

Icelandic River Basin Management Plan 2022 - 2027

English summary



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March 2024
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1. Background

Water is a vital part of life and appears to us in various forms, such as drinking water and water used in industrial processes, agriculture and aquaculture. We also enjoy rivers, lakes and coastal seas through outdoor activities and tourism. It is important to preserve biological diversity and the natural state of ecosystems in fresh water and the ocean for both current and future generations. Researching and monitoring water resources give us information on the quality of water essential for all who depend on clean water and ocean.

In 2011, the Water Framework Directive 2000/60/EC (WFD) was transposed into Icelandic regulation (No. 36/2011) which now represents Iceland's water management. The main aim of the Water Framework Directive (WFD) is to protect waters and aquatic ecology, hinder deterioration, improve water quality and enable sustainable use of water. The requirements of the WFD are clear: all water bodies should at least reach "good status". The Environment Agency of Iceland is responsible for the formal implementation of the regulation and has accordingly delivered Iceland's first River Basin Management¹ Plan (RBMP) that entered into force in April 2022 and will run until 2027.

Iceland is considered as one whole River Basin District (IS1) and is further divided into four Water Regions. The country is considered to have high volumes of surface water and groundwater. Iceland is one ecoregion, and the country's geology and bedrock type are different from what is known in Europe. Along with soil permeability, soil type and vegetation, this influences the shape of watercourses and water distribution.

2. The River Basin Management Plan 2022-2027

The RBMP presents Iceland's policy in water management and includes data mapping, delineation and characterisation of water bodies; monitoring; and analysing water conditions and quality. The RBMP has a specific Programme of Measures² (PoM), which outlines measures and actions to ensure good water quality status, and a Monitoring Programme³ (MP), which has the objective to co-ordinate water monitoring across the country and to introduce a coherent approach to monitoring. Together, these three policy documents are in force for 6 years (2022-2027), a time period also referred to as a *water cycle*. It is important that information pertaining to the RBMP's goals, related reports and other policy documents be accessible for stakeholders and the public. This information has been made available on the website of water management (www.vatn.is).

¹ The Environment Agency of Iceland. 2022. [Vatnaáætlun Íslands 2022-2027](#) (River Basin Management Plan 2022-2023, in Icelandic)

² The Environment Agency of Iceland. 2022. [Aðgerðaráætlun 2022-2027](#) (Programme of Measures, in Icelandic).

³ The Environment Agency of Iceland. 2022. [Vöktunaráætlun vatnaáætlunar 2022-2027](#) (Monitoring Programme, in Icelandic).

2.1 Waterbodies and types

The Water Framework Directive applies to surface waters (lakes, rivers, transitional waters and coastal waters) and groundwater. Water is delineated into units called water bodies, each assigned a name and serial number within the Online Water Status Information hub. For example, one lake or a stretch of river can be delineated into one water body. Water bodies can be delineated further into smaller water bodies due to the presence of a particular pressure. Details on specific procedures for defining water bodies are outlined in reports made from 2011–2013^{4,5,6}. Water bodies are grouped into types; this characterisation into types is based on certain descriptors (e.g. type of bedrock, altitude or depth) that highlight qualities that are crucial to development of ecosystems in water bodies and follow the procedures presented in the EU's CIS Guidance documents. Each type of water bodies has a defined reference condition that is a representative of *high* ecological status. Well defined reference conditions are very important in working with large numbers of waterbodies.

A total of 2717 water bodies have been delineated in Iceland: 1870 river water bodies, 3821 lake water bodies, 77 transitional water bodies, 76 coastal water bodies and 311 groundwater bodies. Additional information and detailed data can be found in the [Online Water Status Information](#).

2.2 Status classification and environmental objectives

Specific quality elements are used to determine the overall status of a water body and whether it reaches its environmental objectives of at least good ecological status and good chemical status. According to the WFD, ecological and chemical status of **surface water bodies** shall be established to estimate the effects of various pressures on their ecosystems. Ecological status refers to the biological, physico-chemical and hydro-morphological quality elements relevant to estimate the status of water bodies. This includes determining the composition and abundance of, for example, invertebrates, phytoplankton and aquatic vegetation. Changes in these quality elements are compared to the expected state of water under natural and unpolluted conditions (reference conditions). Chemical status is determined by the presence and levels of polluting chemicals, known as priority substances. The list of priority substances and threshold limits are found in Regulation No. 796/1999 on water pollution prevention.

⁴ Bogi B. Björnsson, Gerður Stefánsdóttir and Jórunn Harðardóttir. 2012. [Auðkennisnúmerakerfi íslenskra vatnshlota](#). Icelandic Meteorological Office BBB/GSt/Jha/2012-01, p. 13 (In Icelandic).

⁵ Bogi B. Björnsson, Kristinn Einarsson and Linda Georgsdóttir. 2013. [Yfirborðs- og grunnvatnshlot Verklagsreglur fyrir skilgreiningu Vatnshlota](#). Icelandic Meteorological Office BBB/KE/LG/2013-01, p. 23 (In Icelandic).

⁶ Agnes Eydal, Sólveig R. Ólafsdóttir, Karl Gunnarsson and Héðinn Valdimarsson. 2011. [Flokkun strandsjávar í vatnshlot og gerðir](#). Marine and Freshwater Research Institute, p. 8 (In Icelandic).

Table 1: Biological and physio-chemical quality elements for lakes, rivers and coastal waterbodies selected to assess ecological status of surface waters in the first water cycle (2022 - 2027).

	Lakes	Rivers	Coastal waters
Biological quality elements	Phytoplankton <i>Chlorophyll a</i>	Benthic algae <i>Chlorophyll a</i>	Phytoplankton <i>Chlorophyll a</i>
	Invertebrate fauna <i>Composition</i> <i>Shannon diversity index</i> <i>Shannon evenness</i>	Invertebrate fauna <i>Composition</i> <i>Shannon diversity index</i> <i>Shannon evenness</i>	Soft bottom benthic invertebrates <i>Quality index NQ11</i>
	Aquatic flora <i>Tlc Trophic Index count</i>	No classification system in place	Benthic algae on hard bottom <i>Algal species biodiversity</i> <i>Ratio of Chlorophyta</i> <i>Ratio of Rhodophyta</i> <i>Ratio opportunistic species</i>
Chemical and physio-chemical quality elements	pH	pH	Nutrients <i>NO₃</i> <i>PO₄</i>
	Oxygen	Oxygen	
	Alkalinity	Alkalinity	
	Conductivity	Conductivity	
	Nutrients <i>NO₃</i> <i>NH₄</i> <i>PO₄</i>	Turbidity Nutrients <i>NO₃</i> <i>NH₄</i> <i>PO₄</i>	

The ecological status of a water body is defined into five categories: *high*, *good*, *moderate*, *poor* and *bad*. Chemical status has two categories: *good* and *bad*. A water body can have a good ecological status yet poor chemical status. This would mean the water body does not achieve its environmental objective. Both quality elements need to reach at least good status for the water body to reach environmental objectives of overall good status.

According to WFD there is a requirement of *no deterioration* and environmental objectives are legally binding. That means that if a water body has been determined in *high* ecological status, the environmental objective is the same, that is the objectives are to stay in *high* status.

The status of groundwater is estimated based on chemical and quantitative status. The chemical status refers to measuring its pH, conductivity, nitrate, ammonium and other polluting chemicals which can cause pressure. A list of polluting chemicals measured in groundwater can be found in Article 2.3 in Annex III of Regulation No. 535/2011 and Regulation No. 797/1999. The quantitative status of groundwater is one part in maintaining and safeguarding the sustainability of the resource. The annual long-term average of water abstraction shall not exceed the corresponding availability of the groundwater body and water abstractions or changes in water level shall not have negative impacts relating to surface waters nor wetland ecosystems. Furthermore, man-made direction change in groundwater streams cannot cause intrusion of salt water or other deposits. For groundwater bodies to achieve overall *good* status and meet

environmental standards, they need to have a *good* chemical and quantitative status. To maintain this status, a groundwater body cannot deteriorate in its chemical or quantitative status.

Certain water bodies can be considered altered to the extent that they are categorised as **heavily modified (HMWB) and artificial water bodies (AWB)**^{7,8,9}. Under this definition are various hydro-morphological alterations that affect the status of the water body, for example, dams used for hydropower. Definitions of such water bodies are not complete in Iceland; however, a report has been made on possible water bodies to be defined as heavily modified and artificial that are under hydropower pressures^{10,11,12}. This has resulted in 59 water bodies proposed as HMWB or AWB. The condition of HMWBs is estimated based on ecological potential, including biological and physio-chemical elements. A classification system for HMWB/AWB has not yet been established. Like natural water bodies (surface and groundwater), the chemical status of HMWB follows the environmental standards for priority substances.

To summarise, the overall ecological status of a water body is estimated by different quality elements depending on the type of water body, since each water type has its own reference condition and a classification system for ecological status. A water body is considered to fail its environmental objective if only one quality element deteriorates to the point of changing its status classification, even though other quality elements do not ("one out - all out rule").

Certain aspects are not fully implemented for this water cycle e.g. data and information on hydrological elements and groundwater. Furthermore, data is lacking on transitional waters, and additional work is needed regarding fish as a biological element in inland water bodies. These will be addressed in more detail and implemented in the next water cycle.

7 WFD CIS. (2003). Guidance document no. 4. Identification and designation of heavily modified and artificial water bodies. Office for official publications of the European Communities, Luxembourg. 118 bls

8 WFD CIS WG 2.2. 2003. Toolbox on identification and designation of artificial and heavily modified water bodies. CIS Working Group 2.2 on Heavily Modified Water Bodies. 163 bls. https://www.oieau.fr/eaudoc/system/files/wg_2.2-hmwb_toolbox_final_200103.pdf

9 WFD CIS. (2019). Guidance Document No. 37. Steps for defining and assessing ecological potential for improving comparability of Heavily Modified Water Bodies. Office for official publications of the European Communities, Luxembourg. 134 bls.

10 The Environment Agency of Iceland. 2020. Fyrstu skref við mat á manngerðum og mikið breyttum vatnshlotum, p. 45 (In Icelandic).

11 Eyðís Salome Eiríksdóttir, Svava Björk Þorláksdóttir, Þóra Hrafnadóttir og Gerður Stefánsdóttir. (2022a). Vatnshlot á virkjanasvæðum. Framhald vinnu við tilnefningu á mikið breyttum vatnshlotum og yfirlit yfir aðgengileg gögn um gæðabætti. Skýrsla Hafrannsóknastofnunar KV2022-16. 22 bls

12 Eyðís Salome Eiríksdóttir, Svava B. Þorláksdóttir, Gerður Stefánsdóttir & Þóra Katrín Hrafnadóttir. (2022b). Vatnshlot á virkjanasvæðum. Viðbót við skýrslu Umhverfisstofnunar UST- 2020:09. Skýrsla til Umhverfisstofnunar, HV 2022-09, VÍ 2022-002, NÍ-22003. 24 bls.

Environmental objectives not met

Despite clear and ambitious regulations stating all water bodies should reach their environmental objectives, they can be deviated from in specific circumstances if it is clear the water body will not reach its environmental objective. In those cases, milder environmental objectives can be defined, or a certain time frame given to reach defined environmental objectives. This is only an option if either certain financial, technical or natural restrictions are in place. Generally, the deadline for all water bodies to reach their environmental objectives is the 6-year water cycle from 2022-2027, meaning they should have high or good status or be at good or maximum ecological potential (for HMWB).

2.3 Pressure on water bodies

When waterbodies have been delineated, an analysis of pressures and impacts pinpoints water bodies that are at risk of not achieving their environmental goals. Different elements may influence the state of surface and groundwater bodies. Various pressures can have direct impacts on water ecosystems, e.g. if pollutants are released into a water body (such as from industries, agriculture and wastewater), groundwater abstraction, dam construction, road construction, harbour construction or dredging. A fundamental part of implementing the River Basin Management Plan is identifying various pressures and their impacts in water bodies. Pressure analysis identifies the pressures on water bodies and quantifies the likelihood of a water body of potentially not reaching its environmental objectives.

Pressure analysis was conducted in 2012-2013¹³ by the Environment Agency of Iceland with stakeholders such as Water Region Committees and local health inspectorates. The analysis focused on pressures from industry or wastewater contamination. The findings were then updated in 2019 by adding more information, including data from possible contaminations originating from aquaculture, urban wastewater and industry. The pressure analysis will be re-evaluated for the next water cycle.

Water body pressure is determined based on a rating system for pressure types. This rating system used existing knowledge and input from experts to rate each pressure type. The main types of pressures observed in Icelandic water bodies are wastewater, runoff in urban areas, fish farming (aquaculture), hydro-morphological elements, various industries, agriculture and groundwater abstractions. In the pressure analysis, the water bodies were divided into three risk categories according to the results of the rating system. These three categories were: *not at risk*, *in uncertainty* or *at risk*. If a water body is considered either *at risk* or *in uncertainty*, procedures have to be carried out to determine the cause, either through specific measures or monitoring.

¹³ The Environment of Iceland. 2013. [Stöðuskýrsla fyrir vatnasvæði Íslands. UST 2013-11 \(In Icelandic\)](#).

The process of documenting relevant pressures on water bodies in the Icelandic Water Viewer is not complete. Thus far, the data gathered focuses on pressure from large hydropower plants, urban areas, point source pollution (e.g., from waste and landfill), fish farming (aquaculture) and wastewater. More information on this can be found in the Online Water Status Information hub. Water bodies can be under various pressures yet meet their environmental objectives and have an overall good status. It is important to have an overview of different types of pressure to make informed decisions for water management. As the RBMP implementation progresses, documentation of pressures in water bodies will improve in the Online Water Status Information hub, which will result in a better overview of existing pressures.

As stated before, Iceland has 2717 water bodies. Based on the report of Iceland's Water District from 2013, 34 waterbodies were categorised as *in uncertainty*, two *at risk* for failing to reaching their environmental objectives. Since this report, data has been collected which illustrates the pressure present in some of these water bodies, and consequently, the status of 12 water bodies changed from *in uncertainty* to *not at risk*. Thus, 22 water bodies are currently *in uncertainty* and one water body is *at risk* for not reaching its environmental objectives and one has been confirmed in bad chemical status.

2.3.1 Waterbodies at risk

The 2 water bodies considered *at risk* are *Tjörninn in Reykjavík* (a lake water body) and the groundwater body *Rosmhvalanes 2*. **Tjörninn** is a water body located in an urban area. A priority substance analysis to screen for priority substances revealed the presence of the chemicals perfluorooctane sulfonic acid and its derivatives (PFOS) (e.g., found in firefighting foam and de-icing liquid), fluoranthene (released from the combustion of fuel, found in tar) and Polycyclic aromatic hydrocarbons, PAH's (released from fuel combustion). These exceeded the limits of annual average concentration. Therefore, Tjörninn does not reach its environmental objective for good chemical status. Measures have been outlined to map the origin of these substances and further define more measures to reduce this contamination. Ecological and physico-chemical elements and priority substances will be monitored. Since Tjörninn has been confirmed in bad chemical status the water body should be in good chemical status in the end of this water cycle, or in 2027. If this deadline is not met, reasons should be made explicit and a decision made as to whether an alternative timeframe is to be granted.

Rosmhvalanes 2 is a groundwater body located in an area close to Keflavík Airport, urban areas, landfills and polluting industries. The pressure analysis from 2013¹⁴ and reports from the Icelandic Meteorological Office¹⁵ and ÍSOR¹⁶ show various types of

¹⁴ The Environment Agency of Iceland. 2013. [Stöðuskýrsla fyrir vatnasvæði Íslands. UST-2013:11, p. 67 \(In Icelandic\).](#)

¹⁵ Gerður Stefánsdóttir, Davíð Egilsson and Svava Björg Þorláksdóttir 2019. [Eiginleiki grunnvatnshlota undir efnaálagi.](#) Icelandic Meteorological Office 2020-002, p. 62 (In Icelandic).

¹⁶ Daði Þorbjörnsson and Sigurður Ýmir Richter. 2021. [Rosmhvalanes 2 – Áætlun um skipulag yfirlitsvöktunar. Unnið fyrir Umhverfisstofnun.](#) Greinargerð ÍSOR-2021/009 (In Icelandic).

contamination. The contamination in Rosmhvalanes 2 is multifaceted, but pressures analysis revealed the presence of various heavy metals, priority substances and other polluting chemicals from old landfills. The concentration of heavy metals and lead is high in boreholes close to old landfills. A reduction in the concentration of organic substances is observed in the airport area of the historic Icelandic defence force. This may indicate that the substances are being washed away with the groundwater currents or that they accumulate in the groundwater layers (freshwater or saline), depending on mass. Nitrate contamination due to urea used for de-icing airstrips is also observed in the groundwater body. The concentration has, however, reduced from 100 mg/L since 1990 down to the current level of 5 mg/kg, or 1/10 of the allowed drinking water limit. This contamination is quite localised in 4-5 places. BTEX (Benzene, Toluene, Ethylbenzene and Xylene), which are used as additives in petrol and oil, were found in several boreholes. Pressures from oil usage were considerable until 1995 but have reduced as the US defence force evacuated the area. The presence of other substances has been observed, such as chlorohydrocarbons, trichloroethylene and tetrachloroethylene. The latter two have been found in water reserves close to Njarðvík (Bolafótur) and Keflavík (Eyjabyggð). The reserves by Bolafótur were of concern, as the concentration of trichloroethylene was considerably high. The use of these water reserves has consequently been stopped. The water reserve in Eyjabyggð showed low contamination concentrations.

Furthermore, possible contamination may originate from the increased traffic from Keflavik Airport. This means monitoring the use of de-icing liquid for airstrips and aircrafts. As the contamination at Rosmhvalanes 2 is still to be researched further, it is still defined as *at risk* for not meeting its environmental objectives. Measures have been outlined to estimate the origin of the contamination and execute monitoring and possible follow-up actions.

2.3.2 Waterbodies in uncertainty

The 22 water bodies categorised as *in uncertainty* of reaching their environmental objectives include coastal water, rivers, lakes and groundwaters around the country. The pressure types vary depending on the water body, but the major trend is pressure from wastewater, with a few water bodies under pressure from old landfills, fish farming (aquaculture) and agriculture.

Water bodies categorised as *in uncertainty* will undergo monitoring and be subjected to further research to determine their status regarding their environmental objectives. Some of these water bodies are already being monitored, such as Pingvallavatn and Mývatn. Others are scheduled to be monitored according to the MP. Several water bodies will also be monitored under operating licenses. A complete list of water bodies still *in uncertainty* can be found in the complete RBMP on vatn.is.

2.4 Protected and vulnerable areas

According to the Water Framework Directive, for each river basin district, the register or registers of protected areas shall be kept under review and up to date. The Environment Agency has the role to document such areas specifically. The list includes e.g. protected areas where drinking water abstraction takes place, areas protected due to economically important aquatic organisms, water bodies designated or characterised as recreational waters, areas vulnerable to nutrients and areas designated for the conservation of habitats or species, where water is an important part of the conservation.

The register for protected and vulnerable areas lists water bodies that have abstraction of more than 10m³ of water each day. Most of Icelandic drinking water comes from abstracting groundwater so the majority of water bodies on the register are groundwater bodies. No Icelandic regulation acts specifically for the designation of economically important species, at least no regulation that corresponds to the biological quality elements of the WFD. The only Icelandic regulation that covers this on the is an Icelandic regulation on salmon and trout fishing. In that regulation, areas can be designated for protection. Today no such areas have been defined. Water bodies for recreational use is supposed to be registered also. Thus far, two bathing areas (Nauthólsvík and Urriðavatn in Egillstaðir) are listed as such. Furthermore, areas vulnerable to nitrates are supposed to be on the register, but no such areas have yet been defined. Areas designated for the conservation of habitats or species refer to Natura 2000 and The Habitats Directive and The Birds Directive, which have not been implemented in Iceland. However, Iceland has a nature conservation law which somewhat corresponds to those directives. Around 100 areas in Iceland are protected under this law, and 23 are protected based on their uniqueness relating to water or aquatic organisms. All protected areas should have a protection and management plan, and according to the water management regulation, their ecological status should be high or good. If protected areas that have water bodies *at risk*, monitoring shall be conducted, and measures made to reverse that risk assessment.

In 2018, a committee appointed by the Ministry for the Environment, Energy and Climate, under the supervision of the Environment Agency of Iceland, was tasked with developing guidelines for the listing of these two types of water bodies in Iceland. Additionally, the committee proposed a list of heavily altered and artificial water bodies. The results were published in a report released in 2020¹⁷.

2.5 Environmental estimate of the RBMP

Extensive plans such as the RBMP can have significant impacts, and it is important that they are as positive as can be for the environment and society. A part of the RBMP is to

¹⁷ Umhverfisstofnun 2020: [Fyrstu skref við mat á manngerðum og mikið breyttum vatnshlotum](#).

carry out an environmental assessment for the plan in accordance with the Act on Environmental Assessments of Plans (No. 105/2006). The results will then be used to reduce negative environmental impacts. This assessment was conducted simultaneously to the formulation of the RBMP. The main result from the assessment is that the aims of the RBMP and its policies have a positive impact on environment and society. Furthermore, since one of the measures is on increased purification of wastewater, there is a potential of reducing greenhouse gas emissions and increasing the circularity of waste by using the sludge nutrients for land reclamation. This is presented in a report¹⁸. Most effective climate actions for this RBMP are thus to ensure acceptable purification of wastewater and reuse to nutrients captured.

2.6 Measures for the first and second water cycle

This first RBMP runs from 2022–2027, and in this time period, its objectives will be re-evaluated and a new RBMP made for the next water cycle. Implementing the WFD is a long-term project with a different emphasis each time but always focused on having all water bodies reach at least “good status”. Up until now, efforts have focused on setting up many of the basic elements of the water management system. Due to prioritisation, several components still need work, e.g. re-evaluating the pressure analysis and strengthening knowledge on type-specific reference conditions. Additionally, more work is needed to finalise the classification methodology to estimate ecological status of water bodies, and various ecological data are still missing.

The PoM and MP are important for continued data collection on water and to execute the measures to ensure the aims of the water management regulation are achieved. The data collected for this water cycle will then be used to continue the work for the next RBMP in 2028–2033.

As stated previously, further work is still required, and significant prioritisation was carried out for this first water cycle. Many aspects could not be completed in this first RBMP but will be expanded on in the next. The aspects to consider for the next water cycle include, but are not limited to:

- **Groundwater** needs to be researched further in terms of Iceland’s hot groundwater. Only cold groundwater is addressed in this water cycle. More research is needed regarding actions and mapping for the groundwater resource. Delineation of water bodies is still needed, specifically in relation to further dividing up groundwater bodies based on pressures.
- **Heavily modified and artificial water bodies** and work related to them has started in this water cycle. However, more research is needed to finalise their definitions. This includes pressure analyses and estimating hydro-morphological changes and ecological status to determine if they really are HMWB.

¹⁸ Efla. 2020. Losun gróðurhúsalofttegunda við bætta fráveituhreinsun, p. 12 (In Icelandic).

- **Pressure analysis** for this first water cycle is from 2013, and a new one needs to be conducted to include up-to-date data and information which may have changed since the first analysis. Additional knowledge gathered since the first analysis can also better inform researchers on various pressures. Simultaneously, more information is needed on hydro-morphological pressure elements relating to smaller infrastructure such as bridges, bocks, wastewater and others which may impact ecological statuses of water bodies.
- **Hydro-morphological quality elements** as a part of the ecological status of water bodies are not included in this water cycle but need to be researched further to be included in the status classification in the next water cycle.
- **Alien and invasive species** need to be researched and mapped in Icelandic waters if their presence is detected. This includes determining if they are negatively impacting biodiversity and if they are spreading.
- **Monitoring priority substances in sediments and biota** is important to make long-term estimates on the strength of substances. This will be done in the next water cycle.
- **Climate change and RBMP.** European states should consider climate change in their RBMPs and ensure that the plans do not exacerbate emissions. It is also important to consider how climate change will influence water environments for the future and how it will in turn influence measures and monitoring. Certain quality elements may need to be reconsidered to account for changes related to climate change. Ocean level rise can influence sewer systems, and research is needed on whether rising temperatures can change surface water ecosystems. This will be done in more detail in the next water cycle.

More detailed information on the sections in this summary can be found in the complete documents for the RBMP, PoM and MP on vatn.is (only in Icelandic).

3. Monitoring Plan (MP)

To achieve the aims of the WFD, a Monitoring Plan (MP) has been made for the whole country. The purpose of the MP is to co-ordinate monitoring based on water management regulation, enable the comparing and processing of monitoring results and present proceedings on how to survey water bodies. Monitoring should be precise enough to estimate the condition and long-term changes in the natural state of water bodies and impacts of pressure from various activities. Monitoring of water bodies is to keep track of impacts of the Programme of Measures (PoM) made to improve the quality status of water and prevent water body deterioration.

The Icelandic Environment Agency enforces the MP and ensures it follows the methodology outlined by the WFD, which guarantees scientific quality and comparable results. The Marine and Freshwater Research Institute, Icelandic Meteorological Office and Icelandic Institutes of Natural History were involved in formulating this MP and will cover consultancy for the monitoring of specific quality elements when appropriate.

The MP is the first holistic monitoring plan presented for water in Iceland in terms of co-ordinated research, monitoring and protection of water. The MP shall be re-evaluated every six years along with the RBMP. Despite entering into force in 2022, specific MPs have been made for two lake water bodies, *Mývatn*¹⁹ and *Þingvallavatn*²⁰, due to their uniqueness and their uncertainty in reaching their environmental objectives of at least good ecological status.

Monitoring will occur on two types of water bodies: those seen as in a natural state and thus monitored as type-specific reference conditions and those water bodies considered under pressure or which have already been categorised as *in uncertainty* or *at risk* of not meeting their environmental objectives. For this water cycle, 22 water bodies will be monitored, excluding water bodies monitored according to operating licenses. Various stakeholders will work on monitoring under the water management regulations, and a specific methodology and plan is assigned to each water body.

Monitoring is slightly different depending on the water body. Aspects monitored are the quality elements and priority substances introduced above. For surface water bodies, the monitoring is separated into three categories: surveillance, operational and investigative monitoring. The first will be conducted on water bodies considered in a natural state and to provide an assessment of the overall surface water status, the second on water bodies *at risk* and to assess changes in the status of such water bodies resulting from measures taken. The third is to find causes as to why a water body or water bodies *at risk* are failing to meet their environmental objective and focuses on isolated quality elements. For groundwater, monitoring categories are surveillance and operational monitoring for chemical elements and monitoring for quantitative elements. If a groundwater body is not under pressure, monitoring is not required.

4. Programme of Measures (PoM)

The aims of the RBMP is to prevent deterioration of water quality and improve the condition of aquatic ecosystems which do not reach at least “good status”. To enable water bodies to reach their environmental objectives, pressures on water bodies need to be managed and reduced where needed. To achieve these aims, a Programme of Measures (PoM) is produced to ensure the Icelandic water is protected and the objectives of the Water Framework Directive are met. Furthermore, the measures shall have the least negative environmental impact possible and the impact of climate change on water needs to be explored. A detailed analysis was made regarding improved wastewater treatment and its effect on reduced greenhouse gas emissions.

¹⁹ The Environment Agency of Iceland. 2018. [Vöktunaráætlun fyrir Mývatn 2018-2023](#) (In Icelandic).

²⁰ The Environment Agency of Iceland. 2020. [Vöktunaráætlun fyrir Þingvallavatn 2019-2024](#) (In Icelandic).

The Icelandic Environment Agency proposes measures in collaboration with the Water Council, Regional Water Committees, Advisory Committees, municipalities and others. The PoM presents financial obligations of the state and municipalities. These entities had opportunities to influence the specific measures, as long as they conformed with the aims of the WFD and the water management regulation. The measures approved by the Minister for the Environment and Natural Resources are then binding for involved authorities. The responsibility of executing the measures will be spread across different sectors, both among those within the administration and those who utilise the water resource. For each measure, there will be a responsible party who ensures the measures are carried out. The PoM will officially enter into force in 2022; however, several measures have been initiated due to their urgency.

The measures focus on enforcing the provisions of water protection regulations, work components to ensure correct implementation of the WFD in Iceland, monitoring and researching water bodies and various actions to reduce pressure on water bodies. There are 57 measures (see table 2), which are divided into 6 categories: Implementation of the WFD, Administrative measures, Education and capacity building, Monitoring of water bodies, Wastewater treatment improvements and Water bodies at risk due to chemical status. Based on the Icelandic water management regulation, the measures outlined for this water cycle shall be completed within the water cycle itself. The Environment Agency can resort to enforcements in the form of reminders or daily fines (Article 28 in the water management regulation) to force the implementation of measures.

Furthermore, water costs need to be considered according to water management regulations. The government should account for cost recovery in water provision, including environmental and natural resource-related costs stemming from damage to water resources. The WFD requires states to implement a policy regarding water prices that encourages users to use the water resource in an economical way that supports the environmental objectives of the WFD. This is not necessary if the price of water services undermines the purpose and aim of the WFD. According to a 2011 report from the Economics Department of the University of Iceland²¹, the price of cold water in Iceland does not encourage economical use of water. The PoM specifies a need to review this analysis and the resulting actions needed.

²¹ Economics Department of the University of Iceland. 2011. [Hagfræðileg greining á nýtingu vatns](#). C11:04, p. 56 (In Icelandic).

Table 2: All measures (57 total) in Programme of Measures (PoM) 2022 - 2027

Nr.	Implementation of the WFD	Description of the measure
A1	Processing and presenting information to the public	Regular compilation of data on water bodies, such as delineation of water bodies, information on various pressures, measures related to water bodies, and their status, shall be communicated to the public on vatn.is and in the Icelandic Water Viewer.
A2	Assessment of ecological status of water bodies designated as heavily modified and artificial water bodies	Assess whether the water bodies that have undergone significant hydro- morphological changes achieve at least good ecological status. Water bodies that achieve good ecological status will not be classified as heavily modified water bodies.
A3	Analysis of hydro- morphological pressures other than those caused by major hydro power plants	Analysis of hydro- morphological pressures for other pressures than hydro power plants likely to cause significant changes of the status of water bodies. These may include pressures from small power plants (less than 10 MW), flood control measures, fjord crossings, and road construction.
A4	Portal for data reporting - development	Development of a portal for data reporting of water body quality elements results.
A5	Portal for data reporting - operation	Operation and maintenance of the portal for data reporting of water body quality elements.
A6	Online Water Status Information hub	Operation of the Icelandic Online Water Status Information hub management. Updates and maintenance of the website.
A7	Expert advice on monitoring biological and physico- chemical quality elements	Expert advice on monitoring biological and physico- chemical quality elements. Development and issuing work instructions for sampling of quality elements.
A8	Expert advice on monitoring hydro- morphological quality elements	Guidelines for the Local Health Inspectorates that issue pollution permits for hydro power plants.
A9	Analysis and risk assessment in accordance with the results of priority substance monitoring	Analysis of the results of priority substance monitoring. Prioritize substances based on their frequency and magnitude in Icelandic water bodies. Develop a plan to reduce their use. Conduct a risk assessment.
A10	Invasive species and their impact on ecological status	Mapping of invasive alien species to assess whether their distribution may have an impact on the ecological status of water bodies.
A11	Educational seminar for monitoring of quality elements	Organizing an educational seminar for scientist and other stakeholders, demonstrating sampling procedures.
A12	Revision of groundwater and surface water bodies names	Revision of groundwater and surface water bodies names, in accordance with changes of i.e. delineation and new information.

A13	Pressure analysis for RBMB 2028 - 2033	Revision of the pressure analysis according to the methodology presented in the Environment Agency status report (2013). Including analysis of pressures that since have emerged, i.e. from aqua culture and those that the analysis did not include i.e. hydro-morphological and agricultural pressures.
A14	Further delineation of groundwater bodies in the capital area due to pressures	Revision of the groundwater body Straumsvíkurstraumur (104-265-G) delineation due to various pressures. Additionally, assessment of need for further delineation of other groundwater bodies in the capital area due to quantity or chemical pressures.
A15	Further descriptions of groundwater bodies in the capital area	Further description of the groundwater bodies Straumsvíkurstraumur (104-265-G) and Stór-Reykjavík (104-261-2-G) according to Articles 7 and 11 of Regulation No. 535/2011.
A16	Reference status of hydro-morphological quality elements of rivers and lakes	Define and describe the reference status of hydro-morphological quality elements used to assess the ecological status of rivers and lakes.
A17	Pressure analysis of water bodies associated with major hydro power plants	Complete an assessment of hydro-morphological changes in water bodies that were not included in the report on heavily modified and artificial water bodies. This includes river sections that have been diverted from natural channels into reservoirs of hydro power plants. The assessment will determine whether these water bodies will be designated as heavily modified and artificial water bodies.
A18	Classification system for heavily modified and artificial water bodies - Definition of ecological potential	Analysis of data from water bodies designated as heavily modified and artificial water bodies. Preparation for the development of a classification system for heavily modified and significantly altered water bodies, including the definition of boundaries between high, good, and poor reference conditions.

Nr.	Administrative measures	Description of the measure
B1	Implementing requirements of the Nitrogen regulations	Implementation of the regulation will be organized and enforced in cooperation with Local Health Inspectorates. Criteria for the classification of sensitive areas will be developed in connection with measure A2. Among other things, areas sensitive to nitrogen pollution will be defined and delineated, and samples and data from them collected.
B2	Review of pollution permits, and monitoring plans issued by the EAI	A plan will be issued for the review of pollution permits issued by the Environmental Agency. Pollution permits and monitoring plans will be updated in accordance with the Water Framework Directive requirements, with priority given to water bodies of uncertain status and at risk.

B3	Analysis of the implementation of requirements in operational licenses and pollution permits	Analysis of whether the requirements of the Water Framework Directive should be implemented through the National Energy Authority's licenses or through permits issued by the Local Health Inspectorates. Comprehensive review on the law framework will be performed as well as mapping, and prioritization of work.
B4	Review of pollution permits issued by the Local Health Inspectorates	Revision of pollution permits and monitoring plans issued by the Local Health Inspectorates. The revision will be prioritized according to i.e., water bodies status and in accordance with the requirements of the Water Framework Directive.
B5	Analysis of regulations for drinking water, water protection, and groundwater	Analysis and mapping of the role and responsibilities each public authority is responsible for regarding implementation of drinking water requirements, water protection areas and groundwater requirements. Specifically, regarding permits, supervision and monitoring.
B6	Revision of the regulation on the management of sewage sludge.	Completing the revision of regulation No. 799/1999 on sewage sludge management, with focus on alternative solutions for sludge management and use and environmental limits for heavy metals.
B7	Economic analysis of water use	A revision of the economic analysis of water use according to Article 7 of Act No. 36/2011 on water management (WFD). Analyzing the ways to recover costs for water use in accordance with the Water Framework Directive.
B8	Proposal based on the economic analysis of water use	A committee will be established to oversee the revision of the economic analysis of water use. The committee shall set up various scenarios in accordance with measure B7, seeking ways to comply with the requirements for cost recovery for water use and possible related measures. The committee shall submit a proposal to fulfill the requirements of the Water Framework Directive.
B9	Division of responsibilities between authorities regarding drinking water and groundwater	Establish a collaboration platform among the public authorities responsible for the implementation of regulations for drinking water and groundwater. The goal is to clarify the roles of each authority and establish rules for cooperation. The group will ensure compliance with the regulations and monitoring. The group will also make suggestions on the division of roles among institutions regarding the implementation of the new directive on drinking water.
B10	Definition of safeguard zones	Analyzes of the safeguard zones requirements and its synergy with the Icelandic water protection areas.

Nr.	Education and capacity building	Description of the measure
C1	Communication of water and wastewater issues	Organized communication/dissemination on various issues related to the status of water bodies and pressures on water resources. The focus of dissemination will be decided in collaboration with stakeholders. The aim is, among other things, to focus this measure on education regarding pharmaceuticals in water, use of organic pesticides instead of plant protection products, and environmentally friendly car washing.

C2	Nordic Water Conference	The Nordic Water Conference is held every other year, bringing together experts in water management and research. The Nordic countries take turns hosting the conference, and Iceland hosted it in 2022.
C3	Consultation and Cooperation with Agricultural Stakeholders	Initiate consultations and cooperation with stakeholders in agriculture, including government authorities, research institutions, and industry representatives. With an emphasis on education about fertilizer use, organic pesticides, and good farming practices.
C4	Update of Guidelines on Good Farming Practices with an Emphasis on Water Issues	The guidelines need to be updated in accordance with the requirements of WFD and comply with Regulation No. 804/1999 on protections against water pollution caused by agricultural and other activities.

Nr.	Monitoring of water bodies	Description of the measure
D1	Preparation for Groundwater Monitoring	Developing methodology for groundwater monitoring (quantitative and chemical status). Development of guidance documents to be used for monitoring.
D2	Preparation for Priority Substances Monitoring in Organisms and Sediments	Development of methodology for sampling priority substances in sediments and organisms in accordance with the requirements of the WFD and guidance documents.
D3	Development of Work Procedures for Water Bodies that will be Monitored	Work procedures will be developed for each water body in the monitoring program, including description of methods and sampling, such as the location and number of sampling stations, the number of sampling events, parameters to be measured for each quality element, and the methods to be used.

Nr.	Wastewater treatment improvements Water bodies at risk due to chemical status	Description of the measure
E1	Methodology for Classification of Sensitive Areas	Development of a methodology for a classification of sensitive areas to meet the requirements of Regulation No. 798/1999 on wastewater treatment and Regulation No. 804/1999 on protection against water pollution caused by agricultural and other operations.
E2	Classification of Sensitive Areas	Classification and definition of areas sensitive to nutrients in accordance with the requirements of Regulation No. 798/1999 on wastewater treatment and Regulation No. 804/1999 on protection against water pollution caused by nitrogen compound from agricultural and other operations. This measure is a continuation of measure A1, for which the workflow has been developed.
E3	Guidelines for determining Less sensitive Areas	Guidelines will be provided for municipalities to define areas less sensitive to wastewater in accordance with the requirements of Regulation No. 798/1999 on wastewater.

E4	Guidelines for Small Wastewater Systems	Guidelines for small wastewater systems will be revised and issued.
E5	Guidelines for Inspection and Monitoring of wastewater	Guidelines will be developed for monitoring of wastewater facilities in accordance with the requirements of Regulation No. 798/1999 on wastewater treatment. The guidelines will be for both operators of treatment facilities and Local Health Inspectorates who enforce the requirements.
E6	Coordination of wastewater facilities operational license	Development of a coordinated operational license for wastewater facilities (appropriate treatment, primary treatment, secondary and tertiary treatment) in accordance with the requirements of Regulation No. 798/1999 on wastewater treatment.
E7	Operational License for wastewater facilities	<ol style="list-style-type: none"> 1. Health Inspectorates will develop a work plan for issuing operational licenses for wastewater facilities in accordance with Act No. 7/1998 on pollution control. The plan will include operational licenses that need to be revised and new issued where needed. 2. New and current operational license for wastewater facilities will be revised and issued in accordance with the requirements of Regulation No. 798/1999 on wastewater treatment.
E8	Prioritization of wastewater improvements	Development of prioritization for improvements in wastewater treatment in urban areas. Health Inspectorates, in cooperation with the Environment Agency and the Ministry for the Environment, Energy and Climate, will issue a prioritization of improvements according to risk assessment.
E9	Seminar on new legislation for wastewater requirements	When the new regulation on wastewater treatment will be issued the Ministry of Environment, Energy and Climate will present and communicate to stakeholders the requirements of the legislation.
E10	Hvolsvöllur - Wastewater Treatment Improvements	<ol style="list-style-type: none"> 1. Monitoring of wastewater treatment and WFD quality elements. 2. The municipality will present a plan for wastewater treatment improvements.
E11	Hella - Wastewater Treatment Improvements	<ol style="list-style-type: none"> 1. Monitoring of wastewater treatment and WFD quality elements. 2. Evaluate the possibility of improving treatment from companies in the food industry. 3. Develop a strategy/action plan to meet the requirements of Regulation No. 798/1999 on wastewater
E12	Selfoss - Wastewater Treatment Improvements	<ol style="list-style-type: none"> 1. Construction of a secondary treatment facility for the south part of Selfoss 2. Operational license issued and monitoring plan.
E13	Ísafjörður - Wastewater Treatment Improvements	<ol style="list-style-type: none"> 1. Combining discharge points and construction of a wastewater treatment facility.
E14	Akureyri - Wastewater Treatment Improvements	<ol style="list-style-type: none"> 1. Monitoring of WFD quality elements

E15	Egilsstaðir - Wastewater Treatment Improvements	1. Development and construction of treatment facility for secondary treatment.
E16	Höfn í Hornafirði - Wastewater Treatment Improvements	1. Definition of the receiving water as less sensitive 2. Close discharge points in a sensitive area. 3. Issuing of a operational license.

Nr.	Water bodies at risk due to chemical status	Description of the measure
F1	Lake Tjörnin - findings and reaction to monitoring of priority substances	A working group (Local Health Inspectorate of Reykjavík city) and EAI will analyze findings and issue proposal for actions.
F2	Preparation for monitoring of quality elements	Issuing a monitoring plan for quality elements for lake Tjörnin.
F3	Lake Tjörnin - Monitoring	Monitoring to be carried out in 2022- 2027 in accordance with monitoring plan in action E2.
F4	Lake Tjörnin - Measures	Analysis of origin of priority substances in lake Tjörnin. Analysis of possible measures to take to reduce the pressure of chemicals.
F5	Monitoring in the groundwater body Rosmhvalanes 2	Analysis of pressures on the water body with monitoring.
F6	Mapping of pressures on the groundwater body Rosmhvalanes 2	In cooperation between EAI and the Local Health Inspectorate, mapping of pressures will be produced.