KEY CHALLENGES AND ISSUES COMMONLY ENCOUNTERED IN WATER SUPPLY SYSTEMS

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23.8.2025

Content Outline

1. Introduction to a typical water supply system.
2. Classifications of water supply system
3. Common complaints in a water supply system
4. Key Challenges
5. Solutions
6. Lessons learned by me
7. Question and answer

Introduction To A Typical Water Supply System

Introduction to a typical water supply system.

Surface Water

- Water source
- Intake system
- Raw water collection tanks/ reservoirs
- Raw water intake pumps(optional)
- Water treatment plant
- Disinfection unit
- Clear water tank
- Clear water booster pumps(optional)
- Clear water transmission main(optional)
- Clear water collection and distribution tank
- Distribution main and distribution system
- Water meters and billing system
- Laboratory
- Customer complaint center
- Capacity building and training center
- Store
- Workshop

Ground Water

- Tube wells/ Radial collector wells
- Disinfection unit
- Clear water tank
- Clear water booster pumps(optional)
- Clear water transmission main(optional)
- Clear water collection and distribution tank
- Distribution main and distribution system
- Water meters and billing system
- Laboratory
- Customer complaint center
- Capacity building and training center
- Store
- Workshop

Classifications of water supply system

Classifications of water supply system

- we can classify water supply systems based on a spectrum of service levels that implicitly integrate affordability and reliability. This approach is more common in development and humanitarian contexts.
- Service Levels based on Affordability and Reliability
- This classification moves beyond just the technical design and focuses on the end-user experience. It's often used by organizations like the World Health Organization (WHO) and UNICEF.

key performance indicators or criteria used to evaluate and compare water supply systems

Reliability: This is a multifaceted concept that includes:

Tangible effects

Availability: Is water available when needed? (e.g., 24/7, for a specific period).

Continuity: Is the supply uninterrupted? (e.g., how often do pipe breaks or power outages happen, infrastructure failure).

Quality: Is the water safe to drink? (e.g., is it free from contaminants).

Resilience: Can the system withstand shocks like droughts, floods, or mechanical failures? (e.g., does it have backup sources or storage, The system is well-maintained, with quick repairs for outages.).

Technology: Water 4.0, Residual pressure, Billing system is very easy to pay, Notification system

Intangible effects

intangible effects like brand loyalty or customer satisfaction are subjective and often rely on qualitative feedback, surveys, or observational data.

key performance indicators or criteria used to evaluate and compare water supply systems

Intangible effects

customer satisfaction index: The Customer Satisfaction Index (CSI) is a metric that quantifies the level of satisfaction customers have with a product, service, or overall experience with a company. It's a valuable tool for businesses to understand how well they are meeting customer needs and expectations.

The CSI is typically calculated by gathering customer feedback, most often through surveys. These surveys ask customers to rate their satisfaction on various aspects of their experience, such as:

Product or service quality: How well the product or service performs.

Customer service: The helpfulness and responsiveness of the support team.

Value for money: The perceived quality and benefits in relation to the price.

Overall experience: A general rating of their satisfaction with the company.

The responses are usually collected using a rating scale, like a 1-to-5 or 1-to-10 scale, where a higher score indicates greater satisfaction.

key performance indicators or criteria used to evaluate and compare water supply systems

Affordability: This is typically measured in relation to household income.

- **Direct Costs:** Connection fees, monthly bills (tariffs), and charges for water from vendors.
- **Indirect Costs:** While the unit cost may be low, the overall cost, including the time and effort to collect water, can be a burden, and the cost of health care for waterborne illnesses.

Financial recovery

ISO 24510

Common complaints in a water supply system

Common complaints in a water supply system

- Water shortage
- Intermittence supply system and short time supply
- Don't get water regularly due to well pumps and booster pump failure or pipeline failure
- Don't get water regularly due to power cut(system breakdown, line fault, bad weather, bluster)
- Water meter is blocked by debris or trash or sediments or aquatic live or scale
- Residual pressure weak, therefore need assistance of suction pump
- Poor water quality (Water has bad smell, Colour is turbid and brown or black or yellowish, aquatic organisms are found in tap water)

KEY CHALLENGES

KEY CHALLENGES

- Water shortage, inadequate water due to intermittent supply system
- Aging/ poor infrastructure
- NRW high
- Insufficient water resources
- Budget limitations
- Poor water quality to use or drink directly
- Financials Deficit
- High power consumption

Reason for the challenges in water supply systems

- The challenges faced in water supply systems are diverse and ever changing. They vary significantly based on a range of interconnected factors, including

  Geographical location and accessibility of sustainable water sources

  Topographical and geographical diversity

  Underlying Geological Formation

  Climatic and weather variability

  Awareness and mindset development of key stakeholders

  Socioeconomic conditions of the target population

  Perceived value of water and the community's willingness to pay

  Effectiveness of government governance and institutional policies

  Organizational capacity and operational Structure

  Rapid Population growth, urban expansion and migration trends

Reason for the challenges in water supply systems by nature

Geographical location and accessibility of sustainable water sources

- Firstly, It is very important to be sustainable water sources.
- Second, If you have a chance to choose a good one among water sources, you should choose good quality water source and then
- Third, you should choose a source that is located higher than city

Reason for the challenges in water supply systems by human

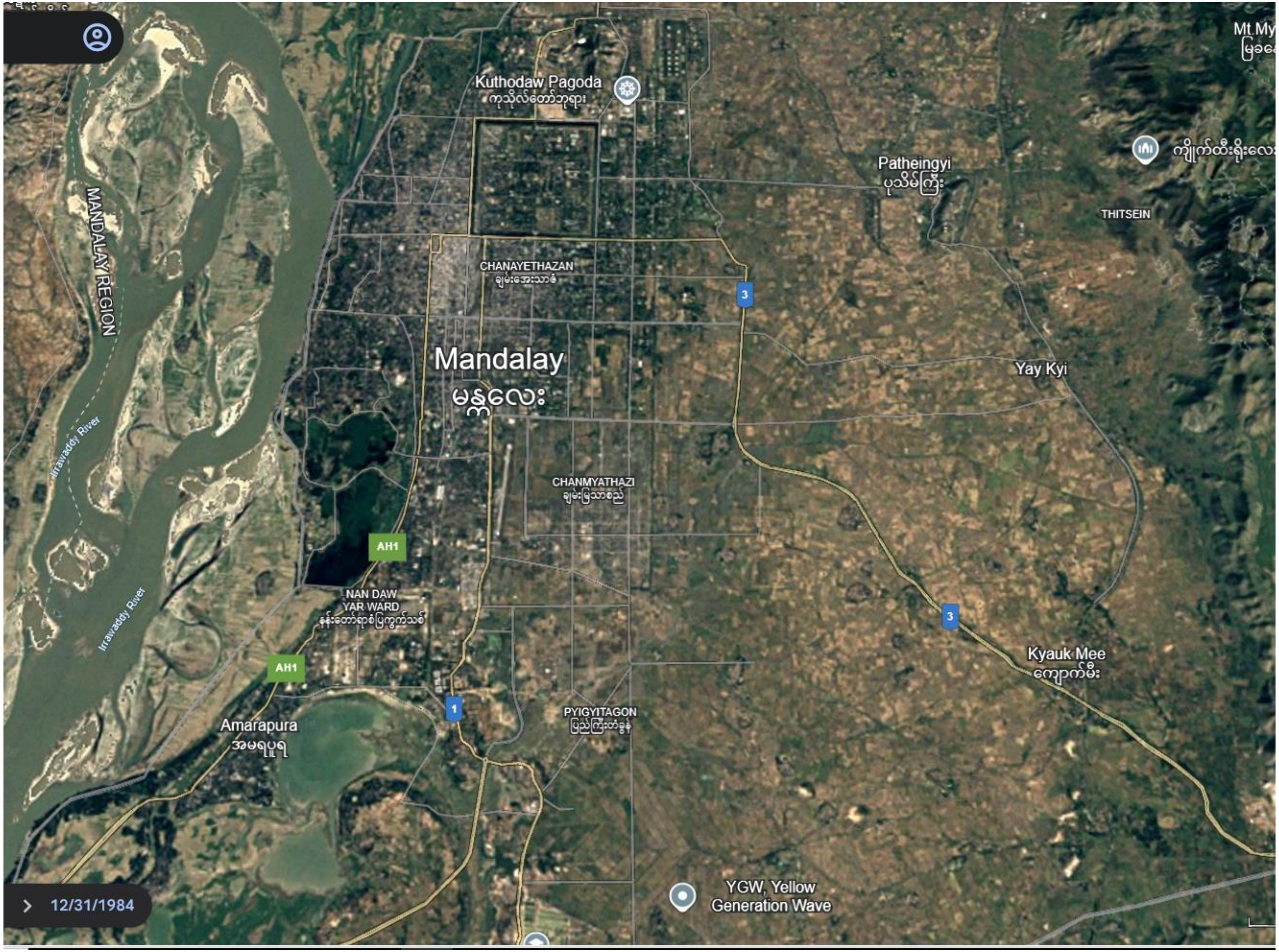
- **Awareness and mindset development of key stakeholders**
- **Socioeconomic conditions of the target population**
- **Perceived value of water and the community's willingness to pay**
- Effectiveness of government governance and institutional policies
- Organizational capacity and operational Structure

Rapid Population growth, urban expansion and migration trends

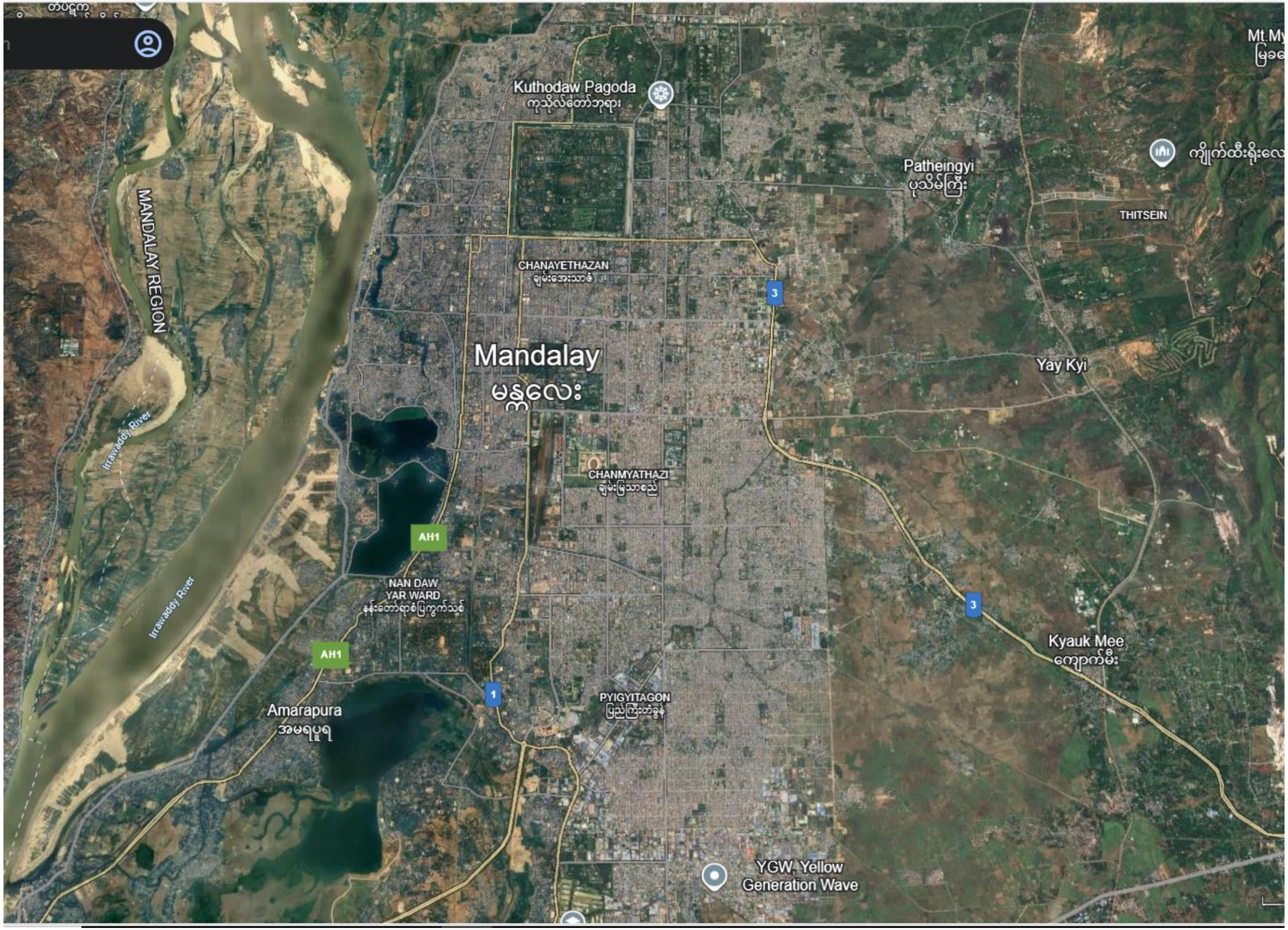
Rapid population growth can increase the daily water demand of a water supply system

- Master plan of water supply system
- Detail design of water supply system
- Network design simulation
- Water resources management, Water resources development

MANDALAY CITY



MANDALAY CITY



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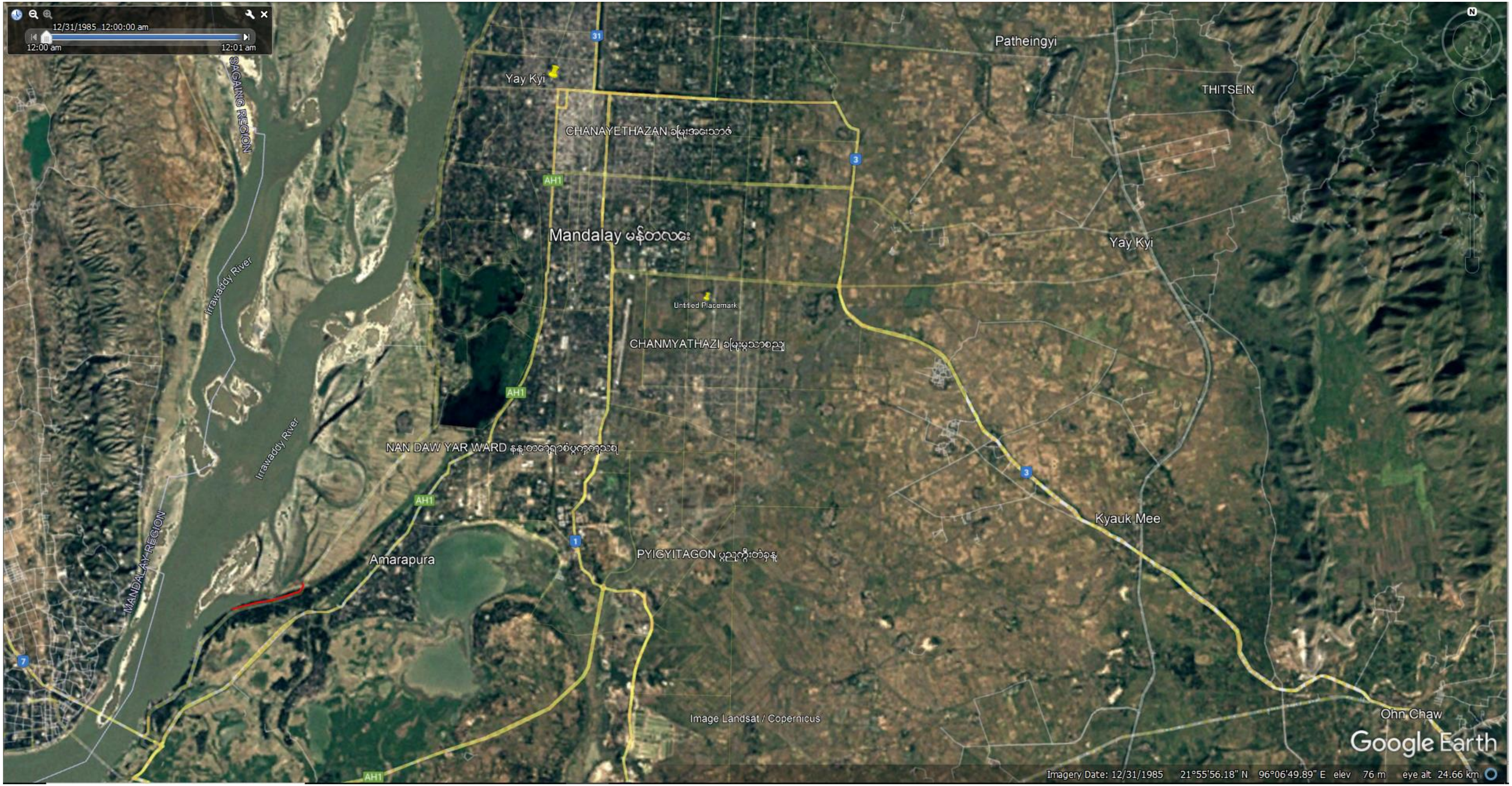

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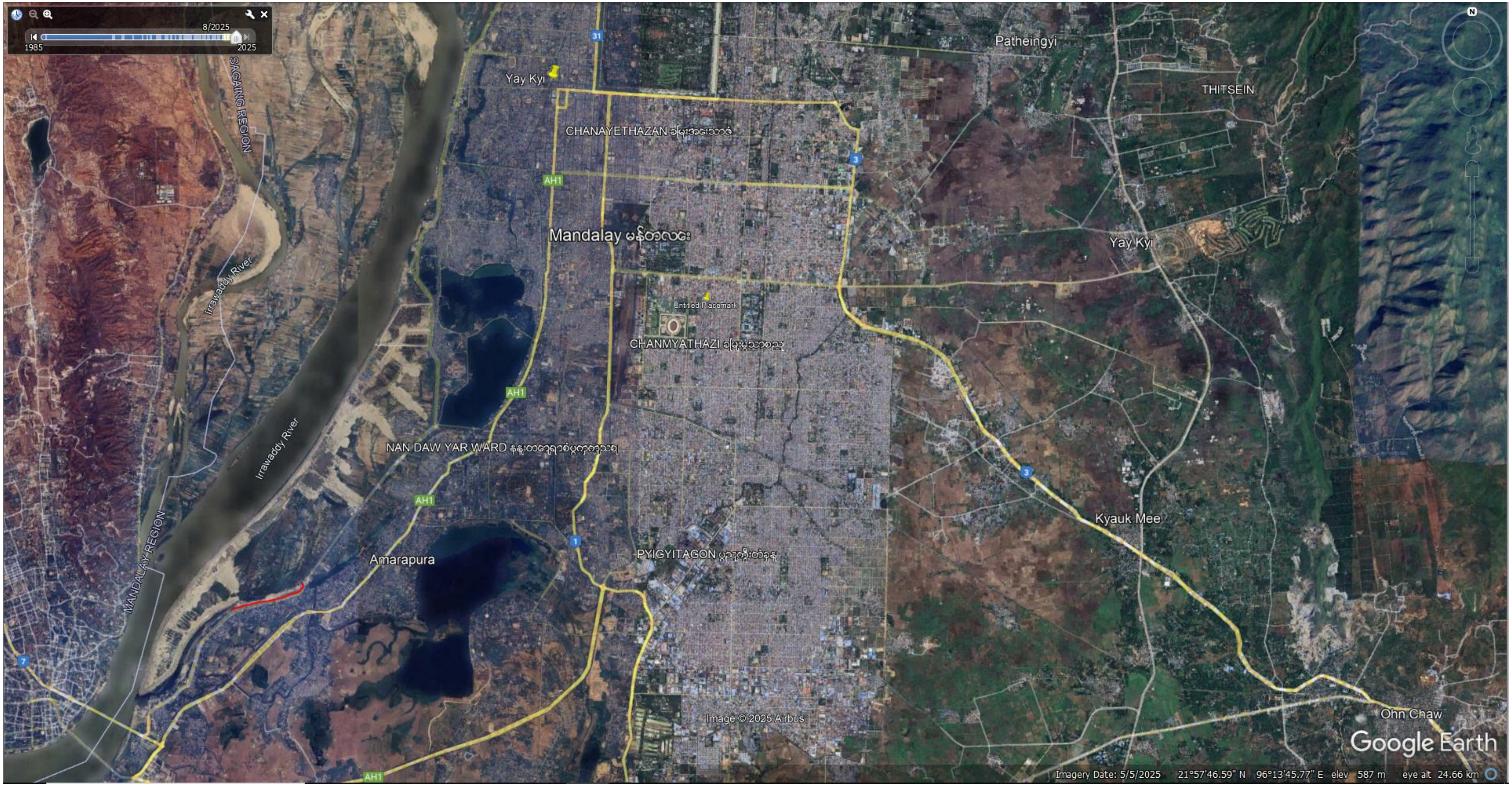

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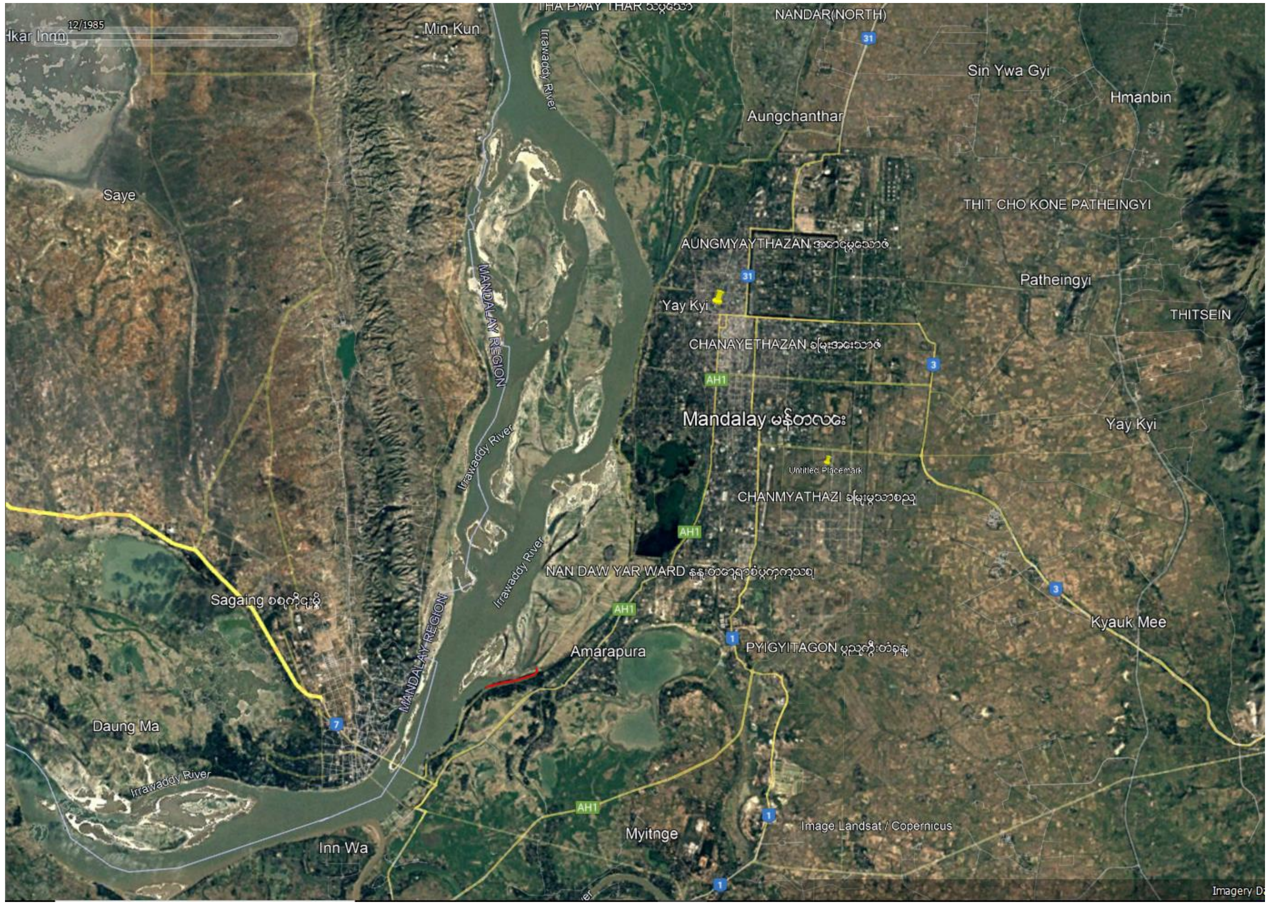
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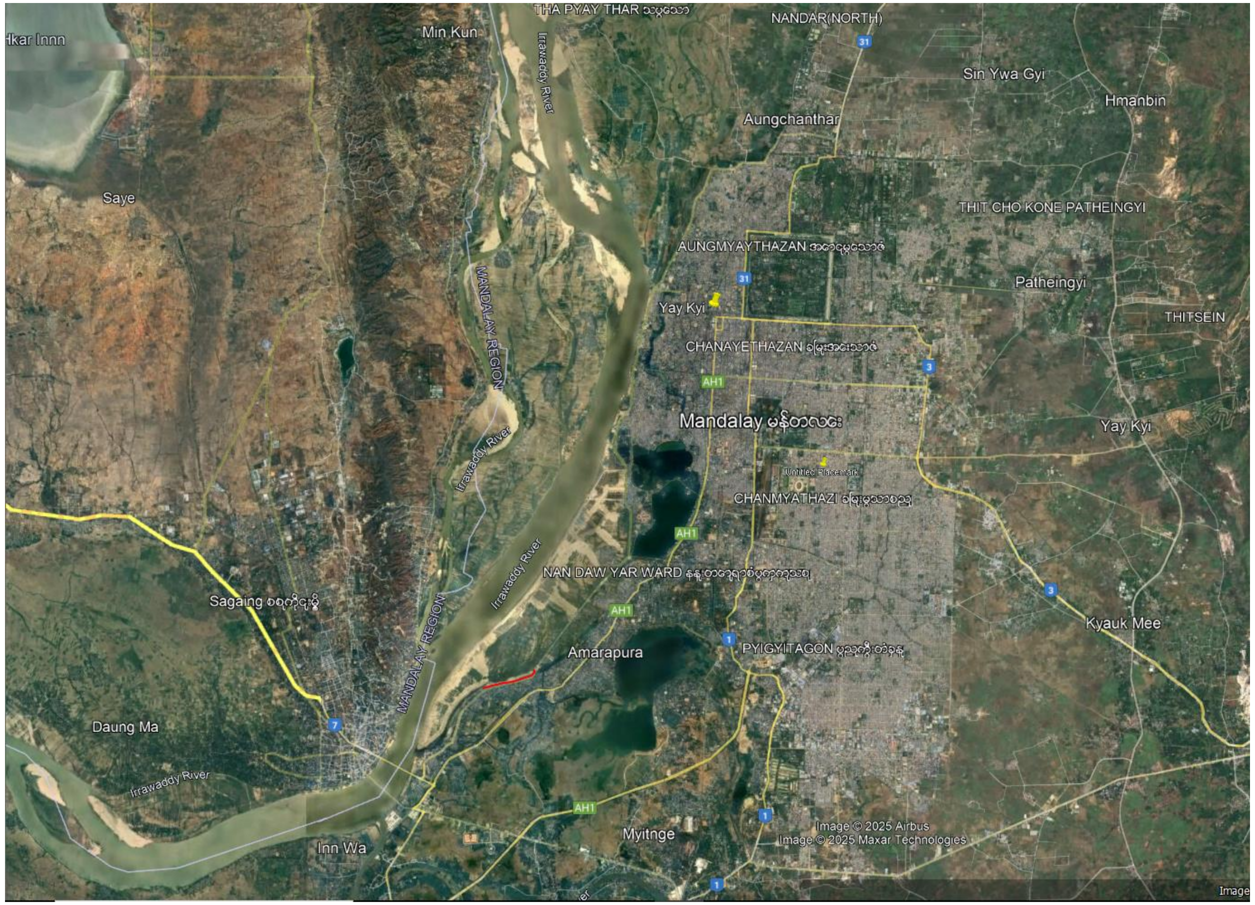
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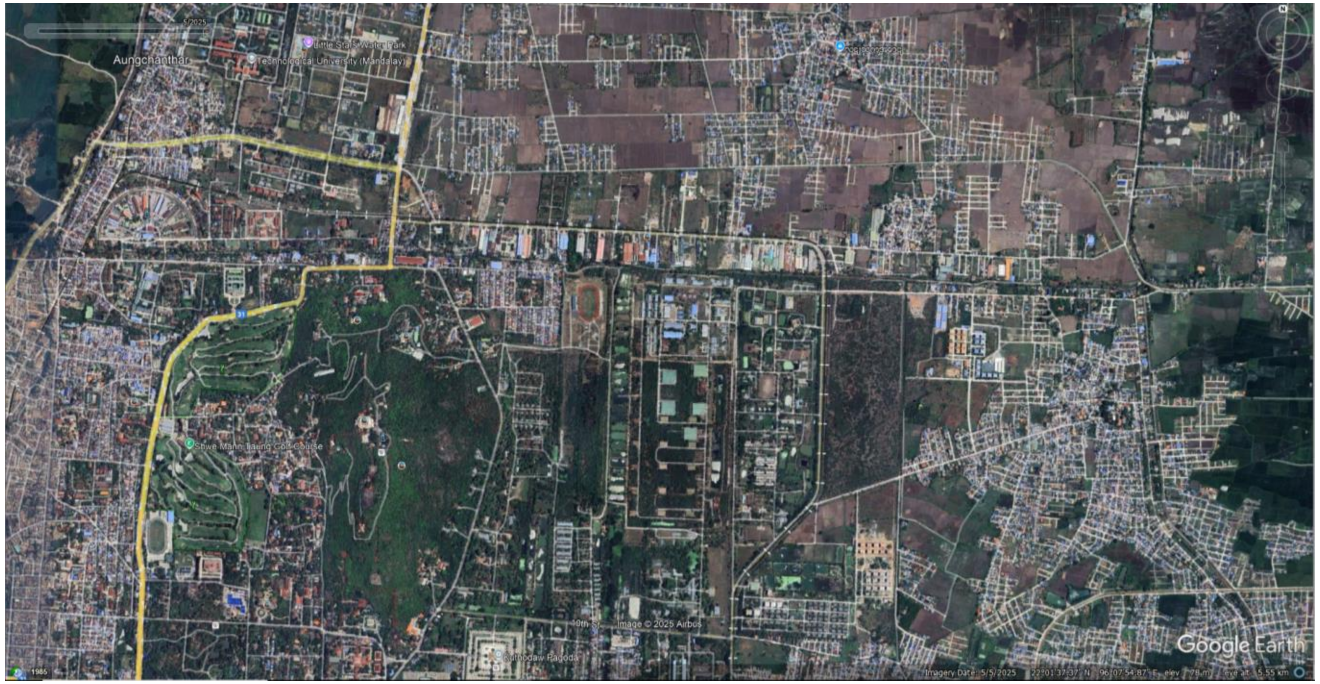
Eastern Site of Mandalay Hill



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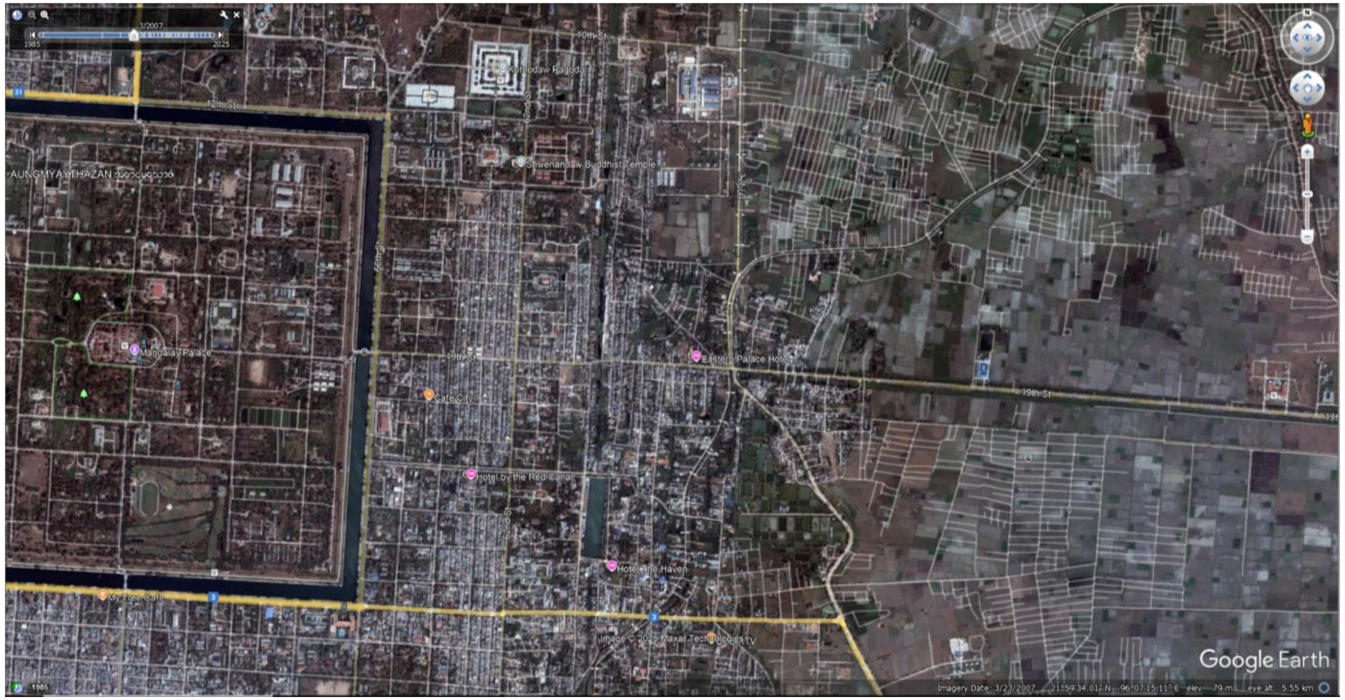

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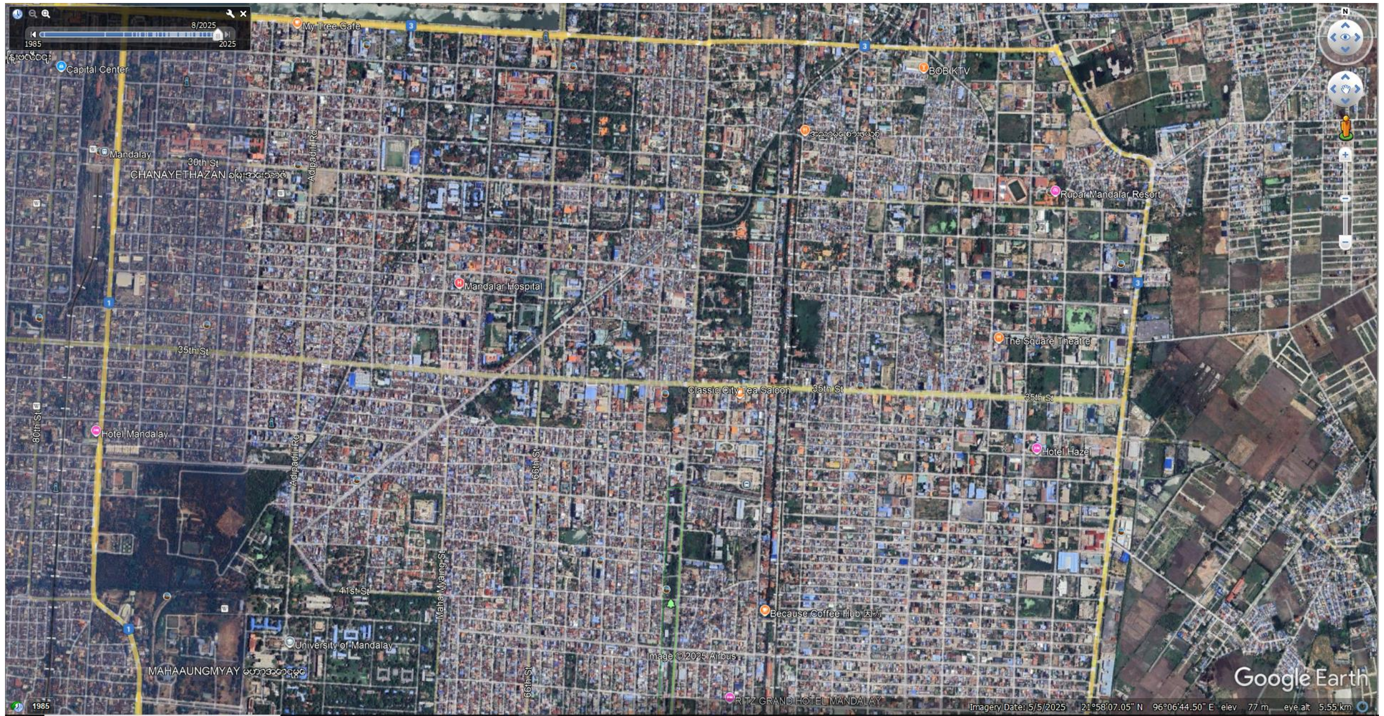


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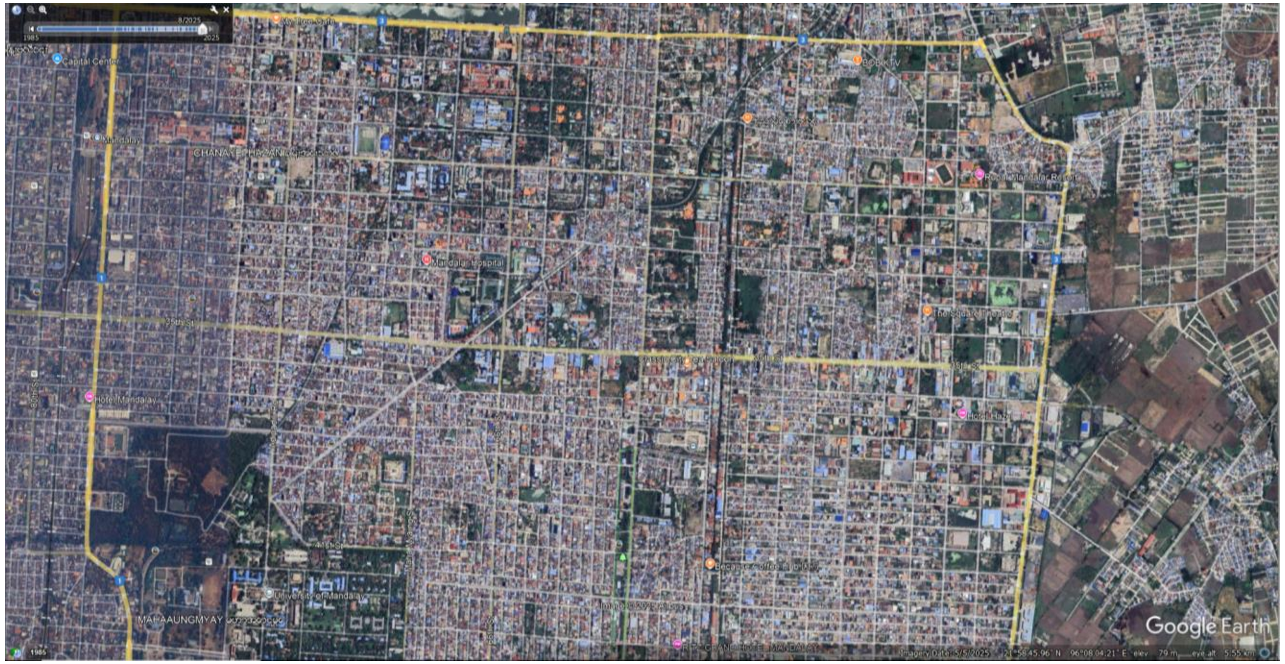
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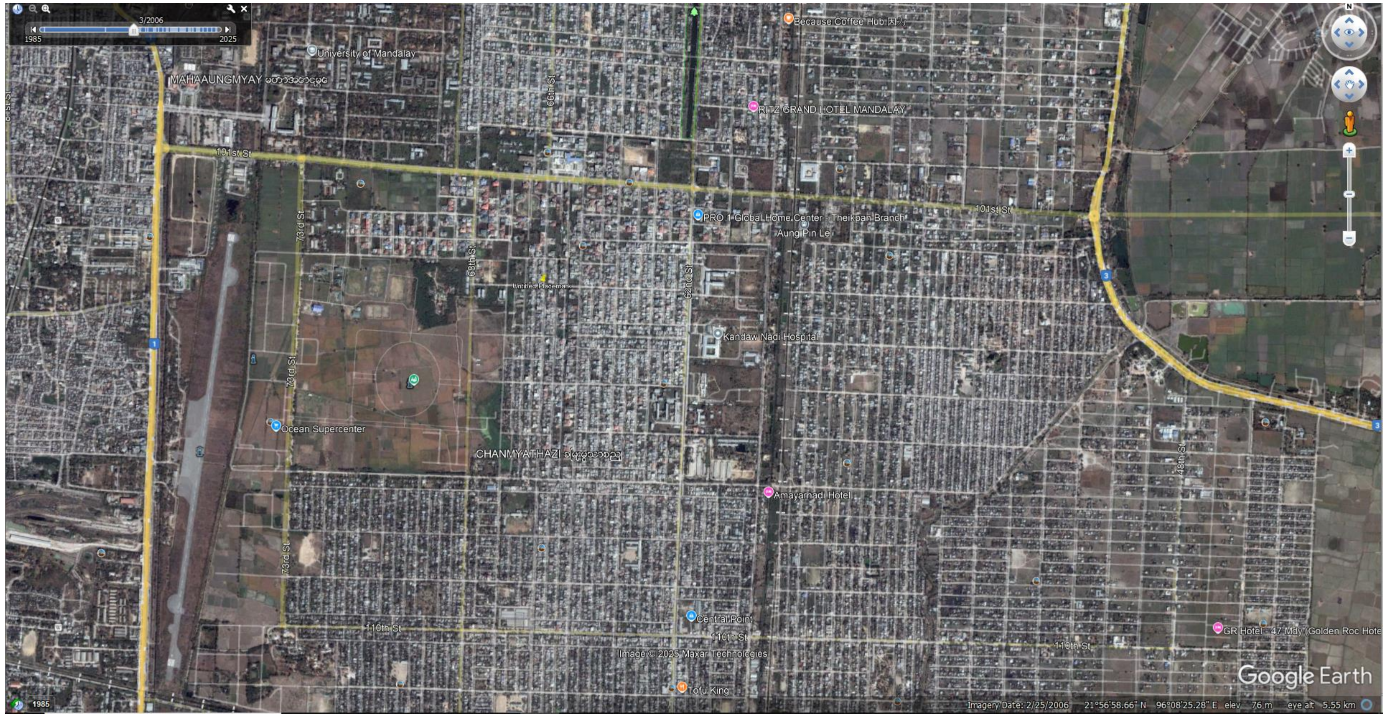

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PRO 1 Global Home Center - Theikpan Branch
Aung Pin Le
Kandaw Nadi Hospital
Ocean Supercenter
CHANMYATHAZI
Amayarnadi Hotel
Central Point
Tofu King
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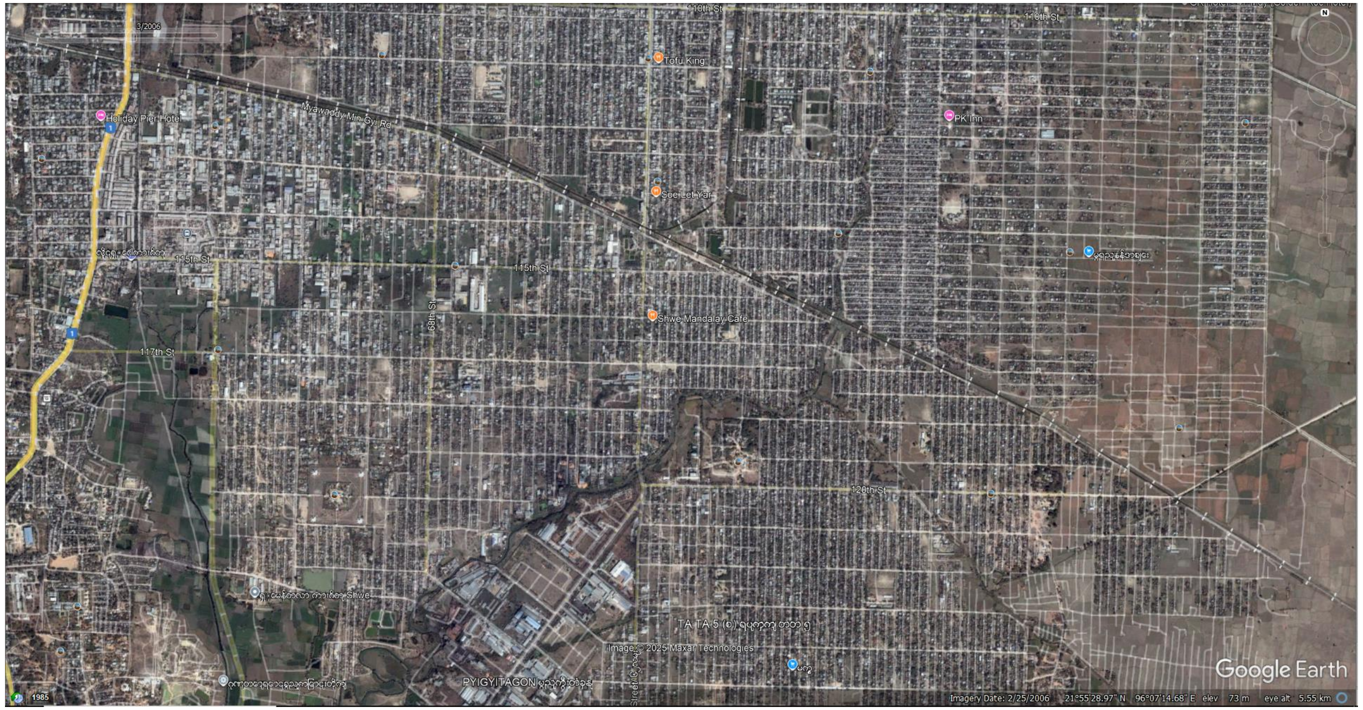
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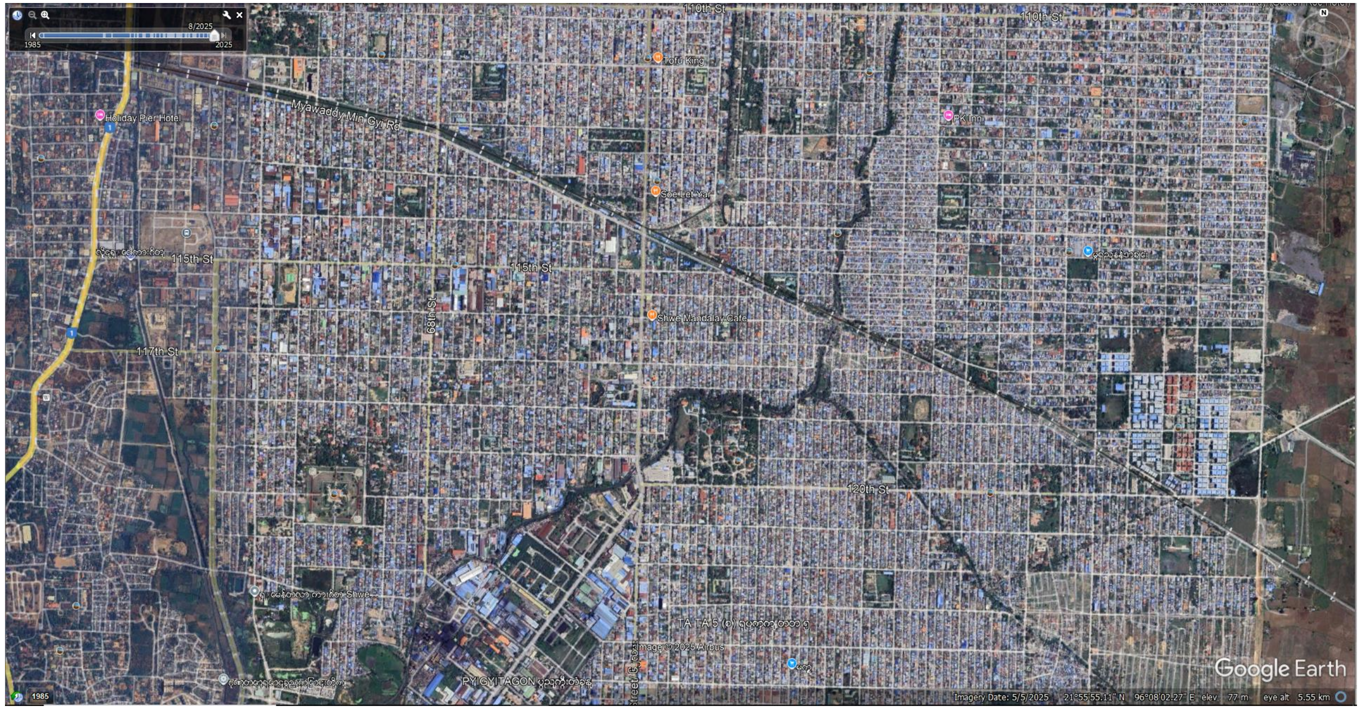
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Tollway Toll Plaza
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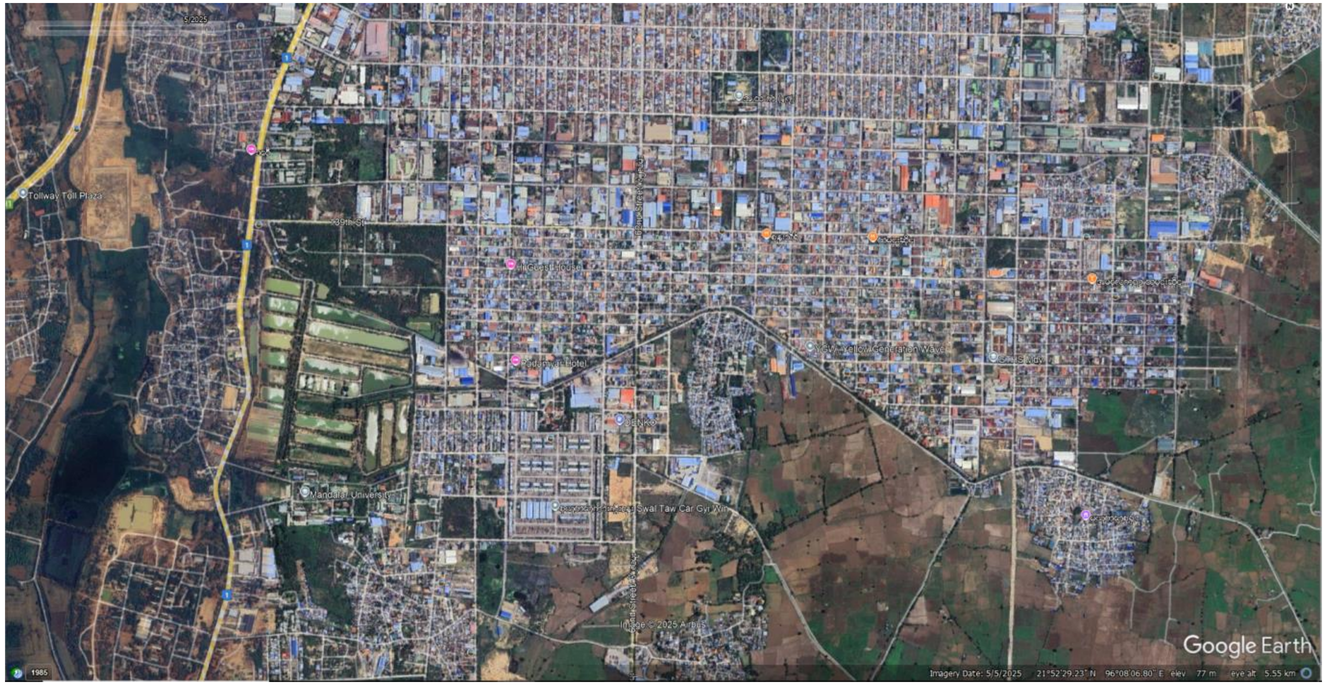
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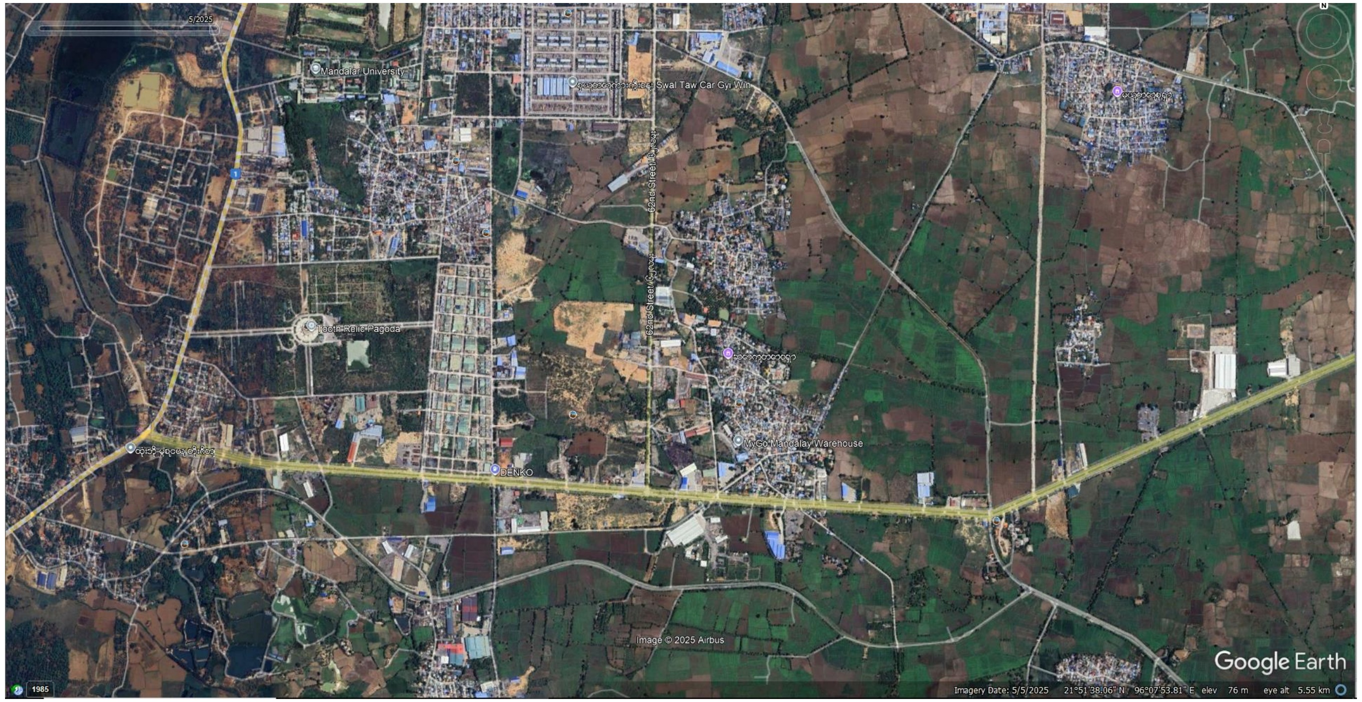

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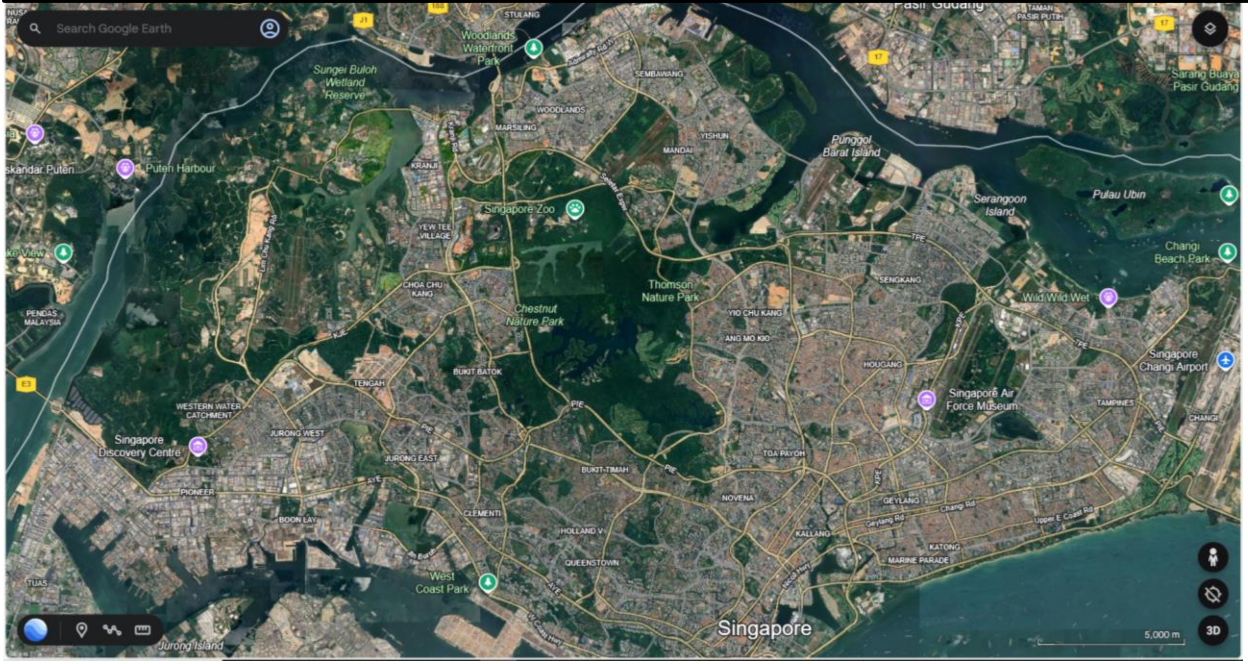
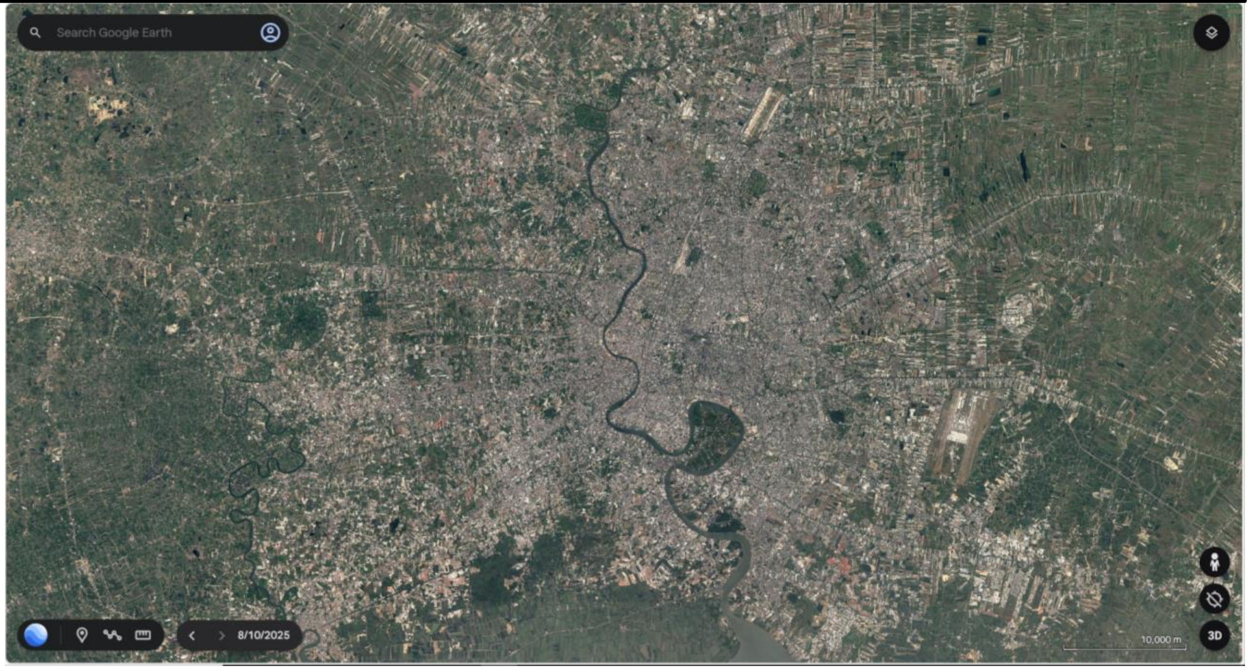
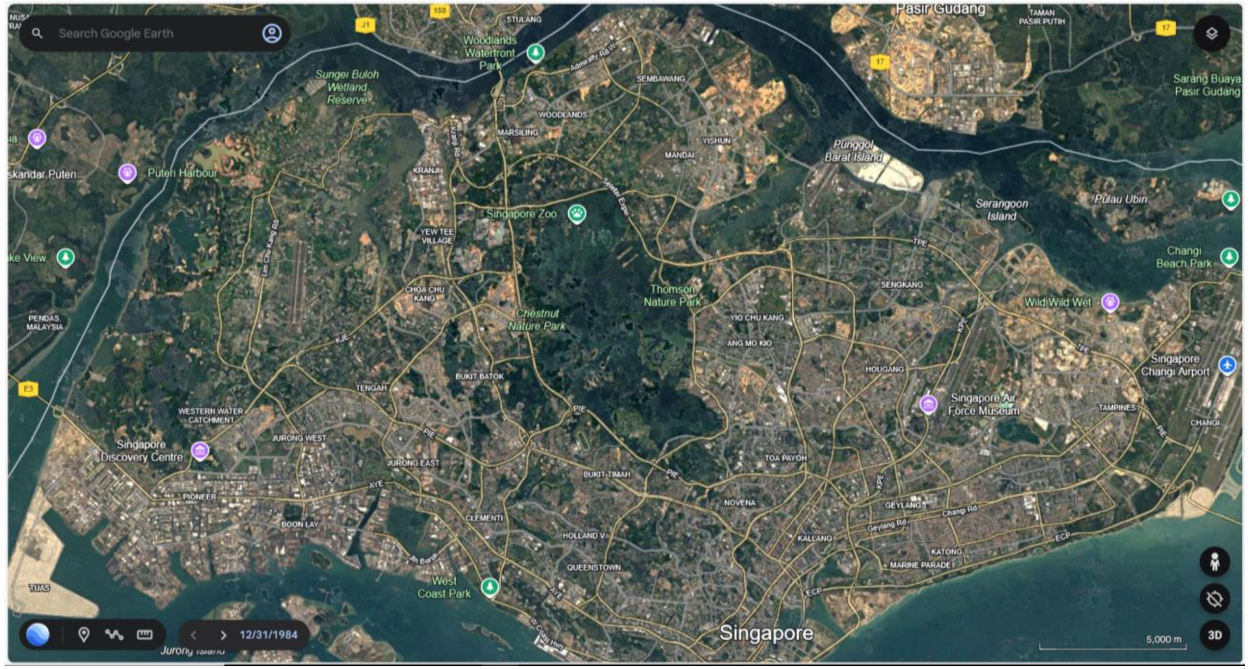
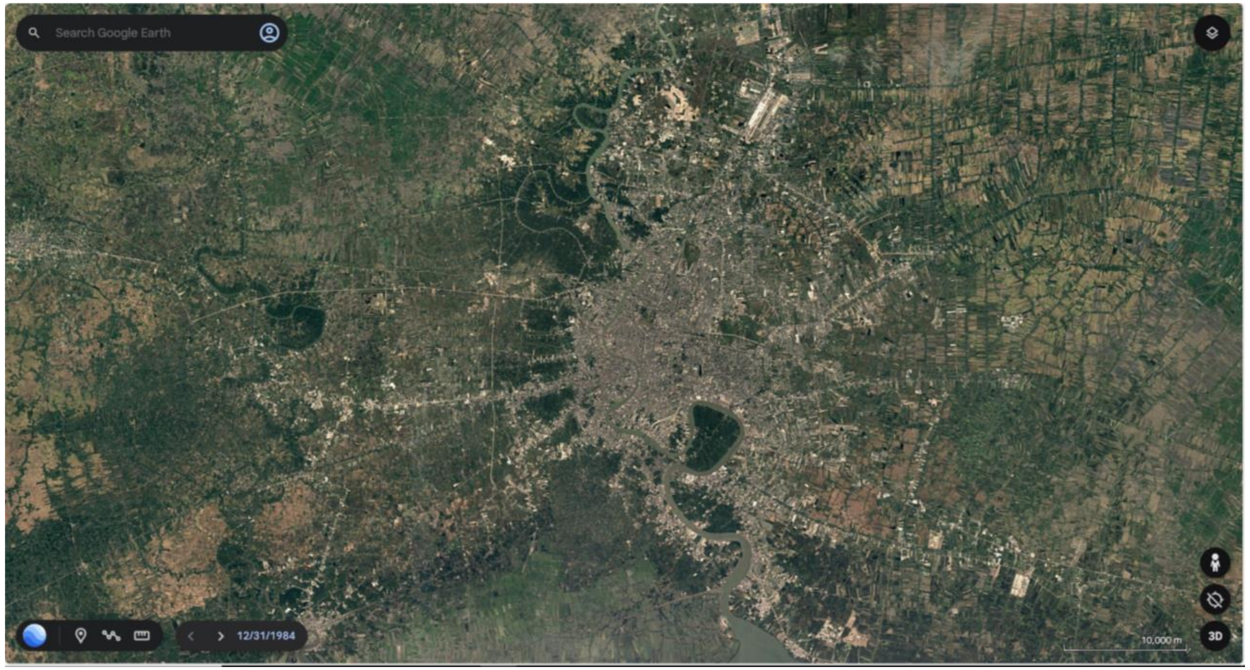
Comparison Statement of Singapore and Bangkok

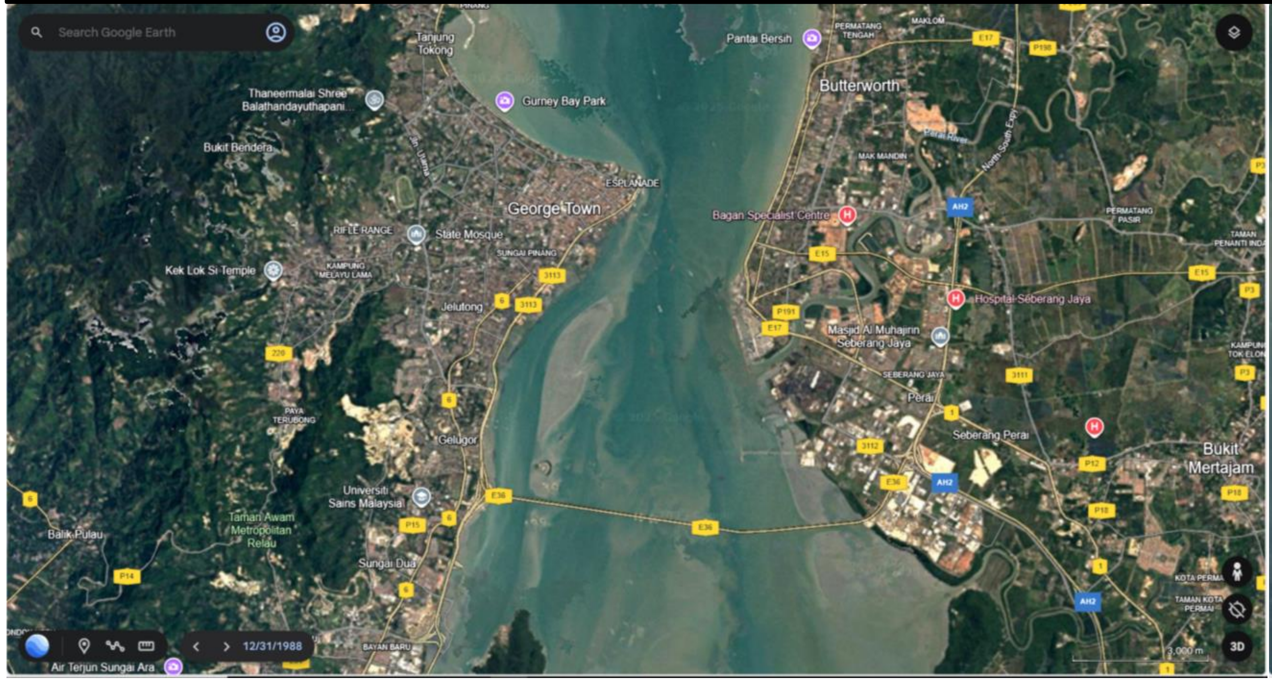


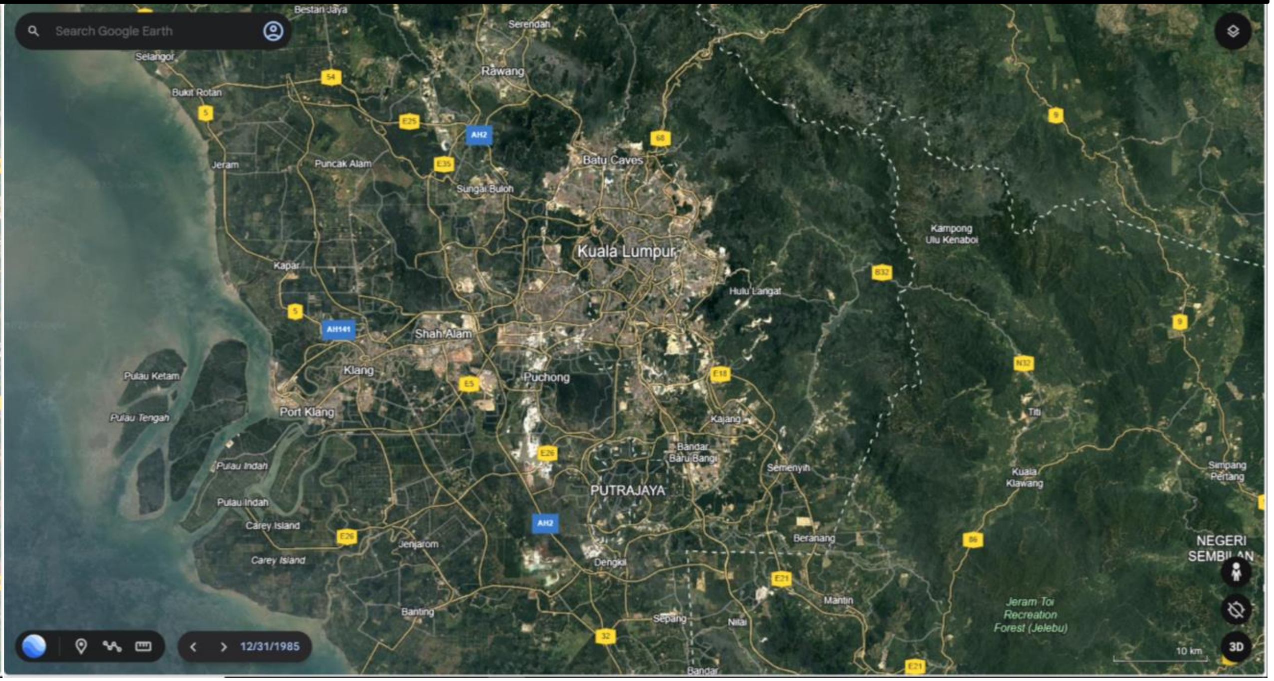


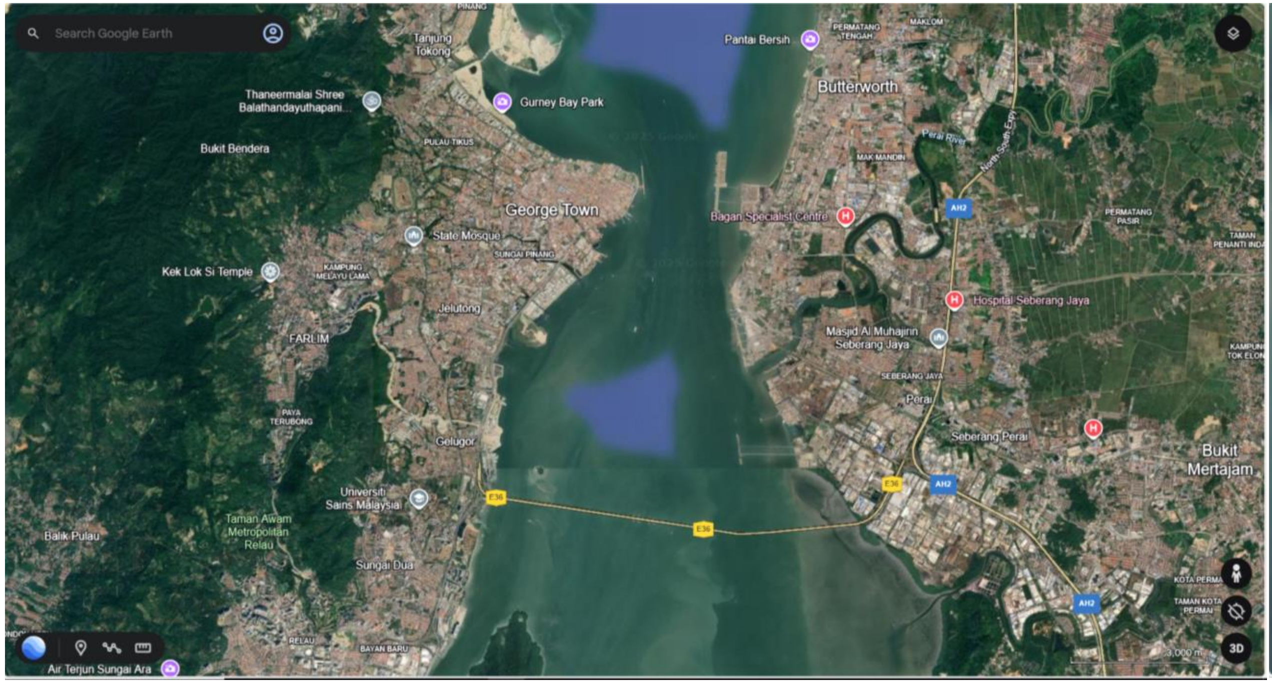


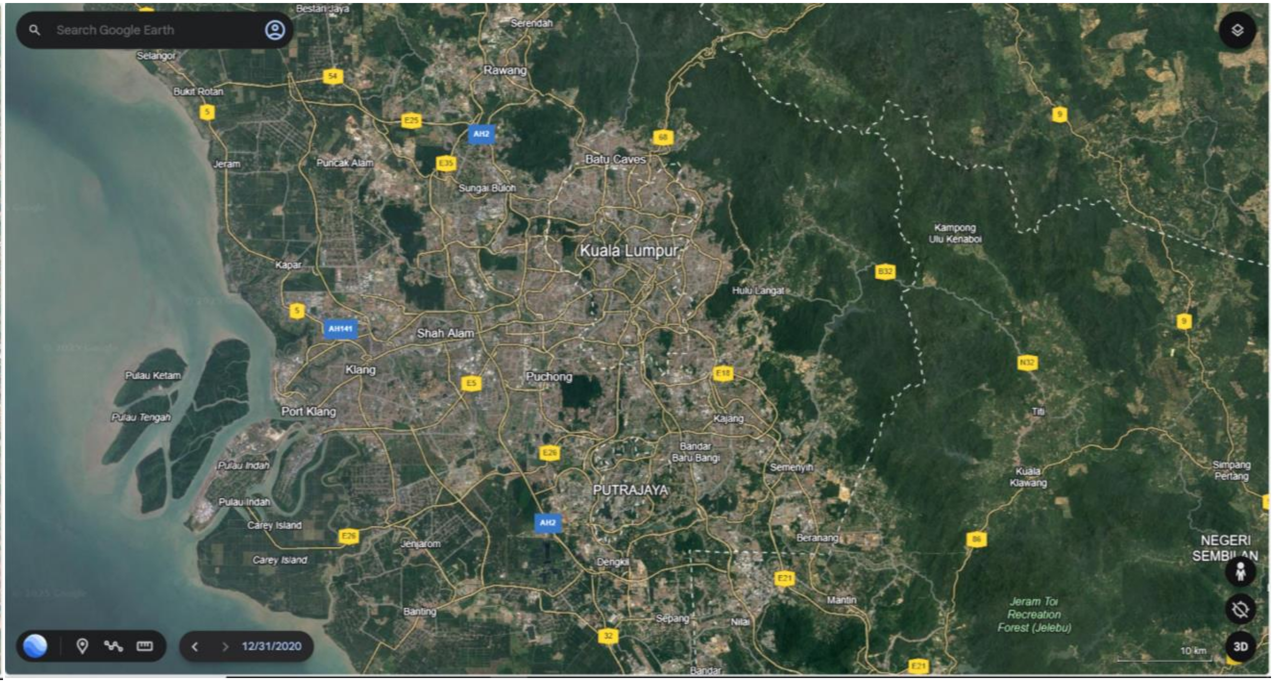


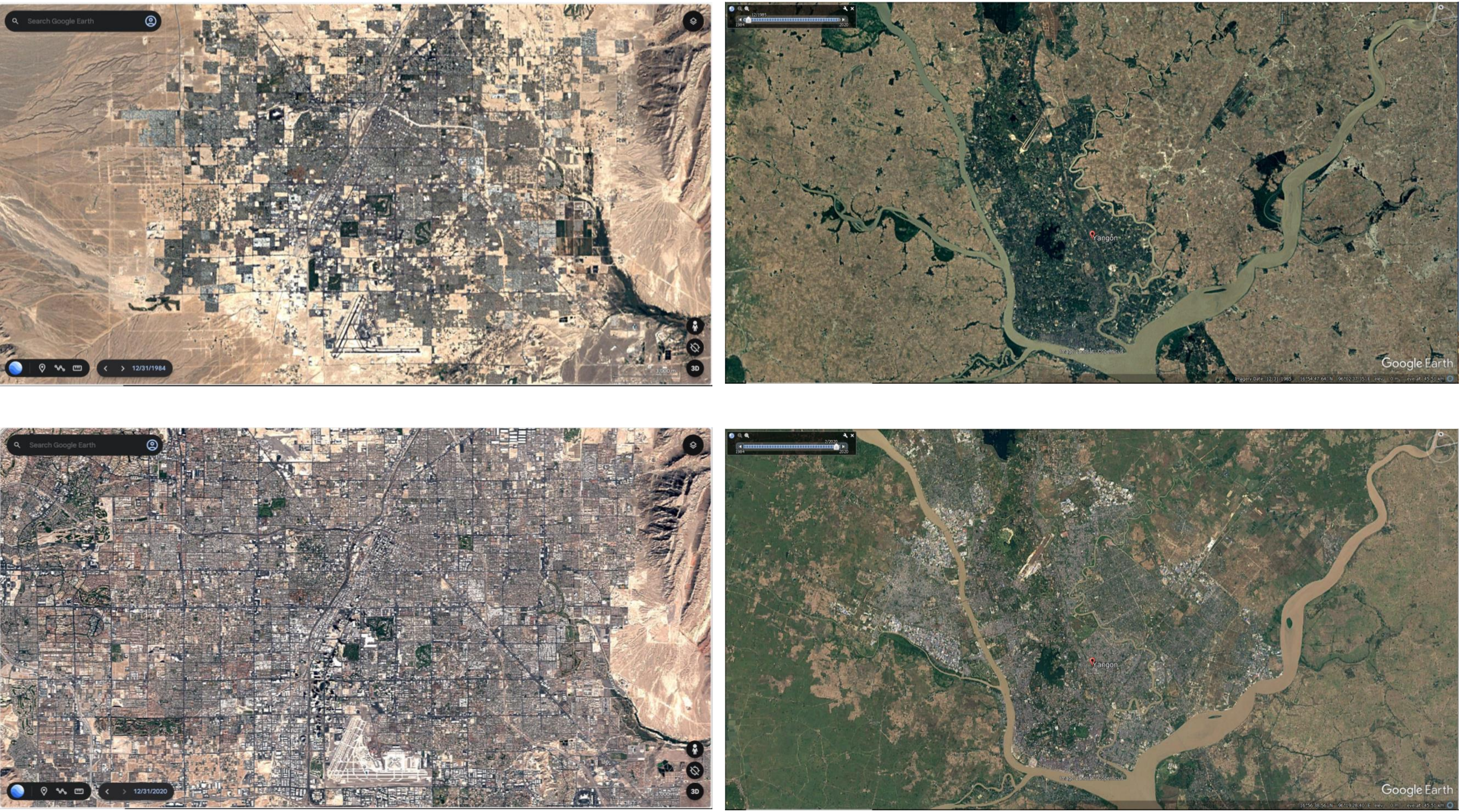
Comparison Statement of Malaysia







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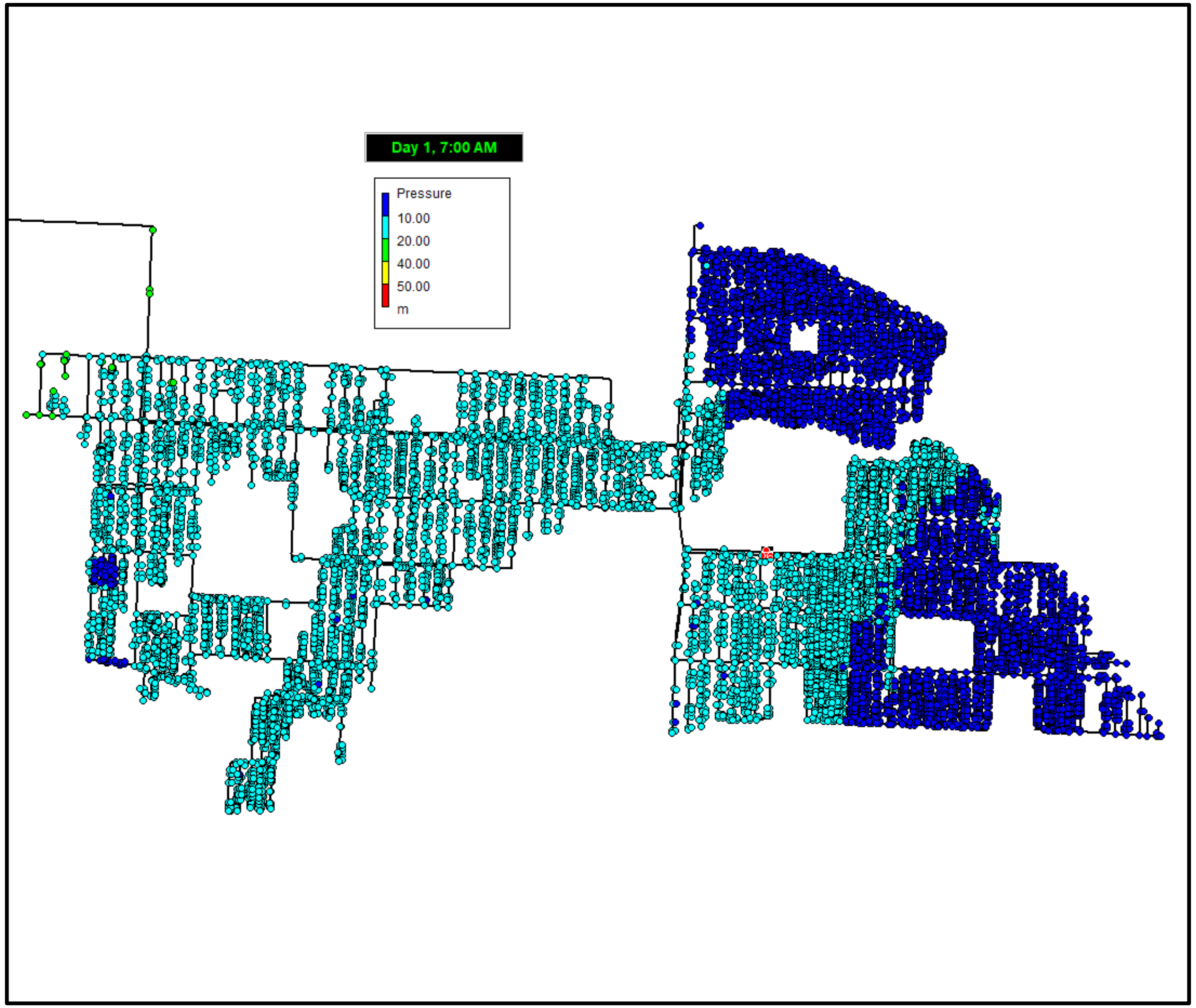
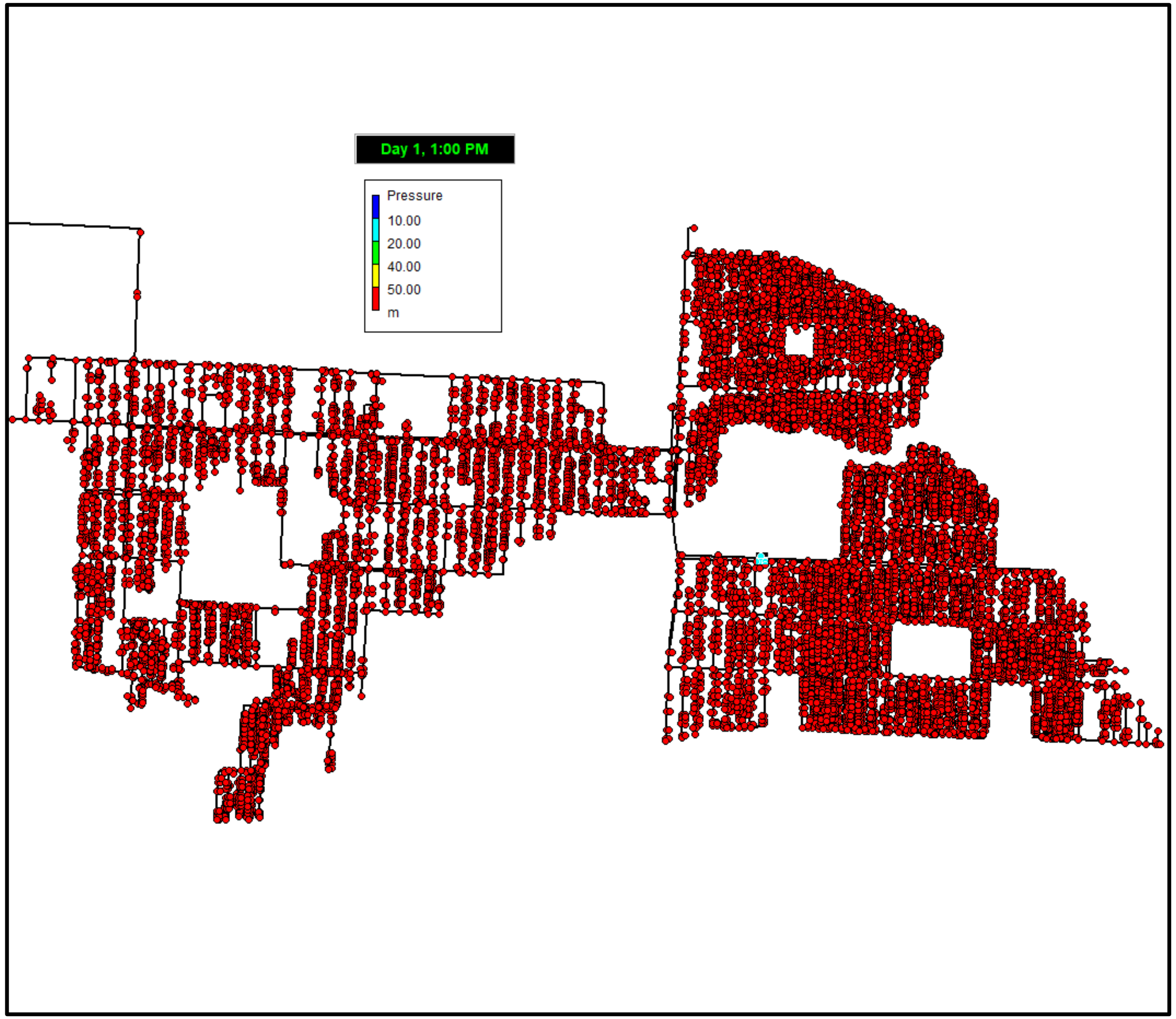
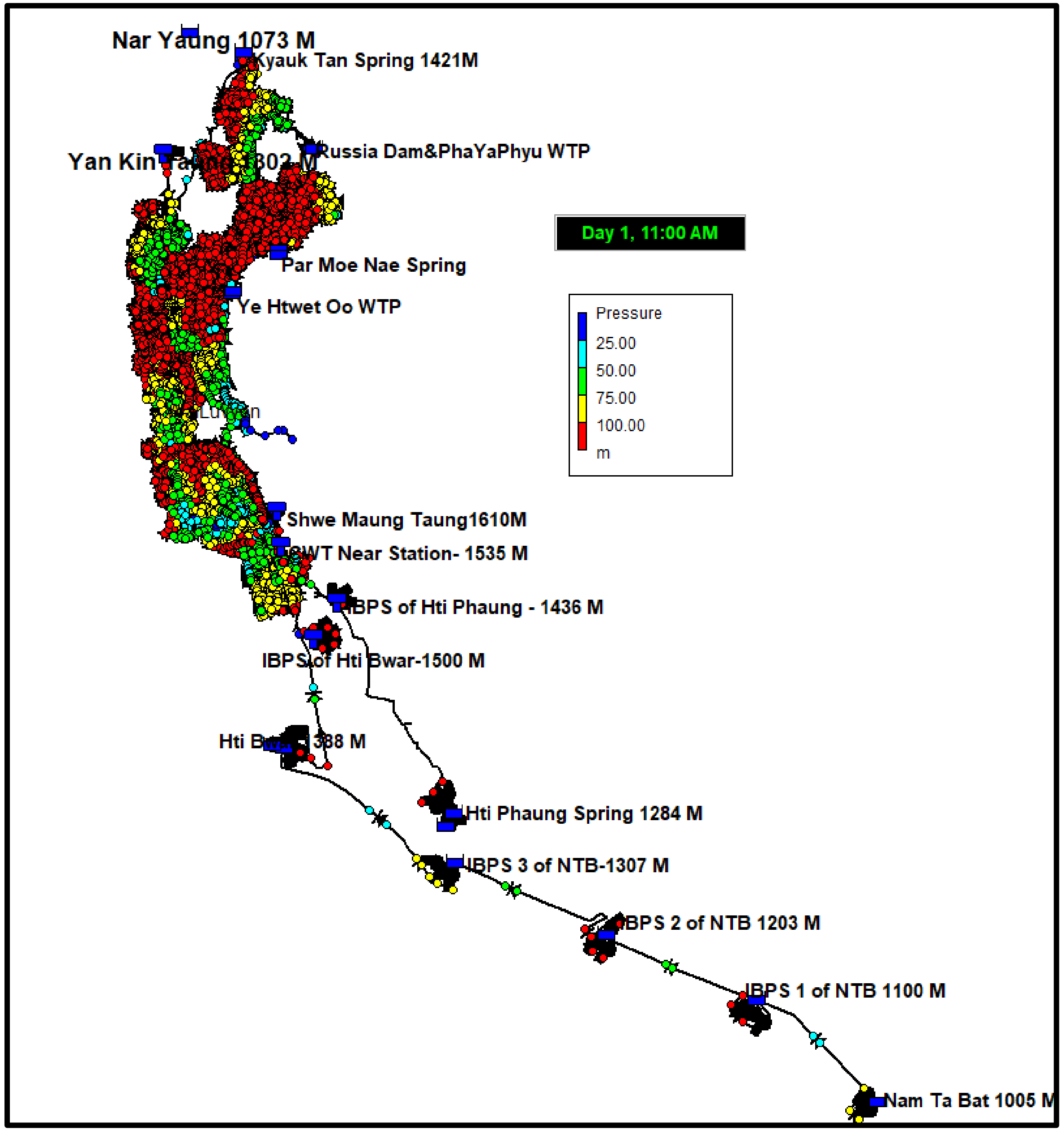
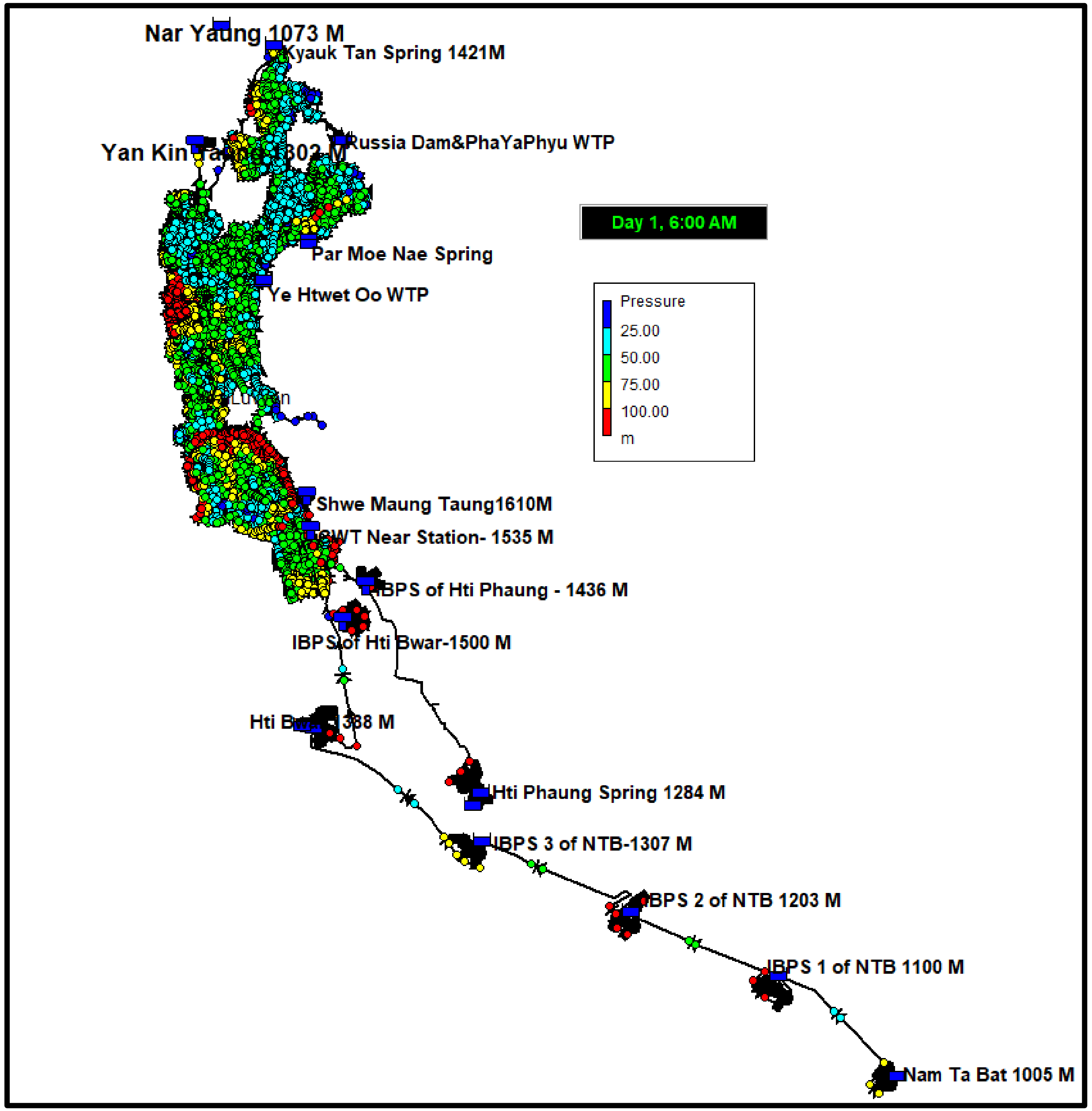
Detail design of water supply system





Detail design of water supply system





Water resources management, Water resources development

Surface water

1. Type of water sources may be difference such as dam or creek or river or reservoir or natural spring
2. Design of intake structure
3. Water quality is consistence or inconsistence, It has seasonal changes or not
4. Water quality can be seriously affected by human activities such as logging and mining through environmental impact such as deforestation and soil erosion

Water resources management, Water resources development

Ground water

To study the effects of over-extraction on groundwater aquifers, we need to monitor changes in water levels and quality. This involves a combination of direct measurement, data analysis, and modeling. A key concept to understand is that excessive pumping can lower the water table, creating a "cone of depression" around wells. If the pumping rate exceeds the natural recharge rate, this can lead to long-term depletion of the aquifer.

Key Monitoring and Study Methods

To effectively study this issue, you would use several interconnected methods:

- **Observation Wells:** This is a direct measurement method. You install dedicated wells, or use existing ones, to periodically measure the depth to the
- **Water Table.** This data, collected over time, shows how groundwater levels fluctuate seasonally and decline over the long term due to over-extraction.
- **Remote Sensing:** Satellite data from missions like GRACE (Gravity Recovery and Climate Experiment) can measure changes in the Earth's gravity field, which are directly related to changes in the mass of water stored underground. This provides a large-scale, regional view of aquifer depletion.
- **Geophysical Surveys:** Techniques like electrical resistivity imaging (ERI) or seismic surveys can help map the underground structure of the aquifer. This can reveal the depth of the water table, the thickness of the aquifer, and how it's being affected by pumping, such as the intrusion of saltwater in coastal areas.
- **Groundwater Modeling:** Using specialized computer software, you can create a numerical model of the aquifer. You input data on pumping rates, rainfall, and aquifer properties (like porosity and hydraulic conductivity) to simulate groundwater flow and predict how water levels will change under different extraction scenarios. This is crucial for forecasting future impacts and testing management strategies.

Water resources management, Water resources development

Impacts to Study Beyond Water Levels

Over-extraction doesn't just lower the water table; it has other significant consequences that must be studied:

- Land Subsidence: When water is removed from an aquifer, the pore spaces in the soil and rock can collapse. This leads to the ground surface sinking, a phenomenon known as subsidence. Monitoring can involve GPS receivers, satellite-based interferometric synthetic aperture radar (InSAR), and repeat leveling surveys.
- Water Quality Degradation: As the water table drops, poorer-quality water can move into the aquifer. This includes saltwater intrusion in coastal areas or the upward movement of naturally occurring contaminants like arsenic or other minerals from deeper rock layers. Regular water quality sampling is essential to detect these changes.
- Reduced Surface Water Supplies: Groundwater and surface water are often connected. Excessive pumping can reduce the flow in nearby rivers, streams, and springs, which are sustained by groundwater discharge during dry periods. Studying this involves monitoring the flow rates of these surface water bodies and analyzing their relationship with nearby groundwater levels.

Top 10 Cities by Subsidence Severity

Rank	City	Country	Max Subsidence Rate	Cumulative Subsidence	Causes	Status
1	Mexico City	Mexico	50 cm/year	~10 m	Aquifer overuse, clay soils	Ongoing
2	Jakarta	Indonesia	25 cm/year	~4+ m	Wells, lack of piped water	Critical
3	Tehran	Iran	25 cm/year	~4–5 m	Unregulated pumping	Severe
4	Fresno (CA)	USA	30 cm/year	~8–9 m (localized)	Agriculture, soft sediments	Improving
5	Bangkok	Thailand	10 cm/year	~1 m	Groundwater overuse, delta basin	Stabilized
6	Beijing	China	11 cm/year	~1.5 m	Industry, urban growth	Ongoing
7	Dhaka	Bangladesh	7–10 cm/year	~1 m	Population boom, deep aquifers	Rising
8	San Jose (CA)	USA	4–5 cm/year	~3+ m (historic)	Groundwater reliance	Reduced
9	Houston	USA	~3 cm/year	~2–3 m (localized)	Suburban development	Managed
10	Venice	Italy	~2 cm/year	~25 cm total	Industrial pumping, delta zone	Under control

Key Takeaways

- Mexico City and Jakarta have the most severe subsidence
- Regulated pumping and recharge can stabilize the trend
- Land subsidence is often irreversible once compaction occurs
- Urgent need for managed aquifer recharge and water governance

Challenges of Water Utilities in US and Europe

Texas water resources institute	

- Aging infrastructure
- Leaking Pipes
- Financing improvements
- The value of water
- Long-term water supply
- Water contamination
- Retirement and talent attraction, retention
- Population fluctuation
- Implementing innovative technology
- Infrastructure resiliency and emergency preparedness

- Regulatory Challenges
- Water scarcity and drought
- Aging Infrastructure
- High operational costs
- Water quality issues
- Public perception and trust
- Climate change impacts
- Capital investment needs
- Workforce staffing shortages

Challenges of Water Utilities in US and Europe

EurEau **8 big challenges for the water sector in the next 10 years**	**3BL Media**
• Delivering safe and reliable water services 24/7 • Protecting water as a vulnerable resource • Promoting the value of water services to ensure long-term sustainable financing • Promoting water in the circular economy • Moving towards resource-efficient and climate-neutral water service • Enabling innovation and inspiring professionals to meet current and future challenges • Managing long-term assets in a fast-changing environment • Reinforcing the resilience of water services	• Aging infrastructure • Technology • Workforce development • Regulatory Compliance • Contaminants of emerging concern • Water source protection • Climate change • Population dynamics • Financing • Public trust

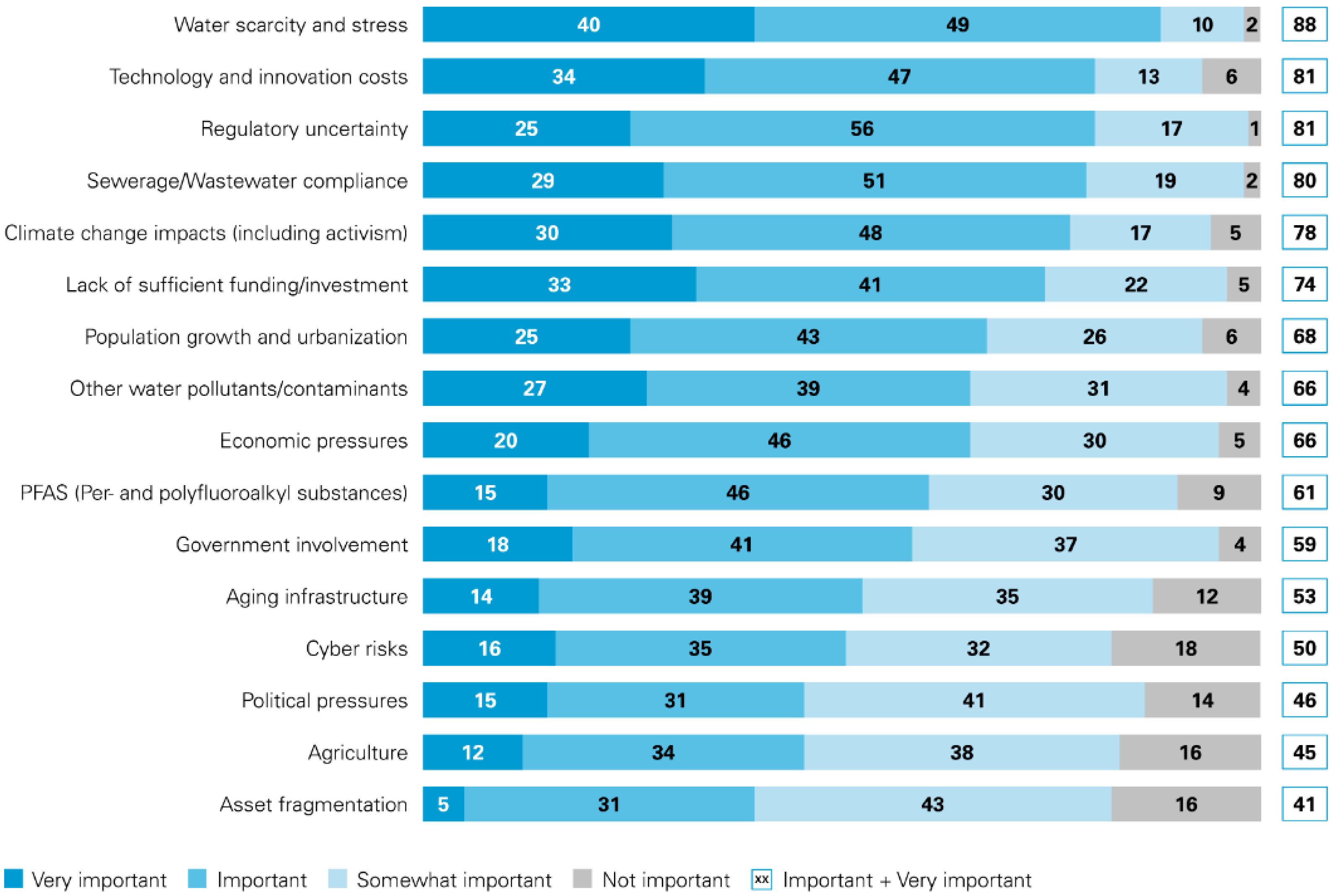
Challenges of Water Utilities in US and Europe

IIOT World

- Droughts and floods
- Water scarcity
- High energy costs
- Non-revenue water
- Financing
- Water quality
- Water reuse
- Shrinking tax base
- Aging infrastructure

Challenges of Water Utilities in US and Europe

Importance of challenges for the water sector (%)



Challenges of Water Utilities in US and Europe

Key findings

01

Approximately nine out of ten decision-makers view water scarcity as an important challenge for the water sector

02

One-third of decision-makers identify uncertainty (both regulatory and geopolitical) as their primary challenge

03

42 percent of the decision-makers expect policy shifts in the water sector, and one in three expect tighter regulations

What will happen to water in 2030 and the future predictions for water?

- In 2030, water issues are expected to intensify. There will likely be increased pressure on water resources due to population growth and climate change. Sustainable practices, technological innovations, and global collaboration will be crucial for addressing water challenges in the future.

What are the future predictions for water?

- Future predictions for water include increased demand due to population growth, the impact of climate change on water availability, advancements in water technology, and a growing emphasis on sustainable water management practices.

Is the water industry growing?

- Yes, the water industry is growing, driven by factors like urbanization, industrial expansion, and the need for improved water infrastructure. There’s an increasing focus on water conservation, treatment technologies, and smart water management.

What will happen to water in 2030 and the future predictions for water?

In today's increasingly complex water landscape, investors and operators face a range of challenges that threaten to redirect—or, in some cases, even obstruct—strong currents of capital. Water scarcity is the sector's primary concern, with 88 percent of the respondents identifying it as important or very important. This existential challenge is compounded by the perceived high costs of the technological innovation needed to address it, with 81 percent of respondents indicating that costs were an important or very important challenge. Some leaders argue that a narrow focus on upfront technology costs obscures the broader value calculation.

"In terms of costs, we don't have a technology problem, we have a 'value of water' problem," says Devesh Sharma, CEO at Aquatech International. "People will say that technology is expensive, but what's the alternative? Against what is the cost being measured? The costs of inaction will be much higher. The technology is out there and it can always improve. What's more important is whether the business model, financial model and regulatory environment are positioned to support," explains Sharma.

Asset Fragmentation

In the water sector, **asset fragmentation** refers to the condition where the management, ownership, and information related to water infrastructure assets are dispersed across multiple entities, systems, and processes, rather than being unified and coordinated.

Here's a breakdown of what that entails:

- **Disparate Ownership/Management:** Instead of a single, integrated authority overseeing all water assets (like pipes, pumps, treatment plants, reservoirs, wells, etc.) within a region or service area, different parts of the system might be owned or managed by various local authorities, private companies, departments, or even individuals. This can be seen in:
  - **Multiple water utilities:** Several smaller utilities operating independently within a larger geographical area.
  - **Public vs. Private:** Some assets are publicly owned, while others are privately operated through concessions or contracts.
  - **Siloed responsibilities:** Different government departments or agencies responsible for distinct aspects like water supply, sanitation, irrigation, flood protection, and groundwater, often without coordinated planning.
- **Scattered Information and Systems:** Each entity or department might use its own distinct practices, formats, and systems for managing asset information. This leads to:
  - **Incomplete, inaccurate, or unreliable records:** Data about assets (location, age, condition, maintenance history) is not standardized or easily accessible.
  - **Lack of spatial context:** Difficulties in mapping and visualizing assets, especially vertical ones like pump stations, making it hard to locate components for maintenance.
  - **Manual or legacy systems:** Reliance on paper records, outdated software, or individual knowledge, leading to inefficiencies and potential errors.
- **Fragmented Policies and Governance:** Legal and regulatory frameworks may also be fragmented, with different jurisdictions having their own water legislation, regulators, and approaches. This can result in:
  - **Incoherent or contradictory water management practices:** Decisions made by one entity might negatively impact others.
  - **Lack of uniform standards:** Different quality standards, maintenance protocols, or investment priorities across a system.
  - **Difficulty in overall planning and investment:** Challenges in developing long-term strategies for water security and infrastructure development due to a lack of a holistic view.

Impact of Asset Fragmentation:

Asset fragmentation poses significant challenges to effective water management, leading to:

- **Operational Inefficiencies:** Delays in maintenance, difficulty in identifying critical assets, increased risk of errors, and higher operational costs.
- **Water Losses:** Higher rates of non-revenue water due to poor infrastructure condition and difficulty in identifying and repairing leaks.
- **Suboptimal Investment Decisions:** Challenges in prioritizing investments, leading to deferred maintenance and a reactive approach to asset management rather than proactive planning.
- **Reduced Resilience:** Slower response and recovery times during disasters or system failures due to a lack of comprehensive asset information.
- **Difficulty in Addressing Broader Challenges:** Hindrance in tackling issues like water scarcity, climate change impacts, and water quality degradation, as integrated solutions are harder to implement.
- **Unequal Service Provision:** Disparities in water service quality and access for different populations within a fragmented system.

Pipeline Route

- Transmission Pipeline Routes
- Distribution Pipeline Routes

Transmission Pipeline Route

- Generally, in urban water supply systems, most water sources are located outside the municipal boundaries.
- In such situations, the accurate and proper alignment of the transmission main and the systematic execution of construction works are both critical to the success and sustainability of the water supply system.
- Above all the most critical factors are ensuring cost-effectiveness from an economic standpoint and maintaining long-term durability and sustainability.
- To make the right decisions in all these matters, a wealth of experience is required.

Distribution Pipeline Routes

- When laying and connecting water distribution pipelines within municipal boundaries, it is often necessary to work around existing infrastructure such as telecommunication fiber cables, gas pipelines, power cables, sewer lines, telecommunication poles, electricity poles, advertisement boards, platforms, drains, and bridges and substations.
- Therefore, it is essential to develop and follow a Standard Operating Procedure (SOP) to ensure proper coordination and safe, efficient execution of the works.

Distribution Pipeline Routes

- For any new construction or maintenance works related to the aforementioned basic infrastructure, it is essential that the responsible departments coordinate in advance with the relevant focal departments associated with those infrastructures.
- Written notifications and prior consultations should be carried out to discuss the technical details and obtain mutual understanding before implementation begins.
- Only through such coordination can the works be carried out successfully—ensuring safety, minimizing risks, reducing potential damages, and avoiding costly mistakes.

SOLUTION

Solution

- Water shortage, inadequate water due to intermittent supply system
- Aging/ poor infrastructure
- NRW high
- Insufficient water resources
- Budget limitations
- Poor water quality to use or drink directly
- Financials Deficit

Budget Availability

Need to draw a Systematic Design and Financial model based on concession loan

Need to set water tariffs to cover the cost of production per unit of water

Corporate structure or PPP

No experience, Multi - stakeholder, political pressure, no autonomous power

LESSON LEARNED

Lesson Learned By Me

- Mostly, town water supply systems were established by development committee within limited budget.
- Initial investment is very high to establish a water supply system.
- Therefore, It is not easy to implement a water supply system which is relevant with its master plan without concession loan. So, need to try to get loan.
- Need to draw financial model and then follow-up to get profit. Also Need to do network design simulation for hydraulic flow patterns and 24/7 system.
- Lack of technical expertise is a one of the challenges.
- We need to do training programs regularly for capacity building to reduce lack of skill labor.
- Pipeline networks are very crucial part for a water supply system but we need to excavate to lay and construct pipeline networks, there are a lot of negative impact damaging basic infrastructure such as roads, bridges, culverts, pavements, power and fiber cable lines while constructing pipeline. Therefore we need to consider quality assurance and quality control issues for sustainability.
- We need to avoid environmental and social impacts to establish a water supply system.
- Issue of water quality control is very important. We need to use some chemical substances to treat and purify for poor raw water quality, it can lead negative impact for human's health. So we should use chemical substances carefully.
- We need to do well plan of land acquisition for long-term asset.
- High Electric power consumption is a one of the challenges to be sustainability for a water supply system. So we should use renewable energy for sustainability.

Lesson Learned By Me

- Design period, working pressure and residual pressure

Q&A