relation to the strict conformity to the ICES QMC, as industry and stakeholders have indeed been established. Rather, the decreased ranking of the establishment of the external context is a result of the absence of publication and solidification of industry and community stakeholder goals and objectives under a concrete timeframe. The SMPTE accounts for this by recognizing that planning is intrinsically a flexible and ongoing communication process between internals and externals, and is framed as such throughout the SMPTE process. However, in conformity with the ICES MSP QMS, it is recommended that industry and community stakeholder goals and objectives should be established and published at the beginning of the engagement process under a set timeframe in order to refer to a definitive baseline upon which set timeframes can demonstrate the evolution of stakeholder input, thereby providing for a more transparent, accountable, and defensible engagement process.

While ranking strong overall, the establishment of the internal context demonstrates shortfalls in relation to employing a formalized consultation, feedback, communication, and decision making process within MS itself. Most consultation, feedback, communication, and decision making is done so on what can be argued to be an *ad hoc* basis, where lack of formalized structure can itself cause confusion, lack of accountability and reliability, and subsequently affect the external engagement procedures with industry and community stakeholders (Cormier *et al.,* 2015). It is recommended that a formalized consultation, feedback, communication, and decision making regime internal to MS be established with regards to the SMPTE process.

The establishment of both the external and internal contexts demonstrated an absence of ecosystem management criteria, with the external context lacking ecosystem targets and indicators, as well as the lack of identification of ecosystem boundaries, and the internal context lacking ecosystem management outcomes, significant ecosystem feature justification, as well as the lack of identification of ecosystem boundaries. In theory, this can weaken the ecosystem protection agenda from the very beginning of the SMPTE process, as well as further discussions

between internal and external stakeholders pertaining to the status of ecosystem elements, a factor which is jeopardized further when considering the low ranking attributed to the internal consultation, feedback, communication, and decision making processes. It is recommended that the SMPTE strengthen its ecosystem protection agenda so that internal and external stakeholders can work together to define significant ecosystem components, and, therefore, potential ecological interactions between marine species and functions with commercial-scale TCT deployment will be better understood by the public, which can reduce the potential for public backlash and subsequent delays in the SMPTE and TCT implementation process (Alexander, Janssen, Arciniegas, O'Higgins, Eikelboom, & Wilding, 2012).

In relation to conformity to the ICES MSP QMS, the SMPTE demonstrates very weak risk identification framework, specifically with regards to identifying and quantifying ecosystem boundaries and services, as well as defining drivers, establishing the criteria used to validate their significance, and their activities both within and outside the management area. These factors ultimately feed into the risk profile, and, therefore, any risks not identified due to the absence of ecosystem context quantification and driver activity identification will subsequently be excluded from the risk profile, which in turn eliminates their analysis from the remainder of the SMPTE process and negates the strength demonstrated by the SMPTE evaluation and review and monitoring components (Cormier *et al.,* 2015).

It is recommended that the SMPTE quantify ecosystem services and identify ecosystem boundaries while establishing criteria to determine the significance allotted to significant drivers and determine the spatial, temporal, and magnitude of driver activities within and outside the management area that may compromise such ecosystem services within ecosystem boundaries. Although the SMPTE is strategic in nature and its construction is predicated on the notion of informing the strategic siting of tidal energy development within the broader context of the NMP, impacts resulting from commercial-scale TCT array implementation can potentially alter natural hydrology patterns (Bryden *et al.,* 2007) and cause sediment deposition in the far field (Ahmadian *et al.,* 2012), thereby affecting the larger marine ecosystem up and downstream. However, these issues will have to be informed by the NMP, as its geographic reach can facilitate the management of ecosystem-scale boundaries.

In relation to conformity to the ICES MSP QMS, the SMPTE demonstrates a sub-par risk analysis framework. The result of the ranking, however, is mostly in relation to the strict conformity to the ICES QMC, as gaps concerning the quantification of the pressure-activity-state change-impact chain, duration and trajectory of recovery, feasibility of mitigation or restoration strategies, and methods used to conduct cause

and effect analysis cannot yet be established due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world. Although, as the SMPTE and the tidal energy industry develop in the near future, it is recommended that components of the cause and effect analysis be quantified in order to better inform ecosystem services, impacts and consequences, economic consequences, driver conflicts, and legal repercussions, and subsequently the risk profile and significant driver activities and pressures in which cause and effect analysis components directly feed in to.

In relation to conformity to the ICES MSP QMS, the SMPTE demonstrates a very strong risk evaluation framework. The only absence discovered in the quality review was that no individual or group of individuals have been delegated responsibility to review the risk register. Although the risk register itself is yet in place due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, the lack of delegation of authority to individual MS employees over consultation, feedback, communication, and decision making process has become a persistent theme first identified in the establishment of the internal context. It is, therefore, recommended that an individual or group of individual MS employees be delegated responsibility to review the risk register in order to provide for a more structured and accountable SMPTE process.

In relation to conformity to the ICES MSP QMS, the SMPTE demonstrates a very weak risk treatment framework, meaning that even when risks are identified in the comparatively weak risk identification process, analyzed, and evaluated in the very strong risk evaluation process, their treatment may be insufficient and, therefore, the strong monitoring and review component will have to inform the reiteration of the several facets of the SMPTE process in a timelier and costlier manner than would be necessary if risks were appropriately identified from the start. This dilemma has the potential to evoke a distrust in regulators and spur public backlash (Bronfman *et al.,* 2012), thereby hindering the commercial deployment of TCT arrays and subsequently delimit the potential for the SMPTE to meet its strategic aims of identifying preferred development areas for tidal energy implementation in Scotland, facilitating enhanced economic development, investment, and employment, and minimizing adverse implication on people, other sectors, and the environment (Marine Scotland, 2013a).

Specifically, the SMPTE risk treatment process lacks clarity on how management options will be undertaken, as the economic and technical feasibility of management

options, costs of implementation, and thresholds of public acceptance are not quantified, while plans and programs that will require updating following management implementation have yet to be considered. Furthermore, criteria used to inform consultation processes justifying how management measures may prompt a reduction in risk pertaining to traditional, cultural, social, and economic ecosystem services have not been identified. Such management option criteria form an upper tier foundation which is clearly linked to the output of the SMPTE as a final product. Therefore, it is recommended that the SMPTE establish criteria to identify economic, technical, financial, social, traditional, and cultural management options pertaining to the treatment of risk, and the associated consultation measures to inform such criteria, in order to effectively alleviate and/or mitigate the potential for risk in relation to tidal energy development within and outside the SMPTE management area.

In relation to conformity to the ICES MSP QMS, the SMPTE demonstrates a strong monitoring and review framework. Gaps identified in the monitoring and review component consist of the lack of identification of criteria to determine the effectiveness of management measures, particularly pertaining to cultural and socio-economic indicators and human and financial resource quantification. However, this is mostly due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, and, therefore, such monitoring data is yet available. Although, it is recommended that criteria be established to identify cultural, socio-economic monitoring measures, and the associated human and financial resources required to implement such measures as the SMPTE and tidal energy industry develop in the near future, thereby providing a baseline of cultural and socio-economic thresholds and associated expenditures.

Table 4

ICES MSP QMS quality management review recommendations for the SMPTE

Quality Management Review Recommendations
Industry and community stakeholder goals and objectives should be established and published at the beginning of the engagement process under a set timeframe.
A formalized consultation, feedback, communication, and decision making regime internal to MS should be established with regards to the SMPTE process.
The SMPTE should strengthen its ecosystem protection agenda so that internal and external stakeholders can work together to define significant ecosystem components, and therefore potential ecological interactions between marine species and functions with commercial-scale TCT deployment will be better understood by the public.
The SMPTE should quantify ecosystem services and identify ecosystem boundaries while establishing criteria to determine the significance allotted to significant drivers and determine the spatial, temporal, and magnitude of driver activities within and outside the management area that may compromise such ecosystem services within ecosystem boundaries.
Components of the cause and effect analysis should be quantified in order to better inform ecosystem services, impacts and consequences, economic consequences, driver conflicts, and legal repercussions, and subsequently the risk profile and significant driver activities and pressures in which cause and effect analysis components directly feed in to, as the SMPTE and the tidal energy industry develops in the near future.
An individual or group of individual MS employees should be delegated responsibility to review the risk register in order to provide for a more structured and accountable SMPTE process.
The SMPTE should establish criteria to identify economic, technical, financial, social, traditional, and cultural management options pertaining to the treatment of risk, and the associated consultation measures to inform such criteria, in order to effectively alleviate and/or mitigate the potential for risk in relation to tidal energy development within and outside the SMPTE management area.
It is recommended that criteria be established to identify cultural and socio-economic monitoring measures, and the associated human and financial resources required to implement such measures as the SMPTE and tidal energy industry develop in the near future.

7. Conclusion and Future

As coastal communities continue to increase in geographical size and population, associated economies will have to expand in unison (UN Atlas of the Oceans, 2010). This relationship gives rise to an increase in user – user and user – environment conflicts, as economic drivers acting within the marine environment proliferate in size, number, and intensity (Douvere, 2008). Such factors have acted as drivers to promote the implementation of MSP in coastal nations with extensive sea uses, such as that of Scotland's relationship to the North Sea and the subsequent construction of their NMP (Marine Scotland, 2014). Another player in the context of MSP has been the advent of climate change and the negative implications it has and is projected to have on marine environments and coastal communities, resulting in the

promotion of commercial-scale offshore renewable energy uptake in order to alleviate and/or mitigate the effects of climate change in unison with national GHG emissions reductions targets, such as that of Scotland's aim to assist the SG in achieving GHG emissions reduction targets of 42% below 1990 levels by 2020 and 80% below 1990 levels by 2050, while committing to providing 30% of it's energy demand from renewables by 2020, with an interim embedded target of 100% renewably generated electricity. Such targets, in conjunction with the acknowledgement of increasing marine user – user and user – environment conflicts have prompted the SG to produce the worlds first SMPTE (Marine Scotland, 2013a). Due to the early stages of SMPTE implementation, the pre-commercial stage in which TCT implementation currently resides, and the SMPTE's status as the first sectoral tidal energy plan devised in the world, it is imperative that the SMPTE process be constructed in such a manner to streamline the licensing and permitting processes that facilitate the eventual commercial deployment of TCTs, as can be seen in the implementation of the first commercial TCT array via the MeyGen (2016) project scheduled for this year. In light of this matter, this paper undertook a quality management review of Scotland's SMPTE with criteria set out in the most recently published MSP best practice guideline document, the ICES MSP QMS.

Overall, the quality review demonstrated a 79.5% compliance ranking of the SMPTE in relation to the ICES MSP QMS, with risk evaluation, monitoring and review, and establishment of the internal context framework demonstrating strong conformity, risk analysis demonstrating sub-par conformity, and risk identification, risk treatment, and the establishment of the external context demonstrating comparatively low conformity, respectively. A more in depth analysis reveals that the SMPTE should establish a formalized consultation, feedback, communication, and decision making regime internal to MS, quantify ecosystem services, define ecosystem boundaries, establish criteria to justify the allotment of significant drivers within and outside the management area, define risk treatment management plans, and provide baseline estimates for human and financial resource requirements.

The construction of Scotland's SMPTE can act as a best practice framework in itself for other nations with tidal current energy potential to base their MSPs around, whether they are taken in a sectoral context or as a part of a broader national MSP. Such planning efforts are essential in order to create a governance structure that facilitates the transition of TCTs from the pre-commercial to the commercial implementation stage, thereby making them a viable global player to assist the transition of the world economy from carbon-based to renewables. This quality review can further inform nations constructing an MSP in relation to tidal energy development of what factors have been, should be, and must been considered in the

development of their plan. The criteria set out in this framework should not only be limited to sectoral or national tidal energy planning, but can be adopted to inform broader regional, ecosystem-based, and international MSP collaborations such as the NorthSEE initiative, in order to set in motion a governance structure and associated regulatory framework that accounts for environmental, ecological, economic, social, traditional, and cultural elements pertaining to user – user, user – environment, and climate change factors related to marine environmental management.

References

Ahmadian, R., Falconer, R., & Bockelmann-Evans, B. (2012). Far-field modelling of the hydro-environmental impact of tidal stream turbines. *Renewable Energy*, *38*(1), 107-116.

Alexander, K. A., Janssen, R., Arciniegas, G., O'Higgins, T. G., Eikelboom, T., & Wilding, T. A. (2012). Interactive marine spatial planning: siting tidal energy arrays around the Mull of Kintyre. *PLoS One*, *7*(1), e30031.

Bronfman, N. C., Jiménez, R. B., Arévalo, P. C., & Cifuentes, L. A. (2012). Understanding social acceptance of electricity generation sources. *Energy Policy*, *46*, 246-252.

Bryden, I. G., Couch, S. J., Owen, A., & Melville, G. (2007). Tidal current resource assessment. *Proceedings of the Institution of Mechanical Engineers, Part A: Journal of Power and Energy*, *221*(2), 125-135.

Cormier, R, Kannen, A., Elliott, M., Hall, P., Davies, I.M. (2013). Marine and coastal ecosystem-based risk management handbook. ICES Cooperative Research Report, No. 317. 60 pp.

Cormier, R., Kannen, A., Elliott, M., & Hall, P. (2015). Marine Spatial Planning Quality Management System. ICES Cooperative Research Report, No. 327. 106 pp.

Davies, I. M., Gubbins, M., & Watret, R. (2012). *Scoping study for tidal stream energy development in Scottish waters*. Scottish Marine and Freshwater Science, Vol.3, No 1, 38pp.

Douvere, F. (2008). The importance of marine spatial planning in advancing ecosystem-based sea use management. *Marine policy*, *32*(5), 762-771.

Douvere, F., & Ehler, C. N. (2009). New perspectives on sea use management: initial findings from European experience with marine spatial planning. Journal of environmental management, 90(1), 77-88.

Ehler, C., Douvere, F. (2007). Visions for a Sea Change. Report of the First International Workshop on Marine Spatial Planning. Intergovernmental Oceanographic Commission and Man and the Biosphere Programme. IOC Manual and Guides No. 48, IOCAM Dossier (pdf, 3.01 MB) No. 4. Paris, UNESCO.

Ehler, C., Douvere, F., & Intergovernmental Oceanographic Commission. (2009). *Marine spatial planning: a step-by-step approach toward ecosystem-based-management*. UNESCO.

Elliott, M. (2013). The 10-tenets for integrated, successful and sustainable marine management. *Marine pollution bulletin*, *74*(1), 1.

EMEC. (2016). Grid-connected tidal test sites. Retrieved from http://www.emec.org.uk/facilities/tidal-test-site/

Esteban, M., & Leary, D. (2012). Current developments and future prospects of offshore wind and ocean energy. Applied Energy, 90(1), 128-136.

European Union (EU). (2012). Blue Growth opportunities for marine and maritime sustainable growth. Communication from the commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee on the Regions. COM(2012) 494 final.

Foley, M. M., Halpern, B. S., Micheli, F., Armsby, M. H., Caldwell, M. R., Crain, C. M., Prahler, E., Rohr, N., Sivas, D., Beck, M. W., Carr, M. H., Crowder, L. B., Duffy, E. J., Hacker, S. D., McLeod, K. L., Palumbi, S. R., Peterson, C. H., Regan, H. M., Ruckelshaus, M. H., Sandifer, P. A., & Steneck, R. S. (2010). Guiding ecological principles for marine spatial planning. Marine Policy, 34(5), 955-966.

Fraenkel, P. L. (2002). Power from marine currents. Proceedings of the Institution of Mechanical Engineers, Part A: Journal of Power and Energy, 216(1), 1-14.

Fraenkel, P. L. (2006). Tidal current energy technologies. Ibis, 148(s1), 145-151.

Hoyle, D. (2011). Process management principles. In ISO 9000 Quality Systems Handbook: Using the standards as a framework for business improvement. pp. 157-158. 6th Edition. Routledge, New York. ISBN 978-1-8561-7684-2. 802 pp.

Halpern, B.S., Walbridge, S., Selkoe, K.A., Kappel, C.V., Micheli, F., D'Agrosa, C., Bruno, J., Casey, K.S., Ebert, C., Fox, H.E., Fujita, R., Heinemann, D., Lenihan, H.S., Madin, E.M.P., Perry, M., Selig, E.R., Spalding, M., Steneck, R., Watson, R., (2008). A global map of human impact on marine ecosystems. *Science*, *319*(5865), 948-952.

ICES. (2012). Joint DFO/KnowSeas, and ICES Workshop on Quality management in

MSP (WKQAMSP), 28 February– 1 March 2012, Dartmouth, Canada. ICES CM 2012/SSGHIE:02. 48 pp.

ISO. (2005). Quality management systems-Fundamentals and vocabulary. International Organization for Standardization. ISO 9000:2005(E).

ISO. (2009). Risk Management Principles and Guidelines. International Organization for Standardization. ISO 31000:2009(E).

Johnson, K., Kerr, S., & Side, J. (2012). Accommodating wave and tidal energy–Control and decision in Scotland. Ocean & coastal management, 65, 26-33.

Kerr, D. (2007). Marine energy. Philosophical Transactions of the Royal Society of London A: Mathematical, Physical and Engineering Sciences, 365(1853), 971-992.

Lester, S. E., Costello, C., Halpern, B. S., Gaines, S. D., White, C., & Barth, J. A. (2013). Evaluating tradeoffs among ecosystem services to inform marine spatial planning. Marine Policy, 38, 80-89.

Marine Scotland (UK). (2013a). Planning Scotland's seas: Sectoral marine plans for offshore wind, wave, and tidal energy in Scottish waters consultation draft. http://www.gov.scot/Publications/2013/07/8702

Marine Scotland (UK). (2013b). Planning Scotland's seas: Sustainability appraisal for sectoral plans for offshore renewable energy in Scottish waters. http://www.gov.scot/Publications/2013/07/2403

Marine Scotland (UK). (2014). Scotland's national marine plan. Marine Scotland, Edinburgh(UK).

Marine Scotland (UK). (2015a). Planning Scotland's seas: Developing the socio-economic evidence base for offshore renewable sectoral marine plans in Scottish waters; Final report. http://www.gov.scot/Publications/2013/07/5841

Marine Scotland (UK). (2015b). Planning Scotland's seas: Habitats regulations appraisal of the sectoral marine plans for offshore renewable energy in Scottish waters; Draft summary report. http://www.gov.scot/Topics/marine/marineenergy/Planning/drafthra

Marine Scotland (UK). (2015c). Planning Scotland's seas: SEA of plans for wind, wave, and tidal power in Scottish marine waters; Environmental report. http://www.gov.scot/Publications/2013/07/2403

Marine Scotland Science staff. (2016a). Interview, June 10, 2016

Marine Scotland Science staff. (2016b). Interview, June 14, 2016

Marine Scotland Science staff. (2016c). Interview, June 23, 2016

MeyGen. (2016). Retrieved from www.meygen.com

Myers, L. E., Keogh, B., & Bahaj, A. S. (2011, September). Layout optimisation of 1st generation tidal energy arrays. In Proc. of 9th European Wave and Tidal Energy Conference.

OSPAR. 2010. Quality Status Report 2010: Regional Summaries. No. 154. OSPAR Commission. London. 176pp.

O'Rourke, F., Boyle, F., & Reynolds, A. (2010). Tidal energy update 2009. Applied Energy, 87(2), 398-409.

Pelc, R., & Fujita, R. M. (2002). Renewable energy from the ocean. Marine Policy, 26(6), 471-479.

Pendleton, L., Atiyah, P., & Moorthy, A. (2007). Is the non-market literature adequate to support coastal and marine management?. *Ocean & Coastal Management*, *50*(5), 363-378.

Professional Standards Board PSB. (2016). Why professional certification? Retrieved from http://www.psbplanningcanada.ca/STUDENTS/certification.php

Rice, J., Trujillo, V., Jennings, S., Hylland, K., Hagstrom, O., Astudillo, A., and Nørrevang-Jensen, J. 2005. Guidance on the Application of the Ecosystem Approach to Management of Human Activities in the European Marine Environment, ICES Cooperative Research Report, No. 273. 22 pp.

Sardà, R., Diedrich, A., Tintoré, J., Pablo Lozoya, J., Cormier, R., Hardy, M. and Ouellette, M. (2010). Decision Making (DEMA) tool and demonstration. KnowSeas. Deliverable 6.2 Development of Risk Assessment. European Community's Seventh Framework Programme [FP7/2007-2013] under grant agreement number 226675.

Sardà, R., O'Higgins, T., Cormier, R., Diedrich, A., and Tintoré, J. (2014). A proposed ecosystem-based management system for marine waters: linking the theory of environmental policy to the practice of environmental management. Ecology and Society, 19(4): 51.

Schultz-Zehden, A., Gee, K., & Scibior, K. (2008). Handbook on Integrated Maritime Spatial Planning. *INTERREG III B CADSES PlanCoast Project*.

Tarbotton, M., & Larson, M. (2006). Canada ocean energy atlas (phase 1) potential tidal current energy resources analysis background. Report to Canadian Hydraulics Centre.

The Crown Estate, (2012). UK Wave and Tidal Key Resource areas project– Summary report. http://www.thecrownestate.co.uk/media/5478/uk-wave-and-tidal-key-resource-areas-technological-report.pdf

UN Atlas of the Oceans. (2010). Human settlements on the coast. Retrieved from http://www.oceansatlas.org/servlet/CDSServlet

World Resources Institute. (2005). Millennium ecosystem assessment. *Summary for decision-makers, 2005*.

Acronyms and Abbreviations

ALARP	As low as reasonably practicable
BAT	Best available techniques
CA	Competent authority
EEZ	Exclusive economic zone
EA	Environmental assessment
EIA	Environmental impact assessment
EMEC	European Marine Energy Centre
GHG	Greenhouse gas
GVA	gross added value
GW	Gigawatt
HRA	Habitat regulations appraisal
HS	Historic Scotland
ICES	International Council for the Exploration of the Sea
IPF	Initial plan framework
JNCC	Joint Nature Conservation Committee
Km2	Kilometers squared
MPA	Marine protected area
MS	Marine Scotland
MSF	Marine Strategy Forum
MSFD	Marine Strategy Framework Directive
MSP	Marine spatial planning
MW	Megawatt
M/s	Meters per second
NM	Nautical mile
NMP	National marine plan
NMPi	National marine plan interactive
PV	Present value
P1	Consistency of purpose
P2	Clarity of purpose
P3	Connectivity with objectives
P4	Competence and capability
P5	Certainty of results
P6	Conformity to best practices
P7	Clear line of sight
QOP	Quality objectives of the plan
QMC	Quality management checklist
QMO	Quality management objectives
QMP	Quality management programme

QMS	Quality management system
RLG	Regional locational guidance
RSPB	Royal Society for the Protection of Birds
R&D	Research and development
SAC	Special area of conservation
SEA	Strategic environmental assessment
SEPA	Scottish Environmental Protection Agency
SG	Scottish Government
SMART	Specific, measurable, achievable, realistic, time-bound
SMP	Sectoral marine plan
SMPTE	Sectoral marine plan for tidal energy
SNH	Scottish Natural Heritage
SPA	Special protected area
SPRG	Sectoral plan review group
TCT	Tidal current turbine
TWh/yr	Terawatt hours per year
TZ	Territorial zone
T1	Environmentally/ecologically sustainable
T2	Technologically feasible
T3	Economically viable
T4	Socially desirable/tolerable
T5	Legally permissible
T6	Administratively achievable
T7	Politically expedient
T8	Ethically defensible
T9	Culturally inclusive
T10	Effectively communicable
WKQAMSP	Workshop on Quality Management of MSP Processes