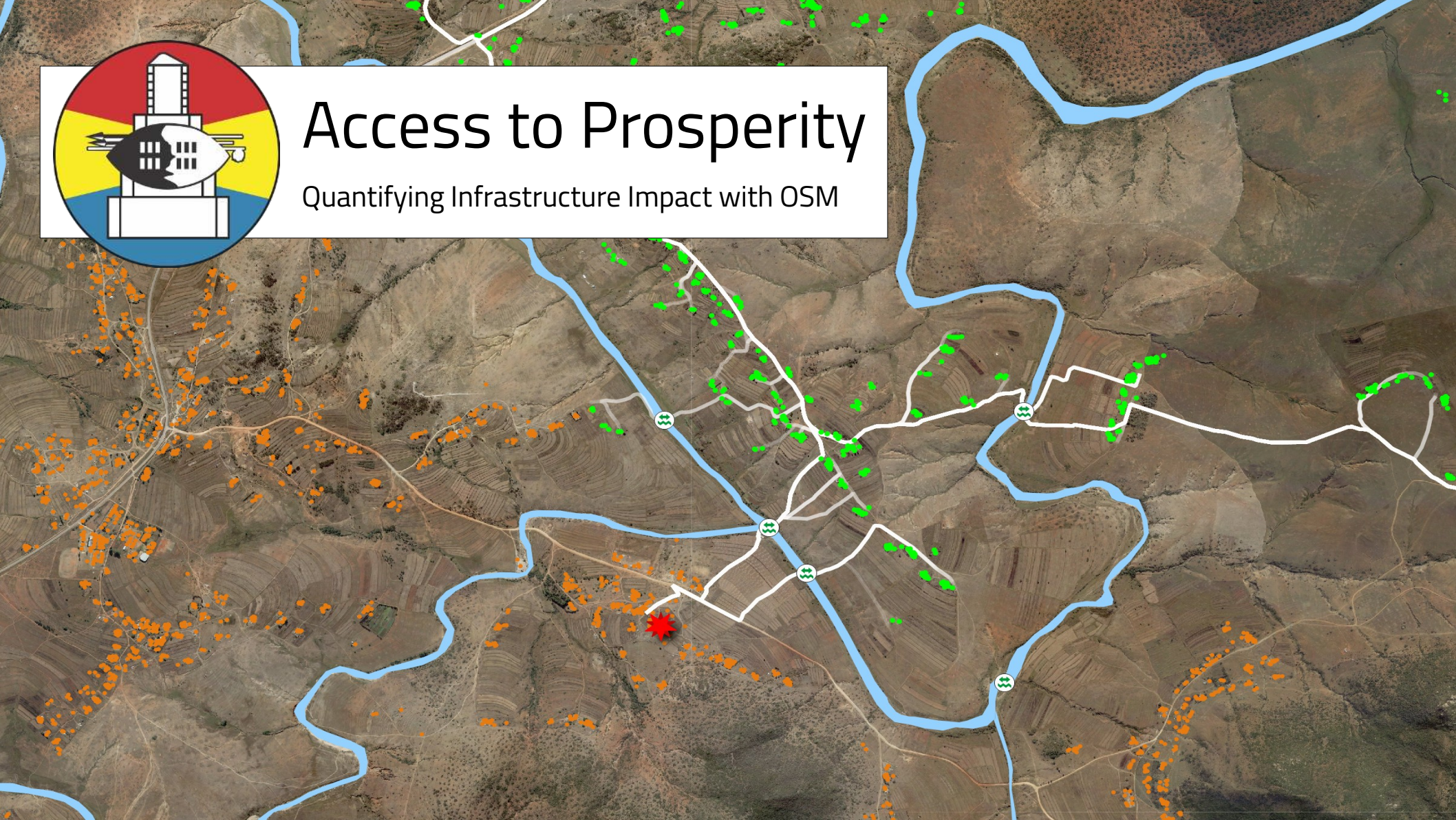




Access to Prosperity

Quantifying Infrastructure Impact with OSM





Talk Agenda

Quantifying Infrastructure Impact with OSM

- **Why:** Community development projects in eSwatini
- **How:** Using data analysis with OSM to help maximize impact
- **What:** Routing analysis with *tebetebe* python package



Where is eSwatini (Swaziland)?





Where is eSwatini (Swaziland)?





Where is eSwatini (Swaziland)?





eSwatini

South
Africa

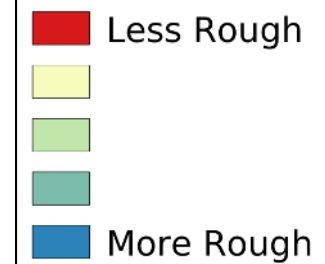
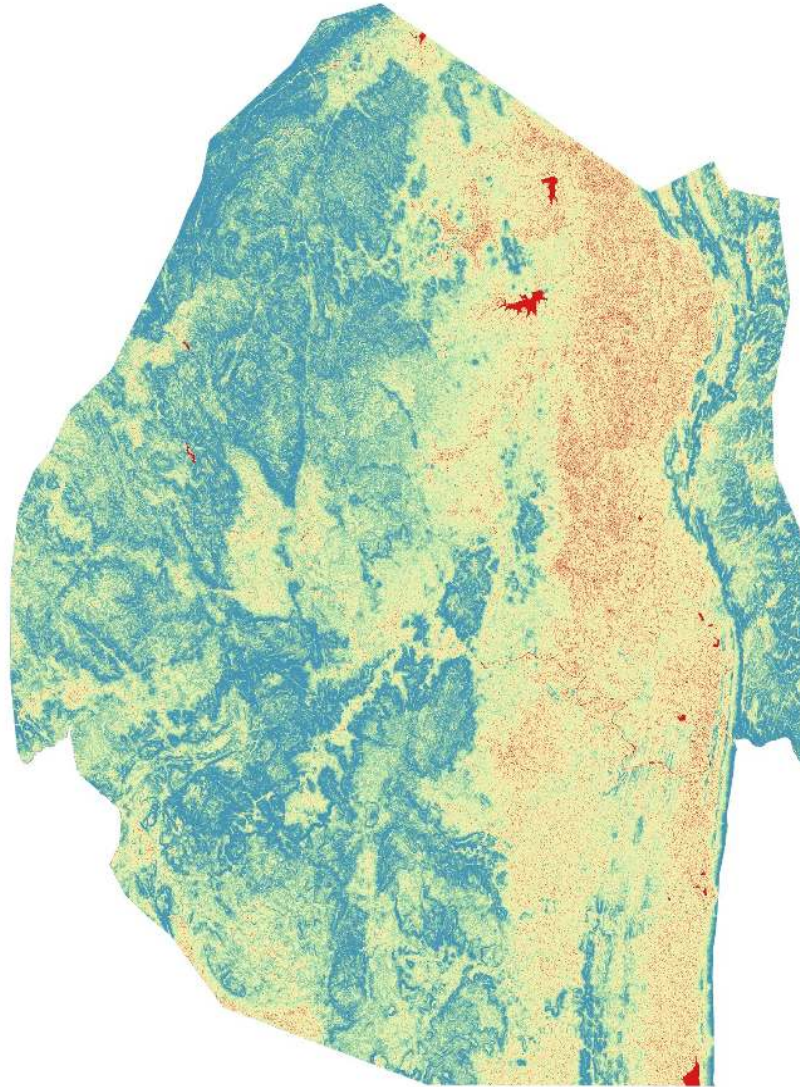
Mozambique



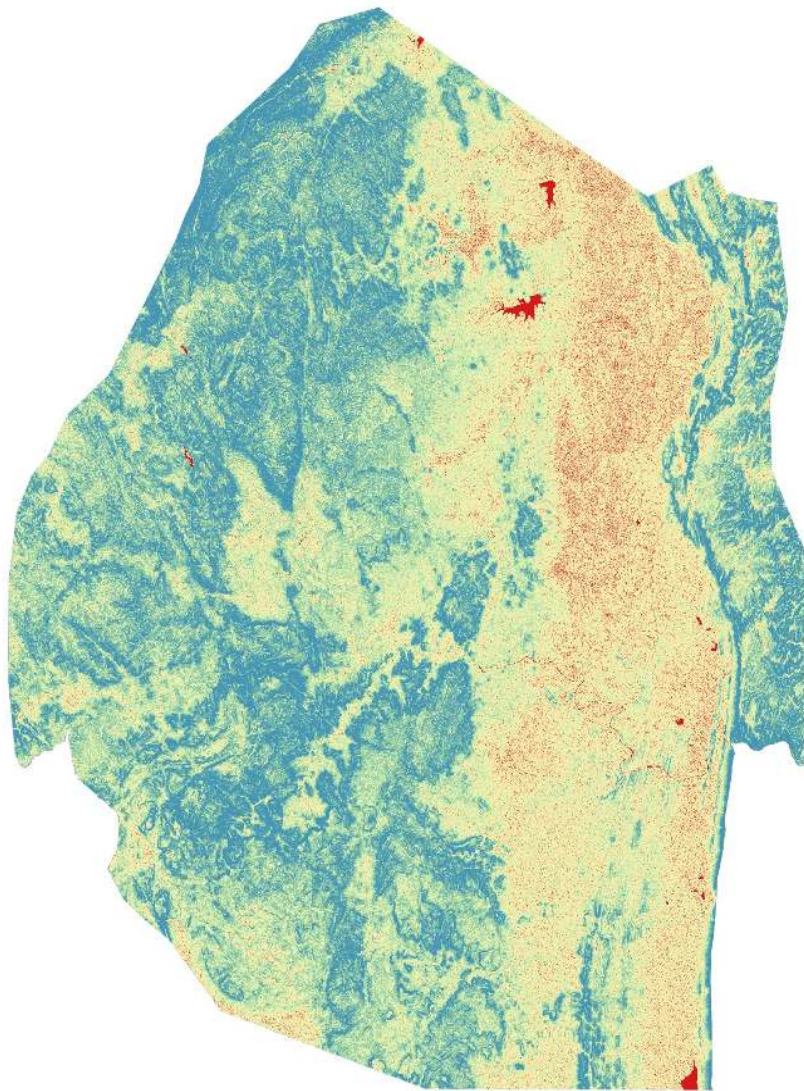


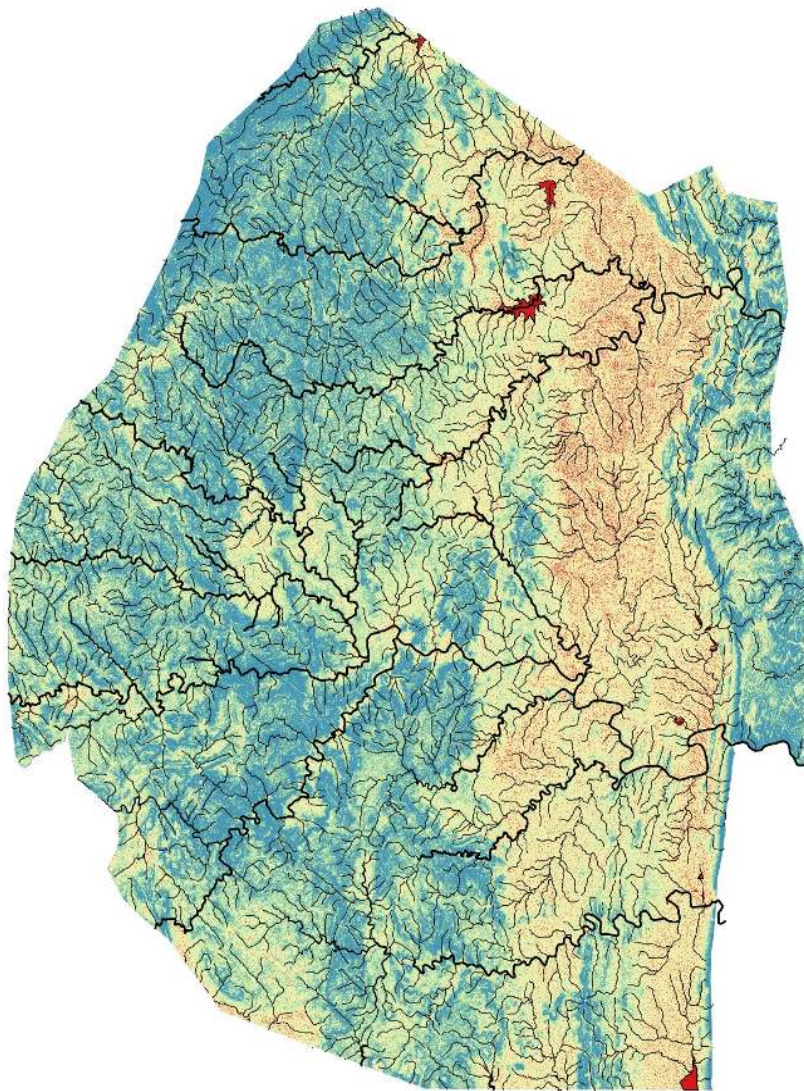


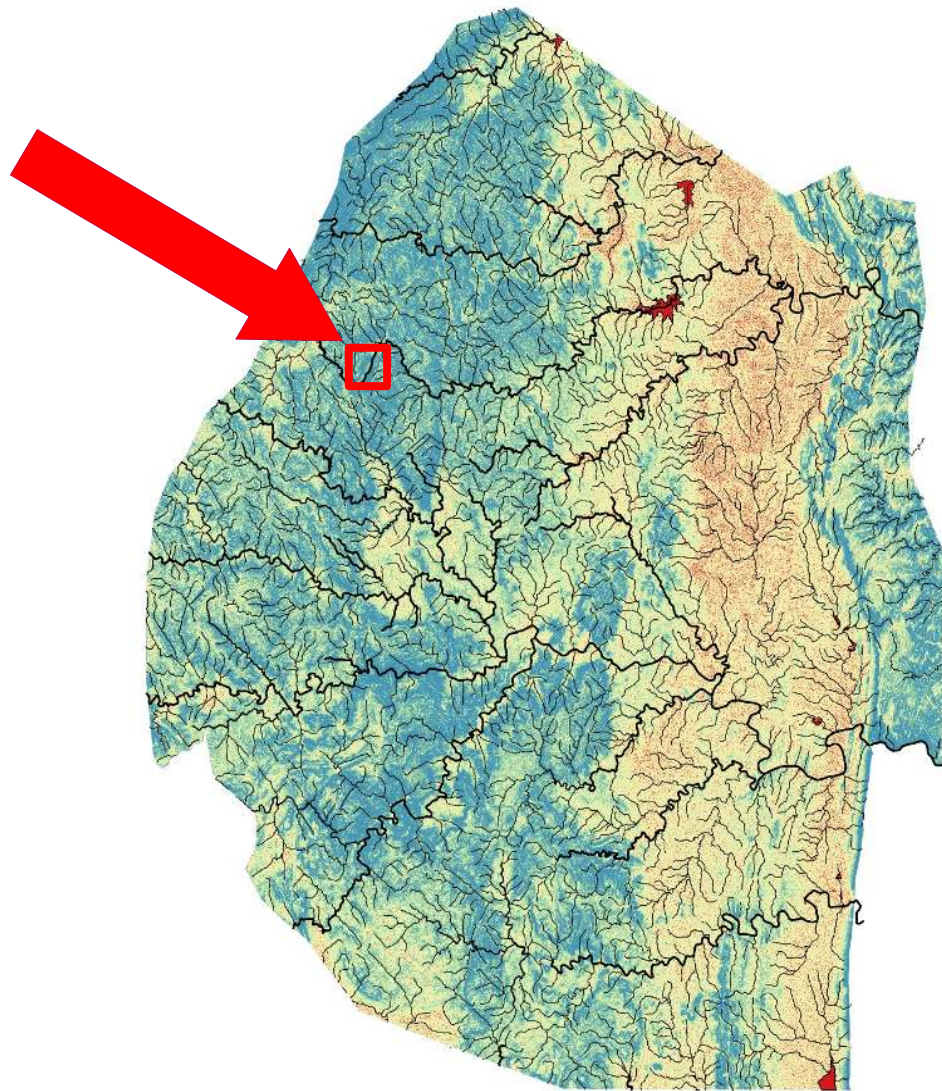
Terrain Ruggedness Index

















Tuesday, March 7, 2017

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DANGEROUS CROSSING



PIGG'S PEAK – Ntfontjeni Member of Parliament Sompisi Magagula and some residents of Mganda cross the flooded Mlumati River. The situation has seen some pupils of Lufafa Primary School not being able to go to school for about two weeks. **SEE PAGE 4** (Pic: Joseph Zulu)

**Top soldier
dies in car
roadblock**

**Angry residents
stop census
recruitment**

**Did ex-Mhlaba
head pay
for Kuw...**





Project Beginnings

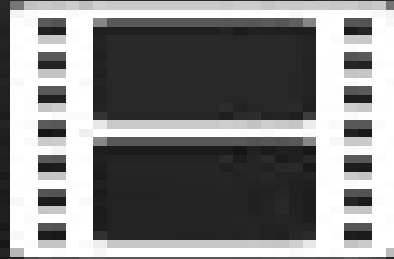








https://youtu.be/RT_MPrKsCMM



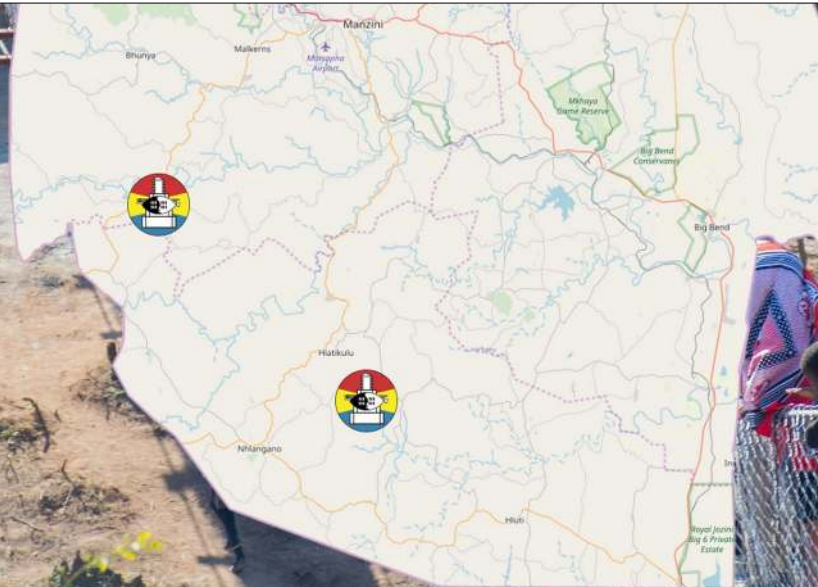








Now What?





Now What?

- Develop Sustainable Partnership Structure
- Perform National Needs Assessment



Now What?

- ~~Develop Sustainable Partnership Structure~~
- Perform National Needs Assessment



National Needs Assessment

Where is there a need for footbridges in the country?





Footbridge Needs Assessment: Old Way

Pros:

- It works

Cons:

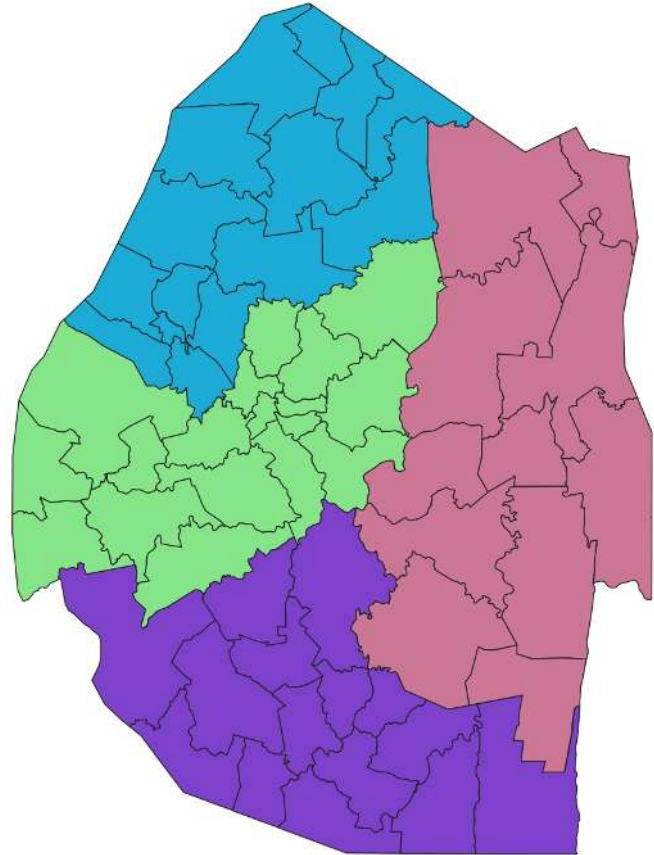
- Time Consuming



New Needs Assessment: Powered by OSM

1) Visit Tinkhundla Meetings

- Present project to local leaders
- Record lon/lats of potential bridges (QGIS)





Inkhundla Meetings: (QGIS)

- Potential Site lon/lat
- Destination POIs
- Flood Prone Bridges





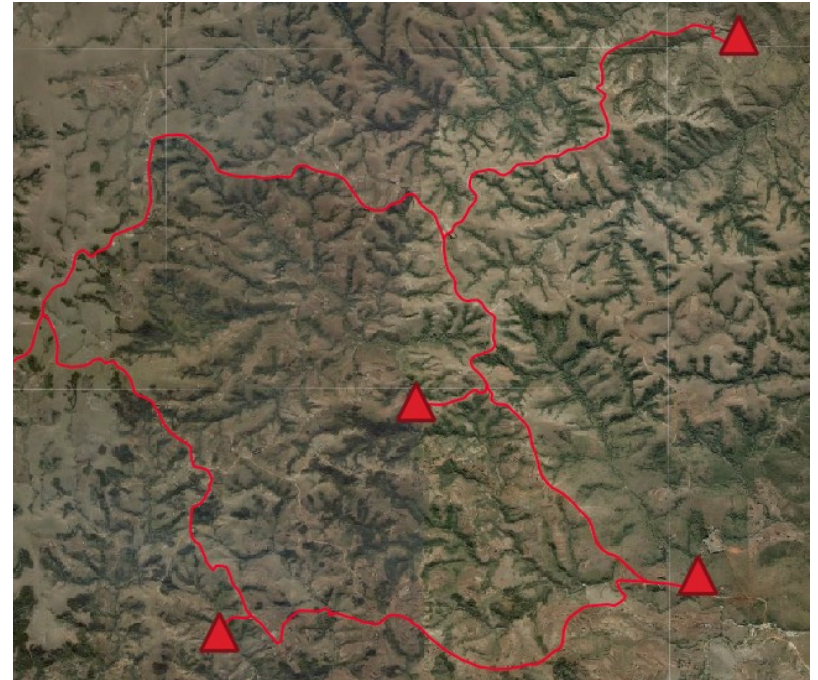
New Needs Assessment: Powered by OSM

1) Visit Tinkhundla Meetings

- Present project to local leaders
- Record lon/lats of potential bridges (QGIS)

2) "Travelling Salesman" Site Visits

- On-site assessment trip (OsmAnd)
- Social & technical survey (ODK)





Site Visits: (ODK & OsmAnd)

- Social & Technical Survey
- Collect Site Media





Site Visits: (ODK & OsmAnd)

- Social & Technical Survey
- Collect Site Media





New Needs Assessment: Powered by OSM

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3) Footbridge Impact Analysis





New Needs Assessment: Powered by OSM

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- Record lon/lats of potential bridges (QGIS)

2) "Travelling Salesman" Site Visits

- On-site assessment trip (OsmAnd)
- Social & technical survey (ODK)

3) Footbridge Impact Analysis





Footbridge Impact Analysis

We have:

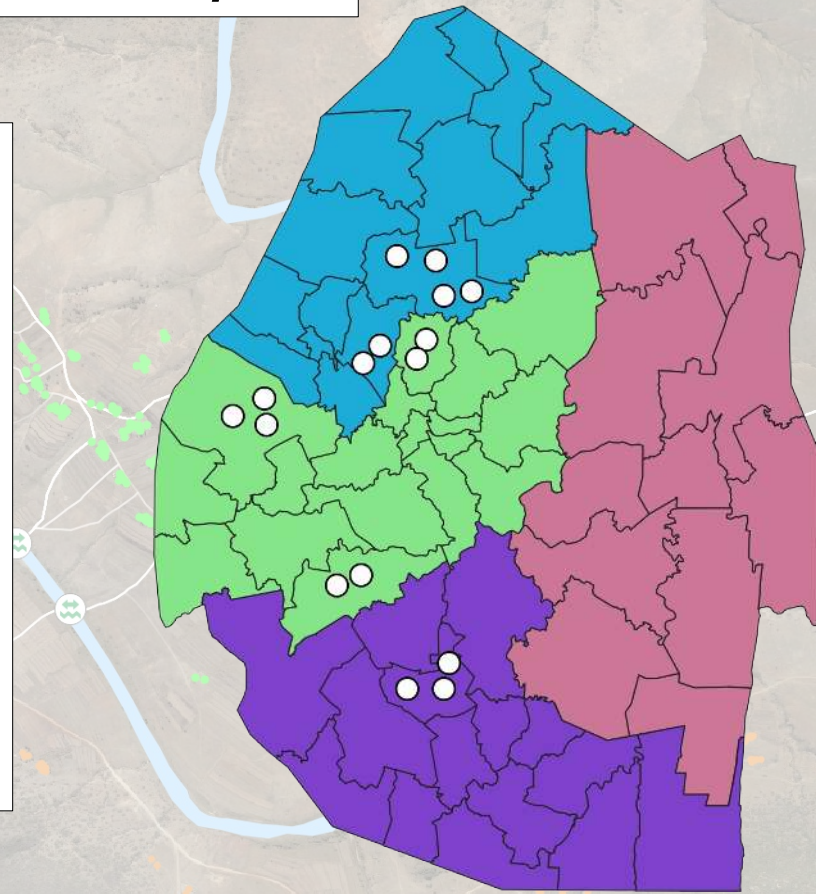
- Litany of potential sites
- Heaps of social & technical data

We want:

- Prioritized list of sites, ordered by impact

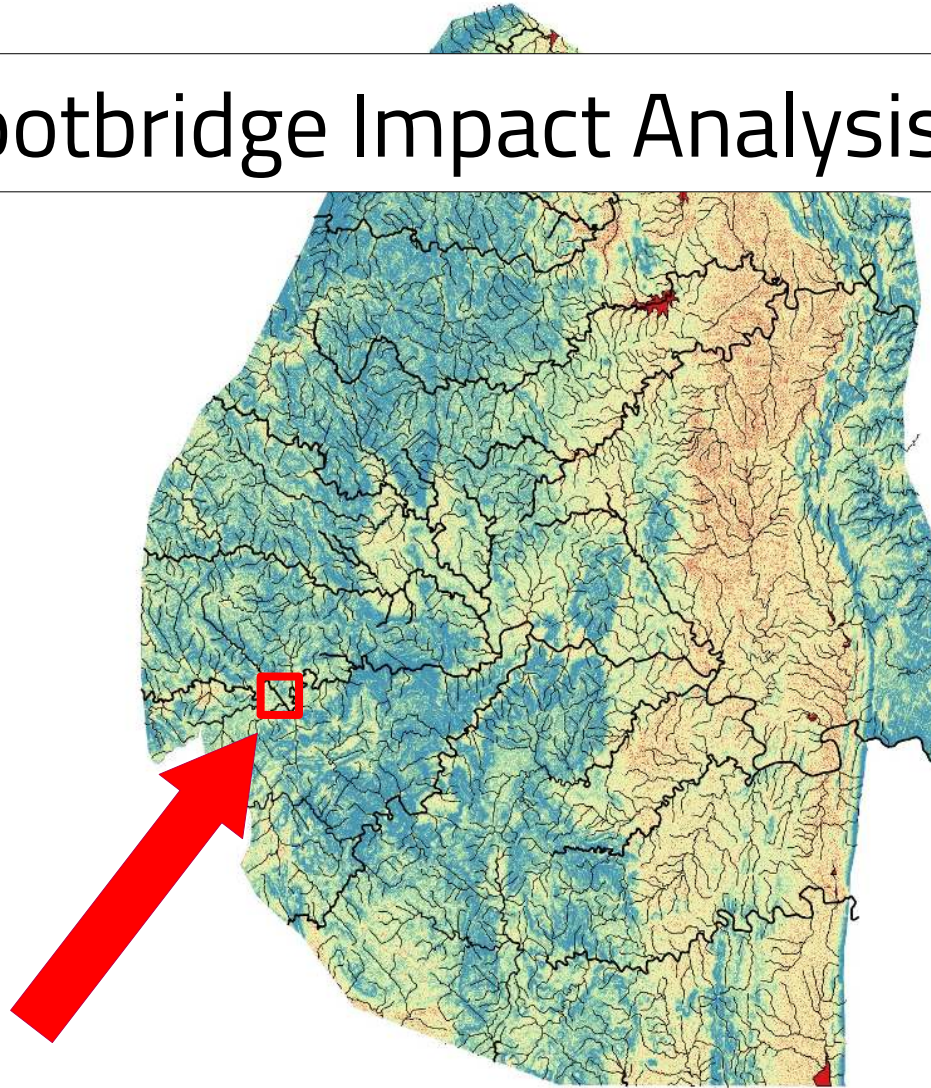
But...

- Collected impact data is unreliable
- We want a deterministic approach



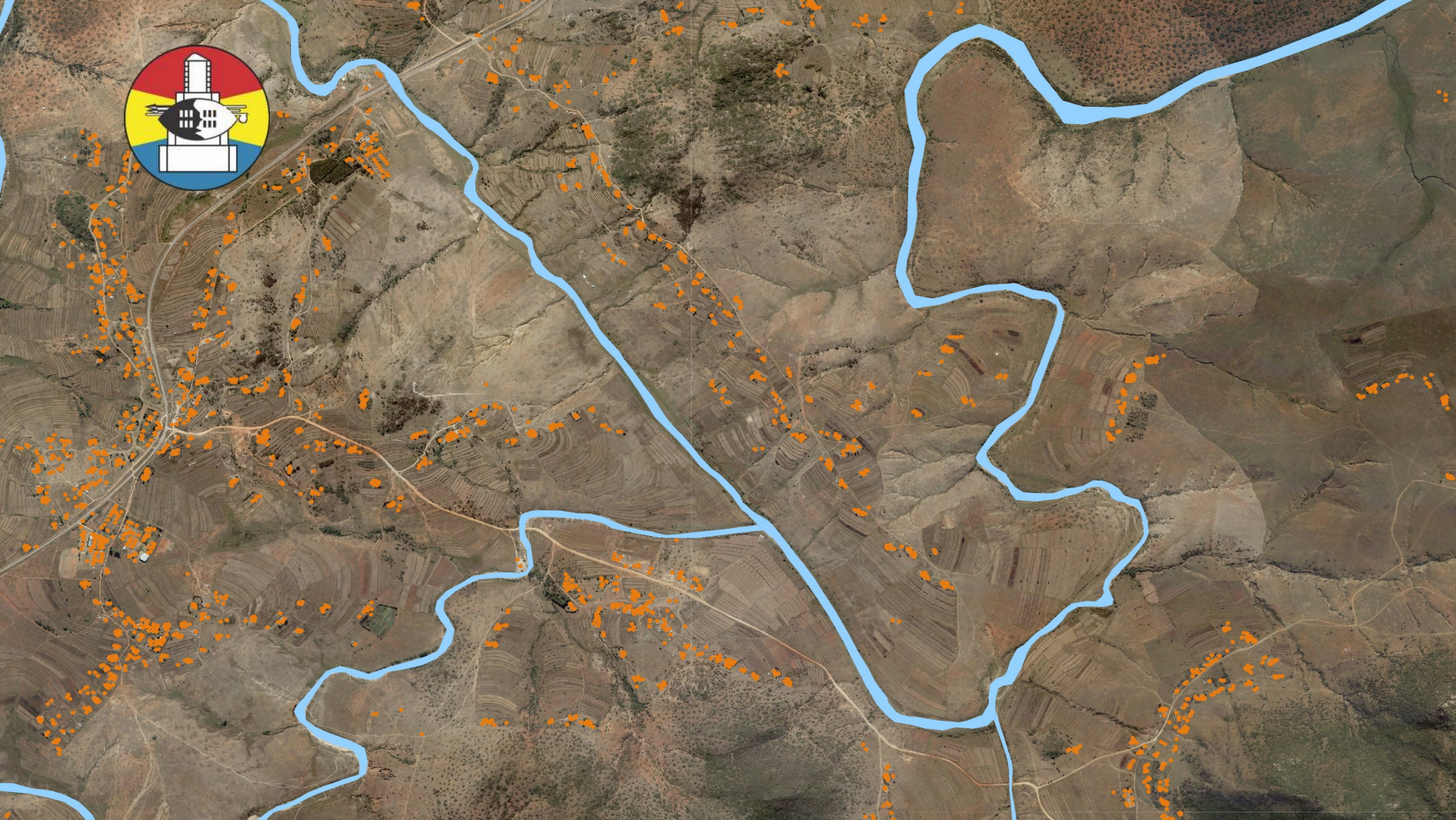


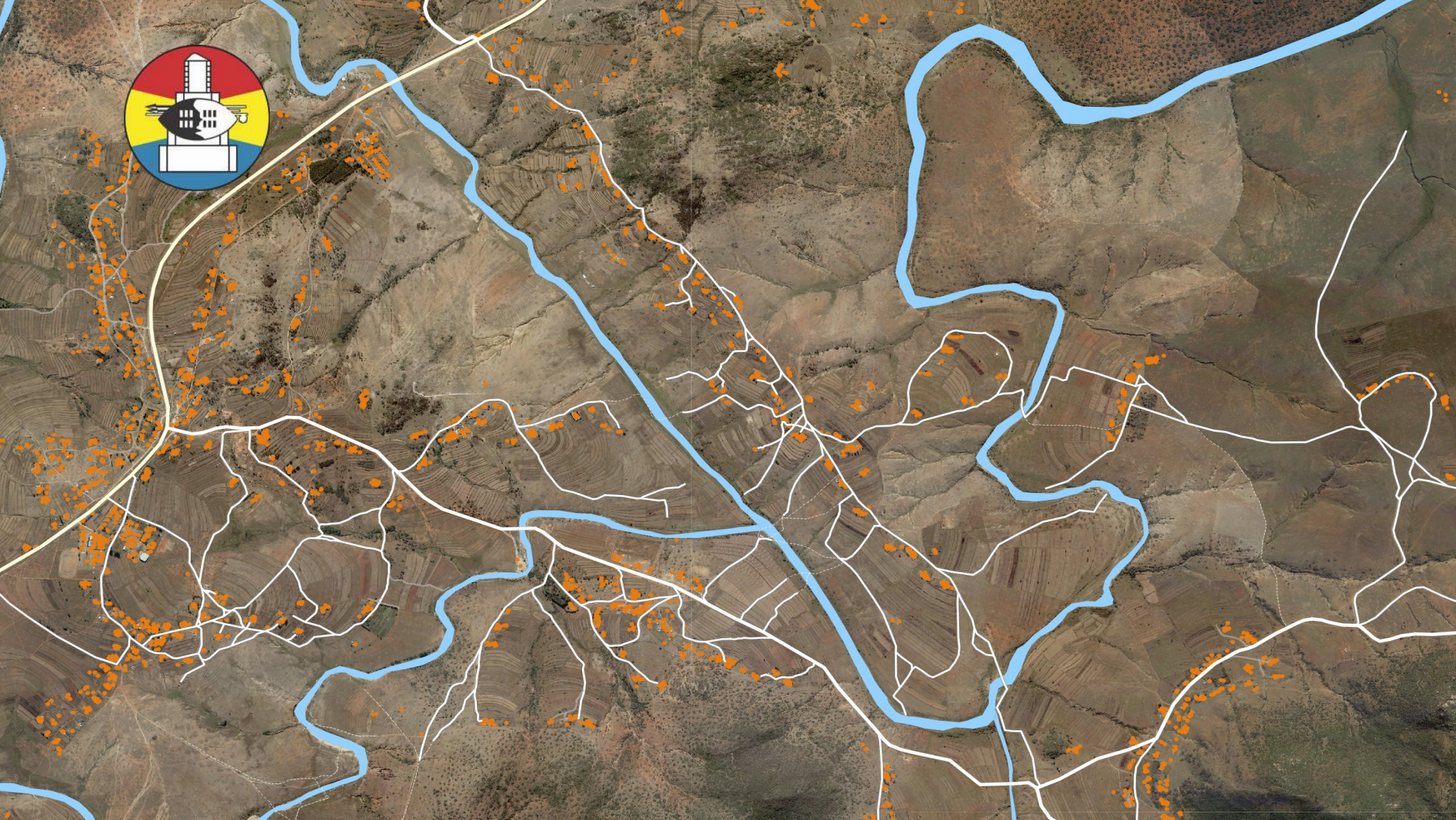
Footbridge Impact Analysis

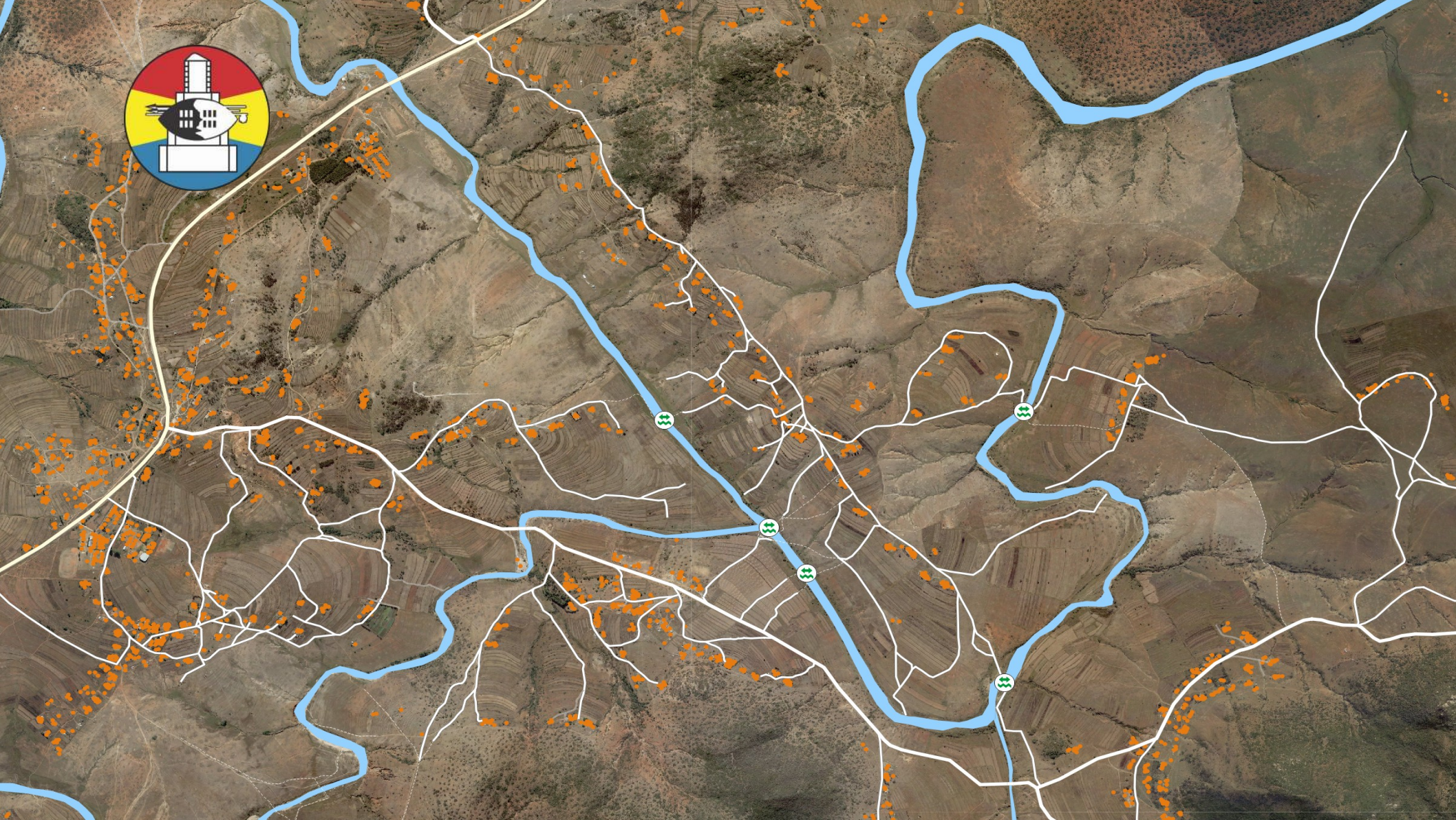








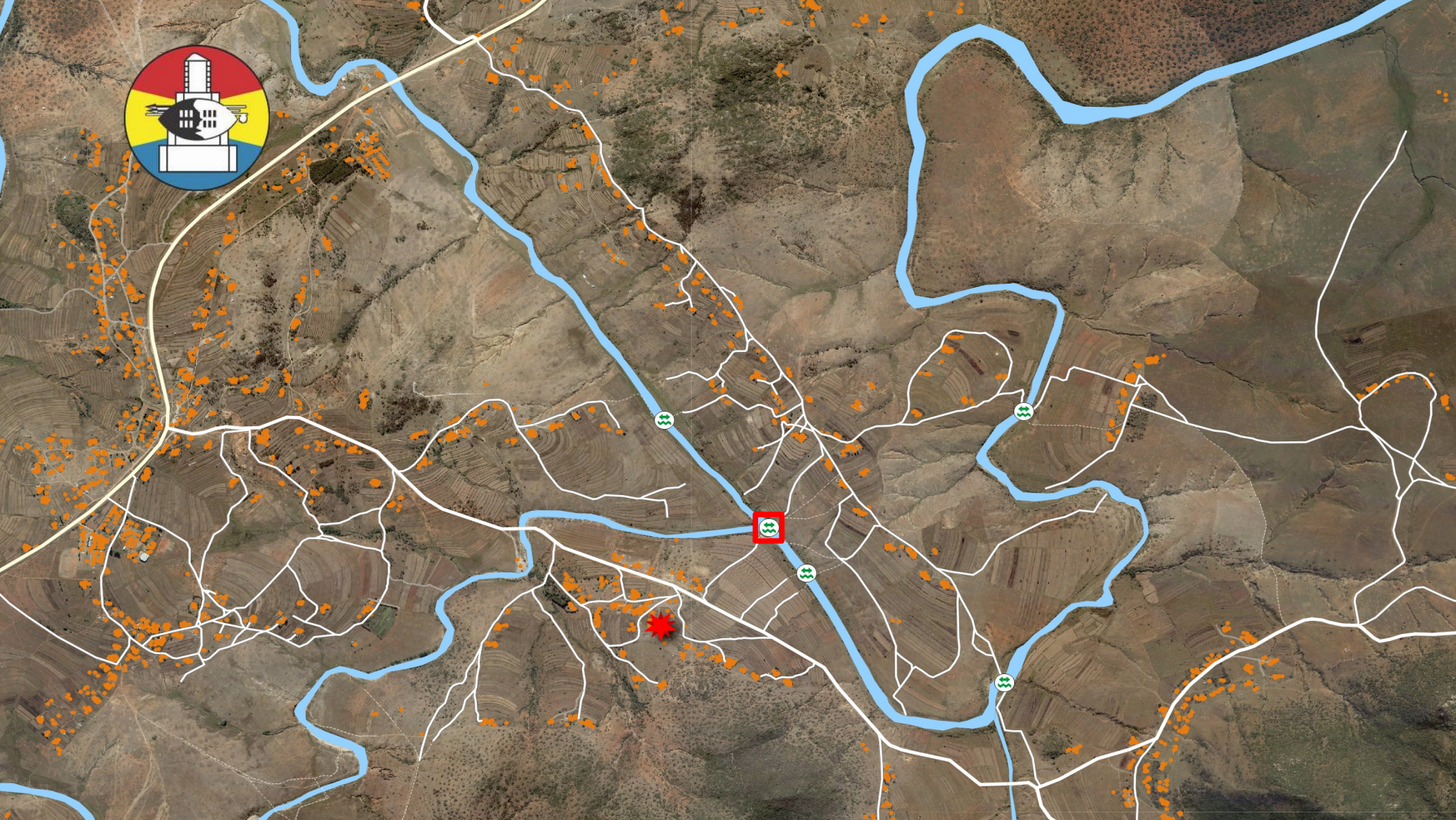








Tsawela Primary School





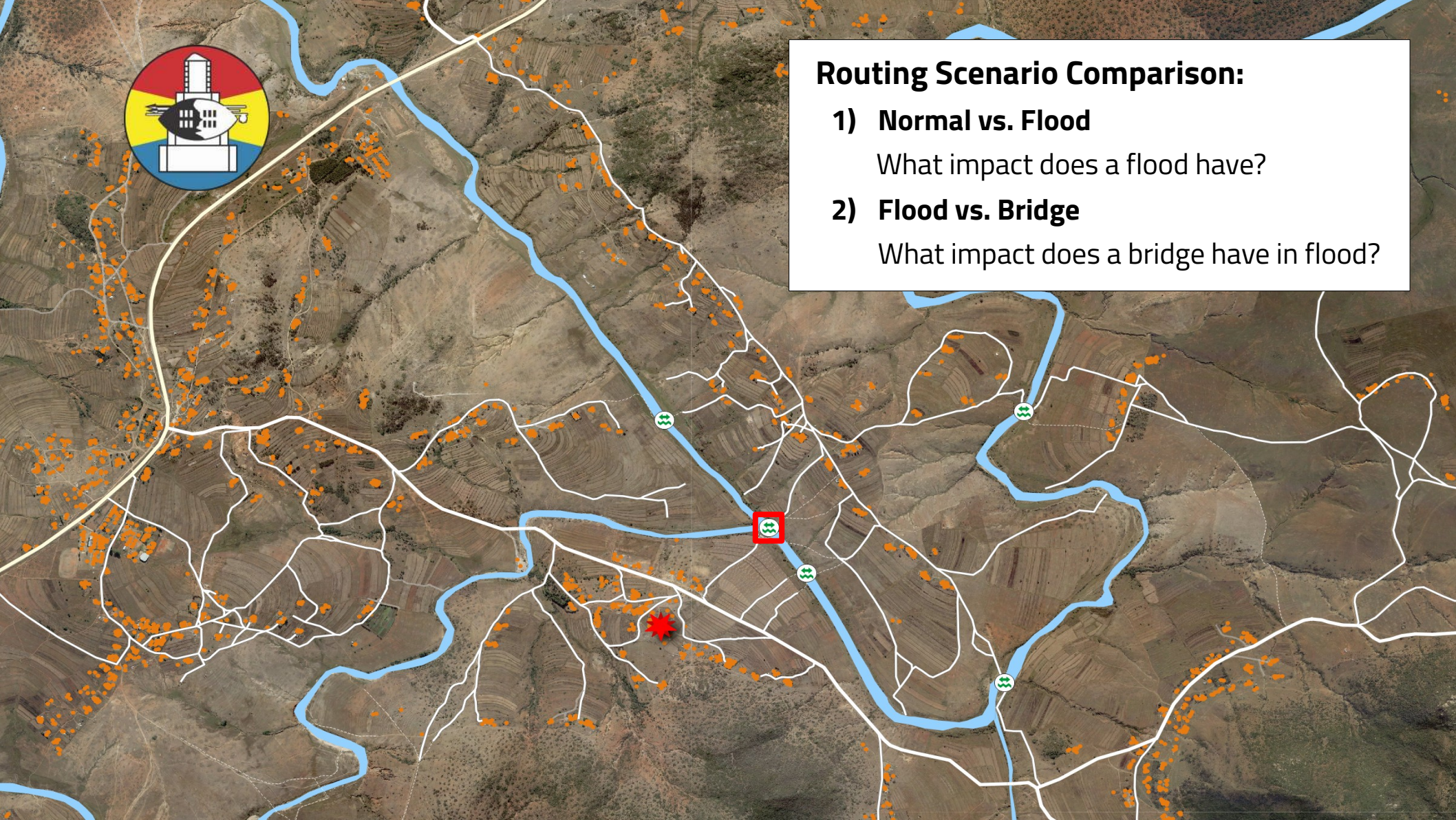
Routing Scenario Comparison:

1) Normal vs. Flood

What impact does a flood have?

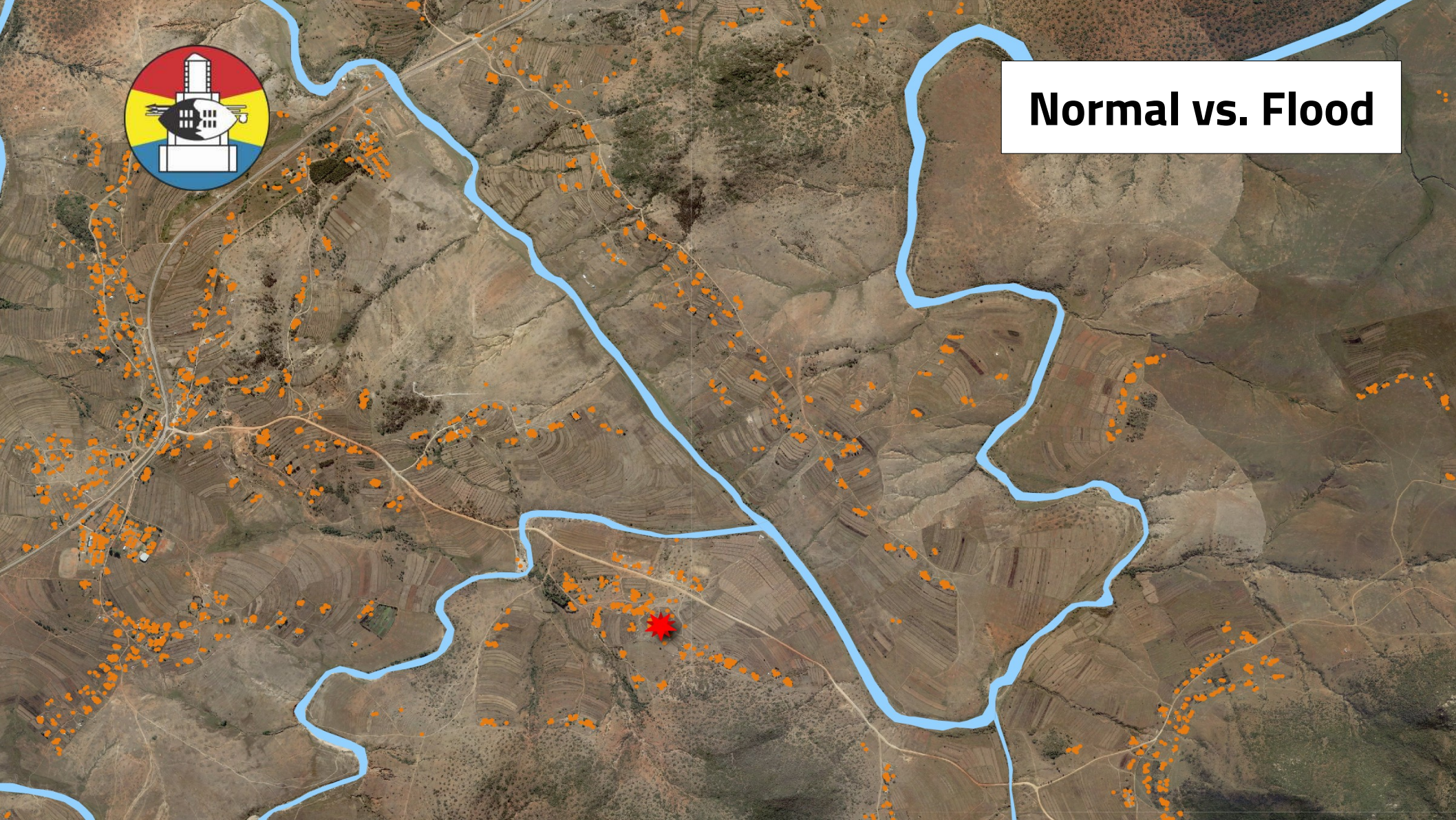
2) Flood vs. Bridge

What impact does a bridge have in flood?



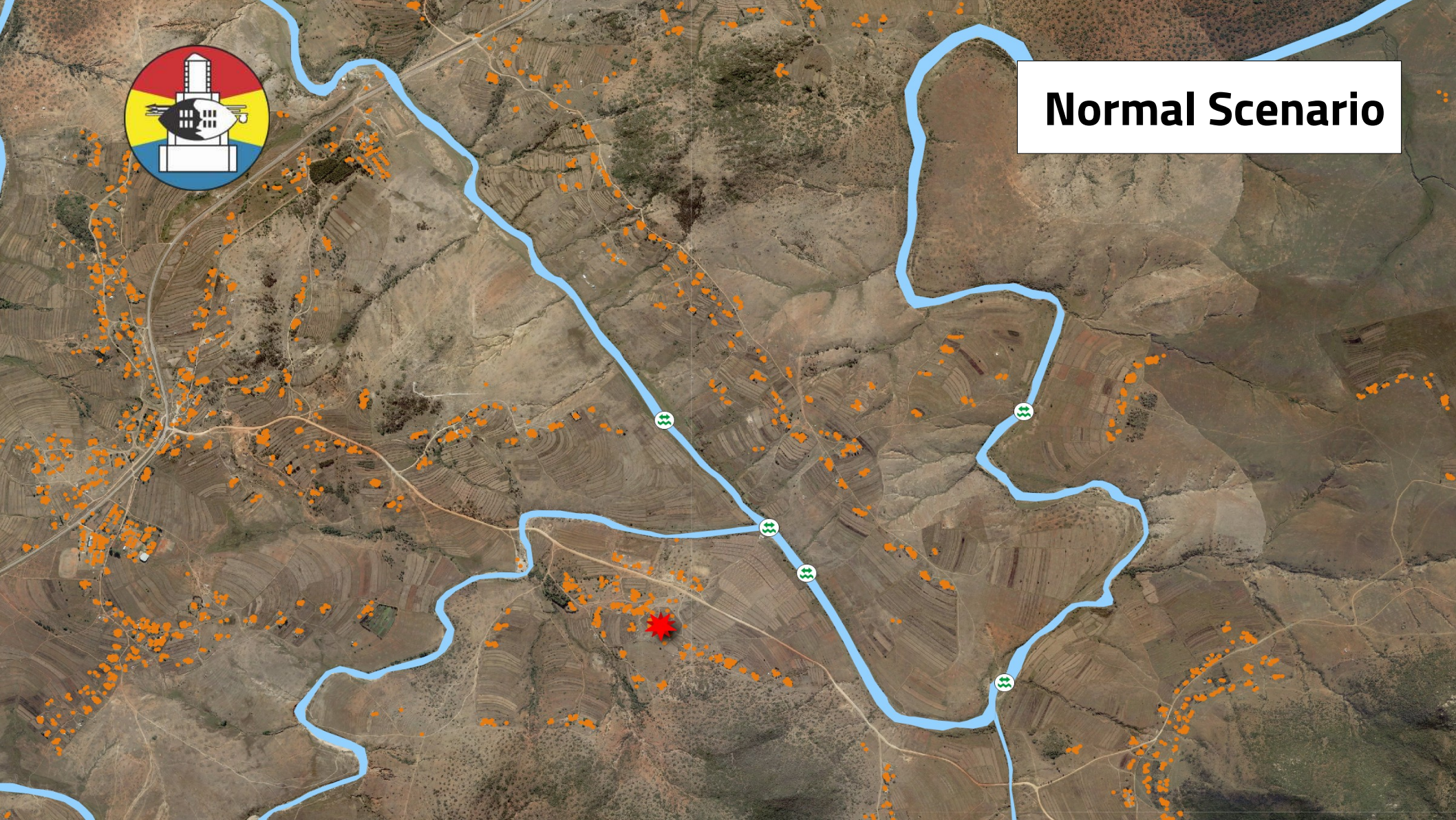


Normal vs. Flood



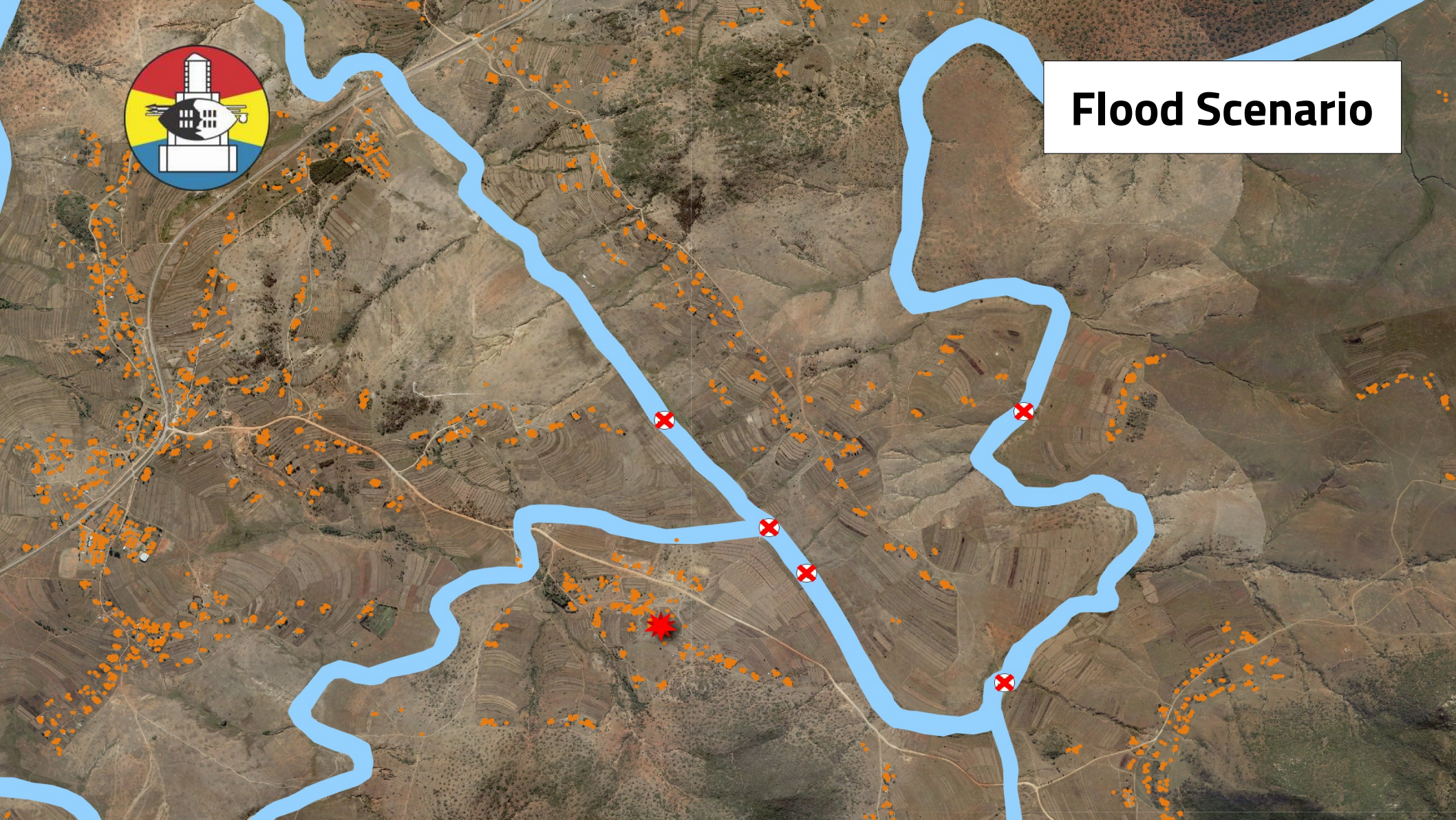


Normal Scenario



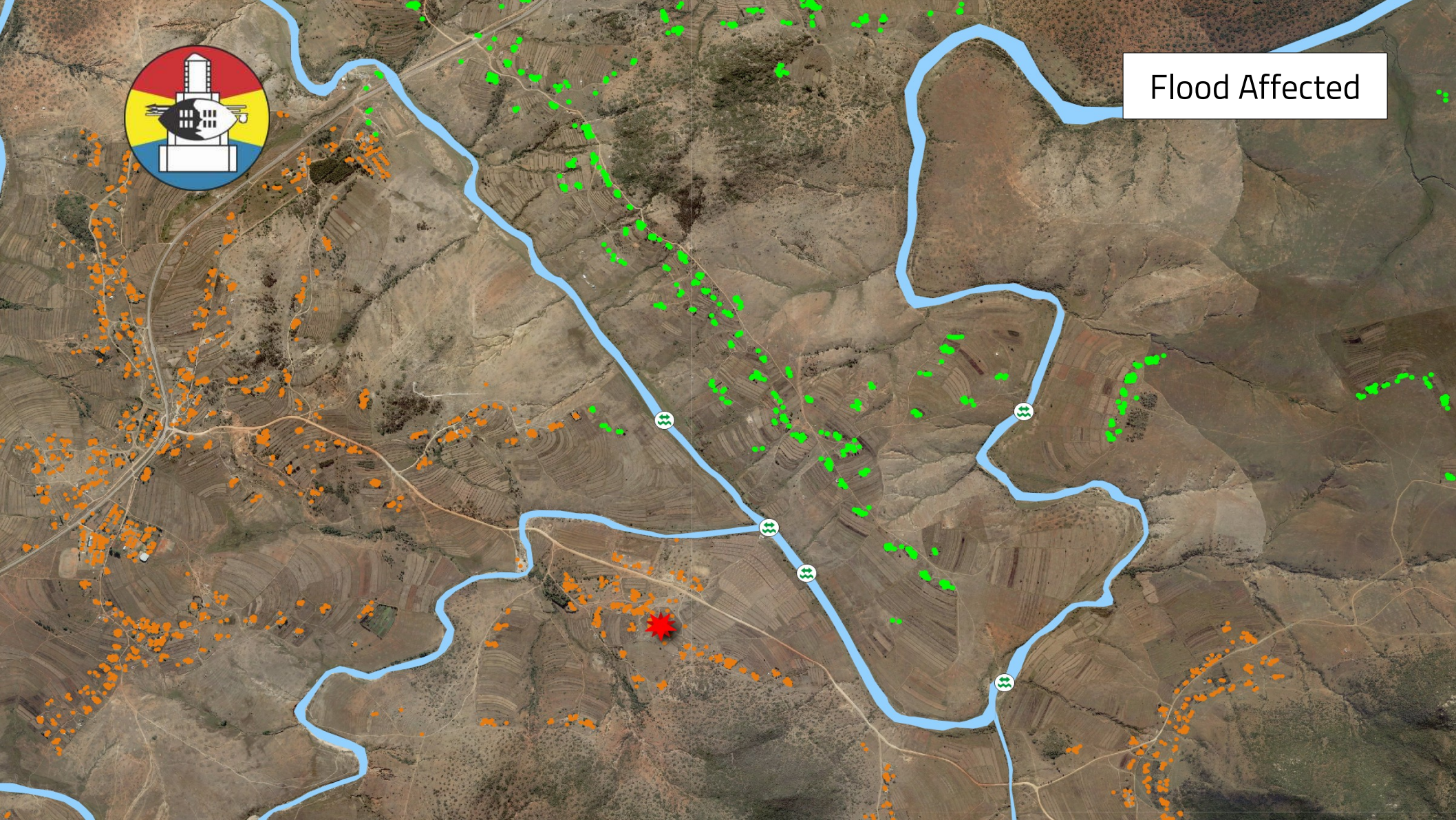


Flood Scenario



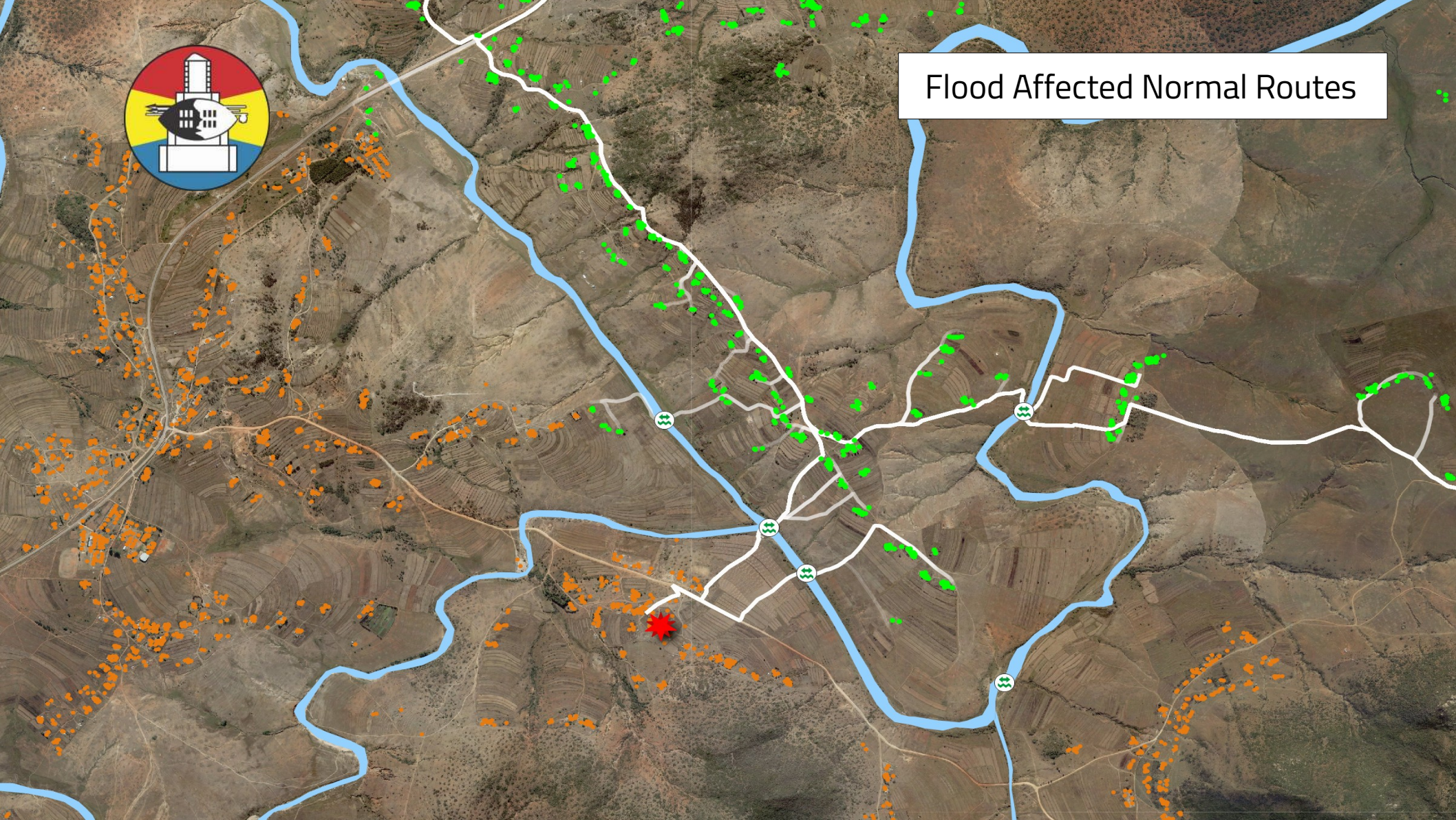


Flood Affected



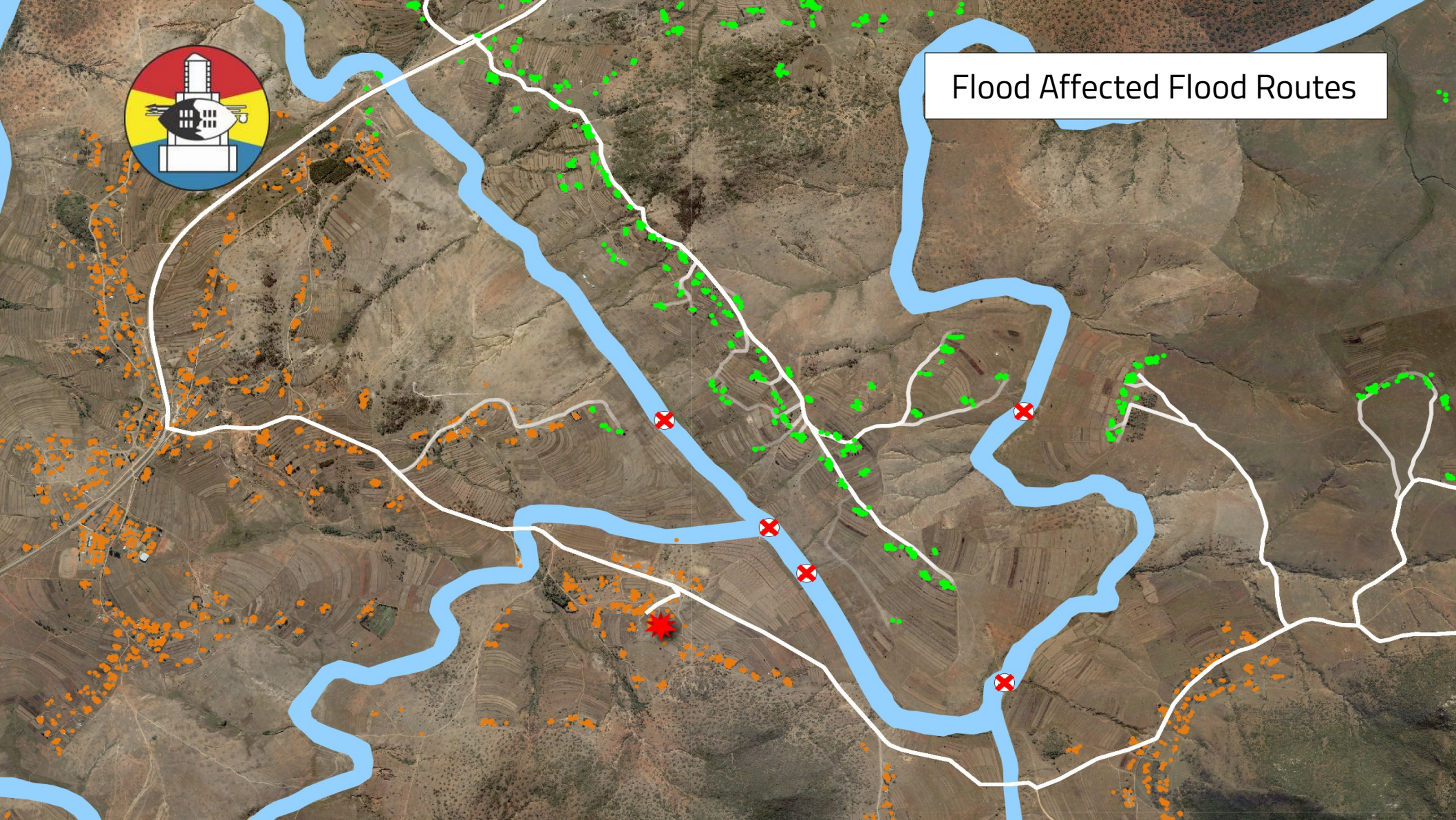


Flood Affected Normal Routes



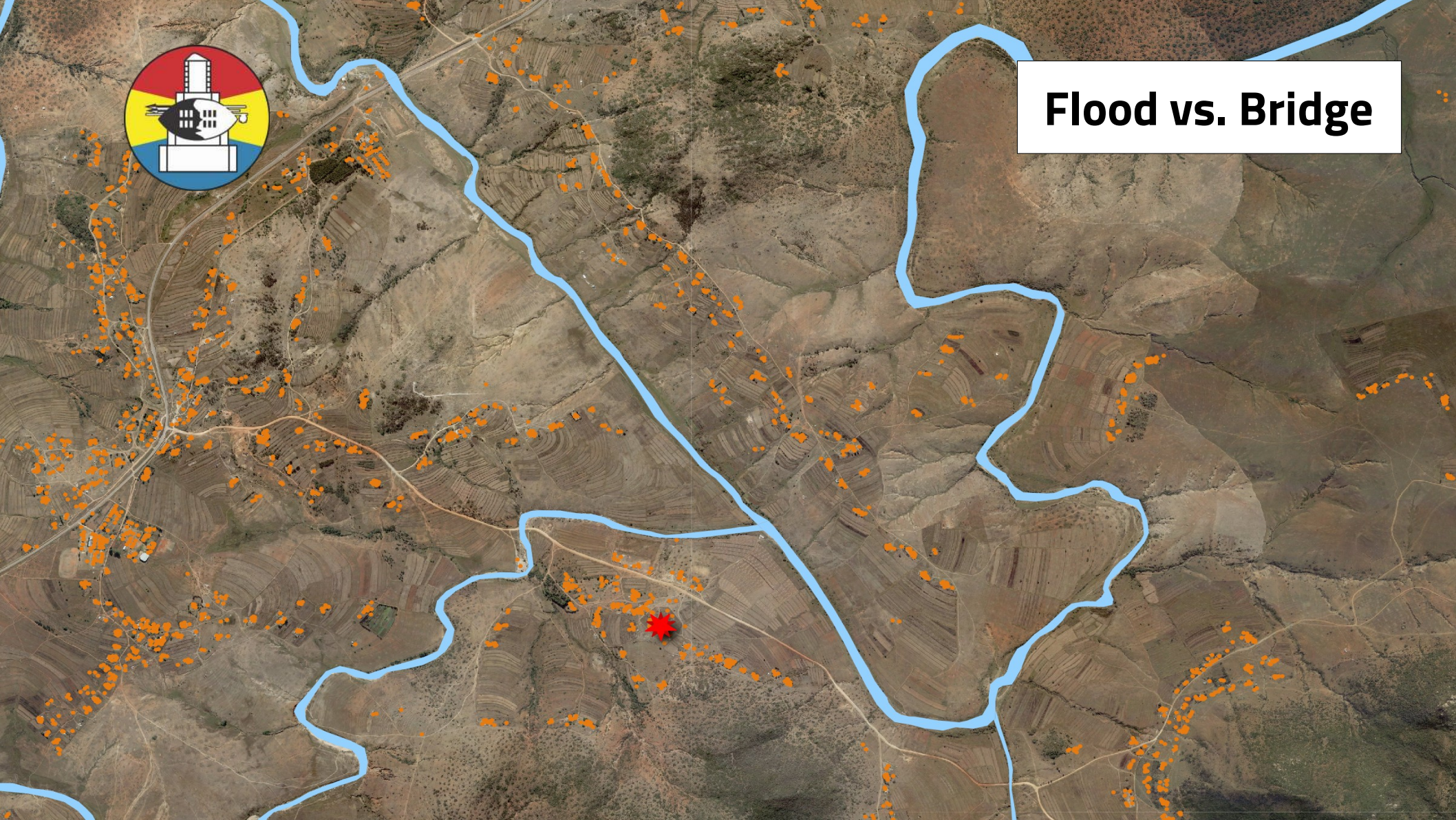


Flood Affected Flood Routes



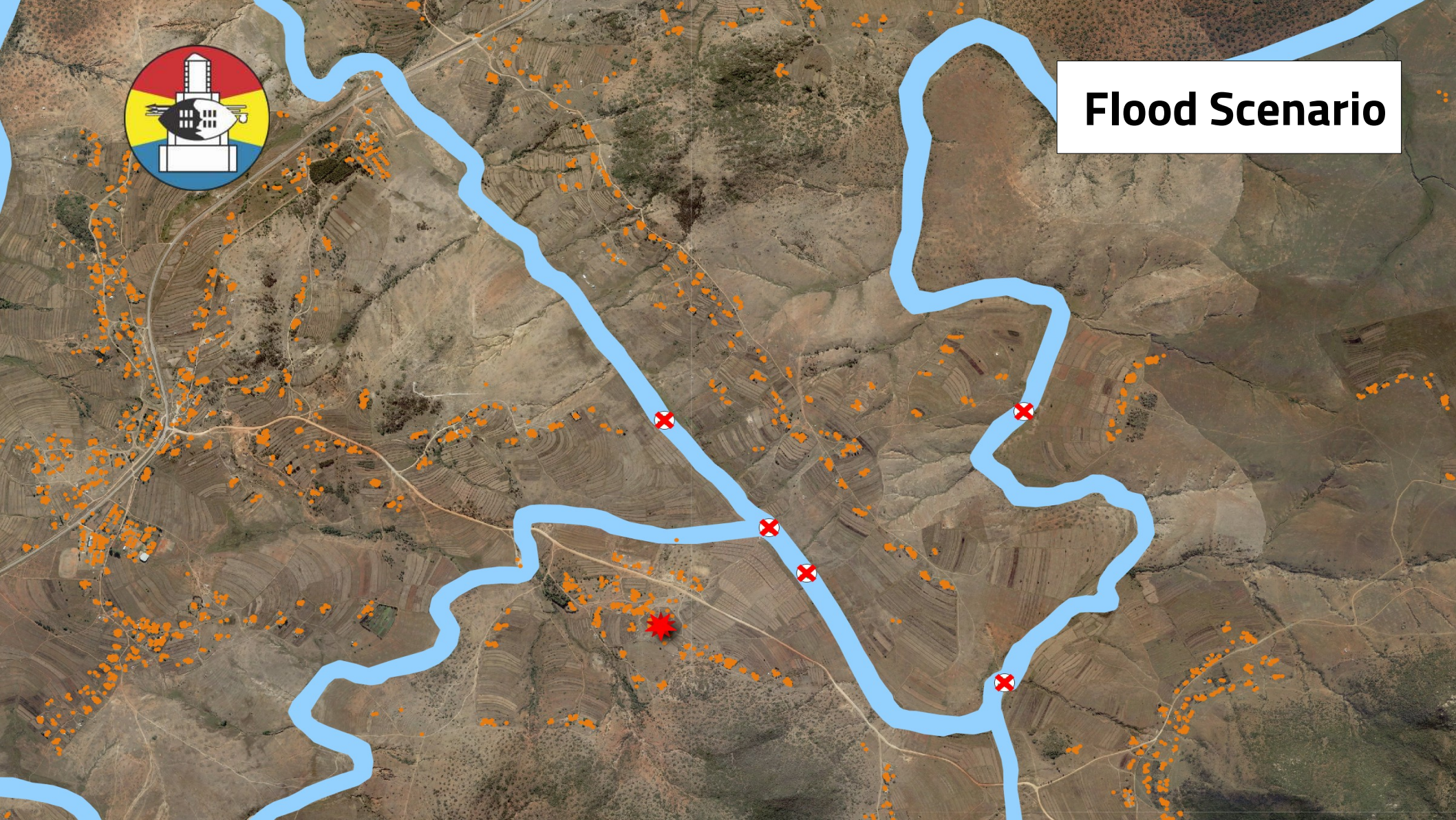


Flood vs. Bridge



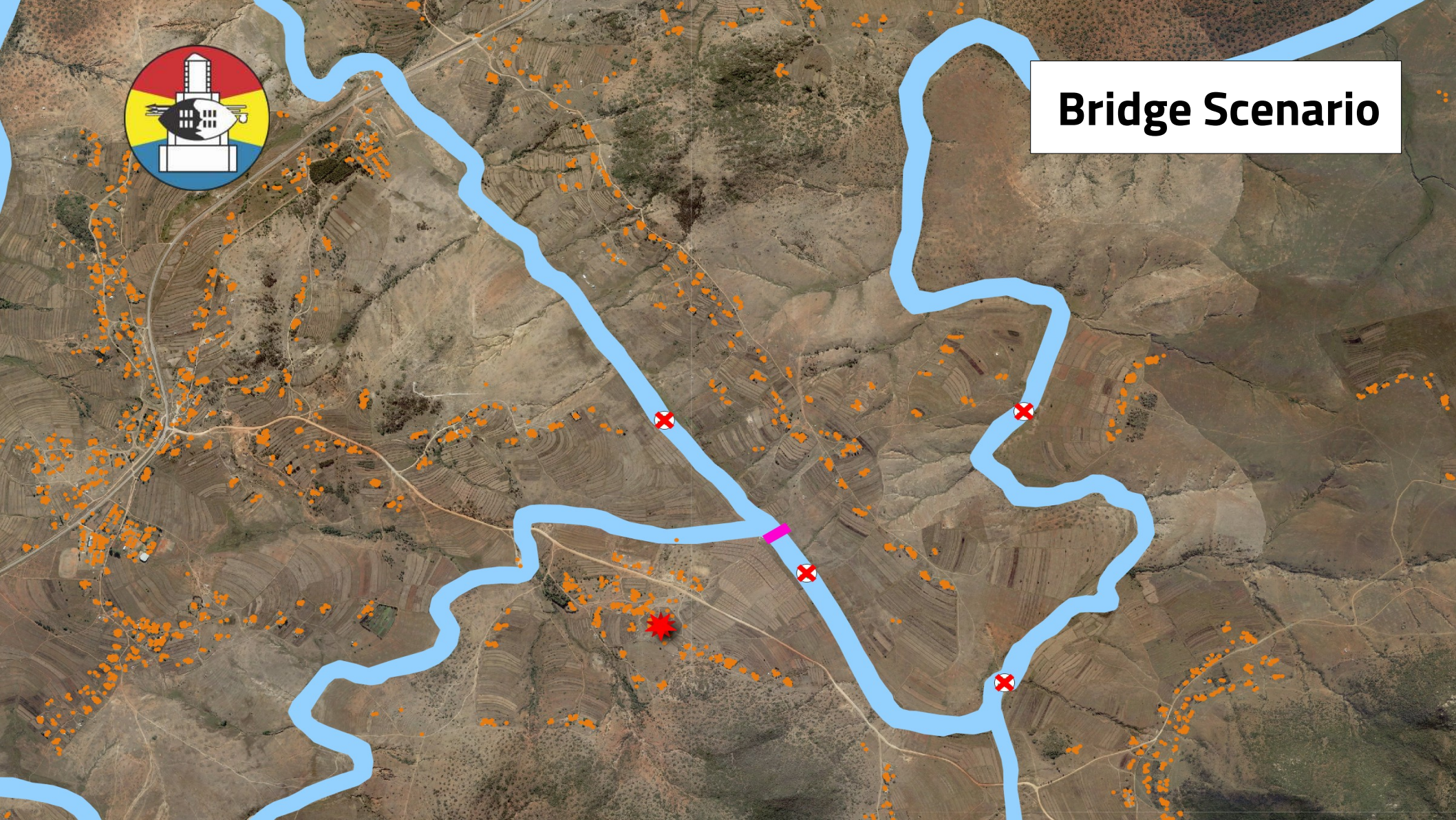


Flood Scenario



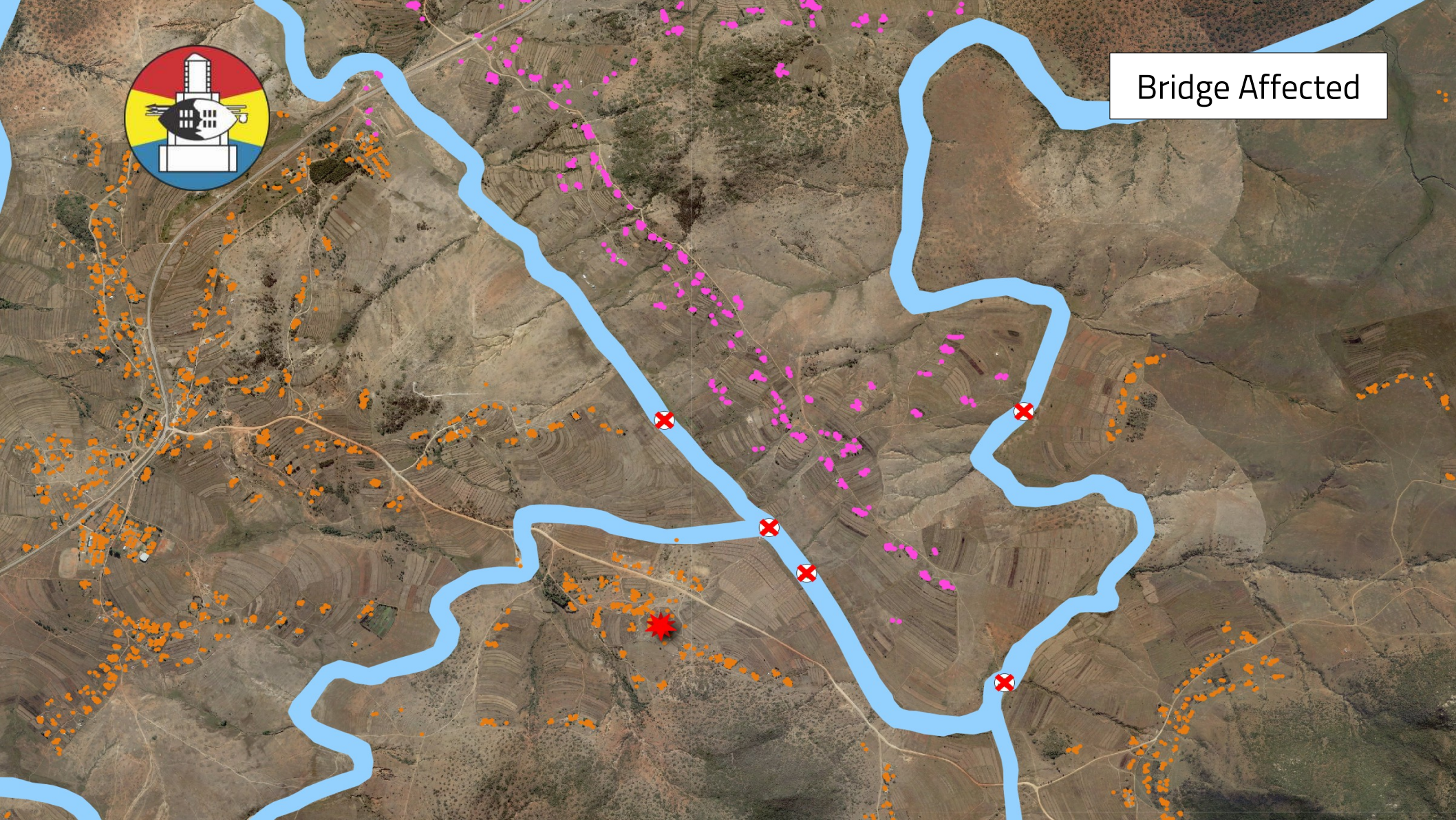


Bridge Scenario



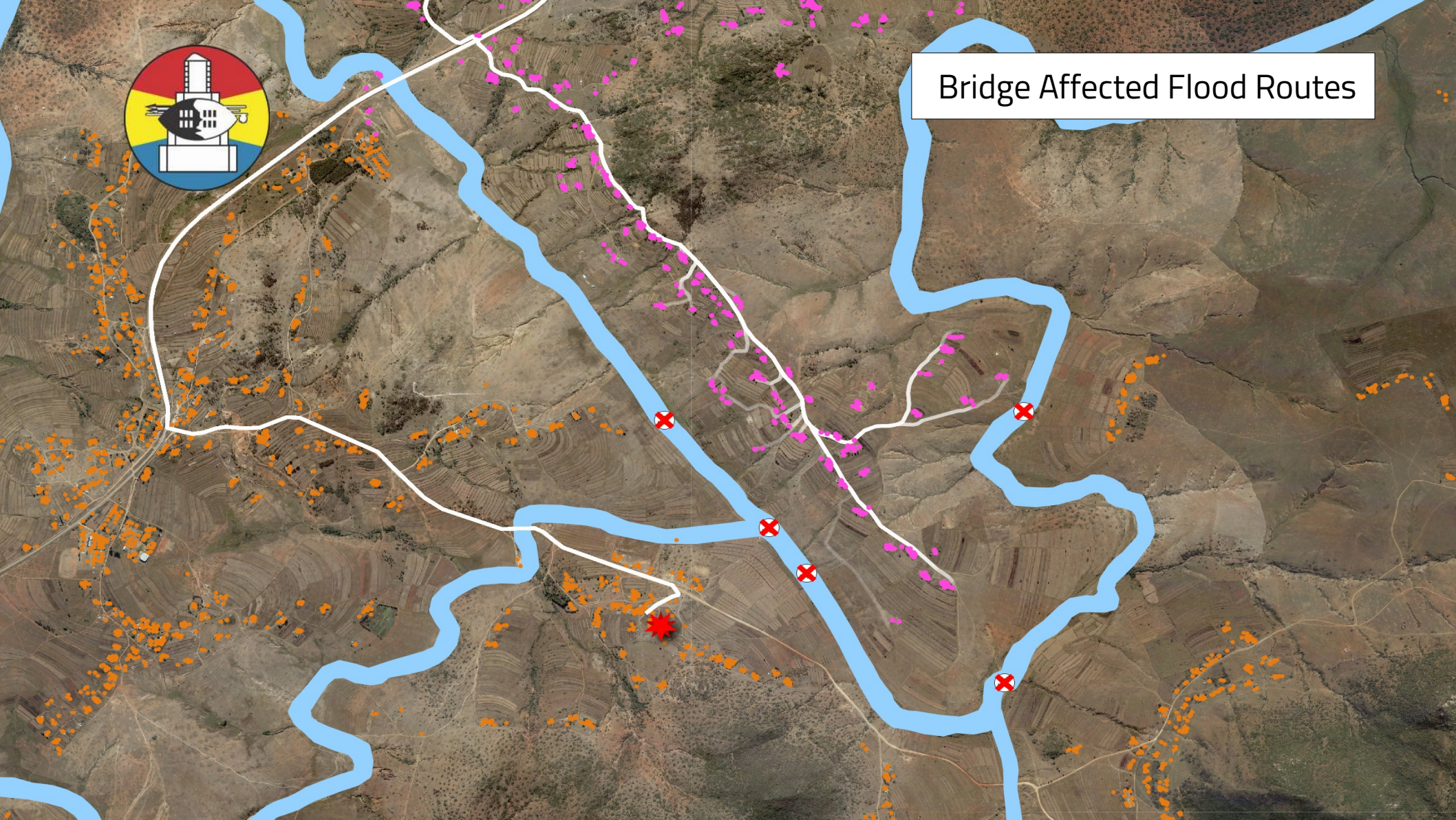


Bridge Affected



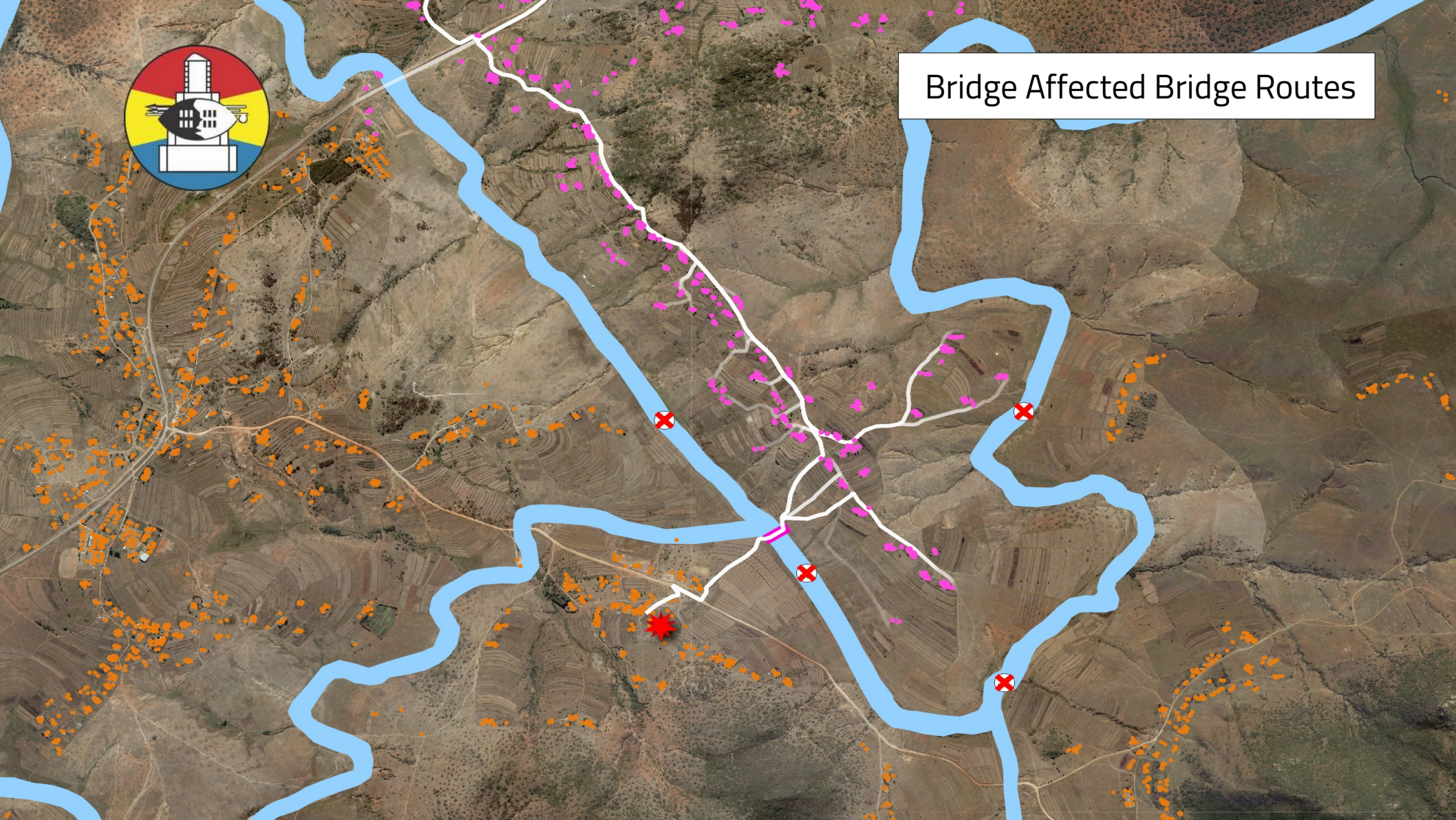


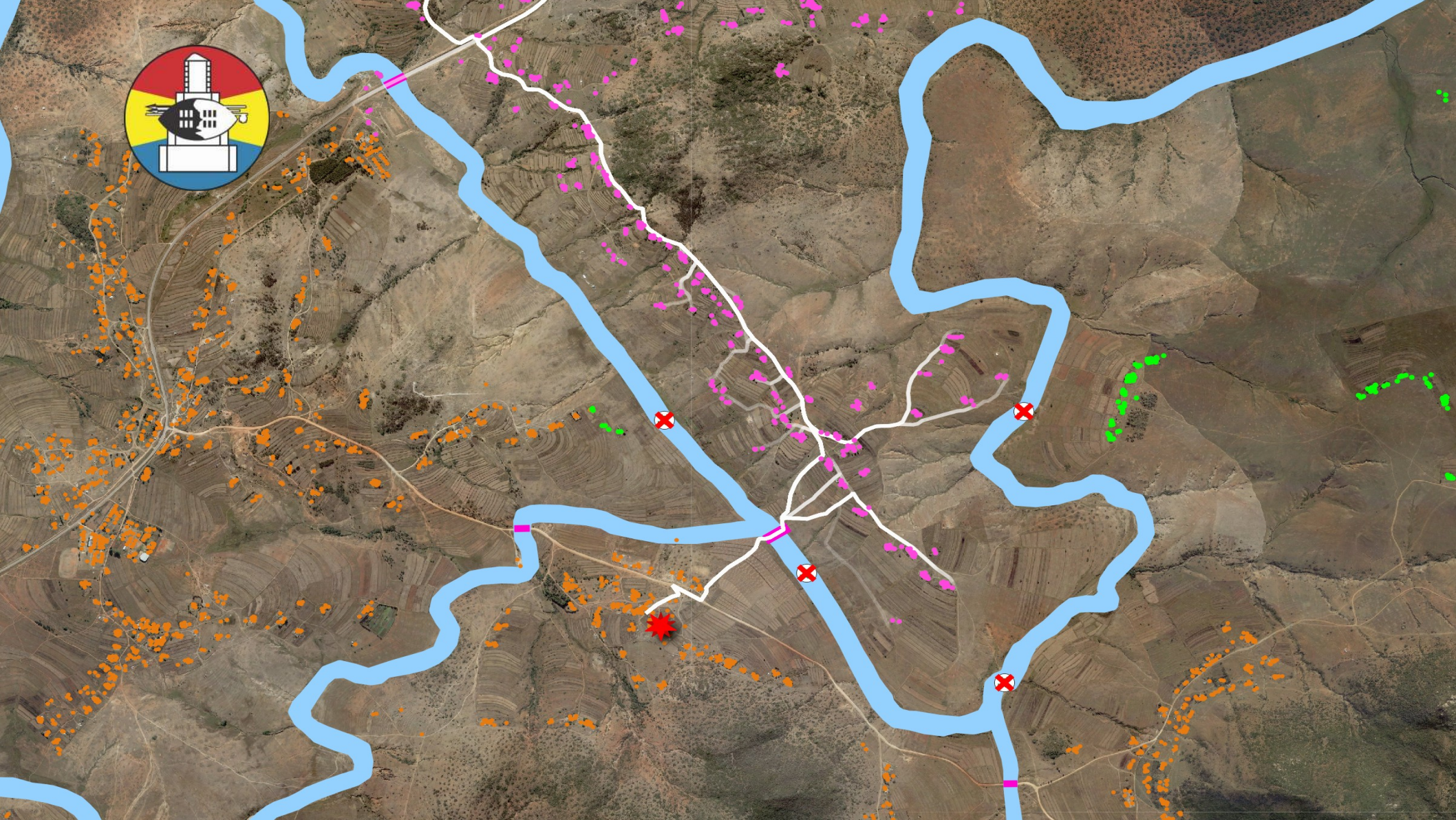
Bridge Affected Flood Routes





Bridge Affected Bridge Routes





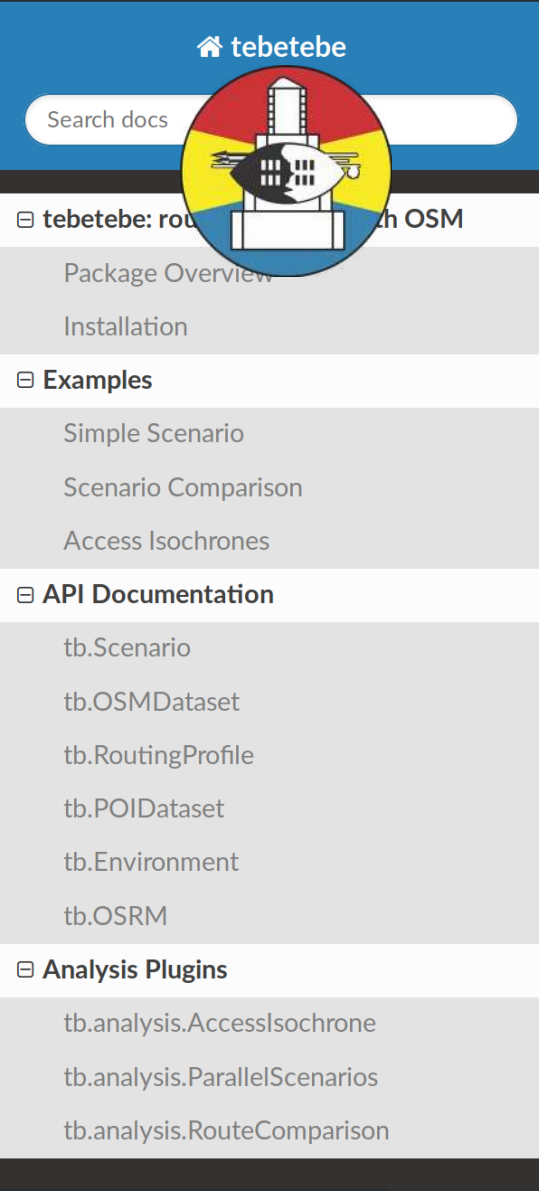


flood_affected :: Features Total: 2688, Filtered: 2688, Selected: 0

	origin_id	dest_id	normal_dist	normal_time	flood_dist	flood_time	bridge_dist	bridge_time	
1	405361898	718997017	5730	4125	7285	5245	5753	4142	
2	404537021	718997017	8829	6357	9002	6481	9002	6481	
3	405361899	718997017	5732	4127	7287	5246	5755	4143	
4	405361892	718997017	5527	3979	7082	5098	5550	3995	
5	405374012	718997017	7766	5592	9321	6711	7789	5608	
6	405361893	718997017	5565	4007	7120	5126	5588	4023	

Show All Features

How much time / distance is saved for each homestead, on average?



tebetebe: routing analysis with OSM

tebetebe is a Python API to compile, serve, and query routable networks using the [Open Source Routing Machine](#) (OSRM) and [OpenStreetMap](#) data, and provides a framework for routing analysis using these networks.

Package Overview

tebetebe makes it easy to compile a custom routing *Scenario* by abstracting OSRM executables into a pythonic API and provides a framework for routing analysis. With the range of customization available in the .lua configuration scripts, specific, accurate and *readable* transportation models can be developed and analyzed.

tebetebe also simplifies the routing analysis pipeline by enabling data to be pulled live from the OSM via the Overpass API and providing various user-contributed classes which automate common routing analysis tasks, such as isochrones.

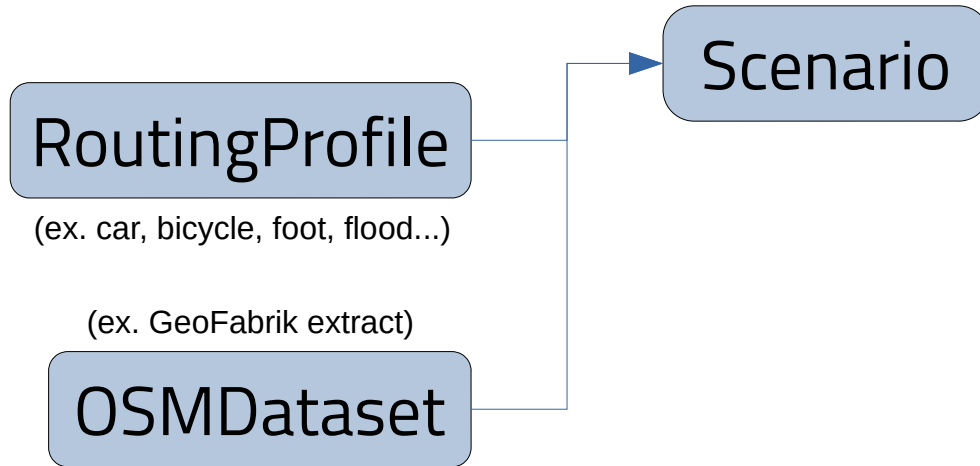
Installation

1. Install **osrm-backend** binaries

- See the [osrm-backend wiki for instructions](#) on how to build and install from source.

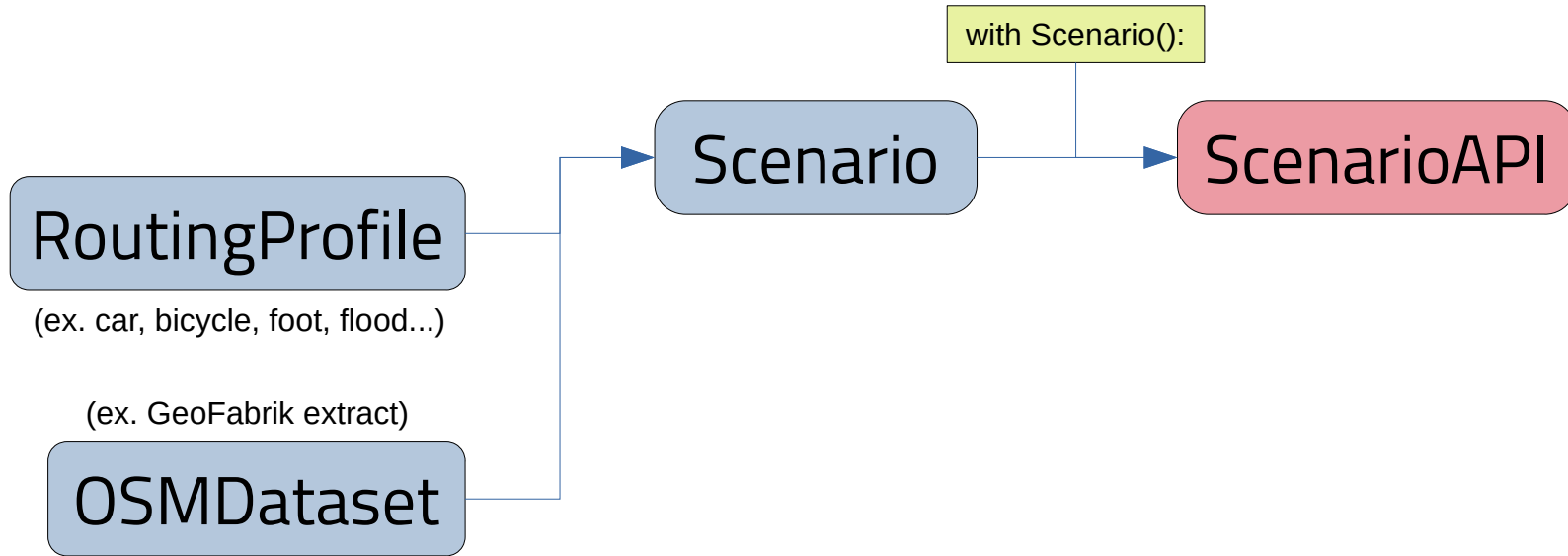


Scenario Schematic



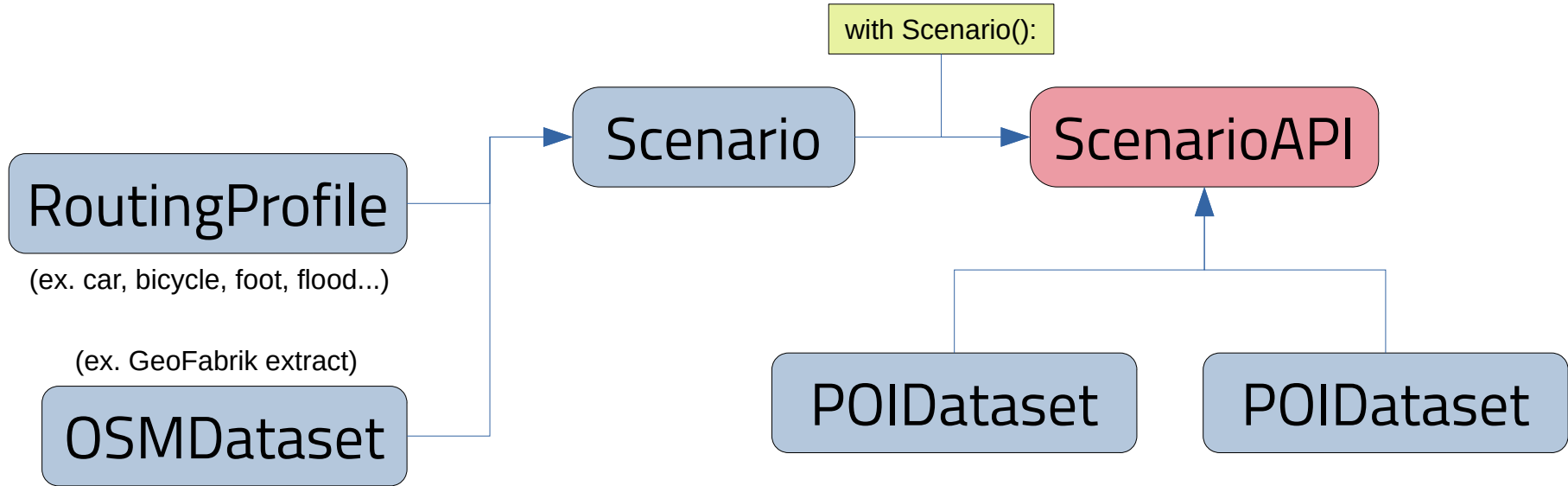


Scenario Schematic



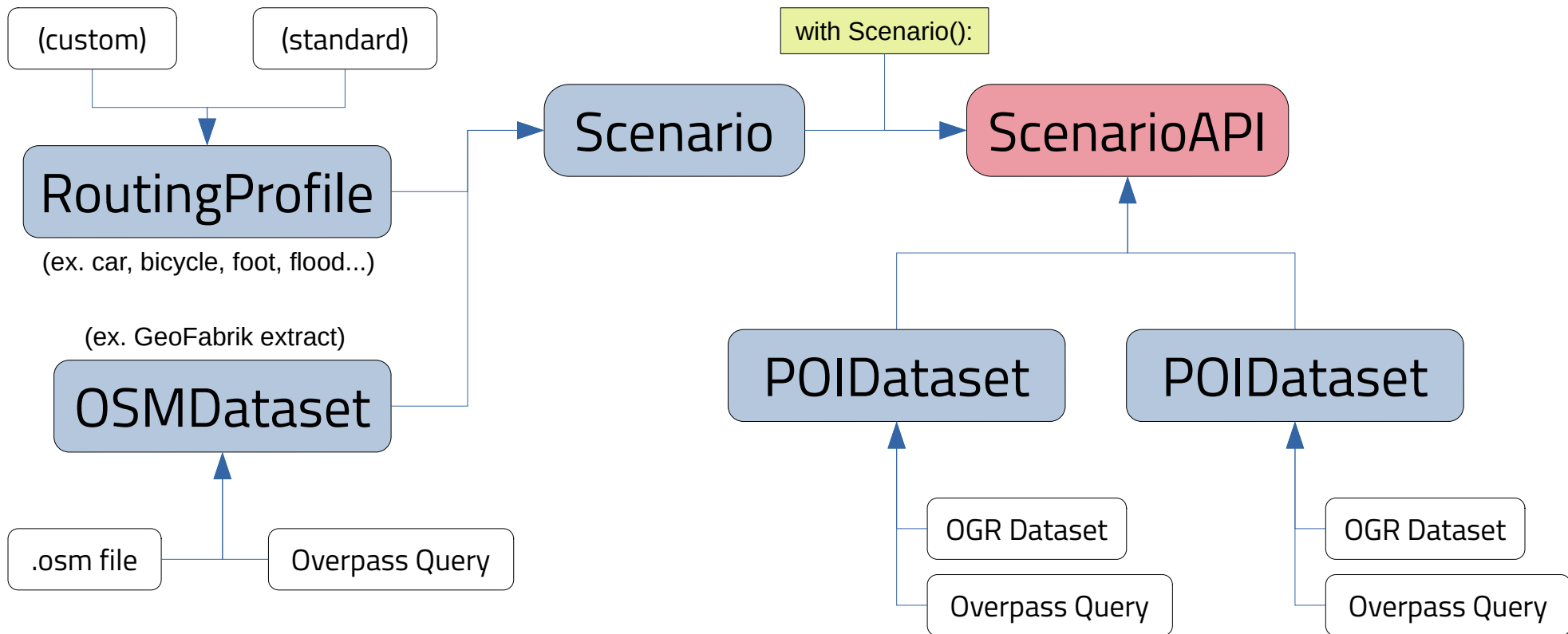


Scenario Schematic



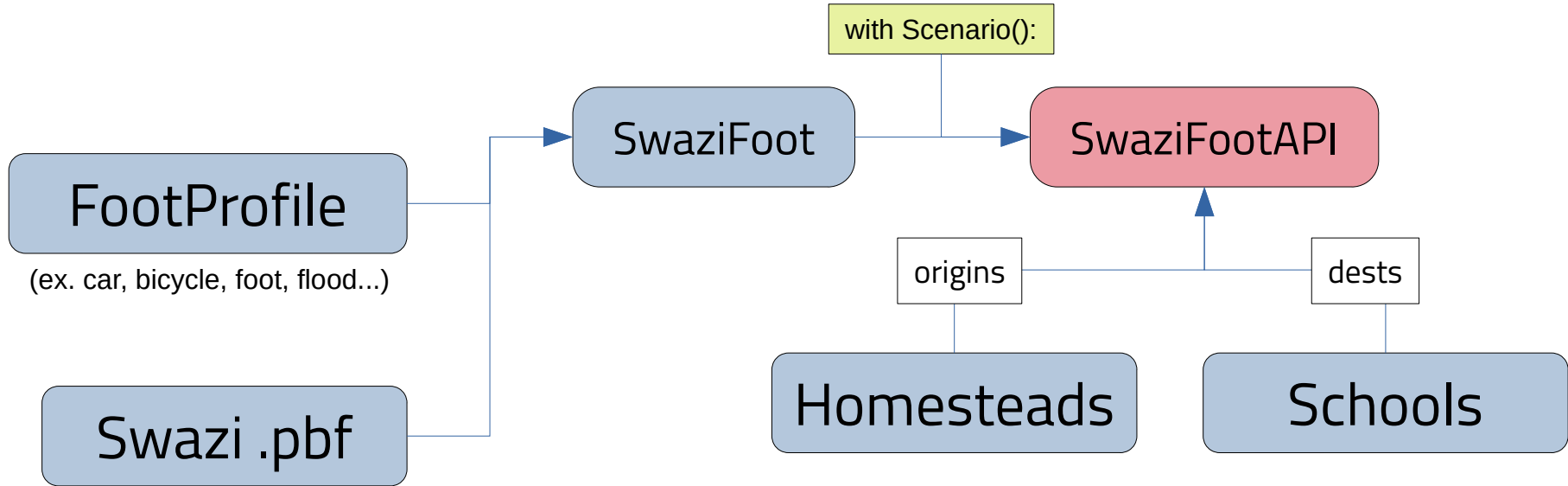


Scenario Schematic



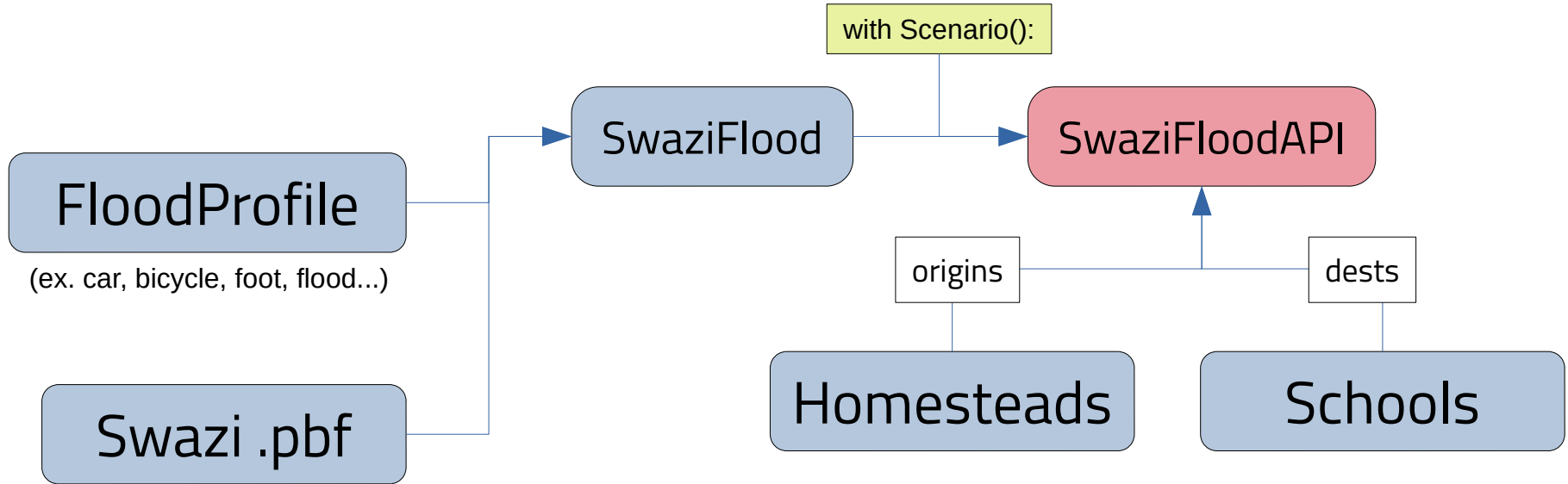


Normal Scenario





Flood Scenario





Flood Scenario

FloodProfile

(ex. car, bicycle, foot, flood...)

Swazi .pbf

SwaziFlood

with Scenario():

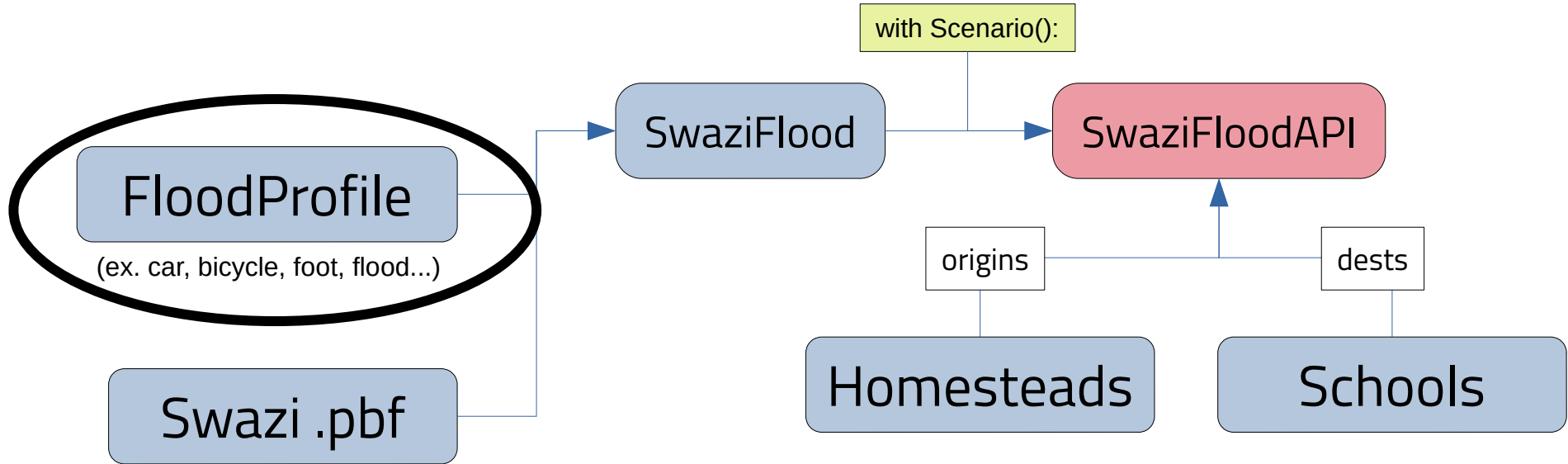
SwaziFloodAPI

origins

dests

Homesteads

Schools





Flood Scenario Profile

block bridges with *flood_prone=yes*

```
function WayHandlers.no_flood_prone(profile,way,result,data)
  bridge = way:get_value_by_key("bridge")
  flood_prone = way:get_value_by_key("flood_prone")

  if bridge == "yes" and flood_prone == "yes" then
    return false
  end
end
```

block nodes with *ford=yes*

```
local ford = node:get_value_by_key("ford")
if "yes" == ford then
  result.barrier = true
end
```



```
from tebetebe.profiles import foot
import tebetebe as tb

tb_env = tb.Environment(tmp_dir="./tmp/simple_scenario")

mbabane = (31.1367, -26.3054)
simunye = (31.9274, -26.2108)

## Initialize scenario using eSwatini GeoFabrik extract and default foot profile
scenario = tb_env.Scenario("./tmp/swaziland-latest.osm.pbf", foot)

## Compile and run scenario
with scenario() as api:
    ## Query OSRM HTTP `simple_route` service to calculate route
    route = api.simple_route(simunye, mbabane)

    duration = route['routes'][0]['duration'] / 60
    distance = route['routes'][0]['distance'] / 1000

    print("Walking from Simunye to Mbabane")
    print(" Duration: {:.2f} minutes".format(duration))
    print(" Distance: {:.2f} km".format(distance))
```



```
from tebetebe.profiles import foot
import tebetebe as tb
```

```
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```

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```

```
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```

```
print("Walking from Simunye to Mbabane")
```

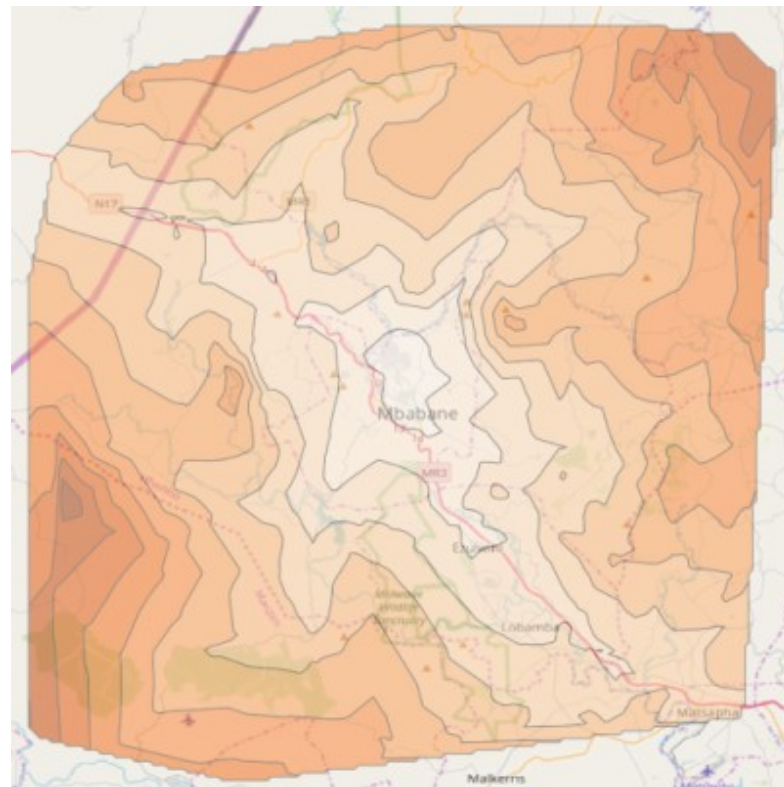
```
print("    Duration: 1420.70 minutes")
```

```
print("    Distance: 118.39 km")
```




tebetebe Features

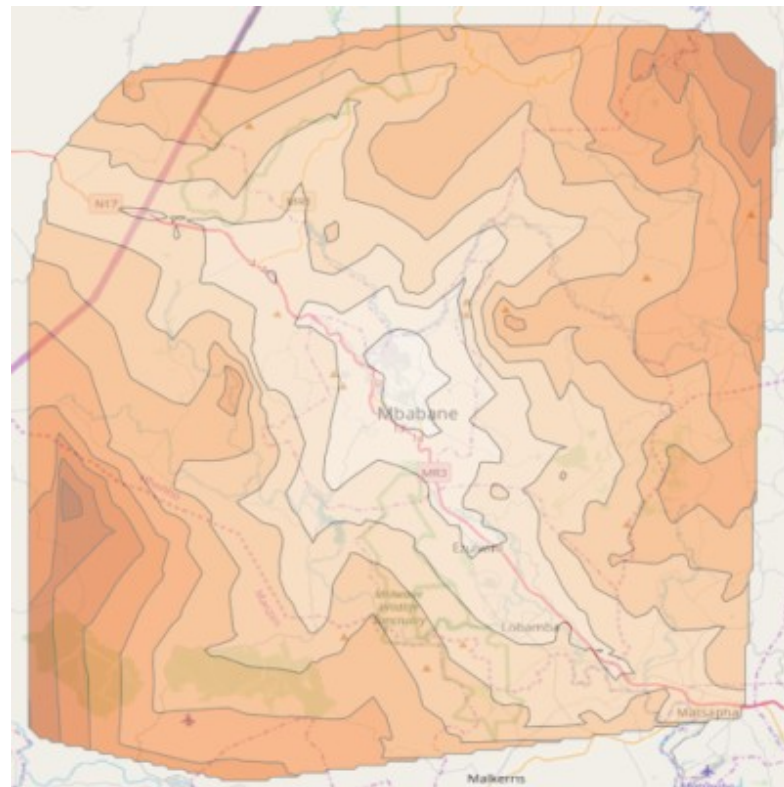
- OSRM Scenario API
- Analysis Plugins
 - Accessibility Isochrones
 - Route Comparison
 - Parallel Scenarios
- Routing Analysis Pipeline
 - Analysis Environment
 - Overpass Integration





tebetebe Wish List

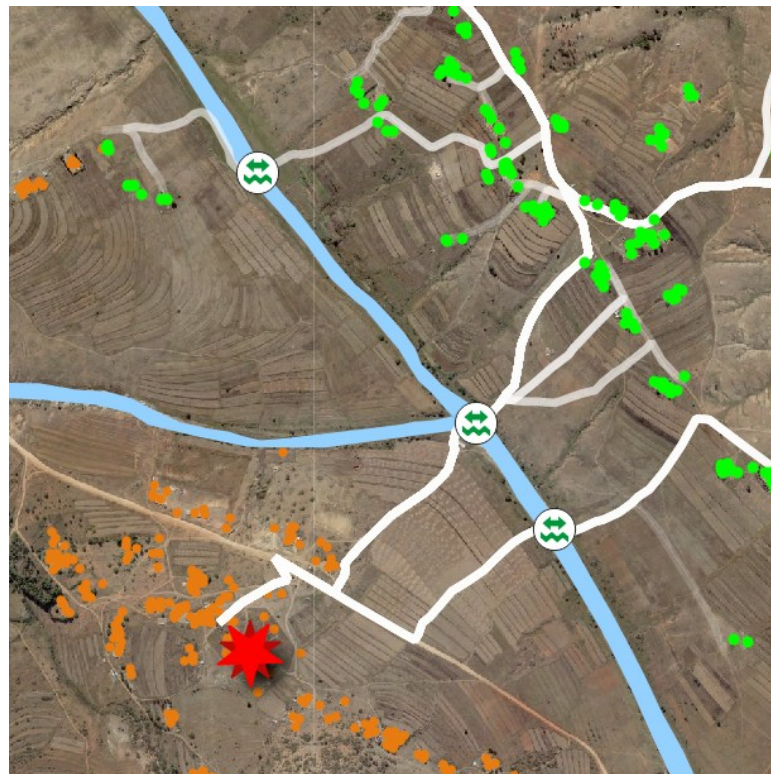
- Implement Shared Memory
 - Route network manipulation without recompilation
- Incorporate Osmium filters
 - Allow programmatic edits of route networks
 - ex. upgrade all tertiary roads to paved
- Parallelization
 - Asynchronous to multiple scenarios
- Remove python-osrm dependence
 - Streamline communication to HTTP API
- QGIS Plugin
 - Bring routing analysis to the masses





tebetebe Caveats

- HTTP API means a lot of overhead
 - If performing bajillions of single requests, this can be a bottleneck
- File System I/O
 - OSRM reads OSM data from disk and writes scenarios to disk
 - Not ideal in some circumstances (planet.osm)
- Default routing profiles may not be accurate for your use case!
 - Accurate routing requires customization





Check out the Docs!

<https://1papaya.github.io/tebetebe/>

- Script Examples
- API Documentation



Acknowledge Mints





Acknowledge Mints



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Cristiano
Giovando

Working Groups

Associated Projects

Missing Maps





Modern C++ routing engine for
shortest paths in road
networks.

[VIEW DEMO](#)

[DOCUMENTATION](#)



Flexible import of



Handles continental sized



Supports car, bicycle,

Get in Touch.

[IRC Channel](#)



**OpenStreetMap
Foundation**



#MapLesotho



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Building footbridges for a

BRIGHTER FUTURE

<https://eiabridges.org>



 geoDavey.us

 me@geoDavey.us

 1papaya

 mDav

 wavydavy



Thank You!!!

Dankeschön!

Muchisimas Gracias!

Merci!

Siyabonga Kakhulu!

Ke a leboha Haholo!

благодарю вас!

Salamat!

Sko Buffs!