TOKYO SMART CITY STUDIO: KYOJIMA

Georgia Institute of Technology
Spring 2019

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ACKNOWLEDGEMENTS

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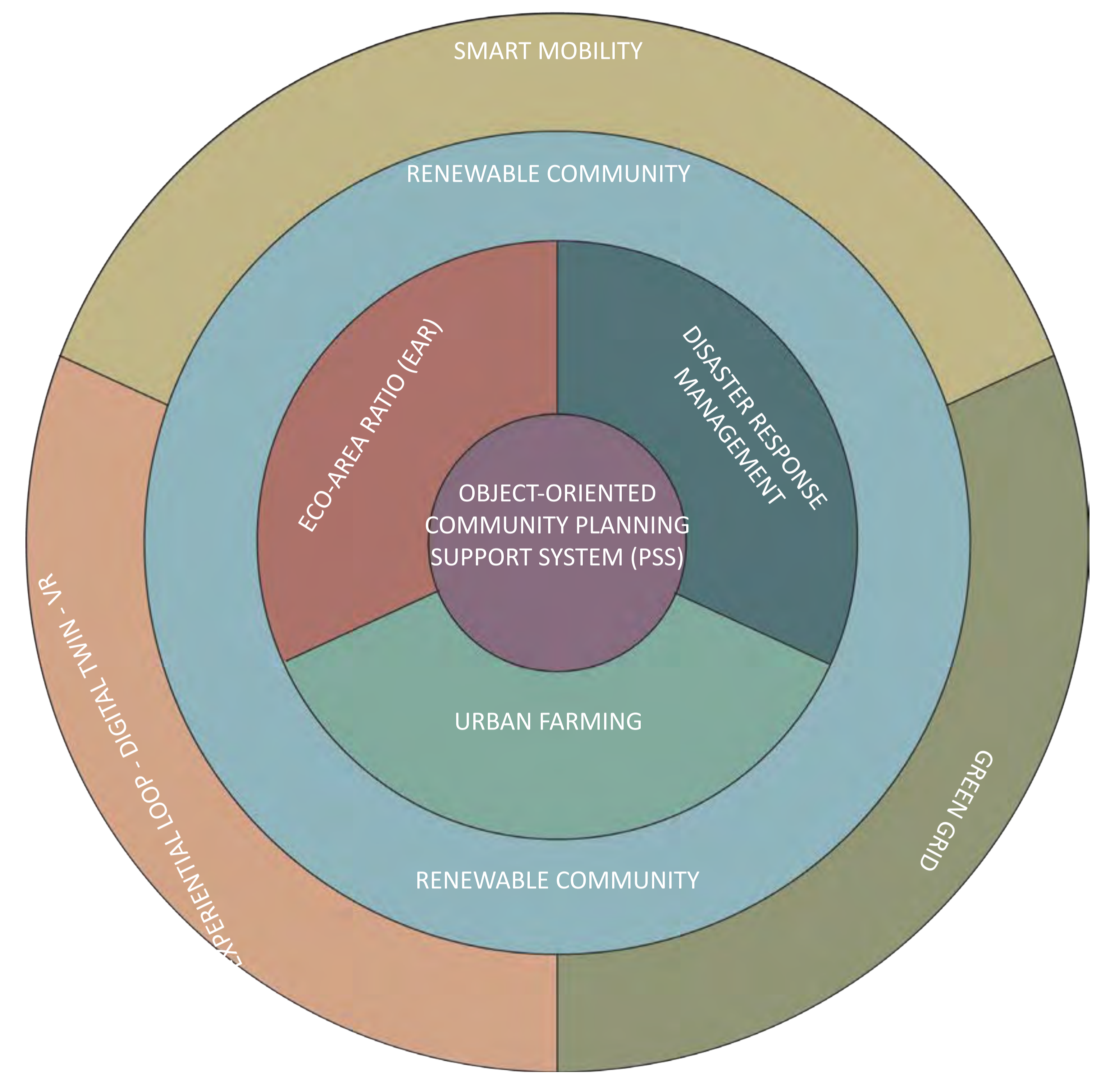
I. EXECUTIVE SUMMARY

The 2019 Tokyo Smart City studio is a semester-long project housed within the Georgia Institute of Technology (Georgia Tech) Eco Urban Lab. In collaboration with the Global Carbon Project (GCP), the National Institute for Environmental Studies of Japan (NIES), the Department of Urban Engineering of the University of Tokyo, and the University of Tsukuba, students built upon the work of the 2018 studio to address critical issues facing Kyojima.

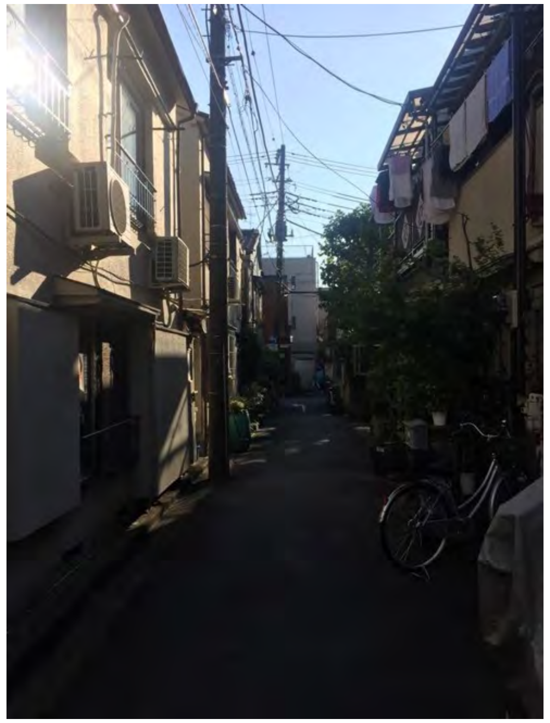
An assessment of existing conditions was conducted prior to the field visit. Figures and statistics were generated using data acquired from the NIES Core Team and other various online resources. The area of interest was divided into segments based on the appropriate scale.

The Spring Tokyo workshop was a collaborative effort among the Georgia Tech team and its sponsors. More information on the studio proess is forthcoming.



II. INTRODUCTION

Kyojima is one of Tokyo's traditional Japanese living environments. It is located in Sumida Ward in the Eastern part of Tokyo. Bordered by the Arakawa and Sumida Rivers, Sumida Ward is subject to flooding during storm events. While predominantly a dense residential area, it also houses a shopping mall, a historic shopping district, and industrial activities. The overall Kyojima population is aging, but it is expected to attract an influx of a young population due to the affordability of the housing stock. The infrastructure in Kyojima predominantly aging. The community has an older housing stock, traditional above-ground power lines, and small, narrow streets. While there have been efforts to expand the roads to allow for safety vehicles to enter the community, this has been a slow process.



The spatial organization of Kyojima makes it an area of concern. In the case of flooding, fire or earthquake, the safety of neighborhood residents is at risk. With new developments and rebuilding of single-family houses, this is an opportune time to propose a master plan that mitigates safety concerns, integrates technology, and retains the historic character of Kyojima.

II. a. OBJECTIVES

The Core Team objectives are as follows:

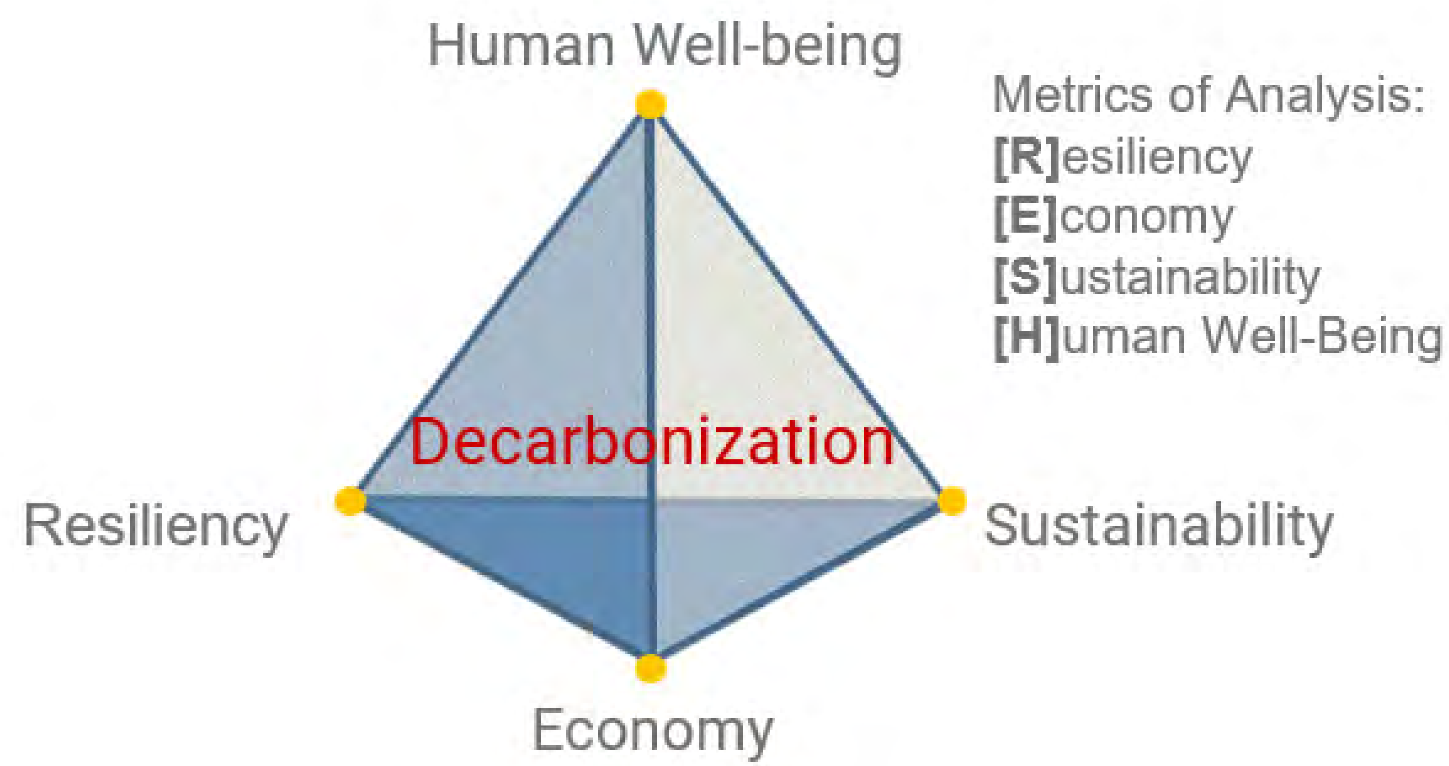
1. Development of a smart mobility system, addressing mobility as service

2. Examining the building and transportation nexus

3. Creation of green grid strategies and methods to serve buildings and communities

4. Utilizing data for facilitating human based decisions with

The larger mission of this project is to understand how to reform performance-driven smart and resilient urban systems that respond to experiential conditions under decarbonization constraints, while also maintaining a respect for the existing cummunity and general human-well-being.



II. b. STUDIO PROCESS

CORE TEAM [CT] – NIES, University of Tokyo, and Akito-san

In charge of observational data and controlling the central databases. Set to examine the core research question in depth, primary function is research and support of Studio Team:

- Observation (Data + Data Analysis)
- Modeling (Baseline + Future)

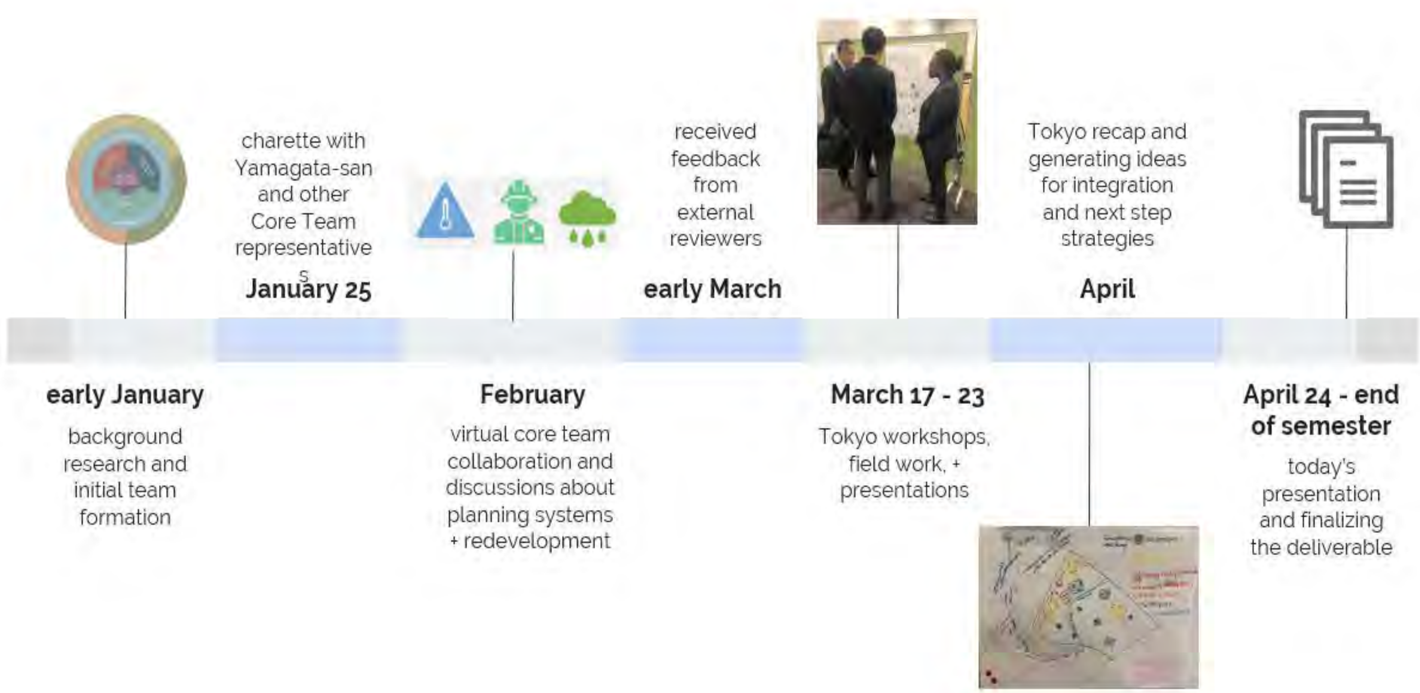
ADDITIONAL CORE TEAM [AC] – Helen, Nirvik, and Perry

Additional staff from GT who's expertise directly facilitates the primary research objective. Focused on aiding in procedural generation and future modeling potential:

- Change (Procedural)
- Modeling (Future)

STUDIO TEAM [S] – Studio Members

Studio members who focus more on design and research intuition than running the entire complex modeling. Set around research and design to propose a new scenario for the area.



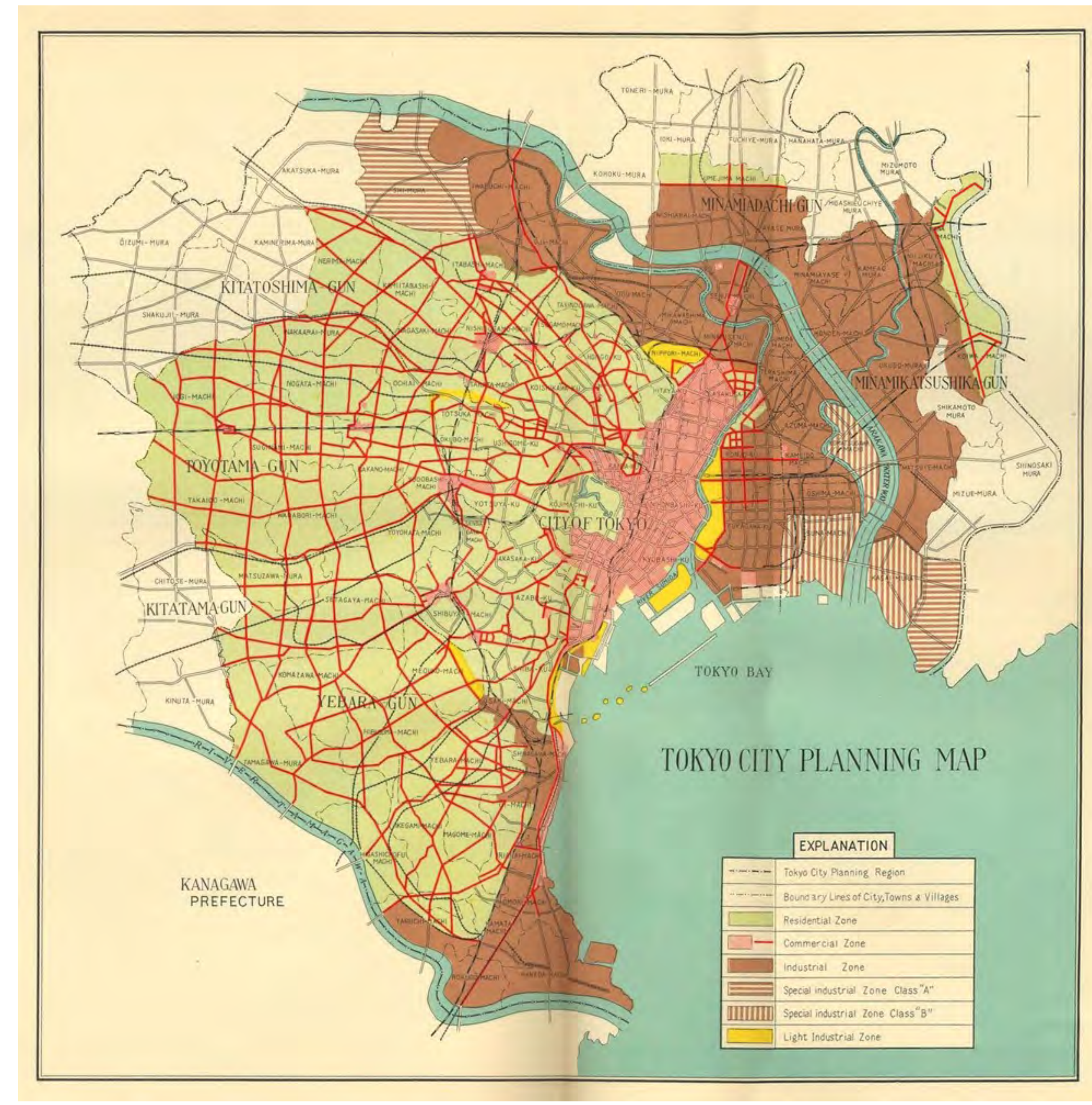
Georgia Tech's role in this project is to **research** and develop **design** strategies that support the overall mission. As such, we divided ourselves into seven different groups based on individual interest:

[1a] Mobility
[1b] Experiential
[1c] Green Grid
[2a] Renewable Communities
[2b] Renewable Communities Design
[2c] Urban Farming
[3] Planning Support System

III. HISTORICAL MOVEMENT

The great Kanto Earthquake of 1923 devastated Tokyo through the quake destruction and ensuing fire. The government undertook a 6-year process to readjust and reconstruct the land in Tokyo. Some politicians proposed to build a new city, that considered the health, hygiene, and comfort and sensibilities of future residents. However, while many residents moved from Shitamachi lowland area to western hills of Yamanote, the contention of the existing residents and businesses was to return to normalcy in their old locations rather than a complete overhaul. In the rationalization of land lots, open spaces between buildings (hiyokechi) were created as firebreaks and evacuation points, which also serve as community parks and playgrounds.

At the time, North Sumida was outside of the jurisdiction of Tokyo City and mostly agricultural land and was therefore outside of the reconstruction efforts in Tokyo. Map showing Administrative Zone from the period – What districts that now comprise N Sumida were outside of the urban planning area, but considered part of Greater Tokyo.



Zoning plan from the period –
notice Sumida is zoned industrial

III. HISTORICAL MOVEMENT

After World War II, Tokyo's population dropped by 50% from 1940 levels to 3.49 million when the government surrendered. Much of the city was destroyed in the bombings.

In 1947, the Tokyo adopted the Metropolis governing system with 23-wards.

Initially, shortage of materials limited adequate reconstruction and simple wooden buildings were instead erected on the old sites; however, during the Korean War in the early 1950s, American investment in Japan's industry as a strategic base helped stimulate rapid economic growth and population influx to major cities like Tokyo.

Adoption of Western planning principles and major change of urban environment were difficult due to extant land ownership laws, excessive lot division, and weakness of planning powers, which are prevalent and visible throughout the neighborhood.

With a growing population and increased personal automobile ownership, congestion and sprawl became major issues faced by officials and planners of the time.

Infrastructure redevelopment efforts were sped up in the late 1950s to prepare for 1964 Olympic Games. The Japan Highway Public Corporation was established to build a network of roads and elevated expressways to support the growing personal automobile on the roads. The government poured large investments into physical infrastructure: highways, trains (shinkansen), airports, buildings, stadiums, and hotels. Space below elevated expressways was utilized as leasable storefront space, which evolved into a thriving shopping area. Elevated expressway construction over old canals resulted in the loss of many traditional industries and local residents and businesses protested against it.

III. HISTORICAL MOVEMENT

1945, bank and bridge over Sumida River

2008, Tokyo Skytree is the new icon overlooking Sumida River and the restored bridge

III. HISTORICAL MOVEMENT

After long period of depression after the oil crisis, the government relaxed regulations and sold state-owned or public-owned land for large-scale redevelopment projects by private companies in 1986.

The boom halted with the recession in the 1990s and was then rekindled in the 2000s.

The rise of 'smart cities' is quickly changing the ways in which urban planners and designers solve urban problems. The theoretical framework of urban metabolism was historically limited by the lack of data as well as simulation and visualization tools, which made the implementation of design ideas informed by metabolism difficult for everyday practitioners at the neighborhood level. Recent advancements in information and communication technologies (ICT) are changing this. The increasing availability of sensors with real-time wireless communication in devices, buildings, and urban environments can now provide a basis for modeling metabolic processes occurring in our cities. Spatial data coupled with visualization allows planners and designers to rethink how energy and material flow can be optimized at the neighborhood level. The data is available at a scale that enables more sophisticated insights into metabolic processes.

In some cases, Smart City initiatives have been largely confined to routine task optimization and coordination, as well as the installation of sensors that monitor pollution and ambient air temperatures. Although such advancements are positive, they have contributed to the perception of Smart Cities as technocratic and hyped. Nevertheless, there is considerable support for Smart Cities as a driver for economic development and more importantly climate change action, if used purposefully and with strategic intentions.

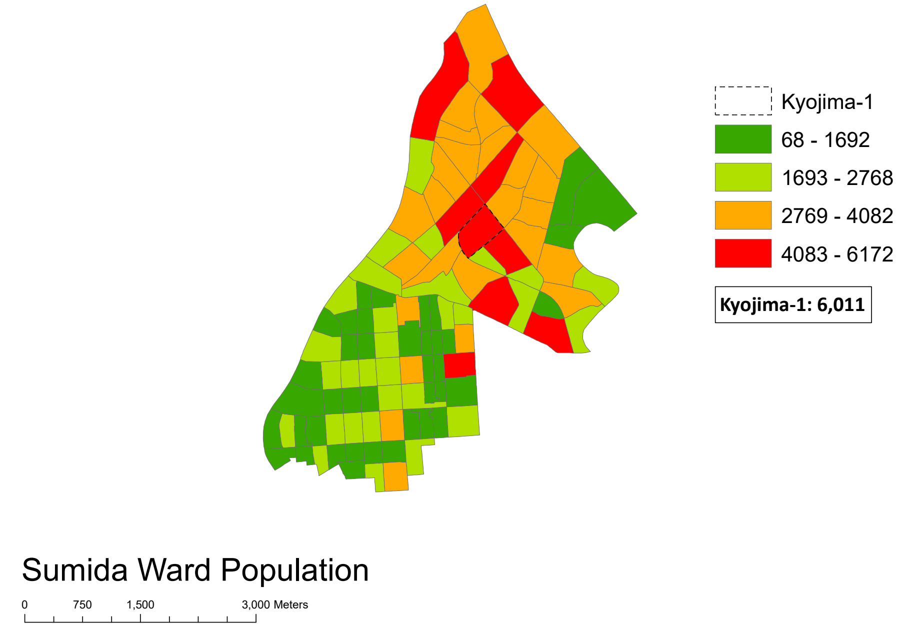
Major capabilities of smart cities:

- Measuring and mining data
- Visualizing flows in networks
- Coordinating tasks and projects
- Connecting citizens

Source: Batty, M. 2013, The future cities agenda, in Environment and Planning B: Planning and Design, 40 191-194.

IV. EXISTING CONDITIONS

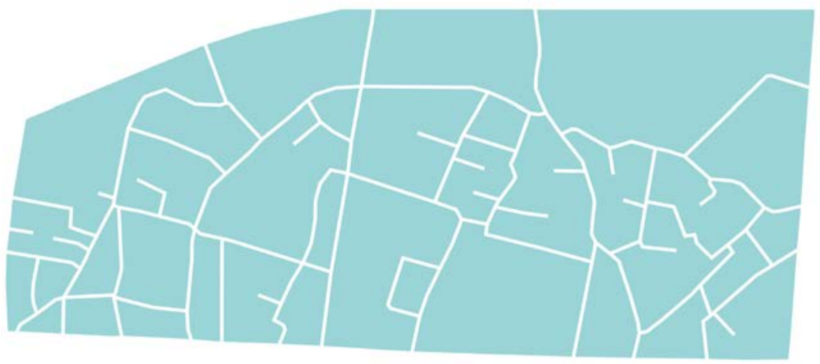
Japan's location on a tectonically active plate inherently poses many natural hazards, from earthquakes to tsunamis. In addition to the larger-scale problems, Kyojima is highly subject to secondary hazards, such as fires and flooding as a result of earthquakes, tsunamis, as well as its position between two major rivers. Approximately 1.5 million people live below sea level near the Arakawa River. Kyojima has thus been dubbed the "epicenter of disaster risk" by multiple news outlets. Greenspace in the area is sparse.



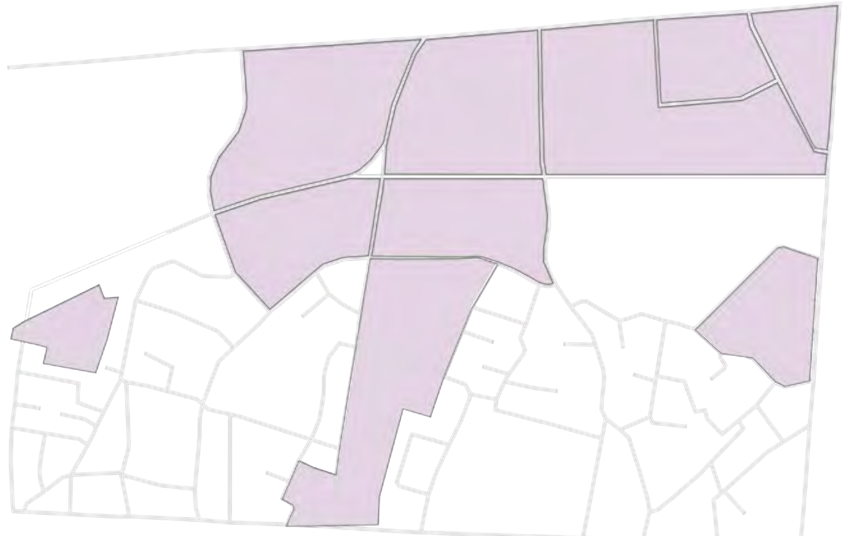
Kyojima is dominated by elderly residents, many of whom have lingering health problems; however, young people are unexpectedly moving to the area due to its cheap costs. All residents aware of the risks of inhabiting the area, but cultural attitudes and nostalgia stymie government-led disaster prevention efforts. Furthermore, the confusing system of property ownership makes it difficult to initiate redevelopment. Even so, Kyojima hosts a tight-knit community due to the risks of living there – they protect each other.

Wooden *nagaya* (tenement houses) built between 1923-1960 are prevalent in Kyojima. This, combined with the narrow streetscape, poses a threat to the safety of its residents. The government suggested building replacement in the early 1970s due to wide-spread fires and the lack of access for emergency vehicles, but locals resisted. In the 1980s, the government adopted more incremental tactics, including the widening of roads, installation of emergency underground water storage tanks, and training of community leaders.

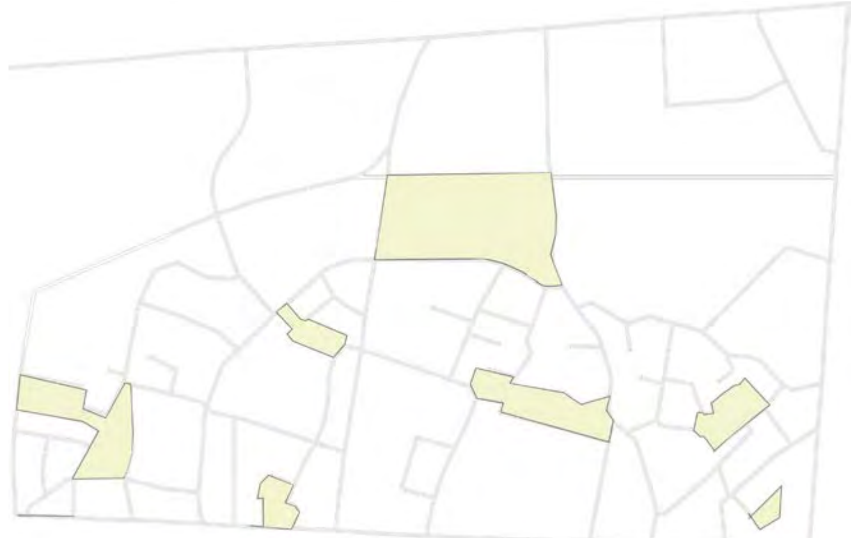
IV. EXISTING CONDITIONS



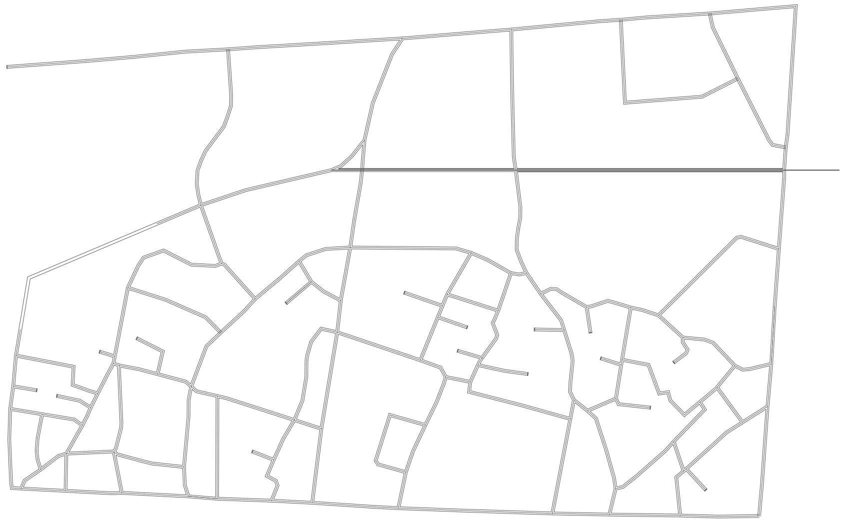
existing block network



existing new (recent) development



opportunity zones



existing street network

parking lots

V. GEORGIA TECH INDIVIDUAL PROPOSALS

1. Smart Mobility
    1a. Network + People Flow
    1b. Experiential Loop/Digital Twin
    1c. Green Grid
2. Renewable Communities
    2a. Renewable Community Redevelopment
    2b. Renewable Community Design
    2c. Urban Farming
3. Object-Oriented Smart-Community Planning Support System

I. SMART MOBILITY

1a. Network + People Flow
- i. Existing Conditions
- ii. Mobility Framework
- iii. Motorized Mode Split Analyses
- iv. Walking
- v. Disaster Impacts on Transportation
- vi. Pedestrian Experience Planning

1b. Experiential Loop/Digital Twin

1c. Green Grid

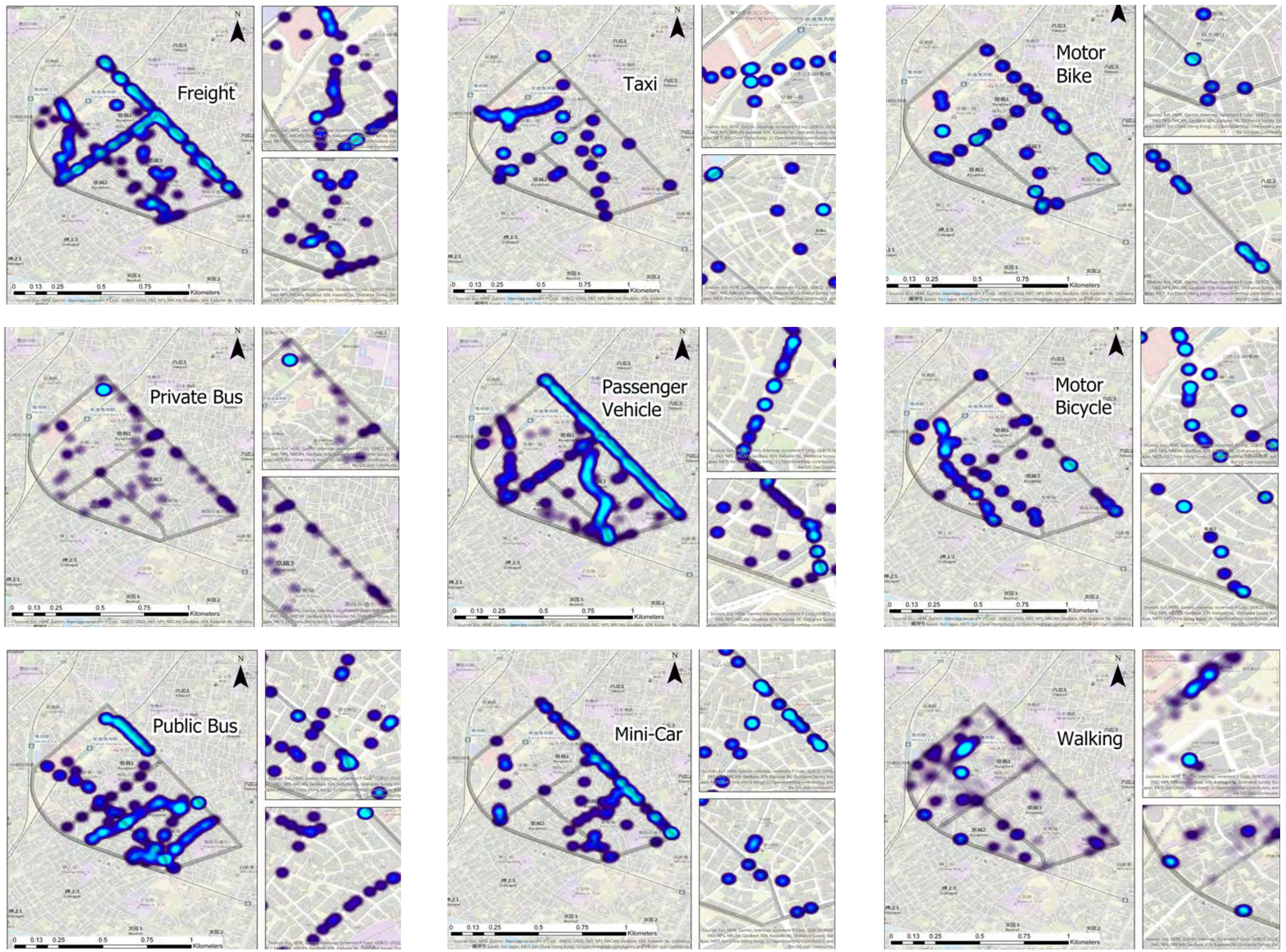
Principles of Smart Mobility

1. **Flexibility**: Multiple modes of transportation allow travellers to choose which ones work best for a given situation.
2. **Efficiency**: The trip gets the traveller to their destination with minimal disruption and in as little time as possible.
3. **Integration**: The full route is planned door-to-door, regardless of which modes of transportation are used.
4. **Clean Technology**: Transportation moves away from pollution-causing vehicles to zero-emission ones.
5. **Safety**: Fatalities and injuries are drastically reduced.

A major goal for Kyojima is making the best use of the existing transportation network, land use and infrastructure to meet smart city and smart mobility requirements. To this end, examining both trip purpose and time of day associated with GPS points locations can be used to identify:

- activity hubs for specific modes
- time of day associated with mode type frequency
- potential traffic and safety issues based on multimodal congestion
- potential connectivity issues in the network
- opportunities to plan for increased efficiency, connectivity, and best mode options and multi-modal linkages

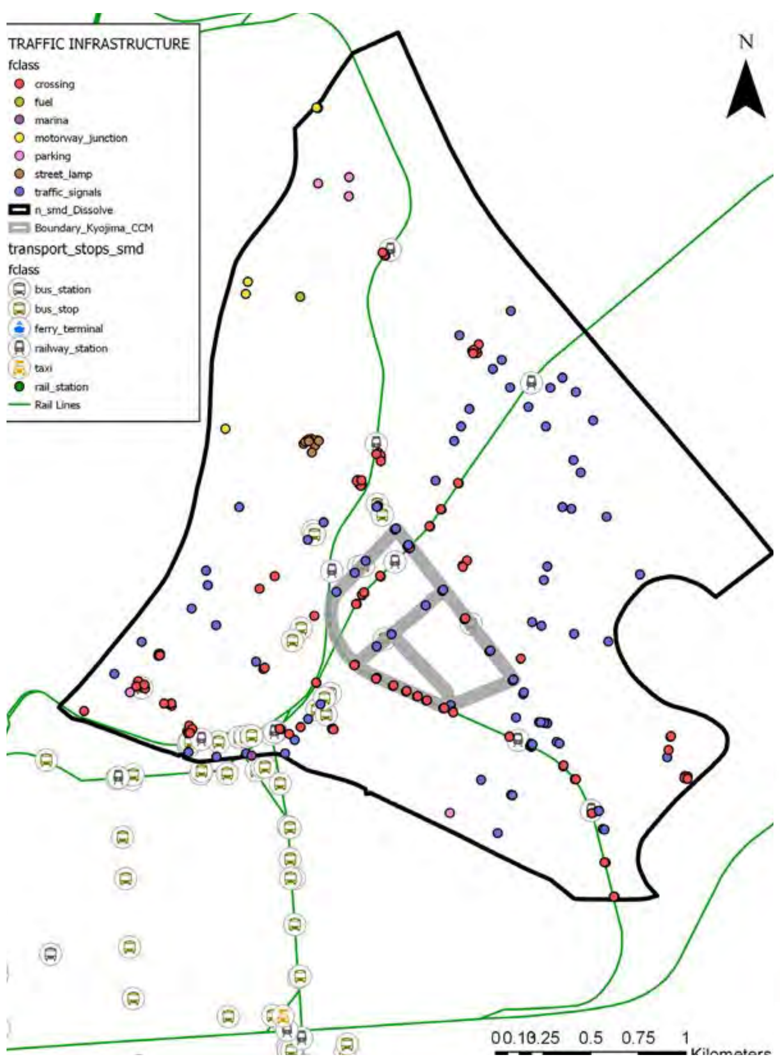
1a. i. Existing Conditions



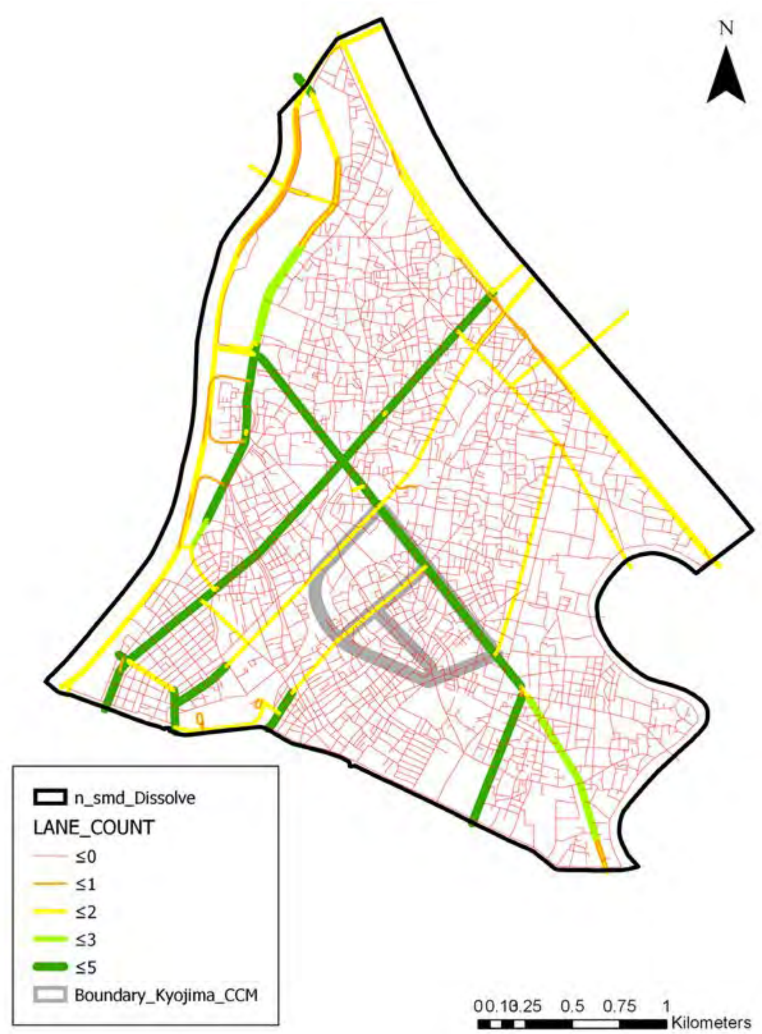
Existing Transportation Modes + Prevalence of Use

These maps depict a general density of points based on mode type, derived from GPS points provided by the core team. Cyan indicates high-density of mode presence while dark purple indicates a lesser density of mode presence. Inset maps depict zoomed-in intersections of denser point prevalence. Future analyses will include mode frequency by time-of-day.

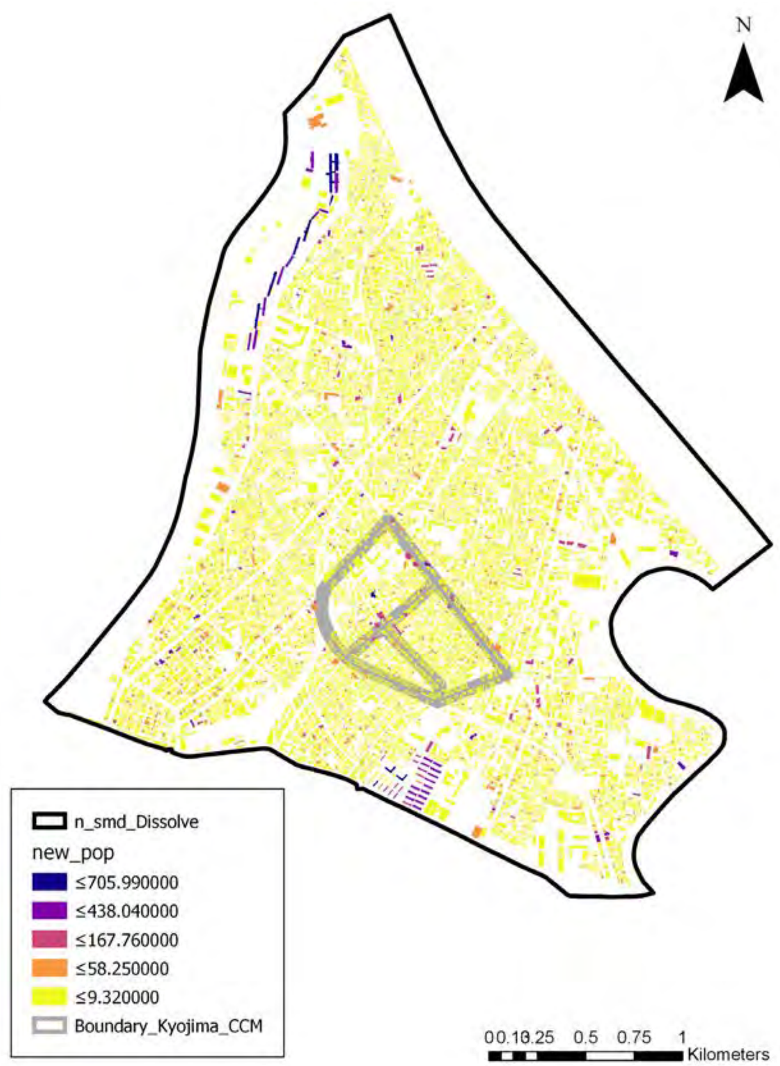
1a. i. Existing Conditions



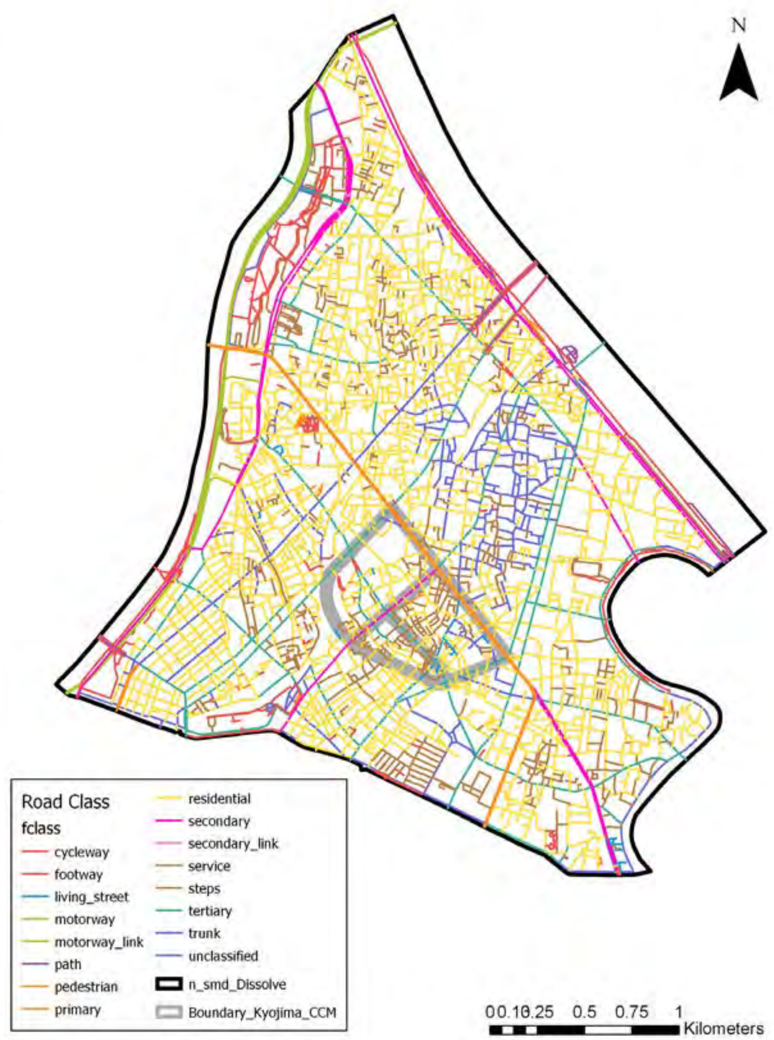
transit



road width by lane count

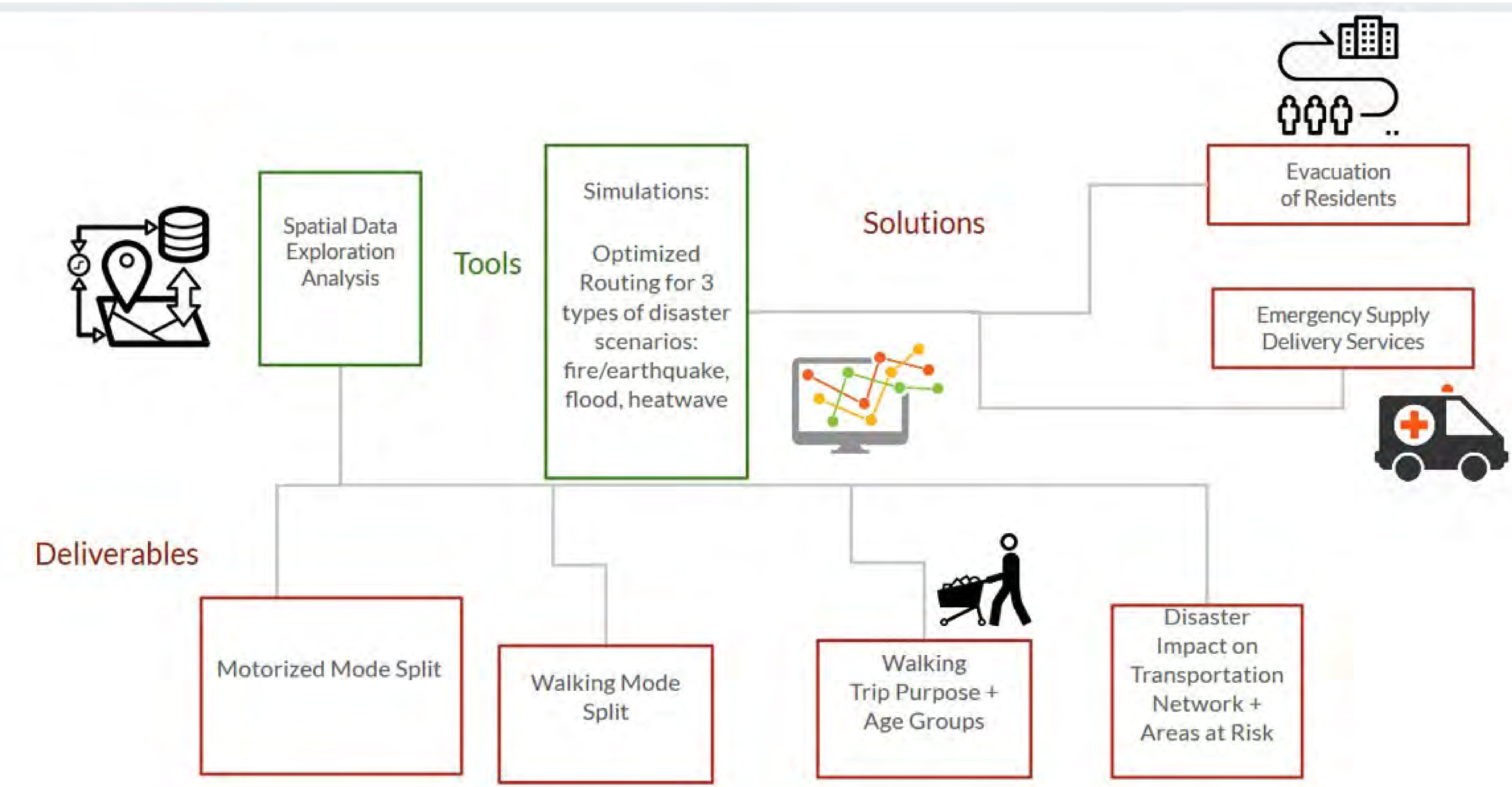


building population

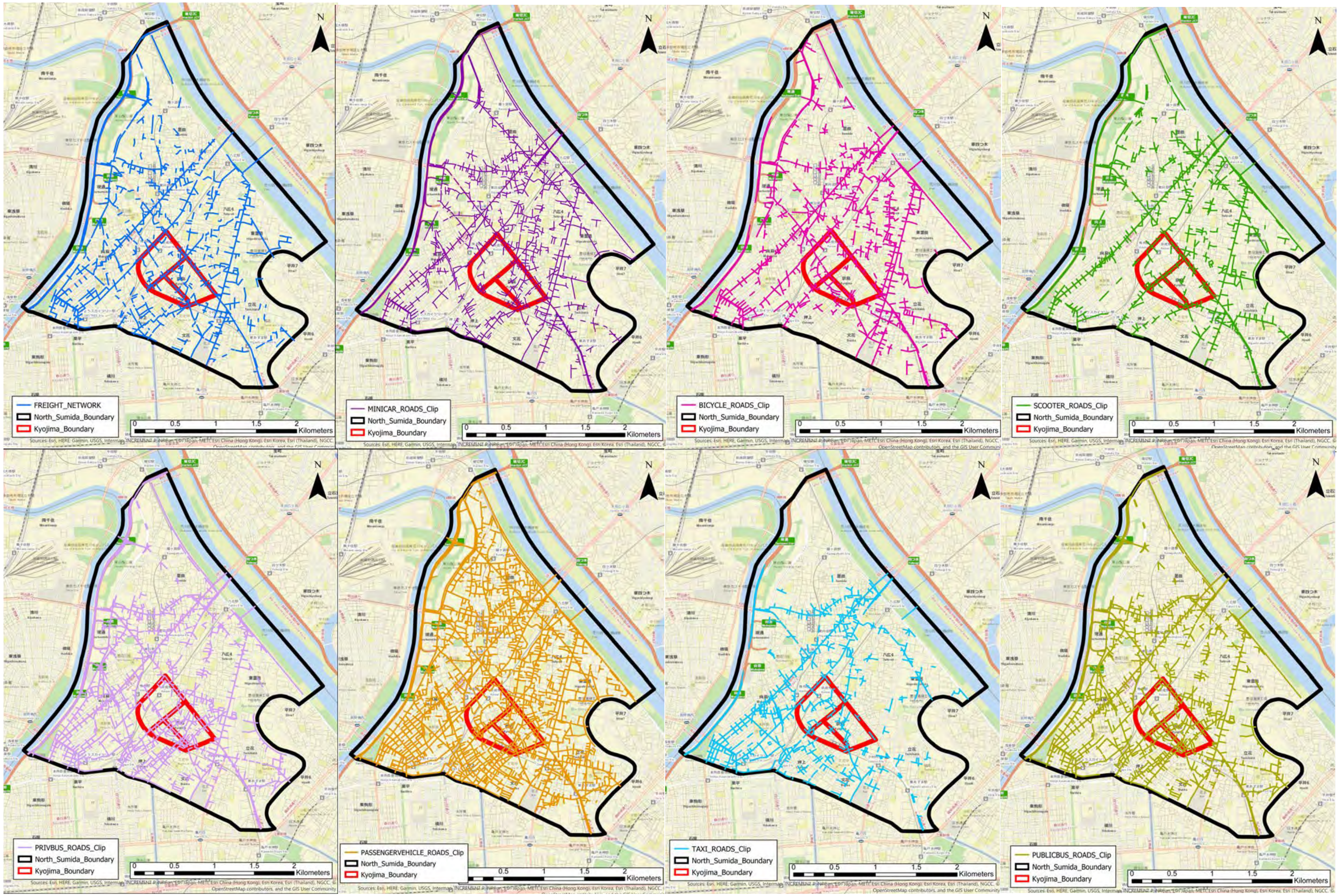


road classification

1a. ii. mobility framework



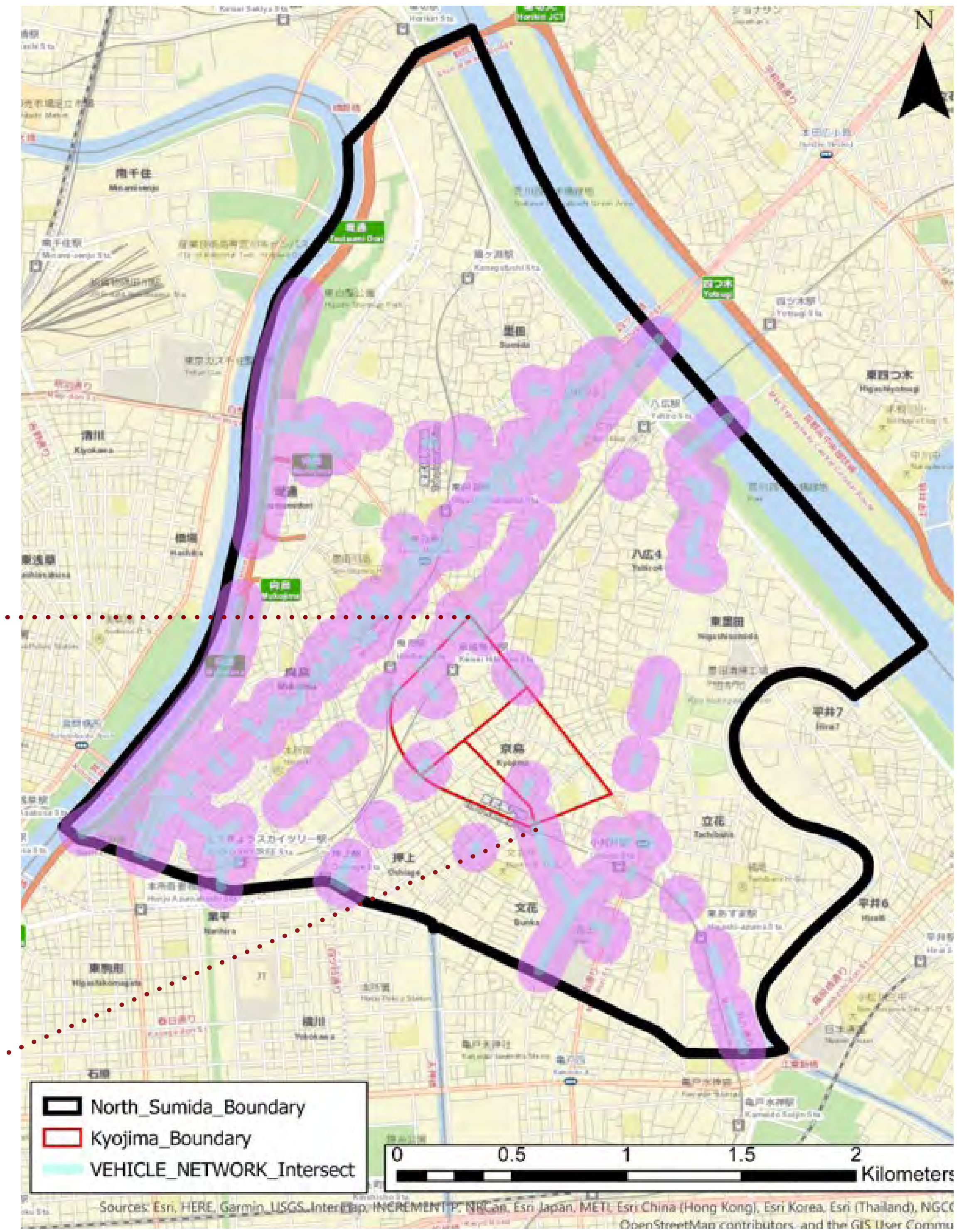
1a. iii. motorized mode split analyses

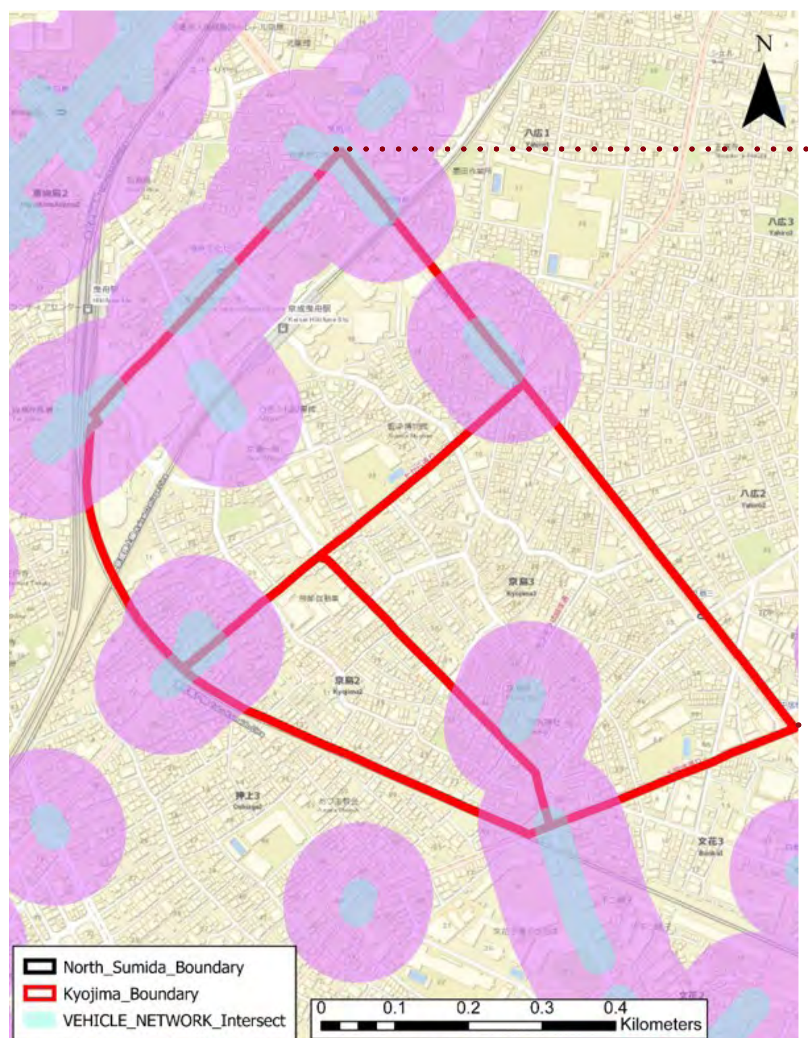


These maps show the roads utilized by all types vehicles in North Sumida, using data collected from the GPS database.

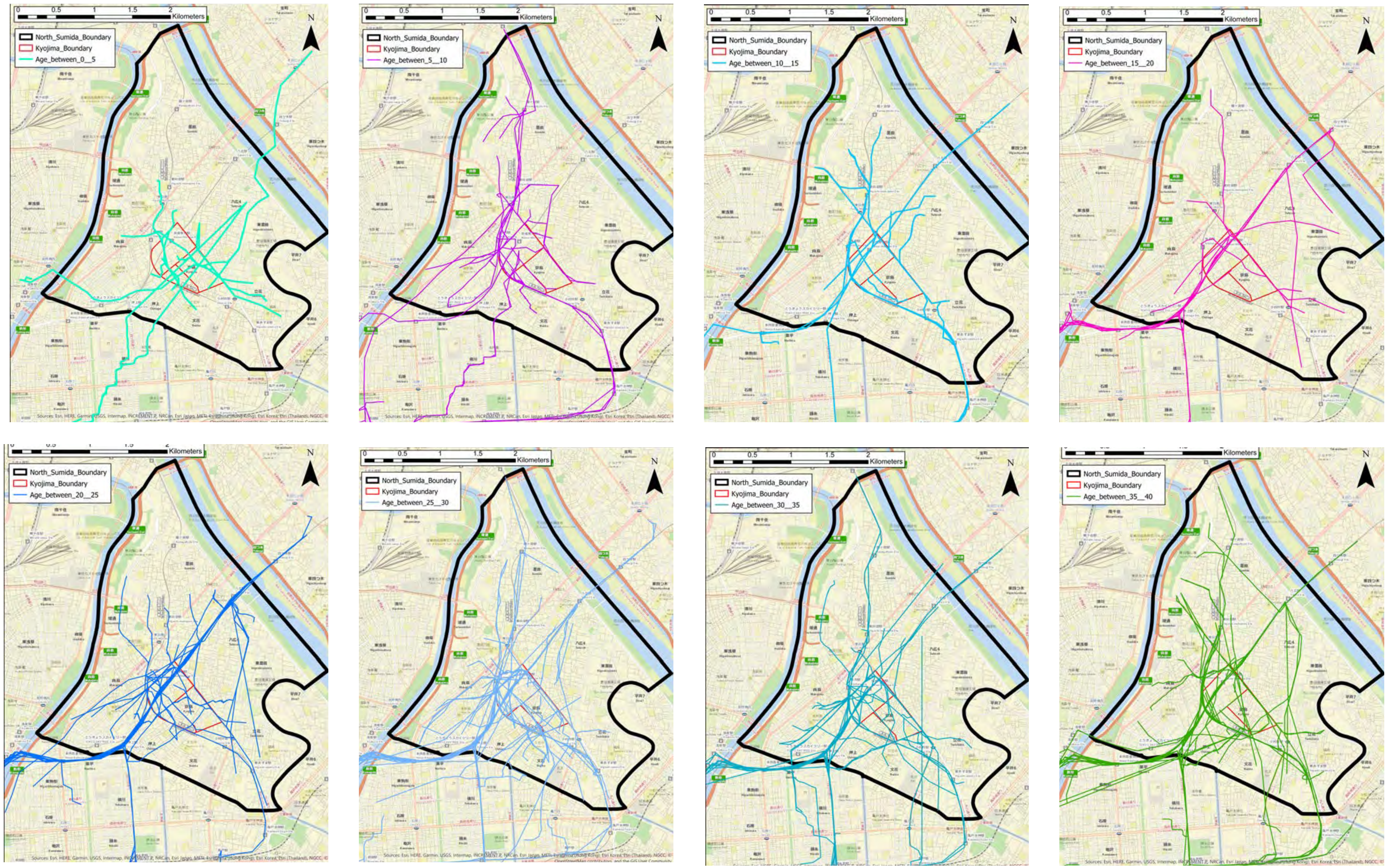
1a. iii. motorized multi-modal intersections

These maps show the convergence or intersection of paths used by all motorized vehicles. These intersections are problematic because of the congestion and safety hazards produced by the presence of so many different types of vehicles. Highlighted in the map is a standard 20m pedestrian walking buffer along with a 100m pedestrian walking buffer. Infrastructure updates along these intersections and within the buffer zones should be more pedestrian-friendly.





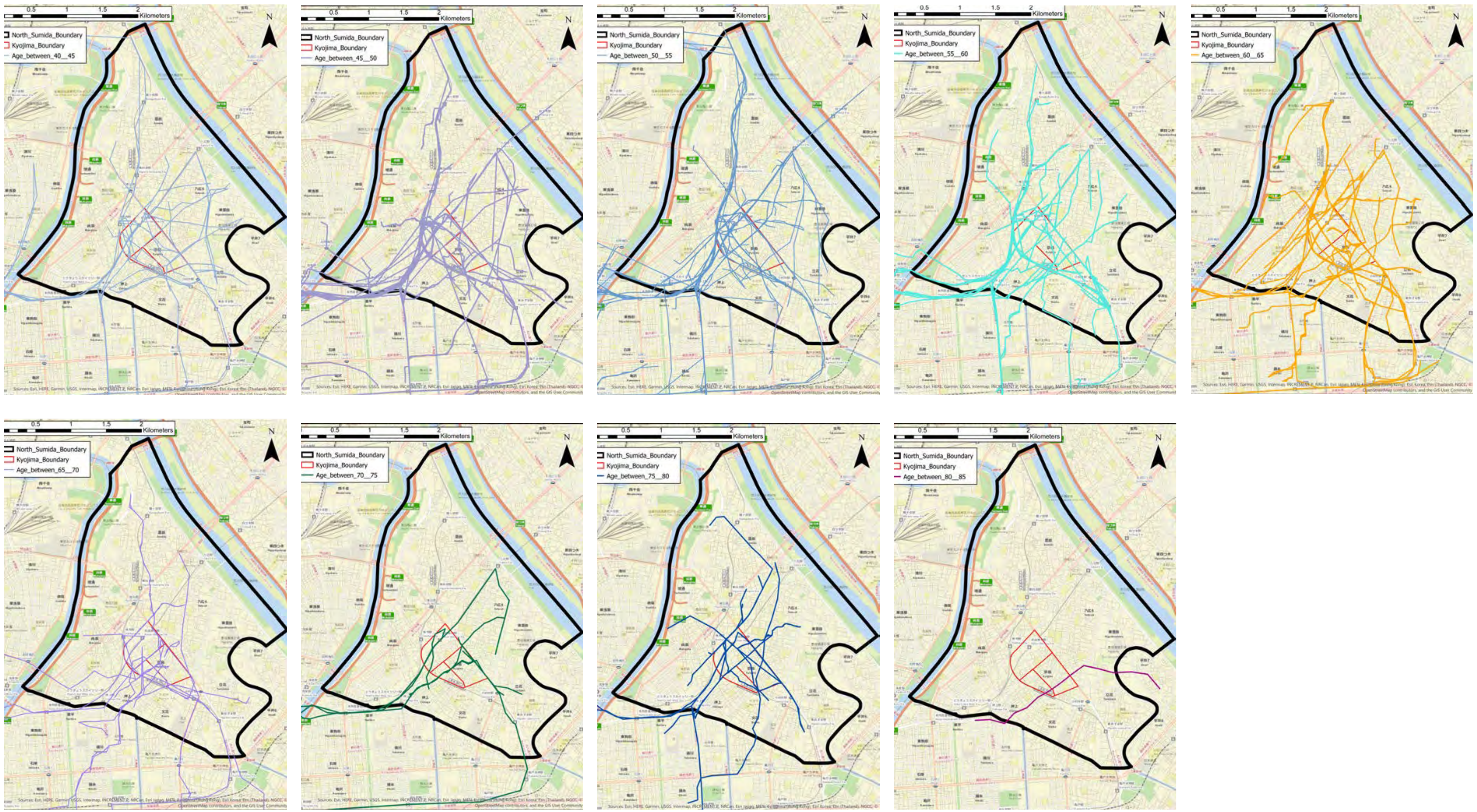
1a. iv. walking, age groups



These maps show the routes of various age groups of survey participants. One insight gathered from this analysis was that most people, despite age, utilize the train tracks as their primary walk path. However, participants in the age 70-75 bracket do not follow this pattern and in fact take shorter, linear, more direct paths to get where they need to go.

1a. iv. walking, age groups

This means that the elderly need more amenities planned near their homes so that they do not need to walk so far. Furthermore, more investment should be directed toward paths along the train tracks since most people walk there.



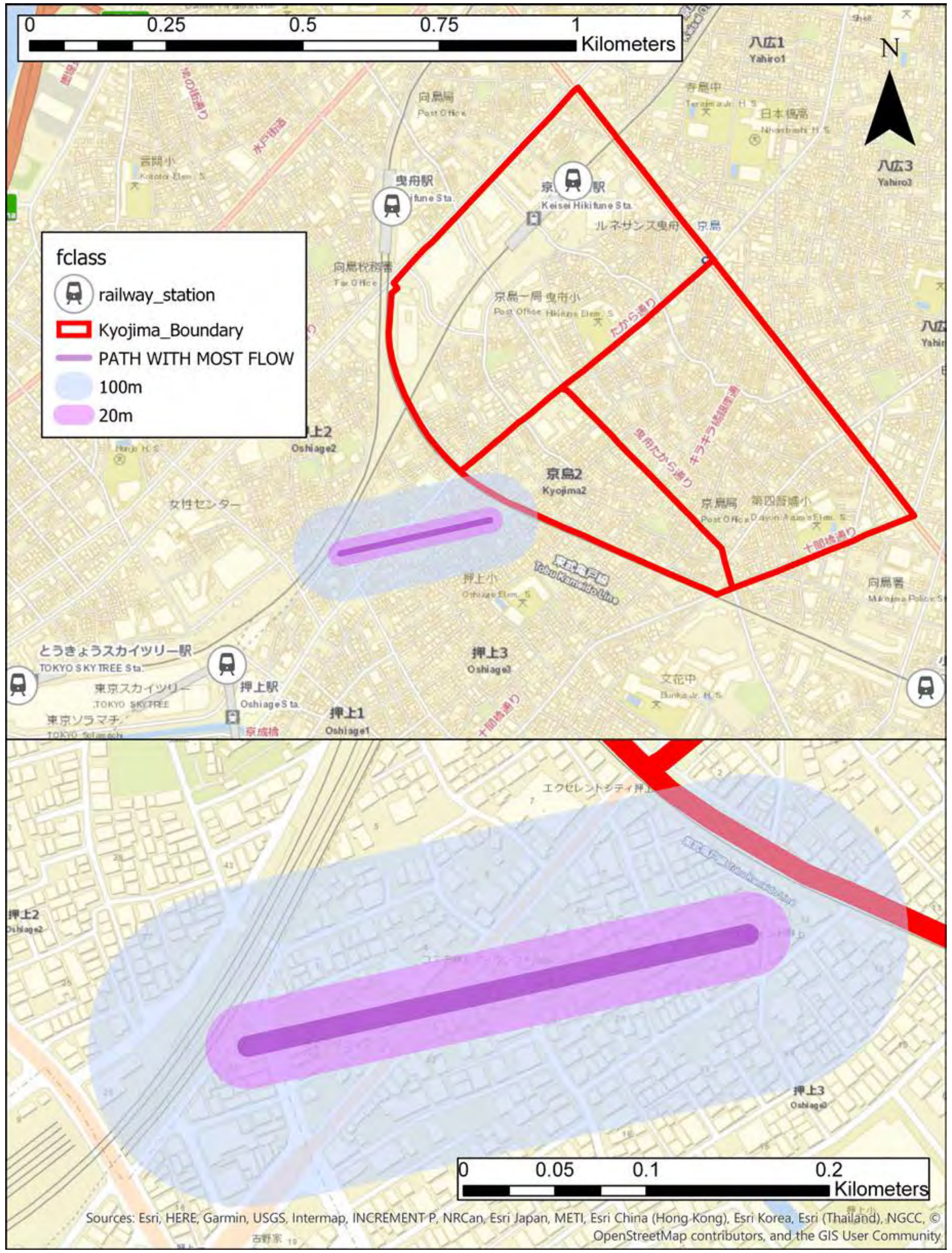
1a. iv. walking, trip purpose

Patterns visualized here for walking pedestrians illustrate common walk flows throughout North Sumida Ward, based on trip purpose. From our analyses, it was observed that most people pass through this area on their way home and live in this heavily residential ward. Most people (in this survey) walk along the railroad tracks and generally do not approach the waterfront areas of the ward.

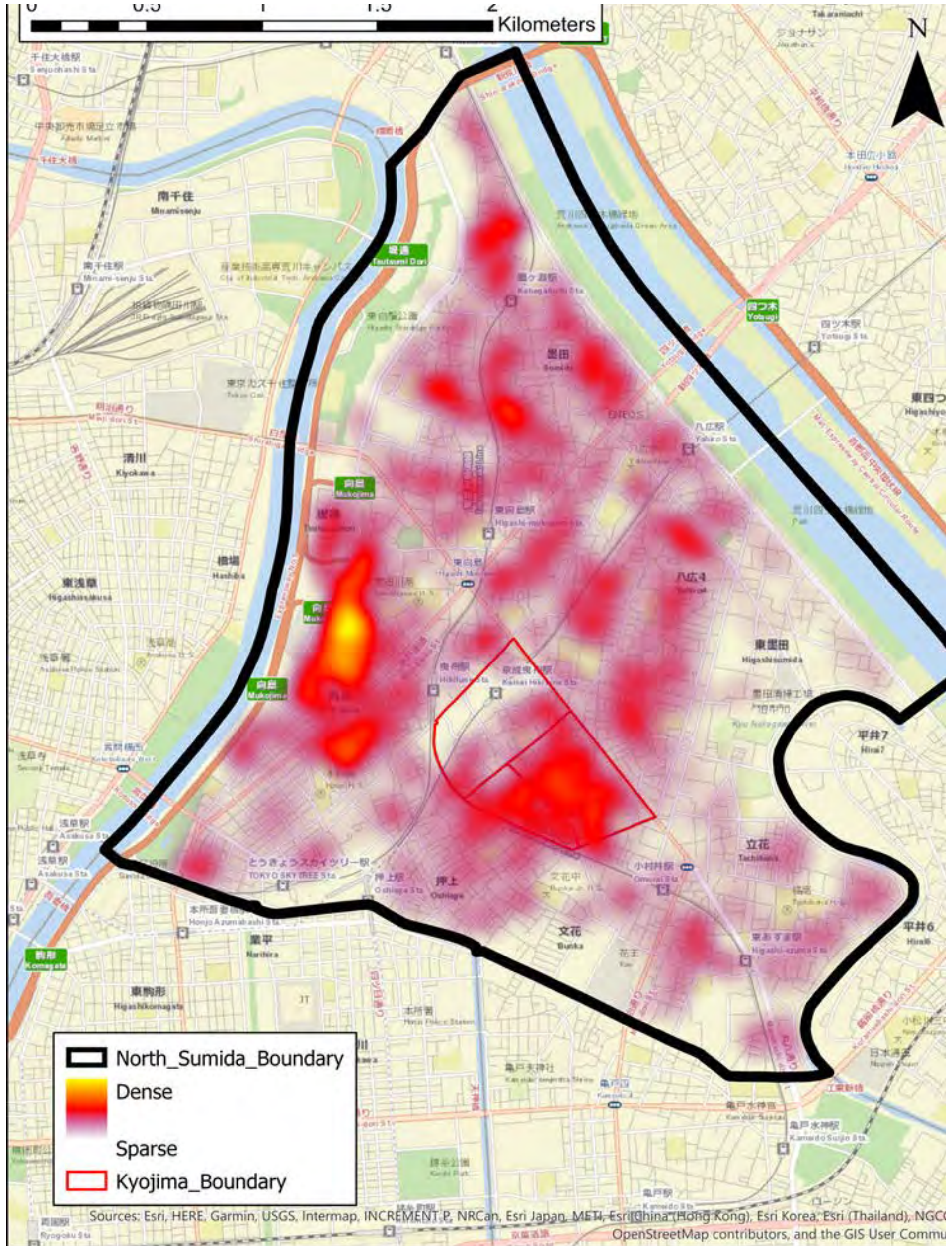
1a. v. walking

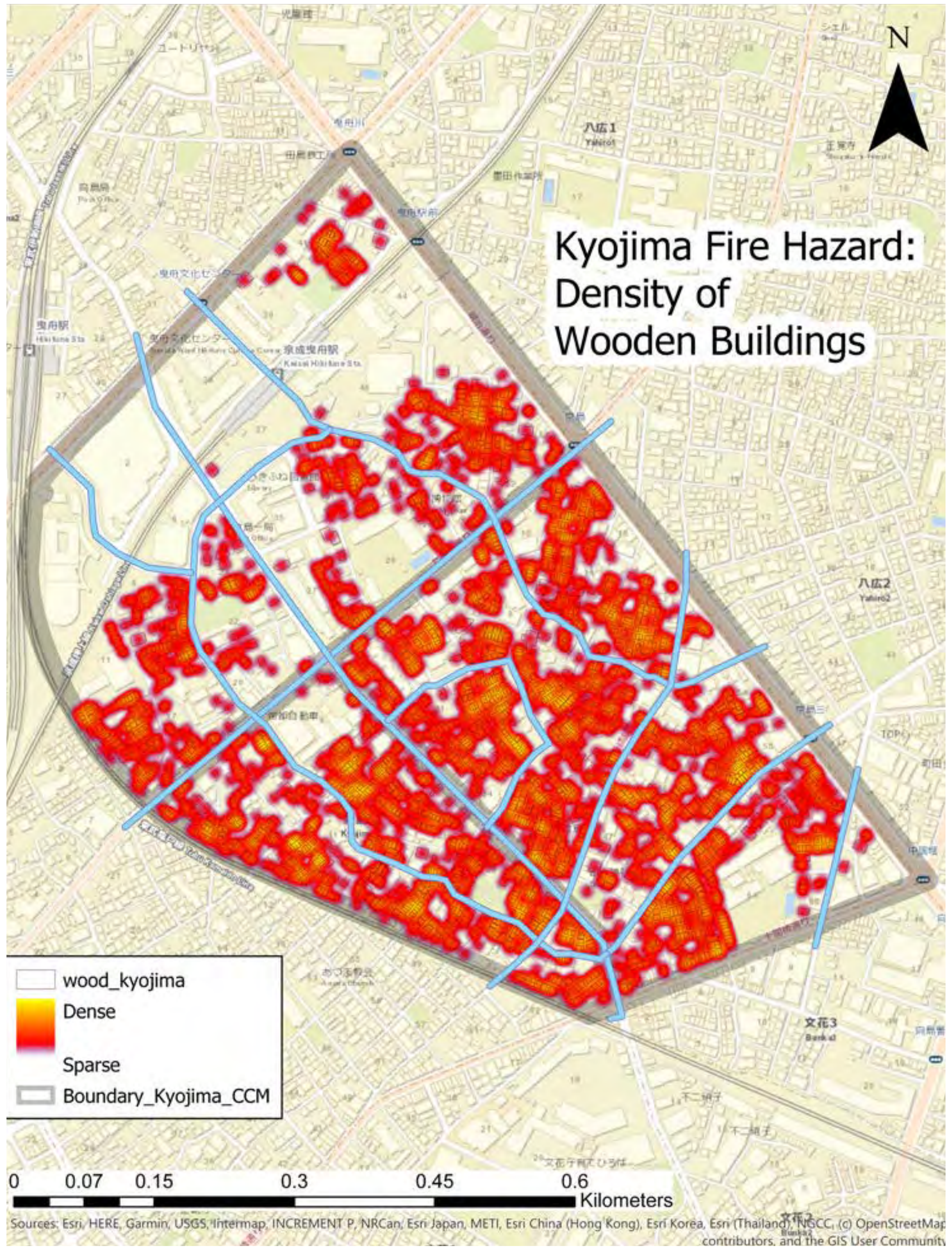
This is the intersection of most survey takers' paths despite age, gender, occupation or trip purpose. The analysis shows that this corridor is essentially the "heart" or "center" of North Sumida and very near the primary entrance to the Kyojima neighborhood. In addition, this corridor matches the proposed path linking the heavy pedestrian traffic area around Tokyo Skytree, with the Kyojima neighborhood.

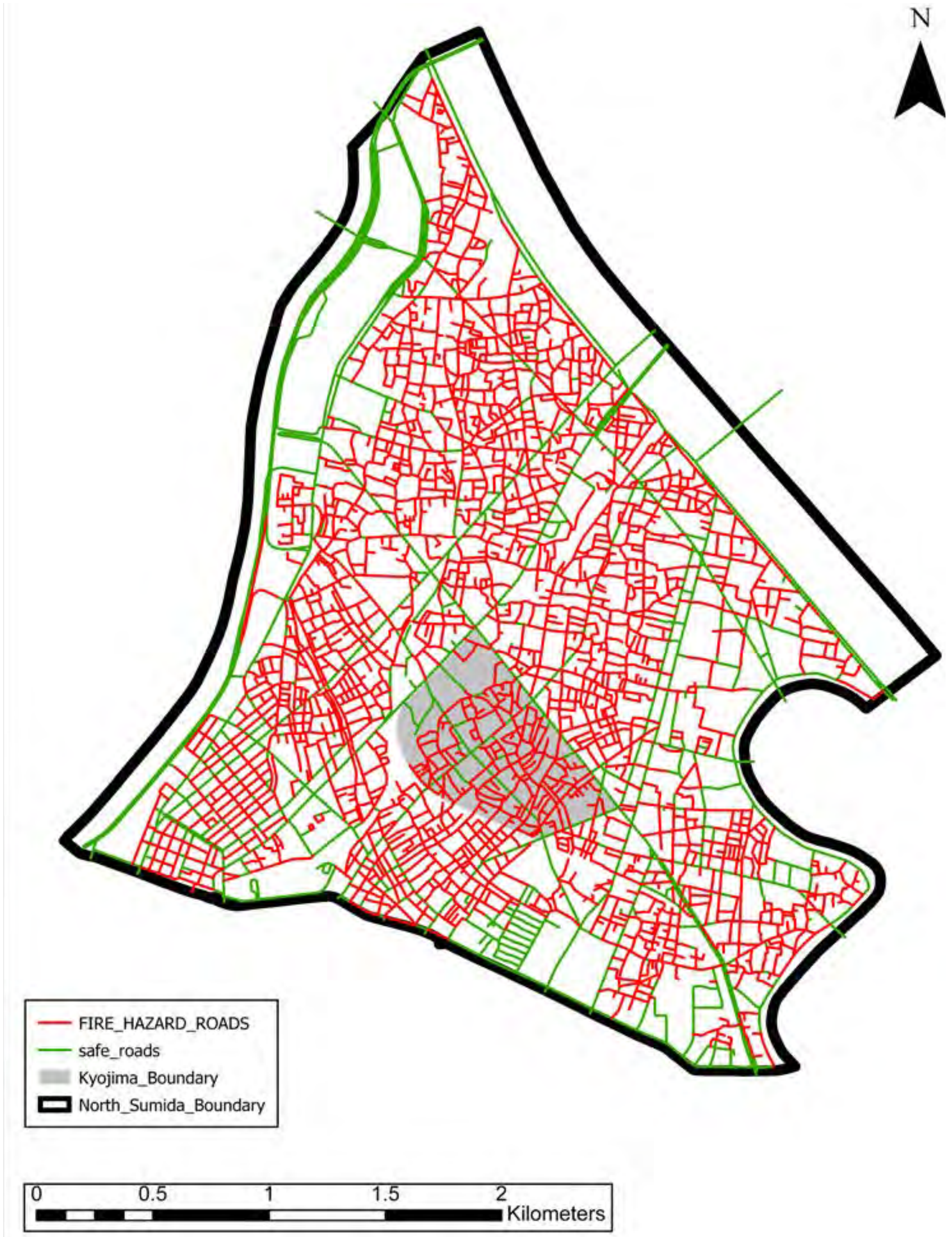
Highlighted in the map is a standard 20m pedestrian walking buffer along with a 100m pedestrian walking buffer.



1a. v. Disaster Impact on Transportation: fire/earthquake

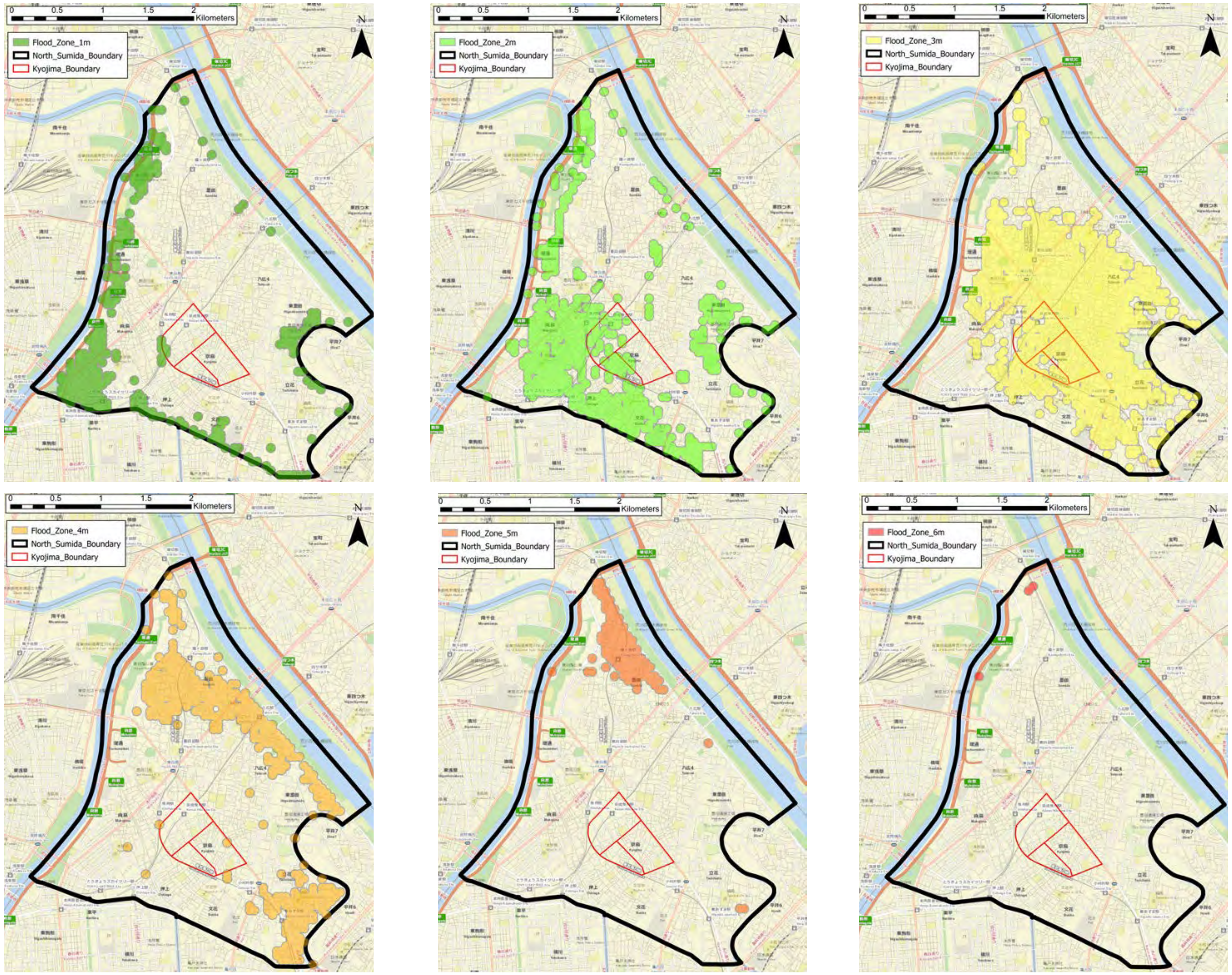






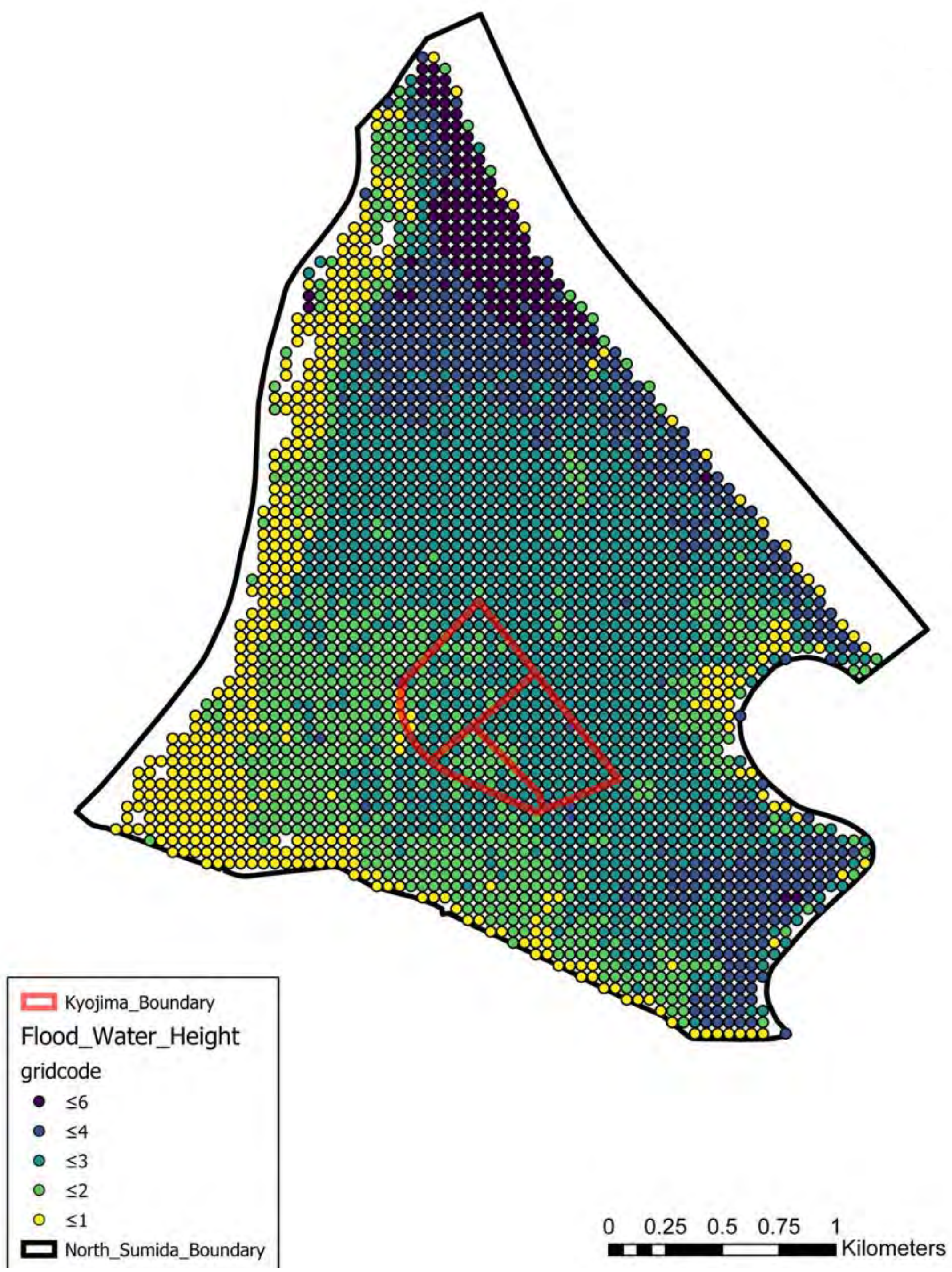
These maps depict density of potential fire outbreaks based on point density (converted from polygons) of traditional wooden buildings. Using this data, firebreaks aimed at preserving major Kyojima blocks are proposed for the primary thoroughfares (light blue).

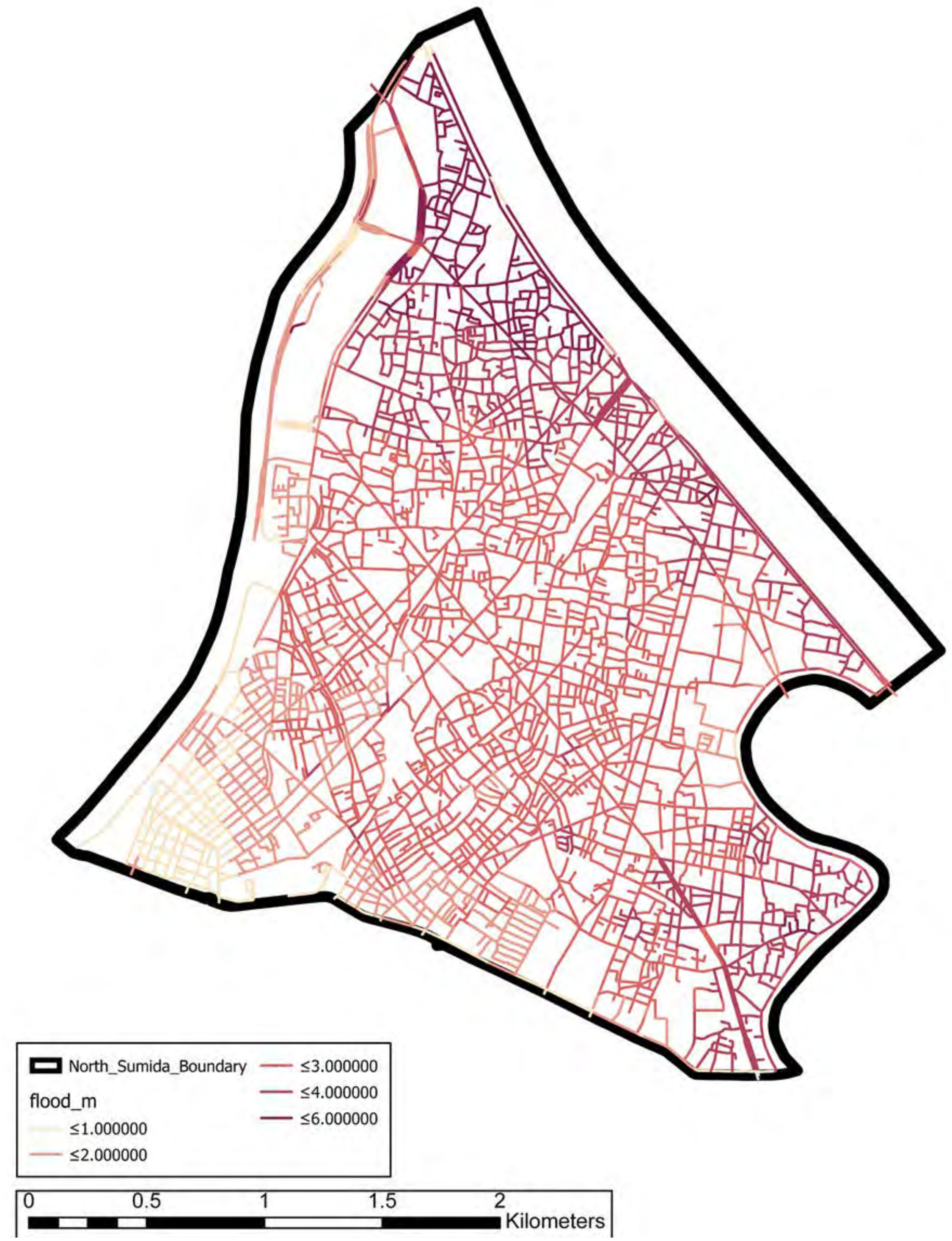
1a. v. Disaster Impact on Transportation: flooding



These maps show flood impacts under multiple flood-level scenarios, from 1-meter to 6-meters.

1a. v. Disaster Impact on Transportation: flooding

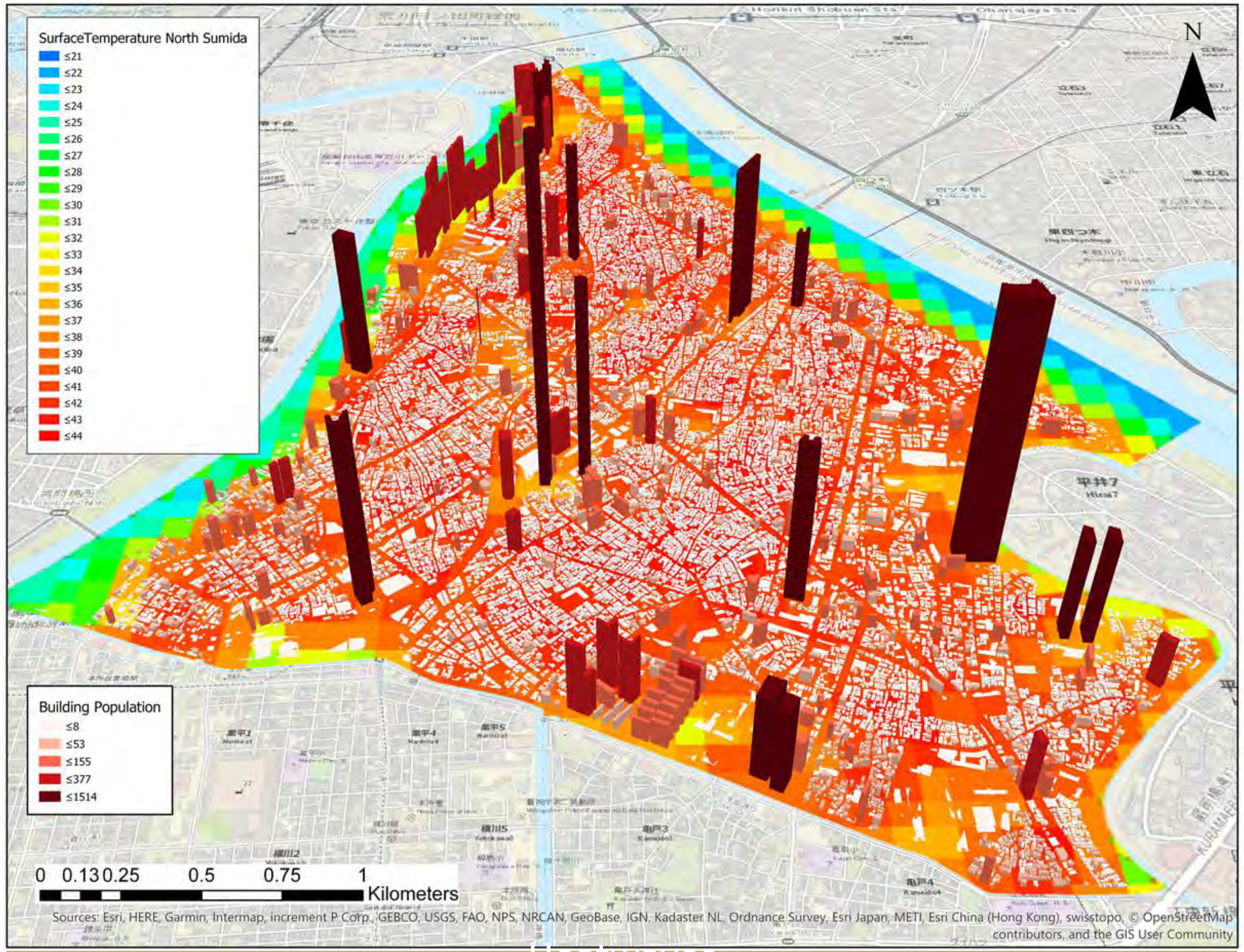




These maps show flood impacts under multiple flood-level scenarios, from 1-meter to 6-meters

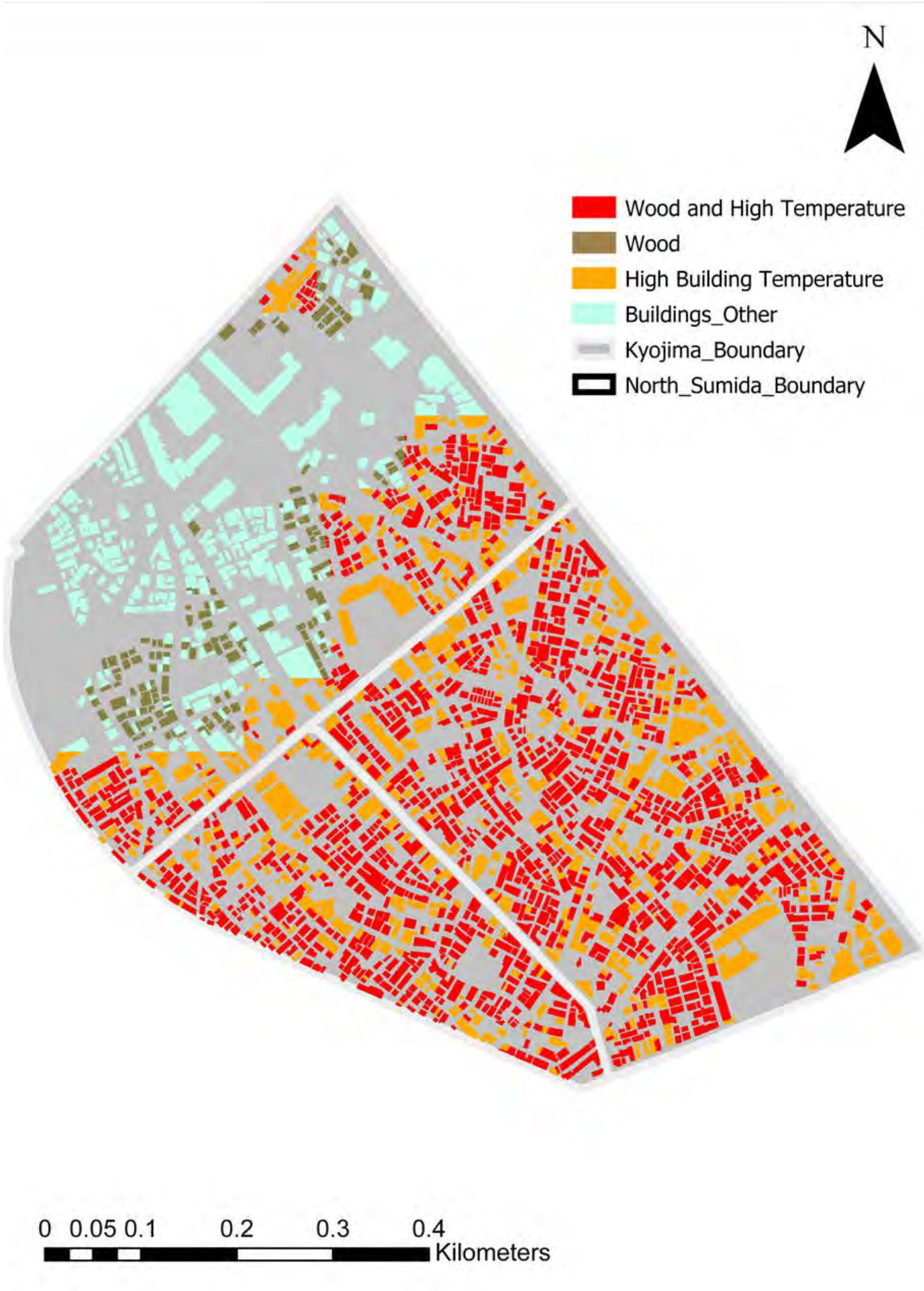
1a. v. Disaster Impact on Transportation: heat wave

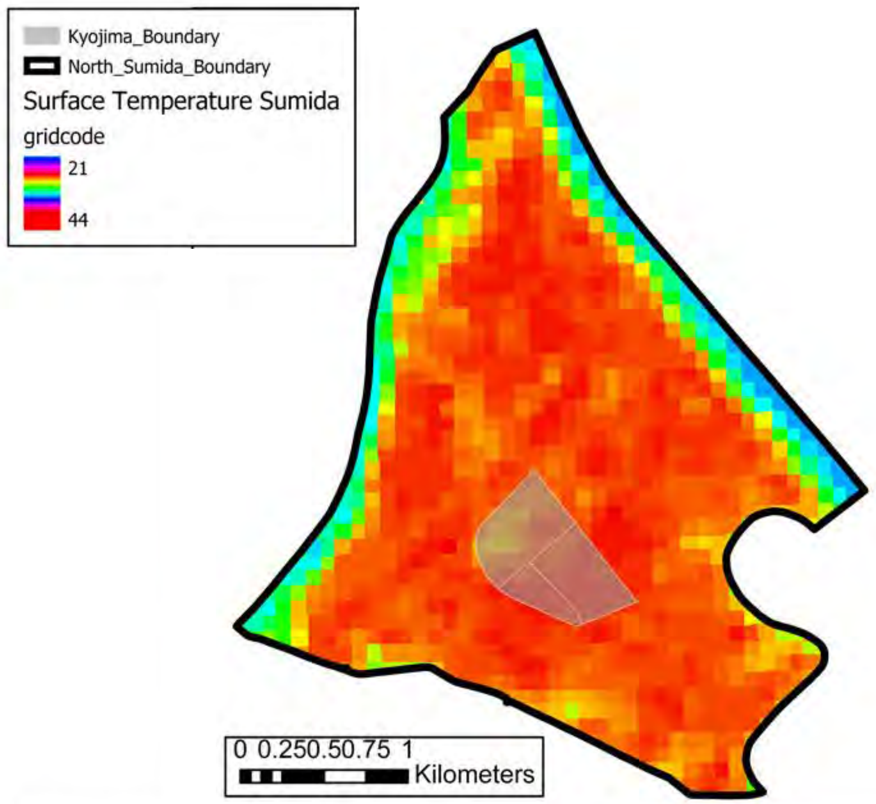
This map depicts a 3D scene displaying population extruded at the building level, overlaid with surface temperature. This layer presents critical elements of the heatwave attack scenario model.

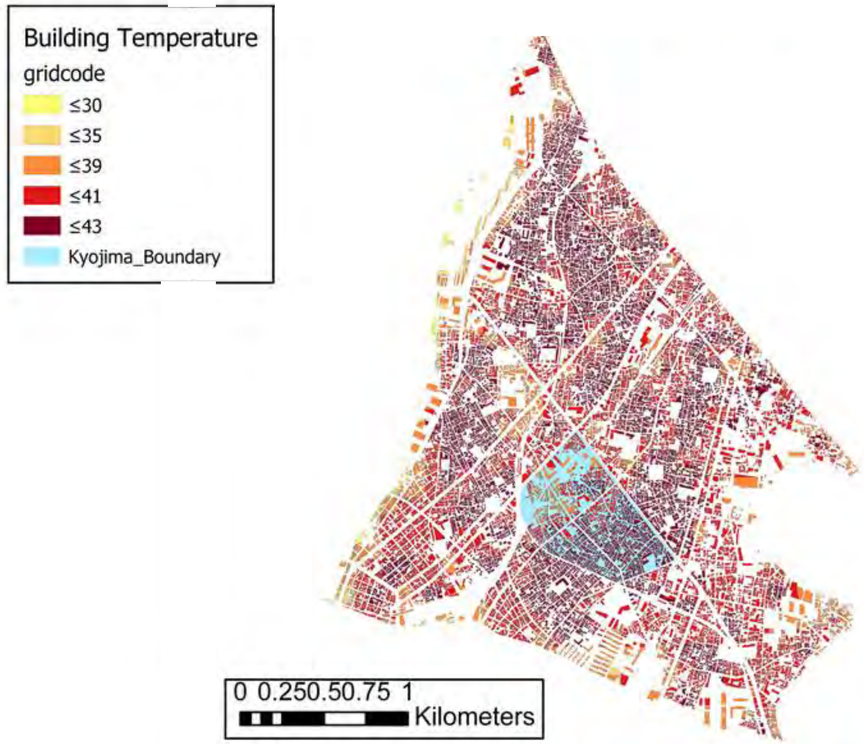


Heatwaves

1a. v. Disaster Impact on Transportation: heat wave



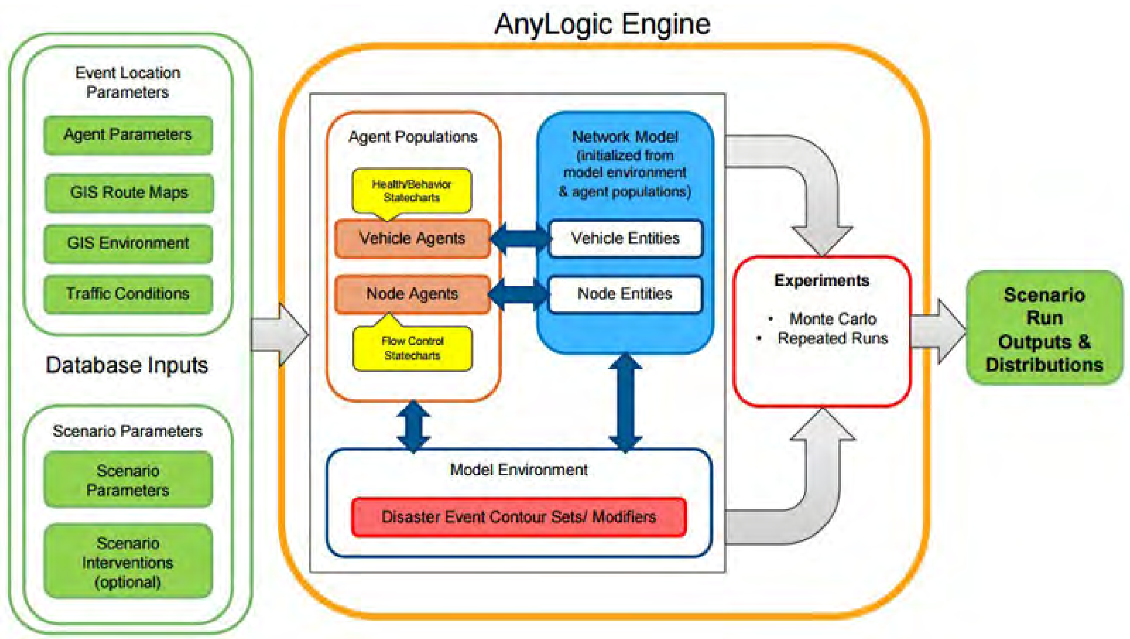


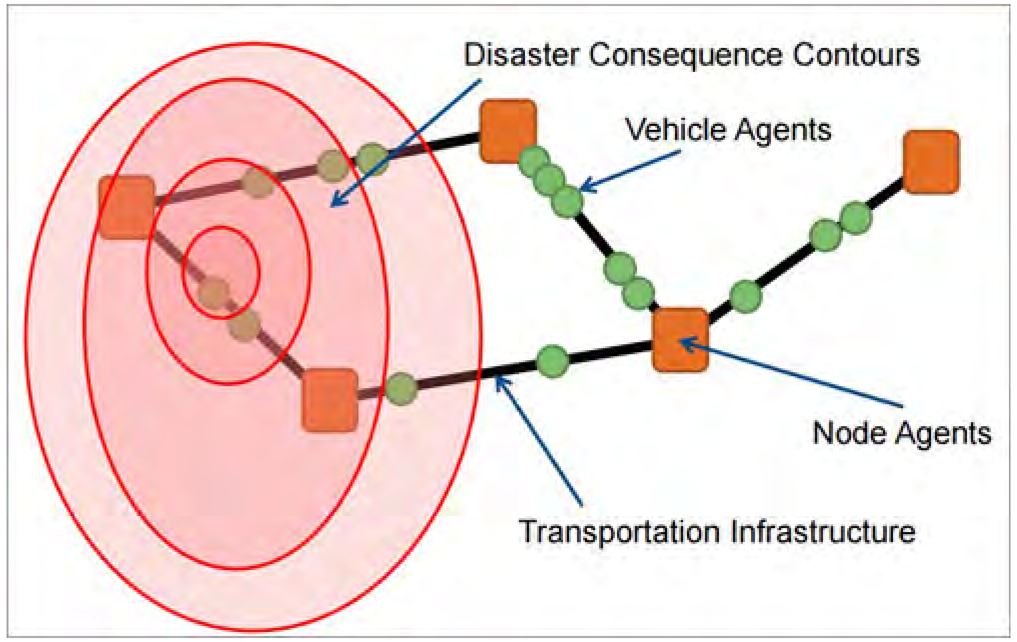


1a. v. Disaster Impact on Transportation

AnyLogic is an open-source simulation software intended specifically for modelling disaster evacuation scenarios. More importantly, this software is easy to use and compatible with GIS file types, such as shapefiles. The AnyLogic multiple-intervention framework and interchangeable model components correspond with the evacuation objectives proposed:

- evacuation routing of people specific to type of disaster scenario
- emergency vehicle routing for supply delivery





Source: https://www.anylogic.com/disaster-response-applications-using-agent-based-modeling/

1a. vi. Pedestrian Experience Planning

Neighborhood planning that prioritizes pedestrian experiences are generally safe, comfortable, and pleasing. The experience is not only at a single point in space in time, but a sequence through space and over time as the person navigates the urban fabric. As the scene evolves, the environment will, too, resulting in a varied and interesting experience for the pedestrian.

Several methods give insight to the current level of safety, comfort, and pleasantness of pedestrian paths, and correlate to people's perception and behavior. Most of the methods described in this section are ways to analyze current conditions. Future conditions can be modeled and simulated, although one potential challenge is that the effects of greenery will be more difficult as trees are hard to model for simulations in GIS or Rhino. Potential future street retrofit can be conducted top-down through massive transformative design, or bottom-up through scene-by-scene change with adjustments to individual buildings and tree plantings.

A major goal for Kyojima is making the best use of the existing transportation network, land use and infrastructure to meet smart city and smart mobility requirements. To this end, examining both trip purpose and time of day associated with GPS points locations can be used to identify:

- activity hubs for specific modes
- time of day associated with mode type frequency
- potential traffic and safety issues based on multimodal congestion
- potential connectivity issues in the network
- opportunities to plan for increased efficiency, connectivity, and best mode options and multi-modal linkages

GIS analyses of the pedestrian experience are aggregated into Experiential Route East (ERE) and Experiential Route West (ERW) segments.

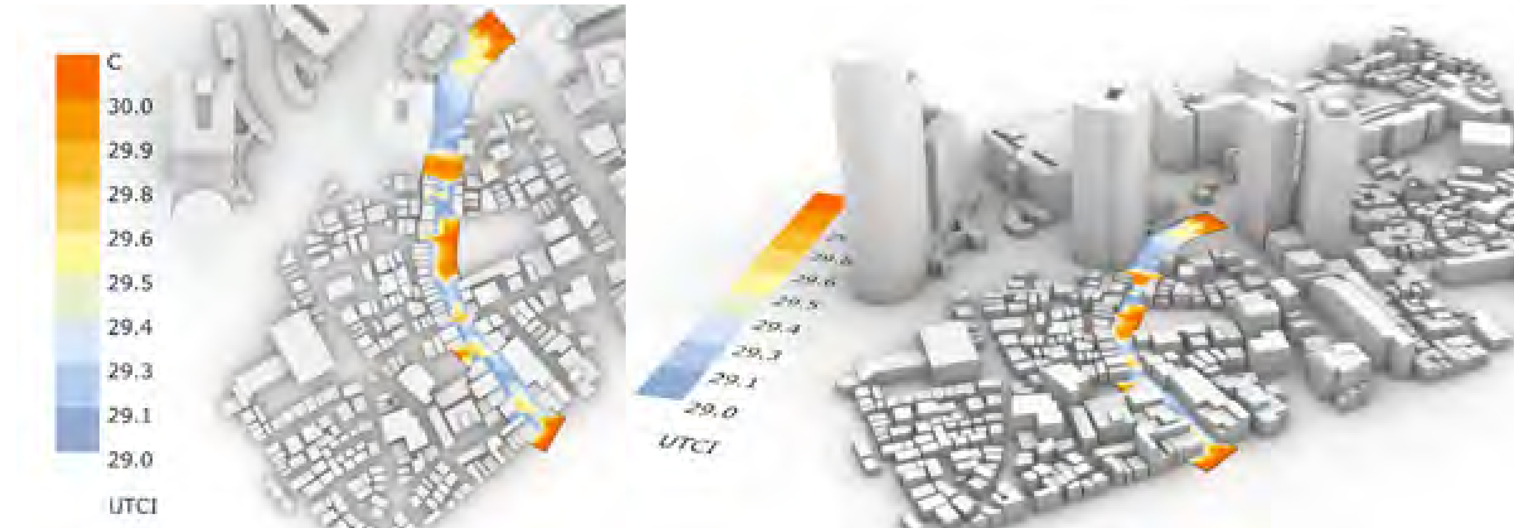
1a. vi. Pedestrian Experience Planning

Pedestrian safety evaluation can be decomposed into whether pedestrian traffic is comingled with vehicular traffic greater than 25 km/hr. Generally, if the road has multiple lanes and the traffic moves fast, a separated walking lane with appropriate barriers would be needed. Within Kyojima, because most interior roads are narrow or winding, separate pedestrian path is usually unnecessary or infeasible due to space constraints. Therefore, we can look to other strategies to enhance safety. On-site data-collection can give insight to safety of interior paths.

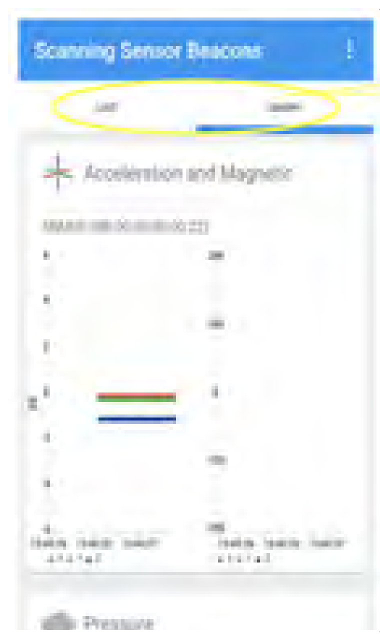
1a. vi. Pedestrian Experience Planning

Experiential Route West surface temperature simulation from Rhino, in 2D and 3D view, analysis period is June 7 through August 7, which covers the hottest week of 7/29-8/5 in Tokyo.

For comfort analyses, Rhino-Grasshopper enables analyses of temperature assessment based on surrounding context.

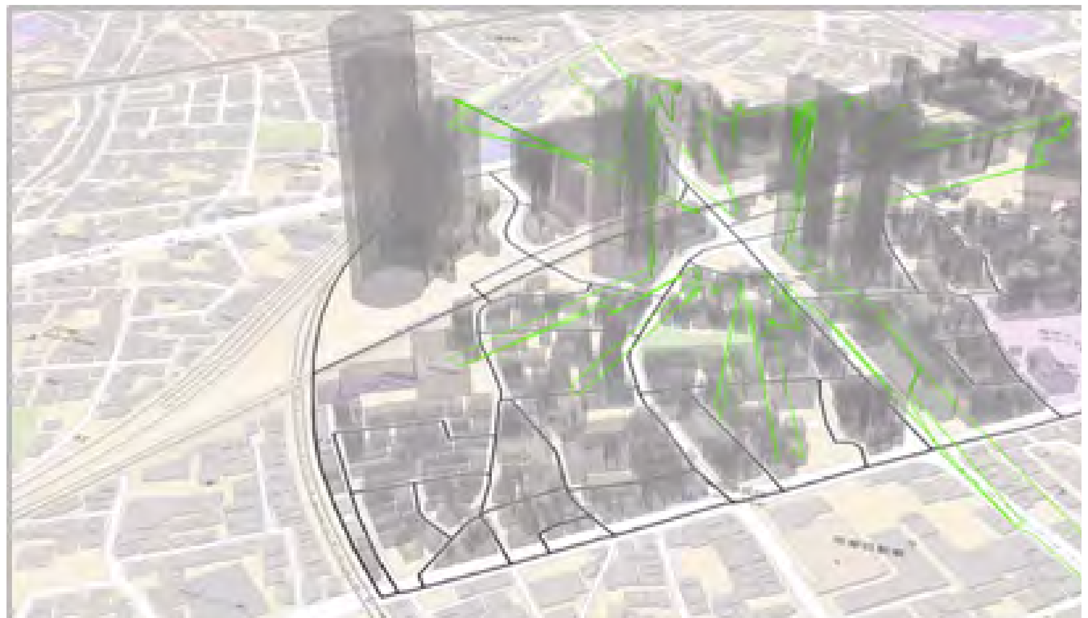


Experiential Route East surface temperature simulation from Rhino, in 2D and 3D view, analysis period is June 7 through August 7, which covers the hottest week of 7/29-8/5 in Tokyo.

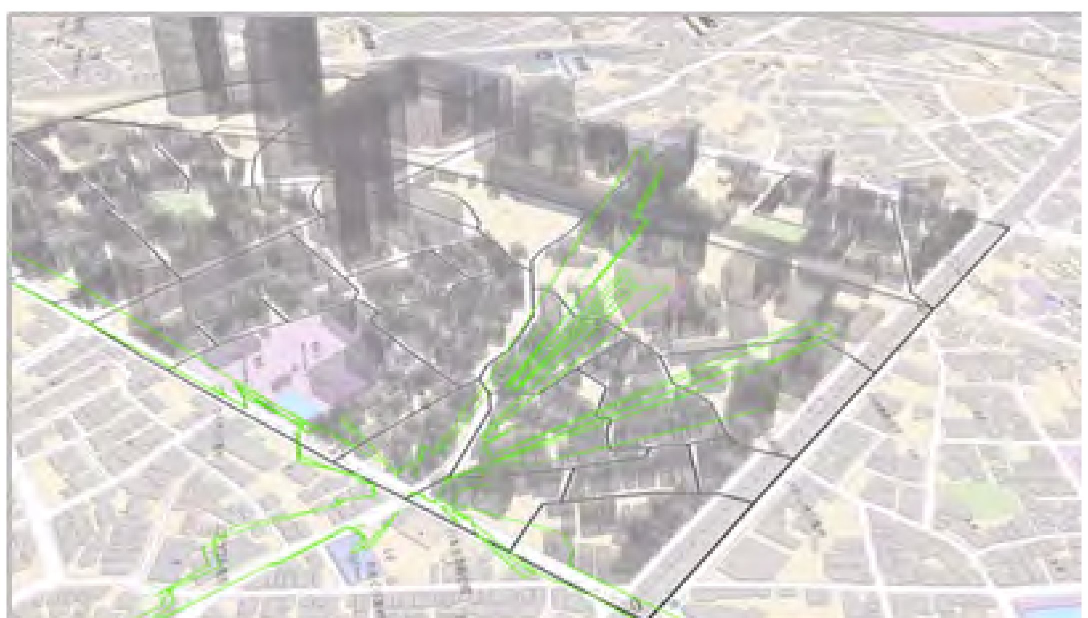


Comfort levels will be measured and validated using on-site measurements with microsensors. Environmental data (ambient temperature, pressure, humidity, UV radiation) are collected as people walk through the spaces.

1a. vi. Pedestrian Experience Planning

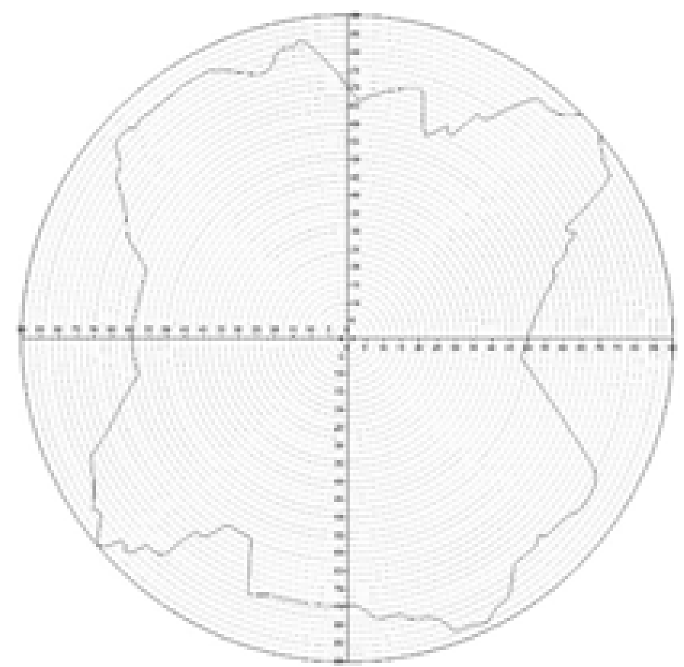


ERE has a higher sky view factor than ERW.

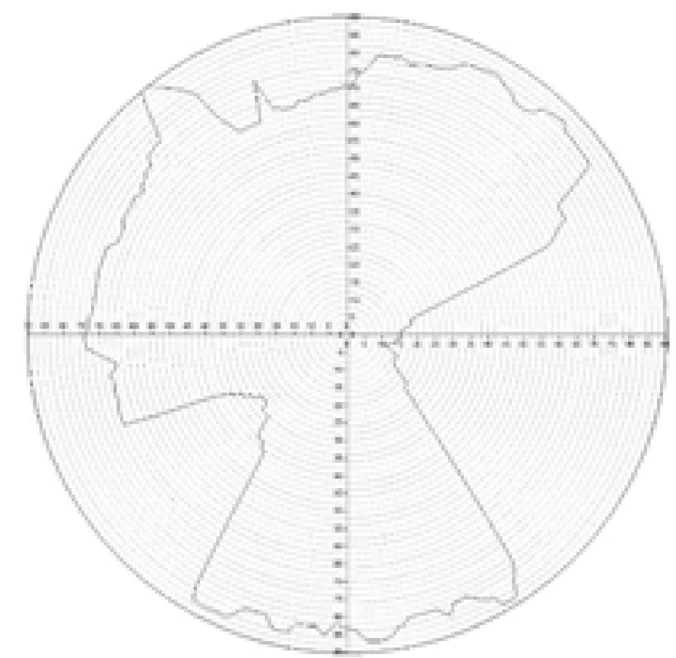


Skyline visibility is generally highest around the Hikifune train station and decreases as observer moves away from the train station in both

Viewshed can be analyzed in GIS and by using actual images. GIS analyses are geometrically accurate with consideration to 3D objects (e.g. buildings), while Google Street View (GSV) analyses of scene compositions are based on image analysis. Rather than 3D objects, GSV includes trees which affect shading and views.



ERE Skyview: 70.8%



W Skyview: 57.6%

1a. vi. Pedestrian Experience Planning

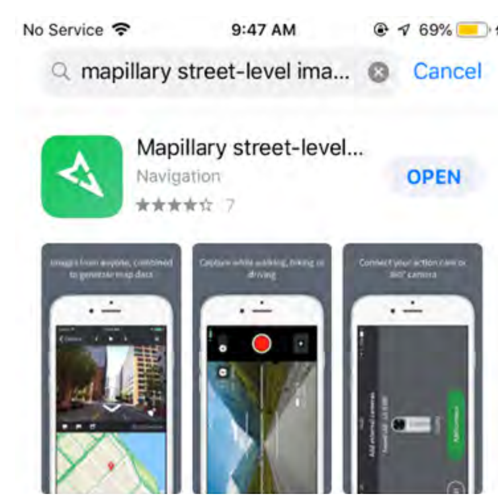
GSV sequence taken at 10m distance along Experiential Route East to West

Streetscape image classification to identify Sky, Building, and Greenery composition in scenes at 10-meter intervals to quantify view sequence.

Segment images for Sky, Buildings, Greenery, and others, to evaluate the visual experience along the route.

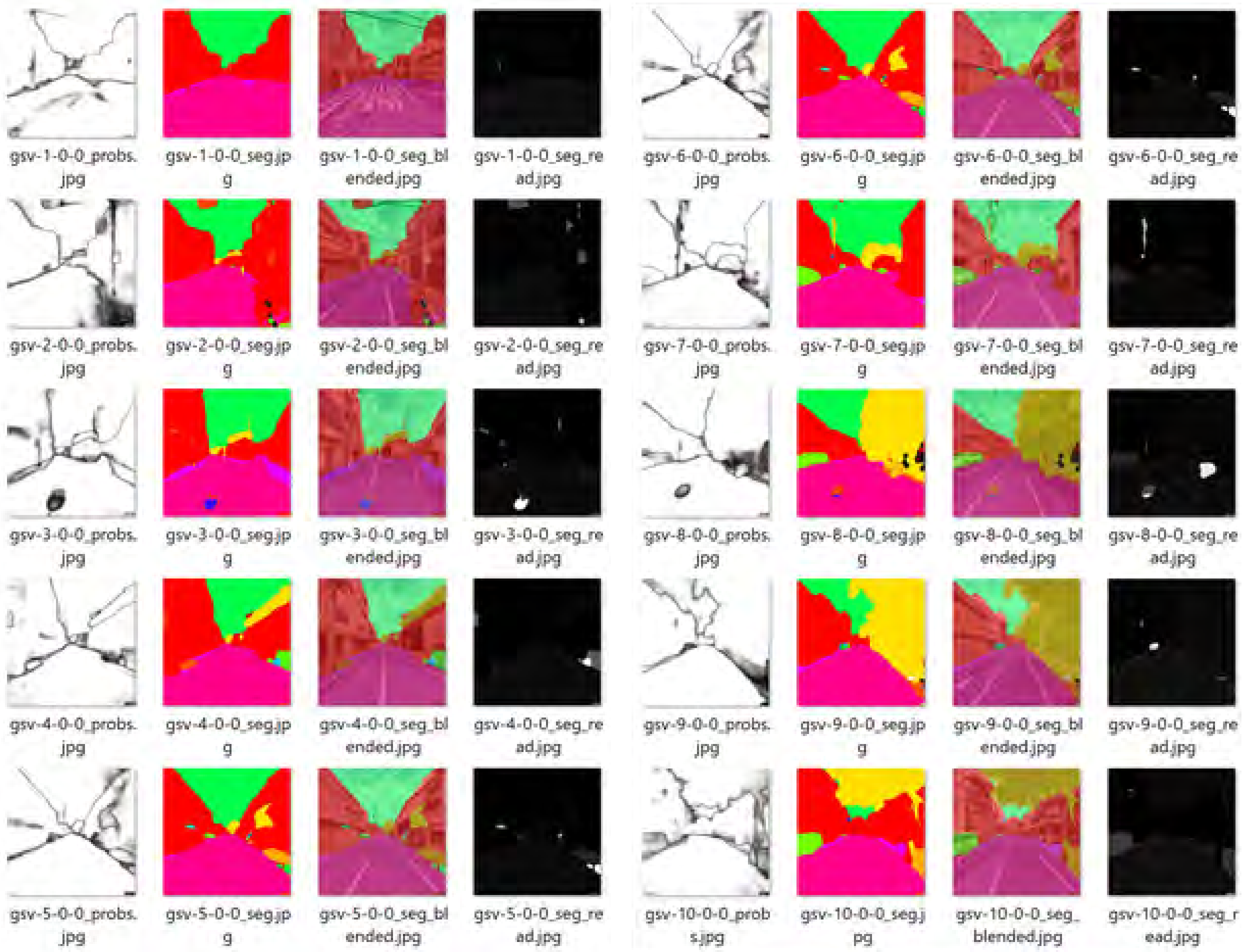
The segmented images are analyzed for percentage of building, sky, greenery, and others.

Then all image characteristics are plotted in a linear sequence.



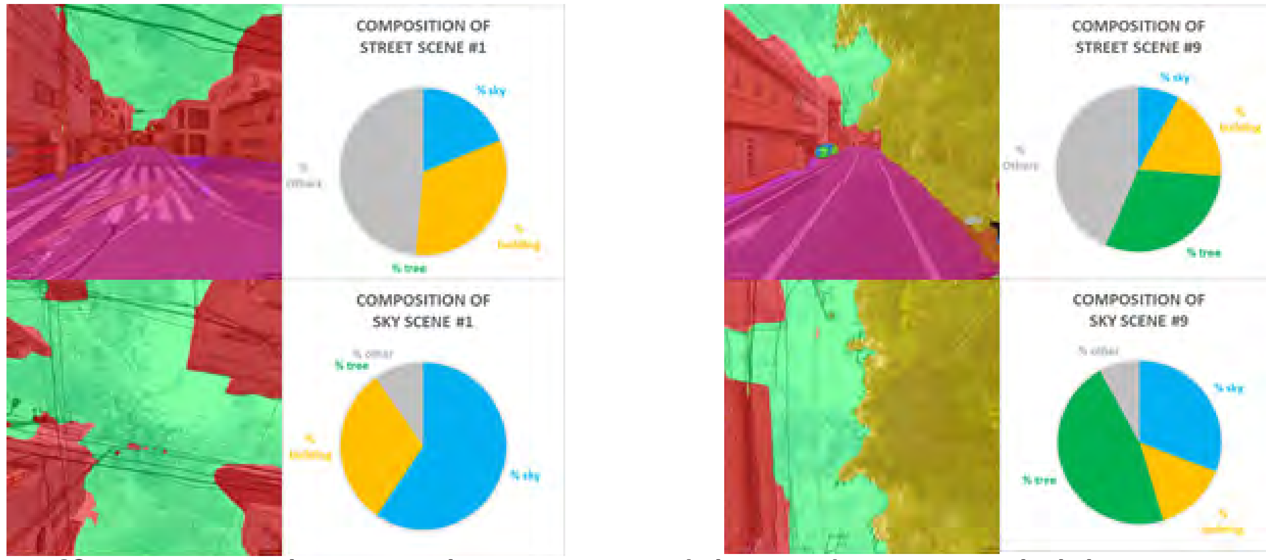
As alluded to earlier, images can be collected where GSV are not available. We do this using Mapillary, and correspond the in-situ measurements to georeferenced points, generating our own sequences of experiences for analysis.

1a. vi. Pedestrian Experience Planning



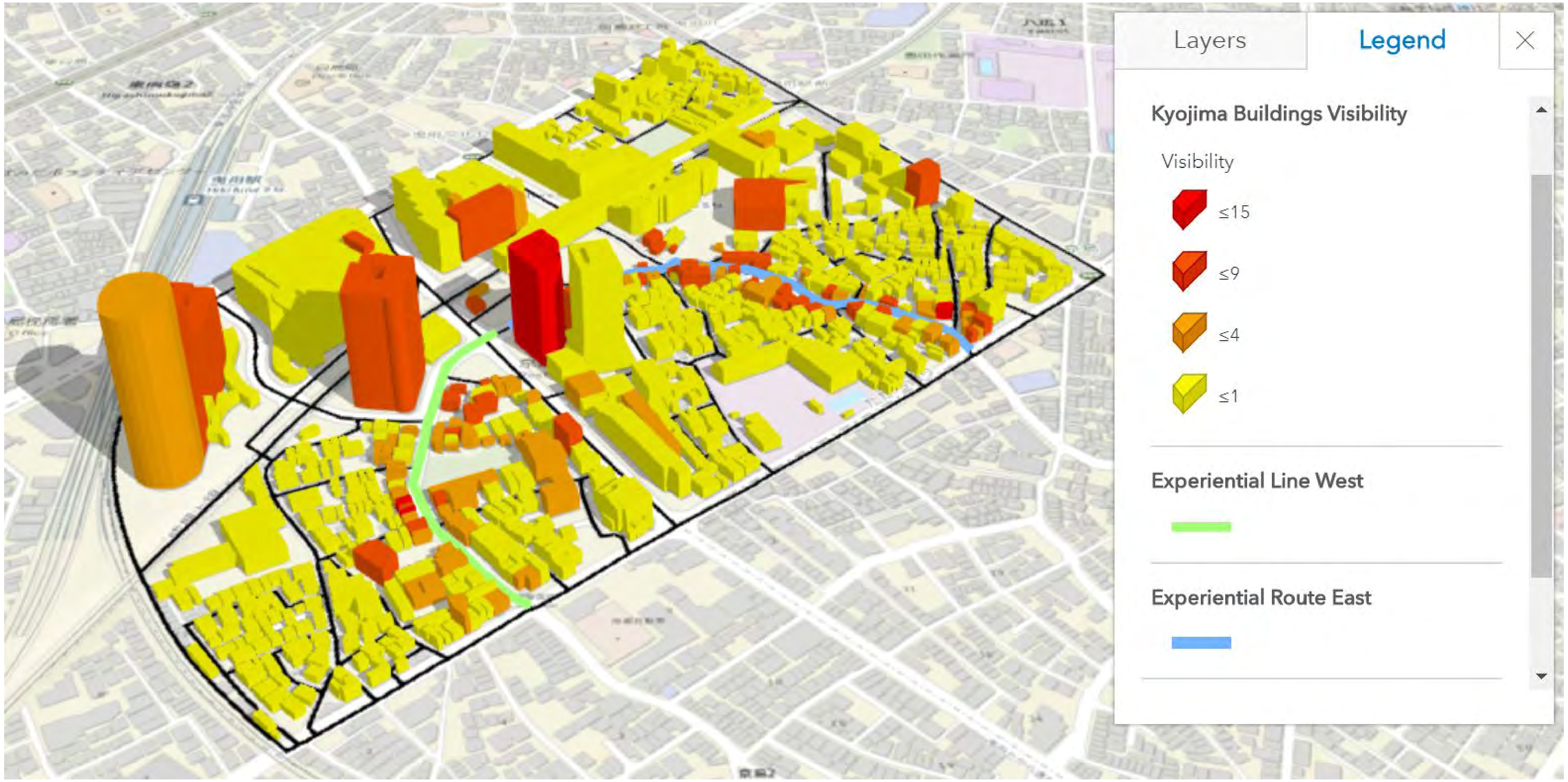
Segment images for Sky, Buildings, Greenery, and others, to evaluate the visual experience along the route.

The sequence shows that only a small section of the route currently has any significant amount of greenery or tree shading (around image 9 or 90 meters from the starting point of this sequence). Post-development should have more greenery and tree-shading than pre-development stage, to provide a more pleasant and shaded environment for walking comfort.



Different paths can be mapped based on available street view imagery and analyzed for sequence characteristics. The path qualities based on this composition can be useful for route selection (or recommendation). For example, two paths going from the same origin and destination could have different characteristics, and pedestrians may choose a slightly longer route if the characteristics are more comfortable and pleasant – this analysis helps to quantify those thresholds.

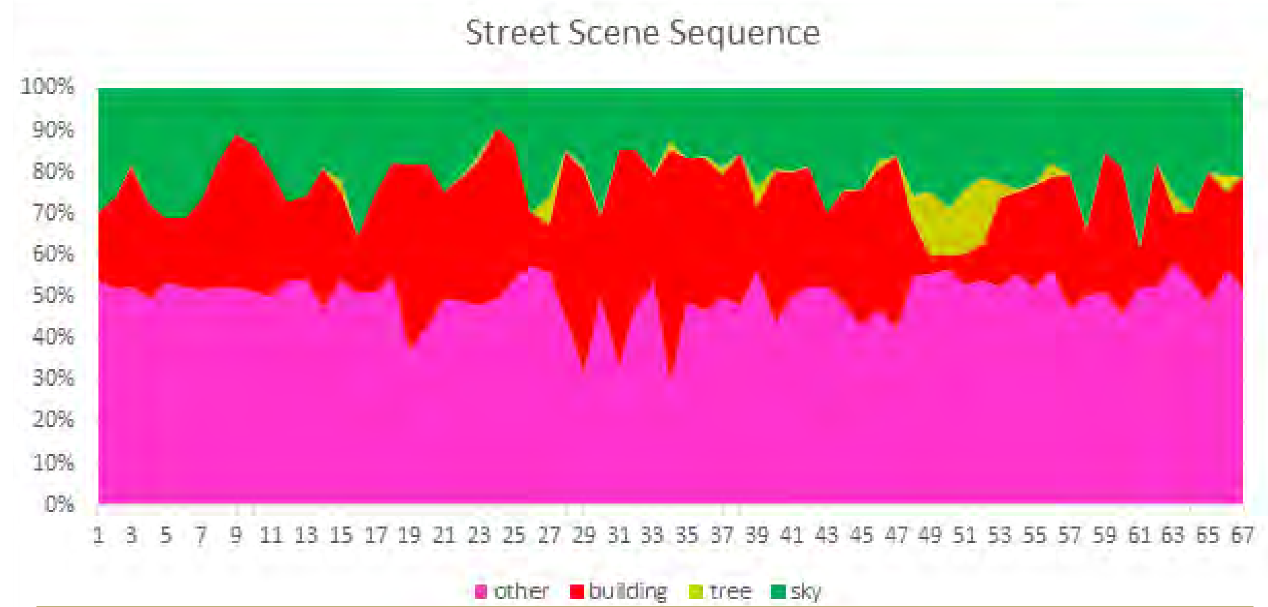
1b. Experiential Loop/Digital Twin



Visibility assessment interpolated based on viewshed analysis along experiential route.

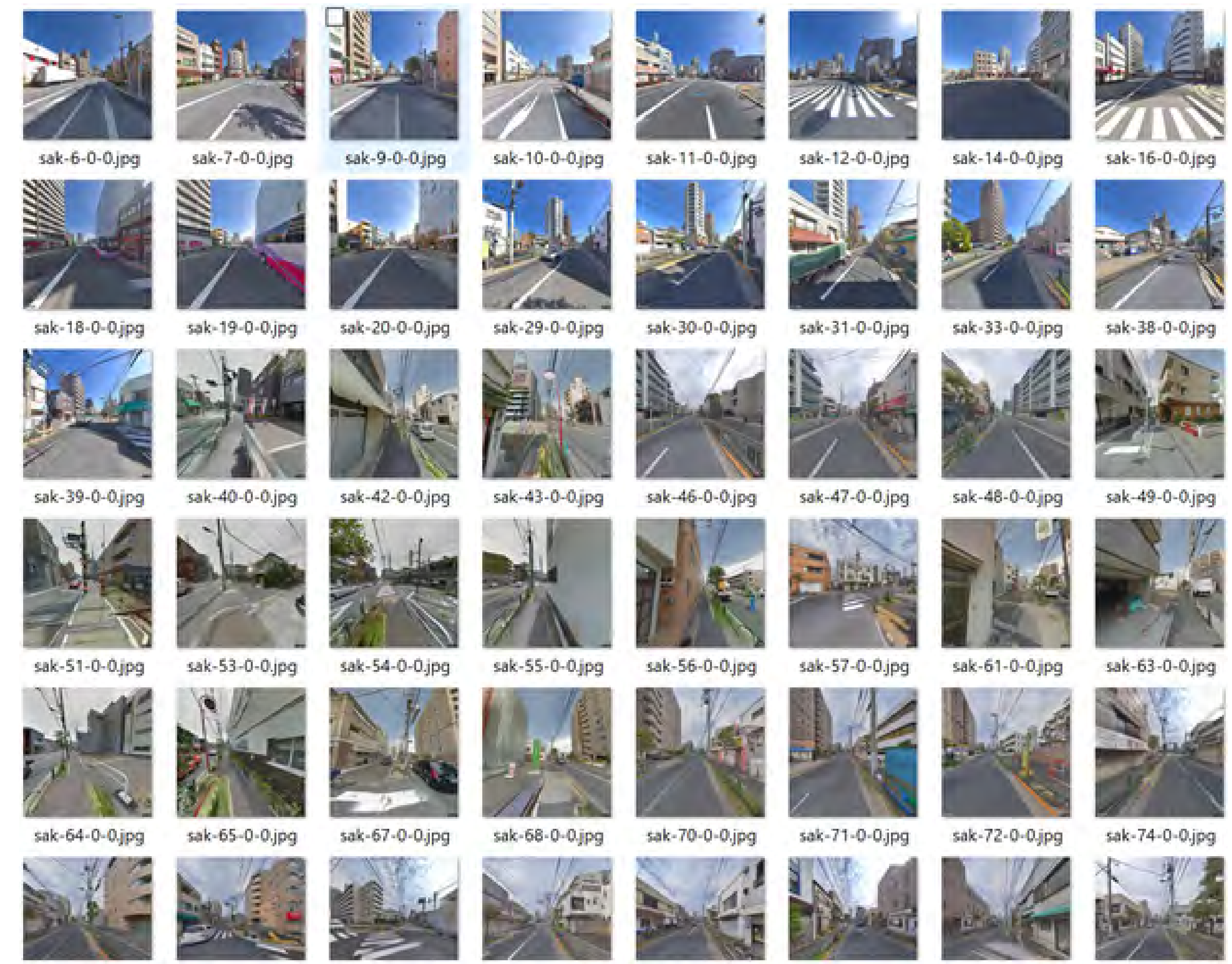
1b. Experiential Loop/Digital Twin

Based on map path analysis and GPS people flow data, we identify two potential paths from Kyojima to the area around Tokyo SkyTree – the second tallest building in the world that attracts millions of global visitors annually. From SkyTree to Kyojima is only 1.2km or 16 minutes by walking, however not many visitors are drawn into Kyojima. One of the issue is the lack of strong attraction of Kyojima itself, and we propose that another reason is the walking experience of the path between the two areas.



Street Scene Sequence - Yotsume-dori

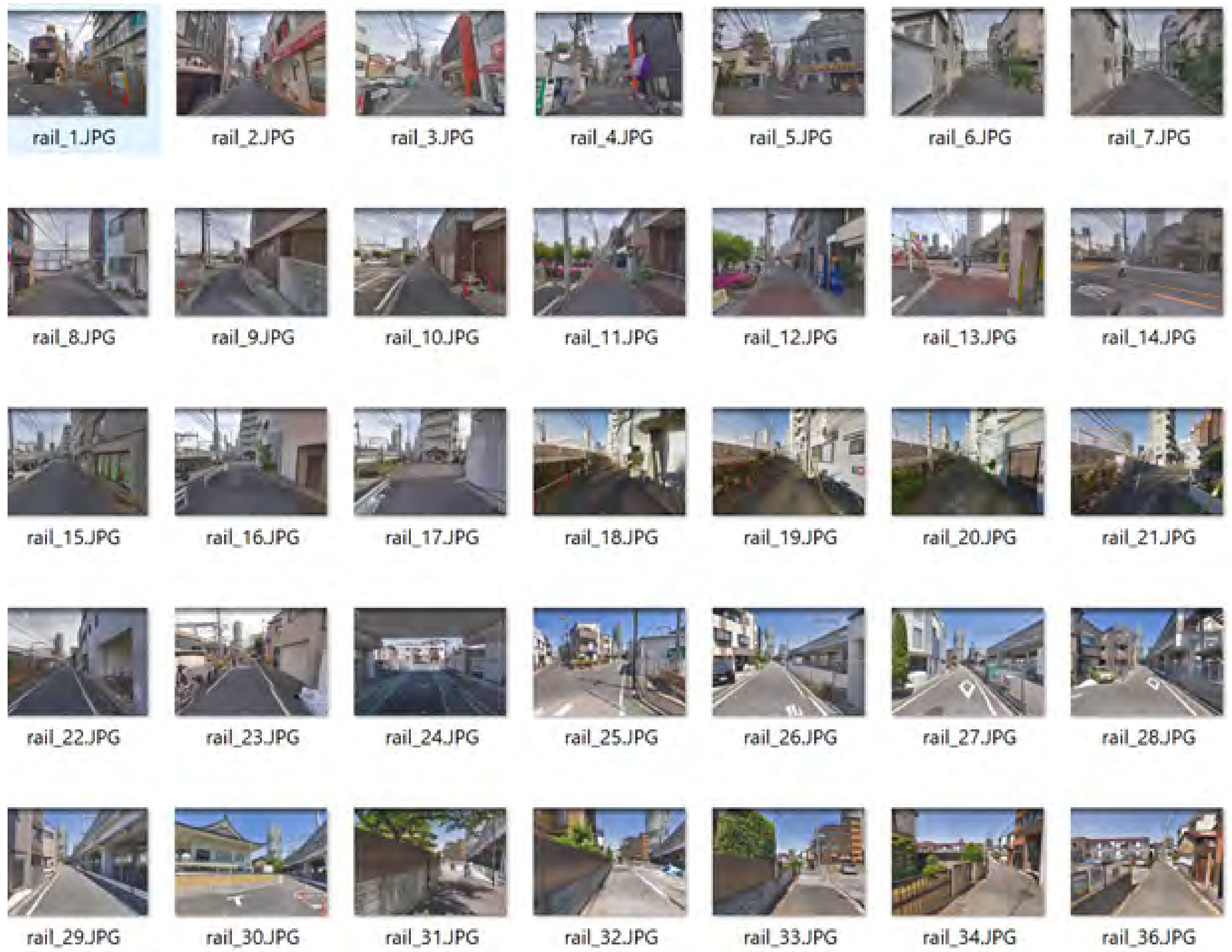
Yotsume-dori is straight and wide with multiple lanes of traffic and heavily used by passenger and freight vehicles. The street scene sequence shows high percentage of the scene taken by road and other paved surfaces (indicated by other in the figure above).



A selection of the visual experience along Yotsume-dori, the road from SkyTree to

There is little presence of trees along this path, with the exception of one stretch of the road farther into Kyojima. We suggest that this path is not attractive enough to draw pedestrians to continue walking through it for leisure purposes.

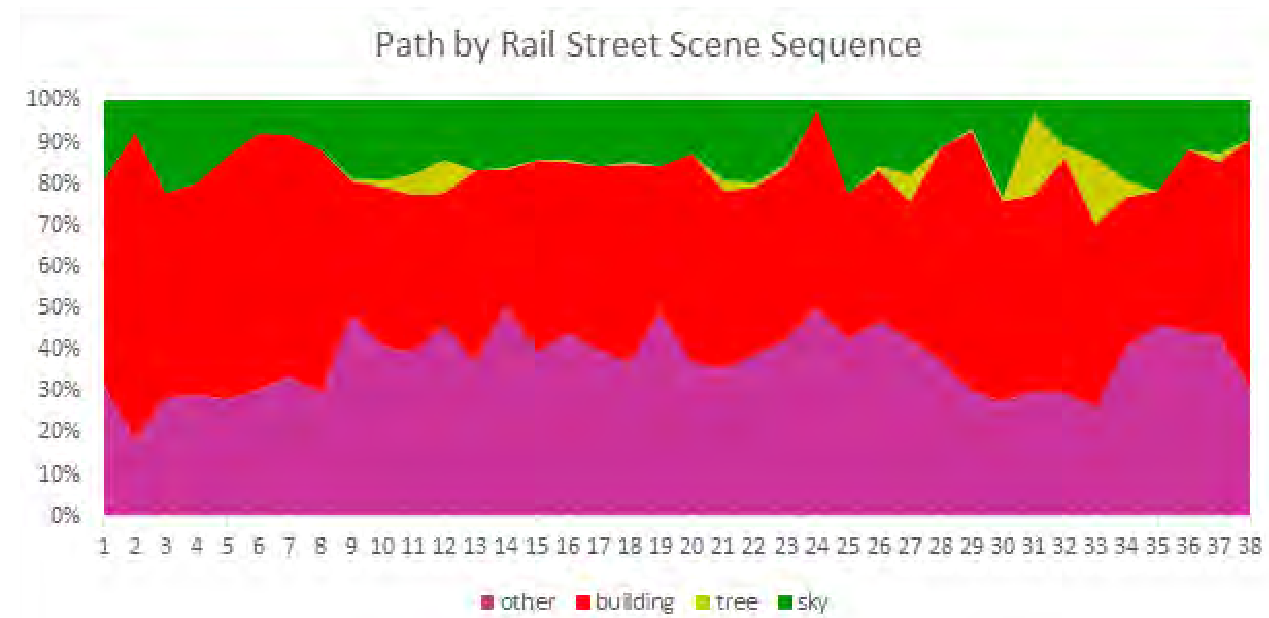
1b. Experiential Loop/Digital Twin



A selection of the visual experience along the rail line

Another path that shows significant pedestrian and bicycle usage based on the GPS data is a path next to the rail line. This is a narrow (usually only one lane) and meandering path with many twists and turns. Even though for some portions of the path, one side of the path is taken by the railway, which may be perceived as "boring", and at one point the path crosses under the railway, this path still sees many bicycle and pedestrian users.

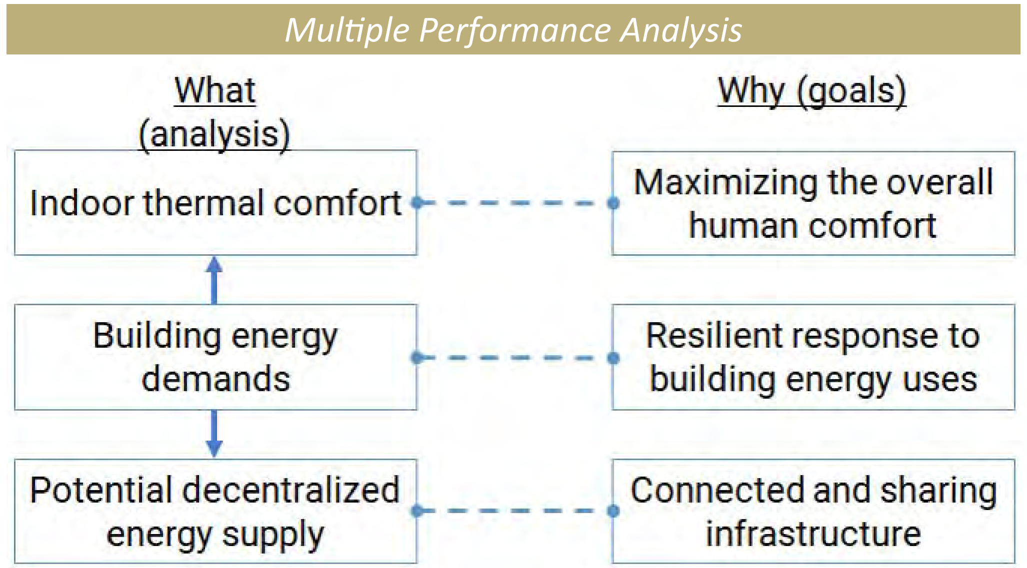
The Street Scene Sequence analysis shows that along the path the view taken by roads and other paved surfaces is significantly less that the path down Yotsume-dori, and with higher variation. There are also more sections of the path that offer greenery in the form of planters and small parks. We suggest that this type of experience is more conducive to pedestrian and bicycle traffic. One potential is to improve a narrow, walker-friendly path and mark it to attract tourists to explore the local flavor of Kyojima.



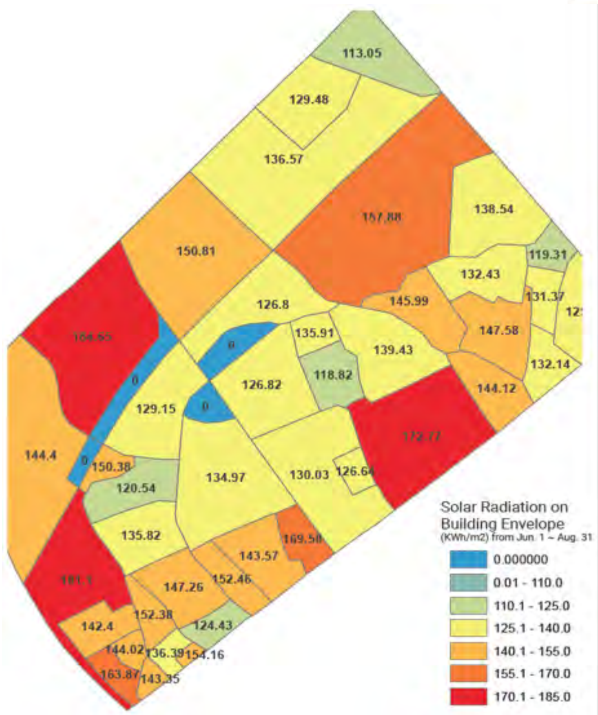
1c. Green Grid

The area's imminent redevelopment presents an opportunity for Kyojima to become a global leader in carbon emissions reduction initiatives. As such, we pose the following question:

How can existing communities be transformed the sustainable communities maximized renewable energy potentials, achieved energy efficiency and security, reduced CO2 emissions, and decarbonized during the community service life cycle, while also considering human, urban, buildings interactions?



Existing building conditions in Kyojima



Solar radiation on building envelope

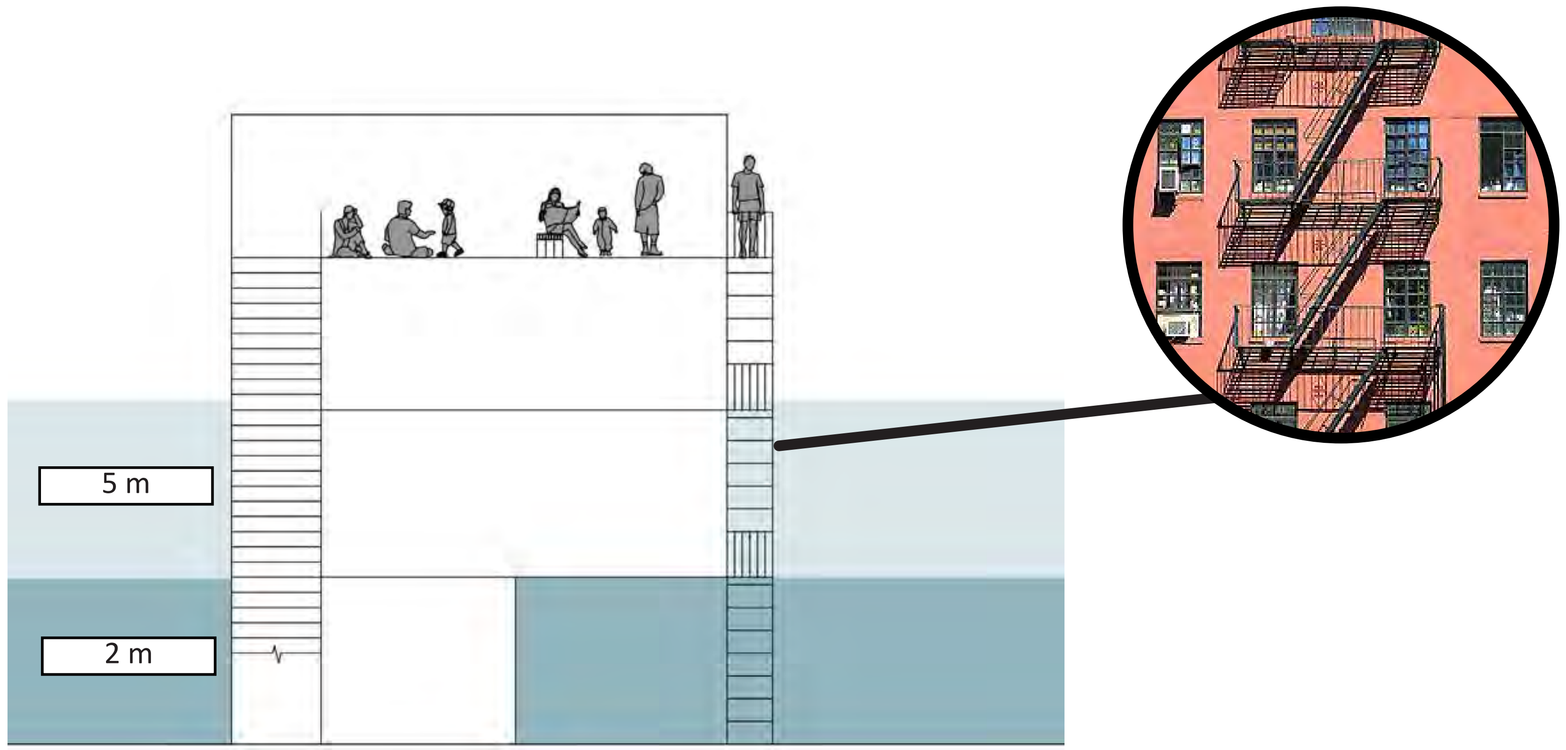
Predicted annual energy demands (KWh/m2)

Predicted percentage of comfort hours per year

RENEWABLE COMMUNITIES

2a. Renewable Community Redevelopment
    i. Renewable Communities Plan
2b. Renewable Community Design
    i. Redevelopment Tools
2c. Urban Farming
    i. The Problem
    ii. Proposed Solutions

2a. i. Renewable Communities Plan



In the early stages of our analysis, it became apparent that access to the evacuation centers in Sumida is problematic. The reasons ranged from not having easy access to facilities to simply not wanting to be in overly-crowded centers for multiple days at a time.

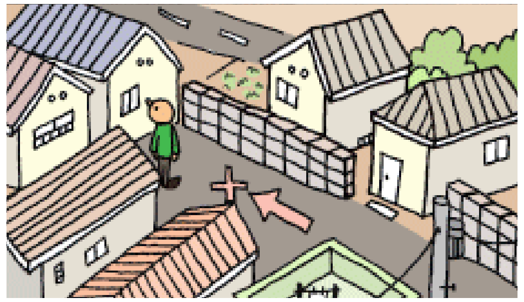
It is our recommendation to implement a decentralized evacuation system. This is a short-term strategy that would result in a series of safe havens - locations where neighbors can conglomerate with other neighbors to evade hazards and be in safe areas. As new residential buildings are replacing older ones, it is an opportunity to build these space into the urban fabric.

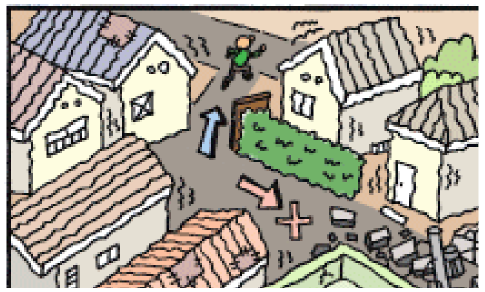
With the government financially supporting the addition of third or fourth floors with reduced property taxes and/ or financial support, families can add an additional floor that is equipped to sustain hazardous events life severe rain, flooding and heat waves. Features like exterior stairs, back up batteries, and food storage could be stored in these locations for events and when not, they are additional spaces for families to use for activities.

2a. i. Renewable Communities Plan

Most working-age residents of Kyojima 1 travel to Tokyo during the day, leaving the most vulnerable citizens (children under 18 and the elderly) to navigate the disaster setting. Of the population in the area, kids are likely the most capable/active in emergency situations.

Preparation for this scenario is crucial. As such, it is our recommendation to establish a community association. With the aid of town councilmembers and support staff, local elementary schools and KiraKira shopowners would hold quarterly disaster management workshops.





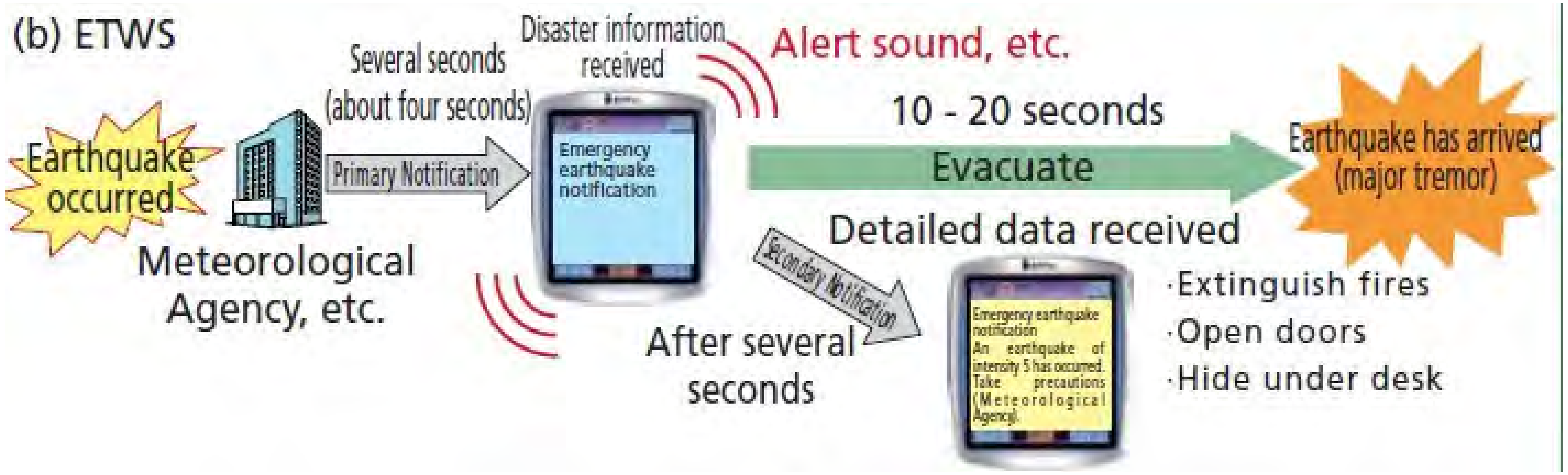
Many roads in Kyojima 1 are too narrow to safely and effectively serve as evacuation routes. However, tight, winding alleyways contribute to the existing character of the neighborhood - they provide safe play areas for children and their car-free nature inherently contributes to GHG reduction.

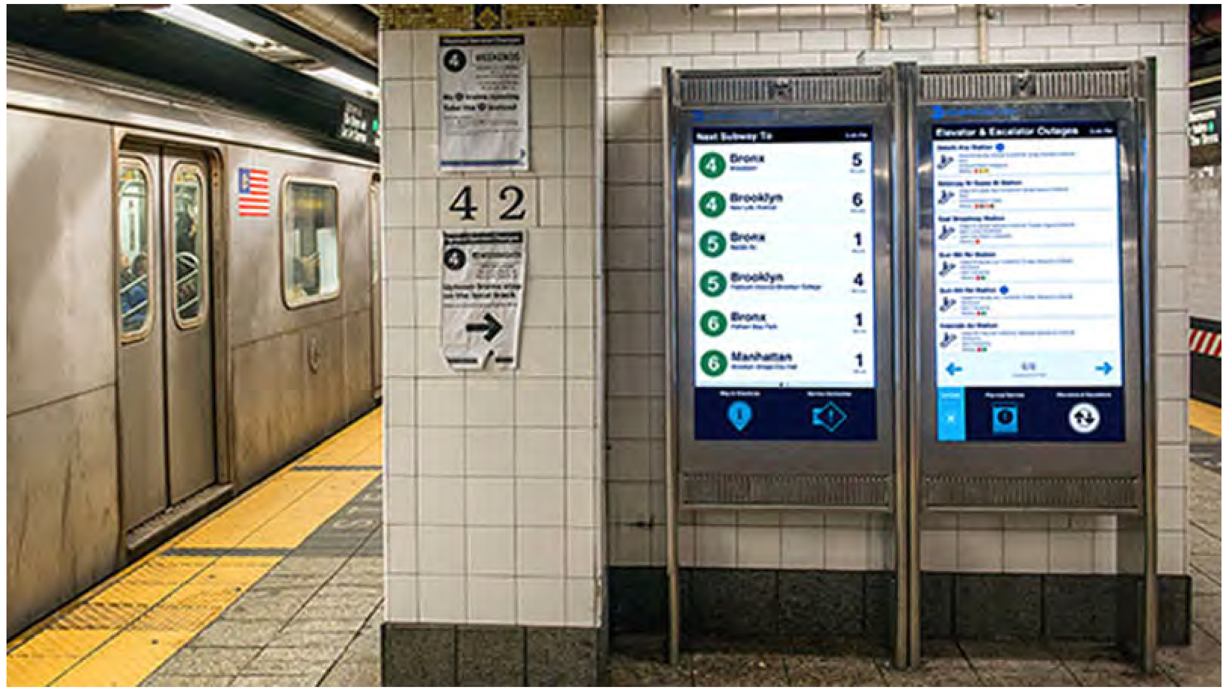
Rather than widen roads and remove alleyways, we recommend the integration of a flexible urban system that reflects the diverse needs of Kyojima 1.

2a. i. Renewable Communities Plan

The proposed interactive evacuation maps would be placed strategically around the neighborhood in designated queue areas. These facilities would depict real-time information,
including:

- The evacuation spot/shelter's overall capacity;
- The existing capacity of the evacuation spot/shelter;
- A list of alternative evacuation spots/shelters in the event the closest one is at capacity





The multi-functional capacity of this technology to contribute to the day-to-day life in Kyojima1 is significant.

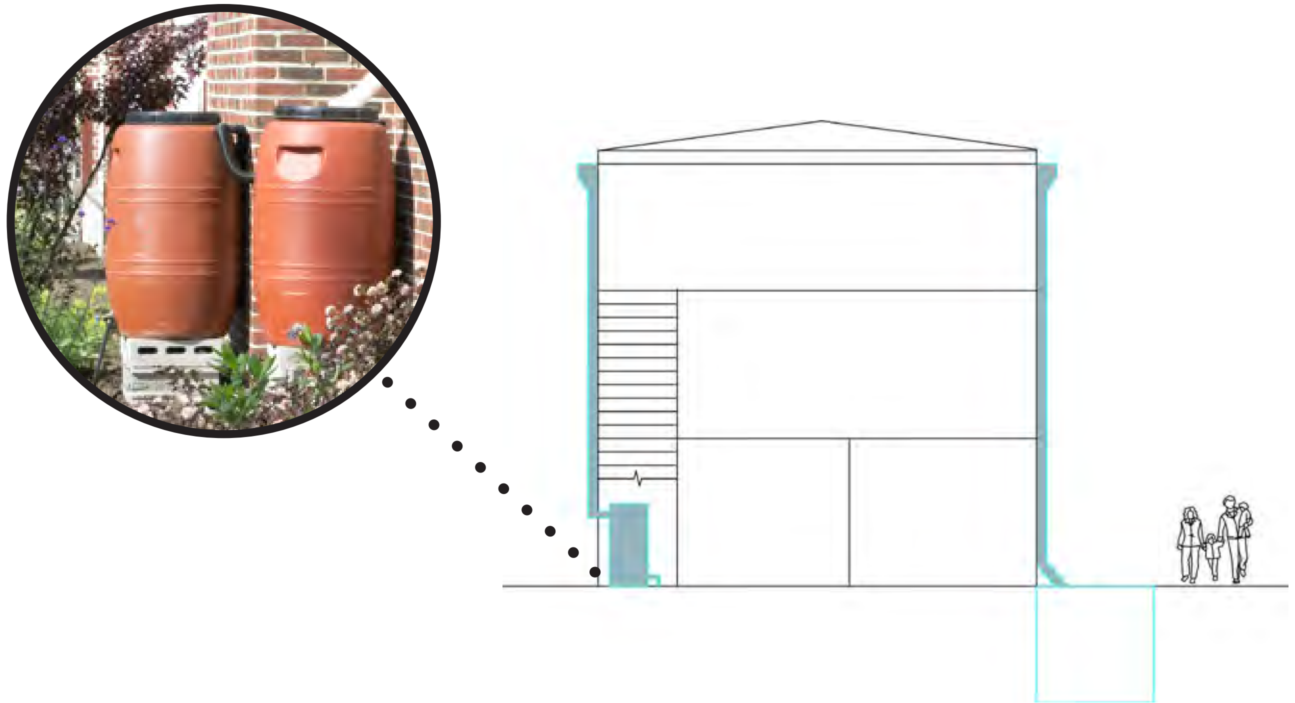
Cardiac calls and fires are specific situations in which faster response times could have enormous implications for health and safety.

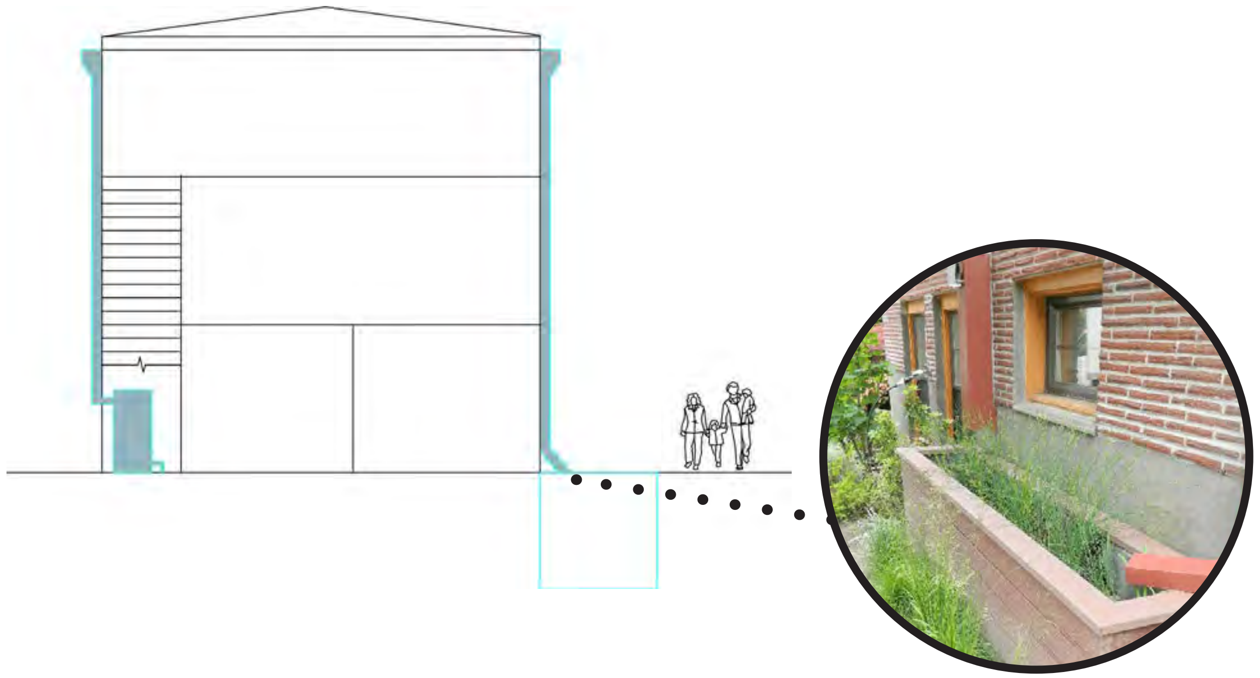
Interactive smart maps would also facilitate tourism and economic development, encouraging tourists to extend their stay they identify nearby places of interest.

They could also serve as an educational tool that reveals the historic and cultural charm of Kyojima.

2a. i. Renewable Communities Plan

Rainwater harvesting provides an opportunity to a) remove surplus water from the system in the case of severe rain events, and b) to decrease water usage.



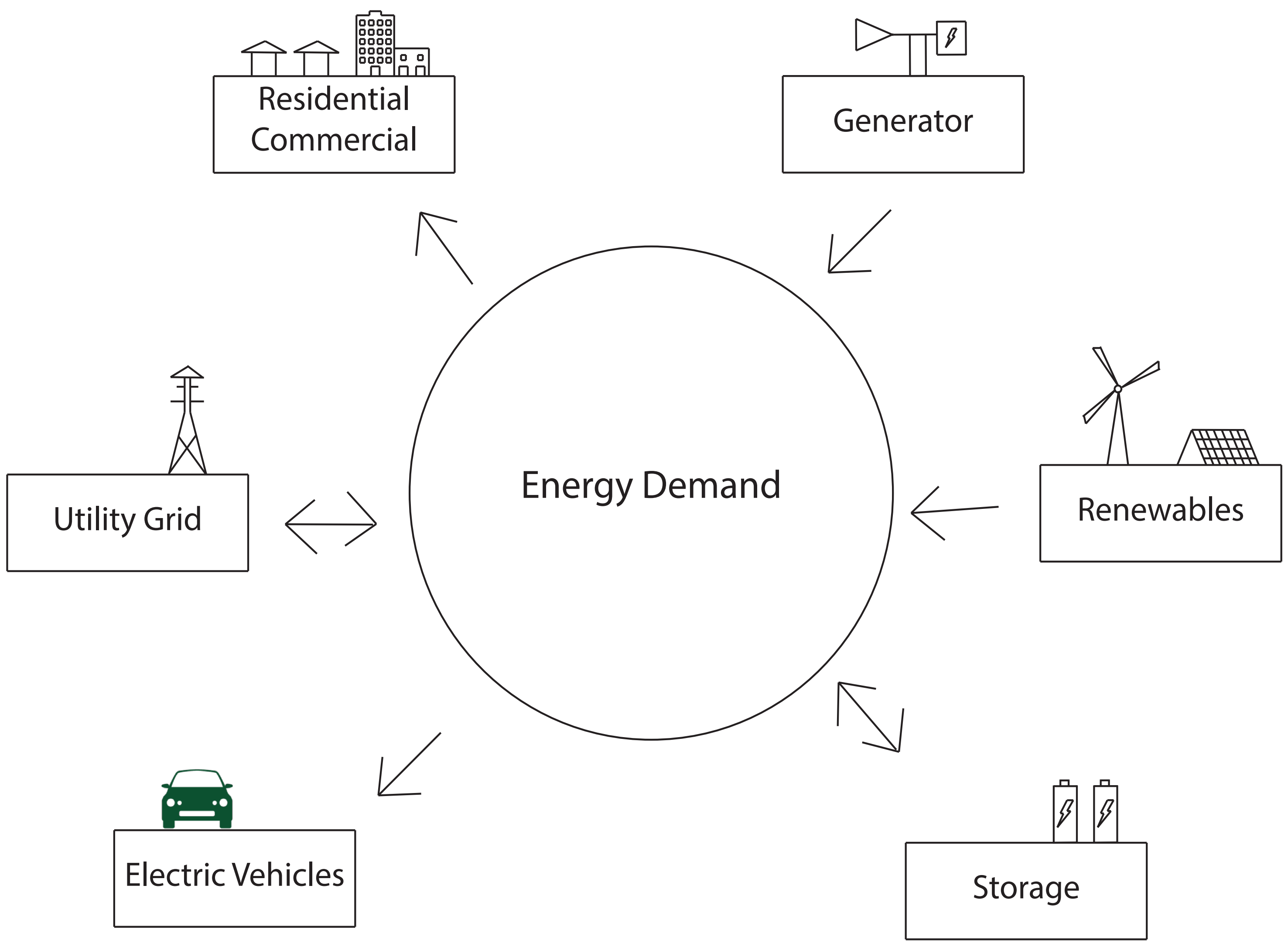


Rain water from roofs is a source of potable water. This water could be used for non-drinking purposes like flushing toilets, watering plants, etc. By disconnecting storm drains and realigning drains directly from the roof, the community can contribute to rainwater harvesting.

It is a small-scale solution contribution to the larger efforts surrounding flood mitigation across Kyojima by preventing water from entering the stormwater system.

Based on the average rain volume per year relative to the monthly water usage for toilet flushing, rainwater harvesting can fill the equivalent of approximately 1,497 shipping containers if 30% of the community disconnect their downspouts.

2a. i. Renewable Communities Plan

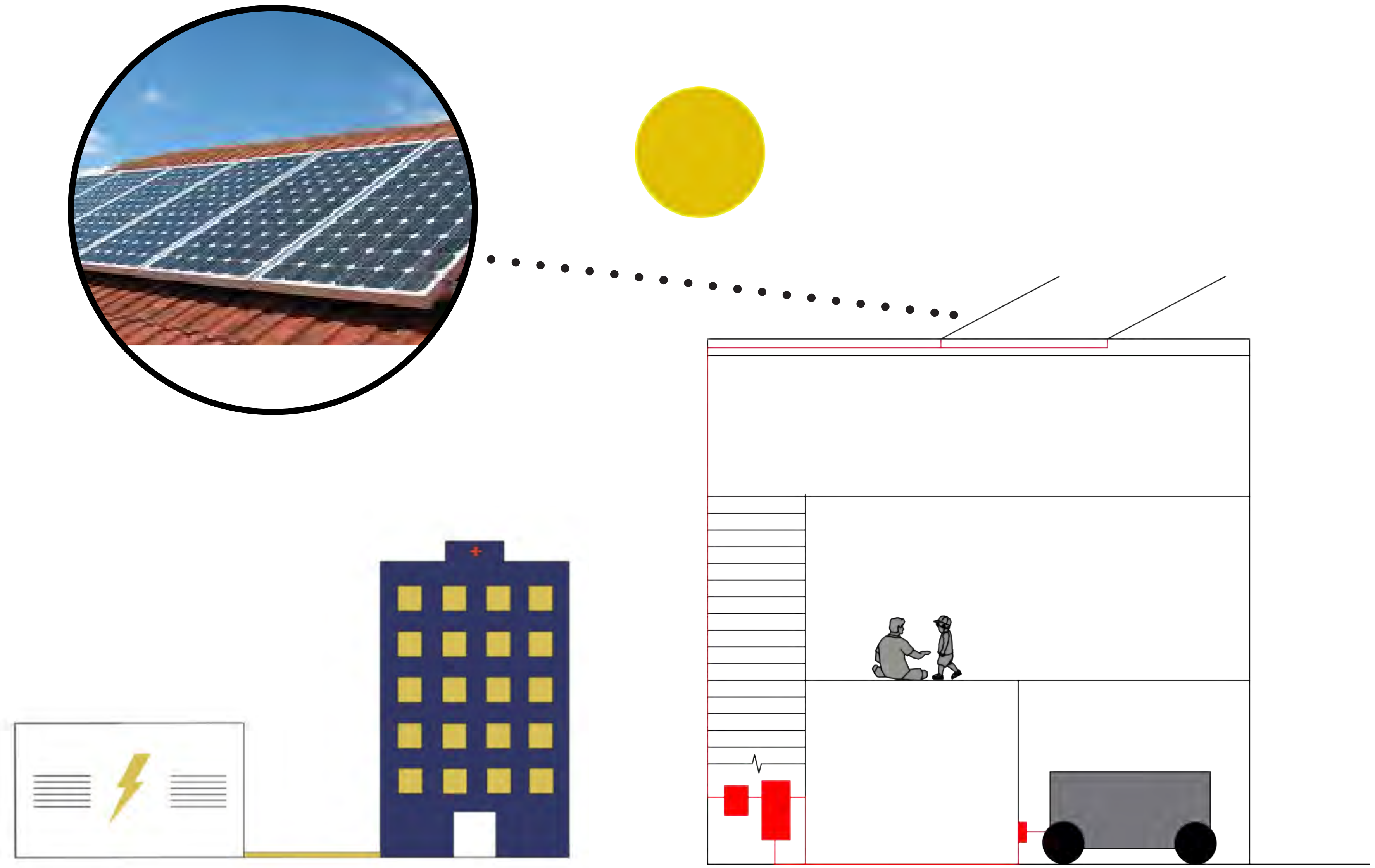


One of the overarching goals for Tokyo is to reduce energy usage. With the implementation of solar roofs, it can assist in creating a productive community that generates its own energy sustainably.

Renewable energy sources vary based on nature's schedule. Integrating them into the grid while maintaining and improving reliability is critical to forming a resilient city.

The proposed microgrid would function as a battery, storing excess energy from renewable sources, providing energy when needed. In the event of a disaster it would balance fluctuations in grid voltage or frequency, allowing hospitals and other emergency services to conduct business as usual.

2a. i. Renewable Communities Plan



This type of retrofitting would be best for properties with a roof that could support the weight of the system or newly constructed buildings. The incentive of a reduced electricity bill will be an encouragement for some to retrofit. It may also be worth implementing a tax credit for the year the solar panels were installed to incentivize retrofitting.

Based on the average energy usage for a residential property in Tokyo, a 4 panel 4 kilowatt solar panel system can produce 44% of the energy used by a residential property per month. This is the equivalent to cutting the energy bill in half.

The power generated could also be utilized as back up storage in the event of severe events that may disturb power distribution.

2a. i. Renewable Communities Plan

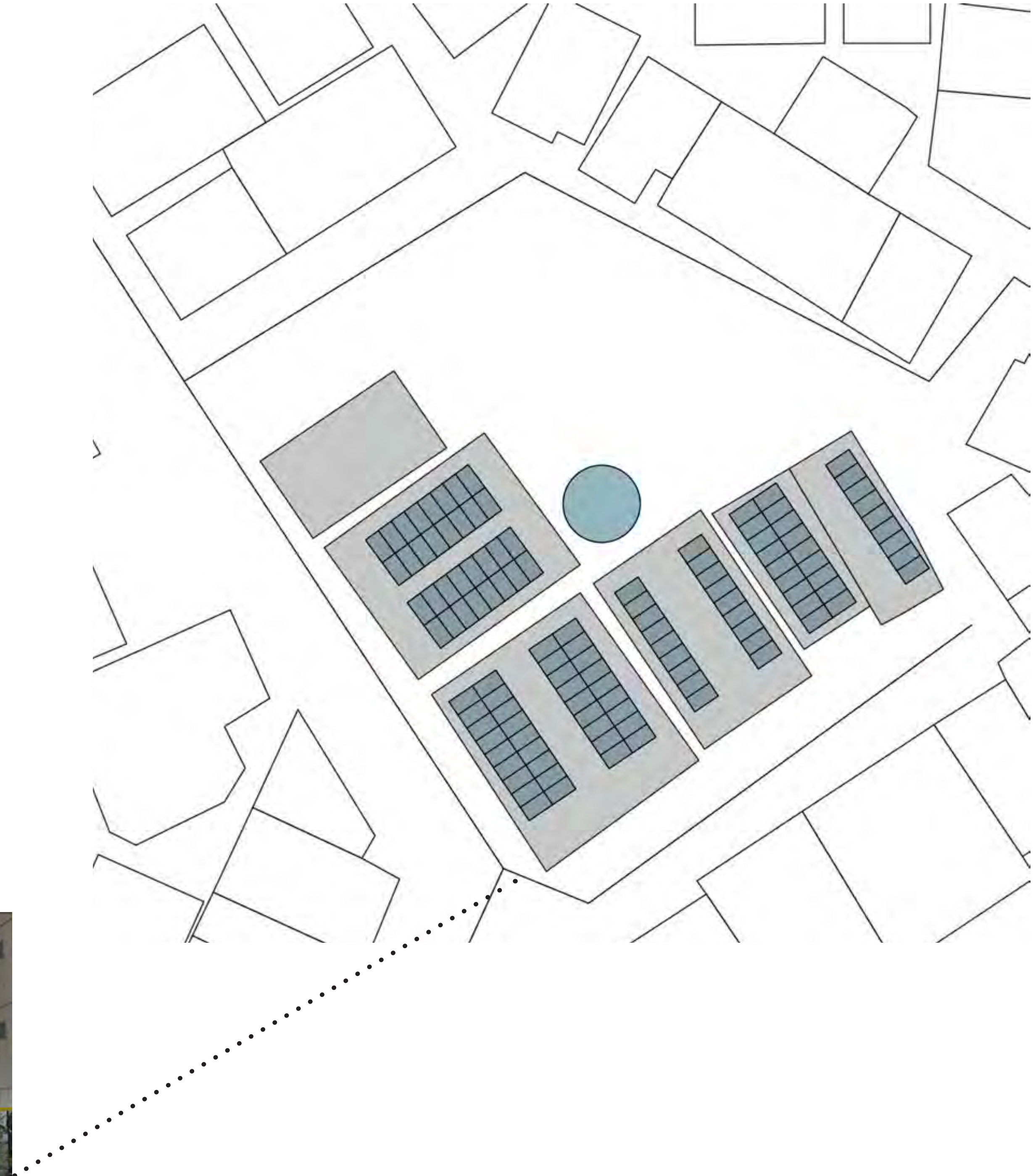
Downspout
Disconnection
Retrofits

504 gallons of
water diverted

Solar Production
Retrofits

16,993 kw of
energy
produced

Safe Haven
Retrofits



2b. i. Renewable Communities Design

Based on the analyses in the previous section, there is sufficient precedent to formulate a strategy to redevelop Kyojima into a safe, sustainable, and resilient community. Incremental redevelopment is to be moved by new policies and incentive mechanisms, and is to be illustrated by phasing through block level design. The following list is a set of recommendations that will, if implemented, contribute to this goal:

1. Multifamily housing should be adjacent to the roads designated for cars and autonomous vehicles.

2. Queue areas will act as boundaries between roads for cars and pedestrian only roads.

3. Single family housing should face toward pedestrian only roads.

4. Areas between blocks should be public and used as open space to encourage community interaction and provide opportunities for community-led activities (i.e. gardening, urban agriculture).

5. Access between blocks should be facilitated to increase walkability for pedestrians and help retain the historic character.

6. While the existing block framework of Kyojima is organic, these principles would help retain the density and character of Kyojima while also increasing access and safety.

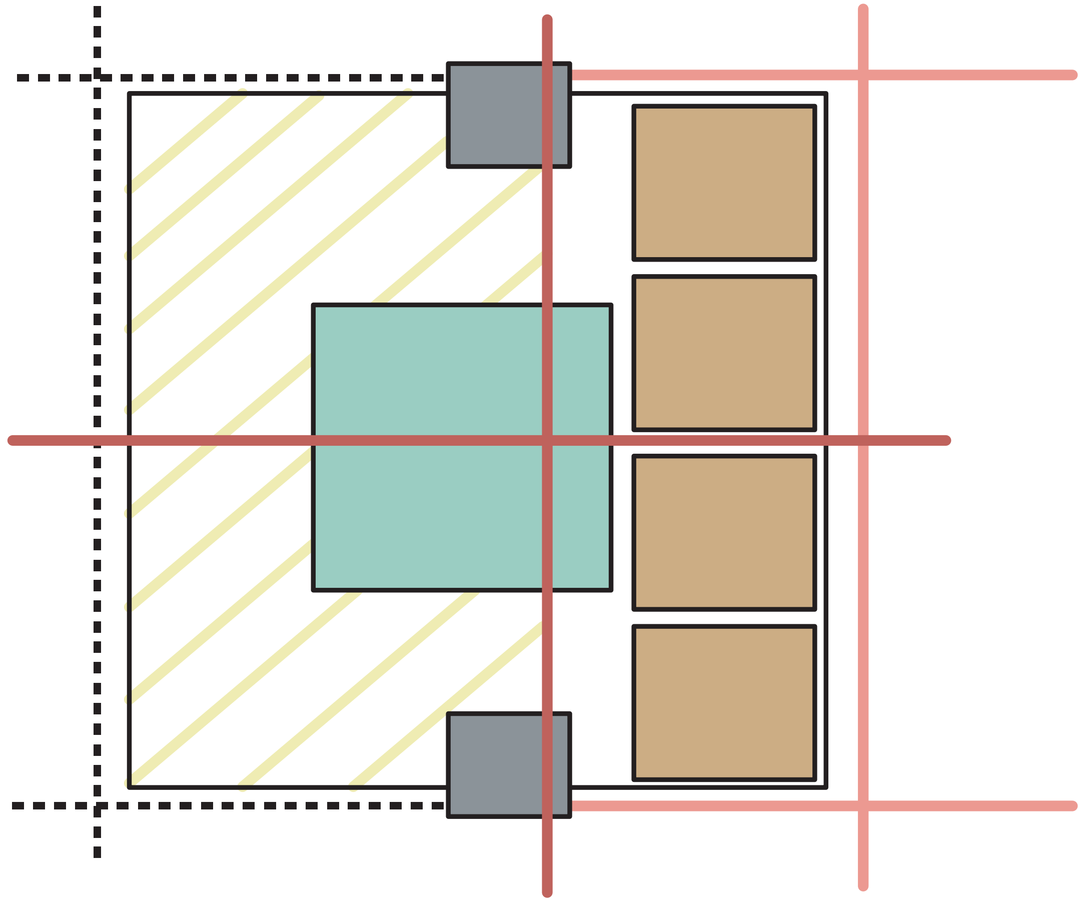


Diagram of block revisions

2b. i. Renewable Communities Design

The renewable communities plan is designed to enhance the safety and quality of the community by improving the street network, providing greater access to green space, and revitalizing commercial activity with the designation of a commercial corridor. The recommendations described on the next few pages are proposed as incremental strategies to achieving a more resilient Kyojima.

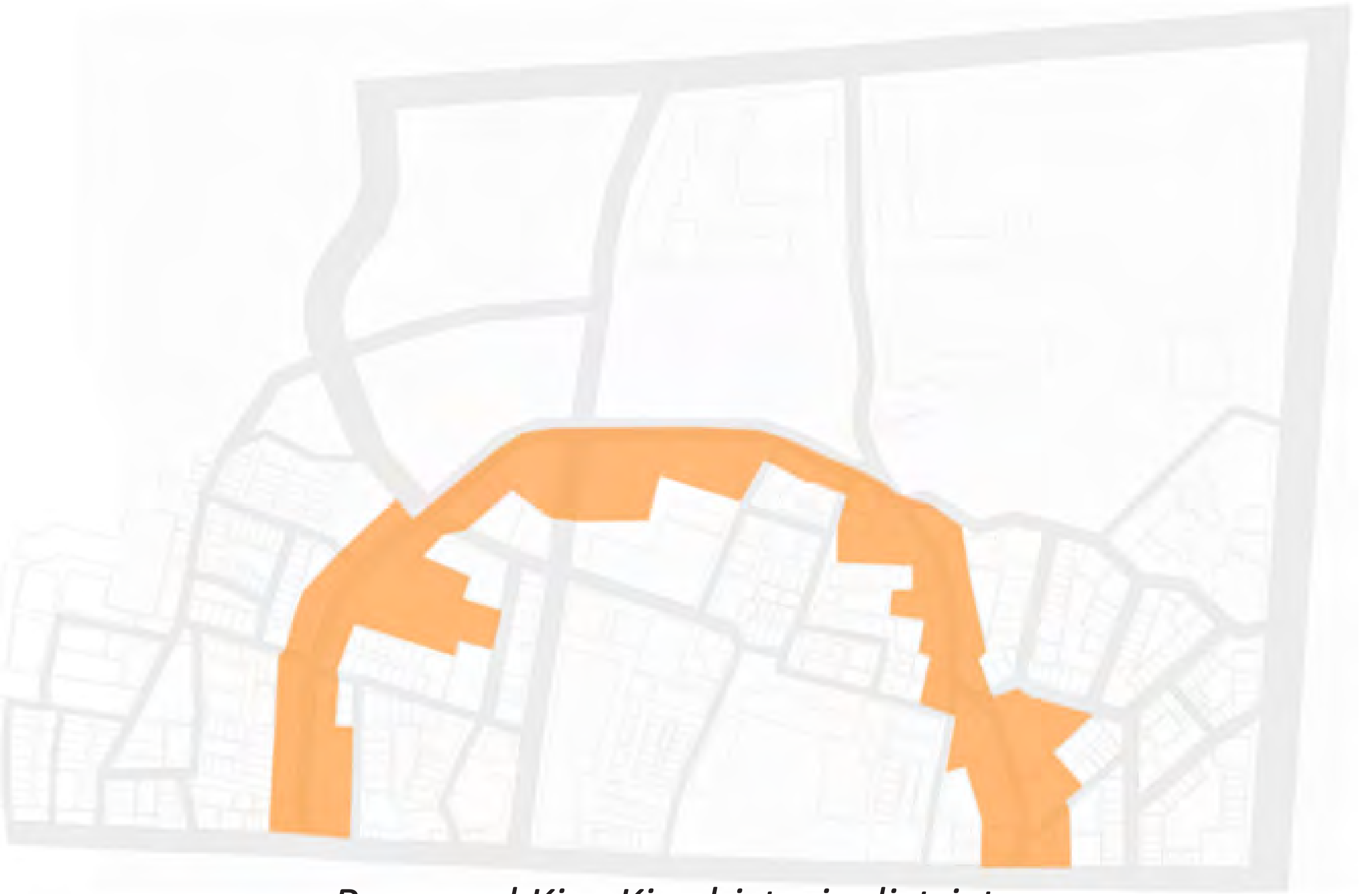
Strategy: The government can offer to tax the property with the lesser of the property values for up to 5 years following the realignment of the parcels.

Unification of the block to realign the parcels is the most ideal scenario for transformation of the community. It allows for development to continue to occur but requires sustainable and safer redevelopment that address issues. While this would require demolition of existing buildings, it ultimately provides an opportunity to reorient housing for better performance.

Reorganization of blocks

2b. i. Renewable Communities Design

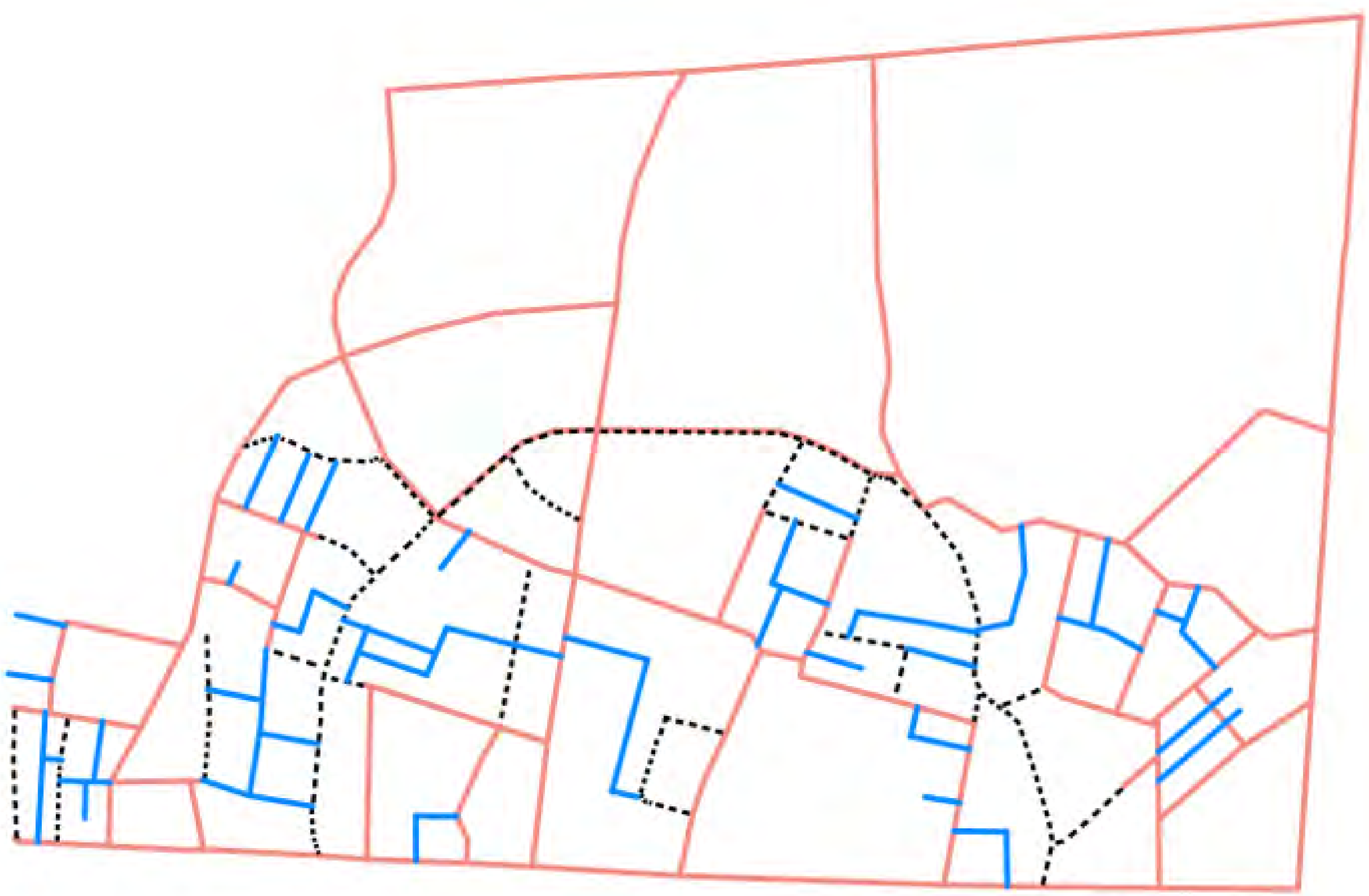
In an effort to preserve what remains of the historic character of Kyojima, we recommend policy amendments that would prohibit building heights of over 6 stories along the selected KiraKira loop. In addition, the local community would benefit from the designation of a historic district along this path.



Proposed Kira Kira historic district

2b. i. Renewable Communities Design

Upon reorganization of the blocks, the street network would also have to be revised to accommodate both pedestrians and automobiles. Existing alleyways are preserved to provide space for children to play under supervision of their guardian(s), and to encourage car-free commuting. Select automobile lanes would be widened based on the road network analysis provided in the previous section.



Proposed street network hierarchy

Street Types:

Cars and Autonomous Vehicles

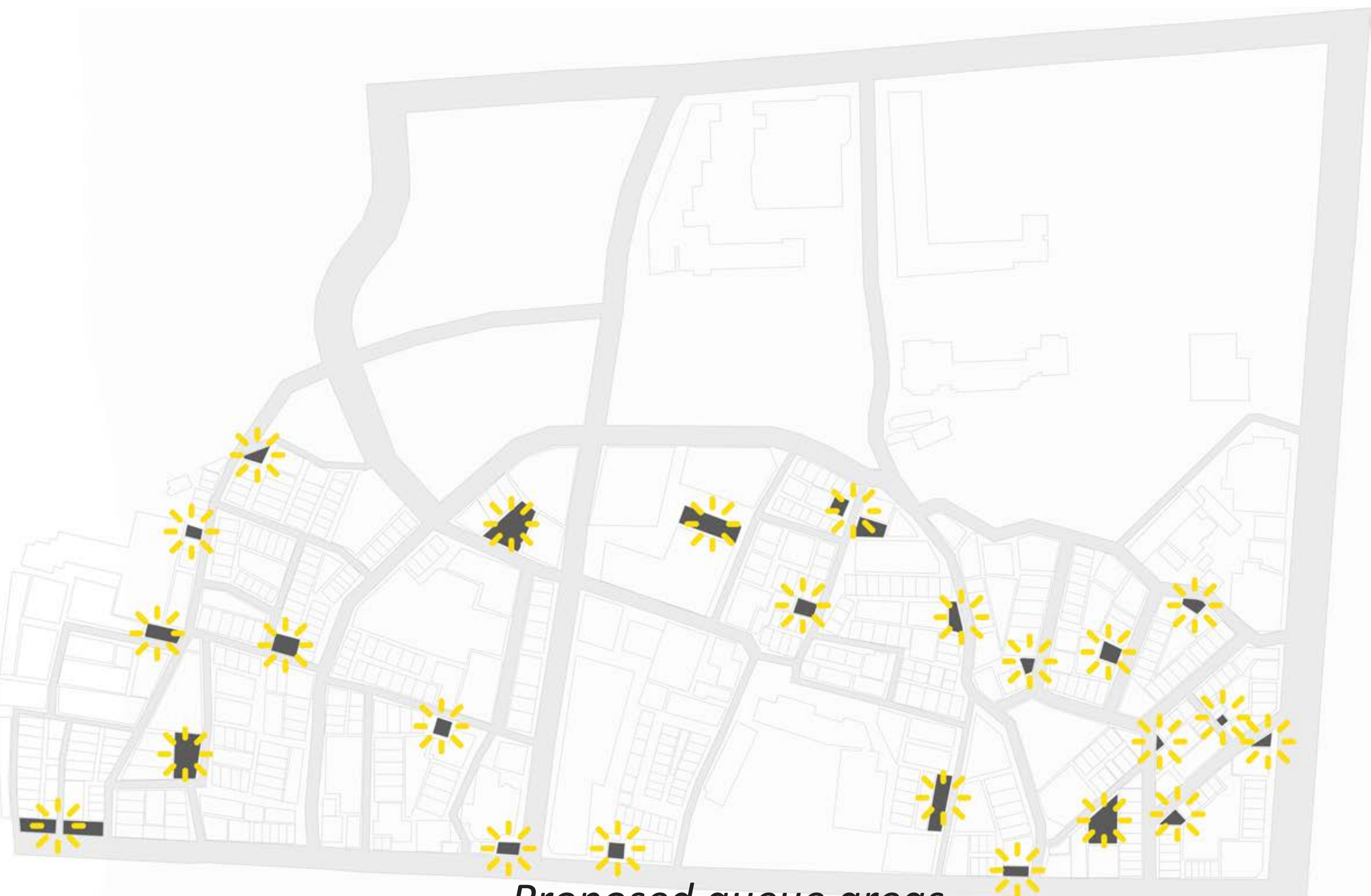
- 2-lane and 4-lane roads with sidewalks

Pedestrian Only

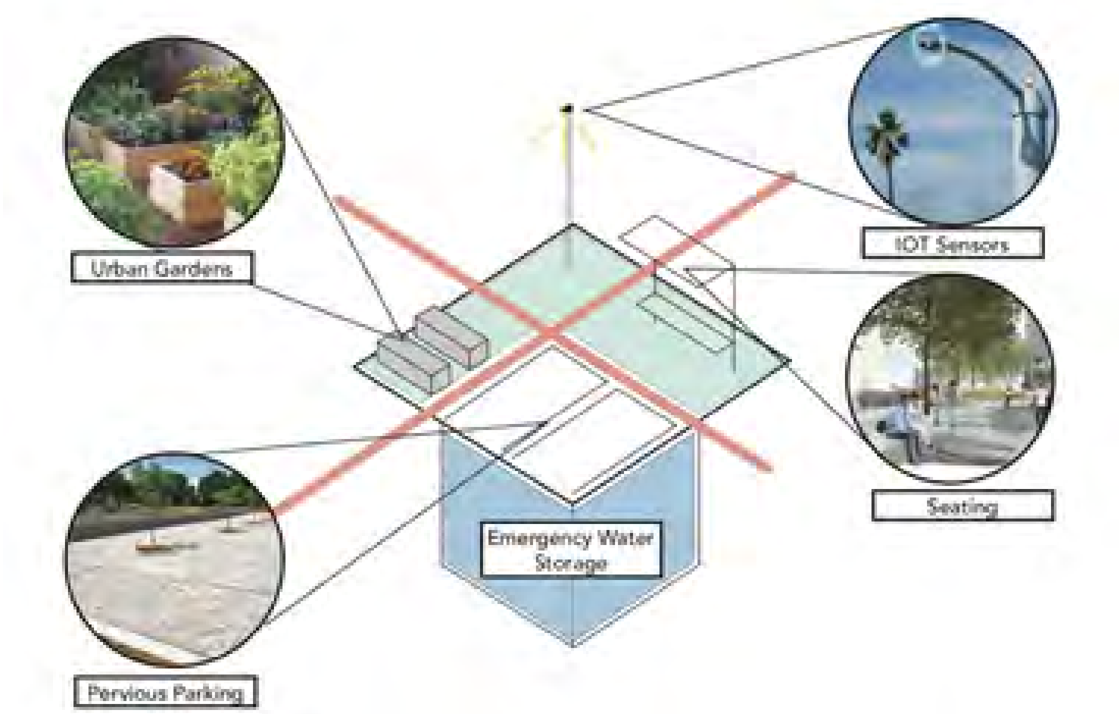
Pedestrian Alleys

- Allows for pedestrians to travel through the block
- Width is ~3 meters

Proposed queue areas have been designated strategically around the selected Kyojima block. These multifunctioning areas would serve residents and visitors of all ages and abilities, and would be subject to flexible zoning depending on their chosen purpose. Their functions are outlined to the right of this page.



Proposed queue areas



Queue Area Functions:

1. Pick up and drop off locations for both online and in-store purchases
2. Paid parking spaces or charging stations for autonomous vehicles
3. Evacuation spots for post-disaster (earthquake, fire, etc.) organizing
4. Farmer's markets
5. Green space
6. Water storage

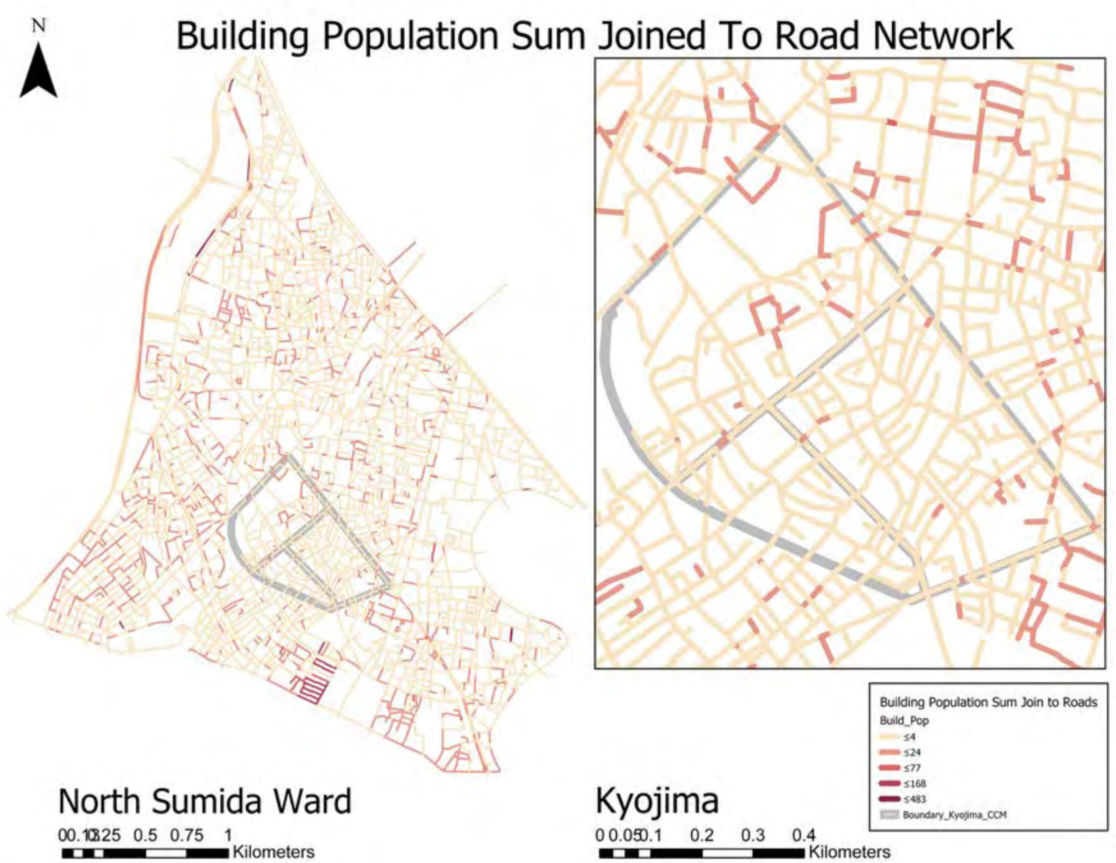
2b. i. Renewable Communities Design

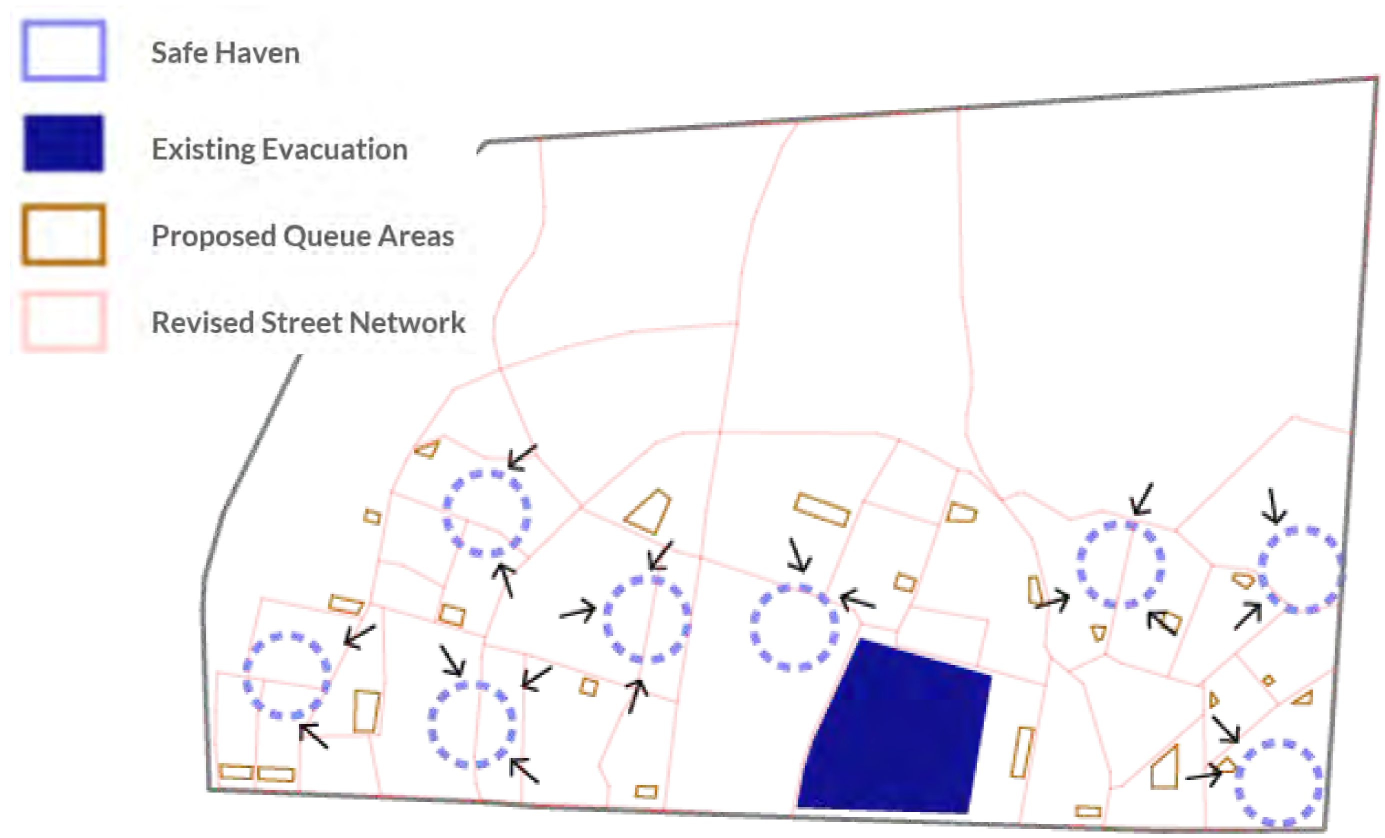
Proposed open space areas

The existing parks and open space areas in Kyojima are sparse and largely composed of concrete material. We propose “greening” some of these areas to reduce the urban heat island effect, capture storm water, and provide a natural, eye-catching aesthetic for residents and visitors to play and relax.

2b. i. Renewable Communities Design

The map below depicts building population snapped to individual road segments in North Sumida and Kyojima. The existing building population was spatially joined to closest road segment, providing a theoretical estimate of number of people flocking to streets if a disaster were to strike. This map highlights roads that would experience maximum people flow in a disaster scenario. Combined with the analyses described in the previous section, this figure was used to develop the proposal described to the right.





Combined incremental strategies

‘Safe havens’ are a concept that would assist residents, particularly the elderly, disabled, or otherwise marginalized individual(s) in the event of a flood or other natural disaster. Existing evacuation areas are often overcrowded and unpleasant for people in need. Safe havens include the addition of one floor to existing homes or new-builds to provide refuge until emergency services are able to assist.

2b. i. Renewable Communities Design

reorganization of blocks

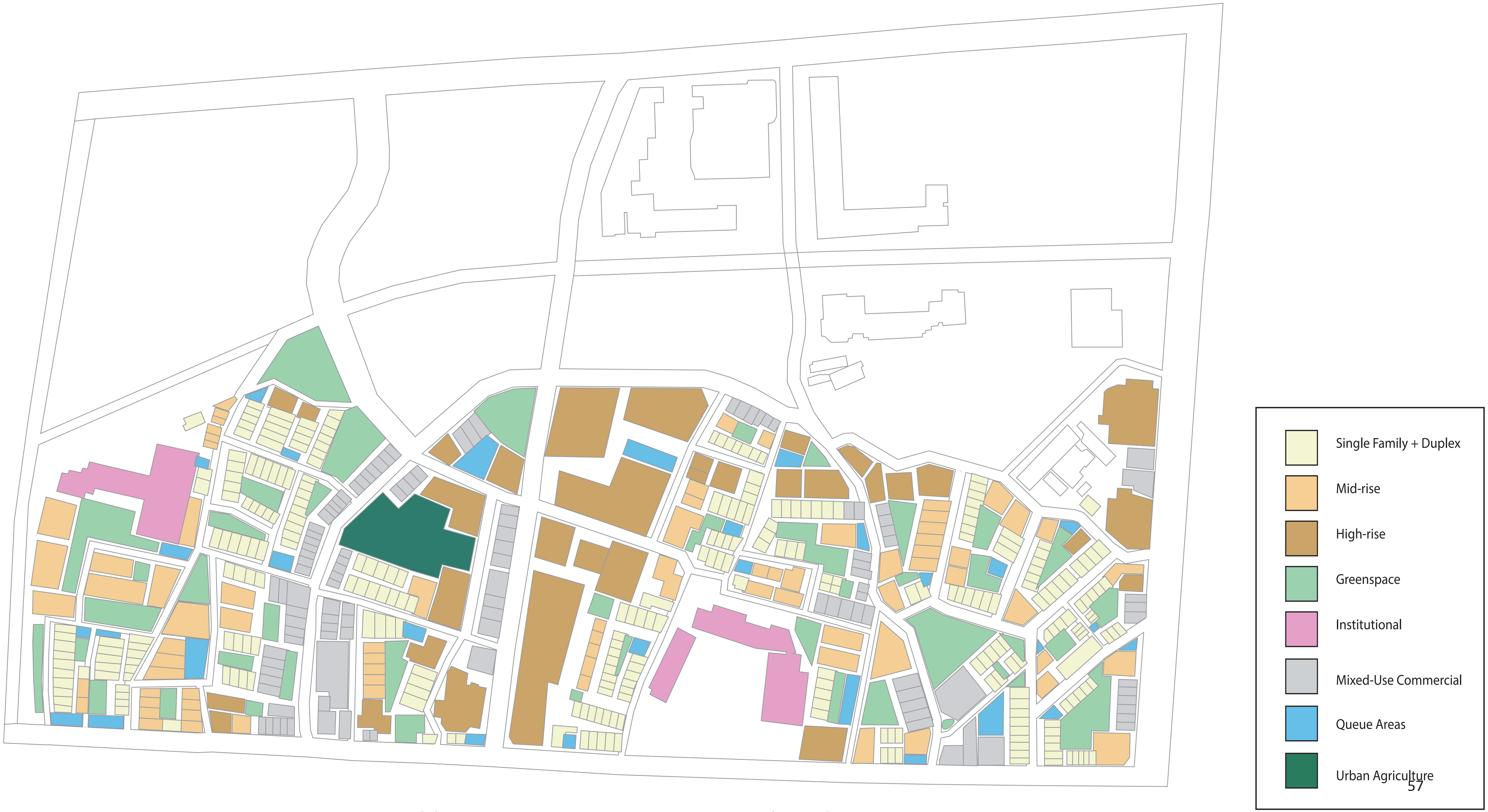
reconfiguration of alleyways

proposed street hierarchy

redevelopment along KiraKira corridor

proposed queue areas

proposed open space

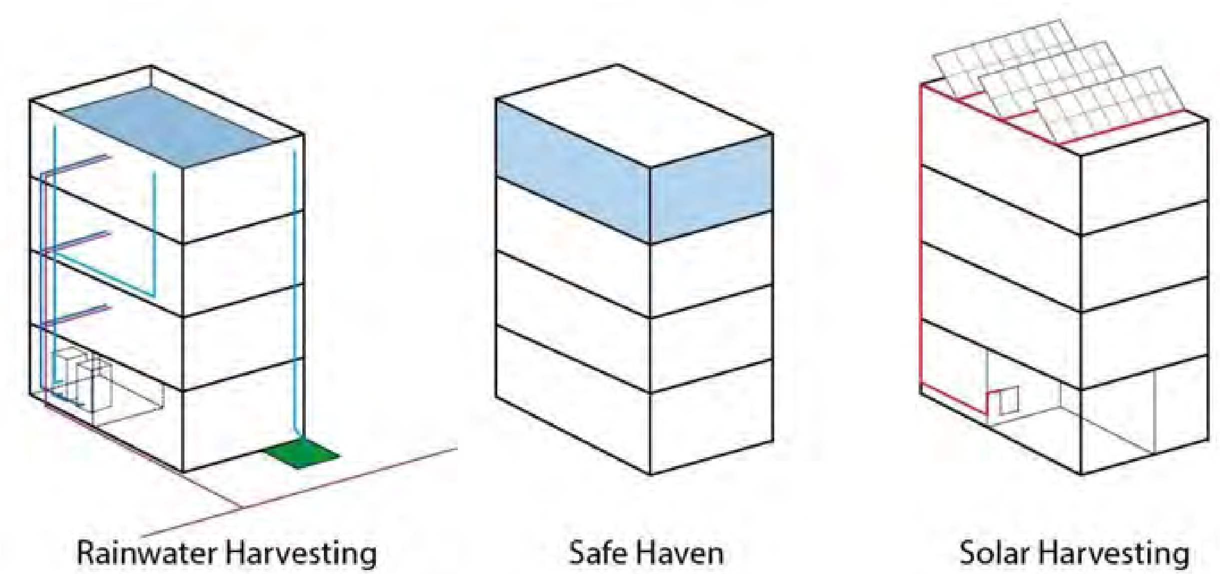


Renewable communities strategies, combined

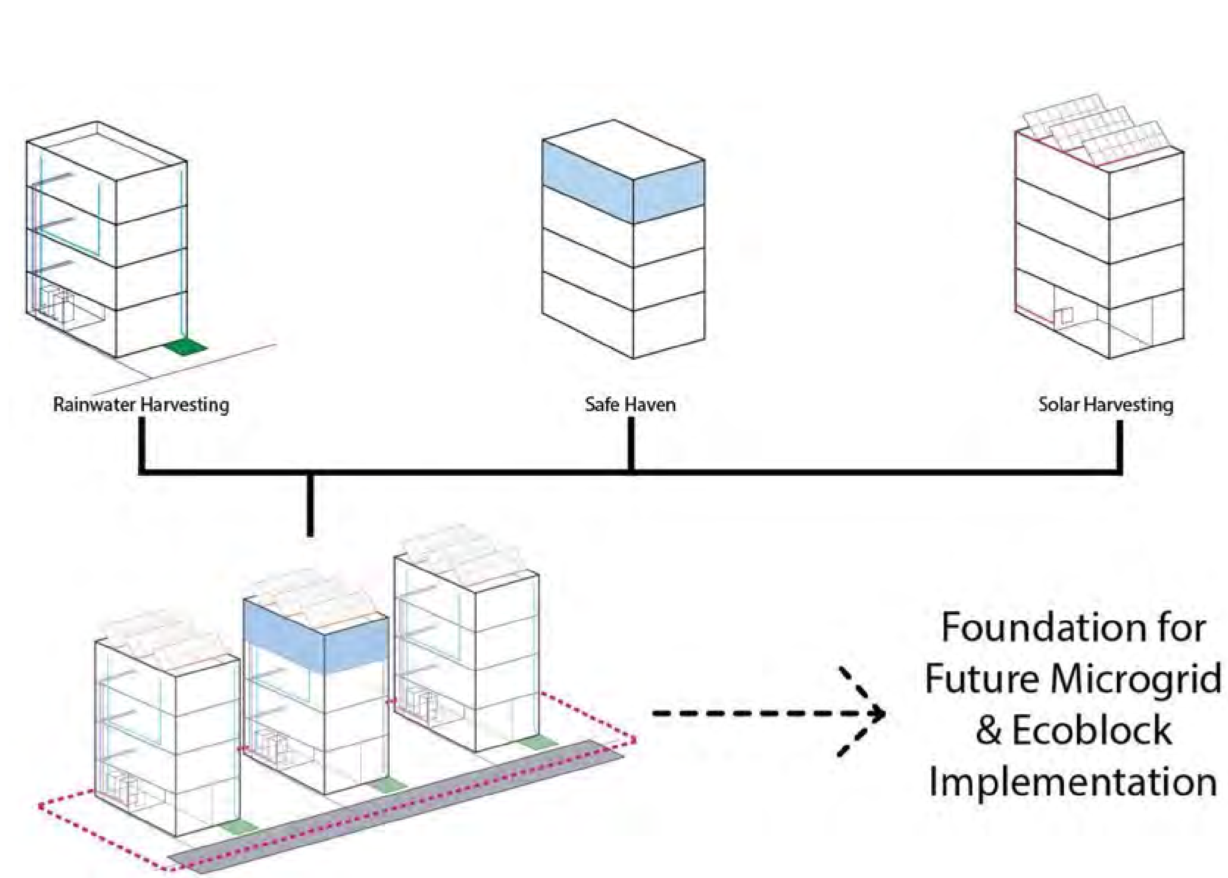
2b. ii. Redevelopment Tools

If property owners within the block can't come together to agree to realign the parcels, individual owners wanting to improve the property should retrofit properties in the existing allotted parcel using best design and sustainability practices for short term strategies proposed.

Eco-Area Ratio focuses on the impact of urban geometry on energy performance. It measures the amount of carbon reduction after site redevelopment. By meeting the policy goal of carbon reduction set by the Tokyo government, the developer would gain additional FAR as the bonus.

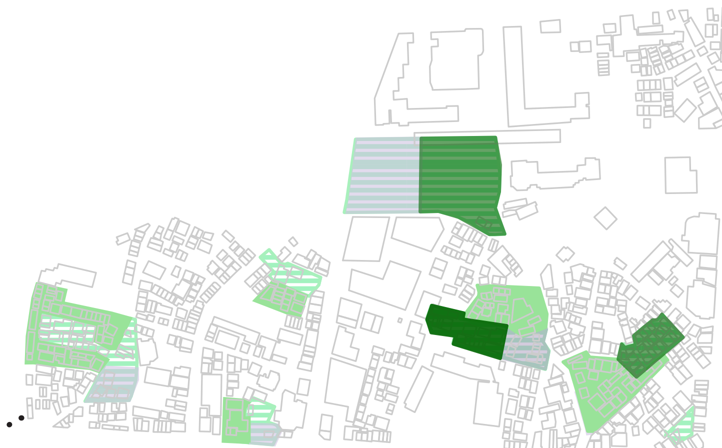


Tool: Individual retrofits



Tool: Eco-Area Ratio

2b. ii. Redevelopment Tools



Build on clear land and relocate people to Phase II areas to give room for new mixed-use development

Identify vacant properties to accommodate density and clearing

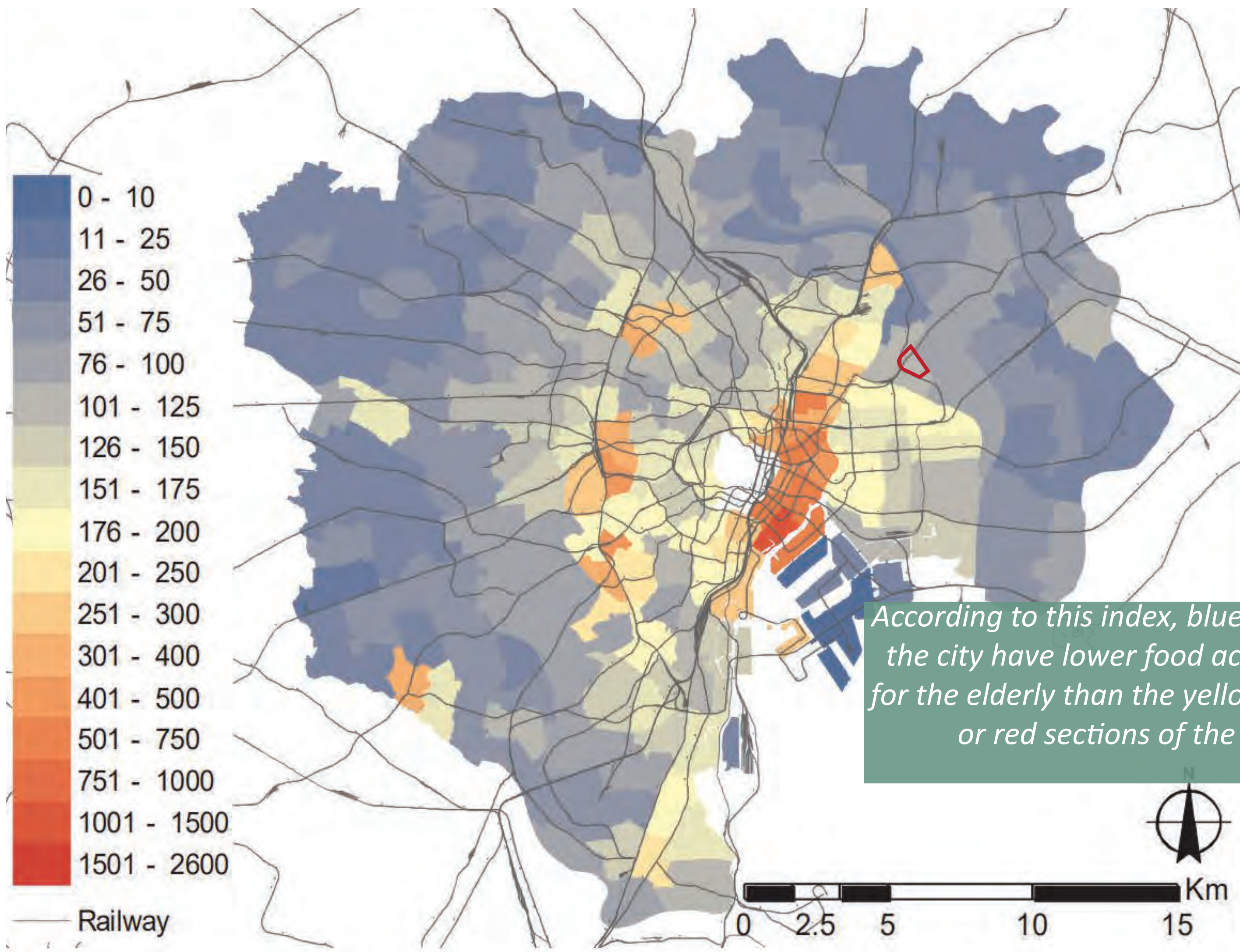
Development and provision of public space should occur together; they are not independent of each other

Rehabilitate strategic areas for mixed-use development

2c. Urban Farming

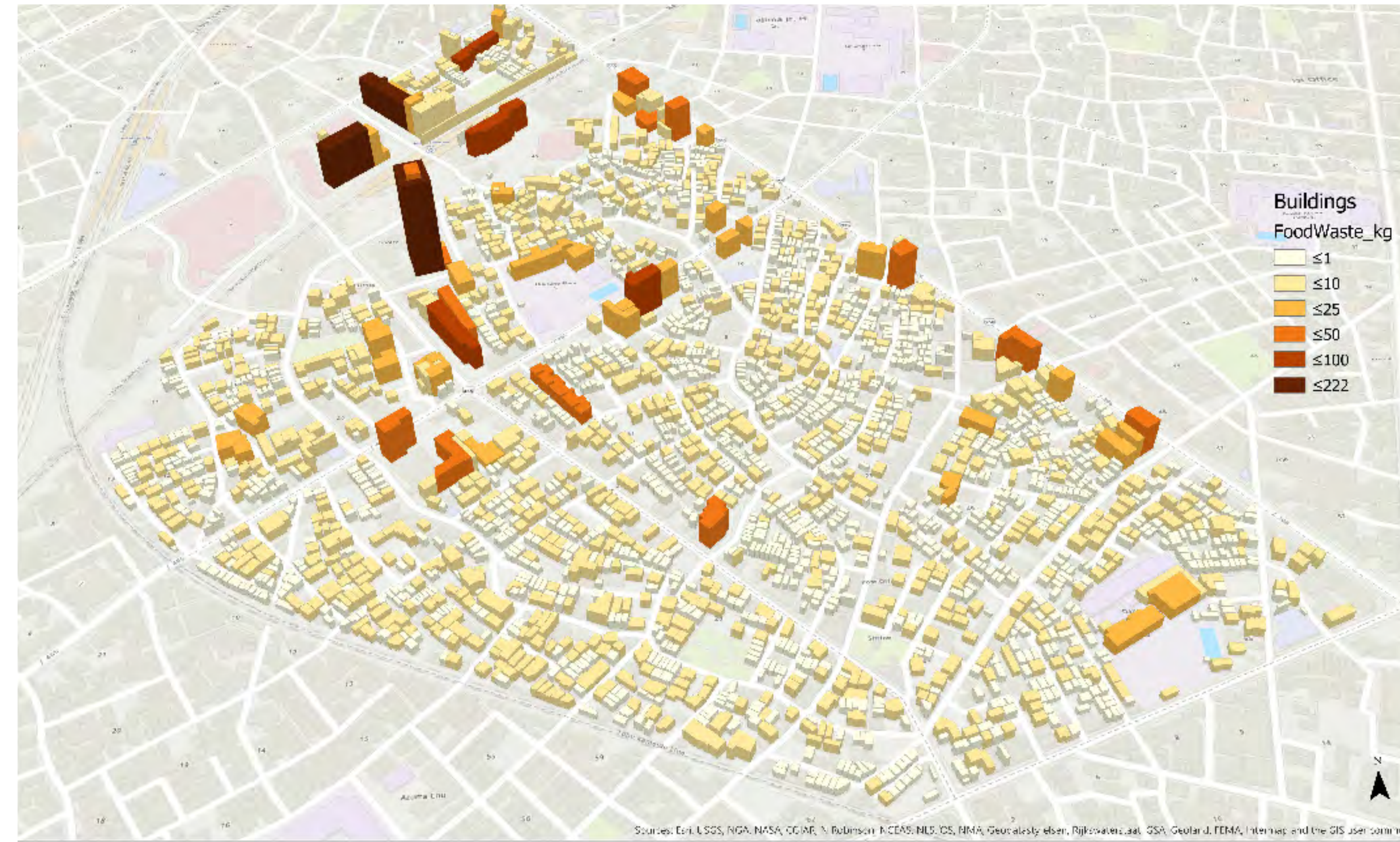
2c. i. The Problem

Average accessibility of supermarkets + other grocery retailers for elderly residents of Tokyo



According to this index, blue regions of the city have lower food accessibility for the elderly than the yellow, orange, or red sections of the city.

Yuran, C., & Tsutomu, S. (2013). Food deserts, activity patterns, & social exclusion: The case of Tokyo, Japan. Retrieved from https://core.ac.uk/download/pdf/56654741.pdf



2c. i. The Problem

Japan's Food Waste			Source
Japan's Annual Food Waste	6.2	billion kg	1
Japan's Population	127	million people	
Japan's Annual Food Waste per Person	48.82	kg	
Japan's Daily Food Waste per Person	0.134	kg	
Average Methane Emissions per kg of Food Waste	1.9	kg CO2-e	2
Japan's Annual Food Waste Methane Emissions per Person	92.76	kg CO2-e	
Japan's Annual Food Waste Methane Emissions	**5.34**	**billion kg CO2-e**	

Tokyo's Food Waste		
Tokyo's Annual Food Waste	453	million kg
Tokyo's Population	9.28	million people
Tokyo's Annual Food Waste per Person	48.82	kg
Tokyo's Daily Food Waste per Person	0.134	kg
Average Methane Emissions per kg of Food Waste	1.9	kg CO2-e
Tokyo's Annual Food Waste Methane Emissions per Person	92.76	kg CO2-e
Tokyo's Annual Food Waste Methane Emissions	**390**	**million kg CO2-e**

Japan's Recoverable Water from Food Waste			
Average Water Recovered per kg of Food Waste	0.569	liters	3
Japan's **Potential Annual Water Recovery** from Anaerobic Digestion of Food Waste	**3.53**	**billion liters**	

Tokyo's Recoverable Water from Food Waste		
Average Water Recovered per kg of Food Waste	0.569	liters
Tokyo's Potential Annual Water Recovery from Anaerobic Digestion of Food Waste	**257.76**	**million liters**

Japan's Recoverable Energy from Food Waste			
Average Electricity Generated from Anaerobic Digestion (CHP) per kg of Food Waste	0.24	kWh	3
Japan's Potential Annual **Electricity Generation** from Anaerobic Digestion of Food Waste	1.49	billion kWh	
Japan's Average Electricity Consumption per Person	2,245.8	kwh	4
Anaerobic Digestion of Japan's Food Waste could provide enough electricity for	**663,461**	**people**	
Japan's Coal Plants' Average CO2/kWh	0.87	kg CO2-e / kWh	5
Japan's **Potential Reduction in Coal CO2 Emissions** by Utilizing Anaerobic Digestion	1.30	billion kg CO2-e	

Tokyo's Recoverable Energy from Food Waste		
Average Electricity Generated from Anaerobic Digestion (CHP) per kg of Food Waste	0.24	kWh
Tokyo's Potential Annual **Electricity Generation** from Anaerobic Digestion of Food Waste	108.7	million kWh
Japan's Average Electricity Consumption per Person	2,245.8	kwh
Anaerobic Digestion of Tokyo's Food Waste could provide enough electricity for	**48,401**	**people**
Japan's Coal Plants' Average CO2/kWh	0.87	kg CO2-e / kWh
Tokyo's **Potential Reduction in Coal CO2 Emissions** by Utilizing Anaerobic Digestion	94.6	million kg CO2-e

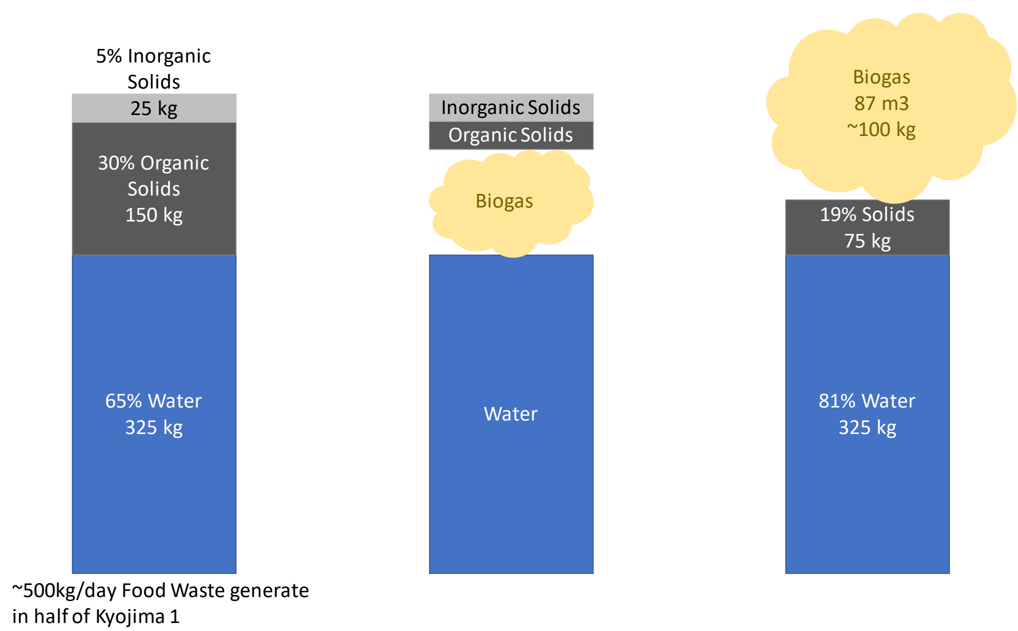
Sources
1. https://www.nippon.com/en/features/h00278/mottainai!-japan-wastes-around-6-5-million-tons-of-food-per-year.html
2. https://watchmywaste.com.au/food-waste-greenhouse-gas-calculator/
3. https://pdfs.semanticscholar.org/1409/db3c2932252628c17bcfdf8e9613e8f4f03a.pdf
4. https://www.statista.com/statistics/597901/household-consumption-of-electricity-per-capita-in-japan/
5. http://www.iberglobal.com/files/2017/japon_energy.pdf

Although Japan has one of the lowest levels of food waste per person in the world, there is still room for improvement. Nutrients from food waste can be used to produce energy while simultaneously conserving water, yielding a net reduction in greenhouse gas emissions and a more sustainable community.

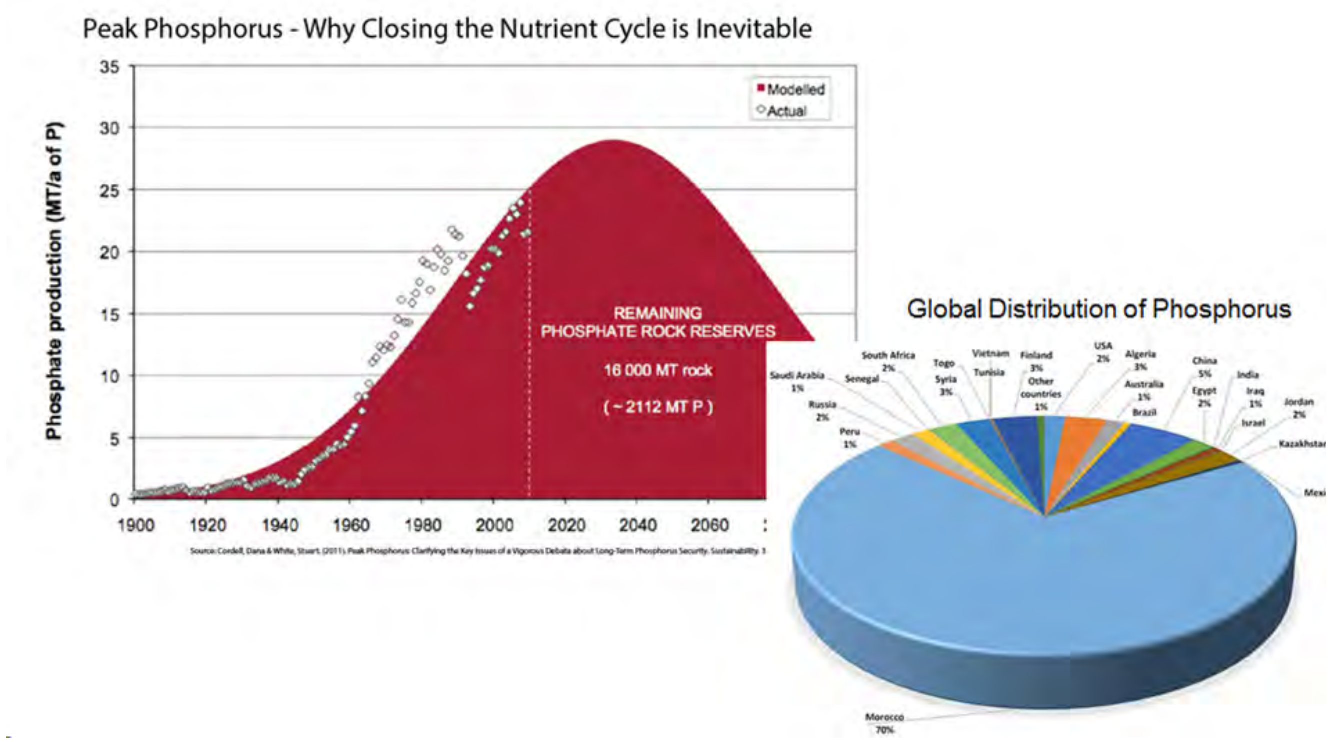
2c. i. The Problem

			Kyojima-1 population	6,000	people
Superblock population	6,000	Based on GIS	% Participating Population	5%	
Food Waste	0.13	kg/p/d	Participating Population	300	
Food Waste	0.04	ton/day	**Waste generated (WW)**	**40**	**kg/day**
Biogas production	642	m3/ton VS	**Biogas production**	**6**	**m3**
Methane content	62%		**Methane production**	**4**	**m3**
Digestate / total input	73%		**Digestate generated**	**41**	**kg/day**
Farming			Farming		
Nitrogen as fertilizer	4	gN/m2/yr	Hydroponic area supported	18,831	m2
Kyojima-1 Area	214,824	m2	Hydroponic Area Available	4,320	m2
Vegetable production	10	kg/m2/yr	Vegetable production	43,200	
Vegetable consumption	64	kg/p/yr	% Veg. Self-Sufficiency	11%	of superblock vegetable demand
Nitrogen Needed	0.05	kgN/day	Digestate needed	9.30	kg/day
# buildings, roughly	1,200	buildings	Avg Farm area/building	4	m2

Anaerobic Digestate Conversion Potential

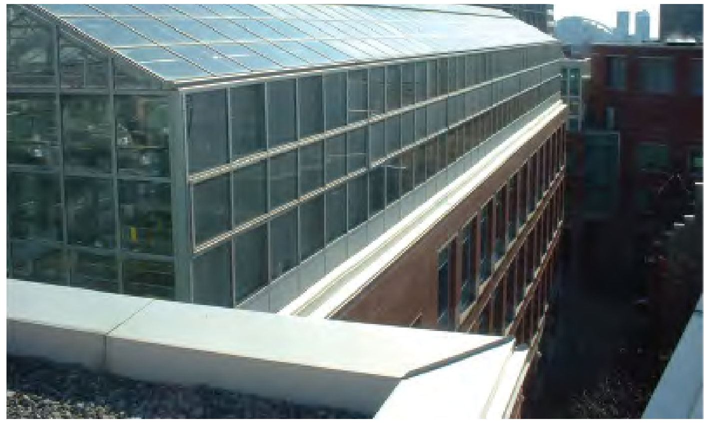


Incinerating food waste is a waste of resources: water, energy, and fertilizer. It also releases greenhouse gases, which can be diverted. **Hydroponics** is the process of intensively growing plants without soil. **Anaerobic Digestion** is the process of converting food waste into water, energy, and fertilizer, which can be utilized as resources. This is essential, because the world is running out of fertilizers, and we must close the loop on nutrient cycles.



2c. ii. Proposed Solutions

Digeponics is the process of turning food waste into food, back into food waste, etc. It is a sustainable technology that helps to significantly increase the sustainability of the food system. Although artificial lights can be used, sunlight is significantly more sustainable and cost-effective. For this reason, greenhouses are the preferred structure. They can be placed in empty lots that receive adequate of sun, or they can be placed on rooftops, as long as the building is strong enough to handle the increased weight. Digeponics facilities can be big or small, but the bigger they are, the more efficient they will be so it's better to make a few large facilities than a multitude of tiny ones.



2c. ii. Proposed Solutions

CM per side	CM Squared	M per side	M Squared	Ft Squared	Kg of Tomatoes	lb of Tomatoes	Tomato Plants	Conventionally-Grown Tomatoes - kg of CO2-e	Digeponics-Grown Tomatoes - kg of CO2-e
36	1296	0.36	0.1296	1.4	16	35	1	3	0.1
		1	1	10.8	123.45	272	8	27	0.5
		3.16	10	108	1234.5	2,722	77	268	5.4
		4.47	20	215	2469	5,444	154	536	10.7
		10	100	1,076	12,345	27,218	772	2,679	53.6
		20	400	4,304	49,380	108,872	3,086	10,715	214.3

Assuming 16kg (35.27 lbs) of tomatoes produced per plant per year. *1
Assuming .217 kg of CO2-e per kg of Tomatoes. *2

Sources:
1. Pena, J. G. (2005, May). Greenhouse Vegetable Production Economic Considerations, Marketing, and Financing. Retrieved from https://aggie-horticulture.tamu.edu/greenhouse/hydroponics/economics.html
2. Cembalo, Luigi & Del Giudice, Teresa & Caracciolo, Francesco. (2013). CO2 Emission in the Fresh Vegetables Chains: A meta-analysis. Quality - Access to Success. 14. 96-102.

By utilizing its waste, Japan can make its urban agriculture more sustainable. Through the process of digeponics, Japan could **produce approximately 12,000 kg of tomatoes per year for every 100 sq meters of land** that it allocates towards this process. In addition to tomatoes, Japan could utilize its waste to grow cucumbers, lettuce, and a variety of other delicious fruits and vegetables.

Japan's calorie-based self-sufficiency rate is about 40%, meaning that **Japan imports approximately 60% of its food**, and Japan's government has expressed interest in becoming more self-sustaining. By utilizing the process of digeponics, the government could increase the nation's food security, making Japan less reliant on food from other countries, while also reducing Japan's food waste and carbon footprint.

As this diagram shows, you can produce a lot of tomatoes in a relatively small space using digeponics.

Rooftop gardens and digeponics facilities offer impressive yields of fresh fruits and vegetables all year long. They are highly profitable, as the facilities can charge a premium for their produce due its superior freshness and the novelty of eating food grown on a roof in a city. These innovations also provide a layer of insulation for the building below, reducing excessive heating and cooling costs. Finally, they are an opportunity for low-income communities to have increased access to healthy food.

Kyojima's Food Waste		
Tokyo's Annual Food Waste	292,913	kg
Kyojima's Population	6,000	people
Kyojima's Annual Food Waste per Person	48.82	kg
Kyojima's Daily Food Waste per Person	0.134	kg
Average Methane Emissions per kg of Food Waste	1.9	kg CO2-e
Kyojima's Annual Food Waste Methane Emissions per Person	92.76	kg CO2-e
Kyojima's Annual Food Waste Methane Emissions	**556,535**	**kg CO2-e**

Kyojima's Recoverable Water from Food Waste		
Average Water Recovered per kg of Food Waste	0.569	liters
Kyojima's Potential Annual Water Recovery from Anaerobic Digestion of Food Waste	**166,668**	**liters**

Kyojima's Recoverable Energy from Food Waste		
Average Electricity Generated from Anaerobic Digestion (CHP) per kg of Food Waste	0.24	kWh
Kyojima's Potential Annual Electricity Generation from Anaerobic Digestion of Food Waste	70,299	kWh
Japan's Average Electricity Consumption per Person	2,245.8	kWh
Anaerobic Digestion of Kyojima's Food Waste could provide enough electricity for	**35**	**people**
Japan's Coal Plants' Average CO2/kWh	0.87	kg CO2-e / kWh
Kyojima's Potential Reduction in Coal CO2 Emissions by Utilizing Anaerobic Digestion	**61,160.3**	**kg CO2-e**

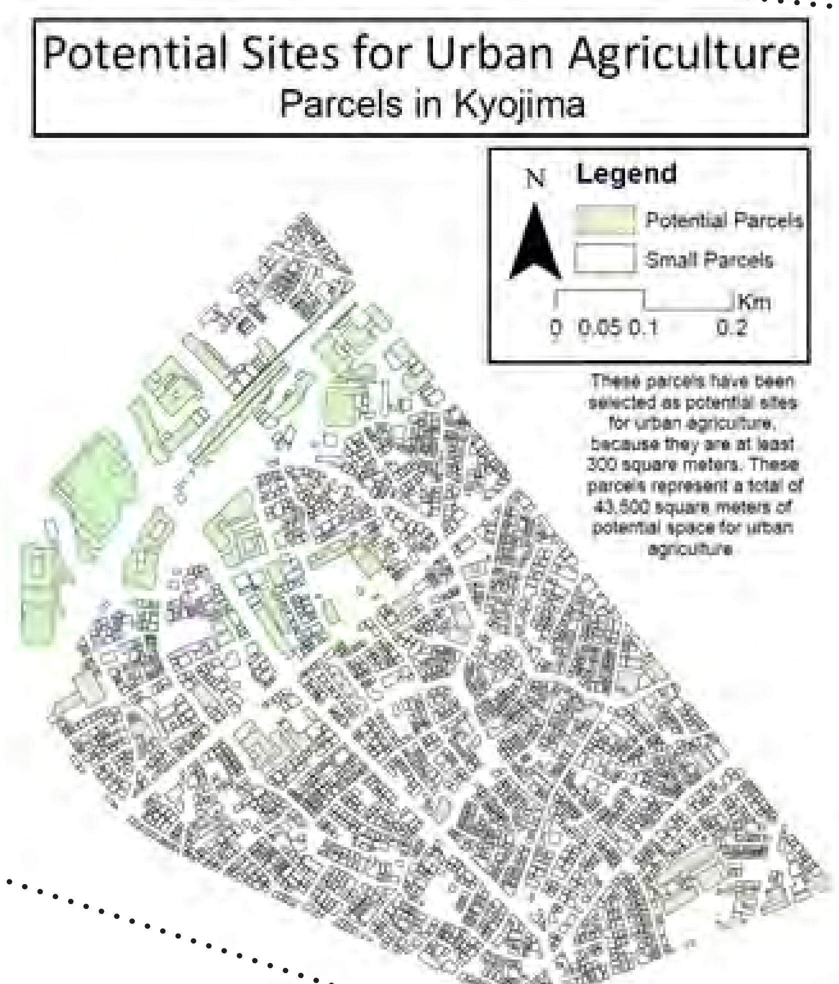
Kyojima's Potential Production & Requirements

Production	
Plant Space	2,175 Square m
Tomatoes	268,504 kg/year
Tomato Plants	16,782

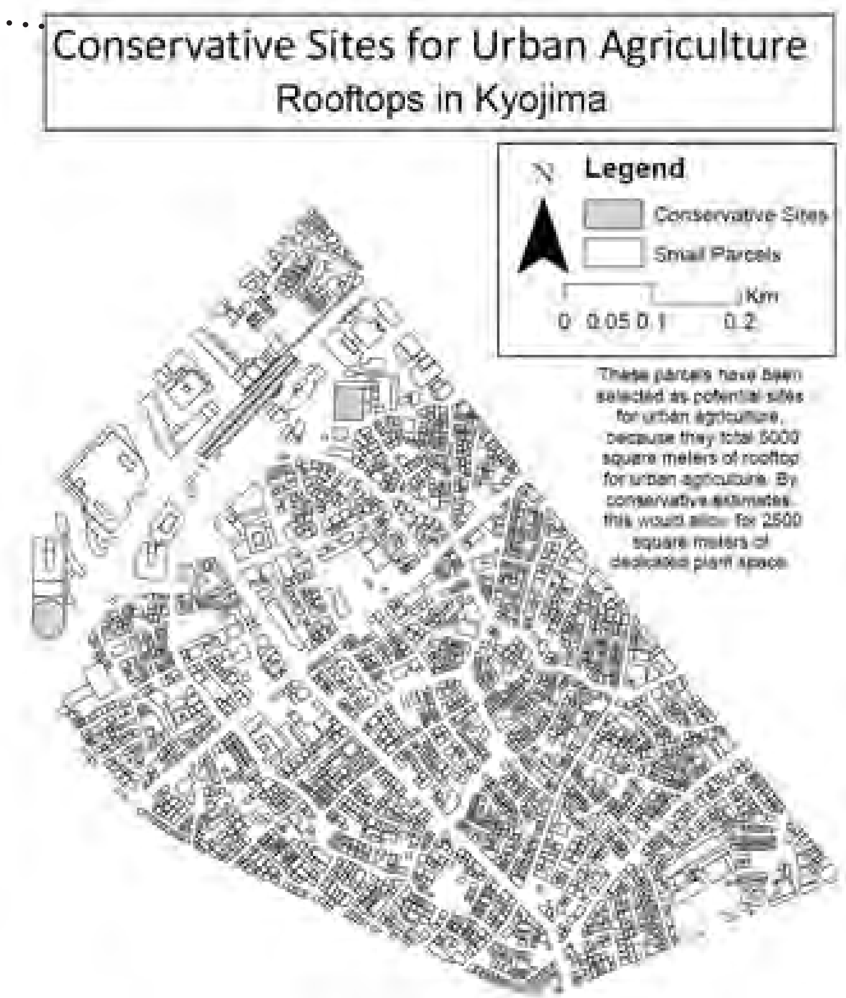
Water	
Water Reservoir Requirements per Plant	10 liters
Total Water Reservoir Requirement	167,820 liters
Water Requirement per Plant per Week	0.5 liters/week
Total Water Requirement per Week	8,391 liters/week
Average Water Recovered per kg of Food Waste	0.569 liters
Kyojima's Food Waste	292,913 kg/year
Kyojima's Food Waste per week	5,633 kg/week
Recovered Water from Kyojima's Food Waste	3,205 liters/week

Fertilizer	
Fertilizer Required per liter	1 mg/liter
Fertilizer Required per week	8,391 mg/week
Fertilizer Required per year	0.44 kg/year
Fertilizer Produced per kg of food waste	0.03 kg
Total Fertilizer Produced	6,787 kg/year

Emissions Reduction	
Total CO2-e Reduction	675,961 kg CO2-e
Kyojima's Annual Food Waste Methane Emissions	556,535 kg CO2-e
Kyojima's Potential Reduction in Coal CO2 Emissions by Utilizing Anaerobic Digestion	61,160 kg CO2-e
Conventionally-Grown Tomatoes - kg of CO2-e	58,265 kg CO2-e



Aggressive plaement for digeponics facilities



Conservative plaement for digeponics facilities

Benefits

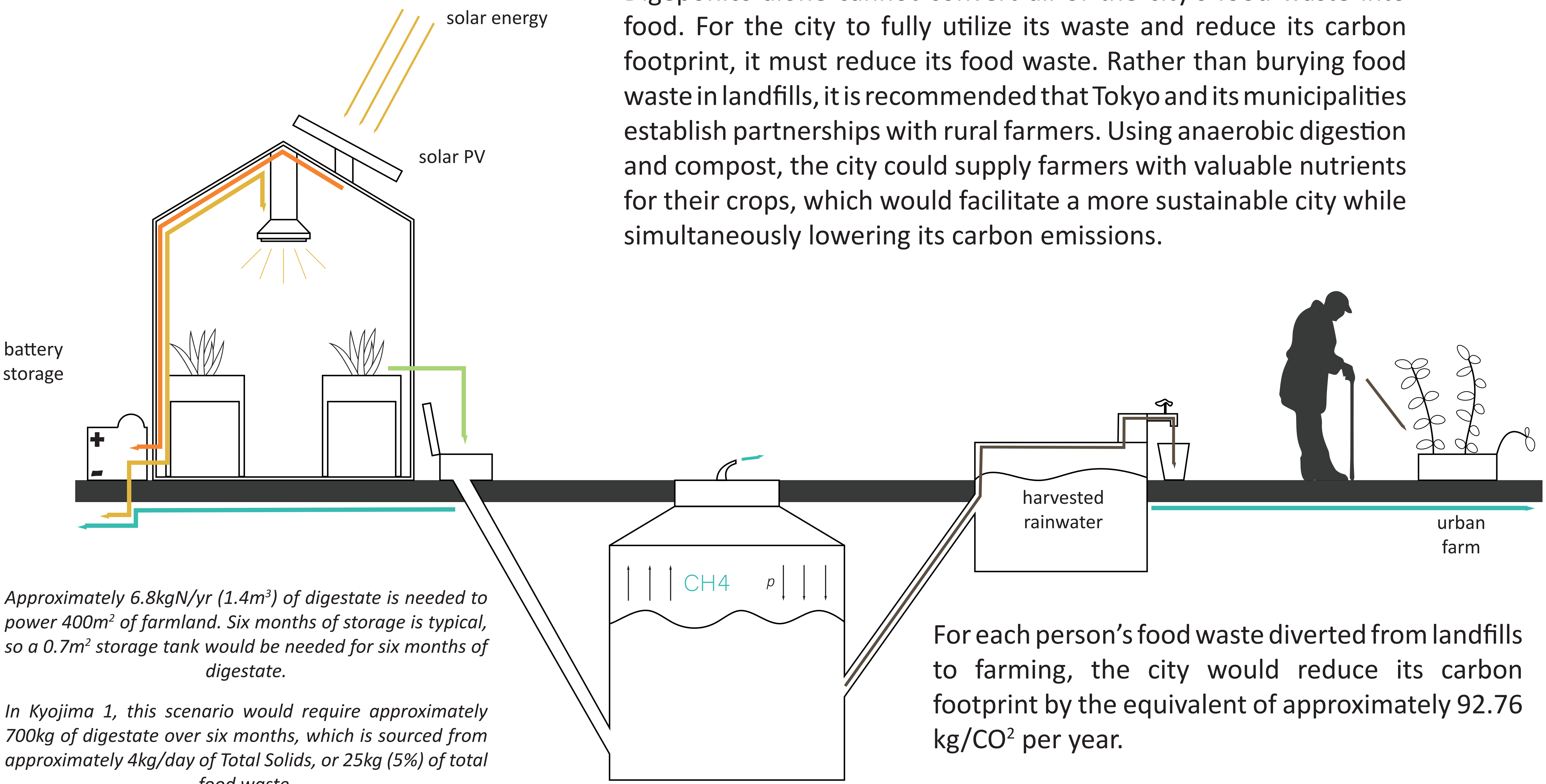
- 2 million kg of food per year; 8,700 kg of fertilizer per year.
- 99% reduction in water use per kg of food produced using a distilled water hydroponics system when compared to conventional agriculture.
- Cooling effects on the city due to evapotranspiration. Due to the intensity of the agriculture, this cooling effect would be greater than if these rooftops were covered in trees.
- Insulation of the rooftops would lead to lower cooling costs and cooler buildings.
- Allocates space for solar panels.

Costs

- Would require an external source of water (potentially from rural agriculture);
- System can be expensive to build up-front
- Difficult to maintain unless assigned a dedicated and trained

2c. ii. Proposed Solutions

Digeponics alone cannot convert all of the city's food waste into food. For the city to fully utilize its waste and reduce its carbon footprint, it must reduce its food waste. Rather than burying food waste in landfills, it is recommended that Tokyo and its municipalities establish partnerships with rural farmers. Using anaerobic digestion and compost, the city could supply farmers with valuable nutrients for their crops, which would facilitate a more sustainable city while simultaneously lowering its carbon emissions.



Approximately 6.8kgN/yr (1.4m³) of digestate is needed to power 400m² of farmland. Six months of storage is typical, so a 0.7m² storage tank would be needed for six months of digestate.

In Kyojima 1, this scenario would require approximately 700kg of digestate over six months, which is sourced from approximately 4kg/day of Total Solids, or 25kg (5%) of total food waste.

For each person's food waste diverted from landfills to farming, the city would reduce its carbon footprint by the equivalent of approximately 92.76 kg/CO^2 per year.

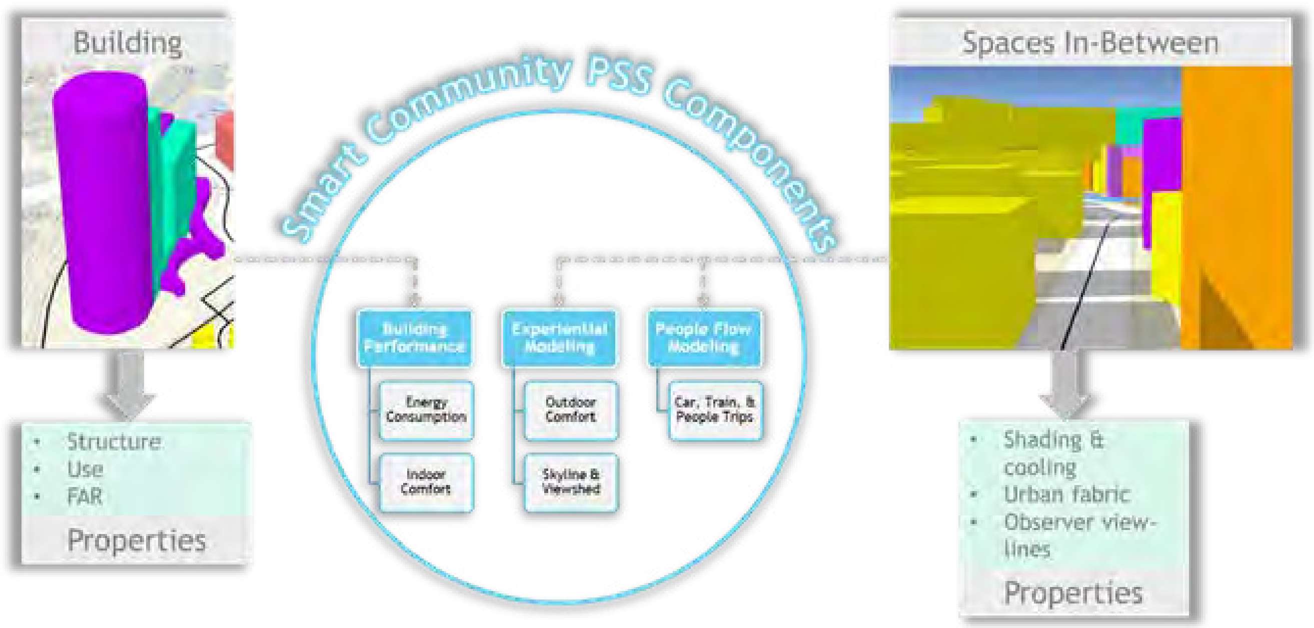
2c. ii. Proposed Solutions


Smart trucks for food waste collection

- Small, electric vehicles, which can fit on narrow streets
- Can collect food waste from around the city - sorted by citizens, similar to recycling
- Sensor technology can collect data on food waste per household
- Utilization of data can allow the city to map its food waste and nutrient flows
- Can be used for redistrubting the organic fertilizer produced by Digeponics

3. SMART COMMUNITY PLANNING SUPPORT

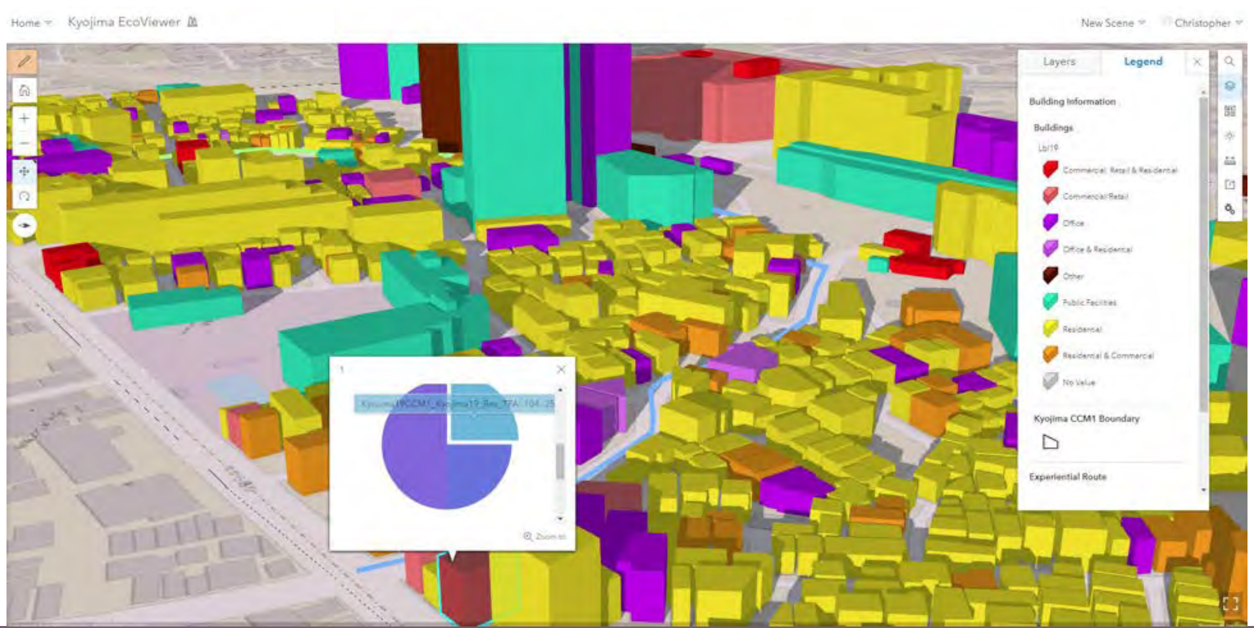
I. Object Oriented PSS
II. End-User Web GIS PSS Interfaces



Smart Community PSS Components

Buildings and the spaces in-between them can be seen as unique objects with idiosyncratic characters, and active agents within a complex urban system. An objected-oriented approach in the context of a planning support system attempts to numerically assess the quality of the built environment by utilizing a set of urban design measurement criteria applied to building and spaces in-between. Our approach chooses a few yet critical components to make up our object-oriented PSS.

3. PSS: I. Object-oriented PSS



Smart Community PSS Screenshot

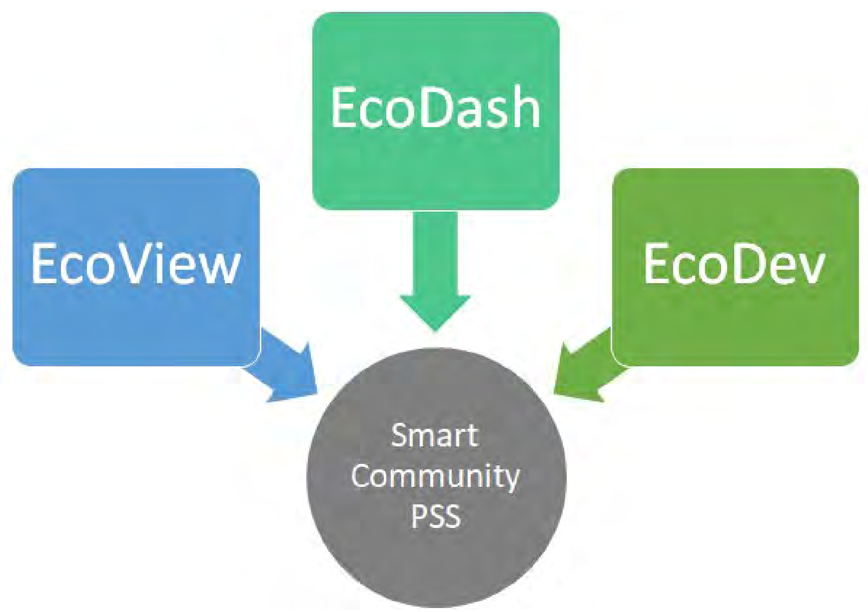
Building Performance

Two measures are used to benchmark building performance in the PSS, and they are energy consumption and indoor comfort. Buildings in Kyojima-1 each have a yearly energy consumption per square meter figure as well as a comfort index generated by the core team using Rhino Grasshopper.

Experiential and People Flow Modelings

The experiential measure utilizes outdoor comfort simulations generated in Rhino Grasshopper as well as skyline and viewshed visibility assessments conducted in ArcGIS. GPS data representing people movement via train, car, and walking are also synthesized in the viewer to represent people flow.

3. PSS: II. End-User Web GIS PSS Interfaces



Smart Community PSS WebGIS PSS Interfaces

WebGIS PSS Interfaces

The Smart Community PSS is a people-focused platform for connecting citizens, planners, and developers to a local area using a web-based GIS analysis and visualization platform.

- EcoView (Citizen Interface)
- EcoDev (Developer Interface)
- EcoDash (Government Interface)

WebGIS as a PSS Platform

An object-oriented approach in a PSS yields large amounts of data that is often hard to aggregate into one cohesive page. However, it is becoming increasingly common for organizations and local planning authorities to utilize applications, typically in web form, to disseminate information. Such platforms also provide planners with the ability to visualize a wide array of data in 3D. In the last few years providers like ESRI have been providing tools to create customizable 3D applications. The viewers created in this studio demonstration how 2D and 3D web-apps can be used to handle monitoring and analysis tasks, thus providing a platform for decision support with the view that one day near real-time data an be readily embedded.

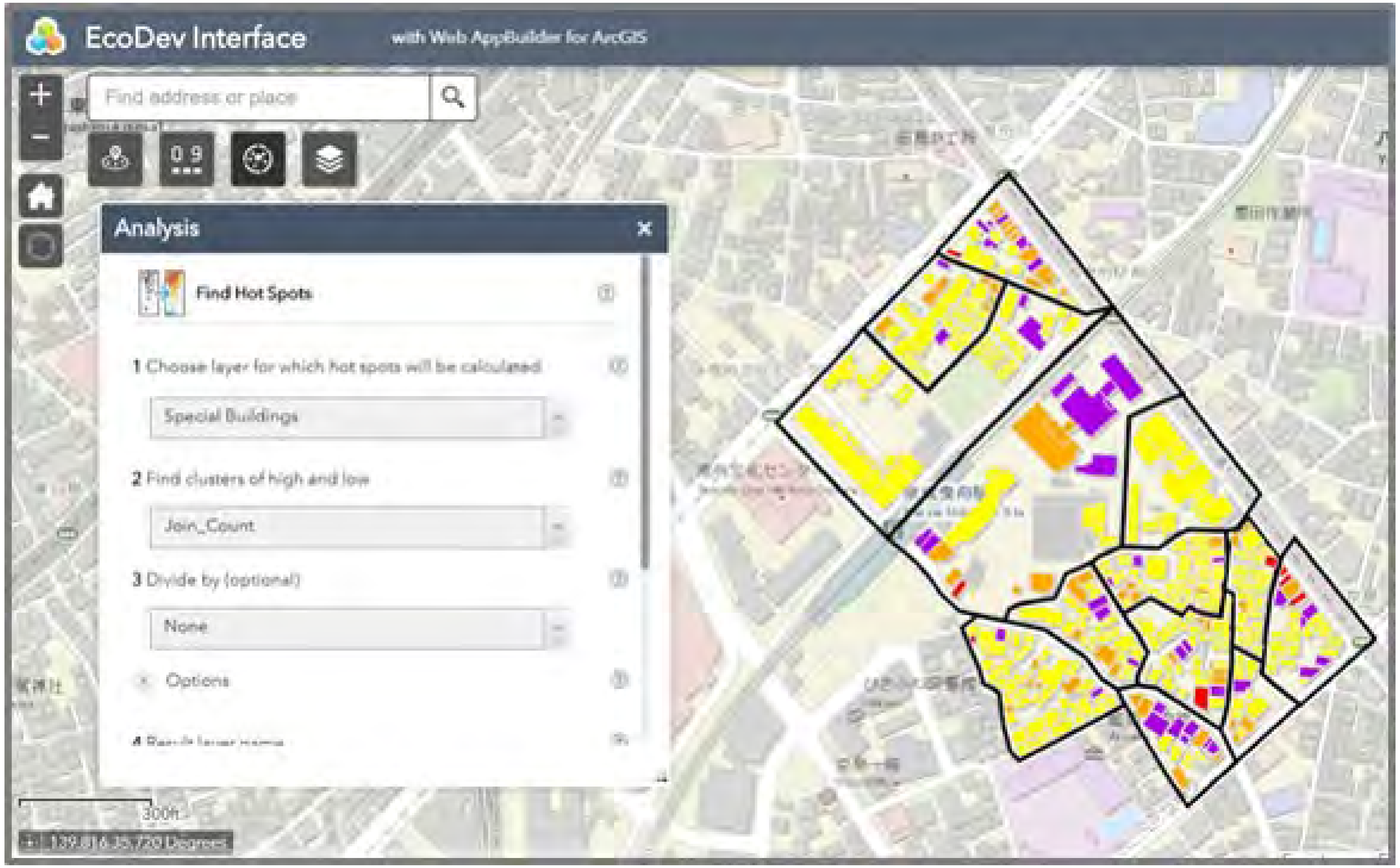
3. PSS: II. End-User Web GIS PSS Interfaces

EcoDev

•Description: An interface to aid in building and site suitability assessment using custom-made multi-objective models and analysis tools. Suitability models can be built in ArcGIS using ModelBuilder, and uploaded to the EcoDev interface to be used as an interactive analysis. In addition, pre-made tools such as hot-spot analysis can be embedded as well.

•Target Users: Property developers, economic development and planning officials

ArcGIS ModelBuilder

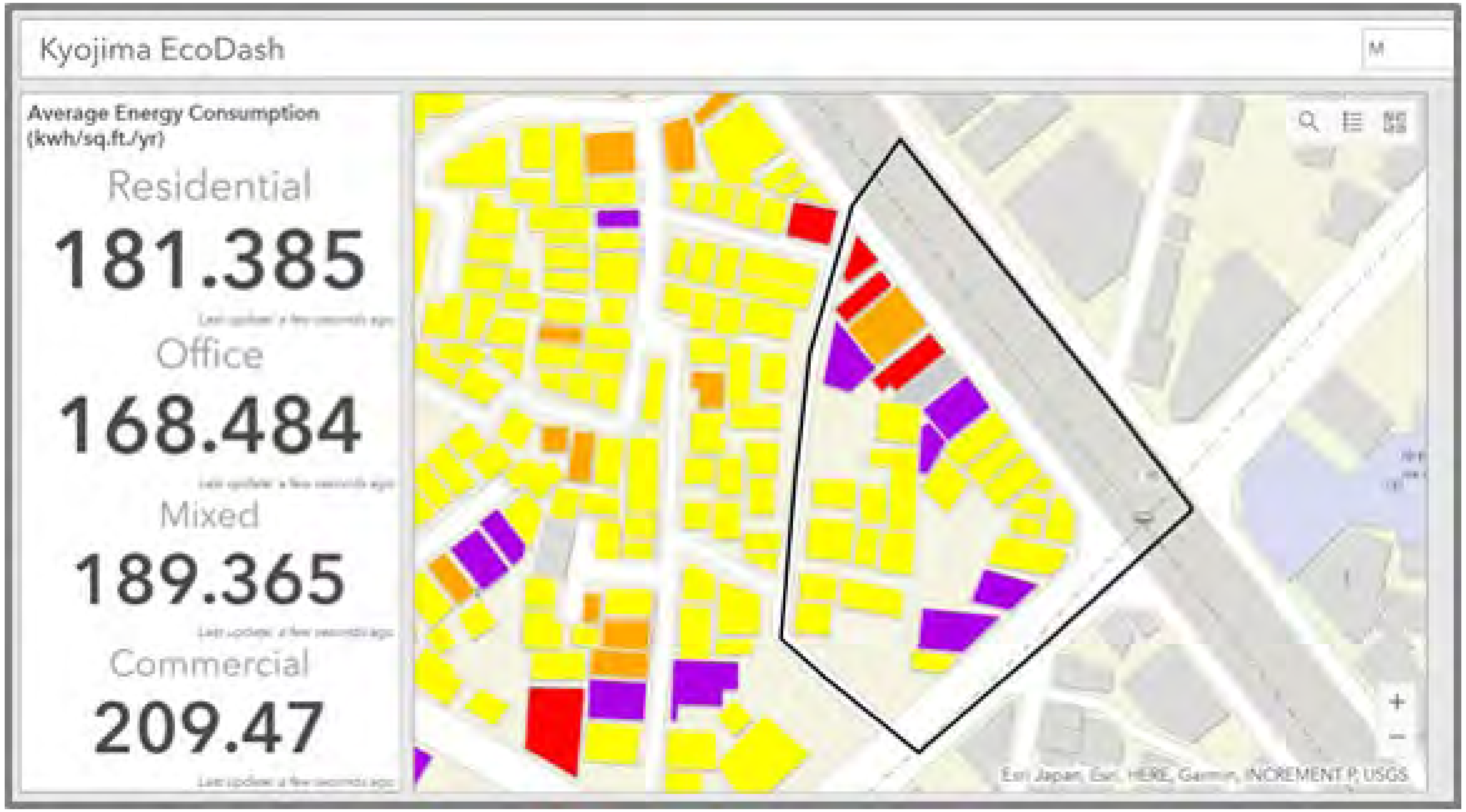


3. PSS: II. End-User Web GIS PSS Interfaces

EcoDash

•Description: Multiple dashboards for tracking ongoing changes in neighborhood energy usage, developments, and other targets. The dashboards are custom-built according to the data/information needed to be tracked.

•Target Users: Local government planning and public policy officials

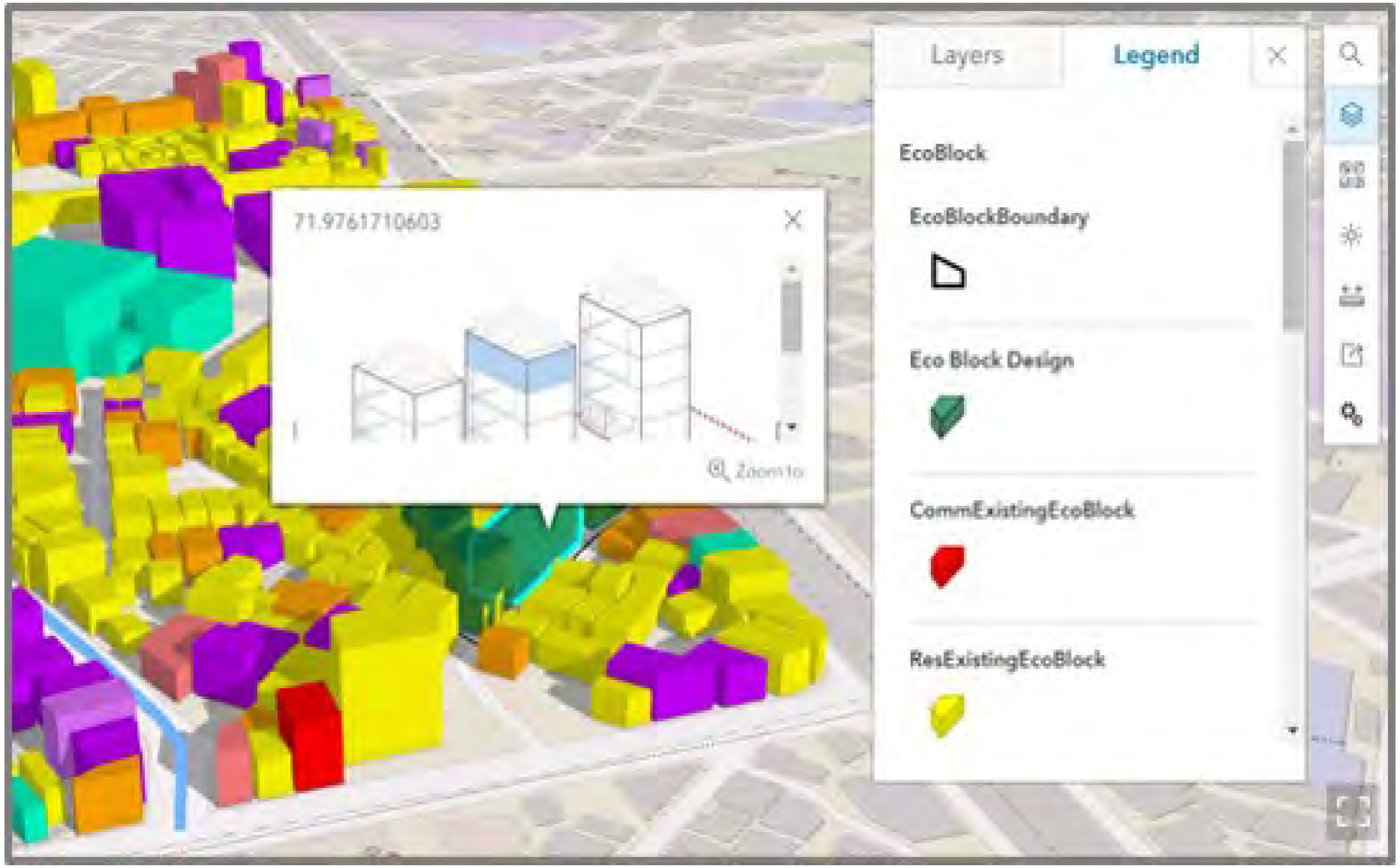


3. PSS: II. End-User Web GIS PSS Interfaces

EcoView

•Description: An interface for sharing updates, data, analyses, and plans with the local community in 3D. The interface aims to create more realistic impressions of a smart community's future development. Planning officials can push new updates and data directly to the EcoView interface. Citizens and neighborhoods groups can also make data requests/comments using the interface.

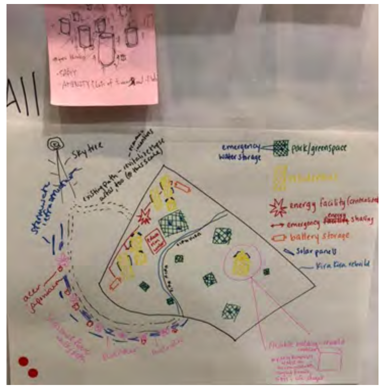
•Target Users: General public, community organizers

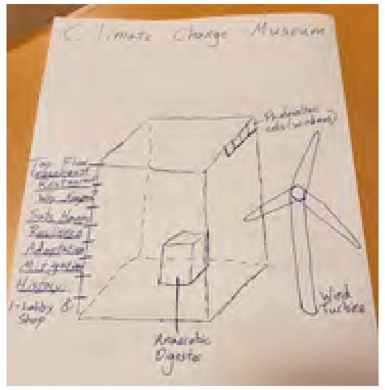


VI. INTEGRATION SCENARIOS

1. MULTI-GENERATIONAL LIFESTYLE PLAN
2. EVOLVING CITY

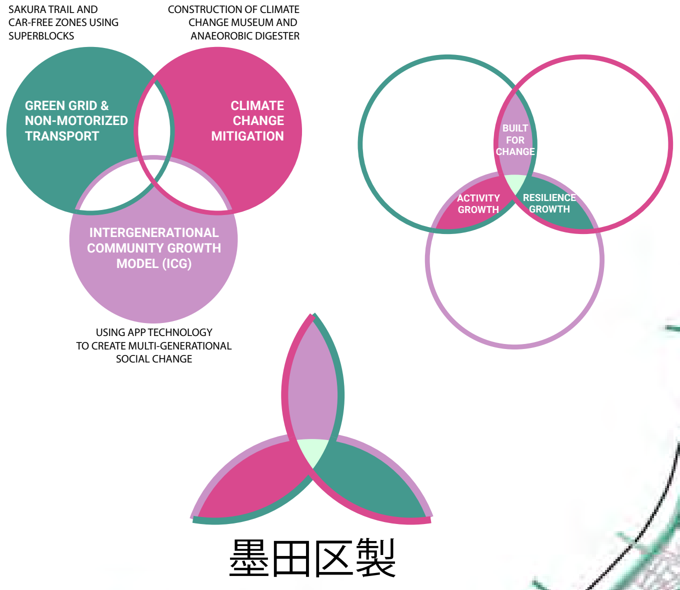
The ideas described in the Georgia Tech proposal were combined during the week-long workshop in Tokyo. The concepts described on the following pages are the result of this collaborative integration.

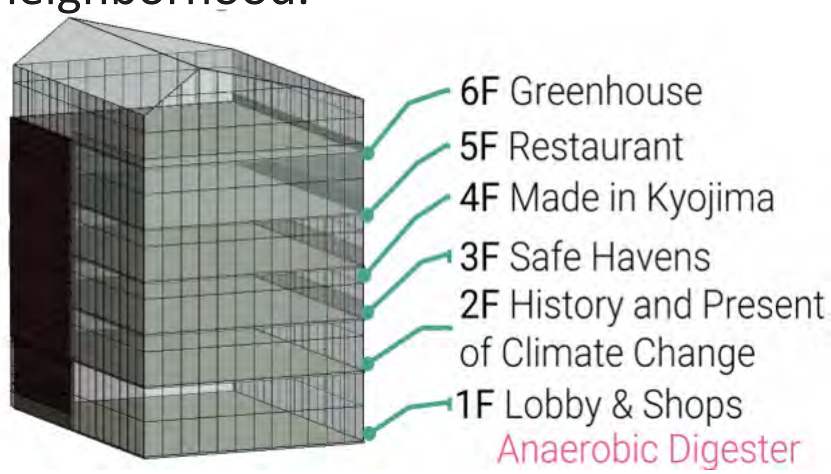




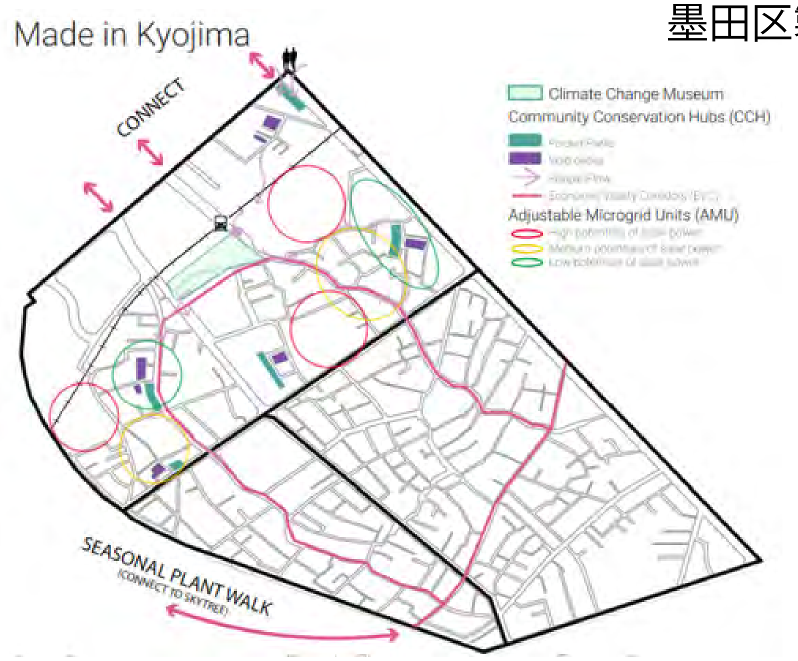
VI. Multi-Generational Lifestyle Plan

Using big data from surveys and GPS, this concept contributes to smart mobility and disaster impact and prevention strategies. The Sakura trail and greenway corridors directly serve the mission of this project, which is to primarily reduce carbon emissions. Finally, the concept provides cultural resilience via transportation by preserving narrow alleyways meant for resident use, avoiding road widening, and encouraging regeneration elsewhere in the neighborhood.

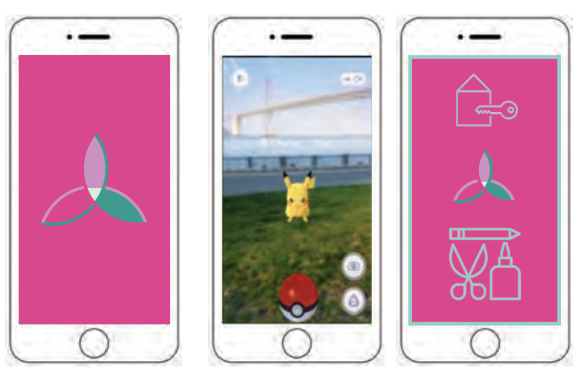




A climate change museum with anarobic digester and microgrid can help aid in education for chainging social behaviors.

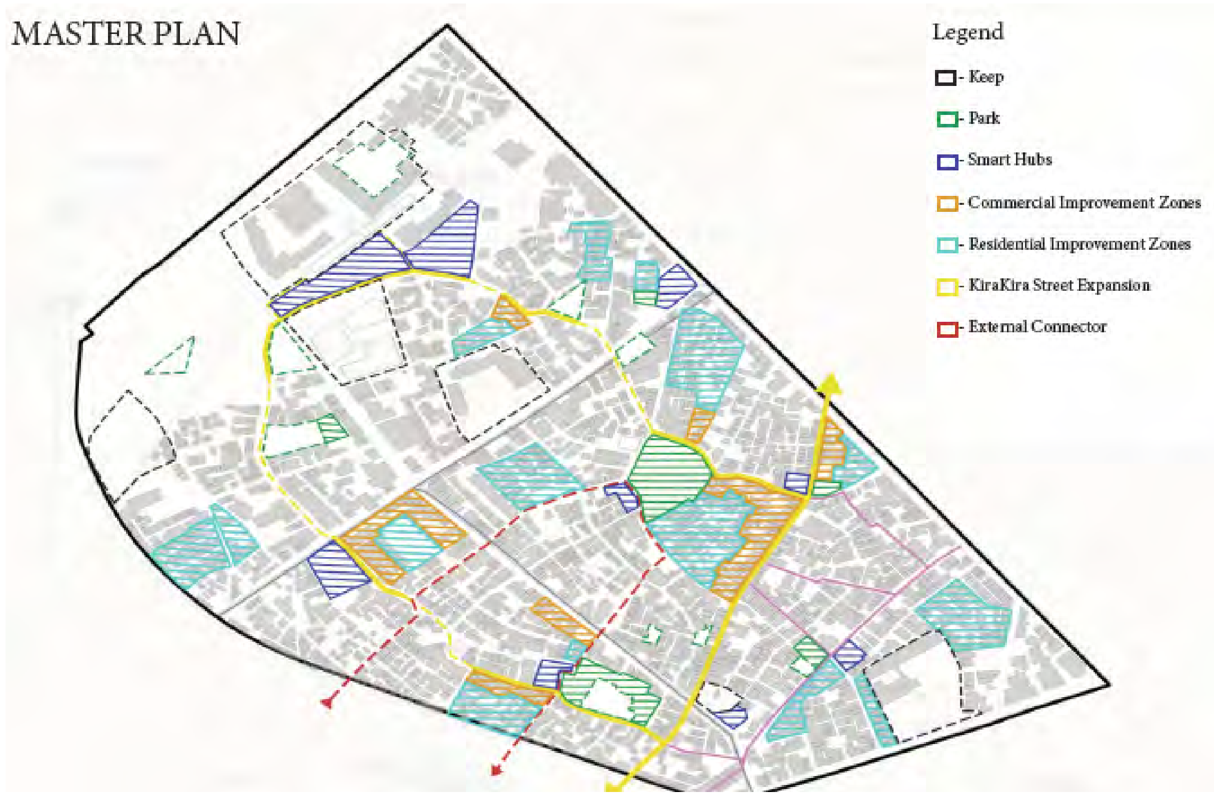


Lifestyle and social change can occur by bringing different generations together to experience Sumida in a different, but combined way using new apps like Pokemon Go. With Pokemon Go used by young people, the older generation could set out to find seasonal flowers and crafts developed in the Sumida Ward.

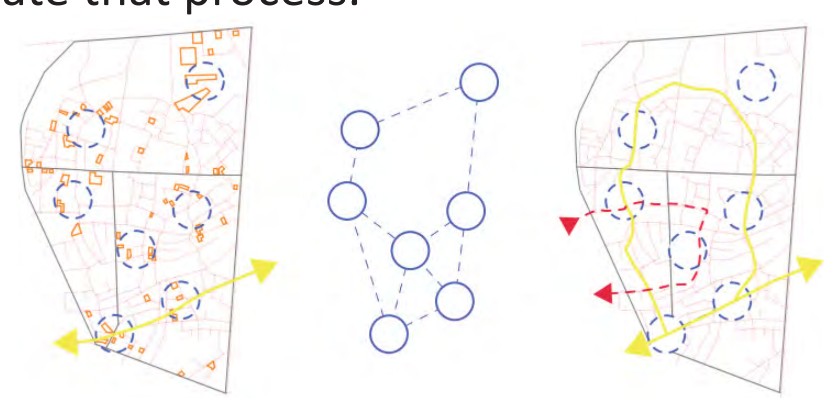


The seasonal plant walk, also referred to as the "Sakura Trail", is a seasonal attraction that would stimulate economic activity and reduce the heat island effect via the planting of native, flood- and drought-tolerant vegetation. The climate change museum would be strategically located along the path and would educate residents and visitors on the impacts of climate change, as the majority of Sumida ward is below sea level.

VI. Evolving City



To revitalize Kyojima, we propose a circular process of transforming underutilized and public spaces to strategically transform the community based on a long-term plan with broader goals of economic vitality, resiliency and sustainability. This process follows the traditional redevelopment process with the input of local government and the community to accelerate that process.



Multi-purpose smart hub

Completing an extensive SWOT Analysis of Kyojima's assets would be required. An example of this would be to identify:

- vacant properties
- unsafe areas
- evacuation areas
- parking lots

Next, selecting locations that can be utilized to further enhance the long-term land use that are publicly owned would be the locations selected first to create an "evolving city". This process would require the local government to adopt an active role in purchasing vacant properties and parking lots or designating a redevelopment authority to do so. Providing incentives for helping to further these goals should be investigated in the future.

With the repurposing of underutilized and poorly placed infrastructure like evaluation areas for other purposes like commercial and residential, it will incentivize residents to move because areas are built to higher quality and in safer locations. The exchange of properties between residents and the government allows for the process of the evolving city to continue.

New buildings and public spaces should be required to be development with best management and best design practices in mind to further sustainability and resiliency goals.