Optimization of Land Use Assignment in Shlisselburg

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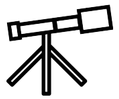
Goals and Motivation

Land Use Optimization

Develop a method to optimize the allocation of functional land use zones within the transformation territory in Shlisselburg

Strategic Urban Development

Align with the ITMO NTI Center’s mission to advance value-oriented urban design and systemic territory development



Integration of Advanced Tools

Utilize BlocksNet and IDUEDU libraries to assign land use zones and evaluate accessibility

Improved Urban Efficiency

Propose land use zoning that provides balanced urban development and enhances overall city structure

Initial Data

GeoJSON Files for the territory

A land plot in Shlisselburg that is currently not developed for assigning new functions

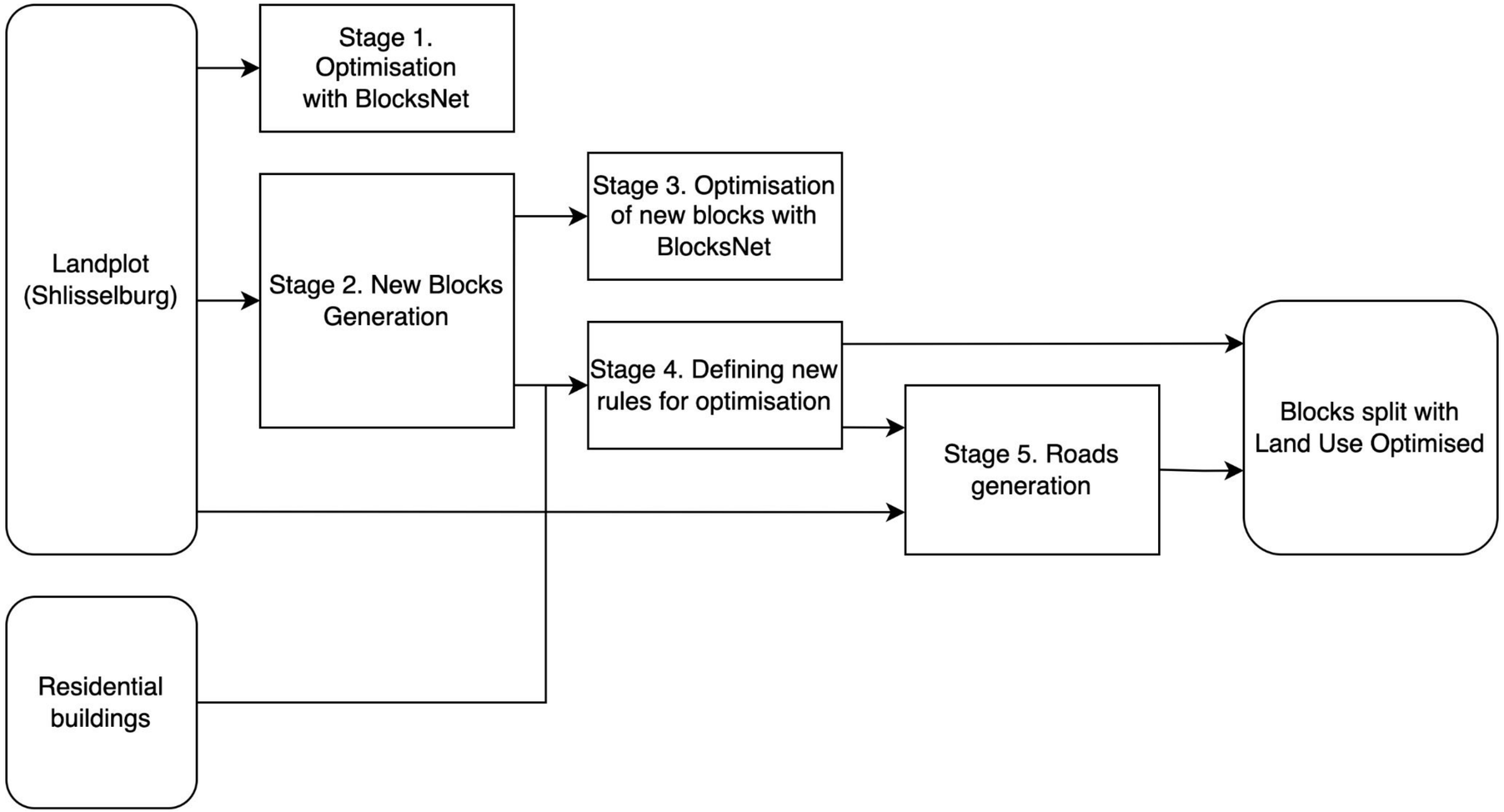
Types of Land Use from Urban Planning Code

Residential, Business, Recreation, Industrial, Agriculture, Special, Transport

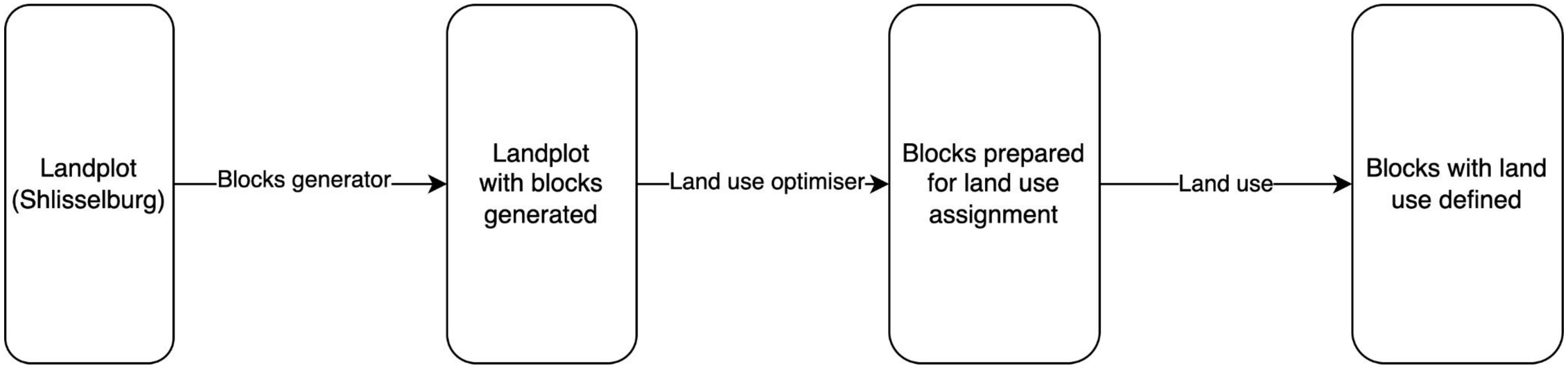
Existing buildings

Retrieved data about existing infrastructure for initial land use assignment

Project Methodology Overview



Stage 1: Optimization with BlocksNet



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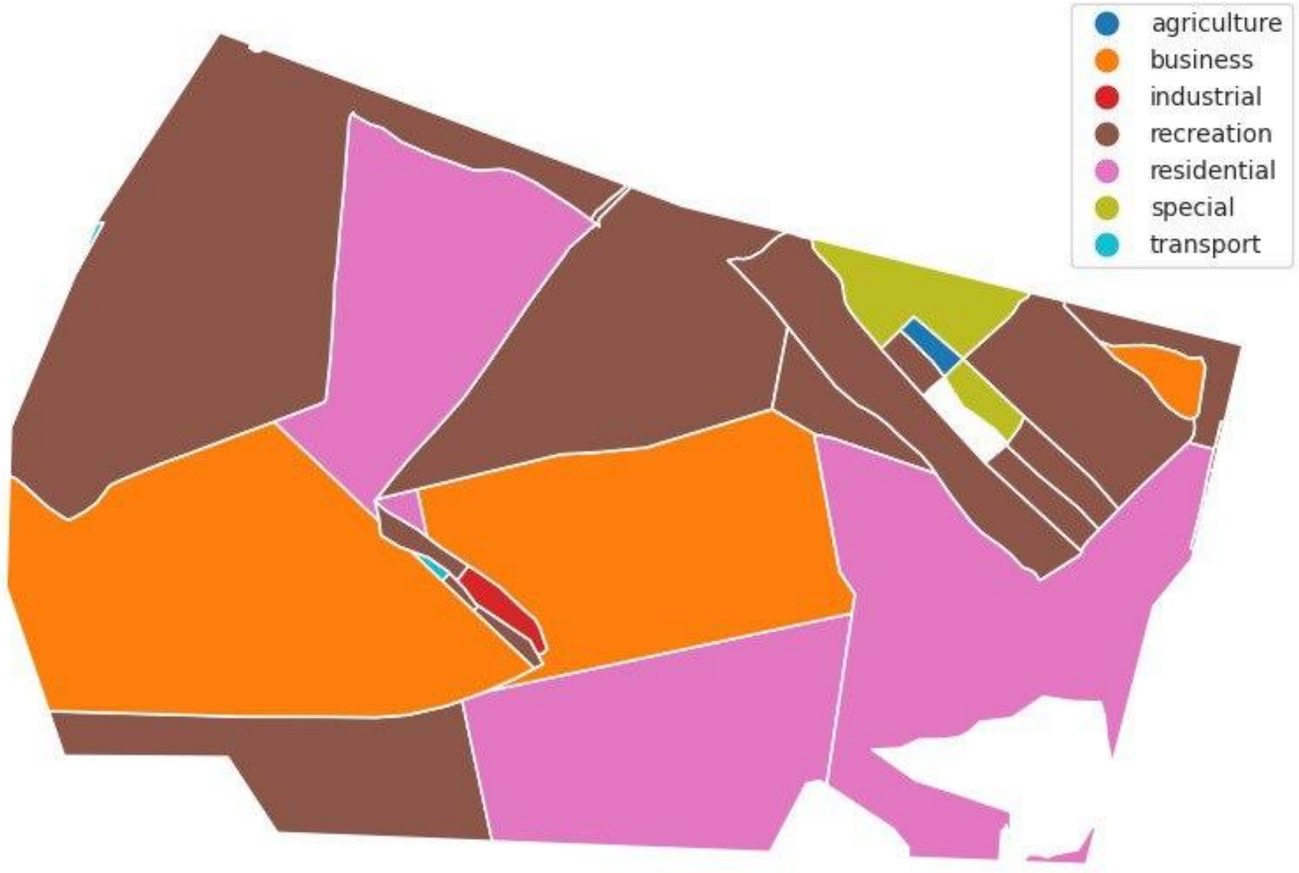


Oversized blocks

Oversized blocks lacking diversity and accessibility

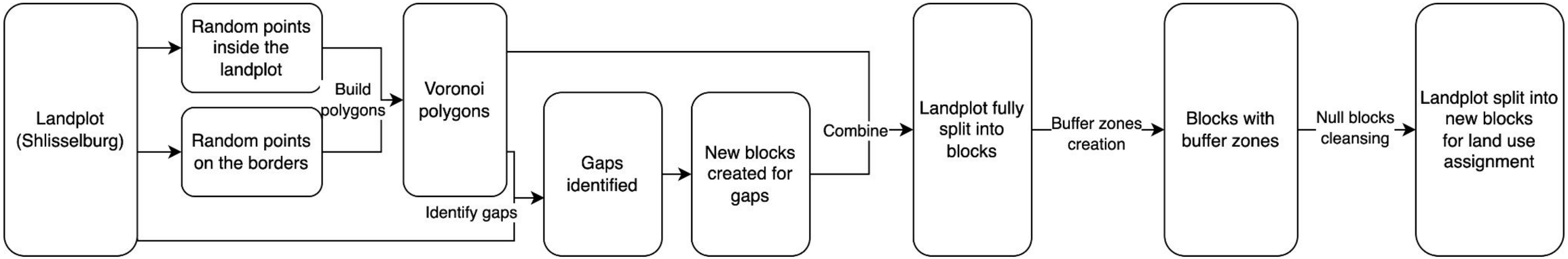
Lack of rules

Lack of defined rules and constraints leads to unpredictable, inconsistent outcomes

Zoning and Allocation Limitations

Random block placement, missing essential zones, misrepresented transportation infrastructure

Stage 2: New Blocks Generation



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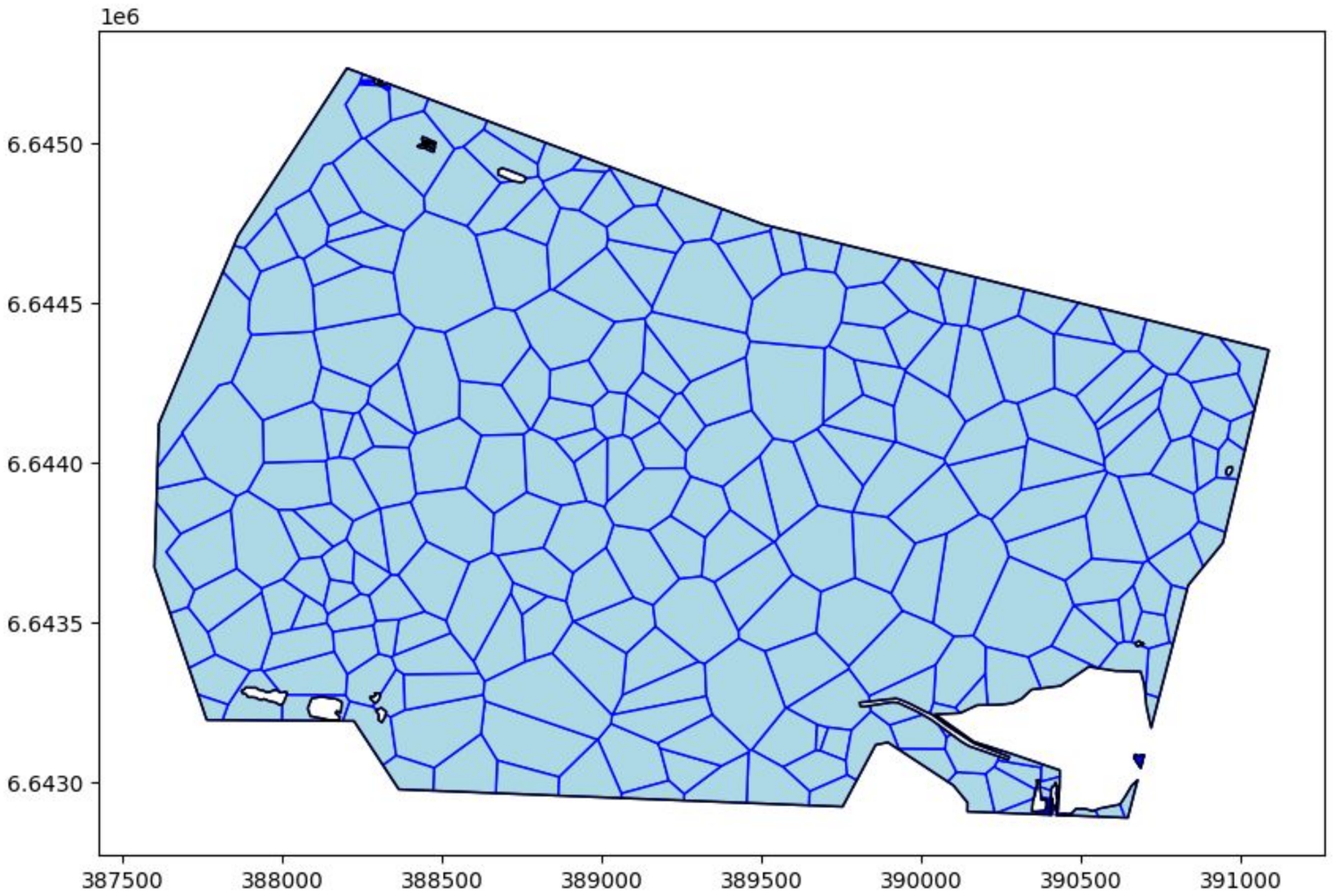


New blocks split

Voronoi polygons were created for coverage improvement with smaller areas

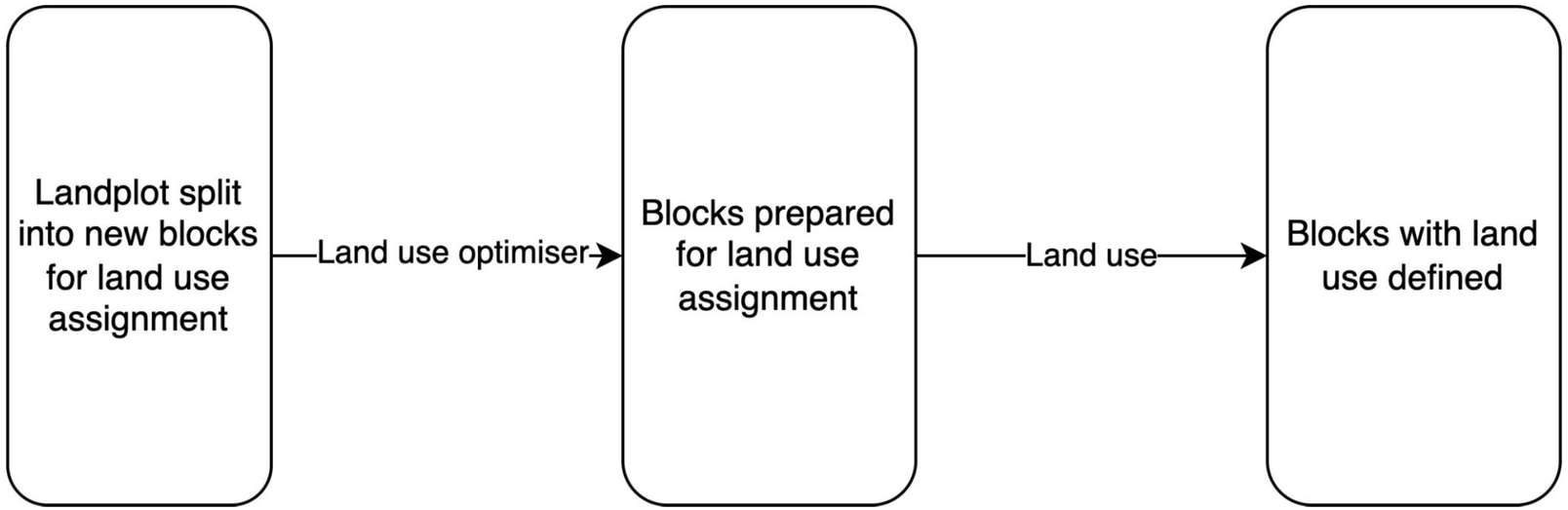
Visualization

Displayed Voronoi polygons overlaid on the plot boundary for clear division of areas

Opportunities for better land use distribution

Better variability of zone placement

Stage 3: Optimization of new blocks with BlocksNet



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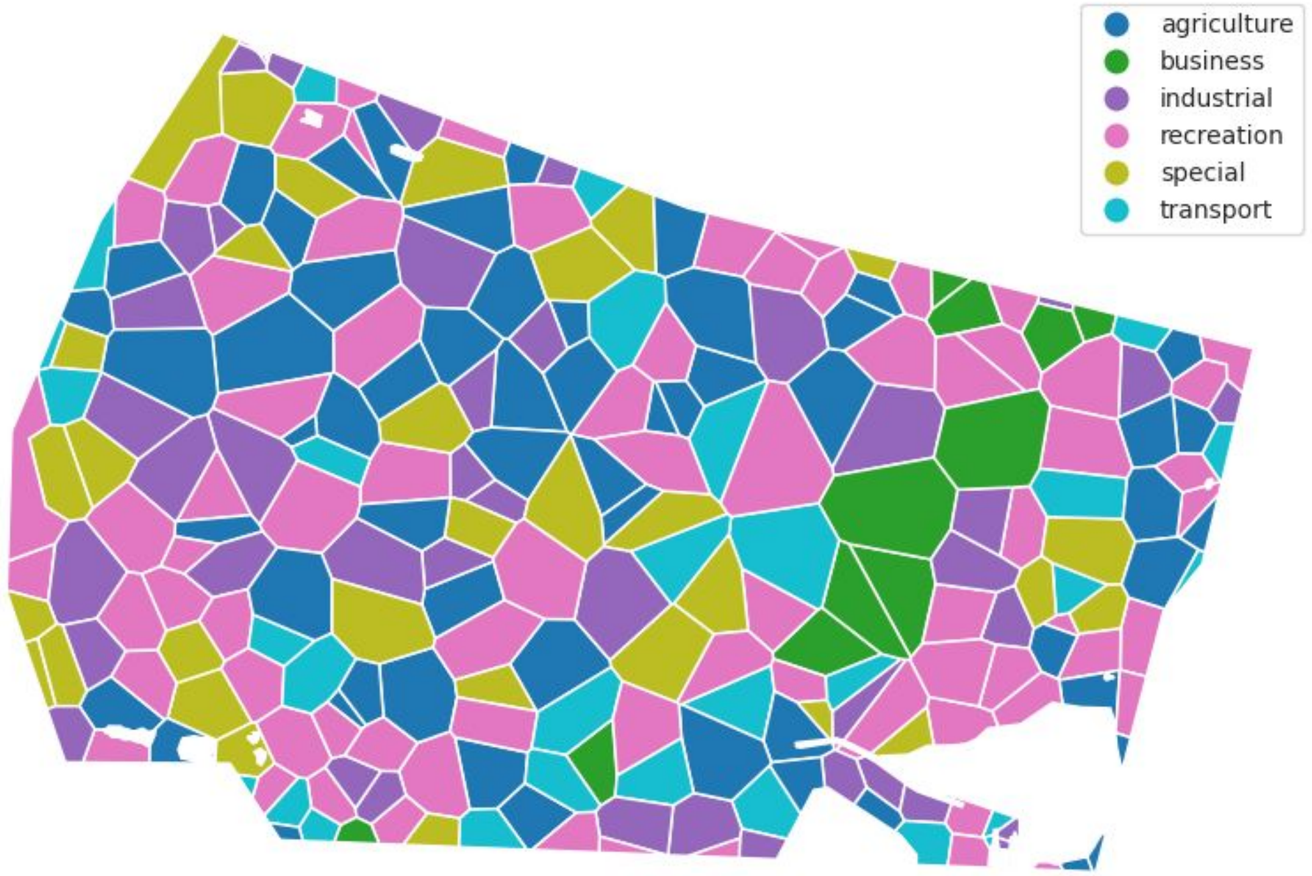


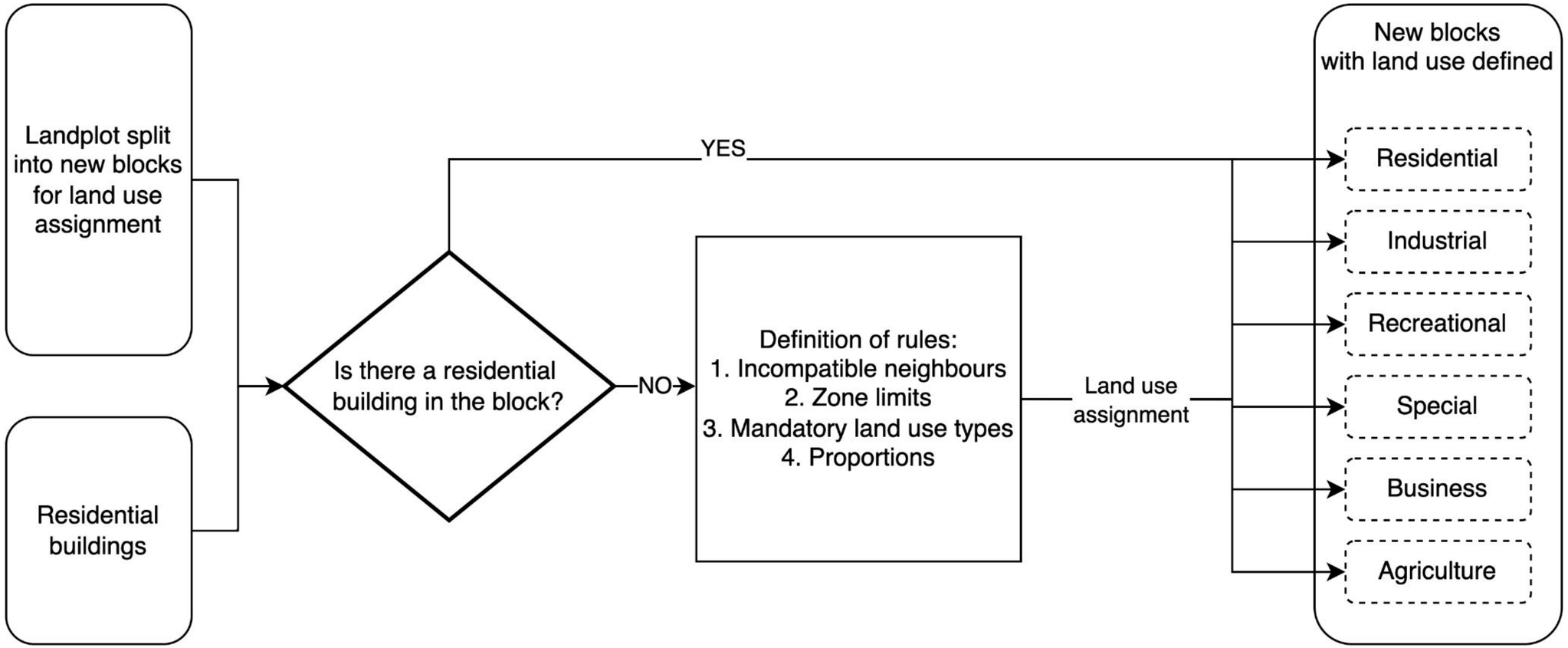
Lack of functional land use zones

The distribution of land use missed essential zones, such as residential areas, even though they were allocated a 0.5 share

Unreasonable proportions

A large proportions of zones was assigned with transport land use, relatively small amount of business land use zones

Stage 4: Defining new rules for optimization



Rules

Incompatible Neighbors:

- residential areas cannot be located next to factories and special zones;
- factories cannot be placed next to housing areas and farms;
- agriculture cannot be located next to industrial and special zones;
- special zones cannot be placed next to residential and agricultural areas

Mandatory Land Use Types:

- existing residential building
  automatically assigns
  residential land use zone

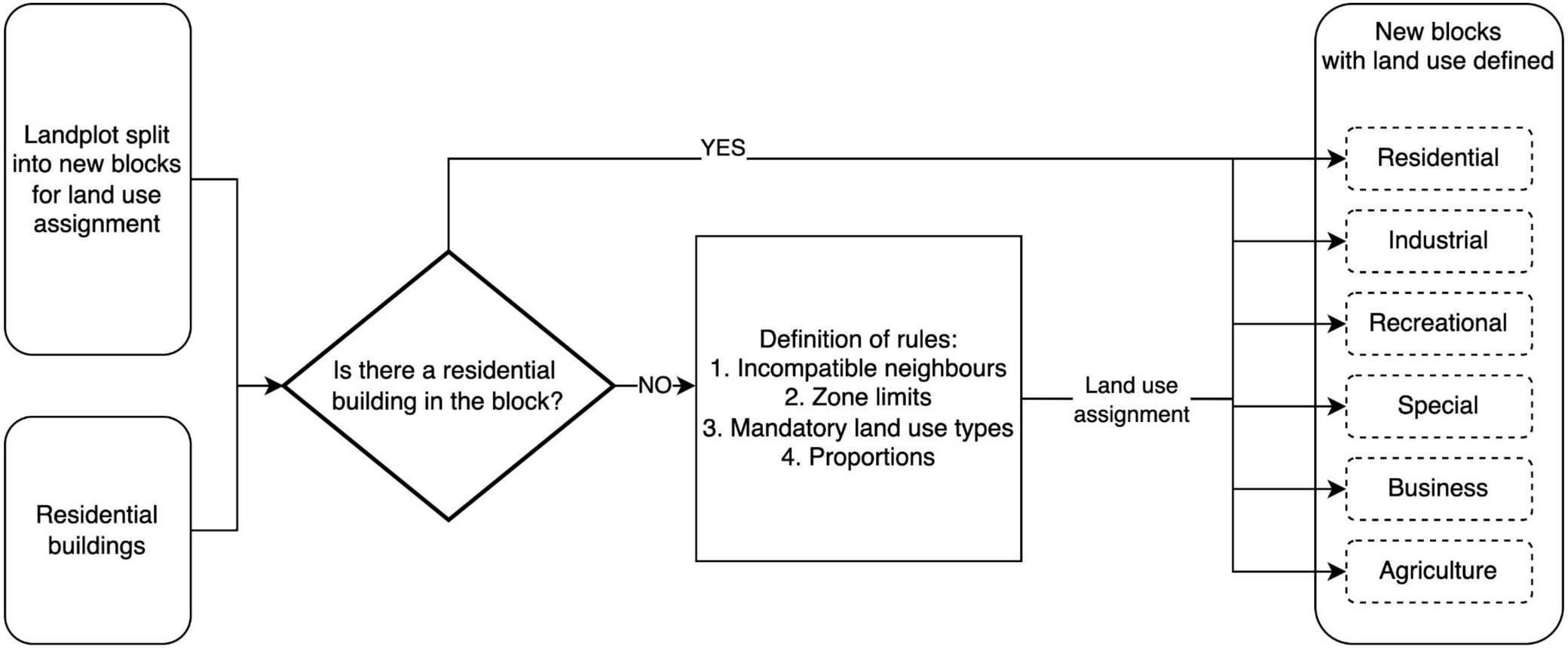
Zone Limits:

- recreational areas: 20;
- special areas: 5;
- industrial areas: 3;
- agricultural zones: 4;
- business zones: 70

Proportions:

- residential areas: 0.7;
- business areas: 0.12;
- recreational areas: 0.2;
- industrial areas: 0.03;
- agricultural areas: 0.02;
- special areas: 0.04

Stage 4: Defining new rules for optimization



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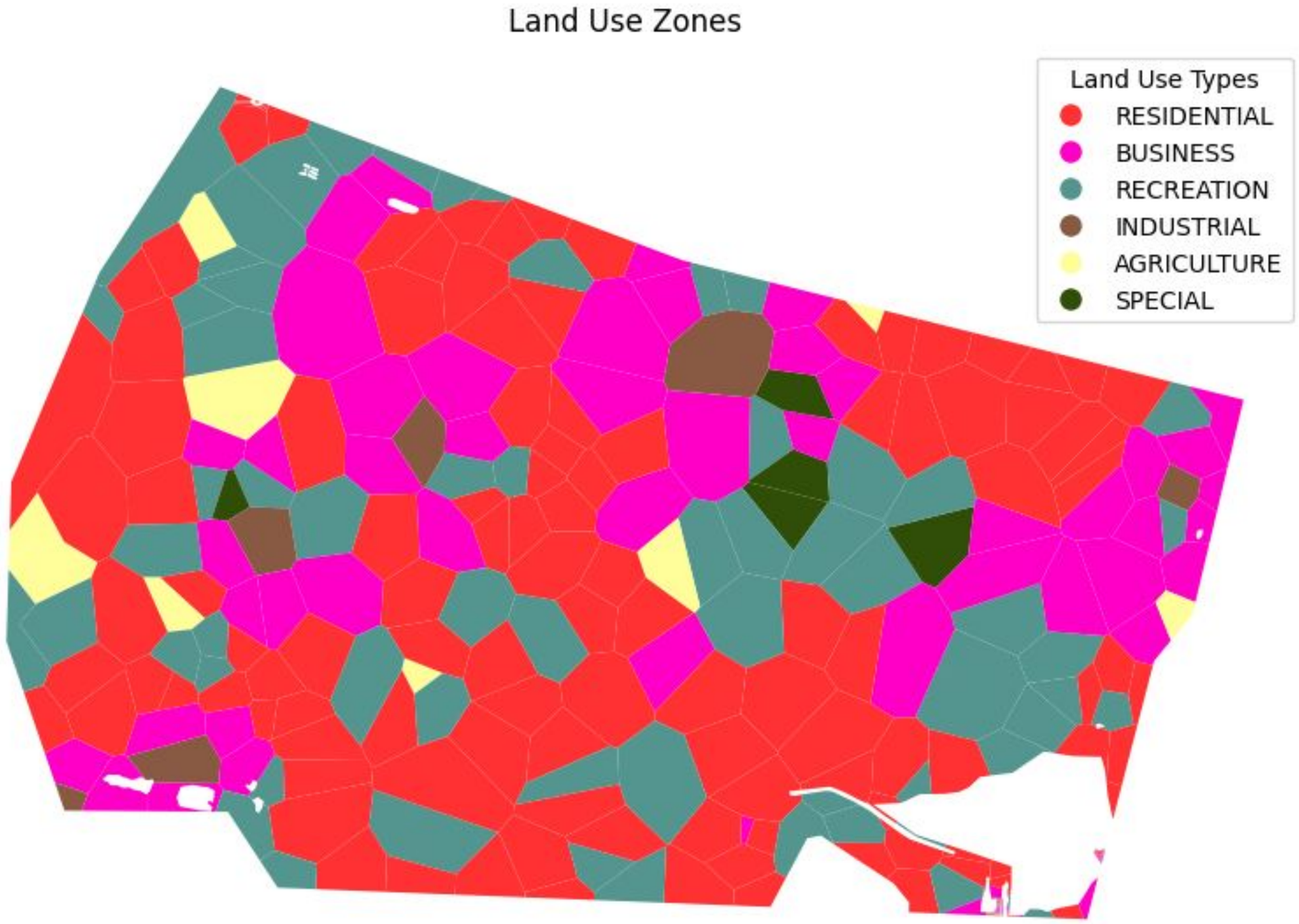


Optimized Land Use Distribution

Achieved proportional land use allocation while respecting limits and mandatory zones.

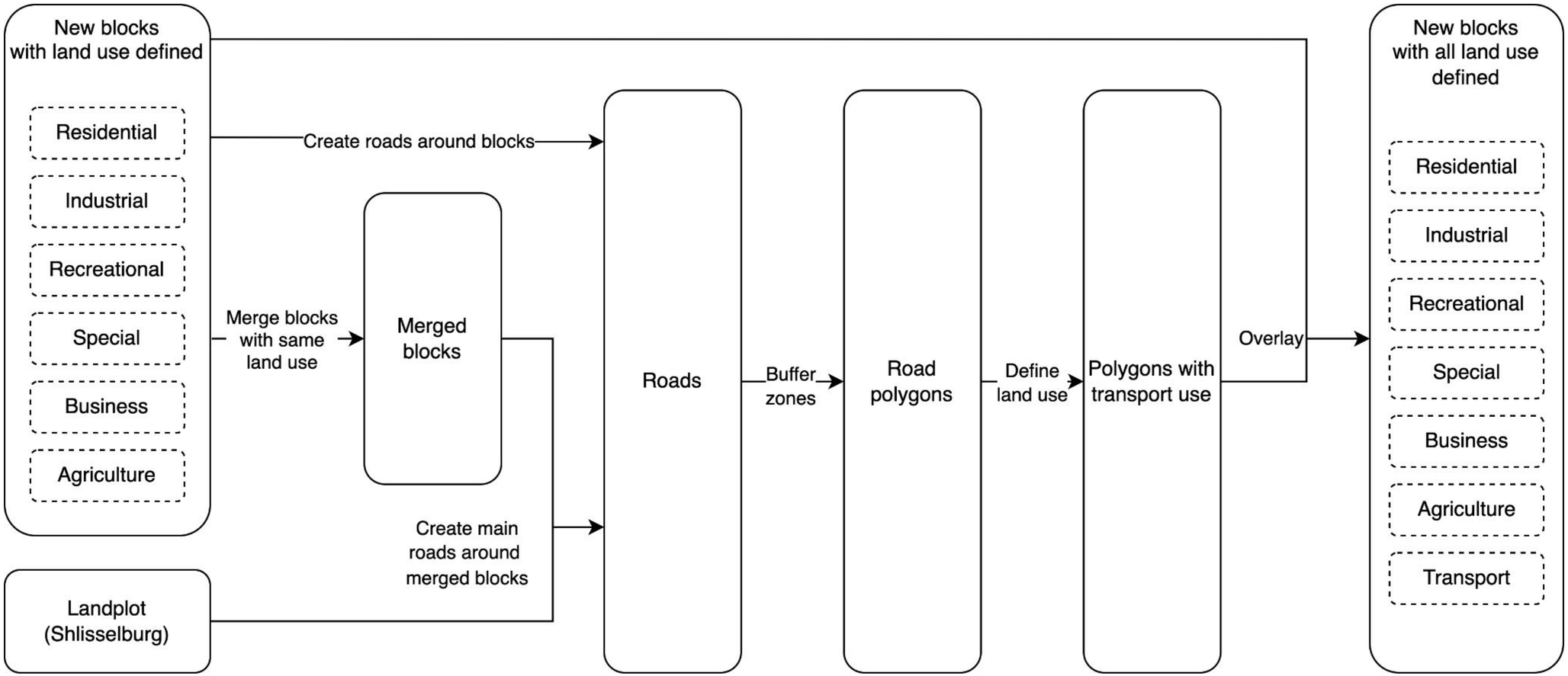
Spatial Data Integration

Housing data and spatial indexing integrated to apply rules for residential zones and neighbor compatibility.

Statistical Overview

Verified land use distribution with a breakdown of blocks assigned to each category, highlighting compliance with proportions and constraints.

Stage 5: Roads generation



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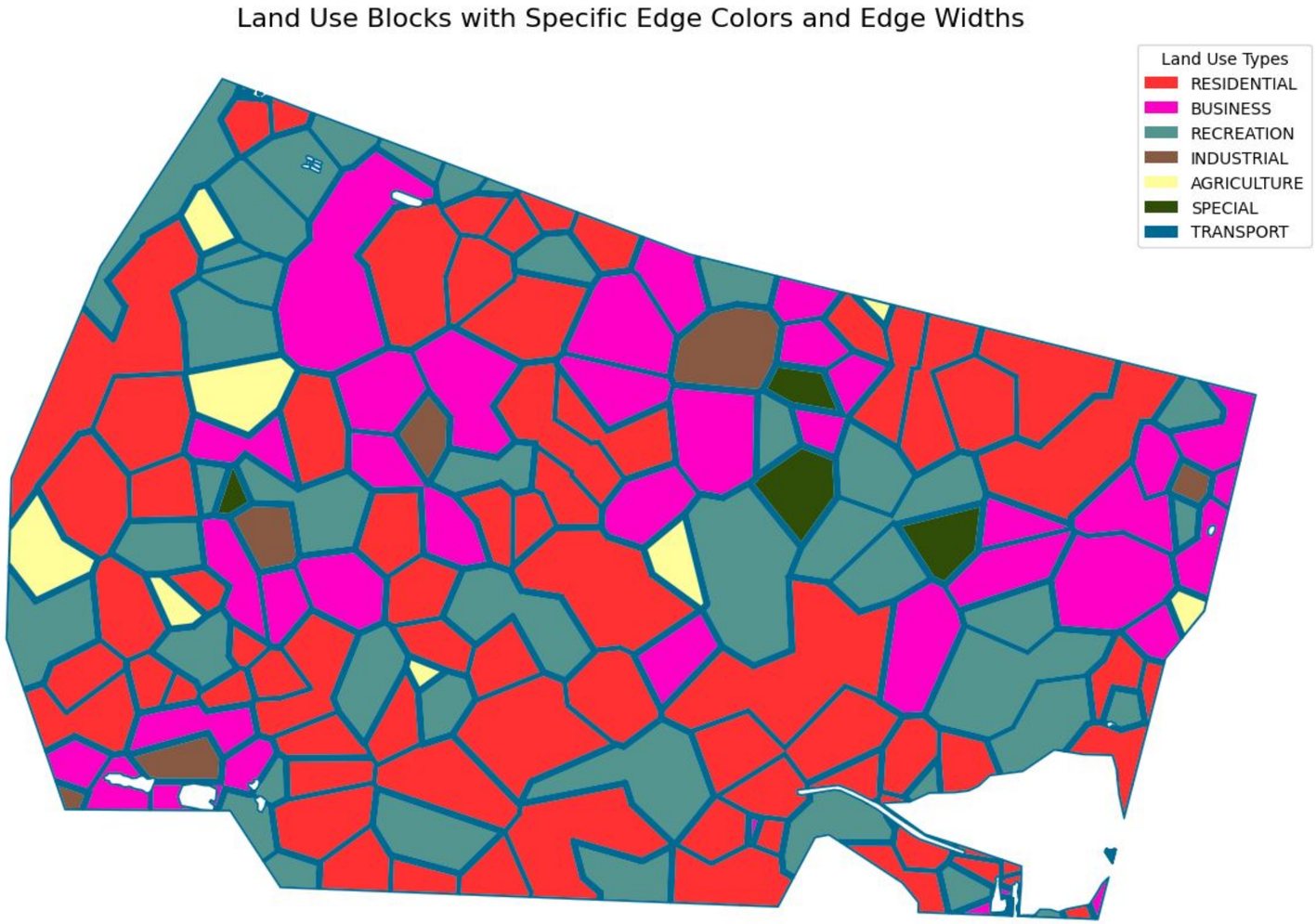


Geometry Preparation

Merged land use blocks were buffered and cleaned to ensure valid geometries for main road generation.

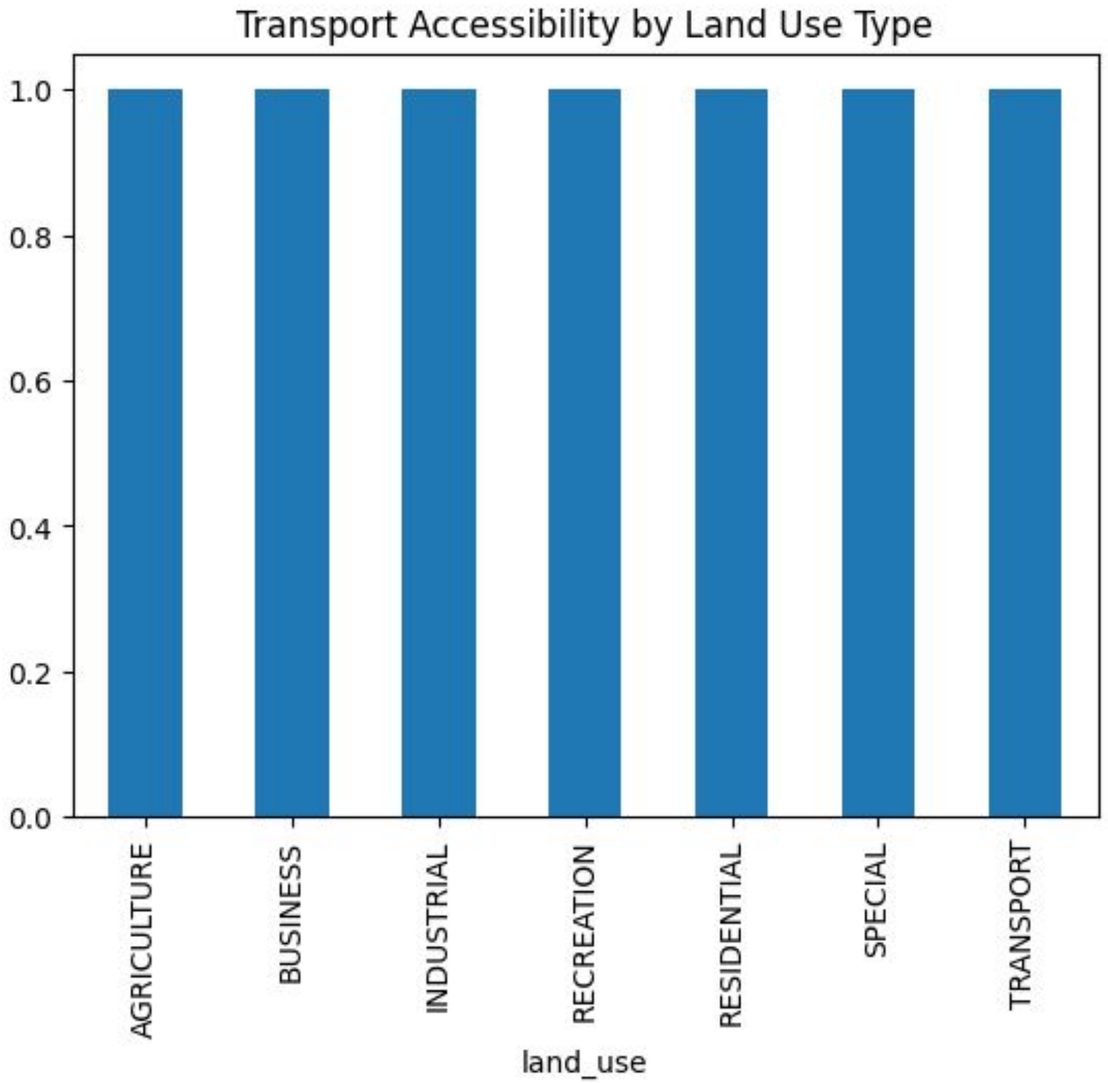
Road Network Creation

Roads were generated by buffering the blocks and extracting boundary lines.

Transport land use assigned

Roads were added as a 'TRANSPORT' category to the land use dataset through overlay operations.

Transport Accessibility



Population Calculation
Residential areas – 0.03 p/sqm, business areas – 0.01 p/sqm.
Area*density=population.
The implementation of the land use plan would lead to the increase of the population up to **72648 people**.

Road Accessibility
If the distance is < 300 meters, the block is considered to have good road accessibility.

Conclusion

What Was Done

- Optimized land use allocation for Shlisselburg using Voronoi polygons
- Assigned land use types while adhering to zoning constraints
- Analyzed transport accessibility and its impact on land use efficiency

Challenges addressed

- Improved block sizing
- Random zone allocation leading to creation of industrial zones surrounded by a bunch of residential blocks
- Avoiding incompatible neighbours and setting rules for zone adjacency
- Smoothening land use types proportions

Future Development

- Enhance algorithm adaptability to varying urban densities;
- Integrate more advanced constraints and improve transport infrastructure accuracy;
- Further development along with the BlocksNet library for advanced urban transformation analysis.

Thank you for your attention!