TAMBAK SARIOSO

A Nurture Based Solution Approach. We build the institution before the embankment.

Project by:

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ABSTRACT

"Integrated" is a buzzword in infrastructure development, particularly in the face of global transitions, driven by climate change, technology advancement, geopolitical pressure, economic instability, and social uncertainty. As in the premise from Infravison Student Competition 2026, those drivers push infrastructure to evolve faster, demanding an integrated approach. The buzzword idealises "one-size-fits-all" or "kill two birds with one stone" for infrastructure development, so it can solve many development issues with one best practice. However, the reality is more diverse and messier than a single best practice, taken from different contextualities. The friction between design and reality creates alien results that sometimes adversely impact society, as the Foucauldian lexicon "witches' brew" (Foucault, 1991). In our design case, the site has suffered from annual floods and continuous land subsidence. Our team sees it as a problem of genuineness: the people do not genuinely care with the existing infrastructure. Drawing from feminist ethics of care, new infrastructure development should emulate stewardship towards these newly built environments. To co-exist, rather than dominate each other. Our team argues to build infrastructure as close as possible with the affected site, co-produce with them, so they can nurture the built environment. We trust this approach will solve both effectiveness and maintenance issues in new infrastructure development. In that sense, we deconstruct the meaning of integration and reuse the buzzword to genuinely engage with diverse epistemic positions, before producing the design. Considering three future scenarios (drastic economic, environmental, and social change), we propose bold bets to organize community-based polder bodies, ask for zero groundwater extraction, avoid unnecessary development, and integrate knowledge. As the outcome, our proposed project aims for plural and systemic values, through building institutions of care first before the infrastructure.

PROJECT OVERVIEW

Nurture as equal standing for broad sources of knowledge

Tidal Flood Inundate Dense Kampung in Surabaya (ANTARA/Didik Suhartono, 2023)

The project tries to genuinely nurture broad knowledge, rather than suppress them, for long-lasting resilience

Witches' brew from the unseen and messy reality

Several cities on Java's North Coast face a difficult choice: pursue economic growth or increase flood risk. These goals are inherently contradictory, as higher growth can lead to higher flood risks.

Unseen hazards further complicate matters. Land subsidence and rising sea levels progress at different rates but together create a potentially catastrophic combination, trapping rain and river water within the city, preventing it from flowing naturally to the sea. It will result permanent inundation.

The existing solution triad of protect, adapt and retreat is insufficient. In practice these solutions struggle against the messy realities they face, creating a Foucauldian witches' brew. When they encounter lived bodies (humans and non-humans), institutions and resistance, well-designed solutions fall short. This project aims to genuinely connect with those realities. Nurture, rather than dominate them.

PLACE OVERVIEW

Chronic hazards in Kelurahan Tambak Sarioso, Surabaya

Size : 7.94 km^2

Population : 7,246 people

Surabaya, Indonesia's second-largest city by GDP and population, serves as the core of the GKS Metropolitan Area. The GDP in 2023 was US$46.9 billion and its population in 2024 was more than 3 million people. While its population and GDP growth are steady, the city struggles with ecological challenges.

Kelurahan Tambak Sarioso, a fifth-level Indonesian administrative area within Surabaya City, exemplifies these challenges. The area's future hinges on finding a balanced approach to development, protection and retreat. This project aims to explore the extensive knowledge held within Kelurahan Tambak Sarioso particularly from less visible sources, by placing intervention close to them.

FIVE LEVELS OF INDONESIAN GOVERNMENT ADMINISTRATION

01	02	03	04	05
National Indonesia	**Province East Java**	**City Surabaya**	**District Asemrowo**	**Sub-District Tambak Sarioso**

01

PROBLEM ARTICULATION

The messy reality in Kelurahan Tambak Sarioso

ARTICULATING PROBLEM

Incompatible land-use: Two residential areas, Tambak Langon (1) and Greges Barat (2), nestled between factories and warehouses.

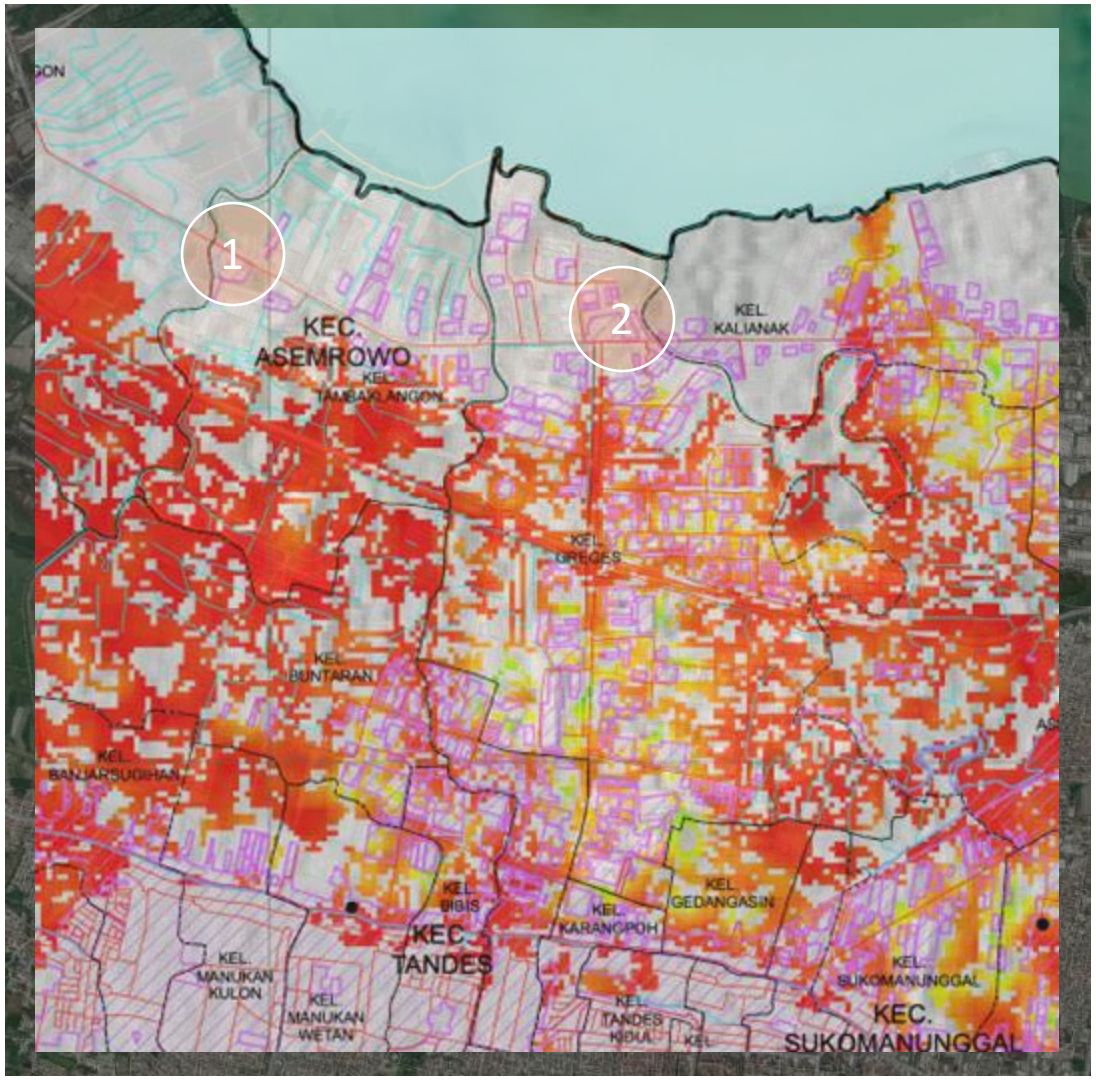
The two residential areas existed before the surrounding industrial development. This industrialisation placed social, economic, and environmental pressure on the existing residential area. While it has created many new economic opportunities, the ecological impact has been chronical. For project exploration, Tambak Langon (1) will be considered as a potential site.

ARTICULATING PROBLEM

The Northcoast Java National Road comprises two national logistic backbones connecting Tanjung Priok, Indonesia's second-largest port, to Jakarta. These are the older north highway and the newer parallel south toll road

Banjir Rob Senin Pagi, Tambak Osowilangun Macet dan Polisi Alihkan Arus Lalu Lintas (Suarasurabaya.net, 2026)

Floods frequently disrupt these roads, especially the northern road. According to some news, tidal flood is recurring event in this road. The picture shows tidal flood on the road on April, 2026. According to Surabaya Drainage Master Plan 2018-2038, tidal flood in Tambak Langon road needs about 120 minutes to be drained.



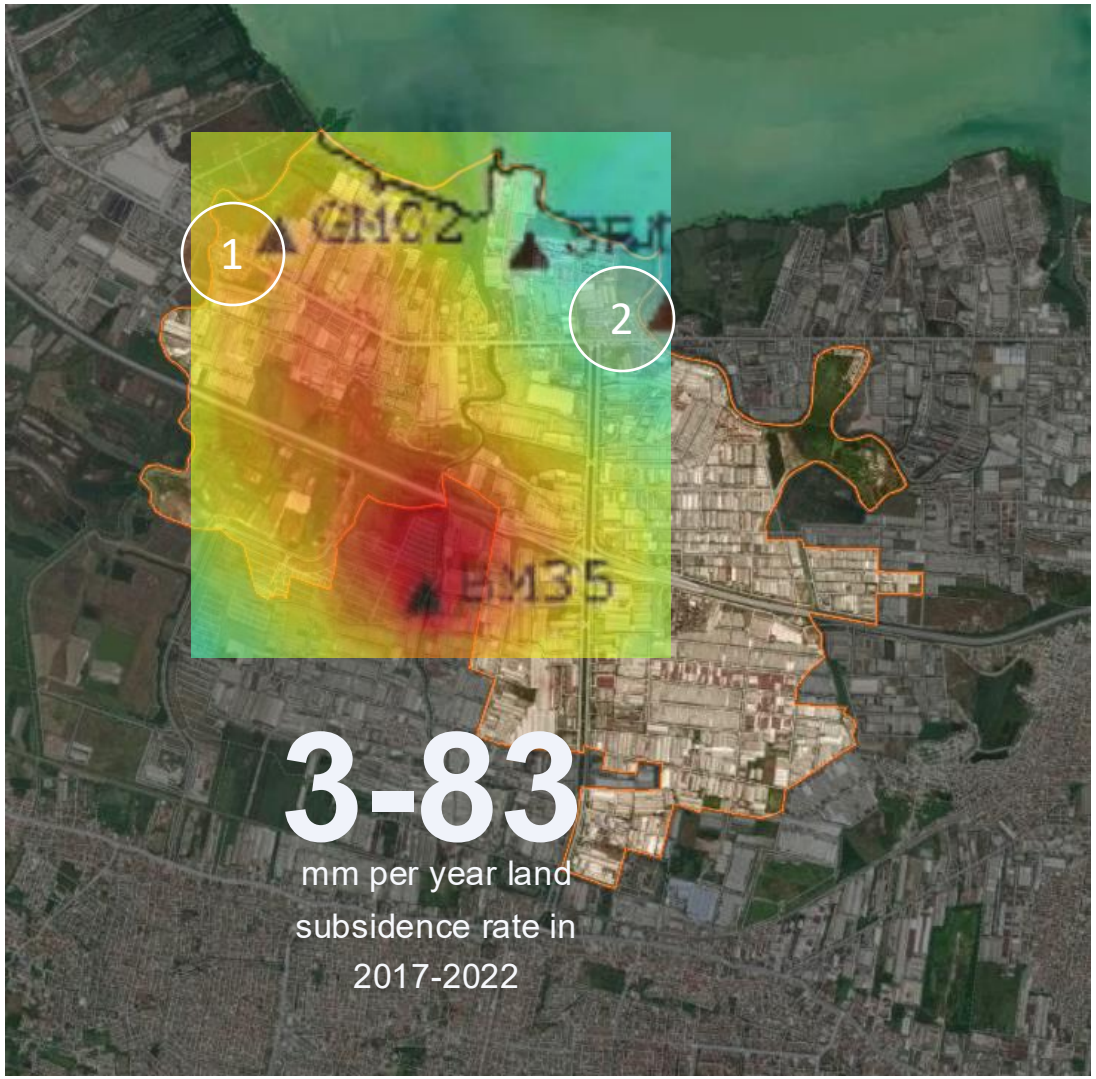
Flood Exposure Map (source: https://inarisk.bnpb.go.id/pdf/Jawa%20Timur/bahaya_banjir_Kota%20Surabaya.pdf)

ARTICULATING PROBLEM

***Tidal flood** in Tambak Langon (1) and Greges Barat (2) are invisible to official risk map*

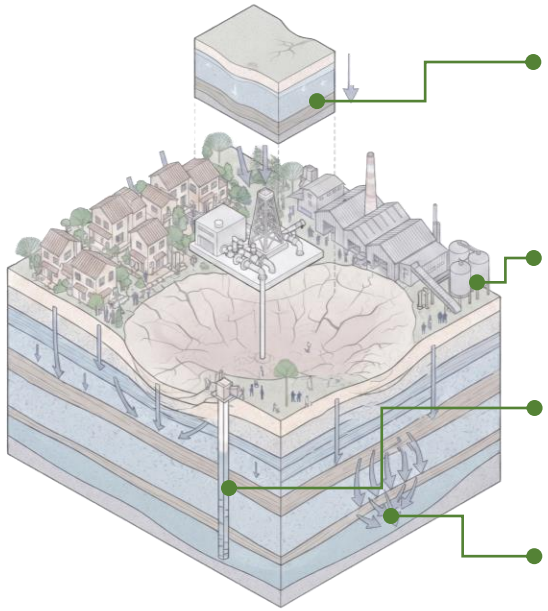
Tidal Flood Inundate Dense Kampung in Surabaya (ANTARA/Didik Suhartono, 2023)

News reports indicate that these residential areas experience annual tidal flooding (local term: *rob*). However, the official government risk map (INARISK) doesn't classify them as high flood risk because of tidal floods label, which, aren't recognized as disasters according to the BNPB / National Disaster Prevention Agency, despite its influence on coastal flood.



ARTICULATING PROBLEM

Land subsidence *in this area trapped tidal runoff from the sea (tidal), local rainfall (pluvial) and over-bank river flow (fluvial), like water in a bowl.*



The existing soil has high compressibility, prone to consolidation.

Development of industrial buildings add physical burden to the soft soil.

Unregulated groundwater extraction accelerates land subsidence.

Subtle geological movement also contributes to subsidence.

The residential areas are sinking due to the soft soil profile combined with industrial development and unregulated groundwater extraction. Between 2017 and 2022 the subsidence rate was recorded in ranged from 3 to 83 mm per year[1].

[1]C. N. Riastama, et al 2023. IOP Conf. Ser.: Earth Environ. Sci.1127012002

02

FUTURE SCENARIOS

Three plausible, contrasted worlds for 2030–2035.
Not best case, base case, worst case.

DRIVING FORCES

Primary catalyst or variables for future changes, determining how different future scenarios will unfold and be addressed by this project

Economic Growth

The degree to which economic development drives industrial expansion and influences the demand for land and water.

Climate Pressure

The intensity of climate-related hazards: sea-level rise, land subsidence, tidal and fluvial flooding, extreme rainfall.

Technology Adoption

The extent to which smart technologies are integrated into infrastructure planning and management.

Funding Availability

The availability of funding and financing to develop and operate infrastructure systems, regardless of its sources.

Environmental Conservation

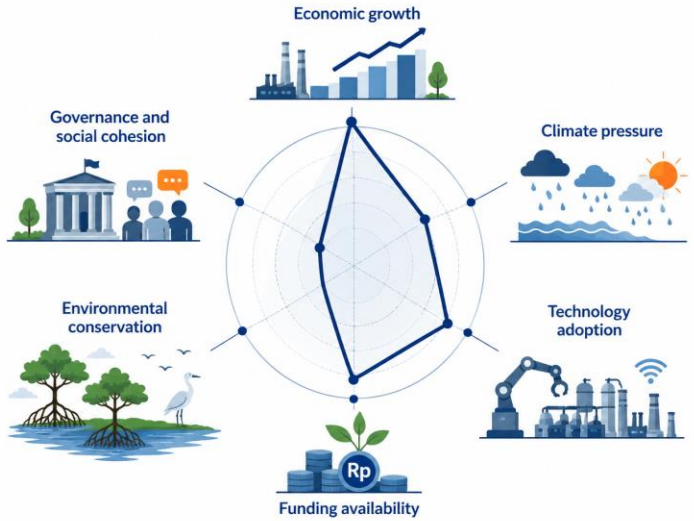
The level of commitment to protect, restore, and preserve the natural ecosystem.

Governance and Social Cohesion

The quality of collaboration, social trust, local knowledge integration, and stakeholder participation.

SCENARIO A

Industrial Boom (Economic Uncertainty)



Future context

In this scenario, **industrial areas expand significantly,** as regional economic growth is the primary driver of development.

Climate change remains present, but it is not the dominant force shaping development.

Industrial development comes with high technological innovation, including efforts to protect the industry from the risks of flooding.

Economic growth is in line with funding availability, including capacity to address the flood issue in the area.

Environmental conservation is considered less important. Vacant land likely converted for industry and related infrastructure rather than protected or restored.

Governance and social cohesion are limited, with decision-making led mainly by the government (top-down) based on economic purposes. Local knowledge, community practices, and public participation remain a concern, but are less dominant.

Key Challenge

This situation consequently led to increased demand for land and water for industrial purposes, a continued risk of subsidence, and increased runoff from built-up areas.

Viability

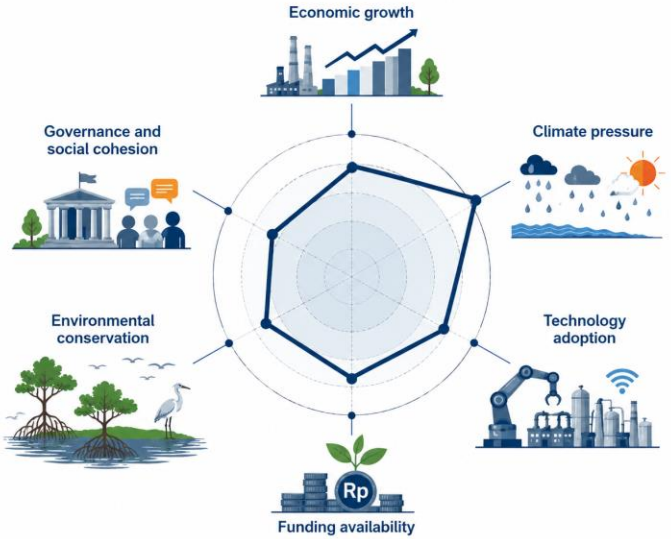
The project remains effective, as it allows the polder system to grow alongside industrial development. However, continuous upgrades are necessary to align with ongoing growth.

Project response

- Increase the role of industrial actors in funding the development, maintenance, and upgrading of the polder system.
- The government commits to providing clean water following the increasing demand, while groundwater extraction is prohibited.
- Pumping capacity, pipe network, and retention pond capacity are upgraded incrementally.
- Land-use changes are carefully managed to protect critical polder assets.

SCENARIO B

Climate Change Acceleration (Environmental Uncertainty)



Future context

In this scenario, climate-related hazards are increasing faster than projected, creating uncertainty about the future effectiveness of existing flood-management systems.

Economic development continues as business as usual, as people give more attention to addressing climate-related hazards.

Technology adoption continues at a moderate level, supporting flood management without fundamentally transforming the system.

Funding remains available for climate adaptation, although increasing disaster-response costs put pressure on public budgets.

Awareness of environmental conservation is emerging, but the focus remains on addressing climate-related hazards in the short and medium term.

Governance and social cohesion are moderate, with decision-making already based on collaboration between government and communities, though power relations remain an issue.

Key Challenge

Climate change is accelerating, with sea-level rise, flooding, and land subsidence worsening.

Viability

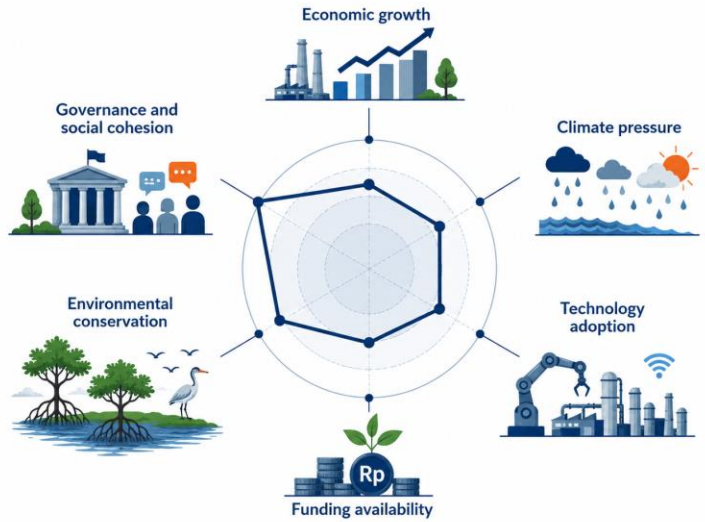
The project remains viable, as the system can be upgraded over time. By combining retention ponds, drainage systems, pumps, embankments, and selective displacement, the system can adapt to increasing climate risks more effectively than a single-purpose infrastructure solution.

Project response

- Adjust embankment designs as needed to address changing flood risks.
- Maintain the capacity of the existing aquaculture pond and, where feasible, convert vacant land into new retention ponds.
- Relocate communities from the most vulnerable areas, such as riverbanks.
- Implement a combination of flood protection measures, including drainage systems, retention ponds, pumps, and embankments.
- Preserving local wisdom as nature steward and integrate it into formal institution.

SCENARIO C

Social Transformation (Social Uncertainty)



Future context

In this scenario, **public participation, local knowledge, and collaborative governance become increasingly important**. Communities have greater influence in the decision-making process.

However, in this type of development, conflicts of interest among stakeholders are more visible. Consensus also requires significant time and coordination as diverse perspectives are involved. Therefore, this makes infrastructure projects implemented more slowly.

Key Challenge

Balancing diverse stakeholder interests and minimizing social conflicts while maintaining effective, timely decision-making.

Viability

The project remains viable despite evolving social dynamics, as adaptive and accountable mechanisms help maintain stakeholder commitment, collaboration, and public trust over time.

Project response

- Establishing stakeholder agreements to secure long-term commitments and responsibilities.
- Implement a shared governance framework to clearly define stakeholder roles and enable periodic reviews and adjustments.
- Adopt a participatory monitoring mechanism to integrate local knowledge and reduce power imbalances in decision-making.
- Develop a conflict-resolution mechanism to address social disputes.
- Maintain project transparency, allowing stakeholders to track progress and strengthen public trust.

SCENARIO COMPARISON & STRESS FACTOR

Comparing three alternative scenarios based on driving factors and analyzing their resilience against potential failure points

Scenario Comparison

	Scenario A: Industrial Boom	Scenario B: Climate Change Acceleration	Scenario C: Social Transformation
Economic growth	High	Medium	Medium
Climate Pressure	Medium	High	Medium
Technology Adoption	High	Medium	Medium
Funding Availability	High	Medium	Low
Environmental Conservation	Low	Medium	High
Governance and Social Cohesion	Low	Low	High

Stress Analysis

	Stress factor	Failure point	Adaptive response
Scenario A: Industrial Boom	• Excessive industrial water demand • Uncontrolled Industrial land expansion • High levels of illegal groundwater extraction	• Subsidence accelerates • Flood frequency and volume increase • Polder systems become insufficient	• Increase industrial actors' financial contributions • Incrementally upgrade and maintain the polder system • Commit to providing a reliable piped clean water supply
Scenario B: Climate Change Acceleration	• Sea level, extreme rainfall, and land subsidence accelerate beyond expected projections. • Tidal and fluvial flooding occur more frequently and simultaneously	• The polder system reaches its maximum capacity: retention ponds overflow, pumping systems operate at their design limits, and embankments become insufficient. • Flood extent and duration increase.	• Upgrade the capacity of infrastructure: Embankments, drainage systems, retention ponds, and pumps • Selective displacement from the most vulnerable areas • Strengthen the periodic reassessment of flood-risk thresholds • Preserving local wisdom
Scenario C: Social Transformation	• Uncontrolled social conflicts • Major political and institutional transition (influencing stakeholder commitment) • Declining public trust	• Project implementation, operation, and future upgrades are delayed or disrupted due to stakeholder fragmentation and declining commitment	• Institutionalized adaptive governance mechanism, including stakeholder agreement, shared governance frameworks, participatory monitoring, and conflict resolution processes • Maintain transparency

03

NURTURE-BASED POLDER SYSTEM

Our interpretation of "integrated" project to tackle flood in Tambak Langon

SITE ILLUSTRATION – TAMBAK LANGON

A settlement forms in a bowl, hardened on every edge and draining through a single canal.

The site illustration was created using AI from an aerial photograph of the area at a 50-metre scale.

1. **Jalan Gresik** is the main logistical road and is elevated above the residential area. This elevation causes water runoff into the residential area.
2. **Kali Branjangan.** This is the main drainage channel in the area with occupied riverside. Its proximity to the sea causes its direct influence from the tides.
3. **Tambak ponds.** Retention and livelihood at once. This is the contested land the polder would need.
4. **Warehouse platforms.** Industry raises its own ground and abstracts groundwater; the kampung absorbs both effects.
5. **Tambak Langon core (±4.5 ha).** Tambak Langon core, a dense, low, subsiding residential area with limited access to the sea, has existed before the industrial development (see 2009 image below).

WHY CURRENT APPROACHES FALL SHORT

Finding the witches' brew involves protecting, adapting and retreating, each strategy failing when confronted with reality.

Protect

Seawalls, pumps, conventional polder system

The existing protection measure has failed because the drainage and pump capacity are insufficient. This area receives runoff water from wealthier areas, and groundwater extraction from industrial areas causes land subsidence.

Adapt

Maintain drainage and wall, elevated housing

Repairing and maintaining rigid grey infrastructure is expensive because of constant hazards. On the people side, raising house elevations becomes unaffordable, causing homes to sit below road levels where they become basins for rain runoff.

Retreat

Relocation, resettlement, abandonment

The local economy relies heavily on industrial activities. Employment is skewed towards industry/warehouse/logistics and small kiosks catering to workers. Fishing and fish trading also play a role.

FILLING THE GAP

Flood prevention measures should be closer to affected households rather than at a distance. The project will identify solution that can foster genuine stakeholder interaction.

DESIGN PRINCIPLES

Four commitments the design must be judged against

01 · Nurture knowledge, do not suppress it

Embodied knowledge of where water arrives, how deep and for how long, carries the same standing as hydraulic modelling.

02 · Prioritize to stay in place

Protection is for households, not the other way around. Here livelihoods are closely tied to the industrial edge and the ponds.

03 · Reuse and optimize the existing assets

Kampung roads and alleys function as micro-drainage while existing tambaks become retention ponds under agreed terms. Unsuitable areas for planting are avoided and cosmetic mangroves, which benefit neither nature nor residents, are not introduced.

04 · Maintainable by those who live with it and paid for by those who cause it

Local labor and materials can repair components within days, incentivized to do so. Groundwater abstractors and the elevated logistics road also share the cost of their operations.

THE PROJECT ASSETS

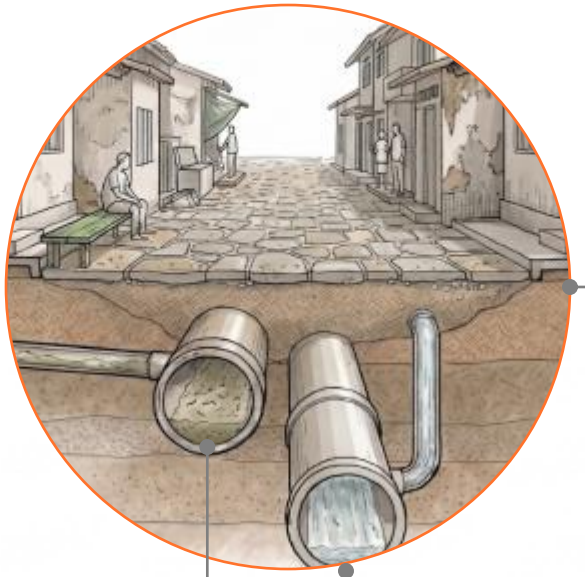
The four design principles to guide intervention and the Assets

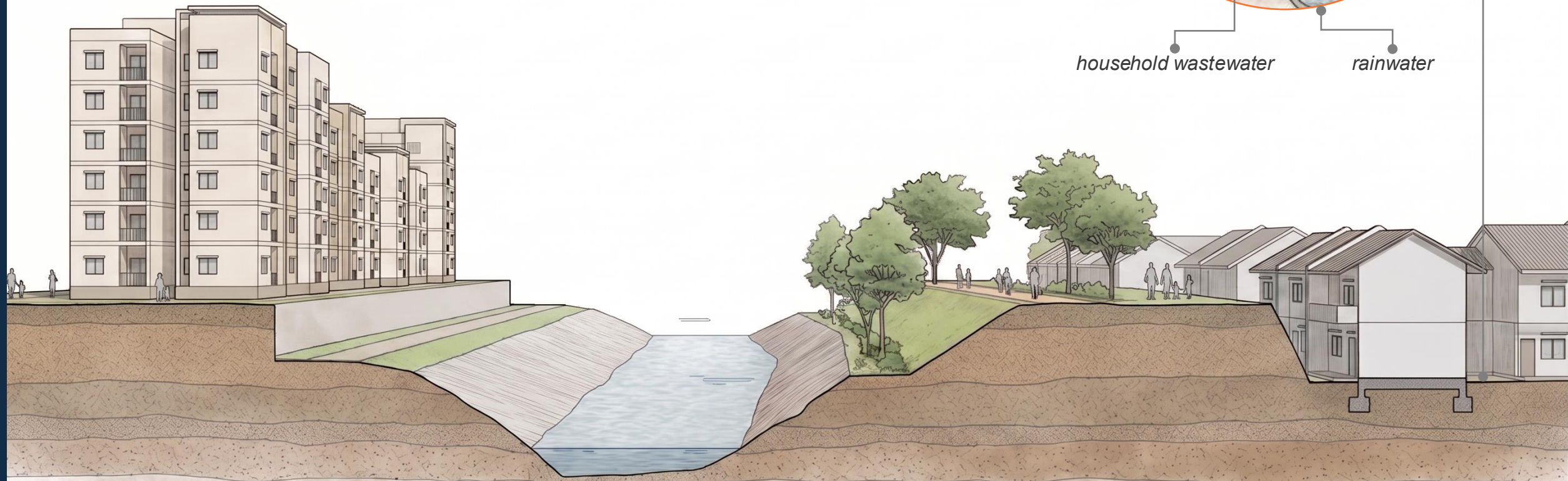
Following the principles, the intervention should use existing assets that form polder system, such as:

1. **Twin pipes**: Reuse existing Kampong's road as improved micro drainage system. The drainage has two pipes to separate households' wastewater and rainwater.
2. **Embankment**: The former site of riverside houses become earth embankment with accessible pathway.
3. **Retention pond:** Negotiate with *tambak* / pond's owners and farmers to use it as retention lake without destroying their livelihood.
4. **Resettlement**: Resettling riverside housing to vacant sites across the river, close to the original location.
5. **Pump**: Runoff water from the highway and the retention pond will be pumped to the river.
6. **WWTP**: Grey water from the twin pipes will be treated before flow into the retention pond.

VISION - WHAT THIS PROJECT DOES

- **The site will be protected against a 1:50-year flood event and annual tidal flooding until 2040**. Regular evaluations will monitor and respond to any changes in the local ecosystem.
- **The twin pipes will be fully operated effectively**. During high tide or flooding, the embankment will be inundated. Rainwater will be collected directly into the retention pond while household wastewater is treated off-site before entering the pond.
- **Land subsidence will stop or stable.** Reused water from the pond will replace groundwater extraction or be pumped into Kali Branjangan. Along with continuous groundwater monitoring.





VALUE CREATION

The improved value should be recognised by the communities directly affected, not by distant institutions

FINANCIAL VALUE

Avoided flood damage

Capex avoided by reuse.

Lower O&M.

Ponds keep producing.

Avoided industrial loss.

EXTRA-FINANCIAL VALUE

Days of work and school not lost

Staying put.

Sharing risk and benefit

Knowledge kept.

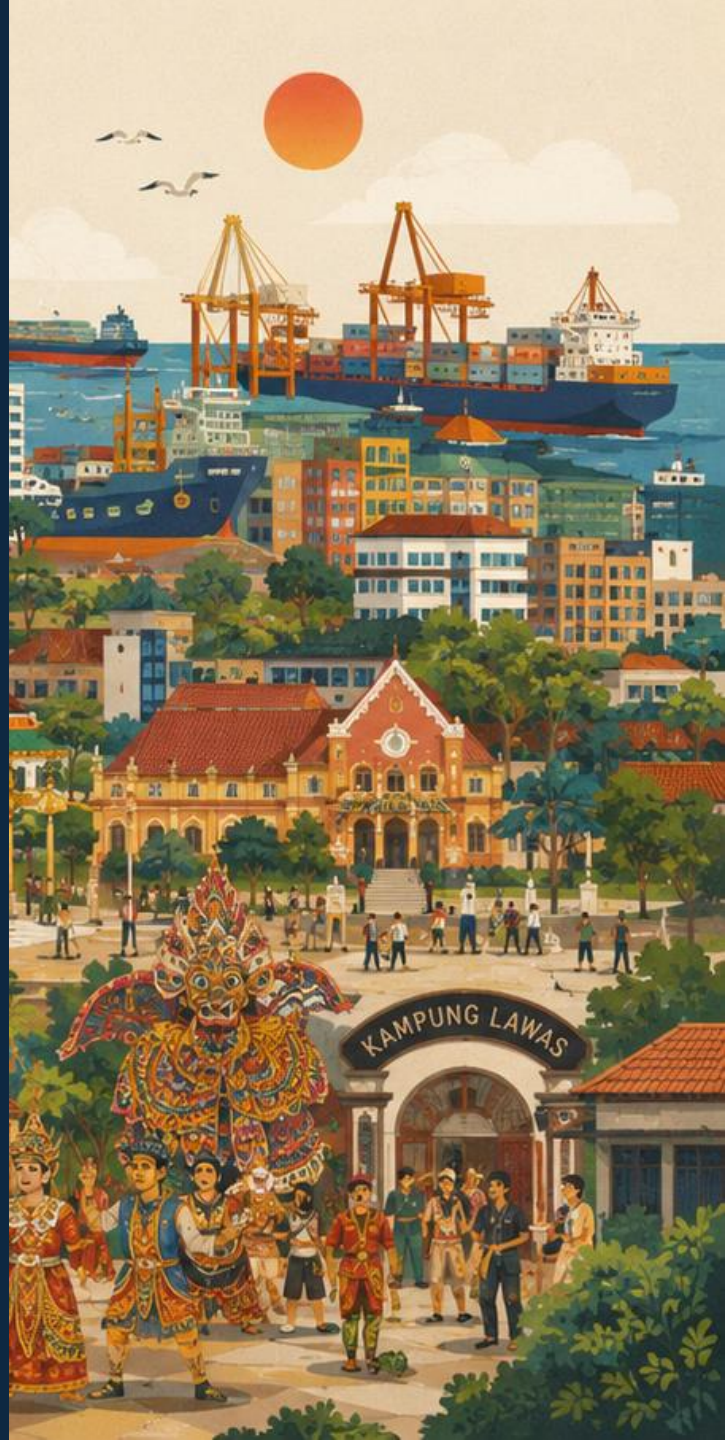
Institutionalized partnership.

> Prioritize effective measures and avoid large-scale change requiring permanent displacement unless necessary. Then develop change that genuinely benefits the affected community fostering their genuine care.

04

STRATEGIC CHOICES

Trade-offs made explicit, bold bets placed, quick wins banked.



INTERVENTION RISKS

The Nurture principle aims for assets stewardship, so the assets are the kind of thing that can be cared for.

Twin pipes

The existing drain already proximate to the residents. If that drain are choked, proximity has already been tested and failed. That is why walk and listen is the essential first step on this project.

Earth embankment

If the flood is pluvial and tidal, the water can still reach the site. A total enclosed embankment circling the site might be necessary but is impractical due to the highway's proximity.

Retention pond

Reusing brackish pond water is hardly feasible. Salt damages fixture and fabric. Moreover, static brackish pond emit unpleasant odor. On the other hand, the loss of livelihood of aquaculture farmer need to be replaced.

Resettlement + medium-rise housing

The project decides the riverbank should be floodplain. This is an expert judgement overriding residents' locational preference, which reflects livelihood access, not ignorance of risk

Pump

A pump converts a hydrological problem into a permanent institutional dependency and legitimizes continued occupation of ground that is subsiding below the tidal plane.

Wastewater Treatment Plant

Effluent quality is invisible to residents; they cannot verify whether the plant works, so "care" has no informational basis to act on.

Buried pipes, a treatment plant, and a pump are all invisible when working and invisible when failing. They offer no feedback to the people meant to tend them. The embankment and the pond are legible. The housing is legible but not maintainable by occupants; the rest are black boxes.

NECESSARY CONDITION FOR THE BENEFIT TO ARRIVE

Water leaves

Gravity outlet to Kali Branjangan works; pumps cover the rest

›

Land holds

Subsidence slow enough that the design is not outrun

›

Households stay

The people protected are the people who were here

›

Someone maintains

Local-Rooted institution to maintain finance, operation, and system

BOLD BETS

To ensure that the benefits are delivered, four necessary conditions have to hold: water leaves, no land subsidence, the beneficiary stay e.g. households, and someone maintains it. Each bet below is our attempt to secure one of them.
But a bet is a bet because it can lose. Every one of these carries a risk, and every one forces a trade-off we cannot design away. Therefore, for each bet we set out both: the trade-off it forces, and the final strategic choice we take.

1. Community-Based Polder Body

The polder is not just a structure, it is a system that should be maintained so the benefit actually delivers, and the job has to be done every year, for decades. In fact, infrastructure usually gets built first and maintained later, which is why so much of it stops working. So, we build the institution first: Polder Body, a local and community-based authority that responsible for all operational and non-operational management.

- Trade-off: Centralized management vs delegated authority
- Our strategic choice: Split the risk, the body holds the money and mandate, the cooperative tools and local knowledge

2. Zero! Groundwater Extraction

The ground here sinks partly because the factories around it pump groundwater. We do not tax the practice, we end it: piped supply and water reused from the retention pond replace industrial abstraction inside the polder catchment. Households and small-scale fisheries are untouched, since the law already exempts them.

- Trade-off: Huge cost at front for substitute supply vs decrease the risk of land subsidence
- Our strategic choice: The replacement supply is built first. Until it is ready, the wells stay open but every cubic meter is metered and charged, at a price that rises each year. The ban starts the day the replacement is delivered.

3. Avoid Unnecessary Displacement

We protect and keep the 4.5 ha village in their existing place and resettle only the riverside strip. Livelihood here is spatially bound: the industrial edge, the ponds, and markets. Unnecessary displacement will destroy the local economics system and income.

- Trade-off: Livelihood conservation vs ecological remediation
- Our strategic choice: Rent storage from the pond rather than buy land for it. The pond keeps producing and we get the volume without taking any ground

4. Integrated Knowledge

‘One size fits all’ fails here. Local knows best where the water arrives, how deep it gets, and how long it stays. We record that knowledge and model them integrated with AI and data processing model. It also fixes something broken: the official hazard map does not list this area as high flood risk, even though it floods every year. Their records are the evidence we use to correct it.

- Trade-off: Lived experience and professional modelling will not always agree, and one of them has to give way.
- Our strategic choice: The model defines the safety standard, because residents cannot visualize a 1-in-50-year flood event. Within that boundary, choices remain theirs: we provide compliant design options, and residents select what best fits their needs. AI only translates community inputs into structured records.

FINANCING MODEL

Keeping the spirit of nurture-based-solution, the budget logic and financing of this project rest on collaboration among several actors across a defined timeframe. One caveat: a polder system generates almost no user-paid revenue. A conventional PPP, in which private partners recover their capital from user charges, therefore cannot work here.

The government budget remains the catalyst for the initial investment, particularly for the embankment, the drainage, the pond easements, and the resettlement housing. For the pump station and the wastewater treatment plant, an alternative option is a PPP with availability payment, under which the government pays an annual fee for a service delivered to a metered standard.

The question that follows is: who is responsible once the system is built. As mentioned in the Bold Bets section, we propose a Polder Body holding Local Public Service Agency (BLUD) status. This status allows the local unit to retain the revenue it generates and to manage it independently, financing every business process the system requires. The main goals is that ten years after the project begins, operation and maintenance no longer rely on the national (APBN) or regional (APBD) budget.

Y0 — institution first. polder body established as BLUD, tenure over the 4.5 ha settled, all project package tendered and signed including PPP-AP

Y1-3 — initial investment, development of embankment, drainage, pond easements, resettlement housing, pump station, and wastewater treatment plant financed by: government budget, PPP availability payment

Y3-4 — shift who pays. all income: groundwater tax, betterment charge, CSR, etc. and expenses are all managed by polder body

Y5-7 — impact evaluation. replication gate: evidence against the baseline Y0, possible replication in another districts

Y10 — polder body self financing. own source revenue covers every recurring expenses, including the payment of PPP-AP

05

STAKEHOLDERS & SYSTEM

Whose interests must align, and how the polder sits inside the wider city system.

STAKEHOLDERS MAP

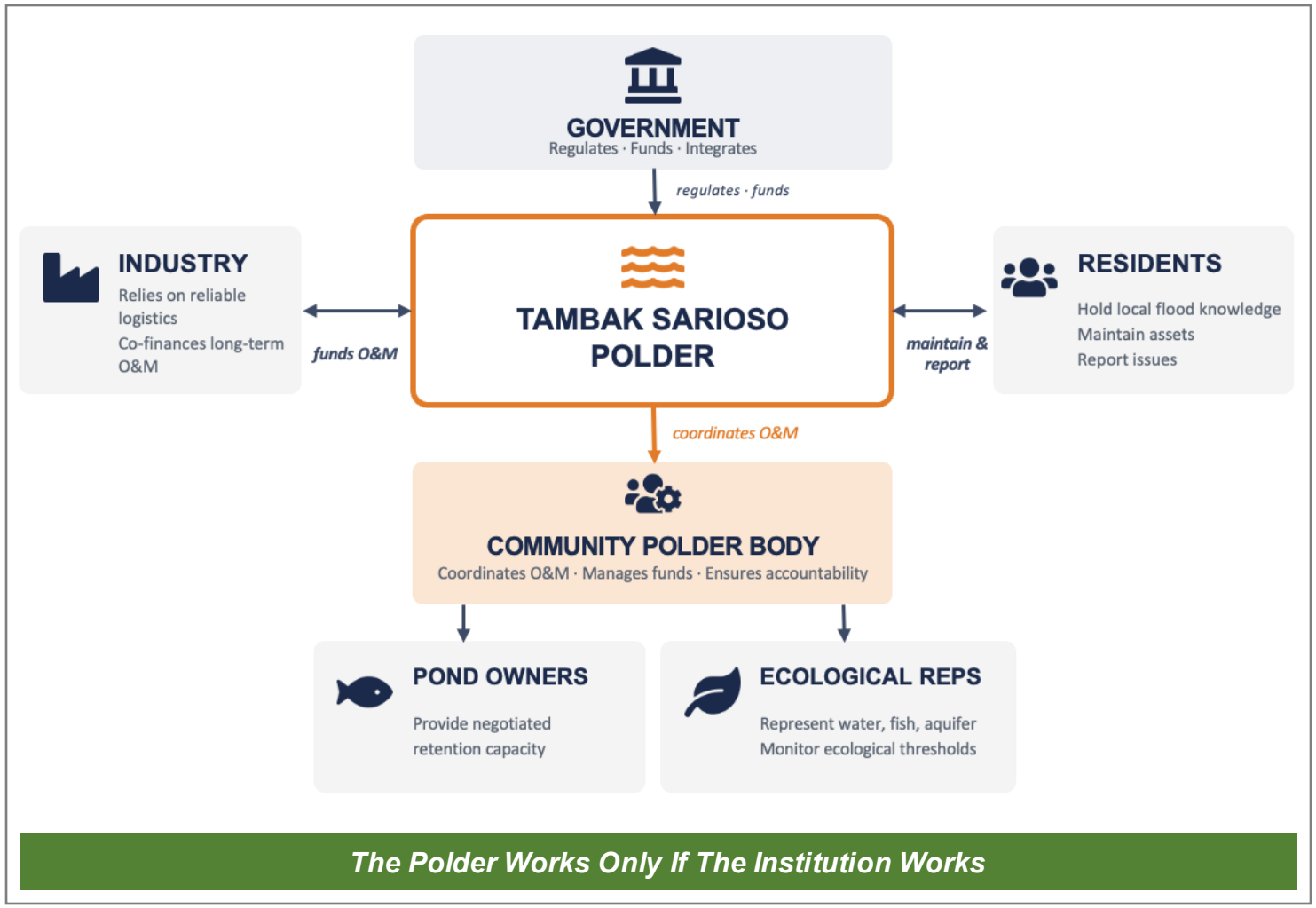
Who keeps the polder alive?

Unlike conventional flood infrastructure, the Tambak Sarioso Polder is not designed to be owned and operated by a single institution. Its long-term performance depends on the continuous alignment of actors who each control a different part of the system.

Residents contribute local flood knowledge, monitor drainage conditions, and perform routine stewardship that cannot be replicated through periodic government inspections alone. The Community-Based Polder Body serves as the operational coordinator, managing maintenance, funding allocation, and accountability while connecting local actions with formal institutions. Government agencies establish the regulatory framework, provide initial investment, and ensure integration with spatial planning, drainage management, and groundwater regulation. Industrial actors, whose operations benefit directly from reliable access and reduced flood disruption, contribute to long-term operation and maintenance while progressively reducing groundwater abstraction. Pond owners provide negotiated retention capacity without sacrificing productive livelihoods, while ecological representatives ensure that environmental thresholds and water quality remain integral to operational decision-making.

Rather than assigning isolated responsibilities, the project creates an institutional ecosystem where every stakeholder both contributes to and benefits from the continued functioning of the infrastructure. This distribution of roles reduces dependence on any single institution and strengthens the system's capacity to adapt over time.

Ultimately, the proposed polder is sustained not only by pumps, embankments, and drainage infrastructure, but also by governance arrangements that align incentives, responsibilities, and knowledge across multiple actors. In this project, the institution itself becomes part of the infrastructure.



ALIGNMENT & INCENTIVES

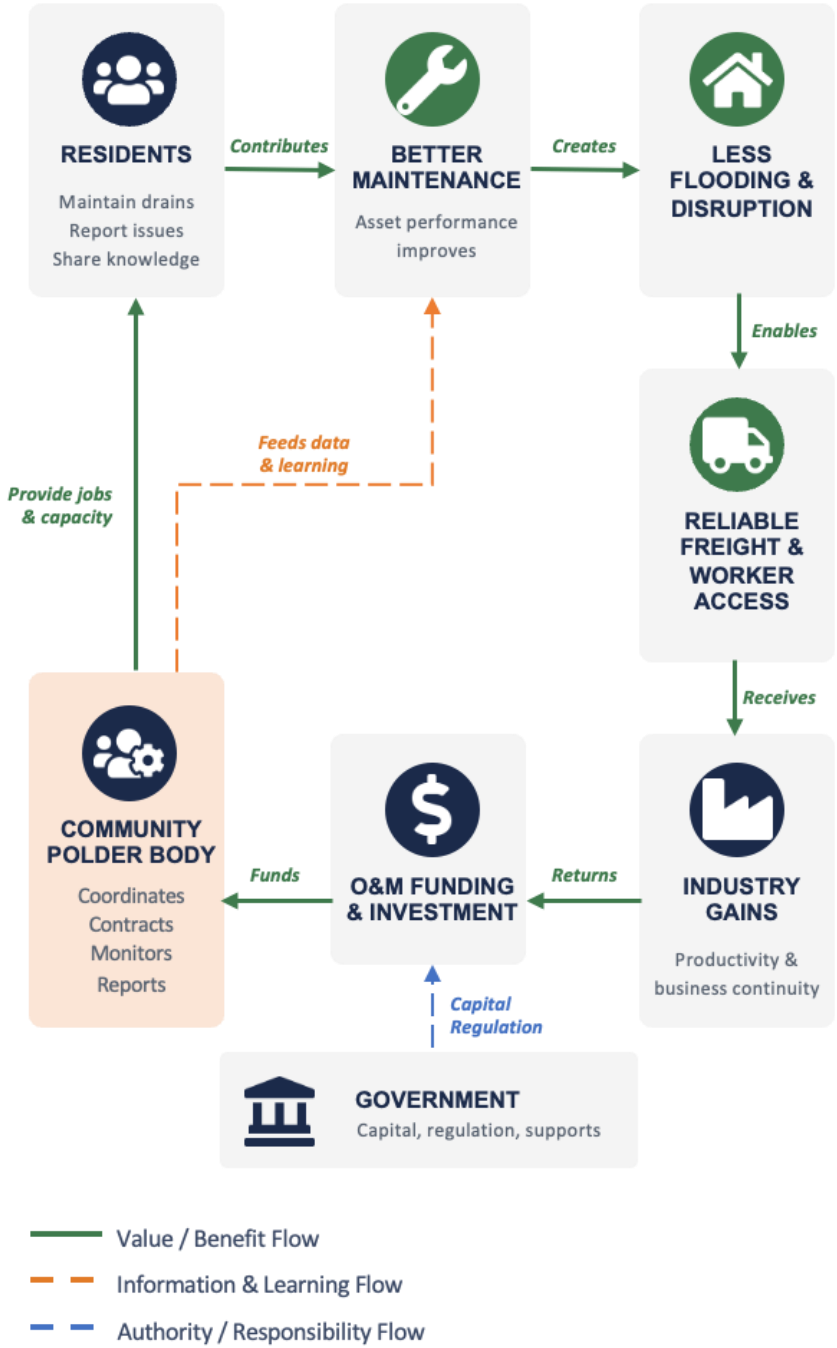
What each actor gives in exchange for what it receives, and why it keeps contributing.

The proposed governance model is built on a simple principle: every stakeholder should receive tangible value in exchange for a clearly defined contribution.

Rather than relying on voluntary participation or short-term project funding, the system creates a continuous cycle of mutual incentives. Residents contribute local stewardship by maintaining accessible drainage, reporting failures, and sharing flood knowledge. These actions improve infrastructure performance, reducing flood disruption and ensuring more reliable access for workers and freight.

As flood risk decreases, surrounding industries experience fewer operational disruptions, more reliable logistics, and lower economic losses. These benefits create a direct incentive for industries to contribute to long-term operation and maintenance through dedicated funding mechanisms. The Community-Based Polder Body manages these resources, coordinates maintenance activities, and transforms local knowledge into operational decisions, ensuring that financial investment is continuously translated into infrastructure performance rather than one-time construction.

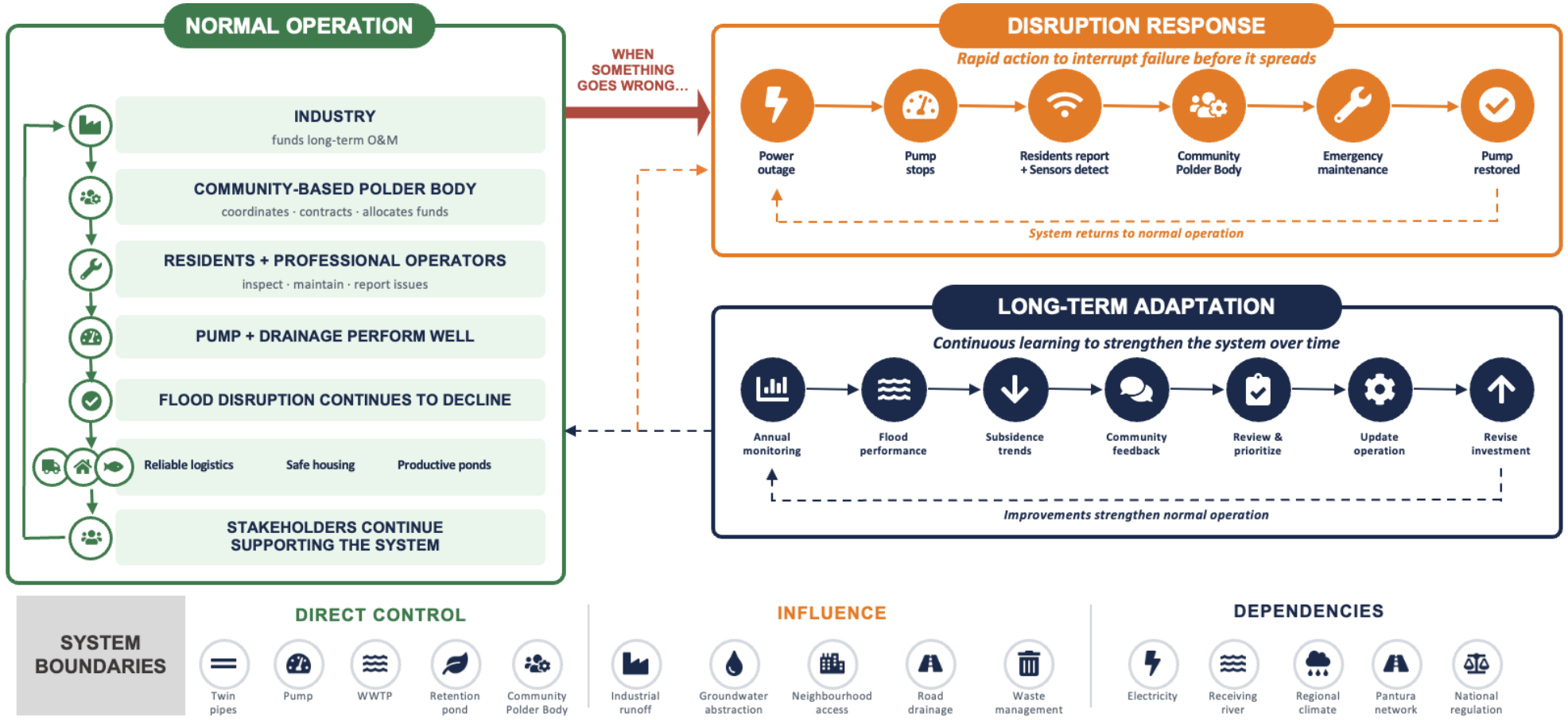
Government complements this cycle by providing the regulatory framework, initial capital investment, and institutional legitimacy required for long-term implementation. Instead of positioning communities, industries, and government as separate actors with isolated responsibilities, the project links them through an incentive structure where improved infrastructure performance generates economic, social, and institutional benefits that reinforce continued participation. In this way, resilience becomes self-reinforcing rather than dependent on periodic external intervention.



HOW THE GOVERNANCE SYSTEM SUSTAINS THE POLDER

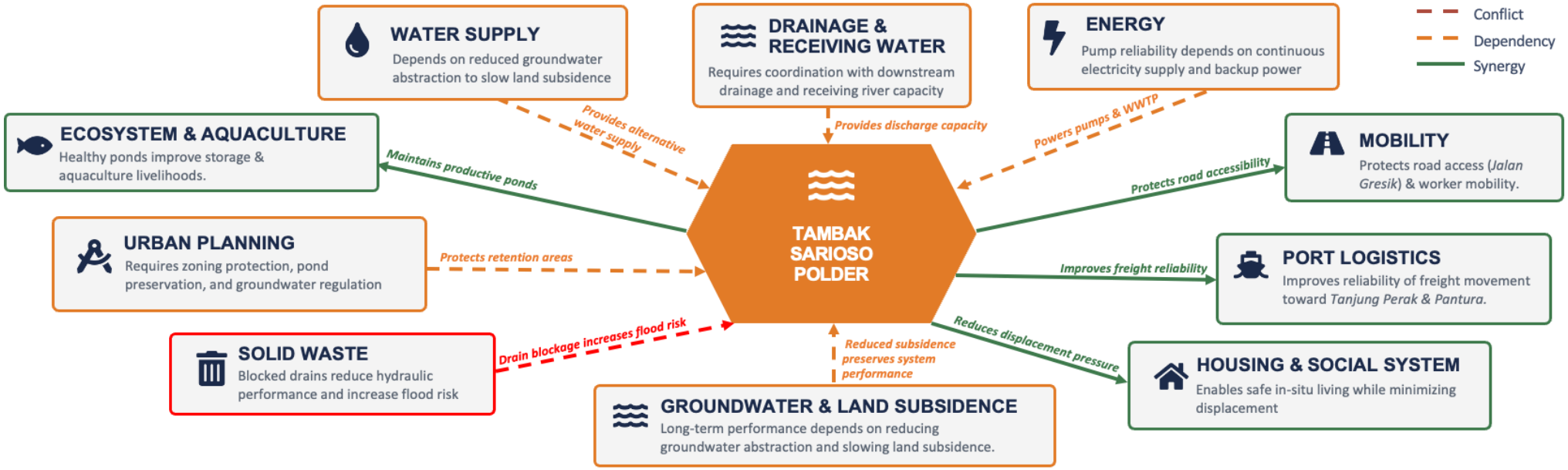
The Nurture-Based Polder is designed as a living governance system that remains functional long after construction.

During normal operation, collaborative stewardship between industry, the Community-Based Polder Body, and residents reinforces infrastructure performance through a continuous feedback loop. When disruptions occur, rapid reporting and coordinated response restore system performance, while continuous monitoring and adaptive management refine operations and future investments. Together, these interconnected processes ensure that the polder remains functional, responsive, and resilient throughout its lifecycle.



THE POLDER WITHIN THE CITY SYSTEM

The polder is not an isolated flood-control project. It is one resilient node within Surabaya's wider infrastructure ecosystem.



The Tambak Sarioso Polder should not be understood as a standalone flood-control project, but as one interconnected node within Surabaya's wider urban infrastructure system. Its long-term performance depends on multiple external systems, including reliable electricity, downstream drainage capacity, alternative water supply, groundwater management, and spatial planning that protects retention areas. At the same time, unmanaged solid waste represents a critical source of system failure by reducing hydraulic performance and increasing flood risk.

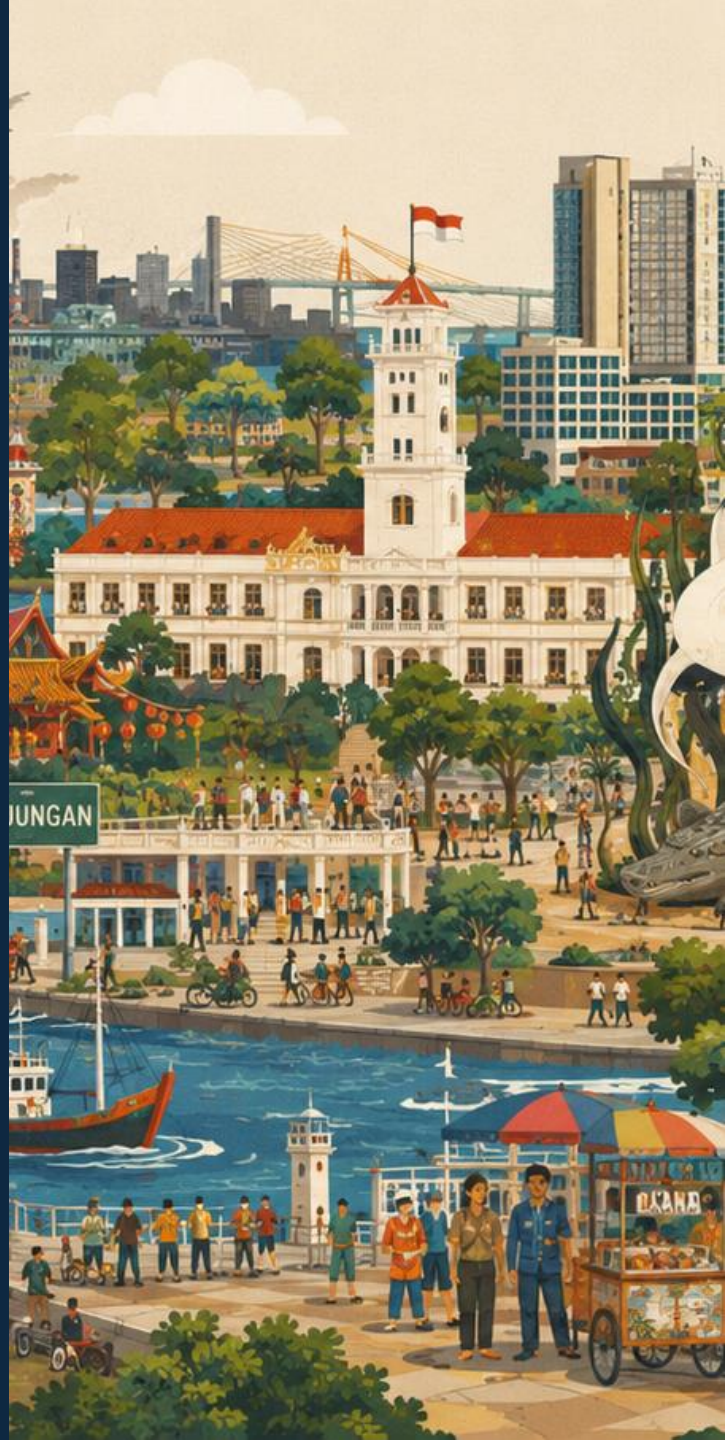
Beyond protecting the project site, the polder generates benefits across multiple urban systems. Improved flood protection enhances road accessibility for residents and industrial workers, supports more reliable freight movement toward Tanjung Perak Port, enables safer in-situ living, and helps preserve productive aquaculture landscapes. These synergies demonstrate that the value of the project extends beyond water management, contributing to the resilience of mobility, livelihoods, local economies, and coastal ecosystems.

Rather than functioning as an isolated engineering asset, the Tambak Sarioso Polder acts as enabling infrastructure that strengthens the performance of the wider urban system. *Its success is measured not only by how effectively it manages water, but by how many interconnected urban systems it helps keep functioning under increasing climate uncertainty.*

06

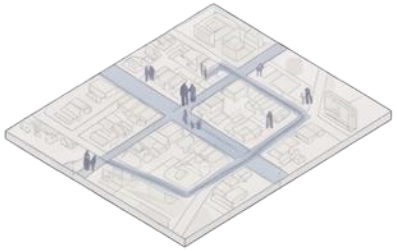
DELIVERY & IMPACT

Phased plan, cost, and enabling conditions.



CO-PRODUCTION AS ADAPTIVE PROCESS

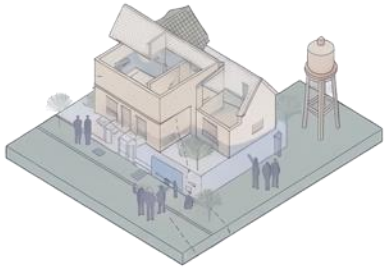
How lived experience enters the decision-making process



01

Walk and listen

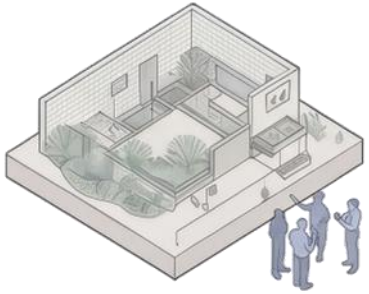
Flood-memory mapping with households: depth marks, timing, duration, coping routes.



02

Inventory the assets together

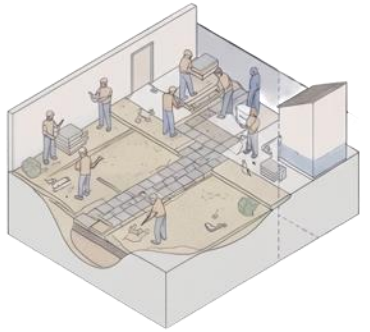
Which roads, alleys, walls and ponds already or potentially can act as drainage or storage and who owns them.



03

Design the cell jointly

Options tested against 1:50-year and annual tidal flooding to 2050; residents choose between configurations that all meet the standard.



04

Build with local labour

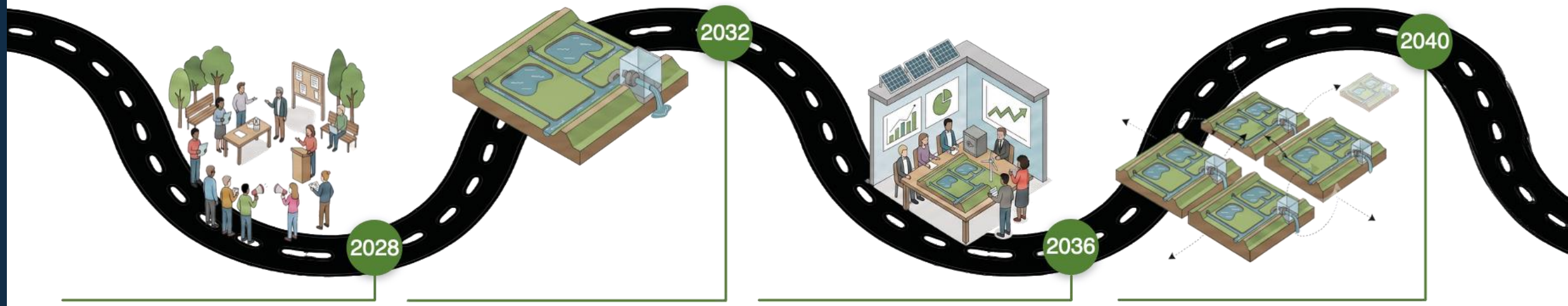
Road-and-alley micro-drainage, pond inlets and outlets, pump house use local materials and familiar methods so the residents can repeat.

05

Maintain, monitor, revise

Paid resident maintenance crew; annual review of subsidence, tide, pond ecology and repair records.

IMPLEMENTATION ROADMAP



Phase 1 · 2026–28

BASELINING

Milestone: The Polder Body has been established with BLUD *or Koperasi* status. A flood memory baseline has been recorded with households and a twin-pipe alley block has been built as a pilot. Tenure over the 4.5 hectares is settled groundwater abstraction is metered and charged.

Phase 2 · 2029–32

CONSTRUCTING

Milestone: Embankment, pond easement, pump house and WWTP commissioned; the polder holds a 1:50-year event and annual rob. Replacement piped water supply delivered. Zero groundwater extraction starts that day, or Phase 2 waits.

Phase 3 · 2033–36

DELEGATING

Milestone:
Evaluation passed against the Y0 baseline according to the drivers of scenario.
Polder Body self-financing with own-source revenue covers all recurring O&M and the PPP availability payment, with no APBN or APBD transfer.

Phase 4 · 2037–40

UPSCALING

Milestone: The polder is contextually replicated to Greges Barat if subsidence holds under 30 mm/yr,or the design switches to staged retreat of the lowest strip if it does not.
It is not copy-pasting, but contextually modified, as in "special pasting"

COST ESTIMATION

Civil works as upfront investment must be paid by Government money

Total cost 2026-2040
$21.5 M

COST LINE	PHASE 1	PHASE 2	PHASE 3-4	TOTAL
Civil works (embankment, retention, pumps)	$ 0.8 m	$ 6.5 m	$ 3.2 m	**$ 10.5 m**
Landscaping (riverside)	$ 0.2 m	$ 1.1 m	$ 0.7 m	**$ 2.0 m**
Co-production & capacity	$ 0.6 m	$ 0.5 m	$ 0.4 m	**$ 1.5 m**
Monitoring & digital	$ 0.3 m	$ 0.4 m	$ 0.3 m	**$ 1.0 m**
Annual O&M	$ 0.05 m/yr	$ 0.35 m/yr	$ 0.45 m/yr	**$ 0.45 m/yr**

Unit-cost basis:
Surabaya drainage and embankment rates (BPIW, 2024)
earth embankment ≈ $95/m, twin-pipe alley drainage ≈ $140/m, pump station ≈ $1.4 m per m³/s installed, resettlement housing ≈ $18k per unit for 60 riverside households.

Comparator:
Banger Polder, Semarang: a comparable soft-soil coastal polder at roughly $12 m over a decade.

Construction phase (Phase 2) cannot start unless:

(1) Piped water supply to all households and industrial buildings before prohibit groundwater extraction;

(2) Community use of pond are signed with tambak owners at agreed rent;

(3) The Polder Body holds BLUD or *Koperasi* (Village-owned enterprise) status, with authority to retain and spend its own revenue.

IMPACT ASSESSMENT

Indicators and target to be achieved in 2040

THE MAIN INDICATOR

Tidal-flood days per household: from 4-5 a year in 2026 to zero event in 2040

Chosen because this is the most visible impact from the project. The residential areas and roads are flooded, created significant disruption to daily activities. The flood disappearance also reduce traffic disruptions due to flood on the highway, producing less emission and more productive logistic activity.

SECONDARY INDICATOR 1

Ecological: pond and river water quality within agreed salinity and Biochemical Oxygen Demand (BOD) thresholds to be reused as raw water supply and aquaculture.

SECONDARY INDICATOR 2

Institutional: share of recurring O&M covered by the Polder Body' own-source revenue.

SECONDARY INDICATORS 3

Distributional: resettled households rehoused within 500 m of their original plot and livelihood.