UKRAINE

Residential building damage assessment Irpin, Kyivska oblast, February-March 2022

REACH Informing more effective humanitarian action

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Cover images: World-View 3 satellite image (Maxar Technologies) of residential buildings (before and after damage) in Irpin City (Kyivska oblast, Ukraine) acquired on 28 February 2022 and 31 March 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.

UKRAINE – Irpin residential damage assessment

Irpin, Kyivska oblast, February-March 2022

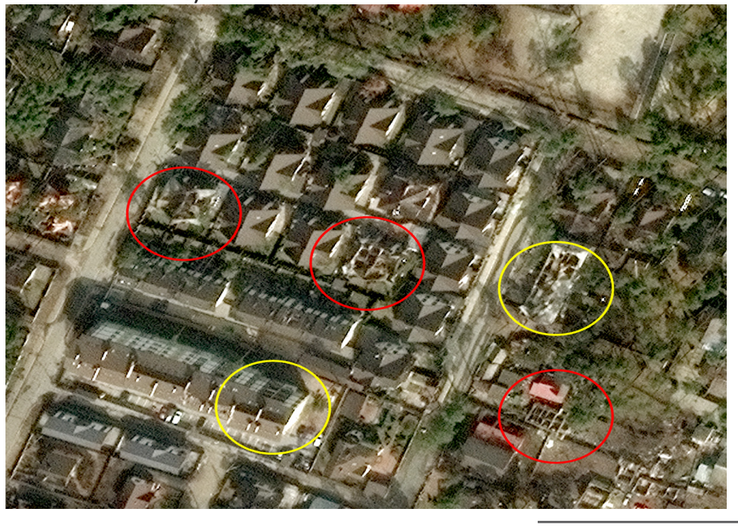
Context

Following the Russian invasion in Ukraine on the 24th of February, 2022, the suburbs in the northwest of Kyiv, Ukraine's capital city, were occupied and/or became battle grounds in late February. Through the end of March, hundreds of residential buildings were reportedly damaged, with various degrees of severity.[1]

Official estimates of damaged infrastructure (both residential and non-residential structures) based on field inspections remain rather scarse. According to official estimates, 70-75% of Irpin's buildings had been damaged, with at least 115 having been completely destroyed. An alternative look on situation with infrastructure's damage was applied by United Nations Satellite Centre (UNOSAT). They used high-resolution satellite imagery to assess a number of structures visually sustained damage or destruction.[2] More than 1,000 buildings (28%) were revealed to be damaged; most of them correspond to rather 'severe damage' or 'total destruction' than to 'moderate or possible damage' category (**Image 1 and 2**).

An assessment based on remote sensing data (i.e., satellite imagery) can provide not only the estimates of damaged structures' number, but additional insights of economic loss and harm to social well-being. However, light damage (e.g., broken windows) cannot easily be detected by two-dimensional satellite images. Another reliable source for damage estimates can be the imagery acquired during drone surveys and accompanied with three-dimensional surface models. A recent assessment for Irpin[3] revealed the substantial number of light damaged buildings and was a basis for the estimation of economic loss. Based on building construction prices, it reported the loss of 922 mln. USD and 48% of buildings being damaged.[4]

Image 1 and 2: Examples of detected damage to residential buildings in Irpin based on satellite imagery. Red circles - single-household apartments; Yellow circles - apartment buildings; Blue circle - town-house (a group of single-household apartments connected by the common sidewalls).



Methodology

This factsheet presents the estimated number of people who have been affected by damages to residential structures, based on remote sensing damage analysis conducted by UNOSAT with data from March 31st.[5] The identification of residential buildings and their subsequent classification into single-family homes and multiapartment buildings are based on visual inspection of buildings marked as damaged by UNOSAT, using pre and post-damage high-resolution imagery acquired by World-View satellite, and Google Street View mode in Google Earth.

Information on the number on the apartments in the multiapartment buildings was collected from two main sources: commercial website containing recently constructed apartment buildings LUN[6] and harnessing the prior knowledge for old apartment buildings. Old apartment buildings were visually inspected in Google Street View mode to estimate a combination of floors and entrances. For each unique combination of those floors and entrances a distinct number of apartments was assigned to the building.

A total number of apartments and single-family houses were multiplied by the average number of household members in Kyivska oblast (2.63 people) according to State Statistics Service of Ukraine (2021).[7] Every single-household apartment was assumed to have 2.63 people disregarding a size of such a house.

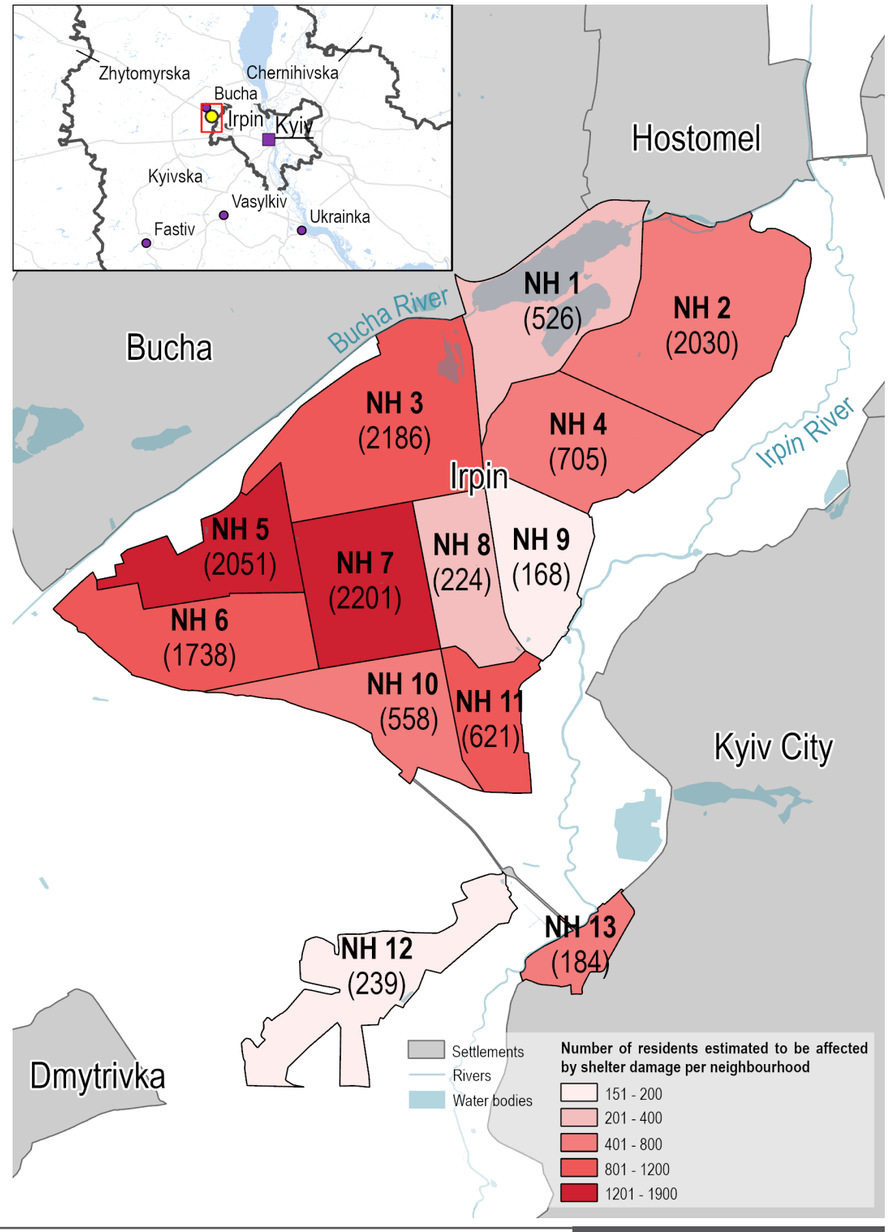
Every residential building labeled by UNOSAT as damaged (including the possible damage category) was considered as the entirely damaged building where all residents are affected by shelter damage The same rule was applied for large multiapartment buildings where only some part of structure possessed a certain damage visible on the satellite image.

In the absence of official and available information on neighbourhood divisions and other spatial subunits in Irpin, REACH used satellite imagery, city development plans, and street networks data extracted from OpenStreetMaps to draw neighbourhood demarcations (13 in total).

Key Findings

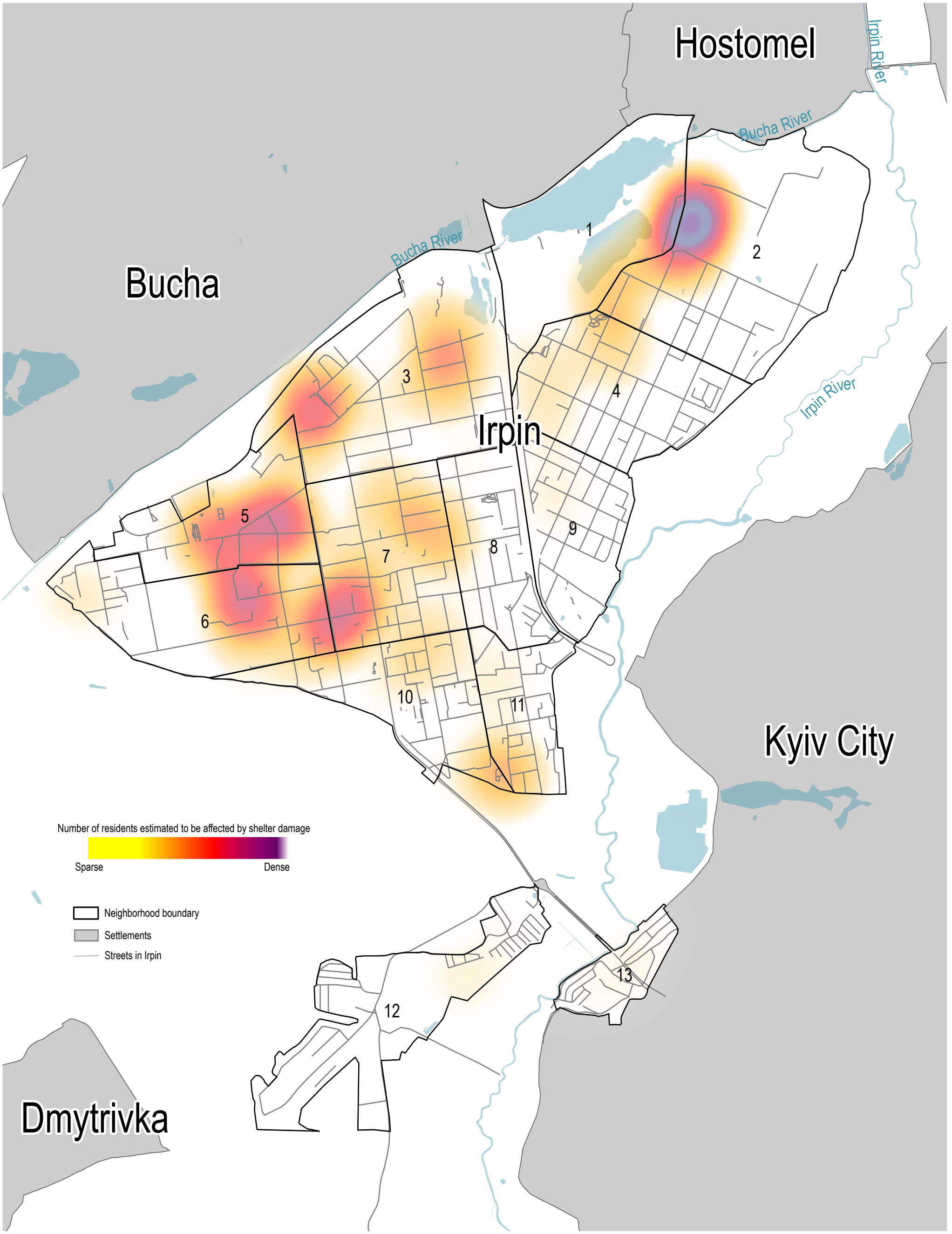
In total, at least **110 apartment buildings and 501 single-household houses** with visible damage were found in Irpin. There are estimated **13,431 people who lived in these residential buildings** and are affected by shelter damage. In 5/13 neighbourhoods, findings suggest that at least 1,000 people were affected by shelter damage, particularly residents of apartment buildings. Each of these neighbourhoods is located in the northern part of the city, close to the hotspots of the hostilities in February and March.

The image below depicts the estimated number of individuals affected by damage to residential buildings. Colors represent affected population weighted by neighbourhood area.



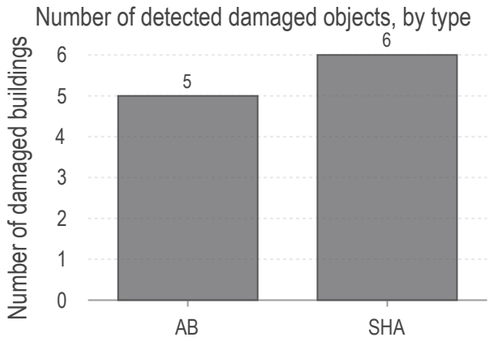
UKRAINE – Irpin residential damage assessment

Damage density map



UKRAINE – Irpin residential damage assessment

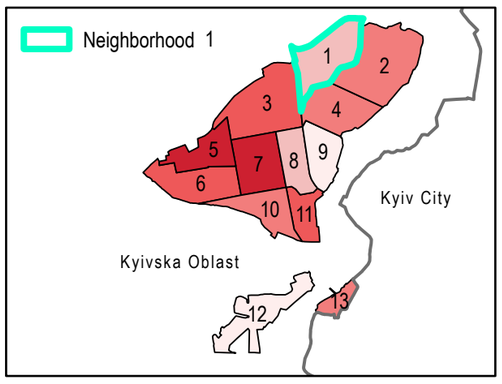
Neighborhood 1



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

Number of residents estimated to be affected by shelter damage

Sparse — Dense

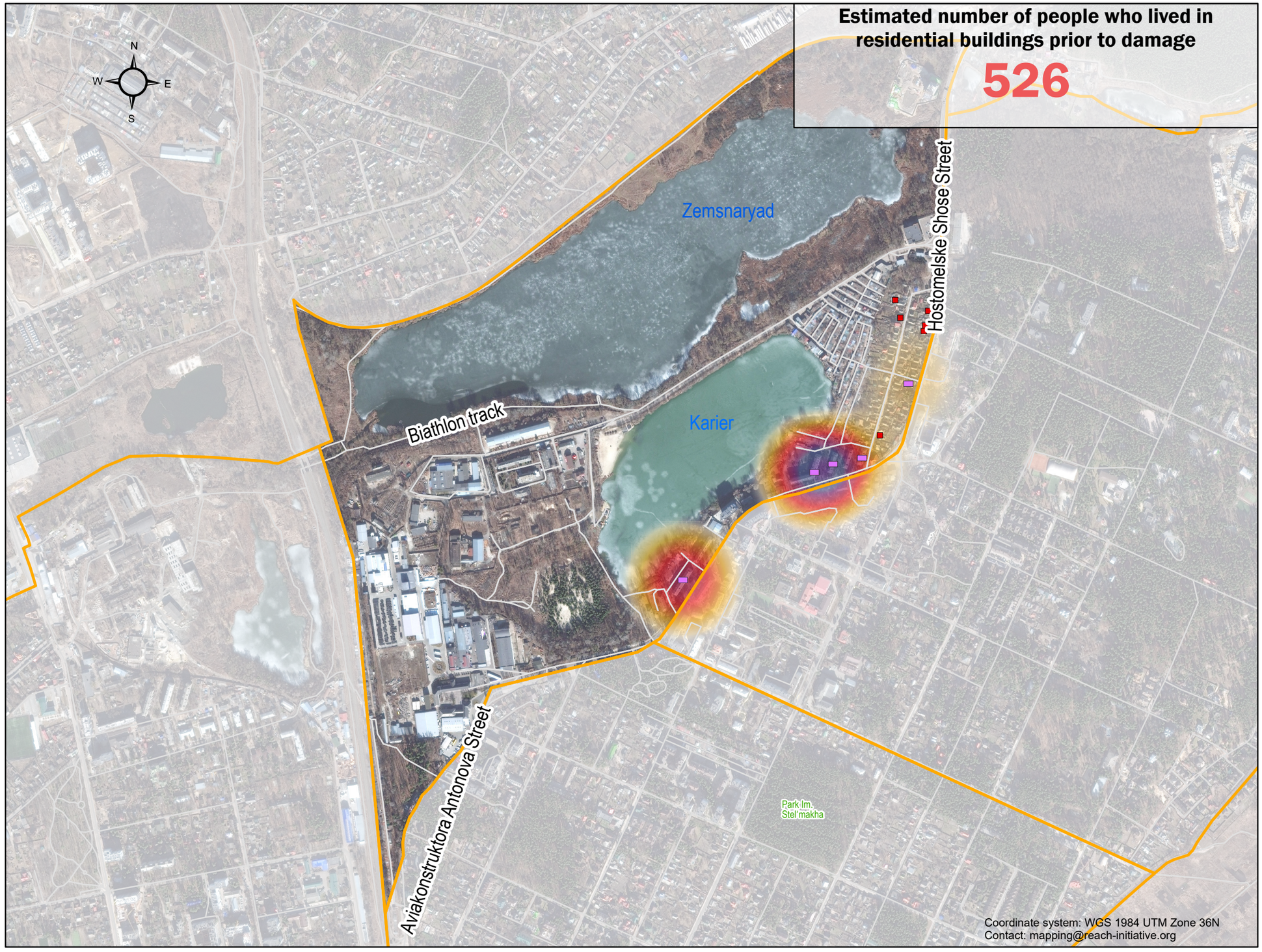


Single-household apartment

Apartment building

Neighborhood boundary

Oblast boundary



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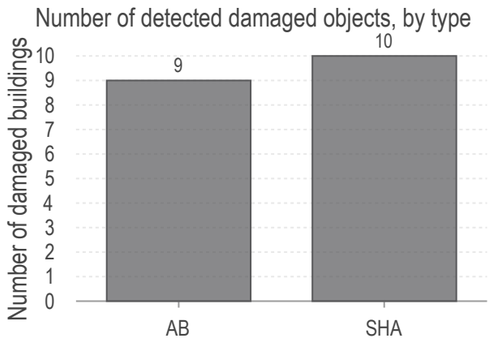
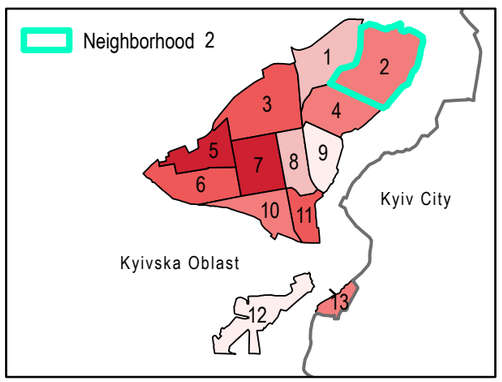
Neighborhood 2



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

Number of residents estimated to be affected by shelter damage

Sparse — Dense

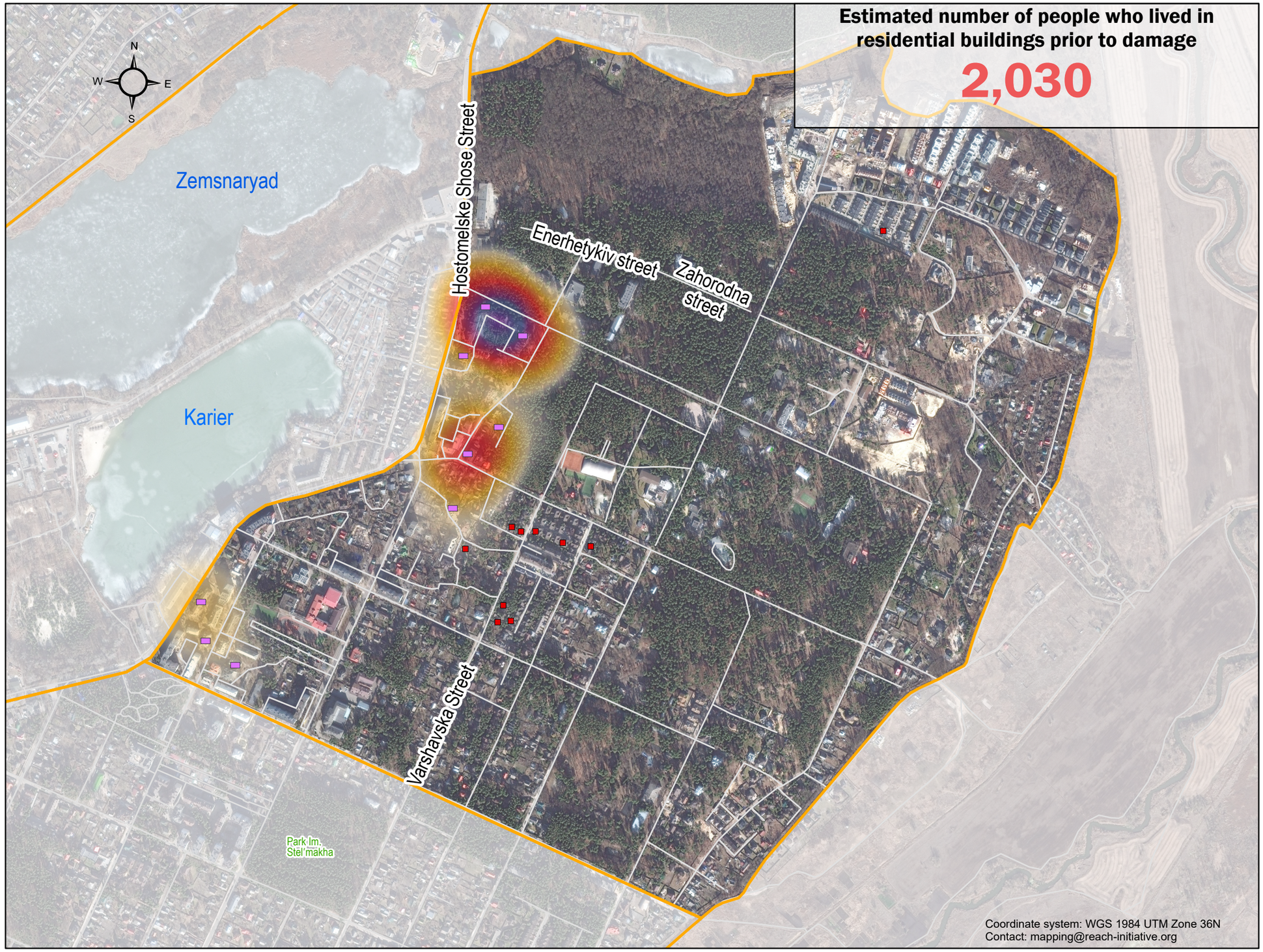


Single-household apartment

Apartment building

Neighborhood boundary

Oblast boundary



Coordinate system: WGS 1984 UTM Zone 36N
Contact: mapping@reach-initiative.org

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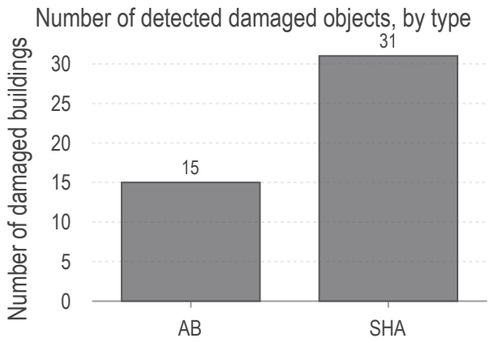
Neighborhood 3



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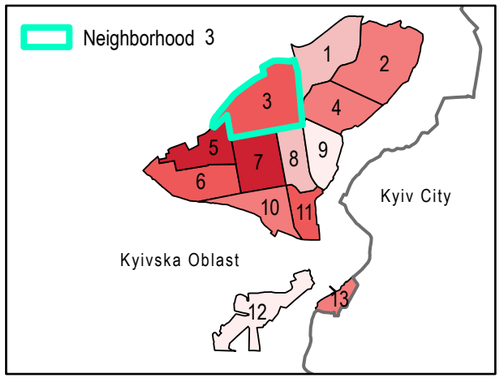
Number of residents estimated to be affected by shelter damage

Sparse — Dense

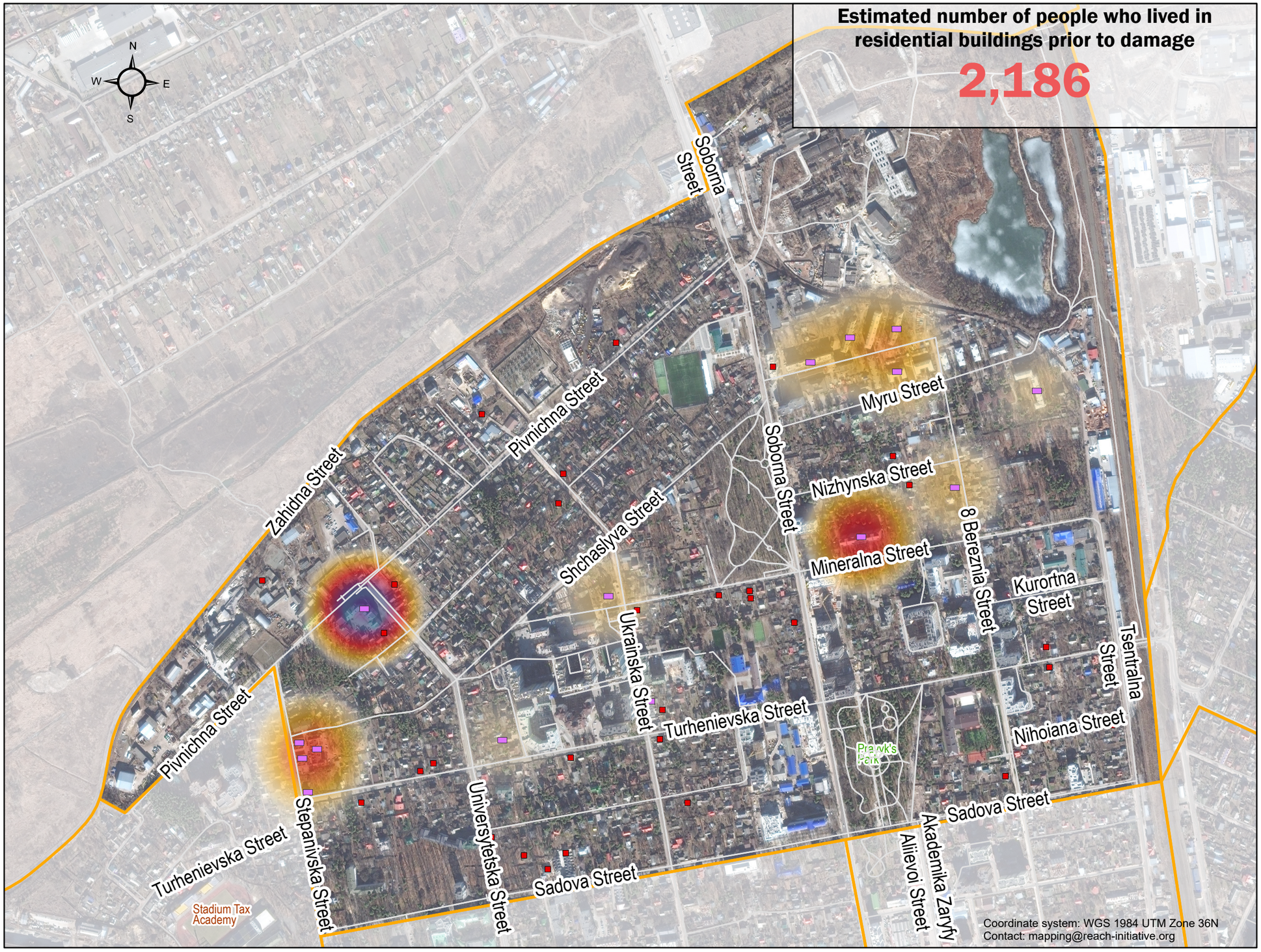


Single-household apartment

Apartment building

Neighborhood boundary

Oblast boundary



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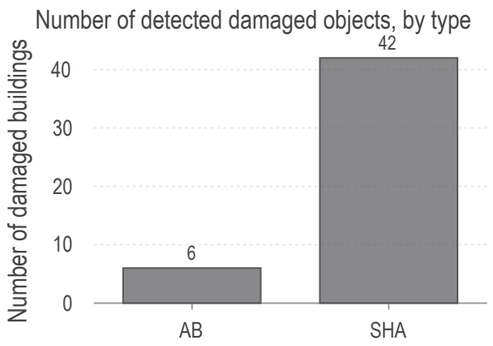
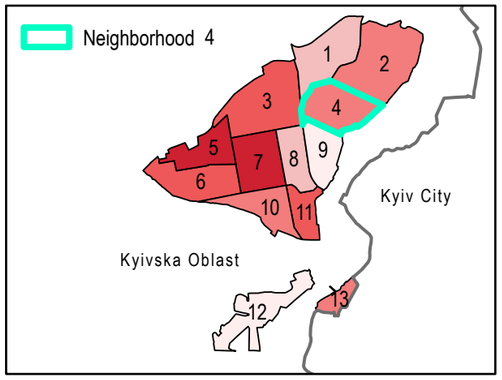
Neighborhood 4



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

Number of residents estimated to be affected by shelter damage

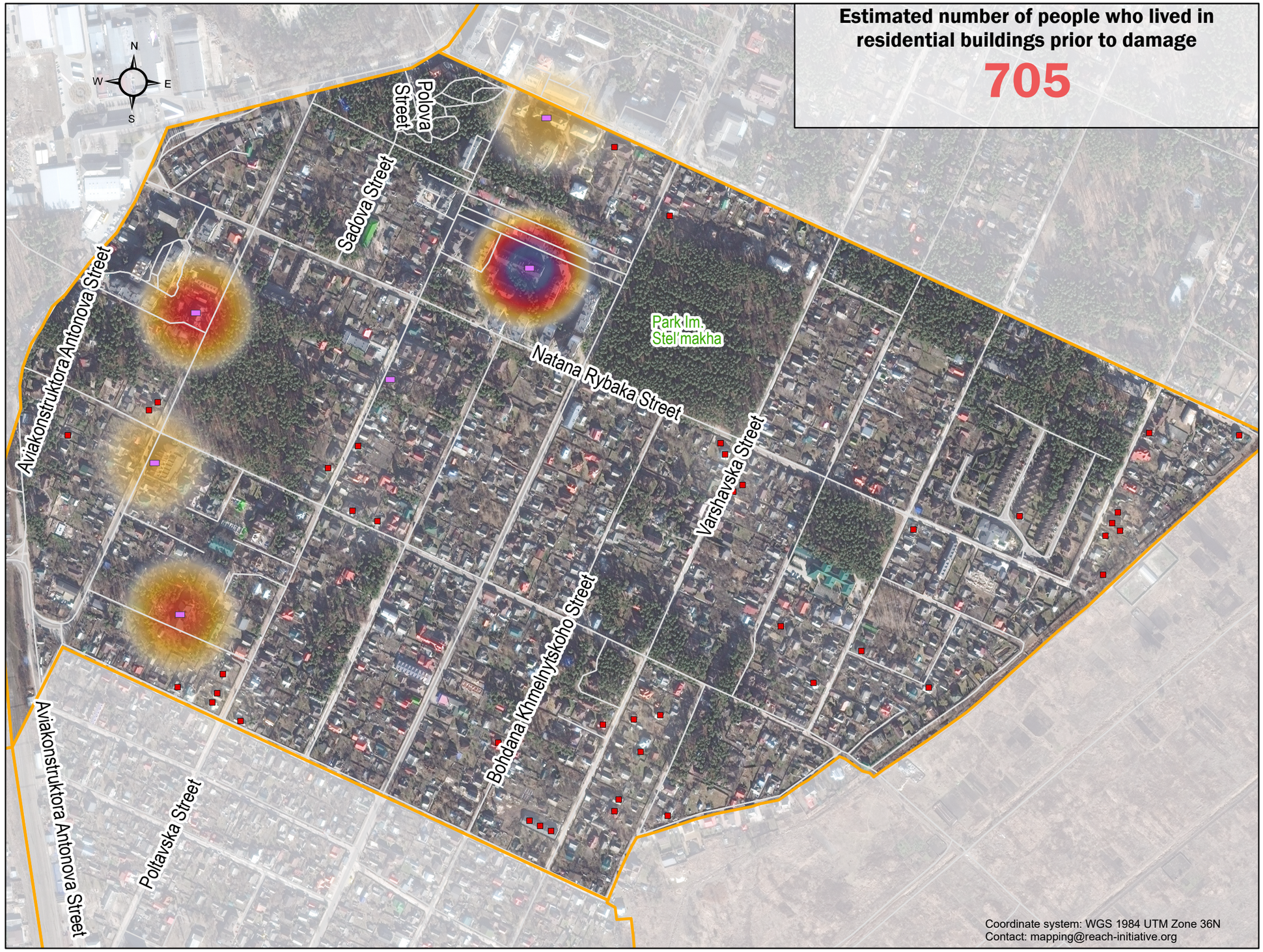
Sparse — Dense



- Single-household apartment
- Apartment building
- Neighborhood boundary
- Oblast boundary

Estimated number of people who lived in residential buildings prior to damage

705



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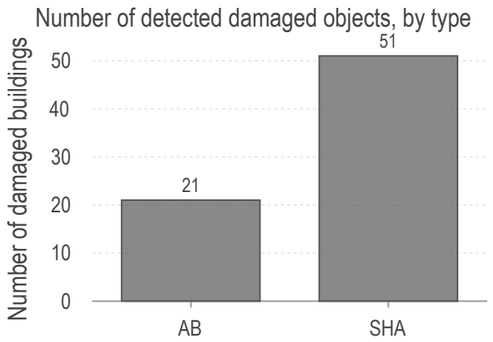
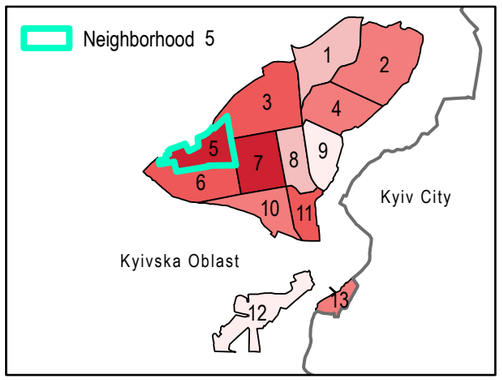
Neighborhood 5



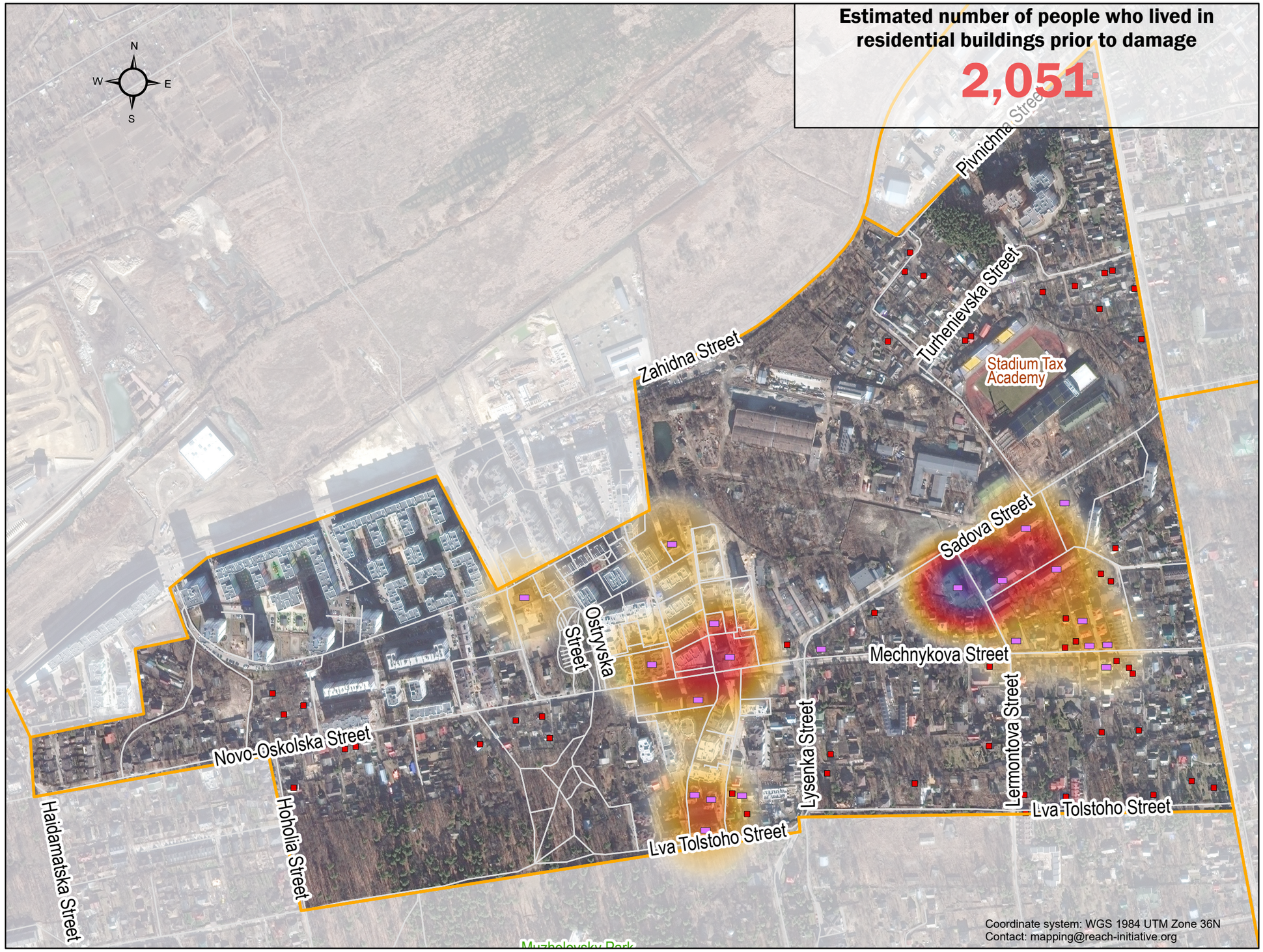
Note: AB - apartment building, SHA - single-household apartment

Number of residents estimated to be affected by shelter damage

Sparse — Dense



- Single-household apartment
- Apartment building
- Neighborhood boundary
- Oblast boundary



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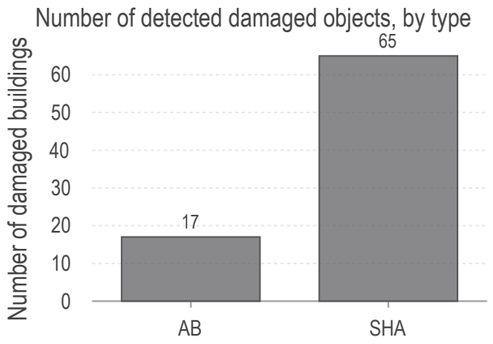
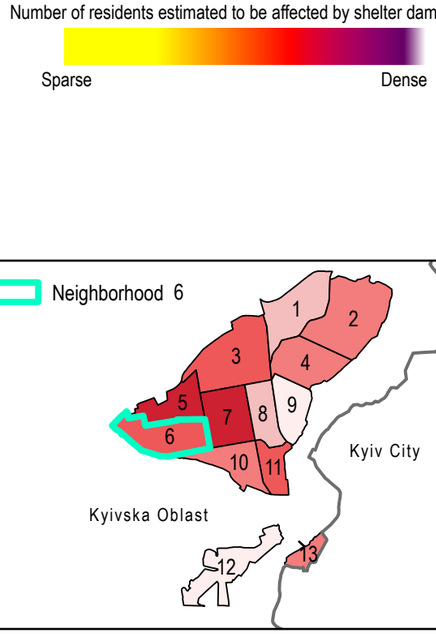
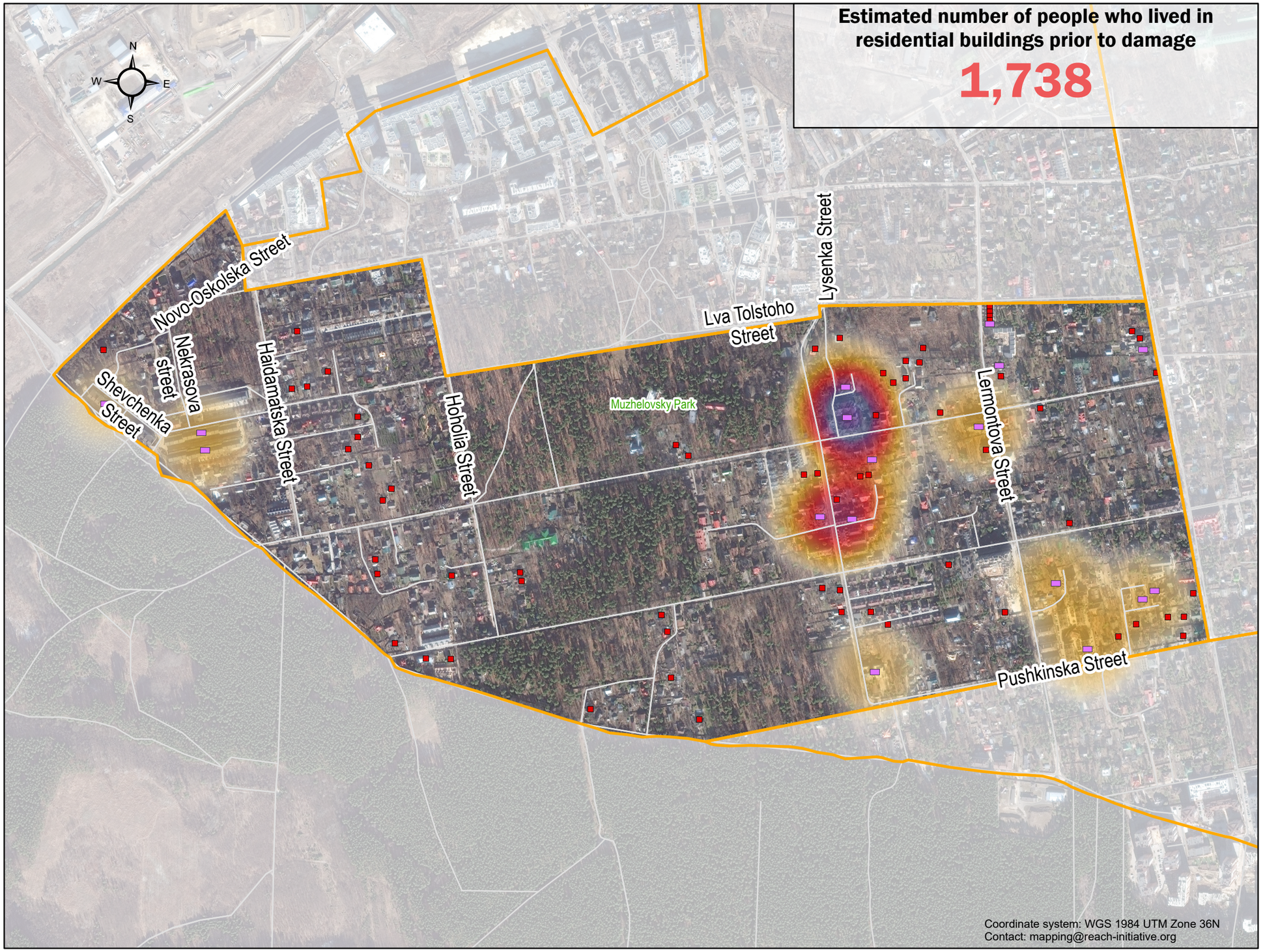
Neighborhood 6



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





Number of residents estimated to be affected by shelter damage

Sparse — Dense

Single-household apartment

Apartment building

Neighborhood boundary

Oblast boundary

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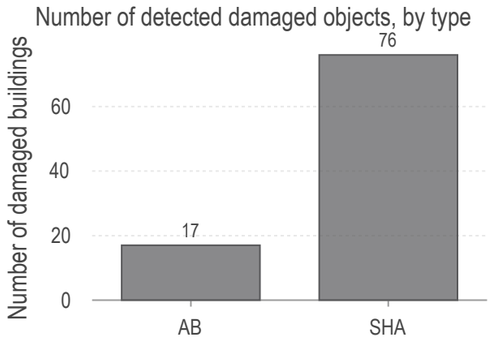
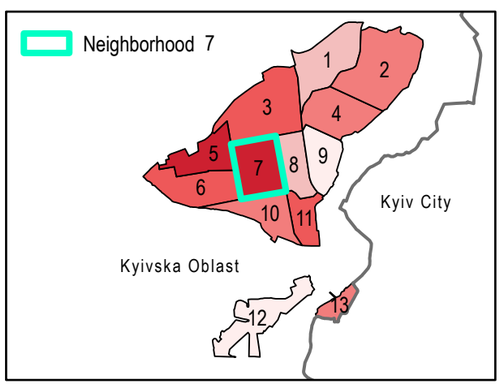
Neighborhood 7



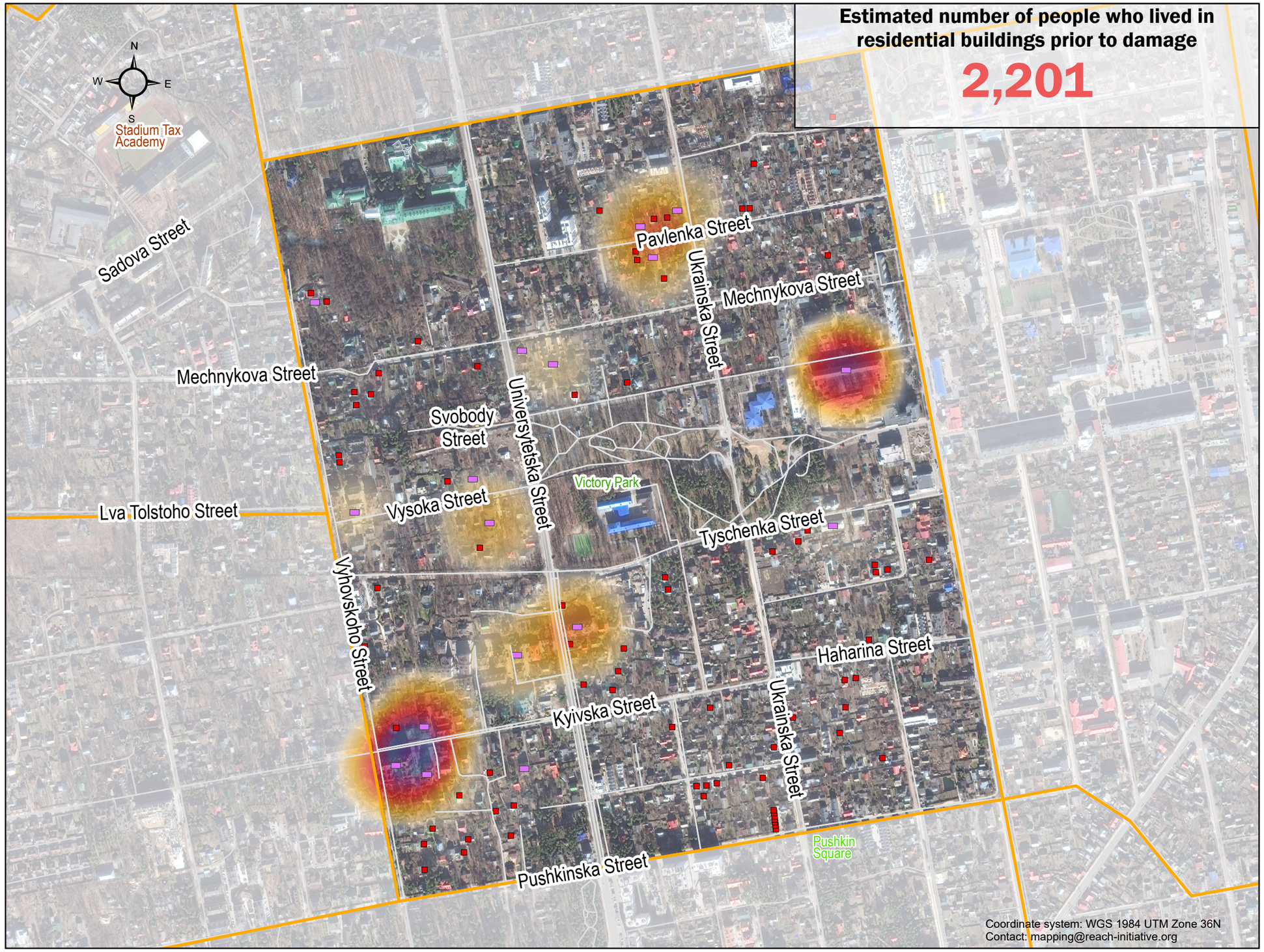
Note: AB - apartment building, SHA - single-household apartment

Number of residents estimated to be affected by shelter damage

Sparse — Dense



Single-household apartment
Apartment building
Neighborhood boundary
Oblast boundary



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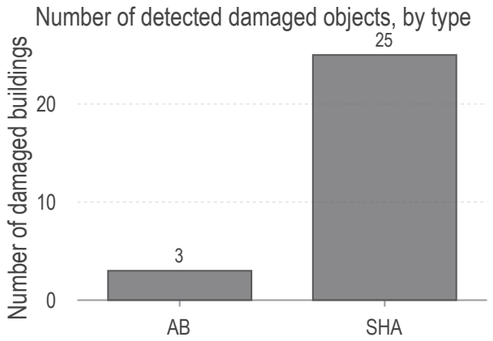
Neighborhood 8



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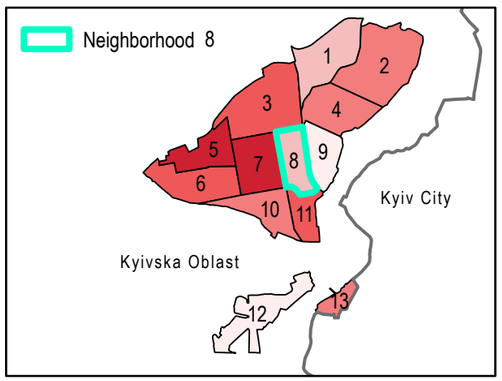
Number of residents estimated to be affected by shelter damage

Sparse — Dense

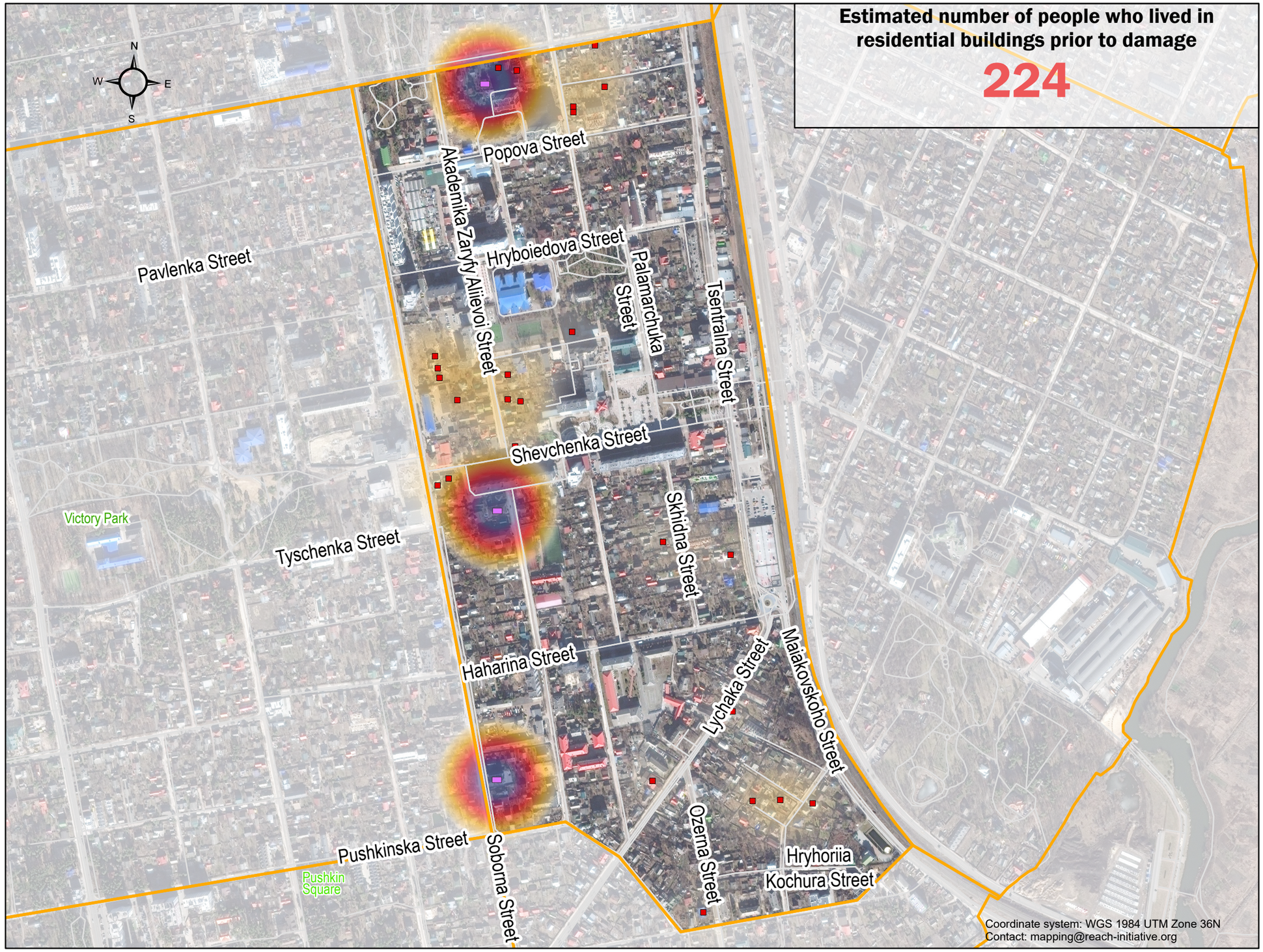


Single-household apartment

Apartment building

Neighborhood boundary

Oblast boundary



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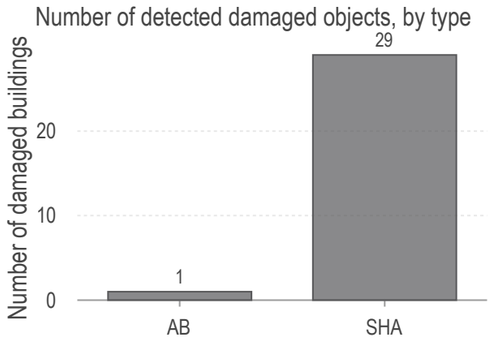
Neighborhood 9



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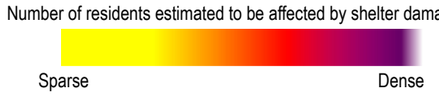

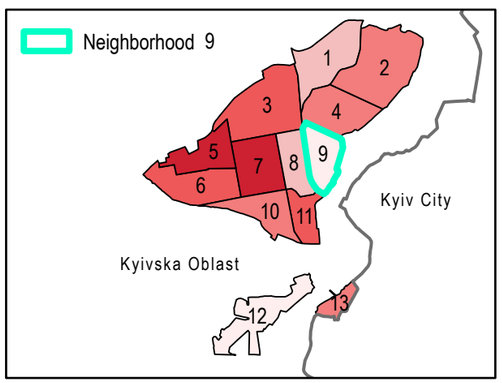

Single-household apartment

Apartment building

Neighborhood boundary

Oblast boundary

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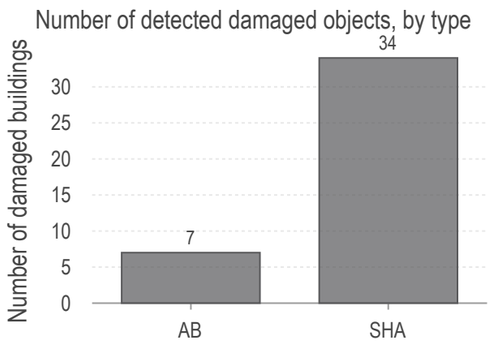
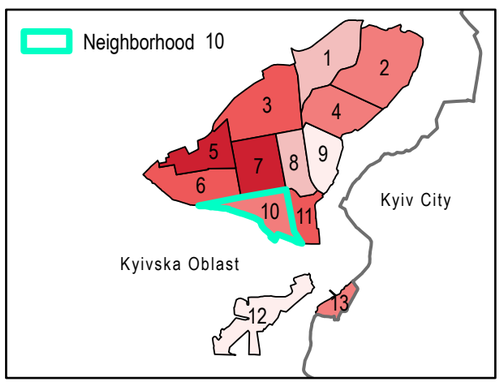
UKRAINE – Irpin residential damage assessment
Neighborhood 10



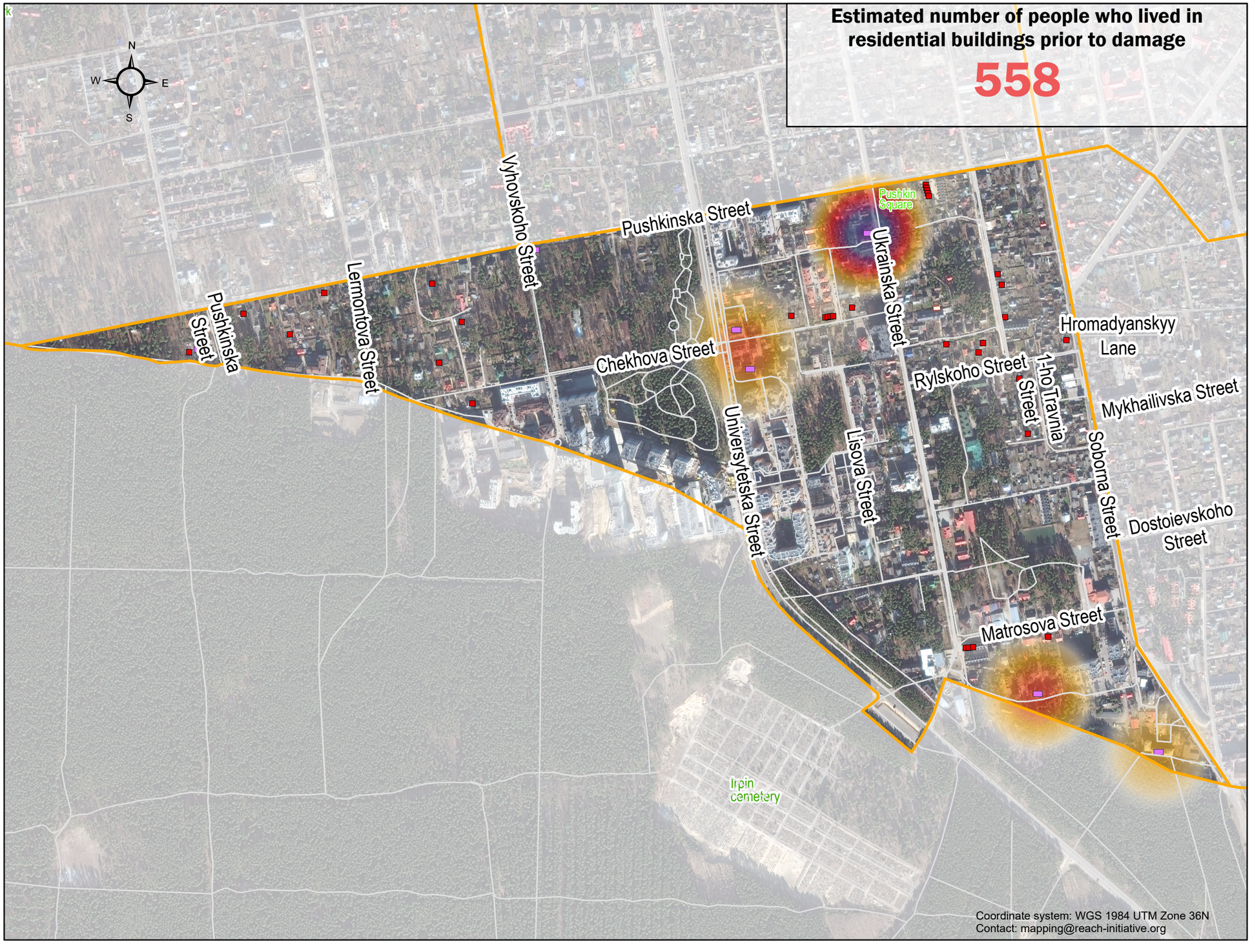
Note: AB - apartment building, SHA - single-household apartment

Number of residents estimated to be affected by shelter damage

Sparse — Dense



Single-household apartment
Apartment building
Neighborhood boundary
Oblast boundary



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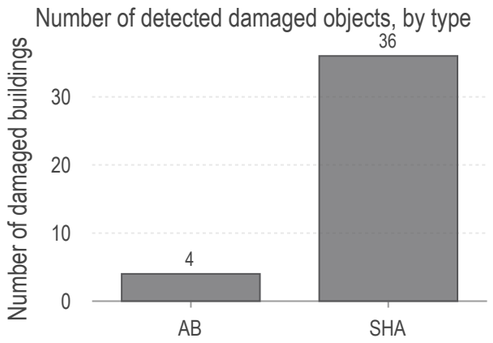
UKRAINE – Irpin residential damage assessment

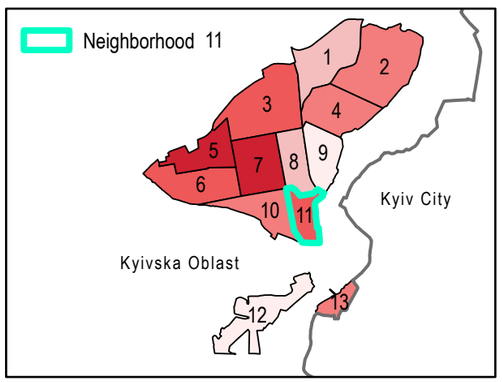
Neighborhood 11



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

Number of residents estimated to be affected by shelter damage

Sparse — Dense

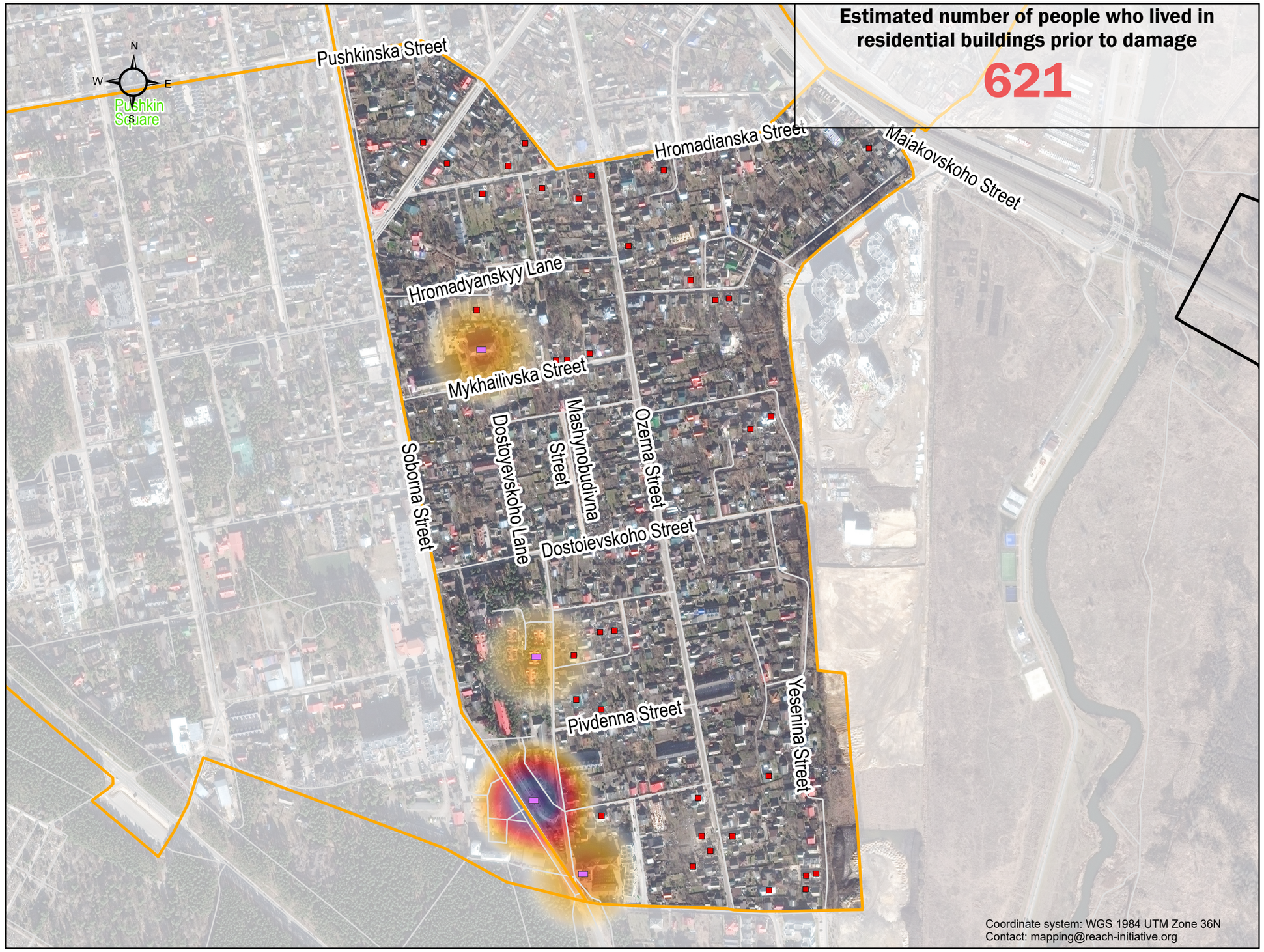


Single-household apartment

Apartment building

Neighborhood boundary

Oblast boundary



Coordinate system: WGS 1984 UTM Zone 36N

Contact: mapping@reach-initiative.org

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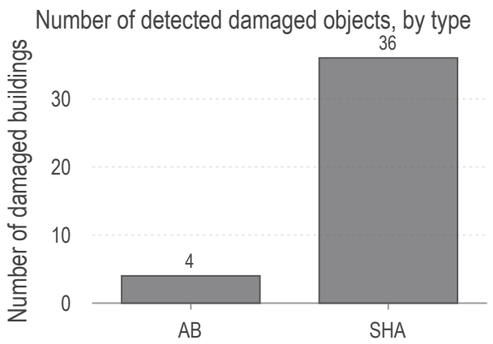
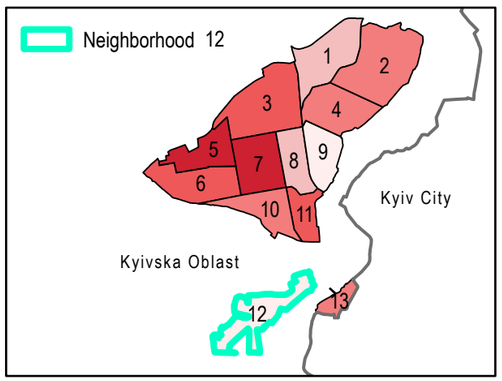
UKRAINE – Irpin residential damage assessment
Neighborhood 12



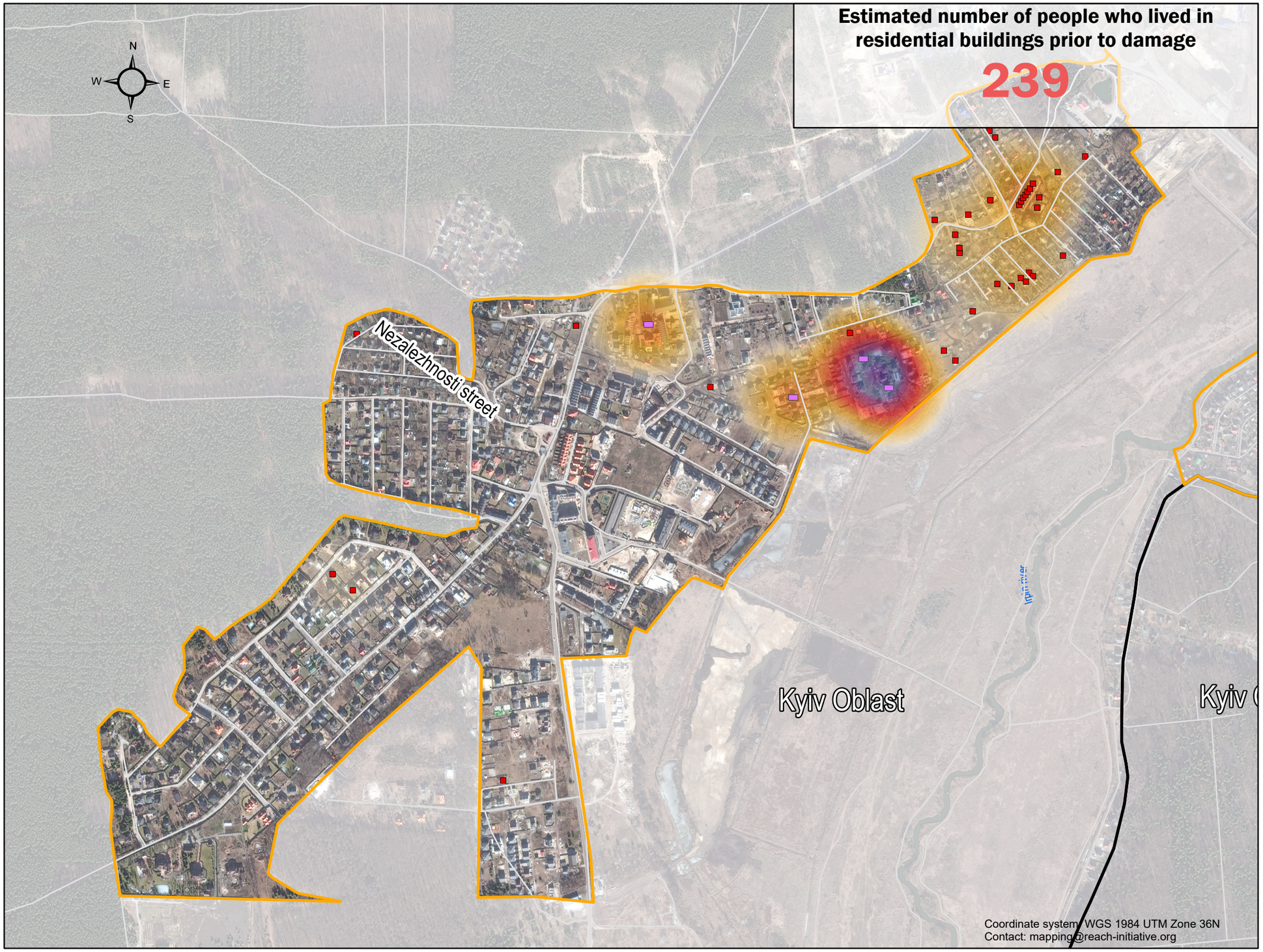
Note: AB - apartment building, SHA - single-household apartment

Number of residents estimated to be affected by shelter damage

Sparse — Dense



Single-household apartment
Apartment building
Neighborhood boundary
Oblast boundary



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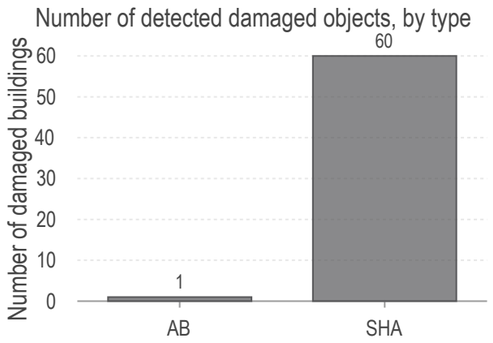
UKRAINE – Irpin residential damage assessment
Neighborhood 13



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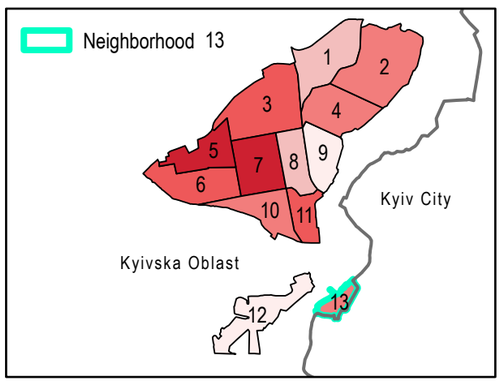
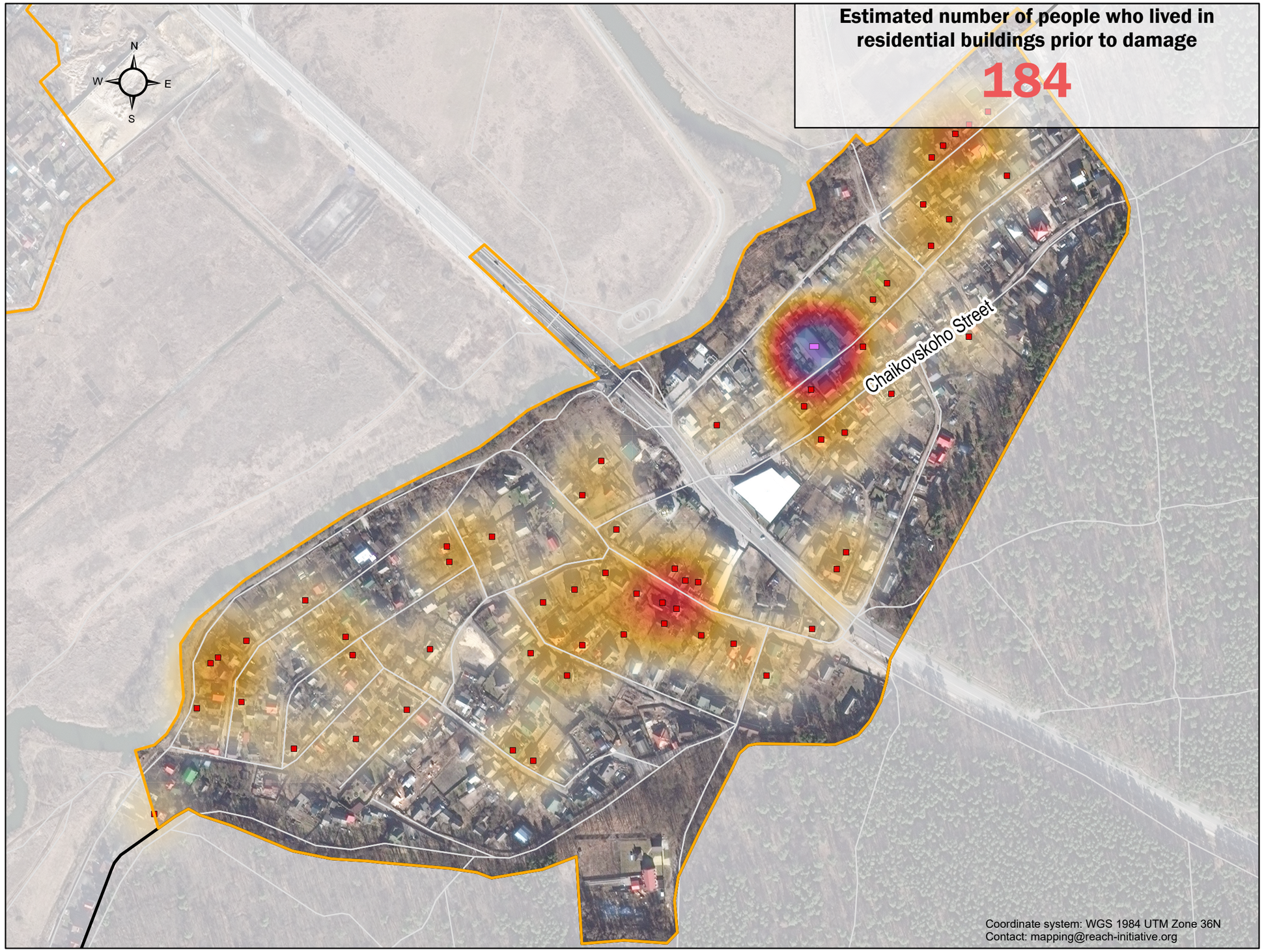
Sparse — Dense





Single-household apartment
Apartment building
Neighborhood boundary
Oblast boundary

Coordinate system: WGS 1984 UTM Zone 36N
Contact: mapping@reach-initiative.org

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Reference List

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2 Sundries, **More Than 1,000 Buildings In Irpin Were Damaged: 115 Were Completely Destroyed**, 15 April 2022
3 Rebuild.UA, **Irpin City Damage Analysis**
4 Mind, **Infrastructure damages in Irpin reach almost $922 million – KSE Institute**, 14 July 2022
5 UNOSAT, **Irpin Imagery Analysis v.2**, 18 April 2022
6 **LUN**
7 **State Statistics Service in Kyivska Oblast**

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