



BELEDWEYNE

Working paper on

FLOOD RISK

and

URBAN RESILIENCE

Beledweyne, the largest city of Hishabelle State of Somalia, has constantly suffered from devastating floods. Over the past decade, floods have increased in magnitude and recurrence, reaching alarming levels by 2019, where 68% of the city was flooded.

Students from the Institute for Cooperation in Basic Habitability (ICHaB-ETSAM) and colleagues from UN-Habitat Somalia Programme have jointly developed this working paper. It aims to establish the spatial basis for flood risk analysis and urban resilience of Beledweyne.

ICHaB-ETSAM is an academic institution that belongs to the Universidad Politécnica de Madrid (UPM). Since its foundation in 1995, ICHaB has continuously carried out teaching, research and awareness-raising activities in the field of basic habitability with a special focus upon informal settlements.

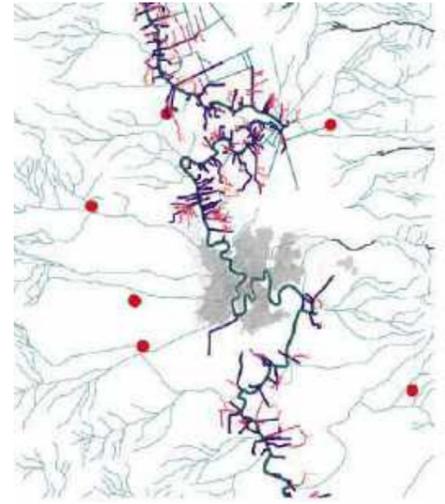
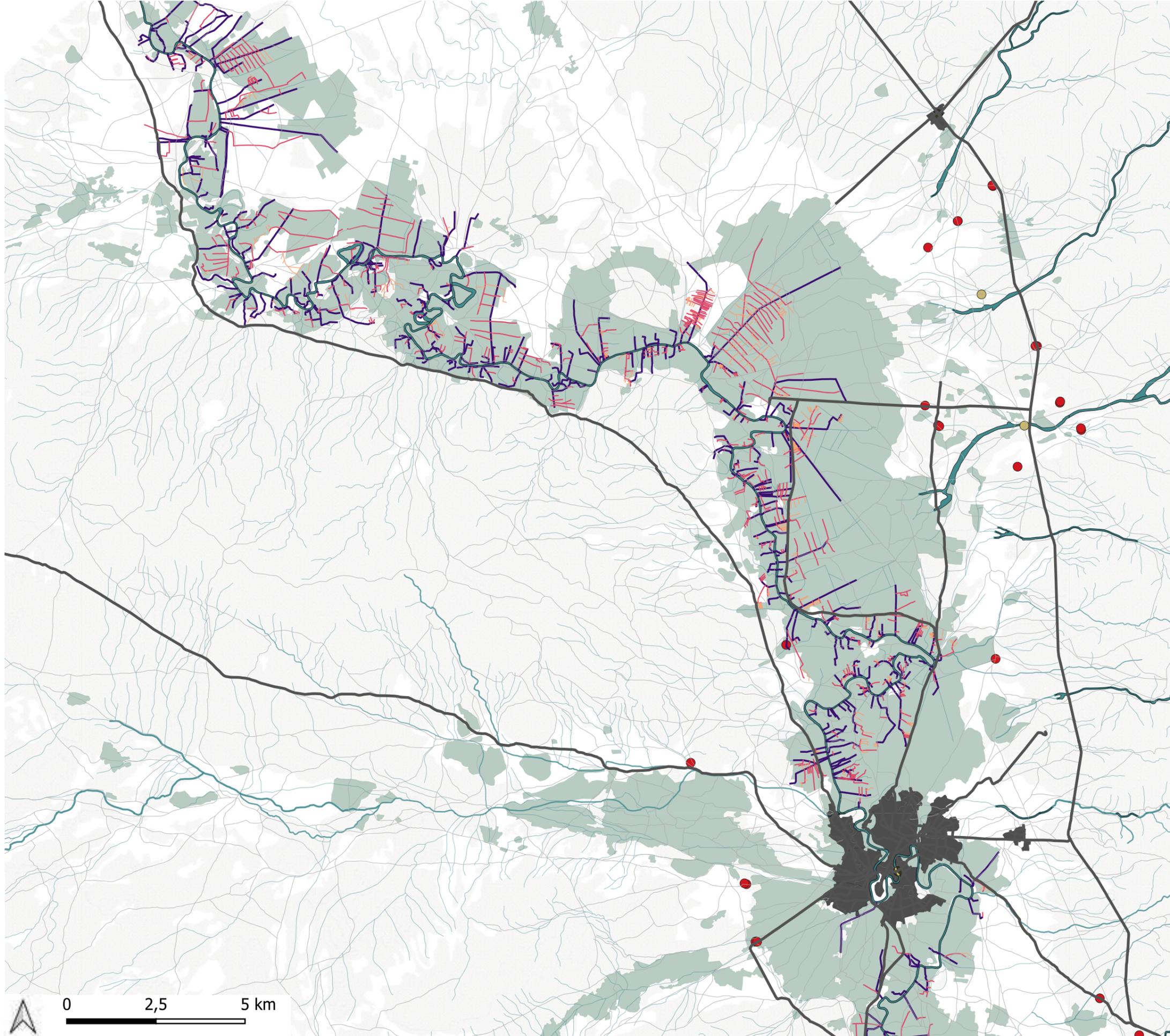
This working paper has been developed under Midnimo II (Unity) project - Support for the Attainment of Durable Solutions in Areas Impacted by Displacement and Returns in Galmudug and Hirshabelle States, funded by United Nations Peacebuilding Fund.

This study has been conceived as a first step to explore long-term solutions to make the city of Beledweyne, including its most vulnerable communities, more resilient to floods and other natural hazards.

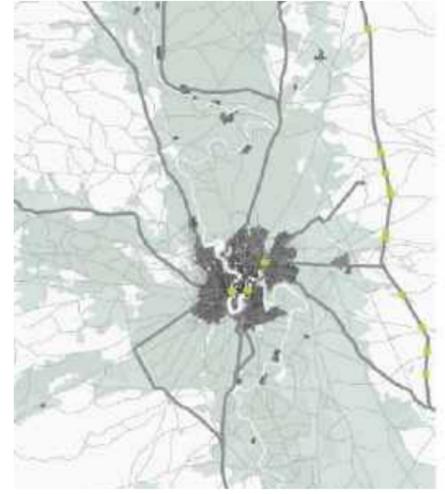
Comments and further inputs to consolidate this paper are highly appreciated. Please send feedback to: unhabitat-som@un.org



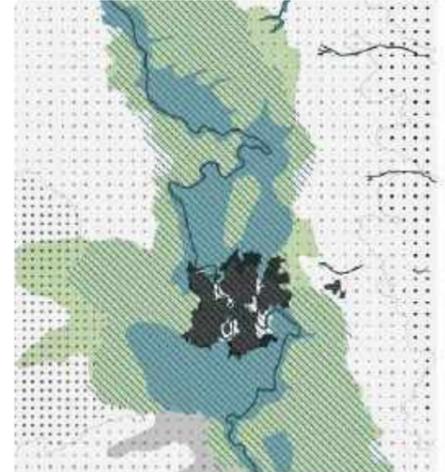
MAP 01 - ANALYSIS Territorial scale



- Irrigation infrastructure
- Direct intake
 - Secondary canal
 - Tertiary canal
 - Dam
 - Dug well



- Primary road
- Secondary road
- Bridge
- Built-up area
- Crops



- Pastoralism (low density)
- Pastoralism (mid density)
- Pastoralism (high density)
- Agropastoral
- Irrigated agriculture
- Rainfed agriculture
- Rangeland
- Wooded vegetation
- Built-up area

In pre-war Somalia, large-scale irrigation schemes existed along the Juba and Shabelle basins. This irrigation system comprised primary, secondary canals and numerous tertiary canals. Currently, the majority of this infrastructure is not functioning, and the area under irrigation has been significantly reduced.

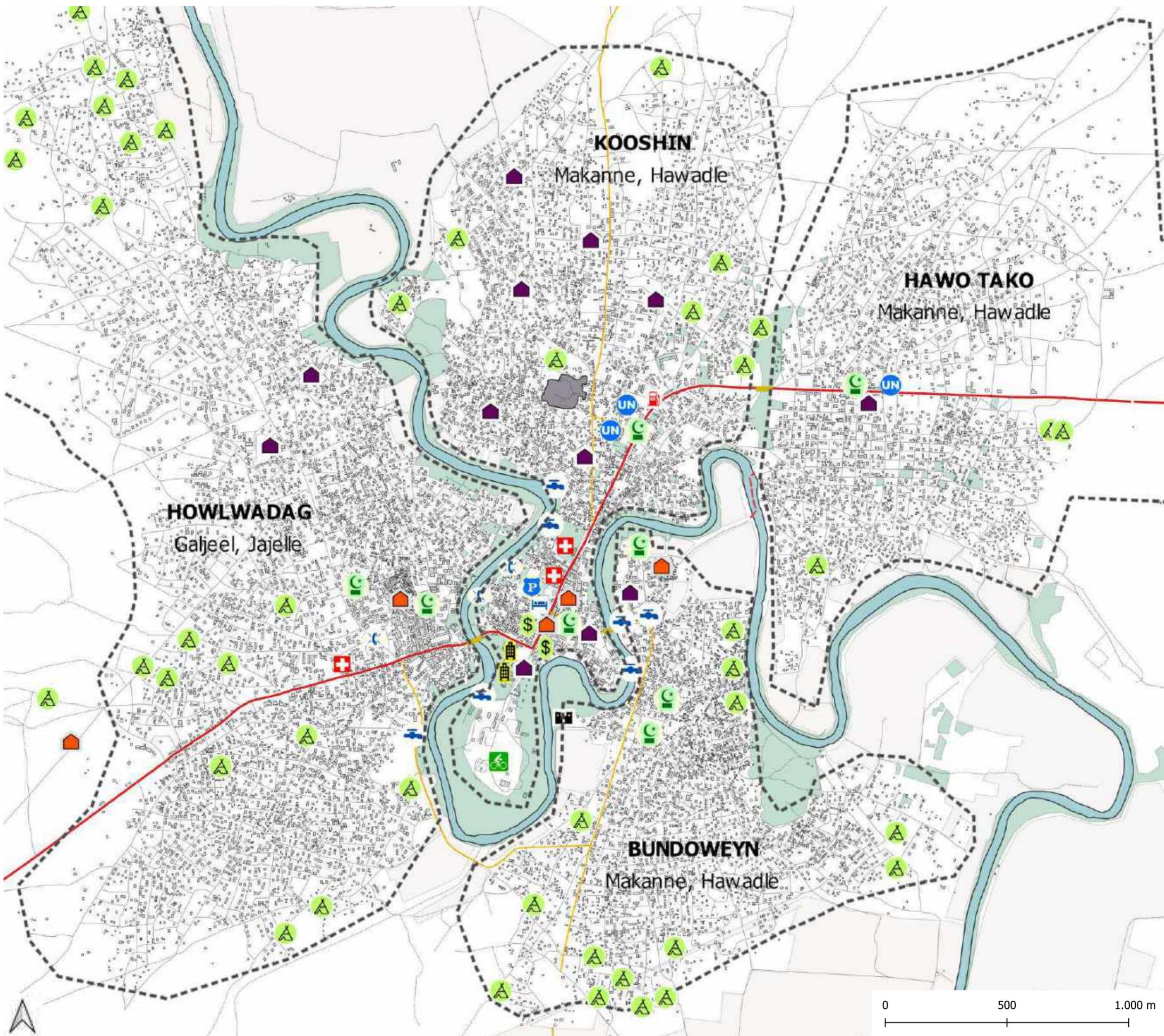
Somalia economy is predominantly agricultural and it depends highly on water availability, which in turn is reliant on rainfall. There are two types of agriculture in Beledweyne area: Rainfed Agriculture characterized by water harvesting, and Irrigated Agriculture.

Land degradation in Somalia is negatively affecting land productivity

Sources (links):

FAO SWALIM ([historical floods](#), [river breakages 2019](#)), UNOSAT ([november 2019 flood](#)) Humanitarian response: [UNICEF](#), [health cluster](#), [OCHA](#)

MAP 02 - ANALYSIS Urban scale

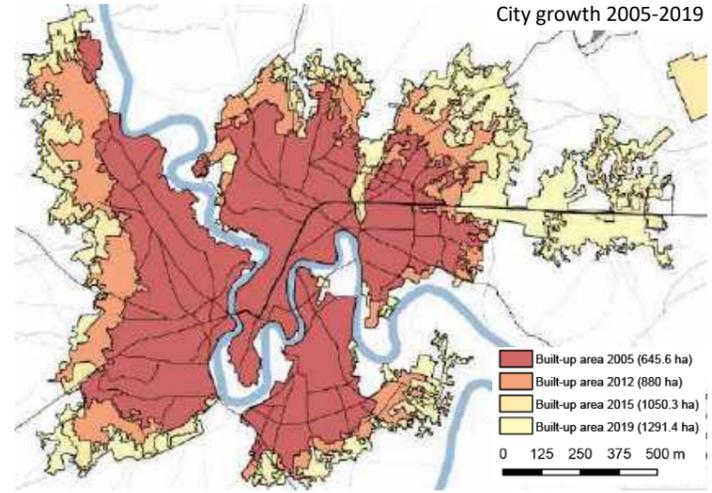


- Legend**
- Bridge
 - Educational
 - River
 - UN
 - Green zone
 - Place of worship
 - Crops
 - Water
 - Cemetery
 - Prison
 - Track
 - Sport venue
 - Street
 - Government
 - Main street
 - Fuel station
 - Primary road
 - Police
 - IDP Camp
 - Telecom
 - Medical
 - Accomodation
 - Bank
 - Market

The urban form is totally defined by the course of the river Shabelle. In the central part of the city, surrounded almost entirely by the meanders of the river, is one of the most dense areas characterized by having the **main urban services of the city: hospitals, markets and government facilities.**

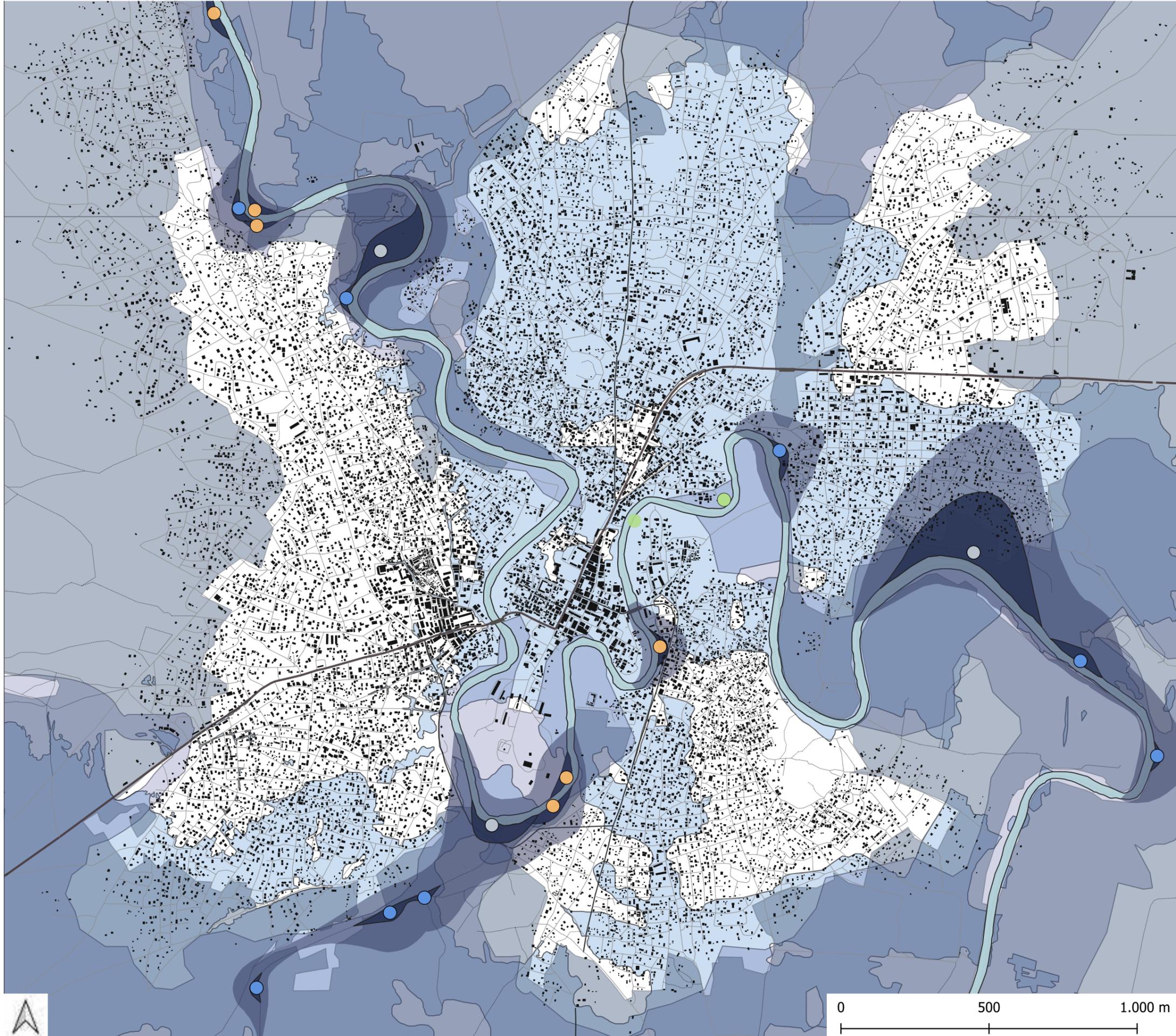
The built-up area in Beledweyne has **grown steadily at an average rate of 5% per year** over the last fifteen years. This growth has mainly taken place in two urban villages and towards two directions: Howlwadag to the west and southwest, and Hawo Tako to the east and northeast. Most likely the city has grown in these directions by fleeing the north and south areas that are prone to continuous flooding. These two urban villages, Kooshin in the north and Bundoweyn in the south, are not expected to grow much further in the future as they border large areas of crops.

In the last five years, due to the lack of any planning system, a dispersed, organic development has sprawled towards the east, along the road that connects the city center with the trade corridor that goes from Mogadishu to Ethiopia. **The fast urbanisation rates of Beledweyne and the lack of proper planning will multiply vulnerability of the urban population, its physical assets and its economy because of the increasing frequency and intensity of natural hazards.**



Sources: Beledweyne Urban Profile (Draft). UN-Habitat

MAP 03 - ANALYSIS Historical floods and river breakages



Legend

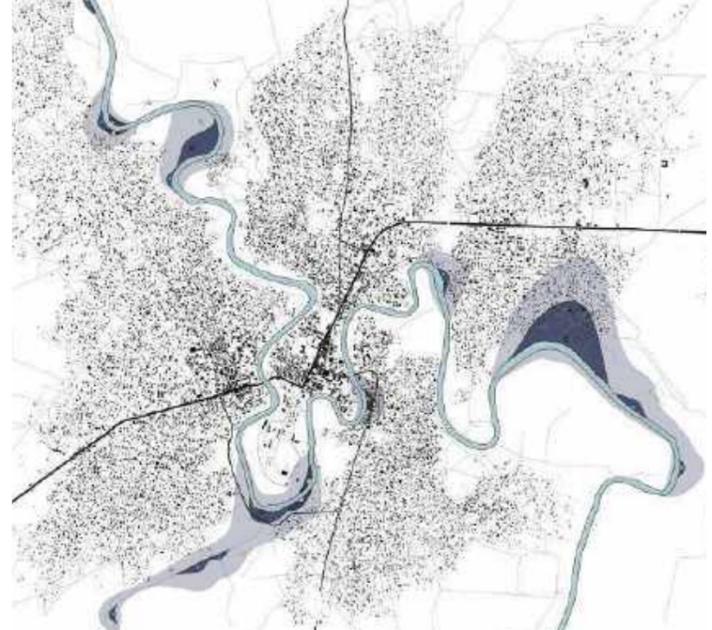
- Flood-prone area (UNOSAT)
- Flooded area (SWALIM 2018)
- Flooded area (UNOSAT 2019)
- Overflow area
- Overflow point
- Open breakage point
- Closed breakage point
- Potential breakage point

Map 03 Historical floods and river breakages analyzes the flooding data of the last few years as well as the points of the Shabelle River overflow. For this purpose, information layers from different sources indicated below have been superimposed.

Historical floods



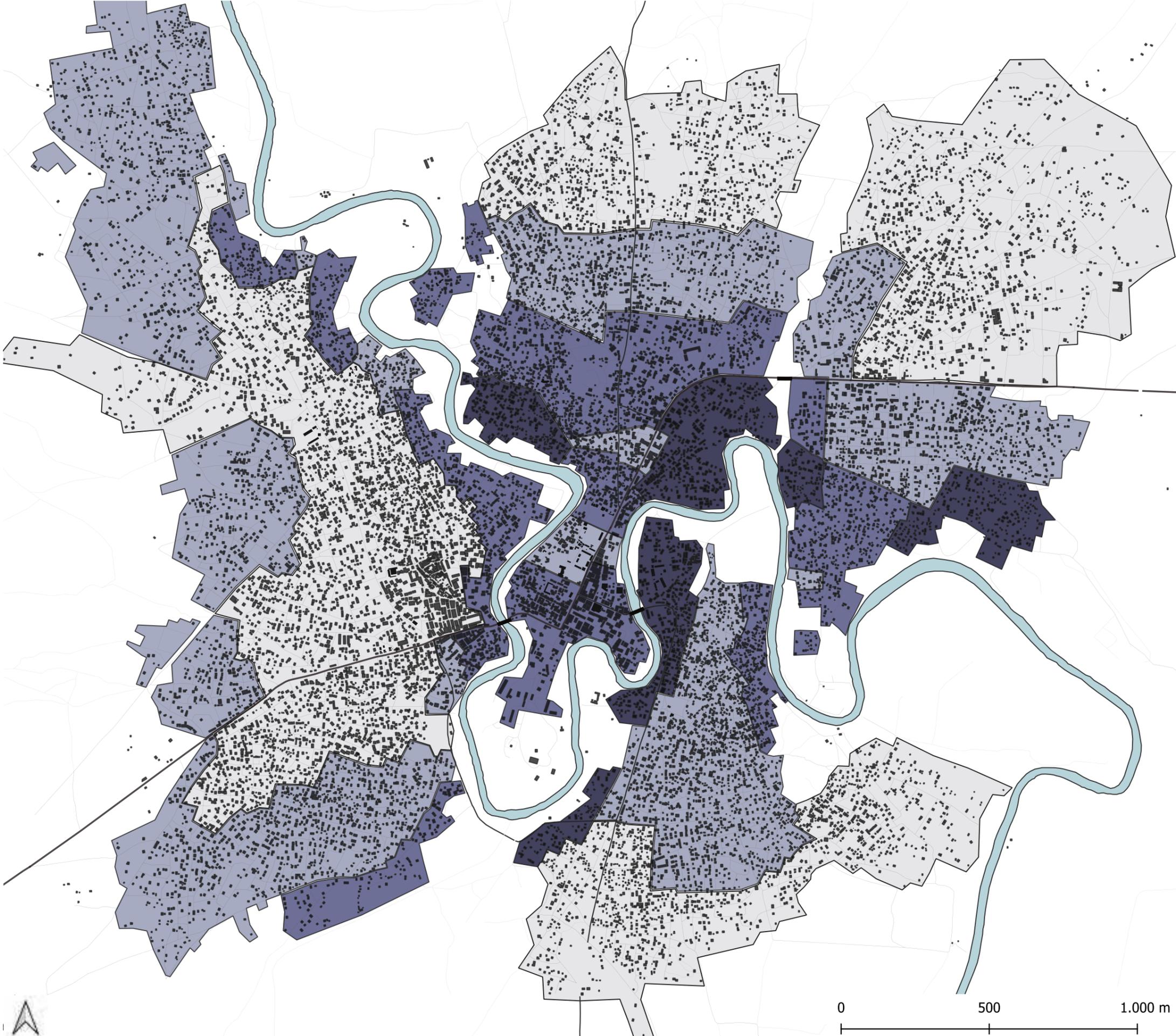
River breakages



Sources (links):

FAO SWALIM ([historical floods](#), [river breakages 2019](#)), UNOSAT ([november 2019 flood](#)) Humanitarian response: [UNICEF](#), [health cluster](#), [OCHA](#)

MAP 04 - ANALYSIS Flood exposure



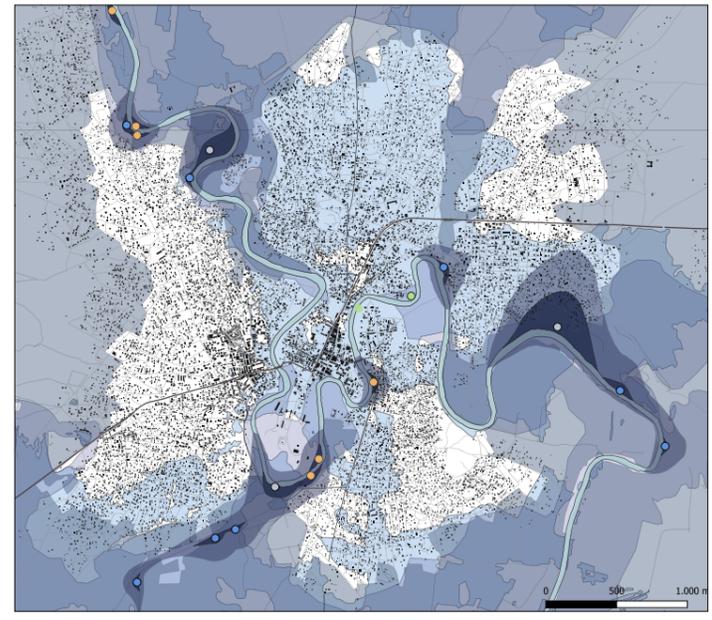
- Legend**
- Very High Exposure
 - High Exposure
 - Medium Exposure
 - Medium - Low Exposure

Flood exposure is the situation of people, infrastructure, housing, production capacities and other tangible human assets located in flood-prone areas.

MAP 04 - ANALYSIS Flood exposure aims to synthesize the different parameters analyzed in the previous map to spatially categorize Beledweyne in different areas according to their level of exposure to flooding.

Beledweyne town is not only flooded by the river overflows caused by rainwater from the highlands of Ethiopia but also flash floods injecting huge amounts of water into the river. The city also rests in a huge depression between mountains that supports an easy flow of flood water from upstream, descending towards the depression zone in the lower stream.

Reference: MAP 03 - ANALYSIS



Sources (links):
 FAO SWALIM ([historical floods](#), [river breakages 2019](#)), UNOSAT ([november 2019 flood](#)) Humanitarian response: [UNICEF](#), [health cluster](#), [OCHA](#)

MAP 05 - ANALYSIS Vulnerability



Legend

- < 400 people
- 401 - 700
- 701 - 1200
- > 1200

- 534 IDP settlement female population
- 930 IDP settlement total population
- 1244 Informal settlement estimated population

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.

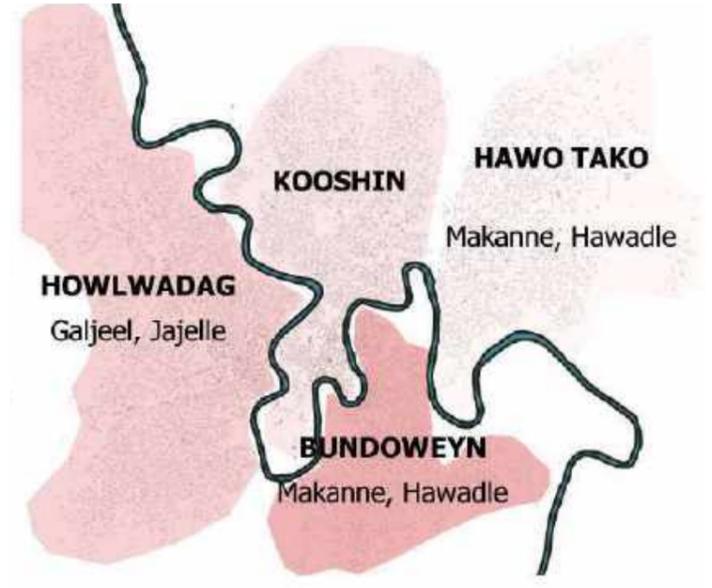
Vulnerability is multidimensional and cannot be measured simply by analyzing a satellite image.

However, **MAP 05 - ANALYSIS Vulnerability** attempts to identify two settlement types of Beledweyne that are particularly vulnerable to flooding:

- IDP camps with gender-disaggregated population data and,
- Informal settlements, identified through visual analysis of the density and irregularity level of the settlements as well as housing building quality.

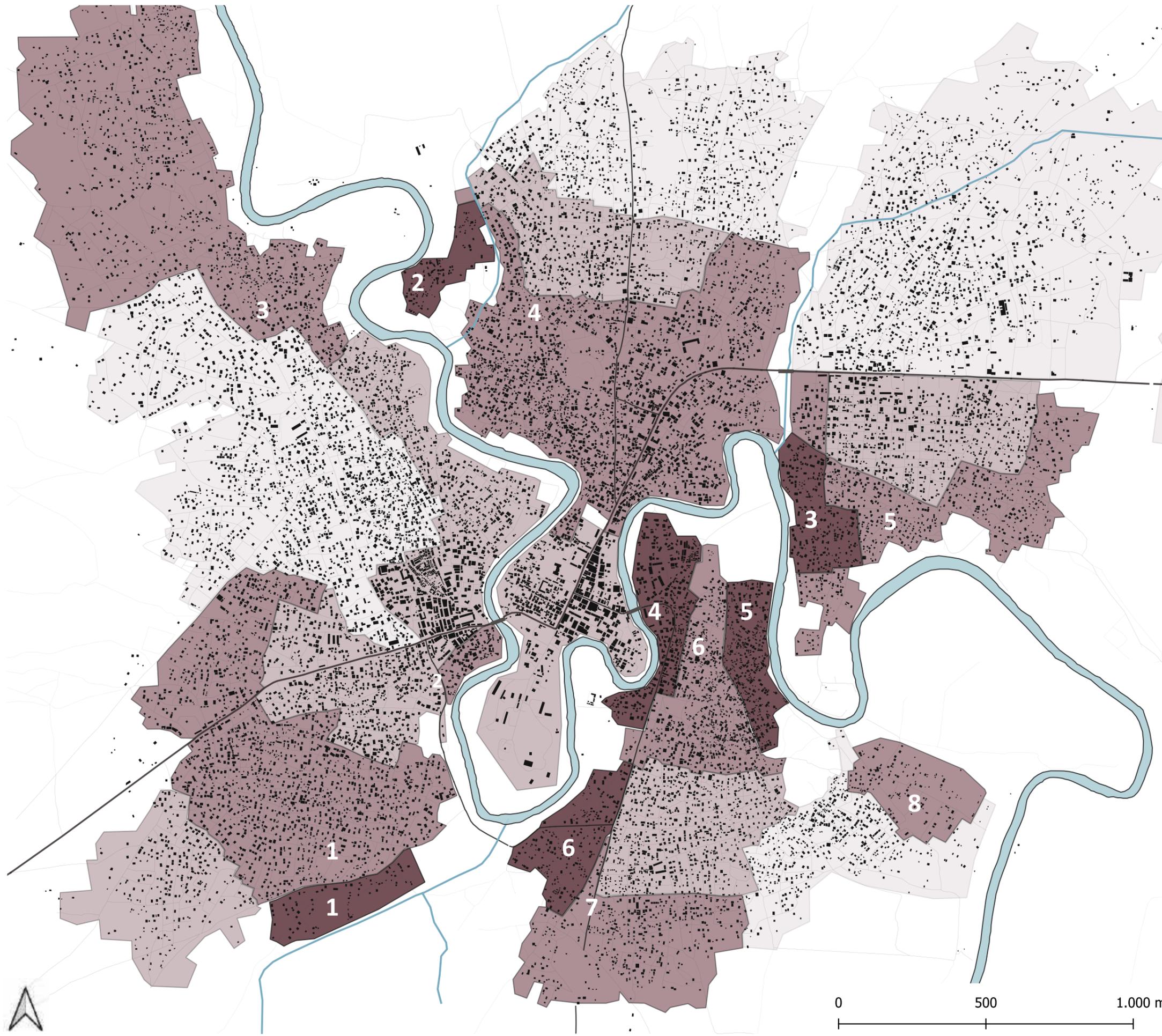
A more detailed analysis of the rest of the factors, including data collected on the ground, is necessary to achieve a more accurate and comprehensive vulnerability diagnosis of Beledweyne

Reference: Urban villages and clan distribution



Sources (links):
 CCCM Cluster 2020 IDP data in Beledweyne, and 2017 information.
 Political Economy Analysis of Urban Networks and Centres in Somalia. Beledweyne City Report. 2018

MAP 06 - ANALYSIS Flood Risk



- Legend**
- Very High Risk
 - High Risk
 - Medium Risk
 - Medium - Low Risk

$$\text{RISK} = \frac{\text{HAZARD} \times \text{EXPOSURE} \times \text{VULNERABILITY}}{\text{CAPACITY}}$$

MAP 06 - ANALYSIS Flood Risk aims to analyse the flood risk levels by overlaying the **MAP 04 - ANALYSIS Flood exposure** and **MAP 05 - ANALYSIS Vulnerability**

The map is complemented by the table below which aims to estimate through GIS analysis the population exposed to different levels of risk both in IDP camps and informal settlements.

	TOTAL INDIVIDUALS	IDP settlements		informal settlements		
		# households	individuals	households	individuals	
VERY HIGH RISK	18,053	9	1,310	7860	1,671	10,193
1		1	213	1278	133	811
2		2	571	3426	192	1,171
3		1	73	438	267	1,629
4					395	2,410
5		3	237	1422	443	2,702
6		2	216	1296	241	1,470
HIGH RISK	70,754	30	3,786	22,716	7,875	48,038
1		9	648	3888	1,700	10,370
2					95	580
3		8	1,431	8586	1,155	7,046
4		4	722	4332	2,350	14,335
5		2	200	1200	793	4,837
6					797	4,862
7		5	485	2910	725	4,423
8		2	300	1800	260	1,586

Reference: Overlay of Map4 Exposure + Map3 Vulnerability

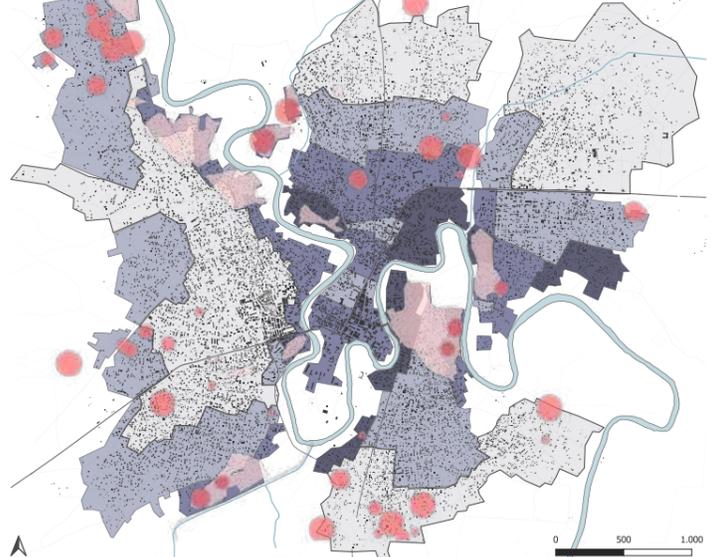
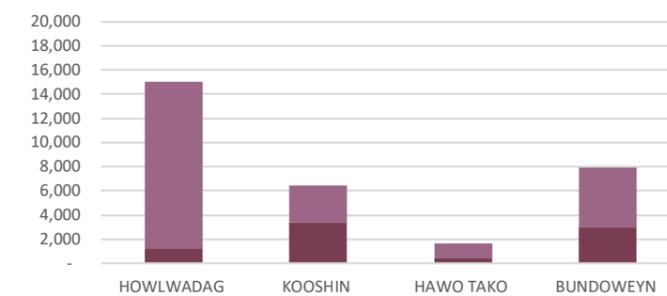


TABLE 01 - ANALYSIS Population at Flood Risk

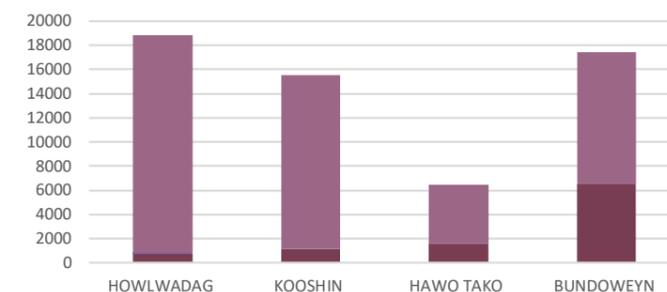
NEIGHBOURHOOD	RISK LEVEL	(Map ref #) Site Name	Households	Individuals	Male (0 - 4)	Female (0 - 4)	Male (5-17)	Females (5-17)	Male (18-59)	Female (18-59)	Male (> 60)	Female (> 60)	Total male	Total female	Disabled
HOWLWADAG	VERY HIGH RISK	(1) Bardaale	120	720	108	132	89	91	112	128	27	33	336	384	15
KOOSHIN	VERY HIGH RISK	(2) Billsdild	271	1,626	248	250	218	252	175	201	95	187	736	890	8
KOOSHIN	VERY HIGH RISK	(2) Buloqorah	300	1,800	301	323	287	307	189	185	96	112	873	927	21
HAWO TAKO	VERY HIGH RISK	(3) Gabooye2	73	438	74	72	89	93	40	46	11	13	214	224	4
BUNDOWEYN	VERY HIGH RISK	(5) Barwaaqo	88	528	80	90	100	120	50	82	2	4	232	296	5
BUNDOWEYN	VERY HIGH RISK	(5) Bilan 2	54	564	61	80	162	168	42	45	3	3	268	296	3
BUNDOWEYN	VERY HIGH RISK	(5) Lafweyn	95	570	92	98	123	162	21	24	22	28	258	312	25
HOWLWADAG	VERY HIGH RISK	(1) El - Ali	93	558	90	61	110	89	88	95	11	14	299	259	4
BUNDOWEYN	VERY HIGH RISK	(6) Doonsubagle G.	162	972	144	152	133	129	114	118	89	93	480	492	17
BUNDOWEYN	VERY HIGH RISK	(6) Towliiq	54	324	36	62	64	68	38	48	3	5	141	183	-
HOWLWADAG	HIGH RISK	(1) Asal	70	420	67	73	100	110	22	26	9	13	198	222	-
HOWLWADAG	HIGH RISK	(1) Beerey	73	438	63	57	83	61	58	67	23	26	227	211	34
HOWLWADAG	HIGH RISK	(1) Bulsho	80	480	73	90	82	85	65	70	6	9	226	254	2
HOWLWADAG	HIGH RISK	(1) Doofil	85	510	119	153	43	77	30	61	18	9	210	300	3
HOWLWADAG	HIGH RISK	(1) Fabxi 1	97	582	120	112	103	83	56	81	11	16	290	292	19
HOWLWADAG	HIGH RISK	(1) Fabxi 2	78	468	58	98	112	122	28	30	8	12	206	262	8
HOWLWADAG	HIGH RISK	(1) Qaatumo	70	420	68	72	95	115	18	22	12	18	193	227	6
HOWLWADAG	HIGH RISK	(1) Rajo2	50	300	38	62	52	68	28	33	8	11	126	174	3
HOWLWADAG	HIGH RISK	(1) Dabadeey	45	270	42	48	67	68	15	17	5	8	129	141	5
HOWLWADAG	HIGH RISK	(3) Alla-amin2	379	2,274	248	320	540	670	220	260	7	9	1,015	1,259	2
HOWLWADAG	HIGH RISK	(3) Alla-Suge	207	1,242	165	249	184	230	175	190	20	29	544	698	2
HOWLWADAG	HIGH RISK	(3) Barakac Sigaaloo	40	240	35	45	52	68	12	18	4	6	103	137	12
HOWLWADAG	HIGH RISK	(3) Dayax Siigaalow	80	480	70	92	118	122	28	30	12	8	228	252	4
HOWLWADAG	HIGH RISK	(3) Iftin	260	1,560	180	340	263	295	270	290	8	14	621	939	13
HOWLWADAG	HIGH RISK	(3) Nasri 2	110	660	102	110	170	160	42	45	13	18	327	333	11
HOWLWADAG	HIGH RISK	(3) Naxariis	155	930	100	210	187	199	102	115	7	10	396	534	3
HOWLWADAG	HIGH RISK	(3) Tawakal2	200	1,200	210	190	280	320	75	90	15	20	580	620	5
KOOSHIN	HIGH RISK	(4) Gurmad iyo Gargar	142	852	123	131	111	118	98	106	76	89	408	444	15
KOOSHIN	HIGH RISK	(4) Nasteho	300	1,800	280	320	438	462	107	118	33	42	858	942	10
KOOSHIN	HIGH RISK	(4) Rabi yasir	60	360	55	65	85	90	26	27	5	7	171	189	-
HOWLWADAG	HIGH RISK	(4) Wabi-Shabele	220	1,320	241	245	158	150	189	252	66	19	654	666	19
HAWO TAKO	HIGH RISK	(5) Badbaado	80	480	68	92	108	132	30	28	9	13	215	265	10
HAWO TAKO	HIGH RISK	(5) Birmaal	120	720	120	140	138	145	72	65	18	22	348	372	15
BUNDOWEYN	HIGH RISK	(7) Cadaani	37	222	38	41	27	33	19	30	14	20	98	124	11
BUNDOWEYN	HIGH RISK	(7) Daryeel Bundoweyn	100	600	111	94	71	85	96	82	29	32	307	293	11
BUNDOWEYN	HIGH RISK	(7) Jabaanjiblow	60	360	57	63	87	93	14	17	12	17	170	190	8
BUNDOWEYN	HIGH RISK	(7) Midnimo	217	1,302	211	245	157	201	175	145	77	91	620	682	7
BUNDOWEYN	HIGH RISK	(7) Cadileey	71	426	81	87	55	63	41	47	24	28	201	225	9
BUNDOWEYN	HIGH RISK	(8) Doomeey	250	1,500	150	225	450	300	125	130	48	72	773	727	4
BUNDOWEYN	HIGH RISK	(8) Kulmiye	50	300	51	41	65	53	33	42	8	7	157	143	2
	MED. LOW RISK	Ceynta	162	972	152	172	195	210	98	107	16	22	461	511	7
	MED. LOW RISK	Gaboya 1	40	240	26	47	41	45	33	40	3	5	103	137	4
	MED. LOW RISK	Guhaad1	120	720	108	132	135	165	70	80	13	17	326	394	5
	MED. LOW RISK	Jumbur (7)	323	1,938	258	388	323	450	196	270	23	30	800	1,138	2
	MED. LOW RISK	Kulan	273	1,638	303	243	399	420	101	112	27	33	830	808	4
	MED. LOW RISK	Kutimbo	254	1,524	291	217	183	223	205	247	73	85	752	772	49
	MED. LOW RISK	Nasiib (1)	420	2,520	412	571	343	288	341	368	101	96	1,197	1,323	20
	MED. LOW RISK	Nuuriyoww Tawakal (7)	369	2,214	319	326	296	319	257	264	213	220	1,085	1,129	7
	MED. LOW RISK	Qaboobe	142	852	134	150	218	242	41	45	9	13	402	450	3
	MED. LOW RISK	Shabele	160	960	161	146	127	125	135	125	63	78	486	474	7
	MED. LOW RISK	Shiilow	79	474	57	64	71	81	77	89	13	22	218	256	4
TOTAL IDPs (CCCM cluster data February 2020)			7,438	44,868	6,799	7,886	8,087	8,825	4,692	5,253	1,518	1,808	21,096	23,772	467

RINAL DISPLACED PERSONS

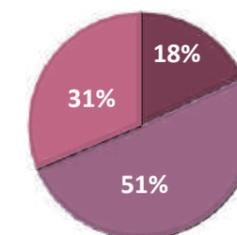
IDP sttlements population at risk by neighborhood



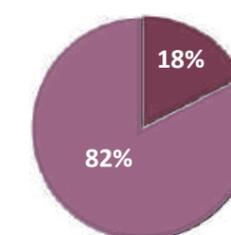
Informal sttlements population at risk by neighborhood



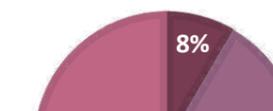
IDP settlements population



Informal settlements population



Beledweyne population



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