SEPA
Scottish Environment Protection Agency
Buidheann Dìon Àrainneachd na h-Alba

Graeme Dey MSP
Convener
Environment, Climate Change and Land Reform Committee
c/o Clerk to the Committee
Room T3.40
The Scottish Parliament
Edinburgh EH99 1SP

By email only

28 March 2018

Dear Graeme,

Request for further information: Environment Climate Change and Land Reform Committee (ECCLR) inquiry into the environmental impacts of salmon farming

Thank you for your letter requesting further information on issues relating to the above. I trust that you will find this response helpful.

This is an important topic and I read your Committee's report to the Rural Economy and Connectivity Committee with great interest. Your Committee has done an excellent job in identifying the main issues that must be addressed to protect and improve the environment if the industry is to be able to grow sustainably.

I am also in complete agreement that the status quo is not an option for securing the protection of the environment alongside ongoing increases in production. This is why I made aquaculture one of the first industries for which SEPA is developing a sector plan. The plan will consider the industry's whole environmental footprint and set out the steps needed for One Planet Prosperity, our regulatory strategy for securing environmental protection and improvement in ways that, as far as possible, also create health and well-being benefits and sustainable economic growth. It will include:

1) protecting the environment and biodiversity by ensuring fish production is matched to environmental capacity;
2) increasing the capture and beneficial use of waste;
3) reducing medicine releases into the environment;
4) supporting action to protect wild fish; and
5) strengthening the evidence base.

Matching production to environmental capacity

The capacity of different parts of the water environment to accommodate fish farm development differs. For sustainability, we need to encourage and ensure that fish farming businesses look at the most environmentally suitable locations in their development planning. One such step

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towards this is our proposal for depositional zone regulation. This removes potential disincentives to investment in locations where the impacts of open-net farming systems on the sea bed are likely to be small and disease risks can be less. We want and expect businesses to start to re-locate and consolidate open-net farming in such locations and away from the most unsustainable sites in terms of pressures on the environment and fish health.

Increasing the capture and beneficial use of waste

Reducing pressure on the environment and re-using waste materials wherever possible are key to One Planet Prosperity. For the industry to be able to achieve its growth targets, a transition to innovative farming systems that reduce pressure on the environment by capturing and making beneficial use of waste is going to be essential. Some very promising low impact production techniques are already being trialled. These include a range of membrane technologies and other systems capable of capturing a significant proportion of waste food, faeces and medicine residues. Early signs are that some of the systems are likely to have the added benefit of reducing the risk of fish disease. Innovation appears to be particularly strong in the Norwegian industry. Over the last few months, we have been engaging with the Scottish industry's leaders to encourage much more focus on innovation here at home. In due course, our intention is for innovative production systems, appropriately matched to the farm location, to become a prerequisite for new and expanding farms as well as an alternative to re-location for farms in the most unsustainable locations.

Reducing medicine releases into the environment

It is also important that the industry finds ways of ensuring that the quantity of medicine residues discharged into the environment is decoupled from production growth and reduced over time. This will require much greater emphasis by the sector on:

- reducing infection risk;
- increasing the use of non-chemical parasite removal, for example, by using freshwater baths and other systems for lice removal; and
- where medication is needed, the use of methods that allow the capture and treatment of a significant proportion of medicine residues.

We have been working with the industry and other regulators to drive practice in this direction and will continue to do so.

Supporting action to protect wild fish

As the ECCLR report highlights, it is increasingly clear that sea lice from fish farms and escapes of farmed fish can pose a risk to wild sea trout and salmon. The sector needs to better manage this risk. We are in the process of exploring with other regulators, in particular Marine Scotland, how we can contribute. This includes reviewing how the different policy and regulatory frameworks, including our own wide regulatory powers, can be used to better effect. Subject to the outcome of this review, we are open to taking account of the risk posed to wild fish in assessing the appropriateness of farm locations in our advice to local planning authorities and in our permitting process.

Strengthening the evidence base

Continually strengthening the evidence base on the environmental effects, and performance, of fish farms is important to enable the right investment decisions. This is also important to enable us to identify and apply the right level of precaution when managing risks.

We already have an established and significant programme of evidence work. The programme includes our own routine monitoring, model development and investigative surveys. The latter are increasingly focused on improving understanding of cumulative risks to marine ecosystems.

A second core element of the evidence base is the information that fish farm operators provide through our licencing regime. The regime requires operators to know and understand environmental risks and provide ongoing, quality assured, monitoring information to us. We audit and check this data on an ongoing basis and use it to help us ensure that there are no adverse impacts on the environment. Our revised approach to regulating marine cages (DZR) will increase the protection of the marine environment by providing enhanced monitoring and modelling information, including information from marine hydrodynamic modelling to help assess risks over large scales. Operators will be required to provide much more information but we will also increase our audit monitoring of farms.

The third way that the evidence base is being strengthened, and a key part of our approach to promoting and supporting innovation in environmental protection, is innovative research. This involves collaboration with universities; other research institutes; the sector; and public body partners. For example, we are currently supporting a project with Crown Estates and aquaculture interests investigating the potential to extract value from aquaculture wastes. In another, we are contributing to the development of novel, eDNA monitoring techniques. These will enable rapid assessments of sea bed health; allow more information to be collected more efficiently; and, in due course, help shorten adaptive management response times.

One area where the evidence base requires particular strengthening is in relation to the risks posed to wild salmon and sea trout. We have committed to a large, jointly funded project with Marine Scotland and Scottish Natural Heritage to improve understanding of the current status of salmon in rivers across Scotland. This information will help us evaluate the results of the investigative surveys we have been carrying out into salmon stocks in rivers on the West Coast.

The Committee's report has usefully highlighted a number of other areas that need to be addressed to enable the industry to develop sustainably. I will make sure we consider how we can contribute to addressing each of these as we complete the development of our sector plan.

I have provided the detailed information you requested in the Annex below. Please do not hesitate to get in touch if you need anything further.

Yours sincerely

Terry A'Hearn
Chief Executive Officer

Annex 1: Detailed response to request for further information

Monitoring and consenting

1. **What were these unacceptable impacts and how were they identified?** *(p. 110 of the ECCLR Committee's report)*

   The impacts were pollution of the sea bed. They were identified on the basis of environmental samples showing that:

   a) the diversity and abundance of the invertebrates had been so altered that pre-defined environmental standards for the condition of those invertebrates were breached. Breaches of the standards that apply close to the cages mean that impacts are so severe that even populations of those animals that are able to cope best in polluted conditions and breakdown organic wastes are reduced to very low numbers and low diversity; or
   b) concentrations of fish farm medicines were in excess of environmental standards and hence at levels likely to result in adverse effects on the health and diversity of invertebrate animals.

   The majority of the samples used to identify these impacts were quality assured samples provided to us by the fish farmers in accordance with monitoring conditions specified in their licences.

Sea bed monitoring results for the period 01/01/2015 to 31/12/2017		
	Emamectin benzoate sampling results	Sea bed invertebrate survey results
Number of samples/surveys	466 results (188 farms)	312 surveys (224 farms)
Number of samples/surveys showing unacceptable impacts	38 (29 farms)	91 surveys (76 farms)

2. **How many times was the permitted biomass reduced, over how many farms? and what was the subsequent impact of that reduction?** *(p. 110 of the ECCLR Committee's report)*

   Our regulatory response to unacceptable impacts on the sea bed is detailed in our licence review procedure. Where appropriate, this response includes reductions in the permitted biomass. Between 1 January 2015 and 19 March 2018, action has been taken to reduce the permitted biomass on 42 fish farm licences, nine of the reductions were volunteered by the companies concerned. The purpose of such reductions is to allow the sea bed to recover and then be maintained to the appropriate environmental standard.

Outcome of reductions in permitted maximum biomass in the period 01/01/2015 and 19/03/2018			
Farm operation	Farm site fallowed (ie not in	Farm operational	Total permitted biomass reduced

change	use)				
Sea bed condition change	Recovered	Confirmed recovered	Confirmed not recovered[1]	Not yet assessed[2]	
Totals	8	10	8	15	42

Notes

1. *Further action is in process of being identified as part of our normal, planned approach to addressing such impacts. This may include a further biomass reduction.*
2. *The required follow up sea bed surveys are not yet due to be submitted by the operator.*

3. What are the information gaps in relation to the sea-bed in the vicinity of fish farms? *(p. 130 of the ECCLR Committee's report)*

We routinely have to make regulatory decisions that factor in uncertainties resulting from evidence gaps. We take account of the limitations of our current knowledge by incorporating the appropriate level of precaution into our decision-making and using adaptive approaches to management. This allows us to manage environmental risk effectively even where there are gaps in information. In this regard, the way we regulate salmon farming is no different to the way we regulate any other sector.

On-going work to strengthen and expand scientific understanding of the risks that fish farming can pose to marine and freshwater ecosystems is particularly important given the industry's growth ambitions.

Information gaps: pollution risks from marine cage fish farms	
What information is needed?	**Why is it needed?**
1. Far-field risks – risks beyond the permitted zone of impact on the sea bed	
Improved assessment of where any wastes, including medicine residues, that are transported from cages end up and the risks posed	Waste from some farms can be transported over considerable distances as a result of the action of tides and wind. Impacts can result if pollutants in the waste accumulate to harmful levels in the water column or on the sea bed. We are strengthening our ability to assess this risk by: (a) carrying out investigative surveys; (b) increasing use of hydrodynamic modelling, including requiring applicants to develop hydrodynamic models; and (c) improving analytical methods to allow detection of very low concentrations of medicine residues
Improved information on the chronic, non-lethal effects of medicine residues	Environmental standards are set using all available scientific information about the effects of pollutants on a range of potentially sensitive organisms with the aim of identifying a no-effects concentration. Where there are gaps in information, a safety factor is applied to define a likely no-effects concentration. There are gaps in chronic, non-lethal effects of fish farm medicine residues. Manufactures are not obliged to provide data. We are working with the Veterinary Medicines Directorate to help strengthen its approval process.
Improved methods of assessing	Our ability to assess the impact of deposition is best where that

Information gaps: pollution risks from marine cage fish farms	
What information is needed?	**Why is it needed?**
the effects of waste deposition on coarse and hard sea bed substrates	deposition is on sea beds with soft sediments, samples of which can be collected easily using grabs. The expansion of the industry could result in more deposition on coarse and hard substrates, even if only transiently. Practical techniques for investigating impacts are needed (eg using remotely operated submersible vehicle survey) to improve understanding of risks.
2. Cumulative impact of near-field impacts – permitted impact on sea bed	
Improved information on the areal extent of impacted sea bed in the vicinity of cages, including how this area changes over time	To improve the assessment of the cumulative risk from permitted areas of deposition around multiple marine cage sites in sea lochs, improved resolution of our estimates of the total impacted area is needed. Under DZR, enhanced sea bed monitoring at farms will address this gap.
Improved information on the distribution of different sea bed habitats in coastal waters	Different communities of sea bed biota are found in different sea bed habitats. The biodiversity of the seas is a product of the diversity of habitats. Improved information on sea bed habitats would improve ability to understand cumulative risks to different habitats and improve spatial planning of development. We are working with partner agencies to improve sea bed habitat mapping, including exploring the opportunity to build on a Europe-wide mapping project.

4. What proactive work has SEPA engaged in to monitor the impact of fish farms in the vicinity of protected features (PMFs, MPAs, SACs)?

Monitoring effects of existing fish farms

Marine Scotland is responsible for assessing the condition of MPAs and whether the sites' conservation objectives are being met. Scottish Natural Heritage (SNH) is responsible for assessing the condition of SACs.

Monitoring of MPAs and SACs is coordinated under the Scottish MPA Monitoring Strategy. The strategy was developed by Marine Scotland and Marine Scotland Science in partnership with SNH and the Joint Nature Conservation Committee (JNCC). SEPA was consulted during the Strategy's development.

We require operators to monitor the impact of operational farms on the sea bed around all marine cages, including those in, or in the vicinity of, MPAs, SACs and PMFs. Where necessary, we include additional requirements for farms in, or in the vicinity of, protected sites. We share the monitoring information that we hold on a regular basis with SNH and Marine Scotland. We also arrange joint surveys where possible to allow SNH and Marine Scotland Science to make use of our survey vessel.

If the assessments made by Marine Scotland and SNH identify that action is needed to reduce the impact of a fish farm in order to achieve a conservation objective for an MPA or SAC, we would review the authorisation for the farm concerned and work with the farmer to ensure appropriate action was taken. To date, no existing fish farms have been identified as compromising the objective for a protected site.

Assessing risk posed by new developments

We are responsible for assessing the risk posed to PMFs, MPAs and SACs when considering proposals for new marine cage fish farms or proposals to change the operation of existing farms.

Proposals that have a clear potential to threaten protected sites are normally identified during joint, pre-application discussions with SNH and the company concerned. Most such proposals are not progressed further by the company and no application for authorisation is made.

Any application we receive for a fish farm development in, or in the vicinity of, an MPA, SAC or PMF is subject to an assessment of its likely effects on the protected interests. If necessary to make these assessments, we require applicants to fill any relevant gaps in available information. This may involve applicants carrying out additional environmental surveys or modelling studies.

5. **What is the process and criteria for determining the programme of unannounced visits to fish farms and has this changed over time?** *(p. 117 of the ECCLR Committee's report)*

SEPA's programme of visits is currently scheduled and announced in advance. This is because our inspectors:

(a) need the right farm staff to be present if they are to be able to check that the site is being operated correctly;
(b) use the farms' personal protective equipment to minimise the risk of transferring diseases between farms; and
(c) rely on the use of the farms' boats to transport them to and from the cages;

Unannounced visits will be made in appropriate circumstances, for example, if we have reason to believe there has been a serious pollution incident.

We are in the process of exploring ways of changing the way we regulate to allow us to develop programmes of unannounced visits for all regulated premises used for animal production, including fish farms and intensive pig and poultry units.

Programmed inspections extend to all fish farm premises in marine and freshwater locations. All marine cage fish farm premises are inspected at least once per growth cycle. Some may be inspected 2 or 3 time per growth cycle. In the year 2016-17, we carried out at total of over 230 inspections of marine cage fish farms.

The number of inspection visits we make is determined using a framework that we apply to all regulated activities. The number of visits depends on the level of compliance and the scale of risk. The depth and scope of inspections also varies with the scale of the activity and risk posed.

As well as site visits, we also analyse and assess compliance by examining the information that farmers are required to submit to us on a quarterly basis as a condition of their licences. Most of this information is then published on Scotland's Aquaculture Web.

As well as site inspections, we carry out investigative surveys to identify any pollution impacts from aquaculture. Since 2013, we have substantially increased the emphasis given in our marine survey programme to assessing the effects of aquaculture. In 2016, we carried out detailed investigative surveys of Loch Shell, Loch Scridain, Loch Sunart, Orkney (two sites) and Loch Etive. In 2017, work was concentrated on Shetland. Up to four aquaculture areas are planned for survey in the 2018 programme.

6. **What resource is SEPA currently allocating to monitoring and reporting on the sector?** *(p. 315 of the ECCLR Committee's report)*

The staff resource we allocate to the salmon farming sector varies from year to year. It depends on a range of factors, including the number of operational farms; their levels of compliance; and the phasing of our environmental survey programmes.

Average staff resource allocated to fish farm work per year in full time equivalents		
Direct regulatory resource[1]	**Environmental monitoring and development resource[2]**	**Total resource**
13	30	43

Notes
1. *Includes site inspection; reporting; processing applications; enforcement work; etc)*
2. *Includes freshwater and coastal water monitoring; data analysis and modelling; regulatory framework development; sector planning; etc)*

We have also invested in our in-house analytical capabilities, with further investment planned in 2018.

Recent and planned investment in assessment capabilities	
2017 investments	**Planned investments for 2018**
Developed new emamectin benzoate analytical method able to measure to very low concentrations (using new instrumentation costing £250,000)	A new analytical method for azamethiphos in sea water (using new instrumentation costing over £280,000)
Improved method for measuring organic carbon	Sample collection for partnership research project into the use of new eDNA techniques in monitoring the environmental effects of marine cage fish farms
Improved method for particle size analysis (using new instrumentation costing over £50,000)	Potential in-house eDNA analytical facility

7. **What change in resource is planned as a result of the proposed introduction of DZR and the expansion of the sector?** *(p. 315 of the ECCLR Committee's report)*

   Introduction of DZR
   Our current charging scheme incorporates provision for an additional charge for DZR-type regulation should this be needed to recover any additional resource costs.

   The DZR approach will involve an increase in the amount of audit monitoring we will carry out; and an increase in the amount of information that operators will have to provide. The increase in monitoring will increase the amount of environmental information that we have to check and analyse when assessing proposed developments and evaluating the environmental performance of operational farms. In contrast, the resource required to deal with non-compliances may reduce if farm performance improves and the number of non-compliances reduces.

   Expansion of the sector
   A number of factors affect the scale of the resource we allocate to fish farming. One of the biggest is the number of operational farms. If the expansion of the sector involves an increase in the number of farms, this will result in more resource being allocated to fish farm work to undertake the additional inspection, monitoring and assessment work required to protect the environment. Our charging scheme is set up to enable us to recover the costs of regulating the sector. The additional charging income from an increased number of farms will allow us to proportionately increase the resource allocated.

8. **The Committee is extremely concerned that SEPA may, in the past, or may currently, be permitting the discharge of priority substances and potentially damaging substances** *(p. 182 of the ECCLR Committee's report)*

   Priority substances are pollutants identified at European-level under the Water Framework Directive as presenting a significant risk to, or via, the water environment. Currently, no priority substances have a veterinary medicines marketing authorisation for use as a fish farm medicine in the UK[1]. Farms do discharge other medicine residues and these have the potential to be harmful to aquatic life.

   We protect the environment by setting limits on medicine quantities and application rates. The limits are calculated with the aim of ensuring that concentrations of residues do not exceed levels at which damage to biodiversity could result. Safe levels in the environment are defined by environmental standards. We use a combination of monitoring data provided by operators and the results of our own monitoring and investigative surveys to check that the standards are being met in the environment. Where we find failures of standards, we take appropriate action to secure the protection of the marine environment. This action may include reducing the permitted biomass or medicine usage.

[1] *A directive identifying cypermethrin as a priority substance was transposed in 2015. Cypermethrin no longer has a veterinary medicines marketing authorisation. Previously it had been used as a sea lice medicine.*

The environmental standards are set at a level at which no effects would be expected. The standards incorporate a safety factor to account for any gaps in information on the "no effects concentration" for different groups of species. The standard for emamectin benzoate is currently being reviewed to ensure it takes account of the latest science and has the right safety factor applied.

We use the same approach to controlling discharges from other sectors and of other pollutants into the water environment.

9. **The Committee is concerned that there appear to be very significant data and analysis gaps related to the discharge of medicines and chemicals into the environment, including analysis of cumulative or additive effects. This requires to be addressed. The Committee has seen little evidence of proactive activity or action to systematically address the data gaps, either by the industry or the regulator** *(p. 182 of the ECCLR Committee's report)*

   SEPA publishes the following information on Scotland's Aquaculture website:

Annual emissions data by farm	Quarterly data returns for each farm
Copper (from feed & nets)	Maximum licenced fish biomass & actual biomass
Zinc	Quantity of feed applied
Nitrogen	Mortalities (by weight)
Phosphorus	Quantities of any sea lice medicines used
Total organic carbon	Results of sea bed surveys (including emamectin benzoate levels in sediments if applicable)

We also hold information on the amount of anti-microbials and the volume of hydrogen peroxide used per farm. This information is currently only available on request. We are exploring ways of making sure this information is also as visible as possible to the public.

Depositional zone regulation

1. The advantages and disadvantages SEPA envisages are associated with this approach

The DZR proposals constitute a fairly minor change to one aspect of the regulation of marine cage fish farming. They were developed during 2016 and brought together into a consultation paper during the first half of 2017.

During the same period, we also initiated work to develop a sector plan for fish farming. Thinking on this plan has evolved considerably since the DZR consultation was issued. We intend to publish the plan in the summer. It will encompass a broad range of integrated and innovative regulatory and non-regulatory initiatives.

The basic principles and goals of DZR will be included among these, although the detail of some of the proposals will change to take account of consultees' views and to ensure they complement the sector plan's overall approach.

<u>Advantages envisaged</u>

The key advantages and primary drivers for changing the current approach to regulating deposition are:

(a) increased environmental protection through enhanced environmental monitoring and modelling; and

(b) the removal of potential disincentives to investment in farms in exposed and more remote locations with strong tides, where:
   (i) waste impacts on the sea bed will normally be much less severe than elsewhere; and
   (ii) the risks of disease and, hence, medicine usage, are also likely to be lower.

The removal of the disincentives will make it more attractive for fish farm businesses to consider re-locating to, and consolidating production at, sites that have the greatest capacity to cope with farm wastes. It will also help work with operators to plan licence revocations for sites in the most unsustainable locations in terms of environmental risks and disease issues.

The use of remote, exposed locations requires significant investment in cage infrastructure. Removal of the previous 2,500 tonne maximum biomass limit allows the potential for large scale farms that could attract the necessary investment in infrastructure and innovation.

Up to now, the 2,500 tonne cap reflected the appropriate level of precaution given the degree of uncertainty in risk assessments for large farms with the then available modelling techniques. The revised version of the depositional model coupled with hydrodynamic modelling and more extensive monitoring provide us with the necessary confidence to remove the cap.

<u>Disadvantages envisaged</u>

The proposals are designed to deliver increased protection of the environment through enhanced modelling and monitoring. We do not envisage disadvantages from this.

We received 144 responses to the DZR consultation. There were opposing views on some of the details of the proposals. We are considering all the points raised as we finalise how the revised approach is best implemented. The concerns raised are summarised in Annex 2.

2. The basis and development of the regulation *(p. 139 of the ECCLR Committee's report)*

Basis

When determining applications for marine cage fish farms, we have a duty to assess the risk posed to the water environment. One of the risks posed is to the health of the sea bed as a result of the deposition on the sea floor of waste food, faeces and medicine residues. The DZR proposals represent an important but small change to how we assess and manage this risk.

The basis of the proposal is similar to the basis on which we operate currently: With the open-net fish cages that are used throughout the Scottish industry, some degree of pollution impact on the sea bed is likely at a large proportion of farm locations. The basis of our current approach is to:

a) allow waste deposition to cause impacts on the sea bed in the vicinity of the cages provided that:
   (i) the impacts do not compromise the condition of PMFs, SACs, MPAs or the wider marine ecosystem; and
   (ii) the intensity of the impacts does not become so severe that the ability of sea bed animals to break down the accumulated waste around the cages between production cycles is lost; and
b) prevent impacts occurring beyond the allowed zone of impact in vicinity of the cages.

DZR retains this basis for all sites but develops the implementation of the approach in the following principal ways:

a) the use of improved risk assessment techniques. These provide better assessments of risks in a wide range of locations, including exposed, deep water locations with strong tides; better assessments of risks from large biomass farms; better assessment of local and wide-scale effects; and
b) the use of more and better monitoring information to inform and adapt decisions; and
c) setting a limit to the permitted scale of local impact on the sea bed around marine cages. Previously, there was no limit on the size of impact footprint. Permitted footprints varied from farm to farm depending on farm size and site characteristics.

Development

The changes proposed under DZR are made possible by the adoption of improved modelling and monitoring. These significantly enhance our ability to assess the risk posed by proposed fish farm expansions.

The model we use to help assess the extent and intensity of impacts on the sea bed in the zone around fish farm cages ("DEPOMOD") has recently been re-developed by an independent scientific institute, the Scottish Association of Marine Science. The new model provides much better predictions of sea bed impacts across a wide variety of sea environments. At the same time, the ability to identify a risk of wider, cumulative effects on the sea bed beyond this zone has been considerably improved through the use of hydrodynamic modelling techniques. These latter models are able to take account of the effects of tides and wind on the dispersal of waste material over long distances from farms.

It is our normal practice to improve the way we assesses environmental risk as scientific understanding advances and new assessment techniques become available.

3. The scientific evidence supporting the regulation, including any assumptions made *(p. 138 of the ECCLR Committee's report)*

The science behind DZR is embedded in improvements in the performance of our environmental modelling capability backed up by enhanced environmental monitoring.

Modelling is important, not least because it is impossible to monitor everything, everywhere, all of the time. Models are used routinely by regulators to help assess a wide range of environmental risks. They provide an invaluable means of synthesising and interpreting all the available environmental information to enable us to:

(a) make an overall assessment of the condition of the environment;
(b) predict the likely effects on that condition of development proposals and other changes that increase or reduce pressure;
(c) better target environmental monitoring programmes.

Modelling involves simplifications and assumptions. Its purpose is to capture the main environmental processes that determine if and where impacts are likely to occur. The validity of the simplifications and assumptions in the models are tested by comparing model predications with environmental monitoring results. This testing tells us how much potential error and hence uncertainty there is in the predictions. Knowing this allows us to apply the appropriate level of precaution when using model results to inform our decisions about development proposals.

During the last two summers, we have undertaken monitoring surveys to understand the scale of impacts at a range of existing farms, in various hydrographic environments. These surveys have enabled us to test the new modelling and monitoring framework.

Weaknesses in the old model for predicting waste deposition were identified by comparing predictions with monitoring results. The performance of the new model will be continually refined through testing its predictions against the monitoring information collected as part of DZR.

4. **The peer review process for the DZR** *(p. 110 of the ECCLR Committee's report)*

We have not had, or sought, a peer review of the DZR proposals. The DZR proposals are principally about changes to the way we regulate. We only subject proposed changes to the scientific basis for things like environmental standards to peer review. For example, proposals for revised environmental standards for the medicine, emamectin benzoate, will be subject to scientific peer review. We normally consult the public on any significant changes to regulatory policies.

The models that we use for risk assessment include:
(a) an updated depositional model for assessing the risk of deposition in the vicinity of the cages;
(b) hydrodynamic models for assessing the risk of effects from any transport of waste into the wider ecosystem.

These incorporate independent scientific understanding and expert knowledge.

The previous depositional model has been in use for many years. It was peer reviewed and validated using environmental monitoring results at a selection of fish farm sites. The development of the new model involved considerable technical input from a wide range of marine specialist. It incorporates updated scientific understanding and an improved representation of sea bed processes affecting the erosion and re-suspension of material.

The development of the new model was led by Marine Scotland and undertaken by the Scottish Association of Marine Science. SEPA modelling specialists were closely involved in scoping the project.

The model has been tested by SEPA. This testing has shown that the model can predict the intensity and area of impacts accurately when calibrated using suitable sea bed data. Where such data are not available, it can also be used as a risk-screening tool by applying appropriately precautionary assumptions.

The predictions made by both types of models used for DZR will continue to be tested against environmental monitoring results. This testing ensures that the models' performance is understood and refined over time.

5. **How wider impacts (beyond deposition on the sea bed) are taken into account** *(p. 139 of the ECCLR Committee's report)*

We assess the risk posed by the releases of pollutants from marine cage fish farm before granting authorisation.

For operational farms, we use a combination of operator self-monitoring and our own monitoring and investigative surveys to monitor for impacts both close to the farms and over a much wider scale.

The pollutants posing the most significant risks include fish farm medicine residues from in-feed treatments and from bath treatments; plant nutrients from waste food and faeces; and organic matter. The risk from other pollutants, such as copper used as anti-fouling, is low subject to the operator complying with good practice requirements on use.

Bath treatments for sea lice infections *(azamethiphos & deltamethrin)*[2]	Prior to authorising discharges of bath treatment medicine residues, we undertake a risk assessment procedure. The medicines are released into the water column (azamethiphos in solution and deltamethrin frequently associated with suspended particles) and they are dispersed by currents and tidal movements. We use modelling to take account of the effects of dispersion. The models consider the rate of application and the half-lives of the medicines in the environment. To assess risk, we compare the predicted concentrations in the environment with environmental standards designed to protect the most sensitive aquatic wildlife. We require operational farms to provide us with quality assured monitoring data and we undertake our own investigative monitoring surveys of the condition of sea bed life and of medicine concentrations to check that concentrations in the environment are being maintained at safe levels. An investigative survey on azamethiphos is programmed for this year.
In-feed treatments for sea lice *(emamectin benzoate)*	Prior to authorising discharges of emamectin benzoate from marine cage fish farms, we undertake a risk assessment procedure. Emamectin benzoate is released in uneaten medicated food and through excretion from treated fish, mainly in faeces. As a result, its dispersion and deposition follow that of these wastes. Our assessments consequently use the same types of modelling and monitoring approaches that we use for waste deposition generally. The models differ primarily by inclusion of information on the likely rates of release of emamectin benzoate from the treated fish; and on the medicines half-life in the environment. The updated deposition model and hydrodynamic models used for DZR will also be used for all proposals to discharge emamectin benzoate. To decide if there is a risk to the environment, we compare the concentrations predicted in the environment with environmental standards. These standards are currently under review. Among other things, the review will confirm whether uncertainties in risk are being reflected through use of an appropriate safety factor. During the review, we have modified our risk assessment procedure to add extra precaution in relation to SACs, MPAs and PMFs.
Nutrients in waste *(dissolved inorganic nitrogen)*	Prior to authorising discharges of the nutrient, nitrogen, from marine cage fish farms, we undertake a risk assessment procedure using the locational guidelines published by Marine Scotland. The procedure predicts the likely effect of increased biomass on nutrient concentrations and then compares the prediction with environmental standards. The standards are set out in the Scotland River Basin District (Standards) Directions 2014. As the industry expands production, we will be increasingly using more detailed hydrodynamic modelling to improve the assessment of cumulative risk. We also carry out monitoring programmes to assess the status of coastal waters, including their nutrient status. The results of these programmes are published on our classification hub.

[2] Hydrogen peroxide is also used as a bath treatment. It is a very short-lived in the environment, being highly reactive. The UK Veterinary Medicines publishes information on its website about products containing hydrogen peroxide (Paramove - Vm 31011/4000 and ASPERIX Vet - Vm 47367/4000) and how they should be administered. We are currently reviewing whether current practice on the use of hydrogen peroxide remains sufficient to ensure the risks posed to the water environment are minimal.

6. **Stakeholder engagement in development of the DZR (including how views were taken into account)** *(p. 139 of the ECCLR Committee's report)*

   The principles behind the DZR proposals were developed during 2016 and then incorporated into a package of proposals for consultation.

   During 2016, SEPA discussed its thinking on the regulation of waste emissions from farms and the developing ideas for DZR with aquaculture trade associations; individual fish farm businesses; Marine Scotland; SNH; local authorities; other Scottish public bodies; environmental non-government organisations; shellfish farm businesses; and regulators from other major salmon producing countries. There were at least 24 meetings involving such discussions. More than half of these meetings included representatives from the sector.

   The consultation on the proposals was launched on 26 June 2017. We received 144 responses. These have been analysed and the different views are being taken into account in finalising the details of the approach. Further information on the consultation responses can be found in Annex 2. Once we have finalised the details of our approach, we will publish information explaining how we have responded to the views and suggestions expressed in the responses.

7. **The Committee would welcome an explanation of the rational for the DZR approach being limited to expansions in exposed locations** *(p. 142 of the ECCLR Committee's report)*

   The core element of the DZR package of proposals is the introduction of improvements to the way we assess the environmental capacity of different locations in the marine environment to accommodate a proposed new farm or a proposed expansion to an existing farm.

   The improved risk assessment process will be applied to all proposals for new farms and expansions to existing farms, irrespective of location.

   We already risk assess all such proposals to enable us to prevent deterioration of the biodiversity of marine ecosystems and the condition of MPAs, SACs and PMFs. The improved capabilities of the new risk assessment system will allow some of the precaution (e.g. the 2,500 tonne maximum biomass limit) in the current system to be appropriately reduced. That precaution had been incorporated to account for gaps in understanding but was producing the perverse effect of creating disincentives for farms to locate where the environment is best able to accommodate them.

   The DZR proposals are of less relevance to farms that are not planning to expand or re-locate. DZR will involve increased sea bed monitoring around cages, at least in the initial period of a farm's operation under the system. The purpose of this is to confirm the extent and severity of impacts in the vicinity of the cages to help validate the risk assessment models and improve the evidence base for an adaptive approach to managing risk.

In some circumstances, we may also need additional monitoring information from existing farms, for example, to improve assessments of cumulative risk. Where this is the case, we will apply DZR monitoring to the relevant existing sites.

8. **The Committee understands the volume of waste (and untreated waste) discharged from fish farms into the marine environment is half the volume of human (treated) effluent of Scotland. This would not be acceptable in any other sector and the Committee questions why this has been allowed to happen in the development and expansion of the salmon farming industry** *(p. 143 of the ECCLR Committee's report)*

We regulate waste emissions from all marine cage farms in a way designed to prevent damage to the marine environment beyond a permitted footprint of impact on the sea floor around the cages.

We do this by setting limits on fish biomass and on medicine usage. The limits are calculated with the aim of ensuring that concentrations of pollutants beyond the permitted zone of impact do not exceed levels at which damage to biodiversity could result. These safe levels are defined by environmental standards. We use a combination of monitoring data provided by operators and the results of our own monitoring and investigative surveys to check that the standards are being met.

Where we find failures of standards, we take appropriate action to secure the protection of the marine environment. This action may include reducing the permitted biomass or medicine usage.

We also tightly control the severity of impact on the sea bed in the permitted zone of impact around the cages and we do not permit such zones if they would be likely to compromise the conservation objectives of any MPA, SAC or PMF.

The way we control risks beyond the permitted zone of impact on the sea bed is the same as the way we control the risk posed by other discharges, including urban waste water discharges. The difference between the regulation of fish farms and urban waste water discharge relates to the permitted zone of impact. There is no direct equivalent for urban waste water discharges beyond an initial mixing zone of the waste effluent. This is because sewage solids are settled out as sludge prior to discharge.

We want to see the sector progressively reduce the extent of the zone of impact on the sea bed around fish farms. Our DZR proposals remove disincentives to locating farms in exposed, dispersive environments where current speeds significantly reduce accumulation of waste on the sea bed.

In other areas of the sea, we expect the industry to transition away from open-net cages, either by re-locating production to exposed, dispersive locations or by starting to replace open-net systems with circular economy solutions as technologies able to capture a significant proportion of farm wastes become increasingly available. The extent of transition to new farming systems versus optimisation of farm locations will depend in part on finding ways to manage captured wastes that do not create greater risks to the environment overall.

We are currently contributing to a project investigating options for utilising wastes. This mirrors the approach to urban waste water, where we are jointly exploring with Scottish Water how to maximise the value from sewage waste.

Further information on the development and implementation of a Scottish containment standard

Containment is important to reduce the risk of escapes of farmed fish breeding, or otherwise interfering, with wild stocks. We provided some advice during the development of the Scottish containment standard. We have not played a role in its implementation and Scottish Government leads on this.

Good containment infrastructure is going to be particularly important for large farms operating in exposed locations. We would like to see further work to ensure that the standards are suitable and implemented.

Annex 2: Concerns raised by consultees on the DZR proposals

Proposal	Main disadvantages suggested by consultees	SEPA comments about suggested disadvantages
Principle of making it easier and more attractive for businesses to locate in exposed, deep waters with strong tides	(a) landscape impact may be greater; (b) risk of infrastructure failure and fish escapes may be greater; and (c) increased challenges for safe working.	• landscape impacts will continue to be considered by the local planning authority; • containment standards will continue to be important and need to be appropriate to the risk. Farms locating in such areas will need to invest in suitably robust cage infrastructure.
Removal of the current 2,500 tonne cap on maximum biomass	(a) potential greater risk to wild fish from sea lice; (b) increased cumulative risk from such expansion	• other elements of the proposal mean that, in practice, large farms would be limited to more exposed locations where the risk of infection with sea lice and other diseases can be less; • irrespective of this proposal, a separate package of measures are needed to appropriately protect wild salmonids; • cumulative risks will continue to be assessed and the way this is done will be improved as part of the proposals
Allow up to a 10% increase in biomass per production cycle without re-modelling if sea bed monitoring results good	(a) larger increases should be allowed if shown to be acceptable; (b) concern that operator would have more scope to take risks and breach environmental standards	• The use of monitoring results in adaptive management of environmental risks is important for effective regulation. We are reviewing how best to implement an adaptive approach, taking account of other changes to the content of licences aimed at making them simpler for businesses to understand.
Responsibility for sea bed monitoring Consultation proposed SEPA would take on all monitoring of the deposition zone around the cages rather than fish farm operators	(a) uncertainty of the capacity of SEPA to undertake such a programme of monitoring (b) concern about risk to biosecurity from survey equipment being moved between farms	• We are reviewing whether a different balance between self-monitoring and SEPA monitoring would be appropriate. However, the core proposal for more and better monitoring will not change.

Proposal	Main disadvantages suggested by consultees	SEPA comments about suggested disadvantages
	(c) potential delays in feedback on monitoring results.	
Breaches of sea bed standards to result in a break in production until the sea bed has sufficiently recovered	(a) economic risk to businesses if forced to stop production whilst sea bed recovers	• As a result of the proposed improvements to monitoring and modelling, we expect the numbers of breaches of sea bed standards to reduce. • We are reviewing whether a break in production would be necessary in all cases.
Proposal to set a maximum area of 50 hectares of sea bed in the vicinity of the cages in which adverse impacts would be permitted, subject to consideration of cumulative effects; risks to SACs, PMFs and SACs; and the interests of other users of the marine environment. There is no maximum limit in the present system	(a) 50 hectare threshold too small to enable industry to grow (b) 50 hectare threshold bigger than most currently permitted zones of impact. The footprint allowed should be reducing not increasing.	• Overtime and in parallel with industry growth, we do want to see a progressive reduction in the footprint of impact on the sea bed around marine cages. This will require investment in locations where waste is less likely to accumulate on the sea bed and in farming systems that can capture a significant proportion of the wastes as part of a circular economy. This will requires a broad packages of measures beyond the DZR proposals. • We are considering what package of measures in our sector plan is most suitable for controlling and reducing the impact footprint of farms.

END