Open Cities Kinshasa

FINAL REPORT

WORLD BANK GROUP

GFDRR
Global Facility for Disaster Reduction and Recovery

CREWS CLIMATE RISK & EARLY WARNING SYSTEMS

OSFAC

Potentiel3.0

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Acknowledgments

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We congratulate and thank the teams at OSFAC, Potential 3.0 and the partners who spared no effort in carrying out this important work on flooding and erosion in the city of Kinshasa.

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List of acronyms

ACGT	Agence Congolaise de Grands Travaux
BEAU	Bureau d'Etude et d'Aménagement Urbains
CRREBaC	Centre de Recherche des Ressources en Eau du Bassin du Congo
IGC	Institut Géographique du Congo
INBTP	Institut National des bâtiments et Travaux Publics
INS	Institut National de Statistique
ISAU	Institut Supérieur d'Architecture et d'Urbanisme
METTELSAT	Agence National de Météorologie et Télédétection par Satellite
ODK	OpenDataKit
OMK	OpenMapKit
OR	Office des Routes
OSFAC	Observatoire Satellital des Forêts d'Afrique Centrale
OSM	OpenStreetMap
OVD	Office des Voiries et Drainage
PNA	Programme National d'Assainissement
QA/QC	Quality assessment and Quality control
UNIKIN	Université de Kinshasa
URF-GRN	Unité Recherche et Formation- Gestion des Risques Naturelles

PART 1 : Project Overview

1.1 Problem statement

Floods and erosions problems affect populations living in areas exposed to these natural disasters (river banks, steep or hilly areas). These populations are mostly poor and live in fragile structure housing.
The major problem addressed by this project is related to natural disasters, particularly floods and erosions in Kinshasa urban areas. Indeed, the pressure for housing, resulting in uncontrolled construction in undeveloped areas, and causes the road and drainage infrastructure deterioration. In Kinshasa, the combined effect of the non-implementation of a town plan, the predominantly sandy soil and a particularly strong rainfall regime, induces a greater occurrence of erosive phenomena and floods. These natural disasters usually occur during the rainy season as a heavy rainfall result. In Kinshasa this period is located between the months of September and June of each year, with peaks between March and May, and affect areas most often located on hillsides, low-lying areas and those bordering rivers.
These disasters cause among other things: home and property material loss; human lives loss; populations relocation; Increasing of population poverty and insecurity; etc.
Thus, the consequences of no intervention will lead to the aggravation of these natural disasters which will result in: the disappearance of some neighborhoods; homes and property material loss; population relocation; poverty aggravation; insecurity upsurge; etc.
However, solving these problems will help on:

- populations Security;
- homes and property material protection;
- population sedentarization;
- population poverty reduction;
- viable urban plan establishment;
- etc.

1.2 Overview of the project

In recent years, it is common to hear through the media, information about the loss of homes and infrastructure, loss of human lives, forced displacement of populations due to floods and erosion. In fact, these natural disasters are among the major challenges facing the world today. Kinshasa is not immune to this reality.

Kinshasa is a city characterized by the dynamism of its population. Since the 1950s, the city has experienced high annual growth rates supported by the strong natural growth of the urban population and rural exodus. Its population is now nearly 30 times higher than in 1960. In this densely populated city, floods and erosion problems are becoming recurrent, particularly in areas that are highly exposed

to natural disasters such as hillsides, river banks, etc. The intensity and frequency of these phenomena are increased by the combined effect of the failure to carry out a specific urbanization plan, a predominantly sandy soil, a particularly intense rainfall regime and a climate change increasingly felt (heat waves, torrential rains, etc.) causing tragic losses in human life and materials.

The vulnerability of the population living there is increased by poverty, precariousness and unsanitary housing, as well as the lack of urban amenities that generally characterize peri-urban spaces (lack of specific development, limited public transit access to the downtown area that polarizes most urban jobs, goods and services, etc.).
Managing urban growth while strengthening the resilience of its population to natural hazards and the impacts of climate change is becoming an important challenge as urban populations and vulnerability increase.

By initiating the Open Cities Africa Project in Kinshasa, the World Bank and its partners are making a major contribution to the prevention of natural disaster risks and to improving the populations resilience. The Open Cities Kinshasa project was carried out by OSFAC (Observatoire Satellital des Forêts d'Afrique Centrale) and Potential 3.0.

Its objective was to develop tools to enable key stakeholders, mainly decision-makers, to use information on the risks of natural disaster and infrastructure exposed on the ground (houses, roads, drainage networks). Further, it will help the government to better meet the challenge of managing urban growth while strengthening the resilience of the population to natural hazards and the impacts of climate change.
The project was implemented in the urban watershed areas of the N'Djili and Tshangu rivers, covering an area of 64.64 Km^2 in 70 neighborhoods of 8 communes in the city of Kinshasa.

Three main features have marked this project: (i) the participatory approach which allowed close collaboration between several stakeholders with complementary but sometimes divergent concerns, (ii) the use of opensource and free access tools for field data collection, analysis and processing (iii) a user-centered design of the tools through which the choice of products was made by the users.

The information gathered from various sources (partner institutions, OSM platform, field surveys, scientific and local communities, etc.) is first "cleaned" before being uploaded to OSM database therefore analyzed in order to produce a series of maps in paper or interactive format.

In the end, the Open Cities Kinshasa project produced relevant and reliable results, among others : (1) a database containing geospatial information on the physical environment, buildings, infrastructure (health, schools/universities, places of worship), roads, drainage network, occupation and use of space,

floods and erosion; (2) a range of 240 maps different from each other by their thematic (general, flood or erosion), by their coverage (project area, municipality or neighborhood) or by their format (A0, A1 and a4); (3) an Atlas with more than a hundred thematic maps on erosion areas and potentially floodable areas in 8 municipalities and 70 neighborhoods.

The success of this project, among others, takes into account the participation of the partners starting with the kick-off workshop, focus group meetings, exchanges on the collection field, validation workshop with the local community and the final workshop.

PART 2 : Data Collection Process

The data collection process consisted in collecting all useful information for the characterization of the targeted disasters (erosion and flooding) and of the infrastructures exposed to these risks (buildings, roads, drainage network) in the project area. It took place in two stages: the collection of existing data and the collection and creation of new data.

2.1 Field Data Collection

2.1.1 Data capture methodology

An assessment list of useful information and potential holders was made. Details are given in Annex 1.

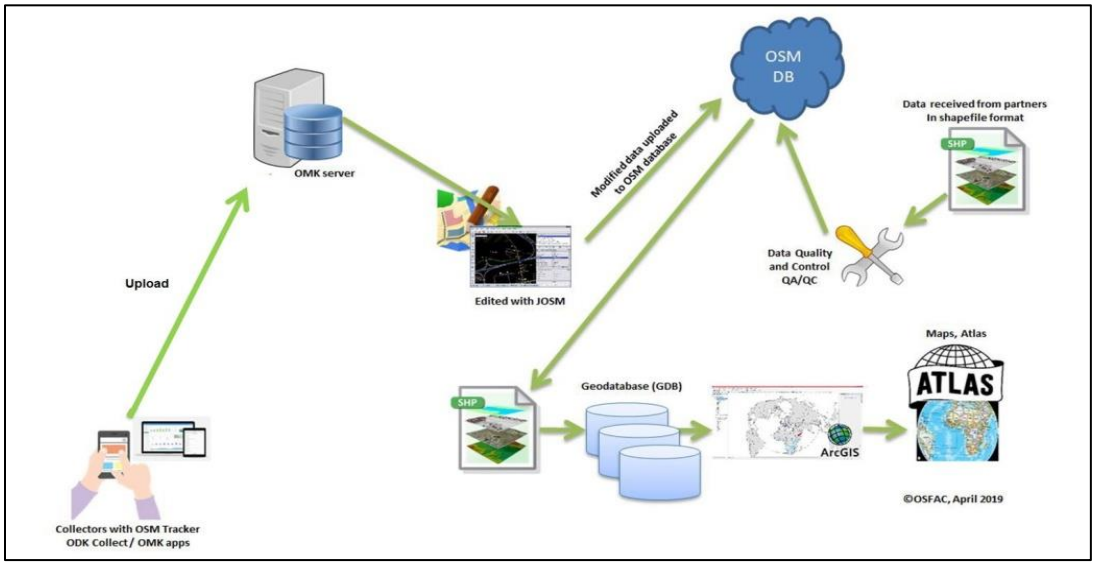


Figure 1. Methodology workflow

2.1.1.1 Existing data collection

The various institutions able to hold the information sought had been invited to take part in the kick-off workshop. This initial contact made it possible to present not only the project's objectives and expected results but also the project's expectations regarding their contribution (data, authorizations, field guides, etc.). Unfortunately, some structures were not able to respond favorably to our request.
In spite of that, we received a range of data, including data on the characterization of the project area's environment (climate, soil, administrative boundaries) and the boundaries of some erosion and flood zones.

Structures	Contribution
ACGT	No data received but they have actively participated to the validation of maps designed and the final workshop
BEAU	We received boundaries from them. They also actively participated to
Cellule Infrastructure	
CENI	No data received
CRGM	No data received but they have participated to the final workshop
CSD	No data received
DDD	No data received
GRN/UNIKIN	We received data on MATETE watershed characterization, meterological data and some boundaries of neighbors
INS	No data received
JICA	No data received
METTELSAT	We received meteorological data
Ministère du Plan	No data received
MONUSCO	No data received
OVD	We received Roads and drainage network data
Potentiel 3.0	Drone imagery
UNFPA	No data received
URF-GRN/UNIKIN	We received data on ravins and landuse

2.1.1.2 Collection and creation of new data

The gap between the existing data collected and the need for data helped to establish the list of items to be digitalized and attributes to be collected in the field.

a Remote mapping of infrastructure and erosions

Digitalization consisted of the mapping of the different elements considered: erosion, flood zones and infrastructure (buildings, road network, drainage network).

- **Buildings remote mapping** was carried out by a multidisciplinary team of 35 people previously trained in the use of mapping with JOSM. Several tasks were created through the HOTOSM Tasking Manager covering the entire project area.
  Below are links to various remote mapping tasks:
  - ✓ https://tasks.hotosm.org/project/4685#bottom
  - ✓ https://tasks.hotosm.org/project/4764#bottom
  - ✓ https://tasks.teachosm.org/project/788
  - ✓ https://tasks.teachosm.org/project/792
  - ✓ https://tasks.hotosm.org/project/5363
  - ✓ https://tasks.teachosm.org/project/840
  - ✓ https://tasks.teachosm.org/project/929
  - ✓ https://tasks.teachosm.org/project/835
  - ✓ https://tasks.teachosm.org/project/839

- **Erosions remote mapping**: available erosions boundaries in the project area were obtained from URF-GRN (University of Kinshasa Centre of research). Others more recent were mapped on the basis of very high spatial resolution and the acquired drone images.
- **Roads remote mapping** missing roads were mapped especially residential roads in almost all the communes with their attributes added or updated. A field data collection with OMK was necessary to add more roads and further correct attributes.

b Drainage mapping

Part of the data on the drainage network of the project area was provided by the Office des Voiries et Drainage (OVD). Additional data was obtained through field data collection with KoBoCollect. More process was required to obtain the data from the KoBoToolbox platform in a geospatial format (shapefile) through a Python script.

c Delineation of flood zones

Some the floodable areas boundaries of the MATETE river watershed were provided by the Congo Basin Water Resources Research Center (CRREBaC) using a simulation of ASTER DEM data. They carried out a field trip to the MAZIBA and MALEMBA neighborhoods to validate their work and also to have precise measurements of the water levels that the area has already experienced.

OSFAC also generated the other boundaries by simulation using SRTM data (30 m resolution), see figure below.

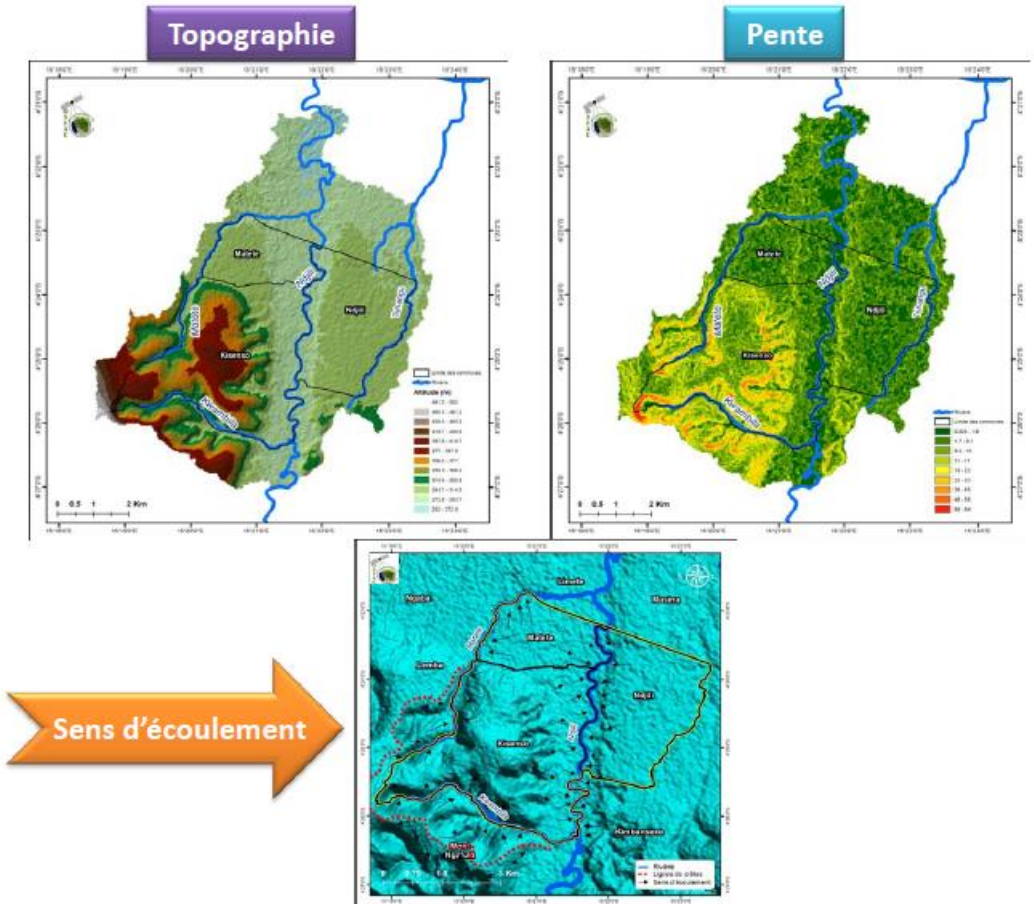


Figure 2. Simulation for delimitation of flooding area

d Field data collection

Prior to the field data collection, the various administrative authorities were contacted to obtain authorization therefore the actual field data collection started.

Informing the administrative authorities (communes and neighborhoods) of the project's objectives and activities to be carried out in their respective jurisdiction was an essential step. It helped to have an overview of their expectations while highlighting the benefits that could be derived from the implementation of the project.

- At the commune level, missions were organized to meet the mayor. Right away the procedures for obtaining the authorizations for the field data collection was granted.
- At the neighborhood level, an information meeting was held for the 70 leaders of the neighborhoods concerned by the project. The objective of this meeting was to present the project and the need to integrate members of the local community as guides during the field data collection while specifying the expected profile needed.

The field data collection was carried out by a team of 50 surveyors previously trained to the use of opensource tools. The surveyor team included 42% of women versus 48% of man and 62% of students versus 38% of professionals.

	F	M	Total
Students	11	20	31
Professionnal	10	9	19
Total	**21**	**29**	**50**

Five themes were selected with forms: Buildings, Roads, Drainage, Erosion, Floods. The forms used were specific to each theme.

2.1.2 Note Areas of Interest (AOIs), and a short description of the activities conducted in each area

The project is being implemented in the urban watersheds of the N'Djili and Tshangu rivers. 70 neighborhoods in 8 different communes are concerned (Table 1). All the activities described in section 2.1.1 relating to the data capture methodology have been carried out in each neighborhood.

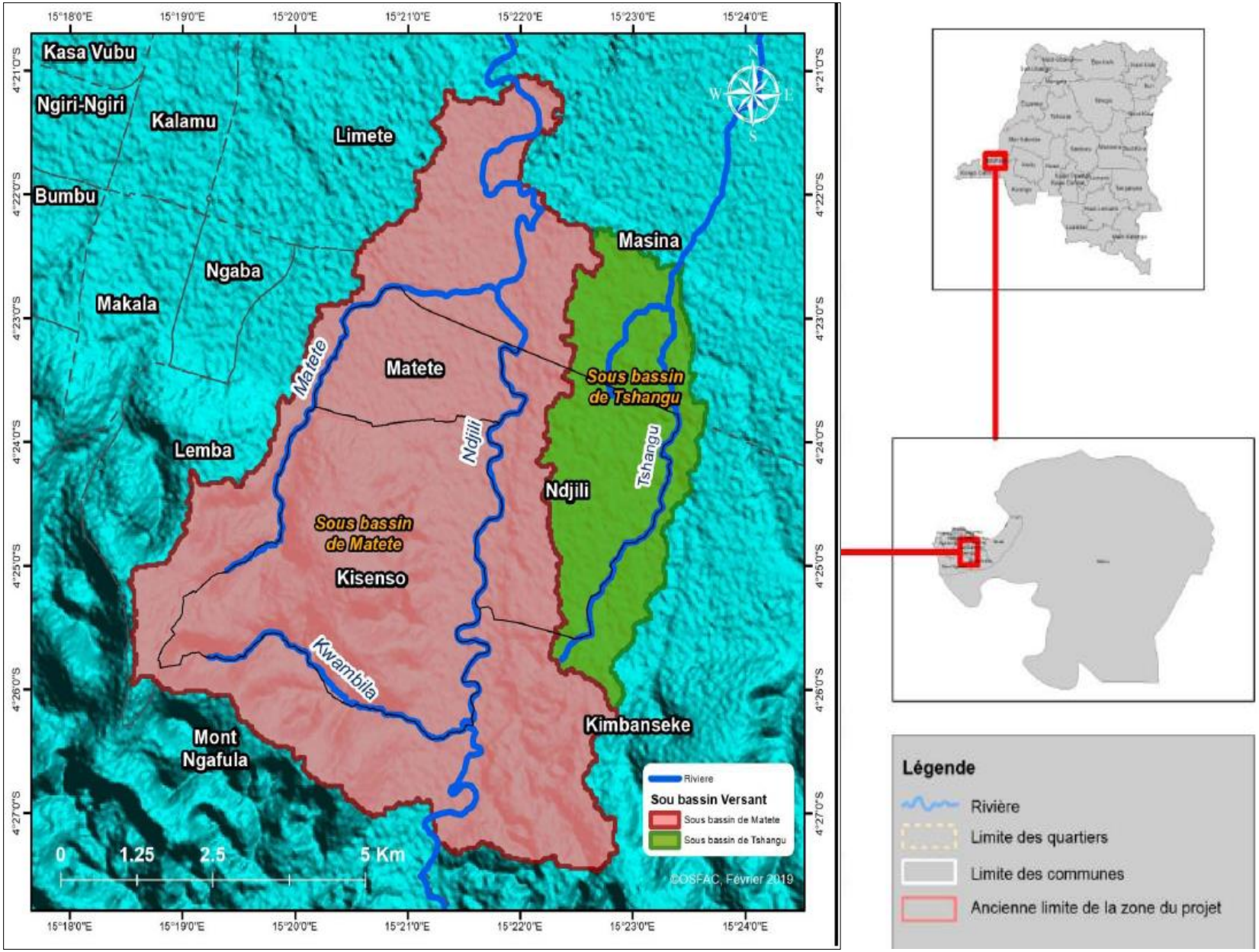


Figure 3. Open Cities Kinshasa Project Area

Tableau 1. Communes and neighborhoods in the project area

KIMBANSEKE	LEMBA	MONT-NGAFULA	N'DJILI	KISENSO	MATETE
1. Bahumbu	1. Echangeur	1. N'djili-Kilambo	1. Makasi/Q1	1. 17-mai	1. Loeka
2. Bamboma	2. Livulu	2. Plateau 1	2. Bilombe/Q2	2. Amba	2. Lubefu
3. Boma	3. Mbanza-Lemba		3. Equateur/Q3	3. Bikanga	3. Lukunga
4. Esanga	4. Salongo		4. Katanga/Q4	4. De la paix	4. Lumumba
5. Kutu			5. Kivu/Q5	5. Dingi-Dingi	5. Lunionzo
6. Maviokele			6. Kasai/Q6	6. Kabila	6. Malemba
7. Nsumabwa	**LIMETE**	**MASINA**	7. Oriental/Q7	7. Kisenso-Gare	7. Maziba
8. Pierre Fokom	1. Industriel	1. Abatoire	8. Ubangi/Q8	8. Kitomesa	8. Mbombipoko
9. Salongo	2. Ndanu	2. Boba	9. Mongala/Q9	9. Kumbu	9. Dondo
	3. Nzadi	3. Imbali	10. Tshuapa/Q10	10. Libération	10. Sankuru
	4. Salongo	4. Kimbangu	11. Goma/Q11	11. Mbuku	11. Sumbuka
		5. Lundula	12. Bandundu/Q12	12. Mission	12. Totaka
		6. Nzuzi wa Mbombo	13. Inga/Q13	13. Mujinga	13. Vivi
		7. Sans Fil		14. Ngomba	
		8. Télévision		15. Nsola	
				16. Regideso	
				17. Révolution	

2.1.3 Data Model (and how it potentially evolved)

The data model was designed to incorporate the selected variables and attribute values based on their relevance to the management of erosion and flood risks in the project area. The table below presents the data model for all layers. These attributes were collected for all non residential buildings such as hospitals, schools, churches, restaurant, etc..

Table 2. Open Cities Kinshasa Data model

	Buildings	**Highway**	**Drainage**	**Erosion**	**Floods**
Form	buildings_pois.xlsx	highway.xlsx	Drainage.xlsx	Erosion.xlsx	Floods.xlsx
Attributes	Building	Highway	Waterway	Natural	Natural
			Layer		
			Diameter		
			Height		
			City / Town		
			Commune		
			Neighborhood		
			Surface		
			Wet perimeter		
			Slope		
			Type		
			Flow sense		
			Behavior		
	Building Material	Highway Name	Covered	Depth	Wetland
	Building Condition	Highway Name Informal	Blockage	Surface	Tidal
	Number of Floors	Highway Surface	Width	Managed	Managed
	Address Number (House Number)	Smoothness	Depth	Altitude	Seasonal
	Street Name	Width	Covered Material	Stage of evolution	Intensity
	City / Town	Elevation relative	Material	Means of stabilization	Nature
	Commune	Oneway	Width_top	Soil type	Height
	Quarter	Bridge	Width_bottom		Length
	Building Name	Description	Profile		Frequency
	Type of Establishment (Amenity)	City / Town	Elevation		City / Town
	Type of Office	Commune	Elevation Relative to road		Township
	Type of Religion	Quartier	Tunnel		Neighborhood
	Type of Shop		Channels		

2.1.4 Field Mapping (and any training activities prior)

The objective of the field mapping was to collect field related attributes relevant to the characterization of buildings (points of interest), roads, drainage network, erosions and flood zones. To do this, several mobile tools were used: OSMTracker, ODK Collect, OpenMapKit and KoBoCollect. Thus, various training sessions were organized for data collectors in order to ensure that the use of data collection tools was well under control.

2.1.4.1 Training

- *Remote mapping with JOSM*

The remote mapping was done entirely with JOSM. Preliminary training sessions were organized for digitalizers to teach them how to use this tool. The digitalizers learned how to :

- Download and install JOSM;
- Create an OSM account;
- Change the editor's settings;
- Perform some basic operations;
- Install plugins;
- Use an aerial image;
- Using HOT's task manager;
- Map buildings, etc.

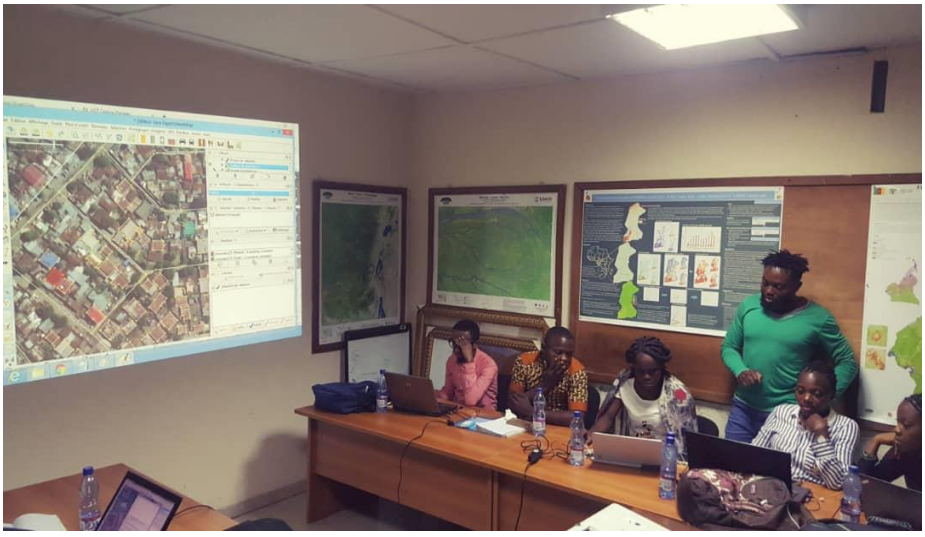


Figure 4. Training on remote mapping with JOSM

Table 3. Number of participants in JOSM training

STRUCTURE	GENDER		TOTAL
	F	M	
ISAU	2	1	3
INBTP	3	0	3
URF-GRN	1	6	7
CRREBaC	1	2	3
OSM	4	4	8
OSFAC	2	4	6
OVD	1	2	3
OR	1	1	2
Min. Prov TPI	0	3	3
Civil protection	2	0	2
TOTAL	17	23	**40**

- *Field data collection with OSMTracker*

  The training on the use of OSMTracker was organized for data collectors and the local guides.

  It consisted of:

  ✓ a general presentation of the Android application OSM Tracker (interface, tools, usual tags, etc.),

  ✓ a hands-on exercise in collecting points of interest with tags.

Table 4. Number of participants in training on the use of OSM Tracker

STRUCTURE	GENDER		TOTAL
	F	M	
OSFAC	4	2	6
OSM	4	3	7
Local community	8	40	48
Total	16	45	**61**

Figure 5. On-site training of a member of the local community

- *Training on ODK/OMK*

  The training on ODK/OMK was given in two sessions with the participation of 30 people including 11 women. It consisted of:

  - a presentation of the tool;
  - download and install ODK Collect and OMK;

- a general overview on how to create a form,
- change the app settings (the username and server address),
- downloading and filling out ODK/OMK forms, etc.

Figure 6. ODK/OMK training in OSFAC GIS Lab/UNIKIN

Table 5. Number of participants on ODK/OMK training

STRUCTURE	GENDER		TOTAL
	F	M	
UNIKIN	1	7	8
ISAU	2	1	3
INBTP	3	0	3
OSM	2	5	7
OSFAC	3	6	9
Total	11	19	**30**

- *KoBoCollect training*

The training on KoBoCollect was attended by 15 participants and consisted of:

- a presentation of the tool (download and install);
- changing the app settings (username and server address);
- an overview of how to create a form and different types of data that can be collected with the KoBoToolbox platform;
- a practical data collection exercise with KoBoCollect.

Table 6. Number of participants in the KoBoCollect

STRUCTURE	GENDER		TOTAL
	F	M	
ISAU	0	1	1
INBTP	1	0	1
UNIKIN	0	1	1
OSM-RDC	1	1	2
OVD	1	2	3
OR	1	1	2
MIN. PROV TPI	0	3	3
CIVIL PROTECTION	2	0	2
TOTAL	6	9	**15**

- *Training on QA/QC with JOSM*

A compulsory training attended by 8 people, 3 of whom were women was organized on the evaluation and quality control of the collected data to be uploaded into the OSM database. Its objectives were to teach the participants to identify and how to fix frequent errors encountered: attribute errors, geometry errors, etc.

Table 7. Number of participants on validation with JOSM training

STRUCTURE	GENDER		TOTAL
	F	M	
OSFAC	3	5	**8**

2.1.4.2 Field mapping activities

Following the points highlighted above on the different trainings held, a significant amount of buildings mapped, roads was added to the OSM database. More attributes were added and also corrected in regard to OSM requirements. On the other side, erosions and gully were updated as they constantly change because of climate changes. The local guides assigned to surveyors were more than helpful especially in unknown areas of less security.

The thematic maps produced as part of the Open Cities Kinshasa project were submitted for review by both project staff and end-users.

2.2 Data QA/QC

2.2.1 Validation of information by the local community

It was important to present the collected data in a user-friendly format as thematic maps for review. The reviewers came from neighborhoods, communes, government and academic institutions. The main remarks focused on the document form: title, legend, map scale, representations of flood zones. These were all taken into account in the production of the final maps.

- What measures were put in place to enforce quality control in the field data collection, and data upload processes?
    - Focus groups were organized with local communities to enable them to validate the information collected in the field. Thanks to this validation, the population approved or corrected the names of the streets, neighborhoods boundaries, points of interest location and name, and flood zones boundaries.
    - The JOSM 'validate' tool was used with the ToDoList before any upload. This activity was done by Potential 3.0 and a trained OSFAC team.
- What data cleaning procedures were carried out?
    - Names of POIS and roads
    - Attribute Consistency
    - Errors in OSM tags attributes values
    - Geometry errors
        - Buildings on top of each other
        - Buildings crossing roads, waterways, etc.
        - Duplicate buildings (point and polygon)
- **Were these measures effective?**
  The measures used for data quality evaluation and quality control were effective. Indeed, the validations were carried out by the local communities, in particular the neighborhood chiefs and members of the neighborhood administration.
  For each neighborhood, three (3) focus sessions were held: (*i*) a focus group for the validation of data collected, (*ii*) a focus for the choice of the tools to be developed and (*iii*) a focus for the validation of the thematic maps designed.
  Fifty-two (52) women was attended to those sessions.
  The main changes pointed out by the community members relay to the localization of points of interest, erosion, flooding area and boundaries of their neighborhood.

2.3 Geospatial Data Overview

The data collected during the project can be grouped into three (3) categories: data characterizing the environment, data characterizing infrastructure and data characterizing floods and erosions.

- You may include an overview of the metrics presented in the monthly reports, as well as report on the number of, and different types of features and attributes collected.

Table 8. Data collected during the Open Cities Kinshasa project

Data group	Data	Description	Source	Format	Spatial coverage	Location
Environment	**CLIMAT**					
	Monthly rainfall	Monthly rainfall (mm) from January 1961 to December 2013	METTELSAT	Excel	BINZA	**OSFAC**
		Monthly rainfall (mm) from January 1930 to December 2010	METTELSAT	Excel	N'Djili	**OSFAC**
	Estimated average monthly Rainfall (optimal)	Estimate of the optimum monthly rainfall amount	CRREBaC	Excel	MATETE watershed	**OSFAC**
	Average monthly rainfall (maximum estimate)	Estimated maximum monthly rainfall amount	CRREBaC	Excel	MATETE watershed	**OSFAC**
	Rainfall Average Monthly (minimum estimate)	Estimated monthly minimum rainfall amount	CRREBaC	Excel	MATETE watershed	**OSFAC**
	Evapotranspiration		CRREBaC	Excel	MATETE watershed	**OSFAC**
	Temperature (average, maximum, minimum)		CRREBaC	Excel	MATETE watershed	**OSFAC**
	Saturating steam pressure		CRREBaC	Excel	Matete watershed	**OSFAC**
	Wind speed		CRREBaC	Excel	Matete watershed	**OSFAC**

	Insolation			CRREBaC	Excel	Matete watershed	**OSFAC**
	Rainfall parameters			CRREBaC	Excel	Matete watershed	**OSFAC**
	PEDOLOGIE						
	Spatial distribution of soils			FAO	Shapefile	Project area	**OSFAC**
	HYDROGRAPHIE						
	Rivers		the main rivers in the project area (Matete, N'Djili, Tshangu)	OSFAC	Shapefile	Project area	**OSFAC**
	GEOMORPHOLOGIE						
	Digital Terrain Model (DTM)		OSFAC	Tin	Project area	**OSFAC**	
	Topographic map with contour line	Topographic map with contour line	OVD	Carte	Kisenso	**OSFAC**	
	SRTM		OSFAC	Raster	Project area	**OSFAC**	
	Drones data (DSM, MNT)		Potentiel 3.0	Raster		**www.openaerialmap.com**	
	Land-use		URF, CRREBaC	Shapefile	Project area	**OSFAC**	

	Watershed Characteristics	Area (Km^2), Perimeter (Km), Gravelius Coefficient (Kg), Gradient (m), Slope along drainage (%), Concentration time (minutes), Drainage density (m/km), Total drainage length (km), Longest flow path (km), Watercourse order, Sinuosity, Flow characteristics	CRREBaC	Excel	Matete watershed	**OSFAC**
	Administrative Boundaries	Administrative boundaries of Kinshasa neighborhood	OSM, BEAU	Shapefile	Project area	**OpenStreetMap (OSM)**
Infrastructures	Buildings	Mapped buildings	OSM, OSFAC	Shapefile	Project area	**OpenStreetMap (OSM)**
	Roads		OSM, OCK (OSFAC)	Shapefile	Project area	**OpenStreetMap (OSM)**
	Drainage	Drainage network	OVD, OCK (OSFAC)	Shapefile	Project area	**OSFAC**
Natural disasters	Erosions	Erosion limits	URF, OCK (OSFAC)	Shapefile, carte	Project area	**OSFAC**
	Floods	Floodplain Boundaries	CRREBaC, OCK (OSFAC)	Shapefile, carte	Project area	**OSFAC**
Multimedia						**OSFAC**

PART 3 : Project Results

3.1 Monitoring and Evaluation

Using the template developed for your monthly reports, please provide a final Monitoring and Evaluation report that includes your cumulative numbers over the course of the project.

Objective 1 - – To create, collate and release open spatial data about the built environment, critical infrastructure, and natural hazards.

Indicator	Metric	Target	Data Source	Disaggregation
1.1 Amount of area mapped using a participatory approach, that has been validated	64.64 km^2	N/A		N/A
1.2 Number of geospatial layers developed relevant to the resilience problem identified	30	17		N/A
1.3 Number of attributes collected relevant to the resilience problem identified	160 (for disaggregation, see Tableau 9 at annex)	>150		Disaggregated by: data layer
1.4 Number of government or other pre-existing datasets used relevant to the resilience problem identified	22	17		N/A
1.5 Data collection has taken into account gender vulnerabilities	Data collection has taken into account gender vulnerabilities by taking a good representativity of women in field team (50% of data collectors were women and 20 % of guides were women) Collect of existing datasets was done by a woman.			

Objective 2 - – To develop targeted data products to support the utilization of risk information for disaster risk management by key stakeholders.

Indicator	Metric	Target	Data Source	Disaggregation
2.1 Number of people attending presentations who are made aware of the data product	318 (for disaggregation, see **Tableau 10** at annex)	65	Attendance list	Disaggregated by: sex, stakeholder group
2.2 Number of people trained to use data product	105 (for disaggregation, see **Tableau 11** at annex)	65		Disaggregated by: sex, stakeholder group
2.3 Number of people with improved understanding of the resilience problem identified based on data product	300 (for disaggregation, see **Tableau 12** at annex)	55		Disaggregated by: sex, stakeholder group
2.4 Number of people who would use data product to inform their disaster risk management decisions	92 (for disaggregation, see **Tableau 13** at annex)	45		Disaggregated by: sex, stakeholder group

Objective 3 - To enhance local capacity and institutional development to support the design and implementation of urban resilience initiatives.

Indicator	Metric	Target	Data Source	Disaggregation
3.1 Number of training events held	**18** (for disaggregation, see **Tableau 14** at annex)	**10**		Disaggregated by: event type, topic
3.2 Number of people trained	**105** (for disaggregation, see **Tableau 15** at annex)	**100**		Disaggregated by: sex, event type, stakeholder group
3.3 Number of people participating in community mapping activities	**147** (for disaggregation, see **Tableau 16** at annex)	**150**		Disaggregated by: sex, stakeholder group
3.4 Number of stakeholder groups consulted (in planning activities, product development, etc.)	93 (for disaggregation, see **Tableau 17** at annex)	**25**	OSFAC	Disaggregated by: topic, stakeholder group
3.5 Number of women engaged in the design of community maps	52 (for disaggregation, see **Tableau 18** at annex)	**30**		Disaggregated by: organization (if applicable)
3.6 Gender-differentiated vulnerabilities identified through Gender Analysis	N/A			
3.7 Number of barriers to women's participation in Open Cities Africa identified	**3**	3		N/A
3.8 Number of barriers to women's participation in Open Cities Africa addressed	**3**	3		N/A

3.9 Exchanges and/or discussions with other City teams	5 members of the staff project and 3 members of government institutions have participated to the 3 meetings held by the world bank.

3.2 Gender

To incorporate the findings from our Gender Analysis into our project approach and activities, the team applied the following strategies:

- During the group work, an effort was made to have women as team leader where men will also appear. Thishelped them to express themselves, which will help in the future to share risk information collected by women
- As for men, women will be invited to present their mapping results and their vision of the risks present in their environment.

The actions undertaken were :

- Plan project activities at times when women will be available
- Involve project women in the recruitment of women in the community.
- In the field, the participation of women will be equal to that of men (training activities, community meetings, etc.).
- A special capacity building will help women to understand and use technology tools for collecting and sharing data

    - **To what extent you were able incorporate findings on how men and women are affected differently by natural hazards in your city into your project?**

The analysis on gender perception identified 3 specific barriers to women's participation: inferiority complex, low level of education and time spent on household chores. This identification shaped the methodology for the recruitment of people involved in the project: positive discrimination in favor of women was applied in order to increase their participation rate for data collection in the field, participatory mapping during focus groups. Thus, all the project components had the participation of women: the coordination of the project was entrusted to a

woman, 2 out of 4 trainers were women and 42% of the data collectors from academic, governmental, OSFAC and OSM-DRC institutions were women.

Figure 8. Validation of the thematic maps by the quarter delegates

Figure 7. Women's contribution to participatory mapping

3.3 Stakeholder and Community Engagement

At the beginning of the project, some stakeholders were targeted for possible involvement in the implementation of the project.

These stakeholders were from government, public services, the local community, the scientific community or international organizations. The level of prioritization of their contribution ranged from low to high based on their expertise, knowledge or information that they could provide to the project.

Each of them has been invited to the kick-off workshop, during which they were presented with the project (objectives, expected results, etc.).

Stakeholder engagement has evolved to some extent during the implementation of the project. Some, initially reluctant in view of the disappointment caused by previous projects, were able to identify the interest of the project over the course of the project and become more involved. On the other hand, some stakeholders initially identified as important did not participate.

The table below shows the evolution of stakeholder engagement during implementation. It lists all stakeholders, whether or not they were identified at the beginning of the project. Based on their identification at the beginning of the project and their participation, three groups of stakeholders were defined:

- those identified but not involved (not highlighted)
- those initially identified and involved in the implementation of the project (highlighted in yellow), and
- those who were not identified at the beginning of the project but who participated in the implementation of the project (highlighted in blue)

Table 9. Project stakeholders

Name	Potential role / contribution	Level of Prioritization
1. Government		
Ministère de plan et de l'Intérieur (Protection civile)	Project Monitoring	Medium
Ministère de l'Urbanisme et Habitat		
Ministère Provincial des Travaux Publics et Infrastructures		
Township locals Authorities		
Neighborhoods locals Authorities	Facilitations Data and tools validation	
2. Public services		
Institut Géographique du Congo (IGC)	Technical Support and data contribution	Medium
Institut National de Statistique (INS)	Data contribution	
Programme National d'Assainissement (PNA)	Data contribution	
Office des Voiries et Drainage (OVD)	Data contribution Field data collection and validation	
Bureau d'Etudes d'Aménagement et d'Urbanisme (BEAU)	Technical Support and data contribution	
Agence des Grand Travaux (ACGT)	Technical Support and data contribution	
Agence Nationale de météorologie par satellite (METTELSAT)	Technical Support and data contribution	
Aviation civile	Data contribution	
3. Local community members		
Local NGOs (IDDE, USK, CODEC, CONAFED, CCD, etc.)	Technical Support and Project Management	High
Local Neighborhood Development Community	Field data collection; data validation	
Church (Catholic, protestant, Islam, …)	People sensibilization;	
4. International organizations		

MONUSCO and ONU Agencies (e.g. UNFPA)	Data support	Low
JICA	Data support	
ENABEL (CTB)	Data support	
FAO	Data support	
5. Scientific Communities (University)		
Université de Kinshasa (Dpt. Géoscience, Dpt. Natural Resources Management)	Technical Support and research and Field data collection	High
Université de Kinshasa (Centre de Recherche en Ressources en Eau du Bassin du Congo)	Field data collection	
Institut Supérieur d'Architecture et d'Urbanisme (ISAU)	Data validation	
Institut National des Bâtiments et Travaux Publics (INBTP)	Data validation	
Office des Routes	Training	
Direction de la Protection Civile (Ministère de l'Intérieur)	Data validation	
6. OSM Community		
OSM DRC	Technical Support and data collection	High
7. Youth and/or Women's Groups		
Association (AJDK, AFDI)	Field data collection and People sensibilization; Participatory mapping	High
Women NGO	Field data collection and People sensibilization; Participatory mapping	

3.4 Final Product

- **How were stakeholder needs and/or wants reflected in the final data tool or product?**

  It is important that tools produced reflect the needs and expectations of stakeholders for better ownership. Thus, the OpenCitiesKinshasa project took this into account during the design of the tools by letting the ***users select the tools to be produced*** (Before the analysis of the collected data, a list of tools had been proposed to the users, i.e. the governmental and academic institutions, municipalities and neighbourhoods concerned by the project). Their choice was based on two tools: thematic maps and data obtained during the implementation of the project. Once the tools were produced, the end users ***validated*** them through working sessions.

- **How did the design of your product evolve over the course of the project?**
  - **Were stakeholder needs and/or wants, different than you anticipated?**
    The list of tools initially proposed included a mobile application, road signs, interactive maps, paper maps and a database, among others.
    In the end, only two of these tools had been selected by end-users: database and thematic maps.
  - **Was your final data tool or product exactly what you predicted it to be at the onset of the project?**
    The final data tool or product was a little different from what was originally planned. We predicted to have an application or an interactive map and printed thematic maps as tool product. But due to the the user choice and requirements, only printed thematic maps and database was made.

- **Present the final data visualization product.**
  - **Provide a short descriptive overview of the final product**

(1) A geodatabase has been created. It contains geospatial information on the physical environment, buildings, infrastructure (health, schools/universities, places of worship), roads, drainage network, occupation and use of space, floods and erosion;

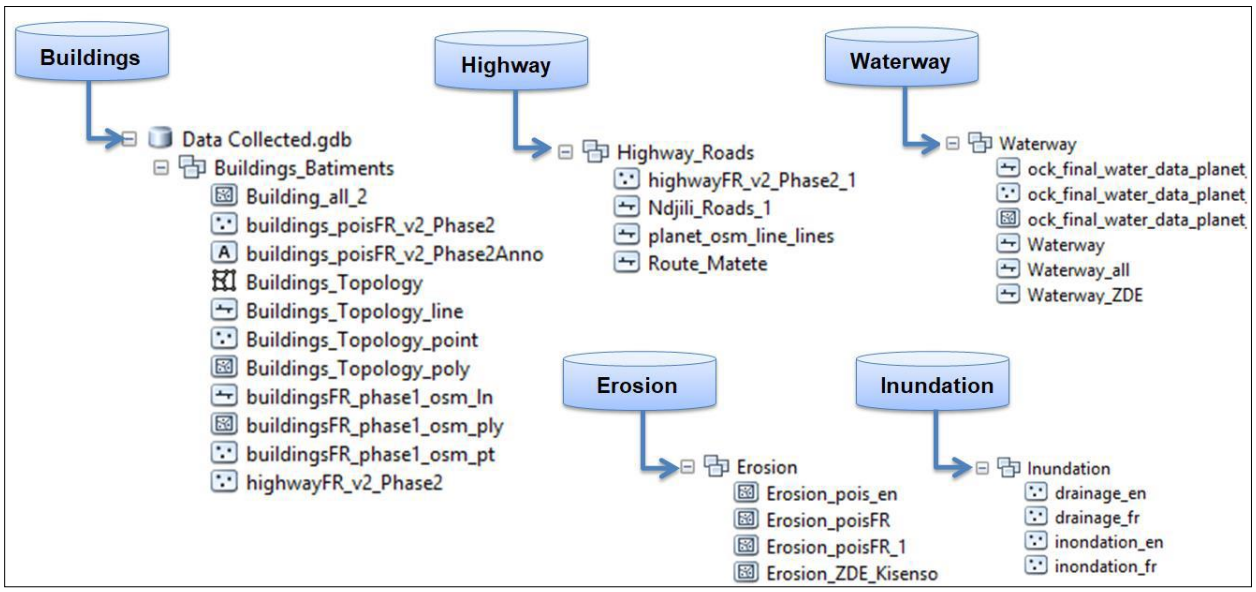


Figure 9. Geodatabase overview

Data collected from partners

- Erosions (source: URF-GRN):

http://www.osfac.net/opencities/shapefiles/erosions.zip;

Floods (source CRREBAC): http://www.osfac.net/opencities/shapefiles/inondations.zip

- Neighborhood boundaries (Source BEAU)

http://www.osfac.net/opencities/shapefiles/limites_quartiers.zip

- Weather data (Source METTELSAT)

http://www.osfac.net/opencities/mettelsat/pluviometrie.zip

(2) A total of **240 maps** are produced: These maps take into account the theme (flood, erosion), the area covered (project area, commune or neighborhood) and the format (A0, A1 and A4).

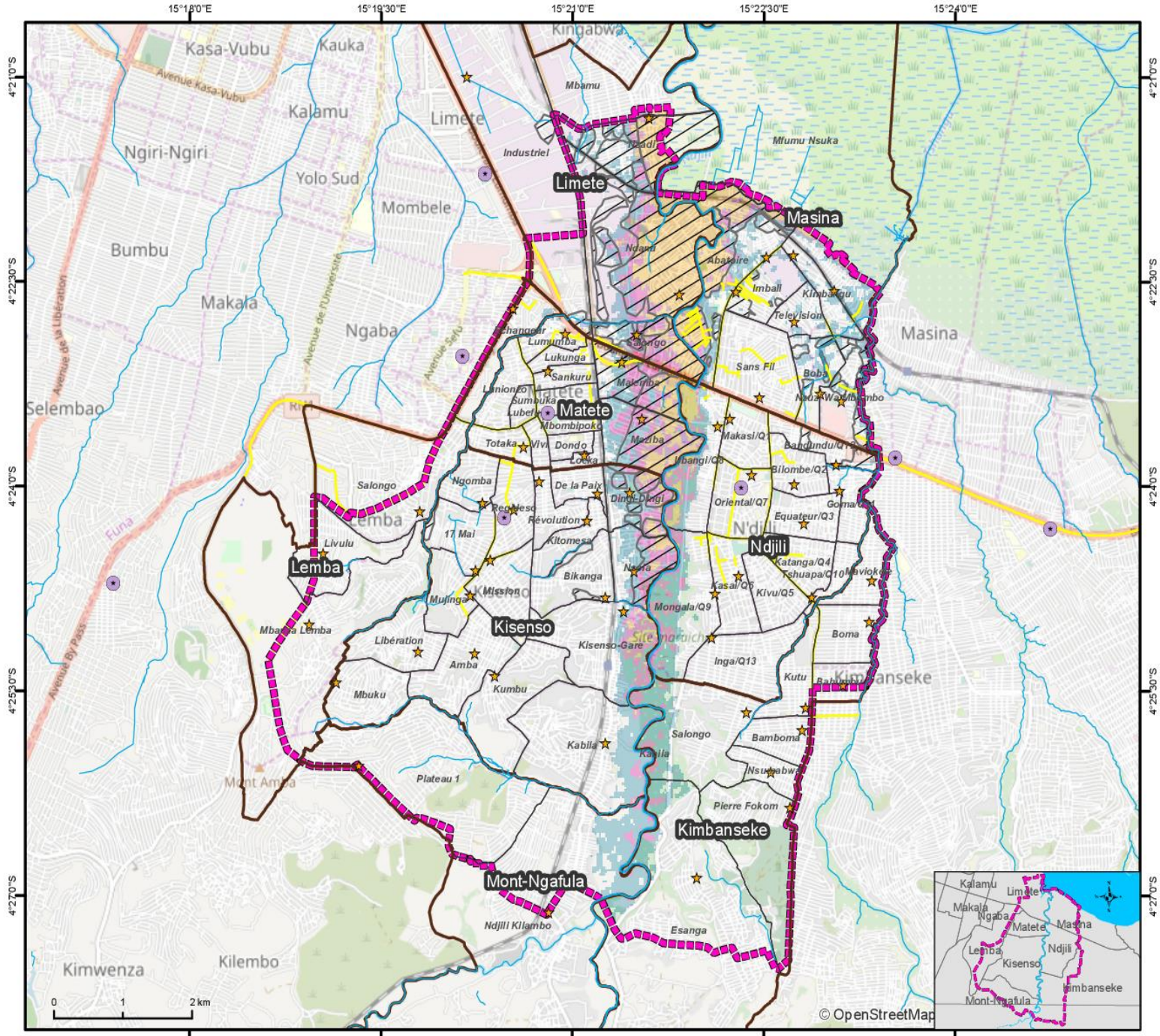
Table 10. Thematic maps produced

COVERAGE	PROJECT AREA	COMMUNE	NEIGHBORHOOD		TOTAL
Format	A0	A1	A4	A1	
General	1	8	70	70	**149**
Flood	1	8	28	28	**65**
Erosion	1	1	12	12	**26**
Total	**3**	**17**	**110**	**110**	**240**

(3) an Atlas has been produced. It contains about 100 thematic maps on erosion zones and potentially floodable areas in 8 communes and 70 neighborhoods covered by the project.

- **Please include a link to the product, or, size permitting, a full copy of the product in the appendix.**
  https://osfac.net/opencities/atlas/OpenCitiesKinshasa_ATLAS.pdf

Zone du Projet Open Cities Kinshasa
Carte des inondations potentielles



Open Cities Kinshasa

- Zone du projet
- Limite Commune
- Limite Quartier

Zones potentiellement inondables

- Résidentiel inondé ≤ 277m
- Résidentiel inondé ≤ 280m
- Résidentiel inondé ≤ 285m
- Résidentiel inondé signalé par la communauté locale

Route et chemin de fer

- Route
- Chemin de fer
- Cours d'eau
- Ouvrage d'assainissement

Commodités

- Maison communale
- Bureau du quartier

Utilisation des terres

- Bâtiment
- Industriel

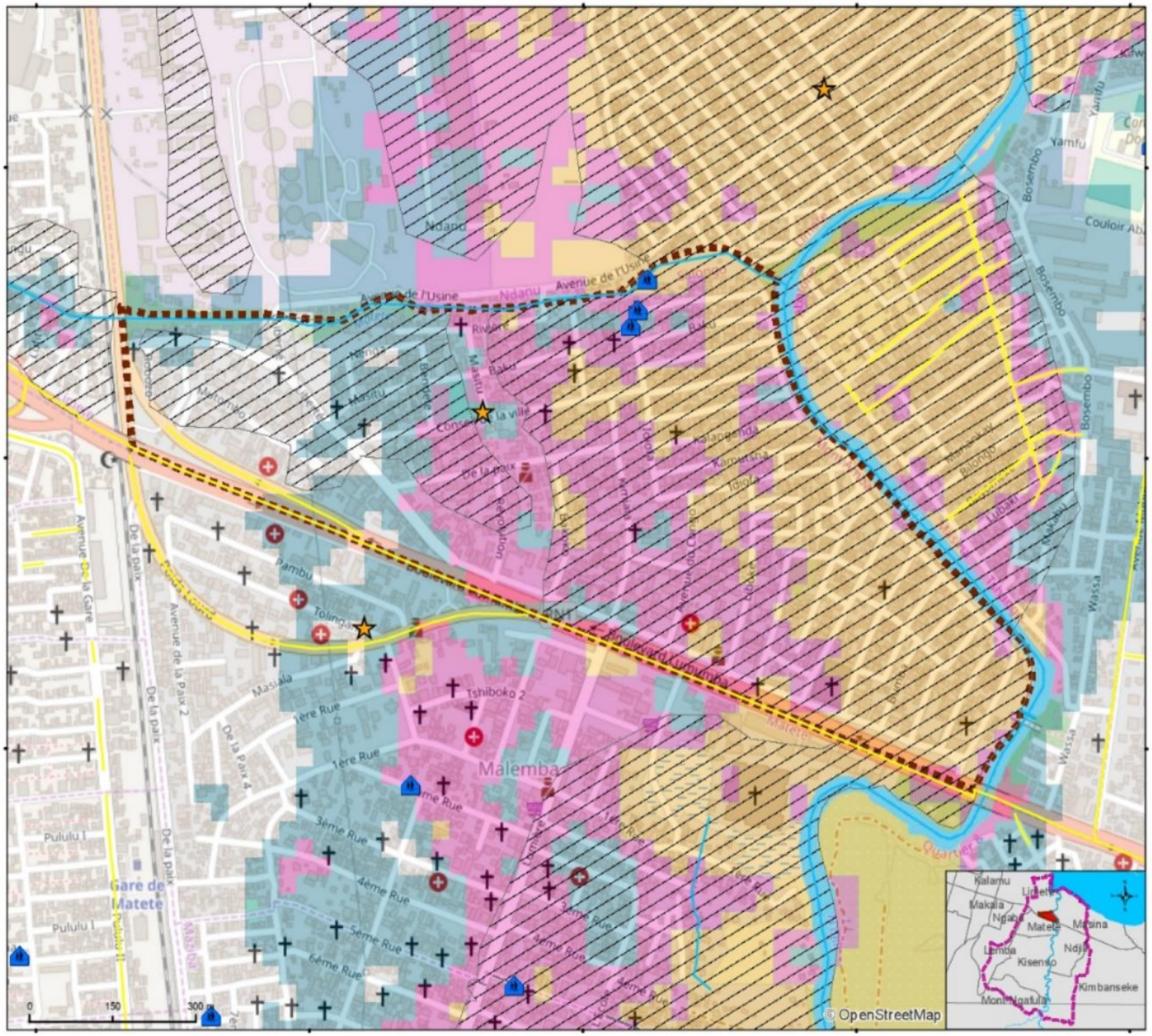
Partenaires

WORLD BANK GROUP

GFDRR

Source des données : OSFAC, Potentiel3.0, BEAU, OpenStreetMap, CRREBaC, OVD, Communauté locale.
Système des coordonnées géographiques
Datum WGS 1984

Commune de Limete
Carte des inondations du Quartier Salongo



Open Cities Kinshasa

- Zone du projet
- Limite quartier

Zones potentiellement inondables

- Résidentiel inondé ≤ 277m
- Résidentiel inondé ≤ 280m
- Résidentiel inondé ≤ 285m
- Résidentiel inondé signalé par la communauté locale

Route et chemin de fer

- Route
- Chemin de fer
- Cours d'eau
- Ouvrage d'assainissement

Commodités

- Maison communale
- Bureau du quartier
- Lieu de culte
- Infrastructure sanitaire
- Ecole

Utilisation des terres

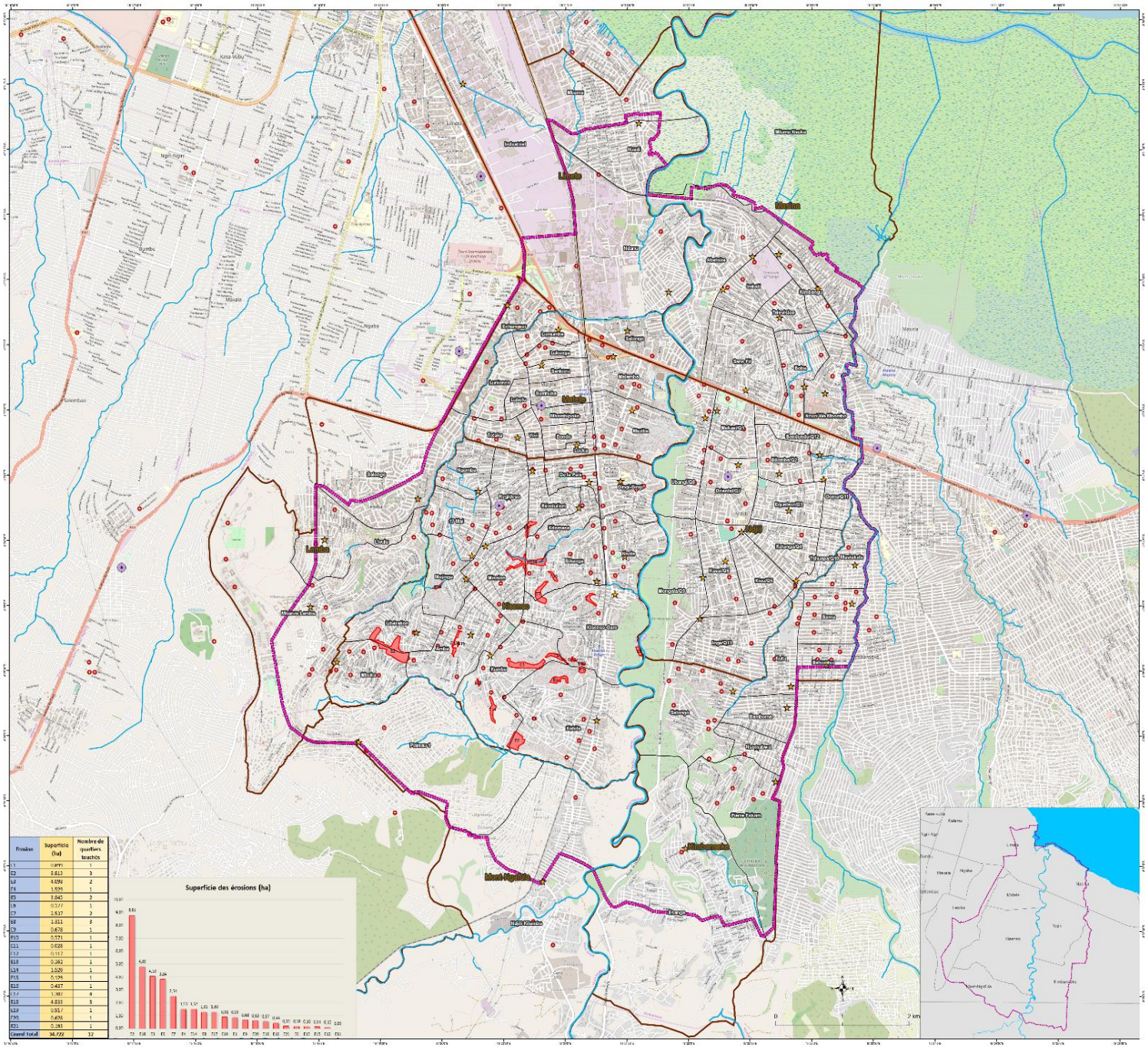
- Bâtiment
- Industriel

Partenaires

WORLD BANK GROUP
GFDRR
CREWS
OSFAC
Potentiel3.0

Source des données :
OSFAC, Potentiel3.0, BEAU, OVD,METTELSAT
OpenStreetMap, Communauté locale.
Système des coordonnées géographiques
Datum WGS 1984

Zone du Projet Open Cities Kinshasa
Carte des érosions



Erosion	Superficie (ha)	Nombre de quartiers touchés
E1	0.0970	1
E2	8.813	3
E3	4.036	2
E4	1.926	1
E5	1.845	2
E6	0.577	1
E7	2.537	2
E8	2.811	3
E9	0.678	1
E10	0.571	1
E11	0.028	1
E12	0.117	1
E13	0.162	1
E14	3.520	1
E15	0.126	1
E16	0.437	1
E17	1.387	3
E18	4.833	3
E19	0.917	1
E20	0.670	1
E21	0.193	1
Grand Total	34.722	32

Open Cities Kinshasa

- Zone du projet
- Limite Commune
- Limite Quartier
- Erosion

Route et chemin de fer

- Route
- Chemin de fer
- Cours d'eau
- Maison communale
- Bureau du quartier
- Infrastructure sanitaire

Utilisation des terres

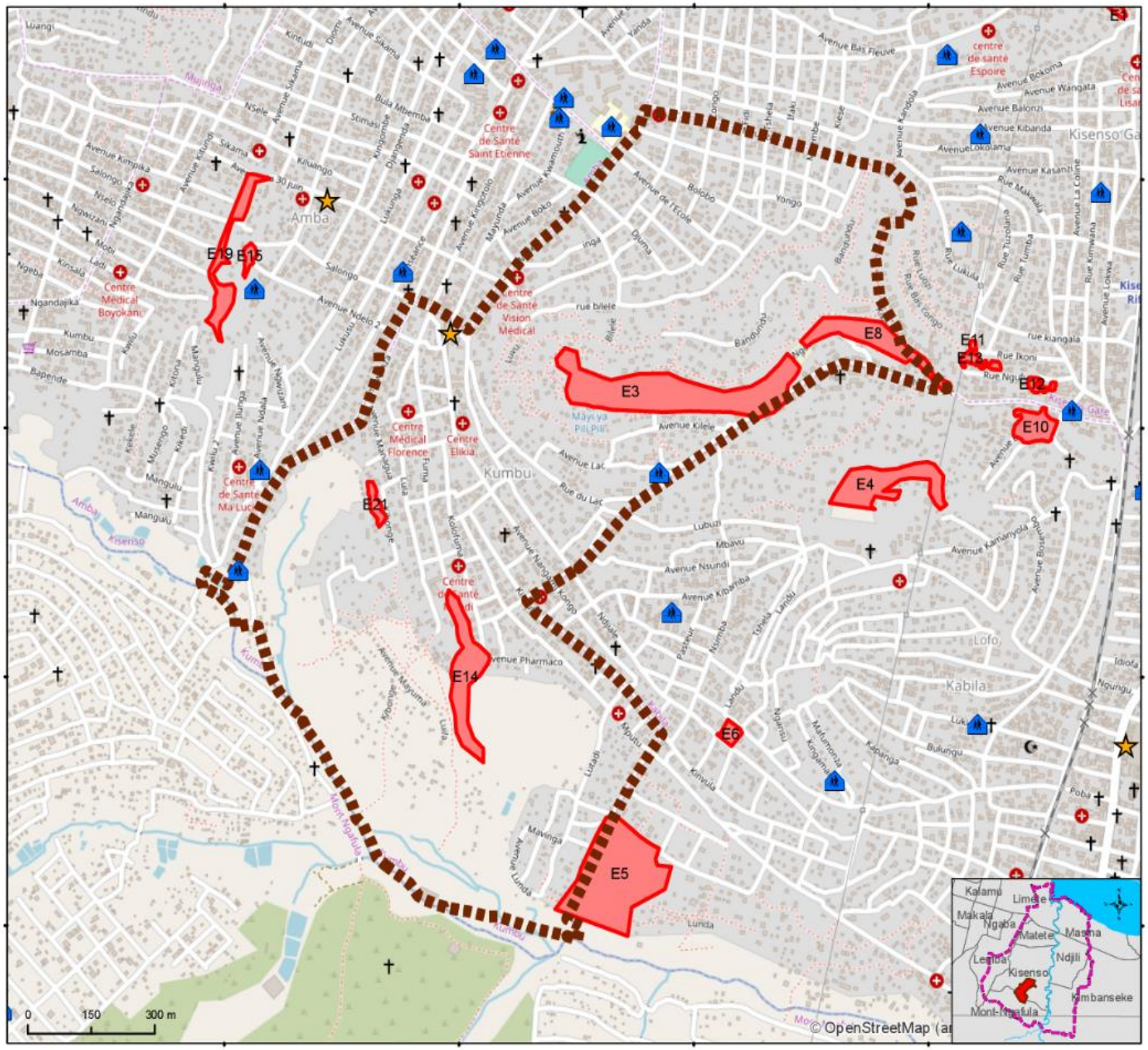
- Bâtiment
- Industriel

Esanga : Label quartier

Ngili : Label commune

Partenaires

Commune de Kisenso
Carte des érosions du Quartier Kumbu



Open Cities Kinshasa

- Zone du projet
- Limite quartier
- Erosion (E n°)

Route et chemin de fer

- Route
- Chemin de fer

- Cours d'eau
- Ouvrage d'assainissement

Commodités

- Maison communale
- Bureau du quartier
- Lieu de culte
- Infrastructure sanitaire
- Ecole

Utilisation des terres

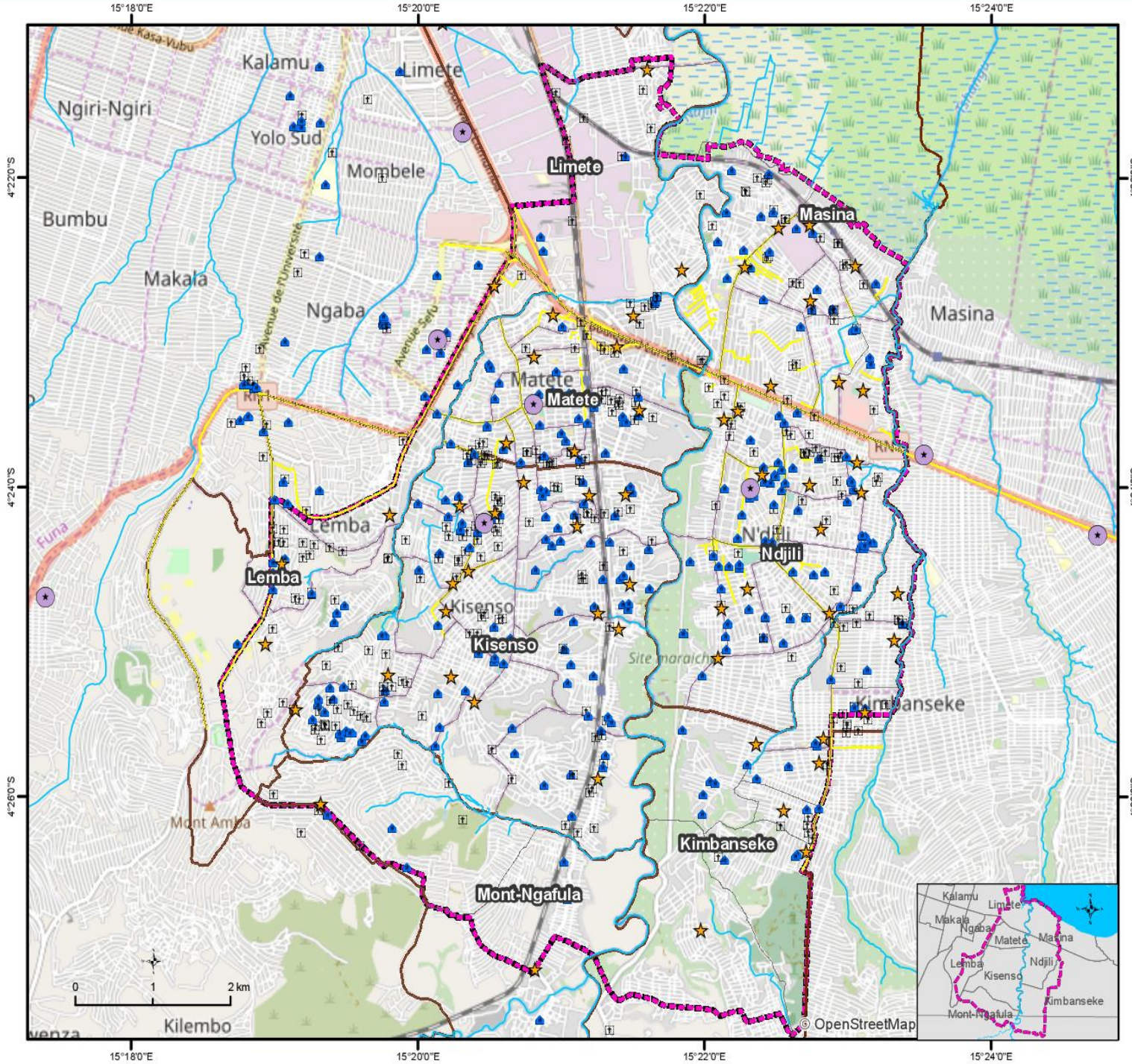
- Bâtiment
- Industriel

Partenaires

WORLD BANK GROUP
GFDRR
REWS
OSFAC
Potentiel3.0

Source des données :
OSFAC, Potentiel3.0, BEAU, OVD, OpenStreetMap, Communauté locale.
Système des coordonnées géographiques
Datum WGS 1984

Zone du Projet Open Cities Kinshasa
Carte Générale



Open Cities Kinshasa

- Zone du projet
- Limite Commune
- Limite Quartier

Route et chemin de fer

- Route
- Chemin de fer
- Ouvrage d'assainissement
- Cours d'eau

Commodités

- Maison communale
- Bureau du quartier
- Lieu de culte
- Infrastructure sanitaire
- Ecole

Utilisation des terres

- Bâtiment
- Industriel
- Lemba — Label Commune
- *Esanga* — Label quartier

Partenaires

WORLD BANK GROUP

GFDRR

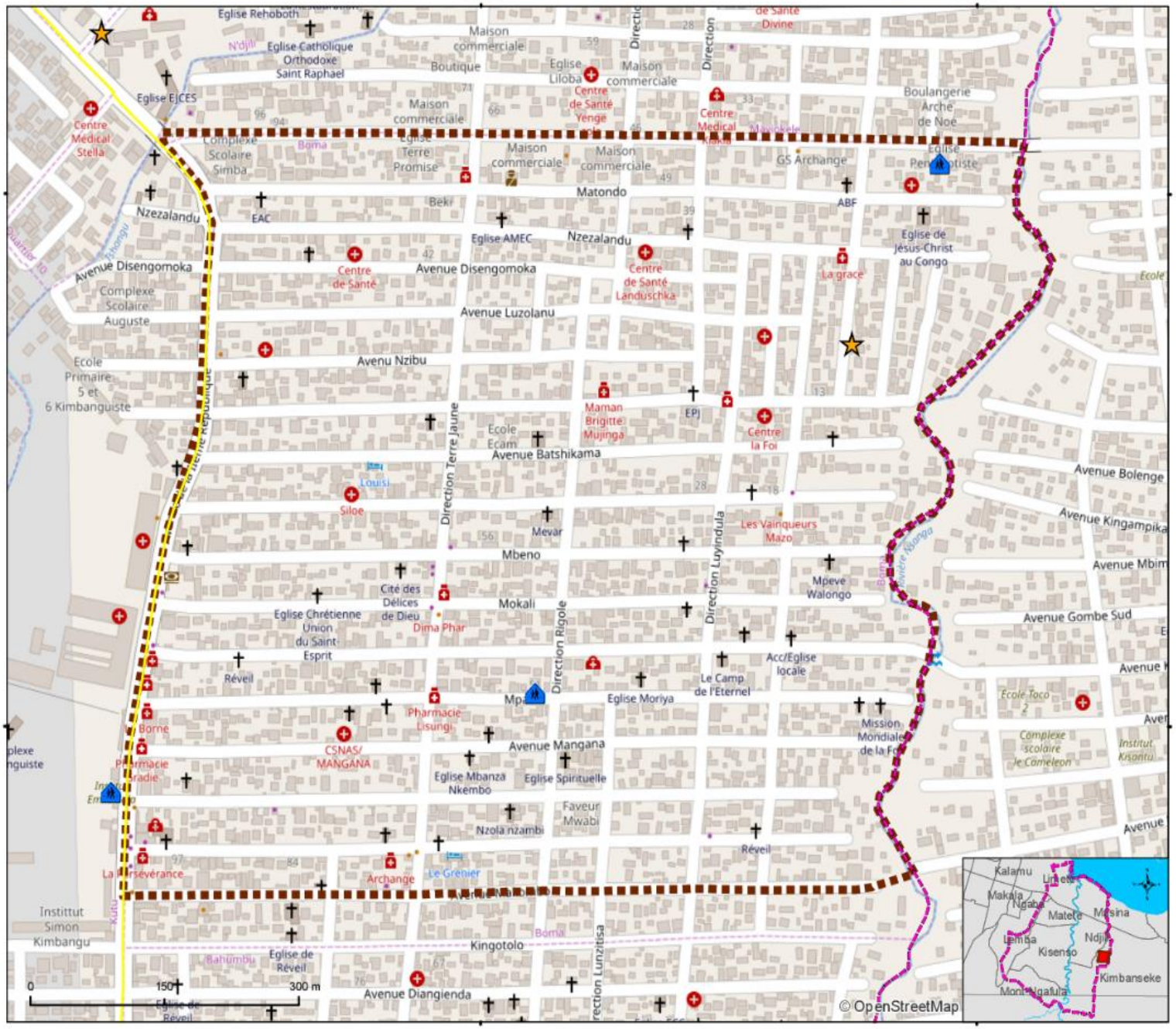
REWS

OSFAC

Potentiel3.0

Source des données :
OSFAC, Potentiel3.0, BEAU, OVD,
OpenStreetMap, Communauté locale.
Système des coordonnées géographiques
Datum WGS 1984

Commune de Kimbanseke
Carte Générale du Quartier Boma



Open Cities Kinshasa

Zone du projet

Limite quartier

Route et chemin de fer

- Route
- Chemin de fer
- Cours d'eau
- Ouvrage d'assainissement

Commodités

- Maison communale
- Bureau du quartier
- Lieu de culte
- Infrastructure sanitaire
- Ecole

Utilisation des terres

- Bâtiment
- Industriel

Partenaires

WORLD BANK GROUP

GFDRR

REWS

OSFAC

Potentiel3.0

Source des données :
OSFAC, Potentiel3.0, BEAU, OVD, OpenStreetMap, Communauté locale.
Système des coordonnées géographiques
Datum WGS 1984

PART 4 : The Open Cities Africa Experience

4.1 Challenges & Successes

- What challenges did you encounter in implementing Open Cities Africa?

  - ✓ Bringing together several institutions from different sectors with divergent interests;
  - ✓ Covering such a large and diverse area (70 neighborhoods);
  - ✓ Collecting representative and relevant data on natural disasters;
  - ✓ Integrating the gender aspect during the implementation of the project;
  - ✓ Involving the local community in all stages of project implementation;
  - ✓ Obtaining the necessary authorizations from the administrative authorities (city, communes) for the data collection.

- What successes are you most proud of?

  - ✓ An effective awareness by the populations and other stakeholders of the problem posed by natural disasters (erosion and floods).
  - ✓ Capacity building of several institutions and the local community in data collection through free and opensource tools.
  - ✓ Availability of reliable geospatial data on floods and erosions, physical environment, buildings (health infrastructure, schools/universities, places of worship, etc.), road and drainage network, land use and occupation;
  - ✓ Availability of decision-making tools (thematic maps, atlas) to predict and manage natural disasters (erosion and floods).

4.2 Lessons Learned

- **What lessons did you learn over the course of project implementation?**
  The main lessons learnt over the course of the project implementation was the followings:
  1. From the outset, it is essential to clarify to the various stakeholders the objectives of the project as well as the expected results. This should be reiterated if necessary, during the implementation of the project.
  2. Community involvement in all stages positively influences the achievement of the project objectives.
  3. The focus group is an ideal framework for sharing and discussing information for different stakeholders.

4. Visible tools (thematic maps) facilitate the understanding of the analyzed problem (flooding and erosion)
5. Women are interested in and have a good understanding of the topic under discussion, which has allowed their active participation.

4.3 Recommendations

- Do you have any recommendations for how Open Cities Africa could be improved?
    - What aspects of the initiative did you enjoy or find most beneficial?
        - The Bank's various training modules
        - The use of open source tools.
        - User-centered design
        - Local community and stakeholder participation
        - Issues addressed
        - Gender integration over the course of the project implementation
    - What aspects would you change?
        - The duration of the project (relatively short at the start)
        - The study area of the project. It would be nice if the project covered the whole city.
    - Is there specific programming or activities that you would suggest be added and/or removed?

      We can suggest the adding of the following activities:
        - completing missing data;
        - extending activities to the whole city of Kinshasa
        - involving more women and students in the implementation of the project;
        - setting up a continuous data collection
        - initiating disaster prevention and control program
        - creating a synergy between different projects working on the same theme (erosion and floods);
        - having more exchange frameworks between the different Open Cities Africa projects.

PART 5 : Sustainability Plan

The objectives of **Sustainability Plan** is (i) to identify the **beneficial activities** associated with the Open Cities Africa project for Kinshasa and (ii) to plan the continuity and potential improvement of these activities going forward.

Organizations exist to address problems or fill gaps in specific services, but it is all too common for busy organizations to place themselves at the center of planning activity, rather than acknowledge their role as one of many important players **around a shared goal, or problem statement**. For this assignment, we want you to think about your role as part of the operational community and the ultimate impact you are trying to have.

This sustainability plan considers the various roles, working relationships, operational dynamics between the actors in the ecosystem; or lack thereof to identify **gaps** in both **essential services** and **communication**, and how future goals can address these needs/gaps.

Use the following guidelines to consider the elements and challenges of sustainability facing your team:

The elements and challenges of sustainability facing our team can be presented following four points: (1) Assessment of benefits currently provided or in progress, (2) Challenges to the sustainability of the key benefits identified, and ways to address each of them, (3) Review of the key actors in your operational ecosystem (4) Concrete goals and actions

5.1 Assessment of benefits currently provided or in progress

- ✓ Data collection (field, UAVs, local community)
- ✓ Continuous data quality assessment and control
- ✓ Updating data on disasters under study (floods and erosions) and exposed infrastructure (buildings, roads, drainage).
- ✓ Mapping of floods and erosions with updated information
- ✓ Capacity building in data collection and the use of open source tools.
- ✓ Production of decision-support tools
- ✓ Sustaining stakeholder consultation and collaboration

The table below presents in a column the benefits should be sustained going forward (and if so, for how long) and in a other one those who have a natural conclusion that coincides with the end of the current funding.

Benefits that should be sustained going forward	Benefits have a natural conclusion that coincides with the end of the current funding
✓ Continuous data quality assessment and control ✓ Updating data on disasters under study (floods and erosions) and exposed infrastructure (buildings, roads, drainage). ✓ Capacity building in data collection and the use of open source tools. ✓ Sustaining stakeholder consultation and collaboration	✓ Data collection (field, UAVs, local community) ✓ Updating data on disasters under study (floods and erosions) and exposed infrastructure (buildings, roads, drainage). ✓ Mapping of floods and erosions with updated information ✓ Production of decision-support tools

The benefits we wish to sustain can be, by priority order, are the following

1. Production of decision-support tools
2. Sustaining stakeholder consultation and collaboration
3. Capacity building in data collection and the use of open source tools.
4. La collecte des données (terrain, drones, communauté locale)
4. Updating data on disasters under study (floods and erosions) and exposed infrastructure (buildings, roads, drainage).
5. Mapping of floods and erosions with updated information
6. Continuous data quality assessment and control

List of stakeholders/actors that will be involved

- ✓ Provincial Ministries of the City of Kinshasa (Budget, Planning, Public Service, Employment, Transport and Communication; Public Works and Infrastructure; Land Affairs, Urban Planning and Housing; Interior, Security, Decentralization and Customary Affairs)
- ✓ The local community (neighborhoods, communes)
- ✓ Association of young people working in the areas concerned
- ✓ Association of women working in the areas concerned
- ✓ Academic institutions (Institut Supérieur d'Architecture et d'Urbanisme, Institut National des Bâtiments et Travaux Publics, Université de Kinshasa)
- ✓ Gouvernement institutions (Bureau d'Etude et d'Aménagement Urbains, Agence Congolaise des Grands Travaux, Institut National de Statistique, Office des Routes, Office des Voiries et Drainage, Protection civile)
- ✓ OSM-DRC Community

5.2 Challenges to the sustainability of the key benefits identified, and ways to address each of them

The challenges will be presented following four lenses: financial, social, technical and institutional.

a. Financial

In these expenditures, the state must provide a budget for the fight and prevention of natural disasters. National and international partners must support the state's disaster initiatives.

b. Social

Helping people cope with the adverse consequences of natural disasters;
To help the populations improve their living environment through better housing and sanitation.

c. Technical

Floods: operationalize and create more drainage network to facilitate water evacuation.
Erosions: Find appropriate methods to stabilize erosion areas.

d. Institutional

Making the stakeholder consultation framework for disaster control more functional.

5.3 Review of the key actors in your operational ecosystem

e. Actor category of the implementer

OSFAC is a regional non-governmental organization (NGO) interested in mapping and training students and professionals. It has relationships with external organizations and donors.

f. Key actors with which we are already working within our operational ecosystem

- ✓ **Small local NGOs/community groups:**

- Local non-governmental organizations (NGOs) and locally-founded community-based organizations (CBOs) that are primarily interested in mapping;
- NGOs and CBOs born from relations with external organizations/donors (World Bank, Red Cross, USAID, GIZ, FAO, UNDP, UNEP, etc.) and which remain largely dependent on these organizations and donors;
- OSM antennas and networks;
- Organizations that work primarily on issues other than mapping, but engage in mapping to support a defined area of this work (CRREBaC, URF-GRN).

✓ **Individual consultants to larger international NGOs, governments, or the aid sector**

✓ **Universities and student groups :** University of Kinshasa, Université Pédagogique Nationale, University of Lubumbashi, Institut Supérieur d'Architecture et Urbanisme, Institut National des Bâtiments et Travaux Publics, Simon Kimbangu University, Father LOYOLA University, etc.

✓ **Technologists creating marketable commercial products and applications with OSM software:** Potential 3.0.

✓ **State Cartographers:** mappers

g. Gaps in essential services and functions performed by the actors listed above

Low capacity in the use of certain new technologies (GIS, remote sensing, GPS, Opensource tools, etc.).

5.4 Concrete goals and actions

This set of concrete goals is developed based on the above and complete with associated action items for our team

Goals	Action items
Continued dialogue and collaboration with stakeholders in the implementation of natural disasters activities	- Initiate and strengthen the capacities of these structures in the use of remote sensing, GIS, the OSM platform and opensource tools. - Dissemination of information
Production and continuous dissemination of decision-making tools (thematic maps, risk maps)	
Ensure continuous data collection (field, drone, local community) to complete missing data and update on the disasters under	- Updated flood and erosion mapping - Extension of the project's area of intervention;

study (floods and erosions) and exposed infrastructure (buildings, roads, drainage).	
Involve different social categories, especially women and youth, in the implementation of natural disasters activities	- Initiate and strengthen the capacities of these structures in the use of remote sensing, GIS, the OSM platform and opensource tools. - Field data collection - Focus group

PART 6 : CONCLUSION

Open Cities Africa is a project initiated by the World Bank in order to contribute strongly to the prevention of natural disaster risks and to improve the resilience of populations. In Kinshasa, the project was implemented by OSFAC (Observatoire Satellital des Forêts d'Afrique Centrale) and Potential 3.0 in the urban watershed of the N'Djili and Tshangu Rivers.

The objective of the project was to develop tools to enable key stakeholders, mainly decision-makers, to use information on natural disaster risks and thus better meet the challenge of managing urban growth while strengthening the resilience of the population to natural hazards and the impacts of climate change.

Three main features have marked this project: (i) the ***participatory approach*** which allowed close collaboration between several stakeholders with complementary but sometimes divergent concerns, (ii) the ***use of open-source and open-access tools*** for field data collection, analysis and data processing, and (iii) a ***user-centered design of the tools*** through which the choice of products was made by the users.

In the end, the Open Cities Kinshasa project produced relevant and reliable results, among others: (1) a database containing geospatial information on the physical environment, buildings, infrastructure (health, schools/universities, places of worship), roads, drainage network, occupation and use of space, floods and erosion; (2) a range of 240 maps that differ from one another by their theme (general, flood or erosion), by their coverage (project area, commune or neighbourhood) or by their format (A0, A1 and a4); (3) an Atlas with more than a hundred thematic maps in A4 format on erosion and potentially floodable areas in 70 neighbourhoods in 8 communes of the city of Kinshasa.

These very useful results are free of charge, free of access and will surely be capitalized on by the ongoing projects in Kinshasa. Decision-makers, administrative authorities, national institutions or agencies, local communities, researchers, planners, urban planners will find in these results first-rate information to inform their decision-making.

ANNEXES

ANNEXE 1. General GIS Data

Based on the assessment of external data, some data sources that would be useful to help update the OSM map was identified. As shown in the table below, these data from 10 institutions will provide new information on 17 thematic.

Note: detailed information on the data are in the excel file which is sent with this report, as annex.

Tableau 1. List of relevant data

Dataset	Description: (Assessment of Data Quality and Utility)	Agency/organization that provided the dataset
Administrative Boundaries	Township and neighborhoods Boundaries, Parcels, Industrial area	BEAU, CRREBAC, OSFAC
Gazetteer (City/town/village points)	Markets, Airport, Bridge, Port, Station (SNEL et Regideso), locality	OSM, field data collection
Aerial Imagery	Ikonos, Pleiade,	OSFAC
Drone Imagery	Very high-resolution imagery	Potentiel 3.0
Digital Elevation Model	DEM (SRTM), elevation data (DEM from drone data)	Potentiel 3.0, OSFAC
Hydro Network (rivers/streams/canals)	Rivers (N'djili et Matete), N'djili watershed	OSFAC
Drainage Network		OVD and field data collection
Waterbodies	Congo river,	OSFAC
Meteorological data	Precipitation, temperature,	Mettelsat, CRREBaC
Buildings	Hospital, Restaurants, Health structures (HGR, CS, PS, etc.), Churches, Administrative buildings, Schools,	Field data collection
Transportation	Road, Railway, avenue	Field data collection
Census Data (population)	demographic data	
Land Use/Land cover	Market gardening area, loti area, vegetation	URF-GRN and OSM
Vegetation (also possibly part of land use)	Vegetation	OSFAC
Floodplains	Flood area, watershed	OSFAC, CREEBaC, Local community
Soils and soils risk	Ravines and erosion heads, Topography, Soil, geology,	URF-GRN, OVD, OSFAC, local community
Historical Flood Extent		Local community

Table 2. Number of attributes collected relevant to the resilience problem identified

Data layer	Number
Environment	27
Buildings	15
Road	9
Drainage	60
Floods	22
Erosions	27
TOTAL	**160**

Table 3. Number of people attending presentations who are made aware of the data product

Stakeholders group	Sex		Total
	F	M	
Government Institutions	4	3	7
Academic Institutions	6	1	7
Research Institutions	4	9	13
Government	2	3	5
Local Community	39	215	254
OSM Users	8	8	16
Training structure	6	8	14
Non-governmental and other organizations	1	1	2
TOTAL	**70**	**248**	**318**

Table 4. Number of people trained to use data product

Stakeholders group	Sex		Total
	F	M	
Government Institutions	2	3	5
Academic Institutions	5	1	6
Research Institutions	2	9	11
Government	2	3	5
Local Community	8	40	48
OSM Users	8	8	16
Training structure	6	8	14
TOTAL	**33**	**72**	**105**

Table 5. Number of people with improved understanding of the resilience problem identified based on data product

Stakeholders group	Sex		Total
	F	M	
Government Institutions	2	3	5
Academic Institutions	5	1	6
Research Institutions	2	9	11
Government	2	3	5
Local Community	27	138	165
OSM users	8	8	16
Training structure	6	8	14
Local Authorities	5	73	78
TOTAL	**57**	**243**	**300**

Table 6. Number of people who would use data product to inform their disaster risk management decisions

Stakeholders group	Sex		Total
	F	M	
Government Institutions	0	6	6
Academic Institutions	0	1	1
Research Institutions	0	2	2
Government	2	3	5
Local Authorities	5	73	78
TOTAL	**7**	**85**	**92**

Table 7. Number of training events held

Training events topic	Event type	Number
OSM Tracker	Theorical training	2
	Practical training	2
Remote mapping with JOSM	Theorical training	2
	Practical training	2
OpenDataKit / OpenMapKit	Theorical training	2
	Practical training	2
Kobo Collect	Theorical trainings	1
	Practical trainings	1
Validation with JOSM	Theorical trainings	2
	Practical trainings	2
	TOTAL	**18**

Table 8. Number of people trained

Stakeholders group	Sex		Total
	F	M	
Government Institutions	2	3	5
Academic Institutions	5	1	6
Research Institutions	2	9	11
Government	2	3	5
Local Community	8	40	48
OSM users	8	8	16
Training structure	6	8	14
TOTAL	**33**	**72**	**105**

Table 9. Number of people participating in community mapping activities

Stakeholders group	Sex		Total
	F	M	
Communes	2	5	7
Neighborhoods	16	124	140
TOTAL	**18**	**129**	**147**

Table 10. Number of stakeholder groups consulted (in planning activities, product development, etc.)

Stakeholder group	Providing datasets	Planning activities	Remote mapping	Field data collection	Participatory mapping	Validation of tools	TOTAL
Government Institutions	3	1	0	0	1	2	**7**
Academic Institutions	0	0	2	2	0	1	**2**
Research Institutions	2	0	3	3	0	1	**3**
Government	0	1	0	0	0	1	**2**
Local Authorities	0	78	0	0	56	0	**78**
Local Community	0	0	0	70	70	0	**70**
OSM users	0	0	1	1	0	0	**1**
TOTAL	**5**	**1**	**6**	**76**	**79**	**5**	**93**

Table 11. Number of women engaged in the design of community maps

Organization	Number
Government (chief of neighborhood)	16
Local Community	32
Commune (delegee)	2
Civil Protection	2
TOTAL	**52**

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