The Project for the Flood Control Using Integrated Dam Management System

Annual Project Progress Report

The Government of Japan

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Acronyms

AWP	Annual Work Plan
Delft-FEWS	Delft Flood Early Warning System
EPP	Emergency Preparedness Plans
EWS	Early Warning System
HS	Hydraulic Structures
IAC	Information and Analytical Center for Water Resources
ICOLD	International Commission on Large Dams
RBEC	Regional Bureau for Europe and the Commonwealth of Independent States
MDA	Multifunctional Dam Assessment
MES	Ministry of Emergency Situations
MWRI	Ministry of Water Resources and Irrigation of the Republic of Kazakhstan
NISWR	National Information System for Water Resources
ToR	Terms of Reference
UNDP	United Nations Development Programme
UNSDCF	United Nations Sustainable Development Cooperation Framework

I. Executive Summary

In 2025, the Project made a progress towards enhancing a National Information System for the security of hydrotechnical structures, an essential element of Kazakhstan's flood early warning and preparedness framework. The Project advanced both institutional capacity through focused seminars and safety of pilot dams through comprehensive dam assessment studies, both of which are needed to improve national dam safety and risk management.

During the reporting period, **70 operators that are responsible for 360 of 405 dams (88%)** enhanced their capacity on modern dam safety practices and were introduced to a comprehensive assessment approach. These activities contributed to more consistent operational standards across regions and strengthened the technical foundations for safer dam management.

The Project also initiated a **multi-functional dam assessment (MDA)**, which is to be concluded in April 2026. Key progress in 2025 included completion of a **GAP Analysis** comparing national standards with international best practices. The resulting recommendations provide a clear pathway for revising Kazakhstan's regulatory framework to better support risk-informed dam management. Flood study as well as dam assessment reports were prepared for 2 strategically important large reservoirs of Kazakhstan in Kostanay region (Karatomar and Verhnetobolskoye).

Technical guidance on dam integrity, monitoring, and operation was provided, regulatory guidance on specifying the structure, key parameters, and time intervals for conducting comprehensive dam safety reviews, manual for dam impact zones identification, emergency preparedness plans, as well as the annual dam safety report template were developed to strengthen the safety, integrity, monitoring and operation of dams. 14 consultation sessions, presentations, workshops and training events were conducted on the latest developments in water management, flood management, and dam safety regulation, engaging key relevant agencies and drawing on international technical expertise.

National information system was enhanced by integration of information on existing dams. From September to December 2025, metadata for **228 dams (56%)** was integrated into the **National Water Information System (NWIS)**, improving data availability for government agencies. Additionally, **150 users** gained access to the NWIS, facilitating more informed decision-making and reinforcing Kazakhstan's shift toward centralized, digital monitoring tools.

While the Project achieved significant results, challenges related to fragmented datasets and varying data quality highlighted the need for continued strengthening of institutional coordination and information management.

The Project utilized majority (88%) of its **2025 annual budget of USD 504,680**.

II. Introduction / Background

The flood situation in 2024 was an unprecedented event. Frozen soil, sudden temperature rise and rainfall in conjunction with a considerable snow cover resulted in extremely high flows in the north and west of Kazakhstan. Many rivers experienced all-time high-water levels and flood defense structures could not cope with the extreme flood volumes. The flood inundated large areas including settlements and agricultural zones and Aktobe was one of the hardest-hit cities in Kazakhstan. The fact that two dam breaks happened in Kazakhstan in the past 14 years, the Kyzylagash dam in 2010 (Zhetysu oblast) and the Kokpektinskaya dam in 2014 (Karaganda oblast), is evidence that threats are real and action is needed.

To manage flood risks, it is essential that dams are fully integrated into Kazakhstan's national flood management concept so that dams play an important role in flood management. This integration requires the enhancement of early warning systems, improved dam monitoring, the rehabilitation of outdated infrastructure, and the updating of operational guidelines. Dams need urgent modernization in terms of three pillars: (1) Dam integrity; (2) Monitoring and dam surveillance; (3) Operation to enhance the flood management strategy in Kazakhstan, protect downstream riparians and ensure the full potential of flood attenuation of dams.

The main objective of the Project is to develop a National Monitoring System for the security of hydrotechnical structures and operationalize the System as part of the country's flood early warning and preparedness approach. The aim of this project is to integrate water infrastructure, especially dams, into the national flood management and preparedness strategy by

1. developing the dam flood and safety management concept
2. pilot the assessment of dams with the new flood and safety management concept
3. making dam integrity, dam monitoring and surveillance, and reservoir operation an integral part of the national water information system.

Main events during the reporting period:

- The project signing ceremony was held in Astana, Kazakhstan on March 7, 2025.
- Dam site visit by the International Consultant in April 2025.
- Dam site visit by the contracting company for Multi-functional Dam Assessment in October 2025.
- 3 online seminars were conducted led by the International Consultant, the contracting company for Multi-functional Dam Assessment and Information Analytical Centre respectively during November and December 2025.

III. Progress Review: Key Activities and Results in 2025

Section 1: Analysis of Theory of Change

Although a Theory of Change was not articulated in the project document due to the emergency and humanitarian nature of the project, below is the theory of change developed with the current progress of the project. The underlying assumptions of the project hold true. Currently, no changes are required.

If the project:

- establishes a national dam flood and safety management concept,
- pilots multi-functional dam assessments,
- introduces automated monitoring and early warning systems,
- integrates dam data into the National Water Information System,
- and builds institutional capacities of dam authorities and operators,

Then:

- dam integrity at pilot dams will improve,
- early warning lead time for downstream populations will increase,
- decision-making will become data-driven,
- emergency preparedness will strengthen,
- capacity of dam authorities and operators will increase.

Section 2: Overall progress against outcomes

UNSDCF Outcome 3.2. By 2025, all people in Kazakhstan, in particular most vulnerable, benefit from increased climate resilience, sustainable management of environment and clean energy, and sustainable rural and urban development.

The project makes a direct and substantive contribution to this outcome by strengthening national climate resilience, improving flood preparedness, modernizing critical infrastructure, and enhancing the safety and sustainability of water resources management—all of which are key to Outcome 3.2.

1. Strengthening National Climate Resilience

The project modernizes dam safety, monitoring, and early warning systems to better manage climate-induced floods. This significantly improves Kazakhstan's ability to anticipate and respond to extreme weather events.

2. Protecting Vulnerable Populations

By increasing flood warning lead time and improving dam safety, the project reduces risks for more than 580,000 people living downstream. Vulnerable rural and urban communities become safer and better prepared.

3. Supporting Sustainable Environmental Management

The project updates dam monitoring and develops early warning system, enabling sustainable and climate-responsive water management. This reduces environmental risks associated with outdated hydraulic infrastructure.

4. Advancing Digital Innovation for Climate Adaptation

By integrating dam data into the National Water Information System, automated monitoring and digital tools enable faster and more informed decision-making.

5. Building Institutional Capacity and Governance

Training dam managers and authorities strengthens long-term national capacity for climate-resilient water management. Clearer roles, standards, and procedures improve governance and emergency response.

6. Supporting Kazakhstan's NDC Commitments

The project directly contributes to national climate adaptation goals outlined in the NDCs, especially in water management and disaster risk reduction. This alignment ensures stronger national ownership and long-term sustainability.

Section 3: Monitoring and Evaluation[1] of activities.

Although no monitoring and evaluation activities were performed due to the fact that project began in March 2025, risk log was reviewed and updated in December 2025 to mitigate potential risks. Monitoring activities are planned for 2026.

Section 4: Progress against each output

Project Output 1: Development of the national dam flood and safety management concept		
Output indicators	**Targets**	**Progress against targets**
1.1 Increased integrity of dams through exposure to best practices and comprehensive assessment approach. (% of dams covered)	Baseline: 405 AWP target: 30%	Reporting period: 88% of dams (360 out of 405)

[1] The later if applicable.

1.2 Capacity of dam managers on the application of new approach to dam safety improved (% of dam managers in Kazakhstan)	Baseline: 405 AWP target: 30%	Reporting period: managers responsible for **88%** of dams (360 out of 405)

Key Activities:

Activity 1.1: Define best practice for the three pillars dam integrity, monitoring, operation. Integration of ICOLD standards.

Comprehensive Technical Guidance on dam integrity, monitoring, and operation (ICOLD standards) was developed within the following activity. Technical advice outlines that dam integrity should be grounded in robust design criteria, including clear safety goals, hydrological analyses reflecting climate change, and adequate flood passage requirements. Monitoring must follow ICOLD's three-pillar surveillance approach—instrumentation-based monitoring, visual inspections, and regular testing—to enable early detection, diagnosis, and action on abnormal dam behavior. Operational best practice emphasizes clear operating rules, redundancy of critical systems, structured gate operation plans, and comprehensive maintenance and testing regimes to ensure reliable flood management and safe hydraulic structure performance. Integrating these elements provides a harmonized framework that strengthens dam safety governance, reduces human and technical risks, and brings Kazakhstan's dam management in line with modern international standards.

Activity 1.2: Develop annual dam safety reports template as mandatory instrument for safety review.

Standardized Annual Dam Safety Report (ADSR) Template was developed as a mandatory tool to strengthen dam safety governance and ensure systematic, year-to-year safety evaluations. The ADSR framework—aligned with international dam safety management principles—provides a structured annual review of dam safety, covering operation, maintenance, surveillance, emergency preparedness, and any incidents occurring within the reporting period. The template introduces clear, uniform reporting requirements through two sections: Part A, which compiles consistent general information on dam characteristics, classification, hydrology, and infrastructure; and Part B, which documents annual inspections, monitoring results, structural conditions, hydrological events, and compliance with safety regulations. By making ADSRs a mandatory requirement for all dam operators, MWRI ensures regular documentation of dam behavior, facilitates early identification of risks, improves accountability, and forms a continuous feedback loop feeding into broader Multi-functional Dam Assessments and long-term safety planning.

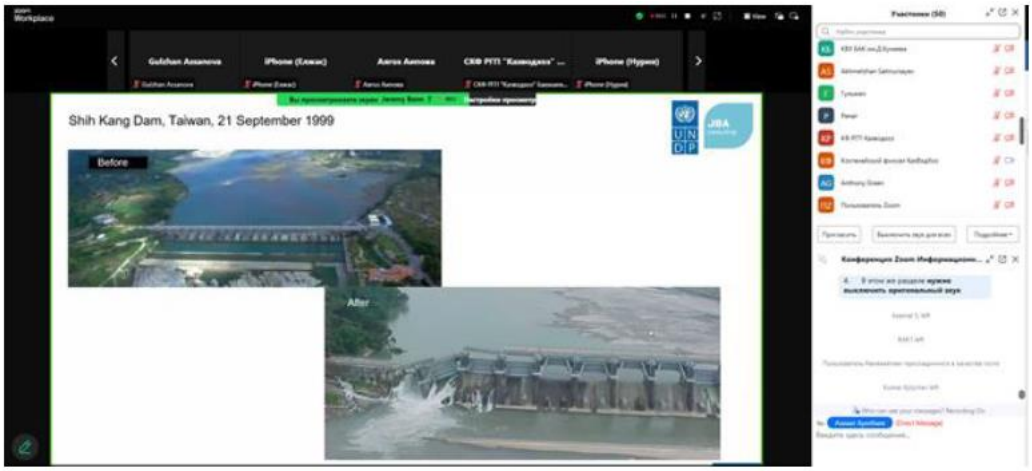
Activity 1.3: Devise the approach to identify the dam impact zone with affected people, settlements.

Within this activity a clear, step-by-step approach to identify dam impact zones, combining 2D hydrodynamic modelling with GIS-based analysis was developed. The methodology begins with preparing high-resolution terrain data (DEM), defining the modelling extent, carving river channels, and generating key GIS layers such as 2D areas, breaklines, and roughness polygons, which form the basis for reliable HEC-RAS simulations. Flood scenarios—such as design floods, check floods, and historical events—are then simulated to map inundation extents and determine where water depths exceed safe thresholds, highlighting downstream areas, settlements, infrastructure, and population clusters at risk. The approach integrates technical modelling with participatory validation: flood maps are shared with local communities, who provide ground-truth observations from past events, helping refine results and identify critical hotspots and vulnerabilities. The final impact zone assessment supports the development of preparedness measures, evacuation planning, and targeted communication strategies, forming a robust foundation for emergency response planning and integration into national early warning systems. Dam impact zone assessments and a thorough result analysis is key to guide the discussion between flood managers at the MWRI, emergency flood responders from the Ministry of Emergency situation, stakeholders on site and the dam operators. It is strongly recommended to expand this approach to all flood critical locations step by step and include inundation results into the nationwide Flood and Drought Early Warning System.

Activity 1.4: Define the content of a comprehensive dam safety review and its time interval.

Guidance on the structure, key parameters, and time intervals for conducting comprehensive dam safety reviews was developed for technical assistance to the MWRI. The review is defined as a detailed evaluation covering all major components influencing dam safety, including hydrology, geology, reservoir operation, structural condition of the dam and spillway, sedimentation, historical modifications, inspection and maintenance plans, and the adequacy of surveillance and instrumentation systems. A comprehensive review must compile updated documentation, layout drawings, design criteria, stability analyses, hydrological assessments, instrumentation records, and evidence of operational performance, supported by visual inspections, testing results, and analysis of long-term monitoring trends. The manual highlights that special or in-depth safety assessments should be carried out periodically based on hazard classification, consistent with ICOLD guidance, while Kazakhstan's regulatory framework currently mandates multifactor surveys every five years—although international practice in many countries allows intervals of up to ten years when complemented by mandatory annual safety reporting. Defining these time intervals and the full scope of review ensures that structural, hydrological, operational, and emergency preparedness aspects are reassessed regularly, allowing early detection of emerging risks, incorporation of new hydrological or seismic information, and continuous updating of dam safety management processes.

2 seminars have been conducted for managers of 360 dams (out of 405) on best practices and comprehensive assessment approach and on the application of new approach to dam safety. The first seminar was conducted on 12 December , 2025, format: online (Zoom) with simultaneous translation. Seminar objective: to present and discuss application of new approach to dam safety and the comprehensive assessment methodology used for the pilot dams, for at least 60% of dam operators of Kazakhstan (out of existing 405 dams), building institutional understanding and readiness to replicate MDA in line with revised standards.



Key thematic blocks:

- causes and mechanisms of dam failures, including hydrological and structural factors;
- flood estimation and control;
- methodology for assessing the condition of dams (visual inspections, frequency, data analysis);
- monitoring and surveillance, maintenance and emergency planning;
- risk-based decision making, including impact assessment and Portfolio Risk Management.

Expert presentations were given by international specialists. During the seminar, international experts presented interrelated reports covering the full cycle of dam safety assessment, from identifying potential failure scenarios to making management decisions based on risk assessment. International experts presented an introductory report on dam failure mechanisms. During the presentation, the main types of damage (hydrological, geotechnical, structural and operational) were defined, as well as approaches for assessing and managing flood risks were considered. Special attention was paid to the importance of early identification of signs of degradation of structures and the role of regular monitoring in emergency prevention. Afterwards Jeremy Benn and James Howard presented the structure and logic of dam condition assessment in the first part of the methodological block. In detail the following have been reviewed:

- dam and infrastructure elements subject to mandatory inspection;
- recommended frequency of control examinations;
- approaches to the fixation, systematization and primary analysis of identified defects and deviations;

- principles of forming reasonable conclusions based on survey results.

In the second part of the methodological block, the seminar focused on the issues of long-term dam safety management. This covered the organization of monitoring and surveillance systems, planning and performing maintenance, as well as the development and updating of contingency plans. The presented approaches were focused on practical application and integration into existing operational processes. International Expert presented the final thematic block on risk-based decision making. This part reviewed methods for assessing the consequences of possible accidents, the use of F-N diagrams, and approaches to risk management at the dam portfolio level. The experts emphasized the importance of a risk-based approach in prioritizing investments and measures to improve security.

During the seminar, the participants were asked practical questions concerning:

- specific risk factors for dams in the conditions of the Republic of Kazakhstan;
- adaptation of international methodologies to national regulatory requirements;
- consideration of climatic and geotechnical features (including soil freezing).

On 22 December 2025, an online seminar was conducted by International Consultant Dr. Hubert Lohr. Objective of the seminar: to provide an overview of the key elements of modern dam safety management by examining design floods, the three pillars of dam safety, the relevance of ICOLD international standards, and the essential measures for emergency preparedness.

A central theme was how to conceptualize a design flood, bridging everyday flood operations and rare, catastrophic events. The presenter positioned design floods along a continuum—from normal operation and known events through exceptional events with high damage potential, illustrating how return periods (e.g., 1-in-10, 1-in-100, 1-in-1,000 years) and climate change alter both the likelihood and the intensity of extreme inflows. This framing helps operators understand when systems move from standard flood management into emergency. The session then connected design floods to structural performance limits and failure modes—overtopping/overturning, seepage and piping, slope stability issues, and foundation

failures—reinforcing that the choice of design flood drives the engineering checks. A succinct three-step workflow was outlined for hydrological dam safety assessment:

- Classify the dam (by hazard, size, exposure, operational context),
- Select the design floods appropriate to that classification,
- Apply the design floods under "design cases"—accompanying adverse conditions deemed realistic (e.g., debris, equipment malfunction, lightning, power cut, landslides), not just a clean hydrograph.

This approach ensures the design flood is not treated in isolation but in combination with credible concurrent stressors that complicate operations during real events. The classification portion emphasized that hazard to life and assets, technical attributes (height, reservoir capacity, spillway type and capacity), downstream exposure, lead time, data reliability, staff experience, and site access all matter when assigning a dam to a category.

The seminar then consolidated dam safety into four pillars—Design, Monitoring, Operation, Preparedness—explicitly overlaying climate change across each:

- Design: anchor designs in rules, regulations, and standards, define design floods, identify geotechnical/geological/operational criteria, and explicitly recognize local conditions
- Monitoring: establish early warning systems in the catchment, surveillance at the dam, and instrumentation to extend lead time and detect problems early
- Operation: keep operating rules current, clarify the interplay between normal operation and emergency preparedness, maintain robust documentation, and embed river basin management thinking
- Preparedness: prepare Emergency Preparedness Plans (EPP), perform failure mode and dam-break analyses, conduct 2-D hydraulic modeling and flood mapping, and assess risks beyond the design cases

Preparedness was broken into a crisp three-step logic: detection of problems, diagnosis, and action. Examples showed how manual readings can fail during adverse weather (e.g., lightning) and why automated monitoring systems—while still supported by manual validation and operator experience—are essential to maintain situational awareness.

Activity 1.5: Draft the content of gender responsive Emergency Preparedness Plans (EPP) as integral part of the flood and safety management concept.

The content and structure of a gender-responsive Emergency Preparedness Plan (EPP) was developed, ensuring that emergency planning for dam safety and flood management incorporates inclusive, equitable, and people-centered approaches. The EPP template provides a comprehensive framework covering risk and threat analysis, operator responsibilities, warning levels, communication flows, emergency actions, preparedness measures, monitoring procedures, and inundation mapping. To integrate gender responsiveness, the approach emphasizes the differentiated vulnerabilities and capacities of women, men,

girls, and boys in flood situations, encouraging planners to consider diverse needs in evacuation planning, communication channels, access to warning systems, and allocation of emergency resources. This includes ensuring that notification procedures, safe areas, evacuation routes, and shelter arrangements take into account mobility constraints, caregiving roles, and safety concerns commonly faced by women and marginalized groups. The EPP also highlights the importance of community engagement and training—through drills, simulations, and serious gaming—to ensure all population groups, including women, are meaningfully informed and able to participate in preparedness and response processes. By embedding gender-sensitive risk assessment and response considerations throughout the EPP components, the activity ensures that dam-related emergency planning strengthens both safety and social equity.

Activity 1.6: Review roles and responsibilities related to the supervision of flood management and adherence to dam safety regulation.

14 consultation sessions, presentations, workshops, or training sessions conducted on the latest developments in water management, flood management and dam safety regulation with key appropriate agencies. The institutional roles, responsibilities, and coordination mechanisms among Kazakhstan's national agencies involved in flood management, early warning, and dam safety supervision was examined. The results provide evidence of a multi-institutional environment in which several actors—primarily the Ministry of Water Resources and Irrigation (MWRI), its Information Analytical Centre (IAC), Kazhydromet, and the Ministry of Emergency Situations (MoES)—play crucial but interdependent roles. A review of their functions reveals both progress and remaining gaps in supervision, regulatory enforcement, and operational coordination. MWRI is the authorised body responsible for dam safety oversight, registration of hydraulic structures, approval of dam passports, and ensuring compliance with safety regulations under the Water Code (Articles 68–74). It approves safety declarations and oversees multifactor inspections conducted by certified third parties. MWRI also supervises reservoir operations and is responsible for developing and enforcing regulations, including flood-related procedures and dam operation rules. The Information Analytical Centre (IAC) serves as the technical operator for hydrological modelling, nationwide flood and drought early warning systems, and water information platforms such as TALSIM, Delft-FEWS, and QazSu. IAC's responsibilities include:

- Hydrological model development, calibration, and verification for all river basins.
- Daily flood forecasting, model adjustments, and dissemination of results to MWRI and MoES.
- Data management, including integration of reservoir data, climate data, satellite altimetry, and ERA5 reanalysis datasets.
- Acting as technical partner in international consultations and training activities.

With the expansion of the nationwide system, IAC is expected to monitor and adjust modelling at hundreds of nodes, requiring strengthened staff capacity and clearer allocation of responsibilities among modellers. Kazhydromet provides:

- Meteorological and hydrological measurements (precipitation, temperature, streamflow).
- Rating curves and hydropost observations, including ice condition classifications.
- Foundational data for TALSIM calibration and FEWS forecasting.

Limitations arise due to measurement gaps, data inconsistencies, and challenges in high-flow conditions, requiring greater collaboration between Kazhydromet and IAC for improving data quality, rating curves, and flood forecasts.

MoES is responsible for:

- Public safety, flood emergency response, and evacuation measures.
- Use of inundation maps, warnings, and forecast information for operational decision-making.
- Coordinating disaster management efforts at regional and local levels.

Effective flood management requires timely information flow from MWRI and IAC to MoES. This is emphasised in consultations and EPP guidance, where MoES is identified as a key recipient of forecast updates, warning levels, and reservoir release information.

The review reveals several cross-cutting issues:

- Fragmented operational responsibilities: Although MWRI supervises dam safety, operational data and hydrological modelling remain with IAC, while emergency response is led by MoES. This requires clear protocols and well-defined data-sharing mechanisms.
- Need for harmonised flood forecasting workflows: Forecast nodes and responsibilities for model corrections must be distributed across IAC modellers, as the workload exceeds what a single expert can handle.
- Dependence on third-party inspections: MWRI relies on certified external organisations for multifactor safety inspections, requiring strong regulatory oversight to ensure quality and consistency.
- Insufficient integration of reservoir data and cross-sections: Forecast accuracy and dam safety risk assessment depend on complete datasets that are still under development for several basins (Syrdarya, Ural, Shu, Talas, Ili).
- Capacity gaps: IAC requires continued training in operational forecasting, model calibration, and FEWS configuration; MoES needs improved access to timely and actionable forecast outputs.

Key Results:

Technical Guidance on dam integrity, monitoring, and operation (ICOLD standards) developed.

Standardized Annual Dam Safety Report Template developed, approved by national stakeholders from MWRI and Ministry of Emergency Situations through Project Board.

From March-December 2025, 70 operators of 360 dams (out of 405), which equals to 88% were introduced to best practices and comprehensive assessment approach.
From March-December 2025, 70 operators of 360 dams (out of 405), which equals to 88% were introduced to application of new approach to dam safety.

Project Output 2: Pilot the assessment of dams with the new flood and safety management concept		
Output indicators	**Targets**	**Progress against targets**
2.1 Capacity of dam operators on detection, interpretation, and diagnoses of readings with the new dam monitoring improved (% of dam operators in Kazakhstan)	Baseline: 405 AWP target: 30%	Reporting period: Budget for new dam safety monitoring system (sensors procurement, installation) is transferred to 2026, therefore no progress on this activity.
2.2 Number of people benefitting from improved dam safety monitoring	Baseline: 0 AWP target: 120k	Reporting period: Budget for new dam safety monitoring system (sensors procurement, installation) is transferred to 2026, therefore no progress on this activity.

Key Activities:

Activity 2.1 Perform the multi-functional dam assessment for the selected dams

Comprehensive multi-functional dam assessment is being conducted from 1 October 2025 to 30 April 2026. In 2025, 3 key activities are as follows:

1) Gap Analysis of existing standards and rules on the multifunctional dam assessment (MDA) in comparison to international best practices. Report was provided with recommendations on the revision of national standards for MDA tailored to Kazakhstan.

Identified key findings of gaps are as follows:

Gap		**Description**
1	Use of risk-informed tools and decision making	Order No. 156 mandates the content required of the MDA. The outcome is an assessment of the overall technical condition. The Order does not explicitly reference modern risk-informed tools and decision making such as Potential Failure Mode Analysis (PFMA), Portfolio Risk Management (PRM), or the "As Low As Reasonably Practicable" (ALARP) principle, which are critical components discussed in World Bank guidance for prioritising safety measures.

		There is a lack of explicit reference to Risk-Informed Decision Making (RIDM), PFMA and PRM.
2	Dam Safety Plans	Order No.156 does not explicitly mandate the four World Bank recommended Dam Safety Plans (especially concerning organisational capacity and dedicated funding): 1) Construction Supervision and Quality Assurance Plan (CSQAP) 2) Instrumentation Plan (IP) 3) Operation and Maintenance Plan (OMP) 4) Emergency Preparedness Plan (EPP)
3	Inspection and assessment of dams	The mandated 5-yearly interval between multifactor surveys (safety assessment) aligns with international practice for high hazard dams. It is more frequent than that typically used for lower hazard dams. A more flexible interval between safety assessments (MDAs) could be considered with the timescale for the next assessment to be specified depending on hazard and the outcome of the last assessment, and to then have a more regular inspection regime in between.
4	Flood passage requirements	More detail could be provided on the requirement of deriving an Inflow Design Flood (IDF) for a multifactor survey and for the assessment of the dam to safely pass the IDF with sufficient freeboard.
5	Spillway and spillway gate operating requirements	The following items are missing compared to global practice: • Structured Gate Operation Plan (GOP) – which could be incorporated into the rules for operation of hydraulic structures. • Redundancy (backup power, manual overrides). • Scheduled functional or load testing. • Requirement for spillway operational rule curves. ICOLD Bulletin 203 requires mechanical reliability assessments and emphasises manuals, redundancy, emergency operating protocols.
6	Classification and proportionality	Order No.156 does not detail how the results of the multifactor survey, declaration, or frequency of inspection and assessment are proportionately varied based on the dam's hazard classification. The lack of a clear classification system linkage prevents assessment of whether the frequency or sophistication of the survey is appropriate for the risk level. The 4-tier hazard classification system set out in Kazakhstan Order No. 173 does not have a minimum threshold. It is suggested that dams with a height lower than 10m or a volume less than 50,000 m^3 are excluded from classification on the basis that the hazard they present is inherently low. These thresholds on the average of those used in other countries.
7	Monitoring and early warning	Order No.156 calls for surveys but does not explicitly require hydrological or meteorological instrumentation.

		It requires emergency alerting plans but not automated flood detection. The following are recommended for the highest hazard reservoirs: • Real-time hydrological monitoring. • Instrumentation for reservoir levels, flows, rainfall, and seepage. • SCADA or equivalent alarm systems. Documented inspection & monitoring regimes.
8	Capacity and training	Dam safety would be aided by the production of additional guidance manuals. There are many such manuals available from ICOLD and other bodies. However, there are particular areas which could benefit from specific guidance manuals for the Republic of Kazakhstan. These are listed in Section 3.10.
9	Multiple ownership	It is recommended that a lead operator is identified by the MWRI for each dam and that the lead operator is made responsible for producing the MDA covering the entire dam and reservoir and ensuring compliance with its recommendations.
10	Incident reporting	Order No.156 does not mandate the reporting of incidents which could impact on the safety of an HS - although Order No.173 does require such reporting. The reporting of incidents at dams assists in emergency preparedness and also allows the sharing of information which improves shared learning and good practice.
11	Financial and Institutional Framework	Absence of Funding Mandate: Order No.156 makes no explicit mention of the financial requirements, resources, or budget allocations necessary for the owner to perform long-term O&M, periodic rehabilitation, or compliance with safety measures. Regulatory Funding: Order No.156 does not specify the financing mechanisms (e.g., user pays or government budget) used to fund the regulatory and enforcement body (the Committee for the Regulation, Protection and Use of Water Resources). Financial frameworks are crucial, especially as dam infrastructure ages.

2) MDA of a pilot dam cascade Verkhnetobolskoye and Karatomar - with onsite technical presence based on the best international practices. A comprehensive report was provided on MDA results including flood study, dam conditions, findings on adequacy of spillway, adequacy of dam embankment and recommendations for safety, Resilience During an Emergency, Maintenance, Surveillance, Monitoring.

Key findings of MDA Risk assessment are as follows:

Risk Assessment for Verkhnetobolskoye Reservoir

Part of Reservoir	Risk	Likelihood	Consequence	Risk
Spillway Capacity	Inadequate for design flood - embankment overtops	High	High	High
Gate Operation	Unable to open spillway gate(s)	High	Severe	High
Embankment	Upstream slope failure	Moderate	Moderate	Moderate
	Downstream slope failure	Moderate	Moderate	Moderate
	Internal erosion leading to failure	High	Severe	High
Spillway and Embankment	Earthquake	Low	Moderate	Moderate
Spillway Structure	Uplift pressures result in instability	Low	Severe	High

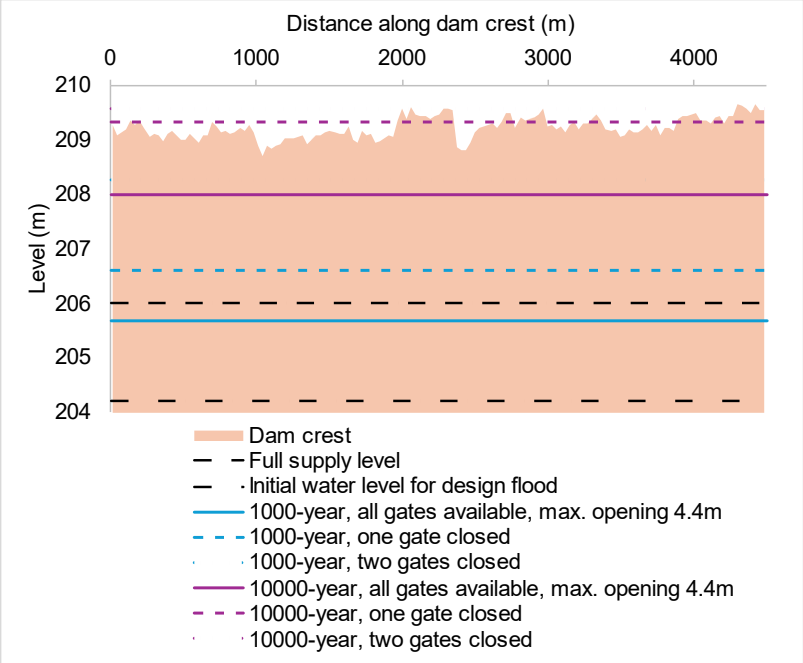
Risk Assessment for Karatomar Reservoir

Part of Reservoir	Risk	Likelihood	Consequence	Risk
Spillway Capacity	Inadequate for design flood - embankment overtops	High	High	High
Gate Operation	Unable to open spillway gate(s)	High	Severe	High
Embankment	Upstream slope failure	Moderate	Moderate	Moderate
	Downstream slope failure	Moderate	Moderate	Moderate
	Internal erosion leading to failure	High	Severe	High
Spillway and Embankment	Earthquake	Low	Moderate	Moderate
Spillway Structure	Uplift pressures result in instability	Low	Severe	High

Key findings of flood study are as follows:

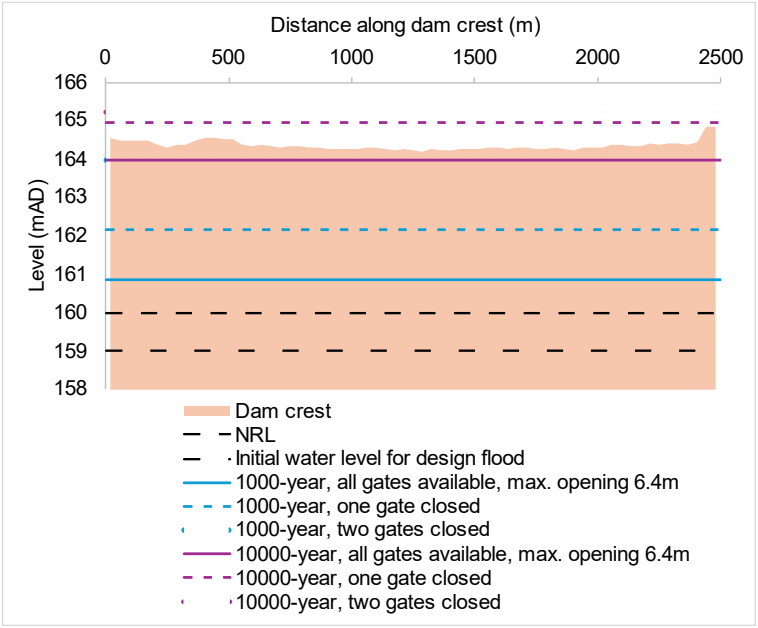
Verkhnetobolskoye Dam

- The 1000-year flood level is well below the dam crest, even if one gate is unable to be lifted.
- For the 10,000-year flood, the water level is much closer to the dam crest, even with all six gates operational.
- For the PMF (not shown), the dam is predicted to overflow.



Karatomar Dam

- The modelled flood level for the 1000-year flood is well below the dam crest, even if one of the gates is unable to open.
- For the 10000-year flood the modelled level is close to the dam crest, even if all seven gates can open.
- For larger floods or for scenarios with fewer gates available, the model predicts overflowing of the dam crest.



3) A sample ToR for equipment procurement with recommendations on standardized list of necessary equipment for dam surveillance system (monitoring equipment, automation technologies, and early warning communication tools).

Proposed Instrumentation of the Karatomar Dam

Monitoring Parameter	Typical Instrumentation	Proposal
Seepage (Piezometric surface within the embankment)	• Piezometers Installed in arrays from embankment shoulder to the toe of the embankment at intervals along the embankment	Installation of Piezometer array either side of the concrete spillway structure and then at 500m intervals along the embankment.
Water pressure beneath the spillway	• Piezometers Installed below spillway structure upstream and downstream of the seepage cutoff.	Installation of Piezometers in existing monitoring wells in the spillway structure
Seepage (Toe drainage flow)	• V-notch weir with level instrument Typically, this shall be measured on the end of the left and right drainage runs but on longer crests the number of monitoring points may be increased. • Typically, the water level upstream of the V-notch is detected using an ultrasonic or radar type instrument	**Left Embankment:** The drainage is via an open ditch which is then discharged to the river via a pipe through the left abutment of the spillway structure. The proposal is to install a pre-fabricated V-notch assembly within the open ditch just upstream of the piped section. **Right Embankment:** The toe drainage is piped system with nine inspection manholes. The proposal is to install a v-notch weir within the final manhole (No. 23). Due to the ambient air temperature range, it is proposed that piezometers are used to determine level at the v-notches rather than an ultrasonic or radar instrument as these cannot operate reliably in the colder temperatures that are experienced at the site.
Reservoir Water Level	• Radar or Ultra-sonic level detector • Installed above the reservoir but at location that will not be affected by any flow control structure or low water level	Due to the ambient air temperature range and ice formation on the reservoir surface it is proposed that piezometers are used to determine level and not an ultrasonic or radar instrument as these cannot operate reliably in the colder temperatures that are experienced at the site.
Additional Monitoring data	• Satellite Imagery There are many systems that use satellite imagery to detect changes in adjacent land use such as downstream developments that may influence breach consequence	• Satellite Imagery This would be deemed a 'nice to have' rather than a 'need to have'. There are numerous systems/products available with differing advantages and costs. Publicly available information such as Google Earth can be reviewed periodically to check land use changes near the site • Inclinometers As no significant defects were discovered where an inclinometer would provide meaningful data then these are not being currently

	classification. It is also possible to monitor changes in surface elevation using InSAR data. • Inclinometers • Automated inclinometers are relatively expensive and more suited to being used to target a known defect or suspicion of a defect to monitor movement in the subsurface.	recommended. The data logging system should be designed with sufficient capacity so that additional instruments (such as inclinometers) can be added at a later date without requiring significant upgrades.
Weather station	• Various instruments Ideally to measure: rainfall, snowfall, air temperature, wind speed, reservoir water temperature and solar radiation. •	Installation of a weather station at the dam site is recommended. This should be carefully sited to avoid local influence from existing structures.
CCTV	• Camera • This system is simply to monitor which state the gates are in i.e. open or closed	Installation of a CCTV system that monitors the upstream and downstream faces of each gate. In addition to these, there should be cameras monitoring the stilling basin downstream of the gates and reservoir upstream of the gates.

Proposed Instrumentation types at Verkhnetobolskoye Dam

Monitoring Parameter	Typical Instrumentation	Proposal
Seepage (Piezometric surface within the embankment)	• Piezometers Installed in arrays from embankment shoulder to the toe of the embankment at intervals along the embankment	Installation of Piezometer array either side of the concrete spillway structure and then at 500m intervals along the embankment.
Water pressure beneath the spillway	• Piezometers • Installed below spillway structure upstream and downstream of the seepage cutoff.	Installation of Piezometers in existing monitoring wells in the spillway structure
Seepage (Toe drainage flow)	• V-notch weir with level instrument Typically, this shall be measured on the end of the left and right drainage runs but on longer crests the number of monitoring points may be increased.	**Left Embankment:** The drainage is piped system with numerous inspection manholes. The proposal is to install a pre-fabricated V-notch assembly within a new headwall structure where the existing pipe discharges downstream of the stilling basin.

	Typically, the water level upstream of the V-notch is detected using an ultrasonic or radar type instrument	**Right Embankment:** The toe drainage is piped system with numerous inspection manholes. The proposal is to install a v-notch weir within the final manhole (k40). Due to the ambient air temperature range it is proposed that piezometers are used to determine level and not an ultrasonic or radar instrument as these cannot operate reliably in the colder temperatures that are experienced at the site.
Reservoir Water Level	• Radar or Ultra-sonic level detector Installed above the reservoir but at location that will not be affected by any flow control structure or low water level	Due to the ambient air temperature range and ice formation on the reservoir surface it is proposed that piezometers are used to determine level and not an ultrasonic or radar instrument as these cannot operate reliably in the colder temperatures that are experienced at the site.
Additional Monitoring data	• Satellite Imagery There are many systems that use satellite imagery to detect changes in adjacent land use such as downstream developments that may influence breach consequence classification. It is also possible to monitor changes in surface elevation using InSAR data. • Inclinometers • Automated inclinometers are relatively expensive and more suited to being used to target a known defect or suspicion of a defect to monitor movement in the subsurface.	• Satellite Imagery This would be deemed a 'nice to have' rather than a 'need to have'. There are numerous systems/products available with differing advantages and costs. Publicly available information such as Google Earth can be reviewed periodically to check land use changes near the site • Inclinometers As no significant defects were discovered where an inclinometer would provide meaningful data then these are not being currently recommended. The data logging system should be designed with sufficient capacity so that additional instruments (such as inclinometers) can be added at a later date without requiring significant upgrades.
Weather station	• Various instruments Ideally to measure: Rainfall, snowfall, air temperature, wind speed, reservoir water temperature and solar radiation. •	Installation of a weather station at the dam site is recommended. This should be carefully sited to avoid local influence from existing structures.
CCTV	• Camera • This system is simply to monitor which state the gates are in i.e. open or closed	Installation of a CCTV system that monitors the upstream and down stream faces of each gate. In addition to these, there should be cameras monitoring the stilling basin downstream of the gates and reservoir upstream of the gates.

Key Results:

From March- December 2025 activities were performed to identify the list of necessary equipment for dam surveillance system (monitoring equipment, automation technologies, and early warning communication tools). Procurement and installation of these sensors are planned for 2026. Therefore, there is no progress on the above-mentioned indicator.

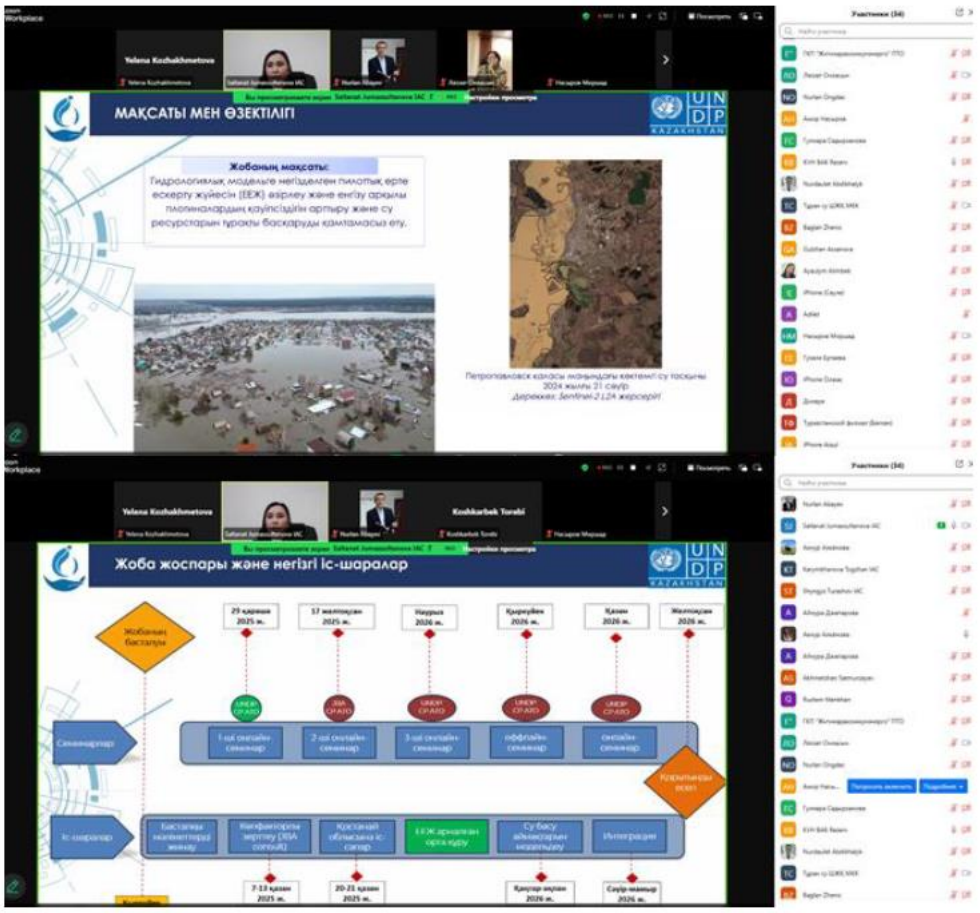
Project Output 3: Implementation of a demonstration pilot for an Early Warning System (EWS) for a dam with potential for scaling up		
Output indicators	**Targets**	**Progress against targets**
3.1 Capacity of dam managers on the use of the Early Warning System improved (% of dam managers in Kazakhstan)	Baseline: 405 AWP target: 30%	Reporting period: 88% of dams (360 out of 405)
3.3 Number of citizens/residents directly benefiting from Early Warnings	Baseline: 0 AWP target: 150k	Reporting period: development of EWS is still in progress, therefore no progress in this indicator

Key Activities:

Activity 3.1: Setting up the EWS environment for one dam/catchment

A key component of the project is the modernization of the dam monitoring system, which will be linked to flood early warning and preparedness systems. Emphasizing the importance of digitalization, the project focuses on building a robust early warning system and enhancing flood preparedness through the digitalization of data and automation with advanced hardware and software. Digital technologies are central to the initiative playing a crucial role in monitoring, operating, and surveilling dams, thereby increasing operational efficiency and enhancing dam safety. The Project framework was designed to engage a partner in the role of the Responsible Party to provide support to the Project, carry out project activities and produce outputs. Responsible party agreement was signed with Information and Analytical Center for Water Resources (IAC) as a Responsible Party for achieving the goals and key outputs.

On 28 November 2025, an online seminar 'Capabilities and Use of the Early Warning System (EWS) for the Safe Operation of Hydraulic Structures' was conducted to enhance capacity of dam managers from 360 dams (out of 405) on the use of the Early Warning System.



The seminar offered participants an in-depth and structured understanding of the architecture, functionality, and purpose of the Early Warning System (EWS), emphasizing its critical role within the broader framework of ensuring the safety of hydraulic structures (HS). Particular attention was given to the integration of digital solutions, demonstrating how modern data systems enhance real-time monitoring, risk forecasting, and operational decision-making. As a result, managers and specialists gained clarity on how the EWS will operate, what types of data it will utilize, and what tangible benefits the system will provide in terms of risk reduction, early detection of hazards, and prevention of accidents.

A part of the discussion focused on the interaction between the Ministry of Emergency Situations (MES) and the National Information System for Water Resources (NISWR). Participants examined how data from both institutions will be interoperable, ensuring seamless and timely information exchange during routine operations and emergency situations. The MES expressed strong interest in participating in the testing of alert mechanisms and integrating EWS-generated notifications into its internal response channels. The seminar further showcased a demonstration of the NISWR interface and the upcoming EWS module, shifting the conversation from conceptual design to practical, hands-on understanding. Participants explored the system's interface, functionality, data flows, and decision-support tools they will interact with in their daily work. Beyond theory, the session provided a clear vision of specific operational steps and actions required at each hydraulic structure during the rollout of the system. The combination of technical

explanations, system demonstration, and inter-agency dialogue enabled participants to grasp not only the strategic importance of the EWS but also its practical implications for improving safety, coordination, and climate resilience across Kazakhstan's water infrastructure.

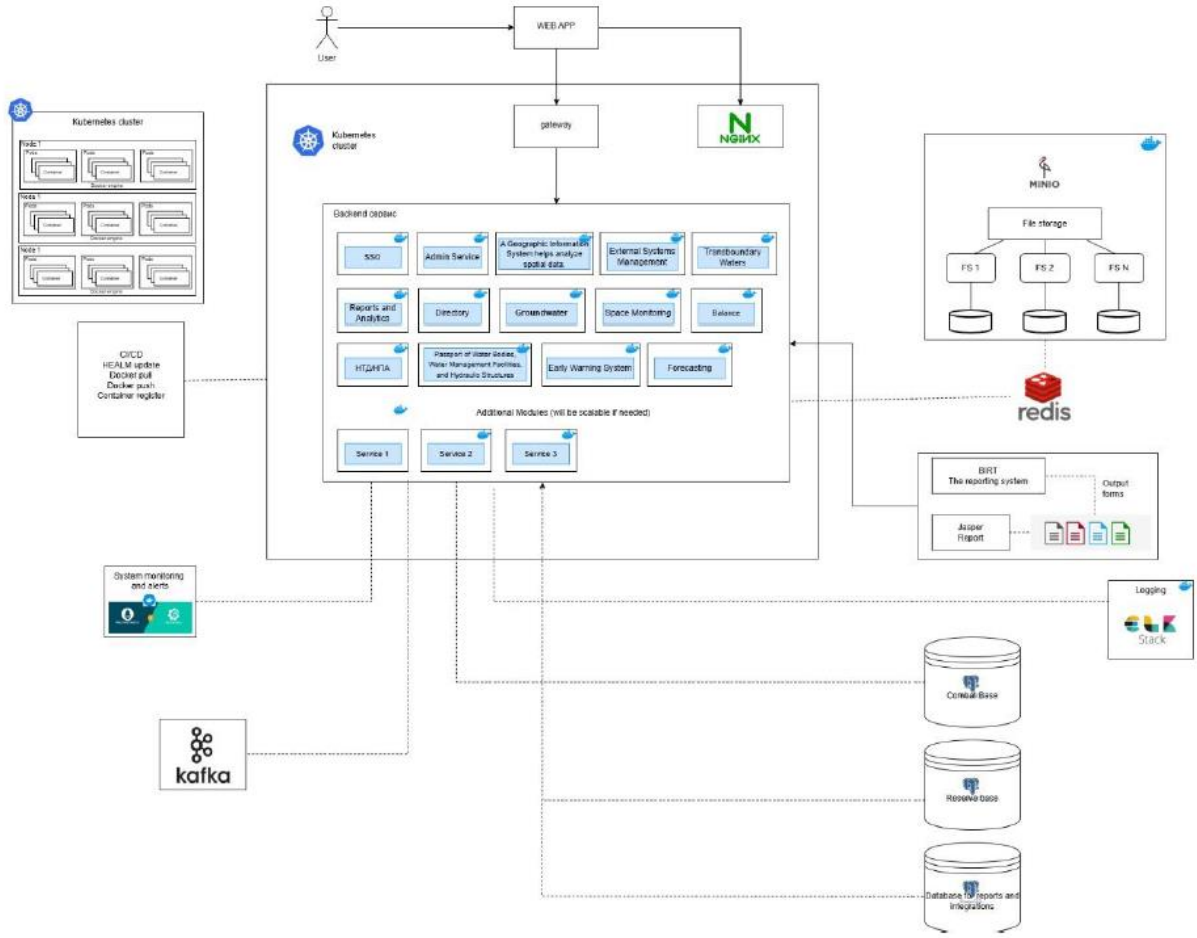
The "Early Warning System" (EWS) module is being developed and implemented as part of the National Water Resources Information System (NWRIS). The module is designed for spatial monitoring of hydraulic structures and analysis of hydrological and hydrodynamic modeling results that affect the safety of dam and reservoir operations. Based on comprehensive analysis, the system identifies potentially dangerous trends, threshold exceedances, and deviations from regulatory operating regimes of hydraulic structures.

One of the key achievements is the implementation of the EWS module with an interactive map covering 636 dams (including 310 dams with reservoirs), as well as meteorological station points with connected forecast and historical data, with the possibility of expanding and scaling the module's functionality. Monitoring within the EWS is carried out in an automated mode based on the integration of heterogeneous data sources and their spatial visualization. The system collects, processes, and displays operational data on forecasted and actual water discharges, release volumes, water levels in reservoirs and at hydrological stations, as well as actual reservoir storage volumes. Additionally, meteorological observation data from Kazhydromet is used, including information on precipitation, air temperature, and other weather parameters that affect the water regime.

The EWS has been deployed centrally in the infrastructure of the Information and Analytical Center (IAC) for Water Resources in Astana, which ensured a stable, scalable, and fault-tolerant system architecture, as well as unified user access to NWRIS data. Integration of the EWS module with internal NWRIS components has been implemented, and the possibility of connecting external analytical and forecast models has been provided.

The main technical solutions of the EWS are formed based on analytics and aimed at ensuring stable system operation when processing heterogeneous data. The system includes the following components: Data Collection, Data Storage and Processing, Analytical and Predictive Modules, Visualization and Notifications, System Capabilities.

An architectural solution was developed that provides for the inclusion of two new backend services in the system: "Early Warning System" and "Forecasting." The solution was implemented in line with the logic of the existing microservice architecture and is shown in the diagram below



Technical Support for Delft-FEWS and TALSIM development

Technical support for Delft-FEWS and TALSIM development resulted in the creation, configuration, and operationalization of hydrological models across multiple major river basins in Kazakhstan, including the Yesil, Nura, Ural, Syrdarya, Shu, Talas, Ili, Ertis systems. The work included extensive data acquisition, GIS-based model setup, and integration of time series, followed by calibration and verification using both Kazhydromet observations and ERA5 reanalysis data to address gaps in national datasets. Delft-FEWS was fully configured to interface with TALSIM, enabling automated warm-up runs, daily forecasts, and integration of ECMWF 16-day and ensemble forecasts across all operational basins. The consultant also executed daily forecast monitoring and adjustments during the 2025 season, establishing operational workflows and correcting key variables such as temperature to ensure accurate snowmelt forecasting. A series of more than twelve structured training sessions strengthened the capacity of IAC modellers in hydrological modelling, calibration, forecasting, GIS workflows, and FEWS configuration, including hands-on exercises with a dedicated test environment and Python processing tools. By late 2025, the national early warning system expanded significantly, with more than 2,000 forecast nodes prepared and a roadmap defined for full readiness for the 2026 flood season, including reservoir integration, model corrections, and

mock flood forecasting drills. Overall, the technical support established a functioning nationwide forecasting capability while strengthening institutional technical expertise within MWRI and IAC.

Key Results:

From March-December 2025, 70 operators of 360 dams (out of 405), which equals to 88% were introduced to use of the Early Warning System.

Technical Support for Delft-FEWS and TALSIM development was provided to MWRI and IAC.

Project Output 4: Integration of dam integrity, dam monitoring & surveillance, reservoir operation to the national water information system		
Output indicators	**Targets**	**Progress against targets**
4.1 National Water Information System is improved to comprehensively monitor dam safety through integration of metadata related to: 1. Dam integrity 2. Monitoring & dam surveillance 3. Reservoir operation (% of dams integrated into the system)	Baseline: 0 AWP target: 25%	Reporting period: 25%
4.2 Number of users of the water-information system for informed decision-making (Ministries, dam managers, consulting engineers, Universities)	Baseline: 0 AWP target: 60	Reporting period: 150 users

Key Activities:

Activity 4.1: Definition of metadata which best represent dam integrity, monitoring & surveillance and operation including the dam classification system of ICOLD.

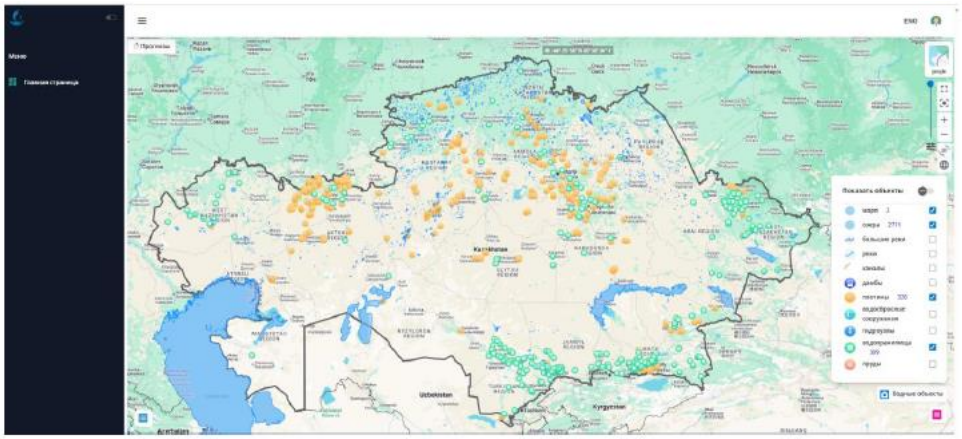
Under Activity 4.1, a comprehensive national metadata template for dams and reservoirs aligned with international standards from the International Commission on Large Dams (ICOLD) was developed. The work began with a full review of ICOLD bulletins and the World Register of Dams (WRD) to identify all required data categories necessary for assessing dam integrity, monitoring and surveillance systems, and operational behavior. A unified metadata structure was then drafted, covering identification parameters, structural characteristics, hydrological indicators, operational information, instrumentation and monitoring data, and safety-related attributes, including dam classification elements such as dam type, height category, storage capacity, and risk class.

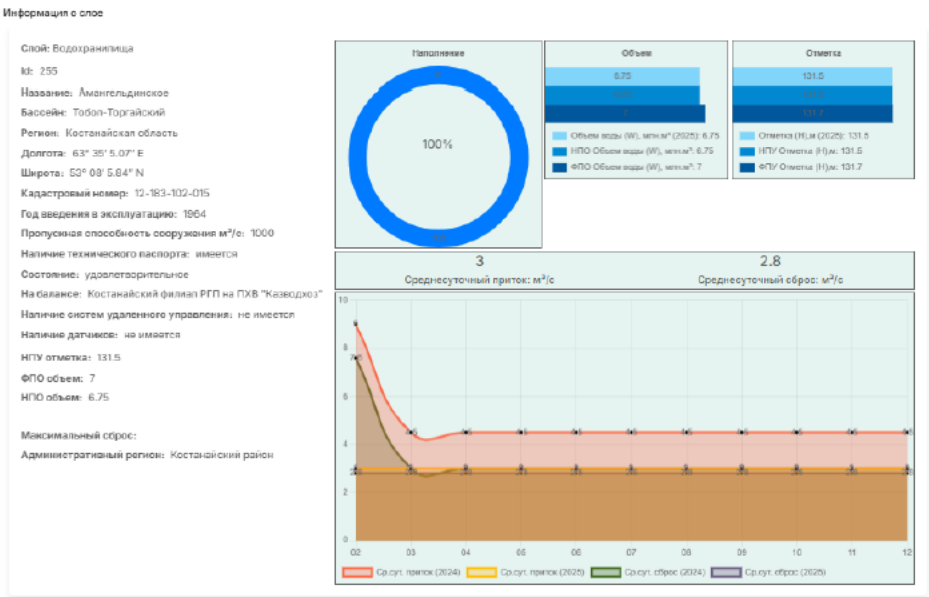
To ensure compliance with global best practice, the project engaged directly with the ICOLD Secretariat. The Chair of the World Register of Dams Committee, Mr. Patrick Le Delliou, reviewed the metadata template, confirmed its full alignment with ICOLD requirements, and approved it for adoption as a national standard for Kazakhstan. This milestone created the formal foundation for integrating ICOLD-compliant dam safety metadata into the country's digital water information systems.

Activity 4.2: Enhancement of the water information system metadata

Activity 4.2 focused on integrating and expanding metadata capabilities within the National Water Resources Information System (NWRIS) to support comprehensive dam safety monitoring. The ICOLD-compliant metadata template developed in Activity 4.1 was integrated into the system's architecture, enabling standardized storage and visualization of dam integrity, monitoring/surveillance, and reservoir operation data. The NWRIS was enhanced with geospatial layers and object cards displaying detailed technical, operational, and hydrological attributes for each dam and reservoir.

During this activity, the system was strengthened to accommodate large-scale metadata, including upgrades to backend services, database structures, microservice architecture, and data routing logic. Two new backend modules—Early Warning System and Forecasting—were added to support real-time monitoring and analytical functions. The NWRIS now displays dams and reservoirs on an interactive national map, with each object linked to its metadata profile, including ICOLD identifiers, dimensions, hydrology, safety class, and monitoring instrumentation. These enhancements prepared the system for future integration of automated early warning data and full-scale national dam safety surveillance.





<u>Activity 4.3: Collection of dam metadata from the 405 existing reservoirs in Kazakhstan.</u>

Under Activity 4.3, a nationwide campaign was conducted to collect, verify, and systematize metadata for existing dams and reservoirs. The detailed structural, hydrological, operational, and safety information for Kazakhstan's hydraulic structures was gathered, leading to the creation of a unified metadata database for 517 water infrastructure objects, including 289 reservoirs and 228 dams—representing the vast majority of the 405 priority facilities targeted under the project.

The work involved compiling data from facility passports, operator records, regional branches of Kazvodkhoz, hydrological yearbooks, and national registries. Field visits were also conducted to validate metadata and fill gaps—particularly for the Tobol River basin—through visual inspections, discussions with operators, and collection of missing operational details. The collected metadata were digitized, standardized according to the ICOLD-approved template, and uploaded into the NWRIS for nationwide access and use in dam safety monitoring, risk assessment, and early warning system development.

Key Results:

From March-December 2025, metadata on 228 dams (out of 405), which equals to 56% were integrated into National Water Information System.

From March-December 2025, 150 users have access to National Water Information System for informed decision-making.

Section 5: Cross-Cutting Integration

Human and Social Context:

- **Leave No One Behind**

The project's selection of Kostanay region dams as a pilot was driven by its high vulnerability to floods. By prioritizing a locality at greatest risk, the project ensures that communities most exposed to climate and disaster risks are targeted first, which is a core LNOB principle.

- **Cultural Heritage –** Not applicable

Interactions between Social and Environmental Factors:

- **Sustainability and Resilience**

The project strengthens long-term sustainability and resilience by building institutional mechanisms that support coordinated, data-driven decision-making in Kazakhstan. It advances integrated planning by ensuring that dam safety, monitoring, and early warning systems become part of a broader climate-resilience agenda. Through activities such as enhancing the National Water Information System, modernizing dam monitoring, improving early warning capabilities, the project lays the groundwork for durable, scalable, and system-wide resilience improvements. These measures create a lasting framework that enables Kazakhstan to manage climate-induced flood risks more effectively, protect vulnerable communities, and strengthen national preparedness capacities.

Natural Environment:

- **Biodiversity Conservation –** Not applicable
- **Sustainable Natural Resource Management –** Not applicable
- **Climate Change**

The project strengthens climate resilience by modernizing dam safety and embedding dams into the national flood management strategy, explicitly addressing increased flow intensity, variability, and extreme events linked to climate change (e.g., 2024 floods). It upgrades monitoring, early warning, and operation so reservoirs can attenuate floods and stabilize water supply under changing climatic conditions.

- **Disaster Risks**

The project reduces disaster risk for downstream populations by establishing automated monitoring, dam surveillance, and early warning at priority dams, and by flood mapping to prepare for dam-break scenarios. It advances coordinated disaster preparedness through dam assessments, identification of urgent measures (monitoring, automation, operation) improving lead time, evacuation readiness, and operational reliability during extreme flood events.

IV. Partnerships and Sustainability

Partnerships

Engagement with Japanese partners

Embassy of Japan

- On 7 March 2025, the project signing ceremony took place in Astana, Kazakhstan, with the participation of the Vice-Minister of Water Resources and Irrigation of the Republic of Kazakhstan. Mr. Yasumasa Iijima, Ambassador Extraordinary and Plenipotentiary of Japan to the Republic of Kazakhstan, delivered welcome remarks. The press release was issued in English, Kazakh, Russian, and Japanese.
- On 5 August 2025, the first Project Board Meeting was held. Mr. Koichi Ogyu, First Secretary of Japan in the Republic of Kazakhstan, delivered welcome remarks. During the meeting, project updates were presented. Additionally, the project progress report was shared on 21 August.
- The project announced two tenders in 2025: one on multi-functional dam assessment and another on dam modeling. Announcements of these tenders were shared with the Embassy of Japan and the Japanese Commerce and Industry Association in Kazakhstan.
- Project updates have been provided periodically through meetings and emails. Details of media coverage are listed in Annex 5.

JICA

- The project team has shared project updates through meetings held in April and September, as well as through email communications. Tender announcements were also provided to JICA.

- The project team requested JICA to share JICA's dam report from 2024, which had been conducted prior to this project and served as a foundation for its formulation. JICA kindly provided the reports to the project team, contributing to an enhanced quality of the multi-functional assessment.

Private sector

The project team held meetings in 2025 with Japanese private sector possessing expertise relevant to the project, including Pacific Consultants Co., Ltd. and Oyo Corporation.

Responsible partner

By engaging IAC as a responsible party, the project connected dam safety workstreams (integrity, monitoring/surveillance, and operations) to the National Water Information System, enabling standardized metadata definitions and large-scale collection/upload from 405 reservoirs. This has accelerated national coverage, improved data quality, and made data informed decisions. IAC's role in data management and system integration underpins the Early Warning System (EWS) pilot and its embedding into national platforms, which expands lead time, automates monitoring streams, and links basin hydrology with dam operations. This strengthens preparedness and day-to-day decision-support for dam managers and authorities. Partnering with IAC reduced duplication and transaction costs by reusing existing government infrastructure and teams, while focusing project resources on multi-functional dam assessments and the hardware/software package for one priority dam (monitoring, automation, communication).

Sustainability

The project produced following reports, which will be used beyond project duration:

- Annual dam safety report template, which could be used by relevant stakeholders during annual inspection of dam safety
- Gap Analysis of existing standards and rules on the multifunctional dam assessment (MDA) in comparison to international best practices;
- MDA of a pilot dam cascade Verkhnetobolskoye and Karatomar - with onsite technical presence based on the best international practices tailored to Kazakhstan.
- Flood study results could be used to duplicate such analysis for other dams and evaluate hydrologic and hydraulic capacity of such dams.
- The EWS is embedded into the National Water Information System (NISWR), making it part of the government's permanent digital infrastructure for hydrological monitoring and decision-making. This integration ensures continuity of EWS operations beyond the project and creates a strong basis for long-term national ownership.

V. Update on risks and mitigation measures

The project is implemented within an environment where various external and institutional factors may pose challenges. Natural hazards, technological accidents, or other force-majeure situations can interrupt activities and restrict access to key locations. Additionally, political changes—whether at the national, regional, or international level—may slow decision-making, shift governmental priorities, or result in reduced engagement from participating stakeholders or countries. During reporting period, Risk number 2 (There is a risk that activities based on existing data may be delayed) have caused an issue during the conduction of MDA as this activity relies on existing data related to reservoir and spillway characteristics, bathymetry/level–area–volume curves, and prior safety documentation. Where these data are incomplete, outdated, fragmented across institutions, or require validation, downstream tasks are at risk of schedule slippage. These factors increased the likelihood of delays for activities that depend on "existing data". Instead of relying solely on ministry channels, the team switched to requesting datasets directly from dam operators (e.g., reservoir levels, inflow/outflow records, instrumentation logs). This shortened response cycles, reduced bottlenecks, and improved the completeness and timeliness of the data received. The team instituted regular data pulls and systematic follow-up calls with clear checklists and cut-off dates. Each request was paired with clarification notes (formats, time windows) and quick validation loops to resolve inconsistencies immediately.

VI. Key Challenges, Lessons Learned and Recommendations

The implementation of project activities in 2025 revealed a series of systemic challenges—primarily related to fragmented datasets, institutional coordination gaps, and uneven technical capacities across agencies. While the project made substantial progress in strengthening capacity, integrating metadata into the National Water Information System, and piloting dam assessments, these achievements also highlighted deeper structural constraints that must be addressed for long-term resilience.

Challenges:

The 2025 implementation experience demonstrated that strengthening national dam safety requires more than technical tools and methodologies—it also depends on data availability, institutional coordination, and operational readiness. A central challenge emerged around the fragmentation and inconsistency of hydrological, operational, and structural data, which significantly slowed activities such as dam assessments, flood studies, etc. Collecting data and documentation required extensive coordination across institutions because the information was dispersed, incomplete, or outdated.

A second challenge related to dependencies on existing datasets. Activities that required validated historical records—such as design-flood selection, dam-break modelling, or metadata integration—experienced delays when data quality was poor or required additional verification.

Finally, capacity disparities across institutions and regions posed challenges. While 360 dam operators participated in trainings, knowledge levels varied significantly.

Lessons Learned:

Lesson 1: Centralized and Harmonized Data Systems Are Essential for Efficient Implementation

Success factors:

- A unified metadata template aligned with ICOLD standards created a consistent structure to organize dam information.
- Standardized metadata improved the quality, comparability, and usability of dam characteristics for modelling, monitoring, etc.

Limitations:

- The lack of a centralized national data repository for dams made initial data collection slow and resource-intensive. Hydrological, structural, and operational data required extensive manual consolidation.
- Differences in data formats, completeness, and archival practices complicated analytical tasks and delayed downstream technical activities.

Lesson 2: Coordination Across Institutions Determines the Effectiveness of Dam Safety Reforms

Success factors:

- Intensive engagement with MWRI, IAC, and Kazvodkhoz facilitated field visits, improved data validation, and strengthened understanding of roles in emergency response and flood forecasting.
- Direct communication with dam operators significantly improved the speed and completeness of data collection.

Limitations:

- Institutional mandates and information flows are not fully aligned.
- Emergency communication workflows and modelling responsibilities need clearer distribution, especially as the early warning system expands nationwide.

Lesson 3: Adoption of New Technical Methodologies Requires Tailored Capacity Support

Success factors:

- A large proportion of the dam operator community—88% of operators responsible for 360 dams—participated in capacity-building sessions.

Limitations:

- Technical capacity differed substantially across regions and agencies.
- Applying methodologies such as ICOLD aligned safety reviews or hydrodynamic dam break modelling requires not only technical know-how but also internal coordination, leadership engagement, and sustained institutional support.

Recommendations

1. **Expand and strengthen the national dam data ecosystem.** Continue enhancing NISWR as the single authoritative repository for dam integrity, monitoring, surveillance, and operational data. This includes integrating historical datasets, remote sensing, automated monitoring streams, and validated metadata from the remaining dams.
2. **Formalize interagency coordination mechanisms.** Develop clear protocols for real-time data sharing, early warning dissemination, and joint decisionmaking across MWRI, IAC, MoES, and Kazhydromet. Establish technical working groups and shared operating procedures for flood events and emergency responses.
3. **Tailor capacitybuilding programs to institutional needs.** Provide specialized training modules on modelling, monitoring technologies, ICOLD aligned reviews, Emergency Preparedness Plans, and the use of risk-informed methodologies (PFMA, PRM). Support local agencies in coordinating across departments and applying new methods in practice.
4. **Scale up digitalization and automation of dam monitoring.** Prioritize 2026 activities related to sensor procurement, SCADA type automation, weather stations, and CCTV installation. Automated monitoring will increase lead time, enhance safety, and strengthen realtime operations.
5. **Expand impact zone modelling and integrate flood maps into national systems.** The methodology piloted for the Tobol basin should be systematically applied to other flood-critical reservoirs. Integrating dam break modelling outputs into the national Flood and Drought Early Warning System will enhance preparedness and inform evacuation planning.

VII. Financial Summary[2]

Table 1: Overview of available resources for the project duration

Donor	*Opening Balance*	*Contribution Received*	*Available Resources*
Government of Japan	0		2,032,028.14
UNDP TRAC	0	15,000	15,000
Total	0		2,047,028.14

Table 2: Overview of allocation and utilization[3] per output

Output	*Donor Government of Japan*		*Donor UNDP TRAC*		*Total Budget*	*Total Utilization*
	Budget	*Utilization*	*Budget*	*Utilization*		
Output 1: Development of the national dam flood and safety management concept	*23,652*	*23,000*	*0*	*0*	*23,652*	*23,000*
Output 2: Pilot the assessment of dams with the new flood and safety	*371,831*	*324,559*	*15,000*	*15,000*	*386,831*	*339,559*

2 Disclaimer 1: Data contained in this financial report section is an extract of UNDP financial records. All financial provided above is provisional. Certified financial statements will be provided on <indicate date (30 June of the following year)>.

3 Disclaimer 2: Of the USD 446,183.2 presented above, USD 158,649.27 corresponds to eligible expenses (as per IPSAS terminology), and USD 287,533.95 corresponds to legal commitments in force between UNDP and third parties for the reporting period.

management concept						
Output 3: Implementation of a demonstration pilot for an Early Warning System (EWS) for a dam with potential for scaling up	*28,749*	*28,000*	*0*	*0*	*28,749*	*28,000*
Output 4: Integration of dam integrity, dam monitoring & surveillance, reservoir operation to the national water information system	*23,220*	*23,000*	*0*	*0*	*23,220*	*23,000*
Output 5: Project Management Costs	*42,228*	*32,624*	*0*	*0*	*42,228*	*32,624*
Total	*489,680*	*431,183*	*15000*	*15000*	*504,680*	*446,183*[4]

[4] Out of the total of $446,183, commitments equal $287,533.95.

VIII. Annexes

Annex I: Progress Review: detailed matrix of activities and results

Output 1	Indicators	Baseline	Annual target	Progress / Milestone
Development of the national dam flood and safety management concept Budget: 23,652 Expenditure to date: 23,000	• Increased integrity of dams through exposure to best practices and comprehensive assessment approach. (% of dams covered)	405	30%	30%
	• Capacity of dam managers on the application of new approach to dam safety improved (% of dam managers in Kazakhstan)	405	30%	30%
Output 2	**Indicators**	**Baseline**	**Annual target**	**Progress / target**
Pilot the assessment of dams with the new flood and safety management concept Budget: 1,380,636 Expenditure to date: 339,559	• Capacity of dam operators on detection, interpretation, and diagnoses of readings with the new dam monitoring improved (% of dam operators in Kazakhstan)	405	30%	30%
	• Number of people benefitting from improved dam safety monitoring	0	120k	120k
Output 3	**Indicators**	**Baseline**	**Annual target**	**Progress / target**
Implementation of a demonstration pilot for an Early Warning System (EWS) for a dam with potential for scaling up	• Capacity of dam mangers on the use of the Early Warning System improved (% of dam managers in Kazakhstan)	405	30%	30%

Budget: 232,969 Expenditure to date: 28,000	• Number of citizens/residents directly benefiting from Early Warnings	0	150k	150k
Output 4	**Indicators**	**Baseline**	**Annual target**	**Progress / target**
• Integration of dam integrity, dam monitoring & surveillance, reservoir operation to the national water information system • Budget: 84,300 Expenditure to date: 23,000	• National Water Information System is improved to comprehensively monitor dam safety through integration of metadata related to: • Dam integrity • Monitoring & dam surveillance • Reservoir operation • (% of dams integrated into the system)	0	25%	25%
	• Number of users of the water-information system for informed decision-making (Ministries, dam managers, consulting engineers, Universities)	0	60	60

Annex II: Updated Risk Log

#	Description	Date Identified	Type	Impact & Probability	Counter-measures / Mngt response	Owner	Last Update	Status
1	There is a risk that the Ministry/Government may not approve developed documents/systems	14- Mar-25	7. STRATEGIC (7.5. Government commitment) - UNDP Risk Appetite: OPEN TO SEEKING	Likelihood: 2 - Low likelihood Impact: 3 - Intermediate Risk level: MODERATE (equates to a risk appetite of EXPLORATORY)	Closely coordinate with MWRI and other stakeholders in the government to ensure their needs and priorities are well reflected in the development of documents/systems.	Project Team	31- Dec-25	No change
2	There is a risk that activities based on existing data may be delayed	14- Mar-25	3. OPERATIONAL (3.8. Capacities of the partners) - UNDP Risk Appetite: EXPLORATORY TO OPEN	Likelihood: 2 - Low likelihood Impact: 3 - Intermediate Risk level: MODERATE (equates to a risk appetite of EXPLORATORY)	Conduct research on available resource when designing the details of activities.	Project Team	31- Dec-25	No change
3	There is a risk that activities	14- Mar-25	4. ORGANIZATIONAL (4.9.	Likelihood: 3 - Moderately likely	Preparation for seeking contractors/comp	Project Team	31- Dec-25	No change

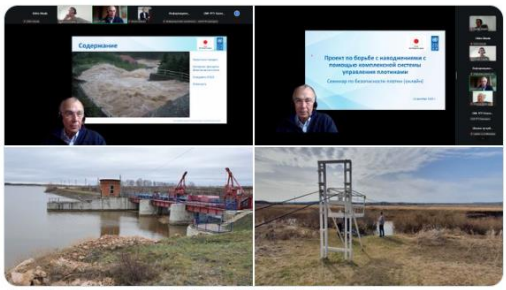
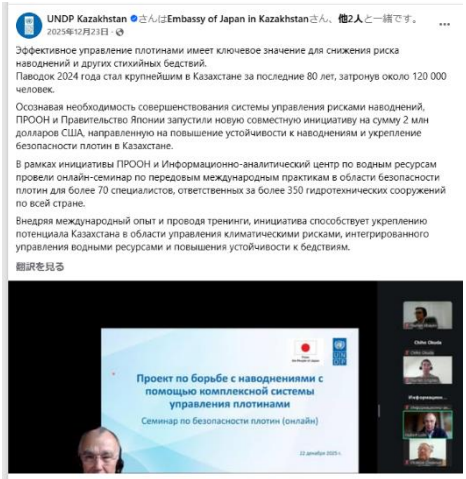
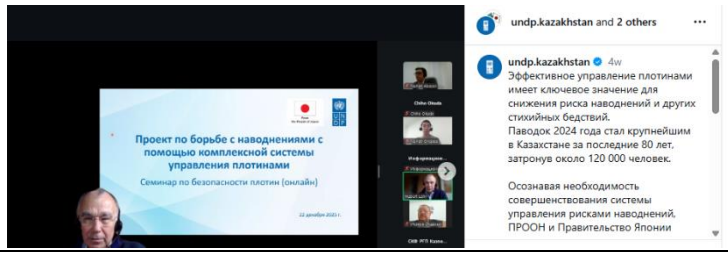
	involving the hiring of contractors or companies may be delayed		Procurement) - UNDP Risk Appetite: EXPLORATORY TO OPEN	Impact: 3 - Intermediate Risk level: MODERATE (equates to a risk appetite of EXPLORATORY)	anies should be done in advance.			
4	There is a risk that assessments and other relevant activities involving site visits of dams in the flood-affected areas may be interrupted or delayed.	14- Mar-25	1. SOCIAL AND ENVIRONMENTAL (1.5. Climate change and disaster risks) - UNDP Risk Appetite: CAUTIOUS	Likelihood: 2 - Low likelihood Impact: 2 - Minor Risk level: LOW (equates to a risk appetite of CAUTIOUS)	As floods in the region are seasonal and to some extent foreseeable, this risk can be avoided through careful planning of site visits and other activities. The project team will also closely coordinate with local authorities to ensure the safety and adequate scheduling of activities.	Project Team	31- Dec-25	No change

Annex III:
Annual Work Plan for (next year)
Separate attachment.

Annex IV: Assets List.
Not applicable.

Annex V: Knowledge Generation
UNDP coverage

Date	Type	Description and link
07.03. 2025	UNDP Kazakhstan Website	'Japan and UNDP launch new initiative to strengthen Kazakhstan's flood preparedness under the auspices of the Coordination Council of Partners for the Development of the Water Sector' https://www.undp.org/kazakhstan/press-releases/japan-and-undp-launch-new-initiative-strengthen-kazakhstans-flood-preparedness-under-auspices-coordination-council-partners 
10.03. 2025	UNDP Kazakhstan Website	'日本と UNDP、水セクター開発パートナー調整評議会と連携によりカザフスタンの洪水対策強化に向けた新たな取り組みを開始' https://www.undp.org/ja/japan/press-releases/japan-and-undp-launch-new-initiative-strengthen-kazakhstans-flood-preparedness-under-auspices-coordination-council-partners 
22.12. 2025	UNDP Kazakhstan X	https://x.com/UNDPKAZ/status/2003078153938604038?s=20

		UNDP Kazakhstan @UNDPKAZ Effective dam management for flood control is vital for #DisasterRiskReduction. W/support from Japan, UNDP & the Information & Analytical Centre for Water Resources held an online seminar for 70+ specialists responsible for over 350+ hydraulic structures across Kazakhstan  MOFA of Japan and 国連開発計画（UNDP）駐日代表事務所
23.12.2025	UNDP Kazakhstan Facebook	https://www.facebook.com/UNDPKazakhstan/posts/pfbid02WHFNvoj44kGQrDihRhkwJy6ED9caoyoYoJBRtWg3KX1zREysBvhqcNPamgpDgaSxl?rdid=eAOkXpTca1ezoSQn#  UNDP Kazakhstanさんは Embassy of Japan in Kazakhstanさん、他2人と一緒です。 2025年12月23日 · Эффективное управление плотинами имеет ключевое значение для снижения риска наводнений и других стихийных бедствий. Паводок 2024 года стал крупнейшим в Казахстане за последние 80 лет, затронув около 120 000 человек. Осознавая необходимость совершенствования системы управления рисками наводнений, ПРООН и Правительство Японии запустили новую совместную инициативу на сумму 2 млн долларов США, направленную на повышение устойчивости к наводнениям и укрепление безопасности плотин в Казахстане. В рамках инициативы ПРООН и Информационно-аналитический центр по водным ресурсам провели онлайн-семинар по передовым международным практикам в области безопасности плотин для более 70 специалистов, ответственных за более 350 гидротехнических сооружений по всей стране. Внедряя международный опыт и проводя тренинги, инициатива способствует укреплению потенциала Казахстана в области управления климатическими рисками, интегрированного управления водными ресурсами и повышения устойчивости к бедствиям. 翻訳を見る Проект по борьбе с наводнениями с помощью комплексной системы управления плотинами Семинар по безопасности плотин (онлайн)
23.12.2025	UNDP Kazakhstan Instagram	https://www.instagram.com/p/DSmmQXMCCYS/?utm_source=ig_web_copy_link&igsh=MzRlODBiNWFlZA%3D%3D  Проект по борьбе с наводнениями с помощью комплексной системы управления плотинами Семинар по безопасности плотин (онлайн) undp.kazakhstan and 2 others undp.kazakhstan 4w Эффективное управление плотинами имеет ключевое значение для снижения риска наводнений и других стихийных бедствий. Паводок 2024 года стал крупнейшим в Казахстане за последние 80 лет, затронув около 120 000 человек. Осознавая необходимость совершенствования системы управления рисками наводнений, ПРООН и Правительство Японии