POLITECNICO DI MILANO

School of Civil, Environmental and Land Management Engineering
M.Sc. programme in Civil Engineering for Risk Mitigation

Geospatial Data Processing to Support Seismic Emergency Management

WebGIS Services to Support Locational Choices of Shelters

Presented by: Group 1

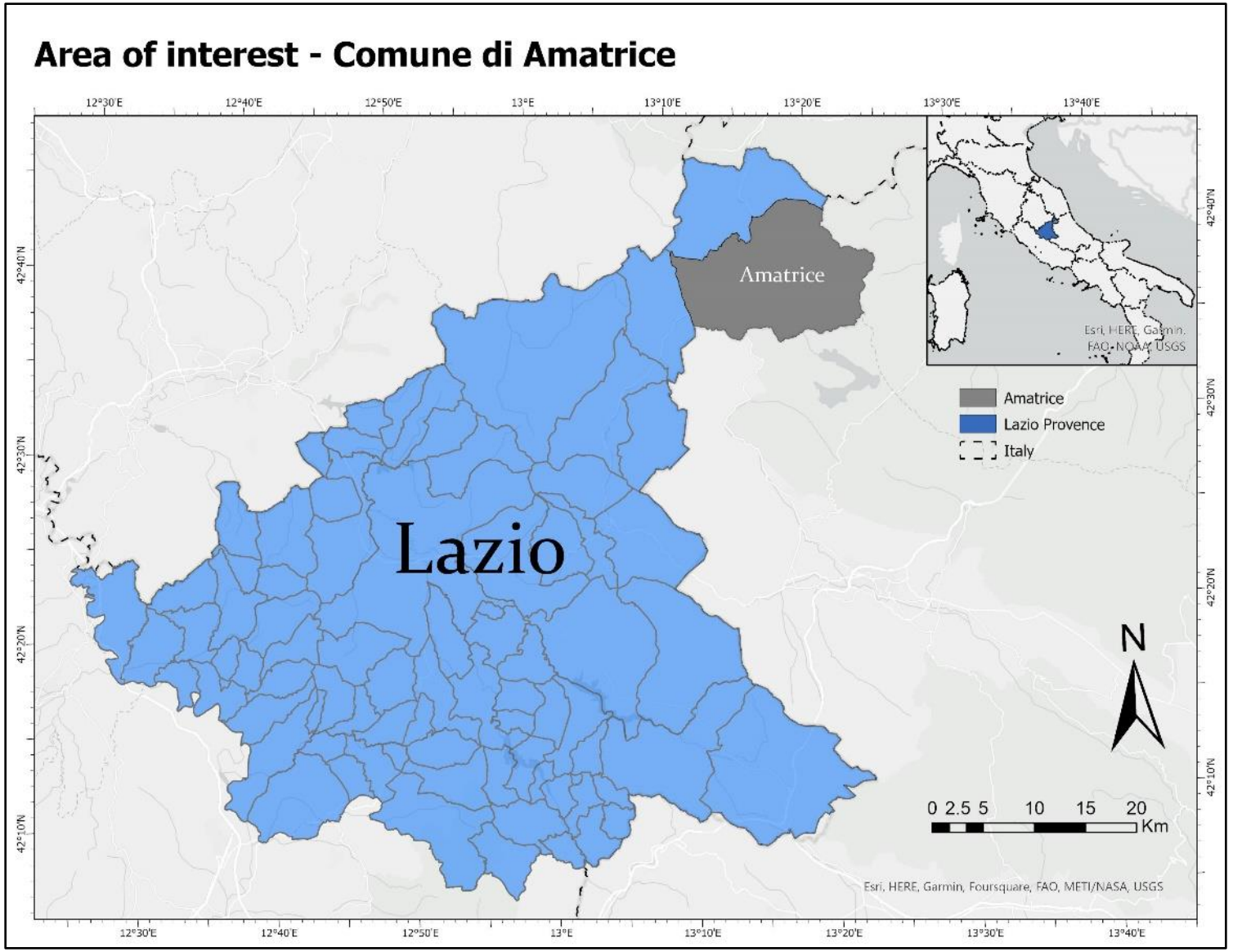
Supervised by: Professor Daniela Carrion, Professor Maria Pia Boni and Professor Scira Menoni

Introduction

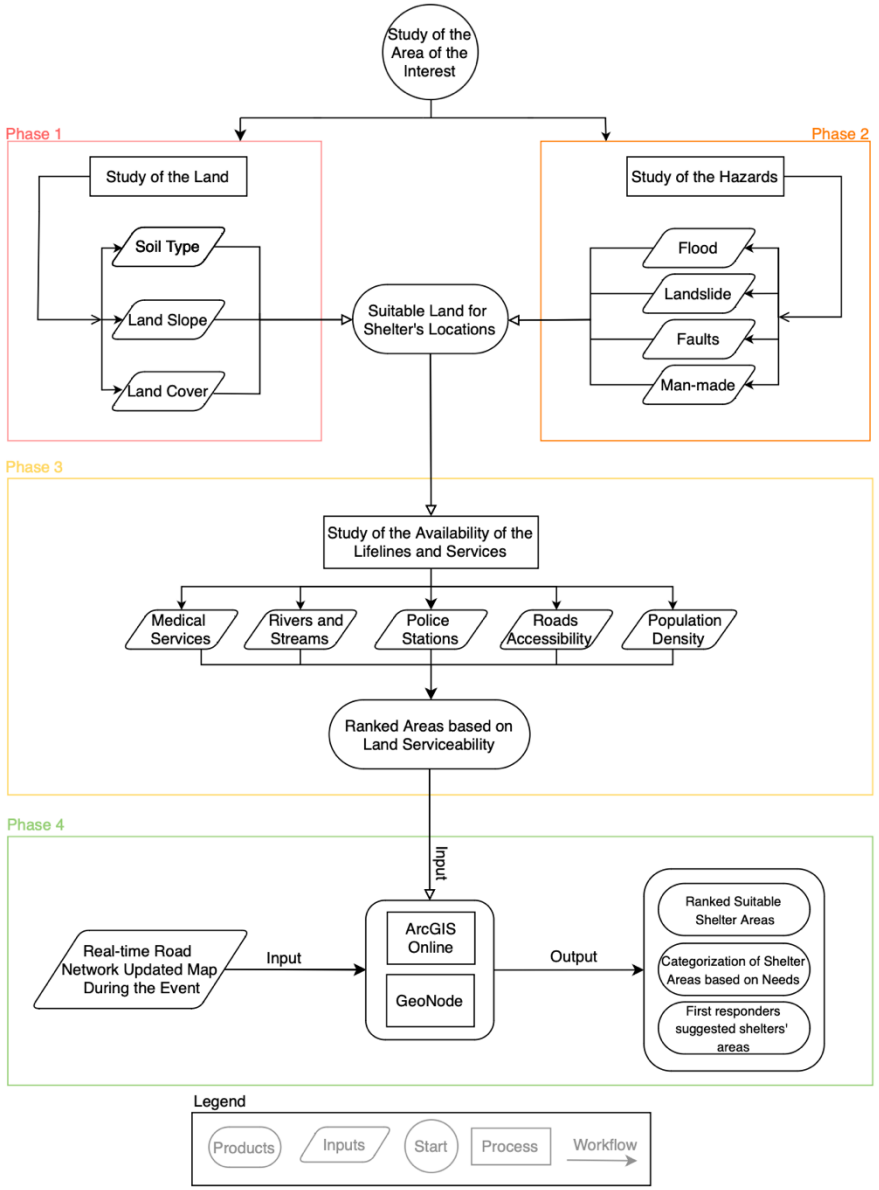
Emergency plan for shelter locations in Amatrice, Italy

Using Geospatial data to identify suitable shelter locations during and after the event

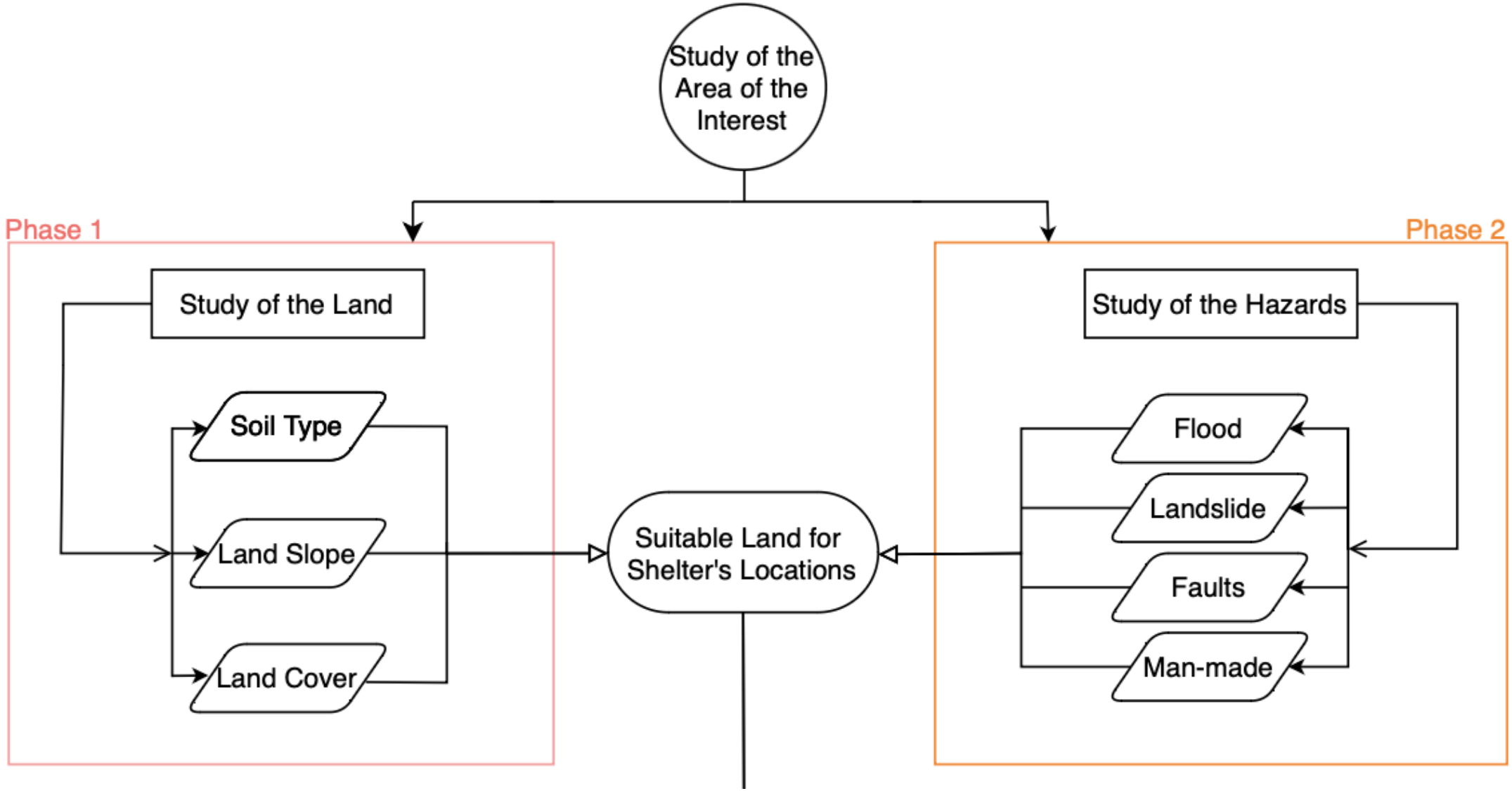
WebGIS platform to visualize and access the computed data. Factors like accessibility and facilities considerations will be analyzed to choose suitable shelter locations



Framework


Study of the Area of the Interest
Phase 1
Study of the Land
Soil Type
Land Slope
Land Cover
Suitable Land for Shelter's Locations
Phase 2
Study of the Hazards
Flood
Landslide
Faults
Man-made
Phase 3
Study of the Availability of the Lifelines and Services
Medical Services
Rivers and Streams
Police Stations
Roads Accessibility
Population Density
Ranked Areas based on Land Serviceability
Phase 4
Input
Real-time Road Network Updated Map During the Event
Input
ArcGIS Online
GeoNode
Output
Ranked Suitable Shelter Areas
Categorization of Shelter Areas based on Needs
First responders suggested shelters' areas
Legend
Products
Inputs
Start
Process
Workflow

Framework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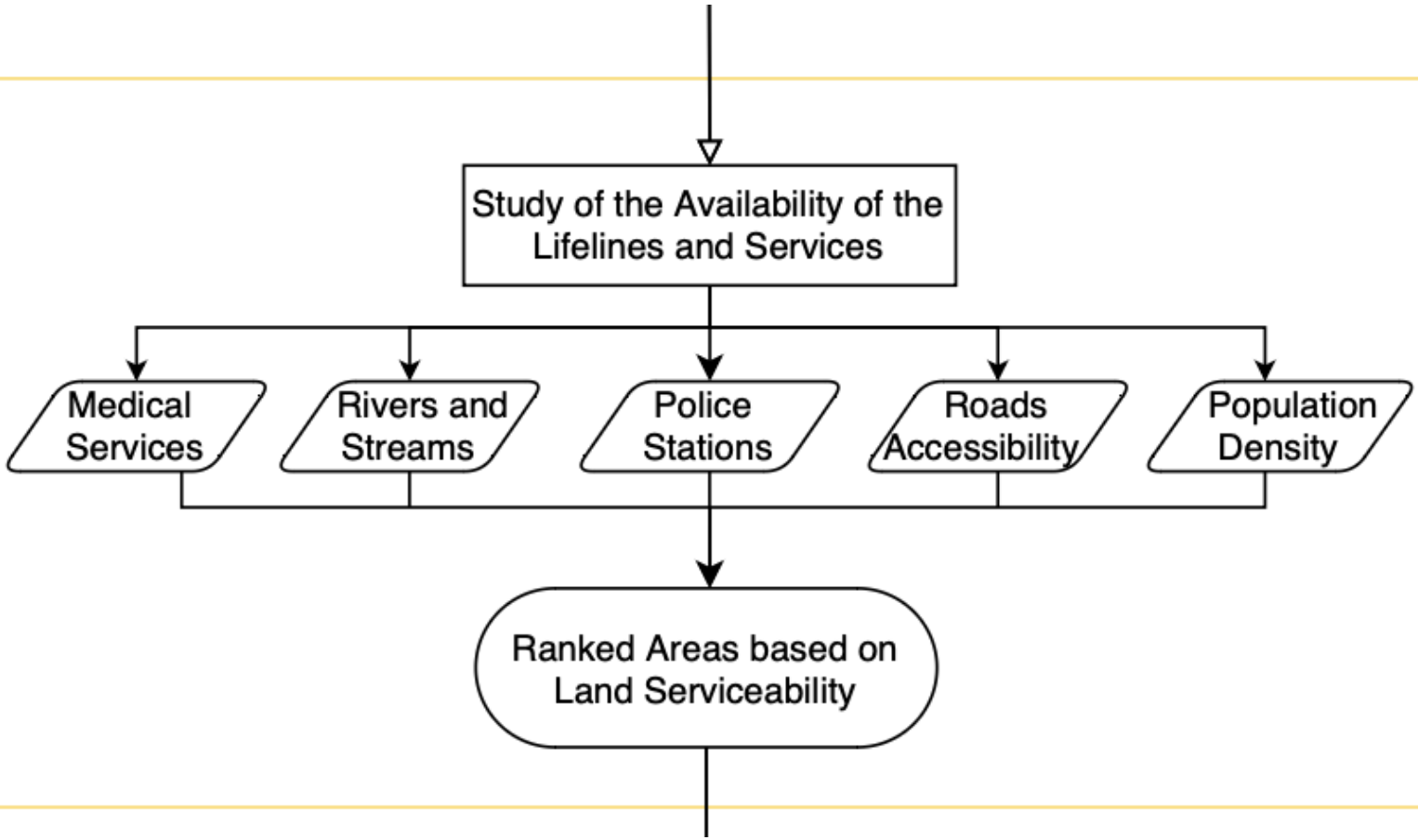
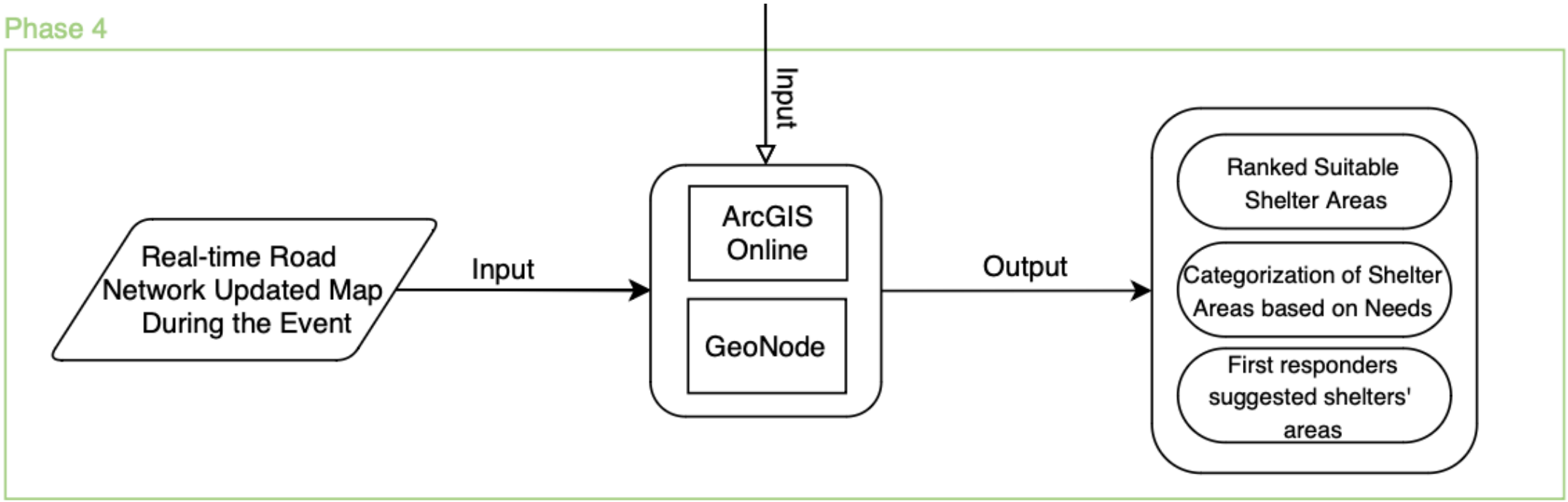
Framework

Phase 3



Framework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Weights Assignment

Phase	Layers	Classification	Interpretation	Suitability Weights	Main Weight
	Slope	$\theta \leq 2° \ \& \ \theta > 10°$	Unsuitable	0	7
		$2° < \theta \leq 4°$	Neutral	2	
		$4° < \theta \leq 10°$	Suitable	5	

Phase 1

Flood Hazard	Susceptible areas	Unsuitable	0	-
	Un-susceptible areas	Suitable	1	

Phase 2

Population Density	No. of People <20	Less suitable	1
	21< No. of People < 50	Neutral	1,23
	No. of People > 51	Suitable	1,35

Phase 3

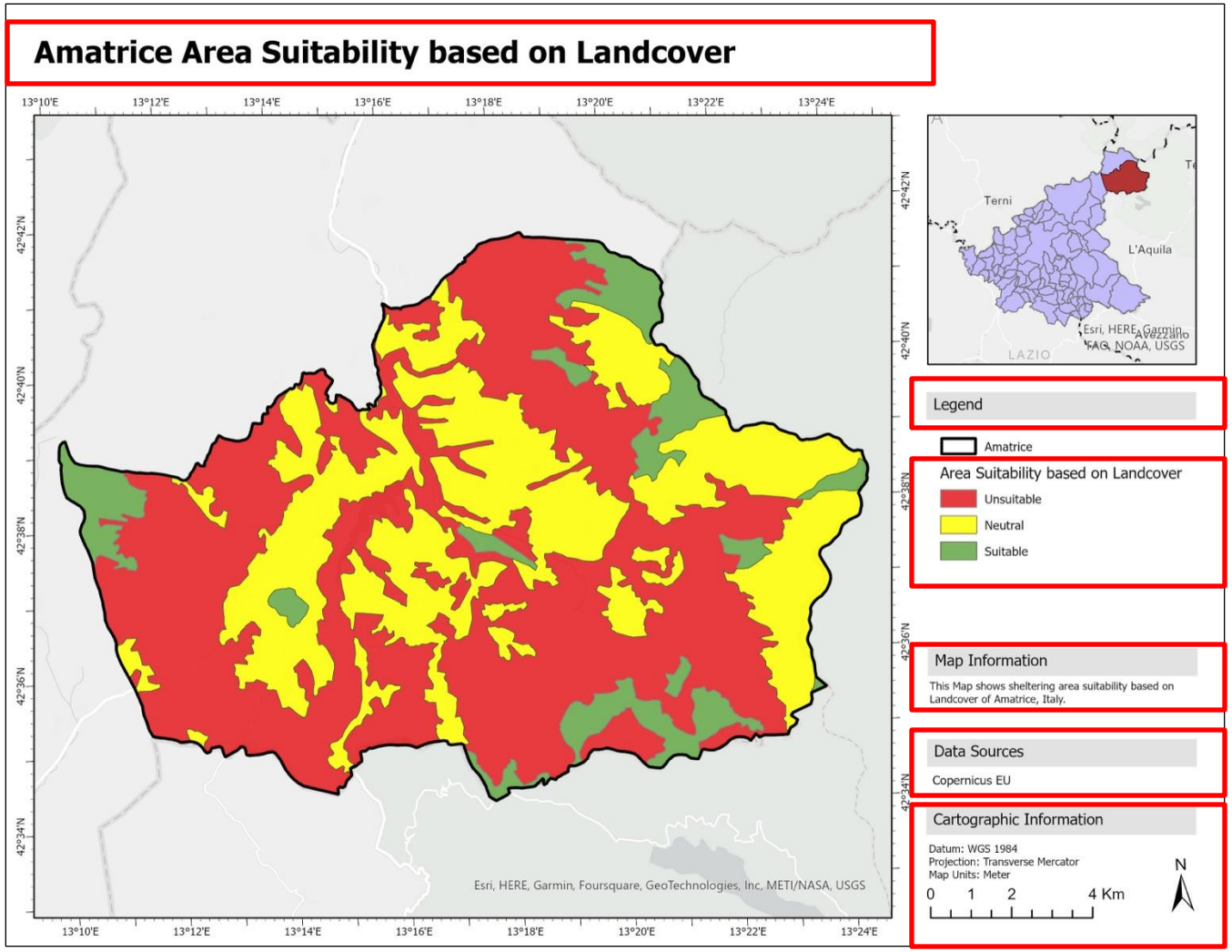
Estimated Number of Evacuees

Inhabitants

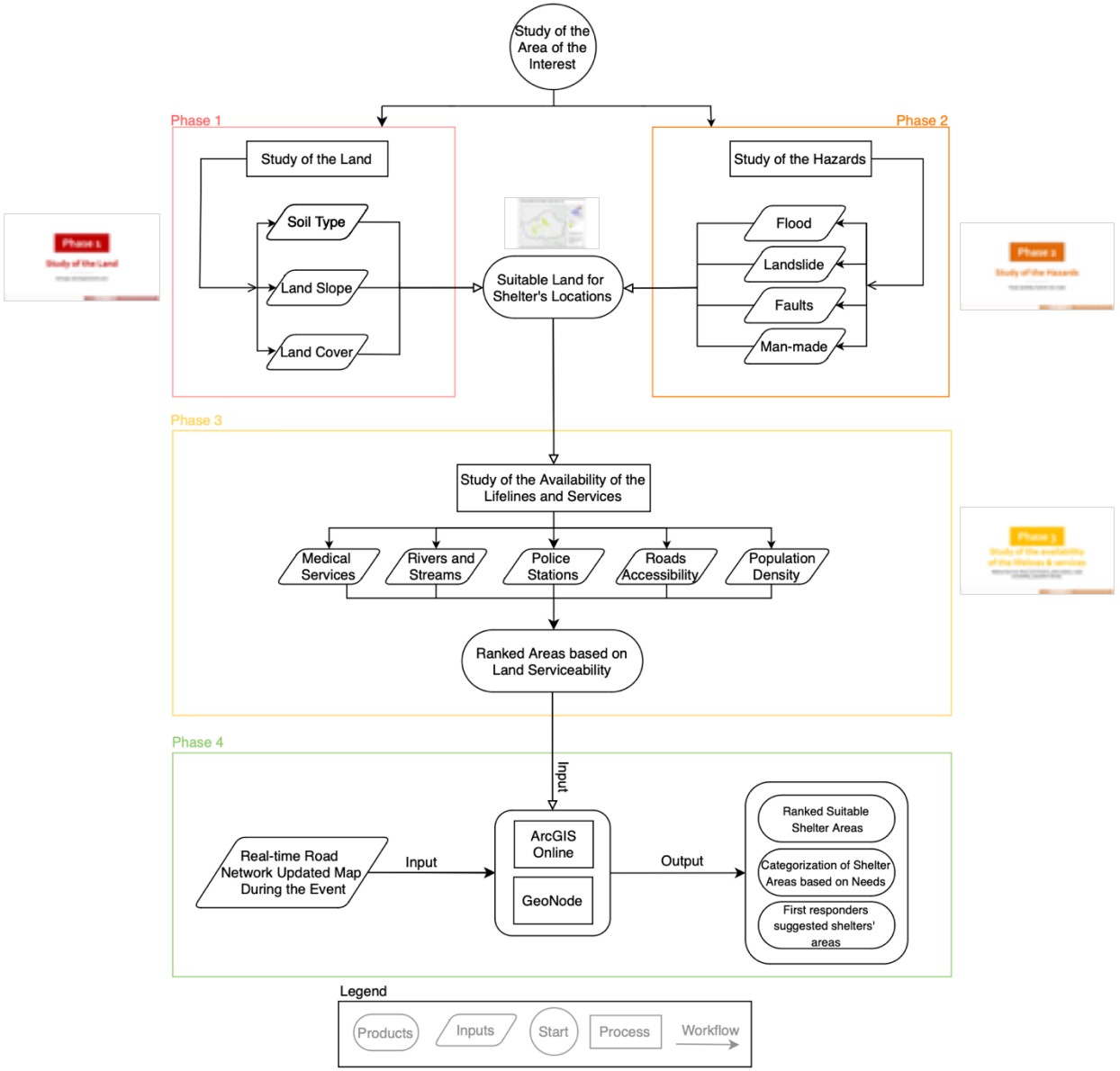
SAR Team

Estimated Number of Evacuees = 2689 + 200(SAR) = 2889

Map Template



Workflow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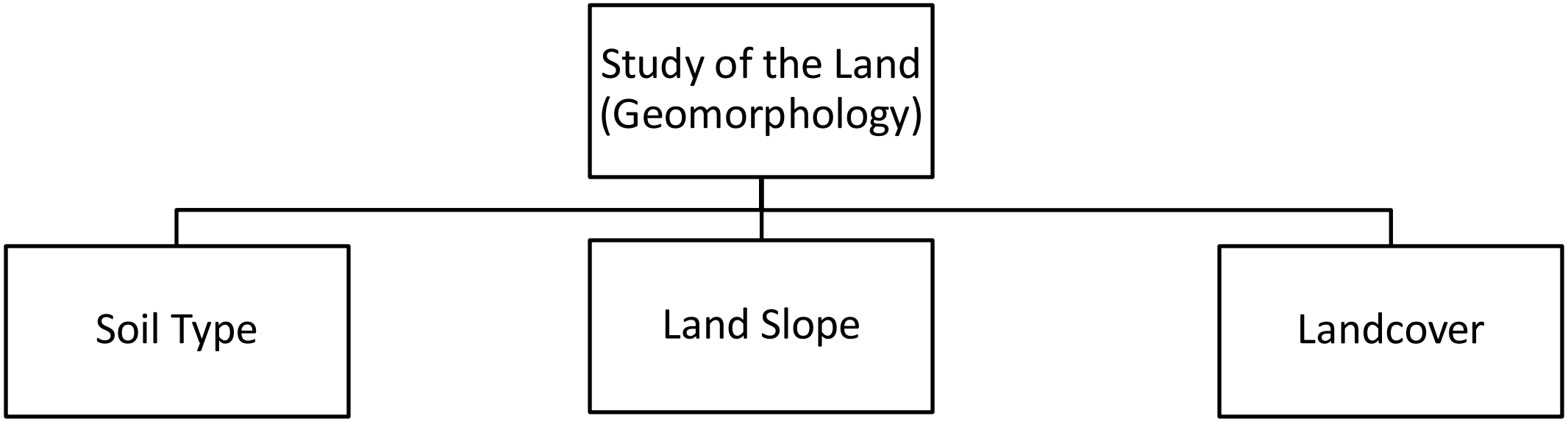
Phase 1

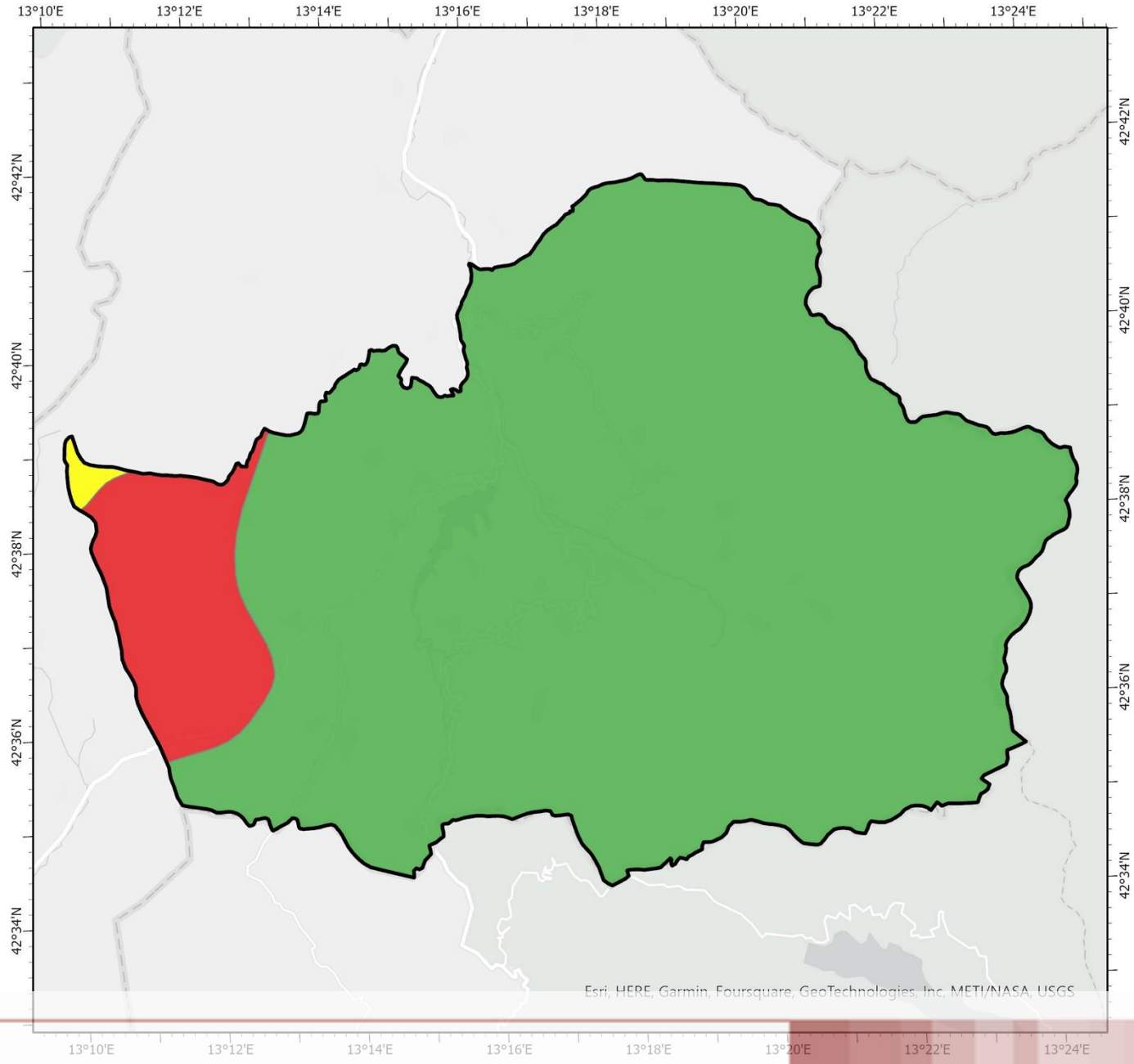
Study of the Land

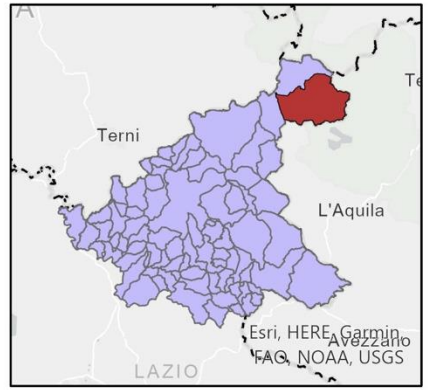
Soil type, land slope & land cover

Study of the land (Phase 1)



Amatrice Area Suitability based on Soil Type





Legend

- Amatrice

Area Suitability based on Soil Type

- Unsuitable
- Neutral
- Suitable

Map Information

This Map shows sheltering area suitability based on Soil Type of Amatrice, Italy.

Data Sources

BGR's IHME1500

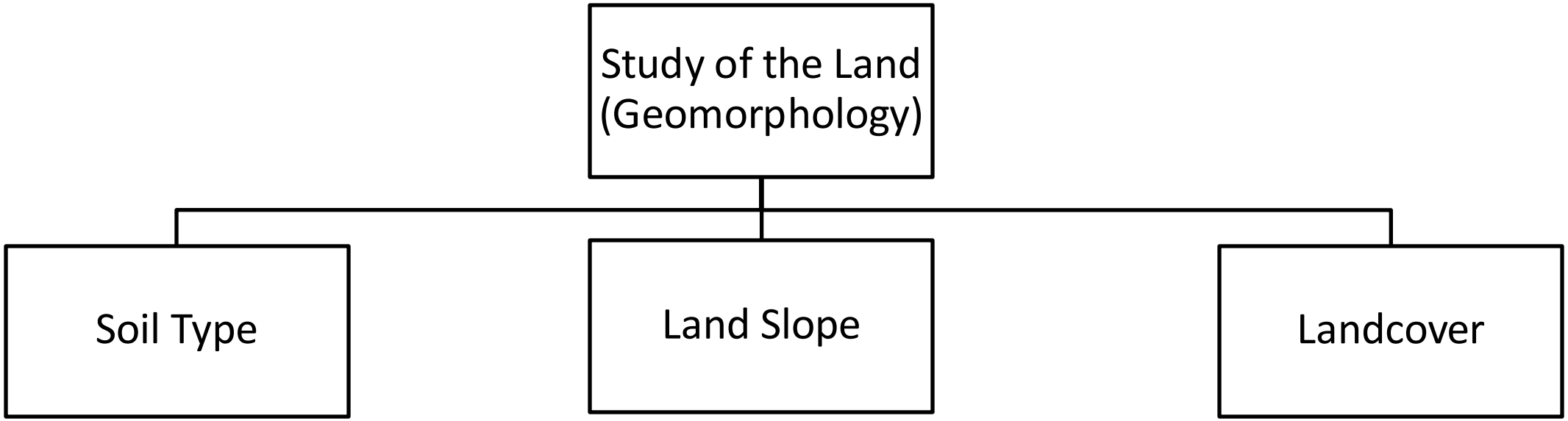
Cartographic Information

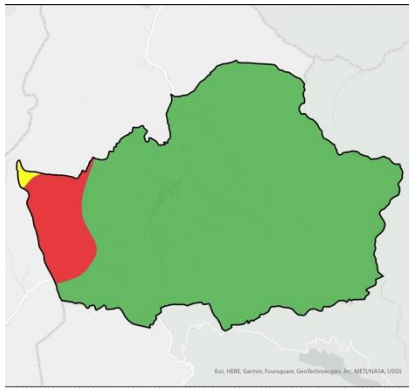
Datum: WGS 1984
Projection: Transverse Mercator
Map Units: Meter

0 1 2 4 Km

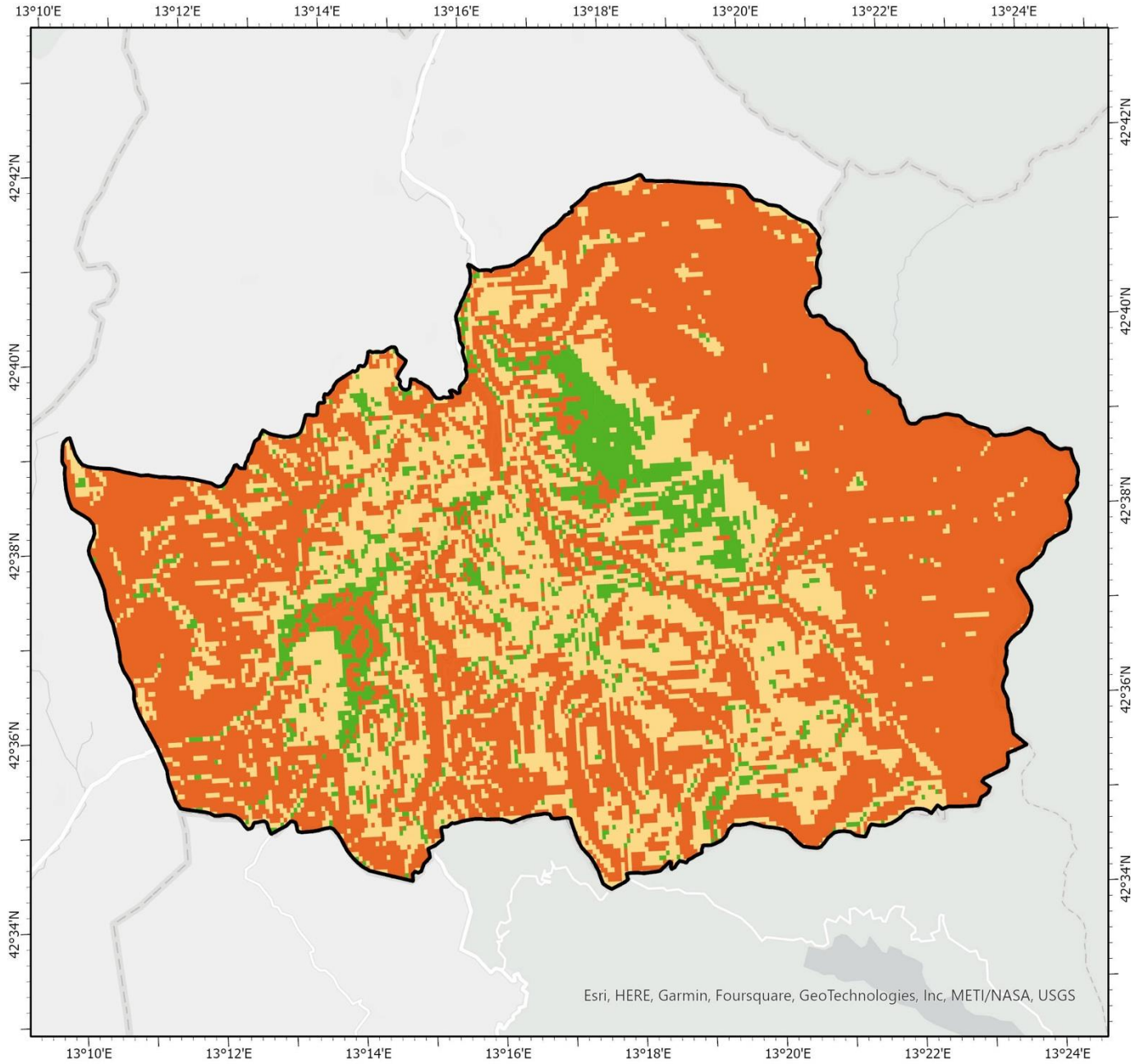
N

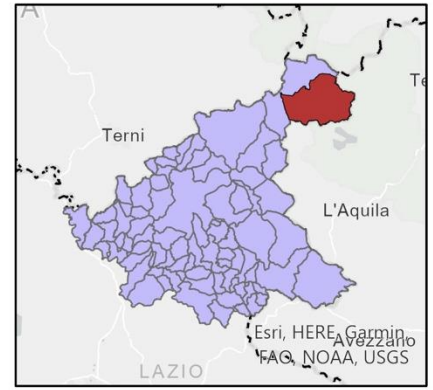
Study of the land (Phase 1)





Amatrice Area Suitability based on Slope





Legend

- Amatrice

Area Sutability based on Slope

- Unsuitable
- Neutral
- Suitable

Map Information

This Map shows sheltering area suitability based on slope of Amatrice, Italy.

Data Sources

Regional Geoportal Lazio

Cartographic Information

Datum: WGS 1984
Projection: Transverse Mercator
Map Units: Meter

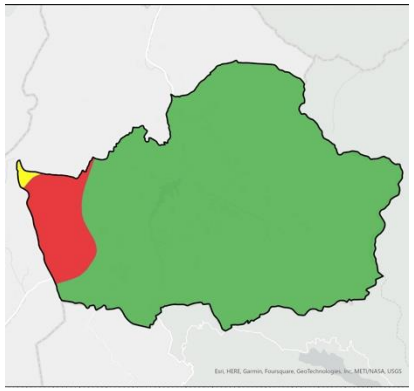
0 1 2 4 Km

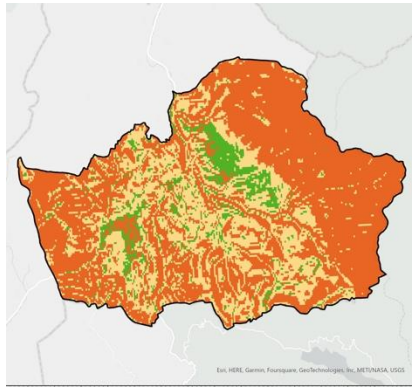
N

Study of the land (Phase 1)

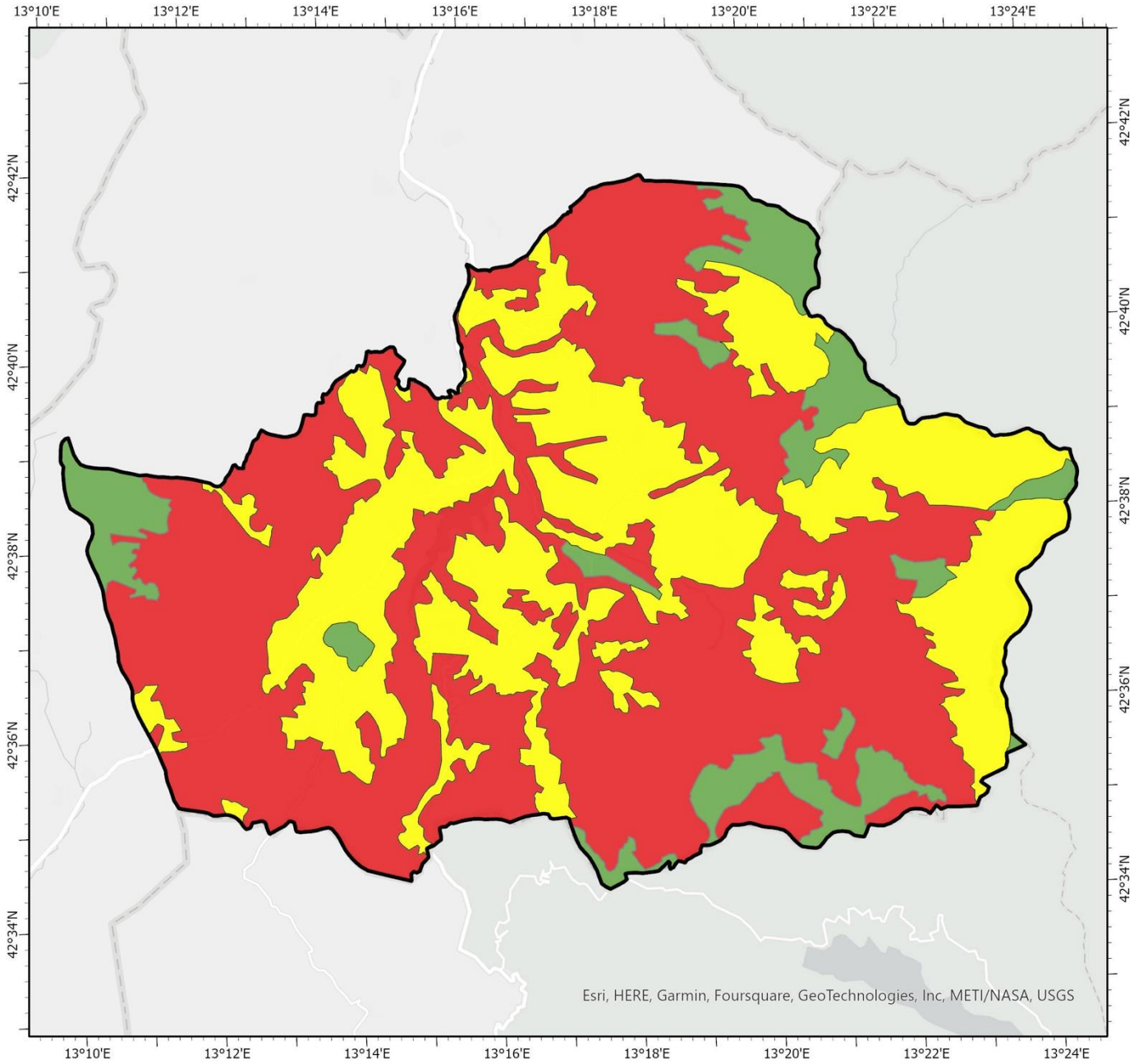
Study of the Land (Geomorphology)

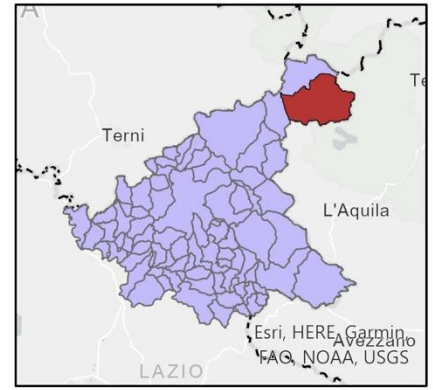
- Soil Type
- Land Slope
- Landcover





Amatrice Area Suitability based on Landcover





Legend

- Amatrice

Area Suitability based on Landcover

- Unsuitable
- Neutral
- Suitable

Map Information

This Map shows sheltering area suitability based on Landcover of Amatrice, Italy.

Data Sources

Copernicus EU

Cartographic Information

Datum: WGS 1984
Projection: Transverse Mercator
Map Units: Meter

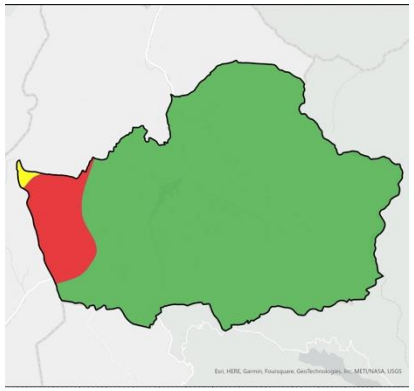
0 1 2 4 Km

N

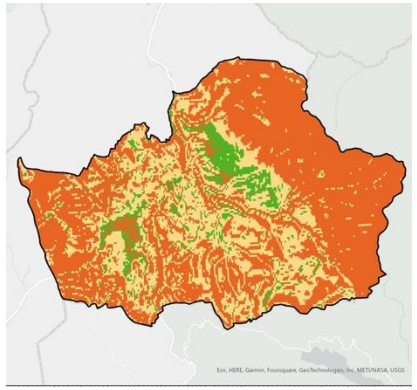
Study of the land (Phase 1)

Study of the Land (Geomorphology)

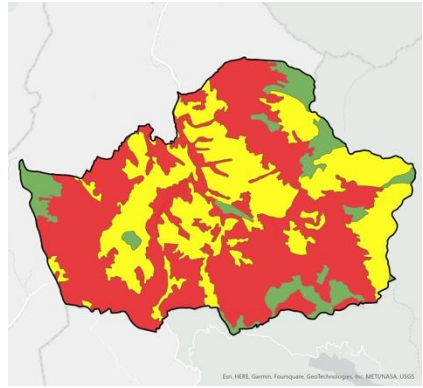
Soil Type



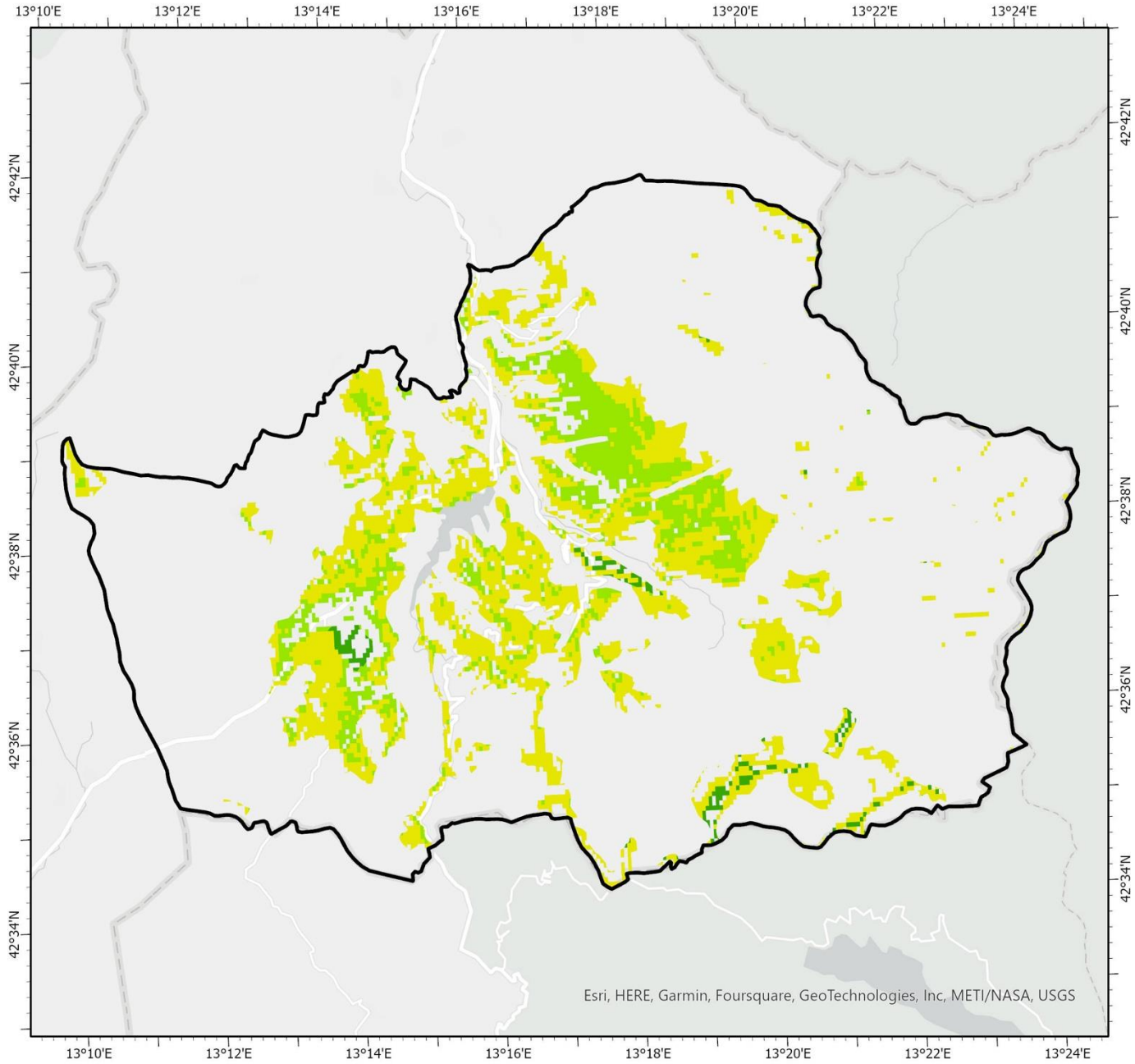
Land Slope

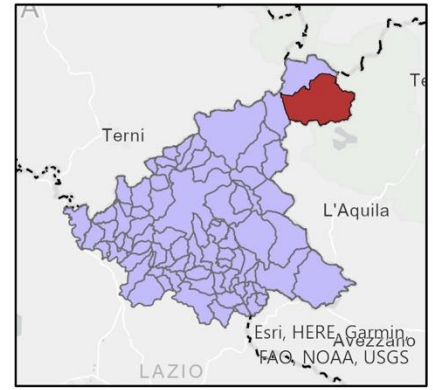


Landcover



Amatrice Sheltering Area Suitability (Study of the land)





Legend

- Amatrice

Area Suitability

- Suitable
- High Suitability
- Very High Suitability

Map Information

This Map shows sheltering area suitability for phase 1 "Study of the land" of Amatrice, Italy. Layers used to produce this map: Soil Type, Land Slope, and Landcover.

Data Sources

Copernicus EU, BGR's IHME1500, Regional Geoportal Lazio

Cartographic Information

Datum: WGS 1984
Projection: Transverse Mercator
Map Units: Meter

0 1 2 4 Km

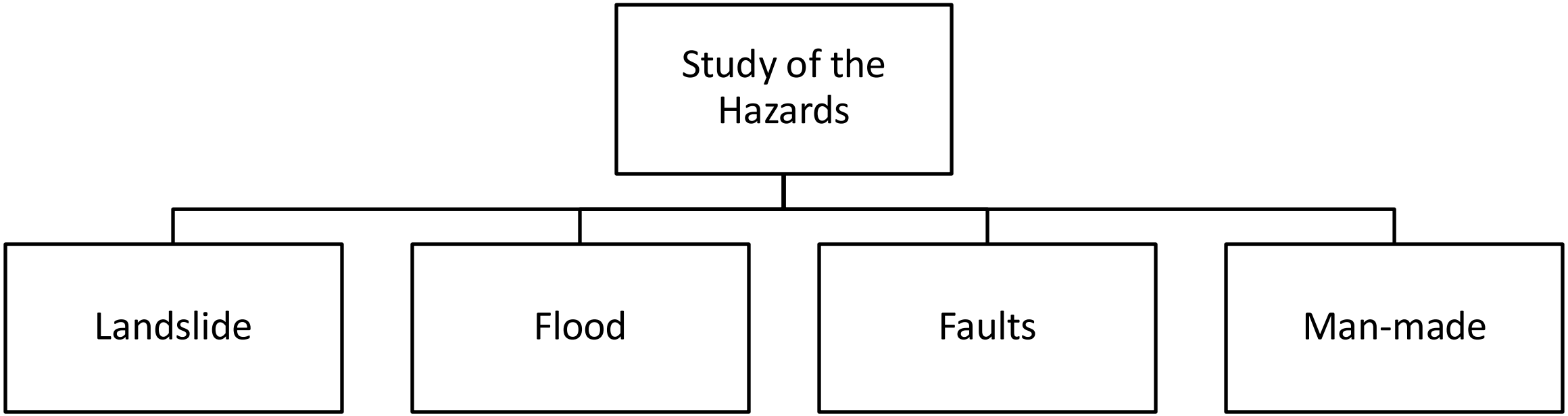
N

Phase 2

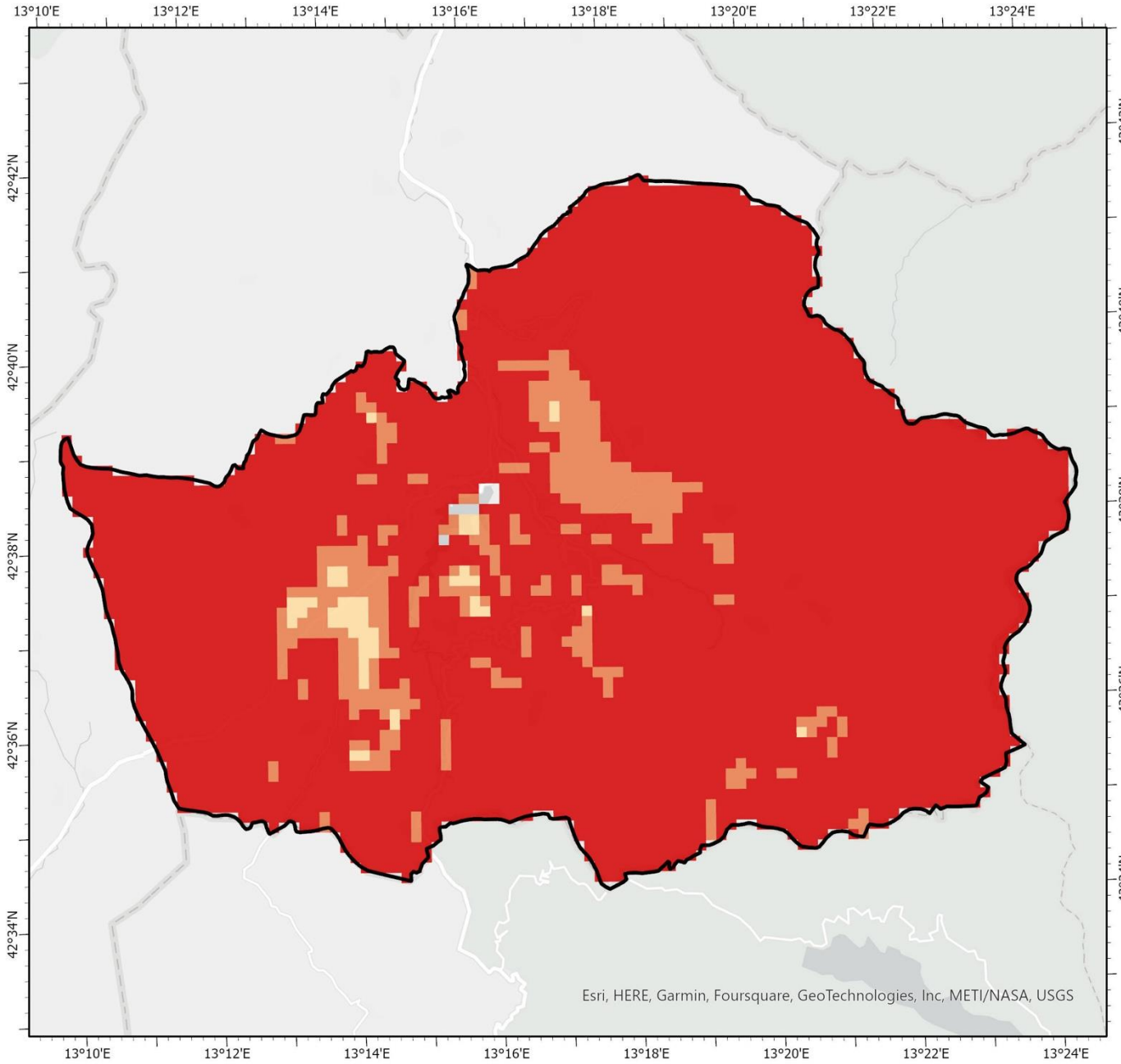
Study of the Hazards

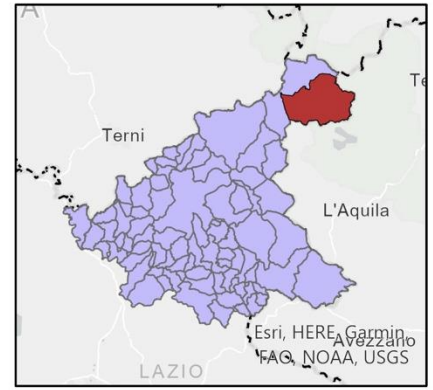
Flood, landslide, faults & man-made

Study of the Hazards (Phase 2)



Amatrice Landslide Hazard Map





Legend

- Amatrice

Landslide Hazard Level

- Hazardous
- Low Hazard
- Very Low Hazard

Map Information

This Map shows landslide hazard classification for Amatrice, Italy.

Data Sources

European Commission JRC

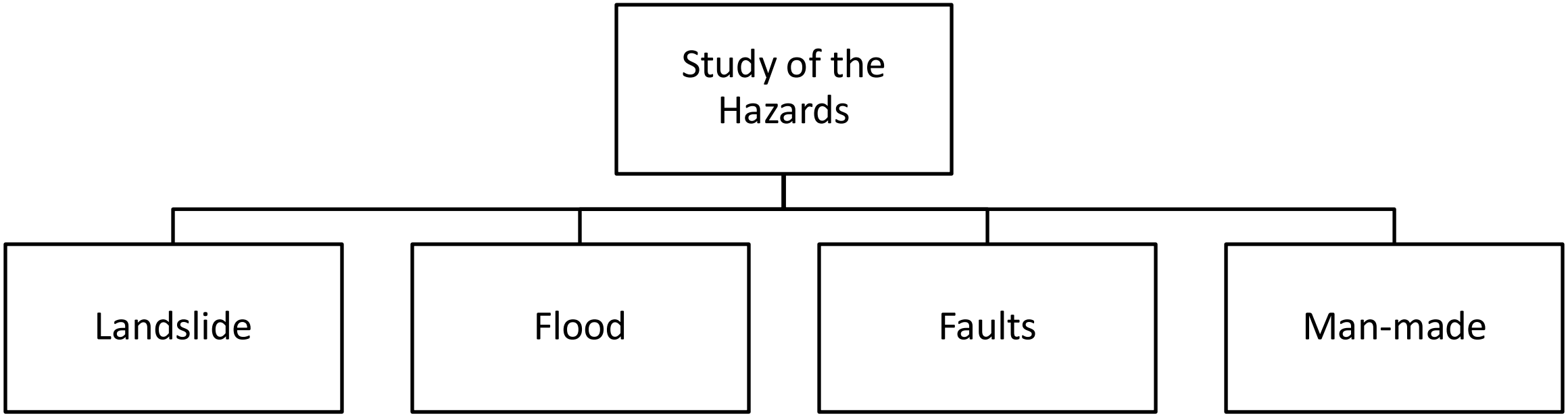
Cartographic Information

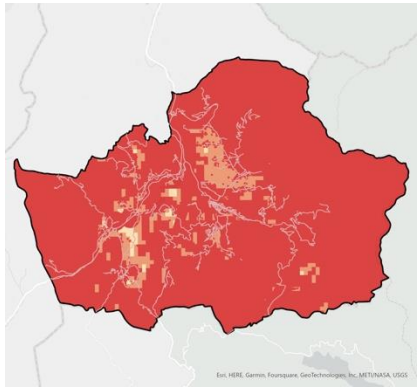
Datum: WGS 1984
Projection: Transverse Mercator
Map Units: Meter

0 1 2 4 Km

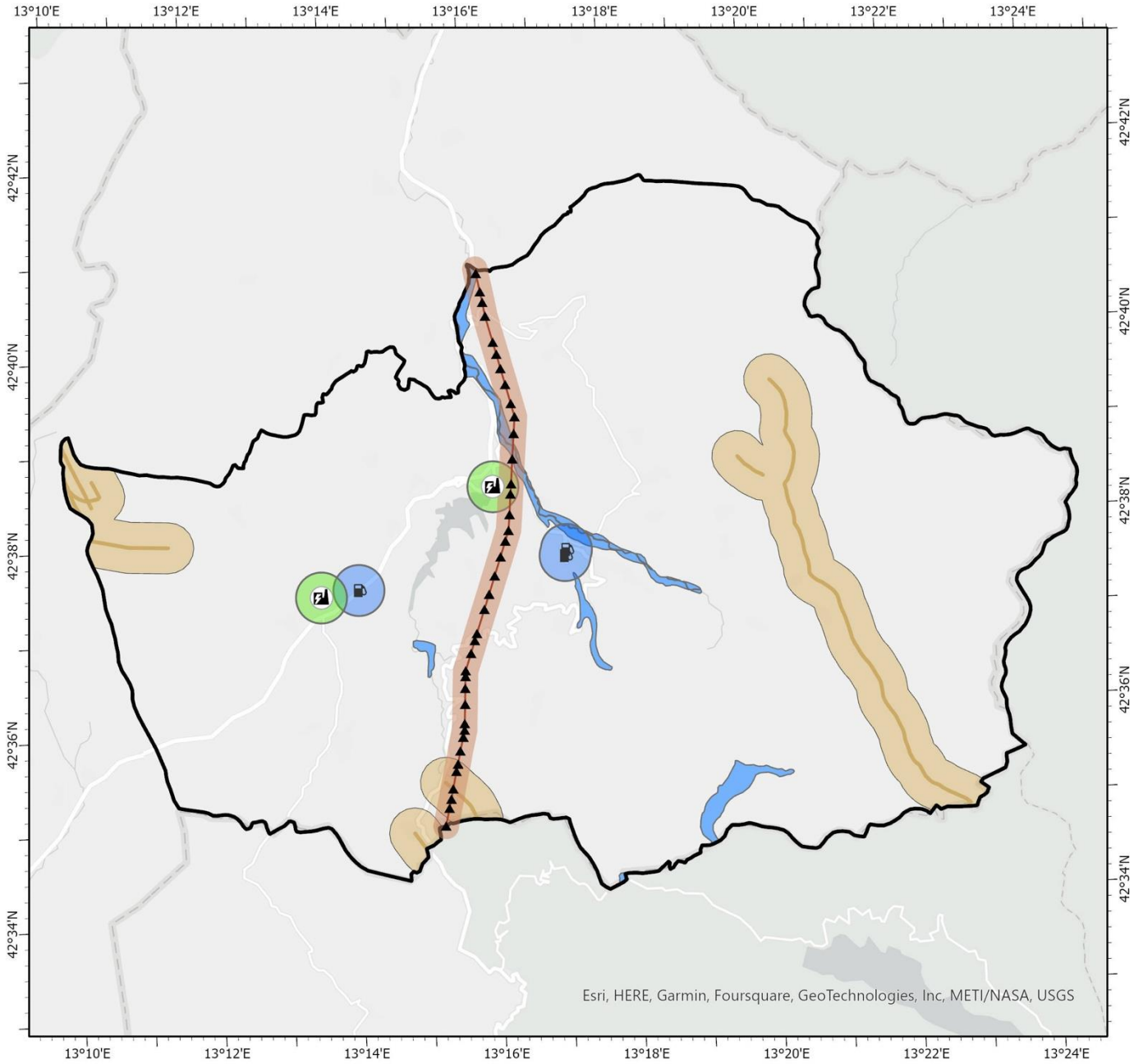
N

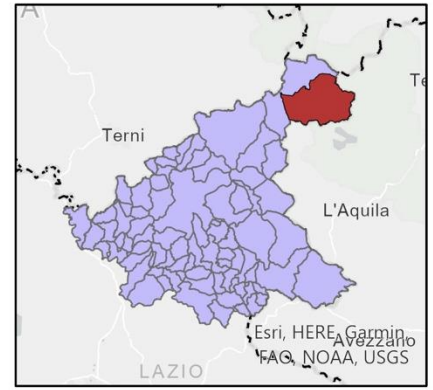
Study of the Hazards (Phase 2)





Amatrice Hazard Map





Legend

- Amatrice
- Power Plants
- Fuel Stations
- Power Towers
- Faults
- Power Line
- Flood Hazard
- Buffer (500m)
- Buffer (500m)
- Buffer (250m)
- Buffer (500m)

Map Information

This Map shows hazards and manmade hazards considered for Amatrice, Italy.
Layers presented: Faults, Flood Hazard, Power Plants, Fuel Stations, and Power Towers

Data Sources

Regional Geoportal Lazio, OpenStreetMap

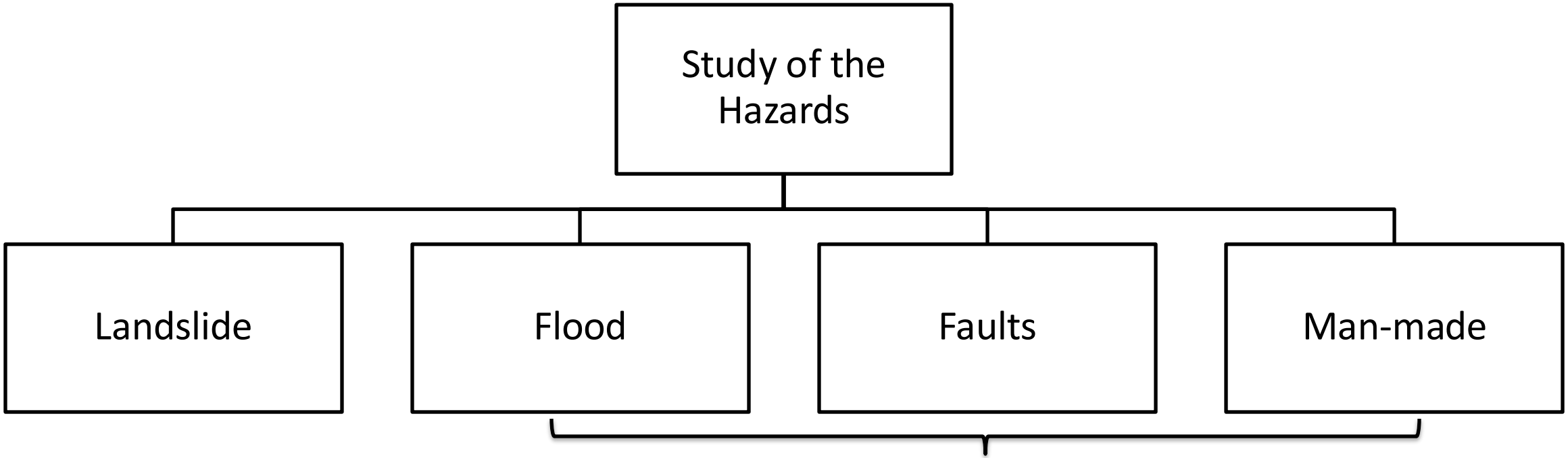
Cartographic Information

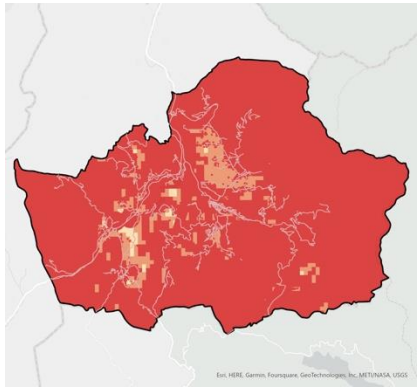
Datum: WGS 1984
Projection: Transverse Mercator
Map Units: Meter

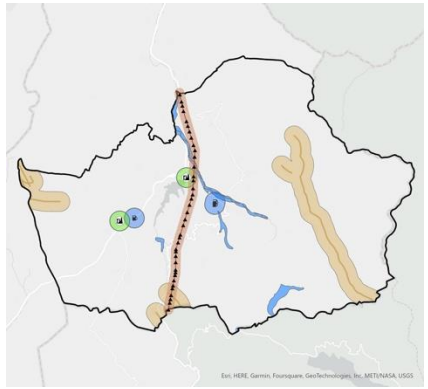
0 1 2 4 Km

N

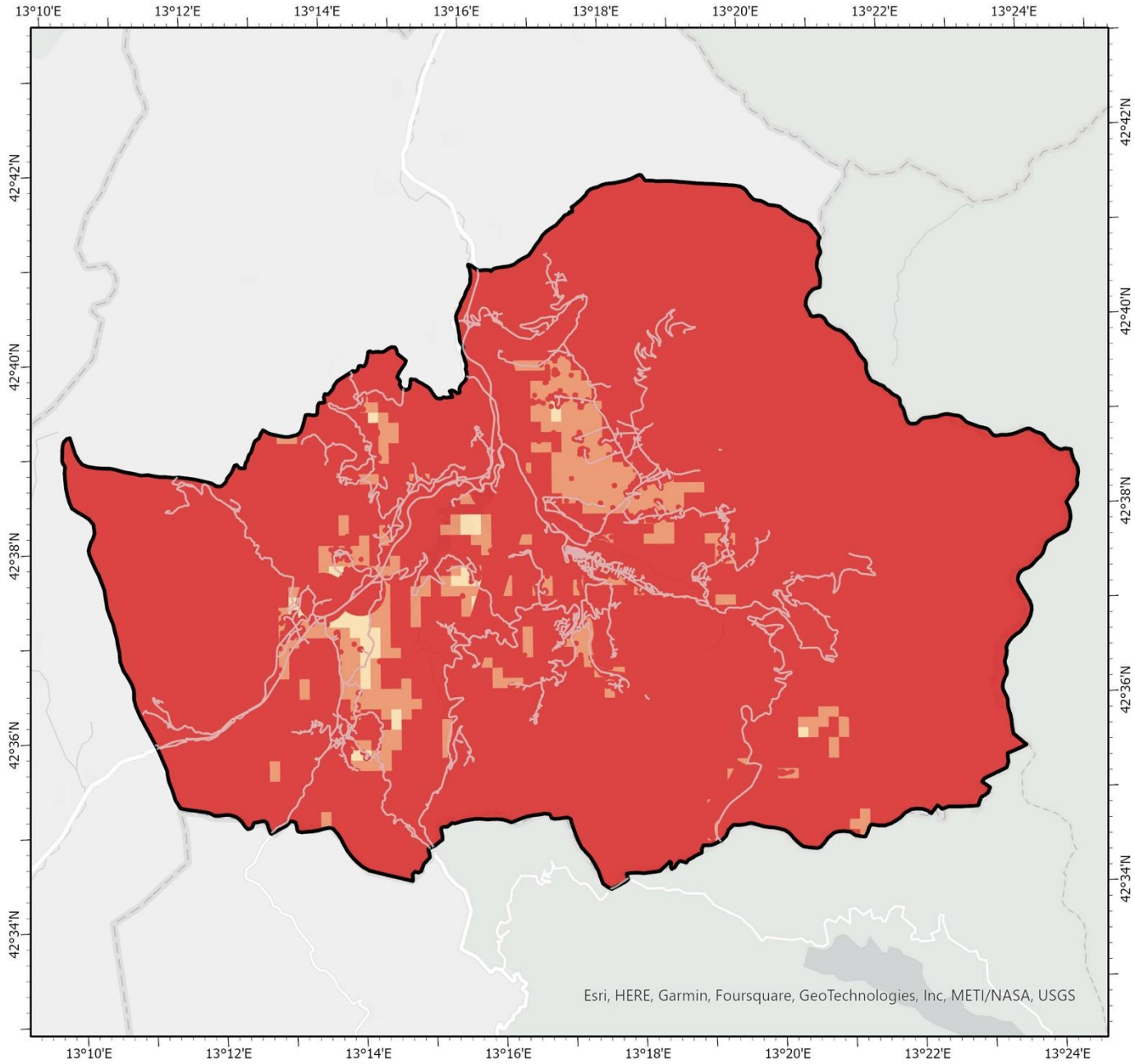
Study of the Hazards (Phase 2)

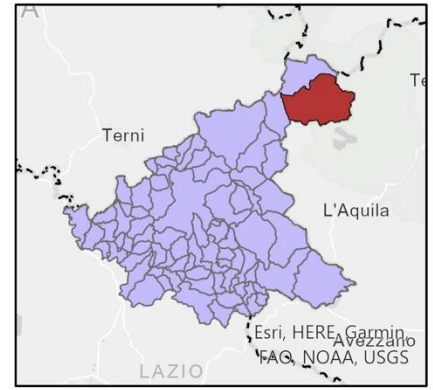






Amatrice Hazard Level Map "phase 2"





Legend

- Amatrice
- Road Network

Hazard Level

- Hazardous
- Low Hazard
- Very Low Hazard

Map Information

This Map shows hazard classification for Amatrice, Italy. It is produced considering:
- Natural Hazards: Landslide Hazard, Flood Hazard
- Manmade Hazard: Fuel Station, Power Plant, and Power Towers

Data Sources

European Commission JRC, Regional Geoportal Lazio, OpenStreetMap

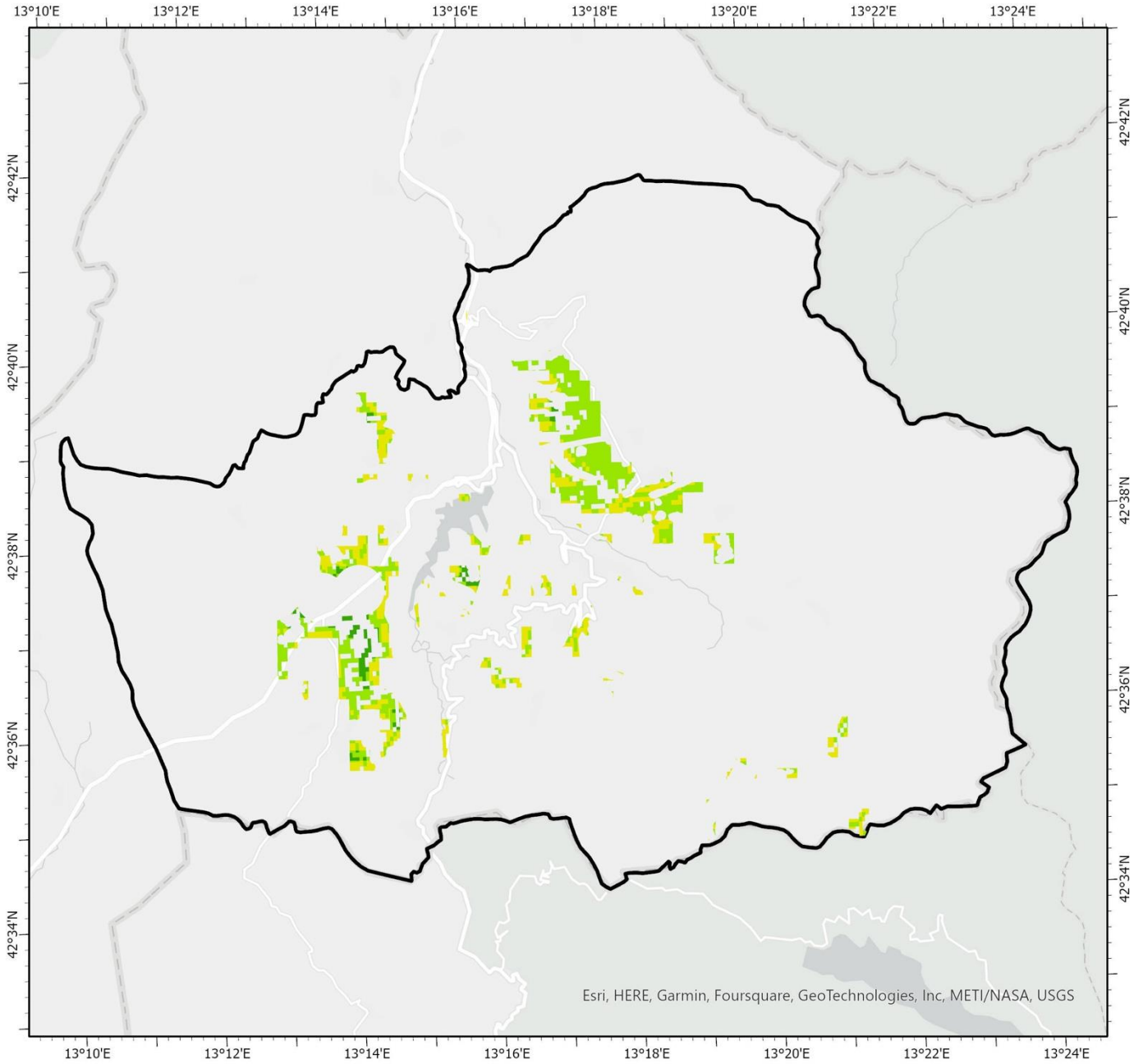
Cartographic Information

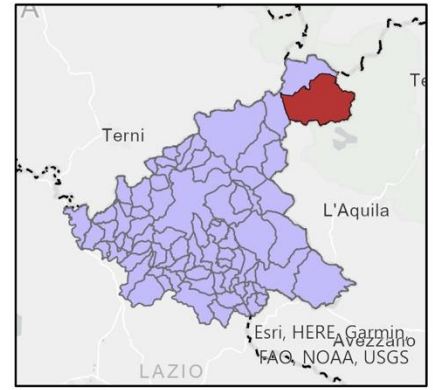
Datum: WGS 1984
Projection: Transverse Mercator
Map Units: Meter

0 1 2 4 Km

N

Amatrice Suitable Area for Shelter's location (Phase 1 &2)





Legend

- Amatrice

Sheltering Suitability Area

- Neutral
- High
- Very High

Map Information

This Map shows suitable area for shelter's location for Amatrice, Italy. It is a product of Phase 1 and Phase 2.

Data Sources

European Commission JRC, Regional Geoportal Lazio, BGR's IHME1500, Copernicus EU, OpenStreetMap

Cartographic Information

Datum: WGS 1984
Projection: Transverse Mercator
Map Units: Meter

0 1 2 4 Km

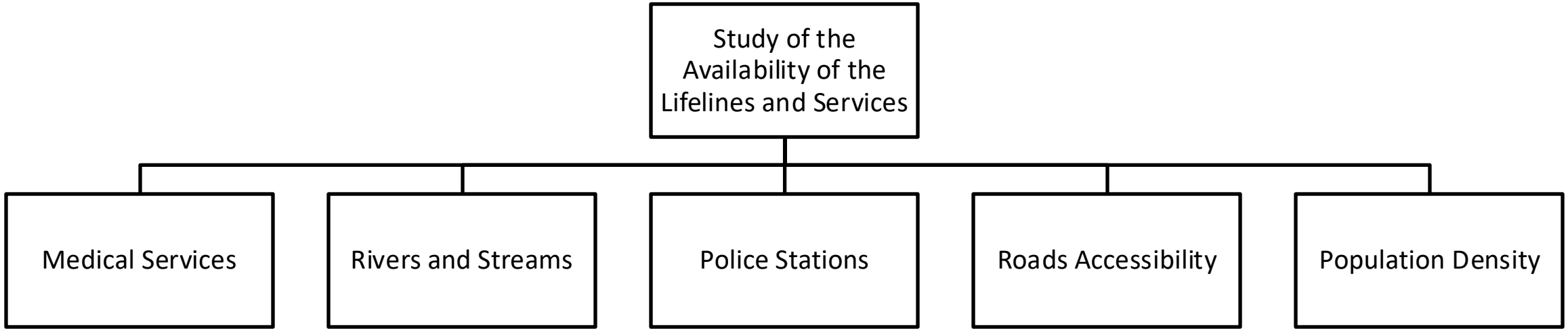
N

Phase 3

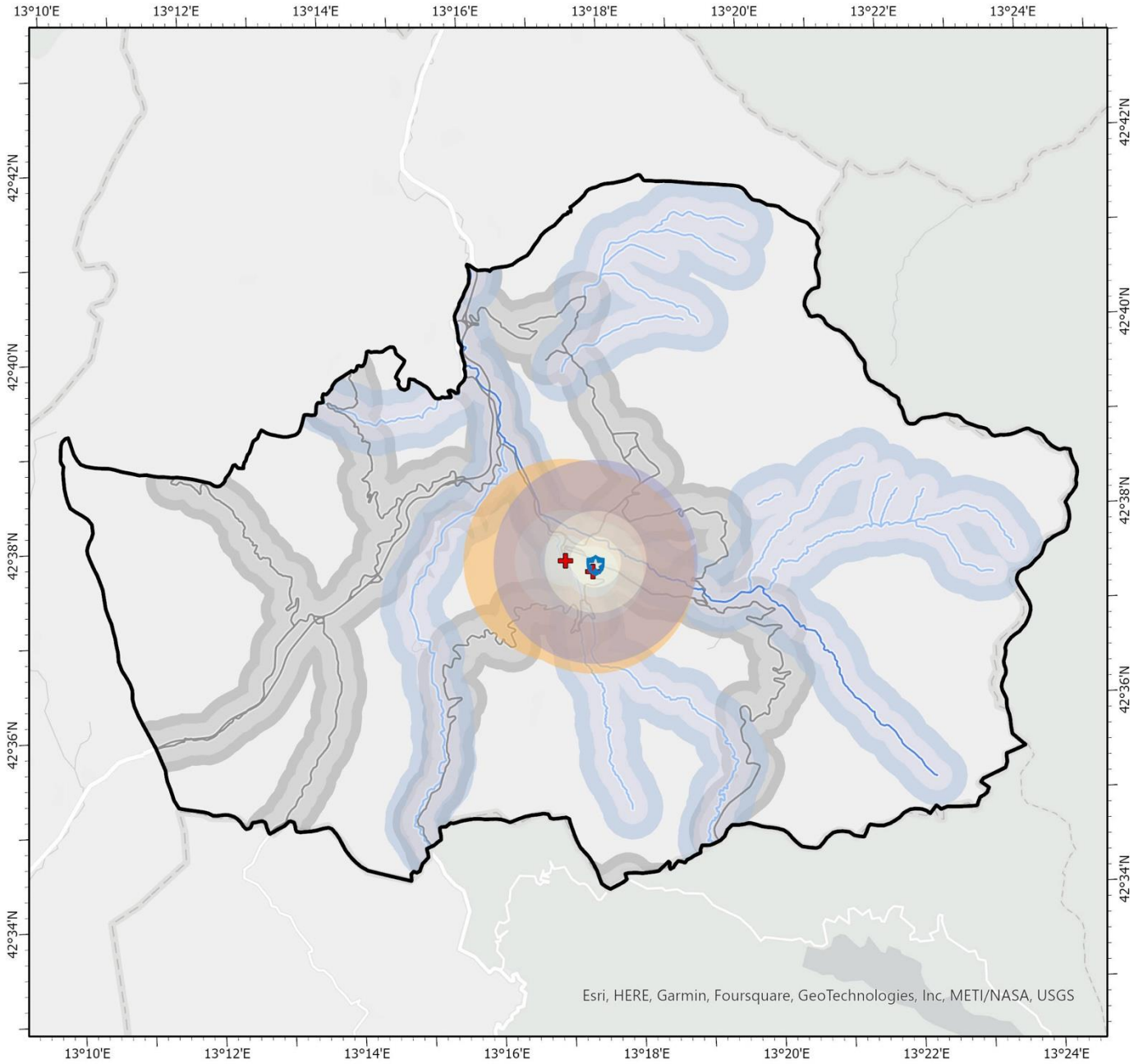
Study of the availability of the lifelines & services

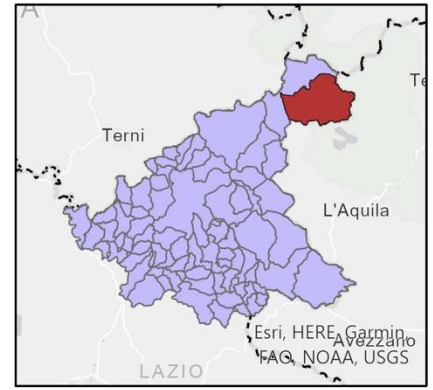
Medical Services, Rivers and streams, police station, roads accessibility, population density.

Study of the availability of the lifelines & services



Amatrice Lifelines and Services Map





Legend

- Amatrice
- Police Station
- Medical Services
- Road Network
- River
- Main Streams

Police Buffer	Road Buffer
500 m	50 m
1000 m	300 m
2000 m	500 m

Medical Buffer	Water Buffer
500 m	50 m
1000 m	300 m
2000 m	600 m

Map Information

This Map shows the lifelines and services used to rank the areas based on serviceability (Phase 3) for Amatrice, Italy. Layers used: Medical Services, Police Stations, River, Streams, and Road Network.

Data Sources

OpenStreetMap

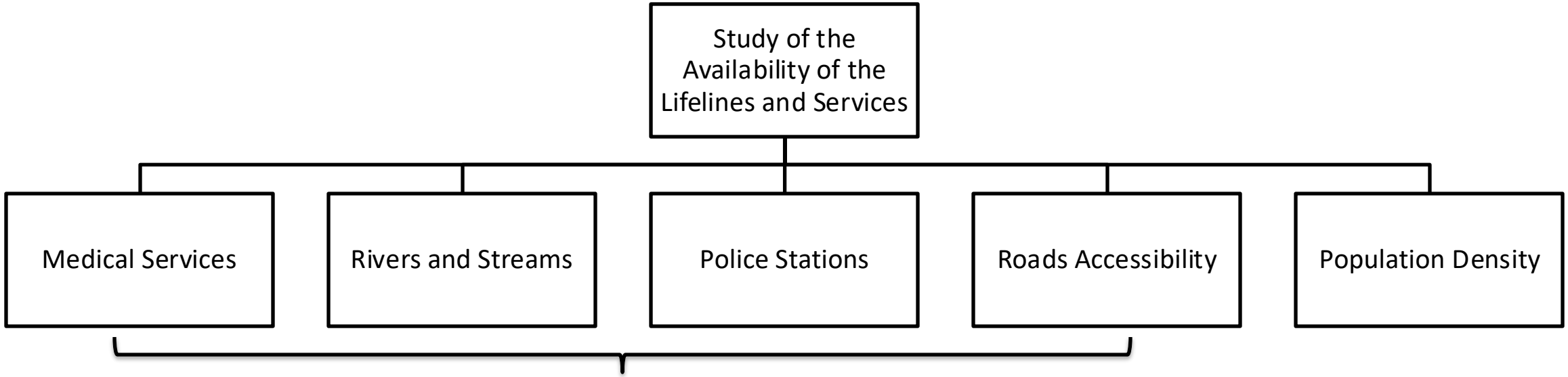
Cartographic Information

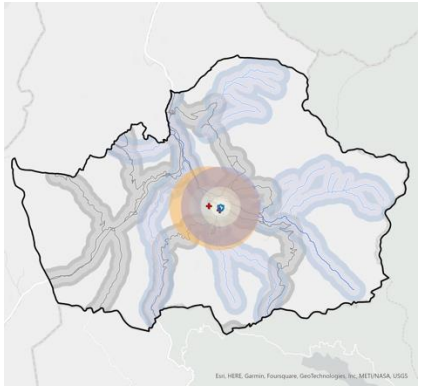
Datum: WGS 1984
Projection: Transverse Mercator
Map Units: Meter

0 1 2 4 Km

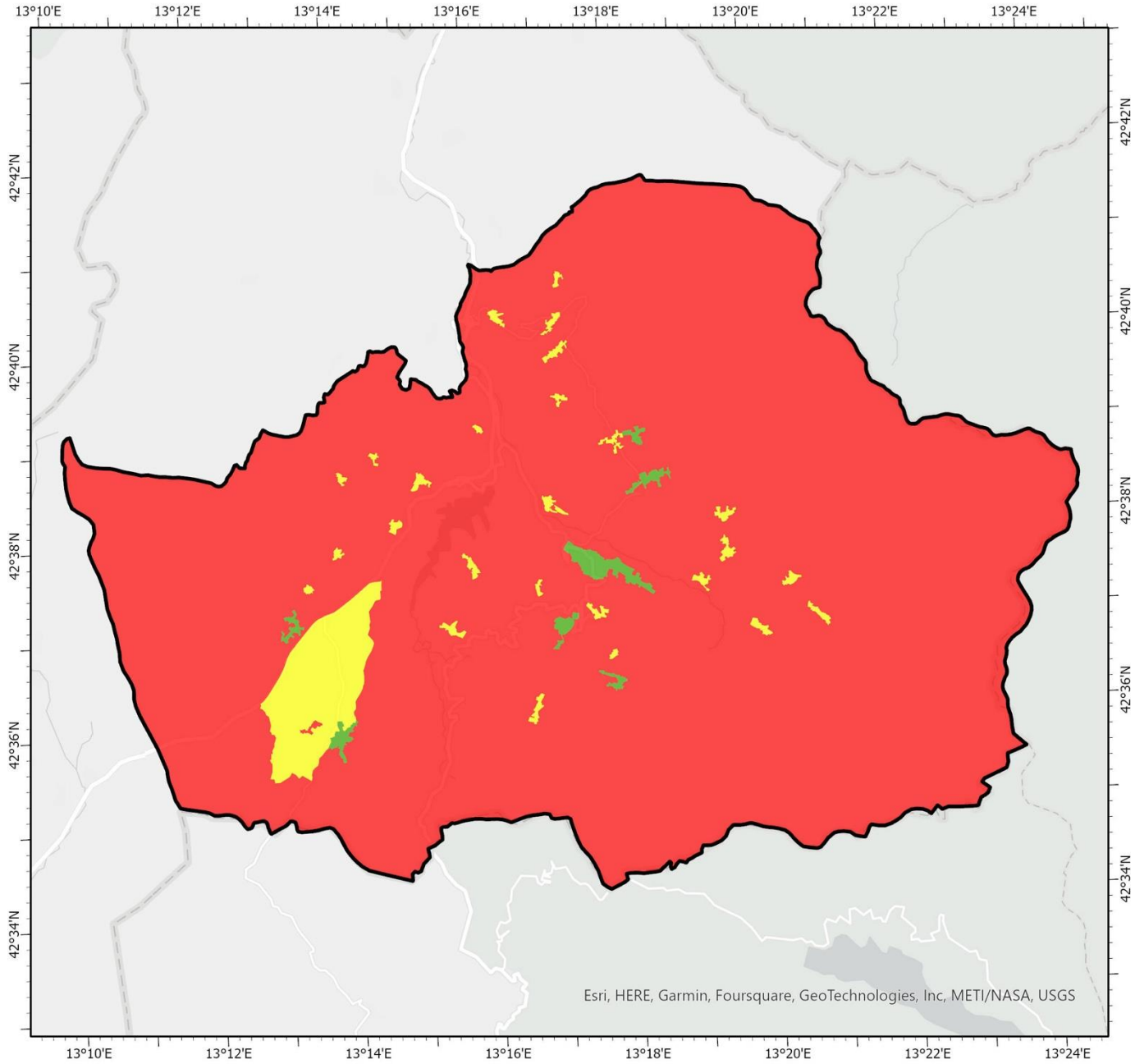
N

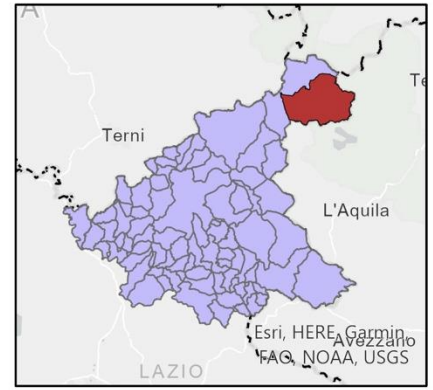
Study of the availability of the lifelines & services





Amatrice Area Suitability Map based on Population Density





Legend

- Amatrice

Population Density Area Suitability

- Less Suitable
- Neutral
- Suitable

Map Information

This Map shows the Population density area suitability which is used to rank the areas based on serviceability (Phase 3) for Amatrice, Italy.

Data Sources

Regional Geoportal Lazio

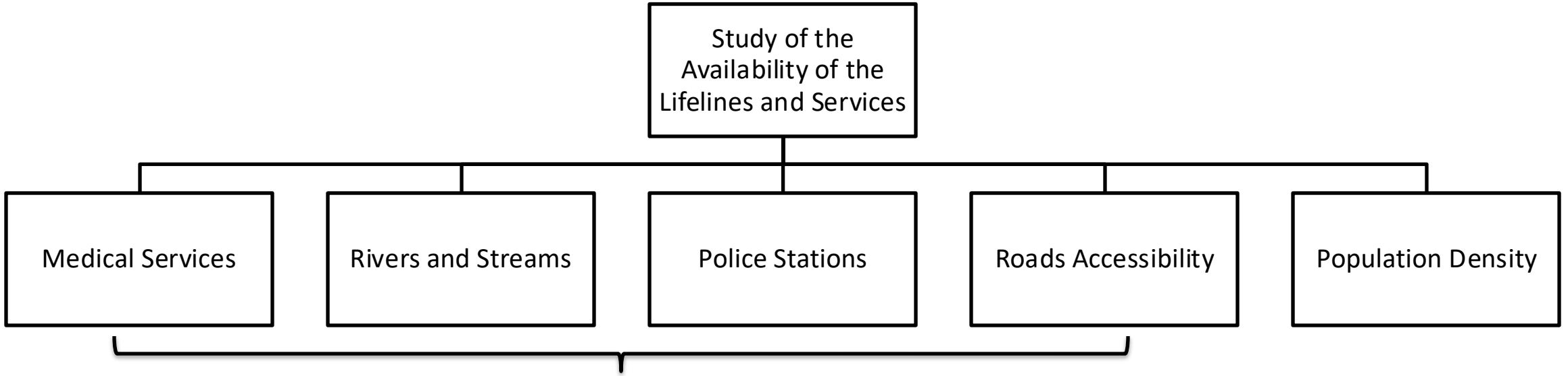
Cartographic Information

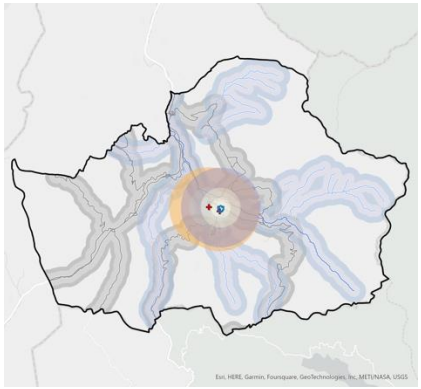
Datum: WGS 1984
Projection: Transverse Mercator
Map Units: Meter

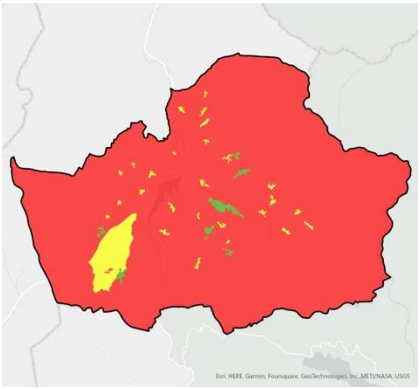
0 1 2 4 Km

N

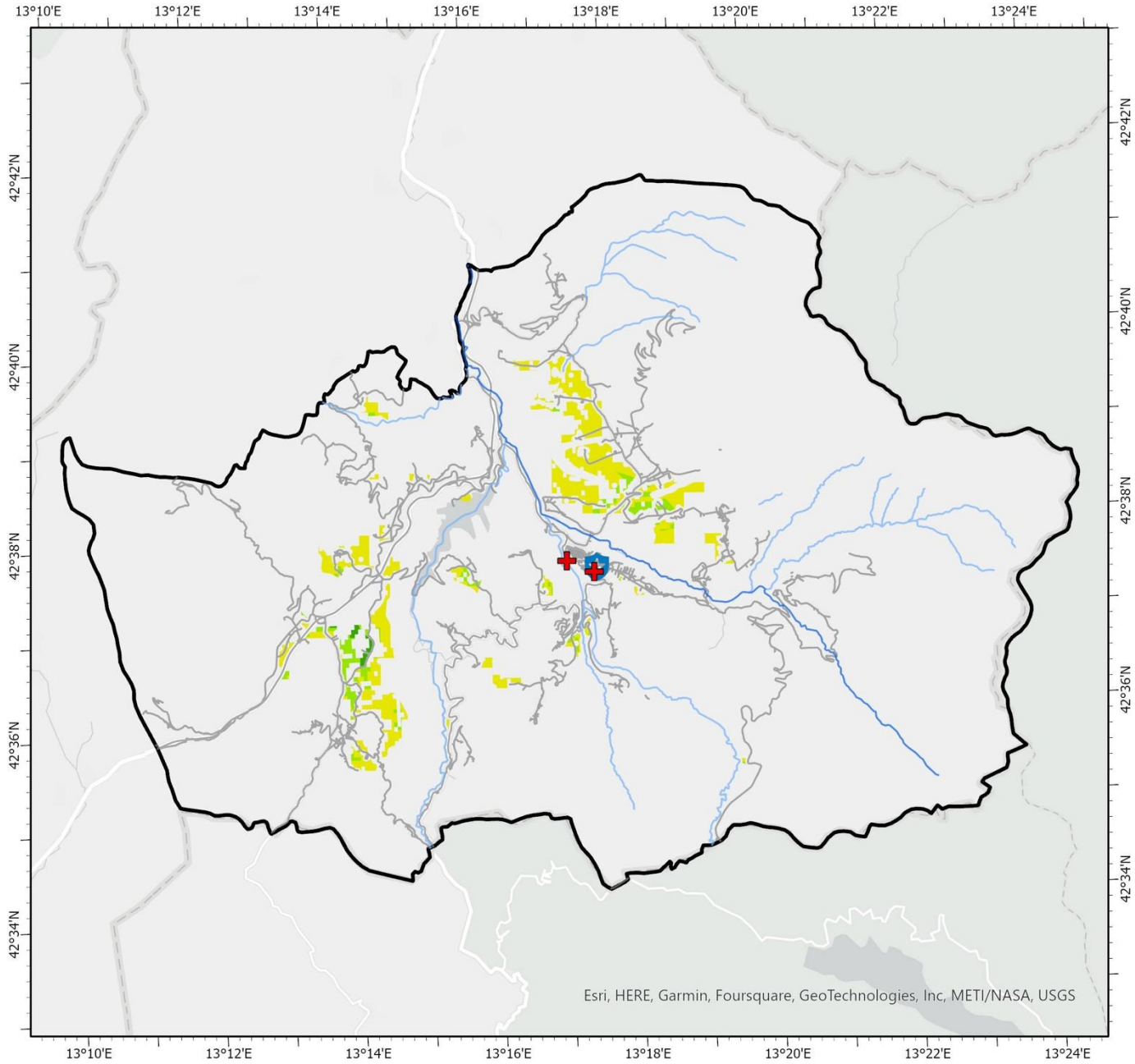
Study of the availability of the lifelines & services

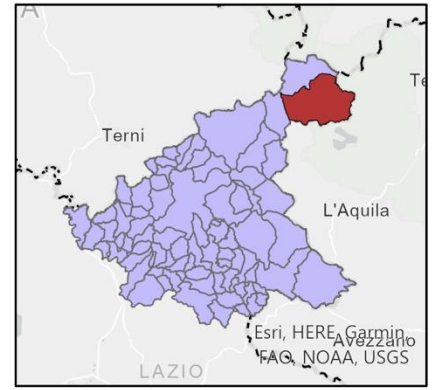






Amatrice Area Suitability after Applying Serviceability Factors





Legend

- Amatrice
- Road Network
- Police Station
- Medical Services
- River
- Main Streams

Area Suitability

- Suitable
- High Suitability
- Very High Suitability

Map Information

This Map shows Suitable Sheltering Areas after applying serviceability factors for Amatrice, Italy.
Layers used to produce the map: Soil Type, Slope, Landcover, Landslide Hazard, Flood Hazard, Faults, Fuel Stations, Power Plants, Power Towers, Police Station, Medical Services, Roads, River, Streams, and Population Density.

Data Sources

Copernicus EU, BGR's IHME1500, Regional Geoportal Lazio, European Commission JRC, OpenStreetMap

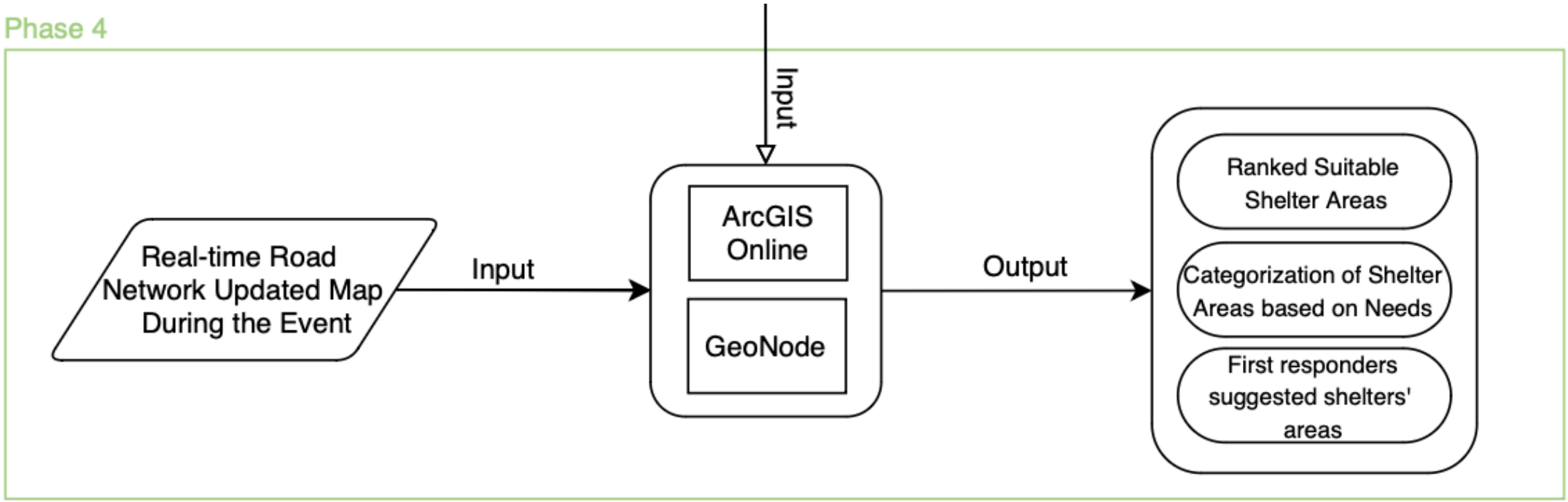
Cartographic Information

Datum: WGS 1984
Projection: Transverse Mercator
Map Units: Meter

0 1 2 4 Km

N

Workflow: Phase 4

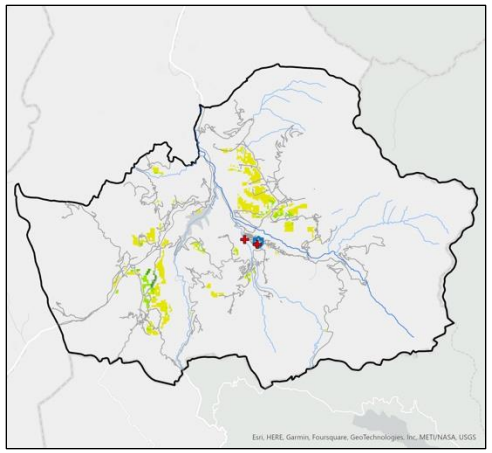


Workflow: Phase 4

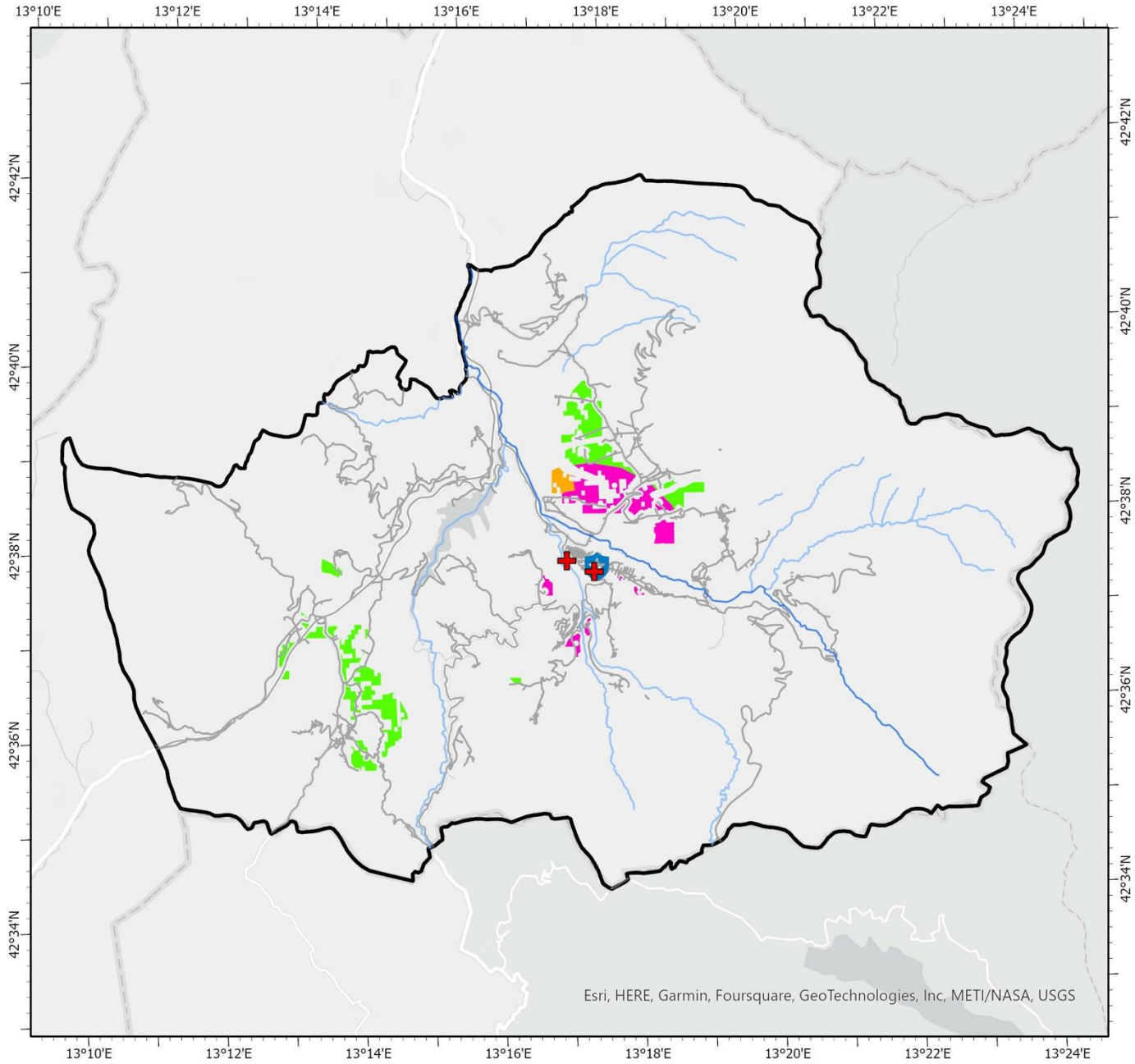
Ranked Suitable Shelter Areas

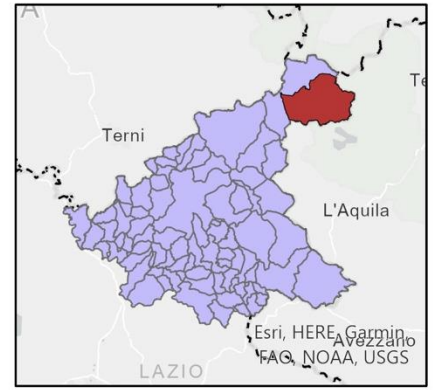
Categorization of Shelter Areas based on Needs

First responders suggested shelters' areas



Amatrice Categorization of Shelter's Areas Based on Needs





Legend

- Amatrice
- Road Network
- Police Station
- Medical Services
- River
- Main Streams

Suitable Proximity According to

- Populated Areas
- Police Stations, and Medical Services
- Police Stations, Medical Services, and Populated Areas

Map Information

This Map shows Categorization of Shelter's Areas Based on Needs for Amatrice, Italy.

Data Sources

Copernicus EU, BGR's IHME1500, Regional Geoportal Lazio, European Commission JRC, OpenStreetMap

Cartographic Information

Datum: WGS 1984
Projection: Transverse Mercator
Map Units: Meter

0 1 2 4 Km

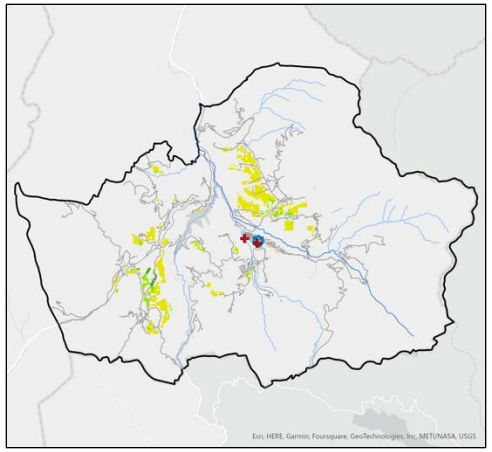
N

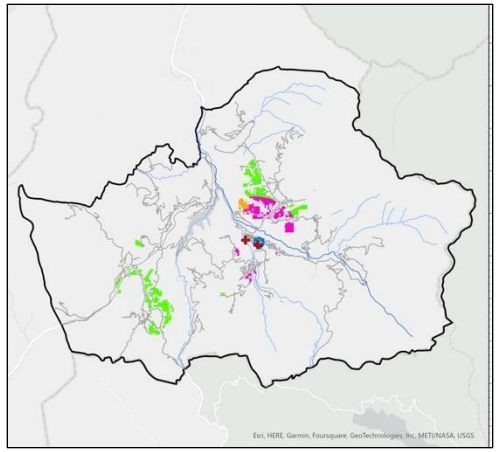
Workflow: Phase 4

Ranked Suitable Shelter Areas

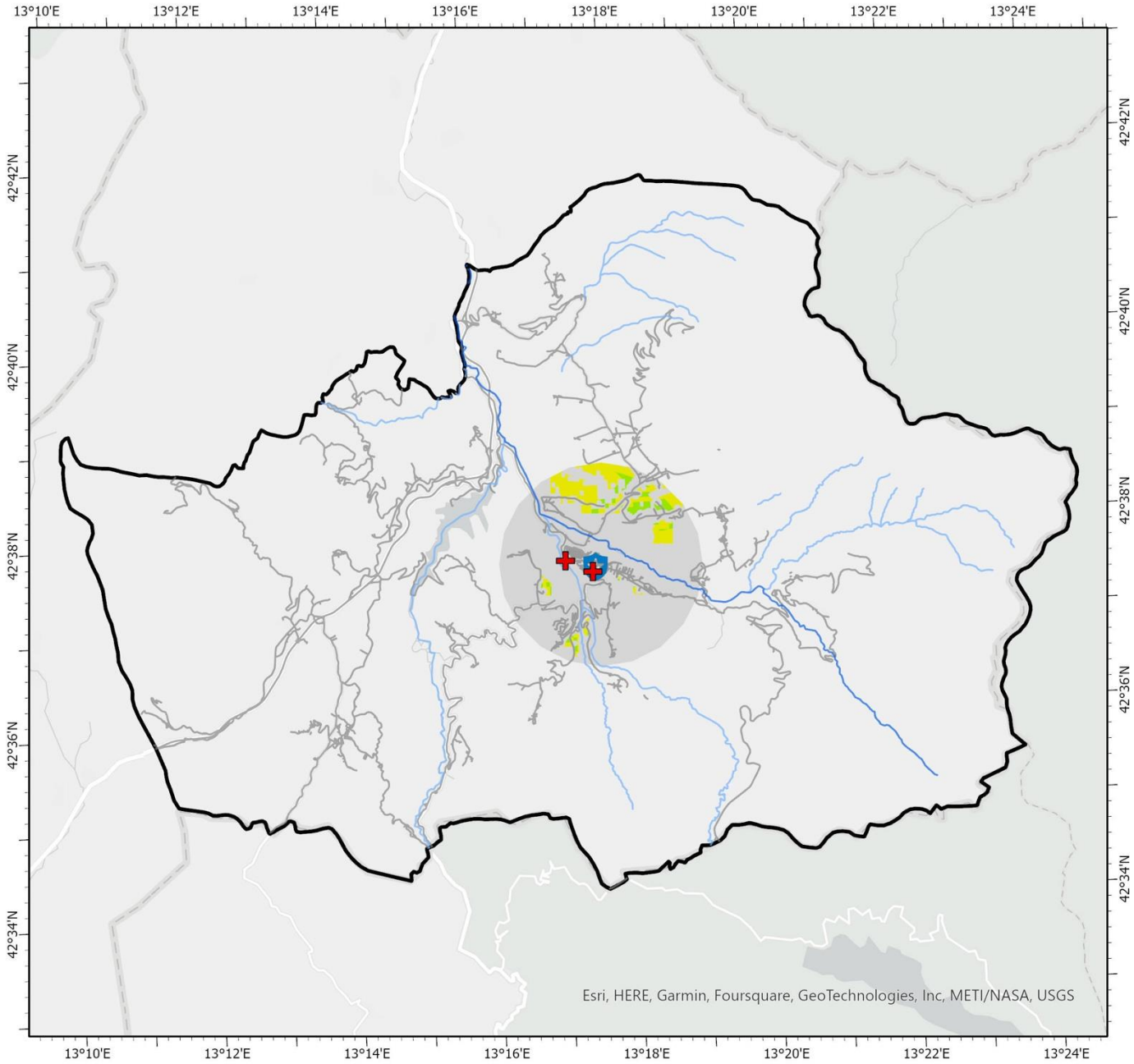
Categorization of Shelter Areas based on Needs

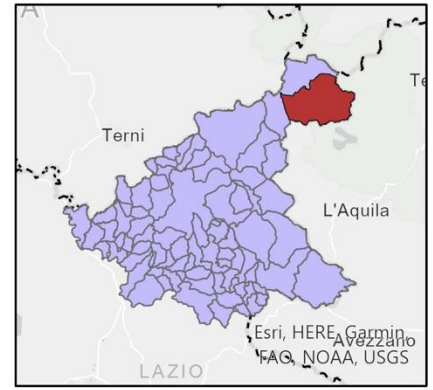
First responders suggested shelters' areas





Amatrice Suggested Shelter's Areas for First Responders and Civil Protection





Legend

- Amatrice
- Road Network
- Police Station
- Medical Services
- River
- Main Streams
- Buffer (2000m)

Area Suitability

- High Suitability
- Suitable
- Very High Suitability

Map Information

This Map shows suggested shelter's areas for first responders and civil protection for Amatrice, Italy.

Data Sources

Copernicus EU, BGR's IHME1500, Regional Geoportal Lazio, European Commission JRC, OpenStreetMap

Cartographic Information

Datum: WGS 1984
Projection: Transverse Mercator
Map Units: Meter

0 1 2 4 Km

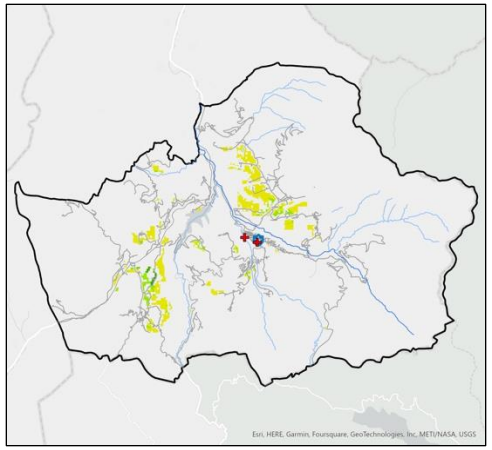
N

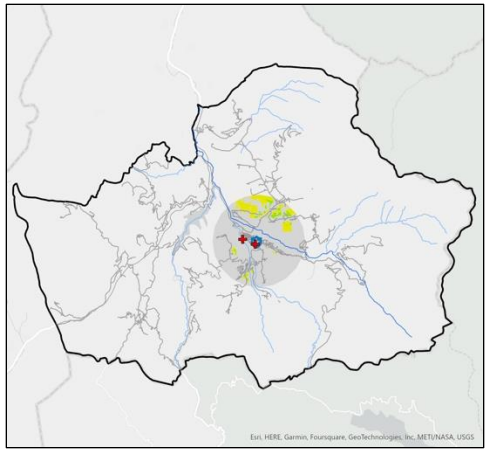
Workflow: Phase 4

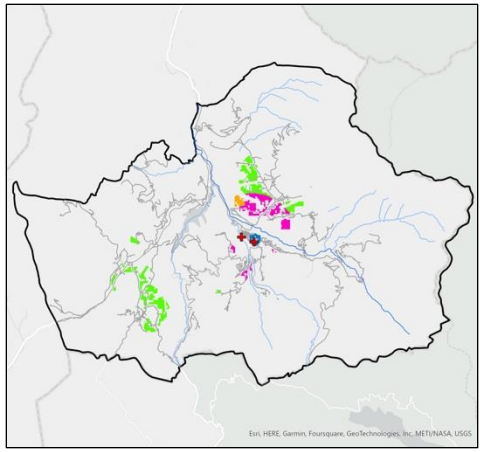
Ranked Suitable Shelter Areas

Categorization of Shelter Areas based on Needs

First responders suggested shelters' areas







Phase 4

Suitable shelter areas

Ranked, based on needs & first responders suggested areas

WebGIS design

Why?

To publish the final maps online, on a WebGIS platform using ArcGIS Online and GeoNode.

Added value

- Dynamic exploration of spatial data: interactive tools.
- Real-Time Access: up-to-date information by incorporating real-time data.

GeoNode

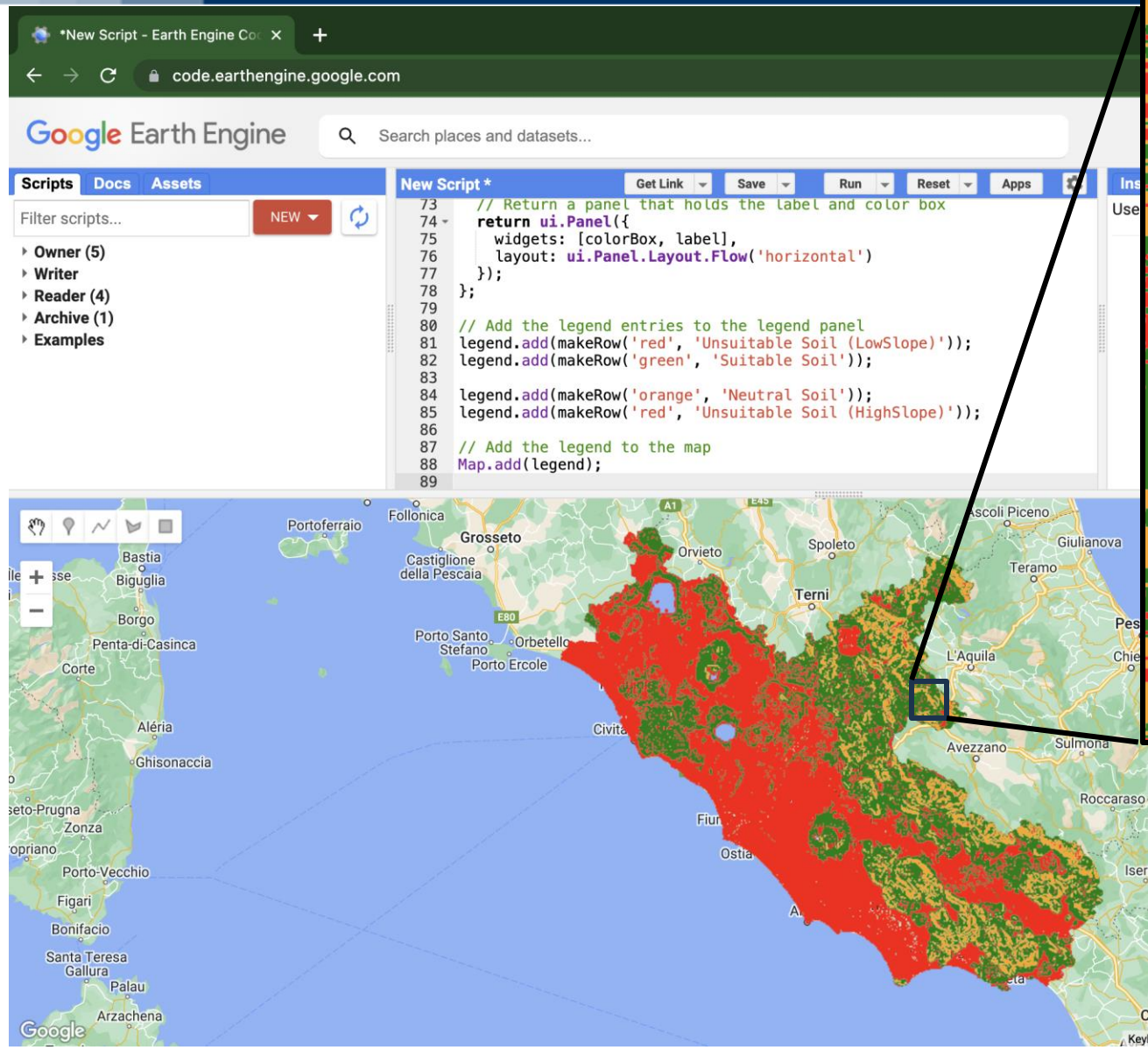
Further Development

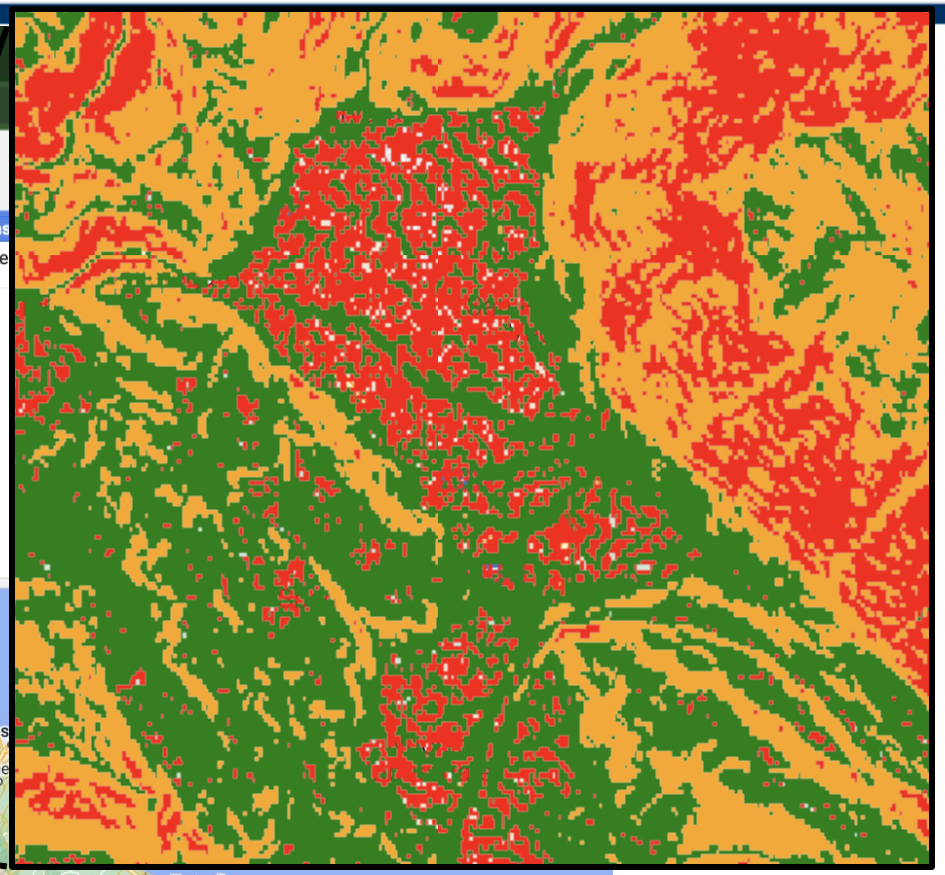
Traditional Workflow Problems **Vs.** **Google Earth Engine**

- Scalability
- Computational Cost
- Updatability
- Licensing and Integration

- Scalable
- Computations on Clouds
- Can be Connected to the Satellites
- Free (to some extent)

Suggestions for Future Works





Thank you!