



UKRAINE

**Residential building damage assessment
Mykolaiv, July-September 2022**

Funded by:



Partners:



ACTED

Cover images: World-View 3 satellite image (Maxar Technologies) of residential buildings after damage in Mykolaiv City (Mykolaivska oblast, Ukraine) acquired on 17 September 2022.

ABOUT REACH:

REACH is a leading humanitarian initiative providing granular data, timely information and in-depth analysis from contexts of crisis, disaster and displacement. The work of REACH directly feeds into aid response and decision-making by providing accessible and precise information on the humanitarian situation of crisis-affected populations.

Created in 2010, REACH is a joint initiative of IMPACT Initiatives, ACTED and the United Nations Operational Satellite Applications Programme (UNOSAT). REACH activities are conducted in support and within the framework of inter-agency coordination mechanisms at field and global levels to enabling more efficient aid planning and response.

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Context

The city of Mykolaiv is a major urban centre in the south of Ukraine and the administrative centre of Mykolaiv Oblast. In the beginning of 2022, the city hosted 476,101 inhabitants.¹ With access to the Black Sea, an important shipbuilding industry and a major transportation hub (sea port, river port, commercial highway, railway junction and international airport), Mykolaiv holds strategic and economic importance for Ukraine.

Mykolaiv was an epicentre of Russia’s invasion of Ukraine from its beginning on the 24th of February 2022, with the Armed Forces of the Russian Federation first entering the city on the 26th of February.² Active fighting ensued in Mykolaiv and its surroundings until early April, when the Ukrainian Armed Forces regained control of the area.³ However, shelling on Mykolaiv continued on a nearly daily basis until mid-November 2022.⁴

As a result of hostilities, Mykolaiv suffered significant damage to residential buildings and infrastructure. All the city’s districts and surrounding settlements were affected to various degrees.⁵ Local authorities reported that the total damage was estimated at 852 million euros, of which damage to housing accounts for 400 million euros.⁶

In support of humanitarian response and reconstruction planning, IMPACT Initiatives conducted a detailed damage analysis to triangulate estimations and precisely locate the damage, determine damage severity and density, and estimate the number of affected residents.

Methodology

The City of Mykolaiv was selected for this assessment based on the intensity of hostilities within and around the city’s boundaries, the extend of reported residential damage, and the need to inform reconstruction planning in a timely manner. This factsheet covers the entirety of Mykolaiv City, namely Tsentralnyi, Ingulskiyi, Korabelnyi and Zavodskiyi districts.

Image 1 and 2: Examples of detected damage to residential buildings in Mykolaiv based on satellite imagery. Red circles depict buildings with clearly visible damage



This assessment adopts a similar methodological approach to that used for previous residential damage assessments conducted by REACH in **Chernihiv**⁷ (November 2022), **Izium**⁸ (October 2022) and **Irpin City**⁹ (July 2022). It entails the analysis of high-resolution satellite imagery (dated 17th September 2022 and acquired on the 19th of October 2022), triangulated with official information about population and spatial subdivisions of Mykolaiv city, as well as secondary data review. The analysis leverages REACH’s in partnership with the United Nations Satellite Centre (UNOSAT), which conducts pre- and post- inspection of high-resolution imagery provided by MAXAR Technologies (World-View and Geo-Eye satellites with 50cm spatial resolution) to detect damage to buildings in urban settlements. UNOSAT determines damage severity upon assessment of structural degradation, distinguishing between "possible", "moderate", "severe" and "destroyed" categories.

The identification of residential buildings and their subsequent classification into single-occupancy dwellings and multi-apartment buildings is based on visual inspection of buildings marked as damaged by UNOSAT via Google Street View mode in Google Earth. Every residential building labelled by UNOSAT as damaged or possibly damaged was considered as a damaged building. The same rule was applied to multi-apartment buildings (meaning that apartment buildings with only partial structural damage were considered as damaged).

The number of apartments units for each multi-apartment building was calculated based on their unique combination of floors and entrances through visual inspection in Google Street View. The number of apartments was multiplied by the average number of household members in Mykolaivska oblast (2.54 people, according to 2021 data from the State Statistics Services of Ukraine)¹⁰ to estimate the number of affected people.

Limitations

While satellite imagery is an effective method to estimate the degree of structural damage, it should be noted that light damage (e.g., broken windows) cannot always be detected.¹¹ The absence of up-to-date information on the number of people living in damaged buildings immediately prior to the impact also limits the accuracy of the estimates.



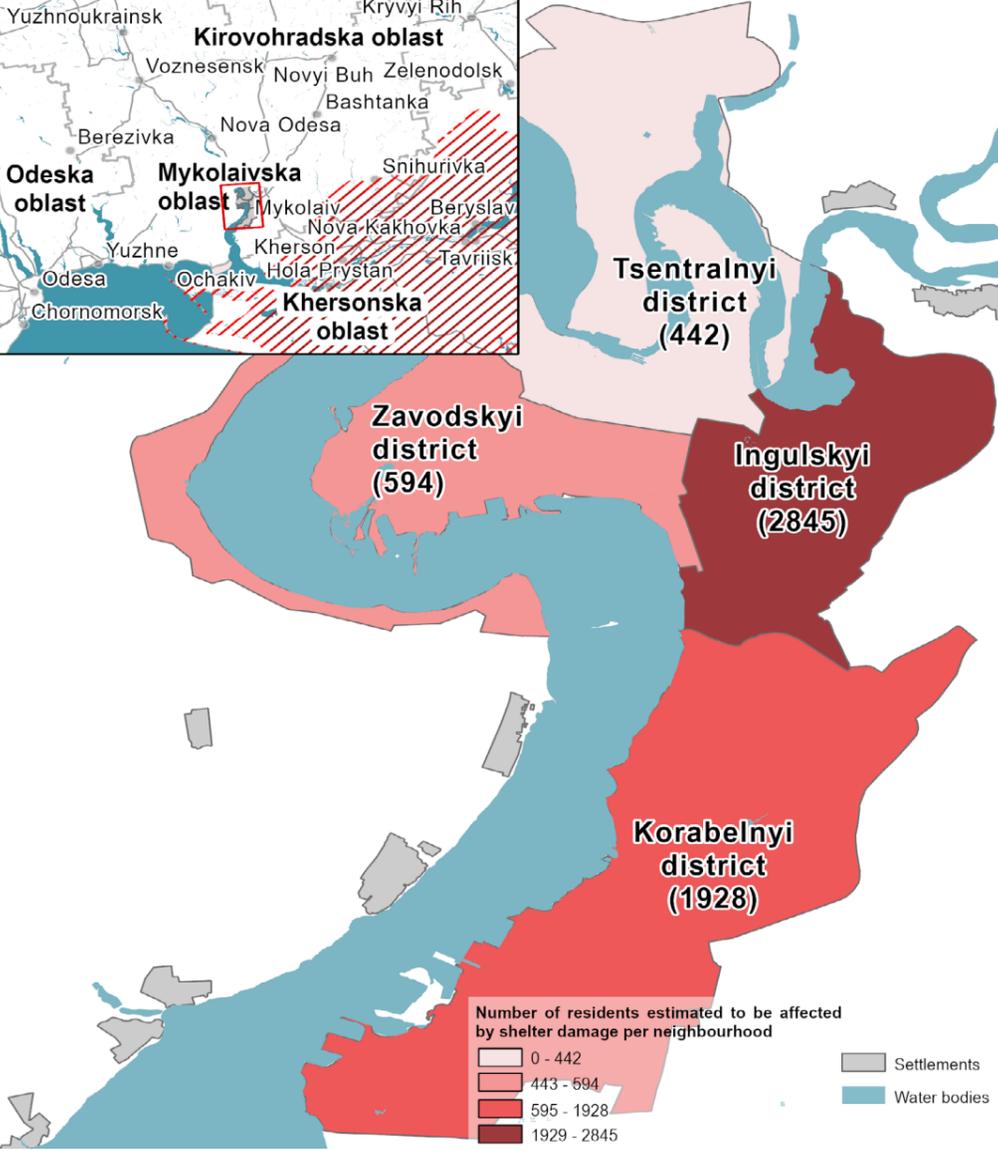
Key Findings

In total, damage was detected for 115 residential buildings, including 14 multi-apartment buildings and 101 single-occupancy dwellings. The majority of identified buildings (55%) fall into the “moderate”, “severe” and “destroyed” damage levels categories.

Throughout Mykolaiv, **5,809 residents are estimated** to have been affected by shelter damage. **The most affected areas are Ingulskiyi and Korabelnyi districts**, located in the eastern and south-eastern parts of Mykolaiv, near industrial facilities. While Ingulskiyi district suffered concentrated points of damage to major multi-apartment buildings (**2,845 estimated impacted people**), Korabelnyi district mainly experienced damage to single-occupancy dwellings over a wider area, with an **estimated 1,928 people affected**.

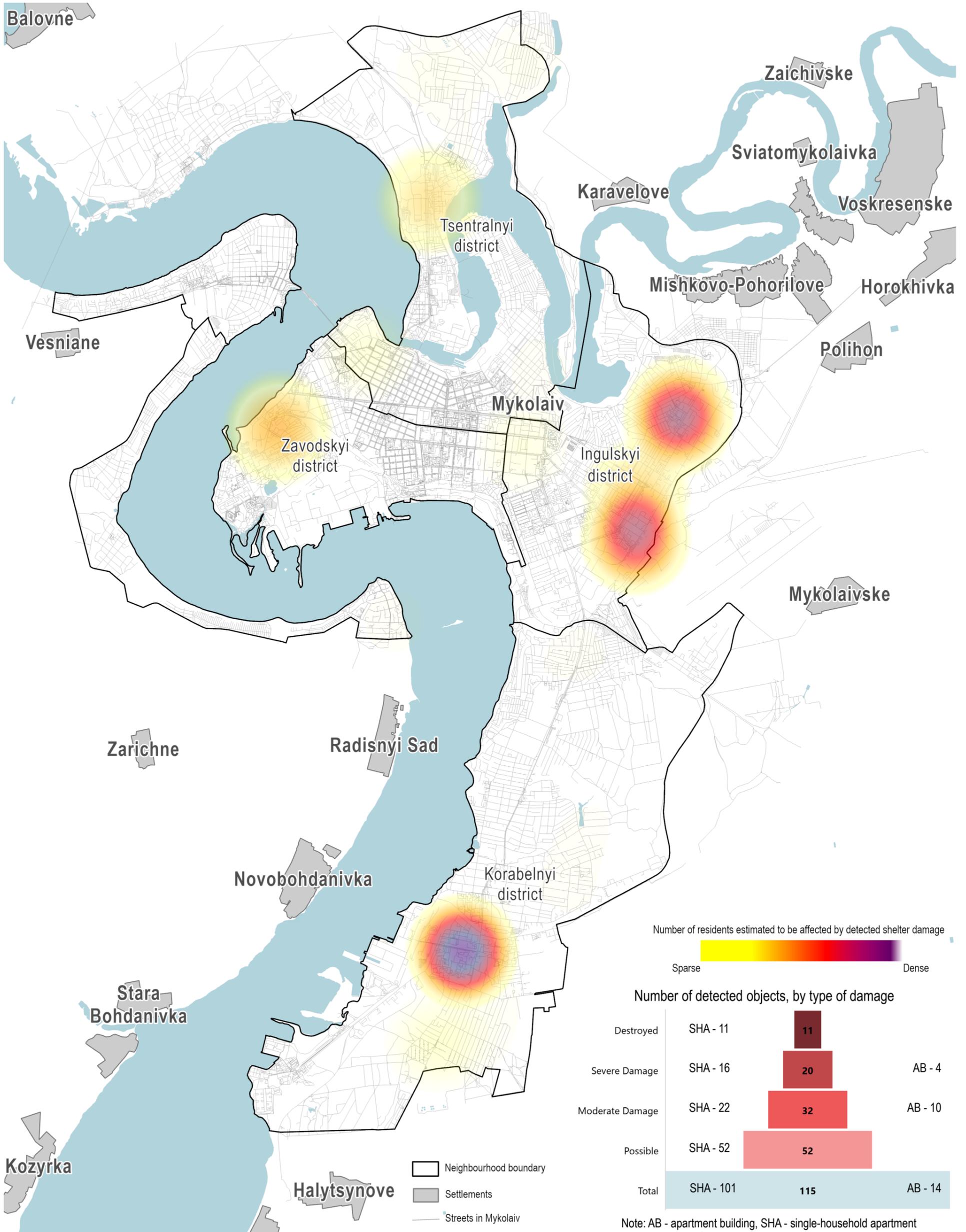
In Mykolaiv, the impacts of residential damage must be understood in the context of the broader humanitarian situation, severely compounded by damaged public infrastructure and disruption to essential services. In particular, damage to water-supply infrastructure resulted in reduced water availability and quality for a majority of its inhabitants.¹²

The map below depicts the estimated number of individuals affected by detected damage to residential buildings.



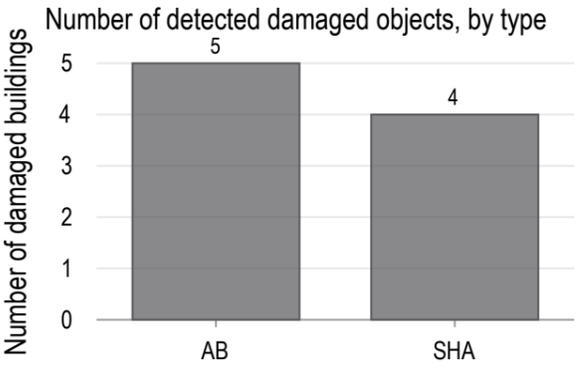
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Damage density map

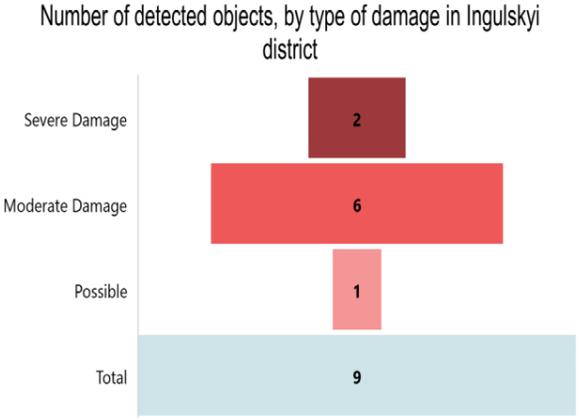
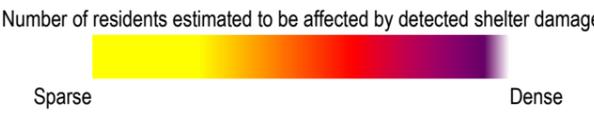


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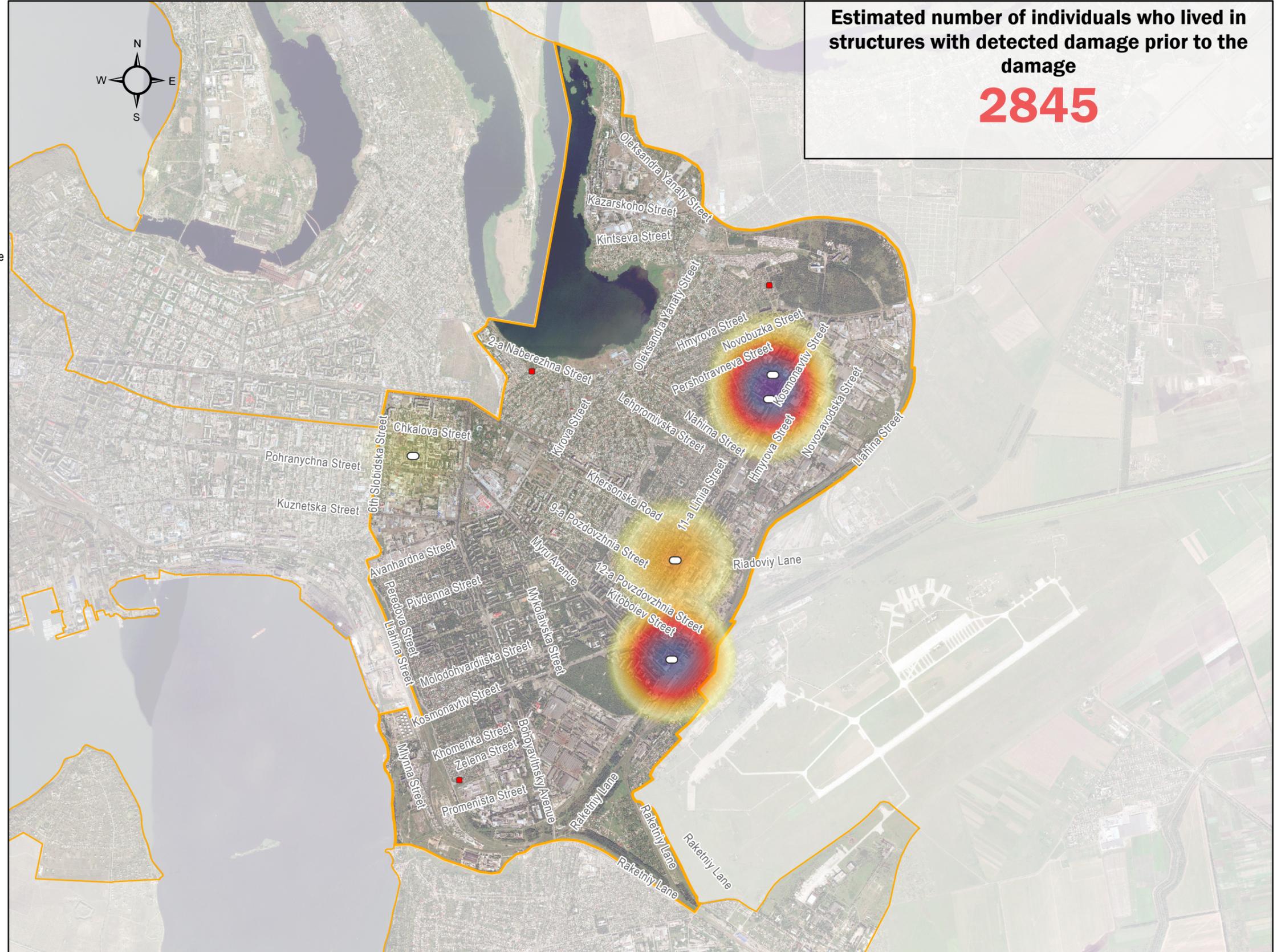
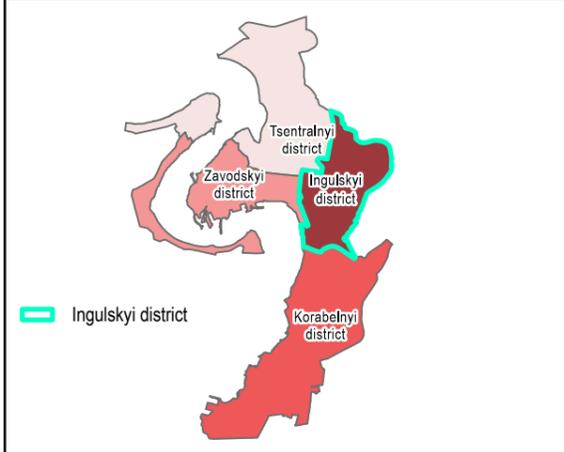
Ingul'skyi district



Note: AB - apartment building, SHA - single-household apartment



- Apartment building
- Single-household apartment
- Neighbourhood boundary

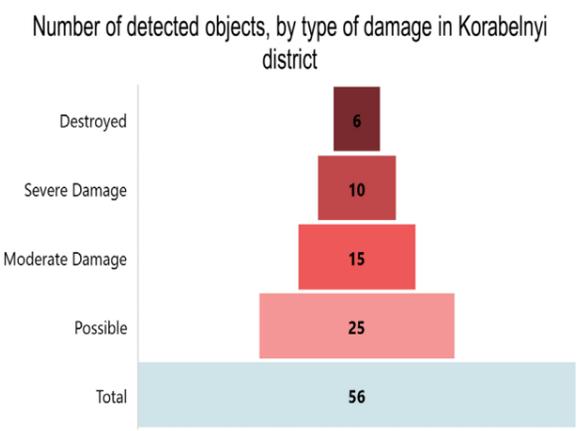
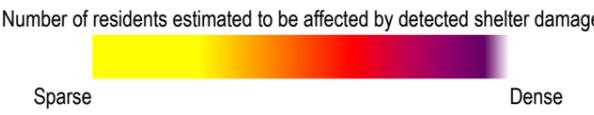
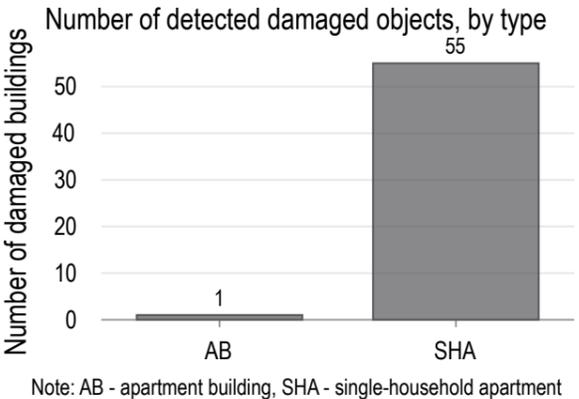


Estimated number of individuals who lived in structures with detected damage prior to the damage

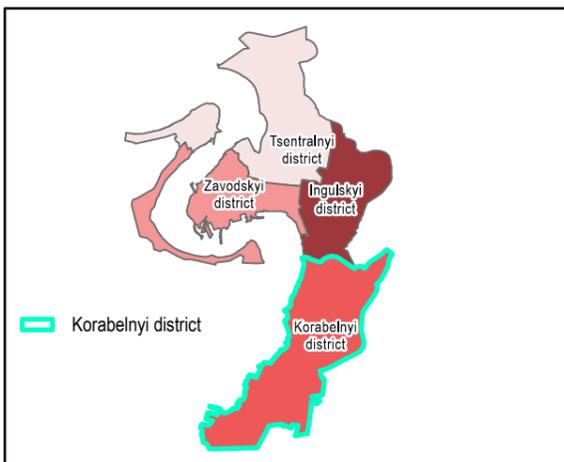
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Korabelnyi district

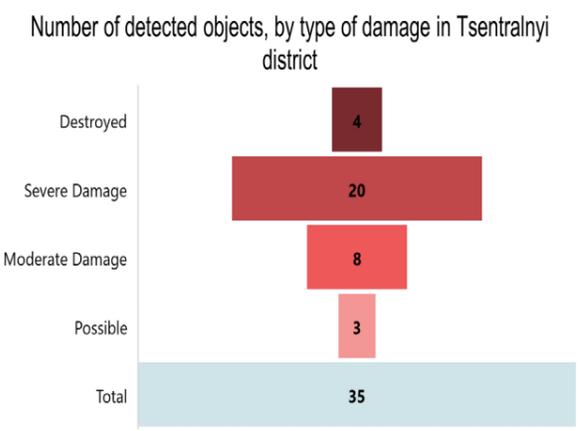
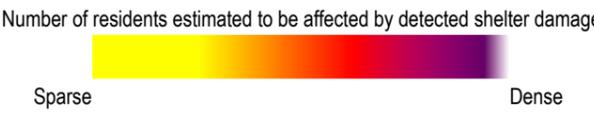
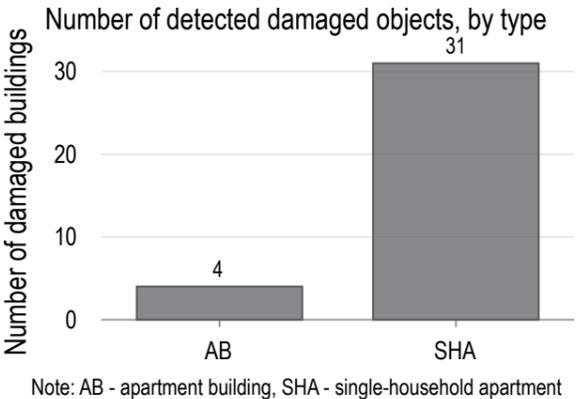


- Apartment building
- Single-household apartment
- Neighbourhood boundary

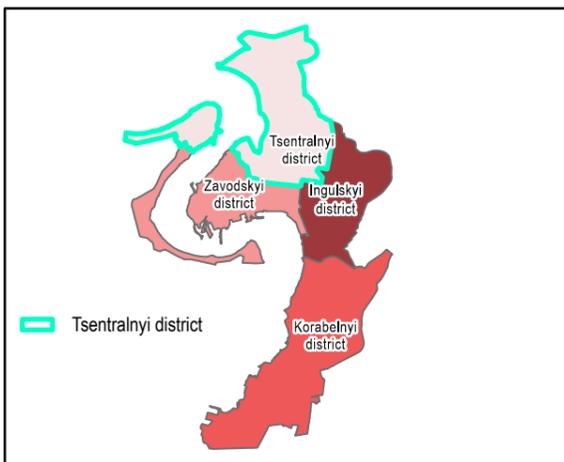


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Tsentralnyi district

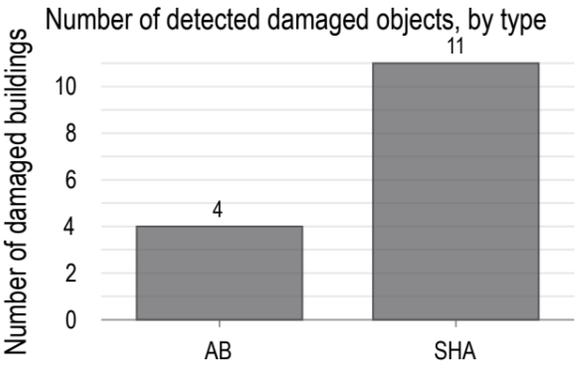


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- Single-household apartment
- Neighbourhood boundary

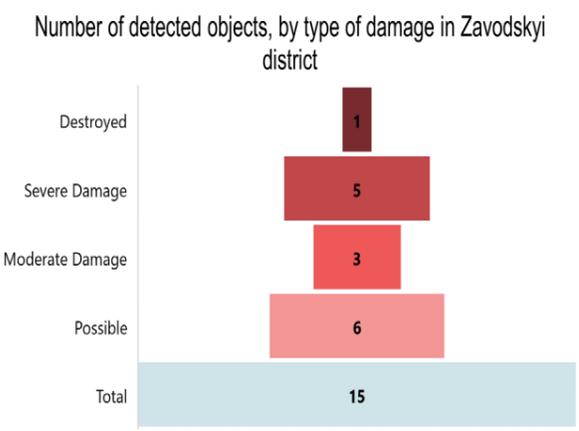


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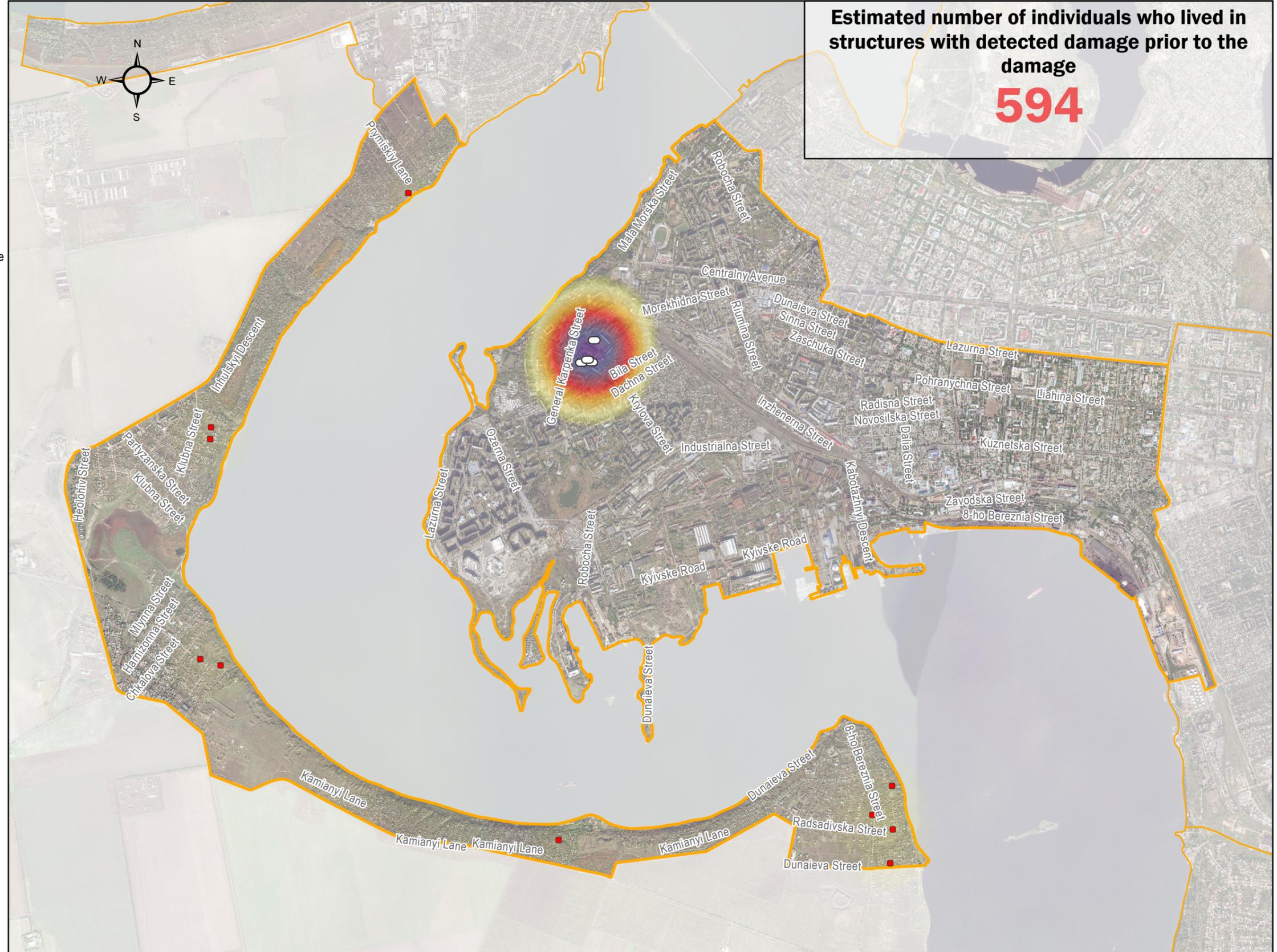
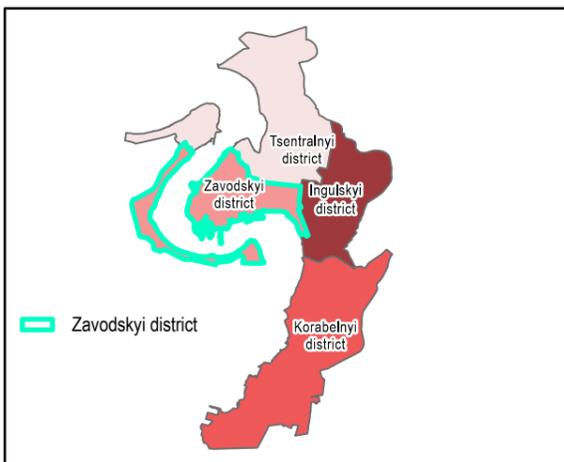
Zavodskiyi district



Note: AB - apartment building, SHA - single-household apartment



- Apartment building
- Single-household apartment
- Neighbourhood boundary



Reference List

- 1 State Statistics Service of Ukraine, **Number of Present Population of Ukraine**, January 2021.
- 2 Institute for the Study of War, **Russian Offensive Campaign Assessment**, 28 February 2022.
- 3 Wall Street, **Ukrainian Counteroffensive Near Mykolaiv Relieves Strategic Port City**, 18 March 2022.
- 4 Radio Free Europe, **House Collapses following shelling in Mykolaiv - Casualties are reported**, 11 November 2022 (Ukrainian).
- 5 Radio Free Europe/Radio Liberty, **"The situation is very bad. Every day something flies in, someone dies." The mayor of Mykolaiv about life in the city under shelling**, 24 June 2022.
- 6 Mykolaiv City Council, **Mykolaiv assesses damage caused by the Russian aggressor: the preliminary figure is 852 million euros**, 16 December 2022.
- 7 REACH, **Chernihiv Residential Damage Analysis**, November 2022.
- 8 REACH, **Izium Residential Damage Analysis**, October 2022.
- 9 REACH, **Irpın Residential Damage Analysis**, July 2022.
- 10 **State Statistics Service in Mykolaivska Oblast**, January 2021.
- 11 More advanced methods to assess and triangulate damage (e.g., drone surveys and 3-dimensional surface modeling) could not be employed for this assessment due to the prohibition of civil drone flights in areas in the vicinity of hostilities.
- 12 The Washington Post, **Salty, yellow water disgusts residents and breaks pipes in war-torn Mykolaiv**, 9 November 2022.

