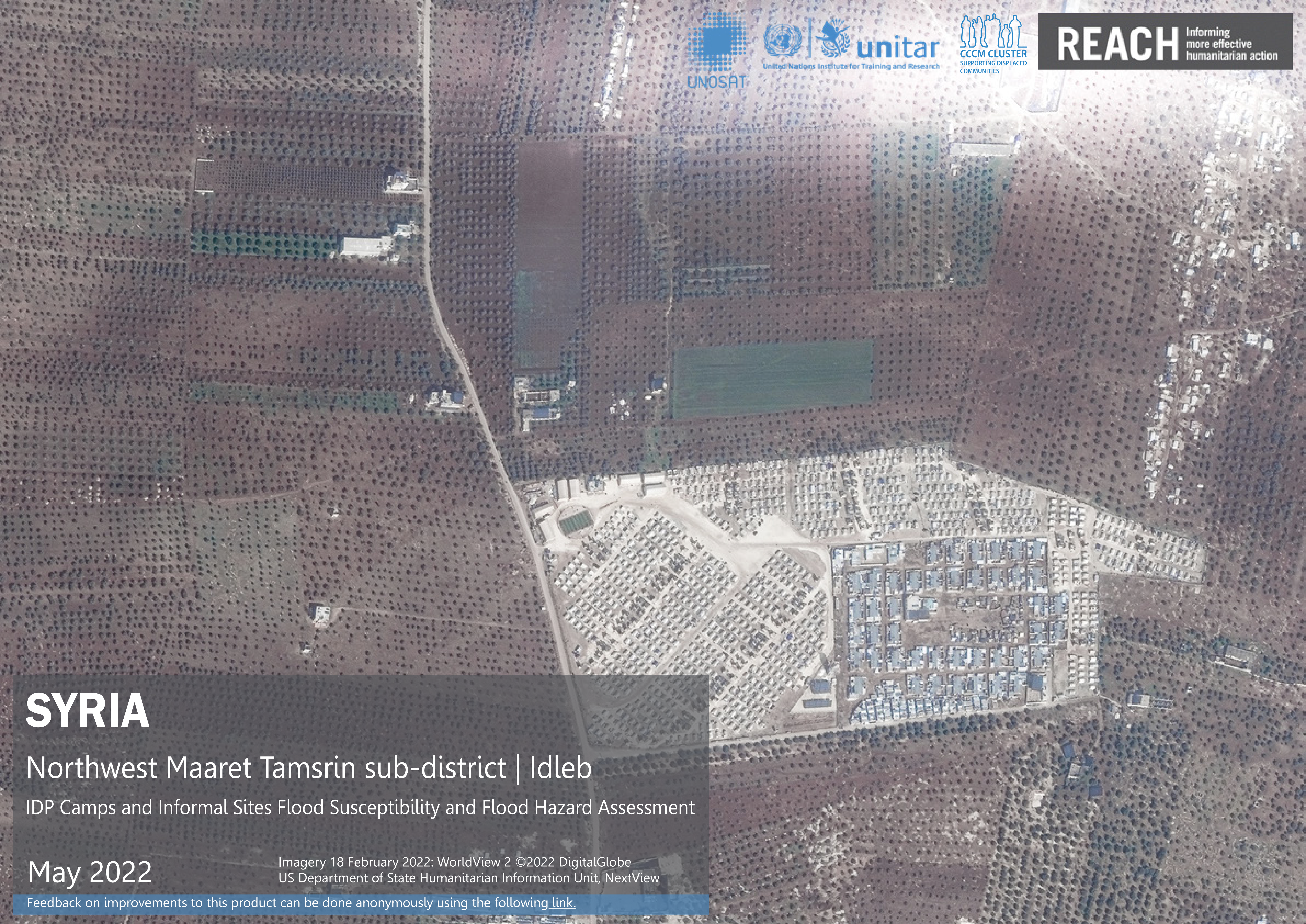


SYRIA

Northwest Maaret Tamsrin sub-district | Idleb

IDP Camps and Informal Sites Flood Susceptibility and Flood Hazard Assessment

May 2022

Imagery 18 February 2022: WorldView 2 ©2022 DigitalGlobe
US Department of State Humanitarian Information Unit, NextView

Feedback on improvements to this product can be done anonymously using the following link.

CONTEXT

In Northwest Syria, winter storms have the potential to generate devastating floods, which have a disproportionate effect on internally displaced persons (IDPs) living in camps and informal sites. Recurrent heavy rain and snowstorms between 18 and 31 January 2022 generated widespread flooding throughout northwest Syria, affecting an estimated 250,000 IDPs. More than 287 camps and sites throughout the governorates of Idleb and Aleppo were impacted by the floods, 10,000 tents have been destroyed or damaged[1], with many roads leading to the camps cut off by heavy rains.[3] Thousands of households were forced to seek shelter in schools, mosques, and open spaces where winter temperatures dipped below freezing point.[4]

Winter flooding within IDP camps and sites throughout Idleb and western Aleppo has been a recurrent problem for several years, the recent devastation suffered by vulnerable populations in these locations is tragically only the most recent example following many similar previous events in the past. In November 2016, camps in Maaret Tamsrin sub-district were impacted by flooding, which inundated tents and accessways, causing destruction of property and movement difficulties.[5] In December 2018, another severe storm resulted in widespread flooding throughout Idleb and Aleppo, and damage to tents and property was reported in more than 60 camps.[6] Again, in March 2019, heavy rainfall caused severe flash flooding in the region, damaging road infrastructure and destroying food stocks.[7] In June 2020, heavy rain in Maaret Tamsrin sub-district caused severe flooding, resulting in the loss of three lives at least,[8] as heavy rains turned IDP camps into 'lakes'[9] and reportedly destroyed hundreds of shelters, putting sanitation facilities out of service.[10]

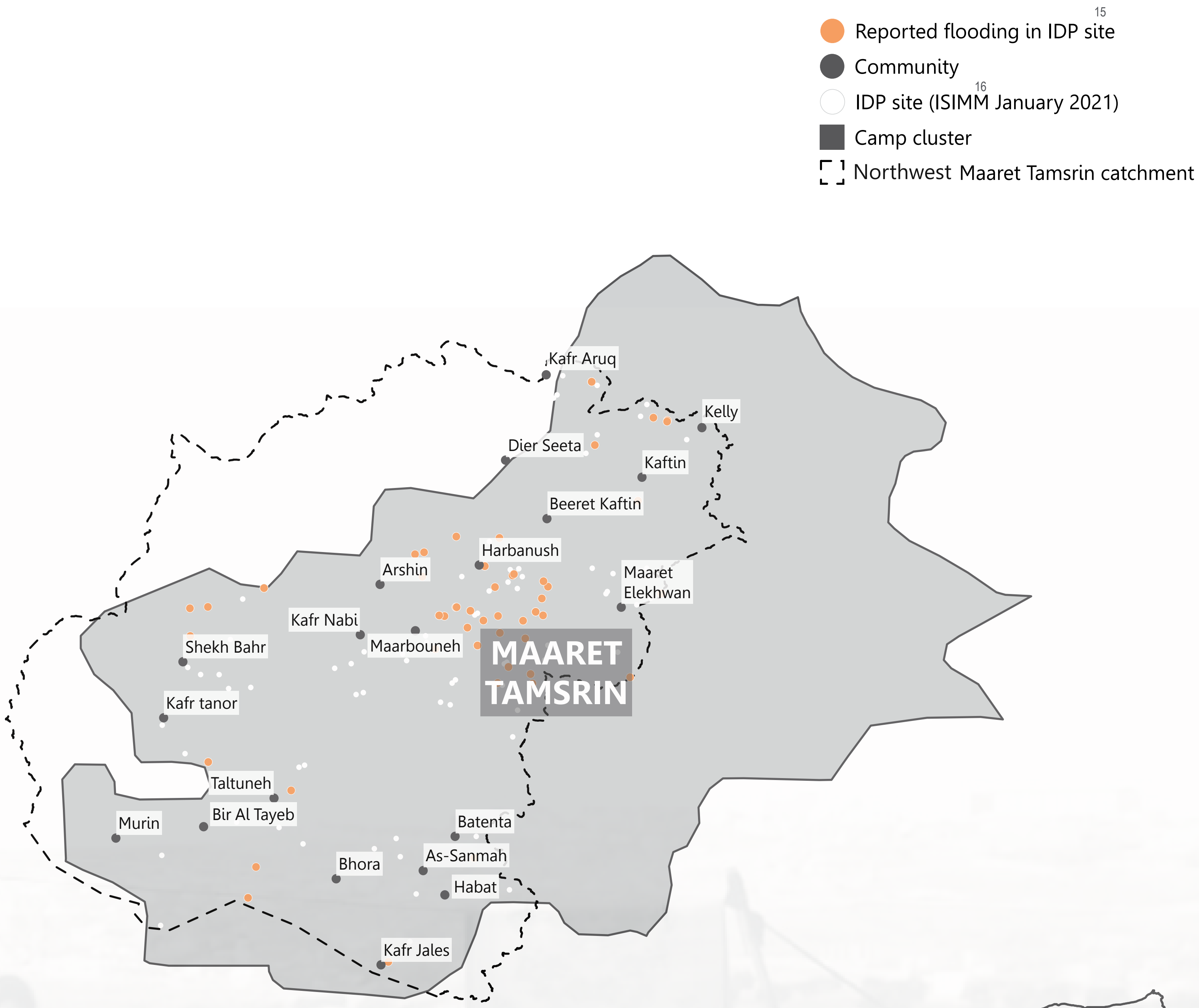
IDPs are among the population groups most vulnerable to the impacts of disasters associated with natural hazards for a number of reasons. The primary reasons are linked to the locations and living conditions of the sites where IDPs live. IDP sites and settlements are frequently located on land that has traditionally been considered uninhabitable due to environmental factors such as steep terrain, rocky or arid ground, or land that is known to be prone to seasonal flooding. The close proximity of IDP camps and informal sites to flood susceptible locations increases the exposure of IDPs to flood hazards. IDPs in camps and informal sites often also live in densely populated environments, in shelters that are not designed to resist natural hazards. Both of these factors exacerbate the risks natural hazards present for IDP populations.[11] In addition to the immediate hazard flash floods present to people and property, poor drainage and persistent standing water in and around shelters can lead to numerous health and sanitation problems in camps and informal sites, extending the adverse effects of flooding beyond the event itself. Considering the current outbreak of COVID-19 and rising numbers of confirmed cases in northwest Syria,[12] degraded sanitation conditions and overcrowding in camps and informal sites are of particular concern this winter.

Since the beginning of winter 2019, the number of IDPs living in Maaret Tamsrin sub-district alone has increased by more than 35% from 617,000 IDPs in November 2019 to 845,000 in August 2020, following an escalation in conflict in early 2020.[13] As of July 2021, the number of IDPs in Maaret Tamsrin is 916,273.[14] Increased migration to areas with already high IDP populations is likely to result in IDPs living in increasingly dense settings in locations considered less suitable for habitation and potentially more exposed to natural hazards like flooding.

To support the humanitarian response in Northwest Maaret Tamsrin, REACH conducted a flood hazard assessment to highlight shelters located within IDP sites that may be most susceptible to flood hazards. The assessment focuses on the catchment of Northwest Maaret Tamsrin sub-district, which includes Kafr Aruq Cluster, Harbanush Cluster, Maaret Elekhwan, Kaftin, and Shekh Bahr camp clusters, which have reportedly experienced flooding on multiple occasions since 2016.

Flooding in Sarmada camps | January 2021 | REACH field team

OVERVIEW MAP

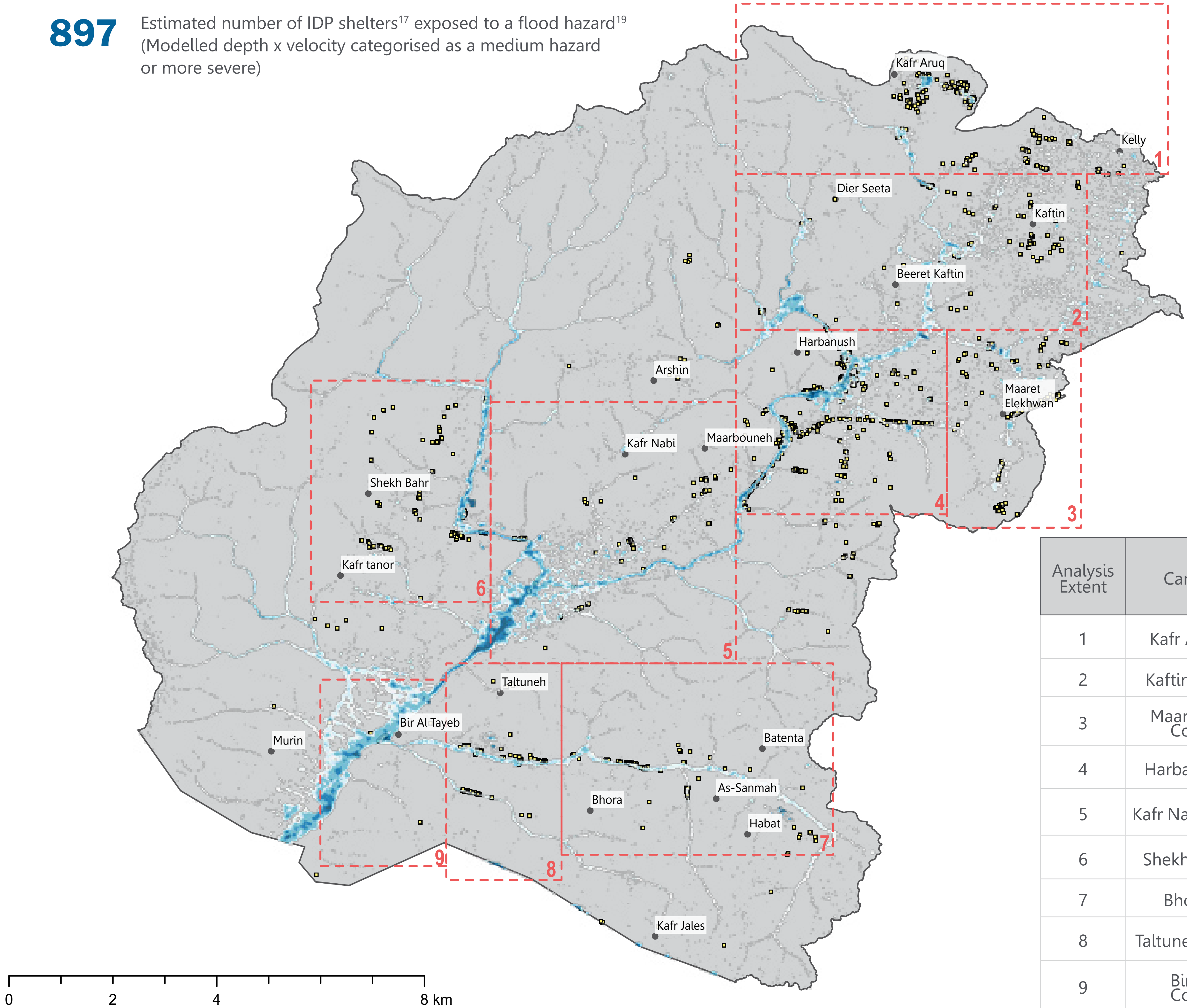


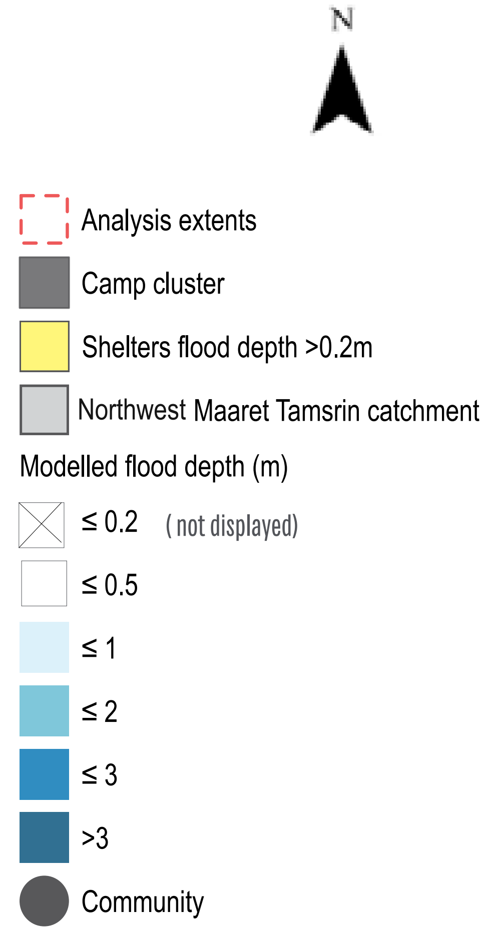
1 UNHCR| SEVERE WINTER WEATHER RESPONSE IN NORTH-WEST SYRIA-| 3 Feb 2022
2 AL JAZEERA | Child dies as heavy rains | 19 Jan 2021
3 United Nations (UN) | Tens of thousands in northwest Syria lose shelter after floods inundate camps|Jan 2021
4 Camp Coordination and Camp Management (CCCM) bulletin | 20210201 Floods Updates - Monday 1 February 2021
5 Assistance Coordination Unit (ACU) | Winter Needs In Northern Syria | November 2016
6 REACH | North-west Syria:Inter-sector Rapid Needs Assessment - Flood Impact | January 2019
7 Daily Sabah | Northern Syria flooding | 20 Dec 2019
8 Daily Sabah | UN calls for safer living conditions after storms kill 3 children in Syria's tent camps | June 2020
9 AL JAZEERA | syrias-rainstorm-kills-child-damages-displacement| 19 Jan 2021
10 United Nations Office for the Coordination of Humanitarian Affairs (OCHA) | Situation Report No. 16 | June 2020
11 United Nations High Commissioner for Refugees (UNHCR) | Displacement and Disaster Risk Reduction
12 Médecins Sans Frontières (MSF) | Ten-fold increase in COVID-19 cases adds new challenges in northwest Syria | September 2020
13 Humanitarian Needs Assessment Program (HNAP) | Mobility needs monitoring | November 2019 & August 2020
14 OCHA population task force July 2021
15 Flood affected sites data provided by CCCM cluster updated to August 2021
16 IDP Sites Integrated Monitoring Matrix

KEY FINDINGS

1,956 Estimated number of IDP shelters[17] exposed to flash flooding[18] with a modelled flood depth exceeding 200mm (16-hour design storm of 97.7mm with a peak rainfall intensity of 143.5 mm/hr)

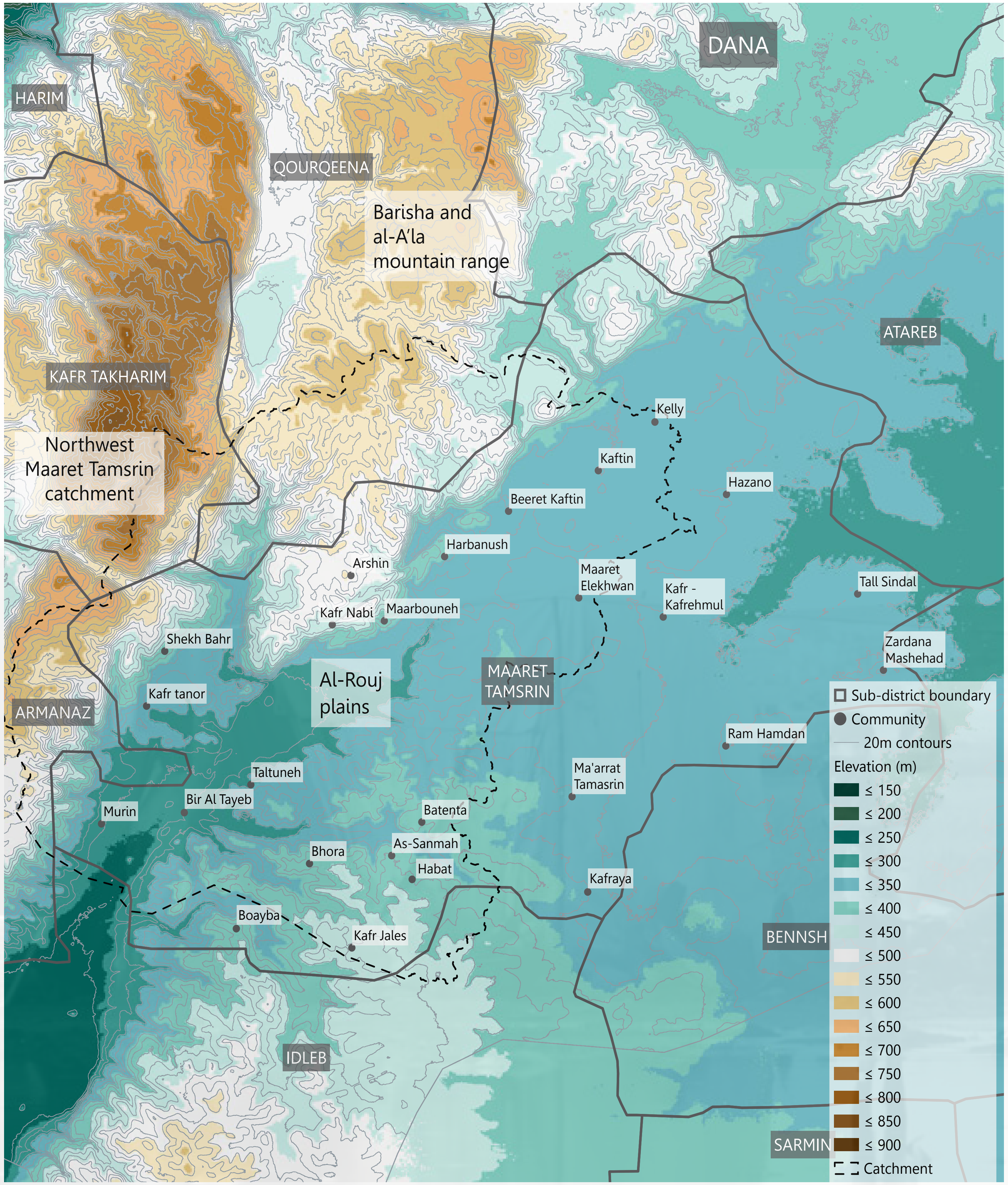
897 Estimated number of IDP shelters[17] exposed to a flood hazard[19] (Modelled depth x velocity categorised as a medium hazard or more severe)





Analysis Extent	Camp Cluster	# Shelters within modelled flood extents (>200mm depth)	# Shelters exposed to hazard (medium hazard or greater)
1	Kafr Aruq Cluster	314	8
2	Kaftin Community	129	48
3	Maaret Elekhwan Community	156	1
4	Harbanush Cluster	746	418
5	Kafr Nabi Community	102	56
6	Shekh Bahr Cluster	100	45
7	Bhora Cluster	112	87
8	Taltuneh Community	198	178
9	Bir Al Tayeb Community	30	29
10	Others	69	27

17 REACH | Satellite detected shelters/structures 24 August 2020
18 Flash flooding is generated by heavy rainfall over a short period of time. Flash floods are characterised as having relatively high peak discharges and short response times between rainfall and the onset of flooding, usually within 12 hours | World Meteorological Organization - No.577
19 A flood hazard is a product of both flood depth and flood velocity. This output utilises a flood hazard classification based on simplified D*V severity grid symbolisation categories published by the US Federal Emergency Management Agency (FEMA) | Guidance for Flood Risk Analysis and Mapping

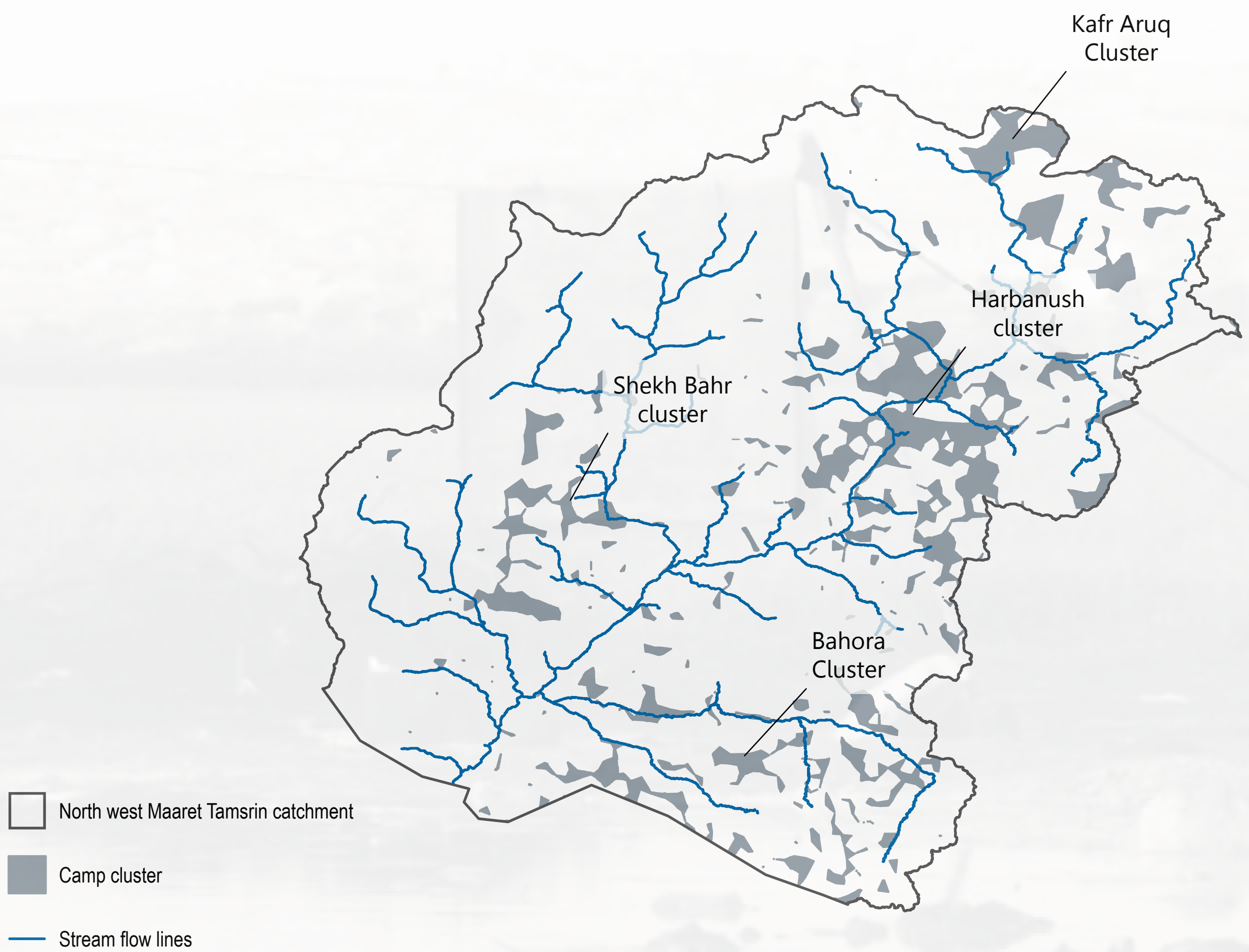


CATCHMENT CHARACTERISTICS

Much of Maaret Tamsrin sub-district is composed of flat agricultural land, the Idlib plains to the east and the al-Rouj plains to the west. The sub-district is bounded to the north by the steep slopes of the Barisha and al-A'la mountain ranges, which extend to a maximum elevation of approximately 750m above sea level, and to the south by hills and mountains west of Idlib, which reach a maximum elevation of approximately 600m above sea level.

Maaret Tamsrin sub-district is split into two catchments along a dividing line that runs from north to south through the central plains via highpoints in the vicinity of Kelly and Maaret El Ekhwan communities. The Northwest catchment, which is the focus of this assessment, runs northwest from the Barisha mountain range through Kelly community reachs Kafir Nabi community and towards the Idlib plains. The west of the catchment is bounded by the ridgelines from Kafr Takharim sub-dustrict and slopes eastwards from an elevation of approximately 750m above sea level down towards Shakh bahr community and the Idlib plains. The two ridges merge at an elevation approximately 320m above sea level at the middle of North-west Maaret Tamsrin Catchment. From there, the catchment continues east, exiting into Idleb sub-district From Murin community at an elevation of approximately 150m above sea level

The extent of the Northwest Maaret Tamsrin catchment was delineated from a 2.5m resolution Digital Terrain Model (DTM) utilising System for Automated Geoscientific Analyses (SAGA) - hydrology and channel tools (fill sinks Wang & Liu; catchment area; channel network; watershed basins). The result of these processes is shown below.



METHODOLOGY

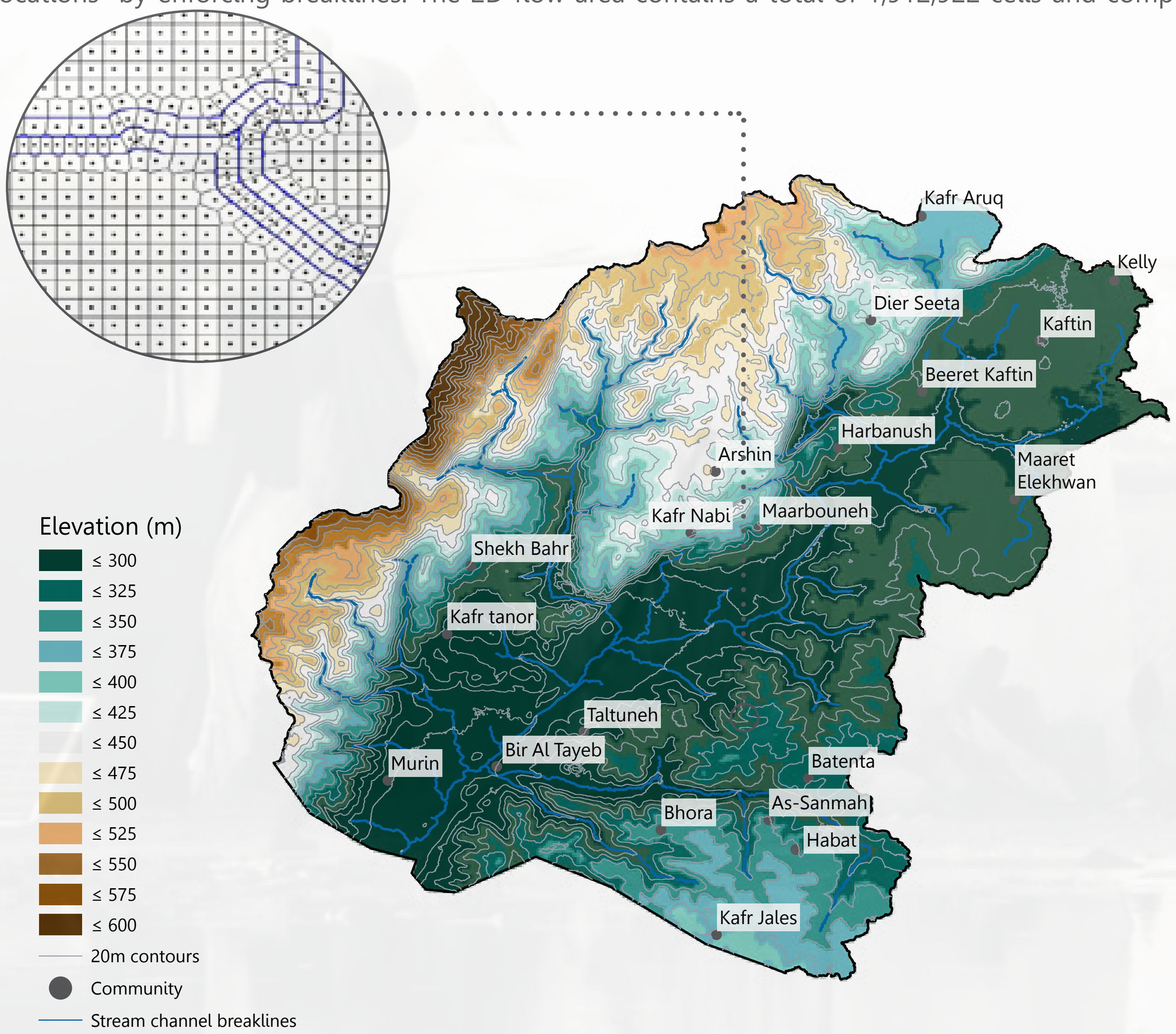
RAPID FLOOD HAZARD ASSESMENT

A direct precipitation two-dimensional (2D) hydraulic model was built using HEC-RAS in order to provide insights on flash flooding in Northwest Maaret Tamsrin catchment during heavy rainfall events. This method of 2D flood modelling is often referred to as a Rapid Flood Hazard Assessment (RFHA).

A RFHA can provide a high-level understanding of flood hazards on a catchment wide scale - large enough to include all or most of the effects to the relevant area - and helps to identify flood-susceptible areas. The following section outlines the methodology utilised to obtain the flood extents and flood depth x velocity results presented in this output.

MODEL INPUTS - TERRAIN/2D FLOW AREA

The terrain utilised for the HEC-RAS analysis is a 2.5m resolution DTM built utilising satellite imagery acquired by the Advanced Land Observing Satellite of the Japan Aerospace Exploration Agency (JAXA). The raw surface model has been processed to remove anomalies and adjusted to account for the presence of trees and structures.[20] The 2D flow area extents were defined in the HEC-RAS model environment and model computation points were generated at 10m intervals. Additional computation points were added along stream centrelines and along the stream banks of lower reaches to improve the resolution of the 2D flow area in these locations by enforcing breaklines. The 2D flow area contains a total of 1,912,922 cells and computation points.



MODEL INPUTS - LANDUSE AND ROUGHNESS PARAMETERS

Using a machine learning algorithm,[21] Northwest Maaret Tamsrin catchment was delineated into 6 different landuse categories using satellite imagery as shown in the figure below. Each category was assigned a roughness coefficient (Manning's n) which was subsequently used as an input parameter for the HEC-RAS model.

The Manning's n values assigned to the different landuses are provided in the table below:[22]

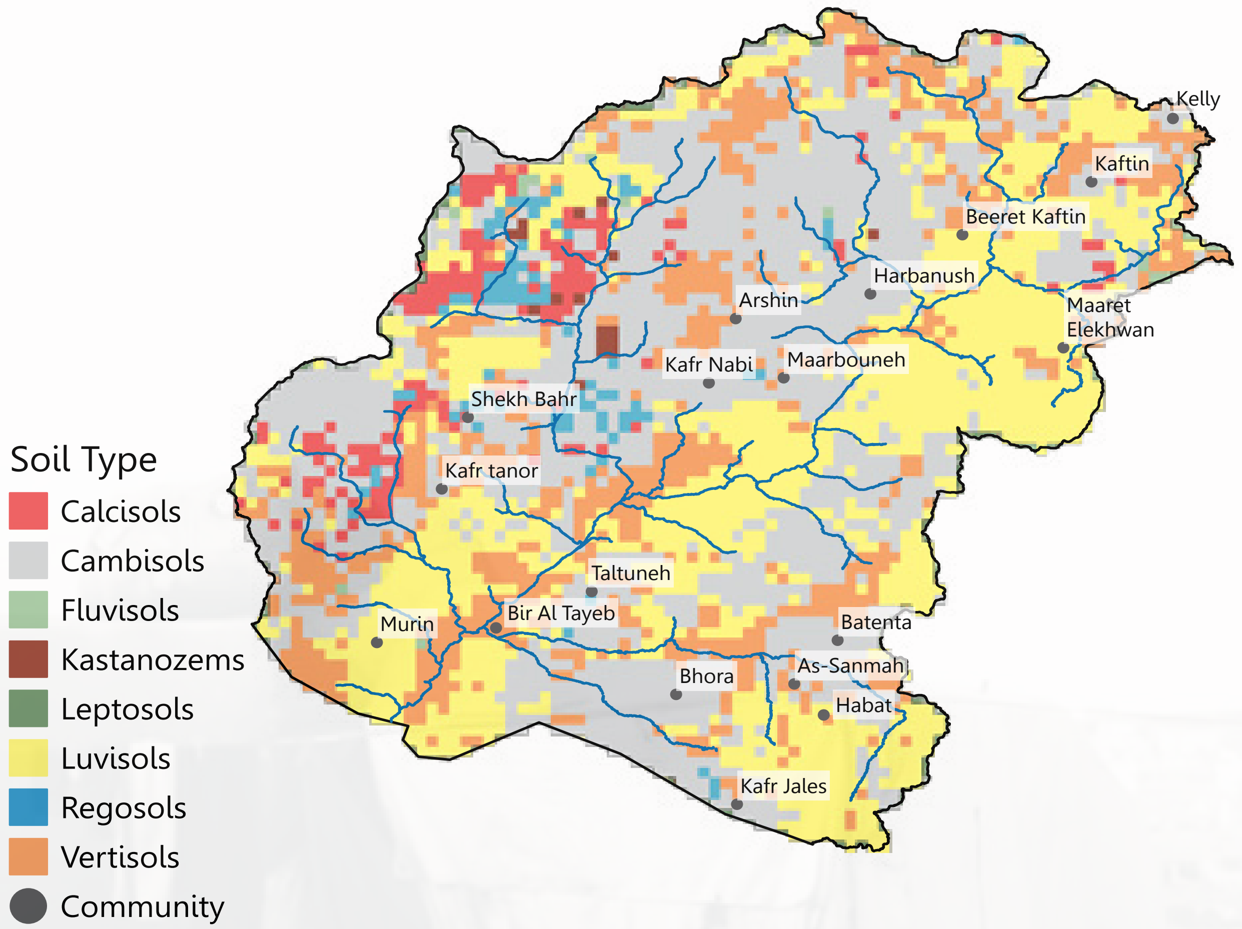
Landuse Category	Manning's n value
Bare/ rocky areas	0.04
Olives orchard	0.05
Agriculture areas	0.06
Forested areas	0.07
Camp/ informal settlement	0.1
Urban/ residential areas	0.1

20 For more information on the digital terrain model utilised for the model build refer to AW3D product details | https://www.aw3d.jp/en/products/standard/
21 Land cover classification method available at | https://github.com/victor-m-olsen/nature-food
22 Manning's n values were based on reference tables for Manning's n values for Channels, Closed Conduits Flowing Partially Full, and Corrugated Metail Pipes (Chow, 1959) | http://www.fsl.orst.edu/geowater/FX3/help/8_Hydraulic_Reference/Mannings_n_Tables.htm

MODEL INPUTS - SOIL TYPE AND INFILTRATION LOSS PARAMETERS

The Soil Conservation Service (SCS) Curve Number method was used to estimate losses due to infiltration for different soil types and land uses.

Data on the most probable soil types within the catchment was obtained from the International Soil Reference and Information Centre's (SRIC) soilgrids information system.[23]



SRIC soil type	SCS Hydrologic soil group
Calcisols	Group C
Cambisols	Group C
Fluvisols	Group C
Kastanozems	Group C
Leptosols	Group C
Luvisols	Group C
Regosols	Group C
Vertisols	Group D

INFILTRATION CLASSIFICATION

The catchment was classified into different hydrologic soil groups based on the soil types above and assigned SCS curve numbers for each of the landuses defined in the previous section. Curve numbers were integrated into an infiltration layer file and used as an input in the HEC-RAS model.

The SCS curve numbers assigned to the different landuses and soil types are provided in the table below.[24]

Landuse Category	Curve Number – type C soil	Curve Number – type D soil
Camp/ informal settlement	86	89
Urban/ residential areas	90	92
Bare/ rocky areas	86	89
Agriculture areas	84	88
Olives orchard	82	85
Forested areas	77	83

23 https://soilgrids.org/
24 Curve numbers based on guidance from the HEC-RAS 2D user's manual https://www.hec.usace.army.mil/confluence/rasdocs/r2dum/latest/developing-a-terrain-model-and-geospatial-layers/infiltration-methods

METHODOLOGY

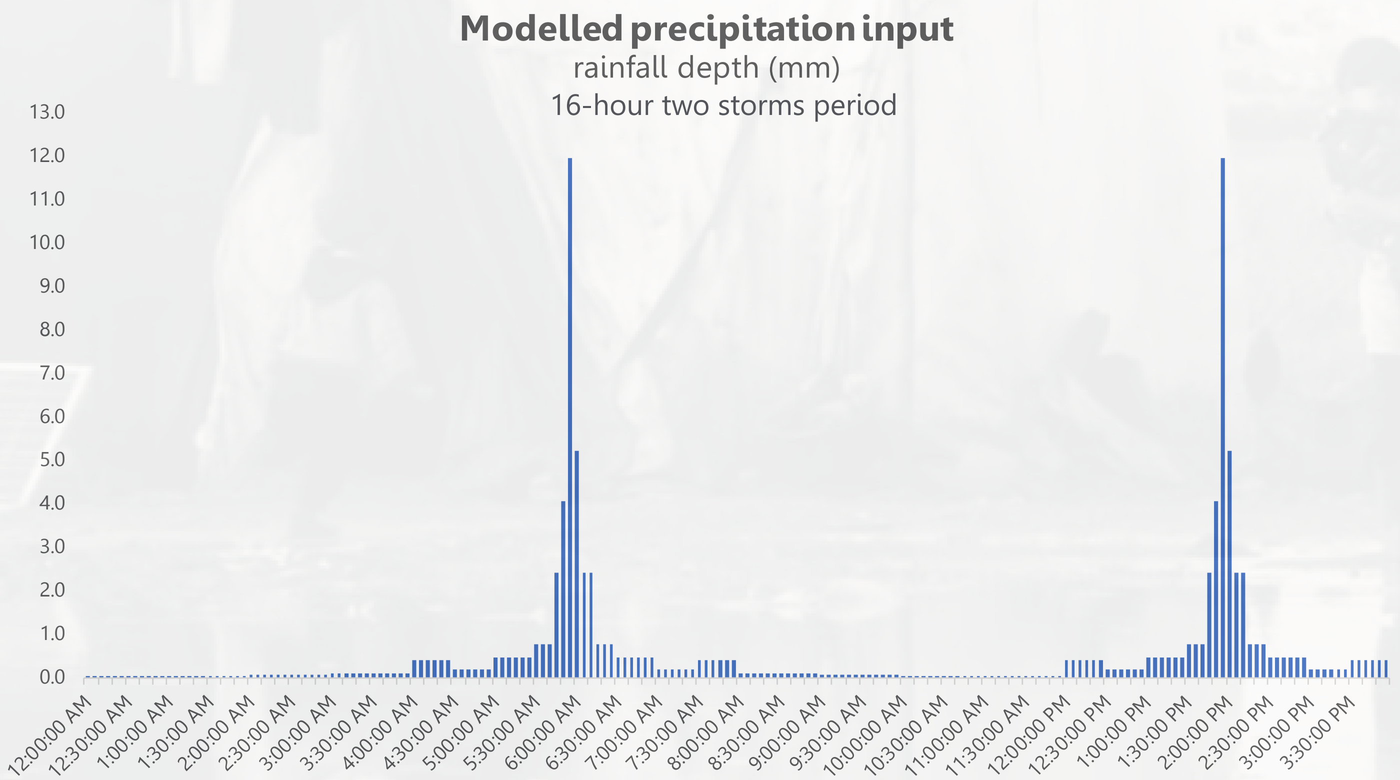
BOUNDARY CONDITIONS

A review of available regional precipitation data, rainfall gauge data, and remote sensing datasets was undertaken in order to define appropriate rainfall inputs for the hydraulic model. In the absence of rainfall gauge data or associated statistical analysis of rainfall within Northwest Syria, the precipitation data used as an input in the model was drawn from an intensity duration frequency (IDF) analysis undertaken for the city of Gaziantep[25] located in Turkey, approximately 116 km northeast of westren Maaret Tamsrin. The precipitation input used in the model was derived from IDF curves using the alternating block method. Eleven storms with a 25-year return period ranging in duration from 5 minutes to 12 hours were combined to synthesise a hyetograph with a peak rainfall intensity of 143.5 mm/hr and a total storm depth of 51.7 mm.

Preliminary model runs highlighted a large volume of storage throughout the catchment, which greatly reduced peak flows downstream catchment. A single 12 hour 25 year recurrence interval storm event did not contribute enough accumulated rainfall to exceed the storage capacity of the upper catchment and generate runoff. In an effort to model a "worst case scenario" event, the modelled precipitation inputs were modified to simulate the impact of a high intensity storm, arriving after considerable accumulated rainfall had saturated the upper catchment, limiting the volume of active storage capacity remaining at the time of the storm's peak. This was achieved by adding an additional 4 hour 25 year recurrence interval storm to the end of the modelled precipitation input (shown below). The total depth of the modelled 16 hour storm is 97.7mm.

As a second source of rainfall estimates, NASA's Global Precipitation Measurement (GPM) dataset was reviewed using Google Earth Engine in order to compare the synthesised design storm, with estimates of extreme rainfall inside Syria. Rainfall depths were extracted from the GPM dataset for dates of reported flooding in Northwest Syria. Between 1- 21 January 2021, several large storm events in Northwest Syria were identified, including one rainfall event on 16-18 January 2021, centred south of the study area in Darkosh, with an accumulated rainfall depth over 48 hours of 100mm. The majority of the storm's depth (76mm) fell within a 24 hour period. This observed extreme rainfall event is comparable to the design storm in terms of total accumulated depth.

A normal depth boundary was applied along the southeast edge of the 2D flow area east of Murin community. The normal depth boundary was calculated based on a channel slope of 1.3%.



UNSTEADY FLOW ANALYSIS PARAMETERS

An unsteady flow analysis was run in HEC-RAS with a simulation time window of 36 hours. The additional 20 hours was added to the simulation at the end of the 16 hour precipiation input to ensure the receding limb of the runoff hydrograph was adequately captured despite the long lag time of the catchment. A computation timestep of 2 seconds was used for the simulation.

HAZARD CLASSIFICATION

The severity of a flood hazard is a product of both the flood depth and flood velocity. Studies undertaken around the world[26] aimed at classifying modelled depth x velocity results into flood severity categories have focused on identifying hazardous floodplain conditions for people attempting to wade through floodwater, vehicles moving through floodwater, and buildings and structures located within the floodplain. The approach that has been adopted for this analysis, is the simplified approach presented in the US Federal Emergency Management Agency guidance on Flood Depth and Analysis Grids.[27] The flood severity categories used to produce the hazard maps included in this output are provided below:

Flood severity category	Depth x Velocity Range (m^2/s)
Low	< 0.2
Medium	0.2 - 0.5
High	0.5 - 1.5
Very High	1.5 - 2.5
Extreme	> 2.5

LIMITATIONS

A RFHA is a simplified modelling approach which is suitable for obtaining a 'big picture' perspective of flooding over an assessed area. it is not intended to provide precise flood depths and extents. The results presented in this output should be considered as estimates, to be confirmed and validated with subsequent analysis at the individual site level.

The following should be considered when viewing the results presented in this output:

- Hydraulic structures, such as bridges and culverts, piped drainage networks, irrigation canals, and open channels have not been included in the hydraulic model.
- Obstructions to flow such as buildings, parked vehicles, and vegetation are not included directly in the model. The effect of obstructions on the modelled flow regime are approximated by the selection of surface roughness parameters.
- The modelled terrain was not validated and may not reflect recent changes to the landform resulting from natural or engineered changes in stream morphology or cut and fill earthworks operations.
- The HEC-RAS hydraulic model is neither calibrated nor validated.
- Rainfall inputs are applied directly onto the 2D flow area as a single time series without spatial variability.

For questions or comments on the methodology, please contact: mena.reach@impact-initiatives.org

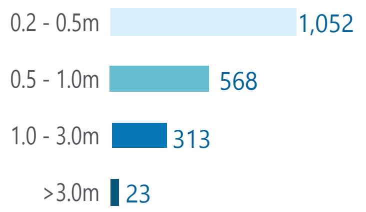
25 Yuce, Mehmet & Deger, Ibrahim | Rainfall Intensity-Duration-Frequency Analysis for the City of Gaziantep | April 2019
26 researchgate | Classification of flooding (high, medium, low flood severity/damage) in New York | Jan 2015
27 FEMA | Guidance for Flood Risk Analysis and Mapping | February 2018

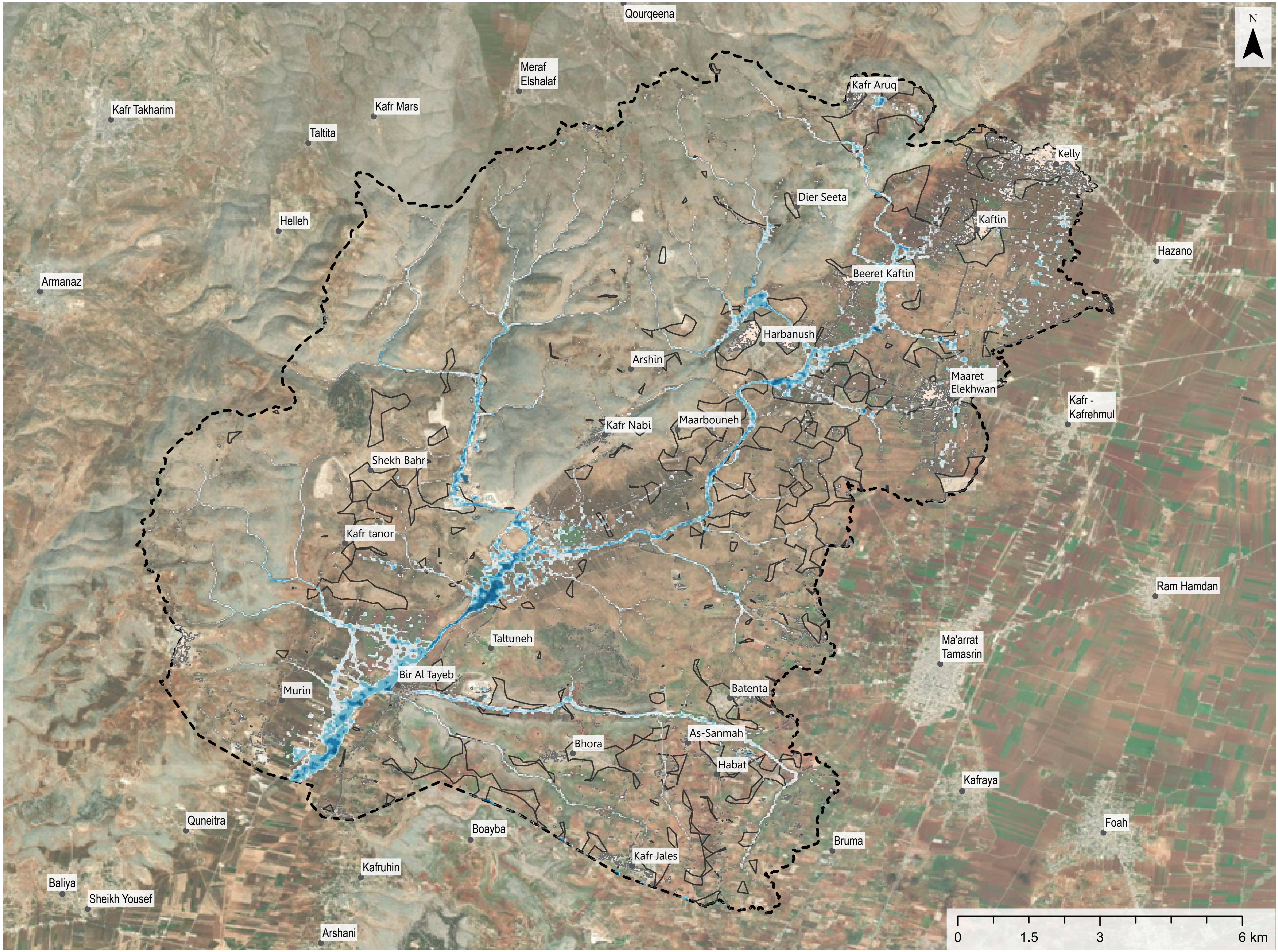
MODELLED FLOOD DEPTH RESULTS - CATCHMENT OVERVIEW

1,956

Shelters are estimated to lie within the modelled flood extents*, where flood depth exceeds 200mm.

Breakdown of number of shelters by ranges of flood extents





Populated area

- IDP sites/settlements
- Residential area
- Community

Modelled flood depth (m)

- ≤ 0.2 (not displayed)
- ≤ 0.5
- ≤ 1
- ≤ 2
- ≤ 3
- >3

*Modelled flood extents calculated based on 25-year design storm derived from IDF curves for the city of Gaziantep, Turkey. Peak rainfall intensity is 143.5 mm/hr and the total storm depth is 97.7 mm over 16 hours.

Satellite imagery:
Open source, world imagery

FLOOD HAZARD CLASSIFICATION - CATCHMENT OVERVIEW

897

Shelters are exposed to a flood hazard* categorised as a medium severity hazard or higher based on modelled depth x velocity

Breakdown of number of shelters by the level of severity of flood hazards

Severity	Shelters
Medium	370
High	409
Very High	87
Extreme	31

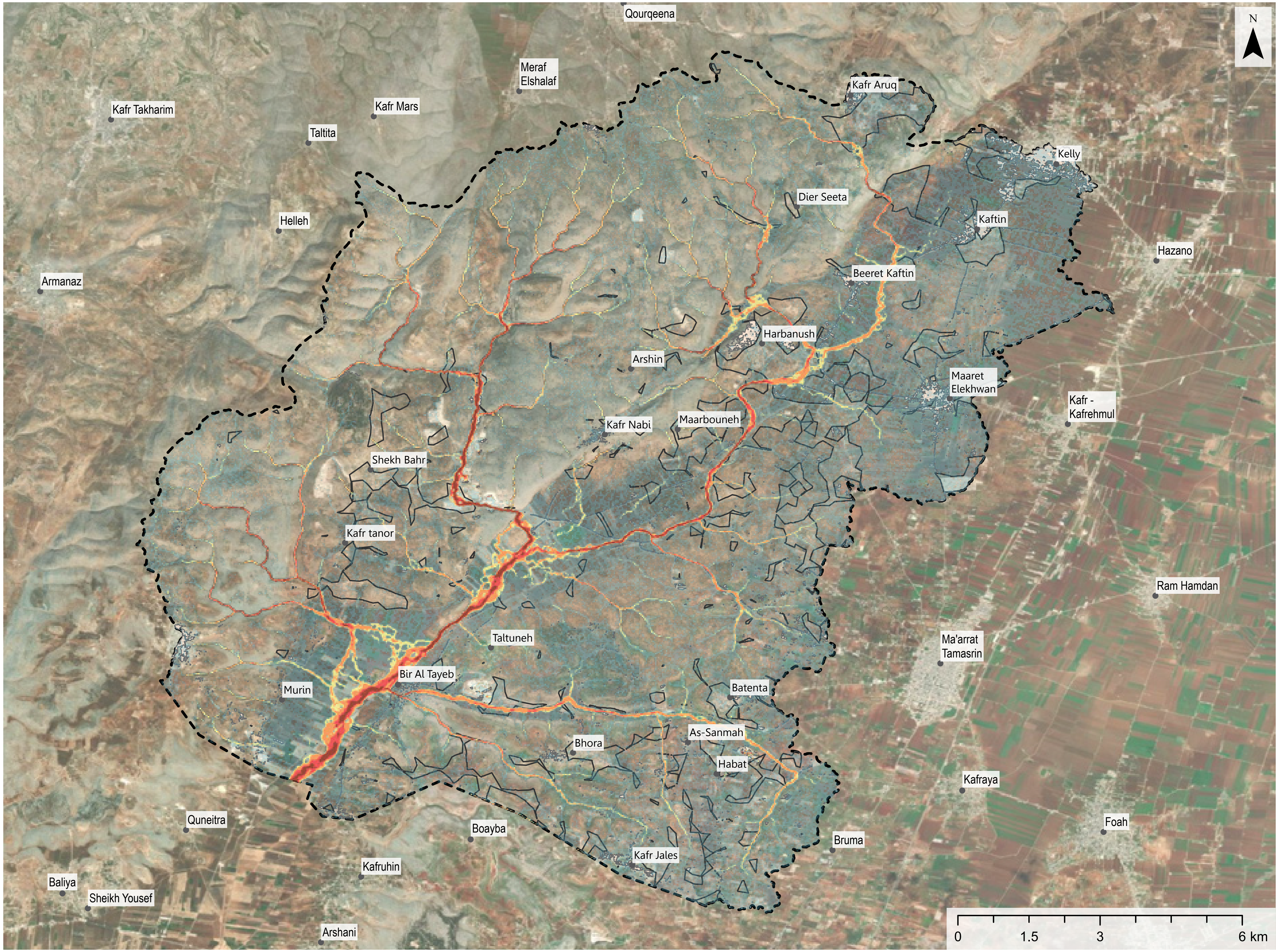
Populated area

- IDP sites/settlements
- Residential area
- Community

Flood hazard classification

Value

- Low
- Medium
- High
- Very High
- Extreme



*Flood hazard classification based on simplified D*V severity grid symbolisation categories by FEMA : Guidance for Flood Risk Analysis and Mapping

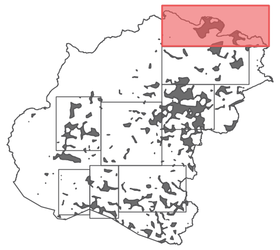
Satellite imagery:
Open source, world imagery

314

Shelters are estimated to lie within the modelled flood extents*, where flood depth exceeds 200mm.

Breakdown of number of shelters by ranges of flood extents

0.2 - 0.5m	199
0.5 - 1.0m	79
1.0 - 3.0m	36
>3.0m	0



Shelters flood depth >0.2m

Analysis extent

Modelled flood depth (m)

≤ 0.2 (not displayed)

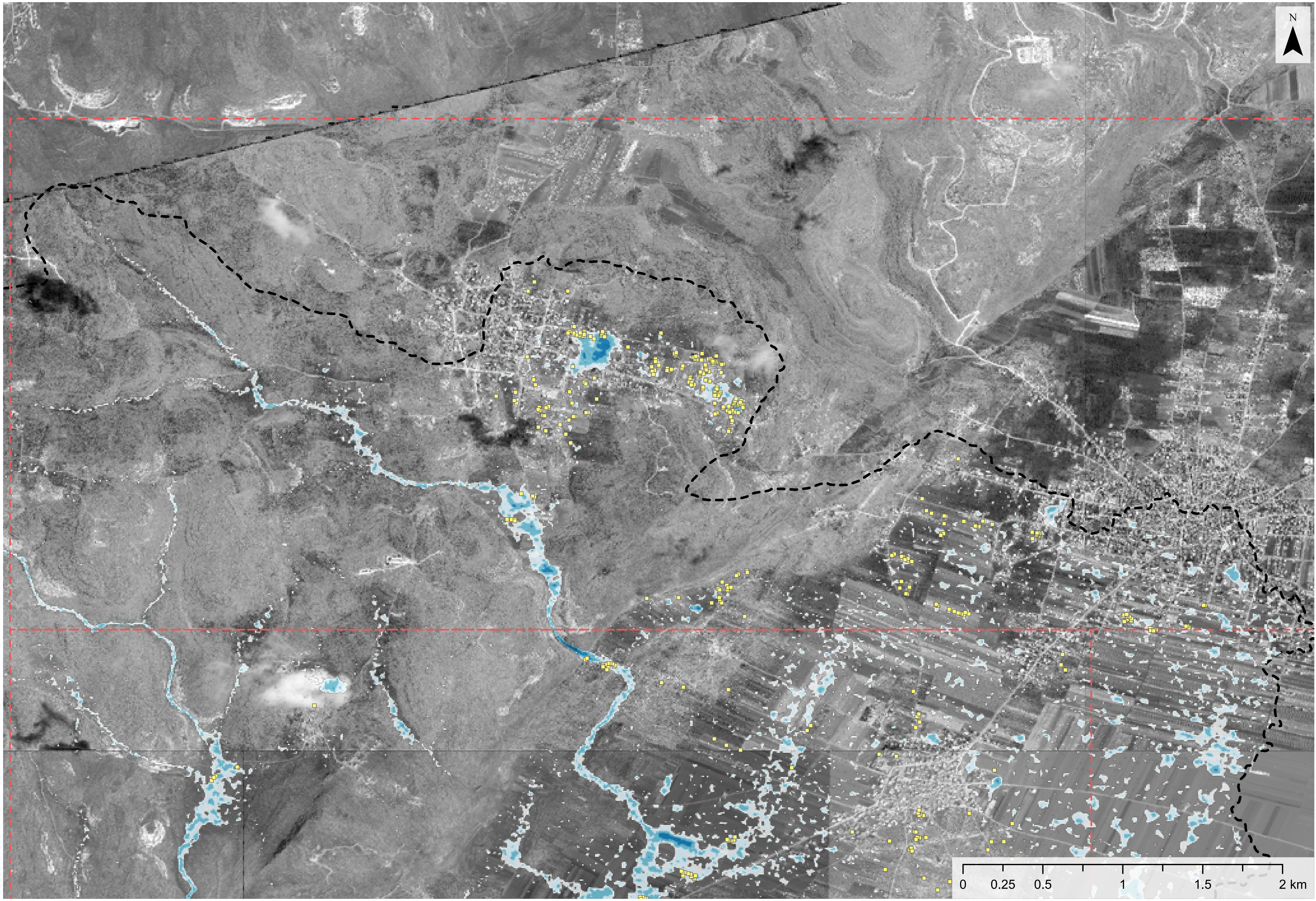
≤ 0.5

≤ 1

≤ 2

≤ 3

> 3



*Modelled flood extents calculated based on 25-year design storm derived from IDF curves for the city of Gaziantep, Turkey. Peak rainfall intensity is 143.5 mm/hr and the total storm depth is 97.7 mm over 16 hours.

Satellite imagery:
WV01 from 26 Febraury 2021
Copyright: © 2020 DigitalGlobe
Source: US Department of State, Humanitarian Information Unit, NextView license

REACH Informing more effective humanitarian action

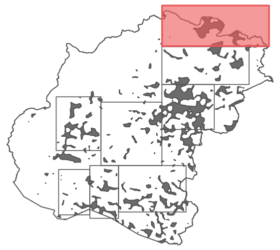
FLOOD HAZARD CLASSIFICATION - Kafr Aruq Cluster

8

Shelters are exposed to a flood hazard* categorised as a medium severity hazard or higher based on modelled depth x velocity

Breakdown of number of shelters by the level of severity of flood hazards

Medium	7
High	1
Very High	0
Extreme	0



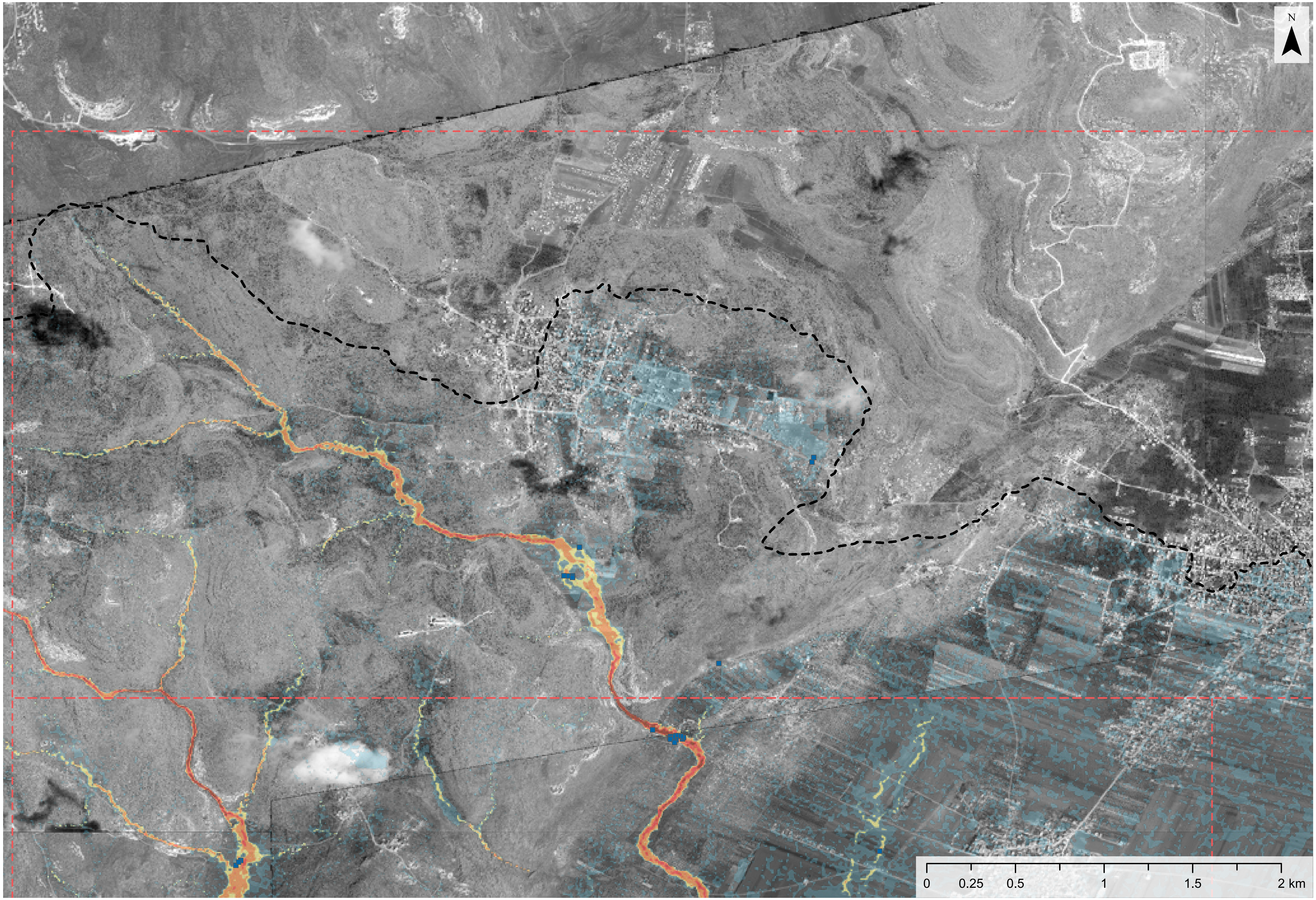
Shelters exposed to flood hazard (medium hazard or greater)

Analysis extent

Flood hazard classification

Values

- Low
- Medium
- High
- Very High
- Extreme



*Flood hazard classification based on simplified D*V severity grid symbolisation categories by FEMA : Guidance for Flood Risk Analysis and Mapping

Satellite imagery:
WV01 from 26 Febraury 2021

Source: US Department of State, Humanitarian Information Unit, NextView license

MODELLED FLOOD DEPTH RESULTS - Kaftin Community

129

Shelters are estimated to lie within the modelled flood extents*, where flood depth exceeds 200mm.

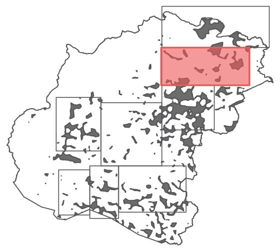
Breakdown of number of shelters by ranges of flood extents

0.2 - 0.5m 87

0.5 - 1.0m 30

1.0 - 3.0m 12

>3.0m 0



Shelters flood depth >0.2m

Analysis extent

Modelled flood depth (m)

≤ 0.2 (not displayed)

≤ 0.5

≤ 1

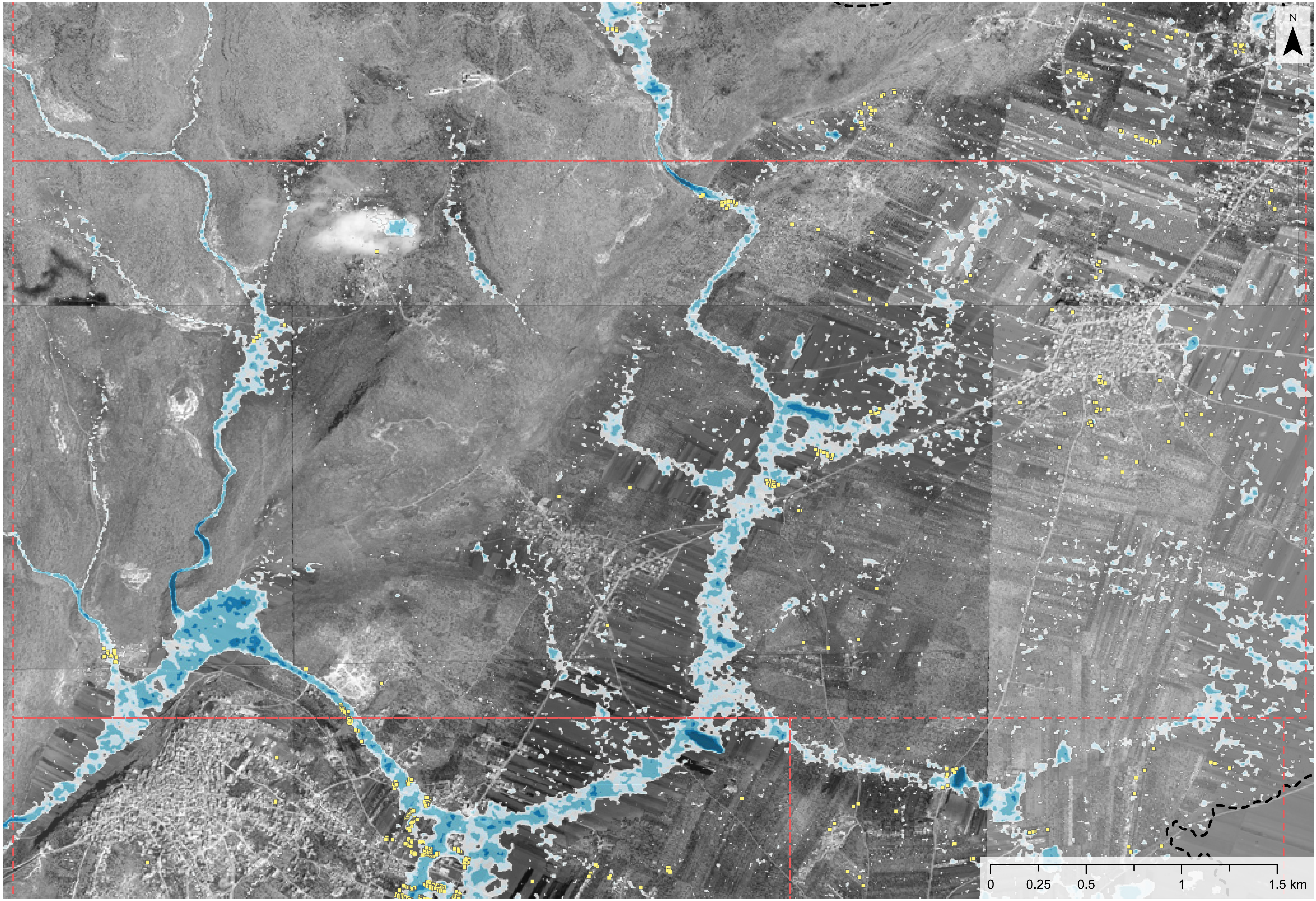
≤ 2

≤ 3

> 3

*Modelled flood extents calculated based on 25-year design storm derived from IDF curves for the city of Gaziantep, Turkey. Peak rainfall intensity is 143.5 mm/hr and the total storm depth is 97.7 mm over 16 hours.

Satellite imagery:
WV01 from 26 Febraury 2021
Copyright: © 2020 DigitalGlobe
Source: US Department of State, Humanitarian Information Unit, NextView license



REACH Informing more effective humanitarian action

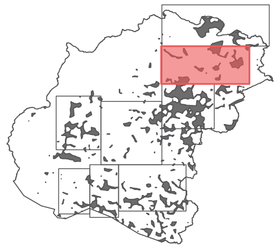
FLOOD HAZARD CLASSIFICATION - Kaftin Community

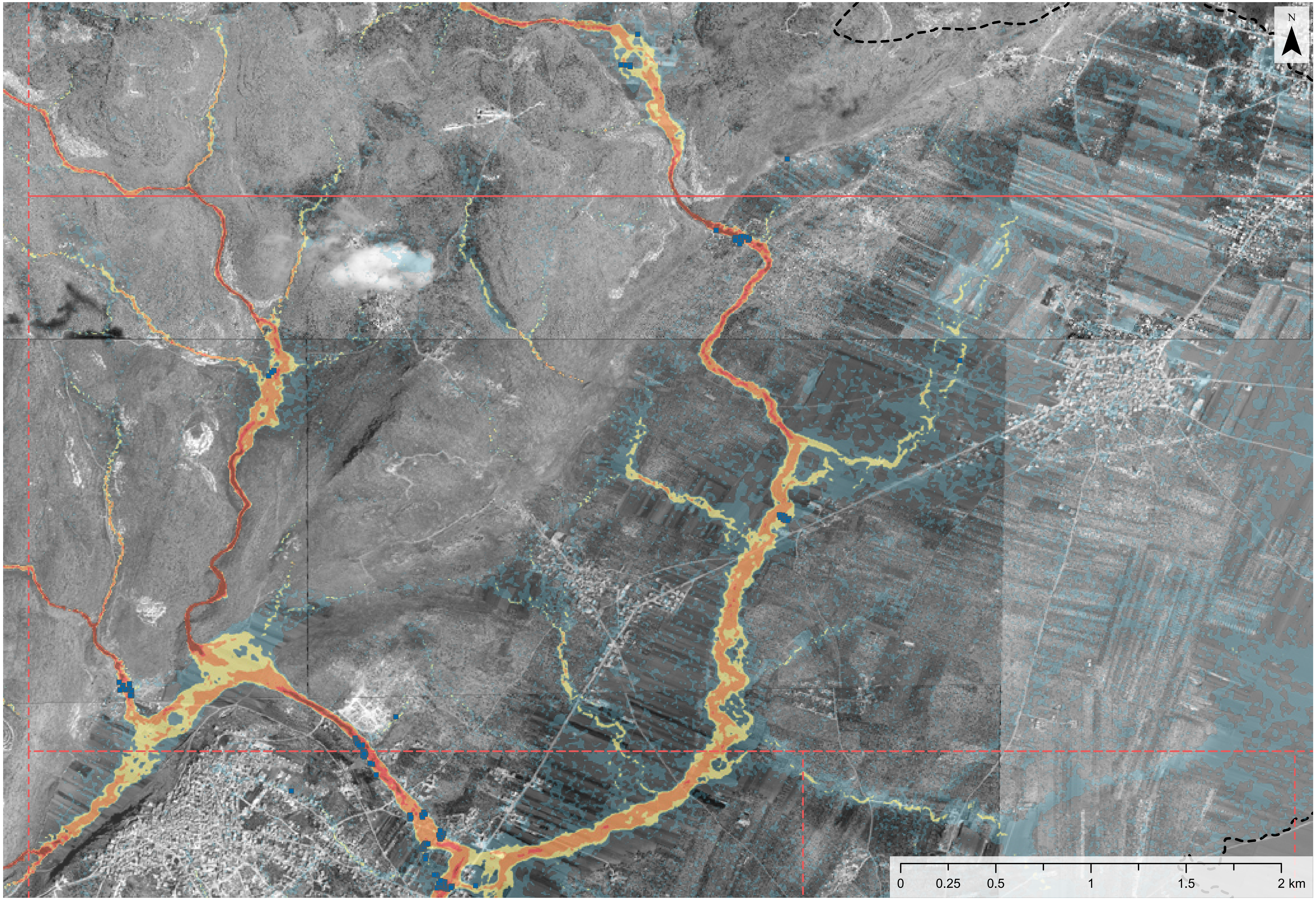
48

Shelters are exposed to a flood hazard* categorised as a medium severity hazard or higher based on modelled depth x velocity

Breakdown of number of shelters by the level of severity of flood hazards

Medium	23
High	14
Very High	6
Extreme	5





Shelters exposed to flood hazard (medium hazard or greater)

Analysis extent

Flood hazard classification

Values

- Low
- Medium
- High
- Very High
- Extreme

*Flood hazard classification based on simplified D*V severity grid symbolisation categories by FEMA : Guidance for Flood Risk Analysis and Mapping

Satellite imagery:
WV01 from 26 Febraury 2021
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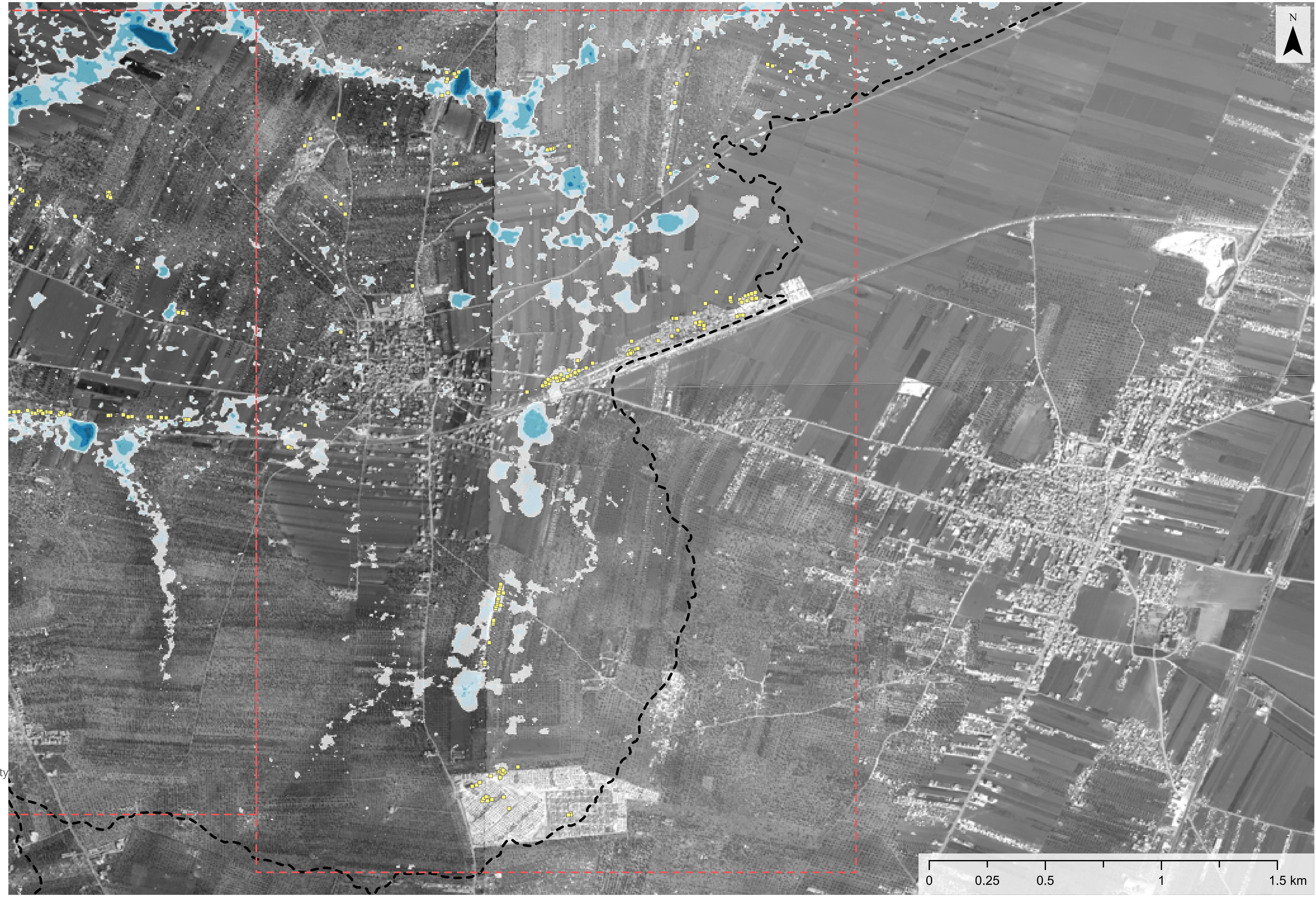
MODELLED FLOOD DEPTH RESULTS - Maaret Elekhwan Community

156

Shelters are estimated to lie within the modelled flood extents*, where flood depth exceeds 200mm.

Breakdown of number of shelters by ranges of flood extents

0.2 - 0.5m	135
0.5 - 1.0m	18
1.0 - 3.0m	3
>3.0m	0



Shelters flood depth >0.2m

Analysis extent

Modelled flood depth (m)

≤ 0.2 (not displayed)

≤ 0.5

≤ 1

≤ 2

≤ 3

> 3

*Modelled flood extents calculated based on 25-year design storm derived from IDF curves for the city of Gaziantep, Turkey. Peak rainfall intensity is 143.5 mm/hr and the total storm depth is 97.7 mm over 16 hours.

Satellite imagery:
WV03 from 19 October 2020

Source: US Department of State, Humanitarian Information Unit, NextView license

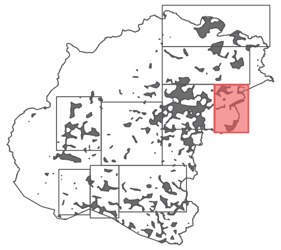
FLOOD HAZARD CLASSIFICATION - Maaret Elekhwan Community

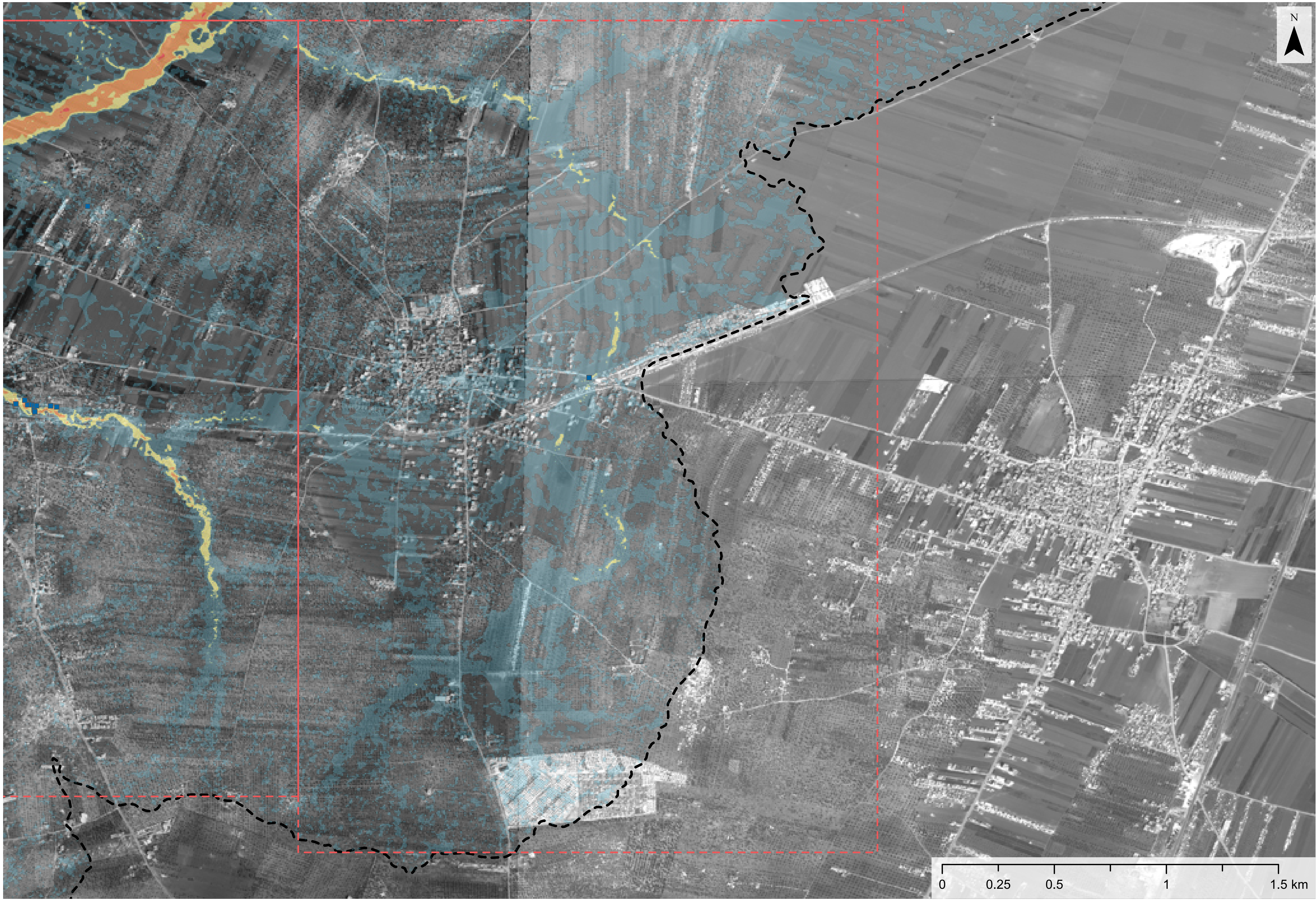
1

Shelters are exposed to a flood hazard* categorised as a medium severity hazard or higher based on modelled depth x velocity

Breakdown of number of shelters by the level of severity of flood hazards

Medium	1
High	0
Very High	0
Extreme	0





Shelters exposed to flood hazard (medium hazard or greater)

Analysis extent

Flood hazard classification

Values

- Low
- Medium
- High
- Very High
- Extreme

*Flood hazard classification based on simplified D*V severity grid symbolisation categories by FEMA : Guidance for Flood Risk Analysis and Mapping

Satellite imagery:
WV03 from 19 October 2020
Copyright: © 2020 DigitalGlobe
Source: US Department of State, Humanitarian Information Unit, NextView license

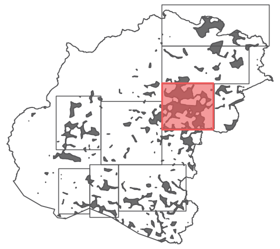
MODELLED FLOOD DEPTH RESULTS - Harbanush Cluster

746

Shelters are estimated to lie within the modelled flood extents*, where flood depth exceeds 200mm.

Breakdown of number of shelters by ranges of flood extents

0.2 - 0.5m	315
0.5 - 1.0m	228
1.0 - 3.0m	180
>3.0m	23



Shelters flood depth >0.2m

Analysis extent

Modelled flood depth (m)

≤ 0.2 (not displayed)

≤ 0.5

≤ 1

≤ 2

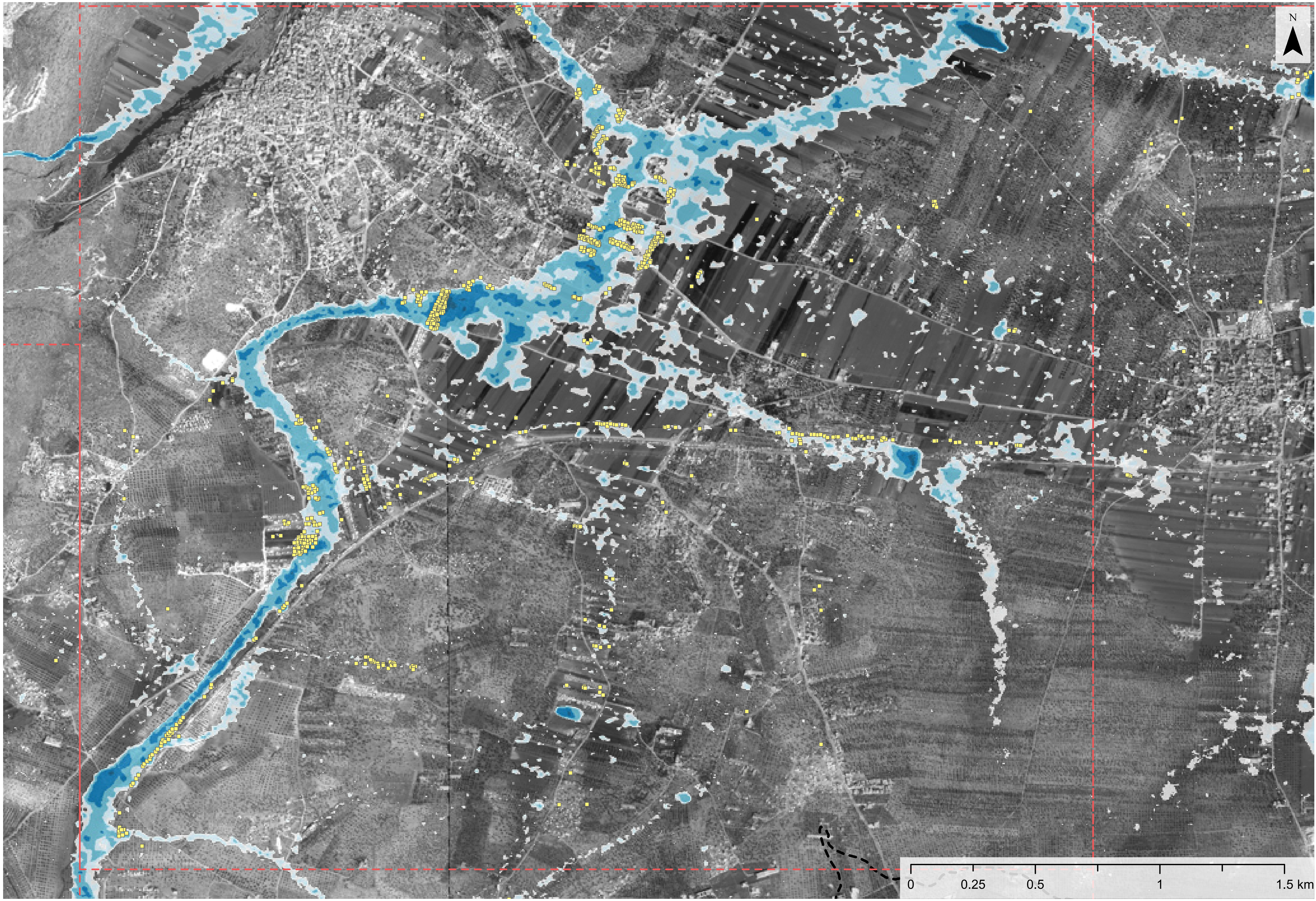
≤ 3

> 3

*Modelled flood extents calculated based on 25-year design storm derived from IDF curves for the city of Gaziantep, Turkey. Peak rainfall intensity is 143.5 mm/hr and the total storm depth is 97.7 mm over 16 hours.

Satellite imagery:
WV03 from 19 October 2020

Source: US Department of State, Humanitarian Information Unit, NextView license



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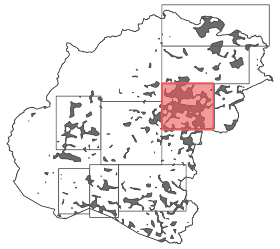
FLOOD HAZARD CLASSIFICATION - Harbanush Cluster

418

Shelters are exposed to a flood hazard* categorised as a medium severity hazard or higher based on modelled depth x velocity

Breakdown of number of shelters by the level of severity of flood hazards

Medium	180
High	204
Very High	30
Extreme	4



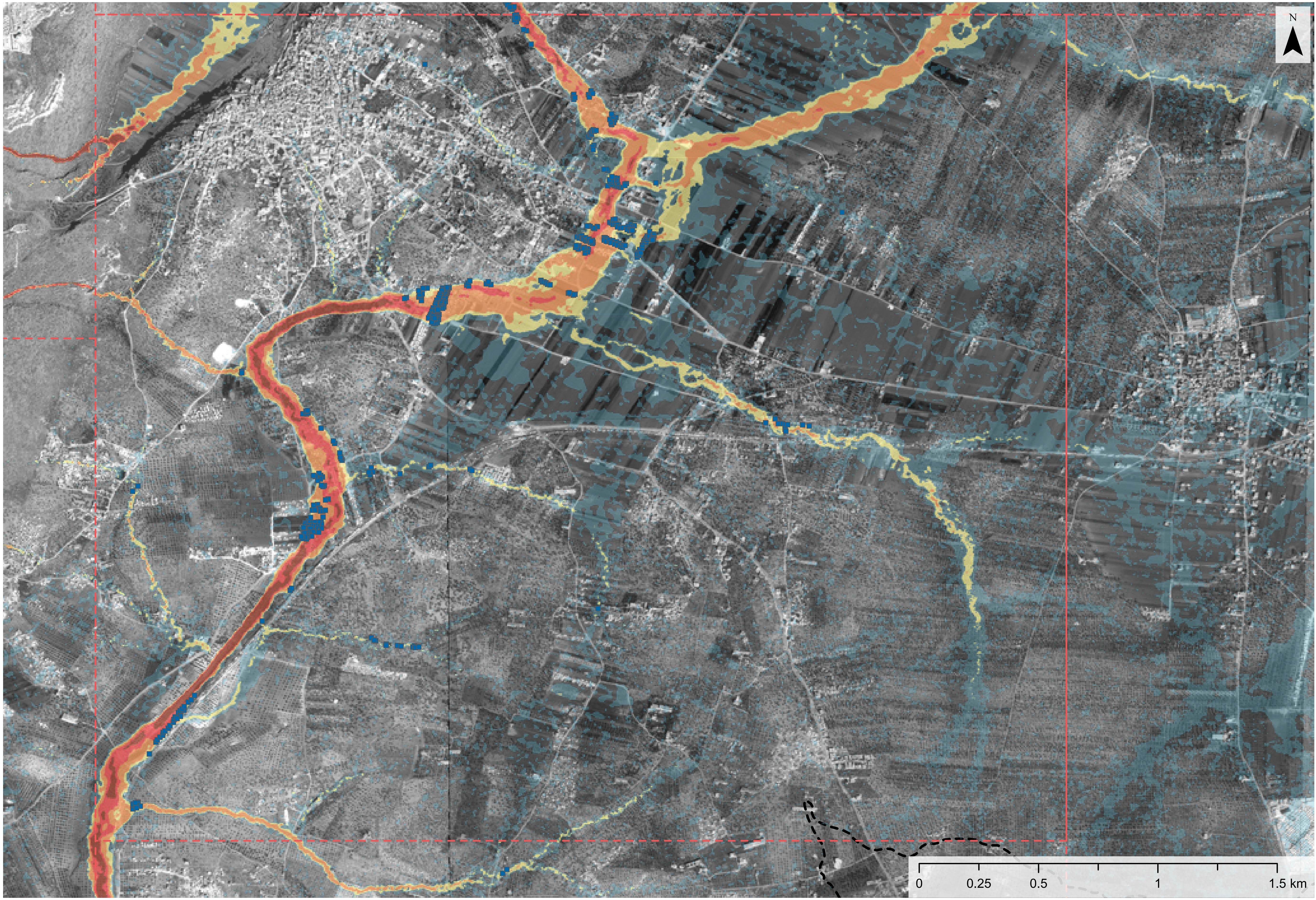
- Shelters exposed to flood hazard (medium hazard or greater)
- Analysis extent

Flood hazard classification
Values

- Low
- Medium
- High
- Very High
- Extreme

*Flood hazard classification based on simplified D*V severity grid symbolisation categories by FEMA : Guidance for Flood Risk Analysis and Mapping

Satellite imagery:
WV03 from 19 October 2020
Copyright: © 2020 DigitalGlobe
Source: US Department of State, Humanitarian Information Unit, NextView license



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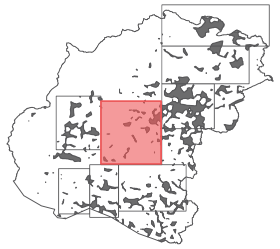
MODELLED FLOOD DEPTH RESULTS - Kafr Nabi Community

102

Shelters are estimated to lie within the modelled flood extents*, where flood depth exceeds 200mm.

Breakdown of number of shelters by ranges of flood extents

Flood depth	Shelters
0.2 - 0.5m	62
0.5 - 1.0m	16
1.0 - 3.0m	24
>3.0m	0

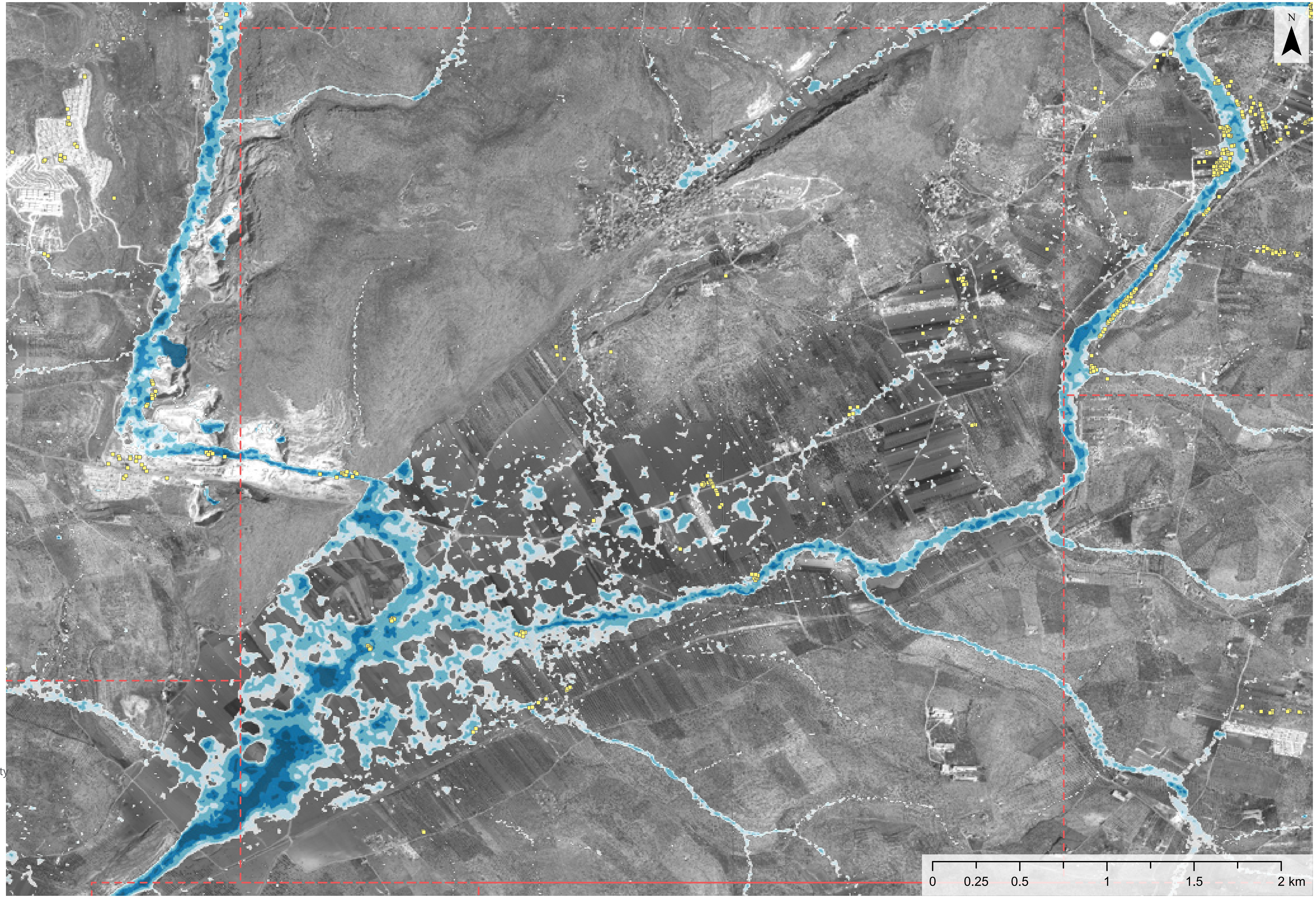


Shelters flood depth >0.2m

Analysis extent

Modelled flood depth (m)

- ≤ 0.2 (not displayed)
- ≤ 0.5
- ≤ 1
- ≤ 2
- ≤ 3
- > 3



*Modelled flood extents calculated based on 25-year design storm derived from IDF curves for the city of Gaziantep, Turkey. Peak rainfall intensity is 143.5 mm/hr and the total storm depth is 97.7 mm over 16 hours.

Satellite imagery:
P001 from 21 February 2021

Source: US Department of State, Humanitarian Information Unit, NextView license

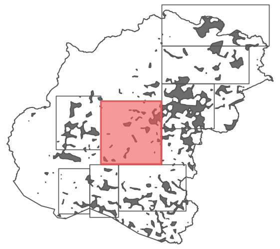
FLOOD HAZARD CLASSIFICATION - Kafr Nabi Community

56

Shelters are exposed to a flood hazard* categorised as a medium severity hazard or higher based on modelled depth x velocity

Breakdown of number of shelters by the level of severity of flood hazards

Severity	Shelters
Medium	22
High	10
Very High	12
Extreme	12



Shelters exposed to flood hazard (medium hazard or greater)

Analysis extent

Flood hazard classification

Values

- Low
- Medium
- High
- Very High
- Extreme

*Flood hazard classification based on simplified D*V severity grid symbolisation categories by FEMA : Guidance for Flood Risk Analysis and Mapping

Satellite imagery:
P001 from 21 February 2021
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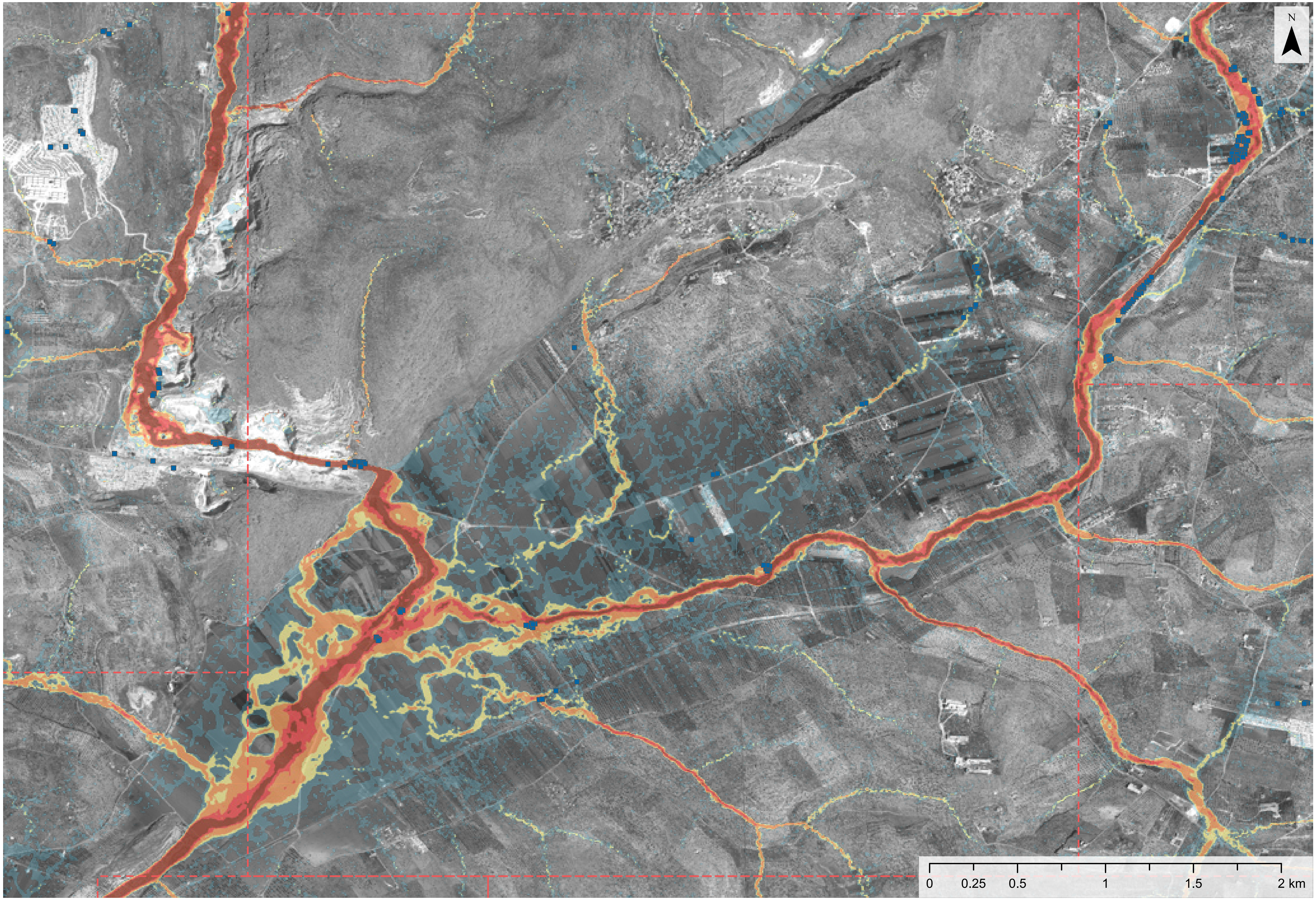
Source: US Department of State, Humanitarian Information Unit, NextView license



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MODELLED FLOOD DEPTH RESULTS - Shekh Bahr Cluster

100

Shelters are estimated to lie within the modelled flood extents*, where flood depth exceeds 200mm.

Breakdown of number of shelters by ranges of flood extents

0.2 - 0.5m	73
0.5 - 1.0m	16
1.0 - 3.0m	11
>3.0m	0

Shelters flood depth >0.2m

Analysis extent

Modelled flood depth (m)

≤ 0.2 (not displayed)

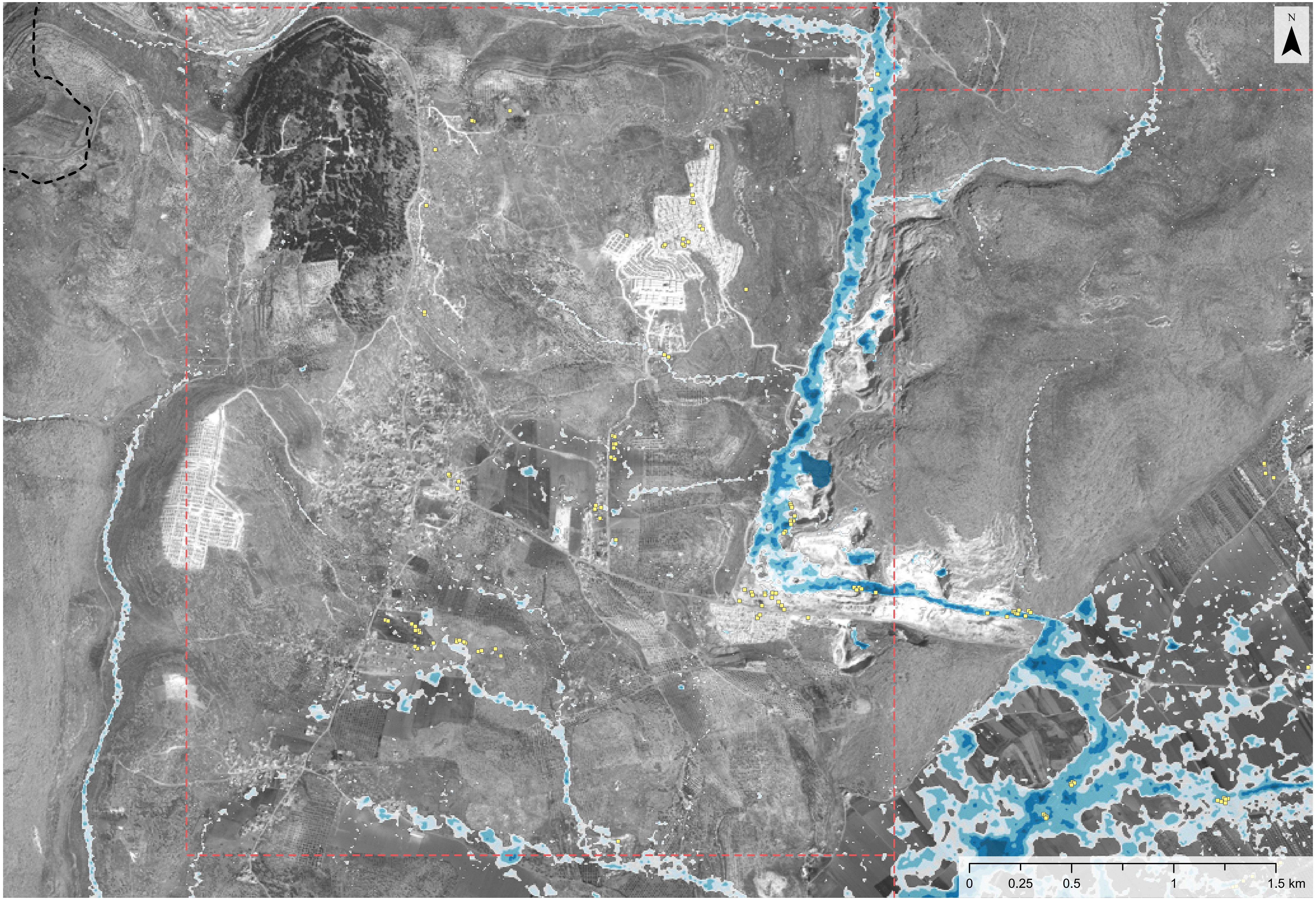
≤ 0.5

≤ 1

≤ 2

≤ 3

> 3



*Modelled flood extents calculated based on 25-year design storm derived from IDF curves for the city of Gaziantep, Turkey. Peak rainfall intensity is 143.5 mm/hr and the total storm depth is 97.7 mm over 16 hours.

Satellite imagery:
P001 from 21 February 2021

Source: US Department of State, Humanitarian Information Unit, NextView license

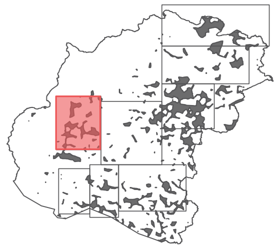
FLOOD HAZARD CLASSIFICATION - Shekh Bahr Cluster

45

Shelters are exposed to a flood hazard* categorised as a medium severity hazard or higher based on modelled depth x velocity

Breakdown of number of shelters by the level of severity of flood hazards

Medium	26
High	12
Very High	2
Extreme	5



Shelters exposed to flood hazard (medium hazard or greater)

Analysis extent

Flood hazard classification

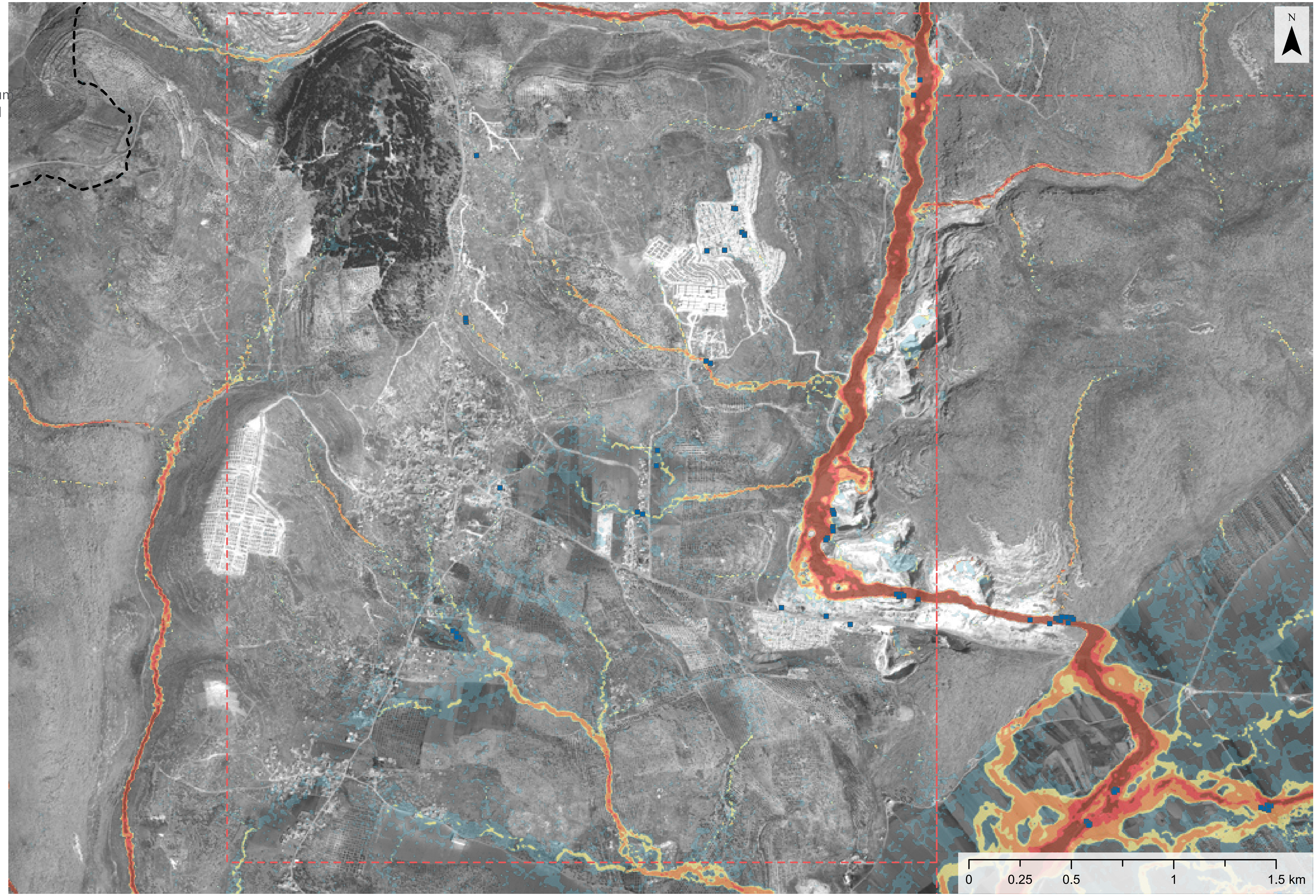
Values

- Low
- Medium
- High
- Very High
- Extreme

*Flood hazard classification based on simplified D*V severity grid symbolisation categories by FEMA : Guidance for Flood Risk Analysis and Mapping

Satellite imagery:
P001 from 21 February 2021

Source: US Department of State, Humanitarian Information Unit, NextView license



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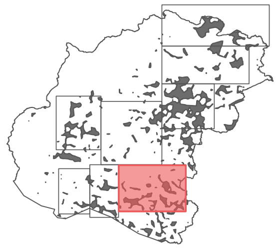
MODELLED FLOOD DEPTH RESULTS - Bhora Cluster

112

Shelters are estimated to lie within the modelled flood extents*, where flood depth exceeds 200mm.

Breakdown of number of shelters by ranges of flood extents

0.2 - 0.5m	55
0.5 - 1.0m	46
1.0 - 3.0m	11
>3.0m	0



Shelters flood depth >0.2m

Analysis extent

Modelled flood depth (m)

- ≤ 0.2 (not displayed)
- ≤ 0.5
- ≤ 1
- ≤ 2
- ≤ 3
- > 3

*Modelled flood extents calculated based on 25-year design storm derived from IDF curves for the city of Gaziantep, Turkey. Peak rainfall intensity is 143.5 mm/hr and the total storm depth is 97.7 mm over 16 hours.

Satellite imagery:
P001 from 21 February 2021

Source: US Department of State, Humanitarian Information Unit, NextView license

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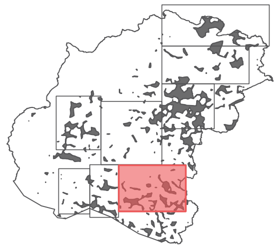
FLOOD HAZARD CLASSIFICATION - Bhora Cluster

87

Shelters are exposed to a flood hazard* categorised as a medium severity hazard or higher based on modelled depth x velocity

Breakdown of number of shelters by the level of severity of flood hazards

Medium	32
High	45
Very High	9
Extreme	1



Shelters exposed to flood hazard (medium hazard or greater)

Analysis extent

Flood hazard classification

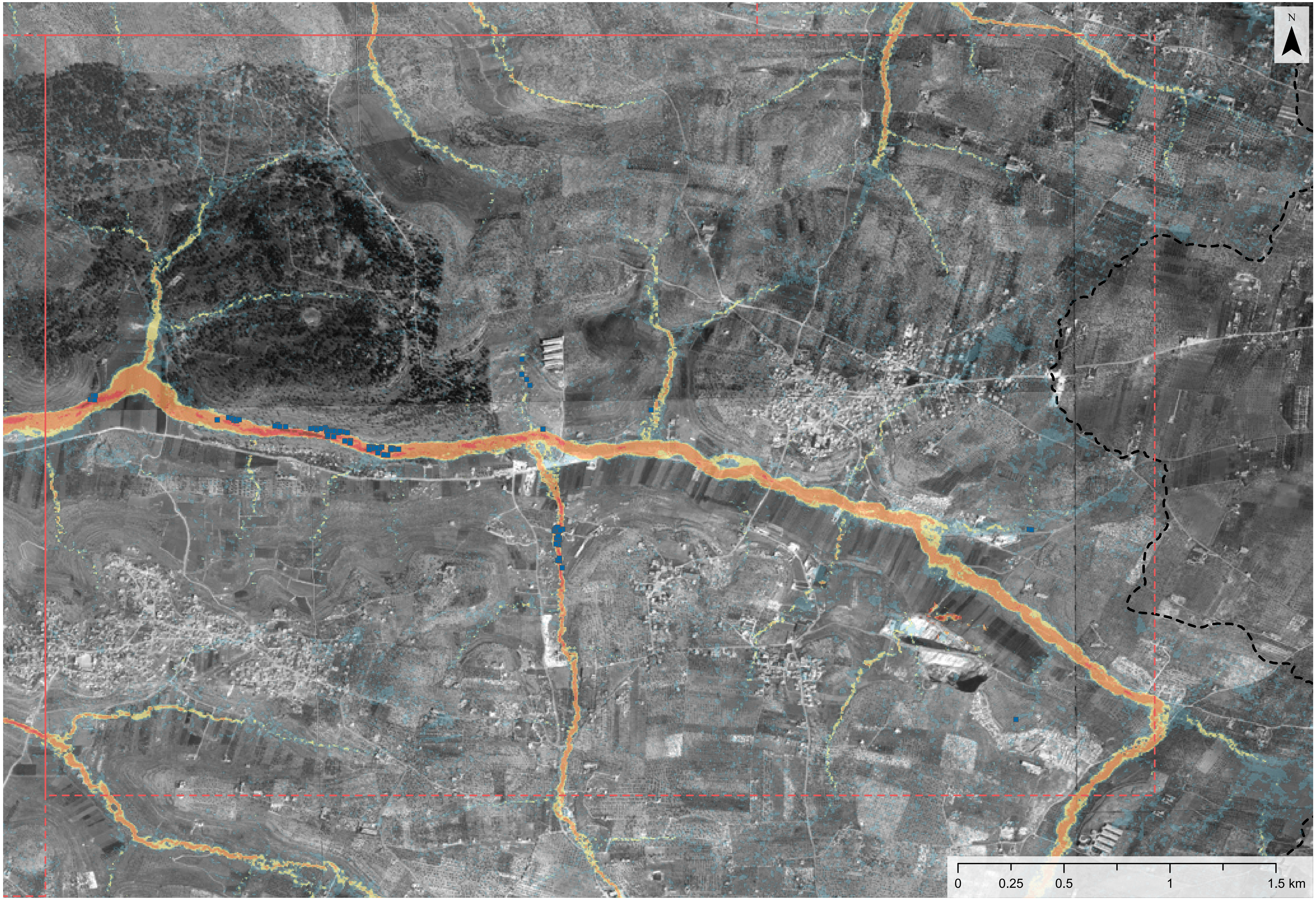
Values

- Low
- Medium
- High
- Very High
- Extreme

*Flood hazard classification based on simplified D*V severity grid symbolisation categories by FEMA : Guidance for Flood Risk Analysis and Mapping

Satellite imagery:
P001 from 21 February 2021

Source: US Department of State, Humanitarian Information Unit, NextView license



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MODELLED FLOOD DEPTH RESULTS - Taltuneh Community

198

Shelters are estimated to lie within the modelled flood extents*, where flood depth exceeds 200mm.

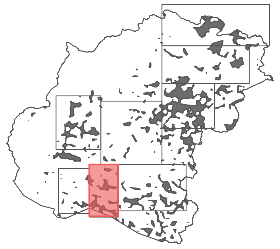
Breakdown of number of shelters by ranges of flood extents

0.2 - 0.5m 61

0.5 - 1.0m 110

1.0 - 3.0m 27

>3.0m 0



Shelters flood depth >0.2m

Analysis extent

Modelled flood depth (m)

≤ 0.2 (not displayed)

≤ 0.5

≤ 1

≤ 2

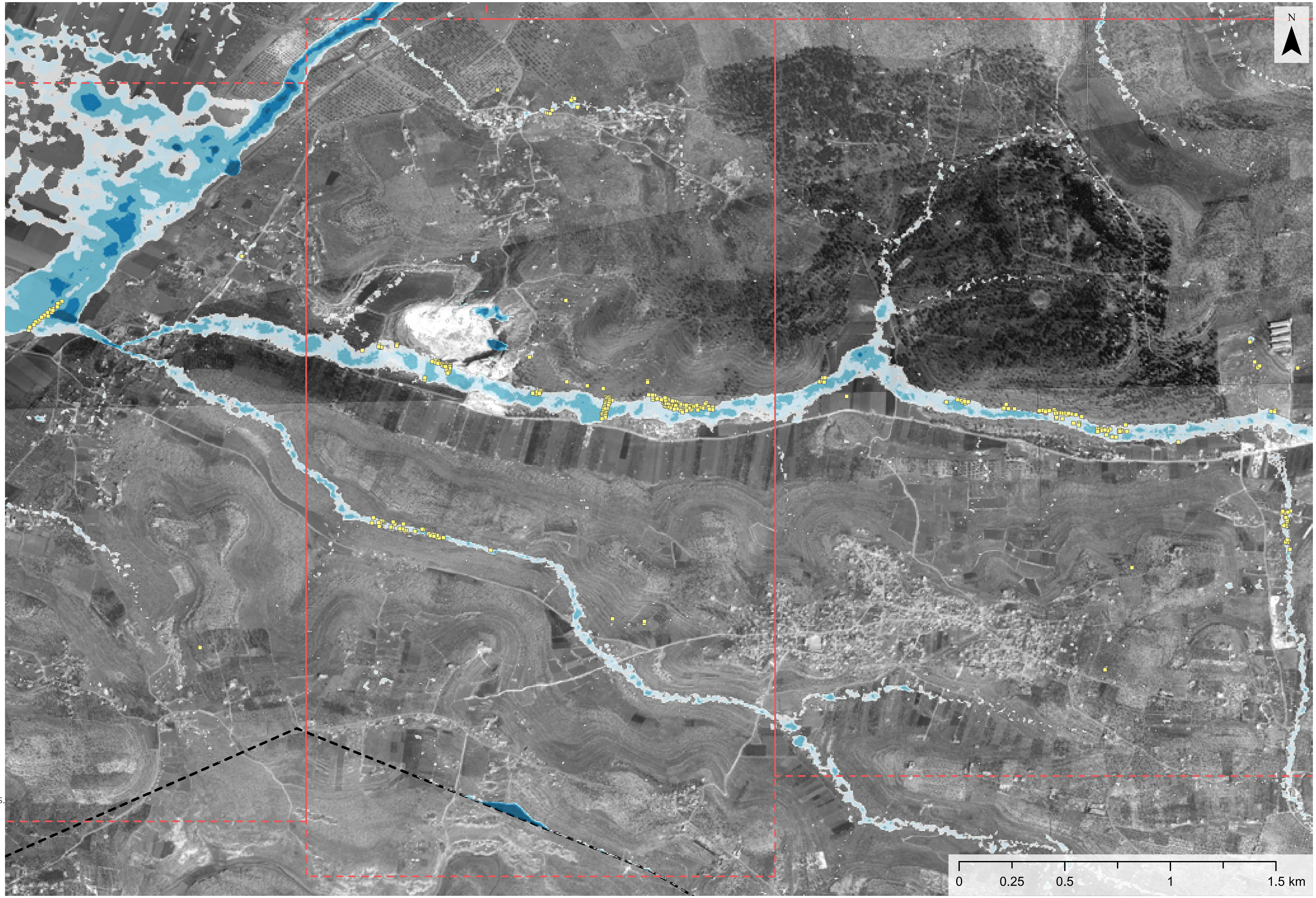
≤ 3

> 3

*Modelled flood extents calculated based on 25-year design storm derived from IDF curves for the city of Gaziantep, Turkey. Peak rainfall intensity is 143.5 mm/hr and the total storm depth is 97.7 mm over 16 hours.

Satellite imagery:
P001 from 21 February 2021

Source: US Department of State, Humanitarian Information Unit, NextView license



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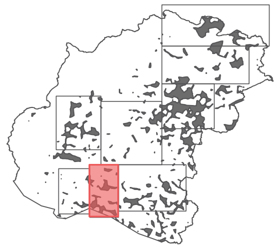
FLOOD HAZARD CLASSIFICATION - Taltuneh Community

178
Shelters are exposed to a flood hazard* categorised as a medium severity hazard or higher based on modelled depth x velocity

Breakdown of number of shelters by the level of severity of flood hazards

Medium	50
High	101
Very High	23
Extreme	4



Shelters exposed to flood hazard (medium hazard or greater)
Analysis extent

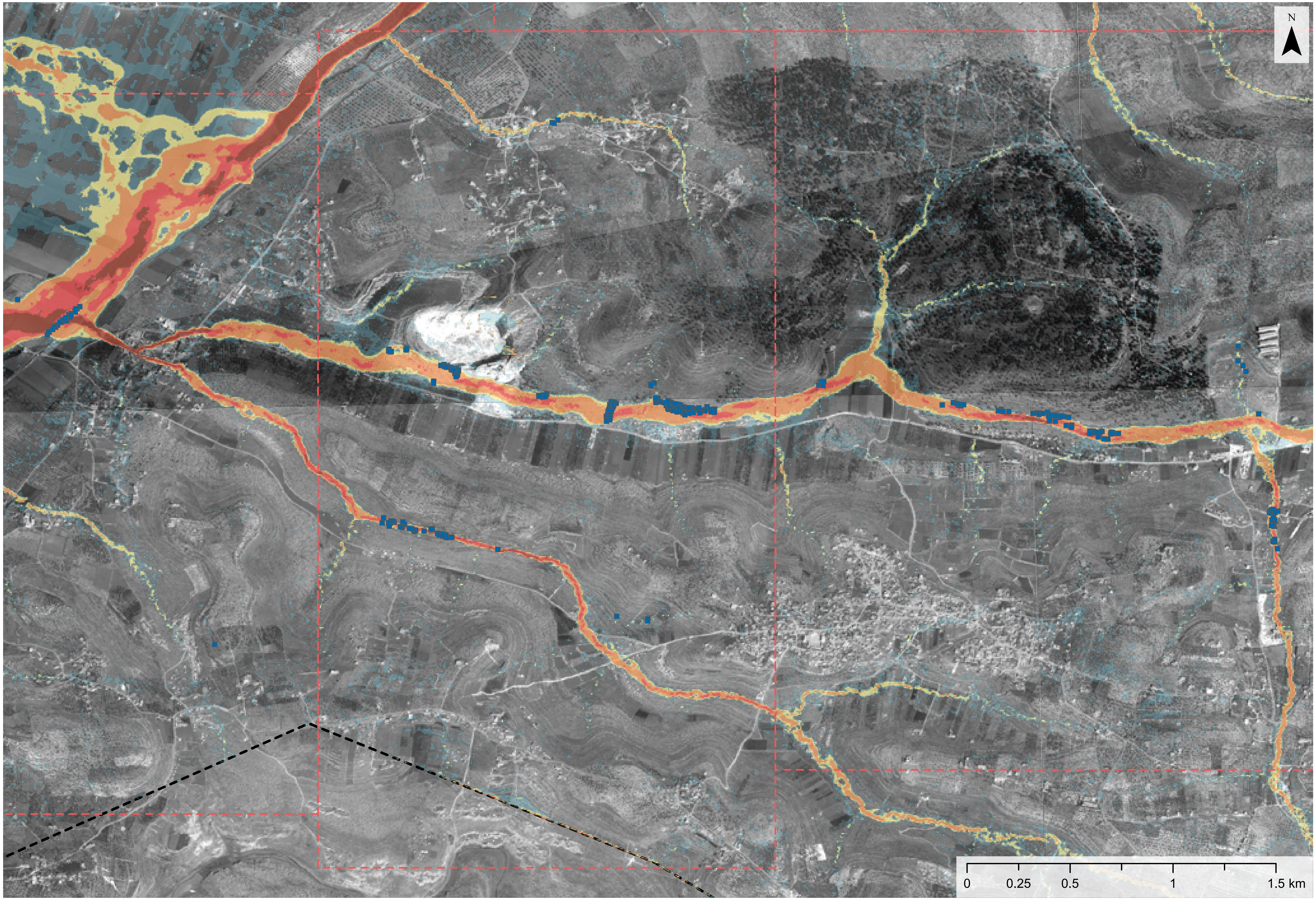
Flood hazard classification
Values

- Low
- Medium
- High
- Very High
- Extreme

*Flood hazard classification based on simplified D*V severity grid symbolisation categories by FEMA : Guidance for Flood Risk Analysis and Mapping

Satellite imagery:
P001 from 21 February 2021

Source: US Department of State, Humanitarian Information Unit, NextView license



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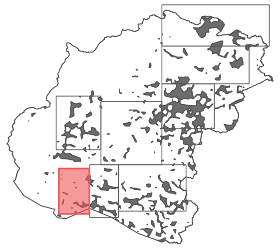
MODELLED FLOOD DEPTH RESULTS - Bir Al Tayeb Community

30

Shelters are estimated to lie within the modelled flood extents*, where flood depth exceeds 200mm.

Breakdown of number of shelters by ranges of flood extents

0.2 - 0.5m	8
0.5 - 1.0m	15
1.0 - 3.0m	7
>3.0m	0



Shelters flood depth >0.2m

Analysis extent

Modelled flood depth (m)

≤ 0.2 (not displayed)

≤ 0.5

≤ 1

≤ 2

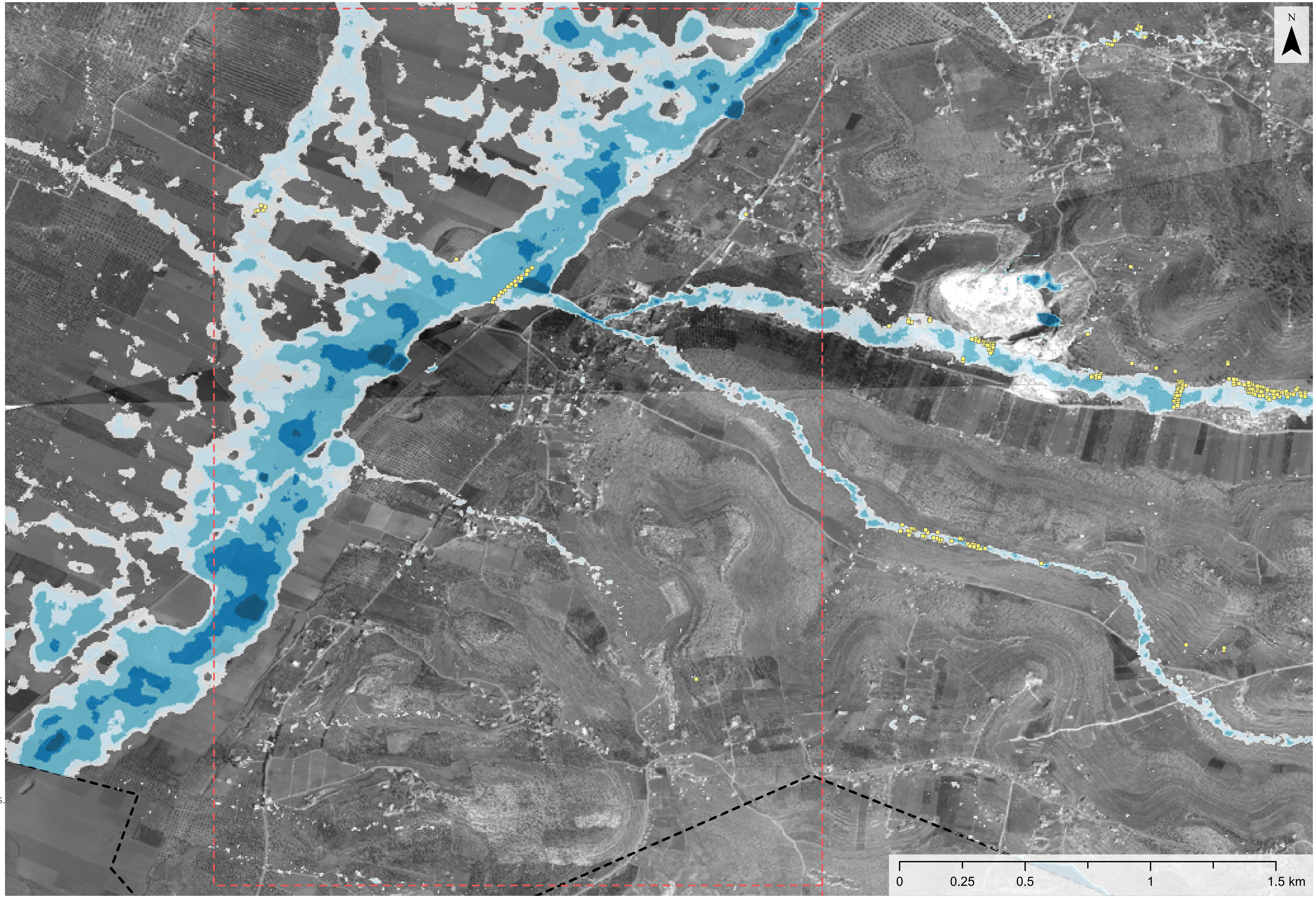
≤ 3

> 3

*Modelled flood extents calculated based on 25-year design storm derived from IDF curves for the city of Gaziantep, Turkey. Peak rainfall intensity is 143.5 mm/hr and the total storm depth is 97.7 mm over 16 hours.

Satellite imagery:
P001 from 21 February 2021

Source: US Department of State, Humanitarian Information Unit, NextView license



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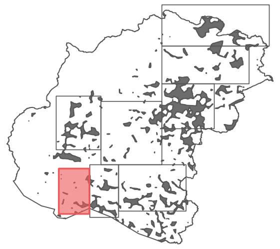
FLOOD HAZARD CLASSIFICATION - Bir Al Tayeb Community

29

Shelters are exposed to a flood hazard* categorised as a medium severity hazard or higher based on modelled depth x velocity

Breakdown of number of shelters by the level of severity of flood hazards

Severity	Shelters
Medium	6
High	18
Very High	5
Extreme	0



Shelters exposed to flood hazard (medium hazard or greater)

Analysis extent

Flood hazard classification

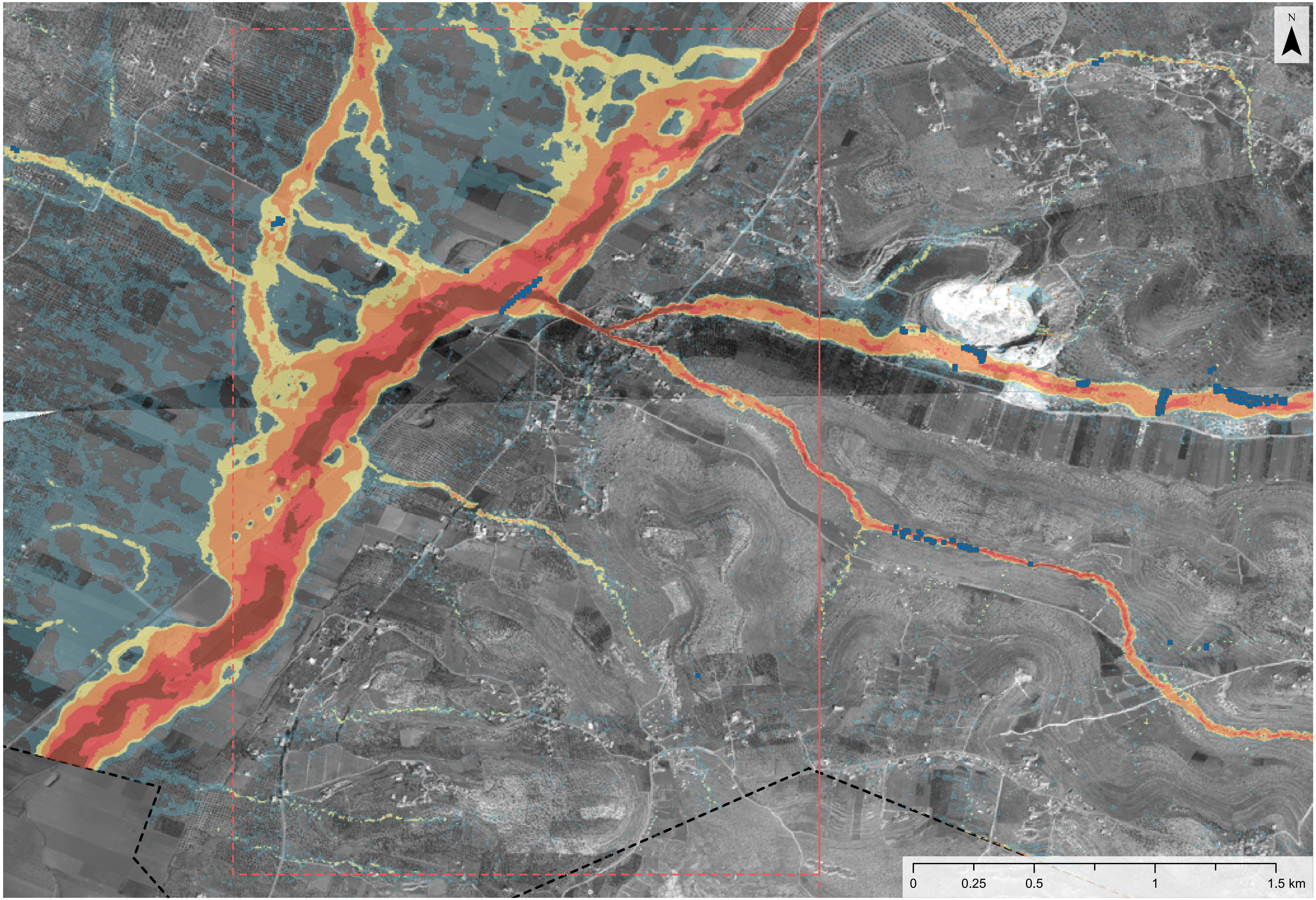
Values

- Low
- Medium
- High
- Very High
- Extreme

*Flood hazard classification based on simplified D*V severity grid symbolisation categories by FEMA : Guidance for Flood Risk Analysis and Mapping

Satellite imagery:
P001 from 21 February 2021

Source: US Department of State, Humanitarian Information Unit, NextView license



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