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Pasig River Plastic Waste Digital Twin

ADB Circular Economy Forum

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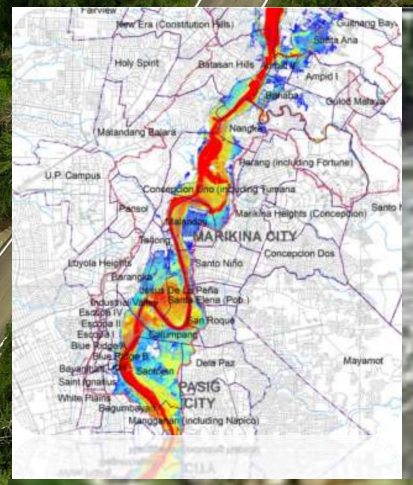

10 years ago

(2013)

DEPARTMENT OF SCIENCE AND TECHNOLOGY

Introduction

PASIG RIVER PLASTIC WASTE

ADB CHALLENGE

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THE CHALLENGE

How can we leverage digital twin technology to effectively reduce plastic pollution in the Pasig River, one of the largest contributors to global ocean plastic, by developing scalable and data-driven solutions?

Introduction

PASIG RIVER PLASTIC WASTE

ADB CHALLENGE

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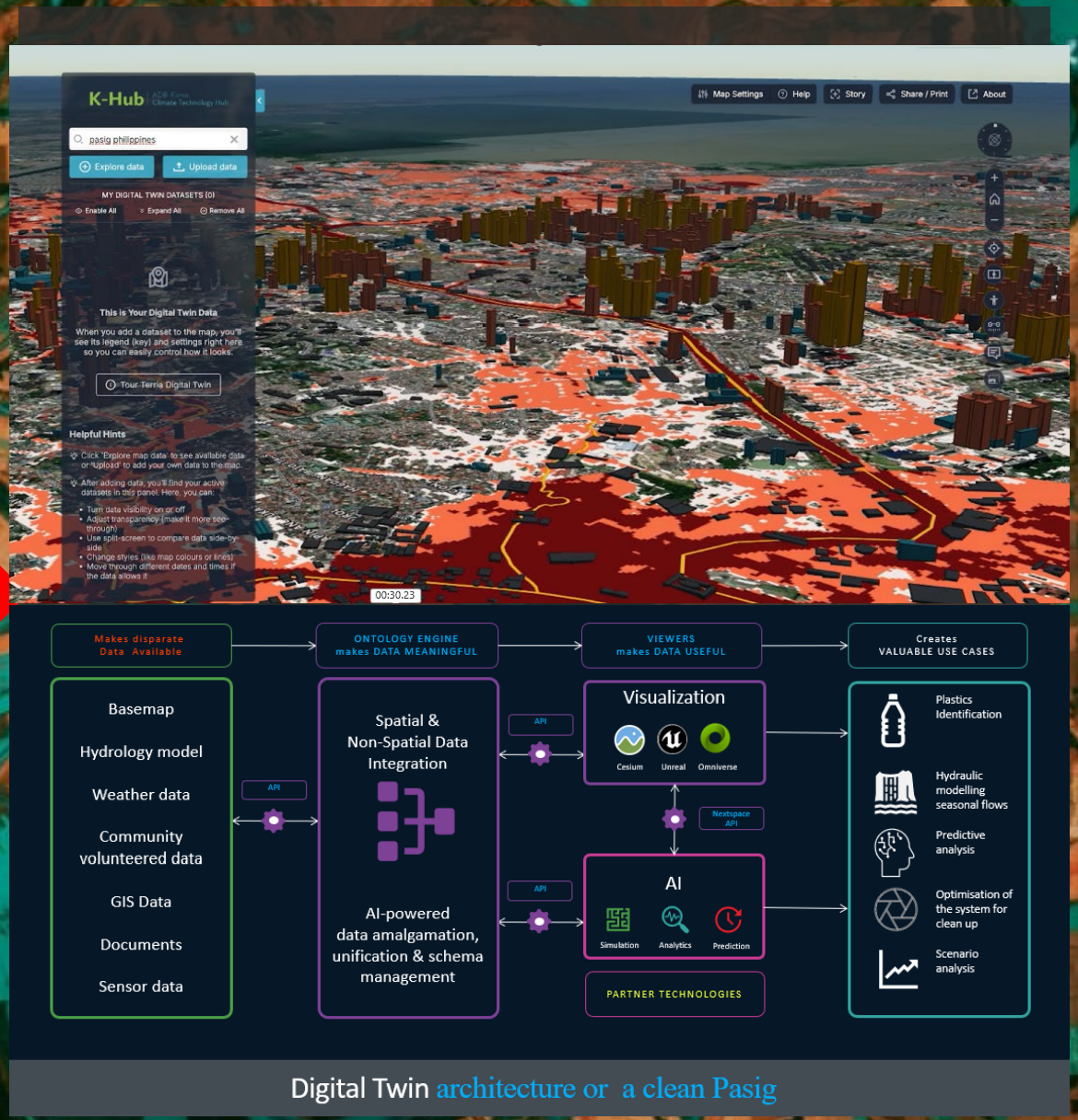
THE RESPONSE

Using Digital Twin Technology that will accurately reflect the physical river, allowing for real-time monitoring and analysis of plastic hotspots, identifying key pollution sources and tracking the flow of plastics through seasonal variations and develop actionable insights to reduce plastic waste

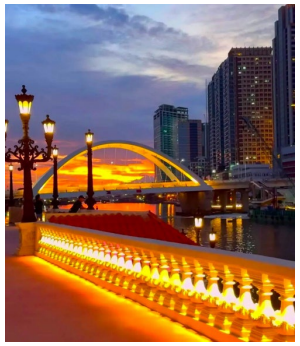


Digital Twin architecture or a clean Pasig

Partnership for Pasig: ADB is incorporating key lessons learned over decades of partnership in revitalizing the Pasig River, in support of GoP's renewed urban redevelopment efforts under the PBBM priority project

Nov-Dec 2024
MoU Signing between ADB and UAE's Clean Rivers

Launch of Pasig River Plastic Waste Discovery Space



Commercial Activities commence on Pasig River Esplanade

2025

10 February 2025
ADB, City Government of Manila, and DENR-EMB launch the Manila City Action Plan for Plastic Circularity in HQ

12 February 2025
MoU Signing between Government of the Philippines and UAE (UAE announced $20M pledge for Pasig River)

27 February 2025
Inauguration of the West Showcase Area (Plaza Mexico, Maestranza Esplanade, and Fort Santiago Riverwalk)

24-25 March 2025
Collaborative Engagement Lab for Developing the Pasig River Digital Twin

ADB GoP

ADB SPECIAL INITIATIVE: REJUVENATING PASIG RIVER FOR A LIVABLE MANILA

ADB

PASIG BIGYANG BUHAY MULI

PASIG RIVER URBAN DEVELOPMENT

6 KEY PRIORITIES

- Water system rehabilitation
- Transportation
- Recreation
- Mixed-use development
- Tourism
- Sustainable human settlement

15 MEMBERS IN THE INTERAGENCY COUNCIL

Department of Human Settlements and Urban Development (chair of interagency council)
Metro Manila Development Authority (vice-chair)

9 DISTINCT SEGMENTS OF THE RIVER

ADB'S HOLISTIC SOLUTION

- Integrated, sustainable planning and governance
- Enhanced multimodal connectivity
- Multi-river, low-carbon mobility
- Modern vessel traffic control system

Transportation
Water systems
Urban planning
Tourism and recreation
Natural resource
Circular economy

- Coastal resilience and flood risk management
- Solid waste and wastewater management, and river clean-up
- Pedestrian and bicycle mobility, and green public spaces

CROSSCUTTING THEMES

Digital Transformation
Digital twins
Futureproofing

Gender Mainstreaming
Gender action plan
Human-centric design

Governance and Institutional Capacity
Interagency capacity

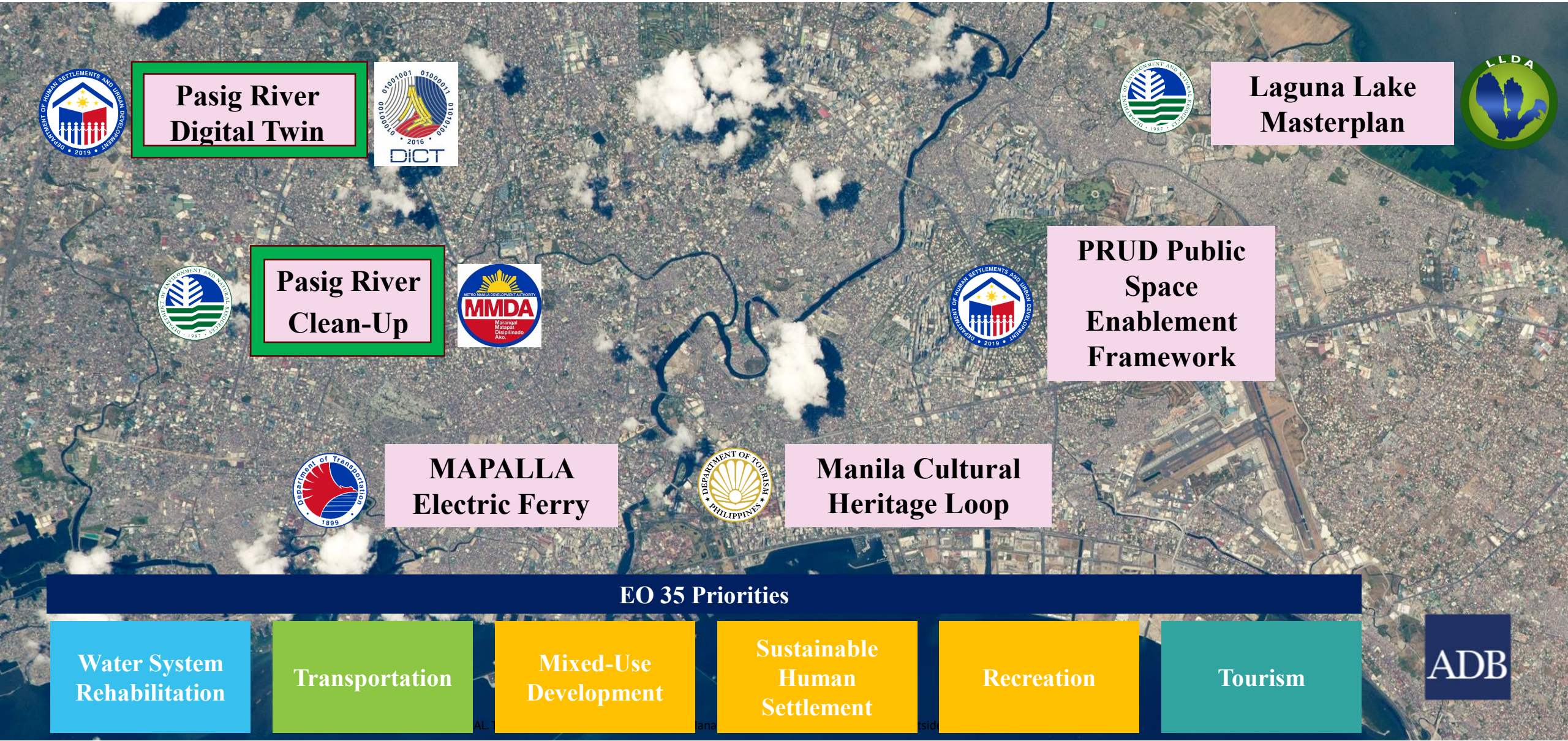
PUBLIC AND PRIVATE SECTOR

Structuring of **public and private sector climate financing** and **public–private partnerships**

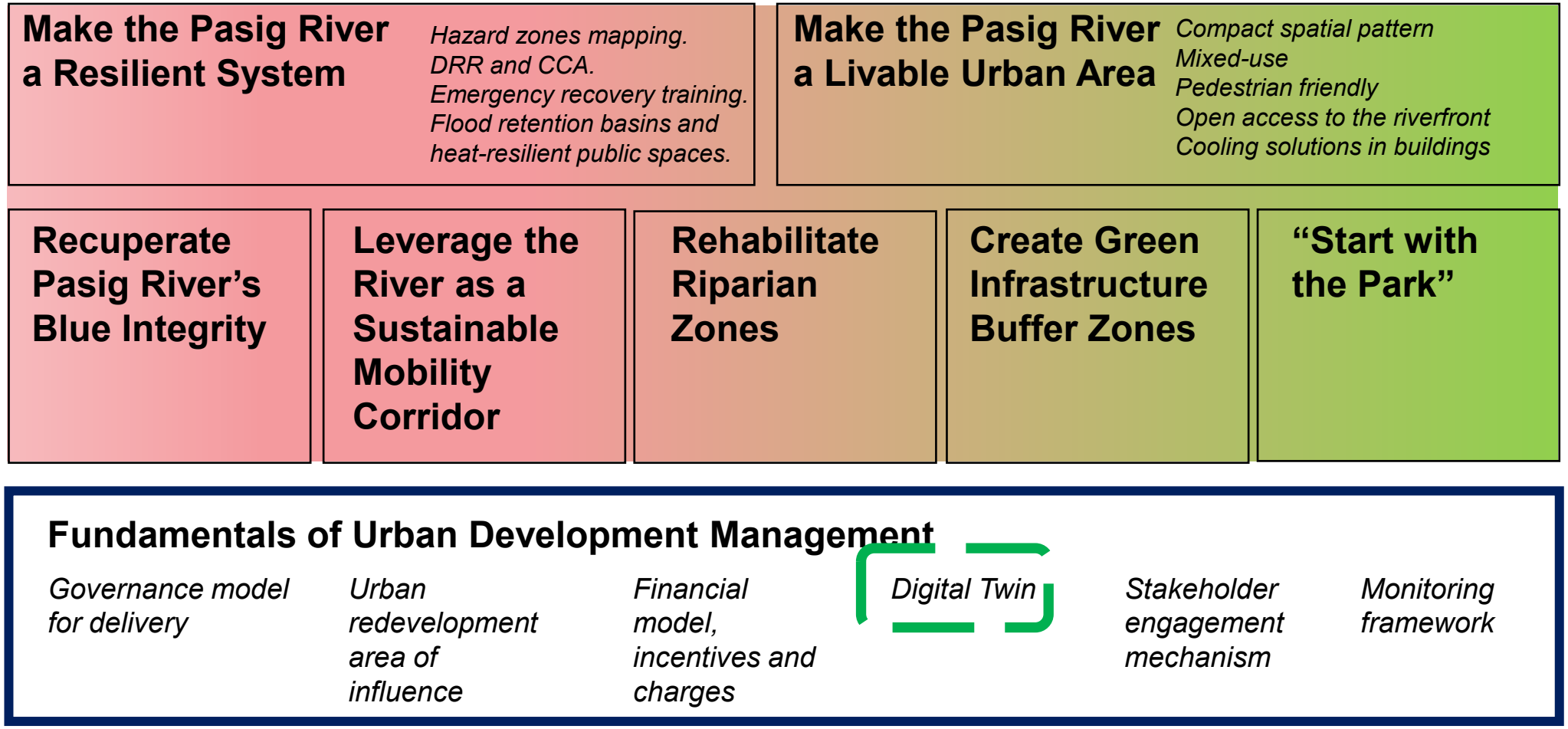
ARM240443-2
Printed on recycled paper

ADB's holistic approach incorporates **smart, climate-resilient**, and **integrated** urban planning and investment solutions in support of PRUD's 6 key priorities.

ADB's solution supports **sustainable, inclusive and more integrated** economic and urban development throughout the Greater Manila Bay



Enablement Framework for Pasig River Urban Development – Guiding Principles



Pasig River Digital Twin
Proposed Phases of Development

We recommend a three-phase implementation plan - guided by the Pasig River IAC and supported by ADB and informed by global best practices - to ensure scalability, institutional ownership, and long-term sustainability.

Phase 0

Technical Assistance (6 months)
Pasig River Plastics Digital Twin Prototype

Phase 1

Foundational Build

- DHSUD and DICT establish TWG, Governance & Strategy for the Pasig River Digital Twin.
- Define Platform Architecture and core technical foundations.
- Integrate priority data sources and DICT environment (data sharing).
- Build two pilot use cases & Initial User Interfaces (UI)
- Roadmap future use cases

Proposed Duration: 2 years
Steered by the TWG

Phase 2

Operational Expansion

- Scale functionality, geographic coverage & sectoral modules
- Add advanced analytics & simulation
- Roll out additional use cases across agencies

Estimated Duration:
2-3 years

Phase 3

Maintenance & Upgrading

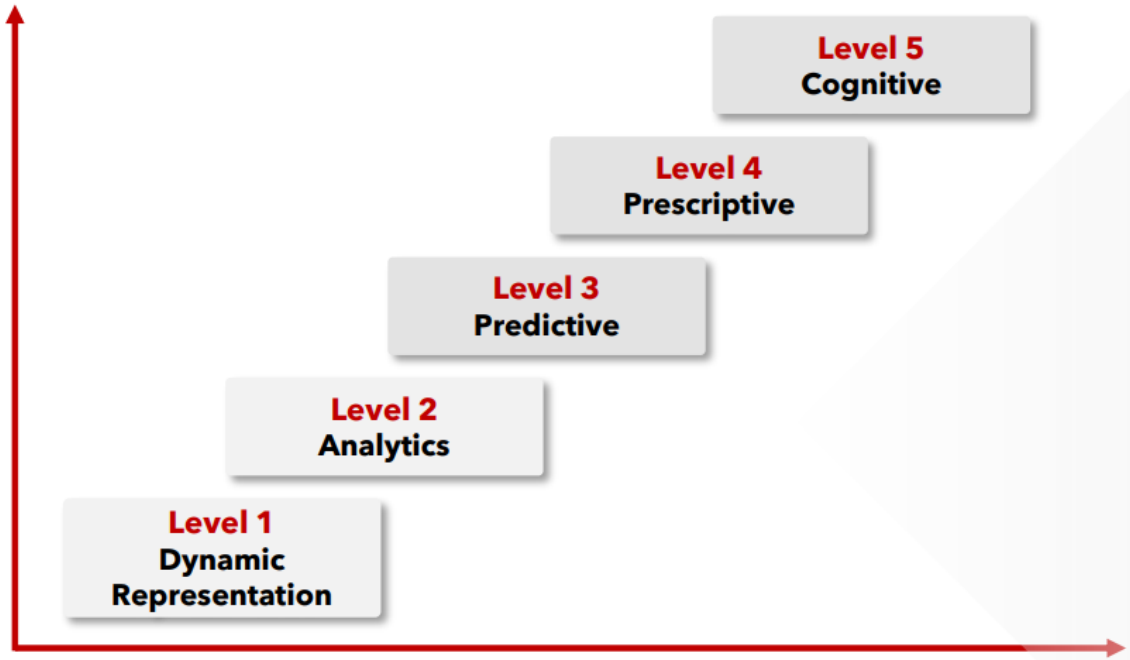
- Perform ongoing model updates- Integrate with smart-city and e-governance systems
- Set up governance & financing for operations
- Develop regulatory & PPP engagement strategies

Estimated Duration:
2-3 years

Digital Twin Maturity (ADB)

Enabling Technologies
Describes the configuration of the Digital Twin based on the utilization of key enabling technologies.

The higher it is on the axis, the more enabling technologies involved.



Digital Twin Capabilities
The **higher maturity level corresponds to more Digital Twin capabilities**. This ranges from static to dynamic representation of data to predictive intelligence.

Level 5 – Cognitive
Capable of taking **autonomous actions and interventions** within defined boundaries.

Level 4 – Prescriptive
Evolves to incorporate more advanced AI capabilities to generate **prescriptive analytics.**

Level 3 – Predictive
Ability to **generate predictive insights** through advanced data science or AI capabilities.

Level 2 – Analytics
Incorporates data analytics to **generate more sophisticated insights and feedback**.

Level 1 – Dynamic Representation
Primary feature of aggregating and visualizing data to create a **dynamic virtual representation** of its physical counterpart with real or near-real time data.

Source: ADB Discovery space

The Pasig River in the Philippines

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Overview

The Pasig River Plastic Digital Twin is being developed as an open source and scalable spatial digital twin aligned with the Gemini Principles

Purpose: Must have clear purpose	**Public good** Must be used to deliver genuine public benefit in perpetuity	Value creation Must enable value creation and performance improvement	Insight Must provide determinable insight to the built environment
Trust: Must be trustworthy	**Security** Must enable security and be secure itself	**Openness** Must be as open as possible	**Quality** Must be built on data of an appropriate quality
Function: Must function effectively	**Federation** Must be based on a standard connected environment	**Curation** Must have clear ownership governance and regulation	**Evolution** Must be able to adapt as technology and society evolve

The Gemini Principles paper (University of Cambridge,2018)

The Pasig River Digital Twin is being built for integration of federated data and where the data license permits it allows for data to be accessed via API feeds.

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Plastic Use Case

Current Reality of Pasig River

Plastic Waste Crisis starts from Tributaries and Waterways

It will answer all our questions?

What are the sources?

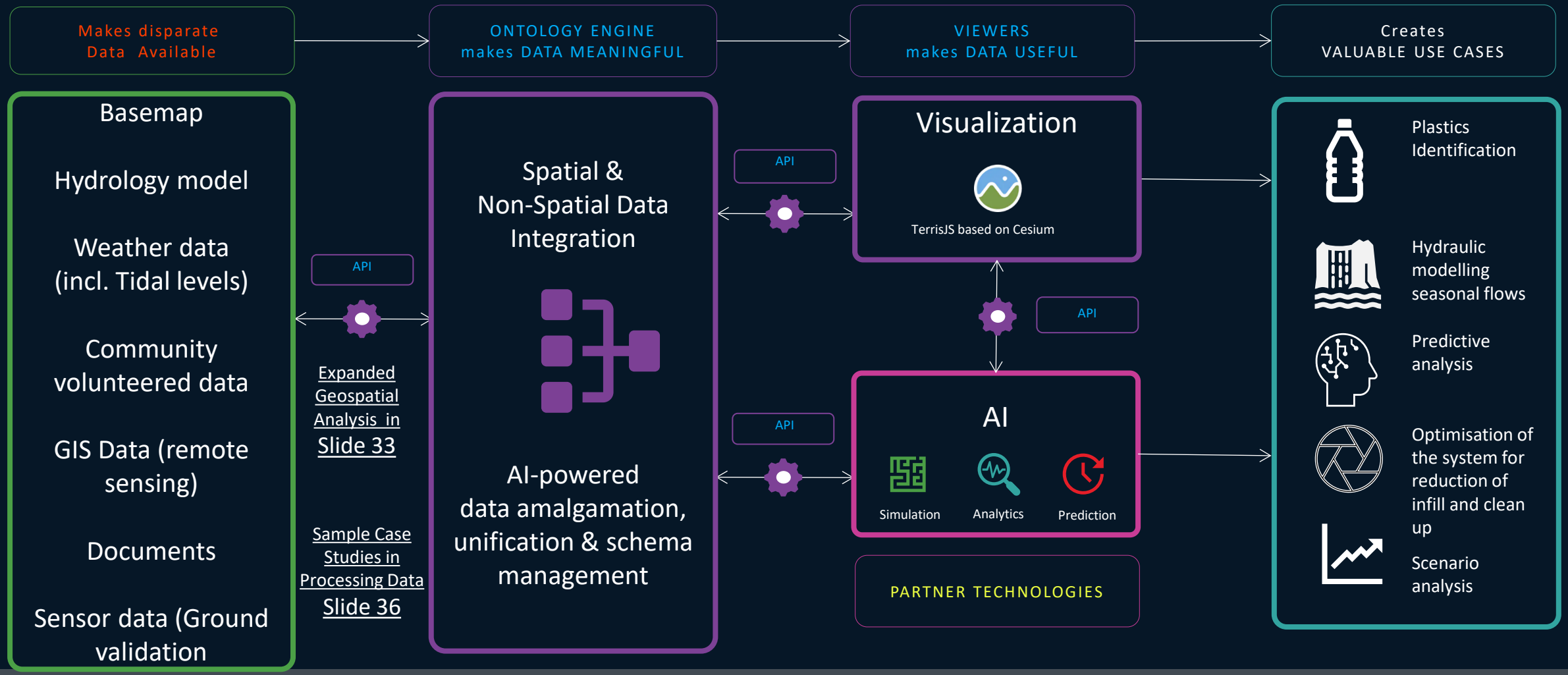
Where does it end up?

Where does it block up?

What do those plastic flows mean?

What should be the interventions?

Digital Twin architecture for a clean Pasig



Harmonise the data into a unifying platform (TerriaJS), this will allow the data to be rapidly searched, queries to be executed and the ability to visualise results. **Enable** results from **scenario** to be called and the results to be integrated via API. This will allow the very best models to be used and the results to be integrate 'minimising reinvention' at the same time allowing the base open source twin to be scaled.

Predictive modelling approach

The Digital twin will be brought to life through use cases, the foundation for the use cases is the Hydraulic modelling of seasonal flows. This will demonstrate the seasonal flow of plastics in the river. Using the digital twin we will test different flows and plastic removal strategies. This data will be validated and tested via River Recycle – ultimately creating an optimised waste removal strategy.

Creates VALUABLE USE CASES → **Predictive Modelling PROCESS** → **IMPACT**

- Plastics Identification
- Hydraulic modelling seasonal flows
- Predictive analysis
- Optimisation of the system for reduction of infill and clean up
- Scenario analysis

Utilise vision analytics and training data from River Recycle to identify plastic Types to be modelled (Macro/Micro)
Actual plastic type flow can also be used for model validation
(Refer to slide 35, one possible solution for collecting Validation Data)

↓

Input plastic types + weather data into a hydrodynamic model of plastic flow on river

↓

Model Assumptions and Scenario Development (**refer to Slide 5 on testing and experimenting plastic removal strategies**) - Using Data to Support Decision Making: Developing actionable insights to reduce plastic waste

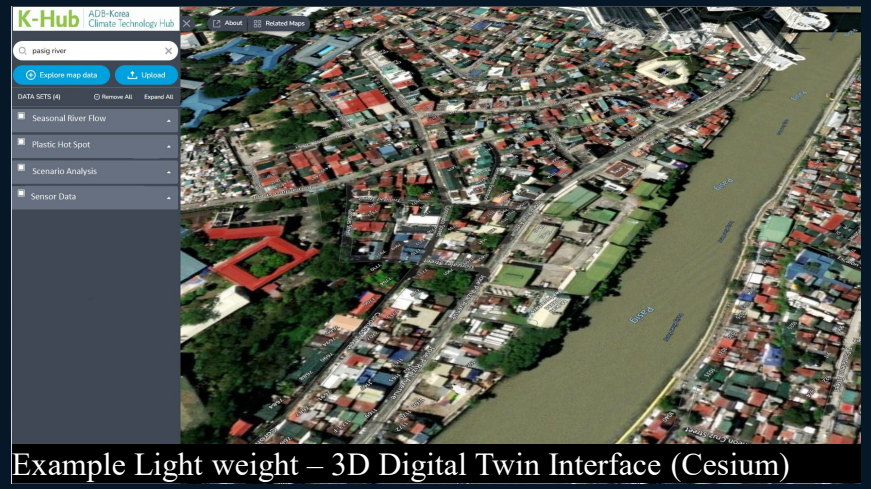
↓

Plastic hotspots on Pasig River analysed and options for reduction investigated

↓

Plastic reduction into the river system reduced.
Refined Plastic Removal Strategies
- Presence of Plastic barriers
- River/Estuary cleanup efforts

Informed plastic collection efforts
- Allocation of personnel resources
- Provision of Plasticbanks/Junkshops



Example Light weight – 3D Digital Twin Interface (Cesium)

Government Stakeholders

DENR

Department of Environmental and Natural Reources

Pasig River Coordinating and Management Office

(PRCMO)

Solid Waste Management Division

(SWMD)

Knowledge and Information Systems Service

(KISS)

Foreign-Assisted and Special Projects Service

(FASPS)

DHSUD

Department of Human Settlements and Urban Development

DICT

Department of Information and Communications Technology

DOTr

Department of Transportation

Manila

City of Manila LGU

PhilSA

Philippine Space Agency

DILG

Department of the Interior and Local Government

DPWH

Department of Public Works and Highways

MMDA

Metro Manila Development Authority

Mandaluyong

City of Mandaluyong LGU

Project e-SMART

Eco-System Modeling and Material Transport Analysis for the Rehabilitation of Manila Bay

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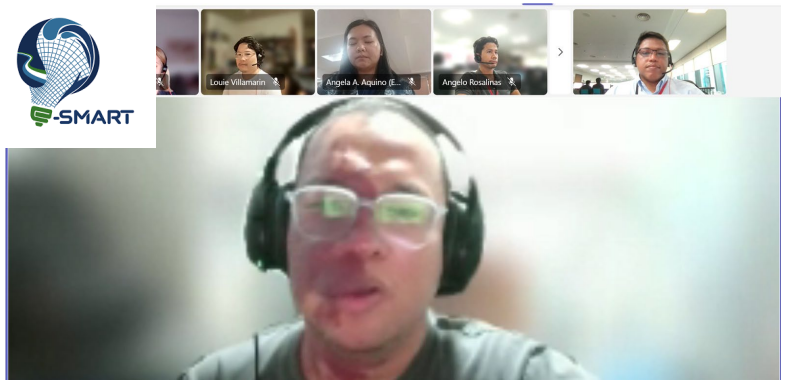
Stakeholder Engagement



Stakeholder Discussion
Identifying Gaps and Opportunities

~Who in your agency would **benefit from using the Plastic Digital Twin** (roles, departments?

~What **specific decisions or tasks** would it help them with?

~What **challenges do they currently face** (e.g hotspot identification, tracking illegal dumping on river) **that the Plastic Waste Digital Twin might help solve?**

~What **outputs or functionalities should the Plastic Waste Digital twin include** (e.g., plastic flow maps, risk hotspots, forecasting plastic accumulation)?

~What **plastic-relevant data does your agency currently collect** that can support the digital twin (e.g waste audits, clean up reports?

~What is the **status of this data (open, restricted, internal use only)?** What are your agency's **current protocols or challenges** regarding **data sharing?**

~What features would encourage you to **continue investing time and resources in** using the tool for long term?

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Starting with a Digital Twin User Journey Map

PASIG RIVER PLASTIC WASTE REMOVAL JOURNEY (CURRENT STATE)

PHASE

Trigger & Early Awareness → Planning & Permitting → Deploy Booms & Traps → Collection & Removal → Sorting, Recycling & Disposal → Reporting, Community Engagement & Policy → Continuous Improvement

USER(S) STEPS

(Sequence of activities in workflow - Add one Post-it per step)

Target digital twin user (This could be yourself, your team, your org, your client, your audience)

"There is a continuous collection of waste ... if it's a rainy season or if there's a typhoon coming in ... [plastic] will be flushed out directly to the ocean." — Rudolph

"It takes some permit before they could deploy booms or trash traps." — Rudolph

"They have these booms across and they have to turn the booms around." — Serryn

""They're literally sacks and each one takes about 20 kilos ... they count how many sacks they've done for the day."" — Serryn

"River Recycle are making boards ... about an inch thick ... you can use it for building materials." — Serryn

"They would publish all their cleanup operations there. So through Facebook ... PRCMO." — Rudolph

"We're investigating using satellite imagery ... then set up some cameras ... look at velocity." — Serryn

Daily river patrols | Watch rain/typhoon bulletins | Visual tide check. → Identify hotspot | request LLDA | PRCMO permit | Schedule crews/boats → Tow semi-permanent booms; | Orient efforts with tide | Adjust daily → Net plastic | Fill 20 kg sacks | Load sacks to trucks/rafts | Haul sacks to transfer station.l | Segregate at transfer station | River Recycle melts soft plastic into boards | Residue to landfill | Count Number of sacks pulled from river | Submit to head office/online → MMDA & PRCMO post cleanup stats on Facebook | ADB needs quarterly reports | Education roadshows → Retrain camera model | Load new satellite imagery | Tune hydrology model.

TOUCH POINTS

(What tools & people do they interact with at each step?)

Mobile SMS from Weather Bureau; MMDA flood dashboard; staff "looking at the water."
""We just look at the water and go 'I think it's coming in now."" — Serryn

PDF forms; agency phone calls; ad-hoc spreadsheets.
"So it's not just ... you will automatically do cleanup. There is some permitting process."— Rudolph

MMDA ops dashboard; on-site crews; heavy equipment.
"Some ... connect their booms to large pylons ... the direction ... needs to change." — Serryn

Paper logbooks; Google Sheets; truck GPS (when available).
"The data collection are entirely manual ... maybe Google spreadsheet."
Waste being collected in pumping station

Recycling-facility ERP; River Recycle QA logs; landfill weighbridge.
"River recycle make boards – inch thick – building materials." —
Workshop Sticky Note

Terria public catalog; social media; workshops.
"I can imagine ... take a photo and geolocate and get that process happening a lot faster." — Serryn
Google spreadsheet

Jupyter/GIS servers; Slack; ADB oversight.
""There is ... sensors out there that are mapping tidal changes."" — Serryn

DATA

(What data do they need to complete this step?)

- Hourly water-level sensors; tide tables; rainfall forecast.
- Illegal dumping
- Cameras - measure velocity of flow
""There is ... sensors out there that are mapping tidal changes."" — Serryn
- Hourly water mapping
- Locations and streets of booms
- Waste accumulation
- Pumping Station locations

Permit checklist; hotspot layers; historic clearance list.
"Need a permit before you can deploy a trash boom." — Amber
indicate duration of operation.
Agreement in number of resources

Tide predictions; live current vectors; anchor points.
"Booms & trash traps – ad hoc basis." — Amber

Sack counts; truck routes; camera velocity estimates.
"Count how many sacks for the day."

Plastic-type classification; output volumes; QA photos.
Count how many sacks for the day
Number of sacks pulled from river

Baseline heat-map; citizen photos; time-series exports.
"Facebook / Community / Social Media"

Maxar imagery; machine-vision outputs; ETL health logs.
"Data collection are entirely manual."" — Rudolph

PAIN POINTS

(Where do they struggle at each step)

Info scattered; no predictive alert; action happens same day as rainfall.
"Rain event = Same day (Upstream)" | "No way to warn in advance."
- Tourism impact - pain point
- Satellite imagery - measure volume of plastics
- Scattered in different systems
- Hard to maintain data on a daily basis
- Continuous effort to clean up and rehabilitate the river

Paperwork delay lets plastic drift to sea; approvals vary by LGA.
"Delay – involves multiple LGAs – moving target."
- Missed plastic goes into ocean
- Delay in getting approvals
Some data is out of date

- Dangerous in typhoon conditions; manual judgment.
"They cannot really operate if there is a strong typhoon ... it's also an issue of safety .. heavy equipment." — Rudolph
Delay between reporting and it moving downstream - makes it hard to 'Catch'
- Tides - turn booms around
- No way to track in real time.
- Water velocity = Hard to collect plastic & data
- Can't fully shut booms
- No clear contact details.
- Extreme events - makes it hard to adapt due to water
- Infrastructure makes booms hard to set up
- Water velocity = Hard to collect plastic & data

- Lost/late data; unsafe debris.
- Dangerous to be in the river
- Pumps get stuck - plastic waste
- Data collection is manual
- Heavy equipment -
"The waste ... are not just plastics ... syringes or hard materials like metals." — Rudolph

Early-stage market; need incentives for up-cycling.
"There needs to be grants for small businesses to ... take this recycled material and create a thing." — Amber Standley
Plastic can smell bad by the end of the journey.
Not all plastic - could be hard materials, medical waste.

Metrics in silos; slow community reporting.
"No way to warn in advance."
Data recorded on Paper
Data recorded in scattered systems

Manual ingestion; camera fouling; funding uncertainty.
"Scattered in different systems." — Rudolph
No way to integrate with other systems and

OTHER DATA

(What other spatial data that could enhance this step?)

Google reality mesh?
Social Events?
What else?

Recycling Vs. Waste %
Ecology - plant traps and slows down the plastic flow - Water Hyacinth Plant

Gov/River Recycle | Stats on recycle rates and $? | Local jobs

DIGITAL TWIN OPPORTUNITIES

(List any of the 8 benefits of Digital Twins enhance this step?)

Fuse sensors + forecast to push a single notification that predicts hotspot load 6 h ahead.
""It would really help ... a mobile notification ... on where and what's the best time [to deploy]."" — Rudolph

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Overview of Data we want to Integrate in the Digital Twin

Plastics Waste Use Case

Hydrology Data

Data related to Water Flow Dynamics (Hydrodynamics) of Pasig River and its major upstream Tributaries

Weather & Climate Data

Data related to climate variables (water levels, rainfall, RealTime IoT Sensors)

Plastic Related Data

Plastic Types, Hotspot Areas, Historical + Real Time Clean Up Efforts Data

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What good data looks like

Benchmarking criteria to assess various datasets for Plastic Use Case Digital Twin

4 key benchmarking criteria

Criterion 1 **Availability**

- ✓ **Relevant** data sets required for Plastic Waste Monitoring available
- ✓ **Complete** and comprehensive datasets available

Criterion 2 **Accessibility**

- ✓ **Readily accessible** via platforms, portals and tools
- ✓ **Transparent** datasets that are open source

Criterion 3 **Quality**

- ✓ **Timely** and up to date
- ✓ **Accurate and precise** data that has been checked
- ✓ **Reliable** and trustworthy

Criterion 4 **Usability**

- ✓ **Format** that data is captured and stored
- ✓ **Consistent** and interoperable
- ✓ **Resolution** and scale

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Data Governance

- Data within the Plastic Digital Twin is published under a Creative Commons License. This is a free and flexible way for creators to grant permission to others to use their work, while retaining their copyright.
- Where data cannot be published directly using a Creative Commons License it will be used in the development of aggregated models and published as graphs and charts.
- Data for the Plastic Digital Twin is currently being collected through 2 processes 1) Raw data collection (surveys, WACS) and from key administrative agencies.
- The Plastic Digital Twin is based on an open-source TerriaJS platform and is intended to be scalable and adaptable to enable integration beyond the plastic use case.

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Data and Information mapping

- *Some datasets are publicly viewable but restricted for download*
- *Some datasets are publicly viewable but shows limited information*
- *Some datasets are publicly viewable but the required data format is for further request*

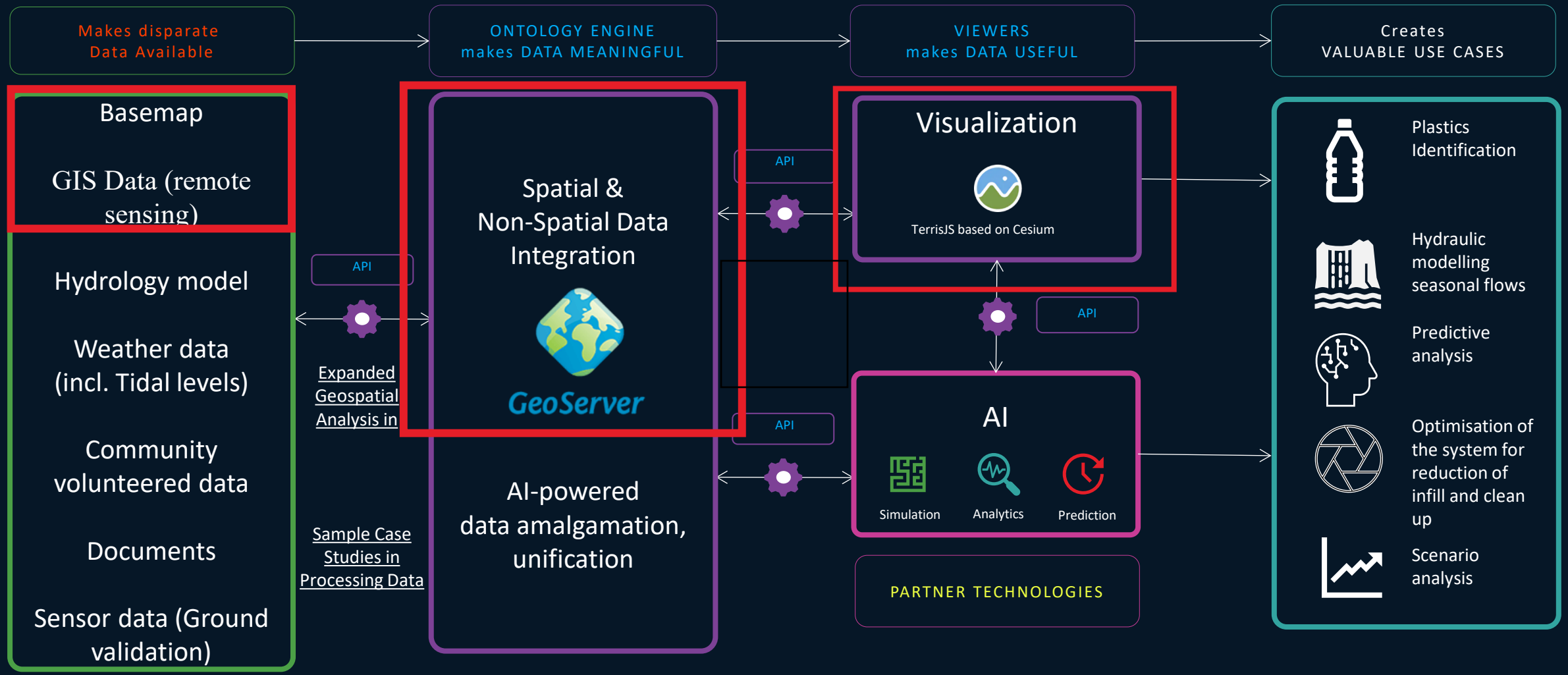
Public datasets

- Waterways/Tributaries
- CleanUp Operations
- Flood Data
- Typhoon tracks
- Climate projections
- Low/Medium Resolution Satellite Data

Non-public datasets

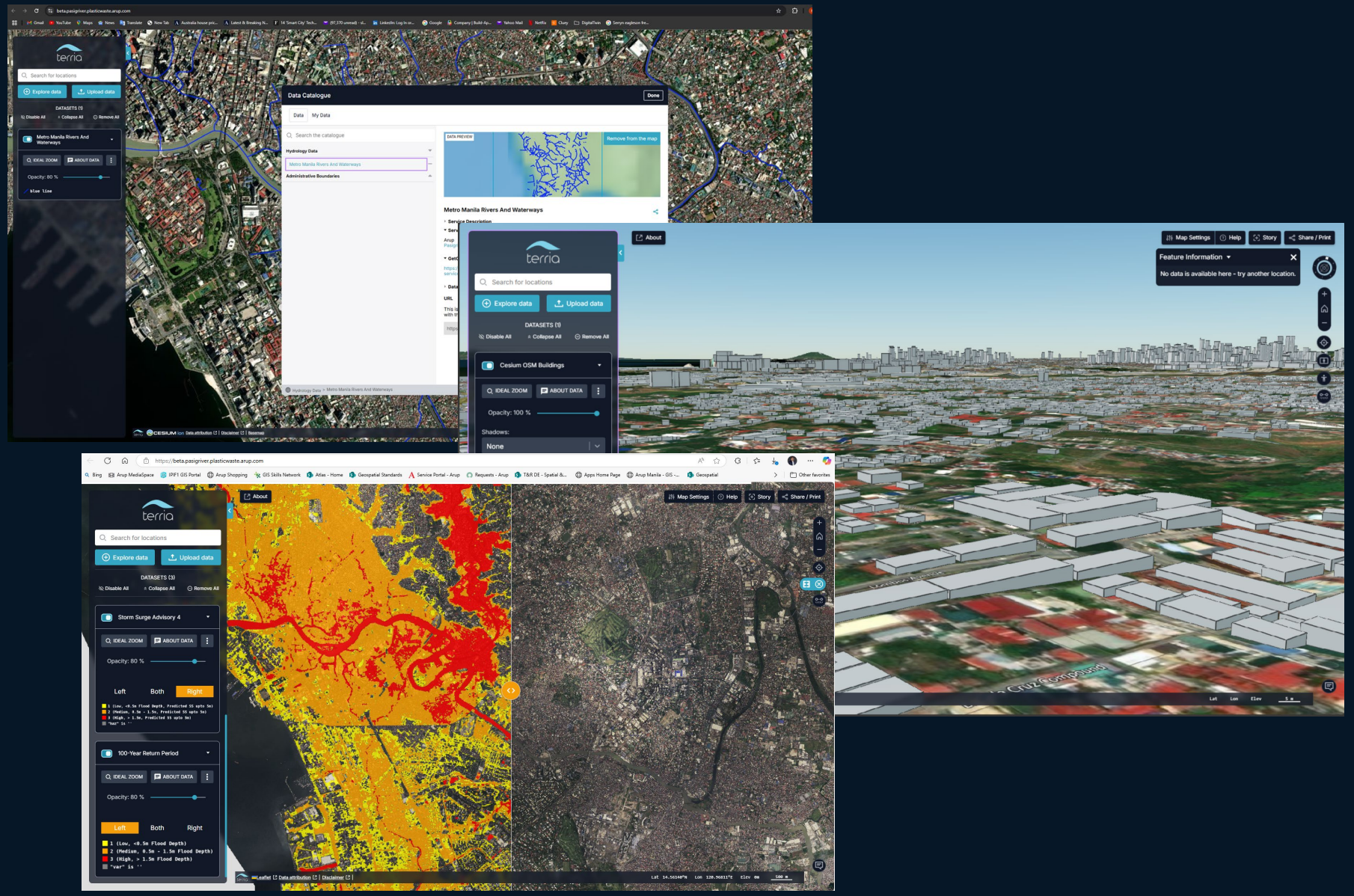
- Hydrologic/Hydrodynamic Models
- Historical Data (Climate)
- Realtime IoT Sensors
- Plastic Hotspots Data/Water Quality
- High Resolution Satellite Data

Digital Twin architecture for a clean Pasig



Complete

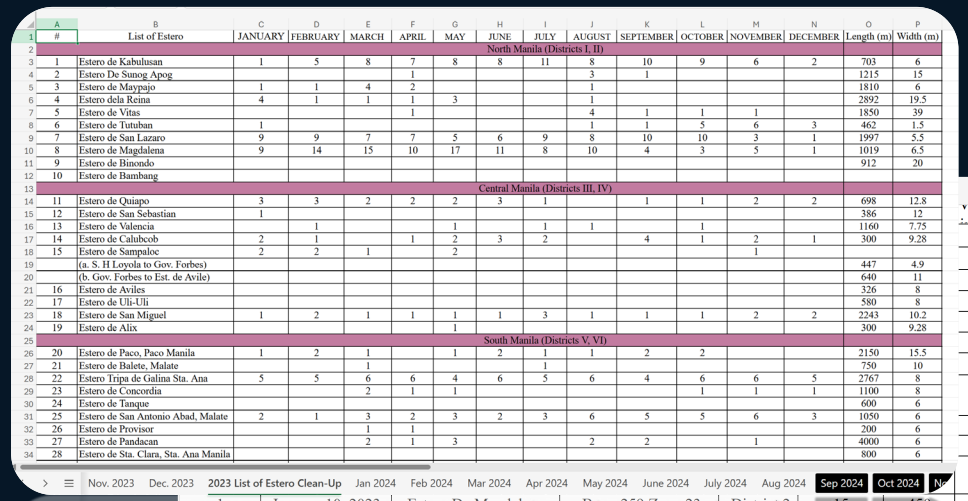
Digital Twin Platform for Various Data Integration



Data collection
(underway)

- Remote sensing
- Waste analysis and Characterization (WACS)
- Automatic classification of waste from cameras
- Hydrodynamic and Hydraulic model
- Community survey
- Administrative data

Transforming Unstructured Data into Insights using Geospatial Analysis



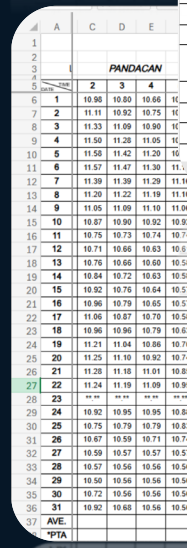
#	List of Estero	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	Length (m)	Width (m)
	North Manila (Districts I, II)														
1	Estero de Kabulusan	1	5	8	7	8	8	11	8	10	9	6	2	703	6
2	Estero De Sunog Apog				1				3	1				1215	15
3	Estero de Maypajo	1	1	4	2				1					1810	6
4	Estero dela Reina	4	1	1	1	3			1					2892	19.5
5	Estero de Vitas				1				4	1	1	1		1850	39
6	Estero de Tutuban	1							1	1	5	6	3	462	1.5
7	Estero de San Lazaro	9	9	7	7	5	6	9	8	10	10	3	1	1997	5.5
8	Estero de Magdalena	9	14	15	10	17	11	8	10	4	3	5	1	1019	6.5
9	Estero de Binondo													912	20
10	Estero de Bambang														
	Central Manila (Districts III, IV)														
11	Estero de Quiapo	3	3	2	2	2	3	1		1	1	2	2	698	12.8
12	Estero de San Sebastian	1												386	12
13	Estero de Valencia		1			1		1	1		1			1160	7.75
14	Estero de Calubcob	2	1		1	2	3	2		4	1	2	1	300	9.28
15	Estero de Sampaloc	2	2	1		2						1			
19	(a. S. H Loyola to Gov. Forbes)													447	4.9
20	(b. Gov. Forbes to Est. de Avile)													640	11
21	16 Estero de Aviles													326	8
22	17 Estero de Uli-Uli													580	8
23	18 Estero de San Miguel	1	2	1	1	1	1	3	1	1	1	2	2	2243	10.2
24	19 Estero de Alix					1								300	9.28
	South Manila (Districts V, VI)														
26	20 Estero de Paco, Paco Manila	1	2	1		1	2	1	1	2	2			2150	15.5
27	21 Estero de Balete, Malate			1				1						750	10
28	22 Estero Tripa de Galina Sta. Ana	5	5	6	6	4	6	5	6	4	6	6	5	2767	8
29	23 Estero de Concordia			2	1	1					1	1	1	1100	8
30	24 Estero de Tanque													600	6
31	25 Estero de San Antonio Abad, Malate	2	1	3	2	3	2	3	6	5	5	6	3	1050	6
32	26 Estero de Provisor			1	1									200	6
33	27 Estero de Pandacan			2	1	3			2	2		1		4000	6
34	28 Estero de Sta. Clara, Sta. Ana Manila													800	6

Volume in Cubic	Length
0.18	10
0.27	10
0.3	20
8.1	20
0.24	30
0.24	20
0.21	20
0.84	20
0.51	20
0.33	20
1.35	10

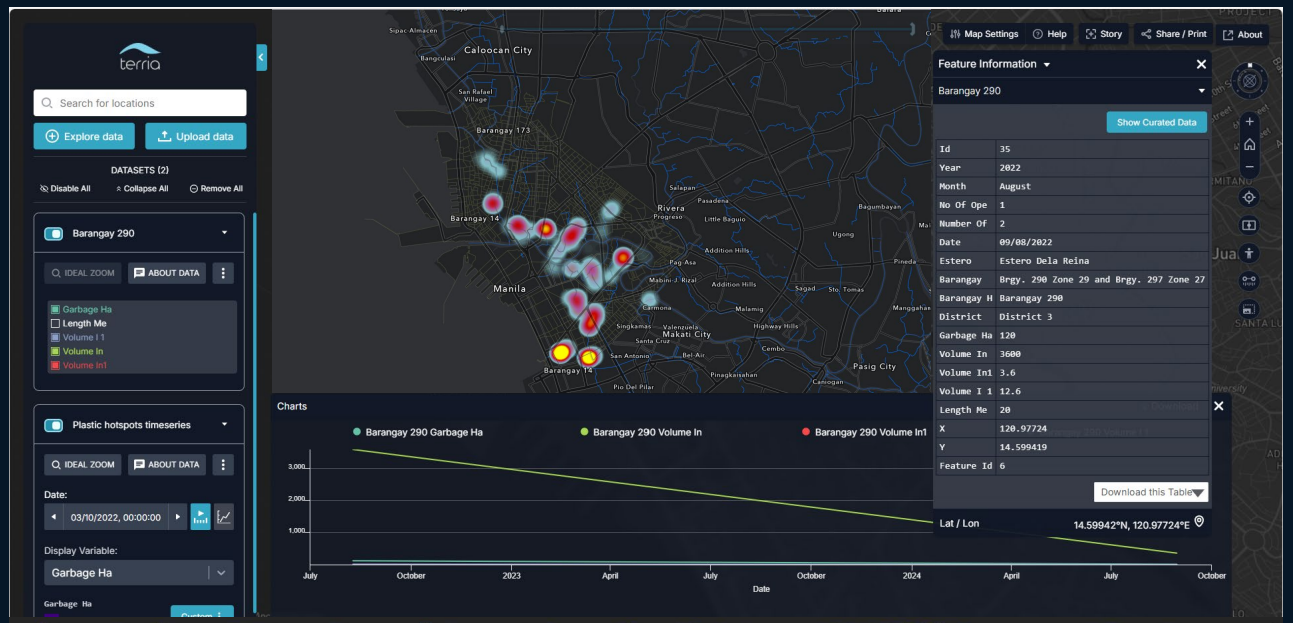
Nov. 2023 | Dec. 2023 | 2023 List of Estero Clean-Up | Jan 2024 | Feb 2024 | Mar 2024 | Apr 2024 | May 2024 | June 2024 | July 2024 | Aug 2024 | Sep 2024 | Oct 2024

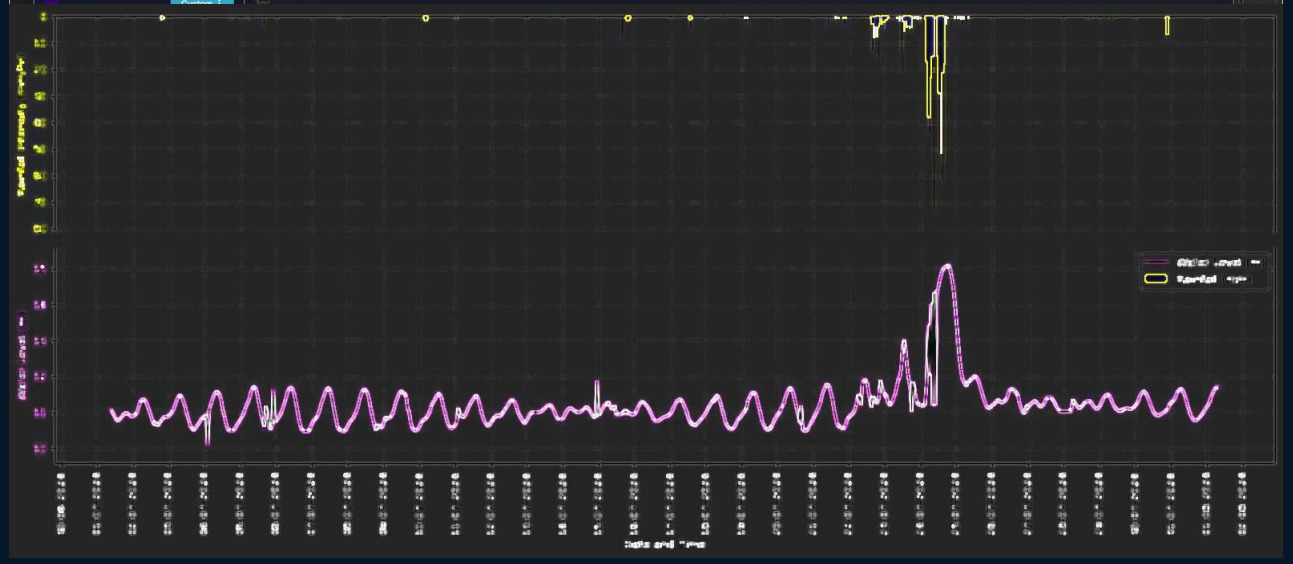
1	January 10, 2023	Estero De Magdalena	Brgy. 259 Zone 23	District 2	15	450	0.45	1.58	20
1	January 11, 2023	Beata Creek	Brgy. 835 Zone 91	District 6	11	330	0.33	1.16	10
1	January 11, 2023	Beata Creek	Brgy. 860 Zone 94	District 6	8	240	0.24	0.84	10
1	January 11, 2023	Estero De Abad	Brgy. 720 Zone 78	District 5	37	1110	1.11	3.89	20
1	January 13, 2023	Estero Tripa De Galina	Brgy. 730 Zone 79	District 5	4	120	0.12	0.42	10
1	January 16, 2023	Estero De Magdalena	Brgy. 292 Zone 28	District 3	57	1710	1.71	5.99	20
1	January 16, 2023	Estero De San Lazaro	Brgy. 256 Zone 28	District 2	8	240	0.24	0.84	20
1	January 17, 2023	Estero De Magdalena	Brgy. 250 Zone 23	District 2	37	1110	1.11	3.89	20
1	January 17, 2023	Manila North Cemetery Creek	Brgy. 372 Zone 37	District 3	5	150	0.15	0.53	10
1	January 17, 2023	Estero Tripa De Galina	Brgy. 794 Zone 87	District 5	38	1140	1.14	3.99	20
1	January 18, 2023	Estero De Quiapo	Brgy. 394 Zone 40	District 3	23	690	0.69	2.42	30
1	January 18, 2023	Estero De Paco	Brgy. 679 Zone 74	District 5	10	300	0.3	1.05	10
1	January 19, 2023	Estero De San Lazaro	Brgy. 299 Zone 29	District 3	26	780	0.78	2.73	10

Dec. 2022 | List of Estero Clean-Up 2022 | Jan. 2023 | Feb. 2023 | Mar. 2023 | Apr. 2023 | May 2023 | June 2023 | July 2023



PANDACAN



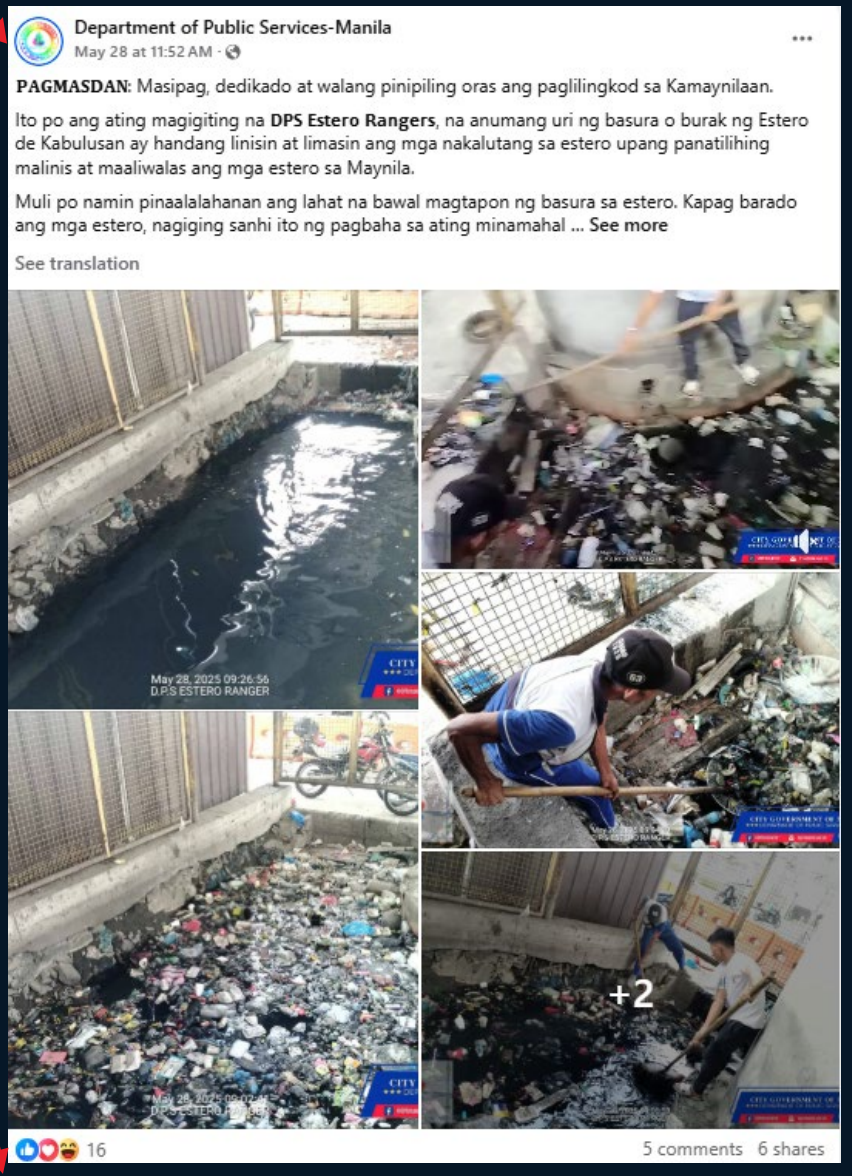


Transforming Unstructured Data into Insights using AI Image Vision Analytics

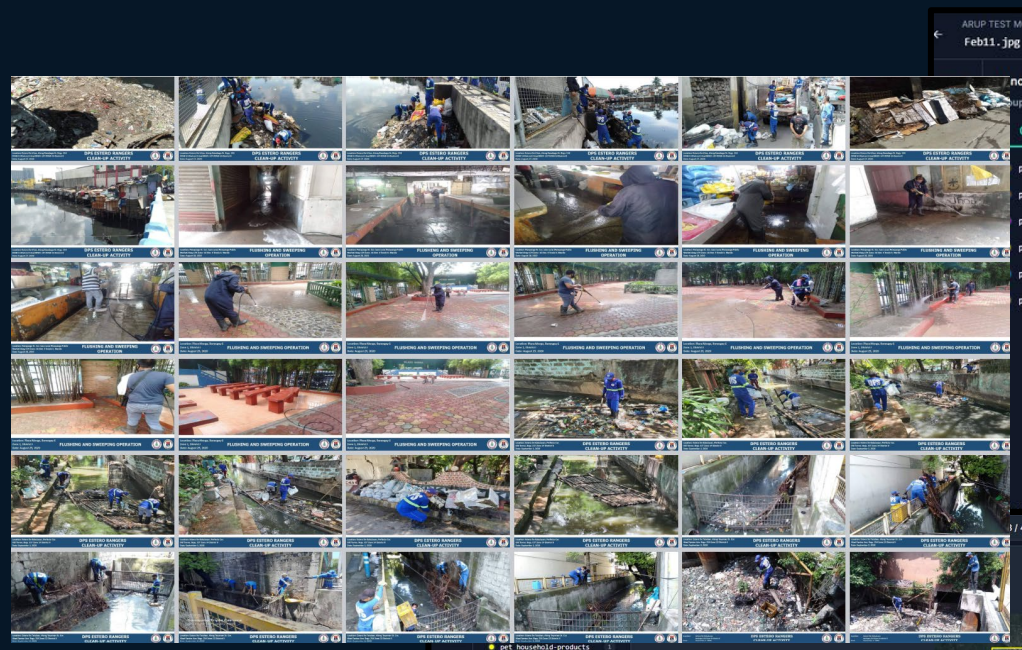
- Year 2020
- Year 2021
- Year 2022
- Year 2023
- Year 2024
- Year 2025

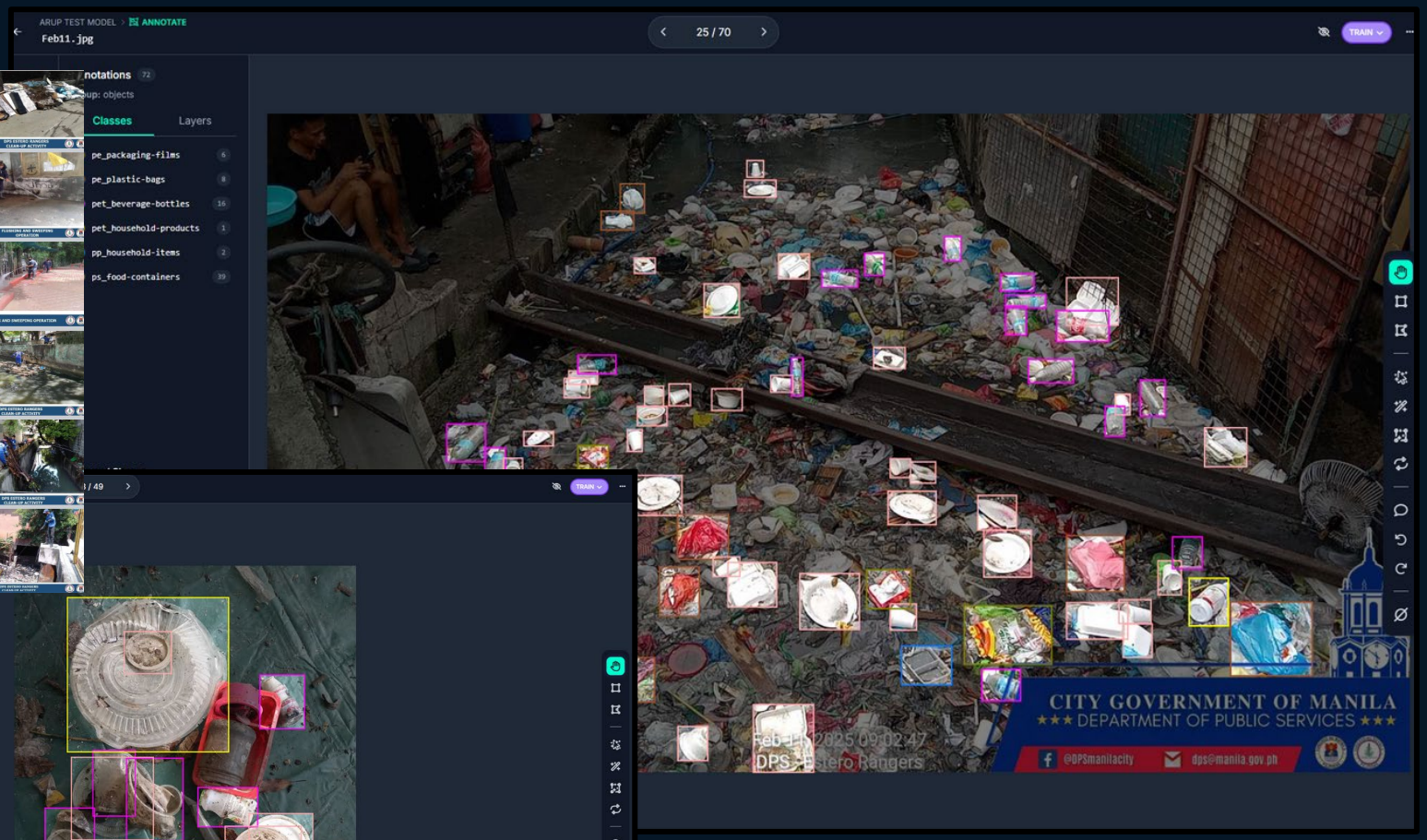
- (1) January-2024
- (10) October 2024
- (11) November-2024
- (12) December-2024
- (2) February-2024
- (3) March-2024
- (4) April-2024
- (5) May-2024
- (6) June-2024
- (7) July-2024
- (8) August-2024
- (9) September 2024

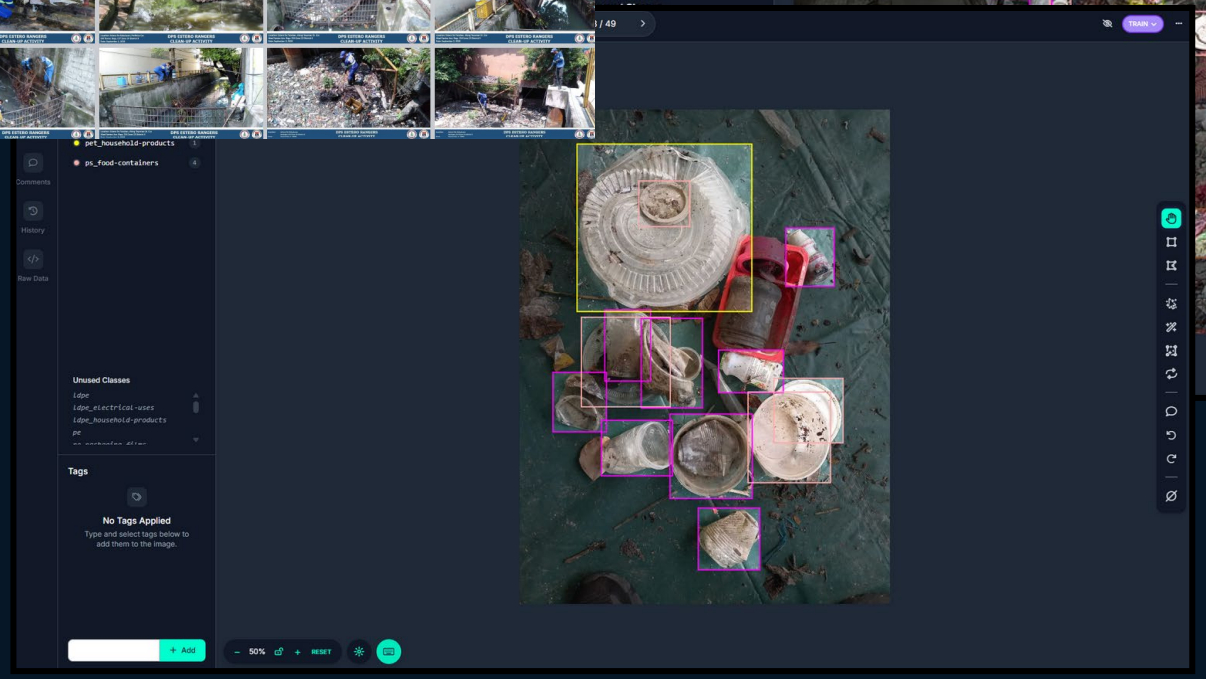
- to post march 1, 2024 Estero De Kabulusan Brgy. 218 Zone 20 District 2
- to post march 1, 2024 Estero De Kabulusan Brgy. 220 Zone 20 District 2
- to post march 1, 2024 Estero De San Lazaro Brgy. 328 Zone 33 District 3
- to post march 10, 2024 Estero Tripa De Gallina Brgy. 730 Zone 79 District 5
- to post march 11, 2024 Estero De Kabulusan Brgy. 220 Zone 20 District 2
- to post march 11, 2024 Estero De Magdalena Brgy. 250 Zone 23 District 2
- to post march 11, 2024 Estero De San Miguel Brgy. 641 Zone 66 District 6
- to post march 12, 2024 Estero De Kabulusan Brgy. 219 Zone 20 District 2
- to post march 12, 2024 Estero De Sta. Clara Brgy. 883 Zone 97 District 6
- to post march 13, 2024 Estero De Sta. Clara Brgy. 883 Zone 97 District 6
- to post march 14, 2024 Estero De San Lazaro Brgy. 225 Zone 23 District 2
- to post march 14, 2024 Estero De San Lazaro Brgy. 328 Zone 33 District 3
- to post march 14, 2024 Estero De Tutuban Brgy. 224 Zone 21 District 2
- to post march 15, 2024 clean up Harbour View Beside Army Navy Club
- to post march 15, 2024 Estero De Quiapo Brgy. 394 Zone 40 District 3
- to post march 16, 2024 Estero De Maypajo Brgy. 120 wDENR MEO West Estero Rangers and L...
- to post march 18, 2024 Estero De Concordia Brgy. 662 Zone 71 District 5
- to post march 18, 2024 Estero De Magdalena Brgy. 259 Zone 23 District 2
- to post march 18, 2024 Estero De Pandacan Brgy. 859 Zone 93 District 6
- to post march 19, 2024 Estero De Abad Brgy. 720 Zone 78 District 5
- to post march 19, 2024 Estero Tripa De Gallina Brgy. 730 Zone 79 District 5
- to post march 2, 2024 Estero De San Lazaro Brgy. 260 Zone 24 District 2
- to post march 20, 2024 Beata Creek Brgy. 835 Zone 91 District 6
- to post march 20, 2024 Estero De Tutuban Brgy. 224 Zone 21 District 2
- to post march 21, 2024 Estero De Kabulusan Brgy. 219 Zone 20 District 2
- to post march 21, 2024 Estero De San Lazaro Brgy. 328 Zone 33 District 3
- to post march 21, 2024 Manila North Cemetery Creek Brgy. 372 Zone 37 District 3
- to post march 22, 2024 Beata Creek Brgy. 839 Zone 91 District 6
- to post march 23, 2024 Estero De Magdalena Brgy. 250 Zone 23 & Brgy. 262 Zone 24 District 2
- to post march 24, 2024 Estero De Kabulusan Brgy. 220 Zone 20 District 2
- to post march 25, 2024 Estero De Quiapo Brgy. 394 Zone 40 District 3
- to post march 25, 2024 Estero De Sta. Clara Brgy. 883 Zone 97 District 6
- to post march 26, 2024 Beata Creek Brgy. 835 Zone 91 District 6
- to post march 26, 2024 clean up Harbour View Beside Army Navy Club
- to post march 26, 2024 Estero De Concordia Brgy. 662 Zone 71 District 5
- to post march 27, 2024 Estero De San Lazaro Brgy. 225 Zone 23 District 2
- to post march 29, 2024 sweeping From P. Casal St. San Sebastian Church Bilibid Viejo St. Quez...
- to post march 3, 2024 Estero Tripa De Gallina Brgy. 730 Zone 79 District 5



Transforming Unstructured Data into Insights using AI Image Vision Analytics



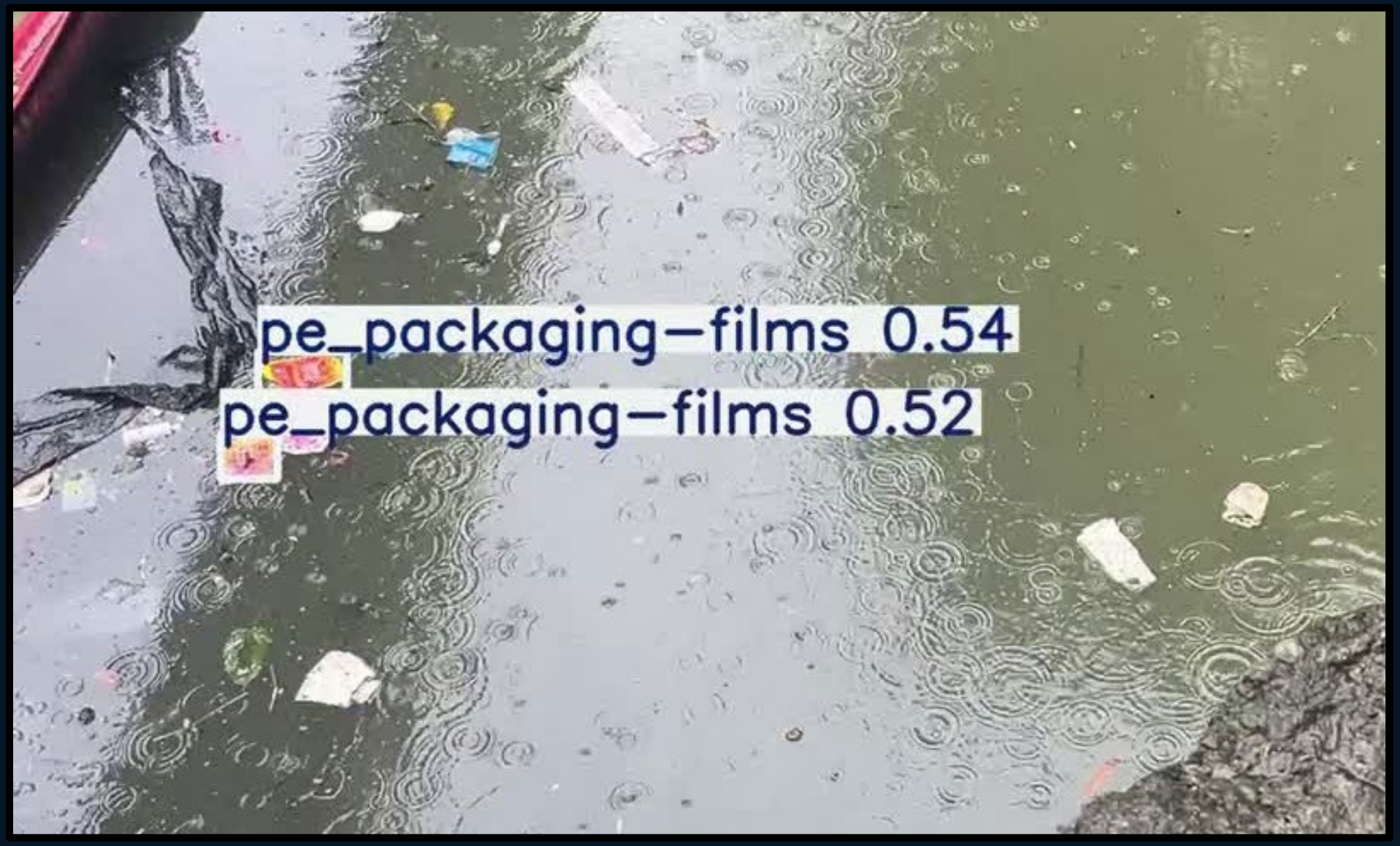




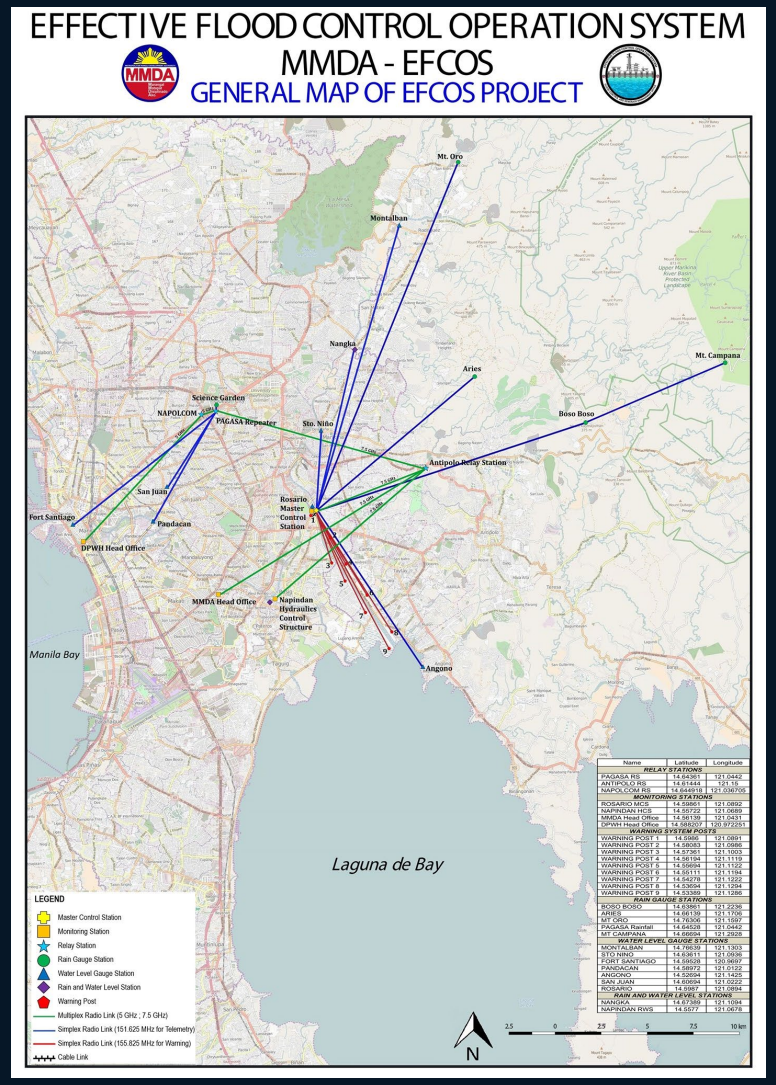
Transforming Unstructured Data into Insights using AI Image Vision Analytics

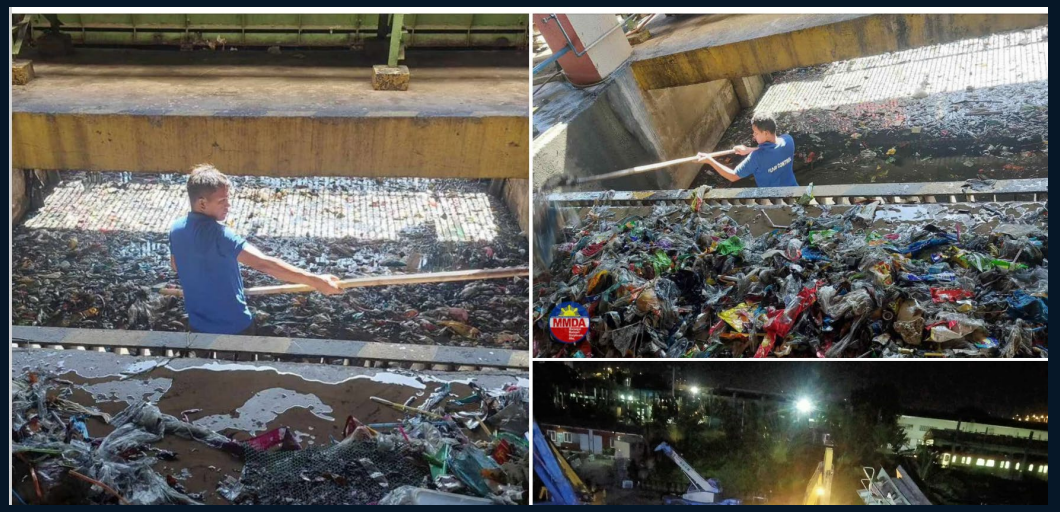
Chemical Composition	Typical Item(s)
Polyethylene Terephthalate (PET)	*water bottles & plastic cups*
Polypropylene (PP)	*plastic straws & disposable plastic utensils*
Polyethylene (PE)	*sachets*
Polystyrene (PS)	*styrofoam containers (cups, plataes)*
Low-density Polyethylene (LDPE)	*tetra packs, greenhouse films, and electricals*

Transforming Unstructured Data into Insights using AI Image Vision Analytics

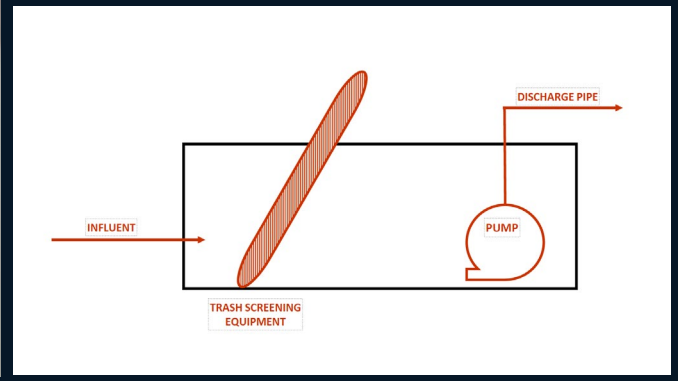


Scaling Up and Expanding Use Case: Flood Control Mitigation





An entire panel of plywood, along with plastic materials, impeded the flow of water in the drainage system, MMDA general manager Procopio Lipana said in a *dzBB* interview. "Despite our continuous cleaning of waterways, we still get a lot of garbage," Lipana said in Filipino.



Our Programme and Delivery

Month 1	Month 2	Month 3	Month 4	Month 5	Month 6

Work Package 1: Baseline model creation and data integration

- A functional digital twin framework that tracks plastic flow (MVP)
- A functional digital twin (MVP)

Work Package 2: Plastic classification and seasonal flow analysis

- Concept predictive model
- **Predictive models** forecasting seasonal trends and accumulation patterns

Work Package 3: Predictive analytics development and validation

- Comprehensive report on plastic types and their potential sources
- Impact on the Pasig Ecology

Work Package 4

- Documentation and training materials to support

RiverRecycle ARUP

Summary

Technical Summary

- Open source/Non proprietary
- Value for Money/No operation Cost for tool or dataset in future
- Scalable and Replicable after Discovery Phase & to other cities
- Lightweight Solution

Our Key Differentiator

- Real and Actual Hands-On Stakeholder Connections and Engagement
- Shared connection with, and investment in, the Pasig River
- Our collaborative approach and leveraging from our global experience

PHOTO BY PAULO ALCAZAREN