TOKYO SMART CITY DESIGN AT SHINAGAWA

INTERNATIONAL URBAN DESIGN STUDIO - SPRING 2020

ECO URBAN LAB - SCHOOL OF CITY AND REGIONAL PLANNING & SCHOOL OF ARCHITECTURE
COLLEGE OF DESIGN - GEORGIA INSTITUTE OF TECHNOLOGY

IN COLLABORATION WITH

GLOBAL CARBON PROJECT (GCP)
NATIONAL INSTITUTE FOR ENVIRONMENTAL STUDIES OF JAPAN
DEPARTMENT OF URBAN ENGINEERING - THE UNIVERSITY OF TOKYO

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This proposal is the output of the urban design studio of the graduate school educational program, and does not reflect the intentions of the local stakeholders.

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PREFACE

The Tokyo smart city project is an international collaboration from 2016 to 2020 between the Eco Urban Lab of School of City and Regional Planning and School of Architecture at Georgia Tech, Global Carbon Project (GCP), the National Institute for Environmental Studies of Japan, and the Department of Urban Engineering of the University of Tokyo. Tokyo provides a living urban laboratory for designing complex urban settings, agglomerations of physical, cultural and technological systems. The Tokyo Smart City Studio in Spring 2020 investigates Shinagawa and its surroundings at the Tokyo Bay waterfront area in the context of new maglev high speed rail station area development, one of the biggest urban development projects in the City of Tokyo of the next decade. The operation of the new high-speed maglev rail station from 2030 will make Shinagawa a 70-70 new gateway, 70 minutes from Tokyo to Osaka for a region with 70 million population. The new infrastructure will compress the concept of space and time, and will change the inter-cities relation. Its future city vision will have profound impact to the urban forms, functions and experiences of the city. The project aims to develop a test bed of urban systems design to demonstrate how a smart community is designed, evaluated, and implemented in Japan by incorporating governmental agencies, stakeholders and communities, with focuses on urban design and modeling, urban analytics of big data, Internet of Things (IoT), smart mobility and eco urban performance evaluation.

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IMPACT OF COVID-19

The unpredictable shock of Covid-19 had a significant impact to the studio this year. The international field trip to Tokyo, originally scheduled on March14-22 of 2020, was canceled abruptly. On the 16th of March, we co-organized a video conference with Tokyo partners to present the midterm work. A final presentation was conducted on the 20th of April, 2020. Both meetings went surprising well with very good attendance. Stimulating conversations and discussions occurred between the U.S. and Japan while we were all locked down at home.

One of the pedagogic objectives of the urban design studio is to simulate professional practices of the real world. Students learn how to design for a complex social and urban setting, in which the studio provides a learning environment for designing and managing an actual urban project, as in a professional urban design, planning or architecture firm. Context is extremely important. In the Tokyo studio project this year, students engaged actual urban sites at Shinagawa and involved local partners. The idea of studio and its operation, however, was adjusted before the midterm. We took advantages of the digital platform for communication, data sharing and design collaborations. In a way, the Tokyo studio was able to simulate contemporary urban design practices that now go globally - Urban designers constantly take projects remotely from an international setting, and operate a design and planning process both digitally and collaboratively.

The Covid-19 is also creating impacts on how cities, geographic spaces, behavioral patterns and information are organized, and how urban designers, planners and architects practice in future. Some assumptions and values behind urban design are becoming problematic and questionable:

- **Density matters**: For many urban systems to function properly, density has been seen as a necessity, not the obstacle. The high-density living environment offers proximity and intimacy of social relationship that is becoming problematic in pandemics. Cities like New York and New Orleans are now having the serious outbreak. Discourse of “anti-urbanism” might be arising that is threatening contemporary urbanity. Tokyo, together with other Asian cities such as Taipei, Hong

Kong, Singapore and Seoul, those controlled Covid-19 relatively well are showing that density may not be necessarily the threat to the post-Covid-19 urban reconstruction. Some Asian high-density urban systems demonstrated their governance of “technocracy”, a combination of democracy and smart management to swiftly handle the crisis in much denser urban settings during the pandemic.

- **Accessibility question**: We advocate walkability, accessibility and connectivity in designing physical urban environment. In the context of post-covid-19 cities, do people still reach their surrounding resources by the walkshed? When public transportations are seen as potential exposure to the crowd, design for a safer urban environment for walking to adjacent locations for schools, groceries and medical facilities, are probably far more important than ever before. Future urban design should focus on small-scale walkable environment to be safer, healthier and more walkable.

- **Diversity and mixed uses**: When the segregation and social distancing is becoming a new norm, how will the proximity and intimacy of urban environment accommodate various uses and diverse social groups, and still function as a community based on the placemaking? We probably need smarter urban systems to ensure the diversity measurable, both physically and digitally in this new context.

Instead of making “anti-urban” proposition, we may propose the following arguments and questions:

- Cities should be designed as situational spaces, in which places might be reconfigured or restructured when crises or events occur. Cities should maintain its quality of urbanity, and adapt to changes.

- Cities should be resilient to shocks, and get recovered sooner and be more robust than before. Learning from water resilient cities, an attempt to go behind defensive way of protecting cities from increasing risk of flooding, we should build a resilient urban system for adapting shocks such as Covid-19.

- Is there a pandemic-resilient urban design approach that can turn urban spaces to be situational, responsive and resilient to virus threat? What’s our urban design strategies to the pandemic, a multi-scale complex problem that transcends spatial scales from DNA mutation, individual persons, healthy buildings, defensive communities and cities, states to around the globe?

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- Cities are now both digital and physical. Social networking operates in augmented environment. What digital twin city design would accommodate new mode of working and learning, collaborating and sharing, and then living and entertaining?

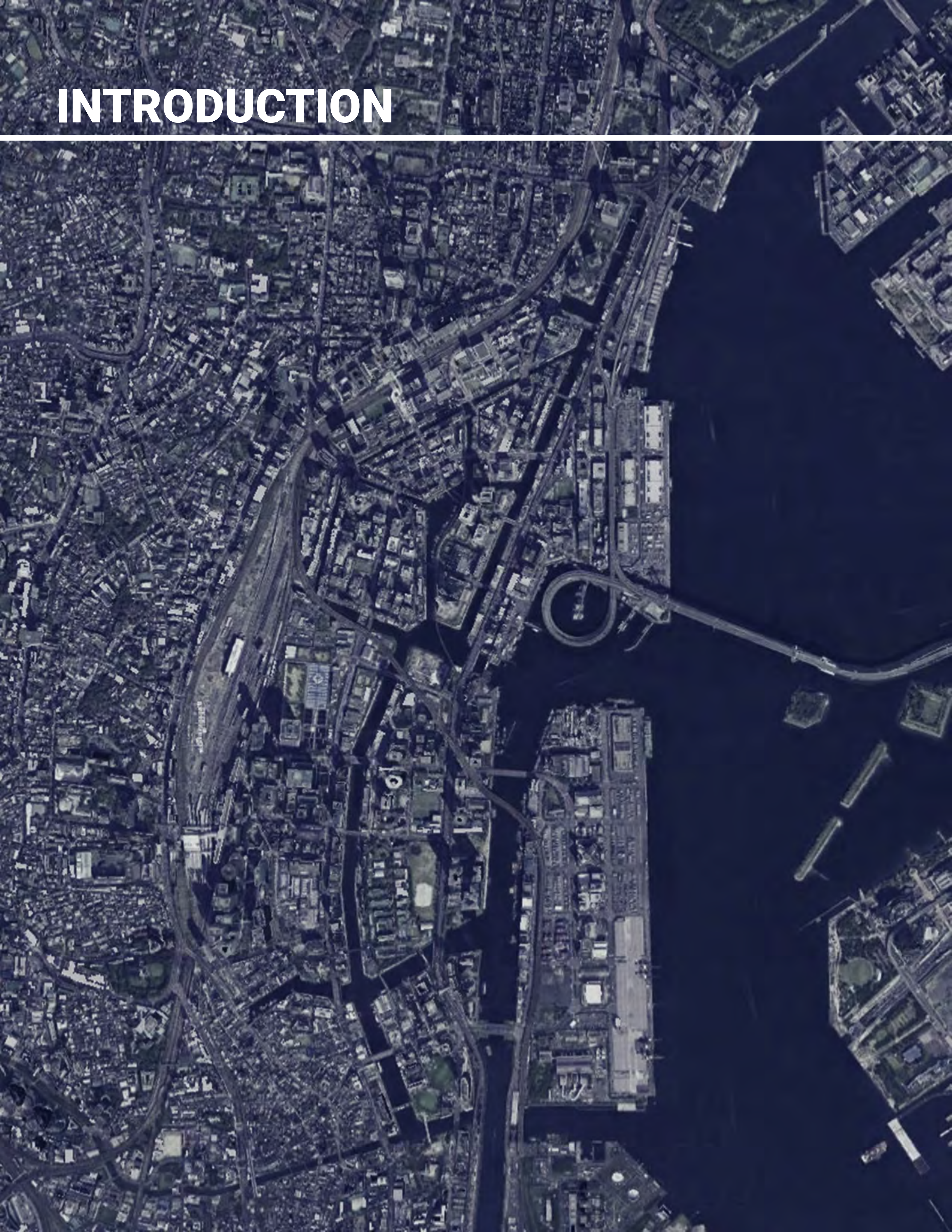
- Finally, how will the Covid-19 impact influence the movement of smart cities development?

SHINAGAWA PROJECT AS STRATEGIC PLANNING

The above thinking may not be fully reflected on the current studio report. The Shinagawa project will continue to offer opportunities for city design in the post-covid-19 context. Shinagawa project in the 2020 Georgia Tech urban design studio can be defined as a strategic planning, in which planners have minimum control over the process. The prediction of urban transition is long-term. Therefore, the main goal should be relatively simple and measurable, **e.g. carbon reduction, climate adaptation, mobility, water and energy resilience. The project context of Shinagawa studio was specifically defined the process of new maglev station operation from 2027, 2037 and then to 2057, which generate planning scenarios for benchmarking its progress over time. Perhaps only these kinds of goals can be communicated clearly, and the studio achievements would be recognized by multiple stakeholders in Japan, particularly by our Tokyo partners and their connections to the district government, developers, communities and future users. The Georgia Tech studio report offers a strategic planning that aims be useful for the next step.**

Perry Yang, May 13, 2020

INTRODUCTION



OVERVIEW

In 2027 Chuo Shinkansen will arrive at Shinagawa Station and introduce a rail service to Tokyo that has no comparison. Never before has there been a 70 minute-70 million person rail connection - effectively creating a 70 million person mega-region. The Chuo Shinkansen will travel 500 km/hr between Tokyo, Nagoya, and Osaka (2037) and connect 70 million people within a 70 minute train ride. The Chuo Shinkansen has no precedent. The station and urban morphology surrounding the train's terminals have no precedent.

This context will be introduced to the Shinagawa Station Area (Station 70-70) which is rich with historical context as a destination for travelers. Shinagawa is located at a critical stepping off point for the historic Tōkaidō road that connected Edo and Kyoto. The road was developed during the Edo period (1603-1868) and served as one of the 5 primary roads connecting the capitol, Edo, and other major cities. Importantly, the Tōkaidō Road was the fastest route between the historic capital of Japan, Kyoto, and the new capital, Edo. This history of a gateway to Edo, now Tokyo, is maintained today. The Shinkansen serves Shinagawa Station. The Station Area, hosts the largest concentration of hotel rooms in Tokyo.

The Shinagawa Station Area is poised for exceptional growth in population, employment, and visitors with the addition of the Chuo Shinkansen. However, the Station Area is at the nexus of the anthropocene. Innovative technology has powered Japan's rail systems, economy, and land use but all have contributed to trammelled ecosystems, terraforming, and climate change - all characteristics of the anthropocene. The Station Area then, should be at the apex of utilizing innovative technology to humbly mitigate and absolve the externalities of the anthropocene.

Station 70-70 is a Smart City framework of development that reflects the changes of the Chuo Shinkansen and the Anthropocene. The Station 70-70 Smart Cities framework was developed to address Mobility, Urban Design, and Water aspects of the Station. First, a Smart City definition was developed through a participatory hackathon. Utilizing dozens of rapidly generated ideas of what a Smart City achieves a working definition of Smart was developed.

The Smart City operationalizes innovation, technology, and investment to become responsive and resilient, green, data driven, connected, and inclusive. A Smart City is a process and not a destination. It is an iterative process that creates, evaluates, and course corrects. This definition guides this plan and acknowledges that this plan is a snapshot of 'Smart' at this moment. Without evaluation and course corrections, this plan becomes obsolete as future technologies and values become reality. The Station 70-70 Plan develops the vision for Smart, a plan, and the evaluative methods to develop course corrections.

HISTORIC OVERVIEW

Shinagawa was originally founded as the first shukuba, or post town, of the Tōkaidō during the Edo era of Japan. The Tōkaidō was the eastern sea route that linked Edo (modern-day Tokyo) to Kyoto via a pedestrian path. Being the first stop outside of the capital, Shinagawa attracted a population of around 7,000 and was know as a transit point for goods and people. During and after the Edo era, Shinagawa grew in size with the land reclamations of Tokyo Bay and following the Meiji Restoration, was instituted as a prefecture in 1869 (though it was absorbed into Tokyo Prefecture two years later). The period after the Meiji Restoration saw Shinagawa transform into an industrial city as the Meguro River became the site for large amounts of factories. This concentration of industry saw the population rapidly grow. During World War II, Tokyo, and by extent Shinagawa, experienced sustained bombings by the United States. While much of Shinagawa was destroyed, it was quick to reconstruct postwar, leading a number of businesses to relocate to the area from inner Tokyo.

Shinagawa's roots as a post town have continued into the modern era. The area saw another boom in construction due to the 1964 Olympic games, which coincided with the beginning of the Tōkaidō Shinkansen high speed rail line between Tokyo and Osaka. Despite running through Shinagawa, it wouldn't be until 2003 when the Tōkaidō Shinkansen would service Shinagawa Station. Reflective of its historical reputation as a transportation center, Shinagawa has the highest concentration of hotel accommodation in Tokyo, contains many corporation headquarters, and remains at the forefront of transit.

The original Shinagawa Station was first completed in the early 1870s. Despite its name, Shinagawa Station located just north of Shinagawa in the Minato ward. The area surrounding the station was countryside known for the fishing community that supplied fish to Tokyo and was considered irrelevant to passengers moving between Toyo and Yokohama. In 1924, the Keikyu Line opened at Takanawa Station located directly across the street. Shinagawa Station relocated to the site of Takanawa Station in 1933 and begun service on the both Keikyu and Tōkaidō Main Lines. Despite its innocuous beginnings, Shinagawa Station has grown to be one of the busiest stations operated by the Japan Rail Company. Since 2000, the number of daily average passengers has grown. In 2017 it saw a daily average of over 370,00 passengers. As Shinagawa Station prepares to welcome the Chuo Shinkansen, the expected number of daily passengers is expended to drastically increase as the station will be linking 3 major cities within a 70 minute train ride.


Shinagawa-juku in the 1830s- Hiroshige


Habor in Shinagawa in 1857- Hiroshige

VISION

The Station Area will become the new urban center for Tokyo anchored by Shinagawa Station on the West and a pinnacle urban greenspace fronting Tokyo Bay on the East. Starting at Shinagawa Station the urban fabric is regenerated into a network of complex blocks which meld historic context and modern structures. These blocks flow away from the Station and connect new retail and entertainment districts that flank the protected waters. These retail and entertainment districts bring life to the waterways and enrich urban fabric. The pedestrian scaled environment is enlivened by the balance of retail, commercial, and residential buildings while sustaining the community with strategically placed community amenities.

The site is stitched together with a network of green streets that invert the paradigm of an urban street by bringing ecological services to the center of streets through green infrastructure. This revision of the streetscape to nature is enabled by the efficiency of the guided autonomous vehicles and congestion pricing protocols. Green streets stitch the community together and raise awareness of the natural environment of the Station Area which began as a reclaimed bay. However, this awareness fosters the responsibility and accountability that is needed to achieve water and energy resiliency. The Station Area will provide water resiliency and protection from severe storms and the 500 year projected sea level rise.

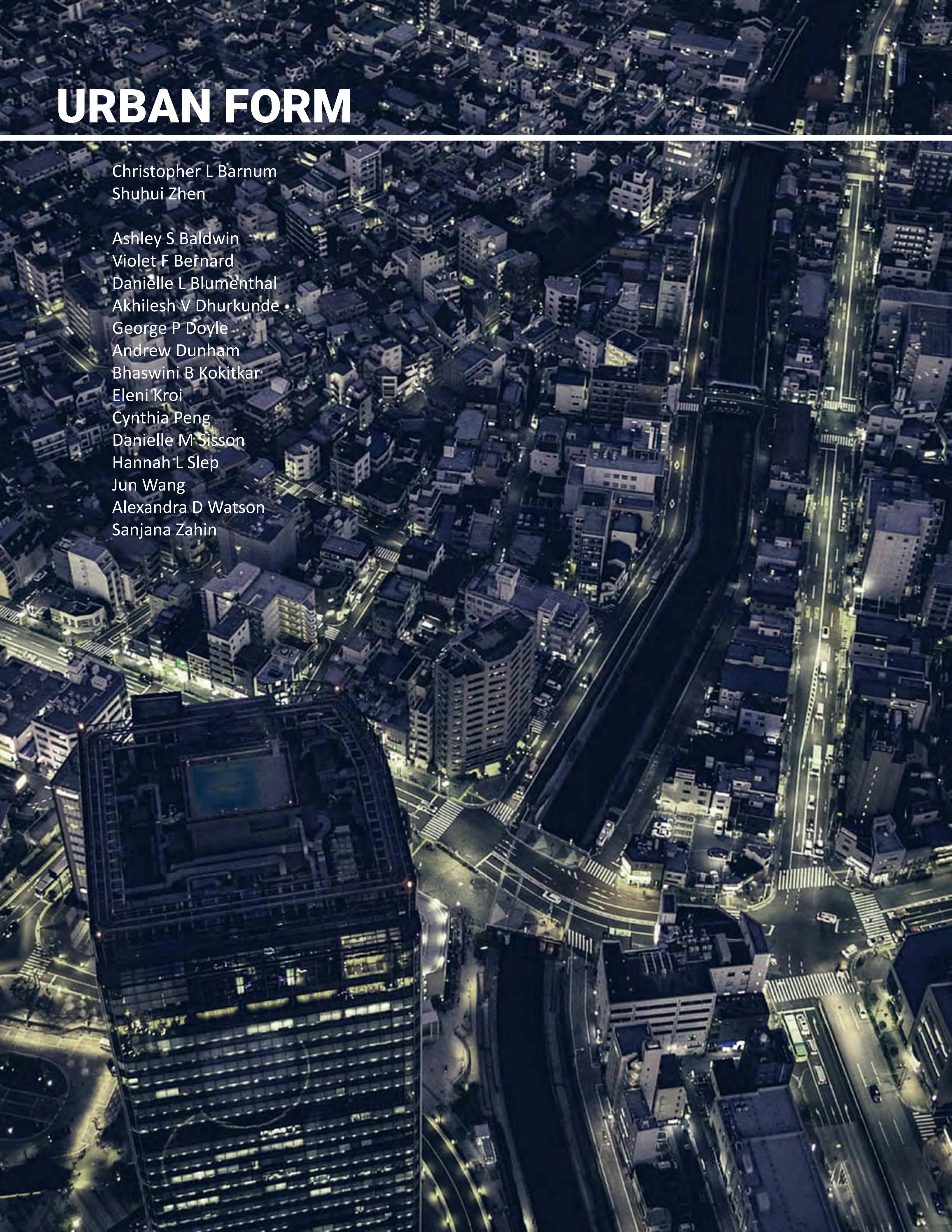
A community responsible and accountable to the natural repercussions of community action is the result of this plan and so, the community will have a tool to evaluate their performance and progress towards the development of an urban-human ecosystem. The Shinagawa Station Area will have the tool to continually improve and course-correct the trajectory of Shinagawa - which, afterall, is a SMART strategy.

GOALS

Mobility:
- All residents will be within a 2 minutes of bike network, 5 minutes of AV network, and 7 minutes of mass transit.
- 75% of road space is dedicated to active modes of transportation
- 75% of all buildings are within 5 minute walk to 5 key amenities

Design:
- All residential areas are mixed-use and have at minimum 20% non-residential space
- All blocks' longest dimension is less than 182 meters
- All blocks aggregate-built FAR is greater than 5
- Site has 10-square meters of open space per resident
- Site maintains an urban-diversity index of greater than 0.80.

Energy and Water Resilience:
- Energy Balance for site achieves net-zero
- Water consumption balance for site achieves net-zero
- All site mitigates the 500-year storm event via green infrastructure
- 30% of buildings have green roofs



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OVERVIEW

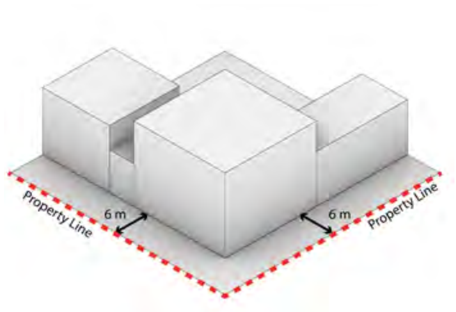
The urban form of Shinagawa is disjointed and nonuniform. To the south of the district, there is the historic district that is characterized by super fine grain building placement. It contains many back alleys and narrow streets. Moving north towards Shinagawa Station, open space becomes more frequent. Large buildings with little connections between them become the norm, creating a feeling of isolation in the space between. As one moves east, the urban fabric becomes denser and more tight-knit before completely opening up to a shipping port that takes up the entire eastern border of the study area.

The urban form section contains guidelines for urban design that can be used across the study area. Additionally, it also contains proposals for 4 individual sites that were identified during a previous studio investigation conducted by the University of Tokyo. The sites, A, B, C, and D, were chosen due to the high likelihood that they would be easily redeveloped in the near future.

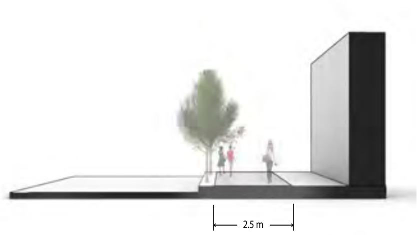
In tandem with the core studio group, members of the Urban Ecological Design course offered by the School of City and Regional Planning at Georgia Tech conducted their own evaluations and design-process for the specific sites. There are three groups who focused on site design, while a fourth group investigated the study area as a whole.

GUIDELINES

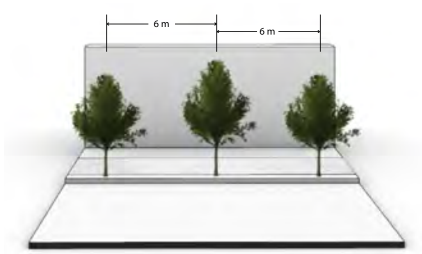
The following guidelines are meant to be used throughout the entire study area in order to bring cohesion to the urban form. Implementation will create a public realm that is able to handle the increase in foot traffic, while maintaining sensitivity to climate change and mitigation. The four main guidelines, as well as their descriptions are as follows:



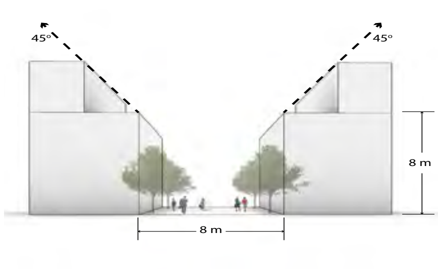
Building Setbacks: A minimum building setback of 6 meters is recommended. This will ensure that there is enough room for implementation of the remaining guidelines. Additionally, this will provide ample space for pedestrians moving between buildings.



Sidewalk Width: As this area is poised for a drastic increase in pedestrian traffic due to the Chuo Shinkansen, the development of space to handle such flows is critical. Sidewalks throughout the site are recommended to maintain a width of 2.5 meters. This provides enough space to handle comforatble directional traffic flows both ways.



Street Tree Palcement: An aspect that is missing from much of the study area is the existence of street trees. In addition to providing shade and cooling benefits to pedestrians, trees also help combat urban heat island and increase air quality. A recommended distance of 6 meters between trees will adequately shade the ground, while maintaining enough space for the development of roots.



Transitional Height Plane: In such a dense urban environment such a Tokyo, sunlight reaching the ground level is paramount to the growth and health of urban ecology. A transitional height plane on all new development would help ensure that sunlight has a path. Starting at 8 meters, the next floor of the building must be offset

SITE A: GATEWAY TO SHINAGAWA

By Christopher Barnum

Located directly adjacent to Shinagawa Station, Site A is at the forefront of the influx of new travelers to the area. This site is best known for the water treatment facility that comprises the majority of the land. Elevated parks cap parts of the water treatment facility, creating public space in what would otherwise be an inaccessible property.

The redesign of Site A is centered around the connection point between Shinagawa Station and the study area. As such, this design is titled “Gateway to Shinagawa”. By extending the existing cap to cover the entirety of the treatment facility, a grand plaza is created, providing ample greenspace and freedom of movement to future visitors to the site. A pedestrian-only grid is established on the north end of the cap which provides an intimate experience for commercial real estate, surrounding a greenspace. To the south of the cap, primarily residential buildings are proposed to take advantage to the proximity to the station. North of the cap is proposed as the business hub of the site, allowing easy access to transit and the study area.

Site A Masterplan

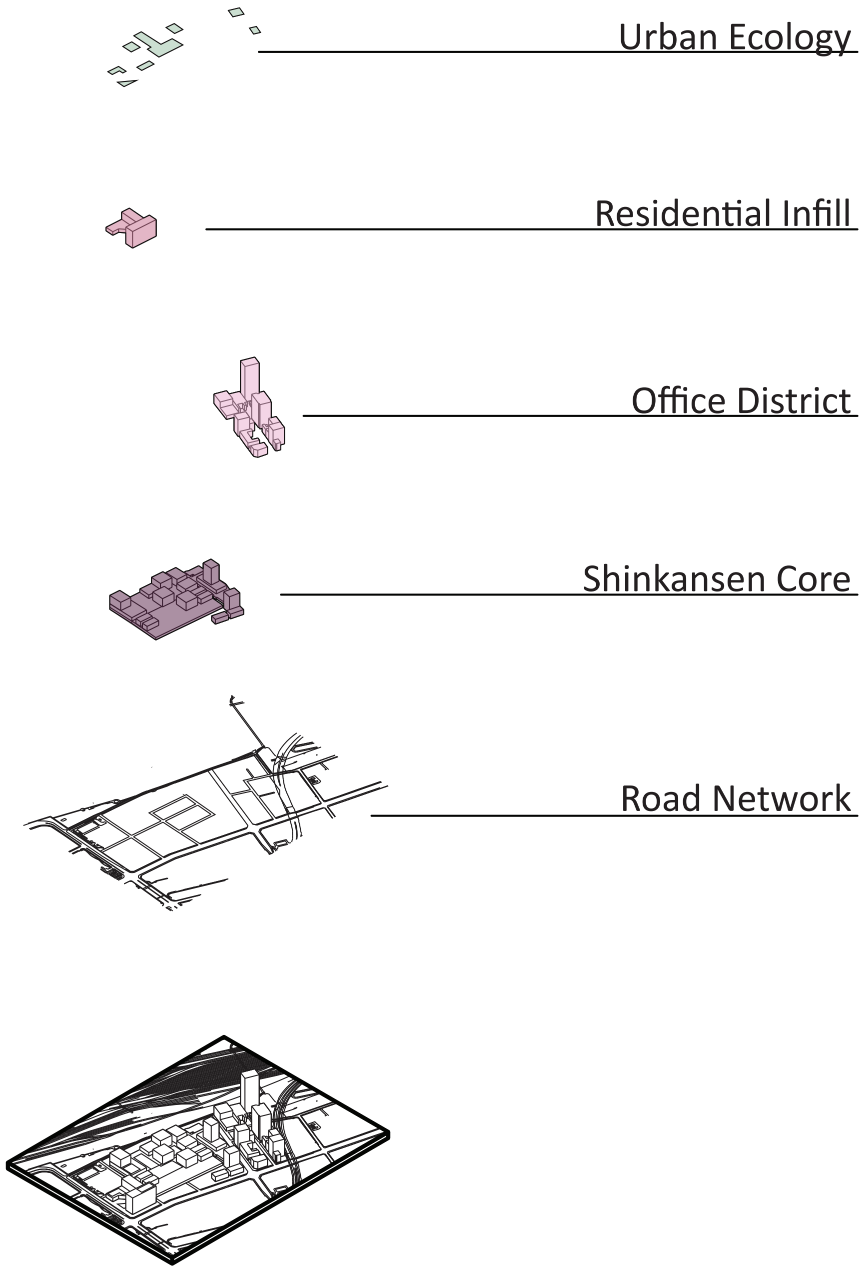
Shinkansen Connection

Major Thoroughfares

Connect to Neighborhoods

Site Circulation

Site A Conceptual Diagrams



Site A Exploded Axonometric

PHASING

Existing: 2020

- The existing buildings in Site A do not feature programming outside of park space for the public. These areas shall be retained in future phases to provide ample open space for visitors to the site.

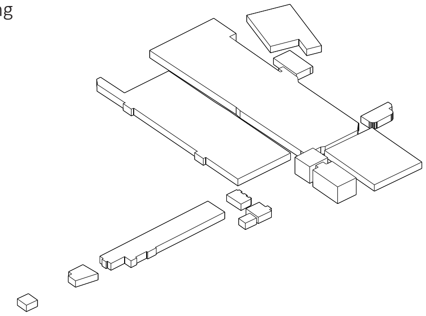
Phase One: 2027

- Extend the cap to accommodate the opening of the Chuo Shinkansen. Commercial development on the cap with provide an active space for shopping and retail. The integration of the greenspace and water treatment facility will begin to drive the site towards complete water reuse.

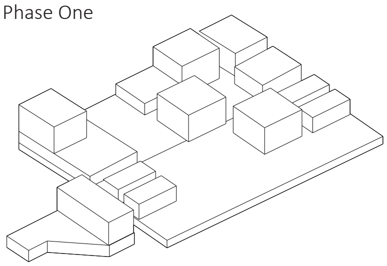
Phase Two: 2037

- Development of the office sector to the north of the cap. This area will create a fine grain street network to help spread traffic flow evenly throughout the site while providing more connection points to outside areas.

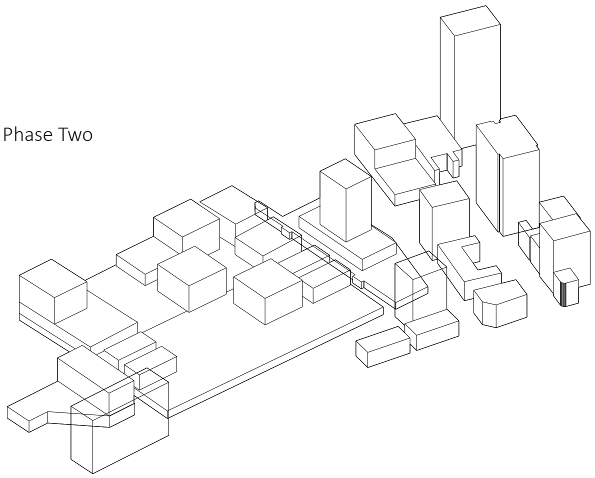
Existing

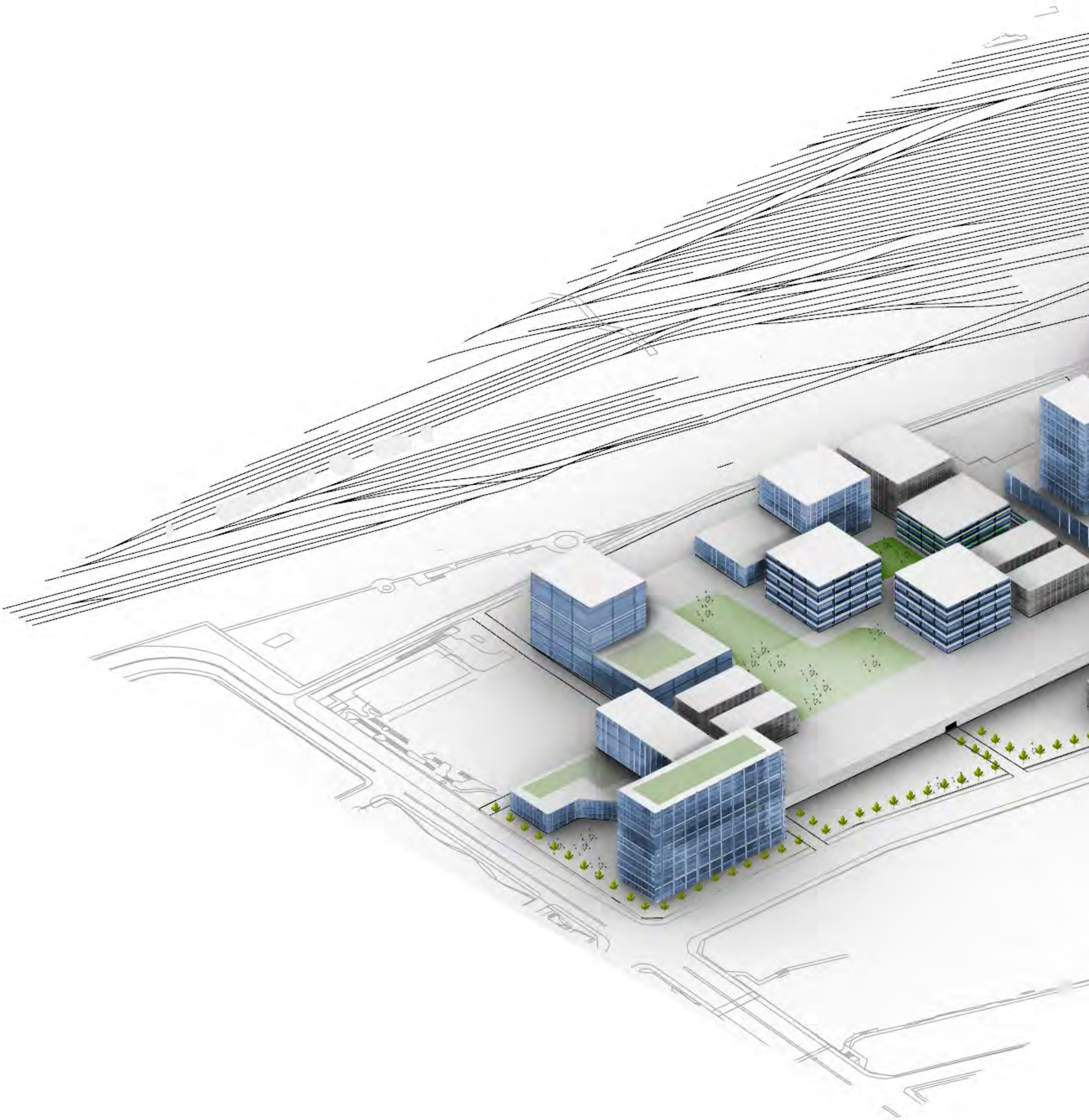


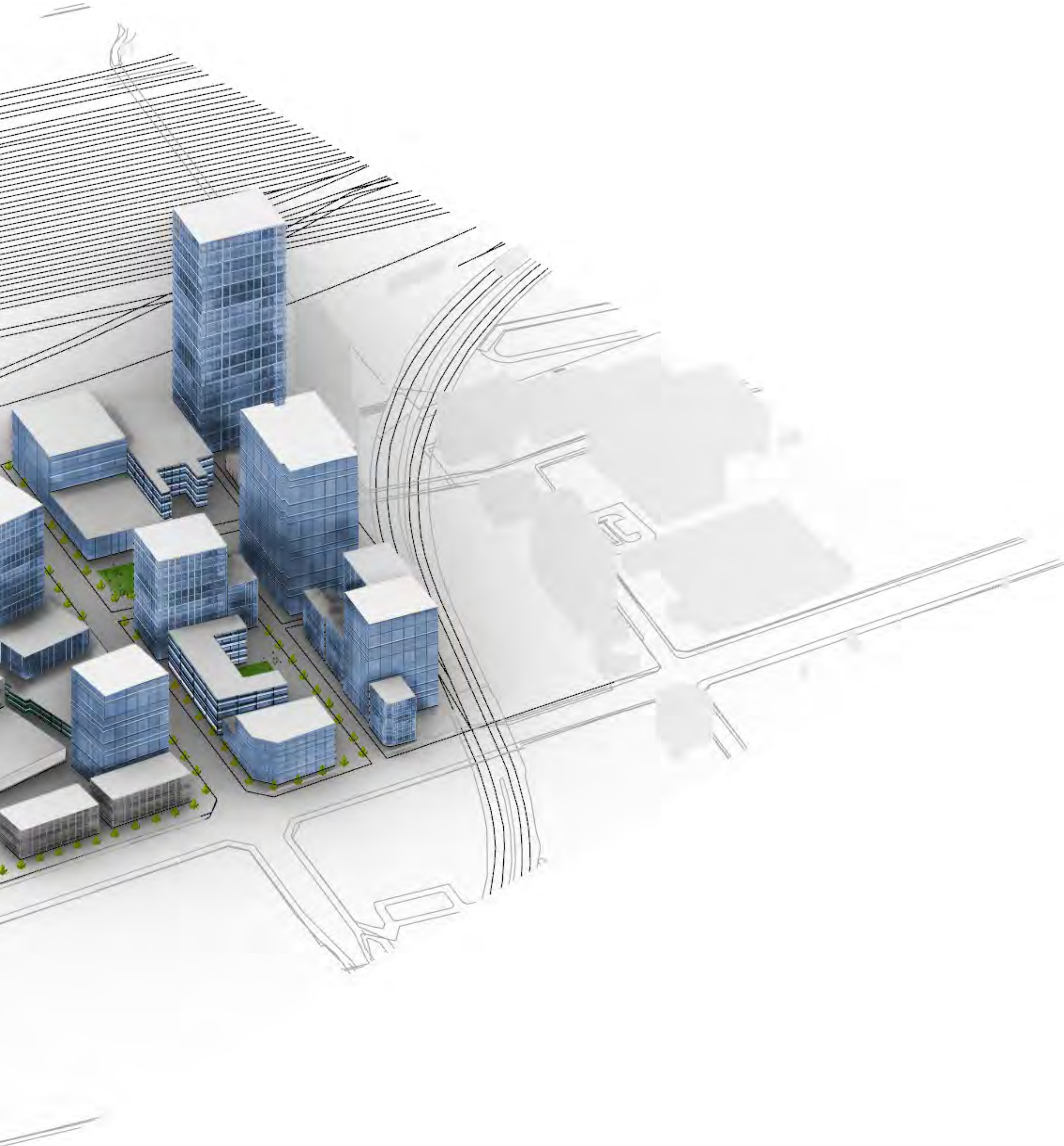
Phase One



Phase Two







SITE A (UED GROUP)

By George Doyle, Eleni Kroi, Jun Wang

Introduction

Shinagawa's Gateway City poises itself as Tokyo's new urban interchange. Designing Shinagawa Station as a new urban interchange is not an entirely new concept. Tokyo has an intellectual legacy of precedent designs like these. Former concepts from successful precedent Japanese designs were incorporated within the design parameters of Shinagawa Station, like that of Shinjuku Station which services 3.5 million daily passengers.

As a new nexus within JR Company's rail system, our design embraces innovation, technology, and investments through strategic planning and design efforts. It optimizes complex and dynamic urban fabrics through integrative and innovative approaches. The main goals of this design are geared toward relatively simple and measurable parameters. These design parameters include new urban form, new block levels, smart mobility, and multi-leveled programming schemes.

Background Conditions

Site A of Shinagawa is a 175,000 square meter plot of land currently zoned as an industrial land use. Although it is listed as an industrial zone, the existing land uses within Site A comprise of commercial (15%), residential (15%), and office (70%). The existing station at our site is currently being redeveloped by the world-renowned Kengo Kuma.

Site A is located closest to the new station, where it has a number of public parks that are integrated with high-rise towers. The site's most prominent feature is the water treatment plant, which covers the majority of the ground-level site. This feature will be used as an asset for the proposed design in ways that integrate the system with the overall function of the site rather than its existing segregated condition. Future urban forms of this space need to accommodate for regional movements and flows between Tokyo and adjacent cities along the JR Company corridor. The regional network of these new transit systems in Tokyo are expected to service 70 million daily passengers.

Given this projected growth factor, the current station on our site services 800,000 daily passengers. Upon Completion of Kengo Kuma's new station, it is expected to service 1.5 million daily future passengers. As an emerging Gateway City, Shinagawa would accommodate for the spatial demands and growth demands of these people through and organized complexity of revised urban forms and block structures. New floor area ratios (FAR) and building coverage ratios (BCR) are needed to meet these scalar demands. Shinagawa is currently being considered for the rezoning of its land uses. Therefore, the proposed design revises Shinagawa's existing zoning to an overlaid commercial and residential zoning district. These land use types accommodate for the population and functional demands that Shinagawa will experience with JR Company's newly developed station.

New Urban Form as a Design Parameter

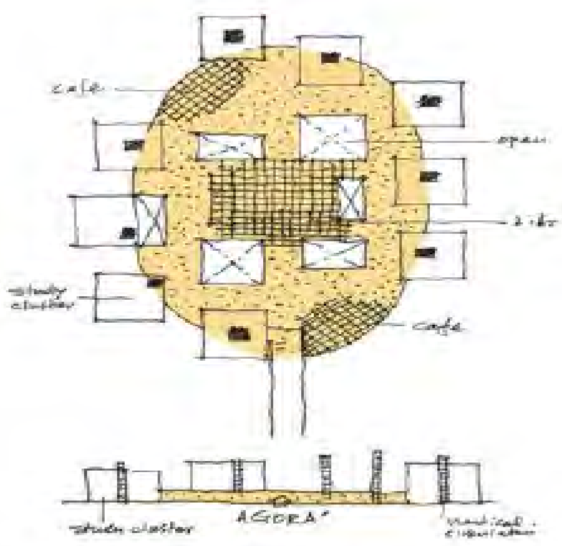
We fundamentally believe that urban forms follow their urban functions. By optimizing the functional characteristics of the Shinagawa site, the form that is produced complements its function. The new building framework implemented on site accommodates for an 11.5 FAR and a 70% BCR, compared to its existing 3.49 FAR and 58% BCR. Implementing new grid networks to the site will help optimize internal captures and internal spaces that attract people to it. The planned parameters behind these revised street block sizes allow for a denser living environment to optimizes land use performances and efficiencies. These details are explained more thoroughly on the next page. The complete build-out of these forms were conducted in incremental ways that allow for an influx flow of people once the Shinagawa Station is complete, integrating infrastructures for multi-scale movements and flows.

New Block-Levels as a Design Parameter

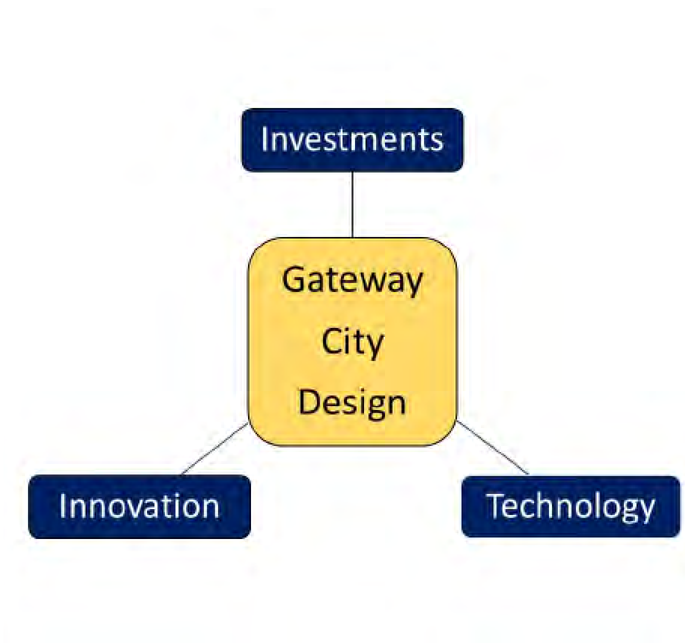
The Site A designs are illustrations of major changes that offer unique qualities of the proposed urban setting. Modular buildings are organized around a super deck concept that connects Site A to the Shinagawa Station, elevating the main pedestrian corridor above minor programmed spaces.

The Gateway design of Site A somewhat resembles the "group form" theory from Fumihiko Maki and his Singapore Polytechnic campus, shown below on the left. The incremental process of its development resulted in a quality of “organized complexity” in its block structure, shown below on the right. The elevated walkway along station in our sight plan on the right shows a similar ground-like pedestrian environment. This design strategy introduces multi-leveled programming schemes on site, where artificial grounds act as a lobotomy between the layered functions of its spaces. The incremental process of its development resulted in a quality of “organized complexity” in its block structure, which we emulated in our overall scheme to introduce a sense of fluidity between private and public spaces to perform efficient in function.

Fumihiko Maki's Singapore Polytechnic Campus

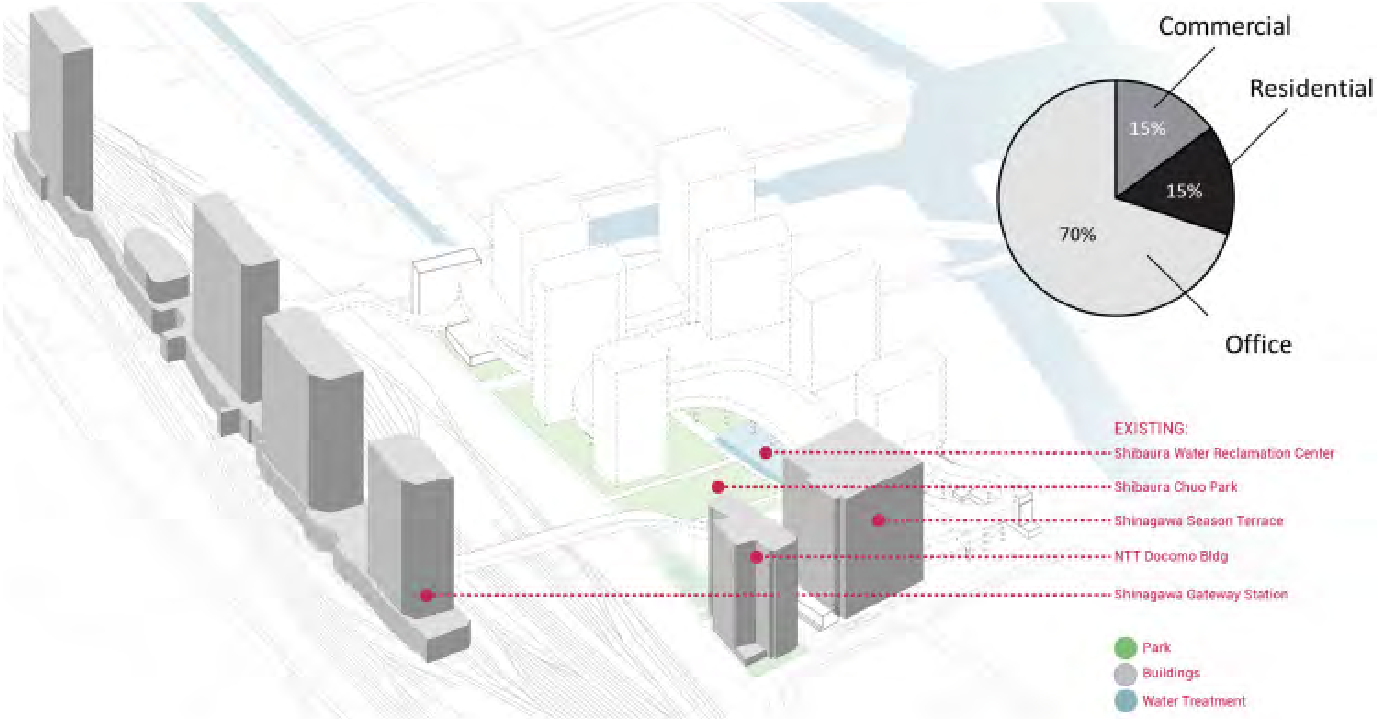


Goals for Proposed Urban Design

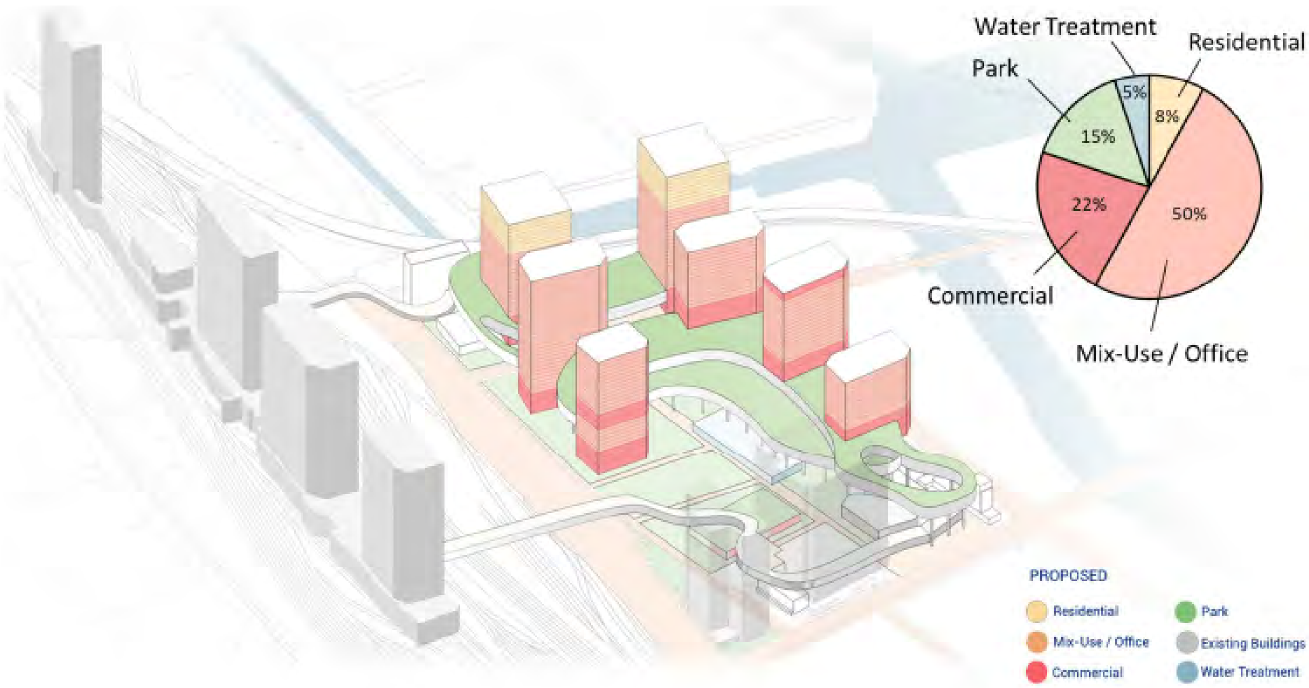


Aerial View of Existing Site

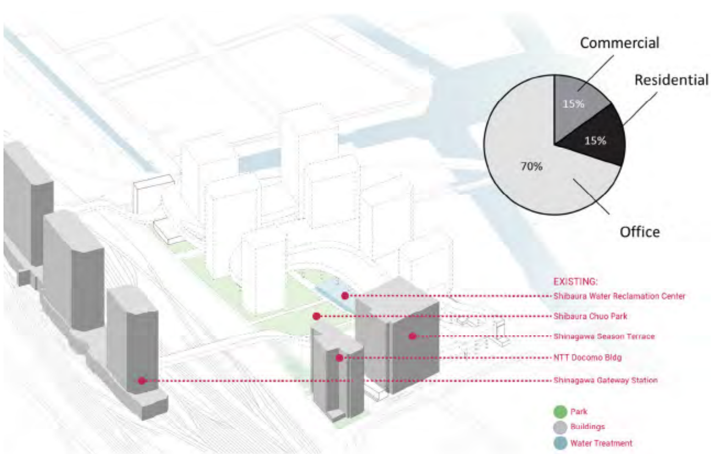
Existing Condition

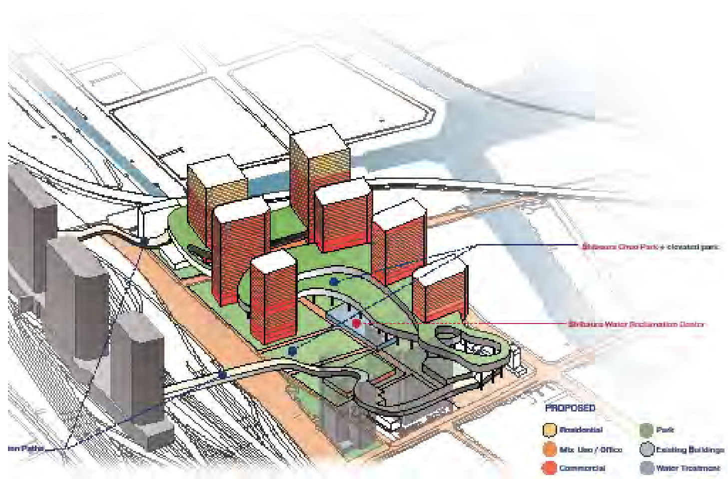


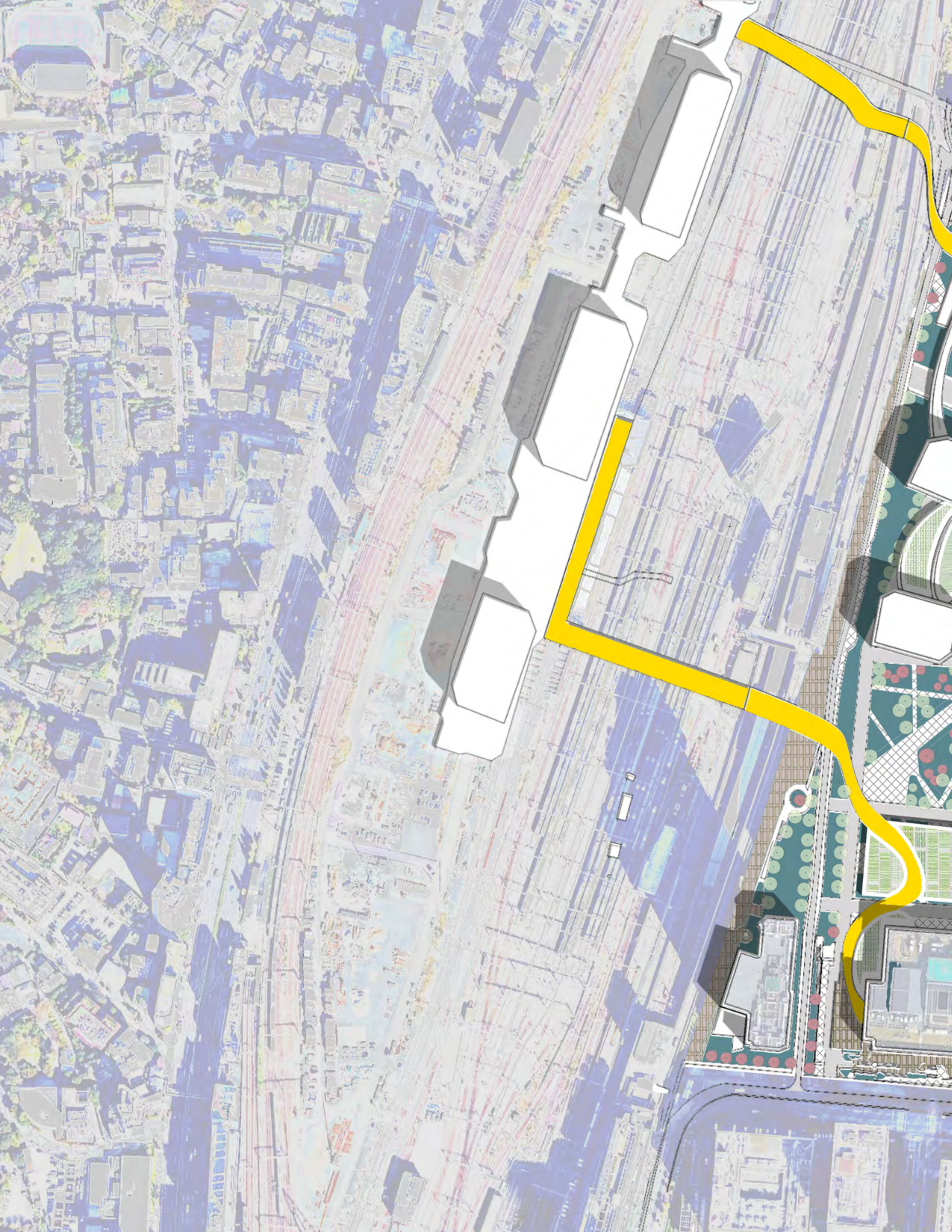
Proposed Program

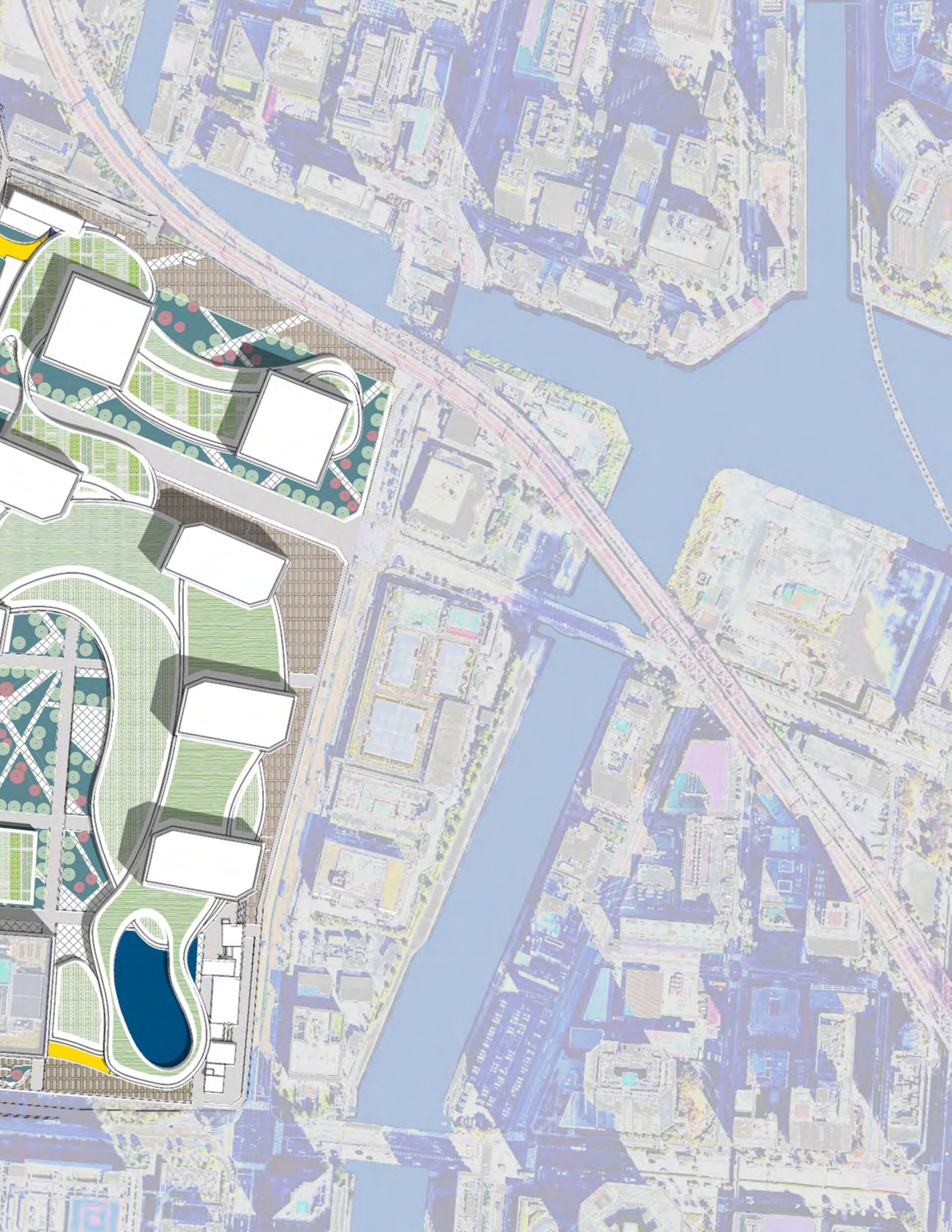


Existing Condition and Proposed Connections









Smart Mobility as a Design Parameter

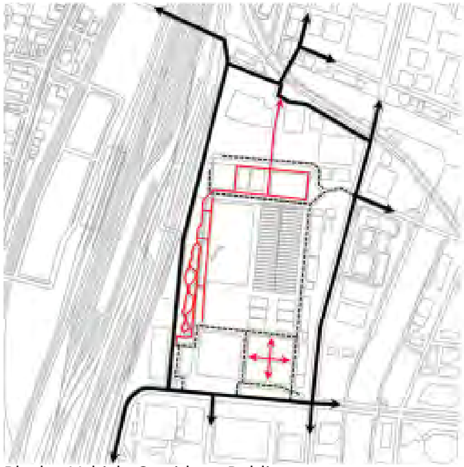
Shinagawa's existing interchange of 800,000 daily passengers is expected to service 1.5 million daily passengers once JR Company completes its construction. With such an influx of people in a concentrated area, smart mobility planning is needed to optimize the existing spaces of this interchange. Therefore, a design parameter that prioritizes walkable travel times over automotive travel has been implemented in our design. Ten-minute walkable measures between spaces were factored into the smart mobility concept of this plan, which incorporates accessibility criterion from different land uses that reduce gaps in walking time to increase internal capture rates of trips made within the site.

Internal capture trips from the station to Site A can be accomplished by breaking up the existing grid structure of the site into smaller and more walkable spaces. Within these smaller spaces, the presence of inner space is emphasized. Tokyo's cultural pattern of certain streets and block divisions follow a typical building framework concept known as *shitamachi*. This concept emphasizes the presence of inner space, where important functional spaces are internalized from the road networks that lead to it. The walkable design system addresses both normal and abnormal conditions of the interchange space, allowing an oscillating behavior to function between split grids during peak hour flows that reduce corridor bottlenecking. The smart mobility planning initiatives made address the ways in which intense flows of people can be channeled in various ways to accommodate for more specialized single trips through a combined multi-modal design initiative.

Incorporating autonomous-vehicle (AV) networks into the scope of our design was also associated with our smart mobility parameters. AV networks introduce a new urban "DNA" that provides different social and spatial requirements from traditional motorized vehicles. AV is lighter, cleaner, and safer than contemporary vehicular modes of transit. Cleaner energy of AV systems uses the alternative energy source of batteries, which mean that an urban battery storage facility will be needed while AVs are not in use. Although our site emphasizes the pedestrian grid network and the internal captures of JR Company's travelers, we propose an AV charging station on site that will act as the AV "center" for adjacent sites that will use the AVs more regularly. This allows Site A to act as a polycentric center not just for the proposed

Shinagawa Station, but for all other adjacent neighborhoods in future years. The impact AV systems have on cities and urban spaces are based on new mobilities experienced within future street designs that are embedded in Site A's pedestrian friendly environments. AV-driven cities and districts need to be analyzed through a Travel Demand Estimation (TDE) process that is organized by an Internet of Things (IoT) platform. Conducting a TDE allows for walkability mapping and urban network analyses that explain the physical properties of network structures in collaboration with flow information demands evaluated in the IoT platform.

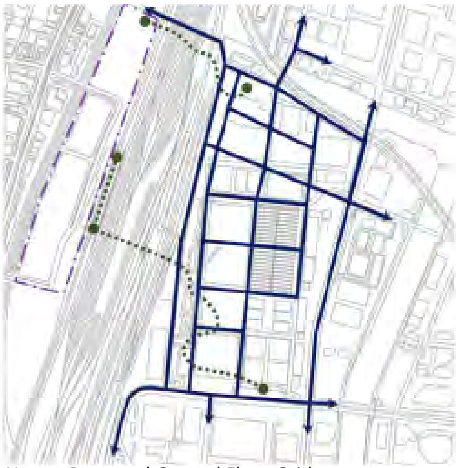
Exisiting Grid Network



Black = Vehicle Corridors, Public
Dashed = Maintenance Corridors, Private

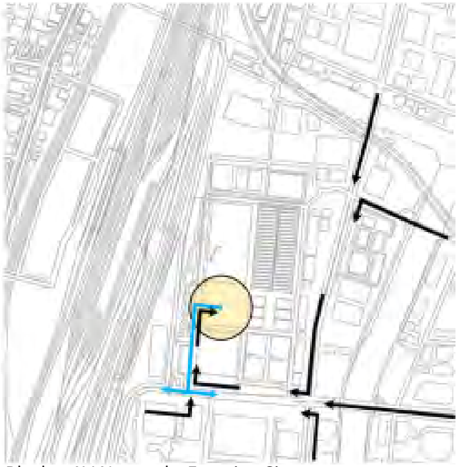
Red = Pedestrian Circulations

Proposed Grid Network



Navy = Proposed Ground Floor Grid
Dashed Purple = Future Shinagawa Station
Dashed Green = Elevated Pedestrian Walkways between Shinagawa Station and Site A

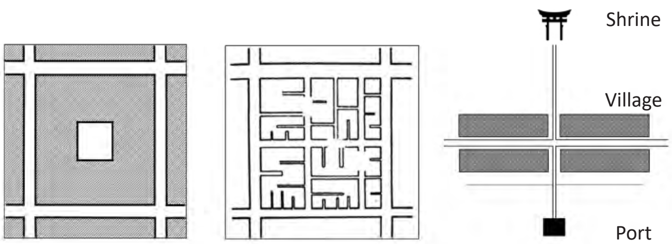
Proposed AV Systems Hub



Black = AV Networks Entering Site
Blue = AV Networks Exiting Site

Gold = AV Hub within Site A

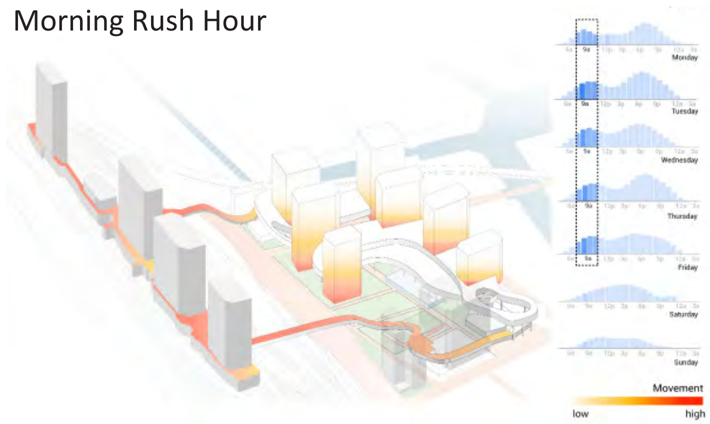
Blocks



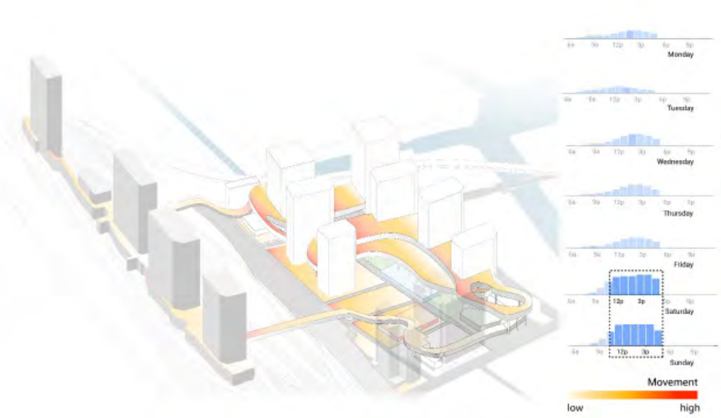
Typical Street and Block Divisions of the shitamachi area of Tokyo

-Uzo Nishiyama

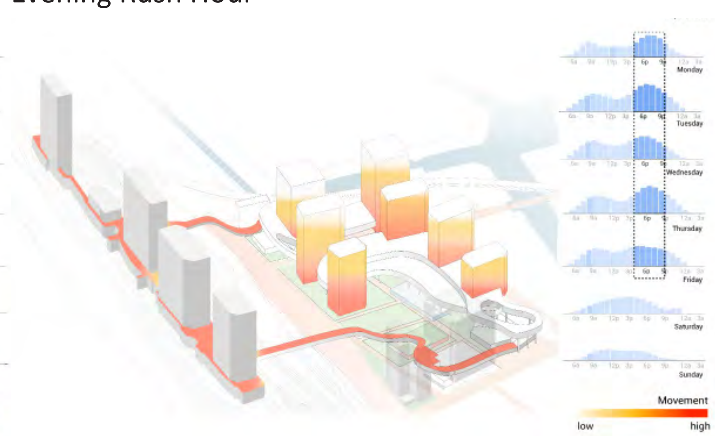
Morning Rush Hour



Weekend Park Popular Times



Evening Rush Hour



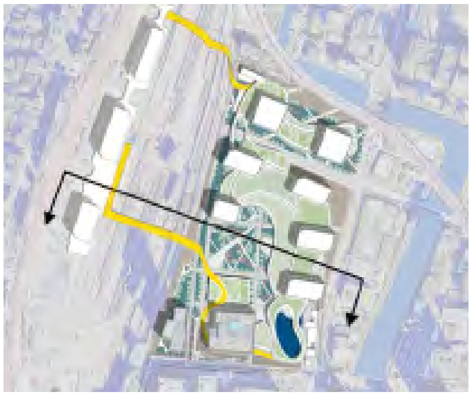
Multi-Leveled Programming Schemes as a Design Parameter

By establishing multi-leveled programming schemes on site in conjunction with the previously mentioned design parameter implementations, we were able to establish a synthesized interconnectivity between new forms and new functions. The Shinagawa Gateway Station Paths allow for travelers to enter live-work spaces and elevated parks that are multi-layered in function. These multi-layered urban systems engage and incorporate new infrastructures with dynamic architecture through various integrative landscapes. They all connect together, forming and generating a new urban metabolic structure that merges the park and water treatment facility functions together to foster new rainwater harvesting mechanisms on site.

We looked at different design options that significantly leverage the asset of localized water resources in various ways. The top of the water treatment plant forms as an artificial ground in order to bring overflows of these people into spaces for new urban activities. We looked at ways to have diverse vegetations remove and filter pollutants from stormwater runoff. We propose installing soft surfaces on the parks, porous pavements throughout the site, and green roofs on the building typologies in order to achieve this. The Water Reclamation Center on site will be used to harvest rainwater and distribute it back to the immediate site area or to adjacent lots in times of emergency. These interactive landscapes reflect the multi-leveled programming schemes our site encompasses, truly fostering the Smart City Design that Tokyo will see at the new urban interchange of Shinagawa Station.

Urban System Metabolism

Site A- Shinagawa Gateway City of Tokyo's Smart City Design



Perspective of Elevated Park

Mutil-Leveled Urban System

SITE B: URBAN REGENERATION

By Christopher Barnum

Site B is located near the heart of the study area. Currently, it is home to a meat processing plant and market. This superblock is nearly inaccessible to the public, with no connections through the site. There are a handful of larger buildings that are primed for retrofitting.

The redesign of Site B focuses on maintaining the larger buildings while incorporating other defining factors of Shinagawa. To the southwest of Site B exists a historic district that is characterized by a fine grain urban form of smaller, more compact buildings. The new masterplan brings these elements to blend the old with new, while maintain the overall layout of the original site. A road is added to split the block and expand the exiting grid, providing more access to the inner site.

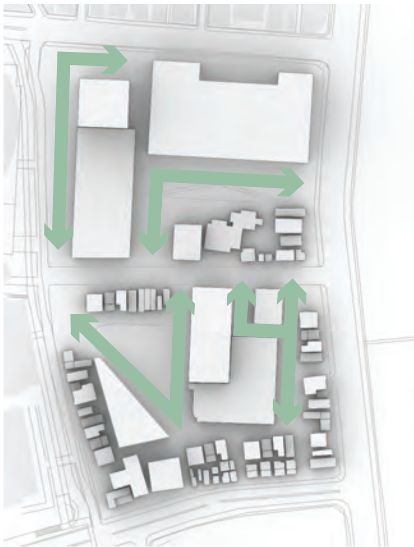
Site B Masterplan

Greenspace Flow

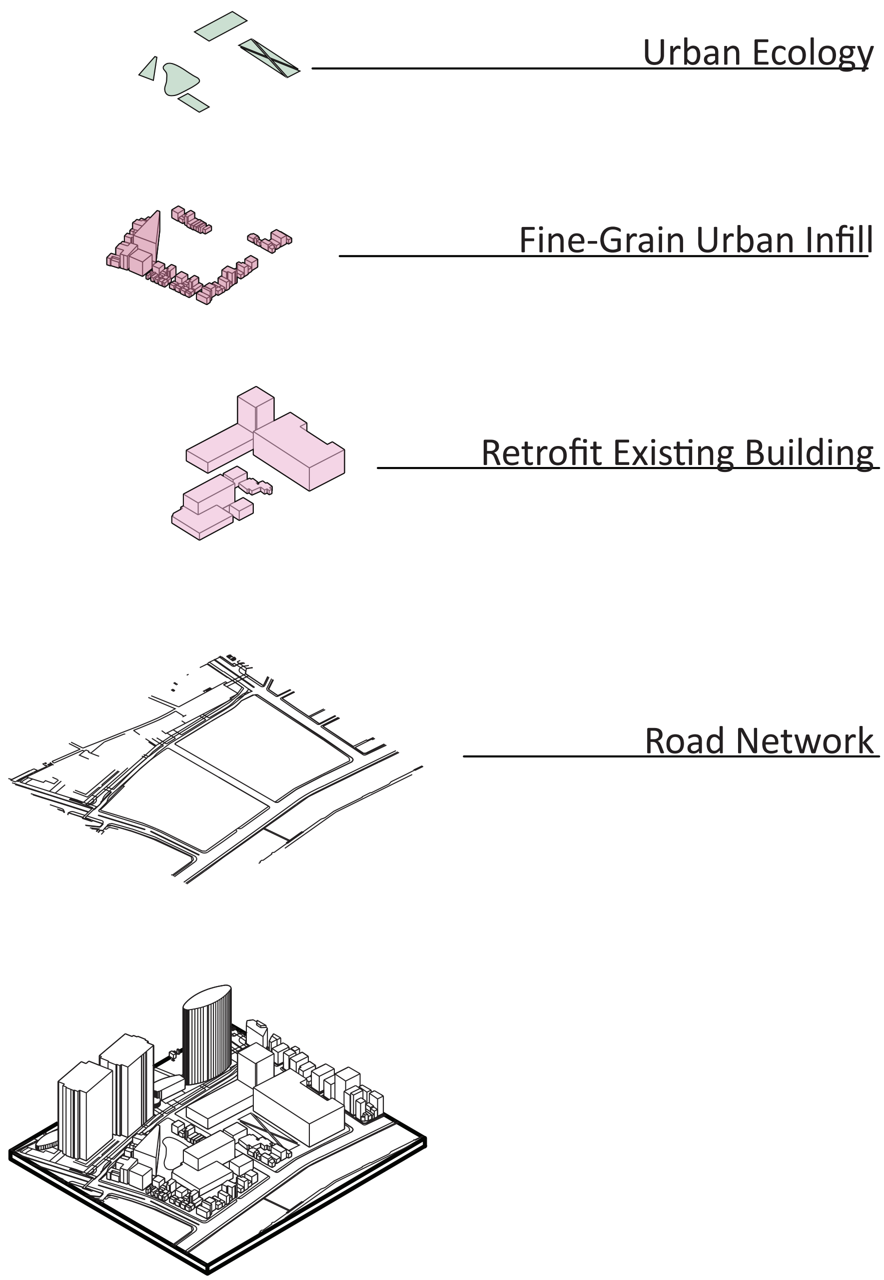
Major Thoroughfares

Pedestrian Gateways

Site Circulation



Site B Conceptual Diagrams



Site B Exploded Axonometric

PHASING

Existing: 2020

- Site B is defined by the meat market the occupies the majority of the property. The large scale buildings shall be retained and retrofitted for a more diverse programing.

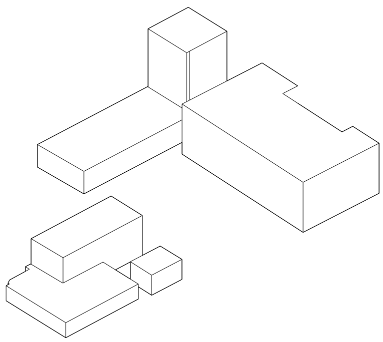
Phase One: 2027

- The block is bisected by a road to reconnect the grid. Infill mimicking the historic district to the souths platting begins around the east and west of the site to tie together the urban fabric. This helps connect Shinagawa Station to Sites C and D.

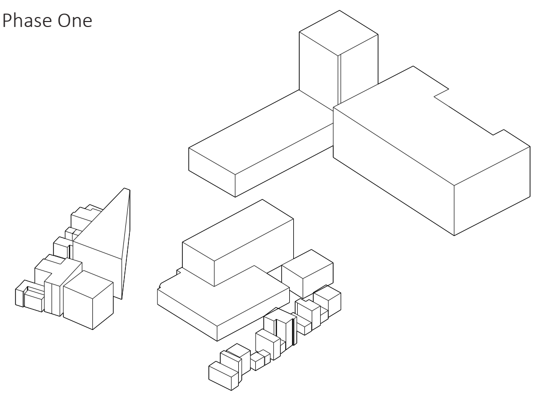
Phase Two: 2037

- Remainder of infill development. The majority of these buildings are categorized for residential and commercial uses.

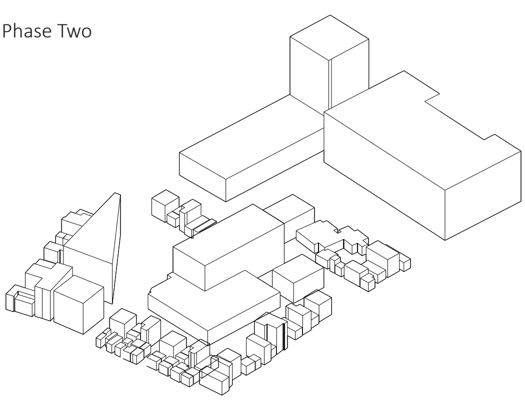
Existing

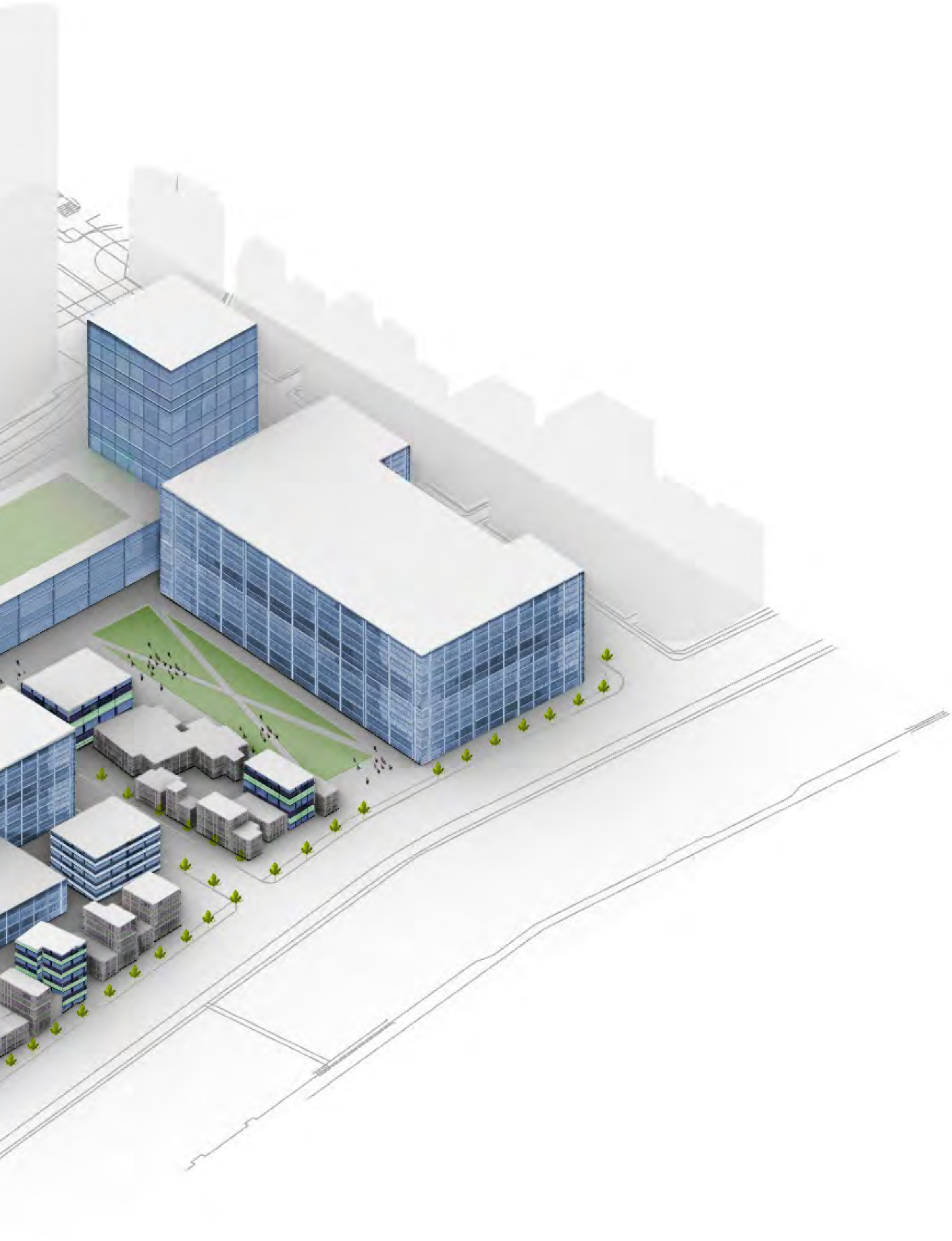


Phase One



Phase Two





SITE B (UED GROUP)

By Danielle Blumenthal, Bhaswini Kokitar

Introduction

The waterfront lies between site B & C. There are 3 connecting bridges which connects the islands to the mainland. Out of 3 bridges, 2 are pedestrian and 1 with heavy vehicular movement and pedestrian. Currently, the waterfront is been used for pedestrian movement towards site B and vehicular movement towards site C (Campus area). There are multiple vacant potential sites such as one near the pedestrian bridge which connects site B and Site C as well as near the connection of campus and waterfront. Physically there is no connection between the water and the land, which makes the waterfront development a potential scheme.

For our proposal, we made both sides (Site B & C) pedestrian friendly. The key design ideas that are implemented in the project are:

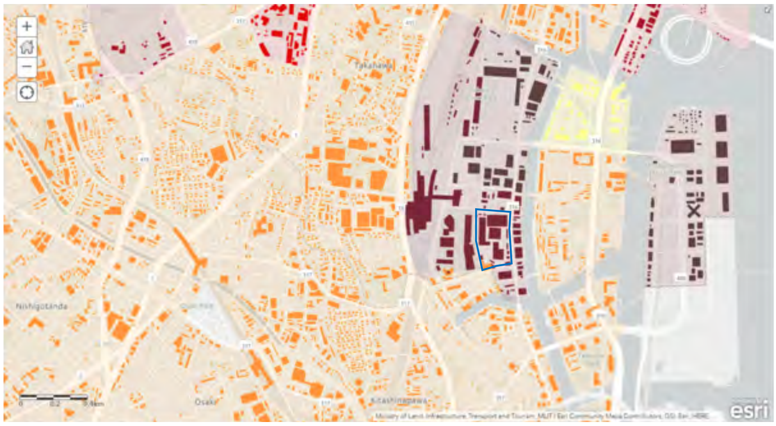
1. Sustainable
2. Walkable
3. Diverse
4. Inclusive
5. Vibrant

The main idea of developing the waterfront was to revitalize the area and make it more accessible to people and connect the campus to the city. It becomes a place of celebration in the future, where humans and technology mix together and create a lively place. Amphitheatre and floating platform in the water with the help of the Toyota e-palette makes the place an entertainment center during the night-time. Also, the seasonal park and seating places that capture human senses throughout the day make the waterfront more engaging with the people. Making the site accessible to all the age groups which further makes the site Inter-Generational. All the features that are implemented in the design make the waterfront more vibrant and engaging.

Existing Factors

Open Space

- Open Space
- Parks
- Signature Park



Population density

- Highest
- Very High
- High
- Low
- Very Low
- Lowest

Housing Density

- High
- Medium
- Low

Getting in the Design
- Focus on simple, inclusive and human-scale design
- Adaptive reuse
- Making optimum use of existing infrastructure
- Aim: Pulling more people to the area, in turn benefitting the surrounding
- In proximity of the site- Tokyo Marine University, Shinagawa rail station
- Site has good potential of attracting the public

Proposed Design
- Demolition of all structures except two
- New building with flexible space (approx. 48,000 sq.ft floor space)
- Smart parking lot
- Open park (approx. 160k sq.ft)

1.
- Changing internal design
- Solar panels
- Adaptive reuse
- Mixed use structure (shops/restaurants/activity centers)
- Community space (library/ auditorium/theatre)

2.
- Green roof
- Convertible/flexible space
- Viable option in the light of the current situation

3.
- Smart parking
- In-ground sensors
- Green buffer

4.
- Encouraging pedestrian activity
- Good residential density
- Not many parks in proximity


1
1
3
2
4

Street Design
By Danielle Blumenthal

The existing street design in the study area is not ideal for the future of the space. The focus of this section is on Kyu-Kaigan-Dori Avenue, a primary road running north to south that is situated between the meat market to its left and the university to its right. The proposed design can apply to other primary roads on the site or be modified for certain tertiary roads.
Currently, Kyu-Kaigan-Dori Avenue is automobile focused, with five lanes for car travel and a 12-foot sidewalk on either side. The right-of-way is 86 feet, so there is a lot of room to make improvements to the avenue. For our proposal, we take the road down to four lanes for vehicular traffic: each twelve feet wide. We also extend the sidewalk on either side to 14.5 feet in width, as well as incorporate 2, single direction bike lanes with green buffers. This proposed street design will help liven up the streets of Shinagawa, making them more bike and pedestrian-friendly, and a lot brighter.

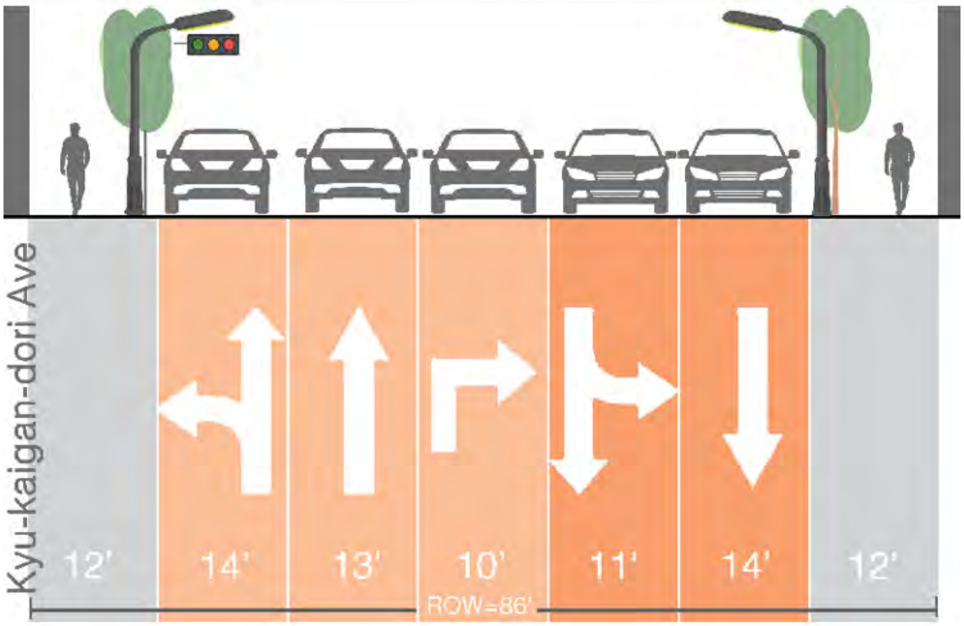
Moving forward into the future, it is important to utilize different technologies into public spaces, including streets. Our proposed design features 4 smart technologies, making the streets as smart as they are functional.

1. Energy harvesting sidewalk panels collect power as people walk across them. That harvested energy can then be used to power things like streetlights, sensor networks, and more. They are a very forward-thinking and sustainable asset to any street design.

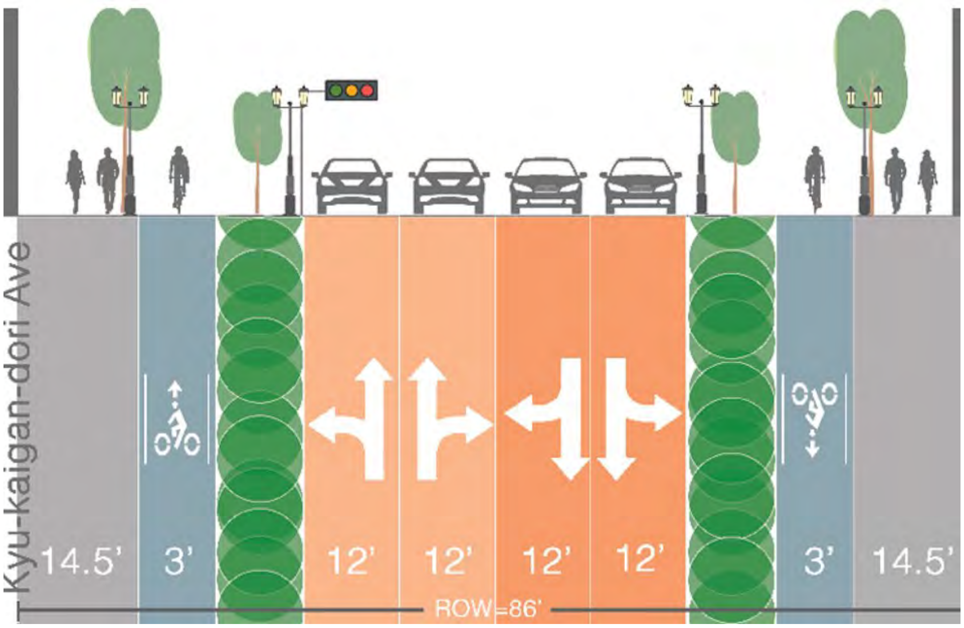
2. Having traffic lights that are triggered by sensors, rather than being set on timers, they can have several benefits. This technology can minimize wait time at traffic lights and increase traffic flow. This also has a positive environmental impact, by decreasing the number of vehicles idling at intersections. Another means of accomplishing these things is by installing inductive loop detectors beneath the road surface.

3. Potentially powered by energy harvesting sidewalks, sensor networks are useful in that they can measure environmental performance, such as air quality. It would be interesting to see how this data changes based on time of day, season, or during certain events, such as the current COVID-19 pandemic.

4. Toyota E-Palettes will be incorporated in the final phase of development. These innovative machines offer countless benefits, such as convenient shopping, food delivery, taxi services, and much more. During a possible future pandemic, E-Palettes would be effective in delivering food and supplies to those who need it, without requiring any type of contact, helping to limit the spread of disease. This would be possible by adapting roads and parking spaces. Our following proposal for a green, E-Palette, and AV friendly road would maximize the efficiency of these vehicles within the space, while still creating a space to be shared by pedestrians and bicyclists.

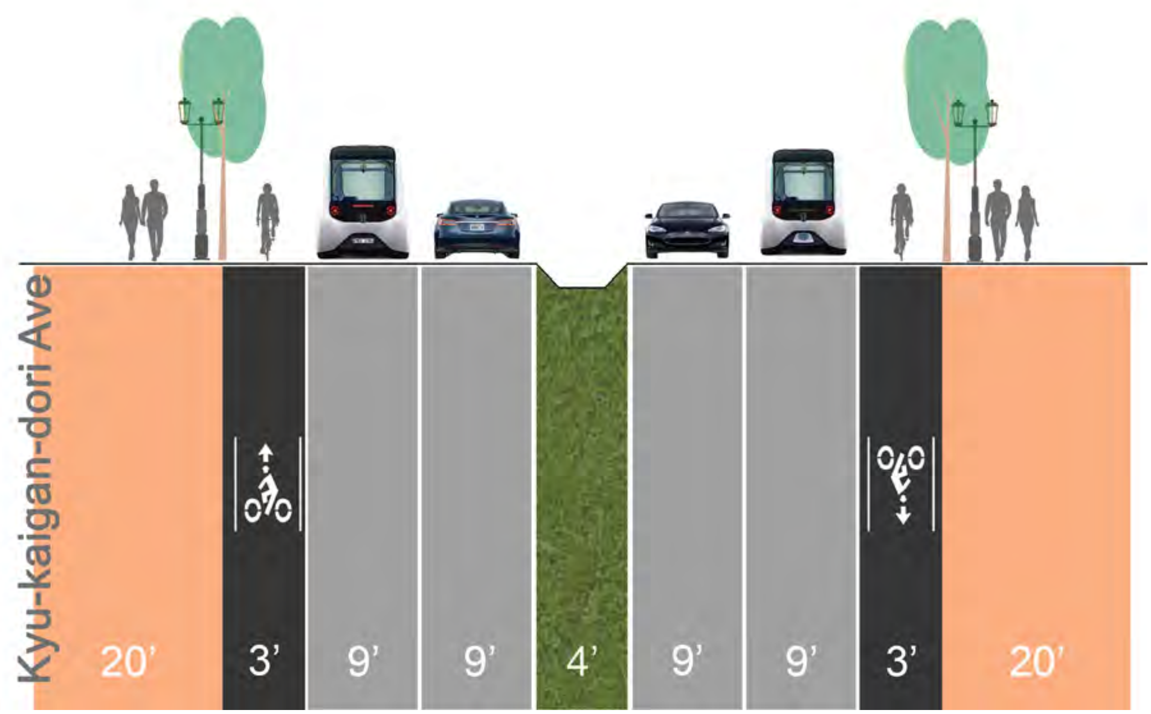


Existing Street Design



Proposed Street Design

Future Street Design



- Middle of road is lowest point
- Narrow lanes for cars
- AVs and E-Palettes
- Extra wide sidewalks
- Alternative option
- Shrink green median and sidewalks to make way for E-Palette stopping lanes
- Allow for loading/unloading passengers, shopping, etc.

SITE C (UED GROUP)

By Akhilesh Dhurkunde, Sanjana Zahin

Introduction

The main concept for the Shinagawa University of Marine Science and Technology campus is to revitalize the existing campus through retrofitting and design interventions to make it inclusive as well as sustainable. The university campus has the potential to become a social leaning place not only for the students but also for the nearby communities. The goal is to transform the traditional bleak university campus into a vibrant social learning hub.

The key design priorities that will be implemented in the campus revitalization project are:

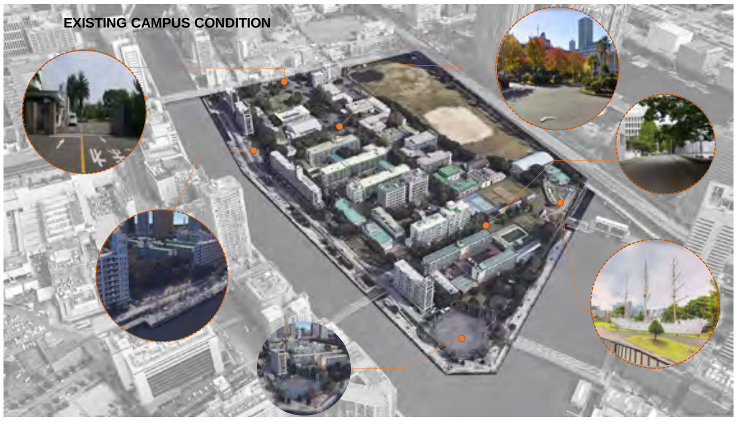
1. Pedestrian-friendly campus,
2. Connection with communities,
3. Sustainable campus infrastructures.

The campus revitalization process will happen in several stages in different implementation areas so that it will not disrupt the overall campus activities. The first stage is the creation of a new student center and student plaza along with revitalized student corridor. The old administration building, auditorium, the student health center will be replaced by the new student center which will provide instrumental support to student's campus activities. The new building will include important student facilities such as- auditorium, health center, student common room as well as some public facilities like restaurants, an art exhibition hall to encourage community engagement.

The student plaza is the main outdoor activity space of the university campus to enhance the student's quality of life. The plaza is situated in between of the student center, museum, and library and creates a connection between the canal and the campus. The pedestrian-only open plaza will act as a student and public gathering space and can be used for outdoor events.

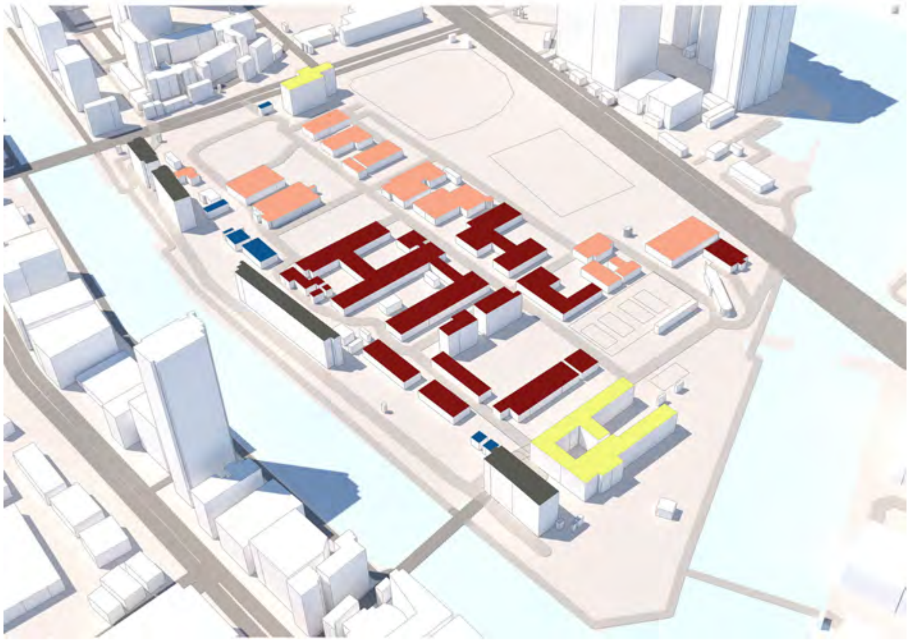
The next phase of the campus revitalization process will incorporate retrofitting the old campus buildings with essential infrastructure upgrades to support the growth and demand of the campus


TOKYO UNIVERSITY OF MARINE SCIENCE AND TECHNOLOGY
ESTABLISHED: 1875
TOTAL STUDENTS: 3500
TOTAL AREA: Approx. 50 acres


EXISTING CAMPUS CONDITION


PROBLEMS
NO DIRECT CONNECTION WITH WATER
NO STUDENT GATHERING SPACE
NO PUBLIC FUNCTION

FUNCTION OF EXISTING CAMPUS BUILDINGS



ACADEMIC

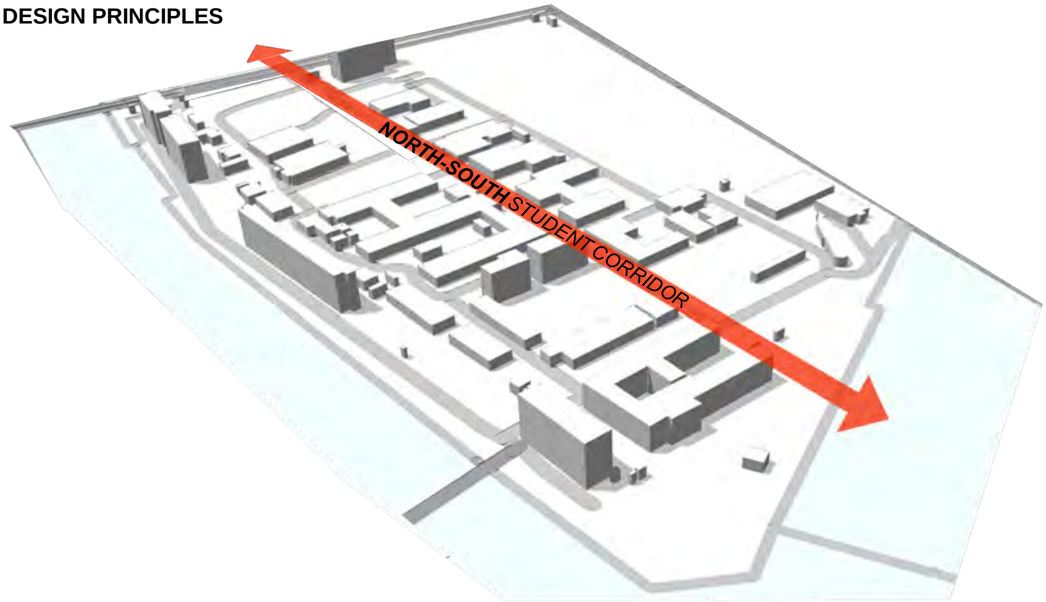
STUDENT FACILITIES

HALL & DORMATORIES

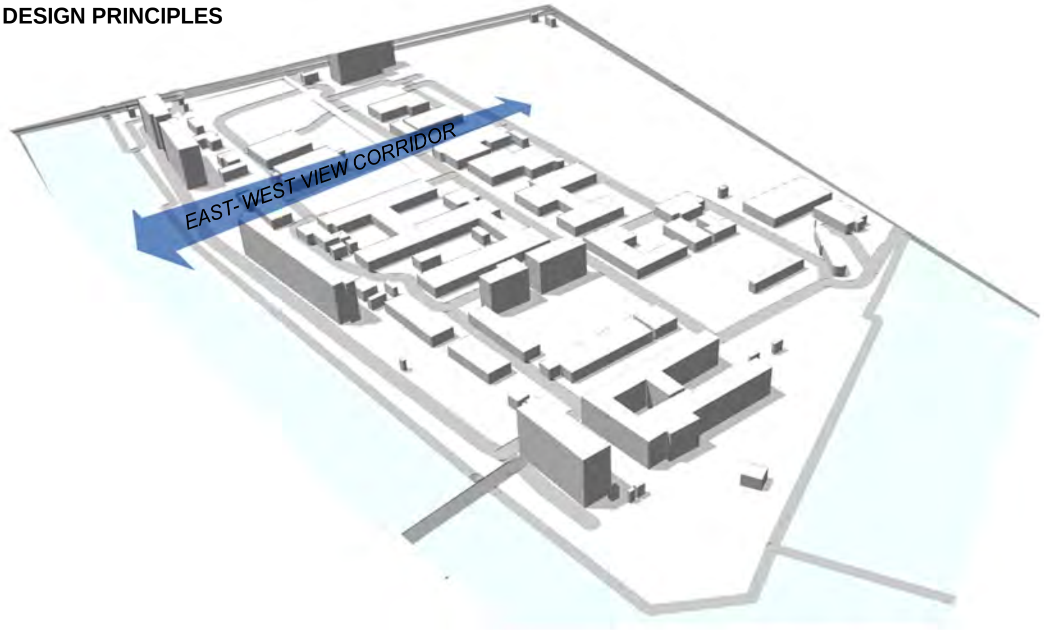
SERVICE

RESIDENTIAL

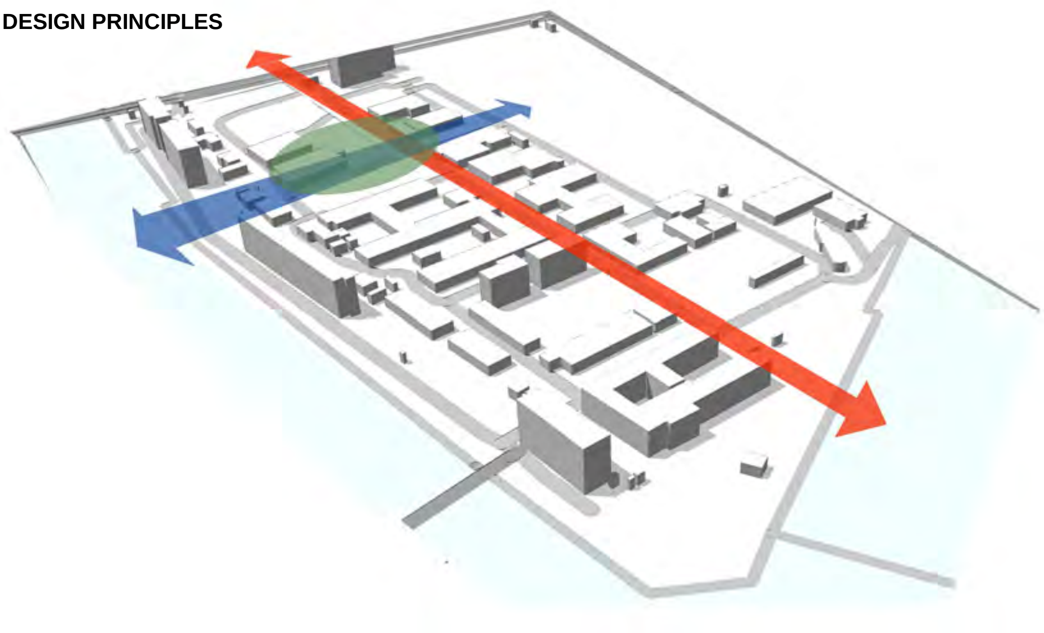
DESIGN PRINCIPLES

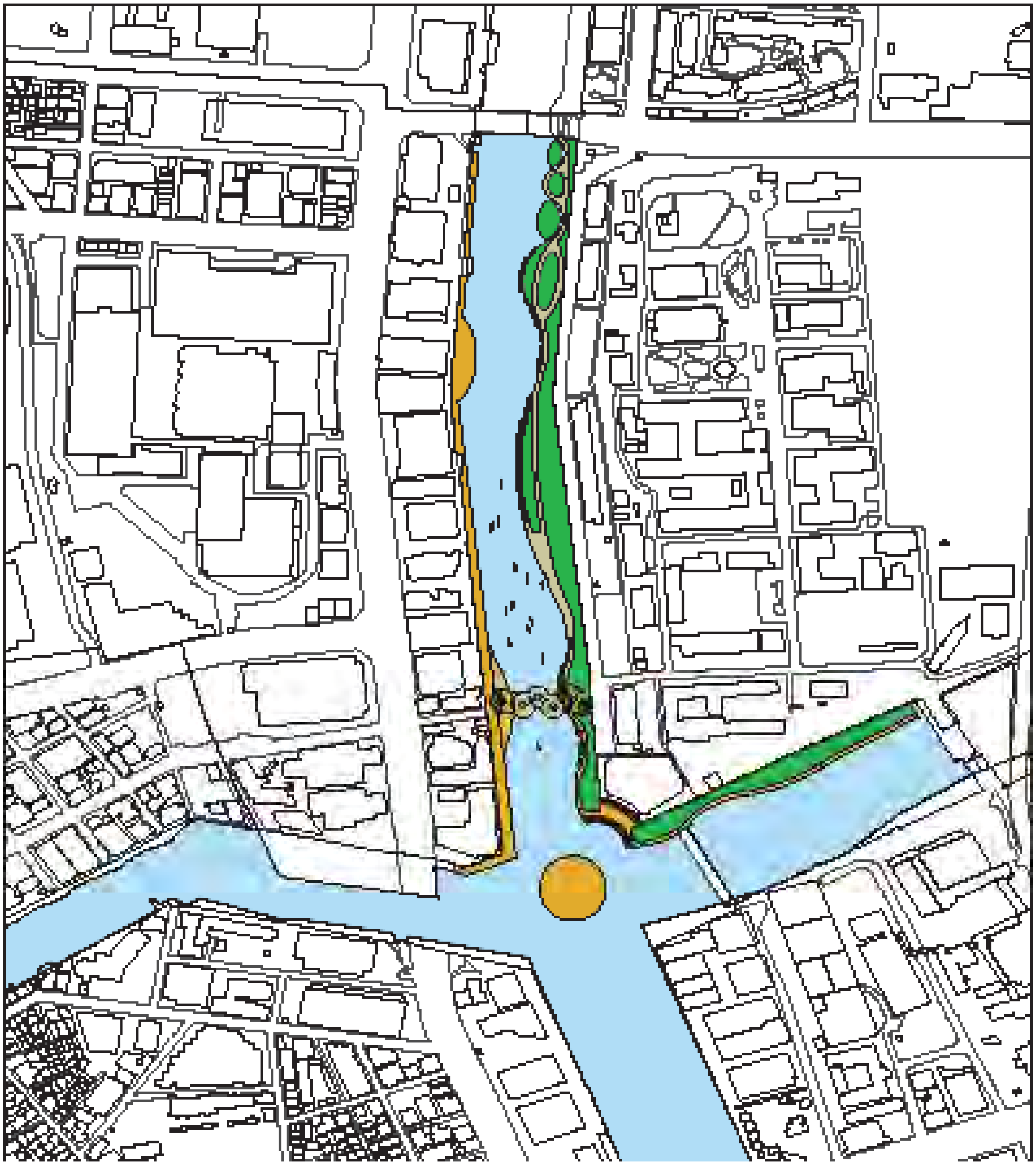


DESIGN PRINCIPLES



DESIGN PRINCIPLES





Waterfront Development

MASTERPLAN

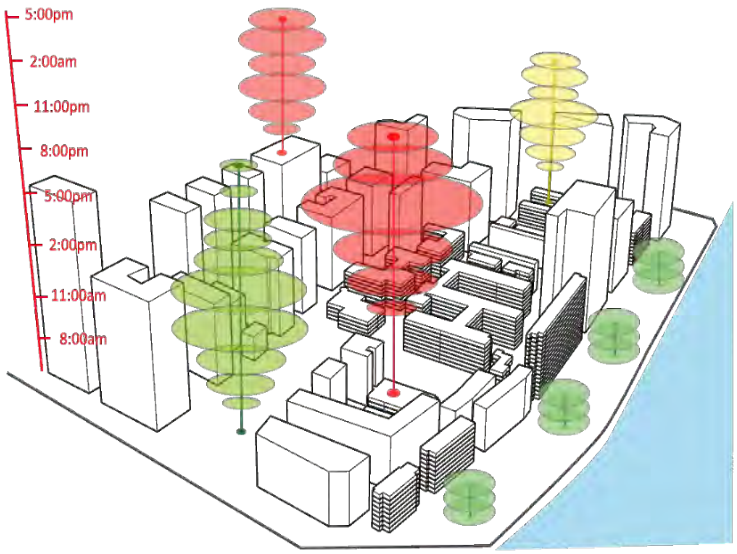
SITE C: 24-HOUR CITY

By Shuhui Zhen

Site C is Tokyo Marine University with low rise buildings, big green spaces right now. It is redesigned into a 24 hours active place where life occurs at all scales. After re-development, the FAR of this site is 5.0 and BCR is 30%. For the land use, basically, commercial, residential and office are almost equally distributed.

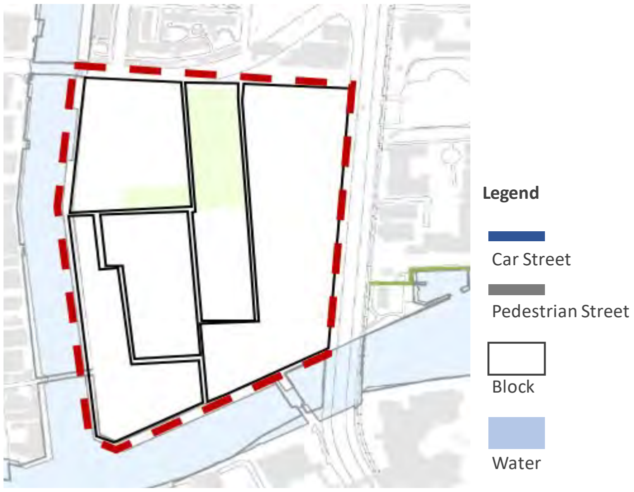
The Site C is an infill development to turn a campus-like environment to a vibrant, mixed-use and fine-grain waterfront setting for live, work and play. While it ren-ovates existing campus building to be an environment, like WeWork, it should provide flexible spaces and well-connected social networking settings to make a creative and stimulating working environment. It also introduces new density to inject urban living, retails, entertainment and hotels along the waterfronts. The successful redevelopment of the adjacent block, Tennozu Island suggests that the similar programs, activities patterns and development would spill over to the Ma-rine University campus site.

Site C Masterplan

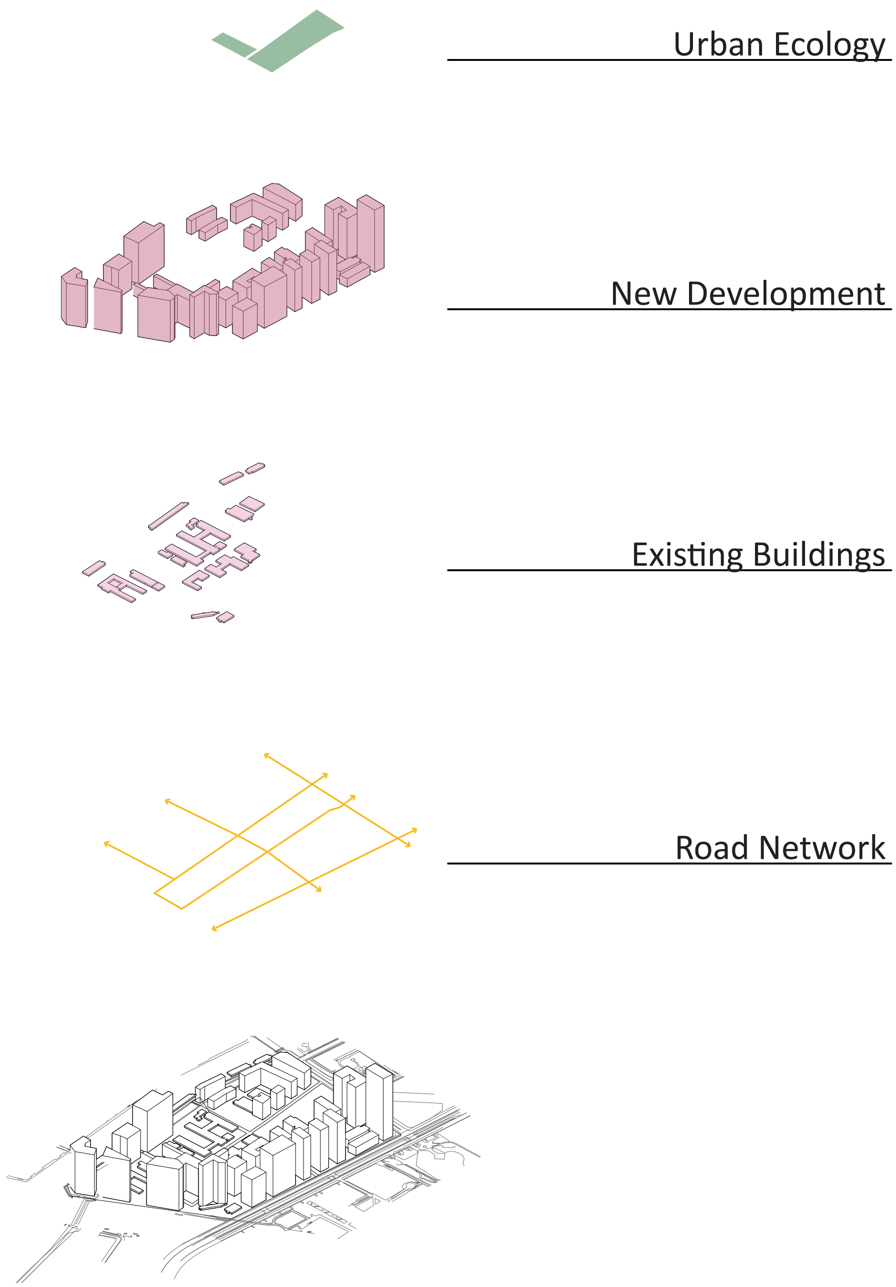


Site C 24-hour conceptual diagram

Site C 24-hour conceptual diagram



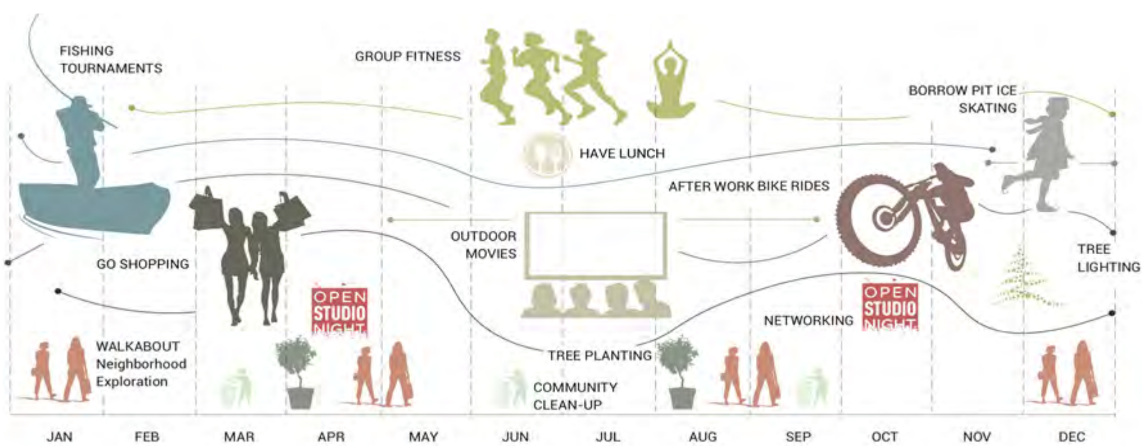
Site C 24-hour conceptual diagram



Site C Exploded Axonometric

RIVERFRONT DEVELOPMENT GOALS

- Development of various activities along the waterfront to serve the residents and visitors
- Creation of high-quality public spaces in which people can spend more time and interact and shop
- Development of the natural environment and revitalization of waterfront and making them attractable special places
- Establishment of public access and designing new public places which reflects the accessibility of the waterfront
- Improve the quality of waterfront for residents, visitors, commercial activities
- As well as popular public open spaces, supporting the activities such as ferry, shipping, cruise ships etc.
- Adoption of sustainable design approach for the design of buildings and public spaces.



The successful redevelopment of the adjacent block, Tennozu Island suggests that the similar programs, activities patterns and development would spill over to the Marine University campus site.

PHASING

Existing: 2020

- The spatial legacy of original campus of Marine University should continue to be traced, while new innovative elements can be inserted into its future programs.

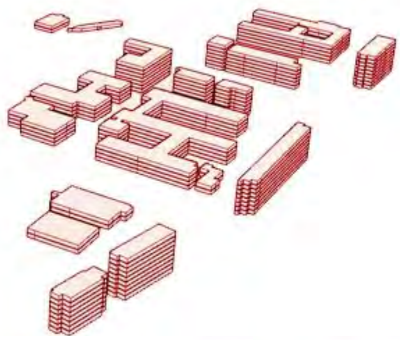
Phase One: 2027

- We propose in 2027, many existing buildings will be retrofitted, and more floors will be added on the top of them. Some new buildings will be built to increase density of the site. By that time, more residents and visitors are to be bring into site C. Diversity and density can be both significantly increased.

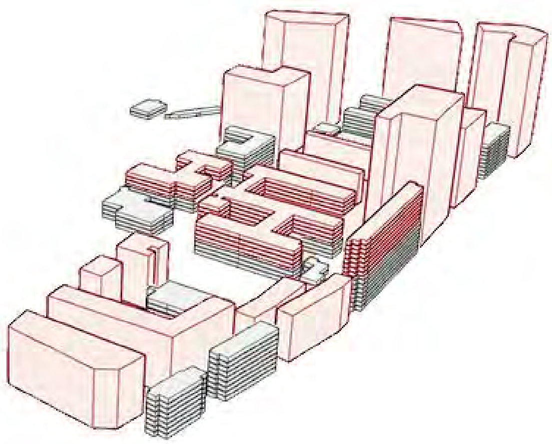
Phase Two: 2037

- We propose in 2037, a new office district will be built on the existing green space to further develop site C. It also introduce new density to inject urban living, retails, entertainment and hotel. By that time, this site will achieve the goal that diverse people can have all-scale activities in 24 hours here.

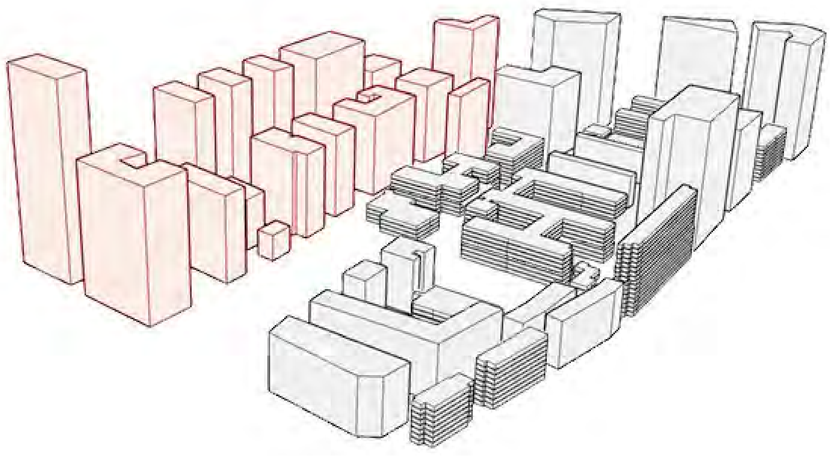
Existing

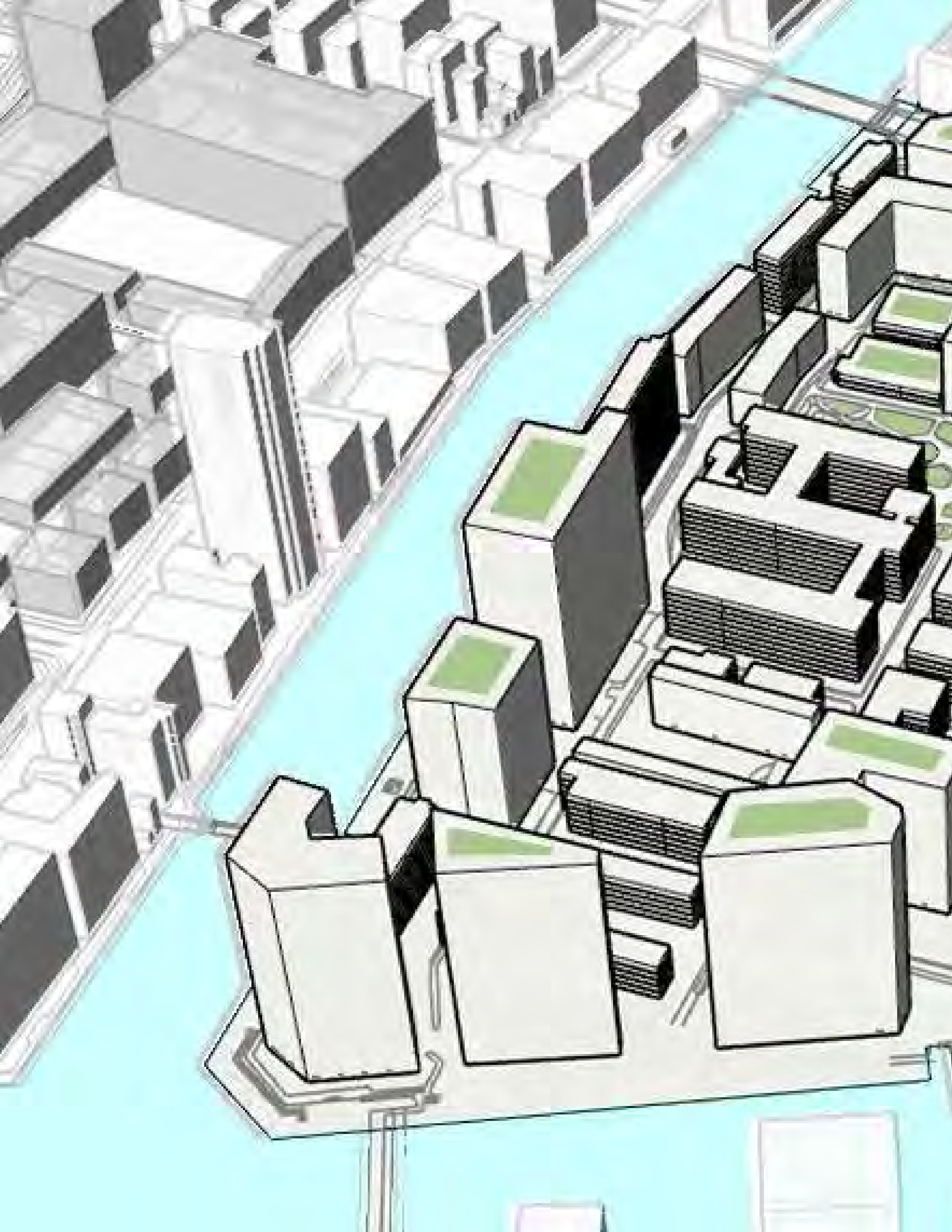


Phase One



Phase Two



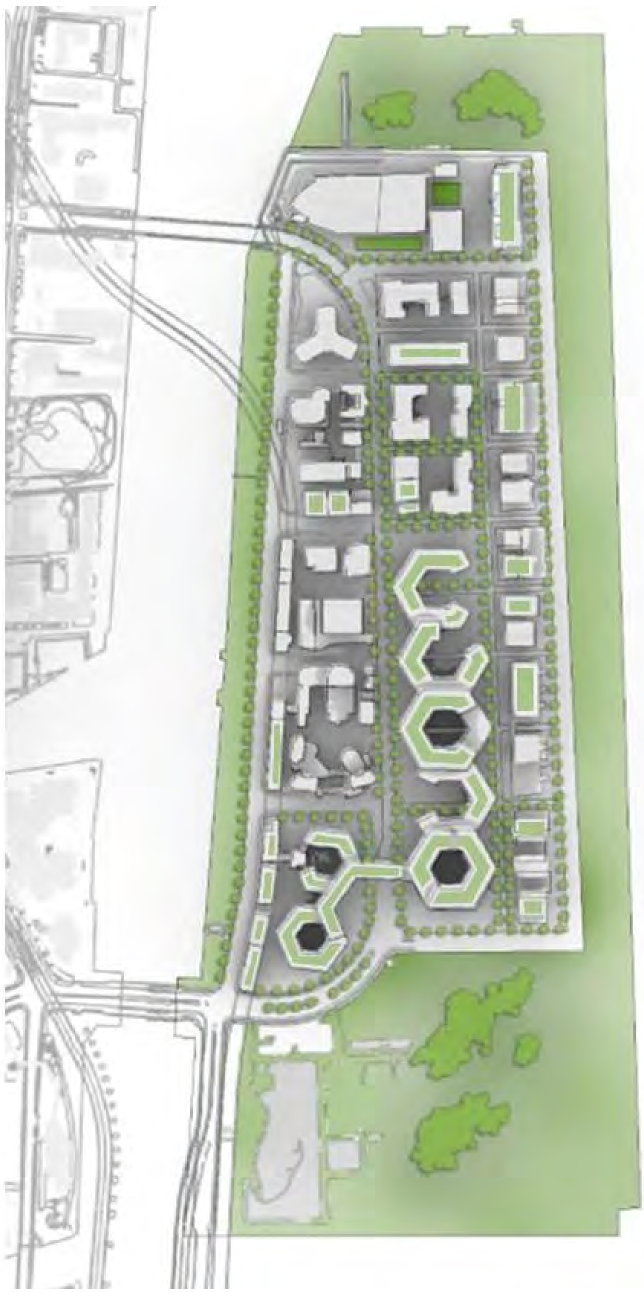


SITE D: SELF-SUSTAINING ECO ISLAND

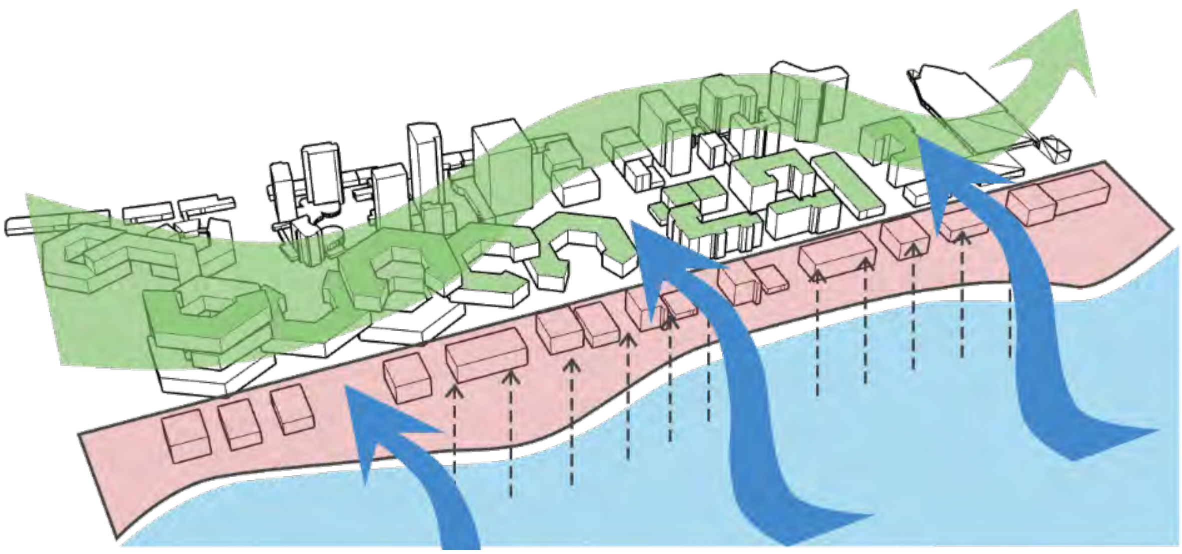
By Shuhui Zhen

Site D is an Eco Island design which should respond to water resilience issues. After redevelopment, the FAR of this site is 2.0 and BCR of this site is 25%.
In Shinagawa Site D, it's a coastal landscape that is resilient to flooding, storm surge and potential sea level rise. So there will be a huge green spaces on the island especially on the edges of the island.

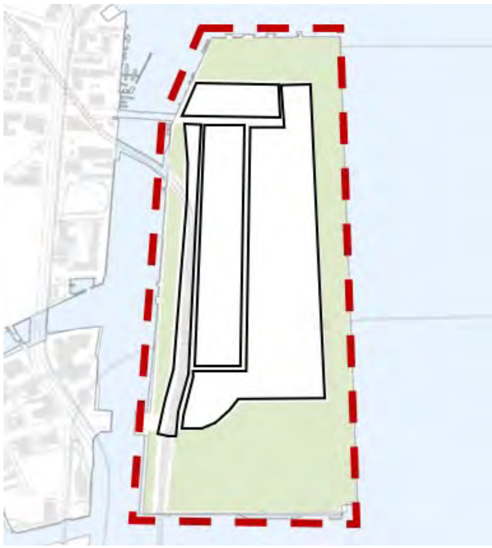
Because of the particularity and valuable attribute of Shinagawa site D, this site will also have dedicated urban design guidelines. For example, as it is very broader, the aspect ratio of this site should be less than the standard on the other area of whole Shinagawa.



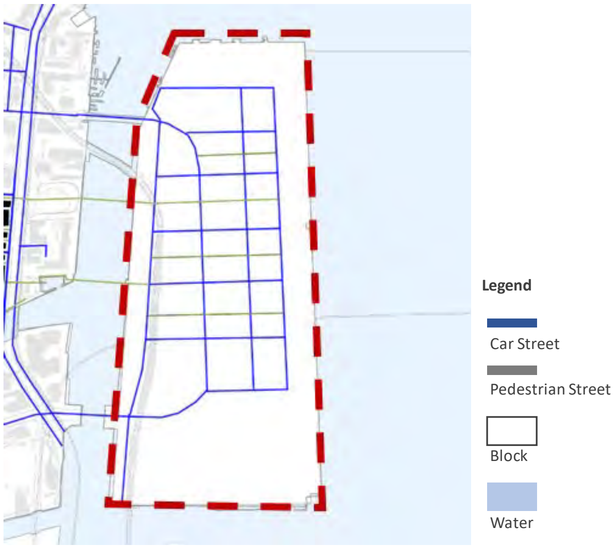
Site D Masterplan



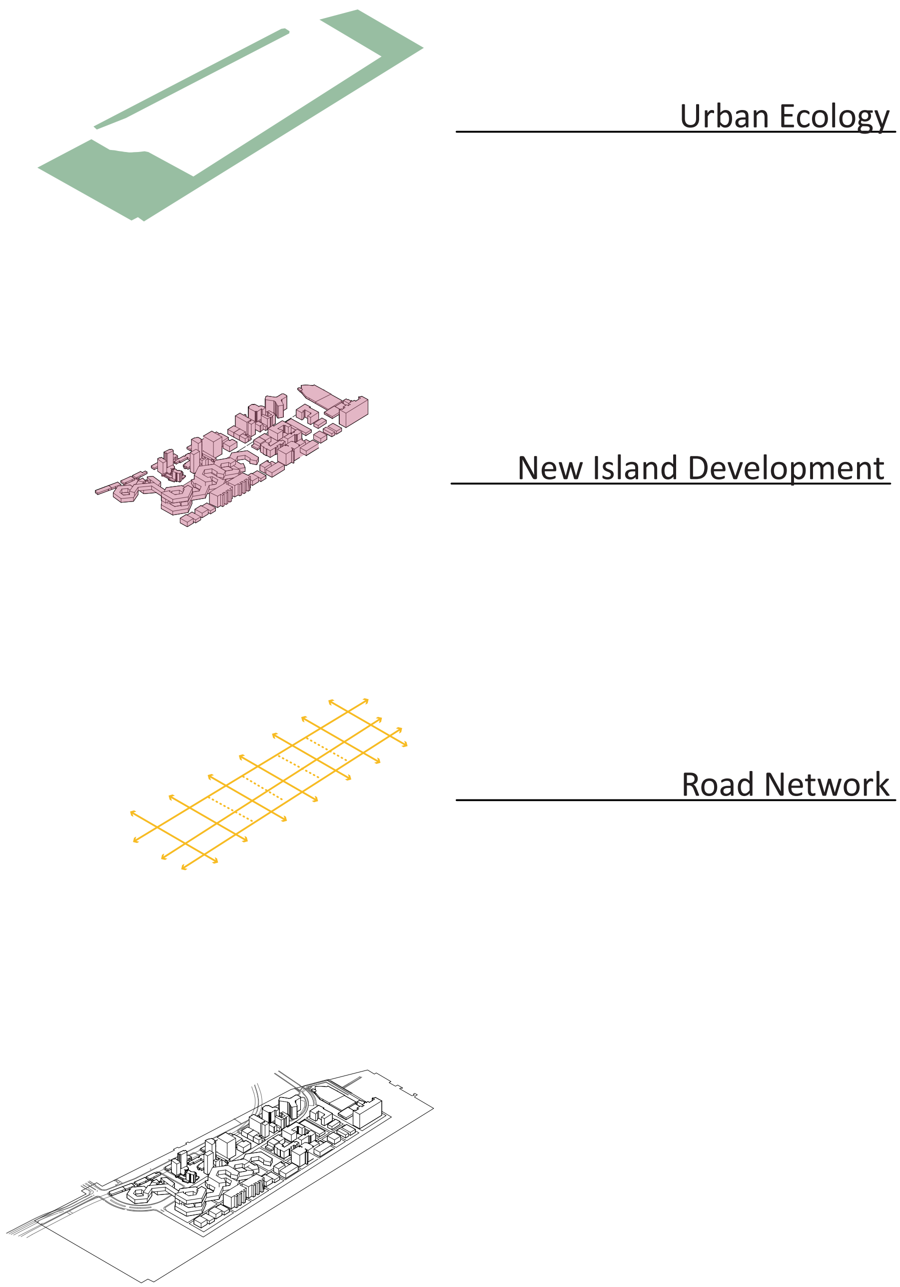
Site D Eco Island conceptual diagram



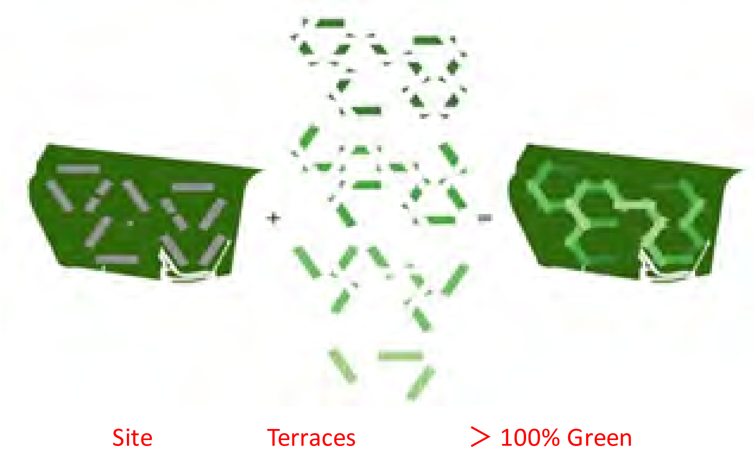
Site D Block Structure

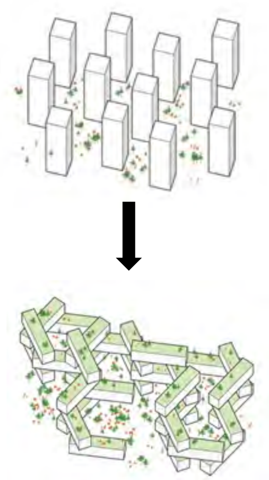


Site D Transportation Circulation



Site D Exploded Axonometric

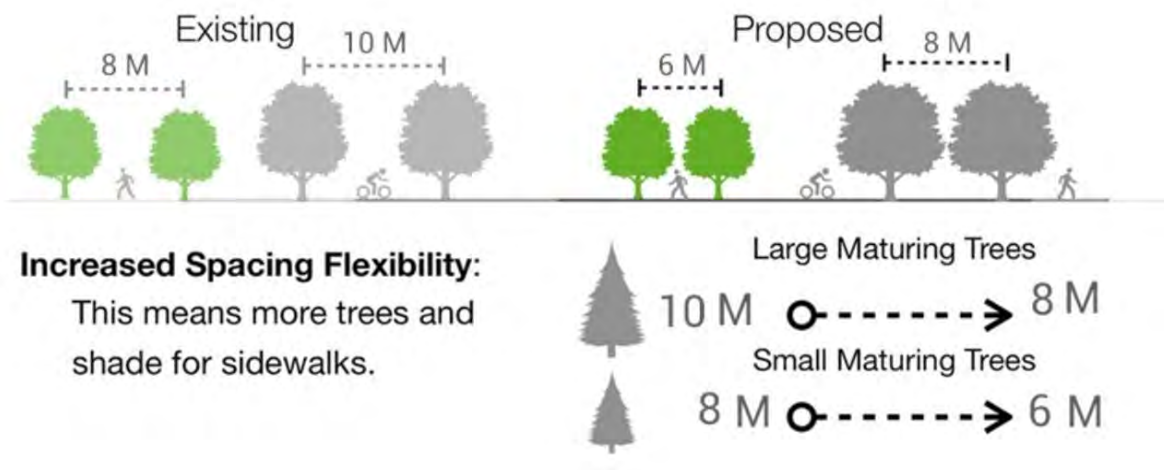




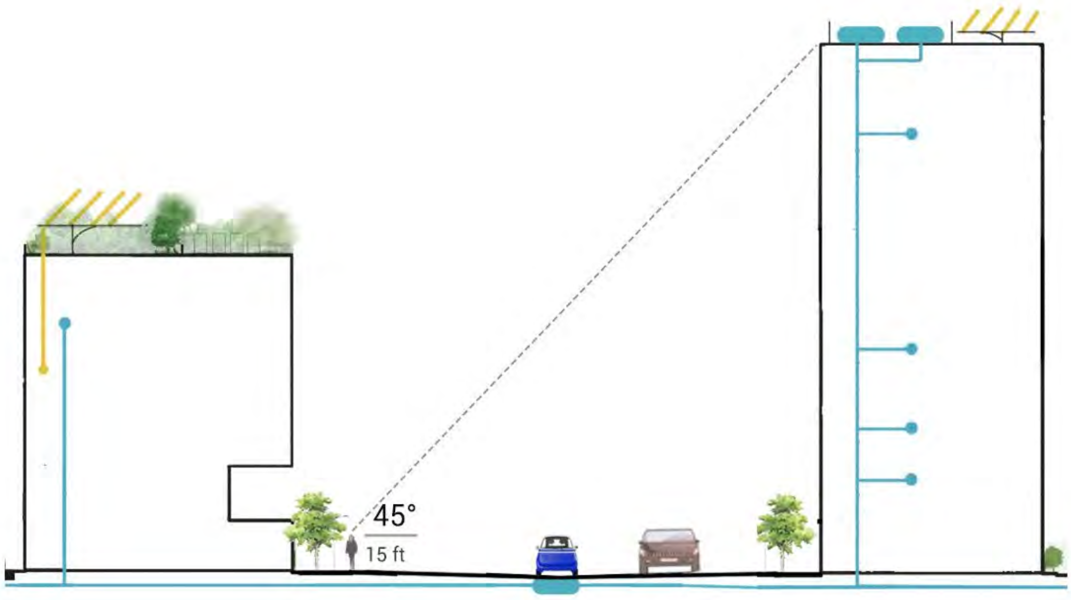
Maximize Greenspaces

Riverfront Belt-shaped Park Concept

Mixed-use Buildings Concept



Street Tree Placement



Eco Island Transitional Height Plane

PHASING

Existing: 2020

- Only several buildings will be kept. The building under railway will be retrofitted into retail and railway stations. The factory in the north of D site will be kept.

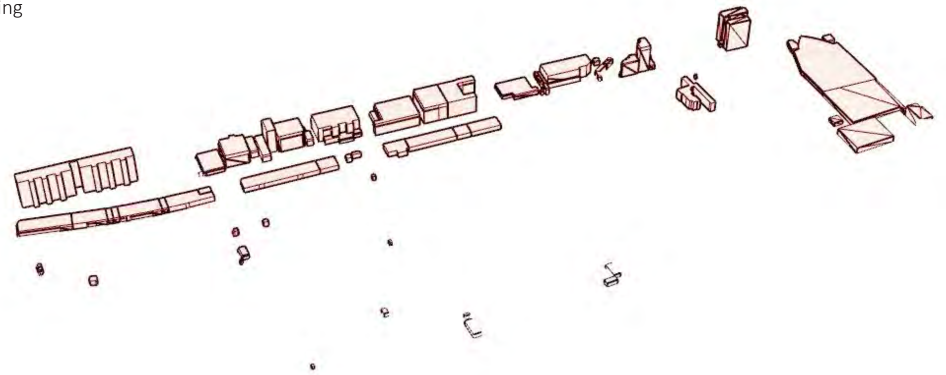
Phase One: 2027

- We propose in 2027, many mixed-use buildings will be built. Green roofs and solar panels will be built on the top of them to improve ecological performance. The Eco Island’s high-rise urban living provide a high-density and low building footprint, which detaches from a very different ground from Shibuya.

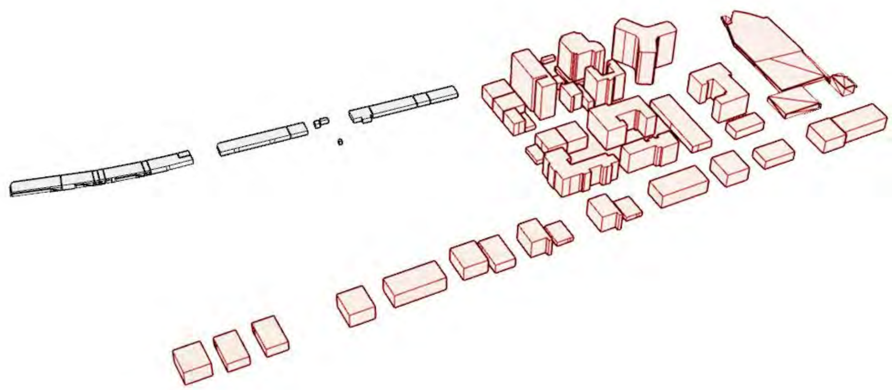
Phase Two: 2037

- We propose in 2037, a new office district will be built to further develop site C. Perhaps the compact high-density central business district intends to bring in density and vibrant activities to activate the public space along the water edge. Also, a hexagon-shaped mixed-use building will be built to make site D more self-sustained.

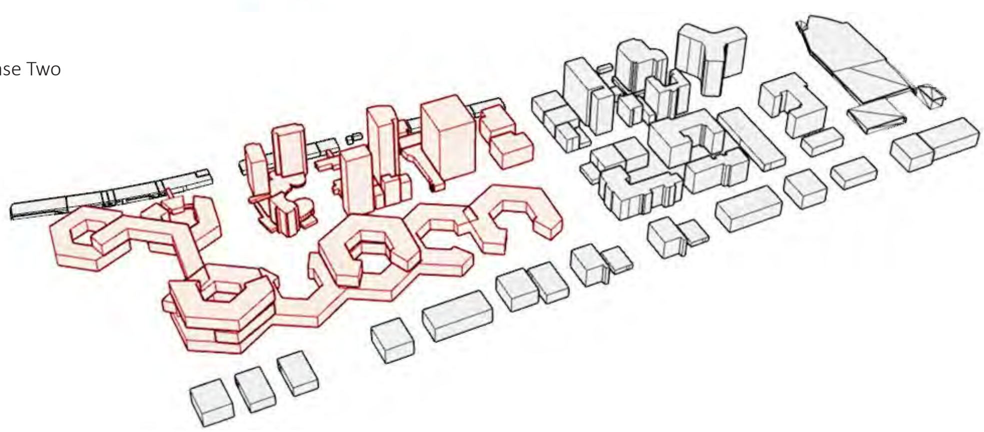
Existing



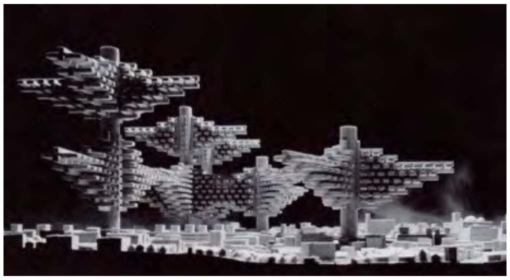
Phase One

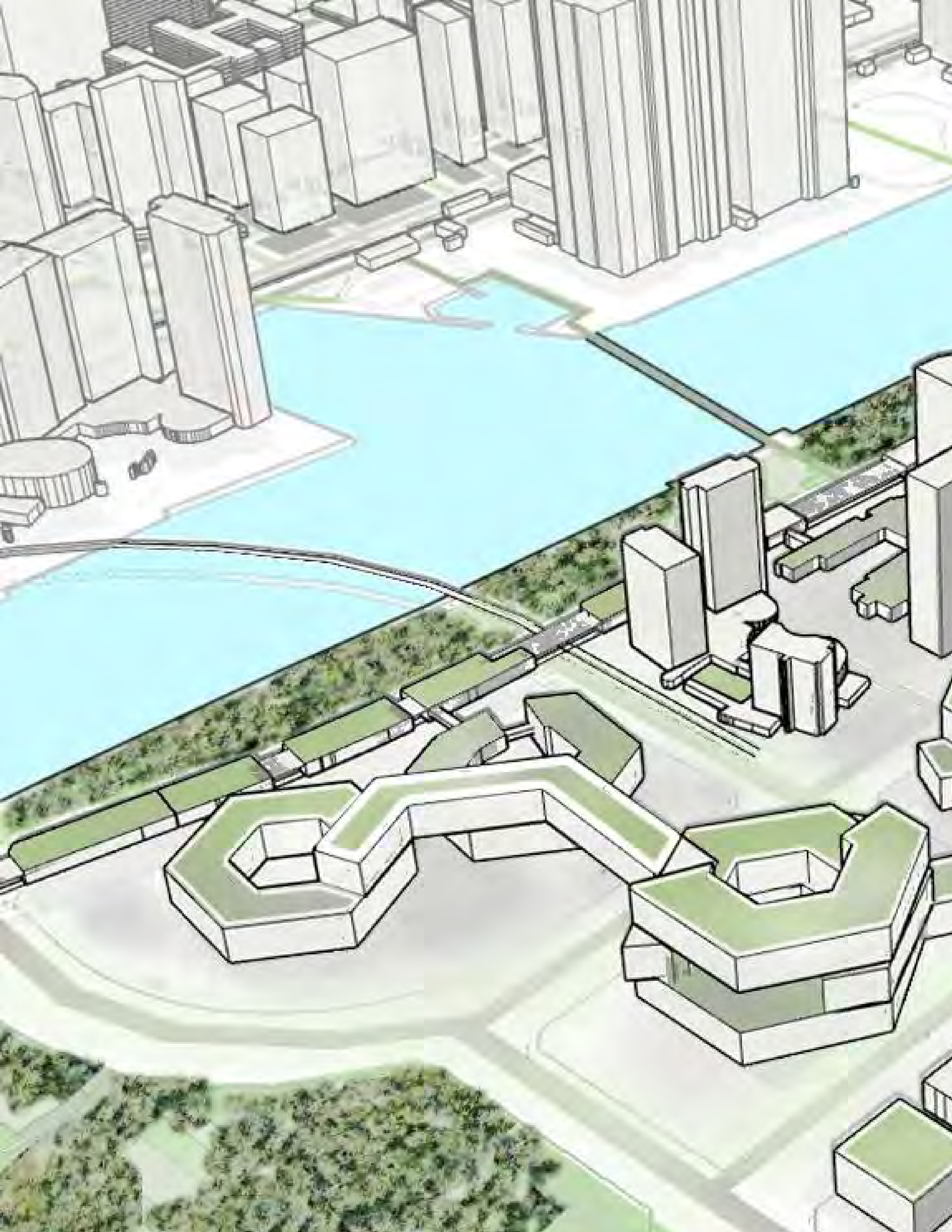


Phase Two



The housing type of the hexagon mixed-use building suggests a minimum building footprint and maximum permeable green surface (top image), which reminds us the 1961 Disaster Prevention Plan designed by Kiyonori Kikutake, an elevated “water city” design in inner city Tokyo to be like Venice (bottom left image). The studio’s proposed housing typology which actually learning from OMA’s Singapore housing project represents some propositions from the 1960 Japanese metabolism, e.g. Arazta Isozaki’s City in the Air proposal for Shibuya in 1962 (bottom right image), where high-rise urban living is detached from the ground, a fine-grain and hyper vibrant Shibuya commercial district.





SITE D (UED GROUP)

By Ashley Baldwin, Violet Bernard, Alexandra Watson

Purpose

To create a proposal that recommends and illustrates a use for Site D within Shinagawa's public realm that focuses on an effort to bring more wildlife and natural habitat into what is currently an industrial site and ever growing city.

Approach

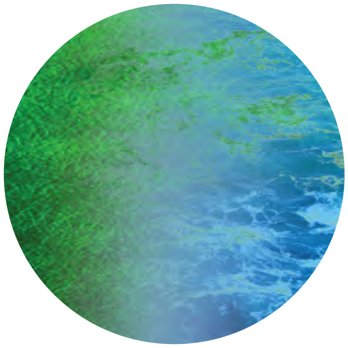
The goal of bringing nature back into the city was completed through 4 large moves:

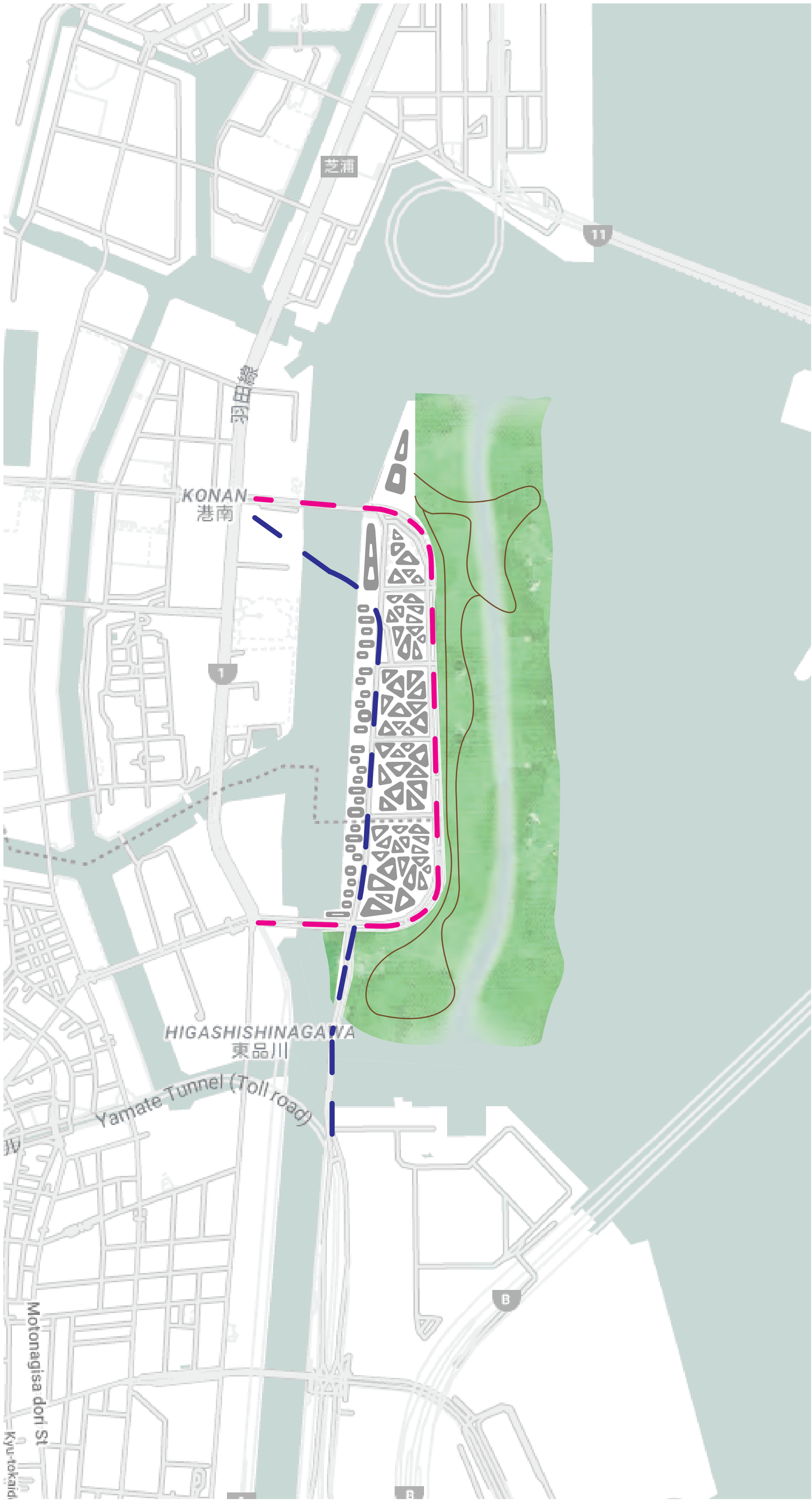
1. Cutting a water path through the island to create a natural barrier between the soon to be wetlands and the man made infrastructure

2. Allowing the Eastern portion of the island to be dedicated wetlands with little to no human interaction to promote wildlife growth

3. Self sustainable infrastructure that promotes green living and micro climates within their own systems

4. Raised transit that looks towards the future with sea level rise all while hovering above the wildlife in an effort not to disturb the natural process.

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KONAN
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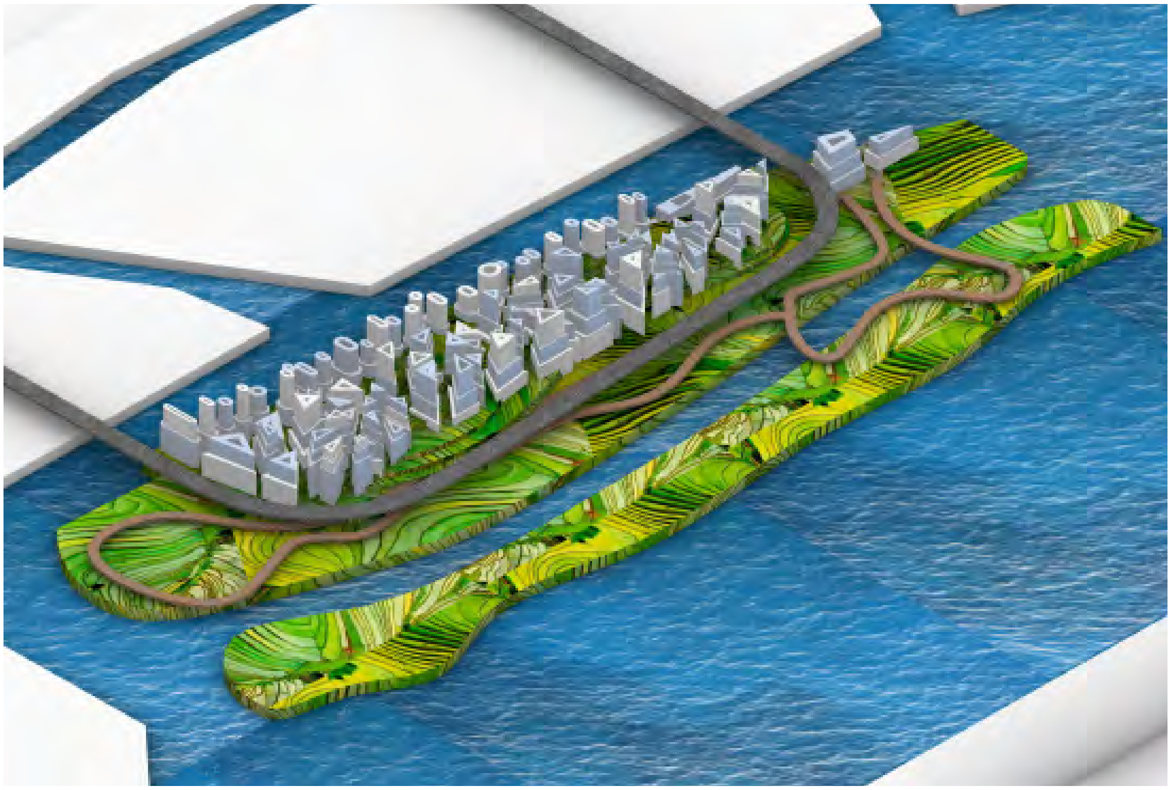
HIGASHISHINAGAWA
東品川
Yamate Tunnel (Toll road)
B
Motonagisa dori St
Kyu-tokaid

Move 1.

Through cutting a water way in the island a natural barrier is created between the wetlands and natural habitats and the human infrastructure. This new water way also gives an opportunity to build up the land higher on either side by taking the dredged soil from the waterway and placing it back on top of the retained land mass.

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Move 2.
The eastern portion of the Island, the wetlands brings an opportunity for the natural cleaning of air, reintroduction of natural wildlife and a learning opportunity for the community.

Japan's flora of is approximately classified into four zones based on temperature and precipitation differences:

1. Alpine zone
2. Sub-alpine zone
3. Summer-green broad-leaved forest zone
4. Evergreen broad-leaved forest zone

Shinagawa is located in the Evergreen broad-leaved forest zone, Yabutsubaki Class: Containing trees such as Yabutsubaki: amellia japonica and Shii: Castanopsis spp.

Cleaning/filtering water with plants/moss
Moss, not having a root system, absorbs water and nutrients throughout the entire plant and rids dangerous substances. Mosses can absorb a large quantities of lead due to a special kind of acid in its cell walls.
Metals, bacteria, oil and other pollutants can be removed by wetland plants. Cattail an remove metals such as zinc, cadmium, lead and nitrate from water. Water mint, Once it is, water mint can help clean water by removing bacterias like E. coli and Salmonella. Soft rush, or Juncus Effuses is a grass like aquatic plant, in addition to bacteria and oil, Soft Rush also removes heavy metals such as zinc, copper and cobalt from the water.
Pond plants can act as water filters. Water lilies and iris's are two great pond plants that do this. Water lilies are especially effective in absorbing heavy metals from the H2O, and they help to reduce algae growth. Submerged plants that grow under the water absorb pollutants as well as oxygenate the water and keep fish well.

Trees clean air
Trees absorb odors and pollutant gases and filter particulates out of the air by trapping them in their leaves and bark. Trees improve air quality by absorbing CO2, therefore absorbing heat in atmosphere.

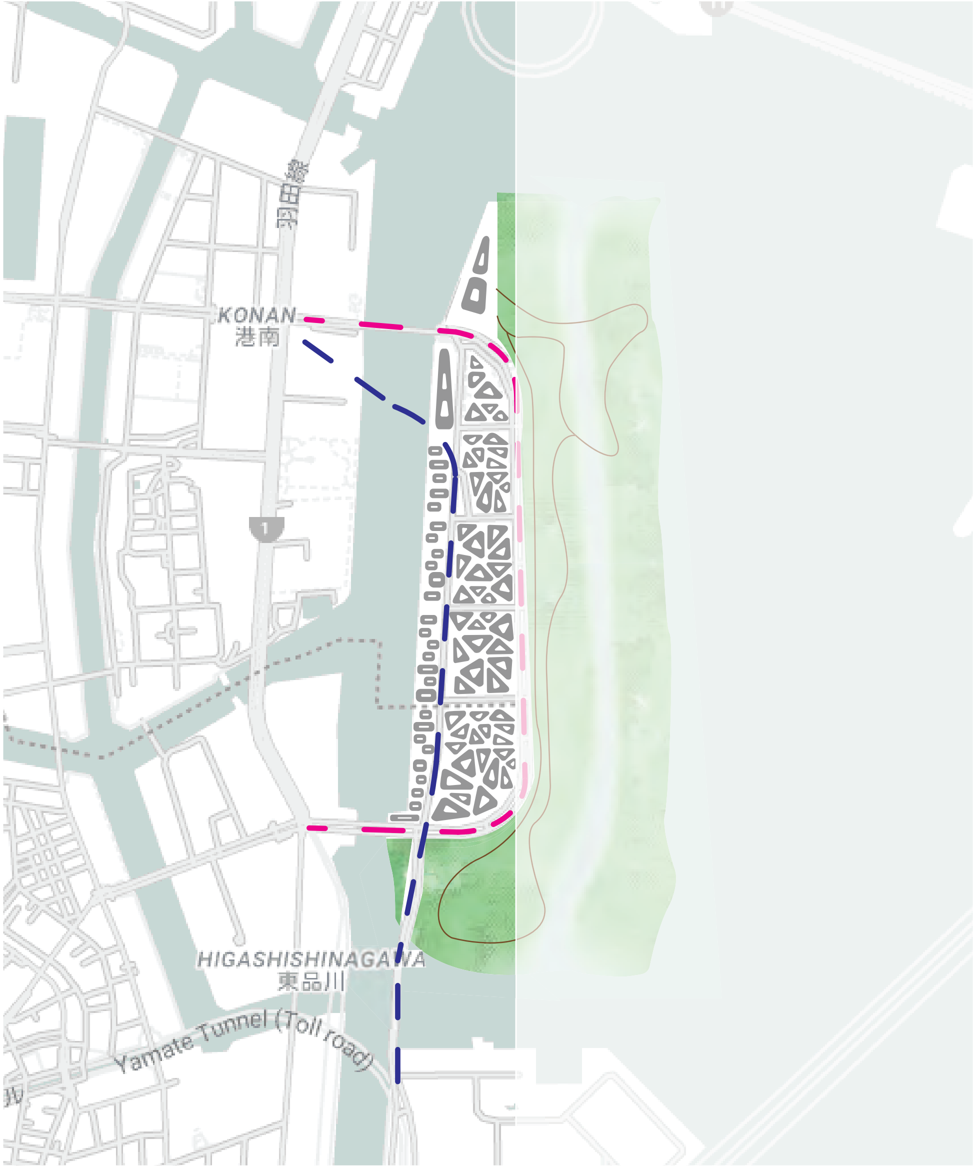
羽田線
KONAN
港南
HIGASHISHINAGAWA
東品川
Yamate Tunnel (Toll road)

Move 3.
Self sustainable infrastructure that then promotes green living and micro climates within their own systems. We would put in place guidelines for the buildings in this area that include:

1. Interior building courtyards
2. Native plants in courtyards and on green roofs that promote healthy air and clean water
3. Water collection & recycling systems
4. Porous pavements

The introduction of thoughtfully place and shaped building is also proposed. We proposed placements that do not restrict wind flow and allow for fresh, clean air to circulate throughout the island. By using the wind patterns and flows on the island the buildings can also take advantage of the clean air and use it within the buildings own systems as well.

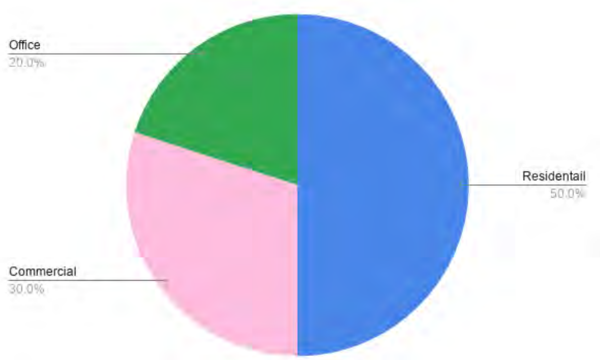
5. Building placement should respond to the airflows on the island
6. Staggered balcony systems that would allow air flow to constantly clean the air and not just recirculate old air
7. Take advantage of natural ventilation within the courtyards and buildings



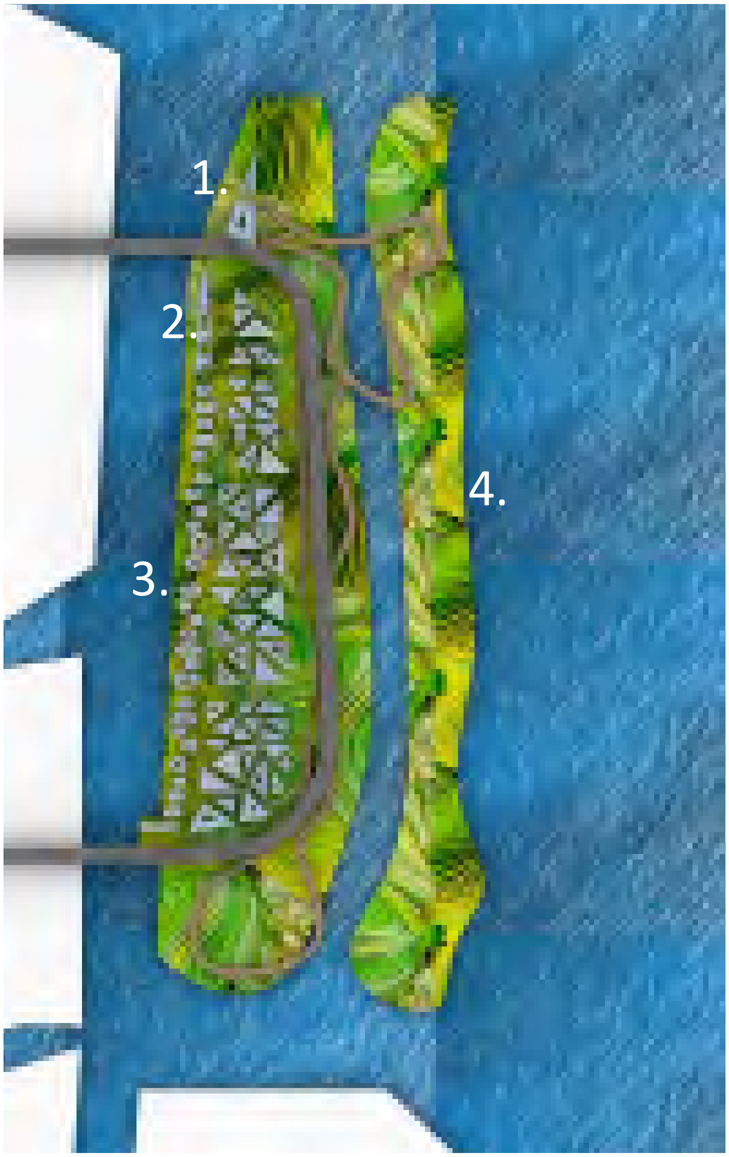
羽田線
KONAN
港南
HIGASHISHINAGAWA
東品川
Yamate Tunnel (Toll road)

Proposed Program
1. Wilderness Center
2. Transit Center
3. Mixed-Use Buildings
4. Wetlands

Building Breakdown




Site D section


1.
2.
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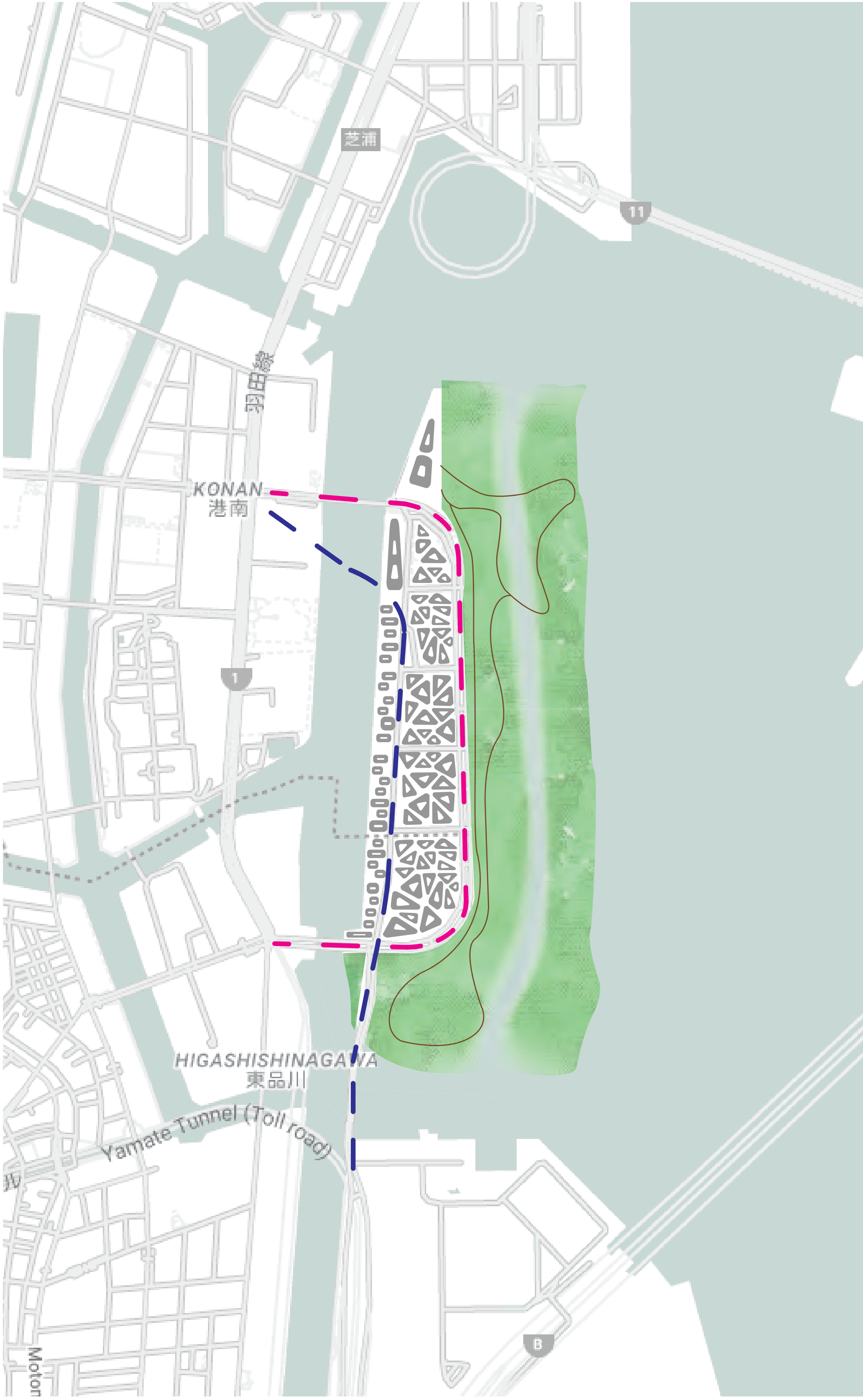
4.

Move 4.
Raised transit that looks towards the future with sea level rise. The raised transit also allows for the wildlife not to be disturb while still allowing patrons of the wetlands observe to their existence. In the built areas of the island the raised motorways then give more ease to pedestrians on the ground level. Additionally, in the future when autonomous vehicles are more prevalent, these raised motorways can be converted into pedestrian friendly walkways that allow for better views of the water and wetlands.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HIGASHISHINAGAWA
東品川
Yamate Tunnel (Toll road)
B

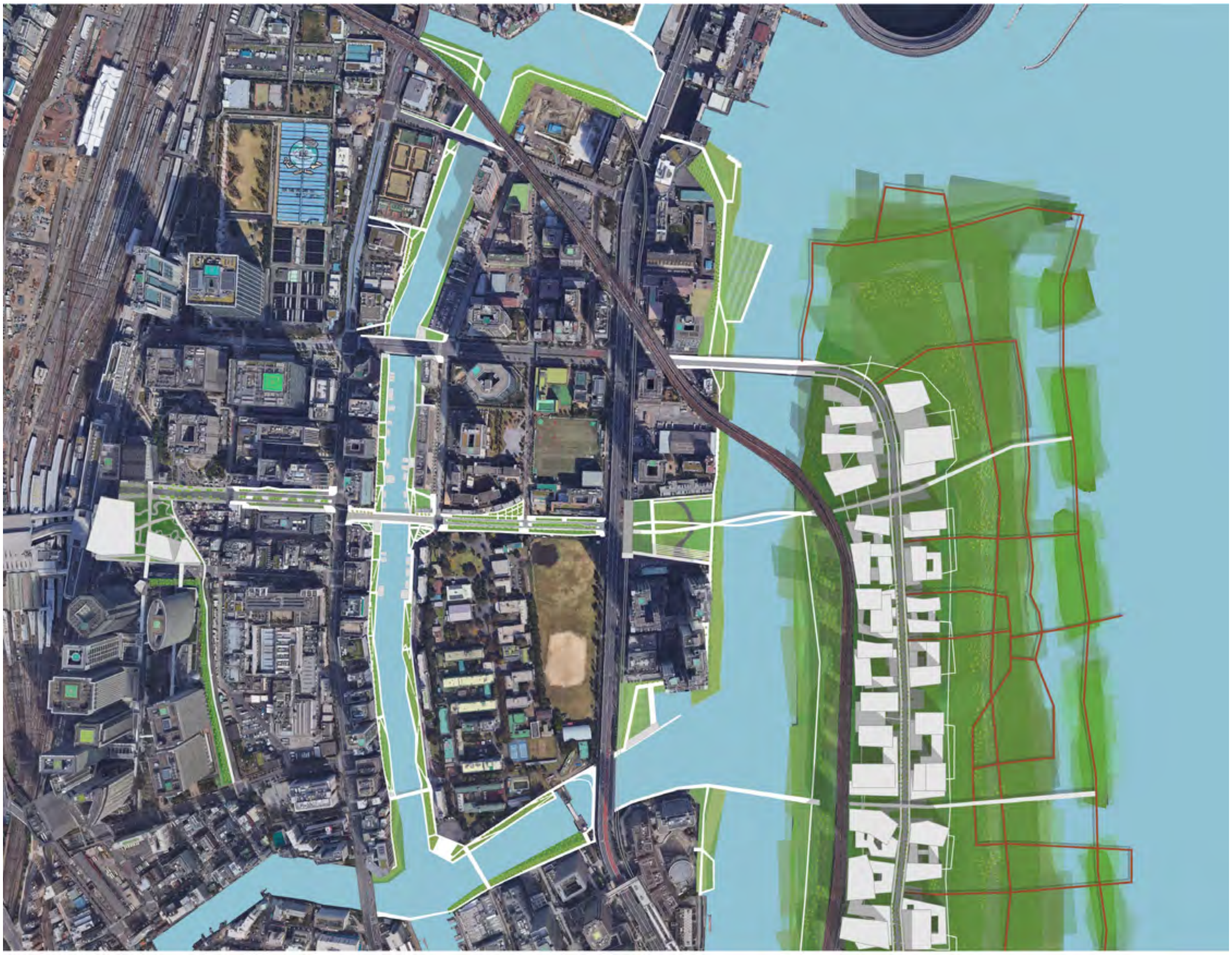
SHINAGAWA FRAMEWORK DESIGN (UED GROUP)

By Andrew Duhnam, Cynthia Peng, Danielle Sisson, Hannah Slep

In preparation for a new Maglev rail link, the district surrounding Shinagawa station will have the unique opportunity to transform itself into a truly regional, national, and international center as a result of its proximity to the rail hub. By 2030, roughly one million people will enter, exit, or transfer at Shinagawa station on any given workday and adjacent land will concurrently develop in order to harness the economic value associated with its role of a regional center.

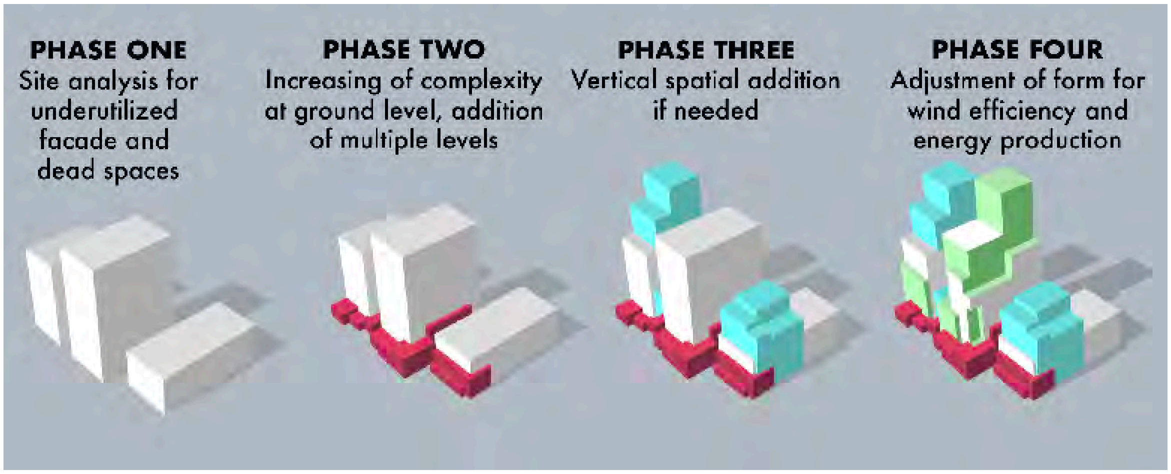
Nexus Shinagawa intends to provide a framework to guide development in a manner that is sustainable, innovative, regionally beneficial, and approachable on a human scale. We seek to envision a Shinagawa district that is vibrant at any hour of the day, displaying a mix of uses all accessible by wide and inviting pathways; we also seek to inject the area with greenery and green infrastructure, supplementing the Tokyo region with much-needed green space and ensuring continual habitation through climate resiliency and self-sufficiency, respectively.

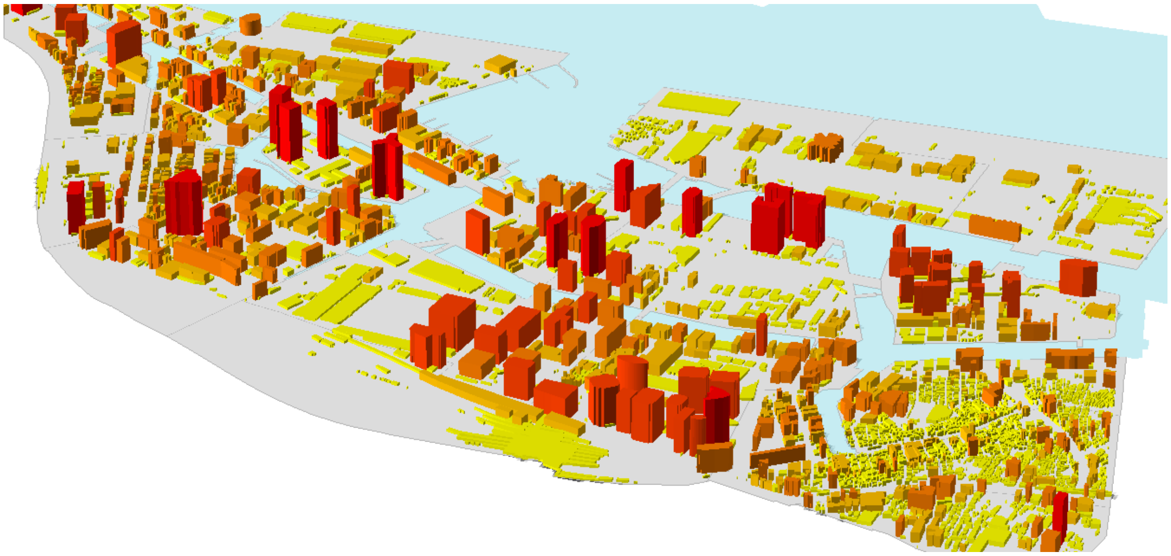
This juncture in Shinagawa's history represents an opportunity to re-imagine the Shinagawa Port District in a way that serves as a shining example of the fruitful future found at the intersection of ecology, economy, and urbanism for the metropolises of the future to follow.


Study area concept

VERTICAL VILLAGE

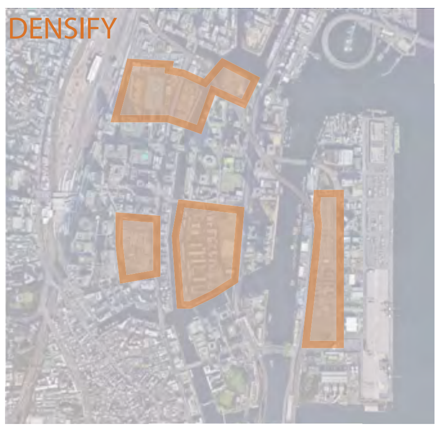
District-wide targeting of monolithic, high-density blocks and implementing design interventions that increase urban richness and complexity.

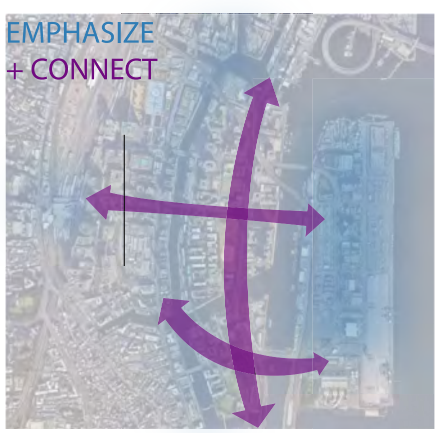




Shinagawa density


TAKANAWA
SHINAGAWA
COMMERCIAL
CENTER
TOKYO
UNIVERSITY
OF MARINE
SCIENCE +
TECH
KITASHINAGAWA


DENSIFY


EMPHASIZE
+ CONNECT

Form

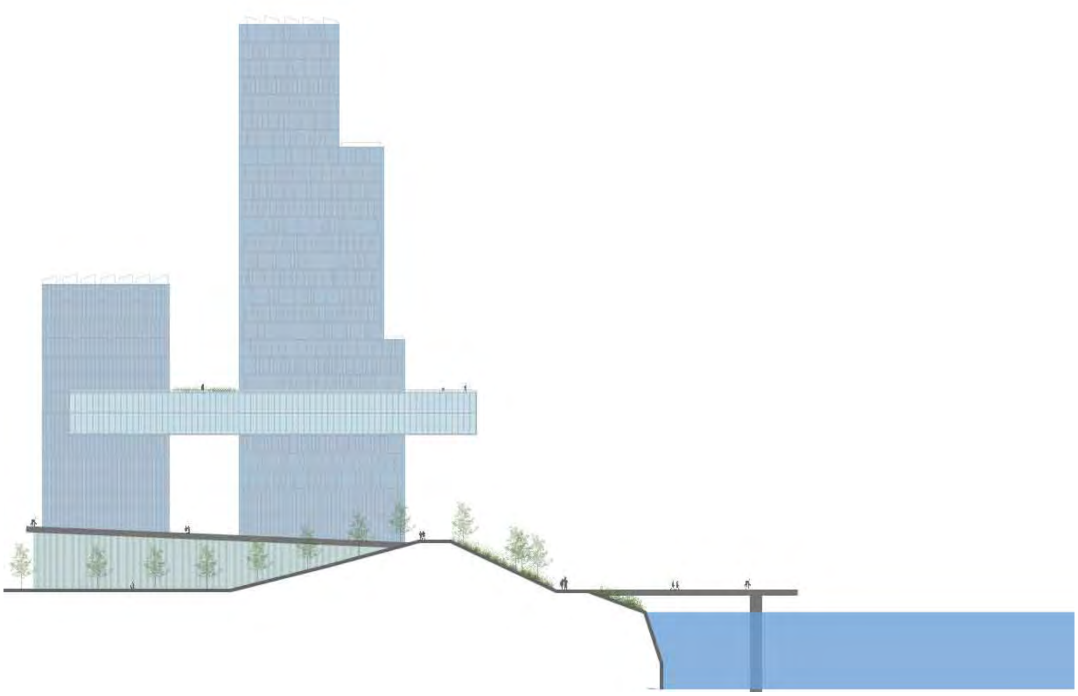
The Shinagawa Eco Island is intended to serve as a regional park, employing natural systems and wetlands to improve water quality, recreating natural dunes for flood protection, and juxtaposing a vibrant central corridor street with an expansive natural space, experienced by elevated trails.

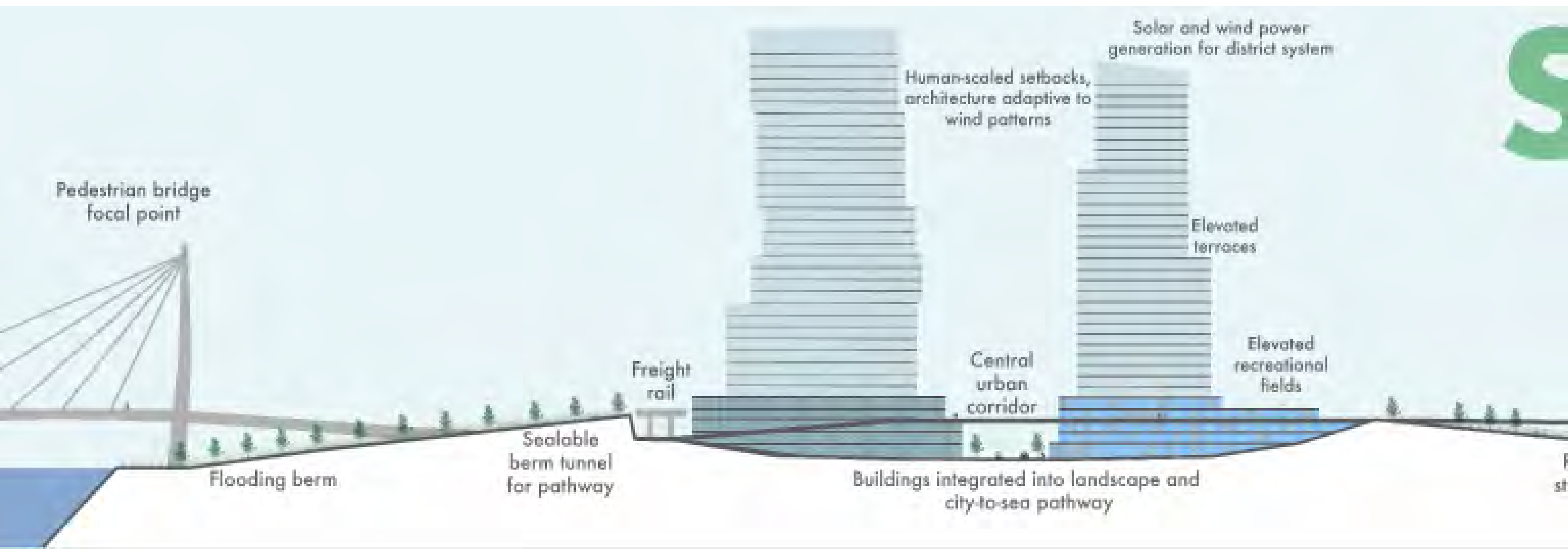
Much like the Eco Island, a series of berms will shield the urban neighborhoods from potential flooding events alongside a series of dikes that control the water level of Shinagawa's canals.

These berms will equate to roughly two stories of protection and pathways and native plantings will adorn the water-facing side. On the other side, future buildings should interact with the berm, affording the opportunity for daily activity to occur on multiple elevations contingent upon the location best suited for the activity.

Boardwalks will jut out into the sea and be used as portages forrecreational kayakers and canoers. Floating plants will improve water quality, acting as sponges for pollution.


Site D Eco Island


Eco Island section



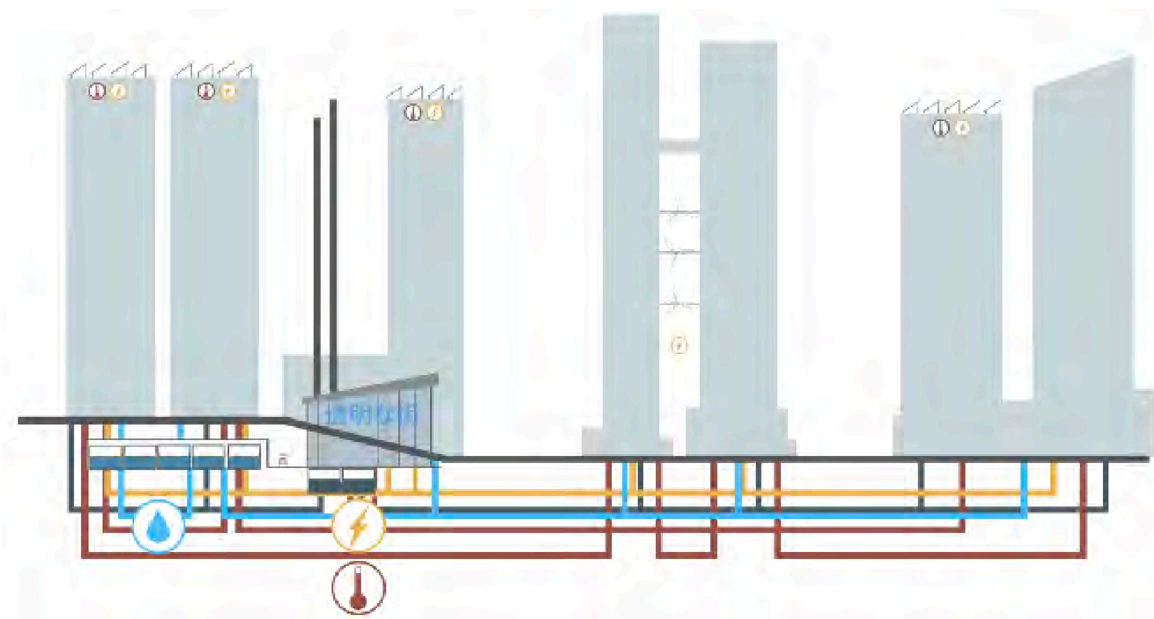
Pedestrian bridge focal point
Flooding berm
Sealable berm tunnel for pathway
Freight rail
Human-scaled setbacks, architecture adaptive to wind patterns
Solar and wind power generation for district system
Elevated terraces
Central urban corridor
Elevated recreational fields
Buildings integrated into landscape and city-to-sea pathway


SHINAGAWA ECO
ISLAND
City-to-sea active pathway
Harbor boardwalk
Reconstructed dunes for
orm surge management
and natural park
Restorative wetland space and kayaking creek

District heating, water, and electricity should be introduced as an efficient and ecologically-friendly means of distributing resources across the district. The large footprint of the water treatment plant can easily accommodate a small-scale biomass heating and energy facility on its grounds. The energy and heat would be distributed across the district alongside energy and heat from individual buildings and distributed as needed to vastly reduce waste.

The low-rise site of the water treatment plant should be capped and the new space should be maximized in the form of a new, mixed-use community. The community should center around the glass-clad power plant (labeled in pink), rather than face away from it, as the transparent exterior provides an excellent, living "steampunk" backdrop for public gatherings.

The main pathway of this mini-neighborhood should extend west to connect to the Takanawa station and the north side shouldinclude aeration ponds to improve water quality, emptying into a canal.



District energy distribution

Site A Masterplan

MOBILITY

Ryan L Colburn
Natcha O-charoen

OVERVIEW

The Station 70-70 site has an exceptionally diverse built environment. Block structures range fromtraditional, pre-war era neighborhoods with extremely narrow, winding streets to expansive superblocks lined by giant mutli-lane roads. Rapid transit routes line the outer edges of the site, but provide sparse connections when compared to much of the rest of Tokyo, and the street network and typologies across much of the site lends themselves more to automotive transportation rather than more environmentally conscious modes such as walking, bicycling, and transit.

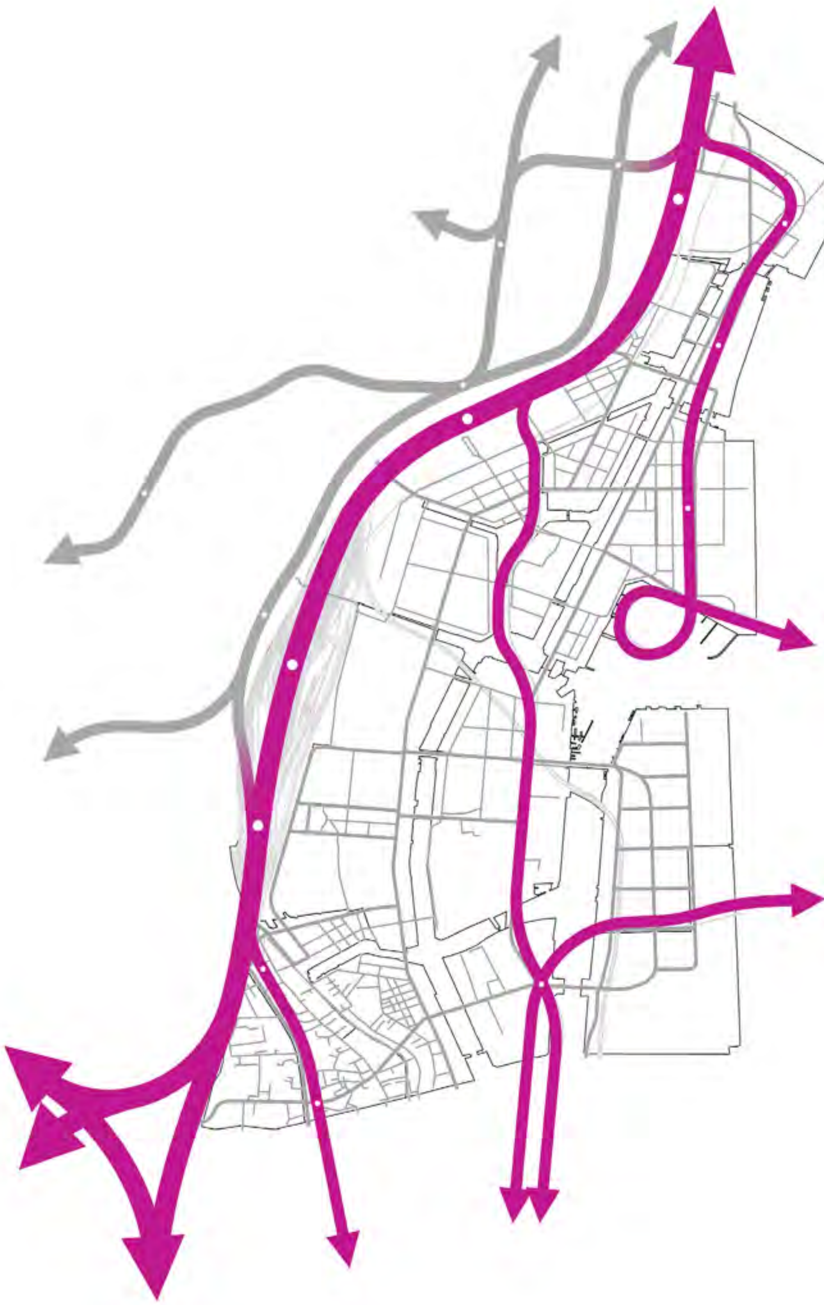
EXISTING CONDITIONS

Much of the current site is largely unwalkable. This was determined by performing a walkshed analysis on the site. This process allowed us to determine which buildings were within five, ten, or fifteen minute walks of important facilities: grocery venues, schools and educational institutions, parks and green spaces, medical facilities, and rapid transit stations.

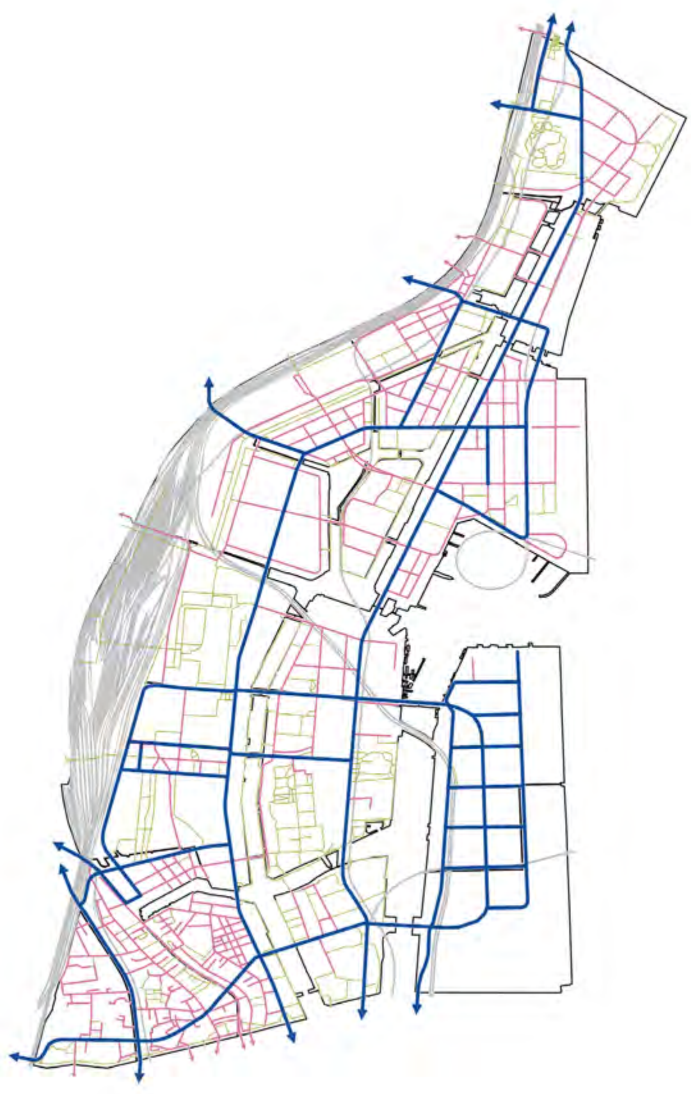
Each area was given a score between zero and three based on its distance to the respective facility type. Areas within a five minute walk were given a score of three. Areas within a ten minute walk received a two. Places within a fifteen minute walk received a one. Areas beyond a fifteen minute walk scored a zero. The scores from each facility type were then combined to produce an overall walkability index from the site, with scores ranging from fifteen (most walkable) to zero (least walkable).

The average walk-score for the site was determined to be 9.9 out of fifteen.
Dense areas near existing rapid transit lines scored higher than the rest of the site, while areas designated for redevelopment as part of this project typically scored low.

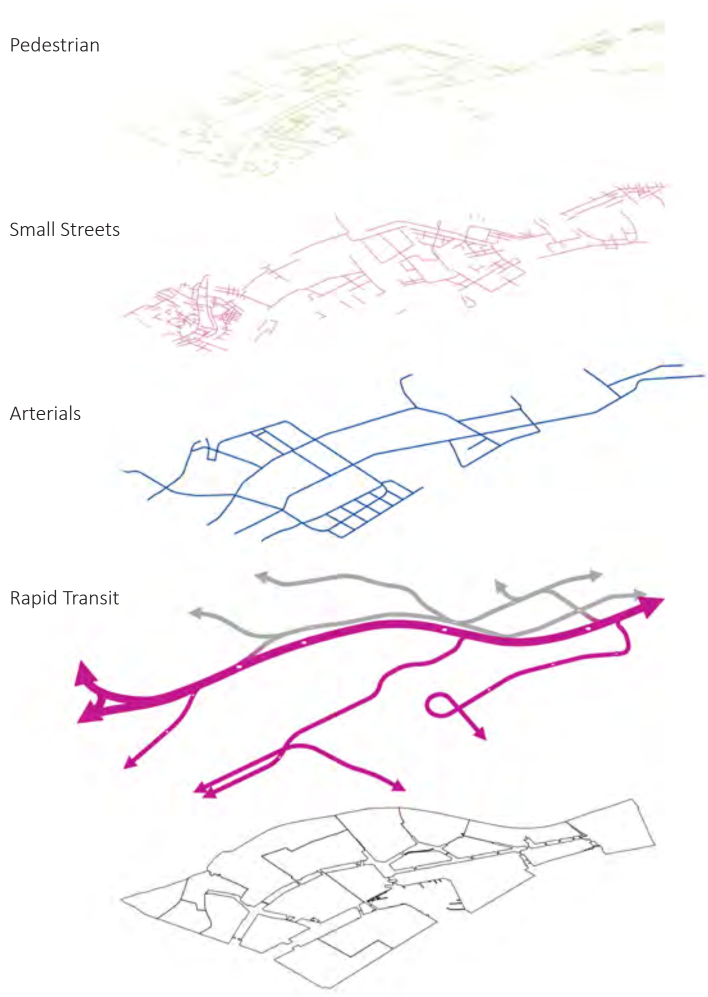
Existing Walkshed Analysis



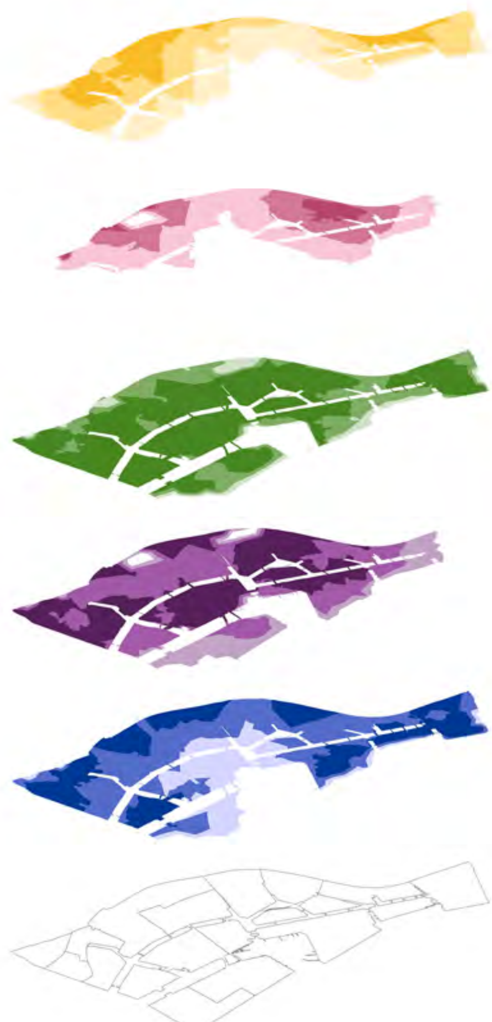
Existing Rapid Transit



Existing Street Network



Exploded Axonometric of Existing Transit Systems



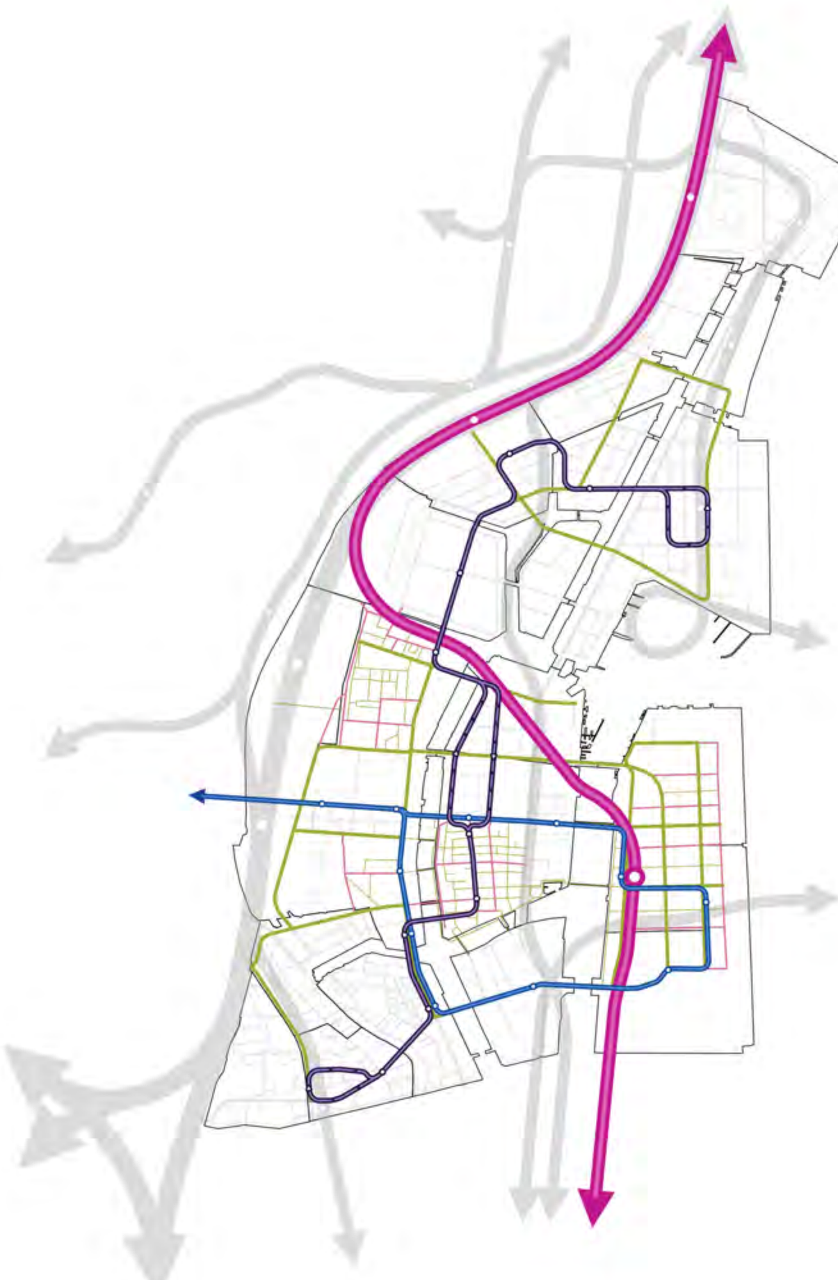
Exploded Axonometric of Existing Walkshed Vectors

MASTERPLAN

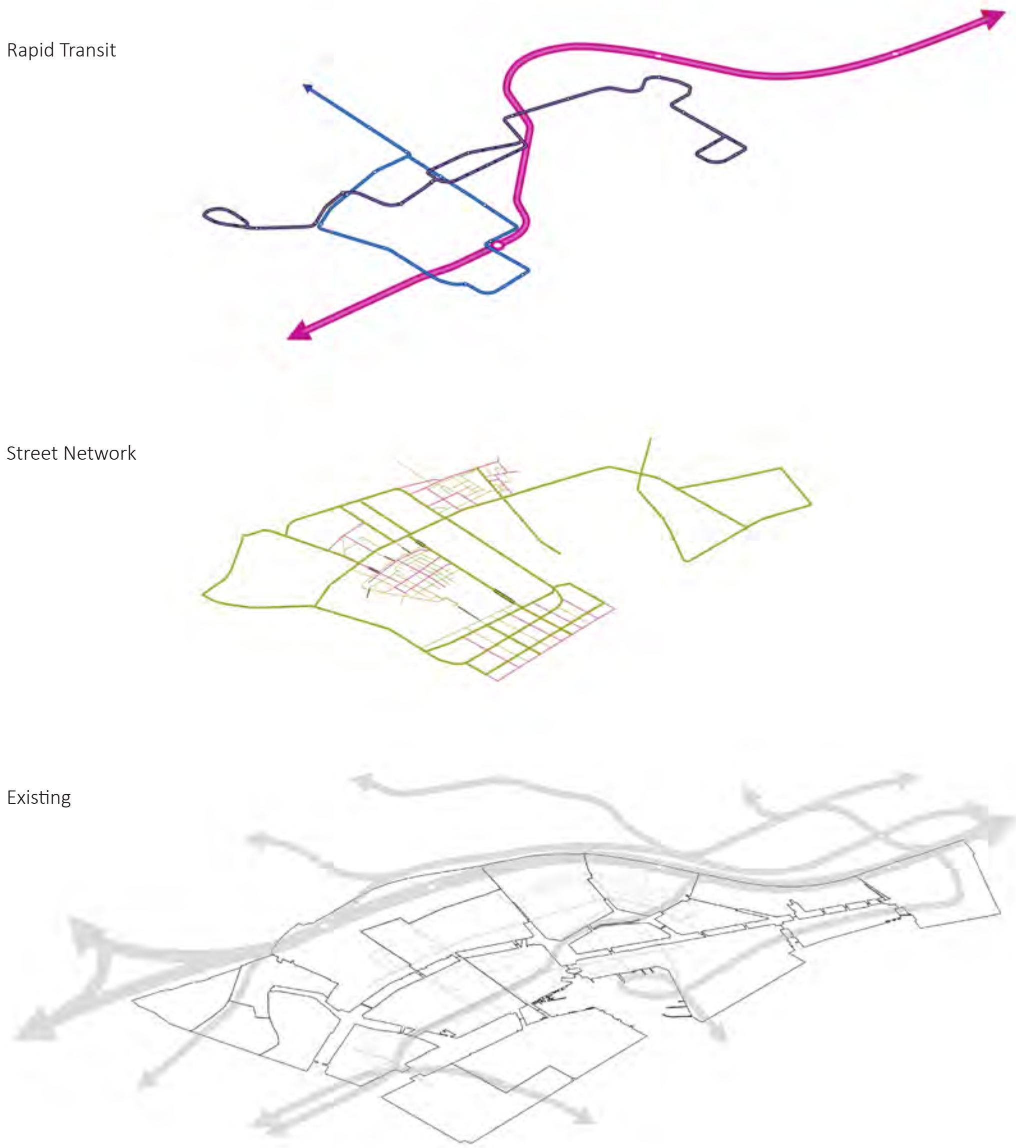
One of the most important aspects of urban life is mobility. Mobility defines how one is able to move within and around a city and thus determines how we are able to perceive, enjoy, and experience the urban environment. In a Smart City, mobility also plays a critical role in developing a city that is connected, data-driven, green, inclusive, responsive and resilient. Using our analysis of the site and our Smart City guiding principles, we envision transforming the Station 70-70 area from a largely unwalkable urban space into a vibrant, lively, active city.

In order to transform the Station 70-70 into a Smart City, we've developed a series of proposals framed around our Smart City principles to create a city that is connect- ed, data-driven, green, inclusive, responsive and resilient. These proposals are rooted in a shift away from privateautomobile traffic towards more active and sustainable modes in order to promote health lifestyles while reducing the area's carbon foot- print.

In order to drive this modal shift we've developed a plan that aims to proactively reduce private vehicle traffic in the area by implementing a comprehensive congestion pricing program in order to shift people to increase their usage of walking, biking, and transit.



Proposed Transit Masterplan



Exploded Axonometric of Proposed Systems

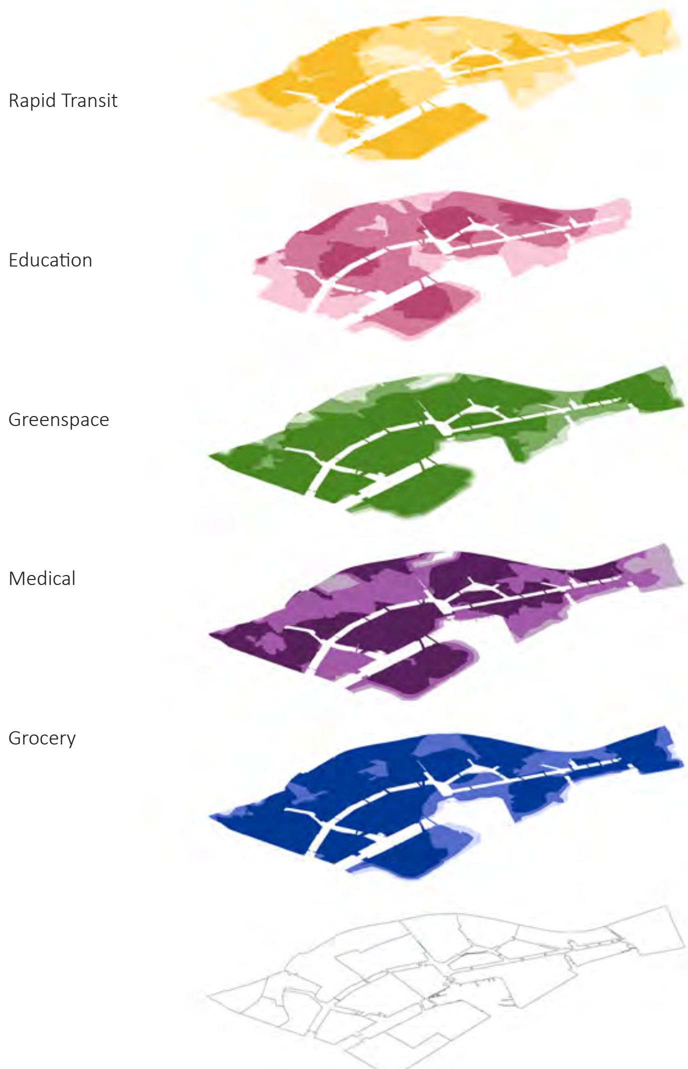
In order to meet the increased demands for mobility solutions caused by this modal shift (and theincreased traffic in the area generated form the opening of the mag- lev line at Shinagawa Station), we also propose the development of three new rapid transit lines in the area (top left).

The first, a heavy rail line, would run along the existing access track that connects the Tokaido mainline to the Shinkansen depot south of the site. This line would be used to better connect residents to central Tokyo and Haneda Air- port. The remaining two lines would make use of existing road space that would be- come available as private car traffic decreases. These lines would use autonomous vehicle technology in dedicated rights-of-way to provide bus-rapid transit like service at high frequencies with high reliability. Autonomous vehicle technology would also allow the system to function more safely at closer headways than traditional buses or lightrail vehicles with improved fuel efficiency as a result of more precise vehicle controls. The lines would bring rapid transit service within a five minute walk to much of the site that currently lacks such services.

In order to provide the dedicated rights-of-way needed for these new transit net- works streets will have to be noticeably altered. The need for unique street de- sign resulted in the development of a "green street" design. These streets prioritize transit, bicycling, and walking while also providing green space for improved water management and a more friendly and inviting user experience. These streets also are able to move more people per hour than existing typologies. In addition to these green streets, improved street designs along with several pedestrian bridges, will also improve pedestrian and bicycle accessibility across the Station 70-70 area.

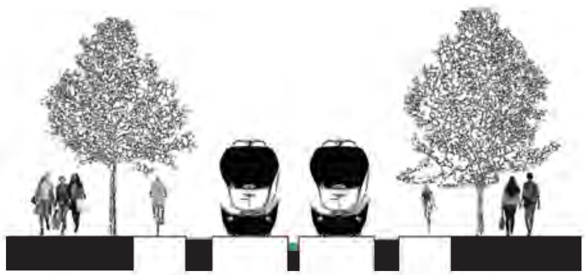
As a result of these proposed infrastructure and transit service changes, coupled with the development of new critical facilities in strategic locations, walkability over much of the site has been drastically improved. The number of buildings within a five minute walk of all five critical facilities has increased from 0.3% to 5%. The per- centage of buildings with a walk-score above ten will increase from 71.3% to 95%. The average walk-score for the entire site will now be 12.1, representing a 22% increase from the existing site. The improved walkability will support a city that will become increasingly vibrant, lively, and active.

Proposed Walkshed Analysis



Exploded Axonometric of Proposed Walkshed Vectors

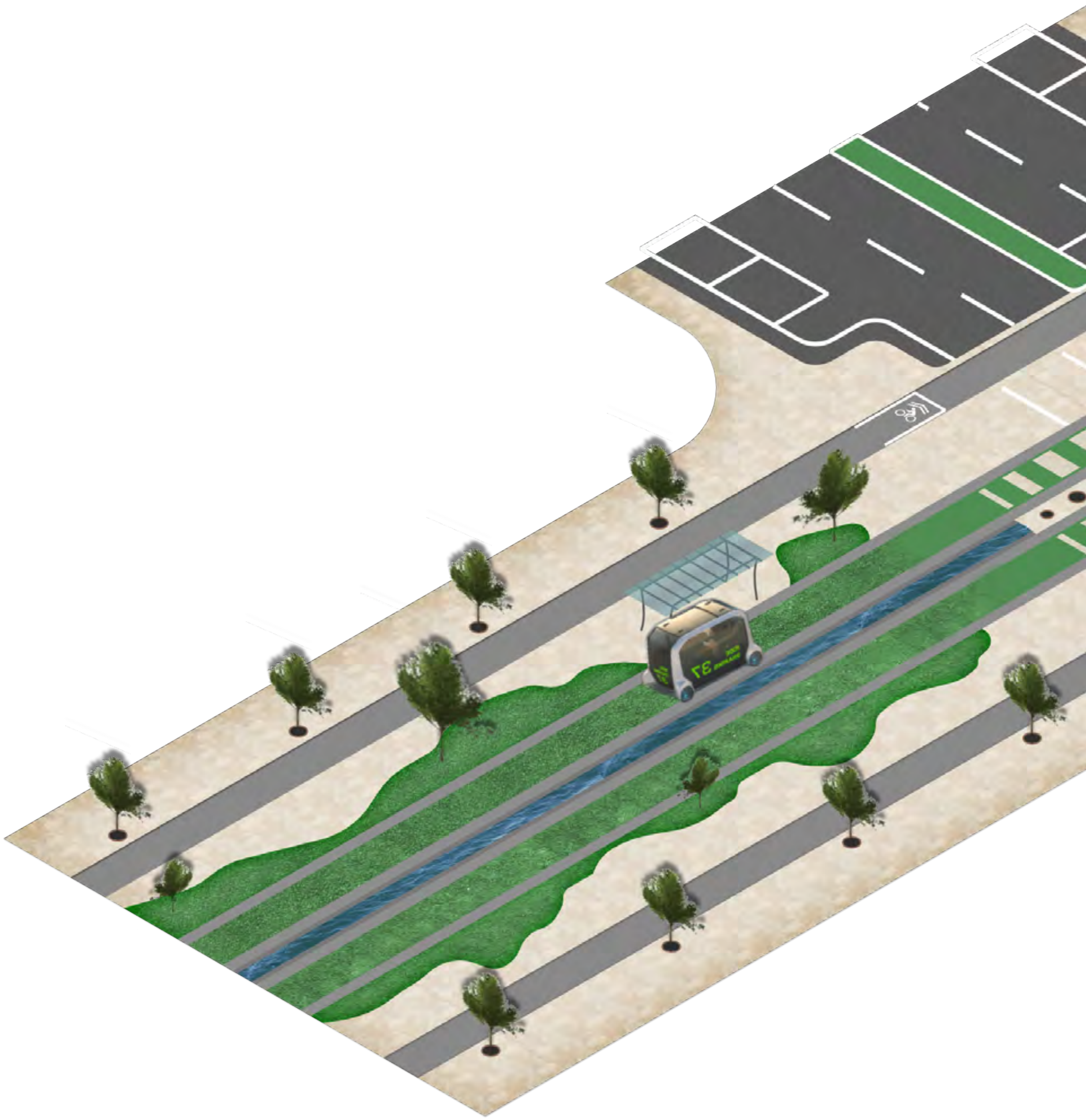
Proposed



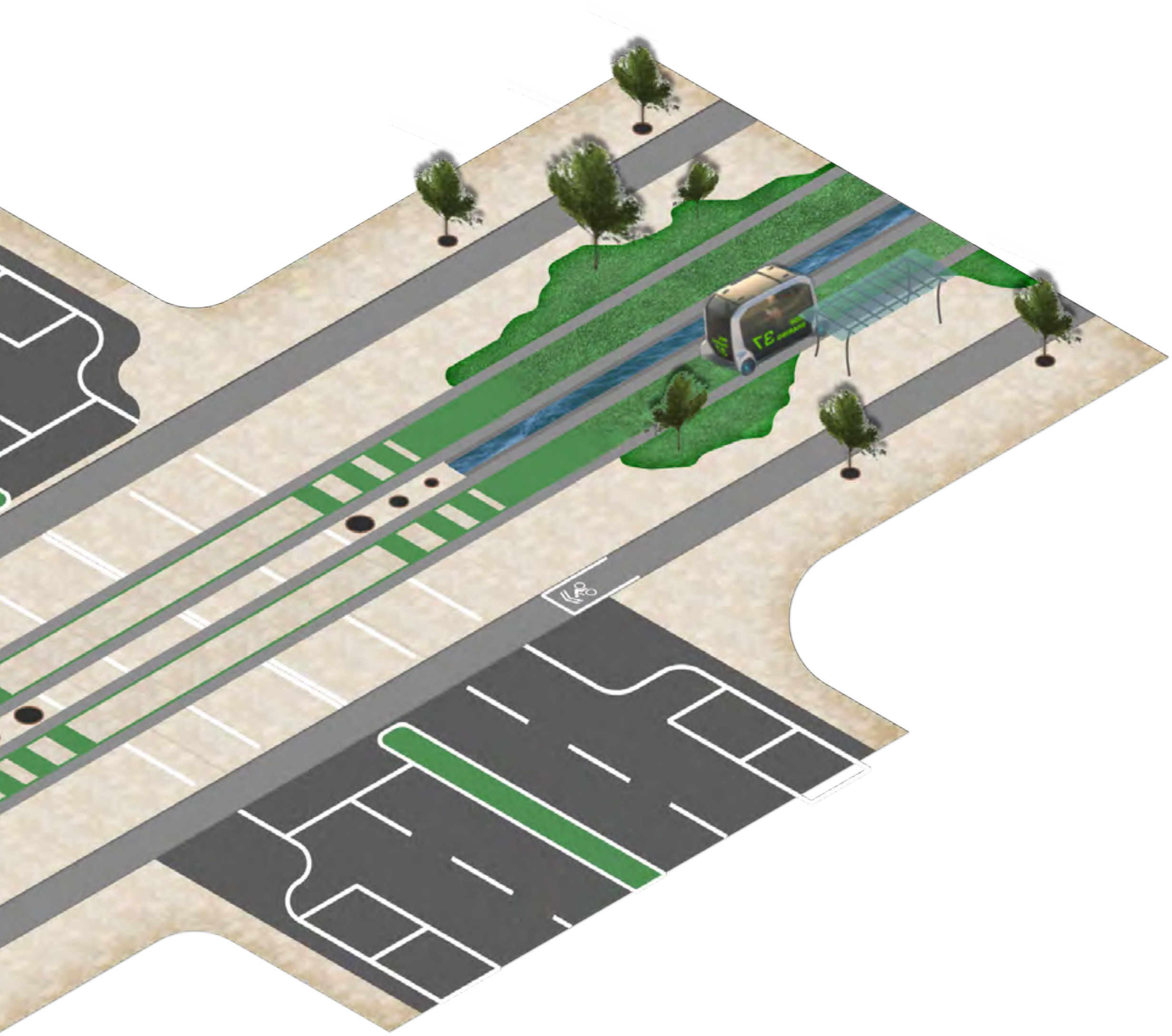
Existing

Proposed

Existing



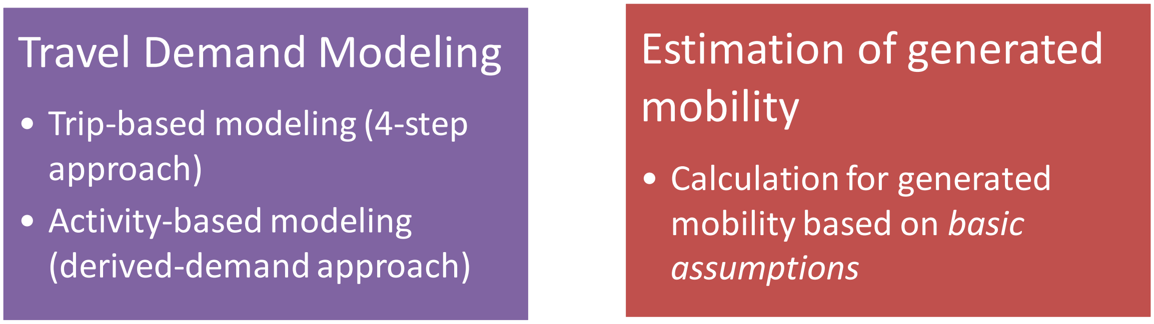
Proposed Green Street Concept



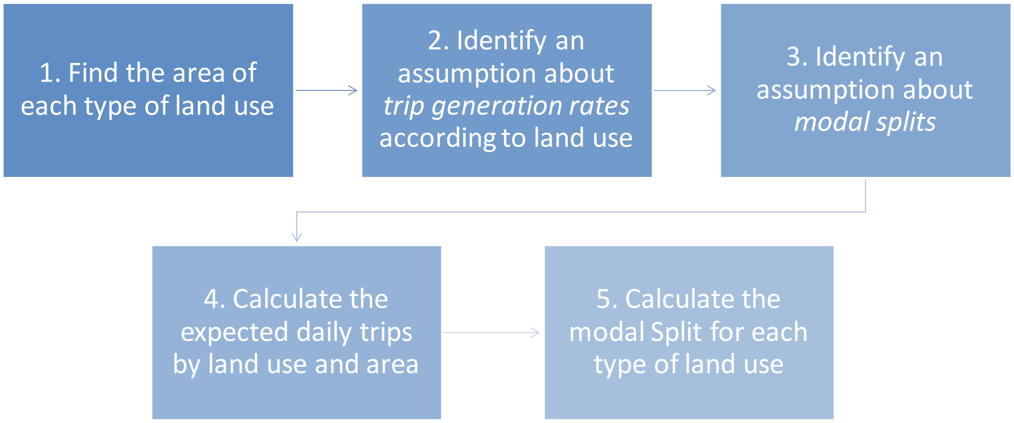
TRAVEL DEMAND ANALYSIS

Goals:

- To estimate the traffic generated by the existing condition
- Compare it with the proposed scenarios



Current approach



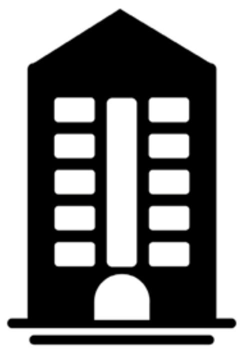
Estimation Process

Assumptions about trip generation rates:

- Category averaged from Institution of Transportation Engineers (ITE)

Residential
6.9 trips/dwelling unit*

*Assumption: 1 unit = 60 sq.m.



Office
2.52 trips/sq.m.

Retail
23.91 trips/sq.m.

	Area	Trip Generation Rate per unit	unit	#Units	#Trips
Residential	1,249,367	6.90	Dwelling Unit	20,823	143,573
Office	8,711,296	2.52	1000 sqm	8,711	21,962
Retail	5,291,690	23.91	1000 sqm	5,292	126,520
Vacant	3,595,681				
Total	15,489,807				211,762

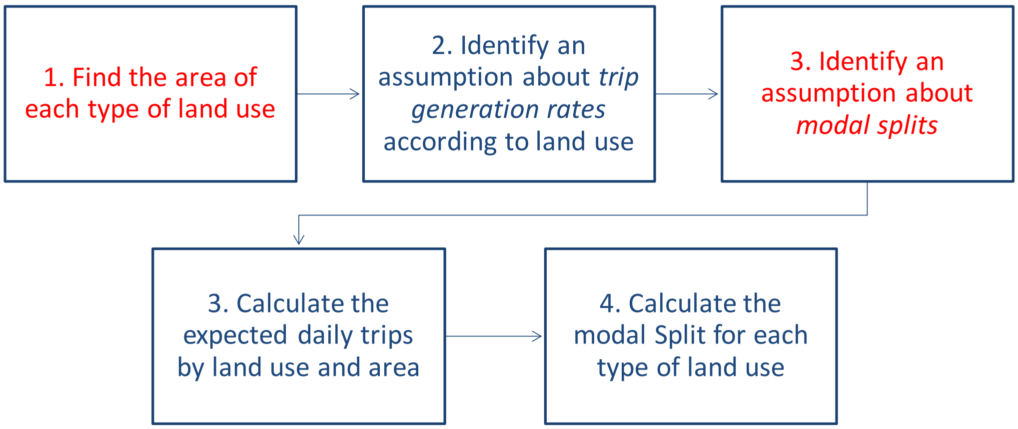
Current Scenario: Trip Generations by land use type

Mode	Mode share	Residential	Office	Retail	Total
Private cars	0.20	28,715	4,392	9,246	42,352
Public transit	0.29	41,636	6,369	13,406	61,411
Walking	0.29	41,636	6,369	13,406	61,411
Bicycle	0.21	30,150	4,612	9,708	44,470
Others	0.01	1,436	220	462	2,118

Current Scenario: Modal Split

New Scenarios: 2027 & 2037

- They will change the land-use area sizes and modal splits



Changes in the New Scenarios

Land use areas

- According to the proposed changes in urban form

Modal splits (rough estimations)

- % Private cars: 20% >> 5%
- % Transit: 29% >> 34%
- % Walking: 29% >> 35%
- % Biking: 21% >> 25%

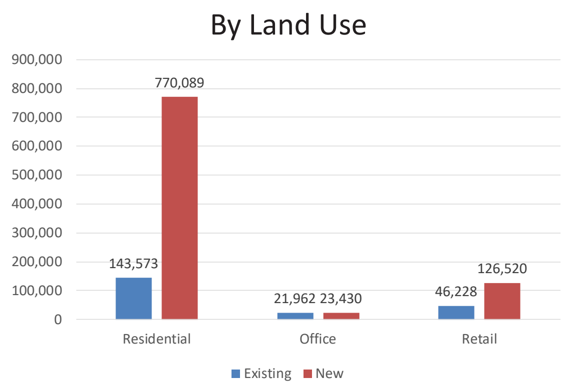
	Area	Trip Generation Rate per unit	unit	#Units	#Trips
Residential	6,701,280	6.90	Dwelling Unit	111,688	770,089
Office	9,293,670	2.52	1000 sqm	9,294	23,430
Retail	5,291,690	23.91	1000 sqm	5,292	126,520
Total	21,286,640				920,039

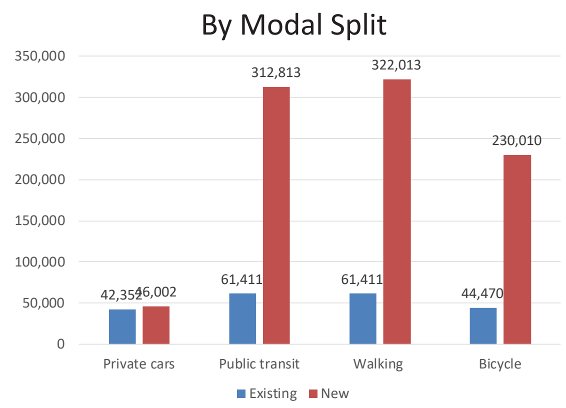
New Scenarios: Land use

Mode	Mode share	Residential	Office	Retail	Total
Private cars	0.05	38,504	1,171	6,326	46,002
Public transit	0.34	261,830	7,966	43,017	312,813
Walking	0.35	269,531	8,200	44,282	322,013
Bicycle	0.25	192,522	5,857	31,630	230,010
Others	0.01	38,504	1,171	6,326	46,002

New Scenarios

Changes in travel demand





Limitation & Future Studies

Limitations

- Due to limited resources, trip generation rates from the actual area could not be used in calculation
- Modal splits used in the calculation are rough estimations, not according to the actual person-trip data from the site

Future Studies

- Incorporate the site's person-trip data
- Use more advanced models for complete analysis

WATER + ENERGY

Christopher L Barnum
David J Pedrick

OVERVIEW

A Smart City should be prepared for the environmental conditions that are present and the likely environmental conditions of the future. The present paradigm of design standards based on 100-year storm events, or even less, is a tacit acknowledgement that occasional disaster is acceptable. However, a Smart City's environmental systems should be designed to accommodate the known extremes and future extremes, especially considering the long-range time scale of environmental systems. Such a time scale will see extraordinary changes that impact the effectiveness of environmental systems. Climate change will bring larger rain events, larger storm surges, and an elevated sea. The Smart City should address these increases and design water infrastructure to manage these increased water volumes. To do so increases the cities resilience and reduces chronic stressors and economic damages which discorporate impact the least advantaged.

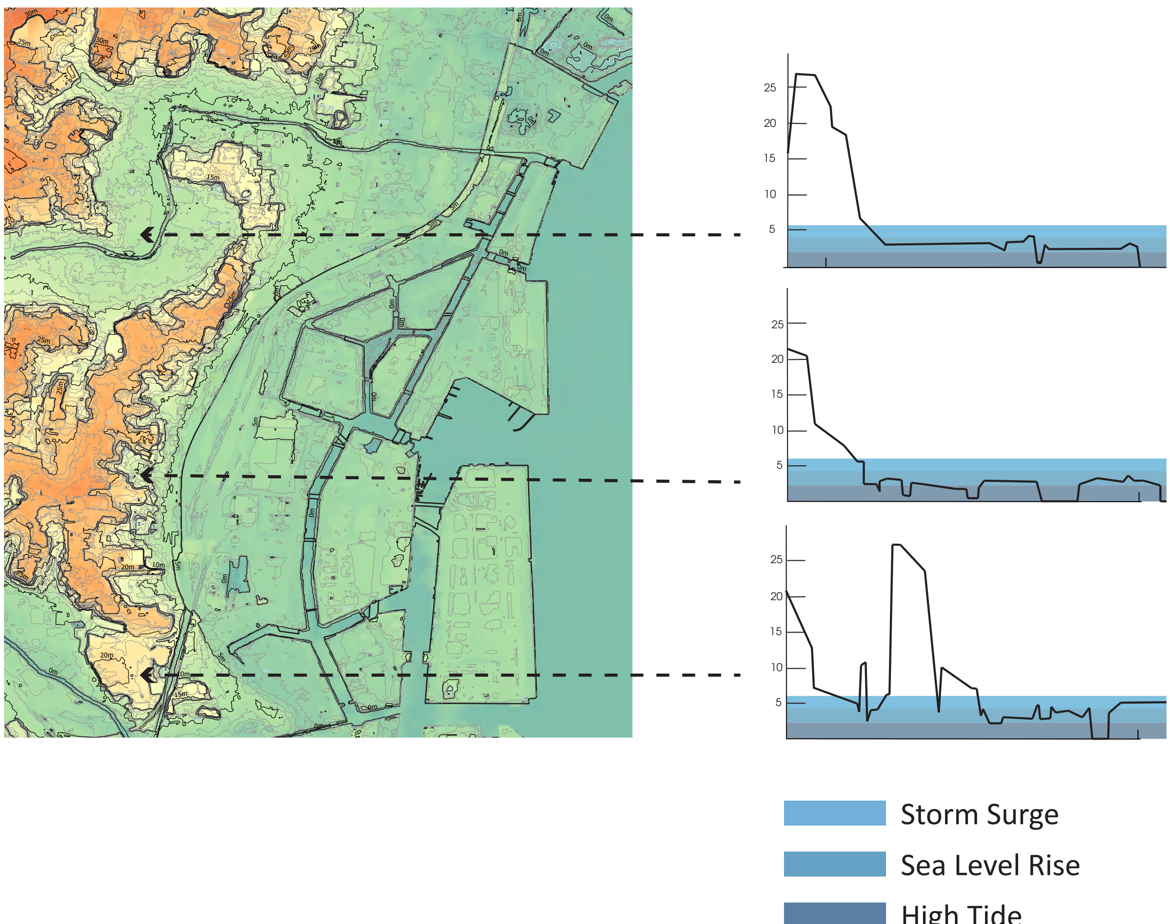
WATER MANAGEMENT

The site is less than 5 meters above sea level with very little topographical change. It sits on a reclaimed ocean that has been reclaimed in the past. The historic coastline was to the west of the Shinagawa Station rail yard. Additionally, the site is predominantly covered with impervious surfaces that increases risk from storm water runoff and storm surge. However, most of the site is defended from storm surge with Tokyo's network of levees and storm surge gates. These provide minimal protection from storm surge and sea level rise. In the event of a 100-year storm surge much of the site is below storm water levels but protected by the levee system. This system, however, is reliant on functioning pumping stations to evacuate rainfall runoff.

The site will handle all extreme rainfall events with no flooding. Storm surge will be mitigated by environmentally sensitive ecosystem services on the exterior island as well as utilizing Tokyo's existing defenses. As sea-level rise reduces the effectiv eness of these strategies, a super-dam will be implemented to protect all Tokyo Bay. The vision for rainfall runoff protection will be operationalized through a geo-spatially linked rainfall runoff calculator. The calculator guides planning decisions towards resilience.

The site's water resilience plan must address three issues which are relevant over three time-scales. Water resilient design must first address rainfall runoff and stormwater, then a specific solution must be developed for storm surge, and finally a unique sea level rise solution is developed. All three strategies must work in tandem to prepare for the worst case scenario when large rainfall occurs during storm surge at high-tide once the sea level has increased as a result of climate change.

Rainfall runoff is best managed through ecological mimicking systems. These networks of systems integrate ecological services such as infiltration, water purification, and storm-water storage into the urban landscape. Our plan is designed to contain the 500 year storm event through infiltration and storage. This storm event is infiltrated through a network of permeable pavers, bioretention areas, and street tree planting areas. To increase the effectiveness of these limited strategies, a

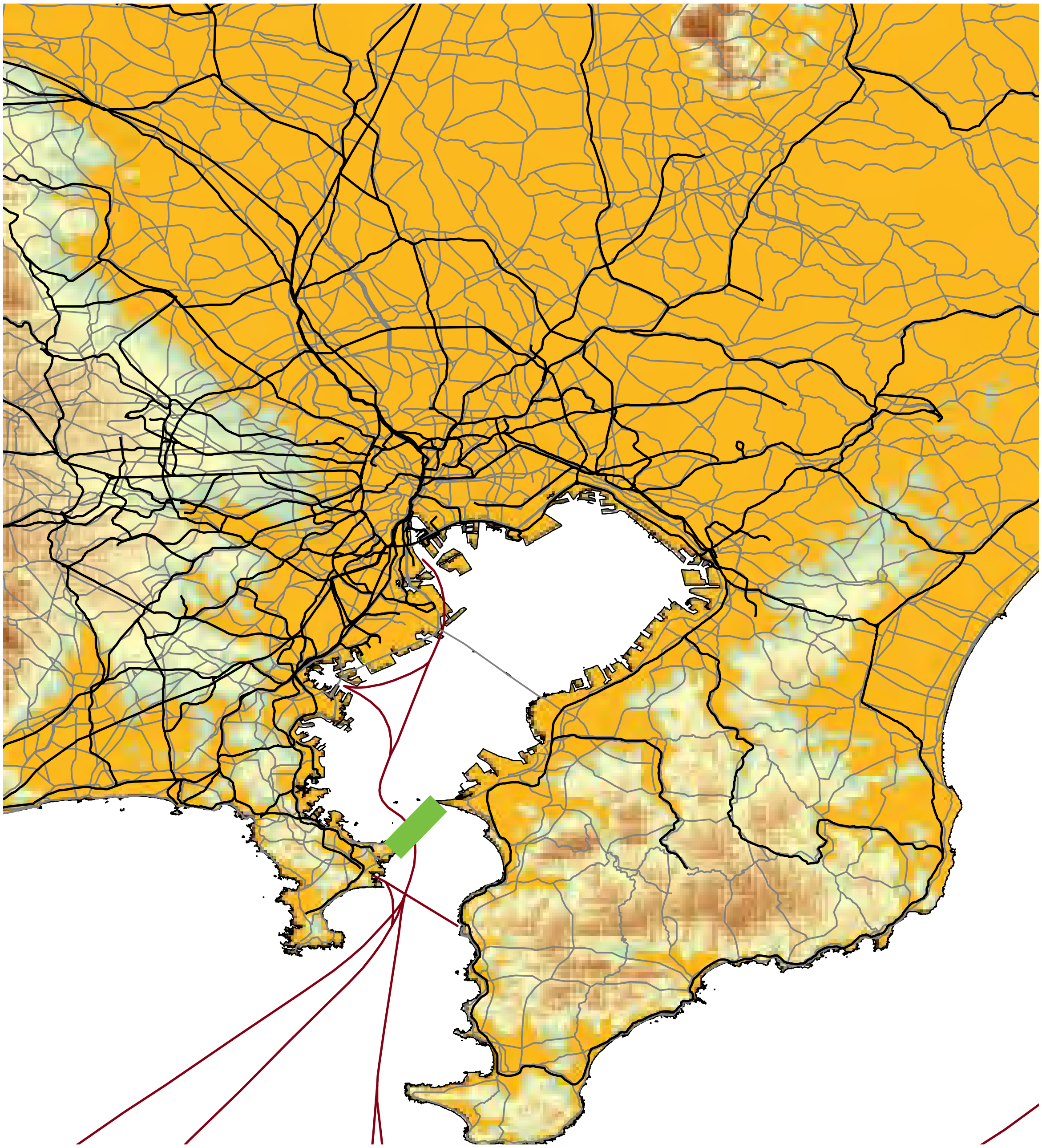


Future Water Levels in Shinagawa

green roof retrofit program is planned. Retrofitting 33% of the buildings with green roofs allows the site to reduce 5% of the stormwater discharges on site. Most importantly, the pocket parks will provide stormwater detention volume to detain water during the largest of storms. These detention areas are integrated into urban infrastructure such as courtyards, basketball courts, and plazas. Finally, a system of stormwater cisterns will be installed to capture water for future use as a greywater system. The cisterns will be installed along the edges of each island in order to create a wide pedestrian promenade to increase public space and store water for use.

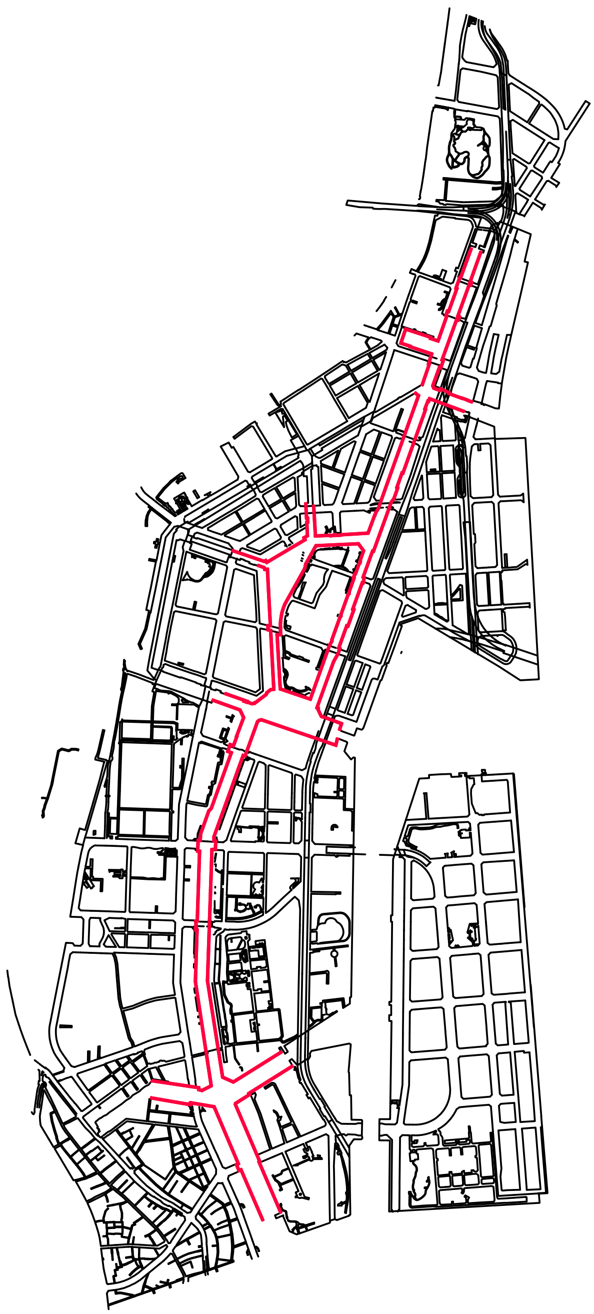
As a coastal site, there will be impacts from storm surge created by typhoons. The City of Tokyo currently has a system of levees and dams to protect the mega-region from storm surge induced flooding. This system will continue to be used as it provides needed protection. However, additional protections are planned. The development of ecologically inspired coastal wetlands and marsh along the exterior boundary of the 'NEW' island will provide needed protection. Marshland dissipates the energy of storm surge by increasing the 'friction' of the coastline.

Sea level rise proves a menace to Tokyo. Many millions of people live within the areas projected to be flooded by sea level rise. Estimates vary widely considering different scenarios of climate action but the rule may be that for every Degree Celsuis of global warming there will be a 2.3 meter increase in mean sea level rise. This predicts mean sea level rise for Tokyo Bay to exceed 5 meters by 2100 and many estimates indicate that 11 meters of mean sea level rise are unavoidable by 2500. While these time-scales are long, developing an action plan to tackle 5 meter sea level rise should accommodate an action plan for 11 meters of sea level rise. The most practical solution is to build a super-dam across Tokyo Bay to eliminate sea level rise in the Bay. Tokyo has a long history of developing mega projects inside the Bay.

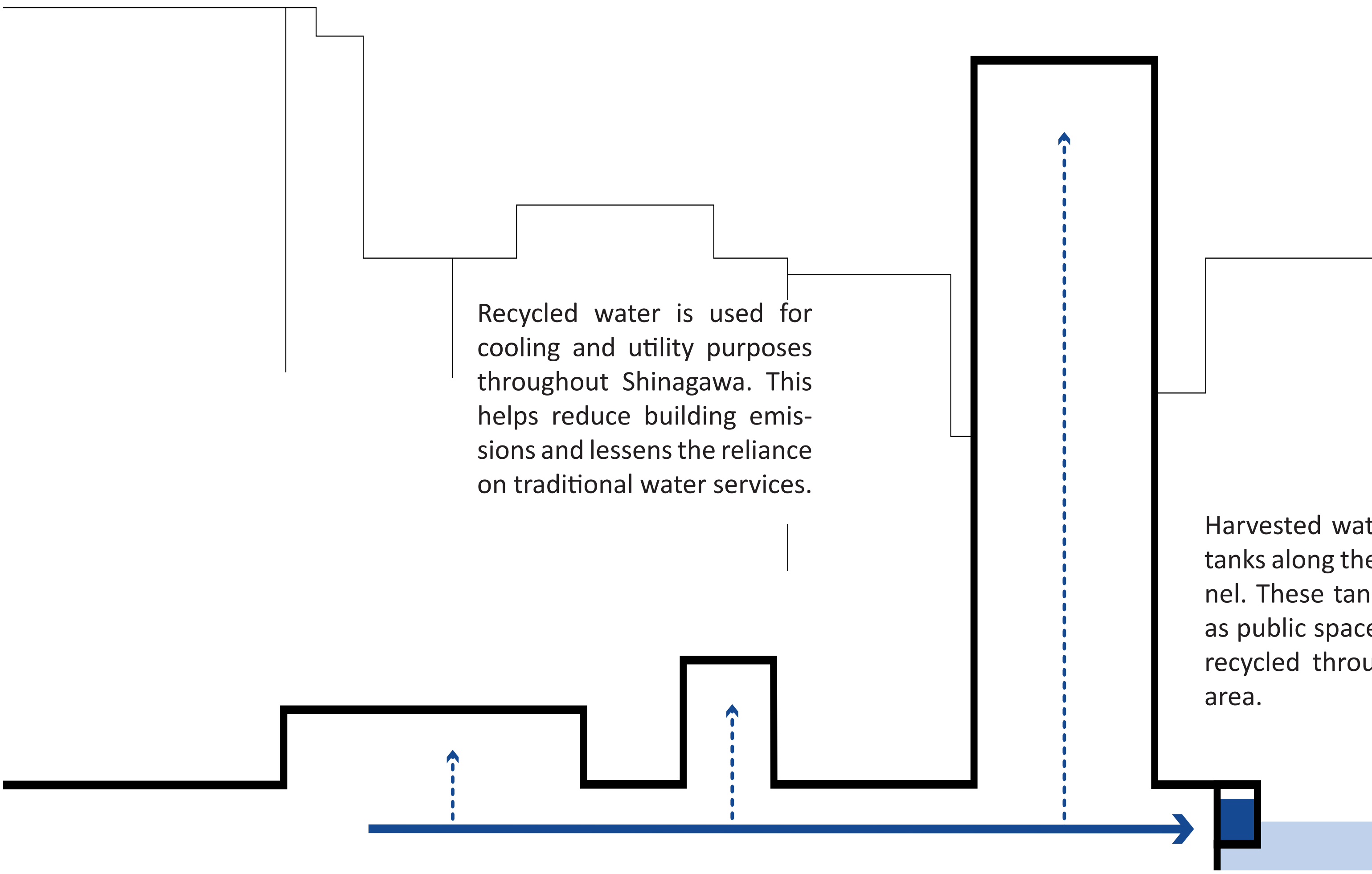


Proposed Superdam Location

Proposed Greenspace Network



Proposed Stormwater Retention System



Recycled water is used for cooling and utility purposes throughout Shinagawa. This helps reduce building emissions and lessens the reliance on traditional water services.

Harvested wat
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recycled throu
area.

Site Cross Section- Water Circulation

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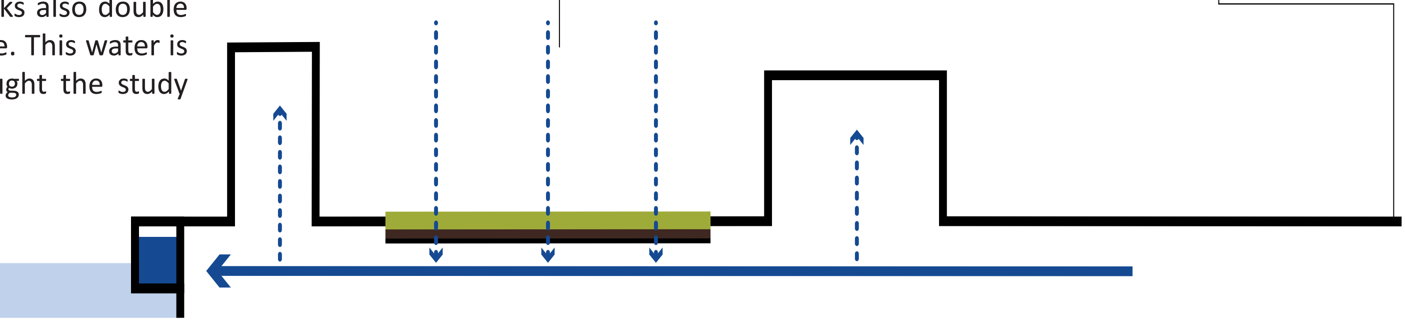
Rainfall infiltrates through greenspace and pervious pavement into the system. Infiltration is proposed on nearly all blocks in the study area in order to best capture and manage runoff.



SCENARIO PLANNING

David J Pedrick

OVERVIEW

Shinagawa 70-70 is an iterative process to develop an incremental approach to achieving a more sustainable future for the Shinagawa station area. The Shinagawa station will be the terminus for the Chuo Shinkansen rail service starting in the year 2027 when the first leg is completed between Tokyo and Nagoya. This is the first leg of the Chuo Shinkansen which will eventually connect 70 million people within a 70 minute train ride once the Tokyo and Osaka urban areas are connected. This is an unprecedented railroad connection which will require extensive planning to accommodate the preceding growth that such a piece of infrastructure will generate. To systematically plan for these additional services to the Shinagawa Station the Shinagawa 70-70 plan addresses the problem incrementally. The first Chuo Shinkansen train will arrive in Shinagawa in 2027. Then in 2037 the Chuo Shinkansen will make its first trip to Osaka. Then 20 years later, to complete a long-range planning process the Shinagawa 70-70 plan will be completed in 2057.

Each of the timeframes is evaluated and planned for as an increment of advancement from the year 2020 to the year 2057. Traditional planning scenarios are based on different assumptions applied to the same city over the same time period. Because the Chuo Shinkansen is the defining change agent in the Shinagawa Station area, this loosens the timeframe. Each scenario is not over the same time period but instead a benchmark in time. The first scenario is 2027, then 2037, and finally 2057. The scenarios are standalone plans which outline the progress which can be made between 2020 and 2057 towards increasing the evaluative results of the criteria established.

Each scenario was evaluated using the GIS and the functions established for the planning support system. The results of the evaluated measures are as follows:

	Baseline -- non-points based	**2027**	**2037**
Rainfall runoff from 500 year storm event is treated on site	500-yr storm; 356.1mm; 19875.0m^3; 16.1 acre-feet	108% of 500 yr storm	108% of 500 yr storm
Water metabolism balance	4,887,601,630	23.08%	23.08%
Energy metabolism balance	16,471,033,079	21	21
Miles of bike infrastructure (meters)	42,375	56,242	70,554
Urban diversity index	0.750	0.788	0.827
Absolute Compactness	10.6	11.1	11.7

SCENARIO CALCULATOR

Shinagawa 70-70 developed a set of evaluative criteria to benchmark the current status of the district with respect to five categories: Connected, Data Driven, Green, Inclusive, and Responsive and Resilient. Each of these categories have multiple criteria which help in evaluating the progress made towards the Shinagawa 70-70 plan. Core to Shinagawa 70-70 is the iterative evaluation of these criteria to course correct, report improvement, and guide development decisions to a positive outcome. Of these criteria, many are geospatial in nature.

Geospatial criteria include key metrics such as intersections per square kilometer, rainfall runoff volume reductions, and urban diversity index. These metrics can all be calculated utilizing basic geospatial functions within a geographic information system along basic algebra. Due to the simplicity of these measures and in alignment with the Data Driven metrics of Shinagawa 70-70, a Planning Support System is proposed and a proof of concept is developed to provide the evaluation results of the iterative design process of the plan as well as each incremental development added to the Station District.

A planning support system is a tool which assists planners make data driven decisions. They require data inputs, complete an evaluative process, and some are geospatial in nature. The support system may generate a modeled future, a scenario, or simply calculate the total traffic generated based on land use. They are varied and fundamentally allow planners to make faster and better informed decisions.

As part of the Shinagawa 70-70 evaluation criteria there are sixteen which are able to be calculated via a simple planning support system. The planning support system developed for Shinagawa is a system which with a few GIS Shapefiles is able to calculate sixteen of the evaluation criteria. These criteria are listed in Table 1. Additionally, the planning support system is able to calculate the same criteria for individual development sites. Instead of utilizing district wide datasets a development site would utilize the planning support system to demonstrate the development project's contribution to the progress sought through the Shinagawa 70-70 planning process.

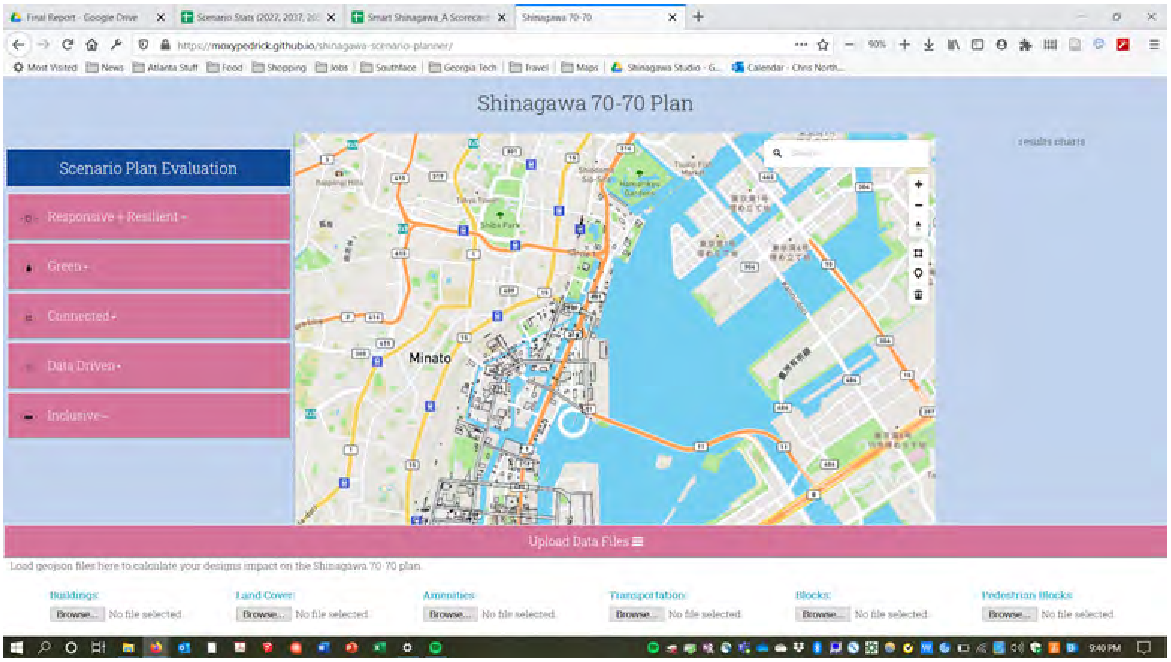
Utilizing the planning support system for evaluation of individual development projects turns the system into a zoning and building construction compliance tool. Each development that is proposed in Shinagawa can use the web-based tool to evaluate its design against the goals of Shinagawa 70-70. With such an interactive tool the development and design team can iterate, just as this plan has done over specific site designs to achieve the best result. The municipal government of Shinagawa could use such a tool as a replacement to traditional zoning or a layered approach to zoning approval. The Planning Support System would be a performance zoning check for approval or contribution to the progress towards Shinagawa 70-70.

How it works:

The Planning Support System would evaluate the Station District's or individual development sites results of sixteen evaluation criteria. The results of these criteria are established through the provision of five shapefiles of specific attributes and characteristics that represent the building footprints, land covers, amenities, transportation, and pedestrian blocks. The specifications for each shapefile can be found in Table 2. Utilizing each of these shapefiles the evaluation web-based planning support system is able to calculate the results.

The user of the system is able to import the shapefile into the web-based platform. This is completed through a simple import function that is native to html and javascript. With the shapefiles stored locally in the browser of the user, the engine of the planning support system is able to calculate the evaluation metrics. The engine of the PSS is Mapbox GL JS and the Turf.js packages. These allow for basic geospatial functions to be completed on the imported data. These calculations are listed in Figure 3. The shapefiles are then used to calculate the performance of the site or development site against the metrics established in the Shinagawa 70-70 plan.

This planning support system is the best way to allow for innovation towards achieving the goals of Shinagawa 70-70. The planning support system becomes part of the evaluative toolset which planners and developers use to design Shinagawa 70-70.



Scenario Calculator Website Prototype

Building shapefile	Geometry	Polygons				
	Attributes	Roof-type (solar, green roof, na)	Usage (see categories in CBECs, REUWS, existing file	Floor Area	Volume	Total Occupants (worker, resi-dent)
Land cover shapefile	Geometry	Polygons				
	Attributes	Type (road, building, park, GI-BMP(Paver, Bioretention, Multi-Purpose, Green Roof, Cistern), open space, green space)				
Amenities shapefile	Geometry	Points				
	Attributes	Type: [senior center, affordable housing, child care centers, grade schools, Google Amenities, schools, grocer, rapid transit, hospital, parks]				
Transportation shapefile	Geometry	Polyline				
	Attributes	Type (road, bike lane)				
Pedestrian Blocks	Geometry	Polyline				
	Attributes	Length				

Scenario Calculator Inputs

Criteria #	Name	Description
1	Rainfall runoff from 500 year storm event is treated on site	Design storm that is treated on site
2	Sea Level Rise (site design resilient to 500 year sea level rise,	Protect the site from current projected sea level rise.
3	Green roof	Retrofit buildings to have green roofs which treat a percentage of rainfall runoff
4	Water metabolism balance	Percent of water usage demand divided by the amount of water storage capacity
5	Energy metabolism balance	Percent of energy usage demand divided by the amount of energy generation capacity based on roof solar access, incineration, and biogas.
6	Balance in usage between activity and residence zones	Percent of area that has greater than 20% non-residential floor area
7	Proximity to transportation networks alternative to car	Percentage of population with simultaneous access to the following networks; AV network, metro, bicycle network within 5, 7, and 2 minutes respectively
8	Road space for pedestrians	Percentage of street intended for pedestrians over the total width of the road. This is a cross section measure.
9	Number of intersections per square kilometer	Total number of intersections per square kilometer - x desired. 1. Input the polyline file of the streets. 2. Determine how many intersections there are using lineIntersect (turf.js) 3. Divide number of intersections by the area of site/parcel
10	Buildings within 5 minutes walk to 5 amenities	
11	Residential buildings within five minutes walk to public transit	Proximity to transportation networks alterna-tive to car
12	Miles of bike infrastructure	Show increase in miles of bike infrastructure
13	Maximum pedestrian network block length of 182 meters	Input block shapefile, determine which blocks have perimeter of less than X meters.

Criteria #	Name	Description
14	Urban Diversity Index	Create a diverse community with varied uses and amenities. 1. Use the simpson's diversity index to calculate the urban diversity 2. For the site or parcel count how many total amenities are located there 3. Then count how many of each type of amenity is located in site/parcel (grocery:5, movie theater: 2, retail: 30, office: 2, etc ; total = 39) 4. Sum the number of individual uses multiplied by uses minus 1. 5. Divide the sum by the total amenities multiplied by N minus 1. 6. 1 minus the result. 7. 1 is absolute diversity. Scores closer to 1 are better. eg. 1-((sum(n(n-1))/N(N-1))
15	Absolute Compactness	Measure of how compact/dense the site is: 1. Calculate the total building volume on site/parcel 2. Divide total volume by land area of the whole site/parcel 3. Essentially this is an FAR calculation 4. Desired outcome is 5 meters or more
16	Green Space Deficit (covid19)	To allow space for physical distancing and in times of healthfulness provide adequate space for gatherings. 1. Calculate total greenspace and public space provided on site/parcel 2. Determine number of people being served by green space and public space. 3. There should be 5 m2 of green space and 10 m2 of public space per inhabitant

SMART CITY POLICY

Zachary W Starbuck

OVERVIEW

Smart Cities should be envisioned as urban centers that incorporate technological systems into their analysis process as a means for accomplishing critical tasks. This development is a relatively recent phenomenon. The term has been described in recent years as being an assortment of strategies for how information and communication technologies can be used to address various issues that cities would be facing, with an understanding that the success of the proposed strategies would depend on coordination and integration of separately developed technology systems. The opinions regarding this subject have shifted in recent years, given that initial discussions about smart cities occurred during the 20th century which viewed this development as being a science-fiction fantasy. The sentiment surrounding this changed with the development of intelligence services such as smart phones. These devices enhance the data collection process at various scales and provide context in regard to the following: the travel patterns and routines of individuals; quality of life for residents of a city; equity; mobility; and traffic congestion. The framework/process for designing a smart city is also an important aspect of the research as it enables planners to observe the results of their work as well as improve upon their initial proposals and strategies.

There are three concepts crucial to consider throughout the development process of a smart city: vision, goals of research, and research challenges/opportunities. The vision is the broad statement for what a smart city should accomplish and details the information that the planning process would gather from the selected location. The vision of a smart city typically emphasizes the utilization of Information and Communications Technology (ICT) and the integration of different information services to better understand how cities currently function and the improvements that can be made to urban systems. Smart Cities tend to emphasize their metropolitan areas as being interconnected with each other in terms of transit, information technology, and planning.

The opportunities and challenges related to the research focus on the potential pitfalls and discoveries associated with the research element. The data collection process has benefitted from the proliferation of smart phone technology within major parts of society. The challenges relate to the potential difficulties associated with implementation and application of smart city technologies. The correct methods for utilizing smart phone data is the primary issue. Examples of research challenges include relating informational infrastructure to their ideal purposes, exploring the innovation potential of smart cities, providing portfolios of urban simulation, and the enabling of citizen-based participation (Batty et al. 485). Realizing the benefits of these data services involves ensuring that services are being coordinated in the correct manner.

GOALS OF SMART CITY RESEARCH

New Understanding of Urban Problems (Batty et al. 2012):

- Batty et. al defined cities as complex developments created through various processes with contributions from different individuals and organizations, with varying strategies. They state that "complexity sciences are integral to their understanding which is a moving target in that cities themselves are becoming more complex through the very technologies that we are using to understand them"(483). Therefore, a program needs to be created prior to the decision-making process.

Effective and Feasible Ways to Coordinate Urban Technologies (Batty et al. 2012):

- Coordination between technologies that provides data, software, and organizational forms is essential for sustained development of urban services. This research aspect is used to "integrate and add value to the provision of urban services," and should "provide the mandate for the sustained development of new methods"(483). If this goal is not being met, the research will end up working in a relatively inefficient manner.

Models and Methods for Using Urban Data across Spatial and Temporal Scales (Batty et al. 2012):

- The third goal involves merging real-time data with traditional cross-sectional data into simulations that analyze real-time problems. "Multilevel integrated modelling is thus key to this effort" (483). Currently, the available databases help meet this goal and allow for systems such as GIS to analyze this data.

Developing New Technologies for Communication and Dissemination (Batty et al. 2012):

- This goal for planners is to engage the community which would require new forms of online participation. This also requires upgraded technology to disseminate the problems, plans, and policies to the community. These can be accomplished using "latest ICT in terms of distributed computation and state of the art human computer interaction (HCI)"(483). This goal might be the most important because the feedback from the community provides context about why residents would or would not support certain policies.

New Forms of Urban Governance and Organization (Batty et al. 2012):

- This goal refers to the new methods and that cities can utilize to redevelop as smart cities, while emphasizing privacy and access (484). This goal highlights the need for greater interactions between the local governmental bodies and planners.

Defining Critical Problems Relating to Cities, Transport, and Energy (Batty et al. 2012):

- Identifying critical issues related to a city can reveal its infrastructure. "The analysis of such problems and their identification is crucial to the sustainability and resilience of smart cities" (484). Simulation models need to be updated to account for the changes that cities would experience. These models are designed to explore the rapid changes and to understand the cycles of these dynamics. This particular goal is the first step necessary for planning a smart city.

Risk, Uncertainty and Hazard in the Smart City (Batty et al. 2012):

- Cities should be envisioned as "strongly coupled systems that generate unexpected and surprising dynamics," requiring further understanding (484). Technology is a factor that can impact those dynamics in either a positive or a negative manner. The goal is that future technology will be able to anticipate the problems that smart cities could face and design proactive solutions.

OPPORTUNITIES

Cell phone data and open data sources have become increasingly available in recent years. Governments have made their data available to the public as a means for increasing the analyses conducted on existing data sources. Coordination between these sources and different levels of government is critical for producing analyses. The variety in perspectives and data sources enables different analysis methods.
Utilizing the opportunities for development depends on the success of coordination between technologies of various levels and time spans. The integration of sciences will be utilized through Information Technology (IT) services, with synergy between hardware, software, database, and organizational technologies. For cities in general, the opportunities revolve around utilizing cell phone data and open data sources. For Shinagawa, this data can be used to identify travel patterns and create new networks.

CHALLENGES

Developing technology that assists with smart cities is a major goal of the planning process. The results are not the only concept of importance to this process, as planners also need to understand the strategies that were used to achieve the answers. Having knowledge about the process provides context for the successes and failures of certain strategies. This mindset should be used to analyze projects for both past and future efforts.

Batty et. al name several challenges related to their seven goals of research. The first is "to relate the infrastructure of smart cities to their operational functioning and planning through management, control and optimization"(485). Information Technology has quickly embedded itself into the lives of many individuals and technology has shifted towards wireless formats. Planners need to be able to utilize digital infrastructure to explain how these tools can be used to identify solutions for a city. The second challenge is "To Explore the Notion of the City as a Laboratory for Innovation" (485). Innovation is a crucial aspect of smart cities, in order to improve the efficiency by which services are delivered and businesses operate. Models are used to judge the operations of these cities and determine how they can improve their competitiveness. The studio explored this concept and proposed developments that would increase its connectivity. The third challenge is “To Provide Portfolios of Urban Simulation which Inform Future Designs” (485). Sensor tools have the potential to provide information about long-term changes. To utilize these models, data analysis will need be processed at smaller levels. Another objective is to utilize different kinds of models for the same city and with a “pluralistic” approach. The studio incorporated this approach through its usage of different metrics for analysis. The fourth challenges is “To Develop Technologies that Ensure Equity, Fairness and Realize a Better Quality of City Life” (485). Technological advances have provided more efficient economic outcomes in recent years. However, they have also created a digital divide. The key to addressing this challenge is discovering how to bridge that divide, which leads directly into the fifth challenge of developing “Technologies that Ensure Widespread Participation”(485). That participation is the key component for models to provide accurate analyses. The intention is that residents will provide planners with their own information about the current makeup of an area. The studio has not reached this phase of planning interaction yet, as our information sources in Tokyo have been limited to university professionals. The final challenge is “To Ensure and Enhance Mobility for Urban Populations” (486). The improvements for mobility pertain to increased access to jobs, social connections, and other factors. The methods for bridging potential divides are through either physical distance or communication. The studio’s mobility group focused on analyzing the travel sheds for Shinagawa, utilizing GIS for the Network/ Urban Network Analysis, and proposing new transit stations.

UNDERSTANDING SMART CITIES

Planners emphasize, at different planning levels, the various functions of a smart city, which may change as the priorities of smart cities shift in the future. Batty et al (2012) list their suggestions they think should be prioritized by smart city planners. The first focus, “new forms of data base organization and mining” (493) is critical component that provides context about the existing conditions of cities. Integrating different data sources, which can be accomplished with ArcGIS tools, identifies correlations between selected features and the surrounding geography.

The second focus "infrastructure we provide collectively" (493), which is necessary to reduce the cost of collecting data. The infrastructure of note for this studio is the public transit network and potential Autonomous Vehicle (AV) systems. These systems are designed to reduce the amount of land demanded by roads and the costs associated with increased road congestion: healthcare costs, overuse of roads, and traffic accidents.

The third focus emphasizes ICT: "The development of multimodal trip planners and advice systems are in their infancy and we expect FuturICT to spur the development of such applications." (494).

The fourth focus consists of the net of networks, related to transportation and com munication that "both social and physical, needs to be explored using a wealth of traces which our computing and telecommunication systems can now generate" (494). The net of networks refers to the interconnection of both transit networks and communication systems and how these functions might overlap with each other. The traces can be used to analyze the relationships that exist between nodes (buildings) on these networks.

The fifth focus emphasizes the cities' roles as an enterprise hub, noting "cities are essentially sets of markets where individuals and groups come together to exchange" (494). Markets are necessary for the success of smart cities and should collaborate with each other, which can be extended toward the development of databases.

The sixth focus is to "develop agent representations of the firms by size, type and sector" (Batty et. al 2012, 495). Agent representations are the characteristics which define the firms: scale at which they operate, type of business operation, and geographic location in the city. GIS and other tools can identify businesses according to these characteristics and note any overlaps that exist between these attributes. The studio created maps to represent these reforms and strategies according to size and type. This has not been extended to the firms.

The seventh focus involves computer-generated analyses: “Future ICT will explore the way community networks can be generated using new social media and related connectivities” (Batty et. al 2012, 495-496). Social media and surveys can be used to identify a person’s travel patterns and track general movements. The studio used GIS to map out travel sheds for major areas in Shinagawa.

SMART CITIES: A POLICY FRAMEWORK

According to Batty et. al (2012), the policy phase of the development of a Smart City focuses on the proposed reforms to which include changes to policies that concern data collection (the largest emphasis), building energy usage, available transit services, and street design (500). Since improvements to the data gathering process are critical to the success of the remaining components, the policy phase needs to address that component first.

“Technology and the Future of Cities” was published in February of 2016 for President Obama by the President’s Council of Advisors on Science and Technology (PCAST). The study sought to answer the question: “how can the Federal Government best support science and technology and the related opportunities that can improve America’s cities—in terms of quality of life, social services, infrastructure, and sustainability for all their residents?” (PCAST 2016, 7). The current growth for cities is attributed to the following factors: desire for social connections and closeness to work, along with a decreased reliance on car travel. Smart Cities are designed to address these desires, along with the challenges posed by growth in urban population. Large cities are using technology and data to solve problems in the following categories: health, transportation, sanitation, safety, economic development, and street maintenance. District-centered strategies are the preferred scale for smart city planning (PCAST 2016, 16).

URBAN SECTORS

The transportation sector will experience massive changes in the upcoming years. Coordination between car manufacturers and technology entities has stimulated the development of AVs. AVs are designed to address the shortcomings that many cities' transit networks are facing. by reducing the number of vehicles in roads. This change would result in enormous cost savings for cities through a reduction in traffic accidents and associated healthcare costs (PCAST 2016, 10). For Shinagawa, the changes in transportation involve the gradual shift towards AVs along with the insertion of two additional subway stations as a means for reducing car usage throughout the city.

The energy sector focuses on the electrification of several systems' energy grids. The electrification process will involve shifting away from using fossil fuels for conversion, which has led to energy efficiency becoming a priority for most officials (PCAST 2016, 12). Simulation technology is a tool that detects how efficient an energy system is and help it lower energy demand in conjunction with increased LEED standards.

Smart Cities will offer residents the ability to construct their housing with cheaper materials that includes sensory technology. The US lags Japan and Scandinavia in this construction option. This strategy includes four phases for its construction process: pre-fabrication, used for higher precision and lower costs; modular construction, standardization between components of buildings' interfaces; customization and personalization, providing input from customers about how they want to input features into their buildings; sensing technologies insert technology into buildings which read and change environmental conditions as needed. (PCAST 2016, 13).

Water network proposals have been designed to address various issues at the regional, watershed, and local levels. Some planners believe the focus should shift toward local investments in stormwater capture and other specialized investments to reduce water imports for a geographic area and overlap traditional regional systems. (PCAST 2016, 14).

Urban Farming will shift toward soil-less systems that are installed on various features of buildings. This strategy will help produce growing environments that do not have consistent access to water (PCAST 2016, 15). Urban farming can convert dilapidated lands into farming areas, which could be used for portions of Shinagawa.

Urban Manufacturing is the production of a small set of specialized products that serve a select spectrum of customers. The primary benefit of this service is that it supports higher median wages compared to jobs in the retail or service industry. The technologies used for this sector tend to be cleaner compared to older manufacturing and provide services that are more accessible for customers (PCAST 2016, 15-16).

Urban Sector	Technologies / Concepts	Objectives
Transportation	Multi-modal integration via ICT applications and models On-demand digitally enabled transportation Design for biking and walking Electrification of motorized transportation Autonomous vehicles	Save time Comfort or productivity Low-cost mobility and universal access Reduced operating expenses to transportation providers Zero emissions, collisions, fatalities Noise reduction Lifestyles Tailored solutions for the underserved, disabled, and elderly
Energy	Distributed renewables Co-generation District heating and cooling Low-cost energy storage Smart-grids, micro-grids Energy-efficient lighting Advanced HVAC systems	Energy efficiency Zero air pollution Low noise Synergistic resource management with water and transportation Increased resilience against climate change and natural disasters
Building and Housing	New construction technologies and designs Life-course design and optimization Sensing and actuation for real-time space management Adaptive space design Financing, codes, and standards conducive to innovation	Affordable housing Healthy living and working environments Inexpensive innovation and entrepreneurial space Thermal comfort Increased resilience
Water	Integrated water systems design and management Local recycling Water efficiency via smart metering Re-use in buildings and districts	Active ecosystem integration Smart integration of water, sanitation, flood control, agriculture, and the environment as a system Increased resilience
Urban Manufacturing	High-tech, on-demand 3D printing Small batch manufacturing High-value added activities requiring human capital and design Innovation parks	New job creation Training and education Urban space conversion and re-use Close integration of living and work
Urban Farming	Urban agriculture and vertical farming	Lower water use Cleaner delivery Fresher produce

PCAST Table of City Infrastructure Technologies

PLANNING PHASE

City officials and planners begin to outline their strategies for addressing the problems facing the city. Planners utilize various perspective to analyze the current issues, and determine which proposals would best develop the area. Understanding the nature of the city is a critical element. Smart cities are developed by beginning with initiatives at a smaller scale. Network technologies enable data collection at these lower levels, providing information about spatial patterns that can identify individuals' travel behaviors (Batty et al. 2012, 493). This information can be used to discern the locations of social networks and to develop simulations which mine data from those localities. The coordination of different databases is necessary for improving this process.

Batty et al.'s (2012) article includes a chart that lays out a time scale for how to emphasize policy proposals for a city to be remade as "smart." The chart is divided according to seven policy emphases: city services, citizens, communication, water, business, and energy. These issues are analyzed based on the following time scales: "today…" the problems and features associated with the selected issues; "what if a city could category," how a smart city would address the aforementioned issues primarily the deficiencies in existing urban systems; and "already, cities are," the components that are already in place in that city (487).

The process for planning smart cities involves using new forms of databases and data mining methods that link components of an urban network. The objectives are to improve the efficiency of gathering information and the livelihood of cities, utilizing multiple strategies for the process of developing a smart city. Multiple data systems are needed to identify the various aspects of a city. Databases should integrate with other sources and depict necessary information.

Governance relates to how officials and businesses interact with each other through the application of technology. Structure is critical for this issue; planners needing to discern which function stakeholders play in the development of a smart city.
The object of the research is to provide planners with information about the current systems, so they may determine which policies would most benefit the cities.

Today…	What if a city could…	Already, cities are…
City services * Service delivery in silos with one size fits all	Tailor services to the needs of individual citizens	Using technology to integrate the information systems of different service delivery agencies to enable better services for citizens
Citizens * Cities have difficulty using all the information at their disposal * Citizens face limited access to information about their healthcare, education, and housing needs	* Reduce crime and react faster to public safety threats, by analyzing information in realtime? * Use better connections and advanced analytics to interpret vast amounts of data collected to improve health outcomes?	* Putting in place a new public safety system in Chicago, allowing realtime video surveillance and faster, more effective response to emergencies * Giving doctors in Copenhagen instant access to patients' health records, achieving the highest satisfaction and lowest error rates in the world
Transport * Transporting people and goods is dogged by congestion, wasted hours, and wasted fuel	* Eliminate congestion and generate sustainable new revenues, while integrating all transport modes with each other and the wider economy?	* Bringing in a dynamically priced congestion charge for cars to enter Stockholm, reducing inner-city traffic by 25% and emissions by 6% and generating new revenue streams
Communication * Many cities have yet to provide connectivity for citizens * Going "online" typically means at slow speeds and at a fixed location	* Connect up all businesses, citizens, and systems with universal affordable high-speed connectivity?	* Merging medical, business, residential, and government data systems into a so-called ubiquitous city in Songdo, Korea, giving citizens and business a range of new services, from automated recycling to universal smartcards for paying bills and accessing medical records
Water * Half of all water generated is wasted, while water quality is uncertain	* Analyze entire water ecosystems, from rivers and reservoirs to the pumps and pipes in our homes? * Give individuals and businesses timely insight into their own water use, raising awareness, locating inefficiencies and decreasing unnecessary demand?	* Monitoring, managing, and forecasting water-based challenges in Galway, Ireland, through an advanced sensor network and realtime date analysis, giving all stakeholders - from scientists to commercial fishing - up-to-date information
Business * Businesses must deal with unnecessary administrative burdens in some areas, while regulation lags behind in others	* Impose the highest standards on business activities, while improving business efficiency?	* Boosting public sector productivity, while simplifying processes for business in Dubai through a Single Window System that simplifies and integrates delivery and procedures across a range of almost 100 public services
Energy * Insecure and unsustainable energy sources	* Allow consumers to send price signals - and energy - back to the market, smoothing consumption and lowering usage?	* Giving households access to live energy prices and adjust their use accordingly, as in a Seattle-based trial, reducing stress on the grid by up to 15% and energy bills by 10% on average

Smart cities begin with a more hypothetical concept. Then models are to analyze how the cities operate in the digital world versus actual. Community participation is emphasized, and very necessary to assist with the development of simulations, with an understanding that citizen feedback is needed to understand the environment that planners are attempting to model.

IMPLEMENTATION PHASE

Implementation is the component which is studied when planners attempt to understand the planning process for previous strategies. Batty et. al (2012) listed four mechanisms that are utilized throughout this phase of the process: firms and organizations, the individuals who would be affected by the planning process; urban governance, the scales of time and size that will define smart city projects; open data sources, the spatial information available to the public; and new simulation models, the digital systems by which the data is processed (500). The implementation phase shifts its strategies from research to projects. The project aspect involves settling on a topic and establishing a date by which certain metrics will be met.

An example of a smart city project is the integration of databases. The implementation phase would involve determining which companies have the required datasets and then establishing a connection between these organizations. Modeling travel behavior is another sample project. This process would involve determining the large-and-small scale behaviors of commuters. Implementing a smart city plan requires that planners understand which individuals and organizations have interest in the selected project.

MANAGING PLANNING PROCESSES OF A SMART CITY

Decision-makers must understand the stakeholders and simulation tools that are available throughout the process, as well as the different forms of expertise that planners bring to the table. The smart city process contains an assortment of tasks which will need to be distributed to the experts on the topics of databases, street design, environmental planning, building design, and other subjects.

Geodesign is defined as a way to incorporate geography into the structure of a project which enables collaboration between geographic scientists and design professionals. This provides insight from both, who can determine the necessary scale and size needed for a project. Carl Steinitz (2012) in his book, A Framework for Geodesign: Changing Geography by Design, notes four groups of people who play critical roles in these assignments: local stakeholders, residents with interest in the project who provide information and context about their needs and who determine the project's location; geographers who provide context as to the physical layout of the study area and explain how receptive the land is for the development; design professionals consist of architects, planners, landscape architects, and civil engineers who focus on the buildings themselves and ensure that the structure of proposed projects is feasible; and technologists who use simulations to provide analyses typically through the scales of local, regional, and global (4).

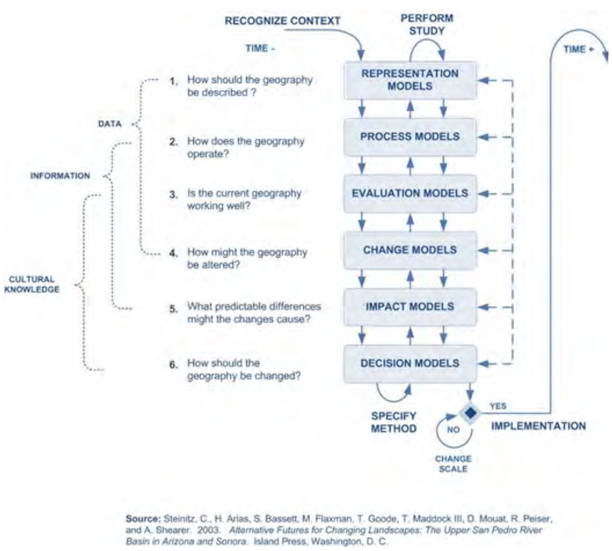
There is often overlap between these groups during the planning process, as evidenced by geographical scientists frequently using simulations to provide information about their selected environment. Simulations are also used to provide insight into the potential situations of the future. The differences between the geographic sciences and technology can be attributed to conflicts of theory. These differences are evident in the viewpoints about the size and scale of projects. Design professionals tend to view projects starting from the smaller scale, as their preference is that larger projects tend to require more complex and unmanageable designs. Their intention is to view things on an increasing scale. Geographers are of the opposite opinion. Their belief is that analysis should begin on the larger scale to understand the larger issues and work down to the smaller scale. Another major difference between these groups is that design professionals focus on understanding general issues about a study area, while geodesigners tend to specialize themselves toward a specific topic during a specific time period. Culture and objectives are other major differences between these two groups, as planners will have different priorities in the process of designing a smart city and what values they hold. Land use is a commonly debated subject. Planners question whether certain land-use strategies should be applied on a universal scale or a limited basis. The inclusion of individuals is another value example. Some planners believe that the process should be limited to selected stakeholders, while others believe that there should be greater inclusion.

FRAMEWORK AND ITERATION OF PLANNING PROCESS

The process for developing smart city relies on the use of six different models: representation, process, evaluation, change, impact, and decision. These represent questions about a proposed study area of interest: its description, its function, how well it currently works, how the area can be changed, the implications for its change, and how the change should occur.

Steinitz's (2012) framework for a smart city asks those questions in three iterations to accomplish different tasks relative to the study area. The first focuses on the context and scope of potential work. During this phase, planners are getting a better understanding of the nature of study area as well as the proposed level of project. Steinitz frames these as the "WHY" questions: explaining the problems, opportunities and limitations, while noting the scale of the potential changes and the potential impacts of these suggestions (26-27). Representation models are used to define the study area and how it should be defined relative to its geography and history. Process models explain an area's economic growth, social productivity, the study area's connectivity to other locations. Evaluation models define the area's relative attractiveness, economic situation, and the current problems facing the area. Change models forecast the expected shifts in the area and whether they are the results of expansions or recessions. Impact models measure whether these changes are beneficial, as well as their magnitude. Decision models explain the main purpose for the study, identify the stakeholders and note limitations that guide the activities of the geodesign area.

The second iteration addresses the "HOW" questions and focuses on the methods of study for a proposed project (28-29). For this phase, the six questions are asked in reverse order. The first is about how the decisions will be made and by whom. The model determines what information is needed to answer this question, as well as the process by which projects are evaluated. The impact models are used in the next part and ask what changes the most importance and the extent of complexity have required by the initial impact assessment. Change models determine the assumptions and requirements for change, and the selected scenarios with their related time scales, which involves design and/or simulations. The evaluation model determines metrics of the project, such as politics or the environment. The process determine which models should be included, how complex they should be, and the scale by which they should operate. The representation question asks about the location and boundaries of the study area along with the necessary data. This iteration develops the project's methodology, drawing upon the experience and judgment of the geodesign team. Other necessary questions to ask: ones regarding the participation of local residents, the trade-offs between inaction and results, and the expected costs for the project.



Iterations for a Smart City Planning Process

Steinitz's (2012) third iteration focuses on the "WHAT, WHEN, and WHERE" questions, during the implementation phase (30-31). The framework for this iteration is a top-to-bottom process that focuses on concerns about identifying and gathering data. Organization of the information is another important aspect to this iteration as a means for developing existing baselines which study the current area and future changes that could occur in the area. The designs should account for future alternatives and assess their potential impacts. Representation models are used to obtain the data and organize it according to proper technology and over the course of space and time. Process models are implemented, calibrated, and tested. The evaluation models visualize past and present conditions. Change models propose and represent future changes. Impact models assess and compare the impacts of each change model, while the decision model compares the impact models and determines whether a proposal is feasible. The framework is not limited to the three iterations. Professionals can use alterations of these strategies if they are tailored to the current needs of a planning project.

One example that utilized the framework was the '67-'68 Boston planning studio, in which Carl Steinitz participated. Steinitz (2012) stated that the objective was to model conflicts of environmental quality for the southwestern Boston metro area, the potential attractiveness of land in this location, and to measure urban growth potential. Initial diagrams were designed based on an understanding of the decision-making process and contained land-use demands and an attractiveness evaluation. The flow of information analysis began with the decision model and worked through the other five models (13-14).

CURRENT WORK ACCOMPLISHED BY THE STUDIO

The Studio's currently work on Shinagawa should be viewed from the following perspectives: three phases that are expected to be completed by 2027, 2037, and 2057, respectively; four sites labeled A , B, C, and D that address the respective issues of gateway design, urban retrofitting, live/work/play, and self-sustained cities; design layouts of the four sites that include floor area ratio (FAR), building coverage ratio (BCR), percentages of land by zoning type, as well as proposed additions of greenspace, buildings, and roads to each site; groups that were designated to address mobility, flooding, and building design; and the evaluation criteria for Smart Cities - responsive and resilient, green, data-driven, connective, and inclusive, along with their associated metrics.

The objective of the master plan is to revamp Shinagawa into a Smart City and to understand how the process can be adjusted for potential future proposals. The proposals include the development of additional transit lines, along with the converting vehicles to AVs. Road alterations are included in this plan to accommodate the new transit lines and greenspace infrastructure. The phases are the first important component, given that they explain which policy objective the studio is emphasizing for a selected year. Each phase describes its objective and the expected changes that the studio expects for Shinagawa: phase one accounts for an increase in the number of travelers and demand for available housing and office space; phase two anticipates Shinagawa Station to reach 70 million passengers by 2037; and phase three expects Tokyo Bay to be facing massive sea level rise exacerbated by a decline in the quality of green infrastructure.

The phases also contain policies that will be implemented during their time periods which address the issues that define the subsections of this studio: design, mobility, and water. Phase one's design section focuses on redeveloping Sites A, B, and C to account for the growth in offices, retail, and residences in proximity to the new train route. Its mobility component contains congestion pricing and pedestrian bridges and its section on water promotes the development of a pocket park network and prototype green streets that support AV infrastructure. The first phase also begins the implementation of a pilot program for a bus system, while completing the basic infrastructure for Site D. Phase Two shifts the focus towards the redevelopment of Site D, while placing a larger emphasis on mobility and water-related issues. This section is designed to accommodate the expected 70 million passengers by 2037 with proposals that emphasize the development of green streets and AV networks. The objective is to reduce the amount of land needed for transportation networks to enable the development of green infrastructure. Phase three highlights the studio's long-term goals for the year 2057. The intentions of these plans are the full automation of vehicles and the development of a major dam that provides resistance to two meters of sea level rise.

PLANNING PROCESS OF THE STUDIO

An important aspect of the project to understand is that it could be modified for future efforts. The evaluation of these strategies involves a comparison of the studio's management of a planning process along with how it handled policy, planning, and implementation to the tactics employed by the Smart City and Geodesign articles while retracing the steps that were taken throughout the planning process to produce their current plan.

Groups were divided according to site and coordinated with the efforts of the students from Georgia Tech's Urban Ecology Course. The ecology course also had its tasks divided according to the four sites and the objective of designing a master plan. The Tokyo Studio was divided into three categories: performance goals and evaluation; mobility; and urban form/ water/energy.

The policy aspect served as the foundation from which the planning and implementation phases evolved. The proposals focus on mobility (transportation specialists), water-related issues (environmental planners), and building design (architects). Initially, members were given maps of Shinagawa to create conceptual sketches of their desired reforms for the city, which were expanded into covering small, medium, and large levels of city design. Group members next developed an understanding of the framework of smart cities and the urban design process. More conceptual sketches were created that entailed an increased reliance on digital tools for performance modeling. Architects used Grasshopper and Rhino to design buildings and the mobility group used ArcMap for their analyses on travel behavior and mobility. Phase Three involved adjusting portions of the project until they were ready for the Midterm.

POLICY, PLANNING, AND IMPLEMENTATION

The studio began its efforts with a focus on the policy reforms necessary for Shinagawa, utilizing conceptual sketches as the means for analyses. The next step encompassed the planning process for this studio, which involved determining the criteria for how Shinagawa should be analyzed regarding the five LEED categories. This phase divided tasks according to the three group topics: performance goals and evaluation; mobility; and urban form/ water/energy. The implementation phase involved establishing the reforms for the selected years and determining in what increments the policies of vehicle automation and green infrastructure would be enacted.

Batty et al.'s (2012) analysis of the three phases are structured in a similar manner.

His policies are found in the vision, goals of research, and key themes sections. The last lays out the policies that identify an area as a smart city, while contrasting those objectives with the efforts that are currently underway for those areas (483-485). The planning section begins which strategies should be taken to enact reforms on data collection and increase citizen participation (496). The implementation phase is also similar given that Batty et al.'s recommendations also involve utilizing urban simulation systems to present analyses on traffic behavior (510).

MANAGEMENT OF PLANNING PROCESS

As Steinitz suggests, the studio's process contained three iterations of questions which helped provide necessary information about Shinagawa and its project. The studio utilized these models to progress through the planning process: demographic information for the representation model, building energy design for process models, and conceptual sketches as the evaluation models and change models. This studio did not utilize impact or decision models, because the proposed changes had not yet gone into effect.

PLANNED REVISIONS

The outbreak of the Coronavirus poses potential complications to this project, due to expected "anti-urbanism" arguments. Social distancing could possibly become a common feature for some areas, which could hinder the productivity of cities. Urban residents may be more inclined to substitute walking for car-based travel and public transit. Adjusting to this potential paradigm shift will be a critical factor for the continued development of Shinagawa as a smart city.

PERFORMANCE METRICS

Willie M Bolden

OVERVIEW

This study takes a look at ways to measure and quantify metrics to establish the baseline and projected progress towards sustainability and resiliency using internationally established frameworks that define and measure Smart City development. The methods used to evaluate the project were indices from L.E.E.D. ND version 4, published by the U. S. Green Building Council (2016), The Smart City Framework, published by the British Standards Institute (2014), CASBEE for Cities, published by the Institute for Building and Environment and Energy Conservation (2014), and the Ecological Urbanism Certification with Sustainability Criteria, published by the Barcelona Urban Ecology Agency (2012).

Using these combined indicators, metrics were developed for the purpose of gauging progression towards the attainment of Smart City certification using five discrete values that define our collective vision of a Smart city. The five values framing our design process include: Green, Data Driven, Connected, Responsive and Resilient, and Inclusive.

During our initial visioning process, we defined our values using shared nomenclature that encompassed a spectrum of Smart City goals designed to benchmark targets towards 10-year increments using the current state as a base. From here, we projected for years 2027 and 2037 to align with our 70/70 vision of 70 million people with access to regional destinations within 70 minutes of the Shinagawa rail station.

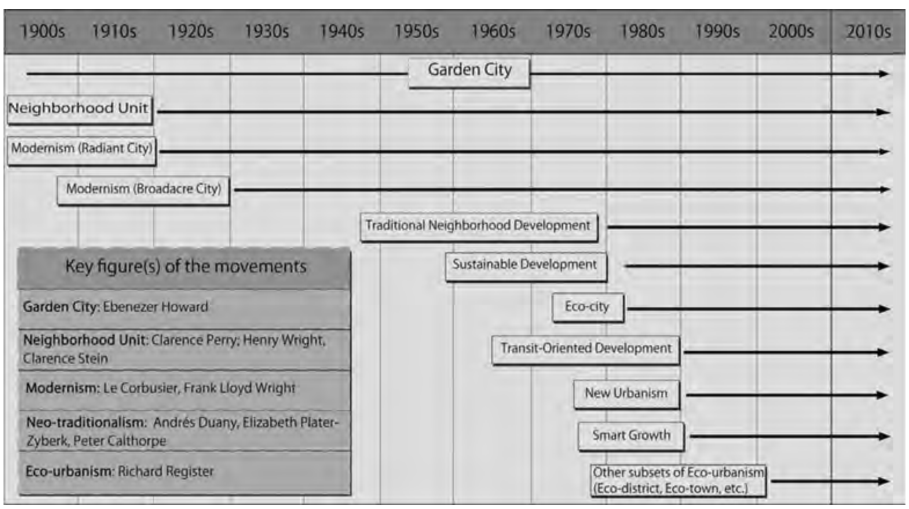
This informed much of our design and measurement goals. This new increased access will create important demographic shifts and demands on the natural, built and social environments for which we developed the urban design plan and programming.

Due to the unforeseen circumstances of the pandemic Coronavirus, much of our process pivoted to available data and urban form resources accessible online via open source platforms including GIS, the Japan statistics bureau home page, world population review and others. In addition to these, we were provided with additional demographic data courtesy of our Japan cohort. The pandemic mandated quarantine impacted our ability to experience the critical vision of place to determine the texture and nuances of the site designed for. This mitigated our ability to contextualize unique place-based characteristics and caused a shift in design modeling to focus on accessible virtual features and typologies without the benefit of distinct evaluation, site interpretation and cultural immersion.

To structure the evaluative strategy, framework and tool a literature review was conducted to ascertain a historical and contemporary context of Japanese and international evaluation and measurement best-practices methods for developing smart urban environments and projects. Highlights from this study revealed a broad but interconnected array of frameworks which all interpret and validate regional priorities, imperatives and goals steeped in four broad spheres of development. These are created using a dynamic web of big data analysis and the IoT to iteratively inform the intersection of economic, environmental, structural, and social programming and development towards realizing sustainable, responsive and resilient regions, cities, communities, neighborhoods and households.

Each framework posits that it is critical to incorporate a regional and global lens in developing metrics and indices to ensure the fluency and shared nomenclature required for global accountability and action towards operationalizing shared common goals. Thus, the most utilized frameworks have international components that are easily translatable and immersible at a local level across the globe. As Sharifi demonstrates, Smart growth has been a framework for planning since the early 1990s and Eco urbanism since the early 21st century.

As metrics and indicators evolve, a hierarchy ensues that embraces more elements and measurements towards a more holistic framework as depicted in Figure 1.



The evolving agenda and key figures of the studied movements (inspired by Fig. 1.8 of Wheeler (2004)).

CERTIFICATION: THE GLOBAL FRAMEWORK

Ecological Urbanism with Sustainability Criteria: One of the most widely used comprehensive frameworks for global certification is the Ecological Urbanism Certification with Sustainability Criteria. This certification at its core attempts to decouple economic growth from “metabolic fluxes” and center on de-materializing the economy with a decided focus on quality of life indicators, environmental sustainability and the built environment. Major incentives are located in metrics defined by diversity, housing and jobs, and citizen quality of life which demonstrates a strong emphasis on social components. This is a marked shift from the CASBEE for Cities certification which was initially developed with a major focus on environmental stewardship. This certification uses environmental load and quality of life indicators as a quantifiable binary framework with some metrics augmented with qualitative points. L.E.E.D. ND certification has a leading focus on the built environment awarding structural processes incorporating green building inputs with major points.

However, over the years, all the major certification frameworks have progressively increased their focus on the social quality of life metrics to balance the imperatives of the 21st century namely exponential population growth in urban environments, an aging demographic globally and climate change.

THE SMART CITY FRAMEWORK

In 2014, the British Standards Institute published the Smart City Framework with the goal of integrating advanced data-led decision making to develop greener, more equitable, sustainable and resilient communities. This framework aggregates data to inform impacts and pivots in the built, natural, economic and social environments. The approach has gained universal acceptance and is widely used to structure certifiably sustainable projects and communities. In its evolving iteration, the Smart City framework is rapidly evolving into a more globally responsive framework entitled CityKEYS which places a heavy emphasis on the 4 Ps of people first, planet second, prosperity third, governance fourth and propagation fifth thus expanding the goals of the measurement to be more socially comprehensive. This rubric offers keen insight into the direction performance measurement is advancing in this modern era.

The dramatic shifts and turns brought about by climate change in highly urbanized areas has highlighted the need for resiliency as an equally needed measure to define and undergird sustainability. Access to advanced data analysis and technologies, ICT infrastructure, IoT and machine learning has opened the window for cities to leverage their current resources towards mitigating and planning for disruptions and crises in the environmental, economic and social sectors due to climate change.

Water and energy management have emerged as critical sectors requiring vigilante monitoring and assessment. While cities and urban spaces seek to decrease the carbon footprint efforts are also being made to adapt and identify more ways to mitigate the current crisis. Certifying organizations are keenly aware of the need to iteratively incorporate metrics and measures into their frameworks that integrate and “talk to” mega platforms such as Google earth, ESRI, National Geographic and others.

New nomenclature is also a hallmark of 21st century measurement frameworks. Words such as redundancy and or propagation (in this context system replication), fintech, blockchain, omni-channel integration, ICT, IoT, bioswales, bio sweeps, advanced data integration, etc. have entered the lexicon for communicating activities across global platforms as well as connecting diverse and unique peoples and places in this shared agenda.

CITYkeys performance measurement framework

SHINAGAWA SMART CITY INDICATORS AND SCORECARD

Each of the five categories measured represent 20% of the total score generated towards certification criteria. Our position is that each category individually accounts for resilient and sustainable development but collectively they add a synergistic value creating a sustainably responsive and resilient network. Each category selected for this scorecard benchmarks progress towards sustainability. This framework allows the development to be L.E.E.D. ND certified for projects as a vast majority of the indicators were derived from L.E.E.D ND. The main difference for indicator usage is the scoring and point rubric which was developed using minimum and desired outcomes. The most original scoring metrics are evident in the Inclusive category which was based upon a combination of current best practices for urban development inclusive indications.

Included with this assessment and review is a rubric for a scorecard that should be used to benchmark and track resilience and sustainability goals as outlined. Constraints among various categories prevented the actual measurements from being completed. However, this scorecard rubric incorporates the five discrete categories to be used for measurement and tracking over the current, 2027, and 2037 period. While the goal is to plan for the next 30 years, we start where we are with design and programming principles we believe can be accomplished within the next decade.

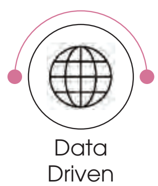
Responsive and Resilient

Category I Responsive and Resilient (20% of total score): This category measures 3 distinct metrics for water and storm runoff protections using the 500 year storm event and sea level rise specifically. Indicators include:

- Rainfall runoff from 500 year storm event (treated on site)
- Sea level rise resilient to 500 year sea level rise (based upon current sea level rise projections)
- Buildings designed or retrofitted with green roofs to treat a percentage of rainfall runoff (first floors can be water-proofed)

Category II Green (20% of total score): This category measures 6 distinct metrics for water, energy and design indicators measuring usage demand parameters and infill site development. Indicators include:

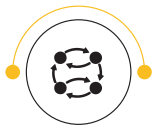
- Water metabolism balance
- Energy metabolism balance
- Low-impact development for stormwater management
- Infill site was previously developed
- Site design incorporates green rooftops
- Site design includes a minimum of twenty-five percent tree canopy coverage



Category III Data Driven (20% of total score): This category measures 8 distinct metrics for systems integration, data tracking and capture analytics, technology platforms and design matrices. Indicators include:

- Balance in usage between activity and residence zones
- Infrastructure and communications services are adaptable to future service fa-

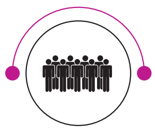
cilities
- Data capture systems translate into measurable analytics
- Data is accessible for IoT infrastructure and modeling
- Site employs a flood sensor network using industrial IoT applications
- Site employs ICT standards for a Smart City
- Data systems are used to inform mobility, energy and service sector usage
- A data platform exits that is accessible to the public



Connected

Category IV Connected (20% of total score): This category measures 10 distinct metrics for travel mode split, proximity and design parameters. Indicators include:

- Proximity to transit networks as an alternative to auto use
- Road space for pedestrians
- Mode split
- Densely designed parking infrastructure
- Proximity to bike parking
- Number of intersections per square kilometer
- Buildings are within a 5 minutes' walk to 5 amenities
- Residential buildings are within a 5 minutes' walk to public transit
- Miles of bike infrastructure
- Maximum pedestrian network block length of 182 meters



Inclusive

Category V Inclusive (20% of total score): This category measures 9 distinct metrics for the degree, percentage, presence or absence of diverse and inclusive socio-demographic and design characteristics. Indicators include:

- Measure urban diversity using the urban diversity index; community offers diverse and varied uses and amenities
- Absolute compactness based upon total compactness/density per parcel
- Adaptability of green space for distancing (current Covid 19 environment) or public gathering as measured by total greenspace and public space available on parcel
- Minimum of thirty percent of residential development accommodates households on fixed incomes
- Percentage of employers within a twenty minutes' walk of a minimum 30% dwelling units
- Percentage of site design incorporating flexible structures for emergency shelter
- Minimum forty percent of project site has a senior amenity within 5 minutes' walking distance
- Minimum twenty-five percent of site offers affordable child care within a five minute's walking distance
- Minimum thirty percent of affordable housing within 10 minutes' walking distance to grade schools

CONCLUSION

This study revealed some important opportunities which should be given consideration. As climate change ensues and Shinagawa experiences growth, measures should be taken to ensure the safety and mitigation of island dwellers and workers. One of the ideas generated was to institute an amphibious bus terminal so that residents could be quickly evacuated in the event of a flood emergency. This would also open opportunities for educational programming, recreation and entertainment when the buses were not in use. More study would need to be done before developing a proposal as well as a more in-depth feasibility study which is beyond the scope of this project

With the senior population and the growing family population increasing, creating job opportunities on site within walkable distances will be even more prescient.

This amphibious bus programming would offer some employment economic development opportunities related to policy and planning, disaster management, environmental education and stewardship as well as add to the current area-wide disaster mitigation plan in place. It can undergird economic development activities with seniors and youth in roles that adapt smart technologies to support local initiatives towards the Japan 5.0 Society goals. This proposal aligns directly with Category I Responsive and Resilient programming.

Another opportunity this study exposed was the introduction of a new trend in sustainable development, labeled biomorphic urbanism. This design approach fuses natural and built elements into an urban architecture that has at its foundation a goal for development to share the planet at least equally with the natural habitat and eco-system. It eschews that idea that mere density or structural inputs can shift the environmental imbalance but that there should be a threshold that developers must not venture beyond—namely half of the space left to natural morphic adaptation without human incursions with the purpose of strengthening and restoring them to their natural habitat.

Taken together, these two trends encompass a broad intentional strategic blend of curated big data repositories, AI and advanced machine learning, and transdisciplinary collaboration to create distinct yet highly adaptable and intelligent ecosystems and forms. Many projects using this emergent design model take place although not exclusively in water-bounded urban spaces capitalizing upon the multiple benefits and opportunities urban waterfronts are inherently imbued with. Shinagawa's location, topography, demographic and geographical would surely benefit from some of these design programs.

Example of Smart Shinagawa Scorecard