Research Terms of Reference
Mariupol Area-Based Risk Assessment
RCID – UKR2002
Ukraine

June 2021
V.1

IMPACT Shaping practices Influencing policies Impacting lives

1. Executive Summary

Country of intervention	Ukraine					
Type of Emergency	X	Natural disaster	X	Conflict	□	Other *(specify)*
Type of Crisis	X	Sudden onset	X	Slow onset	X	Protracted
Mandating Body/ Agency	*ACTED, IMPACT, SeeD*					
IMPACT Project Code	*64 EDJ*					
Overall Research Timeframe *(from research design to final outputs / M&E)*	20 / 04 / 2021 to 31 / 07 / 2021					
Research Timeframe *Add planned deadlines (for first cycle if more than 1)*	1. Pilot/ training: N/A		6. Preliminary presentation: 30 / 06 / 2021			
	2. Start collect data: 20 / 04 / 2021		7. Outputs sent for validation: 10 / 07 / 2021			
	3. Data collected: 15 / 05 / 2021		8. Outputs published: 24 / 07 / 2021			
	4. Data analysed: 15 / 06 / 2021		9. Final presentation: 31 / 07 / 2021			
	5. Data sent for validation: 15 / 06 / 2021					
Number of assessments	X	Single assessment (one cycle)				
	□	Multi assessment (more than one cycle)				
Humanitarian milestones *Specify **what** will the assessment inform and **when** e.g. The shelter cluster will use this data to draft its Revised Flash Appeal;*	**Milestone**		**Deadline**			
	□	Donor plan/strategy	_ _/_ _/_ _ _ _			
	□	Inter-cluster plan/strategy	_ _/_ _/_ _ _ _			
	□	Cluster plan/strategy	_ _/_ _/_ _ _ _			
	□	NGO platform plan/strategy	_ _/_ _/_ _ _ _			
	X	Other (Specify): IcSP Internal Strategic and Operational planning / National Regional Development monitoring / Oblast Regional Development plans	Ongoing			
Audience Type & Dissemination *Specify **who** will the assessment inform and **how** you will disseminate to inform the audience*	**Audience type**		**Dissemination**			
	X Strategic		X General Product Mailing (e.g. mail to NGO consortium; HCT participants; Donors)			
	X Programmatic		X Cluster Mailing (Education, Shelter and WASH) and presentation of findings at next cluster meeting			
	□ Operational		X Presentation of findings (e.g. at HCT meeting; Cluster meeting)			
	□ [Other, Specify]		X Website Dissemination (Relief Web & REACH Resource Centre)			
			□ [Other, Specify]			

Detailed dissemination plan required	□	Yes	X	No, included in URK2001 dissemination plan
General Objective	To improve understanding of hazards exposure in Mariupol Raion and specific urban hazards and risks in Mariupol city to support resilience building and inform local-level disaster risk reduction planning.			
Specific Objective(s)	1. To understand natural and anthropogenic hazards[1] exposure of populations and critical infrastructure, and local-level vulnerability to selected hazards in Mariupol Raion (district)[2] 2. To understand hazards specific to urban areas, vulnerability and potential risks affecting populations and critical infrastructure in Mariupol city[3] 3. To understand the level of resilience capacity[4] in Mariupol city[5] and identify key areas of action influencing and supporting resilience-building. 4. To inform local authorities about such risks using concise and accessible analysis relevant to preparedness, disaster risk management planning and resilience building.			
Research Questions[6]	1. What are the natural and anthropogenic hazards exposure of populations and critical infrastructure, and local-level vulnerability to selected hazards in Mariupol Raion (district)? 1.1. What are the key environmental and demographic characteristics, and primary built assets[7], within Mariupol Raion? 1.2. What are the main hazards[8] and their characteristics (for example, frequency, duration, intensity) that populations, the environment, and built assets are exposed to in rural and urban areas within Mariupol Raion? 1.3. To what extent are populations, environment, and built assets exposed to natural and anthropogenic hazards in the Raion? 2. What is the hazards, vulnerability and risk profile of populations and built assets in different neighborhoods in Mariupol city? 3. What is the resilience profile of Mariupol city and what are the key areas for action to support resilience building in Mariupol city?			
Geographic Coverage	Mariupol Raion (Mariupol City and periphery)			
Secondary data sources	• Geospatial datasets. Sources will include: OpenStreetMap, OCHA, Sentinel 2, Sentinel 5P, Copernicus Emergency Management Service, FIRMS, USGS Earth Explorer etc. • IMPACT UCVA of basic services in Mariupol (HH interviews) • IMPACT Azov Sea Area Socioeconomic Resilience Assessment (ASERA), (HH; small and medium enterprises survey) • Meteorological data (e.g., RP5 weather records , Climate Data Online, Google Earth Engine) • National (State Statistics Service of Ukraine) and regional statistics data (Donetsk Oblast Statistics Service)			

1 Local-level environmental, hydro-meteorological, anthropogenic (technological), societal and biological (COVID-19) hazards
2 Through analysis of various global, national, and regional databases on natural and anthropogenic hazard exposure of populations, infrastructure and assets
3 Vulnerability and risk profile is calculated only for Mariupol city council area due to the availability and representativeness of data.
4 Resilience capacity is a potential for proactive measures to be taken to achieve and maintain gains in well-being, despite exposure to shocks and stresses.
5 Based on vulnerability and risk profile, resilience section is also targeting only Mariupol city
6 for detailed research questions see Annex 2
7 Here: critical infrastructure (e.g., transport systems, air and sea ports, electricity, water and communications systems, hospitals and health clinics, and centres for fire, police and public administration services)
8 See p.5 in Methodology section for types of selected hazards

	• See Table 1 below for more information					
Population(s) *Select all that apply*	□	IDPs in camp		□	IDPs in informal sites	
	X	IDPs in host communities		□	IDPs [Other, Specify]	
	□	Refugees in camp		□	Refugees in informal sites	
	□	Refugees in host communities		□	Refugees [Other, Specify]	
	X	Host communities		X	[Other, Specify] General population	
Stratification *Select type(s) and enter number of strata*	X	Geographical #: 2 Mariupol City (including 13 neighbourhoods), Mariupol Raion Population size per settlement is known? X Yes* □ No *Specific population figures not known for neighbourhoods. Will be estimated from residential building density.	□	Group #: _ _ _ Population size per strata is known? □ Yes □ No	□	*[Other Specify]* #: _ _ Population size per strata is known? □ Yes □ No
Data management platform(s)	X	IMPACT	□	UNHCR		
	□	[Other, Specify]				
Expected ouput type(s)	□	Situation overview #: _ _	X	Report #: 1	□	Profile #: _ _
	X	Presentation (Preliminary findings) #: 1	X	Presentation (Final) #: 1	□	Factsheet #: _ _
	□	Interactive dashboard #:_	□	Webmap #: _ _	□	Map #: _ _
	□	[Other, Specify] #: _ _				
Access	X	Public (available on IMPACT website and other humanitarian platforms)				
	□	Restricted (bilateral dissemination only upon agreed dissemination list, no publication on IMPACT or other platforms)				
Visibility *Specify which **logos** should be on outputs*	***IMPACT***					
	***Donor:** EU*					
	Coordination Framework:					
	***Partners:** : ACTED, SeeD*					

2. Rationale

2.1 Background

After more than five years of armed conflict in Eastern Ukraine, civilians continue to bear the effects of conflict. Since April 2014, more than 3,000 persons have died, and 9,000 have been injured. As a result of the conflict, there are 1.5 million Internally Displaced Persons (IDPs). Today, despite the Minsk agreements, the conflict continues to affect 5.2 million people, of whom 3.5 million are in urgent need of protection and humanitarian assistance. The UN Office for the Coordination of Humanitarian Affairs (UNOCHA) estimates that 3.2 million people are in need of humanitarian Water, Sanitation and Hygiene (WASH) assistance.

In parallel, the population remains vulnerable to pre-existing natural hazards such as extreme weather events, including harsh winters and extreme summers and frequent droughts. In addition, Ukraine is highly vulnerable to climate change. Both conflict-related damage as well as dilapidation due to lack of maintenance of systems or infrastructure which could otherwise cope with these hazards have heightened vulnerability, alongside limited local capacity to plan and prepare.

Populations living close to the contact line face conflict-related hazards including frequent shelling, significant landmine/UXO contamination, frequent utility cuts (which are particularly dangerous in winter due to the risk of insufficient warmth). Such hazards are compounded by pre-existing industrial/ecological concerns including a significant number of hazardous sites due to the highly industrialised nature of the region prior to the conflict. Such industrial hazards suffer from a lack of monitoring and a lack of maintenance due to the additional hazards posed by conflict as well as ambiguity over the parties responsible for such maintenance and monitoring.

Over the past six years, it has been well established that the armed conflict in eastern Ukraine has affected economic, social and civic dynamics, and hazard exposure in Donetsk and Luhansk oblasts. Therefore, most of the research on conflict, industrial and natural risks/hazards focus on close to contact line areas in Luhansk and Donetsk oblasts (Government and Non-Government controlled areas). Less analysis has been conducted on the conflict's consequences, and industrial and natural risks/hazards, for the wider Azov Sea Area (ASA), inclusive of Donetsk, Zaporizhzhia and Kherson oblasts. There is an information gap, which this research cycle seeks to fill in, specifically on how the wider ASA is affected by natural and anthropogenic risks, especially in relation to recent events including the geopolitical events in Donbas and Crimea in 2014, events in the Sea of Azov in 2018 and the outbreak of COVID-19 in 2020. In this context, Ukraine and the ASA has also more recently been affected by COVID-19, with 1.73 million cases confirmed nationally as of April 2021.

IMPACT has already completed 5 Area-Based Risk Assessments (ABRAs) in 2019-2020 in hromadas on the line of contact in Government-controlled area (GCA) of Donetsk and Luhansk oblasts. IMPACT has all the required resources, techniques, and an established network on site to successfully accomplish this ABRA in Mariupol Raion (Donetsk oblast), including a focus on Mariupol city – the second largest city in Donetsk Oblast and main industrial port in the Sea of Azov. However, the assessment will be completed in the context of the project, "Resilience of the Azov Sea Area", which focusses on the entire Azov Sea area, and the study will therefore draw on and compare risks across the region. This Area-based Risk Assessment will serve as a useful indication of which risks are most prominent in the region and which settlements / neighborhoods to prioritize for implementing risk reduction programmes and help to inform local-level disaster risk reduction planning.

2.2 Intended impact

This assessment aims to support resilience building across the Azov Sea Area. Through investigating the range of anthropogenic and natural risks affecting Mariupol Raion and the wider area, the resultant area-based risk assessment aims to assist communities, governments, and industries to better prepare for potential future events. In addition, the assessment will serve as a guide for prioritising humanitarian interventions and assist in planning processes, providing a clear picture of the scale and geographical coverage of various environmental and trade indicators in the region. As many of these shocks could be repeated in coming years, the assessment will serve as a useful information tool to predict, prepare for and respond to future risks. IMPACT and SeeD will seek to consult with the stakeholders listed below during the review and dissemination phases of the project. It is intended that information products will be useful to these stakeholders in the following ways:

- **Civil Society:** A key objective of the project is to produce information that will provide civil society organisations with material for evidence-based advocacy on issues for the ASA community and concerning trends in the region.
- **National and local government actors:** Products may be used to inform policy, aid in selection of projects to be funded or monitor of progress against development strategies.
- **Humanitarian and development actors:** Products may be used in identifying concerns of local community and provide an evidence base for new programming.
- **Donors:** Products may assist in shaping calls for proposal and reality-check those received, guiding programmatic goals and identification of advocacy points.

3. Methodology

3.1 Methodology overview

The Area-Based Risk Assessment (ABRA) aims to fill the information gaps in both natural and anthropogenic hazards and the conflict-related complexity in Mariupol Raion, through collecting, processing, and utilising secondary, openly available geospatial data on predominant hazards, exposure and vulnerability (including susceptibility, coping capacity and adaptive capacity). For the secondary data review data from the last 20 years was considered with a specific focus on dynamics changes in data since 2014 till 2021. It is important to analyse environmental and climatic trends in particular over a longer time period to understand changes and patterns over time. Some data is only available for a shorter time period, limiting the analysis to a shorter timeframe. For example, vulnerability data is generally only available in the last few years. The timeframe for this research cycle is 20th April – 31st July 2021.

Methodological approaches used within this ABRA fall within the framework of The Global Facility for Disaster Reduction and Recovery (GFDRR), which is a global partnership that helps countries better understand and reduce their vulnerability to natural hazards and climate change (GFDRR, 2019).

In this assessment, we will analyse hazards, exposure, vulnerability, risk, and resilience across the region, based on the following definitions:

- **Hazard:** a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation. Hazards may be natural or anthropogenic in origin (UNDRR, 2017)
- **Exposure**: the situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas (UNDRR, 2017)
- **Vulnerability:** the conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards. Components of vulnerability include susceptibility, which is the likelihood of suffering harm; coping capacity, the capacities to reduce negative consequences; and adaptive capacity, the capacities for long-term strategies for societal change (UNDRR, 2017)
- The ABRA will aim to focus particularly on the adaptive capacity element of vulnerability to better understand the resilience of exposed communities to natural and anthropogenic hazards. **Risk:** the potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity (UNDRR, 2009)
- **Resilience:** the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions (UNDRR, 2017)

3.1.1. Data collection

Primary data from households and small and medium enterprises interviews undertaken by IMPACT and SeeD (IcSP SERA survey,) will also be utilized in this assessment. The assessment will conduct analysis at the sub-raion level where possible to provide information that is usable by local sub-regional authorities in their disaster mitigation and response planning process.

Secondary data sources for this assessment will include global datasets with the focus on ASA and specifically on Mariupol Raion. Where possible, area-based risk data for the assessment will also utilise local, regional and national data holders and will be conducted in parallel with geospatial consulting aimed to raise awareness of geospatial data usage in local planning and the importance of open data. Key stakeholders that will be consulted during the data acquisition process include state structures, organizations and enterprises including:

- Mariupol (Zapozhzhya, Kherson) city council
- State Emergency Services of Ukraine office in Mariupol
- Central office of State Emergency Services of Ukraine, Donetsk oblast
- Department of Environmental Monitoring in Donetsk oblast
- National Academy of Sciences of Ukraine?
- National Environmental Academy of Postgraduate Education?
- Mariupol Ports Authority?

Some of these organisations were already contacted by IMPACT during the data collection process for a series of ABRAs produced under the 3P Consortium in other parts of Donetsk and Luhansk oblasts between 2019 and 2020.

3.1.2. Data analysis

Different types of hazards predominant in Mariupol Raion will be analysed and mapped by their technical characteristics such as location, intensity, frequency and probability using geospatial data and GIS. Based on UNDRR Hazard definition & Classification review technical Report, 2020, following hazard categories were selected for analysis:

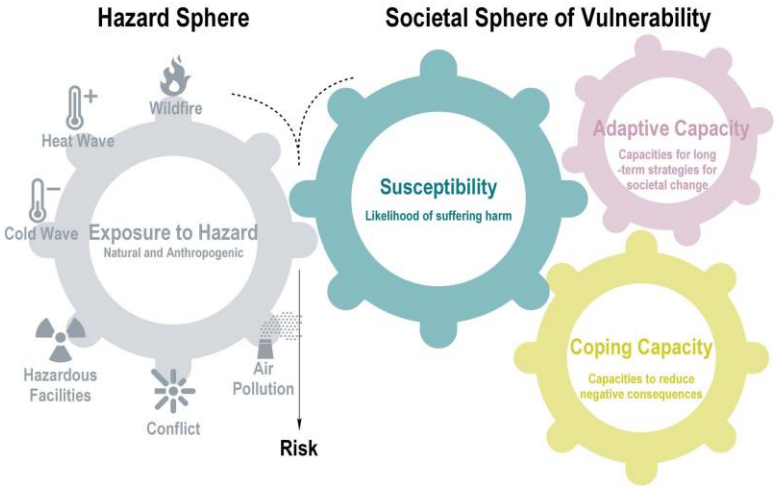
Hazard type	Specific Hazards
environmental	sea level rise, coastal erosion, land subsidence, soil salinity, land degradation, air pollution, wildfires (including anthropogenic fires), biodiversity loss
hydro-meteorological	heavy precipitation, flooding, drought, strong winds, heat waves, cold waves
technological (anthropogenic)	heavy metals contamination of soils and water, hazardous industrial facilities, poor waste management, tailing dams, oil spills
societal	Non-international armed conflict
biological	COVID-19 (SARS-CoV-2)

Next will be analysed and calculated the exposure components as a total value of elements situated in a potential hazard-prone area (number of people or build assets in an area).

The vulnerability and risk components of this assessment will be analysed and calculated only for Mariupol city on neighborhood level. Vulnerability is comprised of three components that interact with each other; susceptibility, coping capacity, and adaptive capacity. For each vulnerability component, a set of indicators will be identified on neighborhood level (See Annex 1), weighted, and summarised into vulnerability index /indices, which after combination with hazard exposure data will result into a neighborhood-level risk index.

The risk factor in this assessment is represented in the following equation:
Risk = (Hazard x Exposure x Vulnerability). Fig 1. represents a conceptual framework, which will be later adapted and modified according to specific hazard-exposures and vulnerabilities in the target area.

Figure 1. Risk Diagram



Source: adapted from Bündnis Entwicklung Hilft, 2020

Resilience will be analysed and assessed by following selected four areas based on operational framework for making cities resilient of the Sendai Framework at the local level[9]:

- Identification and understanding of current and future scenarios of hazard exposure.
- Understanding patterns of social vulnerability and societal capacity for resilience.
- Assessing the capacity and adequacy of critical infrastructure to providing essential services, responding to disasters, and reducing the creation of risks from hazards.
- Identifying ecosystem services and nature-based solutions within urban areas to enhance their use for risk reduction and resilience building.

3.2. Population of interest

This assessment will cover Mariupol Raion, including both the city and surrounding rural settlements (the new Raion boundary as of 2020 will be used) in Donetsk oblast in southeastern Ukraine. The city and Raion of Mariupol was selected because the contact line passes through the eastern part of the Raion and the city is of strategic importance within the overarching RASA project area, which includes the oblasts of Donetsk, Zaporizhzhia and Kherson on the Sea of Azov. The area remains at risk from conflict incidents, as well as natural hazards, and there are many hazardous facilities located in and around the city. Previous ABRAs produced by IMPACT under the 3P Consortium focused on Raions further north along the contact line and this ABRA will also complement the geographic coverage of this series.

The population of interest in this study includes host community members, IDPs, returnees and general population in Mariupol Raion. These areas were selected due to a) being more affected by armed conflict and annexation of Crimea b) having higher rates of industrialisation prior to the conflict and c) their vulnerability profiles as identified in previous IMPACT studies.

[9] An operational framework of the Sendai Framework at the local level, which consist of the Ten Essentials for Making Cities Resilient, based on Sendai priorities of action and its indicators for monitoring actions on disaster risk reduction

Socioeconomic data from household survey and expert surveys undertaken by IMPACT and SeeD is representative at the level of Mariupol City Council and Mariupol Periphery. Vulnerability data from CVA of basic services in Mariupol will be utilized to differentiate between vulnerability and risk profiles of different neighborhoods in Mariupol City. The geospatial nature of some of the environmental datasets meanwhile will allow for coverage at a finer geographical unit, although data can also be summarised to settlement or city level for consistency if necessary.

3.3. Secondary data review

Global datasets
Global hazard, exposure and vulnerability datasets (where available) will be used in the first steps of the Area-Based Risk Assessment. This data will include satellite data to indicate hazard extent, frequency and magnitude, including for example fire occurrence data from FIRMS, land surface temperature and NDVI data from MODIS (accessed through e.g. USGS Earth Explorer and Google Earth Engine); gridded raster data on exposure such as global population datasets, like the GHS Population Grid; and crowdsourced geodata from services like OpenStreetMap, which will provide base layers and data on built asset exposure. By definition, global datasets cover the entire planet, meaning that they could be used for risk analysis in any country. However, global data are always presented on very generalized level and could be used only for the small-scale risk analysis on country level. Therefore, they will be supplemented by regional and local sale data where available.

National-level risk assessments
Only one national risk assessment has been conducted in Ukraine. The "Regional risk atlas ERRA" was developed for the State Emergency Services of Ukraine (SESU). Although it is not publicly available, the report was provided to IMPACT by request to the Kyiv office SESU. This "Regional risk atlas ERRA" consists of 11 point layers. Layers are divided by risk type (chemical, radiation, and waste-related risks) and each layer includes 50 points per oblast. For selected target area only a few layers are fully available, (including sludge warehouses, waste, toxic waste) and they represent only the location of such hazards or in some cases the settlement which is exposed to risk. Whilst such data could be useful for national level risk planning and preparedness, it lacks significant details which makes it less applicable on a regional level.

Risk assessments in target areas
Considering the high level of industrial development of Donetsk oblast, where Mariupol Raion is located, several local-level risk assessments have been conducted in the last decades. However, due to the lack of access to records in areas currently outside of government control, such assessments have become inaccessible in the former offices of Donetsk SESU now in NGCA.

Additionally, the Organisation for Security and Cooperation in Europe (OSCE) has also conducted several assessments. For example, The Donbas Environment Information System, jointly developed by OSCE and the former Ministry of Ecology, incorporates information on the main industrial and ecological risks in Donetsk oblasts. This information system provides a valuable source of information about hazards (especially industrial) on oblast level. However, as with other data sources, they are insufficient for Raion-level planning and decision making as the data is presented only in visual form, limiting the ability of other entities to utilise it for additional analyses.

One more assessments on request of Ministry of Ecology was the "Assessment of Environmental Damage in Eastern Ukraine", aimed analyzing the environmental situation, assessing and minimizing environmental risks resulting from the hostilities in eastern Ukraine.

The OSCE additionally contracted the Ukrainian Scientific Institute of Technical Ecology to conduct the "Donbas: territory of existing assessment" covering technological and ecological risks in Donetsk oblast. Despite presenting sufficient detail, interviews with local authorities within target areas demonstrated that results of this assessment were not effectively utilised for planning, potentially because the complete version of the report has restricted access, and the publicly available version only contains a brief overview summary which is not enough for comprehensive disaster risk reduction activities.

Local level data
Data from household and SME (small and medium enterprise) surveys undertaken by IMPACT Initiatives, also as part of the RASA project, will be utilised for the vulnerability component of the analysis. This data available for 2 strata in Mariupol Raion (Mariupol City Council and Mariupol Periphery). Data from the Urban CVA of basic services in Mariupol, based on key informant interviews and household surveys, will be utilized for vulnerability

component on neighborhood-level in Mariupol City. Data from SeeD`s expert scoring panel is also available for both 2018 and 2019. Results of other previous IMPACT studies could also be utilised here.

Table 1: List of data sources to be utilised

Data source	Short description	Area	Available data and comment	Risk data type
HAZARD				
ECAD	Meteorological datasets	Europe	Air temperature, air pressure, precipitation	hydro-meteorological
European Severe Weather Database	Web-portal with information about severe weather events	Europe	Meteorological data: severe wind, large hail, heavy rain, heavy, snowfall/snowstorm	hydro-meteorological
Climate Data Online	Archive of global historical weather and climate data	Global	Archive on climatological data (wind speed)	hydro-meteorological (dry winds)
Giovanni NASA	Meteorological datasets: temperature, precipitation, soil moisture	Global	Atmospheric chemistry, precipitation, evaporation rate, vegetation (Leaf area index)?	hydro-meteorological
MODIS normalized difference vegetation index (NDVI)	Vegetation cover index	Global	Vegetation green ness, density and assess changes in plant health	hydro-meteorological (drought)
NOAA historical weather index	Meteorological datasets	Global	Data on temperature, precipitation, and drought time series	hydro-meteorological
RP5 weather records	meteorological datasets	Global	Weather prognosis, records (Mariupol city)	hydro-meteorological
MODIS land surface temperature	LST, 2001-2020	Global	Data on historical land surface temperatures	hydro-meteorological
FIRMS fire data	Near real-time active fire data	Global	Active fires	environmental (wildfires)
Automated environmental monitoring system in Donetsk region	Air pollution data	Donetsk oblast	Air pollution data from air quality posts	environmental (air pollution)
The Sentinel-5 Precursor mission	RS	Global	Atmospheric SO2, NO2, Aerosol index, CO concentration	environmental (air pollution)
Global Forest Watch	Forest cover, loss and gain	Global	Forest cover, forest loss, forest gain	environmental (biodiversity loss, wildfires), vulnerability (adaptive capacity)
Sentinel 1	RS (radar)	Global	C-band radar images	environmental (land cover change, biodiversity loss, land subsidence)
Ministry of Ecology and Energy	web-map with description	Ukraine	Illegal landfills	technological
Ministry of Ecology and Energy	table with description	Ukraine	Potentially hazardous objects	technological
Waste site locations	web-map, ArcGIS Online	Donetsk oblast, GCA	Waste site locations and characteristics	technological
Wikimapia	Crowdmapping portal	Global	Includes locations of dangerous objects (farms, waste-sites, industrial facilities	technological

ACLED conflict incidence	Conflict incidence 2018-present time	Ukraine	Conflict incidents as recorded by ACLED	Societal
EXPOSURE				
GLS	Land use and land cover data	Global	15-30m resolution land cover raster (Landsat based)	Exposure
OSM buildings network (building type, residential areas, pop. Density proxy)	Vector layer	Global	raw OSM	Exposure
OSM railways network	Vector layer	Global	raw OSM	Exposure
OSM river network	Vector layer	Global	raw OSM	Exposure
OSM road network	Vector layer	Global	raw OSM	Exposure
GHS built environment raster (radar-based)	Global map of built-up areas	Global	Data on build-up areas	Exposure
GHS population raster	Geospatial data on population distributions, demographic	Global	Population raster, RS-based	Exposure
Electricity infrastructure	web-map, Leaflet	Donetsk oblast, GCA	Locations of electricity transformers	Exposure
OCHA settlement and admin boundaries	Administrative boundaries and associated population estimate	Ukraine	Administrative boundaries: country, oblasts, raion,	Exposure
VULNERABILITY				
SCORE index *(SeeD)*	Experts scoring panel, reports, webmap	Ukraine	Socio-economic indicators obtained from HH surveys, e.g. civic engagement rate, level of trust in local authorities	susceptibility, adaptive capacity
Donetsk State Statistics Services	Complex regional statistics	Mariupol city	Labour market, employment, and income statistics	susceptibility
Ukraine open data portal	data portal	Mariupol city	Data on diagnosis types in Mariupol city	susceptibility (chronical illnesses)
CVA of basic services in Mariupol	Survey undertaken in 2019-2020 for three urban settlements estimating use and capacity of basic services	Kramatorsk, Mariupol and Severodonetsk	Data on healthcare, education, unemployment, social and administrative services	susceptibility, coping capacity
IMPACT key facilities interviews	Education, health and social facilities database	Donetsk and Luhansk	Locations of key facilities	coping capacity
DSNS	SESU site locations	Ukraine	Locations of SESU facilities	coping capacity
WHO MHPSS WG	MHPSS services map	Mariupol Raion	Location of MHPSS public facilities	adaptive capacity
Copernicus global land cover	Green areas within settlements	Global	Data on green areas within settlements	adaptive capacity (for heat wave and climate change hazards)

MULTIPLE RISK DATA TYPE				
WWF Hydrosheds	Hydrological data and maps based on Shuttle Elevation Derivatives at multiple Scales	Global	Hydrographic information for regional and global-scale, river networks, watershed boundaries, drainage directions, and flow accumulations	Hazard/Exposure
Water resources web map	web-map with basins	Ukraine	Available borders of main river basins and subbasins	Hazard, exposure, vulnerability
INFORM country risk profiles	Web-portal with risk estimation on country level	Global	Ranked hazard, exposure and vulnerability information on country level	Hazard, exposure, vulnerability
Landsat 8	ptherafadad	Global	Multispectral imagery (15-30 meters)	Exposure, also NDVI layers (for drought hazard calculation?)
Sentinel 2	RS (multispectral)	Global	Multispectral imagery (10-30 meters)	Exposure, also NDVI layers (for drought hazard calculation?). Also land cover change (steppe / grassland loss + biodiversity loss)
Open Access Environment	Webmap	Ukraine	Water and air quality, renewable energy use, waste	Hazard, vulnerability (adaptive capacity)
Protected Planet	Webmap on protected areas	Global	Terrestrial and marine protected areas	Exposure/Vulnerability (adaptive capacity)
Surface water data samples	Surface water chemical data 2003-200721	Ukraine	Surface water quality data	Vulnerability / exposure?
Water quality data	Locations and main characteristics of water quality	Ukraine	CSV-dataset with coordinates, have time-series data	Vulnerability / exposure?
State water agency of Ukraine	Surface and groundwater characteristic data	Ukraine	Water intake and quality data	Exposure/Vulnerability
IMPACT PANDA household surveys	Surveys undertaken in 2021 as part of the RASA project, includes questions on demographics, vulnerability and, environmental issues)	Donetsk, Kherson and Zaporizhzhia	Demographics, environmental concerns/hazards, impacts, and coping / adaptive capacity	Hazard, vulnerability, (incl. adaptive capacity), exposure
IMPACT PANDA small and medium enterprise (SME) surveys	Surveys undertaken in 2021 as part of the RASA project, includes questions on business, vulnerability and, environmental issues)	Donetsk, Kherson and Zaporizhzhia	Business practices, economics, environmental concerns/hazards, impacts, and coping / adaptive capacity	Hazard, vulnerability, (incl. adaptive capacity) exposure
Public Health Centre Ukraine	COVID-19 statistics (and other health-related data)	Ukraine	Data on COVID-19 cases, hospitalisations and data for other health conditions	Hazard (biological), vulnerability

3.4 Primary Data Collection

No primary data collection will be conducted as part of this assessment.

3.5 Data Processing & Analysis

Table 2 outlines the way in which geospatial data will be processed and analysed within each section of the Area-Based Risk Assessment. Note that these are the proposed methods, but they may need to be adjusted based on available data and suitability of different methods.

Table 2: Summary of data processing and analysis

Section name	Process / analysis
Population density (exposed population)	Calculate from OSM buildings layer – using OCHA settlement population estimates, extract areas of settlements that are residential, and analyse types of buildings present (houses/apartments, etc) to delineate discrete parcels and estimate population density.
Exposure to air pollution	Yearly averaged Sentinel-5P data on atmospheric SO_2, NO_2, CO, CH_4 and aerosols concentrations, highlighting the stationary pollution sources in 2020 or 2021. Multiplied by the population density dataset to get an estimate of exposure.
Agricultural land (exposed assets)	Agricultural land extracted from Copernicus Global Land Cover layer (latest version is 2019).
Exposure to land degradation	Land degradation calculated over long-term period using Trends.Earth. Categorises land degradation into whether land has degraded, remained stable or improved. This layer will then be overlaid on agricultural areas to see which areas have been exposed to land degradation.
Biodiversity loss	Calculate land cover change using Landsat record or an existing dataset (if available), to determine steppe grassland loss in the region (also deforestation, but this is not a major issue as most of the Raion is already deforested).
Exposure (and risk?) to fires	FIRMS dataset for months of June-August 2001-2021 will be aggregated into 1 sq.km. bins, and then mean frequency and intensity of fires per season will be calculated for each bin. Locations of critical infrastructure and assets as well as settlements will be overlaid to understand exposure. A risk index could also be calculated for this hazard, using available vulnerability data. Locations of landmine areas and shelling incidents will be mapped in relation to previous fires to better understand risk.
Risk of sea level rise	Model inundation scenarios based on predicted sea level rise in Mariupol Raion and overlay with coastal defence locations and exposed settlements or include short review of existing work.
Exposure to soil salinity	Model soil salinity using data from Landsat-7 ETM images (Enhanced Thematic Mapper) to detect coastal saline areas, using Google Earth Engine code. (https://www.sciencedirect.com/science/article/pii/S2352938518303069?via%3Dihub)
Exposure to land subsidence and coastal erosion	Estimate the spatio-temporal changes that occurred in the coastal area of Mariupol Raion using remote sensing data (Landsat MMS, Landsat TM?) and overlay with population exposure data. Coastal defense data and geological data could be utilised here if available.
Climate change and meteorology trends	Use data from Giovanni on area-averaged climatic trends or from specific weather stations from RP5 data to create graphs of long-term precipitation, temperature, soil moisture and wind speed trends, plus predominant wind directions.
Drought risk	Calculate drought exposure based on accumulated vegetation condition index in spring and summer over a long time period (calculated from MODIS NDVI or Sentinel 2 NDVI data, with non-agricultural land masked out). Then calculate risk by multiplying exposure by drought vulnerability component (e.g. land ownership, diversity of crops, irrigation use, etc)
Dry winds	Spatiotemporal distribution of dry winds (number of days with dry winds) calculated as simultaneous values of the meteorological parameters: air temperature 25°C and higher, wind speed at 10 m height is 5 m/s or more, and relative air humidity is 30% or lower (Lipinskiy et al., 2003) from meteorological stations of Ukraine located in the coastal zone of the Black Sea and Sea of Azov, using the Climate data Online, Rp5.ua
Heat wave risk	Extract periods of extremely high temperatures that have occurred recently. For the map, calculate zonal statistics for land surface temperatures for June-August 2001-2019 in Mariupol Raion: minimum, maximum, mean, standard deviation. Calculate mean number of days per season with temperatures above (mean +1 standard

	deviation), per pixel. Calculations carried out in Google Earth Engine with MODIS LST product. Then multiply the exposure index (mean LST in settlement) by population density in that settlement to get measure of risk.
Cold wave risk	Extract periods of extremely low temperatures that have occurred recently. For the map, calculate zonal statistics for land surface temperatures for December-February 2001-2019 in Mariupol Raion: minimum, maximum, mean, standard deviation. Calculate mean number of days per season with temperatures below (mean -1 standard deviation), per pixel. Calculations carried out in Google Earth Engine with MODIS LST product. Then multiply the exposure index (mean LST in settlement) by population density in that settlement to get measure of risk.
Road infrastructure	Clean and display OSM data
Electricity	Clean and display OSM data, digitise data from satellite imagery and state documentation
Hazardous objects	Display potentially hazardous objects dataset, compiled of data from SESU, Donbas Environmental Information System, ACTED, OSM, IMPACT sources.
Loss / damage disaster case study	Case study of potential loss/damage from an accident at a selected hazardous facility. Overlay a buffer zone around a facility to see the population, buildings and infrastructure that could be exposed.
Hydrography	Display digital elevation data, OSM water objects, potentially dangerous objects (chemical), calculate runoff direction
Water infrastructure	Display WASH cluster data on water infrastructure and water monitoring posts (water quality data).
Wastewater	Data on discharge of wastewater from industrial facilities should be collated and mapped.
Hazardous landfills	Locations of hazardous landfills should be collated and mapped.
Conflict incidence (ACLED)	ACLED conflict incidence data will be aggregated into 3 sq.km. bins and displayed as average number of incidents per month.
COVID -19	Analyse COVID-19 records, e.g., from the Ukraine Public Health Centre and create visualisations on trends in regional cases, deaths, hospitalisations, etc.
Natural and anthropogenic multi-hazard exposure	Based on the existing data, environmental risk will be calculated (based on zonal statistics of proximity/frequency of natural hazard occurrence). Technological multi-hazard risk will be calculated based on proximity of hazardous objects, industrial waste, and frequency of failures in the past.
Vulnerability data	Analyse and visualize data on vulnerability. Integrate with vulnerability calculations for specific hazards and those affecting Mariupol City. Create vulnerability index / indices based on these indicators.
Risk analyses for selected major hazards affecting Mariupol City	Risk analyses focusing on specific selected hazards affecting Mariupol City and integrating neighborhood-level vulnerability data from HH surveys and other sources. Create risk index / indices for these hazards.

4. Roles and responsibilities

Table 2: Description of roles and responsibilities

Task Description	*Responsible*	*Accountable*	*Consulted*	*Informed*
Research design	*DRR Assessment officers*	*Research Manager*	*Research Manager, DRR team, IMPACT Research Design and Data Unit (RDDU)*	*SeeD*
Supervising data collection	*DRR Assessment Officers*	*Research Manager*	*GIS Officer, Data Officer,*	*SeeD, RDDU*

			Research Manager, DRR team	
Data processing (checking, cleaning)	*DRR Assessment Officers, GIS Officers*	*Research Manager*	*GIS Officer, Data Officer, Research Manager, DRR team, RDDU*	*SeeD*
Data analysis	*DRR Assessment Officers, GIS Officers*	*Research Manager*	*GIS Officer, Data Officer, Research Manager, DRR team, RDDU*	*SeeD*
Output production	*DRR Assessment Officers*	*Research Manager*	*GIS Officer, Data Officer, Research Manager, IMPACT Research Reporting Unit (RRU)*	*SeeD, EU, local authorities*
Dissemination	*DRR Assessment Officers*	*Research Manager*	*Research ManagerDRR team, RRU*	*SeeD, EU, local authorities*
Monitoring & Evaluation	*DRR Assessment Officers*	*Research Manager*	*Research Manager, RDDU*	*SeeD*
Lessons learned	*DRR Assessment Officers*	*Research Manager*	*Research Manager, RDDU*	*SeeD*

Responsible: *the person(s) who executes the task*
Accountable: *the person who validates the completion of the task and is accountable of the final output or milestone*
Consulted: *the person(s) who must be consulted when the task is implemented*
Informed: *the person(s) who need to be informed when the task is completed*

6. Monitoring & Evaluation Plan

IMPACT Objective	External M&E Indicator	Internal M&E Indicator	Focal point	Tool	Will indicator be tracked?
Humanitarian stakeholders are accessing IMPACT products	Number of humanitarian organisations accessing IMPACT services/products Number of individuals accessing IMPACT services/products	# of downloads of final report from Resource Centre	Country request to HQ	User_log	X Yes
		# of downloads of final report from Relief Web	Country request to HQ		□ Yes
		# of downloads of final report from Country level platforms	Country team		□ Yes
		# of downloads of final report from 3P Consortium Repository	Country team		X Yes
		# of page clicks on final report from REACH global newsletter	Country request to HQ		□ Yes
		# of page clicks on final report from country newsletter, sendingBlue, bit.ly	Country team		□ Yes
		# of visits to x webmap/x dashboard	Country request to HQ		□ Yes
IMPACT activities contribute to better program implementation and coordination of the humanitarian response	Number of humanitarian organisations utilizing IMPACT services/products	# references in HPC documents (HNO, SRP, Flash appeals, Cluster/sector strategies)	Country team	Reference_log	*Ukraine HNO 2022, OCHA HRP 2022, All Ukrainian Clusters Strategies*
		# references in single agency documents			*DSNS response plan (national and oblasts)*
Humanitarian stakeholders are using IMPACT products	Humanitarian actors use IMPACT evidence/products as a basis for decision making, aid planning and delivery	Perceived relevance of IMPACT country-programs	Country team	Usage_Feedback *and* Usage_Survey template	
		Perceived usefulness and influence of IMPACT outputs			*Usage survey to be conducted in August 2021, following the release of ABRA Mariupol outputs and final presentation, targeting 3P Consortium partners, IcSP*
		Recommendations to strengthen IMPACT programs			

	Number of humanitarian documents (HNO, HRP, cluster/agency strategic plans, etc.) directly informed by IMPACT products				*partners as well as all partners involved in data collection.*
		Perceived capacity of IMPACT staff			
		Perceived quality of outputs/programs			
		Recommendations to strengthen IMPACT programs			
Humanitarian stakeholders are engaged in IMPACT programs throughout the research cycle	Number and/or percentage of humanitarian organizations directly contributing to IMPACT programs *(providing resources, participating to presentations, etc.)*	# of organisations providing resources (i.e.staff, vehicles, meeting space, budget, etc.) for activity implementation	Country team	Engagement _log	□ Yes
		# of organisations/clusters inputting in research design and joint analysis			□ Yes
		# of organisations/clusters attending briefings on findings;			□ Yes

ANNEX 1: METHODOLOGY NOTES: VULNERABILITY INDICATORS

Susceptibility			
	Indicator	*Source*	*Strata / geography*
Dependency ratio	*Proportion of the population that are IDPs*	Mariupol city council statistics *(on request)/ Ministry of Social Policy* *CVA of basic services in Mariupol*	*Mariupol City*
	Percentage of population below 15 and over 65 years of age	*DonetskStat /Medical statistics of Donetsk oblast*	*Mariupol City*
	Proportion of households (HoH) with three or more children	*IcSP SERA HH survey*	*Settlements in Mariupol Raion / Mariupol City as a whole*
	Proportion of the HoH with one or more disability	*IcSP SERA HH survey,* *IMPACT UCVA of basic services in Mariupol (HH interviews)*	*Settlements in Mariupol Raion / Mariupol City as a whole*
	Proportion of HoHs who are either a widow, a single parent, or single female HoH	*IMPACT UCVA of basic services in Mariupol (HH interviews)*	*Mariupol City*
Health	*Proportion of HH suffering from chronic illness (allergy, cardiovascular, etc.)*	*IMPACT UCVA of basic services in Mariupol (HH interviews)* *Ukraine open data portal* *Medical statistics Donetsk obl (on request)*	*Mariupol City*
	Percentage of population receiving treatment from government or private hospitals	Medical statistics of Donetsk oblast	*Mariupol City*
Economic capacity &income	*Proportion of HH that are unemployed (informal employment)*	*IcSP SERA HH survey* *CVA of basic services in Mariupol*	*Settlements in Mariupol Raion / Mariupol City as a whole*
	Proportion of households whose average income per capita fell below the actual subsistence minimum (UAH 3,968)	*IcSP SERA HH survey* *REACH HERA survey*	*Settlements in Mariupol Raion / Mariupol City as a whole*
	Proportion of population that rely on social payments (e.g. unemployment or disability benefits, pension etc.	*IcSP SERA HH survey*	*Settlements in Mariupol Raion / Mariupol City as a whole*
Coping capacity			
Availability (number per 10,000 of population) of service facilities	*Ratio of social services facilities to pop.* *Ratio of health care facilities to pop.* *Ratio of admin. service centres to pop.* *Ratio of employment services to pop.*	*IMPACT UCVA of basic services in Mariupol (KI interviews)*	*Mariupol City*
Service quality and access issues	*Perceived quality and barriers to access of health care facilities*	*IMPACT UCVA of basic services in Mariupol (KI interviews)*	*Mariupol City*
Medical services	*Number of psysician per 10.000 population/Number of hospital beds per 10.000 population*	*Medical statistics of Donetsk oblast*	*Mariupol City*
Conflict	*Number of conflict incidents reported in a settlement or within a 2km radius.*	*ACLED*	*Mariupol Raion*

Adaptive capacity			
Social equity	*Civic engagement rate*	*SCORE index (SeeD)*	*Mariupol City*
Economic	*Proportion of population owning health/property/unemployment insurance*	*Tbd*	*Tbd*
	Percent of households that own land (relevant to drought + land degradation)	*Tbd*	*Tbd*
Technological (ecological)	*Percentage of public green open space as a proportion of total city space*	*Copernicus global land cover*	*Mariupol City*
	Number of water treatment plants	*WASH cluster data (on request)*	*Settlements in Mariupol Raion / Mariupol City as a whole*
	Percentage of/investment rate in green energy sources use	*Investment Energy efficiency/ Donetsk Regional State Administration (on request)*	*Donetsk oblast*
	Sustainable household and business practices	*IMPACT SERA HH and SME surveys*	*Azov Sea Area*
Information&skills	*Population (adult) literacy rate/with higher education*	*IcSP SERA HH survey CVA of basic services in Mariupol*	*Azov Sea Area*
	Access to information/internet use rate	*Ukrstat (telecommunication statistics)*	*Donetsk oblast*
	Access to emergency-related warning system information	*DSNS Donetsk oblast (on request)*	*Mariupol City*
Infrastructure	*Number of formal and informal inclusive social facilities that promote well-being and prevent or reduce mental health and psychosocial problems*	*WHO MHPSS services map*	*Settlements in Mariupol Raion / Mariupol City as a whole*
Institutions	*Level of trust to local authorities*	*SCORE index (SeeD)*	*Mariupol City*
Agriculture	*Land ownership*	*Tbd*	*Tbd*
	Sustainable business practices in agriculture	*IMPACT SERA SME survey*	*Azov Sea Area*
	Proportion of population whose livelihood is agriculture	*IMPACT SERA HH survey*	*Azov Sea Area*
	Fertliser use	*Oblast statistical websites*	*Azov Sea Area*

ANNEX 2: DETAILED RESEARCH QUESTIONS

1.1 What are the key environmental and demographic characteristics, and primary built assets, within Mariupol Raion?

a. *What vulnerabilities[10] are reported by the population, and observed in the environment and built landscape in the area?*
b. *What is the land cover and land use profile of Mariupol Raion?*
c. *What is the infrastructure profile of Mariupol Raion?*
d. *What is the built environment profile of Mariupol Raion?*

1.2. What are the main hazards and their characteristics (for example, frequency, duration, intensity) that populations, the environment, and built assets are exposed to in rural and urban areas within Mariupol Raion?

a. *What are the main environmental hazards affecting Mariupol Raion (both urban and rural areas)[11]?*
b. *What are the main hydro-meteorological[12] hazards affecting Mariupol Raion and what are the climate change trends in the region?*
c. *What are the main anthropogenic[13] hazards affecting Mariupol Raion?*
d. *What are the main societal hazards, in particular conflict events, affecting Mariupol Raion?*
e. *How has COVID-19 affected Mariupol Raion?*

1.3. To what extent are populations, environment, and built assets exposed to natural and anthropogenic hazards in the Raion?

a. *What areas of the Raion are most exposed to each hazard?*
b. *Where is a higher proportion of population exposed to these hazards?*
c. *Which physical assets are the most exposed and where are they located?*
d. *Where is the environment most exposed to hazards in the Raion?*
e. *Which type of land cover is most exposed to each hazard?*
f. *How does hazard exposure in the Raion compare with other parts of the Azov Sea Area?*
g. *What is the potential loss and damage from an accident at a selected hazardous facility in Mariupol Raion/city?*

2.1. What is the vulnerability and risk profile of populations and built assets in different neighborhoods in Mariupol city council?

a. *What are the main hazards that populations and assets are specifically or disproportionately exposed to in Mariupol city?*
b. *What are the population demographics and social vulnerabilities in different neighborhoods of the city?*
c. *What is the land use profile of the city?*
d. *What is the built environment profile of the city?*
e. *What is the risk profile* of populations and built assets in different neighbourhoods in Mariupol city?

3.1. What is the resilience profile of Mariupol City?

a. *How resilient is Mariupol City to natural and anthropogenic hazards, climate change, energy transition and conflict threats?*
b. *How resilient are small and medium enterprises (SMEs) to natural and anthropogenic hazards and shocks?*
c. *What are the key areas for action to support resilience building in Mariupol city*

[10] Vulnerability is defined as cumulative index of susceptibility, coping capacity and adaptive capacity indices.

[11] E.g., *sea level rise, coastal erosion, land subsidence, soil salinity, land degradation, air pollution, wildfires (including anthropogenic fires) and biodiversity loss*

[12] E.g., *heavy precipitation, flooding, drought, strong winds, heat waves and cold waves*

[13] E.g, heavy metals contamination of soils and water, hazardous industrial facilities, poor waste management, tailing dams and oil spills

ANNEX3: WORK PLAN

		April		May				June				July				August	
#	Activity	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2
1	Research design &SDR																
2	Drafting of ToR																
3	Data collection																
4	Development of report template (InDesign)																
5	Data analysis																
6	Output drafting																
7	Output review &Validation																
8	Output published																
9	Dissemination/final presentation																
10	M&E, lessons learned																