REACH Ukraine Situational Overview
Kakhovka Dam breach 16 June 2023

Background and Methodology

On 6 June, the Kakhovka Hydroelectric Power Plan (about 70 km upstream from Kherson city) was severely damaged by explosions, including damage to the dam, causing water to flood areas downstream and inundating at least 80 settlements on both sides of the river bank. By 7 June, UNOSAT analysis of satellite imagery estimated around 20% of Kherson city was flooded. Ukrainian authorities reported that on 8 June the water on the right bank of the river reached its highest level at 5.6 metres. In some areas, houses were completely flooded. The destruction caused by the flow of water led to a large amount of hazardous debris formation.

Since then, water levels have continued to recede. However, over 3.500 homes and businesses in areas under Ukrainian control remain affected by flood waters, with water levels just above 2 metres on 14 June, according to authorities. At the time of writing, thousands of persons remain displaced with limited ability to assess the damage to their homes and livelihood. This situational overview looks at the humanitarian needs of displaced persons affected by the flood. Further, it combines concerns shared by local authorities related to health, water, sanitation and hygiene (WASH) with data on potential pollutants and contamination of surface water and soil obtained through remote sensing.

Information shared in this situational overview is based on 10 in-depth interviews (IDIs) and one focus group discussion (FGD) with evacuees in Kherson city and Bilozerka, 5 Key informant interviews (KIIs) with local authorities, open-source media, and observations by the field teams in Kherson. Additional information was gathered using remote sensing based on satellite imagery from the Sentinel-3. The situation remains volatile and subject to change. Findings from interviews should be considered indicative rather than representative of the situation and are limited to areas under Ukrainian control.

Key takeaways

The breach of the Kakhovka dam and subsequent flooding of Kherson city and surrounding areas has had an immediate and profound impact on local communities, infrastructure and environment. The full extent of even the most immediate consequences such as damage to homes and small businesses cannot yet be assessed while water levels remain elevated. Wider impacts on the environment, public health and the local economy will take more time to reveal themselves.

Short term impact and needs of evacuees:

- A majority of interviewed evacuees reported having left with very few items –documents, clothes and cash. The limited number of evacuees REACH interviewed reported having their immediate needs mostly met, in great part due to the locally led humanitarian response.
- The majority of interviewed evacuees spontaneously mentioned a willingness to receive MPCA – indicating this is perceived as a suitable modality of assistance.
- All interviewed evacuees reported remaining close to their habitual residence, with the intention to regularly check on water levels to inform their decision regarding return. In Kherson city, return intentions varied more compared to Bilozerka.

Medium and long term impact and concerns:

- Oblast and hromada authorities shared severe concerns related to the anticipated health and environmental impact of surface and groundwater contaminated by the flooding of facilities such as sewage collecting sites, cemeteries and landfills. In this respect, the need for rapid clean up operations was mentioned as a top priority by authorities.
- REACH identified up to 24 hazardous industrial facilities as affected by flooding, a cluster of which are located close to densely populated areas in Kherson. These facilities store a variety of substances that are harmful to human health and/or the environment and have been previously exposed to conflict.
- Oblast and hromadas authorities raised concerns around the outbreak of diseases and epidemics, as previous floods show that infectious diseases occur due to scarcity of safe water, inadequate sanitation, injuries, and disruptions in accessing healthcare services.
- Disruptions in water supply for irrigation channels are likely to have an extensive effect on agriculture, and by extent to people's livelihoods in the region.
- Monitoring water quality will enable informed decision-making, which will be essential for mitigating the effect of the flood on human health, preserving ecosystems, ensuring safe drinking water, supporting agricultural needs, and guiding the remediation process.

Humanitarian needs and movement intentions of evacuees

All reported needs, especially the reported absence of unmet basic needs, are specific to the interviewed evacuees REACH field team had access to. It is important to note that more than half of evacuees interviewed in Kherson (six out of ten) and one FGD participant reported having knowledge of neighbours who refused to evacuate flooded areas. Out of those evacuees, half of them reported it was only older persons refusing to evacuate. REACH therefore expects (but is unable to confirm) the presence of people in need remaining in flooded areas.

Humanitarian assistance and reported humanitarian needs

Immediate response and needs on arrival

Evacuees in Kherson and Bilozerka hromadas reported having left with very few items – roughly what fits in a single bag. The majority of evacuees reported taking their documents, clothes and cash, in addition to a few other items. No evacuee reported taking enough drinking water, food or medicines to cover their immediate basic needs. The immediate humanitarian response, led by local civil society and personal networks (relatives, friends, neighbours), appears to have been effective in covering most needs of those displaced, as all evacuees that REACH spoke with reported their immediate needs mostly covered.

Shelter

Interviewed evacuees in Kherson and Bilozerka reported living in dormitories in collective sites or staying with relatives, friends or neighbours. All evacuees reported living close to their habitual residence, with all participants of the FGD in Bilozerka reporting deliberately choosing shelters close to their flooded homes so they can return quickly. It is not clear how long evacuees' current housing arrangements can remain in place, both for evacuees living in collective sites or hosted by their personal networks.

Mental health and psychosocial support (MHPSS)

Except for one evacuee mentioning the need for child-specific MHPSS, no evacuee reported the need for MHPSS although this need is likely to be underestimated due to the majority of interviewed evacuees in Bilozerka and Kherson expressing or demonstrating feelings of anxiety, insecurity and distress. For those reporting or exhibiting such feelings, a major factor was reported as not being able to assess the damage to their homes and therefore not knowing the exact impact on their lives.

Information needs

Six out of ten interviewees reported having received information and assistance on arrival from volunteers. In Bilozerka, FGD participants reported receiving information via local social services, but gaps remained concerning health hazards, soil and water contamination, and the risk of mine contamination in flooded areas. Interviewees in Kherson likewise reported receiving information mainly through volunteers, but some felt they were unable to make informed decisions due to lack of information on the state of their flooded homes. Importantly, four out of ten evacuees reported a lack of information and follow-up after registering for cash assistance.

Assistance modality: multi-purpose cash assistance (MPCA) versus in-kind

Reported preference for MPCA

The majority of FGD participants, as well as eight out of ten interviewed evacuees in Kherson, spontaneously mentioned a willingness to receive MPCA – indicating this is perceived as a suitable modality of assistance. In Kherson, most evacuees reported buying items in local markets. Indeed, data from REACH's Joint Market Monitoring Initiatives (May 2023) showed no significant issues regarding the availability of items prior to the flood. However, it is important to note that price increases were reported, and supply chains for food and non-food items (NFIs) are reported to be largely local, meaning they could potentially have been disrupted. While at the time of writing REACH is unable to confirm the possible effect of the flood local supply chains, it is important to note that none of the interviewees spontaneously reported serious issues related to market situations at this time.

Movement intentions

Displacement patterns

All interviewees in both Kherson and Bilozerka chose to evacuate but stay close to their flooded homes to be able to assess water levels daily. In Bilozerka, all participants in the FGD arranged accommodation themselves and reported being hosted by their personal network, while in Kherson the majority stayed in a collective site.

The majority of FGD participants in Bilozerka reported wanting to return to their home as soon as possible, regardless of its condition. In Kherson however, the picture was more mixed with half of interviewees reporting the same, while the other half reported preferring to wait for more information, as well as authority clearance, before making a decision. One individual anticipated longer displacement, reporting the intention to remain in Kherson and look for work.

The interviews suggest the main trigger for future movement is likely water levels. As homes become accessible, those displaced by the flood are likely to return immediately. Security was only marginally reported as a factor influencing movement intentions. This may lead to early returns in unsafe conditions, with the structural integrity of buildings possibly affected by floodwaters, as well as the presence of mines/unexploded ordnance (UXOs) and other health hazards both in the water and in places where it has receded to leave mud and mould.

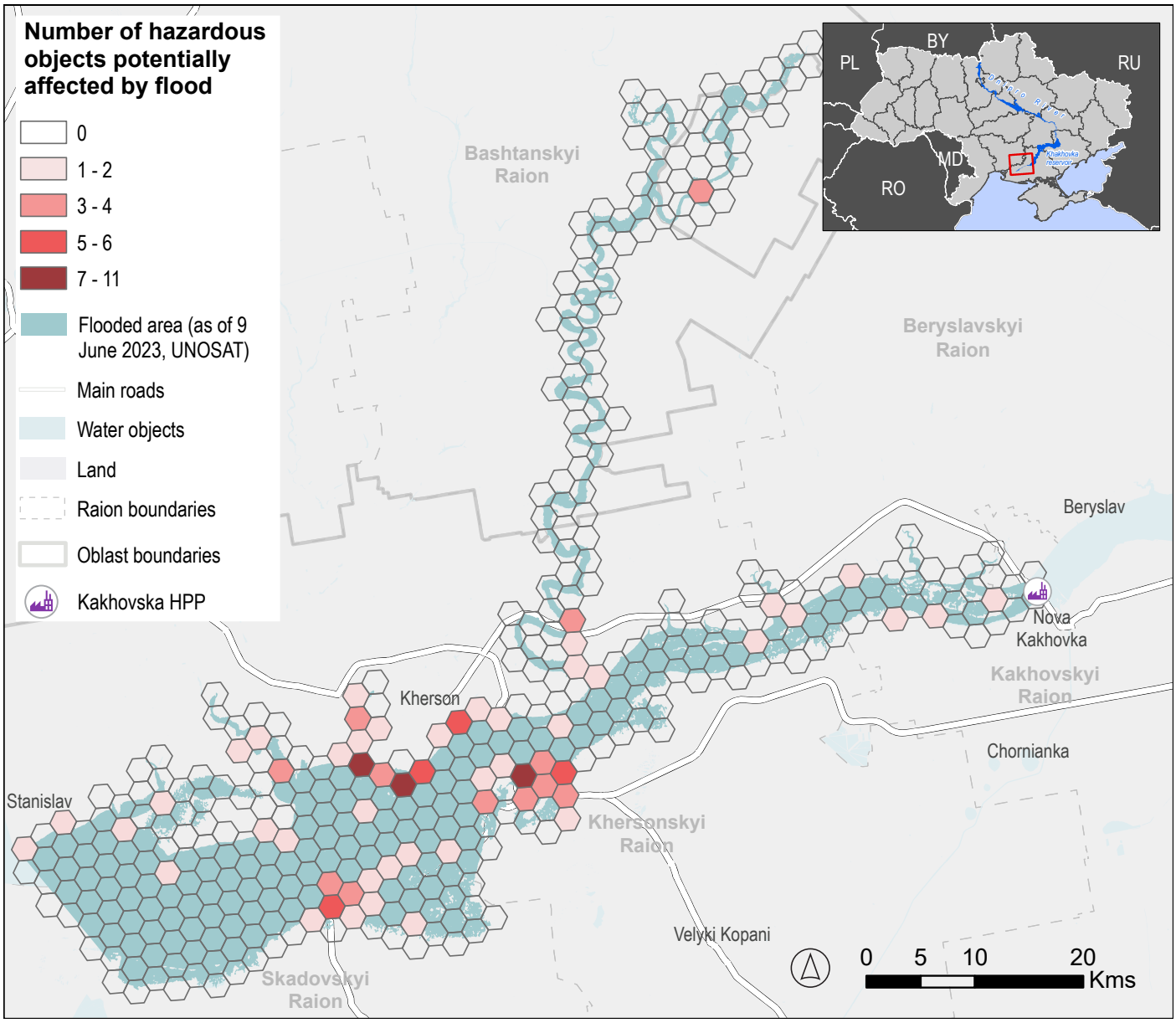
Water contamination and health risks

The deputy head of Kherson oblast, as well as Bilozerka and Kherson hromadas shared severe health concerns related to the contamination of both surface and groundwater contamination in their administrative areas.

According to the KIs, 465.000 tons of transformer oil from the Kakhovka Hydroelectric Power Plant (HPP) ended up in the water and could pose significant health risks. Oil is a highly flammable substance with risk of ignition due to ongoing military operations in the area. Oil contamination has significant effects on the environment, altering the physical, chemical, and biological properties of water, soil, and natural habitats. It is particularly toxic to aquatic organisms and can cause persistent groundwater contamination. Additionally, sedimentation on the soil leads to the suppression of vegetation, primarily soil algae, and can have long-term consequences for microorganisms, resulting in mass mortality in areas of severe contamination. In terms of the potential human health impact, oil exposure can cause irritation to the skin and eyes. It can also negatively impact various bodily systems, including the central nervous, respiratory, and cardiovascular systems, as well as the blood, liver, kidneys, and gastrointestinal tract. Based on data obtained by REACH from OLCI (Ocean and Land Color Instrument) aboard the Sentinel-3 satellite, 54 oil facilities have been impacted by the flood.

Rapid analysis based on REACH's Hazardous Events Monitoring Initiative (HEMI) identified 134 objects potentially affected by flooding, including 24 hazardous industrial facilities. These facilities are a significant concern due to their previous exposure to conflict (including direct damage) and their storage of substances that are harmful to human health and/or the environment. The flooding is expected to increase the risks of both immediate and long-term impacts. These facilities contain a variety of hazardous substances, each with its own environmental and health risk profiles. They include ammonia, antibiotics, biodiesel, chlorine, isopropyl alcohol, kerosene, oils and solvents, and various petroleum products. A cluster of hazardous facilities is found within and in close proximity to Kherson city, where the high population density exacerbates threats to human health.

Map 1. Density of hazardous sites potentially affected by flooding



Communicable diseases

During floods, the most commonly reported health-related issues include a scarcity of safe water, inadequate sanitation, injuries, and disruptions in accessing healthcare services. Although uncommon in Europe, the WHO in its report on health risks related to flooding reports that infectious diseases can occur during floods due to factors such as rodents, vectors, or poor water quality.

Authorities also raised concerns around the outbreak of diseases and epidemics, in particular as a consequence of landfills and cemeteries being flooded. On 09 June, the deputy head of Kherson oblast identified one cemetery in Oleshki - on the left bank of the river - to be flooded. This is further corroborated by remote sensing analysis by UADAMAGE, which identified two cemeteries and one waste disposal site impacted by the flood. REACH identified 18 biohazardous sites (such as landfills and cemeteries) affected by the flood.

In addition, authorities in Kherson and Bilozerka mentioned the death and decomposition of fish in the flooded area once water recedes could present a risk if not promptly cleaned up. Furthermore, authorities in Bilozerka reported concerns on the possible outbreak of rabies in their community. According to KIs, much of the wildlife in flooded grasslands and forests has been displaced to more urban areas increasing the chance of transmitting diseases onto pets and subsequently to humans.

The deputy head of the Kherson city administration reported the flooding of 6 sites that collect sewage. Untreated sewage can contaminate both surface and groundwater with harmful bacteria such as E. Coli and V. cholerae, potentially leading to the outbreak of waterborne diseases including Cholera.

It is important to note that these risks are not uniformly distributed across the population, but rather depend on existing vulnerabilities. The lack of access to healthcare services resulting from the flood may further exacerbate the risks associated with infectious diseases. Because risks linked to such diseases may manifest several weeks after the flood, long-term planning is important. Additional mitigation strategies such as the use of full personal protective equipment, limiting exposure to disease sources and hepatitis A and/or B vaccinations for high-risk individuals, such as utility workers, may further decrease the risk of infectious diseases. Indeed, Kherson authorities have requested support in the provision of personal protective equipment (PPE) and medicine. An itemised list of needs developed by oblast authorities is included in Annex I of this report.

Serious concerns are also raised regarding the mud that will be left behind once the floodwater recedes. While flooding can result in the dilution of chemical spills due to the large amount of water involved, it is important to note that chemical pollution can still remain significant in specific areas and residual mud. Therefore, it is crucial to exercise caution and take appropriate measures when addressing clean-up efforts. The health sector plays a pivotal role in providing health advice on the clean-up process and any short- and long-term risks to health from flood contaminants. Further complicating upcoming clean-up operations, according to Kherson authorities, will be the likely presence of mines and UXOs in the mud and water.

Oblast authorities currently lack the materials to conduct a rapid clean up, and request support in the form of items such as brooms, shovels, and containers, as well as more heavy machinery like dump trucks, and machines to shred and crush debris. Further specifications regarding items needed for clean-up operations are included in Annex I.

Mitigation and water supply

Monitoring water quality after dam damage is essential for protecting human health, preserving ecosystems, ensuring safe drinking water, supporting agricultural needs, and guiding the remediation process. It allows for informed decision-making and timely interventions to address any water quality issues arising from dam failure.

Kherson authorities reported that, despite early mitigation measures, such as the sealing of wells and a stop to the pumping of water from the Dniper river, the likelihood of groundwater contamination is high due to the presence of informal wells. Moreover, these measures themselves lead to serious concerns regarding the local water supply. As of 09 June, municipal authorities in Bilozerka and Kherson reported issues around salinity of water with taste reportedly being affected.

Moreover, the depletion of water in irrigation channels is likely to have an extensive effect on agriculture, and by extend people's livelihoods, in the region. Surface water monitoring helps identify and assess any potential health hazards, enabling authorities to take appropriate actions to protect public safety. The suggested types of water quality testing considering the types of pollution include salinity, pH, nutrient levels, and the presence of harmful substances. With increased monitoring, farmers will be able to make informed decisions regarding water usage, crop selection, and the need for additional treatments.

Wider impact on water quality in the region

Using Sentinel-3 satellite imagery, REACH explored the data between June 5 and 15 2023, obtained from OLCI (Ocean and Land Color Instrument). Satellite remote sensing can detect and map water contamination by analysing spectral signatures and identifying changes in water quality parameters in such as water turbidity and sedimentation. Secchi depth (SD) methodology was applied by REACH to monitor the spread of suspended particulate matter (sediments).

The map below shows the sediments run off and spread from Dniper River into the Black Sea. Highly sediment contaminated water (marked with yellow and brown on Map 2), potentially contaminated with sewage, chemicals and landmine residues spread fast over the Northern part of the Black Sea reaching Odesa and Chornomorsk cities on the eastern side of the Black Sea, as visible of the image from June 9.

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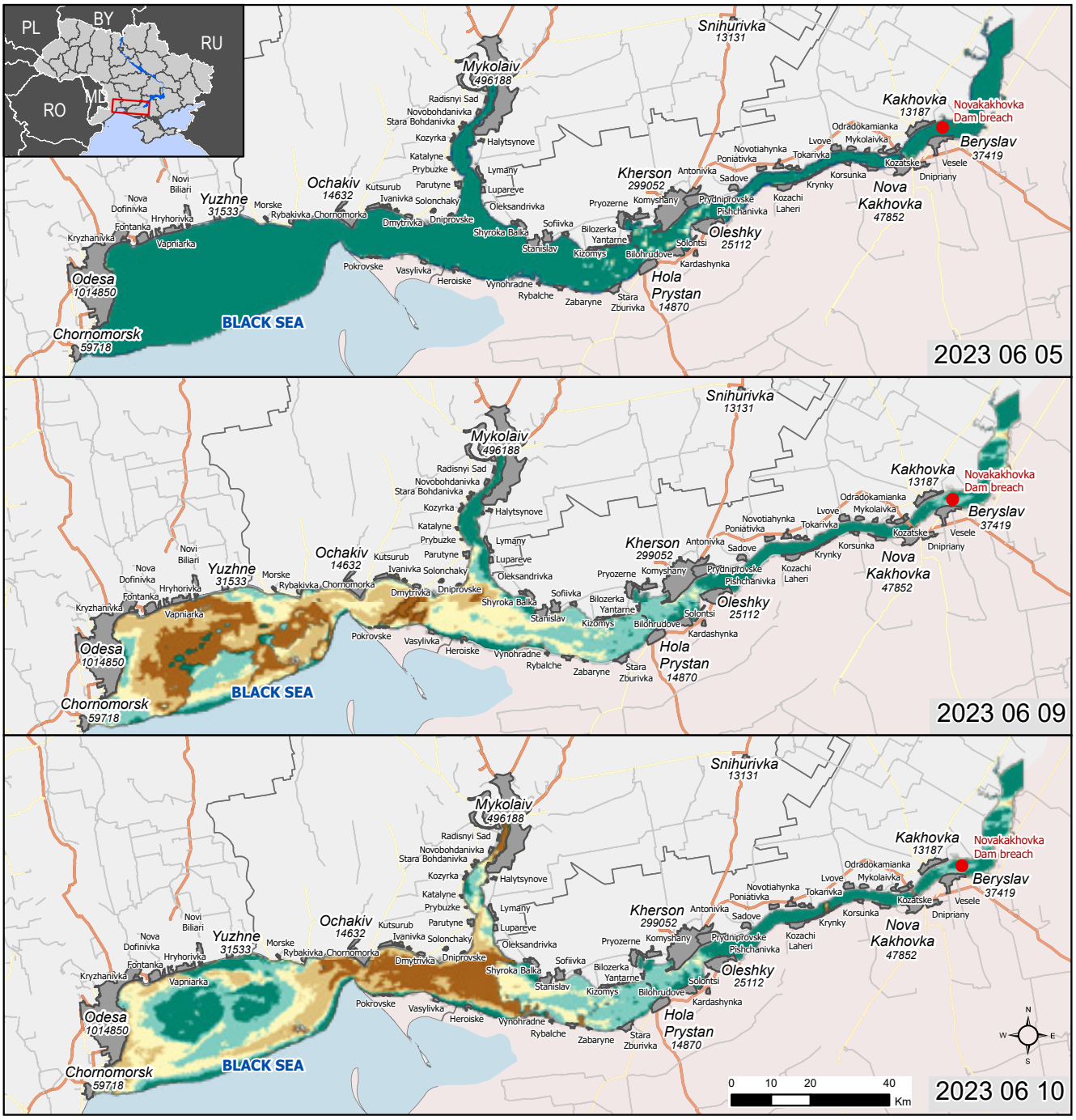
Map 2: Sediments plume dynamic, visible on Sentinel-3 images



Sediments index
- Very high
- High
- Medium
- Low
- Very low

Odesa 1014850 Population in the city
- Settlements
- Out of governmental control of Ukraine
- Black Sea

Roads
- primary
- secondary
- tertiary

Data sources:
Water index- classified Sentinel-3/OLCI imagery of 05-10 June 2023, accessed from https://apps.sentinel-hub.com/
Sediment index calculated as SD=0.036×((B4)/B6×B8))+0.79 according to https://doi.org/10.3390/rs14092172;
Permanent water, roads, railways - ©OpenStreetMap contributors;
Settlements - OCHA;
Population number - Ukrstat, IMPACT, January 2022
NGCA as of 5 June 2023 - https://liveuamap.com/uk

The images show clear evidence of water quality deterioration along the Pivdenny Bukh river, extending to Mykolaiv city. The analysis indicates that surface and groundwater contamination not only leads to health concerns in Kherson oblast, but possibly extending to other oblasts such as Mykolaiv and Odesa. Moreover, while local authorities in urban areas have conducted outreach campaigns to warn the public on the risks associated with water contamination, it is not clear to what extend this communication is reaching more rural, isolated communities along the coastline as well as the Pivdenny Bukh river.

ANNEX I: List of needs for Kherson hromada, as shared with REACH by the deputy head of Kherson hromada military administration on 9 June 2023

Name of product	Reference	Handling unit (HU)	Total needs
MACHINES AND MECHANISMS			
Dump truck	Scania, Volvo, Reno (with a payload capacity of 20-25 tons and a body volume of 20-30 m3)	unit	3
Dump truck	"FORD TRUCKS 1833D DUMP TRUCK (load capacity 4-5 tons)"	unit	5
Truck with a manipulator	Truck with a DAEWOO manipulator, or an analog	unit	5
Tow truck	ISUZU GIGA (up to 20 tons)	unit	3
Truck 5 tons (with tail lift)		unit	
Front loader	JCB, MANITOU, Komatsu	unit	6
Mini loader	JCB 155	unit	4
Motor grader	SHANTUI SG 18-3 (or equivalent)	unit	1
Emergency vehicle TK-IV-ARM (based on IVECO DAILY)	Emergency vehicle TK-IV-ARM (based on IVECO DAILY), or equivalent	unit	4
Multifunctional compact utility machine	EGHOLM Park Ranger 2150	unit	3
Gantry hopper truck	"KGP-8.2 COBALT on FOTONDAIMLER chassis or equivalent (8m3 of waste up to 8 tons) (or equivalent)"	unit	3
Garbage truck (diesel) with a capacity of up to 12 m3 for a Euro container	Garbage truck HIDRO-MAK (DIESEL) with a capacity of 12M3 (MAZ-5340C2 chassis)	unit	5
"Minibus (diesel) with a passenger capacity of 18-20 people"	Van Hool T916 Acron 2007	unit	5
Minibus cargo and passenger		unit	1
Specialized vehicle for catching animals on the basis of a chassis-cab with a body	on the basis of a cab chassis with a body extension PEUGEOT Boxer CHL3; Renault Macmep;	unit	2
Biological waste incinerator KB-900	KB-900 (as an example)	unit	2
Shredder for construction waste	IMPACTOR 250 (or equivalent)	unit	1
Crusher - shredder		unit	3
Car vacuum cleaner 5m3	Truck vacuum cleaner 5m3 FOTON, or equivalent	unit	3
Sewer flushing machine	"MK-6 on the DAYUN-CGC1120 chassis (or equivalent)"	unit	3

Name of product	Reference	Handling unit (HU)	Total needs
Trailer for launching PRL-0512	Trailer for lowering PRL-0512 or equivalent	unit	2
Motor pump 1	Honda WT 20 XK4 DE, or equivalent, set of sleeves	unit	50
Motor pump 2	HONDA WT 40 XK3 DE, or equivalent, set of sleeves	unit	30
Trailer motor pump	"(at least 600 cubic meters per hour), a set of hoses"	unit	5
Fire pumping hose stations	Mobile, motor pump MP 1600	unit	5
Vacuum cleaner Karcher WD 6 P Premium 1.348- 271.0	Vacuum cleaner Karcher WD 6 P Premium 1.348- 271.0 or equivalent	unit	1
Diesel heat gun	Denzel DHG-30, heat output from 30 kW	unit	50
Heat gun	"DEWALT DXKH080E, heat output up to 20 kW"	unit	50
Rockla (hydraulic trolley), 3 tons		unit	15
Hand trucks		unit	10
Hydraulic stacker		unit	6
CLEANING AND WASTE DISPOSAL			
Bayonet shovel		unit	100
Shovel shovel		unit	200
Plastic broom T1-5-120 with handle 120 cm		unit	500
Garbage bags 240 l		unit	5 000
Polypropylene bag		unit	5 000
Construction gloves		pair	3 000
Rubber overalls complete with rubber boots		unit	100
Battery operated spotlights		unit	30
Water filters (jug)		unit	20 000
Thermopot		unit	5 000
STUDIES AND ASSESSMENTS			
Development of design and estimate documentation and arrangement of pump rooms			

ANNEX I: List of needs for Kherson hromada, as shared with REACH by the deputy head of Kherson hromada military administration on 9 June 2023 (continued)

Name of product	Reference	Handling unit (HU)	Total needs
FOOD ITEMS			
Instant soups		unit	30 000
Instant noodles		unit	30 000
Instant mashed potatoes		unit	30 000
Canned meat		unit	30 000
Breads		unit	10 000
Tea/coffee 20\20 thousand units		unit	40 000
Sugar (in sticks)		unit	20 000
Packaged biscuits		unit	15 000
Energy bars		unit	30 000
Food packages		unit	20 000
Food for dogs/cats		kg	2 000
OFFICE EQUIPMENT			
Laptop (complete with computer mice) - 10 pcs.		unit	10
MFP		unit	4
Power banks		unit	5000
MEDICINE			
Antibiotics			
Sedatives			
HYGIENE PRODUCTS			
Toilet paper 2-ply 4 rolls white			
Wet wipes 120 pcs. 1 п.			
Female sanitary pads Normal 4 drops (at least 18 pcs.) 1 p.			
Feminine daily pads odorless 1 p.			

Name of product	Reference	Handling unit (HU)	Total needs
Soap (bar, 0.7 - 0.8 g) 1 pc.			
Toothbrushes 2 pcs.			
Toothpaste 100-125 ml. 1 pc.			
Shower gel 0.3 l. - 0,5 л. 1 pc.			
Shampoo (unisex) 0.3 - 0.5 liters. 1 pc.			
Disposable shaving machine 2 pcs.			
Dry Serving Cups (10 pcs./1 p) 10 pcs.			
Paper towels (2 pcs.)			
Baby gel + shampoo 2 in 1 or baby liquid soap			
Antiseptic 1 pc. 0.2-0.4 liters.			
Hand cream			
Diapers for children (size 5, 6, 7), 500 units each.			
Diapers for adults (all sizes), 1000 packs each.			
Disposable diapers 15 thousand pcs.			
Washing powder/gel		unit	10 000
Dishwashing detergent		unit	10 000
Sponges for washing dishes		unit	10 000
Bed linen		set	10 000
Mold remedies		bottle	20 000